Washington State Department of Transportation

I-5/College Way Interchange Value Planning Study

Final Report
June 13, 2011

Executive Summary

Improvements are needed to address the severe traffic congestion experienced by travelers on College Way (SR 538) at, and in the vicinity of, the I-5 College Way interchange in Mount Vernon. Traffic conditions will significantly worsen in the future with long traffic delays and backups occurring for more hours of the day on College Way and on roadways connecting to College Way, including Interstate 5.

WSDOT's long-term plan calls for a full re-build of the interchange that we cannot presently afford. The city of Mount Vernon has proposed lower cost interim improvements that reduce the severity of peak hour traffic conditions and keeps traffic moving well into the future until such time that a new interchange can be funded and built. Proposed are additional travel lanes on College Way, one lane eastbound and one lane westbound in-between the bridge columns and bridge abutments under the existing I-5 interchange bridge. Adding these lanes frees up room under the bridge for full length dedicated left-turn lanes to the I-5 northbound and southbound on-ramps while still providing for two through lanes both eastbound and westbound.

Existing conditions, looking east along SR 538 at the I-5 northbound on-ramp

Proposed improvements: Conceptual design photo prepared by David Evans & Associates for the city of Mount Vernon.

The Value Planning Study (VPS) is a technical analysis that evaluates the benefits and feasibility of the city's proposed improvements within the study area on College Way running from Freeway Drive to Riverside Drive. We worked from the assumptions and recommendations of the Conway to Cook Interstate 5 Master Plan (IMP) to ensure consistency in land use and travel demand projections and for potential future integration into connecting I-5 corridor improvements recommended in the IMP.

What did we learn?

With the proposed improvements 2025 peak hour level-of-service is improved at two of the five intersections in the study area, and delay is significantly reduced at three of the five intersections, when compared to the no-build alternative. It is important to note that these improvements do not enable four of the five intersections to meet the current adopted intersection level-of-service standard of LOS D in the 2025 peak hour, but they do keep both the I-5 northbound and southbound ramp intersections from failing (LOS F) and prevent longer backups on the I-5 off ramps. Reductions in traffic backups at the I-5 northbound ramp intersection are dramatic and benefit traffic movements from Freeway Drive all the way to Riverside Drive.

We have determined, through our VPS conceptual design analysis, that construction of the proposed improvements may be feasible, and that there are congestion relief benefits as a result. Further analysis is needed to confirm the feasibility of constructing the retaining walls required to make room for the additional lanes under the I-5 bridge.

A summary of the VPS analysis findings indicates that:

- Traffic conditions improve in 2015 and 2025 with the proposed additional lanes.
- Additional traffic operational strategies (advanced signal timing and intersection modifications) may also be needed prior to 2025.
- The new lanes will fit underneath the existing I-5 interchange bridge.
- The new lanes can be constructed to meet WSDOT geometric design standards.
- Building new retaining walls under the I-5 bridge may be feasible but there are risks.

The VPS findings provide sufficient justification for WSDOT to proceed with project scoping in order to confirm construction feasibility, evaluate risks, and set a baseline cost estimate that can be used to position the proposed improvements for funding consideration to begin full design engineering.

WSDOT's 2008 Interstate Master Plan recommends construction of a new single-point urban interchange (SPUI) at I-5/College Way before 2035. A new SPUI, along with the associated costs to modify the I-5 mainline, could well exceed $50 to $70 million (2008 dollars). The proposed additional lanes provide a relatively low cost interim improvement that reduces the severity of peak hour traffic conditions, particularly at the signalized I-5 ramp intersections on College Way, and keeps traffic moving well into the future until such time that a SPUI can be funded and built.

What's next?

- Complete a project scoping analysis.
- Determine construction feasibility and risk.
- If determined to be feasible, incorporate the proposed improvements as an unfunded project in local, regional and statewide plans.
- Pursue project funding.

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Chapter 1: Introduction

The I-5 College Way interchange was determined to be the I-5 corridor's key choke point as documented in the Washington State Department of Transportation's (WSDOT) Conway to Cook I-5 Interstate Master Plan (IMP) completed in 2008. By 2035, if not well before then, College Way arterial traffic congestion will spill back to the interchange off-ramps and onto the I-5 mainline. The I-5/College Way interchange has the highest volume of ramp traffic and intersecting arterial traffic of any interchange in the corridor in the IMP's existing (2006) and forecasted 2035 PM peak periods. College Way experiences heavy traffic volumes during daily peak periods and has for many years. Several low cost operational improvements have been completed in recent years in order to maximize the efficiency of traffic on College Way.

The IMP, completed in 2008, recommends construction of a single-point urban interchange (SPUI) at the I-5/College Way interchange to address the growth in traffic volumes anticipated by 2035. In addition to the SPUI, the profile of the I-5 mainline north and south of the College Way interchange would require extensive modifications in order to match into a taller and wider SPUI interchange structure, at a cost that could well exceed $50 to $70 million in 2008 dollars. The state and city have not secured funds for this project, and the costs far exceed amounts that developers could reasonably be expected to contribute as mitigation for their traffic impacts.

It is unlikely that funding for a new SPUI will be available anytime soon. The City of Mount Vernon has urged WSDOT to consider a lower cost improvement that would construct additional lanes on College Way under the existing I-5 interchange bridge. The proposed additional lanes would be an interim improvement that may provide 10 to 15 years of operational benefit.

The I-5/College Way Interchange Value Planning Study (VPS) will evaluate the effectiveness of the proposed improvements in handling future traffic volumes, and for how long, and will investigate the feasibility of designing and constructing the proposed improvements. The VPS worked from the assumptions and recommendations of the IMP to ensure consistency in land use and travel demand projections and for potential future integration into connecting I-5 corridor improvements recommended in the IMP.

How did we do it?

The VPS is a cooperative, staff-level effort of WSDOT in coordination with the city of Mount Vernon and Skagit Council of Governments, the Metropolitan Planning Organization. Our work included a planning-level traffic analysis, risk analysis, conceptual design and preliminary cost estimate.

What you'll find in this report:

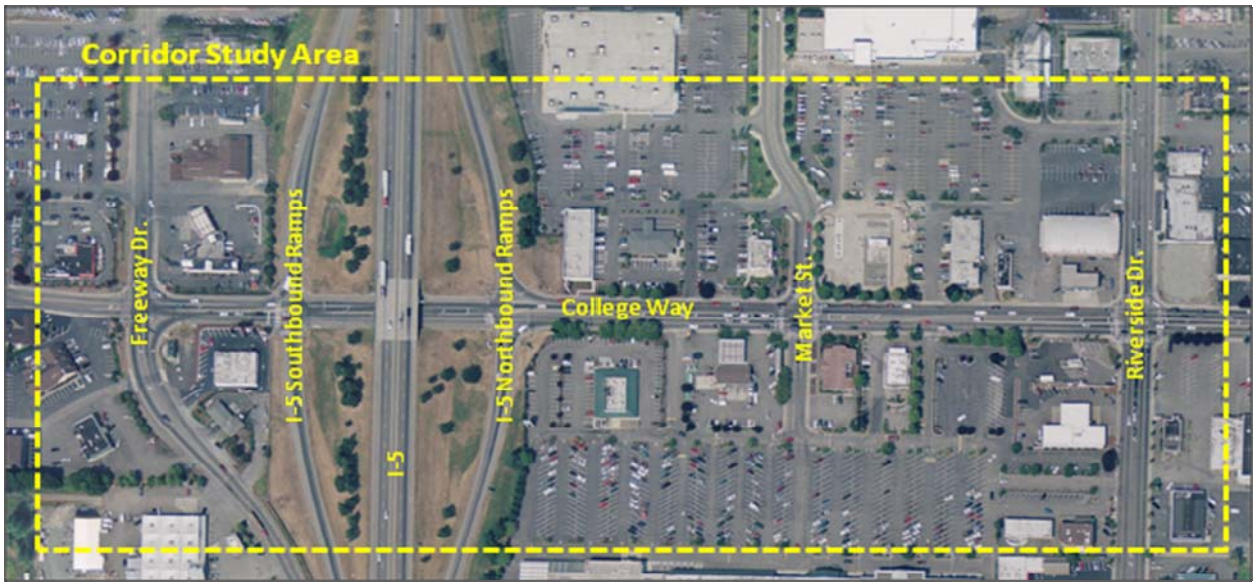
- Corridor profile
- Transportation needs
- Evaluating the proposed improvements
- Recommendations

Chapter 2: Corridor Profile

College Way is a state highway (SR 538) beginning at the mid-point of the roadway under the I-5 interchange bridge, and continuing 3.62 miles east to its intersection with SR 9.

The College Way corridor study area is located within the incorporated city limits of Mount Vernon beginning at the College Way/Freeway Drive intersection, extending east approximately 0.3 mi to the College Way/Riverside Drive intersection. Within the corridor there are five closely spaced signalized intersections at:

- Freeway Drive
- I-5 southbound ramps
- I-5 northbound ramps
- Market Street
- Riverside Drive



Eastbound, there are two general purpose lanes beginning at the intersection with Freeway Drive, continuing to and through the Riverside Drive intersection. Left-turn lanes are provided at the intersections with Freeway Drive, the I-5 northbound ramps, Market Street and Riverside Drive. Right-turn lanes are provided at the intersections with the I-5 southbound ramps and at Riverside Drive.

Westbound, there are two general purpose lanes on College Way between Riverside Drive and Market Street. West of Market street one lane continues through to Freeway Drive, while the

second westbound lane ends as a right turn lane to the I-5 northbound on-ramp. Left-turn lanes are provided at the intersections with Riverside Drive, Market Street, the I-5 southbound ramps and at Freeway Drive. Right-turn lanes are provided at the intersections with Riverside Drive, the I-5 northbound ramps and at Freeway Drive.

College Way general purpose lanes and turn lanes are typically 11 ft wide per lane west of the I-5 northbound ramp intersection, and 12 ft. wide per lane east of the same intersection. The roadway surface is asphalt concrete with the exception of the intersection with Riverside Drive which is Portland cement concrete. The state functional classification of College Way within the study area is urban-minor arterial. The posted speed limit is 25 miles per hour.

Sidewalks are provided on College Way eastbound and westbound between Freeway Drive and Riverside Drive. There are no bicycle lanes in either direction of travel.

Located in the study area is the I-5 mainline bridge crossing over College Way. The bridge was constructed in 1955. In its original configuration the bridge spanned over three lanes of College Way (one eastbound through lane, one westbound through lane and one back to back left turn lane, plus two sidewalks, all located in between the bridge column supports. In 1974 the bridge was widened ten feet to the east and to the west to add wider shoulders for the I-5 mainline. At that time a fourth lane was added on College Way under the bridge to provide for a second eastbound through lane. To make room for the fourth lane, the sidewalks were moved to the outside of the bridge column supports and retaining walls were constructed to stabilize the slope of the bridge foundation soils.

Within the College way study area, average annual daily traffic (AADT) ranged from 19,000 to 28,000 vehicles per day in 2010. The highest volumes are concentrated between the I-5 northbound ramps intersection and Riverside Drive (28,000 AADT). On an average weekday, traffic volumes along College Way grow beginning with the morning commute hour and continue to rise throughout the day, peaking between 4:00 PM to 6:00 PM. Traffic volumes at mid-day are nearly as high as the PM peak hours.

Chapter 3: Transportation Needs

Traffic conditions on College Way

College Way, from Freeway Drive to Riverside Drive, is a dense commercial corridor traversing one-third of a mile with high volumes of peak hour traffic concentrated in and around five closely spaced signalized intersections. Today, bottlenecks are a daily occurrence on College Way at the signalized I-5 northbound and southbound ramp terminal intersections, where large volumes of left and right turning vehicles exceed the capacity of short turn lanes, resulting in backups that block adjacent through lanes and upstream intersections.

Bottlenecks occur frequently at the short left-turn lane to the I-5 northbound on-ramp

The turn lane bottlenecks are further exasperated by a reduction in westbound travel lanes from two lanes approaching the northbound ramps intersection down to one lane west of the intersection in the very location where traffic volumes are the highest in the corridor.

Given these conditions it is easy to see why traffic forecasts for 2015 show recurring westbound traffic queues at the College Way/I-5 northbound ramps intersection backing upstream nearly to Riverside Drive, and by 2025 backing east beyond Riverside Drive. Indeed, there are times today when we see these traffic backups. The frequency and severity of the problem will increase as traffic volumes grow in the future.

Existing conditions, looking east along SR 538 at the I-5 northbound on-ramp

A key measure of the corridor's traffic operations is level-of-service and average vehicle intersection delay. The adopted intersection level-of-service in the study area is LOS D, correlating to average intersection delay ranging from 35 to 55 seconds per vehicle. By 2015 two intersections fall below LOS D with one failing at LOS F during peak hour periods. By 2025 four intersections fall below LOS D with three failing at LOS F due to long delays for drivers.

Traffic conditions on I-5 at the College Way interchange

A significant concern is the effect that traffic congestion along College Way has on traffic exiting I-5 at the northbound and southbound off-ramps. The I-5 College Way interchange was determined to be the I-5 corridor's key choke point in the I-5 Conway to Cook Interstate Master Plan (IMP) forecasted future traffic conditions in 2035 PM peak hour. By 2035, if not well before then, College Way traffic congestion will result in traffic backing up the I-5 off-ramps onto the I-5 mainline, resulting in reduced interstate capacity and an increased risk for high speed rear-end collisions. The interchange has the highest volume of ramp traffic and intersecting arterial traffic of any interchange in the I-5 Conway to Cook corridor.

For stakeholders, including motorists, freight carriers and those having facilities that rely on access to or along SR 538, increased delays and long traffic queues mean significantly longer travel times, longer delays, and increased congestion at intersections and at access points for businesses. Severely congested traffic conditions will spread well beyond the current peak traffic time periods. As the corridor grows more congested, traffic operations on connecting roads and intersections will degrade.

Low vertical clearances under the I-5 bridge

When new interstate bridges are constructed, or when modifications are made to travel lanes under an existing interstate bridge, current WSDOT design standards recommend a minimum bridge clearance of 16 ft. above the undercrossing roadway. Existing bridge clearances under the I-5 bridge at College Way range from 14.5 ft at the outside edge of the eastbound and westbound lanes, to 15.5 ft at the centerline of College Way. There is evidence of numerous bridge strikes on the underside of the bridge, aligning with the center of each travel lane, as seen in the lower right photo. Bridge strikes are repaired when they occur, and the bridge remains structurally sound. Any modifications that would add additional travel lanes under the I-5 bridge should be designed to achieve a minimum 16 ft clearance over any portion of the new travel lane below.

Standard height trucks fit under the I-5/College Way bridge, but clearances are tight

Concrete patches show a pattern of over-height vehicle strikes under the I-5 interchange bridge at College Way

Limited funding for improvements

It is unlikely that funding for a new I-5/College Way interchange, with the associated I-5 mainline reconstruction, will be available anytime soon. The city of Mount Vernon urges WSDOT to consider adding additional lanes on College Way in between the I-5 northbound and southbound ramp terminal intersections as a lower cost interim improvement that reduces the severity of peak hour traffic conditions and keeps traffic moving well into the future until such time that a SPUI can be funded and built.

Chapter 4: Evaluating the Proposed Improvements

The city of Mount Vernon's proposed improvements for College Way are outlined below.

- Construct one new westbound general purpose lane from the I-5 northbound ramp intersection to the I-5 southbound ramp intersection
- Construct one new eastbound general purpose lane from the I-5 southbound ramp intersection to the I-5 northbound ramp intersection
- Construct a new westbound right-turn lane on College Way to the I-5 northbound on-ramp
- Construct a dedicated westbound left-turn lane on College Way to the I-5 southbound on-ramp
- Construct a dedicated eastbound left-turn lane on College Way to the I-5 northbound on-ramp that can extend an additional 270 ft back to the Freeway Drive intersection

The existing and proposed lane configurations for College Way at the I-5 interchange, looking west towards the bridge, are shown in figures 1 and 2.

Figure 1: Existing roadway cross section, College Way under the I-5 bridge

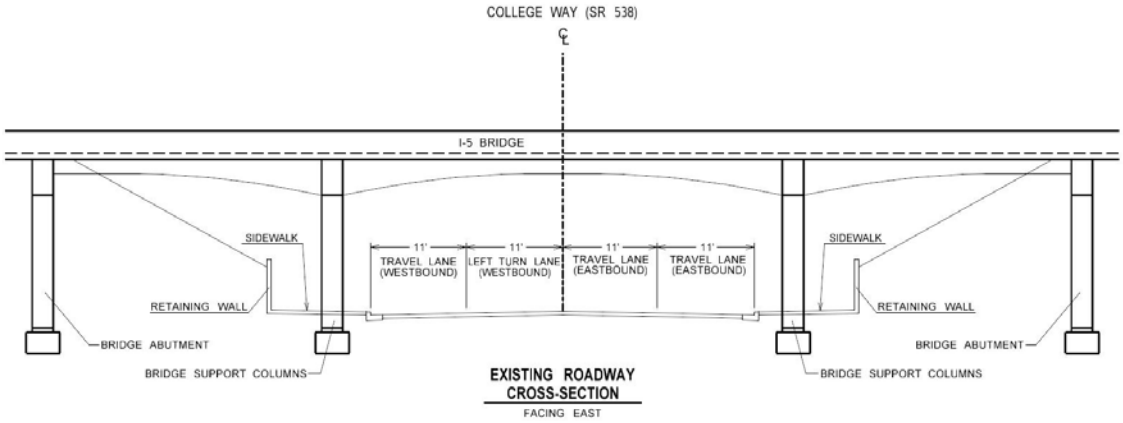
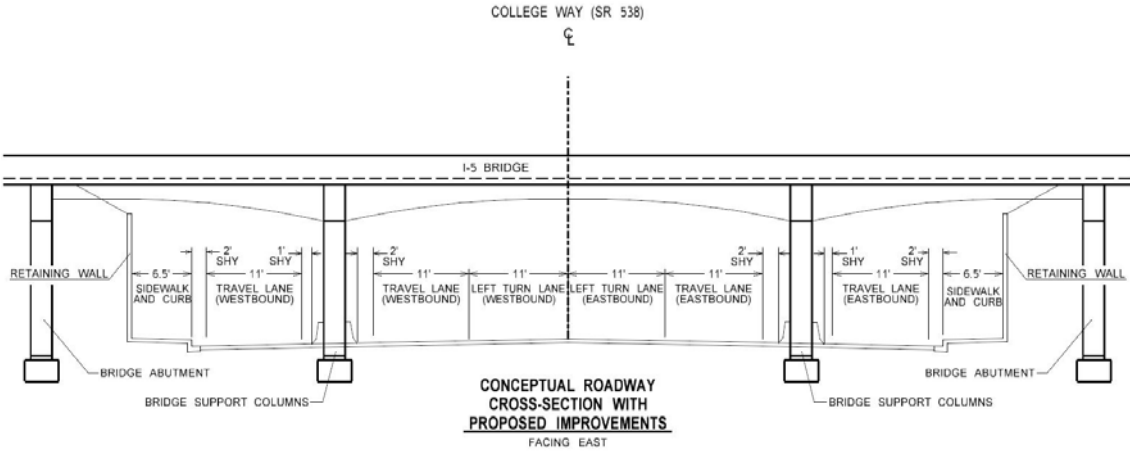


Figure 2: Roadway cross section with proposed improvements



The conceptual design photo below shows a west-facing view of the proposed new lanes under the I-5 bridge.

Proposed improvements: Conceptual design photo prepared by David Evans & Associates for the city of Mount Vernon.

To guide our evaluation of the proposed improvements our analysis focused on answering the following questions:

- Do traffic conditions improve with the proposed improvements?
- Will new lanes fit in between the I-5 bridge columns and abutments?
- Can retaining walls be constructed, and if so, what are the potential risks?
- What is the estimated cost to complete the proposed improvements?

Do traffic conditions improve with the proposed improvements?

We chose 2015 for our base year traffic analysis and 2025 for our future year traffic analysis. We based this on the assumption that 2015 is the earliest year the proposed improvements could be completed and open for traffic if funding were secured for design, right-of-way and construction. Currently, there is no funding available. We chose 2025 in order to determine if the proposed improvements will continue to provide ten or more years of benefit to travelers. Our evaluation consisted of an analysis of PM peak hour traffic conditions, with and without the proposed improvements, for the forecast years of 2015 and 2025.

Our analysis of 2015 PM peak hour traffic delays, traffic backups and level-of-service determined that the proposed improvements will provide some benefit, particularly at the I-5 northbound ramp intersection where significant reductions in delay and backups remove key westbound and eastbound bottlenecks on College Way that also benefit upstream intersections.

In 2025 PM peak hour traffic conditions level-of-service is improved at two of the five intersections, and delay is significantly reduced at three of the five intersections, when compared to the no-build alternative. It is important to note that these improvements do not enable four of the five intersections to meet the current adopted intersection level-of-service standard of LOS D in the 2025 PM peak hour, but they do keep both the I-5 northbound and southbound ramp intersections from failing (LOS F) and prevent longer backups on the off ramps. Once again, reductions in traffic backups at the I-5 northbound ramp intersection are dramatic and benefit traffic movements from Freeway Drive all the way to Riverside Drive.

However, additional traffic management strategies will be needed, particularly at the Market St. intersection, in order to achieve acceptable 2025 PM peak hour traffic conditions at that intersection. Potential strategies may include advanced signal timing optimization as well as turning movement restrictions that have the effect of redirecting traffic to other access points.

The table below provides a comparison of no-build and build intersection level-of-service (LOS) and average vehicle delay at each intersection in 2015 and 2025.

2015 - 2025 PM Peak Hour Intersection Level-of-Service Comparison

	2015 No-build		2015 Build		2025 No-build		2025 Build	
Intersection	**LOS**	**Delay**	**LOS**	**Delay**	**LOS**	**Delay**	**LOS**	**Delay**
College & Freeway Dr	C	30	C	32	D	47	D	42
College & I-5 SB Ramps	D	38	D	40	F	94	E	63
College & I-5 NB Ramps	F	95	D	36	F	153	E	72
College & Market St.	E	73	E	75	F	141	F	103
College & Riverside Dr.	D	51	D	48	E	62	E	60

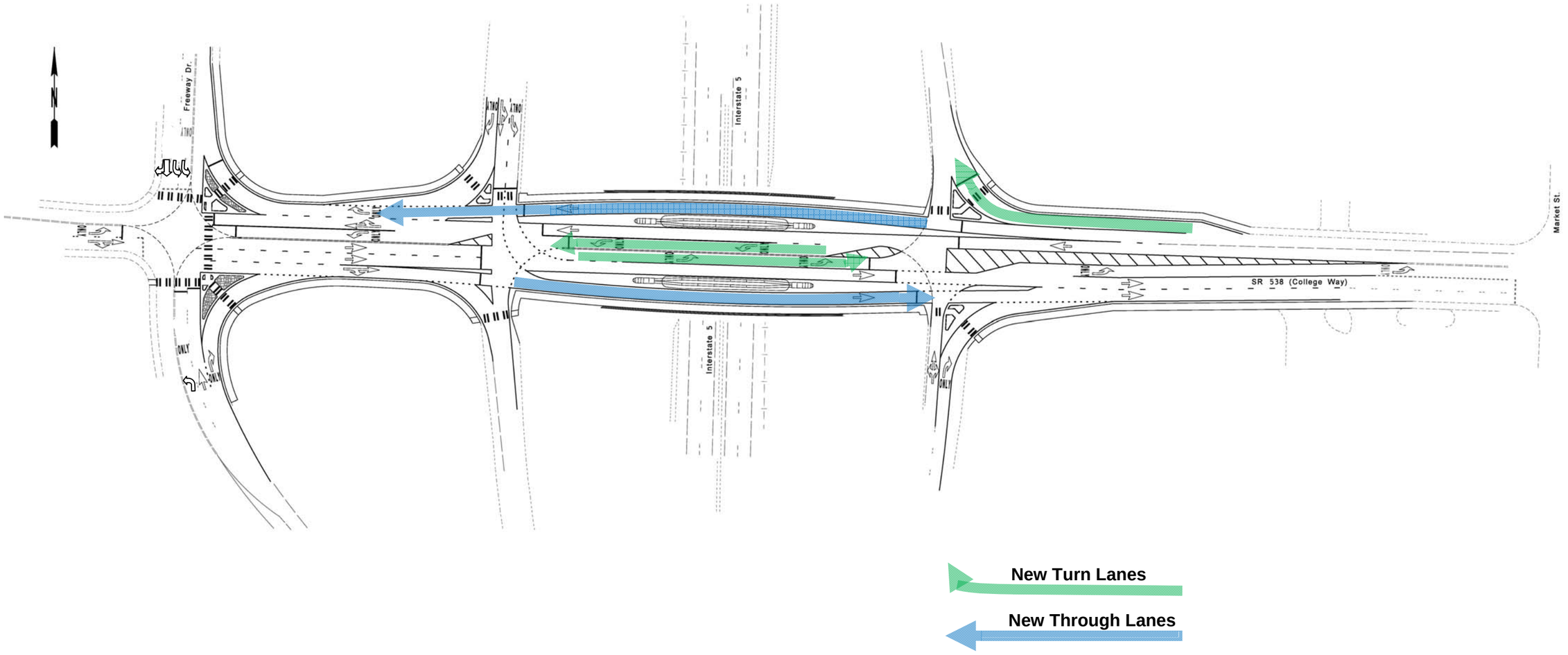
Will new lanes fit in between the I-5 bridge columns and abutments?

We identified three potential lane alignments and evaluated each one based on the following criteria:

- Provides a minimum of 16 ft. vertical clearance between the new lane and the I-5 bridge.
- Meets WSDOT design standards for road curvature and stopping sight distance.
- Leaves room for pedestrian sidewalks.
- Maximizes available space under the I-5 bridge to construct retaining walls.
- Avoids impacts to footings that support the bridge columns and abutments.
- Can be designed to utilize the existing storm water drainage system on College Way.
- Avoids conflicts with existing utilities.

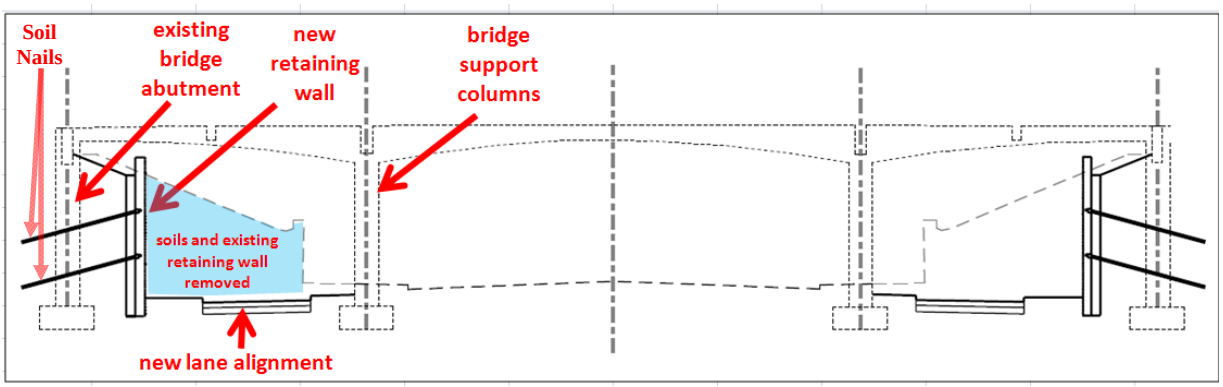
Based on these criteria we confirmed that there is one preferred alignment for new westbound and eastbound lanes on College Way that will fit in between the I-5 bridge columns and the bridge abutments on each side of the bridge. Figure 3 shows a conceptual channelization plan view of the proposed improvements.

Figure 3: Conceptual channelization plan with proposed improvements



Can retaining walls be constructed, and if so, what are the potential risks?

This question sparked the most discussion and debate. The existing bridge approach foundation soils at the College Way interchange are considered to be of poor quality, meaning they could shift and collapse if the soil slope is disturbed or cut away, or if an existing retaining wall is removed in order to make room for new lanes under the I-5 bridge. The bridge is constructed with spill-through abutments, providing no ability for the abutments to act as a soil retaining wall.



The consequences of undermining the bridge approach foundation soils during construction are significant. With 70,000 vehicles per day traveling I-5 through Mount Vernon we cannot risk a partial or full closure of I-5 as a result of destabilized soils under the bridge.

There are other constructability concerns as well. There is minimal space under the bridge to set up construction equipment to build a retaining wall and angle the soil nails in order to avoid the buried bridge abutment columns.


Large drilling equipment used to construct soil nail walls will be difficult to fit in the tight space under to I-5 bridge

Aware of the potential risks of soil instability, I-5 mainline impacts, and space to construct a soil nail wall, WSDOT staff in our Bridge Engineering, Materials Engineering, and Region Design offices discussed potential retaining wall designs and construction methods that could minimize the risk of soil instability during the removal of soils and construction of a new retaining wall. From these discussions we determined that a wall design (soil nail wall), and costlier construction methods involving a higher degree of hand work and additives to stabilize the soils, had a reasonable probability of success, meriting further engineering design analysis to better understand the risks and refine our cost estimate

What is the estimated cost to complete the proposed improvements?

We developed a preliminary cost estimate, based on our conceptual design, for the purposes of guiding future funding decisions. We constructed the estimate using information on bid prices from recent, similar projects and quantities. The estimate does not include a cost adjustment for risk factors that could increase the cost of design, right of way and construction.

WSDOT will complete a project scoping analysis by Fall 2011, including a constructability review by WSDOT and construction industry experts, that may refine the estimates listed below for design, right-of-way and construction. A cost risk assessment will also be completed in order to prepare a more reliable risk-adjusted cost estimate.

Preliminary project cost summary (not adjusted for risk)

	Cost ($Millions)
Preliminary Engineering	$1.0
Right-of-Way	$0.1
Construction	$5.1
Total Project Cost*	$6.2

*Cost estimate in 2010 dollars. Actual project cost will be higher depending on inflation, construction schedule and risk.

Chapter 5: Recommendations

Our VPS conceptual design analysis determined that construction of the proposed improvements may be feasible, and that there are clear traffic operational benefits as a result. A summary of the analysis findings indicates that:

- Traffic conditions improve in 2015 and 2025 with the proposed additional lanes.
- Additional traffic operational strategies (advanced signal timing and intersection modifications) may also be needed prior to 2025.
- The new lanes will fit underneath the existing I-5 interchange bridge.
- The new lanes can be constructed to meet WSDOT geometric design standards.
- Building new retaining walls under the I-5 bridge may be feasible but there are risks.

WSDOT's 2008 Interstate Master Plan recommends construction of a new single-point urban interchange (SPUI) at I-5/College Way before 2035. A new SPUI, along with the associated costs to modify the I-5 mainline, could well exceed $50 to $70 million (2008 dollars). The proposed additional lanes provide a relatively low cost interim improvement that reduces the severity of peak hour traffic conditions, particularly at the signalized I-5 ramp intersections on College Way, and keeps traffic moving well into the future until such time that a SPUI can be funded and built.

Action Plan

As a follow-up to this VPS, we recommend the following steps be taken:

1. WSDOT to complete a project scoping pre-design analysis that refines the engineering estimates for design, right-of-way, construction, risk and cost.
2. WSDOT to present our scoping pre-design findings to the WSDOT/Associated General Contractor (AGC) Constructability Review Roundtable (an assembly of WSDOT construction engineers and industry contractors), in order to confirm construction feasibility and project risks.
3. If construction feasibility is confirmed in step 2, update the scoping-level cost estimate and risk analysis as needed and go to step 5
4. If construction is determined to be infeasible in step 2, notify the city staff and the MPO. Do not proceed to steps 5 and 6.
5. Identify the proposed improvements as part of state, regional and local transportation plans.
    - WSDOT Highway System Plan (update HSP database with VPS results)
    - Mount Vernon Transportation Improvement Program (unfunded planned project)
    - Skagit MPO Transportation Improvement Program (unfunded planned project)
6. Pursue funding opportunities in order to advance to full engineering design, right-of-way and construction of the proposed improvements.

Appendix A: Technical Reports

- Traffic Analysis
- Lane Alignment Alternatives Analysis
- Conceptual Design Analysis

Appendix B: References

- WSDOT Design Manual, M22-01. July 2010
- WSDOT Right-of-Way Plans
- WSDOT As-built Plans: Contract 4795 (1954) and Contract 9548 (1973)
- WSDOT Right-of-Way Plans, 1971
- WSDOT Risk Management Plan – Modeling Spreadsheet
- WSDOT Mobility Project Prioritization Process Benefit/Cost Software
- WSDOT Topographical Surveys at I-5 Interchange completed Aug. 24 and Nov. 17, 2010
- SCOG Model forecasts
- William Popp Associates: College Way (SR 538)/Freeway Dr. Improvements Study, March, 2009
- Reichardt & Ebe Engineering, Inc. Preliminary College Way/Freeway Dr. Channelization Plan, January, 2010