Appendix C

Alternative Analysis Reports and Scoping Summary

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June 2013

FEDERAL WAY TRANSIT EXTENSION

Level 1 Alternatives Screening Report

SOUNDTRANSIT

CENTRAL PUGET SOUND
REGIONAL TRANSIT AUTHORITY

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Acronyms

AA	Alternatives Analysis
ACS	American Community Survey
BAT	Business Access Transit
BRT	Bus Rapid Transit
BMPs	Best Management Practices
CFR	Code of Federal Regulations
CTP	Comprehensive Transportation Plan
EDR	Environmental Data Resource
EIS	Environmental Impact Statement
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
FWTC	Federal Way Transit Center
FWTE	Federal Way Transit Extension
GMA	Growth Management Act
HCC	Highline Community College
HCT	High Capacity Transit
HOV	High Occupancy Vehicle
KCM	King County Metro
LOS	Level of Service
LRT	Light Rail Transit
LWCF	Land and Water Conservation Fund
MAP-21	Moving Ahead for Progress in the 21st Century
MPH	Miles Per Hour
MPO	Metropolitan Planning Organization
NEPA	National Environmental Policy Act
O&M	Operation and Maintenance
OCS	Overhead Catenary System
P&R	Park and Ride
PSE	Puget Sound Energy
PSRC	Puget Sound Regional Council
RCW	Revised Code of Washington
SCC	Standard Cost Categories
SEPA	State Environmental Policy Act
ST	Sound Transit
ST2	Sound Transit 2 Plan

TOD	Transit Oriented Development
TSP	Transit Signal Priority
TSM	Transit System Management
WAC	Washington Administrative Code
WSDOT	Washington State Department of Transportation

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1.0 Executive Summary

1.1 Purpose of this Report

Sound Transit (ST) and the Federal Transit Administration (FTA) are conducting an alternatives analysis to start the public planning and environmental processes for the Federal Way Transit Extension (FWTE) in South King County in the metropolitan Puget Sound region. The proposed project is part of the Sound Transit 2 (ST2) Plan approved by voters in 2008. It would start at the regional light rail system at the future Angle Lake Station in the City of SeaTac at S. 200th Street. **Exhibit 1-1** shows where the FWTE is located. The FWTE is an element of the region's Metropolitan Transportation Plan (the Puget Sound Regional Council's (PSRC) Transportation 2040), and Sound Transit's Long-Range Transit Plan. These plans anticipate the eventual extension of high capacity transit (HCT) service south to Tacoma.

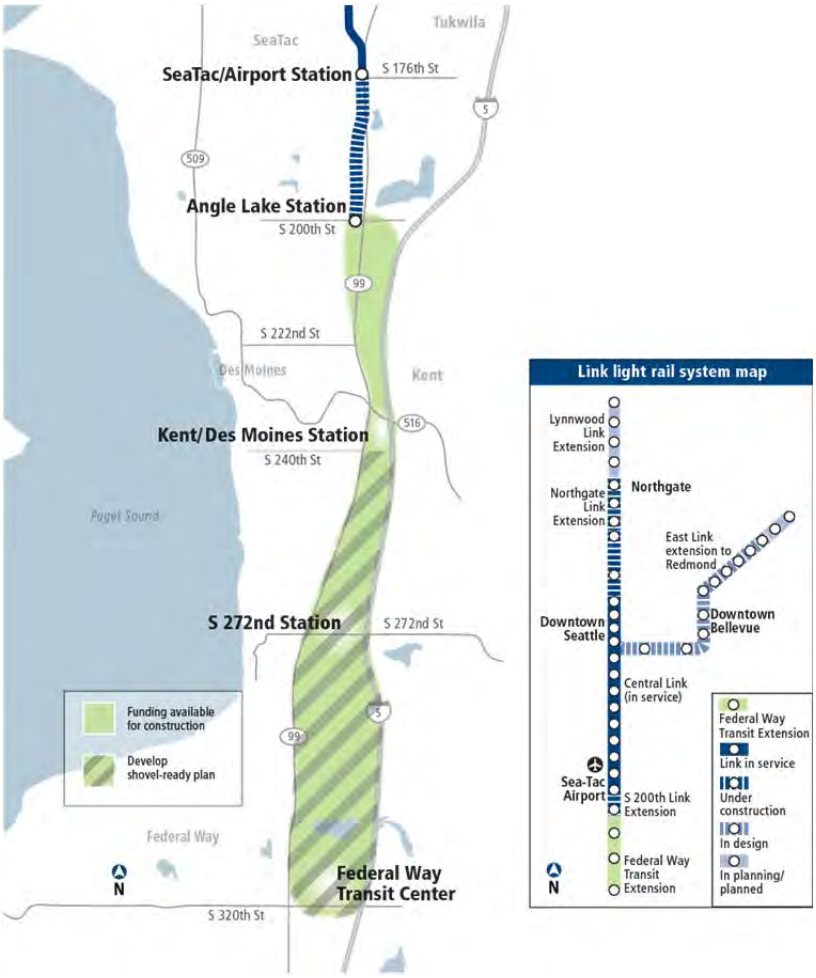

EXHIBIT 1-1
FWTE Project Study Area

This report is organized in six sections:

- Introduction
- Pre-Screening of Alternatives
- Definition of Level 1 Alternatives
- Evaluation Criteria
- Level 1 Data Results
- Findings and Conclusions

1.2 Purpose and Need of the Federal Way Transit Extension Project

The purpose of the Federal Way Transit Extension is to expand the Sound Transit Link light rail system from SeaTac to the cities of Des Moines, Kent, and Federal Way in King County in order to meet the following objectives:

- Provide a rapid, reliable, accessible, and efficient alternative for travel to and from the corridor and other urban growth and activity centers in the region with sufficient capacity to meet projected demand.
- Expand mobility alternatives to traveling on congested roadways and improve connections to the regional multimodal transportation system with peak and off-peak service.
- Provide the high-capacity transit (HCT) infrastructure to support adopted regional and local land use, transportation, and economic development plans.
- Advance the long-range vision, goals, and objectives for transit service established by the Sound Transit Long-Range Plan for high-quality regional transit service connecting major activity centers in King, Pierce, and Snohomish counties.
- Implement a financially feasible system that seeks to preserve and promote a healthy environment.

The following conditions within the project corridor demonstrate the need for the project:

- North-south transit demand is expected to grow by 30 to 40 percent by 2035 as a result of residential and employment growth in the FWTE corridor and regionally.
- The FWTE corridor population is a highly transit-dependent population with needs for efficient, reliable regional connectivity.

- Congestion on I-5 and on the key corridor arterials leading in and out of the study area will increase and further degrade existing transit performance and reliability.
- There is a lack of reliable and efficient peak and off-peak transit service connecting persons in the FWTE corridor with the region's growth centers.
- Regional and local plans call for HCT in the corridor consistent with PSRC's *VISION 2040* and the *Regional Transit Long-Range Plan*.
- Implementing the project will help meet environmental and sustainability goals of the state and region, including reduced vehicle miles traveled and greenhouse gas emissions.

Any alternative evaluated for the FWTE must demonstrate the ability to address these needs and achieve the project purpose.

1.3 Pre-Screening of Alternatives

Development of alternatives for the project was informed by FTA guidelines on project development and alternatives analyses. Potential alternatives for the FWTE came from two sources: previous regional and local planning studies (see Section 2.2.2) and input from the public and agencies during a 30-day early scoping period between October 18 and November 19, 2012. The early scoping period included two public open houses (one in Des Moines and one in Federal Way), an online survey, and opportunities for the public to provide comments on comment forms at the meeting, online, or via postal mail. The public open houses provided several interactive opportunities for attendees to provide input, including a large map of the project corridor where attendees could draw alignment suggestions. An online agency meeting and public meeting were also conducted and provided opportunities to ask questions and provide comments.

Feedback received during the early scoping period was positive and indicated a desire for improved transit service in the project area. Comments provided by agencies, local jurisdictions, institutions, and members of the general public indicated a strong preference for light rail transit. Stakeholders expressed concerns about parking, travel time, connections to future light rail expansion in Tacoma and to other transit facilities in the study area, and multimodal connections. Comments received on alignment, profile preference, and station locations were mixed.

Alternatives considered include different modes, profiles and alignments. Mode refers to the method of transportation, such as bus or light rail. Profile refers to a vertical location, such as above grade (elevated), at-grade, below-grade (retained cut or tunnel), or mixture of one or

more profile. Alignment refers to the horizontal location within a corridor. **Table 1-1** and **Exhibit 1-2** below show the initial range of alternative types considered.

Table 1-1
Initial Alternative Types Considered

Mode	Transportation System Management (TSM) Bus Rapid Transit (BRT) Light Rail Transit (LRT)	
Profile	At-grade Elevated Mixed at-grade/elevated Tunnel	
Alignment	SR 99	West Side
		Median
		East Side
	I-5	West Side
		Median
		East Side
	30th Avenue S.	West Side
		Median
		East Side
	24th Avenue S.	West Side
		Median
		East Side

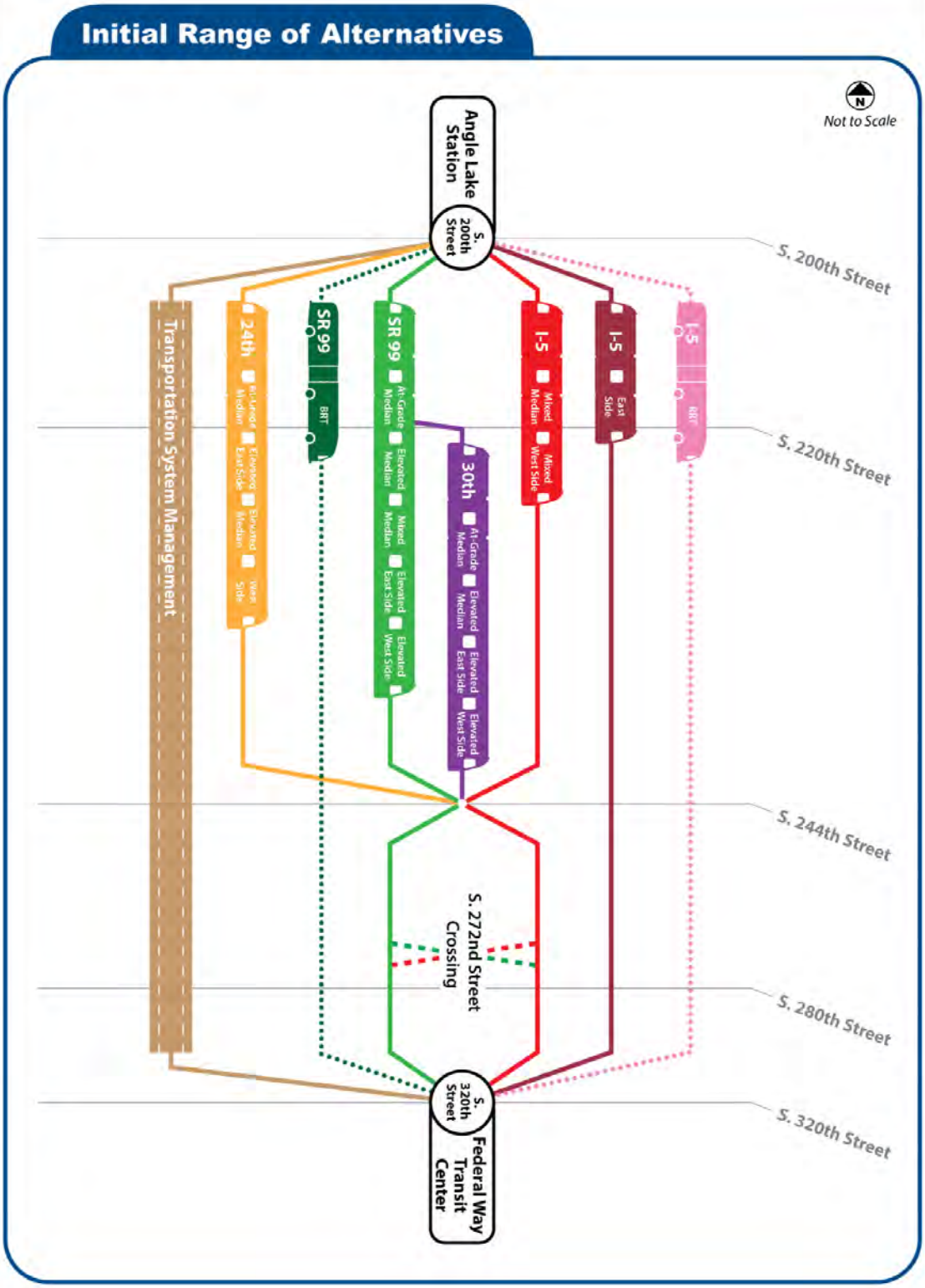

EXHIBIT 1-2
Initial Range of Alternatives

Some of the modes, profiles and alignment alternatives were not evaluated in the Level 1 process because they would not meet the stated purpose and need for the project, they had substantial impacts to environmental resources that must be avoided, or they had design features that would substantially increase the project cost compared to other alternatives that make them infeasible to keep under consideration. **Table 1-2** and **Exhibit 1-3** show the alternatives that were not evaluated as part of Level 1. On Exhibit 1-3, the alternatives not carried forward to Level 1 are shown in gray. Section 3.3.3 of this report explains in detail why these alternatives were not evaluated in the Level 1 screening process.

Table 1-2
Alternatives Not Evaluated in Level 1

Alternative Type	Alternative	Corridor
Mode	TSM	I-5 or SR 99
	BRT	I-5 or SR 99
Profile	Tunnel	SR 99
Alignment	East Side	I-5
	Crossing at S. 272nd Street	I-5 / SR 99 Hybrid
	Behind Businesses	SR 99
	West Side	24th Avenue S.

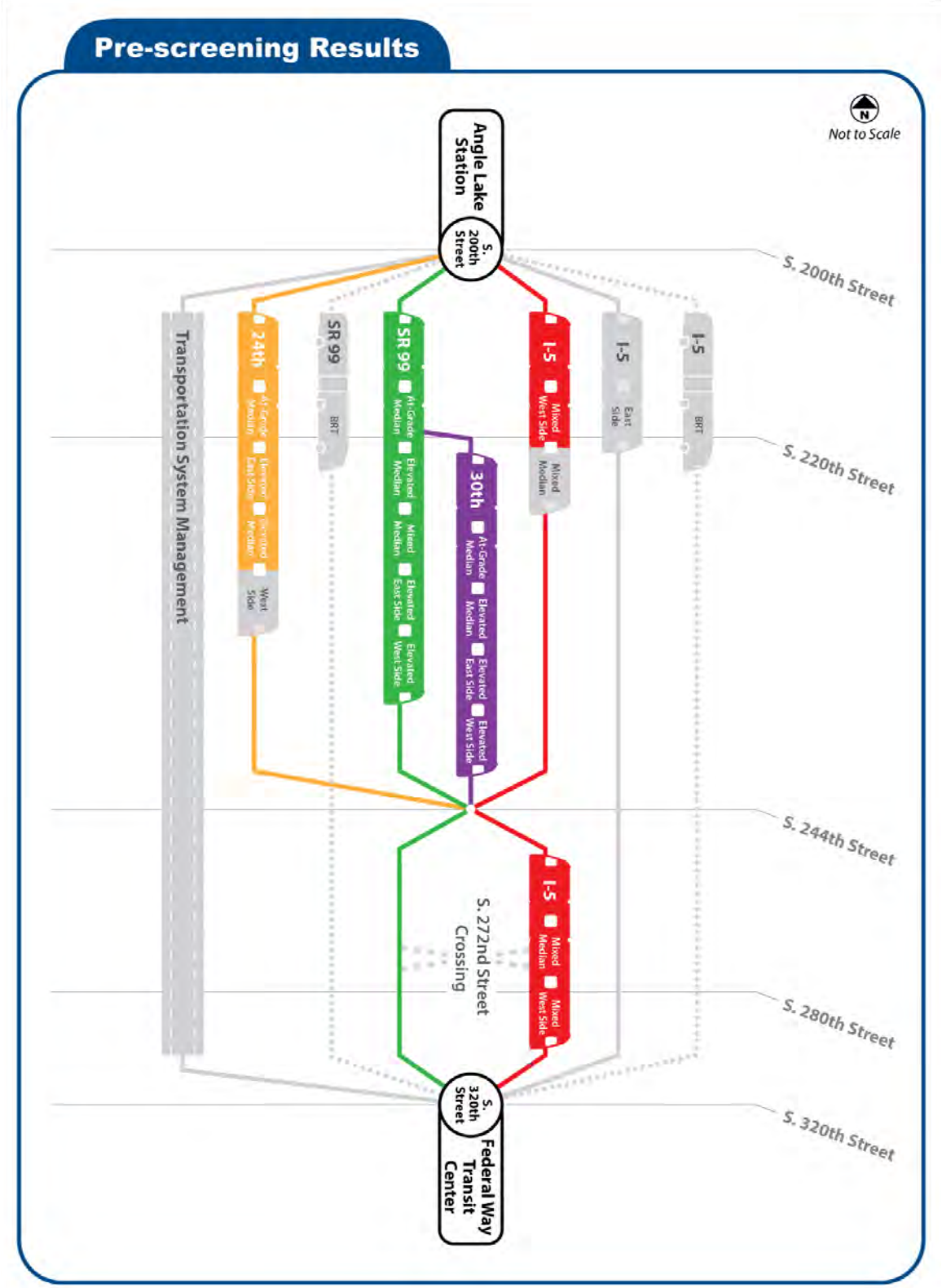

EXHIBIT1-3
Pre-Screening Results

1.4 Definition of Alternatives Evaluated in Level 1

The following alternatives were evaluated in Level 1, as shown in **Table 1-3** and **Exhibit 1-4**.

Table 1-3
Level 1 Alternatives

Corridor	Profile
SR 99	At-grade Median
	Mixed Median
	Elevated Median
	Elevated West Side
	Elevated East Side
I-5	Mixed West Side
	Mixed Median
30th Avenue S.	At-grade Median
	Elevated Median
	Elevated West Side
	Elevated East Side
24th Avenue S.	At-grade Median
	Elevated Median
	Elevated East Side

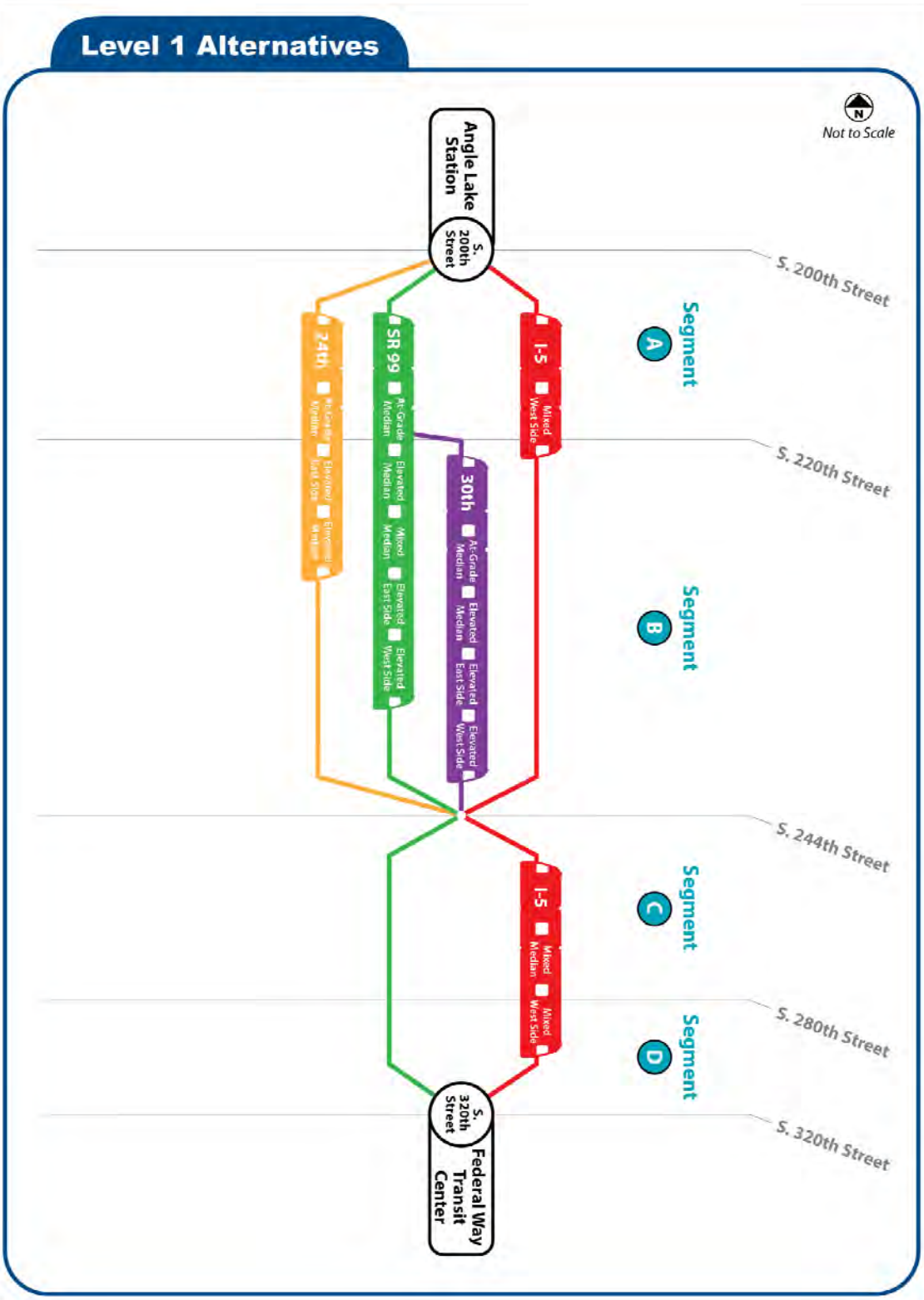

EXHIBIT 1-4
Level 1 Alternatives

For the Level 1 evaluation, the entire corridor was broken into four segments to allow for easier comparison within areas where major differences would occur. The SR 99 and I-5 alternatives would continue through the full corridor length, from the Angle Lake Station at S. 200th Street to the Federal Way Transit Center (FWTC). The 30th Avenue S. alternatives and 24th Avenue S. alternatives would only occur in the northern half of the corridor, and could connect with either a SR 99 or an I-5 alternative after the proposed station near S. 240th Street.

- Segment A: S. 200th Street to S. 220th Street. Within Segment A, there are distinct alignments along SR 99, I-5, and 24th Avenue S.
- Segment B: S. 220th Street to S. 244th Street. This segment would include a station at approximately S. 240th Street for all alternatives. Within Segment B, there are distinct alignments along SR 99, I-5, 30th Avenue S. and 24th Avenue S.
- Segment C: S. 244th Street to S. 280th Street. This segment would have a station at approximately S. 272nd Street. Within Segment C, there are distinct alignments along SR 9 and I-5 only.
- Segment D: S. 280th Street to S. 320th Street. This segment would have a station in the approximate vicinity of the Federal Way Transit Center. Within Segment D, there are distinct alignments along SR 99 and I-5 only.

1.5 Level 1 Evaluation Criteria

The evaluation criteria for this study originated from goals and objectives established in the Purpose and Need. **Table 1-4** presents the complete set of evaluation criteria that were used to review the alternative concepts in Level 1. Details on the specific measures and methodologies for each criterion can be found in Section 5 of this report.

Table 1-4
Evaluation Criteria for Level 1 Screening

Evaluation Criteria	Measures
Objective: Provide Effective Transportation Solution to Meet Mobility Need	
Ridership potential	• 2035 daily project riders (projected) • Travel time in study area
Connections to regional multimodal transportation systems	• Transit integration with Link system • Transit integration with facilities in the study area
Objective: Support Equitable Mobility	
Transit-dependent population	• Low-income population within ½ mile of stations • Elderly population (age 65 or older) within ½ mile of stations • Youth population (age 16 or younger) within ½ mile of stations • 0-car households within ½ mile of stations
Objective: Support Land Use Plans and Economic Development	
Transit-supportive land use and economic development policies	• How well an alternative provides enhanced mobility to existing high-density land use centers
Objective: Preserve a Healthy Environment	
Effect on natural environment	• Impacts on wetlands • Potential to affect stream crossings
Effect on built environment	• Visual aesthetic impacts of alternative • Potential property acquisition • Impacts to known parks • Number of community facilities affected • Impacts on known or eligible historic or other sensitive properties • Number of potentially impacted noise receptors • Level of Service (LOS) at intersections; evaluation of capacity/flow (existing conditions) • Traffic circulation and access; number of mid-block opportunities
Objective: Design an Affordable and Constructible Project	
Design Considerations	• Potential utility effects • High-risk hazardous materials • Geologic hazards • Park and Ride lot locations
System Costs	• Estimated capital cost ($2013) • Estimated annual operations and maintenance cost ($2013) **Not evaluated in Level 1. Will be included in Level 2.*

1.6 Level 1 Analysis Summary

Chapter 6 of this report documents the data that was developed for the Level 1 evaluation. The sections below summarize the data that most differentiates the alternatives and supports conclusions to either carry an alternative forward to the Level 2 evaluation or to not study the alternative further. The data is summarized by alternative in **Exhibit 1-5,** Level 1 Alternatives Analysis Summary Table, on the following pages.

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Executive Summary

Sheet 1

	At-Grade Median	Mixed Median	Elevated Median	Elevated East	Elevated West
Provide an effective transportation solution to meet mobility needs					
Daily project riders (2035)	19,000 to 19,500	21,500	23,500 to 24,000	23,500 to 24,000	23,500 to 24,000
Travel time in study area	20 to 21 minutes	18 minutes	14 to 15 minutes	14 to 15 minutes	14 to 15 minutes
Potential to affect Link system-wide operations and reliability	High	Moderate	Low	Low	Low
Transit integration with other transit services and facilities	Likely effects to RapidRide; near existing transit hub (HCC)	Some effects to RapidRide; near existing transit hub (HCC)	Minimal effects to RapidRide; near existing transit hub (HCC)	Minimal effects to RapidRide; near existing transit hub (HCC)	Minimal effects to RapidRide; near existing transit hub (HCC)
Support equitable mobility					
Low-income population within access area	2,100 people (20%)	2,100 people (20%)	2,100 people (20%)	2,100 people (20%)	2,100 people (20%)
Elderly population (age 65 or older) within access area	2,500 people (23%)	2,500 people (23%)	2,500 people (23%)	2,500 people (23%)	2,500 people (23%)
Youth population (age 16 or younger) within access area	1,000 people (9%)	1,000 people (9%)	1,000 people (9%)	1,000 people (9%)	1,000 people (9%)
Zero-car households within access area	310 households (2%)	310 households (2%)	310 households (2%)	310 households (2%)	310 households (2%)
Support land use plans and economic development					
Total acreage of high density/mixed use zoning within 1/4 mile of alternative's centerline	614 acres (26%)	614 acres (26%)	614 acres (26%)	622 acres (27%)	605 acres (26%)
Total acreage of TOD/high density/mixed use zoning within station access areas	534 acres (27%)	534 acres (27%)	534 acres (27%)	537 acres (27%)	531 acres (26%)
Preserve a healthy environment					
Acres of wetlands potentially affected	0 acres	0 acres	0 acres	0 acres	0 acres
Number of stream crossings potentially affected	2 streams	2 streams	2 streams	1 streams	2 streams
Potential visual effects	Moderate	Moderate	Moderate	Moderate	Moderate
Number of residential properties within 100 ft. of the alternative's centerline	17 properties	17 properties	17 properties	26 properties	12 properties

Key to Ranking: Higher Performing / Lower Performing

EXHIBIT 1-5

Level 1 Alternatives Analysis Summary Table

Sheet 1 (Cont.)

Executive Summary

Mixed West (I-5)	Mixed West/ Median (I-5)	At-Grade Median (30th)	Elevated Median (30th)	Elevated East (30th)	Elevated West (30th)	At-Grade Median (24th)	Elevated Median (24th)	Elevated East (24th)
		Coupled with SR 99 Elevated Median						
23,500	23,500	19,000 to 19,500	23,500	23,500	23,500	19,000 to 19,500	23,500 to 24,000	23,500 to 24,000
14 minutes	14 minutes	21 minutes	15 minutes	15 minutes	15 minutes	22 minutes	15 minutes	15 minutes
Low	Low	Moderate	Low	Low	Low	Moderate	Low	Low
Minimal effects to RapidRide; near existing regional transit facility (Star Lake P&R)	Minimal effects to RapidRide; near existing regional transit facility (Star Lake P&R), potential for I-5 flyer stops)	With transition to SR 99 at-grade likely effects to RapidRide; near existing transit hub (HCC)	Minimal effects to RapidRide; if transition to SR 99 near existing transit hub (HCC), if transition to I-5 near Star Lake P&R	Minimal effects to RapidRide; if transition to SR 99 near existing transit hub (HCC), if transition to I-5 near Star Lake P&R	Minimal effects to RapidRide; if transition to SR 99 near existing transit hub (HCC), if transition to I-5 near Star Lake P&R	Likely effects to RapidRide; along SR 99; near existing transit hub (HCC)	Minimal effects to RapidRide; near existing transit hub (HCC)	Minimal effects to RapidRide; near existing transit hub (HCC)
2,000 people (20%)	2,000 people (20%)	2,100 people (20%)	2,100 people (20%)	2,100 people (20%)	2,100 people (20%)	2,100 people (20%)	2,100 people (20%)	2,100 people (20%)
2,500 people (25%)	2,500 people (25%)	2,500 people (23%)	2,500 people (23%)	2,500 people (23%)	2,500 people (23%)	2,500 people (23%)	2,500 people (23%)	2,500 people (23%)
1,000 people (10%)	1,000 people (10%)	1,000 people (9%)	1,000 people (9%)	1,000 people (9%)	1,000 people (9%)	1,000 people (9%)	1,000 people (9%)	1,000 people (9%)
600 households (6%)	600 households (6%)	250 households (2%)	250 households (2%)	250 households (2%)	250 households (2%)	250 households (2%)	250 households (2%)	250 households (2%)
380 acres (16%)	358 acres (13%)	634 acres (29%)	635 acres (29%)	635 acres (29%)	636 acres (29%)	368 acres (16%)	368 acres (16%)	368 acres (16%)
488 acres (24%)	483 acres (24%)	534 acres (27%)	534 acres (27%)	534 acres (27%)	534 acres (27%)	534 acres (27%)	534 acres (27%)	534 acres (27%)
0.4 acres	2.1 acres	0 acres	0 acres	0 acres	0 acres	0 acres	0 acres	0 acres
1 stream	1 stream	2 streams	2 streams	2 streams	2 streams	2 streams	2 streams	2 streams
Low to Moderate	Low	Moderate	Moderate to High	Moderate to High	Moderate to High	Moderate to High	Moderate to High	Moderate to High
130 properties	52 properties	43 properties	43 properties	43 properties	43 properties	98 properties	98 properties	98 properties

Key to Ranking: Higher Performing / Lower Performing

EXHIBIT 1-5

Level 1 Alternatives Analysis Summary Table

Executive Summary

Sheet 2

	At-Grade Median	Mixed Median	Elevated Median	Elevated East	Elevated West
Preserve a healthy environment (cont'd)					
Number of commercial properties within 100 ft. of the alternative's centerline	359 properties	359 properties	359 properties	196 properties	193 properties
Impacts to park within 50 ft. of an alternative's centerline (acres)	0 acres	0 acres	0 acres	0 acres	0 acres
Impacts to park within 200 ft. of an alternative's centerline (acres)	0 acres	0 acres	0 acres	0 acres	0 acres
Number of community facilities adjacent to an alternative	4 facilities	4 facilities	4 facilities	1 facility	3 facilities
Number of community facilities within 200 ft. of the alternative's centerline	1 facility	1 facility	1 facility	3 facilities	2 facilities
Number of potentially impacted noise receptors within 350 ft. of unobstructed exposure to noise and 175 ft. with intervening obstruction to noise	389 properties	609 properties	827 properties	885 properties	865 properties
Number of affected Level of Service "F" intersections	3 intersections	0 intersections	0 intersections	0 intersections	0 intersections
Number of un-signalized intersections or side-streets with restricted turns	12 intersections or streets	12 intersections or streets	12 intersections or streets	0 intersections or streets	0 intersections or streets
Number of properties affected by restricted turns at midblock U-turns and/or median two-way left turn lanes	83 properties	83 properties	83 properties	0 properties	0 properties
Design an affordable and constructible project					
Potential utility effects	High	High	Moderate	High	High
Number of hazardous materials sites in study area	75 sites	75 sites	75 sites	75 sites	75 sites
Location of hazardous material sites in study area	Highest number of sites located in Segment B	Highest number of sites located in Segment B	Highest number of sites located in Segment B	Highest number of sites located in Segment B	Highest number of sites located in Segment B
Geologic hazards	Low risk	Low risk	Low risk	Low risk	Low risk
Park-and-Ride access	4 lots 3,864 spaces	4 lots 3,864 spaces	4 lots 3,864 spaces	4 lots 3,864 spaces	4 lots 3,864 spaces
Estimated capital cost ($2013) in billions of dollars	$1.1 to $1.3	$1.2 to $1.3	$1.5 to $1.7	$1.6 to $1.9	$1.6 to $1.8
Estimated annual operations and maintenance cost	Not evaluated in Level 1. Will be evaluated in Level 2.				

Key to Ranking: Higher Performing / Lower Performing

EXHIBIT 1-5

Level 1 Alternatives Analysis Summary Table

Sheet 2 (Cont.)

Executive Summary

Mixed West (I-5)	Mixed West/ Median (I-5)	At-Grade Median (30th)	Elevated Median (30th)	Elevated East (30th)	Elevated West (30th)	At-Grade Median (24th)	Elevated Median (24th)	Elevated East (24th)
		Coupled with SR 99 Elevated Median						
71 properties	53 properties	334 properties	336 properties	336 properties	336 properties	264 properties	264 properties	264 properties
0 acres	0 acres	0 acres	0 acres	0 acres	0 acres	<0.1 acres	0 acres	<0.1 acres
0.4 acres	0.1 acres	0 acres	0 acres	0 acres	0 acres	1 acre	1 acre	1 acre
3 facilities	1 facility	4 facilities	4 facilities	4 facilities	4 facilities	9 facilities	9 facilities	9 facilities
1 facilities	0 facilities	0 facilities	0 facilities	0 facilities	0 facilities	0 facilities	0 facilities	0 facilities
967 properties	811 properties	1,186 properties	1,348 properties	1,348 properties	1,348 properties	918 properties	918 properties	1,005 properties
0 intersections	0 intersections	0 intersections	0 intersections	0 intersections	0 intersections	0 intersections	0 intersections	0 intersections
0 intersections or streets	0 intersections or streets	16 intersections or streets	16 intersections or streets	12 intersections or streets	12 intersections or streets	19 intersections or streets	19 intersections or streets	19 intersections or streets
0 properties	0 properties	144 properties	144 properties	83 properties	83 properties	150 properties	150 properties	83 properties
High	High	High	High	High	Moderate	High	High	High
23 sites	23 sites	77 sites	77 sites	77 sites	77 sites	70 sites	70 sites	70 sites
Highest number of sites located in Segment B	Highest number of sites located in Segment B	Highest number of sites located in Segment B	Highest number of sites located in Segment B	Highest number of sites located in Segment B	Highest number of sites located in Segment B	Highest number of sites located in Segment B	Highest number of sites located in Segment B	Highest number of sites located in Segment B
High risk	Moderate risk	Moderate risk	Moderate risk	Moderate risk	Moderate risk	Moderate risk	Moderate risk	Moderate risk
7 lots 4,167 spaces	7 lots 4,167 spaces	4 lots 3,864 spaces	4 lots 3,864 spaces	4 lots 3,864 spaces	4 lots 3,864 spaces	4 lots 3,864 spaces	4 lots 3,864 spaces	4 lots 3,864 spaces
$1.3 to $1.5	$1.5 to $1.7	$1.4 to $1.6	$1.5 to $1.7	$1.5 to $1.7	$1.5 to $1.7	$1.5 to $1.7	$1.5 to $1.7	$1.4 to $1.7

Key to Ranking: Higher Performing / Lower Performing

EXHIBIT 1-5

Level 1 Alternatives Analysis Summary Table

1.6.1 SR 99 At-Grade Median Alternative

The SR 99 At-Grade Median alternative is one of the lowest cost alternatives. It would have the lowest ridership and longest travel time of all SR 99 alternatives. It would require extensive reconstruction of the recently reconstructed SR 99 roadway, as well as extensive utility relocation, resulting in the greatest disruption to adjacent properties and the surrounding communities and presenting substantial engineering challenges associated with widening. Traffic and other transit operations would be adversely affected, and the potential delays associated with at-grade operation would adversely affect system-wide operations.

Conclusion: Based on the key findings above, the project purpose and need, and the analysis completed to date using the evaluation criteria, the SR 99 At-Grade Median alternative is not proposed for further evaluation.

1.6.2 SR 99 Mixed Median Alternative

The SR 99 Mixed Median alternative would have lower ridership and longer travel time than the elevated SR 99 alternatives. Like the SR 99 At-Grade Median alternative, it would require extensive reconstruction of the recently-reconstructed SR 99 roadway, as well as extensive utility relocation, resulting in disruption to adjacent properties and the surrounding communities. This alternative would avoid some traffic, transit, and system-wide impacts associated with the SR 99 At-Grade Median alternative because it would cross major intersections on an elevated structure.

Conclusion: Based on the key findings above, the project purpose and need, and the analysis completed to date using the evaluation criteria, the SR 99 Mixed Median alternative is not proposed for further evaluation.

1.6.3 SR 99 Elevated Median Alternative

The SR 99 Elevated Median alternative would be more expensive than the at-grade or mixed median alternatives, but would have higher ridership and faster travel times. It has the potential to limit reconstruction of SR 99 to intersections and station locations, reducing potential for utility relocations and disruption to adjacent properties.

Conclusion: Based on the key findings above, the project purpose and need, and the analysis completed to date using the evaluation criteria, the SR 99 Elevated Median alternative is proposed for further evaluation.

1.6.4 SR 99 Elevated East Side Alternative

The SR 99 Elevated East Side alternative would be more expensive than the at-grade or mixed median alternatives, but would have higher ridership and faster travel times. High-voltage electrical transmission lines on the east side of SR 99 would need to be relocated. Acquisition of properties on the east side of the road could result in business and residential displacements, and could limit the potential for redevelopment of these properties following construction. Topographical constraints on the east side of SR 99 in some places would present engineering challenges.

Conclusion: Based on the key findings above, the project purpose and need, and the analysis completed to date using the evaluation criteria, the SR 99 Elevated East Side alternative is not proposed for further evaluation.

1.6.5 SR 99 Elevated West Side Alternative

The SR 99 Elevated West Side alternative would be more expensive than the at-grade or mixed median alternatives, but would have higher ridership and faster travel times. Acquisition of properties on the west side of the road would likely result in business and residential displacements, and could limit the potential for redevelopment of these properties following construction. Topographical constraints on the west side of SR 99 in some places would present engineering challenges.

Conclusion: Based on the key findings above, the project purpose and need, and the analysis completed to date using the evaluation criteria, the SR 99 Elevated West Side alternative is not proposed for further evaluation.

1.6.6 I-5 Mixed West Side Alternative

The I-5 Mixed West Side alternative would be less expensive than elevated alternatives along SR 99. Based on current information from WSDOT, it appears this alternative could be constructed largely within WSDOT right-of-way, limiting residential or business displacements, and avoiding impacts to local roadway operations. Ridership and travel time would be similar to the SR 99 elevated alternatives. Potential risks include proximity to Highline Water District water tanks, a Puget Sound Energy substation, and the Midway Landfill, which also presents a potential hazardous materials concern and geologic hazard.

Conclusion: Based on the key findings above, the project purpose and need, and the analysis completed to date using the evaluation criteria, the I-5 Mixed West Side alternative is proposed for further evaluation.

1.6.7 I-5 Mixed West Side/Median Alternative

The I-5 Mixed West Side/Median alternative would be less expensive than elevated alternatives along SR 99. Based on current information from WSDOT, it appears this alternative could be constructed largely within WSDOT right-of-way, limiting residential or business displacements and avoiding impacts to local roadway operations. Ridership and travel time would be the same as SR 99 elevated alternatives. Potential risks include proximity to Highline Water District water tanks and a Puget Sound Energy substation. This alternative would avoid the Midway Landfill and the engineering challenges that this crossing presents, and would also have the lowest potential for visual impacts.

Conclusion: Based on the key findings above, the project purpose and need, and the analysis completed to date using the evaluation criteria, the I-5 Mixed West Side/Median alternative is proposed for further evaluation.

1.6.8 30th Avenue S. At-Grade Median Alternative

The 30th Avenue S. At-Grade Median alternative would avoid the disruption of SR 99 associated with construction activities and widening of the roadway between S. 220th Street and S. 240th Street. It would have a longer travel time and lower ridership than elevated alternatives, and would require reconstruction of 30th Avenue S., a two-lane primarily residential road. This reconstruction would involve utility relocations and result in impacts to local traffic by eliminating left turns from side streets and adjacent properties. This alternative would cross Kent-Des Moines Road at-grade directly adjacent to on and off-ramps to I-5. This alternative would have high potential for noise and visual impacts and would bifurcate the Pacific Ridge neighborhood between S. 220th Street and Kent-Des Moines Road.

Conclusion: Based on the key findings above, the project purpose and need, and the analysis completed to date using the evaluation criteria, the 30th Avenue S. At-Grade Median alternative is not proposed for further evaluation.

1.6.9 30th Avenue S. Elevated Median Alternative

The 30th Avenue S. Elevated Median alternative would have a similar travel time and ridership as other elevated alternatives on SR 99 and I-5. It would require reconstruction of 30th Avenue S., a two-lane primarily residential road. This reconstruction would involve utility relocations and would result in impacts to local traffic by eliminating left turns from side streets and adjacent properties. This alternative would have high potential for noise and visual impacts and would bifurcate the Pacific Ridge neighborhood between S. 220th Street and Kent-Des Moines Road.

Conclusion: Based on the key findings above, the project purpose and need, and the analysis completed to date using the evaluation criteria, the 30th Avenue S. Elevated Median alternative is not proposed for further evaluation.

1.6.10 30th Avenue S. Elevated East Side Alternative

The 30th Avenue S. Elevated East Side alternative would have a similar travel time and ridership as other elevated alternatives on SR 99 and I-5. It would require reconstruction of 30th Avenue S., a two-lane primarily residential road. This reconstruction would involve utility relocations and property acquisition on the east side of the road, likely resulting in residential displacements. This alternative would have high potential for noise and visual impacts and would bifurcate the Pacific Ridge neighborhood between S. 220th Street and Kent-Des Moines Road.

Conclusion: Based on the key findings above, the project purpose and need, and the analysis completed to date using the evaluation criteria, the 30th Avenue S. Elevated East Side alternative is not proposed for further evaluation.

1.6.11 30th Avenue S. Elevated West Side Alternative

The 30th Avenue S. Elevated West Side alternative would have similar travel time and ridership to other elevated alternatives on SR 99 and I-5 and is likely to require only partial reconstruction of 30th Avenue S., a two-lane primarily residential road. This alternative would have high potential for noise and visual impacts and would bifurcate the Pacific Ridge neighborhood between S. 220th Street and Kent-Des Moines Road. This reconstruction would avoid major utility relocations associated with median and east side alternatives on 30th Avenue S.

Conclusion: Based on the key findings above, the project purpose and need, and the analysis completed to date using the evaluation criteria, the 30th Avenue S. Elevated West Side alternative is proposed for further evaluation.

1.6.12 24th Avenue S. At-Grade Median Alternative

The 24th Avenue S. At-Grade Median alternative would avoid the disruption of SR 99 associated with construction activities and widening of the roadway between S. 200th Street and S. 240th Street. It would have a longer travel time and lower ridership than elevated alternatives, and would require reconstruction of 24th Avenue S., a two-lane collector road in a residential area. This reconstruction would involve utility relocations and would result in effects to local traffic by eliminating left turns from side streets and adjacent properties. This alternative would have high potential for noise and visual effects and could have indirect effects to parks and

neighborhood cohesion between S. 216th Street and Kent-Des Moines Road. Additional costs would be associated with structures for crossing the proposed SR 509 right-of-way and S. 208th Street.

Conclusion: Based on the key findings above, the project purpose and need, and the analysis completed to date using the evaluation criteria, the 24th Avenue S. At-Grade Median alternative is not proposed for further evaluation.

1.6.13 24th Avenue S. Elevated Median Alternative

The 24th Avenue S. Elevated Median alternative would avoid the disruption of SR 99 associated with construction activities and widening of the roadway between S. 200th Street and S. 240th Street. This alternative would require reconstruction of 24th Avenue S., a two-lane collector road in a residential area. This reconstruction would involve utility relocations and would result in effects to local traffic by eliminating left turns from side streets and adjacent properties. This alternative would have high potential for noise and visual effects and could have indirect effects to parks and neighborhood cohesion between S. 216th Street and Kent-Des Moines Road. Additional costs would be associated with structures for crossing the proposed SR 509 right-of-way and S. 208th Street.

Conclusion: Based on the key findings above, the project purpose and need, and the analysis completed to date using the evaluation criteria, the 24th Avenue S. Elevated Median alternative is not proposed for further evaluation.

1.6.14 24th Avenue S. Elevated East Side Alternative

The 24th Avenue S. Elevated East Side alternative would avoid the disruption of SR 99 associated with construction activities and widening of the roadway between S. 200th Street and S. 240th Street. This alternative would result in acquiring properties on the east side of 24th Avenue S. for right-of-way, possibly displacing residences and/or churches. This alternative would have high potential for noise and visual effects and could have indirect effects to parks and neighborhood cohesion between S. 216th Street and Kent-Des Moines Road. Additional costs would be associated with structures for crossing the proposed SR 509 right-of-way and S. 208th Street.

Conclusion: Based on the key findings above, the project purpose and need, and the analysis completed to date using the evaluation criteria, the 24th Avenue S. Elevated East Side alternative is not proposed for further evaluation.

1.6.15 Developing a New Alternative (Hybrid)

The results of the Level 1 analysis showed that different segments of each of the SR 99 alternatives could work, but each one of them as a “stand alone” alternative has substantial flaws. A combination of conceptual design elements (a mix of east side, west side, and median alignment; at-grade and elevated profile) could result in an alternative that operates better with less adverse effects than the “stand alone” SR 99 alignment alternatives studied in Level 1. For the Level 2 evaluation, this new alternative will be called the “hybrid” alternative.

Conclusion: A new SR 99 Hybrid alternative should be developed for study in the Level 2 evaluation. It should be made up of segments of the SR 99 alignment and grade alternatives (at-grade, median elevated, east elevated and west elevated) that have been developed and examined in the Level 1 evaluation.

Exhibit 1-6 summarizes the Level 1 evaluation, showing which alternatives will not be studied further (shown in gray) and which alternatives will be studied further in Level 2 (shown in color).

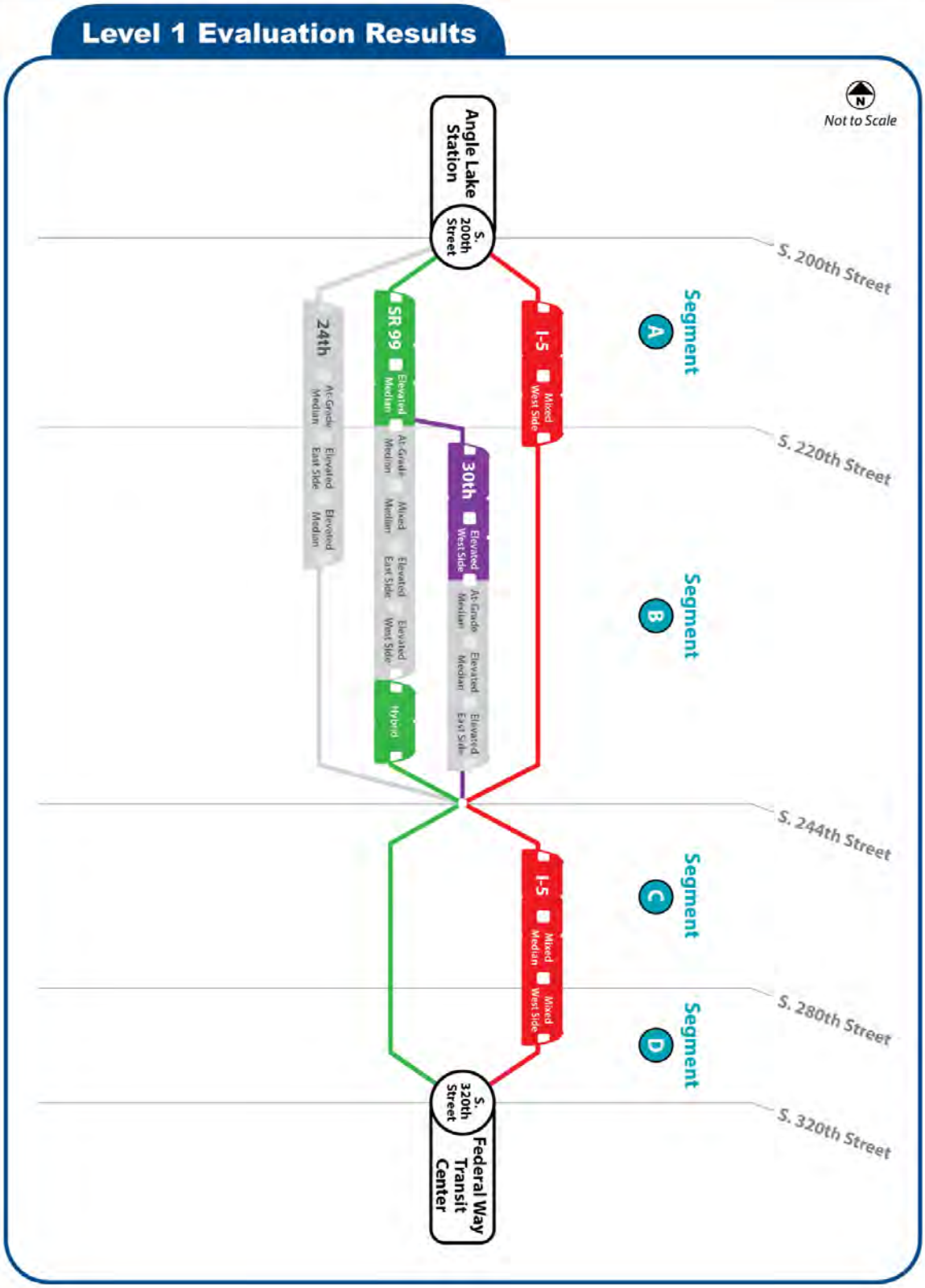

EXHIBIT 1-6
Level 1 Evaluation Results

2.0 Introduction

This chapter provides an introduction to the Alternatives Analysis (AA) phase of the Federal Way Transit Extension (FWTE), the background on the corridor, and an explanation of the AA process.

The Central Puget Sound Regional Transit Authority (Sound Transit) intends to extend regional high capacity transit (HCT) between the cities of SeaTac and Federal Way. The Sound Transit 2 (ST2) Plan, approved by voters in 2008, included environmental study and design of this extension. This approximately 7.6 mile extension would extend HCT south from the future Angle Lake Station terminus of the Sound Transit Link light rail system at S. 200th Street in SeaTac (scheduled to open in 2016) to the Federal Way Transit Center at S. 320th Street. The voter-approved extensions to the Link light rail system will bring 36 new miles of service to the north, south, and east over the next few years, creating a 55-mile light rail system serving the Puget Sound region.

The FWTE will help fulfill regional plans developed by the Puget Sound Regional Council (PSRC) and Sound Transit. PSRC's Vision 2040 (PSRC 2009) and Sound Transit's 2005 Regional Transit Long-Range Plan (Sound Transit, 2005) both call for future HCT in the FWTE corridor. **Exhibit 2-1** shows the Regional Transit System Plan map

EXHIBIT 2-1

Sound Transit Current Service and Future Projects

2.1 Relationship of this Study to Project Development

This report summarizes the portion of the AA process that has been completed to date to identify and evaluate alternatives. The alternatives performing best against evaluation criteria may be analyzed in an Environmental Impact Statement (EIS) under the National Environmental Policy Act (NEPA) and under the Washington State Environmental Policy Act (SEPA). The study identified an initial range of potential alternatives based on previous plans and studies and input from the public and agencies. This study evaluated those potential alternatives to determine which should undergo further study and design during the AA and EIS processes. At the end of the project development and environmental review process, the Sound Transit Board is expected to select the project to build and operate.

Sound Transit intends to maintain eligibility for future New Starts or other federal funding from the Federal Transit Administration (FTA). To be eligible for federal funding the planning process for the project must be done in compliance with FTA planning and project development guidance. The new transportation funding bill, Moving Ahead for Progress in the 21st Century (MAP-21), eliminates the formal AA requirement from the New Starts Program and instead relies on the review of alternatives performed during the metropolitan planning and environmental processes. The following chapters document this local planning process both prior to initiation of the FWTE project and as part of this alternatives analysis.

Throughout the AA and NEPA/SEPA processes, Sound Transit is committed to engaging the public, agencies, and key stakeholders. Agencies involved in the Interagency Working Group include each city in the corridor (SeaTac, Des Moines, Kent and Federal Way), PSRC, Highline Community College, WSDOT, and King County Metro. Key stakeholders include local community and business organizations and community service providers. Input from each of these groups (public, agencies, and stakeholders) is important throughout the process to ensure that the community concerns and issues are considered during the evaluation and design process.

2.2 FWTE Corridor Background

This section provides context on the FWTE corridor within the greater regional transit system and an overview of previous planning efforts within the corridor.

Sound Move, the first phase of regional transit investments, was approved and funded by voters in 1996. Sound Transit is now completing its implementation. It includes light rail, commuter rail and regional express bus infrastructure and service. As a result of the *Sound Move* initiative, in 2009, Sound Transit began light rail operations between downtown Seattle and Sea-Tac International Airport, and an extension to the University of Washington is under construction and scheduled to open in 2016.

The S. 200th Link Extension is currently under construction, extending light rail from the Sea-Tac Airport to S. 200th Street, terminating at the Angle Lake Station. The FWTE will extend this system south to Federal Way in order to expand regional service as well as make progress toward reaching Tacoma, the long-term southern terminus of the Link light rail system planned for in Sound Transit's 2005 Regional Transit Long-Range Plan.

In 2004, Sound Transit began planning for the next phase of investment to follow *Sound Move*. This included updating the long-range plan and associated environmental review. Following several years of system planning work to define, evaluate and prioritize the next round of regional transit system expansion, voters in 2008 authorized funding to extend the regional light rail system south to Federal Way as part of the Sound Transit 2 (ST2) Plan. The ST2 Plan would also extend light rail from downtown Seattle to Bellevue and Redmond to the east and to Northgate and Lynnwood to the north.

Regional and local efforts have studied and identified, through a rigorous planning and outreach process, alternatives for further study and evaluation to bring high-capacity transit to the FWTE corridor. Related regional planning documents include:

- Regional Multi-Corridor Summary Report (Puget Sound Council of Governments, 1986)
- Regional Transit System Plan Final EIS (Joint Regional Policy Committee, 1993)
- 1995 Regional Transit Service Proposal (Sound Transit, 1995)
- The Regional Transit Long-Range Vision and Sound Move-the Ten-Year Regional Transit System Plan (Sound Transit, 1996)
- Destination 2030 (PSRC 2001)
- Regional Transit Long-Range Plan and associated EIS (Sound Transit, 2005)
- Sound Transit 2 (ST2) Plan (Sound Transit, 2008)
- Transportation 2040 (PSRC 2011)

These plans all support an investment in high-capacity transit serving the FWTE study area. In addition, the plans of the cities in the FWTE study area (SeaTac, Kent, Des Moines, and Federal Way), as well as other regional transportation agencies also support a high capacity transit investment in the FWTE corridor. These plans include:

- SR 99 Route Development Plan (Federal Way to Tukwila) (Washington State Department of Transportation (WSDOT), 2006)
- Looking to the Future: Six-Year Transit Development Plan for 2002 to 2007 (King County Metro, 2002)
- Strategic Plan for Public Transportation, 2007 to 2016 (King County Metro, 2007)
- King County Metro Transit Strategic Plan for Public Transportation 2011 to 2021 (King County Metro, 2011)

- City of SeaTac Comprehensive Plan (Updated, 2011)
- City of Des Moines Comprehensive Plan (2009) and Comprehensive Transportation Plan (CTP) (2009)
- City of Kent Comprehensive Plan (2008) and Transportation Master Plan (2008)
- City of Federal Way Comprehensive Plan (Updated, 2010)
- Puget Sound Regional Council Growing Transit Communities Program (2012)

Sound Transit documented these planning and outreach efforts in a November 2012 memo to the FTA titled "Federal Way Transit Extension – Linking Planning and NEPA." The findings of the memo indicate that the planning processes for high capacity transit in the FWTE project area have addressed questions of 'general travel corridor' and 'general mode.'

2.3 Overview of the Alternatives Analysis Process

The purpose of this alternatives analysis is to define the transportation needs in the corridor and identify reasonable alternatives that would address those needs. While this alternatives analysis is a local process, because the resulting project may use federal funding, and FTA is the steward of federal transit funding, FTA's general guidelines for how to conduct alternatives analysis are incorporated into the study. These include four major steps:

- Study initiation
- Development and refinement of alternatives and technical methodologies
- Analysis and evaluation
- Identification of a preferred alternative

Exhibit 2-2 illustrates the steps in the Alternatives Analysis process.

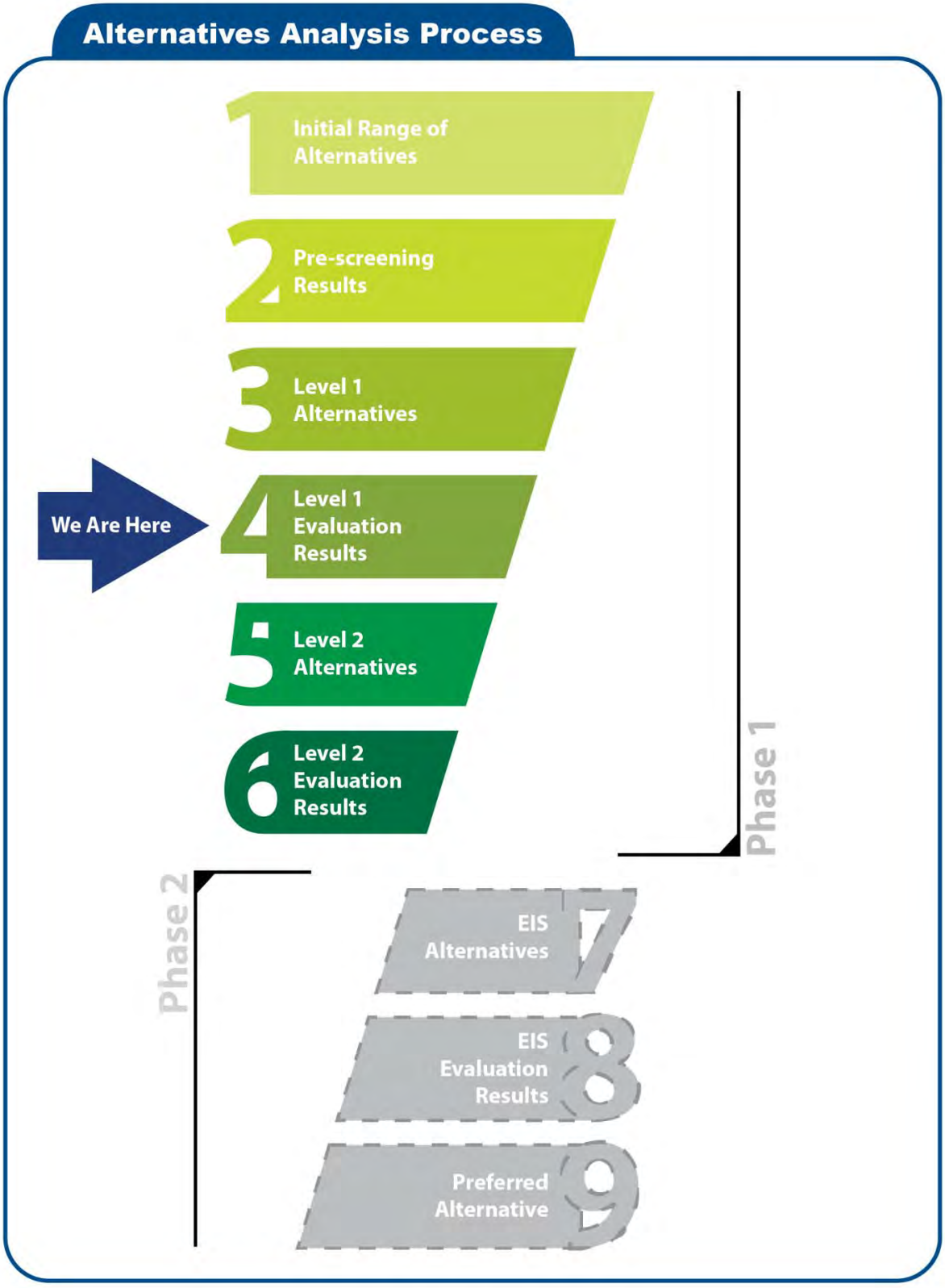

EXHIBIT 2-2
Alternatives Analysis Process

During the study initiation phase, the roles and responsibilities of participating agencies are established, issues to be addressed in the study are defined, and the availability of data and models for addressing these issues is determined. The study initiation phase also includes development of a detailed work plan, a problem statement and purpose and need, evaluation measures to guide the subsequent analysis, and a conceptual definition of alternatives to be included in the study. Chapter 3 of this report summarizes the project purpose and need.

Once the alternatives analysis study has been initiated, the next step is to further refine the study alternatives and analysis methods. This step is designed to ensure that all participants in the process are in general agreement with the alternatives and analysis methods before the alternatives are further developed and evaluated in greater detail. This step often includes a preliminary analysis to screen out those alternatives that clearly cannot satisfy the project purpose and need or that show the least amount of promise. The third step includes the more detailed development of the most promising alternatives followed by the analysis and evaluation of these alternatives. This step constitutes the main work of the alternatives analysis, and includes applying the methodologies developed for each of the study's evaluation measures to assess the transportation, environmental and financial impacts of each alternative. This step has two levels for the FWTE, and this report documents Level 1 of this evaluation. Chapter 4 defines the alternatives studied in Level 1; Chapter 5 describes the criteria used to evaluate the alternatives and the methodologies for applying these criteria; Chapter 6 presents the results of each evaluation measure; and Chapter 7 provides a comparative analysis of alternatives based on these criteria and identifies alternatives to be evaluated further in Level 2.

The Level 1 evaluation applies both qualitative and quantitative criteria to measure the benefits, impacts, and costs of the alternatives. The best performing alternatives will then be studied further in the Level 2 evaluation. Given the expanded information available at this stage of the process, alternatives that will be further studied have a refined design and definition prior to evaluation in Level 2.

The Level 2 evaluation will apply more quantitative criteria and analyses to the remaining, smaller set of alternatives. These alternatives are again compared against one another. This evaluation will compare each alternative's merits and weaknesses relative to the other alternatives. The results of this screening will be presented to Sound Transit Board and will inform alternatives to present during the NEPA/SEPA environmental scoping period. Following scoping, the Sound Transit Board is expected to identify the alternative or alternatives that should be studied in the Draft EIS.

2.4 Organization of this Report

This report is organized by the following chapters:

Chapter 1 – Executive Summary: This chapter provides an overview of the alternatives evaluated in this study and the key findings and conclusions.

Chapter 2 – Introduction: This chapter provides an introduction to the alternatives analysis phase of the FWTE, some background on the corridor, and an explanation of the alternatives analysis process.

Chapter 3 – Pre-Screening of Alternatives: This chapter discusses alternatives identified in previous studies or submitted during the early scoping process that were pre-screened from further evaluation because they do not meet the project purpose and need, they have engineering or environmental constraints that make them infeasible, or they are inconsistent with adopted local and regional plans for public transportation infrastructure. This chapter also provides a summary of the project purpose and need.

Chapter 4 – Definition of Level 1 Alternatives: This chapter describes the Level 1 alternatives. Maps and cross-sections of each alternative are provided here.

Chapter 5 – Level 1 Evaluation Criteria: This chapter presents the evaluation criteria used to examine and compare the alternatives defined in Chapter 4. These criteria relate directly to the purpose and need and goals and objectives of the project.

Chapter 6 – Level 1 Data Results: This chapter provides the results of how each Level 1 alternative described in Chapter 4 performs under each criterion described in Chapter 5. Results are organized by criteria and provide a comparison between alternatives for each criterion.

Chapter 7 – Level 1 Key Findings and Conclusions: This chapter summarizes the key findings of each alternative as they relate to the evaluation criteria, and draws conclusions about the alternative's relative performance. This chapter identifies the alternatives that are to be evaluated further in the Level 2 evaluation.

3.0 Pre-Screening of Alternatives

This chapter summarizes the process used to develop the initial range of potential alternatives, the project purpose and need, the process used to pre-screen alternatives, and analysis and conclusions regarding alternatives that were considered but not evaluated further in the Level 1 evaluation.

3.1 Development of Alternatives

Potential alternatives for the Federal Way Transit Extension (FWTE) came from two sources: previous regional and local planning studies (see Section 2.2.2) and input from the public and agencies during a 30-day early scoping period held from October 18 to November 19, 2012. The purpose of early scoping is to start the public planning and environmental processes for the FWTE project. The early scoping period included two public open houses (one in Des Moines and one in Federal Way), an online survey, and opportunities for the public to provide comments on comment forms at the meeting, online, or via postal mail. The public open houses provided several interactive opportunities for attendees to provide input, including a large map of the project corridor where attendees could draw alignment suggestions. An online meeting for agencies and tribal governments was also conducted and provided opportunities to ask questions and provide comments.

Overall feedback received during the early scoping period was positive and indicated a desire for improved transit service in the project area. Comments provided by agencies, local jurisdictions, institutions, and members of the general public indicate a strong preference and expectation for light rail transit as planned for in the Regional Transit Long-Range and Sound Transit 2 (ST2) Plans. Stakeholders expressed concerns about parking, travel time, connections to Tacoma and to other transit facilities in the study area, and multimodal connections. Comments received on alignment, profile preference, and station locations were varied.

Exhibit 3-1 shows the study area within which alternatives were identified and considered. The study area is generally bounded by SR 99 to the west, I-5 to the east, S. 200th Street to the north and S. 320th Street to the south. Alternatives outside this general area or with different origins or destinations were not considered as part of this evaluation because they would not meet the purpose and need for the project, as described in Section 3.2. Alternatives generally followed two corridors, SR 99 and I-5, between SeaTac and Federal Way, a distance of approximately 7.6 miles. Between S. 200th Street and Kent-Des Moines

Road, alternatives along 30th Avenue S. and 24th Avenue S. were suggested during the early scoping period and were also considered.

Alternatives considered include different modes, profiles and alignments. Mode refers to the method of transportation, such as bus or light rail. Alignment refers to the horizontal location within a corridor, such as east side, west side, or in the median. Profile refers to a vertical location, such as above grade (elevated on columns), at-grade, below-grade (retained cut or tunnel), or mixture of one or more profile. Section 3.3 contains brief descriptions of alternatives not carried forward for further evaluation in Level 1. The alternatives evaluated in Level 1 are more fully described in Chapter 4.

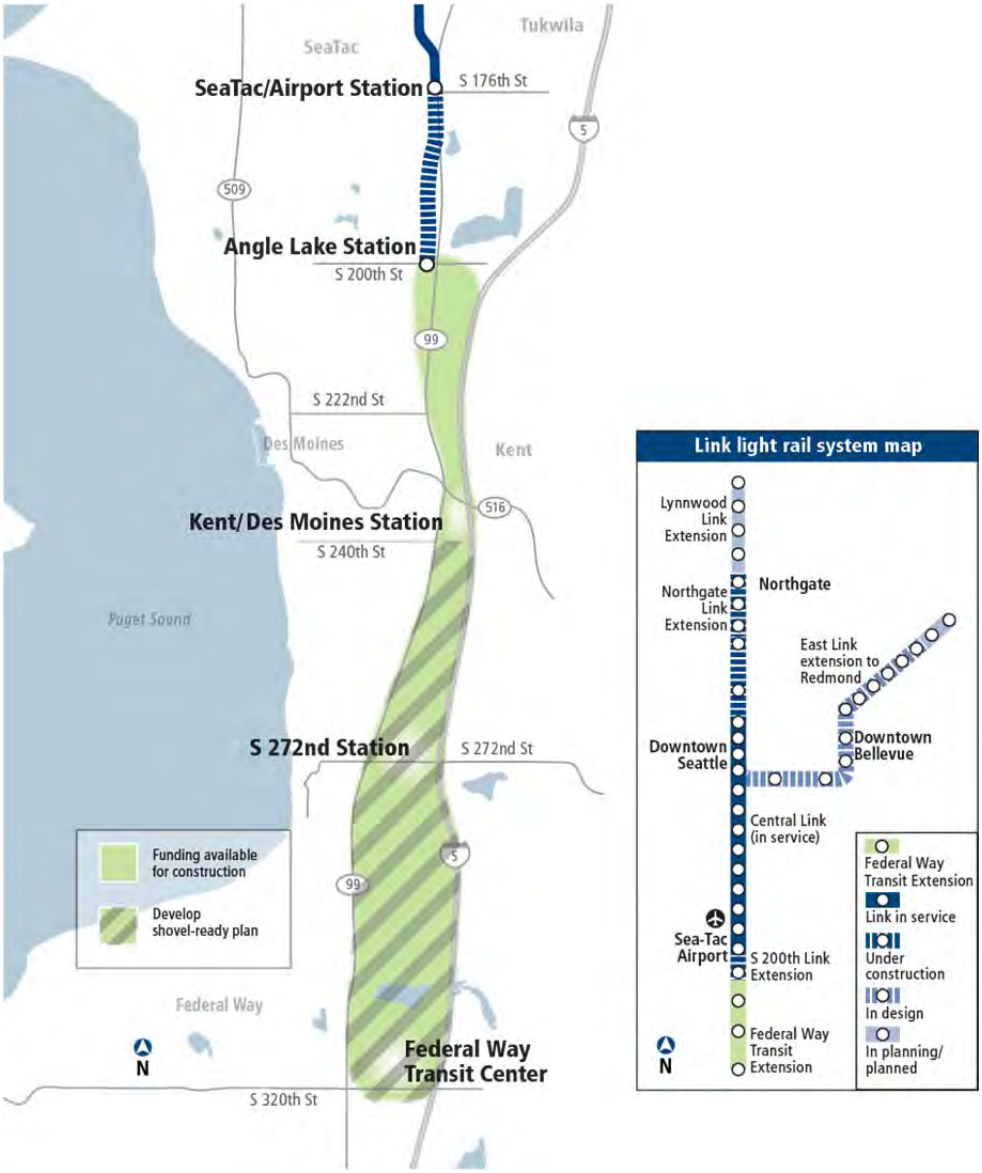

EXHIBIT 3-1
Project Area Map

Exhibit 3-2 illustrates the initial range of alternatives that were identified for the FWTE, which can generally be grouped as shown in **Table 3-1.**

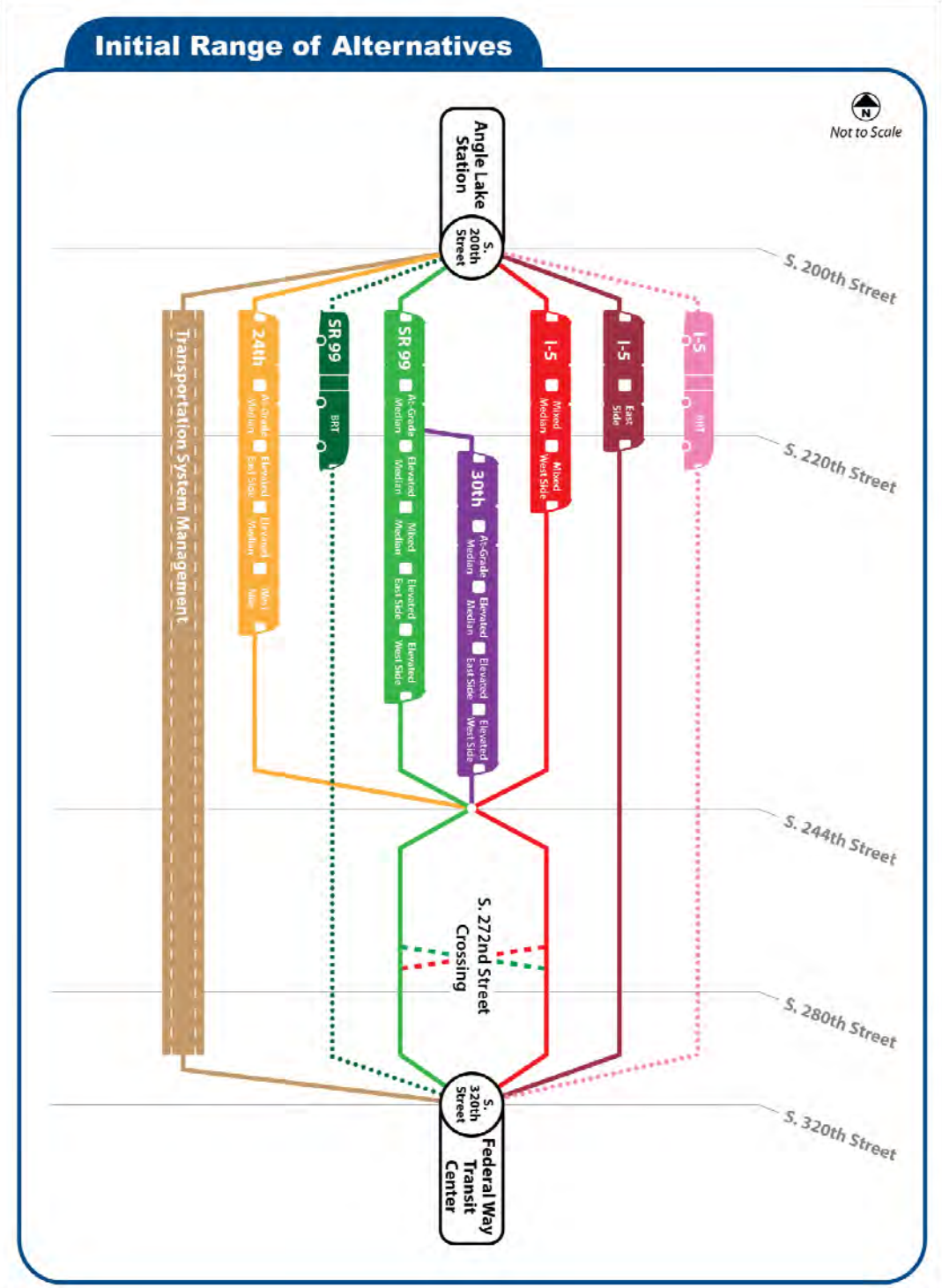

EXHIBIT 3-2
Initial Range of Alternatives

TABLE 3-1
Alternatives Initially Identified or Suggested During Early Scoping

Initial Alternative Types Considered		
Mode	Transportation System Management (TSM) Bus Rapid Transit (BRT) Light Rail Transit (LRT)	
Profile	At-grade Elevated Mixed at-grade/elevated Tunnel	
Alignment	SR 99	West Side
		Median
		East Side
	I-5	West Side
		Median
		East Side
	30th Avenue S.	West Side
		Median
		East Side
	24th Avenue S.	West Side
		Median
		East Side

3.2 Purpose and Need

The purpose of the Federal Way Transit Extension is to expand the Sound Transit Link light rail system from SeaTac to the cities of Des Moines, Kent, and Federal Way in King County in order to meet the following objectives:

- Provide a rapid, reliable, accessible, and efficient alternative for travel to and from the corridor and other urban growth and activity centers in the region with sufficient capacity to meet projected demand.
- Expand mobility alternatives to traveling on congested roadways and improve connections to the regional multimodal transportation system with peak and off-peak service.
- Provide the high-capacity transit (HCT) infrastructure to support adopted regional and local land use, transportation, and economic development plans.
- Advance the long-range vision, goals, and objectives for transit service established by the Sound Transit Long-Range Plan for high-quality regional transit service connecting major activity centers in King, Pierce, and Snohomish counties.
- Implement a financially feasible system that seeks to preserve and promote a healthy environment.

The following conditions within the project corridor demonstrate the need for the project:

- North-south transit demand is expected to grow by 30 to 40 percent by 2035 as a result of residential and employment growth in the FWTE corridor and regionally.
- The FWTE corridor population is a highly transit-dependent population with needs for efficient, reliable regional connectivity.
- Congestion on I-5 and on the key corridor arterials leading in and out of the study area will increase and further degrade existing transit performance and reliability.
- There is a lack of reliable and efficient peak and off-peak transit service connecting persons in the FWTE corridor with the region's growth centers.
- Regional and local plans call for HCT in the corridor consistent with Puget Sound Regional Council's (PSRC) *VISION 2040* and the *Regional Transit Long-Range Plan*.
- Implementing the project will help meet environmental and sustainability goals of the state and region, including reduced vehicle miles traveled and greenhouse gas emissions.

3.3 Alternatives Not Evaluated in Level 1

Mode refers to the type of transit service or transit investment. Previous transportation planning, including Sound Transit's regional long-range transit system planning, PSRC's metropolitan transportation planning, and voter-approved transit investment measures (i.e., the ST2 Plan) have prioritized the extension of light rail transit in the FWTE corridor. Local jurisdictions in the corridor have updated land use and transportation comprehensive plans in anticipation of the extension of light rail from the City of SeaTac to points south. These plans and studies are documented in the FWTE report titled, *Plan Review for High-Capacity Transit in the Project Corridor: S. 200th Street to Federal Way City Center* (Sound Transit, 2012).

Since initiating development and consideration of FWTE alternatives, FTA requirements for alternatives analyses have been in flux. Nonetheless, existing FTA guidance encourages consideration of a range of mode alternatives in the project development process, including lower-cost transit investments. In addition to light rail, other modes initially evaluated for the FWTE include transportation system management (TSM) and bus rapid transit (BRT). These modes were considered in light of existing FTA guidance and/or because they were suggested by members of the public during the early scoping period. Both TSM and BRT were determined not to meet the project purpose and need and were not evaluated in Level 1, as discussed in the following subsections, 3.3.1.1 and 3.3.1.2.

TABLE 3-2
Alternatives Not Evaluated in Level 1

Alternative Type	Alternative	Corridor
Mode	TSM	I-5 or SR 99
	BRT	I-5 or SR 99
Profile	Tunnel	SR 99
Alignment	East Side	I-5
	Crossing at S. 272nd Street	I-5/SR 99 Hybrid
	Behind Businesses	SR 99
	West Side	24th Avenue S.

3.3.1 Modes Evaluated in Pre-Screening, Not Evaluated in Level 1

Modes initially considered for the FWTE include bus, Transit System Management (TSM), and light rail. Alternatives utilizing bus transit include transportation system management, or TSM, and bus rapid transit (BRT). Both TSM and BRT were determined not to meet the project purpose and need and were not evaluated in Level 1, as discussed in the following subsections, 3.3.1.1 and 3.3.1.2.

Consistency with Local Plans

As described below, for several decades multiple regional and local land use and transportation plans have been anticipating high-capacity transit (HCT) in the FWTE corridor. Sound Transit intends to seek FTA New Starts funding which requires compliance with FTA guidance on planning. The most recent transportation funding bill, Moving Ahead for Progress in the 21st Century (MAP-21) eliminates the formal AA requirement from the New Starts Program and instead relies on the review of alternatives performed during the metropolitan planning and environmental processes.

The studies described below demonstrate that the regional planning and decision-making process have met the criteria and led appropriately and logically to the narrowing of mode alternatives in this corridor to light rail transit.

PSRC HCT Corridor Assessment (2004)

In 2004, PSRC conducted the HCT Corridor Assessment (PSRC, 2004), which applied regional travel demand forecasts to determine the relative potential of the corridor to support HCT. The study examined a range of HCT technologies including enhanced bus, bus rapid transit (BRT), light rail, monorail, sky train, and diesel multiple units. It considered the capacity, speed, and performance reliability of each mode. The study concluded that an HCT extension within the FWTE corridor would be a worthwhile investment for the region and local communities. “Corridor-wide land use characteristics and projected growth indicate that this corridor has sufficient land use activity and densities to support HCT in the future” (PSRC,

2004). The report suggests that as urban development continues in the FWTE study corridor, enhanced bus services are unlikely to keep pace with transit demand and that transit reliability will become increasingly difficult to maintain. The report notes that fixed-guideway exclusive rail technologies would have the greatest capability to maintain consistent transit service in the corridor, and to connect with other areas of the metropolitan region.

Sound Transit Regional Transit Long-Range Plan (2005)

The *Regional Transit Long-Range Plan*, adopted by Sound Transit in July 2005, modifies the region's earlier long-range transit plan adopted in 1996, *Sound Move*. The plan represents Sound Transit's goals, policies, and strategies to guide the long-term development of the HCT system through the year 2030 and beyond.

Before adopting the plan, Sound Transit conducted an extensive public outreach program and environmental review of specific plan elements in compliance with the State of Washington's State Environmental Policy Act (SEPA), culminating with the publication of the *Final Regional Transit Long-Range Plan Supplemental Environmental Impact Statement* (Final SEIS) in June 2005 (Sound Transit, 2005). The Long-Range Plan provided the basis for the current ST2 Plan and defined the vision for developing HCT throughout the region, including the FWTE project (identified in the ST2 Plan as the South Corridor).

The Final SEIS contains a series of recommendations for HCT corridors extending throughout the greater Seattle metropolitan region. The FWTE corridor is highlighted specifically among these corridors as a candidate corridor for LRT. The document expressly states that "Under the plan alternative, light rail would (be) include[d among] the following segments… a light rail extension south from SeaTac at S. 200th Street to downtown Tacoma, generally along the I-5 corridor, but also encompassing parallel arterial corridors such as SR 99" (Sound Transit, 2005).

Sound Transit 2 (2008)

In July 2008, the Sound Transit Board adopted Sound Transit 2: A Mass Transit Guide, the Regional Transit System Plan for Central Puget Sound (ST2). ST2 is a package of HCT investments in the regional transit system. Financing for the ST2 package was approved by the voters in November 2008 and includes Link light rail extensions, including:

> "Extension from SeaTac/Airport Station to Redondo/Star Lake with stations at South 200th, Highline Community College, and Redondo/Star Lake (page A-13, in Appendix A: Detailed Description of Facilities and Estimated Costs)."

Municipal Plans

The plans for the cities within the FWTE corridor (SeaTac, Des Moines, Kent, and Federal Way) each address improvements in the overall transit network, and mention extending Sound Transit HCT to the south. Plans that specify light rail as the mode of HCT in this corridor include the City of Des Moines Comprehensive Transportation Plan (2009) and the City of Kent Transportation Master Plan (2008).

3.3.1.1 Transportation System Management (SR 99 and I-5)

TSM was considered during the development of alternatives because it could be a lower-cost solution in the corridor, compared to other alternatives that require construction of new capital infrastructure, and because expansion of regional express service was suggested during the early scoping period by members of the public. A TSM alternative would include enhancements to the existing transportation system, including transit service such as improvements to existing RapidRide A Line service, bus priority treatments, expanded use of Business Access Transit (BAT) lanes, and expanded local and/or express service. The current services provided by King County Metro and Sound Transit have incorporated many of these features, such as use of BAT lanes on SR 99 from S. 320th Street in Federal Way to S. 200th Street in SeaTac, signal prioritization for the RapidRide A line along SR 99, and express service by both Metro and Sound Transit on I-5 beginning in Federal Way and with stops along the FWTE corridor.

Inability to Provide Efficient and Reliable Service

As described below, increased congestion and expected population and employment growth make it difficult for the TSM alternative to meet the growing needs for transit.

Increased Congestion

The TSM alternative would not meet the corridor purpose and need because of the projected increased congestion that will occur on both I-5 and SR 99 that would result in increased travel times and reduced reliability. I-5 and SR 99 are the only major north-south travel options in the FWTE corridor, and travel times are unreliable for many hours of the day as consistent congestion that occurs in the peak-periods is expected to extend the congestion outside of the typical commuting hours. I-5 between Federal Way and Seattle is currently congested for eight hours a day. With expected growth in the future congestion on I-5, by year 2035 congestion is expected to occur for as many as 11 hours out of the day between Federal Way and Seattle without programmed major investments along I-5 (PSRC Travel Demand Model, 2012). Along SR 99, Des Moines, Kent, and Federal Way long-range plans predict traffic congestion on SR 99 and key arterials will increase and up to 19

intersections would operate at Level of Service (LOS) F by the year 2035 without major investments in the area.

Population and Employment Growth

By 2035, north-south transit demand from Seattle south to the city of Tacoma and including the FWTE corridor is expected to grow by 30 to 40 percent as a result of residential and employment growth in the South King County and Pierce County areas (Sound Transit Ridership Model, 2012). PSRC's *VISION 2040* (PSRC, 2009), the regional growth strategy and land use plan, has called upon the two north and south transportation destinations at opposite ends of the FWTE corridor—Seattle and Tacoma—to accommodate 32 percent of the projected regional population growth and 42 percent of the regional employment growth. Similarly, the regional growth strategy calls for Kent and Federal Way to be two of the 14 core cities called upon to accommodate 22 percent of the region's population growth and 29 percent of its employment growth by the year 2040 (PSRC, 2009, Part II, page 8-9). Accommodating this expected growth with a TSM alternative is not realistic due to the limited potential for improvements to the existing transportation system and transit options. Additionally, the TSM alternative would require transfers to connect to existing light rail service and the regional connections that LRT provides, increasing travel times in the corridor.

Conclusion

The TSM alternative was dropped in the pre-screening step and not evaluated further in Level 1 because it would not be able to provide reliable and efficient two-way, peak and off-peak service within the FWTE corridor due to the increased transit demand expected in the corridor accompanied by the increased congestion on both I-5 and SR 99, which is associated with this growth. The existing transportation system and existing transit options already incorporate many TSM features, and transit options in this corridor cannot be improved substantially without at least a semi-exclusive right-of-way to eliminate the effect of increased congestion. It also would not provide a HCT solution that meets the needs of the corridor as planned for at the regional and local level.

3.3.1.2 Bus Rapid Transit (SR 99 and I-5)

Consideration of BRT on SR 99 and I-5 between S. 200th Street and Federal Way was suggested during the FWTE early scoping process by members of the public, and may be considered a lower cost alternative to light rail. BRT scenarios were considered for I-5 and SR 99. BRT would be an enhanced form of bus transit that includes a selection of features to improve travel time, such as exclusive right-of-way, signal prioritization and paying before

boarding, as well as specially designed stations and branded vehicles so that service would be easily identified and easy to use.

BRT already exists in the SR 99 corridor in the form of the King County Metro RapidRide A Line, which travels from the Federal Way Transit Center (FWTC) to the Tukwila International Blvd. Station with 25 stops and a travel time of approximately 40 minutes during peak hours. RapidRide A Line does not include some BRT features, such as exclusive right-of-way, and still uses on-board fare payment. For the BRT alternative on SR 99, exclusive right-of-way would need to be created for the buses to improve reliability and travel times. Grade separation at major intersections would be needed to improve travel times.

BRT on I-5 would use existing high-occupancy vehicle (HOV) lanes and the direct access ramps at S. 317th Street that provide access to the FWTC. Direct access ramps would be added at S. 200th Street, Kent-Des Moines Road and S. 272nd Street to access stations at these locations.

Inability to provide efficient and reliable regional transit connections

Providing BRT service in an exclusive or semi-exclusive right-of-way on SR 99 or I-5 would improve reliability and travel times compared to doing nothing or the TSM alternative. However, the BRT alternatives would still require a transfer to the regional light-rail system and lower vehicle capacity would reduce the ability of the buses to accommodate future transit demand. The BRT alternatives considered in the pre-screening step would result in a poor linkage to the regional transit system and would not provide an efficient connection between the FWTE study area and the region's activity centers because they would force riders to transfer at the Angle Lake Station at S. 200th Street. This forced transfer would add additional wait time (up to 8 minutes inbound based on future projected light rail transit (LRT) headways, plus the time to travel between the bus station and the elevated light rail station) to a person's travel time between the project study area and major destinations accessible via the existing Link system. An eight minute transfer (maximum that could occur) is equivalent to a maximum of 57% of the total LRT travel time (14 to 21 minutes depending on the alternative) projected between Federal Way and the Angle Lake Station.

Limited Capacity

The BRT alternatives would have less capacity than LRT even with the same planned headways. The person-capacity of the BRT system was calculated based upon the bus's seated capacity (with a factor for some standing passengers) and the planned headways during the peak period. This capacity would be 1,050 persons per hour (north and south directions combined). Light rail, however, can accommodate 8,000 (combined) persons per hour with four-car trains (as planned for by Sound Transit in 2035), even with the same

planned headways. BRT, therefore, would be more limited in its ability to meet future transit demand, even with similar operational characteristics.

Consistency with Local Plans

As discussed under Section 3.3.1, regional plans specifically identify a light rail extension south of S. 200th Street. The BRT alternatives would therefore not be consistent with these adopted local plans.

Conclusion

The BRT alternatives were identified for the pre-screening step but not carried forward for further evaluation in the Level 1 evaluation because of the greater travel time (compared to LRT) to regional destinations north of the Angle Lake Station (up 8 minutes additional travel time with transfer), lower passenger carrying capacity than LRT (over 8,000 persons per hour, combined), and incompatibility with existing local plans.

3.3.2 Profiles Evaluated in Pre-screening, Not Evaluated in Level 1

The light rail profile could be at-grade, elevated, or below grade in a retained cut or a tunnel. Light rail alternatives may consist of one or more profile types along the length of the alignment. The only profile suggested in the initial range of alternatives that was not carried forward to be evaluated in Level 1 was the tunnel profile, as discussed in Section 3.3.2.1.

3.3.2.1 Tunnel Profile

A tunnel profile was suggested by the City of Des Moines during early scoping as a way to minimize visual and noise impacts of the light rail alternatives as well as impacts to low-income neighborhoods.

Tunnel profiles are considered by Sound Transit only in specific situations due to the high cost and risk associated with tunnel construction. Generally, tunnel alignments are only considered to be a viable option under certain circumstances, which include:

- To avoid slopes over 3 to 4 percent
- Areas where right-of-way is inadequate for at-grade or elevated profiles
- Areas where surface land uses are sensitive for density (or other) reasons
- Areas where at-grade alternatives would severely impact traffic operations due to high traffic, ridership and frequency of trains
- Locating stations in high ridership areas that cannot be served in any other way

Conclusion

A tunnel alternative was evaluated in the pre-screening step but not carried forward for further evaluation in the Level 1 analysis. The FWTE project team has identified a number of alternatives to a tunnel that that meet the project purpose and need and that could be implemented in the FWTE corridor with less cost, risk, and potential impacts.

3.3.3 Light Rail Alignments Evaluated in Pre-Screening, Not Evaluated in Level 1

The light rail alignments identified during the alternatives identification process included alternatives along four different general routes: SR 99, I-5, 30th Avenue S., and 24th Avenue S. (see Exhibit 3-1). The following light rail alignments within these corridors were considered in the pre-screening but were not carried forward for further evaluation in Level 1:

- *I-5 Elevated East Side*: This alternative was suggested during early scoping by a member of the public. It would travel on the east side of I-5 from the proposed SR 509 right-of-way to either the station at S. 272nd Street or the FWTC.
- *I-5/SR 99 Alignments with a crossing at S. 272nd Street*: This combination of alternatives was suggested during early scoping by a member of the public. This light rail alignment would allow for a crossing between I-5 and SR 99, or vice versa, at approximately S. 272nd Street. One variation on the alignment would cross diagonally between these corridors between S. 260th Street and S. 272nd Street, while another variation would follow the S. 272nd roadway between these corridors.
- *SR 99 Elevated West Side (behind businesses*): This alternative was suggested during early scoping by a member of the public. The alignment would travel behind businesses on the west side of SR 99 to preserve street frontage commercial development.
- *24th Avenue S. West Side (all profiles):* The 24th Avenue S. alternatives were suggested during early scoping by a member of the public as a way to avoid impacts on SR 99. Alignments on the west side, median, and east side of 24th Avenue S. were considered. A west side alignment could be either at-grade or elevated.

A more detailed description of each of these alignments and a discussion of why they were not carried forward for evaluation in the Level 1 analysis is provided in the following subsections.

3.3.3.1 East Side of I-5

This light rail alignment alternative would travel in the proposed SR 509 right-of-way from the Angle Lake Light Rail Station to I-5, then cross to the east side of I-5 and follow I-5 south

to a station on the east side of I-5 at Kent-Des Moines Road. From this station, it would stay on the east side of I-5 until crossing back to the west side of I-5 to access a station at either the Star Lake Park-and-Ride at S. 272nd Street or the FWTC. This alternative was suggested during the early scoping period by a member of the public as a way to avoid utility conflicts on the west side of I-5, including the Highline Water District water towers, a Puget Sound Energy substation and the Midway Landfill.

Design/Construction Considerations

To cross I-5 this alignment would require a clear span structure in excess of 700 feet, requiring cast in place balanced segmental bridge construction. This structure type is typically five to six times the cost of the precast segmental 130 foot span maximum preferred by Sound Transit. It would substantially increase the cost of this alternative compared with other alignments along I-5. Construction would also require at least periodic closures of I-5 while crossings were being constructed, which would be avoidable with other I-5 alternatives.

Accessibility

This alternative would also affect the ability of communities, Highline Community College (HCC), and transit dependent populations in the SR 99 corridor to connect to the regional transportation system efficiently because of the greater distance to stations located on the east side of I-5 near Kent–Des Moines Road and S. 272nd Street. These stations would not serve the corridor populations as well as alignments on the west side of I-5 or those along SR 99. Most routes on SR 99 are north-south and would require a transfer to another route that travels east-west on Kent Des Moines Road or would require up to a half mile walk from stops on SR 99, adding to their travel time and reducing the attractiveness and convenience of LRT service to riders.

Consistency with Local Plans

This alternative would not be consistent with the Midway Subarea Plan (City of Kent, 2012), which identifies a future light rail station between SR 99 and I-5 south of Kent-Des Moines Road. A station on the east side of I-5 would not support the development of transit oriented development (TOD) in this part of the Midway Subarea. The area east of I-5 is within the Midway Subarea, but is not planned for TOD, and I-5 would be a barrier between this station and the area planned for TOD on the west side of I-5.

Conclusion

The I-5 east side light rail alternative would have extra cost and engineering challenges of crossing all lanes of I-5 twice, reduced accessibility for riders (especially transit dependent populations) compared to other alignments along I-5 or SR 99, and would not be consistent with local plans. For these reasons, it was not carried forward for evaluation in Level 1.

3.3.3.2 I-5/SR 99 Hybrid with crossing at S. 272nd Street

This alternative was suggested at early scoping meetings and was intended to allow for a possible connection between alignments on SR 99 and I-5 along S. 272nd Street.

This alternative would have two right angle curves that would require speeds be reduced to ten mph or less. It would add approximately one half mile of east-west travel that would increase the overall travel time. Both of these factors would likely have a negative effect on ridership. Additionally, the alignment would cross a valley and require an elevated structure. Columns of 50 feet or taller would be needed to maintain the maximum Sound Transit LRT grade of four percent. Columns of this height, along with the longer length of the alternative, would increase the cost of this alternative relative to other alternatives without similar structures. Lastly, S. 272nd Street currently exceeds its traffic operational capacity. Taking traffic lanes for LRT is unlikely to be considered acceptable by local jurisdictions because it would worsen traffic. Locating the LRT on either side of the road would result in displacing approximately ten multi-family buildings, and an alignment on the north side of S. 272nd Street could have wetland and Section 6(f) impacts.

Conclusion

Due to the increased travel time, potential to reduce ridership, expected higher costs, and potential impacts to residences, wetlands and Section 6(f) resources, this option was not carried forward for further evaluation in Level 1.

3.3.3.3 SR 99 Light Rail West Side (Behind Businesses on West Side of SR 99)

Identified by a member of the public at an early scoping meeting, this alternative alignment was proposed as a way to minimize right-of-way acquisition from existing businesses fronting SR 99, to maintain access for existing businesses along the west side of SR 99, and to minimize possible limitations on future development that could occur from placement of columns adjacent to SR 99. Between the Angle Lake Station and Kent-Des Moines Road, this alternative would not be directly within the SR 99 right-of-way but would run on an elevated guideway in front of or behind businesses set back some distance to the west of SR 99.

This alignment would include multiple relatively sharp curves in order to minimize the number of property acquisitions, displacements, and potential impacts to properties (such as access, noise, and vibration), which would increase the project cost and would reduce travel speeds from the target of 55 mph to as low as 10 mph in some places. The slower speed and longer travel time would likely decrease ridership. To avoid the businesses along SR 99, there would be displacements of approximately five businesses behind these properties as well as ten or more multi-family residential buildings and 15 or more single family residences, which is a greater impact than if the alignment was directly adjacent to the west side of SR 99.

Conclusion

This alternative was not carried forward for further evaluation in Level 1 because the cost would be higher than similar alternatives that travel along SR 99, travel times would be slower, ridership would be lower, and it would result in more business and residential displacements.

3.3.3.4 Light Rail 24th Avenue S. West Side (all profiles)

This light rail alignment would be elevated on the west side along the two-lane 24th Avenue S. between approximately S. 204th Street and Kent-Des Moines Road. This road currently only exists between S. 208th Street and Kent-Des Moines Road, and adjacent land uses are primarily residential with three churches, three schools, a fire station and a park. The road is expected to be upgraded to four lanes between S. 208th Street and S. 216th Street to accommodate the future Des Moines Creek Business Park proposed on the west side of the road on vacant land. There are no plans to change the configuration of 24th Avenue S. between S. 216th Street and Kent-Des Moines Road and it is expected to remain a local collector road serving the existing residential neighborhood.

An alignment on the west side of the road would be the only alternative to have direct impacts to Steven J. Underwood Memorial Park, a resource protected under Section 4(f) of the Department of Transportation Act that must be avoided if there are other feasible and prudent alternatives. In addition, the alignment would pass directly in front of Midway Elementary and Pacific Middle School, also potential Section 4(f) resources. Lastly, this alignment would likely require reconstruction or relocation of South King Fire Station #26, which is within 20 feet of the western curb line of 24th Avenue S.

Conclusion

This alternative was not carried forward for further evaluation in Level 1 because it would have direct park impacts, it would impact community facilities and would require the displacement of a fire station.

3.4 Summary

This chapter describes the alternatives identified and considered during the pre-screening but not carried forward for further study in the Level 1 evaluation. The alternatives remaining for the Level 1 evaluation are shown on Exhibit 3-3 in color, while those not evaluated further are shown in gray. Chapter 4 provides a definition of the alternatives evaluated in Level 1 and the Level 1 analysis is described in Chapters 5 through 7.

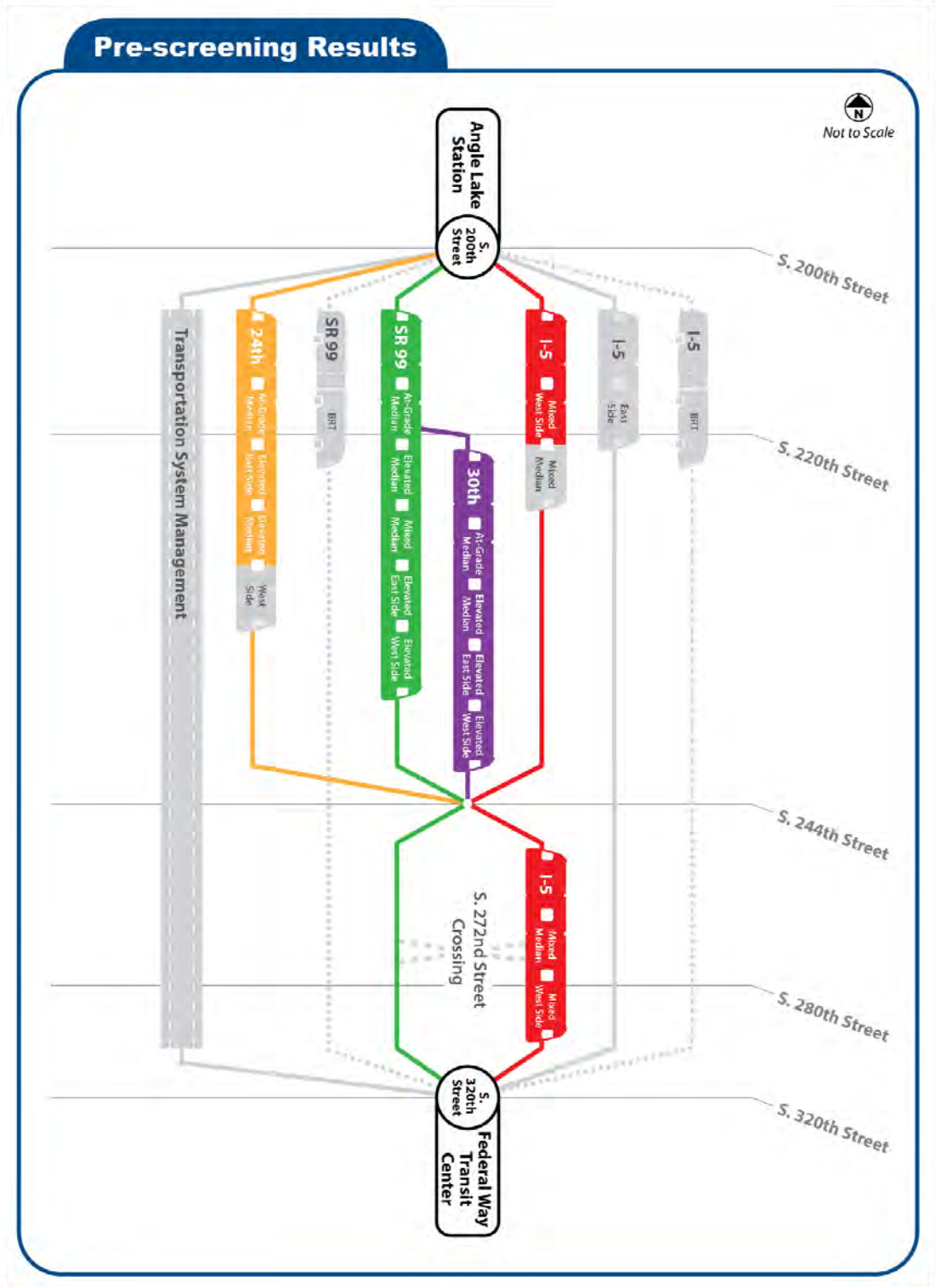

EXHIBIT 3-3
Pre-Screening Results

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4.0 Definition of Level 1 Alternatives

The purpose of this chapter is to define the alternatives evaluated during Level 1. As discussed in Chapter 3, Pre-Screening of Alternatives, non-light rail alternatives were considered but are not evaluated in Level 1. Therefore, all alternatives discussed in this chapter are light-rail alternatives. **Exhibit 4-1** shows the alternatives remaining after pre-screening.

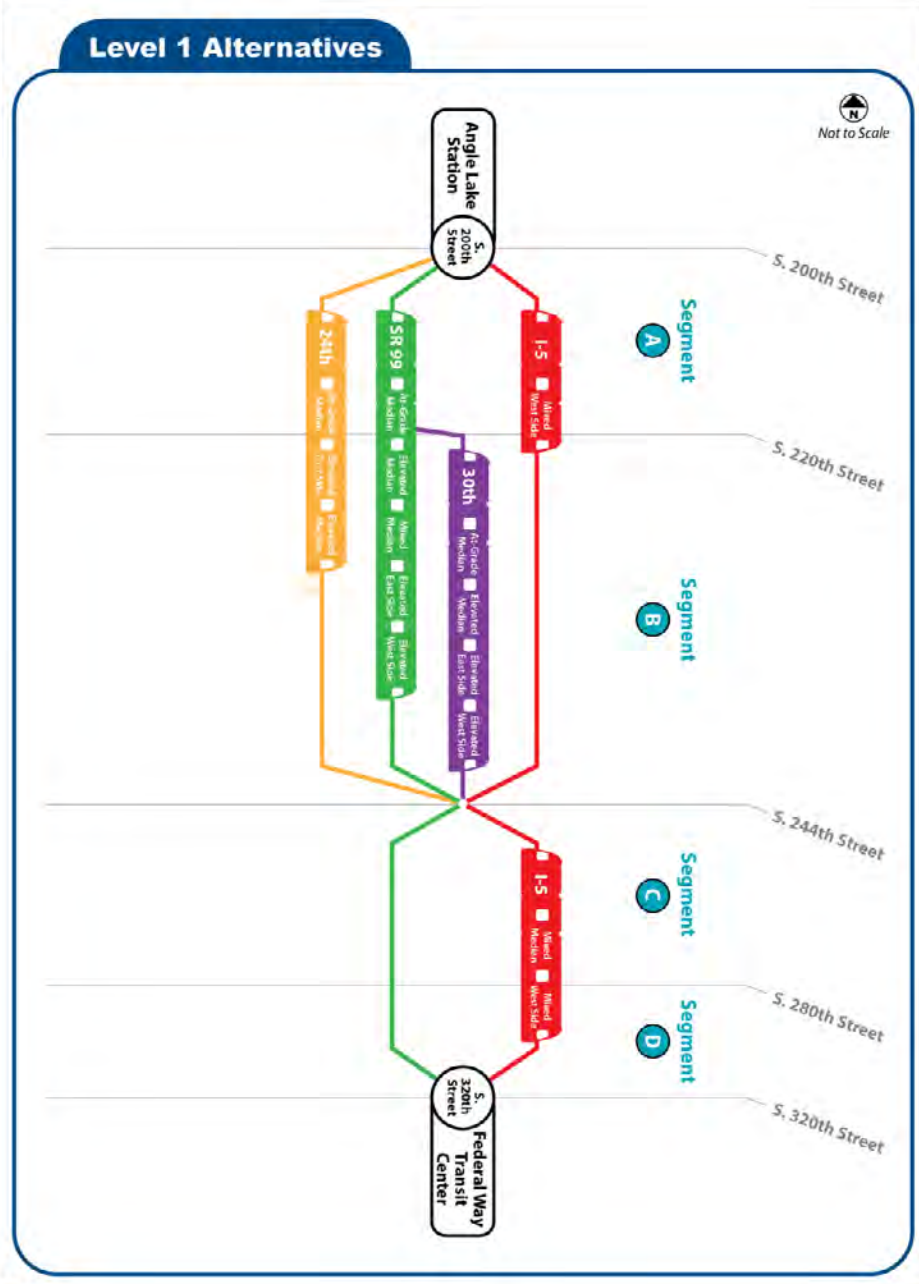


Exhibit 4-1
Level 1 Alternatives

4.1 Overview of Alternatives

For each alternative, there are multiple profile and alignment options included in the Level 1 alternatives evaluation. Alternative profiles (vertical location) include at-grade, elevated, and a combination of both at-grade and elevated, referred to as a "mixed" profile. Alignments (horizontal location) include the light rail within the roadway median, the east side of the roadway, or the west side of the roadway within each corridor.

The alternatives evaluated in Level 1 include those in 4 corridors, as listed in **Table 4-1**. This table also identifies the origin of each alternative.

Table 4-1
Level 1 Alternatives

Corridor	Alternative	Source
SR 99	At-grade Median	Identified in previous planning studies, suggested by public and agencies during early scoping.
	Mixed Median	
	Elevated Median	
	Elevated West Side	
	Elevated East Side	
I-5	Mixed West Side	Identified in previous planning studies, suggested by public and agencies during early scoping.
	Mixed Median	
30th Avenue S.	At-grade Median	Suggested by the City of Des Moines during early scoping.
	Elevated Median	
	Elevated West Side	
	Elevated East Side	
24th Avenue S.	At-grade Median	Suggested by members of the public during early scoping.
	Elevated Median	
	Elevated East Side	

For the Level 1 evaluation, the entire corridor was divided in segments to allow for easier comparison within areas where major differences occur. The SR 99 and I-5 alternatives would be for the full corridor length, from the Angle Lake Station to the Federal Way Transit Center (FWTC). The 30th Avenue S. and 24th Avenue S. alternatives would only occur in the northern half of the corridor, and could connect with either a SR 99 or an I-5 alternative south of the proposed station at S. 240th Street. For the purposes of data collection and comparison in the Level 1 analysis, it was assumed 30th Avenue S. and 24th Avenue S. alternatives would connect to the SR 99 Elevated Median alternative.

These segments are:

- Segment A: S. 200th Street to S. 220th Street. Within Segment A, there are distinct alignments along SR 99, I-5 and 24th Avenue S.

- Segment B: S. 220th Street to S. 244th Street. This segment would include a station at approximately S. 240th Street for all alternatives. Within Segment B, there are distinct alignments along SR 99, I-5, 30th Avenue S. and 24th Avenue S.
- Segment C: S. 244th Street to S. 280th Street. This segment would have a station at approximately S. 272nd Street. Within Segment C, there are distinct alignments along SR 99 and I-5 only.
- Segment D: S. 280th Street to S. 320th Street. This segment would have a station in the approximate vicinity of the Federal Way Transit Center. Within Segment D, there are distinct alignments along SR 99 and I-5 only.

Breaking down each alternative within these segments not only allows for a better understanding of where differences occur between alternatives and along the corridor, but can also allow for combinations of alternative components in order to avoid impacts in one segment while taking advantage of benefits in another segment. This also keeps poor performance or impacts in one segment from precluding higher-performing segments of the alternative from being evaluated in Level 2.

Some criteria used in the Level 1 evaluation focuses on areas where the light rail alternatives would be accessed (potential station areas). These access areas are listed in **Table 4-2** for the SR 99 and I-5 alternatives. Access areas for the 30th Avenue S. and 24th Avenue S. alternatives would be the same as the alternatives they would connect to (either SR 99 or I-5).

Table 4-2
Level 1 Access Areas

Corridor	Access Areas	Segment
SR 99	S. 240th St.	B
	S. 272nd St.	C
	S. 320th St.	D
I-5	S. 240th St.	B
	S. 272nd St.	C
	S. 320th St.	D

4.2 Description of Alternatives

This section includes a one-page summary for each alternative that includes a brief description of the alternative, a plan view of the alignment, and a typical cross-section.

SR 99 At-Grade Median

The SR 99 At-Grade Median Alternative would be **At-Grade in the median of SR 99 from Angle Lake Station to FWTC**. SR 99 is a six-lane state route with four general purpose lanes, two Business Access and Transit (BAT) lanes, and a landscaped median that limits left turns and U-turns except at signalized intersections or designated locations. The alternative would depart Angle Lake Station on an elevated guideway, cross into the SR 99 median in the vicinity of the proposed SR 509 extension near S. 208th Street, and transition to an at-grade profile between the northbound and southbound lanes of SR 99. The guideway would pass through cross-street intersections at-grade, including S. 216th Street, S. 224th Street, Kent-Des Moines Road (SR 516), S. 240th Street, S. 272nd Street, S. 288th Street, Dash Point Road, and S. 312th Street, before ending at FWTC. This alternative would have stations at approximately S. 240th Street, S. 272nd Street and FWTC.

This alternative would require:

- Widening the roadway to one or both sides, as well as extra widening at the S. 240th Street and S. 272nd Street station locations
- Utility relocations
- Signalized intersections at all locations where vehicular and pedestrian traffic crosses
- Passing through the busy Kent-Des Moines Road and S. 272nd Street intersections at-grade

At-grade LRT in the median of a street operates at speeds restricted by safety considerations.

The maximum speed for semi-exclusive right-of-way with at-grade crossings is 35mph unless full railroad crossing gates are used, in which case the speed can exceed 35 mph.

Proposed condition looking north (Not to Scale)

EXHIBIT 4-2
SR 99 At-Grade Median

SR 99 Mixed Median

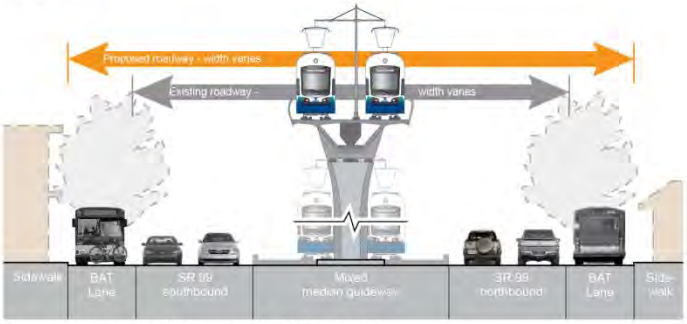
The SR 99 Mixed Median Alternative would be **mixed-profile in the middle of SR 99 from Angle Lake Station to FWTC**. SR 99 is a six-lane state route with four general purpose lanes, two Business Access and Transit (BAT) lanes, and a landscaped median that limits left turns and U-turns except at signalized intersections or designated locations. The alternative would depart Angle Lake Station on an elevated guideway, cross into the SR 99 median in the vicinity of the proposed SR 509 extension near S. 208th Street, and transition to an at-grade profile between the northbound and southbound lanes of SR 99, except at Kent-Des Moines Road (SR 516) and S. 272nd Street, which would each be crossed with short lengths of elevated, grade-separated guideway. This alternative would have stations at approximately S. 240th Street, S. 272nd Street and FWTC.

This alternative would require:

- Widening the roadway to one or both sides, as well as extra widening at the S. 240th Street and S. 272nd Street station locations
- Utility relocations (including high-voltage transmission lines and possibly a high-pressure gas main)
- Signalized intersections at all locations where vehicular and pedestrian traffic crosses
- Grade-separated crossings of the busy Kent-Des Moines Road and S. 272nd Street intersections

At-grade LRT in the median of a street operates at speeds restricted by safety considerations.

The maximum speed for semi-exclusive right-of-way with at-grade crossings is 35mph unless full railroad crossing gates are used, in which case the speed can exceed 35 mph.



Proposed condition looking north (Not to Scale)

EXHIBIT 4-3
SR 99 Mixed Median

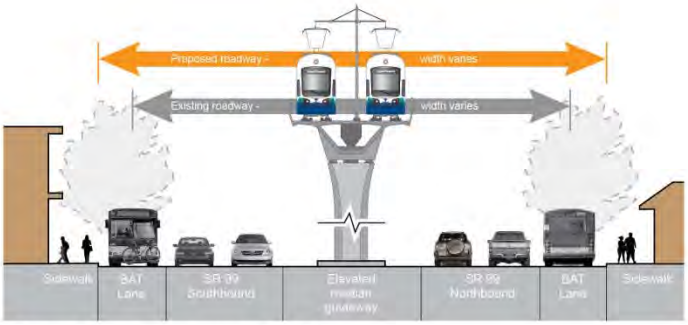
SR 99 Elevated Median

The SR 99 Elevated Median Alternative would be **an elevated light rail guideway in the middle of SR 99 from Angle Lake Station to FWTC**. SR 99 is a six-lane state route with four general purpose lanes, two Business Access and Transit (BAT) lanes, and a landscaped median that limits left turns and U-turns except at signalized intersection or designated locations. The alternative would depart Angle Lake Station on an elevated guideway, cross into the SR 99 median in the vicinity of the proposed SR 509 extension near S. 208th Street, and remain elevated between the northbound and southbound lanes of SR 99. Crossings of all streets would be grade-separated. This alternative would have stations at approximately S. 240th Street, S. 272nd Street and FWTC.

This alternative would require:

- Some roadway widening on one or both sides
- Extra widening at the S. 240th Street and S. 272nd Street station locations
- Utility relocations (including high-voltage transmission lines and possibly a high-pressure gas main)
- Prohibiting left turns under the guideway
- Long spans at most intersections which result in roadway widening at those intersections to accommodate left-turn lane capacity displaced by the guideway
- Cause minimal to no degradation of service at existing intersections

Because this alternative would operate in an exclusive, grade-separated right-of-way, trains could travel at speeds up to **55 mph**.



Proposed condition looking north (not to scale)

EXHIBIT 4-4
SR 99 Elevated Median

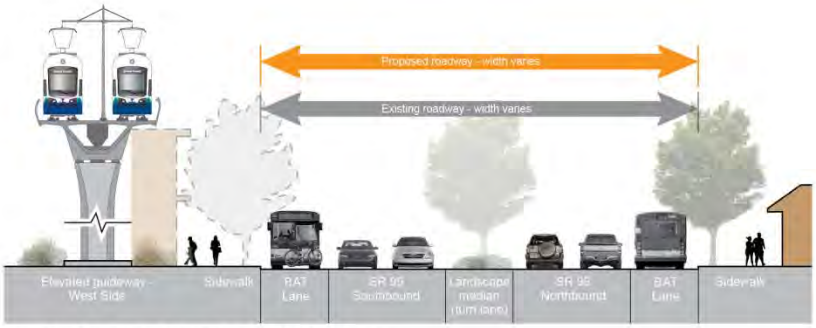
SR 99 Elevated West Side

The SR 99 Elevated West Side Alternative would construct **an elevated light rail guideway on the west side of SR 99 from Angle Lake Station to FWTC**. SR 99 is a six-lane state route with four general purpose lanes, two Business Access and Transit (BAT) lanes, and a landscaped median that limits left turns and U-turns except at signalized intersections or designated locations. The alternative would depart Angle Lake Station on an elevated guideway and continue to the west side of SR 99 in the vicinity of the proposed SR 509 extension near S. 208th Street, and remain elevated through to FWTC. This alternative would have stations at approximately S. 240th Street, S. 272nd Street and FWTC. Crossings of all streets would be grade-separated.

This alternative would:

- Avoid most potential reconstruction of SR 99
- Require utility relocations (including high-voltage transmission lines and possibly a high-pressure gas main)
- Permit turning movements under the guideway
- Require right-of-way acquisition on the west side of the roadway
- Require a setback from SR 99 to permit sight distance for drivers
- Cause minimal to no degradation of service at existing intersections

Because this alternative would operate in an exclusive, grade-separated right-of-way, trains could travel at speeds up to **55 mph**.



Proposed condition looking north (not to scale)

EXHIBIT 4-5
SR 99 Elevated West Side

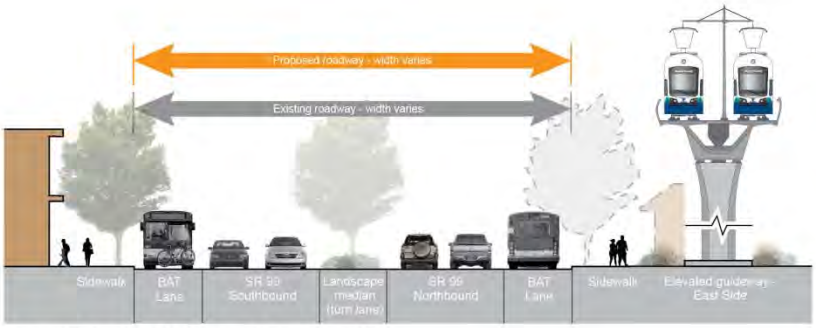
SR 99 Elevated East Side

The SR 99 Elevated East Side Alternative would be **elevated on the east side of SR 99 from Angle Lake Station to FWTC**. SR 99 is a six-lane state route with four general purpose lanes, two Business Access and Transit (BAT) lanes, and a landscaped median that limits left turns and U-turns except at signalized intersections or designated locations. The alternative would depart Angle Lake Station on an elevated guideway, cross SR 99 in the vicinity of the proposed SR 509 extension near S. 208th Street, and remain elevated on the east side of SR 99. This alternative would have stations at approximately S. 240th Street, S. 272nd Street and FWTC. Crossings of all streets would be grade-separated.

This alternative would:

- Avoid most potential reconstruction of SR 99
- Require utility relocations (including high-voltage transmission lines and possibly a high-pressure gas main)
- Permit turning movements under the guideway
- Require right-of-way acquisition on the east side of the roadway
- Require a setback from SR 99 to permit sight distance for drivers
- Cause minimal to no degradation of service at existing intersections

Because this alternative would operate in an exclusive, grade-separated right-of-way, trains could travel at speeds up to **55 mph**.



Proposed condition looking north (not to scale)

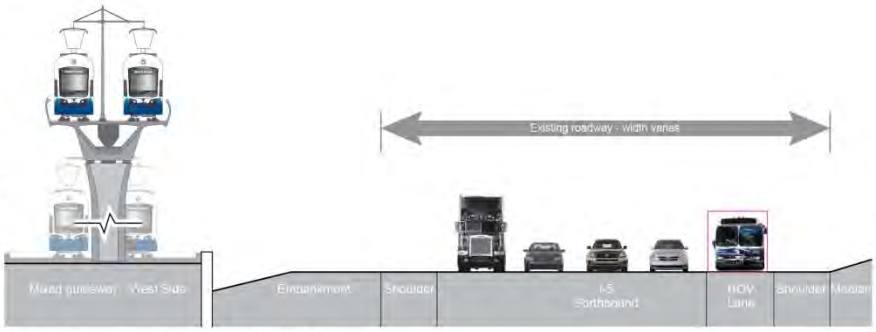
EXHIBIT 4-6
SR 99 Elevated East Side

I-5 Mixed West

The I-5 Mixed West Alternative would be **a mixed-profile alignment on the west side of I-5 from Angle Lake Station to FWTC**. The alternative would depart Angle Lake Station on an elevated guideway, cross SR 99 and the proposed SR 509 on long-span structures, run along the south side of the proposed SR 509 right-of-way to I-5, and then turn south into the west side of the I-5 right-of-way. The guideway would primarily remain in the I-5 right-of-way and pass over S. 216th Street, Kent-Des Moines Road (SR 516), S. 259th Place, S. 272nd Street, Military Road S., S. 288th Street, and Military Road S. once again before turning west at S. 317th Street to access FWTC. This alignment would run in close proximity to the Highline Water District storage tanks, Puget Sound Energy's Midway Switch Station, Midway Landfill, Mark Twain Elementary School and Truman High School. This alternative would have stations at approximately S. 240th Street, S. 272nd Street and FWTC. The alternative would utilize either at-grade or elevated guideway construction depending on requirements related to track profile, roadway crossings, cost, and other notable obstacles.

Crossing Midway Landfill would require extensive investigation into waste mitigation and construction solutions. Right-of-way acquisition outside the WSDOT corridor would be minimal and there would be few utility relocations, although some high-voltage transmission line crossings would need to be raised. There would be minimal to no degradation of service on parallel or crossing roadways.

Because this alternative would operate in an exclusive, grade-separated right-of-way, trains could travel at speeds up to **55 mph**.



Proposed condition looking north (not to scale)

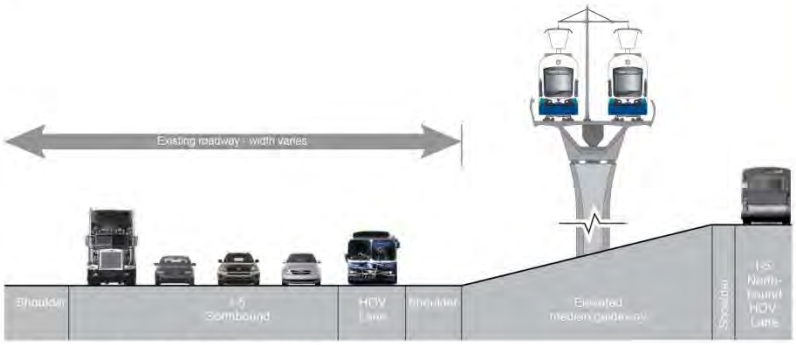
EXHIBIT 4-7
I-5 Mixed West Side

I-5 Mixed West/Median

The I-5 Mixed West/Median Alternative would be **a mixed-profile alignment along I-5 from Angle Lake Station to FWTC**. The alternative would depart Angle Lake Station on an elevated guideway, cross SR 99 and the proposed SR 509 on long-span structures, run along the south side of the proposed SR 509 right-of-way to I-5, and then turn south into the west side of the I-5 right-of-way. At approximately S. 240th Street, the alignment would transition into the median between the northbound and southbound lanes of I-5. This alignment would run in close proximity to the Highline Water District storage tanks and Puget Sound Energy's Midway Switch Station. The primary purpose of this alternative is to avoid the complex issues associated with crossing Midway Landfill. For the purpose of the Level 1 evaluation, the alternative is assumed to continue in the I-5 median to S. 317th Street, though it would return to a west-side alignment at any point south of the landfill. The median alignment would cross S. 259th Place, S. 272nd Street, Military Road S., S. 288th Street, and Military Road S. once again before turning west at S. 317th Street to re-cross the I-5 southbound lanes and access FWTC. This alternative would have stations at approximately S. 240th Street, S. 272nd Street and FWTC.

Right-of-way acquisition outside the WSDOT corridor would be minimal and there would be few utility relocations, although some high-voltage transmission line crossings would need to be raised. There would be minimal to no degradation of service on parallel or crossing roadways.

Because this alternative would operate in an exclusive, grade-separated right-of-way, trains could travel at speeds up to **55 mph**.



Proposed condition looking north (not to scale)

EXHIBIT 4-8
I-5 Mixed West Median

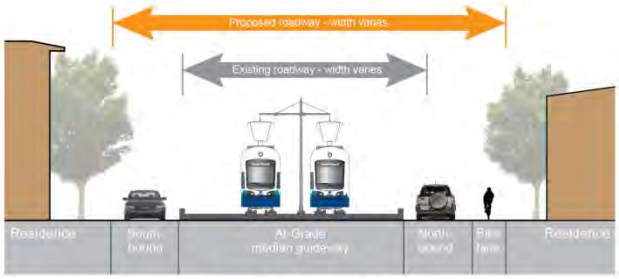
30th Avenue S. At-Grade Median

The 30th Avenue S. At-Grade Median Alternative would be **at-grade in the middle of 30th Avenue S. between S. 224th Street and S. 240th Street.** It would connect to the SR 99 Elevated Median Alternative to the north, and near the intersection of SR 99 and S. 220th Street the guideway would transition east to intersect the 30th Avenue S. corridor at-grade, which would be at a higher elevation than SR 99. 30th Avenue S. is currently a two-lane residential street with a shoulder on the southbound side, a bike lane on the northbound side and minimal sidewalks. From S. 224th Street, the guideway would run south along 30th Avenue S. across Kent-Des Moines Road to S. 240th Street. Near S. 240th Street the guideway would transition to an elevated alignment and could connect to any alternative in the SR 99 or I-5 corridors; for purposes of this analysis, it was assumed to connect to the SR 99 Elevated Median Alternative.

An at-grade guideway would require:

- Complete reconstruction of the roadway, which would include utility relocations
- Prohibiting left turns except at signalized intersections
- Signalized intersections at all locations where vehicular and pedestrian traffic crosses
- Crossing Kent-Des Moines Road at-grade adjacent to the I-5 interchange

At-grade LRT in the median of a street operates at speeds restricted by safety considerations. In the configuration proposed here, the speed limit of **25 mph** on 30th Avenue S. would govern trains as well.



Proposed condition looking north (not to scale)

EXHIBIT 4-9
30th Avenue S. At-Grade Median

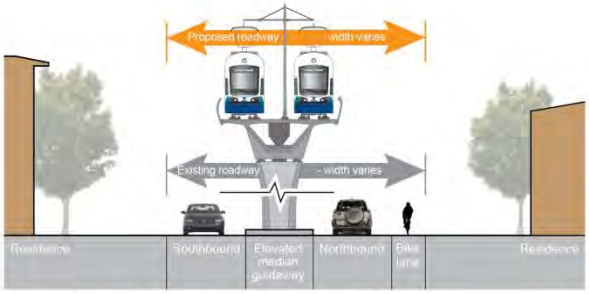
30th Avenue S. Elevated Median

The 30th Avenue S. Elevated Median Alternative would be **elevated in the middle of 30th Avenue S. between S. 224th Street and S. 240th Street.** It would connect to the SR 99 Elevated Median Alternative to the north, and near the intersection of SR 99 and S. 220th Street the guideway would transition east to intersect the 30th Avenue S. corridor, which would be at a higher elevation than SR 99. 30th Avenue S. is currently a two-lane residential street with a shoulder on the southbound side, a bike lane on the northbound side and minimal sidewalks. From S. 224th Street, the guideway would run south in the center of 30th Avenue S. across Kent-Des Moines Road to S. 240th Street, where it could connect to any alternative in the SR 99 or I-5 corridors; for purposes of this analysis, it was assumed to connect to the SR 99 Elevated Median Alternative. Crossings of all streets would be grade-separated.

This alternative would require:

- Complete reconstruction of the roadway
- Continuous barrier in the median, except at signalized intersections, which would prohibit left turns under the guideway
- Long spans at the Kent-Des Moines Road crossing
- Utility relocations (including high-voltage transmission lines)

Because this alternative would operate in an exclusive, grade-separated right-of-way, trains could travel at speeds up to **55 mph.**



Proposed condition looking north (not to scale)

EXHIBIT 4-10
30th Avenue S. Elevated Median

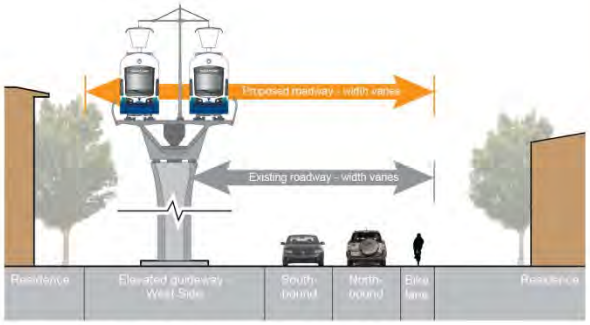
30th Avenue S. Elevated West Side

The 30th Avenue S. Elevated West Side Alternative would be **elevated along the west side of 30th Avenue S. between S. 224th Street and S. 240th Street.** It would connect to the SR 99 Elevated Median Alternative to the north, and near the intersection of SR 99 and S. 220th Street the guideway would transition east to intersect the 30th Avenue S. corridor, which would be at a higher elevation than SR 99. 30th Avenue S. is currently a two-lane residential street with a shoulder on the southbound side, a bike lane on the northbound side and minimal sidewalks. From S. 224th Street, the guideway would run south along the west side of 30th Avenue S. across Kent-Des Moines Road to S. 240th Street, where it could connect to any alternative in the SR 99 or I-5 corridors; for purposes of this analysis, it was assumed to connect to the SR 99 Elevated Median Alternative. Crossings of all streets would be grade-separated.

This alternative would:

- Require complete reconstruction of the roadway
- Require a setback from 30th Avenue S. to permit sight distance for drivers
- Permit turning movements under the guideway
- Require right-of-way acquisition of the west side of the road
- Require long spans at the Kent-Des Moines Road crossing
- Avoid conflict with the east-side high-voltage transmission line

Because this alternative would operate in an exclusive, grade-separated right-of-way, trains could travel at speeds up to **55 mph.**



Proposed condition looking north (not to scale)

EXHIBIT 4-11
30th Avenue S. Elevated West Side

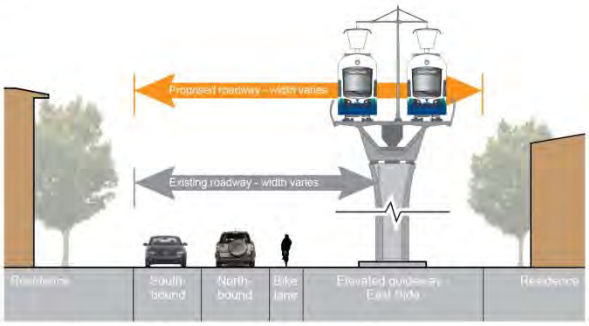
30th Avenue S. Elevated East Side

The 30th Avenue S. Elevated East Side Alternative would be **elevated along the east side of 30th Avenue S. between S. 224th Street and S. 240th Street.** It would connect to the SR 99 Elevated Median Alternative to the north, and near the intersection of SR 99 and S. 220th Street the guideway would transition east to intersect the 30th Avenue S. corridor, which would be at a higher elevation than SR 99. 30th Avenue S. is currently a two-lane residential street with a shoulder on the southbound side, a bike lane on the northbound side and minimal sidewalks. From S. 224th Street, the guideway would run south along the east side of 30th Avenue S. across Kent-Des Moines Road to S. 240th Street, where it could connect to any alternative in the SR 99 or I-5 corridors; for purposes of this analysis, it was assumed to connect to the SR 99 Elevated Median Alternative. Crossings of all streets would be grade-separated.

This alternative would:

- Require complete reconstruction of the roadway
- Permit turning movements under guideway
- Require a setback from 30th Avenue S. to permit sight distance for drivers
- Require long spans at the Kent-Des Moines Road crossing
- Require right-of-way acquisition and utility relocations (including high-voltage transmission lines)

Because this alternative would operate in an exclusive, grade-separated right-of-way, trains could travel at speeds up to **55 mph.**



Proposed condition looking north (not to scale)

EXHIBIT 4-12
30th Avenue S. Elevated East Side

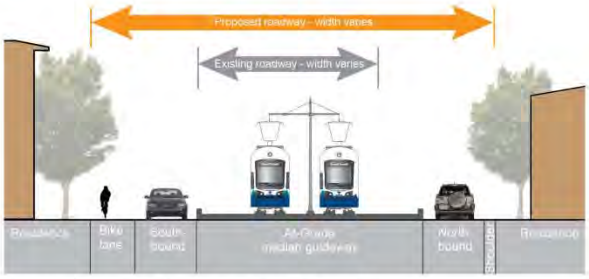
24th Avenue S. At-Grade Median

The 24th Avenue S. At-Grade Median Alternative would be **at-grade in the middle of 24th Avenue S. between approximately S. 208th Street and Kent-Des Moines Road.** 24th Avenue S. is a two-lane minor collector road with a south-bound bike lane between S. 216th Street and Kent-Des Moines Road, and minimal sidewalks. After departing Angle Lake Station, the guideway would continue elevated over S. 204th Street, then turn southwest and begin descending to cross the proposed SR 509 right-of-way and a topographic valley. The guideway would transition to at-grade in the center of 24th Avenue S. near S. 208th Street. Due to the presence of schools, a fire station, and a park west of 24th Avenue S., an at-grade median configuration would require leaving the southbound lane in place and shifting the northbound lane east to accommodate the guideway. Near S. 226th Street, the guideway would transition to elevated and head southeast along Kent-Des Moines Road to return to the SR 99 corridor and connect to the proposed station at S. 240th Street. After this station, the guideway could connect to any alternatives in the SR 99 or I-5 corridors; for purposes of this analysis, it was assumed to connect to the SR 99 Elevated Median Alternative.

This alternative would require:

- Roadway widening on the east side of 24th Avenue S.
- Prohibiting left turns except at signalized intersections
- Utility relocation (including high-voltage transmission lines and possibly a high-pressure gas main)
- Signalized intersections at all locations where vehicular and pedestrian traffic crosses
- Right-of-way acquisition on the east side of the road

At-grade LRT in the median of a street operates at speeds restricted by safety considerations. In the configuration proposed here, the speed limit of **25 mph** on 24th Avenue S. would govern trains as well.



Proposed condition looking north (not to scale)

EXHIBIT 4-13
24th Avenue S. At-Grade Median

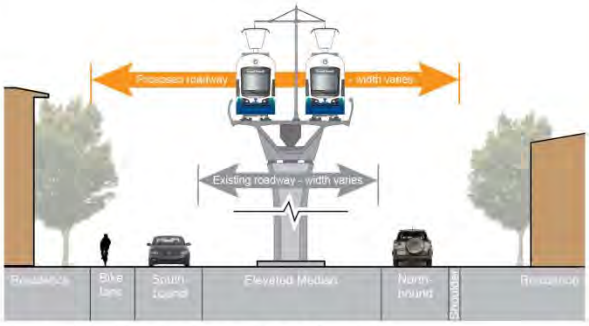
24th Avenue S. Elevated Median

The 24th Avenue S. Elevated Median Alternative would be **elevated in the middle of 24th Avenue S. between approximately S. 208th Street and Kent-Des Moines Road.** 24th Avenue S. is a two-lane minor collector road with a south-bound bike lane between S. 216th Street and Kent-Des Moines Road, and minimal sidewalks. After departing Angle Lake Station, the guideway would continue elevated over S. 204th Street, then turn southwest and begin descending to cross the proposed SR 509 right-of-way and a topographic valley. The guideway would remain elevated and run in the center of 24th Avenue S. beginning near S. 208th Street. Due to the presence of schools, a fire station, and a park west of 24th Avenue S., an elevated median configuration would require leaving the southbound lane in place and shifting the northbound lane east to accommodate the guideway. The guideway would then head southeast along Kent-Des Moines Road to return to the SR 99 corridor and connect to the proposed station at S. 240th Street. After this station, the guideway could connect to any alternatives in the SR 99 or I-5 corridors; for purposes of this analysis, it was assumed to connect to the SR 99 Elevated Median Alternative.

This alternative would require:

- Roadway widening on the east side of 24th Avenue S.
- A continuous barrier in the median, except at signalized intersections
- Prohibiting left turns except at signalized intersections
- Utility relocation (including high-voltage transmission lines and possibly a high-pressure gas main)
- Signalized intersections at all locations where vehicular and pedestrian traffic crosses
- Right-of-way acquisition on the east side of the road

Because this alternative would operate in an exclusive, grade-separated right-of-way, trains could travel at speeds up to **55 mph.**



Proposed condition looking north (not to scale)

EXHIBIT 4-14
24th Avenue S. Elevated Median

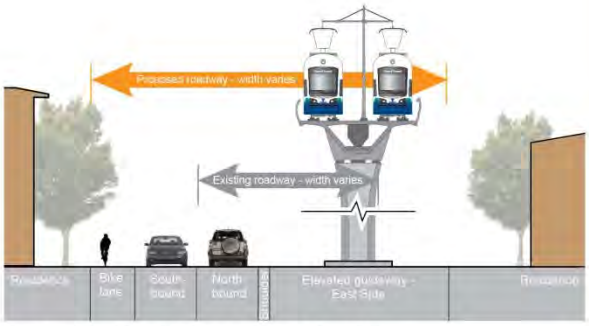
24th Avenue S. Elevated East Side

The 24th Avenue S. Elevated East Side Alternative would be **elevated along the east side of 24th Avenue S. between approximately S. 208th Street and Kent-Des Moines Road.** 24th Avenue S. is a two-lane minor collector road with a south-bound bike lane between S. 216th Street and Kent-Des Moines Road, and minimal sidewalks. After departing Angle Lake Station, the guideway would continue elevated over S. 204th Street, then turn southwest and begin descending to cross the proposed SR 509 right-of-way and a topographic valley. The guideway would remain elevated and run on the east side of 24th Avenue S. beginning near S. 208th Street. Near S. 226th Street, the guideway would transition to elevated and head southeast along Kent-Des Moines Road to return to the SR 99 corridor and connect to the proposed station at S. 240th Street. After this station, the guideway could connect to any alternatives in the SR 99 or I-5 corridors; for purposes of this analysis, it was assumed to connect to the SR 99 Elevated Median Alternative.

This alternative would likely not change the existing 24th Avenue S. roadway configuration, but would require:

- Utility relocation (including high-voltage transmission lines and possibly a high-pressure gas main)
- Right-of-way acquisition on the east side of the road
- A setback from 24th Avenue S. to permit sight distance for drivers
- Long spans at most intersections

Because this alternative would operate in an exclusive, grade-separated right-of-way, trains could travel at speeds up to **55 mph.**



Proposed condition looking north (not to scale)

EXHIBIT 4-15
24th Avenue S. Elevated East Side

5.0 Evaluation Criteria

The criteria used to evaluate the Level 1 alternatives originated from objectives derived from the project's Purpose and Need, described in Section 3.2. These objectives are:

- Objective 1: Provide an effective transportation solution to meet mobility needs
- Objective 2: Support equitable mobility
- Objective 3: Serve supportive land use plans and economic development objectives
- Objective 4: Preserve a healthy environment
- Objective 5: Design an affordable and constructible project

Table 5-1 shows the evaluation criteria established for Level 1 and the objectives with which they correspond. Each criterion has one or more quantitative or qualitative measures that are described in this chapter. These criteria and measures are intended to provide meaningful measures that differentiate between alternatives in terms of project performance and potential impacts.

TABLE 5-1
Evaluation Criteria

Purpose and Need Objective	Evaluation Criteria
Provide an Effective Transportation Solution to Meet Mobility Needs	Ridership potential
	Connections to regional multimodal transportation systems
Support Equitable Mobility	Transit dependent population
Support Land Use Plans and Economic Development	Transit supportive land use and economic development policies
Preserve a Healthy Environment	Effect on natural environment
	Effect on built environment
Design an Affordable and Constructible Project	Design Considerations
	System costs

Table 5-2 presents the complete set of evaluation criteria that were used to review the Level 1 alternatives.

TABLE 5-2
Level 1 Evaluation Criteria and Measures

Evaluation Criteria	Measures
Objective: Provide Effective Transportation Solution to Meet Mobility Need	
Ridership potential	• 2035 daily project riders • Travel time in study area
Connections to regional multimodal transportation systems	• Transit integration with Link system • Transit integration with facilities in the study area
Objective: Support Equitable Mobility	
Transit-dependent population	• Low-income population within ½ mile of station • Elderly population (age 65 or older) within ½ mile of station • Youth population (age 16 or younger) within ½ mile of station • 0-car households within ½ mile of stations
Objective: Support Land Use Plans and Economic Development	
Transit-supportive land use and economic development policies	• How well an alternative provides enhanced mobility to existing or planned high-density land use centers
Objective: Preserve a Healthy Environment	
Effect on natural environment	• Impacts on wetlands • Potential to affect stream crossings
Effect on built environment	• Visual aesthetic impacts of alternative • Potential property acquisition • Impacts to known parks • Number of community facilities affected • Impacts on known or eligible historic or other sensitive properties • Number of potentially impacted noise receptors • Level of Service (LOS) at intersections; evaluation of capacity/flow (existing conditions) • Traffic circulation and access; number of mid-block opportunities
Objective: Design an Affordable and Constructible Project	
Design Considerations	• Potential utility effects • High-risk hazardous materials • Geologic hazards • Park-and-Ride lot locations
System Costs	• Estimated capital cost ($2013) • *Estimated annual operations and maintenance cost ($2013) not included for Level 1. Will be in Level 2.*

5.1 Provide Transportation Solution to Meet Mobility Need

This objective has two criteria: the ridership potential of an alternative and how an alternative improves connections to regional multimodal transportation systems.

Ridership Potential

This criterion is intended to illustrate the projected ridership potential based on two measures: forecasted daily ridership in 2035 and travel time within the corridor for each alternative.

TABLE 5-3
Ridership Potential Measures

Concept Evaluation Measure	Methodology
2035 daily project riders	Using ST forecasting model and general station area assumptions, 2035 forecasted daily ridership was produced. This criterion also qualitatively addresses how well each alternative serves forecasted ridership. Unit of measure: Average daily riders.
Travel time in study area	Travel time in the study area was calculated based on the alternative distance and speed. Speeds were selected based on the alternative profile and intersection delay and station dwell times were factored in, where appropriate. Unit of measure: One way travel time between S. 320th Street and S. 200th Street.

Connections to Regional Multimodal Transportation Systems

This criterion addresses the connectivity of each alternative to the rest of the regional transit system and to facilities within the study area.

TABLE 5-4
Connections to Regional Multimodal Transportation Systems Measures

Concept Evaluation Measure	Methodology
Transit integration with Link system	How the FWTE project affects the current and planned Link system was assessed qualitatively as well as by the potential for delays related to traffic signals. Key considerations were schedule adherence, fleet management and potential extensions beyond the FWTE project. Unit of measure: Number of traffic signals traversed.
Transit integration with facilities in study area	How the FWTE alternatives would affect existing transit services (such as RapidRide) and facilities (such as park and ride lots), as well as the connection between bus and rail was assessed qualitatively. Unit of measure: Qualitative assessment.

5.2 Support Equitable Mobility

This objective has one criterion, which is how well an alternative improves transit access to transit dependent populations.

Transit Dependent Population

This criterion assesses whether or not a corridor improves accessibility to regional destinations for transit-dependent residents, such as low-income, elderly, youth, and households without access to a vehicle.

TABLE 5-5
Transit Dependent Population Measures

Concept Evaluation Measure	Methodology
Low-income population within 1/2 mile of station	2010 Census data was used to create maps of low-income populations with block level Census data. General station areas were assumed; will be refined to specific locations in Level 2. Unit of measure: 2010 Census population estimate of low-income population within ½ mile of station access areas.
Elderly population (age 65 or older) within ½ mile of station	2010 Census data was used to create maps of elderly populations with block level Census data. General station areas were assumed; refined to specific locations in Level 2 Unit of measure: 2010 Census population estimate of elderly population within ½ mile of station access areas.
Youth population (age 16 or younger) within ½ mile of station	2010 Census data was used to create maps of youth populations with block level Census data. General station areas were assumed; refined to specific locations in Level 2. Unit of measure: 2010 Census population estimate of youth population within ½ mile of station access areas.
0-car households within ½ mile of stations	2010 Census data was used to create maps of zero-car households with block level Census data. General station areas were assumed; refined to specific locations in Level 2. Unit of measure: 2010 Census population estimate of 0-car households within ½ mile of station access areas.

5.3 Support Land Use Plans and Economic Development

This objective has one criterion, which is the extent to which an alternative would be consistent with local transit supportive plans.

Transit Supportive Land Use and Economic Development Policies

The intent of this measure is to evaluate the extent to which the alternatives are consistent with and support local plans to create more compact, livable, and sustainable communities with transit in mind. Local comprehensive, transportation, and sub-area plans for the cities of SeaTac, Des Moines, Kent, and Federal Way were reviewed to identify where cities have

identified potential light rail or high capacity transit alignments and have designated areas for transit-oriented development opportunities.

TABLE 5-6
Transit Supportive Land Use and Economic Development Measures

Concept Evaluation Measure	Methodology
How well an alternative provides enhanced mobility to existing or planned high-densityhigh-density land use centers	This criterion evaluated existing zoning that was either high-density residential, transit oriented development, or allowed mixed use. Zoning data was obtained from the cities of SeaTac, Des Moines, Kent and Federal Way. Units of measure: • Total acreage of high-density/mixed use zoning within ¼ mile of alignment • Total percent of available land that is zoned high-density/mixed use within ¼ mile of alignment • Total acreage of high-density/mixed use zoning within ½ mile of station area • Total percent of available land that is zoned high-density/mixed use within ½ mile of station area

5.4 Preserve a Healthy Environment

This objective has two criteria: (1) the extent to which an alternative affects the natural environment, and (2) the extent to which it affects the built environment.

Effect on Natural Environment

This criterion addresses the potential to minimize and mitigate impacts to the natural environment. The FWTE corridor is highly developed, so natural resources are generally limited to wetlands and stream crossings. Due to the regulatory permitting requirements associated with impacts to wetlands and stream crossings, any impacts to these resources would need to be minimized or avoided to the extent possible.

TABLE 5-7
Effect on Natural Environment Measures

Concept Evaluation Measure	Methodology
Impacts on wetlands	Wetlands or waters of the U.S. within 100 feet of the alternative centerline were identified; because there is potential these could be permanently affected. Wetland data was obtained from King County and the U.S. Fish and Wildlife Service National Wetlands Inventory (NWI). Unit of measure: Acreage of wetlands within 100 feet of alternative centerline.
Potential to affect stream crossings	The number of streams that an alternative would cross was identified using available mapping of streams. It is likely that any alternative that reconstructs a roadway would affect these crossings. Data on streams was obtained from King County. Unit of measure: Number of stream crossings for each alternative.

Effect on Built Environment

Level 1 evaluates the effects on the built environment by the alternatives' potential to affect the cohesion of the neighborhood and/or community resources. Division of communities through building a transportation improvement through a neighborhood has the potential to sever residential areas and negatively affect the quality of life for residents in that neighborhood. Other measures include potential impacts to residential and commercial property, parks, visual aesthetics, community facilities, eligible historic properties, noise receptors, traffic flow, intersection capacity, and level of service.

TABLE 5-8
Effect on Built Environment Measures

Concept Evaluation Measure	Methodology
Visual/aesthetic impacts of alternative	An analysis was conducted based on the linear length of elevated guideway where residential properties front the guideway. Unit of measure: Linear length of elevated guideway where residential properties front the guideway for each alternative.
Potential property acquisition	Analysis of residential and commercial properties within 100 feet of the alternative's centerline. It is assumed that property within this distance could have property acquired and would potentially have residences or businesses displaced. Displacements, however, are not estimated at this level of screening. Unit of measure: Number of residential and commercial properties within 100 feet of the centerline.
Impacts to known parks	Direct impacts to parks, which would include acquisition of park property, were measured by determining the area of parkland within 50 feet of the centerline. Indirect impacts, such as noise and visual impacts could occur to parks within 200 feet of the centerline of each alternative. Unit of measure: *Direct impacts*: Acreage of park within 50 feet of an alternative's centerline; *Indirect impacts*: Acreage of park within 200 feet of an alternative's centerline.
Number of community facilities affected	An analysis of potentially affected community facilities located within 200 feet of the centerline of each alternative. For Level 1, community facilities included schools, libraries and churches. Data for these facilities was obtained by the King County Assessor property use information. Unit of measure: *Direct*: Number of community facilities within 100 feet of an alternative; *Indirect:* Number of community facilities within 200 feet of an alternative's centerline.
Impacts on known or eligible historic or other sensitive properties	A record search of property listed on the National Register of Historic Places (NRHP) and those eligible for listing on the NRHP was completed. Unit of measure: Number of NRHP eligible properties within 100 feet of the alternative's centerline.
Number of potentially impacted noise receptors	Using Federal Transit Administration screening guidance, Category II (residential properties and hotels) and Category III (schools and churches) noise receivers within 350 feet of each alternative were identified. The number of receivers within 350 feet of the alternative centerline was determined for buildings with an unobstructed view of the alternative and up to 175 feet for buildings with shielding from the study area. Potential noise sensitive receivers were identified using aerial base maps, with information verified using King County Assessor data and Google Earth. Unit of measure: Category II and III noise sensitive receivers potentially affected by the project.

Level of Service (LOS) at intersections; evaluation of capacity/flow (existing conditions)	Intersections within each alignment (at-grade only) that are currently operating at LOS F were identified. These intersections could worsen if affected by light rail operations. Local jurisdiction (SeaTac, Des Moines, Kent, and Federal Way) documents were used as the data source for this information. Unit of measure: Number of intersections within alignment currently operating at LOS E or F.
Traffic circulation and access; number of mid-block opportunities	Identify the number of locations where turns would be restricted. This would be at un-signalized intersections, mid-block u-turns or median two-way left-turn lane areas that would be removed. It is assumed that these turn movements across the track would not remain unless protected (gates or signal). Unit of measure: Number of restricted turns at un-signalized intersections; number of restricted turns at mid-block u-turns; number of restricted turns at median two-way left turn areas.

5.5 Design an Affordable and Constructible Project

This objective measures the degree to which physical and engineering constraints and system costs would affect the ability to design an affordable and constructible project.

Design Considerations

Similar to the consideration of wetlands and water bodies, there are a number of important engineering considerations during Level 1 that help inform the alternatives' future design to be carried into Level 2, including potential for utility relocations, encountering hazardous materials and geologic hazards, and park-and-ride lot locations that would provide access to future access areas.

TABLE 5-9
Design Consideration Measures

Concept Evaluation Measure	Methodology
Potential utility effects	Readily available major utility lines were reviewed (water, sanitary sewer, and gas and oil main lines) to determine the potential risk and level of impact within the vicinity of the alignments. Data was obtained from local jurisdictions and utility companies. Unit of measure: qualitative assessment of potential for utility relocations and conflicts.
High-risk hazardous materials	Data from Environmental Data Resource (EDR), a database research company, was reviewed for potential high-risk hazardous materials sites that could affect construction. Unit of measure: Location and number of high-risk hazardous materials site within a ¼ mile of alternative centerline.
Geologic hazards	A qualitative geologic risks assessment included reviewing steep slopes, seismic ground shaking, liquefiable soils, fault crossings, and erosion potential from King County Geologic Hazards maps, U.S. Department of Agriculture soils maps, and surface geology. Unit of measure: qualitative assessment.
Park-and-Ride Lot Locations	An assessment of existing park-and-ride lot locations and the existing number of parking spaces at each location. Unit of measure: number of existing lots and parking spaces

System Costs

These evaluation measures capture the estimated capital costs to build, operate, and maintain the project alternatives.

TABLE 5-10
System Cost Measures

Concept Evaluation Measure	Methodology
Estimated capital cost ($2013)	Using unit cost data from recent projects including Lynnwood Link, a range of capital cost estimates was determined for alternatives in current year dollars. Unit of measure: Range of capital costs for alternatives as well as on a per mile basis ($2013).
Estimated annual operations and maintenance cost ($2013)	Not included in Level 1 Alternatives Screening. Will be evaluated in Level 2 Alternatives Screening.

6.0 Level 1 Data Results

The Level 1 alternatives were evaluated based on the project objectives outlined in Chapter 5. All criteria and associated measures that were used to evaluate alternatives were derived from the project objectives and have a basis in the project's purpose and need, as discussed in Section 5.1. Data collected for each evaluation criteria and measure respond to a need to understand both the alternative as whole as well as smaller segments within an alternative. Alternatives were defined in Chapter 4. Some data for some evaluation criteria are presented at the segment level and others are presented at the alternative level, depending on the type of measure and appropriate evaluation logic. **Table 6-1** provides a summary of the level of data collection and analysis associated with each evaluation criteria and measure.

TABLE 6-1
Level of Data Collection by Evaluation Criteria and Measure

Criteria	Measure	Level of Data Collection / Analysis	
		Segment	Alternative
Ridership Potential	2035 Daily Project Riders		✓
	Travel Time in Study Area		✓
Connections to Regional Multimodal Transportation System	Transit Integration with Link LRT System	✓	✓
	Transit Integration with Other Transit Facilities	✓	✓
Transit Dependent Population	Low-Income Population	✓	✓
	Elderly Population	✓	✓
	Youth Population	✓	✓
	0-Car Households	✓	✓
Transit Supportive Land Use and Economic Development Policies	Acres of TOD/high-density zoned land within ¼ mile of alignment		✓
	Acres of TOD/high-density zoned land within ½ mile of access areas	✓	
	% available land zoned TOD/high-density within ¼ mile of alignment		✓
	% available land zoned TOD/high-density within ½ mile of access areas	✓	
Effect on Natural Environment	Effects on Wetlands	✓	✓
	Potential to Affect Stream Crossings	✓	✓
Effect on Built Environment	Visual / Aesthetic Effects	✓	✓
	Potential Property Acquisition	✓	✓
	Effects to Known Parks	✓	✓
	Number of Community Facilities Affected	✓	✓
	Effects to Historic or Sensitive Properties	✓	
	Number of Potentially Affected Noise Receptors	✓	
	LOS at Intersections	✓	
	Traffic Circulation	✓	
Physical and Engineering	Utility Relocation		✓
	High Risk Hazardous Materials	✓	✓
	Geologic Hazards	✓	
	Park-and-Ride Lot Locations		✓
System Costs	Estimated Capital Costs		✓
	Estimated Annual O&M Costs		✓

6.1. Ridership Potential

6.1.1 2035 Daily Projected Riders

Methodology

Year 2035 daily project-wide riders were forecasted for the project alternatives. Ridership estimates were only prepared for the full-length alternatives to understand the potential project-wide benefits. All of the full-length alternatives included three light rail transit (LRT) stations: Kent-Des Moines Road/S. 240th Street, S. 272nd Street corridor, and FWTC. Ridership at a segment (i.e., station) level will be prepared in Level 2 screening. Key considerations for the Level 1 ridership forecasts are station and profile assumptions. Alternatives that have a similar profile (e.g., elevated) and are located on the same roadway (whether side or median) are assumed to produce a similar ridership forecast for the Level 1 screening. Therefore, separate ridership numbers are not provided for each individual alternative described in Chapter 4.

The 24th Avenue S. and 30th Avenue S. alternatives were connected to another alternative (SR 99 Elevated Median) so a project-wide ridership forecast for these alternatives could be produced. The Level 1 ridership forecasts are based on interim year 2035 land use forecast and a conceptual bus network that would support LRT to the FWTC.

Key Results

- The travel demand forecasts indicate a year 2035 project-wide ridership range from 19,000 to 24,000 daily riders. The highest potential daily project-wide ridership is approximately 24,000 for the elevated alternatives, primarily due to faster LRT speeds and shorter travel times.

Discussion of Results

By profile, the daily ridership ranges from 19,000 for an at-grade profile to 24,000 for an elevated profile within the same alignment. This is as much as a 5,000 increase in daily riders (about 25 percent) with an elevated profile compared to an at-grade profile. An alternative with a mixed profile (both at-grade and elevated) would be likely to have a ridership forecast between these two estimates.

These ridership effects due to the alignment profile also apply to the 30th Avenue S. and 24th Avenue S. alternatives. Both of the I-5 alternatives would produce a similar forecast of up to 23,000 to 24,000 daily riders. A summary of the daily ridership estimates for Level 1 alternatives is provided **Exhibit 6-1** and in **Table 6-2** following the discussion of travel time. The table also contains annualized ridership estimates.

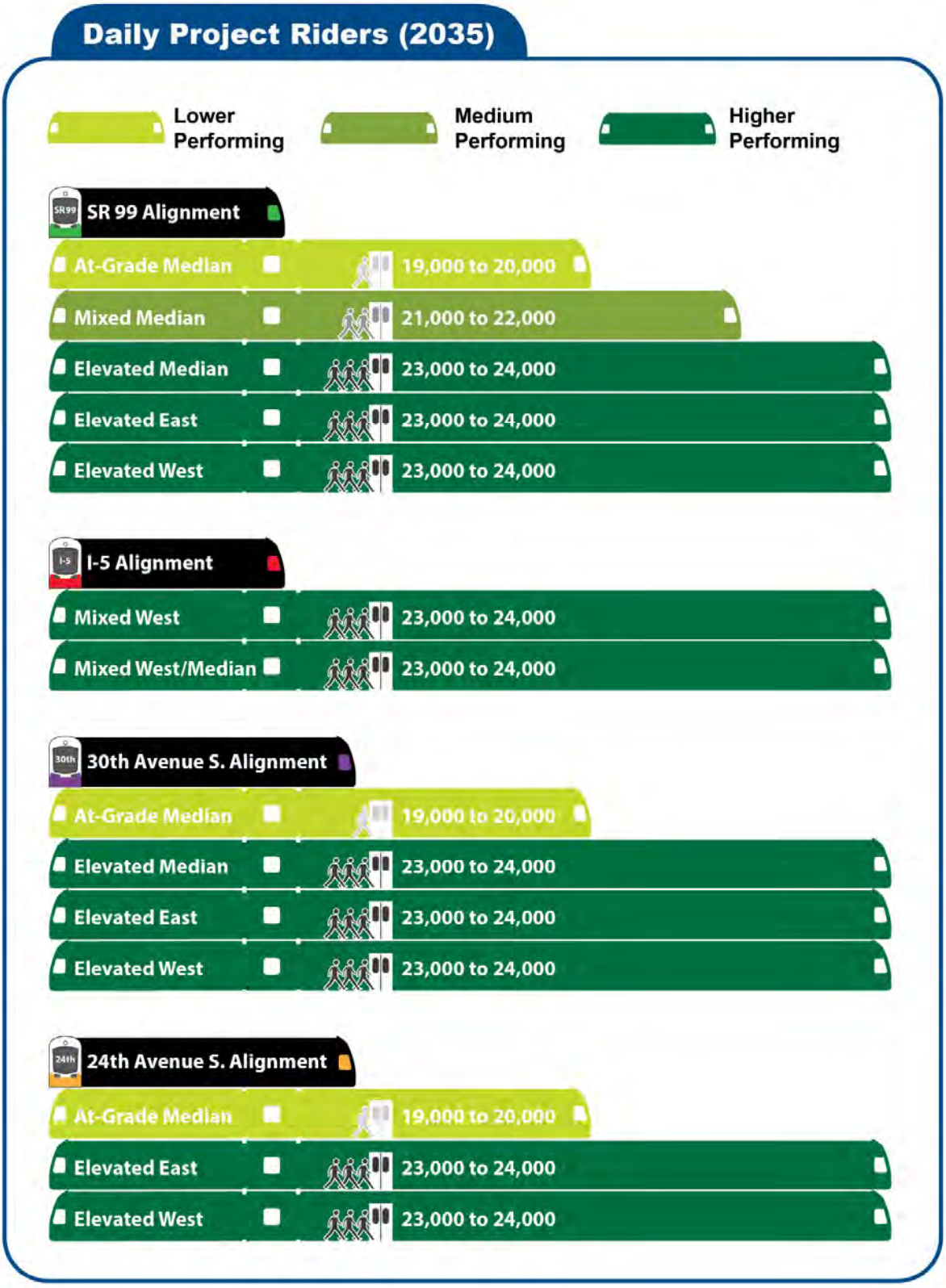


EXHIBIT 6-1
2035 Daily Projected Transit Riders by Alternative

6.1.2 Travel Time in Study Area

Methodology

Estimated travel times represent the time for a light rail vehicle to travel the full length of the FWTE study area between the Angle Lake Station and the Federal Way Transit Center. Travel times for any given segment can be affected by multiple variables including the alignment curvature, transitions between adjacent segments, station locations, and the effects of traffic signals, if applicable, in the case of at-grade operation. Therefore, travel times were estimated for full-length alternatives rather than individual alternative segment.

Key Results

- Travel times in the corridor range from 14 to 22 minutes.
- All of the faster alternatives have fully exclusive guideway.

Discussion of Results

The estimated travel times presented in **Table 6-2** and **Exhibit 6-2** indicate that at-grade alternatives that operate within the roadway right-of-way would result in longer travel times than grade-separated alternatives (elevated or mixed profile). The alternatives that would be fully grade separated from the roadway (i.e., elevated or along I-5) are the fastest alternatives with an estimated end-to-end travel time of between 14 to 15 minutes. This includes the SR 99 Elevated, I-5 Mixed, 30th Avenue S. and 24th Avenue S. alternatives. With a 20 to 22 minute travel time, the three at-grade alternatives (24th Avenue S., SR 99, and the 30th Avenue S.) would be 50 percent slower than the faster alternatives. The SR 99 Mixed alternative would have a travel time of approximately 18 minutes.

TABLE 6-2
Alternative Travel Times and Ridership Projections

Light Rail Alternative	Travel Time (minutes)	2035 Daily Riders	2035 Annual Riders
SR 99			
At-Grade Median	20-21	19,000 – 20,000	6.1 million to 6.4 million
Mixed Median	18	21,000 – 22,000	6.7 million to 7.0 million
Elevated (Any)	14-15	23,000 – 24,000	7.4 million to 7.7 million
I-5			
Mixed West (Either)	14	23,000 – 24,000	7.4 million to 7.7 million
30th Avenue S.			
At-Grade Median	21	19,000 – 20,000	6.1 million to 6.4 million
Elevated (Either)	15	23,000 – 24,000	7.4 million to 7.7 million
24th Avenue S.			
At-Grade Median	22	19,000 – 20,000	6.1 million to 6.4 million
Elevated (Either)	15	23,000 – 24,000	7.4 million to 7.7 million

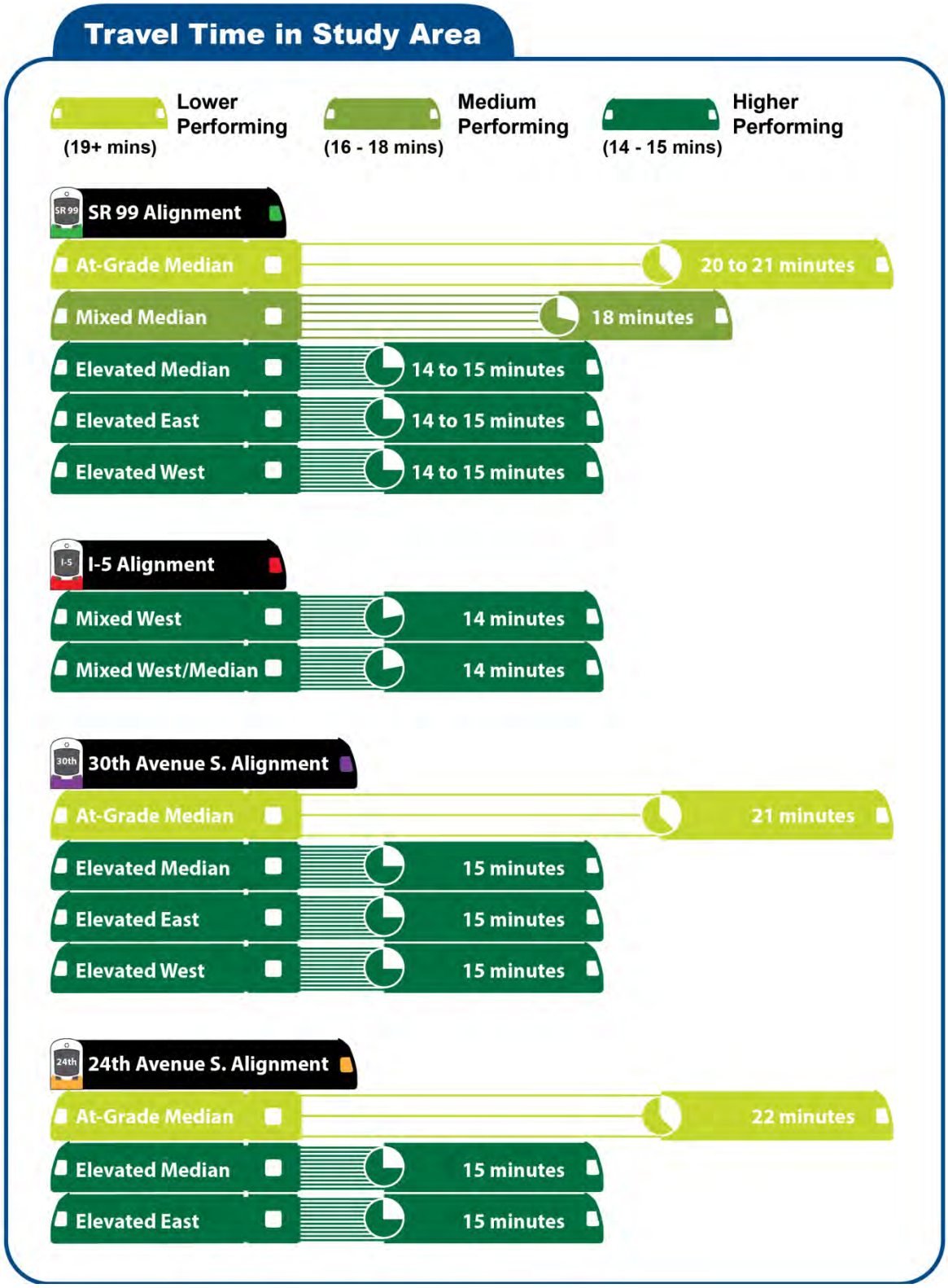


EXHIBIT 6-2

2035 Transit Peak-Period, Peak Direction Travel Times (minutes) from Angle Lake Station to Federal Way Transit Center

6.2. Transit Integration

6.2.1 Transit Integration with Link System

Methodology

Transit integration with the ST Link light rail system was evaluated based on the potential for delays that the Level 1 alternatives could experience due to the alignment interfacing with roadway traffic at signals. While the Level 1 alternatives are expected to have some form of transit priority treatment at the signalized intersections, its effectiveness in improving reliability could vary due to uncertainties in signal phasing, coordination, and traffic congestion. Therefore, the number of signalized intersections that each alternative would traverse through provides an indication of the likelihood for potential system-wide effects to Link operations and reliability.

Key Results

- By avoiding at-grade operations, elevated alternatives are expected to maintain schedule headways; therefore, they are not expected to affect system-wide Link operations and reliability.
- At-grade and mixed alternatives would traverse at-grade through traffic signals, introducing potential delays to scheduled headways and therefore affecting system-wide Link operations and reliability.

Discussion of Results

All of the elevated alternatives do not interface with roadway operations and avoid existing traffic signals. These alternatives are expected to have the greatest ability to maintain scheduled service headways and would therefore have the lowest potential to affect system-wide Link operations compared to the other Level 1 alternatives. In contrast, all at-grade alternatives could experience unpredictable delays within the corridor as each would traverse through multiple traffic signals. Therefore, it could be difficult to maintain vehicle progression through the corridor, which would affect scheduled headways and potentially affect system-wide Link operations and reliability, especially at the International District Station merge with East Link.

Among Level 1 alternatives, the SR 99 At-Grade Median and SR 99 Mixed Median alternatives have the highest number of existing traffic signals that the alignment would traverse through at-grade. With any segment, the highest number of traffic signals (ten) that an alternative traverses through at-grade is associated with the SR 99 At-Grade Median alternative between S. 280th Street and S. 320th Street (Segment C). **Table 6-3** summarizes by alternative the number of traffic signals traversed. **Table 6-4** summarizes the number of traffic signals traversed by segment.

TABLE 6-3
Existing Traffic Signals Traversed by Alternative

Alternative	Traffic Signals Traversed
SR 99	
At-Grade Median	27
Mixed Median	23
Elevated Median	0
Elevated East Side	0
Elevated West Side	0
I-5	
Elevated Mixed West Side	0
Elevated Mixed West Side/Median	0
30th Avenue – SR 99	
At-Grade Median	23
Elevated Median	0
Elevated East Side	0
Elevated West Side	0
24th Avenue	
At-Grade Median	23
Elevated Median	0
Elevated East Side	0

TABLE 6-4
Existing Traffic Signals Traversed by Alternative/Segment

Segment	Description	Alternative	Traffic Signals Traversed
A	Angle Lake Station to S. 220th Street	SR 99 At-Grade Median	3
		SR 99 Mixed Median	2
		SR 99 Elevated Median	0
		SR 99 Elevated East Side	0
		SR 99 Elevated West Side	0
		I-5 Mixed West Side	0
		I-5 Mixed West Side/Median	0
		24th Avenue S. At-Grade Median	2
		24th Avenue S. Elevated Median	0
		24th Avenue S. Elevated East Side	0
B	S. 220th Street to S. 244th Street	SR 99 At-Grade Median	7
		SR 99 Mixed Median	6
		SR 99 Elevated Median	0
		SR 99 Elevated East Side	0
		SR 99 Elevated West Side	0
		I-5 Mixed West Side	0
		I-5 Mixed West Side/Median	0
		30th Avenue S. At-Grade Median	2
		30th Avenue S. Elevated Median	0
		30th Avenue S. Elevated East Side	0
		30th Avenue S. Elevated West Side	0
		24th Avenue S. At-Grade Median	3
		24th Avenue S. Elevated Median	0
		24th Avenue S. Elevated East Side	0
C	S. 244th Street to S. 280th Street	SR 99 At-Grade Median	7
		SR 99 Mixed Median	6
		SR 99 Elevated Median	0
		SR 99 Elevated East Side	0
		SR 99 Elevated West Side	0
		I-5 Mixed West Side	0
		I-5 Mixed West Side/Median	0
D	S. 280th Street to S. 320th Street	SR 99 At-Grade Median	10
		SR 99 Mixed Median	9
		SR 99 Elevated Median	0
		SR 99 Elevated East Side	0
		SR 99 Elevated West Side	0
		I-5 Mixed West Side	0
		I-5 Mixed West Side/Median	0

6.2.2 Transit Integration with Facilities in Study Area

Methodology

Transit integration with facilities in the study area is a qualitative assessment of the interface between the FWTE Level 1 alternatives to existing transit services, such as King County's RapidRide A Line and Sound Transit's express routes, and transit facilities such as park-and-ride (P&R) lots. Potential effects to existing transit services and opportunities to connect to existing transit facilities by segment are documented in this section. **Exhibit 6-3** illustrates the existing transit services and transit passenger facilities in the study area.

Key Results

- Elevated alternatives and the I-5 alternatives would not likely affect the operations of other transit services.
- At-grade and mixed alternatives on SR 99 would receive transit signal priority that could affect existing RapidRide A Line performance.
- SR 99 would likely be better integrated to the transit hubs along SR 99, such as Highline Community College (HCC), but would not connect as well as the I-5 alternatives would to the regional transit facilities, such as Star Lake P&R, along I-5.

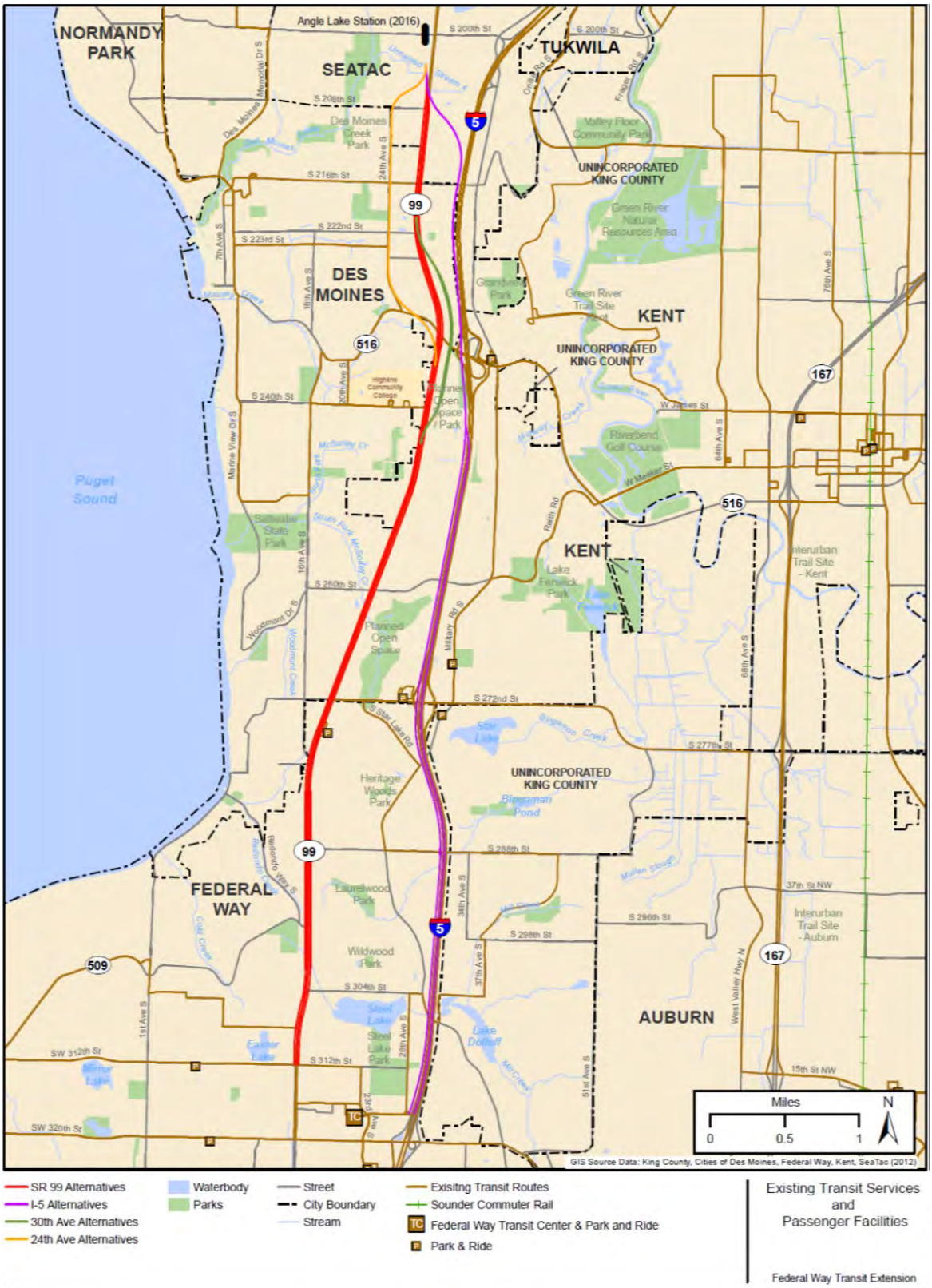


EXHIBIT 6-3
Existing Transit Services and Transit Passenger Facilities in the Study Area

Discussion of Results

One of the considerations for the Level 1 alternatives is how they interface with other transit services in the study area and specifically the potential to interrupt or conflict with the existing RapidRide A Line transit signal priority (TSP). Similar to the "Transit Integration with Link System" evaluation measure, the number of traffic signals traversed provides an indication of the potential level of conflict that may exist between Level 1 alternatives and King County Metro's (KCM) TSP system. Alternatives that traverse along SR 99 in either an at-grade or mixed profile would potentially affect RapidRide A Line's TSP system. This includes the SR 99 At-Grade Median and SR 99 Mixed Median alternatives, but also potentially the at-grade alternatives along 24th Avenue S. and 10th Avenue S. if they transition with SR 99. This potential conflict may affect the overall net travel speed and schedule adherence of the RapidRide A Line. None of the elevated alternatives along SR 99, I-5, 30th Avenue S., and 24th Avenue S. would be likely to affect the operations of other transit services.

Integration opportunities with other transit services in the study area are summarized by segment as follows:

Segment A (Angle Lake Station-S. 220th Street)

All alternatives along SR 99 would have minimal integration with current transit service, as there is no planned station in this segment. Both of the I-5 alternatives in this segment would be separated from the roadway system as they generally follow the planned SR 509 right-of-way; therefore, integration with current transit services for these two alternatives would be minimal.

There is only one local bus route (KCM 156) along 24th Avenue S. in this segment; therefore minimal affects to transit service are expected with any of the three 24th Avenue S. alternatives. There would also be limited integration of the 24th Avenue S. alternatives to other transit facilities as there is no station associated with these alternatives. There are no existing P&Rs in this segment that would be affected by any of the alternatives in Segment A.

Segment B (S. 220th Street-S. 244th Street)

All alternatives along SR 99 provide an opportunity to construct an LRT station near HCC that would be directly connected to existing regional and local multi-directional bus services. HCC is currently served by five KCM routes, including RapidRide A Line.

It is not likely that the operations of other transit services would be affected by either of the I-5 alternatives. These alternatives are farther from existing transit service along SR 99 (and at HCC) than the other alternatives in this segment; however, these alternatives are closer to the Kent/Des Moines P&R. Currently, seven KCM routes and one Sound Transit express route serve the Kent/Des Moines P&R lot, but the I-5/SR 516 interchange is a substantial barrier, making this potential connection difficult for transit riders.

Transit service is not currently provided along 30th Avenue S.; therefore, none of the 30th Avenue S. alternatives would affect other transit services. An LRT station is being considered near 30th Avenue S., south of SR 516. This would require existing transit routes to be restructured to serve this street.

There are only two bus routes (KCM 156 and KCM 122) along 24th Avenue S., therefore minimal effects to transit service are expected. As with the SR 99 alternatives there would be an opportunity to construct a LRT station near HCC with any of the SR 99 and 24th Avenue S. alternatives. A station at or near HCC could provide direct connections to existing regional and local multi-directional bus services.

Segment C (S. 244th Street-S. 280th Street)

The opportunity to integrate with the majority of existing transit services in this segment is associated with the I-5 alternatives. The I-5 alternatives could connect with Star Lake P&R, which is currently served by seven KCM routes and one ST express route. SR 99 alternatives could connect with the Redondo Heights P&R; however this facility is only served by two KCM routes and RapidRide A Line. The relative difference in transit service at these two park-and-ride lots is also one of the likely indicators of the lots' usage. Redondo Heights P&R has a noticeably lower utilization rate (less than 10% full) than Star Lake P&R (close to 60% full).

Segment D (S. 280th Street-S. 320th Street)

Both the SR 99 and I-5 alternatives would terminate at or near the FWTC, providing a connection to a regional transit center. Although the two I-5 alternatives have the potential to be located closer to the Federal Way P&R (south of S. 320th Street) than the SR 99 alternatives in this segment.

Table 6-5 summarizes the transit integration opportunities with other transit services and facilities within the study area.

TABLE 6-5
Transit Integration with Other Transit Services and Facilities

Alternative	Transit Integration Summary
SR 99 At-Grade	Likely to affect RapidRide A Line and other transit service's performance; alignment near existing transit hub (HCC)
SR 99 Mixed Median	Some effects to RapidRide A Line and other transit service's performance; alignment near existing transit hub (HCC)
SR 99 Elevated Median	Elevated profile would have minimal effects on other transit services; alignment near existing transit hub (HCC)
SR 99 Elevated East Side	Elevated profile would have minimal effects on other transit services; alignment near existing transit hub (HCC)
SR 99 Elevated West Side	Elevated profile would have minimal effects on other transit services; alignment near existing transit hub (HCC)
I-5 Elevated Mixed West Side	Grade separated profile would have minimal effects on other transit services; near existing regional transit facility (Star Lake P&R)
I-5 Elevated Mixed West Side/Median	Grade separated profile would have minimal effects on other transit services; near existing regional transit facility (Star Lake P&R), potential for I-5 flyer stops
30th Avenue S. At-Grade Median	With a transition to SR 99 at-grade, there would likely be effects to RapidRide A Line and other transit service's performance; alignment is near existing transit hub (HCC)
30th Avenue S. Elevated Median	Elevated profile would have minimal effects on other transit services; if transition to SR 99 the alignment is near an existing transit hub (HCC), if transition to I-5 the alignment is near a regional transit facility (Star Lake P&R)
30th Avenue S. Elevated East Side	Elevated profile would have minimal effects on other transit services; if transition to SR 99 the alignment is near an existing transit hub (HCC), if transition to I-5 the alignment is near a regional transit facility (Star Lake P&R)
30th Avenue S. Elevated West Side	Elevated profile would have minimal effects on other transit services; if transition to SR 99 the alignment is near an existing transit hub (HCC), if transition to I-5 the alignment is near a regional transit facility (Star Lake P&R)
24th Avenue S. At-Grade Median	With a transition to SR 99 at-grade, there would likely be effects to RapidRide A Line and other transit service's performance; alignment is near existing transit hub (HCC)
24th Avenue S. Elevated Median	Elevated profile would have minimal effects on other transit services; with a transition to SR 99 the alignment is near an existing transit hub (HCC).
24th Avenue S. Elevated East Side	Likely to affect RapidRide and other transit service's performance; alignment near existing transit hub (HCC)

6.3. Transit Dependent Populations

6.3.1 Low-Income Population within ½ Mile of Station, Elderly Population (age 65 or older) within ½ Mile of Station, Youth Population (age 16 or younger) within ½ Mile of Station, and 0-Car Households within ½ Mile of Station

Methodology

A number of measures were used to evaluate each alternative's ability to provide equitable service to transit dependent populations. Data and estimates were extracted from the 2010 Census as well as the 2011 American Community Survey (ACS) on specific measures within ½ mile of access areas along each alternative. Access areas are defined as places along each alternative where there are significant activity and/or population centers. The available census unit of measure includes data for areas outside of the ½ mile access area; therefore, actual results may be higher or lower than reported.

Key Results

- Due to the close geographic proximity of the alternatives, the US Census data do not indicate a strong differentiation among the alternatives. However, the SR 99 alternatives do have approximately 900 more people (estimated total population, not just transit-dependent population) within the access area than the I-5 alternatives.

Discussion of Results

These data are compared to the same statistics for the total of the surrounding four-city area comprised of SeaTac, Kent, Des Moines, and Federal Way. The alternatives exhibit similar values for each measure. Due to their proximity to one another, the alternatives show only modest differences. However, due to the greater number of activity centers and residential areas directly adjacent to the alternative, SR 99 serves the greatest overall population as well as slightly higher numbers for low-income populations. The 24th Avenue S. alternatives include areas with less density of both residential and commercial development and are therefore the lowest in terms of both overall and transit dependent populations served. However, these alternatives are still higher than the overall four-city study area. The 30th Avenue S. alternatives, situated between SR 99 and I-5, include the greatest number of transit dependents for the area between S. 200th Street and S. 240th Street.

All alternatives would serve a higher percentage of low-income and elderly people than are generally found in the larger four-city area. However, the results are not as consistent when comparing the size of the youth population and those households without access to an automobile. Only near the Federal Way Transit Center access area do the alternatives include a higher percentage of youth and households without an access to an automobile than the percentage found in the larger four-city area. **Table 6-6** and **Exhibits 6-4 through 6-7** illustrate the concentrations of low-income population, elderly population (age 65 or older), youth population (age 16 or younger), and 0-car households within ½ mile of access areas.

TABLE 6-6

Year 2010 Low-Income, Elderly, Youth, and 0-Car Households within ½ Mile of Access Areas

Light Rail Alignment Alternatives	Estimated Total Population of Access Area	Estimated Low-Income Population/ %*	Estimated Population 65 Years or Older/%**	Estimated Population 16 Years or Younger**	Estimated 0-Car Households*
Four-City Area					
SeaTac, Des Moines, Kent, and Federal Way	243,000	37,100 / 15%	24,400 / 10%	59,900 / 25%	7,000 / 8%
SR 99					
S. 240th Street	3,900	700 / 19%	700 / 19%	200 / 5%	0 / 0%
S. 276th Street (Redondo Heights P&R)	3,800	700 / 20%	1,300 / 35%	300 / 8%	100 / 6%
Federal Way Transit Center	3,000	700 / 22%	500 / 15%	500 / 17%	150 / 11%
TOTAL	**10,700**	**2,100 / 20%**	**2,500 / 23%**	**1,000 / 9%**	**250 / 2%**
I-5					
S. 240th Street	3,400	600 / 18%	700 / 21%	200 / 6%	100 / 7%
S. 272nd Street (Star Lake P&R)	3,600	700 / 19%	1,300 / 36%	300 / 8%	100 / 7%
Federal Way Transit Center	3,000	700 / 22%	500 / 15%	500 / 17%	400 / 30%
TOTAL	**10,000**	**2,000 / 20%**	**2,500 / 25%**	**1,000 / 10%**	**600 / 6%**
30th Avenue S. (with SR 99)					
S. 240th Street	3,900	700 / 19%	200 / 8%	700 / 26%	100 / 7%
S. 276th Street (Redondo Heights P&R)	3,800	N/A	N/A	N/A	N/A
Federal Way Transit Center	3,000	N/A	N/A	N/A	N/A
TOTAL	**0**	**700 / 19%**	**200 / 8%**	**700 / 26%**	**100 / 7%**
24th Avenue S. (with SR 99)					
Kent Des Moines Road (SR 516)	3,900	700 / 21%	200 / 6%	1,000 / 30%	100 / 11%
S. 276th Street (Redondo Heights P&R)	3,800	N/A	N/A	N/A	N/A
Federal Way Transit Center	3,000	N/A	N/A	N/A	N/A
TOTAL	**0**	**700 / 21%**	**200 / 6%**	**1,000 / 30%**	**100 / 11%**

* - Source: 2011 American Community Survey

** - Source: 2010 Census

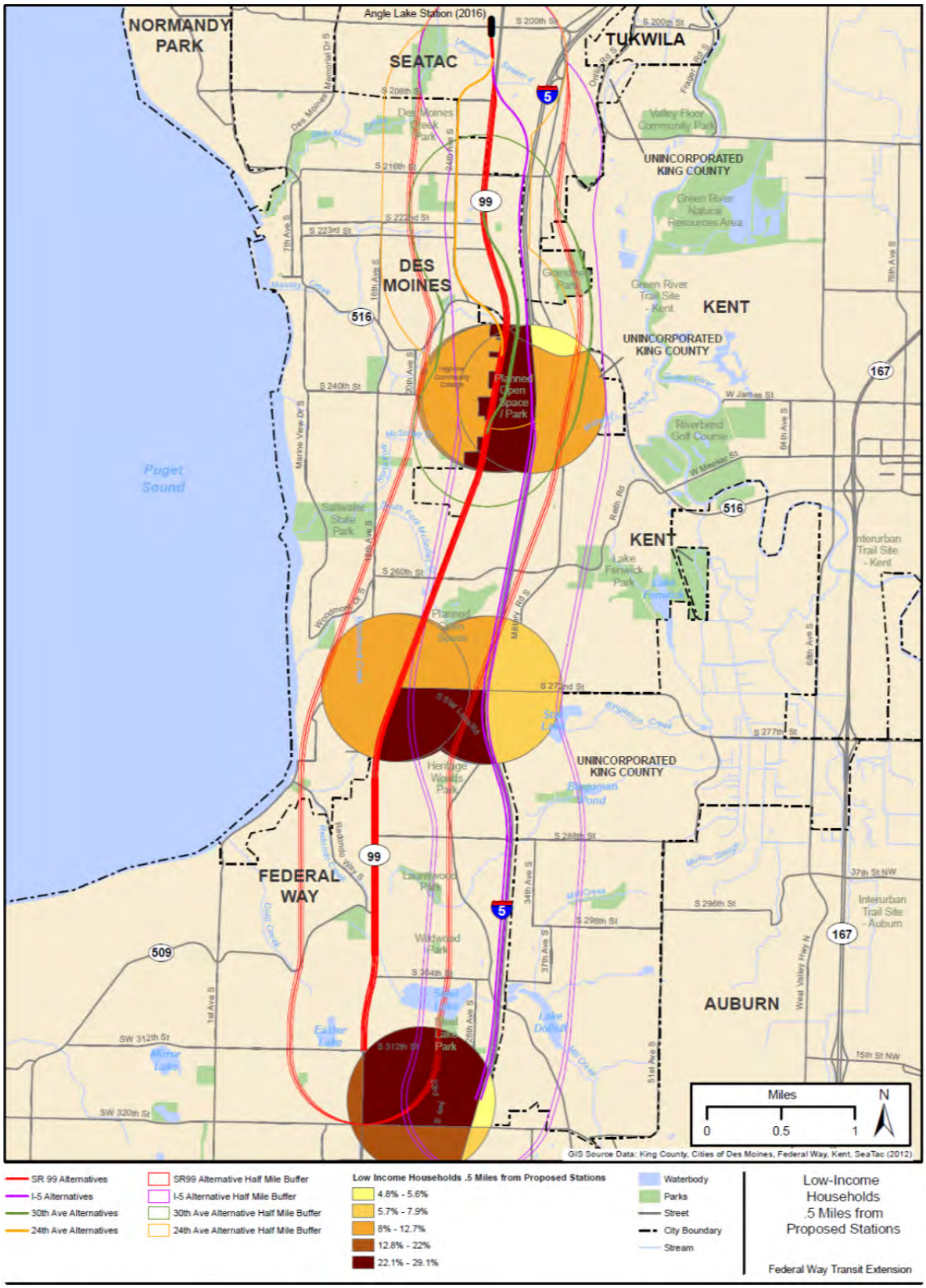


EXHIBIT 6-4
Low-Income Households within ½ Mile of Access Area

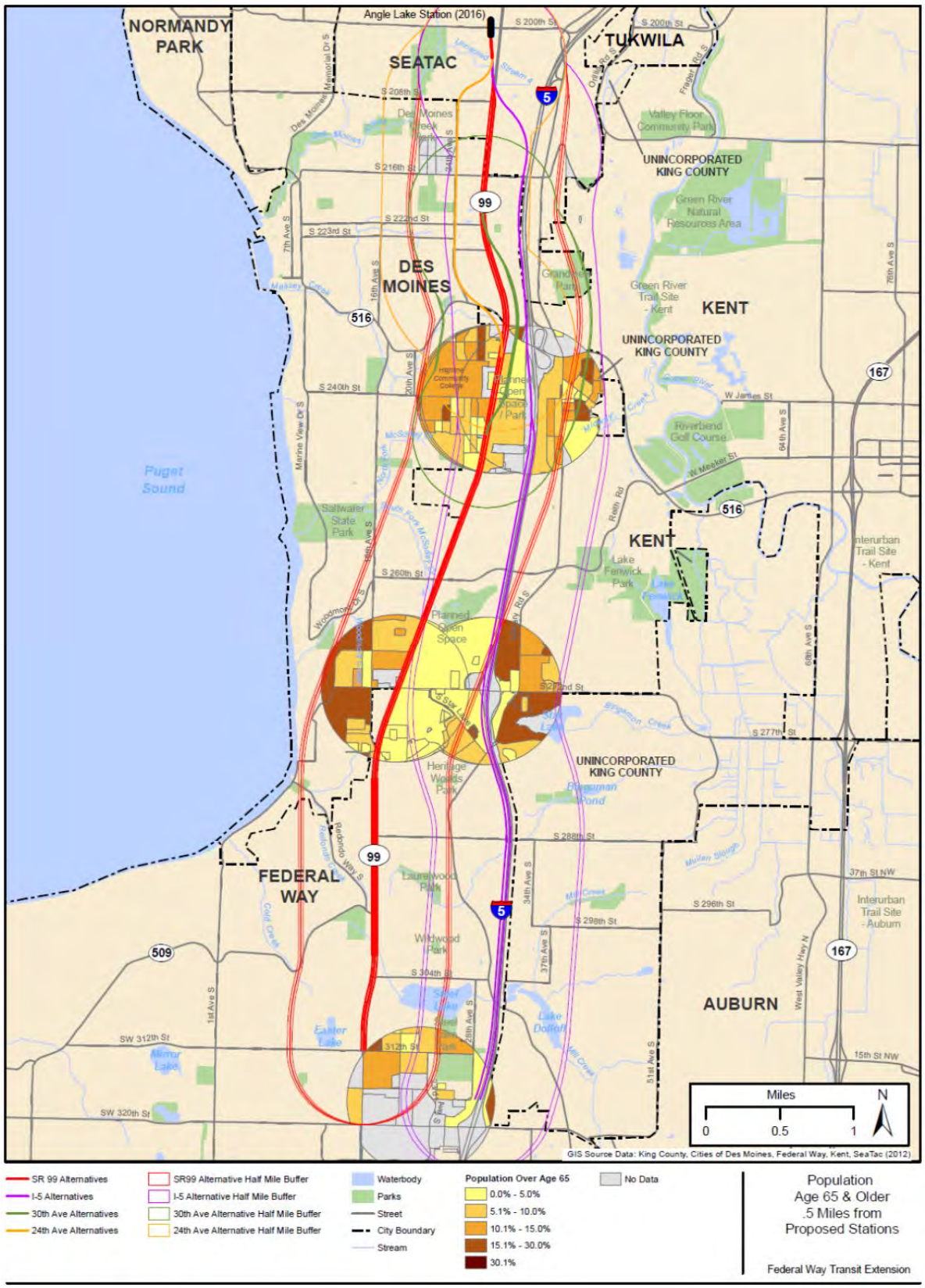


EXHIBIT 6-5
Elderly Population (age 65 and over) within ½ Mile of Access Area

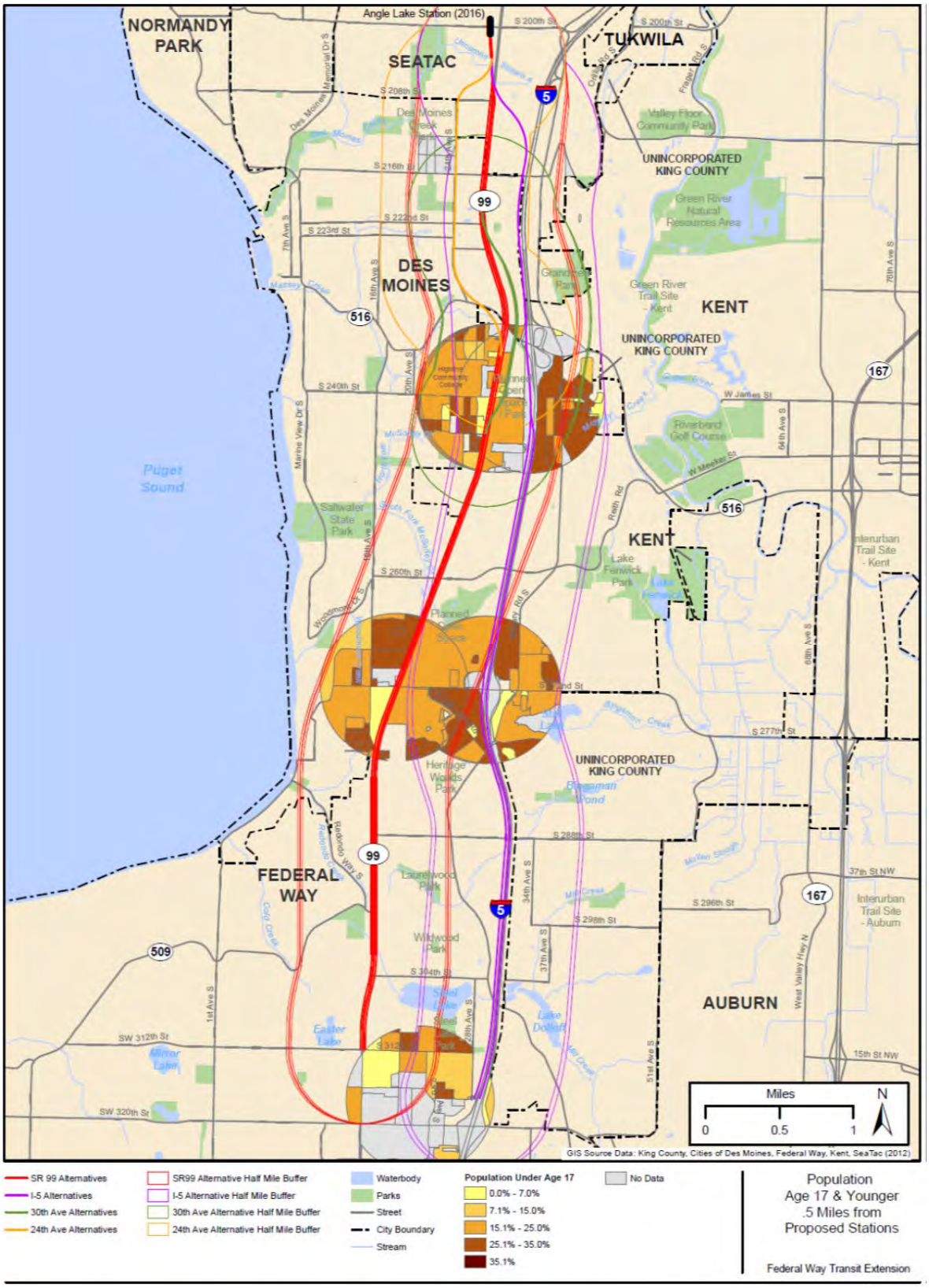


EXHIBIT 6-6
Youth Population (age 17 and younger) within ½ Mile of Access Area

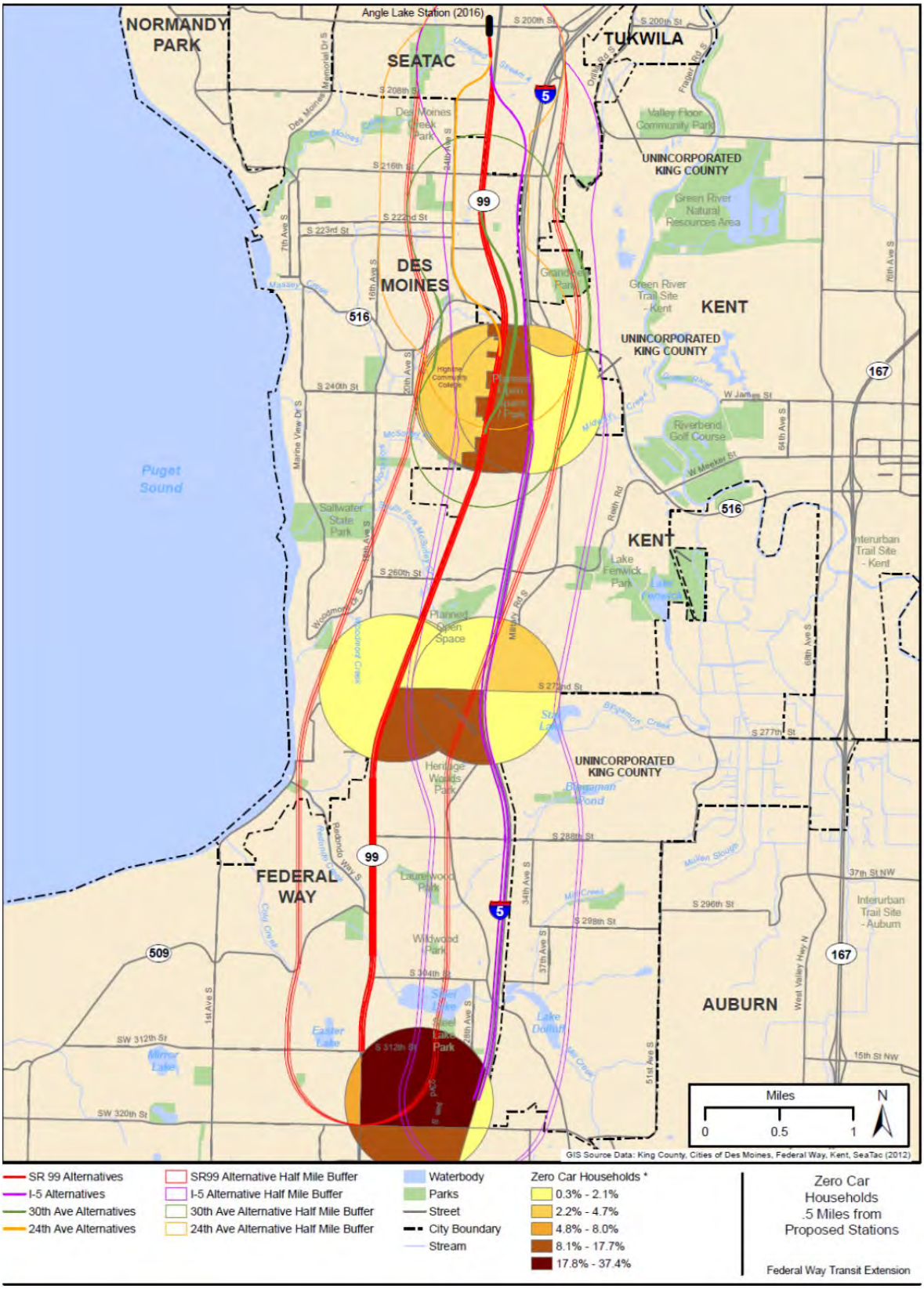


EXHIBIT 6-7
0-Car Households within ½ Mile of Access Area

6.4. Transit Supportive Land Use and Economic Development

6.4.1 How Well an Alternative Provides Enhanced Mobility to Existing High-Density Land Use Centers

Sound Transit's Transit-Oriented Development (TOD) Policy establishes a framework to evaluate, facilitate, and implement TOD strategies in the project planning process. TOD is a land development pattern that integrates transit and land use by promoting transit ridership while supporting community land use and development visions. Sound Transit's primary responsibility is to complete and expand the high-capacity transit system to deliver transit service that connects the region's urban centers, which is a key step toward meeting local and regional land use goals.

During the project development phase, Sound Transit has committed to:

- Identify and document agency and community TOD opportunities and strategies based on information available at the time of plan development, including input from stakeholders.
- Assess the extent to which development of alignments, station locations, and transit support facilities affect and support implementation of agency and community TOD strategies.
- Ensure that evaluation criteria for project alternatives include TOD measures.

Methodology

The ability of each alternative to provide access to high-density land use centers was evaluated based on the following factors:

- Area (in acres) of zoning that supports high-density land uses within ¼ mile of the centerline of each alternative
- The percent of the total acreage within ¼ mile that is zoned for high-density land uses
- Area (in acres) of zoning that supports high-density land uses within ½ mile of potential station access areas
- The percent of the total acreage within ½ mile of potential station access areas that is zoned for high-density land uses

Exhibit 6-8 identifies the location of areas along the study corridor with transit supportive density (TOD, mixed use and high-density land use patterns).

Key Results

- Alternatives along SR 99 and 30th Avenue S. provide greater zoning potential for high-density development at the alignment level. Results are more similar at the station access area level.

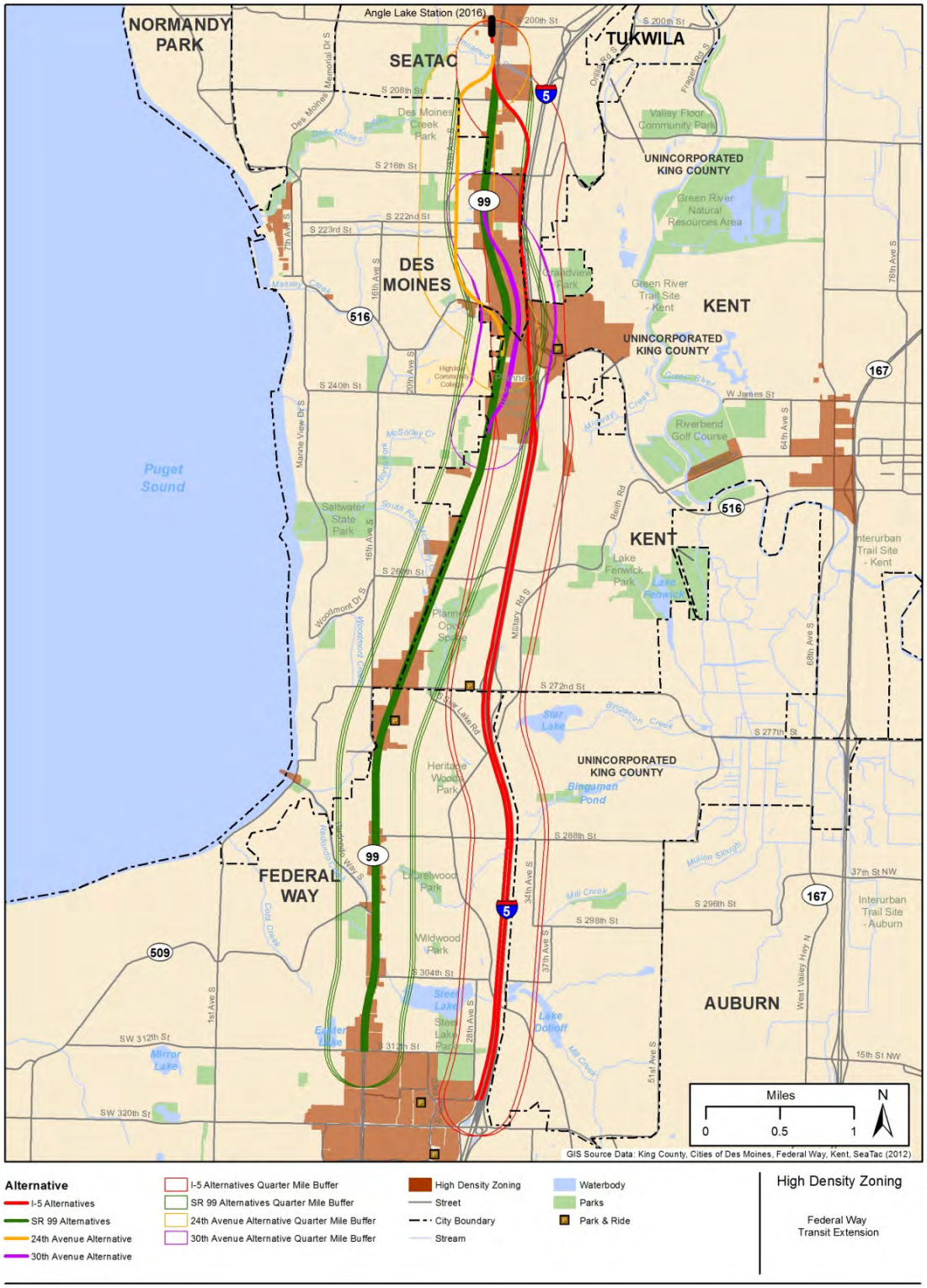


EXHIBIT 6-8
TOD/High-Density Zoning

Discussion of Results

Alternatives along SR 99 and 30th Avenue S. provide greater zoning potential for high-density development than those along I-5 or 24th Avenue S. The SR 99 Elevated East Side alternative has a slightly higher area than the other SR 99 alternatives, and SR 99 Elevated West Side alternative has slightly lower area of high-density zoning. **Table 6-7** summarizes the total land area of TOD/high-density zoning within ¼ mile of an alternative. **Table 6-8** summarizes the total land area of TOD/high-density zoning within ¼ mile of an alternative by segment.

TABLE 6-7
TOD/High-Density Zoning within ¼ Mile of an Alternative – Effects by Alternative

Alternative	Acres of TOD/High-Density Zoning within ¼ mile of the Alternative	Percent of TOD/High-Density Zoning within ¼ mile of the Alternative
SR 99 At-Grade Median	632	27%
SR 99 Mixed Median	632	27%
SR 99 Elevated Median	632	27%
SR 99 Elevated East Side	644	28%
SR 99 Elevated West Side	617	27%
I-5 Mixed West Side	454	19%
I-5 Mixed West Side/Median	449	19%
24th Avenue S. At-Grade Median	472	21%
24th Avenue S. Elevated Median	472	21%
24th Avenue S. Elevated East	471	21%
30th Avenue S. At-Grade Median	660	30%
30th Avenue S. Elevated Median	660	30%
30th Avenue S. Elevated East Side	664	31%
30th Avenue S. Elevated West Side	658	30%

The greatest TOD potential is within Segment B, with most alternatives having over 50 percent land designated for high-density zoning, except those alternatives along 24th Avenue S. Segments A has the next greatest area, with between 24 and 39 percent, with the highest area along SR 99. Segments C and D have similar levels along SR 99, at 17 percent, while areas along I-5 range from 1 to 5 percent.

In Segment A, the SR 99 alternatives have over ten percent more acres zoned as high-density (38 to 40 percent) as the I-5 alternatives (27 percent). In Segment B, the 30th Avenue S. alternatives have the highest percentage of its area zoned for high-density uses, with 87 to 88 percent. The I-5 alternatives have 74 percent of the area zoned for high-density uses, while SR 99 alternatives have between 54 and 57 percent. Between the SR 99 alternatives and the 30th Avenue S. alternatives, the east side running alternatives have slightly more acreage than the west side running alternatives. In Segment C, the SR 99 alternatives have 17 percent zoned for high-density uses, while the I-5 alternative have one to two percent. In Segment D, the SR 99 alternatives again have 17 percent zoned for high density uses, while the I-5 alternatives have 4 to 5 percent.

TABLE 6-8
TOD/High-Density Zoning within ¼ Mile of an Alternative – Effects by Segment

Segment	Description	Alternative	Acres of TOD/High-Density Zoning within ¼ mile of the Alternative	Percent of TOD/High Density Zoning within ¼ mile of the Alternative
A	Angle Lake Station to S. 220th Street	SR 99 At-Grade Median	154	39%
		SR 99 Mixed Median	154	39%
		SR 99 Elevated Median	154	39%
		SR 99 Elevated East Side	156	40%
		SR 99 Elevated West Side	150	38%
		I-5 Mixed West Side	110	27%
		I-5 Mixed West Side/Median	110	27%
		24th Avenue S. At-Grade Median	103	24%
		24th Avenue S. Elevated Median	103	24%
		24th Avenue S. Elevated East	103	24%
B	S. 220th Street to S. 244th Street	SR 99 At-Grade Median	272	55%
		SR 99 Mixed Median	272	55%
		SR 99 Elevated Median	272	55%
		SR 99 Elevated East Side	280	57%
		SR 99 Elevated West Side	263	54%
		I-5 Mixed West Side	303	74%
		I-5 Mixed West Side/Median	302	74%
		30th Avenue S. At-Grade Median	299	87%
		30th Avenue S. Elevated Median	299	87%
		30th Avenue S. Elevated East Side	304	88%
		30th Avenue S. Elevated West Side	298	88%
		24th Avenue S. At-Grade Median	162	24%
		24th Avenue S. Elevated Median	162	24%
		24th Avenue S. Elevated East Side	162	24%
C	S. 244th Street to S. 280th Street	SR 99 At-Grade Median	127	17%
		SR 99 Mixed Median	127	17%
		SR 99 Elevated Median	127	17%
		SR 99 Elevated East Side	127	17%
		SR 99 Elevated West Side	126	17%
		I-5 Mixed West Side	6	1%
		I-5 Mixed West Side/Median	9	2%
D	S. 280th Street to S. 320th Street	SR 99 At-Grade Median	116	17%
		SR 99 Mixed Median	116	17%
		SR 99 Elevated Median	116	17%
		SR 99 Elevated East Side	118	17%
		SR 99 Elevated West Side	114	17%
		I-5 Mixed West Side	35	5%
		I-5 Mixed West Side/Median	28	4%

Additional analysis was done to identify the total zoned TOD/high-density area at station access area locations. At the alternative level, SR 99 access areas demonstrate greater potential at approximately 26 to 27 percent—slightly greater than the I-5 alternatives, which have 24 percent. Between the SR 99 alternatives, the SR 99 Elevated East Side alternative has a slightly higher area than the other SR 99 alternatives. Between the I-5 alternatives, the I-5 Mixed West Side alternative has slightly more area than the I-5 Mixed West Side/Median. **Table 6-9** summarizes the total land area of TOD/high-density zoning within station access areas, while **Table 6-10** summarizes the data by segment.

TABLE 6-9
TOD/High Density Zoning within ½ mile of Station Access Area – Effects by Alternative

Alternative	Acres of TOD/High-Density Zoning within Station Access Areas	Percent of TOD/High-Density Zoning within Station Access Areas
SR 99 At-Grade Median	534	27%
SR 99 Mixed Median	534	27%
SR 99 Elevated Median *	534	27%
SR 99 Elevated East Side	537	27%
SR 99 Elevated West Side	530	26%
I-5 Mixed West Side	487	24%
I-5 Mixed West Side/Median	482	24%

* Results for all 30th Avenue S. and 24th Avenue S. alternatives are assumed to be the same as the SR 99 Elevated Median alternative, as there are no station access areas identified along 30th Avenue S. or 24th Avenue S.

No stations are located in Segment A, so there are no access areas to analyze in this segment. Analysis at this level indicates access areas in Segment D have the highest percentage of high-density zoning, with 57 percent for all alternatives.

In Segment B, the I-5 alternatives have 38 percent high-density zoning in the access area, while the SR 99 alternatives have 31 to 33 percent. Between the SR 99 alternatives, the SR 99 Elevated East Side alternative has a slightly higher area than the other SR 99 alternatives and the SR 99 Elevated West Side alternative has slightly less high-density zoning.

In Segment C, the SR 99 alternatives have 17 percent high-density zoning within the access areas, while the I-5 alternatives have high-density zoning in less than 2 percent within the access areas.

TABLE 6-10
TOD/High-Density Zoning within ½ mile of Station Access Area – Effects by Segment

Segment	Description	Alternative	Acres of TOD/High-Density Zoning within Station Access Areas	Percent of TOD/High-Density Zoning within Station Access Areas
A	Angle Lake Station to S. 220th Street	SR 99 At-Grade Median	0	0%
		SR 99 Mixed Median	0	0%
		SR 99 Elevated Median	0	0%
		SR 99 Elevated East Side	0	0%
		SR 99 Elevated West Side	0	0%
		I-5 Mixed West Side	0	0%
		I-5 Mixed West Side/Median	0	0%
B	S. 220th Street to S. 244th Street	SR 99 At-Grade Median	161	31%
		SR 99 Mixed Median	161	31%
		SR 99 Elevated Median	161	31%
		SR 99 Elevated East Side	164	33%
		SR 99 Elevated West Side	157	31%
		I-5 Mixed West Side	192	38%
		I-5 Mixed West Side/Median	192	38%
C	S. 244th Street to S. 280th Street	SR 99 At-Grade Median	86	17%
		SR 99 Mixed Median	86	17%
		SR 99 Elevated Median	86	17%
		SR 99 Elevated East Side	86	17%
		SR 99 Elevated West Side	86	17%
		I-5 Mixed West Side	8	2%
		I-5 Mixed West Side/Median	3	<1%
D	S. 280th Street to S. 320th Street	SR 99 At-Grade Median	287	57%
		SR 99 Mixed Median	287	57%
		SR 99 Elevated Median	287	57%
		SR 99 Elevated East Side	287	57%
		SR 99 Elevated West Side	287	57%
		I-5 Mixed West Side	287	57%
		I-5 Mixed West Side/Median	287	57%

6.5. Effect on Natural Environment

6.5.1 Effects on Wetlands/Potential to Affect Stream Crossings

Wetlands are important ecosystem areas that provide habitat, contribute to hydrologic function, and water quality function in a given area. Streams are important aquatic habitats for salmonids and other fish. **Exhibit 6-9** indicates the location of potential stream and wetland crossings in the study area. **Table 6-11** shows the total number of resources that could be directly affected for each alternative. **Table 6-12** shows the effects by segment.

Methodology

Wetlands are considered "directly affected" if they are located within 100 feet of the centerline of an alternative. Stream effects are determined by the number of times an alternative crosses a stream. As the alternatives are refined, many potential effects may be avoided or mitigated; therefore, in Level 1 screening this measure is only used to show relative differences among the alternatives.

TABLE 6-11
Ecosystems – Effects by Alternative

Alternative	Wetlands Directly Affected (acres)	Number of Stream Crossings
SR 99 At-Grade Median	0	2
SR 99 Mixed Median	0	2
SR 99 Elevated Median	0	2
SR 99 Elevated East Side	0	2
SR 99 Elevated West Side	0	2
I-5 Mixed West Side	0.4	1
I-5 Mixed West Side/Median	2.1	1
30th Avenue S. At-Grade Median	0	2
30th Avenue S. Elevated Median	0	2
30th Avenue S. Elevated East Side	0	2
30th Avenue S. Elevated West Side	0	2
24th Avenue S. At-Grade Median	0	2
24th Avenue S. Elevated Median	0	2
24th Avenue S. Elevated East Side	0	2

Key Results

- Potential for wetland effects would occur only with the I-5 alternatives.
- Potential for stream effects would be greater with the SR 99 alternatives.

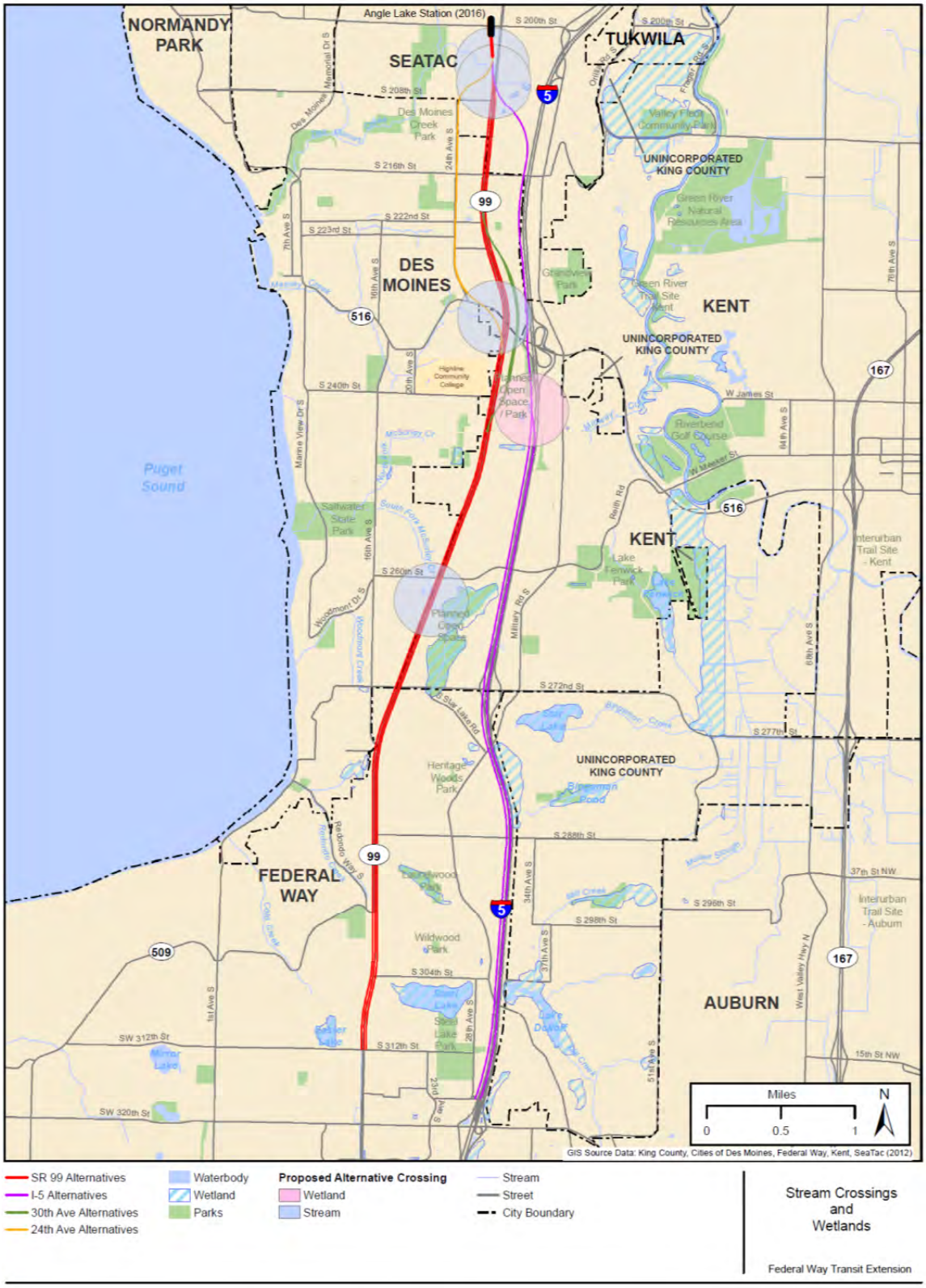


EXHIBIT 6-9
Stream Crossings and Wetlands

TABLE 6-12
Ecosystems – Effects by Segment

Segment	Description	Alternative	Wetlands Directly Affected (acres)	Number of Stream Crossings
A	Angle Lake Station to S. 220th Street	SR 99 At-Grade Median	0	1
		SR 99 Mixed Median	0	1
		SR 99 Elevated Median	0	1
		SR 99 Elevated East Side	0	1
		SR 99 Elevated West Side	0	1
		I-5 Mixed West Side	0	1
		I-5 Mixed West Side/Median	0	1
		24th Avenue S. At-Grade Median	0	1
		24th Avenue S. Elevated Median	0	1
		24th Avenue S. Elevated East Side	0	1
B	S. 220th Street to S. 244th Street	SR 99 At-Grade Median	0	0
		SR 99 Mixed Median	0	0
		SR 99 Elevated Median	0	0
		SR 99 Elevated East Side	0	0
		SR 99 Elevated West Side	0	0
		I-5 Mixed West Side	0.4	0
		I-5 Mixed West Side/Median	0.4	0
		30th Avenue S. At-Grade Median	0	0
		30th Avenue S. Elevated Median	0	0
		30th Avenue S. Elevated East Side	0	0
		30th Avenue S. Elevated West Side	0	0
		24th Avenue S. At-Grade Median	0	0
		24th Avenue S. Elevated Median	0	0
		24th Avenue S. Elevated East Side	0	0
C	S. 244th Street to S. 280th Street	SR 99 At-Grade Median	0	1
		SR 99 Mixed Median	0	1
		SR 99 Elevated Median	0	1
		SR 99 Elevated East Side	0	1
		SR 99 Elevated West Side	0	1
		I-5 Mixed West Side	<0.1	0
		I-5 Mixed West Side/Median	0.5	0
D	S. 280th Street to S. 320th Street	SR 99 At-Grade Median	0	0
		SR 99 Mixed Median	0	0
		SR 99 Elevated Median	0	0
		SR 99 Elevated East Side	0	0
		SR 99 Elevated West Side	0	0
		I-5 Mixed West Side	0	0
		I-5 Mixed West Side/Median	1.6	0

Discussion of Results

Only the I-5 alternatives would potentially affect wetlands. The I-5 Mixed West Side/Median alternative would have the most potential to affect wetlands, with most potential effects occurring in Segments C and D. The I-5 Mixed West Side alternative has fewer potential effects, with most occurring in Segment B. No potential wetland effects were identified for the SR 99 alternatives.

The SR 99 alternatives would affect more streams than I-5 alternatives. All SR 99 alternatives would potentially affect two stream crossings: an unnamed stream in Segment A, which appears to be tributary to Des Moines Creek, and the south fork of McSorley Creek in Segment C. The I-5 alternatives would only cross the same unnamed creek in Segment A. No other affected streams were identified for the I-5 alternatives.

6.6. Effect on Built Environment

6.6.1 Visual Aesthetic Effects

The visual environment is made up of both built and natural elements and provides the cultural and natural features that contribute to the public's appreciation and enjoyment of the area. Visual effects can occur if a project negatively affects the visual character and quality of the environment.

Methodology

In this preliminary assessment, the evaluation does not determine the existing visual quality other than if there are views, existing visual disturbances, and some high-level context along the project corridor. As the alternatives are refined, many potential effects may be minimized through design and landscape features; therefore, this discussion is intended at this time to show relative differences among the alternatives.

Residents are the most sensitive viewers in the study area along any of the proposed alternatives. The method for comparing potential visual effects was measured by determining the length of the alternative next to residential properties. Although the distance of sensitive viewers that may be affected is an important tool to determine effects, the visual context and alternative profile must also be considered in the analysis.

Key Results

- Elevated profiles would affect visual aesthetics more than at-grade profiles, as they often block views and stand out more in the existing environment.
- The I-5 alternatives have low to moderate potential for visual effects.
- The SR 99 alternatives have moderate potential for visual effects.
- Segments C and D have the highest existing visual quality because of views towards Puget Sound and Mt. Rainier in this area.

Discussion of Results

Table 6-13 shows the estimated total length of the alternative that may be visible by residential properties in the study area for each alternative. **Table 6-14** shows the estimated total length in each segment. The results are generalized and do not take into consideration potential mitigation measures or the potential for future development to integrate with the proposed infrastructure. **Exhibit 6-10** (north of S. 260th Street) and **Exhibit 6-11** (south of S. 260th Street) indicate the areas along each alternative that may be visible by residential properties.

TABLE 6-13
Lengths of Visually Sensitive Lands – Effects by Alternative

Alternative	Total Length of Visual Sensitivity (linear ft)	Predominant Profile	Potential Visual Effects
SR 99 At-Grade Median	5,950	At-grade	Moderate
SR 99 Mixed Median	5,950	Mixed	Moderate
SR 99 Elevated Median	5,950	Elevated	Moderate
SR 99 Elevated East Side	5,950	Elevated	Moderate
SR 99 Elevated West Side	5,950	Elevated	Moderate
I-5 Mixed West Side	23,900	Mixed	Low to moderate
I-5 Mixed West Side/Median	8,300	Mixed	Low
30th Avenue S. At-Grade Median	9,750	At-grade	Moderate
30th Avenue S. Elevated Median	9,750	Elevated	Moderate
30th Avenue S. Elevated East Side	9,750	Elevated	Moderate
30th Avenue S. Elevated West Side	9,750	Elevated	Moderate
24th Avenue S. At-Grade Median	9,750	At-grade	Moderate
24th Avenue S. Elevated Median	9,750	Elevated	Moderate
24th Avenue S. Elevated East Side	9,750	Elevated	Moderate

The I-5 alternatives have the least overall potential to affect sensitive views, as the residents along I-5 are either positioned to avoid views of the freeway or already have blocked views. The elevated alternatives along SR 99 may be able to reduce traffic effects on the roadway but may have a visual effect on adjacent residents. The 24th Avenue S. and 30th Avenue S. alternatives are likely to have the greatest effect on viewers in Segment B.

For the SR 99 alternatives, an elevated guideway would have more visual disruption than an at-grade profile. The overall potential visual effect of the elevated SR 99 alternatives is moderate, whereas the at-grade is potentially low to moderate. The elevated guideways have the potential for moderate to high effects on views to the water in the southern segments and changes to the character of the urban arterial. At-grade transit is within the character of the major arterial; while this design profile might have other effects on the built environment, it would not compromise views.

EXHIBIT 6-10
Areas Potentially Visible by Residential Properties (north of S. 260th Street)

SR 99 Alternatives
I-5 Alternatives
30th Ave Alternatives
24th Ave Alternatives
Street
City Boundary
Stream
Areas Potentially Visible by Residential Properties
Waterbody
Parks
Park & Ride

Areas Potentially Visible by Residential Properties – South

Federal Way Transit Extension

EXHIBIT 6-11
Areas Potentially Visible by Residential Properties (south of S. 260th Street)

TABLE 6-14
Lengths of Visually Sensitive Lands – Effects by Segment

Segment	Description	Alternative	Length of Visual Sensitivity (linear ft)	Potential Visual Effects
A	Angle Lake Station to S. 220th Street	SR 99 At-Grade Median	1,300	Low to moderate
		SR 99 Mixed Median	1,300	Low to moderate
		SR 99 Elevated Median	1,300	Low to moderate
		SR 99 Elevated East Side	1,300	Low to moderate
		SR 99 Elevated West Side	1,300	Low to moderate
		I-5 Mixed West Side	5,200	Low to moderate
		I-5 Mixed West Side/Median	5,200	Low to moderate
		24th Avenue S. At-Grade Median	1,800	Moderate to high
		24th Avenue S. Elevated Median	1,800	Moderate to high
		24th Avenue S. Elevated East Side	1,800	Moderate to high
B	S. 220th Street to S. 240th Street	SR 99 At-Grade Median	0	Low
		SR 99 Mixed Median	0	Low
		SR 99 Elevated Median	0	Low
		SR 99 Elevated East Side	0	Low
		SR 99 Elevated West Side	0	Low
		I-5 Mixed West Side	3,100	Low to moderate
		I-5 Mixed West Side/Median	3,100	Low to moderate
		30th Avenue S. At-Grade Median	3,800	Moderate to high
		30th Avenue S. Elevated Median	3,800	Moderate to high
		30th Avenue S. Elevated East Side	3,800	Moderate to high
		30th Avenue S. Elevated West Side	3,800	Moderate to high
		24th Avenue S. At-Grade Median	3,300	Moderate to high
		24th Avenue S. Elevated Median	3,300	Moderate to high
		24th Avenue S. Elevated East Side	3,300	Moderate to high
C	S. 244th Street to S. 280th Street	SR 99 At-Grade Median	0	Low
		SR 99 Mixed Median	0	Low
		SR 99 Elevated Median	0	Low
		SR 99 Elevated East Side	0	Low
		SR 99 Elevated West Side	0	Low
		I-5 Mixed West Side	4,600	Low to Moderate
		I-5 Mixed West Side/Median	0	Low
D	S. 280th Street to S. 320th Street	SR 99 At-Grade Median	4,650	Low to Moderate
		SR 99 Mixed Median	4,650	Low to moderate
		SR 99 Elevated Median	4,650	Moderate to high
		SR 99 Elevated East Side	4,650	Moderate to high
		SR 99 Elevated West Side	4,650	Moderate to high
		I-5 Mixed West Side	11,000	Moderate
		I-5 Mixed West Side/Median	0	Low

In Segment A, the I-5 alternatives would have the longest elevated profile near residential viewers in this segment, but the visual effect would be low to moderate. There would be no

particular viewsheds affected by these alternatives along the SR 509 right-of-way. It is likely that the FWTE would be built prior to SR 509, resulting in a change of the existing condition and affecting the visual aesthetic of the area. Residences along the proposed SR 509 corridor may be affected by the I-5 alternatives, but the effect would be minimal as the residences are oriented away from the potential alignment. For the SR 99 alternatives, the residential units do not face the highway; however, the at-grade alternatives may remove land uses, thereby exposing more residential units to the SR 99 corridor than exists today. Depending on the property acquisition required, an elevated profile may be buffered by existing commercial units from the residences. The 24th Avenue S. alternatives would have the next greatest effect and would pass in front of homes that currently look out onto undeveloped land. 24th Avenue S., however, is planned for widening and improvements in the next few years and the undeveloped land is the location of the planned Des Moines Creek Business Park, which would alter the visual feel of this area. The 24th Avenue S. At-Grade Median alternative could be designed to feel integrated with the design elements of the roadway and would have less potential for visual effects than the 24th Avenue S. Elevated East Side alternative.

In Segment B, the I-5 alternatives would affect the same linear length of residential areas; however, the homes are oriented away from I-5 resulting in minimal affect on the viewers' experience. Views of Mt Rainier would not be affected. There are no residential uses along Segment B for alternatives along SR 99 and there are no immediate views that would be blocked from SR 99 in this segment. The 24th Avenue S. and 30th Avenue S. alternatives would all be visible from the same linear length of residences. The difference in the level of effect would result from the profile and location of the alternative. Elevated structures have the largest visual effect as they often block views and stand out more in the existing environment than at-grade alternatives. The 30th Avenue S. Elevated East Side and 30th Avenue S. Elevated West Side alternatives would have the greatest visual effect of the 30th Avenue S. alternatives, as they would be elevated and would be adjacent to sensitive residential areas (although the most immediate residences would likely be removed, those that remain would be affected). The 30th Avenue S. Elevated Median alternative would have the next largest visual effect because it would be highly visible. It would not be immediately adjacent to homes, but would visually affect both sides of the roadway. The 30th Avenue S. At-Grade Median alternative would have the least visual effect because it would be at-grade and in the median of the roadway. Similarly, the 24th Avenue S. At-Grade Median alternative would have less visual effect on this road because it would be at-grade and in the median; although expanding the roadway would change the character of the road it would likely not diminish the visual environment. The 24th Avenue S. Elevated East Side alternative may result in moderate to high effect on the visual environment because an overhead infrastructure is not consistent with the neighborhood environment and park activities along 24th Avenue S.

In Segment C, the I-5 Mixed West Side alternative would be adjacent to the west side of I-5 while the I-5 Mixed West Side/Median alternative would be located in the I-5 median. The area to the west of I-5 includes open areas, landfill, wetlands, and about 25 percent residential uses. These residential uses appear to be heavily buffered by vegetation to reduce the views toward the freeway; therefore, the visual effects are low to moderate. The I-5 Mixed West Side/Median alternative would be more integrated with the freeway and slightly less noticeable from a visual perspective. There are very few residential uses along SR 99 in Segment C, so the effects of an elevated profile over the at-grade profile would be a tradeoff with the visual improvements along SR 99 that would be removed by an at-grade profile. The elevated alternatives on the east and west sides of SR 99 would affect the roadway less. The at-grade would have the highest effect due to the low presence of sensitive viewers; however, the overall effect is low for all SR 99 alternatives.

In general, Segments C and D would have the highest existing visual quality because of views towards Puget Sound in this area. The SR 99 Elevated Median alternative, SR 99 Elevated East Side alternative, and the SR 99 Elevated West Side alternative all have elevated portions of their alignment in Segments C and D and could affect sensitive water views. The SR 99 Elevated East Side alternative would have a greater visual effect, as it is elevated throughout and blocks sensitive views towards the water from adjacent residential areas. Elevated median alternatives, such as the SR 99 Elevated Median alternative, and mixed elevated and at-grade median alternatives, such as I-5 Mixed West Side/Median and SR 99 Mixed Median alternatives, would disrupt some views but would be in the middle of an existing transportation corridor and would therefore have less of a visual effect than side running elevated alternatives. These elevated and mixed median alternatives are projected to have moderate to high visual effects. The elevated alternatives on SR 99 may provide passengers intermittent views of Puget Sound. The SR 99 At-Grade Median alternative and SR 99 Mixed Median alternative may widen the roadways to open views of Puget Sound without blocking views of remaining land uses, but removal of vegetation in the process would result in visual changes to SR 99. Overall, these alternatives are rated as having low to moderate effects.

There are some views of Mt. Rainier looking east that may be affected by an elevated profile along I-5 at the southern end of the I-5 alternatives. Of these alternatives, the SR 99 Elevated East Side and I-5 Mixed West Side would have the greatest visual effect. I-5 Mixed West Side would cross the greatest area of visual sensitivity in Segment D. However, this alternative would be only partially elevated and would be adjacent to homes on the west side of I-5. The I-5 Mixed West Side alternative, depending on the elevation of the guideway, may affect views of Mt. Rainier and would result in a moderate effect. I-5 Mixed West Side/Median alternative would have a low visual effect, unless the alternative has to cross over I-5 to access the Federal Way Transit Center, which could block views accordingly.

6.6.2 Potential Property Acquisition

Properties would need to be purchased for right-of-way and other project-related facilities and could involve the displacement and relocation of residential and commercial properties. Projects receiving federal funding are required to comply with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1070 (Code of Federal Regulations [CFR] Title 49, Part 24), as amended. This Act provides guidance on how property owners would be compensated and relocated as necessary. Sound Transit adopted the *Real Property Acquisition and Relocation Policy, Procedures, and Guidelines* to guide its compliance with Chapter 8.26 Revised Code of Washington (RCW) and Chapter 468-100 Washington Administration Code (WAC).

Methodology

The number of potential displacements would be estimated in the Level 2 Screening. Because the design of the alternatives is still in the preliminary stages, it is unknown exactly which properties would be acquired for the alternatives; however, in order to compare potential effects of the alternatives being considered, a threshold is used to determine potential acquisition effects. Properties were determined to have the potential to be acquired if they are located within 100 feet of the centerline of the alternative.

Table 6-15 shows the total number of residential and commercial properties that could potentially be required for acquisition for each alternative. **Table 6-16** shows the number of properties that could potentially be acquired in each segment. Individual properties could have one or multiple residential units or businesses. Not all property acquisitions may result in displacements.

Key Results

- Property acquisition would be required for all alternatives.
- SR 99 alternatives (including 24th Avenue S. alternatives) would require more commercial property acquisitions.
- I-5 and 30th Avenue S. alternatives would require residential property acquisitions.

Discussion of Results

The SR 99 At-Grade Median alternative, SR 99 Mixed Median alternative, and SR 99 Elevated Median alternative would result in the greatest number of potential commercial properties acquired, with up to 322 commercial properties affected. The I-5 Mixed West Side alternative would result in the greatest number of potential residential property acquisitions from any alternative with up to 169 residential properties affected. The I-5 Mixed West Side/Median alternative would result in the lowest total amount of potential commercial property acquisitions with 20 potentially affected. The SR 99 Elevated West Side alternative would result in the lowest number of residential acquisitions with 34 residential properties potentially affected.

TABLE 6-15
Potential Property Acquisitions – Effects by Alternative

Alternative	Potential Acquisitions (Residential)	Potential Acquisitions (Commercial)
SR 99 At-Grade Median	58	322
SR 99 Mixed Median	58	322
SR 99 Elevated Median	58	322
SR 99 Elevated East Side	57	167
SR 99 Elevated West Side	34	175
I-5 Mixed West Side	169	33
I-5 Mixed West Side/Median	86	20
30th Avenue S. At-Grade Median	53	47
30th Avenue S. Elevated Median	55	47
30th Avenue S. Elevated East Side	55	47
30th Avenue S. Elevated West Side	55	47
24th Avenue S. At-Grade Median	94	41
24th Avenue S. Elevated Median	94	41
24th Avenue S. Elevated East Side	95	40

Segment A has the fewest potential property acquisitions for the SR 99 alternatives. In Segment B, the SR 99 At-Grade Median alternative, SR 99 Mixed Median alternative, and the SR 99 Elevated Median alternative would result in the greatest number of commercial property acquisitions. The 30th Avenue S. alternatives would have at least 53 residential property acquisitions, whereas the SR 99 alternatives would have three, except for SR 99 Elevated East Side, which would have five.

The SR 99 Elevated East Side alternative would result in the greatest total number of commercial and residential property acquisitions in Segment C. The I-5 Mixed West Side/Median alternative would have the fewest potential acquisitions in Segments C and D because of its location in the I-5 median. In Segment D, the I-5 Mixed West Side alternative would result in the greatest number of residential property acquisitions, while the SR 99 At-Grade Median alternative, SR 99 Mixed Median alternative, and the SR 99 Elevated Median alternative would result in the greatest number of commercial property acquisitions.

TABLE 6-16
Potential Property Acquisitions – Effects by Segment

Segment	Description	Alternative	Potential Acquisitions (Residential)	Potential Acquisitions (Commercial)
A	Angle Lake Station to S. 220th Street	SR 99 At-Grade Median	8	44
		SR 99 Mixed Median	8	44
		SR 99 Elevated Median	8	44
		SR 99 Elevated East Side	9	26
		SR 99 Elevated West Side	4	23
		I-5 Mixed West Side	62	9
		I-5 Mixed West Side/Median	62	9
		24th Avenue S. At-Grade Median	50	13
		24th Avenue S. Elevated Median	50	13
		24th Avenue S. Elevated East Side	51	12
B	S. 220th Street to S. 244th Street	SR 99 At-Grade Median	3	91
		SR 99 Mixed Median	3	91
		SR 99 Elevated Median	3	91
		SR 99 Elevated East Side	5	43
		SR 99 Elevated West Side	4	52
		I-5 Mixed West Side	24	11
		I-5 Mixed West Side/Median	24	11
		30th Avenue S. At-Grade Median	53	47
		30th Avenue S. Elevated Median	55	47
		30th Avenue S. Elevated East Side	55	47
		30th Avenue S. Elevated West Side	55	47
		24th Avenue S. At-Grade Median	44	28
		24th Avenue S. Elevated Median	44	28
		24th Avenue S. Elevated East Side	44	28
C	S. 244th Street to S. 280th Street	SR 99 At-Grade Median	26	105
		SR 99 Mixed Median	26	105
		SR 99 Elevated Median	26	105
		SR 99 Elevated East Side	19	55
		SR 99 Elevated West Side	14	56
		I-5 Mixed West Side	42	5
		I-5 Mixed West Side/Median	42	5
D	S. 280th Street to S. 320th Street	SR 99 At-Grade Median	21	82
		SR 99 Mixed Median	21	82
		SR 99 Elevated Median	21	82
		SR 99 Elevated East Side	24	43
		SR 99 Elevated West Side	12	44
		I-5 Mixed West Side	41	8
		I-5 Mixed West Side/Median	41	8

6.6.3 Effects to Known Parks

Direct effects to parks could include, but are not limited to, the acquisition of public parks, greenbelts, and other undeveloped open spaces, trails, and playfields. Indirect effects include noise, dust, and temporary construction period access restrictions. **Table 6-17** shows the total number of resources that could be directly and/or indirectly affected. **Table 6-18** shows the effects by segment.

Methodology

Direct effects to a park could occur if the park is located within 50 feet of the alternative's centerline, while indirect effects would occur if the park is within 200 feet of the alternative's centerline. As the alternatives are refined, many potential effects may be avoided or mitigated; therefore, this measure is intended to show relative differences among the alternative alignment options and segments.

Key Results

- No potential park effects would occur with the SR 99 or 30th Avenue S. alternatives.
- The 24th Avenue S. At-Grade Median alternative has the greatest potential to affect parks.
- The I-5 alternatives have the greatest potential to indirectly affect parks.

Discussion of Results

The alternative with the highest potential to affect parks is the 24th Avenue S. At-Grade Median alternative. This would be the only alternative with potential direct effects to parks, with less than 0.1 affected acres (Steven J. Underwood Park). All three of the 24th Avenue S. alternatives would have approximately 1 acre of potential indirect effects to the same park. The only other alternatives that would affect parks would be the I-5 alternatives. The only park effects in Segments C and D would occur with the I-5 Mixed West Side/Median alternative in Segment C, which would have 0.1 acre of indirect effects at Old Fire Station Park, and the I-5 Mixed West Side alternative in Segment D, which would have 0.4 acre of indirect park effects at Steel Lake Park.

The I-5 and 30th Avenue S. alternatives have potential to affect a planned open space area in Segment B, if it becomes publicly owned and is opened to the public. The open space is not developed or publicly owned at this time, but there is a potential for an open space effect depending on the timeline of the proposed FWTE project. If so, this would trigger a Department of Transportation Act 'Section 4(f) analysis', which states a "feasible and reasonable alternative" would have to be considered before an alternative that affects a park can be considered.

TABLE 6-17
Parks Effects for the I-5 Alternatives

Alternative	Parks Directly Affected (acres)	Parks Indirectly Affected (acres)
I-5 Mixed West	0	0.4
I-5 Mixed West/Median	0	0.1

No park effects for SR 99 alternatives and 30th Avenue S. alternatives.

TABLE 6-18
Parks Effects by Segment

Segment	Description	Alternative	Parks Directly Affected (acres)	Parks Indirectly Affected (acres)
A	Angle Lake Station to S. 220th Street	SR 99 At-Grade Median	0	0
		SR 99 Mixed Median	0	0
		SR 99 Elevated Median	0	0
		SR 99 Elevated East Side	0	0
		SR 99 Elevated West Side	0	0
		I-5 Mixed West Side	0	0
		I-5 Mixed West Side/Median	0	0
		24th Avenue S. At-Grade Median	Less than 0.1	1
		24th Avenue S. Elevated Median	Less than 0.1	1
		24th Avenue S. Elevated East Side	0	1
B	S. 220th Street to S. 244th Street	SR 99 At-Grade Median	0	0
		SR 99 Mixed Median	0	0
		SR 99 Elevated Median	0	0
		SR 99 Elevated East Side	0	0
		SR 99 Elevated West Side	0	0
		I-5 Mixed West Side	0	0
		I-5 Mixed West Side/Median	0	0
		30th Avenue S. At-Grade Median	0	0
		30th Avenue S. Elevated Median	0	0
		30th Avenue S. Elevated East Side	0	0
		30th Avenue S. Elevated West Side	0	0
		24th Avenue S. At-Grade Median	0	0
		24th Avenue S. Elevated Median	0	0
		24th Avenue S. Elevated East Side	0	0
C	S. 244th Street to S. 280th Street	SR 99 At-Grade Median	0	0
		SR 99 Mixed Median	0	0
		SR 99 Elevated Median	0	0
		SR 99 Elevated East Side	0	0
		SR 99 Elevated West Side	0	0
		I-5 Mixed West Side	0	0
		I-5 Mixed West Side/Median	0	0.1
D	S. 280th Street to S. 320th Street	SR 99 At-Grade Median	0	0
		SR 99 Mixed Median	0	0

Segment	Description	Alternative	Parks Directly Affected (acres)	Parks Indirectly Affected (acres)
		SR 99 Elevated Median	0	0
		SR 99 Elevated East Side	0	0
		SR 99 Elevated West Side	0	0
		I-5 Mixed West Side	0	0.4
		I-5 Mixed West Side/Median	0	0

6.6.4 Number of Community Facilities Affected

For Level 1, community facilities have been defined as schools, libraries, and religious institutions, based on available information from the King County Assessor. These social centers and important meeting areas unify the community as well as provide vital services to communities. **Table 6-19** shows the total number of these resources that could be directly and indirectly affected for each alternative, while **Table 6-20** shows the effects by segment. **Exhibit 6-12** identifies school, church, and government parcels within 100 to 200 feet of each alternative.

Methodology

Community facilities are directly affected if located within 100 feet of the centerline of the alternative. They are indirectly affected if located between 100 to 200 feet from the centerline. As the alternatives are refined, many potential effects may be avoided or mitigated; therefore, this measure is intended to show relative differences among the alternatives.

Key Results

- SR 99 median alternatives and the 24th Avenue S. alternatives have the highest potential to affect community facilities, followed by the SR 99 Elevated West Side alternative.
- The 30th Avenue S. alternatives have no affected community facilities.
- Segment A has the most affected community facilities.

Discussion of Results

In Segment B, the 24th Avenue S. alternatives have at least two more facilities directly affected than the other alternatives. Community facilities are more prevalent in the area of Segment C. The I-5 alternatives have the least potential effects within this segment. In Segment D, the SR 99 At-Grade Median alternative, the SR 99 Mixed Median alternative, the SR 99 Elevated Median alternative, and the I-5 Mixed West Side alternative all have one effect each, while all other alternatives have zero.

TABLE 6-19
Community Facilities – Effects by Alternative

Alternative	Number of Facilities Directly Affected	Number of Facilities Indirectly Affected
SR 99 At-Grade Median	4	1
SR 99 Mixed Median	4	1
SR 99 Elevated Median	4	1
SR 99 Elevated East Side	1	3
SR 99 Elevated West Side	3	2
I-5 Mixed West Side	3	1
I-5 Mixed West Side/Median	1	0
30th Avenue S. At-Grade Median	4	0
30th Avenue S. Elevated Median	4	0
30th Avenue S. Elevated East Side	1	3
30th Avenue S. Elevated West Side	3	1
24th Avenue S. At-Grade Median	9	0
24th Avenue S. Elevated Median	9	0
24th Avenue S. Elevated East Side	6	3

TABLE 6-20
Community Facilities – Effects by Segment

Segment	Description	Alternative	Number of Facilities Directly Affected	Number of Facilities Indirectly Affected
A	Angle Lake Station to S. 220th Street	SR 99 At-Grade Median	0	0
		SR 99 Mixed Median	0	0
		SR 99 Elevated Median	0	0
		SR 99 Elevated East Side	0	0
		SR 99 Elevated West Side	0	0
		I-5 Mixed West Side	0	0
		I-5 Mixed West Side/Median	0	0
		24th Avenue S. At-Grade Median	2	0
		24th Avenue S. Elevated Median	2	0
		24th Avenue S. Elevated East Side	2	0
B	S. 220th Street to S. 244th Street	SR 99 At-Grade Median	0	1
		SR 99 Mixed Median	0	1
		SR 99 Elevated Median	0	1
		SR 99 Elevated East Side	0	0
		SR 99 Elevated West Side	0	1
		I-5 Mixed West Side	1	0
		I-5 Mixed West Side/Median	1	0
		30th Avenue S. At-Grade Median	0	0
		30th Avenue S. Elevated Median	0	0
		30th Avenue S. Elevated East Side	0	0
		30th Avenue S. Elevated West Side	0	0
		24th Avenue S. At-Grade Median	3	0
		24th Avenue S. Elevated Median	3	0
		24th Avenue S. Elevated East Side	3	0
C	S. 244th Street to S. 280th Street	SR 99 At-Grade Median	3	0
		SR 99 Mixed Median	3	0
		SR 99 Elevated Median	3	0
		SR 99 Elevated East Side	1	2
		SR 99 Elevated West Side	2	1
		I-5 Mixed West Side	1	0
		I-5 Mixed West Side/Median	0	0
D	S. 280th Street to S. 320th Street	SR 99 At-Grade Median	1	0
		SR 99 Mixed Median	1	0
		SR 99 Elevated Median	1	0
		SR 99 Elevated East Side	0	1
		SR 99 Elevated West Side	1	0
		I-5 Mixed West Side	1	1
		I-5 Mixed West Side/Median	0	0

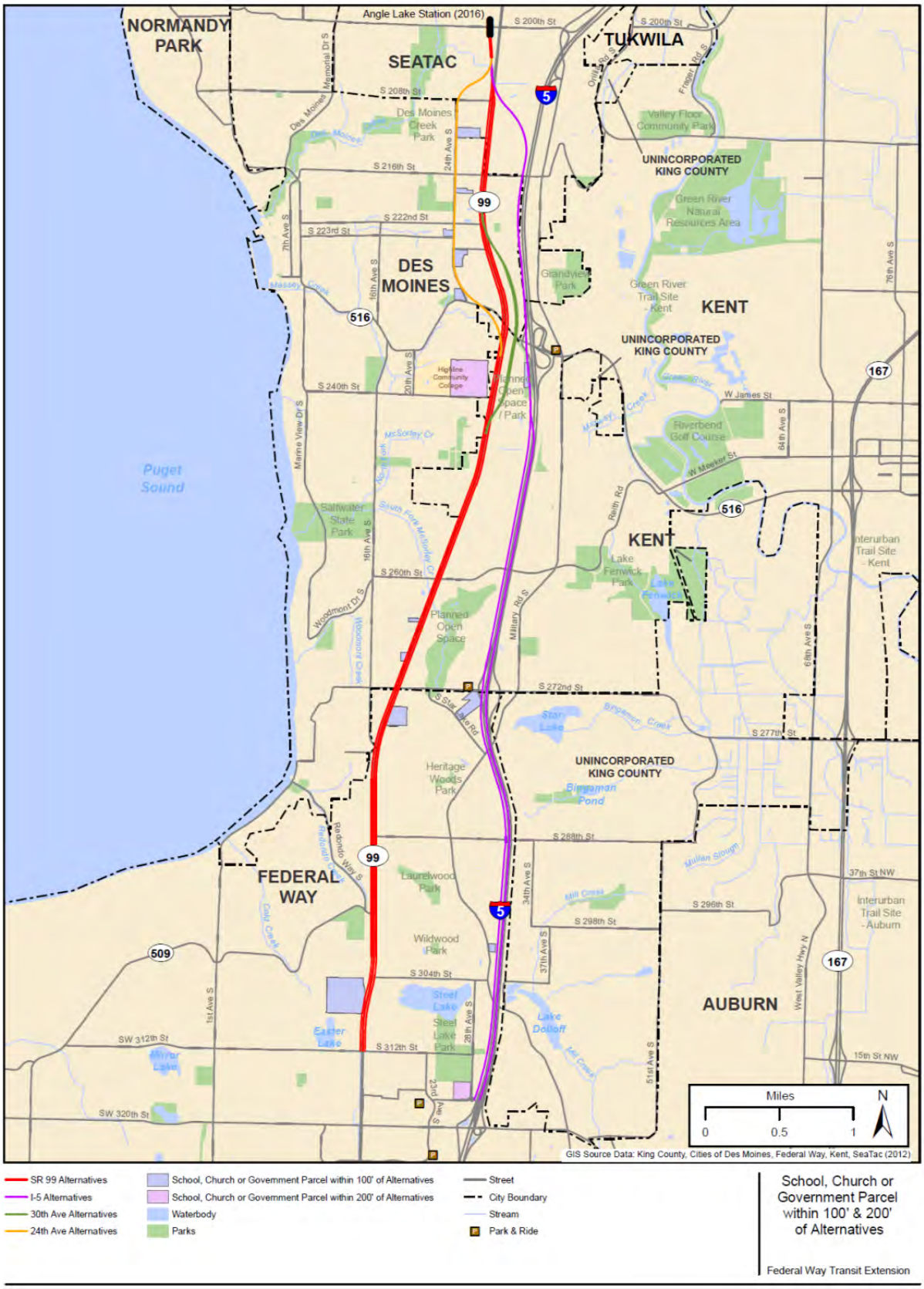


EXHIBIT 6-12

School, Church, or Government Parcel 100' and 200' of Alternatives

6.6.5 Effects on Known or Eligible Historic or Other Sensitive Properties

A preliminary visual review of properties along each alternative and research of historic property databases has not resulted in the identification of any properties eligible for listing on the National Register of Historic Places that would be potentially affected by the Level 1 alternatives.

6.6.6 Number of Potentially Affected Noise Receptors

Noise sensitive receivers were evaluated for Level 1 based on FTA criteria in the *Transit Noise and Vibration Impact Assessment* (FTA 2006), which groups noise sensitive land uses into the following categories:

- Category 1: Buildings or parks where "quiet" is an essential element of their purpose.
- Category 2: Residences and buildings where people normally sleep, including residences, hospitals, and hotels where nighttime sensitivity is assumed to be important.
- Category 3: Institutional land uses with primarily daytime and evening use, including schools, libraries, churches and certain parks used for passive recreation.

Methodology

Within the FWTE study area, potential noise sensitive receivers evaluated for Level 1 include residences and hotels (Category 2 receivers) and schools and churches (Category 3 receivers). All Category 2 receivers would be assumed to have a high potential for noise effects at distances of up to 175 feet from the track. Category 2 receivers along elevated alternatives or in areas with little or no shielding from at-grade alternatives would be considered to have a high potential for noise effects out to 350 feet from the alignment. Schools and churches were considered if within 175 feet of the alternative with no obstructions, based on King County Assessor property data. Additional Category 3 receivers could be identified (and effects on them considered during Level 2 screening) once field verification is completed. Only minimal physical and topographical shielding was considered and used to reduce effects.

Key Results

- The I-5 alternatives have the highest number of potential noise effects.
- 30th Avenue S. and 24th Avenue S. alternatives also have a high number of potential noise effects.
- 24th Avenue S. alternatives have the highest number of schools and churches that could be affected.

Discussion of Results

Table 6-21 summarizes the effects for the entire I-5 and SR 99 alternatives, while **Table 6-22** summarizes these effects by segments and includes effects for the 24th Avenue S. and 30th Avenue S. alternatives. The I-5 Mixed West Side alternative has the greatest potential for noise

effects, while the I-5 Mixed West/Median and SR 99 Elevated alternatives (median, east, and west) would all have similar effects. The SR 99 At-Grade Median alternative would have the least potential for effects overall.

TABLE 6-21
Potential for Noise Effects by Alternative

Alternative	Category 2 Noise Sensitive Receivers (Residences)	Category 3 Noise Sensitive Receivers (Schools, Churches)
SR 99 At-Grade Median	380	9
SR 99 Mixed Median	600	9
SR 99 Elevated Median	818	9
SR 99 Elevated East Side	874	11
SR 99 Elevated West Side	856	9
I-5 Mixed West Side	963	4
I-5 Mixed West Side/Median	808	3
30th Avenue S. At-Grade Median	715	9
30th Avenue S. Elevated Median	1,114	9
30th Avenue S. Elevated East Side	1,196	11
30th Avenue S. Elevated West Side	1,190	9
24th Avenue S. At-Grade Median	446	10
24th Avenue S. Elevated Median	692	11
24th Avenue S. Elevated East Side	861	13

As shown in **Table 6-22**, the SR 99 At-Grade Median alternative would have the lowest potential for noise effects in Segment A, with 41 Category 2 receivers. The I-5 alternatives would have the greatest potential effect, with over 230 Category 2 receivers. At this level of evaluation, only one Category 3 receiver was identified in Segment A. This Category 3 receiver is present along all SR 99 alternatives.

In Segment B, the elevated 30th Avenue S. alternatives would have the greatest potential for effects, with over 500 Category 2 receivers; while the 30th Avenue S. At-Grade Median alternative has 357. The SR 99 Median At-Grade alternative would have the least, with 22. The remaining SR 99 alternatives and the 24th Avenue S. alternatives would all have between 88 and 214 Category 2 receivers. The I-5 alternatives have 335 Category 2 receivers. The 24th Avenue S. alternatives have the greatest number of Category 3 receivers, with four, while the SR 99, I-5, and 30th Avenue S. alternatives have two.

In Segment C, the SR 99 At-Grade Median alternative would have the lowest number of Category 2 receivers, with 44, while the remaining SR 99 alternatives and the I-5 alternatives have a similar number, with between 109 and 193 Category 2 receivers. The SR 99 alternatives have two Category 3 receivers identified, while the I-5 alternatives have one.

TABLE 6-22
Potential for Noise Effects by Segment

Segment	Description	Alternative	Category 2 Noise Sensitive Receivers (Residences)	Category 3 Noise Sensitive Receivers (Schools, Churches)
A	Angle Lake Station to S. 220th Street	SR 99 At-Grade Median	41	1
		SR 99 Mixed Median	70	1
		SR 99 Elevated Median	97	1
		SR 99 Elevated East Side	106	1
		SR 99 Elevated West Side	87	1
		I-5 Mixed West Side	233	0
		I-5 Mixed West Side/Median	233	0
B	S. 220th Street to S. 244th Street	SR 99 At-Grade Median	22	2
		SR 99 Mixed Median	118	2
		SR 99 Elevated Median	214	2
		SR 99 Elevated East Side	188	2
		SR 99 Elevated West Side	176	2
		I-5 Mixed West Side	335	2
		I-5 Mixed West Side/Median	335	2
		30th Avenue S. At-Grade Median	357	2
		30th Avenue S. Elevated Median	510-537[a]	2
		30th Avenue S. Elevated East Side	510-537 [a]	2
		30th Avenue S. Elevated West Side	510-537 [a]	2
		24th Avenue S. At-Grade Median	88	3
		24th Avenue S. Elevated Median	88	4
		24th Avenue S. Elevated East Side	175	4
C	S. 244th Street to S. 280th Street	SR 99 At-Grade Median	44	2
		SR 99 Mixed Median	100	2
		SR 99 Elevated Median	155	2
		SR 99 Elevated East Side	180	2
		SR 99 Elevated West Side	193	2
		I-5 Mixed West Side	148	1
		I-5 Mixed West Side/Median	109	1
D	S. 280th Street to S. 320th Street	SR 99 At-Grade Median	273	4
		SR 99 Mixed Median	312	4
		SR 99 Elevated Median	352	4
		SR 99 Elevated East Side	400	6
		SR 99 Elevated West Side	400	4
		I-5 Mixed West Side	247	1
		I-5 Mixed West Side/Median	131	0

[a] Range is based on connection to SR 99 or I-5 in Segment C. The lower value is for the connection to SR 99 and the higher value is for the connection to I-5.

In Segment D, the I-5 Mixed West Side/Median alternative has the lowest number of Category 2 receivers with 131, while the SR 99 side running elevated alternatives (east and west) has 400. All SR 99 alternatives except the SR 99 Elevated East Side alternative have four Category 3 receivers identified. The SR 99 Elevated East Side alternative has the most Category 3 receivers (six). The I-5 Mixed West Side alternative has one Category 3 receiver, while the I-5 Mixed West Side/Median alternative has no Category 3 receivers.

6.6.7 LOS at Intersections; Evaluation of Capacity/Flow (existing conditions) and Traffic Circulation and Access Number of Mid-block Opportunities

Potential traffic effects include (1) increased waiting time at intersections, which affects an intersection's Level of Service (LOS) and (2) access restriction effect. **Table 6-23** shows the total number of effects from each alternative under each category. **Table 6-24** shows the effects by segment.

Methodology

To determine potential LOS effects, local agencies' transportation plans were reviewed to identify intersections within each at-grade only alternative alignment area that are currently operating at LOS F.

Potential access effects could occur when an alternative restricts access at un-signalized intersections/side streets or when they restrict access to existing U-turns or left-turn lanes that provide indirect access to properties across busy roadways. SR 99 has a number of these points because the roadway has a landscaped median that restricts left turns. As a result, the number of locations where turns would be restricted was identified at un-signalized intersections, mid-block U-turns, or median left-turn lane areas. It was assumed that these turn movements across the track would not remain under project conditions unless they would be protected by gates or signals.

Key Results

- Only the SR 99 At-Grade Median alternative would likely have LOS effects.
- Only the SR 99 Median and 30th Avenue S. Median alternatives are expected to result in restricted access effects at properties and side streets.

Discussion of Results

In general, alternatives located in the median of roadways would have the greatest traffic effects, unless they are along I-5. The I-5 alternatives, the SR 99 Elevated East Side alternative, and the SR 99 Elevated West Side alternative are not expected to have any access restriction effects or LOS effects. The SR 99 At-Grade Median and Elevated Median alternatives are the only alternatives to have potential LOS effects. The most substantial traffic impacts of these

alternatives would occur at three intersections: SR 99 and S. 216th Street, SR 99 and SR 516/Kent Des Moines Road S., and SR 99 and S. 272nd Street. All three SR 99 alternatives in the median would have the same number of potential access effects at side streets (12) and to properties indirectly affected by restricted U-turn and two-way left-turn lane movements (83).

TABLE 6-23
Traffic – Effects by Alternative

Alternative	Number of Affected LOS F Intersections	Number of Unsignalized Intersections/Side Streets Affected	Number of Properties Affected (U-turn or left turn access)
SR 99 At-Grade Median	3	12	83
SR 99 Mixed Median	0	12	83
SR 99 Elevated Median	0	12	83
SR 99 Elevated East Side	0	0	0
SR 99 Elevated West Side	0	0	0
I-5 Mixed West Side	0	0	0
I-5 Mixed West Side/Median	0	0	0
30th Avenue S. At-Grade Median	2	15	115
30th Avenue S. Elevated Median	0	15	115
30th Avenue S. Elevated East Side	0	0	0
30th Avenue S. Elevated West Side	0	0	0
24th Avenue S. At-Grade Median	1	17	110
24th Avenue S. Elevated Median	0	17	110
24th Avenue S. Elevated East Side	0	0	0

The greatest number of potential LOS effects would occur in Segments A, B, and C where one intersection in each segment could be affected by the SR 99 At-Grade Median alternative. These are the only potential LOS effects identified.

Within Segment A, the two 24th Avenue S. alternatives in the median would have access effects that could potentially affect 28 properties, which is the highest in this segment. These alternatives would also affect access at two side streets, which is the greatest within this segment. The 30th Avenue S. Elevated East Side and 30th Avenue S. Elevated West Side alternatives would not result in any traffic effects in Segment B. The 24th Avenue S. Elevated East Side alternative would not have traffic effects in Segments A or B.

TABLE 6-24
Traffic– Effects by Segment

Segment	Description	Alternative	Affected LOS F Intersections	Un-signalized Intersections/ Side Streets Affected	Properties Affected (U-turn or left-turn access)
A	S. 200th to S. 220th Street	SR 99 At-Grade Median	1	1	11
		SR 99 Mixed Median	0	1	11
		SR 99 Elevated Median	0	1	11
		SR 99 Elevated East Side	0	0	0
		SR 99 Elevated West Side	0	0	0
		I-5 Mixed West Side	0	0	0
		I-5 Mixed West Side/Median	0	0	0
		24th Avenue S. At-Grade Median	0	2	28
		24th Avenue S. Elevated Median	0	2	28
		24th Avenue S. Elevated East Side	0	0	0
B	S. 220th to S.244th Street	SR 99 At-Grade Median	1	1	29
		SR 99 Mixed Median	0	1	29
		SR 99 Elevated Median	0	1	29
		SR 99 Elevated East Side	0	0	0
		SR 99 Elevated West Side	0	0	0
		I-5 Mixed West Side	0	0	0
		I-5 Mixed West Side/Median	0	0	0
		30th Avenue S. At-Grade Median	0	4	61
		30th Avenue S. Elevated Median	0	4	61
		30th Avenue S. Elevated East Side	0	0	0
		30th Avenue S. Elevated West Side	0	0	0
		24th Avenue S. At-Grade Median	0	5	39
		24th Avenue S. Elevated Median	0	5	39
		24th Avenue S. Elevated East Side	0	0	0
C	S. 244th to S. 280th Street	SR 99 At-Grade Median	1	8	36
		SR 99 Mixed Median	0	8	36
		SR 99 Elevated Median	0	8	36
		SR 99 Elevated East Side	0	0	0
		SR 99 Elevated West Side	0	0	0
		I-5 Mixed West Side	0	0	0
		I-5 Mixed West Side/Median	0	0	0
D	S. 280th to S. 320th Street	SR 99 At-Grade Median	0	2	7
		SR 99 Mixed Median	0	2	7
		SR 99 Elevated Median	0	2	7
		SR 99 Elevated East Side	0	0	0
		SR 99 Elevated West Side	0	0	0
		I-5 Mixed West Side	0	0	0
		I-5 Mixed West Side/Median	0	0	0

Segment B would have the most potential properties affected by restricted U-turn and two-way left turn lane movements. This effect would occur with the 30th Avenue S. alternatives in the median and could affect 61 properties. Within Segment B, the greatest number of effects to side streets (5) would occur with the 24th Avenue S. median alternatives.

Overall, the greatest effect to side street access would occur in Segment C. This effect is associated with the three SR 99 alternatives in the median, which could affect access at eight intersections or side streets. In Segment C, all three SR 99 alternatives in the median could also affect access at 36 properties.

Although there would be no LOS effects in Segment D, the SR 99 median alternatives could affect access to two side streets and seven properties in this segment. These effects are relatively low when compared to effects identified in other segments.

6.7. Design Considerations

6.7.1 Potential Utility Relocation

Methodology

Existing utility location information for major power transmission lines and gas lines within Segment A (Angle Lake Station to S. 220th Street) were collected to identify potential relocation needs by Level 1 alternative. A more detailed evaluation of utility relocation requirements will be conducted as part of Level 2 after the engineering design process has advanced.

Key Results

The following two major utilities, both owned by Puget Sound Energy (PSE), have been identified for their potential to affect the suitability of Level 1 alternatives:

- High-level power transmission lines in all segments
- A high-pressure gas main in Segment A.

Discussion of Results

Sound Transit requires a minimum of 20 feet of clearance between its Overhead Catenary System (OCS) wires and any power lines. In multiple locations, existing power transmission lines would need to be relocated to accommodate a rail guideway. PSE has indicated that the steel lattice towers on either side of I-5 near S. 224th Street would have to be replaced given their age and structure type related to raising these transmission lines.

A high pressure gas main is currently located within Segment A. The alternatives on SR 99 and 24th Avenue S. would have a potential conflict with it; however, the I-5 alternatives would avoid it. Initial potential major utility conflicts are shown for each alternative in **Table 6-25**.

TABLE 6-25
Potential Major Utility Conflicts Identified

Alternative	Potential Conflict Identified	
	Major Power Transmission Line	Gas Line in Segment A
SR 99 At-Grade Median	Yes	Yes
SR 99 Mixed Median	Yes	Yes
SR 99 Elevated Median	Yes	Yes
SR 99 Elevated East Side	Yes	Yes
SR 99 Elevated West Side	Yes	Yes
I-5 Mixed West Side	Yes	No
I-5 Mixed West Side/Median	Yes	No
30th Avenue S. At-Grade Median	Yes	No
30th Avenue S. Elevated Median	Yes	No
30th Avenue S. Elevated East Side	Yes	No
30th Avenue S. Elevated West Side	No	No
24th Avenue S. At-Grade Median	Yes	Yes
24th Avenue S. Elevated East Side	Yes	Yes
24th Avenue S. Elevated Median	Yes	Yes

6.7.2 High Risk Hazardous Materials

Methodology

Information on reported contaminated sites within ¼ mile of the alternative centerline was collected using a database research company and evaluated to determine which ones should be considered high risk for purposes of the project. The ¼ mile distance was used to identify sites that could be directly within the project footprint or could have contaminated groundwater that has spread within the project footprint.

The presence of contaminated sites in the project area can affect a project in several ways:

- Investigation may be required to determine the potential construction cost impacts of the contaminated site
- Property acquisition cost could be lowered to account for the cost of mitigation during construction
- Contaminated properties that are acquired may require remediation in order to serve their intended purpose on the project (such as a station, maintenance facility, etc.). Engineering controls (such as vapor intrusion mitigation) may also be required.

Key Results

The 30th Avenue S. alternatives had the greatest number of high-risk sites, with a total of 77 for the entire length. The I-5 alternatives had the least, with 23 for the entire length.

High risk sites are defined as sites that might be substantially contaminated and might create liability for Sound Transit either due to construction activities or by virtue of acquiring all or a portion of the site, such as for a maintenance facility. The ¼ mile distance was used to identify

sites that could be directly within the project footprint, or could have contaminated groundwater that has spread within the project footprint.

Discussion of Results

Table 6-26 shows total high risk sites by alternative. **Table 6-27** shows total high risk sites by segment. **Exhibit 6-13** maps the location of the identified high risk hazardous material sites.

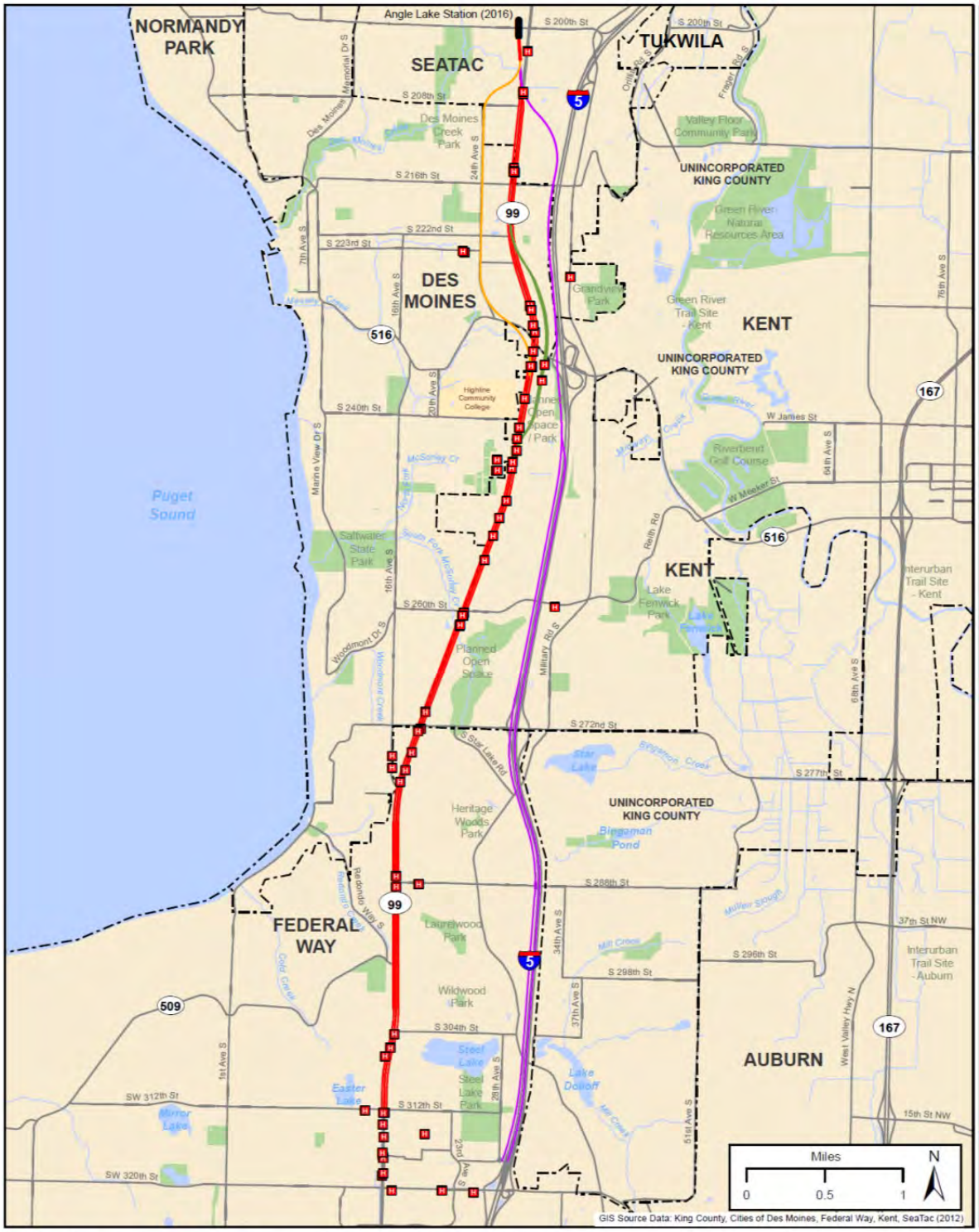
TABLE 6-26
Total High Risk Sites within Study Area by Alternative

Alternative	High Risk Sites within ¼ mile
SR 99 At-Grade Median	75
SR 99 Mixed Median	75
SR 99 Elevated Median	75
SR 99 Elevated East Side	75
SR 99 Elevated West Side	75
I-5 Mixed West Side	23
I-5 Mixed West Side/Median	23
30th Avenue S. At-Grade Median	77
30th Avenue S. Elevated Median	77
30th Avenue S. Elevated East Side	77
30th Avenue S. Elevated West Side	77
24th Avenue S. At-Grade Median	70
24th Avenue S. Elevated Median	70
24th Avenue S. Elevated East Side	70

Within Segment A, the SR 99 alternatives would have nine sites within ¼ mile, compared with three for the I-5 alternatives. Within Segment B, the number of sites is more similar between corridors, with 19 sites for the I-5 alternatives, 25 sites for the SR 99 alternatives, and 27 sites for the 30th Avenue S. alternatives. Within Segment C, the SR 99 alternatives would have substantially more sites within ¼ mile than the other corridor, with 24 sites compared to one in for the I-5 alternatives. However, in Segment C, the I-5 alternatives must address the closed Midway Landfill. Disturbance of the landfill cap for placement of structures presents issues related to engineering design as well as construction, such as movement of waste, potential presence of leachate, cover and liner repair, potential presence of landfill gas, and potential presence of contaminated groundwater. Because the landfill is a Superfund site, regulatory issues will need to be addressed as well. The City of Seattle has recorded an environmental lien (restrictive covenant) on the property. Its provisions have not been determined at this time. In Segment D, there are no sites within ¼ mile of the I-5 alternatives, while there are 17 within ¼ mile of the SR 99 alternatives.

TABLE 6-27
High Risk Sites by Segment for Each Alternative

Segment	Description	Alternative	High Risk Sites within ¼ mile
A	Angle Lake Station to S. 220th Street	SR 99 At-Grade Median	9
		SR 99 Mixed Median	9
		SR 99 Elevated Median	9
		SR 99 Elevated East Side	9
		SR 99 Elevated West Side	9
		I-5 Mixed West Side	3
		I-5 Mixed West Side/Median	3
		24th Avenue S. At-Grade Median	9
		24th Avenue S. Elevated East Side	9
		24th Avenue S. Elevated Median	9
B	S. 220th Street to S. 244th Street	SR 99 At-Grade Median	25
		SR 99 Mixed Median	25
		SR 99 Elevated Median	25
		SR 99 Elevated East Side	25
		SR 99 Elevated West Side	25
		I-5 Mixed West Side	19
		I-5 Mixed West Side/Median	19
		30thAvenue S. At-Grade Median	27
		30thAvenue S. Elevated Median	27
		30thAvenue S. Elevated East Side	27
		30thAvenue S. Elevated West Side	27
		24th Avenue S. At-Grade Median	20
		24th Avenue S. Elevated East Side	20
		24th Avenue S. Elevated Median	20
C	S. 244th Street to S. 280th Street	SR 99 At-Grade Median	24
		SR 99 Mixed Median	24
		SR 99 Elevated Median	24
		SR 99 Elevated East Side	24
		SR 99 Elevated West Side	24
		I-5 Mixed West Side	1
		I-5 Mixed West Side/Median	1
D	S. 280th Street to S. 320th Street	SR 99 At-Grade Median	17
		SR 99 Mixed Median	17
		SR 99 Elevated Median	17
		SR 99 Elevated East Side	17
		SR 99 Elevated West Side	17
		I-5 Mixed West Side	0
		I-5 Mixed West Side/Median	0



SR 99 Alternatives
I-5 Alternatives
30th Ave Alternatives
24th Ave Alternatives
Waterbody
Parks
Street
City Boundary
Stream
Hazardous Materials

High Risk Hazardous Materials Locations

Federal Way Transit Extension

EXHIBIT 6-13
High Risk Hazardous Materials Locations

6.7.3 Geologic Hazards

The Washington State Growth Management Act (GMA) (Revised Code of Washington Chapter 36.70A) requires all cities and counties to identify critical areas within their jurisdictions and to formulate development regulations for their protection. The GMA defines critical areas, including geologically hazardous areas, as areas that are susceptible to erosion, sliding, earthquake, or other geological events; therefore, they are not suited to the siting of commercial, residential, or industrial development consistent with public health or safety concerns.

Methodology

The FWTE passes through four cities (SeaTac, Des Moines, Kent, and Federal Way) and King County, all of which have defined geologically hazardous areas in their respective codes. These definitions and maps were reviewed to evaluate geologic hazards. Mapped geologic hazards are shown on **Exhibit 6-14**. Erosion hazard areas are not shown, although most of the project area would be subject to erosion during construction without the use of best management practices (BMPs).

Key Results

- Portions of the alternatives cross or extend onto areas mapped as erosion and steep slope hazards. These hazard areas are not likely to affect alternative selection because they appear to be relatively minor and can be addressed by typical BMPs and construction practices.
- Seismic and settlement hazard areas are present in limited areas in Segment C and could be a factor in determining the final location of the station near S. 272nd Street.
- Issues related to crossing the Midway Landfill could markedly affect cost of alternatives along I-5 in Segment C.

Discussion of Results

Segment A (Angle Lake Station to S. 220th Street)

Geologic hazards in this segment include erosion and steep slope hazards, both of which can be addressed by typical BMPs and construction practices.

Segment B (S. 220th Street to S. 244th Street)

Mapped geologic hazards in this segment include erosion and steep slope hazards, both of which can be addressed by typical BMPs and construction practices.

Segment C (S. 244th Street to S. 280th Street)

Mapped geologic hazards in this segment include erosion and steep slope hazards, both of which can be addressed by typical BMPs and construction practices.

The Midway Landfill is a 60-acre former gravel quarry that was used as an unlined landfill from 1966 to 1983, ultimately taking approximately 3,000,000 cubic yards of waste, including demolition debris and municipal waste. The landfill was originally capped in 1983. Beginning in 1985, combustible gas was detected in nearby houses. The site has since been cleaned up by the City of Seattle with oversight from Washington Department of Ecology. The current landfill is capped and there are numerous wells in place to capture gases from below the cap.

Alternatives along the west side of I-5 will cross the Midway Landfill and the mitigation and construction costs associated with this crossing would affect the alternative selection for Segment C. These costs include increased effort for design and permitting as well as increased construction costs due to the unknown quantity but likely contaminated character of the undocumented landfill debris.

There is a large area of wetland soils (identified as a seismic and settlement hazard area) bounded by S. 260th Street to the north, SR 99 to the west, S. 272nd Street to the south, and I-5 to the east. The selection of the location for the station at S. 272nd Street could be influenced by the presence of seismic and settlement hazards. Decisions on preferred foundation types would be affected by the presence of these hazards, as would the performance of surface parking facilities.

Segment D (S. 280th Street to S. 320th Street)

Mapped geologic hazards in this segment include erosion and steep slope hazards, both of which can be addressed by typical BMPs and construction practices.

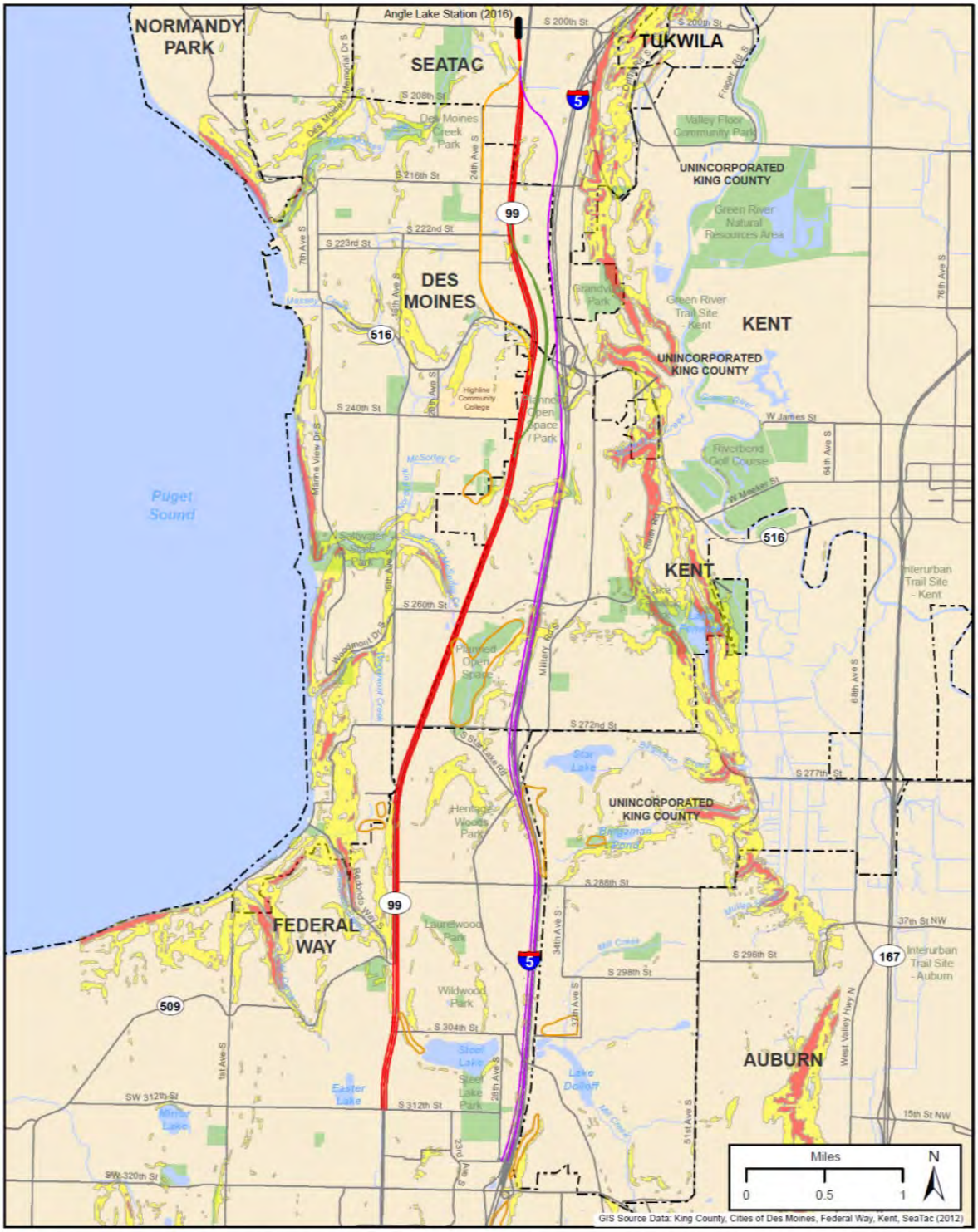


EXHIBIT 6-14
Geologic Hazards

6.7.4 Park-and-Ride Lot Locations

Park-and-Ride (P&R) facilities expand the effective service area of individual transit routes and the transit system as a whole. These facilities would be critical for attracting passengers who either prefer to access the FWTE by automobile or who have no other efficient/viable means of access.

Methodology

Eight P&R locations have been initially identified in the study area, as listed in **Table 6-28**. Based on the proximity of these facilities to each alternative, the number of parking stalls and observed utilization rates were summed to identify the total parking availability for each alternative. For purposes of calculating total parking availability, the minimum number of parking spaces (700) is assumed for the Angle Lake Station P&R. The location of the eight P&R facilities, along with three additional existing P&R facilities near the study area, are shown in **Exhibit 6-15**.

TABLE 6-28
Park-and-Ride Options

P&R Lot	Parking Capacity (spaces)	Utilization	Utilization Rate
Angle Lake Station *	700-1,100	N/A	N/A
Kent/Des Moines P&R Lot	370	345	93%
Redondo Heights P&R Lot	697	56	8%
Star Lake P&R Lot	540	292	54%
All Saints Lutheran Church**	75	63	84%
St. Columba's Episcopal Church **	15	1	7%
Federal Way P&R Lot (south of S. 320th St.)	877	349	40%
Federal Way Transit Center	1,190	1,177	99%

Note: Parking Utilization from KCM Park-and-Ride Lot Utilization – 4th Qtr 2011
* 1,100 parking spaces when station is an interim terminus; 700 spaces when the LRT line is extended to the south.
** leased lots

Key Results

- I-5 alternatives are closer to more parking spaces than the SR 99 alternatives; however, based on current utilization there are more potential parking available spaces in close proximity to SR 99.

Discussion of Results

Three P&R facilities are assumed to be relevant to all alternatives (Angle Lake Station, Federal Way P&R Lot, and Federal Way Transit Center). These three stations account for a majority of the parking available (2,767 total spaces and 1,241 net parking spaces available based on current utilization). The I-5 alternatives are near or adjacent to four additional P&R facilities (Kent/Des Moines P&R Lot, Star Lake P&R Lot, All Saints Lutheran Church, and St. Columbia's Episcopal Church). SR 99 is adjacent to one additional P&R lot (Redondo Heights P&R Lot).

Based on existing capacity and availability, the SR 99 alternatives have 303 fewer total parking spaces than the I-5 alternatives; however, the SR 99 alternatives have 342 more available parking spaces than the I-5 alternatives. This is primarily because the Redondo Heights P&R Lot has limited commuter-oriented transit service to downtown Seattle and is currently only eight percent utilized. Based on the location of the eight P&Rs considered, the 30th Avenue S. and 24th Avenue S. alternatives would have the same capacity as the SR 99 alternatives if coupled with SR 99. **Table 6-29** provides the total P&R parking capacity and net available parking by alternative.

TABLE 6-29
Park-and-Ride Capacity

Alternative	P&R Total Parking Capacity	Net Parking Capacity Available Based on Current Utilization
SR 99 At-Grade Median	3,864	1,882
SR 99 Mixed Median	3,864	1,882
SR 99 Elevated Median	3,864	1,882
SR 99 Elevated East	3,864	1,882
SR 99 Elevated West	3,864	1,882
I-5 Elevated Mixed West	4,167	1,540
I-5 Elevated Mixed/Median	4,167	1,540
30th Avenue S. At-Grade Median	3,864	1,882
30th Avenue S. Elevated Median	3,864	1,882
30th Avenue S. Elevated East	3,864	1,882
30th Avenue S. Elevated West	3,864	1,882
24th Avenue S. At-Grade Median	3,864	1,882
24th Avenue S. Elevated Median	3,864	1,882
24th Avenue S. Elevated East	3,864	1,882

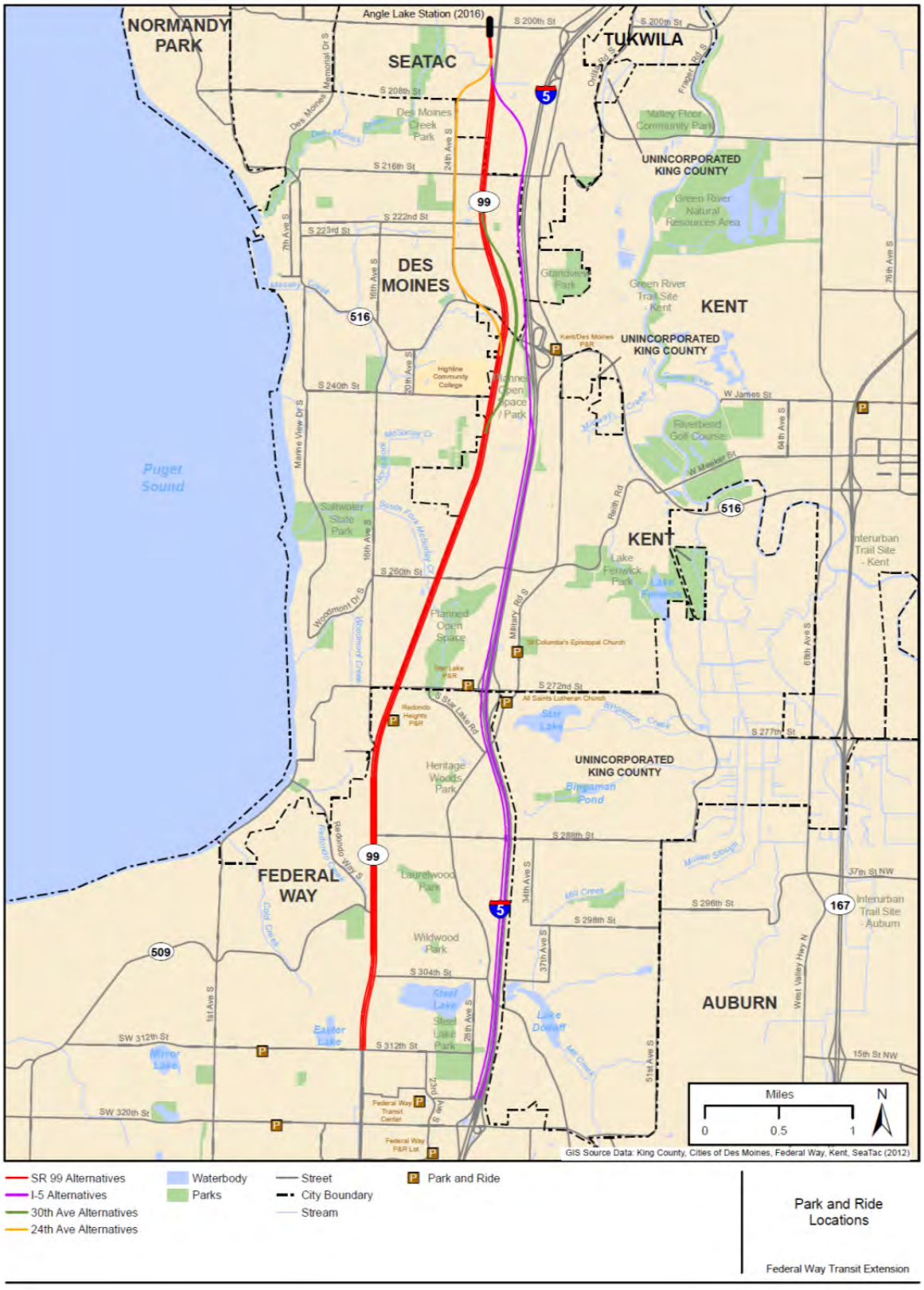


EXHIBIT 6-15
Existing Park-and- Ride Locations

6.8. System Costs

6.8.1 Estimated Capital Cost (2013$)

Methodology

Preliminary capital cost estimates have been prepared for all Level 1 alternatives. For each alternative, a low and high end cost value was estimated to accommodate unforeseen variables not identified during Level 1 conceptual design. The Lynnwood Link Extension Project's Unit Cost Library was used to inform base unit costs for all estimates. Additional unit cost information was sourced from the ST2 Unit Cost Library and other relevant regional projects, including SR 509.

A summary of the capital cost estimates by alternative are presented in **Table 6-30**.

TABLE 6-30
Estimated Capital Costs (2013 $billion)

Alternative	Low End of Range Capital Cost Estimate	High End of Range Capital Cost Estimate
SR 99 At-Grade Median	$1.1	$1.3
SR 99 Mixed Median	$1.2	$1.3
SR 99 Elevated Median	$1.5	$1.7
SR 99 Elevated East	$1.6	$1.9
SR 99 Elevated West	$1.6	$1.8
I-5 Elevated Mixed West	$1.3	$1.5
I-5 Elevated Mixed/Median	$1.5	$1.7
30th Avenue S. At-Grade Median	$1.4	$1.6
30th Avenue S. Elevated Median	$1.5	$1.7
30th Avenue S. Elevated East	$1.5	$1.7
30th Avenue S. Elevated West	$1.5	$1.7
24th Avenue S. Elevated Median	$1.5	$1.7
24th Avenue S. Elevated East	$1.5	$1.7
24th Avenue S. At-Grade Median	$1.4	$1.7

Detailed estimates were produced according to FTA Standard Cost Categories (SCC), which are:

10. Guideway and Track Elements
20. Stations, Stops, Terminals, Intermodals
30. Yards, Shop, Administration/Support Facilities (Note: this cost category is not included in the Level 1 capital cost estimates but will be developed by Sound Transit and provided in later phases)
40. Sitework and Special Conditions
50. Systems
60. Right-of-Way, Land, Existing Improvements
70. Vehicles
80. Soft Costs
90. Unallocated Contingency
100. Finance Charges (Note: This cost category is not included in the Level 1 capital cost estimates but is incorporated in the Sound Transit Financial Model)

Costs for categories 10, 20, 40, and 50 were derived from the alternatives, while costs for categories 60, 70, and 80 were derived from ST guidance. Allocated contingencies applied to the different cost code categories vary from 15 percent to 33 percent depending on the category.

Several key design considerations have been identified at the conceptual design level that help inform this Level 1 capital cost estimate:

- At-grade alternatives are more likely to feature constraints to train speed and reliability in the form of curves, crossings, and potential trackway intrusions. Elevated guideway alternatives feature a higher degree of exclusivity, which leads to faster and more reliable train operations.
- All of the Level 1 alternatives have the design challenge of crossing the SR 509 alignment, which is likely to require multiple long spans.
- Matching the existing roadway profile could be disadvantageous if grades are in excess of LRT vehicle capabilities or if vertical curves do not meet design criteria; these issues could result in reduced operating speeds.

In addition to the Level 1 evaluation general design considerations, several key alternative-specific design considerations have also been identified that help drive the Level 1 cost estimates.

The SR 99 Mixed Median alternative features potential track geometry constraints in the vicinity of Redondo Heights P&R. These constraints could require construction of an elevated station, which would cost more than an at-grade station.

The I-5 Mixed West Side alternative would run along the eastern edge of Midway Landfill for approximately one-third of a mile. Extensive investigation into waste mitigation and construction solutions would be required to prevent potential groundwater pollution and guideway settlement, among other issues. The I-5 Mixed West Side and I-5 Mixed West Side/Median alternatives both have the challenge of constrained space between a WSDOT retaining wall and Highline Water District water tank support infrastructure near S. 216th Street.

The median of I-5 presents a potential conflict with WSDOT's proposed express toll lane component of the SR 509 extension, where a new lane would be constructed in each direction inside of the existing HOV lane. These lanes would reduce the median width to as little as four feet and inserting an elevated guideway column between them would reduce the planned 10-foot shoulder width to six feet. Narrowed shoulders would require a design exception (or "deviation"), which WSDOT may be unwilling to approve for a long stretch of an important highway facility because this design exception would result in only one shoulder on a six- or seven-lane facility available for breakdowns or emergency vehicle bypasses. In addition to these issues, extensive coordination would be required during design to ensure that construction of

the guideway would not inhibit future construction of the express toll lanes nor their related support infrastructure (e.g., signs, gantries, communication, and power lines).

Given the preliminary nature of quantity estimates at this level of screening, cost estimates are rounded to the nearest $100 million (or $0.1 billion) in this Level 1 report. Unit costs have been escalated to represent Year 2013 dollars. Additional details on the cost estimating methodology, assumptions, and results can be found in the project technical memorandum "*Level 1 Alternatives Capital and Operations Cost Estimating Methodology and Results" (March 2013).*

Key Result

- With additional investment in structures, alternatives with elevated profiles generally have the highest estimated capital costs, while at-grade alternatives have the lowest estimated capital costs.

Discussion of Results

SR 99 has the lowest estimated capital cost of any alternative evaluated. With an estimated high end capital cost of $1.35 billion, the SR 99 At-Grade Median alternative is about $200 million less than the lowest capital cost (high end of range) estimated for the I-5 Elevated Mixed West Side alternative. Considering the high end of the capital cost estimate range, the alternative with the highest estimated capital cost is the SR 99 Elevated East Side alternative. The difference between the lowest estimated capital cost alternative and the highest is about $600 million, using high end estimates.

The 24th Avenue S. alternatives range in cost from as low as $1.4 billion (low end of range) to $1.7 billion (high end of range). Both of these are coupled with SR 99, but the primary differential in estimated capital cost is profile. In comparing just the high end of the range, the 24th Avenue S. Elevated East Side alternative is $100 million more than the 24th Avenue S. At-Grade Median alternative.

The 30th Avenue S. alternatives differ from the SR 99 alternatives in that the estimated capital costs for some of the at-grade alternatives are closer to those of the elevated alternatives, reflecting the potentially greater need for property acquisition along 30th Avenue S. The highest cost (high end of range) at-grade alternative on 30th Avenue S. is $1.7 billion.

6.8.2 Estimated Operating Costs

Estimated net operations and maintenance costs (O&M) reflect the potential annual funding requirements necessary to sustain appropriate service levels. Net operating costs capture the labor, energy consumption (fuel), operations and maintenance related administration, planned maintenance, and other variables associated with operating the FWTE. O&M costs will be calculated using Sound Transit's O&M Cost model during the Level 2 evaluation process.

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7.0 Findings and Conclusions

This section summarizes the key data and analysis that were presented in the earlier chapters of this report, and presents the relevant findings and conclusions related to each of the Level 1 alternatives. Each of the following sections provides a summary table of the relative strengths and weaknesses of each alternative. These strengths and weaknesses have been developed based on the evaluation criteria and measures described in Chapter 5, and the data and analysis results presented in Chapter 6. Following the summary table for each alternative, there is a brief narrative that provides the summary conclusions about each alternative, and the concluding assessment of whether the alternative should be carried forward for further study in the Level 2 evaluation.

7.1 SR 99 At-Grade Median Alternative

TABLE 7-1
SR 99 At-Grade Median Alternative Summary Findings

Strengths	Weaknesses
• More high density/TOD zoning than I-5 alternatives • No wetland effects • Would not affect any parks • Fewer sensitive noise receptors • Lower geologic risks than other alternatives (true of all SR 99 alternatives) • Lowest cost of any alternative considered in Level 1	• Lower estimated daily ridership (19,000 – 20,000) • Longest travel time among all SR 99 alternatives (21 minutes), due to slower than desired travel speeds • Likely to affect system-wide Link operations and reliability • Likely to affect RapidRide A Line • Very high potential to displace businesses • Highest number of affected failing (LOS F) intersections of any alternative considered in Level 1 • High utility conflicts based on preliminary analysis • Higher potential for hazardous materials effects due to large footprint

The SR 99 At-Grade Median alternative is one of the lowest cost alternatives. It would have the lowest ridership and longest travel time of all SR 99 alternatives. It would require extensive reconstruction of the recently reconstructed SR 99 roadway, as well as extensive utility relocation, resulting in the greatest disruption to adjacent properties and the surrounding communities and presenting substantial engineering challenges associated with widening. Traffic and other transit operations would be adversely affected, and the potential delays associated with at-grade operation would adversely affect system-wide operations.

Key findings:

1) The operating speeds would not meet the agency's target of 55 mph because the LRT speed would be limited to 35 mph by the safety-driven rules that govern operating in a semi-exclusive environment (in the same fashion as the Sound Transit Link light rail segment along Martin Luther King Way in Seattle). This would contribute to longer

travel times and lower ridership than the grade separated options on SR 99. The at-grade operating configuration would affect reliability due to the LRT having to cross street traffic, which would adversely affect the reliability of the larger ST Link light rail system.

2) The SR 99 Median At-Grade alternative would require a very high number of changes to the SR 99 roadway environment and disrupt both business access and through traffic. For example, left turns would be limited to a few key signalized intersections, effectively reducing access to many businesses along the route. Construction of this alternative would require reconstruction of the entire roadway, and could result in a higher number of displacements than all other SR 99 alternatives.
3) There would be a high potential for encountering hazardous materials sites with all SR 99 alternatives, and this potential would be highest for the at-grade option because it would have the most property acquisition and largest project footprint. Several current and former gas station sites and other auto-related businesses are located along the portion of SR 99 that would be affected by widening.
4) Sloping terrain and existing retaining walls at the southern part of the corridor (generally between S. 272nd Street and Dash Point Road) would present substantial design challenges for this alternative.

Conclusion: Based on the key findings above, the project purpose and need, and the analysis completed to date using the evaluation criteria, the SR 99 At-Grade Median alternative is not proposed for further evaluation.

7.2 SR 99 Mixed Median Alternative

TABLE 7-2
SR 99 Mixed Median Alternative Summary Findings

Strengths	Weaknesses
• More high-density/TOD zoning than I-5 alternatives • No wetland effects • Would not affect any parks • No LOS F intersections affected • Lower geologic risks than other alternatives (true of all SR 99 alternatives) • Second-lowest cost of the 14 alternatives considered	• Lower ridership levels than the SR 99 elevated alternatives (21,000 – 22,000) • Longer travel times than SR 99 fully elevated alternatives (18 minutes) • Moderate to substantial effects on left turns at un-signalized intersections and midblock U-turns • High potential for business displacements • High utility conflicts based on preliminary analysis • Higher potential for hazardous materials effects due to large footprint of at-grade portions of the proposed alignment

The SR 99 Mixed Median alternative would have lower ridership and longer travel time than the elevated SR 99 alternatives. Like the SR 99 At-Grade Median alternative, it would require extensive reconstruction of the recently-reconstructed SR 99 roadway, as well as extensive

utility relocation, resulting in disruption to adjacent properties and the surrounding communities. This alternative would avoid some traffic, transit, and system-wide effects associated with the SR 99 At-Grade Median alternative because it would cross major intersections on an elevated structure.

Key findings:

1) The operating speeds would not meet the agency's target of 55 mph because the LRT speed would be limited to 35 mph by the safety-driven rules that govern operating in a semi-exclusive environment (in the same fashion as the Sound Transit Link light rail segment along Martin Luther King Way in Seattle). This would contribute to longer travel times and lower ridership than the grade separated options on SR 99.
2) This alternative would require a very high number of changes to the SR 99 roadway environment and disrupt both business access and through traffic. For example, left turns would be limited to a few key signalized intersections, effectively reducing access to many businesses along the route. Construction of this alternative would require reconstruction of the entire roadway, and could result in a higher number of displacements than most other SR 99 alternatives.
3) Operating at-grade in some sections would affect reliability due to traffic interaction. Potential delays at intersections would cause transit unreliability within the corridor and would adversely affect the reliability of the larger ST Link light rail system.
4) Construction of this alternative would require reconstruction of the entire roadway in the at-grade segments, and would result in a greater amount of property acquisition than most other SR 99 alternatives.
5) There is a high risk of encountering hazardous materials sites with all SR 99 alternatives, and the risk would be highest for the at-grade portion of this option because this is where the project would have the most property acquisition and widest project footprint.

Conclusion: Based on the key findings above, the project purpose and need, and the analysis completed to date using the evaluation criteria, the SR 99 Mixed Median alternative is not proposed for further evaluation.

7.3 SR 99 Elevated Median Alternative

TABLE 7-3
SR 99 Elevated Median Alternative Summary Findings

Strengths	Weaknesses
• All elevated SR 99 alternatives have the highest projected daily ridership levels among the Level 1 alternatives (23,000 – 24,000) • Elevated SR 99 alternatives would have the lowest travel time among SR 99 alternatives (15 minutes) • No effects on system-wide Link operations and reliability due to fully elevated operation • Minimal effects to RapidRide A Line • More high-density and transit-oriented development zoning than I-5 alternatives • No wetland effects • Would not affect any parks • No LOS F intersections affected • Lowest potential conflict with utilities of any of the SR 99 alternatives • Lower geologic risks than other alternatives (true of all SR 99 alternatives)	• All SR 99 alternatives have high potential for hazardous materials conflicts • Long spans to cross intersections, increased footprint for potential straddle bent design • Higher cost than SR 99 at-grade or mixed alternatives

The SR 99 Elevated Median alternative would be more expensive than the at-grade or mixed median alternatives, but would have higher ridership and faster travel times. It has the potential to limit major reconstruction of SR 99 to intersections and station locations, reducing potential for utility relocations and disruption to adjacent properties. SR 99 has more high-density and transit oriented development zoning than alternatives along I-5.

Key findings:

1) The operating speeds for the median elevated option would meet the agency's target of 55 mph, which contributes to lower travel times and higher ridership than the at-grade and mixed grade alternatives on SR 99.
2) The SR 99 Elevated Median alternative would require fewer changes to the SR 99 roadway environment than the other SR 99 alternatives. For example, more existing left turns and accesses can be maintained than with the at-grade and mixed grade options.
3) This alternative would be more reliable because transit operations would not be affected by street traffic. Reliability would be higher in the corridor and within the larger ST Link light rail system.
4) The median position of the guideway would not require the high-voltage electrical transmission lines that run along SR 99 to be relocated.

Conclusion: Based on the key findings above, the project purpose and need, and the analysis completed to date using the evaluation criteria, the SR 99 Elevated Median alternative is proposed for further evaluation.

7.4 SR 99 Elevated East Side Alternative

TABLE 7-4
SR 99 Elevated East Side Alternative Summary Findings

Strengths	Weaknesses
• Highest daily ridership (23,000 – 24,000) • Lowest travel time among SR 99 alternatives (15 minutes) • No effects to system-wide Link operations and reliability • More high-density/TOD zoning than I-5 alternatives • Minimal reconstruction of SR 99 • No wetland effects • Would not affect any parks • Lower geologic risks than other alternatives (true of all SR 99 alternatives)	• All SR 99 alternatives have high potential for hazardous materials conflicts • Engineering challenges with existing retaining walls and adjacent structures • Usability of remnant parcels after acquisition for guideway would be limited • The terrain on the east side of SR 99 is much higher than the roadway at some locations • Highest potential for effects to community facilities of any alternative considered • Would conflict with existing side-running high voltage transmission lines for much of the corridor • Higher cost than at-grade, mixed-grade, and elevated median alternatives for SR 99

The SR 99 Elevated East Side alternative would be more expensive than the at-grade or mixed median alternatives, but would have higher ridership and faster travel times. High-voltage electrical transmission lines on the east side of SR 99 would need to be relocated. Acquisition of right-of-way on the east side of the road could result in business and residential displacements, and could limit the potential for redevelopment of these properties following construction. Topographical constraints on the east side of SR 99 in some places would present engineering challenges.

Key findings:

1) There are large future redevelopment impacts associated with right-of-way acquisition along the east side of SR 99 that other SR 99 alternatives would not have.
2) The alternative would conflict with existing high-voltage power lines for a significant portion of the length of the project (S. 212th Street to S. 220th Street and S. 240th Street to the terminus at approximately S. 316th Street). Relocation of these power lines would represent a substantial project cost due to the need for pole reconstruction and replacement.
3) There are a number of locations along the east side of SR 99 where the terrain is higher than the roadway. In some places there are tall retaining walls that could conflict with the alignment, requiring realigning the roadway and/or rebuilding the retaining walls.
4) There is a high risk of encountering hazardous materials sites with all SR 99 alternatives, and it would be higher for this alternative than for the median elevated alternative because property acquisition would be required for the full length of SR 99 along the east side, where the guideway would be located.

Conclusion: Based on the key findings above, the project purpose and need, and the analysis completed to date using the evaluation criteria, the SR 99 East Side alternative is not proposed for further evaluation.

7.5 SR 99 Elevated West Side Alternative

TABLE 7-5
SR 99 Elevated West Side Alternative Summary Findings

Strengths	Weaknesses
• Highest daily ridership (23,000 – 24,000) • Lowest travel time among SR 99 alternatives (15 minutes) • No effects to system-wide Link operations and reliability • More high-density/TOD zoning than I-5 alternatives • Minimal reconstruction of SR 99 • No wetland effects • Lowest potential residential property acquisition • Would not affect any parks • Lower geologic risks than other alternatives (true of all SR 99 alternatives)	• All SR 99 alternatives have high potential for hazardous materials conflicts • Engineering challenges with existing retaining walls and adjacent structures • Usability of remnant parcels after acquisition for guideway would be limited • The terrain on the west side of SR 99 is much lower than the roadway at some locations • Highest potential for effects on community facilities of any alternative considered • Would conflict with existing side-running high voltage transmission lines for much of the corridor • Higher cost than at-grade, mixed-grade, and elevated median alternatives for SR 99

The SR 99 Elevated West Side alternative would be more expensive than the at-grade or mixed median alternatives, but would have higher ridership and faster travel times. Acquisition of properties on the west side of the road would likely result in business and residential displacements, and could limit the potential for redevelopment of these properties following construction. Topographical constraints on the west side of SR 99 in some places would present engineering challenges.

Key findings:

1) There would be large future redevelopment effects associated with right-of-way acquisition along the west side of SR 99 that other SR 99 alternatives would not have.
2) The alternative would conflict with the existing high voltage power lines for a portion of the length of the alternative (S. 204th Street to S. 212th Street) and there is a potential conflict with a high pressure gas line between S. 204th Street and S. 208th Street.
3) There are a number of locations along the west side of SR 99 where the terrain is lower than the roadway. In some places there are tall retaining walls that would conflict with the alignment that would need to be reconstructed or would require a shift in the roadway to accommodate light rail between the retaining walls and the roadway.
4) There is a high risk of encountering hazardous materials sites with all SR 99 alternatives. It would be higher for this alternative than for the median elevated because it would

require acquisition of properties the full length of SR 99 along the west side, where the guideway would have a new right-of-way footprint.

Conclusion: Based on the key findings above, the project purpose and need, and the analysis completed to date using the evaluation criteria, the SR 99 West Side alternative is not proposed for further evaluation.

7.6 I-5 Mixed West Side Alternative

TABLE 7-6
I-5 Mixed West Side Alternative Summary Findings

Strengths	Weaknesses
• High ridership levels, on par with SR 99 elevated alternatives (23,000-24,000) • I-5 alternatives have the lowest travel time (14 minutes) of any of the Level 1 alternatives • No effects to system wide Link operations and reliability due to fully-separated alignment; minimal effects to RapidRide A Line • Lower potential for visual effects • No parks within 50 feet of the alternative's centerline • Minimal effects to street traffic operations; no LOS F intersections affected • I-5 alternatives would have lower number of hazardous materials sites • Lower cost than all but two alternatives (SR 99 At-grade Median and SR 99 Mixed Median)	• Some wetland effects • Most adjacent residential properties within 100 feet of centerline of any alternative • Potential utility conflicts with Highline Water District water tank, Midway Landfill, power lines, and PSE sub-station • Higher potential risk of geologic hazards • Limited mixed use/high-density zoning

The I-5 Mixed West Side alternative would be less expensive than elevated alternatives along SR 99 and, based on current design information, could be constructed largely within Washington State Department of Transportation (WSDOT) right-of-way, limiting residential or business displacements and avoiding impacts to local roadway operations. Ridership and travel time would be similar to the SR 99 elevated alternatives. Potential risks include proximity to Highline Water District water tanks, a Puget Sound Energy substation, and the Midway Landfill, which also presents a potential hazardous materials concern and geologic hazard.

Key findings:

1) The operating speeds for this alternative would meet the agency's target of 55 mph, which contributes to faster travel times and higher ridership than at-grade.
2) Based on the conceptual level of design, it appears that this alternative could fit largely within existing WSDOT right-of-way, thereby requiring limited displacements.
3) The I-5 alternatives generally have a lower risk of encountering hazardous materials than the SR 99 alternatives. However, the Midway Landfill site is a Superfund site that could present hazardous materials risk for this alternative, because disturbing the capped landfill material could require expensive construction methods and mitigation.

4) The I-5 Mixed West Side alternative would have the greatest number of residential properties affected of any alternative.

Conclusion: Based on the key findings above, the project purpose and need, and the analysis completed to date using the evaluation criteria, the I-5 Mixed West Side alternative is proposed for further evaluation.

7.7 I-5 Mixed West Side/Median Alternative

TABLE 7-7
I-5 Mixed West Side/Median Alternative Summary Findings

Strengths	Weaknesses
• High ridership levels, on par with SR 99 elevated alternatives (23,000-24,000) • I-5 alternatives have the lowest travel time (14 minutes) of any of the Level 1 alternatives • No effects to system wide Link operations and reliability due to fully-separated alignment; minimal effects to RapidRide A Line • Lowest potential for visual effects of any Level 1 alternative • Lowest number of commercial properties within 100 feet of the alternative's centerline • No parks within 50 feet of the alternative's centerline • Minimal effects on street traffic operations; no LOS F intersections affected • Would not directly impact Midway Landfill • I-5 alternatives would have lower number of hazardous materials sites	• Lowest mixed use/high-density zoning of any alternative • Highest potential wetland impacts of any alternative • Potential future WSDOT express toll lane design conflicts • Potential utility risk with Highline Water District water tanks and PSE substation • Higher costs associated with design considerations for crossing I-5

The I-5 Mixed West Side/Median alternative would be less expensive than elevated alternatives along SR 99 and could be constructed largely within WSDOT right-of-way, limiting residential or business displacements and avoiding impacts to local roadway operations. Ridership and travel time would be the same as SR 99 elevated alternatives. Potential risks include proximity to Highline Water District water tanks and a Puget Sound Energy (PSE) substation. This alternative would avoid the Midway Landfill and the engineering challenges that this crossing presents, and would also have the lowest potential for visual impacts.

Key findings:

1) The operating speeds for this alternative would meet the agency's target of 55 mph, which contributes to faster travel times and higher ridership than at-grade and mixed alternatives.
2) Based on the conceptual level of design, it appears that this alternative could fit largely within existing WSDOT right-of-way, thereby requiring few displacements. However, this alternative would occupy some of the land area potentially needed for future express toll lanes under consideration by WSDOT.

3) The I-5 Mixed West Side/Median alternative would have the lowest risk of encountering hazardous materials of all Level 1 alternatives because it would avoid the Midway Landfill site and because the I-5 alternatives generally would have a lower risk than the SR 99 alternatives.

Conclusion: Based on the key findings above, the project purpose and need, and the analysis completed to date using the evaluation criteria, the I-5 Mixed West Side/Median alternative is proposed for further evaluation.

7.8 30th Avenue S. At-Grade Median Alternative

TABLE 7-8
30th Avenue S. At-Grade Alternative Summary Findings

Strengths	Weaknesses
• No wetland effects • No impacts to parks • No LOS F intersections affected; does not affect complex SR 99/Kent Des Moines Road intersection • More high-density/TOD zoning • Less disruption to businesses along SR 99	• Lower ridership levels than elevated alternatives (19,000 to 20,000 per day) • Longest travel time among all 30th Avenue S. alternatives (21 minutes) due to slower than desired travel speeds • Potential delays in system-wide Link operations and reliability due to at-grade operation • High potential for effects to environmental justice populations related to noise, visual, displacements, traffic and construction • Would cross Kent-Des Moines Road/I-5 interchange at-grade in Level 1 configuration • Restricts left turn access at un-signalized intersections or driveways • High number of sensitive noise receptors • Higher potential utility effects, including high-voltage electrical power lines • At-grade alignment would bifurcate the neighborhood, as pedestrians and vehicles must go to signalized crossings.

The 30th Avenue S. At-Grade Median alternative would avoid the disruption of SR 99 associated with construction activities and widening of the roadway between S. 220th Street and S. 240th Street. It would have a longer travel time and lower ridership than elevated alternatives, and would require reconstruction of 30th Avenue S., a two-lane primarily residential road. This reconstruction would involve utility relocations and result in impacts to local traffic by eliminating left turns from side streets and adjacent properties. This alternative would cross Kent-Des Moines Road at-grade directly adjacent to on and off-ramps to I-5. This alternative would have high potential for noise and visual impacts and would bifurcate the Pacific Ridge neighborhood between S. 220th Street and Kent-Des Moines Road.

Key findings:

1) The operating speeds for the at-grade alternative would not meet the agency's target of 55 mph because it would need to match the adjacent traffic speed limit of 25 mph on

30th Avenue S. This contributes to much slower travel times and lower ridership than grade-separated options.

2) The at-grade operating configuration is less reliable due to it being in the surface traffic environment. Potential traffic delay at Kent-Des Moines Road would cause transit unreliability within the corridor and would adversely affect the reliability of the larger ST Link light rail system.
3) There would be a high degree of change required to the 30th Avenue S. roadway (which is currently a two-lane residential road) and to the adjacent multi-family neighborhood environment. For example, extensive new right-of-way would be required for widening the roadway and adding a median for light rail operation. The at-grade option would have the largest footprint of the 30th Avenue S. alternatives. In addition, there would be high potential for utility relocation impacts.
4) The at-grade alternative would create a barrier in the neighborhood, causing noise and visual effects. The residential nature and demographics of the adjacent neighborhood increase the potential for effects to environmental justice populations because they would be the populations experiencing the noise, visual and construction effects, and could potentially be displaced.
5) The 30th Avenue S. alternatives would avoid temporary and permanent effects to SR 99 between S. 220th Street and S. 244th Street, including the highly congested Kent-Des Moines Road (SR 516) intersection.

Conclusion: Based on the key findings above, the project purpose and need, and the analysis completed to date using the evaluation criteria, the 30th Avenue S. At-Grade Median alternative is not proposed for further evaluation.

7.9 30th Avenue S. Elevated Median Alternative

TABLE 7-9
30th Avenue S. Elevated Median Alternative Summary Findings

Strengths	Weaknesses
• Higher ridership than at-grade alternatives (23,000-24,000) • Lower travel time than most alternatives considered • No effects to system-wide Link operations and reliability • More high density/TOD zoning • No wetland effects • Would not affect any parks • Avoids Kent-Des Moines Road effects	• High potential for effects to environmental justice populations related to noise, visual, displacements, and traffic • Higher visual sensitivity • High number of noise sensitive receptors such as residences, schools, and churches • Substantial effects to unsignalized left turns and u-turns throughout the corridor • All 30th Avenue S. alternatives have high potential for hazardous materials conflicts

The 30th Avenue S. Elevated Median alternative would have a similar travel time and ridership as other elevated alternatives on SR 99 and I-5. It would require reconstruction of 30th Avenue

S., a two-lane primarily residential road. This reconstruction would involve utility relocations and results in impacts to local traffic by eliminating left turns from side streets and adjacent properties. This alternative would have high potential for noise and visual impacts and would bifurcate the Pacific Ridge neighborhood between S. 220th Street and Kent-Des Moines Road.

Key findings:

1) There would be a high degree of change required to the 30th Avenue S. roadway (which is currently a two-lane residential road) and to the adjacent multi-family neighborhood environment.
2) The elevated median alternative would create a barrier in the neighborhood and introduce noise and visual effects. The residential nature and demographics of the adjacent neighborhood increase the potential for effects to environmental justice populations because they would be the populations experiencing the noise, visual and construction effects, and could potentially be displaced.
3) The 30th Avenue S. alternatives would avoid temporary and permanent effects to SR 99 between S. 220th Street and S. 244th Street, including the highly congested Kent-Des Moines Road (SR 516) intersection.

Conclusion: Based on the key findings above, the project purpose and need, and the analysis completed to date using the evaluation criteria, the 30th Avenue S. Elevated Median alternative is not proposed for further evaluation.

7.10 30th Avenue S. Elevated East Side Alternative

TABLE 7-10
30th Avenue S. Elevated East Side Alternative Summary Findings

Strengths	Weaknesses
• Higher ridership than at-grade alternatives (23,000-24,000) • Lower travel time than most alternatives considered • No effects to system-wide Link operations and reliability • More high density/TOD zoning • No wetland effects • Would not affect any parks • Avoids Kent-Des Moines Road effects	• High potential for effects to environmental justice populations related to noise, visual, displacements, and traffic • Higher visual sensitivity • High number of noise sensitive receptors such as residences, schools, and churches • High potential for utility relocations due to power lines on east side of roadway • All 30th Avenue S. alternatives have high potential for hazardous materials conflicts

The 30th Avenue S. Elevated East Side alternative would have a similar travel time and ridership as other elevated alternatives on SR 99 and I-5. It would require reconstruction of 30th Avenue S., a two-lane primarily residential road. This reconstruction would involve utility relocations and property acquisition on the east side of the road, likely resulting in residential

displacements. This alternative would have high potential for noise and visual impacts and would bifurcate the Pacific Ridge neighborhood between S. 220th Street and Kent-Des Moines Road.

Key findings:

1) There would be a high degree of change required to the 30th Avenue S. roadway (which is currently a two-lane residential road) and to the adjacent multi-family neighborhood environment.
2) Required new right-of-way would displace many multi-family structures located adjacent to the existing right-of-way
3) There would be high utility impacts due to elevated high-voltage power lines along the east side of the right-of-way.
4) The elevated median alternative would create a barrier in the neighborhood and introduce noise and visual effects. The residential nature and demographics of the adjacent neighborhood increase the potential for effects to environmental justice populations because they would be the populations experiencing the noise, visual and construction effects, and could potentially be displaced.
5) The 30th Avenue S. alternatives would avoid temporary and permanent effects to SR 99 between S. 220th Street and S. 244th Street, including the highly congested Kent-Des Moines Road (SR 516) intersection.

Conclusion: Based on the key findings above, the project purpose and need, and the analysis completed to date using the evaluation criteria, the 30th Avenue S. Elevated East Side alternative is not proposed for further evaluation.

7.11 30th Avenue S. Elevated West Side Alternative

TABLE 7-11
30th Avenue S. Elevated West Side Alternative Summary Findings

Strengths	Weaknesses
• Higher ridership than at-grade alternatives (23,000 to 24,000) • Lower travel time than most alternatives considered (15 minutes) • No effects to system-wide Link operations and reliability • More high density/TOD zoning • Avoids major property acquisition impacts of other 30th Avenue S. alternatives • No wetland effects • Would not affect any parks • Avoids Kent-Des Moines Road effects	• High potential effects to environmental justice populations related to noise, visual, displacements, and traffic • High number of noise sensitive receptors • All 30th Avenue S. alternatives have high potential for hazardous materials conflicts

The 30th Avenue S. Elevated West Side alternative would have similar travel time and ridership to other elevated alternatives on SR 99 and I-5, is likely to require only partial reconstruction of 30th Avenue S., a two-lane primarily residential road. This alternative would have high potential for noise and visual impacts and could create a barrier through the middle of the Pacific Ridge neighborhood between S. 220th Street and Kent-Des Moines Road. This reconstruction would avoid major utility relocations associated with median and east side alternatives on 30th Avenue S.

Key findings:

1) The operating speeds for the grade separated alternative would meet the agency's target of 55 mph, resulting in travel time and ridership that would be competitive with the elevated SR 99 and I-5 alternatives.
2) Of all of the 30th Avenue S. alternatives, this alternative would cause the least disruption and impacts. Displacements with the 30th Avenue S. West Side Elevated alternative would be lower than with the other 30th Avenue S. alternatives because the buildings are typically set further from the roadway back on the west side of the street than on the east side.
3) The 30th Avenue S. alternatives would avoid temporary and permanent effects to SR 99 between S. 220th Street and S. 244th Street, including the highly congested Kent-Des Moines Road (SR 516) intersection.
4) Construction of the project improvements would not require complete reconstruction of the 30th Avenue S. roadway. Project improvements would be adjacent to the roadway, to the west, but there would still be substantial construction related impacts.

Conclusion: Based on the key findings above, the project purpose and need, and the analysis completed to date using the evaluation criteria, the 30th Avenue S. Elevated West Side alternative is proposed for further evaluation.

7.12 24th Avenue S. At-Grade Median Alternative

TABLE 7-12
24th Avenue S. At-Grade Median Alternative Summary Findings

Strengths	Weaknesses
• Avoids disruption, property displacement, and construction effects along SR 99 between S 200th Street and Kent-Des Moines Road • No wetland effects • Does not affect any community facilities	• Longer travel time than all alternatives considered • Lower ridership than elevated alternatives • Likely to affect system wide Link operations and reliability due to at-grade operation • Less high density/TOD zoning • Moderate to high visual sensitivity • 24th Avenue S. alternatives have potential effects to about 1 acre of parks, higher than other alternatives • Possible indirect effects to Underwood Memorial Park • Restricts left turns at un-signalized intersections and midblock U-turns • 24th Avenue S. alternatives have the worst potential traffic effects of any of the alignments • Higher structural costs for the tall columns required to bridge SR 509 and S. 208th Street

The 24th Avenue S. At-Grade Median alternative would avoid the disruption of SR 99 associated with construction activities and widening of the roadway between S. 200th Street and S. 240th Street. It would have a longer travel time and lower ridership than elevated alternatives, and would require reconstruction of 24th Avenue S., a two-lane collector road in a residential area. This reconstruction would involve utility relocations and results in effects to local traffic by eliminating left turns from side streets and adjacent properties. This alternative would have high potential for noise and visual effects and could have indirect effects to parks and neighborhood cohesion between S. 216th Street and Kent-Des Moines Road. Additional costs would be associated with structures for crossing the proposed SR 509 right-of-way and S. 208th Street.

Key findings:

1) The operating speeds would not meet the agency's target of 55 mph because the LRT speed would be limited to 35 mph by the safety-driven rules that govern operating in a semi-exclusive environment (in the same fashion as the Sound Transit Link light rail segment along Martin Luther King Way in Seattle). This would contribute to longer travel times and lower ridership than the grade separated options on SR 99. The at-grade operating configuration would affect reliability due to the LRT having to cross street traffic, which would adversely affect the reliability of the larger ST Link light rail system.
2) The at-grade operating configuration is less reliable due to surface traffic operations and the risk for conflict of operations. Potential traffic delay at intersections would cause unreliability within the corridor and would ripple through and cause unreliability within the larger ST Link light rail System.

3) Construction of the project improvements would generally include leaving the southbound lane alone and widening to the east for construction of the project and reconstruction of the northbound lane.
4) There would be a high degree of change required to the 24th Avenue S. roadway (which is currently a two-lane residential road) and adjacent neighborhood environment. For example, right-of-way would have to be acquired from the east side of 24th Avenue S. because of a park and other public facility uses on the west side, but could result in displacement of residences and churches.
5) Because this alternative is located in a primarily residential area, it would likely cause property access, visual and noise effects.

Conclusion: Based on the key findings above, the project purpose and need, and the analysis completed to date using the evaluation criteria, the 24th Avenue S. At-Grade Median alternative is not proposed for further evaluation.

7.13 24th Avenue S. Elevated Median Alternative

TABLE 7-13
24th Avenue S. Elevated Median Alternative Summary Findings

Strengths	Weaknesses
• Avoids disruption, property displacement, and construction effects along SR 99 between S 200th Street and Kent-Des Moines Road • No effects to system-wide Link operations and reliability • No wetland effects	• Right-of-way could be required for elevated guideway to cross most intersections • Less high density/TOD zoning • 24th Avenue S. alternatives have potential effects to about 1 acre of parks, higher than other alternatives • Possible indirect effects to Underwood Memorial Park • 24th Avenue S. alternatives have more community facilities adjacent to the proposed alignment than other alternatives • Moderate to high visual sensitivity • Restricts left turns at un-signalized intersections and midblock U-turns • 24th Avenue S. alternatives have the worst potential traffic effects of any of the alignments • Higher structural costs for the tall columns required to bridge SR 509 and S. 208th Street

The 24th Avenue S. Elevated Median alternative would avoid the disruption of SR 99 associated with construction activities and widening of the roadway between S. 200th Street and S. 240th Street. This alternative would require reconstruction of 24th Avenue S., a two-lane collector road in a residential area. This reconstruction would involve utility relocations and results in effects to local traffic by eliminating left turns from side streets and adjacent properties. This alternative would have high potential for noise and visual effects and could have indirect effects to parks and neighborhood cohesion between S. 216th Street and Kent-Des Moines Road. Additional costs would be associated with structures for crossing the proposed SR 509 right-of-way and S. 208th Street.

Key findings:

1) The project would be constructed so that reconstruction of the southbound lane of 24th Avenue S. would be avoided, and 24th would be widened only to the east to accommodate the median guideway and the northbound lane.
2) There would be a high degree of change required to the 24th Avenue S. roadway (which is currently a two-lane residential road) and adjacent neighborhood environment. For example, right-of-way would have to be acquired from the east side of 24th Avenue S. because of a park and other public facility uses on the west side, but could result in displacement of residences and churches.
3) Because this alternative is located in a primarily residential area, it would cause potential property access, visual, and noise effects.
4) The potential permanent effects to neighborhoods and community facilities along 24th Avenue S. outweigh the temporary benefits of avoiding construction along SR 99.

Conclusion: Based on the key findings above, the project purpose and need, and the analysis completed to date using the evaluation criteria, the 24th Avenue S. Elevated Median alternative is not proposed for further evaluation.

7.14 24th Avenue S. Elevated East Side Alternative

TABLE 7-14
24th Avenue S. Elevated East Side Alternative Summary Findings

Strengths	Weaknesses
• Does not require any roadway reconstruction • Avoids disruption and construction along SR 99 between S 200th Street and Kent-Des Moines Road • No operating speed restrictions • Minimal effects to system-wide Link operations and reliability, and RapidRide A Line	• Higher structural costs for the tall columns required to bridge SR 509 and S. 208th Street • Less high density/TOD zoning • Moderate to high visual sensitivity • High number of category 3 noise sensitive receptors (schools and churches) • Would effect neighborhood cohesion • Possible indirect effects to Stephen J. Underwood Memorial Park

The 24th Avenue S. Elevated East Side alternative would avoid the disruption of SR 99 associated with construction activities and widening of the roadway between S. 200th Street and S. 240th Street. This alternative would result in acquiring properties on the east side of 24th Avenue S. for right-of-way, possibly displacing residences and/or churches. This alternative would have high potential for noise and visual effects and could have indirect effects to parks and neighborhood cohesion between S. 216th Street and Kent-Des Moines Road. Additional costs would be associated with structures for crossing the proposed SR 509 right-of-way and S. 208th Street.

Key findings:

1) The project would be constructed so that reconstruction of the southbound lane of 24th Avenue S. would be avoided, and 24th would be widened only to the east to accommodate the median guideway and the northbound lane.
2) This alternative would require a very high number of changes to the 24th Avenue S. roadway and adjacent neighborhood environment. For example, right-of-way would need to be acquired from the east side of the 24th Avenue S. because of a park and other public facility uses on the west side, but could result in displacement of residences and churches.
3) Because this alternative is located in a primarily residential area, it would have potential visual and noise effects.
4) The potential permanent effects to neighborhoods and community facilities along 24th Avenue S. outweigh the temporary benefits of avoiding construction along SR 99.

Conclusion: Based on the key findings above, the project purpose and need, and the analysis completed to date using the evaluation criteria, the 24th Avenue S. Elevated East Side alternative is not proposed for further evaluation.

7.15 Summary of Findings and Conclusions Related to Level 1 Alternatives

Based on the results of the Level 1 evaluation, the following alternatives will be evaluated further in the Level 2 evaluation:

- SR 99 Elevated Median
- I-5 Mixed West
- I-5 Mixed West/Median
- 30th Avenue S. Elevated West

The results of the Level 1 analysis showed that different segments of each of the SR 99 alternatives could work, but each one of them as a “stand alone” alternative has substantial flaws. A combination of conceptual design elements (a mix of east side, west side, and median alignment; at-grade and elevated profile) could results in an alternative that operates better with less adverse effects than the “stand alone” SR 99 alignment alternatives studied in Level 1. For the Level 2 evaluation, this new alternative will be called the “hybrid” alternative.

Conclusion: A new SR 99 Hybrid alternative should be developed for study in the Level 2 evaluation. It should be made up of elements of the SR 99 alignment and grade alternatives (at-grade, median elevated, east elevated and west elevated) that have demonstrated potential feasibility in the Level 1 evaluation.

The alternatives to be evaluated further in the Level 2 evaluation are shown in **Exhibit 7-1** below in color, with the alternatives that will not be carried forward for Level 2 evaluation shown in gray.

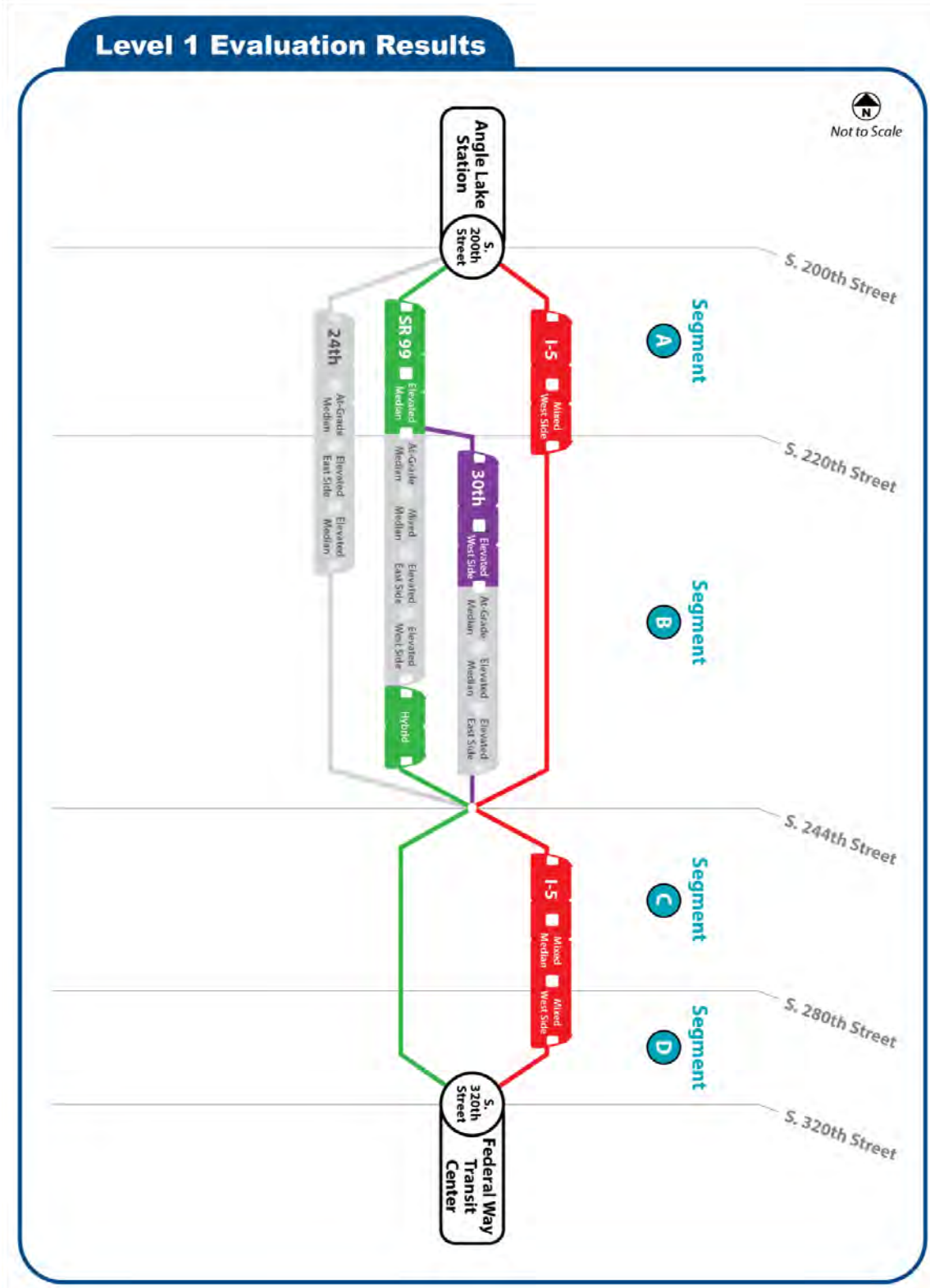

EXHIBIT 7-1
Level 1 Evaluation Results