Chapter 3 Transportation

Chapter 3 –Transportation

Since 1993, the east side of Lake Washington has experienced substantial growth in both residential development and employment, causing increasing traffic volumes on I-90. As the directional split on I-90 has become more balanced during peak hours, the congestion in the traditional reverse-peak direction has increased. This increased congestion has created transit delays that cause riders to miss connecting buses and arrive late at their destinations. These impacts to transit riders diminish the reliability and effectiveness of the transit system and discourage ridership.

Traffic forecasts show that as congestion on I-90 worsens, all travel crossing Lake Washington will become increasingly slow and less reliable. The Build Alternatives are targeted to improve the reliability and travel time of transit and high occupancy vehicle (HOV) users minimizing impacts to the environment and to other users and transportation modes in the corridor.

The transportation performance for each Build Alternative proposed for the corridor was evaluated to assess the degree to which each package of improvements optimized the performance of the I-90 corridor for transit and HOV operations.

This chapter describes existing conditions in the corridor, the consequences of taking no action (shown in Alternative R-1) and the performance of the Build Alternatives (R-2B Modified, R-5 Restripe, R-5 Modified, and R-8A). Proposed mitigation and unavoidable adverse impacts for each Build Alternative are noted.

In response to comments received on the DEIS, sensitivity tests were performed using Alternative R-2B to determine the potential effectiveness of investing in Transportation Demand Management/Transportation System Management (TDM/TSM) investments in the I-90 corridor. See Section 3.1 Transit/HOV Operations (3.1.2.2) beginning on approximately 3.1-17. Updated information on potential crash rates for the various alternatives is included in Section 3.2 Freeway Operations and more discussion of the flexibility or adaptability of converting the corridor for future projects including light rail or high capacity transit has been added.

In Section 3.3 Surface Street Operations, some mitigation measures for local intersections have been eliminated from further consideration or revised based on discussions with local agencies. In Section 3.4 Pedestrian/Bicycle Access, the information on widening the Homer M Hadley (HMH) floating bridge has been removed, the construction closures of the shared-use pathway have been reduced, and a commitment has been added to install screening on top of the barrier for Alternative R-5 Modified and the Preferred Alternative R-8A. In Section 3.5 Freight Movement (3.5.2), additional information has been added on the potential rerouting of trucks carrying flammable cargo if a decision is made by WSDOT to prohibit their use of the I-90 tunnels. The DEIS stated that the trucks would be prohibited from use of the tunnels, however WSDOT has committed to further studying the means of managing risks associated with the movement of these cargoes and no decision has yet been made to change existing policy. The potential impacts to navigable waters (Section 3.6 Navigable Waters) has been removed as the impact is eliminated with no widening of the HMH floating bridge.

Travel Forecasts

Travel forecasts were developed for three primary modes of travel within the I-90 corridor—general purpose traffic, HOV, and transit. Detailed information about the assumptions and methods for these forecasts are included in the I-90 Two-Way Transit and HOV Operations Transportation Discipline Report.

- General Purpose Traffic Forecasts: Traffic forecasts in the I-90 corridor were developed using Puget Sound Regional Council (PSRC) models. The results of the model for the base year (2001) were compared to actual volumes in the study area. Future volumes were forecast using adopted land use forecasts for the region and network assumptions consistent with the PSRC planning efforts and concurrent corridor planning studies. Using these data, volume forecasts for both the corridor freeways and intersection turning movements for surface streets were developed.

- HOV Forecasts: Forecasts of future HOV use were developed by examining the existing HOV percentage of traffic using the study area network and by applying an updated version of the PSRC model developed for regional travel. This new model produces HOV estimates for all trip types, not just work trips.

- Transit Ridership Forecasts: Transit ridership forecasts were also developed using PSRC models. All Sound Transit routes and King County/Metro Transit routes using the I-90 facility were included to reflect both current and future service.

Evaluation Criteria

The performance of each Build Alternative was compared with the conditions that would exist with Alternative R-1, in 2025. The impacts are compared among the following travel modes and facility types:

- Transit
- HOV
- Park-and-Ride
- Freeway
- Arterials and local streets
- Pedestrian and bicycles
- Freight
- Navigable waterways

Evaluation criteria were developed that address the key impacts within these groups, as shown in Table 3-1. The criteria fall into the following categories:

Demand: Addresses the volume of vehicles and persons traveling within the I-90 corridor.

Operations: Addresses a wide range of operational measures, including level of service (a measurement of delay), congestion levels, travel time and speed, and reliability.

Safety: Measures an alternative's possible effect on either decreasing or improving vehicular and nonmotorized safety.

Flexibility and Adaptability: Assesses how well the alternative could accommodate future potential changes in roadway design and/or light rail within the I-90 corridor.

Maintenance: Evaluates whether an alternative will provide safe and efficient conditions for maintenance operations.

Construction: Qualitatively evaluates the impacts of construction, including those related to short-term changes in traffic circulation (motorized and non-motorized) and displacement of traffic and/or parking.

Table 3-1 shows which evaluation criteria were applied to the eight transportation modes and facility types. No weights were assigned to any of the criteria.

Table 3-1
Transportation Evaluation Criteria

	Transit/HOV							
Criteria	Transit	HOV	Park-and-Ride	Freeway	Arterial and Local Streets	Pedestrian/ Bicycle	Freight Movement	Navigable Waterways
Demand								
- Vehicle Volumes	✔	✔	✔	✔	✔			
- Person Volumes	✔	✔		✔		✔		
Operations								
- Level of Service				✔	✔	✔		
- Travel Time	✔	✔		✔			✔	
- Speed				✔				
- Queues				✔	✔			
- Hours of Congestion				✔				
- Person Delay	*	*		✔				
- Reliability	✔							
Safety	*	*		✔	✔	✔	✔	
Flexibility/Adaptability				✔				
Maintenance				✔				
Construction	✔	✔		✔	✔	✔	✔	✔

* Included within Freeway evaluation

3.1 TRANSIT/HOV OPERATIONS

Changes in transit operations were evaluated by measuring the length of transit travel times, reliability in terms of ability to meet published transit schedules, and ridership forecasts. Changes in the operation of carpool and vanpool (i.e., HOV) vehicles were measured using travel times and volumes. Changes in the demand for park-and-ride spaces based on improved transit and HOV operations within the I-90 corridor was also assessed.

3.1.1 Affected Environment

The two center lanes are dedicated to transit and HOV traffic (with an allowance for Mercer Island single-occupant vehicles (SOV) from Island Crest Way to Rainier Avenue S), and are separated from general-purpose traffic in the outer roadways. The lanes are reversible, operating westbound during the morning (AM) peak hours and eastbound during the afternoon (PM) peak hours. Transit and HOV traffic traveling westbound in the morning and eastbound in the evening in the center lanes usually move freely. Transit and HOV traffic traveling in the reverse-peak direction (eastbound AM and westbound PM) must use the outer roadway. These vehicles use the same lanes as general-purpose traffic and are subject to the same traffic conflicts, congestion, and delays.

3.1.1.1 Existing Conditions

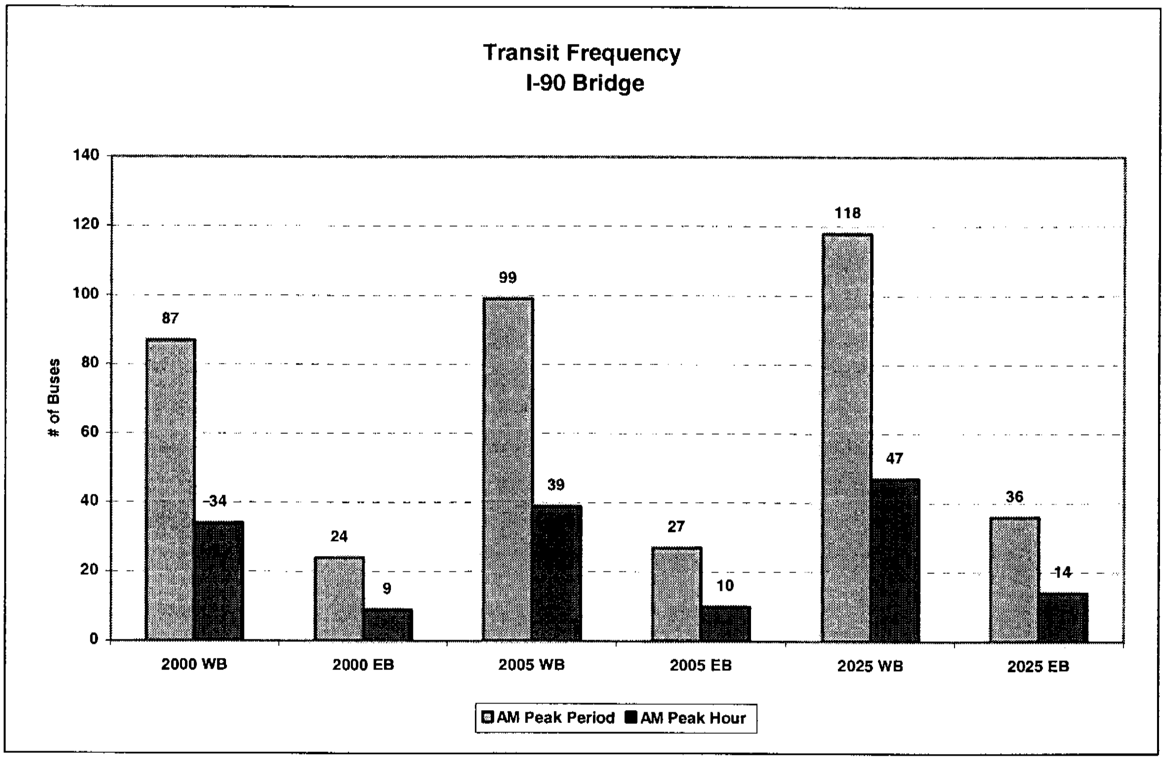
Transit Frequency

Fifteen different bus routes serve the public in the I-90 corridor between I-5 and I-405. The earliest weekday service across the floating bridges leaves the Mercer Island transit station just after 5:00 AM westbound and 5:45 AM eastbound. The last bus serving the station on weekdays is just after midnight in both directions. Sound Transit Express Route 550 is the first and last bus operating in both directions.

King County/Metro Transit defines an AM and PM peak period for fare purposes. These periods are approximately 6 AM to 9 AM (AM peak) and 3 PM to 6 PM (PM peak). The number of buses using the I-90 floating bridges during the 3-hour AM peak period and peak hour (the hour with the highest traffic counts) were counted in the fall of 2001 and are shown in Figure 3.1-1.

During the 3-hour AM peak period, there were 87 westbound buses and 24 eastbound buses crossing the floating bridges. For the 1-hour AM peak hour, there were 34 westbound buses and 9 eastbound buses. In addition to buses that are in revenue service, the I-90 corridor is a major route for buses that are 'deadheading' between Seattle and the Eastside. Deadheading buses are not in revenue service and may be heading to another location to begin service or are heading to or from the bus operations base. Within the I-90 corridor, there are almost two deadheading buses for every revenue bus in the reverse-peak direction during AM and PM peak periods. There are currently 54 deadheading buses eastbound during the AM peak period (i.e., the reverse-peak direction) and 2 westbound. During the AM peak hour, there are 24 eastbound deadheading buses.

Figure 3.1-1
I-90 Bridge – Transit Service (Peak Hour and Peak Period)



Source: Mirai Associates 2002

During the 3-hour PM peak period, the numbers were exactly reversed from the AM peak period with 24 westbound buses and 87 eastbound buses. The PM peak hour numbers were also reversed from the AM peak hour, with 9 westbound buses and 34 eastbound buses. Also during the PM peak period there are 69 westbound buses (29 during the PM peak hour) traveling to/from revenue service.

Travel Times

Transit travel times between Bellevue and Seattle depend on the route, the direction of travel and whether the bus makes a stop on Mercer Island. Routes traveling in the peak direction of travel have access to the center roadway, which can result in significantly shorter transit times than routes traveling in the reverse-peak direction that must use the outer roadway along with general-purpose traffic.

Currently, buses operating with no stops on Mercer Island and HOVs traveling in the peak direction using the center roadway require approximately 5 minutes to travel between the Rainier Avenue S Transit Station and Bellevue Way SE. In comparison, the travel time for buses and HOVs in the outer roadway traveling in the reverse-peak direction ranges from 8 to 9 minutes, unless there is major congestion. Buses that stop at the transit center on Mercer Island going in either direction require an additional 4 to 6 minutes to load and unload passengers.

Transit Reliability

An important transit service measure is reliability. Reliable transit means adhering to established schedules. Within the I-90 corridor, the variable traffic conditions are the major contributing factor to poor transit reliability.

For a transit rider, the vehicle arrival times at the beginning and end of a trip, and at transfer points, determine the wait time, the overall travel time and the likelihood of missed connections and late arrivals. On-time service has a positive effect on riders and ridership because patrons experience less waiting, decreased travel time, fewer missed connections, more on-time arrivals at their destinations, and reduced overall uncertainty as to when they will reach their destination.

Currently, in the reverse-peak direction across I-90, the congested and unstable flow of traffic affects transit operations the same as general-purpose traffic. This causes a lack of predictability in meeting published transit schedules and more uncertainty for transit riders as to how long they will have to wait before a bus arrives. Due to the uncertainty of when the bus will arrive, the "perceived" travel time in the reverse-peak direction may be longer than the actual average travel time. National research shows that this unpredictability can cause some transit riders, particularly those who have other transportation options available, to shift to HOV or SOV use.

Sound Transit Route 550 was selected to illustrate the transit reliability issues within the I-90 corridor. This route provides express transit service between Bellevue and Seattle and travels through Mercer Island via I-90. Route 550 provides reliable service in the peak direction during the AM and PM peak periods. In the reverse-peak direction, buses often start on time but travel progressively further behind schedule as the trips continue across I-90. During the PM peak period, only 35 to 40 percent of the westbound trips from Bellevue (buses traveling in the reverse-peak direction) are on schedule by the time the buses reach the Rainier Avenue S Transit Station. The rest of the trips range from 2 to 14 minutes late, some even as much as 20 minutes late. Most of this delay is directly related to I-90 traffic conditions. Officially, King County Metro considers any buses that are five or more minutes behind schedule to be 'late'.

Deadheading buses (i.e., buses not in revenue service) are affected by the lack of travel time reliability. Most of these buses are traveling in the reverse-peak direction and experience the same delays incurred by revenue buses.

During the PM peak period, some of the delays for westbound reverse-peak buses are due to congested traffic conditions caused by special events, such as Mariners and Sonics games. During the study period, approximately one-third of the days with poor transit reliability occurred on special event days.

Transit Ridership

Peak period, off-peak period, and daily ridership counts for transit are provided in Table 3.1-1.

Table 3.1-1
Existing Transit Ridership on I-90 Floating Bridges

Route	Eastbound				Westbound			
	AM Peak	PM Peak	Off Peak	Daily	AM Peak	PM Peak	Off Peak	Daily
111*		243	25	268	326			326
114*		124		124	150			150
202	19	53	7	79	93			93
205		33	6	39	39		13	52
210		84		84	99			99
212*		256	58	314	355			355
214*		473	23	496	538		28	566
217*	102			102	0	49	13	62
225*		110		110	100			100
229*		172		172	136			136
550	389	948	1143	2480	912	482	1022	2416
554	103	115	345	563	151	124	322	597
942		61	6	67	95			95
983	19			19			27	27
989		19		19	26			26
TOTAL	632	2691	1613	4936	3020	655	1425	5100

* Express bus – makes no stops on Mercer Island

Note: Serve changes that have occurred during 2002-2003 include the elimination of Route 983 and addition of Route 216.

Source: King County Metro Fall 2001 Passenger Counts for riders on Mercer Island floating bridges

During the two AM and PM peak periods, a total of approximately 7,000 people ride transit on a daily basis across the I-90 floating bridges. This is about 70 percent of the total daily transit ridership across the bridges. Approximately 5,700 riders are traveling in the peak direction (westbound in the AM and eastbound in the PM). During the AM peak period, 80 percent of the riders are traveling westbound and 20 percent traveling eastbound. During the PM peak period, approximately 75 percent of the riders are traveling eastbound and 25 percent are traveling westbound.

About 56 percent of the AM peak period trips are on buses that do not stop on Mercer Island. Similarly, in the PM peak period 54 percent of the trips are on buses that so not stop on Mercer Island.

HOV Usage

Current counts (year 2000) of carpools and vanpools are available for the center roadway in the peak direction of travel only. Approximately 2,500 to 3,000 HOVs (2+ occupants per vehicle) use the center roadway during each of the 3-hour AM (westbound) and PM (eastbound) peak periods. These totals include approximately 500 Mercer Island HOVs that access the center roadway along with single occupant vehicles at selected island I-90 ramps. Almost 45 percent of the peak period HOV's travel is during the highest AM and PM peak hours.

HOV counts are not available for the reverse-peak direction. However, estimates of average vehicle occupancies along I-90 indicate that the number of HOVs using the outer roadway eastbound in the AM and westbound in the PM is comparable to the number of HOVs using the center roadway in the peak direction of travel, even though HOV priority lanes do not exist in the outer roadway.

Park-and-Ride Facility Usage

There are four park-and-ride lots in the I-90 corridor, at Mercer Island, South Bellevue, Eastgate, and Issaquah. The total capacity for the four lots is currently at 1,902 spaces. March 2002 week-day utilization was 1,952, or 102 percent. Permanent park-and-ride lots along the I-90 corridor were examined for current utilization rates compared to the number of available marked parking stalls:

- South Bellevue Park-and-Ride: 524 stalls; 563 utilization or 107 percent
- Eastgate Park-and-Ride: 724 stalls; 698 utilization or 96 percent
- Issaquah Park-and-Ride: 397 stalls; 425 utilization or 108 percent
- Mercer Island Park-and-Ride: 257 stalls; 266 utilization or 104 percent.

Demand exceeds the capacity of three of the four study area park-and-ride lots in the study area, resulting in cars parked in aisles and other areas. On Mercer Island, to control over-flow parking, the City has instituted a neighborhood parking permit program and time restrictions on surface street parking in the vicinity of the park-and-ride lot.

3.1.1.2 Future Conditions – 2005, 2025

Alternative R-1 was examined for the Year of Opening (2005) and the Year of Design (2025).

Transit Frequency

With Alternative R-1, small increases in transit service are expected between 2000 and 2005, with service increasing steadily to 2025. By 2025 during the AM peak hour, there would be 47 westbound and 14 eastbound buses per hour crossing Mercer Island on I-90 as compared to 34 westbound buses and 9 eastbound buses operating in 2001. The PM peak hour and period are exactly opposite of the AM transit with 14 westbound and 47 eastbound buses per hour. Figure 3.1-1 shows the transit frequency for 2001, 2005, and 2025. With an increase in transit service, the number of deadheading buses are assumed to also grow.

Transit/HOV Travel Times

2005

In 2005, a typical peak direction trip on the HOV express lanes between Rainier Avenue S and Bellevue Way SE is estimated to take 6 minutes (with no stop on Mercer Island), a minute longer than the current 5 minute trip. The reverse-peak direction would take between 8 and 10 minutes, similar to the current 8 to 9 minute trips.

2025

By 2025, the peak direction transit and HOV travel times for the Bellevue Way SE to Rainier Avenue S section would not change much from the 2005 conditions. This analysis assumes that transit would continue to be given priority treatment for access to and from the center lanes and that the HOV priority rule would be changed to HOV 3+ (3 or more occupants per vehicle). During the PM peak period, travel times for transit and HOV in the reverse-peak direction would increase to over 12 minutes. Travel times for transit and HOV in the reverse-peak direction during the AM peak period would be similar to 2005 time estimates of 8 to 10 minutes.

Transit Reliability

The variable traffic conditions in the I-90 corridor are the major contributing factor to poor transit reliability. This existing variability is partially reflected in the 3 to 6 minute difference in travel times between the peak direction and the reverse-peak direction for Alternative R-1. During the next 20 years, it is likely that the poor levels of transit reliability that currently exist in the I-90 corridor would persist for extended periods of time during the peak periods. Worsening of arterial street and ramp congestion would also contribute delays to transit and further worsen transit reliability within the I-90 corridor. The duration of congestion is expected to increase by over an hour during the AM and PM peak periods by 2025. The effects of transit blockages due to roadway incidents would remain similar to existing conditions.

Transit Ridership

2005

By 2005, transit ridership across the floating bridges is forecasted to increase to 11,000 persons, an 11 percent increase from 2001 levels. Demand will increase by 9 percent in the peak travel direction while the reverse-peak direction ridership will increase by approximately 30 percent.

2025

Daily transit demand across the floating bridges is forecasted to be 21,000 riders, a 110 percent increase from 2001 to 2025. Ridership during the peak period would comprise around 70 percent of the daily ridership. The predominant ridership would remain in the peak direction of travel (i.e., westbound AM; eastbound PM) with growth increasing by almost 90 percent. The growth in reverse-peak direction ridership is forecasted to be 190 to 200 percent, reflecting the growth of the employment base on the Eastside. Most of this ridership will be due to increases in transit service and demographic changes.

HOV Usage

2005

HOV 2+ usage is forecasted to increase steadily from 2000 to 2005. By 2005, between 3,000 and 4,000 HOVs per 3-hour peak period, as compared to Year 2000 levels of 2,500 to 3,000, are expected to travel in each direction along I-90. The reverse-peak direction HOV demand is expected to be similar to the peak direction demand, despite the absence of an HOV priority lane for much of the I-90 corridor within the study area.

2025

By 2025, it is assumed that the Washington Department of Transportation (WSDOT) will change the HOV definition from HOV 2+ to HOV 3+. Under this rule, the peak period HOV use would be greater in the peak direction as compared to the reverse-peak direction. This is because the ability to use the HOV priority lanes in the less-congested center roadway would provide a greater incentive for forming three-person carpools and multiple-person vanpools. For the reverse-peak direction, the HOV traffic would use the same outer roadway lanes as the general-purpose traffic so there would be less incentive to carpool. In the AM peak period, it is estimated that the HOV use of the center roadway would be approximately 50 percent higher than the reverse-peak HOV use of the outer roadway. In the PM peak period, the peak direction HOV demand would be more than twice as high as the reverse-peak direction HOV demand.

Park-and-Ride Usage

The park-and-ride capacity in the I-90 corridor is expected to almost double by 2005 and could increase up to approximately 4,500 spaces by 2025 as compared to current capacity of 1,902 spaces. By 2005, 976 spaces will be added to Eastgate and a park-and-ride with approximately 1,000 spaces will open at Issaquah Highlands. An additional 193 spaces are planned for Mercer Island. By 2025, the projected capacity at each location would be: South Bellevue, 524 spaces; Mercer Island, 450 spaces; Eastgate, 1,700 spaces; Issaquah, 800 spaces; Issaquah Highlands, 1,000 spaces; totaling approximately 4,500 spaces.

3.1.2 Impacts

The performance of transit and HOVs with each Build Alternative was measured using travel times, transit reliability, transit and HOV volumes and ridership. The following sections summarize the findings from the evaluation and compare the Build Alternatives with the R-1 Alternative (the No Build conditions).

3.1.2.1 Transit/HOV Construction Impacts

During the construction of modifications to I-90 between Seattle and Bellevue there would be impacts to transit operations caused by lane closures and incident-caused delays. The potential impacts that are identified below are based on possible representative staging plans that would provide contractors reasonable access to construction areas. The actual construction staging would be determined during the preliminary engineering and final design phases of the project that would occur after selection of a preferred alternative. Extremely limiting restrictions placed on access could result in increases to the cost of the project.

Within this section, several terms are used to describe the duration of construction activities, and accompanying traffic impacts. Off-peak refers to mid-day or nighttime time periods that would avoid affecting AM and PM peak travel periods. Short-duration refers to an activity with duration of less than two weeks, while long-duration refers to an activity with duration in excess of two weeks. These definitions are only approximations; the actual duration of activities will be determined in more detail as the project progresses into final engineering and construction.

Alternative R-2B Modified

Most construction activity associated with Alternative R-2B Modified would occur in the I-90 center roadway. The I-90 center roadway would likely be operated in a one-lane reversible operation for much of the construction period for this alternative. Hours of operation would be similar to existing reversible operations, with westbound operation of the center roadway during the AM hours, and eastbound operation of the center roadway at all other times.

During construction, transit buses would likely have unrestricted access to the D2 Roadway, between 5th Avenue in Seattle and the Rainier Avenue S Transit Station. Transit buses would use the mainline slip ramps at Rainier Avenue S to move between the I-90 outer roadways and the in-line station. Between the Rainier Avenue S Transit Station and the Mercer Island Central Business District (CBD) (Island Crest Way), transit buses and eligible carpools would likely have access to the center roadway except for short-duration, off-peak period closures. East of Island Crest Way, the center roadway would likely be closed except during the AM and PM peak periods. During these periods, a single reversible lane on the center roadway would be provided for transit and HOV use between Island Crest Way and Bellevue Way SE. At all other times, transit buses and other HOV traffic would be on the I-90 outer roadways in mixed-traffic flow. Hours of construction would likely be specified to minimize delay to transit operations. By routing buses through the Island Crest Way ramps rather than the 80th Avenue SE center roadway ramp, there would be some increased travel time during mid-day or other periods when the center roadway was closed.

Alternative R-5 Restripe

Construction work associated with Alternative R-5 Restripe would likely be accomplished during off-peak periods with temporary lane and shoulder closures on the I-90 outer roadways. The center lanes would continue to operate as they do today. As such, it would have a minimal impact on transit and HOV operations in the corridor.

Alternative R-5 Modified

Most construction activity associated with Alternative R-5 Modified would occur in the I-90 outer roadways. The center roadway would continue to operate in a reversible mode and would remain open to transit and other eligible HOV traffic for its full length. Some changes to hours of operation could be expected during the construction period to accommodate outer roadway traffic that would likely be detoured to the center lanes. It is likely that all outer roadway travel lanes would remain open during peak periods. With likely shoulder width reductions on the outer roadway, incidents could result in longer delays than currently occur for transit buses and other HOV traffic operating in the outer roadways in the reverse-peak direction.

Alternative R-8A – *Preferred Alternative*

Most construction activity associated with Alternative R-8A would occur in the I-90 outer roadways, and construction impacts to transit and HOV would be similar to impacts caused by Alternative R-5 Modified. The center roadway would continue to operate in a reversible mode and would remain open to transit and other eligible HOV traffic for its full length. Some off-peak, short-duration closures could be required during reconstruction of the median barrier on the HMH floating bridge. Some changes to hours of operation on the center roadway could also be expected during the construction period to accommodate outer roadway traffic that is detoured to the center lanes. It is likely that all outer roadway travel lanes would remain open during peak periods, but with likely shoulder width reductions. Incidents could result in longer delays than currently occur for transit buses and other HOV traffic operating in the outer roadways in the reverse-peak direction.

3.1.2.2 Operation

The operational changes for transit and HOVs for each Build Alternative as compared with Alternative R-1 were measured by considering: 1) the time for point-to-point travel; 2) transit reliability in meeting published schedules for reverse-peak direction transit; 3) transit ridership; 4) HOV usage; and 5) park-and-ride usage. The hours of transit operation (span of service) and the transit frequency were assumed to be the same for each alternative. A summary and comparison of alternatives is provided at the end of this section.

Transit/HOV – Point-to-Point Travel Time

With any alternative, transit buses in the I-90 corridor would continue to use the existing D2 Roadway between downtown Seattle and the Rainier Avenue S Transit Station. This roadway would be open to transit buses operating in both directions of travel, and to eligible carpools and vanpools, allowing these high-occupancy modes to bypass congestion associated with intersections at the I-90 termini and with the I-90/I-5 interchange. Similarly, transit buses and eligible carpools and vanpools with destinations east of Bellevue Way SE would have use of the existing I-90 outer roadway HOV lanes east of the slip ramps located at the west end of the East Channel bridge.

The Build Alternatives would differ in terms of transit and HOV treatments provided on I-90 between the Rainier Avenue S Transit Station and the East Channel bridge, as described in Chapter 2. One measure of the effectiveness of these treatments is the travel time between the Rainier Avenue S Transit Station (milepost 3.3) and the East Channel bridge (milepost 8.7), a total distance of 5.4 miles. Table 3.1-2 compares point-to-point travel times between these points for each of the I-90 alternatives. Transit buses stopping on Mercer Island would add 4 to 6 minutes of travel time to the through or "express" times shown in Table 3.1-2.

Alternative R-2B Modified

Reverse-peak direction (eastbound AM and westbound PM) transit and HOV travel times would improve with provisions for a single center roadway lane dedicated to this purpose. Transit buses and other high-occupancy vehicles would realize travel time improvements of about 1 minute in 2005 conditions and 2 to 5 minutes in 2025 conditions, with the higher values of travel time savings occurring for westbound transit and HOV traffic during the PM peak period.

Peak direction (eastbound PM and westbound AM) transit and HOV travel times would increase with Alternative R-2B Modified, by about 1.5 to 2.5 minutes, in comparison to Alternative R-1. These increases in travel time would occur because of the reduction in peak-direction center roadway capacity from 2 lanes to 1 lane. This change in roadway capacity would result in lower operating speeds, due in part to a reduced-width roadway envelope that would tend to suppress average travel speeds, a lack of passing opportunities with a single lane, and congestion in the vicinity of transit/HOV ramp merge points on Mercer Island. The latter would primarily be a factor in year 2005 conditions, when the center roadway would be open to HOV 2+ person carpools, which would result in higher traffic demand volumes than year 2025 conditions, when the center roadway would be expected to be limited to HOV 3+ carpools.

Table 3.1-2
Point to Point Travel Time
Rainier Avenue S Transit Station to East Channel Bridge
All Alternatives, Years 2005 and 2025

Roadway	Travel Time in Minutes[1]				
	R-1	R-2B	R-5R	R-5M	R-8A
Year 2005					
AM Peak Hour					
Reverse-Peak Direction					
Eastbound Outer GP Lanes	9.1	8.1	9.1	9.1	7.0
Eastbound Transit /HOV[2]	9.1	8.1	9.1	9.1	6.4
Peak Direction					
Westbound Outer GP Lanes	8.5	8.4	8.5	8.5	7.0
Westbound Outer HOV Lane	–	–	–	–	6.7
Westbound Center (Transit/HOV)	5.9	8.4	5.9	5.9	5.8
PM Peak Hour					
Peak Direction					
Eastbound Outer GP Lanes	9.1	9.5	9.1	9.1	6.9
Eastbound Outer HOV Lane	–	–	–	–	6.7
Eastbound Center (Transit/HOV)	5.9	8.6	5.9	5.9	5.8
Reverse-Peak Direction					
Westbound Outer GP Lanes	9.3	8.3	9.3	9.3	7.0
Westbound Transit /HOV[2]	9.3	8.1	9.2	8.5	6.5
Year 2025					
AM Peak Hour					
Reverse-Peak Direction					
Eastbound Outer GP Lanes	9.3	9.4	9.3	9.3	7.6
Eastbound Transit /HOV[2]	9.3	7.1	9.4	9.4	6.5
Peak Direction					
Westbound Outer GP Lanes	11.5	12.9	11.5	11.5	7.2
Westbound Outer HOV Lane	–	–	–	–	7.0
Westbound Center (Transit/HOV)	5.8	7.3	5.8	5.8	6.0
PM Peak Hour					
Peak Direction					
Eastbound Outer GP Lanes	9.5	9.5	9.5	9.5	6.9
Eastbound Outer HOV Lane	–	–	–	–	6.7
Eastbound Center (Transit/HOV)	5.8	7.9	5.8	5.8	5.9
Reverse-Peak Direction					
Westbound Outer GP Lanes	12.4	9.3	12.4	12.4	10.5
Westbound Transit/HOV[2]	12.4	7.4	9.9	9.5	7.2

Note: Travel times for buses stopping on Mercer Island would add 4 to 6 minutes to transit times.
[1] East Channel bridge to Rainier Avenue S Transit Station during peak-hour
[2] R-1 outer roadway, R-2B center roadway, R-5R & R-5M transit shoulder, R-8A HOV lane
Source: HNTB 2002

Travel times in 2005 would also be affected by changes in arterial traffic flows and intersection delays. Peak direction conditions would not change compared with Alternative R-1. Reverse-peak direction travel would show a net decrease in delay for transit and HOV operations. Intersection delays would increase slightly. Arterial traffic flows and intersection delays in 2025 would have minimal affect on transit/HOV travel times.

Alternatives R-5 Restripe and R-5 Modified

Both Alternatives R-5 Restripe and R-5 Modified would provide transit-only shoulders in the reverse-peak directions of travel, as described in Chapter 2. In the eastbound direction, both alternatives would allow transit buses to use the outside (right-hand side) shoulder. In the westbound direction, transit buses would use the outside (right-hand side) shoulder with Alternative R-5 Restripe, and the inside (left-hand side) shoulder with Alternative R-5 Modified. Transit buses would only use the transit shoulder when average travel speeds in the general-purpose lanes dropped below 35-45 mph, with the speed value dependent on roadway geometrics in each corridor section.

During the AM peak period, eastbound transit buses utilizing the transit shoulders would experience little or no improvement in transit travel times in either year 2005 or year 2025 traffic conditions. The travel time advantage of the transit shoulder relative to the adjacent general-purpose lanes would be offset by the time buses would need for weaving maneuvers from the inside travel lane at the Rainier Avenue S Transit Station to the outside transit shoulder on the LVM floating bridge. Similarly, at the east end of the corridor, buses destined for points on I-90 east of Bellevue Way SE would have to weave from the outside transit shoulder to the inside HOV lane at the East Channel bridge.

During the PM peak period, westbound transit buses operating on the Alternative R-5 transit shoulders would experience an improvement in transit travel times compared to Alternative R-1, for both year 2005 and year 2025 traffic conditions. These travel time savings would be less than 1 minute in 2005, and between 2.5 and 3 minutes in 2025. The transit travel time improvement with Alternative R-5 Modified would be greater than that provided by Alternative R-5 Restripe, because the transit shoulder would be located on the inside (left-hand side) of the westbound outer roadway. With this configuration, weaving would be eliminated for through-buses on I-90 between the East Channel bridge and the Rainier Avenue S Transit Station. With Alternative R-5 Modified, westbound buses stopping on Mercer Island would be provided with a direct access exit ramp at 80th Avenue, eliminating a potential weaving maneuver, but would have to weave back across the general purpose lanes to the inside shoulder after re-entering I-90 via the 76th Avenue entrance ramp. With Alternative R-5 Restripe, buses stopping on Mercer Island would use the existing Island Crest Way and 76th Avenue ramps, accessible from the outside shoulder without weaving.

In the peak direction of travel, transit buses and other eligible HOVs would continue to use the I-90 center roadway between Rainier Avenue S and the East Channel bridge. Travel times for transit buses and HOVs would be the same as with Alternative R-1.

Surface street conditions would not change for either R-5 Alternative in comparison to Alternative R-1, and would not affect transit or HOV travel times in either 2005 or 2025.

Alternative R-8A – Preferred Alternative

HOV lanes would be provided in both directions on I-90's outer roadways, as described in Chapter 2. The center roadway would continue to operate in a reversible mode, westbound in the AM peak periods and eastbound in the PM peak period.

In the reverse-peak direction of travel, transit and HOV traffic on the outer roadway HOV lanes would experience travel time savings in the range of 2.5 to 3 minutes during the AM and PM peak periods with year 2005 traffic conditions. With year 2025 traffic conditions, travel time savings would be similar in magnitude during the AM peak period, but would improve to a savings of approximately 5 minutes during the PM peak period.

In the peak direction of travel, transit and HOV traffic in the center roadway would experience travel times similar to those that would occur with Alternative R-1 with both year 2005 and year 2025 traffic conditions. In 2025, however, center roadway travel times would increase slightly, by about 0.2 minutes, in comparison to Alternative R-1. This increase would be attributable to higher traffic volumes in the center roadway with HOV 2+ eligibility anticipated in the year 2025 with Alternative R-8A. In contrast, by the year 2025 it is anticipated that the eligibility requirement for HOV use of the center roadway for Alternative R-1 would be changed to 3+.

HOV travel times in the outer roadway HOV lanes would be approximately 2.5 to 4.5 minutes shorter than the adjacent general purpose lanes with year 2025 traffic conditions. As noted above, Alternative R-8A is the only Build Alternative that would provide preferential treatment for HOV 2+ person carpools, either with access to the center roadway or an outer roadway HOV lane, with year 2025 traffic conditions.

Travel times would be minimally affected by changes in arterial traffic flows and intersection delays in 2005. In 2025, travel times would be minimally affected in the AM peak period. During the PM peak period, travel times in the reverse-peak direction would show an increase of less than 1 minute due to intersection delay at selected Seattle intersections (e.g., Airport Way/5th Ave/I-90 Express ramps; Airport Way/4th Ave; Jackson/2nd Ave Ext). Surface streets on Mercer Island or Bellevue Way SE would have minimal impact on travel times.

Transit Reliability

Alternative R-2B Modified

In Alternative R-2B Modified, transit reliability measured in terms of on-time arrivals would be improved in the reverse-peak direction. Transit reliability would be highly dependent upon the volumes using the center roadway and the effects of incidents. The results show that reliability would be maintained in 2005 with an HOV 3+ priority rule, while an HOV 2+ definition could result in unstable travel times. An HOV 3+ definition would be required in 2025 to maintain transit reliability.

Alternative R-2B Modified would create a higher likelihood of incident blockages in the center roadway due to reduced width. A blockage could be expected about every week or two. The effects on overall transit reliability would be relatively small.

For Sound Transit Route 550, using the travel time savings for Alternative R-2B Modified and improved reliability, it may be possible to save 1 round-trip coach trip (out of a total of 24 round trips per day) in 2025 during the AM and PM peak periods. The two-way transit/HOV lanes would facilitate the conversion of some one-way 'deadheading' buses into two-way bus service. This would allow a better balance between the number of eastbound and westbound bus trips with a minimal increase in transit service hours.

Alternatives R-5 Restripe and R-5 Modified

Both R-5 Alternatives would improve on-time transit reliability in the reverse-peak direction, whereas peak direction reliability would be the same as in the Alternative R-1 condition. The greatest benefit to transit would be the ability to maintain at least a 45 mph speed during recurring and nonrecurring congestion in the reverse-peak direction of travel.

These improvements in transit reliability for Alternative R-5 Restripe would be partially offset in the PM peak period by decreases in the reliability of the westbound outer roadway due to the loss of the outside (right-hand side) shoulder for use in clearing incidents. One blockage could occur every other day. The frequency of roadway blockages would be most pronounced in Alternative R-5 Modified. These incidents are expected to mostly block the outside lane, while buses (PM peak period) would operate in the inside (left-hand side) shoulder.

For Sound Transit Route 550, the round trip time savings and reliability by 2025 could allow Sound Transit to save up to 1 round-trip coach trip (out of a total of 24 round trips per day) during the AM and PM peak periods.

The addition of the shoulder transit lanes would facilitate the conversion of some one-way 'deadheading' buses into two-way bus service. This would allow a better balance between the number of eastbound and westbound bus trips with a minimal increase in transit service hours.

Alternative R-8A – Preferred Alternative

Alternative R-8A would improve transit reliability in the reverse-peak direction, while peak direction reliability would be similar to the Alternative R-1 condition. The added HOV lane and ramps would provide for consistent travel times across the corridor in both directions. Incident frequency in the center roadway (peak direction) would be similar to Alternative R-1 conditions. In the outer roadway, the frequency of incidents would double, compared with Alternative R-1. In the reverse-peak direction, a blocking incident would occur about every other day. These factors could affect the reliability of travel in the outer HOV lane; however, most incidents would not block the HOV lanes. Alternative R-8A could result in round-trip travel time savings similar to Alternatives R-2B Modified and R-5. In the PM peak period in 2025, Alternative R-8A would achieve the highest travel time and reliability benefits, as compared to the other Build Alternatives.

The addition of the HOV lanes in both directions on I-90 would facilitate the conversion of some one-way 'deadheading' buses into two-way bus service. This would allow a better balance between the number of eastbound and westbound bus trips with a minimal increase in transit service hours.

Transit Ridership

Table 3.1-3 shows transit ridership results for 2005 and 2025.

Table 3.1-3
Transit Ridership Comparison with R-1
Alternative R-1, R-2B, R-5,[1] R-8A, Year 2005 and 2025

Roadway	R-1	Alternative / % change from R-1					
		R-2B	Percent Change	R-5[1]	Percent Change	R-8A	Percent Change
2005							
AM Peak Period							
Eastbound	800	930		870		860	
Westbound	3290	3450		3450		3450	
AM PEAK TOTAL	4090	4380	7.1%	4320	5.6%	4310	5.4%
PM Peak Period							
Eastbound	2930	3070		3070		3070	
Westbound	860	1000		940		930	
PM TOTAL	3790	4070	7.4%	4010	5.8%	4000	5.5%
Off-Peak							
Eastbound	1760	1950		1770		1770	
Westbound	1520	1520		1540		1530	
OFF PEAK TOTAL	3280	3470	5.8%	3310	1.1%	3300	0.6%
Daily							
Eastbound	5480	5940		5710		5700	
Westbound	5670	5970		5930		5910	
DAILY TOTAL	11150	11910	6.8%	11640	4.4%	11610	4.1%
2025							
AM Peak Period							
Eastbound	1830	2010		1880		1910	
Westbound	5710	5750		5740		5750	
AM TOTAL	7540	7760	2.9%	7620	1.1%	7660	1.6%
PM Peak Period							
Eastbound	5080	5110		5110		5120	
Westbound	1980	2170		2030		2060	
PM TOTAL	7060	7280	3.1%	7140	1.1%	7180	1.7%
Off-Peak							
Eastbound	3810	3870		3820		3990	
Westbound	2850	2900		2850		2950	
OFF PEAK TOTAL	6660	6770	1.7%	6670	0.2%	6940	4.2%
Daily							
Eastbound	10730	11000		10810		11010	
Westbound	10540	10820		10620		10760	
DAILY TOTAL	21270	21820	2.6%	21430	0.8%	21770	2.4%

[1] Alternatives R-5 Restripe and R-5 Modified

Source: Mirai Associates 2002

Alternative R-2B Modified

With Alternative R-2B Modified, daily ridership would increase by approximately 3 percent (500-600 daily riders) compared with Alternative R-1. These increases would be most pronounced during the AM and PM peak periods. The reverse-commute direction during the peak periods would show the highest ridership gains of around 10 percent.

Alternatives R-5 Restripe and R-5 Modified

Transit ridership forecasts for both R-5 Alternatives show approximately a 6 percent increase in peak period ridership in 2005, and approximately a 1 percent increase in 2025, compared with Alternative R-1. Off-peak hour ridership shows minimal changes. Increases are most evident in the reverse-peak direction where the travel time benefits occur.

Alternative R-8A – Preferred Alternative

Transit ridership forecasts (2005, 2025) for Alternative R-8A are shown in Table 3.1-3. Results show daily ridership increases of approximately 4 percent compared with Alternative R-1. During the peak period, peak direction ridership would increase at a lower percentage than the reverse-peak direction ridership. This is because the reverse-peak direction would achieve the greatest travel time savings. Off-peak ridership gains are also forecasted, based upon travel time savings occurring outside of usual commute periods. In 2025, the transit ridership would increase slightly if an HOV 3+ rule were assumed.

The transit forecasts for each of the Build Alternatives do not explicitly account for reliability factors, which could affect the transit ridership. Using the transit reliability research findings summarized previously, improvements such as those provided by Alternatives R-2B Modified, R-5, and R-8A could result in reverse-peak ridership increases of 5 to 10 percent compared to Alternative R-1.

HOV Usage

Table 3.1-4 shows HOV forecast results for 2005 and 2025.

Alternative R-2B Modified

With Alternative R-2B Modified, total HOV demand in the peak direction of travel would be similar to Alternative R-1. In the reverse-peak direction, HOVs would be able to use the center roadway, resulting in a diversion of traffic demand away from the outer roadway. The travel time savings for reverse-peak HOVs would not be high enough to cause a large mode shift into carpools or vanpools.

Alternatives R-5 Restripe and R-5 Modified

Both R-5 Alternatives would create a peak period transit-only lane. As such, there would be no additional HOV incentives compared with Alternative R-1. Accordingly, total HOV demand is expected to be comparable with Alternative R-1.

Alternative R-8A – Preferred Alternative

With Alternative R-8A, total HOV demand in the peak direction of travel would be similar to Alternative R-1, as shown in Table 3.1-4. In the reverse-peak direction, HOVs would have a new HOV lane in the outer roadway. In 2005, the travel time savings for reverse-peak HOVs would not be high enough to cause a mode shift into carpools or vanpools.

In 2025, R-8A is assumed to operate as an HOV 2+ facility. In this event, the HOV volumes would be substantially higher than the 2025 Alternative R-1, which assumes that a regional HOV 3+ rule would be in effect. For comparison purposes, Table 3.1-4 shows the estimated HOV forecasts for all alternatives using an HOV 3+ rule in 2025. Under this scenario, it can be seen that the reverse-peak HOV demand (eastbound outer lane) is forecasted to stay virtually the same as Alternative R-1 in the AM peak period. Of note is the potential increase in peak direction HOVs in the AM peak period (westbound center and outer lanes), due to the added HOV lane and improved travel time reliability for HOVs. During the PM peak period, the reverse-peak HOV demand (westbound outer lanes) would increase in response to the travel time savings.

Table 3.1-4
HOV Volume Comparisons (Percent change from R-1)
Alternative R-1, R-2B, R-5,[1] R-8A, Year 2005 and 2025

Roadway	Alternative and the percent change from R-1						
	R-1	R-2B	Percent change	R-5[1] is same as R-1	Percent change	R-8A	Percent change
2005	HOV 2+	HOV 2+		HOV 2+		HOV 2+	
AM Peak Period							
Eastbound Outer	3825	1330		3825		3825	
Eastbound Center	-	2500		-		-	
Eastbound Total	3825	3830	0%	3825	0%	3825	0%
Westbound Center	2940	2990		2940		2560	
Westbound Outer	900	885		900		1345	
Westbound Total	3840	3875	0%	3840	0%	3905	+2%
PM Peak Period							
Eastbound Outer	515	965		515		1115	
Eastbound Center	3100	2655		3100		2500	
Eastbound Total	3615	3620	0%	3615	0%	3615	0%
Westbound Center	-	2305		-		-	
Westbound Outer	2850	590		2850		2900	
Westbound Total	2850	2895	+2%	2850	0%	2900	+2%
2025	HOV 3+	HOV 3+		HOV 3+		HOV 3+	
AM Peak Period							
Eastbound Outer	1200	145		1200		1225	
Eastbound Center	-	1060		-		-	
Eastbound Total	1200	1205	0%	1200	0%	1225	0%
Westbound Center	1435	1585		1435		1540	
Westbound Outer	285	175		285		355	
Westbound Total	1720	1760	+2%	1720	0%	1895	+10%
PM Peak Period							
Eastbound Outer	700	550		700		875	
Eastbound Center	2265	2320		2265		2145	
Eastbound Total	2965	2870	-3%	2965	0%	3020	+2%
Westbound Center	-	1240		-		-	
Westbound Outer	1325	125		1325		1435	
Westbound Total	1325	1365	+3%	1325	0%	1435	+8%

[1] Alternatives R-5 Restripe and R-5 Modified
Source: Mirai Associates 2002

Park-and-Ride Facility Usage

Park-and-ride demand in the I-90 corridor with Alternative R-2B Modified would show minimal change compared with Alternative R-1. Facility capacity would remain consistent with demand within the corridor. These results indicate that much of the ridership increases with Alternative R-2B Modified would occur from walk-access or kiss-and-ride access trips. Shifts in demands to other park-and-ride facilities outside of the I-90 corridor may also occur.

Park-and-ride demand in the I-90 corridor with either R-5 Alternative would show minimal change compared with Alternative R-1. Facility capacity would remain consistent with demand within the corridor.

Park-and-ride demand in the I-90 corridor with Alternative R-8A would show similar demand to Alternative R-1 in 2005. In 2025, the park-and-ride demand for Alternative R-8A with an HOV 2+ rule would be slightly less (less than 5 percent) than Alternative R-1. This result occurs due to various shifts in transit and HOV demand within the I-90 corridor. While transit demand would increase, there would be somewhat lower park-and-ride requirements for an HOV 2+ versus a 3+ policy. Should an HOV 3+ requirement be instituted, the park-and-ride demand would be expected to increase to a level slightly higher than the Alternative R-1 conditions. The overall park-and-ride facility capacity would still remain consistent with demand in the corridor.

TDM/TSM Sensitivity Test

Sensitivity tests were performed to determine the potential effectiveness of investing in Transportation Demand Management/Transportation System Management (TDM/TSM) investments in the I-90 corridor. Implementation of such investments would require commitments by a variety of agencies, including Sound Transit, King County Metro, WSDOT and local jurisdictions.

The tests examined Alternative R-2B, which would provide two-way operation of the center roadway. Three tests were performed, as described in Table 3.1-5. For Tests 1 and 2, a TDM/TSM investment of $30 million (Year 2000 dollars) was considered, in addition to the investment cost of Alternative R-2B. At the time of the analysis, the $30 million was estimated to be approximately the difference in estimated cost between Alternative R-2B and Alternative R-8A. Subsequent cost estimates indicated that the difference in cost between the two alternatives would be closer to $70 million. Therefore, Test 3 was included to show the effects of a higher TDM/TSM investment in the I-90 corridor. Each of the tests featured investments that would increase transit service, expand park-and-ride lots along I-90, and provide system management to improve transit speed and reliability. Horizon years 2005 and 2025 were used for the analysis.

Table 3.1-5
TDM/TSM Sensitivity Test Descriptions

Component	Level of Investment ($Million- 2002 Dollars)		
	Test 1 – Transit Service	Test 2 – Transit Service plus TSM	Test 3- Expanded Transit Service plus TSM and TDM
Transit Service Expansion	$20	$20	$24
Park-and-Ride Expansion	$8	$8	$14
Transportation System Management	$0	$2	$2
Transportation Demand Management	Assumed part of Ongoing Regional Programs		$30
TOTAL Investment	**$28**	**$30**	**$70**

Source: Mirai Associates 2002

Transit Service

- In Tests 1 and 2, approximately $20 Million would be used to increase transit service over the next 20 years. On average, $1.0 to 1.2 Million annually could be spent on the following transit routes that cross Lake Washington using the I-90 floating bridges: ST 550 Weekday Service (Bellevue-Seattle) Reduce peak period peak direction headway from 6 minutes to 4 minutes and peak period off-peak direction headway from 15 minutes to 10 minutes. Sound Transit would need to add two buses to this route.

- ST 550 Weekend Service (Bellevue-Seattle) Reduce Saturday headway from 30 minutes to 15 minutes.

- ST 554 Weekday (Issaquah-Seattle) Reduce weekday peak period headway (both directions) from 30 minutes to 15. Sound Transit would need to buy two buses.

In Test 3, approximately $24 million was allocated to transit service expansion, with an emphasis on transit serving Mercer Island residents. The following routes were affected in 2005:

- ST 554 Weekday (Issaquah-Seattle) Reduce weekday peak period headway (both directions) from 30 minutes to 15. Sound Transit would need to buy two buses.

- Mercer Island Routes 202, 203, 204. Double the frequency of service on these routes. An additional 1 to 2 buses would be required.

- Mercer Island Routes 201 and 205. Add three more trips each peak period, roughly doubling the current service. An additional 1 to 2 buses would be required.

Some of the Test 3 improvements were already assumed to occur by 2025, so the level of additional transit service was slightly reduced.

Park-and-Ride

In Tests 1 and 2, approximately $8 Million would be used to increase park-and-ride capacity as needed to meet demand in the I-90 corridor. Up to 300 spaces could be added.

In Test 3, approximately $14 Million would be used to increase the Mercer Island park-and-ride capacity to 800-900 spaces (assuming around 200 spaces would already be added to the existing park-and-ride lot by Sound Transit). An additional 200 leased park-and-ride spaces would be added along transit routes within Mercer Island.

Transportation System Management

In Tests 2 and 3, up to $2 Million would be earmarked for Transportation System Management (TSM) actions to improve transit reliability. The TSM improvements include ramp metering, installation of traffic signals, transit signal priority, and bus bypass lanes. A brief description of potential TSM components is provided below. The most effective of these treatments could be considered for implementation using the available funds.

- **I-90 (Seattle):**
  - Bus priority signalization at the I-90 ramp terminal with 5th Avenue/Dearborn Street/Airport Way (under the assumption buses would exit here with removal of tunnel access).

- **Mercer Island:**
  - Eastbound I-90 off-ramp/77th Avenue SE: Installation of a traffic signal and bus signal priority for exiting ramp buses at this signal.
  - Westbound I-90 off-ramp/Island Crest Way: Bus signal priority for signal at the exiting ramp terminus.
  - Westbound I-90 on-ramp/76th Ave SE: Construction of bus bypass lane on metered ramp. Installation of a traffic signal and bus signal priority along North Mercer Way for westbound buses approaching the intersection ramp.
  - Eastbound on-ramp/Island Crest Way: Bus signal priority for eastbound buses approaching intersection along 27th Street SE.
  - SE 80th Avenue/27th Street SE: Installation of a traffic signal and bus signal priority for southbound approach on SE 80th Avenue for buses turning left to 27th Street SE.
  - North Mercer Way/SE 80th Avenue: East-west bus signal priority.

- **Bellevue:**
  - Bellevue Way SB HOV lane from South Bellevue Park-and-Ride to I-90.

Transportation Demand Management

Test 3 included a more explicit consideration of Transportation Demand Management (TDM) strategies that could be applied within the I-90 corridor. The test consisted of a package of complementary strategies that focus on enhancing transportation investments that improve regional transit and travel by HOV on I-90 between Seattle and Bellevue.

A key item that was considered during the development of the TDM strategy was the scope and type of project that the Sound Transit Express I-90 project is - one with a project goal to improve transit and HOV travel - and which does not propose significant roadway construction capitol investments for additional highway capacity. Accordingly, the I-90 TDM Plan that was tested is different than the level of proposed TDM investments in other major corridor projects, such as SR 520 and I-405. These corridors include substantial roadway investments proposed for adding more highway capacity. In contrast, the I-90 TDM strategy was based on an appropriate level of TDM investment that addresses the project type, scope and goal, and has proportional investments in TDM that enhance the efficiency of I-90 by maintaining and increasing transit and HOV travel.

Items that were considered during the development of a package of complementary TDM strategies that best support the project goal and other transportation investments include the current and future availability of alternative mode services and facilities, route and trip characteristics (current and future congestion, major trip generators), and the current and future land use environment (housing and employment density that support transit and HOV) in the project area.

Current market research indicates that the I-90 corridor between Seattle and Bellevue is a strong transit and HOV market. The strategy focused on those TDM elements that would support maintaining, and capturing more, of the transit and HOV person-trips in the future – and would support the project's goal and other transportation investments – include increasing vanpools, increasing promotion of transit services, offering trip planning assistance and HOV incentives at employment and residential sites for forming 3+ carpools, offering incentives for CTR and non-CTR employers, increasing work options to spread peak period trips, supporting local connectivity retrofitting projects that increase access to transit/HOV, and offering additional support for special events system management.

An analysis was conducted to identify the major travel markets that could serve as focal points for TDM investments. Currently, the primary trip generators and attractors are Seattle, Bellevue and Mercer Island with most of the trips between those areas. Currently in the 3-hour AM peak period, Seattle attracts approximately 60 percent, and generates approximately 26 percent, of the vehicle trips with the trips primarily coming from or going to Bellevue and Mercer Island. Bellevue generates 23 percent and attracts 17 percent while Mercer Island generates 9 percent and attracts 6 percent. In the PM peak period, Seattle generates 44 percent and attracts 31 percent of the vehicle trips with Bellevue generating 23 percent and attracting 22 percent. Mercer Island generates 7 percent and attracts 9 percent of PM peak period vehicle trips. In 2025, the percent of vehicle trips in these three areas are forecasted to be similar to the current conditions with Seattle slightly decreasing as an AM attractor and increasing as an AM generator.

Transit and carpools currently carry 39 to 49 percent of the person-trips in the peak hour direction (westbound to Seattle in the AM and eastbound to Bellevue in the PM) with 34 westbound and 9 eastbound buses crossing Mercer Island in the AM peak (during the PM peak hour it is the opposite). By 2025, transit and carpools are expected to carry 29 to 43 percent of the person-trips in the peak hour direction with 47 westbound and 14 eastbound buses crossing Mercer Island in the AM peak hour (with the opposite in the PM peak hour). Note that by 2025, transit person-trips are forecasted to increase, while carpools will decrease under an assumed HOV 3+ rule.

Vanpooling is a major component of the TDM strategy. Currently most of the vanpools in the I-90 (and SR 520) corridor travel in the reverse-peak direction (eastbound in the AM and westbound in the PM). A vanpool market research study recently completed estimates that the current (2003) regional vanpool market potential is up to 6.6 times greater than the number of vanpools now in operation. In 2030, the potential regional vanpool market potential was determined to be over 9 times greater than what is now in operation.

These strategies focus on the TDM market in the project area and peak period trips in targeted employment and residential sites in high trip generator/attractor areas in Seattle, Bellevue and Mercer Island. The TDM strategies also support the effectiveness of the Sound Transit Express I-90 Project's other transportation investments by increasing transit ridership, travel by HOV (3+), number of new vanpoolers, number of employees and residents within new HOV programs, and access to transit and HOV facilities and services.

The TDM strategy included in Test 3 is formatted to tie into the I-405 and SR 520 TDM Plans approved within the I-405 and SR 520 Projects (but with the emphasis and level varied for the project type, scope and goal) in order to facilitate integration of the corridor TDM programs in the future. Although the plan may overlap with the other corridors' 20-year plans, the I-90 strategy was considered independently, since it is unknown at this time if the major corridor plans will be funded. Any overlap that may occur would be eliminated as part of a funding-related implementation planning process for the corridors. While Sound Transit would not be the implementing agency for many of these TDM actions, they were included for purposes of the sensitivity test.

The I-90 TDM strategy consists of a monitoring and evaluation program supported by five major elements: 1) vanpool program, 2) public information, education and promotion program, 3) employer-based & HOV programs, 4) land use as TDM, and 5) other TDM programs. The TDM program dovetails with other strategies including park and ride expansion on Mercer Island, expanded transit service to/from and within Mercer Island, and TSM enhancements to improve transit speed and reliability. Some TDM strategies, such as various pricing actions, were not specifically included as they are being evaluated at the regional level. The estimated cost for the I-90 plan is for a 20-year program, with costs shown in current 2002 dollars.

- **Vanpool Program: $7,000,000**
  - Van Acquisition Program (approximately 130 vans)
  - Marketing Program (intensive marketing)
  - Vanpool Formation and Operational Management Program (support for forming vanpools and on-going management of corridor vanpools)
  - Rideshare Parking Program (voucher program and/or leased P&R program for vanpools and carpools)

- **Public Information, Education & Promotion Program: $4,000,000**
  - Transit Service Promotion/I-90 Public Information Program
  - Personalized Trip Planning Assistance (focus on 3+ carpool formation)

- **Employer-based & HOV Programs: $9,000,000**
  - Incentives for CTR and Non-CTR employers in high employment trip destination markets
  - HOV Incentives Program (employer or direct incentives for carpools, vanpools, buses)
  - Work Options (target high employment trip destination markets and major residential origin markets)

- **Land Use: $1,500,000**
  - Local Connectivity Retrofitting Projects (reduce barriers for access to transit/HOV)

- **Other TDM Programs: $7,000,000**
  - Special Events (support for system management during special events)
  - Residential HOV Incentives Program (in targeted high trip generator areas)

- **Monitoring and Evaluation Program: $1,500,000**
  - Monitoring & Evaluation Program (address accountability of program implementation with regular monitoring and evaluation of implemented strategies and provide implementation oversight using "adaptive management" for flexibility in implementing and adjusting programs)
  - Corridor TDM Program Coordination (Coordinate and link implementation of I-90 TDM Plan with implementation of I-405 and SR 520 TDM Plans and other evolving corridor TDM Plans)

Analysis of TDM/TSM Tests

The TDM/TSM elements were analyzed in terms of two performance measures: travel time savings and ridership. For comparative purposes, Alternative R-2B was selected as being representative of the I-90 build alternatives. Travel time savings were estimated using sketch planning analysis while the PSRC ridership forecasting model was used to estimate the changes in ridership. Before the TDM/TSM enhancements were input into the model, the model was run to establish the baseline ridership for Alternative R-2B.

Estimates for the transit travel time savings of the TSM enhancements were derived from typical ranges of time savings for projects of this type. It was conservatively estimated that buses would experience travel time savings of up to 3 minutes in the peak direction and 2 minutes in the reverse peak direction during the peak periods. These time savings were input into the PSRC model in the form of reduced travel times for the affected bus routes.

For the transit portion of the tests, service increases and any applicable TSM travel time savings were input into the PSRC model to estimate the impact on ridership. For comparison purposes, Test 1 was performed first for the transit service increases only. Tests 2 and 3 examined the combined effects of transit service plus TSM improvements. Park-and-ride expansion was assumed under each of the tests. The TDM effects (included in Test 3) were estimated independent of the PSRC model using empirical data from similar applications. A summary of the results of the TDM/TSM test are shown in Table 3.1-6.

Table 3.1-6
Results of TDM/TSM Sensitivity Test

Impacts	Impacts Compared with Alternative R-2B		
	Test 1 – Transit Service	Test 2 – Transit Service plus TSM	Test 3- Expanded Transit Service plus TSM and TDM
Transit Ridership (Peak Period)			
I-90 affected bus routes	+14% (+36%)	+26% (+37%)	+100% (+88%)
I-90 total net riders	+ 3% (+11%)	+6% (+12%)	+11% (+8%)
General Traffic Volumes (Peak Period)			
I-90	Negligible Change	Negligible Change	Negligible Change
SR 520	Negligible Change	Negligible Change	Negligible Change
HOV Traffic Volumes (Peak Period)			
I-90	Negligible Change	Negligible Change	Negligible Change
SR 520	Not Studied	Not Studied	Not Studied

Note: 2005 (2025) Conditions. Park-and-ride expansion assumed in all tests. TDM effects for Test 3 considered separately.
Source: Mirai Associates, 2002

Test 1- Transit Service Increase

The Test 1 results in Table 3.1-6 show that improvements in transit service would result in a sizeable increase in transit ridership on those affected routes; however, much of that increase results from shifting of riders from other I-90 routes as well as a small shift from SR 520 routes. The net increase (both directions) in I-90 transit riders in 2005 would be around 200 persons during the peak three hours. About 2/3 of these rider increases would be in the peak direction. In 2025, the transit ridership increase would be higher, resulting in around 1300 more peak period persons. In this situation, around 60 percent of the increase was estimated to occur in the reverse-peak direction.

Traffic volumes on I-90 and SR 520 would show negligible changes as a result of these actions. Given the heavily congested conditions along both corridors, the capacity freed up by the shift to transit would be offset by heavy general purpose and HOV traffic demand that would otherwise be unmet across Lake Washington.

The addition of park-and-ride capacity would provide negligible change in transit demand for Alternative R-2B Test 1 sensitivity test.

Test 2- Transit Service Increase plus TSM Improvements

The Test 2 results reflect the incremental effects of adding the TSM improvements along I-90. Table 3.1-6 shows that the TSM travel time improvements would attract additional transit riders within the corridor. Most of this increase would be focused on ST Route 550, which would benefit the most from the improvements. Riders would divert from other corridor bus routes to the ST 550. The net increase in transit ridership would be approximately 290 persons per peak period in 2005, rising to around 1350 persons in 2025. Since the TSM improvements would benefit both directions of travel, the ridership gains were relatively equal by direction. Traffic volumes would also remain about the same on both I-90 and SR 520.

The addition of park-and-ride capacity would provide negligible change in transit demand for the Alternative R-2B Test 2 sensitivity test.

Test 3- Expanded Transit Service Increase plus TSM Improvements and TDM Strategy

The Test 3 results reflect the effects of a modified transit service expansion on Mercer Island combined with the TSM improvements along I-90 and a targeted TDM strategy. Strategies aimed specifically at Mercer Island travelers were fairly successful at shifting travelers onto transit, particularly when combined with expanding the Mercer Island park and ride lot. Non-island travelers would also use the lot expansion.

Table 3.1-6 shows that Test 3 would produce almost twice the net transit ridership growth in 2005 compared with Tests 1 and 2. The net transit growth in 2025 is less, since several of the Mercer Island transit enhancements had already been assumed to occur within the No Action alternative. The net increase in transit ridership would be approximately 600 persons per peak period in 2005, rising to around 860 persons in 2025. Around 2/3 of the ridership increase is related to two sources: (1) the expanded transit service within Mercer Island, and (2) the capacity expansion of the Mercer Island Park-and-Ride facilities. The remainder of the ridership growth is focused on the ST Route 554. Mercer Island transit ridership was found to increase by a substantial amount; however, this ridership represents a relatively small proportion of total transit ridership crossing the floating bridges. The peak direction of travel accounts for 80-90 percent of this growth.

Despite the increase in transit ridership, peak period traffic volumes were forecasted to remain about the same on both I-90 and SR 520.

In addition to the travel forecasting, an empirical analysis was conducted for the other TDM components of Test 3.

Most TDM strategies cannot be directly included within the regional forecasting model. Apart from vanpooling effects (described below), the other TDM strategies would support the transit and HOV programs envisioned as part of the sensitivity test. Therefore, the magnitude of the incremental effects of the TDM strategy on further transit ridership is difficult to quantify. It is likely that many of the Test 3 ridership results should be attributable in large part to an expanded TDM program, without which the full transit ridership gains could not be realized. Many of the identified TDM elements are extensions of already functioning TDM programs that have been successful contributors to the transit ridership evidenced today in the Puget Sound Region.

The most recent research on TDM effectiveness has been completed in the Puget Sound region under the auspices of TDM corridor implementation planning conducted by WSDOT. The study (DKS Associates, *Modeling TDM Effectiveness: Developing a TDM Effectiveness Estimation Methodology (TEEM) and Case Studies for the SR 520 Corridor*, for WSDOT, April 2003) examined a wide range of TDM strategies, several of which are similar to those considered in Test 3. As a basis for comparison, the project team examined some of the case study applications from this study, in particular downtown Bellevue and Crossroads. A direct comparison cannot be made, since there was no cost data available for the case studies; conversely, one cannot readily estimate the amount of market penetration that is possible for the estimated TDM expenditures shown in Test 3 for I-90.

It is reasonable, however, to consider the case studies to be reasonably robust applications of TDM within those areas. In this context, the downtown Bellevue study estimated a 3.2 percent reduction in PM peak period 'commute' trips at the affected sites, while Crossroads estimated a 0.9 percent reduction (Table 3-5 of TEEM report). In downtown Bellevue, about half of this benefit was achieved through expanded parking pricing at employment sites. In Crossroads, the benefits were focused on alternative mode subsidies and land use infill and densification.

As a possible parallel to the I-90 corridor, the TDM strategies presented potentially could affect around 5 percent of the commute trips at the targeted activity areas. These trips would disperse throughout the area, with a portion traveling on I-90. Commute trips also represent only a portion of the travel on the I-90 bridge. Overall, the potential reduction in peak period vehicle demand on I-90 would likely be in the 1-3 percent range. This would include the vanpool program effect, which is discussed separately below.

The potential effects of the vanpooling expansion were independently estimated from results of similar studies and the vanpool market survey conducted by WSDOT. The vanpool element of the TDM program has possibly the best potential to target the I-90 corridor directly. The 130 new vans targeted to the I-90 corridor represents a three-fold increase in the 40 vanpools currently operating within the corridor. Over 70 percent of those vans are focused on Eastside employers, i.e., originating in Seattle and traveling to Bellevue or Redmond. Given the growth patterns expected in the I-90 corridor, the markets for the new vanpools is expected to be similar. These new vans could result in a net decrease of up to 700 vehicles (both directions) during each peak period. In the peak direction of travel, this could equate to a peak hour reduction of 80-120 vehicles in the outer roadway, or about 2 percent of the total demand. Note that the center roadway would also show a slight decrease in demand as some carpool users convert to vanpoolers.

Summary of TDM/TSM Sensitivity Tests

Three TDM/TSM sensitivity tests were performed in relationship to Alternative R-2B. The purpose of the tests was to identify the degree to which traffic diverted from the center roadway under Alternative R-2B could be offset by a tailored TDM/TSM program in the I-90 corridor.

To that end, the primary focus of the TDM/TSM analysis is on the 'peak' direction of travel. Under Alternative R-2B in 2005, there would be 570-660 vehicles per hour diverted from the center roadway onto the outer roadway by converting to two-way center operations. Most of this diversion would be Mercer Island Single Occupant Vehicles (SOVs). By 2025, the diversion could approach 625-780 vehicles per hour. These diversions equate to 10-12 percent of total vehicle volume in the outer roadway during these times.

The TDM/TSM sensitivity tests had two primary findings:

(1) Transit ridership would increase on I-90 with additional TDM/TSM investment, and
(2) Traffic volumes would not change much on I-90 or SR 520.

The results showed that up to 250 persons per hour (2005) and 350 persons per hour (2025) could be attracted to transit in the peak direction using an enhanced transit service and TSM package. If one were to assume that all of these riders would switch from autos, this could equate to a traffic reduction of 200 vehicles per hour (2005) and 300 vehicles per hour (2025). However, the travel forecasts showed that any reduction in auto usage would be offset by other traffic diverted to the I-90 corridor.

The vanpool program identified in Test 3 was estimated to attract an additional 80 to 120 SOV users in the peak direction of travel in 2025. The incremental effects of the other TDM strategies (Test 3) would largely be captured by the transit service package but potentially could impart a further 1-2 percent reduction, on the order of 50-100 vehicles per hour.

Combined, these actions might allow up to half of the peak direction excess vehicle demand in Alternative R-2B Modified to be offset by TDM/TSM actions. This assumes that there would not be additional traffic diverted back to I-90. Additional research on this topic is appropriate in the context of the SR 520 Bridge Replacement and HOV Project (formerly SR 520 Trans-Lake Washington Project) corridor study that is examining both the SR 520 and I-90 corridor TDM programs.

Summary of Operational Impacts on Transit and HOV

Transit/HOV – Point-to-Point Travel Time

In the peak direction for both 2005 and 2025, travel times for all alternatives, except Alternative R-2B Modified, would be similar at approximately 6 minutes. Alternative R-2B Modified would be longer by approximately 2 minutes due to increased congestion in the center roadway.

In the reverse-peak direction in year 2005, Alternative R-8A would provide the shortest travel time with an approximately 2 to 3-minute improvement over Alternative R-1. The other Build Alternatives would be similar to or less than Alternative R-1 by approximately 1 minute. By year 2025, Alternative R-8A would continue to have the shortest travel time with almost 3 minutes less than Alternative R-1 in the AM peak period, and over 5 minutes less in the PM peak period. Alternative R-2B Modified travel time would be slightly longer than R-8A. Alternatives R-5 Restripe and R-5 Modified would have travel times similar to Alternative R-1 in the AM peak period, and times that would be approximately 2½ minutes less in the PM peak period.

Transit Reliability

Improved travel time reliability makes transit a more viable alternative to driving alone. The ability to reach destinations and make transfer connections improves the attractiveness of transit. In addition, improved travel time reliability can help reduce transit operations and maintenance costs by allowing for a single bus to be more closely scheduled. Using Sound Transit Route 550 as an example, the current round-trip time for this route (between downtown Seattle and downtown Bellevue) is approximately 85 minutes. By 2025 the round-trip time would approach 95 minutes with Alternative R-1. All Build Alternatives would improve transit reliability as compared to Alternative R-1 by reducing the round-trip time.

Transit Ridership

All Build Alternatives are projected to have an increase in ridership as compared to Alternative R-1. Increases for Alternative R2-B Modified would be the largest, caused by differences in the HOV rules and the lane configurations and resulting travel time differences between modes.

In 2005, Alternative R-2B Modified shows the greatest increase in ridership with a 6 to 7 percent increase over Alternative R-1. This would be an increase of 760 daily transit passengers, compared with 460 to 490 for the other Build Alternatives. Alternative R-2B Modified would also have the largest increase in ridership in the reverse-peak direction, with 270 more passengers on a daily basis compared to 130 to 150 for the other Build Alternatives. With Alternative R-2B Modified, the two-way center roadway would be available for use by transit/HOV in the reverse-peak directions, thus reverse-peak travel times would decrease for transit. Travel times in the peak directions would increase relative to Alternative R-1 due to higher per lane traffic volumes, and a decrease in capacity of the center roadway from two lanes per direction to one.

By 2025, the differences between Alternatives R-2B Modified and R-8A would narrow, with the total daily increase for Alternative R-2B Modified at 2.6 percent (550 riders) and Alternative R-8A at 2.4 percent (500 riders). Both R-5 Alternatives would have an increase of 160 fewer riders than in 2005. In the reverse-peak direction, Alternative R-2B Modified would continue to have the largest increase in ridership, with 230 more daily riders than Alternative R-1. Alternative R-8A would have 160 more daily riders than Alternative R-1. However, in the off-peak hours, Alternative R-8A would have the greatest increase in riders, with 280 (4 percent) more than Alternative R-1. Alternative R-2B Modified would have 160 riders. This would occur because the HOV rule in 2025 would be 3+ for Alternatives R-1, R-2B Modified, and R-5, but would be 2+ for Alternative R-8A. Carpools and vanpools in the peak direction with Alternatives R-2B Modified and R-5 would be identical to Alternative R-1. The carpool and vanpool throughput with Alternative R-8A would increase 66 percent from Alternative R-1. This large increase is attributable to the difference in the HOV rule between Alternatives R-1 and R-8A; where HOV 2+ must travel with general-purpose traffic in Alternatives R-2B Modified, R-5 and R-1.

HOV Usage

For both 2005 and 2025, Alternative R-8A would provide the greatest increase in HOV usage. Estimates for Alternatives R-5 Restripe and R-5 Modified show no increase in HOV traffic because these alternatives would not provide any benefit to carpool operations. In 2005, Alternative R-2B Modified would provide a 2 percent increase in westbound (reverse-peak direction) HOV traffic during the PM peak period and no increase in peak HOV traffic, whereas Alternative R-8A would show a 2 percent increased in westbound HOV traffic in both the AM and PM (reverse-peak) peak periods.

By 2025, the differences between Alternatives R-2B Modified and R-8A would widen (assuming an HOV 3+ definition), with Alternative R-8A showing an increase of 10 percent in HOV traffic in the AM peak period as compared to 2 percent for Alternative R-2B Modified, both in the peak direction. Neither would show an increase in HOV traffic in the reverse-peak direction during the AM peak period.

In the PM peak period, Alternative R-8A would provide for a 2 percent increase in eastbound (peak direction) HOV traffic whereas Alternative R-2B Modified would cause a decrease of 3 percent. Westbound (reverse-peak direction) HOV traffic would increase by 8 percent for Alternative R-8A as compared to an increase of 3 percent for Alternative R-2B Modified. If an HOV 2+ rule is used for Alternative R-8A, the HOV volumes will be substantially higher.

Park-and-Ride Facility Usage

Park-and-ride usage was assumed to match capacity. Year 2005 spaces are estimated to be approximately 3,900 in the project area and are expected to increase to approximately 4,500 by 2025. For 2005, the park-and-ride demand for all alternatives, including the No Build, is estimated to be similar. By 2025, Alternative R-8A would show a slight difference with an estimated decreased demand of less than 5 percent due to shifts into HOVs.

TDM/TSM Sensitivity Analysis

Sensitivity tests were performed to determine the potential effectiveness of investing in TDM/TSM investments in the I-90 corridor. Implementation of such investments would require commitments by a variety of agencies, including Sound Transit, King County Metro, WSDOT and local jurisdictions.

The tests examined Alternative R-2B Modified, which would provide two-way operation of the center roadway. Three tests were performed, ranging from an investment of $30 Million (Year 2000 dollars) up to $70 Million. Each of the tests featured investments that would increase transit service, expand park-and-ride lots along I-90, and provide system management to improve transit speed and reliability. One test included an expanded Transportation Demand Management program.

The addition of park-and-ride capacity showed negligible changes in transit demand for Alternative R-2B Modified.

The results show that improvements in transit service would result in a sizeable increase in transit ridership on those affected routes. However, much of that increase would result from riders choosing to shift from other I-90 routes as well as a small shift from SR 520 routes instead of SOV drivers shifting to transit use.

Traffic volumes on I-90 and SR 520 would show negligible changes as a result of these actions.

The incremental effects of adding the TSM improvements along I-90 show that the travel time improvements would result in a small net increase in I-90 ridership. Most of this increase would be focused on ST Route 550, which diverts riders from other corridor bus routes.

The effects of the TDM investment were examined using empirical data and a newly developed TDM forecasting tool. Many of the identified TDM elements are extensions of already functioning TDM programs that have been successful contributors to the transit ridership evidenced today in the Puget Sound Region. The vanpool program element of the TDM strategy was estimated to attract 80 to 120 peak hour SOV users in the peak direction of travel in 2025. The incremental effects of the other TDM strategies could impart a further 1-2 percent trip reduction, on the order of 50-100 vehicles per hour.

Combined, the sensitivity tests illustrated that implementing the TDM/TSM actions might allow up to half of the peak direction excess vehicle demand in Alternative R-2B Modified to be offset by TDM/TSM actions.

Comparison Table

Table 3.1-7 summarizes the operational impacts on transit and HOV for the Build Alternatives in comparison with Alternative R-1. The transit frequency for 2005 was estimated to be 34 westbound and 9 eastbound buses during the AM peak hour, and 9 westbound and 34 eastbound buses during the PM peak hour. For 2025, the transit frequency was estimated to be 47 westbound and 14 eastbound buses during the AM peak hour, and 14 westbound and 47 eastbound buses during the PM peak hour. Transit frequency was assumed to be the same for all alternatives (both No Build and Build).

3.1.3 Mitigation

No operational mitigation would be required for transit operations.

Table 3.1-7
Comparison of Operational Impacts on Transit and HOV

	R-1	R-2B Modified	R-5 Restripe and R-5 Modified	R-8A
2005				
Travel Times (between Bellevue Way SE and Rainier Ave T.S.)	6 minutes in peak direction. 9 minutes in reverse-peak direction.	8 – 9 minutes in peak direction. 8 minutes in reverse-peak direction.	6 minutes in peak direction. 9 minutes in reverse-peak direction.	6 minutes in peak direction. 6 – 7 minutes in reverse-peak direction.
Transit Reliability	Good reliability in peak direction. 55 – 60% of bus trips are off schedule (delayed) in reverse-peak direction.	Same as R-1 with HOV 3+; worse with HOV 2+ in peak direction. Improved in reverse-peak direction.	Same as R-1 in peak direction. Improved in reverse-peak direction.	Same as R-1 in peak direction. Improved in reverse-peak direction.
Transit Ridership During Peak Periods	6,200 in peak direction. 1,700 in reverse-peak direction.	6,500 in peak direction. 1,900 in reverse-peak direction.	6,500 in peak direction. 1,800 in reverse-peak direction.	6,500 in peak direction. 1,800 in reverse-peak direction.
Transit Ridership During Off-Peak Periods	1,800 in EB direction. 1,500 in WB direction.	2,000 in EB direction. 1,500 in WB direction.	1,800 in EB direction. 1,500 in WB direction.	1,800 in EB direction. 1,500 in WB direction.
HOV Usage	3,000 – 4,000 in each direction in each 3-hour peak period.	No change in AM peak period; 2% increase in westbound during PM peak period.	No change in either AM or PM peak periods.	2% increase in AM peak period; 2% increase in westbound during PM peak period.
2025				
Travel Times (between Bellevue Way SE and Rainier Ave T.S.)	6 minutes in peak direction. 12 minutes in reverse-peak direction.	7 – 8 minutes in peak direction. 7 minutes in reverse-peak direction.	6 minutes in peak direction. 9 - 10 minutes in reverse-peak direction.	6 minutes in peak direction. 7 minutes in reverse-peak direction.
Transit Reliability	Good reliability in peak direction. Continues to worsen with increased congestion in reverse-peak direction.	Same as R-1 with HOV 3+ in peak direction. Improved in reverse-peak direction.	Same as R-1 with HOV 3+ in peak direction. Improved in reverse-peak direction.	Same as R-1 but with HOV 2+ in peak direction. Improved in reverse-peak direction.
Transit Ridership During Peak Periods	10,800 in peak direction. 3,800 in reverse-peak direction.	10,900 in peak direction. 4,000 in reverse-peak direction.	10,900 in peak direction. 3,900 in reverse-peak direction.	10,900 in peak direction. 4,000 in reverse-peak direction.
Transit Ridership During Off-Peak Periods	3,800 in EB direction. 2,900 in WB direction.	3,900 in EB direction. 2,900 in WB direction.	3,800 in EB direction. 2,900 in WB direction.	4,000 in EB direction. 3,000 in WB direction.
HOV Usage	3,000 – 4,000 in each direction in each 3-hour peak period.	2% increase in westbound during AM peak period; 3% decrease in eastbound and 3% increase in westbound during PM peak hour.	No change in either AM or PM peak periods.	With HOV 3+ there would be a 10% increase in AM peak period; 2% increase in eastbound and 8% increase in westbound during PM peak period. With HOV 2+, these volumes would be much higher.

Notes: EB = eastbound, WB = westbound, T.S. = transit station

3.2 FREEWAY OPERATIONS

3.2.1 Affected Environment

3.2.1.1 Existing Conditions

Description of Facilities

The present day I-90 facility comprises three independent freeway alignments: two three-lane outer roadways (eastbound and westbound) and a reversible two-lane barrier-separated center roadway. A full description of these freeway facilities is provided in Chapter 2. A summary is provided in this chapter to aid in the discussion of the impacts.

Center Roadway

The I-90 center roadway extends from 5th Avenue S in Seattle east across Lake Washington and Mercer Island to Bellevue Way SE, for a distance of approximately 8 miles.

Access to and from Seattle via the center roadway is provided by the D2 roadway, which extends from the Downtown Seattle Transit tunnel 5th Avenue S/Airport Way S intersection to the Rainier Avenue S Transit Station. The D2 roadway is a barrier separated, two-way facility providing one travel lane in each direction. The D2 roadway serves transit buses 24 hours daily in both directions. HOV traffic is permitted on the D2 roadway only in the peak direction of travel (entering Seattle in the morning and exiting in the afternoon). General-purpose traffic is not permitted on the D2 roadway.

East of the Rainier Avenue S Transit Station, the center roadway operates in a two lane, one-way reversible mode. The center roadway travels through the Mount Baker Ridge tunnel on an alignment located beneath the westbound outer roadway. The center roadway crosses Lake Washington on the HMH floating bridge, sharing this structure with the westbound outer roadway and a shared-use bicycle/pedestrian pathway.

General-purpose traffic is only allowed on the center roadway between Rainier Avenue S and Island Crest Way. Eastbound general-purpose traffic must exit the center roadway at the 77th Avenue SE or Island Crest Way ramps. Similarly, general-purpose traffic traveling westbound from Mercer Island to Seattle may enter the center roadway at these ramps. East of Island Crest Way, the center roadway is restricted to transit and HOV traffic.

East of the Mercer Way interchange, HOV lanes in the I-90 outer roadways connect with the center roadway via slip ramps. These HOV lanes extend east to Issaquah, providing continuity for transit and HOV trips on I-90. The center roadway continues across the East Channel bridge, where HOV-only direct access ramps are provided to and from Bellevue Way SE (westbound AM and eastbound PM operation) and to I-405 (eastbound PM operation only).

Outer Roadways

The basic section on the I-90 outer roadways provides three general-purpose lanes in each direction. Between the I-5 and Rainier Avenue S interchanges, additional lanes are provided in each direction to facilitate access to and from I-5. The basic section increases to four lanes at the East Mercer Way interchange, including an HOV lane in each direction. Across Mercer Slough, between the Bellevue Way SE and I-405 interchanges, the westbound I-90 basic section is reduced to three lanes, consisting of two general-purpose lanes and one HOV lane—this section represents a bottleneck that restricts the total amount of westbound traffic that can utilize I-90 during peak travel periods.

Reversible Lane Operations

The reversible center roadway provides directional capacity during peak travel hours for commuting to and from Seattle. The direction of travel is controlled with gates and variable-message signs. The center roadway operates in the westbound direction from 1:00 AM to 12:30 PM, and in the eastbound direction from 2:00 PM to 12:15 AM Monday through Friday. On weekends, the center roadway operates in the eastbound direction. The hours of operation on weekends are 2:00 PM Friday to 12:15 AM Monday. These schedules are occasionally adjusted to accommodate traffic associated with major sporting events or maintenance and construction activity.

Under the terms of the 1976 Memorandum Agreement, Mercer Island single-occupant vehicles may use the express lanes between Island Crest Way on Mercer Island and Rainier Avenue S in Seattle. East of Island Crest Way and west of Rainier Avenue S, the express lanes and their ramps are open only to HOV traffic, currently defined as vehicles with two or more occupants, motorcycles, and buses.

Design Speeds

I-90 between Seattle and Bellevue provides the transition between a heavily urbanized area found in downtown Seattle, the western terminus of the facility, and the more open suburban to rural roadway environment found east of I-405. The design speed, a parameter used to determine the various geometric features of the I-90 roadways, likewise varies as a reflection of the constraints represented by the natural and built environments through which the facility passes. Due to these constraints, some geometric elements on I-90 were designed and constructed using values that do not meet WSDOT's current design standards for urban freeways.

The design speeds for the alignments on I-90 between Seattle and Bellevue transition from 30 mph west of I-5, to 50 mph on I-90 from I-5 to Lake Washington, 60 mph across Lake Washington and Mercer Island to Bellevue and I-405, then 70 mph on I-90 east of I-405. The posted speed on I-90 east of I-5 to I-405 is 60 mph.

Ramp Metering

In the study area, entrance ramps to the I-90 outer roadways at service (local) interchanges are metered during peak travel periods. System interchange ramps, including the ramps connecting I-90 to I-5 and I-405, are not metered, nor are the terminus ramps at 4th and 5th Avenues S in Seattle. All metered ramps have HOV by-pass lanes to provide priority entry for HOV traffic and buses except the Island Crest Way to westbound on-ramp, the 76th Avenue SE to westbound on-ramp, the Island Crest Way to eastbound on-ramp and the Bellevue Way SE to eastbound on-ramp.

Maintenance and Operations

There are four major maintenance and operations activity centers within the Project area: the tunnel and lids, the floating bridges, the Mercer Island landscaping, and the reversible center roadway.

The Mount Baker Ridge tunnels and lid and the First Hill lid on Mercer Island require maintenance to lighting, ventilation, and fire suppression systems. In addition, both facilities have traffic monitoring equipment and personnel. Much of the maintenance of these systems can be conducted without affecting traffic flows, due to the presence of shoulders within most portions of the tunnels and lids. Some periodic maintenance operations do, however, require lane or roadway closures.

The HMH and LVM floating bridges require constant maintenance beyond that required for more typical fixed bridges. Maintenance of the mechanical systems that control tension of the anchor cables and the water monitoring equipment are predictable activities requiring access to the pontoons. Several times a month, usually during the winter months, water seepage alarms are activated and inspection of the pontoons is necessary. Both these routine and emergency activities require that WSDOT maintenance crews have access to the pontoons, which under the current roadway configurations can be accomplished with only minor disruptions to traffic flows.

Landscaping adjacent to the roadways across Mercer Island needs ongoing maintenance and control. Most of these routine activities are conducted using the shoulders of the outer roadways. Center roadway landscape maintenance can be performed during the semimonthly closures occurring between 9:30 AM and 2:00 PM.

Operation of the reversible center roadway requires personnel to close gates to the roadway, verify that vehicle traffic has cleared, open roadway gates in the opposite direction, and switch roadway signing. In addition, the reversible ramps on Mercer Island need to be closed and opened for the correct direction of travel.

In addition, there are other maintenance and operation activities associated with roadway pavement, illumination, drainage, signing, and Intelligent Transportation Systems (ITS).

Traffic Operations

Traffic operations on the I-90 roadways are measured in several ways, as discussed in the following sections.

Traffic Volumes

On an annual basis, approximately 145,000 vehicles per day (vpd) travel across Lake Washington each day on I-90. At the East Channel bridge, the annual average daily traffic (AADT) is approximately 155,000 vpd. These volumes represent the combined AADT on the outer and center roadways. On weekdays, traffic levels increase due to added commute and business travel, as well as freight movement. The average weekday traffic (AWDT) on I-90 in 2001, including the center roadway, was 150,000 vehicles per day (vpd) across Lake Washington. The reversible center roadway accounted for 12,500 vpd of the weekday volume on the floating bridges, or about 8.3 percent of the weekday corridor volume.

During 2001, the overall directional split for traffic on the I-90 floating bridges during peak conditions, including the center roadway, was 55 percent westbound during the morning peak hour and 55 percent eastbound during the afternoon peak hour. Considering just the outer roadways, the directional distribution is nearly balanced in both directions in both peak periods. The 2001 peak-hour traffic volume on the floating bridges, including the center roadway, averaged approximately 12,500 vph during each of the AM and PM peak hours.

Mercer Island Traffic. During 2001, approximately 65,000 vehicles per day used the outer and center roadway ramps on Mercer Island. Of these vehicles, approximately 28,000 vpd, or 43 percent of the total, were oriented to and from Seattle, and 37,000 vpd, or 57 percent of the total, were oriented to and from the Eastside suburbs. At these volumes, Mercer Island traffic represents about 18 percent of the total weekday traffic on the I-90 floating bridges, and about 23 percent of the total weekday traffic on the East Channel bridge.

Figure 3.2-1 shows the pattern of changes in peak-hour traffic volumes to and from Mercer Island. In general, peak-hour traffic volumes to and from Seattle (solid lines) have remained stable during the AM peak period but have decreased by about 10 percent during the PM peak period between 1996 and 2002. Most of this PM peak period decrease has been observed in the eastbound center roadway traffic to Mercer Island. Mercer Island traffic, at approximately 850-900 vehicles per hour, makes up 45-50 percent of the total center roadway traffic on the floating bridge during the AM and PM peak hours. Peak-hour Mercer Island traffic volumes to and from the Eastside (dotted lines) have remained stable (PM peak hour) or increased slightly (AM peak hour) during the same period.

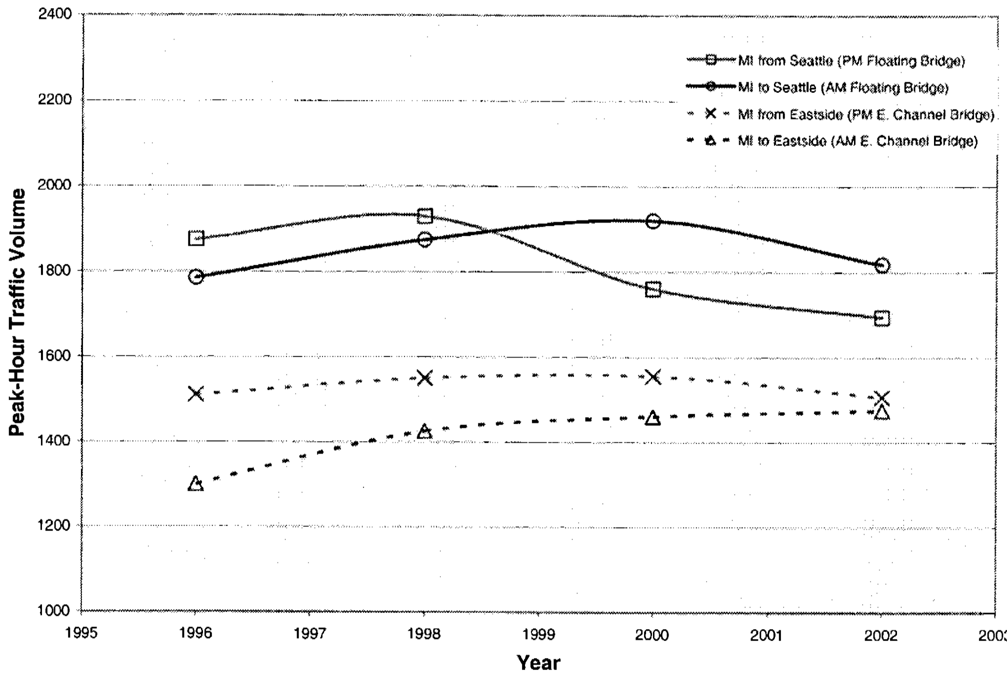
Truck Traffic. Trucks are estimated to comprise about 3 to 4 percent of the daily traffic volume in the I-90 corridor between I-5 and I-405, equating to approximately 4,500 trucks traversing the corridor each weekday. Additional detail concerning truck traffic and patterns is provided in Section 3.5, Freight Movement.

Levels of Service

The ranges of density used to define levels of service for basic freeway sections are shown in Table 3.2-1. Density is measured in terms of passenger cars per mile per lane (pc/mi/ln).

Tables 3.2-2 through 3.2-4 summarize operating measures and levels of service for the I-90 eastbound outer roadway, westbound outer roadway, and reversible roadway for existing peak hour operating conditions. The operating measures include density (pc/mi/ln), speed in miles per hour (mph), and the ratio of volume to roadway capacity (V/C).

Figure 3.2-1
Mercer Island Peak Commute Patterns



Source: WSDOT Ramp & Roadway Traffic Volumes

Table 3.2-1
Level of Service Criteria for Basic Freeway Segments

Level of Service	Density Range (pc/mi/ln)
A	0 – 11
B	11 – 18
C	18 – 26
D	26 – 35
E	35 – 45
F	> 45

Source: 2000 Edition of the *Highway Capacity Manual*

Table 3.2-2
Operating Measures and Level of Service
Eastbound Outer Roadway
Existing Conditions

Subsection	AM Peak Hour				PM Peak Hour			
	Density pc/mi/ln	Speed (mph)	V/C Ratio	LOS	Density pc/mi/ln	Speed (mph)	V/C Ratio	LOS
SB I-5 On-Ramp to Rainier Avenue S Station	90-99	0-10	0.55	F	30-39	30-39	0.70	D
Mount Baker Ridge Tunnel	80-89	10-20	*	F	40-69	20-39	*	E
Floating Bridges	50-59	30-40	0.80	F	40-59	30-39	0.80	E
First Hill Lid	60-69	30-40	0.90	F	50-59	10-29	0.90	F
Island Crest Way Exit to Center Roadway Slip Ramp	50-59	30-40	0.85	F	50-79	20-39	0.90	F
Center Roadway Slip Ramp to I-405 Exit	30-39	40-50	0.75	D	50-59	30-39	0.90	F
I-405 Exit to Richards Rd Exit	10-19	40-50	0.40	B	10-19	40-49	0.40	B

Note: (*) The asterisk indicates over-saturated conditions where V/C > 1.0
The LOS determination is based upon the density parameter with respect to HCM criteria.

Source: HNTB 2002

Table 3.2-3
Operating Measures and Level of Service
Westbound Outer Roadway
Existing Conditions

Subsection	AM Peak Hour				PM Peak Hour			
	Density pc/mi/ln	Speed (mph)	V/C Ratio	LOS	Density pc/mi/ln	Speed (mph)	V/C Ratio	LOS
Bellevue Way SE On-Ramp to Center Roadway Slip Ramp	60-69	20-29	0.90	F	20-29	40-49	0.60	C
Center Roadway Slip Ramp to Island Crest Way Exit	70-79	20-29	*	F	40-49	30-39	0.85	E
Island Crest Way Exit to 76th Ave On-Ramp	70-79	20-29	0.80	F	80-89	10-19	0.75	F
First Hill Lid	60-69	20-29	*	F	50-59	20-29	*	F
Floating Bridges	50-59	30-39	0.90	F	50-59	30-39	0.85	F
Mount Baker Tunnel	60-69	20-29	*	F	50-59	30-39	0.95	F
Rainier Avenue S Station to SB I-5 Off-Ramp	30-49	30-59	0.80	D	20-29	40-49	0.60	C

Note: (*) The asterisk denotes saturation conditions with V/C > 1.0
LOS is determined using density limits as defined in 1997 HCM Table 3-1.

Source: HNTB 2002

Table 3.2-4
Operating Measures and Level of Service
Reversible Center Roadway
Existing Conditions

Subsection	Westbound AM Peak Density pc/mi/ln	Speed (mph)	V/C Ratio	LOS	Eastbound PM Peak Density pc/mi/ln	Speed (mph)	V/C Ratio	LOS
5th Ave S to Rainier Avenue S Station	≤ 10	50-59	0.10	A	≤ 10	50-59	0.10	A
Rainier Avenue S Station to 77th Avenue Exit	20-29	40-49	0.50	C	20-29	40-49	0.60	C
77th Ave Exit to Island Crest Way On-Ramp	20-29	40-49	0.40	C	10-19	40-59	0.30	B
Island Crest Way On-Ramp to Center Roadway Slip Ramp	10-19	40-49	0.30	B	10-19	40-49	0.30	B
Center Roadway Slip Ramp to Bellevue Way SE	≤ 10	50-59	0.10	A	≤ 10	50-59	0.10	A

Note: (*) The asterisk indicates over-saturated conditions where V/C > 1.0
The LOS determination is based upon the density parameter with respect to HCM criteria.

Source: HNTB 2002

Travel Times and Speeds

Travel times for general-purpose traffic using the outer roadways were observed during a series of travel time studies performed in January 1999, extending between I-5 and I-405. Within these limits, observed travel times ranged between 9.7 minutes and 9.8 minutes for westbound travel, and between 11.2 minutes and 11.5 minutes for eastbound travel during the peak hour. These travel times were based on conditions without blocking incidents on the I-90 mainline.

During the January 1999 studies, the average speeds observed on the outer roadways during the morning peak hour ranged from 30 mph to 35 mph westbound and 26 mph to 31 mph eastbound. During the afternoon peak hour, speeds varied between 28 mph and 32 mph in the eastbound direction and 26 mph and 30 mph in the westbound direction. In both cases, speeds in the reverse-peak direction are lower than in the peak direction due to more peak direction capacity (and therefore lower congestion than in the reverse-peak direction) provided by the reversible center roadway. For the center roadway, observed average speeds ranged between 55 mph and 63 mph westbound in the morning. Eastbound in the afternoon, they ranged between 59 mph and 63 mph.

Queues and Hours of Congestion

The extent of congestion in the corridor was estimated for each time period and direction of travel. Hours of congestion were defined to be those time periods when travel speeds drop below 40 mph. Under typical peak period traffic demands, I-90 operates under congested conditions for 1½ to 2½ hours per day.

Mainline Queues. Queues on the I-90 freeway mainline occur as a result of two primary conditions: the interaction between merging ramp traffic and mainline traffic, and capacity imbalances along the freeway mainline that result in bottlenecks. During the AM peak hour, three bottleneck locations are identified in the westbound direction. These include the Mount Baker Ridge tunnel, the First Hill lid and the Luther Burbank lid. Bottleneck locations in the AM peak period for eastbound travel occur at the twin-bore Mount Baker Ridge tunnel section.

During the PM peak hour, vehicle queues for eastbound travel originate at the East Channel bridge and at times extend onto the LVM floating bridge. Another queue forms at the split section of the Mount Baker Ridge tunnel. In the westbound direction, queues originate at the First Hill lid and can extend back to the East Channel bridge.

On-Ramp Queues. Traffic operations at the entrance and exit ramps are summarized in the model FREQ in terms of delay and queues. For the metered on-ramps, queues form on the arterial cross-streets, while off-ramp queues can affect the freeway mainline. Queues can be substantially longer when accidents or incidents affect mainline traffic.

Existing ramp queues at Bellevue Way SE and East Mercer Way generally average less than ¼ mile in morning conditions. At the unmetered on-ramp from I-405, morning queues are generally limited to the adjacent westbound collector-distributor road and the connecting ramps.

In the afternoon, queues form at the on-ramps from north- and southbound Rainier Avenue S, and can reach over a mile in length. At Bellevue Way SE, the queue onto westbound I-90 occasionally extends to the intersection serving the South Bellevue park-and-ride entrance. WSDOT recently added a second peak-period only shoulder lane to the Island Crest Way to eastbound I-90 entrance ramp to reduce queue lengths behind the ramp meter at this location during the PM peak period.

Of particular interest is the performance of the slip ramps, which connect the center and outer roadways near Rainier Avenue S and at Shorewood on Mercer Island. In the morning, most westbound traffic (80 percent) chooses to merge back to the I-90 mainline rather than continue on the D2 roadway. The ramp adds a westbound lane to the I-90 mainline at this point. At this slip ramp, queues can form because demand reaches the capacity of the single-lane slip ramp (about 1,900 vph). Given these patterns of use, the "effective" capacity of the center roadway is limited to about 2,350 to 2,400 vph. Westbound queues are generally contained within the Mount Baker Ridge tunnel, and do not affect HOV and transit traffic destined for the D2 roadway. HOV and transit traffic uses the left lane of the center roadway that is restricted to eligible HOV traffic when the center roadway is running westbound.

In the eastbound direction, afternoon traffic encounters a similar limitation. The single lane slip ramp near Rainier Avenue S serves traffic from the I-90 mainline, which connects to the center roadway. The left mainline lane drops to the slip ramp, providing a capacity estimated at about 1,900 vph. Another 20 percent of center roadway traffic originates from the D2 roadway, providing an "effective" capacity for the center roadway in the range of 2,300 to 2,350 vph.

Off-Ramp Queues. Queues also occur on the off-ramps leading to Mercer Island. There are currently no queuing problems that would affect the operations of the I-90 mainline. The intersection of East Mercer Way and the I-90 Westbound off-ramp creates the longest ramp queues during the PM peak hour. However, this queue does not create any operational problems.

Person Hours/Throughput

Vehicle occupancy is a measure of the degree of ride-sharing in a corridor. Across the I-90 floating bridges, the composite vehicle occupancy in 1998 was 1.12 persons per vehicle (ppv) eastbound, and 1.19 ppv westbound during the AM commute hours. During the afternoon, occupancies were 1.28 ppv eastbound and 1.20 ppv westbound. These figures include the reversible center roadway. Occupancies in the center roadway alone were 1.64 ppv during the AM commute, and 1.65 ppv during the PM commute. Single-occupant vehicles comprised 45 to 47 percent of the flow in the reversible center lanes during the peak hours.

Considering only the outer roadways, vehicle occupancies ranged from 1.12 ppv eastbound to 1.04 ppv westbound during the AM peak period. During the PM peak period, average outer roadway vehicle occupancies ranged from 1.12 ppv eastbound to 1.20 ppv westbound. These figures reflect the availability of HOV lanes in the peak direction of travel in the center roadway, and are identical to the composite occupancies in the reverse-peak direction of travel.

Carpools represent 15 to 22 percent of the total peak hour vehicle flow in the peak direction (to and from Seattle) on the center and outer roadways, accounting for 24 to 34 percent of the overall person trips. In the reverse-peak direction on the outer roadways, carpools represent 9 to 17 percent of the vehicle flow, and account for 17 to 29 percent of the overall person trips. Public transit serves up to 15 percent of person-trips in the peak direction and about 6 percent in the reverse-peak direction.

Overall, single-occupant vehicles comprise 51 to 58 percent of the person-trips in the peak direction of travel, and 62 to 72 percent of the person trips in the reverse-peak direction.

I-5 and I-405 System Interchanges

The I-90 corridor connects to two major north-south interstate freeway corridors just beyond the center roadway limits. On the west, the I-5 interchange serves all movements to and from the north and south with directional ramps. Ramps to and from the north consist of two lanes each, while those to and from the south provide single lanes. A system of collector-distributor roads along I-5 serves multiple ramps in this vicinity, including those to and from I-90. On I-5, the average annual daily traffic volumes are 211,000 vpd south of I-90 and 156,000 vpd north of I-90.

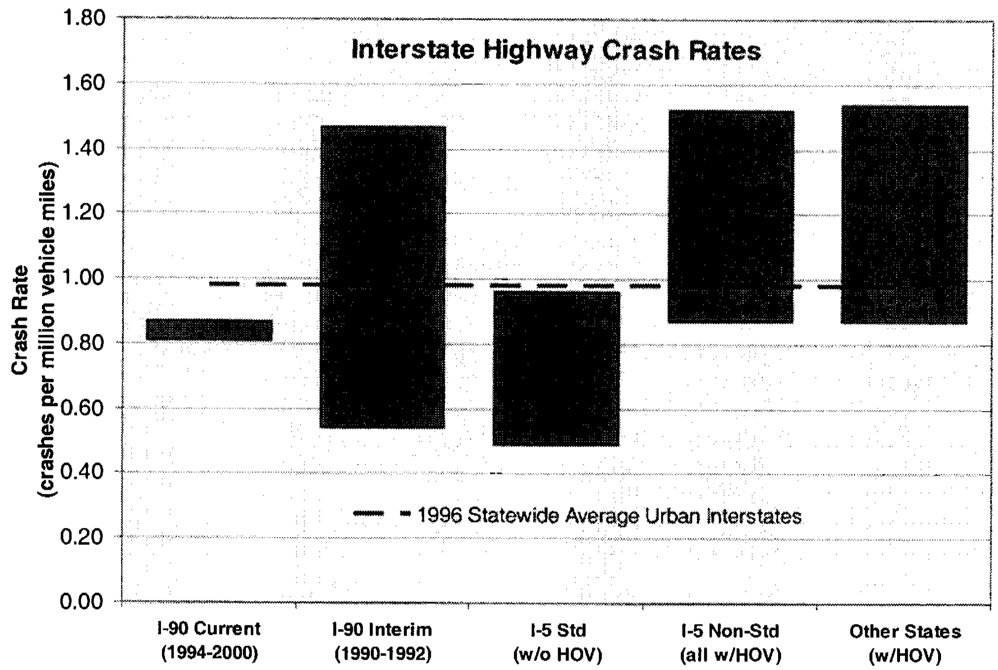
On the east, the I-405 interchange serves all movements to and from the north and south with directional ramps. Most ramps provide a single lane, but several two-lane ramps are provided. A system of collector-distributor roads along I-90 serves the directional ramps and ramps to and from the east at Bellevue Way SE. Daily traffic volumes on I-405 range from 150,000 vpd south of I-90 to 205,000 vpd north of I-90.

Safety

Crash History

A comparison of the current and interim safety experience along I-90 together with local I-5 examples and data from interstate facilities in other states is shown in Figure 3.2-2. During the period from 1989 through 1992, the I-90 corridor was operated in an interim configuration, using only the westbound outer and center roadways. During this period, westbound traffic operated with four lanes on the westbound outer roadway, one of which was designated as an HOV lane, and eastbound traffic operated with three lanes in today's center roadway. In both cases, 11-foot wide travel lanes and reduced-width shoulders were utilized. This operation was necessary under the phased construction of the I-90 corridor, in order to complete the eastbound outer roadway, including replacement of the LVM (eastbound) floating bridge. During the interim operation, the westbound lanes experienced a lower crash rate than the current configuration of I-90, while the eastbound lanes experienced a higher crash rate. Lower levels of congestion, and a lower posted speed, may have contributed to the lower westbound crash rates, while a more constrained roadway environment, higher levels of congestion, and temporary ramp connections may have contributed to the higher eastbound crash rates.

Figure 3.2-2
Comparison of Interstate Highway Crash Rates
Washington State and Other States



Source: WSDOT 2001 and HNTB 2002

Reduced lane and shoulder widths have been used as a strategy to provide for transit and HOV operation on interstate highway facilities for a number of years in the Puget Sound region and in other states, most notably California and Texas. They are frequently used to add an HOV lane to a congested corridor, simultaneously providing priority treatment for HOV and relieving congestion in the general purpose lanes. In most cases where lanes were added by reducing travel lane and shoulder widths, an outside shoulder a minimum of 8 feet wide was retained as a refuge for disabled vehicles. Many of these non-standard facilities are in areas where expansion of the freeway facility to provide standard geometrics was found infeasible due to environmental or community impacts and/or high costs associated with additional freeway widening; some of these are considered interim facilities that will be widened in future projects when funding becomes available.

In the Puget Sound region, this treatment has been used on portions of I-5 between S 320th Avenue and the Southcenter Hill (circa 1991), and between the Snohomish County Line and Northgate (circa 1984). Crash rates for these facilities are depicted on Figure 3.2-2, and can be compared to otherwise similar portions of I-5 that do not contain non-standard design elements. The crash rates for the portions of I-5 with non-standard design elements and HOV lanes are generally higher than those observed for portions of I-5 with standard design elements without HOV lanes.

Historically, I-90 has maintained a safety record with a crash rate that is lower than the statewide urban interstate freeway averages, despite some compromises in the design relative to current WSDOT design standards. These compromises include a 50 mph design speed in Seattle between I-5 and Lake Washington, a 60 mph design speed across Mercer Island to I-405, application of minimum stopping sight distances for a 60 mph design speed in some locations on Mercer Island, retention of narrower lane and shoulder widths in the original Mount Baker Ridge tunnel carrying two of the eastbound general-purpose lanes, and corridor-wide application of a 6-foot wide inside shoulder. With the exception of the 6-foot wide shoulder, which was standard at the time of design, the compromises in the original design were made in recognition of the urban environment traversed by I-90, and to minimize the impact of construction.

The patterns of crashes reveal that the highest overall and injury crash rates in the corridor occur under congested, weekday, peak-period conditions, when rates are about 50 percent higher than the overall injury crash averages. The lowest overall and injury crash rates occur in the weekday off-peak and weekend periods. Most mainline collisions are rear end, sideswipe, or fixed object types of crashes, accounting for 93 percent of all collisions. The fraction of rear-end crashes has increased from 57 percent in 1994–1996 to 63 percent in 1999–2000, while the percentages of sideswipe and fixed object crashes have declined.

Incidents

WSDOT operates an Incident Patrol in the I-90 corridor between I-5 and I-405 on weekdays from 5:30 to 10:00 AM and from 2:30 to 6:30 PM. Two incident response trucks respond to breakdowns and accidents reported in the corridor. Records from the incident management system for 1998 were reviewed to characterize the frequency and clearance times of incidents.

The highest frequency of incidents occurred on the I-90 floating bridges, the First Hill lid and the East Channel bridge, in that order. The westbound PM hours of operation experienced the greatest number of blocking incidents, followed by the eastbound AM and PM hours of operation, and then the westbound AM hours of operation with the fewest incidents.

The highest number of incidents in the center roadway occurred on the floating bridge and the Mount Baker Ridge tunnel/lid. Overall, about three incidents occur each weekday on the outer roadways, and one incident occurs every four weekdays on the center roadway. About one blocking incident occurs each weekday on the outer roadways, and one blocking incident occurs each month on the center roadway.

3.2.1.2 Future Conditions – 2005, 2025

Alternative R-1 was examined for the Year of Opening, 2005 and the Year of Design, 2025. In Alternative R-1, the existing roadway envelope would remain, with three general purpose lanes in each direction on the outer roadways and two reversible lanes serving peak direction flow on the center roadway.

Alternative R-1 would not result in any changes in posted speeds within the corridor. WSDOT would continue to use a range of Intelligent Transportation Systems (ITS) services in managing the corridor, including provisions for peak-period incident response trucks to assist in clearing crashes and vehicles which have broken down.

With Alternative R-1, the center roadway would be available to transit and HOV 2+ vehicles in the opening year (2005), and transit and HOV 3+ vehicles in the design year (2025). In both cases, general purpose traffic would continue to be permitted between Rainier Avenue S and Island Crest Way.

2005 Traffic Operations

With Alternative R-1, the center roadway would be available to transit and HOV 2+ vehicles in 2005. General purpose traffic would continue to be permitted between Rainier Avenue S and Island Crest Way.

Traffic Volumes

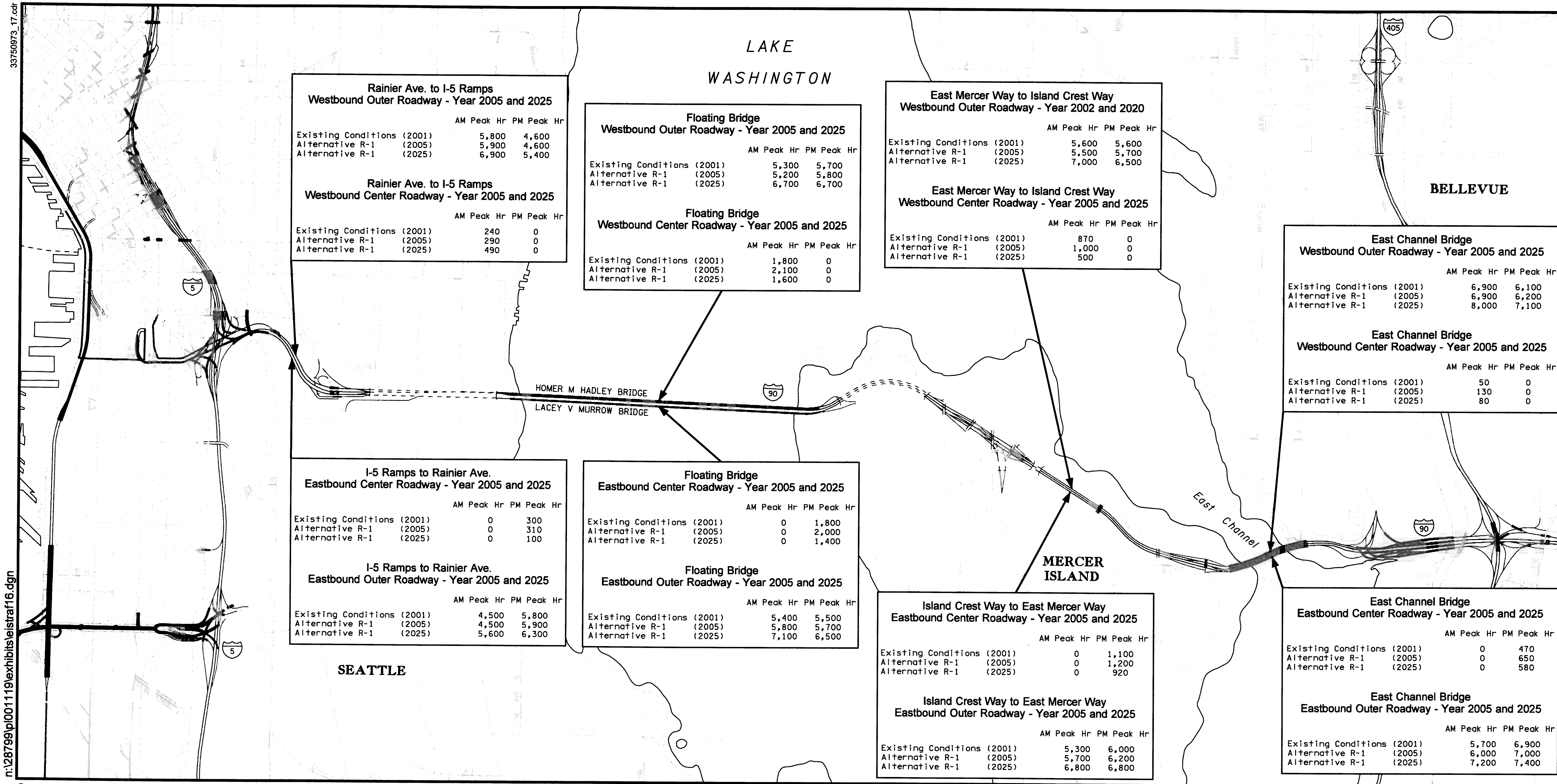
Traffic volumes for Alternative R-1 are expected to grow at an average annual rate of about one percent. Figure 3.2-3 illustrates the mainline and center roadway peak hour volumes for Alternative R-1. At the I-90 floating bridges, Alternative R-1 would serve about 7,000 carpools in the 2005 3-hour AM peak period and about 6,500 carpools in the 3-hour 2005 PM peak period. Carpool traffic would be about equal in both directions during the morning period, and would favor the peak direction (56 percent) in the afternoon period.

Levels of Service

As shown in Tables 3.2-5 and 3.2-6, on the eastbound outer roadway, level of service (LOS) E and F conditions would continue to predominate during both the AM and PM peak hour. These poor operating conditions would affect both general purpose and transit/HOV traffic in this reverse-peak direction of travel.

Travel Times and Speeds

Travel times were estimated for the portion of the corridor between the Rainier Avenue S slip ramps in Seattle and the Bellevue Way SE ramp in Bellevue. Travel times on the outer roadway in the reverse-peak direction would range from 9.1 minutes (eastbound AM) to 9.3 minutes (westbound PM) for all modes. In the peak directions, outer roadway travel times would range from 8.5 minutes (westbound AM) to 9.1 minutes (eastbound PM). The center roadway would be available for peak directional transit and HOV 3+ travel during the peak periods with Alternative R-1. To travel to or from Bellevue Way SE to Rainier Avenue S using the center roadway would take 5.9 minutes.



Rainier Ave. to I-5 Ramps Westbound Outer Roadway - Year 2005 and 2025

	AM Peak Hr	PM Peak Hr
Existing Conditions (2001)	5,800	4,600
Alternative R-1 (2005)	5,900	4,600
Alternative R-1 (2025)	6,900	5,400

Rainier Ave. to I-5 Ramps Westbound Center Roadway - Year 2005 and 2025

	AM Peak Hr	PM Peak Hr
Existing Conditions (2001)	240	0
Alternative R-1 (2005)	290	0
Alternative R-1 (2025)	490	0

Floating Bridge Westbound Outer Roadway - Year 2005 and 2025

	AM Peak Hr	PM Peak Hr
Existing Conditions (2001)	5,300	5,700
Alternative R-1 (2005)	5,200	5,800
Alternative R-1 (2025)	6,700	6,700

Floating Bridge Westbound Center Roadway - Year 2005 and 2025

	AM Peak Hr	PM Peak Hr
Existing Conditions (2001)	1,800	0
Alternative R-1 (2005)	2,100	0
Alternative R-1 (2025)	1,600	0

East Mercer Way to Island Crest Way Westbound Outer Roadway - Year 2002 and 2020

	AM Peak Hr	PM Peak Hr
Existing Conditions (2001)	5,600	5,600
Alternative R-1 (2005)	5,500	5,700
Alternative R-1 (2025)	7,000	6,500

East Mercer Way to Island Crest Way Westbound Center Roadway - Year 2005 and 2025

	AM Peak Hr	PM Peak Hr
Existing Conditions (2001)	870	0
Alternative R-1 (2005)	1,000	0
Alternative R-1 (2025)	500	0

East Channel Bridge Westbound Outer Roadway - Year 2005 and 2025

	AM Peak Hr	PM Peak Hr
Existing Conditions (2001)	6,900	6,100
Alternative R-1 (2005)	6,900	6,200
Alternative R-1 (2025)	8,000	7,100

East Channel Bridge Westbound Center Roadway - Year 2005 and 2025

	AM Peak Hr	PM Peak Hr
Existing Conditions (2001)	50	0
Alternative R-1 (2005)	130	0
Alternative R-1 (2025)	80	0

I-5 Ramps to Rainier Ave. Eastbound Center Roadway - Year 2005 and 2025

	AM Peak Hr	PM Peak Hr
Existing Conditions (2001)	0	300
Alternative R-1 (2005)	0	310
Alternative R-1 (2025)	0	100

I-5 Ramps to Rainier Ave. Eastbound Outer Roadway - Year 2005 and 2025

	AM Peak Hr	PM Peak Hr
Existing Conditions (2001)	4,500	5,800
Alternative R-1 (2005)	4,500	5,900
Alternative R-1 (2025)	5,600	6,300

Floating Bridge Eastbound Center Roadway - Year 2005 and 2025

	AM Peak Hr	PM Peak Hr
Existing Conditions (2001)	0	1,800
Alternative R-1 (2005)	0	2,000
Alternative R-1 (2025)	0	1,400

Floating Bridge Eastbound Outer Roadway - Year 2005 and 2025

	AM Peak Hr	PM Peak Hr
Existing Conditions (2001)	5,400	5,500
Alternative R-1 (2005)	5,800	5,700
Alternative R-1 (2025)	7,100	6,500

Island Crest Way to East Mercer Way Eastbound Center Roadway - Year 2005 and 2025

	AM Peak Hr	PM Peak Hr
Existing Conditions (2001)	0	1,100
Alternative R-1 (2005)	0	1,200
Alternative R-1 (2025)	0	920

Island Crest Way to East Mercer Way Eastbound Outer Roadway - Year 2005 and 2025

	AM Peak Hr	PM Peak Hr
Existing Conditions (2001)	5,300	6,000
Alternative R-1 (2005)	5,700	6,200
Alternative R-1 (2025)	6,800	6,800

East Channel Bridge Eastbound Center Roadway - Year 2005 and 2025

	AM Peak Hr	PM Peak Hr
Existing Conditions (2001)	0	470
Alternative R-1 (2005)	0	650
Alternative R-1 (2025)	0	580

East Channel Bridge Eastbound Outer Roadway - Year 2005 and 2025

	AM Peak Hr	PM Peak Hr
Existing Conditions (2001)	5,700	6,900
Alternative R-1 (2005)	6,000	7,000
Alternative R-1 (2025)	7,200	7,400

Source: HNTB, 2002

No Scale

U.S. Department of Transportation
Federal Highway Administration
Federal Transit Administration
Sound Transit
Washington State Department of Transportation

Figure 3.2-3
Traffic Volumes
Existing and Alternative R-1
Years 2005 and 2025

Table 3.2-5
I-90 – Level of Service Comparison
AM Peak Hour, Year 2005

Direction of Travel	Outer Roadway								Center Roadway							
	General Purpose Traffic				HOV Traffic[3]				General Purpose Traffic[5]				HOV Traffic			
Subsection	R-1	R-2B	R-5[2]	R-8A	R-1	R-2B	R-5[2]	R-8A	R-1	R-2B[4]	R-5[2]	R-8A	R-1	R-2B	R-5[2]	R-8A
Eastbound																
I-5 to Rainier Ave S	C	C	C	B	C	C	C	B	-	-	-	-	-	A	-	-
Mount Baker Ridge Tunnel	F	D	F	C	F	D	F	B	-	-	-	-	-	C	-	-
Floating Bridge[1]	F	D	F	C	F	D	F	B	-	-	-	-	-	C	-	-
First Hill Lid	F	D	F	D	F	D	F	B	-	-	-	-	-	C	-	-
76th Ave SE/77th Ave SE to Island Crest Way	E	D	E	D	E	D	E	B	-	-	-	-	-	C	-	-
Shorewood	E	E	E	D	E	E	E	B	-	-	-	-	-	C	-	-
E Mercer Way to Bellevue Way SE	C	C	C	C	C	C	C	B	-	-	-	-	-	A	-	-
I-405 to Richards Road	B	B	B	B	B	B	B	B	-	-	-	-	-	-	-	-
Westbound																
Bellevue Way SE to E Mercer Way	D	D	D	D	D	D	D	B	A	-	A	A	A	A	A	A
Shorewood	E	E	E	D	E	E	E	B	A	-	A	A	A	C	A	A
Island Crest Way to 76th Ave SE/77th Ave SE	D	D	D	D	D	D	D	B	B	-	B	B	B	D	B	B
First Hill Lid	D	E	D	D	D	E	D	B	A	-	A	A	A	A	A	A
Floating Bridge[1]	D	E	D	D	D	E	D	B	A	-	A	A	A	A	A	A
Mount Baker Ridge Tunnel	D	E	D	D	D	E	D	B	A	-	A	A	A	A	A	A
Rainier Ave S to I-5	D	D	D	D	D	D	D	B	A	-	A	A	A	A	A	A

[1] HMH floating bridge for westbound outer roadway and center roadway. LVM floating bridge for eastbound outer roadway.
[2] LOS for R-5 Restripe and R-5 Modified would be similar to R-1. LOS does not apply to transit-only shoulders.
[3] HOV traffic shares the outer roadways in Alternatives R-1, R-2B Modified, and R-5 with general purpose traffic; therefore, HOV LOS would be identical to general purpose LOS.
[4] Center roadway would be HOV-only with R-2B Modified.
[5] General purpose traffic shares the center roadway in Alternatives R-1, R-5, and R-8A only in the peak direction.

Source: HNTB 2002

Table 3.2-6
I-90 – Level of Service Comparison
PM Peak Hour, Year 2005

Direction of Travel	Outer Roadway								Center Roadway							
	General Purpose Traffic				HOV Traffic[3]				General Purpose Traffic[5]				HOV Traffic			
Subsection	R-1	R-2B	R-5[2]	R-8A	R-1	R-2B	R-5[2]	R-8A	R-1	R-2B[4]	R-5[2]	R-8A	R-1	R-2B	R-5[2]	R-8A
Eastbound																
I-5 to Rainier Ave S	E	F	E	C	E	F	E	C	A	-	A	A	A	A	A	A
Mount Baker Ridge Tunnel	F	F	F	C	F	F	F	C	B	-	B	B	B	D	B	B
Floating Bridge[1]	E	F	E	C	E	F	E	C	B	-	B	B	B	D	B	B
First Hill Lid	F	F	F	D	F	F	F	C	B	-	B	B	B	D	B	B
76th Ave SE/77th Ave SE to Island Crest Way	E	E	E	D	E	E	E	C	B	-	B	A	B	C	B	A
Shorewood	F	F	F	D	F	F	F	C	B	-	B	A	B	C	B	A
E Mercer Way to Bellevue Way SE	D	D	D	D	D	D	D	C	A	-	A	A	A	B	A	A
I-405 to Richards Road	B	B	B	B	B	B	B	B	-	-	-	-	-	-	-	-
Westbound																
Bellevue Way SE to E Mercer Way	D	D	D	C	D	D	D	B	-	-	-	-	-	A	-	-
Shorewood	E	E	E	D	E	E	E	B	-	-	-	-	-	C	-	-
Island Crest Way to 76th Ave SE/77th Ave SE	E	D	E	D	E	D	E	B	-	-	-	-	-	C	-	-
First Hill Lid	E	E	E	C	E	E	E	B	-	-	-	-	-	A	-	-
Floating Bridge[1]	E	E	E	C	E	E	E	B	-	-	-	-	-	A	-	-
Mount Baker Ridge Tunnel	E	E	E	D	E	E	E	B	-	-	-	-	-	A	-	-
Rainier Ave S to I-5	C	C	C	D	C	C	C	B	-	-	-	-	-	A	-	-

[1] HMH floating bridge for westbound outer roadway and center roadway. LVM floating bridge for eastbound outer roadway.
[2] LOS for R-5 Restripe and R-5 Modified would be similar to R-1. LOS does not apply to transit-only shoulders.
[3] HOV traffic shares the outer roadways in Alternatives R-1, R-2B Modified, and R-5 with general purpose traffic; therefore, HOV LOS would be identical to general purpose LOS.
[4] Center roadway would be HOV-only with R-2B Modified.
[5] General purpose traffic shares the center roadway in Alternatives R-1, R-5, and R-8A only in the peak direction.

Source: HNTB 2002

Queues and Hours of Congestion

With Alternative R-1, congestion would develop at existing mainline bottleneck locations in patterns similar to those existing currently. Congested flow would be experienced on the outer roadways in the reverse-peak direction for about 3¼ hours (eastbound AM) to 5 hours (westbound PM). For peak direction travel, outer roadway congestion would persist 3¼ hours (eastbound PM) to 4½ hours (westbound AM). Congestion is not expected to develop on the center roadway in Alternative R-1.

2025 Traffic Operations

With Alternative R-1, the center roadway would be available to transit and HOV 3+ vehicles in the design year (2025). General purpose traffic would continue to be permitted between Rainier Avenue S and Island Crest Way.

Traffic Volumes

By the year 2025, the average weekday traffic would reach 164,000 vpd at the floating bridges. Growth in peak-hour traffic in the corridor would be constrained by the limited capacity at several bottleneck locations. Figure 3.2-3 illustrates the mainline and center roadway peak hour volumes for Alternative R-1. In 2025, the HOV definition is assumed to be changed from HOV 2+ to HOV 3+. As a result, the number of carpools using the center roadway would decline to about 2,900 in the morning period and 4,300 in the afternoon period. HOV 2 users would utilize the mainline I-90 lanes.

Levels of Service

In 2025, during the eastbound AM (reverse-peak direction), level of service F conditions would expand compared to 2005, and would include the section through the Corwin curves. Tables 3.2-7 and 3.2-8 show the LOS for Alternative R-1 for year 2025.

Eligibility for the center roadway would shift by 2025 to transit and HOV 3+ vehicles, with general purpose traffic allowed between Rainier Avenue S and Island Crest Way. In the peak directions of travel, two-person carpools would be displaced to the outer roadways. For eastbound PM travel, level of service F conditions in the outer roadways would expand into the Corwin curves and LVM floating bridge, compared to 2005. The center roadway would operate at LOS B or better during the eastbound PM peak hours.

Travel Times and Speeds

Travel times on the outer roadway in the reverse-peak directions each would increase about 3 minutes compared to 2005, ranging from 11.5 minutes (eastbound AM) to 12.4 minutes (westbound PM). In the peak directions, outer roadway travel times would range from 9.3 to 9.5 minutes.

The center roadway would be available for peak directional transit and HOV 3+ travel during the peak periods with Alternative R-1. To travel to or from Bellevue Way SE to Rainier Avenue S using the center roadway would take 5.8 minutes.

Table 3.2-7
I-90 – Level of Service Comparison
AM Peak Hour, Year 2025

Direction of Travel	Outer Roadway								Center Roadway							
	General Purpose Traffic				HOV Traffic[3]				General Purpose Traffic[5]				HOV Traffic[6]			
Subsection	R-1	R-2B	R-5[2]	R-8A	R-1	R-2B	R-5[2]	R-8A	R-1	R-2B[4]	R-5[2]	R-8A	R-1	R-2B	R-5[2]	R-8A
Eastbound																
I-5 to Rainier Ave S	F	F	F	C	F	F	F	F	-	-	-	-	-	A	-	-
Mount Baker Ridge Tunnel	F	F	F	D	F	F	F	B	-	-	-	-	-	A	-	-
Floating Bridge[1]	F	F	F	D	F	F	F	B	-	-	-	-	-	A	-	-
First Hill Lid	F	F	F	E	F	F	F	B	-	-	-	-	-	A	-	-
76th Ave SE/77th Ave SE to Island Crest Way	E	E	E	E	E	E	E	B	-	-	-	-	-	A	-	-
Shorewood	E	E	E	E	E	E	E	B	-	-	-	-	-	B	-	-
E Mercer Way to Bellevue Way SE	C	D	C	D	C	D	C	B	-	-	-	-	-	A	-	-
I-405 to Richards Road	B	B	B	C	B	B	B	B	-	-	-	-	-	-	-	-
Westbound																
Bellevue Way SE to E Mercer Way	F	F	F	E	F	F	F	B	A	-	A	A	A	A	A	A
Shorewood	F	F	F	E	F	F	F	B	A	-	A	B	A	A	A	B
Island Crest Way to 76th Ave SE/77th Ave SE	F	F	F	D	F	F	F	B	B	-	B	C	B	B	B	C
First Hill Lid	F	F	F	D	F	F	F	B	A	-	A	A	A	A	A	A
Floating Bridge[1]	F	F	F	D	F	F	F	B	A	-	A	A	A	A	A	A
Mount Baker Ridge Tunnel	F	F	F	D	F	F	F	B	A	-	A	A	A	A	A	A
Rainier Ave S to I-5	D	D	D	D	D	D	D	B	A	-	A	A	A	A	A	A

[1] HMH floating bridge for westbound outer roadway and center roadway. LVM floating bridge for eastbound outer roadway.
[2] LOS for R-5 Restripe and R-5 Modified would be similar to R-1. LOS does not apply to transit-only shoulders.
[3] HOV traffic shares the outer roadways in Alternatives R-1, R-2B Modified, and R-5 with general purpose traffic; therefore, HOV LOS would be identical to general purpose LOS.
[4] Center roadway would be HOV-only with R-2B Modified.
[5] General purpose traffic shares the center roadway in Alternatives R-1, R-5, and R-8A only in the peak direction.
[6] R-1, R-2B Modified, and R-5 would allow HOV 3+. R-8A would allow HOV 2+.

Source: HNTB 2002

Table 3.2-8
I-90 – Level of Service Comparison
PM Peak Hour, Year 2025

Direction of Travel	Outer Roadway								Center Roadway							
	General Purpose Traffic				HOV Traffic[3]				General Purpose Traffic[5]				HOV Traffic[6]			
Subsection	R-1	R-2B	R-5[2]	R-8A	R-1	R-2B	R-5[2]	R-8A	R-1	R-2B[4]	R-5[2]	R-8A	R-1	R-2B	R-5[2]	R-8A
Eastbound																
I-5 to Rainier Ave S	F	F	F	C	F	F	F	C	A	-	A	A	A	A	A	A
Mount Baker Ridge Tunnel	F	F	F	C	F	F	F	C	B	-	B	B	B	C	B	B
Floating Bridge[1]	F	F	F	C	F	F	F	C	B	-	B	B	B	C	B	B
First Hill Lid	F	F	F	D	F	F	F	C	B	-	B	B	B	C	B	B
76th Ave SE/77th Ave SE Island Crest Way	E	E	E	D	E	E	E	C	A	-	A	B	A	B	A	B
Shorewood	F	F	F	D	F	F	F	C	A	-	A	B	A	B	A	B
E Mercer Way to Bellevue Way SE	D	D	D	D	D	D	D	C	A	-	A	A	A	B	A	A
I-405 to Richards Road	B	B	B	C	B	B	B	C	-	-	-	-	-	-	-	-
Westbound																
Bellevue Way SE to E Mercer Way	F	D	F	D	F	D	F	B	-	-	-	-	-	A	-	-
Shorewood	F	F	F	E	F	F	F	B	-	-	-	-	-	B	-	-
Island Crest Way to 76th Ave SE/77th Ave SE	F	F	F	F	F	F	F	B	-	-	-	-	-	B	-	-
First Hill Lid	F	F	F	F	F	F	F	B	-	-	-	-	-	A	-	-
Floating Bridge1	F	F	F	F	F	F	F	B	-	-	-	-	-	A	-	-
Mount Baker Ridge Tunnel	F	F	F	F	F	F	F	B	-	-	-	-	-	A	-	-
Rainier Ave S to I-5	C	C	C	E	C	C	C	B	-	-	-	-	-	A	-	-

[1] HMH floating bridge for westbound outer roadway and center roadway. LVM floating bridge for eastbound outer roadway.
[2] LOS for R-5 Restripe and R-5 Modified would be similar to R-1. LOS does not apply to transit-only shoulders.
[3] HOV traffic shares the outer roadways in Alternatives R-1, R-2B Modified, and R-5 with general purpose traffic; therefore, HOV LOS would be identical to general purpose LOS.
[4] Center roadway would be HOV-only with R-2B Modified.
[5] General purpose traffic shares the center roadway in Alternatives R-1, R-5, and R-8A only in the peak direction.
[6] R-1, R-2B Modified, and R-5 would allow HOV 3+. R-8A would allow HOV 2+.

Source: HNTB 2002

Hours of Congestion

Eastbound mainline bottlenecks on the outer roadway would remain at the Mount Baker Ridge tunnel, at Shorewood, and in the vicinity of the East Channel bridge. Westbound mainline bottlenecks would occur at the Mercer Slough, First Hill lid, and Mount Baker Ridge tunnel.

By 2025, congestion in the reverse-peak direction of travel would persist on the outer roadways for 4½ hours (eastbound AM) to 5¾ hours (westbound PM). In the peak directions of travel, congestion would extend 4¾ hours (westbound AM) to 5¼ hours (eastbound PM). No congestion is expected to develop on the center roadway following the regional conversion to HOV 3+.

The longer duration of congestion in the reverse-peak directions in 2025 compared to 2005 would result primarily from increased travel demand on the outer roadway. In both directions of travel, the longer congested periods would result from a shift in eligibility for users of the center roadway.

Safety

Crash Projections

In Alternative R-1, crash patterns would be expected to follow existing trends. As daily traffic volumes and congestion continue to increase, an increase in the number of crashes can be expected. Potential crash rates for the I-90 alternatives potential overall and injury crashes are shown below for 2005 and 2025. The crash rates for all alternatives include the proposed crash reduction mitigation measures discussed in Section 3.2.3 of this chapter.

The potential crash data figures are shown in Tables 3.2-9 and 3.2-10 for the outer and center roadways respectively. The number of crashes under future conditions was estimated using the crash projection methodology. By 2005, the total number of crashes would be expected to rise to 320 to 365 annually, compared to about 245 annually in 1999-2000. These figures correspond to crash rates of 0.81 to 0.93 crashes per motor vehicle mile (MVM), compared to the 1999-2000 rate of 0.81 crashes per MVM.

By 2025, the total number of crashes would rise to 355 to 410 crashes annually, corresponding to rates of 0.84 to 0.97 crashes per MVM. The crash estimates for Alternative R-1 represent increases of 0 to 15 percent in crash rates for 2005, and 4 to 20 percent for 2025, compared to the existing rate.

On the center roadway, the total number of crashes in 2005 would remain below 10 annually, and the number of injury crashes would remain below 5 annually, about equal to the existing levels. In 2025, with the reduced number of users (HOV 3+), crash totals would decline below 5 annually, and injury crashes, below 2 annually.

Table 3.2-9
Crash Data Projections – Outer Roadways
All Alternatives, Year 2005 and 2025

Crash Type	Alternative				
	R-1	R-2B	R-5R[5]	R-5M[5]	R-8A
Year 2005					
With Crash Reduction Measures					
Overall Crashes					
Potential Number[1,2]	NA[4]	285 – 330	380 – 420	335 – 415	330 – 360
Crashes per MVM[1,3]	NA[4]	0.70 – 0.80	0.92 – 1.02	0.82 – 1.01	0.81 – 0.88
Injury Crashes					
Potential Number[1,2]	NA[4]	115 – 130	140 – 155	130 – 150	120 – 165
Crashes per MVM[1,3]	NA[4]	0.28 – 0.31	0.34 – 0.37	0.31 – 0.37	0.30 – 0.40
Without Crash Reduction Measures					
Overall Crashes					
Potential Number[1,2]	320 – 365	320 – 365	425 – 465	375 – 460	475 – 515
Crashes per MVM[1,3]	0.81 – 0.93	0.81 – 0.93	1.07 – 1.18	0.95 – 1.17	1.15 – 1.25
Injury Crashes					
Potential Number[1,2]	125 – 145	125 – 145	155 – 170	145 – 170	190 – 255
Crashes per MVM[1,3]	0.32 – 0.36	0.32 – 0.36	0.40 – 0.43	0.36 – 0.43	0.46 – 0.62
Year 2025					
With Crash Reduction Measures					
Overall Crashes					
Potential Number[1,2]	NA[4]	325 – 375	435 – 480	375 – 460	360 – 390
Crashes per MVM[1,3]	NA[4]	0.73 – 0.85	0.98 – 1.08	0.84 – 1.04	0.81 – 0.88
Injury Crashes					
Potential Number[1,2]	NA[4]	130 – 145	160 – 175	140 – 165	130 – 180
Crashes per MVM[1,3]	NA[4]	0.29 – 0.33	0.37 – 0.39	0.32 – 0.37	0.30 – 0.40
Without Crash Reduction Measures					
Overall Crashes					
Potential Number[1,2]	355 – 410	360 – 415	485 – 535	415 – 510	515 – 555
Crashes per MVM[1,3]	0.84 – 0.97	0.84 – 0.97	1.14 – 1.26	0.98 – 1.21	1.15 – 1.25
Injury Crashes					
Potential Number[1,2]	140 – 160	145 – 160	180 – 195	160 – 185	205 – 275
Crashes per MVM[1,3]	0.33 – 0.38	0.33 – 0.38	0.43 – 0.46	0.37 – 0.43	0.46 – 0.62

Notes:
1. Projected crash numbers and rates are a range. Lower and upper bounds of the range are shown.
2. Potential number of crashes per year.
3. Potential crash rate per million vehicle miles of travel (MVM).
4. By definition, crash reduction measures would not be applied to Alternative R-1.
5. Alternatives R-5 Restripe & R-5 Modified.

Source: HNTB 2002

Table 3.2-10
Crash Data Projections – Center Roadways
All Alternatives, Year 2005 and 2025

Crash Type	Alternative				
	R-1	R-2BM	R-5R	R-5M	R-8A
Year 2005					
Overall Crashes					
Potential Number	7 - 8	9 - 12	7 - 8	7 - 8	4 - 5
Crashes per MVM[1]	0.32 - 0.37	0.50 - 0.66	0.32 - 0.37	0.32 - 0.37	0.32 - 0.37
Injury Crashes					
Potential Number	3 - 5	4 - 8	3 - 5	3 - 5	2 - 3
Crashes per MVM[1]	0.14 - 0.23	0.22 - 0.41	0.14 - 0.23	0.14 - 0.23	0.14 - 0.23
Year 2025					
Overall Crashes					
Potential Number	3 - 4	3 - 4	3 - 4	3 - 4	6 - 7
Crashes per MVM[1]	0.32 - 0.37	0.50 - 0.66	0.32 - 0.37	0.32 - 0.37	0.32 - 0.37
Injury Crashes					
Potential Number	1 - 2	1 - 2	1 - 2	1 - 2	2 - 4
Crashes per MVM[1]	0.14 - 0.23	0.22 - 0.41	0.14 - 0.23	0.14 - 0.23	0.14 - 0.23

Note: Crash number and rates show upper and lower bounds for annual projections.
[1] MVM=Million vehicle miles of travel
Source: HNTB 2002

Incidents

Incident frequency for Alternative R-1 was estimated based on traffic volumes using the outer roadway during peak periods. In 2005, the annual number of incidents would rise to 810 annually, with about 240 blocking incidents annually. In 2025, the annual number of incidents would rise to 970 annually, with 290 annual blocking incidents.

On the center roadway, the total number of incidents in 2005 would reach about 80 annually, about 14 percent above the existing level. Of these, about 10 incidents each year would result in blocking of one or more lanes, about the same as the existing level.

Potential crash numbers and rates for overall and injury crashes are displayed numerically in Tables 3.2-9 and 3.2-10 for the outer and center roadways respectively.

Maintenance and Operations

Alternative R-1 would not involve any roadway modifications or construction apart from that required for preservation and maintenance of the corridor. Maintenance operations would continue as described in the affected environment, except that some maintenance operations would shift to overnight periods as traffic congestion levels increase, limiting hours available during mid-day periods.

3.2.2 Impacts

3.2.2.1 Construction

Construction of modifications to I-90 between Seattle and Bellevue would result in impacts to freeway and ramp traffic operations. Comparative descriptions of the construction operations that would be required for the four Build Alternatives are shown in Table 3.2-11.

The construction staging identified in this document is only intended to be representative of possible construction staging schemes. The actual construction staging would be determined during the preliminary engineering (design file) and final design phases of the project that would occur after selection of a preferred alternative. The potential impacts that are identified in this report are based on possible staging plans that would provide contractors reasonable access to construction areas. Extremely limited restrictions placed on access could result in increases to the cost of the project.

Within this report section, several terms are used to describe the duration of construction activities, and accompanying traffic impacts. Off-peak refers to mid-day or nighttime time periods that would avoid AM and PM peak travel periods. Short-duration refers to an activity with duration of less than one to two weeks, and long-duration refers to an activity with duration longer than one to two weeks. These definitions are only approximations; the actual duration of activities will be determined in more detail as the Project progresses into final engineering and construction.

During construction, various Transportation Demand Management (TDM) measures may be considered to help reduce the volume of traffic across I-90, particularly during peak periods. Many of these TDM strategies would be extensions of ongoing programs by WSDOT and local agencies within the I-90 corridor.

Table 3.2-11
Comparative Construction for Build Alternatives

Roadway Section	Alternative R-2B Modified	Alternative R-5 Restripe	Alternative R-5 Modified	Alternative R-8A
Seattle, I-5 to Mount Baker Ridge	Short off-peak center roadway closures to place barrier, restripe and sign; Transit access to D2, but no HOV; staging at emergency access ramp west of Rainier Ave S station.	No construction this section.	No construction this section.	Long-term east-bound and west-bound shoulder closures and lane-width reductions to widen outer roadways; short off-peak lane closures to restripe and sign; possible staging along Rainier Ave S, Dearborn St. or 4th Ave S.
HMH Floating Bridge (westbound and center lanes)	Short off-peak center roadway closures to place barrier, restripe and sign; minimal staging in this section.	Short off-peak lane closures to restripe and sign; use center roadway for detour; no staging this section.	Short off-peak lane closures for material delivery with center roadway detour.	Long-term closure of shoulders next to median barrier to move barrier; short off-peak lane closures for material delivery with center roadway detour.
LVM Floating Bridge (eastbound lanes)	No construction this section.	Short off-peak lane closures to restripe and sign; use center roadway for detour; no staging this section.	Short off-peak lane closures to restripe and sign; no staging this section.	Long-term closure of north shoulder and lane-width reductions to construct new scuppers; short off-peak lane closures to restripe and sign; no staging this section.
Mercer Island/ First Hill Lid	Short off-peak center roadway closures to place barrier, restripe and sign; minimal staging in this section.	Short off-peak lane closures to restripe and sign; use center roadway for detour; possible staging in right-of-way.	Short off-peak lane closures to restripe and sign; no staging this section.	Long-term closure of westbound outside shoulder and lane-width reductions to widen west portal of First Hill lid; short off-peak closures of adjacent lane for material deliveries; short off-peak lane closures to restripe and sign; no staging this section.
Mercer Island CBD	Long-term outer roadway lane and inner shoulder reductions and center roadway lane reductions for contractor access to structures for 77th Ave SE and 80th Ave SE ramps; short off-peak center roadway closures to place barrier, restripe and sign; staging within center roadway or leased property.	Short off-peak lane closures to restripe and sign; use center roadway for detour; possible staging in right-of-way.	Long-term west-bound and center roadway lane and shoulder reductions and possible long-term closure of one center lane to build 80th ramp; short off-peak outer roadway closures to restripe and sign with center road-way detour; staging within center roadway or leased property.	Long-term center and outer road-way lane and shoulder reductions and possible long-term closure of one center lane to build 77th Ave SE and 80th Ave SE ramps, maintenance pullouts and enforcement areas; short off-peak outer road-way closures to restripe and sign with center road-way detour; staging within center roadway or leased property.
Mercer Island/ Shorewood	Long-term lane closures to widen center roadway; short off-peak center roadway closures to place barrier, restripe and sign; staging within center roadway.	Short off-peak lane closures to restripe and sign; use center roadway for detour; no staging this section.	Long-term east-bound and center roadway shoulder and lane-width reductions to widen outer roadway; short off-peak west-bound	Long-term east-bound and center roadway shoulder and lane-width reductions to widen outer roadway; short off-peak west-bound lane closures to widen outer

Table 3.2-11 (Continued)
Comparative Construction for Build Alternative

Roadway Section	Alternative R-2B Modified	Alternative R-5 Restripe	Alternative R-5 Modified	Alternative R-8A
			lane closures to widen outer roadway; use center road-way for detour; short off-peak center roadway closures for material delivery; staging within center roadway or under E Channel bridge.	roadway; use center road-way for detour; short off-peak center roadway closures for material delivery; staging within center roadway or under E Channel bridge.
East Channel Bridge/ Bellevue/ Bellevue Way SE	Long-term closure of E Channel bridge inside shoulder, one center lane and eastbound lane-width reductions to relocate median barrier; long-term center roadway lane and shoulder width reductions and short off-peak center roadway closures to place barrier, restripe and sign; staging in right-of-way, under E Channel bridge or within center roadway.	No construction this section.	Long-term west-bound and center roadway lane and shoulder width reductions and short off-peak Bellevue Way SE ramp closures to add transit-only lane; short off-peak E Channel bridge lane closures to restripe and sign; staging in right-of-way, under E Channel bridge or within center roadway.	Long-term closure of E Channel bridge inside shoulder, east-bound lane-width reductions and closure of one center lane to move median barrier; long-term westbound and center roadway lane and shoulder width reductions and short off-peak Bellevue Way SE ramp closures to add transit-only lane; short off-peak E Channel bridge lane closures to sign and restripe; staging in right-of-way, under E Channel bridge or within center roadway.

Source: HNTB 2002

3.2.2.2 Operation

Traffic Volumes

Average weekday traffic (AWDT) for the Build Alternatives, including the center roadway, are shown for 2005 and 2025 in Table 3.2-11A. Comparative peak hour traffic volumes for the Build Alternatives in 2005 and 2025 are shown in Figures 3.2-4 and 3.2-5.

Table 3.2-11A
Average Weekday Traffic (AWDT) Volumes Comparison
Year 2005 and 2025

Alternative	Year 2005*	Year 2025*
Alternative R-1	159,000 vpd	164,000 vpd
Alternative R-2B	159,000 vpd	164,500 vpd
Alternative R-5 Restripe	160,000 vpd	164,000 vpd
Alternative R-5 Modified	160,000 vpd	164,000 vpd
Alternative R-8A	161,500 vpd	177,000 vpd

Note: (*) Rounded to the nearest 500 vpd.
vpd: vehicles per day

Source: Mirai Associates (2002)

By 2005 for Alternative R-1, average weekday traffic volumes will increase 6 percent to 159,000 vpd; and by 2025 increase to 164,000 vpd. The small increase in traffic volume by 2025 reflects the capacity limits on I-90 across the lake. Around half of the traffic increase would occur during peak periods; the remainder would likely occur through spreading of the peak periods.

Alternative R-2B Modified

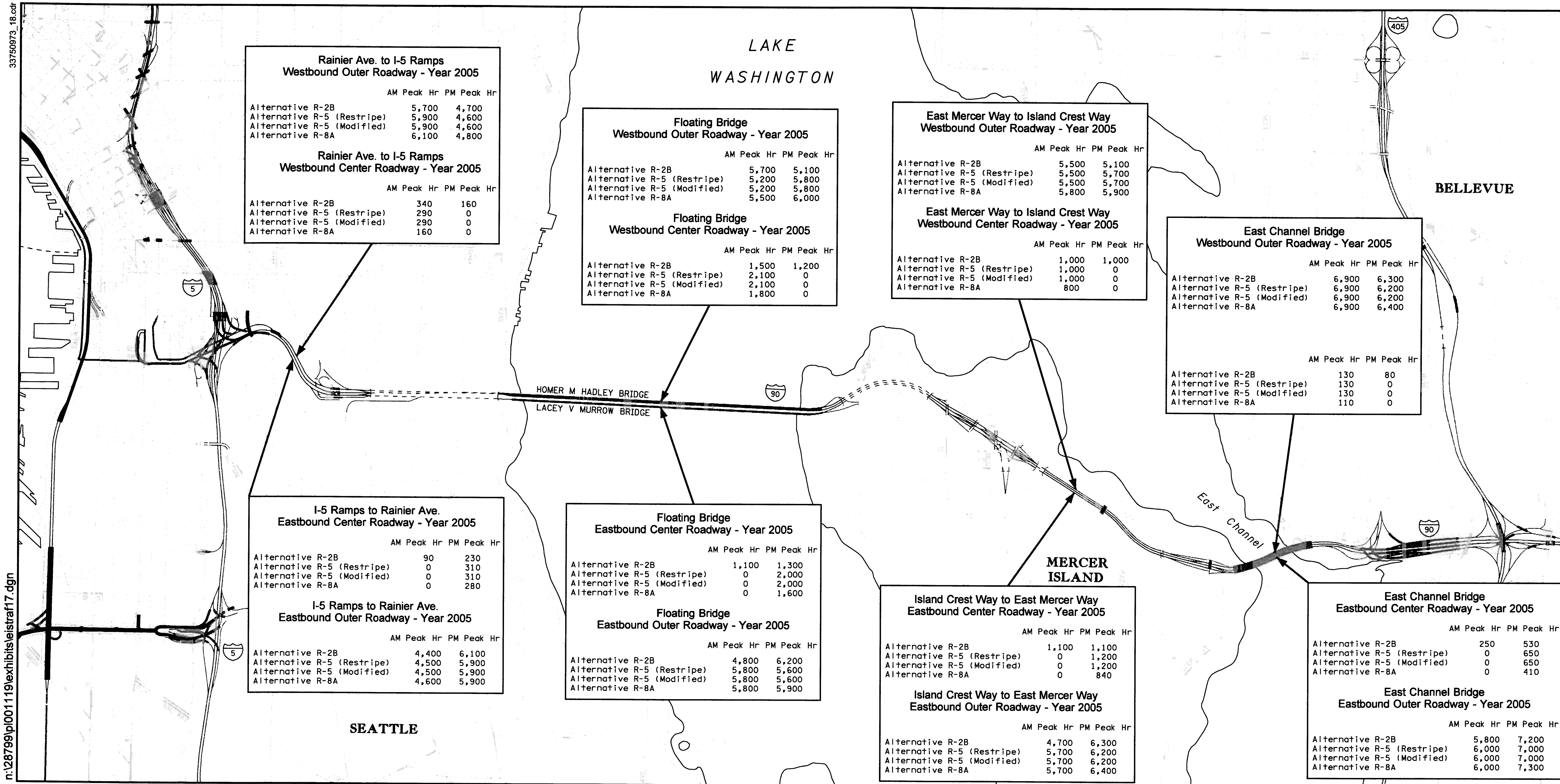
For Alternative R-2B the AWDT would remain similar to Alternative R-1 in 2005 with only a slight increase over Alternative R-1 in 2025. In the outer roadways, Alternative R-2B Modified volumes in the peak directions would be 8 percent higher than Alternative R-1 for both 2005 and 2025. In the reverse-peak directions, Alternative R-2B Modified volumes would be lower than Alternative R-1, because one lane in the two-way center roadway would be open in each direction. The comparative volumes in the center roadways would be lower, but would also be bi-directional.

Alternatives R-5 Restripe and R-5 Modified

Peak and daily traffic volumes for Alternatives R-5 Restripe and R-5 Modified would remain similar to Alternative R-1.

Alternative R-8A – Preferred Alternative

Alternative R-8A would have a slight increase in daily volumes (about 1.5 percent) from Alternative R-1 in 2005. In 2025, Alternative R-8A would have an 8 percent increase from Alternative R-1. This would be due to higher outer road volumes. Alternative R-8A would have 5 percent higher outer roadway volumes in the peak direction than Alternative R-1. In the reverse-peak directions, the volumes would be only 3 percent higher on average. Center roadway volumes for Alternative R-8A would be lower in 2005 and higher in 2025 relative to Alternative R-1.



Rainier Ave. to I-5 Ramps Westbound Outer Roadway - Year 2005

	AM Peak Hr	PM Peak Hr
Alternative R-2B	5,700	4,700
Alternative R-5 (Restripe)	5,900	4,600
Alternative R-5 (Modified)	5,900	4,600
Alternative R-8A	6,100	4,800

Rainier Ave. to I-5 Ramps Westbound Center Roadway - Year 2005

	AM Peak Hr	PM Peak Hr
Alternative R-2B	340	160
Alternative R-5 (Restripe)	290	0
Alternative R-5 (Modified)	290	0
Alternative R-8A	160	0

Floating Bridge Westbound Outer Roadway - Year 2005

	AM Peak Hr	PM Peak Hr
Alternative R-2B	5,700	5,100
Alternative R-5 (Restripe)	5,200	5,800
Alternative R-5 (Modified)	5,200	5,800
Alternative R-8A	5,500	6,000

Floating Bridge Westbound Center Roadway - Year 2005

	AM Peak Hr	PM Peak Hr
Alternative R-2B	1,500	1,200
Alternative R-5 (Restripe)	2,100	0
Alternative R-5 (Modified)	2,100	0
Alternative R-8A	1,800	0

East Mercer Way to Island Crest Way Westbound Outer Roadway - Year 2005

	AM Peak Hr	PM Peak Hr
Alternative R-2B	5,500	5,100
Alternative R-5 (Restripe)	5,500	5,700
Alternative R-5 (Modified)	5,500	5,700
Alternative R-8A	5,800	5,900

East Mercer Way to Island Crest Way Westbound Center Roadway - Year 2005

	AM Peak Hr	PM Peak Hr
Alternative R-2B	1,000	1,000
Alternative R-5 (Restripe)	1,000	0
Alternative R-5 (Modified)	1,000	0
Alternative R-8A	800	0

East Channel Bridge Westbound Outer Roadway - Year 2005

	AM Peak Hr	PM Peak Hr
Alternative R-2B	6,900	6,300
Alternative R-5 (Restripe)	6,900	6,200
Alternative R-5 (Modified)	6,900	6,200
Alternative R-8A	6,900	6,400

	AM Peak Hr	PM Peak Hr
Alternative R-2B	130	80
Alternative R-5 (Restripe)	130	0
Alternative R-5 (Modified)	130	0
Alternative R-8A	110	0

I-5 Ramps to Rainier Ave. Eastbound Center Roadway - Year 2005

	AM Peak Hr	PM Peak Hr
Alternative R-2B	90	230
Alternative R-5 (Restripe)	0	310
Alternative R-5 (Modified)	0	310
Alternative R-8A	0	280

I-5 Ramps to Rainier Ave. Eastbound Outer Roadway - Year 2005

	AM Peak Hr	PM Peak Hr
Alternative R-2B	4,400	6,100
Alternative R-5 (Restripe)	4,500	5,900
Alternative R-5 (Modified)	4,500	5,900
Alternative R-8A	4,600	5,900

Floating Bridge Eastbound Center Roadway - Year 2005

	AM Peak Hr	PM Peak Hr
Alternative R-2B	1,100	1,300
Alternative R-5 (Restripe)	0	2,000
Alternative R-5 (Modified)	0	2,000
Alternative R-8A	0	1,600

Floating Bridge Eastbound Outer Roadway - Year 2005

	AM Peak Hr	PM Peak Hr
Alternative R-2B	4,800	6,200
Alternative R-5 (Restripe)	5,800	5,600
Alternative R-5 (Modified)	5,800	5,600
Alternative R-8A	5,800	5,900

Island Crest Way to East Mercer Way Eastbound Center Roadway - Year 2005

	AM Peak Hr	PM Peak Hr
Alternative R-2B	1,100	1,100
Alternative R-5 (Restripe)	0	1,200
Alternative R-5 (Modified)	0	1,200
Alternative R-8A	0	840

Island Crest Way to East Mercer Way Eastbound Outer Roadway - Year 2005

	AM Peak Hr	PM Peak Hr
Alternative R-2B	4,700	6,300
Alternative R-5 (Restripe)	5,700	6,200
Alternative R-5 (Modified)	5,700	6,200
Alternative R-8A	5,700	6,400

East Channel Bridge Eastbound Center Roadway - Year 2005

	AM Peak Hr	PM Peak Hr
Alternative R-2B	250	530
Alternative R-5 (Restripe)	0	650
Alternative R-5 (Modified)	0	650
Alternative R-8A	0	410

East Channel Bridge Eastbound Outer Roadway - Year 2005

	AM Peak Hr	PM Peak Hr
Alternative R-2B	5,800	7,200
Alternative R-5 (Restripe)	6,000	7,000
Alternative R-5 (Modified)	6,000	7,000
Alternative R-8A	6,000	7,300

Source: HNTB, 2002

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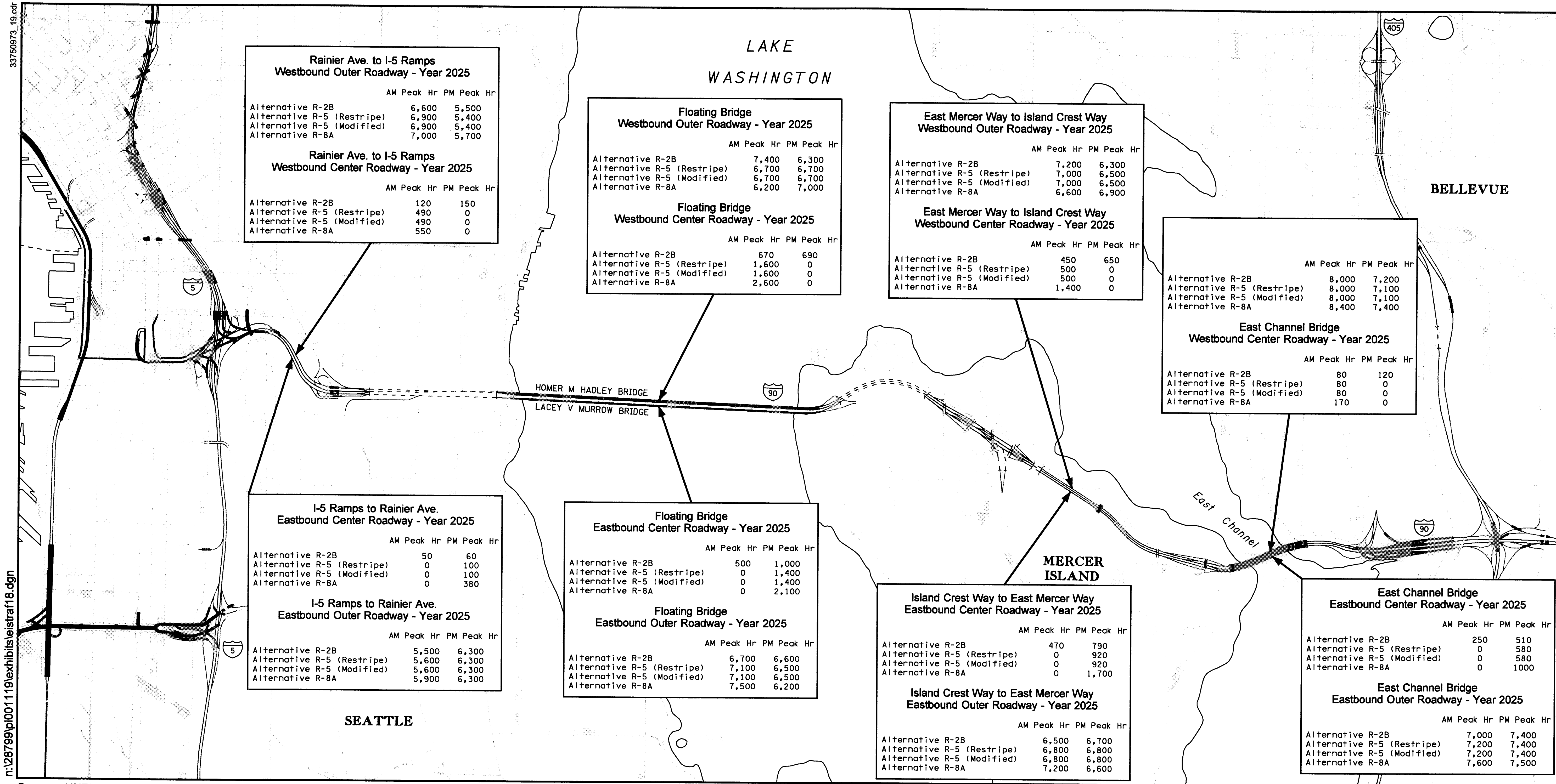
No Scale

SoundTransit

U.S. Department of Transportation
Federal Highway Administration
Federal Transit Administration

Washington State Department of Transportation

Figure 3.2-4
Traffic Volume Comparison
Build Alternatives, Year 2005



Rainier Ave. to I-5 Ramps Westbound Outer Roadway - Year 2025

	AM Peak Hr	PM Peak Hr
Alternative R-2B	6,600	5,500
Alternative R-5 (Restripe)	6,900	5,400
Alternative R-5 (Modified)	6,900	5,400
Alternative R-8A	7,000	5,700

Rainier Ave. to I-5 Ramps Westbound Center Roadway - Year 2025

	AM Peak Hr	PM Peak Hr
Alternative R-2B	120	150
Alternative R-5 (Restripe)	490	0
Alternative R-5 (Modified)	490	0
Alternative R-8A	550	0

Floating Bridge Westbound Outer Roadway - Year 2025

	AM Peak Hr	PM Peak Hr
Alternative R-2B	7,400	6,300
Alternative R-5 (Restripe)	6,700	6,700
Alternative R-5 (Modified)	6,700	6,700
Alternative R-8A	6,200	7,000

Floating Bridge Westbound Center Roadway - Year 2025

	AM Peak Hr	PM Peak Hr
Alternative R-2B	670	690
Alternative R-5 (Restripe)	1,600	0
Alternative R-5 (Modified)	1,600	0
Alternative R-8A	2,600	0

East Mercer Way to Island Crest Way Westbound Outer Roadway - Year 2025

	AM Peak Hr	PM Peak Hr
Alternative R-2B	7,200	6,300
Alternative R-5 (Restripe)	7,000	6,500
Alternative R-5 (Modified)	7,000	6,500
Alternative R-8A	6,600	6,900

East Mercer Way to Island Crest Way Westbound Center Roadway - Year 2025

	AM Peak Hr	PM Peak Hr
Alternative R-2B	450	650
Alternative R-5 (Restripe)	500	0
Alternative R-5 (Modified)	500	0
Alternative R-8A	1,400	0

	AM Peak Hr	PM Peak Hr
Alternative R-2B	8,000	7,200
Alternative R-5 (Restripe)	8,000	7,100
Alternative R-5 (Modified)	8,000	7,100
Alternative R-8A	8,400	7,400

East Channel Bridge Westbound Center Roadway - Year 2025

	AM Peak Hr	PM Peak Hr
Alternative R-2B	80	120
Alternative R-5 (Restripe)	80	0
Alternative R-5 (Modified)	80	0
Alternative R-8A	170	0

I-5 Ramps to Rainier Ave. Eastbound Center Roadway - Year 2025

	AM Peak Hr	PM Peak Hr
Alternative R-2B	50	60
Alternative R-5 (Restripe)	0	100
Alternative R-5 (Modified)	0	100
Alternative R-8A	0	380

I-5 Ramps to Rainier Ave. Eastbound Outer Roadway - Year 2025

	AM Peak Hr	PM Peak Hr
Alternative R-2B	5,500	6,300
Alternative R-5 (Restripe)	5,600	6,300
Alternative R-5 (Modified)	5,600	6,300
Alternative R-8A	5,900	6,300

Floating Bridge Eastbound Center Roadway - Year 2025

	AM Peak Hr	PM Peak Hr
Alternative R-2B	500	1,000
Alternative R-5 (Restripe)	0	1,400
Alternative R-5 (Modified)	0	1,400
Alternative R-8A	0	2,100

Floating Bridge Eastbound Outer Roadway - Year 2025

	AM Peak Hr	PM Peak Hr
Alternative R-2B	6,700	6,600
Alternative R-5 (Restripe)	7,100	6,500
Alternative R-5 (Modified)	7,100	6,500
Alternative R-8A	7,500	6,200

Island Crest Way to East Mercer Way Eastbound Center Roadway - Year 2025

	AM Peak Hr	PM Peak Hr
Alternative R-2B	470	790
Alternative R-5 (Restripe)	0	920
Alternative R-5 (Modified)	0	920
Alternative R-8A	0	1,700

Island Crest Way to East Mercer Way Eastbound Outer Roadway - Year 2025

	AM Peak Hr	PM Peak Hr
Alternative R-2B	6,500	6,700
Alternative R-5 (Restripe)	6,800	6,800
Alternative R-5 (Modified)	6,800	6,800
Alternative R-8A	7,200	6,600

East Channel Bridge Eastbound Center Roadway - Year 2025

	AM Peak Hr	PM Peak Hr
Alternative R-2B	250	510
Alternative R-5 (Restripe)	0	580
Alternative R-5 (Modified)	0	580
Alternative R-8A	0	1000

East Channel Bridge Eastbound Outer Roadway - Year 2025

	AM Peak Hr	PM Peak Hr
Alternative R-2B	7,000	7,400
Alternative R-5 (Restripe)	7,200	7,400
Alternative R-5 (Modified)	7,200	7,400
Alternative R-8A	7,600	7,500

Source: HNTB, 2002

No Scale

U.S. Department of Transportation Federal Highway Administration Federal Transit Administration

Sound Transit

Washington State Department of Transportation

Figure 3.2-5

Traffic Volume Comparison
Build Alternatives, Year 2025

Levels of Service

Comparative levels of service for the Build Alternatives are shown on Tables 3.2-5 through 3.2-8 above for the AM and PM peak hours in years 2005 and 2025.

Alternative R-2B Modified

In 2005, the level of service on the outer roadways for Alternative R-2B Modified in the peak direction of travel would be similar to or slightly worse than Alternative R-1. The level of service on the center roadway, however, would worsen in the peak direction with only one lane of traffic instead of two. Reverse-peak direction of travel would improve on the outer roadways because one lane of traffic in each direction would be provided in the center roadway that does not currently exist.

In 2025, levels of service on the outer and center roadways for Alternative R-2B Modified in the peak direction of travel would be similar to or slightly worse than Alternative R-1. Reverse-peak direction of travel would improve slightly on the outer roadways and one lane of traffic would be provided in the center roadway.

Alternatives R-5 Restripe and R-5 Modified

Levels of service for Alternatives R-5 Restripe and R-5 Modified would remain similar to Alternative R-1.

Alternative R-8A – Preferred Alternative

Levels of service on both the outer and center roadways for Alternative R-8A in 2005 would be similar to or better than Alternative R-1 in both directions of travel. In the PM peak hour in the reverse-peak direction, Rainier Avenue S to I-5 would worsen from LOS C to LOS E. East Mercer Way to Richards Road would worsen from LOS C to LOS D in the AM peak hour reverse-peak direction and from LOS B to LOS C in the PM peak hour peak direction.

With the exception of a couple of worsening conditions at the ends of the corridor, levels of service on the outer roadways for Alternative R-8A in 2025 would be better than or similar to Alternative R-1 in both directions of travel. The center roadway, however, would only be slightly worse in the Mercer Island CBD and Shorewood area in the peak direction. Level of service comparisons can be found in Tables 3.2-5 through 3.2-8 above.

Travel Times

Estimated travel times through the I-90 project corridor are an indication of how well the freeway would operate under the various build conditions. A comparison of general purpose traffic travel times calculated over a distance of 7.4 miles between I-5 (milepost 2.5) and I-405 (milepost 9.9) is shown in Table 3.2-12.

Table 3.2-12
General Purpose Traffic – Corridor Travel Time I-5 to I-405
All Alternatives, Year 2005 and 2025

Roadway	Travel Time in Minutes[1]				
	R-1	R-2BM	R-5R	R-5M	R-8A
AM Peak Hour, 2005					
Eastbound Outer (reverse-peak direction)	11.5	10.4	11.5	11.5	9.0
Westbound Outer (peak direction)	10.1	9.9	10.1	10.1	8.4
PM Peak Hour, 2005					
Eastbound Outer (peak direction)	11.6	13.8	11.6	11.6	8.9
Westbound Outer (reverse-peak direction)	10.7	9.8	10.7	10.7	8.3
AM Peak Hour, 2025					
Eastbound Outer (reverse-peak direction)	15.4	14.7	15.4	15.4	9.6
Westbound Outer (peak direction)	13.1	14.4	13.1	13.1	8.6
PM Peak Hour, 2025					
Eastbound Outer (peak direction)	13.7	13.8	13.7	13.7	9.0
Westbound Outer (reverse-peak direction)	13.8	10.8	13.8	13.8	11.8

Note:
[1] Travel times are from I-5 to I-405 during peak-hour

Source: HNTB 2002 Alternative R-2B Modified

Travel times for general purpose traffic, with one lane of the center roadway available to HOV, would be approximately 1 minute shorter relative to Alternative R-1 in the reverse-peak directions for year 2005. The westbound AM peak travel time would be similar to that in Alternative R-1, but the eastbound PM peak travel time would degrade by approximately 2 minutes relative to Alternative R-1. Most of the travel time difference in the eastbound PM peak direction between Alternative R-2B Modified and Alternative R-1 would take place between I-5 and the Rainier Avenue S ramps. A bottleneck would occur at this location as a result of only one lane being available to traffic entering the center roadway. Similar patterns would take place in year 2025 in the reverse-peak directions. In the eastbound PM peak direction, congestion levels between I-5 and the Rainier Avenue S ramps would be similar between Alternatives R-1 and R-2B Modified. In the westbound AM peak direction, congestion levels would increase with Alternative R-2B Modified in the vicinity of the Shorewood slip ramp to the center roadway, and would account for the increase in travel time."

Alternatives R-5 Restripe and R-5 Modified

General purpose traffic would not be provided with any travel time advantage with Alternatives R-5 Restripe and R-5 Modified.

Alternative R-8A – Preferred Alternative

The HOV lanes in the outer roadways would provide the lowest travel times for general purpose traffic. Travel time savings of approximately 2 minutes relative to Alternative R-1 would be experienced in year 2005 for both the AM and PM peak hours in both the peak and reverse-peak directions. In year 2025, travel time savings in the range of approximately 2 to 5 minutes relative to Alternative R-1 would be experienced. The added capacity with Alternative R-8A would allow for increased flow, and consequently, better travel times through the project corridor.

Queues and Hours of Congestion

Hours of congestion were defined for this study as the length of time within the six-hour peak traffic period when speeds in the corridor fall below 40 mph. Comparative hours of congestion during the peak traffic periods are shown in Tables 3.2-13 and 3.2-14. The shaded data indicate transit/HOV operations. Queue lengths also were estimated for on and off-ramps serving I-90.

Alternative R-1

The duration of congestion with Alternative R-1 during 2005 would range from 3¼ to 5 hours in the reverse-peak directions of travel, and 3¼ to 4½ hours in the peak directions of travel. By 2025, congestion would extend 4½ to 5¾ hours in the reverse-peak directions of travel, and 4¾ to 5¼ hours in the peak directions of travel.

Mainline Queuing. Alternative R-1 would experience mainline queuing in the eastbound direction of travel at the Mount Baker Ridge tunnel and at the East Channel bridge during both the AM and PM peak periods. Westbound traffic would encounter bottlenecks at the East Channel bridge, the First Hill lid, and in the Corwin curves.

On-Ramp Queuing. Queues at the metered on-ramps would be similar to existing patterns. During the AM peak hour, queues at the Rainier Avenue S and Bellevue Way SE on-ramps would be confined to the ramps. The on-ramp from northbound Rainier Avenue S would spill beyond the ramp limits in AM and PM peak periods in both 2005 and 2025. The queue at the on-ramp from southbound Rainier Avenue S would extend beyond the storage lane provided on southbound Rainier Avenue S in the 2025 PM peak.

On Bellevue Way SE, the 2005 queue would reach beyond the 113th Avenue NE intersection, and by 2025, it would routinely extend beyond the signal at the South Bellevue Park-and-Ride entrance. The on-ramp from Island Crest Way to eastbound I-90 would also experience queues during the PM peak hours, extending beyond the signalized intersection at the ramp terminal in both 2005 and 2025.

Off-Ramp Queuing. Queuing on Mercer Island off-ramps would be satisfactory at most locations for Alternative R-1 conditions in 2005 and 2025. The exception would be at the East Mercer Way/I-90 westbound off-ramp. The volumes currently exceed the ramp capacity in the PM peak hour, and the queue would worsen in the 2005 PM peak hour. In 2025, the AM peak hour ramp volumes would also exceed the ramp capacity, and the PM peak hour volumes would exceed capacity by over 5,800 feet.

Table 3.2-13
Congestion Duration Summary – All Alternatives, Year 2005

Roadway	Hours of Congestion Year 2005				
	R-1	R-2BM	R-5R	R-5M	R-8A
AM Peak Period					
Eastbound Outer (reverse-peak direction)	3¼	2½	3¼	3¼	Less than 1
Eastbound Center (reverse-peak direction)	-	None	-	-	NA
Westbound Center (peak direction)	None	1	None	None	None
Westbound Outer (peak direction)	3¼	4¼	3¼	3¼	Less than 1
PM Peak Period					
Eastbound Outer (peak direction)	4½	4½	4½	4½	Less than 1
Eastbound Center (peak direction)	None	Less than 1	None	None	None
Westbound Center (reverse-peak direction)	-	Less than 1	-	-	NA
Westbound Outer (reverse-peak direction)	5	3	5	5	Less than 1

Note: Shaded areas indicate transit/HOV traffic

Source: HNTB 2002

Table 3.2-14
Congestion Duration Summary – All Alternatives, Year 2025

Roadway	Hours of Congestion Year 2025				
	R-1	R-2BM	R-5R	R-5M	R-8A[1]
AM Peak Period					
Eastbound Outer (reverse-peak direction)	4½	4½	4½	4½	¼
Eastbound Center (reverse-peak direction)	-	None	-	-	NA
Westbound Center (peak direction)	None	None	None	None	None
Westbound Outer (peak direction)	4¾	4¾	4¾	4¾	¾
PM Peak Period					
Eastbound Outer (peak direction)	5¼	5¼	5¼	5¼	Less than 1
Eastbound Center (peak direction)	None	None	None	None	None
Westbound Center (reverse-peak direction)	NA	None	NA	NA	NA
Westbound Outer (reverse-peak direction)	5¾	5¾	5¾	5¾	2¼

Note: Shaded areas indicate transit/HOV traffic

[1] Alternative R-8A is HOV 2+ in 2025. All others are HOV 3+.

Source: HNTB 2002

Seattle off-ramp capacity would be sufficient for 2005 and 2025 volumes. In the 2025 AM and PM peak hour, the queues on the 4th Avenue S off-ramp will be less than 750 feet.

Alternative R-2B Modified

Congestion. The duration of congestion with Alternative R-2B Modified in 2005 as compared to Alternative R-1, would increase in the peak direction of travel (eastbound in the AM and westbound in the PM), and would decrease in the reverse-peak direction of travel. In 2025, outer roadway congestion in Alternative R2-B Modified would persist for 4½ to 5¾ hours in the reverse-peak directions of travel, representing slight increases over Alternative R-1. In the peak direction, congestion would persist 4¾ to 5¼ hours in the PM period. In 2025, these durations would be the same as with Alternative R-1.

Mainline Queuing. Alternative R-2B Modified would experience mainline queuing on the outer roadway in 2005 only in the peak direction of travel, because one less travel lane would be provided in that direction of flow. Mainline queues for eastbound PM travel would originate at the Mount Baker Ridge tunnel and lid in both 2005 and 2025. In the westbound direction, queues would originate at the Mercer Slough. By 2025, the reverse-peak direction would also be affected by mainline queuing. Westbound traffic in the PM peak would be affected by a bottleneck at the First Hill lid, creating queues extending back to the Shorewood area.

On-Ramp Queuing. Queues at the metered on-ramp from northbound Rainier Avenue S in Seattle would be reduced in the 2005 AM peak, compared to Alternative R-1, but otherwise would extend onto Rainier Avenue S at other peak times. Queues at the on-ramp from southbound Rainier Avenue S would extend beyond the storage lane provided on southbound Rainier Avenue S in the 2025 AM peak hour, but would be reduced in the PM peak hour. In 2025, the PM peak queue at Bellevue Way SE would extend beyond the signal at the South Bellevue Park-and-Ride entrance. Queues at Island Crest Way during the eastbound PM peak hour would be reduced to remain within the confines of the ramp.

Off-Ramp Queuing. At most intersections, off-ramp queuing would be comparable with Alternative R-1, especially during the AM peak hour where changes in queue length are typically less than two car lengths. As in Alternative R-1, queues would only exceed capacity at the East Mercer Way/I-90 westbound off-ramp intersection. In the 2005 PM peak hour, Alternative R-2B Modified would decrease volumes and queues westbound at the East Mercer Way/I-90 westbound off-ramp intersection. This improvement would be due to a shifting of HOV and transit vehicles from the outer roadway to the center roadway. These vehicles would exit at the new 80th Avenue off-ramp.

In the PM peak hour, the 77th Avenue SE eastbound I-90 express off-ramp queue length would decrease and the I-90 eastbound outer roadway off-ramp queue length would increase. This change would be due to decreased capacity in the center roadway eastbound in the PM peak hour, resulting in vehicles shifting from the center roadway to the outer roadway.

In Seattle, the off-ramp capacity would be sufficient for the 2005 and 2025 Alternative R-2B Modified volumes. In the AM peak hour, at the I-90 westbound center roadway off-ramp at the Airport Way/Dearborn St/5th Avenue S intersection, Alternative R-2B Modified would have shorter queue lengths than Alternative R-1. This would be caused by the shift of vehicles from the center roadway to the outer roadway due to the decreased capacity of the center roadway westbound in the AM peak hour. The reverse effect would occur in the PM peak hour, where the ramp would have an increased queue length due to the added westbound center roadway capacity and vehicles shifting from the outer roadway to the center roadway in the PM peak hour. This same westbound PM peak hour shift of vehicles from the outer roadway to the center roadway would cause the I-90 westbound off-ramp at 4th Avenue S to improve for Alternative R-2B Modified.

Alternatives R-5 Restripe and R-5 Modified

The extent of queues and duration of congestion for Alternatives R-5 Restripe and R-5 Modified would be identical to those in Alternative R-1 for the year 2005. Congestion would occur for 3¼ to 5 hours in the reverse-peak directions of travel and 3¼ to 4½ hours in the peak directions of travel, similar to Alternative R-1. By 2025, congestion would extend 4½ to 5¾ hours in the reverse-peak directions of travel and 4¾ to 5¼ hours in the peak directions of travel, the same as with Alternative R-1.

Queuing at the on- and off-ramps would be similar to Alternative R-1.

Alternative R-8A – Preferred Alternative

Congestion. In 2005, congested conditions would extend for less than 1 hour. In 2025, congestion in Alternative R-8A would persist for ¾ hour during the westbound AM peak period and 2¼ hours during the westbound PM period. These durations would represent decreases of 3½ to 4 hours compared to Alternative R-1.

Mainline Queuing. No mainline queuing would occur in Alternative R-8A for the year 2005 in either direction of travel. In 2025, queues for westbound AM travel would develop in advance of the Shorewood slip ramp to the center roadway. In the 2025 PM peak, a queue would develop at the First Hill lid.

Alternative R-8A also would experience queues in 2025 for westbound travel in the center roadway in advance of the Rainier Avenue S slip ramp. This queue would extend through the Mount Baker Ridge tunnel onto the west highrise. This queue would not develop in Alternative R-1, with its lower center roadway volume (HOV 3+).

On-Ramp Queuing. In 2005, the on-ramp queues at northbound Rainier Avenue S would be reduced compared to Alternative R-1, but would extend onto northbound Rainier Avenue S. In the 2025 AM peak, the on-ramp queue at southbound Rainier Avenue S would lengthen compared to Alternative R-1 and exceed the capacity of the southbound storage lane. Queues at Bellevue Way SE and Island Crest Way would be reduced for all conditions.

Off-ramp Queuing. As with Alternative R-1, the Alternative R-8A queues would exceed capacity at the East Mercer Way/I-90 westbound off-ramp intersection. In the 2005 AM peak hour, these queues would be less than Alternative R-1. This decrease would be caused by vehicles shifting to the new I-90 westbound outer roadway off-ramp at 80th Avenue SE. The shift to the 80th Avenue off-ramp would also cause the westbound I-90 off-ramp at Island Crest and North Mercer Way to decrease in 2005 and 2025 compared to Alternative R-1.

During the PM peak hour, Alternative R-8A queue lengths would decrease at the I-90 eastbound center roadway off-ramps at 77th Avenue SE. This would be due to the increase in eastbound outer roadway capacity that would cause transit and HOV to shift from the center roadway to the outer roadway. In Seattle, the off-ramp capacities would be satisfactory for the 2005 and 2025 Alternative R-8A volumes. Alternative R-8A would cause some changes in 2005 and 2025 queue lengths. In the 2025 AM peak hour, Alternative R-8A queue lengths at the I-90 westbound center roadway off-ramp at the Airport Way/Dearborn Street/5th Avenue S intersection would increase from 240 feet to 460 feet. This would be due to the increase in westbound center roadway volumes as HOV 2+ can use the center roadway. (Note: Alternative R-1 would allow only transit and HOV 3+ to use the center roadway). Alternative R-8A in the AM and PM peak hour for 2005 and 2025 would increase queue lengths at the I-90 westbound outer roadway off-ramp at the Royal Brougham/1st Avenue S intersection, and at the 4th Avenue S intersection. This would be due to the increased westbound outer roadway capacity created with Alternative R-8A.

Person Throughput

Person throughput is an aggregate measure of the total people traveling through a given corridor, over a given time period, traveling in all available transportation modes. Person throughput was estimated in the I-90 corridor for the peak three hours during the AM and PM peak periods.

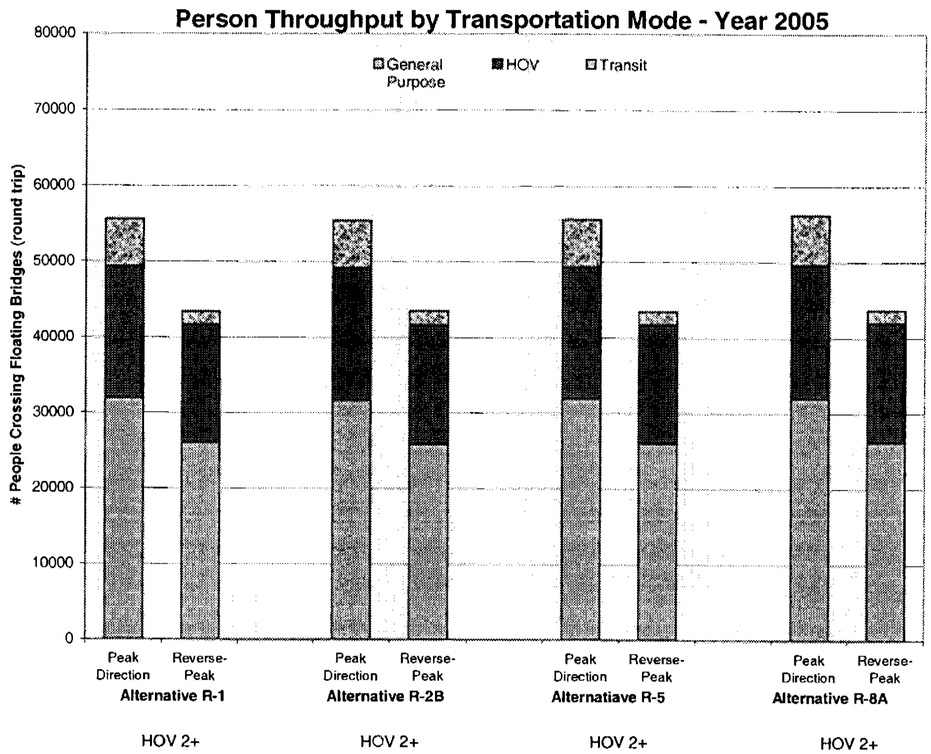
2005

For 2005, total person throughput during these periods would not be expected to vary by more than 600 persons among the Build Alternatives, for travel in the peak directions. For travel in the reverse-peak direction, total person throughput would not be expected to vary by more than 400 persons. These results are shown in Figure 3.2-6.

Transit would carry approximately 10 to 13 percent of the total persons traveling the Project corridor in the peak directions, and approximately 4 to 5 percent in the reverse-peak directions. Alternatives R-2B Modified and R-8A would carry slightly more people in transit than Alternative R-1. Person throughput in transit with Alternative R-5 would be similar to those in Alternative R-1.

People in carpools and vanpools (i.e., HOVs) would account for an additional 30 to 33 percent of the total person throughput in the peak directions and 31 to 41 percent in the reverse-peak directions. All Build Alternatives would be expected to carry similar numbers of people in HOVs in year 2005.

Figure 3.2-6
Person Throughput by Transportation Mode – Year 2005



Note: Volumes represent the peak three hours during the AM and PM peak period for vehicles traveling across the floating bridges.

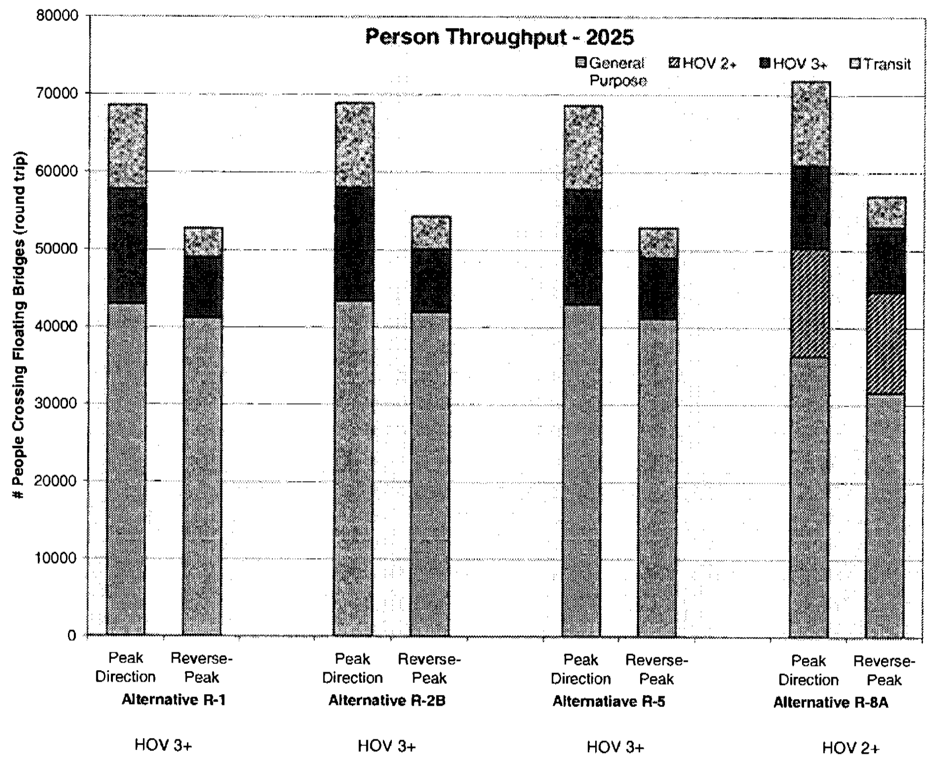
Source: Mirai Associates 2002

General-purpose vehicles would carry the remainder of the people. These types of vehicles would carry approximately 55 to 60 percent of the total person throughput. Travel forecasts indicate that each of the alternatives would carry approximately the same number of persons in general purpose vehicles through the project corridor in year 2005.

2025

In 2025, total person throughput would be expected to vary among the alternatives as shown in Figure 3.2-7. This variation could be as great as 3,000 to 5,800 people in the peak directions, and 1,600 to 4,300 people in the reverse-peak directions. The total person throughput in the peak directions with Alternative R-2B Modified would increase by approximately 5 percent relative to Alternative to R-1. There would be no change in person throughput with Alternative R-5 relative to Alternative R-1. With Alternative R-8A, the increase would be approximately 9 percent. In the reverse-peak directions, the increases in person throughput relative to Alternative R-1 would be expected to be approximately 3 percent with Alternative R-2B Modified and 8 percent with Alternative R-8A. There would be minimal increase in person throughput in the reverse-peak directions with Alternatives R-5 relative to Alternative R-1.

Figure 3.2-7
Person Throughput by Transportation Mode – Year 2025



Note: Volumes represent the peak three hours during the AM and PM peak periods for vehicles traveling across the floating bridges.

Source: Mirai Associates 2002

Transit buses traveling in the peak directions with all alternatives would carry up to 17 percent of the total person throughput. In the reverse-peak directions, transit would carry 7 percent of the total person throughput.

The HOV rule for Alternatives R-1, R-2B Modified, and R-5 would be 3+ for year 2025 and HOV 2+ for Alternative R-8A. Carpools and vanpools would carry approximately 16 to 17 percent of the total person throughput in the AM peak direction with Alternatives R-2B Modified and R-5. These percentages would be similar to those in Alternative R-1. In the PM peak direction, HOVs would comprise around 25 percent of all persons for Alternative R-2B Modified and up to 35 percent for R-8A. These represent increases, compared to Alternative R-1, of 55 percent and 115 percent respectively. Alternative R-5 HOV proportions would be the same as R-1. The large increase in Alternative R-8A is attributable to the difference in HOV rule (i.e., HOV 2+ versus HOV 3+). Comparing just the HOV 3+ portion of carpoolers for peak-direction travel, the number of carpoolers would decrease about 1 percent with Alternative R-2B Modified compared to Alternative R-1, and would decrease 28 percent with Alternative R-8A. In the reverse-peak direction, the HOV 3+ portion would increase 4 percent with Alternative R-2B Modified and 8 percent with Alternative R-8A.

Person Hours of Travel

Person hours of travel provide an aggregate measure for the total time involved in traveling the corridor that encompasses all modes. It is composed of travel time at free-flow speeds, plus time attributable to delays on the freeway mainline, metered on-ramps, and during incidents. The total person-hours of travel are accumulated over the 6-hour AM and 6-hour PM peak periods for a typical weekday. It includes travel in both the outer and center roadways between 4th and 5th Avenues S in Seattle and I-405 in Bellevue.

Total Person Hours

Table 3.2-15 presents the estimates of person-hours of travel for each alternative. Overall person-hours of travel for Alternatives R-1, R-5 Restripe, and R-5 Modified would be similar, at about 40,000 person-hours for the 2005 weekday twelve-hour period. With Alternative R-2B Modified, total person-hours of travel would increase about 8 percent (2005) to 12 percent (2025), compared to Alternative R-1. This effect is attributable to poorer operating conditions in the peak directions of travel that are not offset by the accompanying improved operating conditions in the reverse-peak directions of travel. In Alternative R-8A, total person-hours of travel would improve 15 percent (2005) to 36 percent (2025) compared to Alternative R-1. The additional outer roadway HOV lane provides improved operating conditions in both directions of travel.

Table 3.2-15
Total Person-Hours of Travel
All Alternatives, Year 2005 and 2025

Time Period	Person-Hours (including delay)[1]				
	R-1	R-2BM	R-5R	R-5M	R-8A
Year 2005	39,700	42,700	39,700	40,000	33,600
Year 2025	73,000	81,700	73,200	74,400	46,900

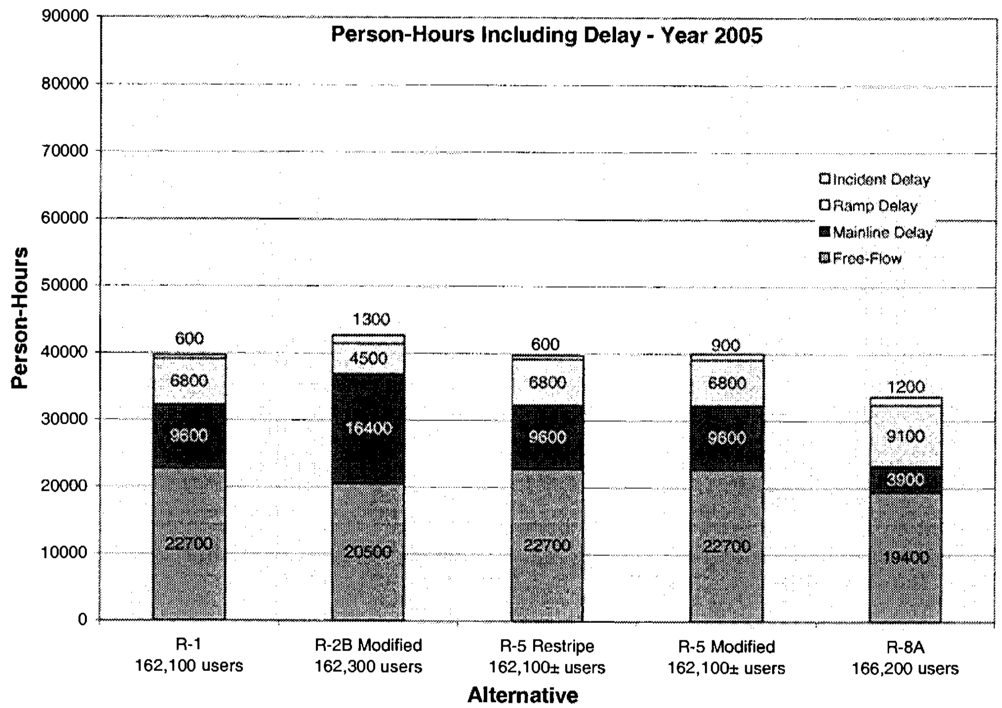
Note: [1] Person-hours were accumulated from 4th Ave to I-405 for AM & PM six-hour peak periods; includes mainline, ramp and incident delay.

Source: HNTB 2002

Person Hours of Delay

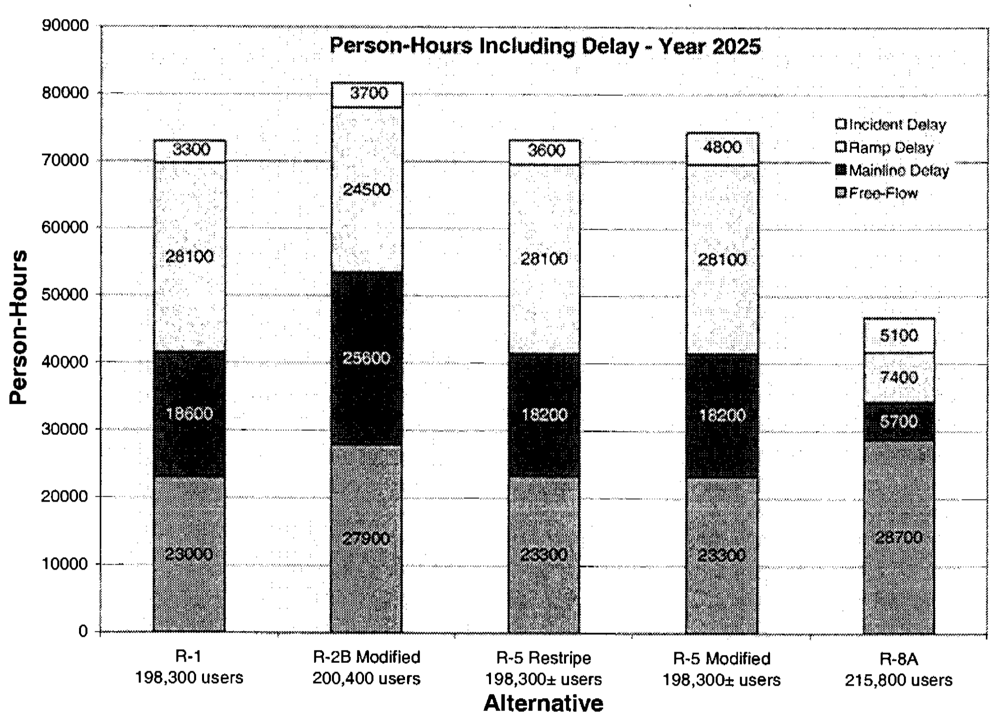
Additional detail concerning the person-hours of travel is provided in Figures 3.2-8 and 3.2-9. In these charts, the contribution of delay is shown for each alternative, with each component of delay identified. In general, delay comprises 43 percent of the total person-hours of travel in Alternatives R-1 and R-5 in 2005, compared to 52 percent in Alternative R-2B Modified, and 42 percent in Alternative R-8A. By 2025, delay would comprise about 68 to 69 percent of total person-hours in Alternative R-1 and R-5, 66 percent in Alternative R-2B Modified, and 38 percent in Alternative R-8A.

Figure 3.2-8
Person-Hours Including Delay - 2005



Source: HNTB 2002

Figure 3.2-9
Person-Hours Including Delay - 2025



Source: HNTB 2002

2005. The delay portion of total person-hours was further analyzed by mode. These results are presented in Table 3.2-16 in terms of minutes of delay per person. These figures represent the delay encountered by travelers on I-90 between 4th/5th Avenues S in Seattle and I-405 in Bellevue.

Table 3.2-16
Average Weekday Delay per Person by Transportation Mode
All Alternatives, Year 2005 and 2025

	Minutes of Delay[1] and Percent Change Relative to Alternative R-1								
	R-1	R-2B		R-5R[2]		R-5M[2]		R-8A	
Year 2005									
Transit									
Peak Direction	0.1	2.0	1900%	0.1	0	0.1	0	0.1	0
Reverse-Peak	4.5	2.1	-53%	4.0	-11%	3.4	-24%	1.3	-73%
Two-Way	**1.0**	**2.0**	**100%**	**1.0**	**0**	**0.8**	**-20%**	**0.3**	**-70%**
Carpool									
Peak Direction	1.5	2.6	73%	1.5	0	1.5	0	1.2	-20%
Reverse-Peak	1.9	1.5	-21%	1.9	0	1.9	0	1.2	-37%
Two-Way	**1.7**	**2.1**	**24%**	**1.7**	**0**	**1.7**	**0**	**1.2**	**-29%**
General Purpose									
Peak Direction	12.2	13.7	12%	12.2	0	12.2	0	12.3	1%
Reverse-Peak	6.3	4.8	-24%	6.3	0	6.7	6%	2.8	-56%
Two-Way	**9.6**	**9.7**	1%	**9.6**	**0**	**9.8**	2%	**8.0**	**-17%**
Year 2025									
Transit									
Peak Direction	0.0	1.5	NA	0.0	NA	0.0	NA	0.1	NA
Reverse-Peak	10.2	1.5	-85%	2.5	-75%	2.2	-78%	1.3	-87%
Two-Way	**2.7**	**1.5**	**-44%**	**0.7**	**-74%**	**0.6**	**-78%**	**0.4**	**-85%**
Carpool									
Peak Direction	3.3	3.2	-3%	3.3	0	3.3	0	1.0	-70%
Reverse-Peak	7.5	1.3	-83%	7.5	0	7.5	0	0.6	-92%
Two-Way	**4.8**	**2.5**	**-48%**	**4.8**	**0**	**4.8**	**0**	**0.8**	**-83%**
General Purpose									
Peak Direction	20.9	26.2	25%	20.9	0	20.9	0	7.1	-66%
Reverse-Peak	18.5	17.5	-5%	19.0	3%	20.1	9%	10.9	-41%
Two-Way	**19.8**	**22.0**	11%	**20.0**	1%	**20.5**	4%	**8.9**	**-55%**

Note: [1] Delay time is calculated from 4th Avenue to I-405 for mainline, ramp, and incident delay, summed over both six-hour AM and PM peak periods.
[2] Alternatives R-5 Restripe & R-5 Modified
[3] Peak direction and reverse-peak direction information has been added to the FEIS.
Source: HNTB 2003

The variability of travel time (i.e., reliability) is not included directly in these measures. In 2005, transit users would experience about 1 minute of delay in Alternative R-1, 2 minutes in Alternative R-2B Modified, and less than one minute in all other alternatives. The increase for Alternative R-2B Modified reflects deterioration of travel times in the peak direction on the center roadway. Although there would be improved travel times in the reverse-peak direction, transit ridership would be lower in these directions of travel, and thus insufficient to offset the peak-direction effects. Transit delay for Alternatives R-5 Restripe and R-5 Modified would be reduced by up to 10 to 20 percent, relative to Alternative R-1. This is due to the shoulder operation in the reverse-peak directions. The outer roadway HOV lanes in Alternative R-8A would reduce transit delay about 70 percent compared to Alternative R-1.

HOVs encounter delay both on the center roadway and on the freeway mainline connecting to the center roadway. With Alternative R-2B Modified in 2005, HOV delay would increase about 24 percent compared to Alternative R-1, attributable to increased delays in the peak directions of travel on the center roadway. HOV delay would be unaffected in Alternatives R-5, and would be reduced by 29 percent with the outer roadway HOV lanes in Alternative R-8A.

General purpose traffic would experience delays of nearly 10 minutes in Alternatives R-1, R-2B Modified, and R-5 in 2005. In Alternative R-2B Modified, delays for general purpose traffic would be reduced in the reverse-peak direction of travel with the additional (HOV) lane provided in those directions, but would increase for peak-direction travel with the loss of that lane. Alternative R-8A would reduce general purpose delays about 17 percent in 2005.

2025. By 2025, delays for transit users in Alternative R-1 would increase to almost 3 minutes, due largely to increasing delays for travel in the reverse-peak direction. Alternative R-2B Modified would reduce delay for transit users about 45 percent, compared with Alternative R-1. In this case, the additional center roadway lane for reverse-peak (HOV) travel would reduce delays in excess of the accompanying increases in the peak directions of travel. Transit delays in Alternatives R-5 and R-8A would be reduced to under 1 minute.

For HOVs, person delays in Alternative R-1 would reach almost 5 minutes in 2025 for HOV 3+ travel, largely due to increased delay in the reverse-peak directions of travel. Alternative R-2B Modified would reduce HOV delays about 48 percent compared to Alternative R-1, by providing preferential treatment with the two-way center roadway. HOV delays in Alternative R-5 would remain similar to those in Alternative R-1 since no HOV priority is provided. In Alternative R-8A, HOV delays (including HOV 2) would be reduced 83 percent with the outer roadway HOV lanes, compared to Alternative R-1.

General purpose traffic would experience delays of 20 to 22 minutes in Alternatives R-1, R-2B Modified, and R-5 by 2025; these figures include HOV 2 traffic. The 11 percent increase in delay for Alternative R-2B Modified reflects deteriorating conditions in the peak directions of travel, though the reverse-peak directions would see reduced delay compared to Alternative R-1. In Alternative R-8A, general purpose traffic would experience a 55 percent reduction in person delay.

Flexibility/Adaptability for Future Light Rail or High Capacity Transit Operation

The Project is not a light rail or High Capacity Transit (HCT) project; it is intended to improve regional express bus transit and HOV operations. If there is a high capacity transit project proposed for I-90 in the future, it would have its own environmental analysis. The project alternatives have been reviewed to determine whether they would be adaptable for a future light rail project. This analysis was completed as part of WSDOT's SR 520 Trans-Lake Washington Project which examined the implications of the implementation of light rail on the I-90 center roadway. Light rail is discussed in this FEIS only as to whether any of the alternatives either preclude future light rail on I-90 or would facilitate future light rail. A similar analysis has not been performed to consider future adaptability to other forms of high capacity transit.

Alternative R-1

With exclusive use of the I-90 center roadway for light rail, transit bus, HOV, and general-purpose traffic would be moved out of the center roadway. This traffic would have to be accommodated in the existing outer roadways. The displacement of this traffic to the outer roadways would be expected to increase the severity and duration of congestion on I-90 between Seattle and Bellevue.

Alternative R-2B Modified

Alternative R-2B Modified would displace general purpose traffic from the center roadway, leaving transit buses and other eligible HOV traffic in the center roadway. As with Alternative R-1, displacement of HOV and bus traffic to the outer roadways would increase congestion levels in the outer roadways. The construction of Alternative R-2B Modified would not preclude a conversion of the center roadway to high-capacity transit in the future. The proposed concrete median barrier would need to be removed from the center roadway for this conversion. With rail-based high-capacity transit, center roadway ramps constructed on Mercer Island as a part of Alternative R-2B Modified would no longer be needed, except for maintenance access.

Alternatives R-5 Restripe and R-5 Modified

Traffic displacements would be similar to those described for Alternative R-1. Modifications to the I-90 outer roadways that would be made as a part of either Alternative R-5 Restripe or Alternative R-5 Modified would not likely conflict with conversion of the center roadway to light rail use, and could likely remain in operation.

Alternative R-8A – Preferred Alternative

Alternative R-8A would be the most adaptable (in physical configuration) alternative in terms of compatibility for conversion of the I-90 center roadway to light rail use. Alternative R-8A would reduce both the construction impacts and long-term impacts of light rail operations on I-90. Alternative R-8A would prepare the corridor for future light rail in the I-90 center roadway by providing HOV lanes and associated HOV direct access ramps on Mercer Island for both directions of travel in the outer roadways, providing a two-way link in the Core HOV lane system for the Puget Sound region. Modifications to the HMH floating bridge would not preclude converting the center roadway to light rail transit or bus rapid transit in the future. Operational impacts of future conversion would be similar to Alternative R-2B Modified due to traffic growth.

Safety

Potential crash rates were estimated using data from the I-90 outer roadways and other congested, urban interstate freeways in Washington State. The estimates contain the expected range of potential crashes based on experiences in these corridors. Crash rates from these corridors were compared in two ways. First, the urban interstate freeways that incorporate standard design elements were compared with those having non-standard lane and shoulder widths. Second, the current operation of I-90 was compared to the interim operation during its construction period, when non-standard lane and shoulder widths were used. The proportionate change in crash rates for these two comparisons provided a range of potential future crash rates for the Build Alternatives without mitigation. Table 3.2-9 in Section 3.2.1.1 shows the potential crash rates and numbers without the application of crash reduction measures.

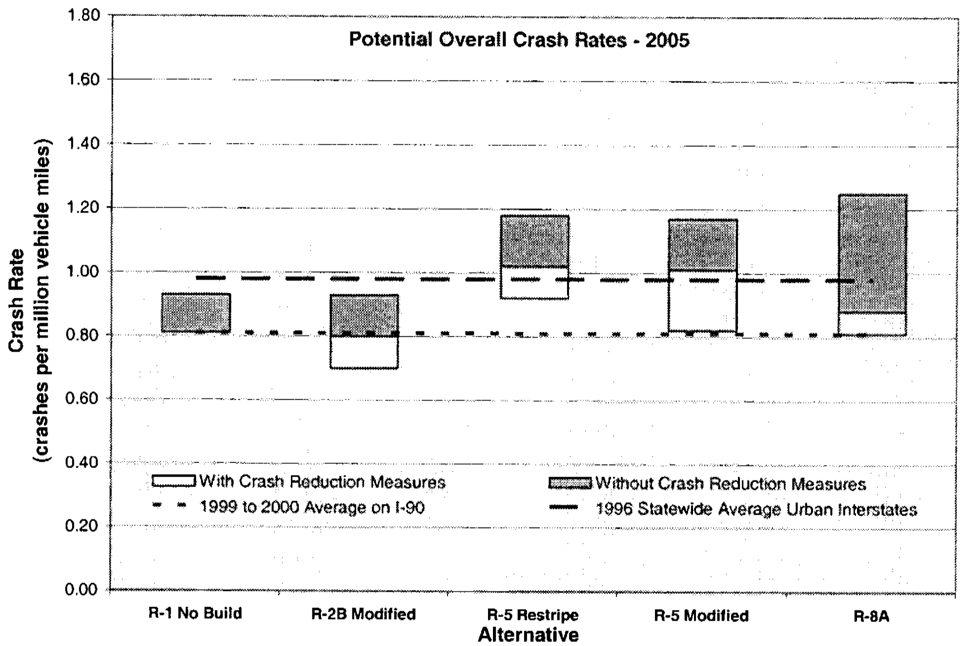
The Preferred Alternative would include crash reduction measures in a targeted program to mitigate the effects of non-standard lane and shoulder widths. Incorporation of these measures would be a condition of Federal Highway Administration (FHWA) approval of any alternative. The effects of the crash reduction measures on potential crash rates and potential crash numbers are also presented in Table 3.2-9.

These estimates are portrayed in Figures 3.2-10 through 3.2-13, showing comparative crash rates for the alternatives. The revised figures explicitly distinguish the effectiveness of the crash reduction measures, showing potential ranges with and without the application of crash reduction measures.

Crash Data

Alternative R-2B Modified. A median barrier would separate the proposed two-way traffic in the center roadway. The addition of the median barrier and associated shy distance would reduce the width of the existing outside shoulders. The outside shoulders on the center roadway would be reduced from 8 feet to 5 feet in both directions except for the Mercer Island Shorewood section where the center roadway would be widened to provide 10-foot shoulders. The 5-foot shoulder widths would be insufficient to accommodate a stalled vehicle without encroachment into the traveled lane. Thus, the potential hazards associated with enforcement, breakdowns, and incident response would increase.

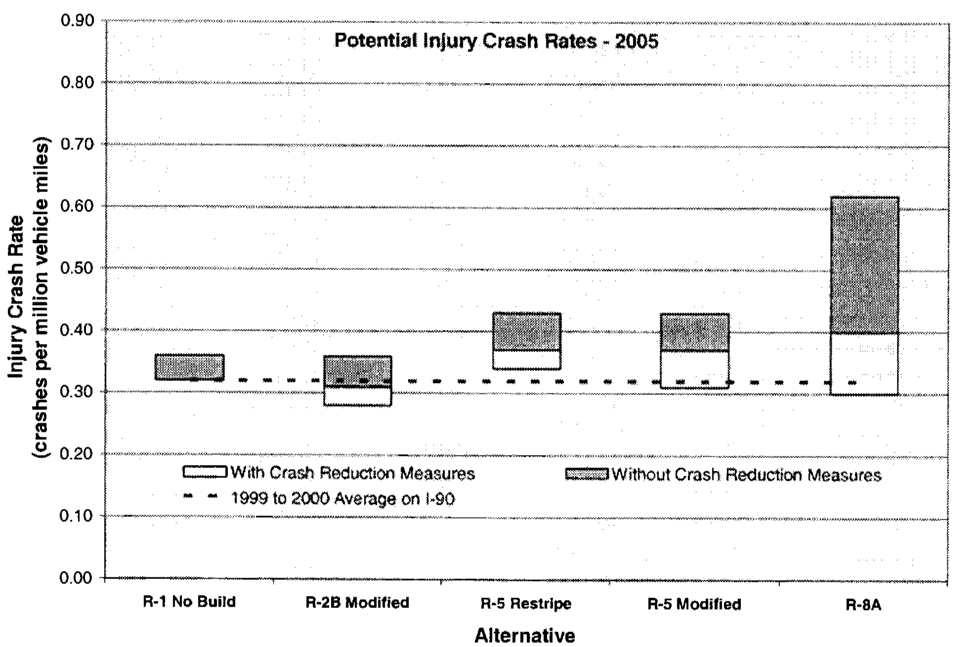
Figure 3.2-10
Potential Overall Crash Rates - 2005



Note: Lower bounds for crash rates include crash reduction measures. Upper bound demonstrate potential crash rates with no crash reduction measures.

Source: HNTB 2002

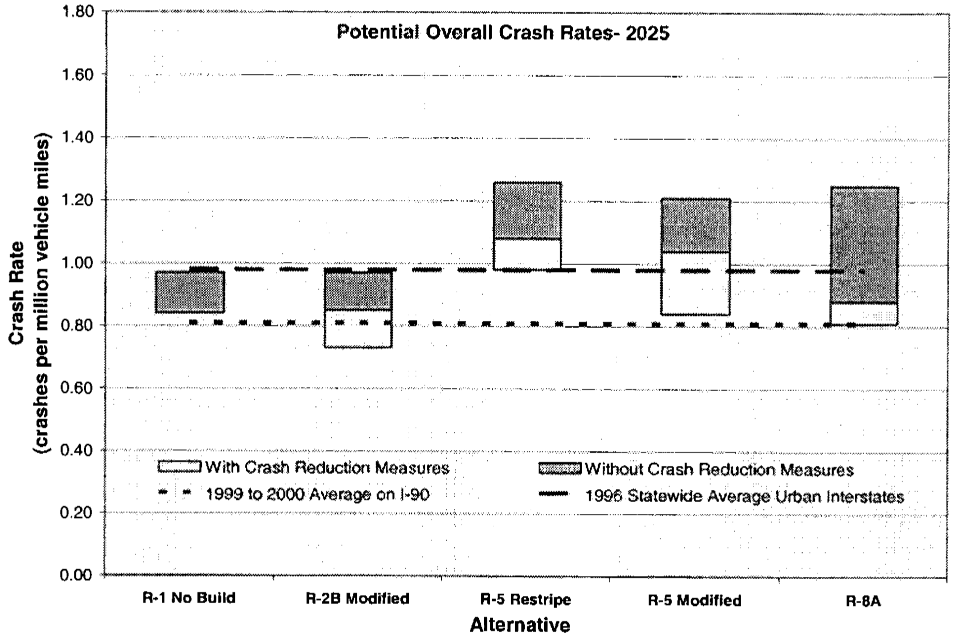
Figure 3.2-11
Potential Injury Crash Rates - 2005



Note: Lower bounds for crash rates include crash reduction measures. Upper bounds demonstrate potential crash rates with no crash reduction measures.

Source: HNTB 2002

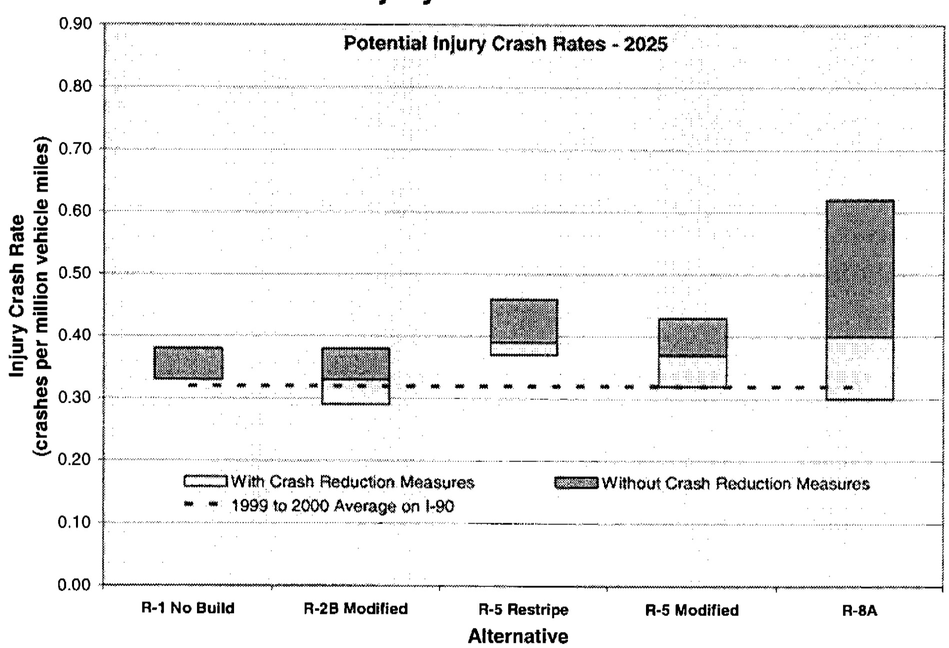
Figure 3.2-12
Potential Overall Crash Rates - 2025



Note: Lower bounds for crash rates include crash reduction measures. Upper bounds demonstrate potential crash rates with no crash reduction measures.

Source: HNTB 2002

Figure 3.2-13
Potential Injury Crash Rates - 2025



Note: Lower bounds for crash rates include crash reduction measures. Upper bounds demonstrate potential crash rates with no crash reduction measures.

Source: HNTB 2002

With a single travel lane in each direction, crashes or stalls could create more frequent blockages of the traveled lane. If the incident involved a bus (no heavy trucks would be present on the center roadway), crash removal would need to be accomplished from downstream or from an adjacent travel lane or shoulder. Although these situations would be infrequent, their consequences would be more severe with the 19-foot roadway envelope that would be provided in each direction with the median barrier. In the case of a stalled bus, trailing buses could be blocked unless the stalled bus was parked within 1 foot of the barrier. In the event of a bus stall, passengers are off-loaded to the right shoulder for transfer to a replacement bus. This passenger movement would require the stalled bus to park with up to 3.3 feet of separation from the barrier to allow transferring passengers to walk to a second bus. In these situations, less than 7.2 feet of width would remain for passing traffic. This width would make even passage of an auto difficult. Consequently, the transfer of passengers would require temporary closure of the center roadway in the direction of travel of the stalled bus. The passage of fire equipment and tow vehicles could be impeded in such incidents.

Alternative R-2B Modified would include crash reduction measures to address safety concerns that would be associated with the reduced roadway envelope available in the center roadway with the addition of a median barrier, and to address increases in congestion in the outer roadways. These crash reduction measures would include speed management such as variable speed limits in the outer roadways, enhanced delineation and signing, and an enhanced incident management program. In addition, the posted speed could be reduced to 50 mph in the center roadway with the Alternative R-2B Modified. This action could produce a favorable impact on crash rates and reduce the severity of injuries in crashes occurring on the center roadway.

The potential number of crashes with Alternative R-2B Modified was estimated using the crash projection methodology. All proposed crash reduction measures have been included and are reflected in the lower bound of the crash data projections. The number of crashes could potentially decrease compared with Alternative R-1, with overall crash rates in the range 0.70 to 0.93 crashes per MVM.

By 2025, the number of crashes could potentially decrease up to 9 percent from Alternative R-1 with the inclusion of crash reduction measures. Overall crash rates could decrease to the range of 0.73 to 0.97 crashes per MVM. The rates of potential injury crashes could range between 0.28 to 0.36 injury crashes per MVM in 2005 and 0.29 to 0.38 injury crashes per MVM in 2025. These rates could potentially be reduced below those of Alternative R-1 with the adoption of the crash reduction measures.

Alternative R-5 Restripe. Alternative R-5 Restripe would provide for transit operations on the shoulders along portions of the outer roadways in the reverse-peak direction (eastbound morning and westbound afternoon). This shoulder operation would serve as a queue bypass for transit buses at congested locations. Bus speeds on the shoulder would be limited to 35 mph through horizontal curves and 45 mph on tangents.

Eastbound buses leaving the Rainier Avenue S Station would be required to weave across the general purpose lanes to reach the transit shoulder. This weaving maneuver would occur on the LVM floating bridge, where traffic flows would be somewhat less constrained than through the Mount Baker Ridge tunnel. Once entering the transit shoulder, eastbound buses stopping on

Mercer Island would exit the outer roadway via the existing exit ramp at 77th Avenue, and would re-enter the freeway via the existing eastbound entrance ramp at Island Crest Way. Through buses would remain on the transit shoulder through this area. East of Island Crest Way, all buses except those destined for Bellevue Way SE would merge across the existing travel lanes on the eastbound outer roadway to enter the existing HOV lane across the East Channel bridge. This process of merging across lanes of slow-moving traffic would introduce weaving delays, based on current operating experience in other corridors with inside HOV lanes.

With the shoulder operation in the eastbound direction, several new conflicts would be introduced at several existing entrance and exit ramps:

- Eastbound motorists exiting the freeway at West Mercer, 77th Avenue SE and Island Crest Way would cross the transit shoulder to reach the exit ramps. This configuration could result in conflicts between traffic exiting to Mercer Island and through buses.

- Vehicles entering eastbound I-90 from Island Crest Way would cross the transit shoulder to merge into the queue in the right travel lane, which could obstruct or delay buses.

Operations at these merge and diverge points would be similar to those that occur on the SR 520 corridor on the existing westbound outside HOV lane. Traffic volumes on the I-90 transit shoulder, however, would be lower than those on the SR 520 HOV lane.

Because it would be on the right side, the westbound transit shoulder operation would have similar conflicts with entrance or exit ramp operations. Through buses would need to weave across the general purpose lanes at both ends of the corridor, in the vicinity of East Mercer Way at the terminus of the westbound HOV lane, and in advance of the Rainier Avenue S station, which would be reached via an existing left-side ramp. Buses stopping on Mercer Island would use the existing exit ramp at Island Crest Way. On returning to the freeway, they would enter the I-90 transit shoulder westbound at 76th Avenue.

The potential number of crashes with Alternative R-5 Restripe was estimated using the crash projection methodology and reduced by the effect of crash reduction measures, as described in Section 3.2.3.1. These measures, which include speed management measures such as variable speed limits, and enhancements to existing delineation and signing, lighting systems, and incident management programs would be focused on the effects of reduced lane and inside shoulder widths with Alternative R-5 Restripe. Compared to Alternative R-1, Alternative R-5 Restripe could potentially result in increases of 55 to 105 annual crashes, representing increases of 15 to 33 percent. Potential crash rates for 2005 could lie between 0.92 to 1.18 crashes per MVM.

By 2025, the increase relative to Alternative R-1 could potentially be 70 to 130 crashes annually, representing a 17 to 37 percent increase. Potential crash rates could range between 0.98 to 1.26 crashes per MVM, reflecting similar increases.

Potential rates of injury crashes could range between 0.34 to 0.43 injury crashes per MVM in 2005 and 0.37 to 0.46 injury crashes per MVM in 2025. These rates represent increases in the potential number of injury crashes of 15 to 35 annually, or up to 22 percent, compared to Alternative R-1.

Alternative R-5 Modified. The westbound shoulder operation would present fewer conflicts with entrance or exit ramp operations. It would occupy the left shoulder of the outer roadway, so through buses would not need to change lanes in the corridor. Buses stopping on Mercer Island would exit the inside transit shoulder on a new ramp at 80th Avenue SE. On returning to the freeway, they would enter I-90 westbound at 76th Avenue SE, and weave across the mixed-travel lanes to the left shoulder. At the Rainier Avenue S station, buses would exit via the existing left-side ramp that provides access to the station and the D2 Roadway.

One ramp conflict would occur at the left-side entrance ramp onto the westbound outer roadway at Island Crest Way, where vehicles entering I-90 would cross the transit shoulder. Except during the AM period when the center roadway operates westbound, Island Crest Way traffic entering I-90 toward Seattle would not have access to the center roadway, and would use the left-side entrance ramp onto the outer roadway. The existing ramp does not provide a parallel acceleration/gap acceptance lane as recommended by current WSDOT design practice. As a result, some motorists could block the transit shoulder as they attempt to merge into the standing queue in the left travel lane. These motorists could obstruct transit buses operating on the inside shoulder. In the year of opening (2005), approximately 250-300 vehicles would enter I-90 during the PM peak hour. Approximately 750 vehicles would utilize this ramp during the anticipated transit shoulder operational period of 3:00 PM to 7:00 PM.

Additional safety impacts would be created by the proposed configuration of shoulders for the westbound outer roadway. The south shoulder width would be increased to 14 feet and the width of the north shoulder decreased to 4 feet. Alternative R-5 Modified would maintain a minimum outside shoulder width of 8 feet in about 70 percent of the corridor that would be useable for breakdowns. Outside these areas, stalled vehicles would be directed to the left shoulder. This movement would be counter-intuitive to motorist's expectations. Travel lanes would be reduced in width with alternative R-5 Modified. Approximately 55 percent of the corridor travel lanes would be the standard 12-foot width. Alternative R-5 Modified would incorporate crash reduction measures to address these safety concerns. Speed management measures such as variable speed limits, and enhancements to existing delineation and signing, lighting systems, and incident management programs would be provided (see Section 3.2.3.1 for additional information).

Compared to Alternative R-1, Alternative R-5 Modified could potentially result in an increase of 15 to 95 crashes annually. Potential crash rates could lie between 0.82 to 1.17 crashes per MVM.

By 2025, the increase relative to Alternative R-1 could be 20 to 100 crashes annually, representing a 6 to 24 percent increase. Potential crash rates could range between 0.84 to 1.21 crashes per MVM.

Potential rates of injury crashes could range between 0.31 to 0.43 injury crashes per MVM in 2005 and 0.32 to 0.43 injury crashes per MVM in 2025. The number of potential injury crashes could increase between 5 and 25 annually, representing an increase of up to 16 percent over the estimates for Alternative R-1.

Alternative R-8A – ***Preferred Alternative.*** Alternative R-8A would provide for transit and carpool operations in high-occupancy vehicle (HOV) lanes that would be established on the eastbound and westbound outer roadways. This would be accomplished with a combination of minor widening and cross-section revisions, including the adoption of lanes and shoulders of non-standard width in the corridor. The HOV designation would be assigned to the inside (median) lane, extending from approximately the Mount Baker Ridge tunnel/lid to the existing Shorewood slip ramps on Mercer Island, where they would connect to the existing inside HOV lanes along I-90 eastward to Issaquah. The portion of the corridor affected by the reduced-width lanes and shoulders would extend from I-5 to the East Channel bridge. Proposed lane and shoulder widths in each corridor section are described in Chapter 2, Section 2.2.5; approximately 60 percent of the corridor would have an outside shoulder 8 feet wide or wider, which would be adequate for use as a refuge for disabled vehicles; approximately 40 percent of the corridor lanes would be the standard 12-foot width.

As described in Section 3.2.1.1 - Existing Conditions, precedent exists for the application of reduced lane and shoulder widths to implement HOV lanes on interstate highway facilities. In addition, I-90 operated for several years in an interim condition that provided a westbound lane configuration similar to that proposed with Alternative R-8A, e.g., with 11-foot wide travel lanes and shoulders 2 to 6 feet in width. Comparative crash rates for these types of facilities are shown in Figure 3.2-2.

Safety issues that arise in the context of this design approach include the lateral placement of vehicles within the non-standard lanes, inadvertent lane line crossings, and limited maneuvering area for large trucks within the traffic stream. The utility of the remaining shoulders for emergency recovery maneuvers, refuge for disabled vehicles, motorist assistance activities, emergency incident response, highway maintenance activities, and traffic law enforcement is also an issue. For these reasons, Alternative R-8A would incorporate crash reduction measures to address these concerns. Enhancements to existing delineation and signing, lighting systems, and incident management programs; design features such as shoulder rumble strips, refuge areas, and additional widening to improve sight distances; and speed management measures would be provided (see Section 3.2.3.1 for additional information). Additionally, the reduction of overall congestion levels in the I-90 corridor would provide safety benefits by reducing congestion-related crashes in the outer roadways, although some concern exists regarding the potential migration of congestion-related crashes to the vicinity of the system interchanges at I-5 and I-405.

By 2005, Alternative R-8A could result in an increase of 10 to 150 crashes compared to Alternative R-1. Potential crash rates could range between 0.81 to 1.25 crashes per MVM. By 2025, the increase in crashes relative to Alternative R-1 could be 5 to 145 crashes. Potential year 2025 crash rates are estimated to be the same as those for year 2005, as Alternative R-8A would continue to provide congestion relief similar in magnitude to that which would occur in the year 2005. Potential rates of injury crashes could range between 0.3 to 0.62 injury crashes per MVM in 2005 and 0.3 to 0.62 injury crashes per MVM in 2025. The number of injury crashes could potentially increase up to 115 injury crashes annually, or about 76 percent, relative to Alternative R-1.

Incidents

Annual incident frequency was estimated based on combined traffic volumes during the hours that WSDOT operates the Incident Patrol. The number of potential annual incidents for all alternatives is shown in Table 3.2-17. Enhanced incident management would be provided on the sections of the corridor with restricted shoulder widths for all Build Alternatives. See Section 3.2.3.4.

Alternative R-2B Modified. Incidents in the outer roadways would increase by 1 to 2 percent compared to Alternative R-1. With the lanes reduced from 2 to 1 in the center roadway, traffic that would use the center roadways today would be diverted to the outer roadways.

The total number of incidents in the center roadway would be fewer than Alternative R-1, but the number of blocking incidents would increase. For each direction of travel through most of the corridor, the median barrier in the center roadway would create an available width of about 19 feet with a 12-foot travel lane. The Mercer Island Shorewood section would have an available width of about 24 feet. Breakdowns in the narrower section could create more frequent blocking conditions. A passenger car breakdown would not block the passage of flowing passenger cars, but could impede or block the passage of a bus. A disabled bus could allow passenger cars to pass, but a following bus would block traffic flow completely. An incident response and clearance plan would be part of Alternative R-2B Modified.

Alternatives R-5 Restripe and R-5 Modified. The total number of incidents in the outer roadways would be the same as Alternative R-1, but the number of blocking incidents would increase. For Alternative R-5 Restripe a 10 percent increase would be due to buses using the outside shoulder in the reverse-peak direction and eliminating this shoulder as a refuge for vehicles in trouble.

Blocking incidents in the outer roadways for Alternative R-5 would increase 48 to 50 percent. Although, Alternative R-5 Modified would be identical to R-5 Restripe in the eastbound direction, the transit shoulder in the westbound direction would be located on the inside. Any westbound vehicle seeking refuge in the shoulder, regardless of peak or reverse-peak direction, would have to realize that the shoulder is on the left. An incident response and clearance plan would be part of both R-5 Alternatives.

Alternative R-8A – *Preferred Alternative*. Incidents in the outer roadways would increase by 5 percent or less compared to Alternative R-1, but blocking incidents would increase from 110 to 123 percent. The increases would be due to the additional lane of traffic and corresponding additional volumes in each direction. Through much of the corridor, inside shoulder widths would be reduced to 2 feet. However, in the westbound direction on the HMH floating bridge and through the First Hill lid, the reduced shoulder width would be located on the right-hand side. Like Alternative R-5 Modified, any westbound vehicle seeking refuge in these sections would have to move to the left. An incident response and clearance plan would be part of Alternative R-8A.

In 2005, incidents in the center roadway would decrease relative to Alternative R-1. With the availability of the outer roadway HOV lane, fewer carpools would be using the center roadway. In 2025, The number of incidents would increase relative to Alternative R-1 because the volume of traffic in the center roadway for Alternative R-8A would be higher. Carpool eligibility under Alternative R-8A in 2025 would continue to be HOV 2+ while Alternative R-1 would have changed the eligibility to HOV 3+.

Table 3.2-17
Potential Annual Incidents
All Alternatives, Year 2005 and 2025

Year/Roadway	Alternative				
	R-1	R-2BM	R-5R[1]	R-5M[1]	R-8A 2+
Year 2005					
Outer Roadways					
Total Incidents	810	820	810	810	850
Change from R-1		+1%	0%	0%	+5%
Blocking Incidents	240	245	265	360	535
Change from R-1		+2%	+10%	+50%	+123%
Center Roadway					
Total Incidents	80	75	80	80	65
Change from R-1		-6%	0%	0%	-19%
Blocking Incidents	10	40	10	10	10
Change from R-1		+300%	0%	0%	0%
Year 2025					
Outer Roadways					
Total Incidents	970	1000	970	970	975
Change from R-1		+3%	0%	0%	+<1%
Blocking Incidents	290	300	320	430	610
Change from R-1		+3%	+10%	+48%	+110%
Center Roadway					
Total Incidents	60	30	60	60	90
Change from R-1		-50%	0%	0%	+50%
Blocking Incidents	10	15	10	10	15
Change from R-1		+50%	0%	0%	+50%

Note: [1] Alternatives R-5 Restripe & R-5 Modified.

Source: HNTB 2002

Maintenance and Operations

Alternative R-2B Modified. Alternative R-2B Modified would reduce the center roadway north side shoulder width on the HMH floating bridge from 12 feet to 5 feet. With this change, pontoon access could only be gained by closing the westbound center roadway, limiting access to the pontoons to off-peak periods, and increasing the cost of routine maintenance operations. Responses to alarms in the pontoons, which occur several times a month in the winter months, would require an emergency closure of the westbound center roadway. This would increase maintenance costs by requiring additional traffic control measures, and would decrease the reliability of the westbound center roadway for transit and HOV traffic, as responses to alarms cannot be deferred to off-peak period times.

With Alternative R-2B Modified, a median barrier would be used to separate opposing traffic. The barrier would become part of the center roadway facility. As with all roadway features, the barrier would have to be maintained. The likely median barrier to be placed would be pre-cast concrete. This type of barrier is placed in sections and pinned together. It resists lateral movement by a combination of inertial friction and the pins. The system is sufficient to prevent crossover vehicles from impacting opposing traffic, but usually results in some displacement of the barrier. With Alternative R-2B Modified, maintenance crews would need to reset the median barrier after crashes, which would require closure of the center roadway, possibly in both directions.

Alternatives R-5 Restripe and R-5 Modified. During the hours of transit shoulder operation, the outside shoulder would not be available for maintenance activities. When not operating as a transit shoulder, the wider outside shoulder would provide increased lateral clearance for maintenance activities.

With Alternative R-5 Modified, in the westbound Mount Baker Ridge tunnel and the First Hill lid, the outside shoulder would be reduced in width from the existing 10 feet to 4 feet. With this width reduction in the westbound direction, some routine maintenance operations such as sweeping shoulders and cleaning CCTV cameras would require closure of the adjacent travel lane.

The pontoons on the LVM floating bridge have access hatches on the north and south side of the bridge. North side hatches are accessible by boat from the lagoon between the two floating bridges. These hatches would continue to be accessible for routine maintenance. Access to the south side hatches is needed on an irregular and infrequent basis. South side hatches would continue to be accessible during the hours the transit shoulder would not be in operation. However, the hatches would need to be upgraded to accommodate transit bus wheel loads.

Drainage structures located on the outside shoulders would require replacement and/or upgrades to accommodate transit bus wheel loads. The grates and covers of these structures would need to be replaced more often with Alternative R-5 (Restripe or Modified) than with Alternative R-1.

Alternative R-8A – *Preferred Alternative*. Alternative R-8A would reduce the inside shoulders in the outer roadways, requiring a closure of the proposed HOV lane to maintain roadway features only accessible from the left side of the outer roadways. However, the existing inside shoulder is not sufficient to allow maintenance operations without closing the adjacent inside lane.

Outside shoulders in Mount Baker Ridge tunnels and the First Hill lid would be reduced in width from the existing 9-10 feet to 4 feet or less. With this width reduction in both directions, many routine maintenance operations such as sweeping shoulders and cleaning CCTV cameras would require closure of the adjacent travel lane.

The HMH floating bridge pontoons are currently reached via the center roadway. On the floating portion of the bridge, there is a 12-foot wide shoulder that is used by WSDOT maintenance forces for routine and emergency access to the pontoon access hatches. Alternative R-8A would reduce the available width of this shoulder to 10 feet, which would still be sufficient for typical maintenance operations. Some operations that require use of larger maintenance trucks, such as cranes with outriggers, would require closure of the adjacent travel lane.

Between First Hill lid and the Luther Burbank lid, the outside shoulders of the outer roadways would be less than 10 feet wide with Alternative R-8A. The reduced shoulder width would impede maintenance operations on the right side of the outer roadways in the vicinity of the Mercer Island CBD. To reduce this impact, Alternative R-8A would provide 14-foot wide maintenance pullouts in the vicinity of the Mercer Island CBD.

Alternative R-8A would reduce the amount of landscaping on Mercer Island. The reduced amount of landscaping would require less maintenance activities as a result.

I-5 and I-405 System Interchanges

To identify the potential effects of the alternatives under consideration on the system interchanges that bound the study corridor, analyses were conducted using the CORSIM microsimulation model. Two separate models were set up, one for the I-5 interchange with I-90, and one for the I-405 interchange with I-90. These models were used to simulate the AM and PM peak hours in both 2005 and 2025, which would represent the highest traffic demands on the freeway system at these locations.

The focus of the system interchange analysis was on the impacts associated with operations on the intersecting freeways and the connecting ramps. These impacts are evaluated using the mainline speeds on sections of I-5 and I-405 immediately adjacent to I-90. For the connecting ramps, maximum lengths of queues were estimated.

I-5 at I-90 Interchange

The I-5 interchange model encompasses an area extending along I-5 from Spokane Street on the south to the collector-distributor merge/diverge in the vicinity of Cherry Street on the north. The model includes the portion of I-90 from the 4th Avenue S/SR 519 ramps to the east portal of the Mount Baker Ridge tunnels. Key traffic movements considered in the system interchange analysis include:

- Westbound I-90 to Southbound I-5
- Westbound I-90 to Northbound I-5
- Northbound I-5 to Eastbound I-90
- Southbound I-5 to Eastbound I-90
- Northbound I-5 between Spokane Street and I-90
- Southbound I-5 between I-90 and Spokane Street

Other traffic movements at the I-5 interchange would not be affected to any large degree by changes in I-90 traffic demands that would occur with the alternatives under consideration.

Alternative R-1. Mainline speeds on I-5 south of I-90 would be in the ranges of 15 to 20 mph for northbound AM peak hour traffic, 35 mph for northbound PM peak hour traffic, and 40 to 45 mph for all other conditions. Queues for westbound I-90 traffic destined for I-5 would extend beyond the ramps back along I-90 into the Corwin curves, similar to today's patterns. In particular, the queue from westbound I-90 to southbound I-5 would extend back to the center roadway slip ramp during the 2005 and 2025 AM peak hours, and would reach the Rainier Avenue S Transit Station during the 2005 and 2025 PM peak hours.

Much of the delay in the I-90 corridor would occur between I-5 and the Mount Baker Ridge tunnels, particularly in the eastbound PM peak period. During this period, more than 50 percent of total corridor delay, occurs in this portion of the corridor. This delay would affect carpools not using the D2 Roadway.

Alternative R-2B Modified. Traffic volumes on I-5 and ramps to and from I-90 would be similar or slightly lower than Alternative R-1. Northbound and southbound I-5 mainline speeds between Spokane Street and I-90 would increase slightly, less than 5 mph, or be the same in comparison to Alternative R-1. AM peak hour queues for westbound I-90 traffic destined for southbound I-5 would be similar to or shorter than Alternative R-1, due to the reduced traffic throughput and increased congestion in the peak direction on I-90 that would be associated with Alternative R-2B Modified. PM peak hour queues for westbound I-90 to southbound I-5 traffic would increase relative to Alternative R-1 because of increased reverse-peak direction throughput with Alternative R-2B Modified, but would not extend back to the center roadway slip ramp.

With Alternative R-2B Modified, increases in year 2005 eastbound PM peak period congestion through the Corwin curves on I-90 would increase person hours of delay by 20-25 percent for outer roadway traffic, including carpools, relative to the No-Build Alternative. With these increases, approximately 60 percent of the total corridor person hours of delay would occur between I-5 and the Mount Baker Ridge tunnels.

Alternatives R-5 Restripe and R-5 Modified. Queues, delays, and speeds at the I-5 interchange would be similar to those in Alternative R-1.

Alternative R-8A – *Preferred Alternative*. Peak hour traffic volumes on I-5 south of I-90 would increase up to 3 percent relative to Alternative R-1. Differences in mainline speeds on I-5 south of I-90 would be less than 5 mph in comparison to Alternative R-1. On the ramps to and from I-90, year 2025 peak hour volume increases would typically be less than 5 percent, except on the ramps to and from the south, where peak hour volumes would increase approximately 4-9 percent relative to Alternative R-1. AM peak hour queues for westbound I-90 traffic destined to southbound I-5 would be reduced in length with the added travel lane on I-90 in the Corwin curves, but would still extend back onto the I-90 mainline, to the Rainier Avenue S Transit Station with 2005 AM peak hour traffic conditions, and the center roadway slip ramp with 2025 AM peak hour traffic conditions. PM peak hour queues would increase relative to Alternative R-1, but would not block the center roadway slip ramp.

Increased capacity with Alternative R-8A would result in large decreases in eastbound PM peak hour person delay in the Corwin curves, over 90 percent, relative to Alternative R-1. This reduction in delay would also apply to carpools.

I-405 at I-90 Interchange

The I-405 interchange model encompassed an area extending along I-405 from Coal Creek Parkway on the south to SE 8th Street on the north. The model included the portion of I-90 from East Mercer Way to a point east of the interchange at the merge/diverge point of the I-405 ramps on I-90. Key movements considered in the system interchange analysis included:

- Eastbound I-90 to southbound I-405
- Eastbound I-90 to northbound I-405
- Northbound I-405 to westbound I-90
- Southbound I-405 to westbound I-90

Other traffic movements at the I-405 interchange would not be affected to any large degree by changes in I-90 traffic demands that would occur with the alternatives under consideration.

Alternative R-1. Mainline travel speeds on I-405 south of I-90 would be in the range of 15 to 20 mph for northbound AM and southbound PM travel. Northbound PM traffic would experience speeds of 25 to 30 mph. North of I-90, speeds on southbound I-405 would be 15 to 25 mph during PM peak hour conditions. Speeds for all other conditions would remain in the range of 45 to 50 mph. Less than 10 percent of the total year 2025 AM peak period westbound I-90 mainline delay would occur between I-405 and Bellevue Way SE.

Queues for eastbound I-90 traffic destined to I-405 would extend onto the I-90 mainline during 2005 and 2025 AM peak hour conditions. Queues for all other conditions would be confined to the ramps and collector-distributor roads.

Alternative R-2B Modified. With the increase in westbound PM capacity on I-90, (reverse-peak direction) year 2005 traffic volumes would increase up to 5 percent. In 2025, and for other traffic movements, these increases would be 1 percent or less. On I-405 south of I-90, mainline speeds would be within 5 mph of those that would occur with Alternative R-1. North of I-90, speeds on the I-405 mainline would decrease 15 mph for southbound 2025 AM peak conditions, compared to Alternative R-1. The AM peak effect can be attributed to the loss of center roadway capacity on westbound I-90 for peak direction travel.

Approximately 50 percent of the total year 2025 AM peak westbound period I-90 mainline delay would occur between I-405 and Bellevue Way SE. This increase in congestion at the eastern end of the I-90 project study area contributes to a three-fold increase in total corridor delay, relative to Alternative R-1.

Queue lengths for the eastbound I-90 movement to I-405 would extend onto the I-90 mainline during both the 2005 and 2025 PM peak hours, similar in length to Alternative R-1. All other queues would be confined to the ramps and collector-distributor roads.

Alternatives R-5 Restripe and R-5 Modified. Queues, delays and speeds at the I-405 interchange would be similar to those in Alternative R-1.

Alternative R-8A– *Preferred Alternative*. Year 2005 PM peak hour traffic volumes on the ramps to and from I-405 would increase 5 to 8 percent relative to Alternative R-1. These increases would be 2 percent or less for year 2025 volumes. Mainline I-405 volumes would change less than 1 percent in the year 2005 and 4 percent in the year 2025. Mainline speeds on I-405 south of I-90 would increase less than 5 mph for the northbound 2005 AM peak hour, and would decrease about 5 mph for the southbound PM peak hour, as a result of the added outer HOV lane on eastbound I-90 with Alternative R-8A. For northbound PM travel, speeds would remain in the range of 25 to 30 mph, similar to Alternative R-1. North of I-90, mainline I-405 speeds would improve almost 10 mph for southbound PM travel, reflecting the added outer HOV lane on westbound I-90.

Approximately 15 percent of the total year 2025 AM peak period westbound I-90 mainline delay would occur between I-405 and Bellevue Way SE. Overall, decreases in westbound I-90 mainline congestion would reduce total person hours of delay by about two-thirds relative to Alternative R-1.

During the peak hour, queues for the eastbound I-90 movement to I-405 would increase with this alternative, extending nearly to the Bellevue Way SE exit ramp. All other queues would be confined to the ramps and collector-distributor roads.

Table 3.2-18 summarizes the I-405 mainline travel speeds.

3.2.2.3 Summary Comparison of Impacts of Alternatives on Freeway Operations

Construction

Table 3.2-19 compares construction activities for each of the Build Alternatives.

Table 3.2-18
I-405 Mainline, Vicinity of I-90 Interchange
Average Peak Hour Travel Speeds

Direction	Peak Hour	Alternative R-1	Alternative R-2BM	Alternative R-5R/R-5M	Alternative R-8A
		(Mainline Speed, miles per hour)			
I-405 South of I-90 (2005)					
Northbound	AM	20-24	20-24	20-24	20-24
Southbound	AM	45-49	45-49	45-49	45-49
Northbound	PM	25-29	25-29	25-29	25-29
Southbound	PM	20-24	15-19 (-5)	20-24	15-19 (-5)
I-405 North of I-90 (2005)					
Northbound	AM	45-49	45-49	45-49	45-49
Southbound	AM	45-49	45-49	45-49	45-49
Northbound	PM	45-49	45-49	45-49	45-49
Southbound	PM	15-19	15-19	15-19	20-24 (+7)
I-405 South of I-90 (2025)					
Northbound	AM	15-19	15-19	15-19	15-19
Southbound	AM	45-49	45-49	45-49	45-49
Northbound	PM	25-29	25-29	25-29	25-29
Southbound	PM	15-19	15-19	15-19	15-19
I-405 North of I-90 (2025)					
Northbound	AM	45-49	45-49	45-49	45-49
Southbound	AM	45-49	30-34 (-15)	45-49	40-44 (-1)
Northbound	PM	45-49	45-49	45-49	45-49
Southbound	PM	20-24	25-29 (+3)	20-24	20-24

(+) Improves relative to R-1
(-) Degrades relative to R-1

Differences > 5 mph:
I-405 North of I-90, Southbound PM Peak Hour: Improves w/R-8A (Year 2005)
I-405 North of I-90, Southbound AM Peak Hour: Degrades w/R-2B Modified (Year 2025)

Source: CORSIM microsimulations, HNTB 2002 & 2003

Table 3.2-19
Comparison of Construction Activities for Build Alternatives

Roadway Section	Alternative R-2B Modified	Alternative R-5 Restripe	Alternative R-5 Modified	Alternative R-8A
Seattle, I-5 to Mount Baker Ridge	Short off-peak center roadway closures to place barrier, restripe and sign; Transit access to D2, but no HOV; staging at emergency access ramp west of Rainier Ave S station.	No construction this section.	No construction this section.	Long-term east-bound and west-bound shoulder closures and lane-width reductions to widen outer roadways; short off-peak lane closures to restripe and sign; possible staging along Rainier Ave S, Dearborn St. or 4th Ave S.
HMH Floating Bridge (westbound and center lanes)	Short off-peak center roadway closures to place barrier, restripe and sign; minimal staging in this section.	Short off-peak lane closures to restripe and sign; use center roadway for detour; no staging this section.	Short off-peak lane closures for material delivery with center roadway detour .	Long-term closures of shoulders next to median barrier to move barrier; short off-peak lane closures for material delivery with center roadway detour.
LVM Floating Bridge (eastbound lanes)	No construction this section.	Short off-peak lane closures to restripe and sign; use center roadway for detour; no staging this section.	Short off-peak lane closures to restripe and sign; no staging this section.	Long-term closure of north shoulder and lane-width reductions to construct new scuppers; short off-peak lane closures to restripe and sign; no staging this section.
Mercer Island/ First Hill Lid	Short off-peak center roadway closures to place barrier, restripe and sign; minimal staging in this section.	Short off-peak lane closures to restripe and sign; use center roadway for detour; possible staging in right-of-way.	Short off-peak lane closures to restripe and sign; no staging this section.	Long-term closure of westbound outside shoulder and lane-width reductions to widen west portal of First Hill lid; short off-peak closures of adjacent lane for material deliveries; short off-peak lane closures to restripe and sign; no staging this section.
Mercer Island CBD	Long-term outer roadway lane and inner shoulder reductions and center roadway lane reductions for contractor access to structures for 77th and 80th ramps; short off-peak center roadway closures to place barrier, restripe and sign; staging within center roadway or leased property.	Short off-peak lane closures to restripe and sign; use center roadway for detour; possible staging in right-of-way.	Long-term west-bound and center roadway lane and shoulder reductions and possible long-term closure of one center lane to build 80th ramp; short off-peak outer roadway closures to restripe and sign with center road-way detour; staging within center roadway or leased property.	Long-term center and outer road-way lane and shoulder reductions and possible long-term closure of one center lane to build 77th Avenue SE and 80th Avenue SE ramps, maintenance pullouts and enforcement areas; short off-peak outer road-way closures to restripe and sign with center road-way detour; staging within center roadway or leased property.

Table 3.2-19 (Continued)
Comparison of Construction Activities for Build Alternatives

Roadway Section	Alternative R-2B Modified	Alternative R-5 Restripe	Alternative R-5 Modified	Alternative R-8A
Mercer Island/ Shorewood	Long-term lane closures to widen center roadway; short off-peak center roadway closures to place barrier, restripe and sign; staging within center roadway.	Short off-peak lane closures to restripe and sign; use center roadway for detour; no staging this section.	Long-term east-bound and center roadway shoulder and lane-width reductions to widen outer roadway; short off-peak west-bound lane closures to widen outer roadway; use center road-way for detour; short off-peak center roadway closures for material delivery; staging within center roadway or under E Channel bridge.	Long-term east-bound and center roadway shoulder and lane-width reductions to widen outer roadway; short off-peak west-bound lane closures to widen outer roadway; use center road-way for detour; short off-peak center roadway closures for material delivery; staging within center roadway or under E Channel bridge.
East Channel Bridge/ Bellevue/ Bellevue Way SE	Long-term closure of E Channel bridge inside shoulder, one center lane and eastbound lane-width reductions to relocate median barrier; long-term center roadway lane and shoulder width reductions and short off-peak center roadway closures to place barrier, restripe and sign; staging in right-of-way, under E Channel bridge or within center roadway.	No construction this section.	Long-term west-bound and center roadway lane and shoulder width reductions and short off-peak Bellevue Way SE ramp closures to add transit-only lane; short off-peak E Channel bridge lane closures to restripe and sign; staging in right-of-way, under E Channel bridge or within center roadway.	Long-term closure of E Channel bridge inside shoulder, east-bound lane-width reductions and closure of one center lane to move median barrier; long-term westbound and center roadway lane and shoulder width reductions and short off-peak Bellevue Way SE ramp closures to add transit-only lane; short off-peak E Channel bridge lane closures to sign and restripe; staging in right-of-way, under E Channel bridge or within center roadway.

Operation

Table 3.2-20 shows the summary of statistics relating to the movement of vehicles, persons and goods within the study area for both the 2005 and 2025 projection years. Additionally, a comparison between Alternative R-1 and the Build Alternatives (R-2B Modified, R-5 Restripe, R-5 Modified, and R-8A) was conducted. Percent changes over Alternative R-1 are shown in the parentheses below for ease in comparing statistics and alternatives.

Table 3.2-20
Comparison of Impacts on Freeway Users, Year 2005 and 2025

	Year	R-1	R-2B Modified	R-5 Restripe and R-5 Modified	R-8A
Travel time - peak direction - AM	2005 2025	10.1 minutes 13.1 minutes	9.9 minutes (-2%) 14.4 minutes (+10%)	10.1 minutes (0%) 13.1 minutes (0%)	8.4 minutes (-17%) 8.6 minutes (-34%)
Travel time - peak direction - PM	2005 2025	11.6 minutes 13.7 minutes	13.8 minutes (+19%) 13.8 minutes (+1%)	11.6 minutes (0%) 13.7 minutes (0%)	8.9 minutes (-23%) 9.0 minutes (-34%)
Congestion duration - peak direction – Daily Total	2005 2025	7¾ hours 10 hours	8¾ hours (+13%) 10 hours (0%)	7¾ hours (0%) 10 hours (0%)	<2 hours (-74%) <2 hours (-80%)
Congestion duration – reverse-peak direction – Daily Total	2005 2025	8¼ hours 10¼ hours	5½ hours (-33%) 10¼ hours (0%)	8¼ hours (0%) 10¼ hours (0%)	<2 hours (-76%) 3¼ hours (-68%)
Person hours of travel	2005 2025	39,700 hours 73,000 hours	42,700 hours (+8%) 81,700 hours (+12%)	39,700 hours (R-5R) (<1%) 40,000 hours (R-5M) (<1%) 73,200 hours (R-5R) (<1%) 74,400 hours (R-5M) (2%)	33,600 hours (-15%) 46,900 hours (-32%)
Delay/person traveling on Transit	2005 2025	1.0 minutes 2.7 minutes	2.0 minutes (100%) 1.5 minutes (-44%)	1.0 minutes (R-5R) (0%) 0.8 minutes (R-5M) (-20%) 0.7 minutes (R-5R) (-74%) 0.6 minutes (R-5M) (-78%)	0.3 minutes (-70%) 0.4 minutes (-85%)
Daily Traffic Volumes (AWDT)	2005 2025	159,000 164,500	159,000 164,000	160,000 164,000	161,500 177,000
Delay/person traveling in Vanpools/Carpools	2005 2025	1.7 minutes 4.8 minutes	2.1 minutes (+24%) 2.5 minutes (-48%)	1.7 minutes (0%) 4.8 minutes (0%)	1.2 minutes (-29%) 0.8 minutes (-83%)
Delay/person traveling in GP Lanes	2005 2025	9.6 minutes 19.8 minutes	9.7 minutes (+1%) 22.0 minutes (+11%)	9.6 minutes (R-5R) (0%) 9.8 minutes (R-5M) (+2%) 20.0 minutes (R-5R) (+1%) 20.5 minutes (R-5M) (+4%)	8.0 minutes (-17%) 8.9 minutes (-55%)

Table 3.2-20 (Continued)
Comparison of Impacts on Freeway Users, Year 2005 and 2025

	Year	R-1	R-2B Modified	R-5 Restripe and R-5 Modified	R-8A
Potential Number of Crashes per year*	2005	320-365	285-365 (-11% to 0%)	380-465 (R-5R) (+15% to +27%) 335-460 (R-5M) (+5% to +26%)	330-515 (+3% to +41%)
	2025	355-410	325-415 (-8% to +1%)	435-535 (R-5R) (+17% to +30%) 375-510 (R-5M) (+6% to +24%)	360-555 (+1% to +35%)
Potential Crash Rate/MVM*	2005	0.81-0.93	0.70-0.93 (-14% to 0%)	0.92-1.18 (R-5R) (+14% to +37%) 0.82-1.17 (R-5M) (+2% to +26%)	0.81-1.25 (0% to +34%)
	2025	0.84-0.97	0.73-0.97 (-13% to 0%)	0.98-1.26 (R-5R) (+17% to +30%) 0.84-1.21 (R-5M) (0% to +25%)	0.81-1.25 (-4% to +29%)

GP Lanes = general purpose lanes
MVM = Million Vehicle Miles
*Potential numbers of crashes and potential crash rates reflect a lower bound with all proposed crash reduction measures, and an upper bound without crash reduction measures. Values shown are for the I-90 outer roadways.

3.2.3 Mitigation

Various mitigation measures could enhance safety and operations in the I-90 corridor. Note: some mitigation measures were removed from further consideration following publication of the DEIS. Lane control signals will not be included in the Preferred Alternative, as time-of-day operation has been dropped from further consideration.

3.2.3.1 Crash Reduction Measures

The effectiveness of various crash reduction measures was investigated for each Build Alternative, based on a review of the safety literature. A series of spreadsheets were developed to estimate the levels of crash reduction that would be expected with each mitigation measure. Table 3.2-21 summarizes the potential mitigation measures by alternative. Estimates of probable construction cost for each alternative include representative costs for the crash reduction measures that would be included with each of the Build Alternatives. Following selection of a preferred alternative, additional design studies would be undertaken to further evaluate the specifics of the implementation of each crash reduction measure, and any other mitigation measures. The FEIS will confirm the implementation plans and the impacts/benefits of implementation of these measures.

Table 3.2-21
Summary of Freeway Mitigation Measures for Alternatives

Mitigation Measures	Alternative		
	R2-B Modified	R-5R and R-5M	R-8A
Crash Reduction Measures:			
Shoulder Rumble Strips	N/A	✔	✔
Speed Management	✔	✔	✔
Enhanced Delineation and Signing			
- Delineation	✔	✔	✔
- Static Signs	✔	✔	✔
- Variable Message Signs	✔	✔	✔
- Lane Control Signals	N/A	N/A	✔
Enhanced Illumination	✔	✔	✔
Enhanced Incident Management	✔	✔	✔
Operation and Maintenance Measures:			
Barriers			
- Narrow Profile Barrier	✔	N/A	N/A
- Barrier Gates	N/A	N/A	✔
Time-of-Day Operation	N/A	N/A	✔
Managed Lanes:			
Managed Lane Opportunities	✔	N/A	✔

N/A = Not Applicable

Source: HNTB 2002

Shoulder Rumble Strips

Rumble strips are a method of alerting motorists who are straying out of the travel lane and onto the shoulder. For I-90, rumble strips would be targeted at fixed-object crashes with walls and barriers during off-peak period in locations where shoulder widths are 4 feet or less. Research into rumble strips shows they are effective in reducing run-off-road crashes by 30 to 65 percent. For I-90, a reduction factor of 35 percent can be applied to off-peak, fixed-object crashes.

TRAN-1. Rumble strips would be provided for Alternative R-8A to mitigate the effects of non-standard lane and shoulder widths. The rumble strips would likely be implemented using profiled edge lines, due to the extent of I-90 roadways carried on structures, where ground-in rumble strips would not be desirable (also see TRAN-3). Rumble strips would not be used with Alternative R-5 because transit vehicles would be driving on the shoulders during peak periods. Standard lane widths would be maintained in Alternative R-2B Modified, and fixed-object crashes are not expected to be a concern.

Speed Management

Variable speed signs can be used to slow traffic that is approaching a downstream bottleneck. By reducing speeds before the slow-down, rear-end collisions may be reduced or avoided.

Studies of variable speed applications in Germany and the Netherlands indicate a reduction of 23 to 35 percent for overall and serious crashes. For I-90, a reduction factor of 10 percent in overall crashes and a reduction of 15 percent for injury crashes can be applied.

TRAN-2. Speed management measures would be included as a part of all Build Alternatives. The most promising of these measures, variable speed limits, would be studied further for potential implementation with Alternative R-8A on I-90 between Seattle and Bellevue. These studies would include development and evaluation of system options and functions to be addressed by the system (e.g. changing speed limits in response to congestion, incidents, weather, etc.), and will consider operational, enforcement, institutional, and legal issues. If variable speed limits are not implemented, other speed management measures, such as reduced speed limits and/or speed advisory signing, would be implemented as a part of Alternative R-8A. In Alternative R-2B Modified, variable speed limits could manage speeds in congested locations. With the other alternatives, their use could mitigate the effects of changes in stopping sight distance in the First Hill lid and Corwin curves.

Enhanced Delineation and Signing

Enhanced delineation and striping could be included as mitigation for all Build Alternatives. Enhanced signage could include static signs, variable message signs, and lane control signals. A crash reduction factor of 5 percent for overall and injury crashes can be applied when this measure is combined with illumination and incident management measures.

The Preferred Alternative will include enhancements to delineation and signing in the I-90 corridor between Seattle and Bellevue, as described below.

Delineation

TRAN-3. For all Build Alternatives, lane visibility would be enhanced by replacing existing painted edge lines and other lane markings throughout the corridor with profiled edge lines and lane lines and other enhancements to existing pavement markings.

TRAN-4. Lane visibility in I-90 lids and tunnels could be enhanced by using illuminated pavement markers. The feasibility of installing illuminated pavement markers would be investigated for any chosen alternative. Illuminated pavement markers would be investigated further as a part of final design, including consideration of trade-offs with potential tunnel lighting enhancements.

TRAN-5. Lane visibility in I-90 lids and tunnels for all Build Alternatives could be enhanced by attaching a linear delineation system attached to the face of traffic barriers in locations where shoulders are of less than standard width. One example of a linear delineation system consists of aluminum panels 6-inches high by 30-inches long that are laminated with retroreflective sheeting and crimped in a sharp "wave" shape. The feasibility and specific types and application of linear delineation would be investigated as part of final design.

Static Signs

TRAN-6. For all Build Alternatives, existing signs could be replaced or refaced as required to maintain reflectivity requirements and to provide improved legibility for older motorists. The final design would include a survey of existing signs to determine which signs should be replaced or refaced. Replaced or refaced signs would meet current standards for reflectivity and would provide improved legibility for older motorists.

TRAN-7. For all Build Alternatives, illuminated guide signs westbound in the Mount Baker Ridge lid could give motorists more time to change lanes for the Rainier Avenue S and I-5 exits. The feasibility of illuminated guide signs to supplement existing signage would be investigated as part of final design.

Variable Message Signs

Variable message signs in advance of interchanges can warn motorists of downstream traffic conditions in the event of incidents, crashes or maintenance and construction activities. Motorists can then chose alternate routes prior to committing to exit ramps.

TRAN-8. The feasibility of adding new or supplementing existing variable message signs would be investigated for any chosen alternative, including a survey of existing variable or dynamic message signs to determine the need for new or supplemental signs.

(**TRAN-9**. Removed from further consideration.)

(**TRAN-10.** Removed from further consideration.)

Enhanced Illumination

Enhanced illumination can reduce nighttime accidents, aid in police protection, and facilitate traffic flow during hours of darkness.

Roadway Lighting

TRAN-11. The feasibility of providing roadway illumination enhancements at enforcement/refuge areas and areas with reduced shoulder widths adjacent to general purpose traffic would be considered during final design.

Tunnel Lighting

Tunnel lighting provides for high lighting levels at tunnel portals during daylight hours and lower lighting levels in the tunnel interior to enhance lane visibility. Preliminary studies of existing lighting levels in the interior zone of the Mount Baker Ridge tunnels indicate that higher lighting levels and adjustments to light fixture spacing may be desirable, subject to additional study that would include laboratory testing of fixtures.

TRAN-12. Enhanced tunnel lighting would be investigated for any chosen alternative except Alternative R-2B Modified, which would not affect the outer roadway lane and shoulder configuration in the tunnels and lids.

Enhanced Incident Management

The number of WSDOT incident response trucks dedicated to the I-90 corridor would be increased from the current two to up to three trucks. The hours of service for these incident response trucks would also be increased to include mid-day periods.

TRAN-13. Enhanced incident management would be provided for all Build Alternatives in the portions of the corridor with restricted shoulder widths. These areas would include the Mount Baker Ridge tunnels and lid, the floating bridges, the First Hill lid, and the Mercer Island CBD. The focus of the increased service would be on the center roadway for Alternative R-2B Modified, and the outer roadways for Alternatives R-5 Restripe, R-5 Modified, and R-8A.

3.2.3.2 Operation and Maintenance Measures

Barriers

Narrow Profile Barrier

TRAN-14. Shoulder widths in the center roadway for Alternative R-2B Modified could be maximized in narrow median sections by using a narrow profile traffic barrier. A narrow profile barrier has face-to-face dimensions of 12 inches in lieu of the 24-inch dimension of standard barriers. The barrier is designed to be movable, which could be used to facilitate maintenance and incident response in narrow lane configurations. The barrier can be realigned after impact by means of a roller attached to a tow truck.

Barrier Gates

SafeGuard Gates by Barrier Systems, Inc. could be installed in situations where access through a traffic barrier is needed for maintenance purposes. These gates come in 13-foot sections that are attached to rigid longitudinal barrier systems with pinned connecting hardware. The gates are provided with casters that are pneumatically lowered when the gate section needs to be moved.

TRAN-15. Barrier gates could be used with Alternatives R-2B Modified or R-8A on the HMH floating bridge where access is limited by the available bridge deck width and the feasible limits on deck widening. Final design would include consideration of barrier gates as a part of the development of enhanced incident management provisions (TRAN-13).

(**TRAN-16.** Removed from further consideration.)

Auxiliary Lanes

Auxiliary lanes can be added to the mainline in advance of system interchange ramps to alleviate long queues or backups resulting from increased traffic volumes.

TRAN-17. With Alternative R-8A, an existing auxiliary lane on eastbound I-90 at the I-405 off-ramp would be extended west towards the Bellevue Way SE off-ramp. The limits of the auxiliary lane extension would be determined during final design.

Managed Lane Analysis

A sketch-planning analysis of converting the existing I-90 center roadway lanes to managed lanes was performed. The intent is to determine capacity that would be available if a managed lane concept were implemented with Alternatives R-2B Modified and R-8A. Managed lanes can increase freeway efficiency by packaging various operational, design and/or pricing actions to optimize traffic flows. Lane management operations may be adjusted to better match corridor and regional goals.

The focus of the analysis is to document the degree to which there would be sufficient capacity to carry the allowed users (transit and HOV for Alternative R-2B Modified, plus Mercer Island general purpose for Alternative R-8A) within the managed lanes. The analysis also examined how the usage of managed lanes could vary throughout the day. Utilization of the I-90 managed lane concept was examined for the year 2025 volumes on the midspan of the floating bridges between Seattle and Mercer Island. The total directional volumes were examined for Alternatives R-2B Modified and R-8A for the 12-hour period from 6:00 AM to 6:00 PM. The maximum capacity for each managed lane was assumed to be 1,600 vph for a single lane and 2,500 vph for two lanes. This reduced capacity reflects the access limitation evident in the I-90 center roadway. The hourly distribution of traffic was derived from comparing the peak period and off-peak period travel forecasts from the PSRC model with hourly diurnal distributions from existing counts obtained by WSDOT on I-90.

Alternative R-2B Modified

The proposed Alternative R-2B Modified center roadway operation in the design year (2025) would be limited to HOV 3+ and transit vehicles in the center roadway, where a single lane would be provided in each direction. The HOV 3+ volumes comprise nearly all of the users of the center roadway facility with the remaining share being transit. Excess capacity would be available during all time periods. This excess capacity could be allocated or sold to other users. This would transfer vehicles from the general purpose lanes to the I-90 center roadway managed lanes and potentially improve the operation of the general purpose lanes in the outer roadways.

Alternative R-8A – *Preferred Alternative*

With Alternative R-8A, the center roadway would be open to transit, HOV 2+, and Mercer Island traffic (westbound traffic in the morning hours and eastbound traffic in the afternoon hours). HOV 2+ vehicles comprise between 60 and 70 percent of the vehicles on the facility. Mercer Island SOV would comprise nearly the remainder of the volumes, and transit volumes would be less than 1 percent. The two reversible lanes in Alternative R-8A could accommodate the 2025 HOV 2+, Mercer Island traffic, and transit volumes. Most of the capacity would be used during the peak periods. However, the excess capacity could be made available to other users during the fringes of the peak and off-peak periods. The removal of vehicles from the general purpose lanes could improve the travel speed of the general purpose lanes.

3.3 SURFACE STREET OPERATIONS

Surface streets, arterials and local streets, that provide access to the I-90 on and off ramps, were analyzed to identify any changes in operations with the Build Alternatives. The levels of service (amount of wait time) at signalized and unsignalized intersections within the study area described below in Section 3.3.1 were evaluated for AM and PM peak hours.

3.3.1 Affected Environment

For this portion of the Project analysis, the study area included selected surface street systems within three jurisdictions:

- City of Seattle—streets extending from Rainier Avenue S on the east to 1st Avenue S on the west.
- City of Mercer Island—streets adjacent to I-90 on and off ramps.
- City of Bellevue—operations along Bellevue Way SE from the I-90 ramps to the intersection of the South Bellevue Park-and-Ride at 112th Avenue SE.

The operational performance of these streets with each Build Alternative was measured by completing an LOS and safety analysis.

3.3.1.1 Existing Conditions

Traffic Volumes

Traffic volumes directly affect the operation of intersections. The traffic counts for the arterial street system in the study area were obtained for the period from June 1998 to May 2002. The lowest two-way traffic volumes within the study area are on city streets in Mercer Island with under 1,000 vehicles per hour; the highest volumes are on Bellevue Way SE with over 4,000 vehicles per hour.

Intersection Levels of Service

LOSs are qualitative descriptions of traffic operating conditions for intersections, ranging from LOS A, with little or no delay to LOS F with extreme congestion. The intersections analyzed are shown in Figure 3.3-1. One unsignalized intersection on Mercer Island currently performs worse than LOS D. In Seattle six intersections currently operate at LOS D during the AM or PM peak hour. In Bellevue the intersection at the South Bellevue Park-and-Ride operates at LOS E in the PM peak hour due to high southbound volumes on Bellevue Way SE traveling to I-90.

Safety

Intersection crash data were gathered for the three affected jurisdictions in the study area for 2001. The cities of Mercer Island and Bellevue reported no high accident locations within the study area. The City of Seattle reported three high accident locations in the study area: at 23rd Avenue S/Rainier Avenue S (13); 6th Avenue S/James Street (12); and at Boren Avenue S/Rainier Avenue S (12).

3.3.1.2 Future Conditions

Traffic Volumes

2005

In 2005, the volumes would change from –7 to +27 percent in Seattle. Mercer Island street volumes would grow less, with a –3 to 12 percent growth. Bellevue Way SE traffic volumes would increase in the AM by 12 percent and in the PM by 2 percent.

2025

By 2025, a relatively modest growth of 10 to 20 percent in surface street volumes is expected on Mercer Island, the City of Seattle will have a +15 to +50 percent increase in surface streets, and on Bellevue Way SE an +8 percent AM and +26 percent PM increase are forecast.

Intersection Level of Service

2005

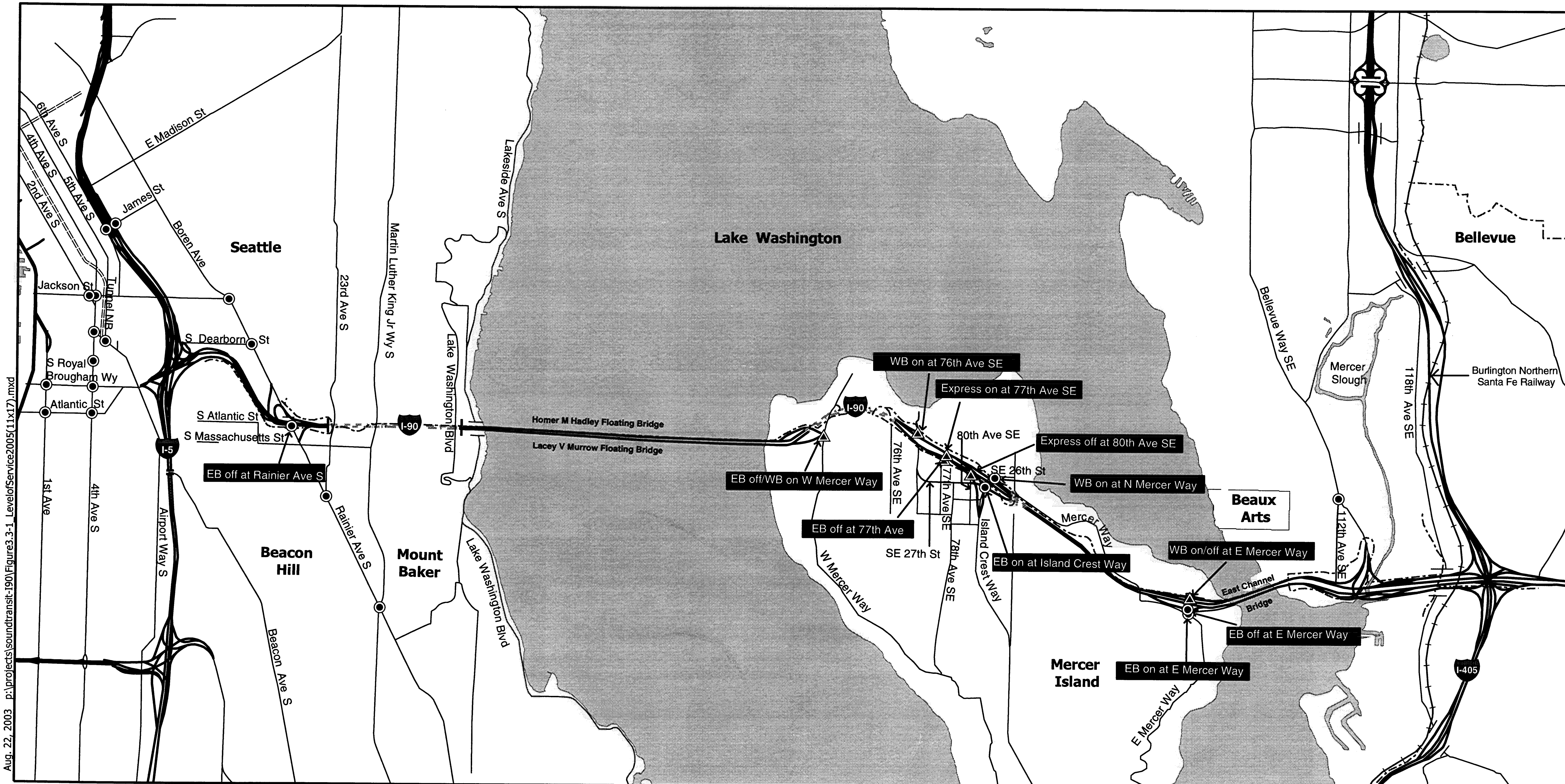
By 2005, all Mercer Island intersections would continue to operate at LOS C or better except for the unsignalized intersection at East Mercer Way/I-90 westbound on and off ramps, which continue with LOS E and F. In Seattle, Phase I of the SR-519 project is assumed to be completed which is the connection of I-90 to 1st Avenue S via Atlantic Street and is anticipated to improve the LOS at some intersections in the area. The remaining Seattle intersections would generally show small increases in average vehicle delay, attributable to increases in population and employment. There is no change in the Bellevue Way SE intersection.

2025

In Seattle, only Phase I was assumed for 2025. The project team consulted with Seattle DOT for guidance on assumptions for SR-519. Year 2025 conditions would continue to deteriorate in Seattle with eleven out of the fifteen intersections analyzed operating at LOS D or worse during the AM or PM peak hour. In Mercer Island, the East Mercer Way/I-90 WB on and off intersection would continue to operate at LOS E in the AM peak hour and LOS F in the PM peak hour. The Bellevue intersection in the study area would continue to operate at LOS F in the PM peak hour.

Safety

Under the No Build conditions, accident patterns would be expected to follow existing trends. As daily traffic volumes and congestion continue to increase, an increase in the number of crashes and injury accidents would be expected.



Source: URS Corporation. Base Data: King County, City of Seattle, City of Bellevue, City of Mercer Island.

Legend

- Roadway Tunnel
- Shared-use Pathway
- Signalized Intersections
- Unsignalized Intersections

0 0.25 0.5 1 Miles

U.S. Department of Transportation
Federal Highway Administration
Federal Transit Administration

Sound Transit

Washington State Department of Transportation

Figure 3.3-1
Intersections Analyzed for Level of Service
Alternative R-1, Year 2005

3.3.2 Impacts

3.3.2.1 Construction

Alternative R-1

With Alternative R-1, construction activities would be limited to routine maintenance of I-90 facilities. No construction impacts to area intersections or surface streets would be anticipated.

Alternative R-5 Restripe

Construction activities for Alternative R-5 Restripe would not cause impacts to area intersections or surface streets.

Alternatives R-2B Modified, R-5 Modified and R-8A – *Preferred Alternative*

No construction would occur on surface street intersections within the City of Seattle as a part of the proposed alternatives. Construction-related truck traffic could be expected on arterial streets intersecting the I-90 ramps. This traffic would primarily be related to material deliveries.

On Mercer Island, construction of new I-90 exit ramps would occur at 77th and 80th Avenues SE with Alternatives R-2B Modified, R-5 Modified (only at 80th), and R-8A. Construction of these ramps would require long-duration shoulder closures and/or lane-width reductions on 77th and 80th Avenues SE where they cross over I-90. Some short-duration lane closures could be required during some construction operations; traffic operations would likely be maintained by way of one-way flagger control and/or detours. Construction-related truck traffic could be expected on arterial streets intersecting the I-90 ramps. This traffic would primarily be related to material deliveries and removal of demolition debris.

At Bellevue Way SE, modifications to the existing center roadway ramp would occur with Alternatives R-2B Modified, R-5 Modified, and R-8A. These modifications would require long-duration shoulder closures and/or lane-width reductions on the Bellevue Way SE ramps to/from the I-90 outer roadways. Some off-peak and short-duration closures of the center roadway ramp at Bellevue Way SE would be likely during reconstruction of the ramp. During these closures, traffic would access I-90 via the outer roadway ramps that would remain open. Construction-related truck traffic could be expected on Bellevue Way SE in the vicinity of the I-90 ramps. This traffic would primarily be related to material deliveries and removal of demolition debris.

3.3.2.2 Operations

A comparison among all alternatives of changes in volumes on surface streets and levels of surface at area intersections is included at the end of this section.

Traffic Volumes

Traffic forecasts for Alternatives R-2B Modified and R-8A for selected arterials within the study area are shown in Table 3.3-1. Traffic forecasts for Alternatives R-5 Restripe and R-5 Modified would be the same as Alternative R-1.

Table 3.3-1
Traffic Volumes on Selected Arterials for Alternatives R-2B Modified and R-8A

Arterial Segment	R-2B Modified				R-8A			
	AM Peak Hour	% Change from R-1	PM Peak Hour	% Change from R-1	AM Peak Hour	% Change from R-1	PM Peak Hour)	% Change from R-1
2005								
Seattle								
S Royal Brougham (E of 1st Ave)	1390	0%	1520	0%	1390	0%	1540	1%
Atlantic St (E of 1st Ave)	1090	-1%	1550	-1%	1100	0%	1560	0%
4th Ave (S of Airport Wy)	2230	0%	2430	0%	2220	-1%	2480	2%
Airport Wy (SE of 4th Ave)	1350	5%	1720	6%	1210	-5%	1630	0%
S Dearborn (E of Airport Wy)	580	0%	900	1%	570	-2%	890	0%
Rainier Ave (S of Dearborn)	2710	0%	3050	0%	2710	0%	3050	0%
Rainier Ave (N of 23rd Ave)	2350	0%	2830	0%	2350	0%	2830	0%
Mercer Island								
W Mercer Wy (S of I-90 Ramps)	510	0%	550	8%	510	0%	510	0%
76th Ave SE (S of WB On)	510	34%	440	-4%	380	0%	460	0%
77th Ave SE (S of Express WB On)	340	-26%	390	-26%	490	7%	530	0%
80th Ave SE (N of Express Ramps)	300	3%	430	-4%	290	0%	440	-2%
Island Crest Wy (S of EB Ramps)	860	-1%	850	0%	860	-1%	850	0%
SE 27th St (W of Island Crest Wy)	650	0%	650	0%	650	-24%	650	0%
E Mercer Wy (S of WB On/Off)	670	0%	850	-3%	620	-7%	880	0%
Bellevue								
Bellevue Wy/112th Ave	3240	1%	4270	0%	3250	1%	4340	2%
2025								
Seattle								
S Royal Brougham (E of 1st Ave)	1970	0%	1870	0%	2050	4%	2030	8%
Atlantic St (E of 1st Ave)	1450	0%	2000	0%	1480	2%	2070	4%
4th Ave (S of Airport Wy)	2700	-1%	3130	0%	2890	6%	3205	2%
Airport Wy (SE of 4th Ave)	1350	-6%	2010	3%	1660	11%	2130	9%
S Dearborn (E of Airport Wy)	660	-1%	1110	1%	710	6%	1160	5%
Rainier Ave (S of Dearborn)	3080	0%	3280	0%	3090	0%	3280	0%
Rainier Ave (N of 23rd Ave)	3050	0%	3370	0%	3050	0%	3360	0%
Mercer Island								
W Mercer Wy (S of I-90 Ramps)	620	0%	640	3%	620	0%	620	0%
76th Ave SE (S of WB On)	530	26%	500	-4%	420	0%	520	0%
77th Ave SE (S of Express Ramps)	520	0%	450	0%	530	2%	620	38%
80th Ave SE (N of Express Ramps)	310	0%	450	0%	320	3%	590	31%
Island Crest Wy (S of EB ramps)	960	0%	940	0%	920	-4%	950	1%
SE 27th St (W of Island Crest Wy)	700	0%	700	0%	710	1%	710	1%
E Mercer Wy (S of WB On/Off)	830	5%	980	0%	790	0%	960	-2%
Bellevue								
Bellevue Wy/112th Ave	3600	-1%	4560	1%	3510	-3%	4560	1%

Note: Alternative R-5 Traffic Forecasts are unchanged from Alternative R-1
Source: Mirai Associates 2003

Traffic volume changes for Alternatives R-2B Modified and R-8A were also examined at surface street ramp connections along I-5 from Spokane Street to James Street, along I-405 from Coal Creek Parkway to SE 8th Street, and to 148th Ave and 156th Ave NE in Eastgate.

I-5 Ramp Connections

Alternative R-2B Modified results in peak hour traffic changes of less than 2 percent at all locations. Alternative R-8A shows minimal changes in peak hour volumes on the Spokane Street ramps to/from I-5 in 2005 and increases of 30 to 120 vehicles per hour (around 5 percent) in 2025. Volume changes at James Street are low in 2005. In 2025, the James Street volumes increase by 70 vehicles in the AM peak hour and 170 vehicles in the PM peak hour.

I-405 Ramp Connections

Alternative R-2B Modified results in peak hour traffic changes of less than 2 percent at all locations. Alternative R-8A shows general reductions or no change in traffic volume demands at the Coal Creek Parkway ramp connections. Volume changes on I-405 to the south of I-90 are minimal with Alternative R-8A. To the north of I-90, the volumes on I-405 are also forecasted to be unaffected with Alternative R-8A, resulting in minimal changes in ramp connection volumes at SE 8th Street. Volumes on I-405 might be reduced if HOV 2+ rules are used on I-90 with Alternative R-8A.

Eastgate Ramp Connections

Alternative R-2B Modified results in peak hour traffic changes of less than 2 percent on I-90 to the east of I-405. Alternative R-8A shows some increases in I-90 mainline volumes to the east of I-405. In 2005, the volume changes at the 148th Ave/156th Ave ramps are less than 50 during the AM and PM peak hours. In 2025, the ramps mostly show slight decreases or no change in volumes in comparison with Alternative R-1.

Intersection Level of Service

Tables 3.3-2 through 3.3-5 show LOS comparisons for all the Build Alternatives with Alternative R-1. The intersections were compared for the AM and PM peak hours in the years 2005 and 2025. Queue lengths on the surface streets were analyzed where intersections changed to or from LOS D or greater.

In the No Action Alternative, two Seattle intersections queue lengths will back up into upstream intersections. In the 2005 PM and the 2025 AM peak hour, the 95th percentile traffic volume queue length from the Airport Way/4th Avenue S intersection will back up into the Airport Way/S Dearborn St/I-90 Ramp/5th Avenue S intersection. In the 2025 PM peak hour, the 50th and 95th percentile traffic volume queue lengths will back up into this intersection. In the 2025 PM peak hour, the 50th and 95th percentile traffic volume southbound queue lengths from the Royal Brougham/4th Avenue S intersection will back up into the I-90 off-ramp/4th Avenue S intersection. The effects of the queues are not specifically reflected in the LOS calculations shown in the comparative tables; they are discussed separately in the text where applicable.

Alternative R-2B Modified

2005

With Alternative R-2B Modified, the surface street facilities would remain the same as in Alternative R-1 with the exception of new directional off-ramps at 77th Avenue and 80th Avenue SE on Mercer Island. The existing center roadway reversible ramps on these streets would be converted to directional entrance-ramps. These center roadway ramps would be restricted at all times to eligible high-occupancy vehicles (HOV 2+ in 2005 and HOV 3+ in 2025). Intersection traffic volumes would be similar to alternative R-1, except on 76th Avenue SE south of the westbound outer roadway entrance-ramp, where volumes would increase by about 300 vehicles per hour during the AM peak hour. As a result of the conversion of the center roadway to two-way, transit and HOV-only operation, the 76th Ave SE/I-90 WB on-ramp/North Mercer Way intersection would show a substantial increase in congestion (LOS A to LOS D in 2005, LOS E in 2025) during the AM peak hour. The shared westbound left-turn and through lane queue length increases from 110 feet to 450 feet.

In Seattle, Alternative R-2B would have minor impacts on intersections in the AM peak hour. In the PM peak hour, the Airport Way/S Dearborn St./I-90 Ramp/5th Ave S intersection would operate at LOS C in the PM peak hour, compared to LOS B with Alternative R-1. The 200 vehicles that would exit the westbound center roadway off-ramp would cause this deterioration of LOS. With Alternative R-1 fewer than 30 buses are expected to exit the ramp during the PM peak hour. Under all alternatives, an additional 50-60 buses per hour could be added to this ramp movement when the bus tunnel closes during light rail construction in downtown Seattle.

Table 3.3-2
Surface Street Intersections – Level of Service Comparison
AM Peak Hour, Existing (2000) and Year 2005

Intersection	Existing	Alternatives				
	2000	R-1	R-2BM	R-5R	R-5M	R-8A
Mercer Island Intersections						
West Mercer Way/I-90 EB Off and WB On*	A	A	A	A	A	A
76th Avenue SE/I-90 WB On/North Mercer Way*	A	A	↓D	A	A	A
77th Avenue SE/I-90 EB Off*	A	A	A	A	A	A
77th Avenue SE/I-90 WB Express On*	A	A	A	A	A	A
77th Avenue SE/I-90 EB Express Off*	-	-	A	-	-	-
77th Avenue SE/I-90 EB Outer HOV Off*	-	-	-	-	-	A
80th Avenue SE/I-90 WB Outer HOV Off*	-	-	-	-	-	A
80th Avenue SE/I-90 WB Express Off*	A	A	A	A	A	A
80th Avenue SE/I-90 EB Express On*	-	-	A	-	-	-
Island Crest Way/North Mercer Way/I-90 WB Off	B	C	↑B	C	C	↑B
Island Crest Way/SE 27th Street/I-90 EB On	B	B	B	B	B	B
East Mercer Way/I-90 WB On and Off*	E	E	E	E	E	↑D
East Mercer Way/SE 36th Street/I-90 EB off	A	A	A	A	A	A
East Mercer Way/I-90 EB On	A	A	A	A	A	A
Seattle Intersections						
James Street /7th Avenue/I-5 NB CD ramp	C	C	C	C	C	C
James Street /6th Avenue/I-5 SB CD ramp	B	B	B	B	B	B
Jackson Street/4th Avenue	B	B	B	B	B	B
Jackson Street/2nd Avenue Ext.	C	C	C	C	C	C
Airport Way/4th Avenue	B	C	C	C	C	C
Airport Way/S Dearborn St./I-90 Ramp/5th Ave S	C	C	C	C	C	C
4th Avenue/I-90 On Ramp terminus	C	C	C	C	C	C
Royal Brougham/4th Avenue	C	C	↑B	C	C	↑B
Royal Brougham/1st Avenue	C	C	C	C	C	C
Boren Ave/14th Ave/Jackson/Rainier	F	F	F	F	F	F
Rainier Avenue S/S Dearborn	C	C	C	C	C	C
Rainier Avenue S/EB I-90 Off-Ramp	A	A	A	A	A	A
Rainier Avenue S/23rd Avenue	C	C	C	C	C	C
Rainier Avenue S/ M.L. King Jr. Blvd.	B	C	C	C	C	C
4th Ave/Atlantic St**	-	A	A	A	A	A
1st Ave/S Atlantic St**	-	C	C	C	C	C
Bellevue Intersections						
Bellevue Way SE/112th Ave SE/South Bellevue P&R	B	B	B	B	B	B

* Unsignalized intersections
** Will exist when built with the SR 519 project
↑ LOS improves from Alternative R-1 conditions
↓ LOS worsens from Alternative R-1 conditions

Source: Mirai Associates 2002

Table 3.3-3
Surface Street Intersections – Level of Service Comparison
PM Peak Hour, Year 2005

Intersection	Existing 2000	Alternatives				
		R-1	R-2BM	R-5R	R-5M	R-8A
Mercer Island Intersections						
West Mercer Way/I-90 EB Off and WB On*	A	A	A	A	A	A
76th Avenue SE/I-90 WB On/North Mercer Way*	B	B	B	B	B	B
77th Avenue SE/I-90 EB Off*	A	A	A	A	A	A
77th Avenue SE/I-90 WB Express On*	-	-	A	-	-	A
77th Avenue SE/I-90 EB Express Off*	A	A	A	A	A	A
77th Avenue SE/I-90 EB Outer HOV Off*	-	-	-	-	-	A
80th Avenue SE/I-90 WB Outer HOV Off*	-	-	-	-	-	A
80th Avenue SE/I-90 WB Express Off*	-	-	A	-	A	A
80th Avenue SE/I-90 EB Express On*	A	A	A	A	A	A
Island Crest Way/North Mercer Way/I-90 WB Off	B	C	C	C	C	C
Island Crest Way/SE 27th Street/I-90 EB On	B	B	B	B	B	B
East Mercer Way/I-90 WB On and Off*	F	F	F	F	F	F
East Mercer Way/SE 36th Street/I-90 EB off	A	A	A	A	A	A
East Mercer Way/I-90 EB On	A	A	A	A	A	A
Seattle Intersections						
James Street /7th Avenue/I-5 NB CD ramp	C	C	C	C	C	C
James Street /6th Avenue/I-5 SB CD ramp	C	C	C	C	C	C
Jackson Street/4th Avenue	B	B	B	B	B	B
Jackson Street/2nd Avenue Ext.	C	C	C	C	C	C
Airport Way/4th Avenue	C	C	C	C	C	C
Airport Way/S Dearborn St./I-90 Ramp/5th Ave S	C	C	↓D	C	C	C
4th Avenue/I-90 On Ramp terminus	D	B	B	B	B	↓C
Royal Brougham/4th Avenue	C	D	D	D	D	D
Royal Brougham/1st Avenue	D	D	D	D	D	D
Boren Ave/14th Ave/Jackson/Rainier	F	F	F	F	F	F
Rainier Avenue S/S Dearborn	D	D	D	D	D	D
Rainier Avenue S/EB I-90 Off-Ramp	B	B	B	B	B	B
Rainier Avenue S/23rd Avenue	D	D	D	D	D	D
Rainier Avenue S/ M.L. King Jr. Blvd.	C	C	C	C	C	C
4th Ave/Atlantic St**	-	A	A	A	A	A
1st Ave/S Atlantic St**	-	E	E	E	E	E
Bellevue Intersections						
Bellevue Way SE/112th Ave SE/South Bellevue P&R	E	F	F	F	F	F

*Unsignalized intersections
** Will exist when built with the SR 519 project
↑ LOS improves from Alternative R-1 Conditions
↓ LOS worsens from Alternative R-1 Conditions

Source: Mirai Associates 2002

Table 3.3-4
Surface Street Intersections – Level of Service Comparison
AM Peak Hour, Year 2025

Intersection	R-1	Alternatives R-2BM	R-5R	R-5M	R-8A
Mercer Island Intersections					
West Mercer Way/I-90 EB Off and WB On*	A	A	A	A	A
76th Avenue SE/I-90 WB On/North Mercer Way*	B	↓E	B	B	B
77th Avenue SE/I-90 EB Off*	A	A	A	A	A
77th Avenue SE/I-90 WB Express On*	A	A	A	A	A
77th Avenue SE/I-90 EB Express Off*	-	A	-	-	-
77th Avenue SE/I-90 EB Outer HOV Off*	-	-	-	-	A
80th Avenue SE/I-90 WB Outer HOV Off*	-	-	-	-	A
80th Avenue SE/I-90 WB Express Off*	A	A	A	A	A
80th Avenue SE/I-90 EB Express On*	-	A	-	-	-
Island Crest Way/North Mercer Way/I-90 WB Off	C	C	C	C	C
Island Crest Way/SE 27th Street/I-90 EB On	B	B	B	B	B
East Mercer Way/I-90 WB On and Off*	F	F	F	F	F
East Mercer Way/SE 36th Street/I-90 EB off	A	A	A	A	A
East Mercer Way/I-90 EB On	A	A	A	A	A
Seattle Intersections					
James Street /7th Avenue/I-5 NB CD ramp	C	C	C	C	C
James Street /6th Avenue/I-5 SB CD ramp	B	B	B	B	↓C
Jackson Street/4th Avenue	C	C	C	C	C
Jackson Street/2nd Avenue Ext.	C	C	C	C	C
Airport Way/4th Avenue	C	C	C	C	↓D
Airport Way/S Dearborn St./I-90 Ramp/5th Ave S	C	C	C	C	↓D
4th Avenue/I-90 Ramp terminus	C	C	C	C	C
Royal Brougham/4th Avenue	D	D	D	D	D
Royal Brougham/1st Avenue	D	D	D	D	D
Boren Ave/14th Ave/Jackson/Rainier	F	F	F	F	F
Rainier Avenue S/S Dearborn	D	D	D	D	D
Rainier Avenue S/EB I-90 Off -Ramp	A	A	A	A	A
Rainier Avenue S/23rd Avenue	D	D	D	D	D
Rainier Avenue S/ M.L. King Jr. Blvd.	C	C	C	C	C
4th Ave/Atlantic St**	A	A	A	A	A
1st Ave/S Atlantic St**	D	D	D	D	D
Bellevue Intersections					
Bellevue Way SE/112th Ave SE/South Bellevue P&R	B	B	B	B	B

*Unsignalized intersections
** Will exist when built with the SR 519 project
↑ LOS improves from Alternative R-1 Conditions
↓ LOS worsens from Alternative R-1 Conditions

Source: Mirai Associates 2002

Table 3.3-5
Surface Street Intersections – Level of Service Comparison
PM Peak Hour, Year 2025

Intersection	R-1	Alternatives			
		R-2BM	R-5R	R-5M	R-8A
Mercer Island Intersections					
West Mercer Way/I-90 EB Off and WB On*	A	A	A	A	A
76th Avenue SE/I-90 WB On/North Mercer Way*	C	C	C	C	C
77th Avenue SE/I-90 EB Off*	A	↓B	A	A	A
77th Avenue SE/I-90 WB Express On*	-	A	-	-	-
77th Avenue SE/I-90 EB Express Off*	A	A	A	A	A
77th Avenue SE/I-90 EB Outer HOV Off*	-	-	-	-	A
80th Avenue SE/I-90 WB Outer HOV Off*	-	-	-	-	A
80th Avenue SE/I-90 WB Express Off*	-	A	-	A	-
80th Avenue SE/I-90 EB Express On*	A	A	A	A	A
Island Crest Way/North Mercer Way/I-90 WB Off	C	C	C	C	C
Island Crest Way/SE 27th Street/I-90 EB On	C	C	C	C	C
East Mercer Way/I-90 WB On and Off*	F	F	F	F	F
East Mercer Way/SE 36th Street/I-90 EB off	A	A	A	A	A
East Mercer Way/I-90 EB On	A	A	A	A	A
Seattle Intersections					
James Street /7th Avenue/I-5 NB CD ramp	D	D	D	D	D
James Street /6th Avenue/I-5 SB CD ramp	D	D	D	D	D
Jackson Street/4th Avenue	B	B	B	B	B
Jackson Street/2nd Avenue Ext.	C	C	C	C	C
Airport Way/4th Avenue	D	D	D	D	↓E
Airport Way/S Dearborn St./I-90 Ramp/5th Ave S	C	↓D	C	C	C
4th Avenue/I-90 Ramp terminus	C	C	C	C	C
Royal Brougham/4th Avenue	E	E	E	E	↓F
Royal Brougham/1st Avenue	E	E	E	E	E
Boren Ave/14th Ave/Jackson/Rainier	F	F	F	F	F
Rainier Avenue S/S Dearborn	E	E	E	E	E
Rainier Avenue S/EB I-90 Off-Ramp	B	B	B	B	B
Rainier Avenue S/23rd Avenue	E	E	E	E	E
Rainier Avenue S/ M.L. King Jr. Blvd.	D	D	D	D	D
4th Ave/Atlantic St**	B	B	B	B	B
1st Ave/S Atlantic St**	F	F	F	F	F
Bellevue Intersections					
Bellevue Way SE/112th Ave SE/South Bellevue P&R	F	F	F	F	F

*Unsignalized intersections
** Will exist when built with the SR 519 project
↑ LOS improves from Alternative R-1 Conditions
↓ LOS worsens from Alternative R-1 Conditions

Source: Mirai Associates 2002

Many of these vehicles would travel northwest to the Airport Way/4th Avenue S intersection and would not change the LOS, but would increase the queue length backing up into the upstream intersection of Airport Way/S Dearborn St/I-90 Ramp/5th Avenue S compared to Alternative R-1.

Bellevue Way SE would remain at LOS F.

2025

In the AM peak hour, the unsignalized intersection of 76th Avenue SE and I-90 westbound on-ramp/North Mercer Way would worsen from LOS B to LOS E with R-2B Modified. The shared westbound left-turn and through lane queue length would increase from 120 feet to 500 feet with R-2B Modified. In the PM peak hour, the 77th Avenue SE and I-90 eastbound off-ramp unsignalized intersection would worsen to LOS B from a LOS A due to an increase of 380 vehicles exiting the ramp. This results from Mercer Island traffic diverted to the outer I-90 roadway.

The intersection of 5th Avenue S at Airport Way S/S Dearborn St/I-90 ramp would worsen during the PM peak hour from LOS C to LOS D because 100 vehicles would exit the westbound I-90 center roadway off-ramp with Alternative R-2B Modified. Fewer than 20 vehicles would exit the ramp with Alternative R-1. Many of these additional vehicles would travel northwest to the Airport Way/4th Avenue S intersection, but would not increase the queue lengths in this section compared with Alternative R-1. The remaining Seattle intersections would operate in a similar to Alternative R-1.

The Bellevue Way SE/112th Avenue S/South Bellevue Park-and-Ride intersection would operate at LOS F, the same as in Alternative R-1. The LOS F conditions would be slightly worse with Alternative R-2B Modified. The intersection's southbound through queue length would be 2,380 feet with Alternative R-2B Modified compared to 2,210 feet with Alternative R-1. The queue length from the downstream I-90 westbound on-ramp would also extend through this intersection in both Alternative R-2B Modified and R-1. The queue length from the I-90 westbound on-ramp is forecasted to slightly decrease with Alternative R-2B Modified.

Alternatives R-5 Restripe and R-5 Modified

Alternative R-5 Restripe would have no impact to intersections compared to Alternative R-1.

Intersection LOS for Alternative R-5 Modified would be the same as for Alternative R-1. The only change in operations would be during the PM peak period along 80th Ave SE. Westbound buses stopping on Mercer Island would exit the inside transit shoulder on I-90 via a new ramp connection on 80th Ave SE. Given the relatively low number of buses involved, the operation of this new T-intersection would not materially affect traffic operations on 80th Avenue SE.

Alternative R-8A – *Preferred Alternative*

Alternative R-8A would show minimal change in traffic volumes in 2005. In 2025, arterial volumes in Seattle would increase from 2 to 11 percent and generally less than 3 percent on Mercer Island, except for 80th Avenue SE (north of the express ramps) and Island Crest Way (south of the EB ramps) where volumes will increase 38 and 31 percent respectively. These changes in volumes affect the LOS at the arterial and local street intersections.

In 2005, two Mercer Island intersections improve in the AM and in Seattle one intersection improves in the AM and in the PM one intersection LOS worsens. The Bellevue Way SE intersection shows minimal change.

In 2025, four Seattle intersections LOS worsen in the AM, and two deteriorate in the PM due to increasing volumes from the off-ramps. In the PM peak hour, the 4th Avenue S and Royal Brougham intersection would degrade from LOS E to LOS F with an additional 230 vehicles using the I-90 off-ramp at 4th Avenue S and turning south to the 4th Avenue S and Royal Brougham intersection. The intersection's southbound through movement queue length would increase from 990 feet to 1,320 feet, and, back up through the upstream intersection of 4th Avenue S and the I-90 westbound off-ramp. The intersection of 4th Avenue S and Airport Way would degrade from LOS D to LOS E due to an increase of 150 vehicles traveling through the 4th Avenue S and Airport Way to access the I-90 eastbound on-ramp, and an increase of 50 vehicles traveling through the intersection after exiting I-90 at 4th Avenue S and turning north. The queue length of the intersection's southbound left turn is estimated to increase from 390 feet to 480 feet. This would exceed the existing left turn pocket storage length. The increase in traffic volumes at the 4th Avenue S and Airport Way intersection would increase the queue length backing up on Airport Way into the upstream intersection of Airport Way/S Dearborn St/I-90 Ramp/5th Avenue S intersection compared to Alternative R-1.

Alternative R-8A would have little impact on the Mercer Island intersections. The Bellevue Way SE/112th Avenue S/South Bellevue Park-and-Ride intersection would exhibit similar LOS and queue lengths for Alternative R-8A compared to Alternative R-1. The queue created at the I-90 westbound on-ramp would also be reduced for Alternative R-8A.

3.3.2.3 Safety

Alternative R-2B Modified

Alternative R-2B Modified would add two new I-90 center roadway ramp connections on 77th Ave SE and 80th Ave SE, resulting in four intersections along these streets in a relatively short distance. These ramps would be restricted to transit and eligible HOV traffic (HOV 2+ in 2005, HOV 3+ in 2025), which would limit the volume of turning traffic at the ramp termini. Safety could be maintained along the surface streets in the vicinity of these ramps with adequate channelization and signing. Sight distance would not be a concern.

In Seattle, the three high accident locations would experience less than a 1 percent change in volumes comparing Alternative R-2B Modified to Alternative R-1. There would be only minor changes in traffic volumes at the other Seattle intersections during the AM peak hour.

Alternative R-5 Restripe

Alternative R-5 Restripe would not create any new safety concerns on the surface street system.

Alternative R-5 Modified

Alternative R-5 Modified would not create any new safety concerns on the surface street system. On Mercer Island, a new transit-only exit ramp would be provided at 80th Avenue SE. During the PM peak period, transit buses would be turning right from this ramp onto 80th Ave SE. The relatively low volume of buses would not create a new safety problem at that location.

Alternative R-8A – *Preferred Alternative*

Alternative R-8A would create two new intersections on Mercer Island by adding transit- and HOV-only freeway ramp connections on 77th Avenue SE and 80th Avenue SE. Safety would be maintained along these surface streets with adequate channelization and signing. Sight distance would not be a concern.

In 2005, the three high accident locations in Seattle would experience less than a 1 percent change in traffic volumes. In 2025, the 6th Avenue S and James Street intersection would experience a 1 percent increase in the AM peak hour and a 4 percent increase in the PM peak hour in comparison with Alternative R-1. The other two high accident intersections in Seattle would experience less than a 1 percent change in traffic volumes in the year 2025.

3.3.2.4 Comparison of Construction and Operational Impacts on Streets

Table 3.3-6 summarizes the operational impacts on surface streets for the Build Alternatives in comparison with Alternative R-1. Most of the impacts were similar among the Build Alternatives, with the exception of selected intersection levels of service affected within the study area.

Table 3.3-6
Comparison of Impacts on Streets

	R-1	R-2B Modified	R-5 Restripe	R-5 Modified	R-8A
Construction Impacts	No impacts	Impacts along 77th and 80th Avenues SE on Mercer Island and along Bellevue Way SE	No impacts	Impacts along 77th and 80th Avenues SE on Mercer Island and along Bellevue Way SE	Impacts along 77th and 80th Avenues SE on Mercer Island and along Bellevue Way SE
Operational Impacts					
Volumes on Surface Streets – 2005					
- Seattle AM	No impacts	Minimal changes	No impacts	No impacts	Minimal changes
- Seattle PM	No impacts	Minimal changes, except one location with a 6% increase	No impacts	No impacts	Minimal changes
- Mercer Island AM	No impacts	Volumes increase by +34% at one location with diverted traffic; decrease by 26% near existing ramp on 77th Avenue SE	No impacts	No impacts	Volumes decrease at some locations due to dispersed traffic at new ramps
- Mercer Island PM	No impacts	Volumes decrease by 26% near existing ramp on 77th Avenue SE, increase at W Mercer Way ramp (8%)	No impacts	No impacts	Minimal changes
- Bellevue AM	No impacts	Minimal changes	No impacts	No impacts	Minimal changes
- Bellevue PM	No impacts	Minimal changes	No impacts	No impacts	Minimal changes
Volumes on Surface Streets – 2025					
- Seattle AM	No impacts	Minimal changes, mostly unchanged or decrease	No impacts	No impacts	Minimal changes, except at 1 location (+11%)
- Seattle PM	No impacts	Minimal changes	No impacts	No impacts	Minimal changes, except at 2 locations (+8 to +9%)
- Mercer Island AM	No impacts	Volumes increase by 26% at one location with diverted traffic; minimal change elsewhere	No impacts	No impacts	Minimal changes
- Mercer Island PM	No impacts	Minimal changes	No impacts	No impacts	Volumes increase by 31 to 38% near new ramps; minimal change elsewhere
- Bellevue AM	No impacts	Minimal changes	No impacts	No impacts	Minimal changes
- Bellevue PM	No impacts	Minimal changes	No impacts	No impacts	Minimal changes

Table 3.3-6 (Continued)
Comparison of Impacts on Streets

	R-1	R-2B Modified	R-5 Restripe	R-5 Modified	R-8A
Volumes on Surface Street Ramp Connections					
I-5 Ramp Connections	No impacts	Minimal volume changes in 2005 or 2025	No impacts	No impacts	Volume increases at Spokane Street minimal in 2005, up to 5% in 2025. Volume increases at James St. minimal in 2005, up to 24% in 2025 PM.
I-405 Ramp Connections	No impacts	Minimal volume changes in 2005 or 2025	No impacts	No impacts	Minimal changes; some volume reductions along I-405 due to HOV 2+ on I-90
Eastgate Ramp Connections	No impacts	Minimal volume changes in 2005 or 2025	No impacts	No impacts	Minimal volume changes in 2005 or 2025
Intersection Levels of Service – 2005 AM Peak Hour	No impacts	Two intersections improve LOS; one worsens	No impacts	No impacts	Three intersections improve LOS
Intersection Levels of Service – 2005 PM Peak Hour	No impacts	One intersection worsens LOS in Seattle	No impacts	No impacts	One intersection worsens LOS in Seattle
Intersection Levels of Service – 2025 AM Peak Hour	No impacts	One intersection worsens on Mercer Island	No impacts	No impacts	Three intersections worsen LOS in Seattle
Intersection Levels of Service – 2025 PM Peak Hour	No impacts	One intersection worsens LOS in Seattle and one intersection worsens LOS on Mercer Island	No impacts	No impacts	Two intersections worsen LOS in Seattle
Safety	No impacts	In Seattle, the three high accident locations experience less than a one percent change in traffic volumes	No impacts	No impacts	In Seattle, one high accident location experiences a 1% increase in the AM and a 4% increase in the PM for the year 2025.

3.3.3 Mitigation

This section describes potential mitigation measures to off-set the increased traffic volumes that would be created by the Build Alternatives as compared to Alternative R-1. Mitigation measures are only outlined for intersections where the LOS would be degraded to LOS E or F.

3.3.3.1 Construction

All Build Alternatives

TRAN-18. Information would be distributed to provide drivers with advance notice of road closures and detours. Detour signs would be erected during road closures.

TRAN-19. To the extent feasible, WSDOT would request special event sponsors to indicate preferable directions of travel in advertisements for special events. If feasible, the construction schedule would be varied to avoid carrying out construction activities that would exacerbate potential delays during special events.

Alternatives R-2B Modified and R-8A – *Preferred Alternative*

TRAN-20. During construction of the ramps at both 77th and 80th Avenues SE for Alternatives R-2B Modified and R-8A, road closures would not occur on 77th Avenue SE and 80th Avenue SE at the same time. This will ensure that access to the Mercer Island CBD is not adversely impacted.

3.3.3.2 Operation

All Build Alternatives

TRAN-21. A warrant analysis would be performed to determine if installing a traffic signal at the intersection of East Mercer Way and the I-90 westbound on/off ramp would meet warrant criteria.

The unsignalized intersection of East Mercer Way and the I-90 westbound on/off ramp currently operates at LOS F; the delay would increase with Alternatives R-2B Modified, R-5 Restripe, and R-8A. A signal could be installed at this intersection to prevent I-90 westbound off-ramp queues from backing up onto the mainline. With a signal in place, the intersection would operate at LOS B during the 2025 PM peak hour, and the off-ramp would have sufficient capacity for westbound queues.

Alternative R-2B Modified

(**TRAN-22.** Removed from further consideration.)

TRAN-23. The approach at the unsignalized intersection of 76th Avenue SE/I-90 westbound on-ramp/North Mercer Way would be changed to a left turn lane and a shared right and through lane.

In the 2005 and 2025 AM peak hour, the unsignalized intersection of 76th Avenue SE/I-90 westbound on-ramp/North Mercer Way would degrade from LOS B to LOS E. The volume at North Mercer Way increases over 300 vehicles, from 211 to 530. The westbound approach to the intersection is currently a right turn lane and a shared left and through lane. If the approach were changed to a left turn lane and a shared right and through lane, the intersection would return to LOS B. This improvement would only require re-striping of the westbound approach.

TRAN-24. An evaluation would be performed on the feasibility of adding a southbound HOV lane through the intersection of Bellevue Way SE/112th Avenue SE/Bellevue Park-and-Ride.

In the 2025 PM peak hour, the Bellevue Way SE/112th Avenue SE/Bellevue Park-and-Ride intersection operates at LOS F with 101 seconds of delay. The delay increases to 118 seconds compared to Alternative R-1 conditions due to increased southbound volumes on Bellevue

Way SE. Adding a southbound HOV lane through the intersection to I-90 could mitigate the intersection. The HOV lane would divert 340 vehicles from the general purpose lanes during the peak hour, and would improve the intersection to 88 seconds of delay.

Alternative R-8A – *Preferred Alternative*

(**TRAN-25.** Removed from further consideration.)

(**TRAN-26.** Removed from further consideration.)

Other Mitigation Considered but Removed

Three other intersections were identified for possible mitigation based upon the LOS results of Alternative R-8A. These intersections included:

- 4th Avenue S and Airport Way
- 1st Avenue S and Royal Brougham
- 1st Avenue S and S Atlantic Street

In each situation, Alternative R-8A increased the total intersection delay in 2025 during the PM peak hour, although the LOS remained at a LOS E or better condition. The potential mitigation included the addition of turning lanes and rechannelization of the intersections. After discussion with the City of Seattle, it was determined that the potential mitigation was not appropriate in the heavy pedestrian zones around the stadiums, or that the mitigation was not likely to be cost effective to implement. Given the uncertainties around the final design of the SR 519 project and the 20-year time horizon, it is recommended that consideration of any design changes at these intersections be deferred until a later time.

A fourth intersection, Royal Brougham and 4th Avenue S, is anticipated to degrade from LOS E to LOS F by 2025. Future decisions on the SR 519 project may improve conditions at this intersection.

3.4 PEDESTRIAN/BICYCLE ACCESS

3.4.1 Affected Environment

3.4.1.1 Existing Conditions

As a part of the original I-90 project, the Interstate 90 Bicycle and Pedestrian Trail was constructed between Seattle and Bellevue via Mercer Island. This 13.5-mile-long system of pathways provides a linkage for bicycle, pedestrian and other non-motorized user modes of travel between regional destinations and non-motorized routes on both sides of Lake Washington. From the perspective of AASHTO and WSDOT design guidelines, the I-90 Trail is considered a shared-use pathway.

Most of the pathway is in or adjacent to the WSDOT I-90 freeway right-of-way. As with most of the urban freeways in the Seattle metropolitan area, bicyclists are prohibited from using the I-90 roadway shoulders within the limits of the study area. With the exception of the HMH floating bridge and the East Channel bridge, the pathway is visually and physically separate from the freeway environment. For most of its length, pathway users are separated from motorized traffic, with a limited number of street crossings.

The shared-use pathway crosses Lake Washington on the HMH floating bridge. The 10-foot-wide pathway is located on the north side of the bridge, adjacent to the westbound outer roadway. A ten-foot wide shoulder and 32 inch high barrier separate motorized traffic on the outer roadway from non-motorized traffic on the pathway.

Table 3.4-1 summarizes typical pathway conditions, including pavement width and type, and other pertinent physical characteristics of the shared-use pathway throughout the corridor. The majority of the pathway is on gradients of 4 percent or less, meeting ADA criteria for this type of facility.

Weekday Patterns of Use – Floating Bridge

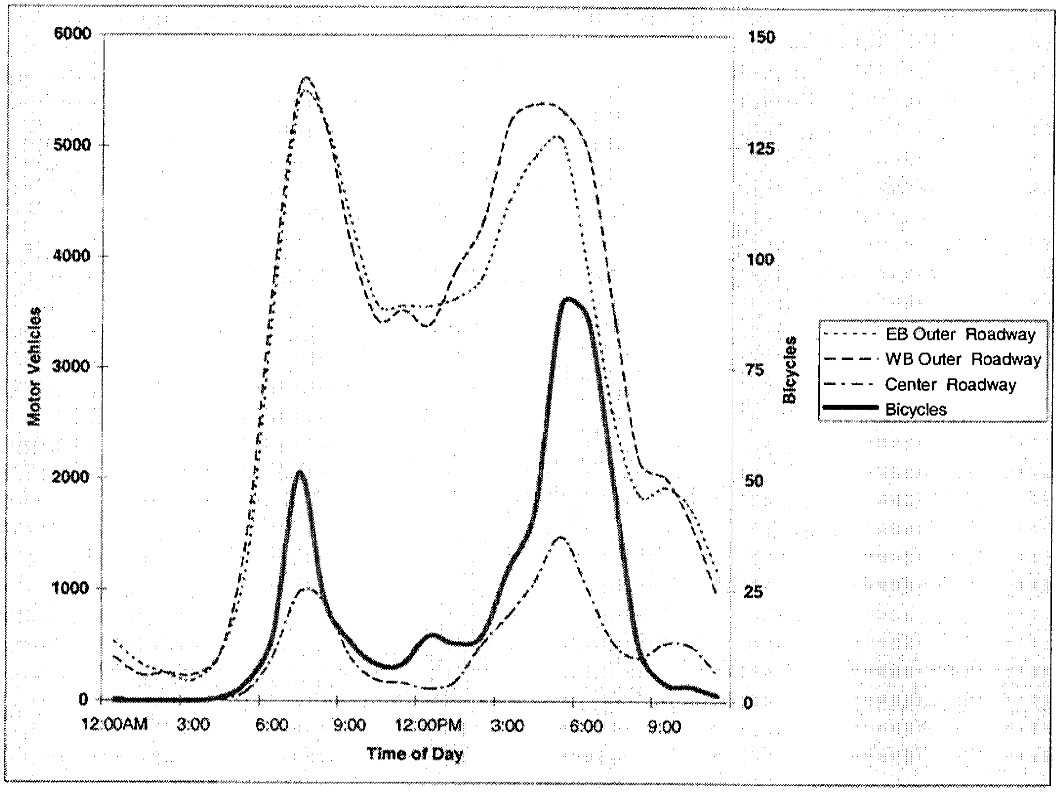
Bicycle and pedestrian counts were performed in August/September 2001, and May 2002. Weekday bicycle volumes averaged 500 bicycle trips daily during the two count periods. Weekday traffic patterns on the floating bridge are similar for motorized and non-motorized users, in that both user groups exhibit pronounced peaks in the AM and PM periods, and lower volumes at mid-day (Figure 3.4-1). Daily patterns differ, however, in that the percentage of daily users occurring during the peak hours is higher for bicyclists in the PM peak period, with approximately 18.5 percent of total bicycle traffic occurring in the PM peak hour, versus about 8.0 to 8.5 percent of the total motorized traffic occurring in the PM peak hour.

Table 3.4-1
I-90 Shared-Use Pathway – Existing Conditions

Corridor Section/Location	Pavement Width	Pavement Type	Notes
Seattle, West of 23rd Avenue	10-11 feet	Asphalt	PCC pavement with 10-foot clear width on structures. Two routes; one south to 12th Ave at Sturgis; one north to Rainier Avenue S at Judkins.
Seattle, 23rd Avenue to Tunnel (Mount Baker Ridge Lid)	15 feet	PCC	Crosses 23rd Ave and MLK Jr. Way at grade (signalized). Meanders through park with open areas and/or shoulders along pathway.
Mount Baker Ridge Tunnel	15 feet	PCC	CCTV monitoring. Continuously lit, ventilated, edge drains.
Mount Baker Ridge East Portal to HMH Floating Bridge	10-15 feet	Asphalt	8-9% grades over short distances. Stairway linkage to Lakeside Ave S.
Lake Washington HMH Floating Bridge	10 feet	PCC	54" high WSDOT std. type "BP" railing on north side, 32" high concrete bridge rail/traffic barrier on south side. Low-level pathway lighting incorporated into bridge rail.
Mercer Island HMH Floating Bridge to W Mercer Way	12 feet	Asphalt	Crosses W Mercer Way at grade. Connecting pathway to 60th Avenue SE.
Mercer Island First Hill Lid	10-12 feet	Asphalt	Two routes; provides access to recreational facilities on lid. 8-10% grades on east side of lid.
Mercer Island – CBD	10-11 feet	Asphalt	Two routes; along N Mercer is shared-use sidewalk; south side is through sculpture garden. Crosses N-S streets at grade, some locations signalized.
Mercer Island Luther Burbank Lid to E Mercer Way	10 feet	Asphalt	One section of 8-10% grade then crosses Shorewood Dr., N Mercer Way and E Mercer Way at grade.
East Channel Bridge	8 feet	Asphalt	54" high concrete/aluminum pipe rail on north side, 32" high concrete bridge rail/traffic barrier on south side. Rough surface on bridge, including utility vaults on west approach. Some pinch points on pathway are less than 8 feet wide.
Bellevue – Enatai Vicinity	10-12 feet	Asphalt	Center stripe on pathway through curves under I-90 structures.
Bellevue – Enatai to S Bellevue P&R/Slough Trail	8-10 feet	Asphalt	Center stripe on pathway where 8 ft wide on curves and 9 ft wide on structures.

Source: HNTB 2001

Figure 3.4-1
Weekday 24-Hour Traffic Patterns
Nonmotorized and Motorized Traffic
I-90 Floating Bridge



Source: 1. Motorized Traffic Volumes – WSDOT CDR data, 2001
2. Non-Motorized Traffic Volumes – adjusted WSDOT counts, May 2002

Based on the weekday manual count data collected in 2001 and 2002, daytime pedestrian use of the portion of the path on the floating bridge averages fewer than 5 pedestrian trips on most weekdays, ranging to a high of 30 pedestrian trips daily. On an hourly basis, pedestrian volumes are typically in the range of 1-2 persons per hour. These volumes include walkers, joggers, and all other users other than bicyclists. The relatively low number of pedestrians on weekdays likely reflects the distances involved in crossing the floating bridge – over one and one-half miles from shore to shore.

Weekday directional splits for bicyclists varied by count day, but generally showed that 55 to 60 percent of the AM peak period trips were westbound trips into Seattle, and 50 to 60 percent of the PM peak period trips were eastbound trips to Mercer Island or Bellevue. Mid-day directional splits were typically within 5 percent of a 50-50 split. These directional splits for bicycle traffic are similar to those seen for motorized traffic on the I-90 floating bridges.

Weekend Patterns – Floating Bridge

On weekends, daily bicycle traffic during the two count periods increased to an average of about 900 bicycle trips per day. Volumes ranged from about 550 to almost 1,500 bicycle trips per day. Bicycle traffic on holiday weekends averaged 650 bicycle trips per day, ranging from a low of 250 bicycle trips on Labor Day to a high of 1,000 bicycle trips on Memorial Day.

Weekend bicycle travel on the floating bridge showed pronounced peaks at mid-day, with about 12 to 13.5 percent of the total daily use occurring during the peak travel hours clustered around the noon hour (Figure 3.4-2).

On weekends, daytime pedestrian activity averages about 60 pedestrian trips per day, ranging to a high of 90 pedestrian trips daily, with hourly volumes in the range of 5-15 pedestrian users per hour. On an aggregate basis, pedestrians typically comprise 1 to 3 percent of weekday path usage, increasing to 10 to 15 percent on occasional weekend or holiday days.

Weekend directional splits for bicycle traffic tended to be within 5 percent of a 50-50 split on a daily basis, with somewhat higher volumes observed in the westbound direction. The higher volumes in the westbound direction may reflect recreational travel patterns associated with the Lake Washington Loop system, a popular ride for bicyclists.

Traffic Volumes and Patterns – East Channel Bridge

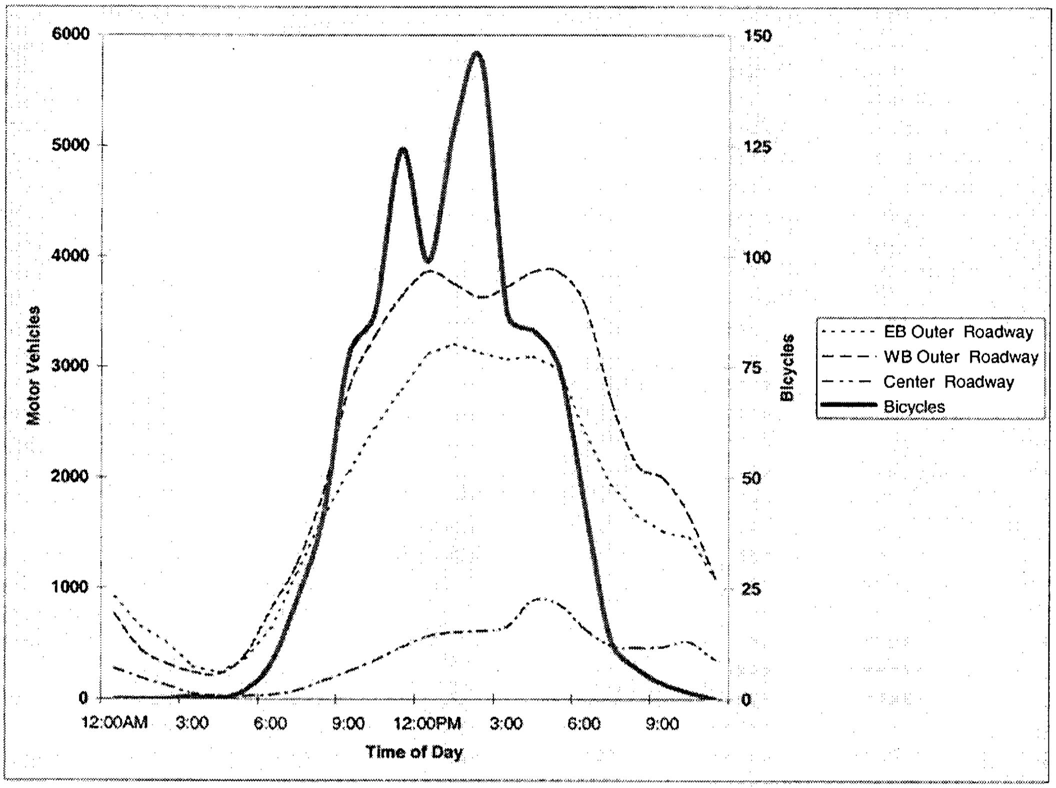
The City of Bellevue has conducted counts on the east end of the East Channel bridge during May for several consecutive years. On weekdays (Monday through Friday), the highest hourly volumes typically occurred between 6 AM and 9 AM in the morning, and 4 PM and 7 PM in the evening. These weekday peak periods for non-motorized users are similar to those that occur on the HMH floating bridge. On weekends, the highest hourly volumes typically occur mid-day, from approximately 10 AM to 2 PM.

Average weekday and peak bicycle volumes on the East Channel bridge are similar in magnitude to those found on the HMH floating bridge. Weekend bicycle volumes on the East Channel bridge appear to be somewhat lower than those on the HMH floating bridge. The City of Bellevue counts at the East Channel bridge indicated that as on the HMH floating bridge, shared-use pathway users are heavily oriented to bicyclists. Bicyclists represented over 90 percent of the shared-use pathway users during the sample count period.

Safety and Maintenance

The Project team attempted to obtain data for bicycle crashes on the portion of the pathway on the HMH floating bridge. WSDOT and the Washington State Patrol (WSP) do not maintain separate databases for bicycle accidents on the shared-use pathway. A query of the WSDOT/WSP traffic accident database indicated that no bicycle accidents had been reported by the WSP. The City of Mercer Island collects accident data for the portions of the I-90 shared-use pathway in the city, not including the bridges over Lake Washington. However, because the Project would not affect the path within the areas covered by the city database, no bicycle accident data have been obtained from that source.

Figure 3.4-2
Weekend 24-Hour Traffic Patterns
Non-Motorized and Motorized Traffic
I-90 Floating Bridge



Source: 1. Motorized Traffic Volumes – WSDOT CDR data, 2001
2. Non-Motorized Traffic Volumes – adjusted WSDOT counts, May 2002

3.4.1.2 Future Conditions

No physical modifications to the existing I-90 shared-use pathway are currently planned or anticipated to occur within the 20-year analysis period.

3.4.2 Impacts

3.4.2.1 Construction

The construction impacts for the I-90 shared-use pathway are summarized in Table 3.4-2. There would be no impacts to users of the shared-use pathway with Alternatives R-1 and R-2B Modified.

Table 3.4-2
Comparison of Nonmotorized Impacts

Alternative R-1	Alternative R-2B Modified	Alternative R-5 Restripe	Alternative R-5 Modified	Alternative R-8A Preferred
HMH Floating Bridge Modifications				
The existing configuration of the shared-use pathway would not be affected by this alternative.	The existing configuration of the shared-use pathway would not be affected by this alternative.	PM peak period buses could create gusting conditions for bicycle traffic. At other times, motorized traffic would be 4 feet farther away. A WSDOT type "BP" railing would be installed on the traffic barrier to increase its height to 54 inches. Some decrease in effective width of pathway with installation of higher railing.	The westbound outside roadway shoulder would be reduced from 10 feet to 4 feet. A screen would be installed on the traffic barrier. Potential increased wind buffeting and road debris in the shared-use pathway with proximity of traffic. Decreases in pathway use could be expected. Some decrease in effective width of pathway with installation of higher railing.	The westbound outside roadway shoulder would be reduced from 10 feet to 2 to 4 feet. A screen would be installed on the traffic barrier. Potential increased wind buffeting and road debris in the shared-use pathway with proximity of traffic. Decreases in pathway use could be expected. Some decrease in effective width of pathway with installation of higher railing.
Construction Impacts				
None	None	Partial closure of shared-use pathway to install railing; contractor work-hour closures on adjacent westbound lane and shoulder. OR Full closure of shared-use pathway to install railing; users shuttle on existing transit service and possibly deadheading buses.	Temporary closures of shared-use pathway to install screening on barrier. Pathway users could be shuttled between Seattle and Mercer Island on existing transit service, possibly deadheading buses or dedicated shuttle or provisions could be made for detour route in the center roadway.	Same as R-5 Modified.
Operational Impacts				
None	None	Some decrease in effective width of pathway with installation of higher railing.	Potential increased wind buffeting and road debris in the shared-use pathway with proximity of traffic. Decreases in pathway use could be expected. Some decrease in effective width of pathway with installation of higher railing.	Same as Alternative R-5 Modified.

Table 3.4-2 (Continued)
Comparison of Nonmotorized Impacts

Alternative R-1	Alternative R-2B Modified	Alternative R-5 Restripe	Alternative R-5 Modified	Alternative R-8A Preferred
Mitigation				
None	None	TRAN-27. Rub rails could be installed on the railings.	TRAN-27. Rub rails could be installed on the railings. TRAN-25. I-90 shuttle service could be provided via dedicated shuttle vans between Seattle and Mercer Island during construction. TRAN-26. Detour routes could be provided on the enter or eastbound roadways during construction. TRAN-28. Screening could be installed on the traffic barrier to a total height of 6 to 8 feet.	Same as R-5 Modified.

With Alternative R-5 Restripe, construction traffic control for railing modifications would have two options: the shared-use pathway could be fully closed for the duration of construction activity associated with this work, which could require several months, or only partially closed during the actual hours of work, which could extend the duration of construction activity and increase impacts on adjacent westbound traffic lanes. If partially closed, flaggers would likely be used to control pedestrian and bicycle traffic on the shared-use pathway during hours of construction.

Alternatives R-5 Modified and R-8A (and possibly Alternative R-5 Restripe) could require short-term and intermittent closure of the shared-use pathway during one to two construction seasons, with other means of access providing passage on I-90 for pedestrians and bicyclists. This would include use of existing transit buses, all of which are equipped with bicycle racks, and/or provisions for use of deadheading buses by bicyclists.

3.4.2.2 Operation

Table 3.4-2 summarizes anticipated operational impacts to non-motorized users of the I-90 corridor by alternative. These impacts would only occur on the HMH floating bridge.

With Alternative R-1, growth in recreational use of the shared-use pathway would likely follow regional and local increases in population. The *Regional Bicycle & Pedestrian Implementation Strategy for the Central Puget Sound Region* (PSRC 2002) identifies trips under five miles in length as a primary target for increases in non-motorized work-trip mode shares. As it relates to work trip or commuter use of the pathway, trips of this length would primarily be those trips between Mercer Island and Seattle, or between Mercer Island and Bellevue. Given that facilities to accommodate bicyclists are largely in place for these trips, growth in commuter use of the shared-use path would likely track with regional and local increases in population, rather than with a shift from motorized to non-motorized modes of travel. With increased use of the path, non-motorized users would experience lower levels of service during weekday evenings and weekend mid-day periods when use of the shared-use pathway is at its highest. No physical modifications to the existing pathway are currently planned or anticipated to occur within the 20-year analysis period.

With Alternative R-2B Modified, no physical modifications would be made to the existing shared-use pathway. Impacts to shared-use pathway users with Alternative R-2B Modified would be similar to those which would occur with Alternative R-1.

With Alternative R-5 Restripe, impacts to non-motorized users of the pathway would be similar to those which would occur with Alternative R-1, except that during the PM peak period transit buses on the proposed outside transit shoulder would be in operation adjacent to the shared-use pathway on the HMH floating bridge. These buses would be expected to operate at speeds of 45 mph or lower, but could create gusting wind conditions for adjacent eastbound bicycle traffic. At other times, motorized traffic would be four feet further away from the shared-use pathway, with a 14-foot wide roadway shoulder replacing the existing 10-foot wide shoulder for the entire length of the bridge. A standard WSDOT type "BP" railing would be installed on top of the existing traffic barrier to increase the height of the barrier to 54 inches, as indicated by current WSDOT *Design Manual* criteria for a shared-use pathway adjacent to a freeway with a shoulder less than six feet wide. The increased railing height would decrease the effective width of the pathway, which could result in some eastbound cyclists traveling closer to the center of the pathway, decreasing the ability of faster cyclists to overtake slower traffic and consequently reducing levels of service during peak-use periods such as evenings and weekends. The shared-use pathway would remain 10 feet wide for the entire length of the floating bridge.

With Alternative R-5 Modified, the shared-use pathway would only be affected on the HMH floating bridge. The westbound outside shoulder that acts as a buffer between auto and truck traffic in the westbound outer roadway, and bicycle and pedestrian traffic on the shared-use pathway, would be reduced from the existing 10-foot width to 4 feet for the entire 8,500-foot length of the bridge. With the reduction in the shoulder width, a standard WSDOT type "BP" railing would be required on the traffic barrier on the south side of the shared-use pathway, increasing its height to a total of 54 inches. As with Alternative R-5 Restripe, the effective width of the pathway would be reduced with the higher railing. Traffic in the adjacent general-purpose lane would operate at free-flow speeds (at 60-65 mph), except during peak periods, when congestion on the westbound outer roadway would constrain roadway traffic speeds. With traffic operating closer to the shared-use pathway, increased wind buffeting of bicyclists would occur, increased amounts of road debris could also be kicked up into the shared-use pathway by passing traffic, and headlight glare for eastbound pathway users would be increased. To reduce the proximity impact of westbound auto and truck traffic operating closer to the shared-use pathway, screening would be provided on top of the 32-inch high traffic barrier in lieu of the standard WSDOT type "BP" aluminum railing. With this degradation in the user environment on the shared-use pathway, some decreases in use of the path relative to Alternative R-1 could be expected. The shared-use pathway would remain 10 feet wide for the entire length of the floating bridge.

With Alternative R-8A, the shared-use pathway would only be affected on the HMH floating bridge. The westbound outside shoulder would be reduced in width for the entire length of the bridge. On the approaches to the bridge, for approximately 2,000 feet on the Seattle side, and

1,000 feet on the Mercer Island side, the shoulder width would be reduced from 10 feet to 4 feet. On the central portion of the bridge, for approximately 5,500 feet, the outside shoulder would be reduced in width from 10 feet to 2 feet. With the reduction in the shoulder width, a standard WSDOT type "BP" railing would be required on the traffic barrier on the south side of the shared-use pathway, increasing its height to a total of 54 inches. As with Alternative R-5 Restripe, the effective width of the pathway would be reduced with the higher railing. With traffic operating closer to the shared-use pathway, impacts would be similar to those described above for Alternative R-5 Modified. To reduce the proximity impact of westbound auto and truck traffic operating closer to the shared-use pathway, screening would be provided on top of the 32-inch high traffic barrier in lieu of the standard WSDOT type "BP" aluminum railing. The shared-use pathway would remain 10 feet wide for the entire length of the floating bridge.

3.4.3 Mitigation

3.4.3.1 Construction

Alternatives R-1 and R-2B Modified

No mitigation is required.

Alternative R-5 Restripe

Both a partial closure and a full closure of the pathway during construction of Alternative R-5 Restripe are being considered. Partial closures of the shared-use pathway during installation of railings on the existing traffic barrier could require that the contractor close the adjacent westbound travel lane and shoulder to provide a working area while still allowing non-motorized traffic through the work area. In this case, flaggers would provide control of bicycle and pedestrian travel through the work area. If the shared-use pathway were closed to non-motorized traffic during railing installations, the total duration of pathway closures may be shorter, and impacts to the adjacent westbound travel lane would be reduced. These and other construction staging schemes would be further evaluated during subsequent project design activities. If it is decided that a full closure is required, mitigation measures TRAN-27 and TRAN-28 described below for Alternatives R-5 Modified and R-8A would also apply to this Alternative.

Alternatives R-5 Modified and R-8A – *Preferred Alternative*

Temporary closure of the shared-use pathway would occur during construction of modifications to the HMH floating bridge, including modifications to the north traffic barrier that separates the shared-use pathway and the westbound outer roadway. These closures would be short-term and intermittent during one to two construction seasons.

TRAN-27. A shuttle service during construction could be provided for pedestrian and bicycle users of the shared-use pathway on the HMH floating bridge. This would be similar to service provided during construction of the low-level West Seattle bridge. It could be a shuttle on existing buses, deadheading buses, or a dedicated shuttle.

TRAN-28. A detour route during construction could be provided on the I-90 center or eastbound roadways. This would be similar to the detour route provided on the Morrison bridge in Portland, OR, during reconstruction of the Hawthorne bridge. This route could supplement the dedicated shuttle service (TRAN-25) to accommodate weekend recreational traffic, or could be in lieu of a shuttle.

3.4.3.2 Operation

Alternatives R-1 and R-2B Modified

No mitigation is required.

Alternative R-5 Restripe

TRAN 29. The addition of the type "BP" railing, which is higher than the existing traffic barrier between the shared-use pathway and the westbound outer roadway, would decrease the effective width of the shared-use pathway. To mitigate this operational issue, rub rails could be installed on the railings on both sides of the pathway, or incorporated into the potential screening on the traffic barrier (see TRAN-28). Rub rails would reduce the potential that a cyclist could snag a bicycle handlebar in the balusters of the existing railing and the type "BP" railing, and would allow cyclists to ride closer to the railings. Trade-offs involving rub-rails would be evaluated during subsequent design phases of the Project.

Alternatives R-5 Modified and R-8A – *Preferred Alternative*

For the full 8,500-foot length of the bridge, users of the shared-use pathway would experience increased wind buffeting, an increased potential for debris, and increased headlight glare from passing traffic in the westbound outer roadway. Potential mitigation measures for these impacts are described below. Further design evaluation would be conducted to determine the specific details of the potential mitigation measures, if Alternative R-5 Modified or Alternative R-8A is selected for implementation.

TRAN-30. To reduce the proximity impact of westbound auto and truck traffic operating closer to the shared-use pathway, screening would be provided on top of the 32-inch high traffic barrier in lieu of the standard WSDOT type "BP" aluminum railing. The impacts to be mitigated by screening are noted below.

- Wind buffeting due to passing traffic and/or gusting winds.
- Improved protection from roadway debris for bicyclists.
- Glare from on-coming traffic (present under existing conditions for westbound bicyclists in the winter months, but would be worsened with a reduced westbound outer roadway shoulder width).

Many design options for screening that could accomplish these goals exist. These could include chain-link fencing, wire mesh panels, lightweight concrete panels, or Plexiglas™ panels mounted on top of the concrete bridge rail for a total maximum height of six to eight feet. Simulations of examples of wire mesh and Plexiglas™ panel screening options are shown in Figure 4.3-4, along with a simulation of the type "BP" railing installation, and a photo of the existing condition. Design issues that would be considered for screening include:

- Wind loads on the floating bridge.
- Maintenance issues including access for bridge inspections.
- Safety and security issues, particularly related to reductions in visibility of the shared use pathway from the westbound roadway.
- Reductions in access to the shared-use path as a refuge for motorists with disabled vehicles.
- Aesthetic concerns, including views to the south from the pathway and views to the north from the roadway.

In addition, with Alternatives R-5 Modified or R-8A, rub rails could be installed on the railings on both sides of the pathway, or incorporated into the potential screening on the traffic barrier (see TRAN-29).

3.5 FREIGHT MOVEMENT

3.5.1 Affected Environment

3.5.1.1 Existing Conditions

The decreasing reliability of the regional transportation system has created a serious problem for truckers in reaching markets and delivering products. Currently there are estimated to be about 1.2 million truck trips per day in the region. Data trends indicate that truck traffic is growing faster than general-purpose traffic.

Table 3.5-1 shows existing truck counts (2002) on I-90 for the AM and PM peak periods and the volume counts for a 12-hour period. The table also shows and the daily traffic volumes for all vehicles and the percentage of traffic made up by trucks. For the purpose of this analysis, trucks are defined as follows:

- Truck: Any vehicle with six or more wheels (excluding buses and dual wheel pickup trucks)
- Medium Truck: Any truck that is not articulated (single-unit trucks)
- Heavy Truck: Any articulated truck (semi-trailer)
- Flammable Truck: Any articulated tanker truck carrying flammable material (red diamond-shaped flammable placard)
- Other Truck: Any truck carrying hazardous material (hazardous material placard) or other tanker trucks not readily identifiable as flammable cargo

Table 3.5-1
Truck Volumes Compared to Daily Traffic Volumes (2002)

	Eastbound			Westbound			Total		
	Total Vehicles	Trucks	%	Total Vehicles	Trucks	%	Total Vehicles	Trucks	%
AM Peak Period (6 - 9 AM)	14,000	500	3.6	17,000	400	2.4	31,000	900	2.9
PM Peak Period (3 - 6 PM)	18,000	300	1.7	15,000	250	1.8	33,000	550	1.7
12-hour Total	54,000	1800	3.3	54,000	1800	3.4	108,000	3,600	3.4

Source: WSDOT Northwest Region Traffic Data (March 2001) and HNTB truck counts (July 2002)

Over the 12-hour period, truck usage is spread out across all lanes of the I-90 outer roadways. There is a higher use of the inside lane westbound compared to the eastbound, potentially because many of the trucks are destined to southbound I-5 towards the Ports of Seattle and Tacoma. Few trucks use the eastbound inside lane. The lane usage trends during the peak periods are similar to the 12-hour patterns.

Trucks carrying flammable cargoes comprise about 4 percent of the total truck movements on a daily basis. Flammable loads are not allowed on the center roadway, because fire suppression systems are not provided on this roadway through the Mount Baker Ridge tunnel and lid, or in the First Hill lid. However, flammable loads are allowed on the I-90 outer roadways, one of the few tunnels in the world to allow such loads, because of the fire suppression and ventilation equipment installed in the tunnels, and provisions for standard width shoulders through the I-90 tunnels and lids.

Alternate Routes During Tunnel Restrictions

Trucks carrying flammable cargo are prohibited from the I-90 tunnels whenever the fire suppression systems are shut down for maintenance or testing. When flammable cargoes are prohibited from the I-90 tunnels, the trucks take either a north route, SR 520 via I-5 and I-405, or a south route, via I-5 and I-405.

Twenty-four-hour counts of trucks carrying flammable liquid cargo were made when flammable cargo was prohibited from the I-90 tunnels and when it was unrestricted. Counts while flammable cargo was prohibited were made on June 9 and 10, 2003. Unrestricted counts were made on July 1 and 2, 2003. The counts were made on I-5 at Albro, on I-405 at SE 42^{nd}, on SR 520 at midspan, and on I-90 at the eastern highrise. Counts were made using video from WSDOT surveillance cameras.

Approximately 65 percent of trucks use the north route as the alternate route when the I-90 tunnels are restricted. The remaining 35 percent use the south route as an alternate route. The count data indicate that more flammable liquid cargo is moved at night during restricted periods, probably to avoid daytime congestion on the alternate routes.

Based on discussions with dispatchers and managers for trucking companies that are carriers of flammable cargo, each driver typically determines the alternate route based on the destination of the cargo and anticipated congestion on routes in the region. Carriers indicated that trucks carrying flammable liquid cargo on I-90 have two primary destinations: local deliveries to gas stations or other retail and wholesale customers in the Puget Sound Regions, and deliveries to customers in eastern Washington via I-90 over Snoqualmie Pass. I-90 tunnel closures do not affect a carrier's routes on surface streets to and from freeways.

Safety

About 4,500 trucks use I-90 daily between Seattle and Bellevue, comprising about 3 percent of the average annual daily traffic volume. Trucks in general are involved in about 8 percent of all crashes, 6 percent of injury crashes, and 17 percent of severe injury crashes. Trucks are typically involved at a disproportionate rate in all categories of crashes, due to their greater mass and stopping distances. These patterns are typical of those on other urban freeways. A national study prepared by Battelle on truck shipment crashes and incidents indicates that trucks carrying hazardous cargoes have an average crash rate of less than one-half the rate of trucks carrying non-hazardous cargo. Trucks carrying flammable cargoes have a crash rate of approximately 68 percent of the rate of trucks carrying non-hazardous cargo.

Local, State and Federal Codes Applicable to Freight Movement

The following local, state and federal codes apply to current freight movement.

SMC 11.62.020. Flammable liquids, combustible liquids and hazardous chemicals. Summary: No person shall load or transport any flammable liquids, combustible liquids except heating oil, or hazardous chemicals upon Battery Street depressed roadway from the Alaskan Way Viaduct to Aurora Avenue North at any time or upon Alaskan Way Viaduct between the hours of seven a.m. and nine a.m. and four p.m. and six p.m. on weekdays.

SMC 11.62.140. Operation on nonarterial streets. Summary: Vehicles over 10,000 lbs. shall not be operated on non-arterial streets, except where the vehicle is an authorized bus or where such operation is necessary for reaching the vehicle's destination or pick-up/delivery point.

RCW 46.48.170, State patrol authority -- Rules and regulations. Summary: The Washington state patrol shall have the authority to adopt and enforce the regulations promulgated by the United States department of transportation, Title 49 CFR parts 100 through 199, transportation of hazardous materials, as these regulations apply to motor carriers.

RCW 46.48.175, Rules -- Penalties -- Responsibility for compliance. Each violation of any rules and/or regulations made pursuant to RCW 46.48.170 or 81.80.290 pertaining to vehicle equipment on motor carriers transporting hazardous material shall be a misdemeanor.

RCW 47.48.050, Transportation of radioactive or hazardous cargo -- Definition -- Violation, penalty. The chief or other officer of the Washington state patrol may prohibit the transportation of placarded radioactive or hazardous cargo over the highways of the state, or a portion thereof, if weather or other conditions create a substantial risk to public safety.

Title 49, Transportation, chapter III – Federal Motor Carrier Safety Administration, Department of Transportation, Part 397 – Transportation of Hazardous Materials; Driving and Parking Rules, Subpart C--Routing of Non-Radioactive Hazardous Materials, Sec. 397.67 Motor carrier responsibility for routing. Summary: A motor carrier transporting NRHM shall comply with NRHM routing designations of a State or Indian tribe pursuant to this subpart. A motor carrier carrying hazardous materials required to be placarded or marked and not subject to a NRHM routing designation, shall operate the vehicle over routes which do not go through or near heavily populated areas, places where crowds are assembled, tunnels, narrow streets, or alleys, except where the motor carrier determines that:

- There is no practicable alternative;
- A reasonable deviation is necessary to reach terminals, points of loading and unloading, facilities for food, fuel, repairs, rest, or a safe haven; or
- A reasonable deviation is required by emergency conditions, such as a detour that has been established by a highway authority, or a situation exists where a law enforcement official requires the driver to take an alternative route.

Sec. 397.71 Federal standards. Summary: State or Indian tribe shall comply with these Federal standards when establishing, maintaining or enforcing specific NRHM routing designations over which NRHM may or may not be transported:

Enhancement of public safety. The State or Indian tribe shall make a finding, that any NRHM routing designation enhances public safety in the areas subject to its jurisdiction and in other areas which are directly affected by such highway routing designation.

Public participation. Prior to the establishment of any NRHM routing designation, the State or Indian tribe shall undertake actions to ensure participation by the public in the routing process.

Consultation with others. Prior to the establishment of any NRHM routing designation, the State or Indian tribe shall provide notice to, and consult with, officials of affected political subdivisions, States and Indian tribes, and any other affected parties.

Through routing. In establishing any NRHM routing designation, the State or Indian tribe shall ensure through highway routing for the transportation of NRHM between adjacent areas.

Agreement of other States; burden on commerce. Any NRHM routing designation which affects another State or Indian tribe shall be established, maintained, or enforced only if: (i) It does not unreasonably burden commerce, and (ii) It is agreed to by the affected State or Indian tribe within 60 days of receipt of the notice sent pursuant to paragraph (b)(3)(i) of this section, or it is approved by the Administrator pursuant to Sec. 397.75.

Timeliness. The establishment of a NRHM routing designation by any State or Indian tribe shall be completed within 18 months of the notice given in either paragraph (b)(2) or (b)(3) of this section, whichever occurs first.

Reasonable routes to terminals and other facilities. In establishing or providing for reasonable access to and from designated routes, the State or Indian tribe shall use the shortest practicable route considering the factors listed in paragraph (b)(9) of this section.

Responsibility for local compliance. The States shall be responsible for ensuring that all of their political subdivisions comply with the provisions of this subpart.

Factors to consider. In establishing any NRHM routing designation, the State or Indian tribe shall consider population density, type of highway, types and quantities of NRHM, emergency response capabilities, results of consultation with affected persons, exposure and other risk factors, terrain consideration, continuity of routes, alternative routes.

3.5.1.2 Future Conditions – 2005, 2025

Regional forecasts for year 2020 anticipate a growing economy and increasing population, and this will cause truck trips to continue to increase. In 2005, congested operations (below 40 mph) would extend to about 8¼ hours daily, increasing to 10½ hours daily by 2025. As a result, some truck traffic may shift to less congested hours of the day, i.e., evenings, nights, and midday periods, or divert to other corridors.

3.5.2 Impacts

3.5.2.1 Construction

The primary effects on freight movement on I-90 during the construction period for each Build Alternative would generally be related to incremental increases in congestion levels during peak periods associated with construction conditions.

3.5.2.2 Operation

Alternative R-1: No Build

With Alternative R-1, the roadway configuration and operational configuration would remain unchanged compared to existing conditions. Travel speeds in the outer roadway would deteriorate as congestion spreads to include additional hours of the day. In Alternative R-1, lane and shoulder widths would remain in the existing configuration. Patterns of truck lane distribution are expected to remain stable. Trucks carrying flammable cargoes would continue to use the I-90 tunnels.

Alternative R-2B Modified

The outer roadway configuration would remain unchanged. As with Alternative R-1, trucks carrying flammable cargoes would continue to use the I-90 tunnels. Increased congestion would shift some truck traffic to less congested hours or other corridors. The number of crashes and incidents affecting the outer roadways were noted in Section 3.2.2, Freeway Impacts. The outside right shoulders would continue to be available for breakdowns and stalls, but as trucks are more often in the outer lanes, the trucks would be impacted more and their travel times increased. The local, state and federal regulations listed in Section 3.5.1.1 would continue to be followed under Alternative R-2B Modified.

Alternatives R-5 Restripe and R-5 Modified

Even though the widths of two travel lanes and one shoulder would be reduced, truck lane distribution would be similar to Alternative R-1. Trucks transporting flammable cargoes would continue to use the I-90 corridor and tunnels. Travel speeds and the duration of congestion would be similar to Alternative R-1. Any redistribution of truck traffic to less congested hours of the day, or shifts to other corridors, would be similar to that experienced in Alternative R-1. The number of incidents and crashes would be similar to Alternative R-1. In R-5 Restripe, the outside right shoulders would be available for breakdowns. In R-5 Modified, the outside (right) shoulder would be available to serve stalled vehicles and breakdowns in the eastbound direction. In the westbound direction, the inside (left) shoulder would serve breakdowns and stalls. The local, state and federal regulations listed in Section 3.5.1.1 would continue to be followed under Alternatives R-5 Restripe and R-5 Modified.

Alternative R-8A – *Preferred Alternative*

With Alternative R-8A, the width of the shoulders would be reduced in the outer roadway through the Mount Baker Ridge tunnel and lid and through the First Hill lid. As a result, trucks carrying flammable cargoes may be prohibited from the I-90 tunnels, however no decision has been made by WSDOT or FHWA at the time of preparing this EIS. These restricted cargoes would be required to use other regional routes.

The estimated number of trucks carrying flammable liquid cargo are shown in Table 3.5-2 for existing conditions, and for future conditions with the No Build Alternative and the Preferred Alternative (R-8A). Volumes of trucks carrying flammable liquid cargo with Alternatives R-2B Modified, R-5 Restripe, R-5 Modified would be similar to the No Build Alternative volumes.

Table 3.5-2
Annual Average Daily Trucks on I-90

Truck Cargo	2001 Existing	2025 No Build	2025 R-8A
Flammable Liquid Cargo[1]	180	200	220
Total Truck AADT[2]	4500	5000	5400

Notes: [1] Flammable liquid cargo includes all tanker trucks with placard including gasoline (flammable) and diesel (combustible).
[2] AADT = Average Annual Daily Traffic

Source: HNTB 2003

Trucks that currently cross the lake with these cargoes would reroute to the SR 520 floating bridge to the north (North Alternate Route) or the I-405/I-5 route to the south (South Alternate Route). These diversions could affect about 90 trucks daily in each direction of travel or about 4 percent of trucks currently using the I-90 corridor currently. By year 2025, these numbers are projected to increase to 110 trucks in each direction, or a total of 220 trucks. Currently, many of these trucks carrying flammable liquids obtain their loads on Seattle's Harbor Island from the Olympic Pipeline distribution points, and then use northbound I-5, or local streets in Seattle's industrial area south of downtown, to access eastbound I-90. The rerouting of flammable cargo would increase the number of trucks on I-5 either south from Harbor Island to Renton or north to SR 520. If all the rerouted trucks used I-405 and I-5 south of Lake Washington, the added volume would constitute an increase of less than 0.15 percent of the total traffic on these routes. If all these trucks were to divert to SR 520, they would represent an increase of 0.17 percent of the total traffic on this route.

Mileage and VMT (vehicle-miles traveled) for the current I-90 route and the two alternate flammable cargo routes are shown in Table 3.5-3. The values for vehicle-miles traveled were calculated using the estimated volumes shown in Table 3.5-2 for trucks carrying flammable cargo. Two-thirds (150 vpd) of the rerouted trucks would likely use the north alternate route via SR 520, and one-third (70 vpd) would likely travel the south alternate route via I-405 and I-5 by 2025.

Table 3.5-3
Annual Truck Vehicle-Miles-Traveled
Current and Alternate Flammable Cargo Routes

Flammable Cargo Route	Route Length[1]	Truck VMT[2] 2025 R-8A
Current I-90 Route w/o prohibition	9.1	730,000
North Alternate Route (SR 520) w/ prohibition	16.0	860,000
South Alternate Route (I-405/I-5) w/ prohibition	19.5	520,000
Total Rerouted Truck VMT w/ prohibition		1,380,000

Notes: 1. Route length is in miles
2. VMT = vehicle-miles traveled annually (# trucks x # miles x 365 days/year)
3. All trips shown here are trips by trucks currently on I-90.

Source: HNTB 2003

The increase in mileage and vehicle-miles-traveled for the alternate flammable cargo routes over the current I-90 route is shown in Table 3.5-4 of the FEIS. For trucks traveling between Harbor Island and I-90 to the point of the I-90 intersection with I-405, the route is 9.1 miles. If these trucks were to instead use a route from Harbor Island going north on I-5, east on SR 520, and then south on I-405, the route would be approximately 16 miles, an increase of approximately seven miles. A south alternate route from Harbor Island consisting of south on I-5 to I-405 and then north on I-405, would be approximately 19.5 miles, an increase of approximately 10.5 miles.

Operating costs for motor carriers would increase as a result of the diversion of flammable liquid cargoes to other highways. Estimates of motor carrier operating costs for trucks was prepared that included the costs of driver, interest and depreciation, repairs and maintenance, fuel, tires, and taxes. Estimates of typical operating costs for all trucks and for large tankers were obtained for 1989 and 1999 from the Federal Highway Administration, and adjusted to 2003 dollars using the producer price index for the trucking industry. For large tank/trailer combination vehicles, operating costs are estimated to be about $2.12 per vehicle mile. Diversion of these vehicles from I-90 would increase annual operating costs (current dollars) to the industry by $1.1 M in 2003 and $1.5 M in 2025 with the Preferred Alternative. These figures represent an annual cost increase of 89 percent for the immediate routes of interest, but would represent an increase of about 3 to 5 percent for a 200-mile truck trip.

Table 3.5-4
Alternate Flammable Cargo Routes
Length & VMT Increases over Current I-90 Route

Alternate Flammable Cargo Route with Prohibition on I-90	Route Increase		Increase in Truck VMT[1] 2025 R-8A
	%	Miles	
North Alternate Route (SR 520)	76%	7.0	370,000
South Alternate Route (I-405 & I-5)	114%	10.5	280,000
Total Increase in Truck VMT	—	—	650,000
Percent Increase in Truck VMT	—	—	89%

Note: 1) VMT = vehicle-miles traveled annually

Source: HNTB 2003

The annual number of all potential crashes could increase compared to Alternative R-1 with the non-standard lane and shoulder widths. Various design features would be implemented that would reduce this increment. Without these design features, truck involvement in crashes could rise to levels observed in other interstate corridors with similar geometrics. Additional crash exposure would be generated on alternative routes by the additional travel associated with the flammable cargoes.

The local, state and federal regulations listed in Section 3.5.1.1 would continue to be followed under Alternative R-8A.

Risk Analysis

See Section 4.10 for an analysis of the potential risks of release, fire or explosions due to the increase in trucks caused by rerouting flammable cargoes off of I-90. As noted in Tables 4.10-1 and 4.10-2, the likelihood of a crash is small and the likelihood of a crash resulting in a fire or explosion is remote.

The prohibition of flammable cargoes in the I-90 tunnels and lids requires consideration of both the frequency of occurrence and the consequences of crashes resulting in fires. WSDOT, in an attempt to allow the continued use of the I-90 tunnels and lids by trucks carrying flammable cargo, is committed to further study of the issues associated with the movement of flammable cargo and the means of managing risks associated with the movement of these cargoes in the I-90 tunnels and lids.

If this effort results in a policy decision to prohibit trucks carrying flammable cargo in the I-90 tunnels and lids, WSDOT is committed to further studying the means of managing risks associated with the movement of these cargoes on alternate routes. An operational decision will be made in consultation with FHWA and other project stakeholders, including local fire departments.

WSDOT is also studying an extension of the current operating policy that prohibits flammable cargo to also include all hazardous cargo in the I-90 tunnels and lids while the fire suppression systems is undergoing routine maintenance.

Before a policy decision is made to prohibit flammable and/or hazardous cargo on I-90, a public participation process would be implemented as outlined in the Code of Federal Regulations (CFR), *Title 49 -- Transportation, part 397 -- Transportation of Hazardous Materials; Driving and Parking Rules, Subpart C -- Routing of Non-Radioactive Hazardous Materials, Section 71 Federal Standards (49CFR397.71),* which states that prior to the establishment of a change in flammable or hazardous route designation, WSDOT shall provide public notification and a 30-day period in which to comment. If a public hearing is determined to be necessary the public shall be notified 30 days in advance of the hearing date.

If a policy decision is made to allow the continued use of the I-90 tunnels and lids by trucks carrying flammable cargo, public notification will be provided by WSDOT.

3.5.2.3 Summary of Impacts on Freight Movement

Table 3.5-5 compares the potential impacts on freight movement for all alternatives based on existing truck counts.

Table 3.5-5
Comparison of Impacts on Freight Movement

	R-1	R-2B Modified	R-5 Restripe and R-5 Modified	R-8A – *Preferred Alternative*
Construction	No impact	Delays due to congestion caused by lane closures; same as for other freeway traffic	Same as Alternative R-2B Modified	Delays due to congestion caused by lane closures; same as for other freeway traffic
Operation	No impact	No impact	No impact	Approximately 120 truck trips per day of flammable cargoes may be rerouted to SR 520 and 60 truck trips to I-5/I-405 in 2005. By year 2025, 150 trucks rerouted to SR 520 and 70 trucks to I-5/I-405.

3.5.3 Mitigation

Measures to mitigate the impacts of freight movement in the I-90 corridor would include actions to improve the travel times and reliability for truck traffic, and to enhance safety associated with truck traffic. Mitigation measures are described in Section 3.2.3.

3.6 NAVIGABLE WATERWAYS

3.6.1 Affected Environment

The I-90 roadways cross Lake Washington on two floating bridges. Eastbound traffic uses the LVM floating bridge and westbound and traffic in the reversible center lanes use the HMH floating bridge. The bridges are separated by approximately 65 feet.

Small boat traffic can currently use the channels under the approach structures at both the east and west ends of the floating bridges. Navigation clearance under these structures varies and provides approximately 39 feet of vertical clearance at the high ends closest to both shorelines. The East Channel bridge has a vertical clearance of 65 feet. This clearance allows larger, waterborne vessels to access the south end of Lake Washington.

3.6.2 Impacts

3.6.2.1 Construction

There would be no construction impacts to navigable waterways from any of the alternatives.

3.6.2.2 Operation

There would be no operational impacts to navigable waterways from any of the alternatives.

3.6.2.3 Summary of Impacts on Navigable Waterways

There are no potential impacts to compare.

3.6.3 Mitigation

No mitigation measures are required.