O-005-001

The Bored Tunnel Alternative as defined in the Final EIS does not include the Elliott/Western Connector. The Elliott/Western Connector is an independent project that will be evaluated through its own environmental review process. The Final EIS does describe the Elliott/Western Connector in Chapter 2, Question 9 and cumulative effects of the Elliott/Western Connector and other projects are provided in Chapter 7 of the Final EIS. The detailed transportation cumulative effects analysis is provided in Chapter 8 of Appendix C, Transportation Discipline Report. The purpose of providing both the transportation analysis of the proposed action (the Bored Tunnel Alternative) and the proposed action with other projects identified as part of the broader Alaskan Way Viaduct and Seawall Replacement Program was to meet FHWA's requirements under NEPA for cumulative effects analysis.

Each of the build alternatives evaluated in the Final EIS has independant utility and would meet the purpose and need (see Final EIS Chapter 5, Question 37).

Friends of Seattle

For the green, urban city we need

Via Email

August 15, 2011

Angela Angove
Alaskan Way Viaduct Replacement Project Office
999 Third Avenue, Suite 2424
Seattle, WA 98104-4019
awv2011FEIScomments@wsdot.wa.gov

Dear Ms. Angove,

On behalf of the organization Friends of Seattle, I write to comment on the Final Environmental Impact Statement (FEIS) for the Alaskan Way Viaduct Replacement Project. Friends of Seattle is a citizen's group organized as a nonprofit corporation under the laws of Washington. Its principal office is located in Seattle, Washington.

O-005-001

Segmentation

The definitions of the Project and the reasonable alternatives improperly exclude the Elliott-Western Connector that is slated for construction within the existing footprint of the Alaskan Way Viaduct. This improper segmentation of the Project violates the National Environmental Policy Act (NEPA), regulations of the Council on Environmental Quality (CEQ), and the State Environmental Policy Act (SEPA). An environmental impact statement (EIS) is inadequate if it does not adequately consider the significant individual and cumulative environmental impacts resulting from a Project. Stated another way, by artificially breaking off pieces of the project that is the subject of the EIS, an EIS fails to give policy makers and the public a complete view of a project's significant environmental impacts.

This sort of segmentation is expressly outlawed by 40 C.F.R. § 1508.25. This regulation, concerning the required scope of an EIS, requires that a single EIS be prepared for "[c]onnected actions, which means that they are closely related and therefore should be discussed in the same impact statement." 40 C.F.R. § 1508.25(a)(1). Actions are defined as "connected" when they "[a]utomatically trigger other actions which may require environmental impact statements," 40 C.F.R. § 1508.25(a)(1)(i), "[c]annot or will not proceed unless other actions are taken previously or simultaneously," 40 C.F.R. § 1508.25(a)(1)(ii), or "[a]re interdependent parts of a larger action and depend on the larger action for their justification," 40 C.F.R. § 1508.25(a)(1)(iii).

434 Maple Leaf Pl #201, Seattle, WA 98115

Ms. Angela Angove
August 15, 2011
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O-005-001 The Elliott/Western Connector is described on page 60 of the FEIS and there defined as an "independent" project, for which the co-lead agency City of Seattle will prepare a separate EIS. As the map of the Connector shows on page 58 of the FEIS, the Connector would sit in the footprint of the Viaduct, creating a road passing over the railroad and connecting the waterfront street with Elliott and Western above. This connection is critical for local access and providing freight mobility between the industrial areas in Ballard and SoDo–Duwamish. The Viaduct replacement cannot or will not proceed unless the Connector is built. Likewise, the Connector depends on the larger action—tearing down and replacing the Viaduct—for its justification. There is no adequate justification for excluding the Connector from the FEIS.

By failing to properly include the Connector within the scope of the FEIS, the co-lead agencies have created an inadequate FEIS. When environmental review is segmented in this way, the FEIS is too narrow in scope. The potential environmental impacts of the excluded project segment are not studied. And, for those portions of the project segments that are included, the environmental impacts are misstated because the impacts are different when the segments are properly analyzed as a whole. Consider, for example, that the tolling diversion—and consequential environmental impacts—from the bored-tunnel alternative could be much worse when the Connector is accounted for. This likelihood is discussed in the FEIS Appendix V, pages ES-4 and 2-2 to -4. The analysis comes from a report prepared by Nelson-Nygaard, and it notes WSDOT tolling data that found traffic diversion caused by tolling would be much worse were the Connector included. It is not enough to tuck an analysis of the entire program into chapter 8 of the Transportation Discipline Report, as the FEIS does. Rather, the Connector should be incorporated into the entire FEIS, and the environmental impacts should be examined from all perspectives, not just traffic flow.

To remedy this defect, at the very least, the lead agencies must prepare a supplemental EIS (SEIS) encompassing the environmental effects that would result from construction of the Elliott-Western Connector. An SEIS must be prepared if "[t]he agency makes substantial changes in the proposed action that are relevant to environmental concerns," 40 C.F.R. § 1502.9(c)(1)(i), or if "[t]here are significant new circumstances or information relevant to environmental concerns and bearing upon the proposed action or its impacts," 40 C.F.R. § 1502.9(c)(1)(ii).

Traffic Model and Presentation of Traffic Data

O-005-002 The FEIS's traffic modeling and presentation of the resulting data is so badly limited, for three reasons, that the FEIS is inadequate. First, the model that underlies the FEIS, as discussed in chapter 2 of the Transportation Discipline Report, does not utilize the latest innovations espoused by researchers from the University of Washington's Center for Statistics and the Social Sciences. In a 2009 study they prepared, entitled "Assessing Uncertainty About the Benefits of Transportation Infrastructure Projects Using Bayesian Melding: Application Seattle's Alaskan Way Viaduct," the UW researchers prepared their own models of Alaskan Way Viaduct replacement alternatives. (A copy of the report is attached to this letter as Exhibit A.)

O-005-002

The transportation modeling completed for this project uses current models developed by the Puget Sound Regional Council and the City of Seattle Department of Transportation. The modeling techniques employed are consistent with current professional practice and have been reviewed and approved by FHWA staff at the division and headquarters levels. WSDOT has conducted additional review of the attachments to this comment letter and its analysis is included in the project file. This analysis confirms that the traffic forecasts in the Final EIS are sufficient for purposes of NEPA analysis.

O-005-002 You will see that they criticize the Puget Sound Regional Council model that underlies WSDOT's environmental review of the Alaskan Way Viaduct Replacement Project. As documented in this study, the traffic model used to support the FEIS fails to adequately account for the interrelationship between changes in land use and transportation system. Thus the FEIS fails to give an adequate view of the environmental impacts of each alternative, and it fails to adequately consider alternatives that do not rely as much on vehicular capacity.

The second flaw in the FEIS's traffic model is that it uses unrealistic and outdated assumptions of the level of vehicle miles traveled in the model years studied. As discussed in the series of articles by Sightline in Exhibits B through F, and the state Office of Finance and Management's traffic projections discussed in Exhibit G, annual growth in vehicle miles traveled has tapered off and even dropped. The data show that this trend began before the recent economic recession. The FEIS, however, appears to indicate that its traffic model relied on very outdated forecast data for its assumptions of future travel demand. These flawed assumptions have created an inadequate FEIS, and they also helped result in WSDOT"s mistaken conclusion that alternatives that relied on transit and systematic street improvements would be insufficient to meet the project needs. A supplemental EIS is necessary to give policy makers and the public a realistic view of the environmental impacts, and to reassess the I-5/surface/transit alternatives using accurate data about future travel demand.

The third flaw in the FEIS traffic analysis stems from its presentation of the data produced by its traffic model. The results of traffic models in the FEIS are presented without any indication of the statistical uncertainty that underlies the data. When UW researches looked at a previous WSDOT study that presented data from traffic models in the same way as the FEIS, the researchers concluded, "These point estimates ignore any uncertainty involved in the models used to generate them, and thus could mislead the public into having an unwarranted degree of confidence in the benefits of making these investments." (Ex. A, "Assessing Uncertainty," p. 18.) As the UW researchers explain, policy choices about infrastructure "depend on information that is uncertain, and the public has a direct interest in better understanding how likely it is that spending several billion dollars will actually solve a problem they care about." (*Id.*, p. 2.) By properly accounting for the statistical uncertainty inherent in traffic models, "the expectations of benefits from maintaining the current level of traffic capacity in the viaduct corridor may be higher than can be scientifically supported by the available models and evidence." (*Id.*, p. 18.) As this UW report shows, WSDOT"s failure to present the statistic uncertainty creates a misleading and unreasonable picture of the environmental impacts and reasonableness of each alternative.

The UW researchers' model, which more effectively accounted for land uses and statistical uncertainty, led the researchers to conclude as follows:

> What our results suggest, in short, is that even using a worst-case scenario and comparing it to a capacity-neutral replacement of the Alaskan Way Viaduct, the travel time benefits of the higher capacity alternative are modest, and fairly localized to the viaduct corridor.

O-005-002

There does not appear to be much effect on longer commutes or on I-5 in the vicinity of downtown, as evidenced by the overlapping distributions of the predicted travel times. Further, our combined analysis of land use and transportation reveals considerably more adaptive capacity than the analysis done by the WSDOT, which considers only travel changes and excludes by assumption any adaptation in location choices of households, firms and real estate development. Accounting for uncertainty, in short, the expectations of benefits from maintaining the current level of traffic capacity in the viaduct corridor may be higher than can be scientifically supported by the available models and evidence.

(Ex. A, "Assessing Uncertainty," p. 18.) The FEIS should have employed these same techniques, and its failure to do so has rendered it inadequate.

An SEIS Must Be Done If Another Tolling Scenario Is Chosen

O-005-003

The tolling scenarios range from A - E with significant differences in the effective tolling rate. There would be commensurate variations in the rates of traffic diversion for each tolled alternative. However, the FEIS assumes for all tolled alternatives that tolling scenario C would be implemented. It does not analyze the alternatives with the other tolling scenarios. Traffic diversion would significantly affect transit, the environment, noise, and air quality. The ROD should identify which tolling scenario will be implemented so that the environmental effects of this project are known. Further, if WSDOT proposes to implement a tolling scenario different from tolling scenario C, a supplemental EIS would be necessary. *See* 40 C.F.R. § 1502.9(c)(1)(ii).

Change in Statement of Purpose and Need

O-005-004

The change in the statement of purpose and need still has not been explained sufficiently.

A. A Good Reason for the Change Has Not Been Given

In the 2006 Alaskan Way Viaduct & Seawall Replacement Project Supplemental Draft Environmental Impact Statement ("2006 SDEIS"), the purpose-and-need statement was as follows:

The main purpose of the proposed action is to provide a transportation facility and seawall with improved earthquake resistance. The project will maintain or improve mobility, accessibility, and traffic safety for people and goods along the existing Alaskan Way Viaduct Corridor as well as improve access to and from SR 99 from the Battery Street Tunnel north to Roy Street.

Notably, the project goal was a broad statement favoring the movement of people and goods; capacity for vehicles was not an end to itself, although obviously it could be one means of achieving that goal.

O-005-003

The tolling scenario selected for evaluation in the Final EIS, scenario C, is conservative in that it would result in greater impacts than the other scenarios. Since the other potential tolling scenarios would have fewer impacts, a supplemental EIS would not be required.

O-005-004

All three lead agencies (FHWA, WSDOT, and SDOT) jointly evaluated public comments and information developed during the Partnership Process and concluded the project's purpose and need statement should be revised. The changes to the statement were made with full participation by FHWA, WSDOT, and SDOT and were completed in July 2009. The changes are grounded on careful analysis and public comment.

O-005-004

In 2008, WSDOT convened a Stakeholder Advisory Commit-tee and worked together with the city and county transportation departments ("Partnership Process") to develop alternatives for replacing the Viaduct after Seattle voters, in an advisory vote, rejected both prior alternatives, a four-lane tunnel and an elevated highway. These three agencies established Guiding Principles for the Partnership Process and the Committee's work, and the second such principle echoed the 2006 statement of purpose and needs:

> Provide efficient movement of people and goods now and in the future. Any solution to the Alaskan Way Viaduct must optimize the ability to move people and goods today and in the future in and through Seattle in an efficient manner, including access to businesses, port and rail facilities during and after construction.

After the governor made her decision in early 2009, however, the 2010 SDEIS subtly changed these prior two statements of the project's goals, as follows:

> The purpose of the proposed action is to provide a replacement transportation facility that will:
> - Reduce the risk of catastrophic failure in an earth-quake by providing a facility that meets current seis-mic safety standards.
> - Improve traffic safety.
> - Provide capacity for automobiles, freight, and transit to efficiently move people and goods to and through downtown Seattle.
> - Provide linkages to the regional transportation system and to and from downtown Seattle and the local street system.

The reasons for this change have not been explained by the lead agencies. The federal Administrative Procedure Act requires the lead agencies to articulate a good reason for this change in policy course.[1] As the U.S. Supreme Court has stated, a federal agency may not "depart from a prior policy sub silentio."[2] Rather, "the agency must show that there are good reasons for the new policy."[3] We doubt that such good reasons appear in the agency record, nor can we conceive any facts or community needs that changed between 2006 and 2010 to justify the change. The change appears arbitrary and capricious, especially in light of WSDOT adopting guiding principles for the project in 2008 that did not include bare "capacity" for vehicles. Perhaps a transportation department is justified in stating that a highway-replacement project needs to supply capacity for vehicles. But WSDOT, and by extension the other lead agencies for this project, did not start there initially. It was new for the lead agencies to say the project needs to create "capacity" for "automobiles" and "freight." Thus, a good reason for the change was necessary. The FEIS, in appendix T, C-013-001, did offer an explanation of the differences from the old and the revised statement of purpose and need. But it did not explain the *good reason* for making the change.

The lead agencies' action also appears contrived to exclude consideration of the alternatives that rely more significantly on transit and had been recommended by

[1] *See, e.g., Motor Veh. Mfrs. Ass'n v. State Farm Ins.*, 463 U.S. 29, 42 (1983)
[2] *FCC v. Fox Television Stations*, Inc., 129 S. Ct. 1800, 1811 (2009).
[3] *Id.* (emphasis added).

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O-005-004 WSDOT in December 2008. It potentially excludes alternatives that rely on transit, demand management, and system-wide mobility improvements to the flow of people and goods.

B. The Revised Statement Violates State Law

O-005-005 The FEIS did not respond to Friends of Seattle's comment on the SDEIS regarding the statement of purpose and need's conflict with state laws regarding VMT reductions. Under state law, WSDOT is required to focus on the movement of people and goods, not vehicles, and it must develop strategies for reducing vehicle-miles traveled statewide. For instance, the statute setting forth the goals for the state's transportation system does not mention capacity for vehicles. Rather, it states the goal of "improv[ing] the predictable movement of goods and people throughout Washington state," RCW 47.04.280(1)(d), and "[t]o promote and develop transportation systems that stimulate, support, and enhance the movement of people and goods to ensure a prosperous economy," RCW 47.04.280(1)(a). Capacity for vehicles is not one of the goals. To the contrary, the Legislature has required WSDOT to "[d]evelop strategies to gradually reduce the per capita vehicle miles traveled based on consideration of a range of reduction methods." RCW 47.01.078(4). More specifically, the Legislature has required WSDOT to develop and implement goals for reducing vehicle miles traveled statewide by 18% by 2020, 30% by 2035, and 50% by 2050. RCW 47.01.440(1). Therefore, WSDOT's statement of purpose and need is unreasonably narrow and contrary to law if it specifically requires capacity for automobiles.

The lead agencies should take all steps necessary to change back the statement of purpose and need, and then to revisit its analysis of the project alternatives.

Failure to Fully Study a Reasonable Alternative

O-005-006 The lead agencies still have not adequately explained the rationale for excluding full study of "surface-transit" and other alternatives that rely on transit and other mobility improvements. Especially in light of WSDOT's obligations under state laws concerning VMT and carbon-emission reductions, it was unreasonable to exclude such alternatives from the FEIS.

Section 4(f)

O-005-007 The FEIS's Section 4(f) evaluation improperly views the Pioneer Square Historic District as a collection of protected properties, rather than as a whole district. The bored-tunnel alternative would "use" the streets of the Pioneer Square Historic District by channeling traffic through Pioneer Square, and by directly using portions of the streets for the alternative's network of on- and off-ramps. By failing to view the District, with its legally protected streets, as a whole, the Section 4(f) evaluation falls short. Additionally, the Section 4(f) evaluation improperly failed to determine that the increased levels of traffic on Pioneer Square streets would results in a "constructive use" of the adjacent buildings and frontages. These objections to

O-005-005

WSDOT has provided the following response:

"The law setting the VMT benchmarks directs WSDOT to "adopt broad statewide goals to reduce annual per capita vehicle miles traveled by 2050 consistent with the stated goals of Executive Order 07-02." The state law does not require individual projects to set VMT reductions. WSDOT is working on this task and related tasks in Executive Order 09-05 in conjunction with a working group established for this purpose. The cumulative greenhouse gas impacts of transportation projects are best addressed at a system-wide level where multiple projects can be analyzed in aggregate, such as in regional transportation plans. The Alaskan Way Viaduct Replacement Project is included in PSRC's Regional Transportation Plan, *Transportation 2040*, which considered greenhouse gas emissions along with other transportation objectives."

O-005-006

In the Final EIS Chapter 2 describes the development of alternatives. Additional information can be found in Appendix W, Screening Reports.

O-005-007

The Final Section 4(f) Evaluation, included with the Final EIS, appropriately considers the potential effects ("uses") to historic and other resources subject to Section 4(f) regulations. For this project, all reasonable alternatives involve the use of at least one Section 4(f) resource. This means there is no avoidance alternative. FHWA has carefully reviewed the alternatives and concludes that the Bored Tunnel Alternative is the alternative with the least overall harm. The evaluation, just briefly summarized here, is included in the Final EIS with supporting materials provided in Appendix J. See also responses to O-005-008 through O-005-014.

O-005-007 the Section 4(f) evaluation were discussed in a letter to the FWHA dated June 14, 2011, from Protect Seattle Now and Bill Speidel Enterprises, and that letter (attached as Exhibit H) is fully incorporated here by reference.

Thank you for this opportunity to comment.

Sincerely,

Gary Manca, President

CC: Daniel Mathis, Federal Highway Administration
Peter Hahn, Seattle Department of Transportation

Ex. A

Assessing Uncertainty About the Benefits of Transportation Infrastructure Projects Using Bayesian Melding: Application to Seattle's Alaskan Way Viaduct

Hana Ševčíková, Adrian E. Raftery and Paul A. Waddell
University of Washington

Abstract

Uncertainty is inherent in major infrastructure projects, yet standard practice ignores it. We investigate the uncertainty about the future effects of tearing down the Alaskan Way Viaduct in downtown Seattle, using an integrated housing, jobs, land use and transportation model, on outcomes including average commute times. Our methodology combines the urban simulation model UrbanSim with the travel model Emme/3. We assess uncertainty using Bayesian melding, yielding a full predictive distribution of average commute times on 22 different routes in 2020. Of these routes, 14 do not include the viaduct and eight do. For the 14 base routes that do not include the viaduct, the predictive distributions overlap substantially, and so there is no indication that removing the viaduct would increase commute times for these routes. For each of the eight routes that do include the viaduct, the 95% predictive interval for the difference in average travel times between the two scenarios includes zero, so there is not strong statistical support for the conclusion that removing the viaduct would lead to any increase in travel times. However, the median predicted increase is positive for each of these routes, with an average of 6 minutes, suggesting that there may be some measurable increase in travel time for drivers that use the viaduct as a core component of their commute.

1 Introduction

Major infrastructure investments routinely cost billions of dollars to construct, and are rife with political conflict over the costs, the benefits, and their distribution over often competing stakeholders. Transportation projects such as highways, bridges, and light rail systems are lightning rods for political controversy. One would imagine that with the advanced state of the art in modeling travel behavior and traffic flow dynamics, these questions would be relatively straightforward to address using metrics to measure the benefit of the project in terms of its effects on travel times, for example, as compared to the costs of the project. The state of the practice is substantially less informed than this, unfortunately.

We use a motivating case study that will be a central part of this paper to illustrate. The Alaskan Way Viaduct, an elevated highway constructed in the 1950's along the downtown Seattle waterfront, is often compared to a similarly designed elevated Embarcadero Freeway along the waterfront of downtown San Francisco that was eventually demolished in 1991 after being damaged by the Loma Prieta earthquake in 1989. The Alaskan Way Viaduct was damaged by the 2001 Nisqually earthquake and has been for the past several years a point of controversy among government officials ranging from the Mayor of Seattle to the Governor of Washington, about how to eliminate the risk of catastrophe from a collapse of the elevated highway in the next earthquake, and how to replace the facility in a way that appeases competing interests. It will be a costly project, with estimates ranging from $2.5 billion to well over $4 billion for various options. In January 2009, the Mayor, King County Executive and Governor jointly announced an agreement to replace the viaduct with a tunnel option that would cost approximately $4.25 billion.

But whether we need as much, or more, transportation capacity as is now carried by the viaduct, has been a point of contention with environmentalists and transit advocates, and may be at odds with other objectives adopted in state policy, such as achieving a dramatic reduction in greenhouse gas emissions over the next several decades. Other advocates claim that if we replace the viaduct with any alternative that has less capacity to move high volumes of traffic past the downtown area, as an alternative to the I-5 corridor, the highway system will be slowed to a crawl, with massive costs in delays to commuters and to businesses that depend on this access.

No one questions whether the viaduct should be removed and replaced with some kind of facility. The debate is over what the replacement should be, and how much capacity it should carry. At the heart of this debate, then, are quantities that are uncertain: the benefits in terms of travel time, and the costs of alternative projects. While there is a reasonable basis for assessing uncertainty about costs, there is relatively little guidance on how to assess the uncertainty about benefits. In fact, the models used to predict travel patterns based on alternative transportation networks, are designed to run to a deterministic equilibrium, and traffic modelers rely heavily on the certainty that repeated runs of the model produce consistent results — in other words, that they contain no uncertainty (Boyce 1984).

In fact, these decisions depend on information that is uncertain, and the public has a direct interest in better understanding how likely it is that spending several billion dollars will actually solve a problem they care about. Our paper contributes to this debate and provides a foundation for further work to incorporate uncertainty more systematically into the planning process, and into public deliberation about large, expensive projects with long-term impacts. There is limited prior work that examines the issue of uncertainty in the context of integrated transportation and land use models (Kockleman 2002; 2003, Clay and Johnston 2006, Ševčíková et al. 2007), and in network capacity and design (Sumalee et al. 2009). Our paper extends the literature in this area by using a principled statistical method to calibrate uncertainty in an integrated land use and transportation model system, and hence to assess the uncertainty of specific metrics that reflect the potential benefits of a major transportation facility. To our knowledge, this is the first research to use Bayesian melding to assess the uncertainty about the travel time impacts of alternative investments in major transportation facilities.

The debate centers on the question of whether it is possible to reduce capacity by removing a waterfront highway such as the Alaskan Way Viaduct, without greatly increasing travel times for commuters and commercial vehicles. On its face this seems unlikely to be possible, but some of the literature that addresses induced demand from capacity expansion, such as Downs (2004), suggests an argument that it may be. Downs coined the term 'triple-convergence' to describe the propensity for commuters to take advantage of increases in roadway capacity and temporarily faster speeds by changing routes, times of travel and modes of travel, in order to take advantage of the relative increase in speed of travel on the improved highway at peak hour by single-occupancy vehicles. The question of induced demand has rarely been raised in the context of a capacity reduction, but there is nothing inherent in the reasoning that would prevent it from applying to such a case. In the event of a capacity reduction, such as the loss of a highway, travelers would presumably make short-term choices that would shift away from the relatively higher cost route, time and mode to those that become relatively less expensive. Consider this a case of 'reduced demand'.

In the longer term, of course, persons, households and businesses can adapt to changes in accessibility by changing their locations. These longer-term induced demand or reduced demand effects may be at least as big as the short term effects described by triple-convergence (Downs 2004). In this paper, we set out to explore these questions using a land use model, UrbanSim (Waddell 2002, Waddell et al. 2003; 2007), coupled with a four-step transportation model implemented by the Puget Sound Regional Council (PSRC). The approach we develop is Bayesian melding, a methodology initially developed to calibrate uncertainty in deterministic model systems by Raftery et al. (1992; 1995) and Poole and Raftery (2000), and recently adapted to stochastic models by Ševčíková et al. (2007).

Our contribution is to harness the Bayesian melding approach to calibrate uncertainty in a combined land use and transportation model system, and to use the calibrated system to make inferences about the effects on travel times of two different alternatives of the Alaskan Way Viaduct. As the objective of this paper is not to make a definitive assessment of the specifics of the viaduct project design, we approximate the alternatives by modeling one as having the same capacity as the existing viaduct, and the other as a worst-case scenario in which the viaduct is simply removed, and no mitigation is done in terms of local street configuration and operations or of transit service in this corridor. The intent is to demonstrate on a real-world, and still timely case, the use of uncertainty analysis to inform the policy debate such as this. It should be broadly applicable as a methodology to a much wider set of problems.

The paper proceeds with a brief description of the models, since their internal construction is not the focus of this paper, and details of the models used in the analysis are available in the provided citations. We then present the Bayesian melding approach developed for application to this case study, and close with a discussion of the results and implications for further research.

2 UrbanSim with Integrated Travel Model

2.1 Land Use Models

UrbanSim is an urban simulation model operational in several urban areas in the United States (Waddell 2002, Waddell et al. 2003; 2007). The system is implemented as a set of interacting models that represent the major actors and choices in the urban system, including households choosing residential locations, business choices of employment location, worker choices of jobs and developer choices of locations and types of real estate development. The model system microsimulates the annual evolution in locations of individual households and jobs, including the connection between them, and the evolution of the real estate within each individual geography as the result of actions by real estate developers.

Our application of UrbanSim operates on parcel level. It is configured to run the following models:

1. **Real estate price model**: predicts prices of parcels, using a hedonic regression model.

2. **Expected sale price model**: predicts prices of possible real estate proposals, using a hedonic regression model.
3. **Development proposal choice model**: chooses real estate proposals to be built (including redevelopment), using weighted random sampling based on a predicted return on investment (ROI).
4. **Building construction model**: demolishes buildings (for redevelopment) and builds new buildings according to the chosen proposals.
5. **Household transition model**: creates and removes households and updates the set of persons accordingly. It is based on random sampling and is driven by macroeconomic predictions.
6. **Employment transition model**: creates and removes jobs, using random sampling, and is driven by macroeconomic predictions.
7. **Household relocation choice model**: determines households for moving, using a logit model.
8. **Household location choice model**: locates moving households into buildings, using a multinomial logit model.
9. **Employment relocation model**: determines jobs for moving using weighted random sampling.
10. **Employment location choice model**: locates moving jobs into buildings, using a multinomial logit model.
11. **Work at home choice model**: simulates workers decision to work at home or out of home. It is based on a logit model.
12. **Workplace relocation choice model**: simulates workers decision to change job. It is based on a logit model.
13. **Workplace choice model**: assigns jobs to workers, using a multinomial logit model with sampling alternatives.

Several of the models require coefficients which are obtain by estimating using observed data and Maximum Likelihood Estimation (MLE) of multinomial logit models based on a Random Utility Maximization framework (McFadden 1974; 1978; 1981). Most of the models are stochastic, and involve Monte Carlo sampling of choice outcomes conditional on a probability generated from a Multinomial Logit Model (MNL). A simulation starts to operate on observed data (so called base year data) about households, persons, jobs, buildings, parcels, zones etc. Each iteration of the model system modifies the data and is considered as a prediction for the particular year.

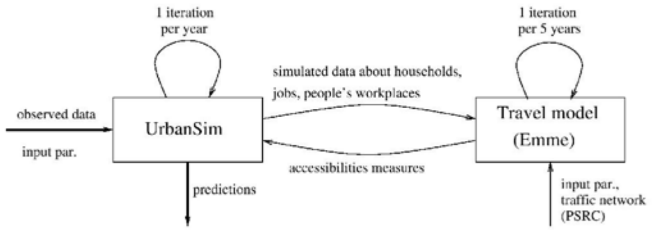

Figure 1: Integrated use of UrbanSim and the Travel Model.

2.2 Travel Model

The travel model used by the PSRC is a state of the practice four-step travel model, in the early stages of transition to a full activity-based travel model system. So far, only the trip generation step has been replaced by an activity generation model, and the rest of the model system operates as a traditional aggregate travel model with destination choice implemented as a gravity model, mode choice as a multinomial logit model, and assignment using Emme/3, with feedback of congested travel times to mode choice. Full documentation of the base model system is available from the PSRC web site (www.psrc.org).

The travel model runs on a zonal system that contains approximately 1,000 zones to cover the Central Puget Sound, consisting of King, Kitsap, Pierce and Snohomish Counties. It is implemented in the Emme/3 software platform, and requires approximately 16 hours to complete one simulation year, including iteration for convergence on assignment, on a high-end desktop computer.

2.3 Integrated Land Use and Travel Model

The integration of UrbanSim and the Travel Model can be explained using Figure 1. UrbanSim is run on an annual basis, i.e. one iteration of the full set of models simulates a land use evolution in one year. Due to the very high run times of the travel model, we run Emme/3 only once in five years of UrbanSim runs. The travel model uses the output from UrbanSim about households, jobs and people's workplaces. In addition, it has its own input parameters and it operates on a network provided by the PSRC. In turn, several UrbanSim models use accessibilities measures computed by the travel model, such as travel times or log sums. They are used mainly as predictive variables in the Employment location choice model.

Figure 2: Seattle's Alaskan Way Viaduct.

3 Policy Question: Seattle's Alaskan Way Viaduct Replacement

The Alaskan Way Viaduct, built in 1953, is an elevated section of State Route 99 that runs along the Elliott Bay waterfront in Seattle's Industrial District and downtown Seattle (see Figure 2). In Figure 4, the viaduct is shown as a black solid line. The viaduct was damaged in the 2001 Nisqually earthquake and since then continuing settlement damage has been discovered (WSDOT 2005). In 2002, the Washington State Department of Transportation (WSDOT) together with the City of Seattle, the Federal Highway Administration and King County have launched a program that would lead to a replacement of the viaduct (WSDOT 2004). Since then, many replacement concepts and designs have been evaluated, and these were narrowed down in 2008 into three hybrid solutions:

- Surface and transit option: the viaduct is removed; significant improvements in surface and transit conditions.
- Elevated structure: the viaduct is rebuilt, but with current design standards which would require a larger structure.

- Tunnel option: a four-lane 2-mile underground tunnel with improvements to the seawall and other streets.

One of the main objections raised by critics of the surface transit option has been a fear that it would produce traffic jams and drastically increased travel times on routes along the viaduct, as well as on I-5, which runs parallel to the viaduct on the east side of downtown. Though proponents of the surface transit option have pointed out that the demolition of the Embarcadero Freeway in San Francisco did not cause significant traffic problems, the viaduct carries considerably more traffic. The viaduct carries approximately 110,000 cars per day, whereas the Embarcadero Freeway carried around 70,000 cars per day before its demolition. Further, the geography of Seattle, constrained by water on its east and west sides, means that the I-5 corridor is the only major north-south freeway through Seattle. It is thus legitimate to ask whether reducing capacity on the viaduct would make the already bad I-5 traffic much worse.

WSDOT released a study that compared various transportation measures for eight different scenarios, see WSDOT (2008) and WSDOT (2007) (meetings from November 13 and November 24 2008). These measures included traffic volume, pattern and modes of travel as well as the quality of those trips as measured by forecast travel times during various periods of the day. The baseline was set to the year 2015 and the study area was limited to the city center of Seattle. The land use data used as inputs for the travel model incorporated a growth in the downtown area. Their key findings in terms of travel time were that a trip through the city from the north to the south side at an AM peak would be approximately 10 minutes longer if there is the surface option implemented as opposed to an elevated structure. Their model did not take into account changes in land use over time, including changes in real estate prices. Moreover, it provides point predictions without any sense about the uncertainty of the results.

In January 2009, the Washington State Governor together with the Mayor of Seattle announced an agreement to pursue the tunnel option. Though a decision on the alternative appears to have been concluded (there have been several changes in the decision process along the way, so this may or may not be the final outcome), we think this case is still relevant for our study, as it highlights the issue of uncertain benefits from large-scale infrastructure projects.

We are interested in comparing changes in travel times over time resulting from different viaduct replacement options. Since our motivation is the development of a better method to inform such decisions, we are less interested in the fine points of the design of the alternatives. Rather, we develop two alternatives that should provide a suitable bracket for the alternatives that have been considered. For simplicity, we use as a base alternative a network that matches the current capacity of the existing viaduct. Whether it comes in the form of a tunnel or a replacement elevated structure is not material to this analysis.

For the other alternative, we take a worst-case scenario that should be dramatically worse in terms of effects on travel times than the surface transit option that has been under consideration: for this worst-case scenario, we simply remove the viaduct in 2010, and provide no mitigation in terms of improved transit service, or improvements to local streets in downtown. It is truly an unrealistically worst case. The rationale for this is that we want to examine whether there is a large enough difference in travel times between these two cases to offset the uncertainty in the analysis of the travel time benefits. One would like to think that the results generate confidence that the investment of more than \$4 billion would improve travel times, over the alternative that was used in the Embarcadero case: simply removing the elevated highway and connecting downtown to the waterfront.

Thus, to summarize, we compare two scenarios:

1. **Capacity-Neutral Replacement** which is our baseline. We use the travel model networks provided by PSRC for years 2005, 2010, 2015 and 2020. In terms of travel times, this scenario approximates a situation in which either the viaduct is rebuilt or a tunnel is built.

2. **Worst-Case: Demolish Viaduct** in 2010. Here we remove links from the 2010, 2015 and 2020 networks that represent the viaduct.

4 Bayesian Melding Method and its Application

4.1 Bayesian Melding Method

Bayesian melding was proposed by Raftery et al. (1992; 1995) and Poole and Raftery (2000) as a way of putting the analysis of deterministic simulation models on a solid statistical basis. The method was modified and applied to stochastic models by Ševčíková et al. (2007), specifically to urban simulation models.

A simple version of the original method for deterministic models is summarized in Figure 3. There is a prior distribution of model inputs $q(\Theta)$ from which we draw input values Θ_i for $i = 1, \ldots, I$. The model runs I times from the starting point to the present and for each input Θ_i it produces as output the quantity of interest, Φ_i. The model can be viewed as a mapping, M, from the space of inputs to the space of outputs, which we denote by $\Phi = M_\Phi(\Theta)$. The "present" time is defined as a time point for which we have observed data available. We use the observed data, denoted by y, to compute a weight w_i for each input Θ_i: $w_i = L(\Phi_i)$. Here, $L(\Phi_i)$ is the likelihood of the model outputs given the observed data, $L(\Phi_i) = \text{Prob}(y|\Phi_i)$. For each of the I runs, the model is run forward until a future time for which we make a prediction. The results of the ith model run are denoted by Ψ_i. The posterior distribution of Ψ is approximated by a discrete distribution with values Ψ_i having probabilities proportional to w_i.

The method was extended to stochastic mechanistic models such as UrbanSim by Ševčíková et al. (2007). The main change was that the conditional distribution of the model outputs Φ given the model inputs Θ, which is a point mass at $M_\Phi(\Theta)$ for deterministic models, became a probability distribution. This distribution had two components, one reflecting the stochastic nature of the model outputs, and the second reflecting model error. Details can be found in Ševčíková et al. (2007).

4.2 Results from Prior Research

In Ševčíková et al. (2007) we applied the method to an UrbanSim application for the Eugene, Oregon region. We were able to determine the posterior predictive distribution of the numbers of households

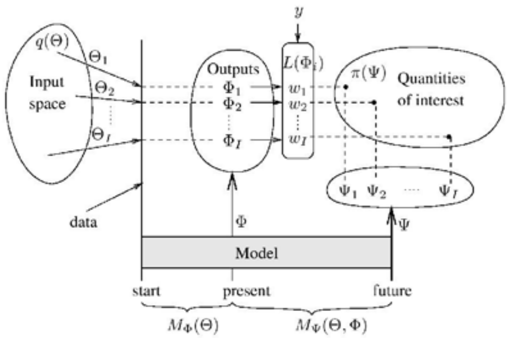

Figure 3: Illustration of the Bayesian melding method for deterministic models. The uncertain model inputs, Θ, refer to the starting time of the simulation, and the outputs, Φ and the data relevant to the outputs, y, are observed at the "present" time, while the quantities of interest, Ψ, refer to the future. The quantities Θ_i, Φ_i and Ψ_i refer to the i-th simulated values of inputs, outputs and quantities of interest, respectively.

in each of the 295 traffic analysis zones and in any aggregation of those[1]. Our starting point was the year 1980, the "present" time was 1994 and the "future" time was 2000. Using observed data in 2000 we were able to validate the results. Our main conclusions were:

- The Bayesian melding approach provided well calibrated results, while simple multiple runs (reflecting the stochastic variation in model output, but not model error) underestimated uncertainty.
- A square root transformation of the quantity of interest (number of households) yielded an approximately constant variance of the model error.
- Variation of the model inputs and random seed did not account for much of the uncertainty.

4.3 Data

Our simulation region is the Puget Sound area, and our starting point, or base year, is 2000. We have detailed information about the Puget Sound area 2000, which includes 1,282,940 households,

[1] In that research, the travel model was not included in the analysis, whereas this current research incorporates both the land use and transportation model components, and extends the method to the assessment of uncertainty in evaluation of infrastructure alternatives.

Figure 4: Seven commuter routes none of which includes the Alaskan Way Viaduct. The viaduct is shown in black.

1,608,426 workers, 1,849,447 jobs, 1,008,869 buildings, 1,177,140 parcels, and 938 traffic analysis zones (TAZ).

We also have less detailed data observed in 2005, taken as the "present" time. This includes the numbers of households in each TAZ and the numbers of jobs in each TAZ divided into 8 groups: mining; construction; manufacturing; wholesale trade, transportation, and utilities (wctu); retail trade; financial, professional, health and other services (fires); education; and government. These will be our calibration data y for the land use model.

In order to calibrate the travel model output, we obtained observed travel times for selected routes in 2005 from the Washington State Department of Transportation (http://depts.washington.edu/hov). These are annual averages over weekdays in five-minute periods, which we averaged over the AM peak (6:00am – 9:00am) in order to do a direct comparison with the travel model outputs. We chose 7 non-overlapping popular commuter routes, i.e. 14 trips, for which average travel times were available; see Figure 4.

4.4 Prior, Likelihood and Posterior distribution of the Land Use Model

We first extend the statistical model of Ševčíková et al. (2007) on which the likelihood function $L(\Phi_i) = \text{Prob}(y|\Phi_i)$ is based, for use with multiple quantities of interest, as follows:

$$(y_{kl}|\Theta = \Theta_i) = \mu_{ikl} + a_l + \epsilon_{ikl}, \text{ where } \epsilon_{ikl} \overset{iid}{\sim} N(0, \sigma_{il}^2), \tag{1}$$

for $i = 1, \ldots, I$, $k = 1, \ldots, K$ and $l = 1, \ldots, L$. Here i indexes the simulation run, k indexes the zone, and the index l refers to the l-th quantity of interest. The quantity μ_{ikl} is the expected value of y_{kl} under the model given Θ_i, ϵ_{ikl} denotes the model error, and a_l is the overall bias in the model predictions of the lth output. The variance σ_{il}^2 and bias a_l are estimated by their sample equivalents: $\hat{\sigma}_{il}^2 = \frac{1}{K}\sum_k (y_{kl} - \hat{a}_l - \hat{\mu}_{ikl})^2$, and $\hat{a}_l = \frac{1}{IK}\sum_{i,l}(y_{kl} - \hat{\mu}_{ikl})$, where $\hat{\mu}_{ikl}$ is the predicted value of y_{kl} from the ith simulation run.

This yields a conditional predictive distribution of our quantity of interest:

$$y_{kl}|\Theta_i \sim N(\hat{a}_l + \hat{\mu}_{ikl}, \hat{\sigma}_{il}^2)\,. \tag{2}$$

We then have

$$w_i \propto p(y|\Theta_i) = \prod_{l=1}^{L}\prod_{k=1}^{K} \frac{1}{\sqrt{2\pi\hat{\sigma}_{il}^2}} \exp\left[-\frac{1/2(y_{kl} - \hat{a}_l - \hat{\mu}_{ikl})^2}{\hat{\sigma}_{il}^2}\right]. \tag{3}$$

The quantities $\hat{\sigma}_{il}^2$ and $\hat{a}_l$ are estimated at the "present" time $t_1 = 2005$. The marginal distribution of the l-th quantity of interest, Ψ_{kl}, in the year $t_2 = 2020$, is given by a mixture of normal distributions, as follows:

$$\pi(\Psi_{kl}) = \sum_{i=1}^{I} w_i N(\hat{a}_l b_a + \Psi_{ikl}, \hat{\sigma}_{il}^2 b_v)\,, \quad k = 1, \ldots, K,\ l = 1, \ldots, L\,. \tag{4}$$

Here, b_a and b_v denote propagation factors of the bias and the variance over the time period $[t_1, t_2]$.

In this application, the long runtime of the travel model made it infeasible to do a large number of runs of the travel model. Also, we found that the results of UrbanSim for numbers of households and jobs were relatively insensitive to the values of Θ_i drawn from the prior (results not shown). Thus the contribution of uncertainty about the UrbanSim inputs Θ to overall uncertainty about average travel times was small. In particular, the variation in σ_{il}^2 between runs was small, and so we used a single estimate, $\hat{\sigma}^2$, using the run based on the prior mean of Θ, estimated from external data. Results (computed on the square root scale) are shown in Table 1.

In addition, we were interested in comparisons between scenarios, and assuming that the propagation factors were the same for both scenarios allowed us to ignore them and set them both equal to 1. Together, these considerations allowed us to approximate (4) by the simpler equation

$$\pi(\Psi_{kl}) = \frac{1}{I}\sum_{i=1}^{I} N(\hat{a}_l + \Psi_{ikl}, \hat{\sigma}^2)\,, \quad k = 1, \ldots, K,\ l = 1, \ldots, L\,. \tag{5}$$

For priors, we used the same approach as Ševčíková et al. (2007). For input parameters that were estimated by multinomial logistic regression or by hedonic regression from external data, we used the

l	measure	$\hat{a}_l$	$\hat{\sigma}^2_{1l}$
1	households	−0.02	7.2
2	mining	−0.21	4.9
3	construction	0.25	20.2
4	manufacture	−0.80	15.4
5	wtcu	−0.08	24.8
6	retail	0.07	21.0
7	fires	0.38	35.4
8	education	−0.57	28.7
9	government	0.39	37.5

Table 1: Estimates for bias and variance, respectively, obtained from the run based on the prior mean of Θ.

multivariate normal distribution $\mathrm{MVN}(\hat{\Theta}, \mathrm{SE}(\hat{\Theta})^2)$, with mean $\hat{\Theta}$, the estimator of Θ, and with as variance matrix the diagonal matrix with diagonal entries equal to the squares of the standard errors of the parameters. For mobility rates used in the Employment relocation model, we used the normal distribution $\mathrm{N}(\hat{r}, (\frac{\hat{r}(1-\hat{r}))^2}{n})$, truncated at zero, where $\hat{r}$ is an estimate of the rate r and n is the number of observations from which $\hat{r}$ was obtained.

The land use model uses regional control totals for number of households and jobs obtained from external sources. We kept the control totals constant, and so the results are conditioned on these totals.

4.5 Calibration of the Travel model

Due to the complexity of the input parameters and the long run-times of the travel model, we assessed uncertainty about the travel model by a simple calibration procedure. In Figure 5, we plotted the simulated average travel times for the different commutes in $t_1 = 2005$ against the observed average travel times (obtained as described in Section 4.3). As can be seen, the travel model overestimates the travel times.

We found that, given the simulated average travel time T_{sim}, the conditional distribution of the observed average travel time, T, was well represented by a normal distribution on the logarithmic scale with an additive bias:

$$\log(T) \sim N(\log(T_{sim}) - 0.70, 0.14^2). \tag{6}$$

5 Results from Integrated Land Use and Travel Model

The posterior distribution of the resulting travel time T is given by

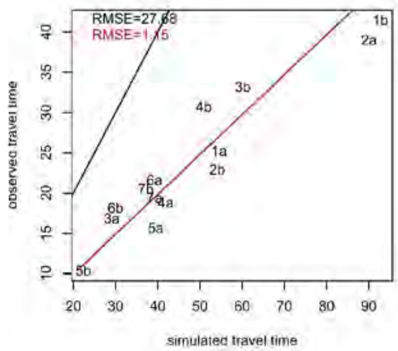

Figure 5: Calibration of the travel times. The solid line is the $y = x$ diagonal; the dashed line is $y = e^{-0.70}x$, corresponding to the calibration in equation (6). The points are numbered according to the routes in Figure 4.

$$\pi(T) = \int p(T|\Psi, \Theta)\, p(\Psi|\Theta)\, p(\Theta)\, d\Theta d\Psi, \tag{7}$$

where $p(T|\Psi, \Theta)$ is given by (6) and $p(\Psi|\Theta)$ is simulated from by running UrbanSim with inputs Θ and applying equation (5). Because we are interested in comparisons between scenarios, we ignore the propagation factors in (4), which we assume will be the same for both scenarios.

For both the baseline (viaduct) scenario and the no-viaduct scenario, we evaluated the integral in (7) by simulation, using the nested simulation scheme depicted in Figure 6. Given the long time needed to run the travel model, we approximated the integral over Θ by simulating a small number, I, of values of Θ from its prior distribution, and approximating the integral by an equally-weighted discrete distribution over $(I + 1)$ values of Θ, namely the I simulated values and the point estimate from external data, as in equation (5). As discussed above, this may overestimate this source of uncertainty, since it does not allow for the additional information about Θ from the 2005 data, but the estimated uncertainty from this source was small in any event, and so we found this approximation adequate.

To simulate a value of the outputs Ψ given a value of Θ, we ran UrbanSim for the first five years

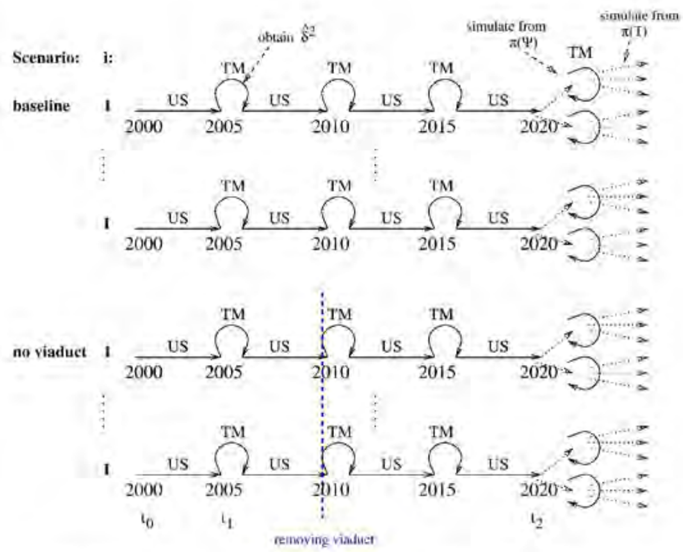

Figure 6: Nested simulation scheme for simulating the posterior distribution of average travel time in 2020 by Bayesian melding.

of the simulation period (2000–2005), and then we ran the travel model. This was repeated for each five-year period until 2020.

For each simulated value of Θ, we simulated J values of the set of outputs Ψ (numbers of households and jobs for each zone in 2020) by the method described in Section 4. Finally, for each simulated value of Ψ, we simulated N values of T from (6). We used $I = 3$, $J = 5$ and $N = 1,000$. Note that $\hat{\sigma}^2$ was obtained only once, from the run with the prior mean for Θ estimated from the external data, and reused in all remaining runs.

Results are shown in Figures 8 and 9. The figures show the posterior distributions of average travel times for the two scenarios: baseline in grey, no-viaduct in red. Figure 8 contains the seven routes (in both directions) from Figure 4 that do not contain the viaduct. Figure 9 contains eight additional routes that go (or would go) directly through the viaduct as shown in Figure 7.

From Figure 8 it is clear that the posterior predictive distributions of average travel times under the two scenarios overlap substantially, so that our analysis does not indicate that removing the viaduct

Figure 7: Routes that include the Alaskan Way Viaduct. Route 11 (shown in black) is the viaduct itself: 11a goes from the north end to the south end of the viaduct, while 11b goes from south to north.

would have any effect on average travel times for commuter routes that do not include the viaduct. For the routes that do include the viaduct, Figure 9 shows that the posterior distributions still overlap, but not completely.

To investigate further whether our results indicate an effect of removing the viaduct on average travel times, we calculated the posterior predictive distribution of the *difference* between average travel times under the two scenarios in 2020. These are shown for all routes considered in Figure 10. The seven base commutes that do not include the viaduct are in the upper part of the figure, and it is again clear that our analysis does not indicate any effect of removing the viaduct for these routes, since zero is close to the center of all the distributions.

For the routes that do include the viaduct the situation is less clear. The 95% predictive intervals for all of these routes includes zero, so our simulation results do not clearly indicate an effect of removing the viaduct. On the other hand, the median change for all eight routes that contain the viaduct is positive, ranging from 1.5 to 9.2 minutes, and averaging 6.1 minutes. The median predicted

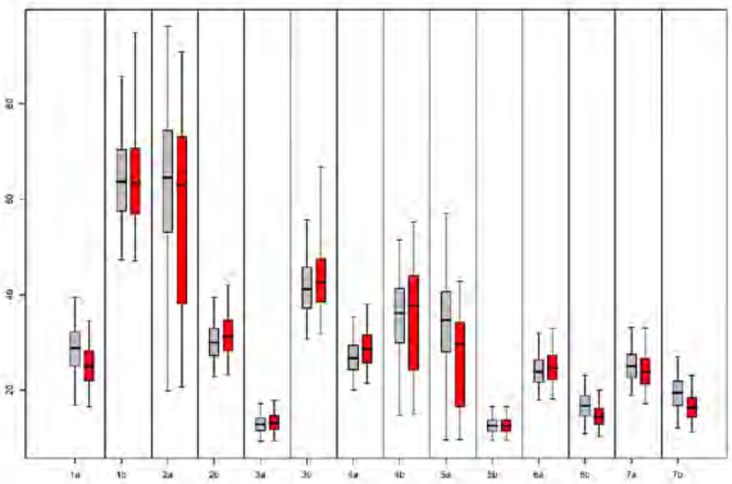

Figure 8: Posterior predictive distributions of average travel times in 2020 for each of the seven routes from Figure 4 in both directions. The posterior distributions are represented by boxplots, with the box containing the interquartile range with the median marked in the middle, and the whiskers covering the 95% posterior confidence interval. The baseline scenario is shown in grey and the no-viaduct scenario in red.

16

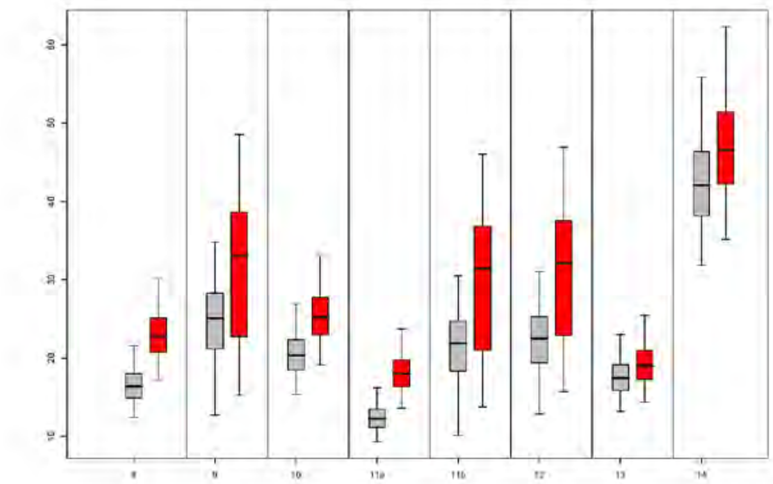

Figure 9: Posterior predictive distributions of average travel times in 2020 for additional routes that directly involve the viaduct. The posterior distributions are represented by boxplots, with the box containing the interquartile range with the median marked, and the whiskers covering the 95% posterior confidence interval. The baseline scenario is shown in grey and the no-viaduct scenario in red.

change for traveling the viaduct alone from north to south (route 11a) is 5.7 minutes, but the predictive interval contains zero.[2]

6 Discussion

In the Seattle Times of November 14, 2008 an article of Gilmore (2008) reported on the WSDOT (2008) study. It indicated that if the viaduct were replaced by another elevated highway in 2015, drivers going from Greenwood in North Seattle to SeaTac International Airport (our route 14) would arrive 10 minutes sooner than if the replacement were a surface boulevard. Furthermore, from Ballard to south of Downtown (our route 13) would be 13 minutes faster and drivers on our route 12 would save 10 minutes on an elevated highway. These point estimates ignore any uncertainty involved in the models used to generate them, and thus could mislead the public into having an unwarranted degree of confidence in the benefits of making these investments. The point estimates for routes 12 and 14 fall into our prediction interval (Figure 10), whereas the 13 minutes for route 13 falls outside our 95% confidence interval.

We should make clear that our analysis is not directly comparable with the WSDOT study. Not only are the prediction years different, but more importantly, the WSDOT study does not consider the long-term changes that occur when transportation projects change patterns of accessibility: households can relocate to be closer to their jobs, workers can change jobs to reduce their commute, businesses can relocate to take advantage of better access at different locations, and real estate developers can respond to new opportunities to develop housing and non-residential space. Our analysis integrates these forms of long-term adaptation, in addition to the short-term adaptations that travelers have when accessibility patterns change: they can change destinations, times of travel, modes of travel, and routes. The collection of these kinds of adaptive behaviors provides a reservoir of flexibility that has not previously been thoroughly examined. In instances such as a temporary or even long-term closure of a major transportation facility, the reality in terms of traffic conditions is often far better than transportation officials expect. These kinds of adaptive behaviors provide a plausible explanation, though many other factors could also contribute.

What our results suggest, in short, is that even using a worst-case scenario and comparing it to a capacity-neutral replacement of the Alaskan Way Viaduct, the travel time benefits of the higher capacity alternative are modest, and fairly localized to the viaduct corridor. There does not appear to be much effect on longer commutes or on I-5 in the vicinity of downtown, as evidenced by the overlapping distributions of the predicted travel times. Further, our combined analysis of land use and transportation reveals considerably more adaptive capacity than the analysis done by the WSDOT, which considers only travel changes and excludes by assumption any adaptation in location choices of households, firms and real estate development. Accounting for uncertainty, in short, the expectations of benefits from maintaining the current level of traffic capacity in the viaduct corridor may be higher than can be scientifically supported by the available models and evidence.

[2]Note that the routes that contain the viaduct all overlap, in some cases substantially, and so the posterior predictive distributions for different routes are not independent. As a result, it is not possible to view these eight posterior predictive distributions as independent samples from a distribution and carry out a standard statistical test on the average value.

In future research, we hope to further develop the methodology described in this paper, and to incorporate refinements in the current generation of models used in supporting the decision-making process on large-scale infrastructure projects such as the Alaskan Way Viaduct.

7 Acknowledgments

This work has been funded by NSF grants EIA-0121326 and IIS-0705898, and EPA grant R831837. The authors would like to thank Larry Blain for helpful discussions and for helping to configure the travel model, and the Puget Sound Regional Council for providing access to the travel model and data.

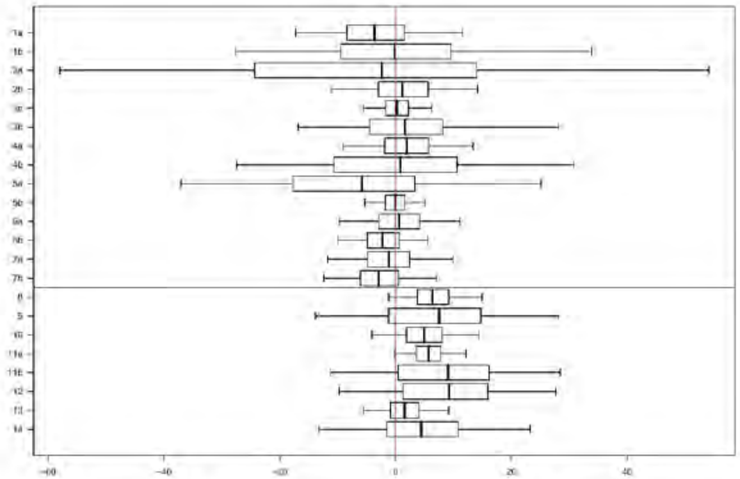

Figure 10: Posterior predictive distributions of differences between average travel times for the two scenarios for all routes. The difference are equal to average travel time for the no-viaduct scenario minus that for the baseline (viaduct) scenario. The posterior distributions are represented by boxplots, with the box containing the interquartile range with the median marked, and the whiskers covering the 95% posterior confidence interval. The routes above the horizontal line are those shown in Figure 4 that do not include the viaduct, while the routes below the line are those that do contain the viaduct.

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Ex. B

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Washington's 20 Billion Mile Diet

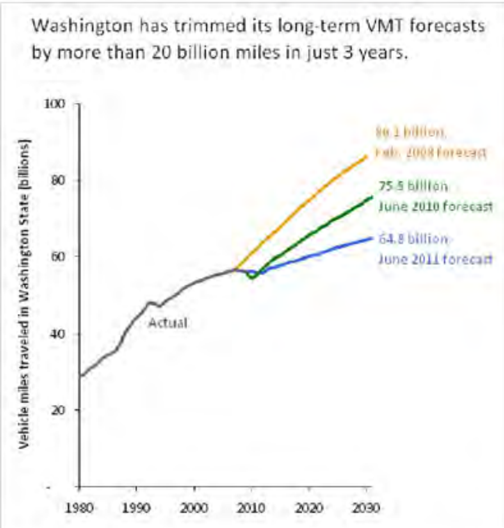
State traffic forecasts have changed radically in just three years.

Clark Williams-Derry on August 2, 2011 at 11:32 am

This post is 13 in the series: Dude, Where Are My Cars?

According to the most recent forecasts from the Washington State Office of Financial Management, drivers in Washington State will rack up about 65 billion miles on the highways in 2031.

I have no idea if that number is anywhere close to accurate. Nobody does. But what I do know is that that number is 21 billion miles *lower* than the forecast that OFM made 3 years ago, and more than 10 billion miles lower than their forecast from just last year. The chart has the details:



It's awfully tempting to suggest this chart shows that OFM is gradually groping towards more realistic traffic projections.

But does it, really? I honestly don't know if the blue line is more "realistic" than the orange line. Sure, the blue line is more consistent with the actual traffic trends over the last decade—a period when annual VMT growth slowed to a crawl. But I don't have a crystal ball to

Sea

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know which line is actually a "realistic" depiction of the future.

Instead, I think the real lessons of the chart lie elsewhere.

The first lesson is this: ***nobody has any special insight into the future***. Future VMT trends aren't a feature of objective reality that smart people can sit in a room and puzzle out. They're just ***guesses***. Sometimes new information comes in, and the guesses change. Sometimes they change radically, enough to make the best guesses from a year earlier look ludicrous. So it's important to remember that even if particular forecast matches up with your world view, ***it's still just a guess***.

Which leads to a second lesson: ***nobody should take official VMT forecasts too seriously***. Three years ago, the "official" guess was that there would be lots of new demand for road space, and lots of new gas tax revenue to pay for it. Today, the "official" guess is that statewide gas consumption peaked in 2002 or 2003, never to rise again; that gas tax revenues are going to decline unless the state ramps up the tax rate; and that the demand for new road space is going to slow to a crawl. Those are two completely contradictory views from the same agency in the same political administration. So all the hot air that was spewed about the dire need for new transportation megaprojects to avoid the near-certainty of a trafficopalypse showed nothing more than hubris, overconfidence, and a dismal understanding of how forecasting actually works.

And there's a third lesson here: ***forecasts can be dangerous***. People have a tendency to take official forecasts awfully seriously. But the decisions we made three years ago that we "had" to put lots of new megaprojects into the pipeline, based on forecasts of massive gridlock in 20 years, could very easily turn out to be dreadfully costly mistakes. When we place too much confidence in any one forecast, we can wind up making terrible decisions.

To me, the rapid change in traffic forecasts argues for a new way to think about transportation investments: that we make them smaller, more versatile, more nimble, more creative, and less likely to lock us into huge long-term expenses for projects that we might not actually need. In short, it argues for an approach that's the ***exact opposite*** of all the multi-billion dollar bridges, tunnels, and highway expansions that are on the docket in the Northwest.

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Southender says:
August 2, 2011 at 11:50 am

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Great post as usual.

As a side note to actual state VMT, the most conservative estimate of the unrecovered costs of driving is $0.15/mile (source: FHWA) (a subsidy by any other name, but anyway...). If we were to asses just the most direct costs, Washington state and its communities would receive $9.75bn every year. That money would go a long way toward dealing with pavement condition, structurally deficient bridges, and even Sen Haugen's beloved ferries — and would reduce a bit of VMT to boot.

Reply

Jim says:
August 2, 2011 at 10:14 pm

I've seen this graph before and it used to justify why we don't need the vast road infrastructure that the state is planning. I take the point that the WSDOT estimates are based on models and are just projections, but the obvious point hasn't been made. I don't know whether its justifiable, but I'll make the point anyway.

Doesn't the "rapid change in traffic forecasts" seem to correspond nicely to the drop in our economy and the shedding of jobs? Would it therefore suggest that these traffic improvements are not unnecessary when the economy returns, jobs return, and people begin commuting to work again?

Reply

Clark Williams-Derry says:
August 3, 2011 at 6:51 am

Jim-

The economy is definitely a major force in the trends from 2008.
It's possible that forecasters are feeling gloomy, and their long-term GDP growth forecasts have been affected by the short-term economic woes.

But reading the numbers, VMT growth slowed WAY before the economy cratered. As I read things, it looks like the forecasts are moving towards a belief that "things in the future will look like they did from 2001-2007, rather than from 1992 through 2000." In some ways, what's happening is that an OLD vintage of super-over-optimistic forecasts that seemed reasonable in the 1990s is going away, and a NEW vintage of semi-optimistic forecasts that match the early 2000's is coming into force.

Here's what I think has changed in the models:

1) Forecasters now think that oil prices are going to remain high. As recently as 2008, ALL of the major oil forecasts showed oil prices at ~$30/barrel and roughly flat/declining as far as the eye can see. The runup that started in 2005 was seen as a temporary blip. But even though the economy is still struggling mightily, oil prices are high — so high & ascending oil prices are now built into the models. (Incidentally, from what I've seen the models are based on assumptions that gas will be ~$3 per gallon).

2) Forecasters now better understand how consumers react to high gas prices. For a couple of decades, gas price blips had no appreciable effect on demand. When gas prices went from $1 to $1.20, nobody batted an eye-everyone kept buying. So the "professional" opinion was that gas price elasticity was incredibly low — people would continue to drive no matter how high prices got. But it seems that gas at $4 a gallon has really made a dent in people's appetite for travel. Elasticity is higher than

people thought. Couple that with higher than expected gas prices, and you get a significant dampening effect on driving.

3) The understanding of demographics — seniors driving less, fewer teens and young people working — may have changed, altering long-term estimates of trip generation.

There are probably other factors. The important thing, though, is that the long-term projections now show that the future will be like 2001-2007, not like the roaring 1990s. That may still be too optimistic! But it's not "just" that the sour economy in 2011 is changing expectations for economic growth in 2030; it's also that the models are catching up to the reality of what was happening in the early 2000s.

Reply

Steve Erickson says:
August 3, 2011 at 10:25 am

These sorts of grossly inflated forecasts have disastrous consequences for long term planning and economics. Right now there are two different sewer projects being planned on Whidbey Island that are based on straight line projections of 10 year old OFM "high-mid" population forecasts that are demonstrably way higher than has actually occurred. This is the result of a combination of the lag in updating the County's GMA population forecasts, attributable to the lack of planning dollars available right now, and the boomers previously in power consistently choosing from the high end of OFM population forecasts, despite hindsight consistently showing that the reality was different. So, now Oak Harbor (current population: about 23,000) is planning a $60 million new sewage plant and the non-municipal urban growth area of Freeland (current population: about 4,000) is planning a $40 million sewer.

Looking at census data since 1970 reveals that since 1980 the rate of population increase has dropped by about 50% for each succeeding decade. If this long term trend continues the 2010-2020 population increase rate will be close to 0%. In fact, Island County has actually lost population (a bit over 3%) in the last 3 years. So, Whidbey and Camano Island may be about to achieve a steady state population or decline. This is something boomers just can't comprehend.

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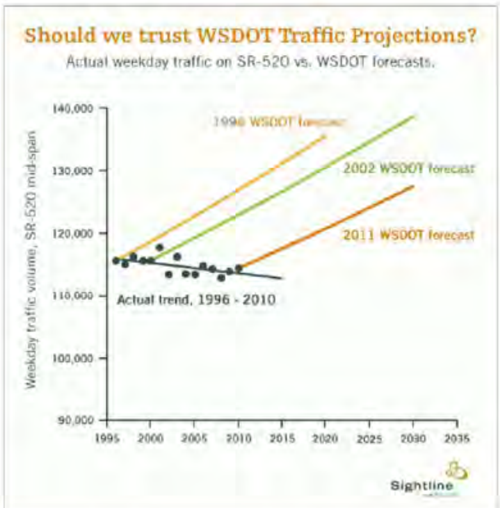
WSDOT vs. Reality

Puget Sound traffic forecasts don't even pass the laugh test.

Clark Williams-Derry on July 13, 2011 at 1:35 am

This post is 12 in the series: Dude, Where Are My Cars?

I wish I were making this up. The Washington State Department of Transportation continues to insist that traffic volumes on the SR-520 bridge across Lake Washington are going up up up—even though actual traffic volumes have been flat or declining for more than a decade! Here's a chart that makes the point.



In a charitable mood, you could forgive the 1996 projections. Back then, rapid traffic growth on SR-520 was a recent memory: up through about 1988, traffic growth was both steady and rapid.

By 2011, however, it should have been perfectly obvious that the old predictions were proving inaccurate. Yet WSDOT just kept *doubling down on their mistakes*—insisting that their vision of the future remained clear, even as their track record was looking worse and worse. So now they've wound up with an official traffic forecast, in the final Environmental Impact Statement no less, that doesn't even pass the laugh test.

It would be funny—if the state weren't planning billions in new highway investments in greater

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Seattle, based largely on the perceived "need" to accommodate all the new traffic that the models are predicting will show up, any day now.

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In case you don't believe me about the numbers, feel free to check out the sources directly. I'd be happy to be corrected.

The data on recent traffic volumes—the dark green dots—come from three sources. I start with WSDOT's biennial Ramp and Roadway Report. Then, to add in the missing years I factor in data from the Annual Traffic Report series and Seattle's Traffic Flow Data. The blue trend line is just the basic linear regression of the blue dots, as calculated by Excel.

The light orange line is based on a projection that dates back to 1996, which was mentioned in WSDOT's 1999 Trans-Lake Washington Study. Since that report is only available on CD-ROM, but not online, I'll quote the report directly:

> Under the No Action solution set, Trans-Lake travel [on SR-522, SR-520, and I-90] is expected to increase by about 168,000 daily person-trips…in the year 2020…Because capacity is limited on SR 520, only about 20,000 additional vehicle…trips are expected there.

(If current trends hold, the projections of 20,000 additional vehicle trips will be off by about 20,000 additional vehicle trips.)

The green line is from the 2002 Trans-Lake Washington Project report, also available on CD-ROM, which projected that traffic under the "No-Action Alternative" would grow by 20 percent through 2030.

The dark orange line—127,400 cars by 2030—is from the recently released Final Environmental Impact Statement for the SR-520 bridge replacement project. It's based on the projections described in part 1 of the "transportation discipline report" (see Exhibit 5-3 on p. 92 of the pdf, and the projections for SR-520 at Midspan under the 2030 No Build Alternative: 127,400 vehicles by 2030).

I could have included another projection from the 2006 Draft Environmental Impact Statement —127,860 vehicles per day by 2030, as claimed in Exhibit 10-8 in Appendix R part 6. But it was getting hard to fit all the wrongness on a single chart.

Now, I know that total traffic volumes aren't the only traffic trends worth paying attention to. The traffic models make projections about peak-hour delays as well, which are probably what commuters care most about. But given that the models have proven so stubbornly and preposterously wrong about traffic volume trends, it's hard to believe that they have much of value to say about future traffic delays.

[Thanks to Jake Kennon and Pam MacRae for help with the numbers!]

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Cheryl dos Remedios says:
July 13, 2011 at 11:36 am

This is WSDOT's reality: a 12-lane highway cutting through the Arboretum's wetlands, from Montlake to Foster Island.

It breaks down like this: 3 lanes of traffic + 2 lanes of ramps + 1 lane of shoulder x 2 = 12.

I'm not sure how to reconcile the traffic data above with what I know about this project, so Clark, I could use your help.

During peak hours, my understanding is that I-5 cannot handle the increased traffic of a 6-lane bridge, so WSDOT is planning 4 lanes of ramps in the Arboretum's wetlands to store cars as they try to merge onto I-5. This will prevent back-ups into the Montlake neighborhood and at the I-5 interchange itself.

Word on the street is that the "ramps will be removed from the Arboretum," but this just isn't true. It is true that the existing ramps that peel off and connect to Lake Washington Boulevard (LWB) will be eliminated, yet the negative impacts to the Arboretum increase. Here's how: WSDOT is planning for the new ramps placed in the wetlands to connect back into LWB, just at a point that is technically outside of the Arboretum. WSDOT expects highway traffic to increase through the heart of the Arboretum along LWB.

Under current federal regulations, we should not be able to bisect a historic park with highway traffic at all, but WSDOT leans on the site's "pre-existing conditions."

Watch this video and please pay especially close attention to 3:40 – 3:50 and 4:14 – 4:30: http://www.youtube.com/watch?v=nCV7COUSs0k

And next time you are on I-5, count the lanes and imagine that swath pavement cutting through the Arboretum. Imagine kayaking in the Arboretum with 12 lanes of highway overhead.

12 lanes of highway to store idling cars in Seattle's most pristine wetlands. . . this is WSDOT's reality? This is insane.

Reply

Randy says:
July 13, 2011 at 1:01 pm

Bottom line, Seattle and WSDOT have no clue what they're doing. If you think effective traffic management is creating HOV lanes in on ramps and going from 6 lanes to 2 lanes downtown is effective, you're high. Even the express lanes aren't express any more. When it takes 45 minutes to get across either the 90 or 520 bridge, it is obvious there is no planning. There was no plan for traffic management in Seattle and I've lived in much larger cities where traffic wasn't half as aggravating. Add to the poor planning drivers who have NO clue how to drive and it all becomes a pile of mess.

I challenge anyone to figure out how to get the appropriate amount of traffic across any highway in this town all the while focusing on the environment. It can't be both ways. We can't expect to fix traffic issues and keep ALL environmentalists happy. It seems to me all the idling I do on the highway is worse for the environment.

Ex. D

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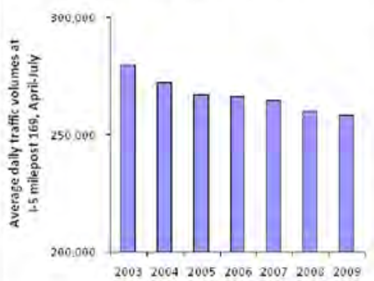
Where Are My Cars: I-5 Through Seattle

Traffic volumes on I-5 through Seattle started to fall in 2003.

Clark Williams-Derry on May 2, 2011 at 12:45 pm

This post is 5 in the series: Dude, Where Are My Cars?

Traffic volumes on I-5 through Seattle started to decline long before gas prices soared.



Remarkably enough, state figures show that traffic on I-5 through Seattle declined pretty steadily from 2003 through 2009. Take a look at the chart to the right. In total, traffic volumes on I-5 across the ship canal bridge fell by well over 7 percent. Remember, this is total traffic, not per capita. The per capita trends have been even more dramatic.

The state didn't report express lane data for 2010, but it looks like traffic volumes on the regular lanes inched back up a bit in 2010, to roughly their 2007 levels. So the downward trend from the chart may not have continued. (As the investment industry is so careful to point out, past performance is no guarantee of future results.)

But here's the thing: I have it on good authority that **the models used to predict future traffic volumes in the Puget Sound would *never* have predicted the actual traffic trends seen on I-5 through Seattle.** Most traffic models simply assume that car trips increase more or less in step with population and the economy: more people earning more money means more trips. But that's the opposite of what's happened: traffic counts fell, even as population and economic activity increased. (Yes, I know, I know, the economy faltered in 2008–but the downward trend started much earlier.)

Why does this matter? Because the supporters of big highway megaprojects in the Pacific Northwest (and beyond) typically claim that there's a "need" to accommodate all the traffic that's being predicted by traffic models. But those predictions aren't facts: more than anything, they're simply assumptions built into the models themselves!

In effect, then, the models simply assume what they're trying to prove. And in this case, as in many, many others, the assumption that traffic volumes are on the rise, always and everywhere, is proving to be a serious–and potentially costly–mistake.

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Washington's 20 Billion Mile Diet

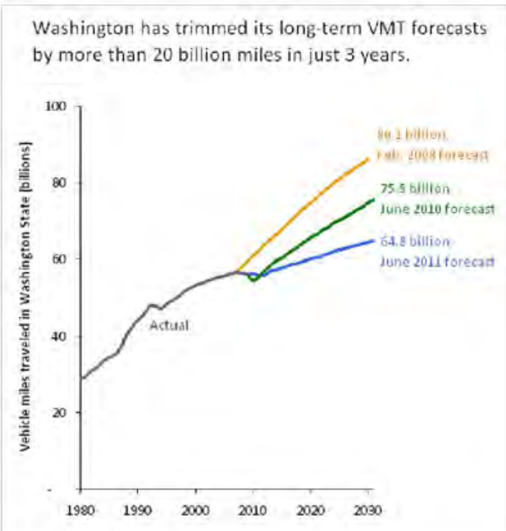
State traffic forecasts have changed radically in just three years.

Clark Williams-Derry on August 2, 2011 at 11:32 am

This post is 13 in the series: Dude, Where Are My Cars?

According to the most recent forecasts from the Washington State Office of Financial Management, drivers in Washington State will rack up about 65 billion miles on the highways in 2031.

I have no idea if that number is anywhere close to accurate. Nobody does. But what I do know is that that number is 21 billion miles *lower* than the forecast that OFM made 3 years ago, and more than 10 billion miles lower than their forecast from just last year. The chart has the details:



It's awfully tempting to suggest this chart shows that OFM is gradually groping towards more realistic traffic projections.

But does it, really? I honestly don't know if the blue line is more "realistic" than the orange line. Sure, the blue line is more consistent with the actual traffic trends over the last decade–a period when annual VMT growth slowed to a crawl. But I don't have a crystal ball to

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The first lesson is this: ***nobody has any special insight into the future.*** Future VMT trends aren't a feature of objective reality that smart people can sit in a room and puzzle out. They're just ***guesses***. Sometimes new information comes in, and the guesses change. Sometimes they change radically, enough to make the best guesses from a year earlier look ludicrous. So it's important to remember that even if particular forecast matches up with your world view, *it's still just a guess.*

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And there's a third lesson here: *forecasts can be dangerous.* People have a tendency to take official forecasts awfully seriously. But the decisions we made three years ago that we "had" to put lots of new megaprojects into the pipeline, based on forecasts of massive gridlock in 20 years, could very easily turn out to be dreadfully costly mistakes. When we place too much confidence in any one forecast, we can wind up making terrible decisions.

To me, the rapid change in traffic forecasts argues for a new way to think about transportation investments: that we make them smaller, more versatile, more nimble, more creative, and less likely to lock us into huge long-term expenses for projects that we might not actually need. In short, it argues for an approach that's the *exact opposite* of all the multi-billion dollar bridges, tunnels, and highway expansions that are on the docket in the Northwest.

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August 2, 2011 at 11:50 am

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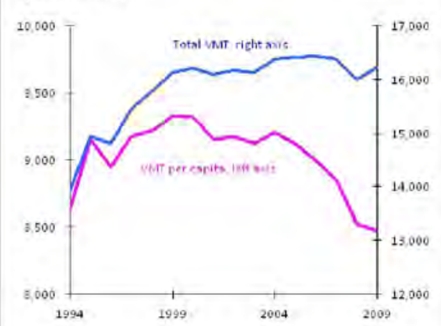
Where Are My Cars: King County

A 9 percent decline in driving over a decade.

Clark Williams-Derry on June 8, 2011 at 1:30 pm

This post is 9 in the series: Dude, Where Are My Cars?

I said I wouldn't post a new one for a while, but apparently I just can't help myself. Here's a chart of VMT per capita in King County, Washington, based on data provided by the state department of transportation. (Here's the VMT data, and the population counts.)



As you can see, total vehicle travel in the county was basically flat from 1999 to 2009. But the county's population grew over the same period, meaning that vehicle travel per capita fell by 9 percent.

I'll say it again: transportation models say this sort of thing simply doesn't happen. Yes, we've been through a couple of recessions over the last decade. Yet population and the region's economic output grew, and traffic volumes *still* remained flat. And the per capita decline started before gas prices soared, and well before the economy cratered. So to me, it's hard to avoid the notion that transportation planners have to abandon their assumptions of endless traffic growth. About a decade ago, something, or more likely some combination of things – demographics, psychographics, fuel prices, frustration with congestion, development patterns, and basic economics – started changing our relationship with our cars.

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Alf Hanna says:
June 10, 2011 at 2:01 pm

Where are the calculations behind this? The city site doesn't actually call it out.

Reply

sara says:
July 9, 2011 at 8:13 pm

AGREE with comment above. Also would like more/clearer explanation re what VTM per capita, purple left axis means as opposed to blue VTM, right axis... Thanks.

Reply

Clark Williams-Derry says:
July 9, 2011 at 9:14 pm

Yikes, I should have labeled the right axis better.

The purple line is just the exact same VMT per capita data that was reported by King County, on a different scale andas a line chart rather than a bar chart.

The blue line is VMT per capita multiplied by population. But (my bad!) it should be labeled as millions of miles. That is, the right axis should range from 12 billion to 17 billion total vehicle miles traveled per year. That's a lot, I know, but it's what happens when you have almost 2 million people driving well over 8,000 miles per capita.

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June 2011 Transportation Economic and Revenue Forecasts

Volume IV: Alternative Forecast Tables

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REVENUE AND RIDERSHIP PROJECTIONS

JUNE 2011 FORECAST

FISCAL YEARS 2011-2027

Prepared for
Washington State Ferries

for Presentation to the
Transportation Revenue
Forecast Council

June 16, 2011 Meeting

Prepared by
Parsons Brinckerhoff

June 15, 2011
Revised June 17, 2011*

Adopted June 16, 2011

* No change in forecast values

Washington State Ferries

June 2011 Revenue and Ridership Forecasts — Fiscal Years 2011-2027

JUNE 2011 FORECAST NOTES

The fare revenue and ridership forecasts for Washington State Ferries (WSF) are completed in four stages. First, monthly ridership projections by six fare categories are prepared for each route using time series analysis methods, with a forecast horizon from the present through fiscal year (FY) 2027.

The second stage of the process generates system-wide ridership projections. Econometric models combine ferry fare scenarios and state economic variables to produce system-wide unconstrained ridership forecasts by six fare categories through FY 2027. Within each fare category, the individual route forecasts are then calibrated to match the system-wide forecast totals from the econometric models.

The third stage of the process consists of adjusting the calibrated passenger and vehicle ridership by route to reflect seasonal vehicle capacity constraints, changes in service hours, and/or the net impacts from adding or eliminating service.

Last, the appropriate fares and average fare realizations are applied to the calibrated, capacity-constrained ridership forecasts for each route by fare category. This yields monthly and annual revenue forecasts by route for six fare categories.

Three scenarios differing in fare assumptions were prepared for the March Forecast:

- **Baseline Forecast** – assumes no changes in the posted fares through the forecast horizon, resulting in a declining real fares trend due to inflation;

- **Alternative 1 Forecast** – assumes consecutive 2.5% increases each October, from 2011 through 2026 (FY 2012-27), which results in slightly increasing real fares given that inflation, as measured by the Implicit Price Deflator for Personal Consumption, is projected to average 1.9% over the forecast horizon.

- **Alternative 2 Forecast** – combines the 2.5% increases of Alternative 1 with a 25¢ capital fare surcharge applied to all fares, per recent legislation (ESSB 5742). The surcharge is applied to each fare sold, regardless of whether the fare is collected in both directions or only in one direction for a round-trip.

The June 2011 Forecast results for FY 2011 include actual ridership counts through April 2011 and actual revenue collections through May 2011. In addition, they also capture the actual effects of reduced Mukilteo-Clinton service due to terminal construction closures during three weekends in the late winter / early spring of 2011.

Ridership Impacts

The June 2011 ridership demand forecasts reflect the latest ridership data and updated economic variable projections produced by the State and Global Insight. The following points summarize the updated ridership forecast.

- The June forecast for employment has been revised lower through FY 2017, and then noticeably higher thereafter, compared with the March forecast. Real personal income shares a similar trend, with a small downward revision through FY 2021 and an upward revision thereafter. Collectively, these factors contribute to a downward revision in ridership until FY 2020, and an upward revision thereafter through FY 2027, compared with March.
- The forecast for real gasoline prices are materially higher than projected in March, which tends to suppress vehicle demand throughout the forecast horizon.
- Overall, the ridership projections are lower in the early years of the forecast and higher in the latter years. However, the increase in the latter years is driven by higher passenger ridership; the higher fare vehicle/driver ridership remains a bit below the March forecast levels.
- The capital fare surcharge in Alternative 2 would initially reduce ridership demand by up to 1.3%, with the effect gradually reducing to 0.8% by the end of the forecast period.

Revenue Impacts

- Revenues under both the Baseline and Alternative 1 Forecasts for the 2009/11 biennium are projected at $294.2 M, or $0.2 M (0.1%) higher than March.
- The Baseline Forecast fare revenue projections are 1.4% lower in the 2011/13 biennium, 1.2% lower in the 2013/15 biennium, and thereafter less than 1% lower by the end of the forecast horizon, relative to March.
- The Alternative 1 Forecast fare revenue projections are also 1.4% lower in the 2011/13 biennium, and 1.2% lower in the 2013/15 biennium, but then taper off to very small differences both up and down relative to March.
- The 25¢ capital surcharge in Alternative 2 generates a net increase in revenue of $4.1 M in the 2011/13 biennium over Alternative 1, after accounting for the reduction in demand due to effectively higher fares.
- A projected total of $6.4 M in surcharge revenues would be transferred to the capital program in the 2011/13 biennium. This transfer is projected to result in a $2.3 M reduction in revenues available to support the operating program, relative to Alternative 1.

Washington State Ferries
REVENUE PROJECTIONS ~ BASELINE FORECAST
No Changes in the Current Posted Fares[1]
June 2011 Forecast – Fiscal Years 2011-2027

Fiscal Year	June 2011 Capacity-Constrained Revenue Forecast	Fiscal Year Annual Growth Rate	June Biennium Total	June vs. March Forecast: % Change by Fiscal Year	June vs. March Forecast: $ Change and % Change by Biennium		March 2011 Baseline: Capacity-Constrained Revenue Forecast	March 2011 Baseline: Biennium Total
2008[2]	$148,379,626	1.1%						
2009[2]	$144,540,455	(2.6%)	$292,920,081					
2010[2]	$147,009,545	1.7%		0.0%			$147,009,545	
2011[2]	$147,148,000	0.1%	$294,157,545	0.2%	$235,000	0.1%	$146,913,000	$293,922,545
2012	$148,508,000	0.9%		(1.5%)			$150,813,000	
2013	$152,688,000	2.8%	$301,196,000	(1.4%)	($4,419,000)	(1.4%)	$154,802,000	$305,615,000
2014	$157,168,000	2.9%		(1.4%)			$159,353,000	
2015	$161,728,000	2.9%	$318,896,000	(1.1%)	($4,011,000)	(1.2%)	$163,554,000	$322,907,000
2016	$165,793,000	2.5%		(1.0%)			$167,452,000	
2017	$169,675,000	2.3%	$335,468,000	(0.9%)	($3,192,000)	(0.9%)	$171,208,000	$338,660,000
2018	$173,454,000	2.2%		(0.5%)			$174,401,000	
2019	$176,794,000	1.9%	$350,248,000	(0.4%)	($1,653,000)	(0.5%)	$177,500,000	$351,901,000
2020	$179,592,000	1.6%		(0.2%)			$180,018,000	
2021	$181,881,000	1.3%	$361,473,000	(0.2%)	($704,000)	(0.2%)	$182,159,000	$362,177,000
2022	$183,886,000	1.1%		(0.3%)			$184,364,000	
2023	$185,624,000	0.9%	$369,510,000	(0.4%)	($1,295,000)	(0.3%)	$186,441,000	$370,805,000
2024	$187,301,000	0.9%		(0.6%)			$188,454,000	
2025	$188,807,000	0.8%	$376,108,000	(0.9%)	($2,818,000)	(0.7%)	$190,472,000	$378,926,000
2026	$190,330,000	0.8%		(0.8%)			$191,940,000	
2027	$191,798,000	0.8%	$382,128,000	(0.9%)	($3,288,000)	(0.9%)	$193,476,000	$385,416,000

[1] The Baseline Forecast includes the recent 2.5% fare increase on January 1, 2011, but assumes no further changes to the current nominal fares thereafter. This leads to declining real fares over the forecast horizon. The Baseline Forecast also reflects the current programmed level of service subject to capacity constraints.

[2] Reflects/includes historical data.

Washington State Ferries

REVENUE PROJECTIONS ~ ALTERNATIVE 1 FORECAST

2.5% Annual Fare Increases FY 2012-27[1]

June 2011 Forecast – Fiscal Years 2011-2027

Fiscal Year	June 2011 Capacity-Constrained Revenue Forecast	Fiscal Year Annual Growth Rate	June Biennium Total	June vs. March Forecast: % Change by Fiscal Year	June vs. March Forecast: $ Change and % Change by Biennium		March 2011 Alternative: Capacity-Constrained Revenue Forecast	March 2011 Alternative: Biennium Total
2008[2]	$148,379,626	1.1%						
2009[2]	$144,540,455	(2.6%)	$292,920,081					
2010[2]	$147,009,545	1.7%		0.0%			$147,009,545	
2011[2]	$147,148,000	0.1%	$294,157,545	0.2%	$235,000	0.1%	$146,913,000	$293,922,545
2012	$150,587,000	2.3%		(1.5%)			$152,945,000	
2013	$157,657,000	4.7%	$308,244,000	(1.4%)	($4,516,000)	(1.4%)	$159,815,000	$312,760,000
2014	$165,216,000	4.8%		(1.3%)			$167,436,000	
2015	$173,041,000	4.7%	$338,257,000	(1.1%)	($4,133,000)	(1.2%)	$174,954,000	$342,390,000
2016	$180,517,000	4.3%		(1.0%)			$182,281,000	
2017	$188,300,000	4.3%	$368,817,000	(0.8%)	($3,345,000)	(0.9%)	$189,881,000	$372,162,000
2018	$196,674,000	4.4%		(0.5%)			$197,638,000	
2019	$205,397,000	4.4%	$402,071,000	(0.2%)	($1,389,000)	(0.3%)	$205,822,000	$403,460,000
2020	$214,205,000	4.3%		0.1%			$214,021,000	
2021	$222,750,000	4.0%	$436,955,000	0.3%	$913,000	0.2%	$222,021,000	$436,042,000
2022	$230,859,000	3.6%		0.3%			$230,068,000	
2023	$239,073,000	3.6%	$469,932,000	0.2%	$1,343,000	0.3%	$238,521,000	$468,589,000
2024	$247,554,000	3.5%		0.2%			$247,123,000	
2025	$256,090,000	3.4%	$503,644,000	0.0%	$471,000	0.1%	$256,050,000	$503,173,000
2026	$264,753,000	3.4%		0.0%			$264,725,000	
2027	$273,646,000	3.4%	$538,399,000	(0.1%)	($192,000)	(0.0%)	$273,866,000	$538,591,000

[1] The Alternative 1 Forecast includes the recent 2.5% fare increase on January 1, 2011, followed by annual 2.5% fare increases with nickel up-rounding each October 1 through 2026 (FY 2012-27). This yields increasing real fares under the current inflation projection. The Alternative 1 Forecast also reflects the current programmed level of service subject to capacity constraints.

[2] Reflects/includes historical data.

Washington State Ferries

REVENUE PROJECTIONS ~ ALTERNATIVE 2 FORECAST

25¢ "Capital Surcharge" per Fare Sold in Addition to 2.5% Annual Fare Increases FY 2012-27[1]

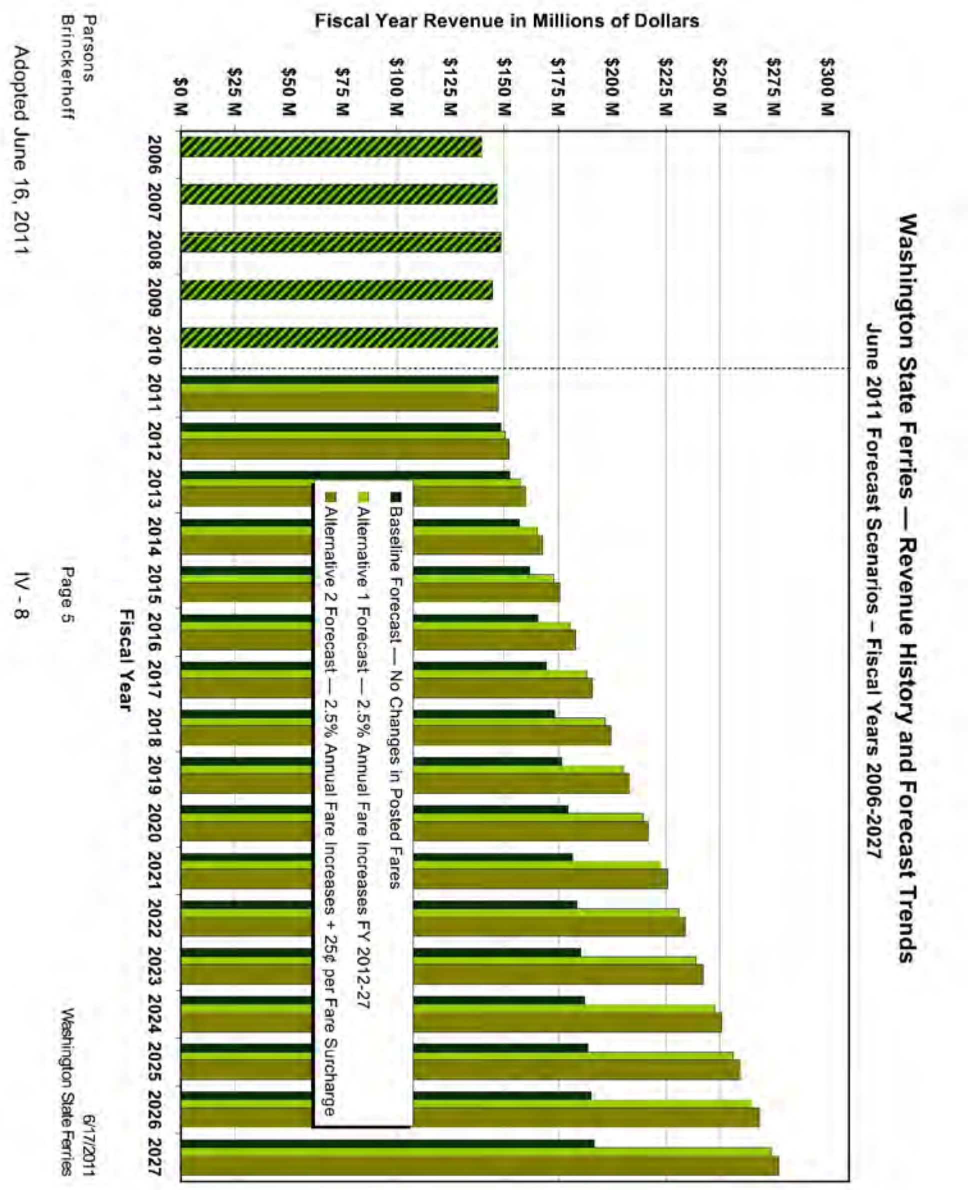
June 2011 Forecast – Fiscal Years 2011-2027

				25¢ Surcharge Revenue Impact		Distribution of Fare Revenue with Surcharge		
Fiscal Year	June 2011 Capacity-Constrained Revenue Forecast	Fiscal Year Annual Growth Rate	June Biennium Total	Net Additional Revenue from 25¢ Surcharge per Fare	% Increase over Alt. 1	Surcharge Revenue for Capital Program	Fare Revenue Remaining for Operating Program	Operating Revenue Loss Compared to Alternative 1[3]
2008[2]	$148,379,626	1.1%						
2009[2]	$144,540,455	(2.6%)	$292,920,081					
2010[2]	$147,009,545	1.7%						
2011[2]	$147,148,000	0.1%	$294,157,545					
2012	$152,235,000	3.5%		$1,648,000	1.1%	$2,581,000	$149,654,000	($933,000)
2013	$160,075,000	5.1%	$312,310,000	$2,418,000	1.5%	$3,801,000	$156,274,000	($1,383,000)
2014	$167,689,000	4.8%		$2,473,000	1.5%	$3,888,000	$163,801,000	($1,415,000)
2015	$175,571,000	4.7%	$343,260,000	$2,530,000	1.5%	$3,979,000	$171,592,000	($1,449,000)
2016	$183,104,000	4.3%		$2,587,000	1.4%	$4,050,000	$179,054,000	($1,463,000)
2017	$190,931,000	4.3%	$374,035,000	$2,631,000	1.4%	$4,120,000	$186,811,000	($1,489,000)
2018	$199,351,000	4.4%		$2,677,000	1.4%	$4,192,000	$195,159,000	($1,515,000)
2019	$208,246,000	4.5%	$407,597,000	$2,849,000	1.4%	$4,268,000	$203,978,000	($1,419,000)
2020	$217,129,000	4.3%		$2,924,000	1.4%	$4,340,000	$212,789,000	($1,416,000)
2021	$225,849,000	4.0%	$442,978,000	$3,099,000	1.4%	$4,406,000	$221,443,000	($1,307,000)
2022	$234,007,000	3.6%		$3,148,000	1.4%	$4,460,000	$229,547,000	($1,312,000)
2023	$242,293,000	3.5%	$476,300,000	$3,220,000	1.3%	$4,511,000	$237,782,000	($1,291,000)
2024	$250,891,000	3.5%		$3,337,000	1.3%	$4,564,000	$246,327,000	($1,227,000)
2025	$259,599,000	3.5%	$510,490,000	$3,509,000	1.4%	$4,613,000	$254,986,000	($1,104,000)
2026	$268,347,000	3.4%		$3,594,000	1.4%	$4,659,000	$263,688,000	($1,065,000)
2027	$277,283,000	3.3%	$545,630,000	$3,637,000	1.3%	$4,704,000	$272,579,000	($1,067,000)

[1] The Alternative 2 Forecast includes the annual 2.5% fare increases of Alternative Forecast 1, combined with a 25¢ capital surcharge on each fare sold, beginning October 1, 2011. The surcharge would be applied to one-way and round-trip fares equally. The Alternative 2 Forecast also reflects the current programmed level of service subject to capacity constraints.

[2] Reflects/includes historical data.

[3] Implementation of the surcharge reduces overall ridership demand slightly; as s result, diverting the full surcharge amount for capital uses leaves less revenue for operating uses than Alternative 1.



Washington State Ferries — Revenue History and Forecast Trends
June 2011 Forecast Scenarios – Fiscal Years 2006-2027
Fiscal Year Revenue in Millions of Dollars
$0 M
$25 M
$50 M
$75 M
$100 M
$125 M
$150 M
$175 M
$200 M
$225 M
$250 M
$275 M
$300 M
2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027
Fiscal Year
Baseline Forecast — No Changes in Posted Fares
Alternative 1 Forecast — 2.5% Annual Fare Increases FY 2012-27
Alternative 2 Forecast — 2.5% Annual Fare Increases + 25¢ per Fare Surcharge
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RIDERSHIP PROJECTIONS ~ BASELINE FORECAST

No Changes in the Current Posted Fares[1]

June 2011 Forecast – Fiscal Years 2011-2027

Fiscal Year	June 2011 Unconstrained Demand Forecast	June 2011 Capacity Constrained Projections: Passenger Ridership	Vehicle/Driver Ridership	Total Ridership	Annual Rate of Growth	March 2011 Projections: Total Ridership	Jun. % Chg from Mar.
2008[2]	23,281,551	12,889,403	10,392,148	23,281,551	(2.9%)		
2009[2]	22,477,473	12,572,707	9,904,766	22,477,473	(3.5%)		
2010[2]	22,587,537	12,453,226	10,134,311	22,587,537	0.5%	22,587,537	0.0%
2011[2]	22,215,000	12,284,000	9,931,000	22,215,000	(1.6%)	22,282,000	(0.3%)
2012	22,447,000	12,510,000	9,937,000	22,447,000	1.0%	22,661,000	(0.9%)
2013	23,168,000	12,939,000	10,229,000	23,168,000	3.2%	23,409,000	(1.0%)
2014	23,960,000	13,437,000	10,523,000	23,960,000	3.4%	24,226,000	(1.1%)
2015	24,785,000	13,960,000	10,820,000	24,780,000	3.4%	25,001,000	(0.9%)
2016	25,454,000	14,341,000	11,106,000	25,447,000	2.7%	25,657,000	(0.8%)
2017	26,144,000	14,739,000	11,362,000	26,101,000	2.6%	26,280,000	(0.7%)
2018	26,866,000	15,148,000	11,611,000	26,759,000	2.5%	26,859,000	(0.4%)
2019	27,624,000	15,578,000	11,819,000	27,397,000	2.4%	27,423,000	(0.1%)
2020	28,413,000	16,020,000	11,986,000	28,006,000	2.2%	27,949,000	0.2%
2021	29,205,000	16,471,000	12,096,000	28,567,000	2.0%	28,443,000	0.4%
2022	29,946,000	16,928,000	12,171,000	29,099,000	1.9%	28,933,000	0.6%
2023	30,670,000	17,362,000	12,231,000	29,593,000	1.7%	29,427,000	0.6%
2024	31,451,000	17,830,000	12,280,000	30,110,000	1.7%	29,935,000	0.6%
2025	32,272,000	18,333,000	12,304,000	30,637,000	1.8%	30,455,000	0.6%
2026	33,118,000	18,859,000	12,317,000	31,176,000	1.8%	30,959,000	0.7%
2027	33,989,000	19,399,000	12,332,000	31,731,000	1.8%	31,470,000	0.8%

[1] The Baseline Forecast includes the recent 2.5% fare increase on January 1, 2011, but assumes no further changes to the current nominal fares thereafter. This leads to declining real fares over the forecast horizon. The Baseline Forecast also reflects the current programmed level of service subject to capacity constraints.

[2] Reflects/includes historical data.

Washington State Ferries

RIDERSHIP PROJECTIONS ~ ALTERNATIVE 1 FORECAST

2.5% Annual Fare Increases FY 2012-27[1]

June 2011 Forecast – Fiscal Years 2011-2027

Fiscal Year	June 2011 Unconstrained Demand Forecast	June 2011 Capacity Constrained Projections: Passenger Ridership	Vehicle/Driver Ridership	Total Ridership	Annual Rate of Growth	March 2011 Projections: Total Ridership	Jun. % Chg from Mar.
2008[2]	23,281,551	12,889,403	10,392,148	23,281,551	(2.9%)		
2009[2]	22,477,473	12,572,707	9,904,766	22,477,473	(3.5%)		
2010[2]	22,587,537	12,453,226	10,134,311	22,587,537	0.5%	22,587,537	0.0%
2011[2]	22,215,000	12,284,000	9,931,000	22,215,000	(1.6%)	22,282,000	(0.3%)
2012	22,318,000	12,447,000	9,871,000	22,318,000	0.5%	22,532,000	(0.9%)
2013	22,812,000	12,744,000	10,068,000	22,812,000	2.2%	23,046,000	(1.0%)
2014	23,369,000	13,099,000	10,270,000	23,369,000	2.4%	23,624,000	(1.1%)
2015	23,953,000	13,475,000	10,478,000	23,953,000	2.5%	24,171,000	(0.9%)
2016	24,379,000	13,708,000	10,669,000	24,377,000	1.8%	24,589,000	(0.9%)
2017	24,805,000	13,937,000	10,863,000	24,800,000	1.7%	24,975,000	(0.7%)
2018	25,242,000	14,166,000	11,068,000	25,234,000	1.8%	25,335,000	(0.4%)
2019	25,704,000	14,414,000	11,263,000	25,677,000	1.8%	25,695,000	(0.1%)
2020	26,185,000	14,662,000	11,455,000	26,117,000	1.7%	26,043,000	0.3%
2021	26,661,000	14,905,000	11,616,000	26,521,000	1.5%	26,364,000	0.6%
2022	27,084,000	15,150,000	11,725,000	26,875,000	1.3%	26,663,000	0.8%
2023	27,483,000	15,374,000	11,825,000	27,199,000	1.2%	26,976,000	0.8%
2024	27,926,000	15,626,000	11,919,000	27,545,000	1.3%	27,299,000	0.9%
2025	28,384,000	15,894,000	11,981,000	27,875,000	1.2%	27,617,000	0.9%
2026	28,847,000	16,165,000	12,034,000	28,199,000	1.2%	27,921,000	1.0%
2027	29,320,000	16,446,000	12,079,000	28,525,000	1.2%	28,222,000	1.1%

[1] The Alternative 1 Forecast includes the recent 2.5% fare increase on January 1, 2011, followed by annual 2.5% fare increases with nickel up-rounding each October 1 through 2026 (FY 2012-27). This yields increasing real fares under the current inflation projection. The Alternative 1 Forecast also reflects the current programmed level of service subject to capacity constraints.

[2] Reflects/includes historical data.

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Washington State Ferries
RIDERSHIP PROJECTIONS ~ ALTERNATIVE 2 FORECAST
25¢ "Capital Surcharge" per Fare Sold in Addition to 2.5% Annual Fare Increases FY 2012-27[1]

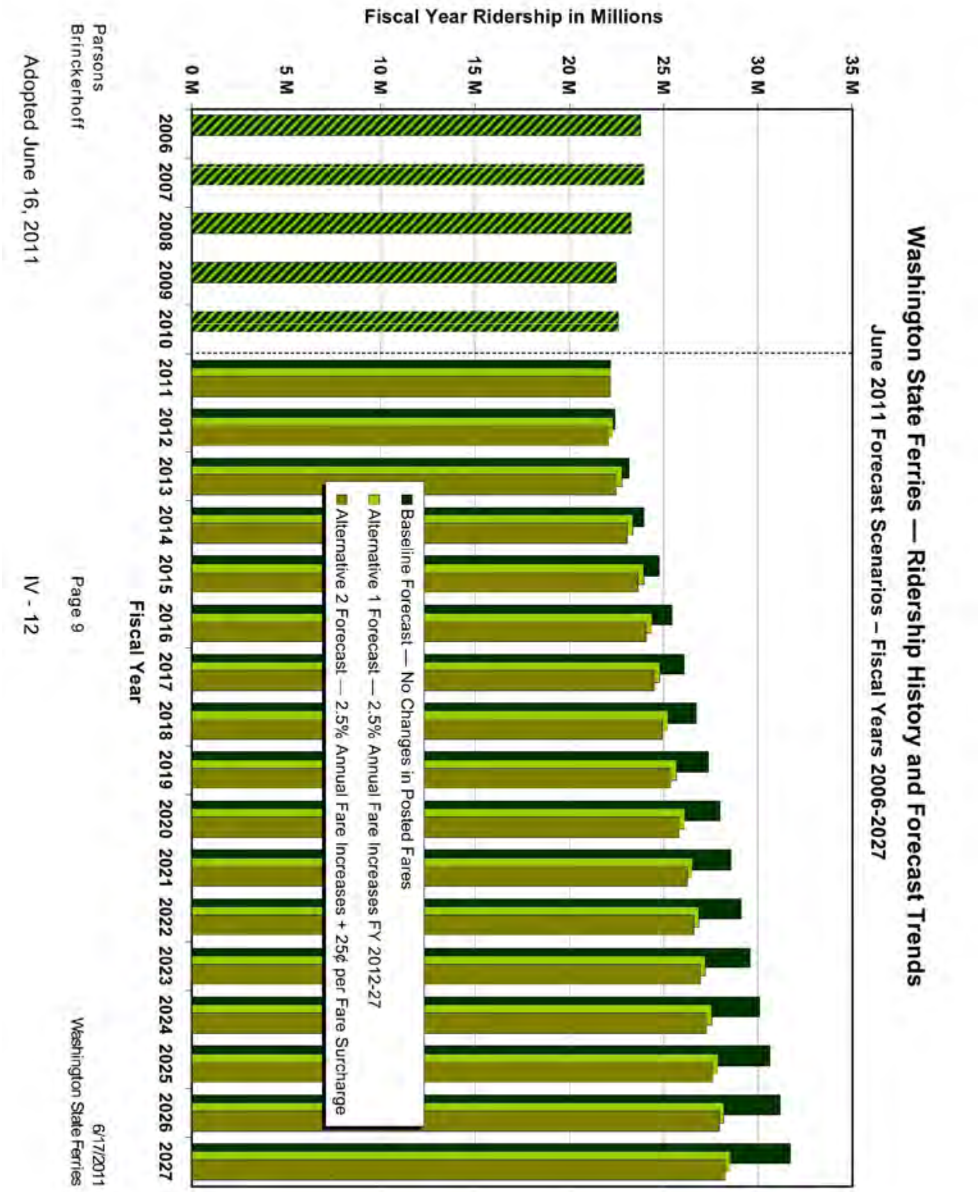
June 2011 Forecast – Fiscal Years 2011-2027

Fiscal Year	June 2011 Unconstrained Demand Forecast	June 2011 Capacity Constrained Projections: Passenger Ridership	Vehicle/Driver Ridership	Total Ridership	Annual Rate of Growth	25¢ Surcharge Ridership Impact: % Decrease over Alternative 1	Net Decrease in Ridership[3]
2008[2]	23,281,551	12,889,403	10,392,148	23,281,551	(2.9%)		
2009[2]	22,477,473	12,572,707	9,904,766	22,477,473	(3.5%)		
2010[2]	22,587,537	12,453,226	10,134,311	22,587,537	0.5%		
2011[2 3]	22,215,000	12,284,000	9,931,000	22,215,000	(1.6%)	0.0%	0
2012	22,104,000	12,286,000	9,818,000	22,104,000	(0.5%)	(1.0%)	(214,000)
2013	22,505,000	12,508,000	9,997,000	22,505,000	1.8%	(1.3%)	(307,000)
2014	23,062,000	12,863,000	10,199,000	23,062,000	2.5%	(1.3%)	(307,000)
2015	23,645,000	13,237,000	10,407,000	23,644,000	2.5%	(1.3%)	(309,000)
2016	24,075,000	13,473,000	10,600,000	24,073,000	1.8%	(1.2%)	(304,000)
2017	24,503,000	13,705,000	10,795,000	24,500,000	1.8%	(1.2%)	(300,000)
2018	24,943,000	13,936,000	11,000,000	24,936,000	1.8%	(1.2%)	(298,000)
2019	25,408,000	14,185,000	11,210,000	25,395,000	1.8%	(1.1%)	(282,000)
2020	25,892,000	14,435,000	11,403,000	25,838,000	1.7%	(1.1%)	(279,000)
2021	26,371,000	14,680,000	11,575,000	26,255,000	1.6%	(1.0%)	(266,000)
2022	26,796,000	14,928,000	11,685,000	26,613,000	1.4%	(1.0%)	(262,000)
2023	27,198,000	15,155,000	11,789,000	26,944,000	1.2%	(0.9%)	(255,000)
2024	27,644,000	15,407,000	11,891,000	27,298,000	1.3%	(0.9%)	(247,000)
2025	28,105,000	15,676,000	11,962,000	27,638,000	1.2%	(0.9%)	(237,000)
2026	28,571,000	15,950,000	12,019,000	27,969,000	1.2%	(0.8%)	(230,000)
2027	29,047,000	16,233,000	12,065,000	28,298,000	1.2%	(0.8%)	(227,000)

[1] The Alternative 2 Forecast includes the annual 2.5% fare increases of Alternative Forecast 1, combined with a 25¢ capital surcharge on each fare sold, beginning October 1, 2011. The surcharge would be applied to one-way and round-trip fares equally. The Alternative 2 Forecast also reflects the current programmed level of service subject to capacity constraints.

[2] Reflects/includes historical data.

[3] Implementation of the surcharge reduces overall ridership demand slightly relative to the Alternative 1 Forecast.



Washington State Ferries — Ridership History and Forecast Trends
June 2011 Forecast Scenarios – Fiscal Years 2006-2027
Fiscal Year Ridership in Millions
0 M
5 M
10 M
15 M
20 M
25 M
30 M
35 M
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
Fiscal Year
Baseline Forecast — No Changes in Posted Fares
Alternative 1 Forecast — 2.5% Annual Fare Increases FY 2012-27
Alternative 2 Forecast — 2.5% Annual Fare Increases + 25¢ per Fare Surcharge
Parsons Brinckerhoff
Page 9
6/17/2011
Washington State Ferries
Adopted June 16, 2011
IV - 12

Vehicle Miles Traveled Forecast
(Preliminary)

June 2011

Contact: Thomas L. R. Smith, Ph. D., Washington State Department of Transportation, 360-705-7941, smithtm@wsdot.wa.gov

WSDOT Vehicle Miles Travelled Forecast (PRELIMINARY)

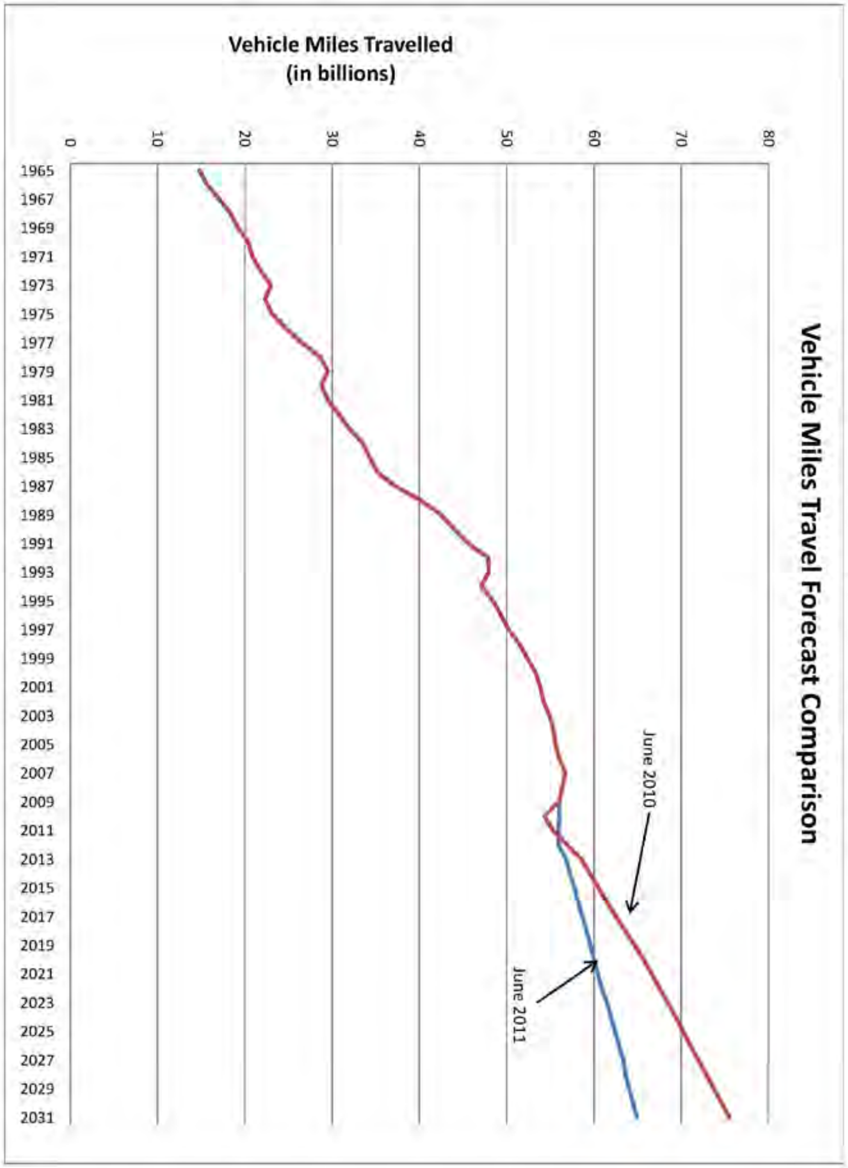
- WSDOT has produced a statewide VMT forecast for more than twenty years
- Through February 2008, the VMT forecast was a byproduct of the fuel consumption forecast
- WSDOT convened a multiagency work group in 2009 and 2010 to select a better statewide VMT forecast model
- This is a preliminary forecast. While all independent variables have been updated from the latest data, WSDOT Statewide Travel & Collision Data Office (STCDO) is still updating actual Vehicle Miles Travelled data for calendar year 2010.
- The current forecast is above the previous forecast in the first two years. This is due primarily to better employment projections and a faster recovery of vehicle registrations. However, in the out-years, VMT is significantly lower due to much lower employment projections.

Statewide VMT Forecast Methodology

- The Statewide VMT model is of log-log functional form which includes log of the following independent variables:
  - Washington employment
  - Washington motor vehicle registrations
  - Washington gas prices
- The forecast model considers three separate types of impacts on VMT: economic activity, vehicles registered, and gas prices
- This model had the best overall fit, most significant t-statistics, and other critical statistics were better than other models
- Each of the independent variables has their own separate and distinct forecast which can be used to project statewide VMT

Source of Independent Forecasted Variables

- <u>Washington employment</u> – Economic and Revenue Forecast Council June 2011 forecast in the near-term and from OFM's 2010 long-term non-farm employment projections for Washington.
- <u>Washington motorized vehicle registrations</u> –WSDOT-Economic Analysis section for the Transportation Revenue Council June 2011 forecast
- <u>Washington gasoline prices</u> –WSDOT forecast for the Transportation Revenue Council June 2011 forecast


Vehicle Miles Travel Forecast Comparison
Vehicle Miles Travelled
(in billions)
June 2010
June 2011

June 2011 Preliminary Forecast of Vehicle Miles Traveled (History and Forecast), VMT per capita, and Independent Variables

YEAR	Total VMT (Billion Miles)	Percent Change	VMT Per Capita	Percent Change	VMT Per Driver Pop	Percent Change	Independent Variables: Washington Employment[1] (in Thousands)	Percent Change	Vehicles Registered[2] (in Thousands)	Percent Change	Gas Prices[3]	Percent Change
1965	14.401						869		1,525		0.15	
1966	15.695	5.59%					940	8.12%	1,619	6.16%	0.16	3.08%
1967	13.067	9.09%					1021	8.63%	1,727	6.67%	0.20	3.48%
1968	13.547	7.50%					1075	5.27%	1,834	6.20%	0.20	1.60%
1969	19.211	4.75%					1116	3.82%	1,971	7.47%	0.21	3.87%
1970	20.377	6.04%	6,087		9,069		1109	-0.63%	1,971	0.00%	0.21	2.50%
1971	20.844	2.32%	6,188	1.67%	10,122	0.83%	1062	-4.30%	1,998	1.37%	0.22	2.12%
1972	21.835	4.75%	6,498	5.00%	9,493	4.06%	1079	1.60%	2,078	4.00%	0.22	-0.82%
1973	22.977	5.23%	6,813	4.80%	9,835	3.60%	1127	4.41%	2,200	5.87%	0.23	7.72%
1974	22.357	-2.67%	6,498	-4.63%	9,272	-5.72%	1172	3.96%	2,288	4.00%	0.36	54.09%
1975	23.105	3.34%	6,615	1.80%	9,340	0.73%	1217	3.86%	2,358	3.06%	0.40	10.11%
1976	24.666	6.61%	6,939	4.50%	9,690	3.75%	1249	2.62%	2,483	5.30%	0.41	4.09%
1977	26.445	7.22%	7,286	5.00%	10,077	3.99%	1322	5.86%	2,649	6.69%	0.43	4.84%
1978	28.605	8.05%	7,621	4.60%	10,445	3.65%	1427	7.94%	2,743	3.55%	0.44	1.64%
1979	29.511	3.17%	7,579	-0.54%	10,307	-1.32%	1534	7.48%	2,969	8.24%	0.66	37.50%
1980	28.856	-2.28%	7,118	-6.09%	9,621	-6.75%	1607	4.75%	3,092	4.14%	1.25	81.05%
1981	29.402	2.16%	7,195	0.17%	9,579	-0.33%	1615	0.49%	3,219	4.11%	1.40	11.90%
1982	30.774	4.20%	7,353	3.13%	9,831	2.63%	1590	-1.53%	3,214	-0.16%	1.25	-7.96%
1983	31.955	3.97%	7,595	3.29%	10,114	2.87%	1564	-1.61%	3,256	1.31%	1.23	-4.13%
1984	33.430	4.60%	7,890	3.59%	10,450	3.33%	1623	3.77%	3,328	2.21%	1.20	-2.85%
1985	34.309	2.54%	7,958	1.15%	10,553	0.98%	1685	3.82%	3,422	2.82%	1.20	-0.17%
1986	35.152	2.46%	8,073	1.45%	10,688	1.28%	1745	3.56%	3,569	4.30%	0.98	-18.14%
1987	37.207	5.85%	8,426	4.38%	11,129	4.13%	1805	3.44%	3,768	5.58%	1.01	2.67%
1988	40.101	7.79%	8,906	5.72%	11,738	5.47%	1897	5.12%	3,876	2.87%	1.02	0.69%
1989	42.404	5.90%	9,222	3.52%	12,128	3.32%	1992	4.99%	4,007	3.38%	1.13	10.90%
1990	43.924	3.59%	9,266	0.48%	12,207	0.65%	2104	5.63%	4,219	5.29%	1.33	17.70%
1991	45.535	3.65%	9,312	0.49%	12,295	0.72%	2160	2.66%	4,293	1.75%	1.22	-8.27%
1992	47.858	5.13%	9,564	2.71%	12,654	3.82%	2201	1.90%	4,448	3.61%	1.24	1.64%
1993	47.965	0.22%	9,362	-2.11%	12,409	-1.95%	2237	1.60%	4,480	0.72%	1.15	-4.03%
1994	47.025	-1.96%	9,014	-3.73%	11,953	-3.68%	2280	1.93%	4,512	0.71%	1.21	5.68%
1995	48.410	1.90%	9,109	1.05%	12,075	1.01%	2332	2.28%	4,581	1.53%	1.22	1.16%
1996	49.323	1.88%	9,119	0.10%	12,030	-0.03%	2375	1.67%	4,587	0.13%	1.32	1.13%
1997	50.205	1.79%	9,128	0.10%	12,064	-0.05%	2465	3.80%	4,701	2.49%	1.20	-9.07%
1998	51.482	2.54%	9,225	1.06%	12,145	0.72%	2558	3.80%	4,847	3.11%	1.10	-8.33%
1999	52.303	1.59%	9,248	0.25%	12,138	-0.16%	2622	2.48%	4,938	1.75%	1.43	30.00%
2000	53.319	1.94%	9,335	0.94%	12,173	0.85%	2683	2.32%	5,195	5.38%	1.56	11.19%
2001	53.819	0.95%	9,304	-0.33%	12,086	-0.71%	2718	1.33%	5,256	1.17%	1.37	-13.64%
2002	54.200	0.69%	9,271	-0.34%	11,994	-0.76%	2665	-1.95%	5,422	3.16%	1.56	13.87%
2003	54.860	1.07%	9,310	0.40%	11,989	-0.05%	2655	-0.40%	5,472	0.92%	1.79	14.74%
2004	55.310	0.83%	9,284	-0.29%	11,910	-0.65%	2673	0.71%	5,645	3.16%	2.12	18.44%
2005	55.565	0.46%	9,190	-0.91%	11,764	-1.22%	2737	2.39%	5,720	1.33%	2.67	25.94%
2006	55.988	0.77%	9,094	-1.16%	11,600	-1.39%	2821	3.04%	5,832	1.96%	2.64	1.12%
2007	56.733	1.34%	9,058	-0.40%	11,528	-0.62%	2897	2.70%	5,912	1.37%	2.88	9.09%
2008	56.309	0.75%	8,854	-2.25%	11,238	-2.52%	2960	2.19%	6,161	4.21%	3.34	15.97%
2009	56.013	-0.53%	8,702	-1.72%	11,013	-2.01%	2900	-2.04%	6,030	-2.13%	2.83	-15.30%
2010	56.000	-0.02%	8,619	-0.95%	10,873	-1.27%	2785	-3.97%	5,950	-1.32%	2.92	3.18%
2011	55.876	-0.22%	8,518	-1.18%	10,716	-1.44%	2798	0.48%	6,106	2.62%	3.38	15.47%
2012	55.890	0.02%	8,423	-1.11%	10,582	-1.25%	2848	1.81%	6,202	1.59%	4.00	18.31%
2013	56.794	1.61%	8,446	0.27%	10,603	0.20%	2916	2.36%	6,324	1.96%	4.14	3.48%
2014	57.239	0.79%	8,404	-0.50%	10,547	-0.53%	2945	1.00%	6,423	1.58%	4.22	2.01%
2015	57.773	0.93%	8,379	0.30%	10,511	0.34%	2974	1.00%	6,522	1.53%	4.22	0.04%
2016	58.190	0.73%	8,338	-0.49%	10,457	-0.52%	3004	1.00%	6,620	1.51%	4.32	2.41%
2017	58.640	0.77%	8,303	-0.42%	10,409	-0.46%	3034	1.00%	6,720	1.51%	4.41	2.01%
2018	59.126	0.83%	8,276	-0.33%	10,372	-0.36%	3064	1.00%	6,818	1.46%	4.46	1.14%
2019	59.575	0.76%	8,245	-0.38%	10,334	-0.36%	3095	1.00%	6,920	1.50%	4.57	2.37%
2020	59.981	0.67%	8,211	-0.41%	10,275	-0.57%	3126	1.00%	7,020	1.44%	4.71	3.03%
2021	60.443	0.76%	8,187	0.29%	10,239	-0.35%	3148	0.70%	7,118	1.40%	4.70	-0.24%
2022	60.833	0.64%	8,157	-0.36%	10,176	-0.61%	3170	0.70%	7,219	1.41%	4.78	1.79%
2023	61.492	1.08%	8,171	0.17%	10,180	0.03%	3192	0.70%	7,319	1.39%	4.53	3.90%
2024	61.933	0.72%	8,155	-0.20%	10,152	-0.28%	3214	0.70%	7,418	1.36%	4.55	0.53%
2025	62.390	0.73%	8,145	-0.12%	10,118	-0.34%	3237	0.70%	7,521	1.40%	4.56	0.07%
2026	62.877	0.77%	8,137	-0.10%	10,085	-0.32%	3260	0.70%	7,628	1.40%	4.55	-0.03%
2027	63.343	0.75%	8,142	0.07%	10,055	-0.30%	3283	0.70%	7,732	1.37%	4.56	0.00%
2028	63.563	0.36%	8,113	-0.40%	9,995	-0.60%	3305	0.70%	7,830	1.32%	4.60	0.88%
2029	64.012	0.62%	8,116	0.02%	9,960	-0.31%	3329	0.70%	7,936	1.35%	4.64	0.81%
2030	64.410	0.68%	8,113	0.03%	9,929	-0.31%	3352	0.70%	8,039	1.30%	4.87	0.81%
2031	64.897	0.66%	7,931	-2.26%	9,899	-0.30%	3375	0.70%	8,144	1.30%	4.91	0.86%

[1] Forecast 2010-2013 from Economic and Revenue Forecast Council's June 2011 Forecast
Forecast 2014-2030 extended based on OFM forecast growth rate May 2011
[2] Forecast 2010-2011 from Transportation Revenue Forecast Council's June 2011 Forecast
[3] Forecast 2010-2031 from Transportation Revenue Forecast Council's June 2011 Forecast

Ex. H

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Reply to: Seattle Office

June 14, 2011

VIA EMAIL AND U.S. MAIL

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Dear Ms. Naber, Dr. Toothman, and Mr. Westberg,

On behalf of Bill Speidel Enterprises, Inc. and the citizens' group Protect Seattle Now, we would like to share with you our grave concern for the Pioneer Square Historic District in Seattle. We believe this district, listed on the National Register of Historic Places and designated as a City of Seattle historic district, is under threat from the Washington State Department of Transportation's (WSDOT) proposal to locate a massive highway interchange and the world's largest bored tunnel next to the district.

O-005-008 WSDOT's preferred alternative for the SR99 viaduct replacement project will "use" land from the Pioneer Square Historic District within the meaning of Section 4(f). WSDOT's tunnel design provides only a single access point for all of downtown Seattle: a huge interchange at Pioneer Square. This interchange would sprawl across 14 lanes of concrete. It would commandeer the narrow, pedestrian-oriented, and physically fragile streets of the Historic District as highway access routes for huge volumes of vehicular traffic. Pioneer Square's streets would become feeder streets for a network of on- and off-ramps for WSDOT's tunnel. Pioneer Square's streets, however, are an essential component of the historic resource and specifically protected under the City's ordinance for Pioneer Square. The use of Pioneer Square streets for high capacity highway access unquestionably will compromise the Historic District.

WSDOT has been aware of the Pioneer Square traffic problems caused by the location of this mega-interchange for over 18 months. Many local organizations and community groups have diligently requested WSDOT to identify solutions that avoid these harms via the environmental review process. However, the problems remain unsolved and unmitigated, even at this late hour.

O-005-009 A feasible and prudent alternative to the bored tunnel that avoids these harms exists. It involves investments in transit, surface streets, and nearby Interstate 5. This alternative has been recognized by WSDOT, the City, and King County as one of the two best options to be evaluated. But WSDOT has refused to consider this alternative in detail, without adequate explanation.

Section 4(f) and the National Environmental Policy Act (NEPA) require the Federal Highway Administration (FHWA)—and WSDOT as the state agency to which the FHWA delegated its responsibilities—to analyze in detail alternatives that either pursue a less harmful alternative, or to provide solutions or mitigation that would prevent harm to the Historic District. Section 4(f), of course, also requires that the alternative that avoids impacting the Historic District actually be selected, unless it is not feasible or prudent. By disregarding avoidance alternatives, leaving significant problems unsettled in its planning process and unfunded in its budget, WSDOT is compromising the integrity of the Pioneer Square Historic District and violating federal law.

We urge you to fully protect the Pioneer Square Historic District under Section 4(f) of the Department of Transportation Act of 1966.

I. BACKGROUND

A. Bill Speidel Enterprises, Inc. and Protect Seattle Now

Bill Speidel Enterprises is the family-owned company that operates the Underground Tour in the Pioneer Square Historic District. For nearly five decades, the Underground Tour has been a steward of and advocate for the Pioneer Square Historic District. The Underground Tour would lose business if the FHWA permits WSDOT to proceed with its preferred alternative for replacing the Viaduct, as the inevitable increase in vehicular traffic and damage to the District's pedestrian environment would decrease pedestrian activity and the number of customers interested in the Underground Tour.

O-005-008

FHWA responded to this letter on July 15, 2011. The following responses incorporate information from that response and provide additional information contained in the Final EIS and supporting technical reports. The Section 4(f) Evaluation in the Final EIS considered the potential for a use of the Pioneer Square Historic District. The Section 4(f) Evaluation concluded that the Tolled Bored Tunnel alternative would result in a "use" of the District, but the use would be confined to the area of the Western Building, which is a contributing resource to the District. While the Tolled Bored Tunnel would increase traffic volumes in the District, it was determined through Section 106 consultation under the National Historic Preservation Act that the increased traffic would not result in an "adverse effect" on the District (Appendix I, Historic, Cultural, and Archaeological Resources Discipline Report, Section 7.1). Based on that finding, FHWA concluded that the "use" of the District is confined to the area of the Western Building.

O-005-009

The Section 4(f) Evaluation in the Final EIS analyzed alternatives for avoiding or minimizing harm to the Pioneer Square Historic District, and concluded that there are no prudent and feasible avoidance alternatives. The Section 4(f) Evaluation specifically considered the Surface/Transit/I-5 Hybrid alternative and concluded that it is not a feasible and prudent alternative for avoiding the use of historic resources because it would not meet the purpose and need of the project.

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Protect Seattle Now is an association of citizens, including people who work in Pioneer Square, enjoy spending leisure time in the District, and pay the state and federal taxes and fees that would be used to pay for the bored tunnel. The purposes of Protect Seattle Now include educating the public about the bored tunnel, advocating for alternatives that pose fewer environmental and financial risks, and ensuring that government agencies comply with their legal obligations for the Viaduct replacement project.

B. The Pioneer Square Historic District

O-005-010 Pioneer Square was the City's original business district. It was designated a historic district in 1970. According to the City of Seattle,

> Pioneer Square marks Seattle's original downtown, dating back to 1852. Rebuilt after the devastating "Great Fire" of 1889, the district is characterized by late nineteenth century brick and stone buildings and one of the nation's best surviving collections of Romanesque Revival style urban architecture. Established as both a National historic district and a local preservation district in 1970, Pioneer Square is protected by an ordinance and design guidelines focused on preserving its unique historic and architectural character, assuring the sensitive rehabilitation of buildings, promoting development of residential uses for all income levels, and enhancing the district's economic climate for residents, employers, workers, and visitors.

http://www.seattle.gov/neighborhoods/preservation/pioneersquare.htm.

Protections for the Pioneer Square Historic District are defined in Seattle Municipal Code (SMC) 23.66.100. Protection of its quiet local streets and its pedestrian character are some of the fundamental reasons for the establishment of the special review district:

- "to avoid a proliferation of vehicular parking and vehicular-oriented uses," SMC 23.66.100.A;
- "to encourage the use of transportation modes other than the private automobile," *id.*;
- "and to encourage pedestrian uses," *id.*

The Pioneer Square Historic District is more than just individual buildings. The overall urban design, and specifically the interplay between the streets, sidewalks, underground areaways, and buildings create the unique character and historic value of Pioneer Square. In order to protect the streets, with their quiet traffic and pedestrian character, one of the prohibited uses in the Historic District is defined in SMC 23.66.122:

- "Transportation facilities, except passenger terminals, rail transit facilities, parking garages, and streetcar maintenance bases"

O-005-010

The historic features of the Pioneer Square Historic District were thoroughly evaluated and documented in accordance with Section 106 of the National Historic Preservation Act. The Section 106 process includes identification and evaluation of historic properties that are listed in or eligible for the National Register of Historic Places. As part of that process, FHWA considered the historic features of the Pioneer Square Historic District as documented in the National Register nomination form for this district. The nomination form describes the historically significant features of the Pioneer Square Historic District as follows:

> "The district is being nominated based on the following National Register Criteria: "A. Property is associated with events that have made a significant contribution to the broad patterns of history"; and criterion C: "Property embodies the distinctive characteristics of a type, period, or method of construction or represents the work of a master, or possesses high artistic values, or represents a significant and distinguishable entity whose components lack individual distinction." The district is clearly associated with the "broad patterns" of United States History, beginning with 1889, after the Great Fire and ending with the Second Avenue Extension, which had a far-reaching effect on both the buildings and the streetscape of the district until 1931. In terms of Criterion C, the district presents many examples of buildings that are architecturally distinctive and are the work of a large number of well known, although local architects. In addition, the district has several public squares and a small collection of artifacts of significance. The areas of significance for the district, based on National Register categories, are: architecture, commerce, community planning and development, engineering, industry, landscape architecture, politics/government, social history and transportation."

Please see the map of the Pioneer Square Historic District for reference on the accompanying CD-ROM, and here: http://www.seattle.gov/neighborhoods/preservation/pioneersquare_map.htm

C. The Alaskan Way Viaduct Replacement Project

The current Alaskan Way Viaduct is an elevated road traveling next to the Pioneer Square Historic District and along Seattle's waterfront. This portion of SR-99 carries up to 100,000 cars a day, and offers seven on- and off-ramps to allow travelers access to and from the commercial core of downtown Seattle. It was damaged in 2001 Nisqually earthquake, and planning for replacement has been underway since then.

II. ANALYSIS

As you know, Section 4(f)[1] of the Department of Transportation Act of 1966 creates substantive protections for our nation's most cherished parks, natural resources, and historic sites. It announces a policy that the United States government should undertake "special effort" in order to "preserve" the country's "historic sites." 49 U.S.C. § 303(a). Section 4(f) is triggered when a "transportation program or project" will "use" any "land of an historic site of national, state, or local significance (as determined by the federal, state, or local officials having jurisdiction over the park, area, refuge, or site)." 49 U.S.C. § 303(c). FHWA may not approve any such transportation project unless the applicant agency establishes, and the FHWA finds, that the two strict standards of Section 4(f) are met: First, "there is *no* prudent and feasible alternative to using that land." 49 U.S.C. § 303(c)(1) (emphasis added). Second, "the program or project includes *all* possible planning to minimize harm to the . . . historic site resulting from the use." 49 U.S.C. § 303(c)(2) (emphasis added).

The cultural resources that enjoy protection under Section 4(f) include national and local treasures such as the Pioneer Square Historic District in Seattle. WSDOT, however, has fallen short of meeting both elements of Section 4(f). According to WSDOT's own technical studies, there is a an alternative that would effectively move people and goods into and through the central city, while minimizing the use of the Pioneer Square Historic District by distributing vehicle trips away from that area. Yet WSDOT has refused to analyze this alternative in detail in its EIS. WSDOT has also failed to adequately plan for the harm that a tunnel alternative will cause to Pioneer Square.

A. The Pioneer Square Historic District, as Defined by City Law, Is Protected Under Section 4(f)

O-005-011 The Pioneer Square Historic District is on the National Register of Historic Places. City law recognizes that the area is "an area of great historical and cultural significance," and therefore the City has designated it as a "special review district" subject to rigorous use and development

[1] This letter uses the term "Section 4(f)" in the same way that the term is defined in the USDOT regulations, 23 C.F.R. § 771.107(e), namely as the identical statutory obligations imposed on the FHWA by 49 U.S.C. § 303 and 23 U.S.C. § 138.

The description of this resource in the National Register nomination form is used as the basis for FHWA's evaluation of effects under Section 106 and evaluation of "use" under Section 4(f). See FHWA Section 4(f) Policy Paper Question 3C (http://www.environment.fhwa.dot.gov/projdev/4fpolicy.pdf).

O-005-011

The Section 4(f) Evaluation in the Final EIS recognizes that the Pioneer Square Historic District is listed in the National Register of Historic Places and therefore is a Section 4(f) resources. The District's status under local ordinances does not confer protection under Section 4(f), nor does it change the way the District is treated for purposes of compliance with Section 4(f).

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O-005-011 restrictions. SMC 23.66.100.A. Therefore, the full protections of Section 4(f) attach to this historic area.

B. **The Project Would "Use" the Pioneer Square Historic District**

O-005-012 We urge you to determine that the bored-tunnel alternative for replacing the Viaduct would "use" the Pioneer Square Historic District within the meaning of Section 4(f) and the FHWA's rules, 23 C.F.R. 774.15 and 23 C.F.R. § 774.17. We believe this "use" determination is compelled by the evidence summarized below and detailed in the 2010 supplemental draft environmental impact statement (SDEIS) and the documents attached to the hard copy of this letter, especially the April 2011 Nelson-Nygaard Draft Full Report to the Seattle Department of Transportation entitled, "Additional Review of the Impacts of the Deep Bored Tunnel Tolling Diversion on City Streets; Identification of Mitigation." (Nelson-Nygaard Report)

The proposed bored tunnel alternative replaces the seven existing on- and off-ramps for the downtown area with a single mega-interchange, immediately adjacent to the Pioneer Square Historic District. Project officials expect at least 50,000 cars, trucks, and buses to use this interchange ea ch day for the non-tolled alternative. High tolls are expected to motivate an additional 20,000 potential users to exit the road to bypass the tolled portion, which undoubtedly would increase volumes at the Pioneer Square interchange. (WSDOT refused to study the impact of tolling diversion on Pioneer Square streets in their 2010 SDEIS.)

Many community organizations, historic preservation professionals, local businesses, professional groups, and agencies have raised concerns about the risks to the Historic District caused by the proposed bored tunnel alternative. See the comment letters on the DEIS sent in November and December 2010 by the following entities:

- Seattle Department of Transportation,
- American Institute of Architects, Seattle Chapter,
- Historic Seattle,
- Bill Speidel Enterprises (The Underground Tour), and
- People's Waterfront Coalition.

These letters are available online at www.tunnelfacts.com/eis/, and we have also included electronic copies on the CD-ROM accompanying the hard copy of this letter.

WSDOT's plan does not designate access routes for this huge volume of traffic, nor fund any improvements to city streets to manage this volume, nor mitigate the volume with transit or demand management. Instead, WSDOT's plan expects drivers to "use" Pioneer Square streets for highway access. This creates significant, unresolved problems for the Pioneer Square Historic District.

- In the 2010 SDEIS for their proposed tunnel project, WSDOT admits that the high volume of traffic causes "unacceptable" congestion on local city streets. *See* 2010 SDEIS at 214-15. But it does not offer any other solutions or mitigation funding to provide

O-005-012

The Section 4(f) Evaluation in the Final EIS considered the potential for a use of the Pioneer Square Historic District. The Section 4(f) Evaluation concluded that the Tolled Bored Tunnel alternative would result in a "use" of the District, but the use would be confined to the area of the Western Building, which is a contributing resource to the District. While the Tolled Bored Tunnel would increase traffic volumes in the District, it was determined through Section 106 consultation under the National Historic Preservation Act that the increased traffic would not result in an "adverse effect" on the District (see Appendix I, Historic, Cultural, and Archaeological Resources Discipline Report, Section 7.1). Based on that finding, FHWA concluded that the "use" of the District is confined to the area of the Western Building.

In determining that the Tolled Bored Tunnel alternative would not have an "adverse effect" on the District, and therefore would not "use" the District, FHWA considered the comprehensive analysis conducted as part of Section 106 consultation, including the following facts (summarized from the Final EIS Appendix I, Historic, Cultural, and Archaeological Resources Discipline Report):

- The District is located in an urban area, directly adjacent to a large elevated highway (the Alaskan Way Viaduct) and an industrial waterfront district.
- The portal for the Tolled Bored Tunnel is located outside of the Pioneer Square Historic District boundaries. (See Final EIS Exhibits 4-10 and 4(f)-1).
- Under current conditions, traffic on city streets through the district is heavy at certain times of day, and during special events. The increased traffic volumes - which will occur on some streets in the historic district, at some times during the day - may be noticeable, but are not out of character with a historic district in an urban area.
- Traffic in Pioneer Square is controlled by traffic signals; with

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O-005-012 alternatives.

- There is not enough room on historic district streets to accommodate the expected concentration of increased bus traffic. Modeling from the 2010 SDEIS shows unacceptable levels of congestion and a severe degradation of transit reliability. The congestion forecasts will undoubtedly be worse when a model is run that includes tolling and the expectation that large numbers of drivers will exit at the last off-ramp before the toll—Pioneer Square.

- Pioneer Square streets are built upon old and decaying underground infrastructure and low-quality fill from the reconstruction of city streets over 100 years ago. Streets and sidewalks were raised one story, and are structurally supported by an unusual and fragile system of retaining walls and underground "areaways", the now-underground former sidewalks. Can streets physically withstand the high volumes of traffic and heavy loads expected? Shouldn't this answer be known before WSDOT is given approval to overload the streets?

To the extent that WSDOT has been willing to acknowledge this problem at all, it has suggested that the adverse impacts can be resolved later. This, of course, is contrary to NEPA's command that impacts and potential mitigation be analyzed before decisions are made, not afterwards. That need to study in advance is particularly critical here because the problem of too much traffic in this area turns out to be very difficult—perhaps impossible--to solve.

The Pioneer Square Historic District is boxed in by two stadiums, the train station, and the Port of Seattle terminals. If WSDOT insists on a mega-interchange near Pioneer Square, use of Historic District streets is inevitable. WSDOT may have no choice but to increase capacity on protected streets to accommodate this high volume of generated traffic. The City's ordinance prohibiting "transportation facilities" within the Historic District creates a significant obstacle: Will the Pioneer Square ordinance allow tearing out the central median strips, removing the mature London Plane street trees, removing on-street parking, or destroying the protected underground areaways if these are necessary to accommodate this traffic?

If WSDOT's project requires changes or "improvements" to these unique and historic streets to make room for an expected huge increase in cars, trucks and buses, WSDOT must identify these changes, ensure changes comply with the Pioneer Square ordinance, get approval from the Pioneer Square Preservation Board, and show sufficient funding—before the FEIS is signed and the tunnel project is approved.

C. Inadequate Funds for Solutions and Mitigation

O-005-013 We have serious doubts that WSDOT's funding plan ensures "all possible planning" can be undertaken to mitigate the harm to the Pioneer Square Historic District from the bored tunnel's use. *See* 49 U.S.C. 303(c)(2); 23 C.F.R. § 774.3(a)(2). As you know, 23 C.F.R. § 774.17 states, "All possible planning means that all reasonable measures identified in the Section 4(f) evaluation to minimize harm or mitigate for adverse impacts and effects *must be included in the*

increased volumes, traffic speeds will be reduced. Therefore, while tolling may cause an increase in traffic volumes within the District, the increased traffic volume is not expected to affect the pedestrian character of the area or make it more difficult to walk to shops or restaurants.

- While the project will cause some impacts on the historic district, the project also will benefit the historic district by removing the overhead Alaskan Way Viaduct structure, which today results in both noise and visual impacts to the district. The existing structure separates the historic district from the waterfront, which was an important connection during the period of significance. By removing the Viaduct, the project actually helps to restore an important aspect of the historic character of the district.

FHWA is satisfied that the record supports a determination that the Tolled Bored Tunnel alternative does not result in an "adverse effect" on, and does not "use", the Pioneer Square Historic District.

O-005-013

The Section 4(f) Evaluation in the Final EIS considers measures to minimize harm to Section 4(f) resources that would be used by the project, including Pioneer Square Historic District. Because the area of use of the District under the Tolled Bored Tunnel alternative would be confined to the area of the Western Building, the measures to minimize harm are focused on the Western Building. However, although not required as measures to minimize harm under Section 4(f), mitigation is discussed in the Final EIS for general effects including effects related to tolling. As you will see in Chapter 8 of the Final EIS, entitled "Mitigation," WSDOT has committed to establishing a Tolling Advisory Committee, which would work to develop mitigation strategies to minimize the effects of diversion due to tolling on affected areas, including the Pioneer Square Historic District.

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O-005-013 *project*." (Emphasis added.) Without adequate funding, reasonable mitigation measures are illusory and will not be included in the construction and operation of the bored tunnel.

The project budget is already stretched thin. WSDOT acknowledges a $300 to $700 million shortfall of secured funds. Of course, if funding remains short, it likely will be mitigation—certainly not the tunnel itself—that is cut short. Yet WSDOT has refused to address this issue either, in particular with regard to the impact it would have on the (yet to be determined) mitigation measures for Pioneer Square. According to Seattle Department of Transportation's (DOT) December 2010 SDEIS comment letter:

> The contingencies set aside in this budget may be too low, and there is little included in the budget for mitigation. The potential impacts of the project running over budget or the Port of Seattle not providing the $300 million needed for the project are not addressed. There is significant concern to the City of Seattle, as we can only assume the elements important to the City…. would be the first to be eliminated from the project. We believe that the EIS should identify and examine the potential impacts of the project if significant elements are underfunded.

It is quite possible that no funds will be available for necessary solutions or mitigation to protect the Historic District later if solutions are not negotiated and funding set aside now.

Furthermore, the state's financial commitment to mitigation and future needs has already shrunk, with the contingency fund of $415 million cut down to $160 million in order to give incentives to the tunnel contractor. Some of the sub-contingency funds within that $160 million are tied to only certain designated risks, with any leftovers given to the contractor rather than reserved for unanticipated risks.

As part of your scrutiny of this project under Section 4(f), therefore, we believe you should require WSDOT to demonstrate that it has adequate funding to actually implement the reasonable mitigation measures that would be required.

D. Feasible and Prudent Avoidance Alternatives

O-005-014 To date, WSDOT has not included any "I-5/Surface/Transit" alternative in its analysis of the Viaduct replacement project under NEPA. Such an alternative is a feasible and prudent alternative to the bored-tunnel alternative, and thus a Section 4(f) statement must include it.

In 2008, a year-long collaborative process between transportation agencies of the State of Washington, King County, and the City of Seattle compared eight options, and recommended two as viable. The two solutions that were recommended were the Elevated/ Transit hybrid, which was a taller skinnier elevated highway with additional transit, and the I5/ Surface / Transit hybrid. The latter alternative increases transit; adds a lane and makes other improvements to the parallel Interstate 5; and increases connectivity in the street grid north and south of downtown Seattle to enhance mobility.

O-005-014

The Section 4(f) Evaluation in the Final EIS analyzed alternatives for avoiding or minimizing harm to the Pioneer Square Historic District, and concluded that there are no prudent and feasible avoidance alternatives. The Section 4(f) Evaluation specifically considered the Surface/Transit/I-5 Hybrid alternative and concluded that it is not a feasible and prudent alternative for avoiding the use of historic resources because it would not meet the purpose and need of the project.

O-005-014 This alternative costs about $700 million less than the bored tunnel alternative, requires no unproven technology,[2] equals or surpasses the tunnel option in terms of moving people and goods into and through Seattle, and results in fewer carbon emissions than the tunnel option. It avoids concentrating highway traffic into a mega-interchange next to the Pioneer Square Historic District. Instead, it distributes trips away from the Historic District, putting far less pressure on these historic streets. Specifically:

- Because there is no mega-interchange, there would be no excessive concentration of highway traffic generated at the edge of the historic district.
- Because there is no mega-interchange, there would be no need to alter historic district streets to make room for 50,000 – 70,000 additional cars, trucks, and buses.
- Because traffic will not be concentrated in this area, but rather distributed around it to I-5, transit, and other streets beyond the Historic District borders, there would not be on-going pressure for traffic to overwhelm these fragile historic streets.

For more information about this I-5/ Surface/Transit alternative, see the documents on the CD-ROM included with the hard copy of this letter. The most relevant documents are the Nelson-Nygaard Report and the documents explaining Scenario B presented by WSDOT during the 2008 planning process.

Even though the State, County and City transportation agencies agreed that this alternative was in the top two for further study in 2008, WSDOT has refused to analyze this alternative in its EIS. How could it avoid analyzing this alternative in detail? WSDOT could not argue that it was not a reasonable alternative because WSDOT had been involved in identifying it as one of the top two. Instead, WSDOT changed the ground rules. Without any public input, WSDOT subtly but dramatically re-defined the purpose and need for the project. Out went the purpose of moving people and goods in and through the city. In came the purpose of moving cars. With that sleight of hand, the alternative that relied heavily on increased transit became a non-starter.[3]

The public has constantly complained about this gamesmanship, but to no avail. Despite numerous letters to WSDOT protesting the new, contrived purpose and need statement in the 2010 SDEIS, WSDOT has indicated it will not return to the original formulation and will continue to exclude from the FEIS the more transit-oriented option it previously agreed was a feasible and prudent solution. WSDOT's manipulation of the NEPA process will not survive judicial scrutiny. It should not survive your scrutiny, either.

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[2] The proposed tunnel would be the largest single-bore tunnel ever constructed. The technology for the bore was unveiled only in the last couple of years and is, as yet, unproven.

[3] The 2006 SDEIS defined the project's purpose and need as, in relevant part, to "maintain or improve mobility, accessibility, and traffic safety for people and goods along the existing Alaskan Way Viaduct Corridor." 2006 SDEIS at 122. The 2010 SDEIS changed this statement, without explanation, to "[p]rovide capacity for automobiles, freight, and transit to efficiently move people and goods to and through downtown Seattle." 2010 SDEIS at 6. As recently as the 2008 planning process, WSDOT had agreed to a set of guiding principles for the project which included the goal of "[p]rovid[ing] efficient movement of people and goods now and into the future." 2010 SDEIS at 50. Thus, the statement of purpose and need subtly shifted, for no stated reason, to emphasize capacity for automobiles.

O-005-014 We urge FHWA to analyze the I-5/Surface/Transit alternative known as Scenario B, which WSDOT developed during the 2008 planning process. (Scenario B performs as well as option C, but the street in Scenario B fits with the plans for Seattle's waterfront recently developed by the City of Seattle, dovetails better with Pioneer Square streets, and performs better for local access than Option C.) The Nelson Nygaard Report notes that traffic impacts on Pioneer Square would be reduced, in general, with either I5/Surface/Transit alternative compared to the tolled tunnel. *See* Nelson-Nygaard Report at 4-1.

III. REQUEST FOR FULL PROTECTION UNDER SECTION 4(F)

O-005-015 The requirements of Section 4(f) are "stringent," allowing a transportation project to use a protected area "only in the most exceptional cases." *Stop H-3 Ass'n v. Dole*, 740 F.2d 1442, 1447, 1452 (9th Cir. 1984). Yet WSDOT is proceeding full speed ahead, pursuing its preferred alternative without addressing the significant harms to the Pioneer Square Historic District streets. WSDOT has brought the proposed tunnel to the brink of a Record of Decision based on a fundamentally flawed review process.

WSDOT's preferred tunnel alternative would "use" the streets of the Pioneer Square Historic District as highway access routes. But WSDOT has not studied alternatives that would reduce or eliminate this impact, nor has it sufficiently proven it can use Pioneer Streets without seriously compromising the integrity of the Historic District. We request that you give Pioneer Square Historic District full protection under Section 4(f). We implore you to direct WSDOT, under Section 4(f), to both fully explore the I-5/Surface /Transit alternative that does not include a mega-interchange next to the Pioneer Square Historic District, and include in its tunnel alternative fully funded solutions to minimize harms to the Pioneer Square Historic District.

Thank you for your attention and for defending this beloved historic resource.

Sincerely,

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Enclosure: CD-ROM with supporting documents

O-005-015

The Section 4(f) documentation has been thoroughly reviewed by FHWA staff at the Division and headquarters levels, and FHWA has confirmed that it meets all applicable requirements.

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