November 2016

Federal Way Link Extension

Final Environmental Impact Statement

TRANSPORTATION TECHNICAL REPORT

Appendix G1

SOUNDTRANSIT
Central Puget Sound
Regional Transit Authority

U.S. Department of Transportation
Federal Transit Administration

SOUNDTRANSIT

Federal Way Link Extension

Transportation Technical Report

Prepared for:
Sound Transit

Prepared by:
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November 2016

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Acronyms and Abbreviations

ADA	Americans with Disabilities Act
ADT	average daily traffic
CAC	collision analysis corridor
EIS	Environmental Impact Statement
FGTS	Freight Goods Transportation System
FHWA	Federal Highway Administration
FWLE	Federal Way Link Extension
HC	Highline College
HCM	Highway Capacity Manual
HCT	high-capacity transit
HOV	high-occupancy vehicle
HSM	*Highway Safety Manual*
HSS	Highway of Statewide Significance
I-5	Interstate 5
ITE	Institute of Transportation Engineers
LOS	level of service
Metro	King County Metro Transit
MEV	million entering vehicles
MIC	manufacturing and industrial centers
mph	miles per hour
MVMT	million vehicle miles traveled
N/A	not applicable
NHS	National Highway System
PDO	property damage only
PSCR	Puget Sound Regional Council
RPZ	residential parking zones
Sea-Tac Airport	Seattle-Tacoma International Airport

SOV	single-occupant vehicle
SR	State Route
ST	Sound Transit
ST2	Sound Transit 2
TCQSM	Transit Capacity and Quality of Service Manual
TRB	Transportation Research Board
TWSC	two-way stop controlled
v/c	volume to capacity ratio
VHD	vehicle hours of delay
VHT	vehicle hours traveled
VMT	vehicle miles traveled
WSDOT	Washington State Department of Transportation

1.0 Introduction

1.1 Project Background

The Central Puget Sound Regional Transit Authority (Sound Transit) is proposing to expand the regional light rail system south from the city of SeaTac to Federal Way, Washington, as shown in Exhibit 1-1. This project is currently known as the Federal Way Link Extension (FWLE). The FWLE corridor was included in Sound Transit's 1996 *Regional Transit Long-Range Vision* (Sound Transit, 1996a) and in the 2014 *Regional Transit Long-Range Plan* (Sound Transit, 2014a). Sound Move, adopted in 1996 (Sound Transit, 1996b), implemented the first phase of the *Regional Transit Long-Range Vision*. In 2008, the voters approved financing for the Sound Transit 2 Plan (Sound Transit, 2008; "ST2"), which prioritized the second round of regional transit system investments, including the FWLE.

This 7.6-mile extension would connect the future Angle Lake Station at S 200th Street in SeaTac with the Federal Way Transit Center in Federal Way. The FWLE corridor parallels State Route (SR) 99 and Interstate 5 (I-5), and generally follows a topographic ridge between Puget Sound and the Green River Valley.

Major east-west arterials connecting I-5 and SR 99 include Kent-Des Moines Road (SR 516), S 272nd Street, and S 320th Street, which are served by major transit stops, including the Kent-Des Moines Park-and-Ride, Redondo and Star Lake park-and-rides (S 272nd Street), Federal Way Transit Center (S 317th Street), and Federal Way S 320th Street Park-and-Ride. According to the 2010 U.S. Census, the combined population for the cities in the FWLE corridor was approximately 240,000, with SeaTac's population at 26,909, Des Moines' at 29,673, Kent's at 92,411, and Federal Way's at 89,306. Key issues facing the corridor include growth in north-south transit demand, populations that are highly transit-dependent, and lack of reliable and efficient transit service.

1.2 Transportation Elements and Study Area

The analysis of the transportation system considered a number of transportation elements: regional facilities and travel, transit operations, arterial and local street operations, safety, parking, non-motorized facilities, and freight mobility and access.

This technical report discusses each transportation element individually. The discussion of each element covers the affected environment for the existing year (2013, when the data were collected), and the expected long-term and short-term environmental impacts for the design year (2035) (comparing the No Build Alternative to the build alternatives), including potential mitigation.

In addition to this Chapter 1, Introduction, this report comprises the following chapters:

- Chapter 2, Methodology and Assumptions, summarizes the analysis methods used to assess the alternatives in this report.
- Chapter 3, Affected Environment, discusses existing transportation conditions.

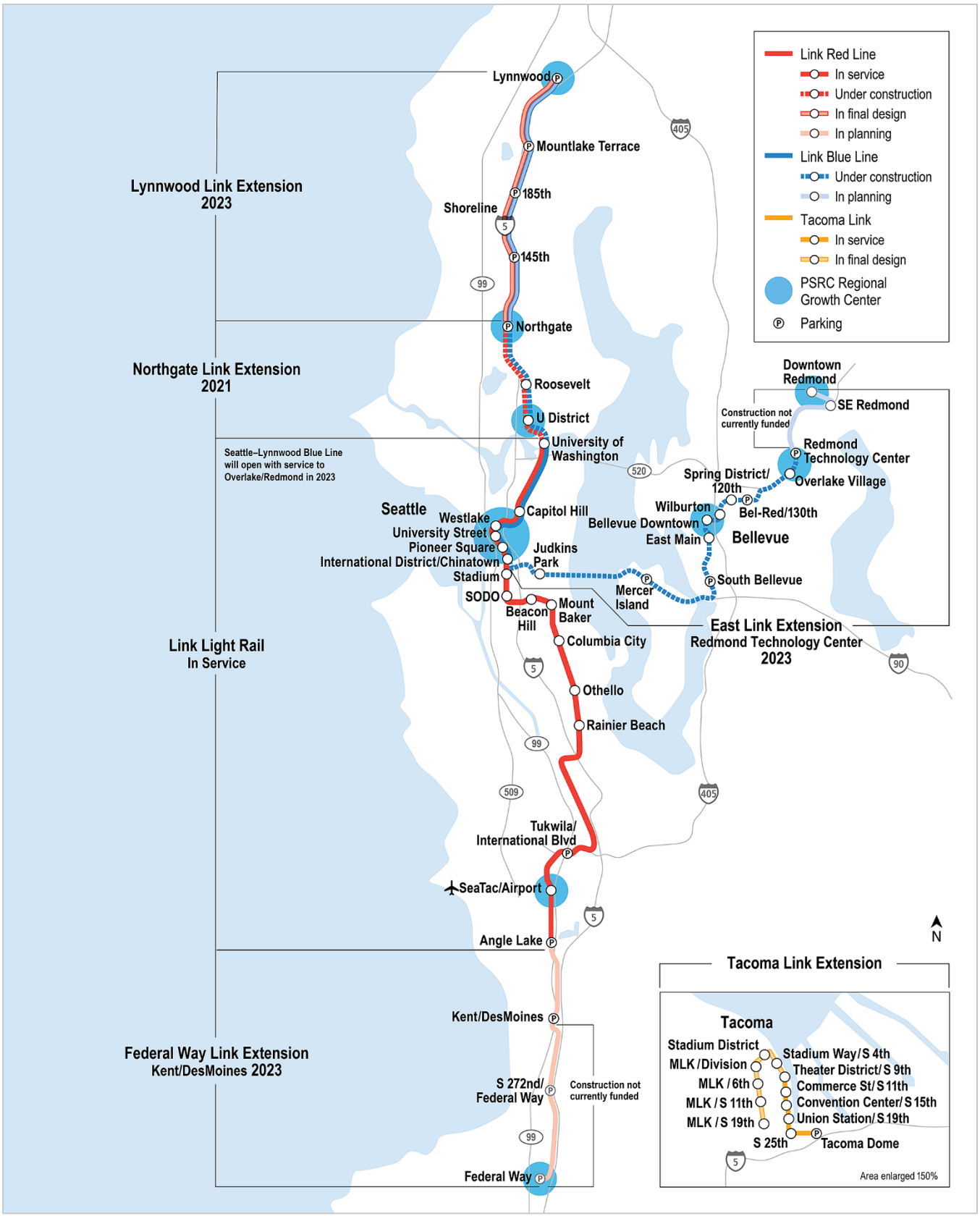


EXHIBIT 1-1
Sound Transit Link Light Rail System and FWLE Location

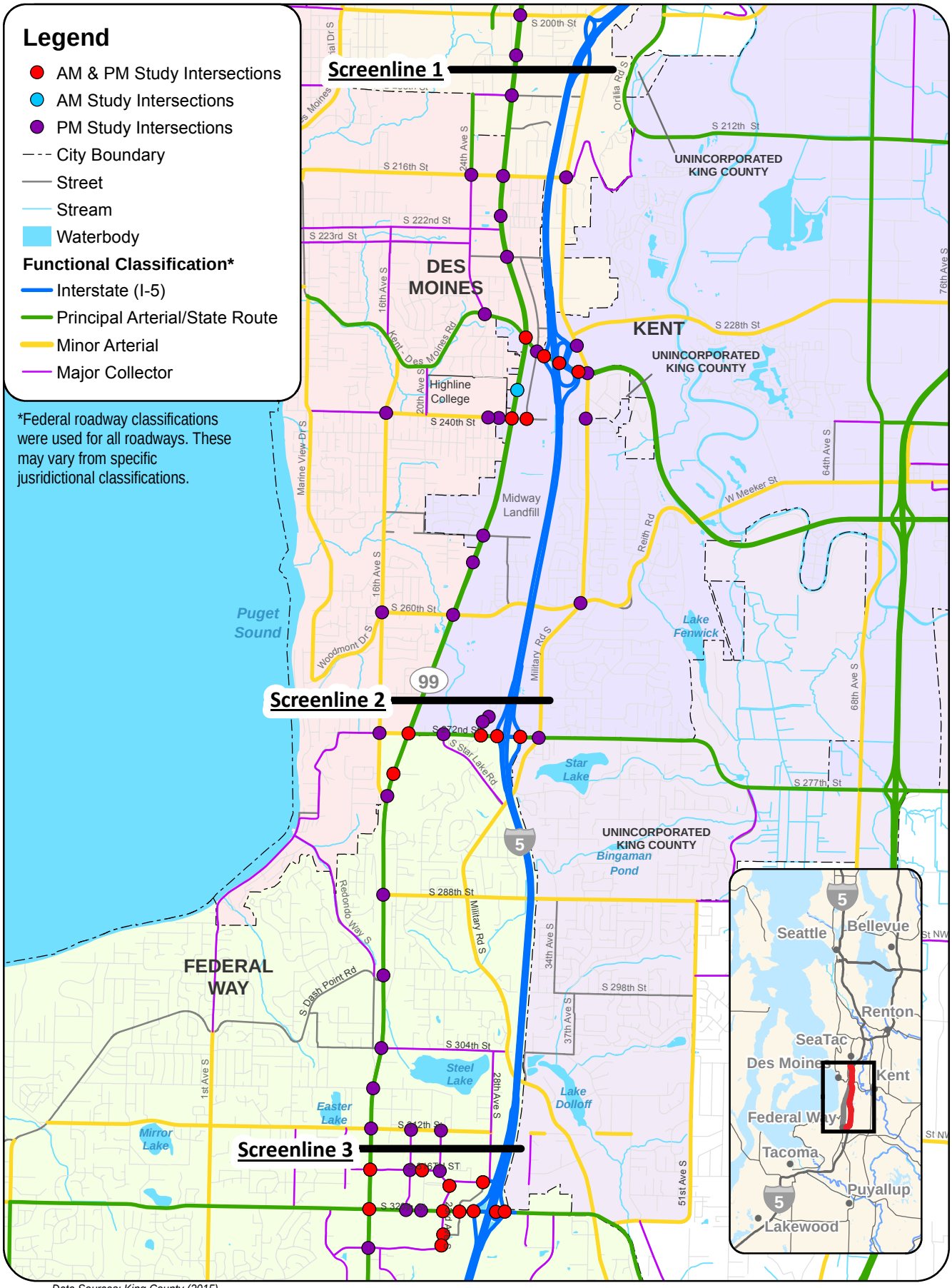
- Chapter 4, Environmental Impacts, describes anticipated impacts in terms of the following:
  - Regional facilities and travel
  - Transit operations
  - Arterial and local street operations
  - Safety
  - Parking
  - Non-motorized facilities
  - Freight mobility and access
- Chapter 5, Construction Impacts, discusses expected transportation impacts resulting from project construction activities.
- Chapter 6, Indirect Impacts, describes the project impacts that could occur later in time or some distance from the project.
- Chapter 7, Potential Mitigation Measures, describes the potential measures that could be implemented to mitigate effects of the project.
- Chapter 8, Cumulative Impacts, describes the potential additional cumulative transportation effects of other projects that were not included in the traffic and ridership modeling.
- Chapter 9, References, lists the sources used in preparing this report.

The following appendices support information presented in this report:

- Appendix A, Transportation Technical Analysis Methodology
- Appendix B, Level of Service Definitions Used for Federal Way Link Extension Analysis
- Appendix C, Existing and Future Transit Routes and Level of Service
- Appendix D, Existing and Future Intersection Level of Service Results
- Appendix E, I-5 Ramp Terminal Queue Length Results
- Appendix F, Pedestrian Level of Service
- Appendix G, Construction Preliminary Impacts, Staging Areas, and Truck Haul Routes
- Appendix H, I-5 Clear Zone Analysis

Highway operations and safety are addressed under Regional Facilities and Travel (screenline performance), Arterial and Local Street Operations (I-5 ramp terminal intersection operations and off-ramp queues), and Safety (crash history and clear zone). Navigable waterways are not evaluated in this analysis because there are no such waterways in the FWLE transportation study area (study area).

The study area for this transportation analysis generally includes the SR 99 and I-5 corridors from S 200th Street in SeaTac to approximately S 324th Street in the City of Federal Way. Study intersections were identified along major arterials and near station areas. For non-motorized and parking facilities, a fixed buffer or radius around the proposed stations was defined for analysis purposes. Specific study areas vary by transportation element and are described in following sections. Exhibit 1-2 shows the overall transportation study area and other key transportation study elements.



Data Sources: King County (2015)

N

0 0.5 1 2 Miles

EXHIBIT 1-2
FWLE Transportation Study Area

Federal Way Link Extension

2.0 Methodology and Assumptions

The methodology and assumptions used for the FWLE Draft Environmental Impact Statement (Draft EIS) to analyze the transportation impacts of the FWLE were compiled in the *Federal Way Link Extension Transportation Technical Analysis Methodology*, which is provided in Appendix A of this technical report. For the Final EIS analysis, the methodology and assumptions were updated in the *Final EIS Transportation Technical Analysis Methodology Overview and Updates* memorandum, also, in Appendix A.

Several changes in the assumptions for the transportation analysis presented in this Transportation Technical Report took place between publication of the Draft EIS and the Final EIS. These changes are summarized in Table 2-1.

TABLE 2-1
Changes in Assumptions

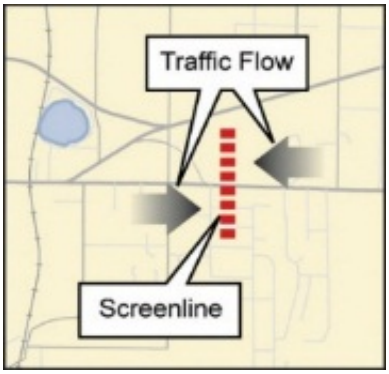
Change in Assumption from Draft EIS to Final EIS[a]	Reason for Change	Elements Affected
Background projects were updated to include: • WSDOT's SR 509 Corridor Completion and Freight Improvement Project (SR 509 Extension) as defined in the FHWA's 2003 ROD • WSDOT's SR 167 Tacoma to Edgewood New Freeway Construction Project as defined in FHWA's 2007 ROD • WSDOT's I-5/SR 161/ SR 18: Federal Way Triangle Vicinity Improvements • Local jurisdiction/agency intersection and roadway projects as part of TIPs and CIPs	Approval of Connecting Washington, a statewide transportation package, and updates from local agencies	Regional Facilities and Travel, Transit Operations, Arterials and Local Street Operations, Parking, Non-Motorized Facilities, Freight Mobility and Access
There will be more bus routes serving the FWLE corridor, with better headways.	King County Metro, Pierce Transit, and Sound Transit are planning bus service modifications	Transit Operations, Non-Motorized Facilities
Transportation system and transit forecasts were updated to reflect the most recent available PSRC and Sound Transit Demand models.	To reflect 2015 conditions and latest regional land use forecasts	Regional Facilities and Travel, Transit Operations, Arterials and Local Street Operations, Parking, Non-Motorized Facilities, Freight Mobility and Access
The existing year for transit data has changed from 2013 to 2015.	To reflect 2015 ridership and service conditions	Affected Environment, Transit Operations
Revised jurisdictional LOS standards.	Updated with new City of Federal Way standard	Arterials and Local Street Operations

[a] Details of changes assumed are described in detail in Appendix A, Transportation Technical Analysis Methodology.

CIPs = capital improvement programs; FHWA = Federal Highway Administration; PSRC = Puget Sound Regional Council; ROD = Record of Decision; TIPs = transportation improvement programs

The report and memorandum present the following information:

- Agency guidelines and regulations regarding the transportation analysis
- Data collected and sources, such as traffic volumes, parking supply and utilization, pedestrian and bicycle facilities, crash data, and transit service characteristics
- Transportation analysis methodology, including relevant definitions, and procedures for regional traffic analysis, transit operations, local and arterial traffic analysis, intersection operational analysis, and safety assessments
- Methods for traffic forecasting and transit ridership estimates
- Methods for assessing impacts related to light rail station and park-and-ride areas, parking, non-motorized facilities and modes, property access and circulation, freight, transit, and construction



*A **screenline** is an imaginary line across a section of freeways or arterials. These screenlines are used to provide a snapshot of how much volume is entering or exiting a particular area.*

The transportation impacts of the FWLE were analyzed from three different perspectives: regional, screenline (corridor), and local operations. The regional and screenline assessments studied larger areas of the study area. The operational assessment identified and analyzed specific roadways, intersections, and transit facilities. The following types of information were developed and evaluated:

- Regional analysis, such as projectwide ridership, daily vehicle miles traveled (VMT), and vehicle hours traveled (VHT)
- Screenline analysis of transit service and ridership, roadway volumes, volume to capacity (v/c) ratio, and mode share
- Operational analysis, which includes an analysis of the level of service (LOS) and safety of arterial and local streets, and information about the multimodal connections (station areas) in the light rail network; arterial and local street analysis, which focused on intersection operations and safety analysis
- Impacts on parking in terms of any removal, replacement, or addition
- Impacts on non-motorized facilities, which includes pedestrian and bicycle access to the study intersections and potential station locations
- Transit operations, which includes service coverage and circulation, LOS for service frequency, hours of service, passenger load, and on-time reliability
- Impacts on freight movement
- Any indirect impacts on transportation system caused by changes in travel patterns with the project; any potential mitigation measures required to meet jurisdictional standards
- Any cumulative impacts on the transportation system and impacts during construction period

3.0 Affected Environment

The affected environment for transportation, described in the following sections, includes existing conditions for all the transportation system components in the study area. This chapter describes the traffic-related operations and performance on all roadway facilities, transit (road-based and rail), parking, bicycles and pedestrians, and freight. This chapter also describes the safety conditions on the roadways in the study area.

Transportation Analysis Terms

Vehicle miles traveled (VMT): Total number of vehicle miles traveled in a specific geographic area over a given period of time.
Vehicle hours of delay (VHD): Extra vehicle hours expended traveling on the roadway network below the posted speed limit in a specified area during a specified time period (a measure of congestion).
Vehicle hours traveled (VHT): Total vehicle hours expended traveling on the roadway network in a specified area during a specified time period.
Average daily traffic (ADT): Total volume of traffic during a given time period divided by the number of days in that time period, representative of average traffic in a one-day time period.
Vehicle volume to capacity (v/c): Ratio of vehicle demand compared to roadway capacity, used as the performance measure to assess travel conditions on the regional facilities in the study area.
Peak hour: Hour of the day in which the maximum demand for service is experienced, accommodating the largest number of automobile or transit patrons.
Mode share: Percentage of people using a particular type of transportation (automobile, high-occupancy vehicle, or transit).

3.1 Regional Facilities and Travel

This section describes the regional travel conditions in the study area, which is served by two north-south highway facilities, SR 99 and I-5. East-west connections are mainly major arterial roadways such as Kent-Des Moines Road, S 272nd Street, and S 320th Street. These arterials provide connections within the study area and to/from the highways and areas to the west and east.

Travel times in the FWLE corridor are unreliable for many hours of the day because congestion that occurs in the AM and PM peak periods (6:30 a.m. to 9:30 a.m. and 3:30 p.m. to 6:30 p.m., respectively) is extending the congestion period outside of these typical commuting hours. To travel between Federal Way and Downtown Seattle (approximately 22 miles) during morning and afternoon peak periods, when congestion is high and delays are unpredictable, a commuter must allow 62 minutes in the AM peak period and 46 minutes in the PM peak period to ensure arriving on time 95 percent of the time. These peak period travel times are expected to increase by nearly 20 percent over the next 20 years with the projected population and employment growth in the region, increasing this travel time by about 10 minutes to ensure arriving on time 95 percent of the time, for the trips between Federal Way and Downtown Seattle during peak periods. Projected growth will continue to worsen traffic congestion on both I-5 and SR 99 and other key arterials in the study area and will affect bus service.

Different transit agencies provide transit services in the Puget Sound Region, including Sound Transit, King County Metro Transit (Metro), and Pierce Transit within the FWLE corridor. These agencies offer long-distance services between the major urban centers in the region and also serve several transit centers, park-and-ride facilities, neighborhoods, and activity centers.

For I-5 ramp terminal operations, refer to Section 3.3.2, Intersection Operations and Level of Service. Existing I-5 mainline and ramp safety is documented in Section 3.4, Safety.

3.1.1 Vehicle Miles Traveled and Vehicle Hours Traveled

VMT and VHT are systemwide measures that are useful primarily for comparison purposes. In this report, they are used to compare the future conditions with and without the FWLE to indicate travel growth in the region and the effect of the project on that growth. Today, over 85 million VMT occur daily within the central Puget Sound Region (which includes King, Kitsap, Pierce, and Snohomish counties). This results in over 2.8 million VHT and approximately 340,000 VHD for all users of the transportation system. Table 3-1 shows the daily VMT and VHT for the Puget Sound Region for the existing year by mode.

TABLE 3-1
Existing Regional Travel – Daily VMT and VHT by Mode

Mode	Vehicle Mode Split %	VMT	VHT
Passenger Vehicles (including high-occupancy vehicles [HOV])	96.6%	84,956,000	2,713,000
Heavy Vehicles	3.3%	3,618,000	91,000
Transit Buses	< 0.1%	193,000	14,000
Light Rail Vehicles	< 0.1%	9,000	<500
Commuter Rail Vehicles	< 0.1%	6,000	<500
Total	100.0%	**88,782,000**	**2,819,000**

Source: PSRC, 2014a; NTD, 2013.

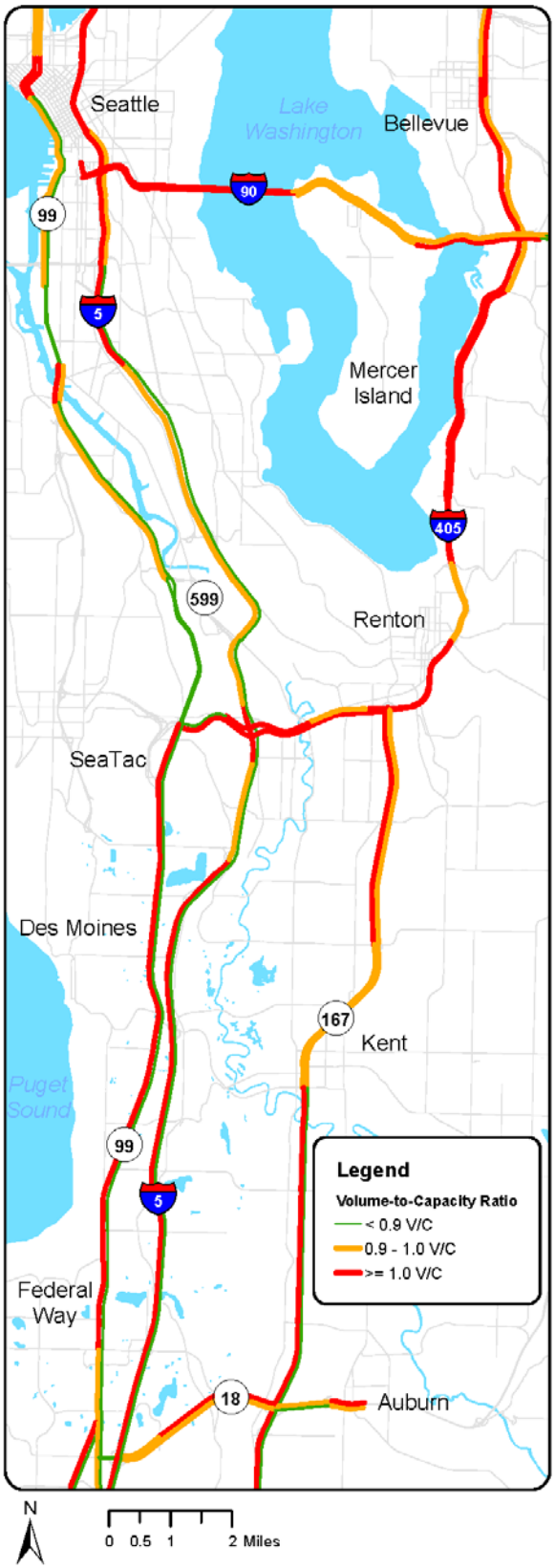


EXHIBIT 3-1
Existing PM Highway Volume-to-Capacity Ratios

3.1.2 Regional Roadways

There are few regional highways that directly connect the study area to the region's major population and employment areas, and travel is constrained during the peak periods. Exhibit 3-1 shows the existing conditions on regional highways in the Puget Sound Region based on the v/c ratio. Vehicle v/c is a ratio of the vehicle demand compared to the roadway capacity and is used as the performance measure to assess travel

conditions on the regional facilities in the study area. Capacity deficiencies might exist when a v/c ratio exceeds 0.9. A v/c ratio over 1.0 suggests that demand exceeds capacity and congestion could be prohibiting efficient movement of people and goods.

Currently, the traffic demand on SR 99 and I-5 is at or over capacity during the PM peak period. In the future, congestion would continue to worsen as v/c ratios approach 1.0 on other congested roads. Without a more reliable transportation alternative, all modes will be affected, including HOV and transit (both bus and rail).

Interstate freeways and state highways in the study area are identified in Table 3-2. A range of ADT volume is provided because travel characteristics are variable along these regional roadways. Local roadways in the study area are inventoried and discussed in Section 3.3.

TABLE 3-2
Existing Major Highway Facilities

Roadway	Roadway Classification	Number of Lanes	Speed Limit (mph)	ADT[a]	Bike Lanes	Sidewalk
SR 99	Principal Arterial	4–6	40–45	23,000–36,000	No	Yes
I-5	Freeway	8–10	60	176,000–206,000[b]	No	No
Kent-Des Moines Road (SR 516)	Principal Arterial	4	45	30,000–35,000	No	Partial

[a] ADT is based on 2013 traffic count information where available, otherwise 2012 counts with one year growth were used.
[b] Value based on Washington State Department of Transportation *Ramp and Roadway 2012* (WSDOT, 2012).
ADT = average daily traffic, mph = miles per hour

Major Roads and Highways

Arterial: A major thoroughfare used mainly for through traffic rather than access to residential neighborhoods. Arterials generally have greater traffic-carrying capacity than collector or local streets and are designed for continuously moving traffic.
Highway of Statewide Significance (HSS): Interstate highways and principal arterials needed to connect major communities in the state.
Highway of regional significance (non-HSS): State transportation facilities not designated as being of statewide *significance.*
National Highway System (NHS): A network of major highways important to the nation's economy, mobility, and defense.

SR 99 provides a major north-south connection extending through Seattle south to Fife and is classified by the Washington State Department of Transportation (WSDOT) as an HSS and is part of the NHS. This road is the major north-south arterial west of I-5 within the study area. The facility is also called International Boulevard through the city of SeaTac and is called Pacific Highway S through the cities of Kent, Des Moines, and Federal Way.

I-5 is classified as an HSS, is a limited-access facility, and connects the study area directly to key regional urban areas such as Downtown Seattle and Tacoma. I-5 is also part of the NHS.

Kent-Des Moines Road, which runs east-west and connects the Kent and Des Moines communities, is a non-HSS and is part of the NHS. The road provides connections to Downtown Kent, the Kent Manufacturing/Industrial Center, and Downtown Des Moines. The road is classified as a principal arterial serving 30,000 ADT. There are two general-purpose lanes in each direction.

3.1.3 Screenline Performance for All Modes

Three screenlines, which cut across I-5 and SR 99, were established to assess the regional north-south travel within the study area. These screenlines provide a snapshot of traffic operations, such as volumes and travel mode share along each corridor. Mode share information provided from the Puget Sound Regional Council (PSRC) and Sound Transit travel demand models allocates the vehicle demand on a roadway by vehicle type, which includes single-occupancy vehicles (SOVs), HOVs, and transit. Exhibit 1-2 shows the project's three screenline locations:

- Screenline 1 – South of S 200th Street
- Screenline 2 – North of S 272nd Street
- Screenline 3 – South of S 312th Street

Table 3-3 shows the performance at screenlines for the existing PM peak-hour conditions. The three screenlines cross areas with volumes at or close to capacity, which indicate substantial congestion in the southbound direction (the peak direction in the PM peak hour). This level of congestion is expected during the PM peak period as commuters are leaving large employment centers such as Downtown Seattle north of the study area. The northbound direction of travel does not currently have congestion and has v/c ratios between 0.54 and 0.65. This indicates on aggregate these roads (SR 99, I-5, and Military Road) have available capacity in the northbound direction of travel. A substantial portion of the existing northbound traffic is from south corridor employment centers, such as Tacoma, Federal Way, and Kent. Transit mode share at the three screenlines in the northbound direction is only 3 percent, but is as high as 8 percent in the southbound direction. Overall, the SOV mode is the dominant mode choice, with more than 70 percent in the northbound direction and about 55 percent in the southbound direction. The HOV share is about 25 percent in the northbound direction and close to 40 percent in the southbound direction.

TABLE 3-3
Existing PM Peak-Hour Screenline Performance (4:30 p.m. to 5:30 p.m.)

Screenline Location	v/c Ratio		Vehicle Volume		Persons		Travel Mode Share Percent					
							SOV		HOV		Transit	
	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB
South of S 200th Street	0.65	0.93	8,200	12,400	9,800	17,500	74	55	23	37	3	8
North of S 272th Street	0.62	1.02	8,300	13,600	10,000	18,800	73	57	24	36	3	7
South of S 312th Street	0.54	0.84	7,500	11,600	9,000	16,200	72	56	26	37	3	7

Source: PSRC, 2014a.

NB = northbound; SB = southbound

3.2 Transit Operations

This section describes existing conditions of regional and local transit facilities, operations, and services within the study area.

3.2.1 Regional Transit Performance

Transit services within the study area are provided by Sound Transit, Metro, and Pierce Transit, with connections to the regional urban centers. Table 3-4 shows the existing daily boardings and transit trips served by regional transit. The regional transit system serves riders with over 0.5 million daily boardings.

TABLE 3-4
Existing Weekday Transit Ridership

Measure of Effectiveness	Existing
Total Regional Systemwide Daily Boardings	569,000
Total Daily Transit Trips	387,000

Source: Sound Transit, 2014b.

3.2.2 Transit Service and Facilities

Transit centers and park-and-ride facilities are the major transit facilities within the study area. Metro, Sound Transit, and Pierce Transit provide bus service to these facilities. Metro provides most of the bus service in the area with express and local routes throughout King County. Sound Transit's Regional Express buses provide regional service within the study area to King and Pierce counties. Pierce Transit buses provide service between Pierce County and south King County. Table 3-5 lists the existing transit facilities in the study area. Approximately 3,700 park-and-ride spaces are provided at these transit facilities in the study area.

TABLE 3-5
Existing Transit Facilities in FWLE Transportation Study Area

Transit Facility	Facility Type	Served by Routes	Park-and-Ride Spaces
Kent-Des Moines Park-and-Ride and Freeway Station	Park-and-ride, freeway station	Metro 158, 159, 166, 192, 193, 197 ST 574	370
Star Lake Park-and-Ride and Freeway Station	Park-and-ride	Metro 183, 190, 192, 193, 197 ST 574	540
Redondo Heights Park-and-Ride	Park-and-ride	Metro 190; RapidRide A Line	697
Federal Way Transit Center	Transit center, park-and-ride	Metro 179, 181, 182, 183, 187, 193, 197, 901, 903; Metro RapidRide A Line PT 402, 500, 501 ST 574, 577, 578	1,190
Federal Way/S 320th Street Park-and-Ride	Park-and-ride	Metro 177, 178, 193 PT 402, 500, 501	877

Source: Metro, 2015.
PT = Pierce Transit; ST = Sound Transit

As of fall 2015, 26 bus routes serve the study area. A mix of peak and all-day routes is provided, with peak service serving regional destinations north of the study area, including Downtown Seattle, First Hill, and the University of Washington. All day service provides local feeder service from surrounding communities. Bus frequency and hours of service are discussed below in Section 3.2.4, Transit Levels of Service.

Within the study area, Sound Transit's Regional Express buses have an approximate average headway (how often a vehicle passes by a particular point along the route) of 30 minutes in the peak periods. Sound Transit (ST) route 577 between Federal Way and Seattle offers more frequent service, with headways of 15 minutes, but this is a peak-only route. In general, during the peak periods, the number of buses and routes in the peak direction are greater than the number of buses running in the opposite "reverse-peak" direction. The RapidRide A Line operates along SR 99 frequently all day for both weekdays and weekends, but most other Metro routes in the study area offer limited to no existing transit service during off-peak periods and on weekends. Routes that do operate during these times operate with less frequent service, generally about one bus per hour. Existing bus routes within the study area are listed in Table 3-6.

TABLE 3-6
Existing Transit Services in FWLE Transportation Study Area

Route	Service Period	Peak Headway	Off-Peak Headway	Service Area
Metro 121	Peak	30 minutes	-	Downtown Seattle, Burien Transit Center, Normandy Park, Highline College
Metro 122	Peak	30 minutes	-	Downtown Seattle, Burien Transit Center, Des Moines Memorial Drive, Highline College
Metro 156	Daily	30 minutes	30 minutes	SeaTac Airport, Southcenter, Des Moines Memorial Drive, Highline College
Metro 158	Peak	30 minutes	-	Downtown Seattle, Kent-Des Moines Park-and-Ride and Freeway Station, Kent/James Street Park-and-Ride, Kent Station Transit Center and Park-and-Ride, Lake Meridian, Timberlane
Metro 159	Peak	30 minutes	-	Downtown Seattle, Kent-Des Moines Park-and-Ride and Freeway Station, Kent/James Street Park-and-Ride, Kent Station Transit Center and Park-and-Ride, Lake Meridian, Timberlane
Metro 166	Daily	30 minutes	30 minutes	Kent Station, Kent-Des Moines Park-and-Ride, Highline College
Metro 177	Peak	30minutes	-	Downtown Seattle, Kent-Des Moines Park-and-Ride, Federal Way Transit Center, Federal Way/S 320th Street Park-and-Ride
Metro 178	Peak	15minutes	-	Downtown Seattle, Kent-Des Moines Park-and-Ride, Federal Way Transit Center, Federal Way/S 320th Street Park-and-Ride, S Federal Way Park-and-Ride
Metro 179	Peak	30 minutes	-	Downtown Seattle, Kent-Des Moines Park-and-Ride, Federal Way Transit Center, Federal Way/S 320th Street Park-and-Ride, Twin Lakes Park-and-Ride
Metro 181	Daily	30 minutes	30 minutes	Twin Lakes Park-and-Ride, Federal Way Transit Center, Auburn Station, Green River Community College
Metro 182	Daily	30 minutes	60 minutes	Federal Way Transit Center, South Federal Way, Tacoma
Metro 183	Daily	30 minutes	60 minutes	Kent Station, Star Lake Park-and-Ride, Federal Way Transit Center
Metro 187	Daily	30 minutes	60 minutes	Federal Way Transit Center, Twin Lakes
Metro 190	Peak	30 minutes	-	Downtown Seattle, Star Lake Freeway Station, Redondo Heights Park-and-Ride
Metro 192	Peak	30 minutes	-	Downtown Seattle, Kent-Des Moines Freeway Station, Star Lake Park-and-Ride
Metro 193	Peak	30 minutes	-	First Hill, Tukwila Park-and-Ride, Kent-Des Moines Park-and-Ride, Star Lake Park-and-Ride, Federal Way Transit Center, Federal Way Park-and-Ride

TABLE 3-6
Existing Transit Services in FWLE Transportation Study Area

Route	Service Period	Peak Headway	Off-Peak Headway	Service Area
Metro 197	Peak	30 minutes	-	University District, Kent-Des Moines Freeway Station, Star Lake Freeway Station, Federal Way Transit Center, Twin Lakes Park-and-Ride
Metro 901	Daily	30 minutes	30 minutes	Federal Way Transit Center, Mirror Lake
Metro 903	Daily	30 minutes	30 minutes	Federal Way Transit Center, Twin lakes
PT 402	Daily	30minutes	60 minutes	Federal Way Transit Center, Puyallup Sounder Station, South Hill Mall Transit Center, Graham, Spanaway, Mountain Highway
PT 500	Daily	30minutes	60 minutes	Federal Way Transit Center, Fife Business Park, Tacoma Dome Station, Downtown Tacoma
PT 501	Daily	60 minutes	60 minutes	Federal Way Transit Center, Weyerhaeuser Way, Milton, Fife Business Park, Tacoma Dome Station, Downtown Tacoma
ST 574	Daily	30 minutes	30 minutes	Lakewood Park-and-Ride, Star Lake Park-and-Ride, Kent-Des Moines Freeway Station, SR 512 Park-and-Ride, Federal Way Transit Center, Tacoma Dome Station, SeaTac Station, SeaTac Airport
ST 577	Peak	15 minutes	-	Downtown Seattle, Federal Way Transit Center
ST 578	Daily	30 minutes	30 minutes	Downtown Seattle, Auburn Sounder Station, Federal Way Transit Center, Sumner Station, Puyallup Sounder Station
Metro RapidRide A Line	Daily	10 minutes	15	Tukwila International Boulevard Link Light Rail Station, S 176th Street Sea-Tac Airport Link Light Rail Station, Angle Lake, Highline College, Des Moines, Redondo Heights Park-and-Ride, Federal Way Transit Center

Sources: Metro, 2016b; Sound Transit, 2016; Pierce Transit, 2016.

3.2.3 Screenline Performance

The existing PM peak period transit ridership at the three study area screenlines is presented in Table 3-7. This shows the high demand on transit for the southbound commute during the PM peak hour.

TABLE 3-7
Existing PM Peak Period Ridership by Screenline Location (4:30 p.m. to 5:30 p.m.)

Screenline Location	Direction	Existing
South of S 200th Street	Northbound	1,000
	Southbound	4,500
North of S 272th Street	Northbound	1,000
	Southbound	4,000
South of S 312th Street	Northbound	500
	Southbound	3,500

Source: Sound Transit, 2014b.

3.2.4 Transit Levels of Service

Transit level of service (LOS) performance measures were analyzed for the PM peak period (3:00 p.m. to 7:00 p.m.), unless otherwise noted. Transit LOS is assessed with four performance measures: service frequency, hours of service, passenger load, and reliability. For transit LOS performance, LOS A indicates frequent peak-period service, more hours served during the day, high on-time performance, and minimal passenger crowding in a transit vehicle. Conversely, LOS F indicates infrequent or irregular service, minimal service hours, poor reliability, and passenger crowding in the vehicle.

3.2.4.1 Service Frequency

Service frequency LOS is the number of times within the PM peak hour that a bus or light rail train stops at a specific location. Generally, the shorter the transit headway, the less time a rider has to wait between transit arrivals; hence, the better the service frequency LOS. Transit routes that have headways of less than 10 minutes are considered LOS A, whereas headways longer than 60 minutes reflect LOS F. (Table B-1 in Appendix B, Level of Service Definitions used for Federal Way Link Extension Analysis, shows the thresholds for each LOS level).

Overall, the majority of the transit routes operate with a peak period service frequency that indicates LOS D or worse, meaning average headways (how often transit will pass by a particular point along the route) are 21 minutes or longer. The transit routes between the key origin and destination pairs as a system show better LOS. Exhibit 3-2 provides a summary of the PM peak period transit frequencies by LOS. Bus routes that provide service between Downtown Seattle and the FWLE study area currently operate at average headways of 15 minutes to 30 minutes, with most routes operating at a 30-minute headway. The RapidRide A Line, which provides service between Tukwila and Federal Way on SR 99, provides the most frequent bus service in the study area. This route operates with 10-minute headways during the PM peak period and is the only route that operates at LOS B or better.

3.2.4.2 Hours of Service

Hours of service LOS is the total transit operating hours provided within a 24-hour (daily) period. Hours of service LOS is intended to measure the availability of transit service to riders and potential users. The longer that transit service is provided throughout the day, the better the LOS. (Table B-2 in Appendix B shows the thresholds for each LOS level).

The LOS for hours of service between areas connected by transit is shown in Exhibit 3-3. Other than Downtown Seattle, little to no direct transit service is provided between the study area and key Puget Sound regional employment centers such as Downtown Bellevue, Redmond, the University of Washington, Northgate, and Lynnwood. Within the study area, transit service is available along SR 99 throughout most of the day as RapidRide A Line travels between the Federal Way Transit Center and Tukwila, operating at LOS A.

3.2.4.3 Passenger Load

Passenger load LOS is intended to measure passenger comfort and the ability of a rider to find a seat on the bus or train during the PM peak hour. Passenger load LOS also measures crowding in the transit vehicle. On buses, passenger load LOS is defined by the number of passengers per seat (load factor). For light rail, passenger load LOS is a measure of square footage available (standing room) for each

standing passenger. Passenger load LOS A indicates that riders are able to spread out on the vehicle along with the potential to use empty seats for carry-on items instead of using their laps or the floor. A passenger load LOS at or worse than LOS D might reflect overcrowding, and the transit service provider might need to increase service frequency to improve LOS. In addition, a large number of passengers can cause the bus to dwell longer at stops as a result of crowded passenger boarding and alighting. The longer dwell time can negatively affect travel time and service reliability. (Tables B-3 and B-4 in Appendix B show the thresholds for each LOS level for bus and light rail, respectively.)

The average weekday PM peak-hour passenger load LOS was calculated for two of the three study area screenlines (south of S 200th Street and south of S 312th Street). At these screenlines, some of the transit routes are crowded, while others have seats available. Table 3-8 shows that at each screenline, the average passenger load was LOS B or better, meaning many seats were unoccupied on these routes, thereby allowing passengers the ability to choose where they sit and have some seats available to store carry-on items.

TABLE 3-8
Existing Average Weekday PM Peak-Hour Route Passenger Load (4:30 p.m. to 5:30 p.m.)

	Direction	Average Load	Average Capacity	Load Factor (passengers/seat)	LOS
South of 200th Street	Northbound	15	39	0.39	A
	Southbound	28	45	0.62	B
South of 312th Street	Northbound	17	49	0.43	A
	Southbound	22	43	0.53	B

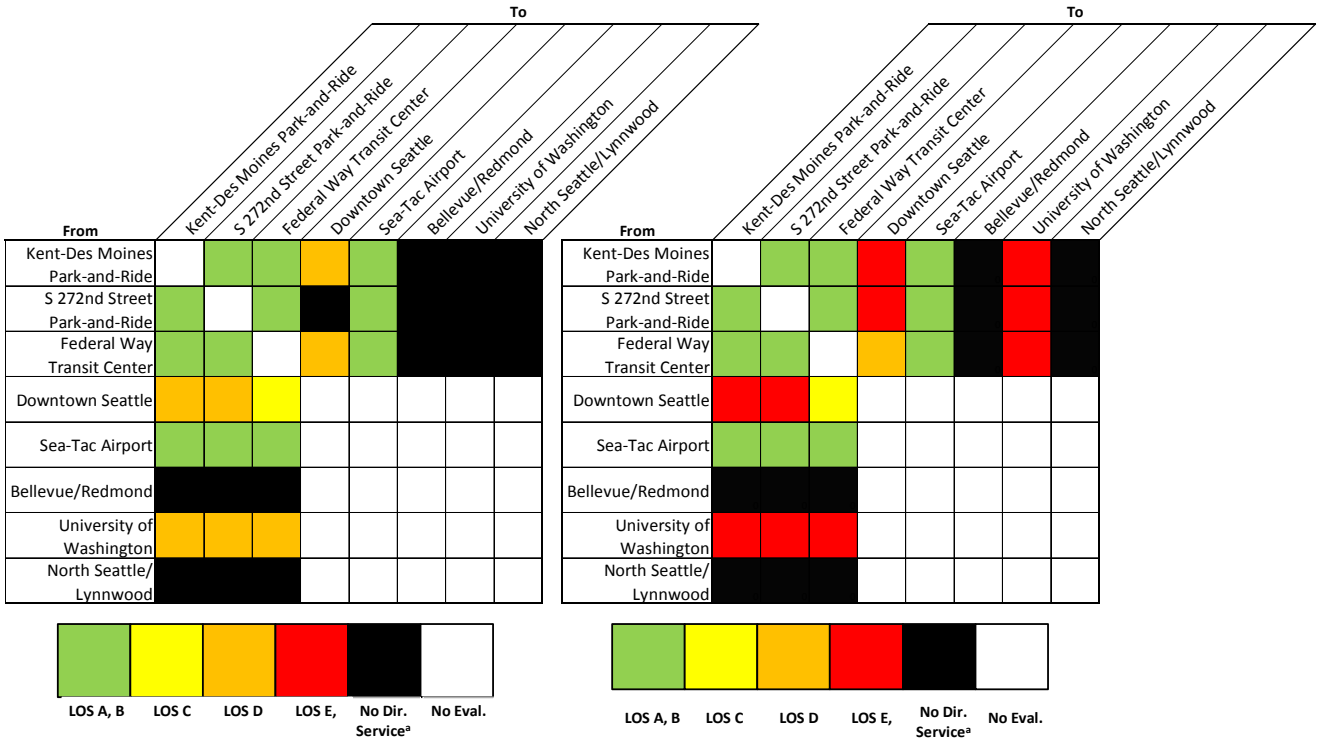
Source: Metro, 2015; Sound Transit, 2015.

Note: Screenline average load and average capacity are weighted based on the total number of peak hour vehicles per route.

Sound Transit routes 577 and 586 running southbound during the PM peak have passenger load factors of 1.16 and 1.14, respectively, which correspond to LOS D and reflects overcrowding. Sound Transit routes 574 and 595 running southbound during the PM peak have a passenger load factor of 0.79, which correspond to LOS C. All other routes have passenger load factors less than 0.75, which corresponds to LOS B or better.

3.2.4.4 On-time Reliability

Reliability of service LOS was analyzed at major transit hubs within the FWLE corridor. The reliability LOS measures the degree to which a transit vehicle meets or misses the scheduled headway at its arrival station. This includes both a transit vehicle arriving late as well as a transit vehicle leaving early from a stop. A bus leaving early would mean that some transit riders would miss their bus.



[a]No direct service or requires one or more bus transfers.
For frequency, at LOS A, transit routes have headways of less than 10 minutes while at LOS F, transit routes have headways of greater than 60 minutes.
For hours of service, at LOS A, service is available most or all day (>19 hr) while at LOS F, transit service is only offered for a few hours a day (<3 hr).

EXHIBIT 3-2
Existing PM Peak-Period Service Frequency Level of Service

EXHIBIT 3-3
Existing Transit Levels of Service for Hours of Service

Two methods were used to determine transit reliability. For transit routes with scheduled headways greater than 10 minutes, on-time reliability was evaluated in terms of on-time performance, defined as a departure being 1 minute early to 5 minutes late. For transit routes operating at scheduled headways of 10 minutes or less, headway adherence was used to determine reliability. Reliability was calculated using the *Transit Capacity and Quality of Service Manual* (TCQSM) methodology (TRB, 2013), which compares the standard deviation of actual headways to scheduled headways of transit routes at major transit centers and park-and-ride lots within the study area. (Table B-5 and Table B-6 in Appendix B show the thresholds for each LOS level).

Service reliability at regional transit facilities, including on-time performance and LOS results for the existing PM peak-hour, is shown in Table 3-9. The detailed performance analysis by each route is shown in Table C-2 in Appendix C, Existing and Future Transit Routes and Level of Service. The International District/Chinatown Station was chosen for this analysis because regional transit service between the FWLE study area and Seattle travels through this Downtown Seattle station. The other four transit hubs selected are key transit destinations within the study area.

Most buses operate with poor on-time performance due to congestion and wide variations in roadway travel times.

TABLE 3-9
Existing PM Peak-Hour Transit On-Time Performance and Reliability at Transit Hubs

Transit Hub	On-Time Performance Percentage	Reliability LOS
International District/Chinatown	28%	F
Kent-Des Moines Park and Ride/Kent-Des Moines and I-5 Freeway Stop	37%	F
Highline College	65%	F
Star Lake Park-and-Ride	40%	F
Federal Way Transit Center	53%	F

The RapidRide A Line reliability measure is not based on on-time performance but rather its headway adherence because it operates at 10-minute headways during the PM peak period. At the two station areas where RapidRide A Line reliability is measured (Federal Way Transit Center and Kent-Des Moines Road), the route operates with typical headway adherence at LOS D or better.

The on-time performance for the transit routes serving the FWLE station areas on average is poor (LOS F). The Highline College hub offers the most reliable transit service, with a 65 percent average on-time performance. Conversely, International District/Chinatown has the least reliable service, with a 28 percent average on-time performance.

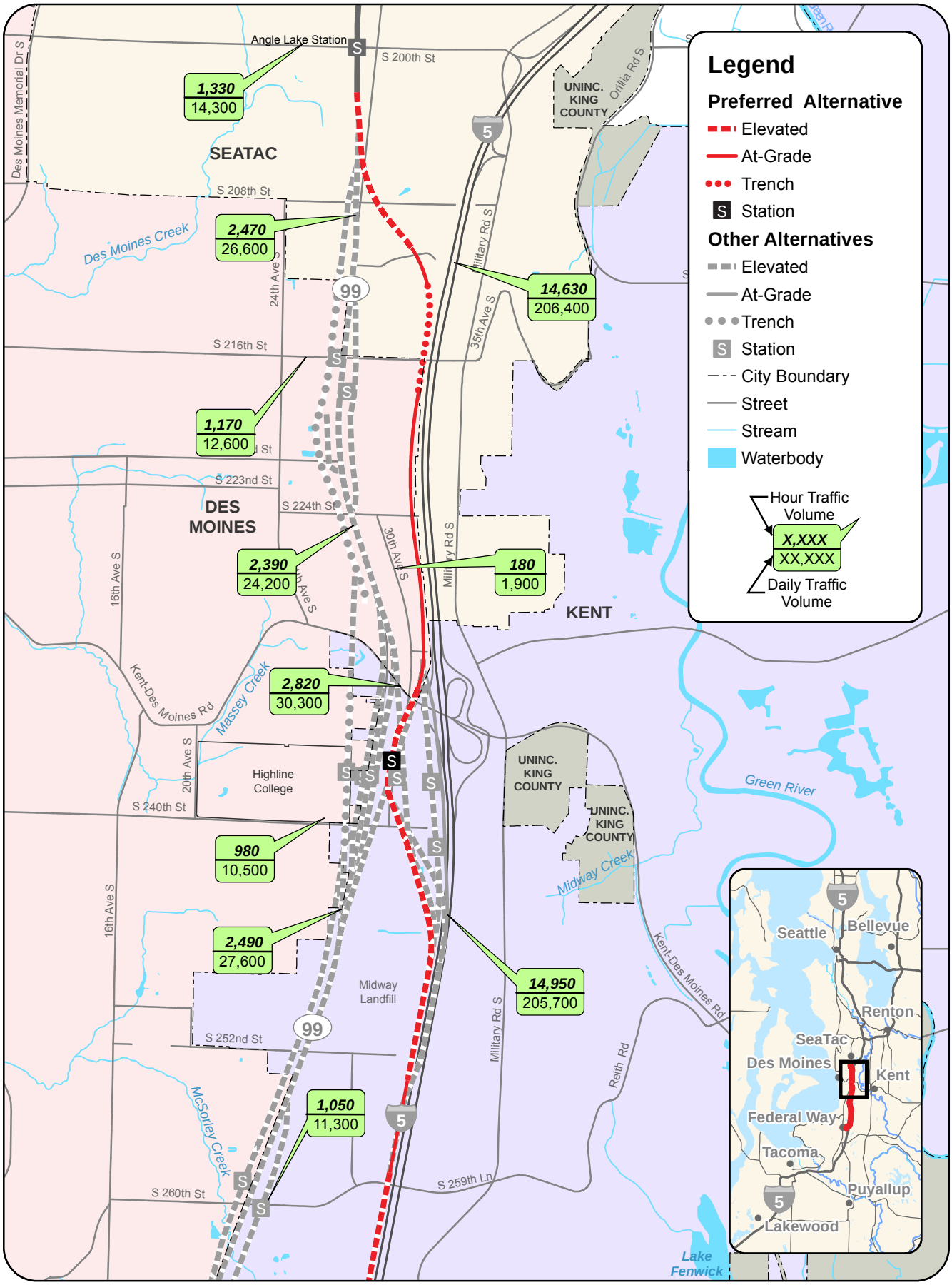
3.3 Arterial and Local Street Operations

This section describes existing conditions for arterials and local roadway facilities, intersection operations, and traffic safety within the study area.

3.3.1 Arterial and Local Roadways

Exhibits 3-4 and 3-5 show the roadways and volumes in the northern and southern study area, respectively, including the PM peak hour and daily volumes. Local and arterial north-south roads, including Military Road, generally have two travel lanes and speeds between 25 to 40 miles per hour (mph), while east-west roadways have between two and six lanes and speeds under 40 mph.

Average daily traffic volumes range from a few thousand vehicles per day to up to 43,000 vehicles along S 320th Street. Most roadways in the study area have full or partial sidewalks but generally do not have bicycle lanes. Average daily traffic volumes, speed limits, and functional classification for major roadways in the FWLE corridor are shown in Table 3-10.

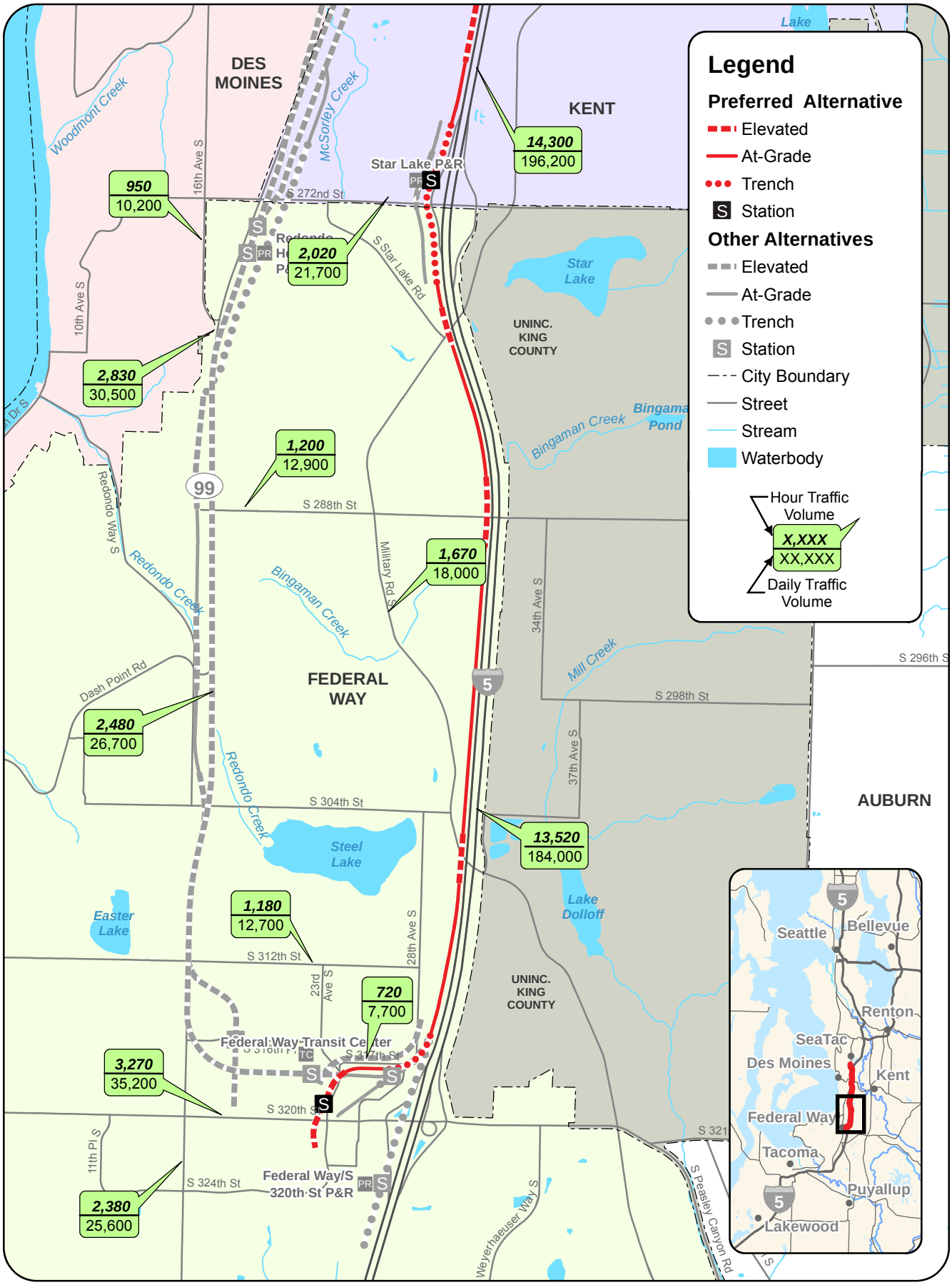


Data Sources: WSDOT (2012), King County (2015)

N

0 0.25 0.5 1 Miles

EXHIBIT 3-4
Existing PM Peak-Hour and Daily Volumes
Northern Extent
Federal Way Link Extension



Data Sources: WSDOT (2012), King County (2015)

N

0 0.25 0.5 1 Miles

EXHIBIT 3-5
Existing PM Peak-Hour and Daily Volumes
Southern Extent
Federal Way Link Extension

TABLE 3-10
Existing Local Roadway Facilities

Roadway	Arterial Classification	Number of Lanes	Speed Limit (mph)	ADT[a]	Bike Lanes	Sidewalk
East-West Roadways						
S 200th Street	Principal arterial	4	35	14,300	N	Y
S 208th Street	Collector arterial	2	25	3,000	N	N
S 216th Street	Minor arterial	2-3	35	12,600	Partial	Partial
S 240th Street	Minor arterial	2	35	10,500	N	Partial
S 260th Street	Minor arterial	2-3	35	11,300	Partial	Y
S 272nd Street	Principal arterial	4	35	21,700	N	Y
S Star Lake Road	Principal collector	2	35	6,000	N	Partial
S 288th Street	Minor arterial	4	35	12,900	N	Y
Dash Point Road	Principal arterial	2	40	16,000	N	Partial
S 312th Street	Minor arterial	4	35	9,000–13,000	N	Partial
S 320th Street	Principal arterial	6	35	27,000–43,000	N	Y
S 324th Street	Minor arterial	3	30	11,000	Partial	Y
North-South Roadways						
Military Road S	Principal Arterial	2	35–40	11,000–18,000	Partial	Partial
24th Ave. S	Collector arterial	2	30	5,000	Partial	Partial
30th Ave. S	Neighborhood collector	2	25	1,900	N	N
16th Ave. S	Minor arterial	2	25–35	10,200	Partial	Partial
28th Ave. S/S 317th Street	Minor arterial	2	30–35	6,000	Partial	Partial

Note: Table only includes local roads and roads classified as arterial and above.
[a] ADT based on latest available traffic count information unless otherwise noted.
N = no; Y = yes

3.3.2 Intersection Operations and Level of Service

Key intersections in the study area were analyzed to understand their operating conditions. All key intersections identified were analyzed for the PM peak hour (4:45 to 5:45 p.m.). For the AM peak hour (7:00 to 8:00 a.m.), however, only a subset of PM study intersections, which includes all ramp terminals and critical intersections near the station areas, were analyzed.

The quality of traffic operations is also described in LOS terms for signalized and unsignalized intersections. LOS ratings range from LOS A to LOS F; LOS A represents the best operations and LOS F the poorest operation. LOS was calculated for all study intersections. Intersection results at signalized intersections are the average delay of all vehicles. Appendix B shows the level of service definitions for signalized and unsignalized intersections.

Furthermore, intersections are considered failing when they do not operate at or better than the agency's intersection LOS standard. Failing LOS standards indicate that vehicles incur substantial delay and vehicle queuing is evident. Table 3-11 lists the LOS standards, or lowest acceptable LOS threshold, for each of the affected jurisdictions in the study area.

Many jurisdictions in the study area maintain a consistent LOS standard for a given facility type; however, the cities of SeaTac, Des Moines, and Kent allow exceptions along SR 99, as indicated in Table 3-11. For facilities that are owned by WSDOT (such as SR 99) but are maintained by the local jurisdictions, the WSDOT standards, which are the most conservative, were used as the basis of comparison. For ramp terminal intersections, the WSDOT LOS standard was assumed because those intersections are within WSDOT jurisdiction.

TABLE 3-11
LOS Standards for Affected Agencies

Agency/Jurisdiction	LOS Standard
Washington State Department of Transportation	LOS D for HSS LOS E for regionally significant state highways (non-HSS)
City of SeaTac	LOS E for principal and minor arterials LOS D for collector and lower classification streets
City of Des Moines	LOS D for signalized intersections or Xc less than 1.0, with the following exceptions (with their LOS threshold) along Pacific Highway South (SR 99): • S 216th Street (LOS F) (Xc < 1.0 standard) • Kent Des Moines Road (LOS F) (Xc < 1.2 standard) • S 220th Street (LOS E) (Xc < 1.0 standard) • S 224th Street (LOS E Xc < 1.0 standard)
City of Kent	LOS E for non-SR 99 intersections LOS F for all SR 99 intersections
City of Federal Way	v/c of 1.2 for signalized intersections v/c of 1.0 for unsignalized intersections Maintain an average v/c of 1.1 for signalized intersections within City Center
King County	LOS E for signalized and unsignalized intersections

Sources: City of Des Moines, 2015; City of Federal Way, 2015; City of Kent, 2008; King County, 2001; WSDOT, 2010.
Note: For intersections that have approaches with multiple roadway classifications, the LOS threshold for the highest classified roadway will apply (e.g., for an intersection between a principal arterial and a collector arterial, the LOS threshold for the principal arterial will apply).
< = less than; Xc = critical volume to capacity ratio

Results for the AM peak hour are shown in Exhibit 3-6, and the PM peak hour results are shown in Exhibits 3-7 and 3-8.

All of the intersections currently meet the respective jurisdictions' mobility standards except for Kent-Des Moines Road and I-5 southbound ramps during the PM peak hour, and Kent-Des Moines Road and SR 99 intersection during both the AM and PM peak hours. These intersections do not meet the WSDOT standard of LOS D for HSS facilities.

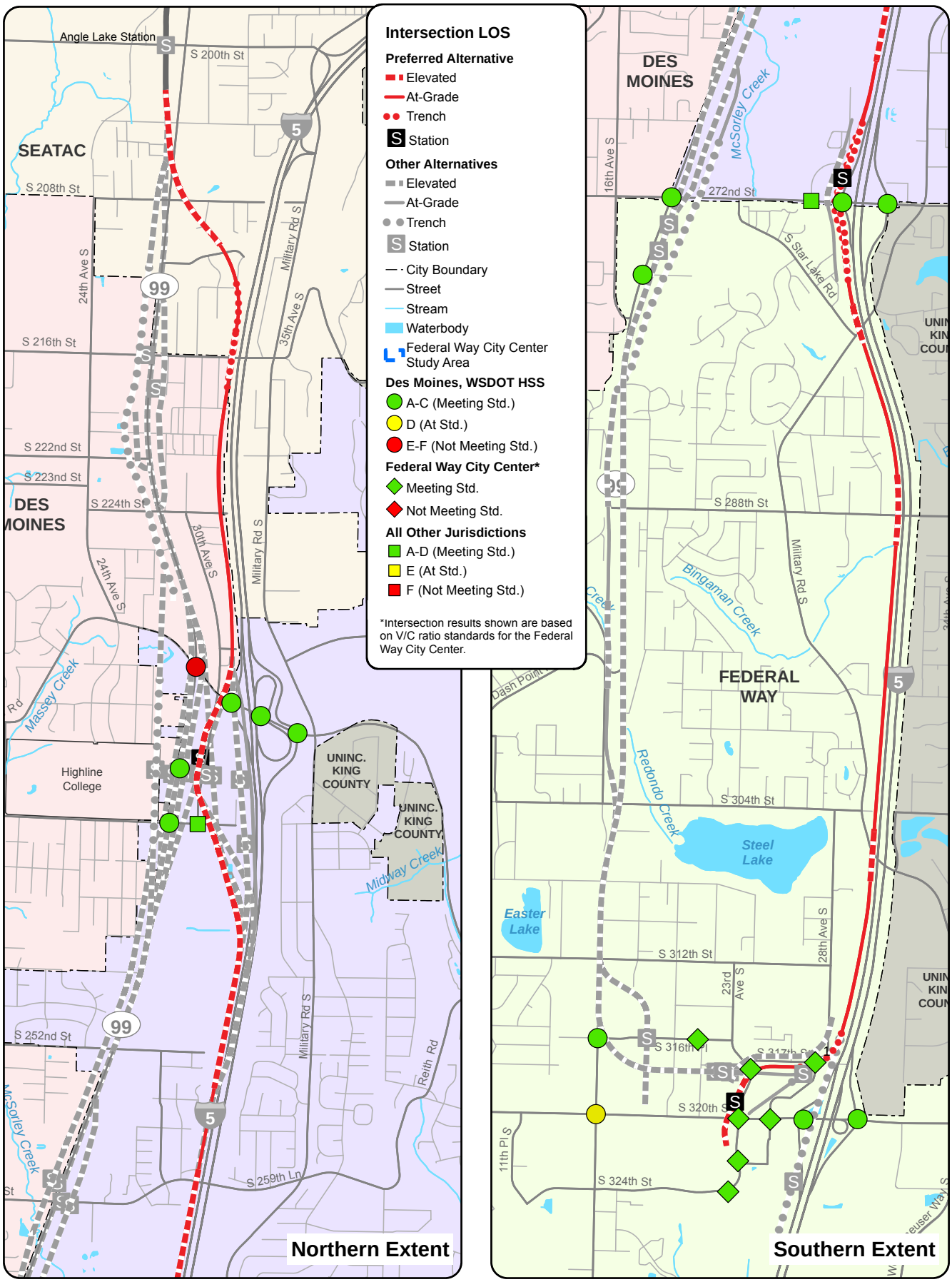
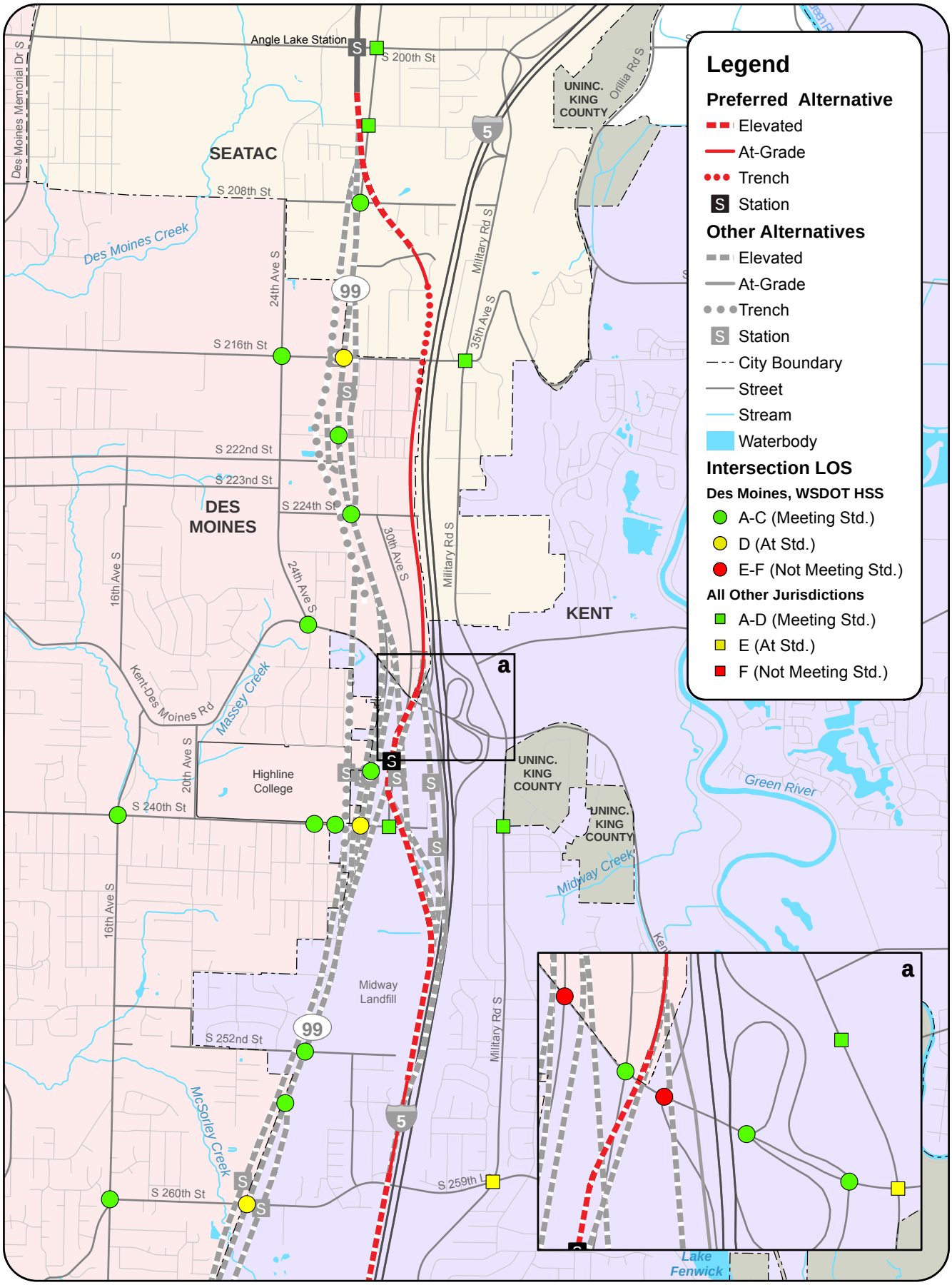
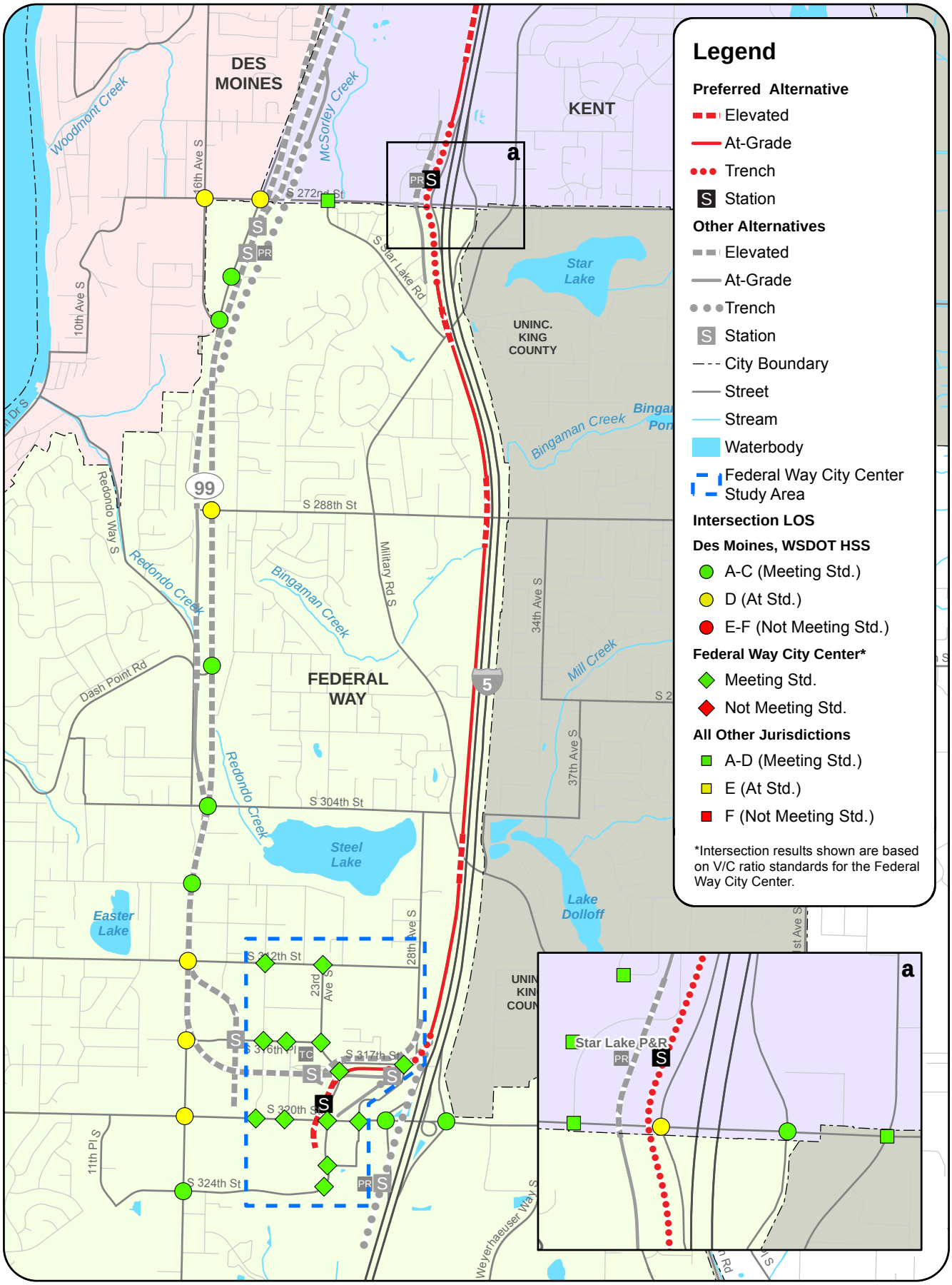


EXHIBIT 3-6
Existing AM Intersection Level of Service Northern and Southern Study Area Extents
Federal Way Link Extension



Data Sources: King County (2015).
HSS = Highway of Statewide Significance

EXHIBIT 3-7
Existing PM Intersection Level of Service
Northern Study Area Extent
Federal Way Link Extension



Data Sources: King County (2015).
HSS = Highway of Statewide Significance

N

0 0.25 0.5 1 Miles

EXHIBIT 3-8
Existing PM Intersection Level of Service
Southern Study Area Extent
Federal Way Link Extension

Table D-1 in Appendix D, Existing and Future Intersection Level of Service Results, provides a detailed summary of the traffic analysis results for the existing AM and PM peak-hour conditions, signal control, and the applicable LOS standard.

3.4 Safety

This section discusses current safety-related conditions in the FWLE corridor. This includes a review of crash data records for roadways in the study area and an assessment of locations along the I-5 southbound lanes where clear zones and/or guardrails currently exist.

3.4.1 Crash Analysis

Crash data records were collected for a 5-year period between 2007 and 2011 from WSDOT for intersections, arterials, I-5 ramps, and the I-5 mainline within the study area. The majority of the crashes in the study area occurred at intersections (as opposed to roadway segments).

The safety analysis completed for arterials includes intersection-related and non-intersection-related crashes. Intersection-related crashes include those occurring at an intersection or those caused by intersection operations (e.g., rear-ends resulting from vehicle queuing). The non-intersection-related analysis, or corridor analysis, includes those crashes that occur between intersections and may include crashes caused by driveways. For I-5, the crash analysis includes crashes that occurred on the I-5 mainline between interchanges, including both the general purpose and HOV lanes. I-5 ramp crashes were also documented and include those crashes that occurred on the ramps but are not intersection-related.

Crash rates were calculated for the study area intersections as the number of crashes per million entering vehicles (MEV). The intersection of SR 99 and Kent-Des Moines Road had the greatest number of crashes (193) and the highest intersection crash rate of 2.16 crashes per MEV within the study period. Table 3-12 shows the intersection locations by jurisdiction and indicates intersection traffic entering volumes, crash numbers by type, and crash rates for the intersections.

TABLE 3-12
Existing Intersection Crash Analysis Results (2007–2011)

Jurisdiction/Intersection	ADT (Entering Volume)	2007–2011 Crash Frequency (# of crashes)				Crash Rate (crashes/ MEV)
		Property Damage Only	Injuries	Fatality	Total	
City of SeaTac						
SR 99 and S 200th Street	39,550	32	16	0	48	0.68
SR 99 and S 204th Street	30,150	8	7	0	15	0.31
SR 99 and S 208th Street	30,550	12	12	0	24	0.43
City of Des Moines						
SR 99 and S 216th Street	35,900	40	18	0	58	0.90
24th Ave. S and S 216th Street	14,900	4	2	0	6	0.22
SR 99 and S 220th Street	24,800	12	5	0	17	0.38
SR 99 and S 224th Street	25,100	15	12	0	27	0.59

TABLE 3-12
Existing Intersection Crash Analysis Results (2007–2011)

Jurisdiction/Intersection	ADT (Entering Volume)	2007–2011 Crash Frequency (# of crashes)				Crash Rate (crashes/ MEV)
		Property Damage Only	Injuries	Fatality	Total	
SR 99 and Kent-Des Moines Road	50,050	126	67	0	193	2.16
30th Ave. S and Kent-Des Moines Road	31,750	6	2	0	8	0.14
16th Ave. S and S 272nd Street	17,050	11	1	0	12	0.39
City of Kent						
Military Road S and Kent-Des Moines Park-and-Ride	16,950	9	2	0	11	0.39
I-5 SB on-/off-ramp and Kent-Des Moines Road	42,950	69	34	0	103	1.33
I-5 NB on-/off-ramp and Kent-Des Moines Road	38,450	39	22	0	61	0.87
I-5 NB off-ramp and Kent-Des Moines Road	34,700	21	11	0	32	0.51
Military Road S and Kent-Des Moines Road	44,250	69	24	0	93	1.16
SR 99 and S 240th Street	34,300	27	23	0	50	0.81
SR 99 and S 252nd Street	28,600	18	7	0	25	0.50
SR 99 and Fred Meyer driveway	31,650	8	7	0	15	0.26
SR 99 and S 260th Street	36,100	32	20	0	52	0.81
SR 99 and S 272nd Street	46,450	54	39	0	93	1.11
S Star Lake Road and S 272nd Street	24,850	39	17	0	56	1.24
26th Ave. S and S 272nd Street	22,650	8	11	0	19	0.46
I-5 SB on-/off-ramp and S 272nd Street	30,750	33	13	0	46	0.82
I-5 NB on-/off-ramp and S 272nd Street	28,150	37	12	0	49	0.99
City of Federal Way						
SR 99 and S 276th Street	32,300	6	9	0	15	0.25
SR 99 and 16th Ave. S	35,400	26	9	0	35	0.56
SR 99 and S 288th Street	39,950	19	22	0	41	0.56
SR 99 and Dash Point Road	36,200	19	13	0	32	0.48
SR 99 and S 304th Street	27,950	26	19	0	45	0.88
SR 99 and S 308th Street	28,650	12	13	0	25	0.48
SR 99 and S 312th Street	39,000	57	32	0	89	1.25
20th Ave. S and S 312th Street	15,700	11	4	0	15	0.52
23rd Ave. S and S 312th Street	12,900	5	1	0	6	0.25
SR 99 and S 316th Street	33,450	23	19	0	42	0.69
20th Ave. S and S 316th Street	12,050	8	3	0	11	0.50
23rd Ave. S and S 316th Street	9,850	2	5	0	7	0.39
23rd Ave. S and S 317th Street	16,650	6	3	0	9	0.30
28th Ave. S and S 317th Street	10,150	3	0	0	3	0.16
SR 99 and S 320th Street	59,100	86	48	1	135	1.26

TABLE 3-12
Existing Intersection Crash Analysis Results (2007–2011)

Jurisdiction/Intersection	ADT (Entering Volume)	2007–2011 Crash Frequency (# of crashes)				Crash Rate (crashes/ MEV)
		Property Damage Only	Injuries	Fatality	Total	
20th Ave. S and S 320th Street	37,550	21	20	0	41	0.60
23rd Ave. S and S 320th Street	48,050	50	16	0	66	0.75
I-5 SB on-/off-ramp and S 320th Street	50,100	76	39	0	115	1.28
I-5 NB on-/off-ramp and S 320th Street	33,050	19	13	0	32	0.53

Source: WSDOT, 2013.

Corridor crash rates were calculated for the study area corridor as the number of crashes per million vehicle miles traveled (MVMT). As mentioned above, the corridor crash rates do not include any crashes that occurred at intersections. The 2011 statewide collision average for principal arterials within WSDOT's jurisdiction in urban areas is 2.07 crashes per MVMT. Two sections of SR 99 in the study area were above this average: S 216th Street to Kent-Des Moines Road in Des Moines and S 288th Street to S 320th Street in Federal Way. South 320th Street between SR 99 and I-5 had the greatest number of crashes (161) and the highest corridor crash rate of 2.99 crashes per MVMT. The other section of the corridor above the statewide collision average is S 272nd Street between SR 99 and I-5, with a crash rate of 2.59. Table 3-13 presents a summary of the crash data collected for roadway sections of the study area corridor extending from the S 320th Street to the S 200th Street. This table shows the corridor segment locations and indicates corridor traffic volumes (as ADT), crash numbers by type, and crash rates for the corridor segments.

TABLE 3-13
Existing (2007–2011) Corridor Crash Analysis Results

Corridor Segment		ADT	2007–2011 Crash Frequency (# of crashes)				Crash Rate (crashes/MVMT)
			Property Damage Only	Injuries	Fatality	Total	
SR 99	S 200th Street to S 216th Street	26,600	21	5	0	26	1.81
	S 216th Street to Kent-Des Moines Road	24,200	10	4	0	14	2.55
	Kent-Des Moines Road to S 260th Street	27,550	52	12	0	64	1.74
	S 260th Street to S 288th Street	30,450	44	26	0	70	1.82
	S 288th Street to S 320th Street	26,650	21	8	0	29	2.56
S 200th Street		14,300	9	2	0	11	0.77
S 216th Street		12,550	6	3	0	9	1.12
Kent-Des Moines Road		30,300	30	11	0	41	1.32
S 272nd Street		21,650	54	35	0	89	2.59
S 320th Street		35,150	102	59	0	161	2.99

Source: WSDOT, 2013.

Additionally, WSDOT uses a system of collision analysis corridors (CAC) or collision analysis locations (CAL) to identify locations with high potential for safety improvements. The CACs include 236 state facilities with the highest expected frequency of fatal and serious injury crashes. In western Washington, these CACs have an expected crash frequency greater than 2.86 crashes per MVMT.

On the I-5 mainline, through the study area, there were a total of 1,705 crashes between 2007 and 2011. A summary of the mainline crashes and crash rates by direction and severity is included in Table 3-14. The 2011 statewide collision average for interstates within WSDOT's jurisdiction in urban areas is 1.24 crashes per MVMT. All I-5 mainline segments in the study area have a crash rate less than the statewide average. In addition, the only CAC on I-5 in the study area is a 0.3-mile section at the S 272nd Street interchange. WSDOT concluded that no improvements are needed at this time.

The crash rate on the segment of Kent-Des Moines Road within the study area has an accident rate around 1.3 crashes per MVMT, less than the statewide average for urban arterials (2.07 crashes per MVMT). Two SR 99 segments, S 216th Street to Kent-Des Moines Road (2.55 crashes per MVMT) and S 288th Street to S 320th Street (2.56 crashes per MVMT) have crash rates over the statewide average.

There were a total of 378 crashes on the I-5 ramps in the study area between 2007 and 2011. A summary of the ramp crashes by direction and severity is included in Table 3-14. WSDOT does not report average collision rates for interstate ramps. The southbound off-ramp to S 320th Street had the highest crash frequency of about 17 crashes per year, but it also has the highest volume of any of the ramps in the study area. The northbound HOV on-ramp from S 317th Street had the lowest crash frequency with zero crashes per year. This ramp has one of the lower ramp volumes of any in the study area.

TABLE 3-14
Existing (2007–2011) I-5 Mainline and Ramp Crash Analysis Results

Mainline or Ramp Segment	ADT	2007–2011 Crash Frequency (# of crashes)				Crash Rate (crashes/MVMT)
		Property Damage Only	Injuries	Fatality	Total	
I-5 Northbound Mainline						
S 200th St to S 216th St	98,800	62	32	1	95	0.63
S 216th St to S Kent-Des Moines Road	103,300	171	46	1	218	0.60
S Kent-Des Moines Road to S 260th St	101,900	53	23	0	76	0.55
S 260th St to S 272nd St	97,100	119	59	0	178	0.87
S 272nd St to S 320th St	90,900	219	111	0	330	0.57
I-5 Southbound Mainline						
S 200th St to S 216th St	98,450	54	32	0	86	0.57
S 216th St to S Kent-Des Moines Road	103,100	127	64	0	191	0.53
S Kent-Des Moines Road to S 260th St	103,750	26	16	2	44	0.31
S 260th St to S 272nd St	99,050	71	32	0	103	0.50
S 272nd St to S 320th St	93,050	255	127	2	384	0.65

TABLE 3-14
Existing (2007–2011) I-5 Mainline and Ramp Crash Analysis Results

Mainline or Ramp Segment	ADT	2007–2011 Crash Frequency (# of crashes)				Crash Rate (crashes/MVMT)
		Property Damage Only	Injuries	Fatality	Total	
I-5 Northbound Ramps						
On-Ramp from Westbound Kent-Des Moines Rd	6,210	3	4	0	7	2.06
Off-Ramp to Westbound Kent-Des Moines Rd	3,920	47	23	0	70	42.54
On-Ramp from Eastbound Kent-Des Moines Rd	8,880	8	1	0	9	1.85
Off-Ramp to Eastbound Kent-Des Moines Rd	5,120	11	5	0	16	5.35
On-Ramp from S 272nd St	12,020	15	5	0	20	2.85
Off-Ramp to S 272nd St	6,160	25	2	0	27	8.01
On-Ramp (HOV) from S 317th St	1,830	0	0	0	0	0.00
On-Ramp from Westbound S 320th St	2,890	3	0	0	3	1.16
On-Ramp from Eastbound S 320th St	10,150	24	9	0	33	4.69
Off-Ramp (HOV) to S 317th St	1,330	0	1	0	1	1.25
Off-Ramp to S 320th St	8,690	6	9	0	15	3.94
I-5 Southbound Ramps						
Off-Ramp to Kent-Des Moines Rd	13,210	33	24	0	57	10.75
On-Ramp from Kent-Des Moines Rd	9,350	1	0	0	1	0.37
Off-Ramp to S 272nd St	11,440	14	6	0	20	3.19
On-Ramp from S 272nd St	5,940	2	0	0	2	0.88
Off-Ramp (HOV) to S 317th St	1,830	4	1	0	5	6.24
On-Ramp (HOV) from S 317th St	1,210	4	0	0	4	8.23
Off-Ramp to S 320th St	14,550	59	24	0	83	10.42
On-Ramp to S 320th St	9,530	4	1	0	5	0.76

Source: WSDOT, 2013.

3.4.2 I-5 Clear Zone

A minimum clear zone is defined by geometric considerations, including if a recoverable slope is present and if the area is free of fixed objects so an errant vehicle can recover. Based on WSDOT Design Manual criteria for clear zone distances, a distance ranging between 30 and 45 feet, measured from the edge of traveled way, would allow for sufficient clear zone along the FWLE project corridor. The clear zone is a function of posted speed limits, sideslope, and traffic volumes.

A roadside clear zone inventory for the I-5 mainline was completed for the western edge (southbound) of I-5 between S 211th Street and S 317th Street. Table 3-15 documents the southbound I-5 roadside conditions. The table includes the length of available clear zone along I-5 and where barriers along I-5 are located for safety (e.g., grade-separated crossings). All areas without a barrier meet the clear zone criteria according to the WSDOT Design Manual. In areas where minimum clear zone conditions are not

currently available, barriers (guardrail, barrier, or walls) or impact attenuators are provided to "shield" vehicles from roadside hazards. These hazards generally include:

- Nonrecoverable slopes (slopes steeper than 1 foot vertical to 4 feet horizontal)
- Tree stands
- Communications cabinets
- Power poles
- Other landscaping elements
- Street grade-separation
- Other non-breakaway or non-barrier features

A detailed inventory of existing and potential clear zone locations is provided in Appendix H, I-5 Clear Zone Analysis. Exhibit 3-9 shows the inventory of existing barrier locations.

TABLE 3-15
Southbound I-5 Existing Clear Zone Summary (Between S 211th Street and S 317th Street)

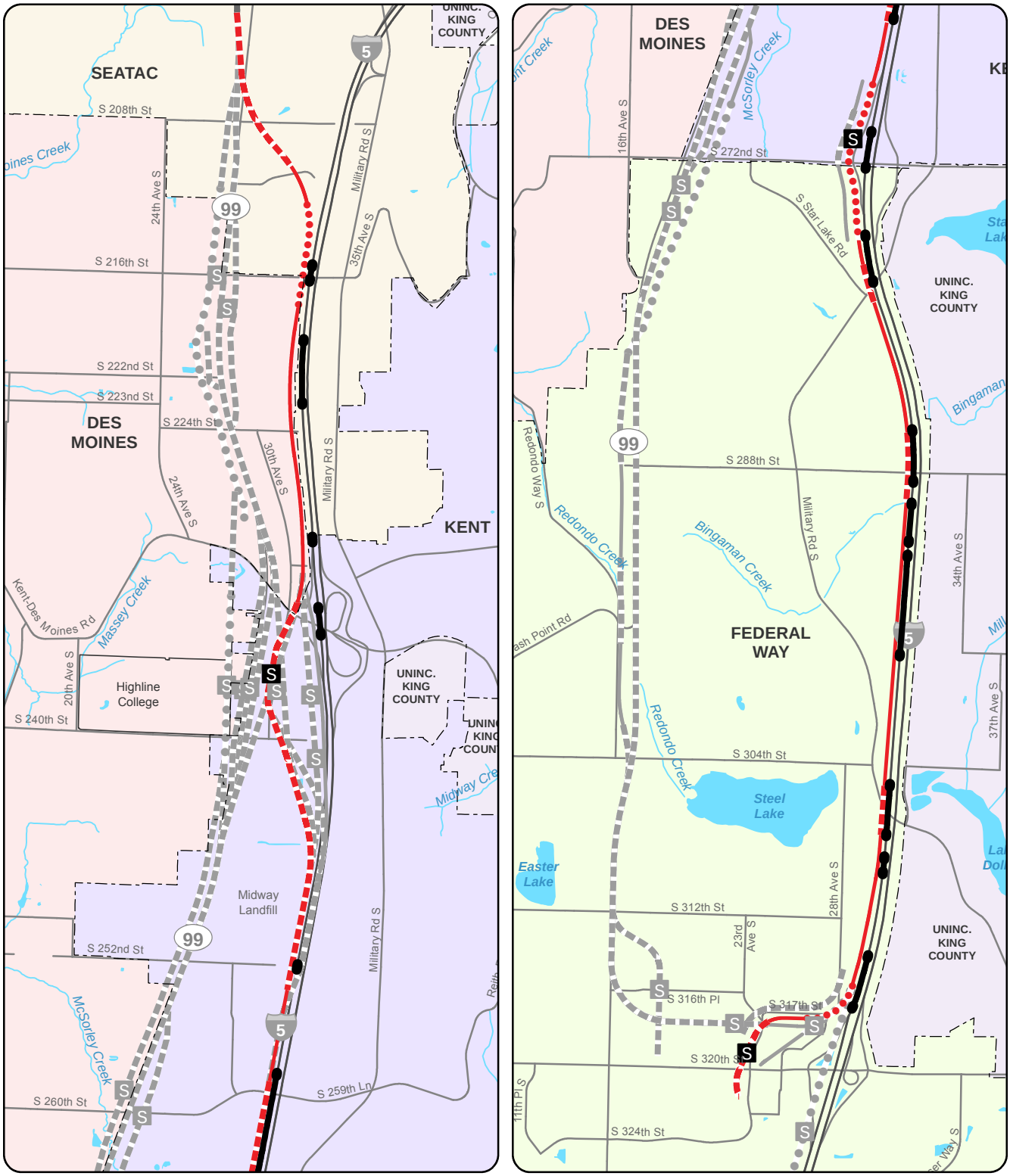
I-5 Roadside Condition	Length of Segment (feet)
	Existing Conditions
Available Clear Zone[a]	22,900
Barrier Provided[b]	11,500
Total Length	34,400

[a] Represents areas without a barrier.
[b] Represents areas where barriers currently exist. These areas include shielding to protect highway infrastructure, tree stands, steep sideslopes, and other landscaping elements or are used to protect grade-separated crossings.

Within the FWLE study area, 22,900 feet of existing clear zone (approximately 2/3rd of the total length) is present along the I-5 southbound mainline roadside. The remaining 1/3 (11,500 feet) is currently shielded by guardrail, walls, or barrier. The shielded segments of the southbound I-5 roadside include 9,300 feet where WSDOT could potentially create a clear zone by alteration, removal, or relocation of the roadside hazards described above. Approximately 2,200 feet of barrier would shield grade-separated streets and a clear zone cannot be created.

Median horizontal clearances were also analyzed for the potential of an errant vehicle to cross the median and encounter a fixed object or oncoming traffic. In general, median barriers are present on limited access facilities with posted speed limits of 45 mph or higher and have median widths less than 50 feet. Within the FWLE study area, the I-5 median horizontal clearance was also assessed between S 244th Street and S 256th Street (approximately 2/3 mile), near the Midway Landfill.

The median is approximately 55 feet wide from the edge of the northbound and southbound travel ways. Between approximately S 244th Street and S 248th Street, the median along the southbound I-5 traveled way is shielded with a Jersey barrier, and between S 248th Street and S 256th Street, the median is shielded by a guardrail along the northbound traveled way. A small break is provided in the median at approximately S 248th Street for emergency vehicle access.



Legend

Preferred Alternative
- Elevated
- At-Grade
- Trench
- Station

Other Alternatives
- Elevated
- At-Grade
- Trench
- Station
- Existing Barrier
- City Boundary
- Street
- Stream
- Waterbody

Data Sources: King County (2015).

N

0 0.125 0.25 0.5 Miles

EXHIBIT 3-9
Existing Southbound I-5
Roadside Barrier Locations
Federal Way Link Extension

3.5 Parking

Existing on-street parking supply and utilization information was collected for the areas surrounding the FWLE station areas and is provided in Table 3-16. On-street parking supply and demand data were collected in the spring of 2012 on all roads within a 1/4-mile radius of each FWLE station area. The park-and-ride utilization data are from fall of 2015. Among the proposed station areas, the Federal Way Transit Center has the highest on-street parking utilization rate (43 percent) but only has 21 on-street unrestricted parking stalls. The potential additional S 216th Street West or East station option area has similar on-street parking utilization rate, with 33 percent and 51 on-street unrestricted parking stalls. The other station areas have much lower rates, which indicates that there is generally on-street parking available in the station areas.

The park-and-rides near the station areas have a utilization rate of 38 percent or more, except the Redondo Heights Park-and-Ride, which has a 9 percent utilization rate. The Star Lake Park-and-Ride, located adjacent to I-5 near S 272nd Street, has a 52 percent utilization rate. The only park-and-ride near the Kent/Des Moines Station area is located east of I-5 and would not likely be used by any station area users west of the freeway. Currently, there are no privately operated parking facilities near the FWLE station areas.

Most parking stalls surrounding the Kent/Des Moines Station area are located in residential neighborhoods. These stalls are signed as residential parking only. While on-street parking is provided east of I-5, this parking was not considered because the total walking distance would be substantially greater than 1/4 mile from the station, the distance most pedestrians are willing to walk to access transit service. The Star Lake Park-and Ride adjacent to I-5 has some unrestricted on-street parking located north of the park-and-ride facility. The parking at nearby multi-family housing is restricted to residents. The Federal Way Transit Center Station area has limited on-street parking.

In addition to on-street parking and park-and-ride facilities, there are a few other parking facilities in the study area. In the Kent/Des Moines Station area, Highline College (HC) has several parking lots, but these are restricted to students and faculty with a permit. There are two relatively small leased park-and-ride lots (All Saints' Lutheran Church and Saint Columba's Episcopal Church) near the Star Lake Park-and-Ride east of I-5. In the Federal Way Transit Center Station area, the Commons Mall area has a substantial amount of parking, but it is private parking for mall patrons only.

TABLE 3-16
Existing Weekday Parking Supply and Utilization by FWLE Station Area

Station Area	Parking Type	SR 99			I-5		
		Stalls	Demand	% Utilization	Stalls	Demand	% Utilization
S 216th Street	Park-and-Ride	-	-	-	-	-	-
	On-Street Unrestricted	51	17	33	-	-	-
	Total	51	17	33	-	-	-
Kent/Des Moines	Park-and-Ride	370	341	92	370	341	92
	On-Street Unrestricted	0	0	-	0[a]	0[a]	-
	Total	370	341	92	370	341	92
S 260th Street	Park-and-Ride	-	-	-	-	-	-
	On-Street Unrestricted	10	0	0	-	-	-
	Total	10	0	0	-	-	-
S 272nd Street	Park-and-Ride[b] (Redondo & Star Lake)	697	63	9	540	282	52
	Park-and-Ride (Leased)	-	-	-	90[c]	60	67
	On-Street Unrestricted	15	2	13	24	3	13
	Total	712	65	9	654	345	53
Federal Way Transit Center	Park-and-Ride	1,190	1,174	99	1,190	1,174	99
	On-Street Unrestricted	21	9	43	21	9	43
	Total	1,211	1,183	98	1,211	1,183	98
S 320th Street	Park-and-Ride	-	-	-	877	336	38
	On-Street Unrestricted[d]	-	-	-	21	9	43
	Total	-	-	-	898	345	38
Total	**Park-and-Ride**	**2,257**	**1,578**	**70**	**3,067**	**2,133**	**70**
	On-Street Unrestricted	**97**	**28**	**29**	**66**	**21**	**32**
	Total	**2,354**	**1,606**	**68**	**3,133**	**2,214**	**69**

[a] On-street parking east of I-5 is not included in the parking data due to impractical access to the station.
[b] Redondo Heights Park-and-Ride is in the FWLE SR 99 Alternative S 272nd Redondo Station area, and Star Lake Park-and-Ride is in the Preferred Alternative S 272nd Star Lake Station area and S 272nd Star Lake Elevated Station Option area.
[c] Includes All Saints' Lutheran Church and St. Columba's Episcopal Church leased lots.
[d] The on-street parking for both Federal Way Transit Center and S 320th Street Park-and-Ride is considered to be same as the surrounding area, with available on-street parking overlaps for both locations.

3.6 Non-motorized Facilities

This section describes the existing non-motorized facilities within the study area.

3.6.1 Sidewalks

Existing sidewalks were inventoried on all study area arterials, as shown in Exhibit 3-10. The inventory includes streets classified as arterials, collector arterials, and collectors. Sidewalks are provided on both sides of SR 99 and are also along many arterial streets within the study area; however, some arterials are missing sidewalks on one or both sides of the road, such as Kent-Des Moines Road east of I-5 and

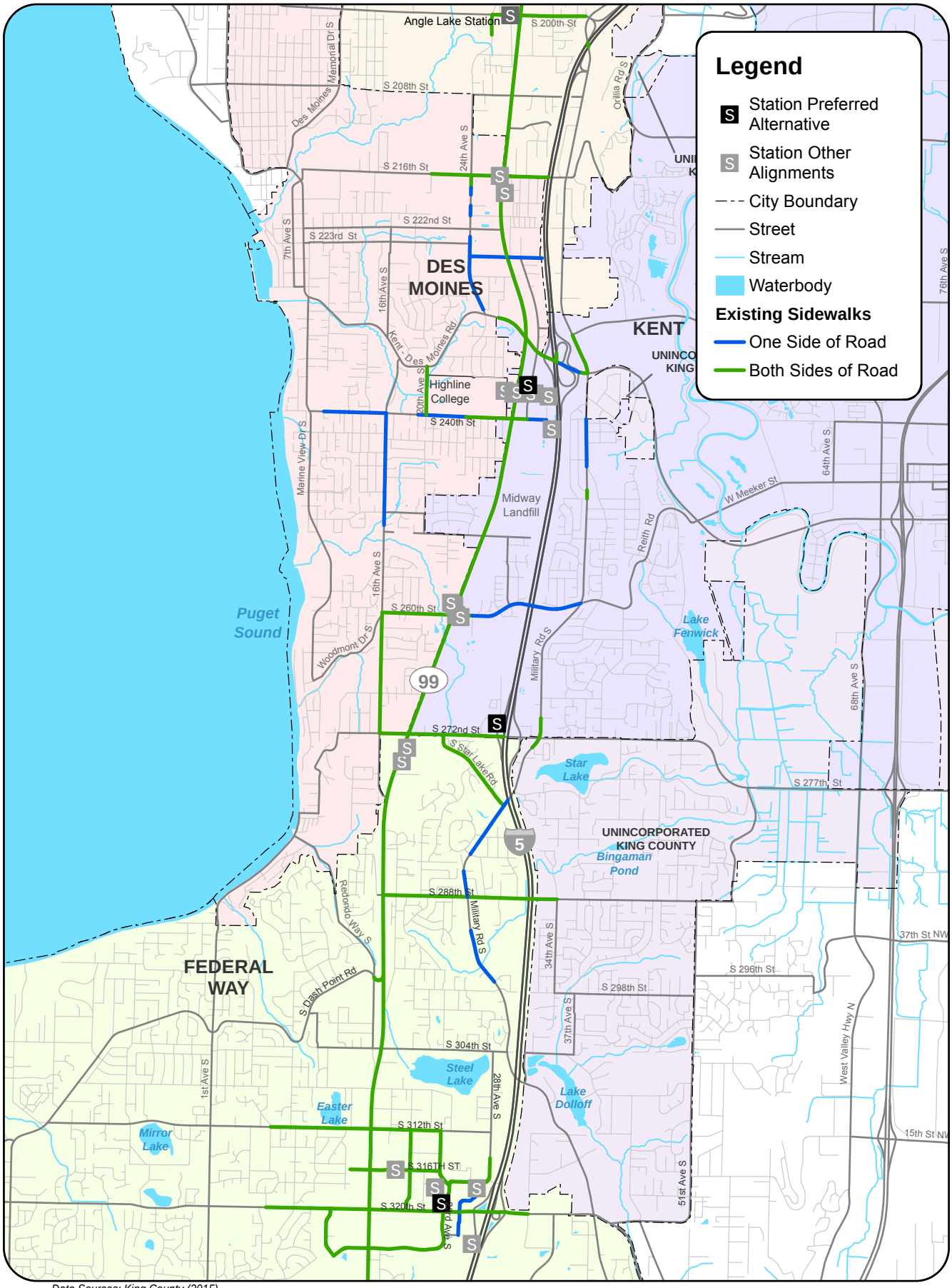
S 240th Street. Many residential neighborhoods and local streets also lack sidewalks but generally have lower volumes and less pedestrian activity.

Pedestrian mobility between the station areas and east of I-5 occur at the Kent-Des Moines Road, S 272nd Street, and S 320th Street interchanges. Sidewalks around these interchange areas are intermittent, and combined with high traffic volumes and congestion at the interchanges, non-motorized travel through these areas is difficult and uncomfortable.

3.6.2 Bicycle Facilities and Multi-use Trails

There are only a few bicycle facilities in the study area, as shown in Exhibit 3-11. South 216th Street is the only roadway that currently provides a designated bicycle lane that runs the entire length between I-5 and Puget Sound. The remaining bicycle lanes/paths are generally shorter in length and connect to signed bicycle routes along other roadways. Kent-Des Moines Road, S 240th Street, and S 260th Street are all signed bicycle routes that have a wide shoulder to accommodate bicycles. These designated bicycle routes do not necessarily have marked lanes, although signage typically is present, which indicates to motorists that bicyclists are likely to share the roadway with vehicles. There are currently no bicycle facilities on SR 99, S 272nd Street, or S 320th Street.

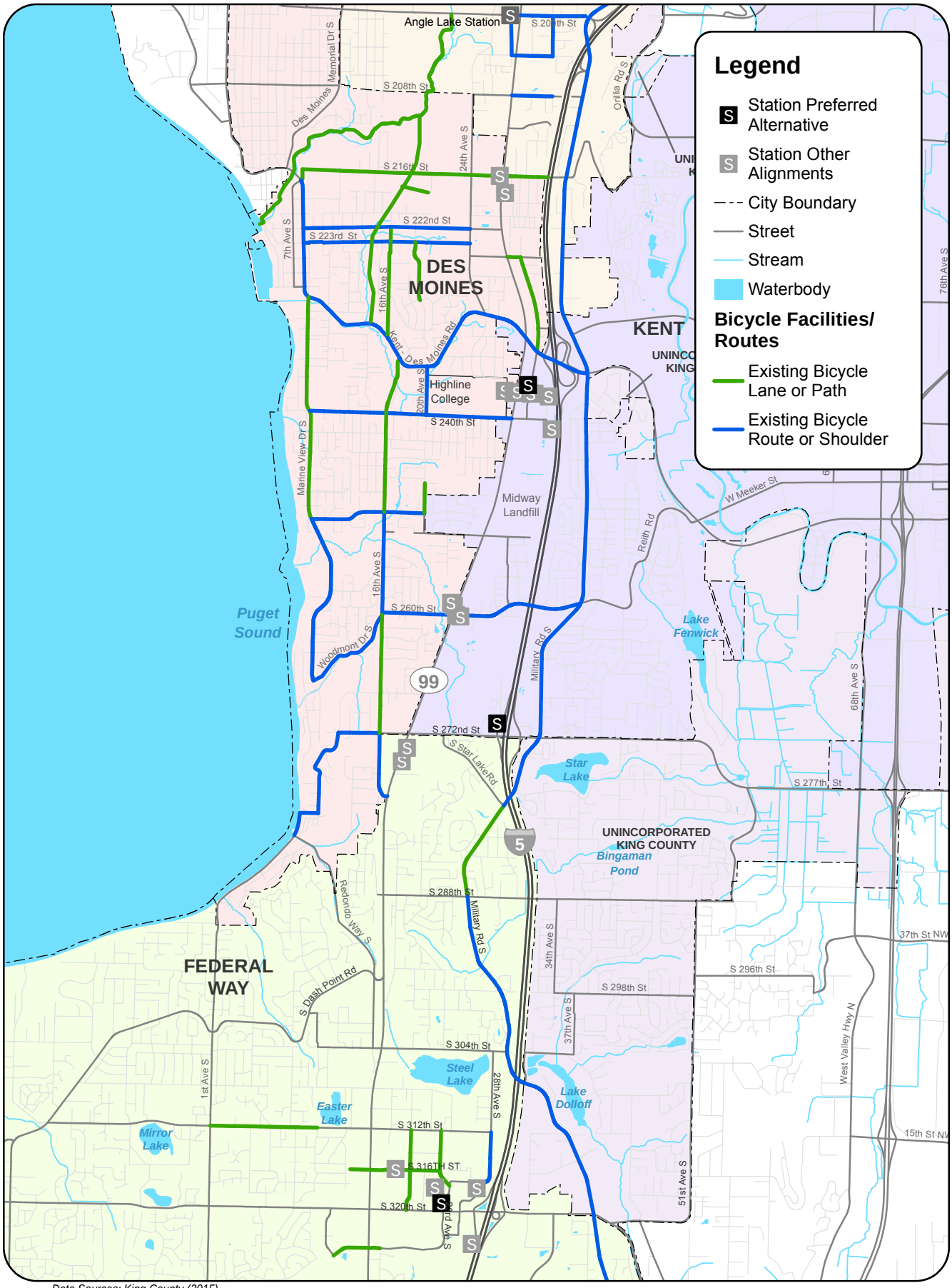
The Des Moines Creek Trail and the Bonneville Power Administration (BPA) Trail are the closest regional trails to the study area. The Des Moines Creek Trail begins about 1/2 mile west of SR 99 at S 200th Street and extends southwesterly toward Puget Sound to just south of S 216th Street. The BPA Trail begins at S 324th Street and 11th Place S in Federal Way.



Data Sources: King County (2015).

EXHIBIT 3-10
Existing Sidewalk Locations

Federal Way Link Extension



Data Sources: King County (2015).

N

0 0.5 1 2 Miles

EXHIBIT 3-11
Existing Bicycle Facilities and Routes

Federal Way Link Extension

3.7 Freight Mobility and Access

Truck mobility within the Puget Sound Region is largely supported by a system of designated freight routes (Exhibit 3-12) that consist of freeways and arterial streets connecting major freight destinations. To prioritize truck routes, WSDOT adopted the Freight Goods Transportation System (FGTS), which classifies roadways according to the amount of annual tonnage transportation (T1–T5). The classifications range from roadways that carry more than 20,000 tons in 60 days to those that carry more than 10,000,000 tons annually (Table 3-17). Jurisdictions determine their designated truck route system on arterial streets according to the FGTS classifications. Within the study area, the transportation system is vital to moving freight and goods to and from major transportation hubs such as the Port of Seattle, Sea-Tac International Airport (Sea-Tac Airport), Kent Manufacturing/Industrial Center, Port of Tacoma, and other business and consumer destinations. Within the study area, there are no active freight rail lines.

TABLE 3-17
Freight and Goods Transportation System Classifications

FGTS Classification	Annual Gross Tonnage
T-1	Over 10,000,000
T-2	4,000,000 to 10,000,000
T-3	300,000 to 4,000,000
T-4	100,000 to 300,000
T-5	Over 20,000 in 60 days

Source: Washington State Legislative Transportation Committee, 1995.

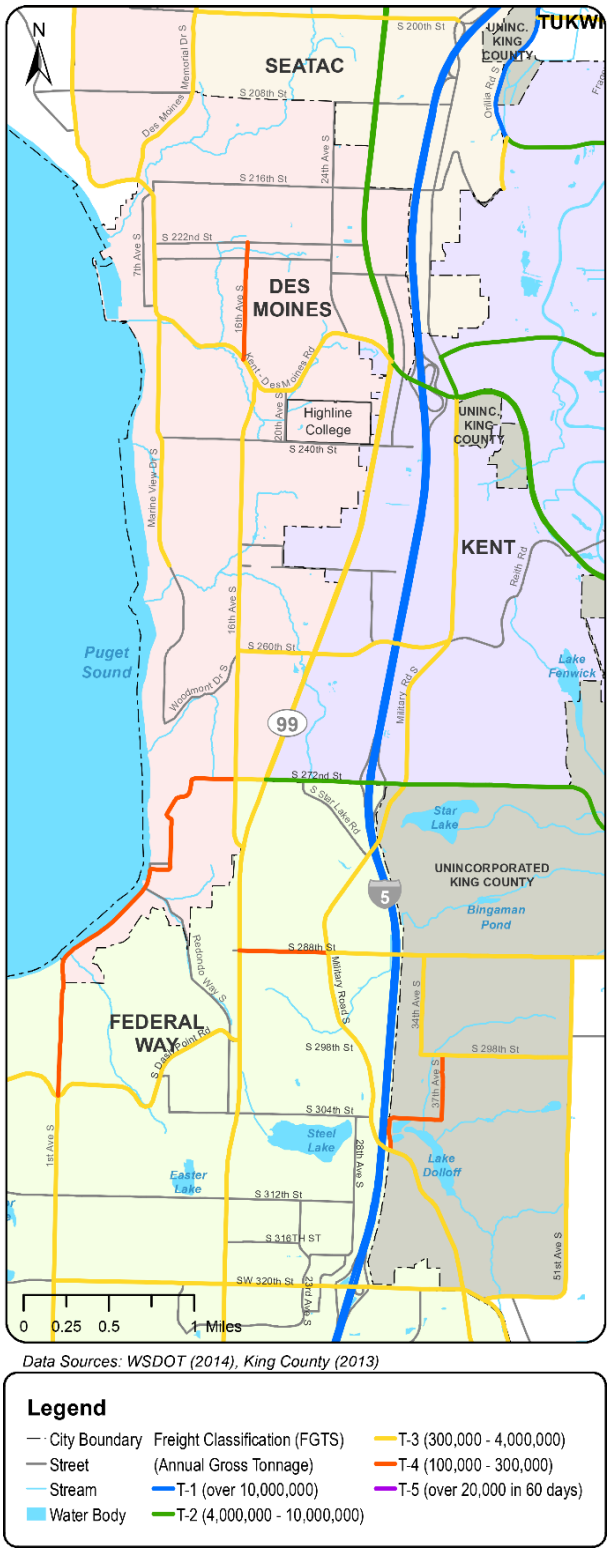


EXHIBIT 3-12
Existing Freight Routes and Classifications

As shown in Table 3-18 and Exhibit 3-12, I-5 is the only FGTS Class T-1 roadway in the study area. Within the study area, all of the principal arterials are classified as either T-2 or T-3 routes. I-5 is a key freight corridor that serves not only the Puget Sound Region but also national and international markets. More than 72 million tons of freight are hauled annually on I-5. About 8 percent of the vehicles that travel on I-5 are trucks. Between Sea-Tac Airport and Kent-Des Moines Road, SR 99 carried 3.6 million tons of freight in 2013. About 4 percent of the total vehicles on SR 99 are trucks. Many of these truck trips are destined for the Port of Seattle and/or the Kent Manufacturing Industrial Center. Truck travel on these two roadways occurs throughout the day, with most trucks travelling outside of the AM and PM peak periods to avoid the more heavily congested times of day.

TABLE 3-18
Freight and Goods Transportation System Classification for Key Highways in FWLE Transportation Study Area

Route	Description	Length (miles)	FGTS Class	2013 Tonnage
I-5	King/Pierce County line to SR 599	16.44	T-1	72,630,000
SR 99	SR 18 to Kent-Des Moines Road	7.35	T-3	2,360,000
SR 99	Kent-Des Moines Road to SR 518	4.94	T-2	3,660,000
Kent-Des Moines Road	Marine View Drive to SR 99	1.79	T-3	1,050,000
Kent-Des Moines Road	SR 99 to SR 169	14.70	T-2	3,780,000

Source: WSDOT, 2014.

Most of the arterials in the study area are classified as either T-2 or T-3 routes. S 272nd Street is classified as a T-2 freight route. S 200th Street, Kent-Des Moines Road (west of SR 99), S 260th Street, S 288th Street (east of Military Road S), Dash Point Road, and S 320th Street are all designated as T-3 routes. S 216th Street, S 240th Street, and S 312th Street are the only east-west arterials in the study area that are not classified on the FGTS system. Beyond SR 99 and I-5 in the study area, only Military Road S (T-3 freight route) is a north-south oriented roadway classified in the state's FGTS system.