I-5 PAVEMENT RECONSTRUCTION PROJECT

Existing Pavement Conditions and Traffic Operations Analysis Results Report

November 2007

Washington State Department of Transportation

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Executive Summary

This report documents 2004 pavement conditions in terms of faulting and panel cracking of the concrete pavement between on Interstate 5 in Seattle, between Boeing Access (MP158) and NE 175th (MP 177.76). The study found that the worse faulting and panel cracking of the 40+ year concrete pavement is between NE 175th and NE Northgate Way and is largely considered in extremely poor condition.

This report also provides one-page project summaries of operational improvement projects identified in WSDOT's 2003 Lane Continuity Report as well as some additional operational improvements that were subsequently identified. The summary pages report travel speeds and travel time with, and without the project in 2004 and 2030 using a VISSIM traffic simulation model.

Chapter 1 Project Background

The Washington State Department of Transportation (WSDOT) has identified the need to rehabilitate or reconstruct the pavement of Interstate 5 (I-5) through the city of Seattle between approximately Boeing Access Road and NE Northgate Way. As part of the I-5 Pavement Reconstruction Project, several short-range and long-range transportation improvements were evaluated. This report summarizes the pavement and traffic analysis conducted for the I-5 Pavement Reconstruction Project.

1 Why was the I-5 Pavement Reconstruction Project initiated?

The pavement on I-5 through much of Seattle is over 40 years old and is well beyond its design life. It is showing signs of failure at several locations along I-5. It is not unusual to see long cracks in the concrete panels and worn surfaces in the concrete that expose stone aggregate, creating rough and noisy driving conditions. The concrete will continue to deteriorate over time, and the ride quality for drivers will continue to worsen. Drivers will incur more vehicle maintenance costs for wheel alignments and other repairs, and traffic accidents will likely increase as traction on the freeway decreases over time.

WSDOT currently has funding programmed in 2017 to reconstruct or rehabilitate the pavement between Boeing Access Road and NE Northgate Way. WSDOT is taking the approach that while the I-5 pavement is going to be reconstructed, there may be additional benefits to improve

traffic operations, safety, and possibly stormwater drainage at the same time.

WSDOT's goal is to complete a plan for the comprehensive pavement reconstruction of the freeway through the city of Seattle, together with operational, safety, and environmental improvements that are determined feasible. This report focuses on the pavement conditions and potential operational improvements that may be incorporated into the plan.

2 What information is provided in this report?

This report documents the existing pavement conditions and analyzes alternatives to improve traffic operations. Phase 1 of the I-5 Pavement Reconstruction Project initially identified several operational improvements to improve traffic flow on I-5 between NE Northgate Way and Boeing Access Road. Phase 2 analyzes these improvements, combinations of these improvements, and other improvements in more detail using a traffic micro-simulation package called VISSIM. This report summarizes the additional analysis and the underlying methodology used to determine the operational benefits or impacts of each proposed alternative.

What is VISSIM?

VISSIM is a microscopic, behavior-based traffic simulation program created by PTV, a German software company. The tool offers a wide variety of applications, including freeway modeling. Once models are created, they can also be converted into a 3-D format that can help better inform decision makers.

For each project analyzed, a one-page project summary is provided in Chapter 4 of this report. These summaries provide a high-level description of the improvement option, the benefits and drawbacks of the project, and the operational benefits of each project.

3 What is the project study area?

The I-5 project traffic operations study area extends from Boeing Access Road to NE 205th Street. This area includes the northbound and southbound mainline lanes, the reversible roadway lanes, collector-distributor roadways in Downtown Seattle, and on- and off-ramps associated with all the interchanges along the study corridor. Although the Washington State Legislature only targeted construction dollars for the section of I-5 between NE Northgate Way and Boeing Access Road, the project evaluated capital improvement needs

What is a collector-distributor road?

A collector-distributor roadway, or CD for short, is a one-way facility adjacent to a freeway that is used to minimize conflicts on the mainline lanes due to merging from on- and off-ramps. These roadways move vehicle weaving conflicts due to on- and off-ramps from the freeway mainline to these adjacent facilities.

for a larger segment of I-5. The operational analysis also investigated traffic operational impacts of some project alternatives on several critical arterial street intersections and ramp terminals near the I-5 corridor. Exhibit 1-1 highlights the extent of the operational analysis.

4 What information was included in prior project studies?

The first phase of the I-5 Pavement Rehabilitation Project consisted of a planning effort to develop a problem statement and assemble needed background data and information. The result of the Phase 1 effort, the *I-5 Pavement Reconstruction Project - Problem Definition Report* (WSDOT 2005), highlighted the following items:

- Establishing the need for I-5 pavement rehabilitation, including analyzing existing and future pavement conditions.
- Documenting existing conditions of the study area, including geometrics, transit usage, freight mobility, traffic operations, noise, and stormwater drainage conditions.
- Documenting funded and unfunded improvement projects along the study corridor.
- Identifying an initial list of operational and pavement reconstruction options.

Chapter 2 Existing Pavement Conditions

1 What criteria were used to evaluate current pavement conditions?

WSDOT engineers conducted a comprehensive inventory of current pavement conditions in the I-5 corridor between Boeing Access Road and NE Northgate Way. This section summarizes overall pavement conditions by direction and segment based on faulting and panel cracking information. Faulting and panel cracking were the two criteria used to develop the general pavement condition information.

Information on two other criteria, International Roughness Index (IRI) and wheel path wear, was collected but not used in the pavement condition summary. IRI was not considered as important as faulting and panel cracking because it is a summation of all the pavement distresses (especially faulting). Wheel path wear was also not considered because it does not result in structural failure of portland cement concrete (PCC) pavement.

Although IRI and wheel path wear were not directly used in the pavement condition summary, both have operational and safety implications and affect ride quality, especially in wet weather conditions. For instance, the absence of traction in wet weather, related to roughness, can create unsafe conditions. Similarly, wet weather conditions, in combination with wheel path rutting, could result in hydroplaning, a condition that occurs when a thin layer of water builds between rubber tires and the road surface, preventing the vehicle from responding to driver control inputs.

Worst of the Worst

This method is based on the concept that all lanes of a roadway are controlled by the condition of the single worst lane. This method depicts the condition of the I-5 pavements in a worst-case condition. The images that follow have been developed using this method.

2 What method was used to evaluate and prioritize pavement conditions on I-5?

Three methods were examined for illustrating the general pavement condition of the I-5 PCC pavements: (1) worst of the worst, (2) average of dominating distress, and (3) average of distress. Each method is based on the assumption that faulting and cracking levels result in equivalent pavement distress. For instance, faulting of 0 to 1/8 inch is considered equivalent to 0 to 5 percent of panels with two or more cracks using the "worst of the worst" rating method. These pavement distress levels are shown graphically on the I-5 corridor maps (Exhibits 2-2 through 2-6) based on average assigned values of 1, 2, or 3, with **1 being the best condition** and **3 being the worst**. Exhibit 2-1, below, shows the correlation between faulting and cracking levels, overall pavement condition, and color coding on the maps.

Average Distress

For this method, the distress values of all lanes were averaged for each tenth of a mile section resulting in eight values, one for cracking and one for faulting, for each of the four lanes. This method is the most straightforward but does not have any significant basis for decision-making, and, as such, is not shown here.

Exhibit 2-1 Pavement Condition Matrix

Faulting	Cracking	Assigned Value	Color	Pavement Condition
0–1/8"	0–5%	1	Green	Good
1/8"–¼"	5%–10%	2	Yellow	Poor
¼"+	10%+	3	Red	Extremely Poor

Average Dominating Distress

With this method, the dominating distress of each lane in each tenth of a mile section was determined. The average values assigned to each lane were used to produce a representative overall pavement condition value. The ARC GIS plots produced using this method are not shown in this report.

3 What are the current pavement conditions on I-5?

The pavement on I-5 through much of Seattle is over 40 years old and is well beyond its design life. In many locations, it is showing signs of failure. It is not unusual to see long cracks in the concrete panels and worn surfaces in the concrete that expose stone aggregate, creating a rough and noisy condition. While most of the pavement has never been rehabilitated, some sections were rehabilitated to some degree in 1999 and 2001. The differences in performance levels associated with these various pavement states suggest that pavement failure rates accelerate over time. In other words, once concrete panels begin to fail, the rate of failure continues to increase over time. As such, the

existing concrete panels will continue to deteriorate over time.

Exhibits 2-2 through 2-6 summarize current pavement conditions on northbound and southbound I-5 between NE 175th Street and Boeing Access Road. This information is based on data collected by WSDOT's Materials Laboratory during July 2004. Pavement conditions shown in Exhibits 2-2 through 2-6 and described below only include on-grade sections of I-5, since pavement conditions on bridge structures are treated differently. Most of these have already been or will soon be rebuilt and/or resurfaced.

- NE 175th Street to NE Northgate Way (Exhibit 2-2) – Pavement conditions in this segment are mostly extremely poor in both directions, with the exception of a short northbound segment north of NE 155th Street rated poor or good.
- NE Northgate Way to NE 45th Street (Exhibit 2-3) – Pavement conditions in this segment are mostly poor or extremely poor with similar conditions both northbound and southbound.
- NE 45th Street to I-90 (Exhibit 2-4) – Pavement conditions in this segment are primarily in poor condition, with short segments in the extremely poor or good category. This segment also has significant segments where pavement conditions are not rated because they are on bridges.
- I-90 to S Michigan Street (Exhibit 2-5) – Pavement conditions in this segment are mostly poor or good in the northbound direction, and extremely poor or good in the southbound direction. I-5 from Spokane Street to the I-90 interchange is an elevated bridge that is not rated in Exhibit 2-4. In August 2007, WSDOT construction crews will replace the expansion joints on the northbound bridge, resurface the northbound lanes, and repair the expansion joints on the southbound bridge.
- S Michigan Street to Boeing Access Road (Exhibit 2-6) – Pavement conditions in this segment are mostly good or poor, especially in the northbound direction.

Exhibit 2-2. I-5 Pavement Condition: NE Northgate Way to NE 175th Street

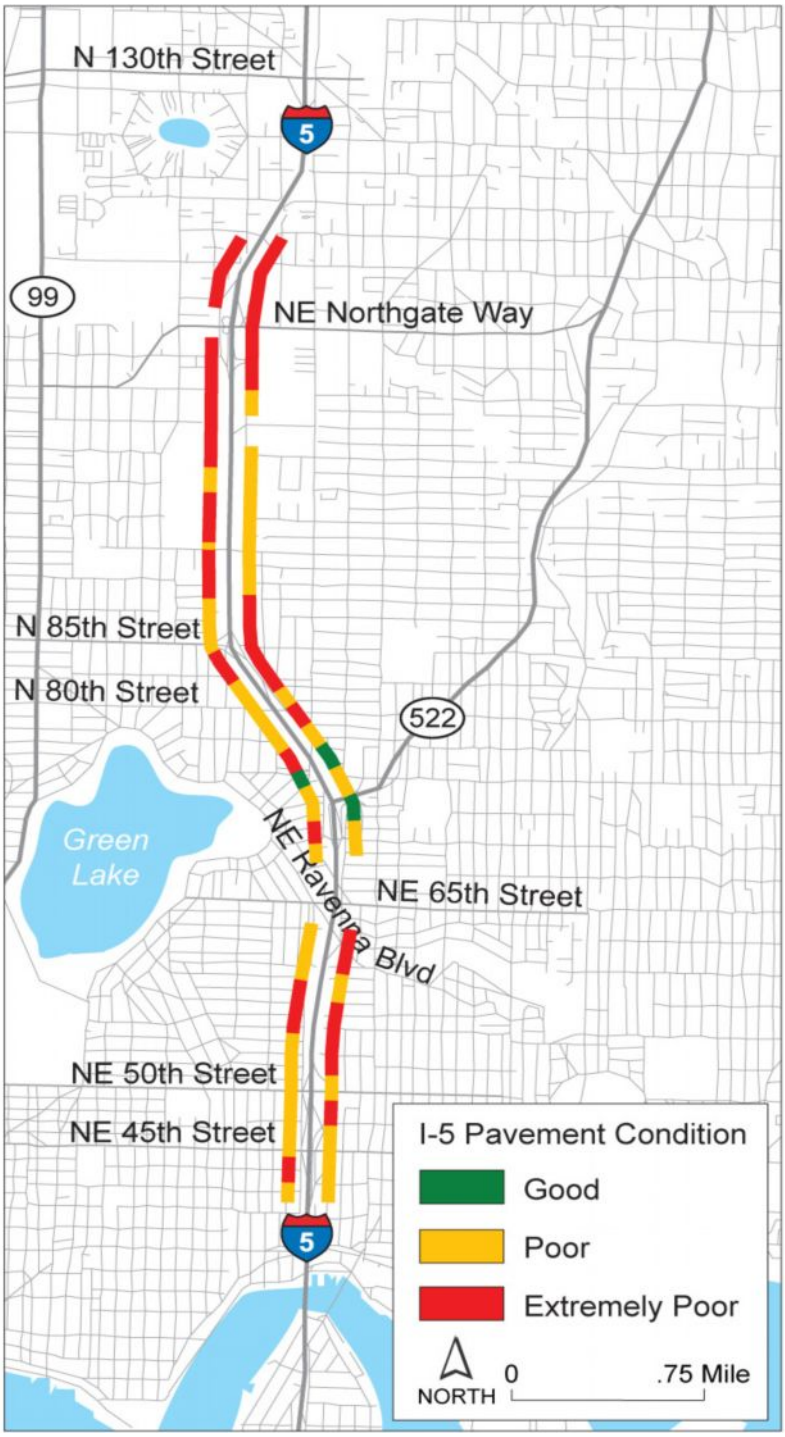


Exhibit 2-3. I-5 Pavement Condition: Ship Canal Bridge to NE Northgate Way

Exhibit 2-4. I-5 Pavement Condition: I-90 to the Ship Canal Bridge

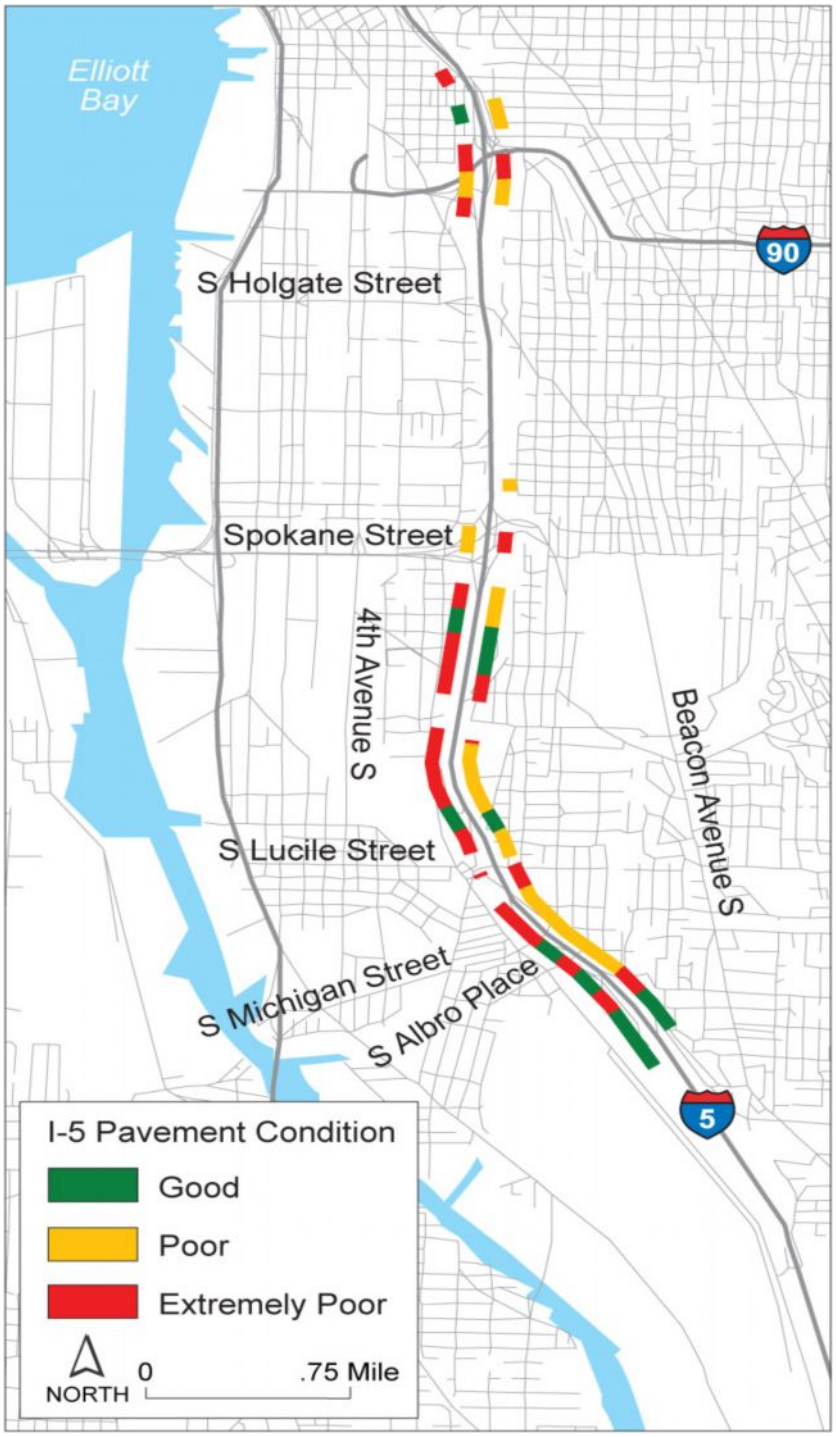


Exhibit 2-5. I-5 Pavement Condition: S Albro Place to I-90

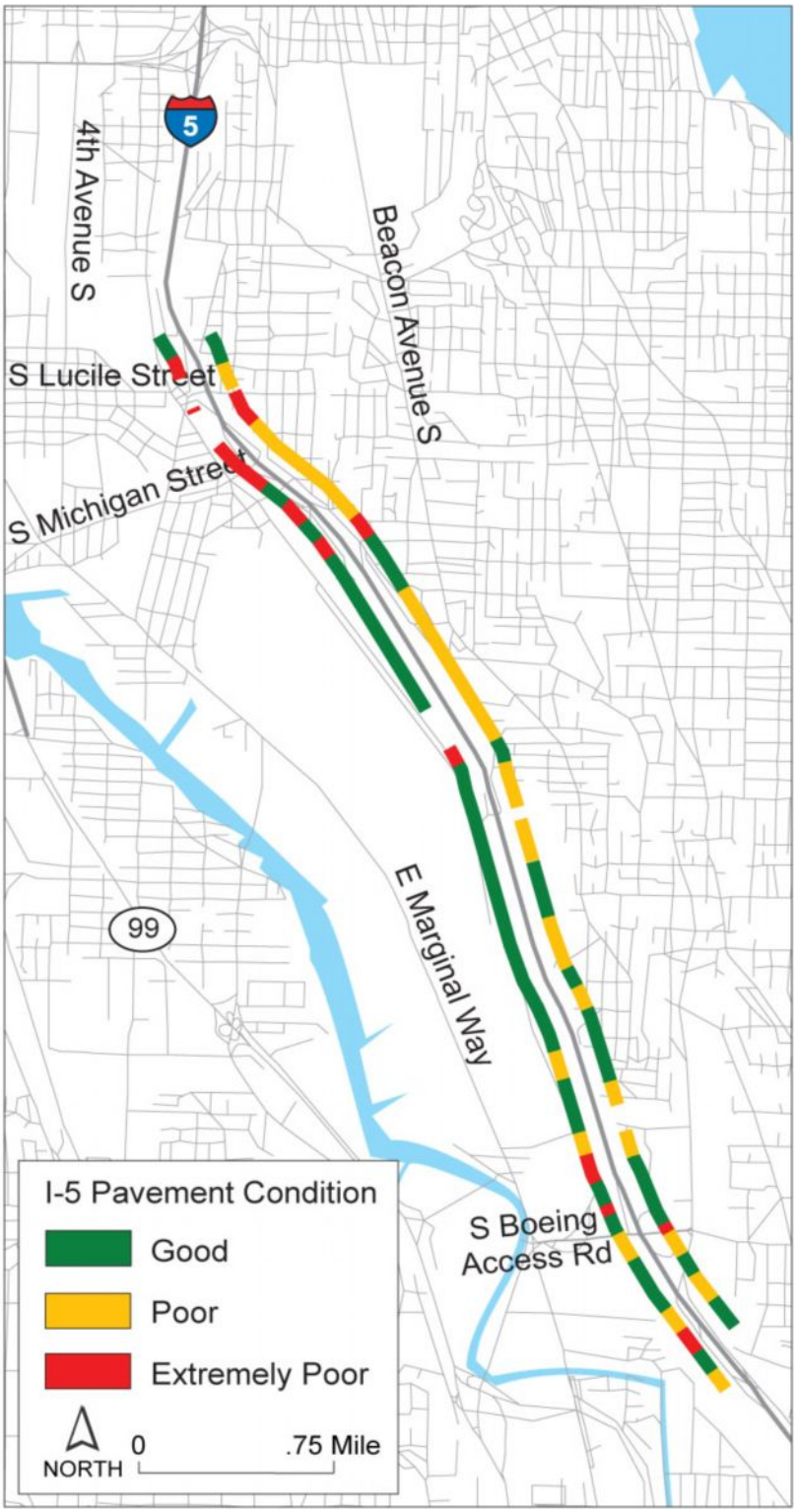


Exhibit 2-6. I-5 Pavement Condition: S Boeing Access Road to S Albro Place

Chapter 3 Existing and Future Conditions

1 Where and when is existing traffic congestion occurring on I-5?

Traffic congestion on I-5 is a typical daily occurrence for many sections of the corridor. Congestion in and around downtown Seattle primarily occurs during the morning and evening commute hours. Congestion is caused by several factors, including insufficient roadway capacity (number of lanes), substandard roadway design, traffic incidents, and driver behavior. For this analysis, only recurring congestion caused by roadway capacity or design constraints was modeled.

Many traffic engineers use speed diagrams to determine the intensity and duration of congestion. These diagrams show average vehicle speed contours plotted against time and location. They are very similar to topographical maps or temperature weather maps. Colors on the map change from green to blue to red indicating progressively slower travel speeds at a particular time and location. Engineers visually inspect these maps to identify areas of congestion.

Exhibits 3-1 through 3-6 show the existing (2004) traffic congestion for both travel directions of I-5 and the I-5 reversible lanes for a typical mid-week commute.

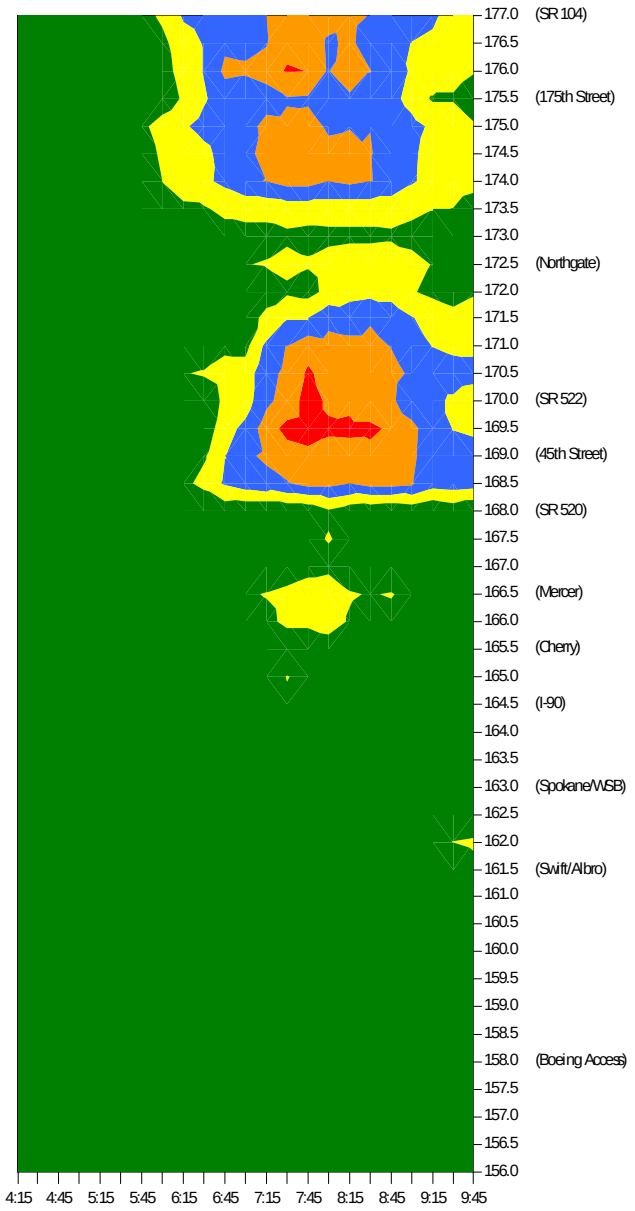


Exhibit 3-1 Existing Congestion - Morning Southbound Lanes

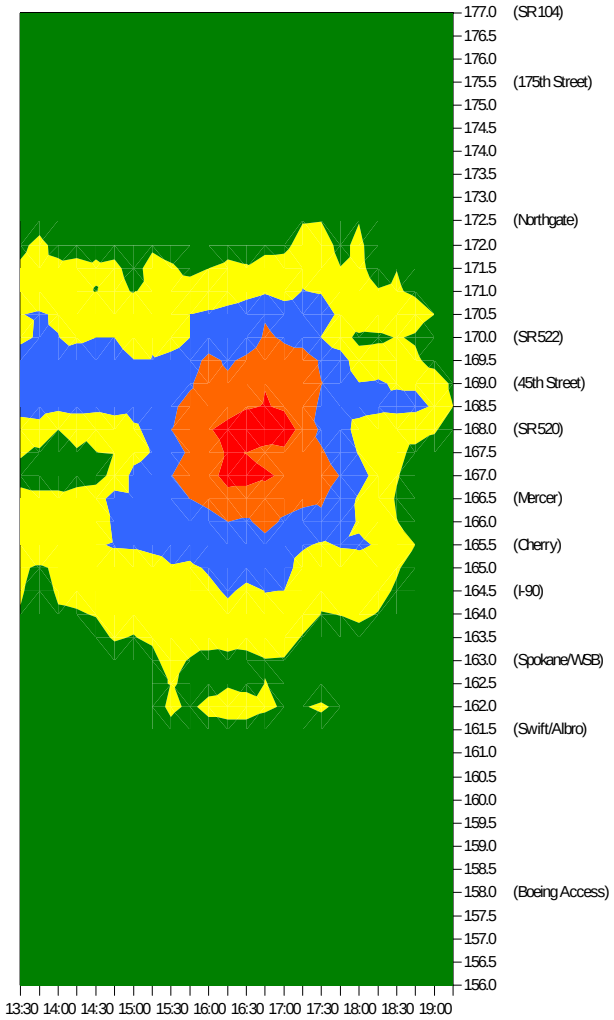


Exhibit 3-2 Existing Congestion - Evening Southbound Lanes

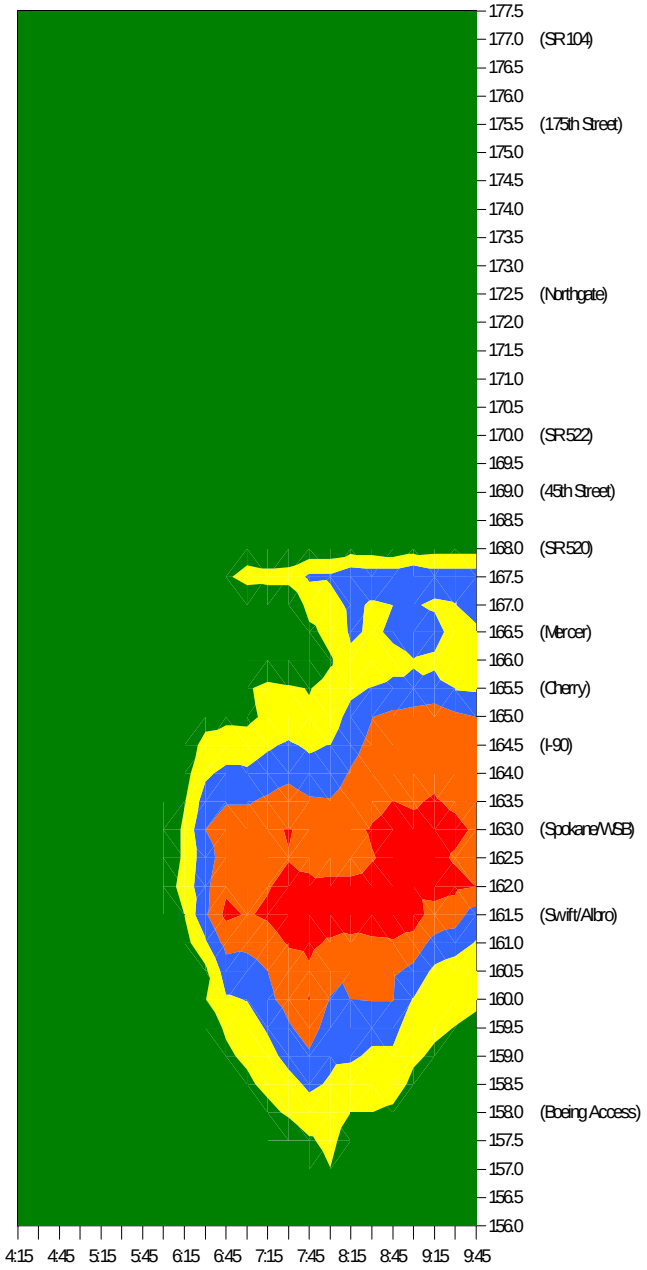


Exhibit 3-3 Existing Congestion - Morning Northbound Lanes

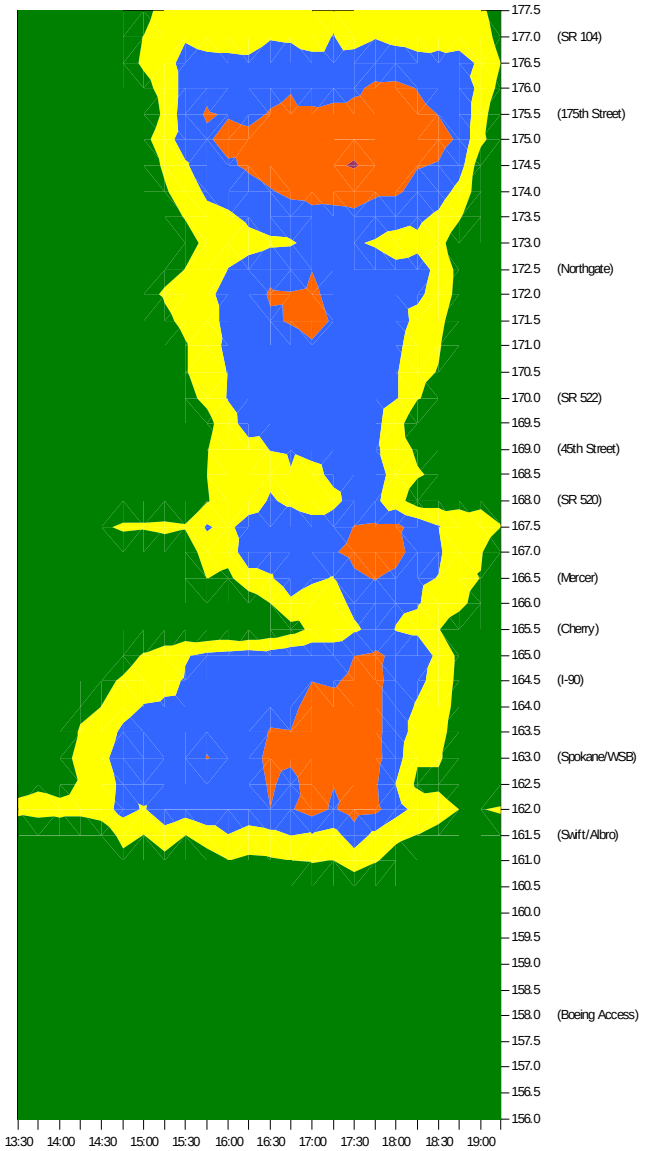


Exhibit 3-4 Existing Congestion - Evening Northbound Lanes

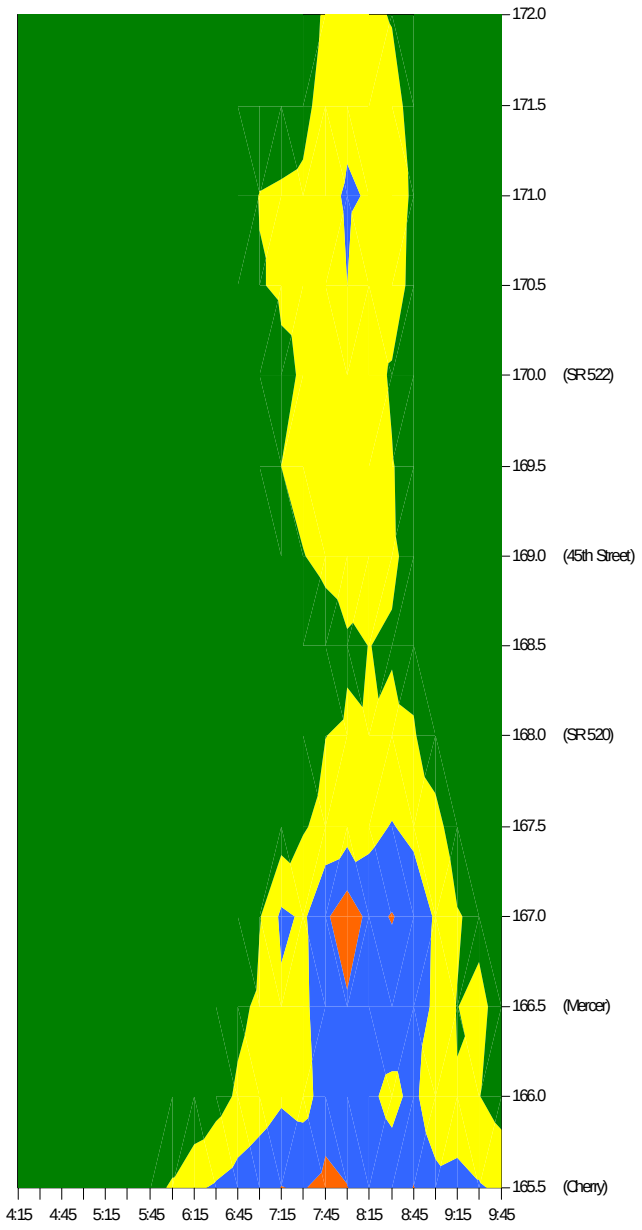


Exhibit 3-5 Existing Congestion - Morning Reversible Lanes

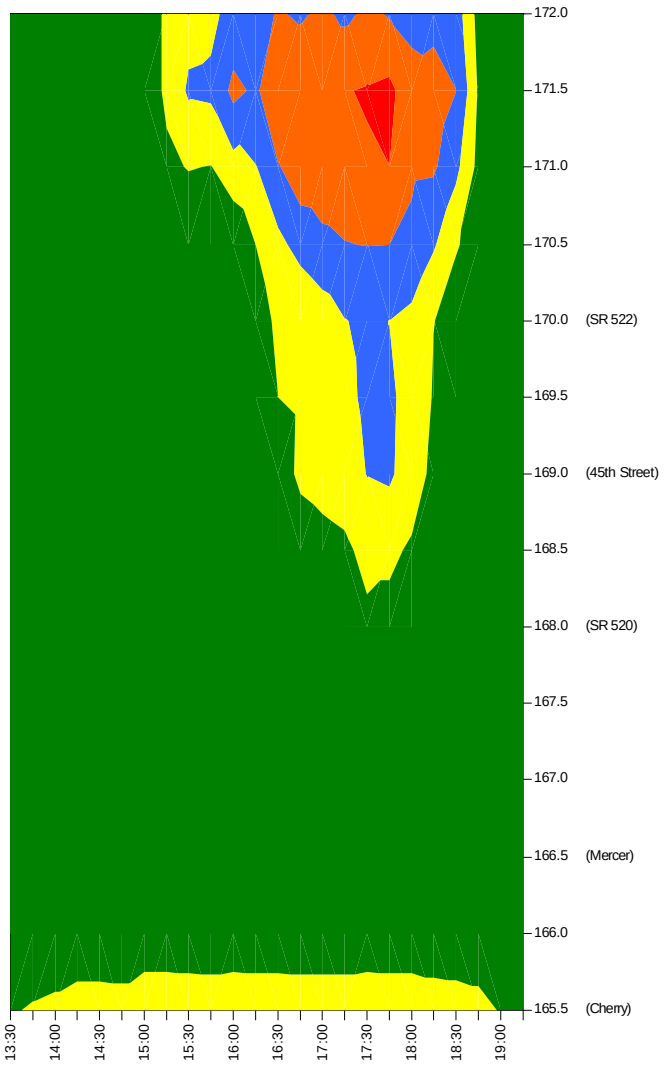


Exhibit 3-6 Existing Congestion - Evening Reversible Lanes

Morning:

Southbound – Congestion starts at SR 520 and extends north approximately 4 miles to around Northgate. The worst congestion occurs around the 45th Street NE on- and off-ramps, with travel speeds dropping to as low as 10 miles per hour (mph) during a typical weekday commute. Roadway capacity is highly constrained in this location, due to motorists weaving from the 45th/50th Street NE on-ramps to the SR 520 off-ramp and vehicle queuing that spills back onto southbound I-5 from eastbound SR 520. This congestion lasts over three hours, with noticeable congestion starting around 7:00 AM and extending until 10 AM. Other congestion occurs just north of 130th Street NE and extends north into South Snohomish County. No noticeable congestion occurs south of SR 520 on southbound I-5 during the typical AM peak commute period.

Northbound – On northbound I-5 during the AM peak period, motorists typically experience traffic congestion starting around Boeing Access Road. This congestion extends north through downtown and terminates at the SR 520 interchange. The worst congestion occurs around the Spokane Street/West Seattle Bridge interchange with average travel speeds dropping to as low at 10 mph between 6:30 AM and 10:00 AM. Traffic congestion also occurs through downtown Seattle near Seneca Street where only two general-purpose lanes are provided. Less congestion occurs between Cherry Street and the SR 520 interchange as typical travel speeds are 30 to 50 mph. North of SR 520, northbound traffic is typically free-flowing during the morning commute.

Reversible Lanes – The reversible lanes operate in the southbound direction in the morning. The reversible roadway segment between the northern terminus near NE 103rd Street and SR 520 generally operates free flow during the morning commute period. On an average weekday, the segment does experience some congestion between NE 85th Street and SR 520 between 7:30 and 8:30 AM when average speeds drop slightly below 50 mph.

Traffic congestion created by weaving and queue jumping movements near Mercer Street, Pine and Pike Streets, and the southern terminus results in severe southbound traffic congestion along the reversible roadway south of SR 520. The decrease in roadway capacity from two lanes to a single lane at the southern end of downtown Seattle also a major cause of congestion. The average travel speeds along the reversible roadway south of SR 520 are reduced to approximately 25 mph between 7:00 and 9:00 AM, except for the westernmost high-occupancy vehicle (HOV) lane that leads to the Cherry/Columbia ramp south of Roanoke Street.

Evening:

Southbound – The southbound traffic congestion along I-5 extends between the SR 522 interchange and south of the I-90 interchange during the PM peak commute period between 3:00 and 6:30 PM. The southbound I-5 sections north of the SR 522 interchange and south of the I-90 interchange generally operate free flow during the evening commute period.

The existing lane configuration along southbound I-5 south of the Mercer Street on-ramp results in major weave movements. Mercer Street on-ramp general-purpose vehicles are forced to weave to general-purpose lanes, I-5 southbound HOVs weave to the HOV lane that originates at the Mercer Street on-ramp, Yale on-ramp HOVs weave to the HOV lane, and some of the Mercer Street on-ramp vehicles weave to downtown exits. Other weaving movements between the Yale on-ramp and Union and Columbia/James off-ramps compound the weaving activity in this area and cause severe congestion to occur in downtown Seattle. This congestion, along with congestion near the SR 520 interchange, results in traffic queues that extend to the SR 522 interchange.

Northbound – During the PM peak period, congestion starts around the Swift Avenue/Albro Place interchange and extends north to the 205th Street NE/SR 104 interchange within the project study limits.

With a one-lane ramp entrance to the reversible roadway from the northbound I-5 mainline, a bottleneck is created at the southern entry to the reversible roadway. This bottleneck, in addition to other capacity constraints between the Spokane Street interchange and the I-90 interchange, results in severe traffic congestion along the I-5 mainline during the evening commute period between 3:00 and 7:00 PM.

The short weaving segment between the Mercer Street on-ramp and SR 520 off-ramp creates a bottleneck between the Mercer Street off-ramp and SR 520 interchange. The other major bottleneck occurs near the 175th Street NE interchange due to capacity constraints resulting in severe traffic congestion between 205th Street NE and 130th Street NE. The congestion lasts for over 3 hours with travel speeds dropping to 10 to 20 mph.

Reversible Lanes – The reversible roadway segment between downtown Seattle and NE 42nd Street generally operates free flow during the evening commute period.

Of the two remaining general-purpose lanes north of SR 522, only one lane continues through the northern terminus of the reversible roadway to enter the I-5 mainline at Northgate. Traffic back-ups in the segment between SR 522 and the northern terminus produce severe traffic congestion along the reversible roadway extending from NE 42nd Street north, mainly between 4:00 and 6:30 PM. This congestion affects both general-purpose traffic and HOV traffic including transit south of SR 522. North of SR 522 the HOV lane operates free flow onto the I-5 mainline at Northgate.

2 How were year 2030 traffic volume forecasts developed?

The project team selected 2030 as the future analysis year for improvements in the corridor. Year 2030 traffic volumes were derived using the Puget Sound Regional Council (PSRC) travel demand forecasting model. This travel demand model is calibrated to a 2000 base year and reflects regional travel demand patterns. Along the I-5 corridor, this model was used to

What is a screenline?

A screenline is an imaginary line that is used to report vehicle volumes. For the I-5 Pavement Reconstruction Project, a total of eight screenlines were used to capture vehicle volumes on the corridor. The total of these volumes includes northbound and southbound general-purpose and HOV volumes and the reversible lanes.

The local area screenlines captured all on-ramps, off-ramps, and arterial streets that cross the I-5 corridor in between each screenline. The local area screenline represents the growth occurring near the I-5 corridor, but not necessarily on the corridor.

obtain traffic volumes at eight screenline locations on the I-5 corridor, and in between screenlines at on-ramps, off-ramps, and arterial streets that cross over the highway network. Future transportation network improvements assumed for the year 2030 consisted of PSRC's "medium investment" scenario, which includes capacity improvements on I-405; additional HOV lane facilities on SR 520, SR 99, and I-90; and several interchange improvements on I-405. These improvements are anticipated to divert a small percentage of vehicle trips off of the I-5 corridor to these other corridors.

Traffic volumes at each of the I-5 screenline locations for existing conditions and the year 2030 were reviewed to develop an annual growth rate for each screenline. These growth rates were applied to existing 2004 count data to determine planning level traffic volume forecasts for the year 2030. The overall annual growth rate varied from a negligible growth rate upwards to 0.5 percent annual growth. While these growth rates may appear low, increases in daily traffic volumes on I-5 have been minimal in the past 10 years since the roadway has been operating at capacity for some time now. Without any further improvements to the I-5 corridor, traffic forecasts indicate an overall maximum traffic volume growth of 16 percent between 2004 and 2030 during the morning and evening peak periods.

3 How was the micro-simulation model used and calibrated?

To evaluate the improvement alternatives, the project team needed a model of existing and future traffic conditions in the I-5 corridor. Using VISSIM, an industry leading micro-simulation tool, the project team developed a model that realistically simulates existing traffic flow and congestion conditions on the freeway through an extensive calibration process. Engineers used the model to simulate a 5-hour AM peak period and a 5-hour PM peak period for an average weekday. Using an average of hourly traffic counts from Tuesdays, Wednesdays, and Thursdays in October 2004, and with observed knowledge of current traffic congestion on the

Why is calibrating the simulation model important?

The model calibration process is often a long and tedious step in developing a micro-simulation model. Model calibration is an iterative process to match existing traffic flow as closely as possible. The calibrated model is then used to evaluate future conditions on the corridor. Calibration accuracy is necessary to ensure that model results from evaluating corridor improvements are accurate and reliable.

freeway, engineers calibrated the simulation model to mirror existing weekday travel conditions on I-5. This model was calibrated to closely match the traffic volumes and congestion on the corridor during both morning and afternoon 5-hour analysis periods.

At most locations, the simulation model matched existing volumes at on-ramps, off-ramps, and mainline sections within 15 percent for all time periods. Using data from the model, engineers estimated travel times and speeds along various segments in the study area for a variety of improvements. The existing travel times and vehicle speeds were used as a basis to analyze the operational benefits or impacts in future years.

4 Where and when is traffic congestion expected to occur in the year 2030?

The year 2030 volume forecasts were applied to the calibrated 2004 VISSIM model to develop a baseline 2030 model. Traffic congestion is expected to increase significantly compared to existing conditions. Congestion is anticipated to last longer and affect longer I-5 segments compared to today, and new areas of congestion are expected to develop.

Morning:

Southbound – Severe traffic congestion is expected to occur at SR 520 and extend north of 205th Street NE. This congestion is anticipated to last over 4 hours compared to the current 3 hours, with noticeable congestion starting around 6:00 AM and extending beyond 10 AM. No noticeable congestion is anticipated to occur south of SR 520 on southbound I-5 during the typical AM peak commute period.

Northbound – The 2030 analysis indicates that the northbound I-5 traffic congestion would begin near Interurban Avenue during the AM peak period. This congestion would extend north through downtown and terminate at the SR 520 interchange. The worst congestion would occur around the Spokane Street/West Seattle Bridge interchange with average travel speeds dropping to as low as 10 mph between 6:00 AM

and 11:00 AM. North of SR 520, traffic would be typically free-flowing during the morning commute.

Reversible Lanes – The reversible roadway segment between the northern terminus near NE 103rd Street and SR 520 would operate free flow during the morning commute period. Traffic congestion created by weaving and queue jumping movements near Mercer Street, Pine and Pike Streets, and the southern terminus would continue to cause severe southbound traffic congestion along the reversible roadway south of SR 520.

Evening:

Southbound – The southbound traffic congestion would deteriorate significantly by 2030, and the congestion along I-5 would extend from north of the 205th Street NE/SR 104 interchange to south of the I-90 interchange during the PM peak commute period between 2:30 and 7:30 PM. The southbound I-5 section south of the Spokane Street interchange would continue to operate free flow during the evening commute period.

Northbound – During the PM peak period, congestion would begin south of the Swift Avenue/Albro Place interchange and extend north to the 205th Street NE/SR 104 interchange within the project study limits. The congestion would last over 4 hours along several segments of the study corridor.

Reversible Lanes – The reversible roadway congestion during the evening commute would deteriorate significantly by 2030, and the congestion would extend between Mercer Street and the northern terminus of the roadway.

Chapter 4 Alternative Analysis Intro

1 What alternatives were considered?

Alternatives to improve I-5 traffic operations included 10 northbound alternatives (N1-N10), 6 southbound alternatives (S1-S6), and 5 reversible roadway alternatives (R1-R5). Each alternative was initially evaluated separately to determine the traffic operations benefits as a stand alone improvement. This section provides a one to two page summary for each of the stand alone improvement projects.

The alternatives were then grouped into logical combinations to evaluate the added traffic operations benefit of considering several improvements together. Combination alternatives included 5 in the northbound direction (NC1-NC5), and 4 in the southbound direction (SC1-SC4). A one to two page summary is also provided for each of the combination alternatives.

2 What was evaluated for each alternative?

A project description, identification of potential benefits and impacts, and implementation challenges are identified for each alternative. Project benefits focus on travel speed, travel time, and overall congestion in the vicinity of the improvement. A design analysis has not been undertaken for all the alternatives; therefore, how each alternative might be implemented will require further study. Some alternatives may require significant deviations from accepted roadway geometric design standards and may have high associated construction costs.

3 What were the analysis results?

A summary of the analysis results for each alternative are shown on Exhibits 4-1 and 4-2 for the individual alternatives, and on Exhibit 4-3 for the combination alternatives.

Exhibit 4-1 Draft AM Peak Period Results

AM Peak Period Results

Alternative	Description	Study Segment	Segment Length (miles)	AM Period (5:00 AM to 10:00 AM)					
				2004 Average Speed (mph)			2030 Average Speed (mph)		
				No-Build	Build	Percent Difference	No-Build	Build	Percent Difference
Northbound Mainline									
N1	Manage NB HOV lane operations north of Spokane Street	NB Mainline - Interurban Ave to n/o I90	8.8	23	19	-17%	18	15	-17%
N2	Meter NB Spokane Street On-Ramp	NB Mainline - s/o Spokane Off to n/o I-5 CD Off	2.4	17	31	82%	16	20	25%
		NB Mainline - Interurban Ave to n/o I90	8.8	23	44	91%	18	23	28%
N3	Braid Spokane Street NB On-ramp with exit ramp to I-5 CD	NB Mainline - Interurban Ave to n/o I90	8.8	23	49	113%	18	29	61%
N4	Add a second lane to the NB I-5 CD roadway between the I90 EB Off-ramp and Dearborn Street On-Ramp	NB I-5 CD - Begin to End	1.5	28	30	7%	24	26	8%
		NB Mainline - Interurban Ave to n/o I90	8.8	23	23	0%	18	18	0%
N5	Add a NB lane between Seneca Street Off and SR 520 Off	n/o Seneca Off to s/o SR 520 Off	2.4	47	52	11%	41	51	24%
		Interuban Avenue to 205th Street	21.8	33	33	0%	29	29	0%
		n/o SR 520 Off to n/o Ravenna	2.1	58	59	2%	58	58	0%
		NB Mainline - n/o I-5 CD Off to n/o SR 520 Off	3.5	23	23	0%	20	22	10%
N6	Shift NB Mercer Street On-Ramp from left to right side	NB Mainline - n/o Seneca Off to s/o Ravenna Off	3.5	52	53	2%	47	51	9%
N7	Add a transit-only shoulder lane between Olive Way On-Ramp and SR520 Off-Ramp	NB Mainline - n/o Olive On to s/o SR 520 Off (Transit Vehicles)	1.4	43	53	23%	32	52	63%
N8	Add a transit-only shoulder lane between Olive Way On-Ramp and SR520 Off-Ramp and Meter the Olive Way On-Ramp	NB Mainline - n/o Seneca off to n/o SR520 Off	2.5	47	55	17%	41	52	27%
N9	Add a NB mainline lane between SR 520 On-Ramp and NE 45th Off-Ramp	NB Mainline n/o SR 520 On to s/o Ravenna Off	1.7	59	60	2%	59	59	0%
N10	Add a NB mainline lane between Ravenna Boulevard and Northgate Way	NB Mainline - s/o 45th Off to n/o 130th Off	4.7	59	60	2%	59	60	2%
Southbound Mainline									
S1	Add a SB mainline lane between 85th St Off-Ramp and SR 522 On-Ramp	SB Mainline - s/o Northgate On to s/o 45th On	3.5	23	28	22%	20	27	35%
S2	Add a SB mainline lane between s/o SR 520 On-Ramp and s/o Spokane Street On-Ramp	SB Mainline - s/o 85th On to s/o Spokane Street	8.7	53	56	6%	52	55	6%
S3	Shift SB SR 520 On and Off ramps from left hand side to right hand side	SB Mainline - s/o Northgate On to n/o Union Off	6.5	26	40	54%	23	37	61%
S4	Manage SB HOV Lane Operations between Mercer Street and Spokane Street	SB Mainline - s/o 85th On to s/o Corson	10.4	34	36	6%	32	34	6%
S5	Meter SB Yale On-Ramp	SB Mainline - s/o SR 520 to n/o Forest Street	4.2	53	53	0%	52	52	0%
S6	Add a second lane to SB I-5 CD south of I90 Off-Ramp	SB I-5 CD - Begin to End	1.4	55	55	0%	55	55	0%

Exhibit 4-1 Draft AM Peak Period Results (continued)

AM Peak Period Results

Alternative	Description	Study Segment	Segment Length (miles)	AM Period (5:00 AM to 10:00 AM)					
				2004 Average Speed (mph)			2030 Average Speed (mph)		
				No-Build	Build	Percent Difference	No-Build	Build	Percent Difference
Reversible Lanes									
R1	Add a second lane along the south end portion of the Reversible lanes to maintain two lanes to/from the Mainline	Reversible Lanes - s/o 42nd Street to End	3.7	41	55	34%	44	55	25%
R2	Add an HOV ramp connection between reversible lanes and SR 520	Reversible Lanes - s/o Ravenna On to End (AM)	4.4	43	41	-5%	46	41	-11%
R3	Modify Stewart to HOV-only and Cherry/Columbia to GP (all lanes open to GP south of Stewart Street Off-Ramp)	Reversible Lanes - s/o 42nd Street to End	3.7	41	54	32%	44	54	23%
R4	Modify Stewart to HOV-only and Pine/Pike to GP	Reversible Lanes - s/o 42nd Street to End	3.7	41	41	0%	44	44	0%
R5	Modify Stewart to HOV-only (Pine/Pike & Cherry/Columbia remain HOV-only)	Reversible Lanes - s/o 42nd Street to End	3.7	41	24	-41%	44	32	-27%

Legend:

- Short-term projects with traffic operational benefits
- Long-term projects with traffic operational benefits
- Projects with little or no traffic operational benefits or have constructability/feasibility issues

Exhibit 4-2 PM Peak Period Results

PM Peak Period Results

Alternative	Description	Study Segment	Segment Length (miles)	PM Period (2:30 PM to 7:30 PM)					
				2004 Average Speed (mph)			2030 Average Speed (mph)		
				No-Build	Build	Percent Difference	No-Build	Build	Percent Difference
Northbound Mainline									
N1	Manage NB HOV lane operations north of Spokane Street	NB Mainline - Interurban Ave to n/o I90	8.8	40	40	0%	26	28	8%
N2	Meter NB Spokane Street On-Ramp	NB Mainline - s/o Spokane Off to n/o I-5 CD Off	2.4	24	55	129%	20	31	55%
		NB Mainline - Interurban Ave to n/o I90	8.8	40	58	45%	26	41	58%
N3	Braid Spokane Street NB On-ramp with exit ramp to I-5 CD	NB Mainline - Interurban Ave to n/o I90	8.8	40	58	45%	26	51	96%
N4	Add a second lane to the NB I-5 CD roadway between the I90 EB Off-ramp and Dearborn Street On-Ramp	NB I-5 CD - Begin to End	1.5	33	40	21%	17	21	24%
		NB Mainline - Interurban Ave to n/o I90	8.8	40	40	0%	26	23	-12%
N5	Add a NB lane between Seneca Street Off and SR 520 Off	n/o Seneca Off to s/o SR 520 Off	2.4	40	57	43%	31	43	39%
		Interurban Avenue to 205th Street	21.8	37	37	0%	25	25	0%
		n/o SR 520 Off to n/o Ravenna	2.1	44	38	-14%	32	27	-16%
		NB Mainline - n/o I-5 CD Off to n/o SR 520 Off	3.5	30	35	17%	26	28	8%
N6	Shift NB Mercer Street On-Ramp from left to right side	NB Mainline - n/o Seneca Off to s/o Ravenna Off	3.5	40	40	0%	31	33	6%
N7	Add a transit-only shoulder lane between Olive Way On-Ramp and SR520 Off-Ramp	NB Mainline - n/o Olive On to s/o SR 520 Off (Transit Vehicles)	1.4	30	54	80%	23	53	130%
N8	Add a transit-only shoulder lane between Olive Way On-Ramp and SR520 Off-Ramp and Meter the Olive Way On-Ramp	NB Mainline - n/o Seneca off to n/o SR520 Off	2.5	40	56	40%	31	55	77%
N9	Add a NB mainline lane between SR 520 On-Ramp and NE 45th Off-Ramp	NB Mainline n/o SR 520 On to s/o Ravenna Off	1.7	41	42	2%	30	30	0%
N10	Add a NB mainline lane between Ravenna Boulevard and Northgate Way	NB Mainline - s/o 45th Off to n/o 130th Off	4.7	42	44	5%	29	34	17%
Southbound Mainline									
S1	Add a SB mainline lane between 85th St Off-Ramp and SR 522 On-Ramp	SB Mainline - s/o Northgate On to s/o 45th On	3.5	25	37	48%	13	13	0%
S2	Add a SB mainline lane between s/o SR 520 On-Ramp and s/o Spokane Street On-Ramp	SB Mainline - s/o 85th On to s/o Spokane Street	8.7	23	55	139%	17	53	212%
S3	Shift SB SR 520 On and Off ramps from left hand side to right hand side	SB Mainline - s/o Northgate On to n/o Union Off	6.5	19	30	58%	13	17	31%
S4	Manage SB HOV Lane Operations between Mercer Street and Spokane Street	SB Mainline - s/o 85th On to s/o Corson	10.4	24	55	129%	19	53	179%
S5	Meter SB Yale On-Ramp	SB Mainline - s/o SR 520 to n/o Forest Street	4.2	23	50	117%	20	26	30%
S6	Add a second lane to SB I-5 CD south of I90 Off-Ramp	SB I-5 CD - Begin to End	1.4	42	42	0%	39	39	0%

Exhibit 4-2 PM Peak Period Results (continued)

PM Peak Period Results

Alternative	Description	Study Segment	Segment Length (miles)	PM Period (2:30 PM to 7:30 PM)					
				2004 Average Speed (mph)			2030 Average Speed (mph)		
				No-Build	Build	Percent Difference	No-Build	Build	Percent Difference
Reversible Lanes									
R1	Add a second lane along the south end portion of the Reversible lanes to maintain two lanes to/from the Mainline	Reversible Lanes - Begin to s/o 42nd Street Off	3.7	57	34	-40%	20	17	-15%
		NB Mainline n/o I-5 CD Off to SR 520 Off	3.7	28	42	50%	25	35	40%
		NB Mainline n/o I-5 CD Off to Reversible s/o 42nd Off	4.6	33	37	12%	18	19	6%
R2	Add an HOV ramp connection between reversible lanes and SR 520	Reversible Lanes - Begin to Ravenna Off (PM)	4.4	46	41	-11%	29	28	-3%
R3	Modify Stewart to HOV-only and Cherry/Columbia to GP	Reversible Lanes - Begin to s/o 42nd Street Off	3.7	57	57	0%	20	22	10%
R4	Modify Stewart to HOV-only and Pine/Pike to GP	Reversible Lanes - Begin to s/o 42nd Street Off	3.7	57	52	-9%	20	20	0%
R5	Modify Stewart to HOV-only (Pine/Pike & Cherry/Columbia remain HOV-only)	Reversible Lanes - Begin to s/o 42nd Street Off	3.7	57	59	4%	20	24	20%

Legend:

Short-term projects with traffic operational benefits
Long-term projects with traffic operational benefits
Projects with little or no traffic operational benefits or have constructability/feasibility issues

Exhibit 4-3 Combo Results

Combo Results

Alternative	Description	Study Segment	Segment Length (miles)	PM Period (2:30 PM to 7:30 PM)					
				2004 Average Speed (mph)			2030 Average Speed (mph)		
				No-Build	Build	Percent Difference	No-Build	Build	Percent Difference
Northbound Mainline									
NC1	Braid Spokane Street NB On-ramp with exit ramp to I-5 CD, Add a NB lane between Seneca Street Off and SR 520 Off, Add a NB mainline lane between Ravenna Boulevard and Northgate Way	NB Mainline - Interurban Ave to 205th Street	21.8	37	44	19%	25	30	20%
		NB Mainline - Interurban Ave to n/o I90	8.8	40	59	48%	26	52	100%
		NB Mainline - Ravenna to 205th Street	7.8	37	38	3%	29	31	7%
NC2	Braid Spokane Street NB On-ramp with exit ramp to I-5 CD, Add a NB lane between Seneca Street Off and SR 520 Off, Add a NB mainline lane between Ravenna Boulevard and Northgate Way, Meter Olive Way On-Ramp	NB Mainline - Interurban Ave to 205th Street	21.8	37	52	41%	25	34	36%
		NB Mainline - Interurban Ave to n/o I90	8.8	40	59	48%	26	52	100%
		NB Mainline - Ravenna to 205th Street	7.8	37	48	30%	29	34	17%
NC3	Braid Spokane Street NB On-ramp with exit ramp to I-5 CD, Add a NB lane between Seneca Street Off and Northgate Way	NB Mainline - Interurban Ave to 205th Street	21.8	37	45	22%	25	29	16%
		NB Mainline - Interurban Ave to n/o I90	8.8	40	59	48%	26	52	100%
		NB Mainline - Ravenna to 205th Street	7.8	37	39	5%	29	27	-7%
NC4	Braid Spokane Street NB On-ramp with exit ramp to I-5 CD, Add a NB lane between Seneca Street Off and 205th Street	NB Mainline - Interurban Ave to 205th Street	21.8	37	55	49%	25	42	68%
		NB Mainline - Interurban Ave to n/o I90	8.8	40	59	48%	26	52	100%
		NB Mainline - Ravenna to 205th Street	7.8	37	56	51%	29	54	86%
Southbound Mainline									
SC1	Add a SB mainline lane between 85th St Off-Ramp and SR 522 On-Ramp, Meter Yale Avenue On-Ramp	SB Mainline - 205th Street to Interurban Avenue	21.8	32	54	69%	21	37	76%
SC2	Add a SB mainline lane between 85th St Off-Ramp and SR 522 On-Ramp, Meter Yale Avenue On-Ramp, Add a second lane to SB I-5 CD south of I90 Off-Ramp	SB Mainline - 205th Street to Interurban Avenue	21.8	32	54	69%	21	37	76%
SC3	Add a SB mainline lane between 85th St Off-Ramp and SR 522 On-Ramp, Meter Yale Avenue On-Ramp, Manage SB HOV Lane Operations between Mercer Street and Corson Avenue	SB Mainline - 205th Street to Interurban Avenue	21.8	32	55	72%	21	54	157%
SC4	Add a SB mainline lane between 85th St Off-Ramp and SR 522 On-Ramp, Manage SB HOV Lane Operations between Mercer Street and Corson Avenue	SB Mainline - 205th Street to Interurban Avenue	21.8	32	55	72%	21	54	157%

Alternative	Description	Study Segment	Segment Length (miles)	AM Period (5:00 AM to 10:00 AM)					
				2004 Average Speed (mph)			2030 Average Speed (mph)		
				No-Build	Build	Percent Difference	No-Build	Build	Percent Difference
Northbound Mainline									
NC5	Braid Spokane Street NB On-ramp with exit ramp to I-5 CD, Add a NB lane between Seneca Street Off and 45th	NB Mainline - Interurban Ave to 205th Street	21.8	33	49	48%	29	39	34%
		NB Mainline - Interurban Ave to n/o I90	8.8	23	49	113%	18	31	72%

Alternative N1: Manage Northbound High-Occupancy Vehicle Lanes

1. What is the project?

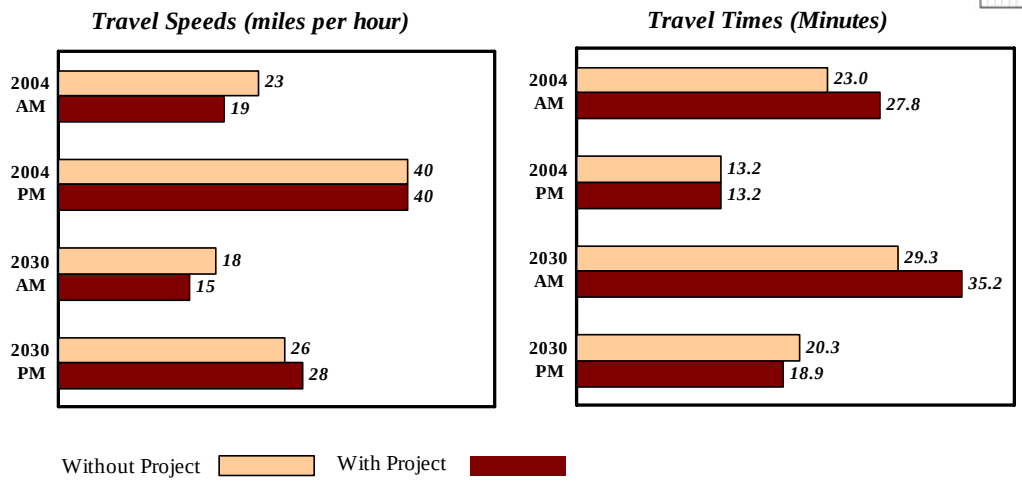
The project would allow general-purpose traffic to use the existing high-occupancy vehicle (HOV) lane along northbound I-5 between I-90 and S Spokane Street during high-volume time periods. The adjacent figure shows the project area.

2. What are the potential benefits and impacts of this project?

The project would increase the traffic volume on the existing northbound I-5 HOV lane north of S Spokane Street. This lane near S Dearborn Street allows general-purpose traffic to exit to the reversible roadway (PM peak only).

During the morning commute period, added general-purpose traffic merging into the mainline lanes would slightly worsen traffic operations along the I-5 corridor between Interurban Avenue and I-90. During the evening commute period, the project would have negligible benefits to travel speeds and travel times along the I-5 corridor between Interurban Avenue and I-90. The charts below show how the project would change average travel speeds and travel times along the I-5 study segment during the peak 5-hour morning and evening commute periods.

Study Segment - I5 Northbound Mainline: Interurban Avenue to n/o I90 (8.8 miles)



3. What are the implementation challenges with this project?

Constructing the project would not pose a challenge. However, allowing general-purpose traffic to use an existing HOV lane may be viewed by some as counter to the long standing policy of encouraging HOV use by providing travel time and reliability advantages over general purpose-traffic.

Alternative N2: Meter Northbound Spokane Street On-Ramp

1. What is the project?

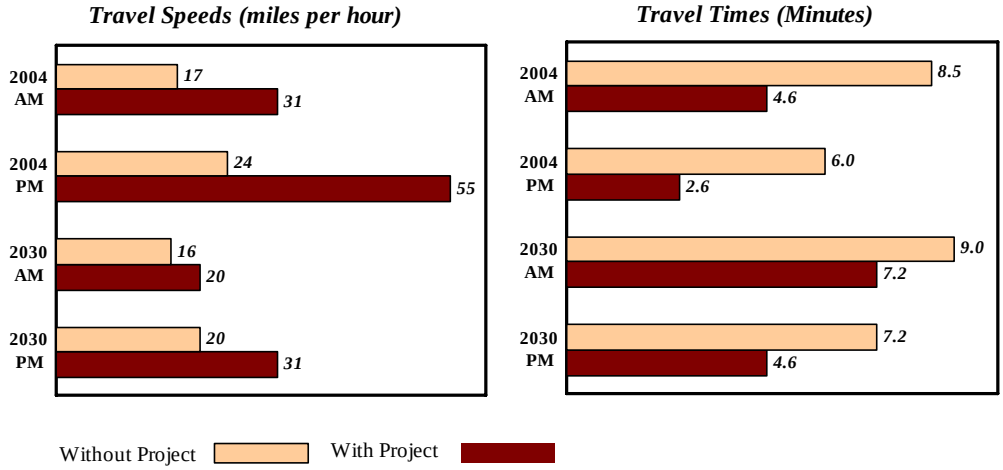
The project would provide a ramp meter on the S Spokane Street on-ramp to control the amount of traffic entering northbound I-5. The adjacent figure shows the project area.

2. What are the potential benefits and impacts of this project?

The S Spokane Street ramp meter would reduce traffic volumes on northbound I-5, improving travel speeds and travel times along the corridor between S Spokane Street and I-90. The charts below show the improved average travel speeds and travel times along the I-5 study segment that the project would create during the peak 5-hour morning and evening commute periods.

The project would lower on-ramp volumes by approximately 600 to 700 vehicles per hour on the S Spokane Street on-ramp during peak periods. This restriction would divert most of this traffic to other local streets and highways and thereby increase local traffic congestion on those roadways. Some of the major roadways that may experience more traffic congestion due to this project include S Spokane Street, Alaskan Way Viaduct, 1st Avenue S, 4th Avenue S, and Airport Way S.

Study Segment - I5 Northbound Mainline: S Spokane Street to I90 (2.4 miles)



3. What are the implementation challenges with this project?

Because the project would divert a significant amount of S. Spokane Street traffic to other local roadways during peak periods, appropriate mitigation measures should be evaluated on those roadways prior to installing a ramp meter on the S Spokane Street on-ramp. In addition, the northbound on-ramp has limited storage capacity and vehicle queues forming behind the ramp meter could impact other traffic on the Spokane Street Viaduct.

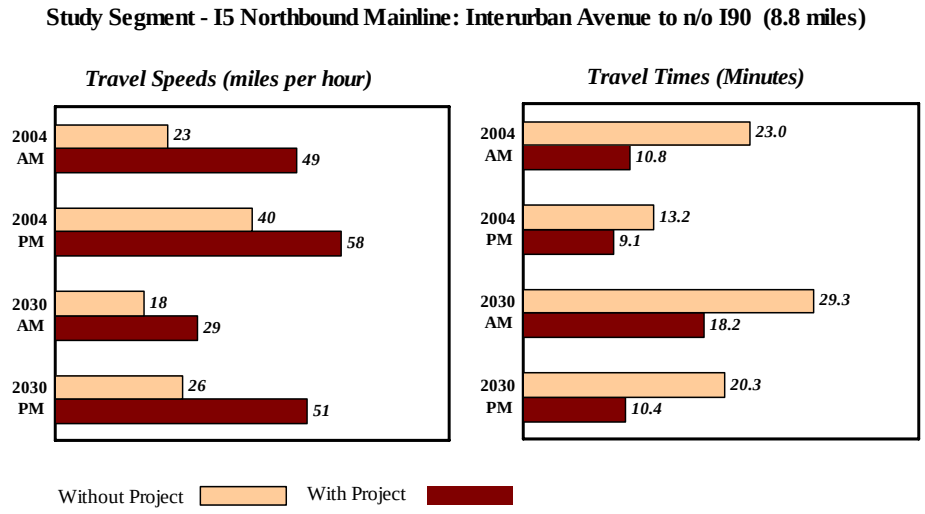
Alternative N3: Braid Northbound S Spokane Street On-Ramp with the Existing I-5 Collector-Distributor Road

1. What is the project?

The project would close the existing I-5 exit ramp to the northbound I-5 Collector-Distributor road and braid the Spokane Street on-ramp with the northbound I-5 Collector-Distributor road. This would extend the northbound I-5 Collector-Distributor road south to S Spokane Street. The project would also provide three exiting lanes at the northbound Spokane Street/Columbian Way exit ramp. The adjacent figure shows the project area.

2. What are the potential benefits and impacts of this project?

The project would remove the major weave segment on northbound I-5 between the S Spokane Street/Columbian Way on-ramp and the I-5 Collector-Distributor off-ramp. This would improve travel speeds and travel times significantly along the I-5 corridor between Interurban Avenue and I-90. The charts below show how the project benefits average travel speeds and travel times along the I-5 study segment during the peak 5-hour morning and evening commute periods.



3. What are the implementation challenges with this project?

Project costs would be high due to a significant amount of structure and retaining walls for the new ramp. Construction phasing and traffic control would also be a challenge. Environmental impacts are unknown at this point and given the scale of the project could become a consideration.

Alternative N4: Northbound I-5 Collector-Distributor Road Improvements

1. What is the project?

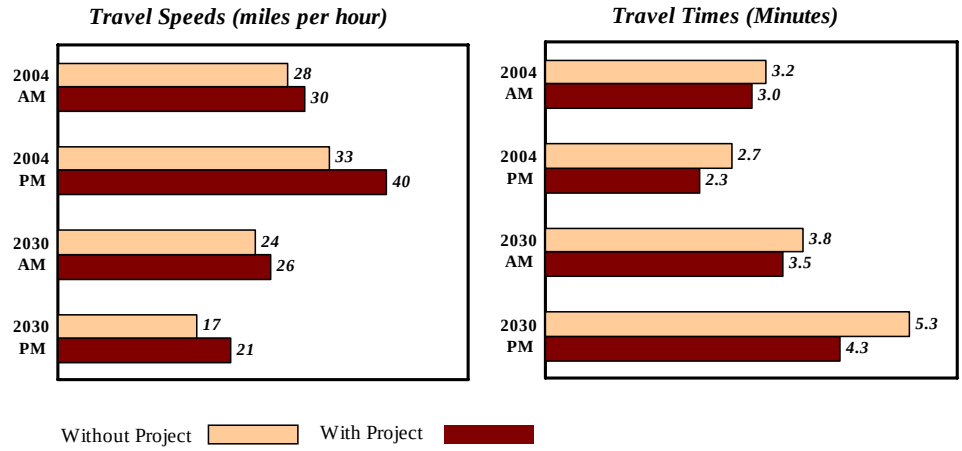
The project would add a second lane along the northbound I-5 Collector-Distributor (CD) road between the I-90 eastbound off-ramp and the S Dearborn Street on-ramp. The project would also change the S Dearborn Street on-ramp configuration from an add lane to a merge lane along the I-5 CD road. The adjacent figure shows the project area.

2. What are the potential benefits and impacts of this project?

The project would improve traffic operations somewhat along the I-5 CD road. The chart below shows the resulting improved average travel speeds and travel times along the northbound I-5 CD road during the peak 5-hour morning and evening commute periods.

The existing lane configuration of the I-5 CD exit ramp includes two lanes. One lane drops to I-90 and the second lane continues onto the CD. This lane configuration underutilizes the capacity of the I-5 CD exit ramp and therefore causes vehicles queuing from the I-5 CD exit to spill back onto the I-5 mainline. The project would allow both exit lanes to be used to reach the CD and would increase the lane utilization and capacity of the I-5 CD exit ramp. The project would also provide additional storage space along the northbound I-5 CD during peak periods when queued vehicles spill back onto the I-5 mainline.

Study Segment - Northbound I5 CD: Begin to End (1.5 miles)



3. What are the implementation challenges with this project?

The construction costs would be relatively low because of the project's short distance. The project would require some short-term detours or ramp closures.

Alternative N5: Add a Northbound Lane between Seneca Street and SR 520

1. What is the project?

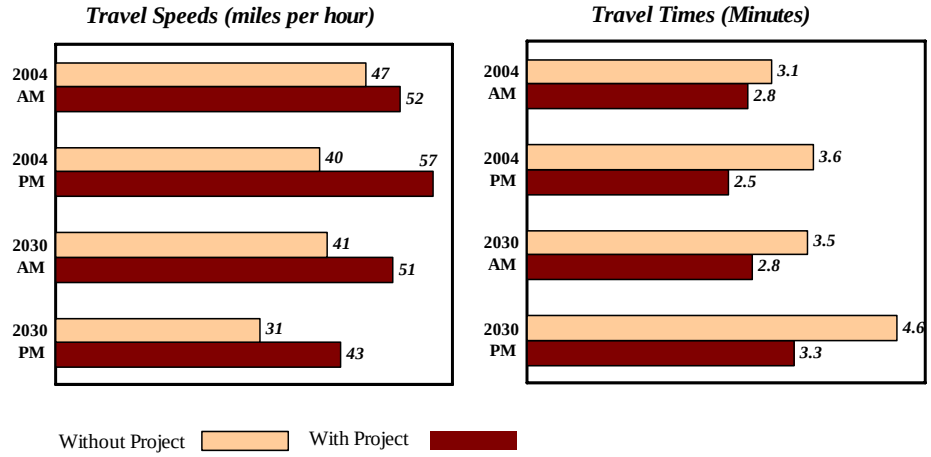
The project would add a northbound mainline lane between Seneca Street and SR 520. The additional lane would end at the SR 520 off-ramp, resulting in two lanes dropping to SR 520. The adjacent figure shows the project area.

2. What are the potential benefits and impacts of this project?

With additional capacity from the added lane, the project would improve travel speeds and travel times along the section of I-5 between Seneca Street and SR 520. The charts below show the resulting improved average travel speeds and travel times along the I-5 study segment during the peak 5-hour morning and evening commute periods.

With increased a higher vehicle discharge flow rate through the section of I-5 between Seneca Street and SR 520, the downstream sections north of SR 520 would experience higher traffic volumes and lower travel speeds during the PM peak period. The travel speeds between SR 520 and Ravenna Boulevard would drop by approximately 15 percent during the PM peak period. Added benefit to travel speeds and travel times would exist if this project was combined with Alternatives N9 and N10.

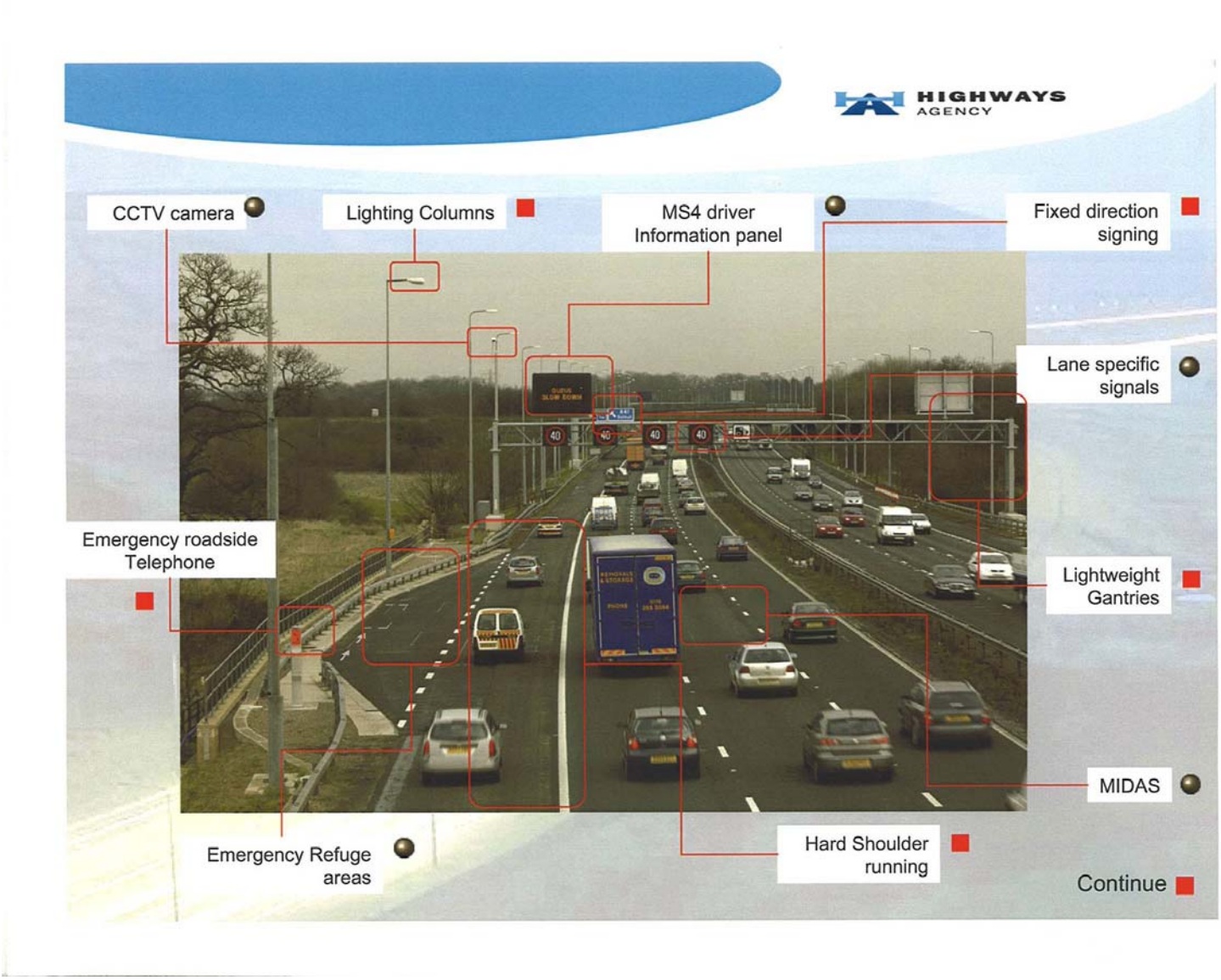
Study Segment - I5 Northbound Mainline: Seneca Street to SR 520 (2.4 miles)



3. What are the implementation challenges with this project?

The project would require more significant design standard deviations compared to the current configuration, including limited shoulder widths. Active traffic management concepts such as reducing travel speeds during high-volume periods and closing the outside lane during lower-volume periods are being explored to minimize the impact of the design standard deviations. Some examples of active traffic management concepts that have been implemented in Europe are shown in the following figure.

Exhibit- Active Traffic Management Concepts



Alternative N6: Shift Northbound Mercer Street On-Ramp

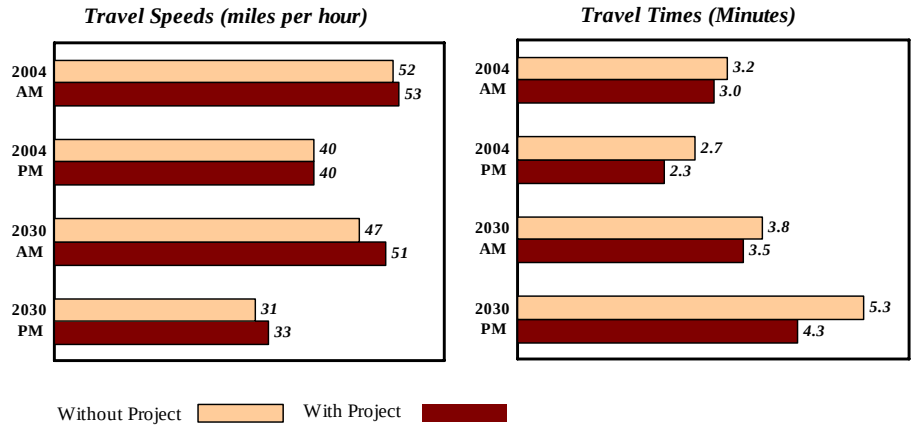
1. What is the project?

The project would shift the existing northbound Mercer Street on-ramp to enter the freeway mainline from the right side instead of the left side. The adjacent figure shows the project area.

2. What are the potential benefits and impacts of this project?

The project would not completely stop the weaving activity between Mercer Street and SR 520 and therefore would slightly improve travel speeds and travel times along I-5 between Seneca Street and Ravenna Boulevard. The charts below show the resulting improved average travel speeds and travel times along the I-5 study segment during the peak 5-hour morning and evening commute periods.

Study Segment - I5 Northbound Mainline: Seneca Street to Ravenna Boulevard (3.5 miles)



3. What are the implementation challenges with this project?

Construction costs would be high because the ramp modification would require a tunnel under I-5. In addition, the project has the potential to have short term and/or long term environmental and possibly community impacts given the constrained environment.

Alternative N7: Add a Northbound Transit-Only Shoulder Lane between Olive Way and SR 520

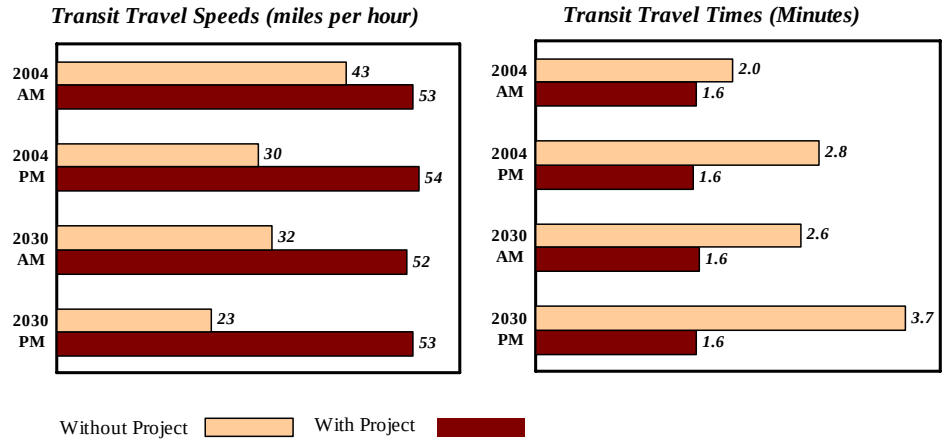
1. What is the project?

The project would add a transit-only northbound shoulder lane between Olive Way and SR 520 during weekday peak periods. The adjacent figure shows the project area.

2. What are the potential benefits and impacts of this project?

The transit-only lane would allow transit vehicles to bypass any traffic congestion on I-5 between Olive Way and SR 520, which would significantly improve travel speeds and travel times for the transit vehicles. The charts below show the resulting improved average travel speeds and travel times for transit along the I-5 study segment during the peak 5-hour morning and evening commute periods.

Study Segment - I5 Northbound Mainline: Olive Way to SR 520 (1.5 miles)



3. What are the implementation challenges with this project?

During peak periods, the existing shoulder lane on northbound I-5 north of Olive Way would be used by transit vehicles only and would not be available for emergency use. The project would not require any significant construction on I-5.

Alternative N8: Add a Northbound Transit-Only Shoulder Lane between Olive Way and SR 520 and Meter Olive Way On-Ramp

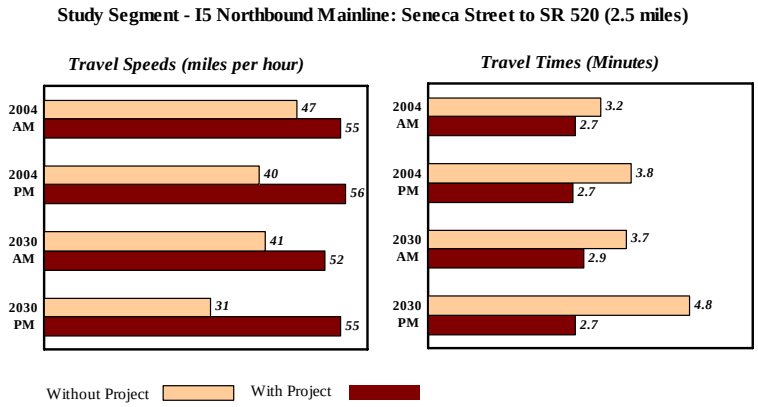
1. What is the project?

The project would add a transit-only northbound shoulder lane between Olive Way and SR 520 and also turn on the existing ramp meter on the Olive Way on-ramp to control the amount of traffic entering northbound I-5. The adjacent figure shows the project area.

2. What are the potential benefits and impacts of this project?

The transit-only lane would allow transit vehicles to bypass any traffic congestion along the I-5 corridor between Olive Way and SR 520, which would significantly improve travel speeds and travel times for the transit vehicles. The Olive Way ramp meter would reduce the traffic volumes on northbound I-5 and therefore improve traffic operations for all vehicles traveling between Seneca Street and SR 520. The charts below show the resulting improved average travel speeds and travel times along the I-5 study segment during the peak 5-hour morning and evening commute periods.

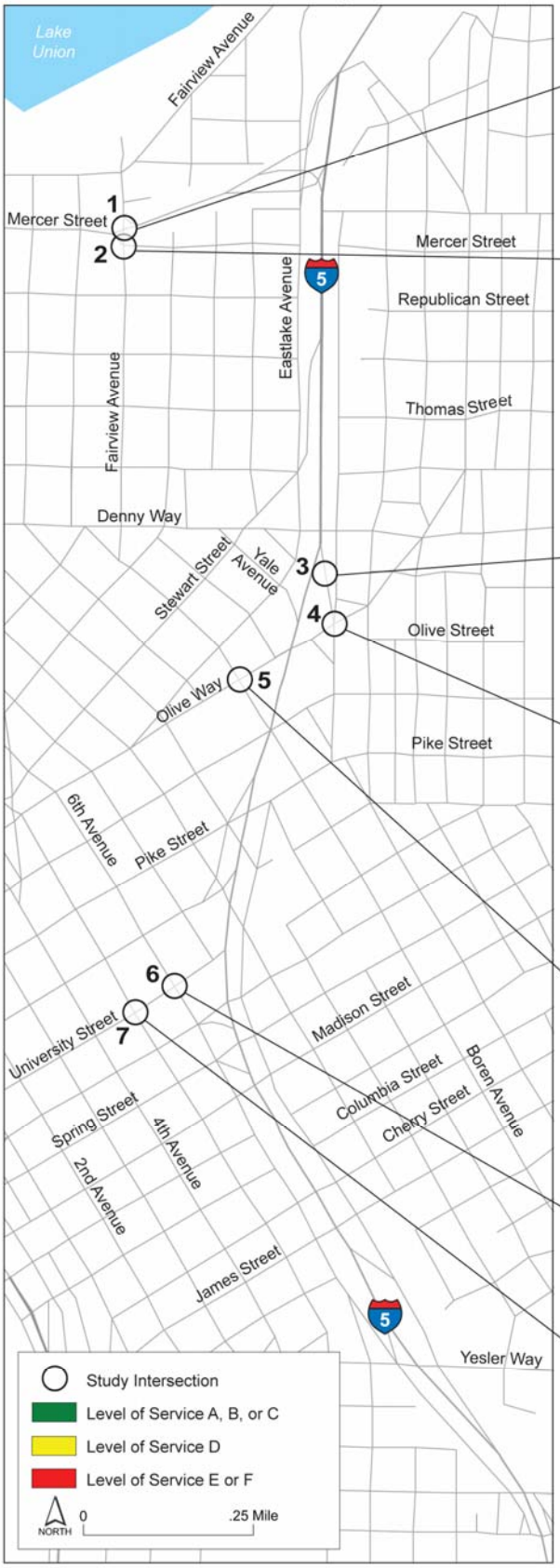
The project would restrict approximately 400 to 500 vehicles per hour on the Olive Way on-ramp during evening peak periods. This restriction would divert some traffic to other local streets and thereby increase the traffic congestion on those roadways. Some of the major roadways that may experience more traffic congestion due to this project are shown on the figure on the next page and include Mercer Street, University Street, and 5th Avenue.

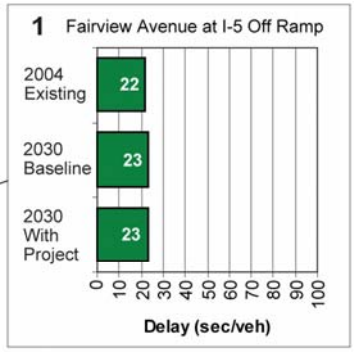


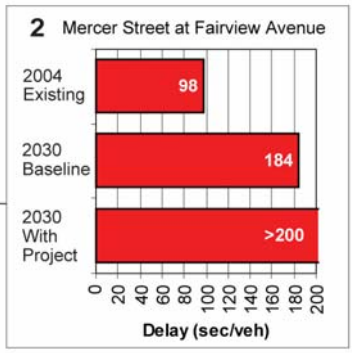
3. What are the implementation challenges with this project?

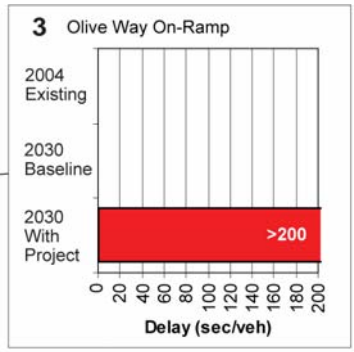
Because the project would divert some Olive Way traffic to other local roadways during peak periods, appropriate mitigation measures should be evaluated on those roadways prior to turning on the ramp meter on the Olive Way on-ramp. In addition, the ramp has limited storage space and queues that might develop behind the meter could interfere with transit and HOV access to the ramp as well as impede through movements on Olive Way.

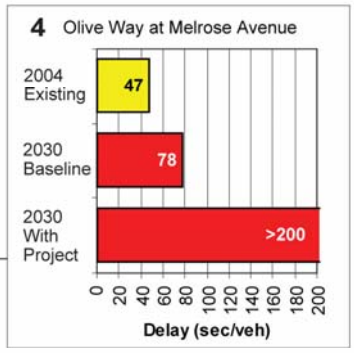
Alternative N8 Weekday PM Peak Hour Level of Service and Delay Results

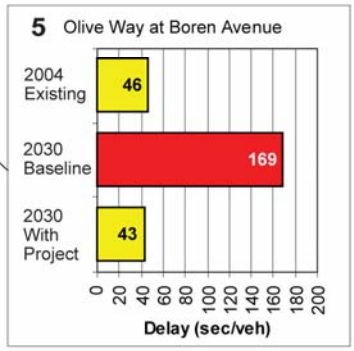


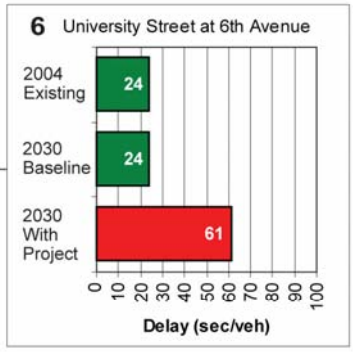


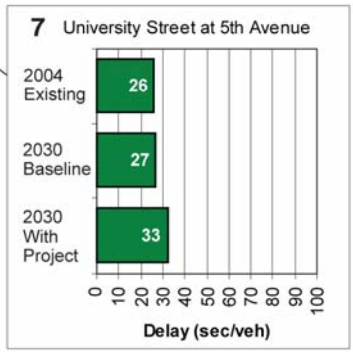












Alternative N9: Add a Northbound Lane between SR 520 and NE 45th Street

1. What is the project?

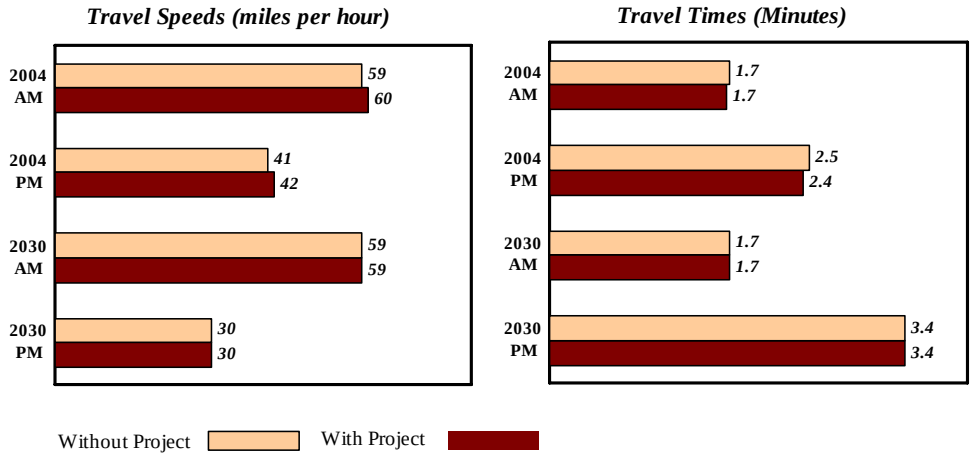
The project would add a northbound mainline lane between SR 520 and NE 45th Street, ending as a drop lane to NE 45th Street. The adjacent figure shows the project area.

2. What are the potential benefits and impacts of this project?

With an additional lane and capacity, the project would improve travel speeds and travel times along the section of I-5 between SR 520 and NE 45th Street.

The project would increase the vehicle discharge rate through the section of I-5 between SR 520 and NE 45th Street, causing the downstream sections north of NE 45th Street to experience higher traffic volumes and lower travel speeds. Overall, the project would result in negligible improvement of traffic operations along the I-5 corridor between SR 520 and Ravenna Boulevard. The charts below show the resulting average travel speeds and travel times along the I-5 study segment during the peak 5-hour morning and evening commute periods. Travel speeds and travel times would improve more if this project were combined with Alternatives N5 and N10.

Study Segment - I5 Northbound Mainline: SR 520 to Ravenna Boulevard (1.7 miles)



3. What are the implementation challenges with this project?

This project requires widening the Ship Canal Bridge, which would be costly. Construction phasing and staging to maintain traffic flow through the area would also be challenging.

Alternative N10: Add a Northbound Lane between Ravenna Boulevard and NE Northgate Way

1. What is the project?

The project would add a northbound mainline lane between Ravenna Boulevard and NE Northgate Way, terminating just north of the NE Northgate Way interchange. The adjacent figure shows the project area.

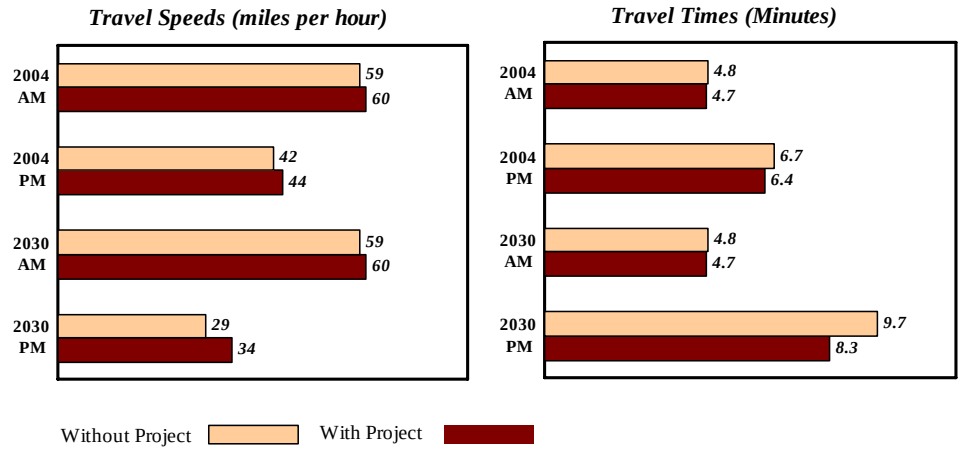
2. What are the potential benefits and impacts of this project?

With an additional lane and capacity, the project would improve travel speeds and travel times along the section of I-5 between Ravenna Boulevard and NE Northgate Way.

The project would increase vehicle discharge flow rate through the section of I-5 between Ravenna Boulevard and NE Northgate Way, causing the downstream sections north of NE Northgate Way to experience higher traffic volumes and lower travel speeds. Overall, the project would improve traffic operations somewhat during peak periods along the I-5 corridor between NE 45th Street and N 130th Street.

The charts below show the resulting improved average travel speeds and travel times along the I-5 study segment during the peak 5-hour morning and evening commute periods. Travel speeds and travel times would improve more if this project were combined with Alternatives N5 and N9.

Study Segment - I5 Northbound Mainline: NE 45th Street to NE 130th Street (4.7 miles)



3. What are the implementation challenges with this project?

To widen approximately 3 miles of the corridor, the project would need to reconstruct several structures and retaining walls. Project costs would be high. Portions of this section of I-5 will be impacted by Sound Transit's planned Light Rail extension to Northgate. Constructing both projects concurrently may result in some cost savings.

Alternative S1: Add a Southbound Mainline between NE 85th Street and SR 522

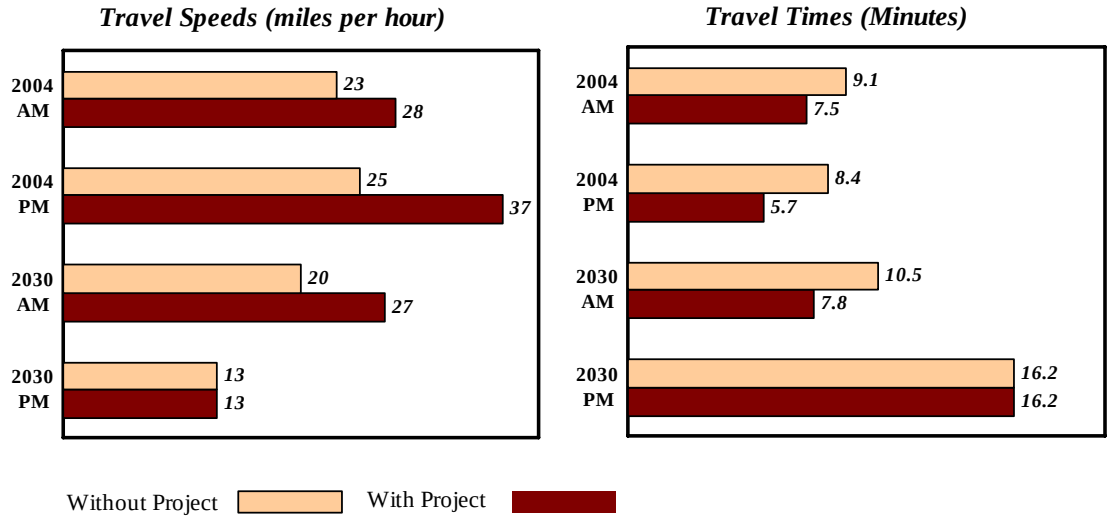
1. What is the project?

The project would add a southbound mainline lane between NE 85th Street and SR 522. The adjacent figure shows the project area.

2. What are the potential benefits and impacts of this project?

The project would provide an additional lane and capacity along the segment between NE 85th Street and SR 522. The project would improve travel speeds and travel times along the section of I-5 between NE Northgate Way and NE 45th Street, especially during the AM peak period. Under 2030 PM peak hour traffic conditions, vehicle queues that begin downstream of the project location are so severe that they extend north of NE Northgate Way. Therefore, the project would not improve traffic operations in the study area without other improvements such as Alternative S2. The charts below show the resulting improved average travel speeds and travel times along the I-5 study segment during the peak 5-hour morning and evening commute periods.

Study Segment - I5 Southbound Mainline: NE Northgate Way to NE 45th Street (3.5 miles)



3. What are the implementation challenges with this project?

This widening project would reconstruct several structures and retaining walls. The project costs would be moderate.

Alternative S2: Add a Southbound Mainline Lane between SR 520 and S Spokane Street

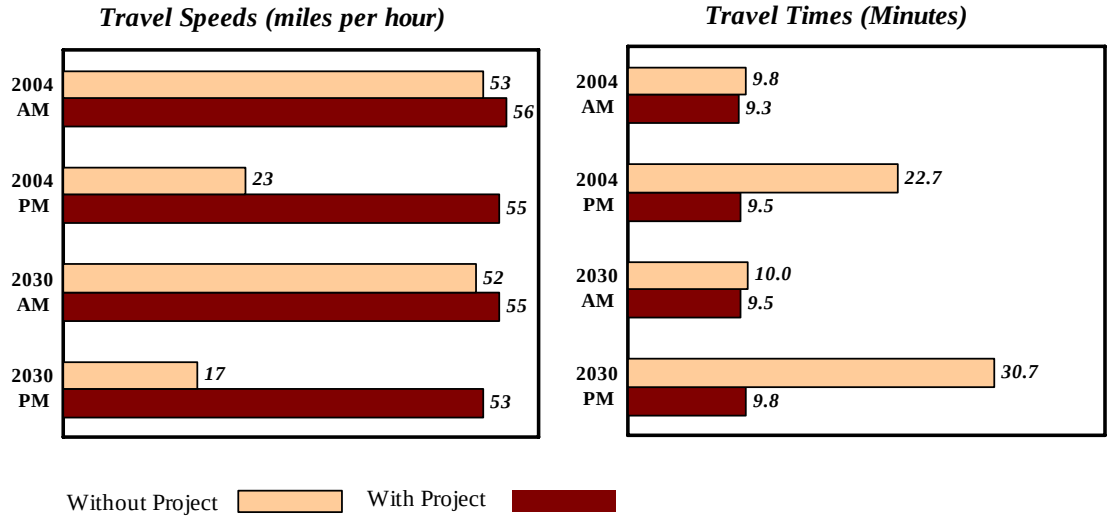
1. What is the project?

The project would add a southbound mainline lane between SR 520 and S Spokane Street. The adjacent figure shows the project area.

2. What are the potential benefits and impacts of this project?

With an additional lane and capacity, the project would improve travel speeds and travel times significantly along the section of I-5 between NE 85th Street and S Spokane Street. The charts below show the resulting improved average travel speeds and travel times along the I-5 study segment during the peak 5-hour morning and evening commute periods.

Study Segment - I5 Southbound Mainline: NE 85th Street to S Spokane Street (8.7 miles)



3. What are the implementation challenges with this project?

Widening over 5 miles of the I-5 corridor through Downtown Seattle would be costly. Several structures and retaining walls would be reconstructed. Construction phasing and staging to maintain traffic flow through the area would also be challenging.

Alternative S3: Shift Southbound SR 520 Ramps

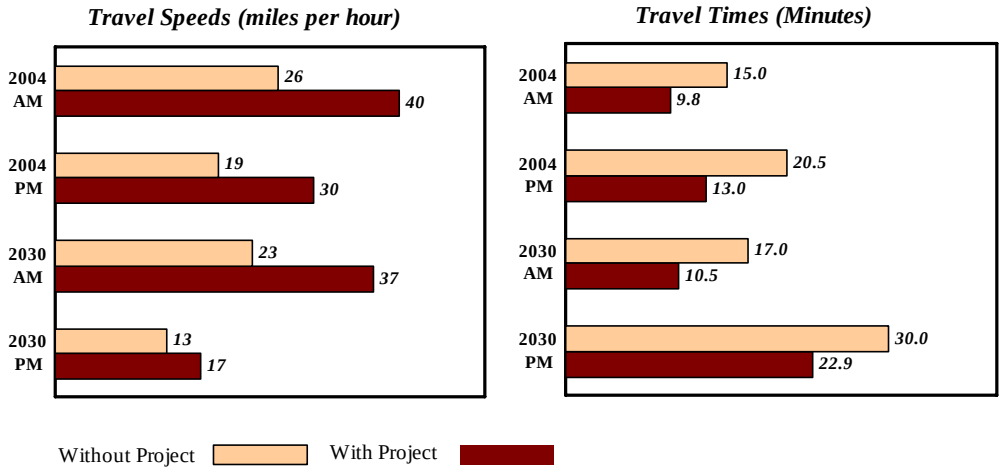
1. What is the project?

The project would shift the existing southbound SR 520 on- and off-ramps from the left side to the right side. The adjacent figure shows the project area.

2. What are the potential benefits and impacts of this project?

The project would substantially improve the major weave segment along southbound I-5 between the NE 45th/50th Street on-ramps and the SR 520 off-ramp across the Ship Canal Bridge. The project would also improve the major weave segment between the SR 520 on-ramp and the Mercer Street off-ramp. This would improve the travel speeds and travel times significantly along the I-5 corridor between NE Northgate Way and Union Street. The charts below show the resulting improved average travel speeds and travel times along the I-5 study segment during the peak 5-hour morning and evening commute periods.

Study Segment - I5 Southbound Mainline: NE Northgate Way to Union Street (6.5 miles)



3. What are the implementation challenges with this project?

The project costs would be high. New overpasses or tunnels would likely need to be constructed for the ramp connections. In addition, the project might have environmental and community impacts given the very tight constraints in the area.

Alternative S4: Manage Southbound High-Occupancy Vehicle Lane

1. What is the project?

The project would allow general-purpose (GP) traffic to use the existing high-occupancy vehicle (HOV) lane along southbound I-5 between Mercer Street and Corson Avenue during high-volume periods. The adjacent figure shows the project area.

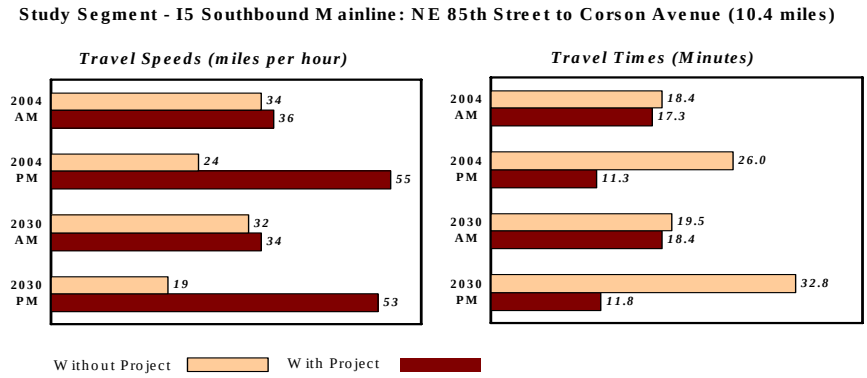
2. What are the potential benefits and impacts of this project?

The existing lane configuration along southbound I-5 south of the Mercer Street on-ramp results in the following major weave movements:

- Mercer Street on-ramp GP vehicles are forced to weave to GP lanes.
- I-5 southbound HOVs weave to the HOV lane that starts at the Mercer Street on-ramp.
- Yale on-ramp HOVs weave to the HOV lane.
- Some of the Mercer Street on-ramp vehicles weave to downtown exits.

Other weaving movements between the Yale on-ramp and Union and Columbia/James off-ramps compound the weaving activity in this area and cause congestion to occur.

The project would significantly reduce the first three weaving movements identified above. This would reduce the traffic congestion, improve safety, and improve travel speeds and travel times significantly along southbound I-5 between NE 85th Street and Corson Avenue. The charts below show the resulting improved average travel speeds and travel times along the I-5 study segment during the peak five-hour morning and evening commute periods.



3. What are the implementation challenges with this project?

Allowing GP traffic in an HOV lane has some sight distance and design speed constraints. Active traffic management concepts such as reducing travel speeds during high-volume periods and closing the outside lane during lower-volume periods are being explored to minimize the impact of the design deficiencies of the existing HOV lane. Allowing GP traffic to use an existing HOV lane may also be viewed by some as counter to the long standing policy of encouraging HOV use by providing travel time and reliability advantages over GP traffic.

Alternative S5: Meter Southbound Yale Avenue On-Ramp

1. What is the project?

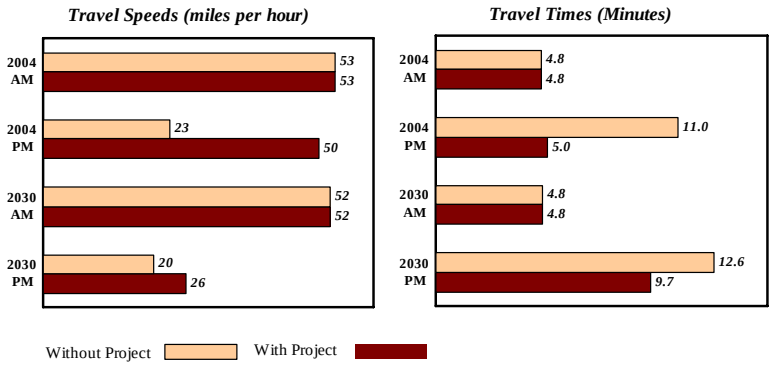
The project would provide a ramp meter on the Yale Avenue on-ramp to control the amount of traffic entering southbound I-5. The adjacent figure shows the project area.

2. What are the potential benefits and impacts of this project?

The Yale Avenue ramp meter would reduce the traffic volume through this complex weaving section on the I-5 southbound corridor and therefore improve the travel speeds and travel times along southbound I-5 between SR 520 and S Forest Street. The charts below show the resulting improved average travel speeds and travel times along the I-5 study segment during the peak 5-hour morning and evening commute periods.

The project would restrict approximately 300 to 500 vehicles per hour on the Yale Avenue on-ramp during peak periods. This restriction would divert most of this traffic to other local streets and highways and thereby increase the traffic congestion on those roadways. The figures on the following pages show intersection level of service and delay for some of the affected local streets during the AM and PM peak hours. Some of the major roadways that may experience more traffic congestion due to this project include Spring Street and 5th Avenue.

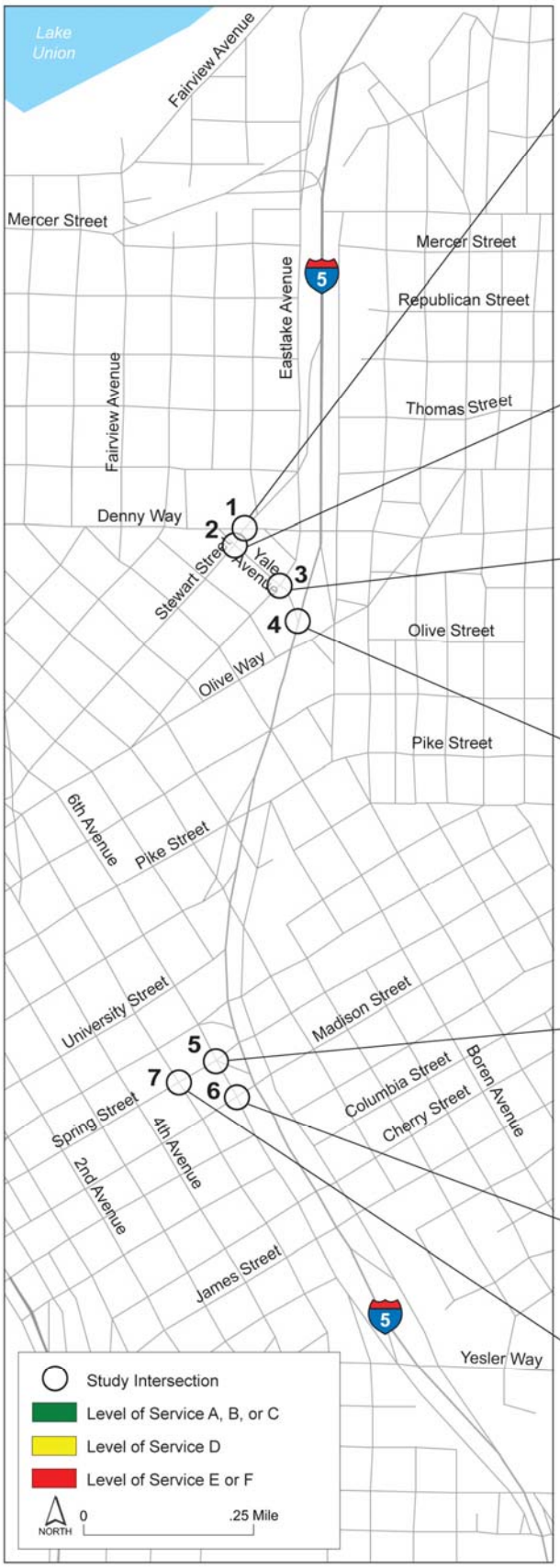
Study Segment - I5 Southbound Mainline: SR 520 to S Forest Street (4.2 miles)

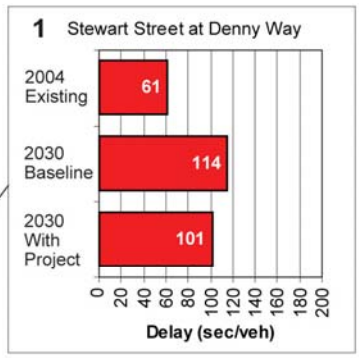


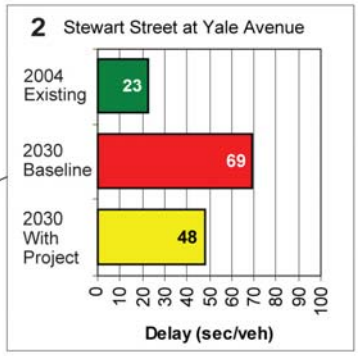
3. What are the implementation challenges with this project?

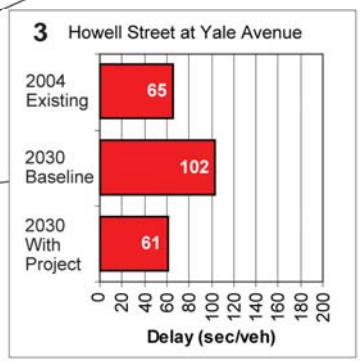
Because the project would divert some Yale Avenue traffic to other local roadways during peak periods, appropriate mitigation measures should be evaluated on these roadways prior to installing a ramp meter on the Yale Avenue on-ramp. In addition, ramp storage is very limited and queues that develop behind the meter may interfere with other traffic movements along Yale Avenue and Howell Street, as well as possibly Denny Way and Stewart Street.

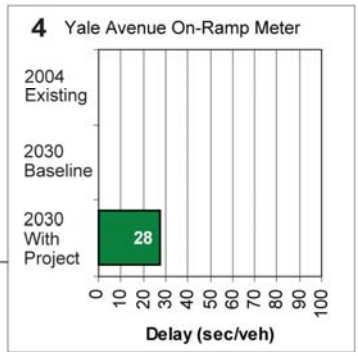
Alternative S5 Weekday AM Peak Hour Level of Service and Delay Results

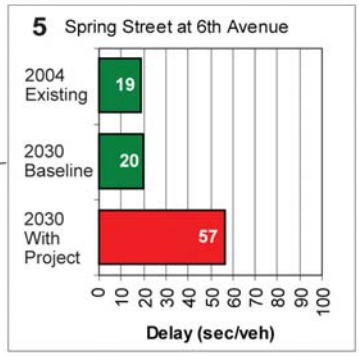


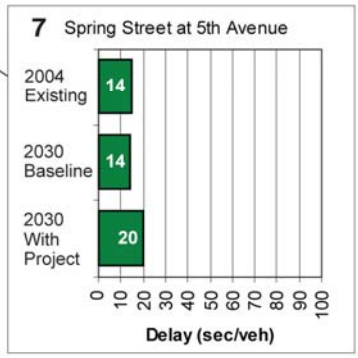




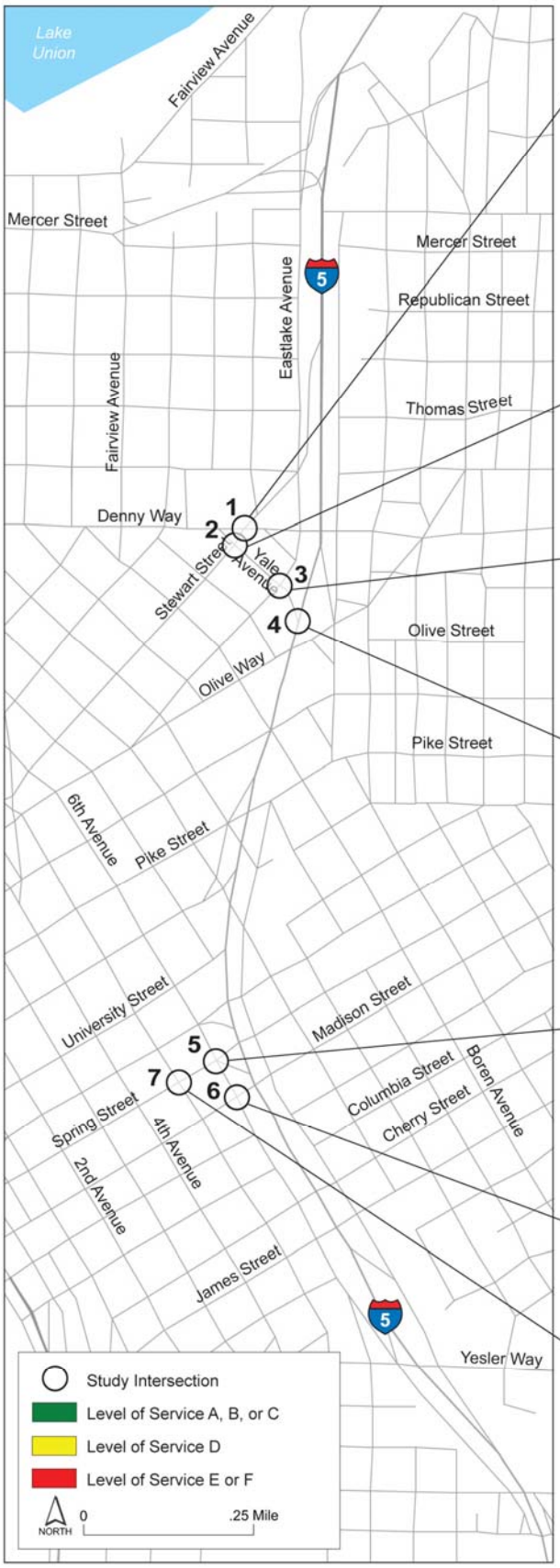


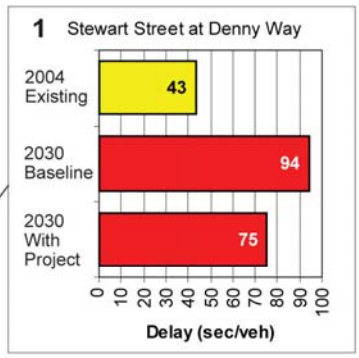


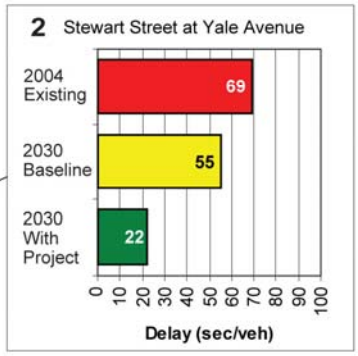


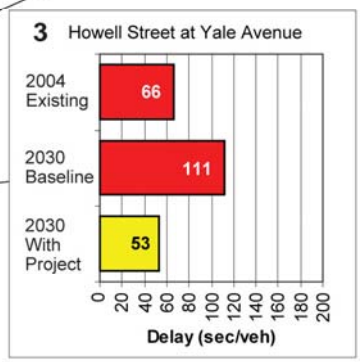


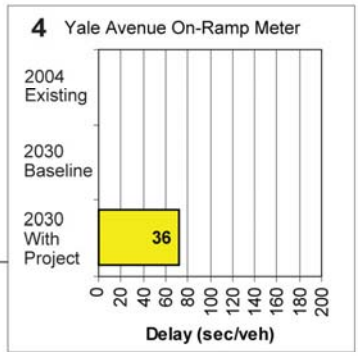
Alternative S5 Weekday PM Peak Hour Level of Service and Delay Results

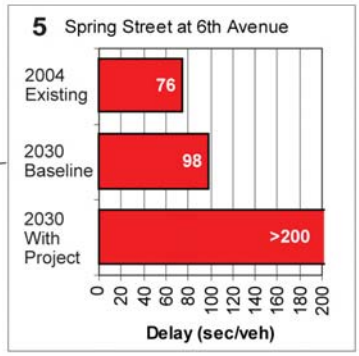


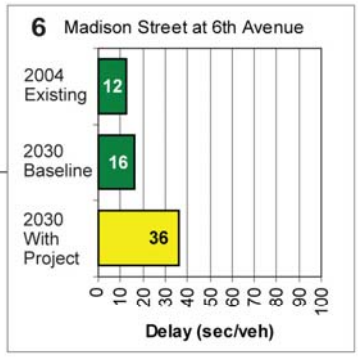


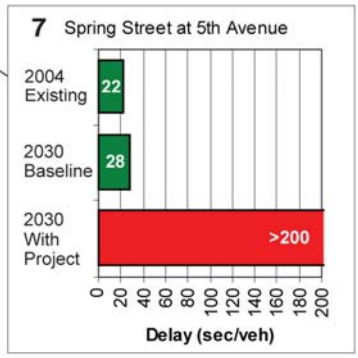












Alternative S6: Southbound I-5 Collector-Distributor Road Improvements

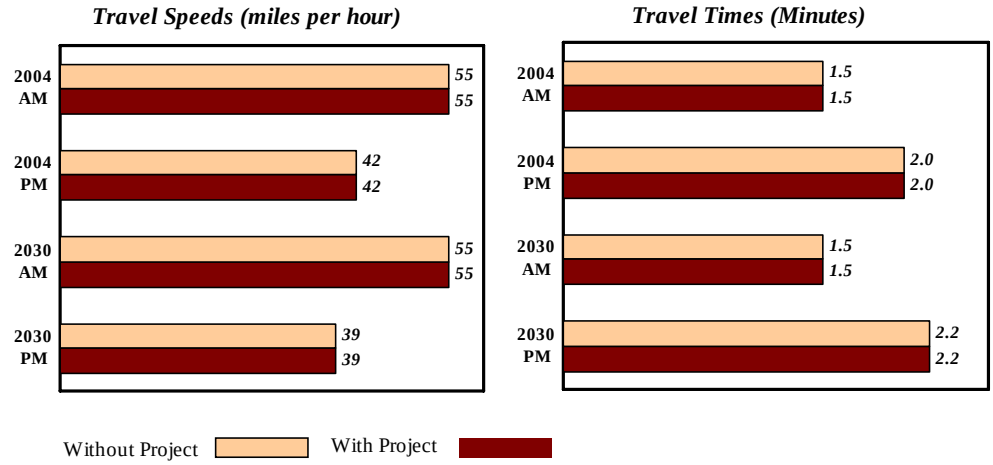
1. What is the project?

The project would add a third lane along the southbound I-5 Collector-Distributor (CD) road beginning at the I-90 westbound on-ramp and ending before S Spokane Street on the I-5 mainline. The adjacent figure shows the project area.

2. What are the potential benefits and impacts of this project?

The existing lane configuration along the southbound I-5 CD road forces the I-90 westbound traffic to merge with the I-90 eastbound/4th Avenue S on-ramp traffic. This creates severe queues along the I-90 westbound ramp. With an added lane, the project allows the I-90 westbound on-ramp traffic to continue south along the I-5 CD and I-5 mainline without forcing the traffic to merge with other ramps, significantly improving traffic operations for the I-90 westbound traffic. This project has limited benefit to the traffic operations along the southbound I-5 CD itself. The charts below show the resulting average travel speeds and travel times along the I-5 study segment during the peak 5-hour morning and evening commute periods.

Study Segment - Southbound I5 CD: Begin to End (1.4 miles)



3. What are the implementation challenges with this project?

Constructing the additional lane would require major widening of existing structures and would most likely be expensive.

Alternative R1: Provide a Two-Lane Connection between the Reversible Lanes and the I-5 Mainline

1. What is the project?

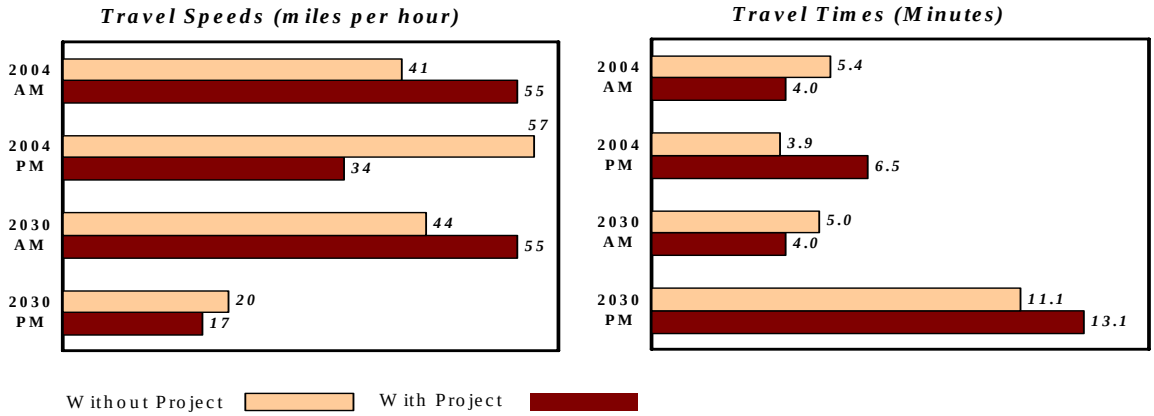
The project would add a second lane along the south end portion of the reversible lanes to provide two lanes to and from the I-5 mainline. The adjacent figure shows the project area.

2. What are the potential benefits and impacts of this project?

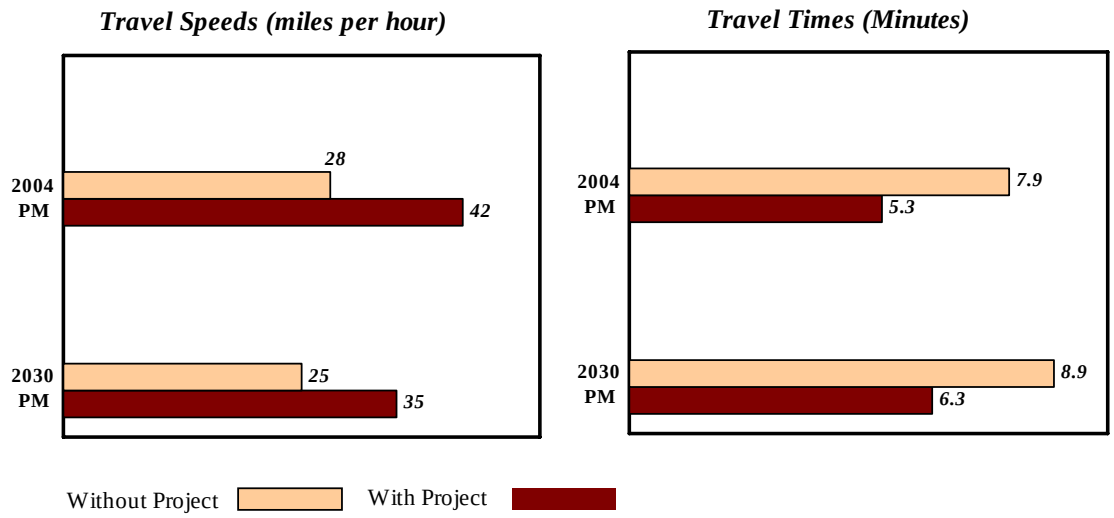
During the AM peak period, the project would provide a two-lane connection to the I-5 mainline south of the Cherry/Columbia off-ramp. This would improve travel speeds and travel times significantly along the section of reversible lanes south of NE 42nd Street.

During the PM peak period, the project would provide a two-lane exit to the reversible lanes from the northbound I-5 mainline and would improve the traffic operations by 40 to 50 percent along the section of I-5 mainline between S Spokane Street and Seneca Street. The decrease in traffic volume through this roadway section of I-5 mainline corridor results in a higher vehicle, discharge flow rate, lower travel speeds, and increased travel times along the section of reversible lanes south of NE 42nd Street. The charts below show the resulting changes in average travel speeds and travel times along the I-5 reversible lanes and the northbound I-5 mainline during the peak 5-hour morning and evening commute periods.

Study Segment - I5 Reversible Lanes: Southend to NE 42nd Street (3.7 miles)



Study Segment - I5 Northbound Mainline: I90 to SR 520 (3.7 miles)



3. What are the implementation challenges with this project?

The project costs for this project would be high because the area is very constrained and there may not be enough space to widen the existing one-lane tunnel section. Either a deeper tunnel or reconstruction of the adjacent roadways and structures might be required.

Alternative R2: Add a High-Occupancy Vehicle Ramp Connection between the Reversible Lanes and SR 520

1. What is the project?

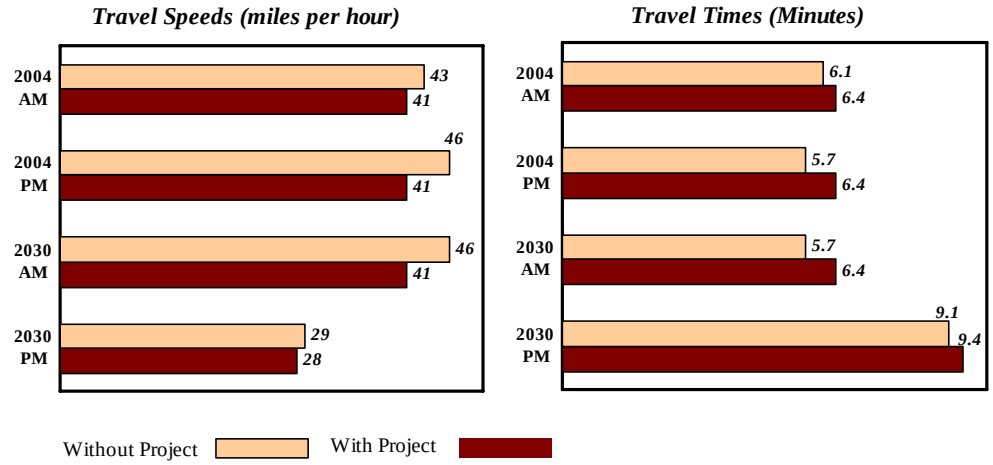
The project would add a high-occupancy vehicle (HOV) ramp connection between the I-5 reversible lanes and SR 520. The ramp would be an add lane to the reversible roadway in the morning and a drop lane in the evening. This connection is also being considered as part of the SR 520 HOV and Bridge Replacement Project. The project would also narrow the I-5 reversible roadway from four to three lanes for approximately 1,500 feet north of SR 520. The adjacent figure shows the project area.

2. What are the potential benefits and impacts of this project?

The project would slightly increase the congestion along the I-5 reversible lanes south of Ravenna Boulevard due to an increase of approximately 400 vehicles per hour on the reversible lanes. Despite the increased congestion, this connection would benefit transit vehicles on SR 520 by providing a faster and more direct route to Downtown Seattle by avoiding congestion on the I-5 mainline. The charts below show the resulting impacts to average travel speeds and travel times along the I-5 reversible lanes during the peak 5-hour morning and evening commute periods.

The project would slightly improve traffic operations along the I-5 mainline segment between Seneca Street and SR 520 due to a decrease of approximately 400 vehicles per hour.

Study Segment - I5 Reversible Lanes: Southend to Ravenna Boulevard (4.4 miles)



3. What are the implementation challenges with this project?

The project costs would be high, and implementation would be more beneficial in conjunction with added HOV lanes in the SR 520 corridor.

Alternative R3: Modify Stewart and Cherry/Columbia Ramps

2. What is the project?

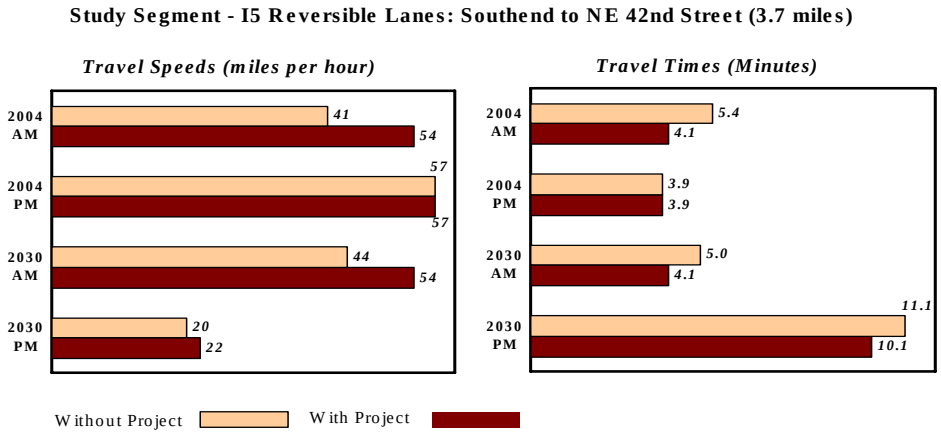
The project would allow only high-occupancy vehicles (HOVs) to access the Stewart Street ramp but would allow all vehicular traffic to access the Cherry/Columbia ramp along the I-5 reversible lanes. The adjacent figure shows the project area.

3. What are the potential benefits and impacts of this project?

During the morning commute period, the capacity of the reversible lanes south of Stewart Street would be significantly increased because the project would open the roadway segment to all vehicular traffic. This would considerably improve traffic operations along the reversible lanes south of NE 42nd Street. However, drivers would experience higher delays and longer queue lengths at intersections near the 5th Avenue/ Cherry/Columbia ramp terminus. The vehicular delays at local intersections along Denny Way and Stewart Street with the project would be comparable to conditions without the project.

During the evening commute period, the project would cause negligible differences in traffic operations along the reversible lanes south of NE 42nd Street.

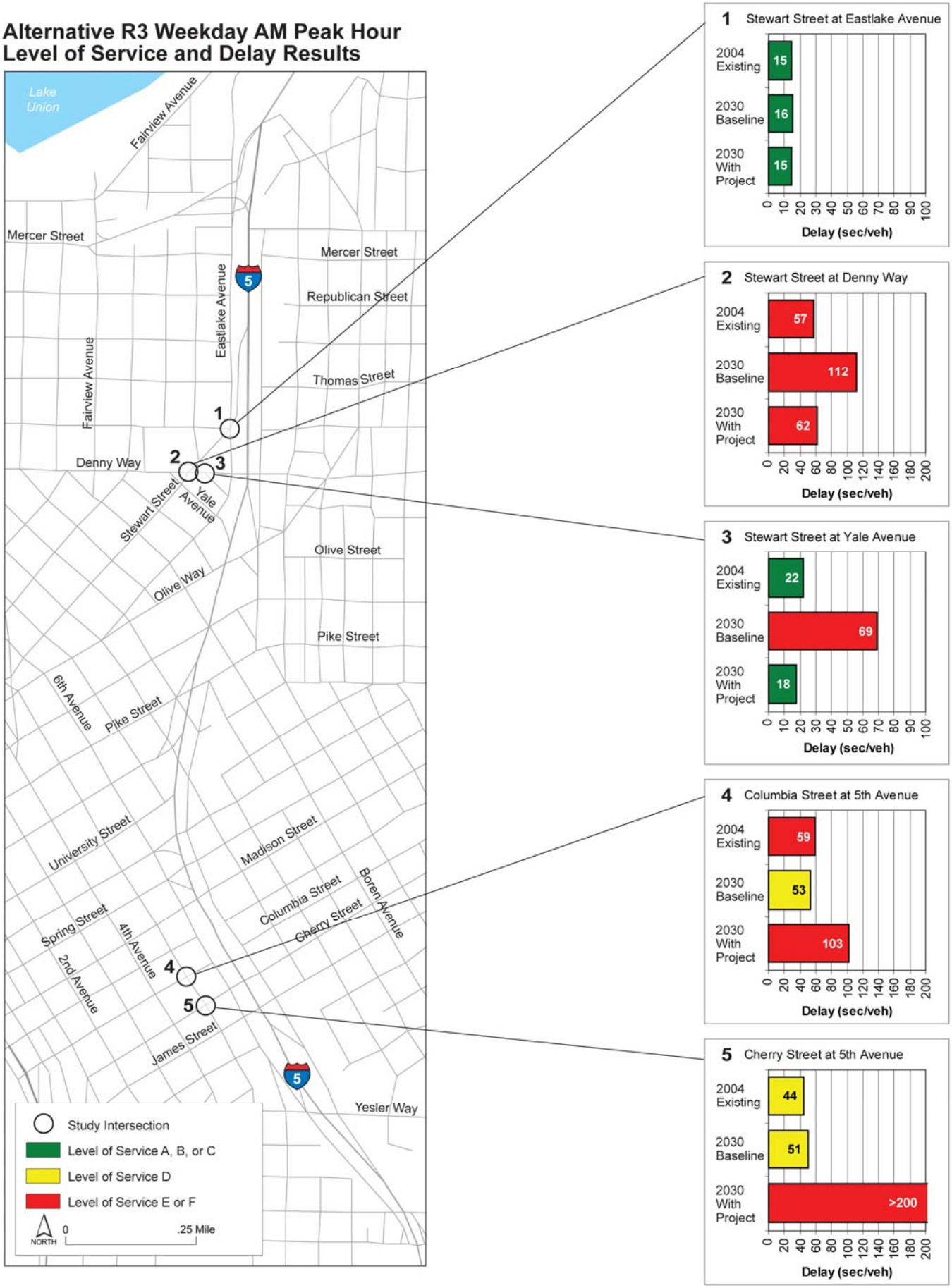
The charts below show the resulting changes in average travel speeds and travel times along the I-5 reversible lanes during the peak 5-hour morning and evening commute periods. The following figure shows level of service and delay at local study intersections during the AM peak hour.



4. What are the implementation challenges with this project?

Traffic congestion on the local streets near the 5th Avenue/Cherry/Columbia ramp terminus would increase. Improvements to mitigate this impact could be considered but may not be possible.

Alternative R3 Weekday AM Peak Hour Level of Service and Delay Results



Alternative R4: Modify Stewart and Pine/Pike Ramps

1. What is the project?

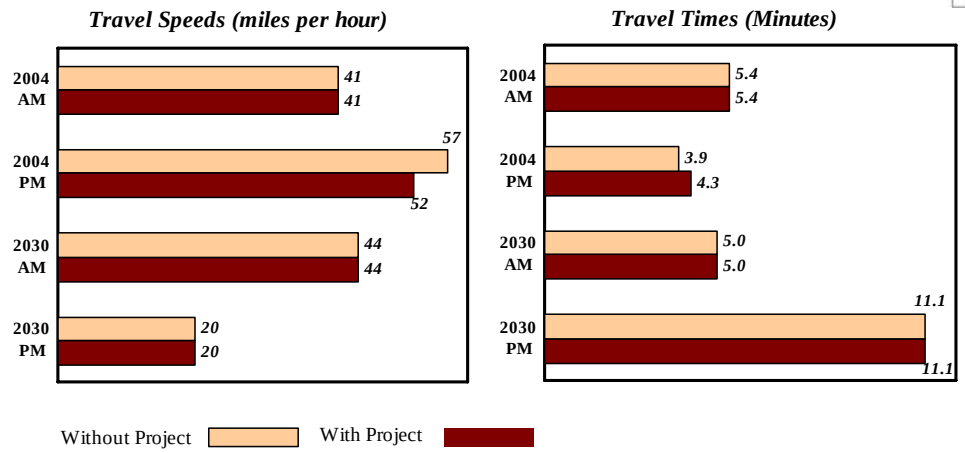
The project would allow only high-occupancy vehicles (HOVs) to access the Stewart Street ramp but would allow all vehicular traffic to access the Pine and Pike Street ramps along the I-5 reversible lanes. This project assumes that Pike Street would be converted to a two-way roadway between 9th Avenue and 5th Avenue. The adjacent figure shows the project area.

2. What are the potential benefits and impacts of this project?

The project would cause a negligible difference in traffic operations along the reversible lanes south of NE 42nd Street. Vehicle delays and queues in the Stewart Street corridor would be significantly reduced. Vehicle delays and queues along the Pike Street corridor between 5th Avenue and 9th Avenue would significantly increase during both morning and evening peak periods.

The charts below show the resulting changes in average travel speeds and travel times along the I-5 reversible lanes during the peak 5-hour morning and evening commute periods. The figures on the following pages show intersection level of service and delay for some of the affected local streets during the AM and PM peak hours.

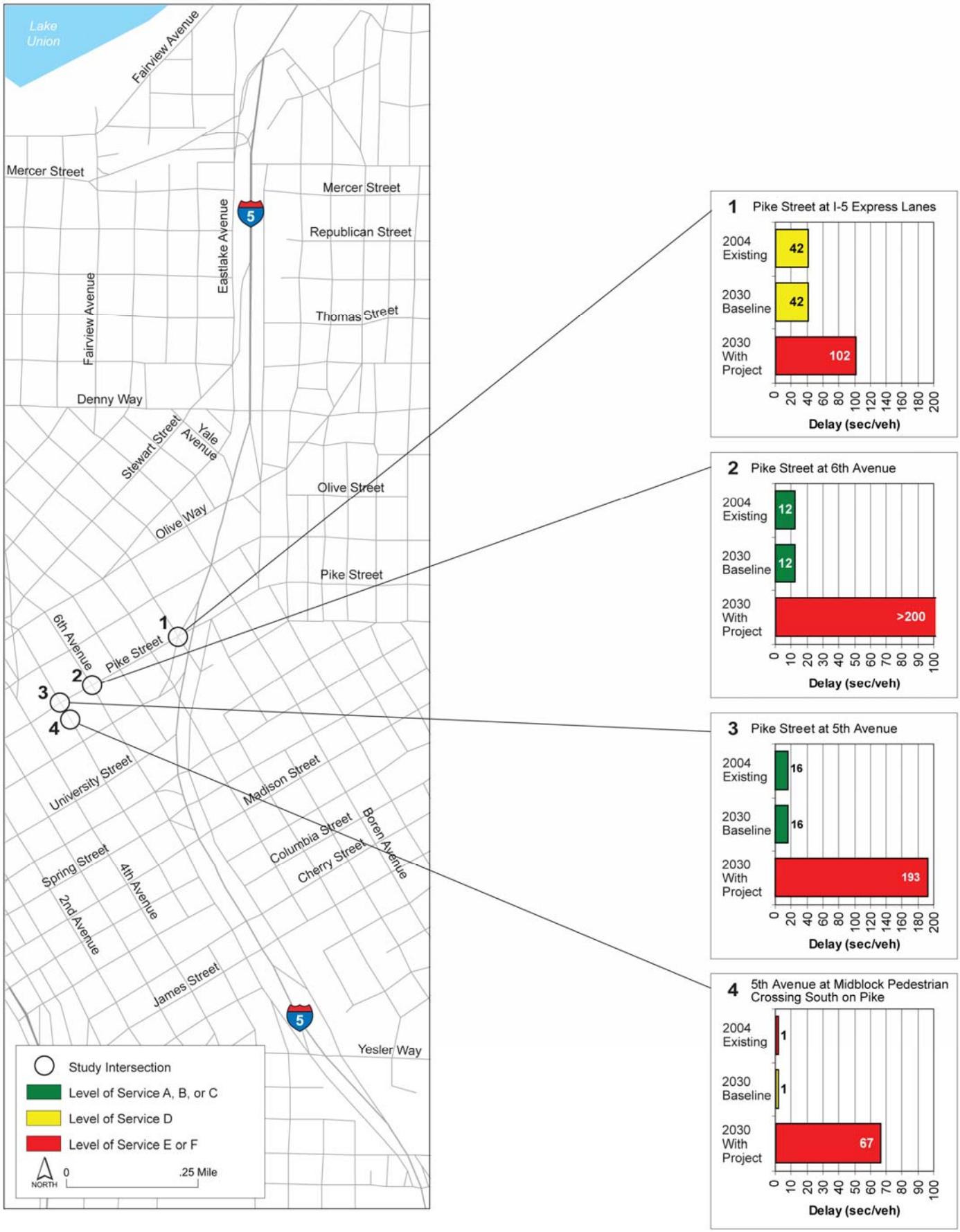
Study Segment - I5 Reversible Lanes: Southend to NE 42nd Street (3.7 miles)



3. What are the implementation challenges with this project?

Traffic congestion on local streets in the Pike Street corridor would increase. Improvements to mitigate this impact could be considered but may not be possible.

Alternative R4 Weekday AM Peak Hour Level of Service and Delay Results



Alternative R4 Weekday PM Peak Hour Level of Service and Delay Results

Alternative R5: Modify Stewart Street Ramp

1. What is the project?

The project would allow only high-occupancy vehicles (HOVs) to access the Stewart Street ramp along the I-5 reversible lanes. The project assumes that the Stewart Street ramp would have a volume of approximately 300 HOVs per hour and the remaining general-purpose vehicles that currently use the ramp would be diverted to Mercer Street and the I-5 mainline equally. The adjacent figure shows the project area.

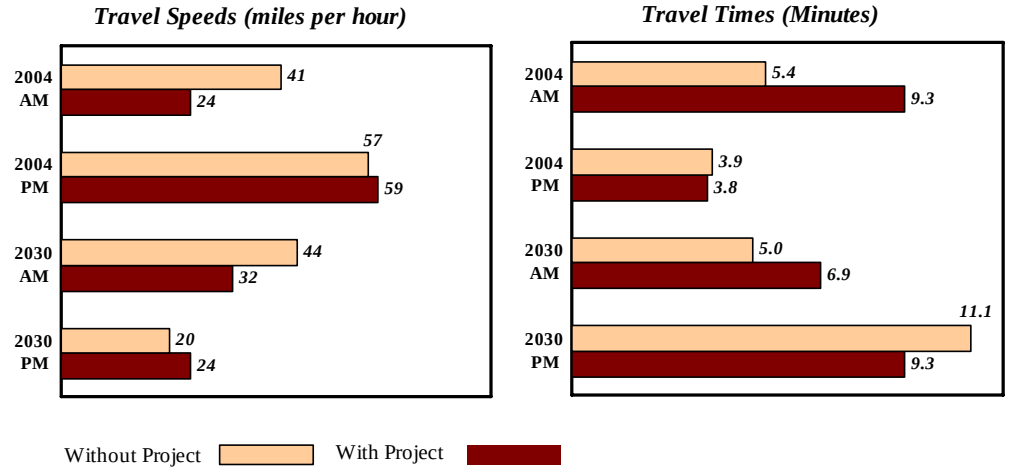
2. What are the potential benefits and impacts of this project?

During the peak morning commute period, an additional 400 vehicles per hour would be shifted to the Mercer Street off-ramp. With more traffic exiting at the Mercer Street off-ramp, the project would worsen traffic operations along the reversible lanes south of NE 42nd Street and at the Mercer Street/Fairview Avenue intersection during the morning commute period.

During the peak evening commute period, an additional 400 vehicles per hour would enter the I-5 reversible lanes at the Mercer Street on-ramp, resulting in increased vehicular traffic and delays at the Mercer Street/Fairview Avenue intersection. However, with overall lower volumes along the I-5 reversible lanes (approximately 400 vehicles per hour shifted to the I-5 mainline), the project improves traffic operations slightly along the I-5 reversible lanes.

The charts below show the resulting changes in average travel speeds and travel times along the I-5 reversible lanes during the peak 5-hour morning and evening commute periods.

Study Segment - I5 Reversible Lanes: Southend to NE 42nd Street (3.7 miles)



3. What are the implementation challenges with this project?

Traffic congestion at the Mercer Street off-ramp and the Mercer Street/Fairview Avenue intersection would increase. Improvements to mitigate this impact could be considered but may not be possible.

Alternative NC1: Braid Northbound S Spokane Street On-Ramp with the existing I-5 Collector-Distributor Road and Add a Northbound Lane between Seneca Street and SR 520 and between Ravenna Boulevard and NE Northgate Way

1. What is the project?

The project would close the existing I-5 exit ramp to the northbound I-5 Collector-Distributor (CD) road and braid the Spokane Street on-ramp with the northbound I-5 CD road. This would extend the northbound I-5 CD road south to S Spokane Street and provide three exiting lanes at the northbound Spokane Street/Columbian Way exit ramp. The project would also add a northbound mainline lane between Seneca Street and SR 520 and between Ravenna Boulevard and NE Northgate Way. The adjacent figure shows the project area.

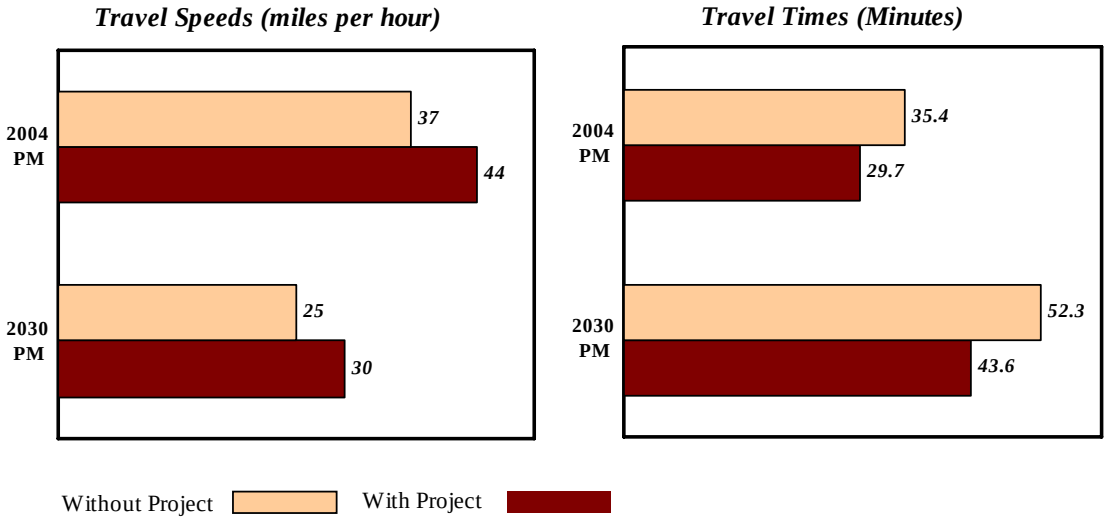
2. What are the potential benefits and impacts of this project?

The project would remove the major weave segment on northbound I-5 between the Spokane Street/Columbian Way on-ramp and the I-5 CD off-ramp. This would improve travel speeds and travel times along the I-5 corridor between Interurban Avenue and I-90.

With additional capacity from the added lane, the project would also improve travel speeds and travel times along the sections of I-5 between Seneca Street and SR 520 and between NE 45th Street and NE 85th Street. However, higher traffic volumes and lower travel speeds are expected in the downstream sections between SR 520 and NE 45th Street and north of NE Northgate Way on I-5 under 2030 traffic conditions since upstream bottlenecks would discharge a higher number of vehicles.

The average travel speeds between Interurban Avenue and NE 205th Street would increase by approximately 20 percent under both 2004 and 2030 PM peak period conditions with this alternative. The charts below show the improved average travel speeds and travel times along the I-5 study segment during the peak 5-hour morning and evening commute periods.

Study Segment - I5 Northbound Mainline: Interurban Avenue to 205th Street (21.8 miles)



3. What are the implementation challenges with this project?

Project costs to braid the Spokane Street northbound on-ramp with the I-5 CD road and widen approximately 3 miles of the corridor between Ravenna Boulevard and NE Northgate Way would be high. Several structures and retaining walls would be constructed or reconstructed. Construction phasing and traffic control would also be a challenge. Portions of this section of I-5 between Ravenna Boulevard and Northgate Way will be impacted by Sound Transit's planned Light Rail extension to Northgate. Constructing both projects concurrently may result in some cost savings. Environmental impacts are unknown at this point and given the scale of the project could become a consideration.

Adding a northbound lane between the Seneca Street and SR 520 off-ramps would also require more significant design standard deviations compared to the current configuration, including limited shoulder widths. Active traffic management concepts such as reducing travel speeds during high-volume periods and closing the outside lane during lower-volume periods are being explored to minimize the impact of the design standard deviations.

Alternative NC2: Braid Northbound S Spokane Street On-Ramp with the Existing I-5 Collector-Distributor Road, Add a Northbound Lane between Seneca Street and SR 520 and between Ravenna Boulevard and NE Northgate Way, and Meter Olive Way On-Ramp

1. What is the project?

Edit The project would close the existing I-5 exit ramp to the northbound I-5 Collector-Distributor (CD) road and braid the Spokane Street on-ramp with the northbound I-5 CD road. This would extend the northbound I-5 CD road south to S Spokane Street and provide three exiting lanes at the northbound Spokane Street/Columbian Way exit ramp. The project would also add a northbound mainline lane between Seneca Street and SR 520 and between Ravenna Boulevard and NE Northgate Way. The project would turn on the existing ramp meter on the Olive Way on-ramp to control the amount of traffic entering northbound I-5. The adjacent figure shows the project area.

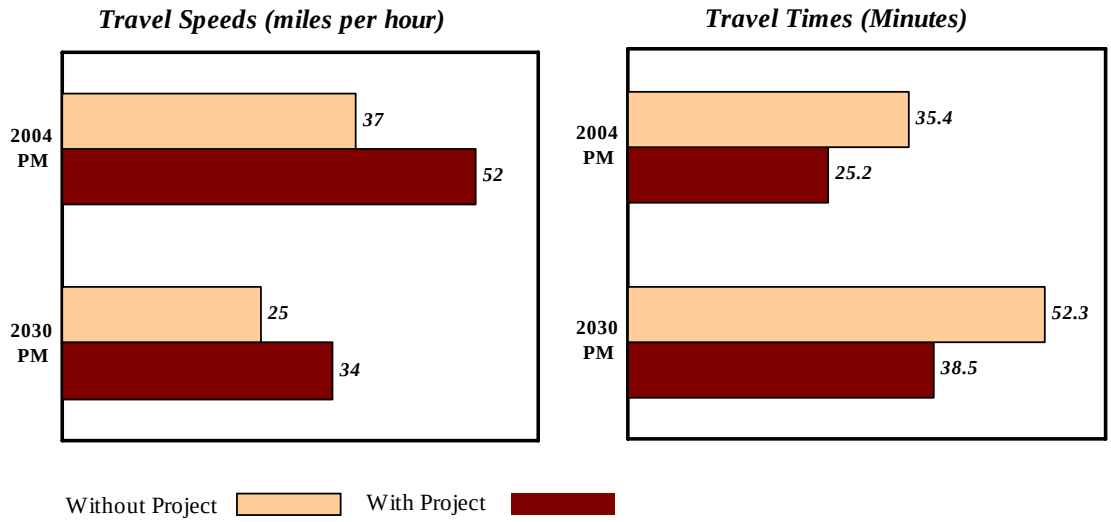
2. What are the potential benefits and impacts of this project?

The project would remove the major weave segment on northbound I-5 between the Spokane Street/Columbian Way on-ramp and the I-5 CD off-ramp. This would improve travel speeds and travel times along the I-5 corridor between Interurban Avenue and I-90.

With the Olive Way ramp meter, the project would restrict approximately 400 to 500 vehicles per hour on the Olive Way on-ramp during evening peak periods. This reduction in northbound I-5 traffic, combined with the additional northbound capacity between Seneca Street and SR 520 and between Ravenna Boulevard and NE Northgate Way, would improve travel speeds and travel times along the section of I-5 from Seneca Street to approximately NE Northgate Way. However, this restriction would also divert some traffic to other local streets and thereby increase the traffic congestion on those roadways.

The average travel speeds between Interurban Avenue and NE 205th Street would increase by approximately 40 percent under both 2004 and 2030 PM peak period conditions with this alternative. The charts below show the improved average travel speeds and travel times along the I-5 study segment during the peak 5-hour morning and evening commute periods.

Study Segment - I5 Northbound Mainline: Interurban Avenue to 205th Street (21.8 miles)



3. What are the implementation challenges with this project?

Project costs to braid the Spokane Street northbound on-ramp with the I-5 CD road and widen approximately 3 miles of the I-5 corridor between Ravenna Boulevard and Northgate would be high. Several structures and retaining walls would be constructed or reconstructed. Construction phasing and traffic control would also be a challenge. Portions of this section of I-5 between Ravenna Boulevard and Northgate Way will be impacted by Sound Transit's planned Light Rail extension to Northgate. Constructing both projects concurrently may result in some cost savings. Environmental impacts are unknown at this point and given the scale of the project could become a consideration.

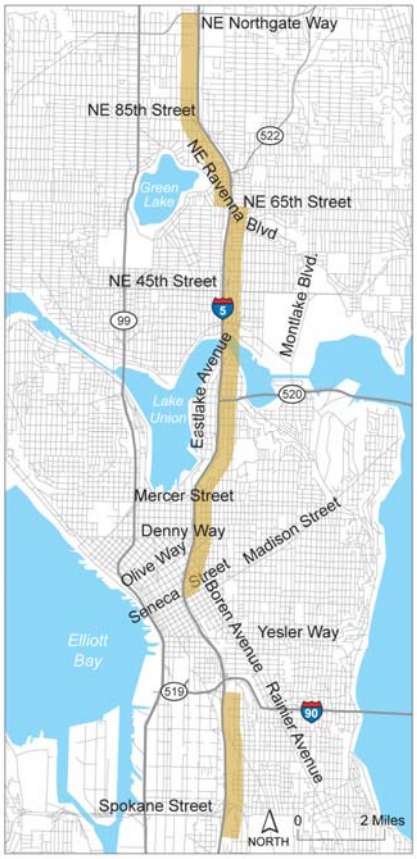
Adding a northbound lane between the Seneca Street and SR 520 off-ramps would also require more significant design standard deviations compared to the current configuration, including limited shoulder widths. Active traffic management concepts such as reducing travel speeds during high-volume periods and closing the outside lane during lower-volume periods are being explored to minimize the impact of the design standard deviations.

Because the project would divert some Olive Way traffic to other local roadways during peak periods, appropriate mitigation measures should be evaluated on those roadways prior to turning on the ramp meter on the Olive Way on-ramp.

Alternative NC3: Braid Northbound S Spokane Street On-Ramp with the existing I-5 Collector-Distributor Road and Add a Northbound Lane between Seneca Street and NE Northgate Way

1. What is the project?

The project would close the existing I-5 exit ramp to the northbound I-5 Collector-Distributor (CD) road and braid the Spokane Street on-ramp with the northbound I-5 CD road. This would extend the northbound I-5 CD road south to S Spokane Street and provide three exiting lanes at the northbound Spokane Street/Columbian Way exit ramp. The project would also add a northbound mainline lane between Seneca Street and NE Northgate Way. The adjacent figure shows the project area.



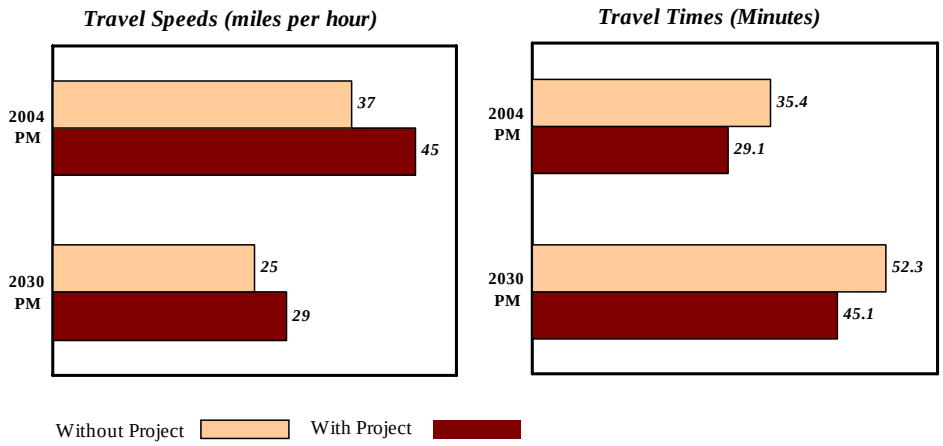
2. What are the potential benefits and impacts of this project?

The project would remove the major weave segment on northbound I-5 between the Spokane Street/Columbian Way on-ramp and the I-5 CD off-ramp. This would improve travel speeds and travel times along the I-5 corridor between Interurban Avenue and I-90.

With additional capacity from the added lane, the project would also improve travel speeds and travel times along the section of I-5 between Seneca Street and SR 522. However, higher traffic volumes and lower travel speeds are expected in the downstream sections between SR 522 and NE Northgate Way during the PM peak period due to a higher vehicle discharge flow rate on I-5 between Seneca Street and NE Northgate Way.

The average travel speeds between Interurban Avenue and NE 205th Street would increase by approximately 20 percent under both 2004 and 2030 PM peak period conditions. However, northbound mainline travel speeds would drop by approximately 7 percent between Ravenna Boulevard and NE 205th Street under 2030 PM conditions. The project benefits along the I-5 study segment, in terms of average travel speeds and travel times during the peak 5-hour morning and evening commute periods, are graphically illustrated below.

Study Segment - I5 Northbound Mainline: Interurban Avenue to 205th Street (21.8 miles)



3. What are the implementation challenges with this project?

Project costs to braid the Spokane Street northbound on-ramp with the I-5 CD road, widen the Ship Canal Bridge, and widen approximately 3 miles of the corridor between Ravenna Boulevard and Northgate Way would be high. Several structures and retaining walls would be constructed or reconstructed. Construction phasing, staging and traffic control would also be a challenge. Portions of this section of I-5 between Ravenna Boulevard and Northgate Way will be impacted by Sound Transit's planned Light Rail extension to Northgate. Constructing both projects concurrently may result in some cost savings. Environmental impacts are unknown at this point and given the scale of the project could become a consideration.

Adding a northbound lane between the Seneca Street and SR 520 off-ramps would also require more significant design standard deviations compared to the current configuration, including limited shoulder widths. Active traffic management concepts such as reducing travel speeds during high volume periods and closing the outside lane during lower volume periods are being explored to minimize the impact of the design standard deviations.

Alternative NC4: Braid Northbound S Spokane Street On-Ramp with the existing I-5 Collector-Distributor Road and Add a Northbound Lane between Seneca Street and NE 205th Street

1. What is the project?

The project would close the existing I-5 exit ramp to the northbound I-5 Collector-Distributor (CD) Road and braid the Spokane Street on-ramp with the northbound I-5 CD. This would extend the northbound I-5 CD roadway south to S Spokane Street and provide three exiting lanes at the northbound Spokane Street/Columbian Way exit ramp. The project would also add a northbound mainline lane between Seneca Street and NE 205th Street. The adjacent figure shows the project area.

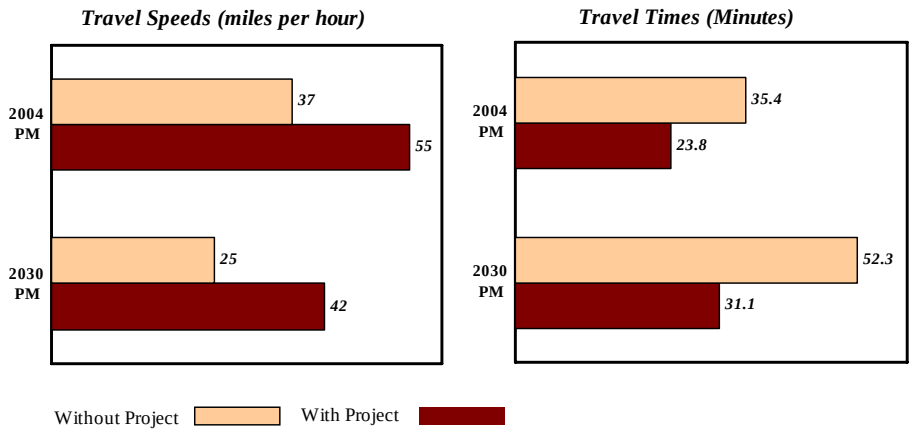
2. What are the potential benefits and impacts of this project?

The project would remove the major weave segment on northbound I-5 between the Spokane Street/Columbian Way on-ramp and the I-5 CD off-ramp. This would improve travel speeds and travel times along the I-5 corridor between Interurban Avenue and I-90.

With additional capacity from the added lane, the project would also improve travel speeds and travel times along I-5 between Seneca Street and limits of the study area (NE 205th Street).

The average travel speeds between Interurban Avenue and NE 205th Street would increase by approximately 50 percent and 70 percent under 2004 and 2030 PM peak period conditions, respectively. The project benefits along the I-5 study segment, in terms of average travel speeds and travel times during the peak 5-hour morning and evening commute periods, are graphically illustrated below.

Study Segment - I5 Northbound Mainline: Interurban Avenue to 205th Street (21.8 miles)



3. What are the implementation challenges with this project?

Project costs to braid the Spokane Street northbound on-ramp with the I-5 CD road, widen the Ship Canal Bridge, and widen the nearly 8 miles of the corridor between Ravenna Boulevard and NE 205th Street would be high. Several structures and retaining walls would be constructed or reconstructed. Construction phasing, staging and traffic control would also be a challenge. Portions of this section of I-5 between Ravenna Boulevard and Northgate Way will be impacted by Sound Transit's planned Light Rail extension to Northgate. Constructing both projects concurrently may result in some cost savings. Environmental impacts are unknown at this point and given the scale of the project could become a consideration.

Adding a northbound lane between the Seneca Street and SR 520 off-ramps would also require more significant design standard deviations compared to the current configuration, including limited shoulder widths. Active traffic management concepts such as reducing travel speeds during high volume periods and closing the outside lane during lower volume periods are being explored to minimize the impact of the design standard deviations.

Alternative SC1: Add a Southbound Mainline Lane between NE 85th Street and SR 522 and Meter Southbound Yale Avenue On-Ramp

1. What is the project?

The project would add a southbound mainline lane between NE 85th Street and SR 522 and provide a ramp meter on the Yale Avenue on-ramp. The adjacent figure shows the project area.

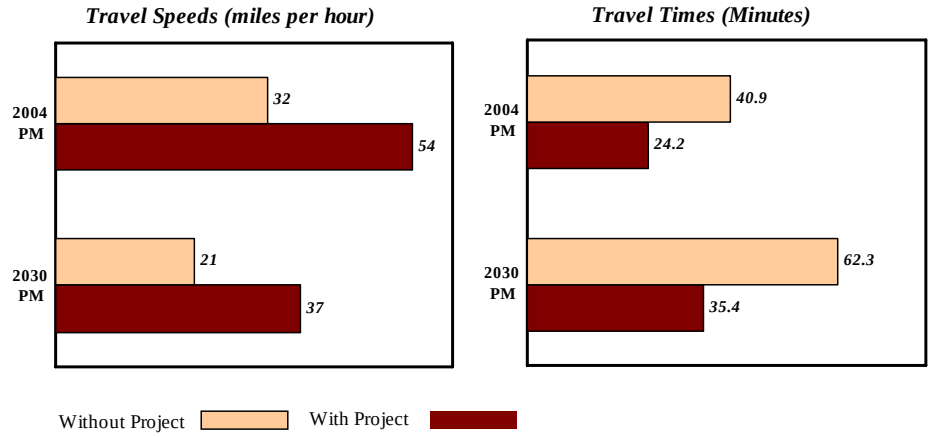
2. What are the potential benefits and impacts of this project?

The project would provide an additional lane and capacity along the southbound I-5 segment between NE 85th Street and SR 522 which would improve travel speeds and travel times on southbound I-5 between NE 205th Street and SR 522. The higher traffic volumes and lower travel speeds that would be expected downstream of SR 522 due to the increased vehicle discharge flow rate would be partially offset by the effects of the Yale Avenue ramp meter.

The Yale Avenue ramp meter would restrict approximately 300 to 500 vehicles per hour on the Yale Avenue on-ramp during peak periods. While this would have a positive effect on travel speeds and travel times on the I-5 mainline, this restriction would divert most of this traffic to other local streets and highways resulting in congestion on some roadways including Spring Street and 5th Avenue.

The average travel speeds between NE 205th Street and Interurban Avenue would increase by approximately 70 percent and 75 percent under 2004 and 2030 PM peak period conditions, respectively. The project benefits along the I-5 study segment, in terms of average travel speeds and travel times during the peak 5-hour morning and evening commute periods, are graphically illustrated below.

Study Segment - I5 Southbound Mainline: Interurban Avenue to 205th Street (21.8 miles)



3. What are the implementation challenges with this project?

The project costs associated with this widening project would be moderate and would involve reconstruction of several structures and retaining walls. Because the project would divert some Yale Avenue traffic to other local roadways during peak periods, appropriate mitigation measures should be evaluated on these roadways prior to installing a ramp meter on the S Yale Avenue on-ramp. In addition, ramp storage is very limited and queues that develop behind the meter may interfere with other traffic movements along Yale Avenue and Howell Street, as well as possibly Denny Way and Stewart Street.

Alternative SC2: Add a Southbound Mainline Lane between NE 85th Street and SR 522, Meter Southbound Yale Avenue On-Ramp, and Provide Southbound I-5 Collector-Distributor Road Improvements

1. What is the project?

The project would add a southbound mainline lane between NE 85th Street and SR 522, provide a ramp meter on the Yale Avenue on-ramp, and add a third lane along the southbound I-5 Collector-Distributor (CD) Road beginning at the I-90 westbound on-ramp and ending before S Spokane Street on the I-5 mainline. The adjacent figure shows the project area.

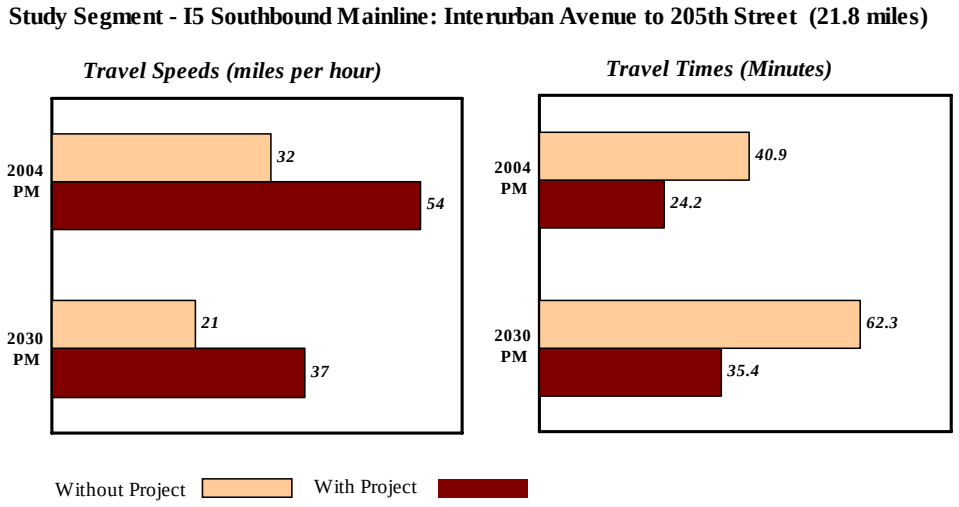
2. What are the potential benefits and impacts of this project?

The project would provide an additional lane and capacity along the southbound I-5 segment between NE 85th Street and SR 522 which would improve travel speeds and travel times on southbound I-5 between NE 205th Street and SR 522. The higher traffic volumes and lower travel speeds that would be expected downstream of SR 522 due to a higher vehicle discharge flow rate would be partially offset by the effects of the Yale Avenue ramp meter.

The Yale Avenue ramp meter would restrict approximately 300 to 500 vehicles per hour on the Yale Avenue on-ramp during peak periods. While this would have a positive effect on travel speeds and travel times on the I-5 mainline, this restriction would divert most of this traffic to other local streets and highways resulting in congestion on some roadways including Spring Street and 5th Avenue.

The added lane along the southbound I-5 CD road allows the I-90 westbound off-ramp to I-5 southbound on-ramp traffic to continue south along the I-5 CD and I-5 mainline without forcing the traffic to merge with other ramps, resulting in significant traffic operations improvements for the I-90 westbound traffic. This project has limited benefit to the traffic operations along the southbound I-5 CD itself.

The average travel speeds between NE 205th Street and Interurban Avenue would increase by approximately 70 percent and 75 percent under 2004 and 2030 PM peak period conditions, respectively. The project benefits along the I-5 study segment, in terms of average travel speeds and travel times during the peak 5-hour morning and evening commute periods, are graphically illustrated below.



3. What are the implementation challenges with this project?

The project costs associated with the widening between NE 85th Street and SR 522 would be moderate and would involve reconstruction of several structures and retaining walls.

Because the project would divert some Yale Avenue traffic to other local roadways during peak periods, appropriate mitigation measures should be evaluated on these roadways prior to installing a ramp meter on the S Yale Avenue on-ramp. In addition, ramp storage is very limited and queues that develop behind the meter may interfere with other traffic movements along Yale Avenue and Howell Street, as well as possibly Denny Way and Stewart Street.

Constructing the additional lane on the CD road would require major widening of existing structures and would most likely be expensive.

Alternative SC3: Add a Southbound Mainline Lane between NE 85th Street and SR 522, Meter Southbound Yale Avenue On-Ramp, and Manage Southbound High Occupancy Vehicle Lanes

1. What is the project?

The project would add a southbound mainline lane between NE 85th Street and SR 522, provide a ramp meter on the Yale Avenue on-ramp, and allow general purpose (GP) traffic to use the existing High Occupancy Vehicle (HOV) lane along southbound I-5 between Mercer Street and Corson Avenue during high-volume time periods. The adjacent figure shows the project area.

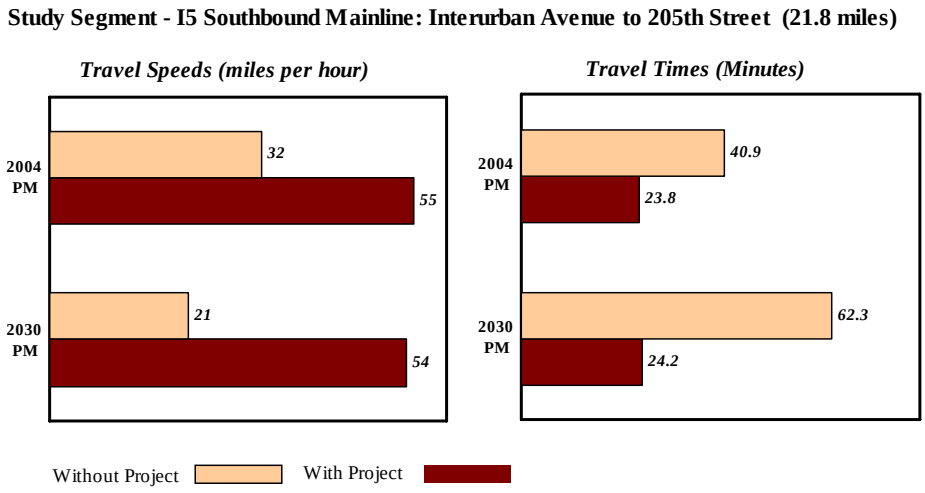
2. What are the potential benefits and impacts of this project?

The project would provide an additional lane and capacity along the southbound I-5 segment between NE 85th Street and SR 522 which improve travel speeds and travel times on southbound I-5 between NE 205th Street and SR 522 during the PM peak period. The higher traffic volumes and lower travel speeds that would be expected downstream of SR 522 due to more discharged vehicles from upstream bottlenecks would be partially offset by the effects of the Yale Avenue ramp meter.

The Yale Avenue ramp meter would restrict approximately 300 to 500 vehicles per hour on the Yale Avenue on-ramp during peak periods. While this would have a positive effect on travel speeds and travel times on the I-5 mainline, this restriction would divert most of this traffic to other local streets and highways resulting in congestion on some roadways including Spring Street and 5th Avenue.

Allowing GP traffic to use the existing HOV lane along southbound I-5 between Mercer Street and Corson Avenue would significantly reduce the GP weave movements from the Mercer Street on-ramp and the weave movements to the existing southbound HOV lane. This would reduce the traffic congestion, improve safety, and improve travel speeds and travel times significantly along southbound I-5 between NE 85th Street and Corson Avenue.

The average travel speeds between NE 205th Street and Interurban Avenue would increase by approximately 70 percent and 160 percent under 2004 and 2030 PM peak period conditions, respectively. The project benefits along the I-5 study segment, in terms of average travel speeds and travel times during the peak 5-hour morning and evening commute periods, are graphically illustrated below.



3. What are the implementation challenges with this project?

The project costs associated with the widening between NE 85th Street and SR 522 would be moderate and would involve reconstruction of several structures and retaining walls.

Because the project would divert some Yale Avenue traffic to other local roadways during peak periods, appropriate mitigation measures should be evaluated on these roadways prior to installing a ramp meter on the S Yale Avenue on-ramp. In addition, ramp storage is very limited and queues that develop behind the meter may interfere with other traffic movements along Yale Avenue and Howell Street, as well as possibly Denny Way and Stewart Street.

Allowing GP traffic in an HOV lane has some sight distance and design speed constraints. Active traffic management concepts such as reducing travel speeds during high-volume periods and closing the outside lane during lower-volume periods are being explored to minimize the impact of the design deficiencies of the existing HOV lane. Allowing GP traffic to use an existing HOV lane may also be viewed by some as counter to the long standing policy of encouraging HOV use by providing travel time and reliability advantages over GP traffic.

Alternative SC4: Add a Southbound Mainline between NE 85th Street and SR 522 and Manage Southbound High Occupancy Vehicle Lanes

1. What is the project?

The project would add a southbound mainline lane between NE 85th Street and SR 522 and allow general purpose (GP) traffic to use the existing High Occupancy Vehicle (HOV) lane along southbound I-5 between Mercer Street and Corson Avenue during high-volume time periods. The adjacent figure shows the project area.

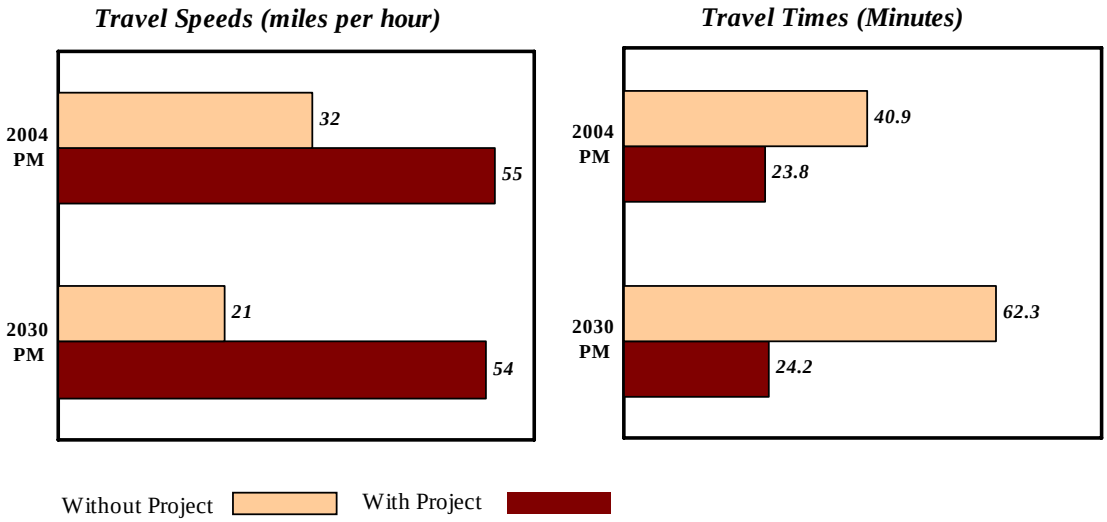
2. What are the potential benefits and impacts of this project?

The project would provide an additional lane and capacity along the southbound I-5 segment between NE 85th Street and SR 522 which improve travel speeds and travel times on southbound I-5 between NE 205th Street and SR 522 during the PM peak period.

Allowing GP traffic to use the existing HOV lane along southbound I-5 between Mercer Street and Corson Avenue would significantly reduce the GP weave movements from the Mercer Street on-ramp and the weave movements to the existing southbound HOV lane. This would reduce the traffic congestion, improve safety, and improve travel speeds and travel times significantly along southbound I-5 between NE 85th Street and Corson Avenue.

The average travel speeds between NE 205th Street and Interurban Avenue would increase by approximately 70 percent and 160 percent under 2004 and 2030 PM peak period conditions, respectively. The project benefits along the I-5 study segment, in terms of average travel speeds and travel times during the peak 5-hour morning and evening commute periods, are graphically illustrated below.

Study Segment - I5 Southbound Mainline: Interurban Avenue to 205th Street (21.8 miles)



3. What are the implementation challenges with this project?

The project costs associated with the widening between NE 85th Street and SR 522 would be moderate and would involve reconstruction of several structures and retaining walls.

Allowing GP traffic in an HOV lane has some sight distance and design speed constraints. Active traffic management concepts such as reducing travel speeds during high-volume periods and closing the outside lane during lower-volume periods are being explored to minimize the impact of the design deficiencies of the existing HOV lane. Allowing GP traffic to use an existing HOV lane may also be viewed by some as counter to the long standing policy of encouraging HOV use by providing travel time and reliability advantages over GP traffic.

Chapter 5 Next Steps

1 What are the next steps for alternatives to be considered further?

The next steps for considering any of the alternatives further would be to develop a detailed project definition and conceptual design to prepare a reasonable cost opinion. Environmental documentation, traffic analysis, and preliminary design work would follow on the group of alternatives moving forward. Environmental documentation could range from relatively short and simple Documented Categorical Exclusions (DCE) on a relatively small improvement demonstrated to have independent utility from other improvements to a full Environmental Impact Statement (EIS) process and document for larger and more complex improvements.

Depending on the range of alternatives carried forward into the next phase, some or all of the alternatives could be combined into a single comprehensive environmental review process and document. Another option would be to cover some of the improvements as mitigation measures for the ongoing Alaskan Way Viaduct and Seawall Replacement Project.

2 What alternatives should be dropped from further consideration?

Based on the results of the traffic operations analysis, WSDOT has developed an initial list of alternatives to drop from further consideration. The following alternatives are not recommended for further work because they have little to no benefit to traffic

flow and operations or have significant implementation challenges that would be difficult or costly to overcome:

- Alternative N1 – Manage northbound HOV lane operations north of Spokane Street. This alternative is not recommended for further study because the added vehicles in this lane would increase traffic congestion at the Seneca Street off-ramp during the AM peak period, and there is little to no traffic operations benefit in the PM peak period.
- Alternative N2 – Meter northbound Spokane Street on-ramp. This alternative is not recommended for further study because of the significant traffic congestion increase expected on the Spokane Street Viaduct and the West Seattle Bridge. The alternative would also increase traffic volumes and congestion on several arterial routes in South Seattle.
- Alternative N6 – Shift northbound Mercer Street on-ramp from left to right side. This alternative is not recommended for further study because construction costs would be high because the ramp modification would require a tunnel under I-5. In addition, the project has the potential to have short term and/or long term environmental and possibly community impacts given the constrained environment.
- Alternative R1 – Add a second lane along the south end portion of the reversible lanes to maintain two lanes to and from the mainline. This alternative is not recommended for further study because of constructibility issues and cost.
- Alternative R5 – Modify Stewart Street off-ramp to HOV-only. This alternative is not recommended for further study because traffic congestion during the AM peak period would increase in the reversible roadway with only the Mercer Street exit designated for general purpose traffic use.