Background Paper #9
Analysis of Illustrative Examples

■ Introduction

One element of the Comprehensive Tolling Study is an analysis of traffic, revenue and other considerations of potential tolling and pricing projects in Washington State. The approach to this effort was developed in consultation with the Washington State Transportation Commission ("the Commission") and Washington State Department of Transportation (WSDOT) staff.

Important Note about the Illustrative Examples

As noted above, the illustrative examples were chosen for their use in illustrating policy concepts as the Transportation Commission considered its policy recommendations to the Legislature. ***The selection of the illustrative examples does not imply that these projects will be considered for tolling. If any of the illustrative examples were to move forward, considerable additional study would be needed to estimate traffic and revenue, operations and implementation considerations, project costs, and appropriate toll rates.***

Selecting the Illustrative Examples

Our first step was to compile a comprehensive list of potential tolling projects, and then identify projects that could serve as illustrative examples of different policies that the State may wish to pursue. Cambridge Systematics then worked with WSDOT staff to develop a proposed list of illustrative examples to use for this study, keeping in mind the following constraints and opportunities:

- Certain projects were named in the legislation that mandated the Comprehensive Tolling Study:
  - Cross Base Highway (SR 704);
  - SR 520 Floating Bridge;
  - I-405 Managed Lanes; and
  - Alaskan Way Viaduct.

- The legislation also directed that this study provide information to support the Regional Transportation Investment District (RTID) to determine the feasibility of value pricing on a facility or network of facilities in King, Pierce, and Snohomish counties.

- WSDOT has a parallel study underway in the Puget Sound region addressing a variety of congestion relief efforts, including those involving pricing, the Congestion Relief Analysis, Phase 2 project.

- The project scope is statewide.

In reviewing the project list, we considered the policy being illustrated; geographic location, aiming for state diversity; and availability of quantitative tools and to evaluate the scenario.

The first step in the process was for the consultant team to work with WSDOT staff and the Commission's Toll Study Committee to develop a comprehensive list of potential tolling applications. That comprehensive list is provided in Appendix A. From that list, we applied the criteria described above to identify those that would be most effective for the policy discussion. The resulting examples are summarized in Table 9.1.

Table 9.1 Illustrative Examples

Project	Illustrates
1. SR 704 Cross Base Highway Two lanes each direction, as designed; one toll point on either side of the center interchange. All-electronic toll collection.	Funding a highway project
2. Snoqualmie Pass Improvements Safety improvements and some capacity enhancement	Funding a highway improvement, maintenance, and operations project
3. SR 520 and I-90 Bridges over Lake Washington **SR 520:** • 3 lanes each direction, one of which is a 2+ HOV lane; • everyone but HOV3+ tolled • variable tolls to manage demand **I-90:** • R8A project (adds one HOV2+ lane each direction in outside roadway) and existing center lane operations. Everyone but HOV3+ tolled	System of tolled bridges for traffic management and funding

Table 9.1 Illustrative Examples (continued)

Project	Illustrates
4. SR 167 and I-405 HOT Lane System: Sumner to Bellevue **SR 167**: • Add one HOT lane and convert existing HOV lane to HOT lane; add HOV lane south of SR 18); results in two HOT and two general purpose lanes in each direction. • HOV2+ are free. **SR 405:** • Add one HOT and one general purpose lane, and convert existing HOV lane to HOT lane in each” direction; results in two managed and three GP lanes in each direction. Consistent with “Option D.” HOV2+ are free.	HOT lane system corridor for traffic management. Anticipates that additional non tolling capital would be required.
5. I-405 North HOT Lanes – SR 520 north to I-5 (Swamp Creek) **Project Capacity Improvements:** • Nickel plus TPA Projects from SR 520 north; • Nickel only from SR 520 South. **HOT Lane Definition:** • Two lanes each direction from 520 to 522 (one added lane plus the existing HOV lane); • One lane each direction from 522 to I-5 (convert existing HOV lane). HOV2+ are free	HOT lane that can be implemented in the near term, consistent with current planning efforts, that includes additional capacity, not just conversion of existing HOV lane.
6. I-5 in Lewis County Two tolling points were assumed, located in segments aimed at mitigating potential diversion while generating significant revenue. The southern tolling location is near the Toutle River Safety Rest Area and the northern tolling location is within the Grand Mound to Maytown segment of I-5.	Toll an existing freeway to generate revenue for major improvements.
7. I-5 and Alaskan Way Viaduct in Seattle Tolling of I-5 from I-405 at Tukwila northward to Northgate for a distance of 18 miles. The Alaskan Way Viaduct would be tolled from Spokane Street to Roy Street for a distance of 4.5 miles. Both facilities were assumed to have all electronic time-of-day distance-based pricing.	Toll existing freeways in a dense urban area to generate revenue for major improvements, with an element of traffic management.
8. Statewide Truck Tolling Commercial vehicles charged a per mile charge in Washington State.	Tolling commercial vehicles to increase system effectiveness, revenue, and as a precursor to more extensive highway tolling.
9. Container Fees Application of a direct user charge to international freight that does not involve a general tax increase.	The use of fees to fund intermodal improvements that aid freight flows in the region.

Overall Approach

We customized the approach to each example to conform to the analytical tools that were available. For projects in the Puget Sound region, we used the regional travel demand model improved by PSRC and WSDOT for use on the Congestion Relief Analysis study. For projects outside of Puget Sound, we used other available data and sketch planning techniques to estimate how travelers might respond to tolls.

In addition to the traffic and revenue components of the study, we also looked at performance measures relating to travel time savings and the value of those savings, and overall efficiency of the system. We built upon cost estimates already prepared by WSDOT for many of the projects, and developed independent, planning level estimates of the additional cost of tolling particular projects.

The financial elements of the analysis were brought together using a spreadsheet analysis which incorporates assumed inflation rates, debt service coverage, and bond interest rates with the 35-year net revenue stream for each project, resulting in an estimate of the amount of construction funds that might be generated for each project.

Travel Demand Modeling Approach in Puget Sound Region

Since several of the illustrative examples were in the Puget Sound region, an important part of the project was use of the modified travel demand model in that region for testing tolling and pricing concepts.

Traffic and revenue forecasts are challenging because they must anticipate the behavior of millions of people, consider the uncertainty of future economic conditions, and take account of policy actions by many government agencies. Numerous traffic and revenue forecasts have been off the mark in recent years. The CRA project worked to develop better methods of analyzing tolling projects and explain the risks and uncertainties inherent in toll road traffic and revenue forecasts. The most important thing about traffic and revenue studies – even if they are not investment grade – is that they be reasonable, conservative, transparent, and supported by the analysis. Regardless of the results, it is important that the Commission and WSDOT understand the assumptions that go into an analysis and the limitations of that analysis.

Traditionally, analyses to support the development of tolling projects focused on one factor – revenue generation. Since tolling is now being asked to accomplish traffic management goals, the analysis needs include the impact on traffic flow – both on and off the target facility.

Improvements to the travel demand model for the Puget Sound region increased its sensitivity to pricing changes. The model incorporates techniques that allow travelers to choose not only their destination and mode based on price, but also whether they will shift time of travel or their route in reaction to congestion or toll prices. These improvements can be summarized as follows:

- **Value of time by market segment –** Research and updates on value of time for nine different market segments, which is used in trip distribution, mode choice, time-of-day choice, and trip assignment model components.

- **Time-of-Day Choice Model –** This component was updated to evaluate congestion and pricing impacts for 30-minute time periods in the peak periods.

- **Modal Impacts on Destination Choice –** Additional processing of transit and HOV3+ trip tables to allow these travelers to choose destinations based on a free pass for pricing alternatives compared to other travelers, who will choose destinations based on various pricing alternatives.

- **Toll Optimization Model –** This model evaluates volumes by time period (15), direction of travel and by link segment to identify the optimum toll rate for any scenario. It is run in an iterative process with the travel demand model to produce an optimum toll structure.

- **Performance Measures –** A series of performance measures and software tools to produce these performance measures were developed to evaluate the performance of each scenario.

Because toll forecasting with regional travel forecasting models is fairly new, many of these techniques were adapted for use in this toll study based on an initial evaluation of the toll forecasting results. For example, since the actual value of time by market segment is not known and is expected to vary considerably among different travelers even within a single market segment, we implemented a range of values of time based on the current research. This enables us to understand the overall impacts of this variable on the results, which is significant.

In addition to the advancements that were made for traffic and revenue forecasting purposes, it is important to recognize the remaining limitations of this analysis. These limitations were described in an earlier working paper and are summarized here for completeness. The remainder of the paper describes the travel forecasting methods, the toll optimization model and the future network assumptions.

Limitations of this Comprehensive Tolling Study

This Comprehensive Tolling Study is structured to take a preliminary look at several illustrative examples of potential toll projects in Washington State, with the purpose of guiding overall policy-making with regards to tolling. In the early phase of the project, the consultant team worked with the Commission to recommend the scenarios that best represented the kinds of projects that might be considered in the State in the near, medium, and long term. Since the entire universe of potential projects is not being

considered, this study is not intended to definitively determine the suitability of any particular project for tolling or pricing, nor as a means to priority rank projects. And it is certainly not intended to be an investment-grade analysis.

■ SR 167/I-405 HOV/ Express Toll Lanes

Description

The SR 167/I-405 corridor is the main north-south artery serving the growing communities on the east side of Lake Washington. WSDOT is in the midst of a planning process considering alternatives to improve mobility in this corridor. The policy objective of this project was to evaluate a set of HOT lanes that can be managed through variable pricing. The lanes would provide a motorist with a choice to travel at near free flow speeds when they have a need or desire to do so.

The toll concept evaluated in this corridor would provide come additional capacity in the form of managed lanes, where price would be used to keep the special lanes free flowing at all times. The illustrative project would provide two HOV/express toll lanes in each direction along most of SR 167 and I-405. The SR 167 portion would add one lane in each direction from SR 410 in Sumner to the I-405 interchange in Renton, a distance of about 19 miles. The new lane, plus the existing HOV lane would be operated as HOV/express toll lanes, and there would also be two general purpose lanes in each direction.

On the I-405 portion, the HOV/express toll lanes would extend from the SR 167 interchange north to SR 522 in Bothell, a distance of about 20 miles. On I-405, two lanes would be added in each direction from SR 167 to I-90, consistent with the "Implementation Plan" configuration being designed by the I-405 project team. One of these new lanes would be a general purpose lane. The other new lane would become a HOV/toll express lane, together with the existing HOV lane, resulting in two HOT lanes in each direction. Between I-90 and SR 522 in Bothell there would be two HOT lanes and three General Purpose lanes in each direction, except at the N.E. 6th Street interchange where one of the HOT lanes would exit at a HOT interchange, with the other HOT lane continuing through the interchange to just beyond SR 520. This is the same amount of overall capacity expansion anticipated by the State's "Nickel" and TPA funding programs.

Access to the HOT lanes would be provided at slip ramps between the HOT and general purpose at various designated locations, generally between each interchange along the project limits. The HOT lanes could also be accessed by a new freeway-to-freeway ramp at the SR 167/I-405 interchange and a few other HOT direct access ramps along I-405. Those vehicles with two occupants or less would be required to pay a toll, while vehicles with three or more occupants would be allowed free access to and from the facility.

Comparison Scenario

Typically, potential transportation improvement projects are compared to a "no build" alternative to evaluate project effectiveness. However, since HOT lanes represent a policy choice of how to provide additional capacity in this corridor, we compared the HOT lane concept to one where the additional capacity was devoted entirely to general purpose traffic. This scenario is called the "Build HOV" condition.

Corridor Performance

With HOT Lanes, the most direct comparison of performance is to consider the overall vehicle miles and hours by travelers in special lanes, in the general purpose lanes, and in total between the HOT lane and Build HOV scenarios (see Table 9.2). The total VMT divided by the total VHT provides a measure of the average system speed, an easy-to-understand performance measures.

The HOT lane scenario is expected to carry more VMT along the corridor as compared to the Build HOV particularly in the northbound peak direction in the a.m. peak period. Even with higher VMT, the Build HOT scenario has lower VHT, indicating overall better utilization of the available capacity than the Build HOV scenario. When looking at average speeds in the corridor, the HOT lanes are expected to be slightly slower than the HOV lane since they allow more vehicles in the HOV lane while still providing for free-flow conditions through pricing. The significant difference is shown in the general purpose lanes where under the Build HOT scenario average speeds are 5 to 9 mph faster in the corridor as compared to the Build HOV scenario. In addition, the overall total average speeds are expected to be 6.6 to 11.1 miles per hour faster under the Build HOT compared to the Build HOV condition. The value of these time savings was conservatively estimated at $43 million per year.

Table 9.2 Comparison of HOT Lanes and Build HOV Scenarios
A.M. Peak Period

	Vehicle Miles Traveled		Vehicle Hours Traveled		Average Speed	
Scenario/Lanes	**SB**	**NB**	**SB**	**NB**	**SB**	**NB**
Build HOT						
GP Lanes	467,750	478,186	10,236	10,471	45.7	45.7
HOT Lanes	110,668	211,697	1,910	3,623	57.9	58.4
Total	578,418	689,883	12,146	14,095	47.6	48.9
Build HOV						
GP Lanes	566,885	638,081	13,975	17,255	40.6	37.0
HOV Lane	19,577	38,513	326	642	60.0	60.0
Total	586,462	676,594	14,301	17,897	41.0	37.8
Differences (Build HOT minus Build HOV)						
GP Lanes	-99,135	-159,895	-3,739	-6,784	5.1	8.7
HOV Lane	91,091	173,184	1,584	2,981	-2.1	-1.6
Total	-8,044	13,289	-2,155	-3,803	6.6	11.1

Revenue Estimates

HOV/toll express lanes work by setting the price at a level that maximizes flow in the toll lane. Since HOV 3+ traffic would be allowed free access to the lanes under this example, toll rate levels are adjusted to managed the amount of toll paying vehicles that access the facility in order to preserve free flow operations of the lanes. In actual operation, toll rates would be adjusted dynamically in response to real-time traffic conditions, which vary from day to day and minute to minute. A regional travel demand model cannot capture this level of precision, but we are able to get a rough estimate of the toll rates that would be needed to achieve the flow-maximizing objective. Since traffic conditions vary at different locations on the highway, the toll rates would vary as well.

The project was divided into seven segments. The estimated a.m. peak period per mile toll rates needed to manage demand ranged from $0.10 to $0.90 in the northbound direction along SR 167 and $0.10 to $0.95 along I-405 in the southbound direction. Toll rates in the hours immediately before and after the peak periods were estimated to vary from $0.10 to $0.40 along SR 167 and $0.10 to $0.25 per mile along I-405. A minimum per-mile toll rate of $0.10 was assumed for all time periods.

We estimated average weekday revenue for each time period and direction by multiplying the segment VMT by the per mile toll rate for that segment (see Table 9.3). A.M. peak period average weekday revenue is estimated to be $56,908 as shown below, with the same amount for the p.m. peak period.[1] Peak-period revenue is estimated to account for more than 70 percent of the estimated revenue. This is because the peak periods not only have higher usage during these time periods due to congestion, but also would have significantly higher toll rates to manage demand. Total estimated annual revenue for year 2030 is $41.3 million in year 2000 dollars.

Table 9.3 2030 Estimated Revenue
2000 Dollars

Period	Average Weekday	Average Weekend Day	Annual
A.M. Peak Period	$56,908	$5,691	$14,881,400
Midday Period	$25,252	$2,525	$6,603,300
P.M. Peak Period	$56,908	$5,691	$14,881,400
Evening Period	$16,248	$1,625	$4,248,800
Night Period	$2,746	$275	$718,100
Total Day	$158,061	$15,806	$41,333,000

Costs

Although the most recent project cost estimates for the 39 mile project are not available, we do know that this project would be extremely expensive to build. Tolling construction cost estimates were developed assuming a total of 42 access points (tolling zones) for northbound and southbound HOT traffic. It was assumed that the roadway improvement projects will include provision for the fiberoptic communication infrastructure for both ITS and tolling purposes. It is similarly assumed that newly constructed general-use lanes will have adequate loop detectors for both ITS and dynamic tolling purposes.

[1] We found that 2030 traffic conditions in the region's travel demand model were so saturated in the p.m. peak period that the estimates of traffic choosing to use a HOT lane in that period were unreliable. As a result, we made the simplifying (and probably conservative) assumption that revenue in the p.m. peak period would match that in the a.m. peak period.

Due to the large number of estimated toll transactions for this system (in excess of 60 million per year) a dedicated central host building and associated infrastructure for toll collection, customer service, and administrative functions has been included in the project tolling costs. Assuming the construction of 42 tolling zones, a central host building and associated infrastructure a tolling cost of $80.2 million is estimated.

Financial Analysis

A financial analysis was performed to estimate the amount of revenue that could be expected to contribute to the corridor improvements. Since the project cost estimates are anticipated to be extremely high, toll revenue is not anticipated to contribute significantly toward this cost. Since HOT lanes have transaction and revenue growth patterns that are not typical of traditional toll facilities, multiple-year forecasts are usually carried out to ensure reflection of the significant elasticity of these projects. In order to perform the financial analysis, forecasts of earlier year transactions and revenue potential were estimated. An assumed 5.0 annual percent rate of growth was assumed between 2010 and 2030 on transactions, with a corresponding 10.0 annual percent growth in revenue. The higher growth assumption on revenue is a result of the need to have real increases in rates beyond inflation to manage demand. Beyond 2030, conservative growth assumptions of 1.0 and 2.0 percent annually were used on transactions and revenue, respectively. At the selected toll rates and assumed growth rates, it is estimated that $228 million (see Table 9.4) could be contributed toward capital improvements. Although this would not cover the cost to construct the facility, it would be more than enough to cover the additional cost of toll collection.

Policy Findings

The policy objective of this project was to evaluate a set of HOT lanes that can be managed through variable pricing. The lanes would provide a motorist with a choice to travel at near free flow speeds when they have a need or desire to do so. Dedicating additional capacity in a congested highway corridor to HOT lanes can improve corridor operations as compared to a nonpricing alternative. Such a system is attractive because it provides drivers a clear choice between improved speed and reliability when they really need it and basic service when they do not.

Revenue generation is expected to be relatively low in comparison to the significant expenditure needed to make the improvements, however more than adequate to cover the incremental cost of tolling. Since the toll lanes also contribute benefits in the form of time savings to travelers, this makes the HOT lanes a reasonable option to consider in this corridor, pending further detailed investigations.

Table 9.4 Financial Analysis of HOT Lanes on SR 167/I-405

	Year of Collection Dollars						
Calendar Year	Passenger Car Toll Rate[a]	Average Toll Rate	Annual Gross Revenue	Annual Operating Expenses	Net Revenue	Senior Lien Debt Service	Present Value
2010						3,810,684	$3,615,450
2011						3,810,684	$3,430,218
2012						3,810,684	$3,254,476
2013						3,810,684	$3,087,739
2014	0.49	0.49	12,925,827	6,257,130	6,668,697	3,810,684	$2,929,543
2015	0.53	0.53	14,644,962	6,767,187	7,877,775	4,501,586	$3,283,385
2016	0.57	0.57	16,592,742	7,318,745	9,273,997	5,299,427	$3,667,285
2017	0.62	0.62	18,799,577	7,915,157	10,884,420	6,219,669	$4,083,592
2018	0.67	0.67	21,299,921	8,560,174	12,739,747	7,279,855	$4,534,791
2019	0.72	0.72	24,132,810	9,257,986	14,874,824	8,499,900	$5,023,515
2020	0.78	0.78	27,342,474	10,012,358	17,330,116	9,902,923	$5,552,860
2021	0.84	0.84	30,979,023	10,828,403	20,150,620	11,514,640	$6,125,803
2022	0.91	0.91	35,099,233	11,711,032	23,388,201	13,364,686	$6,745,759
2023	0.98	0.98	39,767,431	12,665,491	27,101,940	15,486,823	$7,416,411
2024	1.06	1.06	45,056,499	13,697,577	31,358,923	17,919,385	$8,141,678
2025	1.14	1.14	51,049,014	14,813,898	36,235,116	20,705,781	$8,925,691
2026	1.23	1.23	57,838,533	16,021,317	41,817,216	23,895,552	$9,772,973
2027	1.33	1.33	65,531,058	17,327,165	48,203,893	27,545,082	$10,688,409
2028	1.43	1.43	74,246,688	18,739,272	55,507,417	31,718,524	$11,677,271
2029	1.54	1.54	84,121,498	20,266,463	63,855,034	36,488,591	$12,745,148
2030	1.67	1.67	95,309,657	21,918,180	73,391,477	41,937,987	$13,898,078
2031	1.72	1.72	100,132,326	22,914,486	77,217,839	44,124,480	$13,873,504
2032	1.79	1.79	105,199,021	23,955,737	81,243,284	46,424,734	$13,848,903
2033	1.85	1.85	110,522,092	25,044,675	85,477,416	48,844,238	$13,824,158
2034	1.91	1.91	116,114,510	26,182,854	89,931,656	51,389,518	$13,799,370
2035	1.98	1.98	121,989,904	27,372,973	94,616,931	54,066,818	$13,774,471
2036	2.05	2.05	128,162,593	28,617,021	99,545,572	56,883,184	$13,749,516
2037	2.12	2.12	134,647,620	29,917,643	104,729,977	59,845,701	$13,724,479
2038	2.20	2.20	141,460,790	31,277,312	110,183,477	62,961,987	$13,699,374
2039	2.27	2.27	148,618,706	32,698,920	115,919,786	66,239,877	$13,674,177
2040	2.35	2.35	156,138,812	34,185,177	121,953,635	69,687,791	$13,648,903
2041	2.45	2.45	164,039,436	35,562,850	128,476,586	73,415,192	$13,642,262
2042	2.55	2.55	172,339,832	36,995,877	135,343,954	77,339,402	$13,635,173
2043	2.65	2.65	181,060,227	38,486,800	142,573,427	81,470,530	$13,627,612
2044	2.75	2.75	190,221,875	40,037,921	150,183,953	85,819,402	$13,619,592
						Par Amount	$330,741,568
					Subtract Reserve Account	10.0%	$33,074,157
					Subtract Capitalized Interest		$15,242,737
					Subtract Expenses	1.5%	$4,961,124
					Estimated Contribution of Tolls to Construction Fund in 2010		**$277,500,000**

[a] Note that toll rates would likely be rounded to the nearest five cents.

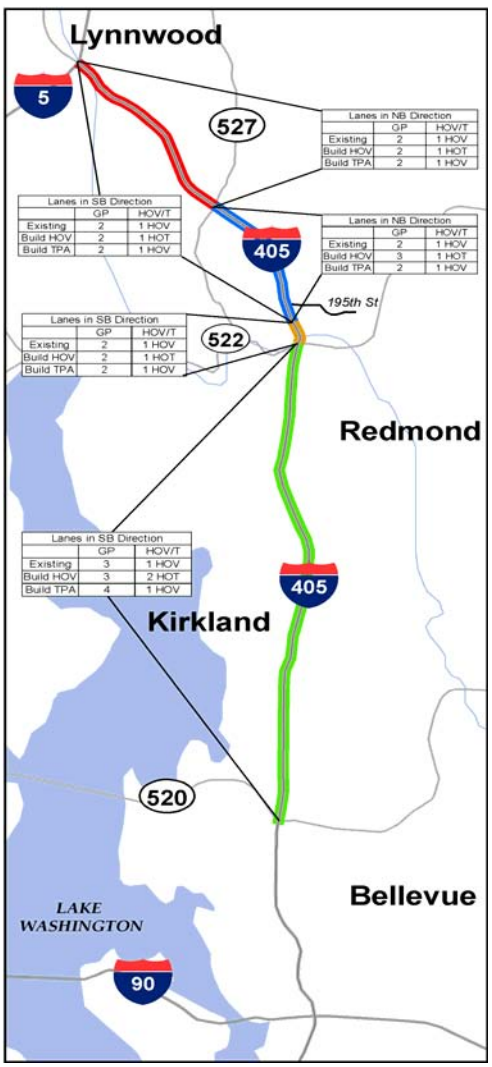
Construction Period	3 years
Bond Sale January 1 of	2010
Earning Period	35 years
Inflation Rate – CPI	3%
Inflation Rate – Costs	3%
Debt Service Coverage Ratio	1.75
Rating	BBB
Bond Interest Rate	5.40%
Assumed Toll Evasion	5%

I-405 North

Description

This project would provide a HOT lanes system on I-405 extending from SR 520 in Bellevue to I-5 in Lynnwood. Two HOT lanes in each direction would extend from a point north of SR 520 to the SR 522 interchange in Bothell. A single HOT lane would continue north from SR 522 to the I-5 Swamp Creek interchange. HOV3+ vehicles could travel for free in the special lanes, and all other vehicles would have to pay the designated toll. The total distance of the project would be about 14 miles. The policy objective of this project was to evaluate a set of HOT lanes that can be implemented in the near term, consistent with current planning efforts, that includes additional capacity, not just conversion of existing HOV lanes.

In order to provide the HOT lanes, additional capacity would be added to the freeway from SR 520 to SR 522, consistent with the "Nickel plus Transportation Partnership Act (TPA)" configuration being designed by the I-405 project team. This design generally would add one lane in each direction between SR 520 and SR 522. This lane would be designated as a HOT lane (combined with the existing HOV lane). In the section between SR 522 and I-5, the scenario would convert the existing HOV lane to a HOT lane without the addition of new lanes, except for a new northbound auxiliary lane between the N.E. 195th Street and SR 527 interchanges.



Access to the HOT lanes would be provided at slip ramps located approximately every two miles between the express toll and general purpose lanes.

Comparison Scenario

Typically, potential transportation improvement projects are compared to a "no build" alternative to evaluate project effectiveness. However, since HOT lanes represent a policy choice of how to provide additional capacity in this corridor, we chose to compare the HOT lane concept to one where the additional capacity was devoted entirely to general purpose traffic. This scenario is called the "Build HOV" condition.

Corridor Analysis Measures

With HOT Lanes, the most direct comparison of performance is to consider the vehicle miles and hours by travelers in special lanes, in the general purpose lanes, and in total between the HOT lane and Build HOV scenarios (see Table 9.5). When VMT and VHT are converted to speed, we can easily see the change in performance in the corridor for different corridor users.

Table 9.5 Comparison of HOT Lanes and Build HOV Scenarios
A.M. Peak Period

	Vehicle Miles Traveled		Vehicle Hours Traveled		Average Speeds	
Scenario/Lanes	SB	NB	SB	NB	SB	NB
Build HOT						
GP Lanes	212,066	136,669	5,247	2,467	40.4	55.4
HOT Lanes	98,119	2,872	1,714	48	57.2	60.0
Total	310,185	139,541	6,961	2,515	44.6	55.5
Build HOV						
GP Lanes	273,257	129,196	9,070	2,280	30.1	56.7
HOV Lane	14,850	2,584	248	43	59.9	60.0
Total	288,107	131,780	9,318	2,323	30.9	56.7
Differences						
GP Lanes	-61,191	7,473	-3,823	187	10.3	-1.3
HOV/T Lane	83,269	288	1,466	5	-2.7	0.0
Total	22,078	7,761	-2,357	192	13.7	-1.2

The HOT lane scenario produces more VMT along the corridor as compared to the Build HOV scenario. It is particularly higher in the southbound, peak direction during the a.m. peak period. Even with higher VMT, the Build HOT scenario has lower VHT, indicating overall better utilization of the available capacity than the Build HOV scenario. When looking at average speeds in the corridor, the HOT lanes are expected to be operating at the same or at slightly slower speeds than the HOV lane since they allow more utilization of the lanes as compared to the HOV lane, while still ensuring free flow conditions through pricing. The significant difference is shown in the general purpose lanes where under the Build HOT scenario average speeds in the peak direction are 10 mph faster in the corridor as compared to the Build HOV scenario. Also, the overall total average speeds are 13.7 miles per hour faster under the Build HOT compared to the Build HOV condition. The value of these time savings was conservatively estimated at $15.6 million per year.

During this same a.m. peak period, the off-peak direction (northbound) shows slightly slower speeds within the general purpose lanes in the Build HOT scenario versus the Build HOV. This is due to a couple of reasons. Since there is little or no congestion in the northbound direction during the a.m. peak period, the minimum toll rate of $0.10 per mile is pricing out most of the non-HOV3+ eligible toll paying traffic demand. This coupled with having one less general purpose lane as compared with the Build HOV scenario causes some degradation in the travel speeds within the general purpose lanes, although they are still estimated to perform at an average speed of 55.4 mph. If we had used a minimum per mile rate of $0.05 we would have likely seen this phenomenon disappear, as much more demand in the off-peak direction would be present in the HOT lanes, therefore reducing the volumes in the general purpose lanes resulting in an average speed of 60 mph in the general purpose lanes

Revenue Estimates

Toll rates by segment for each time period were chosen so as to manage demand within the HOT lanes. The project was divided into three segments for the analysis, with each segment potentially having different per mile toll rates to ensure free flow conditions within each segment. The estimated a.m. peak per mile toll rates needed to manage demand ranged from $0.35 to $0.70 in the southbound direction. Shoulder toll rates ranged from $0.10 to $0.20 per mile. A minimum per mile toll rate of $0.10 was used for all time periods.

Average weekday revenue estimates were calculated for each time period and direction by multiplying the segment VMT by the per mile toll rate for that segment. A.M. peak period average weekday revenue is estimated to be $17,060 as shown in Table 9.6. Peak-period revenue is estimated to account for more than 74 percent of the estimated revenue. Total estimated annual revenue for year 2030 is $12.0 million in year 2000 dollars.

Table 9.6 2030 Estimated Revenue
2000 Dollars

Period	Average Weekday	Average Weekend Day	Annual
A.M. Peak Period	$17,060	$1,706	$4,461,200
Midday Period	$6,968	$697	$1,822,200
P.M. Peak Period	$17,060	$1,706	$4,461,200
Evening Period	$3,862	$386	$1,009,900
Night Period	$972	$97	$254,200
Total Day	$45,922	$4,592	$12,008,700

Costs

This project includes lane additions and HOV lane conversions for I-405 North, between SR 520 North and I-5 (Swamp Creek). The most recent and readily available project cost expressed in 2003 dollars for the I-405 North project is $429 million.

Tolling construction cost estimates were developed for two HOT lanes in each direction, from SR 520 North to SR 522 and a single HOT lane, in each direction, from SR 522 to I-5. A total of 16 access points (tolling zones) for northbound and southbound HOT lanes traffic were considered in cost estimating. It was assumed that the roadway improvement projects will include provision for the fiber optic communication infrastructure for both ITS and tolling purposes. It is similarly assumed that the proposed general-use lanes will have adequate loop detectors for both ITS and dynamic tolling purposes.

An independent operation/toll center for this project would cost an estimated $42.7 million. This includes construction cost of a central host building (containing all the associated equipment, hardware, and software to host the customer service and administrative functions).

If this project was part of a regional toll system with an existing host, in-place and operational, a tolling cost of $20.7 million is estimated. This cost estimate is for construction of the above mentioned tolling collections (16 zones) and interface/modification costs associated with joining an existing operational central host for this region.

Financial Analysis

A financial analysis was performed to estimate the amount of revenue that could be expected to contribute to the corridor improvements. Since HOT lanes have transaction and revenue growth patterns that are not typical of traditional toll facilities, multiple-year forecasts are usually carried out to ensure reflection of the significant elasticity of these projects. In order to perform the financial analysis, forecasts of earlier year transactions and revenue potential were estimated. An assumed 3.75 percent annual rate of growth was assumed between 2010 and 2030 on transactions, with a corresponding 7.5 annual percent growth in revenue. The higher growth assumption on revenue is a result of the need to have real increases in rates beyond inflation to manage demand. These are slightly lower than those assumed for the SR 167/I-405 project, reflecting lower overall growth in the I-405 corridor as compared to the SR 167 corridor. Beyond 2030, conservative growth assumptions of 1.0 and 2.0 percent annually were used on transactions and revenue, respectively. At the selected toll rates and assumed growth rates, it is estimated that $84.0 million (see Table 9.7) could be contributed toward capital improvements, about 20 percent of the cost of highway construction, but more than enough to cover the additional cost of toll collection.

Table 9.7 Financial Analysis of HOT Lanes on I-405 North

	Year of Collection Dollars						
Calendar Year	Passenger Car Toll Rate[a]	Average Toll Rate	Annual Gross Revenue	Annual Operating Expenses	Net Revenue	Senior Lien Debt Service	Present Value
2010						1,746,315	$1,656,846
2011						1,746,315	$1,571,960
2012						1,746,315	$1,491,423
2013						1,746,315	$1,415,012
2014	0.55	0.55	5,425,070	2,369,018	3,056,052	1,746,315	$1,342,516
2015	0.58	0.58	6,006,908	2,531,541	3,475,367	1,985,924	$1,448,502
2016	0.62	0.62	6,651,149	2,705,375	3,945,775	2,254,728	$1,560,307
2017	0.66	0.66	7,364,485	2,890,996	4,473,489	2,556,280	$1,678,354
2018	0.71	0.71	8,154,326	3,089,405	5,064,921	2,894,240	$1,802,890
2019	0.76	0.76	9,028,878	3,301,326	5,727,552	3,272,887	$1,934,305
2020	0.81	0.81	9,997,225	3,527,877	6,469,348	3,696,770	$2,072,887
2021	0.86	0.86	11,069,427	3,770,073	7,299,354	4,171,059	$2,219,009
2022	0.92	0.92	12,256,623	4,028,799	8,227,824	4,701,614	$2,373,116
2023	0.98	0.98	13,571,146	4,305,182	9,265,964	5,294,837	$2,535,619
2024	1.05	1.05	15,026,651	4,600,620	10,426,032	5,957,732	$2,706,898
2025	1.12	1.12	16,638,260	4,916,400	11,721,860	6,698,206	$2,887,412
2026	1.19	1.19	18,422,713	5,253,888	13,168,825	7,525,043	$3,077,646
2027	1.27	1.27	20,398,549	5,614,308	14,784,241	8,448,138	$3,278,159
2028	1.36	1.36	22,586,293	5,999,633	16,586,661	9,478,092	$3,489,388
2029	1.45	1.45	25,008,673	6,411,272	18,597,401	10,627,086	$3,711,949
2030	1.55	1.55	27,690,853	6,851,434	20,839,420	11,908,240	$3,946,342
2031	1.60	1.60	29,092,011	7,162,730	21,929,280	12,531,017	$3,939,970
2032	1.66	1.66	30,564,066	7,488,341	23,075,726	13,186,129	$3,933,537
2033	1.72	1.72	32,110,608	7,828,633	24,281,975	13,875,415	$3,927,094
2034	1.78	1.78	33,735,405	8,184,515	25,550,890	14,600,509	$3,920,602
2035	1.84	1.84	35,442,416	8,556,393	26,886,023	15,363,442	$3,914,107
2036	1.90	1.90	37,235,803	8,945,246	28,290,556	16,166,032	$3,907,572
2037	1.97	1.97	39,119,934	9,351,820	29,768,115	17,010,351	$3,901,002
2038	2.04	2.04	41,099,403	9,776,889	31,322,514	17,898,579	$3,894,403
2039	2.11	2.11	43,179,033	10,221,263	32,957,770	18,833,011	$3,887,778
2040	2.19	2.19	45,363,892	10,685,783	34,678,108	19,816,062	$3,881,132
2041	2.27	2.27	47,659,305	11,116,562	36,542,743	20,881,568	$3,880,284
2042	2.37	2.37	50,070,866	11,564,607	38,506,258	22,003,576	$3,879,298
2043	2.46	2.46	52,604,451	12,030,601	40,573,851	23,185,058	$3,878,175
2044	2.56	2.56	55,266,237	12,515,247	42,750,990	24,429,137	$3,876,919
						Par Amount	$102,822,409
				Subtract Reserve Account		10.0%	$10,282,241
				Subtract Capitalized Interest			$6,985,261
				Subtract Expenses		1.5%	$1,542,336
Estimated Contribution of Tolls to Construction Fund in 2010							**$84,000,000**

[a] Note that toll rates would likely be rounded to the nearest five cents.

Construction Period	3 years
Bond Sale January 1 of	2010
Earning Period	35 years
Inflation Rate – CPI	3%
Inflation Rate – Costs	3%
Debt Service Coverage Ratio	1.75
Rating	BBB
Bond Interest Rate	5.40%
Assumed Toll Evasion	5%

Policy Findings

The policy objective of this project was to evaluate a set of HOT lanes that can be implemented in the near term, consistent with current planning efforts, that includes additional capacity, not just conversion of existing HOV lanes.

As with the SR 167/I-405 concept, this HOT lane idea can provide increased utilization of the highway corridor and provide people a meaningful travel choice and time savings. The toll revenue is not expected to cover the cost of constructing the additional lanes, but it more than covers the additional cost of toll collection.

■ SR 520/I-90

Project Description

SR 520 and I-90 are the only East-West crossings of Lake Washington directly linking Seattle with the fast growing communities on the east (see Exhibit 9.1.)

The SR 520 Evergreen Point Floating Bridge is over 42 years old, does not meet current standards, and is susceptible to damaging windstorms and earthquakes. Two bridge replacement alternatives are being evaluated in an ongoing WSDOT project development process, with both alternatives providing a structure that reduces risks associated with storm and seismic damages. One alternative would have four lanes; the other would have six. All of WSDOT's planning activities have assumed some level of tolling would be required to help pay for the bridge replacement, but these studies did not consider tolling both SR 520 and I-90.

The I-90 bridge is also being studied by WSDOT for future improvements, including alternative uses of the existing center roadway that currently functions as a reversible HOV lane. Some of the alternatives under consideration include converting the center roadway to fixed guideway transit.

For this illustrative analysis in the Tolling Study, we considered an alternative that provided for mobility improvements, including potential use of tolls to manage traffic flow across Lake Washington. The specifics of the scenario included:

- **SR 520 –** A new six-lane bridge with two of those lanes dedicated to HOV2+ traffic. All traffic using the general-purpose lane would be tolled, as well as the HOV traffic that only had two occupants. HOV3+ traffic would be toll free.
- **I-90 –** Improvements were assumed to include the addition of one HOV lane in each direction located on the outside roadway. These lanes would also operate with an HOV2+ definition with HOV2 traffic required to pay a toll. All traffic using the general-purpose lanes would be tolled. The effect of the additional HOV lane would be that there would always be an HOV lane available, even in the reverse-peak direction.

Exhibit 9.1 SR 520 and I-90 Location Map

The policy objective of tolling the facilities is twofold. One is to raise significant revenue to fund the SR 520 bridge reconstruction and the other is to potentially manage traffic demand across Lake Washington.

Toll Analysis

Two pricing options were analyzed under 2030 traffic in which both the SR 520 and I-90 Bridges would be tolled. Under both tolling options, HOV3+ traffic would be toll free. The first pricing option assumed time-of-day pricing where toll rates would vary by facility, time of day, and direction but follow a fixed schedule. This variable pricing mechanism is a tool to manage the amount of traffic crossing the bridge with the aim of providing a free flow ride across Lake Washington during the peaks, while still ensuring significant utilization of the bridge in the off-peak periods through the use of much lower tolls. The second tolling option was to have a $1.50 flat rate toll all day for passenger vehicles. Commercial vehicles under both scenarios were tolled at a proportionately higher rate.

As with the other scenarios, the analysis year was 2030. Toll rates are expressed in 2000 dollars, and would need to be inflated to current dollar levels to have the traffic management effects forecasted.

Variable Pricing Scenario

When studying the variable pricing scenario, the objective was defined as keeping the flow of traffic at a level that would maximize throughput across the lake, assumed to be about 1,600 passenger cars per hour per lane (pcphpl). This would ensure a free flow travel path across the Lake and prevent any breakdowns of traffic flow that may occur when traffic reaches capacity levels and thus diminishes traffic throughput. However, since revenue generation was a secondary objective of this scenario, we set a minimum toll of $0.50 at any time, even though traffic levels were below the 1,600 threshold. If ultimately adopted, there are numerous ways that tolls might be set to achieve these, or similar objectives, including letting traffic go toll free during noncongested periods.

Exhibit 9.2 displays the passenger vehicle toll rate levels (in gray shades) on I-90 westbound that are estimated to be needed to meet the objective described above. The chart shows the 24-hour profiles of toll rates and the forecast volume to capacity ratios in the westbound direction. The pricing profile follows the demand profile with tolls reaching their highest levels of $3.50 during the a.m. peak and $4.25 during the p.m. peak. Six half-hour time periods were analyzed within each of the three-hour a.m. and p.m. peak periods. The a.m. peak is estimated to need a $3.50 toll rate during the 6:30 to 7:00 a.m. timeframe, reducing to a $3.00 toll during the period of 7:00 to 7:30 a.m. and further reducing to a $2.50 toll during the 7:30 to 8:00 a.m. period to meet the demand objective. Volumes shown during the midday, evening, and night periods are shown evenly distributed, because these times were evaluated as larger periods and not as individual hours within those periods. Because the volume to capacity levels are well below the threshold level, these variations are not likely to result in a significant deviation from the $0.50 toll rate shown for these periods.

Exhibit 9.3 displays the forecast toll rates and volume/capacity ratios for the eastbound direction on I-90. Demand is expected to be highest in the eastbound direction during the p.m. peak period resulting in a passenger vehicle toll rate of $5.25 during the 4:30 to 5:00 p.m. period. Tolls in the shoulder periods on either side of the p.m. peak are forecast to range from $2.75 to $4.00. Demand is expected to be much lower in the a.m. peak in the eastbound direction resulting in an estimated toll rate of $2.00 from 6:30 to 7:00 a.m. and $1.00 and $0.75 during the next two half-hour periods.

In practice, it may be more practical to have tolls assessed over slightly longer periods during the peaks than shown while also having smoother transitions in rates from peaks to shoulders, and from shoulder periods to adjacent off-peaks hours. These details would need to be worked out in analysis that is more extensive.

Exhibit 9.2 Forecast 2030 Toll Rates and Volume/Capacity Ratios
I-90 Westbound

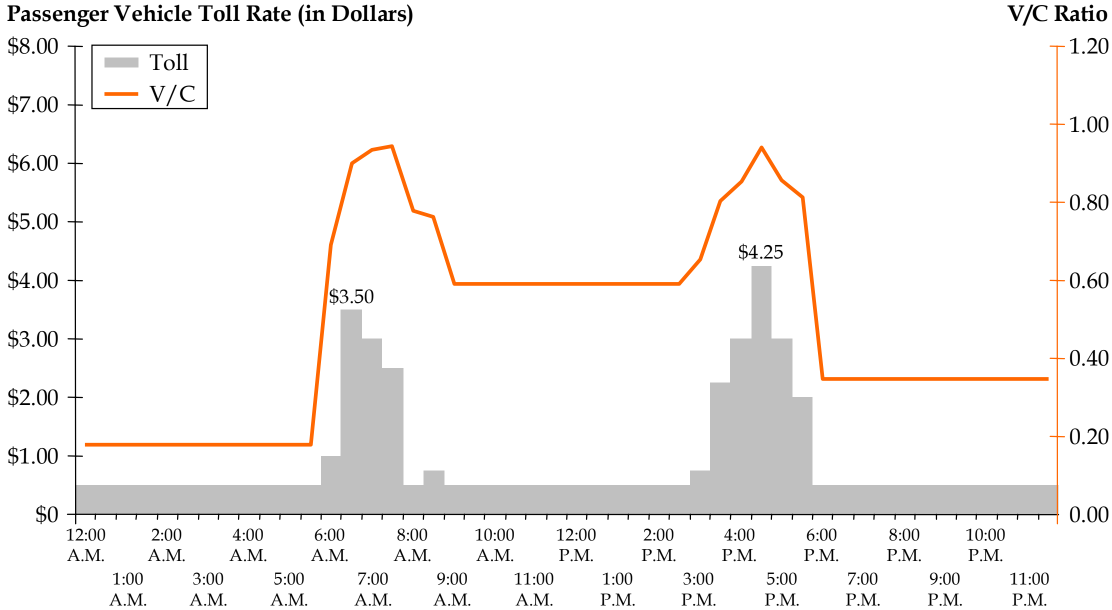


Exhibit 9.3 Forecast 2030 Toll Rates and Volume/Capacity Ratios
I-90 Eastbound

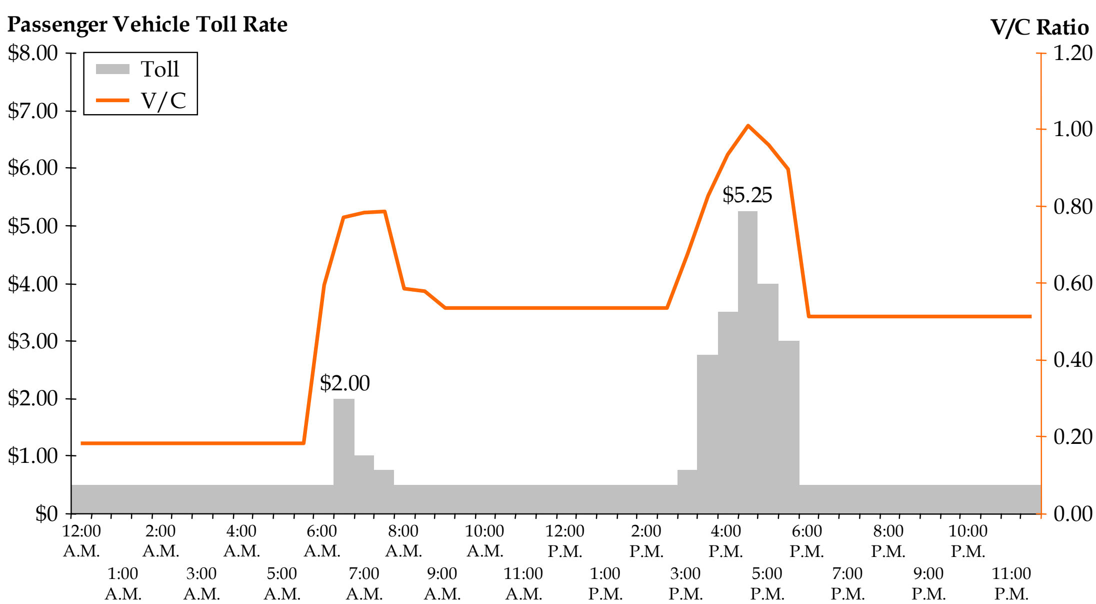


Exhibit 9.4 displays the passenger vehicle toll rate levels (in gray shades) on SR 520 westbound that are estimated to be needed to meet the tolling objective of 1,600 pcphpl. Forecast p.m. peak tolls range from $4.00 to $5.50 during the 3:30 to 6:00 p.m. peak period. The

a.m. peak period follows the demand profile with tolls reaching their highest levels of $3.50 to $4.00 during the 6:30 to 7:30 a.m. hour with shoulder tolls on either side ranging between $1.75 and $2.50.

The eastbound direction results for SR 520 are shown in Exhibit 9.5. The p.m. peak period has the most traffic and thus the highest rates are needed to manage the demand across the facility. The profile of tolls in the p.m. is indicative of the demand build up and the need to keep stepping up the toll to meet the volume to capacity criteria. A maximum toll rate of $5.50 is estimated to be needed during the 4:30 to 5:00 p.m. period with slightly lower tolls in the shoulders.

Flat Rate Pricing Scenario

Under the flat rate pricing scenario, toll rates would remain constant all day. In this case, there may be times when traffic demand exceeds capacity and bottleneck-induced congestion results.

Exhibit 9.4 Forecast 2030 Toll Rates and Volume/Capacity Ratios
SR 520 Westbound

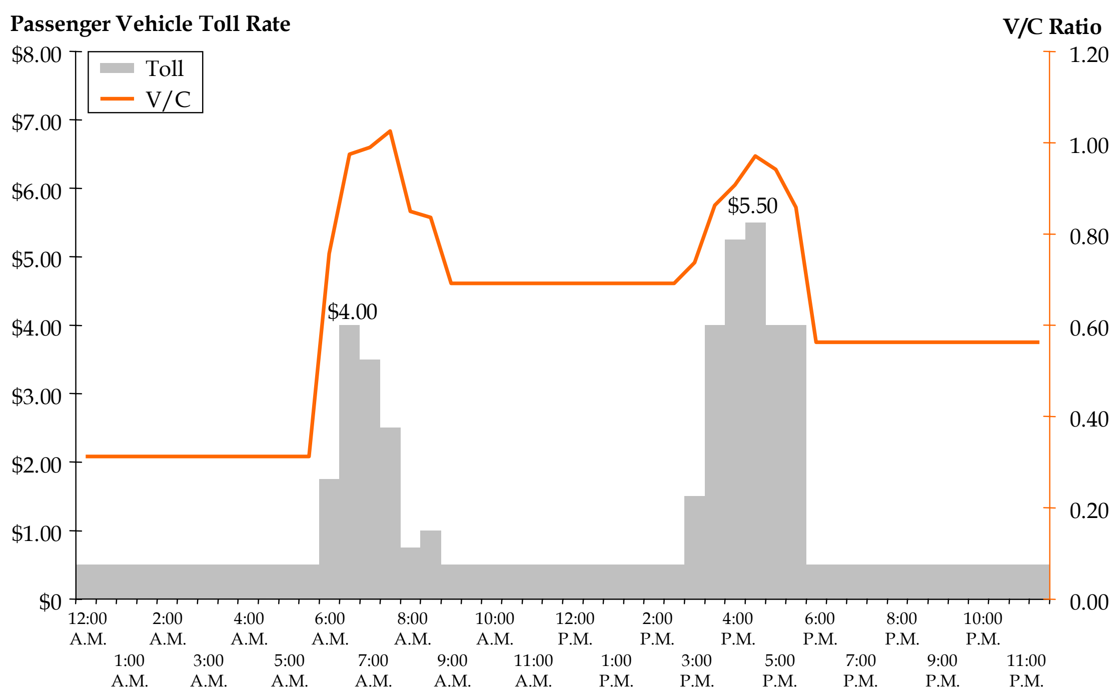
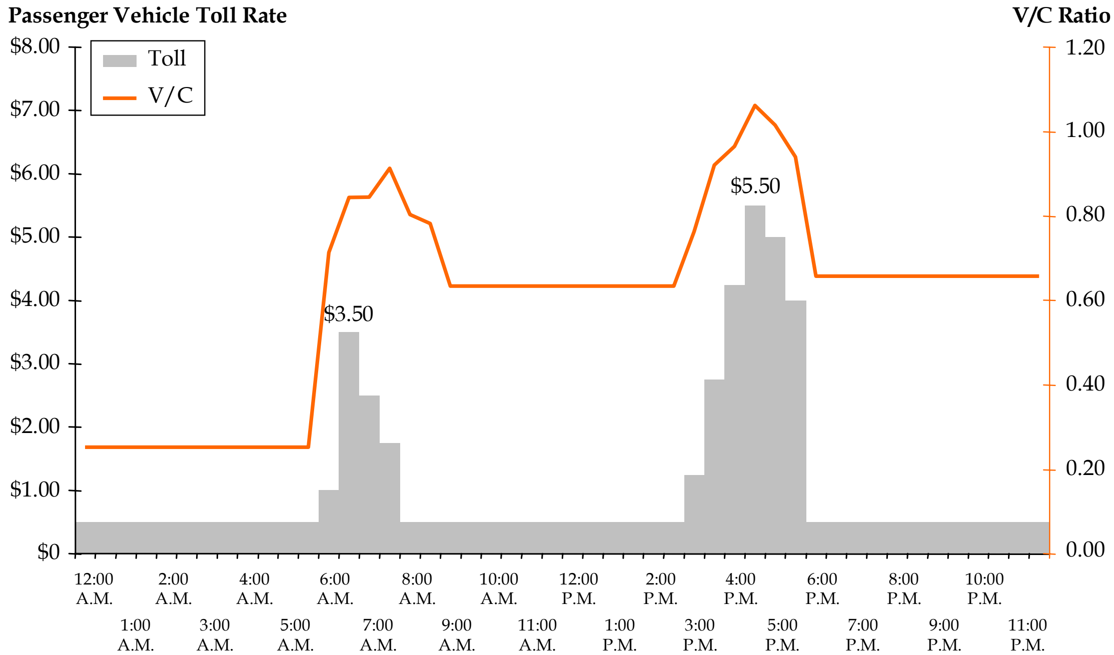


Exhibit 9.5 Forecast 2030 Toll Rates and Volume/Capacity Ratios
SR 520 Eastbound



Composition of Diverted Person Trips

Because the effects of tolling were introduced into the trip distribution and mode choice modeling components of the traffic model in addition to trip assignment, the reduction in traffic is a combination of destination changes, carpool formation, and route diversion (see Table 9.8).

Table 9.8 Expected Composition of Diverted Daily Person Trips

Diversion Type	Variable Toll Pricing	$1.50 Flat Toll
Destination Change	51.4%	60.5%
Alternate Route	16.0%	36.1%
Mode Shift	32.6%	3.4%

Under the variable pricing scenario, the majority of the diversion is expected to be due to a driver changing his or her destination to avoid paying the toll. There is also a significant mode shift forecast, with about one-third of the diversion resulting from low-occupant vehicles (drive-alone and 2+ carpools) forming 3+ carpools to avoid paying the toll while benefiting from a free flow movement across the facility. We attribute the forecast mode shift to the relatively high peak-period toll rates. Only 16 percent of the total expected diversion is related to route diversion due to the alternate routes being fairly unattractive during the peak periods and the use of relatively low off-peak-period tolls where diversion is usually more prevalent.

The high rates of diversion away from the bridge crossings during peak periods is expected to be effective at keeping traffic flowing across the lake. Despite these benefits, however, we found that overall system performance might deteriorate when the toll levels are set so high. This may be possible because the high toll rates are causing drivers to seek alternative destinations and routes, which are also quite congested. Since the regional travel demand model cannot address traffic operational impacts, we cannot verify this finding, but it does signal the need for caution when applying tolling strategies on one part of the system for traffic management purposes.

Under a $1.50 flat toll rate scenario, we expect the majority of the diversion to still be related to a destination change. However, we find the route diversion to play a larger role in the diversion estimates than the variable tolling scenario, reflecting the relatively high tolls in the off-peak periods, when route diversion is more attractive.

Traffic and Revenue Estimates

Average weekday traffic and revenue estimates for the year 2030 are shown in Table 9.9. There is estimated to be 266,840 vehicles using both bridges on an average weekday under the optimized variable pricing option. The flat rate pricing option resulted in 19 percent fewer forecast vehicles than the variable priced scenario. Assuming 250 typical weekdays and 115 typical weekend or holiday days per year, and that weekend days and holidays would carry 50 percent of an average weekday, the optimized variable pricing scenario is forecast to produce $109.4 million in 2030, while a flat rate of $1.50 is forecast to produce $97.6 million. Under both options, SR 520 revenue would account for about 47.6 percent of the total revenue.

Table 9.9 2030 Estimated Traffic and Revenue

	Average Weekday Traffic			Annual Revenue (2000 Dollars)		
Pricing Option	**SR 520**	**I-90**	**Total**	**SR 520**	**I-90**	**Total**
Optimized – Variable	120,650	146,190	266,840	$52,090,500	$57,318,000	$109,408,500
Flat Rate – All Day	104,940	111,030	215,970	$46,524,800	$51,115,700	$97,640,500

Cost Estimates

According to the project fact-sheet as published by WSDOT, the project cost range for the SR 520 project is $2.3 to $2.8 billion in 2013 dollars (midpoint of project construction expenditure period). The duration of construction is expected to be from 2009/2010 to 2015/2017.

Assuming one tolling zone along the bridge with electronic toll collection only (i.e., no cash toll plazas), the additional cost of tolling equipment is estimated to be $27.4 million. This includes construction cost of a central host building containing all the required equipment, hardware, and software in support of customer service and administrative functions.

If this project was part of a regional toll system with an existing host, in-place and operational, then the estimated capital cost of introducing tolling is $5.1 million.

The cost of adding HOV lanes to the I-90 outer roadway, the on and off-ramps on Mercer Island and improving I-90 access at Bellevue Way according to the WSDOT fact-sheet is about $128 million. The additional cost of tolling I-90 is estimated to be $5.1 million and includes the construction of three ETC only toll lanes per direction plus interface/modification costs associated with joining an existing operational host such as the one that would be built for the SR 520.

Financial Analysis

Under the optimized variable pricing scenario, we estimate that $1,029.9 million could be contributed toward capital improvements (see Table 9.10) or about 41 percent of the amount needed for SR 520 alone. Under the assumed flat rate pricing structure, we estimate that $941.7 million could be contributed toward capital improvements as is shown in Table 9.11.

Table 9.10 Financial Analysis of SR 520 and I-90
Optimized Toll Scenario

	Year of Collection Dollars						
Calendar Year	Passenger Car Toll Rate[a]	Average Toll Rate	Annual Gross Revenue	Annual Operating Expenses	Net Revenue	Senior Lien Debt Service	Present Value
2010						63,719,223	$60,454,671
2011						63,719,223	$57,357,372
2012						63,719,223	$54,418,759
2013						63,719,223	$51,630,702
2014	2.06	2.13	137,085,776	25,577,136	111,508,640	63,719,223	$48,985,485
2015	2.13	2.20	142,412,655	26,570,978	115,841,676	66,195,244	$48,281,763
2016	2.19	2.26	147,946,526	27,603,518	120,343,007	68,767,433	$47,588,119
2017	2.26	2.33	153,695,432	28,676,245	125,019,187	71,439,535	$46,904,416
2018	2.32	2.40	159,667,729	29,790,536	129,877,193	74,215,539	$46,230,581
2019	2.39	2.47	165,872,098	30,947,979	134,924,118	77,099,496	$45,566,475
2020	2.46	2.55	172,317,555	32,150,586	140,166,969	80,095,411	$44,911,847
2021	2.54	2.62	179,013,471	33,399,915	145,613,556	83,207,746	$44,266,627
2022	2.61	2.70	185,969,577	34,697,759	151,271,818	86,441,039	$43,630,685
2023	2.69	2.78	193,195,982	36,046,176	157,149,806	89,799,889	$43,003,841
2024	2.77	2.87	200,703,192	37,446,710	163,256,482	93,289,418	$42,386,077
2025	2.86	2.95	208,502,116	38,901,975	169,600,141	96,914,366	$41,777,109
2026	2.94	3.04	216,604,092	40,413,442	176,190,650	100,680,371	$41,176,974
2027	3.03	3.13	225,020,893	41,983,917	183,036,976	104,592,558	$40,585,396
2028	3.12	3.23	233,764,755	43,615,223	190,149,532	108,656,876	$40,002,359
2029	3.22	3.32	242,848,386	45,310,156	197,538,230	112,878,989	$39,427,650
2030	3.31	3.42	252,284,989	47,070,687	205,214,301	117,265,315	$38,861,248
2031	3.41	3.53	261,802,440	48,846,570	212,955,870	121,689,069	$38,261,160
2032	3.51	3.63	271,678,937	50,689,217	220,989,721	126,279,840	$37,670,378
2033	3.62	3.74	281,928,025	52,601,643	229,326,382	131,043,647	$37,088,674
2034	3.73	3.85	292,563,760	54,585,927	237,977,833	135,987,333	$36,515,999
2035	3.84	3.97	303,600,727	56,645,302	246,955,425	141,117,386	$35,952,131
2036	3.96	4.09	315,054,065	58,782,012	256,272,053	146,441,173	$35,397,020
2037	4.07	4.21	326,939,480	60,999,525	265,939,955	151,965,688	$34,850,454
2038	4.20	4.34	339,273,271	63,300,875	275,972,396	157,698,512	$34,312,304
2039	4.32	4.47	352,072,356	65,688,890	286,383,465	163,647,695	$33,782,483
2040	4.45	4.60	365,354,285	68,167,130	297,187,155	169,821,232	$33,260,827
2041	4.59	4.74	378,196,488	70,563,253	307,633,235	175,790,420	$32,665,977
2042	4.72	4.88	391,490,095	73,043,524	318,446,571	181,969,469	$32,081,774
2043	4.86	5.03	405,250,972	75,610,886	329,640,086	188,365,763	$31,508,026
2044	5.01	5.18	419,495,543	78,268,754	341,226,790	194,986,737	$30,944,516
						Par Amount	$1,451,739,879
					Subtract Reserve Account	10.0%	$145,173,988
					Subtract Capitalized Interest		$254,876,891
					Subtract Expenses	1.5%	$21,776,098
			Estimated Contribution of Tolls to Construction Fund in 2010				**$1,029,900,000**

[a] Note that toll rates would likely be rounded to the nearest five cents.

Construction Period	3 years
Bond Sale January 1 of	2010
Earning Period	35 years
Inflation Rate – CPI	3%
Inflation Rate – Costs	3%
Debt Service Coverage Ratio	1.75
Rating	BBB
Bond Interest Rate	5.40%
Assumed Toll Evasion	5%

Table 9.11 Financial Analysis of SR 520 and I-90
Flat Rate Toll Scenario

	Year of Collection Dollars						
Calendar Year	Passenger Car Toll Rate[a]	Average Toll Rate	Annual Gross Revenue	Annual Operating Expenses	Net Revenue	Senior Lien Debt Service	Present Value
2010						58,264,682	$55,279,585
2011						58,264,682	$52,447,424
2012						58,264,682	$49,760,364
2013						58,264,682	$47,210,972
2014	2.27	2.39	122,340,802	20,377,609	101,963,194	58,264,682	$44,792,193
2015	2.34	2.46	127,094,721	21,169,505	105,925,216	60,528,695	$44,148,672
2016	2.41	2.53	132,033,368	21,992,020	110,041,348	62,880,770	$43,514,458
2017	2.48	2.61	137,163,921	22,846,652	114,317,269	65,324,154	$42,889,295
2018	2.55	2.69	142,493,836	23,734,300	118,759,536	67,862,592	$42,273,183
2019	2.63	2.77	148,030,862	24,656,575	123,374,287	70,499,593	$41,665,874
2020	2.71	2.85	153,783,045	25,614,811	128,168,234	73,238,991	$41,067,251
2021	2.79	2.94	159,758,747	26,610,026	133,148,721	76,084,983	$40,477,308
2022	2.87	3.03	165,966,652	27,644,007	138,322,645	79,041,511	$39,895,811
2023	2.96	3.12	172,415,784	28,718,249	143,697,535	82,112,877	$39,322,644
2024	3.05	3.21	179,115,517	29,834,303	149,281,214	85,303,551	$38,757,695
2025	3.14	3.31	186,075,587	30,993,567	155,082,021	88,618,298	$38,200,903
2026	3.23	3.41	193,306,113	32,197,908	161,108,205	92,061,831	$37,652,102
2027	3.33	3.51	200,817,601	33,449,058	167,368,543	95,639,167	$37,111,182
2028	3.43	3.61	208,620,972	34,748,817	173,872,155	99,355,517	$36,578,036
2029	3.53	3.72	216,727,566	36,099,049	180,628,517	103,216,295	$36,052,555
2030	3.64	3.83	225,149,165	37,501,691	187,647,475	107,227,128	$35,534,634
2031	3.75	3.95	233,642,918	38,916,501	194,726,417	111,272,238	$34,985,927
2032	3.86	4.07	242,457,097	40,384,765	202,072,331	115,469,904	$34,445,679
2033	3.98	4.19	251,603,791	41,908,223	209,695,568	119,826,039	$33,913,807
2034	4.10	4.31	261,095,544	43,489,200	217,606,343	124,346,482	$33,390,139
2035	4.22	4.44	270,945,373	45,129,852	225,815,521	129,037,441	$32,874,553
2036	4.35	4.58	281,166,787	46,832,410	234,334,377	133,905,358	$32,366,927
2037	4.48	4.72	291,773,804	48,599,192	243,174,612	138,956,921	$31,867,139
2038	4.61	4.86	302,780,971	50,432,599	252,348,372	144,199,070	$31,375,073
2039	4.75	5.00	314,203,383	52,335,121	261,868,262	149,639,007	$30,890,610
2040	4.89	5.15	326,056,706	54,309,341	271,747,365	155,284,208	$30,413,637
2041	5.04	5.31	337,517,599	56,218,501	281,299,098	160,742,342	$29,869,692
2042	5.19	5.47	349,381,342	58,194,370	291,186,972	166,392,556	$29,335,516
2043	5.35	5.63	361,662,097	60,239,977	301,422,120	172,241,211	$28,810,865
2044	5.51	5.80	374,374,519	62,357,414	312,017,105	178,295,489	$28,295,604
						Par Amount	$1,327,467,308
					Subtract Reserve Account	10.0%	$132,746,731
					Subtract Capitalized Interest		$233,058,728
					Subtract Expenses	1.5%	$19,912,010
	Estimated Contribution of Tolls to Construction Fund in 2010						**$941,700,000**

[a] Note that toll rates would likely be rounded to the nearest five cents.

Construction Period	3 years
Bond Sale January 1 of	2010
Earning Period	35 years
Inflation Rate – CPI	3%
Inflation Rate – Costs	3%
Debt Service Coverage Ratio	1.75
Rating	BBB
Bond Interest Rate	5.40%
Assumed Toll Evasion	5%

Policy Findings

This policy objective of this scenario tests the potential of tolling more than one facility as a system to both manage traffic and raise revenue. Pricing can be effective at managing flow on an individual facility or system of facilities. However, changes in travel patterns at other locations around the network could offset any of the gains in that one particular corridor. This emphasizes the policy recommendation that system impacts be fully considered. More moderate levels of time-of-day pricing may be effective at encouraging some changes in travel behavior without disrupting the rest of the system.

One question we have not definitively answered is whether tolling both SR 520 and I-90 is needed to maintain balance in the trans-Lake system. As traffic grows over the next decade or two, congestion on both sides of Lake Washington will be such that I-90 will be less of a diversion route for most trips. Regardless, there is a compelling argument that the entire Trans-Lake corridor should be treated as a system, including transit, and that a consistent policy on tolls should be applied if only to achieve geographic equity.

The issues associated with tolling an existing corridor are considerable. Further research into the traffic operations of the corridor is needed before coming up with a tolling strategy that maximizes the benefits of the infrastructure improvements as well as the tolling.

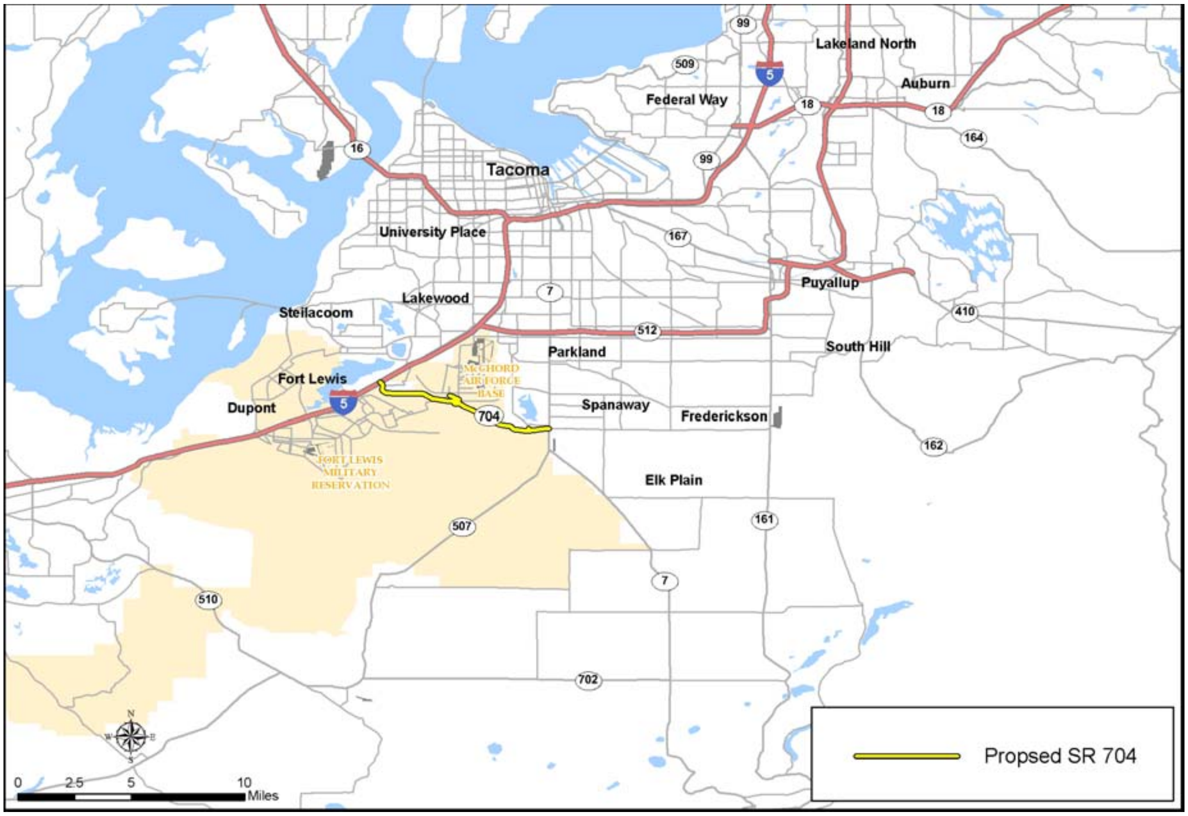
■ SR 704 – Cross Base Highway

Project Description

The Cross-Base Highway (SR 704) would be a new six-mile-long, four-lane highway connecting I-5 at the Thorne Lane interchange at the west end with 176th Street at SR 7 at the eastern terminus. Shown in Exhibit 9.6, it is intended to improve the transportation system linkage between eastern Pierce County and the I-5 corridor for the efficient movement of people and goods. The policy objective of this project was to fund a new highway project through the use of tolling.

SR 704 would have four intermediate access locations with three of the four having signalized intersections. The easternmost intermediate access point would be a signalized intersection at the southward extension of Spanaway Loop. Moving west, there would be a full interchange at A Street, allowing access to and from the McChord Air Force Base and the Fort Lewis Military Reservation. West of this interchange would be the proposed toll collection point, with two more signalized intersections provided at Woodbrook Drive and 150th Street S.W. at the west end of the project.

Exhibit 9.6 SR 704 Cross-Base Highway Regional Location Map



A few of the characteristics of the proposed project have a bearing on the traffic and revenue potential. One is that the limited access portion of the project is four miles long, and that the design speed is 50 miles per hour, relatively slow for a new toll project. The other is that the tolling location has been set to allow drivers to and from the military bases to use the project for free. Traffic to and from the east headed to the bases could exit at A Street before encountering a toll collection point. Traffic to and from the west could exit at Woodbrook Drive or 150th Street S.W., also before passing the toll collection point. In practice, then, the project is set up to toll only the through movements. Also, military personnel could potentially use part of the project to and from the east, exit at A Street, and proceed through McChord Air Force base to get to I-5 at Bridgeport Way. This movement would require passing through military checkpoints with proper military ID.

The new route is intended to help reduce traffic volumes and congestion on Interstate 5, State Routes 512 and 7, Spanaway Loop Road, and 174th Street by providing a more direct travel route through the Fort Lewis and McChord Military Bases.

Project Setting

The I-5 freeway has six lanes south of the Thorne Lane interchange increasing to eight lanes north of the interchange. Current average daily traffic volumes range between 100,000 and 145,000 vehicles on I-5 between SR 510 and SR 512, with volumes steadily increasing as one heads northward. SR 7 is a five-lane arterial connecting SR 512 at the north and SR 507 at the south with average daily traffic volumes of around 40,000 vehicles. Extensive traffic congestion is common on this route. SR 512 is a six-lane limited-access highway with average daily volumes of about 90,000 vehicles between I-5 and SR 7.

Traffic and Revenue Analysis

The regional transportation model developed by PSRC and modified by WSDOT was used to estimate changes in travel that would result from implementation of SR 704 as a toll road. It should be noted that the travel model used for this analysis has been extensively updated since the last published traffic studies were prepared.

The base year (2000) model was reviewed against available count data indicating the study area to be reasonably validated. The project configuration was coded into the future year (2030) highway network and the full model was run multiple times under a toll free condition and a range of toll rate levels.

The following sections of this report focus on toll sensitivity analysis, average weekday traffic estimates, travel time benefits, and cost and financial feasibility estimates.

Toll Sensitivity

The analysis of traffic was done at 2030 levels. The project was first evaluated as under toll-free conditions, and then several toll rates were tested. Since funding is the primary objective for potentially tolling the Cross Base Highway, we developed a recommended toll schedule that sought to maximize revenue.

If Cross Base Highway were built as a toll-free facility, the average weekday traffic is expected to be 20,100 vehicles in 2030 at the proposed toll collection point. Toll rates ranging from $0.05 to $0.30 per mile for passenger cars were tested to understand the relationship of toll rate to traffic. These toll sensitivity tests were done with currency values at year 2000 levels, which is consistent with how currency is handled in the PSRC model. When these values are then used to consider financial performance, we have assumed that toll rates would increase over time to generally match the rate of inflation, meaning that the actual toll that someone might pay in 2030 would be considerably higher than the rates shown.

Toll rates for trucks would be proportionally higher, based upon the relationship between passenger car and truck tolls anticipated at the Tacoma Narrows Bridge. A five-axle truck would pay 2.5 times the amount that a passenger car would pay at any given toll rate.

The top portion of Exhibit 9.7 shows the estimated average weekday revenue that could be expected over the range of toll rates, while the bottom portion shows the number of average weekday transactions. As toll rates increase, traffic would be expected to decrease, but would yield rising revenue through a toll rate of $1.25, after which additional toll increases would be expected to result in declining revenue. A toll rate of $1.00 would be an appropriate toll to select, just short of the maximum revenue level, but leaving room for additional toll increases should additional revenue be needed. At this toll rate, a full length trip on the facility, covering about 6.0 miles would pay about $0.167 per mile. This per-mile toll rate is in the range of per-mile rates for recently opened toll facilities around the country.

At the chosen $1.00 toll rate there are estimated to be 11,500 average weekday users at the toll collection point, about 57 percent of the toll-free level.

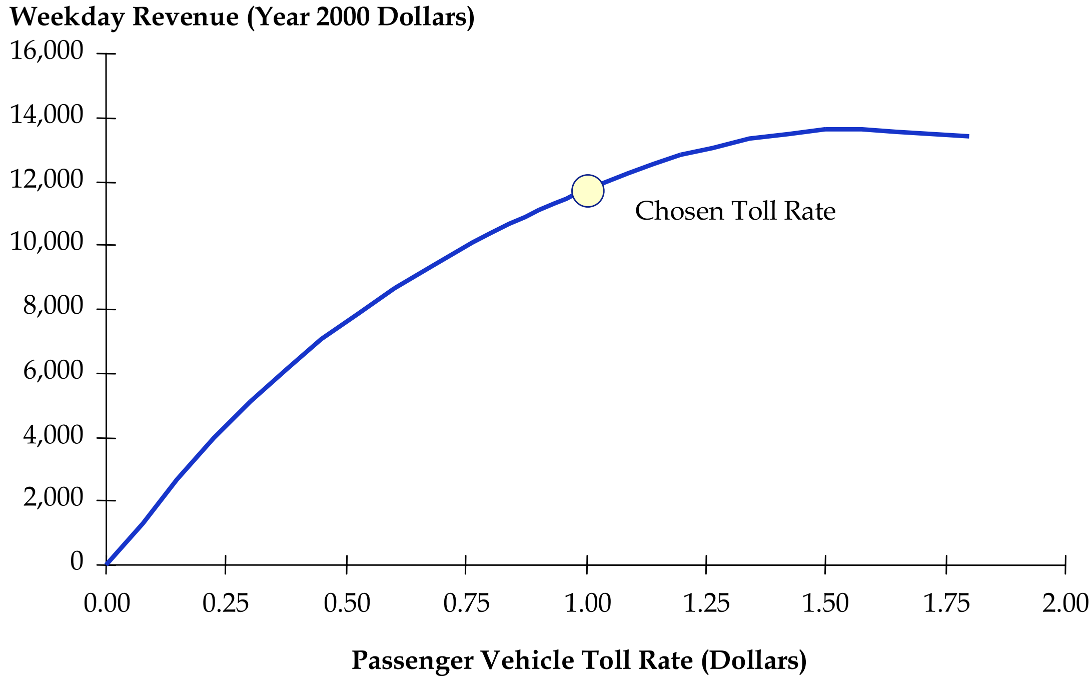
Estimated Average Weekday Traffic

Average weekday traffic along the mainline sections of SR 704 in 2030 at the recommended toll rate are shown in Exhibit 9.8. At the west end of the facility the average weekday volume is estimated to be 18,500 vehicles, while east of the A Street intersection traffic is estimated to be 29,400 vehicles, with 11,500 vehicles passing through the toll collection point. The large variation in volumes west and east of A Street is due to military traffic accessing SR 704 to and from the east at the A Street interchange. The tolling zone was proposed at this location just to allow this toll-free movement.

Time-Distance Relationships

The main reason people will be willing to pay a toll to use a new facility is that the travel time savings provided by the project outweigh the toll cost. A saving in travel distance and a sense of increased safety are other reasons for choosing a toll road over a free facility. We compared the travel times expected by typical combinations of movements between surrounding local communities for trips that might choose to use the SR 704 or an alternate toll free travel routing, based on the results of the 2030 travel demand model.

Exhibit 9.7 SR 704 Toll Sensitivity
2030 Estimated Average Weekday Revenue and Transactions



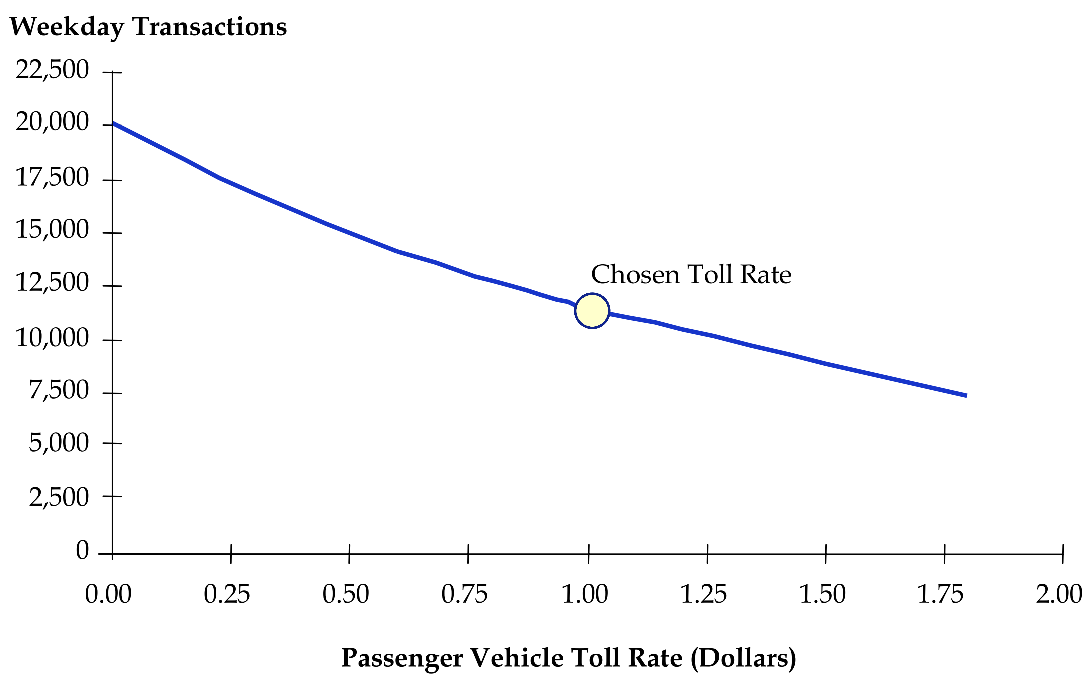


Exhibit 9.8 Estimated Average Weekday Traffic
2030 Levels

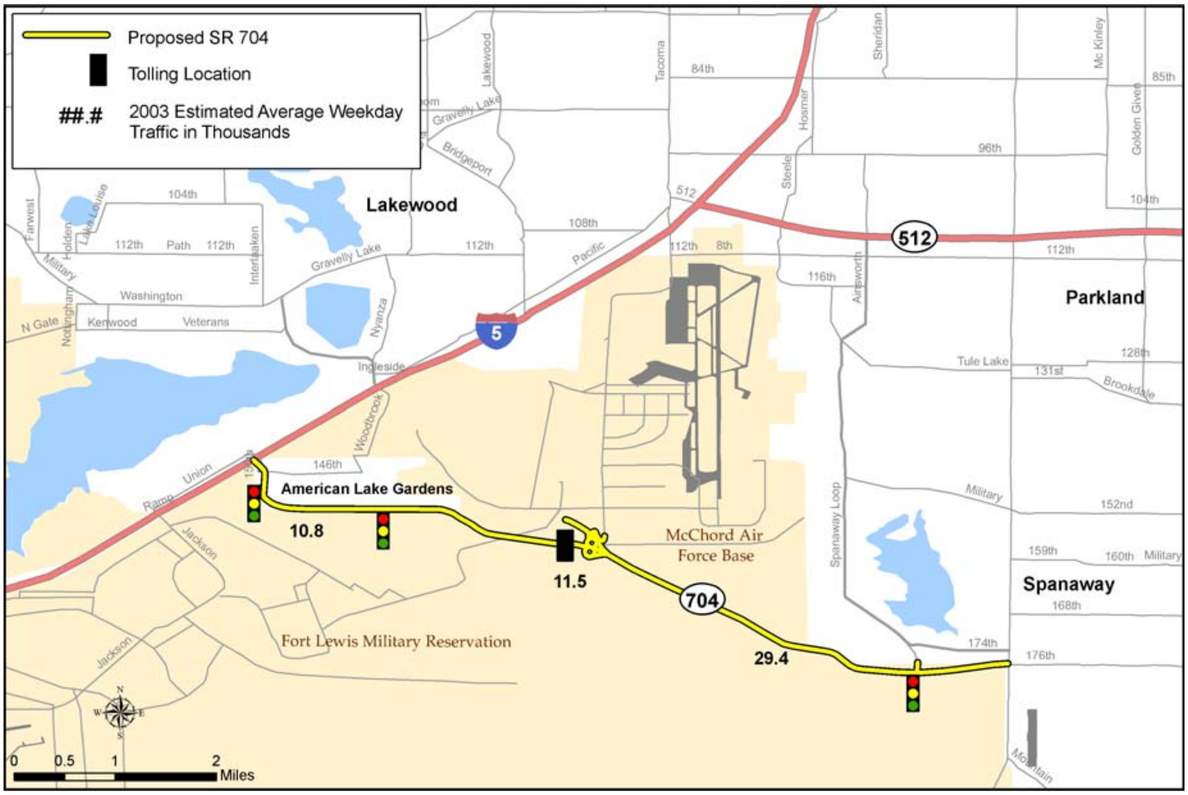


Table 9.12 shows the combinations of movements and the estimated time and distance savings that the SR 704 would provide. The names of the cities used to create the table of movements are listed at the bottom of the table and can be located by referring back to the regional location map of Exhibit 9.6. For example, a trip from Dupont to Frederickson is estimated to save about 8.6 minutes and 4.6 miles. These represent time savings of 30.0 percent and distance savings of 30.9 percent.

The time savings is attributed solely to the distance savings as both the toll path and non-tolled path average about 31 mph. Note that the toll routing for a through trip would encounter several signalized intersections on SR 704 itself. In addition, the relatively high volume of traffic entering eastbound from A Street during the p.m. peak period is expected to reduce speeds along this segment.

Table 9.12 Typical Time-Distance Relationships
2030 Levels

Movement	Routing	P.M. Peak Period Time (Minutes)	Time Savings (Minutes)	Percent Savings	Distance (Miles)	Distance Savings (Miles)	Percent Savings
	SR 704	20.1			10.3		
D-F			8.6	30.0		4.6	30.9
	Alternate	28.8			14.9		
	SR 704	14.1			10.3		
F-D			5.9	29.5		4.2	28.9
	Alternate	20.0			14.5		
	SR 704	29.3			13.9		
S-F			4.9	14.4		1.0	6.9
	Alternate	34.3			15.0		
	SR 704	23.4			13.9		
F-S			1.8	7.0		0.4	2.7
	Alternate	25.1			14.3		
	SR 704	23.3			11.4		
L-F			2.5	9.8		-1.1	-10.9
	Alternate	25.8			10.3		
	SR 704	16.6			11.4		
F-L			-0.4	-2.2		-1.8	-18.5
	Alternate	16.2			9.6		

Note: D = Dupont, S = Steilacoom, L = Lakewood, F = Frederickson.

Revenue Estimates

The financial performance of a toll project depends on early year revenue even more than revenue at a distant time horizon. This is especially important in the case of brand new highways without a demonstrated traffic history. For purposes of this preliminary feasibility study, we assumed that the Cross Base Highway would open in 2010. We estimated 2010 traffic by evaluating the traffic expected to use Cross Base Highway were it to have opened in 2000. We found that the average annual growth rate from 2000 to 2030 was 1.9 percent, which we applied to the 2030 revenue estimates to develop a revenue stream.

We used an average toll rate of $1.02 per vehicle, which reflects the estimate of less than 2 percent trucks that are expected to use the highway. Medium and heavy trucks are assumed to pay 1.5 and 2.5 times the passenger vehicle toll rate, respectively.

Annual revenue estimates were calculated by multiplying the average weekday estimates by 250 nonholiday weekdays and 115 weekend or holiday days. The weekends and holidays were assumed to generate 65 percent of the traffic expected on weekdays.

Estimated weekday transactions at the toll collection point are expected to be 7,900 in 2010 and 11,500 in 2030 (see Table 9.13). These transactions would generate $2.6 million per year in 2010 and $3.8 million per year in 2030, both expressed in 2000 dollars.

Table 9.13 Estimated Transactions and Toll Revenue

Average Weekday	**2010**	**2030**
Transactions	7,900	11,500
Average Toll	$1.02	$1.02
Revenue (2000 Dollars)	$8,058	$11,730
Average Weekend Day		
Transactions	5,100	7,500
Average Toll (2000 Dollars)	$1.02	$1.02
Revenue (2000 Dollars)	5,202	$7,650
Annual Transactions	2,561,500	3,737,500
Annual Revenue (2000 Dollars)	2,613,000	3,812,000

Cost Estimates

According to the latest project fact-sheet by WSDOT, preliminary designs are scheduled to finish by the fall of 2006. More than $41 million of funds have been committed with a remaining shortfall of $216 million.

Assuming one tolling zone with two ETC only toll lanes per direction, a stand-alone project tolling cost of $26.7 million is estimated. This includes construction cost of a central host building (containing all the associated equipment, hardware, and software to host the customer service and administrative functions). If this project was part of a regional toll system with an existing central host, in-place and operational, then a tolling cost of $4.3 million is estimated. This cost estimate includes construction of two ETC only toll lanes per direction plus interface/modification costs associated with joining an existing operational central host.

Financial Analysis

A financial analysis was performed to estimate the amount of revenue that could be expected to contribute to Cross Base project. At the selected, it is estimated that $35.1 million could be contributed toward capital improvements in the corridor (see Table 9.14). This falls well short of the estimated cost to construct the facility. It should be noted that this project is tolling only through trip users of the facility, and therefore, revenue potential could be significantly higher if this assumption was changed.

Equity Analysis

New facility tolls provide a mobility option that does not currently exist. Provided the facility itself is warranted, the only question that pertains to mobility is how toll operations affect the community's mobility options and efficiency. In the case of SR 704, low-income communities exist within a couple of miles, primarily along the I-5 corridor. These communities have an unusually high concentration of households below the poverty level. This, alone, raises the issue of environmental justice.

However, the existing Perimeter Road route is not sustainable and is not a comparative option to the SR 704. As a result mobility for these communities has not been harmed by toll operations, and have actually benefited when situational value of time exceeds the toll charge. The time-distance relationship analysis shows certain scenarios whereby the new facility reduces net distance traveled. When valued at the total cost of ownership per mile (generally $0.30 to $0.45 per mile), paying the facility toll as opposed to driving the additional distance evokes a net economic benefit, regardless of income. Furthermore, to the extent this facility reduces traffic on SR 7 and SR 512, positive spillover effects will be realized for regular travelers of these corridors.

Table 9.14 SR 704 Financial Analysis

	Year of Collection Dollars						
Calendar Year	Passenger Car Toll Rate[a]	Average Toll Rate	Annual Gross Revenue	Annual Operating Expenses	Net Revenue	Senior Lien Debt Service	Present Value
2008						1,691,415	$1,604,758
2009						1,691,415	$1,522,541
2010						1,691,415	$1,444,536
2011	1.38	1.41	3,501,904	541,928	2,959,976	1,691,415	$1,370,528
2012	1.43	1.45	3,676,039	568,879	3,107,161	1,775,520	$1,364,968
2013	1.47	1.50	3,858,866	597,253	3,261,613	1,863,779	$1,359,411
2014	1.51	1.54	4,050,791	626,968	3,423,822	1,956,470	$1,353,907
2015	1.56	1.59	4,252,238	658,085	3,594,153	2,053,802	$1,348,446
2016	1.60	1.64	4,463,651	690,826	3,772,825	2,155,900	$1,342,960
2017	1.65	1.69	4,685,492	725,270	3,960,223	2,262,985	$1,337,444
2018	1.70	1.74	4,918,244	761,328	4,156,916	2,375,381	$1,331,946
2019	1.75	1.79	5,162,409	799,073	4,363,337	2,493,335	$1,326,458
2020	1.81	1.84	5,418,514	838,758	4,579,756	2,617,004	$1,320,920
2021	1.86	1.90	5,687,107	880,477	4,806,629	2,746,645	$1,315,328
2022	1.92	1.95	5,968,758	924,137	5,044,621	2,882,641	$1,309,729
2023	1.97	2.01	6,265,940	969,820	5,296,119	3,026,354	$1,304,578
2024	2.03	2.07	6,577,512	1,017,820	5,559,692	3,176,967	$1,299,338
2025	2.09	2.14	6,904,128	1,068,455	5,835,673	3,334,670	$1,293,963
2026	2.16	2.20	7,246,470	1,121,643	6,124,827	3,499,901	$1,288,499
2027	2.22	2.27	7,605,249	1,177,283	6,427,966	3,673,123	$1,282,990
2028	2.29	2.33	7,983,380	1,235,481	6,747,899	3,855,943	$1,277,844
2029	2.36	2.40	8,379,593	1,297,054	7,082,540	4,047,166	$1,272,499
2030	2.43	2.48	8,790,088	1,360,723	7,429,365	4,245,351	$1,266,425
2031	2.50	2.55	9,189,598	1,422,546	7,767,052	4,438,315	$1,256,156
2032	2.58	2.63	9,607,265	1,487,368	8,119,897	4,639,941	$1,245,940
2033	2.65	2.71	10,043,915	1,554,799	8,489,116	4,850,924	$1,235,858
2034	2.73	2.79	10,500,411	1,625,484	8,874,928	5,071,387	$1,225,830
2035	2.81	2.87	10,977,655	1,699,573	9,278,082	5,301,761	$1,215,859
2036	2.90	2.96	11,476,589	1,776,645	9,699,945	5,542,826	$1,206,017
2037	2.99	3.04	11,998,200	1,857,408	10,140,792	5,794,738	$1,196,232
2038	3.07	3.14	12,543,518	1,941,726	10,601,793	6,058,167	$1,186,540
2039	3.17	3.23	13,113,621	2,030,064	11,083,557	6,333,461	$1,176,905
2040	3.26	3.33	13,709,635	2,122,282	11,587,354	6,621,345	$1,167,363
2041	3.36	3.43	14,262,134	2,207,790	12,054,344	6,888,197	$1,152,192
2042	3.46	3.53	14,836,898	2,296,864	12,540,034	7,165,734	$1,137,206
						Par Amount	$45,342,114
	Subtract Reserve Account					10.0%	$4,534,211
	Subtract Capitalized Interest						$5,074,245
	Subtract Expenses					1.5%	$680,132
	Estimated Contribution of Tolls to Construction Fund in 2008						**$35,100,000**

[a] Note that toll rates would likely be rounded to the nearest five cents.

Construction Period	3 years
Bond Sale January 1 of	2008
Earning Period	35 years
Inflation Rate – CPI	3%
Inflation Rate – Costs	3%
Debt Service Coverage Ratio	1.75
Rating	BBB
Bond Interest Rate	5.40%
Assumed Toll Evasion	5%

Snoqualmie Pass

Project Description

Interstate 90 (I-90) is the principal east-west highway corridor in Washington State connecting the Puget Sound region to the farms and industries in Eastern Washington, as well as to the rest of the United States. I-90 crosses the Cascade Mountains at the Snoqualmie Pass (see Exhibit 9.9). This connection is vital and directly impacts the health of the State's economy. Snoqualmie Pass travelers experience periodic delays due to avalanche closures and rock slides, and deteriorating pavement conditions. There is also occasional congestion during periods of high recreational traffic. Wildlife crossings and low-clearance bridges are also a significant safety issue common to this stretch of I-90.

WSDOT has improvement plans for the Snoqualmie Pass that include capacity improvements such as a widening to a six-lane freeway, longer truck climbing lanes, reconstructed interchanges, and other safety improvements to increase slope stability and sight distance. Cost estimates for needed improvements range from $300 million to $600 million. The high cost of improvements in this corridor is similar to the cost of major bridge improvements, such as Tacoma Narrows or SR 520, leading to the suggestion that tolls might be an effective way to provide funds to accelerate construction of the desired improvements.

In analyzing I-90 as a toll road, one-way toll collection points were assumed to be located on each side of the pass. The eastbound tolling location would be located east of North Bend, while the westbound tolling location would be near Cle Elum. The intent of this configuration is to allow tolls to be collected from all traffic using the Pass, even if one end of the trip terminates in the pass area itself, for example at the ski area at the top. The policy objective of this project was funding a highway improvement, maintenance, and operations project.

Historical Traffic Counts

In 2004, the pass carried 27,000 vehicles on an average daily basis. This is almost triple of all other passes in Washington combined (refer back to Exhibit 9.9). I-90 is also a major freight corridor with commercial vehicles consisting of about 15 percent of the average weekday traffic. The closest pass to I-90 is Stevens Pass on SR 2 that carries 4,500 vehicles on an average day, while the less competitive crossings of North Cascades or Rainy Pass (SR 20) and SR 12/SR 410 (Chinook Pass and White Pass) carry about 1,800 and 4,300 vehicles on an average day, respectively. Rainy Pass and Chinook Pass are closed in the winter.

Table 9.15 displays historical count data from WSDOT's automated data collection sites along I-90 as well as the average annual growth rates.

Exhibit 9.9 Snoqualmie Pass

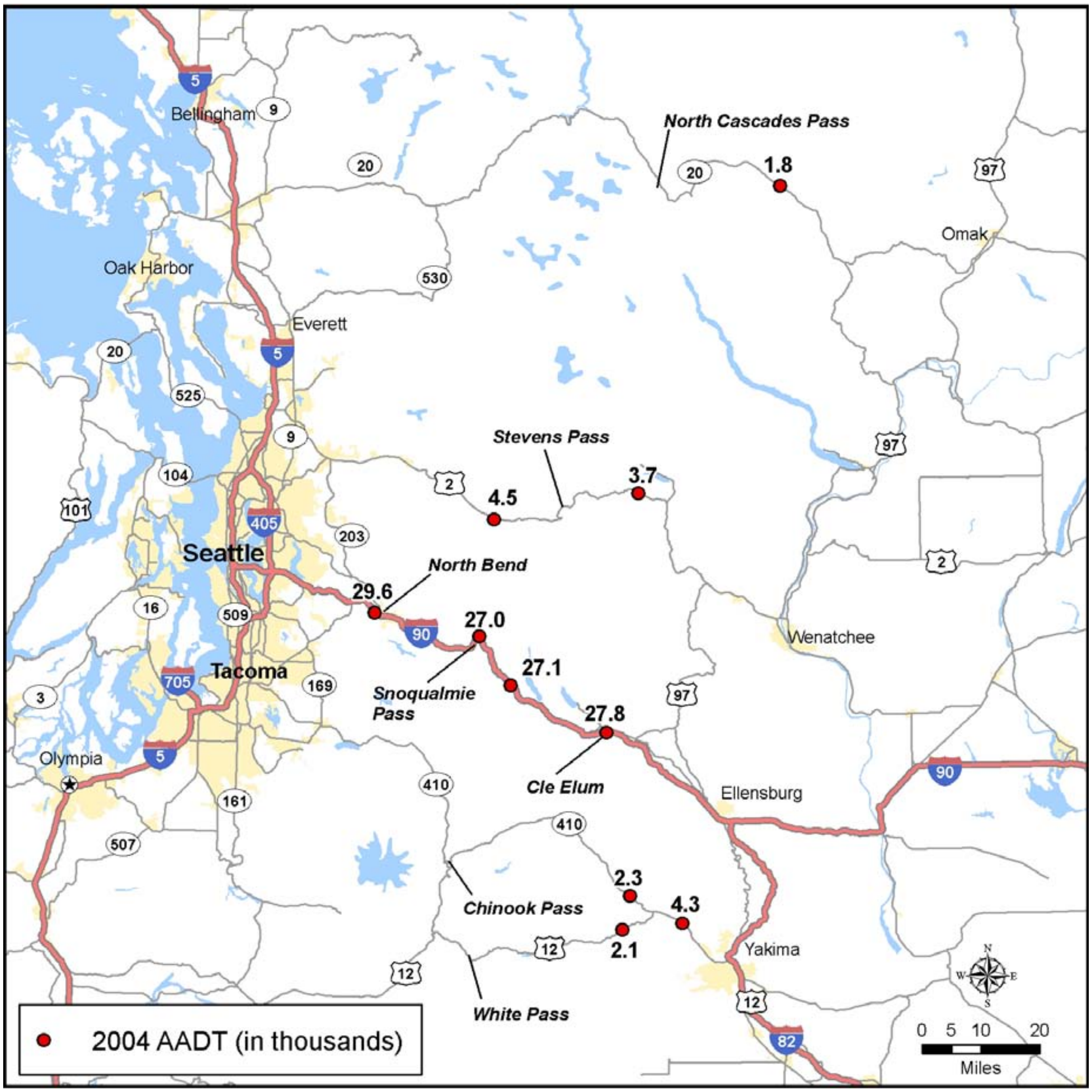


Table 9.15 I-90 Historical Count Data

Year	R039 – w/o 468 Avenue S.E. – North Bend	S901 – At Tinkam Road	S902 – At SR 906 Bridge	S903 – At Cabin Creek Road	B04 – West of Cle Elum Off-Ramp
1996	27,900	24,493	20,541	N/A	N/A
1997	29,252	25,349	N/A	N/A	23,602
1998	30,137	25,657	22,436	N/A	24,271
1999	30,553	N/A	N/A	24,241	23,951
2000	N/A	N/A	25,527	25,172	25,119
2001	30,864	N/A	25,698	25,678	26,043
2002	31,564	28,961	27,087	26,968	27,230
2003	32,047	29,262	27,440	N/A	27,285
2004	31,482	29,568	26,985	27,105	27,778
Average Annual Growth Rates to 2004					
From Year					
1996	1.5%	2.4%	3.5%		
1997	1.1%	2.2%			2.4%
1998	0.7%	2.4%	3.1%		2.3%
1999	0.6%			2.3%	3.0%
2000			1.4%	1.9%	2.5%
2001	0.7%		1.6%	1.8%	2.2%
2002	-0.1%	1.0%	-0.2%	0.3%	1.0%
2003	-1.8%	1.0%	-1.7%		1.8%

Source: Washington State Department of Transportation.

Average annual rate of growth in daily traffic at these stations from 1996 to 2004 is shown to have been between 1.5 and 3.5 percent. The relatively high growth experienced from 1996 to 2002 had a significant influence on this overall average. For instance at Station 902, traffic increased from 20,541 in 1996 to 27,087 in 2002 at an average rate of 4.7 percent annually. From 2002 to 2004 traffic has decreased at this station. Growth at the other four stations shown has followed a similar pattern with recent growth significantly reduced as compared to the growth experienced in the late nineties.

As mentioned above, the eastbound tolling location would be located in the vicinity of North Bend, while the westbound tolling location would be located near Cle Elum. Therefore, the volumes at Stations R039 and B04 were averaged resulting in an average daily toll free volume of 29,630 vehicles for 2004. The assumed annual percent rate of growth used to estimate future year traffic for use in toll analysis is shown below:

- 2004-2010 – 2.5 percent;
- 2010-2020 – 2.0 percent;
- 2020-2025 – 1.5 percent; and
- 2025-2030 – 1.0 percent.

Traffic and Revenue Analysis

The Snoqualmie Pass is at the far eastern boundary of the PSRC travel demand model, making this model unsuitable for direct use in estimating the reaction of travelers to tolls on this route. We therefore used existing traffic count data and travel pattern information obtained from WSDOT's origin and destination survey on I-90 (conducted in 2005)[2] as the basis for understanding travel patterns across the pass, and used travel time and distance measurements between points where travelers could choose to use I-90 or the next best alternate path such as SR 2. Considering the overall cost of taking I-90 versus the best alternate route, including potential tolls, we estimated to diversion of traffic from I-90 to these routes.

Passenger car toll rates ranging from $1.00 to $6.00 were tested in developing a toll sensitivity relationship and estimates of annual transactions and revenue. Proportionally higher rates were assumed for larger vehicles, based upon the relationships proposed for the Tacoma Narrows Bridge.

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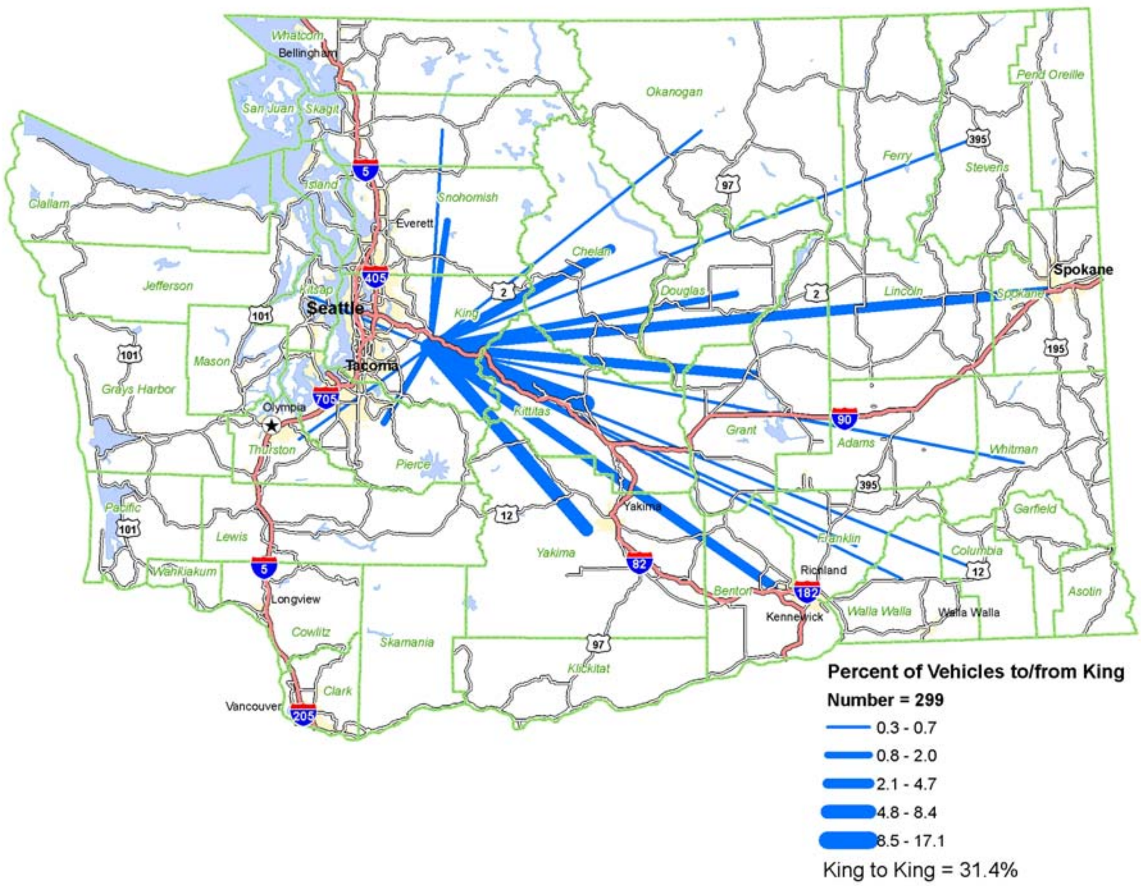
[2] The mail back survey on I 90 was located at 436th Avenue S.E. in North Bend and in the direct vicinity of the proposed eastbound tolling zone. Data was collected via license plate video recording on May 17, 2005 between 6:00 a.m. and 7:00 p.m. Legible license plate reads were matched up with the Department of Licensing (DOL) database and mail back travel surveys were then sent out to the registered owners of the videotaped license plate numbers. The survey also included questions beyond origin and destination such as trip purpose, trip frequency, and vehicle occupancy.

Geographical Distribution of Users

King County was at least one end of the trip for the highest number of origins and destinations using I-90 near North Bend. Exhibit 9.10 displays the desire lines for these King County trips.[3] A significant number of these trips were internal to King County, meaning that one end of the trip was east of North Bend, but still west of the Snoqualmie Pass (the highest point of the Snoqualmie Pass is the eastern boundary of King County). For trips going all the way across the Snoqualmie Pass, the highest percentage of trips was recorded to and from Kittitas and Yakima counties. The next tier of movements includes those to and from Spokane, Benton, Grant, and Chelan.

Exhibit 9.10 King County Desire Lines at Survey Station



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[3] Similar desire line maps were prepared for other movements, but are not shown here for the sake of brevity.

Time-Distance Relationships

After review of the major county to county movements, we identified points of choice for trips that could divert to a nontolled corridor so as to avoid the toll. Then, we estimated travel times and distances for toll and nontoll paths from point of choice locations.

Exhibit 9.11 displays an example of the toll and alternate path routings to Seattle from three points of choice. The travel times and distances measurements associated with those travel paths are shown. For example:

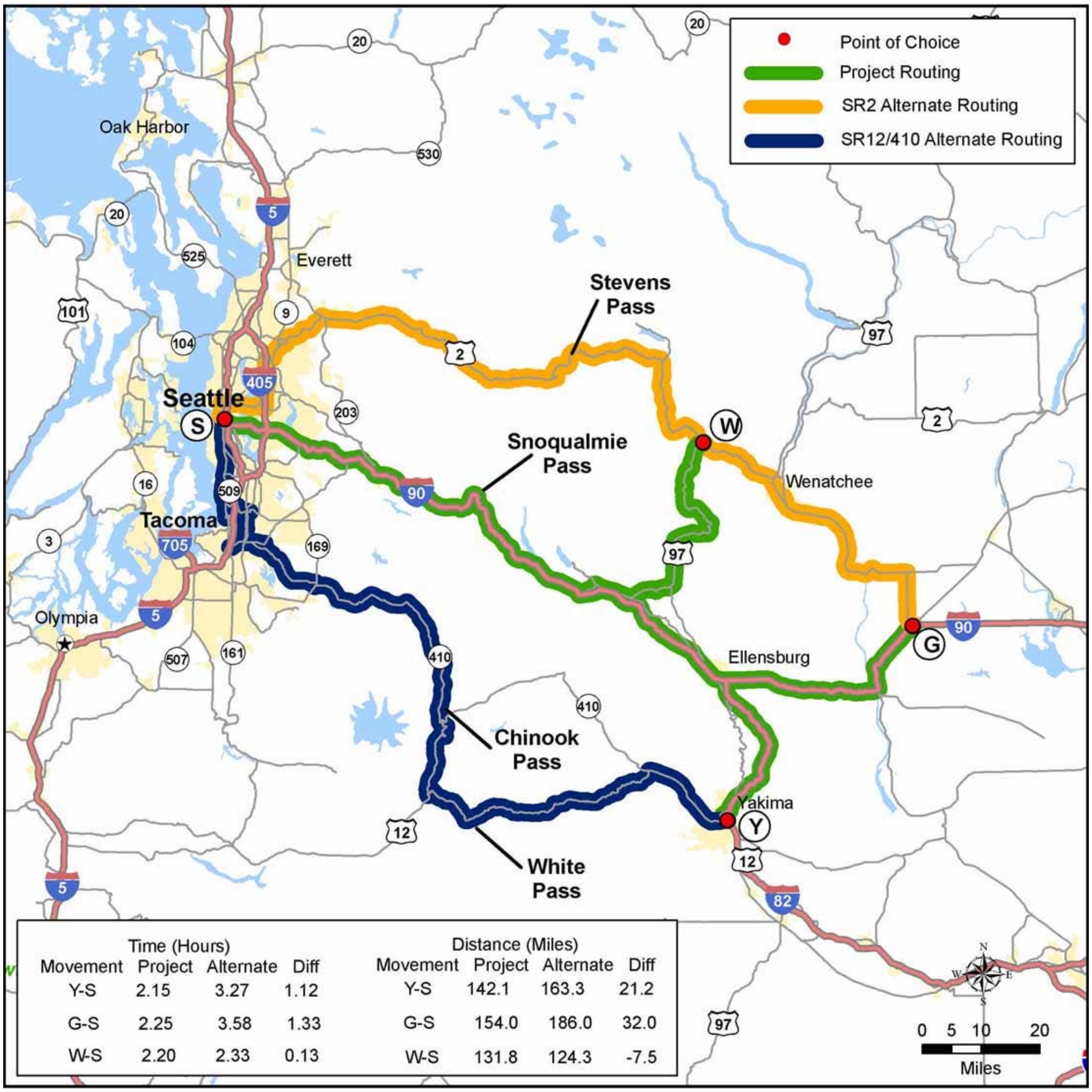
- A trip between Yakima and downtown Seattle (shown as the movement between Y-S) would have an alternate routing choice of SR 12 and SR 410. Compared to using I-90 for this movement, this alternate routing is estimated to be 1.12 hours and 21.2 miles longer.

- A movement between Spokane or Grant County to Seattle is identified as G-S. Again, the alternate routing of SR 2 is not very viable since it would add an additional 1.33 hours and 32.0 miles onto the overall trip as compared to the I-90 routing.

- A trip from counties such as Chelan or Douglass to Seattle is shown with the point of choice movement W-S. In this case, I-90 saves minimal time and actually would be longer by about 7.5 miles than the alternate routing of SR 2. Actual time and distance savings would vary somewhat based on the exact location of the trip origin and destination within Seattle.

Similar comparisons were completed for combinations of movements covering county to county movements determined from the origin and destination survey database. Note that the travel times reflect typical free flow travel times and have not been field verified. Also, people's choice of route involves not just travel time and distance, but also safety and comfort considerations. As a high-grade Interstate route, I-90 offers much better service than its competitors, as evidenced by the significant difference in traffic counts. These factors would tend to make the alternative routes less attractive than portrayed here, making the toll revenue estimates conservatively low.

Exhibit 9.11 Time and Distance Comparisons



Time (Hours)				Distance (Miles)			
Movement	Project	Alternate	Diff	Movement	Project	Alternate	Diff
Y-S	2.15	3.27	1.12	Y-S	142.1	163.3	21.2
G-S	2.25	3.58	1.33	G-S	154.0	186.0	32.0
W-S	2.20	2.33	0.13	W-S	131.8	124.3	-7.5

Estimated Traffic Growth through 2030

Future levels of traffic in 2030 were estimated using the growth schedule discussed previously. Future toll-free average daily traffic is expected to be 47,425 vehicles by 2030 when combining the one-way traffic at each of the proposed tolling locations.

Traffic Response to Tolls

We tested toll rates ranging from $1.00 to $6.00 for passenger cars to understand the relationship of toll rate to traffic. These toll sensitivity tests were done with currency values at year 2000 levels. When these values are then used to consider financial performance, we have assumed that toll rates would increase over time to generally match the rate of inflation, meaning that the actual toll that someone might pay in 2030 would be considerably higher than the rates shown.

Toll rates for trucks would be proportionally higher, based upon the relationship between passenger car and truck tolls anticipated at the Tacoma Narrows Bridge. A five-axle truck would pay 2.5 times the amount that a passenger car would pay at any given toll rate.

The estimate of traffic response to tolls consisted of two parts. The first was an evaluation of route diversion that compares the tolled route to the next best alternative. The other considers the potential suppression of trips that might occur since many of the existing trips across the Snoqualmie Pass have no reasonable alternative. Trip reduction factors were derived from findings reported in the "Tacoma Narrows Bridge Investment-Grade Traffic and Revenue Study" report[4] in which a stated-preference survey was conducted to estimate trips reduction rates under several toll rate levels (see Table 9.16).

Table 9.16 Trip Reduction Factors

Toll Rate	Reduction Factor
$1.00	0.981
$2.00	0.962
$3.00	0.944
$4.00	0.926
$5.00	0.907
$6.00	0.889

[4] SR 16 Tacoma Narrows Bridge Traffic and Revenue Study. Prepared by Wilbur Smith Associates, August 20, 2002.

The top portion of Exhibit 9.12 shows the estimated average daily revenue that could be expected over the range of toll rates, while the bottom portion shows the number of average daily transactions. As toll rates increase, traffic would be expected to decrease, but would yield increasing revenue through the toll rate of $6.00. Because of the lack of viable alternate routes and long trip lengths in general, we would expect traffic in the corridor to be insensitive to the toll rate. Tolls higher than $6.00 would be expected to continue to yield increasing revenue. In view of the passenger vehicle toll rate that will be charged on the Tacoma Narrows Bridge, a $3.00 toll rate was chosen for use in this analysis.

Estimated Average Daily Traffic

Average daily toll transactions for 2030 are estimated to be 44,865 at a $3.00 passenger vehicle toll rate in 2030. This is 2,560 vehicles or 5.4 percent less than what we would expect under toll-free conditions. At 2010 levels there is estimated to be 32,510 average daily toll transactions versus a toll free estimate of 34,360. Of the 2,560 vehicles in 2030 estimated to be reduced on I-90 under a tolled condition when compared to a nontolled condition, 45 percent are estimated to divert to SR 2, 25 percent are estimated to divert to SR 12 and/or SR 410, with the remaining 30 percent reduction occurring due to reduction in trip-making.

Revenue Estimates

For purposes of this preliminary feasibility study, we assumed that the tolling locations on I-90 would be open in 2010.

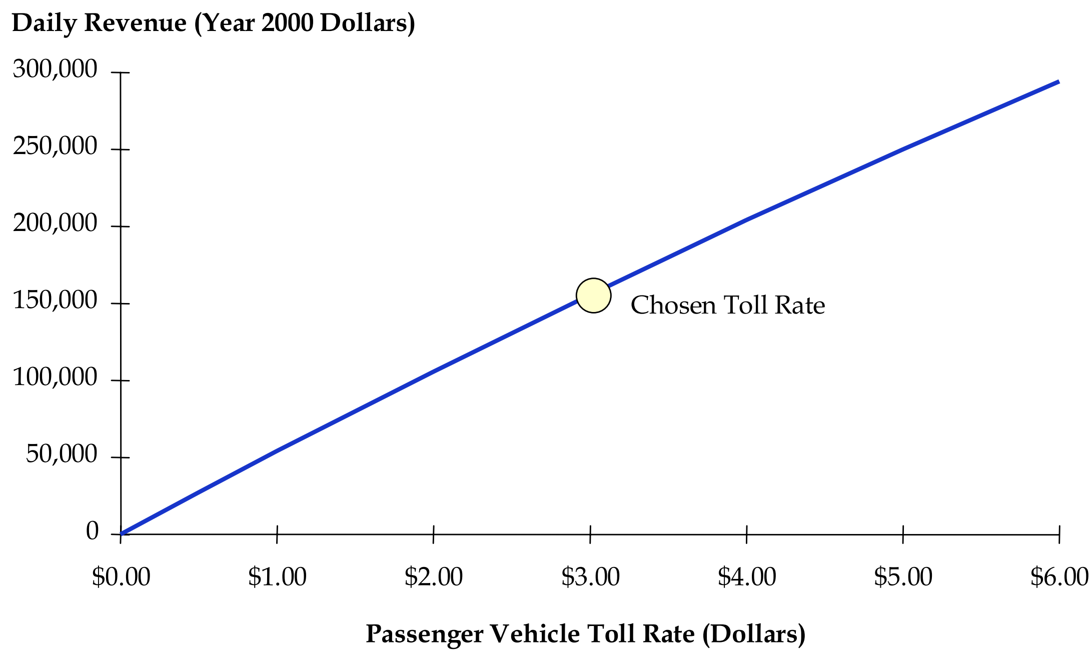
We used an average toll rate of $3.48 per vehicle reflecting the 13 percent trucks on I-90 on an average daily basis. Three quarters of those trucks are assumed to have at least five axles, paying 2.5 times the passenger car toll rate. The remaining 25 percent are assumed to have less than five axles and would pay 1.5 times the passenger car toll rate.

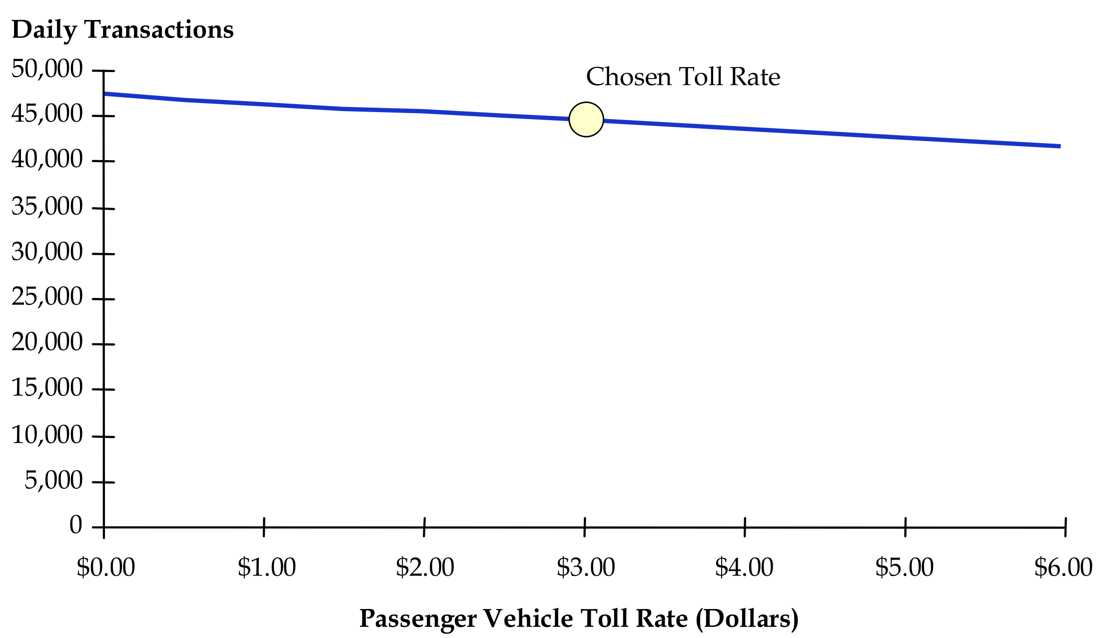
Annual transaction and revenue estimates were calculated by multiplying the average daily estimates by 365 days. These transactions would be expected to generate about $41.3 million per year in 2010 and $57.0 million per year in 2030, both expressed in 2000 dollars (see Table 9.17).

Table 9.17 Estimated Transactions and Toll Revenue

	2010	2030
Average Daily Transactions	32,500	44,900
Average Toll (2000 Dollars)	$3.48	$3.48
Annual Toll Revenue (2000 Dollars)	$41,294,000	$56,988,000

Exhibit 9.12 Snoqualmie Pass Toll Sensitivity
2030 Estimated Average Daily Transactions and Revenue





Cost Estimates

This project assumed there would be both manual and electronic toll collection. The rationale behind this is that tolls could, theoretically, be installed right away, and that all-electronic tolling on a major Interstate route with few options could be troublesome.

This project is divided into two sections, Snoqualmie Pass-East from Hyak to Keechelus Dam, a five miles section and a west section of 10 miles in length from Keechelus Dam to Easton. WSDOT proposes to widen I-90 to six lanes to improve traffic flow and ensure continuous use of the I-90 through construction of tunnels and/or other mitigation measures to eliminate avalanche and rockfall closures.

A draft Environmental Impact Statement (EIS) was released on June 10, 2005 by WSDOT and a preferred alignment will be determined by May 2006. The EIS is to be completed by spring 2007. Construction on Snoqualmie Pass-East project is to begin in 2010.

Total project construction cost estimate of $923 million was provided in October 2005 by the project team. On April 2005, the Washington State legislature passed the 2005 Transportation Partnership Funding Package, providing $387.7 million for the five-mile Hyak to Keechelus Dam project. Tolling cost for this project is estimated at $31.8 million. This cost includes two mainline toll plazas with four mixed (ETC and manual) toll lanes for each direction of traffic and two ETC only toll lanes per direction.

As stated above, due to the noncommuter nature of users of this facility, manual collection was also provided. An ETC participation of 35 percent initially and gradually increasing to 65 percent was assumed. A manual toll processing rate of 350 vehicles per hour was utilized in plaza sizing calculations. Due to the right-of-way constrains a split plaza configuration was assumed in preliminary plaza layout design and project cost estimating. It is anticipated that the cash paying customers will exit the mainlines to a split toll plaza and will merge back to the main line after paying their tolls manually, while the ETC customers will pass under a series of toll zone gantries at normal freeway speed for their toll collection activities.

The cost estimate included construction of one medium and one small administration buildings for housing the customer service and administrative functions of the toll collections and operations.

Financial Analysis

A financial analysis was performed to estimate the amount of revenue that could be expected to contribute to the corridor improvements. At the $3.00 toll rate (2000 dollars), it is estimated that $501 million could be contributed toward capital improvements in the corridor (see Table 9.18). The toll level could be adjusted to match the needed funding amount.

Table 9.18 Financial Analysis for the Snoqualmie Pass Project

	Year of Collection Dollars							
Calendar Year	Passenger Car Toll Rate[a]	Average Toll Rate	Annual Gross Revenue	Annual Operating Expenses	Annual Maintenance Expense	Net Revenue	Senior Lien Debt Service	Present Value
2006							24,669,493	$23,405,591
2007							24,669,493	$22,206,443
2008							24,669,493	$21,068,732
2009	3.91	4.54	50,367,246	3,808,633	3,387,000	43,171,613	24,669,493	$19,989,309
2010	4.03	4.68	52,721,157	3,986,728	3,488,610	45,245,819	25,854,754	$19,876,383
2011	4.15	4.82	55,184,906	4,173,188	3,593,268	47,418,449	27,096,257	$19,763,581
2012	4.28	4.96	57,762,849	4,368,246	3,701,066	49,693,536	28,396,306	$19,650,680
2013	4.41	5.11	60,461,148	4,572,280	3,812,098	52,076,770	29,758,154	$19,538,045
2014	4.54	5.26	63,286,603	4,785,834	3,926,461	54,574,308	31,185,319	$19,426,058
2015	4.67	5.42	66,243,450	5,009,333	4,044,255	57,189,863	32,679,921	$19,314,119
2016	4.81	5.58	69,339,044	5,243,378	4,165,583	59,930,083	34,245,762	$19,202,603
2017	4.96	5.75	72,578,027	5,488,281	4,290,550	62,799,196	35,885,255	$19,091,001
2018	5.11	5.92	75,968,351	5,744,860	4,419,267	65,804,224	37,602,414	$18,979,632
2019	5.26	6.10	79,518,431	6,013,298	4,551,845	68,953,288	39,401,879	$18,868,978
2020	5.42	6.29	83,233,733	6,294,298	4,688,400	72,251,035	41,286,306	$18,758,446
2021	5.58	6.47	87,123,362	6,588,233	4,829,052	75,706,076	43,260,615	$18,648,458
2022	5.75	6.67	91,193,301	6,896,056	4,973,924	79,323,321	45,327,612	$18,538,409
2023	5.92	6.87	95,453,400	7,218,393	5,123,141	83,111,866	47,492,495	$18,428,670
2024	6.10	7.07	99,914,066	7,555,896	5,276,836	87,081,335	49,760,763	$18,319,576
2025	6.28	7.29	104,582,323	7,908,827	5,435,141	91,238,355	52,136,203	$18,210,723
2026	6.47	7.50	109,469,435	8,278,076	5,598,195	95,593,165	54,624,666	$18,102,392
2027	6.66	7.73	114,585,193	8,664,804	5,766,141	100,154,248	57,230,999	$17,994,421
2028	6.86	7.96	119,939,804	9,069,345	5,939,125	104,931,333	59,960,762	$17,886,818
2029	7.07	8.20	125,543,906	9,492,953	6,117,299	109,933,655	62,819,231	$17,779,435
2030	7.28	8.45	131,407,492	9,936,970	6,300,818	115,169,705	65,811,260	$17,671,969
2031	7.50	8.70	137,379,963	10,388,584	6,489,842	120,501,537	68,858,021	$17,542,790
2032	7.73	8.96	143,623,882	10,860,927	6,684,538	126,078,418	72,044,810	$17,414,307
2033	7.96	9.23	150,151,587	11,354,382	6,885,074	131,912,132	75,378,361	$17,286,600
2034	8.20	9.51	156,975,977	11,870,402	7,091,626	138,013,949	78,865,114	$17,159,602
2035	8.44	9.79	164,110,535	12,409,978	7,304,375	144,396,183	82,512,105	$17,033,321
2036	8.69	10.09	171,569,359	12,974,143	7,523,506	151,071,710	86,326,692	$16,907,763
2037	8.96	10.39	179,367,186	13,563,676	7,749,211	158,054,299	90,316,743	$16,782,966
2038	9.22	10.70	187,519,425	14,180,286	7,981,687	165,357,451	94,489,972	$16,658,871
2039	9.50	11.02	196,042,183	14,824,853	8,221,138	172,996,192	98,854,967	$16,535,515
2040	9.79	11.35	204,952,300	15,498,594	8,467,772	180,985,934	103,420,534	$16,412,903
							Par Amount	$650,455,110
	Subtract Reserve Account						10.0%	$65,045,511
	Subtract Capitalized Interest							$74,008,479
	Subtract Expenses						1.5%	$9,756,827
	Estimated Contribution of Tolls to Construction Fund in 2006							**$501,600,000**

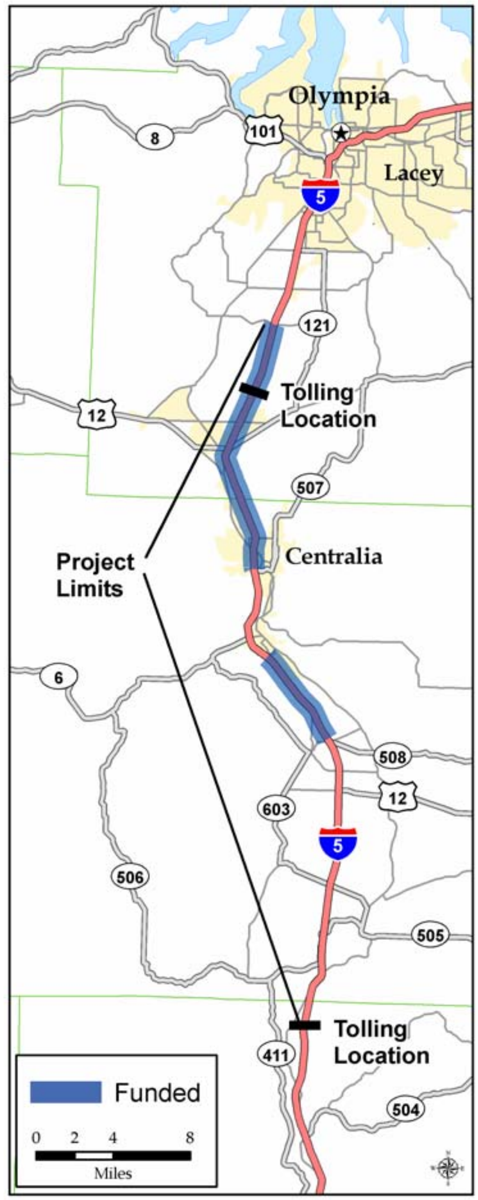
[a] Note that toll rates would likely be rounded to the nearest five cents.

Construction Period	3 years
Bond Sale January 1 of	2006
Earning Period	35 years
Inflation Rate – CPI	3%
Inflation Rate – Costs	3%
Debt Service Coverage Ratio	1.75
Rating	BBB
Bond Interest Rate	5.40%
Assumed Toll Evasion	5%

■ Tolling I-5 in Lewis County

Description

WSDOT is developing an improvement project that focuses on improving the mobility of traffic, particularly freight in combination with enhancements aimed at prolonged economic development and safety along the 40-mile-long section of I-5 from the Toutle River Safety Rest Area in Cowlitz County to the Maytown interchange in Thurston County. Currently, this section of freeway is only four lanes (two in each direction) with increasing congestion levels. The following list highlights the improvements and enhancements that are currently planned and funded within the 40-mile segment. The blue highlights in the map represent those funded sections.



- The Grand Mound to Maytown Widening project will include widening this seven-mile section of roadway from four to six lanes. Construction is expected to begin in 2008. Funding will be provided through the 2003 Gas Tax (Nickel Funding) as well as existing funds totaling $79 million.

- The seven-mile Mellen Street to Grand Mound project will include three phases beginning with a widening of I-5 to six lanes between the Blakeslee Railroad Junction (MP 83.5) and Grand Mound interchange (Exit 88) in 2009. Phase 2 will include replacing the existing Mellen Street interchange, and will begin in 2010. Phase 3 to begin in 2011 will include a widening of I-5 to six lanes with additional auxiliary lanes between the Mellen Street interchange and the Blakeslee Railroad Junction; $160 million in gas tax money was approved to complete this segment.

- The Rush Road to 13th Street (4.5 miles) project will include a widening of the freeway to six lanes and will include the construction of a new interchange at LaBree Road which is intended to provide improved access to and from the Port of Chehalis.

- The Chehalis River Basin Flood Reduction project is result of the severe flooding that has occurred in the river basin, impacting regional transportation and the economic well being of the local area. The project aims at providing flood protection for roads and structures by using levees and other measures. Construction could begin in 2006 if approved. Currently, $30 million is funded through the Nickel Funding with another $65 million anticipated through Congress to the U.S. Army Corps of Engineers.

These funded projects account for 18.5 miles of the 40 miles that are in need of widening and safety improvements. There are two major gaps accounting for the rest of the 21.5 miles that are not funded. These occur between interchanges 76 and 81 through Chehalis and from 71 to the southern extent of the project at the Toutle River Safety Rest Area in Cowlitz County.

The policy objective of evaluating tolling in this area would be to generate funds to expedite these types of major highway improvements. Several issues are envisioned that would need to be addressed if tolling was to take place:

- The difficulty of tolling an existing freeway such as I-5.

- Who and how to toll. Trying to capture the through movements while mitigating any diversion impacts to undersized local roads.

- Mitigating local diversion impacts by utilizing the revenue to improve the local arterials and local roads.

- Implications of possible tolling on the sections of the project that already have funding.

Many different tolling options are possible, ranging from a completely "closed" system where everyone would pay along the 40-mile section to the option of having two or three mainline tolling locations aimed at tolling the through traffic and keeping the local diversion to a minimum. The closed system would be expected to produce significantly more revenue as you would be tolling the whole market as opposed to a percentage of the market, but would also be more costly to operate and may have significant negative impacts to the local roads.

We worked with WSDOT staff to identify a reasonable tolling system for purposes of this illustrative example. Tolling would occur at two locations in both directions, positioned along sections of the freeway that are expected to have less disturbance to the local movements of the corridor:

- The most southern proposed tolling location would at the southern terminus of the project around the Toutle River Safety Rest Area between interchange 52 and interchange 57. This location is also the start of the largest stretch of unfunded portions of the 40-mile corridor. The average daily traffic in 2004 at this location was 43,000 vehicles.

- A second tolling location would be in the northern part of the project north of the U.S. 12/Old Highway 99 interchange within the Grand Mound to Maytown segment. The average daily traffic in 2004 at this location was 55,000 vehicles.

Since the tolling locations are fairly far apart, only those traveling for a significant distance would pay twice. Others whose trip originates or terminates within one of the zones would only pay once.

Traffic and Revenue Estimates

In estimating the extent of diversion under a tolled scenario, we compared the travel times and distances for a trip diverting around the tolling location to those travel times and distances of remaining on I-5. A summary of the toll path and non toll path travel times and distances are shown in Table 9.19.

Table 9.19 Estimated Average Travel Time and Distance Comparison

	Travel Time (Minutes)		Travel Distance (Miles)	
Tolling Location	**I-5 Path**	**Diversion Path**	**I-5 Path**	**Diversion Path**
North	6.5	18.0	7.0	11.7
South	4.9	13.0	5.3	5.6

At the northern tolling location, the alternate path is estimated to take an additional 11.5 minutes and be almost five miles longer than I-5. At the southern tolling location, the travel distances between I-5 and the alternate route are comparable, but it would take an additional eight minutes to divert around the toll due to the significantly lower operating speeds of the alternate route as compared to I-5.

Using these relationships, we estimated the diversion of traffic from I-5 at several toll rates. Table 9.20 summarizes the average daily traffic and annual toll revenue (2000 dollars) that could be expected by the indicated tolls at each tolling location in both directions in 2010.

Diversion percents range from 2.9 percent at a $0.50 toll rate to more than 50 percent at a $3.00 toll rate. From the table, one can see that a toll of about $1.50 at each tolling location might be appropriate since we are nearing the maximum revenue potential, while keeping the amount of diversion to less than 18 percent.

Table 9.20 Estimated Average Daily Transactions and Toll Revenue
2010

Toll Rate (2000 Dollars)	Average Daily Transactions	Estimated Percent Diversion	Annual Revenue (2000 Dollars)
$0.00	107,100		
$0.50	104,000	-2.9%	$24,255,200
$1.00	97,600	-8.9%	$45,525,100
$1.50	88,300	-17.6%	$61,780,800
$2.00	76,800	-28.3%	$71,646,100
$2.50	63,300	-40.9%	$73,815,100
$3.00	49,800	-53.5%	$69,687,000

Financial Analysis

At the $1.50 toll rate (2000 dollars) at each tolling location, it is estimated that $778 million could be contributed toward capital improvements in the corridor (see Table 9.21). The toll level could be adjusted to match the needed funding amount to complete the remaining 21.5 miles and for operation and maintenance costs of the facility.

Policy Findings

The policy objective of evaluating tolling in this area would be to generate funds to expedite these types of major highway improvements. As with Snoqualmie Pass, tolling an existing freeway can produce considerable revenue, especially when there are not many alternatives. The I-5 market in this region is not as captive as that on Snoqualmie Pass. The diversion of 18 percent of existing traffic on I-5 at a $1.50 toll rate could cause issues on local roadways, however some of the toll revenue could be used to fund improvements on arterials in the corridor. Shorter trips are more likely to divert than longer trips, which can provide an operational benefit to the freeway.

Table 9.21 Financial Analysis of Tolling on I-5 in Lewis County

Year of Collection Dollars

Calendar Year	Passenger Car Toll Rate[a]	Average Toll Rate	Annual Gross Revenue	Annual Operating Expenses	Net Revenue	Senior Lien Debt Service	Present Value
2008						40,677,097	$38,593,071
2009						40,677,097	$36,615,817
2010						40,677,097	$34,739,864
2011	2.08	2.65	82,512,382	11,327,463	71,184,919	40,677,097	$32,960,023
2012	2.14	2.73	86,263,666	11,842,227	74,421,439	42,526,537	$32,693,165
2013	2.20	2.82	90,183,904	12,380,473	77,803,430	44,459,103	$32,427,766
2014	2.27	2.90	94,283,272	12,943,230	81,340,042	46,480,024	$32,164,890
2015	2.34	2.99	98,568,158	13,531,414	85,036,744	48,592,425	$31,903,893
2016	2.41	3.08	103,048,150	14,146,450	88,901,700	50,800,971	$31,645,103
2017	2.48	3.17	107,731,782	14,789,515	92,942,267	53,109,867	$31,388,395
2018	2.55	3.26	112,627,949	15,461,667	97,166,282	55,523,590	$31,133,706
2019	2.63	3.36	117,745,915	16,164,345	101,581,570	58,046,611	$30,880,871
2020	2.71	3.46	123,098,762	16,899,060	106,199,702	60,685,544	$30,630,727
2021	2.79	3.57	128,058,865	17,579,970	110,478,895	63,130,797	$30,232,407
2022	2.87	3.67	133,220,347	18,288,441	114,931,906	65,675,375	$29,839,628
2023	2.96	3.78	138,589,389	19,025,571	119,563,818	68,322,182	$29,451,807
2024	3.05	3.90	144,174,194	19,792,300	124,381,894	71,075,368	$29,068,909
2025	3.14	4.01	149,983,280	20,590,003	129,393,278	73,939,016	$28,690,801
2026	3.23	4.13	156,027,545	21,419,696	134,607,849	76,918,771	$28,317,880
2027	3.33	4.26	162,316,363	22,282,861	140,033,502	80,019,144	$27,949,992
2028	3.43	4.39	168,857,299	23,180,826	145,676,473	83,243,699	$27,586,623
2029	3.53	4.52	175,662,517	24,115,206	151,547,311	86,598,463	$27,228,063
2030	3.64	4.65	182,742,523	25,086,971	157,655,552	90,088,887	$26,874,301
2031	3.75	4.79	190,105,859	26,097,839	164,008,021	93,718,869	$26,524,816
2032	3.86	4.94	197,768,544	27,149,613	170,618,932	97,496,533	$26,180,257
2033	3.98	5.08	205,737,533	28,243,922	177,493,611	101,424,921	$25,839,779
2034	4.10	5.24	214,027,432	29,381,915	184,645,518	105,511,724	$25,503,761
2035	4.22	5.39	222,654,005	30,566,144	192,087,861	109,764,492	$25,172,408
2036	4.35	5.56	233,920,298	31,797,881	202,122,417	115,498,524	$25,130,360
2037	4.48	5.72	245,756,665	33,079,297	212,677,368	121,529,924	$25,087,934
2038	4.61	5.89	258,191,952	34,412,362	223,779,590	127,874,052	$25,045,141
2039	4.75	6.07	271,256,465	35,799,440	235,457,025	134,546,871	$25,001,960
2040	4.89	6.25	284,982,042	37,242,033	247,740,009	141,565,719	$24,958,469
2041	5.04	6.44	299,402,133	38,742,995	260,659,139	148,948,079	$24,914,613
2042	5.19	6.63	314,551,881	40,304,303	274,247,578	156,712,902	$24,870,434
						Par Amount	$1,017,247,631
	Subtract Reserve Account					10.0%	$101,724,763
	Subtract Capitalized Interest						$122,031,290
	Subtract Expenses					1.5%	$15,258,714
	Estimated Contribution of Tolls to Construction Fund in 2008						**$778,200,000**

[a] Note that toll rates would likely be rounded to the nearest five cents.

Construction Period	3 years
Bond Sale January 1 of	2008
Earning Period	35 years
Inflation Rate – CPI	3%
Inflation Rate – Costs	3%
Debt Service Coverage Ratio	1.75
Rating	BBB
Bond Interest Rate	5.40%
Assumed Toll Evasion	5%

Tolling Alaskan Way Viaduct and I-5

Project Description

The replacement of the Alaskan Way Viaduct (AWV) is a high-profile, high-cost project that has often been discussed as a candidate for tolling. Previous studies by WSDOT have raised concerns about the amount of diversion to I-5 and the relatively low amount of revenue generated compared to the cost. One way to address this issue would be to include I-5 in the tolling plan, where the revenue could pay for upcoming I-5 rehabilitation needs as well as the AWV project. Since both I-5 and AWV are in the heart of Seattle, tolling could also be used to influence people's time or location of travel, so that the highway system can be used more effectively.

Tolling along I-5 would extend from I-405 at Tukwila northward to Northgate for a distance of about 18 miles. The AWV tolling project would cover 4.5 miles and extend from Spokane Street to Roy Street as highlighted. Three levels of toll rates were analyzed to get a range of potential diversion impacts and revenue generation. As is shown in Table 9.22 we considered peak-period toll rates ranging from 10 to 45 cents per mile, with off-peak rates at less than half those amounts, and early nighttime rates of roughly one quarter those values.

Due to the dense urban environment of these corridors, we assumed that all toll collection would be by electronic means only, meaning a user would be required to have a transponder in order to the road. Since this is an existing Interstate highway, we have assumed that some combination of transponder and video toll collection would be used, thereby reducing the number of people that could not pay a toll because of lack of the needed technology. The policy objective of this project is the tolling of existing freeways in a dense urban area to generate revenue for major improvements, with and element of traffic management.

Table 9.22 I-5 and AWV Per-Mile Toll Rate Levels
2000 Dollars

	Level 1 Rates		Level 2 Rates		Level 3 Rates	
Time Period	**I-5**	**AWV**	**I-5**	**AWV**	**I-5**	**AWV**
6:00 a.m.-9:00 a.m.	$0.35	$0.35	$0.15	$0.15	$0.10	$0.10
9:00 a.m.-3:00 p.m.	$0.15	$0.15	$0.05	$0.05	$0.05	$0.05
3:00 p.m.-6:00 p.m.	$0.45	$0.45	$0.20	$0.20	$0.15	$0.15
6:00 p.m.-10:00 p.m.	$0.10	$0.10	$0.05	$0.05	$0.05	$0.05
10:00 p.m.-6:00 a.m.	–	–	–	–	–	–

Traffic and Revenue

We analyzed changes in traffic patterns at the three toll rate levels using the PSRC travel demand model. Table 9.23 summarized the expected change in VMT for I-5 and AWV under the toll free and tolled conditions at the different toll rates.

Estimated diversion from both I-5 and AWV ranges from 6.6 to 26.5 percent on a daily basis depending on the toll rate. Larger diversion percents are shown during the peak periods where per-mile toll rates are significantly higher than the rest of the day. Significant loss of traffic is shown during the peak periods under toll Level 1 where per-mile rates were 35-45 cents per mile depending on the facility.

Table 9.23 Forecast Percentage Changes in Vehicle Miles Traveled on I-5 and AWV under Pricing

	2030 VMT Percent Impact					
	Peak		Off-Peak		Total Day	
Toll Rate Level	**I-5**	**AWV**	**I-5**	**AWV**	**I-5**	**AWV**
1	-44.7	-33.4	-15.5	-14.0	-26.5	-21.9
2	-14.5	-14.2	-4.8	-4.6	-8.5	-8.6
3	-9.8	-8.9	-5.0	-5.0	-6.8	-6.6

Tolling is expected to result in some improvement to travel times along I-5, however these improvements may be offset by degradation in travel times on other routes from added diversion. More study would be needed to generate results that are more definitive.

Table 9.24 displays the VMT for the I-5 and the AWV under each toll rate level. The corresponding average per-mile toll rate is shown, as is the resulting annual toll revenue estimates for 2030. Total annual toll revenue in year 2030 is estimated to range from $146.1 million to $294.7 million (2000 dollars) depending on the toll rate. Estimated annual transactions range from 15.2 to 18.1 million on the AWV and from 184.7 to 234.3 million on I-5. An average trip distance of nine miles was assumed in converting VMT to estimated transactions.

Table 9.24 2030 Average Weekday Vehicle Miles and Annual Toll Revenue
2000 Dollars

	VMT – Average Weekday (Thousands)		Average Per-Mile Toll Rate		Annual Toll Revenue (Thousands)		
Toll Rate Level	**I-5**	**AWV**	**I-5**	**AWV**	**I-5**	**AWV**	**Total**
1	4,806	394	$0.183	$0.203	$270,142	$24,599	$294,741
2	5,988	462	$0.089	$0.92	$164,709	$13,133	$177,842
3	6,095	472	$0.072	$0.074	$135,346	$10,757	$146,103

Financial Analysis

An assumed 1.0 annual percent rate of growth was assumed prior to and after 2030. The revenue from tolling these projects is conservatively estimated to be sufficient to fund from $1.2 billion at the lowest rates to nearly $3.0 billion at the highest (see Table 9.25). AWV revenue is expected to account for about 7 to 8 percent of total revenue.

Table 9.25 Financial Analysis Summary

	Estimated Contribution of Toll Revenue to Construction Fund (Millions)		
Toll Rate Level	I-5	AWV	Total
1	$2,737.5	$252.3	$2,989.8
2	$1,458.3	$117.4	$1,575.7
3	$1,117.3	$89.7	$1,207.0

Policy Findings

The policy objective of this project is the tolling of existing freeways in a dense urban area to generate revenue for major improvements, with and element of traffic management. Tolling I-5 and AWV could generate a significant amount of revenue to contribute to needed rehabilitation and reconstruction. Such tolling would result in diversion to other facilities, and it is unclear whether the negative impacts of the diversion would outweigh the benefits of the improved performance on the freeways.

Another concept to consider in this corridor would be tolling *only* during peak periods, leaving the highways free the rest of the time. Although this would generate less revenue, it would provide drivers a clear choice relating to time of travel.

■ Statewide Truck Tolling

Project Description

The policy objective of this project was tolling commercial vehicles to increase system effectiveness, revenue, and as a precursor to more extensive highway tolling. Both Austria and Germany have recently implemented a nationwide truck tolling system for their autobahn systems. The overriding policy objective in both cases was to raise revenue from truckers in a way that more closely matched actual usage, and to encourage a shift of some freight from trucks to rail. In both cases, the tolls replaced a flat rate system of tax stickers (available in both annual, and 10-day versions) to use the highways. Although fuel taxes in Europe are much higher than in the United States, the taxes are not dedicated to transportation. Both Austria and Germany are in central Europe, where a considerable share of truck traffic is just passing through – the tolls provide a more effective way to capture revenue from those through-trucks than the flat rate system. The Austrian system uses standard electronic toll collection technology (i.e., transponders and overhead gantries along the highway), and the German system uses new Global Positioning System (GPS) technology. Early reports from both systems is that they have been successful at generating the expected revenue, but less successful at diverting truck traffic to rail. There have also been reports about trucks diverting to secondary roads to avoid the tolls.

Does such a system make sense for Washington? The revenue generation potential of such a system is substantial. If single-unit trucks were charged 10 cents per mile and multi-unit trucks were charged 20 cents per mile, the annual revenue from tolling in 2004 statewide would have been over $500 million. However, in the United States, we have solved the problem of trucks paying their fair share of taxes in each state through the International Fuel Tax Agreement (IFTA) system, whereby truckers pay fuel taxes quarterly to their home state, and the revenues are distributed to other states based on reported mileage in each state. Systemwide tolling, even if just on the freeway system is an expensive way to collect revenue – raising fuel taxes on diesel would be far simpler.

Using tolling to encourage trucks to change their time of travel is another option in the congested part of Washington. Tolling trucks only on highways, however, may not be the best way to accomplish this objective, at least in the short term. The infrastructure and administrative requirements for such as system would be extensive; as would the complications involved in signing up truck drivers from around the country for a system that only pertains to one urban area. In the short to medium term, these practical considerations probably outweigh any potential congestion-relief benefits. Over the long term, the spread of telematics technologies into trucks could make such a system more manageable to implement, and tolling trucks may be a good first step towards a more extensive system that includes autos as well.

Policy Findings

A tolling system devoted to charging trucks is not needed to address a revenue problem – that problem can be solved through traditional tax increases. Tolling to improve system effectiveness is an intriguing idea, however, the details of making it work in one metropolitan area is an idea that is probably ahead of its time due to the complexities of system implementation. In the long term, truck tolling could be a precursor to more extensive highway tolling.

■ Container Fees

Project Description

The policy objective of this project was the use of fees to fund intermodal improvements that aid freight flows in the region. Washington's extensive port facilities generate a large volume of rail and truck traffic that must be accommodated by the State's transportation facilities. Puget Sound area ports handled over 2.8 million TEU (20-foot equivalent) containers in 2002, with that number forecast to rise to over 6.9 million by 2025. To illustrate the revenue potential of a container fee, if a $10 fee per TEU was to be applied in the Puget Sound, annual gross revenue is estimated to be around $42.3 million by 2010, growing to $69.5 million by 2025.

Although Washington is the beneficiary of the employment opportunities generated by the existence of these ports, it still has trouble keeping up with the associated transportation infrastructure needs. Container fees provide a mechanism to apply a direct user charge to international freight that does not involve a general tax increase. The dollars could be used to fund intermodal improvements that aid freight flows in the region, such as the FAST Corridor, extension of SR 167 to the Port of Tacoma, and key improvements to rail bottlenecks.

In many respects, container fees would be similar to the passenger facility charges (PFC) that airports may charge air passengers for airport infrastructure improvements. The fees could be applied by the State or by the Port – collected by the carrier, but passed on directly to the shipper. As with PFC, the fees would be used to pay for a specific list of improvements directly related to the improvement of freight movements in Washington. Ideally, the list of improvements would confer benefits on the shippers and carriers in excess of the cost of the fee itself.

The advantage of container fees over the more general truck-only tolling concept is that the fee could be incorporated into the existing accounting process related to freight movements. Although there would be administration expenses, they would not be as extensive as roadside or GPS-based tolling concepts.

The only application of container fees being applied in the United States is the Alameda Corridor, where a 20-mile-long rail cargo expressway links the ports of Long Beach and Los Angeles to the transcontinental rail network near downtown Los Angeles. Container fees of $33.50 per loaded 40-foot container (lower fees for other types of rail cars) are collected to pay a portion of the project cost. The secret to success of this project was the clear benefits to all of those participating in the finance plan, including the ports, railroads and various levels of government, and the partnership those groups formed to carry out the project. The Alameda Corridor is a unique situation – replicating that success in Washington will require a clear definition of objectives, a focused list of projects to be funded with the fees, and financial commitments from other partners to contribute to the projects.

The ports of Los Angeles and Long Beach have also recently rolled the PierPASS traffic management program aimed at spreading the peak traffic loads at the port. PierPASS assesses a fee of $80 per 40-foot container for cargo that moves through truck gates during peak hours (Mondays-Fridays from 3:00 a.m. to 6:00 p.m.). The program has effectively shifted about 30 percent of freight traffic to off-peak times, thereby reducing congestion. PierPASS came about as a voluntary program instituted by the ports to avoid the potential of a threatened program to be enacted by government. The success of the PierPASS program is the extreme congestion evident in the region, and the willingness of all parties to extend the normal hours of port operation.

Implications of Findings on Tolling Policy

The interim report recommended a tolling policy for Washington State that uses pricing to encourage effective system management and congestion relief and provides a supplementary source of funding for appropriate projects. The report suggests that determining how and where tolling should be used should be based on consistent standards that recognize not only localized benefits but also potential negative system impacts. We analyzed nine illustrative examples of potential tolling applications to put the policy framework to a practical test. This section describes the findings that have emerged from those example projects.

The bottom line of our analysis points toward several basic recommendations:

1. Conversions of HOV lanes to HOT lanes is a proven, relatively inexpensive way to use excess capacity and preserve transit and vanpool performance. Following the example of the SR 167 HOT lane pilot project, additional HOV to HOT lane conversions should be considered in the short to medium term.

2. Using tolls to help fund bridge, or bridge-like improvement projects (including Snoqualmie Pass) is an effective finance tool that also can be used to influence travel behavior to improve system performance when used carefully. These tolling applications also can be considered in the short to medium term.

3. The cost and benefits of building additional HOT lane capacity should be carefully weighed against the risk that this type of project will be made obsolete by more extensive road pricing applications that come about over time. This choice does not have to be made right away, but can be addressed with additional study.

4. Tolling the Cross Base Highway is expected to pay for only 15 percent of the capital cost of the project (after subtracting out operations expenses), making it a poor candidate for tolling.

5. Tolling an existing freeway can generate significant revenue, but implications on diversionary routes should be measured and mitigated if possible. If variable pricing is done in a dense urban area such as Seattle, the potential to improve the efficiency of the freeway needs to be weighed against the potential to degrade performance on other highways in the region. Further study on such effects is recommended.

6. Network-wide truck tolling has been recently implemented on the German and Austrian Autobahn systems. In looking at whether such a system makes sense for Washington, we concluded that the revenue-generation motivations in those countries is not matched in Washington, since revenue distributed to each state in the United

States reflects actual truck usage within each state through the International Fuel Tax Agreement (IFTA). Over the longer term, as the technology to allow pricing becomes more widespread, trying out systemwide tolling applications with trucks may have some merit.

7. The use of Container Fees would be a way to apply a direct user charge to waterborne freight. The dollars could be used to fund intermodal improvements that aid freight flows in the region. The concept may be more cost-effective than the general truck-only tolling concept.

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