Aerial Option

The Aerial Option will construct an aerial structure in the northbound direction and will construct the same underground structure as the Tunnel Option in the southbound direction. The Washington State Convention Center and Freeway Park, together with the large high-rise buildings lining the west side of I-5, make a southbound aerial roadway impractical.

The northbound structure will begin near Yesler Way and will connect to the east side of the Convention Center above Hubbell Place. The structure will return to the median of I-5 near Stewart Street and connect back to the I-5 mainline near Mercer Street with a one-lane on-ramp, which will add one lane to the mainline at this location. A connection will be provided between the northbound bypass and the reversible roadway (express lanes).

Frontage Road Option

The Frontage Road Option includes an additional general purpose lane on the southbound I-5 mainline between SR 520 and I-90 and a frontage road northbound between I-90 and Olive Way. Several northbound on- and off-ramps will tie directly into the frontage road, removing the on- and off-ramp conflict points along the I-5 mainline.

What did the SR 520 project team conclude from the screening of these alternatives?

These options were developed to a planning-level engineering concepts and then screened based on transportation performance, physical feasibility, potential impacts, and magnitude of cost. The project team found all three alternatives to be impractical for a variety of reasons, as discussed below.

- Tunnel Option – Tunneling in this section of I-5 will be extremely difficult and complex and have substantial effects on the existing infrastructure. Because of the geology and unstable hillsides, very densely developed surrounding area, and complex ramp structure of I-5, the tunnel portals and connections to I-5, ventilation structures, and emergency access points could not be built without major reconstruction of I-5 itself. This will result in very high costs, major traffic disruptions lasting years, and significant environmental impacts.

- Aerial Option – The aerial structure option, while less costly than a tunnel, will have many of the same difficulties requiring major modifications to I-5 to tie traffic back into the highway. In addition, the project team judged the building displacements and environmental impacts that will result from placing a new roadway viaduct through this portion of downtown Seattle to be unacceptable.
- Frontage Road – While the frontage road held some promise, the project team found it to be unworkable from a traffic operations standpoint. To work properly with the forecasted traffic volumes, the frontage road will require intersection approach widths that we could not achieve without major property takings through a very densely developed area.

As a result, the SR 520 team concluded that a significant expansion of I-5 between SR 520 and I-90 will be extremely costly, result in major disruption during construction, and have severe impacts that will be difficult to mitigate. For these reasons, the project team decided not to pursue any of these options further.

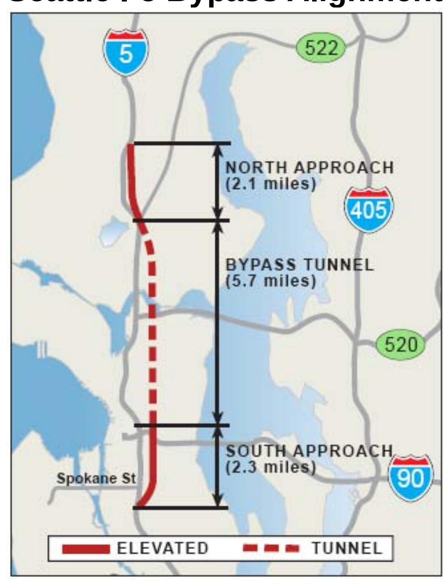
What is the Congestion Relief Analysis, and what were the results regarding I-5?

The Congestion Relief Analysis involved a series of studies undertaken by WSDOT of options to relieve congestion in urban areas in the Puget Sound, Southwest Washington, and Spokane regions. One option, the Highway Focus Scenario, looked at providing substantial additional roadway capacity to ease congestion. This scenario developed alternatives to widen the central portion of I-5 by three additional lanes in each direction through Seattle to meet future possible travel demand. The study quickly concluded that it will be extremely difficult to widen I-5 within its existing right of way through the highly developed urban portions of central Seattle. Therefore, the project team assumed that additional lanes will be constructed in tunnels bypassing the area of highest development.

The Highway Focus Scenario developed as part of the Congestion Relief Analysis will provide highway capacity intended to meet much of the unconstrained travel demand in the year 2025. Its purpose was to examine whether we could alleviate congestion through an aggressive road-building program. The basic logic used to develop the Highway Focus Scenario was that the unconstrained travel demand could be accommodated through a combination of the existing roadway system and additional highway lanes within major corridors.

Because the Congestion Relief Analysis was a planning-level study, the engineering studies were limited to defining the approximate tunnel length and configuration and the length of the adjacent above-grade section. This engineering information allowed the development of a highly generalized cost estimate based on high-level assumptions on the project design features.

Exhibit 2-7
Seattle I-5 Bypass Alignment



While costly to construct, it appears possible to widen I-5 in its present alignment north of Northgate and south of Spokane Street. In the highly developed section between these points, the additional lanes will need to be constructed in a different configuration, because the costs and environmental disruption from building displacements and right of way acquisition will be prohibitive. The Congestion Relief Analysis developed a very general concept that uses three configurations in this section of I-5, as shown in Exhibit 2-7. The bypass scenario assumed that the new six-lane roadway will carry only through traffic and will not require the construction of any intermediate access points between Northgate and Spokane Street.

North Approach

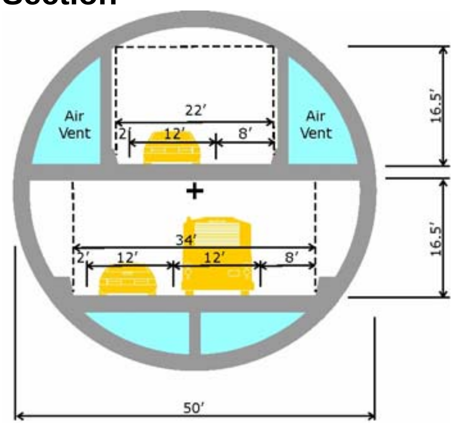
The assumed bypass alignment will begin north of the Northgate interchange. The six lanes will rise on an elevated structure above the existing I-5 express and northbound lanes. The lanes will descend to the north tunnel portals just north of the Lake City Way (SR 522) interchange.

Bypass Tunnel

To accommodate six lanes, the project team envisioned two tunnel bores of approximately 50 feet in diameter. This tunnel size corresponds with the largest tunnel boring machines currently used. The lanes will be configured on two levels, with two lanes below and one lane above.

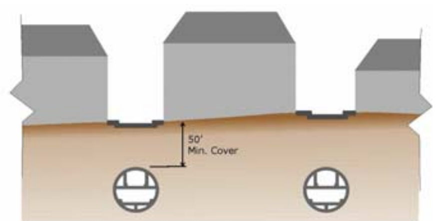
The shoulder will be narrower than standard width to stay within the 50-foot diameter, as the conceptual cross section in Exhibit 2-8 shows. It may be possible to restrict trucks to one level, which will allow for reducing the height of the other level, resulting in additional shoulder space. The areas not occupied by traffic will be used as ventilation ducts.

Exhibit 2-8
Conceptual Tunnel Cross Section



The north portals of the two bypass tunnels will be located at Lake City Way. The tunnels will pass under the Ship Canal and proceed south under Capitol Hill and First Hill. The scenario assumed that the south portals of the two bypass tunnels will be located in the hillside north of Dearborn Street. The tunnel configuration is shown in Exhibit 2-8; the tunnels will likely be located under the street right of way, one block apart (Exhibit 2-9).

Exhibit 2-9
Tunnel Locations



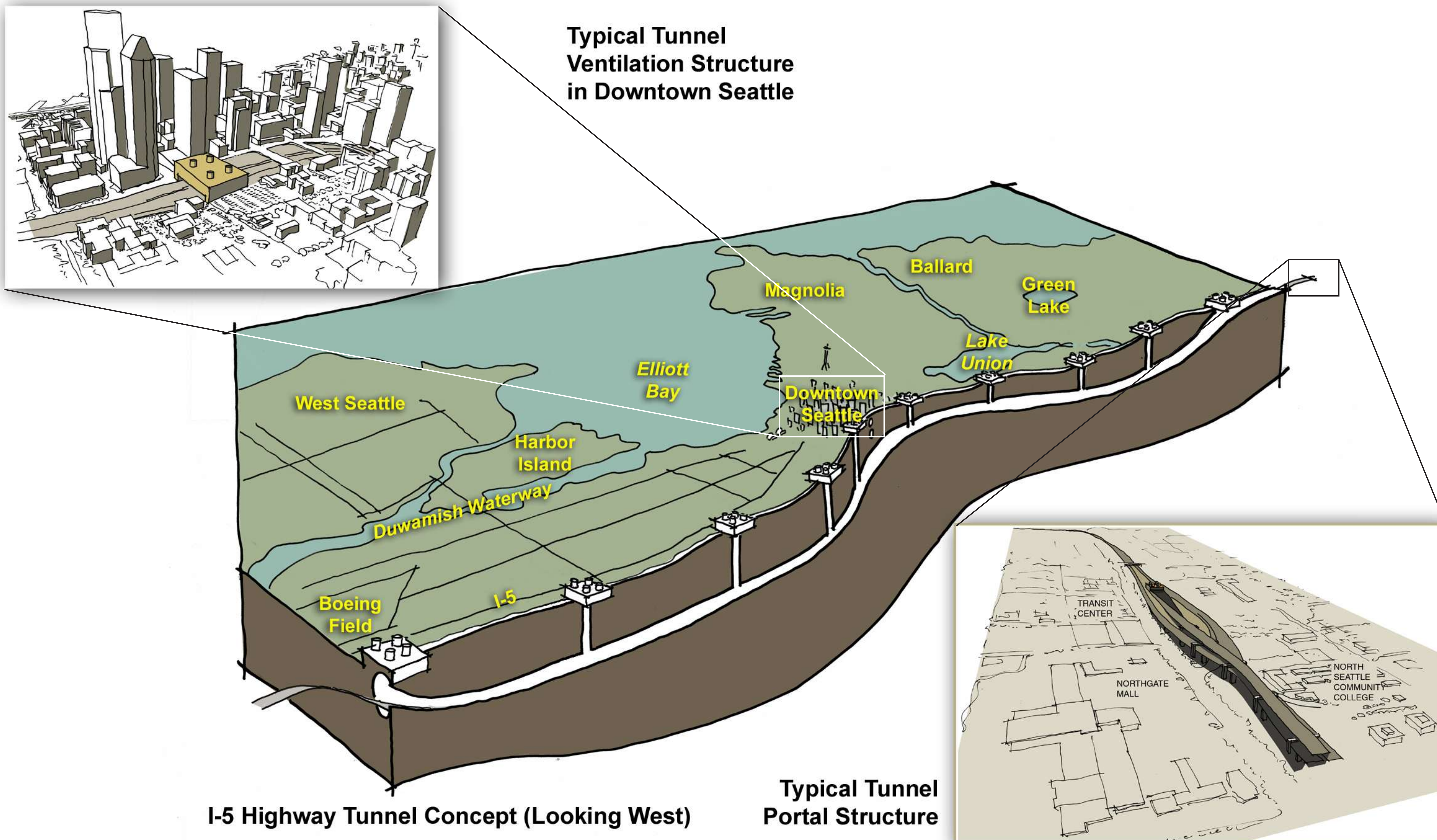
Large ventilation structures will likely be required about every half mile, as shown in Exhibit 2-10. These buildings will be placed in the block between the two tunnels in order to service both tunnels. They will include very large fans that will continuously exhaust vehicle emissions and introduce fresh air to the tunnels below. Emergency egress will have to be provided at 1,000-foot intervals, with either access to the surface or to some underground refuge.

Typical highway ventilation building.

These tunnels will be among the largest soft ground highway tunnels constructed to date and will require the development of a very large staging area near each portal.

South Approach

From the south tunnel portals, the lanes will rise to cross over I-90 on a bridge, at which point the southbound and northbound lanes will have different configurations. The southbound lanes will be on an elevated structure just east of the existing retaining wall. The northbound lanes will be at-grade east of the existing northbound I-5 travel lanes and will be cut into the slope with a line of retaining walls. The assumed bypass alignment will merge with I-5 south of the Spokane Street interchange.



I-5 Highway Tunnel Concept (Looking West)

554-1631-042/D(D802) 8/05 (B)

Potential Cost

The project team assessed the cost of the bypass tunnel in an order of magnitude estimate, or an educated guess. This is because no design work was done, and the cost of tunneling depends very heavily on soil conditions, which have not been specifically explored. The costs were estimated based on the cost developed for a previous project of similar magnitude.

The estimated construction costs for the tunnel alone are expected to be in the range of $4 billion to $6 billion in 2004 dollars. These costs are direct construction costs only, and other costs (including right of way acquisition, environmental mitigation, engineering, permitting, construction management, and administration costs) could add as much as 50 percent more based on experience with similar projects.

Funds are not likely to be available to undertake a major expansion of I-5's capacity. In addition, the SR 520 Bridge Replacement and HOV Project and the Congestion Relief Analysis, indicate that expansion of the highway to carry more vehicles will be highly disruptive and extremely costly and will have many impacts. Therefore, the region has decided building a high-capacity transit system in the corridor is the preferred approach to ensure future mobility and provide the people-moving capacity to ensure the region's health.

What was the I-5 Operations Study, and what did it conclude about I-5's future?

The I-5 Operations Study completed in July 2003 analyzed a 22-mile section of I-5 from NE 175th Street in the city of Shoreline to Spokane Street, south of downtown Seattle. It identified a mix of short- and longer-range improvements (Parsons Brinckerhoff 2003).

The first step of the I-5 Operations Study was to identify existing bottleneck locations and choke points. Then improvement options were developed. The study focused on existing and future traffic conditions, geometric design, lane continuity and balancing, and coordination with other ongoing or proposed projects in the corridor.

The project team developed a number of operational improvement options, including minor design modifications or restriping of roadway segments. They then screened the proposed options using existing traffic data and design analysis. They presented the resulting recommendations to a multi-agency steering committee.

The screening identified 17 options that could benefit the I-5 corridor. The options ranged from restriping a roadway segment to adding capacity to the I-5 corridor. Exhibit 2-11 illustrates where these improvement options are located in the project study corridor. Five options (Options 13 to 17) were considered feasible without further study, and twelve options (Options 1 to 12) were recommended for further study.

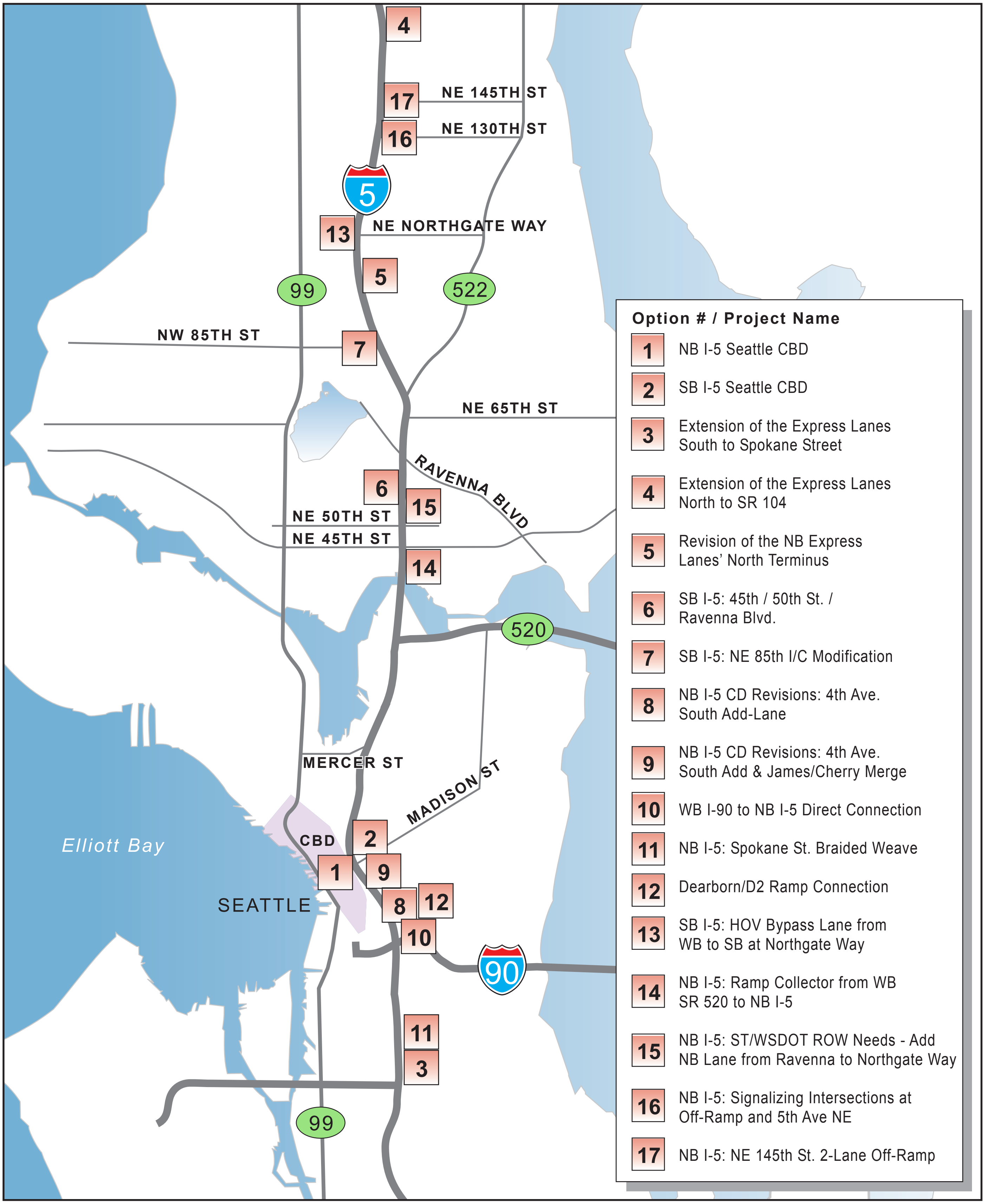
A systems-level I-5 corridor analysis that incorporates some of the concepts analyzed in the I-5 Operations Study will continue in Phase II of the I-5 Capital Improvement Plan.

4 Why are operational improvements important to freight mobility?

Over 12,000 trucks carry freight on I-5 each day in the study corridor, primarily between 6:00 a.m. and 6:00 p.m. Travel time reliability is a significant concern to the costs of moving freight in today's economy. As congestion and travel times increase in the corridor, operating costs also increase. One of the most significant concerns in the trucking industry today is schedule reliability. Reliability is critical to businesses that rely upon timely deliveries. It reduces the need to maintain large inventories and reduces costs related to storage, spoilage, and keeping stock current. Businesses must be able to reliably predict when goods will arrive at the desired location.

Trucks such as this commonly carry freight through the I-5 corridor.

Exhibit 2-12 shows the percentage of daily truck trips on I-5 by day of week. This chart shows that the percentage of trucks on I-5 ranges from 6.1 to 6.7 percent of total traffic on a typical weekday. On weekend days, the truck percentage drops to about 3 percent. Over half (57 percent) of the trucks in the corridor are single units with two to four axles. The remainder consists of double truck/trailer combinations (37 percent) and triple units (6 percent).



Parametrix 554-1631-042/D/D070 6/05 (B)

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Exhibit 2-11
Locations of Proposed Operational Improvement Options

Exhibit 2-12

Daily Truck Volumes per Day of the Week – I-5 at NE 185th Street (October 2003)

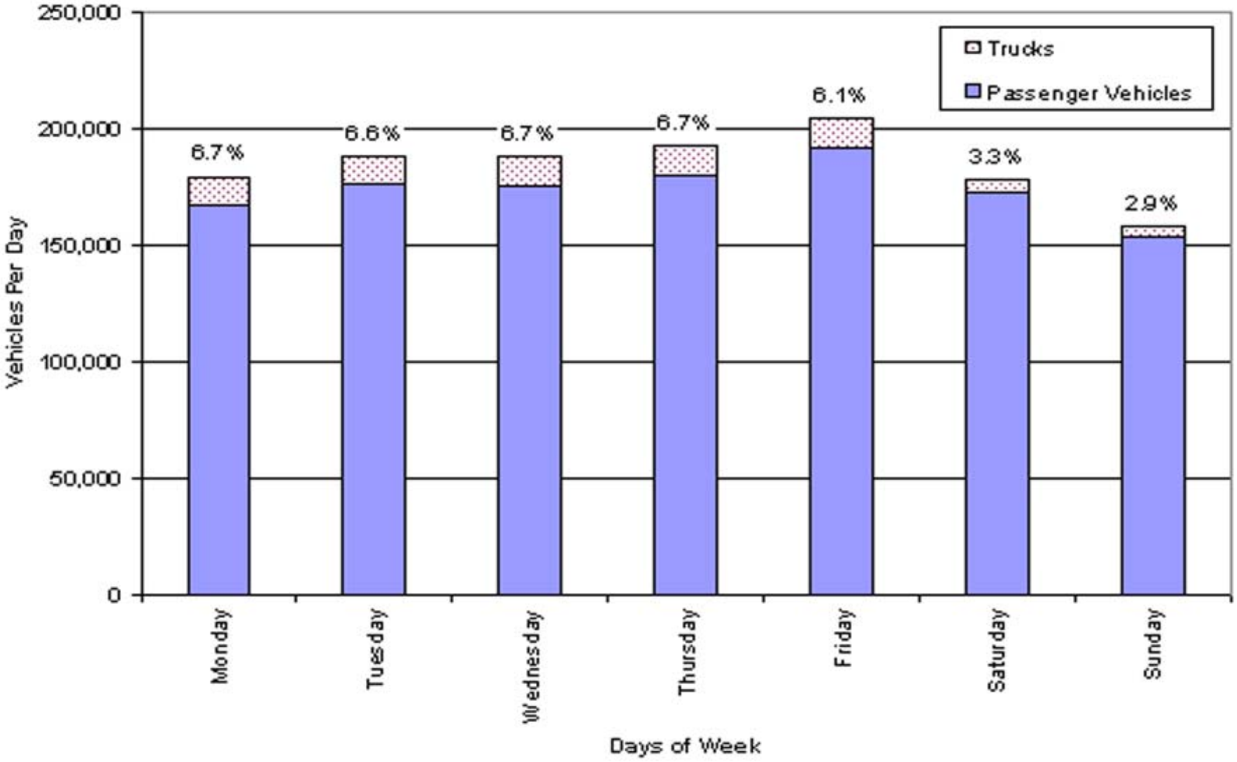
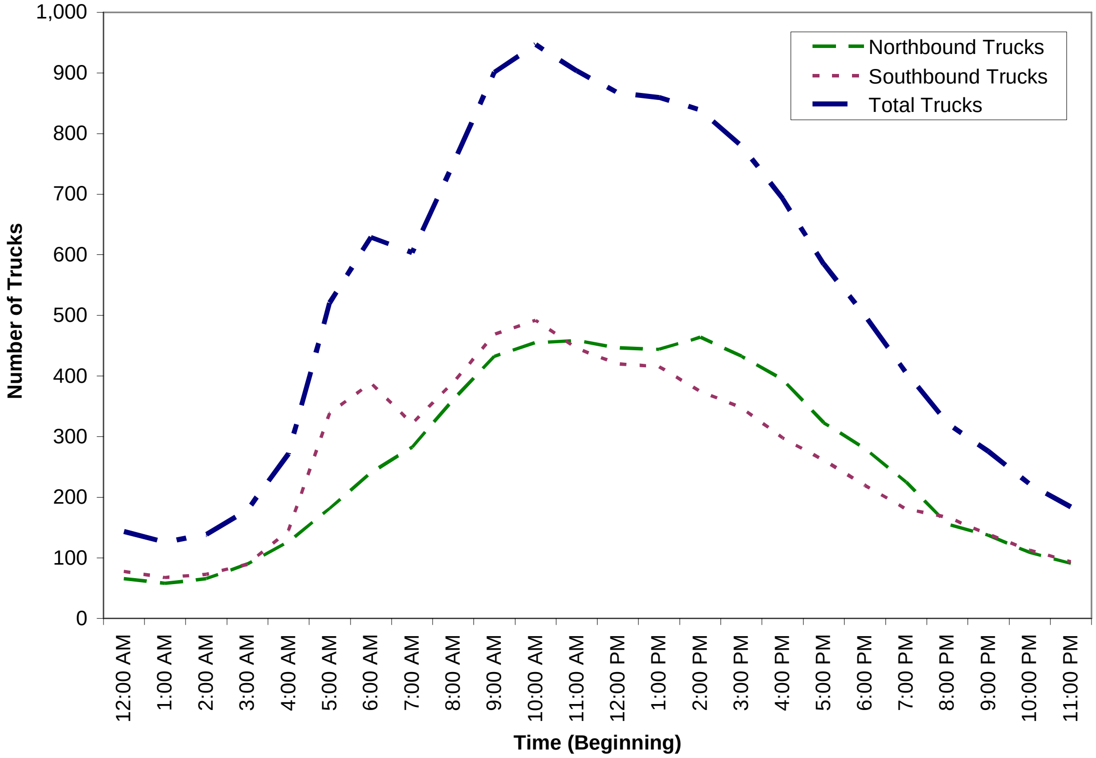


Exhibit 2-13 shows the average weekday truck volumes by time of day and direction. Truck volumes begin to build around 5:00 a.m., peak at 10:00 a.m., and gradually diminish over the rest of the day.

WSDOT estimates that the value of truck movements in the I-5 corridor is approximately $200 million per day. This monetary value highlights the importance of moving freight efficiently and reliably in the corridor. As a result, the I-5 Capital Improvement Plan will evaluate how the corridor improvement options will affect the reliability of freight movement in the corridor.

Exhibit 2-13
Average Weekday Truck Volumes by Time of Day – I-5 at NE 185th Street (October 2003)



Source: Truck classification counts performed by WSDOT Permanent Traffic Recording Station P3 (I-5 at NE 185th Street) for weekdays (Tuesday, Wednesday, Thursday) in October 2003.

5 How many accidents typically occur on I-5?

Over 10,000 traffic accidents occurred on I-5 between 220th Street SW and Boeing Access Road during the 3-year period from 2001 to 2003. To understand whether the number of accidents on different highway segments is higher or lower than average, analysts calculate the number of accidents per million vehicle miles traveled. For urban interstate highways in Washington State, the average accident rate is 1.37 accidents per million vehicle miles of travel. Northbound I-5 has an accident rate of 1.4, and southbound I-5 has an accident rate of 1.7; both exceed the statewide average.

I-5 segments with higher than average accident rates are:

- Northbound from I-90 to Mercer Street with an accident rate of 2.1.

- Southbound from Northgate Way to Mercer Street with an accident rate of 2.1.
- Southbound from Mercer Street to I-90 with an accident rate of 3.2.

WSDOT classifies several ramps in the I-5 study corridor as High Accident Locations. The specific locations are listed in the *I-5 Pavement Reconstruction Projects Final Existing Transportation Conditions Technical Report* (Parametrix 2005).

WSDOT has also reviewed the severity and type of accidents to determine if any common accident patterns emerge. Approximately 62 percent of the total accidents on I-5 are property damage only and do not result in any injuries to the drivers or passengers. Accidents with one or more fatalities amount to approximately 0.2 percent of total accidents, with 20 fatal accidents on this segment of I-5 between 2001 and 2003. The remaining accidents (approximately 38 percent) are collisions where both property damage and injury occurs.

The predominant accident type in the corridor is rear end accidents, which compose approximately 61 percent of the total. Vehicles striking a fixed object are the second highest accident type at 15 percent, followed by sideswipe accidents at 10 percent and angle accidents at 9 percent. The predominance of rear end accidents is fairly typical for an urban freeway with regular traffic congestion on weekdays.

To improve safety in the corridor, WSDOT will review safety benefits for the improvement alternatives evaluated in the Capital Improvement Plan to determine their accident reduction potential. Improvements such as moving left-hand on- and off-ramps to the right side will likely have a significant safety benefit because they will eliminate short-distance weaving sections along I-5.

6 What is the current transit service and ridership in the corridor?

The section of I-5 through Seattle and most notably the section north of the Central Business District is the most important transit corridor in the region. Numerous bus routes currently serve the I-5 CIP corridor. Four operators, King County Metro Transit (Metro), Community Transit, Sound Transit, and the University of Washington Health Sciences Express, provide the transit routes along the study corridor.

Exhibit 2-14 summarizes transit service along four major segments of the I-5 CIP corridor from north to south:

- I-405 to Northgate
- Northgate to the Ship Canal
- Ship Canal to I-90
- I-90 to I-405

Exhibit 2-14
Transit Operators and Routes Serving the I-5 Study Corridor

Corridor Segment	Operators Serving Each Corridor Segment	Number of Routes Serving Each Corridor Segment	Weekday Ridership for Routes Serving Each Corridor Segment
I-405 (Lynnwood) to Northgate	Metro, Community Transit, Sound Transit	8[1]	6,353
Northgate to Ship Canal	Metro, Community Transit, Sound Transit, UW Health Sciences Shuttle	27	25,374
Ship Canal to I-90	Metro, Community Transit, Sound Transit, UW Health Sciences Shuttle	66	48,738
I-90 to I-405 (Tukwila)	Metro	14[1]	14,588

[1] *Only routes that stop within the corridor segment are included. Sound Transit and Pierce Transit have routes that go through these corridor segments, but because they do not make any stops within the corridor, they are not included in the number of routes serving the corridor segment.*

As shown in Exhibit 2-14, the number of transit routes is highest in the downtown Seattle segment between the Ship Canal and I-90. Approximately 66 transit routes operate in this segment, with nearly 50,000 riders on an average weekday.

7 What is the role of rail transit planning in the I-5 corridor?

Proposals to develop rail transit in the I-5 corridor date from the early days of the highway's planning in the 1950s. The City of Seattle favored adding a provision to allow the eventual construction of rail transit in the highway's original design. Instead, the development of a separate rail rapid transit corridor was advanced in parallel with the construction of I-5. Planning and design for a rail system in the corridor began shortly before the highway's completion in the mid-1960s. In 1968 and again in 1970, a rail rapid transit plan was placed on the ballot in King County, but both times the measure failed to gain the needed 60 percent favorable vote to levy the local taxes needed to fund the project. For the next 20 years, transit improvements in the I-5 corridor focused on numerous improvements to the bus system, including the addition of HOV lanes, park-and-ride lots, transit access improvements, and express buses and other expanded services.

In 1990, the most significant of these transit improvements opened with the completion of the five-station Downtown Seattle Transit Tunnel. Along with a grade-separated bus facility parallel to I-5 through downtown Seattle, the Pine Street reversible roadway ramp was converted to provide a direct tie to and from I-5 south of the Central Business District. The Downtown Seattle Transit Tunnel is the most important transit investment in the I-5 corridor and was designed to be eventually converted to rail.

Planning for rail transit in the I-5 corridor began again shortly before the Downtown Seattle Transit Tunnel was finished, following an advisory vote on rail in King County in 1988. However, it wasn't until 1996 that voters approved a Sound Transit plan to finance and construct a light rail line from South 200th Street south of Seattle-Tacoma International Airport to Northgate. A major underlying assumption in Sound Transit's plan was that rail transit will provide the primary means to improve mobility and accommodate future travel growth in the I-5 corridor through Seattle.

The southern half of the Link light rail line from Westlake Station in downtown Seattle to Sea-Tac Airport is now under construction, and revenue service is scheduled to begin by 2009.

In 2003 the Sound Transit Board selected a preferred alignment for North Link light rail (shown in Exhibit 2-15) from downtown Seattle north to Northgate, with the exception of the specific route between Roosevelt and 92nd Avenue NE. The Sound Transit Board considered two routes:

- 8th Avenue NE using the east side of I-5 right of way
- Tunneling under 12th Avenue NE in the Roosevelt commercial district

As a result of a series of workshops conducted in 2004, WSDOT has requested that Sound Transit locate their facilities as close to the I-5 right of way edge as possible to accommodate future I-5 improvements and stormwater drainage facilities.

As now planned, the Link light rail line has the ultimate equivalent people-moving capacity of an eight-lane highway running parallel to I-5. With the exception of a short segment between SR 599 and SR 518 in Tukwila and the section between the Roosevelt District and Northgate in the north, most of the light rail line will not be located in the I-5 right of way. However, plans for extending the line north of Northgate generally contemplate the use of significant amounts of I-5 right of way all the way to Lynnwood. In addition, depending on the final location chosen for the Northgate station and the alignment to the south, the line might require significant construction in the I-5 right of way along the east side of the highway as far south as the Roosevelt District.

Sound Transit's Phase 2 for Link light rail includes a rail line to Everett, potentially using I-5 right of way.

Exhibit 2-15
Proposed North Link Light Rail Alignment and Station Locations Improvement Options

8 How are noise impacts and mitigation determined in the I-5 study corridor?

WSDOT considers noise mitigation when constructing a new highway, adding through-lanes to an existing highway, or moving a highway significantly closer to residents. The Federal Highway Administration (FHWA) and WSDOT may also consider retrofitting an existing highway to mitigate noise impacts in neighborhoods built prior to May 1976. These retrofit projects are ranked and built according to a neighborhood priority list.

Pavement reconstruction and operational improvements to I-5 are unlikely to increase noise levels over the existing conditions. However, consistent with FHWA's retrofit policy, noise mitigation could be implemented in specific areas that meet retrofit requirements.

What are the criteria for noise impacts?

Noise levels are measured and predicted using dBA, the decibel scale (dB) with an A-weighted filter, which cover the frequencies that people can usually hear. FHWA and WSDOT define a traffic noise impact to occur when noise levels for sensitive land uses approach or exceed 67 dBA at locations such as parks, schools, and homes. Severe impacts occur when the noise levels reach 75 dBA.

The noise level change that most people can start to hear is approximately 3 dBA. A 5-dBA change in noise level is clearly noticeable, and an increase of 10 dBA is roughly the same as doubling the perceived sound level.

Noise level depends on air temperature, wind speed and direction, duration of the noise, and the distance from the source, ground, and any obstructions. FHWA uses the Leq (a time weighted average sound level) to evaluate noise impacts. Leq is measured for a 15-minute to 1-hour period during the loudest traffic hour. Noise from free-flowing freeway traffic measured at a distance 50 feet away is approximately 70 dBA (Leq).

When does WSDOT implement noise mitigation?

According to FHWA guidelines, WSDOT must consider noise mitigation when a predicted traffic noise level approaches or exceeds the noise mitigation criteria specified in Exhibit 2-16. FHWA policy leaves some of the specific procedures of implementing the criteria up to WSDOT.

Exhibit 2-16

FHWA Roadway Noise Mitigation Criteria

	Land Use Category	Hourly Leq (dBA)
A	Lands on which serene and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose	57 (exterior)
B	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals	67 (exterior)
C	Developed lands, properties, or activities not included in the above categories	72 (exterior)
D	Undeveloped lands	--
E	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums	52 (interior)

WSDOT normally implements mitigation measures when noise impacts from roadway traffic are modeled in the future design year of the project (usually 20 years into the future) and reasonable and feasible mitigation options are identified. Mitigation can include traffic management measures, highway design measures, and noise barriers. The primary forms of noise mitigation for highway transportation projects are barriers, constructed between the roadway and the affected people to physically block traffic noise.

WSDOT has developed the following criteria to determine if mitigation is feasible and reasonable:

- Noise mitigation is feasible if (1) the topography is compatible with the construction of the mitigation measures; (2) provisions for future access, drainage, safety, and maintenance requirements are met; and (3) the majority of the first row of receivers hear a minimum 5-dBA reduction in noise, and at least one receiver obtains a 7-dBA reduction.
- Noise mitigation is reasonable if it is determined to be cost-effective and the benefiting residence receives at least a 3-dBA noise reduction. The underlying assumption is that

as the predicted future noise level increases and homes are impacted, it is reasonable to implement more costly measures (such as a larger wall) to mitigate noise. For example, WSDOT noise standards based on two homes exposed to noise levels of 70 dBA (Leq) before mitigation identifies a reasonable cost for the barrier of $31,400. The wall size needed to feasibly reduce noise is $29,000. The needed wall size cost is below the allowed cost, which makes the barrier reasonable.

What has WSDOT done previously to minimize noise impacts from I-5?

WSDOT has placed noise barriers along portions of the I-5 corridor, as shown in Exhibit 2-17. South of I-90, a few barriers are located along northbound I-5, adjacent to parks, schools, playgrounds, and residential areas. However, many of the adjacent land uses along this southern stretch of I-5 are industrial, and the residential areas to the east are often up on a hill above the highway. No noise barriers are located along I-5 between I-90 and SR 520 where adjacent land uses are predominantly commercial through the Central Business District, except for a recently noise barrier in the Eastlake/Roanoke area. However, land uses to the north and south of the Central Business District include several residential buildings. North of SR 520, residential areas are more frequently located immediately adjacent to I-5; thus, noise barriers occur in more locations along this section of the highway.

What are noise barriers?

Noise barriers can be constructed as walls or earthen berms (mounds of dirt). Earthen berms require more right of way than walls require. Generally, to be effective, noise walls should be high enough to break the line of sight between the noise source and the receiver. They must also be long enough to stop substantial amounts of noise from coming around the ends of the walls to the homes that we are trying to protect. Noise walls can be made of almost any construction material; however, they are usually made from concrete due to its affordable price, availability, and ease of maintenance.

Typical WSDOT noise wall.

Exhibit 2-17
Location of Noise Barriers along I-5 with Adjacent Land Uses

Direction	Approximate Mile Post(s)	Cross Streets	Adjacent Land Use
Northbound	155 to 156	S 144th Street to northbound SR 599	Park, Foster residential area
Northbound	156	Interurban Avenue S to S 129th Street	Green River
Northbound	161 to 162	S Orcas Street to S Dawson Street	High school, playground, Rainier Valley residential area
Northbound	168	Lakeview Boulevard E to SR 520	Roanoke residential area
Southbound	169 to 171	NE 45th Street to NE 65th Street	Wallingford residential area
Southbound	173 to 175	Northgate Way to south of NE 145th Street	Haller Lake residential area, North Acres Park
Southbound	175	North of NE 145th Street to NE 155th Street	Shoreline residential area, Twin Ponds Park
Southbound	175	Adjacent to Sunnyside Avenue N	Shoreline residential area
Northbound	175 to 176	NE 161st Street to NE 170th Street	Ridgecrest Park, Shoreline residential area
Northbound	176.5	NE 185th Street to NE 190th Street	School, North City residential area
Southbound	176.5 to 177	NE 190th Street to NE 198th Street	Richmond Highlands residential area
Southbound	178.5	Adjacent to 63rd Avenue W	Montlake Terrace residential area
Northbound	179	228th Street SW to 224th Street SW	Mountlake Terrace residential area
Northbound	179	220th Street SW to 212th Street SW	Mountlake Terrace residential area
Southbound	179-180	220th Street SW to 204th Street SW	Cedar Valley residential area
Southbound	181	36th Avenue W to Alderwood Mall Parkway	Commercial

9 What are the existing stormwater drainage conditions in the pavement rehabilitation project corridor?

I-5 passes through portions of three major drainage basins as it traverses the project area: Thornton Creek, Lake Union, and the Duwamish River. These major drainage basins are further divided into subbasins possessing unique discharge points. In addition, the I-5 corridor has been divided into subbasins (A, B, C, etc.), each having individual entry points into the local drainage basins. Exhibits 2-18 and 2-19 identify and characterize the three major basins and associated subbasins that the I-5 corridor passes through.

Exhibit 2-18 summarizes pertinent information for each of the I-5 corridor subbasins (A through L). These subbasins are grouped under the major drainage basins they discharge to and include the approximate length of the highway corridor comprising each subbasin. Exhibit 2-18 also lists the general stormwater discharge location within each major drainage basin and pollutants exceeding state surface water quality standards.

The Washington State Department of Ecology (Ecology) classifies waterbodies that are impaired for at least one beneficial use as Category 5. These waterbodies do not meet state water quality standards for at least one pollutant and do not have a total maximum daily load (TMDL) or other pollution control plan in place. Waterbodies in this category are submitted to the U.S. Environmental Protection Agency (EPA) as the 303(d) List of Threatened and Impaired Waterbodies.

Exhibit 2-18

Drainage Basin Summary

Receiving Water/ Subbasin	Highway Length (miles)	Outfall (discharge point)	Parameters Exceeding State Water Quality Standards
Thornton Creek			
A	0.9	North Fork	Dissolved oxygen, fecal coliform, temperature
B	1.9	South Fork	
King County Combined Sewer*			
D	0.7	Westpoint Wastewater Treatment Plant	None
Lake Union			
C (Densmore)	1.3	North Lake Union	Lead, aldrin, fecal coliform
E	0.9	North Lake Union	
F	1.4	Northeast Lake Union	
G	0.7	East Lake Union	
H	1.3	South Lake Union	
Duwamish River			
I (Diagnol)	3.6	North of Diagonal Avenue	Dissolved oxygen, pH
J	0.4	Unknown	
K (Slip 4)	1.1	West of King County Airport	
L (Norfolk)	2.4	Near S 104th Street	

**Subbasin D can be identified with either the Densmore/Lake Union or the West Lake Washington basins; however, runoff from Subbasin D is collected by the combined sewer system.*

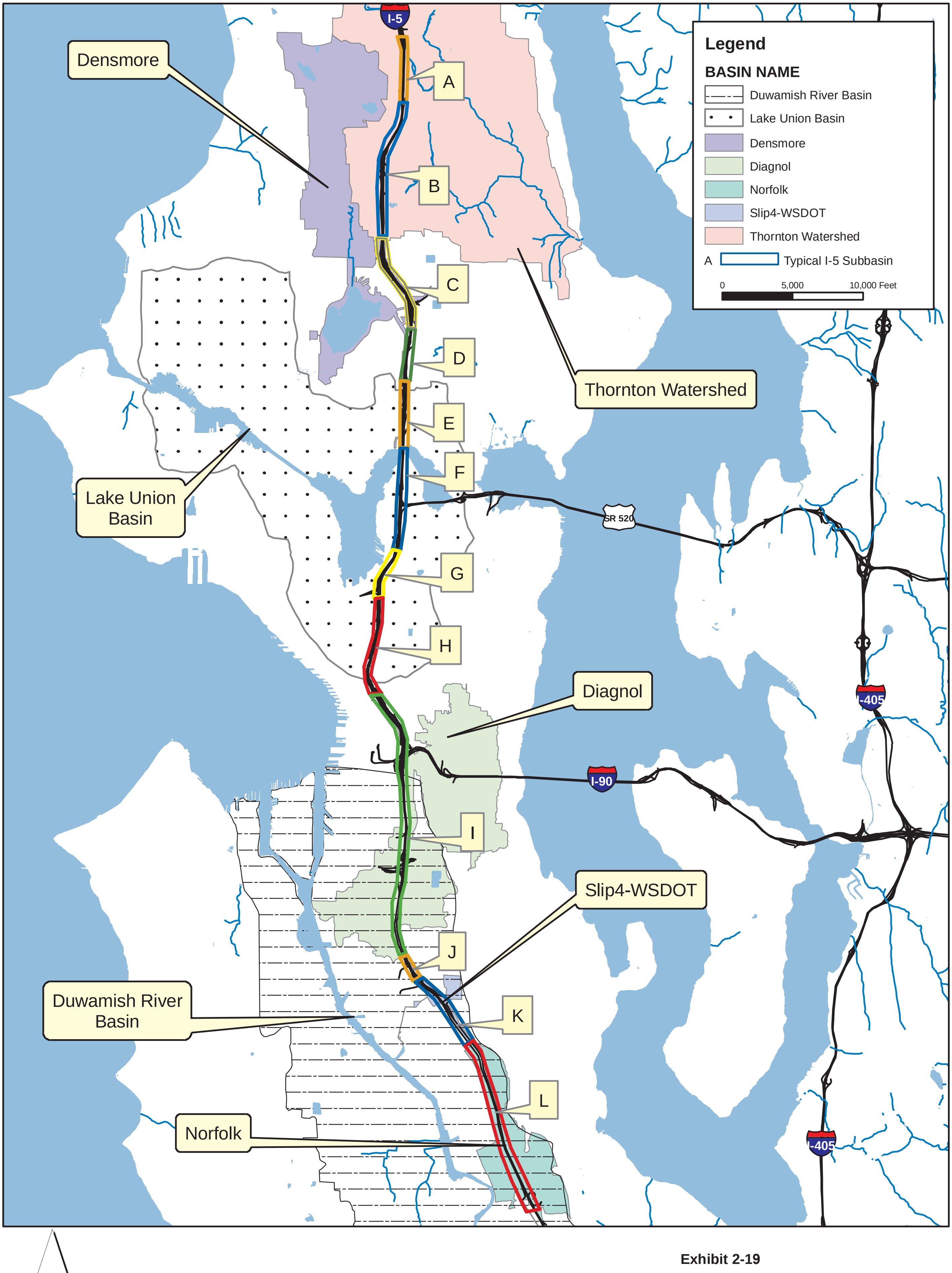


Exhibit 2-19

Project Corridor Drainage Basins and Subbasins

Stormwater Report Recon.mxd - July 22, 2005

Runoff from one I-5 subbasin (Subbasin D, see Exhibit 2-19) is collected in a series of storm drain pipes and discharges to the King County regional combined (sanitary and storm) sewer system. Runoff from Subbasin D is conveyed along the north end of Lake Union to the Westpoint Treatment Plant. From there, it undergoes an extensive treatment process prior to a deep water discharge into Puget Sound. A combined sewer overflow (CSO) is located at the upper end of Ravenna Creek, to the east of Subbasin D. If flow in the combined sewer exceeds pipe capacity during a rainstorm, excess flow could discharge from the piping system to an adjacent receiving water at the CSO location.

What is the King County combined sewer and what is a combined sewer overflow (CSO)?

A combined sewer is a sewer system carrying both stormwater and untreated household and industrial wastewater. When heavy rainfall enters a combined sewer system, the volume of rainwater and sewage that exceeds the system's capacity is forced to overflow into area streams and rivers through combined sewer overflow (CSO) outfalls.

Thornton Creek Basin

I-5 crosses the upper portion of the Thornton Creek Basin in the Northgate area of Seattle. Thornton Creek is located in Water Resource Inventory Area (WRIA) 8 and discharges into Lake Washington, as shown in Exhibit 2-19. I-5 crosses the headwaters of the north and south forks of Thornton Creek.

What uses are protected in the Thornton Creek Basin?

Thornton Creek and its tributaries are to be protected for the following designated uses (Ecology 2004):

- Salmon and trout spawning
- Non-core salmon and trout rearing and migration
- Primary contact recreation
- Domestic use
- Industrial and agricultural water supply
- Livestock watering
- Wildlife habitat
- Harvesting
- Commerce and navigation
- Boating and aesthetic values

Ecology listed Thornton Creek on the 2002/2004 303(d) List of Impaired and Threatened Waterbodies (Category 5) for exceeding fecal coliform, dissolved oxygen, and temperature criteria downstream of the project area (Ecology 2004). The Federal Emergency Management Agency (FEMA) has not mapped a floodplain in the project area.

Lake Union Basin

Lake Union is located in WRIA 8. It receives water from Lake Washington via Portage Bay and drains into Puget Sound via the Ship Canal and the Hiram M. Chittenden Locks near Ballard. The project area crosses the east end of the Lake Union Basin via the I-5 Ship Canal Bridge, which spans the open water. In addition to the natural hydrology of the lake, the basin also receives water from adjacent upland areas, including the project area, via storm drains and CSOs. Land use in this area consists mainly of commercial development and docks on the lake’s northern shore and residential development and a few small parks on the southern shore.

What uses are protected in the Lake Union Basin?

Lake Union is to be protected for the following designated uses (Ecology 2004):

- Salmon and trout spawning
- Non-core salmon and trout rearing and migration
- Primary contact recreation
- Domestic use
- Industrial and agricultural water supply
- Livestock watering
- Wildlife habitat
- Harvesting
- Commerce and navigation
- Boating and aesthetic values

Currently, Lake Union provides freshwater ports, maintenance facilities, and navigation routes for recreational and commercial boats. FEMA has not mapped a floodplain associated with Lake Union; the lake water surface elevation is controlled at the Ballard Locks.

Duwamish River Basin

The Duwamish River is part of WRIA 9. It originates at the confluence of the Green and Black Rivers and flows approximately 13 miles to Elliott Bay. The Duwamish River has a contributing basin of approximately 372,500 acres and is the primary freshwater source to Elliott Bay. The Duwamish River is a Type S stream. Ecology defines Type S streams as streams that are shorelines of the state and typically have high fish, wildlife, or human use (WAC 222-16-031, RCW 90.58). The lower 10 miles of the Duwamish River are tidally influenced and estuarine (Ecology 1994, 1995a).

What uses are protected in the Duwamish River Basin?

The Duwamish River is to be protected for the following designated uses (Ecology 2004):

- Salmon and trout rearing
- Secondary contact recreation
- Industrial and agricultural water supply
- Livestock watering
- Wildlife habitat
- Harvesting
- Commerce and navigation
- Boating and aesthetic values

Ecology listed the Duwamish River on the 2002/2004 303(d) List of Impaired and Threatened Waterbodies (Category 5) for exceeding dissolved oxygen and pH criteria (Ecology 2004). In addition, the Duwamish River is listed for sediment criteria (Ecology 1998a). Exceedances of sediment criteria are generally associated with contamination from current and historic industrial activities and contaminated discharges from CSOs and stormwater outfalls. The EPA has identified seven early action cleanup areas in lower Duwamish River under the Superfund program to clean up contaminated sediments. No total maximum daily loads have been prepared for the Duwamish River.

10 What stormwater management regulations and requirements need to be considered?

Implementing operational improvements on I-5 may require compliance with several stormwater regulations. Stormwater management regulations have been developed and implemented at federal, state, and local levels to protect the physical, chemical, and biological integrity of receiving waters. These regulations vary among each of the major basins since they are designed to be protective of the specific characteristics and beneficial uses of each individual basin. Exhibit 2-20 summarizes applicable stormwater detention and water quality treatment regulations for each basin in the project corridor.

Exhibit 2-20

Summary of Stormwater Management Requirements

	Detention		Water Quality Treatment		
Receiving Water/ Subbasin	**Design Criteria**	**Applicable Manual**	**Design Criteria**	**Applicable Manual**	**Basin-Specific Requirements**
Thornton Creek					
A, B	Detention to match pre-development runoff[1]	WSDOT	Enhanced treatment	WSDOT	Thornton Creek Basin Plan
King County Combined Sewer					
D	To be determined	N/A	None required	N/A	King County Department of Natural Resources
Lake Union					
C, E, F, G, H	Detention to meet allowable discharge[2, 3]	WSDOT	Basic treatment	WSDOT	None
Duwamish River					
I, J, K, L	Match pre-development flows[1]	WSDOT	Basic treatment	WSDOT	None

1 Detention best management practices (BMPs) should be designed so that peak flows during half the 2-year design storm up to the 50-year design storm are the same under pre-development and developed conditions.

2 Detention is not required if the director of Seattle Public Utilities determines that the downstream conveyance system has adequate capacity.

3 Detention BMPs should be designed so that the maximum discharge from the project area is 0.15 cubic feet per second (cfs) per acre of impervious surface during a 2-year design storm and 0.20 cfs per acre during a 25-year design storm.

What is WSDOT's approach to complying with stormwater management regulations?

To implement a program of improvements for I-5 through Seattle, WSDOT is required to identify and comply with significant and varied stormwater regulations if the project warrants it. WSDOT's approach to stormwater management for this project is to develop practical strategies that not only meet the intent of the extensive regulatory framework, but also work within the following constraints:

- In the highly developed urban corridor that I-5 passes through, available space for stormwater facilities is minimal.
- Acquisition of additional land for this purpose will be very expensive and could require demolition of existing structures.
- Related permitting issues could become costly and significantly delay the project schedule.

What are the stormwater management requirements in the Thornton Creek Basin?

Thornton Creek Basin Plan requirements currently emphasize a regional detention approach to stormwater management. An expansion of this regional approach is favored for the basin (refer to the Thornton Creek Basin Plan Requirements on page 2-41 of this document). One solution therefore will be for WSDOT and the City to explore partnering options for regional detention that will meet detention retrofitting requirements for I-5 within the context of the basin's detention approach.

What are the stormwater management requirements in the Lake Union Basin?

Lake Union is a direct discharge receiving water. WSDOT can coordinate with Ecology and the City of Seattle to examine available capacity in existing stormwater piping, weighing the options of on-site detention versus potential piping improvements required to convey runoff from I-5 directly to the lake (after providing water quality treatment). Each of the I-5 subbasins in the Lake Union Basin has unique conveyance capabilities and available capacity. Some convey only highway runoff to the lake. Further investigation of these systems will help determine potential deficiencies in storm piping capacity.

What are the stormwater management requirements in the Duwamish River Basin?

Exhibit 2-15 identifies stormwater management requirements for developments within the Duwamish River Basin. The WSDOT *Highway Runoff Manual* governs requirements for discharge to the Duwamish River and mandates detention. The discharge points for the related I-5 subbasins are located in the downstream reaches of the river, where tidal influences affect river flow. WSDOT recommends additional investigation into the intent of the detention requirements.

What federal stormwater regulations will the I-5 Project need to comply with?

Stormwater discharges are regulated under the federal Clean Water Act Section 402: National Pollutant Discharge Elimination System (NPDES) State Waste Discharge Individual Permit for Process Water and Storm Water. To comply with the Clean Water Act, an NPDES permit is required for any discharge of pollutants into the waters of the United States. Permitted discharges must satisfy discharge permit requirements under Section 402 of the Clean Water Act and Chapter 90.48 of the Revised Code of Washington (RCW).

The project will have to comply with WSDOT's NPDES stormwater permit and the City of Seattle's NPDES wastewater and stormwater permit requirements. In addition, an NPDES permit may be required for modification of an existing outfall. If stormwater runoff will discharge into the combined sewer system, the project must comply with the discharge limits and technology requirements of the municipal stormwater and construction stormwater general NPDES permits. A construction stormwater general permit will be required because the project will disturb more than 5 acres of land.

What state stormwater regulations will the I-5 Project need to comply with?

Washington Administrative Code

Through the Washington Administrative Code (WAC), Ecology regulates discharges to surface waters of the state. Several chapters in the WAC address water quality. Chapter 173-201A WAC, Water Quality Standards for Surface Waters of the State of Washington, summarizes the state water quality standards for ambient water quality and is part of the Section 401 Water Quality Certification, which certifies compliance with state water quality standards. The certification process examines effects of the proposed project related to the state water quality standards and beneficial use.

For all existing highways with greater than 50,000 average daily trips, Chapter 173-270 WAC, Puget Sound Highway Runoff Program, requires that WSDOT either (1) retrofit the highway with all practicable best management practices (BMPs) by the end of 2005, or (2) transfer highway runoff to tribes or local governments for treatment as funding is appropriated.

Ecology and WSDOT Regulations

Ecology published the *Stormwater Management Manual for Western Washington* (2005) to provide guidance for stormwater management. Ecology based this manual on a presumptive approach. That means they assume that a project will meet water quality standards if runoff from the project site is managed by installing stormwater treatment and/or detention BMPs that are designed using the guidance in this manual.

WSDOT developed the *Highway Runoff Manual* (2004) (MS 31-16) to provide guidance for stormwater management from highway runoff. Ecology has determined that this manual is consistent with the Ecology manual, and therefore, a project is presumed to meet water quality standards if it meets the guidance provided in the WSDOT manual.

The WSDOT manual has detention requirements for all projects that create new impervious surfaces and for projects that create new pollutant-generating impervious surfaces. In addition, the WSDOT manual provides guidance for hydraulic analysis, erosion and sediment control, and drainage reports.

Section 2-4 of the WSDOT *Highway Runoff Manual* provides stormwater retrofit guidance for when projects are required to consider stormwater improvements. Stormwater improvements are not required for pavement rehabilitation projects that do not increase the amount of impervious surface.

What coordination effort will be needed with local stormwater regulations?

King County Requirements

King County Ordinance 13680 provides policy guidance for the operation and further development of wastewater systems and policies. The ordinance includes the following guidance:

- King County's wastewater system is impacted by clean stormwater.
- King County's wastewater system should not be used to collect or treat stormwater.

City of Seattle Regulations

The City of Seattle Drainage Code (Seattle 2001) requires that stormwater detention and water quality treatment facilities be installed and maintained to treat the portion of a site being developed. The City's Drainage Code requires detention primarily for sites that discharge to the public combined sewer, or to storm drains if a downstream capacity problem is identified. Detention is not required if the storm drain system has adequate capacity and discharges to a major receiving water, such as Lake Union. The City is currently in the process of updating their manual, and the regulations may change to improve existing and create new regional detention facilities, to increase on-site detention for new construction or redevelopment, and to meet existing and future NPDES requirements.

Thornton Creek Basin Plan Requirements

In addition to the guidelines established in the *Highway Runoff Manual* and the City of Seattle Drainage Code, the Thornton Creek Basin Plan establishes requirements and opportunities for stormwater management in the Thornton Creek Basin. The following elements of this plan may affect long-term stormwater management in Subbasins A and B:

- Improve existing and create new regional detention facilities.
- Increase on-site detention for new construction and redevelopment.
- Continue flow monitoring efforts.

- Meet existing and future NPDES requirements.
- Support and promote public and alternate transportation systems.

11 What are the existing conditions and urban context of the I-5 corridor?

The I-5 corridor is located adjacent to many of Seattle's diverse urban neighborhoods, which each have their own existing constraints and possible opportunities. Exhibits 2-21 through 2-32 provide a series of cross sections and brief descriptions to summarize the existing conditions in the I-5 corridor.

The northern segment of I-5 extends from Northgate Way south to SR 520. Generally, the northbound and southbound lanes in this segment of I-5 operate side-by-side, with the reversible express lanes in between. Landscaping is used throughout as a screen for adjacent residential uses.

Retaining wall separating I-5 from the adjacent neighborhood, north of downtown Seattle.

The central segment of I-5 extends from SR 520 south to Dearborn Street, passing through the most densely developed part of Seattle. The profile for this segment of I-5 is generally characterized by a stepped-down roadway located between retaining walls and buildings. The northbound and southbound lanes operate at different elevations and are separated by retaining walls due to the slope of the land. Landscaped areas are not very common for this segment due to the highly developed nature of the corridor and the lack of right of way.

The southern segment of I-5 extends from Dearborn Street south to Boeing Access Road (Seattle city limits). This segment of I-5, like the central segment, is also situated on sloped land in many areas. The roadway facilities are generally vertically separated and operate at different elevations. There is a generous use of landscaping in this segment, serving to screen adjacent land uses from the freeway and to improve the overall visual quality of the corridor.

General opportunities for improving neighborhood conditions along the I-5 corridor include building or improving noise barriers, landscaping, and nonmotorized connections.

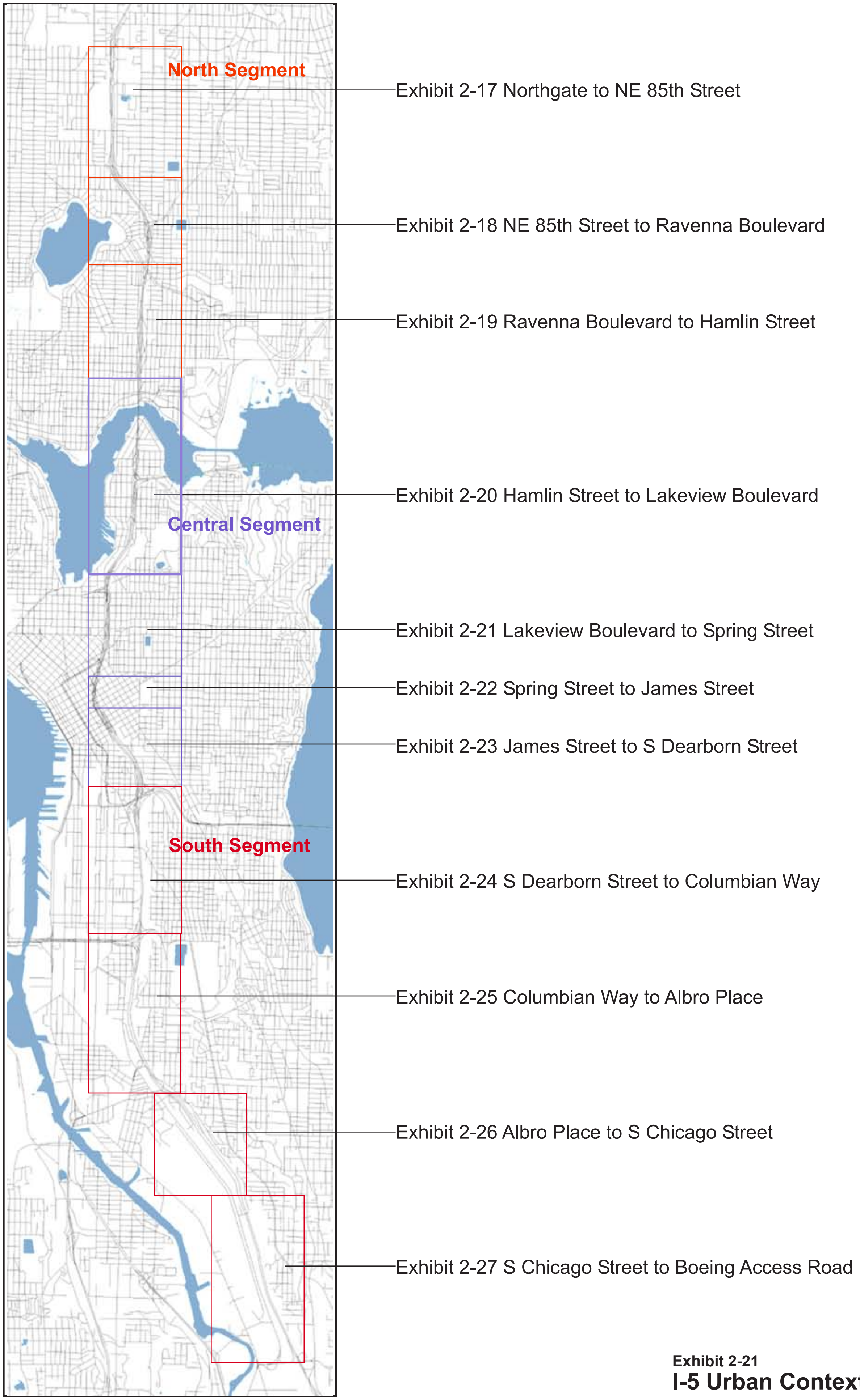
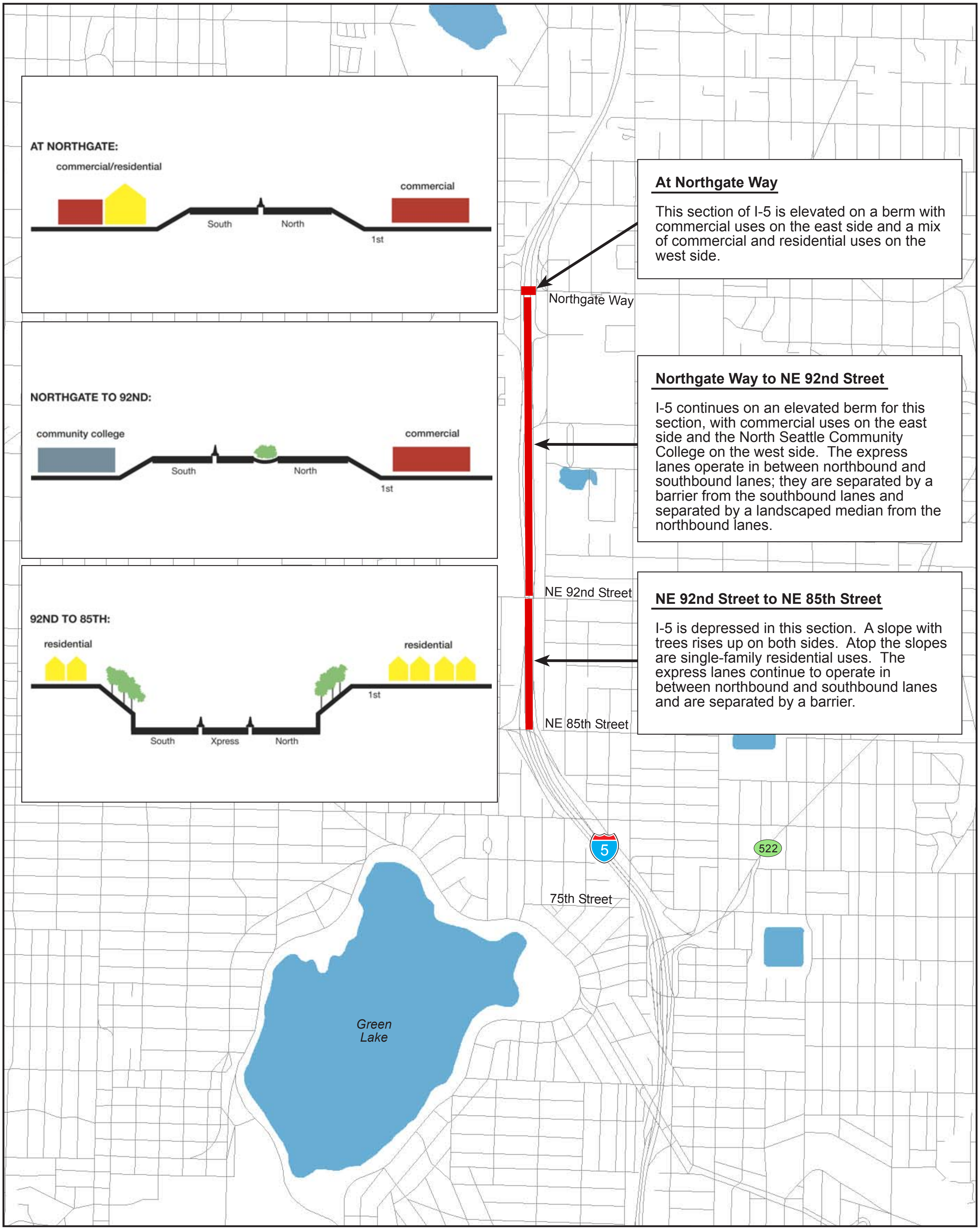


Exhibit 2-21
I-5 Urban Context Index



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SCALE IN FEET

Exhibit 2-22

Urban Context - Northgate Way to NE 85th Street

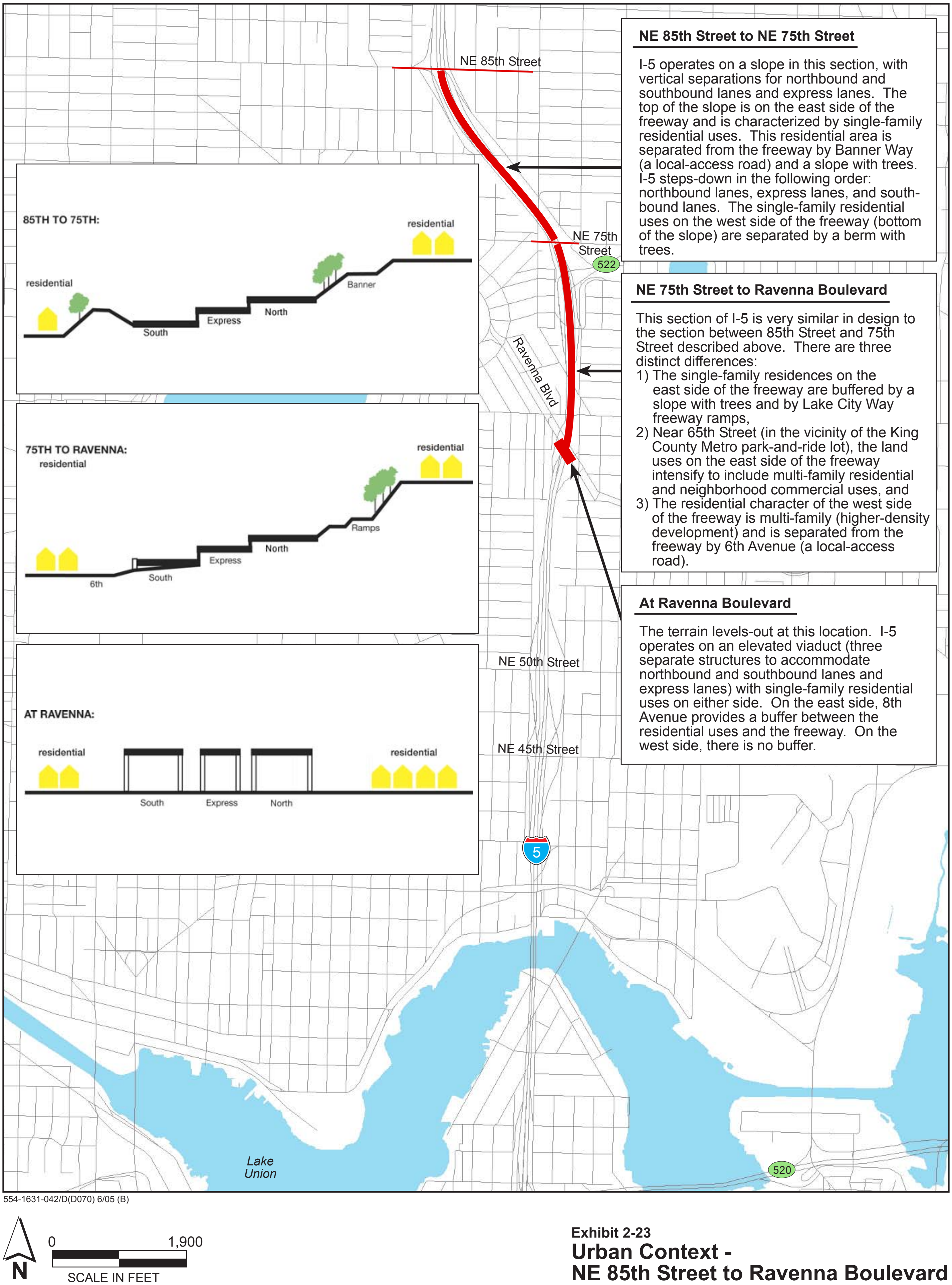
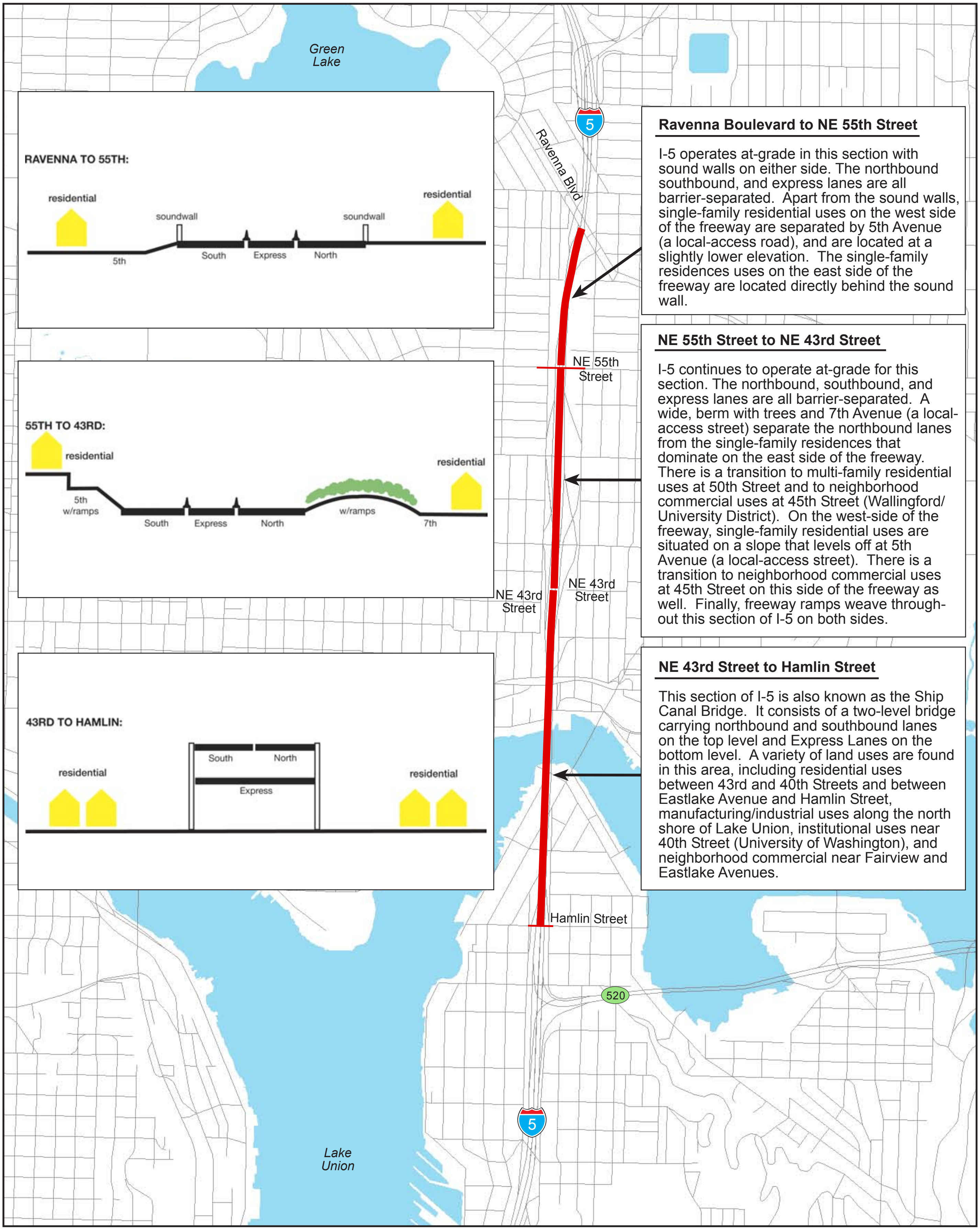


Exhibit 2-23

Urban Context - NE 85th Street to Ravenna Boulevard



Ravenna Boulevard to NE 55th Street

I-5 operates at-grade in this section with sound walls on either side. The northbound southbound, and express lanes are all barrier-separated. Apart from the sound walls, single-family residential uses on the west side of the freeway are separated by 5th Avenue (a local-access road), and are located at a slightly lower elevation. The single-family residences uses on the east side of the freeway are located directly behind the sound wall.

NE 55th Street to NE 43rd Street

I-5 continues to operate at-grade for this section. The northbound, southbound, and express lanes are all barrier-separated. A wide, berm with trees and 7th Avenue (a local-access street) separate the northbound lanes from the single-family residences that dominate on the east side of the freeway. There is a transition to multi-family residential uses at 50th Street and to neighborhood commercial uses at 45th Street (Wallingford/University District). On the west-side of the freeway, single-family residential uses are situated on a slope that levels off at 5th Avenue (a local-access street). There is a transition to neighborhood commercial uses at 45th Street on this side of the freeway as well. Finally, freeway ramps weave throughout this section of I-5 on both sides.

NE 43rd Street to Hamlin Street

This section of I-5 is also known as the Ship Canal Bridge. It consists of a two-level bridge carrying northbound and southbound lanes on the top level and Express Lanes on the bottom level. A variety of land uses are found in this area, including residential uses between 43rd and 40th Streets and between Eastlake Avenue and Hamlin Street, manufacturing/industrial uses along the north shore of Lake Union, institutional uses near 40th Street (University of Washington), and neighborhood commercial near Fairview and Eastlake Avenues.

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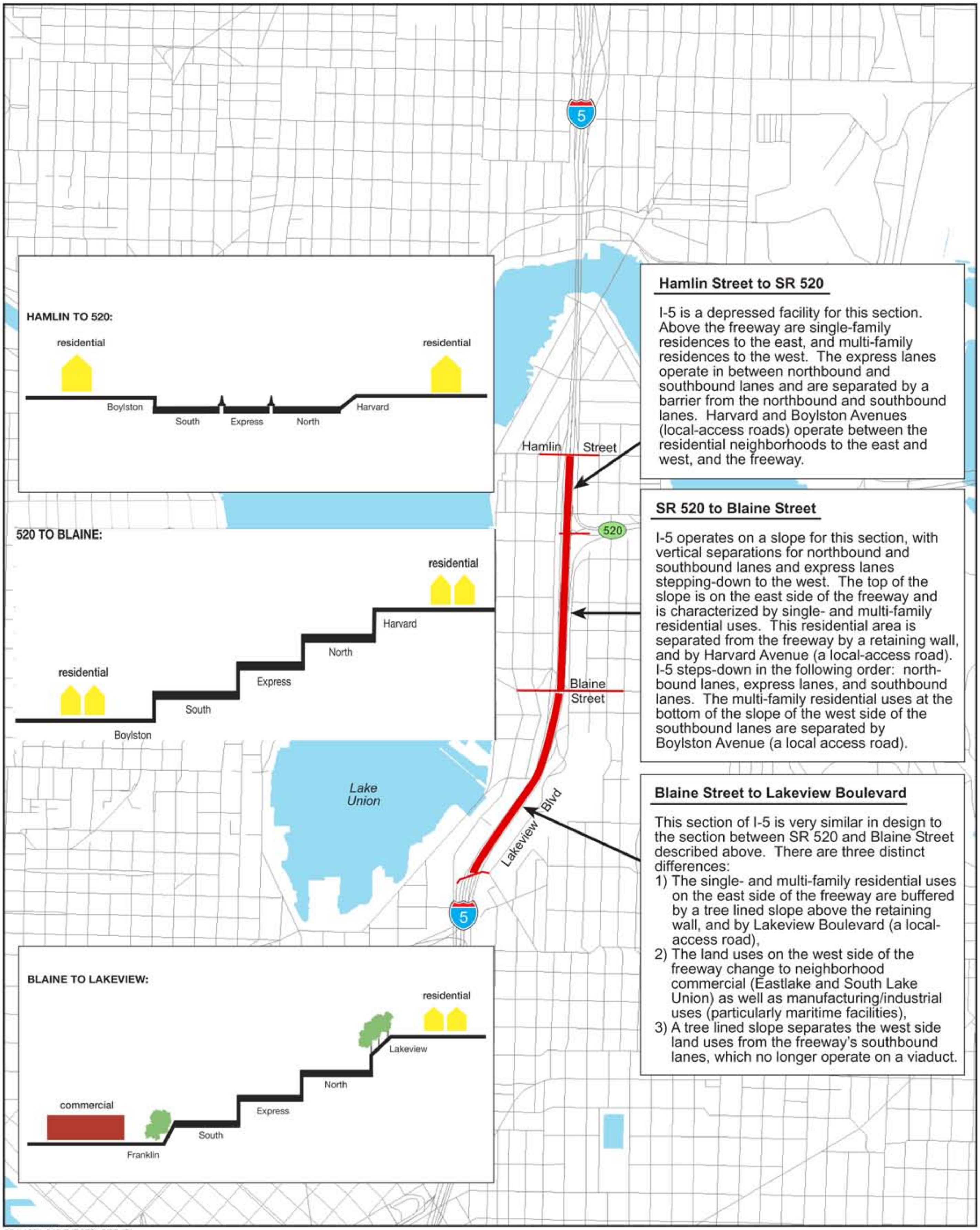
Exhibit 2-24

Urban Context - Ravenna Boulevard to Hamlin Street



Hamlin Street to SR 520

I-5 is a depressed facility for this section. Above the freeway are single-family residences to the east, and multi-family residences to the west. The express lanes operate in between northbound and southbound lanes and are separated by a barrier from the northbound and southbound lanes. Harvard and Boylston Avenues (local-access roads) operate between the residential neighborhoods to the east and west, and the freeway.

SR 520 to Blaine Street

I-5 operates on a slope for this section, with vertical separations for northbound and southbound lanes and express lanes stepping-down to the west. The top of the slope is on the east side of the freeway and is characterized by single- and multi-family residential uses. This residential area is separated from the freeway by a retaining wall, and by Harvard Avenue (a local-access road). I-5 steps-down in the following order: north-bound lanes, express lanes, and southbound lanes. The multi-family residential uses at the bottom of the slope of the west side of the southbound lanes are separated by Boylston Avenue (a local access road).

Blaine Street to Lakeview Boulevard

This section of I-5 is very similar in design to the section between SR 520 and Blaine Street described above. There are three distinct differences:

1) The single- and multi-family residential uses on the east side of the freeway are buffered by a tree lined slope above the retaining wall, and by Lakeview Boulevard (a local-access road),
2) The land uses on the west side of the freeway change to neighborhood commercial (Eastlake and South Lake Union) as well as manufacturing/industrial uses (particularly maritime facilities),
3) A tree lined slope separates the west side land uses from the freeway's southbound lanes, which no longer operate on a viaduct.

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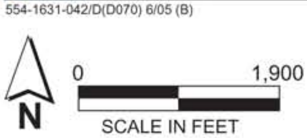
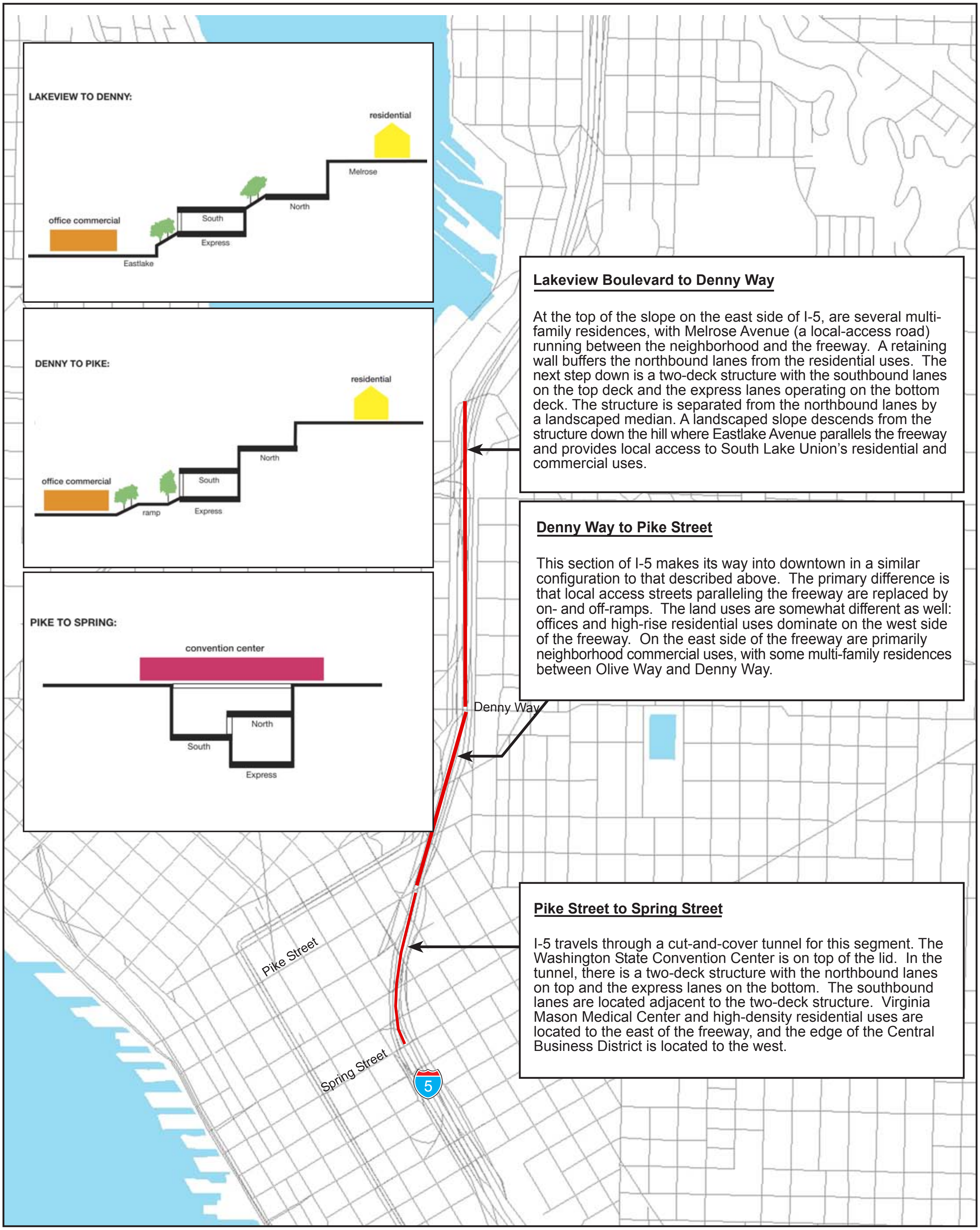


Exhibit 2-25
Urban Context -
Hamlin Street to Lakeview Boulevard



Lakeview Boulevard to Denny Way

At the top of the slope on the east side of I-5, are several multi-family residences, with Melrose Avenue (a local-access road) running between the neighborhood and the freeway. A retaining wall buffers the northbound lanes from the residential uses. The next step down is a two-deck structure with the southbound lanes on the top deck and the express lanes operating on the bottom deck. The structure is separated from the northbound lanes by a landscaped median. A landscaped slope descends from the structure down the hill where Eastlake Avenue parallels the freeway and provides local access to South Lake Union's residential and commercial uses.

Denny Way to Pike Street

This section of I-5 makes its way into downtown in a similar configuration to that described above. The primary difference is that local access streets paralleling the freeway are replaced by on- and off-ramps. The land uses are somewhat different as well: offices and high-rise residential uses dominate on the west side of the freeway. On the east side of the freeway are primarily neighborhood commercial uses, with some multi-family residences between Olive Way and Denny Way.

Pike Street to Spring Street

I-5 travels through a cut-and-cover tunnel for this segment. The Washington State Convention Center is on top of the lid. In the tunnel, there is a two-deck structure with the northbound lanes on top and the express lanes on the bottom. The southbound lanes are located adjacent to the two-deck structure. Virginia Mason Medical Center and high-density residential uses are located to the east of the freeway, and the edge of the Central Business District is located to the west.

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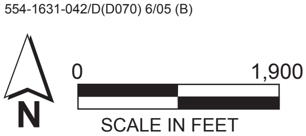
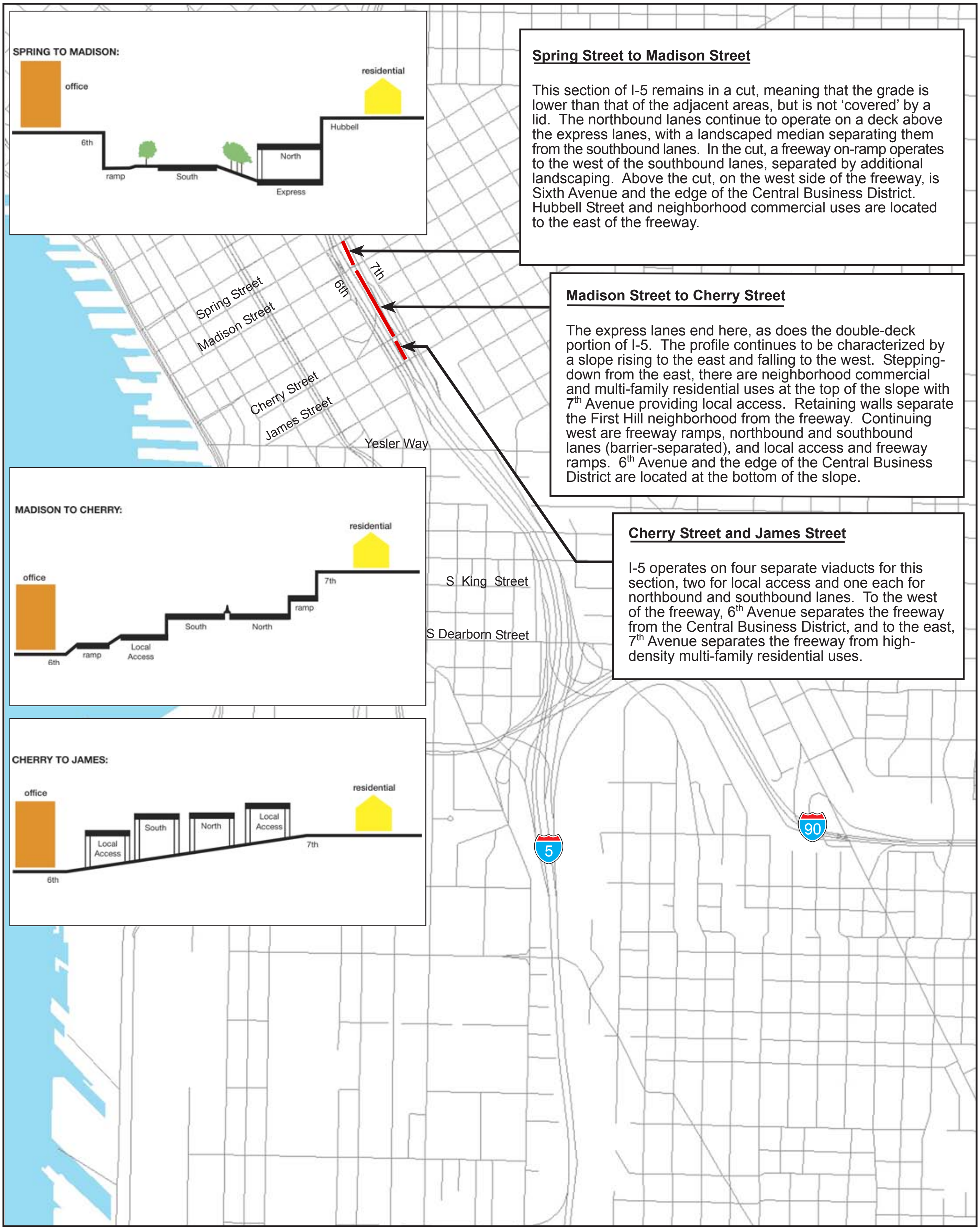


Exhibit 2-26

Urban Context - Lakeview Boulevard to Spring Street



Spring Street to Madison Street

This section of I-5 remains in a cut, meaning that the grade is lower than that of the adjacent areas, but is not 'covered' by a lid. The northbound lanes continue to operate on a deck above the express lanes, with a landscaped median separating them from the southbound lanes. In the cut, a freeway on-ramp operates to the west of the southbound lanes, separated by additional landscaping. Above the cut, on the west side of the freeway, is Sixth Avenue and the edge of the Central Business District. Hubbell Street and neighborhood commercial uses are located to the east of the freeway.

Madison Street to Cherry Street

The express lanes end here, as does the double-deck portion of I-5. The profile continues to be characterized by a slope rising to the east and falling to the west. Stepping-down from the east, there are neighborhood commercial and multi-family residential uses at the top of the slope with 7th Avenue providing local access. Retaining walls separate the First Hill neighborhood from the freeway. Continuing west are freeway ramps, northbound and southbound lanes (barrier-separated), and local access and freeway ramps. 6th Avenue and the edge of the Central Business District are located at the bottom of the slope.

Cherry Street and James Street

I-5 operates on four separate viaducts for this section, two for local access and one each for northbound and southbound lanes. To the west of the freeway, 6th Avenue separates the freeway from the Central Business District, and to the east, 7th Avenue separates the freeway from high-density multi-family residential uses.

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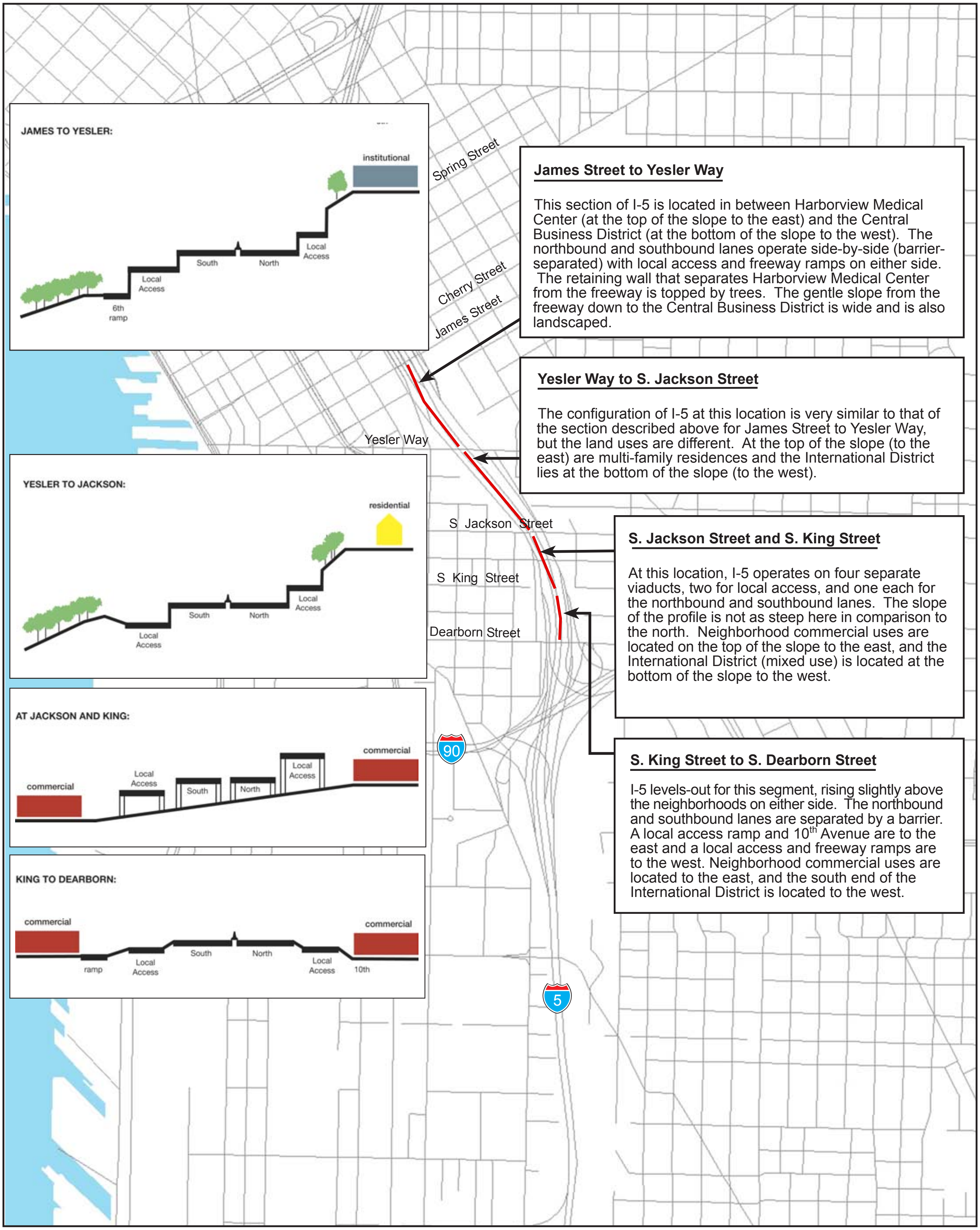
Exhibit 2-27

Urban Context - Spring Street to James Street



James Street to Yesler Way

This section of I-5 is located in between Harborview Medical Center (at the top of the slope to the east) and the Central Business District (at the bottom of the slope to the west). The northbound and southbound lanes operate side-by-side (barrier-separated) with local access and freeway ramps on either side. The retaining wall that separates Harborview Medical Center from the freeway is topped by trees. The gentle slope from the freeway down to the Central Business District is wide and is also landscaped.

Yesler Way to S. Jackson Street

The configuration of I-5 at this location is very similar to that of the section described above for James Street to Yesler Way, but the land uses are different. At the top of the slope (to the east) are multi-family residences and the International District lies at the bottom of the slope (to the west).

S. Jackson Street and S. King Street

At this location, I-5 operates on four separate viaducts, two for local access, and one each for the northbound and southbound lanes. The slope of the profile is not as steep here in comparison to the north. Neighborhood commercial uses are located on the top of the slope to the east, and the International District (mixed use) is located at the bottom of the slope to the west.

S. King Street to S. Dearborn Street

I-5 levels-out for this segment, rising slightly above the neighborhoods on either side. The northbound and southbound lanes are separated by a barrier. A local access ramp and 10th Avenue are to the east and a local access and freeway ramps are to the west. Neighborhood commercial uses are located to the east, and the south end of the International District is located to the west.

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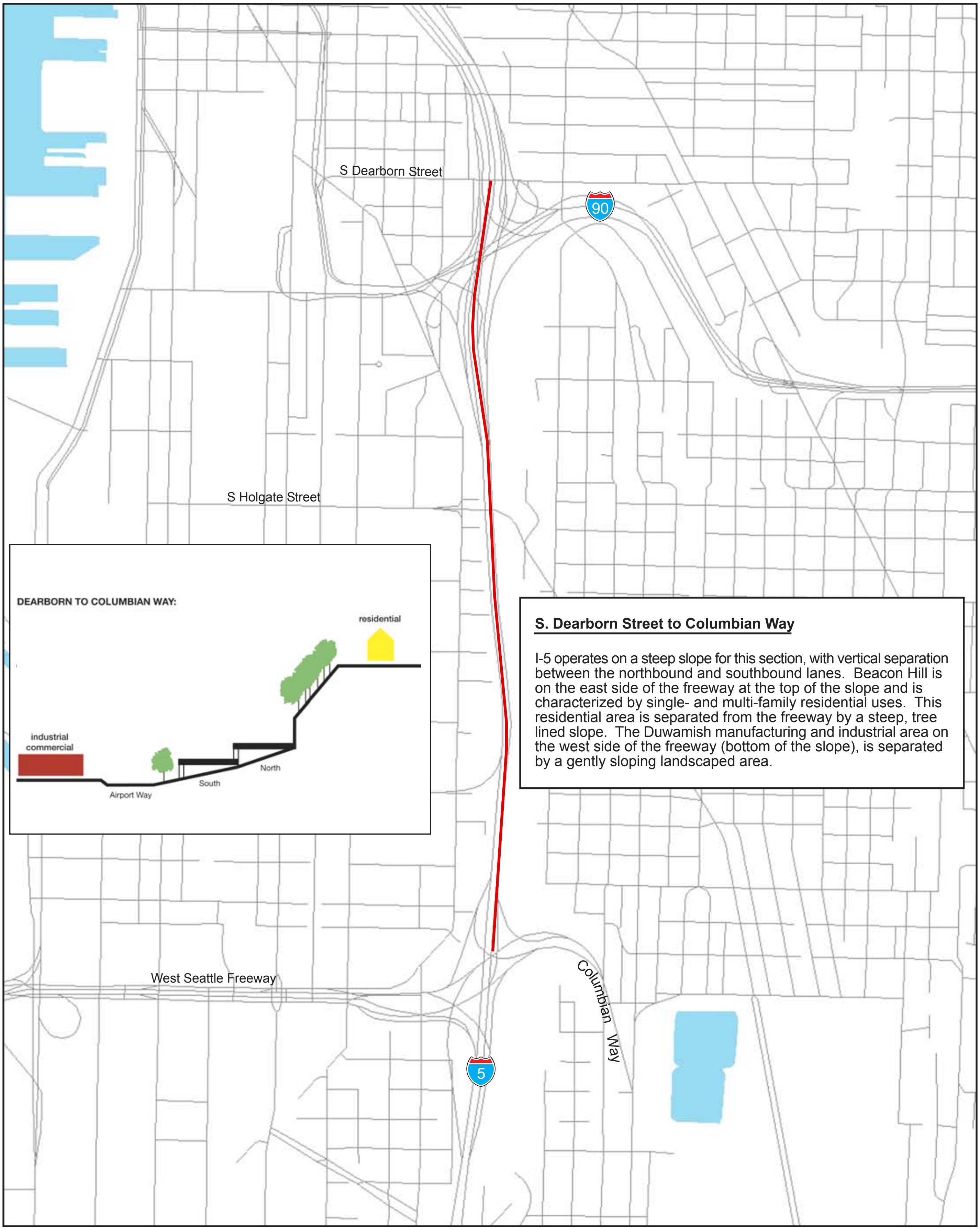
Exhibit 2-28

Urban Context -
James Street to S. Dearborn Street



S. Dearborn Street to Columbian Way

I-5 operates on a steep slope for this section, with vertical separation between the northbound and southbound lanes. Beacon Hill is on the east side of the freeway at the top of the slope and is characterized by single- and multi-family residential uses. This residential area is separated from the freeway by a steep, tree lined slope. The Duwamish manufacturing and industrial area on the west side of the freeway (bottom of the slope), is separated by a gently sloping landscaped area.

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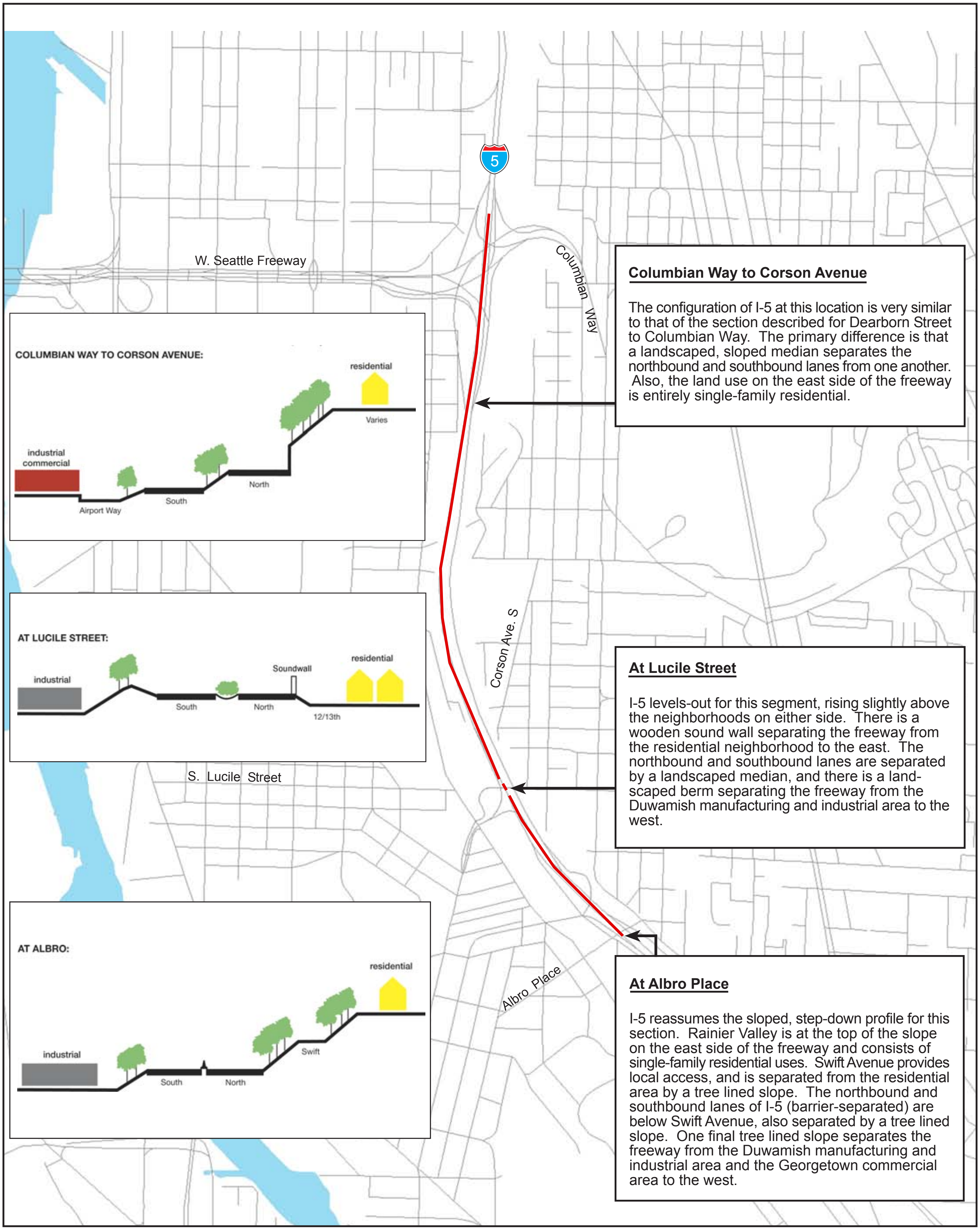
Exhibit 2- 29

Urban Context -
S. Dearborn Street to Columbian Way



Columbian Way to Corson Avenue

The configuration of I-5 at this location is very similar to that of the section described for Dearborn Street to Columbian Way. The primary difference is that a landscaped, sloped median separates the northbound and southbound lanes from one another. Also, the land use on the east side of the freeway is entirely single-family residential.

At Lucile Street

I-5 levels-out for this segment, rising slightly above the neighborhoods on either side. There is a wooden sound wall separating the freeway from the residential neighborhood to the east. The northbound and southbound lanes are separated by a landscaped median, and there is a land-scaped berm separating the freeway from the Duwamish manufacturing and industrial area to the west.

At Albro Place

I-5 reassumes the sloped, step-down profile for this section. Rainier Valley is at the top of the slope on the east side of the freeway and consists of single-family residential uses. Swift Avenue provides local access, and is separated from the residential area by a tree lined slope. The northbound and southbound lanes of I-5 (barrier-separated) are below Swift Avenue, also separated by a tree lined slope. One final tree lined slope separates the freeway from the Duwamish manufacturing and industrial area and the Georgetown commercial area to the west.

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SCALE IN FEET

Exhibit 2-30

Urban Context - Columbian Way to Albro Place

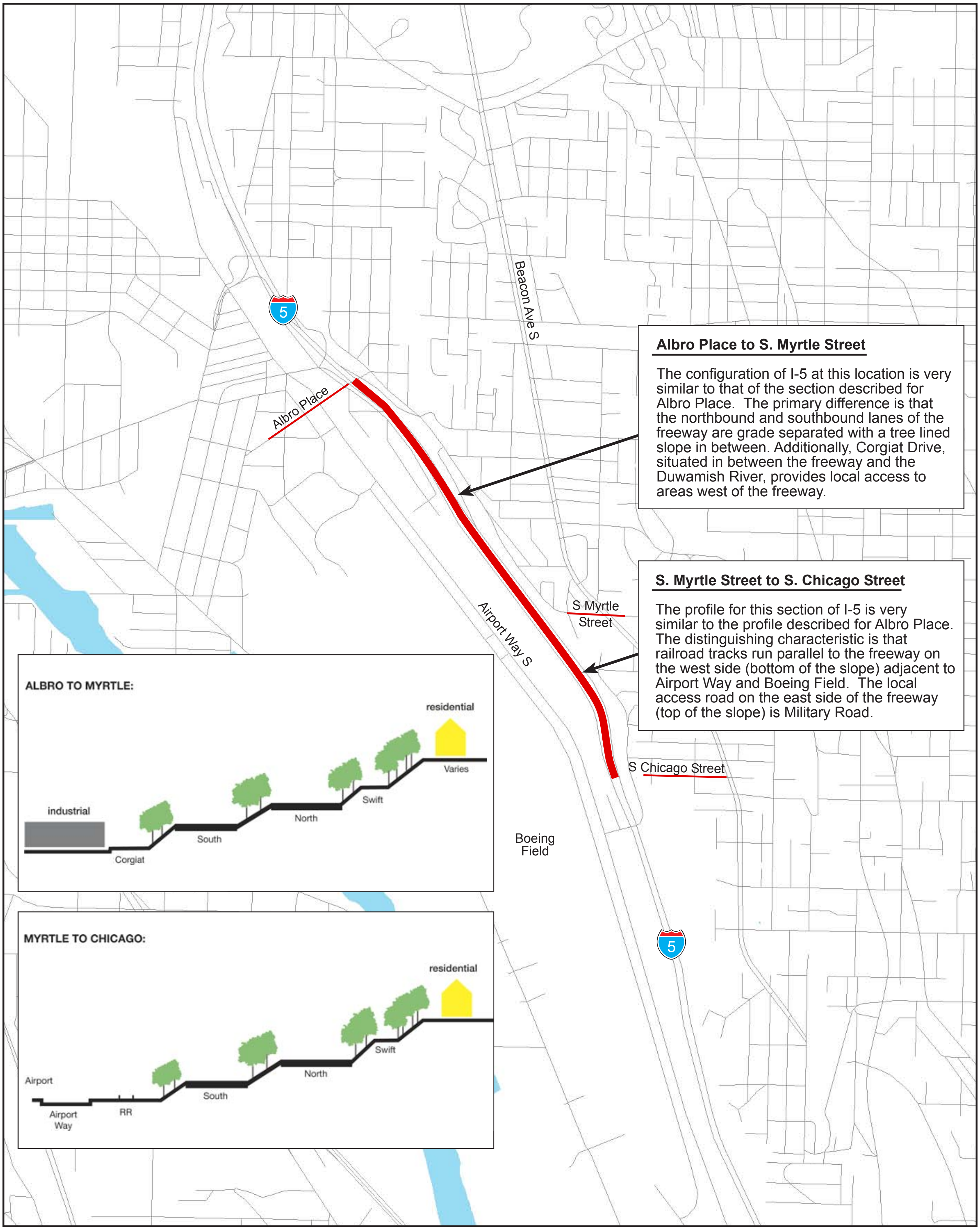

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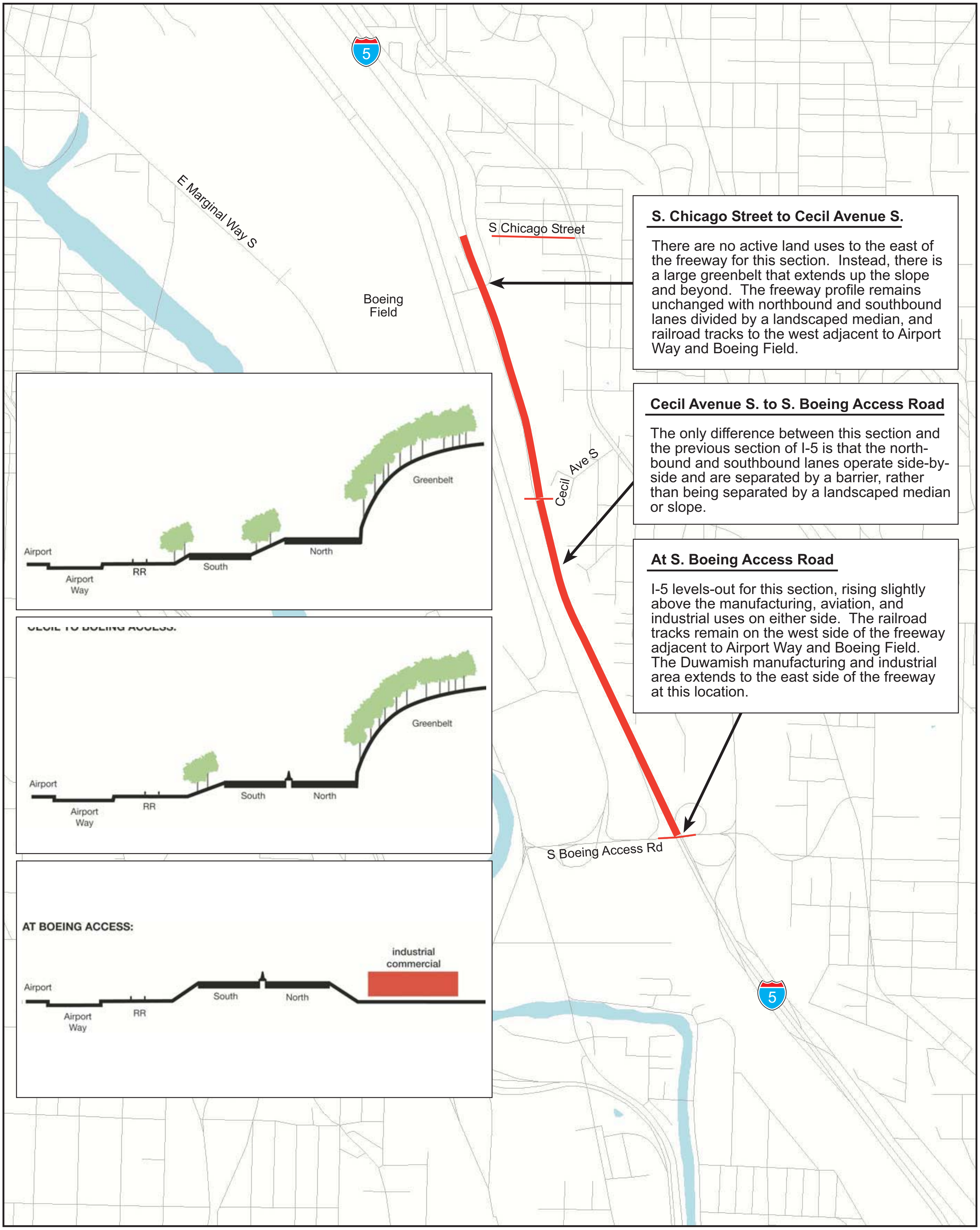
Exhibit 2-31

Urban Context - Albro Place to S. Chicago Street



S. Chicago Street to Cecil Avenue S.

There are no active land uses to the east of the freeway for this section. Instead, there is a large greenbelt that extends up the slope and beyond. The freeway profile remains unchanged with northbound and southbound lanes divided by a landscaped median, and railroad tracks to the west adjacent to Airport Way and Boeing Field.

Cecil Avenue S. to S. Boeing Access Road

The only difference between this section and the previous section of I-5 is that the north-bound and southbound lanes operate side-by-side and are separated by a barrier, rather than being separated by a landscaped median or slope.

At S. Boeing Access Road

I-5 levels-out for this section, rising slightly above the manufacturing, aviation, and industrial uses on either side. The railroad tracks remain on the west side of the freeway adjacent to Airport Way and Boeing Field. The Duwamish manufacturing and industrial area extends to the east side of the freeway at this location.

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SCALE IN FEET

Exhibit 2-32

Urban Context - S. Chicago Street to S. Boeing Access Road

Chapter 3 Improvements for Modernizing the Existing I-5 Corridor

This chapter identifies the initial list of improvements that WSDOT will evaluate in the I-5 Capital Improvement Plan (CIP). The pavement reconstruction plan and environmental documentation options are also discussed.

The CIP will consider a range of modest operational improvements identified at two workshops held during Phase I of the I-5 Project. The I-5 Operations Study described in Chapter 2 was one of the information sources used to identify improvements at these workshops. These workshops did not consider a major capacity expansion of I-5 because previous studies have concluded that such an expansion will be highly disruptive and extremely costly. WSDOT's preferred approach is to build a high-capacity transit system in the corridor to provide people with mobility and capacity in the future.

The improvements that WSDOT will evaluate in the I-5 CIP include:

- Adding an auxiliary lane in several locations to provide more continuous lanes.
- Installing intelligent transportation systems.
- Providing direct access connections for high-occupancy vehicles (HOVs) and transit vehicles.
- Improving interchanges to minimize congestion and accidents.

- Reconfiguring ramps to move left-hand on- and off-ramps to the right side.
- Modifying the highway alignment and interchange ramps to improve safety.
- Assessing tolls and using pricing strategies to manage transportation demand.

1 What I-5 operational and safety improvements are being considered for further study?

WSDOT identified the I-5 operational improvements to be studied by reviewing the existing conditions in the corridor and a variety of past studies, including studies prepared for the SR 520 bridge replacement project, the Congestion Relief Analysis, and the I-5 Operational Study (described in Chapter 2, Question 3). Many of the operational improvements will fix long-standing issues in the corridor dating back to the original freeway construction in the early 1960s. Systemwide improvements such as the role of pricing and toll facilities and additional intelligent transportation systems (ITS) will also be considered.

To improve safety in the corridor, WSDOT will also review safety benefits for the improvement alternatives evaluated in the CIP to determine their accident reduction potential. Improvements such as moving left-hand on- and off-ramps to the right side will likely have a significant safety benefit because they will eliminate short-distance weaving sections along I-5.

We will discuss potential improvements in the I-5 CIP corridor in four sections:

- The north segment from I-405 in Lynnwood to NE 45th Street
- The central segment through downtown Seattle from NE 45th Street to Corson Avenue
- The south segment from Corson Avenue to I-405 in Tukwila

- The reversible express lane roadway operating between Northgate and downtown Seattle

These section boundaries were chosen to establish shorter freeway segments with similar adjacent land use characteristics.

What improvements are being considered in the north segment from I-405 to NE 45th Street?

The north segment of I-5 extends through mixed residential and commercial areas in Lynnwood, Mountlake Terrace, Shoreline, and North Seattle. A variety of destinations are served by I-5, including two regional shopping centers (Northgate Mall and Alderwood Mall), the University of Washington, and three community colleges (North Seattle, Shoreline, and Edmonds). In addition to the interchange with I-405 in Lynnwood, five state highways intersect with I-5 in this section:

- SR 525
- SR 524 (196th Street SW)
- SR 104
- SR 523 (NE 145th Street)
- SR 522 (Lake City Way)

Exhibit 3-1 shows the initial list of I-5 improvement projects that WSDOT will evaluate in the north segment. Improvements include adding an auxiliary lane in several locations to provide more continuous lanes, providing direct access connections for HOVs and transit vehicles, and improving interchanges to minimize congestion and accidents.

What improvements are being considered in the central segment from NE 45th Street to Corson Avenue?

The central segment of I-5 extends from the University District through downtown Seattle and the South Downtown (SODO) industrial area. In addition to the downtown Seattle retail district and the region’s largest concentration of jobs, I-5 serves Pike Place Market, Pioneer Square, most of the special event

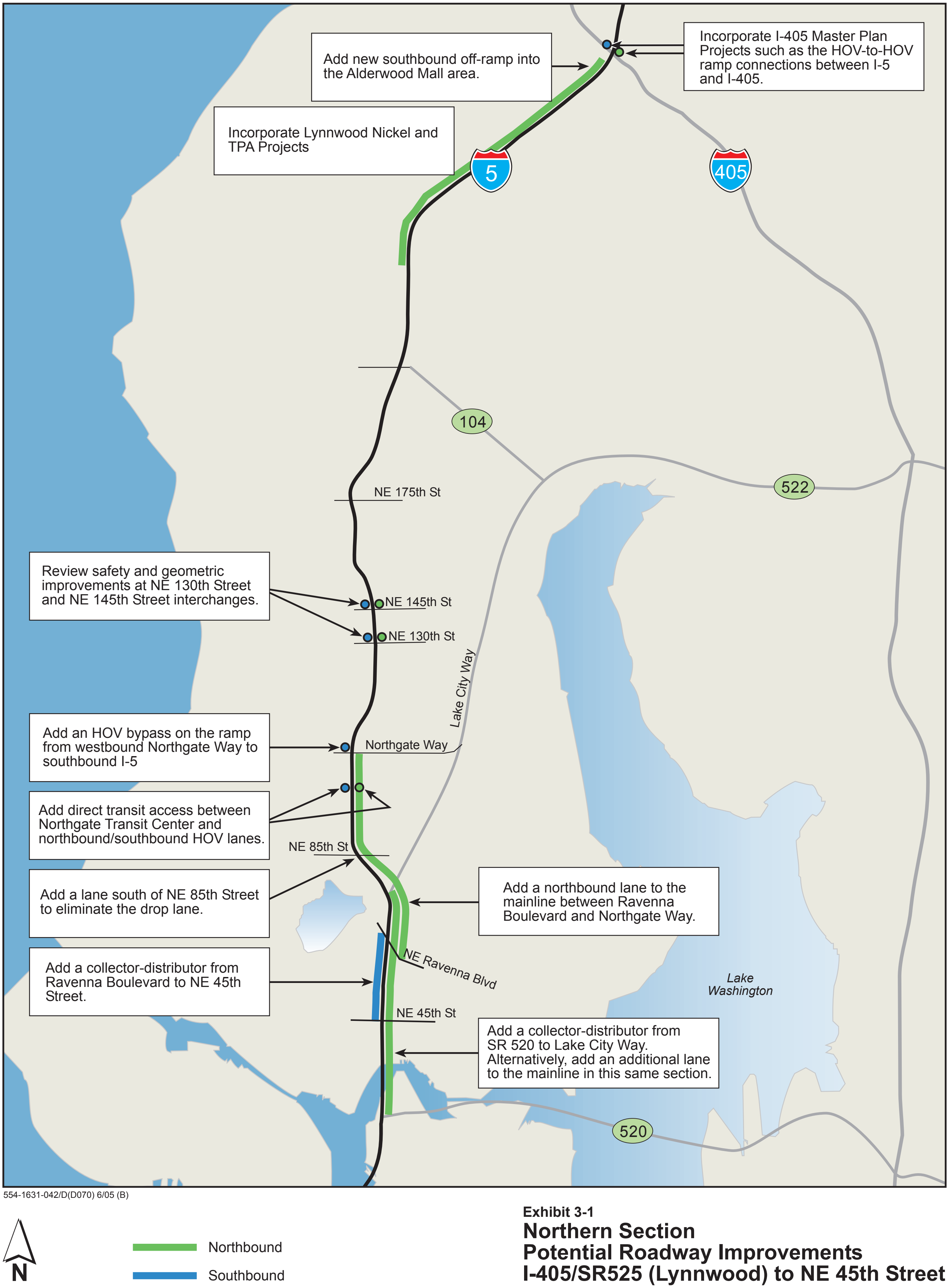


Exhibit 3-1

Northern Section
Potential Roadway Improvements
I-405/SR525 (Lynnwood) to NE 45th Street

venues in Seattle, and several hospitals and medical facilities in the First Hill neighborhood. Two major limited access highways intersect with I-5 in this section: SR 520 and I-90. SR 519 (Royal Brougham Way) and the Spokane Street Viaduct/West Seattle Freeway also intersect with I-5, providing access to Port of Seattle container terminals and Washington State Ferries terminals (Colman Dock and Fauntleroy), with ferry service to Bainbridge Island, Bremerton, Vashon Island, and Southworth.

Exhibits 3-2 and 3-3 show the initial list of I-5 improvement projects that WSDOT will evaluate in the central segment. Improvements in this segment include lane additions to minimize traffic congestion at bottleneck locations and several ramp revisions to move left-hand on- and off-ramps to the right side.

What improvements are being considered in the south segment from Corson Avenue to I-405?

The south segment of I-5 continues through light industrial and residential areas of South Seattle and the northern portion of Tukwila. Significant destinations served by this segment of I-5 include the King County International Airport (Boeing Field) and Southcenter Mall. In addition to the interchange with I-405 in Tukwila, this section of I-5 intersects three other state highways: SR 900, SR 599, and SR 518, providing access to Burien and the Seattle-Tacoma International Airport.

Exhibit 3-4 shows the initial list of I-5 improvement projects that WSDOT will evaluate in the south segment. Improvements in this segment primarily focus on highway alignment and interchange ramp modifications to improve safety.

What improvements are being considered on the reversible roadway?

The reversible roadway, also referred to as the express lanes, provides additional lanes in the peak direction between Northgate and downtown Seattle. On weekdays, the reversible roadway operates in the southbound direction between approximately 5:30 a.m. and 11:00 a.m. and in the northbound direction between approximately 12:00 noon and 11:00 p.m.

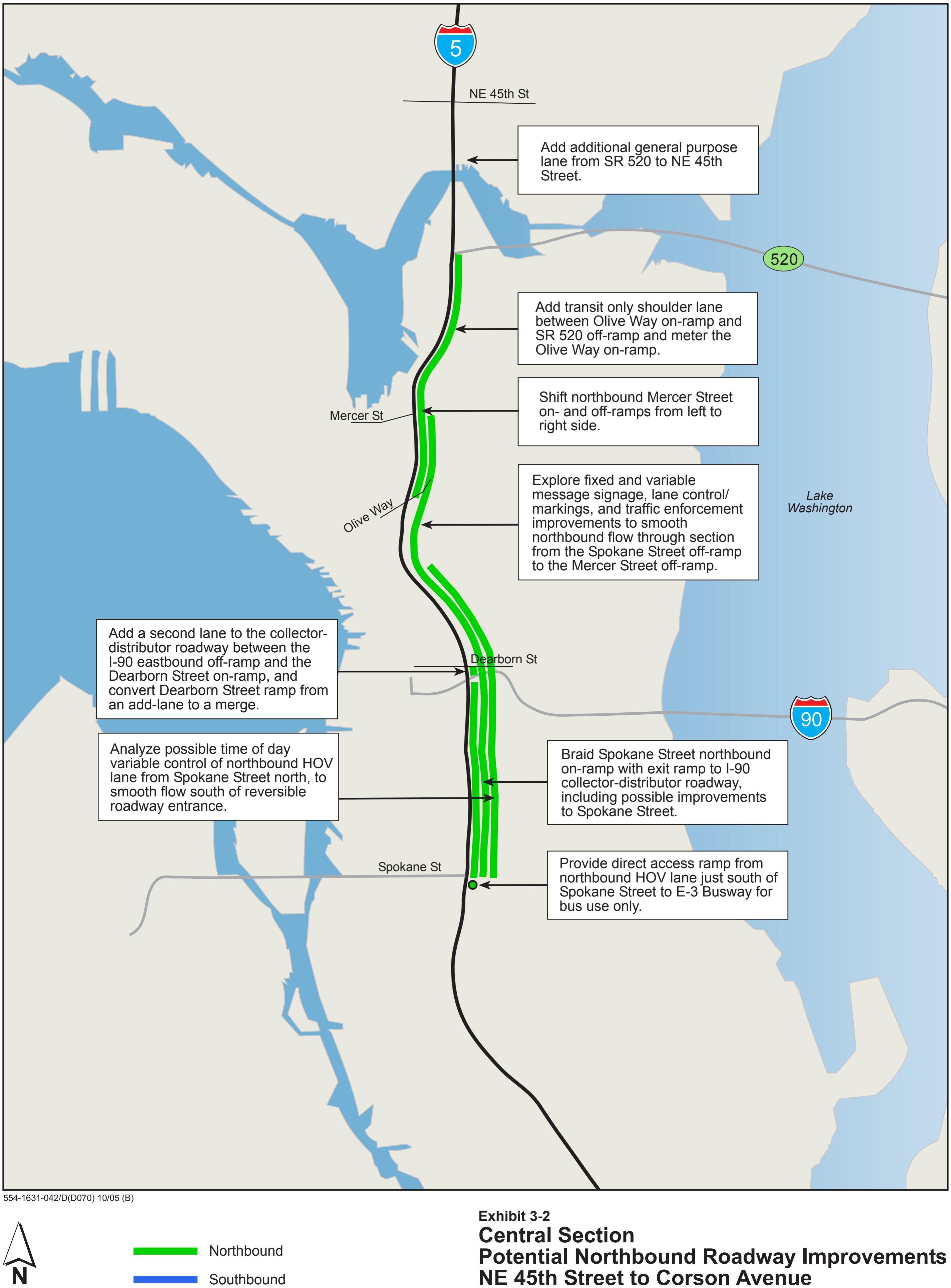
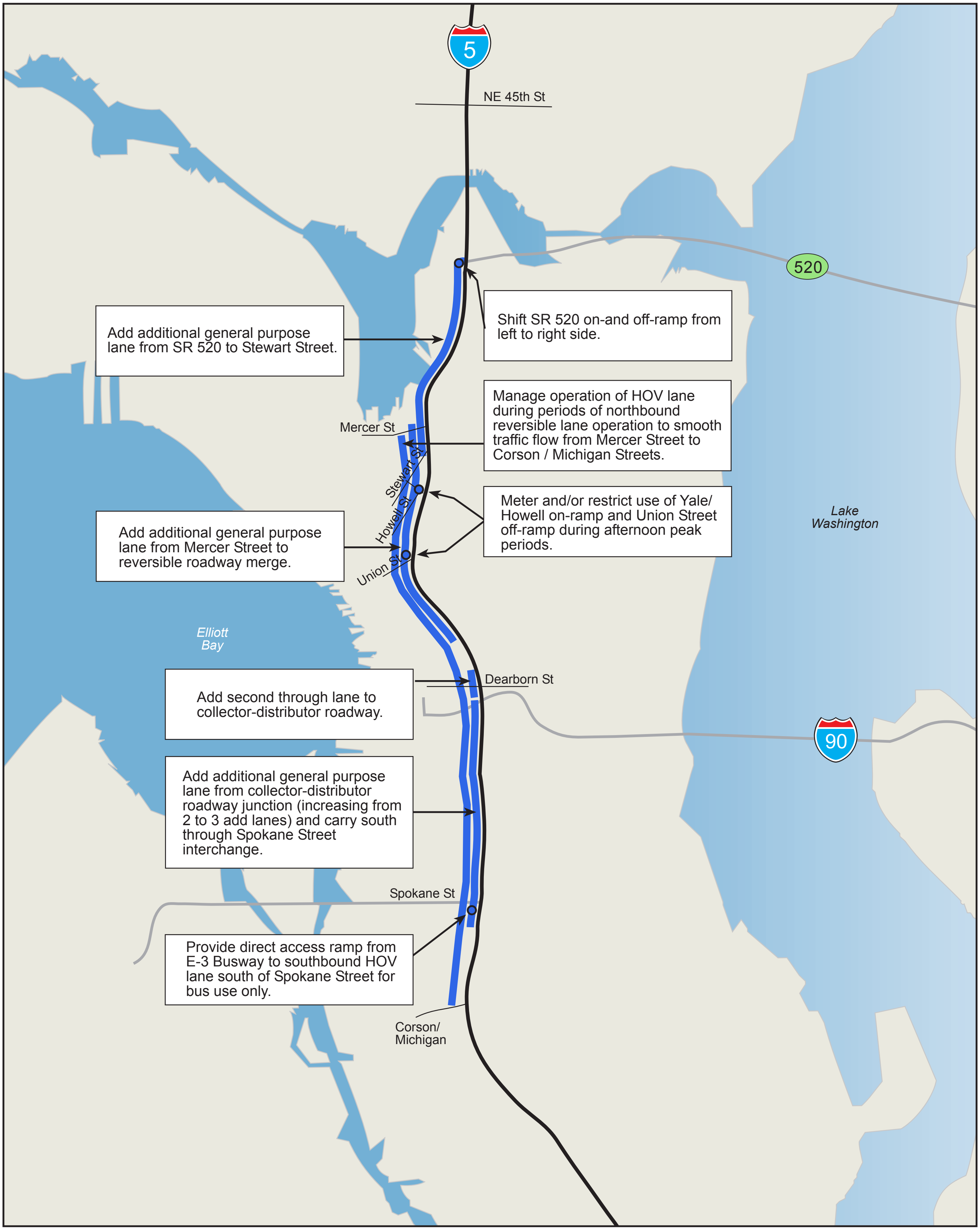


Exhibit 3-2

Central Section
Potential Northbound Roadway Improvements
NE 45th Street to Corson Avenue



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Northbound

Southbound

Exhibit 3-3

Central Section
Potential Southbound Roadway Improvements
NE 45th Street to Corson Avenue

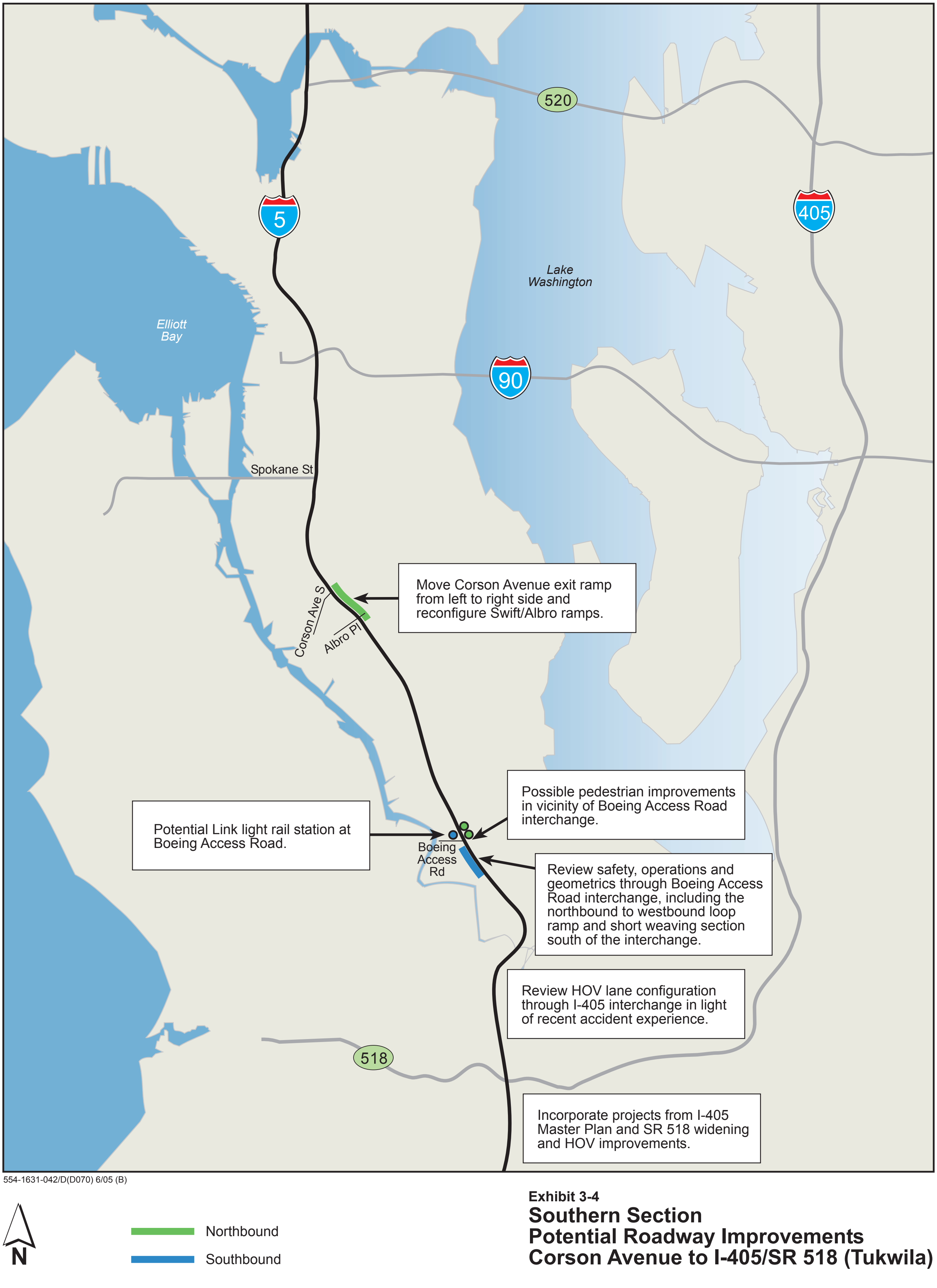

Exhibit 3-4

Southern Section
Potential Roadway Improvements
Corson Avenue to I-405/SR 518 (Tukwila)

The lanes are closed to all traffic during the early morning and also during the midday transition period needed to switch the direction of the lanes. On weekends and holidays, the reversible roadway operates in the northbound direction away from downtown Seattle. The express lanes do not provide access to all interchanges along mainline I-5; access is provided at the following locations:

- NE 103rd Street in Northgate
- SR 522
- NE Ravenna Boulevard (southbound on-ramp only)
- NE 42nd Street in the University District
- Mercer Street
- Several ramps in downtown Seattle

Exhibit 3-5 shows the initial list of I-5 improvement projects on the reversible roadway. These projects include ramp modifications and additions and changes to the northern terminus in the Northgate area and the possibility of converting to two-way operations.

WSDOT will also consider implementing an electronic tolling system on the reversible roadway. WSDOT in the statewide tolling study will conduct a study to determine the feasibility, costs, benefits, and impacts of converting the reversible roadway to a high-occupancy toll (HOT) facility. This will include sensitivity testing of different pricing options and levels and identification of locations for electronic toll readers, signage, and other physical improvements needed to support the HOT lane improvements.

What is a high-occupancy toll facility?

A high-occupancy toll (HOT) facility is a single- or multi-lane facility that allows use by high-occupancy vehicles with no toll. Single-occupancy vehicles are also allowed but are charged a toll to use a HOT lane.

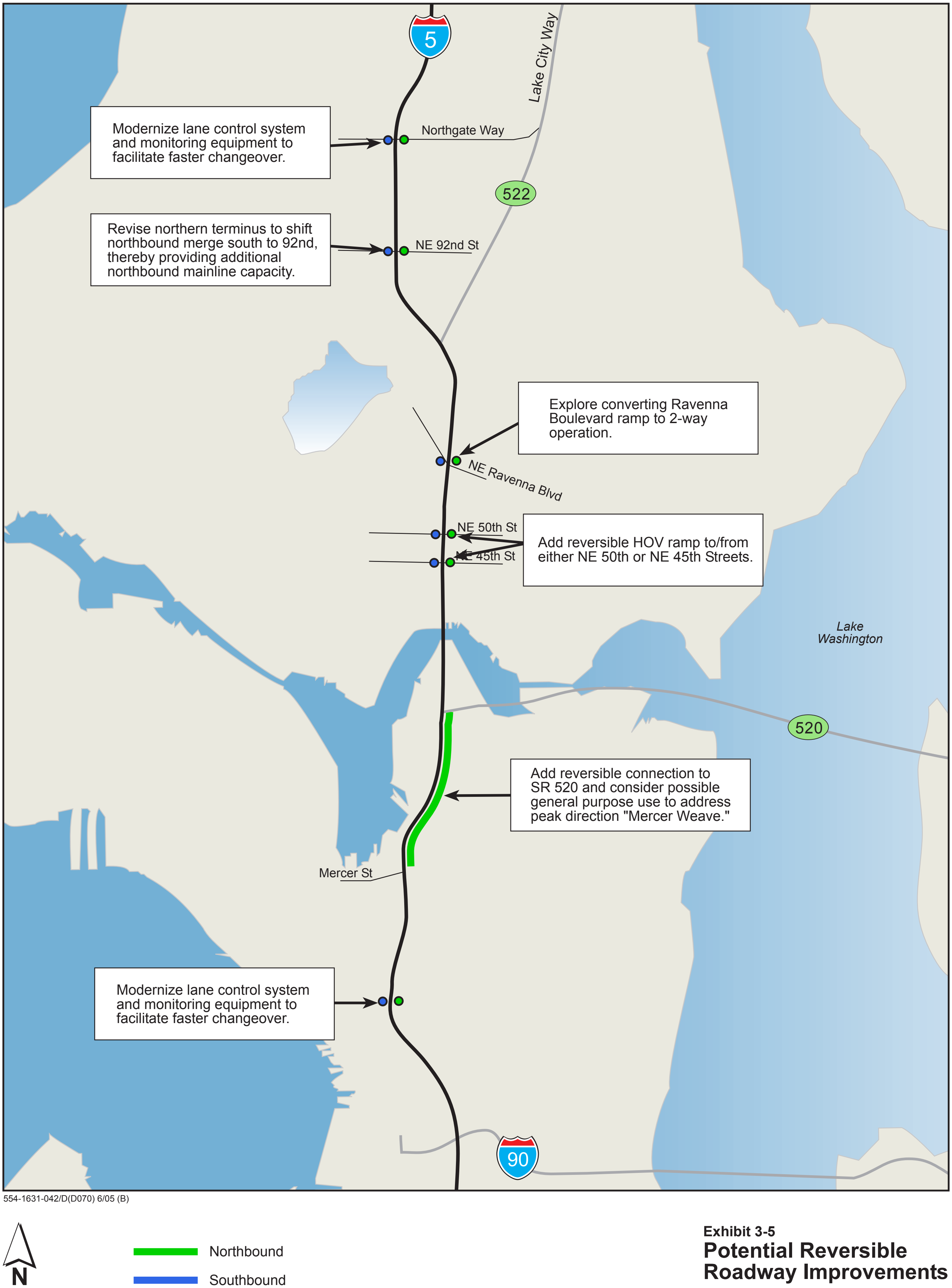

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Exhibit 3-5
Potential Reversible Roadway Improvements

What systemwide improvements are being considered?

Intelligent transportation systems (ITS) are operational improvements that WSDOT could consider systemwide. ITS monitor and manage traffic flow, reduce congestion, suggest alternate routes to travelers, and provide tools for transportation professionals to collect, analyze, and archive data about system performance during peak use hours. The I-5 corridor in central King County and southwest Snohomish County has a significant number of ITS investments, including:

- Traffic data collection and traveler information
- Closed-circuit television cameras
- Dynamic message signs
- Ramp meters
- Highway advisory radio

Each of these ITS categories is described in more detail in the *Final Existing Transportation Technical Report*, Parametrix, March 2005. That report also describes ITS improvements implemented by other cities and transit agencies.

2 What alternatives have been considered for fixing the I-5 pavement?

WSDOT conducted a study in 2002 to evaluate different improvement options for reconstructing the I-5 pavement sections in the 15-mile segment between NE Northgate Way and South Boeing Access Road. A total of nine different options, including a Do Nothing option, were considered. The five options eliminated from further consideration include:

- Do Nothing
- Crack Sealing, Grinding, and Dowel Bar Retrofit
- 4-inch Hot Mix Asphalt Overlay
- Crack and Seat and 4-inch Hot Mix Asphalt Overlay
- Crack and Seat and 6-inch Hot Mix Asphalt Overlay

The four options selected for further study are described below.

What options have been selected for further study?

Pavement Reconstruction with 13-Inch Portland Cement Concrete Pavement

The driving surface in the recommended option will be 13 inches of portland cement concrete pavement. The pavement will rest on top of 4 inches of hot mix asphalt and 4 inches of crushed surface base course. This option will be a full reconstruction, so the existing concrete will be removed and replaced with the new pavement. We will also reconstruct the shoulders and upgrade the stormwater facilities.

Crack Sealing, Grinding, Dowel Bar Retrofit, and Selected Panel Replacement

This option will replace 40 percent of the existing concrete panels. The selected panels are the ones displaying the worst conditions. The existing 9-inch-thick panels will be replaced with 13-inch-thick concrete panels over 4 inches of hot mix asphalt over 4 inches of crushed surface base course. The remaining 60 percent of the roadway will be rehabilitated with crack sealing, grinding, and transverse dowel retrofit. The shoulders will also undergo rehabilitation or replacement. This will allow detouring traffic onto the shoulder to allow for construction staging in future I-5 projects.

Pavement Reconstruction with 13-Inch Hot Mix Asphalt

Under this option, the existing concrete pavement will be removed and replaced with 13 inches of hot mix asphalt placed over 10 inches of crushed surface base course. The shoulders will also be replaced. The service life is expected to be 60 years when the top 2.5 inches of pavement is ground down and overlaid every 15 years.

6-Inch Hot Mix Asphalt Overlay

Under this option, 6 inches of asphalt will be overlaid on the existing 9 inches of concrete paved surface. The existing asphalt shoulder will also be overlaid. A 200-foot section at each undercrossing will be reconstructed with 13 inches of asphalt over 10 inches of base course to maintain vertical clearance. A 10-year service life is anticipated for this option.

WSDOT performed a 40-year life cycle analysis of the four options selected for further study. Engineers estimated the initial construction cost of each option, as well as the necessary maintenance cost in future years. The predicted necessary maintenance for each of the options is as follows:

- Pavement reconstruction with 13-inch portland cement concrete pavement – Initially, the pavement will be fully reconstructed. In year 30, crack sealing, grinding, and 20 percent panel reconstruction will be required.
- Crack sealing, grinding, and select panel replacement – Initially, 40 percent of the panels will be reconstructed. In years 15 and 30, grinding, sealing, and 40 percent panel replacement will be repeated.
- Pavement reconstruction with 13-inch hot mix asphalt – Initially, the pavement will be fully reconstructed. In years 15 and 30, the pavement will be ground down 2.5 inches and resurfaced with asphalt.
- 6-inch hot mix asphalt overlay – The roadway will initially be overlaid. In year 10, 2.5 inches of asphalt will be ground and replaced. By year 20, the road will be reconstructed with 13 inches of hot mix asphalt, and in year 35 the top 2.5 inches will be ground and replaced.

The relative direct costs for each option are shown below in Exhibit 3-6. The 6-inch hot mix asphalt overlay option has the lowest direct cost of the four options selected for further study.

Exhibit 3-6
Relative Direct Cost Difference Between Options

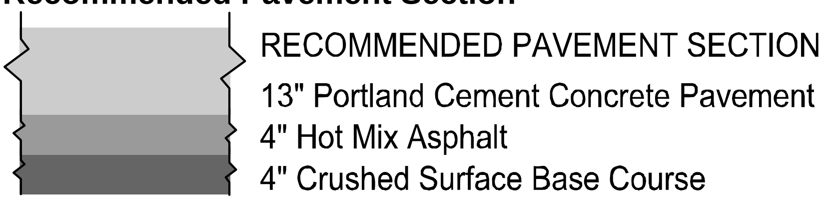
Option	Relative Direct Cost Difference Compared to Lowest Direct Cost Option (6-Inch Hot Mix Asphalt Overlay)
6-Inch Hot Mix Asphalt Overlay	Lowest Direct Cost
Reconstruction with 13-Inch Hot Mix Asphalt	+1%
Reconstruction with 13-Inch Portland Cement Concrete Pavement	+5%
Crack Sealing, Grinding, Dowel Bar Retrofit, and Select Panel Replacement	+32%

What is WSDOT's pavement repair recommendation for I-5?

Three of the nine options studied are feasible and cost comparable. These are (1) reconstruction with 13-inch portland cement concrete pavement, (2) reconstruction with 13-inch hot mix asphalt, and (3) 6-inch hot mix asphalt overlay.

WSDOT recommends reconstruction with 13-inch portland cement concrete pavement. The proposed pavement section is 13 inches of portland cement concrete pavement over 4 inches of hot mix asphalt over 4 inches of crushed surface base course, as shown in Exhibit 3-7.

Exhibit 3-7
Recommended Pavement Section



WSDOT selected this repair option based on the following:

- It has the highest performance life.
- The 13-inch-thick driving surface allows for several grinding treatments, leading to an overall 60-year service life.
- Over the course of the pavement's life cycle, this option minimizes disruption to the traveling public.
- This option is suitable for extremely heavy traffic loads.
- This option minimizes costs to the user. This option allows us to "get in, get it done, get out, and stay out."

What are the limitations and assumptions in the Pavement Type Selection report?

The Pavement Type Selection report does not appear to address the pavement condition of ramps and is unclear as to the inclusion or exclusion of auxiliary lanes because the report focuses on a typical pavement section. Ride quality on bridge decks was excluded from the report because the majority of I-5 bridge decks have been reconstructed in recent years. The report was also unclear as to evaluation of or data collection for the reversible express lanes and the collector-distributor lanes in the Seattle Central Business District.

What pavement and bridge deck rehabilitation projects have recently been completed on I-5?

Over the last 20 years, the majority of bridge decks in the I-5 corridor in Seattle have been rehabilitated. For example, we have rehabilitated the bridge decks of the Ravenna Boulevard overcrossing, as well as a short section of freeway in downtown Seattle. The northbound bridge deck rehabilitation between Spokane Street and I-90 is under design and is slated for construction around 2007 or 2008. The following sections describe bridge rehabilitation projects on I-5 in the last 5 years.

Ravenna Bridge Decks Rehabilitation

In 2001, the northbound and southbound bridge decks at the Ravenna Boulevard overcrossing were rehabilitated. The work involved replacing the reinforcing steel and the concrete in the deck. This was the first resurfacing of the bridge decks over Ravenna Boulevard since the bridges were built. The bridges were rutted, and reinforcing bar was exposed in some places. Each bridge is approximately 1,350 feet long. Although lane closures were necessary during construction, work was finished three days ahead of schedule using the contractor incentive program. The Ravenna Bridge decks are now expected to have another full 40 years of service life.

James Street to Olive Way

Portions of southbound I-5 are being reconstructed in the downtown area. The two outermost southbound lanes between the James Street, Olive Way, and Union Street exits have been paved with portland cement concrete pavement to replace the existing asphalt. In addition, a cracked panel at the south express lane entrance and a bridge joint at the Dearborn Street overcrossing will be repaired. This projected is expected to be completed in 2005.

Repaving I-5 between James Street and Olive Way.

Northbound I-5 from Spokane Street to I-90

WSDOT is currently preparing design plans to rehabilitate the bridge deck on the northbound lanes of I-5 between the Spokane Street interchange and the I-90 interchange. No deck rehabilitation work is currently planned for the southbound viaduct, and expansion joint repair or replacement is planned but not funded. The bridge deck rehabilitation on northbound I-5 is projected for construction in the summer of 2007 or 2008.

What is WSDOT's plan for prioritizing pavement rehabilitation work?

WSDOT is prioritizing pavement rehabilitation work based on the severity of distress identified within the corridor, phasing of other improvements, constructibility, and maintenance of traffic issues. Therefore, we will rehabilitate the north segment first, followed by the northbound south segment, and then the southbound central segment.

Additional studies are recommended to evaluate ramp, auxiliary lane, and bridge deck conditions. WSDOT will coordinate rehabilitation of these facilities with the mainline repair to minimize the number of times traffic will be affected by construction. Additionally, WSDOT will coordinate channelization improvements contemplated within the project corridor to minimize inconvenience to the traveling public.

3 What are the options for meeting NEPA and SEPA requirements?

The I-5 CIP and Pavement Reconstruction Project must comply with both the National Environmental Policy Act (NEPA) and the State Environmental Policy Act (SEPA). Both NEPA and SEPA allow for varying levels of environmental review, depending primarily on the potential impacts of the project on the natural and built environment. There are three types of NEPA environmental documentation: a categorical exclusion (CE), an environmental assessment (EA), and an environmental impact statement (EIS). Each of these three types of environmental documentation could also be used to address SEPA requirements.

The more substantial the potential impacts, the more rigorous the environmental review and associated documentation. This is an important consideration in planning the I-5 Project, because the level of review can greatly affect the budget and time needed to complete the project. The range of possible environmental processes and documentation options under both NEPA and SEPA is summarized in Exhibit 3-8.

Exhibit 3-8

NEPA/SEPA Process and Documentation Options

LEAST COMPLEX → MOST COMPLEX

NEPA	Categorical Exclusion (CE)	Documented CE	Environmental Assessment (EA)	Environmental Impact Statement (EIS)
SEPA*	Categorical Exemption / Adopt NEPA CE (with Added Documentation)	Environmental Checklist and Determination of Non-Significance	Adopt NEPA EA to Satisfy SEPA DNS Requirements	Environmental Impact Statement
Project Type Examples	• Bicycle Lanes • Highway Safety Plan Projects • Noise Barriers • Landscaping • Signs, Pavement, Markings, etc. with No Land Acquisition	• Highway Capacity Increases with Limited Scope of Impacts and No New Right-of-Way Required	• Highway Capacity Increases with Unknown Effects or Where New Right-of-Way is Needed	• Projects with Significant Impacts on Travel Patterns, Land Use, or Other Environmental Resources
Typical Duration	Up to 4 Months	1-6 Months	6-18 Months	18 Months - Several Years

*Most likely SEPA approaches.

The WSDOT *Environmental Procedures Manual*, Section 320, contains additional information regarding types of environmental review.

4 What are the next steps?

WSDOT will prepare a Capital Improvement Plan (CIP), which is a planning study conducted for a state highway corridor, as the next step in the I-5 Pavement Rehabilitation Project. Within the study area, WSDOT will identify existing and future deficiencies and propose appropriate solutions. The scope of the study will focus on analyses of geometric and operating conditions, environmental concerns, population and land use changes, and right of way and other issues that might affect I-5 and its surrounding community. As such, the CIP will provide preliminary assessments of the potential environmental impacts resulting from I-5 Project improvements. These assessments will be used as a starting point to determine the appropriate level of environmental review.

As part of the CIP, WSDOT will conduct an initial screening of environmental impacts. Possible environmental impact categories that the CIP could address include:

- Roadside preservation issues that will be necessary to complete the CIP improvements, including revegetation, side slopes, and drainage systems.
- Potential archaeological, historic, or culturally sensitive sites within the study area.
- Identification of environmental justice communities and issues potentially affected by CIP recommendations.

WSDOT will then determine the most appropriate environmental review strategy for each transportation improvement on a case-by-case basis. WSDOT's preferred strategy will depend on several factors, including the timing for implementation and the magnitude of environmental impacts expected. In some cases, it may be appropriate to package several improvements into a combined environmental process and document if they are in the same geographic area or are similar project types.

The environmental documents necessary for NEPA and SEPA compliance, as well as compliance with other environmental legislation such as the Endangered Species Act, Section 4(f) of the Department of Transportation Act, and Section 6(f) of the Land and Water Conservation Funds Act, will be prepared after completion of the I-5 CIP.