1. PURPOSE AND NEED FOR ACTION

1.1 OVERVIEW

Construction of the 30-mile Interstate 405 (I-405) freeway in the early 1960s as a bypass around Seattle for Interstate 5 (I-5) traffic also opened the rural, agricultural countryside east of Lake Washington to commercial and residential development. Interstate 405 currently ranges from six to ten lanes along the 30-mile corridor, and it is the designated military route through Seattle, as Interstate 5 was deemed too constricted (see Figure 1.1-1). Construction of the Evergreen Point (SR 520) floating bridge in 1963 further set the stage for rapid and substantial changes on the Eastside.

Today, I-405 has changed dramatically from a Seattle bypass to become the region's dominant north-south travel corridor east of I-5. More than two-thirds of the total trips on I-405 begin and end in the corridor itself. The remaining third have strong ties with the communities along SR 167 to the south of the study area, and with developing areas to the east within the urban growth area of King County. However, as the regional importance of the I-405 corridor has grown, it has become increasingly evident that worsening traffic congestion within the corridor has the potential to create serious adverse effects on personal and freight mobility, the environment, the state and regional economy, and the quality of life.

In response to these and other concerns, the Washington State Department of Transportation (WSDOT) has joined with the Federal Highway Administration (FHWA), Federal Transit Administration (FTA), Central Puget Sound Regional Transit Authority (Sound Transit), King County, and local governments to develop strategies to reduce traffic congestion and improve mobility in the I-405 corridor from Tukwila in the south to Lynnwood in the north.

The I-405 Corridor Program is a cooperative effort involving over 30 agencies that have responsibilities for planning, regulating, and implementing transportation improvements in the 250+ square-mile corridor. The decision to be made through the I-405 Corridor Program is to identify the best mix of modal solutions, transportation investments, and demand management to improve movement of people and goods throughout the I-405 corridor, reduce foreseeable traffic congestion, and satisfy the overall program purpose and need.

This programmatic I-405 Corridor Program EIS focuses on broad corridor-wide issues related to travel mode and transportation system performance. This is consistent with the program objective to enable program decisions focusing on mode choice, corridor selection, general location of improvements, and how combinations of improvements may function together as a system to solve corridor-wide transportation problems. A programmatic level of analysis is appropriate and necessary at this early stage in the decision-making process, when many project-level design details would not be meaningful in evaluating effects on mobility and environmental quality across such a large area. Subsequent environmental analysis, documentation, and review will be prepared to enable decisions regarding site-specific, project-level details on alignments, high-capacity transit technology, project impacts, costs, and mitigation measures after a Preferred Alternative has been approved.

1.2 NEED FOR THE PROPOSED ACTION

The need identified for the I-405 Corridor Program is:

> To improve personal and freight mobility and reduce foreseeable traffic congestion in the corridor that encompasses the I-405 study area from Tukwila to Lynnwood in a manner that is safe, reliable, and cost-effective.

The following sub-sections expand upon the issues and trends that influence the need for the proposed action, particularly with respect to travel demand and traffic congestion, and the attendant effects on freight mobility and safety.

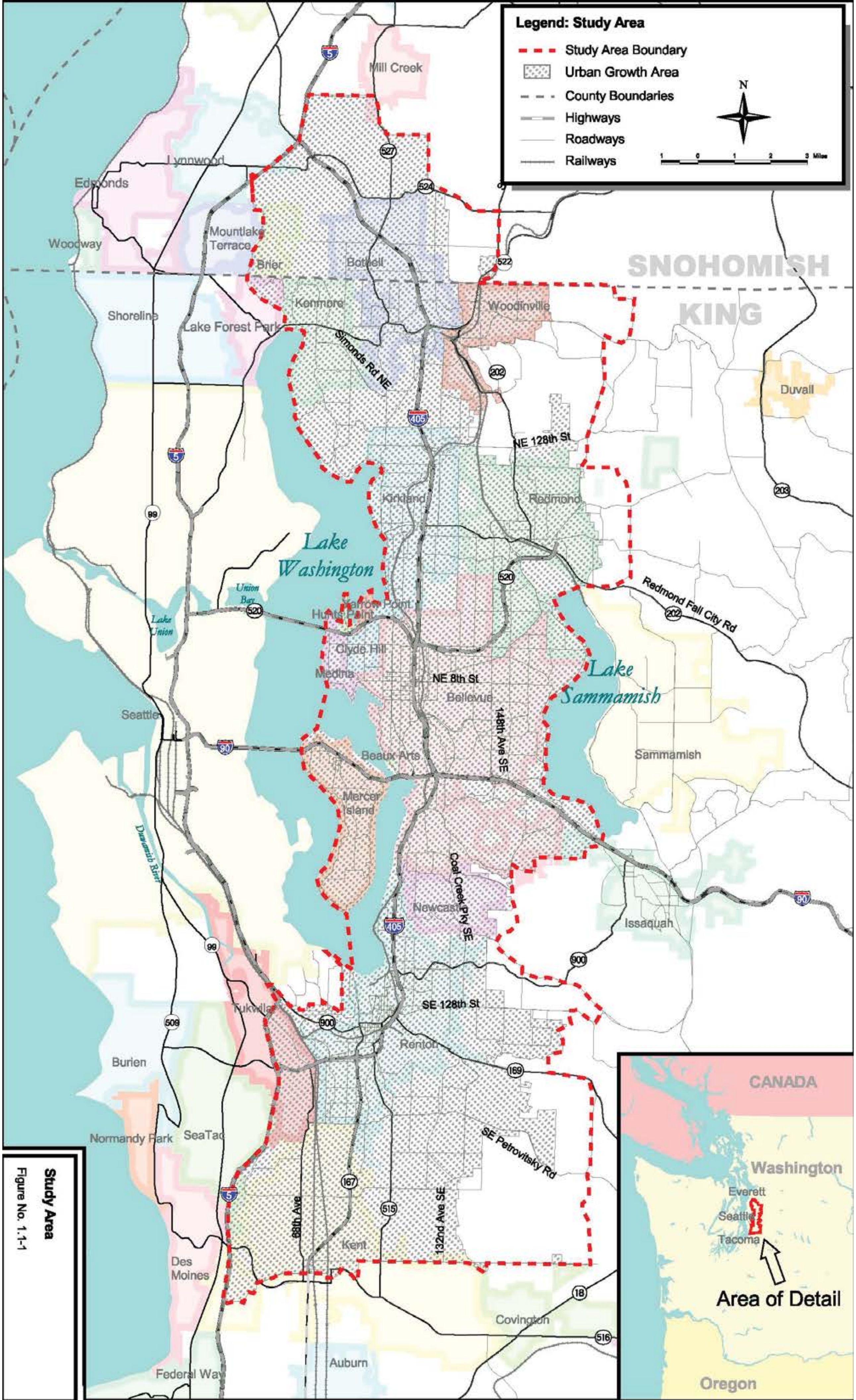
1.2.1 Growth in Travel Demand

Between 1970 and 1990, communities in the I-405 corridor grew much faster than the central Puget Sound region as a whole. During the 20-year period, employment in the study area increased over 240 percent from 94,500 to 323,175 and population grew nearly 80 percent from 285,800 to 508,560.

Population and employment continued to grow during the 1990s; in particular, employment grew at an annual rate of almost 3.5 percent. Looking ahead, growth in the corridor through 2020 likely will keep pace with the robust rate of growth in the Puget Sound region. The I-405 corridor population and employment is forecast to increase by more than 35 percent. This means that by 2020 an additional 144,000 people are expected to be employed within the study area, while the population is expected to reach approximately 765,000, an increase of more than 200,000 people from 1997.

1.2.1.1 Travel Demand

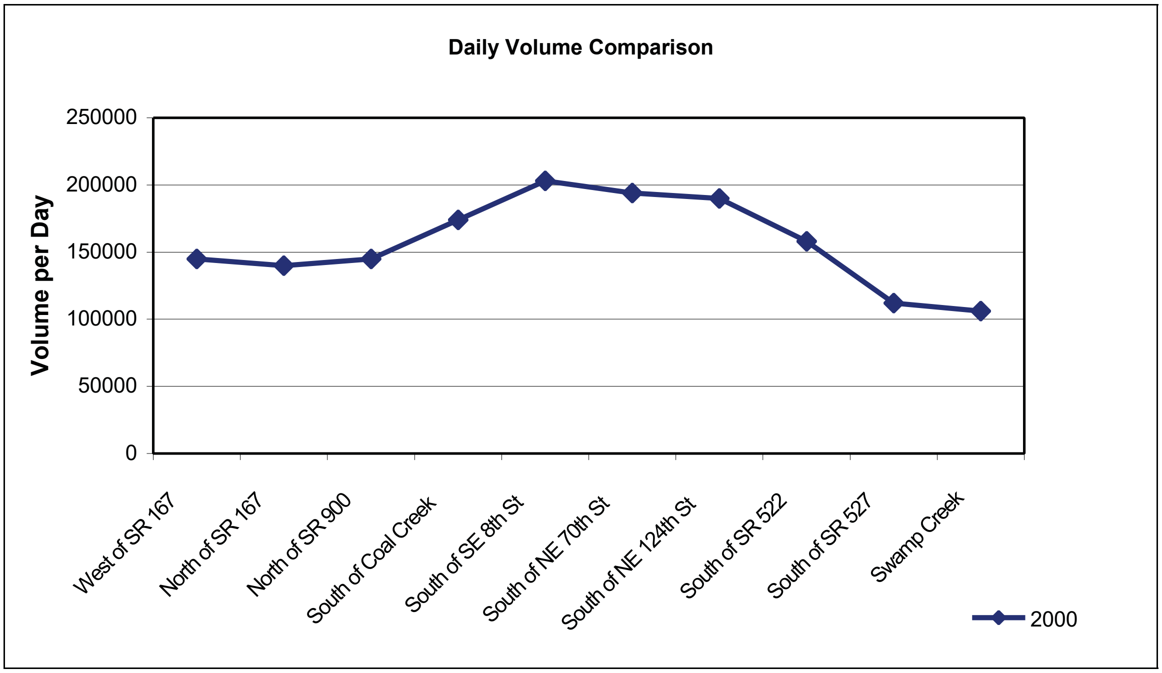
Travel demand in terms of traffic volume is currently the heaviest within the study area on I-405 itself, with the freeway carrying 60 to 70 percent of the total daily traffic volumes passing though the study area in the north-south direction. Conversely, the arterial streets carry 30 to 40 percent. In the east-west direction, the arterial street system plays an important role, with volumes almost equally distributed between the arterial streets and the two east-west freeways, I-90 and SR 520. In 2000, the highest volumes on I-405 occurred between I-90 and SR 520 in Bellevue: with about 205,000 vehicles per day. I-405 at SR 900 in Renton typified traffic volumes on I-405 south of I-90, carrying about 145,000 vehicles per day. Figure 1.2-1 shows these findings. This variation in traffic volumes is the result of different travel demands within the corridor as well as the available capacity on the freeway. At many locations on I-405 daily traffic counts have not increased much in recent years because the segment is nearing capacity. Travel demand trends in the I-405 corridor are expected to match or exceed the population and employment trends: between 1995 and 2020, person-trips are generally expected to increase more than 50 percent. This will result in increased demands on I-405 and the study area arterial system.



Study Area

Figure No. 1.1-1

Figure 1.2-1: Daily Traffic Volumes at Selected Locations on I-405



Source: PSRC Model

1.2.1.2 Mode Split

Single-occupant vehicles (SOVs) generate the majority of traffic demand: up to 78 percent of work trips within the I-405 study area are SOVs. High-occupancy vehicles (HOVs) and transit users comprise around 20 percent of all work trips within the study area. SOV use in the study area is higher than the average for King County, while HOV and walk/bike percentages are lower. These results reflect the more suburban character of the I-405 study area.

The segment of I-405 with the highest peak-period transit ridership is between SR 520 and the Totem Lake area (2,100 riders). Transit ridership near each of the northern and southern termini of I-405 is less than 1,000 riders during peak periods. To encourage more transit demand, Sound Transit’s Regional Express program is currently in the planning and early design stages of new park-and-ride lots, transit centers, and direct access ramps, including large-scale improvements to several I-405 interchanges. King County and Sound Transit's evolving bus transit services concept for the I-405 study area would serve multiple activity centers, instead of the traditional Seattle/Bellevue hub-and-spoke design.

1.2.1.3 Trip Characteristics

Travel demand on I-405 appears greater for longer trips; along several sections of I-405, the average vehicle trip length exceeds 25 miles, roughly three times the study area average.

Forecasts for 2020 show the freeway attracting even more long trips, with over 50 percent of all trips on I-405 exceeding 30 miles in length.

Today in the study area, only 20 percent of the total daily person-trips are home-based work trips, that is, commute trips directly to and from work. Thirty-nine percent of daily person-trips are other home-based trips (e.g., shopping, recreational, personal business) and 28 percent are non-home-based trips (e.g., traveling from work to daycare or shopping). School (2 percent) and commercial vehicle trips (11 percent) make up the rest. The relative shares of each trip purpose are expected to be similar in 2020. The fairly small share of trips that are purely to and from work reflects the fact that people are increasingly linking their trips, stopping on the way home to shop, pick up children, etc. (which are considered non-home-based trips). This poses a challenge for transit and carpool/vanpool use.

1.2.2 Traffic Congestion and Reliability

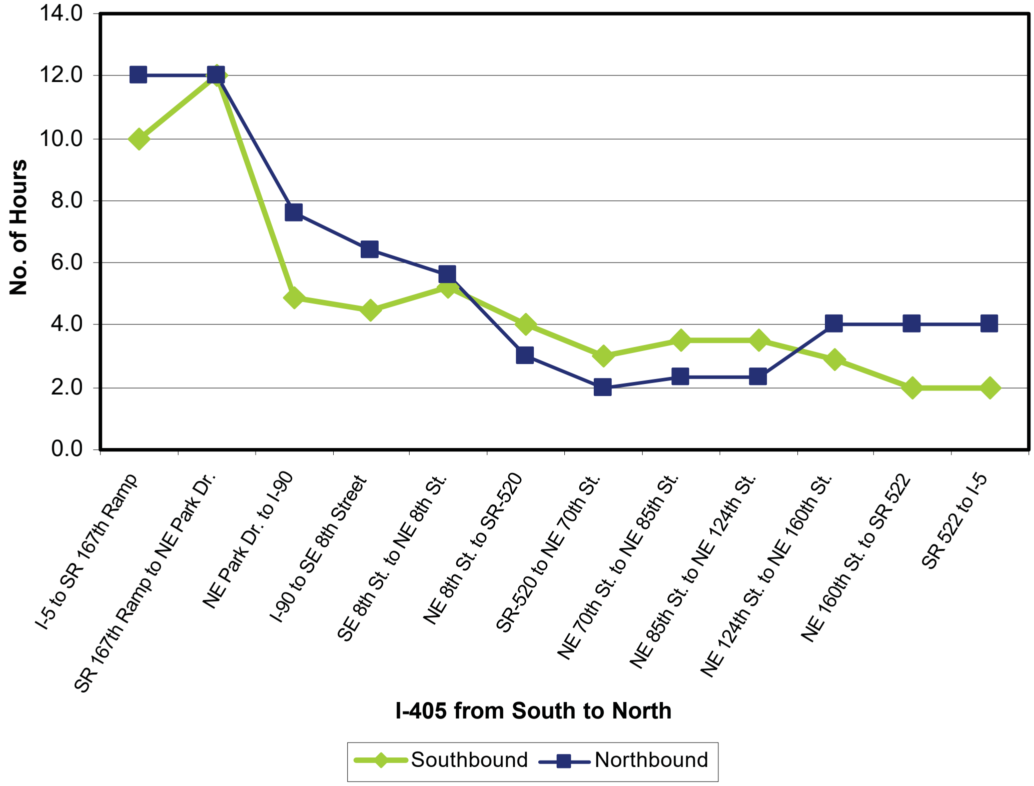
1.2.2.1 Traffic Congestion

Heavy travel demand and frequent traffic incidents contribute to substantial traffic congestion on I-405, although they are not the only causes. Traffic congestion along I-405 is widespread during the morning and afternoon peak periods and has spread to surrounding time periods. A useful way to examine daily congestion is to look at the number of hours during which a facility is congested. For purposes of this analysis, "congestion" on the freeway is defined as travel speeds below 45 mph. Figure 1.2-2 illustrates the severity of traffic congestion that was present in 1997 at twelve points along I-405. The duration of traffic congestion in the northbound and southbound directions is roughly the same. The most congested area of I-405 is from I-5 in Tukwila to NE Park Drive in the city of Renton. Traffic congestion for 10 to 12 hours per day is typical in this section. For most other sections, traffic congestion lasts 2 to 7 hours per day.

The average daily "volume per freeway lane" is quite consistent throughout the corridor, which demonstrates that traffic volumes alone do not cause congestion. The most likely reason for the high hours of congestion in the south end of I-405 relates to freeway "friction" caused by curves (e.g., the "S-Curves"), grades (e.g., Kennydale Hill), and complex interchanges at I-5 and SR 167.

Traffic congestion on I-405 often results in blockage of mainline flows throughout the day by vehicles that cannot get onto the ramps at such locations as SR 167, I-90, SR 520, and SR 522. The spill-over traffic from the ramps has created substantial mainline traffic congestion and operational hazards throughout the I-405 corridor. This congestion also causes traffic to back up onto local arterials.

Figure 1.2-2: Hours of Traffic Congestion on I-405



Source: PSRC Model, Mirai Associates

1.2.2.2 Travel Time

Variation in congestion causes travel times to vary widely within the I-405 study area, depending upon the origin and destination of the trip and the mode of travel being used. Table 1.2-1 summarizes typical P.M. peak-hour travel times (1995 data) for a variety of study area trips, averaging 23 miles in length. The times are for door-to-door travel, including in-vehicle time and access to the trip's origin and destination. The fastest trips are typically by non-transit HOV mode, particularly for longer trips along I-405 that can take full advantage of the HOV lane system. Traveling along the full length of I-405 during the peak period can take longer than one hour for general traffic. Transit travel times are often at least twice as long as driving the equivalent distance, especially for people walking to the transit stops. Transit travel times are 10 to 15 percent faster for park-and-ride access trips compared with walk access transit trips. This is partially due to shorter wait times at park-and-ride locations created by more frequent transit service.

Table 1.2-1: Comparison of Typical I-405 Study Area P.M. Peak Hour Travel Times by Mode

Trip	Distance (miles)	General Traffic Travel Time (min)	HOV Travel Time (min)	Transit Travel Time Walk Access (min)	Transit Travel Time Park-and-Ride Access (min)
Bellevue Central Business District (CBD) to Federal Way/Kent	25	56	40	95	83
Renton to Mill Creek	33	65	49	125	105
Bellevue CBD to Edmonds/Lynnwood	19	42	38	85	76
Tukwila/SeaTac to Redmond/Overlake	23	49	39	116	103
Issaquah/Cougar Mt. to Bothell/Kenmore	23	46	39	108	98
Issaquah/Cougar Mt. to Federal Way/Kent	23	56	47	132	118

Source: Puget Sound Regional Council (PSRC) Model - 1995 base year

1.2.2.3 Travel Time Reliability

Not only do travel times vary by segment within the I-405 study area, they are unpredictable from day to day. The reliability of travel times can be defined in terms of deviation from a mean travel time when travelers in the same transportation mode repeat their trips with identical travel routes starting at a same time of day. A transportation system provides a good level of service when travelers experience the same travel time every time or with little deviation.

The Washington State Transportation Center (TRAC) conducted research to measure the performance of the freeway system in the Central Puget Sound area, which includes the travel time reliability measure for general traffic along I-405. The most recent analysis results are described in the report entitled Central Puget Sound Freeway Network Usage and Performance, 1999 Update, Volume 1 (Washington State Transportation Center and Washington State Department of Transportation). The following summarizes the findings of the travel time reliability data prepared by the TRAC for 1999.

- Existing travel time reliability for the vehicles traveling *from Tukwila to Bellevue CBD* is very poor during the mid-day and evening periods and extremely poor during the morning peak period.
- Existing travel time reliability for the vehicles traveling *from Bellevue CBD to Tukwila* is poor throughout the day (from 6:00 A.M. to 6:30 P.M.). In particular, the travel time reliability during the afternoon peak period is very poor and the traffic flows in the period are highly unstable.
- Existing travel time reliability for the trips *from Bellevue CBD to SR 522* is relatively poor during the P.M. peak period. Travelers starting trips during other periods have experienced good travel time reliability.
- Existing travel time reliability problems for the trips *from SR 522 to Bellevue CBD* are confined to the A.M. peak period. The problem is worst at 8 A.M.

Traffic incidents along the freeway corridor are major causes of the reliability problems. The State's Incident Management Program was implemented to help improve overall travel time reliability within the I-405 Corridor. Reliability of travel in the HOV lanes is considerably better than in the general purpose lanes. HOV travel speeds typically operate from 15-20 miles per hour faster than the adjacent general purpose lanes during congested time periods. HOV travel time reliability suffers when there is a major incident along I-405 with stop-and-go conditions. In these situations, HOV speeds drop and the level of HOV lane violations tends to increase.

The corridor segment south of I-90 is the primary regional roadway linking much of east King County with south King County. Because of topographical limitations, this segment is more susceptible to a major incident shutting down the freeway.

1.2.3 Freight Mobility

The decreasing reliability of the regional transportation system, including I-405, is creating a serious problem for regional freight mobility. The central Puget Sound region serves as an important freight gateway to Pacific Rim countries. Automobiles, forest and agricultural products, communications and computer equipment, and hundreds of other items continuously move over the region's roadways and railroads, to seaports and airports. Substantial delay as a result of transportation system congestion is costing the region's businesses nearly $700 million a year, according to information from WSDOT. The cost to the freight industry itself is estimated to be around $200 million per year.

Products shipped by truck across I-90 from Eastern Washington reach points north and south of Seattle via I-405. At the same time, I-405 serves as a heavily used transport corridor for local freight delivery to and from the cities along the corridor. Smaller trucks, such as delivery vans, account for many freight trips within the region, and these trips could benefit greatly from roadway improvements to I-405.

Interstate 405 continues to be used by freight carriers as an alternative to the preferred I-5 route when severe congestion occurs on I-5 in downtown Seattle near the Convention Center (one of the most substantial freight mobility bottlenecks in the region). I-405 also provides ready access to the distribution centers along SR 167 in the Kent Valley. Volumes of heavy trucks on the portion of I-405 south of I-90 are about double those along the northern portion due to truck movements to and from the Kent Valley. Truckers identify congestion at the SR 167/I-405 interchange as one of the worst transportation system problems in the region, and the trucking community supports improvements to this major truck corridor interchange as one of its top priorities.

The latest data indicate that the central Puget Sound region's roadways carry approximately 1.2 million truck trips each day, with about 70 percent of those trips occurring within King County. I-405 carries a substantial portion of those trips, moving up to 90 percent of the total truck origins and destinations in east King County. Truck volumes along I-405 are expected to grow by 50 percent by the year 2010. Reductions in system reliability and resulting higher transportation costs increase the cost of manufacturing and distributing goods, while adversely affecting economic vitality and job creation. Accessibility to markets becomes increasingly difficult with worsening traffic congestion and delay. Improvements to the I-405 corridor could provide tangible economic benefits for all of Washington State.

In addition to the roadway system, freight is also carried on an existing railroad line that follows the I-405 corridor. The Burlington Northern Santa Fe Railroad (BNSF) currently serves a small number of customers on this Renton to Snohomish line, including retail and manufacturing. A dinner train also operates daily on the line during most of the year. There is potential to replace some truck trips in the future by making improvements to the rail line. The BNSF line also holds the possibility of a future shared use arrangement with passenger/commuter rail, should that become a feasible transportation alternative. This is not expected to occur within the 2020 horizon year of this analysis, and might only include portions of the BNSF line within the I-405 Corridor Program study area.

1.2.4 Safety

Twenty-nine of the 280 high accident locations in King and Snohomish counties are located along I-405. Most high accident locations are associated with ramps connecting to I-405, including those at SR 181 (Interurban), SR 169, SR 900 (Sunset and Park), Coal Creek Parkway, SE 8th Street, NE 4th Street, NE 8th Street, SR 908 (NE 85th Street), NE 116th Street, NE 160th Street, and SR 527. The portion of I-405 north of SR 527 is identified as a high accident corridor due to the relatively higher speeds and more serious injuries associated with these accidents.

Over the three-year period from 1994 to 1996, a total of 5,580 accidents was reported along I-405. Most collisions occurred on the mainline freeway, with about one-fourth of all accidents occurring on the ramps, collector-distributor roads, and cross streets at the interchanges. About half of all collisions involve property damage only, while half involve injuries or fatalities. This injury pattern applies equally to the mainline and ramp segments; however, all seven fatalities reported in this period occurred on the I-405 mainline.

The overall accident rate along I-405 (1.6 accidents per million vehicle miles) is about midrange compared to other freeways in King County. The rates are lower than the average rate for all state highways in Washington (1.88 accidents per million vehicle miles, or MVM) and for state highways in King County (2.27 accidents per MVM). On comparable local freeways, I-5 and SR 520 both exhibit accident rates of about 2.0 accidents per MVM. WSDOT's ramp metering program on I-405 has been very successful. Rear-end and sideswipe accidents have decreased by 60 percent to 70 percent near locations with ramp meters.

Year 2000 accident data on I-405 reveal a total of 2,345 accidents along the length of I-405. This number is greater than the average of 1,860 accidents annually between 1994 and 1996 and is greater than the increase in volumes during the 1996-2000 period.

It is likely that the increase in accidents is related to the worsening congestion and the construction activity along the I-405 corridor. The largest increases in accidents occurred in the Newcastle, Bellevue, and Bothell segments of the corridor.

For state roads serving as surface arterial routes, accident rates typically fall into the range of three to five accidents per MVM. This rate is related to the presence of traffic signals, driveways, pedestrians, and bicyclists, and lower levels of access control. These accident rates are typical of urban arterial facilities. Accident rates for selected arterial and collector routes in the primary study area generally range between two and four accidents per MVM, with some streets higher. These streets also experience higher accident rates due to the presence of signalized intersections, driveways, and other conflicts.

1.3 PURPOSE OF THE PROPOSED ACTION

The purpose of the proposed action is:

> To provide an efficient, integrated, and multimodal system of transportation solutions within the corridor that meets the need in a manner that:
>
> - Provides for maintenance or enhancement of livability for communities within the corridor;
> - Provides for maintenance or improvement of air quality, protection or enhancement of fish-bearing streams, and regional environmental values such as continued integrity of the natural environment;
> - Supports a vigorous state and regional economy by responding to existing and future travel needs; and
> - Accommodates planned regional growth.

1.4 STUDY AREA

The study area for the I-405 Corridor Program defines the general boundaries of the I-405 corridor and encompasses the essential improvements proposed within each alternative. It has an area of approximately 250 square miles that extends on both sides of I-405 between its southern intersection with I-5 in the city of Tukwila and its northern intersection with I-5 in Snohomish County. This area includes the cities of Tukwila, Renton, Newcastle, Bellevue, Redmond, Kirkland, Woodinville, and Bothell, as well as portions of the cities of Issaquah, Kenmore, Kent, Lynnwood, and Mercer Island and adjacent unincorporated areas of King and Snohomish counties.

For purposes of environmental analysis, documentation, and review, potential substantial adverse effects are identified and evaluated wherever they are reasonably likely to occur in the region.

This page left intentionally blank.

2. DESCRIPTION OF ALTERNATIVES

2.1 PROJECT TERMINI AND WHY THEY ARE LOGICAL

The proposed I-405 Corridor Program improvements include freeway widening, new high-capacity transit (HCT), added arterial capacity, and other improvements that address multimodal transportation needs throughout the length of the I-405 corridor. The southern terminus of I-405, at its intersection with I-5 in the city of Tukwila, and northern terminus of I-405, at its intersection with I-5 in Snohomish County, were identified as logical limits for the proposal because the termini encompass the entire length of the I-405 facility. This enables proposed solutions to be examined at a level that demonstrates independent utility, and ensures that solutions consider the direct relationship with I-5, which is the major north-south travel route in western Washington.

2.2 ALTERNATIVES EVALUATED IN THE DRAFT EIS

Four programmatic action alternatives and a No Action Alternative were evaluated in the Draft Environmental Impact Statement (DEIS). In addition, the Preferred Alternative, which is a multimodal solution very similar to Alternative 3 in the DEIS, is evaluated in this Final EIS. Each of the action alternatives is a combination of multi-modal transportation improvements and other mobility solutions packaged to work together as a system. Each package demonstrates a unique emphasis in response to the purpose and need for the I-405 Corridor Program. The improvements and mobility solutions that comprise each action alternative are assembled from the following elements:

- Transportation demand management (TDM)
- Regional transportation pricing
- Local transit service (bus and other technologies)
- Bus rapid transit (BRT) operating in improved-access high-occupancy vehicle lanes on I-405, I-90, and SR 520
- Fixed-guideway high-capacity transit (HCT) operating with physical separation from other transportation modes
- Arterial high-occupancy vehicle (HOV) and bus transit priority improvements
- HOV express lanes on I-405 and HOV direct access ramps
- Park-and-ride capacity expansions
- Transit center capacity improvements
- Basic I-405 safety and operational improvements
- I-405 general purpose lanes
- I-405 collector-distributor lanes
- I-405 express lanes
- SR 167 general purpose lanes

- Capacity improvements on freeways connecting to I-405
- Planned arterial improvements
- Missing segments in the arterial network
- Capacity improvements on north-south arterials
- Arterial connections to I-405
- Pedestrian and bicycle improvements
- Intelligent transportation system (ITS) improvements
- Truck freight traffic enhancements

These elements are described in greater detail in Appendix A (I-405 Corridor Program - Major Elements of Alternatives) and Appendix B (I-405 Corridor Program – EIS Alternatives Project Matrix). Typical cross-sections for the proposed I-405 lane additions are shown in Appendix E (Roadway Sections). Table 2.2-1 shows the major elements contained in each of the alternatives.

2.2.1 No Action Alternative

The No Action Alternative includes the funded highway and transit capital improvement projects of cities, counties, Sound Transit, and WSDOT. These projects are already in the pipeline for implementation within the next six years, and are assumed to occur regardless of the outcome of the I-405 Corridor Program. For this reason, they are referred to collectively as the No Action Alternative.

Under the No Action Alternative, only limited expansion of state highways would occur. No expansion of I-405 is included; however, a new southbound I-405 to southbound SR 167 ramp modification would be constructed. Approximately 15 arterial widening and interchange improvement projects would be implemented within the study area by local agencies. Short-term minor construction necessary for continued operation of the existing transportation facilities would be accomplished, and minor safety improvements would be constructed as required.

It is assumed that Phase I of Sound Transit's regional transit plan would be completed. Approximately 36 HOV direct access projects, arterial HOV improvements, park-and-ride expansions, and transit center enhancements would be implemented in the study area as part of the No Action Alternative. Bus transit service levels by the 2020 horizon year are based upon the Puget Sound Regional Council (PSRC) *VISION 2020* Metropolitan Transportation Plan. Parking costs are expected to increase due to market forces. Additional urban centers and major employment centers within the study area are also assumed to implement parking charges by 2020.

These baseline transportation improvement projects are, or will be, the subject of separate and independent project-specific environmental analysis, documentation, and review. Their direct impacts are not specifically evaluated by the I-405 Corridor Program. However, the secondary and cumulative impacts of these projects are addressed as part of the analyses contained herein.

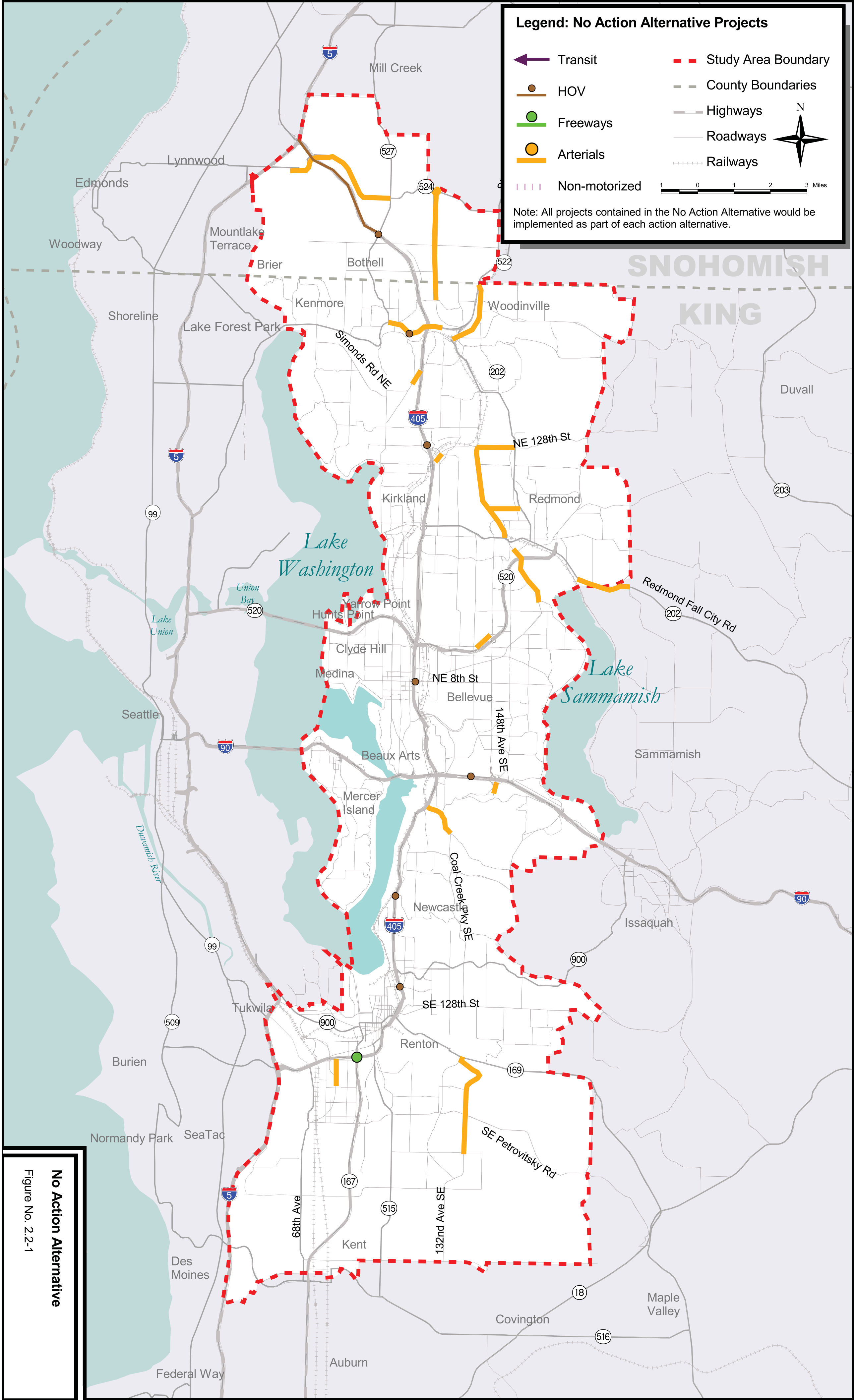
Figure 2.2-1 shows the locations of the improvements contained in the No Action Alternative. Appendix B (I-405 Corridor Program EIS Alternatives Project Matrix) identifies the specific transportation improvements and mobility solutions contained within each system element and alternative.

Table 2.2-1: Elements Contained in Each Alternative

	No Action Alternative	Alternative 1 HCT/TDM Emphasis	Alternative 2 Mixed Mode with HCT/Transit Emphasis	Alternative 3 Mixed Mode Emphasis	Alternative 4 General Capacity Emphasis	Preferred Alternative
Committed and funded freeway projects	X	X	X	X	X	X
Committed and funded HOV projects	X	X	X	X	X	X
Committed and funded arterial projects	X	X	X	X	X	X
Park-and-ride expansions included in No Action	X	X	X	X	X	X
Transit center improvements included in No Action	X	X	X	X	X	X
Transportation Demand Management (TDM)	X	X	X	X	X	X
Expanded TDM regional congestion pricing strategies		X				Contingent upon adopted regional pricing policy
Expand transit service by up to 100% compared to King Co. 6-Year Plan		X	X	X		Expansion limited to around 75% based on demand
Expand transit service by 50% compared to King Co. 6-Year Plan					X	
Physically separated, fixed-guideway HCT system		X	X			
Bus rapid transit operating in improved access HOV lanes				X		X
Arterial HOV priority for transit		X	X	X		X
HOV direct access ramps on I-405			X	X	X	X
Additional park-and-ride capacity expansion		X	X	X		X
Additional transit center improvements		X	X	X		X
Basic I-405 safety and operational improvements		X	X	X	X	X
I-405/SR 167 interchange ramps for all major movements			X	X	X	X
One added general purpose lane in each direction on I-405			X		X	
Two added general purpose lanes in each direction on I-405				X		X

	No Action Alternative	Alternative 1 HCT/TDM Emphasis	Alternative 2 Mixed Mode with HCT/Transit Emphasis	Alternative 3 Mixed Mode Emphasis	Alternative 4 General Capacity Emphasis	Preferred Alternative
Two express lanes added in each direction on I-405 [a]					X	
Collector - distributor and auxiliary lanes as needed			X	X	X	X
Widen SR 167 by one lane each direction to study area boundary [b]			X	X	X	X
Improved capacity of freeways connecting to I-405			X	X	X	X
Planned arterial improvements			X	X	X	X
Complete missing segments of major arterial connecting routes [c]				X	X	X
Expand capacity on north-south arterials [c]					X	X
Upgrade arterial connections to I-405 [c]			X	X	X	X
Pedestrian / bicycle connections and crossings of I-405		X	X	X	X	X
Intelligent transportation system (ITS) improvements		X	X	X	X	X
Truck freight traffic enhancements		X	X	X		X
Consider managed lanes on I-405 [d]					Accommodates future planning for expanded managed lanes in corridor	Accommodates future planning for expanded managed lanes in corridor

[a] Studied as general purpose lanes and as managed high-occupancy/toll (HOT) lanes.
[b] Preferred Alternative widens SR 167 by up to two lanes in each direction south to S 180th Street, but includes no widening beyond S 180th.
[c] With jurisdictional approval.
[d] Strategies and approaches for managing lanes could include intelligent transportation system (ITS) technologies, lane access restrictions, lane occupancy restrictions such as HOV or high-occupancy/toll (HOT) lanes, facility tolls, and regional congestion pricing, among others.



No Action Alternative

Figure No. 2.2-1

This page left intentionally blank.

2.2.2 Alternative 1: High-Capacity Transit/TDM Emphasis

This alternative attempts to minimize addition of new impervious surface from general purpose transportation improvements and to encourage transit use within the study area. To do this, Alternative 1 emphasizes reliance on a new physically separated fixed-guideway HCT system, substantial expansion of local bus transit service, non-construction mobility solutions such as regional transportation pricing, and transportation demand management (TDM) strategies. It does not include any increase in roadway capacity beyond the No Action Alternative. All improvements contained in the No Action Alternative are included in Alternative 1, as well as in the other action alternatives. Table 2.2-1 shows the elements contained in each of the alternatives.

Alternative 1 includes a physically separated, fixed-guideway HCT system, potentially using some form of rail technology and potentially operating within portions of the existing Burlington Northern Santa Fe Railroad (BNSF) right-of-way. The HCT system would serve the major activity centers within the study area, and would include connections to Redmond and Issaquah and west across Lake Washington to Seattle. The connection across Lake Washington is being evaluated as part of the ongoing Trans-Lake Washington Project EIS. Overall transit service would be increased by about 100 percent compared to King County's Fall 2001 proposed 6-year transit development plan. In addition, this alternative would add a new bus maintenance and operations facility in the Green River Valley. Arterial HOV priority for transit, additional park-and-ride capacity for 4,500 vehicles, and 26 transit center improvements also would be provided.

A package of basic improvements to I-405 would be implemented, including climbing lanes, auxiliary lanes, I-90/Coal Creek Parkway interchange improvements, and I-405/SR 167 interchange improvements, among others. No additional general purpose lanes on I-405 would be provided.

Limited arterial HOV/transit improvements would be provided to facilitate access to I-405 and the fixed-guideway HCT system, along with non-construction treatments such as providing priority for transit at signals and intersections. Regional pricing strategies similar to those currently being studied by the Puget Sound Regional Council (PSRC) would be implemented along with a package of core TDM strategies that are common to all the action alternatives.

Figure 2.2-2 shows the location of improvements contained in Alternative 1. Appendix A (I-405 Corridor Program - Major Elements of Alternatives) describes the elements that are the building blocks for the alternatives. Appendix B (I-405 Corridor Program EIS Alternatives Project Matrix) identifies the specific transportation improvements and mobility solutions contained within each element and alternative.

2.2.3 Alternative 2: Mixed Mode with High-Capacity Transit/Transit Emphasis

This alternative attempts to improve mobility options in the study area relative to Alternative 1 by providing the same substantial commitment to transit, combined with the minimum increase in roadway capacity for HOV and general purpose traffic. To do this, Alternative 2 would implement a new physically separated, fixed-guideway HCT system, substantial expansion of local bus transit service, one added lane in each direction on I-405, and improvements to connecting arterials. All improvements contained in the No Action Alternative are included in Alternative 2, as well as in the other action alternatives. Table 2.2-1 shows the elements contained in each of the alternatives.

Alternative 2 includes a physically separated, fixed-guideway HCT system, potentially using some form of rail technology. The HCT system would serve the major activity centers within the study area, and would include connections to Redmond and Issaquah and west across Lake Washington to Seattle. The connection across Lake Washington is being evaluated as part of the ongoing Trans-Lake Washington Project EIS. Overall transit service would be increased by 100 percent compared to King County's Fall 2001 proposed 6-year transit development plan. This is a 50 percent increase in service compared to the current King County, Sound Transit, and Community Transit 6-year plans. In addition, Alternative 2 would add a new bus maintenance and operations facility in the Green River Valley. Arterial HOV priority for transit, additional park-and-ride capacity for 4,500 vehicles, and 26 transit center improvements are included, as well as completion of the HOV freeway-to-freeway ramps along I-405.

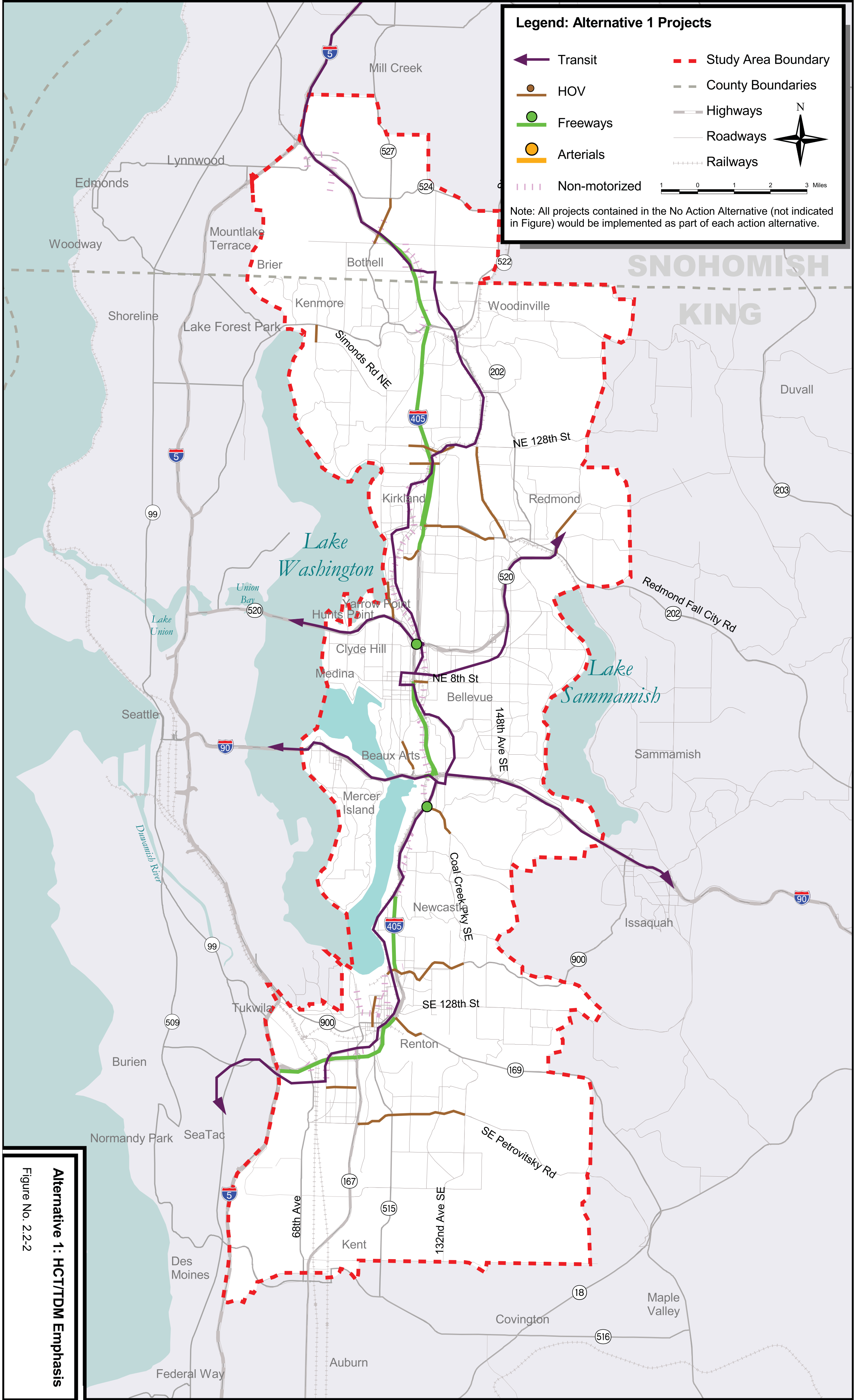
To increase general purpose capacity, I-405 would be widened by one lane in each direction. One lane also would be added in each direction on SR 167 to the study area boundary. The package of basic improvements to I-405 would be implemented, along with the core TDM strategies that are common to all action alternatives. New capacity improvements on connecting arterials and freeways would be provided along with planned arterial improvements of local jurisdictions.

Figure 2.2-3 shows the location of improvements contained in Alternative 2. Appendix A (I-405 Corridor Program - Major Elements of Alternatives) describes the elements for the alternatives. Appendix B (I-405 Corridor Program EIS Alternatives Project Matrix) identifies the specific transportation improvements and mobility solutions contained within each element and alternative.

2.2.4 Alternative 3: Mixed Mode Emphasis

This alternative attempts to substantially improve mobility options for all travel modes and to provide a HCT system throughout the study area at a lower cost than the physically separated, fixed-guideway system proposed in Alternatives 1 and 2. To do this, Alternative 3 would implement a new bus rapid transit (BRT) system, provide substantial expansion of local bus transit service, add two lanes in each direction on I-405, and improve arterials within the study area. All improvements contained in the No Action Alternative are included in Alternative 3, as well as in the other action alternatives. Table 2.2-1 shows the elements contained in each of the alternatives.

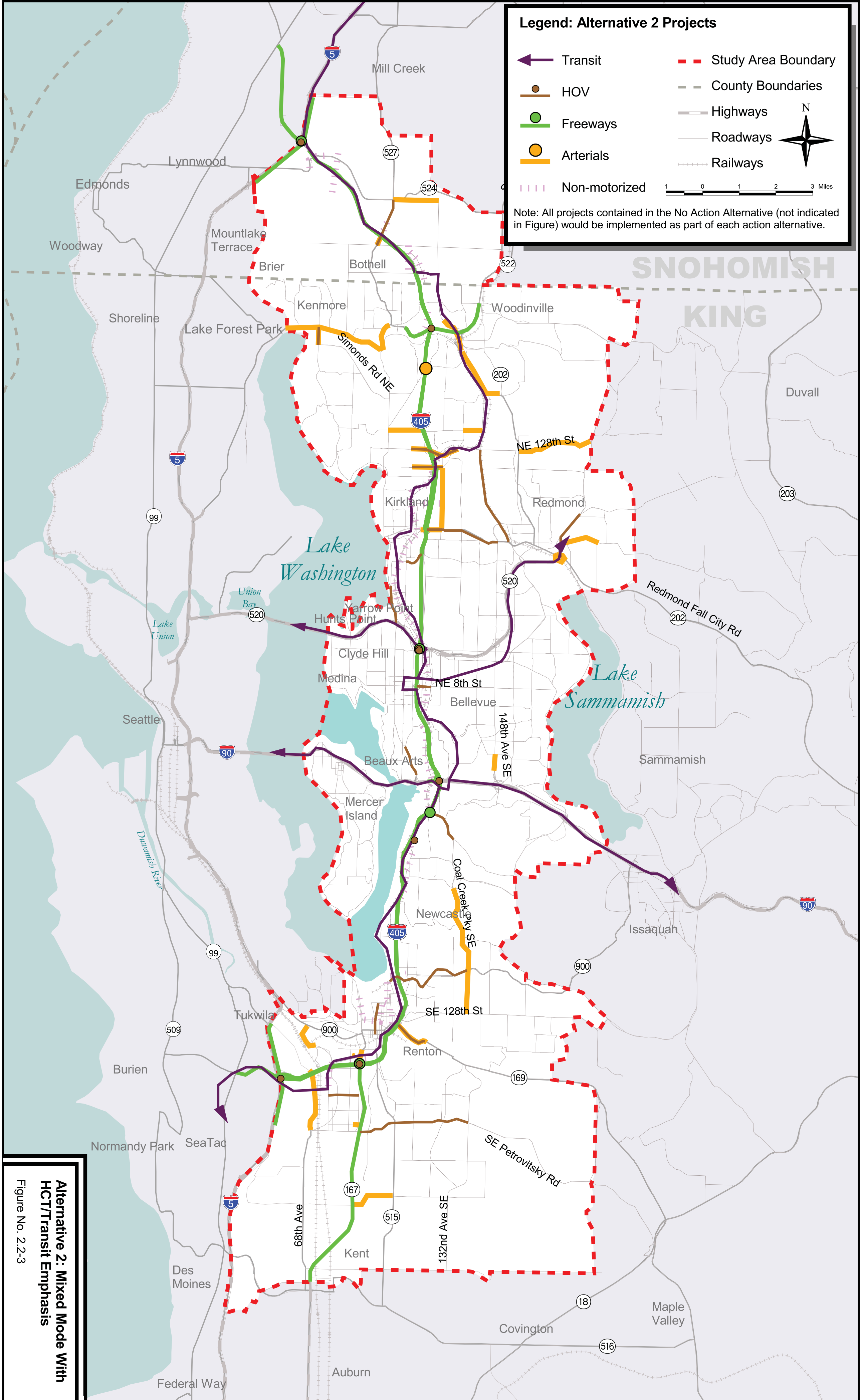
Alternative 3 includes a BRT system operating in improved-access HOV lanes on I-405, I-90, and SR 520. The proposed BRT system includes several features that distinguish it from regular bus service, including clearly identifiable priority lanes (using the existing HOV lane system in most locations), frequent and predictable schedules, uniquely identifiable vehicles, accessible transit stations, and convenient fare-collection procedures. Along I-405, the BRT system would operate with stops every 2 to 3 miles and would use the HOV direct access ramps and in-line transit stations to maximize speed and reliability. Other BRT operations would operate along connecting corridors (such as SR 522, SR 520, I-90, and SR 167) and would use portions of the I-405 BRT facility. The BRT system would serve the major activity centers within the study area, and would include connections to Redmond and Issaquah and west across Lake Washington to Seattle. The connection across Lake Washington is being evaluated as part of the ongoing Trans-Lake Washington Project EIS. Bus transit service would be increased by about 100 percent compared to King County's Fall 2001 proposed 6-year transit development plan. This is a 50 percent increase in service compared to the current King County, Sound Transit, and Community Transit 6-year plans. In addition, this alternative would add a new bus maintenance and operations facility in the Green River Valley. Improved arterial HOV priority for transit, additional park-and-ride capacity for 4,500 vehicles, 11 BRT stations, transit center and capacity improvements, and 9 freeway HOV direct access projects are included, as well as completion of the HOV freeway-to-freeway ramps along I-405.



Alternative 1: HCT/TDM Emphasis

Figure No. 2.2-2

This page left intentionally blank.



Alternative 2: Mixed Mode With HCT/Transit Emphasis

Figure No. 2.2-3

This page left intentionally blank.

This alternative would substantially increase capacity for general purpose traffic on I-405 by adding two lanes in each direction and improving major interchanges. These added general purpose lanes replace many of the auxiliary and climbing lanes contained in the basic improvements to I-405 that are common to the other action alternatives. One lane would be added in each direction on SR 167 to the study area boundary. The core TDM strategies would be implemented. New capacity improvements on connecting arterials and freeways would be provided. Selected arterial missing links would be completed together with planned arterial improvements of local jurisdictions.

Figure 2.2-4 shows the location of improvements contained in Alternative 3. Appendix A (I-405 Corridor Program - Major Elements of Alternatives) describes the elements for all alternatives. Appendix B (I-405 Corridor Program EIS Alternatives Project Matrix) identifies the specific transportation improvements and mobility solutions contained within each element and alternative. Appendix E (Roadway Sections) shows typical cross-sections for the proposed I-405 lane additions.

2.2.5 Alternative 4: General Capacity Emphasis

This alternative places the greatest emphasis on increasing general purpose and HOV roadway capacity, with substantially less reliance on new transit facilities or added local bus service than any of the other action alternatives. To do this, Alternative 4 would provide one additional lane in each direction on I-405, a new four-lane I-405 express roadway, and the other general purpose and HOV roadway improvements on I-405 and connecting freeways contained in Alternative 3. The expansion of local bus transit service would be minimal compared to that proposed under the other action alternatives. However, this alternative would add a new bus maintenance and operations facility in the Green River Valley. All improvements contained in the No Action Alternative are included in Alternative 4, as well as in the other action alternatives. Table 2.2-1 shows the elements contained in each of the alternatives.

Alternative 4 would expand freeway capacity by adding one additional general purpose lane in each direction on I-405 in most segments, improving major interchanges, and constructing a new four-lane I-405 express roadway consisting of two lanes in each direction with limited access points. One lane would be added in each direction on SR 167 to the study area boundary. Completion of the HOV freeway-to-freeway ramps along I-405 and the package of basic improvements to I-405 would be implemented.

Arterial improvements would include additional expansion of major arterial routes and connections to I-405 in conjunction with the planned arterial improvements of local jurisdictions. Transit in this alternative is assumed to be a continuation of the existing local and express bus transit system with a 50 percent increase in service compared to the current King County, Sound Transit, and Community Transit 6-year plans. Additional park-and-ride capacity for 4,500 vehicles would be provided along with the core TDM strategies that are common to all action alternatives.

Figure 2.2-5 shows the location of improvements contained in Alternative 4. Appendix A (I-405 Corridor Program - Major Elements of Alternatives) describes the elements for the alternatives. Appendix B (I-405 Corridor Program EIS Alternatives Project Matrix) identifies the specific transportation improvements and mobility solutions contained within each element and alternative. Appendix E (Roadway Sections) shows typical cross-sections for the proposed I-405 lane addition and express roadway.

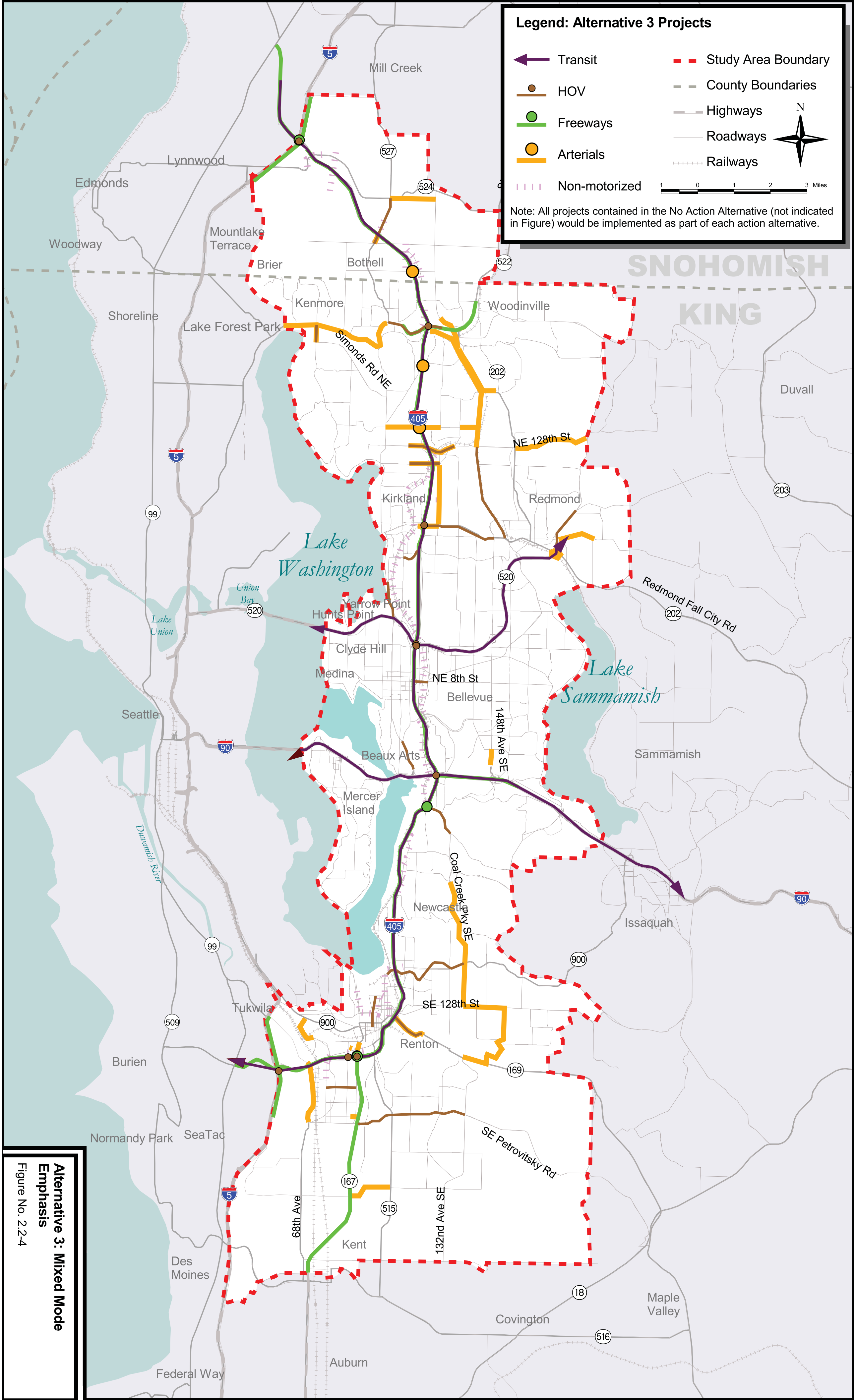
2.2.6 Preferred Alternative

The Preferred Alternative is a multi-modal solution to the transportation needs in the I-405 corridor that is very similar to Alternative 3. It was identified after thorough analysis of its transportation performance and environmental effects in meeting the Purpose and Need for the I-405 Corridor Program. Based upon this analysis, the project proponent, WSDOT, and the I-405 Corridor Program Citizen, Steering, and Executive committees reached consensus on the Preferred Alternative for recommendation to the co-lead agencies for the following primary reasons:

- Transportation performance of the Preferred Alternative was superior to the other alternatives in relation to the committees' adopted evaluation criteria;
- Environmental impacts of the Preferred Alternative within the corridor are believed to be avoidable or effectively mitigatable, and opportunities for enhancement of existing environmental conditions can be achieved through sound design practices and the proposed "basin approach" to considering key environmental features;
- Comparison of program benefits to costs for the Preferred Alternative was more desirable than for the other alternatives; and
- The mix of modal investments in the Preferred Alternative provides a balanced system of roadway, transit, and demand management strategies that are expected to provide a reasonable long-term solution to the needs for personal and freight mobility and congestion reduction within the I-405 Corridor Program study area.

The Preferred Alternative, like Alternative 3, focuses on substantial improvement of mobility options for all travel modes and provision of an effective HCT system throughout the study area at a lower cost than the physically separated, fixed-guideway system proposed in Alternatives 1 and 2. To achieve this, the Preferred Alternative proposes a new bus rapid transit (BRT) system, substantial expansion of local bus transit service, up to two added lanes in each direction on I-405, improvements to arterial capacity and connectivity within the study area, and the other general purpose and HOV roadway improvements contained in Alternative 3. All improvements contained in the No Action Alternative are included in the Preferred Alternative. Table 2.2-1 identifies the elements contained in the Preferred Alternative and each of the other alternatives.

The Preferred Alternative includes a BRT system operating in improved-access HOV lanes on I-405, I-90, and SR 520 as described for Alternative 3. The proposed BRT system includes several features that distinguish it from regular bus service, including clearly identifiable priority lanes (using the existing HOV lane system in most locations), frequent and predictable schedules, uniquely identifiable vehicles, accessible transit stations, and convenient fare-collection procedures. Along I-405, the BRT system would operate with stops every 2 to 3 miles and would use the HOV direct access ramps and in-line transit stations to maximize speed and reliability. Other BRT operations would operate along connecting corridors (such as SR 522, SR 520, I-90, and SR 167) and would use portions of the I-405 BRT facility. It would serve the major activity centers within the study area, and would include connections east to Redmond and Issaquah and west across Lake Washington to Seattle. The connections across Lake Washington are being evaluated as part of the ongoing Trans-Lake Washington Project EIS.



Alternative 3: Mixed Mode Emphasis

Figure No. 2.2-4

This page left intentionally blank.

Overall transit service within the study areas would be increased, based on demand, by up to 75 percent compared to the current King County, Sound Transit, and Community Transit 6-year plans. The Preferred Alternative does not include a new bus maintenance and operations facility as is proposed in the other four action alternatives. Improved arterial HOV priority for transit, additional park-and-ride capacity for 5,000 vehicles, 11 BRT stations, transit center and capacity improvements, 9 freeway HOV direct access projects, and completion of the HOV freeway-to-freeway ramps along I-405 are included, as well as a variety of pedestrian and bicycle connections.

The Preferred Alternative, similar to Alternative 3, would substantially increase capacity for general purpose traffic on I-405 by adding up to two lanes in each direction, along with providing collector-distributor lanes along I-405 at locations where they are warranted. These added general purpose lanes replace many of the auxiliary and climbing lanes contained in the basic I-405 improvements that are common to the other action alternatives. In addition, this alternative includes improvements for major interchanges and added capacity on arterials and freeways connecting to I-405.

The freeway design includes a buffer separating the general purpose lanes and the HOV lane. This buffer, envisioned as a 4-foot painted barrier in most sections, would allow for safer and more reliable HOV and transit operations within the I-405 corridor. Access to and from the HOV lane would likely be limited to the HOV direct access ramps, freeway-to-freeway connections, and clearly identifiable locations along the mainline freeway where the buffer would be open for merging traffic. The buffer design allows for future consideration of expanded managed lane operations along I-405, which could include managing up to two lanes each direction. Strategies and approaches for managing lanes could include intelligent transportation system (ITS) technologies, lane access restrictions, lane occupancy restrictions such as HOV or high-occupancy/toll (HOT) lanes, facility tolls, and regional congestion pricing, among others. Expansion of managed lane operations beyond the single HOV lane proposed in the Preferred Alternative would be subject to further analysis outside of the I-405 Corridor Program EIS process.

The I-405/SR 167 interchange would be expanded to include ramps for all major movements, and SR 167 would be widened by up to two lanes in each direction south from I-405 to S 180th Street in Kent, with no widening beyond that limit. The same expanded list of capacity enhancements on north-south arterials and continuity improvements to complete missing segments of major arterial connecting routes as included under Alternative 4 would be completed, together with other arterial improvements already planned by the local jurisdictions. Truck freight traffic improvements, intelligent transportation system improvements, and an expanded package of more aggressive TDM measures similar to Alternative 1 also would be implemented. This could include expanded options for managing lanes on I-405 such as regional congestion pricing or other management approaches, contingent upon adoption of a regional pricing policy by the PSRC.

Figure 2.2-6 shows the location of improvements contained in the Preferred Alternative. Appendix A (I-405 Corridor Program - Major Elements of Alternatives) describes the elements for the alternatives. Appendix B (I-405 Corridor Program EIS Alternatives Project Matrix) identifies the specific transportation improvements and mobility solutions contained within each element and alternative. Appendix E (Roadway Sections) shows typical cross-sections for the proposed I-405 lane additions.

2.2.7 General Cost Estimates and Schedule of the Action Alternatives

2.2.7.1 Cost Estimates

Over 300 transportation improvements were identified as potential solutions to meet the intent of the Purpose and Need for the I-405 Corridor Program. Recommendations included a wide range of strategies in various modes and locations.

An estimate of cost was prepared for each of these improvements that reflects the initial public cost of providing the improvement. For capital projects such as roadway construction, the estimate included preliminary engineering, right-of-way, construction, construction management, and contingencies. Program costs were estimated for elements such as travel demand management. Annual maintenance and operation costs were not included. All costs were estimated in year 2002 dollars.

High-capacity transit costs include guideways, stations, maintenance and storage facilities, and vehicles. Bus rapid transit costs for Alternative 3 and the Preferred Alternative are included in the costs for freeway HOV, transit services, and park-and-rides.

The TDM program cost estimate includes the 20-year capital costs for vanpooling, "land use as TDM" (as defined in Appendix A), and miscellaneous programs. Revenues for pricing programs would cover costs. Annual spending costs are not included in the TDM preliminary alternative cost estimates.

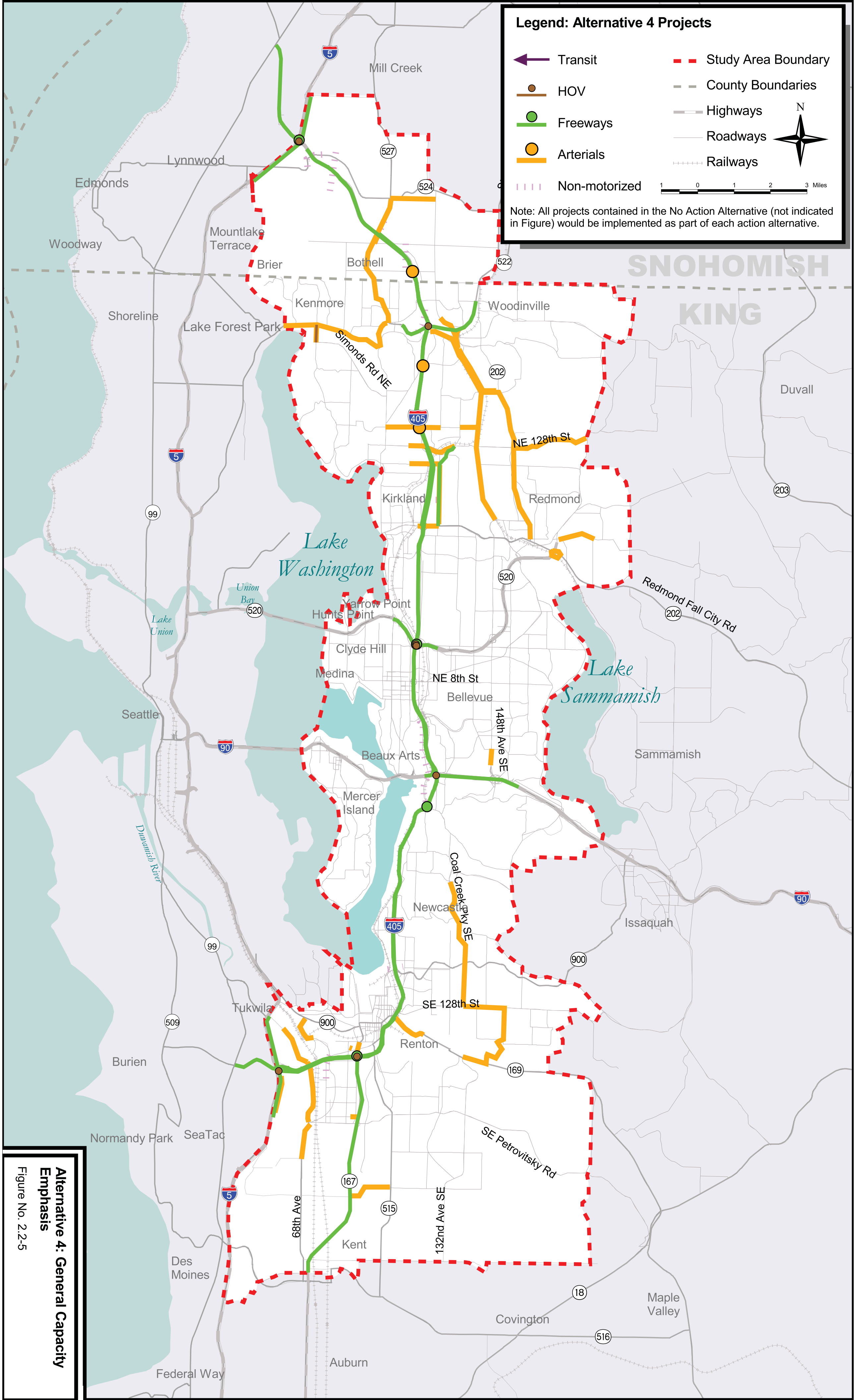
Action alternatives were developed by combining individual transportation improvements that best fit the emphasis of the alternative. Table 2.2-2 presents the preliminary alternative costs summarized by mode.

Maintenance and operation costs were not included in the preliminary alternative costs because the intent was to capture only the initial public cost of providing the improvement. Annual roadway maintenance and operation costs are typically funded from jurisdictions through their ongoing programs.

Table 2.2-2: Preliminary Alternative Costs Summarized by Mode

Element	Cost in Millions - Year 2000[a]					
	No Action Alternative	Alternative 1 HCT/TDM Emphasis	Alternative 2 Mixed Mode with HCT/Transit Emphasis	Alternative 3 Mixed Mode Emphasis	Alternative 4 General Capacity Emphasis	Preferred Alternative Mixed Mode Emphasis
Transportation Demand Management	--	$72.8	$72.8	$72.8	$72.8	$72.8
Freeway General Purpose	$7.0	$768.6	$2,846.0	$4,482.9	$9,397.6	$4,614.5
Freeway HOV[b]	$463.6	--	$800.9	$996.6	$886.8	$1,048.0
Arterial General Purpose	$185.6	--	$463.6	$663.3	$849.3	$765.9
Arterial HOV	--	$217.2	$194.6	$194.6	--	$185.5
High-Capacity Transit	--	$4,018.4	$4,018.6	--	--	--
Transit Services and Park-and-Ride	$20.4	$172.2	$168.7	$319.6	$83.2	$825.1
Pedestrian and Bicycle	--	$67.4	$67.4	$67.4	$42.8	$67.4
Total Cost	**$676.6**	**$5,316.6**	**$8,632.6**	**$6,797.2**	**$11,332.5**	**$7,579.2**

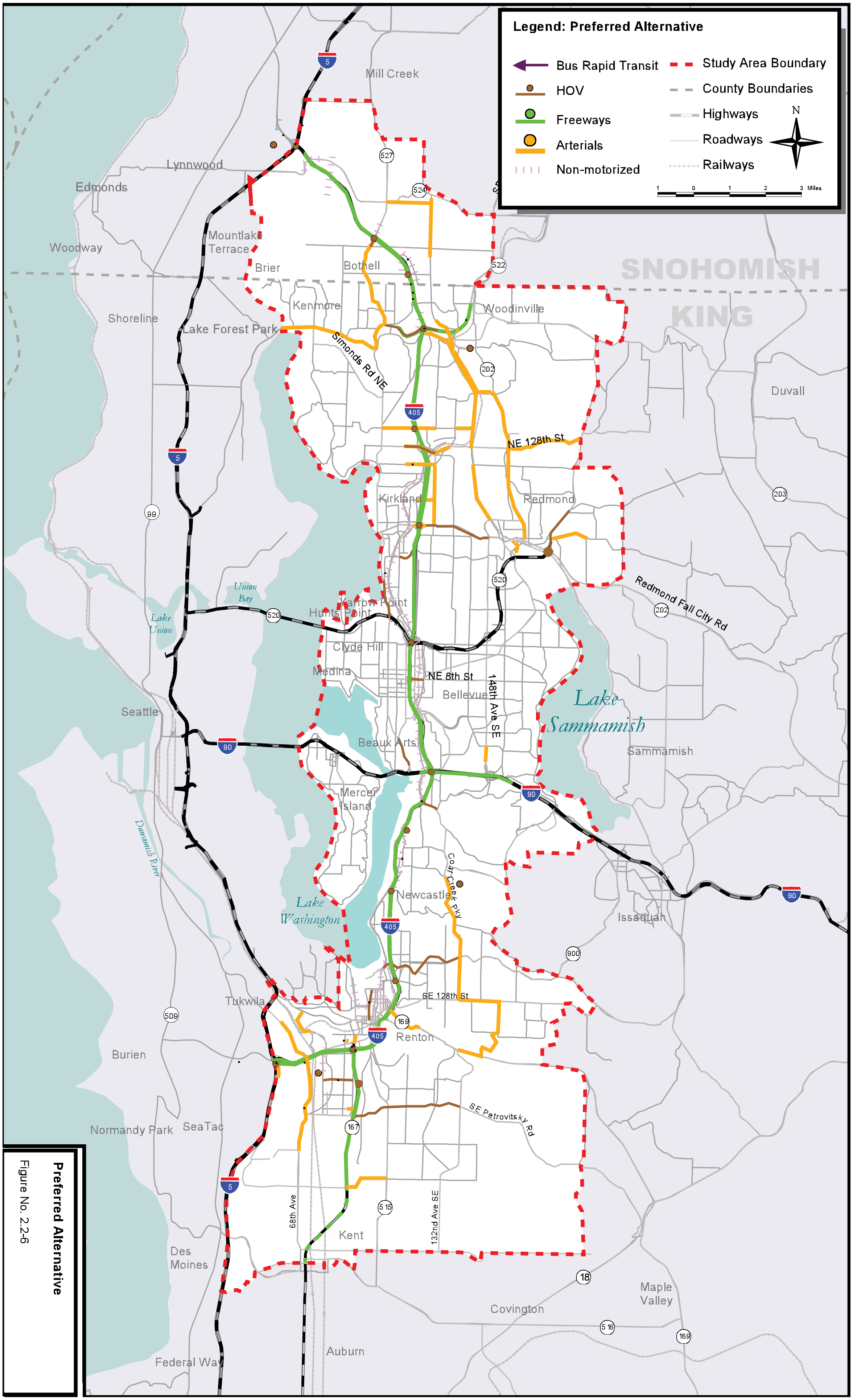
[a] Totals do not include maintenance and operations costs.
[b] Freeway HOV costs include bus rapid transit and direct access connections.
Note: No Action Alternative costs are not included in the estimates for the action alternatives.



Alternative 4: General Capacity Emphasis

Figure No. 2.2-5

This page left intentionally blank.



Preferred Alternative

Figure No. 2.2-6

This page left intentionally blank.

2.2.7.2 Funding, Schedule, and Implementation

Approximately 150 projects or actions were identified in the Preferred Alternative, a 20-year vision for the corridor, that will be the responsibility of WSDOT, Sound Transit, King and Snohomish counties, and the local agencies within the study area. For planning purposes, the capital cost of the Preferred Alternative was estimated at approximately $7.8 billion dollars in year 2002 dollars. WSDOT will be the lead for implementing the freeway portion of the project estimated at about $6.3 billion in year 2002 dollars. The project costs are currently under review and will likely be changed. Sound Transit and King County will be lead agencies for implementing most of the transit improvements, and local governments will lead the arterial improvements.

Availability of funding to implement the projects listed in the Preferred Alternative is uncertain. Currently, the Puget Sound region is spending a total of just under $2 billion annually in public funds on roadways, transit, and ferries. In 2001, approximately 43 percent went to ferries, roads, and highways, 5 percent to the State Patrol, and the remaining 52 percent to public transit including Sound Transit. The population within the primary study area represents about 18 percent of the Puget Sound region. Assuming an equitable distribution of future revenues under current law and given enough time, a limited number of high-priority projects will eventually be implemented through each agency's continuing capital improvement programs.

The bulk of the funding needed to implement the Preferred Alternative will require new revenue sources. The Washington State Legislature, in the 2002 session, provided for 10-year statewide and regional transportation funding packages that included revenues for the I-405 Corridor Program. Both revenue proposals will require a public vote. The statewide ballot measure, Referendum 51, will be voted on by the public in November 2002, and includes $1.77 billion for I-405 subject to certain conditions and limitations. The legislation, Engrossed Substitute Senate Bill 6347, did not stipulate the projects that would be funded within the $1.77 billion.

Engrossed Second Substitute Senate Bill 6140 provides for creation of a regional transportation investment district for the purpose of developing, constructing, and financing transportation projects and services. A regional package of projects is in the process of development and may be presented for public vote in the future. This referendum may include use of high-capacity transit tax authority available currently to Sound Transit. Revenues from the regional package will most likely include significant funding for roads and transit projects within the I-405 Corridor Program. Though specific projects and levels of funding have not been developed, this and the statewide ballot measure could provide approximately $3.5 billion dollars for I-405 investments in the next 10 years if the regional referendum includes a high-capacity transit tax component.

Another potential revenue source for the high-capacity transit (HCT) capital and service elements contained in the Preferred Alternative's BRT system development proposal are tax revenues collected within the Central Puget Sound Regional Transit Authority district and administered by Sound Transit. In 1996, the three county urbanized area voted to adopt a 10-year regional plan, "Sound Move", and approved a 4.0 percent increase in total sales tax and a 0.3 percent increase in the motor vehicle excise tax (MVET). Sub-regional "firewalls" were established to assure tax revenues generated within each of the five identified sub-areas of the district would be programmed to HCT improvements benefiting those sub-areas. Some of the projects being advanced on the preferred alternative's project list are already being funded in the

East King County sub-area under the Sound Move Phase I program through 2006. Sound Transit estimates that East King County could tap as much as $300 million of their unused Phase I bonding authority and $60 million of unanticipated (excess) sub-area revenues to fund new HCT projects substantially begun or completed by 2006. New HCT projects in the East King County sub-area begun after 2006 could not be funded, however, without a Phase II regional vote. East King County's total projected Phase II investment capacity, assuming current RTA tax rates are maintained past 2006, is just over $1 Billion for the 2007-2016 period.

Based on state and regional funding sources, approximately $3.5 to 4.0 Billion could be available for the first 10 years of the I-405 Corridor Program. The Corridor program is currently developing a phasing program for the state and regional ballot measures. This phasing program will be developed by agencies involved in the Corridor Program. The phasing proposal will then be forwarded to the Department of Transportation (state ballot measure) and the King and Snohomish County Councils (regional ballot measure). The County Councils will determine when the regional measure will go to the voters, the amount of funding and the project list. The current process indicates that a public hearing(s) will be held on the projects proposed to be listed on the regional ballot measure. The state ballot measure will go to the voters in November of 2002. The regional ballot measure could be as early as November 2002, but can be delayed till 2003 or later.

The unfunded portion of the program will be requested from federal and future state, regional, and local funding sources. Additional revenue may also be available from more aggressive congestion pricing. To receive Federal Funding the program must be included the Puget Sound Regional Council's (PSRC) Metropolitan Transportation Plan (MTP). The projects in the I-405 Corridor Program Preferred Alternative are currently shown in the MTP as "candidate projects". When a funding program is identified for some or all of the projects a request will be made to the PSRC to move funded project(s) from candidate to approved status. As part of normal operating procedures, the co-lead agencies and local governments are continually looking for opportunities to secure federal funding for transportation program development.

Since funding is uncertain, preliminary construction schedules were prepared for implementation based on high, medium, and low funding availability. High and medium funding availability assumes the entire program is funded, with all funds being available within 10 years for the high scenario and 18 years for the medium scenario. High funding availability allows for work to be accomplished concurrently throughout the corridor with construction beginning in 2004 and completed in 10 years. Medium funding availability requires sequential development and an 18-year construction time frame. Limited funding under the low scenario assumes only the hot spots would be funded over a 30-year period. Different implementation schedules are possible, which could vary construction duration, construction impacts, and completion date.

Project improvements contained within the Preferred Alternative will be re-examined individually and in combination for phased implementation based on a number of considerations, including: revised cost estimates; availability of funding; contribution to improved transportation system operation, congestion relief, mobility, and safety; equity of improvements within the corridor; relationship to other planned and potential improvements within the region and study area; logical construction sequencing and minimization of construction impacts; beneficial and adverse environmental impacts; opportunities for early-action mitigation; demonstration of projects' independent utility and logical termini; anticipated requirements for NEPA/SEPA environmental analysis, documentation, and review; and ability to achieve rapid results, among others.

The Preferred Alternative project improvements are expected to be examined next within four logical corridor sections:

1. I-5 in Tukwila to N 3rd Street in Renton, including improvements to SR 167;
2. N 3rd Street in Renton to SE 8th Street in Bellevue;
3. SE 8th Street in Bellevue to NE 132nd Street in Kirkland; and
4. NE 132nd Street in Kirkland to I-5 in Lynnwood.

The projects, or combinations of projects, that could be advanced for initial implementation is not known at this time. For this reason, the level of NEPA/SEPA environmental analysis, documentation, and review that will be required also cannot be known until more specific proposals for project improvements and phasing are advanced. It is anticipated that improvements to the I-405/SR 167 interchange will be among the hot spots identified for early implementation. It also is likely that environmental review for the I-405 corridor improvements could include the full range of NEPA and/or SEPA environmental analysis, documentation, and review, as appropriate. This would include a combination of categorical exclusions, categorical exemptions, environmental assessments, checklists, EISs, and supplemental EISs.

Projects in the No Action Alternative are currently being developed by the jurisdictions with responsibility. It is anticipated the No Action projects will be completed within the next six years.

Alternatives 1 and 2 focus on physically separated fixed-guideway high-capacity transit, with a substantial increase in bus transit service. Sound Transit would most likely be the lead agency for designing and implementing the fixed-guideway high-capacity transit. Sound Transit Regional Express, King County, and Community Transit would be responsible for implementing increased bus transit service. For Alternative 2, WSDOT would be the lead agency for adding lanes to I-405. Jurisdiction projects would be the responsibility of the local agencies.

The Preferred Alternative, similar to Alternative 3, provides a mix of solutions that place an emphasis on roadway capacity and bus rapid transit operating in improved-access HOV lanes on I-405, I-90, and SR 520. WSDOT, Sound Transit, King County, Community Transit, and local agencies would be responsible for leading implementation of the project elements within each of their jurisdictions. The Preferred Alternative and Alternative 3 propose a lower-cost bus rapid transit system that uses the HOV lanes and HOV direct access system.

Alternative 4 is the most costly and primarily focuses on freeway expansion. WSDOT would be the lead agency responsible for implementing the improvements on I-405 and other state highways.

Mitigation for any specific project impacts is integral to that project and is the prime responsibility of the respective project lead agency. It is expected that agencies will work together as a part of this corridor program to make sure that appropriate and coordinated mitigation measures are implemented.

2.2.8 Alternatives Considered but Not Advanced for Detailed Study

Seven preliminary corridor alternatives (referred to here as themes) were identified and considered by the I-405 Corridor Program Citizens, Steering, and Executive committees. All themes were subjected to a screening analysis based on five categories of criteria:

- Transportation performance
- Financial performance and cost-effectiveness
- Land use plans and policies
- Social impacts
- Environmental impacts

Each category of criteria included key indicators, which were the measures used to estimate the transportation benefits and environmental effects of each theme. In all, more than 25 different key indicators were evaluated, covering a wide range of natural and built environment concerns.

The range of themes being considered and the results of the screening analyses were presented for public review and feedback through a public open house held April 18, 2000, as well as through jurisdictional workshops and numerous community presentations conducted throughout the study area. The Citizens and Steering committees also conducted a series of meetings to receive and assess the screening results and public feedback.

The results of the screening analyses and feedback from the public and study committees revealed several cases where a transportation improvement being considered within one theme might be moved to a different theme to improve performance and ability to satisfy the Purpose and Need for the I-405 Corridor Program. In other cases, the screening results and feedback from local jurisdictions demonstrated that several transportation improvements and mobility strategies were not reasonably effective in meeting the Purpose and Need, and/or they were likely to result in unreasonable and unacceptable environmental consequences.

The results of public feedback and recommendations of the Citizens and Steering committees were advanced to the Executive Committee, which reconfigured the seven themes into four action alternatives. These four alternatives, along with the No Action Alternative, were then approved by the Executive Committee to be advanced for detailed study in the Draft EIS. Concurrence with the Executive Committee's decision was provided by the agencies with jurisdiction as part of the Reinventing NEPA process. A more detailed discussion of the alternatives development and screening process is included in *I-405 Corridor Program: Alternatives Report (Draft)* (DEA and Mirai, 2000).

Transportation improvements and mobility strategies that were not advanced for further consideration in the EIS are described below.

Development of a new east King County freeway corridor would include the new freeway identified through the Corridor Needs Study for East King County (Washington State Department of Transportation, 2000). The freeway assumed a new four-lane, 60 mile-per-hour freeway using the current SR 18 alignment to I-90, then north to US Highway 2, and connecting to I-5. Interchanges would be provided only within Urban Growth Areas.

Preliminary analysis indicated that this strategy could provide substantial congestion reduction to the region and the I-405 corridor. However, this proposal was not advanced because it falls entirely outside the corridor that is the focus of the Purpose and Need for the I-405 Corridor Program. In addition, the proposal would likely fail to meet at least two important objectives of the Purpose and Need related to planned regional growth and environmental protection. First, the facility would be outside the Urban Growth Boundary for King and Snohomish counties, and may not be consistent with land use plans and policies that direct urban facilities to urban areas and attempt to avoid changes in rural character. Second, preliminary studies indicated that the freeway would result in substantial impacts to the natural environment, especially with regard to wetlands, water quality, and fish-bearing streams.

Development of new east King County arterials would include the new arterial/parkways identified through the Corridor Needs Study for East King County. The arterial scenario assumed capacity equivalent to the east King County freeway described previously, using new and existing right-of-way over three alignments.

Similar to the east King County freeway, preliminary analysis indicated that these arterial improvements would provide substantial congestion reduction to the region and the I-405 corridor. However, like the freeway, this proposal also would likely violate the objectives of the I-405 Corridor Program Purpose and Need related to planned regional growth and environmental protection because of its effects outside the Urban Growth Boundary and because of the substantial impacts to the natural environment. For these reasons, the proposal was not advanced for detailed study in the EIS.

Addition of capacity on several north-south arterials was not advanced because the proposed improvements were not reasonably effective in meeting the I-405 Corridor Program Purpose and Need; they were likely to result in unreasonable and unacceptable environmental consequences; and/or they were determined to be not consistent with the land use and transportation plans of the local jurisdictions whose approval is required to advance the specific improvements. Despite the elimination of several projects, substantial improvements in overall north-south capacity on arterials are included in the No Action Alternative and other alternatives that are evaluated in the EIS.

Implementation of free-flow right turns on arterials was not advanced as an individual strategy; however, the concept is included in the broader category of proposed arterial improvements that are evaluated in the EIS.

Implementation of two reversible express lanes on I-405 from I-5 in Snohomish County south to SR 520 was not advanced because the directional split of traffic on I-405 is not sufficient to justify reversible lanes.

Addition of barrier-separated freight lanes would result in constructing freight lanes that were physically separated from other transportation modes. Study results indicated that the volume of trucks projected to use the lanes would not be sufficient to warrant this treatment. For these reasons, the proposal was not believed to be reasonable or effective in meeting the I-405 Corridor Program Purpose and Need relative to its cost.

Addition of one HOV lane in each direction on I-405 would result in two HOV lanes in each direction, with the assumption that 2+ person carpools would continue to use the HOV lanes along with transit. This proposal was not advanced because it does not meet the I-405 Corridor Program Purpose and Need. Modeling results showed that the HOV lane utilization would not be sufficient to reasonably reduce congestion or improve mobility relative to its cost.

Converting existing general purpose lanes on I-405 to HOV lanes would reduce the number of general purpose lanes. Sections of I-405 that currently have only two general purpose lanes would be reduced to one general purpose lane in each direction, thereby eliminating the option for general purpose traffic to pass other vehicles. This strategy was not advanced because it does not meet the I-405 Corridor Program Purpose and Need, and it does not meet the transportation objectives relating to improved mobility and reducing congestion.

Opening existing HOV lanes to general purpose traffic would allow any vehicle to use any lane. This would eliminate the function of the HOV lanes, which are essential to Sound Transit's Regional Express program. This strategy was not advanced because it does not meet the I-405 Corridor Program Purpose and Need, and it does not meet the transportation objectives relating to improved mobility.

Elimination of one travel lane in each direction on I-405 would result in the conversion of an existing general purpose lane on I-405 to alternative uses. The rationale behind this suggestion was to reduce the amount of impervious surface within the corridor and to provide a strong incentive for transit use. This proposal was not advanced because it does not meet the I-405 Corridor Program Purpose and Need. It failed to reduce or maintain congestion levels compared to the No Action conditions under any reasonable scenario of increased transit service based upon modeling results. Study results indicated that study area and regional vehicle hours of travel would increase substantially, while adverse impacts due to spillover traffic on arterials and local streets parallel to I-405 would be likely within adjacent neighborhoods. The proposal also would not be reasonably feasible to implement. Sections of I-405 that currently have only two general purpose lanes would be reduced to one general purpose and one HOV lane in each direction, thereby eliminating the option for traffic to pass other vehicles.

Reducing the number of interchanges on I-405 would likely result in reduced access and mobility for many study area residents, employees, and businesses. For these reasons, the proposal was not believed to be reasonable or effective in meeting the I-405 Corridor Program Purpose and Need.

Addition of barrier-separated bike arterials was not advanced as an individual proposal because it was not specific enough to assess; however, the concept is compatible with the broader category of proposed non-motorized and pedestrian trail improvements that are evaluated in the EIS.

Addition of bike lanes on the NE 70th overpass arterials was not advanced as an individual proposal; however, the idea is considered in the broader context of non-motorized grade crossings of I-405 that are evaluated in the EIS.

Addition of more pedestrian signals was not advanced as an individual proposal because it was not a corridor-level solution and was not specific enough to assess; however, the concept is compatible with the broader category of proposed non-motorized and pedestrian improvements that are evaluated in the EIS.

Provision of special event buses in the I-405 corridor was not advanced as an individual strategy because it is not related to typical trips in the study area, and the proposal is not one that could be effectively implemented as a corridor solution to meet the I-405 Corridor Program Purpose and Need. However, the concept is compatible with the broader category of proposed transportation demand management measures that are evaluated in the EIS.

Reduction of transit fares by 50 percent was not advanced because changes in transit fares are regional policy, and the proposal was not one that could be effectively implemented as a corridor solution. In addition, the proposal does not meet the I-405 Corridor Program Purpose and Need. Study results indicated that this policy would not result in a reasonable modal shift or improvement in mobility relative to its cost. Elimination of transit fares also was dropped from further consideration for the same reasons.

Implementation of corridor congestion pricing applied only within the I-405 corridor was not advanced because it is a state or regional policy that could not be effectively implemented as a corridor solution. The effects of a regionally-applied congestion pricing policy remained as an element of the broader transportation demand management measures that are evaluated in the EIS. The Preferred Alternative includes an additional four-foot buffer in each direction along I-405. This would accommodate expanded managed lane options in the corridor if future regional plans deem them desirable.

Increasing the gasoline tax was not advanced because it is a state or regional policy that could not be effectively implemented as a corridor solution in response to the I-405 Corridor Program Purpose and Need.

Subsidizing relocation of workers to residential areas nearer their place of employment was not advanced because it is a regional policy that could not be effectively implemented as a corridor solution; however, the concept may be compatible with the broader category of proposed transportation demand management measures that are evaluated in the EIS.

Removing unlicensed drivers from the roadway system was not advanced because it is a state policy that could not be effectively implemented as a corridor solution in response to the I-405 Corridor Program Purpose and Need.

Removing existing sound walls along I-405 was not advanced because it does not meet the I-405 Corridor Program Purpose and Need. The sound walls are needed to provide important environmental mitigation for the existing facility.

Improving the Evergreen Point transit station was not advanced as a proposal because it is outside the scope of the I-405 Corridor Program; however, the proposal was advanced to the Trans-Lake Washington Project EIS for consideration.

This page left intentionally blank.

3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter presents the elements of the environment potentially affected by the I-405 Corridor Program. Each subsection includes a description of the evaluation methodology, the existing conditions, and the potential impacts as well as possible measures to mitigate or avoid adverse impacts. Impacts are categorized as:

- Direct impacts (short-term construction and long-term operational)
- Secondary or indirect impacts
- Cumulative effects

Direct impacts are effects that have a straightforward cause-and-effect relationship to the programmatic action.

Secondary impacts, or indirect impacts, are reasonably foreseeable effects of an action that occur later in time or are further removed in distance from the direct effects of the proposal. Secondary impacts are discussed along with cumulative effects in Section 3.23.

Cumulative effects are the incremental or additive effects of the programmatic action in conjunction with other past, present, and future reasonably foreseeable actions, regardless of what agency or person undertakes such other actions. Cumulative effects are discussed along with secondary, or indirect, impacts in Section 3.23 for the scoped critical resources, including air quality, energy, surface water, wetlands, fish and aquatic habitat, and farmlands.

This EIS has identified adverse impacts that are anticipated to occur as a result of the proposed program alternatives to the extent feasible at a programmatic level of detail. Some of these impacts may be considered to be significant or substantial and will also be analyzed during project-level environmental analysis, documentation, and review. Potential mitigation has been identified in this section of the Final EIS and in Appendix J that addresses these adverse impacts, generally at a planning level of detail commensurate with the level of definition for the program alternatives. The details of such mitigation will need to await further project design and future project-level NEPA and SEPA environmental analysis, documentation, and review. Because impacts of the action alternatives include those of the No Action Alternative. The No Action Alternative includes committed or funded capital improvement projects and programs under the lead of cities, counties, Sound Transit and WSDOT. Mitigation for impacts to the No Action Alternative projects would be the responsibility of the project lead and may not in all cases be implemented by an I-405 co-lead agency as part of the I-405 Corridor Program.

Use of the word "significant" to qualify an impact in this EIS is done only for purposes of SEPA. It is not possible to determine at the programmatic level of analysis for this EIS if mitigation would reduce all identified adverse impacts to an insignificant level. However, the lead agencies intend to implement sufficient mitigation to accomplish this. The conclusion of whether there would be significant or substantial adverse impacts remaining after mitigation has been reassessed for the Final EIS based upon public and agency comments on the Draft EIS (see comments in Volume 2). No new significant impacts were identified based on public and agency comments or added analyses conducted as part of the Final EIS. This conclusion will be assessed again within the context of individual project actions during project-level environmental analysis, documentation, and review.

APPROACH TO MITIGATION

Mitigation for impacts is integral to the transportation improvements and is the prime responsibility of the respective project lead agency. It is expected that agencies will work together as a part of this corridor program to make sure that appropriate and coordinated mitigation measures are implemented.

With growth rates in King and Snohomish counties continuing to be among the highest in the state, it is becoming increasingly difficult to identify and acquire sites for mitigation of project impacts. While the growth rates and patterns indicate that there will be increasing pressures upon the available vacant land in King and Snohomish counties over the next 20 years, WSDOT and co-lead agencies are confident that there is a reasonable likelihood of being able to acquire mitigation sites needed to implement the proposed mitigation strategy.

While it is not possible at this programmatic level of analysis to determine the specific mitigation that will be necessary, it is possible to describe the process that the project proponents will use in identifying aquatic and natural resource mitigation measures. The proposed early-action environmental impact mitigation decision-making process identified in the I-405 Corridor Environmental Program will be used to mitigate for impacts of the I-405 Corridor Program projects. Please refer to Appendix J of the FEIS. This will facilitate obtaining mitigation sites well before projects are started. Acquiring these sites in the immediate future will increase the number of sites that can be considered for mitigation. This will allow WSDOT and co-lead agencies to make the greatest use of the mitigation opportunities that currently exist at the sub-basin, basin, and Water Resource Inventory Area (WRIA) levels.

In addition, WSDOT and the co-lead agencies have the ability to acquire property for required mitigation through eminent domain where practicable. If the most appropriate level to replace lost functions requires this tool, it is available. Of course, there may be financial restrictions and other limiting factors. Also, WSDOT has developed and implemented an effective advance environmental mitigation revolving fund that is used to acquire mitigation property well in advance of project construction. Various watershed management tools are also in development that will aid in the location and prioritization of appropriate mitigation actions.

WSDOT, in coordination with co-lead agencies, will develop a corridor-level mitigation plan for the I-405 corridor for resources protected and regulated by federal, state, and local jurisdictions. For further information about aquatic resource impacts and mitigation covered by this corridor level mitigation plan see sections 3.5 through 3.8, 3.10, and 3.11 in the FEIS. The plan will be developed prior to permitting individual projects based on a 5 percent design level planned for the corridor. The plan will include a more detailed analysis of project impacts and an analysis of mitigation opportunities. The mitigation will be focused first on-site, second within the same sub-basin, and third within the same watershed (i.e. WRIA) in order to find the most appropriate or best mitigation opportunity for each impact. Off-site and out-of-kind mitigation opportunities will be evaluated in accordance with the Alternative Mitigation Policy Guidance Interagency Implementation Agreement adopted on February 14, 2002 by WSDOT, the Washington State Department of Ecology (Ecology), and the Washington State Department of Fish and Wildlife to supplement in-kind, on-site opportunities.

The co-lead agencies anticipate that it may not be possible nor the most beneficial to the natural environment to mitigate all project impacts within the same sub-basin where the impact occurs. While the mitigation will be analyzed at various levels (sub-basin, basin, watershed), it will be implemented at the most appropriate level to replace lost natural resource functions. For example, a project proponent may mitigate for lost wetland function and acreage through a combination of opportunities that involve on-site, in-kind mitigation within the sub-basin of impact and off-site mitigation in other sub-basins within the same watershed. The goal is to integrate transportation and environmental investments in a way that improves critical natural resources and supporting habitat, while ensuring that environmental mitigation funds are spent on the greatest environmental benefit.

In order to ensure a viable watershed-based mitigation program, WSDOT will seek state and federal general permits as allowed by the regulatory agencies as an alternative to individual permits. For example, general state Hydraulic Project Approvals covering specific activities may be sought and a General Section 404 Permit and 401 Certification will be sought. The actual scope and coverage of these permits will be determined through a collaborative process with the regulatory agencies. It is anticipated that these permits, once executed, will include general and special conditions agreed upon by the agencies with jurisdiction. This will ensure that WSDOT in cooperation with the resource agencies, local jurisdictions, basin committees and the public develops a comprehensive approach to mitigation planning for the corridor, that is not lost during individual project permitting. The general permits may also specify accelerated agency review/public review procedures as well as specification of applicable geographic areas and other criteria.

The corridor level mitigation plan will be developed prior to issuance of project-level permits. The plan will be consistent with the Corridor Environmental Program and proposed early-action environmental impact mitigation decision-making process presented in Appendix J of the FEIS. The plan will involve a mitigation site selection process based upon the following steps.

CORRIDOR-LEVEL MITIGATION PLAN DEVELOPMENT AT FIVE PERCENT DESIGN

1. Identify the potential unavoidable environmental impacts of the Preferred Alternative projects that will require mitigation based upon a planned 5 percent design level. Determine which impacts and functions must be mitigated on-site and in-kind, or may be mitigated off-site and in-kind, or off-site and out-of-kind.
2. Identify and inventory environmental restoration needs within WRIA 8 and WRIA 9 through the review of existing public documents such as watershed plans, habitat conservation plans, salmon and steelhead habitat limiting factor studies, water resource inventories, basin plans, and eco regional plans.
3. Identify additional restoration opportunities and needs on public and private land by holding partnering workshops in areas of interest. Partnering workshops function to bring together numerous interested parties to discuss and identify restoration needs and opportunities. Interested parties can include local tribes, local jurisdictions, other state agencies, nonprofit organizations such as Trout Unlimited and the Nature Conservancy, local salmon recovery boards, and private landowners among others.
4. Apply the Watershed Characterization Process to the corridor. Participate in the development of WRIA 8 and 9 watershed plans that will support restoration of habitat and maintain or improve water quality. This will include assisting in characterizing watershed conditions and identifying recovery areas that will have the greatest potential for long-term benefit. The characterization process in conjunction with the use of current aerial photos and land use cover data will serve to identify potential mitigation sites.

5. Identify potential mitigation and/or enhancement sites by combining the corridor mitigation needs with watershed characterization results, and the list of restoration needs and opportunities. Identify early-action and concurrent mitigation and/or enhancement opportunities that can be implemented consistent with the phasing of the Preferred Alternative projects.
6. Field verify the potential mitigation sites.

CORRIDOR-LEVEL APPROVALS

1. Narrow the list of potential mitigation sites by convening the Steering Committee or a sub-group of the Steering Committee to act as a mitigation task force. WSDOT, in cooperation with co-lead agencies, will first identify mitigation criteria and principles by consulting with the task force members and other agencies with jurisdiction. Using this information as a framework, WSDOT will develop draft mitigation criteria for the different types of resources impacted. The task force will review and approve the criteria. Selection and ranking of potential mitigation sites will be based upon these criteria. The ranking method will rank sites based on their ability to mitigate for impacted resources, including their proximity to the impacted sites (within the same sub basin, basin or WRIA), the ability to mitigate for functions that can not or should not be mitigated on site, the mitigation goals set by the stakeholders for the watershed, and other criteria as appropriate. Goals can range from maintaining wildlife linkage zones to maintaining habitat connectivity to re-establishing salmon in a sub-basin.
2. Develop a conceptual Corridor Mitigation Plan. Using the criteria and ranking methods created above, WSDOT will develop a draft conceptual Corridor Mitigation Plan. This plan will be submitted to the mitigation task force for review and comment and then to the regulatory agencies for approval.
3. Create programmatic, batched, and/or incremental ESA consultation agreements and work with other permitting agencies to establish and seek approval of corridor-level general permits on the Preferred Alternative projects.
4. Execute corridor-level memoranda of agreement (MOAs) or other appropriate implementation agreements with watershed groups, resource agencies, and local jurisdictions. These agreements would be used to formalize WSDOT's commitment to development and implementation of a comprehensive mitigation plan for the I-405 Corridor Program FEIS. These corridor level memoranda will be executed with the local, state, and federal resource agencies with regulatory authority over the specific resource to be mitigated. Also at this time, WSDOT will execute MOAs/Memoranda of Understanding (MOUs) with the local watershed groups as necessary to implement the corridor mitigation plan. WSDOT anticipates multiple agreements, with a least one between WSDOT and the federal agencies; one between WSDOT and state agencies; and one or more between WSDOT and individual local jurisdictions. Agreements between other project proponents, such as King County, and the regulatory agencies may be necessary. Agreements between WSDOT and the resource agencies and agreements between WSDOT and the WRIA participants will be kept separate.
5. Develop an acquisition strategy for purchasing the sites.

IMPLEMENTATION

1. Develop mitigation site agreements and begin acquisition and permitting process for the mitigation sites. Agreements for each mitigation site will further define the mitigation site, its size, functions to be provided, credits available etc.
2. Implement early actions.
3. Secure project-level permits and implement transportation project-level elements of Preferred Alternative.

The comprehensive mitigation planning process described in this section will be included in the Record of Decision.

This page left intentionally blank.

3.1 AIR QUALITY

3.1.1 Regulatory Background and Coordination

Air quality in the affected area is regulated by the U.S. Environmental Protection Agency (USEPA), Washington State Department of Ecology (Ecology), and Puget Sound Clean Air Agency (PSCAA). Under the Clean Air Act, USEPA has established the National Ambient Air Quality Standards (NAAQS), which specify maximum concentrations for carbon monoxide (CO), particulate matter less than 10 micrometers in size (PM_{10}), particulate matter less than 2.5 micrometers in size ($PM_{2.5}$), ozone, sulfur dioxide, lead, and nitrogen dioxide. The standards applicable to transportation projects are summarized in Table 3.1-1. The eight-hour ozone and $PM_{2.5}$ standards have recently been upheld by the Supreme Court, but have not yet been implemented by USEPA. The eight-hour CO standard of 9 parts per million (ppm) is the standard most likely to be exceeded as the result of transportation projects.

Table 3.1-1: Summary of Ambient Air Quality Standards

Pollutant	National Primary Standard	Washington State & PSCAA Regional Standards
CARBON MONOXIDE (CO)		
One-Hour Average (not to be exceeded more than once per year)	35 ppm	35 ppm
Eight-Hour Average (not to be exceeded more than once per year)	9 ppm	9 ppm
PM_{10}		
Annual Arithmetic Mean	50 µg/m^3	50 µg/m^3
24-Hour Average Concentration (not to be exceeded more than once per year)	150 µg/m^3	150 µg/m^3
$PM_{2.5}$		
Annual Arithmetic Mean	15 µg/m^3	NS
24-Hour Average Concentration (not to be exceeded more than once per year)	65 µg/m^3	NS
TOTAL SUSPENDED PARTICULATES (TSP)		
Annual Arithmetic Mean	NS	60 µg/m^3
24-Hour Average Concentration (not to be exceeded more than once per year)	NS	150 µg/m^3
OZONE		
One-Hour Average (not to be exceeded more than once per year)	0.12 ppm	0.12 ppm
Eight-Hour Average (not to be exceeded more than once per year)	0.08 ppm	NS

Notes: ppm = parts per million
µg/m^3 = micrograms per cubic meter
NS = No Standard

Sources: 40 CFR Part 50 (1997)
WAC chapters. 173-470, 173-474, 173-175 (1987)
PSCAA Regulation 1 (1994)

Nonattainment areas are geographical regions where air pollutant concentrations exceed the NAAQS for a pollutant. Air quality maintenance areas are regions that were previously in non-attainment but have since attained compliance with the NAAQS. The I-405 corridor lies within ozone and CO maintenance areas. Air quality emissions in the Puget Sound region are currently being managed under the provisions of Air Quality Maintenance Plans (AQMPs) for ozone and CO. The current plans were developed by PSCAA and Ecology and approved by the USEPA in

1996. Any regionally significant transportation project in the Puget Sound Air Quality Maintenance areas must conform to the AQMPs. Conformity is demonstrated by showing that the project would not cause or contribute to any new violation of any NAAQS, increase the frequency or severity of any existing violation of any NAAQS, or delay timely attainment of the NAAQS.

3.1.1.1 Air Quality Monitoring

The evaluation of existing air quality is based on ambient air quality data collected and published by Ecology and PSCAA. Ecology and PSCAA have established air pollution monitoring stations throughout Washington State. In general, these stations are located where air quality problems have been identified. The air quality monitoring stations closest to the I-405 corridor for CO are in downtown Bellevue. One exceedance of the eight-hour NAAQS for CO was observed in 1995. No exceedance of NAAQS for CO was observed at these locations in 1996, 1997, or 1998.

Ozone is also monitored by Ecology; the nearest monitoring station is at Lake Sammamish State Park, approximately 10 kilometers (5 miles) east of I-405. No exceedances of the NAAQS for ozone were observed at this location in 1996 or 1997. There were three exceedances in 1998, all during July. Generally, ozone concentrations in the affected area would be lower than those measured at the Lake Sammamish monitoring station, because the affected area is upwind of the monitoring station. Emissions of ozone precursors from transportation sources in the affected area contribute to ozone concentrations measured at the Lake Sammamish State Park and Enumclaw ozone monitoring stations.

Monitoring stations for PM_{10} are located in Lynnwood, Kent, and downtown Bellevue. The arithmetic mean concentration for 1998 at the Bellevue location was 16.7 micrograms per cubic meter ($\mu g/m^3$), which was below the NAAQS of 50 $\mu g/m^3$ averaged over one year. The highest 24-hour average concentration at that location in 1997 was 48 $\mu g/m^3$, which was below the NAAQS of 150 $\mu g/m^3$ averaged over 24 hours. $PM_{2.5}$ is not monitored in Bellevue. Particulate matter less than 10 micrometers in size is also monitored in Lynnwood and Kent near the north and south ends of the I-405 corridor. In 1998, the arithmetic mean concentrations were 12.6 and 19.9 $\mu g/m^3$ for the Lynnwood and Kent sites, respectively.

3.1.1.2 Climate

Weather directly influences air quality. Important meteorological factors include wind speed and direction, atmospheric stability, temperature, sunlight intensity, and mixing depth. Temperature inversions, which are associated with higher air pollution concentrations, occur when warmer air overlies cooler air. During temperature inversions in late fall and winter, particulates and CO from wood stoves and vehicle sources can be trapped close to the ground, which can lead to violations of the NAAQS. In the Puget Sound area, the highest ozone concentrations occur from mid-May until mid-September, when urban emissions are trapped by temperature inversions followed by intense sunlight and high temperatures.

3.1.1.3 Carbon Monoxide

CO is a colorless, odorless, and poisonous gas that reduces the oxygen-carrying capability of the blood by bonding with hemoglobin, forming carboxyhemoglobin, which prevents oxygenation of the blood. The major sources of CO are vehicular traffic, along with industry, wood stoves, and slash burns. In urban areas, motor vehicles are often the source of more than 90 percent of the CO emissions that cause ambient levels to exceed the NAAQS (USEPA, 1992).

Areas of high CO concentrations are usually localized, occurring near congested roadways and intersections during autumn and winter, and associated with light winds and stable atmospheric conditions. These localized areas of elevated CO levels are referred to as CO hot spots. CO concentration decreases in most areas have resulted from more stringent federal emission standards for new vehicles and the gradual replacement of older, more polluting vehicles. CO levels have been declining in urban areas, but are leveling off or increasing in areas with rapid growth in traffic volumes, including the more remote suburbs of the Puget Sound region.

3.1.1.4 Particulate Matter

Particulate matter includes small particles of dust, soot, and organic matter suspended in the atmosphere. Particulates less than 100 micrometers in diameter are measured as Total Suspended Particulates (TSP). Particles less than 10 micrometers in size are measured as PM_{10}, a component of TSP. Particles less than 2.5 micrometers in size are measured as $PM_{2.5}$, a component of PM_{10} and TSP. The smaller $PM_{2.5}$ and PM_{10} particles can be inhaled deeply into the lungs, potentially leading to respiratory diseases and cancer. Particulate matter may carry absorbed toxic substances, and the particle itself may be inherently toxic. Particulate matter can also affect visibility, plant growth, and building exteriors.

Sources of particulates include motor vehicles, industrial boilers, wood stoves, open burning, and dust from roads, quarries, and construction activities. Most vehicular emissions are in the $PM_{2.5}$-size range, while road and construction dust is often in the larger PM_{10} range. Most vehicle fine particulate emissions result from diesel vehicles, which release fine particulates both directly, mostly as carbon compounds, and indirectly in the form of sulfur dioxide (SO_2), a gas that reacts in the atmosphere to form sulfate particulates. High $PM_{2.5}$ and PM_{10} concentrations occur in fall and winter during periods of air stagnation and high use of wood for heat. In the Puget Sound region, fireplaces and wood stoves account for almost two-thirds of winter $PM_{2.5}$ emissions (PSCAA, 1999). On-road vehicle emissions contribute approximately 12 percent of the region's $PM_{2.5}$ emissions, while construction and other dust sources contribute approximately 6 percent. The USEPA's $PM_{2.5}$ standard (Table 3.1-1) has recently been upheld by the Supreme Court, but has not yet been implemented by USEPA.

Particulates emitted from diesel vehicles pose specific health risks when compared to other types of particulate matter. The USEPA's Clean Air Scientific Advisory Committee is currently reviewing recent health assessment data on diesel emissions; however, the data are not yet available for citation. Previous USEPA research (USEPA, 1993) found that components of diesel particulates, primarily high-molecular-weight organic compounds, have several negative health effects including carcinogenesis, accumulation of particles in the lungs, tissue inflammation, respiratory irritation, and other related effects. Health effects associated with diesel particulates were one of the major contributing factors to establishing the new $PM_{2.5}$ standard.

3.1.1.5 Ozone

Ozone is a highly toxic form of oxygen and is a major component of the complex chemical mixture that forms photochemical smog. Ozone is formed by a reaction between sunlight, nitrogen oxides (NO_x), and hydrocarbons (HC). Ground-level ozone is primarily a product of precursor emissions from regional vehicular traffic, industrial point sources, and fugitive emission sources. Tropospheric (ground-level) ozone is a health-risk, while stratospheric (upper-atmosphere) ozone, which is produced through a different set of chemical reactions that only require oxygen and intense sunlight, protects people from harmful solar radiation. In the remainder of this analysis, the term ozone refers to tropospheric ozone.

Ozone irritates the eyes and respiratory tract and increases the risk of respiratory and heart diseases. Ozone reduces the lung function of healthy people during exercise, can cause breathing difficulty in susceptible populations such as asthmatics and the elderly, and damages crops, trees, paint, fabric, and synthetic rubber products. The severity of the health effects are both dose and exposure-duration related (National Research Council, 1992). The USEPA has recently adopted a new eight-hour ozone standard (Table 3.1-1); however, the old one-hour standard is still applicable for current nonattainment and maintenance areas. The eight-hour standard has recently been upheld by the Supreme Court, but has not yet been implemented by USEPA. Maximum ozone levels generally occur between noon and early evening at locations several miles downwind from the sources, after NO_x and HC have had time to mix and react under sunlight. In the central Puget Sound region, northeasterly winds arising during these conditions result in high ozone concentrations near the Cascade foothills, to the south and southeast of major cities. Ozone precursor emissions in the I-405 corridor create the ozone in the Lake Sammamish area and the Cascade foothills.

3.1.1.6 Hazardous Air Pollutants

Other chemicals or classes of chemicals in motor vehicle emissions that are considered hazardous by USEPA include benzene, formaldehyde, 1,3-butadiene, acetaldehyde, and gasoline vapors (USEPA, 1993). Benzene emissions in the Puget Sound region are substantially higher than the national average. The emission quantities of these hazardous compounds are much lower than the emissions of the pollutants evaluated in this section, making an accurate calculation of their emissions more difficult; however, the emissions of hazardous air pollutants from transportation sources would vary among the alternatives in a fashion similar to the other pollutants presented here.

3.1.1.7 Greenhouse Gases

Automobiles also emit "greenhouse" gases, primarily carbon dioxide (CO_2) that may contribute to global warming. CO_2 emissions are proportional to fuel consumption. Passenger cars emit on average 225 grams CO_2 per kilometer traveled (0.8 pound per mile) and sport-utility vehicles and light trucks emit about 50 percent more CO_2 per mile. Because CO_2 emissions are directly proportional to fuel consumption, they vary with speed and are lowest at a speed of approximately 45 mph, where most automobiles are most fuel efficient. Because the emissions pattern relative to vehicle speed is similar to that of CO, CO_2 emissions would vary among the alternatives in a similar pattern to CO emissions, but the emissions would be an order of magnitude greater than the emissions of CO.

3.1.1.8 Coordination with Agencies and Jurisdictions

The methodology and process used for this review were discussed with WSDOT, USEPA, and the Puget Sound Clean Air Agency (PSCAA) on August 16, 2000. A follow-up meeting was conducted with the Puget Sound Regional Council (PSRC) on August 17. Since that point, there has been ongoing coordination with PSRC to assure that the methodology used in this review is consistent with PSRC's conformity analysis procedures.

3.1.2 Methodology

Air quality impacts were assessed by estimating total daily pollutant emissions from transportation sources within the Puget Sound region.

Outputs from the EMME/2 transportation network model, including link volumes, speeds, and travel distances, were processed using the methodology and programs developed by PSRC to determine regional conformity. Emissions per mile traveled for carbon monoxide (CO), hydrocarbons (HC), and oxides of nitrogen (NO_x) were calculated for the average speed of each scenario using the Puget Sound Regional Council (PSRC) input files to the Mobile5a emissions model. Because the baseline transportation network modeled as part of this study differs from the network modeled for the Metropolitan Transportation Plan (MTP) and Transportation Improvement Plan (TIP) in several areas, the results of this review do not determine conformity; however, they provide a robust means of comparison among the alternatives. The results may also be compared to the model runs completed by PSRC, since methodology and emission assumptions are consistent between the analyses. This analysis references results from PSRC's *1998 MTP Progress Report* (PSRC, 1998); because PSRC is constantly updating the regional models, other PSRC results may differ from those referenced here.

The PSRC MTP modeled roadway network incorporates the region's adopted transportation plan, including projects that are not yet funded. The 2020 baseline (No Action) network used for the I-405 corridor review includes only those projects that have committed funding. The starting point for the network was PSRC's "Six-Year Action Strategy - Funded" which is close to a 2010 network. It includes Phase I of the Sound Transit plan. Also added in were projects in the Eastside Transportation Program that were identified as having committed funding. For each of the action alternatives, the planned improvements for that alternative are added to the baseline network.

In addition to the three computed pollutant emissions, ozone, fine particulate matter, greenhouse gases, and hazardous air pollutants are of concern. Because ozone is not produced directly, but is formed by a reaction between sunlight, nitrogen oxides (NO_x), and hydrocarbons (HC), the values calculated for NO_x and HC emissions are a surrogate for ozone production in the study area. Particulate matter, including PM_{10} and $PM_{2.5}$, are emitted primarily from industrial boilers, wood stoves, open burning, dust from roads, quarries, construction activities, and motor vehicles. Greenhouse gases and hazardous air pollutant emissions would differ among the alternatives similarly to the modeled pollutants.

The effect of changes in arterial traffic on local pollutant emission is discussed qualitatively for the Bothell, Bellevue, and Renton areas. Detailed changes in traffic patterns are presented in the *I-405 Corridor Program Draft Transportation Expertise Report* (Mirai and DEA, 2001).

The air quality analyses in this section are based on the *I-405 Corridor Program Draft Air Quality Expertise Report* (Parsons Brinckerhoff, 2001), herein incorporated by reference.

3.1.3 Affected Environment

The Puget Sound Air Quality Maintenance Plan for CO has established a CO motor vehicle emissions budget of 1,358 metric tons of CO per winter day. The factors for HC and NO_x are 225 and 239 metric tons per summer day after 2010 (Table 3.1-2). The 2020 forecast values for the 1998 update to the Puget Sound region's Metropolitan Transportation Plan (MTP) approach the State Implementation Plan (SIP) budget for CO. Subsequent to completion of the air quality analysis for the I-405 Corridor Program, PSRC adopted a new MTP (*Destination 2030*).

Implications of the new MTP, including effects on air quality, are discussed in Section 3.23 of this EIS. The Preferred Alternative was submitted to PSRC for inclusion in a refined air quality conformity evaluation of the MTP. This analysis is discussed under the Preferred Alternative in Section 3.1.4.6.

Table 3.1-2: Baseline Air Pollutant Emissions (metric tons per day)

Pollutant	1997 SIP Budget	2020 PSRC MTP Forecast
Carbon Monoxide	1,358	1,311
Hydrocarbons	225	148
Nitrogen Oxides	239	186

Source: PSRC, 1998

3.1.4 Impacts

3.1.4.1 No Action Alternative

Construction Impacts

Construction of projects under the No Action Alternative would include temporary air pollutant emissions, including dust and combustion emissions. The impacts from these projects are, or will be, addressed within the environmental analysis, documentation, and review for the individual projects.

Operational Impacts

Regional transportation air pollutant emissions modeled for 2020 under the No Action Alternative (Table 3.1-3) were modeled to be slightly greater than those modeled by PSRC for their 1998 MTP Plan update (Table 3.1-2) (PSRC, 1998). The minor difference between the modeling scenarios is a result of other transportation projects planned outside the I-405 corridor that have been included in the PSRC's MTP model. The daily emission values of 1,315 metric tons CO, 143 metric tons HC, and 182 metric tons NO_x are within the region's SIP budget.

Table 3.1-3: Regional Air Pollutant Emissions by Alternative (metric tons per day)

Pollutant	2020 No Action Alternative	2020 Alt. 1 HCT/TDM Emphasis	2020 Alt. 2 Mixed Mode with HCT/Transit Emphasis	2020 Alt. 3 Mixed Mode Emphasis	2020 Alt. 4 General Capacity Emphasis	2020 Preferred Alternative
Carbon Monoxide	1,315	1,313	1,302	1,294	1,256	1,256 to 1,294
Hydrocarbons	143	143	143	142	139	139 to 142
Nitrogen Oxides	182	182	184	186	181	181 to 186

Source: Parsons Brinckerhoff, 2000

3.1.4.2 Alternative 1: HCT/TDM Emphasis

Construction Impacts

The action alternatives for the I-405 corridor study would include construction activities throughout the I-405 study area. Alternative 1 would have less construction-phase emissions than the other action alternatives, but substantially more emissions than the No Action Alternative, especially in the high-capacity transit corridor.

Particulate emissions would vary from day to day depending on level of activity, specific operations, and weather conditions. Particulate emissions would depend on soil moisture, silt content of soil, wind speed, and amount and type of equipment operating. Larger dust particles would settle near the source, while fine particles would be dispersed over greater distances from the construction site.

The quantity of particulate emissions would be proportional to the area of the construction operations and the level of activity. Based upon field measurements of suspended dust emissions from construction projects, an approximate emission factor for construction operations would be 1.2 tons per acre of construction per month of activity (USEPA, 1995). Emissions would be reduced if less of the site is disturbed or mitigation is performed.

Fugitive dust from construction activities would be noticeable near construction sites if uncontrolled. Construction would require mitigation measures to comply with PSCAA regulations that require the control of dust during construction and preventing deposition of mud on paved streets (PSCAA Regulation 1, Article 9). Measures to reduce deposition of mud and emissions of particulates are identified in the Construction Mitigation Section (Section 3.1.6.1).

In addition to particulate emissions, heavy trucks and construction equipment powered by gasoline and diesel engines would generate CO and NO_x in exhaust emissions. If construction traffic were to reduce the speed of other vehicles in the area, emissions from traffic would increase slightly while those vehicles are delayed. These emissions would be temporary, limited to the immediate area surrounding the construction site, and would contribute a small amount compared with automobile traffic in the study area because construction traffic would be a very small fraction of the total traffic in the area.

Some phases of construction would result in short-term odors, particularly paving operations if asphalt is used. Odors might be detectable to some people near the construction site, and would be diluted as distance from the site increases.

Operational Impacts

Regional transportation air pollutant emissions modeled for 2020 for Alternative 1 (Table 3.1-3) were modeled to be slightly less than for the No Action Alternative. The daily emission values of 1,313 metric tons CO, 143 metric tons HC, and 182 metric tons NO_x are within the region's SIP budget. As a result of shifting person-trips from the congested I-405 corridor (under the No Action Alternative) to high-capacity transit, there would be a small regional decrease in vehicle miles traveled (VMT) relative to the No Action Alternative, resulting in a minor emissions reduction. Regional emissions modeled for Alternative 1 are lower than those modeled for the No Action Alternative. Conformity of the MTP and TIP with the Puget Sound region's air quality maintenance plans with this alternative included cannot be determined unless the alternative is included in the official analysis conducted by the PSRC. Emissions of greenhouse gases are also expected to be lower under Alternative 1 than under the No Action Alternative. The difference in emissions between Alternative 1 and the No Action Alternative for other years would be similar to that modeled for 2020.

Changes in traffic volume on I-405 and major parallel arterials can act as a surrogate for local air pollutant emissions along the I-405 corridor (Table 3.1-4). Comparison of arterial roadway volumes between Alternative 1 and the No Action Alternative shows a minor increase in arterial volumes in the Bothell area, but little change in the Bellevue and Renton areas. The additional volume in the Bothell area would result in a minor increase in local air pollutant emissions near those arterials relative to the No Action Alternative. Regional transportation patterns under Alternative 1 would be similar to the No Action Alternative.

Table 3.1-4: P.M. Peak Period North-South Vehicle Trips at Selected Locations

	2020 No Action Alternative		2020 Alternative 1 HCT/TDM Emphasis		2020 Alternative 2 Mixed Mode with HCT/Transit Emphasis		2020 Alternative 3 Mixed Mode Emphasis		2020 Alternative 4 General Capacity Emphasis		2020 Preferred Alternative	
Location	I-405	Arterial	I-405	Arterial	I-405	Arterial	I-405	Arterial	I-405	Arterial	I-405	Arterial
Bothell, South of the County Line	29,500	39,500	29,500	39,600	40,400	39,800	49,600	40,200	56,700	39,600	54,300	38,600
Bellevue, South of NE 8th St.	49,700	51,800	49,200	51,900	65,800	48,500	81,800	45,400	92,100	42,900	101,800	38,800
Renton, West of Renton CBD	31,200	39,700	31,200	39,500	47,400	36,900	62,400	36,000	67,300	34,900	76,300	31,400

Project-level conformity requirements for the individual elements included in Alternative 1 cannot be determined at this point because project-level transportation data are not available; therefore, project-level air quality analysis would be needed at a later time for those individual elements that are not exempt from project-level conformity analysis (CFR 93.134). Analysis of Alternative 1, with the other transportation improvement projects included in PSRC's MTP, is expected to result in emissions values that would be lower than those presented for Alternative 1 in Table 3.1-3.

3.1.4.3 Alternative 2: Mixed Mode with HCT/Transit Emphasis

Construction Impacts

Construction impacts would be similar to Alternative 1; however, Alternative 2 would include substantial additional construction on I-405. As a result, total construction-phase pollutant emissions would be greater under Alternative 2 than under Alternative 1.

Operational Impacts

Regional transportation air pollutant emissions modeled for 2020 for Alternative 2 (Table 3.1-3) were modeled to be slightly less than for the No Action Alternative and Alternative 1 for CO and slightly higher for NO_x. The daily emission values of 1,302 metric tons CO, 143 metric tons HC, and 184 metric tons NO_x are within the region's SIP budget values. While VMT would increase relative to the No Action Alternative, average speed would also increase, resulting in decreased emissions per mile traveled relative to the No Action Alternative. Regional emissions modeled for Alternative 2 are generally lower than those modeled for the No Action Alternative. Conformity of the MTP and TIP with this alternative included cannot be determined unless the alternative is included in the official analysis conducted by the PSRC. Emissions of greenhouse gases are also expected to be lower under Alternative 2 than under the No Action Alternative.

The difference in emissions between Alternative 2 and the No Action Alternative for other years would be similar to that modeled for 2020.

Changes in traffic volume on I-405 and parallel arterials can act as a surrogate for local air pollutant emissions along the I-405 corridor (Table 3.1-4). Comparison of arterial roadway volumes between Alternative 2 and the No Action Alternative shows a minor increase in arterial volumes in the Bothell area and minor decreases in the Bellevue and Renton areas. The additional volume in the Bothell area would result in a minor increase in local air pollutant emissions near those arterials relative to the No Action Alternative. Reduced arterial volumes in Bellevue and Renton would result in a minor reduction in local air pollutant emissions in those areas. Alternative 2 would result in small shifts in travel patterns within the I-405 corridor.

Project-level air quality analysis would be needed at a later time for those individual elements in Alternative 2 that are not exempt from project-level conformity analysis (CFR 93.134). Analysis of Alternative 2 with the other transportation improvement projects included in PSRC's MTP is expected to result in emissions values that would be lower than those presented for Alternative 2 in Table 3.1-3.

3.1.4.4 Alternative 3: Mixed Mode Emphasis

Construction Impacts

Construction impacts would be similar to Alternatives 1 and 2; however, Alternative 3 would include substantial construction on I-405, but would not include a new high-capacity transit system. As a result, there would be no construction emissions in a high-capacity transit corridor as under Alternatives 1 and 2, but emissions from construction of additional non-transit through-lanes in the I-405 corridor would be substantially greater, resulting in total construction-phase pollutant emissions greater than for Alternative 2.

Operational Impacts

Regional transportation air pollutant emissions modeled for 2020 for Alternative 3 (Table 3.1-3) were modeled to be less than for the No Action Alternative and Alternatives 1 and 2 for CO, and slightly higher for NO_x. The daily emission values of 1,294 metric tons CO, 142 metric tons HC, and 186 metric tons NO_x are within the region's SIP budget. While VMT under Alternative 3 would increase relative to the No Action Alternative, average speed would also increase because of the additional capacity provided for general purpose traffic in the I-405 corridor. The increased speed and reduced congestion would result in decreased emissions per mile traveled relative to the No Action Alternative. Regional emissions modeled for Alternative 3 are generally lower than those modeled for the No Action Alternative. Conformity of the MTP and TIP with this alternative included cannot be determined unless the alternative is included in the official analysis conducted by the PSRC. Emissions of greenhouse gases are also expected to be lower under Alternative 3 than under the No Action Alternative. The difference in emissions between Alternative 3 and the No Action Alternative for other years would be similar to that modeled for 2020.

Changes in traffic volume on I-405 and parallel arterials can act as a surrogate for local air pollutant emissions along the I-405 corridor (Table 3.1-4). Comparison of arterial roadway volumes between Alternative 3 and the No Action Alternative shows a minor increase in arterial volumes in the Bothell area and minor decreases in the Bellevue and Renton areas. The additional volume in the Bothell area would result in a minor increase in local air pollutant emissions near those arterials relative to the No Action Alternative. Reduced arterial volumes in Bellevue and Renton would result in a minor reduction in local air pollutant emissions in those areas.

The major widening of I-405 under Alternative 3 would result in considerable increases in peak period travel demand within the study area. Most of this growth shows up on I-405 itself (increases of 45 to 100 percent). The shift of traffic from arterials to I-405 through much of the project corridor would result in a decrease in emissions and localized pollutant levels near the arterial streets.

Project-level air quality analysis would be needed at a later time for those individual elements in Alternative 3 that are not exempt from project-level conformity analysis (CFR 93.134). Analysis of Alternative 3 with the other transportation improvement projects included in PSRC's MTP is expected to result in emissions values that would be lower than those presented for Alternative 3 in Table 3.1-3.

3.1.4.5 Alternative 4: General Capacity Emphasis

Construction Impacts

Construction impacts would be similar to Alternative 3; however, Alternative 4 would include a greater amount of construction within the I-405 corridor. As a result, construction-phase air pollutant emissions would be greater under Alternative 4 than under any of the other alternatives.

Operational Impacts

Regional transportation air pollutant emissions modeled for 2020 for Alternative 4 (Table 3.1-3) were modeled to be less than for the other alternatives. The daily emission values of 1,256 metric tons CO, 139 metric tons HC, and 181 metric tons NO_x are within the region's SIP budget. For the air quality analysis, the I-405 express lanes were modeled to be operated as a general purpose facility. The substantial increase in capacity in the I-405 corridor under Alternative 4 would result in a shift in traffic from the I-5 corridor; the magnitude of the shift at different locations is detailed in the *I-405 Corridor Program Draft Transportation Expertise Report* (Mirai and DEA, 2001). While VMT would increase relative to the No Action Alternative, average speed would increase substantially, resulting in decreased emissions per mile traveled relative to the No Action Alternative. Regional emissions modeled for Alternative 4 are lower than those modeled for the No Action Alternative. Conformity of the MTP and TIP with this alternative included cannot be determined unless the alternative is included in the official analysis conducted by the PSRC. Emissions of greenhouse gases are also expected to be lower under Alternative 4 than under the No Action Alternative. The difference in emissions between Alternative 4 and the No Action Alternative for other years would be similar to that modeled for 2020.

Changes in traffic volume on I-405 and parallel arterials can act as a surrogate for local air pollutant emissions along the I-405 corridor (Table 3.1-4). Comparison of arterial roadway volumes between Alternative 4 and the No Action Alternative shows a minor increase in arterial volumes in the Bothell area and minor decreases in the Bellevue and Renton areas. The additional volume in the Bothell area would result in a minor increase in local air pollutant emissions near those arterials relative to the No Action Alternative. Reduced arterial volumes in Bellevue and Renton would result in a minor reduction in local air pollutant emissions in those areas.

The major widening of I-405 in Alternative 4, including the express roadway, would result in considerable increases in peak period travel demand within the study area. Most of this growth shows up on I-405 itself (increases of 85 to 102 percent). The shift of traffic from arterials to I-405 through much of the project corridor would result in a decrease in emissions and localized pollutant levels near the arterial streets.

Project-level air quality analysis would be needed at a later time for those individual elements in Alternative 4 that are not exempt from project-level conformity analysis (CFR 93.134). Analysis of Alternative 4 with the other transportation improvement projects included in PSRC's MTP is expected to result in emissions values that would be lower than those presented in Table 3.1-3.

3.1.4.6 Preferred Alternative

Construction Impacts

Construction impacts would be similar to Alternative 3; however, the Preferred Alternative would include a slightly greater amount of construction within some segments of the I-405 corridor. Construction emissions under the Preferred Alternative would be between those for Alternative 3 and for Alternative 4.

Operational Impacts

Regional transportation air pollutant emissions for 2020 for the Preferred Alternative (Table 3.1-3) would be similar to the values for Alternatives 3 and 4 because the Preferred Alternative is generally similar to Alternative 3, but includes additional projects from Alternative 4. The daily emission values would be within the region's SIP budget. While VMT would increase relative to the No Action Alternative, average speed would increase substantially, resulting in decreased emissions per mile traveled relative to the No Action Alternative. Regional emissions for the Preferred Alternative would be generally lower than those modeled for the No Action Alternative.

On April 25, 2002, the PSRC Executive Board approved refinement of the MTP to reflect the project elements of the Preferred Alternative. On May 2, 2002, FHWA and FTA made a conformity determination on the MTP adopted in 2001 (*Destination 2030*). The revised modeling runs show regional emissions below the emission budgets for all pollutants in 2010, 2020, and 2030 for the MTP including the Preferred Alternative. PSRC's modeling demonstrates that air quality in the Puget Sound region, including implementation of the Preferred Alternative, would conform at the regional level to the regional air quality maintenance plans. The Preferred Alternative would not cause any new or contribute to any existing regional exceedances of the NAAQS.

Changes in traffic volume on I-405 and parallel arterials can act as a surrogate for local air pollutant emissions along the I-405 corridor (Table 3.1-4). Comparison of arterial roadway volumes between the Preferred Alternative and the No Action Alternative shows minor decreases in the Bothell, Bellevue, and Renton areas. Reduced arterial volumes in Bothell, Bellevue, and Renton would result in a minor reduction in local air pollutant emissions in those areas. The major widening of I-405 under the Preferred Alternative would result in considerable increases in peak period travel demand within the study area. Most of this growth shows up on I-405 itself (increases of 84 to 140 percent).

While the Preferred Alternative has been demonstrated to conform to the Puget Sound air quality maintenance plans at the regional level, project-level air quality analysis would be needed at a later time for those individual elements in the Preferred Alternative that are not exempt from project-level conformity analysis (CFR 93.134).

3.1.5 Mitigation Measures

Because the No Action Alternative does not include construction beyond the baseline projects, it would not require mitigation beyond that incorporated into the baseline projects. All of the action alternatives could incorporate the following mitigation measures, as well as any other mitigation measures identified as subsequent project-level environmental analysis, documentation, and review is completed.

3.1.5.1 Construction

Fugitive dust would be controlled under the provisions of the 1999 Memorandum of Agreement between WSDOT and PSCAA. In general, the two parties would cooperate to control fugitive dust.

Particulate emissions (in the form of fugitive dust during construction activities) are regulated by PSCAA. Any emission of fugitive dust requires best available control technology (PSCAA Rule 1, Section 9.15). According to PSCAA Rule 1, Section 9.15, fugitive dust from construction activities shall not be injurious to human health, plants and animals, or property, and shall not unreasonably interfere with the enjoyment of life and property. Also, a person may not operate a vehicle that deposits particulate matter on a paved, public highway (PSCAA Rule 1, Section 9.15). Monitoring data from the Central Artery/Tunnel Project in Boston indicates that diligent application of best management practices can reduce particulate emissions from construction activities by approximately one-half (Dolan et al. 2000).

Construction impacts would be reduced by incorporating mitigation measures into the construction specifications for the improvements. Measures such as the following could be used to control PM_{10}, deposition of particulate matter, and emissions of CO and NO_x during construction (Associated General Contractors of Washington, 1997):

- Spraying exposed soil with water would reduce emissions of PM_{10} and deposition of particulate matter.
- Covering all trucks transporting materials, wetting materials in trucks, or providing adequate freeboard (space from the top of the material to the top of the truck) would reduce PM_{10} and deposition of particulates during transportation.
- Providing wheel washers to remove particulate matter that would otherwise be carried off-site by vehicles would decrease deposition of particulate matter on area roadways.
- Removing particulate matter deposited on paved, public roads would reduce mud and dust on area roadways.
- Covering dirt, gravel, and debris piles as needed would reduce dust and wind-blown debris.
- Routing and scheduling construction trucks so as to reduce delays to traffic during peak travel times would reduce secondary air quality impacts caused by a reduction in traffic speeds while waiting for construction trucks.

- Requiring appropriate emission-control devices on all construction equipment powered by gasoline or diesel fuel would reduce CO and NO_x emissions in vehicular exhaust. Using relatively new, well-maintained equipment would reduce CO and NO_x emissions.
- Requiring contractor participation in the Puget Sound Clean Air Agency's Diesel Solutions Program, including use of ultra low sulfur diesel and particulate reduction retrofit kits or the use of biodiesel, would reduce diesel particulate emissions.
- Staging of construction between separate projects to minimize overall system congestion and delays would reduce regional emissions of pollutants during construction.
- Other measures may be considered as appropriate.

3.1.5.2 Operation

Because emissions associated with operation of the action alternatives are expected to be within SIP emission budgets, no significant adverse air quality impacts are expected to result from the alternatives and no mitigation measures would be required. Additional measures could be taken within the region to further reduce transportation pollutants, such as adoption of hybrid transit vehicles by transit agencies and increased stringency in the vehicle inspection and maintenance program.

3.1.6 Conformity

On April 25, 2002, the PSRC Executive Board approved refinement of the MTP to be consistent with the I-405 Corridor Program Preferred Alternative. With this MTP revision, the Preferred Alternative conforms at the regional scale to the Puget Sound region's air quality maintenance plans. The Preferred Alternative would not cause any new or contribute to any existing regional exceedances of the NAAQS. Project-level air quality conformity determination would be needed at a later time for those individual elements in the Preferred Alternative that are not exempt from project-level conformity analysis (CFR 93.134).

This page left intentionally blank.

3.2 NOISE

3.2.1 Regulatory Background and Coordination

3.2.1.1 Characteristics of Sound

Sound is created when objects vibrate, resulting in a minute variation in surrounding atmospheric pressure called sound pressure. The human response to sound depends on the magnitude of a sound as a function of its frequency and time pattern (USEPA, 1974). Magnitude measures the physical sound energy in the air. The range of magnitude from the faintest to the loudest sound the ear can hear is so large that sound pressure is expressed on a logarithmic scale in units called decibels (dB). Loudness, compared to physical sound measurement, refers to how people subjectively judge a sound and varies from person to person. Magnitudes of typical sound levels are presented in Table 3.2-1.

Table 3.2-1: Typical Sound Levels

Transportation Sources	Sound Level (dBA)	Other Sources	Description
	130		Painfully loud
Jet takeoff (200 feet)	120		
Car horn (3 feet)			
	110	Maximum vocal effort	
	100	Shout (0.5 feet)	
			Very annoying
Heavy truck (50 feet)	90	Jack hammer (50 feet)	Loss of hearing with
		Home shop tools (3 feet)	prolonged exposure
Train on a structure (50 feet)	85	Backhoe (50 feet)	
City bus (50 feet)	80	Bulldozer (50 feet)	Annoying
		Vacuum cleaner (3 feet)	
Train (50 feet)	75	Blender (3 feet)	
City bus at stop (50 feet)			
Freeway traffic (50 feet)	70	Lawn mower (50 feet)	
		Large office	
Train in station (50 feet)	65	Washing machine (3 feet)	Intrusive
	60	TV (10 feet)	
Light traffic (50 feet)		Talking (10 feet)	
Light traffic (100 feet)	50		Quiet
		Refrigerator (3 feet)	
	40	Library	
	30	Soft whisper (15 feet)	Very quiet

Sources: FTA, 1995; USEPA, 1971; USEPA, 1974

Humans respond to a sound's frequency or pitch. The human ear is very effective at perceiving sounds with a frequency between approximately 1,000 and 5,000 hertz (Hz), with the efficiency decreasing outside this range. Environmental sound is composed of many frequencies, each occurring simultaneously at its own sound pressure level. Frequency weighting, which is applied electronically by a sound level meter, combines the overall sound frequency into one sound level that simulates how an average person hears sounds. The commonly used frequency weighting for environmental sound is A-weighting (dBA), which is most similar to how humans perceive sounds of low to moderate magnitude.

Because of the logarithmic decibel scale, a doubling of the number of sound sources, such as the number of cars operating on a roadway, increases sound levels by 3 dBA. A tenfold increase in the number of sound sources will add 10 dBA. As a result, a sound source emitting a sound level of 60 dBA combined with another sound source of 60 dBA yields a combined sound level of 63 dBA, not 120 dBA. The human ear can barely perceive a 3 dBA increase, while a 5 or 6 dBA increase is readily noticeable and sounds as if the sound is about one and one-half times as loud. A 10 dBA increase appears to be a doubling in sound level to most listeners.

Noise levels from traffic sources depend on volume, speed, and the type of vehicle. Generally, an increase in volume, speed, or vehicle size increases traffic noise levels. Vehicular noise is a combination of noises from the engine, exhaust, and tires. Other conditions affecting traffic noise include defective mufflers, steep grades, terrain, vegetation, distance from the roadway, and shielding by barriers and buildings.

Sound levels decrease with distance from the sound source. For a line source such as a roadway, sound levels decrease 3 dBA over hard ground (concrete, pavement) or 4.5 dBA over soft ground (grass) for every doubling of distance between the source and the receptor (the individual hearing the sound). For a point source such as a piece of construction equipment, sound levels decrease between 6 and 7.5 dBA for every doubling of distance from the source.

The propagation of sound can be greatly affected by terrain and the elevation of the receiver relative to the sound source. Level ground is the simplest case. Sound travels in a straight line-of-sight path between the source and the receiver. The addition of a berm or other area of high terrain would reduce the sound energy arriving at the receiver. Breaking the line of sight between the receiver and the highest sound source results in a sound reduction of approximately 5 dBA.

If the sound source is lowered or the receiver is elevated, sound generally would travel directly to the receiver. In some situations, sound levels may be reduced because the terrain crests between the source and receiver, resulting in a partial noise barrier near the receiver. If the sound source is elevated or the receiver is lowered, sound may be reduced at the receiver, because the edge of the roadway can act as a partial noise barrier, blocking some sound transmission between the source and receiver.

3.2.1.2 Sound Level Descriptors

A widely used descriptor for environmental noise is the equivalent sound level (L_{eq}). The L_{eq} can be considered a measure of the average sound level during a specified period of time. It is a measure of total sound, or a summation of all sounds during a time period, and places more emphasis on occasional high sound levels that accompany general background sound levels. L_{eq} is defined as the constant level that, over a given period of time, transmits to the receiver the same amount of acoustical energy as the actual time-varying sound. For example, two sounds, one of which contains twice as much energy but lasts only half as long, have the same L_{eq} sound levels. L_{eq} measured over a one-hour period is the hourly L_{eq} [L_{eq}(h)], which is used for highway noise impact and abatement analyses. The day/night level (L_{dn}), a daily averaged sound level that ranks sound that occurs during the evening or night more heavily, is often reported. The L_{dn} adds 10 dBA to sound levels that occur between 10 p.m. and 7 a.m. L_{dn} is used for transit noise impact and abatement analyses to residential areas.

Short-term noise levels, such as those from a single truck pass-by, can be described by the highest instantaneous noise level that occurs during the event. The maximum sound level (L_{max}) is the greatest short-duration sound level that occurs during a single event. L_{max} is related to impacts on speech interference and sleep disruption. In comparison, L_{min} is the minimum sound level during a period of time.

3.2.1.3 Effects of Noise

Environmental noise at high intensities directly affects human health by causing hearing loss. Although scientific evidence currently is not conclusive, noise is suspected of causing or aggravating other diseases. Environmental noise indirectly affects human welfare by interfering with sleep, thought, and conversation. The FHWA noise abatement criteria are based on speech interference, which is a well-documented impact that is relatively reproducible in human response studies.

3.2.1.4 Noise Regulations and Impact Criteria

Applicable noise regulations and guidelines provide a basis for evaluating potential noise impacts. The I-405 Corridor Program has components falling in different jurisdictions. FHWA guidelines are applicable to the proposed roadway components, FTA criteria apply to transit components, and local codes regulate construction noise.

For federally funded highway projects, traffic noise impacts are defined to occur when predicted L_{eq}(h) noise levels approach or exceed noise abatement criteria (NAC) as established by the FHWA, or substantially exceed existing noise levels (U.S. Department of Transportation, 1982, Noise Abatement Council). Although "substantially exceed" is not defined, WSDOT considers an increase of 10 dBA or more to be a substantial increase.

The FHWA noise abatement criteria specify exterior L_{eq}(h) noise levels for various land activity categories (Table 3.2-2). For receptors where serenity and quiet are of extraordinary significance, the noise criterion is 57 dBA. For residences, parks, schools, churches, and similar areas, the noise criterion is 67 dBA. For other developed lands, the noise criterion is 72 dBA. WSDOT considers a noise impact to occur if predicted L_{eq}(h) noise levels approach within 1 dBA of the noise abatement criteria in Table 3.2-2. Thus, if a noise level were 66 dBA or higher, it would approach or exceed the FHWA noise abatement criterion of 67 dBA for residences.

Table 3.2-2: FHWA Noise Abatement Criteria

Activity Category	L_{eq} (h) (dBA)	Description of Activity Category
A	57 (exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 (exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	72 (exterior)	Developed lands, properties, or activities not included in Categories A or B above.
D	-	Undeveloped lands.
E	52 (interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

Source: U.S. Department of Transportation, 1982.

For federally funded transit projects the FTA has established impact criteria. Under the FTA criteria, noise impacts occur when predicted L_{eq}(h) or L_{dn} noise levels caused by a project increase the overall noise by between 1 and 10 dBA, depending on the land use and existing noise level (FTA, 1995). In general, the higher the existing noise level, the less a project may increase the overall noise level without causing a noise impact under the FTA criteria. There are three categories of sensitive land use (Table 3.2-3), which may be impacted by noise. Other uses, such as retail and industrial, are generally not noise-sensitive.

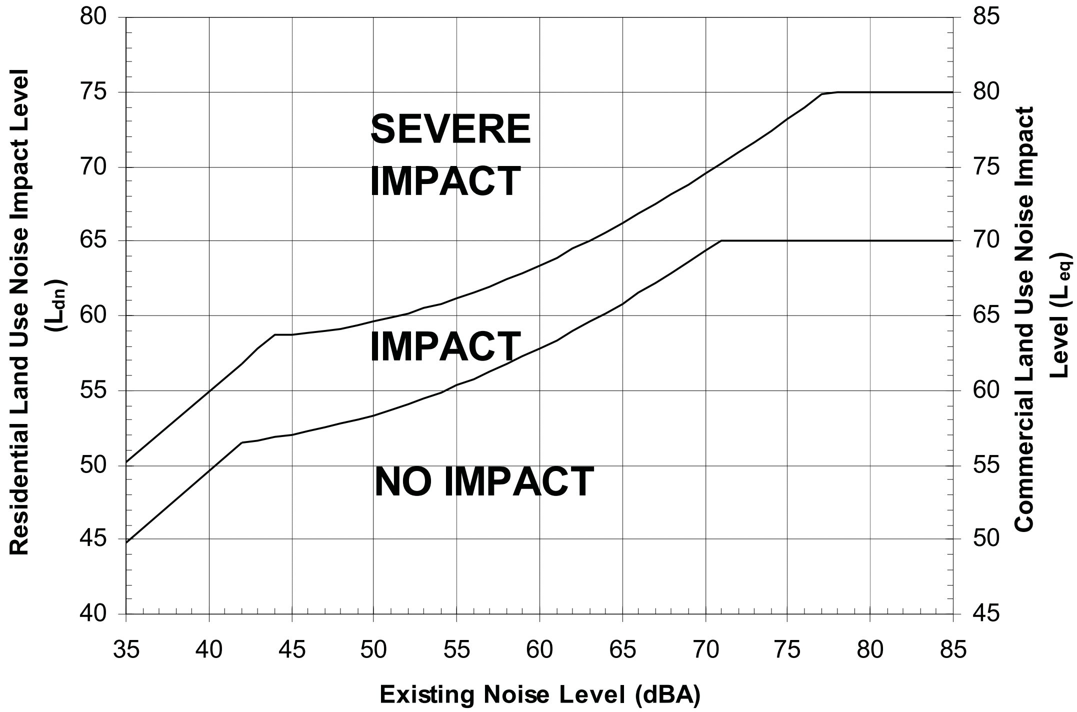
Table 3.2-3: FTA Noise-Sensitive Land Uses

Category	Description of Activity Category
1	The most sensitive land uses. It includes land where quiet is essential, such as outdoor amphitheaters and concert pavilions.
2	Places where people sleep, including homes, apartments, hotels, and hospitals.
3	The least sensitive of the three, includes schools, libraries, medical offices, concert halls, and other similar uses.

Source: FTA, 1995

The project noise exposure levels that define impacts from transit facilities under the FTA criteria are presented in Figure 3.2-1. The noise exposure levels shown in Figure 3.2-1 include only noise generated by the project and not other noise sources that contribute to the overall noise level in the project area. For example, if a project is located in a residential area with an average L_{dn} of 50 dBA, the project can generate up to 54 dBA L_{dn} without causing any impact and up to 59 dBA L_{dn} without causing a severe impact. For noise-sensitive commercial areas, impacts are determined by peak-hour L_{eq}, so if the average L_{eq} is 50 dBA, the project can generate up to 59 dBA L_{eq} without causing any impact and up to 64 dBA L_{eq} without causing a severe impact. Severe impacts generally meet the definition of a significant adverse impact under the National Environmental Policy Act (NEPA).

Figure 3.2-1: FTA Noise Exposure Impact Criteria for Transit Facilities



Washington State Department of Ecology limits noise levels at property lines of neighboring properties (WAC Chapter 173-60). The maximum permissible noise levels depend on the land uses of both the source noise and receiving property (Table 3.2-4). The environmental designation for noise abatement (EDNA) is defined by the land use of a property. In general, residential uses are class A, commercial are class B, and industrial are class C.

Table 3.2-4: Maximum Permissible Environmental Noise Levels

	EDNA of Receiving Property		
EDNA of Noise Source	Class A	Class B	Class C
CLASS A	55 dBA	57 dBA	60 dBA
CLASS B	57	60	65
CLASS C	60	65	70

Source: WAC 173-60-030

Short-term exceedances above the permissible sound level are allowed. The maximum level may be exceeded by 5 dBA for a total of 15 minutes, by 10 dBA for a total of 5 minutes, or by 15 dBA for a total of 1.5 minutes during any one-hour period (WAC 173-60-040). These allowed exceptions are referred to in terms of the percentage of time a certain level is exceeded; an L_{25} is the noise level that is exceeded 15 minutes during an hour. Therefore, the permissible L_{25} would be 5 dBA greater than the values in Table 3.2-4, provided that the noise level is below the permissible level in Table 3.2-4 for the rest of the hour and never exceeds the permissible level by more than 5 dBA. An hourly L_{eq} of approximately 2 dBA higher than the values in Table 3.2-4 is an equivalent sound level to the permissible levels, including the allowed short-term increases. Using this rule, an L_{eq}(h) of 59 dBA corresponds approximately to a noise level of 57 dBA for 45 minutes and 62 dBA for 15 minutes, which is the maximum permissible noise level created by a commercial source and received by a residential property. Both King and Snohomish counties and many cities have adopted the Ecology standards with minor differences.

Construction noise from the project, however, must meet Ecology property line regulations. Construction noise is exempt from property line standards during daytime hours. Noise levels in Table 3.2-4 apply to construction equipment only at rural and residential receiving properties between 10 p.m. and 7 a.m.

3.2.1.5 Coordination with Agencies and Jurisdictions

The methodology and process used for this analysis were discussed with WSDOT, USEPA, and Sound Transit on August 16, 2000. Sound Transit provided monitoring data from the Totem Lake Park-and-Ride environmental studies.

3.2.2 Methodology

Ambient noise levels were measured to describe the existing noise environment and identify major noise sources in the affected area. Ambient noise levels were measured at 35 locations in the affected area to characterize the weekday noise levels. At most locations, 15-minute measurements were taken to estimate the L_{eq}(h). At four locations near major transit noise sources, 24 1-hour measurements were taken to determine the daily noise profile. Measurement locations represent a variety of noise conditions and are representative of other sensitive receptors near the proposed improvements.

L_{eq}(h) traffic noise levels at representative locations in the corridor were predicted using FHWA's STAMINA 2.0 computer model. For the high-capacity transit components of Alternatives 1 and 2, noise exposure levels, the quantity of noise caused by the project that would result from each of the alternatives, were modeled using FTANOISE, the FTA Transit Noise Assessment Spreadsheet Model (HMMH, 1995), near transit noise sources. FTA noise impacts consider the entire noise environment, while FHWA noise impacts are traffic noise only. For the traffic noise impact areas, noise from fixed-guideway high-capacity transit was not considered in the impact calculation, but bus traffic traveling on I-405 was included. For the high-capacity transit noise impacts, traffic noise was factored into the background noise level when calculating the impact distance.

In most cases where the roadway and fixed-guideway high-capacity alignments are in close proximity, the traffic noise impact is greater than the transit noise impact, and the traffic noise impact area includes the impact area of both sources. Generalized traffic noise contours of 66 dBA and transit noise contours that varied by existing background noise levels per Figure 3.2-1 were created using the modeled noise levels.

At the level of analysis available for this corridor study, terrain features and existing noise barriers are not included in the noise contour calculations; therefore, these noise contours define the potential for noise impact, rather than the area adversely affected by noise. The contours were input to the GIS system, and the parcels within the contour were calculated. These parcels were compared to the King County Department of Assessments Residential Parcel File to determine which parcels included residential land use. All parcels within the potential impact contour that include residential uses were counted. The reported number of affected properties overestimates the actual number that would be affected by each of the alternatives because local shielding features were neglected. The same methodology was used for each alternative; therefore, the level of impact can be compared validly among the alternatives.

The noise analyses in this section are based on the *I-405 Corridor Program Draft Noise Expertise Report* (Parsons Brinckerhoff, 2001), herein incorporated by reference.

3.2.3 Affected Environment

3.2.3.1 Land Use

Land use varies along the approximately 30-mile length of the I-405 corridor. Most of the corridor lies in urban and suburban areas with residential, commercial, and industrial noise sources bordering the corridor.

3.2.3.2 Existing Noise Levels

Noise measurements were completed throughout the I-405 corridor. At three locations, 24-hour noise measurements were taken (Locations A, B, and D on Table 3.2-5). In the Totem Lake area, 24-hour data were provided from Sound Transit's Park-and-Ride Study (Entech Northwest, 2000) (Location C on Table 3.2-5). Short-duration noise levels were measured at 31 locations in the corridor to further characterize the noise environment (Table 3.2-6).

Table 3.2-5: 24-Hour Noise Measurements

Location		Max L_{eq}(h) (dBA)	L_{dn} (dBA)
A	Gene Coulon Park, Renton	60	56
B	Terrace Park, Kirkland	62	61
C	Totem Lake P&R	65	68
D	Hawthorn Subdivision, Woodinville	62	60

The potential noise impact area along I-405 was calculated using existing peak-hour noise volumes (Table 3.2-7). This area assumes level terrain and no noise barriers or other shielding in order to describe the potential for noise impact under each alternative. The actual area affected by traffic noise levels that approach or exceed the FHWA Noise Abatement Criteria would be less than the area calculated because the calculations make several simplifying assumptions. This methodology was also used to calculate the receptors that would be affected in the future; therefore, these values provide a baseline to compare areas potentially impacted in the future to those within the current potential impact area. Under existing conditions, 1,396 residential parcels are within the potential traffic noise impact area.

Table 3.2-6: 15-Minute Noise Measurements

Location		Date	Start Time	L_{eq} (dBA)	L_{max} (dBA)
1	Tukwila Park, Tukwila	10/12/00	9:00 a.m.	63	77
2	S 14th St & Whitworth, Renton	10/12/00	9:45 a.m.	70	78
3	819 S 5th, Renton	10/12/00	11:55 a.m.	62	76
4	Mill Ave & S. 4th, Renton	10/12/00	11:30 a.m.	63	79
5	582 Bronson, Renton	10/12/00	11:00 a.m.	65	76
6	High Ave N & NE 24th, Renton	10/17/00	12:10 p.m.	66	74
7	3940 Meadow Ave N, Renton	6/13/00	2:15 p.m.	68	71
8	Nautica Apartments, Newcastle	5/11/00	5:05 p.m.	66	72
9	11007 SE 60th	10/17/00	11:35 a.m.	62	68
10	4964 116th Pl.	10/17/00	11:10 a.m.	61	67
11	4605 Bagley Ln.	10/17/00	12:40 p.m.	65	71
12	12203 SE 35th	10/17/00	10:40 a.m.	69	74
13	1401 121st Ave, Bellevue	11/10/00	2:25 p.m.	63	70
14	1750 112th Ave, Bellevue	11/14/00	4:30 p.m.	66	72
15	Boulders at Pikes Peak Sub.	11/10/00	3:10 p.m.	63	71
16	The Little School on 116th, Bellevue	11/10/00	3:45 p.m.	67	72
17	6512 114th Ave NE	11/14/00	3:25 p.m.	65	69
18	7616 116th Ave	10/24/00	4:45 p.m.	66	75
19	11652 95th St	10/17/00	3:45 p.m.	65	71
20	12105 NE 108th	10/17/00	3:15 p.m.	69	73
21	116th and NE 128th	10/17/00	2:45 p.m.	64	69
22	Kingsgate Park	10/17/00	2:10 p.m.	61	72
23	14504 NE 145th	10/24/00	3:25 p.m.	63	73
24	11601 NE 159th St	10/24/00	2:55 p.m.	60	71
25	Apt at 115th NE and NE 160th	10/24/00	2:10 p.m.	65	78
26	112th and NE 197thSt.	10/24/00	1:30 p.m.	63	70
27	233rd Pl and 25th Pl	10/24/00	12:50 p.m.	60	69
28	21729 4th Ave SE	10/24/00	4:10 p.m.	67	79
29	21431 Royal Ann	10/24/00	10:40 a.m.	64	72
30	20113 S Danvers	10/24/00	11:05 a.m.	68	77
31	1110 Kentish	10/24/00	11:35 a.m.	58	66

Table 3.2-7: Existing Potential Noise Impact Areas

Location on I-405 Corridor (between)		Distance (feet) from I-405 Centerline	Number of Residential Parcels
I-5 (Tukwila)	SR 167	325	6
SR 167	SR 169	400	84
SR 169	NE 44th	350	203
NE 44th	NE 8th (Belv.)	450	449
NE 8th (Belv.)	NE 85th	425	210
NE 85th	NE 124th	425	153
NE 124th	SR 522	475	289
SR 522	NE 195th	325	None
NE 195th	SR 527	325	2
Total potentially affected parcels			1,396

3.2.4 Impacts

3.2.4.1 No Action Alternative

Construction Impacts

The No Action Alternative includes construction of baseline projects outlined in Section 2.2.1 of this report. These construction activities would generate noise independent of the I-405 Corridor Program and would be addressed through the environmental analysis, documentation, and review completed for those projects.

Operational Impacts

Using the same methodology as for existing conditions, the potential noise impact area along I-405 was calculated (Table 3.2-8). The calculation of this area assumed level terrain and no noise barriers or other shielding in order to describe the potential for noise impact under each alternative. The actual area affected by traffic noise levels that approach or exceed the FHWA Noise Abatement Criteria would be less than the calculated area because the calculations make several simplifying assumptions; therefore, this area represents potential for noise impacts, rather than the area adversely affected by noise. The number of residential parcels was calculated within the noise potential area (Table 3.2-9). For the length of the I-405 corridor, there are 1,729 residential properties within the potential impact area under the No Action Alternative in 2020. This figure represents a 24 percent increase in the number of potentially noise-affected residential parcels relative to existing conditions in the I-405 corridor.

3.2.4.2 Alternative 1: HCT/TDM Emphasis

Construction Impacts

Construction activities would generate noise during the construction period. Construction usually would be carried out in several reasonably discrete steps, each of which has its own mix of equipment and, consequently, its own noise characteristics. Roadway construction would involve clearing, cut-and-fill activities, removing old roadways, importing fill, and paving. Rail construction in the high-capacity transit corridor would include similar activities, such as removal of old rail and ties, placement of ballast, construction of structures, and laying new rail.

Table 3.2-8: Year 2020 Potential Traffic Noise Impact Areas Along I-405

Location on I-405 Corridor (between)		Distance (feet) from I-405 Centerline					
		No Action	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Preferred Alternative
I-5	SR 167	350	350	450	525	525	525
SR 167	SR 169	425	425	525	600	650	650
SR 169	NE 44th	400	400	475	525	600	600
NE 44th	NE 8th (Belv)	475	475	525	600	650	650
NE 8th (Belv)	NE 85th	450	450	525	525	600	600
NE 85th	NE 124th	475	475	525	600	650	650
NE 124th	SR 522	525	525	600	725	725	725
SR 522	NE 195th	350	350	425	475	475	475
NE 195th	SR 527	350	350	425	475	475	475
SR 527	I-5	450	450	475	475	475	475

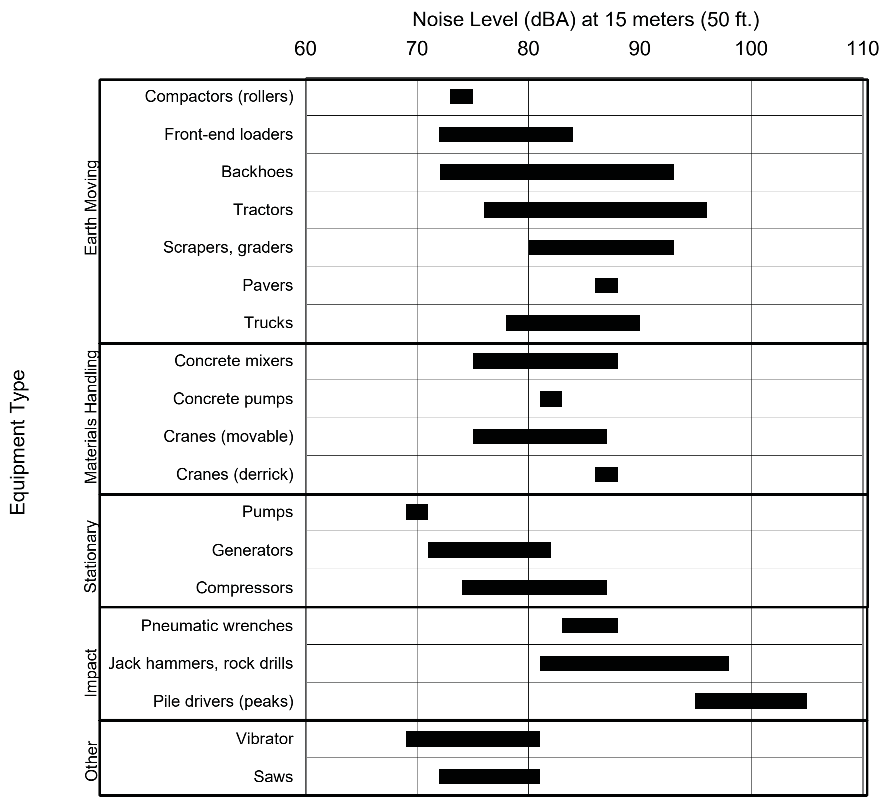
Table 3.2-9: Year 2020 Residential Parcels within Potential Traffic Noise Impact Areas

Location on I-405 Corridor (between)		Number of Parcels					
		No Action	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Preferred Alternative
I-5	SR 167	14	14	15	19	19	19
SR 167	SR 169	92	92	163	192	141	141
SR 169	NE 44th	265	265	316	357	420	420
NE 44th	NE 8th (Belv)	493	493	573	667	725	725
NE 8th (Belv)	NE 85th	277	277	348	378	469	469
NE 85th	NE 124th	198	198	216	262	290	290
NE 124th	SR 522	328	328	416	549	549	549
SR 522	NE 195th	None	None	None	None	None	None
NE 195th	SR 527	62	62	62	62	62	62
Total potentially affected parcels		1,729	1,729	2,109	2,486	2,675	2,675

The most prevalent noise source at construction sites would be the internal combustion engine. Engine-powered equipment includes earth-moving equipment, material-handling equipment, and stationary equipment. Mobile equipment operates in a cyclic fashion, while stationary equipment, such as generators and compressors, operates at sound levels fairly constant over time. Because trucks would be present during most phases and would not be confined to the construction site, noise from trucks could affect additional receptors. Other noise sources would include impact equipment and tools such as pile drivers. Impact tools could be pneumatically powered, hydraulic, or electric.

Construction noise would be intermittent, occurring seasonally during an approximately two-year construction period. Construction noise levels would depend on the type, amount, and location of construction activities. The type of construction methods would establish the maximum noise levels of construction equipment used. The amount of construction activity would determine how often construction noise would occur throughout the day. The location of construction equipment relative to adjacent properties would determine any effects of distance in reducing construction noise levels. Maximum noise levels of construction equipment under all action alternatives would be similar to typical maximum construction equipment noise levels presented in Figure 3.2-2. As shown in Figure 3.2-2, maximum noise levels from construction equipment would range from 69 to 106 dBA at 50 feet (15 meters). Construction noise at residences farther away would decrease at a rate of 6 dBA per doubling of distance from the source. The number of occurrences of the L_{max} noise peaks would increase during construction, particularly during pile-driving activities. Because various equipment would be turned off, idling, or operating at less than full power at any time, and because construction machinery is typically used to complete short-term tasks at any given location, average L_{eq} noise levels during the day would be less than maximum noise levels presented in Figure 3.2-2.

Figure 3.2-2: Construction Noise Levels



Source: USEPA, 1971 and WSDOT, 1999

Construction noise is exempt from local property line regulations during daytime hours. Because of the nature of the proposed improvements to I-405, nighttime construction activities could be required in the corridor for many of the project elements. Any construction activities between 10 p.m. and 7 a.m. would either have to comply with local property line standards (Table 3.2-4) or would require a nighttime construction noise variance from the appropriate local jurisdiction. In addition, construction noise levels could be reduced by the construction practices identified in Section 3.2.5, Mitigation Measures.

Operational Impacts

The potential traffic noise impact area for Alternative 1 along I-405 is calculated in Table 3.2-8. Because Alternative 1 also would include a physically separated, fixed-guideway high-capacity transit component, the potential operational noise impact area for rail transit is also calculated for the HCT corridor (Table 3.2-10). The methodology used to assess transit noise closely followed that for traffic noise; however, the area of potential impact was determined based on the existing noise level in the area and the projected noise exposure, per FTA methodology.

Table 3.2-10: Year 2020 Potential HCT Noise Impact Areas

Location on HCT Corridor (between)		Distance (feet) from HCT Corridor Centerline		
		No Action	Alternative 1	Alternative 2
Tukwila	Renton CBD	None	50 to 110 [a]	50 to 110 [a]
Renton CBD	Factoria	None	75	75
Factoria	Issaquah	None	None	None
Factoria	Downtown Bellevue	None	110	110
Bellevue	Redmond	None	100	100
Bellevue	SR 520	None	75	75
SR 520	Totem Lake	None	75 to 110 [a]	75 to 110 [a]
Totem Lake	Bothell	None	None	None
Bothell	Lynnwood	None	None	None

[a] When a range is given, the lower number is for at-grade sections and the higher number for aerial sections.

The number of residential parcels was calculated within the noise potential areas for traffic and transit in Table 3.2-9 and Table 3.2-11 respectively. For the study area, there are 1,931 residential properties within the potential impact areas for traffic and transit noise under Alternative 1 in 2020. This figure represents a 12 percent increase in the number of residential parcels potentially affected by noise relative to the No Action Alternative, and a 38 percent increase relative to existing conditions.

Table 3.2-11: Year 2020 Residential Parcels within Potential HCT Noise Impact Areas

Location on HCT Corridor (between)		Number of Parcels		
		No Action	Alternative 1	Alternative 2
Tukwila	Renton CBD	None	25	25
Renton CBD	Factoria	None	41	41
Factoria	Issaquah	None	None	None
Factoria	Downtown Bellevue	None	2	2
Bellevue	Redmond	None	14	14
Bellevue	SR 520	None	5	5
SR 520	Totem Lake	None	105	105
Totem Lake	Bothell	None	None	None
Bothell	Lynnwood	None	None	None
Total potentially affected parcels		None	202	202

3.2.4.3 Alternative 2: Mixed Mode with HCT/Transit Emphasis

Construction Impacts

Construction impacts under Alternative 2 would be similar to Alternative 1. There would be slightly more construction noise associated with I-405 under Alternative 2 than Alternative 1.

Operational Impacts

The potential traffic noise impact area for Alternative 2 along I-405 is calculated in Table 3.2-8. Because Alternative 2 also would include a physically separated, fixed-guideway high-capacity transit component, the potential operational noise impact area for rail transit was also calculated for the HCT corridor (Table 3.2-10) using the FTA methodology.

The number of residential parcels was calculated within the noise potential areas for traffic and transit in Table 3.2-9 and Table 3.2-11, respectively. For the study area, there are 2,311 residential properties within the potential impact areas for traffic and transit noise under Alternative 2 in 2020. This figure represents a 34 percent increase in the number of residential parcels potentially affected by noise relative to the No Action Alternative and a 66 percent increase relative to existing conditions.

3.2.4.4 Alternative 3: Mixed Mode Emphasis

Construction Impacts

Construction impacts under Alternative 3 would be similar to Alternatives 1 and 2. There would be more construction noise associated with construction of additional roadway capacity in the I-405 corridor under Alternative 3 than Alternatives 1 and 2; however, there would be no fixed-guideway HCT construction.

Operational Impacts

The potential traffic noise impact area for Alternative 3 along I-405 is calculated in Table 3.2-8. Alternative 3 would not include a fixed-guideway high-capacity transit component; therefore, there would be no additional operational noise impacts in the BNSF alignment.

The number of residential parcels was calculated within the noise potential areas for traffic in Table 3.2-9. For the study area, there are 2,486 residential properties within the potential impact areas for traffic noise under Alternative 3 in 2020. This figure represents a 44 percent increase in the number of residential parcels potentially affected by traffic noise relative to the No Action Alternative and a 78 percent increase relative to existing conditions.

3.2.4.5 Alternative 4: General Capacity Emphasis

Construction Impacts

Construction impacts under Alternative 4 would be similar to those described for the other action alternatives. There would be more construction noise in the I-405 corridor under Alternative 4 than any of the other alternatives because of construction of the express roadway.

Operational Impacts

The potential traffic noise impact area for Alternative 4 along I-405 is calculated in Table 3.2-8. Alternative 4 would not include a fixed-guideway high-capacity transit component or BRT system; therefore, there would be no noise impacts associated with these systems.

The number of residential parcels was calculated within the noise potential areas for traffic in Table 3.2-9. For the study area, there are 2,675 residential properties within the potential impact areas for traffic noise under Alternative 4 in 2020. This figure represents a 55 percent increase in the number of residential parcels potentially affected by traffic noise relative to the No Action Alternative and a 92 percent increase relative to existing conditions.

3.2.4.6 Preferred Alternative

Construction Impacts

Construction impacts under the Preferred Alternative would be similar to those described for the other action alternatives. There would be more construction noise in the I-405 corridor under the Preferred Alternative than under Alternative 3, but less than under Alternative 4.

Operational Impacts

The potential traffic noise impact area for the Preferred Alternative along I-405 is presented in Table 3.2-8. The Preferred Alternative would be the same as Alternative 4 along much of the corridor. The Preferred Alternative would not include a fixed-guideway high-capacity transit component; therefore, there would be no noise impacts associated with this system.

The estimated number of residential parcels within the potential noise impact areas for traffic is shown in Table 3.2-9. For the study area, there are 2,675 residential properties within the potential impact areas for traffic noise under the Preferred Alternative in 2020 prior to application of mitigation measures. This figure represents a 55 percent increase in the number of residential parcels potentially affected by traffic noise relative to the No Action Alternative and a 92 percent increase relative to existing conditions, prior to application of existing and future mitigation.

3.2.5 Mitigation Measures

Noise can be controlled at three locations: (1) at the source, such as with mufflers and quieter engines; (2) along the noise path, with barriers; and (3) at the receptor, with insulation. Noise abatement is generally provided only where frequent human use occurs and where a lower noise level would have benefits.

Mitigation for the No Action Alternative projects would be addressed through the environmental analysis, documentation, and review completed for those projects. WSDOT has constructed noise barriers in portions of the I-405 corridor where capacity has been increased. In most locations the barriers were constructed in conjunction with construction of HOV lanes. WSDOT and/or co-lead agencies will continue to construct noise barriers in portions of the corridor not currently protected by barriers to reduce noise levels along the I-405 corridor per acceptable FHWA and FTA standards.

For all action alternatives, mitigation is discussed for potential to reduce the number of noise impacts under each alternative. Because this is a programmatic EIS with a general assessment of areas of potential impact, detailed mitigation analysis and recommendations are not included in this study. Project-level environmental analysis, documentation, and review will be conducted for individual improvements subsequent to the I-405 Corridor Program Final EIS.

3.2.5.1 Construction

Construction noise could be reduced by using enclosures or walls to surround noisy equipment, installing mufflers on engines, substituting quieter equipment or construction methods, minimizing time of operation, and locating equipment farther from sensitive receptors. To reduce construction noise at nearby receptors along the I-405 and fixed-guideway HCT corridors, the following mitigation measures could be incorporated into construction plans and contractor specifications:

- Erecting noise berms and barriers as early as possible would provide noise shielding.
- Limiting construction activities to between 7 a.m. and 10 p.m. would reduce construction noise levels during sensitive nighttime hours.
- Equipping construction equipment engines with adequate mufflers, intake silencers, and engine enclosures would reduce their noise by 5 to 10 dBA (USEPA, 1971).
- Specifying the quietest equipment available would reduce noise by 5 to 10 dBA.
- Turning off construction equipment during prolonged periods of nonuse would eliminate noise from construction equipment during those periods.
- Requiring contractors to maintain all equipment and train their equipment operators would reduce noise levels and increase efficiency of operation.
- Locating stationary equipment away from receiving properties would decrease noise from that equipment in relation to the increased distance.
- Constructing temporary noise barriers or curtains around stationary equipment that must be located close to residences would decrease noise levels at nearby sensitive receptors.

3.2.5.2 Operation

A variety of mitigation methods can be effective at reducing transportation noise impacts. For example, noise impacts from long-term operation of the improvements can be reduced by:

- Applying traffic management measures
- Acquiring land as buffer zones or for construction of noise barriers or berms
- Realigning the facility
- Installing noise insulation in public use or nonprofit institutional structures
- Constructing noise barriers or berms

These mitigation measures were evaluated for their potential to reduce noise impacts from the proposed action. Final determination of size and placement of noise barriers or berms and implementation of other mitigation methods takes place during detailed project design, after an opportunity for public involvement, and approval at the local, state, and federal levels.

Traffic management measures: These include time restrictions or traffic control devices and signing for prohibition of certain vehicle types (such as motorcycles and heavy trucks), modified speed limits, and exclusive land designations. Restriction of vehicle types and lower speed limits on I-405 could worsen congestion and is contrary to the purpose of the I-405 Corridor Program. Noise impacts could be reduced by land use controls throughout the study area; however, the area is largely built-out. A transportation system management plan to encourage the use of car pools and public transit would reduce vehicle trips and, subsequently, traffic noise. A 3 dBA decrease in traffic noise would require a reduction in traffic by approximately 50 percent.

Land acquisition for noise buffers or barriers: Much of the I-405 corridor is bordered by residential properties which would require relocation of residents and would be unreasonably expensive to acquire for the purpose of noise mitigation.

Realigning the facility: The horizontal alignment is defined by available right-of-way. During design, shifts in horizontal alignment would be considered to reduce noise exposure.

Noise insulation of buildings: Insulation of public and not-for-profit buildings may be feasible.

Noise barriers: These include noise walls, berms, and buildings that are not sensitive to noise. The effectiveness of a noise barrier is determined by its height and length and by the topography of the project site. To be effective, the barrier must block the "line of sight" between the highest point of a noise source, such as a truck's exhaust stack, and the highest part of a receiver. It must be long enough to prevent sounds from passing around the ends, have no openings such as driveway connections, and be dense enough so that noise would not be transmitted through it. Buildings that do not have noise sensitive uses also could function as barriers (U.S. DOT, 1973).

WSDOT typically evaluates many factors to determine whether barriers are feasible and reasonable. The evaluation includes engineering feasibility, i.e., whether barriers could be built in a location to achieve a noise reduction of at least 7 dBA at the closest receptors. Determination of reasonability includes the number of sensitive receptors benefited by at least 3 dBA, cost-effectiveness of the barriers, and concerns such as the desires of nearby residents, aesthetics, and safety. Mitigation costs to address the long-term noise impacts due to new transportation improvements will come from project dollars.

Currently, there are noise barriers along much of the I-405 corridor. WSDOT has been completing a Type I barrier program (retrofit program) for the corridor based on funding availability. Most of the corridor, starting from the south, is now complete. Completion of barriers, to address existing noise impacts along I-405 in areas that are reasonable and feasible is dependent on funding being provided by the state legislature. Those barriers would continue to reduce noise levels along I-405 relative to the noise levels projected in this report.

Because there are very few areas along I-405 that would meet reasonableness and feasibility criteria that would not already have barriers completed, it is expected that few if any new barriers would be required along I-405 as part of the I-405 Corridor Program. Barriers may prove reasonable along parts of the high-capacity transit corridor. Once detailed design information is available during the design of individual project elements, the need to increase the length or height of existing barriers, or construct new barriers would be determined during the detailed analysis of the individual project elements.

3.3 ENERGY AND NATURAL RESOURCES

3.3.1 Studies and Coordination

The Caltrans document *Energy and Transportation Systems* (Caltrans, 1983 and 1993) was reviewed for applicable formulas and data related to energy consumption.

Energy is consumed during the construction and operation of transportation facilities. Energy is used during construction to manufacture materials and transit vehicles, transport materials, and operate construction machinery. Operational energy consumption includes fuel and electricity consumed by public and privately-operated vehicles using the facility, a negligible amount of electricity for signals and lighting, and the inherent losses of energy during transmission. Operational energy consumption impacts are evaluated by qualitatively comparing vehicle energy consumption among alternatives.

Energy consumption rates for vehicles operating on the roadway can be differentiated by comparing changes in traffic operations, as measured by vehicle miles traveled (VMT) and changes in traffic speed throughout the study area. Fuel consumption is proportional to distance traveled, and decreases as speed increases up to about 60 kilometers per hour (40 miles per hour). Fuel consumption increases as speed increases above that point (U.S. Department of Transportation, 1980). Energy consumption estimates for roadway traffic within the affected area are based on the traffic impact analyses prepared for the I-405 Corridor Study. For Alternatives 1 and 2, which include a high-capacity transit (HCT) system, the energy required to operate a physically separated, fixed-guideway HCT system, assuming some form of rail technology using electric propulsion, was estimated separately and added to the estimate for traffic. The alternatives are compared based on daily differences in energy consumed by all traveling vehicles (U.S. Department of Transportation, 1980).

3.3.2 Methodology

Common units of energy measurement are joules and British thermal units (BTUs). One joule is the equivalent of .95 BTU. Because these are relatively small units, energy is often reported in terajoules (1,000,000,000,000 joules). Energy consumption during construction in the corridor is discussed based on the estimated construction cost of the improvements. Energy consumption to complete a project is proportional to the cost of the project. An approximate construction energy consumption factor, adjusted to year 2000 dollars (using the construction price index reported by the *Engineering News Record*) for urban freeway expansion widening is about 10 terajoules per one million dollars of construction cost (Caltrans, 1983). For HCT systems, a construction energy estimate of 21 terajoules per track mile constructed was used (Caltrans, 1983). This figure includes the installation of track and power systems for the fixed-guideway HCT system.

Estimates of operational energy consumption for vehicles operating on the roadway are based on the operational traffic impact analyses prepared for the EIS. Net changes in overall energy use by roadway vehicles are assessed using daily VMT and average speed values calculated from the transportation forecasting model for each alternative. Energy consumption is calculated by multiplying daily VMT by the appropriate fuel consumption rate for the average speed. Estimates of operational energy requirements for the fixed-guideway HCT system are based on calculations of direct propulsion energy, as well as indirect energy needs such as energy lost during transmission from the energy generation site to the HCT vehicles.

Energy calculations for rail HCT systems can involve a large number of variables. These variables include vehicle size, type, weight, and efficiency; passenger-related load factors; system grade; spacing of stations; operational issues such as acceleration, deceleration, and top and average speeds; throttle positions; horsepower to weight ratio; deadheading requirements; etc. These variables result in a wide range of operational energy requirements. For instance, one of the principal variables has been found to be station spacing. Energy requirements tend to increase with reduced distances between stations. This variable alone can create substantial variation in energy intensity throughout a system even for the same vehicles.

Due to the programmatic level of analysis and the complex nature of developing precise calculations of direct propulsion energy, an estimate of direct energy was developed based on a range of light rail HCT energy intensity findings from other studies. An estimate based on such a range is understood to be very broad.

Caltrans published a report that delineated its estimation methodology for propulsion energy calculations and cited a light rail HCT energy intensity range of 50,000 to 100,000 BTUs per vehicle-mile that was developed by the Congressional Budget Office (Caltrans, 1983). Assuming a mid-range energy intensity of 75,000 BTUs per vehicle-mile, daily fixed-guideway HCT energy consumption would be approximately 1.9 terajoules per day based on 24,200 HCT vehicle-miles per day in 2020. This is approximately 1 percent of the energy consumed by vehicles operating on study area roadways.

Analysis of an electrically driven transportation system also includes conversion of energy from a power generation plant to the HCT vehicles. This includes typical losses due to generation, transmission, and conversion of alternating to direct current. A conversion energy factor of 27.4 percent was used in this analysis based on 1983 studies conducted by Caltrans.

The maximum loading period for light rail HCT systems tends to occur during the afternoon peak. If the addition of the fixed-guideway HCT load requires the supplying utility to purchase load-matching generation, the additional load may be purchased in relatively fuel-intensive units, such as gas turbines, without waste heat recovery. Should a sizable portion of the fixed-guideway HCT operating energy be generated in this manner, the overall efficiency factor would be lower than assumed in this calculation and energy requirements would be greater than reported.

The energy analyses in this section are based on the *I-405 Corridor Program Draft Energy Technical Memorandum* (Parsons Brinckerhoff, 2001), herein incorporated by reference.

3.3.3 Affected Environment

The I-405 corridor is one of the primary north-south transportation corridors in the Puget Sound region. It connects with I-5 at both its north and south terminus, bypassing the Seattle urban core. In 1999, I-405 carried up to 210,000 vehicles per day on some sections.

3.3.4 Impacts

3.3.4.1 No Action Alternative

Construction Impacts

Energy would be consumed during construction of any of the alternatives to manufacture materials, transport materials, and operate construction equipment. Estimated construction energy consumption is presented in Table 3.3-1. The No Action Alternative includes construction of planned and committed transit and roadway projects in the I-405 corridor. The energy expended for construction under the No Action Alternative would be substantially less than that for any of the action alternatives because of the comparatively smaller amount of construction that would occur.

Table 3.3-1: Construction Energy Consumption

Alternative	Energy Consumption During Construction (Terajoules)
No Action	4,700
1: HCT/TDM Emphasis	
Roadway	8,000
Fixed-Guideway HCT	2,390
Total	10,390
2: Mixed Mode with HCT Emphasis	
Roadway	32,800
Fixed-Guideway HCT	2,390
Total	35,190
3: Mixed Mode Emphasis	50,300
4: General Capacity Emphasis	96,200
Preferred	60,800

Operational Impacts

Traffic is predicted to increase by the year 2020, independent of the I-405 Corridor Program. Vehicle fuel consumption dominates the total energy use for each alternative, and is largely determined by daily VMT and speed. Thus, these two measures were used to estimate the operational energy consumption among the alternatives. Energy consumption resulting from daily vehicle operations in the affected area is presented for the No Action Alternative and five action alternatives for 2020 in Table 3.3-2. Operational energy consumption would be 1 percent less than the No Action Alternative for Alternative 1, 5 percent greater for Alternatives 2 and 3, 9 percent greater for Alternative 4, and 6 percent greater for the Preferred Alternative.

Table 3.3-2: Daily Operational Energy Consumption

Alternative	Daily Fixed-Guideway HCT Vehicle Miles Traveled	Daily Vehicle Miles Traveled on Roadway	Study Area Average Roadway Speed (mph)	Fuel Consumption Rate (gallons per mile)	Gasoline Consumption (gallons)	Energy Consumption (terajoules)	Change in Energy Consumption Relative to No Action
No Action Alternative	0	22,510,000	19	0.042	945,000	129	N/A
1: HCT/TDM Emphasis	24,200	22,563,000	20	0.041	925,000	128	--1 percent
2: Mixed Mode with HCT/Transit Emphasis	24,200	24,215,000	21	0.040	969,000	135	+5 percent
3: Mixed Mode Emphasis	0	25,346,000	22	0.039	988,000	135	+5 percent
4: General Capacity Emphasis	0	26,208,000	22	0.039	1,022,000	140	+9 percent
Preferred Alternative	0	25,697,000	22	0.039	1,002,000	137	+6 percent

3.3.4.2 Action Alternatives

Construction Impacts

Each of the action alternatives would expend energy to manufacture and transport materials, and operate equipment during construction of the transit and roadway improvements. As shown in Table 3.3-1, the relative amount of construction energy required increases substantially under each of the action alternatives proportional to its cost and the magnitude of the improvements. Overall, these values are a very small fraction of the energy consumed annually for transportation in the state of Washington, and would not put substantial additional demand on energy sources or fuel availability in the region.

Operational Impacts

Each action alternative would add a different level of capacity in the I-405 corridor in different ways. As shown in Table 3.3-2, differences in energy consumption resulting from daily vehicle operations in the affected area would range from 1 percent less than the No Action Alternative for Alternative 1, to 9 percent greater than the No Action Alternative for Alternative 4. These values are not expected to substantially affect energy sources or fuel availability in the region.

3.3.5 Mitigation Measures

Measures to reduce energy consumption during construction could include limiting the idling of construction equipment and employee vehicles, encouraging carpooling or van pools among construction workers, and locating construction staging areas as close as possible to work sites. Any transportation control measures to reduce traffic volumes and congestion would also decrease energy consumption.

3.4 GEOLOGY AND SOILS

3.4.1 Studies and Coordination

For the geology impacts evaluation, the basis of comparison among the alternatives is the estimated length of various transportation improvements within the geologic hazard areas and consideration of the magnitude of disturbance.

The primary data sources for determining the various geologic hazards included:

- The King County and City of Redmond sensitive areas maps (King County Zoning Code Section 21A; Redmond Community Development Guide, code section 20D)
- Snohomish County Geologic Hazard Areas Maps (GeoEngineers, 1991)
- U.S. Geological Survey (USGS) surficial geology maps (Minard, 1985; Galster and Laprade, 1991; Wong et al., 1999)
- U.S. Department of Agriculture, Soil Conservation Service (SCS) soil maps for King and Snohomish County (Snyder, 1973; Debose and Klungland, 1983).
- King County Code and USGS sponsored papers (Hobblitt et al., 1998; Waitt et al., 1995) for volcanic hazards
- USGS sponsored papers (Blakely, 2000; Brocher, 2000; Blakely et al., 1999; Johnson et al., 1999; Wong et al., 1999) and in-house reports (CH2M HILL, 1998) for fault locations and characteristics

3.4.2 Methodology

A detailed, though subjective, rating system, which was used to compare the geologic impacts of each alternative, is discussed in the *I-405 Corridor Program Draft Geology and Soils Expertise Report* (CH2M HILL, 2001), herein incorporated by reference. This section of the EIS contains only relative ratings among the alternatives and a general assessment of the overall impact of each geologic hazard. The comparison of the alternatives' impacts was based on the approximate length of equivalent lane miles of new construction through each geologic hazard area. A rating of low was given if the impacts of the hazard can probably be mitigated without increasing construction cost by more than one percent. A rating of high was given if mitigation of the hazard might increase construction costs by more than 100 percent. No cost estimates were computed; the projection of approximate mitigation cost was based on experience and professional judgement.

3.4.3 Affected Environment

3.4.3.1 Regional Geology

The soils and land types found within the I-405 corridor are heavily influenced by multiple Pleistocene glaciations that resulted in a series of north-south-trending ridges of glacial drift separated by deep troughs. The troughs are now occupied by lakes and streams and their associated alluvial and lacustrine deposits. Regional geology is discussed in detail in the *I-405 Corridor Program Draft Geology and Soils Expertise Report* (CH2M HILL, 2001).

3.4.3.2 Regional Seismicity

The Uniform Building Code (1997) defines the Puget Sound as Seismic Zone 3, which represents an area susceptible to moderately high seismic activity. For comparison, much of Alaska and California are within Seismic Zone 4 and are susceptible to greater seismic activity.

Probabilistic maps that provide ground accelerations for use in design have been developed by the USGS and adopted by the Federal Emergency Management Agency (Building Seismic Safety Council, 1997). The maps combine the effects of earthquakes from three different sources:

- Shallow, crustal earthquakes, for example, along the Seattle Fault, with a magnitude 6.5 to 7.
- Subduction zone earthquakes from the boundary between the Juan de Fuca Plate and the North American Plate that are roughly 40 to 70 kilometers deep beneath the Puget Sound area, with a magnitude of 7 to 7.5.
- Large, shallow subduction zone earthquakes that would occur along the plate boundaries west of the Washington coast, with a magnitude of 8 or 9.

Firm ground conditions would occur at the ground surface along some portions of the alignments; however, in some areas firm ground would occur 100 feet or more below the ground surface. In locations where firm ground is at depth, amplification of the ground motions could occur as the motions propagate toward the surface. The amount of amplification could be 20 percent or higher at sites where more than 100 feet of very soft soil occurs. These levels of acceleration, whether amplified or not, are sufficient to cause liquefaction in loose saturated soil, failure of slopes, and additional inertial loading to structures located on or in the soil.

In addition to the seismic ground shaking discussed above, tectonic movement can occur at fault lines if the fault zones penetrate to the ground surface. One active (i.e., considered to have experienced movement within the last approximately 10,000 to 15,000 years) fault crosses the I-405 corridor, the Seattle Fault. The northern boundary of potential faulting is approximately SE 25th Street in Bellevue, and the southern boundary is approximately N. 40th Street in Renton and SE May Valley Road in Newcastle. Another active fault, the South Whidbey Fault, touches the northeast corner of the study area. Evidence suggests that the return interval for the Seattle Fault is approximately 5,000 years for a magnitude 7.1 event and 1,100 years for a magnitude 6 event (Blakely et al., 1999). The recurrence interval for the South Whidbey Fault may be similar.

3.4.3.3 Soils

The King and Snohomish county soil surveys (Snyder et al., 1973; Debose and Klungland, 1983) provide detailed soil maps of the study area. These maps are generally representative of average conditions in the upper several feet of soil profile. One way in which surficial soil mapping is useful for this study is for determining erosion hazards, as described under Erosion Hazards later in this section.

A detailed description of the soil types is not included here because many of the soils along the existing state highways and arterials have been modified by construction activities. Adjacent to these areas, the most prevalent soil type across the study area is the Alderwood complex. This is a gravelly, sandy loam that forms on glacial till. The permeability is relatively rapid above a hardpan layer, then very slow through it. Available water capacity is low. On slopes steeper than 25 percent, it has rapid runoff and a high erosion hazard.

3.4.3.4 Geologic and Soil Resources

Geologic or soil resources are considered to be culturally or economically valuable. Sand and gravel deposits suitable for mining and mineral deposits are considered as geologic resources. Topsoil suitable for agricultural or landscaping use is considered a soil resource.

There are no known mineral or commercial sand and gravel pits that would be covered over or made unusable by any of the proposed alternatives. However, imported (i.e., from an offsite WSDOT or commercially developed source) sand and gravel for the pavement and pavement base, structural concrete, and specially engineered fills would use a portion of the limited sand and gravel resources that have been permitted and developed within the region. For a study of this scale, it is impossible to estimate the volume of aggregate needed for concrete structures or specially engineered fill. However, very approximate and relative quantities of aggregate for the improvements can be estimated from conservative approximations of the aggregate needed for the pavement, pavement base, and subgrade drainage. These approximate quantities are shown in Table 3.4-1.

Table 3.4-1: Approximate Quantity of Aggregate Required for Each Alternative

Alternative	Estimated Quantity of Aggregate (million tons) [a]
No Action Alternative	1
1. HCT/TDM	1.5
2. Mixed Mode with HCT/Transit Emphasis	3
3. Mixed Mode	3
4. General Capacity	4
Preferred Alternative	3.5

[a] As computed from estimates of pavement, pavement base, and subsurface drainage for typical arterial, freeway, and rail roadway sections.

The following facts help to put the required aggregate quantity estimates of Table 3.4-1 into perspective:

- Washington State construction projects consume nearly 77 million tons of aggregates a year (Washington Aggregates and Concrete Association, 2000).
- There are approximately 20 sand and gravel companies within the 12-county Puget Sound region; the approximate annual production is 20 million tons (Huckell/Weinman, 1993).
- One of the larger pits in the Puget Sound region processes about 3 to 4 million tons of aggregate per year (Huckell/Weinman, 1993).

Although topsoil is present over some of the undisturbed or landscaped areas through which the alternatives would pass, topsoil is generally considered to be readily available throughout the study area. Because it is undesirable to construct facilities on top of topsoil, it is likely that topsoil would not be "lost" due to construction, but rather, removed and used elsewhere in the region.

3.4.3.5 Geologic Hazard Areas

Geologically hazardous areas are defined as areas that, because of their susceptibility to erosion, sliding, earthquake, or other geologic events are not suited for development consistent with public health and safety concerns. Washington State's Growth Management Act (Chapter 36.70A RCW) requires all cities and counties to identify critical areas within their jurisdictions and to formulate development regulations for their protection.

The geologic hazards discussed in this report are erosion hazards, landslide hazards, seismic hazards, mine hazards, and volcanic hazards. Some jurisdictions (King County, Bothell, and Newcastle) have regulations governing steep slope hazards. Since the hazards associated with steep slopes are related to erosion or landslides, steep slope hazards themselves are not discussed in this report.

Construction over soft soils can involve more disturbance of the ground surface than construction over firm soil, and ground settlement, weak soils, and high groundwater are potential design issues. Seismic hazard areas are typically mapped as areas with potentially soft ground due to geologic origin, as discussed in a subsequent section. Therefore, seismic hazards and soft ground hazards are considered together for the remainder of this report.

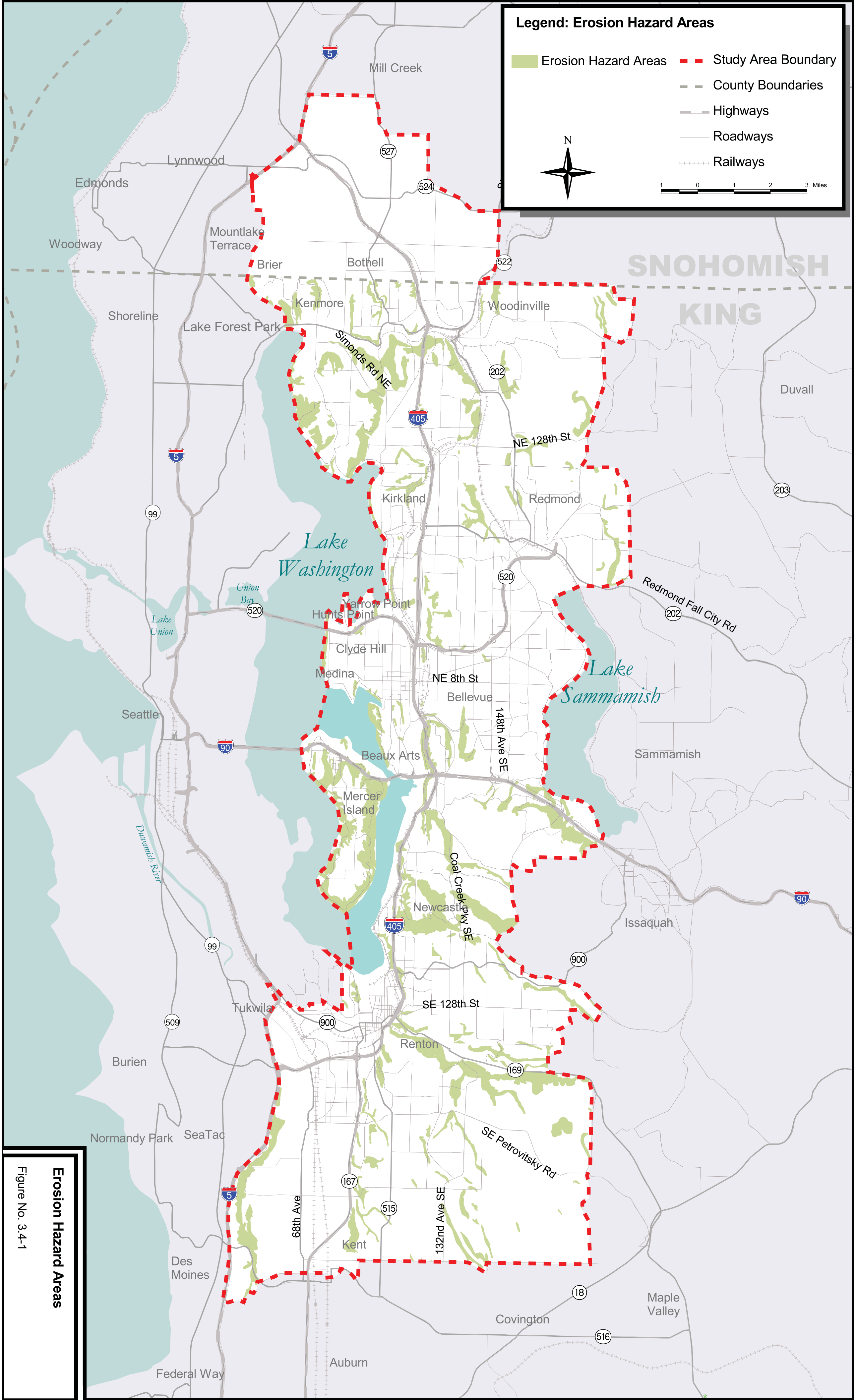
In addition to making construction more difficult and costly or adding risk to the long-term operation of transportation facilities, development activities within these geologic hazard areas are regulated by local and county ordinances. The cities of Bothell, Woodinville, Kirkland, Newcastle, Renton, Redmond, and Tukwila, in addition to Snohomish and King counties, all have their own sensitive areas ordinances. In most cases, development is allowed, but only if approved mitigation measures are designed by competent professionals.

Figures 3.4-1, 3.4-2, and 3.4-3 show the approximate locations of erosion, landslide, seismic, and mine hazard areas, respectively, as mapped by King County (1999), the City of Redmond (2000), and Snohomish County (GeoEngineers, 1991). The definitions of geologic hazards in the ordinances of other cities within the study area have enough similarities to the King County definitions that the King County maps can be used for analysis in cities outside of Redmond. The hazard areas themselves are described in the subsections below.

3.4.3.6 Erosion Hazards

Erosion hazard areas are typically defined as soils that form on fine-grained geologic units or till that are steeper than 15 percent or soils that form on coarse-grained soils that are sloped at 40 percent or more. In addition to regulations to control erosion on slopes as discussed above, King County has recently enacted regulations limiting fall and winter clearing and grading in designated salmon stream watersheds (KCC-16.82.150 d). This is discussed in more detail in the *I-405 Corridor Program Draft Geology and Soils Expertise Report* (CH2M HILL, 2001).

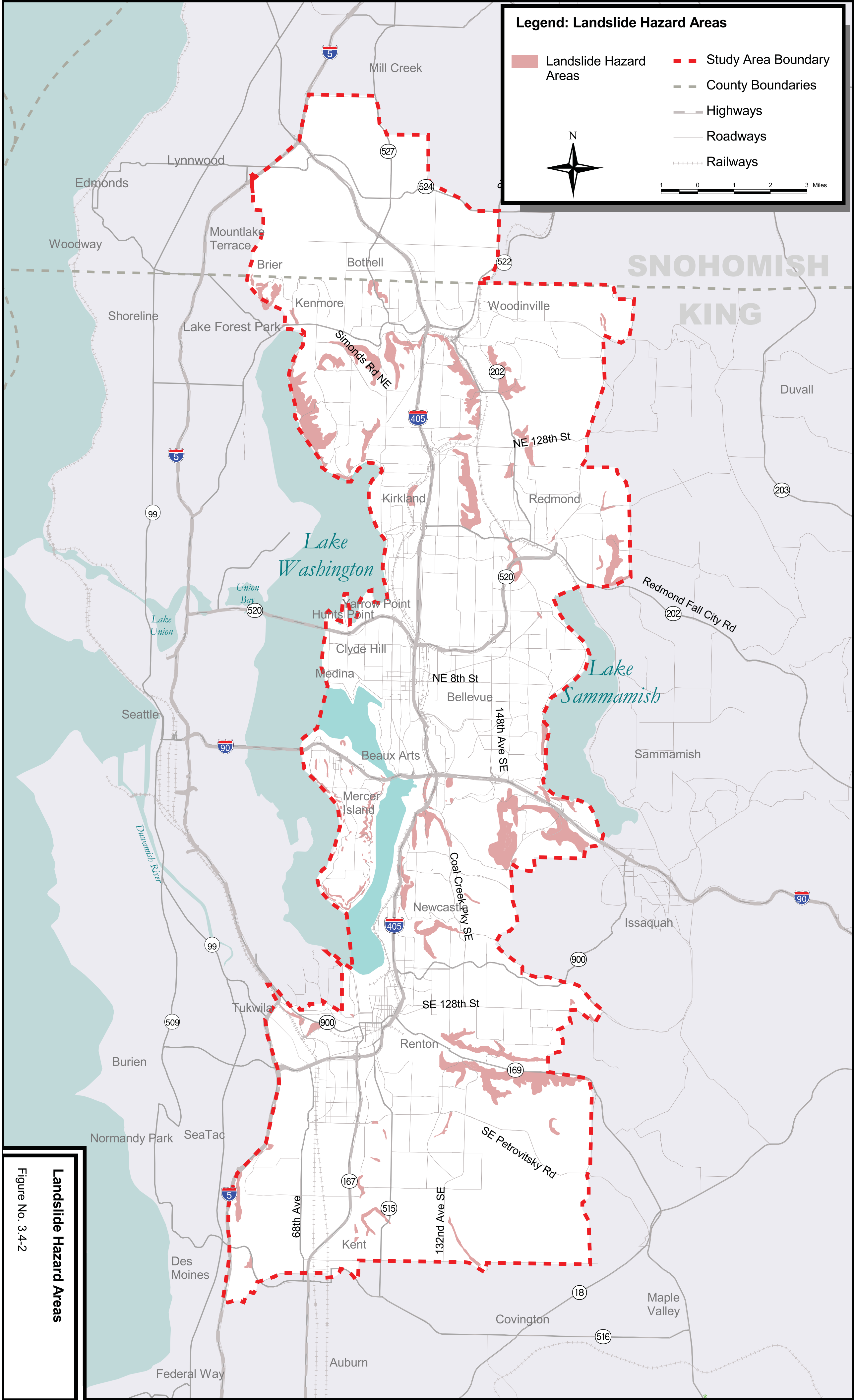
Construction of any transportation facilities that involves clearing the protective vegetation and moving soil within an erosion hazard area involves a relatively high risk of eroding soil particles. Mitigation measures, as discussed in section 3.4.6, can reduce the risk of erosion to medium levels. Alternatively, it may be possible to design the facilities so that vegetation disturbance and the accompanying risk of erosion in erosion hazard areas is minimized, or to locate the facility outside of the erosion hazard area. Many of the proposed alternatives are on the edges of mapped erosion hazard areas, so final siting could place them outside of the hazard area. Erosion



Erosion Hazard Areas

Figure No. 3.4-1

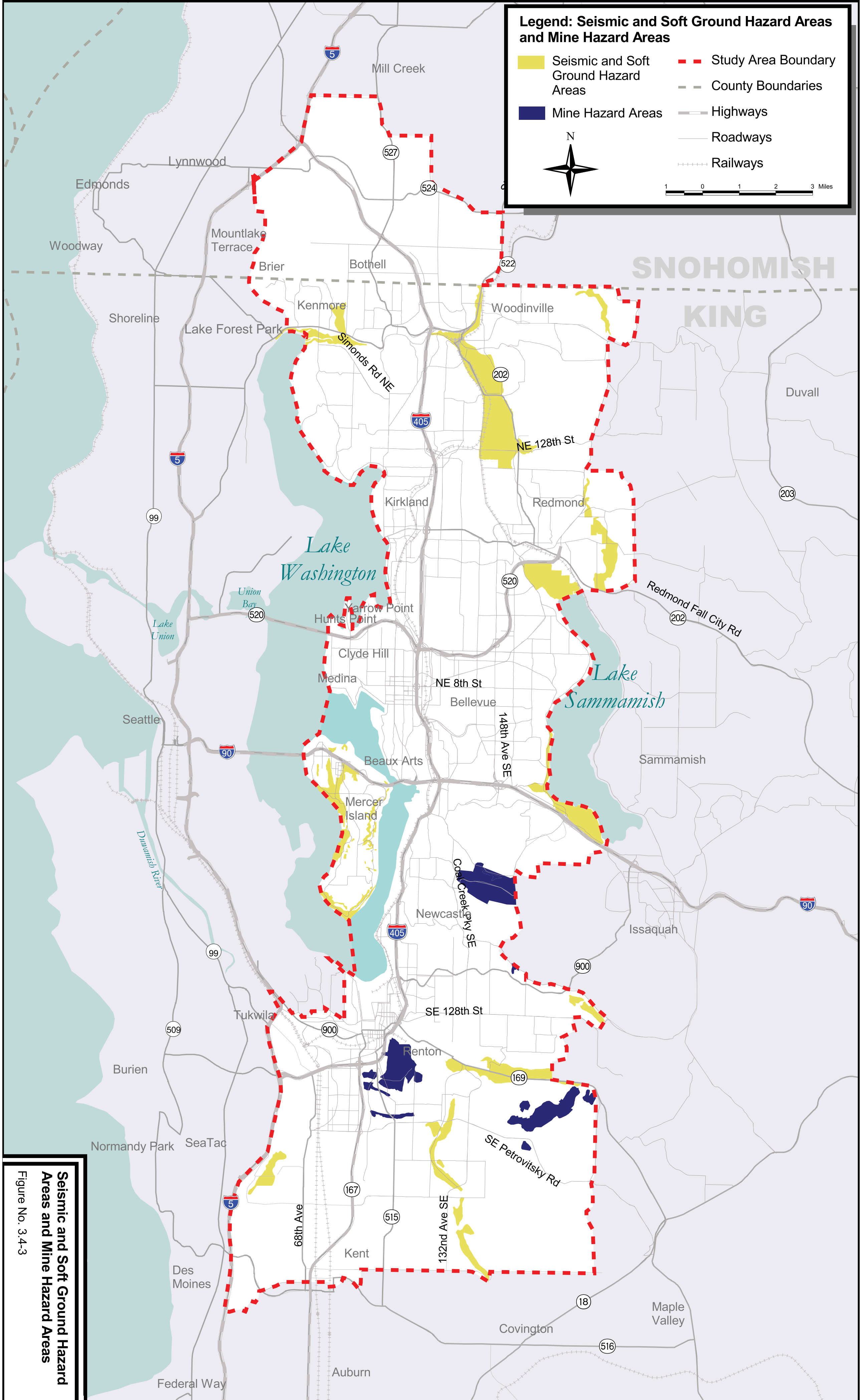
This page left intentionally blank



Landslide Hazard Areas

Figure No. 3.4-2

This page left intentionally blank



Seismic and Soft Ground Hazard Areas and Mine Hazard Areas

Figure No. 3.4-3

This page left intentionally blank

of soil particles could result in sediment accumulation and reduction in water quality downslope. Mitigation measures can reduce the risks of these offsite impacts to low levels. Therefore, erosion at the construction site does not directly translate to riparian zone or stream habitat degradation. Because of concern about the impact of erosion on critical habitat, as defined by the Endangered Species Act, the location of critical habitat relative to erosion hazard areas was examined. Most of the major erosion hazard areas that could be affected by the proposed alternatives are near chinook salmon habitat.

Mapped erosion hazards within the study area are shown on Figure 3.4-1. They are scattered throughout the study area but concentrations of erosion hazards that impact proposed alternatives are located along the margins of the Sammamish River Valley, on the western slope of the Bear Creek Valley, along I-405 between SE 8th St. in Bellevue and Coal Creek Parkway, along I-405 in the Newcastle area, along I-90 across much of Mercer Island, and along I-90 from approximately West Lake Sammamish Parkway to the eastern study boundary.

3.4.3.7 Landslide Hazards

The jurisdictions within the study area inside of King County generally define landslide hazards as any slopes steeper than 40 percent or slopes of 15 percent or more that also have interbedded sand and silt or clay, springs or seeps, landslide deposits or other indications of past landsliding, or show signs of rapid stream downcutting or wave or bank erosion.

Snohomish County has mapped landslide hazards on a scale of moderate to very high. Moderate landslide hazard areas are defined as sloping between 15 and 40 percent and underlain by soils that consist largely of sand, gravel, bedrock, or glacial till. High landslide hazard areas are defined as sloping between 15 and 40 percent and underlain by silt and clay or sloping more steeply than 40 percent. Very high landslide hazard areas are known, mappable landslide deposits.

There are no very high landslide hazard areas within the study area in Snohomish County. Only moderate landslide hazard areas are located adjacent to any of the proposed roadway improvements. All of the landslide hazard areas have been shown on Figure 3.4-2. Notable areas of these hazards that would impact the alternatives are located along the margins of the Sammamish River Valley, on the western slope of the Bear Creek Valley, along I-405 between SE 8th Street in Bellevue and Coal Creek Parkway, along I-405 in the Newcastle area, and along I-90 from approximately West Lake Sammamish Parkway to the eastern study boundary.

3.4.3.8 Seismic and Soft Ground Hazards

Seismic hazards are generally considered to be areas with a severe risk of ground shaking or deformation during an earthquake. Prediction of amplified ground shaking or liquefaction and associated deformation that could damage civil works, engineered structures, or residences requires detailed knowledge of soil composition, stratigraphy, groundwater, and ground slope. Therefore, the local jurisdictions have taken a conservative approach, generally classifying all post-glacial deposits in low-lying areas as seismic hazards. In effect, the seismic hazard map (Figure 3.4-3) can also be considered a soft ground hazard map. Design and construction of transportation facilities over soft ground must contend with potential settlement, weak soil conditions, and typically high groundwater.

Seismic and soft ground hazards within the study area are shown in Figure 3.4-3. The hazard areas affecting study alternatives are the Sammamish River Valley, Bear Creek Valley, North Creek Valley, and the area between I-90 and the south end of Lake Sammamish.

3.4.3.9 Mine Hazards

Coal mine hazards have been mapped by King County as large expanses surrounding underground mines and their shafts and adits. The risk of encountering a mine opening, sinkhole, or enlarging depression within a mapped hazard area is relatively low.

Figure 3.4-3 shows the coal mine hazards in King County. The only coal mine hazards in the vicinity of proposed improvements are in Renton, in the area of the I-405 S-curves and on the eastern side of SR 167 just south of the I-405 interchange. There are no known coal or other underground mines within the study area in Snohomish County.

3.4.3.10 Volcanic Hazards

Volcanic hazards could arise from several different phenomena. The three phenomena of concern to the study area are tephra accumulation, lahars, and the associated flooding. (Tephra is a general term for all pyroclastic materials produced by a volcano. Lahars are mudflows on the flanks of a volcano.)

The annual probability of a one-centimeter or greater accumulation of tephra from any of the Cascade volcanoes within the study area is between 0.02 and 0.1 percent (Hoblitt, et al., 1998). None of the sensitive areas ordinances addresses the tephra hazard. Although accumulations of more than a centimeter of tephra can result in major economic losses, the risk of permanent damage to facilities is small and the risk is similar for all locations within the study area.

Volcanic hazards from lahars and associated flooding are thought to be a risk within several river valleys with headwaters around Mt. Rainier and Glacier Peak. None of the lahar hazard zones from Glacier Peak extend south of Arlington (Waitt, et al., 1995). There is a "significantly reduced risk" below the 100- to 500-year recurrence interval, of lahars or post-lahar sedimentation within the Green River Valley between Auburn and Elliot Bay (Hoblitt, et al., 1998). The King County Sensitive Areas Ordinance does not consider areas north of the White River (just south of Auburn) to be volcanic hazard areas.

3.4.4 Impacts

In order to construct the proposed facilities, the topography would be altered, soils would be disturbed, and impervious surface would be added. In general, more roadway lanes or equivalent disturbance for HCT facilities can be expected to result in greater potential impact and higher cost for mitigation. <u>As described in Section 3.4.2 (Methodology), an impact rating of low was assigned if the identified impacts of the geologic hazard can probably be mitigated without increasing construction cost by more than one percent. A rating of high was given if mitigation of the hazard might increase construction costs by more than 100 percent.</u>

Impacts on the geology and soils within the I-405 Corridor affected area would be considered substantial if an alternative either (1) permanently removes geologic or soil resources that are not readily available elsewhere, (2) causes a threat to public health and safety, or (3) is anticipated to involve mitigation costs that exceed the anticipated construction costs. If the proposed improvements are constructed using generally accepted local geotechnical engineering practice, no substantial impacts are anticipated for any of the alternatives.

3.4.4.1 No Action Alternative

Construction Impacts

Erosion Hazards

Clearing the protective vegetation and moving soil during construction allows rainfall and runoff to erode soil particles. Thus, there is the potential for loss of soil at the site of disturbance and downslope, sediment accumulation in downstream areas, and reduction in runoff water quality. Overall, the risk that unmitigatable impacts could occur as a result of constructing through erosion hazard areas is rated high for all alternatives; however, the design solutions and best management practices (BMPs) identified in Section 3.4.6 are expected to reduce these to levels that are not substantial.

The No Action Alternative involves HOV facilities in the vicinity of the 44th St interchange in Renton and the Sunset interchange in Renton, as well as widening 140th Way SE to 5 lanes on the slopes of the Cedar River Valley in Fairwood, all in erosion hazard areas. The No Action Alternative has the lowest magnitude of erosion hazards of any I-405 Corridor Program alternative.

Landslide Hazards

Construction of rail lines, freeway lanes, or ramps would involve cuts and fills and/or bridge and retaining wall structures that have the potential to destabilize landslide-prone hillsides. Overall, the risk of unmitigatable impacts due to constructing in landslide hazard areas is rated low for all alternatives.

The No Action Alternative involves HOV facilities in the vicinity of the 44th St interchange in Renton, as well as widening 140th Way SE to five lanes on the slopes of the Cedar River Valley in Fairwood, all in landslide hazard areas. The No Action Alternative has the lowest magnitude of landslide hazard of any I-405 Corridor Program alternative.

Seismic and Soft-Ground Hazards

Seismic and soft-ground hazards may potentially affect all of the alternatives. Overall, the risk of unmitigatable construction impacts in these areas is rated low for all alternatives.

The No Action Alternative includes addition of two to three lanes to several sections of existing roadway in the Sammamish River Valley, widening 140th Avenue to five lanes in the Cedar River Valley, and additional ramps or lanes for the I-5/I-405 interchange at Swamp Creek, all in seismic and soft-ground hazard areas. The No Action Alternative has the lowest magnitude of seismic and soft-ground hazards of any I-405 Corridor Program alternative.

Other Hazards

Mine hazards and volcanic hazards within the study area are anticipated to be low for the No Action Alternative and all action alternatives.

Using heavy equipment during construction will cause ground vibrations. Actual vibrations will depend on the type of heavy equipment, distance from the source, and ability of the soil to transmit vibrations. Vibrational impacts are commonly measured in terms of peak particle velocity. In general, peak particle velocity tends to be reduced logarithmically with distance from the source. For example, Wiss (1974) reported that peak particle velocities for most construction equipment were reduced by a factor of 40 with a tenfold increase in distance from the source (i.e., the velocity at a distance of 10 feet is 40 times less than the velocity 1 foot from the source). The threshold for damage to sensitive historic and residential structures is commonly accepted at a peak particle velocity between 0.1 and 1 inch per second, while the damage threshold for commercial structures is generally between 1 and 10 inches per second (Whyley and Sarsby, 1992; Hart Crowser, 1986; Wiss, 1974). Humans generally cannot perceive vibrations of less than 0.01 inch per second and find vibrations greater than 1 inch per second very disturbing. Typical construction vibrations are noted in Table 3.4-2 below (Wiss, 1974).

Table 3.4-2: Typical Construction Vibrations

Equipment Type	Peak Particle Velocity at a Distance of 10 feet (inch/second)	Peak Particle Velocity at a Distance of 100 feet (inch/second)
Small dozer	0.01	<0.001
Truck	0.3	0.009
Large dozer, shaft drilling	0.4	0.01
Diesel pile driver (36,000 feet per pound)	6.0	0.2

As outlined in Table 3.4-2, most of the construction-related vibrations, with the exception of pile driving, will be imperceptible to people outside of the construction zone. Pile-driving vibrations (and noise) may be felt a few hundred feet from the source and have the potential to cause damage to sensitive structures.

The potential for vibration impacts is lowest for the No Action Alternative because it involves the least amount of total construction and involves the fewest number of foundations in soft ground where pile driving would be a potential method of foundation support.

Operational Impacts

Erosion Hazard

Once construction is complete, vegetation can usually be reestablished or some nonerodable surface installed to limit erosion. It may take several seasons for the vegetation to reach pre-construction protective levels and some accelerated erosion may occur during this time. Some surfaces outside of the shoulders may not be allowed to revert to pre-construction vegetation because of maintenance needs (for example, ditches). Overall, the risk of unmitigatable operational impacts due to locating facilities in erosion hazard areas is rated medium for No Action Alternative and all action alternatives.

Erosion that would be considered unmitigatable is the slight acceleration of naturally occurring erosion processes. For example, the increased runoff due to replacing trees with grass and asphalt, even with detention to slow the velocities, might accelerate erosion that would otherwise occur over a longer period of time. With proper mitigation, the erosion rates would not be anticipated to be high enough to change the character of streambed materials or impact downstream water quality by observable amounts.

Other Hazards

Vibrations due to traffic vary with the type of vehicle, the distance from the traveled lanes, the ability of the soil to transmit vibrations, and the speed of the vehicle. Based on the discussion of potential construction vibration impacts, most traffic vibrations will be imperceptible at distances of 100 feet or more from the traveled lane. The No Action Alternative will have the lowest potential for operational vibration impacts because traffic speeds will be lower and there will be fewer new lanes closer to existing structures.

3.4.4.2 Alternative 1: HCT/TDM Emphasis

Construction Impacts

Erosion Hazards

Alternative 1 would involve earthwork for adding one or more rail lines along the BNSF railroad right-of-way, which passes through erosion hazards in the following locations:

- Between SR 522 and NE 124th Street near Totem Lake
- A short section (about 1 mile) in the vicinity of Yarrow Bay in Kirkland
- A segment (about three-quarter mile) near Forbes Drive in Kirkland
- In Bellevue between SE 8th Street and Coal Creek Parkway
- Between approximately SE 68th Street in Bellevue and NE 44th Street in Renton
- The Renton S-curves

Alternative 1 also would add one lane to Avondale Road, which is located within an erosion hazard area. Overall, Alternative 1 has the lowest magnitude of erosion hazards of any of the action alternatives.

Landslide Hazards

Alternative 1 would involve earthwork for adding one or more rail lines along the BNSF railroad right-of-way, which passes through landslide hazards in the following locations:

- Between SR 522 and NE 124th Street near Totem Lake
- A segment (about 3/4 mile) near Forbes Drive in Kirkland
- Between I-90 and Coal Creek Parkway
- Between approximately SE 68th Street in Bellevue and NE 44th Street in Renton

Alternative 1 also would add one lane to Avondale Road, which is located within a landslide hazard area. Overall, Alternative 1 has the lowest magnitude of landslide hazards of any of the action alternatives.

Seismic and Soft-Ground Hazards

Alternative 1 would add one or more rail lines along the BNSF railroad right-of-way and I-405 between NE 124th Street and approximately NE 195th Street, and add one lane to Avondale Road, both in seismic and soft-ground hazard areas. Overall, Alternative 1 has the lowest magnitude of seismic and soft-ground hazards of any of the action alternatives.

Other Hazards

Mine hazards and volcanic hazards within the study area are anticipated to be low.

The potential for construction-related vibration impacts will be higher than the No Action Alternative, but lower than the other alternatives because Alternative 1 has the least amount of earthwork and the least amount of construction in soft soil areas that might use pile foundations (besides the No Action Alternative).

Operational Impacts

Erosion Hazard

Operational impacts related to erosion hazards are the same as described for the No Action Alternative.

Other Hazards

The potential for operational vibration impacts is low.

3.4.4.3 Alternative 2: Mixed Mode with HCT/Transit Emphasis

Construction Impacts

Erosion Hazards

Alternative 2 would result in the same earthwork for adding one or more rail lines along the BNSF railroad right-of-way as described for Alternative 1, as well as the addition of one lane to Avondale Road. Alternative 2 also would add the equivalent of two lanes to I-405 through erosion hazard areas in the following locations:

- The north-facing slope just south of the SR 522 interchange
- In Bellevue between SE 8th Street and Coal Creek Parkway
- In the vicinity of the Coal Creek interchange
- Between approximately SE 68th Street in Bellevue and NE 30th Street in Renton
- The Renton S-curves

In addition, Alternative 2 would construct four to five new lanes between NE 124th Street and NE 145th Street and widen the existing SR 202 roadway by two to three lanes north of NE 145th Street on the western edge of the Sammamish River Valley. Overall, Alternative 2 has a higher magnitude of erosion hazard than Alternative 1, but is ranked lower than Alternatives 3 and 4 and the Preferred Alternative.

Landslide Hazards

Alternative 2 would result in the same earthwork for adding one or more rail lines along the BNSF railroad right-of-way as described for Alternative 1, as well as the addition of one lane to Avondale Road. Alternative 2 also would add the two lanes to I-405 through landslide hazard areas in the following locations:

- The north-facing slope just south of the SR 522 interchange
- In the vicinity of the Coal Creek interchange
- Between approximately SE 68th Street in Bellevue and NE 44th Street in Renton

In addition, Alternative 2 would construct four to five new lanes between NE 124th Street and NE 145th Street and widen the existing SR 202 roadway by two to three lanes north of NE 145th Street on the western edge of the Sammamish River Valley. Overall, Alternative 2 has a higher magnitude of landslide hazard than Alternative 1, but is ranked lower than Alternatives 3 and 4 and the Preferred Alternative.

Seismic and Soft-Ground Hazards

Alternative 2 would add one or more rail lines along the BNSF railroad right-of-way as described for Alternative 1, as well as add one lane to Avondale Road in seismic and soft-ground hazard areas. Alternative 2 also would add two lanes to I-405 through seismic and soft-ground hazard areas between approximately Woodinville Drive and NE 195th Street in the vicinity of the SR 522 interchange.

In addition, Alternative 2 would construct four to five new lanes between NE 124th Street and NE 145th Street, widen the existing SR 202 roadway by two to three lanes north of NE 145th Street on the western edge of the Sammamish River Valley, and add lanes, bridges, and retaining walls in the southern Sammamish River Valley and Bear Creek Valley. Overall, Alternative 2 ranks third-highest in magnitude of seismic and soft-ground hazards, behind Alternative 4 and the Preferred Alternative.

Other Hazards

Mine hazards and volcanic hazards within the study area are anticipated to be low.

This alternative ranks behind Alternative 4 and the Preferred Alternative for potential construction-related vibration impacts because of the amount of soft-ground construction with associated potential for pile foundations.

Operational Impacts

Erosion Hazard

Operational impacts related to erosion hazards are the same as described for the No Action Alternative.

Other Hazards

The potential for operational vibration impacts is low.

3.4.4.4 Alternative 3: Mixed Mode Emphasis

Construction Impacts

Erosion Hazards

Alternative 3 would add four lanes to I-405 through erosion hazard areas in the following locations:

- The north-facing slope just south of the SR 522 interchange (interchange)
- In Bellevue between SE 8th Street and Coal Creek Parkway
- In the vicinity of the Coal Creek interchange

- Between approximately SE 68th Street in Bellevue and NE 30th Street in Renton
- The Renton S-curves

In addition, Alternative 3 would add four to five new lanes between NE 124th Street and NE 145th Street; widen the existing SR 202 roadway by two to three lanes north of NE 145th Street on the western edge of the Sammamish River Valley; and add one lane to Avondale Road within erosion hazard areas as described for Alternative 2. Overall, Alternative 3 has a higher magnitude of erosion hazard than the other alternatives, except for Alternative 4 and the Preferred Alternative.

Landslide Hazards

Alternative 3 would add four lanes to I-405 through landslide hazard areas in the following locations:

- The north-facing slope just south of the SR 522 interchange
- In the vicinity of the Coal Creek interchange
- Between approximately SE 68th Street in Bellevue and NE 44th Street in Renton

In addition, Alternative 3 would add four to five new lanes between NE 124th Street and NE 145th Street; widen the existing SR 202 roadway by two to three lanes north of NE 145th Street on the western edge of the Sammamish River Valley; and add one lane to Avondale Road within landslide hazard areas as described for Alternative 2. Overall, Alternative 3 has a higher magnitude of landslide hazard than the other alternatives, except for Alternative 4 and the Preferred Alternative.

Seismic and Soft-Ground Hazards

Alternative 3 would add four lanes to I-405 through seismic and soft-ground hazard areas between approximately Woodinville Drive and NE 195th Street in the vicinity of the SR 522 interchange. In addition, Alternative 3 would construct four to five new lanes between NE 124th Street and NE 145th Street; widen the existing SR 202 roadway by two to three lanes north of NE 145th Street on the western edge of the Sammamish River Valley; add lanes, bridges, and retaining walls in the southern Sammamish River Valley and Bear Creek Valley; and add one lane to Avondale Road within seismic and soft-ground hazard areas as described for Alternative 2. Overall, Alternative 3 has the fourth highest magnitude of seismic and soft-ground hazards behind Alternatives 2 and 4 and the Preferred Alternative.

Other Hazards

Mine hazards and volcanic hazards within the study area are anticipated to be low.

This alternative probably has a lower potential for vibration impacts than Alternatives 2 and 4 and the Preferred Alternative because it involves less construction in soft-ground (potential pile foundation) areas. Construction vibration impacts are probably less than Alternative 4 because this alternative has less general earthwork.

Operational Impacts

Erosion Hazard

Operational impacts related to erosion hazards are the same as described for the No Action Alternative.

Other Hazards

The potential for operational vibration impacts is low.

3.4.4.5 Alternative 4: General Capacity Emphasis

Construction Impacts

Erosion Hazards

Alternative 4 would create the equivalent of 10 lanes of new disturbance (two general purpose lanes, plus four expressway lanes, plus two expressway shoulders, plus two expressway ditches) along I-405 through erosion hazard areas in the following locations:

- The north-facing slope just south of the SR 522 interchange
- In Bellevue between SE 8th Street and Coal Creek Parkway
- In the vicinity of the Coal Creek interchange
- Between approximately SE 68th Street in Bellevue and NE 30th Street in Renton
- The Renton S-curves

In addition, Alternative 4 would add four to five new lanes between NE 124th Street and NE 145th Street and widen the existing SR 202 roadway by two to three lanes north of NE 145th Street on the western edge of the Sammamish River Valley as described for Alternative 2. Overall, Alternative 4 has the highest magnitude of erosion hazards of any I-405 Corridor Program alternative.

Landslide Hazards

Alternative 4 would create the equivalent of 10 lanes of new disturbance along I-405 through landslide hazard areas in the following locations:

- The north-facing slope just south of the SR 522 interchange
- In the vicinity of the Coal Creek interchange
- Between approximately SE 68th Street in Bellevue and NE 44th Street in Renton

In addition, Alternative 4 would add four to five new lanes between NE 124th Street and NE 145th Street and widen the existing SR 202 roadway by two to three lanes north of NE 145th Street on the western edge of the Sammamish River Valley as described for Alternative 2. Overall, Alternative 4 has the highest magnitude of landslide hazard of any I-405 Corridor Program alternative.

Seismic and Soft-Ground Hazards

Alternative 4 would create the equivalent of 10 lanes of new disturbance along I-405 through seismic and soft-ground hazard areas between approximately Woodinville Drive and NE 195th Street in the vicinity of the SR 522 interchange. In addition, Alternative 4 would construct four to five new lanes between NE 124th Street and NE 145th Street, widen the existing SR 202 roadway by two to three lanes between NE 90th Street and SR 522 along the Sammamish River Valley, and add lanes, bridges, and retaining walls in the southern Sammamish River Valley and Bear Creek Valley within seismic and soft-ground hazard areas. Overall, Alternative 4 has the highest potential impacts from seismic and soft-ground hazards.

Other Hazards

Mine hazards and volcanic hazards within the study area are anticipated to be low.

This option has one of the highest potentials for construction-related vibration impacts because it involves the most overall construction, largest footprint, and most construction in soft-ground areas.

Operational Impacts

Erosion Hazard

Operational impacts related to erosion hazards are the same as described for the No Action Alternative.

Other Hazards

The potential for operational vibration impacts is low overall, but slightly higher than the other alternatives because it would involve the highest number of vehicles with more new facilities closer to existing structures.

3.4.4.6 Preferred Alternative

Construction Impacts

Erosion Hazards

The Preferred Alternative would add four lanes plus two 4-foot lane buffers to I-405 through erosion hazard areas in the following locations:

- The north-facing slope just south of the SR 522 interchange
- In Bellevue between SE 8th Street and Coal Creek Parkway
- In the vicinity of the Coal Creek interchange
- Between approximately SE 68th Street in Bellevue and NE 30th Street in Renton
- The Renton S-curves

In addition, the Preferred Alternative would add four to five new lanes between NE 124th Street and NE 145th Street; add two new lanes to Willows Road; widen the existing SR 202 roadway to five lanes between NE 90th Street and NE 145th on the eastern edge of the Sammamish River Valley; and add one lane to Avondale Road within erosion hazard areas. Overall, the Preferred Alternative has a higher magnitude of erosion hazard than the other alternatives except for Alternative 4.

Landslide Hazards

The Preferred Alternative would add four lanes and two 4-foot lane buffers to I-405 through landslide hazard areas in the following locations:

- The north-facing slope just south of the SR 522 interchange
- In the vicinity of the Coal Creek interchange
- Between approximately SE 68th Street in Bellevue and NE 44th Street in Renton

In addition, the Preferred Alternative would add four to five new lanes between NE 124th Street and NE 145th Street; add two new lanes to Willows Road; widen the existing SR 202 roadway by two to three lanes north of NE 145th Street on the western edge of the Sammamish River Valley; add one lane to Avondale Road; and add HOV access and arterial improvements at the NE 44th interchange in Newcastle within landslide hazard areas. Overall, the Preferred Alternative has a higher magnitude of landslide hazard than the other alternatives except for Alternative 4.

Seismic and Soft-Ground Hazards

The Preferred Alternative would add four lanes, two 4-foot lane buffers, and a truck-climbing lane to I-405 through seismic and soft-ground hazard areas between approximately Woodinville Drive and NE 195th Street in the vicinity of the SR 522 interchange. Two-acre transit centers would be added at seismic and soft-ground hazard areas near the Swamp Creek and the SR 522 "downtown Woodinville" interchanges. In addition, the Preferred Alternative would construct four to five new lanes between NE 124th Street and NE 145th Street; widen the existing SR 202 roadway to five lanes between NE 90th Street and SR 522 along the Sammamish River Valley; widen Willows Road by two lanes; add lanes, bridges, and retaining walls in the southern Sammamish River Valley and Bear Creek Valley; and add one lane to Avondale Road within seismic and soft-ground hazard areas. Overall, the Preferred Alternative ranks behind Alternative 4 in magnitude of potential seismic and soft-ground hazards.

Other Hazards

Volcanic hazards within the study area are anticipated to be low. A 2-acre transit center is planned in a coal mine hazard area in downtown Newcastle.

The Preferred Alternative probably has a higher potential for vibration impacts than Alternatives 1, 2, or 3 because it involves more construction in soft-ground (potential pile foundation) areas. Construction vibration impacts are probably less than Alternative 4 because Alternative 4 has more general earthwork and more soft-ground areas.

Operational Impacts

Erosion Hazard

Operational impacts related to erosion hazards are the same as described for the No Action Alternative.

Other Hazards

The potential for operational vibration impacts is low.

3.4.5 Mitigation Measures

3.4.5.1 Construction

Erosion Hazards

Design solutions, including realignment and relocation of improvements to avoid, minimize, or mitigate disturbance in areas with high erosion potential will be considered. In addition, there are many best management practices (BMPs) to reduce erosion and sedimentation during construction. BMPs to prevent erosion and preserve runoff water quality include dry-season construction, re-establishing vegetation before the rainy season, mulching or applying erosion control blankets, and careful management of runoff to keep water off bare slopes and limit flow velocities. Silt fences, ditch check dams, and sedimentation ponds are among the BMPs used to remove sediment from runoff. King County and many local jurisdictions require use of these BMPs as part of the permitting process. Additional BMPs, especially related to construction timing, could be instituted since many of the erosion hazard areas are adjacent to or upstream from chinook salmon habitat.

Landslide Hazards

Facilities in landslide hazard areas can usually be designed to be safely constructed and operated. Temporary cuts through landslide-prone materials could be limited in height or avoided, requiring the use of special retaining wall systems for earth retention. Walls could be designed for higher lateral pressures to limit soil movement. Subsurface drainage may be needed to increase slope stability. Light-weight fill, bridging structures, or realignment and relocation of improvements could be used to avoid loading slopes. All of these design solutions are mitigation measures.

Mine Hazards

If a project is planned in a mine hazard area, a detailed records study would be undertaken to more precisely locate all of the recorded mine facilities. If there appears to be a possibility of a collapsed mine opening or underground room near the proposed facilities, methods ranging from field reconnaissance to exploratory drilling to geophysical techniques would be used to identify the location and extent of potential ground subsidence.

If an opening or surface depression is found or develops after construction, it will be filled with soil or grout or bridged. Suspect areas along WSDOT facilities will be monitored by maintenance crews.

Construction Vibration

The impacts of construction vibrations can be mitigated by restricting the hours of construction or operation of certain types of equipment to times least likely to disturb nearby residences or businesses. In some instances, a drilled pile could be substituted for a driven pile to reduce vibrations. There are other impacts associated with drilled piles (e.g., disposal of drilling spoils, potential for groundwater alteration, and cost) that should be considered before specifying drilled rather than driven piles. Potential impacts to structures and people will be evaluated on a site-specific basis during design.

3.4.5.2 Operation

Erosion Hazards

Mitigation measures will include use of temporary or permanent erosion control blankets, mulching, or soil amendment to promote plant growth. Landscaping will be planned to increase infiltration and reduce runoff where practicable and in consideration of other impacts. Best management practices (BMPs) such as detention ponds, ditches, or structures will be constructed to reduce the stormwater erosion potential to the receiving waters.

Seismic and Soft-Ground Hazards

Mitigation measures will include many of the following: staged construction of embankments so the soil has time to gain strength; wick drains to hasten consolidation and strength gain; constructing embankments of light-weight materials to minimize loading; reinforcing embankments with geosynthetics to add strength and minimize the footprint; preloading to cause settlement prior to construction of the facilities; construction on pile supports; and increasing grades to keep pavement bases above groundwater. Soft-ground hazards at bridge locations, such as the I-5/I-405 Swamp Creek interchange, the I-405/SR 522 interchange, or the eastern terminus of SR 520, will be mitigated by founding the structures on deep foundations.

Earthquakes also pose long-term risks to safe siting of the facilities. Once an appropriate level of risk has been accepted, transportation facilities in seismic hazard areas will be designed and constructed to withstand earthquake accelerations over the lifetime of the facility.

Lifeline utility and transportation routing would be considered as part of the planning process for any improvements within the study area, although it is uncertain if lifeline planning would have an influence on the selection of an alternative. King and Snohomish counties' departments of emergency management could be involved with setting design standards along lifeline routes within the corridor. The work could also be coordinated with the Federal Emergency Management Agency's (FEMA) project IMPACT, which looks at transportation lifelines between the Port of Tacoma and Port of Seattle (EQE International, 2000). Consideration of lifeline requirements could change the design criteria for structures and possibly embankments under seismic loading.

Volcanic Hazard

The volcanic hazard impacts within the study area are anticipated to be quite low; therefore, no mitigation is required.

Operational Vibration

The potential for operational ground vibration impacts is relatively low. With the exception of complex and expensive foundation isolation systems, the only potential mitigating measure is to increase the distance between source and receptor. Impacts at specific locations where the proposed transportation improvements are close to existing facilities will be evaluated during design.

This page left intentionally blank.

3.5 WATER RESOURCES

This section describes the surface water and groundwater impacts of the I-405 Corridor Program. Note that impacts to floodplains and wetlands are covered in Sections 3.10 and 3.6.

3.5.1 Studies and Coordination

3.5.1.1 Plans and Policies

The following plans, policies, and codes were used in the analysis of impacts for ***surface water:***

- *Stormwater Management Manual for the Puget Sound Basin*, Washington State Department of Ecology, 1992.
- *Stormwater Management Manual for Western Washington*, Washington State Department of Ecology, 2001.
- *Highway Water Quality Manual*, Washington State Department of Transportation, 1988.
- *Highway Runoff Manual*, Washington State Department of Transportation, 1995.
- Washington Administration Code (WAC) 173-270-050 ("Puget Sound Highway Runoff Program"), 2001.
- WAC 173-270-060(5)(a) Long-Range Program for Stormwater Retrofit of Existing Highways, 2001.
- Manuals and guidelines of local jurisdictions, including King County's *Surface Water Design Manual, 1998* and Snohomish County's Title 24, 1999. (Most of the local jurisdictions either have their own manual or have adopted the Ecology manual.)
- Endangered Species Act (ESA), Tri-County Response information, 2000 and 2001.
- WAC 173-201A, Water Quality Standards for Surface Water of the State of Washington, 2001.

The following plans, policies and codes were used in the analysis of impacts and the determination of mitigation for ***groundwater:***

- Redmond-Bear Creek Valley Ground Water Management Plan, Redmond-Bear Creek Ground Water Advisory Committee
- Appendix Q, Wellhead Protection Plan, City of Renton Water System Plan
- Wellhead protection programs and aquifer protection programs, cities of Redmond, Renton, and Kent

The following regulations and programs are relevant to the evaluation of impacts of the I-405 Corridor alternatives on ***groundwater supply and quality***:

- Sole Source Aquifer Protection Program, USEPA
- Federal Safe Drinking Water Act, WAC 246-290-310
- Source Water Protection, WAC 246-290-135
- Wellhead Protection Program, WAC 246-290-135 (3)

- Washington State Growth Management Act, Chapter 36.70A RCW
- Ground Water Management Areas and Programs, WAC 173-100
- Water Quality Standards for Ground Waters, WAC 173-200
- Renton Aquifer Protection Ordinance, Renton Amd. Ord. 4851, 8-7-2000

3.5.1.2 Agencies and Jurisdictions

The compilation of information for surface water included discussions with agencies and municipalities in the I-405 corridor including:

- City of Bellevue
- City of Kent
- City of Redmond
- City of Renton
- City of Kirkland
- King County Department of Natural Resources (DNR), Water and Land Resources Division
- Snohomish County
- WSDOT

The following agencies were contacted for information regarding the groundwater impacts evaluation:

- U.S. Environmental Protection Agency (USEPA) Region 10, Groundwater Protection Unit
- U.S. Geological Survey (USGS)
- Washington State Department of Ecology (Ecology)
- Washington State Department of Health (DOH)
- Washington State Department of Natural Resources (DNR)
- King County Department of Health
- King County Department of Natural Resources, Water and Land Resources Division
- King County Department of Development and Environmental Services (DDES)
- Snohomish County Department of Health
- Snohomish County Department of Planning and Development Services

The cities of Lynnwood, Bothell, Kirkland, Redmond, Bellevue, Renton, and Kent were contacted about their public water supplies, wellhead protection programs, and sensitive area ordinances.

3.5.2 Methodology

3.5.2.1 Surface Water

Surface Water Quantity

Existing rivers, streams, and lakes within the study area and their associated drainage basins were mapped using GIS information made available from King and Snohomish counties. The drainage basins' boundaries and stream network were then refined using USGS quadrangle maps of the study area.

Summary flow data for the major streams in the study area were obtained from the National Water Information System of the USGS, available on the World Wide Web. This was supplemented by information in the USGS-published annual reports, *Water Resources Data for Washington*.

Surface Water Quality

Construction, operation, and maintenance of roadways and HCT facilities discharge pollutants to water bodies. These pollutants include silt, chemicals, paints, and solvents and fuels used by construction equipment. Pollutants from operations may include silt, hydrocarbons, metals, nutrients, and pathogens due to traffic and airborne deposition. Similar pollutants are generated by maintenance activities, particularly silt, pesticides, and de-icing materials.

The Washington Administrative Code (WAC) was reviewed for the current water quality standards for each of the major streams in the study area (see *I-405 Corridor Program Draft Surface Water Resources Expertise Report*, [CH2M HILL, 2001a]). The 303d List published by Ecology, available from the department's Web home page, was used to identify water bodies that did not meet standards. These streams were added to the project GIS database and plotted. The 303d List identified water bodies that are not expected to meet water quality standards over the near to medium term. This list is updated every two years as more water quality data become available. However, it is not a comprehensive list of all water bodies failing to meet water quality standards.

A listing of existing stormwater facilities for I-405 and other major state highways in the study area was developed. Opportunities for retrofit of existing highway stormwater facilities were then identified generally.

Long-term annual pollutant loads along I-405 were estimated using the methods described in the WSDOT *Highway Water Quality Manual* (WSDOT, 1988). As noted in Section 3.5.3.1, there are a number of stormwater treatment facilities currently installed along I-405. The standard water quality treatment provided by these facilities can reduce suspended solids by 80 percent, with considerably smaller reductions in other pollutants, such as nutrients and metals. The effectiveness of these existing stormwater facilities in reducing overall highway pollutant loads has not been quantified regionally. However, the actual pollutant loadings to surface waters in the study area are likely somewhat lower than the amounts calculated for this analysis, which assume no runoff treatment.

Estimates of new impervious surface associated with the proposed highway and road projects were prepared, based upon standard lane widths, project lengths, and other appropriate areal factors. Estimates of total impervious area (TIA) for each of the basins were provided by the King County DNR (Hartley and Burkey, personal communication, January 26, 2000). Digitized

1998 aerial photos were analyzed electronically with visual verification of test areas by staff of the Center for Urban Water Resources at the University of Washington. The procedure produces estimates of impervious surface coverage within one percent accuracy for areas greater than one square mile (640 acres) (Hill et al., 2000).

Roadways, parking areas, transit stations and platforms, and other types of transportation facilities can impact water resources in a number of ways. The pavement or hard surface created by a road, ballasted rail line, or roof is known as impervious surface. Replacement of forest and vegetation with cleared right-of-way and pavement or other impervious surface substantially reduces the amount of rainfall that is evaporated back into the air and the portion that is infiltrated into the soil. As a result, these impervious or less pervious areas are warmer and drier and create higher peak stream flows and more rapid changes in stream flows than forested areas. Summer base flows tend to be reduced. Transportation facilities within riparian corridors can impact the functions of riparian areas and reduce or isolate floodplain capacity. Facilities that cross water bodies can directly affect stream channels, reducing stream channel cross-section or diverting the location of the channel.

A qualitative assessment of impacts to stream flow and water quality was carried out using new impervious surface area attributable to the set of proposed projects within each alternative as the primary indicator. The following criteria were used to define potential important surface water impacts:

- Multiple projects within an alternative (five or more with each disturbing greater than one acre) occurring within basins with a high proportion of steeply sloping area were judged to result in potentially serious water quality impacts during construction.
- Potentially serious operational impacts were judged to occur within basins experiencing a substantial increase in impervious surface (one percent or greater of total basin area per project) which could result in a permanent reduction in stream base flow.
- A number of streams in the study area currently violate water quality standards for temperature and/or heavy metals. If the alternative results in a substantial increase in impervious area in such a basin (one percent or greater of total basin area per project), the associated decrease in base flow could worsen the stream temperature problem. Increased road runoff could intensify metals concentrations in such a stream. Either of these situations was judged to be a potentially substantial operational impact to water quality.

The impact analysis assumes that as part of each project, the standard erosion and sediment control measures and permanent stormwater detention and treatment requirements specified in the *Stormwater Management Manual for Western Washington* published by Ecology in August 2001 or functionally equivalent stormwater guidance would be implemented. WSDOT has two years from the date of publishing to revise its *Highway Runoff Manual* to meet the requirements in the Ecology manual.

The surface water analyses in this section are based on the *I-405 Corridor Program Draft Surface Water Resources Expertise Report* (CH2M HILL, 2001), herein incorporated by reference.

3.5.2.2 Groundwater

A program-level groundwater analysis was conducted to evaluate the effects of each alternative on groundwater quality and quantity. Specifically, the evaluation was based on the following two key technical issues:

1. Would the project adversely decrease the quality of groundwater that is a current or future water supply for areas within the study corridor?
2. Would the project adversely decrease the quantity of groundwater that is a current or future water supply, or that serves as base flow for surface water bodies within the study corridor?

To address these issues, the primary groundwater resources (i.e., aquifers) within the study corridor were identified, including those designated as sole-source aquifers (SSAs). Public and private water supply wells within the study corridor were identified and mapped, and additional hydrogeologic data were obtained from cities for which groundwater is the primary source of drinking water. The potential for groundwater to be affected by contamination was evaluated based on hydrogeology, well locations relative to projects, susceptibility ratings assigned by the Washington State DOH, and wellhead protection areas (WHPAs). The potential for reduced groundwater recharge was evaluated based on surficial geology and critical aquifer recharge area ratings (CARA) assigned by King County DDES and total new impervious surface area estimated under each alternative. The data measures and evaluation criteria for groundwater evaluation are described in detail in the *I-405 Corridor Program Draft Groundwater Resources Expertise Report* (CH2M HILL, 2001b).

The alternatives were divided into sections, then analyzed for:

- Sections that crossed one or more of the groundwater resources: wellhead protection areas, sole-source aquifers, or critical aquifer recharge areas.
- Sections with relative amounts of total new impervious surface area for each alternative within the given section. Generally, the alternative with the higher total new impervious surface area would have a higher potential for impacts.

The analysis was relative only and did not attempt to determine whether potential impacts were substantial. Following the relative ranking of alternatives, a determination based on professional judgement was made as to whether impacts to groundwater quality or quantity were substantial using the following criteria:

- Impacts to groundwater *quality* were considered substantial if groundwater quality at a public water supply well would be degraded to a point where it exceeded primary federal drinking water standards (Safe Drinking Water Act) or state drinking water standards (WAC 246-290-310).
- Impacts to groundwater *quantity* were considered substantial if the supply of groundwater was depleted such that flow to groundwater-fed water resources (e.g., springs and perennial surface water flows) used by other "users" such as fisheries and recreation was substantially reduced.

The groundwater analyses in this section are based on the *I-405 Corridor Program Draft Groundwater Resources Expertise Report* (CH2M HILL, 2001), herein incorporated by reference.

3.5.3 Affected Environment

The I-405 Corridor study area contains abundant water resources. Major surface water features include two large lakes, three rivers, eleven major streams, and numerous smaller lakes and streams. The study area lies within two state Water Resource Inventory Areas (WRIAs). The southern ten percent lies within WRIA 9 – Green-Duwamish River Basin. The remainder lies within WRIA 8 – Lake Washington Basin (Cedar-Sammamish rivers). Both WRIAs drain to Central Puget Sound a few miles downstream of the study area. The upper portions of the Green and Lake Washington basins have undergone relatively little development and most of the land cover is second-growth forest. The lower portions of these basins, in contrast, have undergone extensive land use changes in the form of either agriculture or urban and residential development. Similarly, the basins of the major streams in the study area are also largely developed or are experiencing relatively rapid growth.

3.5.3.1 Surface Water

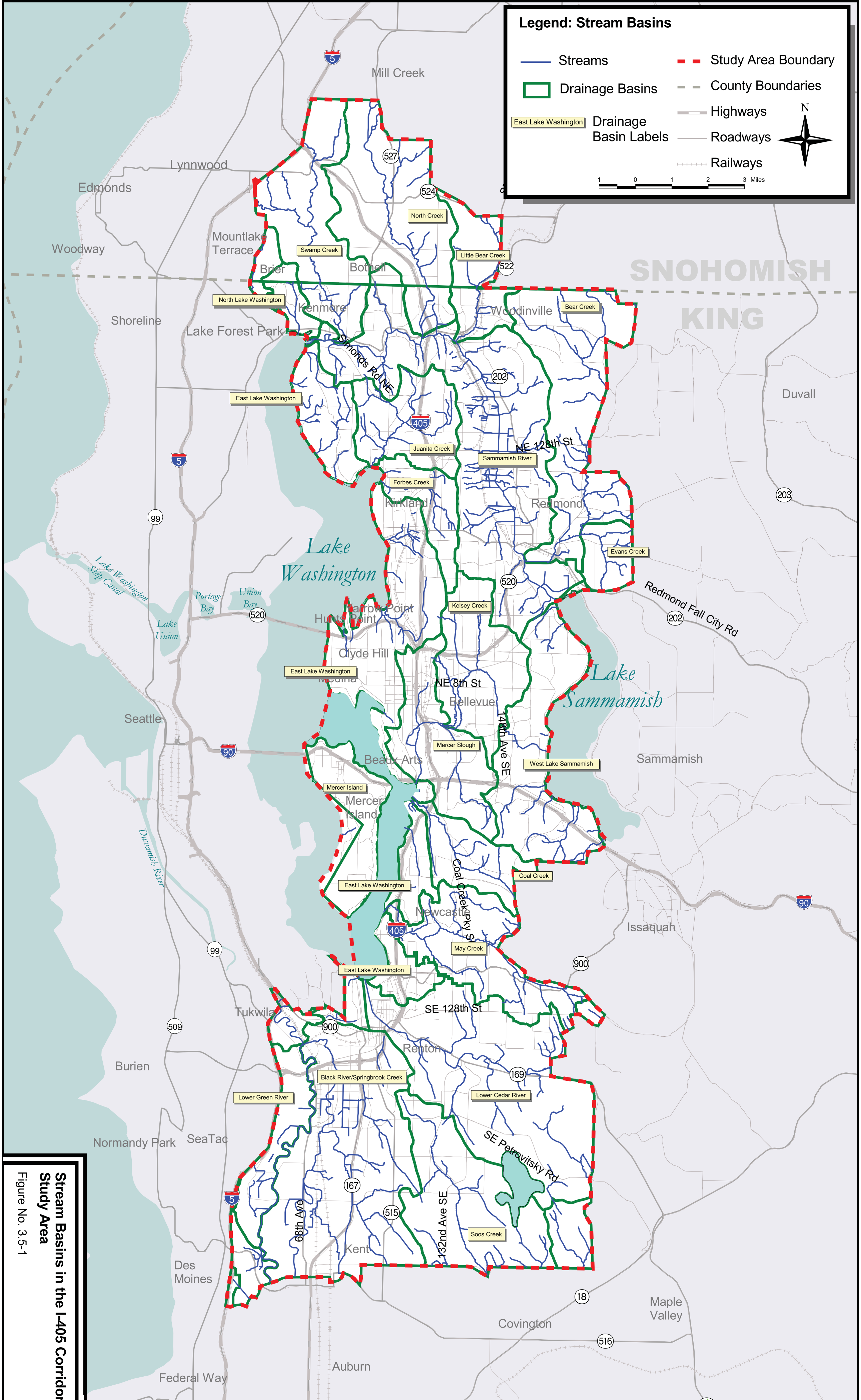
This section briefly describes the major basins within the study area. These basins and related data are described in more detail in the *I-405 Corridor Program Draft Surface Water Resources Expertise Report* (CH2M HILL, 2001a). Figure 3.5-1 shows the following major streams and lakes within the study area:

- **Soos Creek** drains an urbanizing area of south King County. This stream rises in the eastern side of the study area and flows south for 10 miles. It then turns west and joins the Green River just upstream of the city of Auburn. The stream remains one of the most important salmon streams within the urban portions of King County. The hydrology and water quality of this stream have not been as dramatically altered as many of the other streams in the study area. This basin covers 9,400 acres within the study area. Total impervious area (TIA) coverage within the study area is 17 percent.

- The **Green River** rises in the Cascade Mountains 50 miles southeast of the study area. Its flow is partially controlled by Howard Hanson Dam, operated by the Army Corps of Engineers, and by the City of Tacoma's water diversion dam. It enters the low-gradient Kent-Auburn valley and flows north into the study area at Kent. The river has been channelized through the valley. At its junction with the Black River near the border of the study area, the Green River becomes known as the Duwamish River. I-405 crosses the Green River a short distance upstream of this point. This basin covers about 3,000 acres within the study area. TIA coverage within the study area is 39 percent.

- **Springbrook Creek** flows north through the Kent-Auburn valley and generally parallel to the Green River. It receives runoff from Garrison Creek and Mill Creek (Kent), as well as from most of the valley and the plateau to the east. Its drainage area includes downtown Kent. Within the valley floor, this stream channel has been heavily altered, although substantial areas of wetland remain. This stream joins the Black River a short distance above its confluence with the Green River. I-405 crosses the creek at about this point. This basin covers about 14,300 acres within the study area. TIA coverage is 44 percent.

- The **Cedar River** rises in the Cascade Mountains, immediately north of the Green River Basin, 45 miles southeast of the study area. It flows through Chester Morse Reservoir (operated by the City of Seattle), past the town of Maple Valley, and down the Cedar River



Stream Basins in the I-405 Corridor Study Area

Figure No. 3.5-1

This page intentionally left blank.

valley to Renton. The river discharges into the south end of Lake Washington at Renton. I-405 crosses the river a little more than one mile above its mouth at Lake Washington. This basin covers a little less than 14,000 acres within the study area. TIA coverage specific to the study area was not available.

- **May Creek** rises in rural King County, east of Renton. I-405 crosses the stream near its mouth, a short distance above Lake Washington. This basin covers about 5,900 acres within the study area. TIA coverage is 22 percent.
- **Coal Creek** rises on Cougar Mountain, 4 miles east of Lake Washington. The creek suffers from excessive sedimentation due primarily to landslides. I-405 crosses this stream about a mile above its mouth. This basin covers about 3,000 acres within the study area. TIA coverage is 28 percent.
- The **Kelsey-South Kelsey, Forbes,** and **Juanita basins** drain much of the cities of Bellevue and Kirkland. Kelsey Creek drains to Mercer Slough, an important wetland area bordering Lake Washington. Major portions of these creeks and their tributaries have been heavily altered. I-405 crosses these streams generally along their middle reach. Collectively, these basins cover about 17,000 acres within the study area. TIA coverage is 45 percent.
- The **East Lake Washington Basin** includes the smaller streams that flow directly to the lake. This basin extends along the eastern shore of Lake Washington but excludes the mouths of the larger Lake Washington streams mentioned above. It covers about 13,000 acres within the study area, and TIA coverage is 40 percent.
- **Lake Sammamish** is a 5-mile-long lake located along the eastern edge of the study area. The city of Issaquah lies at the south end of the lake. Tibbetts and Issaquah creeks are the largest tributaries to the lake. They drain a mountainous, largely forested area south and east of the lake.
- The **Sammamish River** flows from the north end of Lake Sammamish near Redmond to the north end of Lake Washington. The Sammamish River Valley is low-gradient and ranges from several miles to about one-quarter mile wide. After first flowing north through Marymoor Regional Park, the river passes through downtown Redmond, then through a commercial and office complex and a golf course. After passing through the City of Woodinville, the river turns west, flowing through Bothell and Kenmore and into Lake Washington. The river itself was channelized decades ago. I-405 crosses the Sammamish River in Bothell, about 4 miles east of Lake Washington. This basin covers about 16,400 acres within the study area. TIA coverage is 37 percent.
- **Bear Creek** joins the Sammamish River at Redmond, a short distance downstream of where the river flows out of Lake Sammamish. Much of the riparian area along this stream has remained undeveloped and the stream supports important salmon runs. **Evans Creek** is an important tributary to Bear Creek. The Bear Creek Basin lies to the east of I-405, but several highway or arterial projects could affect this basin. This basin covers about 11,000 acres within the study area. TIA coverage is 23 percent.
- **Little Bear Creek** joins the Sammamish River at Woodinville. Its lower stretch has been extensively channelized. The Little Bear Basin covers about 3,000 acres within the study area. TIA coverage is 28 percent.

- The upper portions of **North** and **Swamp creeks** lie within the cities of Mill Creek and Lynnwood. I-405 crosses Swamp Creek a short distance south of I-5, in the north portion of the study area. Snohomish County has constructed a regional detention facility along the middle stretch of Swamp Creek, just upstream of I-5, to help alleviate downstream flooding. The lowest stretch of North Creek, where it crosses I-405, is also planned for wetland preservation and enhancement. Collectively, these two basins cover about 15,000 acres within the study area. TIA coverage is 39 percent.
- **Lake Washington** forms the western side of the study area. It averages one to three miles in width and extends 18 miles from Renton to Kenmore. It is one of the largest lakes in Washington, and approximately 90 percent of the study area drains to this lake. Its two largest tributaries are the Cedar and Sammamish rivers. On its western shore, opposite the study area, is the City of Seattle.

The overall total impervious area coverage within the 134,000-acre study area is approximately 36 percent. Individual basins range from 17 percent impervious area for the Soos Creek Basin to 55 percent impervious area for the Duwamish River Basin. Research on urban streams by the University of Washington Center for Urban Water Resources suggests that substantial declines in stream invertebrate populations and other measures of stream health occur when development within a basin reaches about 10 percent impervious area (May et al., 1997).

The State has classified all surface water bodies into five water quality categories: Class AA, Class A, Class B, Class C, or Lake Class. Class AA are typically waters of extraordinarily good quality, while Class A waters are classified as excellent quality (WAC 173-201A-120). Table 3.5-1 shows the water quality classifications of the major surface water bodies in the study area. By regulation, all streams draining to lakes, and not otherwise specifically designated, are Class AA.

Table 3.5-1: Classification of the Major Streams and Lakes

WATER BODY	State WQ Class	King Co. Stream Class
Bear-Evans Creek	AA	1
Cedar River	A[a]	1
Coal Creek	AA	2
Duwamish River	B	1
Forbes Creek	AA	Unclassified
Juanita Creek	AA	2
Kelsey Creek	AA	1
Green River	A	1
Little Bear Creek	AA	2
Sammamish River	AA	1
May Creek	AA	2
North Creek	AA	1
Soos Creek	A	2
Springbrook Creek	A	2
Swamp Creek	AA	1
Lake Sammamish	Lake	Not Applicable
Lake Washington	Lake	Not Applicable

[a] Class AA above RM 4.1

King County Stream Classification refers to the general size of the stream. Class 1 covers the larger streams, which are "Shorelines of the State" as defined under the County Shoreline Master Program. Class 2 streams are other perennial streams or streams used by salmon. Class 3 are intermittent streams which are not utilized by salmon. The three rivers and half of the major streams in the study area are Class 1. Most of the remaining streams are Class 2 – other streams supporting salmon.

Every two years, Ecology publishes a statewide water quality assessment known as the Section 305b Report. It includes a list of impaired and threatened water bodies, known as the "303d List," and the parameters that do not meet state water quality standards. This list is not comprehensive in that streams with potential water quality problems, but inadequate water quality data, would not necessarily be on the list. However, it does serve as a useful source of information on water quality problems at the regional level considered in this document. About one-third of the water bodies violate the temperature standard. Some of the lower-gradient, sluggish streams in the study area violate the dissolved oxygen standard. The Green River and Springbrook, May, and Bear-Evans creeks show elevated levels of one or more heavy metals. The Sammamish River has a pH violation, while Kelsey Creek has shown elevated levels of three pesticides.

Streams on the 303d List are required to undergo a study which leads to an allocation of allowable input of the offending pollutants such that water quality standards can be achieved. This allocation is known as Total Maximum Daily Load (TMDL). In 1993, Ecology assigned a TMDL to the Lower Green/Duwamish River for ammonia-nitrogen. A TMDL covering coliform bacteria is under consideration for North Creek.

Ecology has issued to WSDOT a Phase 1 NPDES Municipal Stormwater Permit. Under this permit, WSDOT has developed a stormwater treatment and management program for runoff from its highways. In addition, all construction projects disturbing an area greater than five acres, including road projects, must comply with the provisions of the State's general construction permit. Projects must provide adequate erosion and sediment control measures, as well as permanent stormwater control measures. A Stormwater Pollution Prevention Plan (SWPPP) detailing these measures must be developed and be available for inspection at the construction site.

Among other requirements, temporary and permanent stormwater control measures similar to those found in Ecology's *Stormwater Management Manual for Western Washington* are likely to be required, as well as substantial commitments to operation and maintenance of stormwater facilities. Along I-405 there are 37 detention facilities, 12 water quality treatment facilities, and 7 combined facilities (WSDOT, 2000). Information on the specific portions of I-405 served by these facilities was not available. However, the northern portion of I-405 has more stormwater facilities in operation than the southern portion.

3.5.3.2 Groundwater

The regional hydrogeology for Puget Sound consists of highly variable sequences of glacial, interglacial, and alluvial deposits and is described in detail in the *I-405 Corridor Program Draft Groundwater Resources Expertise Report* (CH2M HILL, 2001b). There is no substantial regional groundwater flow system. Instead, groundwater movement is generally from topographic high to topographic low, usually toward stream drainages. Groundwater in the uppermost aquifer unit generally occurs under water table conditions; groundwater in the deeper units is semiconfined. Recharge is generally in higher elevation areas where semiconfining layers are not present, and groundwater discharges to stream drainages.

Groundwater quality is suitable for most purposes. The water is generally soft to moderately hard. In some of the glacial aquifers, high concentrations of iron and manganese are common.

The majority of the cities within the study area are supplied by surface water. Redmond is in the Redmond-Bear Creek Valley Groundwater Management Area, and Kent and part of Renton are in the South King County Groundwater Management Area. Renton obtains its groundwater from the Cedar Valley aquifer, which is designated as a sole-source aquifer by the USEPA. See Figure 3.5-2 for location of sole-source groundwater aquifers and recharge areas and Figure 4.2 in the Draft Groundwater Expertise Report for the WHPAs of Class A wells and the locations of Class B wells.

3.5.3.3 Sole-Source Aquifers

There are two sole-source aquifers within the study corridor: the Cedar Valley aquifer (a narrow strip along the Cedar River) and a small portion of the Cross Valley aquifer, all stream-flow source areas.

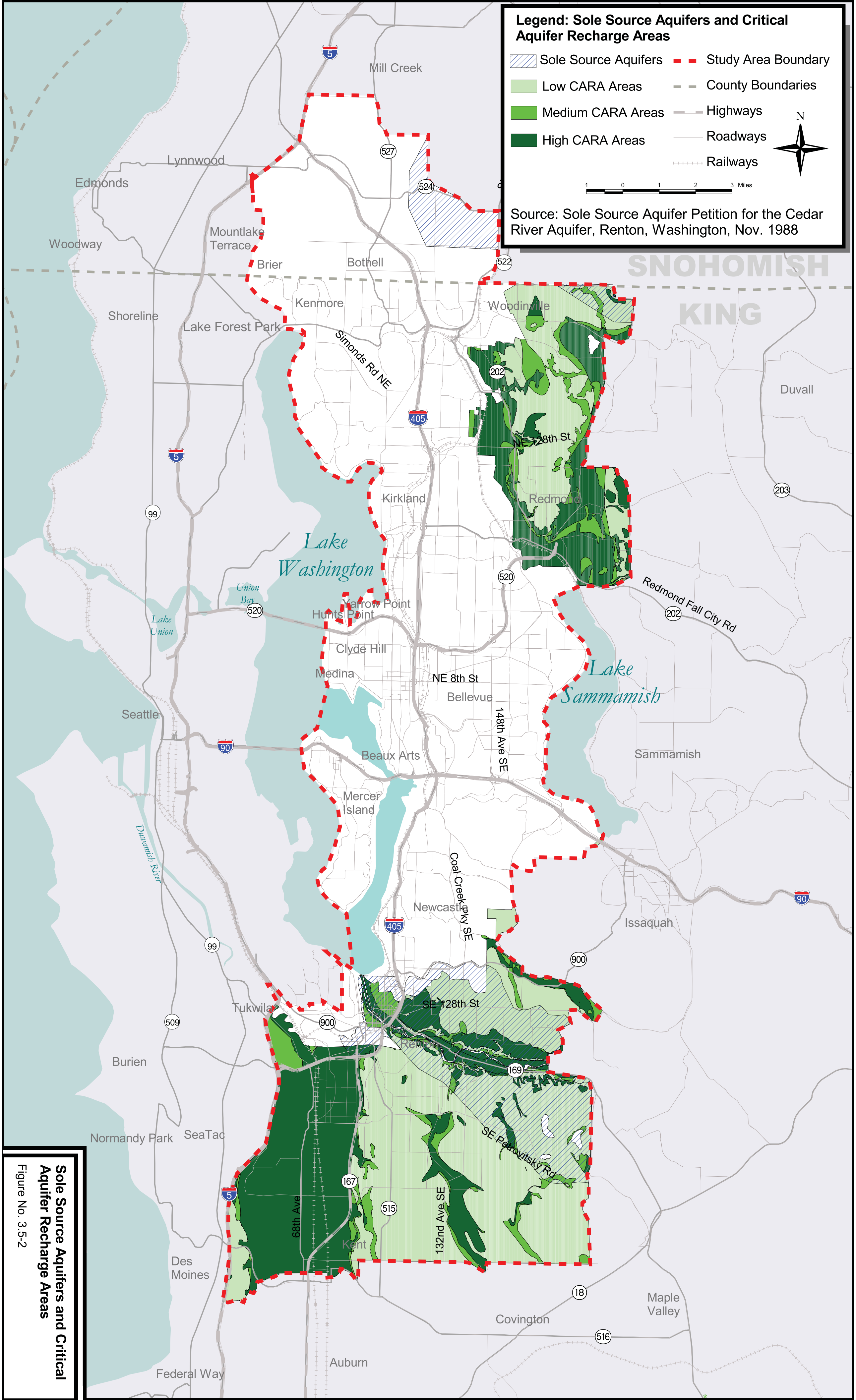
3.5.4 Impacts

This section discusses the overall runoff and water quality impacts of each alternative due to construction and operation of the improvement projects. Project impacts were quantified according to their effects upon discrete hydrologic elements such as surface water basin or wellhead protection area (see Table 3.5-2).

Table 3.5-2: Summary of Water Resources Impacts

Impact	No Action Alternative	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Preferred Alternative
Surface Water:						
Acres of New Impervious Area	173	478	820	773	1,061	974
# Basins – Construction Impacts	1	8	11	10	8	11
# Basins – Base Flow Impacts	0	0	6	3	7	6
# Basins – Water Quality Impacts	0	0	1	0	1	1
Groundwater:						
Public Wells	8	14	38	40	38	40
Other Wells	29	70	156	183	154	183
Wellhead Protection Areas (WHPAs)	7	10	16	17	17	17
Sole Source Aquifers (SSAs)	2	2	2	2	2	2
Critical Aquifer Recharge Areas (CARAs)	3	3	5	5	6	5
Recharge area decrease (acres)	104	215	410	387	531	487

Road and highway projects can negatively impact water resources in a number of ways. Replacement of native or second-growth forest cover with cleared road right-of-way, ditches, road shoulders, and road pavement substantially increases hard-surfaced (impervious) areas and greatly reduces the time period for runoff. These impervious areas have the effect of reducing the amount of rainfall that is evaporated back into the air. In addition, rainwater infiltration into the soil is also



Sole Source Aquifers and Critical Aquifer Recharge Areas

Figure No. 3.5-2

This page left intentionally blank.

greatly reduced. As a result, runoff from road areas can be greatly increased over that of natural conditions. This can result in higher peak flows in the receiving streams. Since groundwater recharge is reduced, summer base flows in the receiving streams can also decline. Roadways built within riparian corridors can impact the functions of riparian areas and reduce or isolate floodplains. Table 3.5-2 summarizes impacts on water resources in the study area by alternative.
In addition to the quantitative measures of groundwater impacts summarized in Table 3.5-2, professional judgement was used to develop an overall qualitative measure of impact using a high, medium, and low scale.

3.5.4.1 No Action Alternative

Construction Impacts

Surface Water

The projects proposed under the No Action Alternative would have the potential to temporarily degrade water quality during construction. Standard best management practices (BMPs) for control of erosion and other pollutants would be implemented during construction, as required by the *Stormwater Management Manual for Western Washington* or functionally equivalent stormwater guidance. These would minimize erosion and sedimentation to water bodies. However, one of the basins (North Creek) could suffer serious short-term water quality degradation due to a combination of its steeper gradient and the relatively high number of projects proposed for construction (five or more) within its boundaries. Wet-weather construction within this basin may seriously degrade water quality. Substantial short-term impacts can be avoided by implementing the wet-weather practices discussed in Section 3.5.5, Mitigation Measures.

Groundwater

The use of hazardous materials during construction near wells, wellhead protection areas (WHPAs), sole-source aquifers, and CARAs may result in direct impacts to groundwater. Potential sources of hazardous materials related to construction include: fuel used by construction vehicles; chemicals used during construction, such as cement curing aids, formcoats, and sealants; and fill material brought in from outside sources that may contain hazardous materials. Similarly, if hazardous materials are present in soil that is newly exposed during construction, it is another source of contamination through direct infiltration and surface runoff.

Eight public water supply wells occur within one-quarter mile of the No Action Alternative projects. Four WHPAs would be intersected by new construction; all four are in the Renton area. In Redmond, two arterial projects would be on the edge of the 1-year WHPA, but would not penetrate the area. In Renton one arterial would pass through the 10-year capture zone for the Maplewood Wells. None of the projects would be within the Aquifer Protection Area (APA) zones.

In Snohomish County, Project HOV-14 (I-405 Segment 9), and portions of 2 other arterials would cross medium aquifer recharge areas (ARAs). In the Redmond area, two arterials would cross CARAs, and two would be on the outer edge of CARAs. In Renton, R-39 would have a portion in a high ARA, and the remainder in a low ARA. Two projects would be in ARAs in the

Kent Green River Valley. About 60 percent of the No Action Alternative projects would cross potential recharge areas.

Multiplying the total new impervious surface area of 173 acres by 60 percent yields a value of 104 acres for the potential recharge area that could be lost as a result of the placement of new impervious surfaces.

Activities that might remove substantial quantities of groundwater from aquifers during construction are pump tests and construction dewatering activities. These would be expected to occur in the areas where groundwater is near the surface, such as downtown Redmond, Renton, near the Cedar River, and in the Kent/Green River valley. The No Action Alternative would have very few projects in these areas. Additionally, since the construction period would be short compared with the operational period, the potential for loss of groundwater supply due to the placement of impervious materials on groundwater recharge areas is low. Therefore, the potential for construction activities for the No Action Alternative to negatively impact groundwater quantity and quality is low.

Operational Impacts

Surface Water

The No Action Alternative would result in 173 acres of new impervious surface within the study area. This would represent approximately a 0.1 percent increase in impervious area across the study area. The North Creek Basin would receive the most new impervious surface, 33 acres. Other basins receiving 15 or more acres of new impervious surface include Sammamish River and Little Bear Creek. The Lower Green and Duwamish rivers and Bear, Coal, Forbes, and Kelsey creeks would each receive less than 5 acres of new impervious surface. On a relative basis, Evans and North creeks would experience the greatest impact, about 0.5 percent increase in impervious surface each.

The proposed road projects under this alternative would result in an increase in runoff to local drainage systems and streams. The standard detention requirements for new projects would be generally sufficient to avoid causing or intensifying downstream drainage or flooding problems. Given the small relative decreases in pervious surface likely to occur in any single basin, it is doubtful that any measurable reduction in base flow would occur.

Annual pollutant loads attributable to traffic along I-405 under the No Action Alternative were calculated. Increases would occur in chemical oxygen demand (COD), zinc, copper, total nitrogen, and total phosphorus, including approximately 379 tons per year of suspended sediment along the entire length of I-405.

Stormwater treatment would be implemented during design and construction for new impervious surfaces associated with each of the new projects proposed as part of this alternative. WSDOT is currently revising its *Highway Runoff Manual* to be functionally equivalent to Ecology's *Stormwater Manual*. The proposed criteria would take into consideration impacts to fish, including chinook salmon. The criteria are also expected to be used by WSDOT in retrofitting existing stormwater quantity and quality systems along the corridor. The overall operational impact of the No Action Alternative upon surface water is judged to be below the threshold of significance.

Groundwater

The primary potential operational (long-term) impacts to groundwater quality would be related to traffic passing through WHPAs, APAs, SSAs, and CARAs. Accidents in which hazardous materials are released onto these areas could contaminate groundwater. Release of small amounts of hazardous materials over time via vehicle fuel, lubricant, or other fluid leaks could be picked up by runoff and, if not contained and treated, could reach the ground and infiltrate to groundwater.

With few projects in these areas, the potential for these impacts under normal operating conditions for the No Action Alternative would be low. However, it is possible that a truck transporting large quantities of hazardous chemicals could conceivably be involved in a traffic accident that would cause the release of a large volume of chemicals that could run off of the roadway and onto soil. If this occurred in a WHPA, APA, SSA, or CARA, then groundwater impacts could be high and substantial. Over time, the potential lost groundwater recharge associated with general road projects could be higher than during construction.

The potential for operational impacts associated with the No Action Alternative to degrade groundwater quality or to decrease groundwater supply under normal conditions is low and not substantial, with the exception of the traffic accident scenario described above, in which impacts to groundwater quality could be substantial.

3.5.4.2 Alternative 1: HCT/TDM Emphasis

Construction Impacts

Surface Water

Under Alternative 1, eight basins would have five or more projects constructed within their boundaries. These projects would have the potential to temporarily degrade water quality during construction. Several of the stream basins would potentially suffer serious, short-term water quality degradation due to a combination of their sloping nature and the relatively high number of projects proposed for construction. These would include East Lake Washington, the Sammamish River, and Forbes, Springbrook, Juanita, North, and South Kelsey creeks. Substantial short-term impacts would be avoided by implementing water quality protection BMPs during construction.

Groundwater

Alternative 1 projects would pass within one-quarter mile of more wells than the No Action Alternative, and cross more WHPAs and high CARAs. Where the same WHPAs and CARAs are crossed, the crossing area would be larger. The additional projects and additional surface area relative to the No Action Alternative would increase the potential for groundwater contamination during construction by increasing the number of construction vehicles, the fueling requirements, the amount of fill imported, the areas where leaks and spills could occur, and the potential for exposing contaminated soils. The primary areas of concern are Redmond and Renton.

Based on the increased intersection of sensitive areas (i.e., WHPAs, APAs, CARAs, and SSAs) by projects in Alternative 1, the potential for construction impacts to groundwater quality is rated moderate.

The potential for construction-related decrease of aquifer recharge would be greater compared with the No Action Alternative as a result of increased impervious area. However, the construction period would be relatively short in terms of recharge times. The potential for Alternative 1 construction activities to decrease groundwater quantity is low. Although some potential exists for construction activities to impact groundwater quality and quantity, the impacts that may occur are not substantial.

An estimated 45 percent of the Alternative 1 projects would cross potential recharge areas. Multiplying the total new impervious surface area of 478 acres (which includes the No Action Alternative) by 45 percent yields a value of 215 acres for the potential recharge area that may be lost as a result of the placement of new impervious surfaces.

Operational Impacts

Surface Water

Alternative 1 would result in 478 acres (including the No Action Alternative) of new impervious surface within the study area. This would represent an increase of 0.4 percent in impervious area across the study area.

The HCT system evaluated in Alternatives 1 and 2 extends north on an exclusive alignment from Tukwila to Lynnwood, with connections west across Mercer Island, east to Issaquah, and northeast to Redmond. The system also includes HCT stations, platforms, and a maintenance and storage facility. With the assumed ballasted guideway calculated as 50 percent pervious, the HCT system results in a total of 167 acres of impervious surface. Depending on the HCT technology used and final design, this total could be higher or substantially lower. By comparison, the two additional lanes on I-405 under Alternative 3 result in a net increase of 97 acres of impervious surface after subtracting the basic improvement projects that would no longer be needed.

The Springbrook Creek Basin would receive the most new impervious surface, 83 acres. Other basins receiving more than 15 acres of new impervious surface would include Sammamish and Cedar rivers and Juanita, Forbes, South Kelsey, and North creeks and East Lake Washington Basin. The Lower Green and Duwamish rivers would each have less than 5 acres of new impervious surface. On a relative basis, South Kelsey Creek would experience the greatest impact, about a 0.9 percent increase in impervious surface. Forbes, Juanita, and North creeks would experience an increase of 0.7 percent impervious surface.

The proposed road projects under this alternative would result in an increase in runoff to local drainage systems and streams. The standard detention requirements for new projects would be generally sufficient to avoid causing or intensifying downstream drainage or flooding problems.

Annual pollutant loads attributable to traffic along I-405 under Alternative 1 were calculated. It should be noted that pollutant load calculations were only carried out for conventional highway traffic along I-405. No attempt was made to estimate pollutant loads from the high-capacity transit (HCT) portion of this alternative. HCT would likely take the form of an electric light rail system. Although some pollutant loading could be expected from its right-of-way, it would be expected to be a small fraction of that of the conventional highway.

The calculated pollutant loadings along I-405 for Alternative 1 are virtually the same as those calculated for the No Action Alternative. Stormwater treatment would be implemented for new impervious surfaces associated with each of the new projects proposed as part of this alternative. The overall operational impact of Alternative 1 upon surface water is judged to be below the threshold of significance.

Groundwater

Additional long-term traffic through sensitive areas would increase the potential for groundwater contamination via the spill and leak mechanisms. Additional impervious surface area passing through the WHPAs, APAs, SSAs, and CARAs would also increase the potential for contamination because more rainfall runoff may pick up contaminants and reach permeable soils if runoff water is not contained. The potential for Alternative 1 operational activities to adversely impact groundwater quality is therefore rated as moderate.

Alternative 1 is estimated to eliminate 215 acres of recharge area (including the No Action Alternative) versus the estimated loss of 104 acres of recharge for the No Action Alternative. Therefore, the potential for Alternative 1 operational activities to adversely impact groundwater recharge would be low. The incremental loss of 101 acres of recharge area is only 4 percent of the current total transportation infrastructure-related impervious surface in the I-405 corridor. Although some potential exists for operational activities to impact groundwater quality and quantity, the impacts that may occur are not substantial under normal operating conditions. However, in the traffic accident scenario, impacts to groundwater quality could be substantial.

3.5.4.3 Alternative 2: Mixed Mode with HCT/Transit Emphasis

Construction Impacts

Surface Water

Under Alternative 2, six basins would have 10 or more projects constructed within their boundaries while an additional five basins would see between 5 and 10 projects. The Sammamish River Basin would experience the highest number of projects (16).

These projects would have the potential to temporarily degrade water quality during construction. Several of the stream basins have the potential to suffer serious, short-term water quality degradation due to a combination of their sloping nature and the relatively high number of projects proposed for construction (five or more). These would include East Lake Washington, the Lower Green, Cedar and Sammamish rivers and tributaries, and Springbrook, Swamp, Forbes, Juanita, South Kelsey, North, and Bear creeks. Wet weather construction within these basins could seriously degrade water quality. Substantial short-term impacts would be avoided by implementing water quality protection BMPs during construction.

Groundwater

Generally, Alternative 2 includes all of the elements of Alternative 1, with several additions. The areas of most potential impact remain Renton (primary) and Redmond (secondary), particularly in their respective downtown areas, where city water supply wells are located. With Alternative 2, the surface area of additional freeway and arterial lanes passing near these wells, within the WHPAs, and within Renton APA zones 1 and 2 would increase. A very rough estimate would be that the new impervious area in WHPAs, and APA zones in both cities is doubled, compared to Alternative 1. A third area of potential concern, the City of Kent, would be added with improvements to SR 167.

The number of public and private wells within one-quarter mile of the project would increase, primarily due to arterials in north Redmond, Newcastle, and Kent. The number of WHPAs affected would also increase from 8 to 13. New lanes on SR 167 and an associated arterial would cross three new WHPAs for Kent wells and the WHPA for Springbrook Springs. The number of other WHPAs would increase from two to three because the end of a new arterial would intersect the Maplewood WHPA.

The new impervious area crossing medium CARAs in Snohomish County would increase. New arterials would approximately double the crossing of high CARAs in downtown Redmond. In the southern portion of the study corridor, new lanes and arterial improvements would also approximately double the high CARA areas crossed. SR 167 would add a fourth CARA region with 6 miles of new lanes in a high CARA.

Approximately 50 percent of the Alternative 2 projects (those shown on the map) would cross potential recharge areas. Multiplying the total new impervious surface area of 820 acres including the No Action Alternative by 50 percent yields a value of 410 additional acres for the potential recharge area that may be lost as a result of the placement of new impervious surfaces.

Operational Impacts

Surface Water

Alternative 2 would result in 820 acres (including the No Action Alternative) of new impervious surface within the study area. This would represent an increase of 0.6 percent in impervious area across the study area. The Springbrook Creek Basin would receive the most new impervious surface, 145 acres. Four other basins would receive more than 50 acres of impervious surface: East Lake Washington, Sammamish River, and South Kelsey and North creeks. Only the Duwamish River would experience less than 5 acres of new impervious surface. On a relative basis, South Kelsey Creek would experience the greatest impact, a 2 percent increase in impervious surface. The Lower Green River, and Forbes, North, Juanita, and Springbrook creeks would experience increases of one percent or greater of new impervious surface within their respective basins.

The improvements proposed under this alternative would result in an increase in runoff to local drainage systems and streams. The standard detention requirements for new projects would be generally sufficient to avoid causing or intensifying downstream drainage or flooding problems. However, runoff detention would not fully offset the changes in hydrology due to increased runoff volumes. The reduction in pervious area and its associated groundwater recharge would increase the frequency of moderate (return intervals of one year or less) stream flows and may result in a reduction in dry season base flows. This would be especially true for those basins mentioned above with a 1 percent or greater increase in impervious surface. Springbrook Creek already does not meet the water quality standard for temperature. Any substantial reduction in base flow could aggravate this situation.

Increases in COD, zinc, copper, total nitrogen, and total phosphorus, including approximately 145 tons per year of suspended solids, would be generated along the entire length of I-405 under Alternative 2, before treatment. There are a number of stormwater treatment facilities currently installed along I-405. Although their effectiveness in reducing overall highway pollutant loads has not been quantified regionally, actual pollutant loadings to the surface waters in the study area would be lower than the amounts calculated for this analysis. In summary, this alternative would result in substantial increases in impervious surface area in three basins. This could result in reductions in the base flows of these streams. This could also aggravate the temperature and heavy metals problems documented in Springbrook Creek. This alternative is expected to have substantial adverse operational impacts to surface water resources based on the criteria identified in Section 3.5.2.1. However, with the mitigation measures proposed in Section 3.5.5, surface water impacts would be reduced to below the threshold of significance.

A comprehensive, basin-wide study is needed to address the serious water quality problems in the Springbrook Creek Basin. Such a study could determine the impact of future development, including transportation improvements, upon the hydrology and water quality of the stream. Measures that may be considered to address the water quality problems identified for Springbrook Creek Basin include groundwater recharge of treated stormwater, flow augmentation, re-establishment of riparian zone vegetation and associated shading, and stormwater treatment to reduce heavy metals. The study could identify stream improvements and stormwater management requirements necessary to achieve a net improvement in the temperature and heavy metal problems currently experienced by this stream.

Groundwater

The potential for Alternative 2 operational activities to adversely impact groundwater quality is rated moderate, but the relative extent of impacts is higher than for Alternative 1 (and the No Action Alternative) as a consequence of the approximate doubling of areas that cross WHPAs, APAs, CARAs, and the Cedar Valley sole-source aquifer.

Alternative 2 is estimated to eliminate 410 acres of recharge area (including the No Action Alternative) versus the estimated loss of 104 acres of recharge for the No Action Alternative. Therefore, the potential for Alternative 2 operational activities to adversely impact groundwater recharge would be moderate. The incremental loss of 306 acres of recharge area is only 12 percent of the current total transportation infrastructure related-impervious surface in the I-405 corridor. Although some potential exists for operational activities to impact groundwater quality and quantity, the impacts that may occur to groundwater quality and quantity are not substantial under normal operating conditions. However, in the traffic accident scenario, impacts to groundwater quality could be substantial.

3.5.4.4 Alternative 3: Mixed Mode Emphasis

Construction Impacts

Surface Water

Under Alternative 3, five basins would have 10 or more projects constructed within their boundaries, while an additional five basins would be affected by between 5 and 10 projects. North Creek would experience the highest number of projects (16). These projects would have the potential to temporarily degrade water quality during construction. Several of the stream basins have the potential to suffer serious, short-term water quality degradation due to a combination of their sloping nature and the relatively high number of projects proposed for construction (five or more). Basins most likely to experience serious short-term water quality degradation include East Lake Washington, the Sammamish and Cedar rivers and tributaries, and Springbrook, Swamp, Forbes, Juanita, South Kelsey, North, and Bear creeks. Mitigation measures identified in Section 3.5.5 would reduce impacts to a level that is not substantial. Wet-weather construction within these basins could seriously degrade water quality. Substantial short-term impacts would be avoided by implementing water quality BMPs during construction.

Groundwater

Alternative 3 impacts are similar to those for Alternative 2, and the potential for construction impacts to adversely impact groundwater is rated moderate for impacts to groundwater quality and quantity. Although the rating of moderate for impacts from Alternative 3 is the same as the rating for impacts from Alternative 2, additional projects and additional surface area in sensitive areas does increase the relative potential for groundwater contamination during construction. The Alternative 3 relative extent of impacts to groundwater would be higher than that for Alternative 2 (and Alternative 1) as a consequence of the increase in areas that cross WHPAs, APAs, CARAs, and the Cedar Valley sole-source aquifer.

Although some potential exists for construction activities to impact groundwater quality and quantity, the potential impacts from implementation of Alternative 3 are not substantial.

Operational Impacts

Surface Water

Alternative 3 would result in 773 acres (including the No Action Alternative) of new impervious surface within the study area. This would represent an increase of 0.6 percent in impervious area across the study area. The Springbrook and North creek basins would receive the most new impervious surface, 111 acres. Three other basins would receive more than 50 acres of impervious surface: Sammamish River, South Kelsey Creek, and East Lake Washington Basin. The Duwamish River and Kelsey Creek would each receive less than 5 acres of new impervious surface. On a relative basis, South Kelsey Creek would experience the greatest impact, a 1.9 percent increase in impervious surface. The Lower Green River and North Creek would each experience an increase of about one percent of new impervious surface.

Increases would occur for COD, zinc, copper, total nitrogen, and total phosphorus including approximately 265 tons per year of additional suspended solids along the entire length of I-405, before treatment. Standard water quality treatment can substantially reduce contaminants, as described in the surface water impacts section for Alternative 2 above. In summary, this alternative would result in substantial increases in impervious surface area in two basins: South Kelsey and North creeks. This could result in reductions in the base flows of these streams. This alternative is expected to have substantial adverse impacts to surface water resources based on the criteria identified in Section 3.5.2.1. However, with the mitigation measures proposed, surface water impacts would be reduced to below the threshold of significance.

Groundwater

The potential for Alternative 3 operational activities to adversely impact groundwater quality is rated moderate, with the relative extent of impact approximately equal to that for Alternative 2.

Alternative 3 is estimated to eliminate 387 acres of recharge area (including the No Action Alternative) versus the estimated loss of 104 acres of recharge for the No Action Alternative. Therefore, the potential for Alternative 3 operational activities to adversely impact groundwater recharge would be moderate, with Alternative 3 having slightly less potential impacts than Alternative 2. The incremental loss of 283 acres of recharge area is only 11 percent of the current total transportation infrastructure-related impervious surface in the I-405 corridor.

3.5.4.5 Alternative 4: General Capacity Emphasis

Construction Impacts

Surface Water

Under Alternative 4, six basins would have 10 or more projects constructed within their boundaries, while an additional four basins would see between 5 and 10 projects. The North Creek Basin would experience the highest number of projects (19), followed closely by the Sammamish River Basin.

These projects would have the potential to temporarily degrade water quality during construction. Several of the stream basins would potentially suffer serious short-term water quality degradation due to a combination of their sloping nature and the relatively high number of projects proposed for construction (five or more). These include East Lake Washington, the Cedar, Sammamish and Lower Green rivers and tributaries, and Springbrook, Swamp, Forbes, Juanita, South Kelsey, and North creeks.

Groundwater

Potential construction impacts to groundwater quality and quantity are similar to Alternative 3. Although there are differences between Alternatives 3 and 4 in the number and width of crossings of areas sensitive to groundwater contamination, the net effect is that the extent of construction impacts to groundwater for Alternative 4 would be approximately the same as for Alternative 3. The distribution of impacts shifts slightly, decreasing the extent of impacts in Redmond while increasing the extent of impacts in Renton and Kent.

Although some potential exists for construction activities to impact groundwater quality and quantity, the potential impacts from implementation of Alternative 4 would not be substantial. The potential for construction impacts to adversely impact groundwater is rated moderate.

Operational Impacts

Surface Water

Alternative 4 would result in 1,061 acres (including the No Action Alternative) of new impervious surface within the study area. This would represent an increase of 0.8 percent in impervious area across the study area. The South Kelsey and North creek basins would receive the most new impervious surface, 160 acres each. Three other basins would receive more than 100 acres of impervious surface: East Lake Washington, Sammamish River, and Springbrook Creek. The Swamp and Juanita creek basins would each receive between 50 and 100 acres of new impervious surface. The Duwamish River and Kelsey Creek Basin would each experience less than 5 acres of new impervious surface. South Kelsey Creek would experience the greatest impact, an approximately 3 percent increase in impervious surface. Forbes, Springbrook, Juanita, and North creeks, and the Lower Green River and East Lake Washington basins would each experience increases of between 1 and 2 percent of new impervious surface.

The standard detention requirements for new projects would be generally sufficient to avoid causing or intensifying downstream drainage or flooding problems from increases in runoff resulting from the proposed projects. However, runoff detention would not fully offset the changes in hydrology due to increased runoff volumes. The reduction in pervious area and its associated groundwater recharge would increase the frequency of moderate (return intervals of one year or less) stream flows and may result in a reduction in dry season base flows. This would be especially true for those basins mentioned above with a 1 percent or greater increase in impervious surface. Springbrook Creek currently does not meet the water quality standard for temperature, and any substantial reduction in base flow could aggravate this situation.

Increases are expected in COD, zinc, copper, total nitrogen, and total phosphorous, including approximately 339 tons per year of additional suspended solids that would be generated along the entire length of I-405. Stormwater treatment would be implemented for new impervious surfaces associated with each of the new projects proposed as part of this alternative. Stormwater retrofit of existing road surfaces associated with these new projects should be evaluated and carried out wherever practicable. In particular, the lane additions proposed for all I-405 segments under Alternative 4 would present an opportunity to retrofit the entire length of I-405. It is a State goal to fully retrofit I-405 and other state highways in the study area by 2015. To the extent that this goal is achieved, quality benefits would result within portions of the study area.

In summary, this alternative would result in substantial increases in impervious surface area in seven basins. This could result in reductions in the base flows of these streams. This could also aggravate the temperature and heavy metals problems documented in Springbrook Creek. This alternative is expected to have substantial adverse operational impacts to surface water resources. However, with the mitigation measures proposed in Section 3.5.5, surface water impacts would be reduced to below the threshold of significance.

Groundwater

The potential for Alternative 4 operational activities to adversely impact groundwater quality is rated moderate. As is the case for construction impacts, the extent of impacts would be similar to those for Alternative 3, with a slightly shifted distribution.

The greatest distinction in potential impacts between Alternatives 3 and 4 is that the increased impervious surface area associated with Alternative 4 may increase the extent of operational impacts on groundwater quantity. Alternative 4 is estimated to eliminate 531 acres of recharge area (including the No Action Alternative) versus the estimated loss of 104 acres of recharge for the No Action Alternative. Therefore, the potential for Alternative 4 operational activities to adversely impact groundwater recharge would be moderate, with Alternative 4 having greater impacts than Alternative 3. The incremental loss of 427 acres of recharge area is only 17 percent of the current total transportation infrastructure-related impervious surface in the I-405 corridor. Although some potential exists for operational activities to impact groundwater quality and quantity, the impacts that may occur to groundwater quality and quantity would not be substantial under normal operating conditions. However, in the traffic accident scenario described above, impacts to groundwater quality could be substantial.

3.5.4.6 Preferred Alternative

Construction Impacts

Surface Water

Under the Preferred Alternative, six basins would have ten or more projects constructed within their boundaries, while an additional seven basins would be affected by between five and ten projects. The North Creek Basin would experience the highest number of projects (21). These projects would have the potential to temporarily degrade water quality during construction. Several stream basins have the potential to suffer serious short-term water quality degradation due to a combination of their sloping nature and the relatively high number of projects proposed for construction (five or more). Basins most likely to experience serious short-term water quality degradation include East Lake Washington, the Lower Green, Sammamish, and Cedar rivers and tributaries, and Springbrook, Swamp, Forbes, Juanita, South Kelsey, Coal, Forbes, North, May, and Bear creeks. Mitigation measures identified in Section 3.5.5 would reduce impacts to a level that is not substantial. Wet-weather construction within these basins could degrade water quality. Substantial short-term impacts could be avoided by implementing water quality BMPs during construction.

Groundwater

Impacts from the Preferred Alternative are similar to those for Alternative 3, and the potential for construction impacts to adversely impact groundwater is rated moderate for impacts to groundwater quality and quantity. Although the rating of moderate for impacts from the Preferred Alternative is the same as the Alternative 3 impacts rating, additional projects and additional surface area in sensitive areas does increase the relative potential for groundwater contamination during construction. The Preferred Alternative's relative extent of groundwater impacts would be higher than that for Alternative 3 as a consequence of the increase in areas that cross WHPAs, APAs, CARAs, and the Cedar Valley sole-source aquifer.

Although some potential exists for construction activities to impact groundwater quality and quantity, the potential impacts from implementation of the Preferred Alternative are not substantial.

Operational Impacts

Surface Water

The Preferred Alternative would result in 974 acres (including the No Action Alternative) of new impervious surface within the study area. This would represent an increase of 0.7 percent in impervious area across the study area. The East Lake Washington Basin would receive the most new impervious surface: 154 acres. Four additional basins would receive more than 100 acres of new impervious surface: Sammamish River, South Kelsey, North, and Springbrook creeks, while Swamp Creek would receive between 50 and 100 acres. The Duwamish River and Kelsey Creek would experience less than five acres of new impervious surface. On a relative basis, South Kelsey Creek (Mercer Slough) would experience the greatest impact, an approximately 2 percent increase in impervious surface. The East Lake Washington, Lower Green River, and the North, Juanita, and Springbrook creek basins would each experience an increase of about 1 percent of new impervious surface.

Increases would occur for COD, zinc, copper, total nitrogen, and total phosphorus, including approximately 276 tons per year of additional suspended solids, along the entire length of I-405 before treatment. Standard water quality treatment can substantially reduce contaminants as described in the surface water impacts discussion for Alternative 2 in Section 3.5.4.3 above.

In summary, the Preferred Alternative would result in substantial increases in impervious surface area in six basins: East Lake Washington, Lower Green River, and the North, Juanita, Springbrook, and South Kelsey creeks. This could result in reductions in base flows of these streams. This alternative could also aggravate the temperature and heavy metals increase documented in Springbrook Creek. Thus, the alternative is expected to have substantial adverse impacts to surface water resources based on criteria identified in Section 3.5.2.1. However, with the mitigation measures proposed, surface water impacts would be reduced to below the threshold of significance.

Groundwater

The potential for the Preferred Alternative operational activities to adversely impact groundwater quality is rated moderate, with the relative impact between Alternatives 3 and 4.

The Preferred Alternative is estimated to eliminate 487 acres of recharge area (including the No Action Alternative) versus the estimated loss of 104 acres of recharge for the No Action Alternative. Therefore, the potential for Preferred Alternative operational activities to adversely impact groundwater recharge would be moderate, with the Preferred Alternative having more potential impacts than Alternative 3 but less than Alternative 4. The incremental loss of 383 acres of recharge area is only 15 percent of the current total transportation infrastructure related impervious surface in the I-405 corridor.

3.5.5 Mitigation Measures

3.5.5.1 Surface Water

The following possible mitigation measures generally apply to all of the alternatives.

- Best management practices such as installing fencing, landscaping, erosion matting, hydro mulching, soil imprinting, straw bales, detention/sediment trap basins, and vegetated fringes would be used as appropriate. WSDOT would use the most current criteria and standards to mitigate stormwater quantity and quality impacts of the selected alternative. These standards will be presented in a WSDOT stormwater or highway runoff manual that will be functionally equivalent to Ecology's stormwater manual. These revisions are expected to address specific issues related to fish, especially chinook salmon.
- Construction disturbance will be limited to the smallest area practical. In particular, natural, undisturbed areas would be disturbed a little as possible. Clearing activities will be staged such that construction areas are cleared no earlier than one week ahead of the start of construction where practical. If this is impractical, cleared areas will be immediately mulched, covered with plastic, or otherwise stabilized.
- For projects constructed within 300 feet of a lake or stream, or where concentrated construction site discharge may flow directly to surface waters, all site grading and initial stabilization could be scheduled to occur only during the dry season, May 1 through September 30. Where construction must occur within stream channels, such construction will occur "in the dry" whereby streamflow is temporarily diverted around the work site where practicable to prevent turbidity. If other construction activities occur during the wet season, such as subgrade or pavement installation, utilities placement, or curbs and sidewalks, a plan will be developed that:
    - Limits disturbed area activities to a maximum of 48 hours at any single location.
    - Has provisions for temporarily ceasing construction and quickly stabilizing a site when rainfall greater than one-half inch in a 12-hour period is measured at the site.

- Uses alternative means for treating construction site runoff such as spray application or overland flow across a vegetated surface, or use of coagulants in the sediment ponds. If coagulants are used, a nontoxic compound will be used, such as an ionic acrylamide.

Grassed road embankments and biofiltration swales will be utilized wherever practical to maximize treatment of road runoff. Where new stream crossings are proposed, the design will consider opportunities to minimize the number of crossings by measures such as co-siting together on-ramps and off-ramps.

Planning for all major road upgrade projects would consider the practicality of retrofitting existing impervious road surface areas for runoff detention and treatment. Where determined to be practicable, retrofit measures will be budgeted into the road upgrade project.

Wherever soil tests and site conditions demonstrate practicality, infiltration of treated stormwater would be utilized. Early in the design of specific projects, opportunities for regional treatment and detention would be explored with adjacent municipalities.

Any new road crossings of streams will be via a bridge spanning the 100-year floodplain unless a hydraulic analysis demonstrates that infringing abutments and/or bridge piers would not substantially change local high-water depths or velocities. Disturbed riparian areas within road right-of-way will be planted with native vegetation for a minimum width of 100 feet from each stream bank.

Opportunities to increase the "perviousness" of impacted stream basins may be explored in cooperation with local agencies; these include replacing low-intensity-use paved areas (parking lots, sidewalks, walking-bicycle paths, etc.) with porous pavement and/or underground retention systems. Deep tillage of playfields, parks, lawns, and other landscape surfaces with amended soils can also be effective in reducing runoff. Pervious portions of the study area may be treated with soil amendments, mulch, and vegetation to help absorb stormwater rather than discharge stormwater to surface waters. All stormwater management facilities will be located outside of stream, steep slope, and wetland buffer areas.

The I-405 Corridor Program will continue to work closely with the U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), the Washington State Department of Fish and Wildlife (WDFW), Ecology, the tribes, local municipalities, and basin stakeholders to develop a program of support for both local and regional stream enhancement projects. Projects that improve stream water quality and habitat, particularly those which would benefit Endangered Species Act-listed species such as bull trout and chinook salmon, would be identified and targeted for accelerated development supported by WSDOT. This support program would also incorporate the mitigation measures contained in the *I-405 Corridor Program Draft Fish and Aquatic Habitat Expertise Report* (DEA, 2001a) and the *I-405 Corridor Program Draft Wetlands Expertise Report* (DEA, 2001b). The reader is referred to the *I-405 Corridor Program Draft Fish and Watershed Summary Report* (DEA, 2001c) for further information on regional mitigation for the program. The mitigation measures in these reports are also presented in Section 3.6.5 (Wetlands) and Section 3.8.5 (Fish and Aquatic Habitat). Regional mitigation would be applied commensurate with residual impacts after direct mitigation measures are applied.

The following are additional specific mitigation measures.

Alternatives 1 and 2. The eastern extension of the HCT to Issaquah lies within the Lake Sammamish Basin. Projects constructed within this basin would require special stormwater treatment to reduce phosphorus.

Alternative 2. With regard to the Juanita, North, South Kelsey, and Forbes basins, stormwater will be infiltrated where practicable so that groundwater recharge is emphasized in these basins. In addition, WSDOT and the affected municipalities will consider implementing mitigation projects that benefit the hydrology and habitat of these streams as measures to compensate for potential reductions in stream base flow resulting from proposed road improvements.

A WRIA-wide approach to mitigation of the program hydrologic impacts would be considered as a means to more effectively address base flow impacts. WRIA-level mitigation will need to demonstrate a greater environmental benefit than on-site mitigation.

Alternative 3. Wherever soil tests and site conditions demonstrate the practicability, infiltration of treated stormwater will be used. This mitigation is particularly applicable to those basins which may otherwise experience depletion of base flows: South Kelsey and North creeks.

In addition, where practicable, WSDOT and the affected municipalities would commit to projects benefiting the hydrology and habitat of these streams as measures to compensate for potential reductions in stream base flow resulting from proposed road improvements.

In addition, a WRIA-wide approach to mitigation of the program hydrologic impacts will be considered as a means to more cost effectively address base flow impacts. WRIA-level mitigation will need to demonstrate a greater environmental benefit than on-site mitigation.

Alternative 4. A portion of Project R.CF.3 involves improvements to I-90 within the Lake Sammamish Basin. Projects constructed within this basin would require special stormwater treatment to reduce phosphorus.

Wherever soil tests and site conditions demonstrate the practicability, infiltration of treated stormwater will be utilized. This mitigation is particularly applicable to those basins which may otherwise experience depletion of base flows: Springbrook, South Kelsey, East Lake Washington, Forbes, Juanita, and North Creek. In addition, where practicable, WSDOT and the affected municipalities would commit to projects benefiting the hydrology and habitat of these streams as measures to compensate for potential reductions in stream base flow resulting from proposed road improvements. The comprehensive basin study for the Springbrook Creek Basin mentioned under Alternative 2 would also apply to Alternative 4.

In addition, a WRIA-wide approach to mitigation of the program hydrologic impacts will be considered as a means to address base flow impacts in a more ecologically beneficial and cost-effective manner.

Preferred Alternative. The mitigation measures presented for Alternative 4 would be applicable for the Preferred Alternative, except infiltration of treated stormwater will be emphasized where practicable in the following basins as a measure to mitigate depletion of base flow: East Lake Washington and Juanita, Springbrook, South Kelsey, and North creeks.

3.5.5.2 Groundwater

Groundwater Quality

Mitigation measures to decrease the potential for groundwater contamination in the sensitive areas are based on minimizing the use of hazardous materials in the areas. During construction, the following mitigation measures will be implemented where practicable and appropriate to the project:

- Refueling and maintenance of construction vehicles will not occur within 100 feet of the edge of any sensitive areas. More restrictive measures may be required where ESA species would be impacted. Refueling will follow the Guidelines for Mobile Fueling of Vehicles and Heavy Equipment in Chapter III of the 2001 Ecology manual or functionally equivalent stormwater guidance.
- Hazardous materials will not be stored closer than 300 feet to any stream, wetland, or other sensitive area at the project site. Where hazardous materials must be temporarily stored at the project site, secondary containment will be provided.
- A project staging area will be located outside of the sensitive areas for vehicle fueling and storage of construction-related hazardous materials. The area will be designed to capture all runoff and/or spills.
- Runoff will be collected from construction areas and treated and/or discharged consistent with Ecology's Stormwater Manual (2001) or functionally equivalent stormwater guidance. Measures to protect Renton's Aquifer Protection Area from infiltration of project runoff will be implemented.
- A plan will be developed for hazardous material spill response.
- Fill will not contain hazardous materials or materials that could adversely affect upland and/or aquatic species due to leaching or bioaccumulation.

Measures for mitigation of operational impacts to groundwater quality are also based on preventing hazardous materials from reaching soil and infiltrating into groundwater. These measures could include:

- Runoff from construction areas will be collected and treated and/or discharged consistent with Ecology's Stormwater Manual (2001) or functionally equivalent stormwater guidance. Measures to protect Renton's Aquifer Protection Area will be implemented.
- Spill prevention, control, and countermeasure plans will be developed and will include local, state, and Federal emergency contact information.
- Barriers will be placed at the sides of roads within WHPAs, SSAs, and high CARAs to prevent spills from reaching soils.

The last two measures may be applied specifically to address the substantial potential for groundwater contamination that could occur under the rare traffic accident chemical spill scenario.

Groundwater Quantity

To mitigate the potential decrease in groundwater recharge in CARAs and other potential recharge areas during construction, stormwater that might have been collected and conveyed to areas outside the CARAs can be re-infiltrated. In this scenario, the mitigation measures will include some form of treatment to ensure that groundwater quality is not adversely affected, such as the use of bioswales or infiltration ponds. Other measures for mitigating long-term loss of recharge to aquifers could include:

- Decreasing slopes of areas not covered with impervious surfaces.
- Planting vegetation in cleared areas.
- Providing adjacent infiltration areas where large areas of impervious surfaces are unavoidable; in other words, interspersing pervious areas among the impervious areas to allow recharge via infiltration of rainwater. Runoff from construction areas will be collected and treated and/or discharged consistent with Ecology's Stormwater Manual (2001) or functionally equivalent stormwater guidance. Measures to protect Renton's Aquifer Protection Area from infiltration of project runoff will be implemented.

Additional mitigation measures may be achieved by following the design guidelines in the local sensitive area ordinances (such as measures to prevent erosion).

To mitigate the depletion of groundwater supplies via construction dewatering or pump testing, the groundwater that is removed may be re-infiltrated, provided programs are in place to test for and/or treat to the groundwater to remove hazardous materials that may have come in contact with the groundwater.

3.6 WETLANDS

3.6.1 Studies and Coordination

3.6.1.1 Data Sources

Wetland data were evaluated using existing information from a variety of federal, state, regional, and local sources. Digital Geographic Information System (GIS) information was available from the United States Department of the Interior (USDI) - National Wetlands Inventory (NWI), Washington State Department of Fish and Wildlife (WDFW) Priority Habitat and Species (PHS) program, and King County. These primary sources were supplemented using the following reference materials:

- I-405 HOV Lanes – Bothell to Swamp Creek Environmental Analysis (DEA, 1996);
- Snohomish County Stream and Wetland Inventory (1987);
- King County Sensitive Areas Map Folio (1990);
- King County Wetlands Inventory Volumes 1 – 3 (1990);
- City of Bothell Critical Areas GIS Map (2002);
- City of Bothell Critical Areas Map (1990);
- City of Kirkland Streams, Wetlands, and Wildlife Study (1998);
- City of Redmond Sensitive Areas Map (1997);
- City of Bellevue Sensitive Areas Notebook (1987);
- City of Kent Wetland Inventory Maps (1998);
- City of Kent Wetland Inventory Report (1990); and
- City of Renton Wildlife Corridor Study (1994).

The following USDI-NWI maps were used to cross-reference digital data from other sources and to assure that overlapping wetlands were given a United States Fish and Wildlife Service classification (Cowardin et al., 1979) if one existed:

- Mercer Island quadrangle (1988);
- Kirkland quadrangle (1988);
- Renton quadrangle (1988);
- Bothell quadrangle (1989);
- Issaquah quadrangle (1989);
- Auburn quadrangle (1988); and
- Redmond quadrangle (1989).

Additional cities were consulted to determine the nature and extent of wetlands within their jurisdictions. These cities include:

- City of Tukwila;
- City of Kenmore;
- City of Mountlake Terrace;

- City of Woodinville; and
- City of Newcastle.

Aerial photographs depicting November 1, 1999, conditions were available for most of the I-405 corridor. They were used to identify probable wetland resources absent from local inventories. These "absent" wetland resources were added to the digital wetland data set to develop a compilation of wetlands potentially impacted by the various alternatives. Secondary resources such as maps and aerial photographs do, however, tend to greatly underestimate wetland acreage and are of limited use in estimating wetland type and function.

Most of the available digital data were derived from sources created over ten years ago (e.g., King County and NWI data, which were developed using aerial photographs). Because of this, and the fact that limited field investigations were conducted during the creation of these data, the estimates of wetlands and acres impacted will vary between the programmatic and project-level phases. Some wetlands identified in the digital data set may have changed or been altered partially or fully by other projects. Furthermore, broad-scale wetland mapping used in this evaluation may miss smaller isolated wetlands not visible in aerial photographs. Although these limitations reduce the overall wetland details, comparisons of trends and potential impacts are considered acceptable at this programmatic level of analysis. On-site investigations will be an integral part of project-level analyses to refine wetland boundaries, types, and functions to determine potential project-specific wetland impacts, avoidance, and mitigation measures.

3.6.1.2 Agency Coordination

Resource agencies contacted included the U.S. Army Corps of Engineers (USACOE), WDFW, Washington State Department of Ecology (Ecology), U.S. Department of Interior - Fish and Wildlife Service (USFWS), and U.S. Department of Commerce - National Marine Fisheries Service (NMFS). Methodologies and strategies for impact assessment, avoidance, minimization, and mitigation were discussed.

3.6.1.3 Policies and Codes

The following wetland policies and codes are relevant to wetlands management in the study area. Policies and codes covering wetlands are complex in that numerous federal, state, and local jurisdictions manage wetlands differently, and various agencies may take jurisdiction over the same wetland depending on the location and degree of potential impact. The following list is not all-inclusive, but highlights many of the relevant policies and codes that have been put into place to protect wetlands and to achieve no net loss of wetlands:

- Federal Clean Water Act – Section 404;
- Federal Clean Water Act – Section 401;
- Federal Rivers and Harbors Act – Section 10;
- Federal Coastal Zone Management Act;
- National Environmental Policy Act (NEPA);
- State Environmental Policy Act (SEPA);
- State Growth Management Act (GMA);
- State Shoreline Management Act;

- State Water Pollution Control Act;
- State Hydraulic Code;
- State Forest Practices Act; and
- Local laws (county and city codes).

Additional measures designed to protect wetlands include Executive Orders such as 89-10 and 90-04 that relate to no net loss of wetlands, and may result in more stringent compensation ratios than required by other agencies. Furthermore, WSDOT Environmental Procedures Manual (Volumes 1 and 2) (WSDOT, 2001) outlines the issues and actions to be addressed prior to authorizing work that could impact wetlands within their right-of-way.

3.6.2 Methodology

Wetland resources identified from the above sources were compiled onto one set of 1"=1,600' maps. The set of maps was then digitized and added to the original set of digital GIS data from NWI, WDFW, and King County to produce the final compiled wetland base map. Preliminary project plans were then overlaid onto the composite GIS wetland resources map using ArcInfo. Projects were identified as having potential wetland impacts when any portion of the road prism or other potential improvements overlapped the wetland boundary or wetland buffer.

The two primary measures used to evaluate wetland impacts were numbers of wetlands and estimated area of impact (in acres) affected by transportation improvements. Because of varying dimensions of facilities and the wide array of project elements associated with each alternative, several simplifying assumptions were made to estimate the potential impacts. These assumptions are outlined in Table 3.6-1 below. The "new improvement distance" is an estimate of the width of the new improvements from the centerline of the existing right-of-way. This width does not include auxiliary facilities such as stormwater best management practices (BMPs) that may require the acquisition or use of additional property within or adjacent to anticipated project improvements. The width accounts for only one side of the centerline. The "impact width" on the table indicates the difference in width between the distance needed for existing facilities and the new improvements. This distance is the anticipated "width of impact" extending beyond the existing transportation facility on each side. This approach resulted in a standardized and repeatable method of impact analysis.

The total acreage and number of wetlands (or portion of wetlands) potentially impacted by the improvements were calculated using ArcInfo Version 7.1.2. Wetland impacts were assumed to be conservative because some projects could actually span wetland areas rather than fill them, many wetlands could already be filled or heavily altered, and some wetlands could be impacted by multiple projects within the same alternative. In situations where a single wetland was affected by more than one proposed improvement, double counting of numerical – not acreage – impacts may have resulted. Furthermore, in some cases under the fixed-guideway high-capacity transit element, the creation of an additional railway line may not be required. Analysis totals from ArcInfo could not be corrected with reasonable effort. This resulted in the total impacts for individual improvement elements appearing to be slightly higher than the overall alternative impact totals.

Table 3.6-1: Summary of Improvement Impact Width Assumptions

Element	Existing Facility Distance from Centerline	New Improvement Distance from Centerline	Potential Impact Width
Arterial HOV	30 feet	45 feet	15 feet
I-405 HOV Direct Access	35 feet	50 feet	15 feet
Basic I-405 Improvements	90 feet	125 feet	35 feet
Add Two General Purpose on I-405 and Express Lanes	90 feet	125 feet	35 feet
Add One General Purpose on I-405	90 feet	110 feet	20 feet
Widen SR 167	90 feet	125 feet	35 feet
Connecting Freeway Capacity	35 feet	50 feet	15 feet
Planned Arterial Improvements	35 feet	50 feet	15 feet
North-South Arterial Capacity	35 feet	50 feet	15 feet
I-405 Arterial Connections	35 feet	50 feet	15 feet
I-405 Non-motorized Crossings	0 feet	7 feet	7 feet
Pedestrian/Bicycle Transit	0 feet	5 feet	5 feet
Fixed-Guideway High-Capacity Transit	0 feet	40 feet	40 feet

In addition, because wetland data were combined from various sources and multiple classification systems, wetlands in the database could contain multiple wetland classes in a single wetland complex. Most discrete wetland classes were either USFWS classes (e.g., PFO, PSS, PEM, or POW) or were the result of wetland boundary data for a specific wetland not exactly matching in shape, size, or exact location (e.g., King County vs. NWI vs. WDFW). Each discrete wetland was given a unique identification code and, if connected to other discrete wetlands, the group of wetlands was given a wetland complex identification code. Unique identification codes for discrete wetlands allow more detailed analysis of impacts to the various wetland types, especially Cowardin classes (Cowardin et al., 1979), but may overstate the total number of impacted wetlands. Complex codes better represent the actual number of wetlands affected than the unique codes, but do not allow for detailed wetland analysis or tracking of impacts.

The wetlands analyses in this section are based on the *I-405 Corridor Program Draft Wetlands Expertise Report* (DEA, 2001), herein incorporated by reference.

3.6.2.1 Analysis Approach

Five approaches were used to analyze wetland impacts: 1) sorting wetland data by High Priority (HP) and Lower Priority (LP) wetlands, 2) sorting available NWI wetlands data, 3) determining buffer impacts, 4) sorting data by jurisdiction, and 5) sorting data by basin.

High and Lower Priority Wetlands. To effectively analyze wetland impacts, a unique system of classifying wetlands was created by WSDOT (DEA 2002). The system attempts to differentiate wetlands of higher biological and hydrological value from those of lower value. Most jurisdictions along the I-405 corridor classify higher-value wetlands as Category 1 or 2. Ecology classifies them as Categories I through III. Because no uniform classification system exists for all wetlands in the corridor, a "priority" ranking system was used. Wetlands were designated as either High Priority (HP) or Lower Priority (LP). HP wetlands include all wetlands in the highest category defined by any jurisdiction or agency and the additional criteria listed in Table 3.6-2. High Priority wetlands are those wetlands:

Table 3.6-2:
High Priority Wetland Criteria by Jurisdiction

	ECOLOGY	KING COUNTY	SNOHOMISH COUNTY	REDMOND	TUKWILA	RENTON	BOTHELL	KENMORE	KENT	WOODINVILLE	KIRKLAND	NEWCASTLE	BELLEVUE
HIGHEST CLASSIFICATION CRITERIA BY JURISDICTION													
Type A - All wetlands related by surface hydrology to a Type A or B riparian corridor.													✍
Presence of T&E species	✍	✍		✍	✍	✍	✍	✍	✍	✍	✍	✍	
Critical or outstanding T&E habitat		✍		✍	✍	✍	✍	✍	✍	✍	✍	✍	
Priority or Sensitive Species present				✍			✍		✍				
WA Natural Heritage Program high quality native wetland	✍								✍			✍	
DNR Heritage Quality Wetland													
Bogs or fens	✍		✍									✍	
Estuarine wetlands or mature forested wetlands	✍		✍									✍	
Plant associations of infrequent occurrence		✍		✍		✍	✍	✍		✍			
No non-native plant populations	✍												
Regionally significant waterfowl or shorebird concentration area			✍										
Locally significant ('exceptional significance' or 'unique & fragile')	✍											✍	
40%-60% open water in dispersed patches w/ = 2 wetland veg. classes		✍		✍	✍	✍	✍	✍	a ✍	✍			
= 10 acres w/ = 3 wetland veg. classes (one of which can be open water)		✍	✍			✍	✍	✍	✍	✍	✍		
= 5 acres w/ = 3 wetland veg. classes					✍								
= 3 wetland classes each over 10% of total area			✍										
= 2 wetland classes		✍						✍					
No sig. human-caused degradation	✍												
= 1/4 acre of organic soils (peat or mucky soils)											✍		
Unique/outstanding #1 rating in King Co. Wetlands Inventory						b ✍				c ✍			
Hydrologically connected			✍										
Contiguous w/ Lake Washington											✍		
ADDITIONAL CRITERIA USED IN THIS ANALYSIS REGARDLESS OF JURISDICTION													
T&E species within habitat polygons (indicated on PHS and Streamnet databases)													
Any wetland located within 0.5 mile of T&E species point													
Any wetland in close proximity to streams with T&E or candidate species													
All wetlands 1 acre or more													

Note: Mountlake Terrace has no categorization criteria but uses SEPA process.

[a] (slight language difference than other citation: = 2 acres having 40% - 60% and = 2 veg. classes.)

[b] based on 1991 ("or most current") inventory

[c] based on 1983 inventory

- Identified by any jurisdiction in the study area as Category 1 or similar rating of the highest value. For example, any wetland in Redmond classified as Category 1 by the City of Redmond is considered HP;
- Containing threatened or endangered species within WDFW – PHS mapped areas (polygons); located within 0.5 mile of a documented threatened and endangered (T&E) species occurrence; or adjacent to streams with T&E or candidate species; or
- Greater than 1 acre in size.

Lower Priority wetlands are those wetlands not rated as HP. Because these wetlands potentially have lower values, protection and mitigation requirements may be less stringent than those for HP wetlands. They may, however, still provide important functions and be subject to permitting and other regulations. In particular, wetlands regulated under Section 404 of the Clean Water Act are subject to the USACOE permitting process. HP and LP wetlands would likely be subject to Section 404.

Because the criteria for rating the wetlands are broad, many wetlands classified at lower levels by local jurisdictions may have been considered HP in this analysis. This HP/LP classification system ensures that all high quality wetlands, including both those designated by agencies and jurisdictions and those that may not meet local criteria but still are of high value, are given HP status.

National Wetlands Inventory (NWI). Wetlands were also analyzed using the USFWS wetland classification system (Cowardin et al., 1979) if existing information was available. Analyzing wetland impacts by the USFWS classification system (Cowardin et al., 1979) provides insight into potential loss of wetland function as it relates primarily to wildlife utilization. Wetlands found along the various alternatives included three of the five classes of NWI wetlands, including Lacustrine, Palustrine, and Riverine systems. The Lacustrine (lake) System is composed of the Limnetic (L1) and Littoral (L2) subsystems. The Palustrine System includes non-tidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 percent.

Palustrine wetlands include one or more of the following classes: forested (PFO), scrub-shrub (PSS), emergent (PEM), and open water (POW). The Riverine System includes wetlands contained within a channel that has been created either naturally or artificially and that usually, but not always, contains flowing water. The Riverine System is divided into four primary subsystems, tidal (R1), lower perennial (R2), upper perennial (R3), and intermittent (R4). These systems contain numerous subsystems, classes, subclasses, and modifiers to further describe the characteristics of a specific wetland.

Wetland Buffer. Wetland buffer impacts were analyzed using the same "impact width" assumptions as outlined in Table 3.6-1 above. Each wetland was assigned either a 100- or 50-foot buffer depending upon assigned priority (HP or LP, respectively). Buffers were considered impacted if any part of the impact width associated with a proposed improvement intersected the assumed buffer assigned to each wetland. Because buffer functionality varies substantially, buffer functions are discussed generally in this EIS. For the purposes of this programmatic assessment, buffer impacts are assumed to be highly correlated with total wetland acreage potentially impacted. Buffer functions and impacts will be analyzed at the project level during future NEPA and SEPA environmental analysis, documentation, and review.

Wetland Functions. Wetlands are known to perform important functions in an ecosystem, some of which are of immediate value to human society. Although these functions are complex, interrelated, and difficult to assess and quantify, guidelines for assessment have been developed by numerous agencies and jurisdictions, including USFWS, Ecology, WDFW, etc. While wetland functions may be considered in defining wetland classification criteria, they are not themselves criteria. Each wetland rating system has its own functional implications. Most of these functions have been included in WSDOT's *Wetland Functions Characterization Tool for Linear Projects*, which is summarized in Table 3.6-3 (Null et al., 2000). Valuable functions include: flood flow alteration; sediment removal; nutrient and toxicant removal; production of organic matter and its export; wildlife habitat; and fish habitat. The attributes that potentially influence wetland functions and are used as rating criteria are also provided in Table 3.6-3.

Table 3.6-3: Summary of Wetland Functions and Rating Criteria

Wetland Function	Attributes Used to Rate Function
Flood Flow Alteration	• Wetland size • Capacity • Location in the watershed (wetlands higher in the watershed have more effect on reducing flooding to downstream areas, while wetlands lower in the watershed may provide greater benefits to a specific area) • Situated within a riparian zone in a floodplain • Contains dense woody vegetation
Sediment Removal	• Configuration (wetland bowl shaped so that water is detained for long durations) • Contains dense herbaceous vegetation
Nutrient and Toxicant Removal	• Configuration (wetland bowl shaped so that water is detained for long durations) • Contains dense herbaceous vegetation
Erosion Control and Shoreline Stabilization	• Part of a watercourse • Vegetation composed of either a dense energy-absorbing, resilient herbaceous layer or a mixture of trees and large multi-stemmed shrubs that can withstand high flow velocities and/or wave action
Production of Organic Matter and its Export	• Large areas of vegetation • Structural complexity (plant layers) • Contains a surface water outlet
Wildlife Habitat	• Possesses two or more USFWS classification systems • Possesses connectivity • Signs of wildlife use present • Contains plant forage species
Fish Habitat	• Associated with fish-bearing waters • Possesses acceptable water quality • Contains appropriate conditions for rearing, refuge, and/or spawning habitat

3.6.3 Affected Environment

A total of 2,395 existing discrete wetlands (1,066 complexes) are located within 19 basins (26 sub-basins) in the study area. Furthermore, approximately 9,814 acres of wetland occur in the study area based on the existing data. Table 3.6-4 depicts the total number of documented discrete and complex wetlands per sub-basin, and the total wetland acreage of each basin in the study area. Basins within the study area with over 100 documented wetland complexes include the Black River (n = 184), North Creek (n = 112), and the Sammamish River (n = 117). Wetlands in the study area appear to be most common in the Kent Valley, the Sammamish Valley of Redmond, in Bellevue at I-405 and I-90, and the North Creek area of Woodinville and Bothell. Major NWI Lacustrine

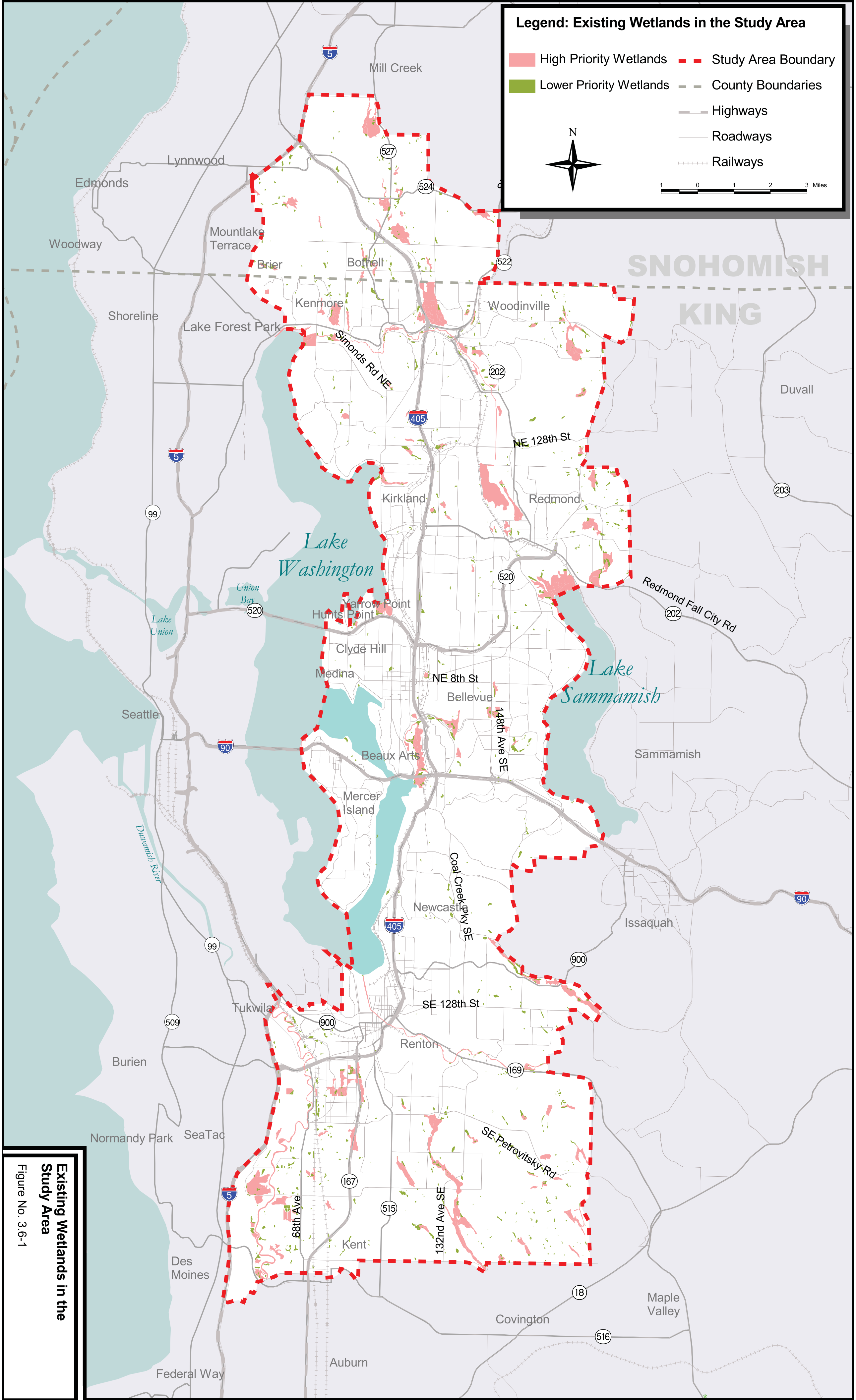
System wetlands in the study area include Lake Washington and Lake Sammamish. Figures 3.6-1 and 3.8-1 (in Section 3.8) generally present the wetlands and basins within the study area.

Table 3.6-4: Summary of Wetland Quantity and Acreage by Sub-Basin within the Study Area.

Basin	Number of Unique IDs	Number of Complexes	Total Area (Acres)
Cedar/Sammamish/ Lake Washington Watershed (WRIA 8)			
Swamp Creek	131	56	494
Big Bear Creek	228	88	744
Lower Cedar River	171	87	622
Coal Creek (Cedar)	7	6	7
West Lake Sammamish	63	38	188
East Lake Sammamish	6	1	6
East Lake Washington	105	80	256
Evans Creek	51	16	252
Forbes Creek	32	14	85
Issaquah Creek	5	1	55
Juanita Creek	51	24	131
Kelsey Creek	55	28	202
Little Bear Creek	50	21	172
Jenkins Creek	31	22	124
Sammamish River	320	117	1,629
Lyon Creek	12	7	20
May Creek	122	26	361
Mercer Island	16	12	289
Mercer Slough	79	17	426
West Lake Washington	1	1	< 0.5
North Lake Washington	11	6	21
North Creek	257	112	1,213
Green/Duwamish Watershed (WRIA 9)			
Lower Green River	77	23	536
Duwamish River	11	5	51
Soos Creek	180	74	815
Black River	323	184	1,116
Total Wetlands	2,395	1,066	9,814

Describing the numbers and acreage of wetlands by basin within the study area provides insight into baseline conditions within hydrologic boundaries. The study area does not follow hydrologic boundaries and includes the lower portion of many of the basins outlined in Table 3.6-4 above. Furthermore, some basins outlined in Table 3.6-4 extend beyond the study area or are not impacted by project-specific activities associated with the various alternatives.

The wetlands in the study area provide a number of functions and values in the biological, hydrological, and societal landscape. For example, these wetlands provide essential habitat for threatened and endangered (T&E) plants and animals, and for species with other special status. HP wetland functions include:



Existing Wetlands in the Study Area

Figure No. 3.6-1

This page left intentionally blank.

- Providing perching, foraging, and/or buffer habitat for wildlife species with state or USFWS T&E species status, and specifically bald eagle and Oregon spotted frog (*Rana pretiosa*), although it is extremely unlikely that the latter species is present in the study area.
- Providing habitat for state and USFWS Species of Concern and Priority Species, including wood duck (*Aix sponsa*), mink (*Mustela vison*), and western toad (*Bufo boreas*).
- Providing habitat buffers for fish species with state or federal status, including Puget Sound chinook salmon (*Oncorhynchus tshawytscha*), bull trout (*Salvelinus confluentus*), and Puget Sound/Strait of Georgia coho salmon (*Oncorhynchus kisutch*). (See *I-405 Corridor Program Draft Fish and Aquatic Habitat Expertise Report* [DEA, 2001b]).
- Providing breeding or foraging habitat for common wetland species such as Canada goose (*Branta canadensis*), pied-billed grebe (*Podikymbus podiceps*), American coot (*Fulica americana*), spotted sandpiper (*Actitis macularia*), belted kingfisher (*Ceryle alcyon*), marsh wren (*Cistothorus palustris*), common yellowthroat (*Geothlypis trichas*), red-winged blackbird (*Agelaius phoeniceus*), several dabbling duck species (*Anas* spp.), vagrant shrew (*Sorex vagrans*), muskrat (*Ondatra zibethicus*), beaver (*Castor canadensis*), tree frog (*Hyla regilla*), and northwestern salamander (*Ambystoma macrodactylum*).
- Providing resting or feeding habitat for migrating birds, including waterfowl and shorebirds.
- Supporting T&E plant species such as water howellia (*Howellia aquatilis*), although no threatened or endangered plant species are known or likely to occur in the study area.
- Providing habitat for other native plant species.
- Removing sediment, nutrients, and contaminants from surface water.
- Reducing peak flows and storing flood waters.
- Recharging groundwater.

Functions that are expected to be present in LP wetlands within the study area include:

- Providing habitat for common wetlands-associated wildlife species.
- Reducing peak flows and storing flood waters.
- Removing sediment, nutrients, and contaminants.
- Recharging groundwater.

Analyzing HP wetlands, as well as total wetlands, is important because HP wetlands will need to be avoided as much as possible while LP wetlands may provide better opportunities for mitigation. LP wetlands are scattered throughout the study area. In general, HP wetlands in the study area are predominantly located near stream corridors in:

- Redmond (east of SR 202 and northwest of Lake Sammamish);
- Woodinville (east of I-405, north of SR 522);
- Bellevue (just west of I-405); and
- Kent (large, scattered wetlands east of I-5 to Kent Valley).

Wetland buffers are required in most jurisdictions within the study area. Buffers help maintain wetland functions and values by limiting many of the typical wetland alterations caused by construction projects. Existing wetland buffers within and adjacent to the right-of-way of the proposed improvements vary in vegetation composition and width. Effective buffers are typically composed of various species of native vegetation that can protect and enhance potential wetland functions. Buffers within the existing roadway prism are typically not effective in protecting many of the functions and values associated with wetlands. Because buffer effectiveness depends upon the nature of the buffer, the specific wetland function or value being protected, and the potential alteration, buffer effectiveness is difficult to quantify. Many of the wetland buffers adjacent to the existing highways, arterials, and railroad right-of-way are mowed or otherwise altered. Wetland buffers within the existing roadway prisms are not typically part of the estimate for buffer impacts. Much of the affected buffer acreage discussed in this report consists of lateral extensions of an existing, mowed road shoulder's toe-of-slope.

3.6.4 Impact Analysis

The ability to quantify impacts of the proposed transportation improvements on wetlands is limited at the programmatic level and therefore any impact must be considered "potential." This level of analysis is consistent with the level of design available and the objectives of a programmatic EIS. Some projects, such as park-and-ride lots, lack specific information. The potential wetland impacts associated with these projects were impossible to determine without specific locations and sizes, and were therefore not quantified. Because detailed design plans are not yet available, acreage impacts are estimates and, while they are useful for comparisons among alternatives, they cannot be accurately determined for each type of transportation improvement. The number of wetlands impacted is used for comparison purposes, since the extent of the impact could only be estimated. All potential wetland impacts presented below represent the reasonable worst-case scenario. Details of wetland resources potentially impacted by the individual projects are recorded in Appendix C of the *I-405 Corridor Program Draft Wetlands Expertise Report* (DEA, 2001a).

For the purposes of the following analysis, wetland impacts are discussed by alternative and by transportation element, sorted by the five approaches: HP/LP, NWI, buffers, basins, and jurisdictions. The following paragraphs present the findings of the impact analyses.

High and Lower Priority. Table 3.6-5 presents a summary of wetland impacts for all alternatives. Impacts for Alternatives 1 through 4 and the Preferred Alternative include the baseline conditions associated with the No Action Alternative. The numbers of wetlands impacted include the number of discrete wetlands followed by the number of wetland complexes in parentheses. Between 35 and 190 discrete wetlands (25 and 110 complexes, respectively) could be impacted by the proposed improvements. These potential impacts are associated with 3 to 56 acres of wetlands. Impacts to HP wetlands range from 16 to 89 acres of unique wetlands.

The values reported in the following tables do not recognize the existing footprint of the BNSF Railroad where portions of the proposed fixed-guideway HCT facility would be aligned (Alternatives 1 and 2 only). This set of values provides a conservative estimate of wetland impacts. It is also a reasonable assumption for a substantial portion of the fixed-guideway HCT alignment that is proposed from Factoria to Issaquah and from Bellevue to Redmond, where no BNSF right-of-way exists. If the existing footprint for the BNSF Railroad had been incorporated into the calculations, the number of wetlands reported for Alternatives 1 and 2 would be less. Alternative 1 would impact 107 discrete wetlands (58 high priority) and 63 wetland complexes

(23 high priority), totaling approximately 14.6 acres (8.5 acres high priority). Alternative 2 would impact 171 discrete wetlands (75 high priority) and 97 wetland complexes (31 high priority), totaling approximately 41.9 acres (19.8 acres high priority).

Table 3.6-5: Summary of Wetland Impacts

	No Action	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Preferred Alternative
Acres of Wetland Area Impacted	3.3	28.9	56.2	39.6	39.0	24.9
Number of Discrete Wetlands Impacted (number of complexes)	35 (25)	126 (76)	190 (110)	170 (96)	152 (96)	150 (85)
Number of High Priority, Discrete Wetlands Impacted (number of complexes)	16 (9)	72 (30)	89 (38)	78 (34)	64 (36)	79 (36)
Acres of HP Wetlands Impacted	1.8	22.2	33.5	19.0	18.5	13.2
Acres of New Impervious Surface Area	173	478	820	773	1061	974

National Wetlands Inventory. USFWS (NWI) wetland classifications were available for only a portion of the potentially impacted wetlands in the existing database. The percentage of wetland impacts that could not be assigned to a specific USFWS classification varied by alternative, ranging from 24 percent (Alternative 1) to 48 percent (No Action Alternative). Wetlands with multiple USFWS classifications that could not be assigned to a specific class also varied by alternative, but ranged from 0 percent (No Action Alternative) to 20 percent (Preferred Alternative). Table 3.6-6 below depicts the acreage of various USFWS wetland classification types impacted by each alternative.

Table 3.6-6: Acres of Wetland Impacts by USFWS Classification

USFWS Classification	No Action	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Preferred Alternative
Lacustrine (L1UBH)	0.0	0.2	0.2	0.0	0.0	0.0
Emergent (PEM)	0.6	9.0	15.6	8.9	8.5	3.5
Scrub-Shrub (PSS)	0.6	6.0	9.8	4.7	4.7	4.9
Forested (PFO)	0.3	1.8	5.4	4.5	4.0	1.0
PUBH & PABH	0.0	0.5	0.6	0.0	0.1	0.1
Riverine (R2 - 4)	0.3	2.8	3.6	2.4	2.2	2.5
Multiple USFWS Classes	0.0	1.9	5.1	4.8	5.1	5.0
Unknown USFWS Class (percent unknown)	1.6 (48)	6.9 (24)	16.0 (29)	14.2 (36)	14.5 (39)	8.1 (39)
Total Impact[a]	3.3	28.9	56.2	39.6	39.0	24.9

[a] Totals may vary due to rounding

Buffers. Impacts to wetlands also occur when buffers are reduced. These buffer impacts can reduce wetland quality and their functionality. Table 3.6-7 lists potential wetland buffer impacts in the study area. Buffer impacts of the alternatives range from 10 to 121 acres.

Table 3.6-7: Acres of Wetland Buffer Impacts by Basin within the Study Area.

Basin	No Action	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Preferred Alternative
Big Bear Creek	0.0	0.6	0.6	< 0.5	0.0	0.0
Black River	1.7	4.9	38.2	37.2	36.2	13.6
Duwamish River	0.0	0.0	< 0.5	< 0.5	< 0.5	< 0.5
East Lake Washington	0.0	4.4	4.7	1.5	1.6	2.0
Evans Creek	0.3	0.3	0.3	0.3	0.3	0.3
Forbes Creek	0.0	< 0.5	0.2	0.2	0.2	0.2
Juanita Creek	0.3	3.0	3.0	1.3	1.3	1.3
Kelsey Creek	0.0	0.5	0.5	0.0	0.0	0.0
Little Bear Creek	0.0	0.0	2.1	2.1	2.1	2.1
Lower Cedar River	0.3	2.6	2.8	3.0	2.4	3.0
Lower Green River	0.0	1.0	1.5	0.9	1.3	1.2
May Creek	0.0	1.8	2.2	2.2	2.2	2.2
Mercer Slough	0.0	8.8	8.8	0.1	0.2	0.1
North Creek	2.0	32.5	36.2	18.4	19.4	18.5
Sammamish River	4.8	8.0	12.9	11.7	12.9	12.6
Soos Creek	0.0	0.9	0.9	0.9	0.0	0.9
Swamp Creek	1.2	4.6	6.2	2.8	3.1	2.8
Approximate total[a]	10.7	74.0	121.2	82.7	83.4	60.9

[a] Totals may vary due to rounding

Basin. Table 3.6-8 below depicts the total numbers of wetlands impacted per basin. The number of discrete wetlands is followed by the total acreage of associated wetland impacts in parentheses. Table 3.6-8 includes only the 14 basins with potential wetland impacts, and is therefore a subset of the 26 sub-basins outlined in Table 3.6-4.

Table 3.6-8: Summary of Wetland Impacts by Basin – Number of Wetlands (Acreage)

Basin	No Action	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Preferred Alternative
Big Bear Creek	0 (0)	2 (0.7)	3 (0.8)	2 (0.3)	2 (0.2)	2 (0.3)
Black River	10 (1.4)	26 (3.2)	63 (25.1)	62 (24.5)	49 (23.5)	40 (9.3)
East Lake Washington	0 (0)	3 (0.3)	3 (0.3)	1 (< 0.5)	2 (0.3)	2 (0.3)
Juanita Creek	2 (< 0.5)	3 (0.2)	4 (0.2)	4 (0.2)	4 (0.2)	4 (0.2)
Kelsey Creek	0 (0)	1 (0.1)	1 (0.1)	0 (0)	0 (0)	0 (0)
Little Bear Creek	0 (0)	0 (0)	4 (1.6)	5 (1.7)	5 (1.7)	5 (1.7)
Lower Cedar River	1 (0.1)	5 (0.9)	6 (1.0)	7 (1.1)	5 (0.9)	7 (1.1)
Lower Green River	0 (0)	1 (0.4)	2 (0.6)	2 (0.4)	2 (0.4)	2 (0.3)
May Creek	0 (0)	0 (0)	3 (0.4)	3 (0.4)	3 (0.4)	3 (0.4)
Mercer Slough	0 (0)	11 (3.5)	11 (3.5)	1 (< 0.5)	2 (0.1)	1 (< 0.5)
North Creek	7 (0.6)	44 (16.2)	49 (17.0)	43 (6.4)	40 (6.7)	43 (6.4)
Sammamish River	12 (0.8)	21 (1.6)	30 (3.3)	30 (3.1)	30 (3.4)	31 (3.3)
Soos Creek	0 (0)	3 (0.2)	3 (0.2)	3 (0.2)	0 (0)	3 (0.2)
Swamp Creek	3 (0.5)	6 (1.7)	8 (2.1)	7 (1.4)	8 (1.4)	7 (1.4)
Total Impact[a]	35 (3.3)	126 (28.9)	190 (56.2)	170 (39.6)	152 (39.0)	150 (24.9)

[a] Totals may vary due to rounding

Jurisdiction. Potentially impacted wetlands were also analyzed by jurisdiction. All wetlands documented within each jurisdictional boundary are included in Table 3.6-9. This analysis includes the number of discrete wetlands impacted based on unique identification codes and number of acres impacted. All totals depicted in Table 3.6-9 include the No Action Alternative. Furthermore, alternative totals do not directly match summarized totals above since some wetlands are bisected by jurisdictional boundaries and are thus counted twice. Jurisdictions with the greatest impacts to wetlands are Bothell and Renton.

Table 3.6-9: Summary of Wetland Impacts by Jurisdiction – Number of Wetlands (Acreage)

Jurisdiction	No Action	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Preferred Alternative
Bellevue	0 (0.0)	12 (3.6)	12 (3.6)	1 (< 0.5)	3 (0.4)	2 (0.3)
Bothell	3 (0.2)	41 (15.4)	48 (17.4)	43 (7.1)	42 (7.6)	46 (7.5)
Kenmore	0 (0.0)	2 (0.2)	2 (0.2)	2 (0.2)	2 (0.2)	0 (0.0)
Kent	0 (0.0)	0 (0.0)	22 (14.8)	22 (14.8)	22 (14.8)	0 (0.0)
King County	4 (0.2)	7 (0.5)	11 (1.3)	13 (1.4)	10 (1.2)	13 (1.4)
Kirkland	1 (< 0.5)	3 (0.2)	4 (0.2)	3 (< 0.5)	3 (< 0.5)	3 (< 0.5)
Newcastle	0 (0.0)	0 (0.0)	3 (0.4)	3 (0.4)	3 (0.4)	3 (0.4)
Redmond	11 (0.7)	16 (1.5)	16 (1.6)	15 (1.1)	12 (0.8)	15 (1.1)
Renton	10 (1.4)	29 (3.6)	48 (10.9)	48 (10.5)	34 (9.3)	44 (10.1)
Snohomish County	8 (0.9)	12 (2.8)	15 (2.8)	13 (1.9)	15 (2.1)	13 (1.9)
Tukwila	0 (0.0)	2 (0.9)	3 (1.1)	2 (0.3)	2 (0.4)	2 (0.4)
Woodinville	0 (0.0)	1 (0.2)	7 (1.9)	8 (1.7)	8 (1.7)	8 (1.7)
Total Impact[b]	37[a] (3.3)	125[a] (28.9)	191[a] (56.2)	173[a] (39.6)	156[a] (39.0)	149[a] (24.9)

[a] Total numbers of wetlands impacted (not acres) vary slightly from previous tables because some wetlands fall within two jurisdictions and were therefore counted twice.
[b] Totals may vary due to rounding.

3.6.4.1 No Action Alternative

The No Action Alternative would potentially result in impacts to 25 wetland complexes, including 9 HP wetland complexes, totaling approximately 3 acres of direct impact and 10 acres of buffer impacts. Most of the improvements near wetlands occur in the cities of Redmond, Woodinville, and Renton. Most impacts to wetlands and their buffers would occur in the Black River, North Creek, and Sammamish River basins. Most of the wetlands did not have NWI classifications (48 percent), and therefore, a discussion of these wetland's classifications could not be provided. The No Action Alternative will result in the lowest number and area of impacts to wetlands and wetland buffers in the study area.

Table 3.6-10 indicates the numbers and acres of wetlands impacted by each type of transportation improvement in the No Action Alternative. Some types of improvements overlap due to multiple impacts to the same wetland system. Committed arterial projects would impact the greatest number of wetlands of any improvement – 23 discrete wetlands, 13 of which are HP (14 wetland complexes, 6 of which are HP).

Table 3.6-10: No Action Alternative Impacts

Type of Improvements	Potential Impacts to Wetland Complexes	Potential Impacts to HP Wetlands	Acres of Wetlands Impacts
Arterial Capacity	1	0	0.4
Arterial Capacity/Committed Arterial	6	3	0.5
Arterial HOV	3	0	0.3
Committed Arterial	14	6	2.1
HOV Ramps	1	0	< 0.5
No Action Total Impacts	25	9	3.3[a]

[a] Totals may vary due to rounding

Construction Impacts

Construction associated with the No Action Alternative would potentially have direct, short-term impacts on approximately 3 acres of wetlands. About 2 acres are associated with the arterial committed projects. Some of these impacts may be avoidable or minimized through engineering design refinements. Habitat fragmentation is a potential direct impact from construction; however, because no new roads are proposed in this alternative, the potential for this alternative to fragment wetland habitat is low. Buffer impacts could indirectly impact additional wetlands and species of wildlife that depend on them, especially in the North Creek Basin.

Short-term impacts due to sedimentation, contamination, and the presence of construction crews and machinery are possible. Increases in human activity and construction can disturb wildlife and alter nesting and breeding behaviors. Short-term increases in sediment and/or pollutant loads may occur during construction, and this may temporarily lessen a wetland's ability to filter sediment and contaminants. Sediment increases are often due to changes in runoff patterns associated with disturbed ground. Project design would incorporate storm drainage features to ensure that contaminants and sediments are controlled. (See *I-405 Corridor Program Draft Surface Water Resources Expertise Report* [CH2M HILL, 2001a]).

Operational Impacts

Permanent increases in impervious surface would likely lead to some degradation of wetlands from associated increases in sediment and contaminant loads from runoff. Because the No Action Alternative includes a 173-acre increase in impervious surface, some impacts are possible. However, this alternative results in the lowest increase in impervious surface of all the alternatives. Potential operational impacts of the proposed projects include increased noise and vehicular traffic, sedimentation, contamination, and changes in runoff pulse and timing.

Project-level design would evaluate the potential for contaminants to be introduced into wetlands via road runoff, and projects would incorporate storm drainage features to ensure contaminants and sediments are controlled. Retrofitting of existing facilities could occur in conjunction with many of the projects. Pollutant loading and overall impacts to surface water from the improvements were presented in the *I-405 Corridor Program Draft Surface Water Resources Expertise Report* and were determined to be below the threshold of significance (CH2M HILL, 2001a).

Wetland hydrology may be altered through the placement of fill and the reduction of storage volume, through changes in permeable surface area, or through rerouting of "feeding" water. Project-level design would consider existing inundation and flooding patterns to ensure projects avoid altering wetland hydrology. Increases in impervious surface may alter groundwater hydrologic regimes within the study area. Project-level drainage design would provide comparable infiltration rates and volumes when appropriate and feasible.

Functional Evaluation. Because of their potential size, category, and/or association with T&E species, HP wetlands are assumed to provide more wetland function than a typical LP wetland. With extreme variability in function of an individual wetland, only HP and riverine systems warranted independent discussion of function. It is assumed that all wetlands provide valuable function.

No wetlands would be impacted by the No Action Alternative within the Big Bear Creek, East Lake Washington, Kelsey Creek, Little Bear Creek, Lower Green River, May Creek, Mercer Slough, and Soos Creek basins. Therefore, no impacts to wetland functions within these basins, would result from the No Action Alternative. A relatively small portion of the overall wetland acreage would be impacted within the North Creek, Black River, Juanita Creek, Lower Cedar River, North Creek, Sammamish River, and Swamp Creek basins. Small areas of potential impacted wetlands within the North Creek, Black River, Lower Cedar River, and Sammamish River basins are considered high priority. A small portion of impacted wetlands within the Sammamish River Basin is designated USFWS Riverine wetlands. Project-level design aimed at minimizing impacts, retention and detention of stormwater implemented at the project level, and retrofitting of existing facilities would help minimize impacts to functions within wetlands.

3.6.4.2 Alternative 1: HCT/TDM Emphasis

Alternative 1 includes a new fixed-guideway HCT system that would follow part of the existing Burlington Northern Santa Fe Railway (BNSF) system. However, in places it does deviate from the existing BNSF tracks and would parallel and cross numerous roads in the study area. Alternative 1 also includes substantial expansion of local bus transit service, non-construction mobility solutions such as regional transportation pricing, and transportation demand management strategies. Arterial HOV priority, additional park-and-ride capacity and transit center improvements, and all actions associated with the No Action Alternative are included in Alternative 1. Section 2.2.2 contains a complete description of improvements associated with Alternative 1, and Figure 2.2-2 depicts the location of improvements associated with Alternative 1.

Alternative 1 would potentially impact 76 wetland complexes, including 30 HP wetland complexes (Table 3.6-5). Total wetland area filled under this alternative would be approximately 29 acres. This is the lowest number and acreage of wetlands and the lowest number of HP wetlands of the action alternatives. However, the total acres of impact to HP wetlands are higher than Alternatives 3, 4, or the Preferred Alternative. Wetland impacts associated with Alternative 1 are mostly to scrub-shrub wetlands, emergent wetlands, and unknown NWI Classes (Table 3.6-6). Although minor, impacts to lacustrine wetlands are a result of the close proximity of the BNSF railway to Lake Washington at Kennydale. Direct impacts to Lake Washington are not likely, but were included due to its shoreline being within 40 feet of the existing railway centerline at that point. By far, the greatest impact to buffer acreage is in the North Creek Basin. The cities of Renton and Bothell have the highest number of discrete wetlands impacted of the jurisdictions in the study area.

Table 3.6-11 indicates the wetland impacts of each type of improvement. The wetland impacts by the HCT under this alternative represent a worst-case scenario, in which the HCT is aligned at the surface (not elevated). This transportation element has high potential for impacting wetlands in the study area, but also the highest degree of design flexibility as the HCT can be designed to bridge sensitive areas, or realigned to avoid wetlands. In actuality, wetland impacts from HCT under this alternative could be much lower than those shown in Table 3.6-11.

The total number of impacts to wetlands presented in Table 3.6-11 is higher than in previous tables because multiple types of improvements caused multiple counts. Totals at the bottom of Table 3.6-11 present the total number of times wetlands are impacted and not the total number of wetlands impacted.

Table 3.6-11: Alternative 1 Impacts

Type of Improvements	Potential Impacts to Wetland Complexes	Potential Impacts to HP Wetlands	Acres
Arterial Capacity	3	1	0.5
Arterial HOV	18	9	3.4
Basic Improvements	21	8	3.4
Committed Arterial	18	8	2.3
Fixed-Guideway HCT [a]	29	9	17.4
HOV Ramps	1	0	< 0.5
I-405 Crossings & Ped/Bicycle	14	10	1.9
Alt. 1 Total Impacts [b]	104	45	28.9

[a] Impacts for HCT are based on a system aligned at the surface and represent realistic worst-case scenarios.
[b] Totals include wetlands impacted by more than one type of improvement and are higher than totals in summary tables

The HCT system would serve the major activity centers within the study area including Redmond, Issaquah, Renton, Bellevue, and across Lake Washington to Seattle. Impacts associated with the Lake Washington to Seattle crossing are addressed in the Trans-Lake Washington Project EIS.

Construction Impacts

Direct, short-term construction impacts associated with Alternative 1 include 28.9 acres of potential wetland impacts. These impacts include the 3.3 acres impacted under the No Action Alternative. Approximately 17 acres of the wetland impacts are associated with the HCT project. Some of these impacts may be avoidable or minimized through engineering design refinements. Design refinements that might be employed include bridging and retaining walls, temporary fencing to restrict the intrusion of construction equipment into wetlands, work area buffers, check dams, temporary seeding, mulching, jute netting, phased construction, and construction during less sensitive seasons. All appropriate avoidance and minimization strategies would be pursued during project-level design. Approximately 7 acres of fill could be avoided by realigning or elevating the HCT. While some part of the HCT system proposed under this alternative may fragment wetlands, much of the new construction presents opportunities to avoid wetlands. The potential for this alternative to fragment wetland habitat is consequently low to moderate. Avoidance opportunities can be examined in detail at the project level. The amount of construction required for this alternative, while greater than that required for the No Action Alternative, is considerably less than for the other action alternatives.

Operational Impacts

Alternative 1 would potentially result in greater operational impacts than the No Action Alternative. Four hundred and seventy-eight acres of increased impervious surface are associated with this alternative. The 478 acres of new impervious surface includes 173 acres associated with the No Action Alternative (see Table 3.6-5). The increased stormwater and associated contaminants would require the same treatment and management as the other alternatives relative to the amount of new impervious surface. Project-level design aimed at minimizing impacts, retention and detention of stormwater implemented at the project level, and retrofitting of existing facilities would help minimize impacts to functions within wetlands. Further discussion of the potential impacts to water resources may be found in the *I-405 Corridor Program Draft Surface Water Resources Expertise Report* (CH2M HILL, 2001a) and the *I-405 Corridor Program Draft Groundwater Resources Expertise Report* (CH2M HILL, 2001b).

Functional Evaluation. Impacts resulting from Alternative 1 would result in greater functional impacts than the No Action Alternative. Although scrub-shrub and emergent wetlands are the most impacted, 24 percent of the wetlands are not NWI unclassified and therefore a complete assessment is not possible at this time. More than 77 percent of the wetlands are HP, indicating that higher functions may be lost, most likely in North Creek, Black River, and Sammamish River basins where the majority of the acreage is impacted.

3.6.4.3 Alternative 2: Mixed Mode with HCT/Transit Emphasis

Alternative 2 includes the fixed-guideway HCT system, widening of I-405 and SR 167, basic improvements to I-405 and core TDM strategies (similar to all alternatives), and new capacity improvements on connecting arterials and freeways as defined in Appendix B and depicted on Figure 2.2-3. Table 3.6-12 indicates the wetlands impacted by improvement types. Again, as described above, the number of wetlands impacted by the HCT under this alternative represents a reasonable worst-case scenario, in which HCT is aligned at the surface. Impacts from HCT under this alternative could be much lower than those shown in Table 3.6-12.

Alternative 2 would result in the greatest impact to wetlands in the study area. Approximately 110 wetland complexes, including 38 HP wetland complexes would be impacted under this alternative. This alternative could impact approximately 56 acres of wetlands in the study area, compared with approximately 25 to 39 acres under the other action alternatives (see Table 3.6-5). Furthermore, Alternative 2 could result in impacts to more than 5 acres of forested wetlands, more than any other alternative. North Creek, Black River, and Sammamish River basins would receive over 60 percent of the impacts. Bothell, Renton, and Kent are the jurisdictions with the most impacts to wetlands for this alternative.

Only a few road projects within this alternative have the potential to alter wetland buffers. Widening SR 167 from I-405 to the study boundary has the most potential to substantially alter wetlands/wetland buffers. New HCT alignments have the potential to alter wetland buffers. Although final alignment design could avoid many wetlands and wetland buffers, some impacts associated with riparian wetland crossings (e.g., the Green River or the Sammamish River) would likely be unavoidable. Overall, the highest percentage of wetland buffer impacts associated with Alternative 2 would occur within the Black River, North Creek, and Sammamish River basins (Table 3.6-7).

The total number of impacts presented in Table 3.6-12 is higher than in previous tables because multiple types of improvements caused multiple counts. Table 3.6-12 presents the total number of times wetlands are impacted and not the total number of wetlands impacted.

Table 3.6-12: Alternative 2 Impacts

Type of Improvements	Potential Impacts to Wetland Complexes	Potential Impacts to HP Wetlands	Acres of Impact
Arterial Capacity	4	2	0.8
Arterial HOV	17	9	3.0
Arterial Interchange	2	1	0.2
Basic Improvements	11	4	1.7
Committed Arterial	16	7	2.1
Connecting Freeway Capacity	14	4	3.7
General Purpose Lane	16	6	2.3
Fixed-Guideway HCT [a]	23	9	16.7
HOV Ramps	2	0	< 0.5
I-405 Crossings & Ped/Bicycle	13	9	1.9
Planned Arterial	8	5	1.8
Widening of SR 167	17	4	22.0
Alt. 2 Total Impacts[b]	143	60	56.2

a Impacts for HCT are based on a system aligned at the surface and represent realistic worst-case scenarios.
b Totals include wetlands impacted by more than one type of improvement and are higher than totals in summary tables.

Construction Impacts

Construction impacts would be similar to those for the other alternatives. Relative to Alternative 1, a higher number of projects are proposed in this alternative. This would result in more potential impacts during the construction period, including noise. However, wetlands along SR 167 typically abut the existing roadway, with emergent wetlands along the west side and multiple wetland types along the east side (PFO, PSS, PEM, and POW). Wetlands associated with Springbrook Creek and its tributaries cross and parallel SR 167 in the vicinity of the proposed project activities.

The potential for this alternative to fragment wetland habitat is consequently high in comparison to the other action alternatives. Many of the impacts associated with Alternative 2 are unavoidable, as they are expansions or additions to existing roads and realignment is not practical.

Operational Impacts

Operational impacts of this alternative are similar to the other alternatives. New road construction would affect over 50 wetland complexes out of a total of 110 complexes impacted by the alternative. Impervious surface area nearly doubles with this alternative compared to Alternative 1. A subsequent increase in the effects of runoff, sedimentation, and contamination, and corresponding impacts to wetlands, would be expected. Project-level design aimed at minimizing impacts, retention and detention of stormwater implemented at the project level, and retrofitting of existing facilities would help minimize impacts to functions within wetlands.

Functional Evaluation. Nearly 60 percent of the acreage impacted is HP wetlands, occurring mostly in the Black River Basin and some in North Creek Basin. Within the Black River Basin, approximately 25 acres of impacts to wetlands and 38 acres to buffers would occur as a result of the Alternative 2 improvements. This amount of wetland impact to the Black River Basin is greater than any other basin and any other alternative. Of the wetlands impacted, approximately 11 acres are considered HP wetlands. None of the wetlands within the Black River Basin are designated Riverine by the USFWS classification system. Because of the higher area of impact to wetlands within the Black River Basin, functional impacts to wetlands would tend to be high.

3.6.4.4 Alternative 3: Mixed Mode Emphasis

Alternative 3 includes implementing a new bus rapid transit (BRT) system, expanding local bus transit service, adding two lanes in each direction on I-405, and improving arterials within the study area. The BRT system would include improved-access HOV lanes on I-405, I-90, and SR 520 with routes to several major activity centers in the study area. Section 2.2.4 contains a detailed account of all the improvements associated with Alternative 3, while project locations are depicted on Figure 2.2-4.

Alternative 3 could impact approximately 96 wetland complexes composed of 34 HP wetland complexes. Total wetland area filled under this alternative would be approximately 39 acres of wetland complexes, including 19 acres of HP wetlands. Furthermore, approximately 83 acres of wetland buffer impacts, mostly in the Black River Basin, are associated with this alternative. Impacts associated with Alternative 3 are typically greater than Alternative 4 and the Preferred Alternative, but less than Alternative 2 (Table 3.6-5). However, the number of acres impacted, number of complexes impacted, and number of HP acres impacted is very similar to Alternative 4. The total acres of new impervious surface associated with this alternative are less than Alternatives 2 and 4 and the Preferred Alternative, but greater than both the No Action Alternative and Alternative 1. Table 3.6-13 presents the wetland impacts for alternative improvements. Wetland impacts from this alternative are mostly to scrub-shrub, forested, and emergent wetlands. Basins with the highest degree of wetland impacts include the Black River and North Creek. Similar to Alternative 2, the cities of Renton, Bothell, and Kent have the highest number and acres of unique wetlands impacted under this alternative.

The total number of impacts to wetlands presented in Table 3.6-13 is higher than previous tables because multiple types of improvements caused multiple counts. Totals on Table 3.6-13 represent the total number of times wetlands are impacted and not the total number of wetlands impacted.

Table 3.6-13: Alternative 3 Impacts

Type of Improvements	Number of Potential Impacts to Wetland Complexes	Number of Potential Impacts to HP Wetlands	Acres of Impact
Arterial Capacity	8	4	1.1
Arterial HOV	21	9	3.6
Arterial Interchange	2	1	0.2
Committed Arterial	18	8	2.3
Connecting Freeway Capacity	11	2	3.1
General Purpose Lane	20	6	3.6
HOV Ramps	2	0	0.0
I-405 Crossings & Ped/Bicycle	13	10	1.9
Planned Arterial	8	4	1.8
Widening of SR 167	18	4	22.0
Alt. 3 Total Impacts [a]	121	48	39.6

[a] Totals include wetlands impacted by more than one type of improvement and are higher than totals in summary tables

Construction Impacts

Direct, short-term construction impacts associated with Alternative 3 include 39.6 acres of potential wetland impacts. Twenty-two of these 39.6 acres are associated with widening of SR 167. General purpose lanes, arterial HOV, connecting freeway capacity, and committed arterial improvements associated with I-405 represent an additional 12.6 acres of impact. Some of these impacts may be avoidable through engineering design refinements and through minimization, to be pursued during project-level design. The number of projects proposed under this alternative is relatively high, and there is the potential for impacts during construction. This impact is about equal to that expected for Alternative 4.

Only a few road projects within this alternative have the potential to substantially alter wetland buffers. Widening SR_167 from I-405 to the study boundary has the most potential to alter wetlands/wetland buffers. Overall, wetlands impacts associated with Alternative 3 could result in similar wetland impacts to those of Alternative 4 (Table 3.6-5).

Most of the wetland impacts associated with this alternative are associated with expansion/widening of existing roads. New construction would affect 44 wetlands, while 100 wetlands would be impacted by construction along existing roads. The HCT proposed in this alternative (BRT) would operate on the existing roadway and potentially impact no wetlands. The potential for this alternative to fragment wetland habitat is consequently moderate to high, while opportunities to avoid wetlands by realigning proposed roads are few. New impervious surface would increase by 773 acres under this alternative. _This large area would create an associated increase in sedimentation and contamination from runoff less than that created by Alternatives 2, 4, and the Preferred Alternative, but high compared to Alternative 1 and the No Action Alternative.

Operational Impacts

Impacts associated with an increase in impervious surface could result in increased hydrologic changes to wetlands in the study area. Because of the close proximity of riverine wetlands adjacent to the Black River/Springbrook Creek system, water quality and quantity impacts associated with this alternative may be higher than alternatives that do not include widening of SR 167. Project-level design aimed at minimizing impacts, retention and detention of stormwater implemented at the project level, and retrofitting of existing facilities would help minimize impacts to functions within wetlands.

Functional Evaluation. Impacts to the Black River Basin would be similar to impacts that would occur in Alternative 2. Nearly 48 percent of the acreage impacted is HP wetlands, occurring mostly in the Black River Basin and some in North Creek Basin. Within the Black River Basin, approximately 25 acres of impacts to wetlands and 37 acres to buffers would occur as a result of the Alternative 3 improvements. None of the wetlands within the Black River Basin are designated Riverine by the USFWS classification system. Because of the higher amount of impact to wetlands within the Black River Basin, functional impacts to wetlands would tend to be high.

3.6.4.5 Alternative 4: General Capacity Emphasis

Alternative 4 includes increasing general purpose and HOV capacity, widening of SR 167 from I-405 to the study area boundary, but fewer new transit facilities and local bus service improvements than the other action alternatives. An increase in general purpose and HOV capacity would be created by adding one lane in each direction along I-405, a new four-lane I-405 express roadway, and other general purpose and HOV improvements along the I-405 corridor. This alternative does not include the HCT that accounted for numerous wetland impacts in the other action alternatives. A detailed description of improvements associated with Alternative 4 is provided in Section 2.2.5, and Figure 2.2-5 depicts the location of these improvements.

Alternative 4 could result in 39 acres of impact to wetlands in the study area, including approximately 18 acres of impact to HP wetlands (Table 3.6-5). The total number of acres impacted by this alternative is very similar to Alternative 3, less than Alternative 2, but more than Alternative 1, the Preferred Alternative, and the No Action Alternative. Ninety-six wetland complexes and 36 HP wetland complexes could be impacted by this alternative. Furthermore, Alternative 4 would result in 1,061 acres of new impervious surface, the highest of any alternative under consideration. Wetland and their buffer impacts occur mostly in the Black River, North Creek, and Sammamish River basins. Similar to Alternatives 2 and 3, the cities of Kent, Renton, and Bothell have the highest numbers and acres of unique wetlands impacted under this alternative.

The total number of impacts to wetlands presented in Table 3.6-14 is higher than previous tables because in some cases multiple types of improvements caused multiple counts of the same wetland. Totals shown on Table 3.6-14 represent the total number of times wetlands are impacted and not the total number of wetlands impacted.

Table 3.6-14: Alternative 4 Impacts

Type of Improvements	Potential Impacts to Wetland Complexes	Potential Impacts to HP Wetlands	Acres of Impact
Arterial Capacity	16	10	2.4
Arterial Interchange	5	3	0.4
Basic Improvements	11	5	1.8
Committed Arterial	18	8	2.4
Connecting Freeway Capacity	15	4	3.7
General Purpose Lane	17	7	2.7
HOV Ramps	2	0	< 0.5
I-405 Crossings & Ped/Bicycle	10	7	1.4
Planned Arterial	8	4	1.9
Widening of SR 167	18	5	22.3
Alt. 4 Total Impacts [a]	120	53	39.0

[a] Totals include wetlands impacted by more than one type of improvement and are higher than totals in summary tables

Construction Impacts

Direct, short-term construction impacts associated with Alternative 4 are similar to those of the other alternatives and include 39 acres of potential wetland fill. As was the case with Alternative 3, approximately 22 acres of impact could occur as a result of widening SR 167. Most of the remaining impacts are included within the various improvements associated with I-405. Several of these projects have the potential to impact wetland buffers. This is especially true within the Black River, North Creek, and Sammamish River basins. Overall, approximately 83 acres of wetland buffer could be impacted by Alternative 4 (Table 3.6-7).

Only a few road projects within this alternative have the potential to alter wetland buffers. Widening I-405 in each direction and widening SR 167 from I-405 to the study boundary have the most potential to alter wetlands/wetland buffers.

Operational Impacts

Alternative 4 would result in the greatest increase in new impervious surface of all the alternatives (1,061 acres). Because this alternative has the highest increase in new impervious surface, there is a corresponding potential increase in sedimentation and contamination. While this increase in impervious surface would require storm drainage mitigation to avoid downstream impacts to wetlands, it is more than five times the impervious surface of the No Action Alternative and could result in far greater impacts than all other alternatives.

Functional Evaluation. Impacts from Alternative 4 to Big Bear Creek, Juanita Creek, Lower Cedar River, Lower Green River, May Creek, Sammamish River, and Swamp Creek basins would be similar to the impacts that would occur in Alternative 1. Impacts to functions within the Black River and Little Bear Creek basins would be similar to impacts in Alternative 2. Within Kelsey Creek and Soos Creek basins no wetlands are impacted by Alternative 4. Therefore, no impacts to wetland functions within these basins would result from Alternative 4. Impacts to wetland functions within the North Creek and Mercer Slough basins would be similar to impacts that could occur in Alternative 3. Project-level design aimed at minimizing impacts, retention and detention of stormwater implemented at the project level, and retrofitting of existing facilities would help minimize impacts to functions within wetlands.

3.6.4.6 Preferred Alternative

The Preferred Alternative includes many aspects of the other alternatives, but is most similar to Alternative 3. It includes a BRT system instead of the fixed-guideway system proposed in Alternatives 1 and 2. It also includes expansion of local bus transit, two additional lanes in each direction on I-405, arterial capacity and connectivity improvements, and the other general purpose and HOV improvements associated with the other alternatives. It includes expansion of the SR 167 and I-405 interchange. State Route 167 would be widened by up to two lanes in each direction south from I-405 to South 180th Street with no widening beyond that limit. The reduction in total length of widening of SR 167 under the Preferred Alternative is a primary factor in the reduction of wetland impacts under the Preferred Alternative compared to the widening under Alternatives 3 and 4. Another important element responsible for the reduction of wetland impacts under the Preferred Alternative is that it does not include the fixed-guideway HCT system that accounted for 16.7 acres of impact under Alternative 2. Section 2.2.6 contains a detailed description of the actions associated with the Preferred Alternative, while Figure 2.2-6 depicts the locations of the proposed improvements.

The Preferred Alternative could result in approximately 25 acres of impact to wetlands in the study area, including approximately 13 acres of impact to HP wetlands. The total acres of wetlands impacted are less than all other action alternatives. Eighty-five wetland complexes and 36 HP wetland complexes could be impacted by this alternative. Furthermore, the Preferred Alternative would result in 974 acres of new impervious surface, the second highest of any alternative under consideration. Wetland and buffer impacts occur mostly in the Black River, North Creek, and Sammamish River basins. The cities of Renton and Bothell have the highest numbers and acres of unique wetlands impacted under this alternative.

The total number of impacts to wetlands presented in Table 3.6-15 is higher than previous tables because in some cases multiple types of improvements cause multiple counts. Totals indicated in Table 3.6-15 represent the total number of times wetlands are impacted and not the total number of wetlands impacted.

Table 3.6-15: Preferred Alternative Impacts

Type of Improvements	Potential Impacts to Wetland Complexes	Potential Impacts to HP Wetlands	Acres of Impact
Arterial Capacity	16	12	2.6
Arterial HOV	10	4	2.1
Arterial Interchange	3	1	0.2
Basic Improvements	2	1	0.2
Committed Arterial	19	8	2.4
Connecting Freeway Capacity	12	4	3.9
General Purpose Lane	18	6	3.4
HOV Ramps	2	0	0.0
I-405 Crossings & Ped/Bicycle	14	10	1.9
Widening of SR 167	2	2	6.7
Planned Arterial	8	4	1.7
Preferred Alternative Total Impacts[a]	106	52	24.9

[a] Totals include wetlands impacted by more than one type of improvement and are higher than totals in summary tables

Construction Impacts

Direct, short-term construction impacts associated with Preferred Alternative are less than those of the other alternatives and include 24.9 acres of potential wetland fill. The Preferred Alternative would result in fewer acres of wetland impacts than all other alternatives except the No Action Alternative. This is a direct result of limited widening of SR 167 and exclusion of the fixed-guideway HCT system in this alternative.

Construction-related impacts are relatively well distributed among the various types of improvements associated with this alternative. However, based on acres of impact, connecting freeway capacity would impact 10.6 acres out of a total of 24.9 acres of total wetland impacts. As was the case with all alternatives, wetland impacts are primarily associated with construction activities within the Black River, North Creek, and Sammamish River basins (Table 3.6-8).

The Preferred Alternative would also have the least quantity of buffer impacts compared with the other alternatives. Overall, 60.9 acres of wetland buffer could be impacted by the Preferred Alternative (Table 3.6-7). Some of these impacts may be avoidable through engineering design refinements and through minimization. All appropriate minimization strategies would be pursued during project-level design.

Operational Impacts

Operational impacts on wetlands would be slightly less than those associated with Alternative 4, but greater than the other alternatives based on the quantity of new impervious surface. The Preferred Alternative could result in 974 acres of new impervious surface. As was the case with the other alternatives, stormwater runoff would be the greatest single operational impact to wetlands under the Preferred Alternative.

Functional Evaluation. Impacts from the Preferred Alternative to Big Bear Creek, East Lake Washington, Juanita Creek, Lower Cedar River, Lower Green River, Sammamish River, Soos Creek, and Swamp Creek basins would be similar to the impacts that would occur in Alternative 1. Approximately 9.34 acres of wetland within the Black River Basin would be potentially impacted by the Preferred Alternative improvements. These impacts are less than in Alternatives 2, 3, and 4, but more than in the No Action and Alternative 1. It is expected that functional impacts to wetlands within the Black River Basin would be greater than in the No Action Alternative and Alternative 1, but less than in Alternatives 2, 3, and 4. Functional impacts within the Little Bear Creek and May Creek basins would be similar to those occurring as a result of the Alternative 2 improvements. Impacts to wetland functions within the Mercer Slough and North Creek basins would be similar to impacts that would occur from Alternative 3. Project-level design aimed at minimizing impacts, retention and detention of stormwater implemented at the project level, and retrofitting of existing facilities would help minimize impacts to functions within wetlands.

3.6.5 Mitigation Measures

3.6.5.1 General Mitigation

The purpose of mitigation is to offset unavoidable impacts and ensure that no net loss of wetland area, function, or value occurs as a result of the proposed action. The sequential steps generally taken in the mitigation process are:

- Avoiding impacts.
- Minimizing impacts.
- Restoring the impacted environment.
- Reducing impacts over the life of the project using preservation and maintenance operations.
- Compensating for adverse impacts by replacing the affected environment or providing substitute resources.
- Monitoring the impacted environment and taking appropriate corrective measures as needed.

Because wetland functions generally vary between HP and LP wetlands, mitigation needs also vary. HP wetlands generally require greater mitigation than LP wetlands. Implementing mitigation prior to wetland disturbance may help minimize temporary losses of wetland functions, although it may take 10 or more years for wetlands to mature enough to fully replace lost functions.

While impacted wetlands within the study area may not provide all of their historic functions, they remain a valuable and sometimes irreplaceable resource. Because of this, the focus during project design and any early-action mitigation will be to implement the aforementioned sequential steps for all wetlands regardless of a wetland's priority status (HP or LP).

Frequently, the relationship between wetland area and habitat value is non-linear. Thus, the impact of filling could vary depending on the size and quality of the original wetland, the relationship of the mitigation to the original wetland, and the surrounding habitat. Wetland mitigation sites frequently have initially lower habitat values than natural systems, as forested wetlands may take 80 or more years to reach maturity and provide their full potential functions. Wetland mitigation often occurs at a ratio greater than 1:1 to compensate for this inequality. Mitigation ratios vary by jurisdiction, responsible agency, and construction-impact timing. They range from 1:1 to 6:1 or greater replacement ratios. Should wetland mitigation use generic ratios rather than incorporating functional assessment strategies, mitigation sites may not provide the same functions and values as those destroyed. Project-level design or early-action mitigation will consider these factors to assure that the appropriate mitigation approach is implemented. Advanced mitigation will be implemented prior to wetland impacts where feasible, to reduce temporary losses of wetland functions (see Appendix J).

Sufficient property is anticipated to be available within the study area for mitigation. In some highly developed watersheds, suitable vacant parcels available for mitigation may be rare. Identification of available parcels for mitigation will be dependent upon specific real estate conditions and will be undertaken during project-level analysis. Mitigation sites should provide connectivity with the remaining wetlands within the basin whenever possible, although isolated wetlands in highly developed areas are not without value, as they provide habitat for urban wildlife. Finding non-wetland property in proximity to a suitable hydrologic source will be increasingly difficult under increased development pressure. In some instances, out-of-kind watershed restoration may provide adequate or even higher levels of wetland/watershed functions than in-kind wetland replacement. While out-of-kind restoration is a potential option for each alternative being analyzed, its value would be assessed on a case-by-case basis.

Mitigation banking will be an option where on-site mitigation is not possible or is less environmentally beneficial. Mitigation banking would allow acquisition of credits, which go toward enhancing, creating, or restoring wetlands at a designated site. Once the wetland is created and functioning, these credits would compensate for unavoidable wetland impacts. The bank creators, or sponsors, assume responsibility for maintaining the wetlands in perpetuity, or they could sell the site to another owner, who would then assume responsibility. Banking may only occur if the wetland impacts could not be avoided or minimized to an acceptable level on-site.

Regional wetland mitigation facilities may have the potential to improve many wetland functions, particularly fish-rearing habitat, peak flow attenuation, large habitat areas with limited disturbance and edge area, and low flow augmentation. Because of the typically large number of oftentimes-small wetland impacts associated with linear transportation projects, there may exist the opportunity for regional wetland restoration or enhancement. However, the specific functions appropriate for restoration and/or enhancement would depend upon the particular mix of transportation elements and projects chosen as the preferred alternative. Combining such impacts into a few regional restoration projects may not be practicable. Opportunities for restoration are highly site-specific, depending greatly upon the functions provided by the existing watershed conditions, and thus specific parcels for wetland restoration or mitigation have not been identified.

This early analysis assumes that avoiding wetlands altogether is the first step in the mitigation process. Project-level impact analysis will evaluate how some operational impacts will be mitigated. For instance, road impacts to wetlands may be avoided or minimized by using methods other than widening at the surface (e.g., stacking lanes or tunneling) where practicable to increase capacity in the vicinity of environmentally sensitive or important areas. Measures to avoid and minimize increases in impervious surfaces and increased stormwater runoff, in order to avoid altering wetland hydrology in downstream reaches, will be incorporated through project-level design where practicable.

Some typical avoidance measures to be contemplated include:

- Using or lengthening bridges to cross streams and their associated riparian corridors and wetlands;
- Using retaining walls to reduce or eliminate lateral extensions of road embankment slopes into wetlands;
- Using guardrails to increase the grade of embankments and avoid wetland fill;
- Stacking lanes or constructing viaducts; and
- Constructing tunnels.

Best management practices (BMPs) will be used to minimize short-term sedimentation and contamination. These practices will include sediment fences, check dams, temporary seeding, mulching, jute netting, phased construction, and/or construction during less sensitive seasons where appropriate. Stormwater treatment facilities will be designed consistent with Ecology's Stormwater Manual or functionally equivalent stormwater guidance, such as WSDOT's highway runoff manual.

Mitigation locations and concepts will be identified during the permitting for specific projects and during possible early-action mitigation activities (see Appendix J of the FEIS). WSDOT has met and will continue to meet with state and local agencies to identify mitigation priorities and options, and to discuss opportunities for on-site mitigation and mitigation banking.

Another option that could be utilized on a case-by-case basis is replacing lower value roadside emergent wetlands with high-value streamside wetlands. Although roadside wetlands provide water quality, groundwater recharge, and stormwater retention functions, replacing them at high ratios would not always be advantageous. Many of these roadside wetlands are dominated by invasive species such as reed canarygrass and can successfully and quickly be replaced (unlike forested wetlands). Since the availability of streamside wetlands that provide refugia for salmonids is often a limiting factor in Puget Sound Lowland streams, shifting part of the mitigation ratio to high-value wetlands that provide other critical functions may be a viable option in some cases. An example of such a scenario is if 1 acre of roadside emergent wetlands was to be filled and the mitigation ratio was 2.5:1. Under this scenario, 2.5 acres of new roadside emergent wetlands could be required to mitigate for the impacts. However, the roadside emergent wetland could be replaced at a 1:1 ratio, with the remaining 1.5 acres of mitigation going toward addressing other basin needs. In this scenario 1.5 acres of streamside wetlands could also be created. WSDOT is currently working on an *Early-Action Environmental Impact Mitigation Decision-Making Process* that will help define a process to help guide the mitigation process and align WSDOT mitigation needs with various watershed and salmonid recovery needs (see Appendix J).

3.6.5.2 Specific Mitigation

Specific mitigation can not be defined at the programmatic level of analysis. This is a result of uncertainties in the actual amount and type of wetland impacts, amount and type of required mitigation, variation in existing opportunities for mitigation in each basin, and early stage of coordination with affected jurisdictions. Furthermore, impact reduction measures to be developed during the project design phase will reduce the amount of required mitigation.

Although the specific method or acreage of mitigation can not yet be defined, it could fall within the range of existing mitigation ratios defined by various jurisdictions in the study area (Table 3.6-16). Furthermore, site-specific surveys conducted during the project-level design phase will probably document wetlands currently not contained within existing databases used for analysis during this programmatic-level review. Although the final acreage of wetland impacts and required mitigation is uncertain, Table 3.6-16 below presents some possible ranges of mitigation based on the existing information. Since replacement ratios vary by jurisdiction, wetland type, and mitigation approach, the following estimates provide a range. Some local jurisdictions do not have specific mitigation ratios within their codes, but rely on either King County or Ecology for guidance. For informational purposes, the following Table 3.6-16 includes mitigation ratios required by each jurisdiction as well as Ecology's anticipated maximum ratio of 12:1.

Table 3.6-16: Summary of Potential Mitigation Ratios by Jurisdiction

Jurisdiction	Wetland Impacts of Preferred Alternative	Minimum Mitigation Ratio	Required Mitigation Based on Minimum Ratio	Maximum Mitigation Ratio	Required Mitigation Based on Maximum Ratio	Acres of Mitigation Based on 12:1 Mitigation Ratio
Bellevue	0.3 acre	1.5:1	0.5 acre	2:1	0.7 acre	4.1 acres
Bothell	7.5 acres	1.25:1	9.4 acres	2:1	15. acres	90.2 acres
Kenmore	0.0 acre	1:1	0.0	2:1	0.0	0.0
Kent	0.0 acre	1.5:1	0.0	3:1	0.0	0.0
King County	1.4 acre	1:1	1.4 acres	2:1	2.9 acres	17.3 acres
Kirkland	0.1 acre	1.25:1	0.1 acre	6:1	0.3 acre	0.5-acre
Newcastle	0.4 acre	1.25:1	0.5 acre	12:1	4.6 acres	4.6 acres
Redmond	1.1 acre	1:1	1.1 acre	6:1	6.5 acres	13.0 acres
Renton	10.1 acres	1.5:1	15.1 acres	6:1	60.3 acres	120.6 acres
Snohomish County	1.9 acres	1:1	1.9 acres	1:1	1.9 acres	23.0 acres
Tukwila	0.4 acre	1.5:1	0.7 acre	6:1	2.6 acres	5.3 acres
Woodinville	1.7 acre	1:1	1.7 acre	2:1	3.5 acres	20.9 acres
TOTALS	24.9 acres	N/A	32.4 acres	N/A	98.3 acres	299.0 acres
Ecology	24.9 acres	1.25:1	31.1 acres	6:1	149.4 acres	299.0 acres

Based on the results presented in Table 3.6-16, 25 acres of impacted wetlands could be replaced by as much as 300 acres of new wetlands. However, the actual amount of compensation would likely fall within a range between 33 and 300 acres, depending upon the types of wetlands impacted and final compensation ratio.

An integral part of mitigation is the replacement of lost wetland functions. Forested wetlands (PFO) are typically of the highest value and most difficult to replace, and therefore require higher compensation ratios. Emergent wetlands (PEM) are typically of lower value and are more easily replaced, and therefore require smaller compensation ratios.

The wide array of potential mitigation and compensation strategies would include long-term monitoring to ensure success. Monitoring typically spans 3 to 10 years and is necessary to assure the achievement of mitigation goals and objectives. The implementation of contingency plans is required when mitigation goals are not achieved. Furthermore, wetlands created or enhanced as part of the mitigation process would be protected in perpetuity through binding covenants, easements, or other mechanisms that follow the title of the property.

WSDOT will develop a mitigation plan for the I-405 corridor for resources protected and regulated by federal, state, and local jurisdictions. It will be consistent with the proposed early-action environmental impact mitigation decision-making process presented in Appendix J. The plan will be developed based on a 5 percent design level prior to permitting individual projects. The plan will include a more detailed analysis of project impacts and an analysis of mitigation opportunities, first on-site, second within the same sub-basin, and third within the same watershed (i.e., in the water resource inventory area [WRIA]) in order to find the most appropriate or best mitigation opportunity for each impact. Off-site and out-of-kind mitigation opportunities will be evaluated in accordance with the Alternative Mitigation Policy Guidance Interagency Implementation Agreement (included in DEA, 2002) adopted on February 14, 2002 by WSDOT, Ecology, and the WDFW to supplement in-kind, on-site opportunities.

WSDOT anticipates that it may not be possible nor most beneficial to the natural environment to mitigate all project impacts within the same sub-basin where the impact occurs. While the mitigation will be analyzed at various levels, it will be implemented at the most appropriate level to maximize environmental benefit in a cost-effective manner. For example, WSDOT may mitigate for lost wetland function and acreage through a combination of opportunities that involves on-site, in-kind mitigation within the sub-basin of impact and off-site mitigation in other sub-basins within the same watershed. The goal is to integrate transportation and environmental investments in a way that improves critical natural resources and supporting habitat, while ensuring that transportation funds are spent on the greatest environmental benefit.

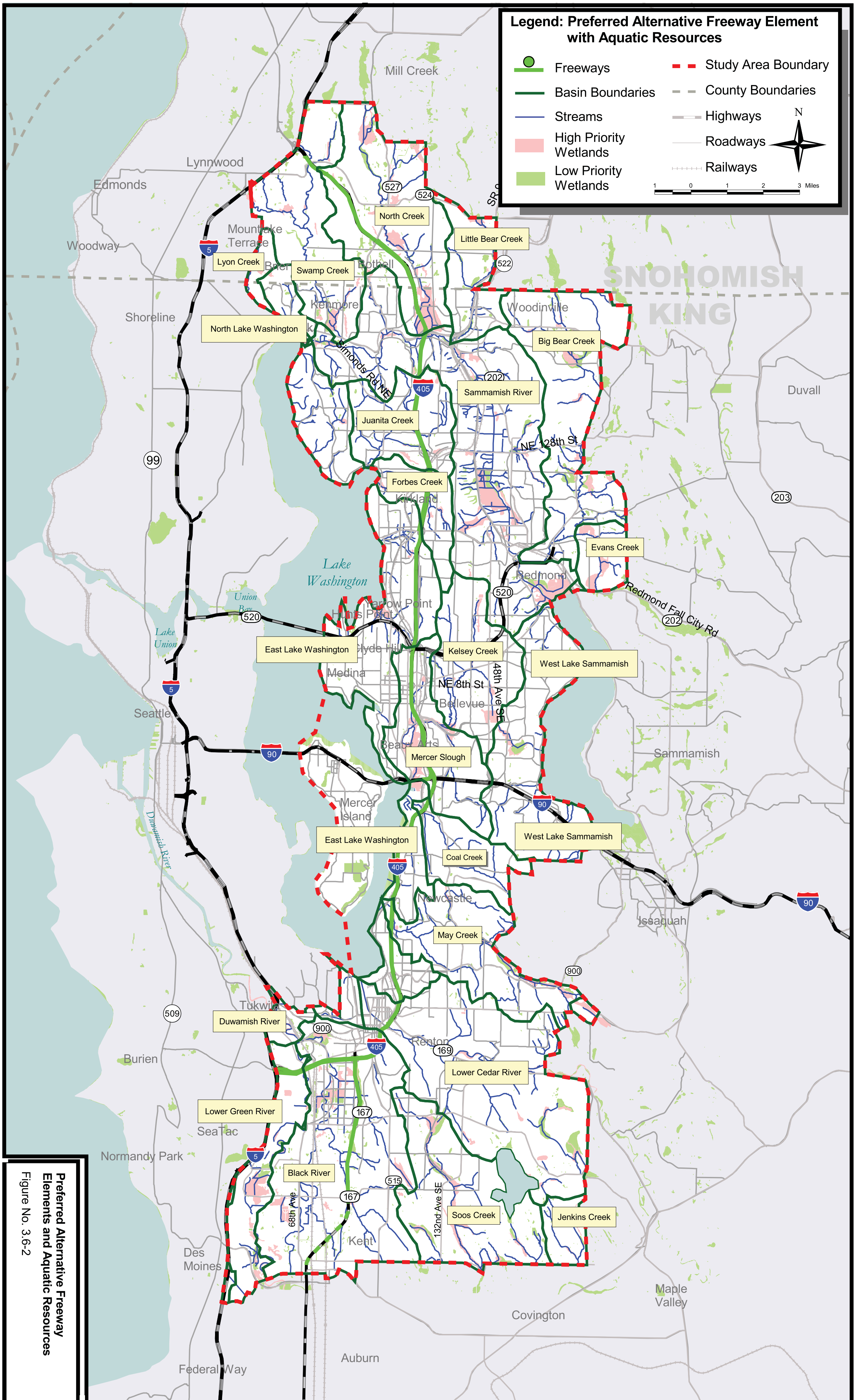
All alternatives are likely to result in unavoidable impacts to wetlands and to streams/riparian areas, and increase impervious surface area. The major projects likely to impact aquatic resources are the addition of one general purpose lane in each direction along I-405 and the arterial projects. Figure 3.6-2 shows an overlay of the I-405 elements relative to stream basins and wetlands and Figure 3.6-3 shows an overlay of the arterial projects relative to the stream basins and wetlands. These overlays generally show where the addition of lanes along I-405 and the arterial projects intersect with the identified wetlands and streams within sub-basins within the I-405 Corridor Program study area. The following paragraphs discuss mitigation for all aquatic resources as an overall perspective. Sections 3.8 and 3.5 present other mitigation for streams and surface water.

Impacts to aquatic resources would occur within WRIA 8, which contains 22 sub-basins, and WRIA 9, which contains 4 sub-basins. The sub-basins within WRIA 8 where the majority of aquatic impacts to wetlands and riparian/stream habitats are likely to occur are the Sammamish River and North Creek sub-basins, and in WRIA 9 the Black River sub-basin. Table 3.6-17 summarizes the aquatic resource impacts of the Preferred Alternative in these sub-basins.

Table 3.6-17: Summary of Resource Impacts of the Preferred Alternative on WRIA 8 and 9

Sub-basin	Wetland Acreage	Number of Riparian/Stream Encroachments	Impervious Surfaces (acres)
Black River	9.3	21	142
North Creek	6.4	21	141
Sammamish River	3.3	129	110
Total of Sub-basins	19.1	171	393
Total of Preferred Alternative and No Action Alternative	25	330	974
Sub-basins as Percent of Total	76%	52%	40%

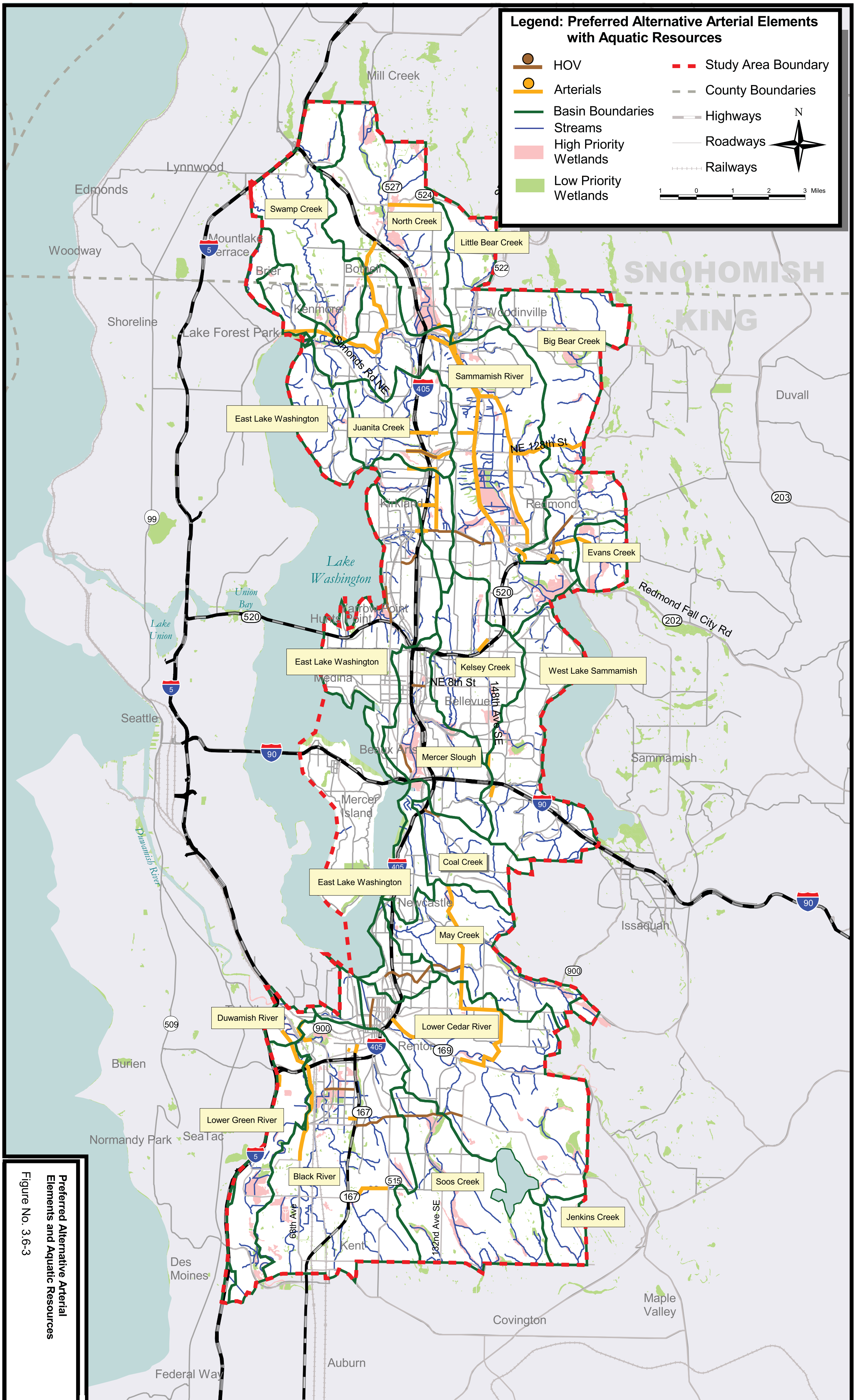
This page left intentionally blank.



Preferred Alternative Freeway Elements and Aquatic Resources

Figure No. 3.6-2

This page left intentionally blank.



Preferred Alternative Arterial Elements and Aquatic Resources

Figure No. 3.6-3

This page left intentionally blank.

Section 3.5.5 of the EIS identifies mitigation measures related to surface water and groundwater applicable to all alternatives, and identifies mitigation measures specific to sub-basins and alternatives. The surface water and groundwater mitigation measures apply primarily to basin base flows, which are important to fish and wildlife resources.

Section 3.8.5 of the EIS identifies mitigation measures related to fisheries and aquatic habitat – primarily riparian and stream encroachments – that apply to all alternatives. During development of the EIS, WSDOT met with basin stewards to obtain information on fisheries and aquatic mitigation opportunities within the sub-basins. Section 3.8.5.2 identifies mitigation opportunities within each sub-basin, which demonstrates that there is a broad range of available and sufficient mitigation opportunities within each sub-basin to offset unavoidable impacts. These will be further quantified at the project-level design stage. Information contained in Section 3.8.5.2 of the EIS along with other mitigation measures that will be identified as part of the WRIA planning efforts can be used to identify mitigation opportunities at the sub-basin, cross-basin, and WRIA levels.

Similarly, Section 3.6.5.1 identifies general mitigation measures to offset unavoidable impacts to wetlands that apply to all of the alternatives and each sub-basin. More detailed information will be developed to identify specific projects that will impact specific wetlands as the project transitions from the program level to the project-level design stage. There is limited ability to identify specific wetland mitigation opportunities within each sub-basin at the program level because:

- On-the-ground, site-specific surveys are needed to document wetlands that are currently not contained within the databases used during the program-level review.
- General wetland impacts have been identified (see Figures 3.6-2 and 3.6-3) but specific information on wetland types and functional impacts is not available for the program-level review.
- The necessary level of detail on available wetland mitigation opportunities within the sub-basins to correlate with project-specific impacts is either not available or is in various stages of development.
- Only general acreage of wetland mitigation opportunities is available to correlate with the estimated impact acreage to specify whether there is sufficient opportunity within a sub-basin to mitigate impacts.
- No detailed evaluation of mitigation site opportunity (ownership, costs, permitting, etc.) has been conducted.
- The level of design detail for the projects is sufficient to overlay on the existing information on wetlands, but it is not sufficient to determine if impacts can be or will be avoided.

Despite these limitations, the following is a discussion of an approach to developing a wetland mitigation strategy within each sub-basin at the project-level design stage. This effort will be done in coordination with the regulatory agencies and in coordination with the WRIA planning groups so that an integrated mitigation approach (e.g., mitigation within a sub-basin, mitigation across sub-basins, mitigation out-of-basin within the WRIA) is developed and implemented within the I-405 study area.

To illustrate this strategy and approach, three sub-basins are discussed in more detail: Black River, North Creek, and Sammamish River. These three sub-basins are discussed because over 75 percent of all wetland impacts occur within these sub-basins, and with the exception of the Sammamish River sub-basin, there is generally more information available on wetland mitigation opportunities. This information suggests whether there are sufficient mitigation opportunities to compensate for unavoidable wetland impacts within the sub-basin and whether compensatory wetland mitigation opportunities are limited within a sub-basin, and helps to identify targeted mitigation opportunities. For example, WSDOT collected numerous data on the I-405/SR 167 interchange project and used the information to develop an Example Project Environmental Analysis to demonstrate an approach to a mitigation strategy. This approach includes identifying and analyzing impacts and identifying mitigation opportunities within the Black River sub-basin. The strategy and approach identified below are applicable to all sub-basins during the project-level design stage.

Black River Sub-Basin

The mitigation approach used for the I-405/SR 167 interchange project (from the BNSF railroad crossing at I-405 [MP 1.2] to the I-405/SR 169 interchange [MP 4.0] and south of SR 167 to SE 180th Street interchange [MP 24.4]) is summarized below to illustrate the mitigation approach that WSDOT can undertake within the Black River sub-basin and that can be adapted to use in all of the sub-basins within the I-405 study area.

The approach was divided into four steps:

1. Evaluate mitigation opportunities on-site, off-site, and out-of-kind based on watershed priorities that address specific habitat impacts.
2. Quantify impacts to wetlands, fish and aquatic habitat, floodplains, water resources (surface water and groundwater), and upland protected species.
3. Estimate impacts based on conceptual design drawings and aerial photographs. During the project-level design stage resource boundaries will be delineated and surveyed.
4. Identify avoidance and minimization measures.

An impact matrix was prepared with Resources and Functions in the first column, and column headings across the matrix of Baseline Conditions, Impacts from Project, On-site Minimization Measures, and Potential Compensatory Measures.

Fish and aquatic resource functions were derived from the NMFS Pathways and Indicators Analysis (NMFS, 1996). Wetland functions were derived from WSDOT's Best Professional Judgment Tool (WSDOT, 2000). Floodplains were derived by FEMA maps, and functions included storage capacity, floodway conveyance, and floodplain connectivity. Water resource functions included temperature, turbidity, chemical contamination, change in peak or base flows, and groundwater exchange. Protected upland species information was derived from the WDFW PHS database, and functions included habitat for birds, mammals, native plant richness, educational values, and uniqueness and heritage value.

A GIS database provided the locations of the resources. Limited field work (e.g., drive-by) confirmed the presence or absence of a resource, after which the Baseline Conditions column was completed. At the project level, additional field work will be conducted to more accurately define and delineate resources.

Conceptual design drawings and aerial photographs were reviewed to define impacts and to input data into the Impacts from Project column of the matrix.

Based on the identified impacts, the conceptual level drawings were used to identify avoidance and minimization measures to complete the Minimization Measures column of the matrix.

Opportunities to compensate for unavoidable impacts were identified by interviewing local, state, and federal agencies, from existing published data on mitigation sites, and from unpublished lists prepared as part of the current WRIA planning efforts. During the project-level design stage, WSDOT will work with the regulatory agencies and the WRIA planning groups to identify mitigation opportunities that can be implemented on the sub-basin level, across sub-basins, and/or within a WRIA.

Based on the analysis conducted for the I-405/SR 167 interchange project, site-specific and basin-wide mitigation opportunities were identified that addressed all of the resources and functions used in the impact matrix. Although mitigation opportunities were identified that addressed all the resources and functions in the impact matrix, only sub-basin wetland opportunities are identified below to illustrate how the results of this analysis can be used to address unavoidable wetland impacts in the Black River sub-basin, and to demonstrate that for the anticipated 9.34 acres of wetland impact under the Preferred Alternative, there appears to be sufficient mitigation opportunities within the sub-basin. These opportunities include:

- Create wetland within the cloverleaf;
- Provide enhancement of low quality wetlands A2 and C2;
- Create and restore wetland along Springbrook Creek;
- Fund a wetland mitigation bank near Oakesdale Avenue and SW 34th Street;
- Acquire Seattle Times site near SW 34th Street for wetland creation;
- Enhance the Elliot Wetland;
- Enhance the wetland and stream habitat at Lower Jones Road;
- Enhance wetland 103;
- Create two groundwater-fed ponds near wetland 37D and extend an outlet channel to the wetland;
- Enhance wetland 132 by increasing structural diversity and creating fish-useable habitat;
- Enhance the wetland at Dorre Don Court;
- Enhance wetland 70; and
- Develop mitigation design for wetland drainage problems between Panther Creek and Springbrook Creek.

When these wetland mitigation opportunities are considered in concert with the many other mitigation opportunities targeted at the other resources and functions evaluated, an integrated mitigation approach can be implemented to offset impacts in the Black River sub-basin and maximize benefits to aquatic resources.

North Creek Sub-Basin

The North Creek sub-basin crosses the King-Snohomish county line north of Bothell and south of Mill Creek and includes the northerly portion of I-405, SR 527, and SR 524. It drains an area of approximately 29 square miles. North Creek originates near the Everett Mall and flows south to the Sammamish River.

Projects presented in the Preferred Alternative within the North Creek sub-basin that may impact wetland and other aquatic resources include:

- Freeway expansion (add up to 2 general purpose lanes in each direction on I-405, provide collector-distributor lanes);
- Connecting freeway expansion from SR 522 to NE 195th;
- Arterial capacity and connectivity expansion at SR 527 from SE 228th Street through the I-405 interchange;
- Arterial expansion in the form of widening the lanes to include sidewalks and bike lanes from 24th street SW to SR 527;
- Capacity expansion on north-south arterials by widening one lane in each direction;
- Upgrade of arterial connections to I-405;
- Bus rapid transit stations at Canyon Park and the Bothell/UW campus in Bothell;
- HOV express access on I-405 with direct access ramps in the vicinity of NE 195th Street (Bothell/UW campus) and SR 527;
- Additional park-and-ride capacity at Canyon Park (between I-405 and SR 527); and
- Additional transit center capacity at Canyon Park.

About 6.4 acres of wetland impact are anticipated from projects in the North Creek sub-basin. Possible mitigation opportunities related to surface waters and fisheries within the North Creek sub-basin are identified in Sections 3.5.5, 3.8.5, 3.8.5.1, and 3.8.5.2 of the EIS. In addition to the possible actions identified in those sections, Snohomish County and WSDOT (Snohomish County PWD, and WSDOT 2000) identified 22 possible aquatic habitat mitigation sites.

The North Creek sub-basin has sites large enough to develop wetland mitigation banks. Within the North Creek sub-basin, about 132 acres were identified that could be used for wetland preservation (38 acres), wetland enhancement (57 acres), wetland creation (20 acres), riparian enhancement (4.5 acres), wetland buffer enhancement (5.3 acres), stream restoration (2 acres), and wetland restoration (4.4 acres). Some specific high-priority opportunities identified by Snohomish County and WSDOT (Snohomish County PWD and WSDOT, 2000) include:

- A site off 35th Avenue SE and south of 132nd Street SE where hog fuel and organic debris have been dumped for several years. The site is bordered on the south and east by existing shrub wetlands and to the west is a 4-acre open water wetland mitigation site. The site is adjacent to Penny Creek, a tributary to North Creek. Mitigation opportunities at this site include up to about 2 acres of wetland creation or restoration and buffer creation.

- There is a multi-parcel site (approximately 25 acres) located north of the North Creek County Park that consists of a large wetland and pasture complex dominated by invasive species. A portion of the site is used for horse pasture and residences also occur on the site. North Creek and Penny Creek border the site. Opportunities at this site include wetland restoration and enhancement and riparian enhancement that would interconnect to another wetland complex to the south.
- A third site located on 180th Street SE, east of 35th Avenue SE, is about 5 acres in size and contains patches of wetland vegetation intermixed with upland pasture grasses. This site provides an opportunity for wetland creation/enhancement and riparian and stream restoration along Tambark Creek, which flows along the site's western border. South of this site is a large wetland complex that receives high amounts of wildlife usage. Created wetlands in this area are expected to reduce flooding, increase stream recharge, and promote wildlife usage.

Based on limited existing information, and taking into account anticipated replacement ratios required to mitigate for wetland impacts, enough acreage appears to be available in the North Creek sub-basin to mitigate for unavoidable wetland impacts as well as impacts to other aquatic resources.

Sammamish River Sub-Basin

The Sammamish River sub-basin extends from just north of the King-Snohomish County line, west towards Lake Forest Park, east to Redmond, and south to the north end of Lake Sammamish. The Sammamish River flows northward and westward from the north end of Lake Sammamish near Redmond to the north end of Lake Washington, and the sub-basin drains about 16,400 acres (25.63 sq miles) within the study area.

Projects presented in the Preferred Alternative that may impact aquatic resources are shown in Figures 3.6-2 and 3.6-3, and are predominantly related to arterial improvements. They include:

- Freeway improvements (add up to 2 general purpose lanes in each direction on I-405, provide collector distributor lanes);
- Widening SR 527 – Bothell Everett Highway;
- Upgrading arterial connections to I-405 from NE 85th to 120th and 228th;
- Adding an arterial HOV at NE 85th from Kirkland Way to 148th Avenue NE;
- Adding one lane in each direction from NE 90th to NE 116th;
- Providing a direct access ramp from SR 522 to the freeway HOV ramps;
- Expanding the capacity from NE 90th to NE 145th;
- Adding transit center capacity;
- Providing a climbing lane from southbound SR 522 to 124th;
- Widening SR 522;

- Constructing new three lane arterial from 132nd to Willows Road exit;
- Constructing new road from NE 124th to NE 145th;
- Widening road between NE 124th and NE 175th on SR 202;
- Constructing new ramp and thru lane at the SR 520/SR 202 interchange;
- Providing access improvements and new freeway ramps at SR 522/SR 202 and SR 522/195th; and
- Adding pedestrian/bike crossing over I-405 and making pedestrian/bike connections between SR 522 and NE 195th and from 228th to 240th.

About 3.34 acres of wetland impact are anticipated from projects developed under the Preferred Alternative in the Sammamish River sub-basin. As stated previously, information on mitigation opportunities in this sub-basin are being developed. Specifically, the Sammamish River Action Plan and the WRIA Early Action Mitigation Studies Plan are expected to provide a valuable source of information that WSDOT will use in implementing a mitigation strategy and approach as defined above under the Black River sub-basin. The 2002 Draft Near-Term Action Agenda for Salmon Habitat Conservation in the Greater Lake Washington Watershed (City of Tacoma, 2002) identifies some wetland opportunities. Opportunities that have been identified include enhancing headwater wetlands on significant tributaries to the Sammamish River and reconnecting existing wetlands to old oxbows or side channels. The final document is expected to identify potential projects, and King County is in the process of completing a wetlands evaluation to identify restoration and enhancement projects.

In summary, WSDOT is committed to a mitigation approach and strategy that is common to all projects (at the 5 percent design level) and that can be used at the sub-basin, cross-basin, and WRIA levels. WSDOT's commitments to the mitigation approach and strategy at the sub-basin level include:

1. Avoiding and minimizing unavoidable impacts during the project design stage.
2. Participating and partnering in the development of WRIA 8 and 9 watershed plans designed for watershed, sub-basin, regional, and segment-scale habitat analyses to focus and prioritize restoration/mitigation efforts aimed at wetlands, fisheries, and water quality. This commitment requires considerable effort to bring together the entities involved in watershed planning to determine the spatial data platforms; the extent of physical, biological, and chemical data for habitat, streams, wetlands, and water quality; data gaps; and the available tools for analyzing habitat conditions and identifying and prioritizing restoration/mitigation efforts.
3. Applying the approach and strategy used for the I-405/ SR 167 interchange project for the Black River sub-basin to other sub-basins.
4. Working with the regulatory agencies to bring the WRIA watershed planning efforts into the sub-basin mitigation approach. For example, as part of the WRIA-based efforts, fish passage barriers were identified in the North Creek sub-basin. One approach WSDOT will use to identify restoration/mitigation projects that benefit fish and aquatic habitat and wetlands is the Salmon and Steelhead Habitat Inventory and Assessment Program (SSHIAP). SSHIAP is a database of salmon stock and habitat conditions (e.g., stream segments, fish distribution,

fish passage barriers, hydromodifications, riparian/wetland conditions, historic habitat conditions) based on data collected or available for each stream segment. This database can be and has been used to determine which projects within a river/stream system would have the greatest benefit to wild salmon production. Specifically, the SSHIAP data can be used to compare culvert projects relative to the miles open to fish passage based on gradients and lake and wetlands habitat, and relate that information to gains in smolt production. Contrary to intuitive thinking, a culvert project that opens up the most miles to fish passage does not necessarily result in the most benefits to salmon if other culvert projects open up more habitat favorable to spawning and rearing over a shorter distance. This is the type of analysis the SSHIAP database is used for, and is one tool WSDOT will use and incorporate into the mitigation approach to evaluate aquatic restoration opportunities on the sub-basin and WRIA level.

5. Developing a tiered list of restoration/mitigation actions by WRIA and sub-basin.
6. Quantifying unavoidable impacts for the Preferred Alternative. For example, unavoidable wetland impacts would be quantified by a site visit/delineation using the local jurisdiction and/or Ecology manuals to define the size and type of the wetland and the extent of surface area and functional wetland impact.
7. Correlating unavoidable impact area and function to the tiered list of restoration/mitigation actions based on local, state, and federal regulatory standards.
8. Developing a matrix that identifies restoration/mitigation actions that can be implemented within a sub-basin, across sub-basins, or within the overall WRIA consistent with phasing the Preferred Alternative projects, and coordinating this effort with regulatory agencies.
9. Developing and entering into a memorandum of understanding for approval of corridor-level impacts and mitigation actions targeted within a sub-basin, across basins, and/or within the overall WRIA.
10. Applying for regional general permits and other regional approvals as appropriate.
11. Implementing restoration/mitigation actions.

To the extent practical at the programmatic review level, WSDOT has identified opportunities for wetland mitigation (based on limited existing information) in two of the three sub-basins where the majority of wetland impacts occur. It appears that for wetland impacts, there is sufficient opportunity and area within the Black River and North Creek sub-basins to implement wetland mitigation as well as other types of mitigation to offset impacts to other aquatic resources. Developing detailed information on mitigation opportunities within the other sub-basins will require determining the extent and quality of existing information, conducting additional studies, interfacing with local, state, federal, and WRIA planning efforts, and project-level design.

This page left intentionally blank.

3.7 WILDLIFE, HABITAT, AND UPLAND THREATENED AND ENDANGERED SPECIES

This section addresses upland habitat and wildlife species, including threatened and endangered, priority, and monitor species, and species of concern. Fish species are discussed in Section 3.8, Fish and Aquatic Habitat. Wetland habitat is discussed in Section 3.6, Wetlands.

3.7.1 Studies and Coordination

The Washington State Department of Natural Resources (WDNR), the Washington Department of Fish and Wildlife (WDFW), the U.S. Fish and Wildlife Service (USFWS), and the National Marine Fisheries Service (NMFS) provided information on wetlands, wildlife, vegetation, threatened and endangered species, and habitat resources documented within the study area. Preliminary information reviewed to assist the field investigation included databases of the WDNR Natural Heritage Data System (NHDS) and WDFW Priority Habitats and Species (PHS) Program. Records of plant or animal species and habitats known or expected to occupy the subject property were reported by these data sources. This information was presented on geographic information system (GIS) maps, which could be superimposed over maps showing the locations of proposed transportation improvements for each alternative. The maps were used to make preliminary assessments of substantial potential impacts to upland vegetation, habitat, wildlife, and federally listed species. Upland vegetation and habitat was further evaluated during field reconnaissance.

Land use in the analysis area was determined to be "Urban," "Suburban," or "Rural," based on city and county comprehensive plans, U.S. Geological Survey (USGS) maps, and aerial photographs. Urban areas are typically highly developed (mostly industrial and commercial use) and sparsely vegetated, offering low habitat value to wildlife. Suburban areas are moderately developed (mostly residential use) and offer moderate habitat value to wildlife in the form of backyard vegetation, parks, and open space. Rural areas are mostly undeveloped (small farms and low-density residential development) and offer sufficient areas of usable habitat. All determinations were subsequently verified in the field.

3.7.2 Methodology

Potential direct impacts to wildlife such as habitat loss and disturbance from proposed construction were assessed. The linear distance of habitats encroached upon was used as an index to quantify habitat impacts. The documented occurrence of priority species and the level of use of wildlife within the analysis area were also evaluated. Indirect impacts to wildlife, such as post-construction disturbance, and potential wildlife mitigation measures were identified.

Each of the improvements that would result in impacts beyond the existing developed right-of-way was identified for each alternative. The location of each of these improvements was identified on base maps and then overlaid with WDFW PHS maps to identify habitat impacts. A field reconnaissance was also conducted to characterize habitat in the analysis area to further describe impacts. Because not enough project information is available to calculate the area of habitat that would be affected by each improvement and alternative, potential habitat impacts were quantified based on the linear distance where each of the improvements would require construction beyond the disturbed right-of-way. The linear distance of habitats encroached upon was used as an index to quantify habitat impacts. Therefore, this linear quantification of impacts assumes that if construction outside of the developed road prism occurs, then impacts to the adjacent habitat would result. This worst-case approach assumes that impacts would occur even though they may be avoided if the functioning habitat does not occur immediately adjacent to the developed right-of-way.

The analyses in this section are based on the *I-405 Corridor Program Draft Upland Vegetation, Habitat, and Wildlife Expertise Report* (DEA, 2001), herein incorporated by reference.

3.7.3 Affected Environment

The following subsections describe the upland habitats that occur in the study area and address the presence of priority habitats, wildlife, and threatened and endangered species in the study area.

3.7.3.1 Upland Vegetation

Historically, land in the vicinity of the I-405 corridor was dominated by mature forests of western hemlock (*Tsuga heterophylla*) and Douglas fir (*Pseudotsuga menziesii*) in drier areas and mixed coniferous-deciduous forests, particularly red alder (*Alnus rubra*) and big-leaf maple (*Acer macrophyllum*), in wetter areas (Franklin and Dyrness, 1973). Much of the study area was logged around the turn of the century, and the land was cleared in the early 1900s for agricultural purposes. Since then, the remaining forests have been further fragmented as development has occurred.

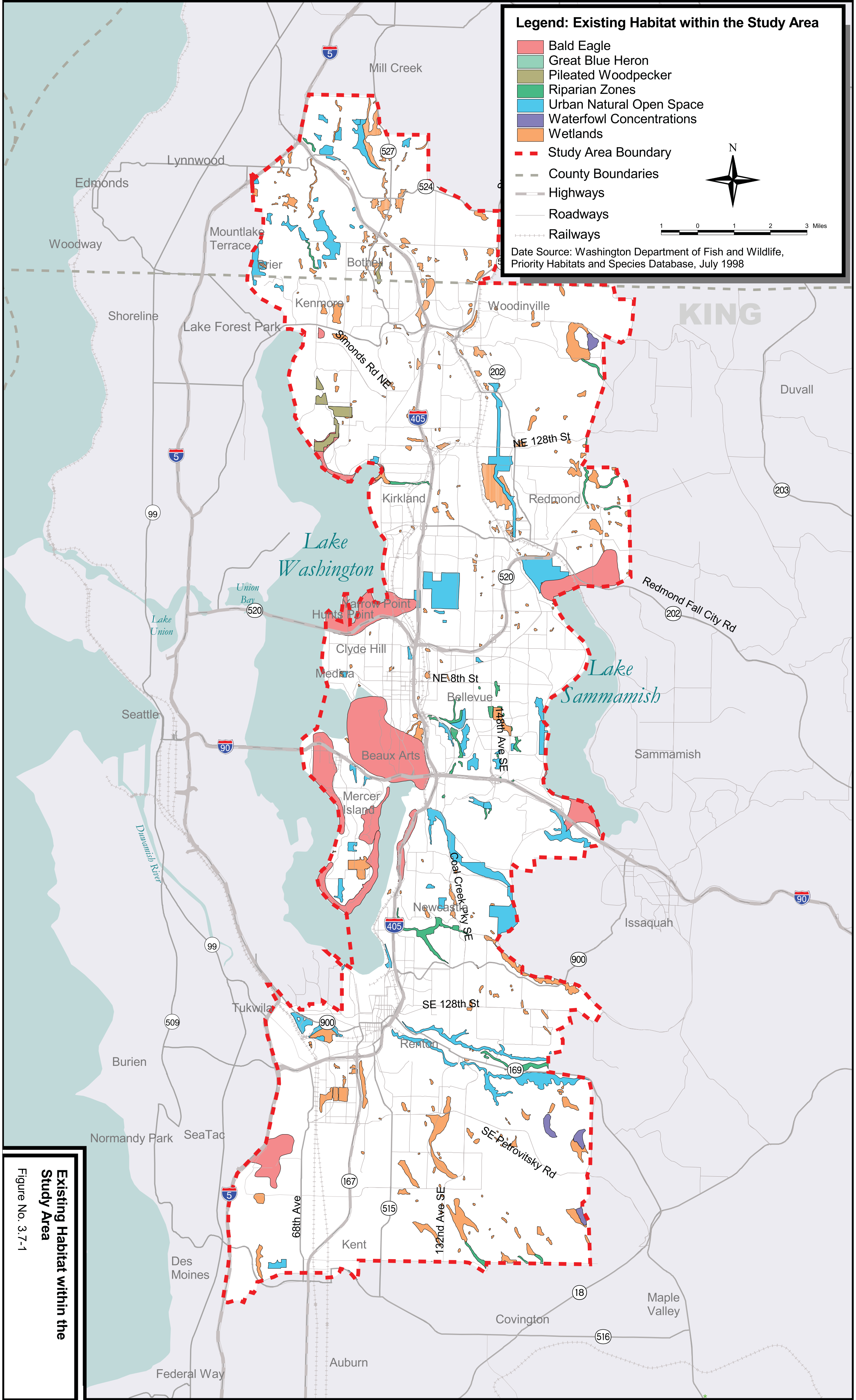
At present, the largest portion of the study area falls within highly developed commercial, industrial, and residential areas categorized as urban areas and moderately developed, mostly residential areas categorized as suburban areas for the purposes of this study. Landscaped vegetation and non-native species have replaced most of the native vegetation in these areas. Many of the affected urban and suburban areas fall within road right-of-way, which is commonly vegetated with landscaped trees, sword fern (*Polysticuum munitum*), Himalayan blackberry (*Rubus procerus*), or mowed grass.

In the low-lying area north of Woodinville, vegetation includes pasture grasses and cultivated crops. The remaining largely undeveloped rural areas falling within the study area contain a mix of landscaped vegetation, pastured areas, herbaceous and shrub vegetation along Bonneville Power Administration (BPA) powerlines, and pockets of forest. These forested pockets are commonly found along drainage ravines, undevelopable slopes, and areas preserved as open space. They are typically dominated by western red cedar (*Thuja plicata*), western hemlock, Douglas fir, red alder, and big leaf maple with an understory of sword fern and vine maple (*Acer circinatum*) scattered throughout.

3.7.3.2 Priority Habitats

Priority habitats are designated under the WDFW PHS program (WDFW, 2000) and are identified as areas with unique or significant value to many species. Priority habitats identified within the analysis area include freshwater wetlands, riparian zones, bald eagle habitat, great blue heron habitat, pileated woodpecker habitat, waterfowl concentration areas, and urban natural open space. Figure 3.7-1 shows the location of these habitats.

Vegetated uplands adjacent to wetland areas are considered to be some of the richest zones for mammals and birds. In Washington State, 85 percent of the terrestrial vertebrate species use



Existing Habitat within the Study Area

Figure No. 3.7-1

This page left intentionally blank.

wetlands and/or the vegetated upland adjacent to wetlands for food, breeding, and shelter (Castelle, et al., 1992). Wetlands are discussed in detail in Section 3.6 and the *I-405 Corridor Program Draft Wetlands Expertise Report* (DEA, 2001a).

Riparian habitat in the study area occurs along lake shorelines and along the banks of streams and rivers and is of similar importance to wildlife. These riparian areas create a network of open space corridors that allow wildlife to move relatively freely among nesting and foraging areas. Riparian corridors in the vicinity of the I-405 Corridor improvements are associated with the Cedar River, May Creek, Panther Creek, Green River, Coal Creek, Springbrook Creek, Molasses Creek, Mercer Slough, Richards Creek, Juanita Creek, Swamp Creek, Horse Creek, North Creek, Bear Creek, and the Sammamish River, as well as Lake Washington, Lake Sammamish, and other smaller lakes and ponds. Although each of these riparian areas falls within the study area, only riparian areas mapped by WDFW along Forbes Creek, Kelsey Creek, and May Creek are encountered by the proposed improvements. However, impacts to unmapped riparian habitat could result along other water bodies in the analysis area.

Urban natural open space is land that has been preserved because it provides habitat for priority species or is an isolated remnant of natural habitat larger than 10 acres and surrounded by urban development. Identified urban natural open space falling within the analysis area includes numerous Bellevue parks, Coal Creek Park, Coal Creek riparian area, and Renton riparian forest.

3.7.3.3 Wildlife

Much of the urbanized portion of the study area is inhabited by species typical of developed areas. The prevalence of development and landscape maintenance activities in these areas have resulted in the predominance of species adapted to degraded and disturbed habitats. These species often include: American robin (*Turdus migratorius*), violet-green swallow (*Tachycineta thalassina*), house sparrow (*Passer domesticus*), European starling (*Sturnus vulgaris*), American crow (*Corvus brachyrhychos*), raccoon (*Procyon lotor*), opossum (*Didelphis virginiana*), and several small mammal species. Fragmented areas of riparian vegetation provide limited corridor habitat through developed areas for wildlife.

The WDFW (2000) identifies five bald eagle territories within the study area, including the St. Edwards Park, Marymoor Park, Hunt's Point, Southeast Mercer Island, and Chism Beach territories. Bald eagle territories are typically proximate to water with an adequate food source and large trees that provide an unobstructed view of the water body.

Three waterfowl concentration areas occur in the southeast corner of the study area; another occurs in the eastern portion of Woodinville; and a fifth occurs at the north end of Lake Sammamish. Five patches of pileated woodpecker habitat occur in the Juanita area of Kirkland (WDFW, 2000).

The WDFW (2000) identifies one area on Mercer Island where osprey (*Pandion haliaetus*) (a State Monitor species) occur and four other territories are reported by WDFW in Bothell, Bellevue, and Tukwila. A single western pond turtle (*Clemmys marmorata*) (State Endangered, USFWS Species of Concern) has been documented in Redmond. The data also identify nine areas located in Bothell, Kenmore, Redmond, Kirkland, Bellevue, Renton, and Kent where great blue heron (*Ardea herodias*, a WDFW Priority species) rookeries occur within the analysis area.

The study area could potentially provide habitat for yuma myotis (*Myotis yumanensis*) and red-legged frog (*Rana aurora*), both USFWS Species of Concern.

Most of the area encountered by the improvements falls within road right-of-way described above in Section 3.7.3.1. This area, especially the maintained portions of the right-of-way, typically has relatively low habitat value to wildlife and is generally highly disturbed, especially in the clear zone. Wildlife could occasionally occupy these areas; however, such occurrence is often short term during movement between more suitable habitats. Nesting and other long-term habitat use is more common in the right-of-way outside of the clear zone where native habitat often occurs. Crows commonly scavenge roadkill and garbage in these right-of-way areas. Some of the more common species expected to use right-of-way areas vegetated with shrubs or small trees include black-capped chickadee (*Parus atricapillus*), chestnut-backed chickadee (*P. rufescens*), common bushtit (*Psaltriparus minimus*), ruby–crowned kinglet (*Regulus calendula*), Bewick’s wren (*Thryomanes bewikii*), spotted towhee (*Pipilo erythtrophthalmus*), dark-eyed junco (*Junco hyemalis*), song sparrow (*Melospiza melodia*), and rats (*Rattus* spp.).

Some species use mowed right-of-way for foraging or travel when shrub or tree cover is nearby. The most common species expected in the analysis area include red-tailed hawk (*Buteo jamaicensis*) (especially in Kent Valley and Woodinville Redmond area), American kestrel (*Falco sparverius*), northern flicker (*Colaptes auratus*), killdeer (*Charadruis vociferus*), brewer’s blackbird (*Euphagus cyanocephalus*), rufous hummingbird (*Selasphorus rufus*), meadow mice (*Microtus* spp.), moles (*Scapanus* spp.), and coyote (*Canis latrans*). Many mowed road right-of-ways are regularly used for hunting by red-tailed hawks. They often perch on trees, fence posts, and utility poles located along the right-of-ways and prey on meadow mice and other small rodents that live along the right-of-way. Given the extensive level of development that has eliminated much of the former agricultural areas in the analysis area, these grass-dominated right-of-ways likely provide important hunting habitat for hawks.

Pockets of forested habitat along road right-of-ways may be used by forest species not overly sensitive to noise or habitat fragmentation. The most common species expected include downy woodpecker (*Picoides pubescens*), hairy woodpecker (*P. villosus*), pileated woodpecker (*Dryocopus pileatus*), Steller’s jay (*Cyanocitta stelleri*), red-breasted nuthatch (*Sitta canadensis*), winter wren (*Troglodytes troglodytes*), varied thrush (*Ixoreus naevius*), western tanager (*Piranga ludoviciana*), raccoon, opossum, and eastern gray squirrel (*Sciurus carolinensis*). However, most of these species would occur only in the larger patches of native vegetation or patches connected to other undeveloped areas by wooded corridors. A more comprehensive list of species expected to utilize the right-of-way habitat is included in Appendix L.

3.7.3.4 Threatened and Endangered Species

The bald eagle (*Haliaeetus leucocephalus*) is the only terrestrial species listed as threatened under the Endangered Species Act (ESA) that is documented within 0.5 mile of the improvements (WDFW, 2000). The WDFW (2000) identifies five bald eagle territories in the analysis area (Section 3.7.3.3).

Nesting activities occur from January 1 through August 15 (USFWS, 1986). Bald eagle nesting territory parameters in the Pacific Northwest include proximity to water with an adequate food source, large trees with sturdy branching at sufficient height for nesting, and tree stand heterogeneity both vertically and horizontally (Grubb, 1976). Nest tree structure is more important than tree species, and nest trees are typically among the largest in the stand, providing an unobstructed view of an associated water body (USFWS, 1986).

In addition to nesting, bald eagles also winter in the vicinity of large bodies of water in tall stands of trees. Bald eagle wintering activities occur from November 15 through March 15 (USFWS, 1986). In the analysis area, bald eagles winter near such water bodies as Lake Washington, Lake Sammamish, and the Cedar River.

The western pond turtle (a state endangered species) is documented near Lake Sammamish. However, this record is not recent, and past surveys by the WDFW did not identify western pond turtles in the vicinity. Viable populations are not expected to occur in the analysis area.

Threatened and endangered fish species are addressed in the *I-405 Corridor Program Draft Fish and Aquatic Habitat Expertise Report* (DEA, 2001b).

3.7.4 Impacts

Impacts of each alternative on upland habitats are discussed in the following sections. Table 3.7-1 summarizes the impacts of the alternatives to priority habitat and land use types.

Table 3.7-1: Comparison of Linear Impacts by Habitat and Land Use Type (linear feet)

Habitat	No Action	Alternative 1[a]	Alternative 2[a]	Alternative 3[a]	Alternative 4[a]	Preferred Alternative [a]
Bald Eagle Habitat	3,600	40,100	54,160	41,260	50,460	60,880
Urban Natural Open Space	12,200	43,100	48,960	52,300	33,900	49,020
Riparian Area	0	12,340	20,900	13,560	11,120	13,560
Total	15,800	95,540	124,020	107,120	95,480	123,460
Urban	132,528	372,551	670,343	658,674	698,966	More than Alternatives 1, 2, and 3. Similar to Alternative 4
Suburban	241,296	478,918	1,051,329	999,057	1,219,919	
Rural	34,320	35,552	36,608	36,608	35,376	
Total	408,144	887,021	1,758,280	1,694,339	1,954,261	

[a]Impacts include the No Action Alternative.

Note: The linear distances that the corridor improvements will encounter in each habitat type were used as an index for comparison of impacts among alternatives.

3.7.4.1 No Action Alternative

Under the No Action Alternative, a variety of improvements would result in impacts to various priority habitats. No improvements under the No Action Alternative encounter riparian habitats identified by WDFW (2000). The No Action Alternative affects 12,200 linear feet of urban natural open space resulting in habitat loss and disturbance to the periphery of habitats. The alternative could affect up to 3,600 linear feet of habitat located within bald eagle territories. Increased noise disturbance could occur at one bald eagle nest that is located within 0.5 mile from an improvement. Wetland habitats are also impacted and are discussed extensively in the *I-405 Corridor Program Draft Wetlands Expertise Report* (DEA, 2001a).

The No Action Alternative is not expected to have substantial adverse impacts on upland vegetation, habitat, wildlife, and endangered/threatened species. Most of the study area is at or near buildout and the opportunity for future development is limited. No Action Alternative improvements are extensions of already developed corridors and roadways, affecting mostly degraded habitats.

Construction Impacts

Construction impacts to upland habitats from the No Action Alternative would result primarily from road widening. Widening could impinge anywhere from a width of 5 to 20 feet in a linear fashion over a variety of priority and unclassified habitats. The majority of impacts would occur in presently degraded habitats such as mowed right-of-way. Along the I-405 corridor, most of the immediate area beyond the right-of-way is landscaped or disturbed from previous improvements and is now dominated by a variety of non-native plants. Although impacts to such habitat generally would have minimal effects on wildlife, these areas provide important habitat for some species. The loss of mowed right-of-way would reduce the available hunting habitat for many raptors, especially red-tailed hawks.

The temporal impacts associated with construction include visual and audible disturbance, and possible contaminant spills. Noise levels associated with construction machinery could affect wildlife, depending on the proximity to the activity and the proximity of other noise sources common in the vicinity. However, given the present levels of disturbance in the analysis area, the effects of construction disturbance to wildlife are likely to be minor for most species. Raptors are likely to be most affected by disturbance from construction. Construction activities could result in a temporary loss of use of raptor hunting habitat. Many fuels and chemicals are used in construction projects, and accidental spills are a possibility. Pollutant spills could impact vegetation and individual wildlife.

The USFWS bald eagle recovery plan asserts that construction activities within 0.25 mile of bald eagle nests and roosts should be regulated to avoid disturbance impacts. That distance increases to 0.5 mile when the nest or roost is in view of the construction activities. However, the bald eagle nests identified in this study are unique in that they occur in urban areas, and development activities commonly occur between the nests and the project areas. Not only are the individual birds habituated to a certain degree to disturbance, but disturbance associated with the improvements in this study would probably not substantially increase the level of disturbance that is already present. It may, however, decrease the overall quality of the habitat within the territory. The actual extent of impacts to bald eagles will not be identified until project-level information is generated. If construction extends well beyond the existing right-of-way, perch trees and prey habitat could be affected. This is most likely to result from improvements that have impacts on aquatic and wetland areas. Impacts to these habitats are addressed in the Fisheries and Wetlands expertise reports (DEA, 2001b and 2001a).

Project R-25 comes within 0.23 mile of a bald eagle nest located in Marymoor Park in Redmond. This area is already developed, and therefore disturbance from noise and human activity is already tolerated by the birds. Additional noise and activity impacts from this improvement would occur farther from the nest than those which already exist, and thus would not likely increase overall disturbance to the birds. However, the activity that would result from construction might differ from that to which the eagles are accustomed, and therefore might affect them differently. The overall impacts to habitat from the proposed improvements could also degrade the quality of the territory. Although unlikely, increased disturbance and/or habitat loss could result in nest abandonment.

Operational Impacts

Operational impacts could occur, yet roadways already exist and expansion would not result in a change in land use, only a slight increase in the level of disturbance. Because most improvements are associated with the freeway, disturbance increases would be negligible. Disturbance associated with increased traffic along arterials and other road expansions would have a slightly greater impact on wildlife. Increases in traffic would likely result in more wildlife mortality from automobiles. The noise associated with traffic increases could reduce the suitability of habitat located within the right-of-way for the more disturbance-sensitive species such as raptors. Increased traffic levels increase the chance of pollution through road runoff and accidental fuel/oil spills.

Disturbance from more automobiles could possibly have impacts on eagle nests, perches, or roosts if they are located within 0.5 mile (with line of sight) and 0.25 mile (without line of sight) from the project areas. Considering the success the eagles in the analysis area have had in this already urbanized environment, they have demonstrated their ability to habituate to human disturbance. Although disturbance impacts to bald eagles could occur, the effects are likely to be insignificant. Nest abandonment is possible, but unlikely to result from operational impacts.

3.7.4.2 Alternative 1: HCT/TDM Emphasis

Alternative 1 includes a variety of improvements that could have linear impacts on various priority habitats. The alternative could impact 12,340 linear feet of riparian habitat identified by WDFW (2000) and is discussed in greater detail in the *I-405 Corridor Program Draft Fish and Aquatic Habitat Expertise Report* (DEA, 2001b). Alternative 1 could affect 43,100 linear feet of urban natural open space, resulting in habitat loss from the installation of the HCT system and disturbance to the periphery of habitats. The alternative could impact 40,100 linear feet of bald eagle habitat, over 10 times that of the No Action Alternative. Construction would occur within 0.3 mile of one bald eagle nest. Wetland habitats also could be impacted and are discussed extensively in the *I-405 Corridor Program Draft Wetlands Expertise Report* (DEA, 2001a). All impacts are in addition to those that would occur under the No Action Alternative.

Some improvements in this alternative, such as the HCT system, would affect some undeveloped areas, but these areas are all within already fragmented habitats within developed areas of the corridor. Further fragmentation may restrict the use of these areas by wildlife (see Section 3.7.3.3) by reducing suitable available habitat or associated cover and corridors. The precise impacts to specific areas cannot be fully assessed until project-level information is available.

Construction Impacts

Construction impacts under Alternative 1 would include those described under the No Action Alternative. In addition, Alternative 1 includes a physically separated, fixed-guideway HCT system that could impact areas previously unaffected by roadway improvements. This contributes to an increased loss of urban natural open space nearly three times that of the No Action Alternative. The additional improvements included under this alternative could result in a similar increase in construction disturbance. New improvements, such as the HCT system, could cause additional fragmentation of habitats and possibly obstruct existing wildlife corridors. In particular, three improvements may impact riparian zones in the May Creek basin, as they require new construction on the edge of a PHS area.

In addition to the encroachment to the Marymoor Park bald eagle nest discussed under the No Action Alternative, Alternative 1 would also encroach on a second bald eagle nest. Project R.HOV-56, under Alternative 1, runs along the eastern edge of Yarrow Bay, within 0.3 mile of a bald eagle nest. Relatively low-density development occurs between the proposed improvement and the nest, but some sections of the current roadway run along the edge of the wetlands and would directly impact the edge of the habitat. The proximity of the improvement to the nest site leaves open the potential for noise disturbance. As under the No Action Alternative, nest abandonment is a possible result, but is unlikely due to the relatively small amount of habitat that would be affected in each nesting territory, and due to the eagles' apparent habituation to disturbance as indicated by their presence in an urbanized area.

Operational Impacts

Operational impacts are the same as in the No Action Alternative, but to a greater magnitude and with the addition of the HCT system. The HCT system would result in additional noise disturbance to surrounding habitats and increased fragmentation of habitats that are already fragmented with the loss of corridors across which species can migrate. Increasing capacity may also result in an increase in noise disturbance along road expansions. The Kennydale Hill climbing lane and Park Drive queue bypass in particular might impact a PHS riparian area in the May Creek basin. Although disturbance impacts to bald eagles could occur, the effects are likely to be insignificant. Nest abandonment is possible, but unlikely to result from operational impacts.

3.7.4.3 Alternative 2: Mixed Mode with HCT/Transit Emphasis

Alternative 2 includes a variety of improvements that could have linear impacts on various priority habitats. Alternative 2 would encounter 48,960 linear feet of urban natural open space in addition to that under the No Action Alternative, resulting in habitat loss from the installation of the new HCT system and disturbance to the periphery of habitats. The alternative could affect 54,160 linear feet of habitat within bald eagle territories. Increased noise disturbance and physical habitat disturbance could occur within this territory. Alternative 2 impinges on 20,900 linear feet of riparian habitat in comparison to none for the No Action Alternative. Riparian impacts are discussed in greater detail in the *I-405 Corridor Program Draft Fish and Aquatic Habitat Expertise Report* (DEA, 2001b). Wetland habitats also could be impacted and are discussed in the *I-405 Corridor Program Draft Wetlands Expertise Report* (DEA, 2001a).

Construction Impacts

Construction impacts under Alternative 2 would be the same as described under the No Action Alternative but with some additions. Alternative 2 includes a physically separated, fixed-guideway HCT system, basic I-405 improvements, and arterial (HOV and planned) improvements that could impact areas that would not be impacted under the No Action Alternative (Appendix B). This could contribute to an increased loss of urban natural open space three times that of the No Action Alternative. The additional improvements contained in this alternative could result in a similar increase in construction disturbance. New improvements, such as the HCT system, could cause additional fragmentation of habitats and possibly close corridors to wildlife. The Coal Creek Parkway arterial improvement widens an existing road crossing of an extensive PHS riparian area along May Creek (see the *I-405 Corridor Program Draft Fish and Aquatic Habitat Expertise Report* [DEA, 2001b] for assessment of the aquatic habitat impacts) and would likely cause some loss of riparian habitat. The addition of one lane on I-405 may also impinge on this area. These impacts are in addition to those described under Alternative 1.

Impacts to bald eagle nests would be the same as those described for Alternative 1, but there is a greater potential for impacts to other bald eagle habitat, as this alternative affects a much greater area of habitat.

Operational Impacts

Operational impacts are similar to those discussed under the No Action Alternative but with the addition of the HCT system and other improvements that increase capacity along various highways. The HCT system and capacity improvements would bring additional noise disturbance to surrounding habitats and increased fragmentation of habitats that could further limit wildlife movement between habitats.

3.7.4.4 Alternative 3: Mixed Mode Emphasis

The scale of improvements and impacts to upland habitat for Alternative 3 are similar to that of Alternative 2. Alternative 3 could affect 52,300 linear feet of urban natural open space in addition to that impacted in the No Action Alternative. The alternative could impact 41,260 linear feet of bald eagle habitat. One bald eagle nest could experience increased noise disturbance. Alternative 3 encroaches on 13,560 linear feet of riparian habitat in comparison to none for the No Action Alternative. Riparian habitat impacts are discussed in greater detail in the *I-405 Corridor Program Draft Fish and Aquatic Habitat Expertise Report* (DEA, 2001b). Wetland habitats also could be impacted and are discussed in the *I-405 Corridor Program Draft Wetlands Expertise Report* (DEA, 2001a).

Impacts to wildlife under this alternative would be similar to those under Alternative 1, but would result in somewhat less loss of suitable bald eagle habitat and slightly greater impacts on documented bald eagle nest territories. Impacts to red-tailed hawks, American kestrels, and other species that commonly occur in habitats located along highway right-of-ways would also be slightly greater.

Construction Impacts

Construction impacts under Alternative 3 would be the same as described under the No Action Alternative with the following additions. New improvements under Alternative 3 would result in additional impacts to urban natural open space, almost four times that of the No Action Alternative. The additional improvements involved would likely result in a proportionate increase in construction disturbance over the No Action Alternative. This could cause additional fragmentation of habitats and possibly further limit wildlife access to habitat.

Alternative 3 would result in the same impacts to endangered species as described in Alternative 1, with slightly greater impact to documented bald eagle territory.

Operational Impacts

Operational impacts under Alternative 3 are similar to those described for the No Action Alternative but with some additions. The addition of lanes on existing highways and the arterial improvements would increase disturbance in surrounding habitats. Increased capacity would potentially result in more wildlife mortality from increased traffic volumes and greater noise disturbance.

3.7.4.5 Alternative 4: General Capacity Emphasis

Alternative 4 encounters 33,900 linear feet of urban natural open space that could suffer habitat loss and disturbance. In addition to the bald eagle impacts identified under the No Action Alternative, Alternative 4 could affect 50,460 linear feet of bald eagle habitat. Alternative 4 encroaches on 11,120 linear feet of riparian habitat in comparison to none for the No Action Alternative. Riparian impacts are discussed in greater detail in the *I-405 Corridor Program Draft Fish and Aquatic Habitat Expertise Report* (DEA, 2001b). Wetland habitats also could be impacted and are discussed in the *I-405 Corridor Program Draft Wetlands Expertise Report* (DEA, 2001a).

Alternative 4 would result in a greater loss of habitat than the other alternatives. As is the case with the other action alternatives, much of the loss would occur in marginal, highly fragmented habitat. However, Alternative 4 would affect more rural area than the other alternatives. Therefore, impacts to higher quality wildlife habitat are more likely under Alternative 4. The majority of the improvements under Alternative 4 involve road expansions and additions, and may therefore affect more habitat located along right-of-ways. Further fragmentation of habitat might also limit the availability of suitable habitat to some wildlife species.

Construction Impacts

Alternative 4 would result in additional construction impacts to those described under the No Action Alternative. The majority of improvements under Alternative 4 are expansions of I-405 and arterials that would result in increased noise disturbance and loss of habitat. Alternative 4 improvements would encounter approximately twice the amount of urban natural open space as the No Action Alternative. The additional improvements involved under Alternative 4 would result in a proportionate increase in construction disturbance over the No Action Alternative. New improvements, such as road extensions, could cause additional fragmentation of habitats and possibly further restrict wildlife movement along corridors. Several road expansions, including four that are not proposed under any other alternative, cross or border riparian habitat along May Creek and would likely impact that high quality riparian area.

Alternative 4 improvements would encounter 14 times the amount of bald eagle habitat as the No Action Alternative. However, none of the improvements under Alternative 4 would occur within 0.5 mile of bald eagle nests. Therefore, impacts to habitat within eagle nest territories would be greater than under the No Action Alternative, but disturbance at nest sites would be the same under Alternative 4.

Operational Impacts

The addition of the new roads that would be built along the periphery of the corridor under Alternative 4 would result in increased wildlife mortality and additional noise disturbance from increased automobile use. Because Alternative 4 would result in more development in rural areas than the other alternatives, it would likely have the greatest disturbance-related impacts to wildlife. Because wildlife in the less developed portions of the analysis area are likely to be less tolerant of human disturbance than those that occur in the more developed areas, disturbance impacts under Alternative 4 are likely to be greater than would occur under the other alternatives.

3.7.4.6 Preferred Alternative

The Preferred Alternative would encounter approximately 3,280 linear feet less urban natural open space than Alternative 3. This would result from the shortening of the HOV improvements along Coal Creek Parkway where it abuts urban natural open space identified by the WDFW (2000).

The Preferred Alternative could affect 19,620 more linear feet of bald eagle habitat than Alternative 3 (Table 3.7-1). This would result from the addition of collector-distributor lanes within a bald eagle territory located between Renton and Bellevue. Disturbance from construction and traffic pose the greatest potential impact to bald eagles. Habitat alteration from highway improvements that occur within bald eagle territories is less likely to affect eagles than construction disturbance because most impacts will avoid the most suitable eagle habitat (lake shores, open water wetlands, riparian areas, mature forest) within and outside of these territories.

Encroachment on riparian habitat would be similar to that described for Alternative 3. Impacts to unclassified upland habitats in urban, suburban, and rural areas would be similar to those described under Alternative 4.

Construction Impacts

Construction activities would result in the direct loss of upland habitat. The majority of the habitat that would be impacted occurs along developed road right-of-way and is of relatively low quality. However, impacts would affect some higher quality habitat such as second-growth forest and riparian areas. The overall amount of habitat impacts to the Preferred Alternative would be similar to Alternative 4, but would be distributed (high and low quality) more similarly to the impacts under Alternative 3. This is because the Preferred Alternative improvements are more similar to the improvements under Alternative 3.

Construction would result in slightly greater disturbance to wildlife than what would occur under Alternative 3. Construction disturbance impacts would be less than what would result under Alternative 4, because Alternative 4 would affect more rural areas than the Preferred Alternative. The most notable effects from disturbance include the potential to disturb nesting bald eagles, great blue herons, and other priority wildlife species during their nesting seasons.

Operational Impacts

The addition of the new roads and additional lanes would result in increased wildlife mortality and additional noise disturbance from increased automobile use. Because the majority of the improvements would occur in urbanized areas, disturbance impacts to wildlife would generally not be substantial. However, increased traffic and pedestrian use near bald eagle and great blue heron nest sites could degrade the quality of the nesting sites. Operational impacts under the Preferred Alternative would be slightly greater than those that would result from Alternative 3 and less than what would occur under Alternative 4.

3.7.5 Mitigation Measures

Generally, the following mitigation measures apply to all alternatives where appropriate to the project. Timing restrictions on construction will be implemented to avoid or minimize disturbance that could threaten bald eagle nesting success. For WSDOT projects located within 0.25 mile of any bald eagle nests or roosts or within 800 feet of any great blue heron rookeries, WSDOT will work with WDFW to develop management plans to avoid and minimize impacts which may occur during construction and operation of the project. (Typical avoidance and minimization strategies may include timing restrictions during construction, installation of noise barriers, protection of perch trees, and/or installation or establishment of visual barriers.) Where practicable, wildlife access corridors will be provided under roadways as a measure to reduce the effects of habitat fragmentation by maintaining connections between habitats. Roadsides and construction zones will be revegetated with native plants to offset loss of habitat from construction.

Other construction mitigation measures will also be employed. Mitigation needs and measures will be evaluated at the project level.

3.8 FISH, AQUATIC HABITAT, AND THREATENED AND ENDANGERED FISH SPECIES

This section describes existing fish population and habitat conditions within the study area and assesses potential impacts of the I-405 Corridor Program. All study area streams, regardless of fish presence, were included in the analysis based on the best available data sources (King County, 1999).

3.8.1 Studies and Coordination

3.8.1.1 Baseline Conditions

The baseline conditions were assessed by basin to adequately identify the widely varying watershed conditions, general habitat conditions, and fish populations throughout the study area. Basins were defined according to King County (1999) delineations. Baseline fish habitat conditions are described in this EIS based on numerous published and unpublished references. Sources include the computer databases and Geographic Information System (GIS) of King County, recent assessment reports for Water Resource Inventory Area (WRIA) 8 (Cedar River/Lake Washington) and WRIA 9 (Green/Duwamish River), the Washington Department of Fish and Wildlife (WDFW), and a number of basin plans and assessments produced by various cities and counties within the study area.

Existing fish species distribution and habitat conditions were described using the most recent and comprehensive available sources. These sources are cited in the *I-405 Corridor Program Draft Fish and Aquatic Habitat Expertise Report* (DEA, 2001a).

It is important to note that baseline conditions as defined for this program do not equate to existing conditions. The No Action Alternative projects are included in all the action alternatives and will be implemented with or without the I-405 Corridor Program; therefore baseline conditions are identified prior to implementation of the No Action Alternative projects. However, mitigation for the No Action Alternative impacts may not be implemented by WSDOT as part of the I-405 Corridor Program.

3.8.1.2 Federal Regulations

Section 404 of the Clean Water Act requires that permits be obtained for discharges to waters of the United States. Proponents of individual improvement projects involving such activities coordinate with the U.S. Army Corps of Engineers as necessary.

Puget Sound chinook salmon and bull trout are listed as "threatened" under the federal Endangered Species Act (ESA). The Puget Sound/Strait of Georgia coho salmon is currently a "candidate" species for federal listing.

The National Marine Fisheries Service (NMFS), in conjunction with state and local jurisdictions as documented in the Federal Register (50 CFR Part 223) issued on July 10, 2000, identified 13 programs and criteria for future programs for which it is not necessary and advisable to impose ESA Section 9(a)(1) prohibitions because they contribute to conserving the Evolutionarily Significant Unit (ESU) upon which listed species rely. These programs and criteria for future programs are commonly referred to as Section 4(d) rules. NMFS can provide ESA coverage through Section 4(d) rules, Section 10 research and enhancement permits, incidental take permits, or through Section 7 consultations with federal agencies. FHWA and WSDOT will work with NMFS and USFWS to identify actions that could result in the take of listed species. FHWA and WSDOT will be initiating programmatic Section 7 consultation under the ESA with NMFS and USFWS on the I-405 Corridor Program Preferred Alternative. FHWA and WSDOT will be working with NMFS and USFWS to define the best method for ESA Section 7 consultation on a programmatic level. Potential impacts to listed species will be fully addressed during the consultation process with both federal agencies.

The 1996 Sustainable Fisheries Act amended federal fisheries management regulations to require identification and conservation of habitat that is "essential" to federally managed fish species. Essential habitat is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The Pacific Fishery Management Council (PFMC) is the body responsible to review relevant habitat issues in the Pacific Northwest, including the study area. The PFMC has designated Essential Fish Habitat (EFH) for the Pacific salmon fishery, federally managed groundfish, and coastal pelagic fisheries (NMFS, 1999b; PFMC, 1999). Only EFH associated with the Pacific salmon fishery is present in the study area. Federal agencies must consult with NMFS on all activities or proposed activities authorized, funded, or undertaken by the agency that may adversely affect EFH.

The Pacific salmon management unit includes chinook (*Oncorhynchus tshawytscha*), coho (*Oncorhynchus kisutch*), and pink salmon (*Oncorhynchus gorbuscha*). The EFH designation for the Pacific salmon fishery includes all streams, lakes, ponds, wetlands, and other water bodies currently or historically accessible to these species in Washington, Oregon, Idaho, and California, except above the impassible barriers identified by PFMC (1999). Pacific salmon EFH also extends into the estuarine and marine areas.

3.8.1.3 State and Local Regulations

The Washington State Hydraulic Code requires review and approval by the WDFW of any project activity within or over streams, including discharge of stormwater. King County and Snohomish County, as well as the municipalities in the study area, have ordinances regulating development within critical areas. The I-405 Corridor Program will comply with the specific standards set by these ordinances, as necessary. Compliance may include production of site-specific baseline studies and detailed impact assessment, establishment of specified buffers, and implementation of mitigation measures. Some local regulations, such as Snohomish County Habitat Management Plan Administrative Rule for Puget Sound chinook salmon, would serve to comply with the ESA Section 4(d) rules and potentially obtain a limitation on the prohibition against taking a protected species.

3.8.1.4 Indian Tribal Treaty Fishing Rights

The "Boldt Decision" of 1974 interpreted treaties between the United States and Indian Tribes in Washington State. The court determined that Indian Tribes have rights to 50 percent of harvestable salmon and have the right to co-manage salmon fisheries within Washington State. The study area falls entirely within the "usual and accustomed" fishing area of three federally recognized Indian Tribes: the Muckleshoot, Snoqualmie, and Yakama Nation; and two state recognized Indian Tribes: the Kikiallus and Duwamish. In 1854 and 1855 many Indian Tribes in the Pacific Northwest entered into treaties with the United States wherein they reserved the right to fish, hunt, and gather in areas off their reservations. These reserved treaty rights are the "supreme law of the land" and where in conflict with state law are preemptive. Judicial decisions have affirmed that treaty Indian Tribes have a right to harvest fish free of state interference, subject to conservation principles; to co-manage the fishery resource with the state; and to harvest up to 50 percent of the harvestable fish. See United States v. Washington, 384 F. Supp. 312 (WD Wn. 1974), aff'd 520 F, 2d 676 (9th Cir. 1975); Washington v. Washington State Commercial Passenger Fishing Vessel Ass'n, 443 U.S. 658 (1979).

The study area falls within the recognized and court-affirmed treaty fishing areas of the federally recognized Muckleshoot Tribe and Yakama Nation, subject to the limitations on the exercise of those rights as set out in the court decisions. In addition, the federally recognized Snoqualmie Tribe has ancestral ties to the study area, but has no affirmed off-reservation rights. No other federally recognized Indian group has an interest in the study area, and no other federally recognized Indian group has any affirmed fishing rights or other affirmed treaty interest in the study area. The Muckleshoot Indian Tribe has a staff of fisheries biologists, operates two salmon hatcheries, one of which is on a Green River tributary, and has taken an active role in managing salmon in the study area.

Since the study area is within recognized and affirmed treaty fishing areas, and could potentially impact access to these areas, coordination with the Muckleshoot Tribe has been initiated and will continue to resolve potential conflicts prior to construction. WSDOT will implement measures that will reduce the likelihood of conflict including coordination with the Muckleshoot Tribe to document important access points in areas where project-specific actions will occur. Adherence to designated fish windows as outlined by the appropriate agencies (WDFW, NMFS, and USFWS) will eliminate in-water interference during periods when returning adult salmonids are present. Avoiding placing structures within streams and rivers will further reduce the likelihood of interference during periods of harvest. Compliance with Presidential Executive Order 12898 and Federal Highway Administration Order 6640.23 is discussed in Appendix G, I-405 Corridor Program EIS Environmental Justice Analysis.

3.8.2 Methodology

Impact assessment for fish and aquatic habitat was based on comparing among alternatives the number of stream encroachments, number of specific locations where construction is proposed within 300 feet of streams, and the amount of new impervious surface. For program-wide comparison of alternatives, impact assessment included consideration of varying fish populations and habitat conditions among the various basins. All study area streams, regardless of fish presence, were included in the analysis based on the best available data sources (King County, 1999; WDFW, 2000a). A description of impacts by basin is included in the *I-405 Corridor Program Draft Fish and Aquatic Habitat Expertise Report* (DEA, 2001a) herein incorporated by reference. In February of 2002 all alternatives were reassessed using ArcInfo GIS. The re-analysis resulted in approximately the same number of potential stream crossings; however, potential encroachments increased because of additional refinements of the data. The overall analysis and relative impact of the alternatives remains unchanged from the DEIS and does not change the results or decision-making processes based on the DEIS.

Federal ESA listings were obtained from the NMFS web site.

3.8.3 Affected Environment

The I-405 Corridor Program study area lies entirely within two major watersheds. Most of the area lies within the Cedar River/Lake Washington watershed (including Lake Sammamish and the Sammamish River), and a relatively small portion in the southwest corner of the area lies within the Green River watershed (Figure 3.8-1).

The Cedar River/Lake Washington watershed (WRIA8) includes all streams discharging through Lake Washington and the Lake Washington Ship Canal (including Union Bay, Portage Bay, and Lake Union) to Puget Sound (Figure 3.8-1). This is one of the major watersheds of western Washington and encompasses nearly 200 square miles (King County, 1993). This basin includes hundreds of streams, and encompasses much of the greater Seattle urban area. The proposed transportation improvements lie primarily within heavily developed portions of the basin east of Seattle. Cedar and Sammamish are the major rivers in this basin. The Cedar River/Lake Washington watershed includes all study area basins except Soos Creek, Black River, and Lower Green River.

Cedar River flows are controlled by three dams located upstream of the study area. The overflow dike at river mile (RM) 37.2 impounds Chester Morse Lake. The Masonry Dam at RM 35.6 generates hydropower, and the Landsburg Diversion Dam at RM 21.6 diverts flow from the Cedar River to supply about 70 percent of greater Seattle's water supply (King County, 1993). The City of Seattle manages most of the upper two-thirds of the watershed lying upstream of these dams to maintain high-quality water runoff.

The Green/Duwamish River watershed (WRIA 9) drains the southern part of the study area. Approximately river miles 11 through 21 of the Green River flow through this portion of the study area (Figure 3.8-1). Basins within this watershed in the study area have been defined as Lower Green River, Black River, and Soos Creek (King County, 1999). These basins include heavily developed areas, including primarily industrial areas in the cities of Kent and Renton.

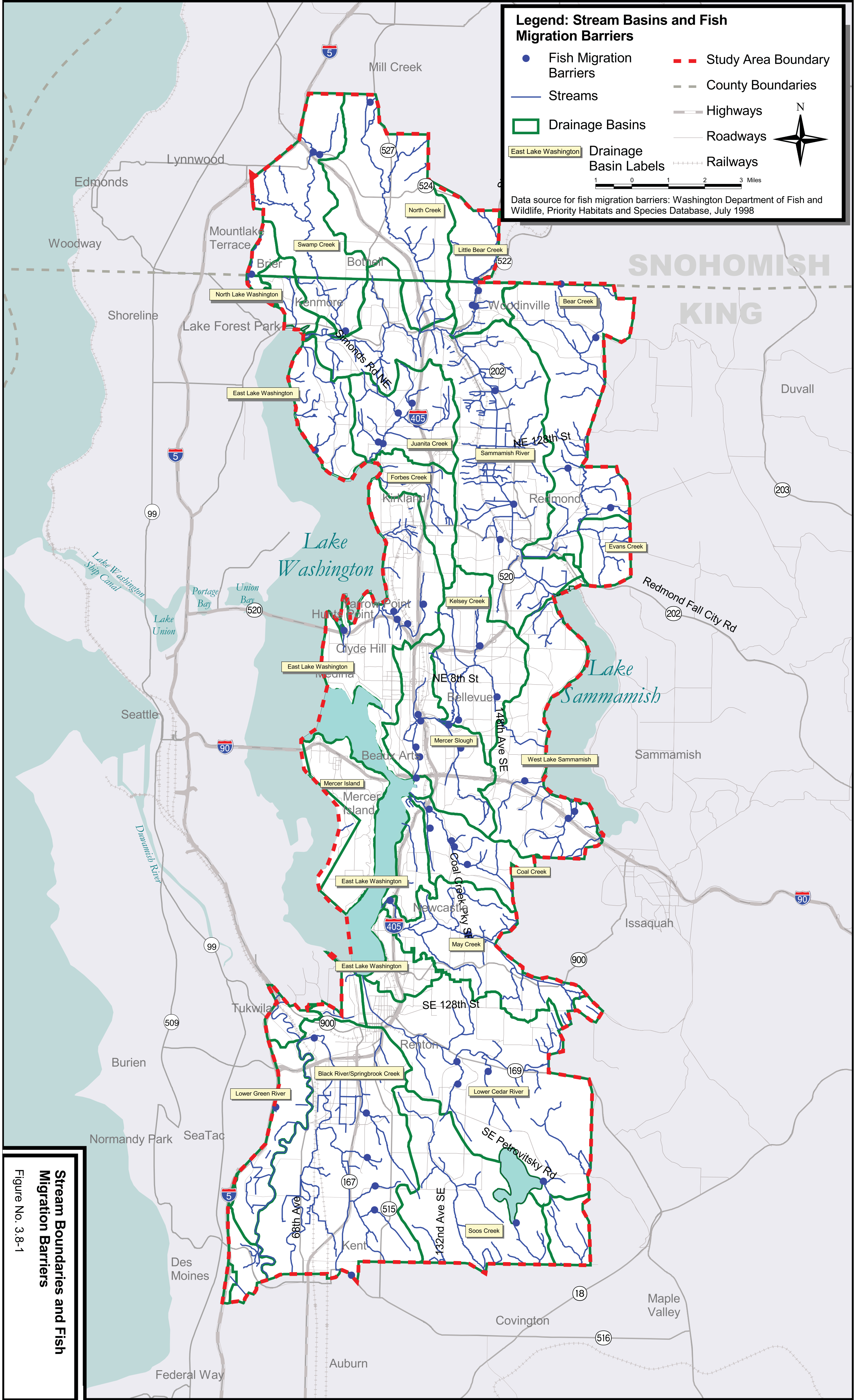
Green River flows have been altered by the diversion of the White River in 1906, diversion of the Cedar/Black River in 1913, construction of Tacoma Water's Headworks Diversion in 1911, and construction of the Howard A. Hanson Dam in 1962 (Kerwin and Nelson, 2000). The Howard A. Hanson Dam, located at RM 64.5, blocks upstream fish migration. Its control of flooding in the lower Green River valley has allowed rapid, intensive industrial development that has adversely affected salmonid habitat and water quality (Grette and Salo, 1986).

3.8.3.1 Fish Species Present

The Puget Sound chinook salmon is listed as "threatened" under the Endangered Species Act and is a "candidate" for the State of Washington listing. The Puget Sound stocks of chinook salmon occur throughout much of the study area, in the Cedar, Green, and Sammamish rivers, as well as larger tributary streams including Swamp Creek, North Creek, Bear Creek, Little Bear Creek, Evans Creek, Mercer Slough, Coal Creek, May Creek, Kelsey Creek, Juanita Creek, and Soos Creek (King County, 2000a; King County, 2001a; WDFW, 2000a).

The Puget Sound/Strait of Georgia coho salmon is currently a "candidate" species for federal listing. WDFW's GIS database shows coho salmon present in the major streams of all study area basins except Mercer Island. Other sources, including the WRIA 9 habitat reconnaissance and local agency publications, show coho salmon inhabiting many smaller streams in each basin.

Bull trout are federally listed as "threatened" and are a "candidate" for State of Washington listing. They are known to occur in both of the major watersheds in the study area, but spawning has been documented only in locations far upstream of the study area (WDFW, 1998). Known self-sustaining populations within the Lake Washington Basin are limited to the Cedar River



Stream Boundaries and Fish Migration Barriers

Figure No. 3.8-1

This page left intentionally blank.

drainage upstream of Lower Cedar Falls at RM 34.2, and within the Chester Morse Reservoir and Rex River (WDFW, 1998; King County Department of Natural Resources [KCDNR], 2000). Other known populations outside of WRIA 8 have been documented in the Snohomish and Skykomish river system, and the White River drainage (KCDNR, 2000).

Confirmed individual occurrences of bull trout, a type of char, in the study area have been scarce and sporadic. One adult bull trout was captured in the Duwamish River estuary on May 24, 1994, while feeding on outmigrating juvenile chinook salmon (Warner and Fritz, 1995). One native char was captured by an angler in Lake Washington in 1981, and four more were captured in Lake Washington by the University of Washington during a multi-year sampling effort between 1984 and 1985 (Beauchamp, unpublished data as reported in KCDNR, 2000). Three native char have been observed in Lake Sammamish and an associated tributary, and at Shilshole Bay (KCDNR, 2000). Furthermore, a small number of native char have been captured in the lower Cedar River below the Landsburg Diversion Dam. Based on the scarce and sporadic pattern of documented occurrence of bull trout in the study area, it is uncertain if these char are native to the watershed or opportunistic marine residents. A review of the existing data indicates migrating bull trout may occasionally be present within the study area in the Green and Duwamish rivers, in the Cedar River, and in Lake Washington.

Study-area salmonids include several species not currently addressed by the ESA, including pink salmon (*Oncorhynchus gorbuscha*), chum salmon (*O. keta*), sockeye salmon (*O. nerka*), kokanee, steelhead trout (*O. mykiss*), coastal cutthroat trout (*O. clarki*), and mountain whitefish (*Prosopium Williamsii*).

Although the Green River stock of pink salmon has been characterized as extinct, a few pink salmon have been observed and captured in the Green River (King County, 2000a). The Green River supports a remnant natural run of chum salmon that is supplemented by the Muckleshoot Tribe's hatchery operations. Spawning habitat occurs upstream of the study area, and emerging juvenile chum salmon migrate out almost immediately to rear in salt water estuaries (Grette and Salo, 1986). Therefore, chum salmon would use the Green River in the study area primarily for spawner migration and juvenile out-migration. However, rearing could also occur in the study area depending on flow conditions and the upstream extent of marine influence (salt wedge). A few chum salmon have been observed in Lake Sammamish tributaries; however, these are assumed to be strays from other stocks since no run is documented in the Cedar/Lake Washington Basin.

Sockeye, a salmon species adapted to complete part of their life cycle in freshwater lakes, occupy lakes Washington and Sammamish in the project area. These sockeye are believed to have originated from non-native stock introduced from Baker Lake in northwestern Washington (WDFW and Western Washington Treaty Tribes [WWTT], 1994). Several publications from the turn of the century suggest that sockeye salmon were in Lake Washington prior to the introduction of the Baker Lake stocks. It is uncertain if these were resident kokanee or sockeye salmon. Although the exact identity of these early stocks is uncertain, a thorough review of the history of sockeye salmon in Lake Washington concluded that "limited runs of sockeye salmon were probably present at the turn of the 19th century" (Hendry 1995 as reported by Kerwin, 2001). Within the study area, they occur in the Cedar River, Sammamish River, and North, Swamp, Little Bear, Bear, Coal and May creeks. Spawning occurs throughout the basin, including most accessible stream reaches and along the lake margin where upwelling occurs

(Kerwin, 2001). The lower reaches of the Cedar River are used extensively by sockeye salmon and several other species (e.g., longfin smelt) for spawning.

Kokanee are sockeye salmon that spend their entire lifecycle in freshwater lakes without migrating to salt water. They spawn in numerous Lake Washington and Lake Sammamish tributaries within the study area including Juanita, Bear, Little Bear, North, Lewis, Kelsey, Laughing Jacobs, Issaquah, and Swamp creeks, and Cottage Lake (Kerwin, 2001). Kokanee within the Lake Washington Basin are segmented by run timing into an early-run and late-run. The escapement level of the early-run kokanee began decreasing dramatically during the early 1980s and as a result was petitioned in 1999 for listing as "Endangered" under the ESA (Kerwin, 2001). The USFWS has yet to officially list the Lake Washington early-run kokanee stock under the ESA.

Coastal cutthroat trout are present in all study area basins. Sea-run cutthroat may be present in many of the accessible streams, and have even been documented in the urbanized East Lake Washington tributaries (Watershed Company, 1998). Resident cutthroat trout are widespread in small streams throughout the study area, including areas above migration barriers for salmon (May, 1996).

Winter runs of steelhead trout are present in both the Green/Duwamish and Cedar/Lake Washington portions of the study area, and both include native wild fish (Grette and Salo, 1986; King County, 1993; WDFW and WWTT, 1994). A non-native summer steelhead run is also present in the Green/Duwamish Basin (WDFW and WWTT, 1994).

Mountain whitefish have been reported in the Cedar River. Atlantic salmon (*Salmon salar*) have been found recently in the Green River, and are assumed to be escaped from net pen fish farming operations in Puget Sound (King County, 2000a).

Non-salmonid native fishes distributed widely throughout large and small streams in the study area include the various species of sculpins (*Cottus spp*.), dace (*Rhinichthys spp*.), stickleback (*Gasterostus aculeatus*), and lampreys (*Lampetra spp*.). The river lamprey (*Lampetra ayresi*) is a "candidate" for State of Washington listing. Species that reside mainly in lakes Washington and Sammamish but may venture into streams include suckers (*Catostomus spp*.), smelt (*Spirinchus spp*.), and chubs (*Mylocheilus spp*.) (King County, 1993).

Numerous non-native exotic and invasive fishes, including various species of bullheads, bass, perch, and sunfish, are also present. Several of these introduced "warmwater" fish prey on juvenile native salmon smolts (Wydoski and Whitney, 1979). Smallmouth and largemouth bass in particular have been found to consume substantial numbers of outmigrating salmonid smolts in Lake Washington and the Ship Canal (Tabor and Footen, 2000).

3.8.3.2 Baseline Conditions of Basins

Table 3.8-1 shows the percentage of impervious area that exists in each basin in the study area. Note: the added impervious surface resulting from the No Action Alternative projects is incorporated into the baseline conditions reported here.

Table 3.8-1: Baseline Impervious Area by Basin

BASIN[a]	Basin Area within Study Area (acres)	Existing Conditions % Impervious [b]	Impervious Area within Study Area (acres)	Baseline (No Action Alternative)	
Cedar/Sammamish/ Lake Washington Watershed (WRIA 8):				New Impervious Acres	% Conv.[d]
Swamp Creek	6,733	41%	2,761	12	0.2%
Bear Creek	9,343	23%	2,149	0	0.0%
Cedar River[c]	13,809	c	---	12	---
Coal Creek	3,020	28%	846	1	0.0%
West Lake Sammamish	7,291	40%	2,916	5	0.1%
East Lake Washington	13,104	40%	5,242	13	0.1%
Evans Creek	1,560	22%	343	9	0.6%
Forbes Creek	2,322	43%	998	0	0.0%
Juanita Creek	4,208	45%	1,894	10	0.2%
Kelsey Creek	5,291	44%	2,328	0	0.0%
Little Bear Creek	3,022	28%	846	15	0.5%
Sammamish River	16,375	37%	6,059	19	0.1%
May Creek	5,858	22%	1,289	9	0.2%
Mercer Slough (S. Kelsey)	5,137	46%	2,363	12	0.2%
North Lake Washington	1,079	43%	464	0	0.0%
North Creek	8,357	38%	3,176	33	0.4%
Green/Duwamish Watershed (WRIA 9):					
Lower Green River/Duwamish [a]	3,837	47%	1,627	0	0.0%
Soos Creek	9,408	17%	1,599	8	0.1%
Black River (Springbrook)	14,293	44%	6,289	6	0.0%
Unassigned				9	
Total	**134,047**	**---**	**43,188**	**173**	**0.1%**

[a] A portion of this basin lies outside the study area.
[b] Unpublished data, King County DNR GIS Data.
[c] Study area impervious area not available for this basin.
[d] % conversion to new impervious surface (new impervious area divided by basin area within the study area).

For many of the sub-basins, the portion within the study area is heavily urbanized, as indicated by the high percentages of impervious surface. The Lower Green River Basin has the greatest percentage of impervious area, at 47 percent. Other highly degraded sub-basins include Mercer Slough, Juanita Creek, Kelsey Creek, Black River, Forbes Creek, Swamp Creek, and North Lake Washington, each with more than 40 percent impervious surface.

Several sub-basins, including Bear Creek, Evans Creek, and Soos Creek sub-basins, as well as the upper reaches of Coal Creek Basin, provide remnants of high quality salmonid habitat. Other sub-basins providing good habitat include Little Bear Creek, Swamp Creek, Juanita Creek, Forbes Creek, and Mercer Slough, each of which contains large or high quality riparian areas. Some of their habitat includes riparian wetlands. Section 3.6 of the EIS and the *I-405 Corridor Program Draft Wetlands Expertise Report* (DEA, 2001b) provide analyses of wetlands occurring in the study area. The Lower Cedar River and Green River sub-basins, while significantly degraded, serve as important migration corridors to more functional habitat for salmon. Further discussion of habitat conditions in individual basins can be found in the *I-405 Corridor Program Draft Fish and Aquatic Habitat Expertise Report* (DEA, 2001a).

3.8.4 Impacts

Impacts to fish and their habitat were analyzed using two indicators: encroachments and new impervious area. In this analysis, potential direct construction impacts are indicated by number of riparian encroachments. Riparian encroachments are locations, including stream crossings, where clearing and grading within 300 feet of any stream would be needed. Encroachment on riparian systems is likely to reduce riparian functions such as water temperature moderation, presence of large woody debris, streambank stabilization, runoff filtration, cover, and contribution of organic matter that contribute to food sources. Impairment of riparian functions is likely to adversely affect fish habitat and population.

The area of new roadway impervious surface is a reliable indicator of potential direct operational impacts to fish and fish habitat because road runoff can contain pollutants, which may reach concentrations that are toxic to aquatic life when discharged into surface waters. In addition, increases in impervious surface alter hydrology in several ways that can adversely impact fish and aquatic habitat.

These hydraulic alterations include increased peak flows and rates of runoff, decreased base flows, increased erosion, decreased infiltration, and decreased evapotranspiration. Urbanization also increases the constructed drainage network and further accelerates the rate of stormwater runoff as it replaces natural drainage features with numerous pipes, man-made channels, etc. These developments typically increase the frequency and magnitude of high-flow and flooding events in streams. This increase in peak high flows has been shown to have numerous adverse effects on aquatic habitat and on salmonid habitat in particular, including the following (May, 1996):

- Gravel that forms spawning habitat is displaced;
- Existing salmonid eggs are washed out or crushed;
- Benthic macroinvertebrate communities on which salmonids rely for food are degraded;
- Channel erosion replaces pool and riffle habitat with less habitable, uniform runs and glides;
- Juvenile fish are directly flushed downstream; and
- Stream flow fluctuation increases more as storm flow frequency increases.

As water runs off more quickly from these urbanized areas, there is typically a corresponding decrease in shallow groundwater recharge. Therefore, base flows are reduced, and water levels may decline much more quickly to levels inadequate for maintaining fish survival through the dry summer season. Reduced base flows kill or injure fish directly by stranding, oxygen depletion, and temperature increase.

Overall, severe degradation of stream habitat has been found to occur as impervious surface exceeds about 5 percent of the area in a drainage basin. Rehabilitation of habitat is generally likely to be feasible in streams for which impervious surface occupies less than 20 percent of the basin. Performance of fundamental natural ecological functions is likely to be problematic in streams with impervious surfaces covering more than 45 percent of their basins (May, 1996).

Impacts to each study_area basin, by action alternative, are summarized in Tables 3.8-2 and 3.8-3. Table 3.8-2 shows the number of locations at which proposed improvements cross or encroach within 300 feet of any stream. Table 3.8-3 lists the estimated new impervious surface that would be constructed in each basin under the various alternatives.

Table 3.8-2: Number of Riparian Encroachments per Basin by Alternative

Basin	No Action Alternative	Alternative 1 HCT/TDM	Alternative 2 Mixed Mode with HCT/Transit	Alternative 3 Mixed Mode	Alternative 4 General Capacity	Preferred Alternative
Cedar/Sammamish/ Lake Washington Watershed (WRIA 8):						
Swamp Creek	6	13	19	16	18	16
Bear Creek	1	8	18	16	11	16
Lower Cedar River	2	14	29	27	19	27
Coal Creek	0	3	4	2	3	3
West Lake Sammamish	0	8	9	1	1	1
East Lake Washington	0	22	27	10	17	17
Evans Creek	1	1	2	2	2	2
Forbes Creek	0	28	45	21	41	21
Juanita Creek	1	4	11	12	18	15
Kelsey Creek	0	6	6	0	0	0
Little Bear Creek	4	6	17	16	16	16
Sammamish River	51	94	136	128	130	129
May Creek	0	5	11	9	6	9
Mercer Slough	0	14	18	5	8	5
North Lake Washington	0	0	1	1	1	1
North Creek	4	19	23	19	18	21
Green/Duwamish Watershed (WRIA 9):						
Lower Green River/Duwamish	0	1	5	4	9	7
Soos Creek	0	3	3	3	0	3
Black River	4	12	37	33	36	21
TOTAL	**74**	**261**	**421**	**325**	**354**	**330**

Table 3.8-3: New Impervious Area per Basin by Alternative

BASIN [a]	No Action Alternative		Alternative 1 HCT/TDM		Alternative 2 Mixed Mode with HCT/Transit		Alternative 3 Mixed Mode		Alternative 4 General Capacity		Preferred Alternative	
	New Imp. Area (Acres)	% Conv.[b]	New Imp. Area (Acres)	% Conv.[b]	New Imp. Area (Acres)	% Conv.[b]	New Imp. Area (Acres)	% Conv.[b]	New Imp. Area (Acres)	% Conv.[b]	New Imp. Area (Acres)	% Conv.[b]
Cedar/Sammamish/ Lake Washington Watershed (WRIA 8):												
Swamp Creek	12	0.2%	15	0.2%	47	0.7%	47	0.7%	58	0.9%	54	0.8%
Bear Creek	0	0.0%	6	0.1%	23	0.2%	18	0.2%	17	0.2%	18	0.2%
Cedar River	12	0.1%	25	0.2%	33	0.2%	46	0.3%	45	0.3%	45	0.3%
Coal Creek	1	0.0%	13	0.4%	15	0.5%	13	0.4%	13	0.4%	18	0.6%
West Lake Sammamish	5	0.1%	12	0.2%	12	0.2%	5	0.1%	5	0.1%	5	0.1%
East Lake Washington	13	0.1%	43	0.3%	68	0.5%	73	0.6%	140	1.1%	154	1.2%
Evans Creek	9	0.6%	9	0.6%	12	0.8%	12	0.8%	12	0.8%	12	0.8%
Forbes Creek	0	0.0%	15	0.7%	23	1.0%	16	0.7%	32	1.4%	17	0.7%
Juanita Creek	10	0.2%	29	0.6%	41	0.9%	38	0.9%	76	1.8%	49	1.1%
Kelsey Creek	0	0.0%	14	0.3%	14	0.3%	0	0.0%	0	0.0%	0	0.0%
Little Bear Creek	15	0.5%	15	0.5%	19	0.6%	19	0.6%	19	0.6%	19	0.6%
Sammamish River	19	0.1%	48	0.3%	83	0.5%	95	0.6%	113	0.7%	110	0.7%
May Creek	9	0.2%	14	0.3%	14	0.4%	13	0.3%	15	0.3%	28	0.5%
Mercer Slough	12	0.2%	47	0.9%	103	2.0%	97	1.8%	160	3.1%	12	0.2%
North Lake Washington	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	87	1.0%
North Creek	33	0.4%	61	0.7%	104	1.2%	111	1.3%	160	1.9%	141	2.5%
Green/Duwamish Watershed (WRIA 9):												
Lower Green River	0	0.0%	4	0.1%	36	0.9%	35	0.9%	43	1.1%	38	1.2%
Soos Creek	8	0.1%	15	0.2%	15	0.2%	15	0.2%	8	0.1%	10	0.1%
Black River (Springbrook)	6	0.0%	83	0.5%	145	1.0%	111	0.7%	139	0.9%	142	1.0%
Impacts Unassigned to a Specific Basin	9	0.2%	9	0.2%	9	0.2%	9	0.2%	9	0.2%	14	0.3%
Rounding Error Adjustment	0	--	4	--	0	--	0	--	0	--	1	--
Total	**173**	**0.1%**	**478**	**0.3%**	**820**	**0.6%**	**773**	**0.5%**	**1,061**	**0.8%**	**974**	**0.7%**

[a] Some of the basins lie outside the project area.
[b] % conversion to new impervious surface (new impervious area divided by basin area within the study area).

3.8.4.1 No Action Alternative

Construction Impacts

The No Action Alternative would create 74 new riparian encroachments. Fifty-one of these would occur in the Sammamish Basin, and no more than six would occur in any of the other sub-basins (Table 3.8-2). This results in less than one-third of the encroachments found in any action alternative.

Operational Impacts

The No Action Alternative would increase impervious surface in the study area basins by 0.1 percent (Table 3.8-1). This percentage represents 173 acres of new impervious surface. The greatest increase would occur in the North Creek Basin, followed by the Sammamish River, Little Bear Creek, Mercer Slough, Cedar River, Swamp Creek, and Juanita Creek sub-basins. No increase is expected for the Bear Creek, Forbes Creek, Kelsey Creek, Lower Green River, and North Lake Washington sub-basins. The *I-405 Corridor Program Draft Surface Water Resources Expertise Report* (CH2M HILL, 2001a) concluded that no substantial direct effects on hydrology or water quality are expected under this alternative. Refer also to Section 3.5.4.1.

Overall, the No Action Alternative will result in less than half the potential impact on fish populations and habitats, including threatened species, of any of the I-405 Corridor Program action alternatives. As discussed in Section 3.8.4, the chief indicator of habitat degradation for this scale of analysis is the creation of new impervious surface area. The No Action Alternative would add less than half the amount of new impervious surface as that found in any of the action alternatives, whether express as acreage or percent of basin. These committed projects provide the baseline for the potential impacts found in the action alternatives.

3.8.4.2 Alternative 1: HCT/TDM Emphasis

Construction Impacts

Two hundred and sixty-one riparian encroachments would occur, with the majority on the Sammamish River, East Lake Washington, Forbes Creek, and North Creek (Table 3.8-2). Alternative 1 would create substantially fewer riparian encroachments than other action alternatives. This indicates substantially less potential for direct construction impacts to fish habitats and populations.

Operational Impacts

Alternative 1 would add 478 acres of new impervious area to the study area basins for a 0.3 percent increase (Table 3.8-3). The Black River (Springbrook), Mercer Slough, Sammamish River, East Lake Washington, and North Creek sub-basins would experience the greatest increases. For the West Lake Sammamish Basin, this alternative, along with Alternative 2, would create the most impervious surface of any alternative.

Overall, Alternative 1 has the least potential impact on fish populations and habitats, including threatened species, of any action alternative. As discussed above, the chief indicator of habitat degradation for this scale of analysis is the creation of new impervious surface area. Alternative 1 would create half or less the amount of new impervious surface of any other action alternative, whether expressed as acreage or percent of basin. The *I-405 Corridor Program Draft Surface Water Resources Expertise Report* (CH2M HILL, 2001a) concluded that no substantial effects on hydrology or water quality are expected under this alternative. Refer also to Section 3.5.4.2 of the EIS.

3.8.4.3 Alternative 2: Mixed Mode with HCT/Transit Emphasis

Construction Impacts

Four hundred and twenty-one riparian encroachments would occur, with the highest numbers on the Sammamish River, Forbes Creek, East Lake Washington, the Lower Cedar River, North Creek and the Black River (Table 3.8-2). Alternative 2 would result in the most or equal to the most encroachments of any alternative in all but two of the basins within the study area. Alternative 2 would have the highest potential for construction impacts to fish habitats and populations of all the action alternatives.

Operational Impacts

Alternative 2 would create 820 acres of new impervious surface to the study area basins for a 0.6 percent increase (Table 3.8-3). The largest increase would be in the Black River (Springbrook) Basin, followed by Mercer Slough, North Creek, and the Sammamish River. Alternative 2 would also create the most impervious surface in Coal Creek Basin and Evans Creek (equal to Alternatives 3 and 4), potentially impacting water quality in the Black River and hydrology of Forbes Creek, Mercer Slough, and the Black River. The *I-405 Corridor Program Draft Surface Water Resources Expertise Report* (CH2M HILL, 2001a) noted that Alternative 2 could have substantial impacts on hydrology and water quality in several study area sub-basins. Refer to Section 3.5.4.3 of the EIS. In addition, Alternative 2 would create the most new impervious surface for several individual sub-basins, including Bear Creek Basin, which retains some of the most intact fish populations and habitat in the study area.

Alternative 2 represents the median potential impact on fish populations and habitats, including threatened species, among the five action alternatives. Alternative 2 would create more new impervious surface than Alternatives 1 or 3, but less that Alternative 4 and the Preferred Alternative, whether expressed as acreage or percent of basin.

3.8.4.4 Alternative 3: Mixed Mode Emphasis

Construction Impacts

Alternative 3 would result in 325 riparian encroachments, with the Sammamish River, Forbes Creek, the Lower Cedar River, North Creek and the Black River experiencing the most impacts within Alternative 3 (Table 3.8-2). Alternative 3 has approximately the same number of impacts as the Preferred Alternative. Impacts on fish habitats and populations are lower than other action alternatives.

Operational Impacts

Alternative 3 would create 773 acres of new impervious surface in the study area sub-basins (Table 3.8-3). This results in a 0.5 percent increase. This is the most added impervious surface of any alternative for the Cedar River Basin. For the Evans Creek and Little Bear Creek sub-basins, Alternatives 2, 3, and 4 create similar amounts of impervious surface. For the North Lake Washington Basin, Alternatives 2 and 3 create similar impacts. For the Soos Creek Basin, Alternatives 1, 2, and 3 create similar impacts. The *I-405 Corridor Program Draft Surface Water Resources Expertise Report* (CH2M HILL, 2001a) concluded that Alternative 3 could have substantial impacts on hydrology and water quality in the South Kelsey Creek and North Creek sub-basins. Refer also to Section 3.5.4.4 of the EIS. Overall, Alternative 3 has the second lowest potential impact on fish populations and habitats, including threatened species, of any action alternative.

3.8.4.5 Alternative 4: General Capacity Emphasis

Construction Impacts

Alternative 4 would result in 354 riparian encroachments, and the highest number of encroachments of any alternative for the Juanita Creek and the Lower Green River sub-basins (Table 3.8-2). Alternative 4 has a similar distribution of impacts throughout sub-basins, albeit lower in total impact.

Operational Impacts

Alternative 4 would result in 1,061 acres of new impervious surface, an increase of 0.8 percent (Table 3.8-3). This is the greatest amount of new impervious surface that any alternative would cause in the East Lake Washington, Forbes Creek, Juanita Creek, Lower Green River, Sammamish River, North Creek, and Swamp Creek sub-basins.

Hydrology of the East Lake Washington, Forbes Creek, Juanita Creek, North Creek, Mercer Slough, and Black River sub-basins, and water quality in the Black River (Springbrook Creek), may be impacted as a result of Alternative 4. Alternative 4 has the highest potential for operational direct impacts based on area-wide impervious surface creation. Alternative 4 would create substantially more new impervious cover than other action alternatives and more than double the new impervious surface compared to Alternative 1. In addition, Alternative 4 includes the only proposed activity outside the Urban Growth Area, an expansion of Highway 202 in the Sammamish River Basin.

The *I-405 Corridor Program Draft Surface Water Resources Expertise Report* (CH2M HILL, 2001a) concluded that hydrology could be substantially altered in seven sub-basins under Alternative 4. Substantial water quality impacts are expected in Springbrook Creek. Refer also the Section 3.5.4.5 of the EIS.

Overall, Alternative 4 has the greatest potential impact on fish populations and habitats, including threatened species, of any action alternative. Alternative 4 would create greater than 120 percent more new impervious surface than Alternative 1, which adds the least new impervious surface among the action alternatives.

3.8.4.6 Preferred Alternative

Construction Impacts

The Preferred Alternative would result in 330 riparian encroachments, with the Sammamish River, Forbes Creek, the Lower Cedar River, North Creek, and the Black River experiencing the most impacts within the Preferred Alternative (Table 3.8-2). The Preferred Alternative has very similar impacts on fish habitats and populations to those of Alternative 3.

Operational Impacts

The Preferred Alternative would create 974 acres of new impervious surface in the study area sub-basins (Table 3.8-3). This results in a 0.7 percent increase. This is the most added impervious surface of any alternative for the Coal Creek, May Creek, and East Lake Washington sub-basins. Refer also to Section 3.5.4.6 of the EIS.

Overall, the Preferred Alternative has the second highest potential impact on fish populations and habitats, including threatened species, of any action alternative. The Preferred Alternative would create more than twice the amount of new impervious surface of Alternative 1, whether expressed as acreage or percent of basin.

3.8.5 Mitigation Measures

Avoiding impacts is the most effective mitigation strategy for fish and aquatic habitat, and is being addressed first by selection of an alternative through the environmental process, and will continue to be addressed later in the design of specific projects. Impacts to fish and aquatic habitat were considered in the selection of the Preferred Alternative. The design of individual projects under any action alternative would minimize in-stream structures or disturbance and riparian vegetation disturbance, and would minimize creation of new impervious surface. Generally, the following mitigation measures apply to all alternatives where appropriate. Impacts avoidance and minimization measures include, but are not limited to, the following:

- Redirecting proposed improvements through developed uplands where practicable;
- Reducing project footprint where practicable;
- Spanning waterways with bridges outside of the active floodplain where practicable;
- Using best available science to document, avoid, and then mitigate for potential impacts; and
- Using permeable pavements and other infiltration techniques, where practicable.

Where impacts to fish and habitat are unavoidable, compensating for lost habitat functions would provide mitigation. Compensatory fish and habitat mitigation measures for the I-405 Corridor Program can be divided into three categories: 1) on-site/in-kind, 2) sub-basin, and 3) watershed level. It is WSDOT policy, at a minimum, to control and treat stormwater runoff that could impact fish and habitat such that downstream flood damage and/or serious water quality problems are not increased as a result of new road projects. This could require on-site/in-kind measures to avoid impact. When a project entails unavoidable environmental impacts that require compensatory mitigation, many regulatory agencies have typically favored on-site/in-kind mitigation. This mitigation type replicates as closely as possible specific lost environmental functions (such as suitable spawning habitat for a specific fish species). On-site/in-kind mitigation may be applicable to the I-405 Corridor Program at the project-level, as the specific impacts of each project are assessed. Mitigation can then be incorporated into project design, or mitigation opportunities can be identified in the immediate vicinity.

However, it is not always feasible to provide suitable mitigation near a project site, particularly in a highly developed mostly urban area such as the I-405 corridor. Some regulatory agencies believe that on-site mitigation may be less effective in a highly urbanized area where pre-existing watershed conditions prevent restoration of good quality salmonid habitat. In these areas, they suggest that advanced watershed-based mitigation elsewhere in the sub-basin or watershed would be a more effective and efficient use of mitigation to protect resources. Advanced watershed-based mitigation may involve efforts such as preservation of higher-quality habitat in locations upstream of the study area. In addition, mitigation could be provided outside the project area to address cumulative impacts associated with transportation improvements in the I-405 corridor.

Compensatory fish habitat mitigation concepts at the sub-basin and watershed levels were obtained primarily from existing published information such as basin plans and from information gathered during a 3-day “fish and basin mitigation” meeting between WSDOT and 13 local jurisdictions/agencies in May 2001. The meeting served to:

- Collect existing information on conditions of watersheds around I-405 related to fish habitat;
- Gather possible mitigation activities that are priorities and/or planned projects in each basin; and
- Initiate local agency involvement in the mitigation planning process for the I-405 Corridor Program.

This mitigation approach allows broader issues such as watershed functions and Puget Sound chinook salmon recovery to be addressed through the I-405 Corridor Program mitigation efforts.

Jurisdictions attending and presenting data included King and Snohomish counties, as well as the cities of Kenmore, Bothell, Woodinville, Kirkland, Bellevue, Renton, and Kent. Other agencies and representatives involved with WRIAs 8 and 9 were also present, including NMFS, Ecology, WDFW, USEPA, and the Kikiallus Nation. Agency comments and project information were compiled in meeting minutes (DEA, 2001c). A breakdown of encroachments by local jurisdictional authority can be found in Table 3.8-4.

Table 3.8-4: Number of Riparian Encroachments per Jurisdiction by Action Alternatives

Basin	No Action Alternative	Alternative 1 HCT/TDM	Alternative 2 Mixed Mode with HCT/Transit	Alternative 3 Mixed Mode	Alternative 4 General Capacity	Preferred Alternative
Bellevue	0	31	41	14	27	22
Bothell	11	31	47	41	47	48
Issaquah	0	2	2	0	0	0
Kenmore	0	2	6	6	4	2
Kent	0	0	10	10	10	0
King County	21	44	81	75	75	78
Kirkland	0	42	61	26	44	26
Lynnwood	0	0	1	1	1	1
Newcastle	0	0	5	5	5	5
Redmond	26	52	61	56	48	56
Renton	4	24	41	35	25	34
SeaTac	0	0	1	1	1	1
Snohomish County	8	15	19	16	18	16
Tukwila	0	4	9	5	15	7
Woodinville	4	14	36	34	34	34
TOTAL	**74**	**261**	**421**	**325**	**354**	**330**

It must be noted that assigning credit for advanced watershed-based mitigation to project-specific impacts will likely require additional analysis and negotiation. Several regulatory agencies would need to agree on the value and degree of replacing lost environmental functions with similar or different functions in different locations. For example, what would the agreement be between jurisdictions/agencies if preservation of upper watershed habitat is encouraged as a mitigation measure for impacts such as a new migration blockage, a thousand square feet of new impervious surface, a thousand square feet of riparian clearing, or placement of a piling in a salmonid spawning area? Many regulatory issues will need to be resolved. As an example, a mitigation ratio might be established to define the area of habitat preservation required for each square foot of new impervious surface.

The State of Washington has developed interagency policy guidance for evaluating aquatic mitigation approaches, including regional mitigation (Ecology, 2000b). In general, regional mitigation may be considered when it will provide equal or better biological and other functional values compared to traditional on-site/in-kind mitigation. In making regulatory decisions, the agencies are instructed to “consider whether the mitigation plan provides equal or better functions and values, compared to existing conditions, for the target resources and species."

3.8.5.1 On-Site/In-Kind Mitigation

Construction Impact Mitigation

Impact Avoidance Measures

A number of best management practices (BMPs) will be employed during construction to reduce the potential for adverse stream impacts. The following bullets describe the types of mitigation measures that will be implemented where appropriate and practicable; however, use of alternate, equally effective BMPs or negotiated mitigation may be developed in the future.

- Construction disturbances will be limited to the smallest area practical. When feasible, clearing activities will be staged such that construction areas are cleared no earlier than one week ahead of the start of construction.
- Seasonal in-stream work "windows", as established by the WDFW, USFWS, and NMFS will be observed. Major clearing and grading will be limited to the dry season: usually May 1 through September 1, where reasonable and feasible to avoid construction impacts. If other construction activities are to take place during the wet season, an erosion and sediment control plan will be prepared detailing measures required to provide adequate control and treatment of construction site runoff during wet season conditions. These measures could include shortened intervals for ground-disturbing activities; ceasing of construction activities and rapid stabilization measures during and following storms greater than one-half inch in 24 hours; and additional treatment to remove suspended solids and turbidity from collected project site runoff prior to discharge (CH2M HILL, 2001b).
- Exposed bare soil will be covered as soon as possible after grading to minimize erosion potential using typical techniques such as hydroseeding, mulching, or matting.
- Erosion on slopes will be minimized by using techniques such as roughening, terracing, or contouring slopes before seeding.
- Sediment transport off-site or into drainage features/facilities will be avoided, using techniques such as filter fabric fence installed downstream of all exposed slopes, around existing drainage inlets, and along river, stream, and drainage channels in the vicinity of work areas.
- Toxic pollution will be controlled by requiring that all equipment be maintained and refueled where potential spills and stormwater runoff can be contained. Toxic spill response plan will be designed to contain any spills that occur. Water quality monitoring programs may be required by jurisdictional agencies to sample above and below construction areas, before, during and after project construction.

Specific construction techniques will be designed at the project phase to reduce the potential of adverse stream impacts. For example, bridge construction methods that avoid temporary work bridges will be considered, and any temporary stream structures will avoid the use of chemically treated wood materials such as creosote or chemonite. Furthermore, creosote-treated wood will not be used for any temporary or permanent instream structures.

Compensatory Measures

On-site/in-kind mitigation is most effective in avoiding construction impacts, but direct displacement of habitat may require compensation. For example, riparian areas cleared for construction staging or access will be revegetated with native plant species. If in-stream habitat is unavoidably displaced by new structures, on-site opportunities for creating additional habitat will be investigated. Habitat enhancement will compensate for the habitat functions that were lost, specific to fish species and life-stage.

Operational Impact Mitigation

Impact Avoidance Measures

The I-405 Corridor Program alternatives presently identify projects only at a conceptual level; no detailed project design has been completed. The most effective mitigation for operational impacts will be to design individual projects for impact avoidance or minimization. Examples of the types of mitigation that will be implemented where practicable and appropriate to the project include:

- Designing stream crossings to be passable for migrating fish.
- Stormwater runoff quantity: Detaining runoff from new impervious surfaces in accordance with Washington State Department of Ecology's (Ecology's) current stormwater drainage manual, or functionally equivalent stormwater guidance, and infiltrate to groundwater where feasible.
- Stormwater runoff quality: Treating collected stormwater runoff from new impervious surface in accordance with the Ecology drainage manual or functionally equivalent stormwater guidance etc. using sedimentation ponds, filter systems, wetponds, vegetated swales and filtering devices.

Compensatory Measures

One compensatory measure for operational impacts will be retrofitting of existing impervious surface for stormwater runoff quantity and quality. Extent of impervious surface has been identified as one of the main factors in fish habitat degradation due to urbanization (May, 1996). Several jurisdictions have mentioned retrofitting of impervious surface as the highest priority mitigation strategies (DEA, 2001c).

Stormwater retrofitting would result in early implementation of WSDOT's current drainage policy to control and treat stormwater according to the most current version of the Ecology Stormwater Management Manual for Western Washington (August 2001) or functionally equivalent stormwater guidance. While current WSDOT standards commit to some stormwater retrofitting in the design of new facilities, retrofitting of additional existing I-405 pavement area could potentially be credited as "out-of-kind" compensatory mitigation for other unavoidable impacts. Beyond this, additional compensation for specific project impacts could be implemented, because I-405 was constructed at a time of less stringent stormwater control standards and much of the stormwater runoff was not detained or treated.

WSDOT will also consider non-engineering solutions, such as removal of existing impervious surfaces and conversion into naturally vegetated habitat, where practicable and permitable.

3.8.5.2 Sub-Basin Level Mitigation

A number of mitigation projects have been previously identified by local jurisdictions to meet existing habitat enhancement/protection needs throughout sub-basins in the I-405 Corridor Program study area. As mitigation for the I-405 Corridor Program improvements, WSDOT will consider participating in some of these projects to gain mitigation credit for project-level impacts while contributing toward overall restoration of sub-basins and watersheds.

Mitigation opportunities identified by each local jurisdiction are summarized below.

Snohomish County Mitigation Opportunities: Swamp, North, and Little Bear Creeks

Snohomish County specifically identified a number of potential mitigation efforts:

- Fund or match funding for priority land acquisitions in Swamp, North, and Little Bear creeks.
- Fund or match funding for repair or replacement of prioritized fish blocking passage structures in Swamp, North, and Little Bear creeks.
- Fund or match funding for priority riparian corridor protection, restoration and connectivity (acquisition, conservation easement, removal of impervious surfaces and hydro-modifications) in Swamp, North, and Little Bear creeks.
- Fund or match funding for monitoring groundwater recharge in south county streams. Precipitation and stream flow could be gauged, and monitoring wells installed to investigate the condition of depth and movement of interflow, shallow groundwater, perched groundwater, as well as regional groundwater aquifers. This study could be implemented in a small pilot basin. Site-specific data needs to be correlated, and a preservation and protection plan for base flows created.
- A project could be designed (and development corporation founded to implement it) that searches out and uses the most advanced techniques to reduce impervious surfaces. Mitigation funds could be used as proactively as possible to gain lessons from these older, rapidly urbanizing watersheds which would be vital to successful development of inevitable new UGAs in the future.
- Easements, right-of-ways, native growth protection areas, community tracts, some detention ponds, and many other open spaces are not mapped in Snohomish County. A project needs to be funded to review all recorded plats, deeds and other records, and digitize the data to create a map of all currently protected open space in south county. This would allow prioritizing decisions to be made based on corridors and connectivity. It would also allow for creation of a management plan based on water quality, stormwater management, habitat, and an interconnected pedestrian trail system. Much of this interconnected open space has huge potential revegetation.
- There are several ox bows (stream features) in mainstem Swamp Creek in the vicinity of Forsgren Park that have high rearing and spawning potential but which currently have excessive flows. High water overflow swales with bio-engineered bank protections could be constructed to divert flood water and protect habitat in the ox bows.
- An inventory could be made of all the most at-risk/inappropriately located structures, and those whose removal would most benefit stormwater retention in naturally functioning

wetlands and riparian areas. Ground-floor elevations would be taken and a short and long range plan for removal created.

City of Kenmore Mitigation Opportunities: Swamp Creek

Much of the city of Kenmore lies within the Swamp Creek Basin, and the City has identified several drainage improvement needs and habitat enhancement opportunities. Swamp Creek Park is owned by King County, but lies within Kenmore at the mouth of Swamp Creek. It is occupied largely by degraded wetlands dominated by invasive exotic species, and enhancement of these wetlands would benefit the in-stream fish habitat. A feasibility study by King County for creation of a wetland mitigation bank in this area is currently underway. Other mitigation opportunities in Kenmore include:

- Retrofitting of the existing Wallace Park sedimentation trap on Swamp Creek;
- Contribute to development of regional stormwater detention facilities to reduce the impact of urbanized hydrology in reaches upstream of the city;
- Acquisition of riparian and floodplain areas, including buy-outs of flood-prone developed properties; and
- Participation in environmental restoration (outside the city of Kenmore) is being considered on a homesite acquired by the City near the mouth of Lyons Creek in Lake Forest Park.

City of Woodinville: Little Bear Creek

Several projects to improve stream habitat and drainage are underway in the Little Bear Creek Basin in the city of Woodinville, including retrofitting of two culverted crossings and acquiring open space lands. Several unfunded or preliminary projects may provide opportunities for WSDOT participation:

- Retrofitting of old rock weirs in Little Bear Creek downstream of 195th Street;
- Acquisition of riparian area along the Little Bear Creek corridor;
- Replacement of existing culverts at 134th Avenue NE with a bridge crossing;
- Creation of wetlands at the mouth of Little Bear Creek; and
- Removal of bank armoring and establishment of native riparian vegetation near the mouth of Little Bear Creek and upstream of the 195th Street crossing.

Other existing conditions that would benefit from mitigation efforts include the uncontrolled runoff from the Woodinville Auto Auction property and other impaired habitat elements such as lack of pool habitat, refugia, and large woody debris (LWD).

City of Bothell Mitigation Opportunities: North Creek and Sammamish River

The Bothell city limits include portions of the North Creek and the Sammamish River sub-basins. The City of Bothell is coordinating closely with the WRIA 8 watershed-level salmonid habitat enhancement efforts. No specific projects were identified. However, the City referred to the Sammamish River Action Plan, completed in January 2002, and the WRIA 8 (see City of Renton Mitigation Opportunities below).

In general, the City sees value in acquiring wetlands, riparian areas, and groundwater discharge/recharge areas for preservation. The City also suggested regional stormwater detention as a valuable mitigation concept for this area. Two recommendations were made for direct mitigation to address existing I-405 impacts: restoration of the compacted construction area within the WSDOT right-of-way at the intersection of SR 522 and SR 405, and retrofitting of uncontrolled stormwater drainage from this intersection.

City of Kirkland Mitigation Opportunities: Forbes and Juanita Creeks and East Lake Washington

The City of Kirkland has an ongoing program of drainage and habitat improvements in Forbes Creek, Juanita Creek, and East Lake Washington sub-basins, with numerous projects underway or fully funded. However, the City has identified several beneficial projects that are currently unfunded, offering a potential for WSDOT involvement:

- Installation of a sediment vault at Central Way and Market Street;
- Dredging of sediment deposits at several Lake Washington stream mouths;
- Culvert replacements on Juanita Creek near NE 120th Place;
- Drainage improvements and riparian property acquisition in the vicinity of NE 70th; and
- Restoration of the Forbes Creek stream corridor.

I-405 forms an impassable migration barrier on both of the two major streams of Kirkland; Juanita Creek and Forbes Creek. Reconnecting these streams across I-405 with some combination of daylighting, channel restoration, and installation of passable culverts would restore anadromous access to upstream habitat. Similar mitigation work may be possible on Yarrow Creek, which is blocked by several impassable crossings of SR 520.

The Draft Natural Environment Policies of the Totem Lake Neighborhood Plan in Kirkland also refers generally to the need for enhancement of the Juanita Creek riparian corridor, and daylighting of culverted sections of Forbes Creek.

City of Bellevue Mitigation Opportunities: Kelsey and Coal Creeks, Tributaries to Lake Sammamish, Lake Washington, and Mercer Slough

Major drainages in Bellevue include Kelsey Creek, Mercer Slough, Coal Creek, and several tributaries to Lake Sammamish. The City has an extensive program of drainage and aquatic habitat improvement. Numerous projects are underway, including culvert retrofitting, barrier removal, and habitat restoration projects at several locations. However, a number of unaddressed problems and preliminary or unfunded projects offer the potential for I-405 mitigation credit:

- Acquisition of headwater riparian areas of Lewis Creek;
- Retrofitting of I-90 culvert barriers at Lewis (tributary to Lake Sammamish), Richards (tributary to Lake Washington), and Vasa (tributary to Lake Sammamish) creeks;
- Acquistion of Kelsey Creek riparian habitat upstream of Kelsey Creek Park and Glendale Golf Course;
- Investigation and correction of drainage problems at an unnamed tributary to Mercer Slough;
- Acquisition of riparian habitat along Richards Creek;

- Replacement of existing bank armoring with more functional habitat features (LWD) outside of the bankfull corridor and retrofitting faulty weirs on Kelsey Creek near Bel-Red Road; and
- Upgrading of I-405 high-flow bypass facilities.

City of Newcastle Mitigation Opportunities: Boren, China, and May Creeks

The City of Newcastle generally identified some drainage and aquatic habitat issues that may offer opportunities for mitigation:

- Culvert replacement on Boren Creek;
- Channel restoration and barrier removal on China Creek;
- Wetland and floodplain property acquisition along May Creek; and
- Large woody debris installation in May Creek.

City of Renton Mitigation Opportunities: May, Panther, Springbrook Creeks and Cedar River

The City of Renton is coordinating closely with WRIA 8 watershed-level salmonid habitat enhancement efforts, and referred to the WRIA 8 Draft Near-term Action Agenda for Salmon Habitat Conservation completed in January 2002.

The May Creek Basin Action Plan makes 53 specific recommendations for implementing solutions to drainage and habitat problems in that sub-basin (City of Renton and King County, 2001). These actions range from establishing new stormwater detention standards to planting coniferous trees in riparian areas.

Several additional specific mitigation opportunities in the city of Renton were identified during the May 2001 mitigation meetings, including:

- Replacing rip-rap with bioengineering structures on the banks of the lower reaches of the Cedar River near the Renton Library;
- Retrofitting uncontrolled stormwater drainage from SR 169;
- Riparian restoration and control of Himalayan Blackberry growth;
- Study and mitigation design for wetland drainage problems between Panther Creek and Springbrook Creek;
- Funding for the proposed mitigation bank near Oakesdale and SW 34th; and
- Acquisition of the Seattle Times site near SW 34th for wetland creation.

City of Kent Mitigation Opportunities: Mill, Meridian, Soos, Soosette Creeks

Extensive restoration efforts are underway in the Black River/Springbrook Creek Basin and the Lower Green River. The City of Kent is constructing a 300-acre regional stormwater detention facility. A U.S. Army Corps of Engineers program is underway to improve drainage and habitat throughout the Mill Creek Basin, including slope stabilization, riparian restoration, and restoring channelized stream reaches. Several opportunities for I-405 mitigation credit were identified:

- Design and construction of an outlet to the proposed regional stormwater facility;
- Levee alteration and riparian revegetation along the Green River; and
- Creation of additional flood storage capacity in mitigation for existing SR 167 impacts.

The City of Kent annexed areas within the Soos Creek Basin in 1996. Extensive drainage and habitat mitigation efforts are underway in this basin as well, including culvert replacement, riparian restoration, and in-stream enhancement. Specific opportunities for potential WSDOT participation include:

- Riparian revegetation and invasive weed control near Clark Lake;
- Restoration of the channelized reaches of Meridian Creek;
- Retrofit Meridian Lake outfall;
- Culvert retrofitting and riparian revegetation on Soosette Creek;
- Enhancement of spawning habtiat upstream of 240th Street; and
- Acquisition of riparian areas on Soos Creek tributaries.

King County Mitigation Opportunities: Green/Duwamish River, May Creek, Bear Creek, Evans Creek

King County has a number of habitat mitigation priorities throughout the study area because of its broadly dispersed jurisdiction.

- In the Green/Duwamish River watershed, preservation of intact habitat in the Middle Green River Basin has been identified as critically important for salmon recovery in several recent documents including the Habitat Limiting Factors and Reconnaissance Assessment Report – WRIA 9 (Kerwin and Nelson, 2000), and WRIA 9 Factors of Decline Subcommittee Direction for 2000 (King County, 2000b). These documents identify a number of specific areas in the watershed that are extremely important to preserve. Other recently published documents identify fish restoration opportunities in the Green/Duwamish watershed, including the Green/Duwamish River Ecosystem Restoration General Investigation: Reconnaissance Report (U.S. Army Corps of Engineers, 1997).
- An immediate opportunity for mitigation participation is at the upper extent of the Sammamish River. Permitting is now underway for a plan to restore meanders to this previously channelized river. However, considerable additional funding is needed.
- About one-half mile of May Creek directly parallels I-405 at the toe of the road fill embankment. This may offer opportunities for direct on-site/in-kind mitigation credit for proposed projects in the vicinity. In addition numerous stormwater outfall pipes presently discharge onto the slopes of the May Creek ravine. Additional funding is needed to complete the retrofitting of these discharges to prevent erosion. Current installation of large woody debris in this stream reach may potentially also be augmented for mitigation credit. Buy-out of flood plain properties in the May Creek Basin has also been identified as a restoration need. The May Creek Basin Action Plan recommends numerous specific mitigation and restoration projects in that basin (City of Renton and King County, 2001).
- The County has stressed riparian acquisition and preservation in the Bear Creek Basin, and there may be potential for WSDOT to contribute to this ongoing effort. Assistance would also be helpful in obtaining easements for planned channel restoration activities along the

lowest reaches of Bear Creek. Large woody debris is lacking in Cottage Lake Creek, a tributary of Bear Creek, and addressing this issue may support a mitigation project.

3.8.5.3 Watershed-Level Mitigation

Steering committees composed of elected officials, local agency staff, and citizens have been established in the study area to oversee development of a plan that responds to salmon listings under the ESA in several WRIAs. Steering committees have been established for both of the study-area watersheds: the Lake Washington/Cedar River watershed (WRIA 8) and the Green/Duwamish watershed (WRIA 9).

The WRIA steering committees are in the process of identifying, evaluating, and prioritizing actions to protect and restore salmon populations, especially actions related to habitat. This conservation strategy will also help lead to agreements that will guide future actions that affect salmon habitat (King County, 2001b). The WRIA committee mission is "to develop a watershed conservation plan that will recommend actions to conserve and recover chinook salmon and other anadromous fish. The focus of this phase shall be to preserve, protect and restore habitat with the intent to recover listed species…"

Many of the local agency jurisdictions are contributing funding and staffing to the WRIA 8 and 9 steering committee efforts. Local agencies may rely on the steering committees to coordinate mitigation efforts throughout the watershed. Some local agencies look to the WRIA organizations to replace or augment specific on-site or in-basin mitigation efforts with broad watershed-wide efforts. Depending on the approval of jurisdictional agencies such as Ecology, WSDOT may contribute to the coordinated watershed-level conservation efforts as a form of off-site, out-of-kind mitigation for various project-specific impacts.

Two main watershed-level mitigation approaches were identified in discussions with local agencies and WRIA representatives: retrofitting stormwater control measures for existing impervious surfaces, and preservation of remaining undeveloped portions of the watersheds.

- Stormwater control retrofitting could be one of the most effective mitigation measures, because much of the existing habitat degradation in the study area can be attributed to uncontrolled and untreated runoff from existing impervious surfaces, including primarily pavement. The adverse effects of such runoff are described above in Section 3.8.4 and the benefits of stormwater control are described in Section 3.8.6.2. In addition, existing uncontrolled runoff could be treated to reduce pollutant loadings. While current WSDOT standards commit to some stormwater retrofitting in the design of new facilities, retrofitting of additional existing I-405 pavement area could potentially be credited as "out-of-kind" compensatory mitigation for other unavoidable impacts.
- Preservation of undeveloped watershed areas could serve as mitigation based on the assumption that these areas would otherwise be developed. Development in these areas would cause the loss of some level of beneficial hydrologic and habitat functions as discussed in Section 3.8.4. In addition, the beneficial functions of undeveloped watershed already extend throughout much of the watershed by such mechanisms as groundwater recharge, baseflow maintenance, and provision of habitat refuge.

Crediting of watershed-level mitigation for project-specific impacts would require close coordination between WSDOT and federal and state regulatory agencies. Comparison of mitigation "value" between qualitatively different types of mitigation would need to be negotiated. The Washington Alternative Mitigation Policy Guidance for Aquatic Permitting Requirements from Ecology and WDFW (*I-405 Errata and Addendum to Expertise Reports* [DEA, 2002]) states that *"Preservation as compensatory mitigation has been determined to be acceptable by the agencies when done in combination with creation, enhancement, or restoration…"* within certain criteria, but that *"Preservation alone shall only be used as compensatory mitigation in exceptional cases."*

WSDOT will use the concepts summarized here as a starting point in the impact mitigation process for the overall I-405 Corridor Program. Mitigation efforts will involve continued collaboration with local jurisdictions, other state agencies, and the WRIA committees.

3.9 FARMLAND

3.9.1 Studies and Coordination

The viability of land in long-term agricultural use and the importance of individual farms are the focus of the State of Washington's various farmland protection acts. Farmland is usually divided into three distinct categories: prime farmland, unique farmland, and farmland of statewide or local importance. Prime farmland is land of exceptional physical and chemical soil characteristics that can be used in agriculture with minimum user input of nutrients, labor, etc. The land must also not be in or committed to urban development or water storage. Unique farmland is lower quality than prime farmland but is still able to produce high-value food or grain products. Farmland of statewide or local importance is farmland that meets Washington State and USDA guidelines and is not protected within the other two groups.

All affected farmland was evaluated to determine the quantity of acres potentially affected. Potential disruption of agricultural uses and farming activities during construction and operation also was evaluated.

The local Natural Resources Conservation Service District Office is the primary contact and authority when dealing with the conversion of farmland for all projects. The offices of the King County Farmland Preservation Program (FPP) also provided assistance.

3.9.2 Methodology

Digital data for farmlands in King County were used to locate and map farmlands within the study area for each alternative (King County GIS, Comprehensive Plan Agriculture Layer, 1998). Locations where alternatives would have effects on farmland were then evaluated based on conceptual plans of the proposed improvements. Figure 3.9-1 shows farmlands located within the study area.

No farmlands exist within the study area in Snohomish County; consequently, no additional detailed analysis was conducted.

The farmland analyses in this section are based on the *I-405 Corridor Program Draft Farmland Expertise Report* (DEA, 2001), herein incorporated by reference.

3.9.3 Affected Environment

3.9.3.1 Farmland

While farmlands are not dominant features within the corridor, they are deemed important and are protected in both King and Snohomish counties. In the Snohomish County portion of the study area, there is no protected farmland. Farmlands in Kenmore would not be affected, and are not discussed here. The northern part of the study area in King County contains portions of the Sammamish River Valley Agricultural District near major roadways. King County owns the development rights on approximately 770 acres of farmland in the Sammamish Valley. Except for 37 acres that are within the city boundary of Redmond, these properties are located in the unincorporated King County part of the valley. All of the farms in this region are also protected under the King County FPP. Within the study area, there are no protected farmlands south of Redmond. The King County FPP currently maintains 12,800 acres of the more than 42,290 acres of farmland within King County.

King County Ordinance 4341, which enabled the FPP, prioritized properties for acquisition of development rights; properties in the Sammamish River Valley were listed as "Priority One" properties. Priority One properties were located in areas designated Agricultural Lands of County Significance by the County in 1977, based on the presence of agricultural Capability Class II and Class III soils and the use of these soils for farming.

The U.S. Department of Agriculture Soil Survey for King County groups soils according to their suitability for most kinds of field crops. The groups, referred to as capability classes, are made according to the limitations of the soils when used for field crops, the risk of damage to the soil when they are used, and the way they respond to treatment. The capability classes are designated by Roman numerals I through VIII, with lower number capability class soils having fewer limitations than those having a higher number class. Class I soils have few limitations restricting their use; however, there are no Class I soils in King County. Class II soils are the best soils (i.e., have the fewest limitations) occurring in King County and are defined as having moderate limitations that reduce the species of plants (grown) or requiring moderate conservation practices.

Approximately 730 acres of Class II soils in the Sammamish Valley are protected under the FPP. About 12 acres of Class III soils are also protected under the FPP. Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both. The remaining FPP acreage in the valley consists of Class IV soils, which have very severe limitations that reduce the species of plants that can be grown, require very careful management, or both; and Class VI soils, which have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture, woodland, or wildlife habitat. The Class IV and Class VI soils are in small areas that slope down to the valley floor west of the Woodinville - Redmond Road. Since they are part of the parcels that contain the Class II and Class III soils, they are also protected under the FPP. There are no Class V soils in the study area.

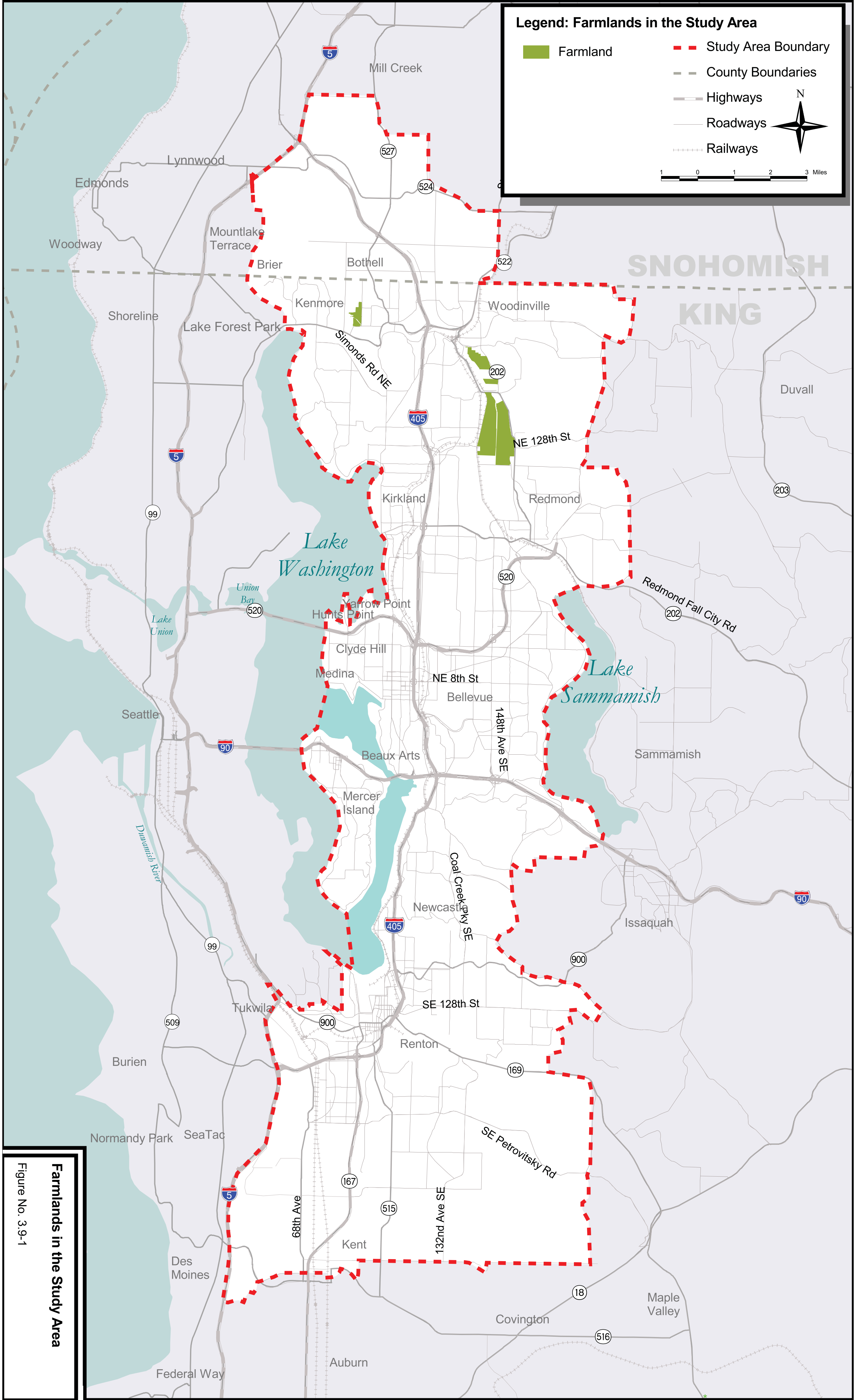
The federal Farmland Protection Policy Act (FPPA) is intended to minimize the extent to which federal activities contribute to the conversion of farmland to non-agricultural uses. The FPPA requires federal agencies to examine the impact of their programs before they approve any activity that would convert farmland. Federal agencies fill out a Farmland Conversion Impact Rating Form (form AD-1066) to rate the relative impacts of projects and score the relative value of sites subject to the FPPA regulation. Under the FPPA, farmlands that score 160 points or less on the AD-1066 land evaluation and site assessment are considered farmland not needing to be given further consideration for protection. All of the Sammamish Valley farmlands fall into this category but are protected under the local jurisdiction guidelines.

3.9.4 Impacts

3.9.4.1 No Action Alternative

Construction Impacts

All of the impacts to farmlands within the I-405 Corridor are in the Sammamish Valley region. The impacts all result from road widening improvements, which have a linear impact on farmland without affecting the majority of the farms or causing additional fragmentation of local farms. Impacts for all of the alternatives are summarized in Table 3.9-1 with the No Action Alternative projects included in all of the action alternatives.



Farmlands in the Study Area

Figure No. 3.9-1

This page left intentionally blank.

Table 3.9-1: Farmlands Potentially Affected

Alternative	Improvement	Statewide and/or Locally Important Farmland Affected (acres)
No Action Alternative	Willows Road Widening (R-47)	5.5
	SR 202/140th Pl. NE Widening (R-111)	0.4
Total		**5.9**
Alternative 1, HCT/TDM[a]	Willows Road Widening (R-47)	5.5
	SR 202/140th Pl. NE Widening (R-111)	0.4
Total		**5.9**
Alternative 2, Mixed Mode with HCT/Transit	Willows Road Widening (R-47)	5.5
	SR 202/140th Pl. NE Widening (R-111)	0.4
	SR 202/175th Pl. NE Widening (R.PA-28 & R.AC-17)	0.2
Total		**6.1**
Alternative 3, Mixed Mode	Willows Road Widening (R-47)	5.5
	SR 202/140th Pl. NE Widening (R-111)	0.4
	Willows Road Widening (R.AC-16)	6.8
	SR 202/175th Pl. NE Widening (R.PA-28 & R.AC-17)	0.2
Total		**12.9**
Alternative 4, General Capacity	Willows Road Widening (R-47)	5.5
	Willows Road Widening (R.AC-15 & R-111)	0.4
	Willows Road Widening (R.AC-16) (RPA-28)	6.8
	SR 202 Widening (R.AC-18 & R.PA-28)	7.2
	SR 202/175th Pl. NE Widening (R.PA-28 & R.AC-17)	0.2
Total		**20.1**
Preferred Alternative	Willows Road Widening (R-47)	5.5
	Willows Road Widening (R.AC-15 & R-111)	0.4
	Willows Road Widening (R.AC-16) (RPA-28)	6.8
	SR 202 Widening (R.AC-18 & R.PA-28)	7.2
	SR 202/175th Pl. NE Widening (R.PA-28 & R.AC-17)	0.2
Total		**20.1**

[a] Alternative 1 has no projects beyond those in the No Action Alternative

Under the No Action Alternative, two areas of farmland would potentially be affected by SR 202 improvements and improvements in the Willows Road Corridor. These widening improvements could impinge about 16 feet into the edge of the farmland adjacent to each roadway, directly affecting about 5.9 acres of farmland. Construction zones along the roadway would be replanted after construction in accordance with local and state guidelines. Landscaped buffer areas could also protect adjacent farms from the runoff from roadways. Projects in the immediate vicinity of farmlands could produce dust and/or air pollution, but with negligible to no effect on agricultural zones. No prime or unique farmlands would be affected.

Operational Impacts

No prime or unique farmlands would be affected by operation of the I-405 corridor improvements.

3.9.4.2 Alternative 1: HCT/TDM Emphasis

Alternative 1 would have no impact on farmland in the I-405 corridor beyond those described previously for the No Action Alternative. This is the lowest potential effect of any action alternative.

3.9.4.3 Alternative 2: Mixed Mode with HCT/Transit Emphasis

Construction Impacts

Under Alternative 2, one area of protected farmland potentially would be affected beyond that identified in the No Action Alternative. This additional improvement could impinge minimally into the edge of the farmland adjacent to SR 202, directly affecting 0.2 acre of farmland, resulting in 6.1 total acres of impact. This effect is nearly as low as for the No Action Alternative and Alternative 1.

Construction zones along the roadway would be replanted after construction in accordance with local and state guidelines. Landscaped buffers could also protect farms from the runoff from roadways. Improvements in the immediate vicinity of farmlands could produce dust and/or air pollution, but with negligible to no effect on agricultural zones. No prime or unique farmlands would be affected.

Operational Impacts

No prime or unique farmlands would be affected by operation of the I-405 corridor improvements.

3.9.4.4 Alternative 3: Mixed Mode Emphasis

Construction Impacts

Under Alternative 3, three areas of protected farmland would potentially be affected beyond those identified in the No Action Alternative. These additional improvements could impinge minimally into the edge of the farmland adjacent to SR 202 and Willows Road, directly affecting about 7 acres of farmland. This level of impact is about midway between the best- and worst-ranked action alternatives resulting in 12.9 total acres of impact.

Construction zones along the roadway would be replanted after construction in accordance with local and state guidelines. Landscaped buffers could also protect farms from the runoff from roadways. Improvements in the immediate vicinity of farmlands could produce dust and/or air pollution, but with negligible to no effect on agricultural zones. No prime or unique farmlands would be affected.

Operational Impacts

No prime or unique farmlands would be affected by operation of the I-405 corridor improvements.

3.9.4.5 Alternative 4: General Capacity Emphasis

Construction Impacts

Alternative 4, as with the Preferred Alternative, has the potential to impact seven areas of farmland beyond those identified in the No Action Alternative. These additional improvements under Alternative 4 could impinge minimally into the edge of the farmland adjacent to SR 202 and Willows Road, directly affecting 14.2 acres of farmland. Alternative 4, along with the Preferred Alternative, has the greatest potential to impact protected farmlands. This will result in a total of 20.1 acres of impacts under Alternative 4.

Construction zones along the roadway would be replanted after construction in accordance with local and state guidelines. Landscaped buffers could also protect farms from the runoff from roadways. Improvements in the immediate vicinity of farmlands could produce dust and/or air pollution, but with negligible to no effect on agricultural zones. No prime or unique farmlands would be affected.

Operational Impacts

No prime or unique farmlands would be affected by operation of the I-405 corridor improvements.

3.9.4.6 Preferred Alternative

Construction Impacts

Under the Preferred Alternative, seven areas of protected farmland would potentially be affected beyond those identified in the No Action Alternative. These additional improvements under the Preferred Alternative could impinge minimally into the edge of the farmland adjacent to SR 202 and Willows Road, directly affecting 14.2 acres of farmland. The Preferred Alternative, along with Alternative 4, has the greatest potential to impact protected farmlands. This will result in a total of 20.1 acres of impacts under the Preferred Alternative.

Construction zones along the roadway would be replanted after construction in accordance with local and state guidelines. Landscaped buffers could also protect farms from the runoff from roadways. Improvements in the immediate vicinity of farmlands could produce dust and/or air pollution, but with negligible to no effect on agricultural zones. No prime or unique farmlands would be affected.

Operation Impacts

No prime or unique farmlands would be affected by operation of the I-405 corridor improvements.

3.9.5 Mitigation Measures

Under the No Action Alternative, the Willows Road improvements could be constructed so that any expansion outside the right-of-way could be done on the west (southbound) side, thus avoiding farmland impact. Avoidance of impingement on farmland along the NE 124th Street improvements is not practicable, as farmlands exist on both sides of the right-of-way.

For Alternative 1, no adverse impacts on farmlands are expected to occur beyond those identified for the No Action Alternative; therefore, no additional mitigation measures would be required.

Where practicable, considering other social, economic, and environmental impacts, all of the improvements for Alternatives 2, 3, 4, and the Preferred Alternative will be designed so that any expansion outside of the right-of-way is done on the side of the road that does not affect farmland, thus avoiding any substantial farmland impacts.

Other mitigation measures could include the landscaped buffer areas noted above.

3.10 FLOODPLAINS

This section addresses floodplains, floodplain attributes, functions, existing conditions, and potential impacts to floodplains resulting from the I-405 Corridor Program. Impacts to fish and aquatic habitat are discussed in Section 3.8. Impacts to wetland habitats are discussed in Section 3.6.

3.10.1 Studies and Coordination

Floodplains are lowlands that are relatively flat and are subject to flooding in any given year. The 100-year floodplain is defined as the area adjacent to a stream or lake that is subjected to inundation by waters having a flood probability in exceedence of one percent in any given year, as determined by standard statistical and hydrologic methods. The 100-year flood is a statistical concept to describe, over the long term, how frequently a "100-year" size flood event occurs; in the short term, a 100-year flood may occur more frequently.

Floodplains are divided into three parts: the Federal Emergency Management Agency (FEMA) floodway, the zero-rise floodway, and the flood fringe. The FEMA floodway is the channel of a river or other watercourse and the adjacent land areas that must be unconfined or unobstructed either vertically or horizontally to provide for the discharge of the base-year flood. The zero-rise floodway is that portion of the floodplain outside the floodway that is inundated by floodwaters and in which encroachment is permissible as long as it doesn't change the flood storage volume or flood elevation. The flood fringe is that portion of the floodplain that tends to collect standing water rather than rapidly flowing water. Development in the FEMA floodway is to be avoided, and structures in the remainder of the floodplain and the flood fringe should be avoided or minimized. In cases where the FEMA floodway is relatively narrow, it can be spanned by a bridge to avoid impacts.

Counties and cities in the region bear the primary responsibility for the regulation of activities in floodplains. Comprehensive plans seek to reduce the number of people exposed to flood hazards by designating major river floodplains primarily for low-density agricultural and other compatible uses. The intent of this approach is to protect public safety and reduce long-term public costs and damage to the environment. The 100-year floodplain is designated as a flood hazard area in sensitive area ordinances.

3.10.2 Methodology

FEMA flood insurance rate maps for King and Snohomish counties were used to identify 100-year floodplains on the major rivers, lakes, and streams for the study area. Much of this information is in the King County GIS database and was available to plot as an overlay on maps of each of the alternatives. Because revisions to some of the FEMA maps have been made since the King County database was developed, maps that were revised since 1995 were inspected to see if changes in the 100-year floodplain had been made in the study area. Locations where proposed transportation improvements and the 100-year floodplains intersected were then evaluated using conceptual plans and USGS 7.5-minute topographic maps so that the potential impacts could be estimated in terms of linear feet of floodplain.

In this evaluation, floodway refers to the designated FEMA floodway, and floodplain is the remainder of the mapped floodplain that is assumed to be equal to the zero-rise floodway. In King County, flood fringe impacts are inside the mapped floodplain and difficult to estimate accurately without a survey and plans, so these specific impacts have not been quantified.

Floodplains for minor streams, wetlands, and closed depressions are not mapped, but according to King County code, they should be determined on an individual project basis. Impacts to these minor floodplains are not included in this study.

In addition to review of the FEMA maps, individual jurisdictions' sensitive areas ordinances were examined in order to gain an understanding of the local controls in effect for floodplain management.

It is expected that all projects would avoid floodway areas. Any projects passing through a floodplain would meet each of the local jurisdiction and FEMA requirements for locating in the floodplain, such as no obstruction in the floodway that would raise the flow height above the zero rise of the flood elevation.

The park-and-ride and transit center alternatives were not evaluated since sites have not been selected. It is assumed that these projects would be developed in full conformance with local floodplain and sensitive areas ordinances.

The floodplains analyses in this section are based on the *I-405 Corridor Program Draft Floodplain Expertise Report* (DEA, 2001), herein incorporated by reference.

3.10.3 Affected Environment

The following sections describe the floodplains located in the study area, and address the floodplains' attributes and functions and the existing conditions in the study area.

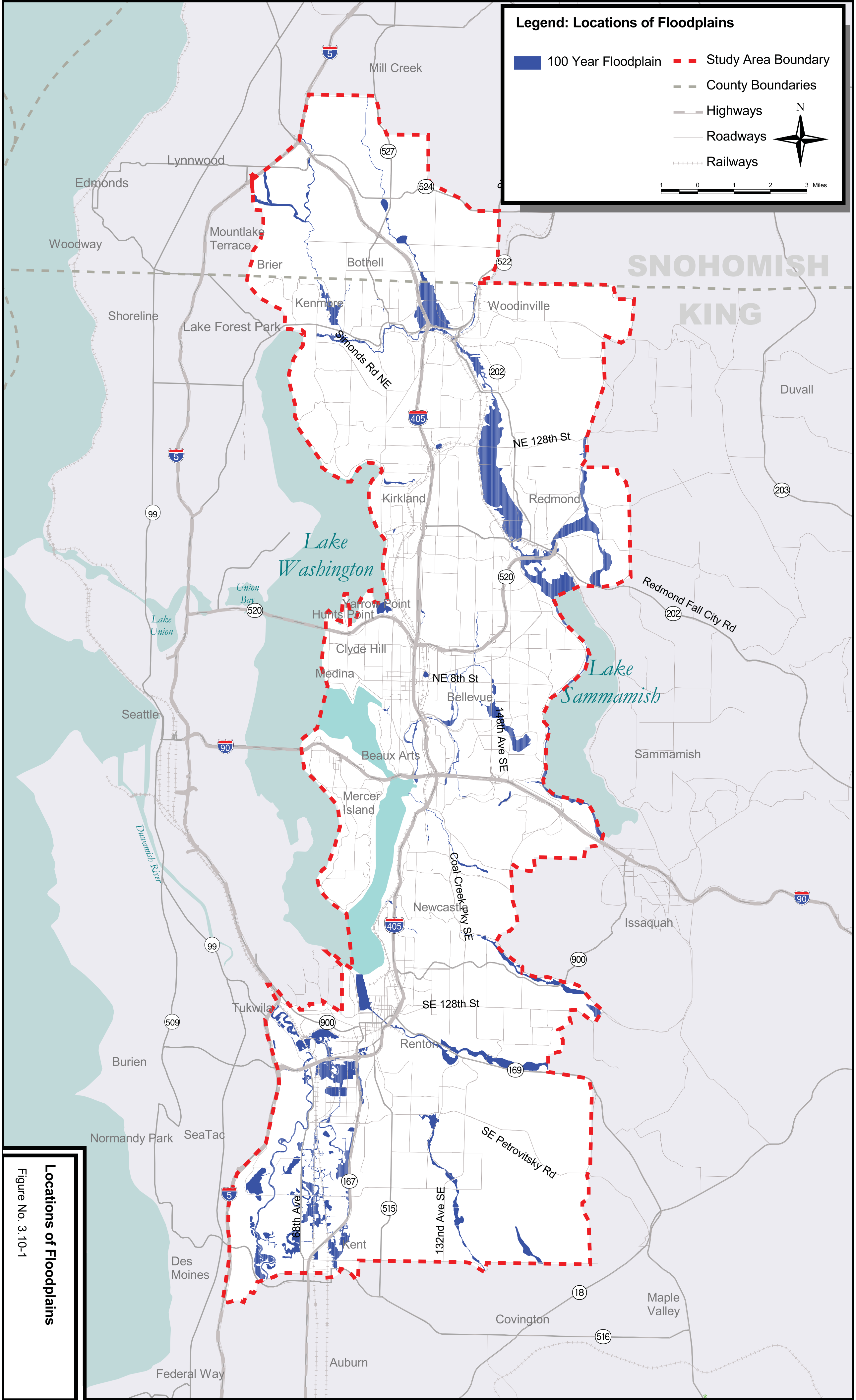
3.10.3.1 Floodplain Attributes and Functions

Floodplains have many important functions. The primary feature is that they carry peak flows of the river or creek. Floodplains allow a river to increase in width to carry the peak flow, reducing the velocity and resulting in less erosion. They also provide an area for deposition and renewal of sediment during flood events. Commonly, wetlands develop in the floodplains due to the silty soils and lack of drainage back to the river or creek. Floodplains are frequently riparian zones with large trees that provide shade and habitat. Even if the floodplain is grassland or pasture, it provides habitat for birds and small mammals. Other sections of this EIS provide more information on the ecological functions provided by floodplains:

- Wetlands, Section 3.6
- Wildlife, Habitat, and Upland Threatened and Endangered Species, Section 3.7
- Fish and Aquatic Habitat, Section 3.8

3.10.3.2 Floodplains and River Systems

Within the project study area there are 18 floodplains that are either crossed or are adjacent to I-405, potential high-capacity corridors, and the arterials being evaluated by this analysis (Figure 3.10-1). In situations where the floodway area of the floodplain is crossed, the floodway would be spanned or bridged so that flows are not impeded. In the Snohomish County portion of the study area, Swamp Creek, Bear Creek, and North Creek each have 100-year floodplains that are crossed by roadways. In the northern part of the study area in King County, North Creek, Swamp Creek, Bear Creek, Little Bear Creek, Evans Creek, the Sammamish River, Kelsey Creek, Mercer Slough, Tibbetts Creek, and Richards Creek, all have 100-year floodplains that are near major roadways or are crossed by bridges. In the southern portion of the study area, Big



Locations of Floodplains

Figure No. 3.10-1

This page left intentionally blank.

Soos Creek, May Creek, Tibbetts Creek, Springbrook Creek, the Green River, the Duwamish River, and the Cedar River have 100-year floodplains that are near roadways or are crossed by bridges. Over the years, as information about the location and importance of floodplains has increased, roads have been designed to avoid the floodway and ensure a zero-rise of the flood elevation. Table 3.10-1 lists the floodplains that are currently crossed or are adjacent to highways and/or arterials in the study area.

Table 3.10-1: Floodplains Crossed or Adjacent to I-405 and Arterials in the Study Area

Floodplain	Roadway
Swamp Creek	Crossed by NE Bothell Way
North Creek	Crossed by I-405, SR 522, NE 195th Street, and Bothell Everett Highway (SR 527)
Sammamish River	Crossed by I-405 and SR 520 Adjacent to NE Bothell Way and SR 522 Crossed by NE 124th Street, NE 175th Street and NE 145th Street (SR 202)
Bear Creek and Little Bear Creek	Adjacent to and crossed by Avondale Road Adjacent to and crossed by Redmond – Fall City Road Adjacent to SR 520
Evans Creek	Adjacent to and crossed by Redmond – Fall City Road
Kelsey Creek	Crossed by Lake Hills Connector, NE 8th Street, 148th Avenue NE Adjacent to SE 8th Street and Bellevue-Redmond Road
Mercer Creek	Crossed by I-90 and I-405 Adjacent to Bellevue Way SE and SE 8th Street
Richards Creek	Crossed by I-90 Adjacent to Richards Road
Coal Creek	Crossed by I-405 Adjacent to and crossed by Coal Creek Parkway
May Creek	Crossed by I-405 Crossed by Lake Washington Boulevard N, Coal Creek Parkway, and SR 900
Tibbetts Creek	Adjacent to and crossed by I-90
Green River	Crossed by I-405 and SR 516 Crossed by Southcenter Blvd., Interurban Avenue, and S 180th Street Adjacent to West Valley Highway
Cedar River	Crossed by I-405 Crossed by Logan Avenue and Bronson Way Adjacent to and crossed by Maple Valley Road
Rolling Hills Creek	Adjacent to Interchange of I-405 and SR 167
Springbrook Creek	Crossed by I-405 Crossed by Grady Way and SW 43rd Street Adjacent to and crossed by SR 167
Mill Creek	Crossed by SR 167
Unnamed Flood Area	Adjacent to I-405 east of I-5
Duwamish River	Crossed by I-5 Adjacent to Interurban Avenue
Issaquah Creek	Crossed by I-90
Black River	Crossed by Monster Road SW

The major rivers in the study area have been channelized as development has occurred in the floodplains. These rivers typically have levees along both banks and limited amounts of existing floodplains in the project area. The exception is the Sammamish River, which still has a large undeveloped floodplain in the project area. All roadways would cross these major rivers on bridges with few or no piers in the floodway. These major rivers include Duwamish River, Green River, Cedar River, and Sammamish River.

Some of the creeks have been channelized, but they do not have levees as extensive as the major rivers. Most of the large floodplains in the project area are due to these creeks. Major roadways such as I-405 typically have bridge crossings of major creeks; however, there are some large culverts. Arterial roadways have both bridge and culvert crossings. These creeks include Springbrook Creek, Mercer Creek, North Creek, and Bear Creek.

Some of the creeks are still fairly natural channels with little channelization and few or no levees. These creeks have larger floodplains where the ground is level and little floodplain where the creek is in a ravine. Most roadway crossings are currently in culverts, although some, such as I-405 and Lake Washington Boulevard over May Creek, are bridges. These creeks include Rolling Hills Creek, May Creek, Coal Creek, Kelsey Creek, Evans Creek, and Swamp Creek.

3.10.4 Impacts

If a river or creek is crossed by a bridge or a culvert, the floodway may be reduced. In a narrower floodway, the meandering zone could be lost and water velocities could increase, creating additional scour and erosion.

A potential impact to floodplains is the permanent loss of flood storage caused by the road fill, additional pavement, and storm drainage treatment areas. In addition, there may be a loss of ecological functions related to wetlands, vegetation, and wildlife. These are both types of potential permanent losses associated with new development. There also may be temporary losses in the construction area, primarily losses of ecological functions due to soil compaction and lost vegetation.

Table 3.10-2 provides a summary of the potential impacts for each of the alternatives.

Table 3.10-2: Summary of Potential Impacts to Floodplains in the Study Area

Alternative	Floodplains Affected	Potential Floodway Crossings[a,b]	Potential Impact Length (ft)[a]	Potential Mitigation
No Action	6 projects affect 5 floodplains	5 (4)	13,950	Walls, bridges, storage, overflow channel
1[a]	23 projects affect 14 floodplains	22 (5)	31,650	Walls, bridges, storage, overflow channel
2[a]	37 projects affect 14 floodplains	41 (51)	48,025	Walls, bridges, storage, overflow channel
3[a]	36 projects affect 14 floodplains	40 (5)	48,125	Walls, bridges, storage, overflow channel
4[a]	36 projects affect 14 floodplains	41 (40)	39,175	Walls, bridges, storage, overflow channel
Preferred Alternative	Approximately 43 projects affect approximately 14 floodplains	Approximately 45 (5)	Approximately 50,000	Walls, bridges, storage, overflow channel

a. The impacts in the action alternatives include the No Action Alternative.
b The number in parentheses indicates new crossings.

In each situation where there is potential for impacts to a floodplain, projects can be designed using conventional engineering techniques so that the floodway is avoided and there is a zero rise in flood elevation. Because restrictions to the meandering of natural streams can usually be avoided, no associated effects on floodplains are expected. Localized loss of flood storage can be compensated for by designing additional flood storage in nearby parts of the floodplain and by complying with compensatory storage requirements for filling of the floodway. Very few of the floodplain crossings identified in Table 3.10-2 are new, and none of the I-405 crossings are new (see the *I-405 Corridor Program Draft Floodplain Expertise Report* [DEA, 2001]). Each culvert and bridge that would be modified or replaced represents an opportunity to evaluate design options that could improve conveyance of floodwaters. As a result, each alternative could be constructed and operated so that substantial direct impacts on floodplains in the study area are avoided.

Flood fringe is that portion of the floodplain outside of the zero rise floodway which is covered by floodwaters during a flood. Generally the flood fringe is associated with standing water as opposed to rapidly flowing water (King County, 2000). Typically flood fringe areas are not individually mapped but rather are included within a jurisdiction's floodplain mapping. In addition, floodplains for small streams, wetlands, and closed depressions are not included in FEMA floodplain mapping. During the design phase, engineering plans, hydrologic models, and surveys accepted by applicable jurisdictions would be used to assess fill in the floodplain, and the hydrology in the study area. Any fill in the floodplain would comply with FEMA and other local regulatory requirements. Required analyses could include floodplains for smaller streams, wetlands, and closed depressions that may occur within the specific project area. In addition, localized flooding conditions will be analyzed on a project-specific basis.

3.10.4.1 No Action Alternative

Under the No Action Alternative there are six projects that would potentially impact five floodplains. These include five culvert or bridge crossings of the floodway. The potential length of floodplain impact is 13,950 feet. Two of the projects are new roads across the Samammish River floodplain that should include flood storage mitigation in the design to avoid storage impacts. Another project is a road across the Springbrook Creek floodplain that would also need to include flood storage mitigation in the design to avoid storage impacts.

Construction Impacts

During construction, no impacts to floodplain storage capacity are anticipated. There may be impacts to floodplain ecological functions that are discussed in other sections. In the event that flooding occurs, equipment would need to be moved out of the floodplain.

Operational Impacts

The operational impacts of the No Action projects are, or will be, addressed in the environmental analysis, documentation, and review conducted for those projects.

3.10.4.2 Alternative 1: HCT/TDM Emphasis

The evaluation of the action alternatives assumes that all of the No Action Alternative projects will be implemented. Estimates of impacts include those of the No Action Alternative. Twenty-three of the Alternative 1 projects would either enter or cross 100-year floodplains. Fourteen different floodplains are either crossed or are adjacent to the projects proposed in Alternative 1. There are 22 floodway crossings by culverts or bridges that would be lengthened or replaced, with a potential for 31,650 linear feet of floodplain impacts. The potential impact on floodplains would be relatively low.

Construction Impacts

During construction, no impacts to the floodplain storage are anticipated. There may be impacts to floodplain ecological functions. The discussion of impacts to ecological functions can be found in Section 3.6 (Wetlands) and Section 3.8 (Fish, Aquatic Habitat, and Threatened and Endangered Fish Species). In the event that flooding occurs, equipment would need to be moved out of the floodplain.

Operational Impacts

No operational impacts are anticipated, since the roadway can be designed to avoid the floodway and structural design requirements would result in a zero rise in flood elevation.

3.10.4.3 Alternative 2: Mixed Mode with HCT/Transit Emphasis

The evaluation of Alternative 2 assumes that all of the No Action Alternative projects will be built; estimates of impacts include the No Action Alternative. Thirty-seven of the Alternative 2 projects would either enter or cross 100-year floodplains. Fourteen floodplains are either crossed or are adjacent to the projects proposed in Alternative 2. There are 41 crossings of the floodway by culverts or bridges that would be lengthened or replaced, with a potential for 48,025 linear feet of floodplain impacts. The potential impact on floodplains would be moderate.

Construction Impacts

During construction, no impacts to the floodplain storage are anticipated. There may be impacts to floodplain ecological functions. The discussion of impacts to ecological functions can be found in Sections 3.6 and 3.8. In the event that flooding occurs, equipment would need to be moved out of the floodplain.

Operational Impacts

No operational impacts are anticipated, since the roadway can be designed to avoid the floodway and structural design requirements would result in a zero rise in flood elevation.

3.10.4.4 Alternative 3: Mixed Mode Emphasis

The analysis of Alternative 3 impacts assumes that all of the No Action Alternative projects will be implemented, and estimates of the impacts include the No Action Alternative. Thirty-six of the Alternative 3 projects would either enter or cross 100-year floodplains. Fourteen floodplains are either crossed or are adjacent to the projects proposed in Alternative 3. There would be 40 crossings of the floodway by culverts or bridges that would be lengthened or replaced, with a potential for 48,125 linear feet of floodplain impacts. The potential impact on floodplains adjacent to I-405 would be similar to Alternative 2.

Construction Impacts

During construction, no impacts to the floodplain storage are anticipated. There may be impacts to floodplain ecological functions. The discussion of impacts to ecological functions can be found in Sections 3.6 and 3.8. In the event that flooding occurs, equipment would need to be moved out of the floodplain.

Operational Impacts

No operational impacts are anticipated, since the roadway can be designed to avoid the floodway and structural design requirements would result in a zero rise in flood elevation.

3.10.4.5 Alternative 4: General Capacity Emphasis

The evaluation of Alternative 4 impacts assumes that all of the No Action Alternative projects will be implemented, and estimates include the No Action Alternative. Thirty-six of the Alternative 4 projects would either enter or cross 100-year floodplains. Fourteen floodplains are either crossed or are adjacent to the projects proposed in Alternative 4. There are 41 crossings of the floodway by culverts or bridges that would be lengthened or replaced, with a potential for 39,175 linear feet of floodplain impacts. The potential impact on floodplains adjacent to I-405 would be similar to Alternative 2.

Construction Impacts

During construction, no impacts to the floodplain storage are anticipated. There may be impacts to floodplain ecological functions. The discussion of impacts to ecological functions can be found in Sections 3.6 and 3.8. In the event that flooding occurs, equipment would need to be moved out of the floodplain.

Operational Impacts

No operational impacts are anticipated, since the roadway can be designed to avoid the floodway and structural design requirements would result in a zero rise in flood elevation.

3.10.4.6 Preferred Alternative

The analysis of Preferred Alternative impacts assumes that all of the No Action Alternative projects will be implemented. Estimates of impacts for the Preferred Alternative include the effects of the No Action Alternative improvements. The Preferred Alternative is similar to Alternative 3. Approximately 43 of the Preferred Alternative projects would either enter or cross 100-year floodplains. Fourteen floodplains are either crossed or are adjacent to the improvements proposed in the Preferred Alternative. There would be approximately 45 crossings of the floodway by culverts or bridges that would be lengthened or replaced, with a potential for slightly more than 48,125 linear feet of floodplain impacts. The potential impact on floodplains adjacent to I-405 would be similar to Alternatives 2 and 3. Floodplain impacts of the Preferred Alternative are greater than those of Alternative 4 because the projects removed to create the Preferred Alternative were either condensed existing projects or were projects that did not impact floodplains. Projects added to create the Preferred Alternative were arterial projects from Alternative 4 which had a greater impact on floodplains. This results in a net increase in floodplain impacts that exceeds Alternative 4.

Construction Impacts

During construction, no impacts to the floodplain storage are anticipated. There may be impacts to floodplain ecological functions. Discussions of impacts to ecological functions can be found in Sections 3.6 and 3.8. In the event that flooding occurs, equipment would need to be moved out of the floodplain.

Operational Impacts

No operational impacts are anticipated, since the roadway can be designed to avoid the floodway and structural design requirements would result in a zero rise in flood elevation.

3.10.5 Mitigation Measures

The best type of mitigation is to limit the amount of fill in floodplains. The amount of fill in the floodplain will be limited by building walls or steep engineered fill slopes adjacent to the floodplain rather than standard fill slopes where practicable. When crossing a river, a longer bridge can be used to span the entire floodway. For a wide floodplain, the effect of the fill on the flood elevation would be analyzed. If there is a detrimental effect, a causeway-type bridge or overflow bridges will be built where practicable. If floodplain storage is lost, an equal volume will be replaced in the same floodplain by excavation, demolition of a structure, or transfer of density rights. The loss of ecological functions is usually accompanied by a loss of riparian or wetland area and will be mitigated by enhancement, restoration, or replacement. Other possible mitigation measures include widening existing bridges, increasing existing culvert sizes, or replacing existing culverts with bridges. Mitigation anywhere along the stream system, including purchase of development rights, will be considered when addressing mitigation to reduce flood flows and limit the rise in the floodplain.

All stream crossing widenings or new crossings will be designed in accordance with WSDOT *Hydraulics Manual* (WSDOT, 1997) for flow passage and the Washington Department of Fish and Wildlife (WDFW) *Fish Passage Design at Road Culverts* (WDFW, 1999) for fish passage. Compensatory storage requirements for filling of the floodway will also be met. The design and construction plans and specifications will be prepared in conjunction with biologists to reduce impacts on the natural stream bed and, when appropriate to the given project, impacts will be mitigated by placing gravel in the culverts, planting riparian trees, and using other natural features such as log weirs, boulders, and other types of woody debris. Where practicable, construction will be done during low flow periods that are least likely to harm fish and other wildlife in accordance with WDFW requirements.

Maintenance of stream crossing structures will be reduced by selecting materials with long lives and low maintenance requirements and by selecting larger sizes of culverts or bridges with more clearance. These large sizes would have less tendency to plug with floating debris or sediment deposition. When maintenance is required, it will be done during low flow and/or with the least obtrusive processes possible.

This page left intentionally blank.

3.11 SHORELINES

3.11.1 Studies and Coordination

Jurisdictional shorelines are designated as such by Washington's Shoreline Management Act (SMA) (Chapter 90.58 RCW) and are incorporated into local zoning ordinances. The shoreline impacts evaluation was conducted on the basis of whether or not proposed transportation improvements entered the shoreland, defined as the 200-foot-wide area landward from a designated shoreline. This shoreland was extended where there were associated 100-year floodplains and wetlands. Since the specific location and design of improvements would be determined during future phases of the projects, only potential encroachments on the jurisdictional shoreland were identified.

Public access to shorelines and shoreline protection, enhancement, and preservation, are important goals of the local shoreline master programs. Consequently, improvements to trails, bikeways, and other public access features are considered as having beneficial impacts. Roadways, while allowable as a beneficial public purpose, would need to incorporate design features that address the stated goals and purposes of the local shoreline master programs. The analysis assumes that when necessary, shoreline protection and preservation, public access, and habitat enhancement can be maintained or improved as part of project development.

In addition to review of maps and local zoning (sensitive areas) ordinances in study area jurisdictions, shoreline regulations and master programs were examined in order to gain an understanding of the local management of wetlands, floodplains, and jurisdictional shorelines. Local officials were also contacted in several instances.

3.11.2 Methodology

To analyze shoreline impacts of the I-405 Corridor Program, the adopted shoreline master programs for King County, Snohomish County, and the cities of Tukwila, Kent, Renton, Newcastle, Bellevue, Kirkland, Redmond, Woodinville, Bothell, and Kenmore were reviewed, and jurisdictional shorelines were mapped. Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps for King and Snohomish counties were examined to identify the associated floodways and the 100-year floodplains associated with jurisdictional streams and lakes within the study area. Critical area maps and the National Wetlands Inventory maps were also reviewed, where available, to identify potential wetland areas that could also be associated with jurisdictional shorelines. Study area floodplains and stream basins were overlaid on alternative maps. Finally, the floodplains, wetlands, and streams that were not associated with jurisdictional shorelines were removed from the maps. Locations where proposed transportation improvements, jurisdictional shorelines, associated wetlands, and the 100-year floodplain intersected were then evaluated using available information and USGS 7.5-minute topographic maps so that impacts could be qualitatively estimated.

Since revisions to some of the FEMA maps have been made since the King County database was developed, maps that were revised since 1995 were inspected to see if changes in the 100-year floodplain had been made in the study area. The most recent maps (November 8, 1999) were included in the review, and the maps showing impacts were modified accordingly.

The boundaries of floodways were assumed to represent the ordinary high water mark (OHWM) and the outer boundary of the 100-year flood plain was assumed to include all associated wetlands. For estimation of impacts, the jurisdictional shoreline boundary was considered to be 200 feet from the floodway boundary and the edge of the 100-year floodplain when it extends beyond 200 feet from the floodway boundary. The I-405 improvements that could be subject to SMA regulations are summarized by jurisdiction and alternatives in Table 3.11-1.

The analyses in this section are based on the *I-405 Corridor Program Draft Shorelines Expertise Report* (DEA, 2001), herein incorporated by reference.

3.11.3 Affected Environment

Jurisdictional shorelines within the study area are shown on Figure 3.11-1. The designated shorelines and the shoreline environment designations (in parentheses) within the study area are as follows:

King County: Lake Washington (Urban, Rural and Conservancy), Lake Sammamish (Urban and Rural), Sammamish River (Urban and Rural), Green River (Urban and Rural) Lake Desire (Rural and Conservancy), Spring Lake (Rural and Conservancy), Shadow Lake (Rural and Conservancy), Panther Lake (Rural and Conservancy), and Lake Youngs (Urban-Lake Residential).

Tukwila: Green/Duwamish River (Manufacturing/Industrial Center and Urban-Open Space).

Kent: Green River (Urban-River Resource) and Big Soos Creek (Urban-Stream Corridor).

Renton: Springbrook Creek (Conservancy and Urban – the shoreline area has a special map further defining the jurisdictional shorelands that include associated wetlands and floodplains), Black River (Conservancy), Cedar River (Conservancy and Urban), May Creek (Conservancy and Urban), and Lake Washington (Urban).

Bellevue: Bellevue has adopted a Shoreline Overlay District (no specific environment designations) for the following shorelines: Lake Washington, Mercer Slough, Phantom Lake, Lake Sammamish, and Lower Kelsey Creek.

Kirkland: Lake Washington (Suburban Residential, Urban Residential 1, Urban Residential 2, Urban Mixed 1, Urban Mixed 2, Conservancy Environment 1, and Conservancy Environment 2). There were no improvements listed that would require a shoreline permit from the City of Kirkland.

Redmond: Lake Sammamish (Urban, Conservancy, and Natural), Sammamish River (Urban and Rural), Evans Creek (Urban and Conservancy), and Bear Creek (Urban and Conservancy).

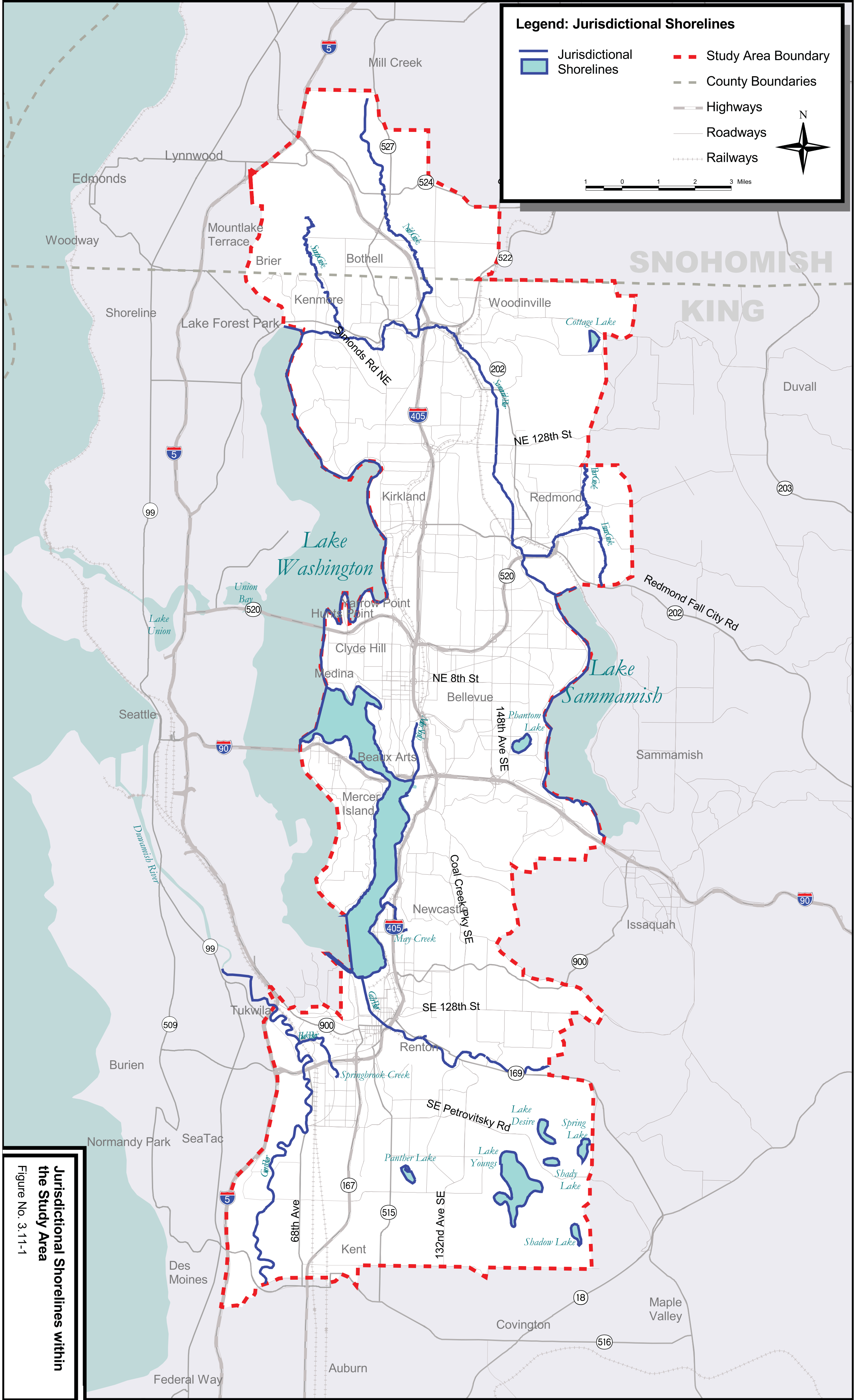
Woodinville: Sammamish River (Urban and Conservancy) and Little Bear Creek (Urban and Conservancy).

Bothell: Sammamish River (Urban, Rural, and Conservancy), and North Creek (Urban).

Kenmore: Lake Washington (Urban and Conservancy), Swamp Creek (Urban and Rural), and Sammamish River (Urban and Rural).

Snohomish County: Swamp Creek (Suburban) and North Creek (Urban).

NOTE: Newcastle: There are no designated shorelines of the state or statewide significance within the city limits.



Jurisdictional Shorelines within the Study Area

Figure No. 3.11-1

This page left intentionally blank.

Table 3.11-1: Number of Improvements Potentially Subject to Shoreline Management Act Regulatory Requirements in the Study Area

Jurisdiction	No Action Alternative	Alternative 1 High-Capacity Transit/TDM Emphasis	Alternative 2 Transit Emphasis	Alternative 3 Mixed Mode Emphasis	Alternative 4 General Capacity Emphasis	Preferred Alternative
King County	1	3	6	7	11	7
Snohomish County	1	1	2	3	5	3
Tukwila	0	3	5	7	5	7
Woodinville	4	4	8	10	11	11
Renton	2	16	19	18	17	17
Bellevue	0	6	9	7	6	7
Kirkland	0	3	4	3	4	3
Redmond	3	6	9	9	8	8
Kenmore	0	2	2	2	2	1
Kent	0	0	0	0	0	0
Bothell	2	10	16	17	20	20
Total of Projects	13	47	67	65	67	72

Note: Appendix N provides a cross reference for improvements (elements) numbers and locations. Improvements affecting multiple jurisdictions were only counted once.

Transportation improvement may be permitted either through a Shoreline Substantial Development Permit or a Shoreline Conditional Use Permit. Compliance with the regulatory framework of each jurisdiction requires avoidance, minimization, and mitigation of all the impacts to the shoreline environment. In many circumstances, increased public access opportunities are a regulatory requirement. There is only one shoreline area within the study area designated Natural. This area is at the north end of Lake Sammamish within Marymoor Park. There are no proposed improvements within this area.

3.11.4 Impacts

Proposed transportation improvements are expected to be designed so that impacts to shorelines are avoided, and minimized when avoidance is not an option.

3.11.4.1 No Action Alternative

The No Action Alternative includes 13 improvements that would affect six jurisdictional shorelines. Park-and-ride lots that are not yet sited are not analyzed here.

Construction Impacts

No substantial impacts to shorelands are anticipated during construction. Avoidance of the shoreline environment (if possible) would be investigated during project design. Potential construction impacts to the shoreline environment include filling, armoring, and disrupting existing public access points. The filling and armoring could result in a loss of near-shore environment that is important to juvenile salmonids making their way from a riverine environment to an estuarine environment. Impacts to the near-shore environment are discussed in Section 3.8, Fish and Aquatic Habitat. Filling and armoring within the shoreline environment also may result in a loss of the floodways' and floodplains' capacity to pass floodwaters. Within areas that have already been urbanized or disrupted by prior construction activities, in many instances filling and armoring of the shoreline banks may have already occurred. Impacts from improvements that may require increased filling or armoring may not be as substantial an impact (due to previous losses) when compared to impacts on non-disturbed shorelines. Meeting the regulatory requirements for shorelines would result in other impacts being avoided, minimized, or mitigated. These issues are addressed in Sections 3.5 (Water Resources), 3.6 (Wetlands), 3.8 (Fish, Aquatic Habitat, and Threatened and Endangered Fish Species), and 3.10 (Floodplains), and are not addressed in detail here.

Construction activities may cause temporary disruption at public shoreline access points, such as the Sammamish River Trail. This impact would only occur during construction. Detours around the construction activity can provide continued access, and improvements for public access may result as part of the construction project.

Operational Impacts

Operation of the proposed transportation improvements should not result in substantial adverse environmental impacts to jurisdictional shorelines. However, without the avoidance and mitigation measures discussed at the conclusion of this section, public access and habitat could be adversely affected.

3.11.4.2 Alternative 1: HCT/TDM Emphasis

Forty-seven of the Alternative 1 improvements would affect jurisdictional shorelines. Ten different jurisdictional shorelines would be either crossed or entered by these improvements.

Construction Impacts

Construction impacts are similar to those discussed for the No Action Alternative. Table 3.11-1 shows the number of improvements within each alternative that may impact jurisdictional shorelines. Assessment of any potential filling or loss of shoreline habitat will be examined at the project-level environmental analysis, documentation, and review.

Operational Impacts

Operation of the proposed transportation improvements should not result in substantial adverse environmental impacts to jurisdictional shorelines. However, without the avoidance and mitigation measures discussed at the conclusion of this section, public access and habitat could be adversely affected through alteration or removal. Avoidance measures can be incorporated into project design.

3.11.4.3 Alternative 2: Mixed Mode with HCT/Transit Emphasis

Sixty-seven of the Alternative 2 improvements would affect jurisdictional shorelines. Ten different jurisdictional shorelines would be either crossed or entered by these improvements.

Construction Impacts

Construction impacts are similar to those discussed for the No Action Alternative. Table 3.11-1 shows the number of improvements within each alternative that may impact jurisdictional shorelines. Assessment of any potential filling or loss of shoreline habitat will be examined at the project-level environmental analysis, documentation, and review.

Operational Impacts

Operation of the proposed transportation improvements should not result in substantial adverse environmental impacts to jurisdictional shorelines. However, without the avoidance and mitigation measures discussed at the conclusion of this section, public access and habitat could be adversely affected through alteration or removal. Avoidance measures can readily be incorporated into project design.

3.11.4.4 Alternative 3: Mixed Mode Emphasis

Sixty-five of the Alternative 3 improvements would affect jurisdictional shorelines. Ten different jurisdictional shorelines would be either crossed or entered by these improvements.

Construction Impacts

Construction impacts are similar to the No Action Alternative. Table 3.11-1 shows the number of improvements within each alternative that may impact jurisdictional shorelines. Assessment of any potential filling or loss of shoreline habitat will be examined at the project-level environmental analysis, documentation, and review.

Operational Impacts

Operation of the proposed transportation improvements should not result in substantial adverse environmental impacts to jurisdictional shorelines. However, without the avoidance and mitigation measures discussed at the conclusion of this section, public access and habitat could be adversely affected through alteration or removal. Avoidance measures can readily be incorporated into project design.

3.11.4.5 Alternative 4: General Capacity Emphasis

Sixty-seven of the Alternative 4 improvements would affect jurisdictional shorelines. Ten different jurisdictional shorelines would be either crossed or entered by these improvements.

Construction Impacts

Construction impacts are similar to the No Action Alternative. Table 3.11-1 shows the number of improvements within each alternative that may impact jurisdictional shorelines. Assessment of any potential filling or loss of shoreline habitat will be examined at the project-level environmental analysis, documentation, and review.

Operational Impacts

Operation of the proposed transportation improvements should not result in substantial adverse environmental impacts to jurisdictional shorelines. However, without the avoidance and mitigation measures discussed at the introduction to this section, public access and habitat could be adversely affected through alteration or removal. Avoidance measures can readily be incorporated into the project design.

3.11.4.6 Preferred Alternative

Seventy-two of the improvements contained in the Preferred Alternative would affect jurisdictional shorelines. Ten different jurisdictional shorelines would be either crossed or entered by these improvements.

Construction Impacts

Construction impacts would be similar to the No Action Alternative. Table 3.11-1 shows the number of improvements within each alternative that may impact jurisdictional shorelines. Assessment of any potential filling or loss of shoreline habitat will be examined at the project-level environmental analysis, documentation, and review.

Operational Impacts

Operation of the proposed transportation improvements should not result in substantial adverse environmental impacts to jurisdictional shorelines. However, without the avoidance and mitigation measures discussed at the conclusion of this section, public access and habitat could be adversely affected through alteration or removal. Avoidance measures can readily be incorporated into project design.

3.11.5 Mitigation Measures

Specific mitigation will be determined after individual project technical and environmental analysis, documentation, and review is completed. All jurisdictional regulations for shorelines will be complied with on a project-level basis. The following types of mitigation and avoidance measures will be incorporated into individual project planning and design as appropriate and practicable:

- Alignment of roadways to keep improvements out of the shoreline.
- Minimizing right-of-way property acquisition within the shoreline by narrowing roadway shoulders.
- Incorporating new public access, shoreline protection and preservation measures, and habitat enhancement to the shoreline (on arterial improvements) into design when mitigation measures are necessary to address substantial adverse environmental impacts from the project.
- Replacing culverts to aid in fish passage.
- Where appropriate (based on project design and project-level environmental analysis, documentation, and review), elevating HCT to allow safe access to shoreline homes and parks that are only accessible by uncontrolled, at-grade rail crossings.
- Including pedestrian and bicycle underpasses in design so that access along shorelines is maintained.
- Including shoreline protection, preservation, and habitat enhancements in project design.
- Modifying existing projects so that shoreline protection and preservation as well as public access along shorelines are improved.

Using aesthetic treatments and barriers to buffer the shoreline from visual and noise effects.

3.12 TRANSPORTATION

3.12.1 Studies and Coordination

3.12.1.1 Studies

The transportation performance of the alternatives proposed for the corridor was evaluated to assess the degree to which each package of improvements optimized the performance of the I-405 corridor. Three primary criteria were used to evaluate transportation performance in the corridor:

- **Mobility:** How well does the alternative improve mobility for travelers along I-405?
- **Congestion:** How well does the alternative reduce congestion in the corridor?
- **Safety:** Does the alternative improve safety for all travelers in the corridor?

The performance of each action alternative was compared with the conditions that would exist under the No Action Alternative in 2020. These criteria and the performance measures used to determine the performance of each alternative are shown in Table 3.12-1.

Table 3.12-1: Evaluation Criteria and Transportation Performance Measures

Evaluation Criteria and Performance Measures	Definitions
A. IMPROVE MOBILITY	
Serve as much of the 2020 peak period travel demand within the corridor as possible.	
Person Volumes	P.M. peak period person volumes by mode across 3 screenlines[a]
	Daily person volumes by mode across 3 screenlines
Vehicle Volumes	P.M. peak period traffic volumes by types of vehicles (SOVs, HOVs, and trucks) at 3 screenlines
	Daily traffic volumes by types of vehicles (SOVs, HOVs, and trucks) at 3 screenlines
	Daily traffic volumes along segments of I-405
	Daily traffic volume shifts between facilities along selected screenlines, I-405, arterials
Improve predictability of travel times for all modes.	
Predictability of Travel Time	Effects on travel time reliability by mode (auto, HOV, transit, freight, nonmotorized)
Provide flexibility to accommodate post-2020 travel demands.	
Future Flexibility	Ability of alternatives to accommodate post-2020 demands
Reduce travel times for all modes door-to-door compared with current conditions.	
Travel time	General traffic travel times (door-to-door) between selected origins and destinations during the P.M. peak period
	HOV travel times (door-to-door) between selected origins and destinations during the P.M. peak period
	Transit travel times (door-to-door) between selected origins and destinations during the P.M. peak period
Reduce the share of peak-period and daily trips by single-occupant vehicles.	
Modal Shares	Percentage of peak-period persons choosing modes of travel at 3 screenlines
	Shares of study area work trips
Transit riders	P.M. peak-period transit riders along key segments
Transportation Demand Management	Effects on non-HOV trip reduction
Provide effective connections to regional and local transportation systems.	
Compatibility with Regional Systems	Degree of compatibility with regional transportation systems

Evaluation Criteria and Performance Measures	Definitions
Compatibility with local systems	Degree of compatibility with local transportation systems
B. REDUCE CONGESTION	
Reduce congestion on study area freeways and arterials below current levels (examine peak-period and daily conditions).	
Hours of Traffic Congestion	Hours of congestion aggregated within the study area by freeway and arterial functional classification
	Hours of congestion in each segment of I-405 and arterial segments in a typical day
Vehicles Miles of Travel	Study area and region-wide daily total
Vehicle Hours of Travel	Study area and region-wide daily total
Speed	Study area
C. IMPROVE SAFETY	
Improve the safety for all modes above current levels.	
Safety	Potential for traffic accident reduction along high accident locations
	System-level effects
	Potential for improving safety for transit vehicles
	Potential for reducing conflicts between vehicles, pedestrians, and bicycles

[a] A screenline is an imaginary line that crosses a number of roadway facilities. Three screenlines were used in the study: the Bothell (north) screenline at the King County / Snohomish County line; the Bellevue (central) screenline through downtown Bellevue along NE 8th Street; and the Renton (south) screenline between SR 167 and SR 181 in Renton.

Note: HOV is defined as three or more persons in a vehicle.

These criteria were carefully selected to identify and measure changes in mobility, congestion, and safety in the corridor. The I-405 Corridor Program Study committees did not assign weights to any of the criteria. Mobility was assessed using measures that compared travel demand by mode, travel time, future flexibility, and connectivity to other regional systems. The congestion criterion measured the hours of congestion and speed on I-405 and other facilities, together with travel demand. Safety was looked at from the perspective of reducing accidents at both the high accident locations and system-wide. The key findings from the technical studies are described in this section and documented in greater detail in the *I-405 Corridor Program Draft Transportation Expertise Report* (Mirai and DEA, 2001).

3.12.1.2 Coordination

From the beginning of the I-405 Corridor Program, the Washington State Department of Transportation has worked in partnership with communities along the I-405 corridor. As a result, throughout the project decision-making process, local city staff have provided input to the study.

In addition, a number of ongoing studies, plans, and projects within the I-405 study area have varying degrees of influence on the I-405 corridor alternatives evaluated here (WSDOT and Mirai Associates, August 1999). Roadways within the project study area are included in regional plans such as King County's Regional Arterial Network (RAN), the WSDOT State Highway System Plan (SHSP), PSRC's Metropolitan Transportation Plan (MTP), Sound Transit's Regional Transit System Plan, and the Eastside Transportation Partnership. All of these plans have strong policy sections intended to shape transportation in the region. Most of the plans also include specific project implementation lists, usually segregated into funded and not funded categories. In addition, each of the fifteen incorporated cities in the primary study area has a transportation plan and policies designated for urban development and concurrency requirements. Additional discussion on plans and policies can be found in section 3.13.2.

Other sub-area and corridor studies affecting the I-405 Corridor Program area include East King County Corridor Study (CONEKC), the Trans-Lake Washington Project, the Fast Phase II Study of Truck Mobility (FASTrucks), Bellevue-Redmond-Overlake Transportation Study (BROTS), and the Eastside Transportation Partnership's Mobility Action Program (ETP). All of these projects are focused on a specific corridor or sub-area location.

The Washington State Growth Management Act (GMA) requires local jurisdictions to adopt and enforce ordinances linking approval of new development to maintenance of transportation level-of-service standards. The ordinances must prohibit development approval if the development would cause the level-of-service on a transportation facility to decline below the jurisdiction's adopted standards unless transportation improvements or strategies to accommodate the impacts of development are made concurrent with (within six years of) the development. This provision is commonly referred to as transportation "concurrency." Each of the jurisdictions within the I-405 corridor has adopted a comprehensive plan and a concurrency ordinance as required by the 1990 GMA.

The projects included in the I-405 No Action Alternative are included as committed projects in the regional and local plans.

At the beginning of the I-405 Corridor Program, one-on-one interviews were conducted with agency and jurisdictional staff. Throughout the project, the project team has collaborated with affected jurisdictions in the study area to identify reasonable and feasible solutions that support (or at least do not conflict) with their jurisdictional planning. Two workshops was held during Summer 2000 to work with jurisdictions on selecting projects for the alternatives, one covering the central corridor segment and one covering the south and north corridor segments.

During the evaluation of the EIS alternatives, the project team met on several occasions with each jurisdiction to further refine the definition of the project elements being studied. This process provided a focused list of design assumptions that were appropriate for each jurisdiction.

The final package of transportation improvements developed through the I-405 Corridor Program will be proposed for adoption into existing local, regional, state, and federal transportation plans and programs.

3.12.2 Methodologies

The future expected transportation performance of each alternative was evaluated by using established travel demand forecasting models and analysis methods as well as experience from across the United States.

The Puget Sound Regional Council (PSRC) four-county travel demand forecasting model was applied to forecast general traffic, carpool, and transit demand for transportation alternatives in the I-405 corridor. The PSRC model is multimodal and captures both regional and corridor-level trip-making. The I-405 Corridor Program used the current version of the PSRC model as updated/refined for use on the Trans-Lake Washington Study. Additional model validation was conducted prior to use at the corridor level. The model was used to develop a number of different performance measures, (such as model demand travel times between activity centers, vehicle miles of travel (VMTs), and vehicle hours of travel (VHTs).

The main differences among the alternatives were captured by changes in the highway and transit model networks. The future highway and transit networks, representing each of the alternatives, were consistent with other ongoing regional studies.

The population and employment forecasts used to produce the 2020 forecasts were the "Working Forecasts" released by the PSRC in 2000 (and consistent with those used for the Trans-Lake Washington Study). These have undergone extensive review by local jurisdictions and have been used for other transportation studies in the region at this time. Year 2030 forecasts were prepared using forecasted population and employment, parking costs, and other data from the PSRC, consistent with the update of the Metropolitan Transportation Plan (PSRC, 2000).

The transportation analyses for the DEIS alternatives and the Preferred Alternative used the most current regionally adopted travel model and forecasts available from the PSRC at the time the alternatives were identified. The DEIS modeling results and forecasts underwent extensive review by local jurisdictions and were the same forecasts used for the Trans-Lake Washington Study and other major transportation studies in the region. Following analysis of the DEIS alternatives and issuance of the I-405 Corridor Program Draft EIS, the PSRC continued its program of ongoing model refinements. These refinements related primarily to updates of base year assumptions and revisions of some land use and network data. The underlying modeling procedures remained unchanged by these routine refinements.

Model refinements that were accomplished by PSRC during the interim period between modeling of the DEIS alternatives and identification of the Preferred Alternative included the following:

- The regional travel forecasting model was updated to 1998 (compared to 1995 which had been used previously). This included bringing the transit network up to 1998 service levels.
- A new regional 2020 No Action Alternative was developed consistent with the updated 1998 base year conditions and assumptions.
- Selected land use and highway network conditions and assumptions were updated to reflect changes in local jurisdictions' plans.

These changes related primarily to the assumptions used as inputs to the travel model; there were minimal changes made to the model itself. For example, there were no changes made to the key trip generation, distribution, and mode split functions within the model.

When the Preferred Alternative was identified after receipt of comments on the DEIS, the travel assumptions and forecasts used originally for the DEIS were no longer current or available due to the model refinements completed by the PSRC discussed above. Thus, it was not reasonably possible to evaluate the Preferred Alternative's transportation performance using the same assumptions and forecasts that had been used for the DEIS. After discussions with PSRC, the decision was made to take advantage of the latest information available using the PSRC's model refinements and current forecasts to evaluate the Preferred Alternative in the Final EIS.

While the forecasts using the updated PSRC travel model are similar to those conducted during the DEIS, the model refinements made direct comparisons between the Preferred Alternative and DEIS alternatives difficult. To enable a more effective comparison between the Preferred Alternative and the DEIS alternatives, new forecasts also were prepared using the refined PSRC model for two DEIS alternatives: the No Action Alternative and Alternative 3. This set of DEIS alternatives is believed to provide the most meaningful direct comparisons to the Preferred Alternative while also approximating the range in transportation performance of the DEIS alternatives under the updated PSRC model and forecasts.

The modeling results produced two primary findings:

1. As expected, the updated model and forecasts produced system-level results that were somewhat different than the previous DEIS results due especially to the change in the base year conditions (1998 compared to 1995). Measures such as vehicle miles of travel, vehicle hours of travel, average speeds, and travel times were affected by this change. Other measures such as average trip length, mode shares, and study area person/vehicle volumes were similar between the two forecasts.
2. However, the overall relative differences between the No Action Alternative and Alternative 3 were very similar to those reported in the DEIS. A comparison of the No Action Alternative and Alternative 3 using the two modeling methods showed almost identical differences and percent changes. This suggests that the performance of all alternatives was affected similarly by the model updates. This is a logical finding given that the forecasting procedures within the updated PSRC travel model were not changed.

For example, the changes in transit and carpool mode shares for Alternative 3 compared with No Action were virtually identical. The relative differences between the Preferred Alternative and Alternative 3 results using the updated model were also very small, as would be expected given the similarities between these two alternatives.

Given that the relative differences among the DEIS alternatives and Preferred Alternative were very similar using the previous and updated models, it was unnecessary to repeat this process for each of the other DEIS action alternatives. The updated model results confirm the anticipated performance of the Preferred Alternative, and the results can be used to effectively compare the Preferred Alternative against the No Action Alternative in a manner directly comparable to the analyses documented in the DEIS.

In summary, this analytical approach using the PSRC's updated model and forecasts for the Preferred Alternative analysis took advantage of the most current ongoing regional model refinements, while also allowing meaningful comparisons to be made to the DEIS alternatives.

The travel forecasting model was also used during the DEIS process for a sensitivity test of "unconstrained demand" in the corridor. This hypothetical analysis helps to answer the question: *By what route would people travel by car within the I-405 corridor if there were no limits on available capacity or any constraints due to traffic congestion?* For this analysis, it was assumed that land use, population, and employment do not change in response to the unlimited transportation capacity. Similarly, it was assumed that the distribution of travel, the number of trips estimated to travel between point A and point B, would not change; only the travel routes would be different.

The PSRC travel forecasting model accounts for the major sources of region-wide induced travel. Induced travel can be defined as an increase in daily travel resulting from an increase in transportation capacity. Such effects are most commonly associated with the expansion of highway facilities.

The I-405 Corridor Program acknowledges that induced travel occurs in response to improvements in transportation accessibility. In fact, the forecasting conducted for the EIS analysis explicitly includes the major induced demand factors cited in published literature. Of the remaining factors, there is no clear research that documents the magnitude of those effects. Many of the research studies try to draw simple correlations between growth in travel and growth in highway capacity. This correlation does not necessarily mean that highway capacity changes cause growth in travel.

The overall effects of induced demand are expected to be limited within the I-405 study area for the following reasons:

- Growth in population and employment is expected to increase daily travel demands by over 50 percent. This growth will leave minimal available capacity to generate additional induced demand. The effects of substantial travel growth also complicate any conclusions regarding the effects of induced demand.
- Peak-period congestion levels with the Preferred Alternative are expected to improve slightly with respect to current levels. However, congestion will still persist during the prime peak hours, providing limited incentives for persons to generate additional trips or to shift travel hours.
- Growth management policies in place within the I-405 corridor will result in limited shifting of land use patterns and resulting trip-making in response to the I-405 improvements.

Given the long-term horizon for the study (i.e., 20 to 30 years), any effects of induced demand (that are not already captured) are expected to be very small in the context of overall corridor growth. In fact, such effects could be eliminated by the implementation of the corridor-level aggressive TDM program, the effects of which were not able to be explicitly modeled in the travel forecasts. The I-405 model produced substantial shifting in travel patterns and trip lengths for the action alternatives, resulting in changes to study area and regional vehicle miles of travel and vehicle hours of travel. This factor is a major component of the induced travel behavior. The modeling also captured diversion of travel between regional corridors and shifts in modes arising from changing transportation accessibility. It is important to note that the reported model results were for the entire transportation system, comprising all freeway and arterial segments within the region.

Table 3.12-2 identifies six sources of induced travel, along with an order-of-magnitude estimate of the degree of their effect on regional travel. The table also indicates how the I-405 Corridor Program has addressed each of these components. As indicated, when one takes a region-wide perspective, the major source of induced travel is the lengthening of trips. Analysts have found that the impact of highway accessibility on the number of motorized person-trips (source 3) is insignificant. The sixth source (shifts in travel route) comes into play if rerouting by travelers due to the highway improvement involves a detour that lengthens the trip distance. Table 3.12-2 shows that the I-405 forecasts have accounted for most of the important sources of potential induced travel.

A review of the planning literature shows that one source that planners usually find difficult to estimate is the effect that transportation investment may have on aggregate regional economic growth and development (sources 1 and 2 in Table 3.12-2). The I-405 Corridor Program forecasts were developed in response to adopted regional land use projections that had been approved by all of the local jurisdictions in the I-405 Corridor Program study area. Each alternative's potential effects on growth and development were evaluated by examining projected future land use based on year 2020 PSRC forecasts and comprehensive plans for jurisdictions in the study area. Land use in the corridor in the study area is guided by local comprehensive plans. The currently adopted comprehensive plans and land use were assumed for all alternatives. The State of Washington has strong growth management policies calling for concurrency of adequate transportation facilities for new development that increases trips on the transportation system. The other induced travel component often cited is new, or additional, trips that might be generated by households or other uses in response to improved transportation accessibility. The I-405 corridor program did not directly model this effect (often termed trip frequency), although the forecasts used the results of regularly-conducted household surveys that are used to update regional trip generation rates. Limited research on this topic (DeCorla-Souza, 2000; Dowling Associates, 1994) indicates that these effects are likely to be small. The issues surrounding these components along with an extensive discussion of induced travel are included in the *I-405 Corridor Program Draft Transportation Expertise Report* (Mirai and DEA, 2001) herein incorporated by reference.

Table 3.12-2: Sources of Induced Travel

Source of Induced Travel	Published Literature	I-405 Forecasts	Magnitude of Expected Effect[c]
1. Increase in residential development, i.e., person-trip production (P) related to new development	YES	NO[a]	Low to none
2. Increase in non-residential development, i.e., person-trip attraction (A) related to new development	YES	NO[a]	Low to none
3. Increase in number of daily motorized person-trip Ps and A's per development unit	YES	NO[b]	Very low
4. Increase in average motorized person-trip distance due to origin/destination changes	YES	YES	High
5. Increase in share of person travel by private motorized vehicles	YES	YES	Low to moderate
6. Shift in vehicle travel to improved facilities from unimproved facilities within a corridor, or through an improved corridor due to diversion of traffic from other corridors	YES	YES	Low to moderate

[a] Secondary and cumulative effects of the alternatives on land use patterns were analyzed using the PSRC land use allocation model, as documented in Section 3.23. These effects were not substantial enough to justify rerunning the regional travel forecasting model.

[b] Specific data to support these changes were not available. The PSRC regularly conducts household surveys to update trip generation rates that account for changing accessibility within the region.

[c] DeCorla-Souza. "Induced Highway Travel: Transportation Policy Implications for Congested Metropolitan Areas." p.18.

3.12.3 Affected Environment

This section summarizes transportation facilities in the I-405 corridor. A discussion of various travel modes in the study area and recent data profiles of traffic conditions along the corridor were summarized in Chapter 1, Purpose and Need for Action. More detail is provided in the *I-405 Corridor Program Draft Transportation Expertise Report* (Mirai and DEA, 2001).

3.12.3.1 Roadway Network

I-405 Facility

I-405 is the region's dominant travel corridor east of Lake Washington. Originally built as a bypass around Seattle, I-405 is now the roadway of choice for most north-south trips for the Eastside. More than two-thirds of the total trips on I-405 begin and end in the corridor itself. The remaining third have strong ties with the communities along SR 167 to the south of the study area, and with developing areas to the east within the urban growth area of King County.

The roadway network within the I-405 study area reflects local geography and the development patterns that have occurred over the years. The relatively sparse roadway network in the I-405 study area creates the demand for the higher capacity state highways (e.g., I-405, I-90, SR 520, SR 522) to frequently serve as the principal means of transportation, even for non-regional trips. Other major arterials have also become heavily congested as the area's population and employment has grown.

Interstate 405 is the transportation backbone of the primary study area, beginning at I-5 in Tukwila and ending in the north at I-5 outside Lynnwood. It is the designated military route through Seattle, since Interstate 5 was deemed too constricted. I-405 varies from six to ten lanes along the 30-mile corridor. The section of I-405 from I-5 in Tukwila to I-90 includes two general purpose lanes and an HOV lane in each direction with 4- to 10-foot shoulders. The next section from I-90 to SR 522 in Bothell has three general purpose lanes and an HOV lane in each direction except for the northbound direction between SR 520 and NE 70th, where it has an additional climbing lane. On the section north of SR 522, I-405 has two general purpose lanes in each direction and an HOV lane in each direction.

There are 25 interchanges on I-405, including the connections with I-5. Under Sound Move, Sound Transit has plans and funding to provide three direct-access connections from the center roadway HOV lanes at Bellevue (1), Kirkland (1), and Renton (1).

Supporting Roadway Network Characteristics

The I-405 corridor includes a considerable number of arterial streets maintained by local jurisdictions including Bellevue, Kirkland, Redmond, Renton, Newcastle, Tukwila, Woodinville, and Bothell. The overall Eastside arterial street network is not very dense. This provides fewer lanes to carry general purpose traffic and transit. In addition, much of the adjacent arterial system is discontinuous because of topography and development patterns. I-405 currently carries a large number of non-regional trips, while traffic congestion on arterial streets remains severe.

The roadway network supporting I-405 consists of freeways and surface streets intersecting with or paralleling I-405. Nine state highways connect with I-405 along its length: SR 167, SR 169, SR 181, SR 900 (Sunset and Park interchanges), I-90, SR 520, SR 908, SR 522, and SR 527. At the north end of the study area, I-405 becomes SR 525 in Lynnwood, while at the south end SR 518 is the extension heading west towards SeaTac and Burien. Two other state highways (SR 515 and SR 524) cross but do not connect with I-405. Another highway in the primary study area, SR 202, parallels I-405 between SR 520 and SR 522. Major local arterials include: Woodinville-Duvall Road, Bellevue-Redmond Road, Petrovitsky Road, Richards Road, 148th Ave. NE, and Coal Creek Parkway.

3.12.3.2 Transit Providers

Transit service in the study area is currently provided by King County, Sound Transit, and Community Transit. King County currently provides local service between and within Eastside communities and provides express service between major urban centers. Community Transit provides express service between urban centers in Snohomish County and the Eastside. Sound Transit began express service between selected urban centers in Fall 1999; as of September 2001, 17 of 19 route commitments from Sound Move are operational. Sound Transit's Regional Express is currently in the planning and early design stages of new park-and-ride lots, transit centers, and direct access ramps, including large-scale improvements to several I-405 interchanges. Historically, King County services primarily served downtown Seattle, the University of Washington, and downtown Bellevue. This is a hub and spoke system based primarily on these three activity centers, with downtown Seattle being predominant. Bus service for the I-405 study area is now beginning to serve multiple activity centers. This type of service concept will greatly increase the convenience of making trips between Eastside activity centers as opposed to focusing on select hubs. King County's and Sound Transit's current planning efforts are being developed around this regional transit service concept.

Park-and-Ride Lots

King County, Sound Transit, and Community Transit serve park-and-ride lots located in the study area. There are 26 permanent park-and-ride lots and 32 leased park-and-ride lots in the primary study area, most of which are located in King County. The total number of available park-and-ride spaces is 10,200, 84 percent of which are in the permanent lots. Although the average utilization among the permanent lots is 84 percent, the parking demand for many of the permanent lots exceeds 100 percent. The lots currently experiencing more than 100 percent utilization are Bothell, Brick Yard, Eastgate, Evergreen Point, Mercer Island, South Bellevue, Wilburton, Kent/Des Moines, South Renton, Tukwila, and Renton Boeing Lot 6. The average utilization of the leased lots is 55 percent. Many of those leased lots are relatively small, with fewer than 50 available parking spaces.

Non-Motorized Facilities

The bicycle and pedestrian facilities in the study area include dedicated trails, sidewalks, and bike lanes. Long commute trips by nonmotorized modes can be problematic due to the lack of north-south arterials, topography, and transportation infrastructure like highways and cul-de-sacs. However, walking and bicycling accounts for up to 5 percent of total daily trips in the study area. To accommodate the bicycling demand, King County's entire bus fleet is equipped with bicycle racks that can carry two bicycles. King County estimates that their buses transport 465,000 bikes a year. Another program King County and Community Transit offer combines biking with transit by providing bike racks and lockers at park-and-ride lots and transit centers.

There is no existing document or data on pedestrian and bicycle deficiencies area-wide. However, discussions with King County bicycle and pedestrian planners have identified that I-405 itself is often a major impediment to nonmotorized connectivity.

3.12.4 Impacts

3.12.4.1 No Action Alternative

The No Action Alternative includes the funded highway and transit capital improvement projects of cities, counties, Sound Transit, and WSDOT. These projects are already in the pipeline for implementation within the next six years, and are assumed to occur regardless of the outcome of the I-405 Corridor Program.

Construction Impacts

The No Action Alternative involves no additional construction beyond what is planned and committed within the corridor. Beside the usual and customary detours and other construction mitigation set for these projects, no additional traffic impacts are expected.

Operational Impacts

Transportation Operational Impacts are defined with respect to three categories of criteria:

1. Mobility Impacts: Travel demand by mode, travel times, compatibility
2. Congestion Impacts: Hours of congestion, system performance
3. Safety Impacts: High Accident Locations; Accident Rates

The key findings from the technical studies are summarized in Table 3.12-3. Extensive detail is provided in the *I-405 Corridor Program Draft Transportation Expertise Report* (Mirai and DEA, 2001.

This page left intentionally blank.

Table 3.12-3: Results of Transportation Performance Analyses

Evaluation Criteria Performance Measures	Alternatives						
	1995 (Reference)	2020 No Action	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Preferred Alternative[e]
A. IMPROVE MOBILITY							
Serve as much of the 2020 peak period travel demand within the corridor as possible							
Person Volumes by Mode across 3 Screenlines							
P.M. Peak Period	See Figures 3.12-1A, 3.12-1B, and 3.12-1C; Appendix I, Table 1						Figures 3.12-4A, 3.12-4B, 3.12-4C
Daily	Appendix I, Table 2; Patterns similar to Peak Period volumes						Appendix I, Table 6
Vehicle Volumes by Types of Vehicles							
P.M. Peak (Avg)	Appendix I, Table 3; Patterns similar to Person Volumes						I-405 Corridor Program Draft Transportation Expertise Report Appendix H
Daily (Avg)	Appendix I, Table 4; Patterns similar to Person Volumes						Appendix I, Table 7
Daily Traffic along Segments of I-405, by Segment	See Fig 3.12-2; Appendix I, Table 5	See Fig 3.12-2; Appendix I, Table 5	Appendix I, Table 5				Figure 3.12-5, Appendix I, Table 8
Daily Volume Shifts between Facilities	Refer to text for discussion; Alternatives 3, 4, and the Preferred Alternative shift traffic from other corridors (e.g., I-5) as freeway capacity is added.						
Improve predictability of travel times for all modes							
Effects on Travel Time Reliability by Mode	Not Applicable	Qualitative Assessment- Refer to text					
Provide flexibility to accommodate past 2020 travel demands							
Future Flexibility- Ability of Alternatives to Accommodate Post-2020 Demands	Not Applicable	Qualitative Assessment- Refer to text					
Reduce travel times for all modes door-to-door compared with current conditions							
Travel Time - Avg of Sample Trips, in Minutes P.M. Peak Hour							
General Traffic	49	64	64	60	57	55	Table 3.12-13

Evaluation Criteria Performance Measures	Alternatives						
	1995 (Reference)	**2020 No Action**	**Alt. 1**	**Alt. 2**	**Alt. 3**	**Alt. 4**	**Preferred Alternative[e]**
HOV	40	48	43	43	43	43	Table 3.12-14
Transit (Walk & Ride/ Park-and-Ride Access)	102/91	102/93	85/79	85/80	89/81	98/89	Table 3.12-15 Table 3.12-16
Reduce the share of peak period and daily trips by single-occupant vehicles							
Modal Shares							
Peak Period (SOV + HOV 2/HOV 3+/Transit %) [a]	Refer to Figures 4-12 through 4-14 in I-405 Corridor Program Draft Transportation Expertise Report (Mirai and DEA, 2001); Appendix I, Table 1						Updated March 2002
Bothell [a] (%)	85/14/1	76/23/1	75/23/2	76/22/2	78/20/2	78/20/2	79/20/1
Bellevue [a] (%)	84/15/1	72/25/3	69/24/7	71/22/7	72/23/5	75/23/2	73/23/14
Renton [a] (%)	81/17/2	67/31/2	66/31/3	69/28/3	72/25/3	72/27/1	73/24/2
Shares of Study Area Work Trips (SOV + HOV 2/HOV 3+/Transit %)	Not Estimated	74/19/7	73/19/8	73/19/8	73/19/8	74/19/7	Similar to Alt. 3
Transit Riders Along Key Segments	Not estimated	Not estimated	Figure 3-12.3	Same as Alt 1	Appendix I, Fig 2	Not estimated	Appendix I Figure 3
TDM Effects: Non-HOV trip Reduction in % VMT (A.M./P.M.)	10-15/7-10	10-15/7-10	18-21 [b] Both peaks	10-15/7-10	10-15/7-10	10-15/7-10	10-15/7-10
Provide Effective Connections to Regional and Local Transportation Systems							
Compatibility with Regional Systems	Not applicable		Qualitative Assessment- Refer to text				
Compatibility with Local Systems	Not applicable		Qualitative Assessment- Refer to text				
B. REDUCE CONGESTION							
Reduce Congestion On Study Area Freeways And Arterials Below Current Levels							
Hours of Traffic Congestion (1999)							
I-405 Average	7	7	7	6	5	4	4
Other Freeways	3	5	5	4	4	3	4
Arterials	3	5	5	4	4	4	4
All Facilities Average	4	5	5	5	4	4	4
Vehicle Miles of Travel -- Daily, in Millions of Miles							
Region	69	101	101	102	102	103	104

Evaluation Criteria Performance Measures	Alternatives					
	1995 (Reference)	2020 No Action	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Preferred Alternative[e]
Study Area (for trips taken wholly within study area only)	16	23	23	24	25	26	27
Vehicle Hours of Travel -- Daily, in Millions of Hours							
Region	2.3	4.0	3.9	3.9	3.9	3.9	3.4
Study Area (for trips taken wholly within study area only)	0.6	1.2	1.2	1.2	1.2	1.2	0.9
Average Speed in Study Area, (A.M./P.M./Daily) mph	30/24/28	26/13/19	26/13/19	27/13/21	28/14/22	29/14/22	34/26/31
C. IMPROVE SAFETY							
Safety[c]							
Fatalities (total annual)	40[d]	56	55	55	54	53	51
High Accident Location Accident Reduction % (State Routes/Local Streets)	NA	15%/6%	32%/9%	60%/19%	60%/19%	62%/19%	62%/19%
System Level Effects (total accident rate/injury rate – per million VMT)	1.9/1.1	2.1/1.3	2.1/1.3	1.9/1.1	1.8/1.0	1.8/1.0	1.7/1.0
System Level Effects (total annual accidents – per million VMT)	10,060	13,900	13,840	13,840	13,640	13,310	13,860
Nonmotorized Safety Hazard Reductions	Not applicable	0%	53%	53%	53%	47%	53%

a Does not include TDM Effects
b Alt 1 includes Congestion Pricing
c Reduction in Mode Conflicts – This measure was originally part of the safety evaluation criteria. Sufficient data were not available on transit technologies and other project details to evaluate this criterion as part of the programmatic EIS.
d Year of reference is 1999.
e Forecasts for Preferred Alternative used an updated modeling base. Refer to text for modifications. Results may not be directly comparable with other action alternatives.

This page intentionally left blank.

Mobility Impacts

To measure how much mobility would be improved in the corridor by the No Action Alternative, answers were sought for the following questions:

1. How well does the alternative meet the 2020 peak-period travel demand in the corridor?
    - What happens to the daily person volumes and P.M. peak-period volumes by mode?
    - What is the effect on vehicle volumes (daily traffic volume shifts between freeways and arterials, changes in traffic volume for daily and P.M. peak periods)?
2. Does this alternative improve the predictability of travel time for the modes of travel?
3. Can this alternative accommodate increases in volume (in all modes) beyond 2020 (the study planning horizon)?
4. Do the travel times improve for the modes in this alternative compared to current conditions (1995)?
5. Does the alternative reduce the number of single-occupant vehicles (SOVs) on I-405 and, as a result, do the improvements and strategies reduce the SOV share of the daily and peak-period trips?
6. How compatible is the alternative with the regional and local transportation systems? Do local and regional plans and policies support the alternative?

Freight impacts were measured for improving mobility (serving future volumes, improving travel time, providing system connections), reducing congestion, and improving safety.

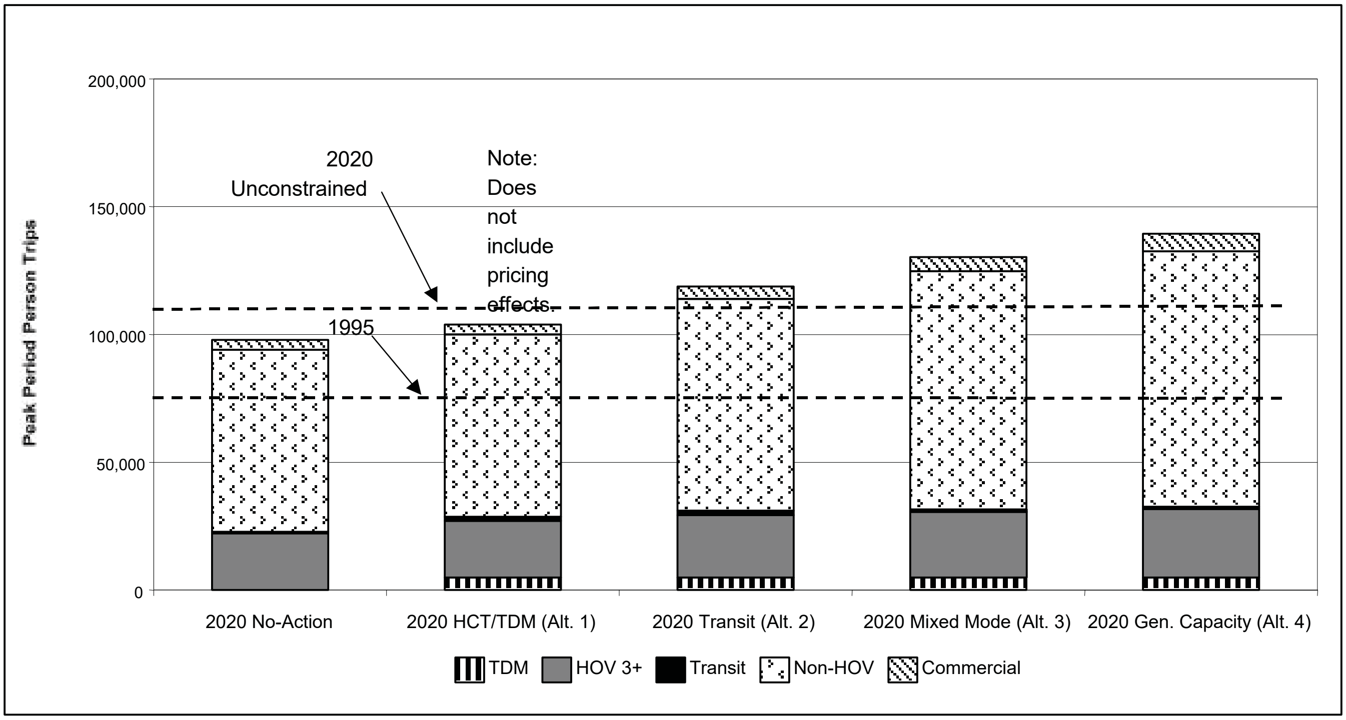
Criterion: Serve as Much of the 2020 Peak Period Travel Demand within the Corridor as Possible

P.M. Peak and Daily Period Person Volumes by Mode Across 3 Screenlines

Person volumes were summarized at three screenline locations: Bothell (north) at the King County/Snohomish County line; Bellevue (central) through downtown Bellevue along NE 8th Street; and Renton (south) between SR 167 and SR 181. On average, the No Action peak person demand at the screenlines is 34 percent higher than the 1995 base conditions as shown in Figures 3.12-1A, 3.12-1B, and 3.12-1C. This demand is consistent with growth expectations within the study area. The trend in daily person-trips is similar to the peak period.

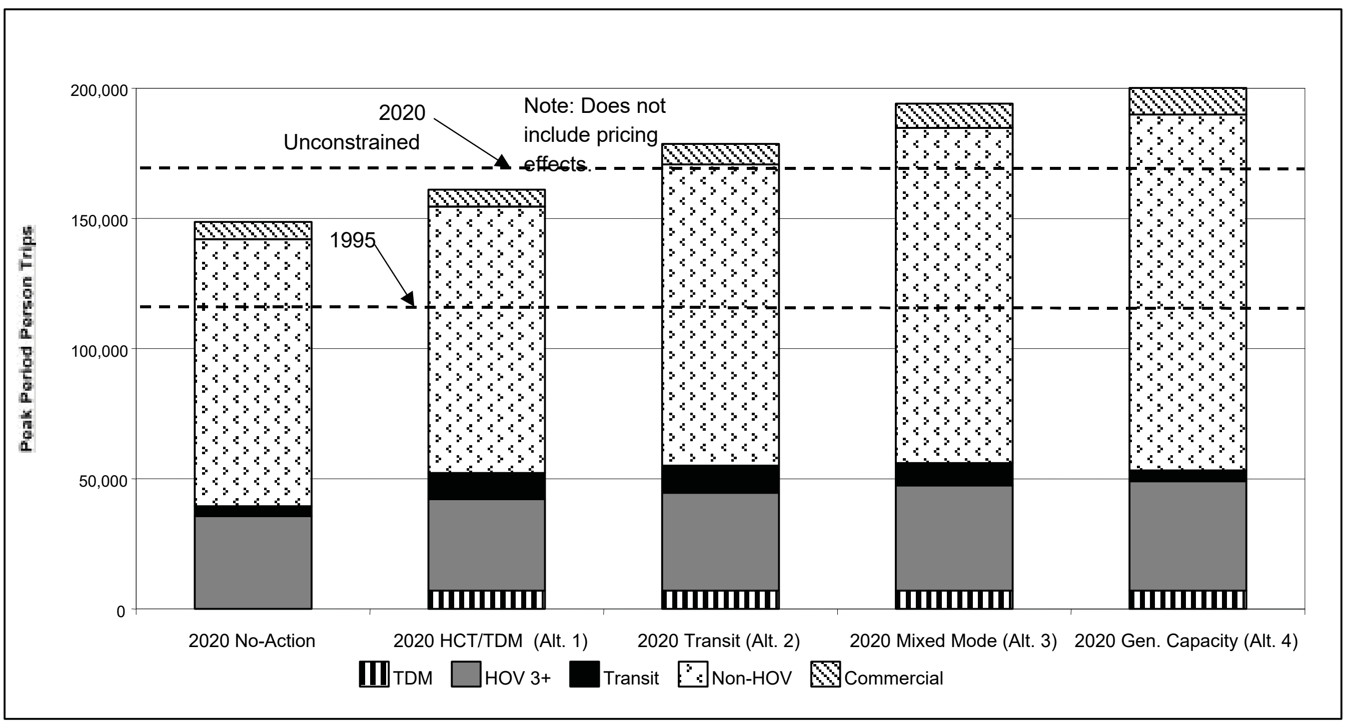
Appendix I contains additional daily vehicle volumes for 30 screenlines throughout the study area. Relative trends in peak-period and person trips can be inferred from these data.

Figure 3.12-1A: Peak Period Person Demand by Mode: Bothell Screenline



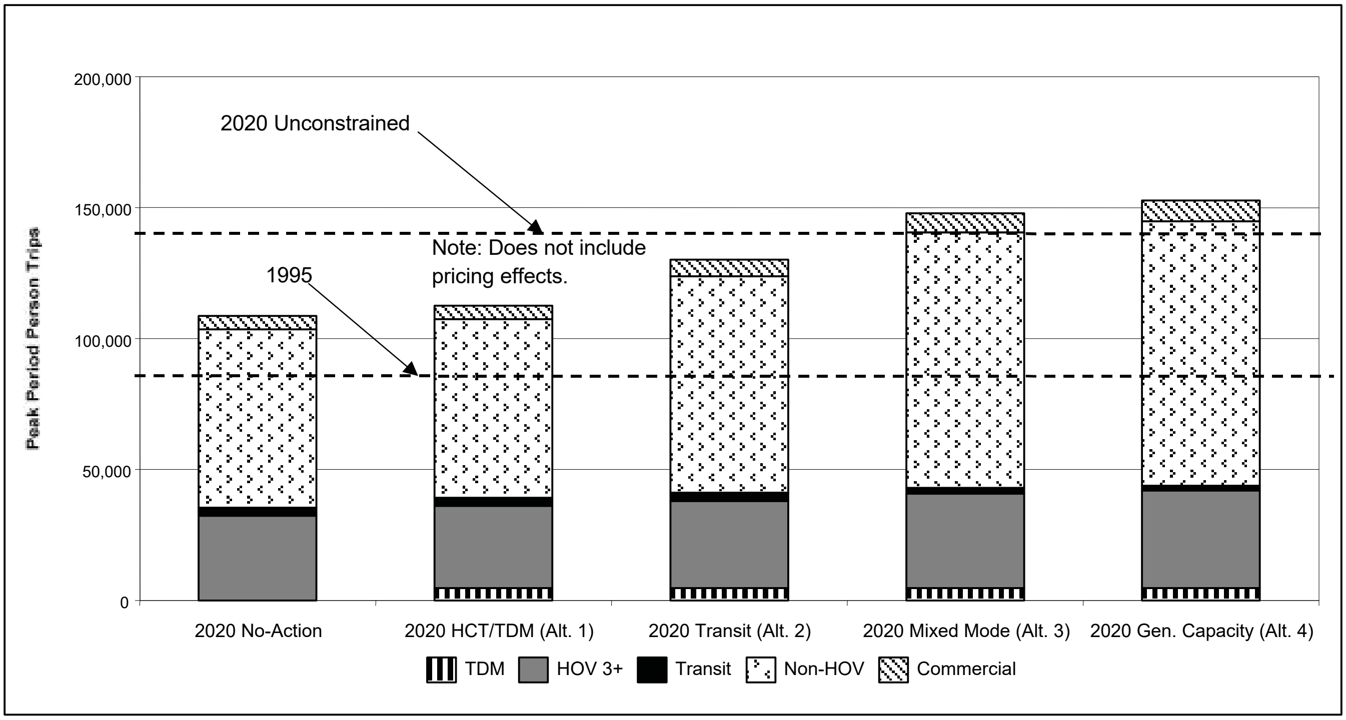
Source: PSRC Model, Parsons Brinckerhoff

Figure 3.12-1B: Peak Period Person Demand by Mode: Bellevue Screenline



Source: PSRC Model, Parsons Brinckerhoff

Figure 3.12-1C: Peak Period Person Demand by Mode: Renton Screenline



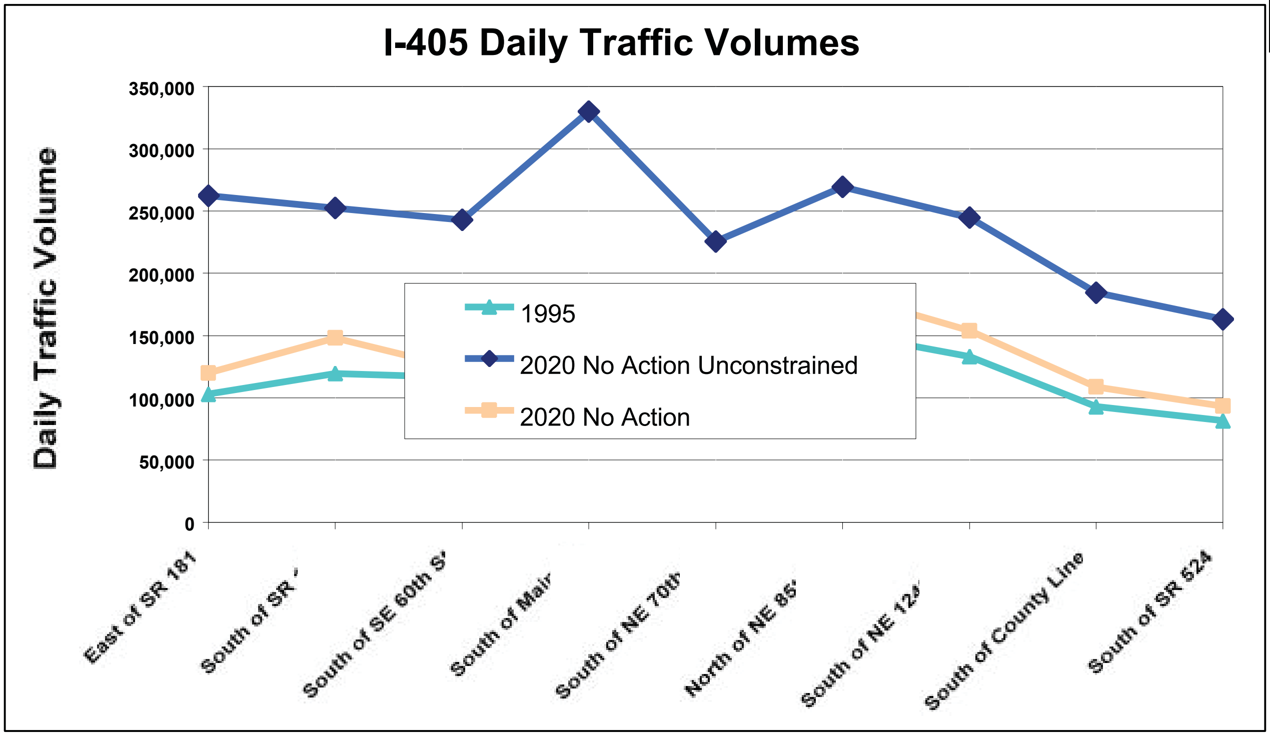
Source: PSRC Model, Parsons Brinckerhoff

Daily and P.M. Peak Period Traffic Volumes by Types of Vehicles (SOVs, HOVs, and Trucks)

On average across these screenlines, peak vehicle demand is 21 percent higher than the 1995 base conditions. This demand is lower than the person demand, reflecting increases in carpooling and transit usage by 2020 due to the general worsening of congestion and the relative travel time advantages of the HOV lanes on major freeways.

The No Action Alternative accommodates lower levels of person demand than any of the action alternatives. Daily traffic volumes along I-405 are shown in Figure 3.12-2. The No Action Alternative volumes are only about 10 percent higher than the 1995 volumes due to the limited spare capacity available on the existing freeway; much of the demand occurs on parallel arterials instead of on I-405. During peak periods, I-405 cannot absorb much more demand; as a result, there is a growing spillover of demand to the parallel arterials.

Figure 3.12-2: I-405 Daily Traffic Volumes at Selected Locations



Note: Data are derived from the PSRC Travel Model and are intended for comparative use only. These freeway data have not been adjusted to match current I-405 volumes, but show similar volume trends throughout the corridor.

Source: PSRC Model

Daily Traffic Volume Shifts Between Facilities

Each alternative was examined with respect to potential shifts in travel patterns between facilities. Vehicular and person volume increases are due to two primary factors: (1) travel demand shifts from heavily congested roadways inside and outside the study area, and (2) changes in travel mobility within the study area that result in different trip patterns and longer trips being made. Traffic shifts onto I-405 were found to come from the I-5 and SR 99 corridor, from East King County, and shifts of trip patterns within the study area. The No Action Alternative provides the baseline for comparison of travel demands among the action alternatives.

The effects of other induced demand are expected to be minimal for the No Action Alternative. However, a test was made to determine whether the land use patterns assumed in the PSRC model would be affected if no additional transportation infrastructure were provided. Section 3.13 (Land Use) documents the results of this analysis, which showed that the overall effects on expected development patterns under the No Action Alternative were small at the regional level.

Criterion: Improve Reliability of Travel Times for All Modes

The reliability of travel time is influenced by the system's ability to move vehicles under various conditions. When more vehicles enter into a transportation network than the capacity provides, the system becomes unstable and slowdowns occur. Fluctuating volumes are most often caused by increased commuter travel demand, weekday volume fluctuations, seasonal volume variations, and special events.

When a system is operating in unstable conditions, heavy rain, accidents, vehicle breakdowns, and other incidents easily disrupt the flow of traffic and cause major delays. Additionally, if the system is not designed to manage such incidents with adequate shoulder widths, sight distances, and other such design features, delays can become more severe and travel times become highly unpredictable. Reliability can also be affected by the presence of redundant facilities in the transportation system. A network of interconnected roadway or transit facilities provides better reliability than a system that emphasizes the use of a limited number of facilities.

Travel time reliability for non-SOV modes such as carpools and transit is the same as the general purpose as long as those vehicles travel with SOVs in mixed conditions. However, when HOV modes are provided with exclusive right-of-way, they can travel in a highly predicable manner.

Overall, under the No Action Alternative, the reliability of travel times would degrade and become much worse than the existing conditions in 1995. The duration of traffic congestion would increase from 4.5 to 5.8 hours a day, spreading beyond the traditional peak periods, and worsening the reliability of travel times. Sections of the existing facilities that do not meet current design standards would not be improved. Similarly, 2-person carpools and transit vehicles would be caught in the growing congestion outside of the 2020 HOV (3+) system.

Criterion: Provide Flexibility to Accommodate Post-2020 Travel Demands

This criterion was measured by looking at the future flexibility of each alternative to accommodate travel demands beyond the year 2020. The issue was addressed from two perspectives: How much system capacity is remaining beyond 2020? Is there potential for the system to adapt to changing needs and conditions?

Comparing the 2020 travel demands, by mode, to the capacity provided by an alternative allowed a qualitative assessment of the remaining capacity available for future growth beyond 2020. In addition, the design and operation of each alternative was examined to provide a qualitative assessment of its ability to be expanded and to adapt to technologies that could be implemented during the next 20 years or beyond.

Additional travel forecasts to the year 2030 were conducted to assist in this analysis. The 2030 forecasts follow a consistent growth trend that was projected from 1995 to 2020, resulting in around a 10 percent increase in regional trips from 2020 to 2030. Within the study area, daily travel on the street system would increase from 5 to 15 percent depending upon the specific location.

The No Action Alternative would have minimal available capacity for travel growth remaining after 2020. By 2030, daily traffic volumes on I-405 are forecasted to increase by only 5 percent over 2020. However, the volumes on the already congested arterials would continue to increase at a faster rate than I-405, as they carry the growing spillover traffic from I-405.

The No Action Alternative contains facilities and programs that are extensions of existing conditions. There are few unique features that would provide potential for adapting to new technologies or designs. The No Action Alternative does include several applications of intelligent transportation systems (ITS) that would continue to maximize the efficiency of the current system.

Criterion: Reduce Travel Times for All Modes Door-to-Door Compared with Current Conditions

This criterion is applied to measure the door-to-door travel time for selected origins and destination trips during the P.M. peak period for three types of trips: general traffic (including 2-person carpools), HOVs (carpool 3+ and vanpool), and transit. The study selected six trips that represent a wide range of typical travels mostly using the facilities in the study area. The 2020 travel times of these six trips for the P.M. peak hour under the No Action Alternative are compared with the 1995 conditions. Table 3.12-4 shows the travel times for general traffic in 1995, No Action, and four action alternatives. Table 3.12-5 shows HOV travel times. In Tables 3.12-6 and 3.12-7, the transit travel times are analyzed by the two types of access to transit service — walk-and-ride and park-and-ride.

Table 3.12-4: General Traffic P.M. Peak Travel Time Comparisons Between Existing (1995), No Action Alternative, and Action Alternatives

Trips	General Traffic[a] Travel Time (Minutes)										
	1995	2020 No Action	Change from 1995	Alt 1	Change from NA[b]	Alt 2	Change from NA[b]	Alt 3	Change from NA[b]	Alt 4	Change from NA[b]
Bellevue CBD to Federal Way/Kent	56	79	+23	79	0	72	-7	67	-12	65	-14
Renton to Mill Creek	65	84	+19	84	0	78	-6	73	-12	71	-14
Bellevue CBD to Edmonds/Lynnwood	42	55	+13	55	0	50	-5	46	-9	45	-11
Tukwila/Sea-Tac to Redmond/Overlake	49	61	+13	61	0	57	-4	53	-8	52	-10
Issaquah/Cougar Mtn. To Bothell/Kenmore	46	62	+15	62	0	58	-4	55	-7	54	-8
Issaquah/Cougar Mtn. to Federal Way/Kent	56	74	+19	74	0	70	-5	68	-7	67	-8

[a] Single occupant vehicles, 2-person carpools, trucks
[b] Change compared to No Action Alternative
Source: Puget Sound Regional Council (PSRC) Model

Table 3.12-5: HOV Traffic P.M. Peak Travel Time Comparisons

Trips	HOV 3+ Travel Time (Minutes)										
	1995	2020 No Action	Change from 1995	Alt 1	Change from NA[a]	Alt 2	Change from NA[a]	Alt 3	Change from NA[a]	Alt 4	Change from NA[a]
Bellevue CBD to Federal Way/Kent	40	42	+3	41	0	41	-2	41	-2	41	-1
Renton to Mill Creek	49	51	+2	50	0	50	-1	50	-1	50	0
Bellevue CBD to Edmonds/Lynnwood	38	36	+1	36	0	36	0	36	-4	37	0
Tukwila/Sea-Tac to Redmond/Overlake	39	42	+3	42	0	42	-1	42	-1	42	0
Issaquah/Cougar Mtn. To Bothell/Kenmore	39	45	+6	45	0	45	0	45	-1	45	-1
Issaquah/Cougar Mtn. To Federal Way/Kent	47	51	+5	50	-1	50	0	50	-1	51	-1

[a] Change compared to No Action Alternative
Source: Puget Sound Regional Council (PSRC) Model

Table 3.12-6: Transit P.M. Peak Period Travel Time Comparisons for Walk-and-Ride

Trips	Transit Travel Time with Walk-and-Ride Access (Minutes)										
	1995	2020 No Action	Diff from 1995	Alt 1	Diff from NA[a]	Alt 2	Diff from NA[a]	Alt 3	Diff from NA[a]	Alt 4	Diff from NA[a]
Bellevue CBD to Federal Way/Kent	95	95	0	77	-17	77	-18	82	-12	92	-2
Renton to Mill Creek	125	126	+1	99	-27	99	-27	109	-17	117	-9
Bellevue CBD to Edmonds/Lynnwood	85	84	-1	77	-7	77	-7	80	-4	79	-4
Tukwila/Sea-Tac to Redmond/Overlake	116	116	0	86	-30	85	-31	88	-27	112	-3
Issaquah/Cougar Mtn. To Bothell/Kenmore	108	114	+6	100	-14	100	-14	99	-15	107	-7
Issaquah/Cougar Mtn. To Federal Way/Kent	132	130	-2	108	-22	108	-22	116	-14	125	-5

[a] Change compared to No Action Alternative
Source: PSRC Model

Table 3.12-7: Transit P.M. Peak Period Travel Time Comparisons for Park-and-Ride

Trips	Transit Travel Time with Park-and-Ride Access (Minutes)										
	1995	2020 No Action	Diff from 1995	Alt 1	Diff from NA[a]	Alt 2	Diff from NA[a]	Alt 3	Diff from NA[a]	Alt 4	Diff from NA[a]
Bellevue CBD to Federal Way/Kent	83	85	+2	69	-16	68	-17	73	-12	83	-2
Renton to Mill Creek	105	112	+7	90	-22	89	-23	95	-17	104	-8
Bellevue CBD to Edmonds/Lynnwood	76	73	-3	67	-6	67	-6	67	-6	68	-5
Tukwila/Sea-Tac to Redmond/Overlake	103	102	-1	78	-24	78	-24	83	-19	101	-1
Issaquah/Cougar Mtn. To Bothell/Kenmore	98	104	+6	93	-11	92	-12	91	-13	98	-6
Issaquah/Cougar Mtn. To Federal Way/Kent	118	119	+1	101	-18	101	-18	107	-12	114	-5

[a] Change compared to No Action Alternative
Source: PSRC Model

The resulting analyses for the No Action Alternative showed the following results:

General Traffic.

Minimal new general traffic capacity is added to the transportation system. As a result, the travelers of all of the six trips would take much longer in 2020 than current conditions. The additional delays would be substantial, in the range of 13 to 19 minutes more than the current conditions. Overall, the 2020 travel times would be 25 to 40 percent slower than current trip times.

HOVs.

The 2020 travel times for HOVs for those six trips would be similar to the 1995 travel times.

Transit.

As is the case for the HOV trips, the 2020 No Action Alternative transit travel times would change little compared with the existing travel times. Transit travel times remain considerably higher than general traffic times for comparable trips.

Freight.

From a freight mobility perspective, the No Action alternative addresses few of the criteria. Committed improvements include the SB to SB ramp at I-405/SR 167, the Coal Creek interchange, and a few arterial improvements. It provides little relief for the problems affecting freight movement in the corridor.

Criterion: Reduce the Share of Peak Period and Daily Trips by Single-Occupant Vehicles

This criterion looked at the percentage of P.M. peak period trips by mode (HOV 3+ and transit) at three screenlines located in Bothell, Bellevue, and Renton (Figures 3.12-1A, 3.12-1B, and 3.12-1C). The pedestrian and bicycle mode was not estimated. In 2020, the regional HOV occupancy policy is assumed be HOV 3+ and is built into the PSRC travel forecasts used in these analyses for all HOV facilities.

Using the HOV 3+ definition, there would be a considerable increase in HOVs by 2020. HOV 3+ usage in the HOV lanes would range from 24 percent in Bothell, to 25 percent in Bellevue, to 32 percent in Renton. In addition, 2-person carpools (HOV 2+) would continue to comprise 10 to 20 percent of the total screenline person demand even though these vehicles would no longer be able to use the HOV lanes. Many of these carpools are expected to be for non-work purposes (e.g., shopping, recreation).

Transit usage increases are small for all three screenlines. The largest increase is at the Bellevue screenline, where peak-period usage increases from 1 percent to 3 percent in 2020; Renton stays in the 2 percent range, while Bothell remains less than 1 percent of the P.M. peak-period person-trips.

High-capacity transit (HCT) is not included in the No Action Alternative.

Criterion: Provide Effective Connections to Regional and Local Transportation Systems

There are two measures under this criterion: 1) the compatibility of the improvement package with the regional transportation systems, and 2) compatibility with local transportation systems. The regional transportation system refers to connections to the regional freeway network. I-405 is connected at the following interchanges to other regional facilities: I-5 (Sea-Tac); SR 167 (Renton); I-90 (Bellevue); SR 520 (Bellevue); and I-5 in the vicinity of Lynnwood.

The No Action Alternative assumes that the existing conditions of the HOV lane system would continue into the future. The existing I-405 facilities are not effectively connected with the regional transportation systems for both general_purpose and HOV traffic. Given that travel demands within the I-405 corridor system in 2020 would increase substantially, the compatibility problem for general_purpose (GP) traffic would degrade and the conditions would become worse.

Problems related to the compatibility with local transportation systems exist in the I-405 corridor today. The compatibility problem between I-405 and local transportation systems would worsen if no action is taken within the I-405 corridor beyond the No Action Alternative improvements.

Congestion Impacts

Traffic congestion along I-405 is widespread during the morning and afternoon peak periods and has spread to surrounding time periods. The use of the measure "hours of congestion" examines the number of vehicles on a road compared to the available capacity, hour-by-hour. For purposes of this analysis, "congestion" is defined as travel speeds below 45 mph on the freeway and 25 mph on arterials. The hours of congestion were estimated separately for I-405, other freeways, and arterials within the study area.

Criterion: Reduce Congestion on Study Area Freeways and Arterials Below Current Levels

Table 3.12-8 shows the estimated hours of congestion for the existing and No Action conditions for each alternative on I-405 and other freeways and arterials in the study area. The last row in the table shows average hours of congestion for all facilities combined.

The hours of congestion on 5 out of 8 segments of I-405 would worsen under the No Action Alternative, compared with the existing conditions. The extended hours of traffic congestion are in a range of 1-4 hours per direction. Of the remaining 3 segments, two would remain the same and one segment from I-90 to SR 520 would improve slightly. Three out of eight sections would operate with more than 10 hours of congestion in 2020 (I-5 to SR 167, SR 167 to NE Park Drive, and NE Park Drive to I-90). The average hours of congestion on other freeways in the study area would extend to five hours from the current three hours; on the arterials, hours would extend to five from the current four hours today.

Table 3.12-8: Hours of Traffic Congestion by I-405 Segment for Existing, No Action, and Action Alternatives

I-405 Segment and Arterials	Hours of Congestion and the Change from No Action Alternative									
	1999	No Action (NA)	Change from 1999	Alt 1	Change from NA[a]	Alt 2	Change from NA[a]	Alt 3	Change from NA[a]	Alt 4	Change from NA[a]
I-5 to SR 167	12	13	+1	13	0	12	-1	6	-7	10	-3
SR 167 to NE Park Dr.	10	14	+4	14	0	13	-1	10	-4	9	-5
NE Park Dr. to I-90	10	11	+1	11	0	12	+1	13	+2	13	+2
I-90 to SR 520	9	8	-1	8	0	5	-3	5	-3	4	-4
SR 520 to NE 85th St.	5	5	0	5	0	5	0	4	-1	5	0
NE 85th Street to NE 124th St.	5	9	+4	9	0	8	-1	5	-4	5	-4
NE 124th St. to SR 522	4	8	+4	8	0	6	-2	5	-3	5	-3
SR 522 to I-5	5	6	+1	6	0	3	-3	1	-5	2	-4
Average of I-405	7	7	0	7	0	6	-1	5	-2	4	-3
Average of Other Freeways	3	5	+2	5	0	4	-1	4	-1	3	-2
Average of Arterials	3	5	+2	5	0	4	-1	4	-1	4	-1
Average of All Facilities	4	5	+1	5	0	5	-1	4	-1	4	-1

[a] Change compared to No Action Alternative (NA)
Source: PSRC Model, Mirai Associates

Vehicle miles of travel (VMT) is a measure of total vehicle trips per day multiplied by the length of the trip (in miles). VMT is summarized at the study area level and regional level and portrays overall changes in travel activity that may occur in response to an alternative. Vehicle hours of travel (VHT) is a similar measure, but captures the quality of travel in terms of travel time.

Table 3.12-9 summarizes the changes in study area and regional daily VMT and VHT for the No Action Alternative compared to 1995 base conditions. Within the I-405 study area and regionally, the growth in VHT would increase at a much higher rate than growth in VMT. This result correlates with the increased congestion levels that are expected to occur in the 2020 No Action Alternative. The VMT changes were relatively consistent during the peak and off-peak periods. However, the increase in VHT was found to be much higher (+160 percent in the study area; +97 percent region-wide) during the P.M. peak period in comparison to other times during the day.

Table 3.12-9: VMT and VHT for Study Area and Region-wide – Existing, No Action Alternative 2020, and Action Alternatives

Alternative	VMT (Daily)		VHT (Daily)	
	Study Area (trips within)	Region-wide	Study Area (trips within)	Region-wide
1995	16,346,000	69,412,000	586,000	2,295,000
2020 No Action Alternative	22,510,000	100,571,000	1,156,000	3,948,000
Change vs. 1995 (%)	37.7%	44.9%	97.3%	72.0%
Alternative 1	22,563,000	100,497,000	1,155,000	3,941,000
Change vs. No Action Alternative(%) Change vs. 1995	0.2% 38.0%	-0.1% 44.7%	-0.1% 97.2%	-0.2% 71.7%
Alternative 2	24,215,000	101,560,000	1,164,000	3,922,000
Change vs. No Action Alternative(%) Change vs. 1995	7.6% 48.1%	1.0% 46.3%	0.7% 98.6%	–0.7% 70.9%
Alternative 3	25,346,000	102,263,000	1,170,000	3,907,000
Change vs. No Action Alternative (%) Change vs. 1995	12.6% 55.0%	1.7% 47.3%	1.2% 99.7%	-1.0% 70.2%
Alternative 4	26,208,000	102,730,000	1,184,000	3,903,000
Change vs. No Action Alternative (%) Change vs. 1995	16.4% 60.3%	2.1% 48.9%	2.4% 102.0%	-1.14% 70.1%

Source: PSRC Model

Average speeds portray the deterioration of travel conditions between the current conditions in 1995 and 2020 and the speed forecasted under each alternative. Table 3.12-10 shows the average speeds for the study area freeways and state routes.

Table 3.12-10: Average Travel Speeds on Study Area Freeways and State Routes

Alternative	Average Speeds in mph (A.M. Peak Period/P.M. Peak Period/Daily)		
	I-405	Study Area (Trips Within)	Region-Wide
Existing 1995	39/33/37	30/24/28	31/28/30
2020 No Action Alternative	34/25/31	26/13/19	29/20/25
Alternative 1	34/25/31	26/13/19	29/20/25
Alternative 2	38/28/35	27/13/21	29/20/26
Alternative 3	42/32/39	28/14/22	29/21/26
Alternative 4	44/34/41	29/14/22	30/21/26

Source: PSRC Model

The local jurisdictions in the I-405 study area are facing serious traffic concurrency problems. If those issues are not managed effectively and addressed adequately by 2020, it is possible that the projected growth might not be realized. The existing concurrency problems in most of the local jurisdictions would be exacerbated in the future with the No Action Alternative. Traffic congestion on I-405 and arterials is expected to increase. The analysis results show virtually every jurisdiction within the study area would reach or exceed concurrency levels by 2020. The land use analysis (Section 3.13) shows that the No Action Alternative may force some land use growth to occur outside of the I-405 study area, partially due to restricted transportation accessibility. The effects of the alternatives on future land use are discussed in the Cumulative and Indirect Effects section (3.23).

Safety Impacts

Criterion: Improve the Safety for All Modes Above Current Levels

The safety analysis examined the effects of alternatives on reducing the number of accidents in high accident locations and decreasing the potential for traffic accidents throughout the I-405 corridor.

Committed projects in the No Action Alternative improve 15 percent of the high accident locations (HALs) within the study area on I-405, I-90, I-5, and the state routes, and 6 percent of the HALs on local streets.

The system-level safety analysis considered the following factors: type of facilities (freeway, arterial; facility design characteristics); the proportion of facilities designed to standards; amount of travel (measured by VMT); the amount of congestion; and traffic patterns in the area. Using WSDOT data assembled for Puget Sound area facilities, the total, injury, and fatal accident rates were developed. The analysis, Table 3.12-11, shows that injury and fatal accidents in the study area are expected to increase by 40 percent between 1999 and 2020.

Table 3.12-11: Study Area Accidents in 1999, No Action Alternative, Action Alternatives

Alternative	Total Accidents (per million VMT)	Injury Accidents (per million VMT)	Fatal Accidents (per 100 million VMT)
1999	10,060 (1.92)	5,910 (1.12)	40 (0.76)
No Action Alternative (2020)	13,900 (2.10)	8,340 (1.26)	56 (0.84)
Alternative 1	13,840 (2.10)	7,480 (1.26)	55 (0.84)
Alternative 2	13,840 (1.93)	8,120 (1.13)	55 (0.77)
Alternative 3	13,640 (1.79)	7,920 (1.04)	54 (0.71)
Alternative 4	13,310 (1.79)	7,680 (1.04)	53 (0.71)

Source: PSRC Model, Mirai Associates

3.12.4.2 Alternative 1: HCT/TDM Emphasis

This alternative emphasizes reliance on a physically separated, fixed-guideway HCT system within the study area and substantial expansion of bus transit service. It also minimizes addition of new impervious surface from general_purpose transportation improvements by placing emphasis on non-construction mobility solutions and transportation demand management (TDM) strategies.

Transportation demand strategies are emphasized in this alternative, along with consideration of regional pricing strategies in the I-405 corridor. Alternative 1 includes a physically separated, fixed-guideway HCT system, probably using some form of rail technology. Transit service would be increased up to 100 percent. I-405 improvements would be limited to minor actions aimed at improving safety and key congestion "hot spots." Minimal improvements would be made to arterials.

Construction Impacts

This alternative would have minimal road construction resulting in the least impact to existing traffic during construction compared to other action alternatives. Much of the HCT alignment would be separated from existing roadways, while HCT alignments that follow existing roadways would be located above, beside, or below existing lanes. Construction of the fixed-guideway HCT within the existing BNSF right-of-way would likely impact the operation of the existing freight and dinner trains along that corridor. In Alternative 1, the basic freeway improvements could be completed by 2010, while the extensive high-capacity transit system construction could extend until 2018. Minimal impacts to arterial or neighborhood traffic patterns would be expected during construction of Alternative 1.

Operational Impacts

Transportation operational impacts are defined with respect to three categories of criteria:

1. Mobility impacts: Travel demand by mode, travel times, compatibility
2. Congestion impacts: Hours of congestion, system performance
3. Safety impacts: High accident locations; accident rates

The key findings from the technical studies are identified in the following sections.

Mobility Impacts

Mobility was evaluated with six performance measures.

Criterion: Serve as Much of the 2020 Peak-Period Travel Demand Within the Corridor as Possible

P.M. Peak-Period Person Volumes by Mode Across 3 Screenlines

The peak person demand in Alternative 1 is virtually unchanged from No Action Alternative conditions. There was a minimal change in demand on parallel arterials.

Daily and P.M. Peak Period Traffic Volumes by Types of Vehicles (SOVs, HOVs, and Trucks)

The peak vehicle demand is virtually unchanged from the No Action Alternative. Daily traffic volumes along I-405 are shown along with other action alternatives in Figure 3.12-2.

Daily Traffic Volume Shifts between Facilities

Travel patterns are very similar to the No Action Alternative with no meaningful shifts between facilities or other induced travel effects.

Criterion: Improve Reliability of Travel Times for All Modes

Transit trip reliability would be greatly improved in Alternative 1. A high-capacity transit (HCT) system would operate on an exclusive right-of-way. This situation would provide high levels of travel time predictability for users of the HCT system. The travel time reliability for general traffic would be slightly better than under the No Action Alternative. The improvements to accident and congestion "hot spots" along I-405 would help reduce delays due to incidents. The reliability would remain worse than existing conditions due to higher levels and duration of congestion. HOV conditions would be similar to the No Action Alternative.

Criterion: Provide Flexibility to Accommodate Post-2020 Travel Demands

Available Capacity in 2020

The transit element of Alternative 1 would have substantial capacity to serve additional persons after 2020. Once built and operational, the fixed-guideway would operate at about 25 percent of the new capacity. The fixed-guideway system can easily respond to increased demand by adding more cars. Such capacity would need to be matched with future transit demand in the corridor.

In contrast, I-405 and the arterial system would remain highly congested as in the No Action Alternative. By 2030, daily traffic volumes in the study area would be very similar to the No Action Alternative condition. This alternative accommodates the second lowest number of persons of the action alternatives.

Potential for Adaptability

Alternative 1 contains a fixed-guideway transit system that offers several opportunities for expansion and modification as demand and technology change. The I-405 and arterial elements would provide limited opportunities for further expansion unless additional capacity was incorporated into the facility design. The alternative includes several applications of intelligent transportation systems (ITS) that would continue to maximize the efficiency of the current system.

Criterion: Reduce Travel Times for All Modes Door-to-Door Compared with Current Conditions

General Purpose Traffic.

The travel times for general purpose travel under Alternative 1 would the same as the No Action Alternative, as shown in Table 3.12-4.

HOVs.

The travel times for HOVs (3+) under Alternative 1 conditions would not change substantially from No Action Alternative. There may be one or two minutes of travel time reduction for certain trips as shown in Table 3.12-5.

Transit.

Alternative 1 would improve transit travel times considerably compared to the No Action Alternative. As shown in Tables 3.12-6 and 3.12-7, the transit travel time reductions for the seven trips are in the range of 7 to 30 minutes for walk-and-ride access, and from 6 to 24 minutes for park-and-ride access. The largest travel time change from the No Action Alternative condition would be for the trip from Tukwila/SeaTac to Redmond/Overlake with a 30-minute travel time reduction for walk-and-ride access. From Renton to Mill Creek, the transit travel times would be shortened by 27 minutes and 22 minutes with walk-and-ride and park-and-ride access, respectively. Two transit trips would have a relatively small improvement in travel time: three to five minutes from the Bellevue CBD to the Seattle CBD, and six to seven minutes from the Bellevue CBD to Edmonds/Lynnwood.

Most of the travel time improvements are due to reductions in in-vehicle transit times. Walk access times also decrease due to more transit routes and more frequent service.

Freight

In terms of the corridor criteria, Alternative 1 provides minimal relief to congestion and does not serve future truck volumes and provide good connections as well as some of the other alternatives. Alternative 1 does not include any additional improvements at the SR 167/I-405 interchange, which is the single most critical bottleneck according to recent surveys of trucking interests done for the FASTrucks effort. There are no connecting arterial improvements or other arterial capacity improvements in this alternative. These arterials are important connectors trucks use to access industrial and warehouse locations.

Alternative 1 could have a negative impact on rail freight movement in the corridor if portions of the rail line are used for high-capacity transit.

Criterion: Reduce the Share of Peak Period and Daily Trips Made by Single-Occupant Vehicles

Modal Shares

HOV usage in Alternative 1 is very similar to the No Action Alternative conditions before considering the effects of TDM (discussed below). Transit usage at all three screenlines would increase. Bothell transit usage increases to 2 percent of the total P.M. peak period trips with a 100 percent increase in total transit trips. Bellevue peak period transit usage would increase by 250 percent; as a result transit mode increases to 7 percent of P.M. peak period trips due to the concentration of transit services and physically separated, fixed-guideway HCT facilities in that area. Renton peak period transit usage would increase by 80 percent compared to the No Action Alternative, although the transit share would only increase from 2 to 3 percent.

Transportation Demand Management Program Effects

Alternative 1 includes a TDM program that is common to each action alternative. This program would provide important financial and service incentives to encourage trip reduction. In addition, Alternative 1 includes a regional 'congestion pricing' strategy. All of these TDM effects were estimated separately from the other travel forecasting processes. As shown in Table 3.12-12, the corridor TDM program was estimated to affect about 5 percent of the daily demand within the study area, and up to 10 to 15 percent of the peak-period demand. These results are based upon a review of comparable TDM programs around the nation applied to characteristics found within the I-405 corridor.

Table 3.12-12: I-405 TDM Program Effectiveness

TDM Element	Estimated Reduction in Daily Travel Demand[a]	Estimated Reduction in A.M. Peak Period Travel Demand[a]	Estimated Reduction in P.M. Peak Period Travel Demand[a]
Vanpooling	0.9%	2.7%	1.6%
Public Information	0.25 - 0.75%	1.0 – 2.0%	0.7 – 1.5%
Employer-Based	0.5 – 1.0%	2.0 – 3.5%	1.5 – 2.5%
Land Use as TDM	1.0 – 2.5%	3.5 – 5.0%	2.0 – 3.5%
Misc. Programs	0.5 – 1.0%	1.25 – 2.5%	0.75 – 1.25%
Total Estimated Travel Demand (VMT) Reduction	**3 – 6%**	**10 - 15%**	**7 – 10%**
Pricing[b]	15%	Not Estimated	Not Estimated
Total Estimated Travel Demand Reduction, Alt. 1 only	**18-21% (Note: may include some double-counting of benefits)**	**Not Estimated**	**Not Estimated**

[a] Results measured in terms of percent reduction in vehicle miles of travel (VMT).

[b] Pricing is included in Alternative 1 only. Regional congestion pricing effects have been studied as part of the Puget Sound Regional Council's *2001 Update Metropolitan Transportation Plan* (PSRC, 2000)

Source: WSDOT

Taken as a whole, the transit and TDM strategies contained in Alternative 1 could result in a reduction of peak-period single-occupant trips (i.e., SOV = one person per vehicle) in the 10 percent range. The transit forecasts indicated that the improved transit mobility would result in higher numbers of transit trips being made without affecting the total amount of vehicle trips (i.e., slightly more overall trips are occurring within the corridor to offset the shift to transit). Therefore, most of the potential SOV trip reduction comes from the supportive effects of the TDM strategies.

The primary effects of the TDM program would be to shift single-occupant vehicle users into carpools, vanpools, and transit. Some peak-period and daily trips may also be eliminated. A planning level analysis was conducted to estimate these relative effects on the different modes during the P.M. peak period. The preliminary findings show that possible effects of the TDM program on the P.M. peak period person-trips for each mode are as follows (without pricing effects):

- Single-occupant vehicles (SOV): reduced 5 to 10 percent
- HOV (carpools, vanpools): increased up to 10 percent
- Transit: increased 20 to 30 percent depending on incentives
- Total person-trips: reduced less than 2 percent

Pricing Effects

Research to-date indicates that congestion pricing can have a major effect on overall regional travel. For example, a scenario was tested that in essence doubled the variable cost of driving a vehicle (approximately $0.20 to $0.25 per mile), which would vary by time of day and congestion levels. Under this scenario, short-range vehicle miles of travel were estimated to be reduced by up to 15 percent on a daily basis. This scenario's effectiveness is shown in Table 3.12-12. Additional regional research will be required to refine these estimates and to characterize the effects of pricing within the I-405 in a regional context and to examine the effects of pricing with the variety of other TDM strategies that are included in the I-405 alternatives.

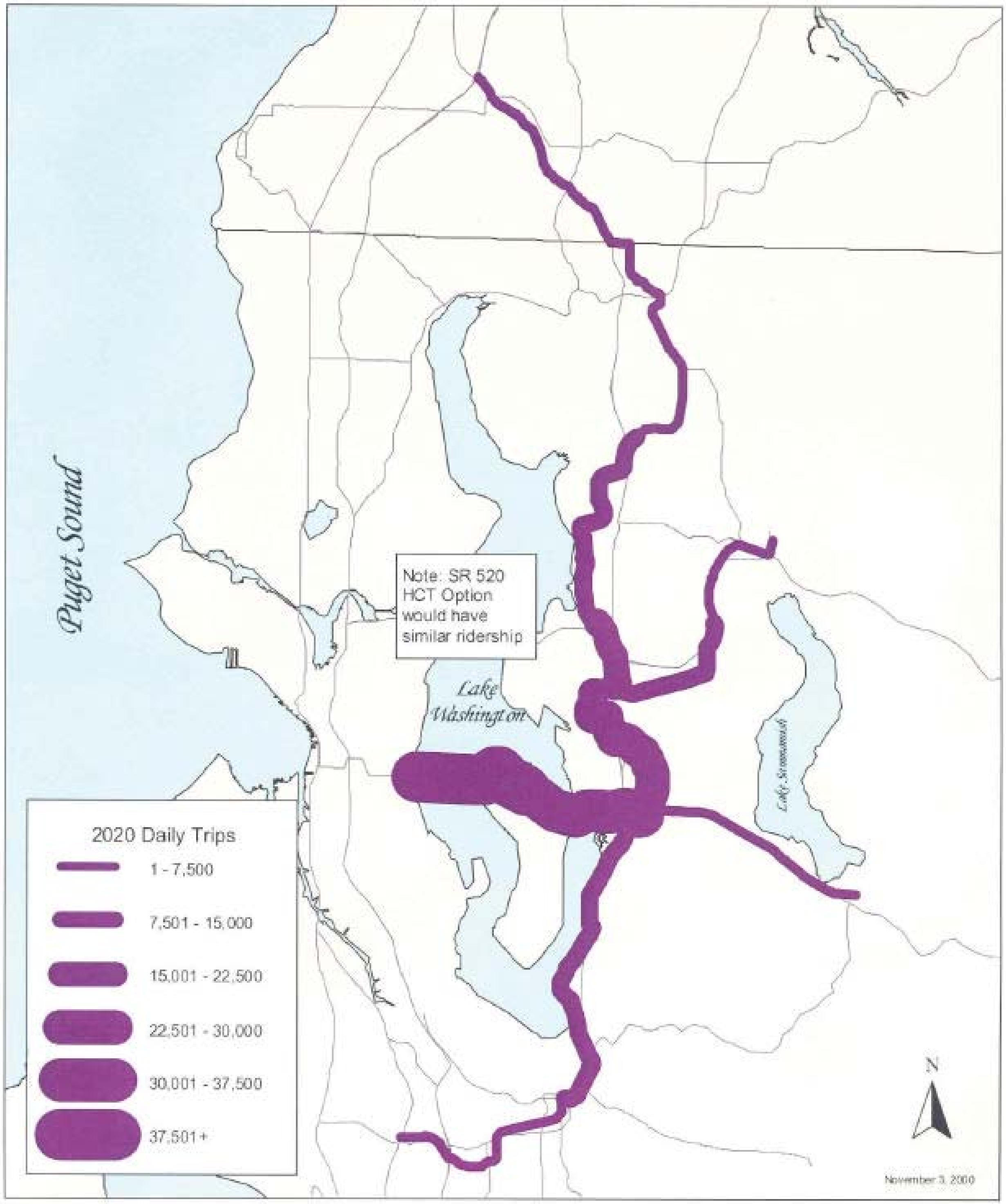
Transit Riders

The segments of highest fixed-guideway HCT ridership (e.g., at least 15,000 riders per day) fall within the central portion of the study area from south Kirkland to Factoria as shown in Figure 3.12-3. Ridership to the north and south along I-405 beyond these points is in the 7,500 to 15,000 range from Factoria to Renton and Kirkland to Totem Lake. The Bellevue to Overlake segment also attracts ridership in that range. Outside of these segments, daily transit ridership is estimated to fall below 7,500 persons.

HCT Service Plan Sensitivity Test

As a sensitivity test, the transit forecast for Alternative 1 was re-run assuming a different HCT service plan. The overall HCT operating parameters (e.g., vehicle speed, number of stations, alignment) were kept the same as Alternative 1. However, the sensitivity test service plan assumed that HCT vehicles would run directly from an origin station to the destination station for the passengers on that vehicle, bypassing intermediate station stops. This would result in faster transit trips along the HCT guideway. The service plan also assumed that this direct station-to-station service could occur between any stations on the Eastside HCT network, including the I-405, SR 520, and I-90 lines, allowing, for example, a direct no-transfer trip between Kirkland and Issaquah. This service plan would result in increased transit usage throughout the study area ranging from a 6 percent increase in Renton to a 25 percent increase at the Bothell screenline.

Figure 3.12-3: High Capacity Transit Daily Ridership - Alternative 1



A second sensitivity test assuming a commuter rail line estimated the 2020 daily ridership that could be expected on a line from Tukwila to Kirkland. This analysis provided updated information contained in previous studies of commuter rail in the corridor. The analysis indicated that an Eastside commuter rail line from Tukwila to Kirkland would carry about 1,800 to 1,900 daily passengers in 2020. If the trains were directly routed from the I-405 corridor to Sound Transit's south commuter rail line to Tacoma, the ridership could grow to about 2,800 passengers a day.

Criterion: Provide Effective Connections to Regional and Local Transportation Systems

The urban centers of the Eastside and Seattle would be connected with a high-capacity transit system under this alternative. The compatibility with the regional HCT system would be excellent. However, the I-405 HOV lanes would not be connected with direct freeway-to-freeway HOV ramps to the other freeway HOV lanes. The compatibility with the regional HOV system would be the same as the No Action Alternative.

This alternative assumes that there would be no major freeway improvements to enhance the general purpose traffic connectivity. The compatibility with the regional freeway network is the same as the No Action Alternative. Overall, this alternative would make the compatibility problem slightly better than under the No Action Alternative. Alternative 1 does not improve mobility on the local system.

This alternative supports improvements in pedestrian and bicycle circulation. Those improvements would enhance the compatibility with local transportation systems.

Congestion Impacts

Criterion: Reduce Congestion on Study Area Freeways and Arterials Below Current Levels

Table 3.12-8 shows the projected hours of congestion for Alternative 1, compared with the No Action Alternative and action alternatives. Although the high capacity transit system assumed to be in place by 2020 for this alternative would reduce traffic congestion slightly, it would not be enough to change hours of congestion. For practical purposes, the hours of congestion under the Alternative 1 conditions are the same as under the No Action Alternative.

Table 3.12-9 summarizes the changes in the study area and region for daily VMT and VHT. Before the effects of TDM strategies are considered, the change in VMT and VHT is very small.

Average travel speeds remain the same as the No Action as seen in Table 3.12-10.

Since Alternative 1 would not act to reduce the levels of traffic congestion on I-405, compared with the No Action Alternative, it would not be effective in addressing the concurrency problems at the local level. Unless local jurisdictions lower their acceptable levels of service standards, concurrency problems would continue to threaten growth in each local jurisdiction under this alternative.

Safety Impacts

Criterion: Improve the Safety for All Modes Above Current Levels

Alternative 1 would improve 32 percent of the high accident locations (HALs) on I-5, I-90, I-405, and state routes, with 40 percent of the HALs on I-405 improved and 9 percent of the HALs on local streets improved.

The system-wide effect of improvements under Alternative 1 would result in a slight reduction in the number of accidents (Refer to Table 3.12-11). This can be attributed to the basic improvements package of actions along I-405 in Alternative 1. The overall accident rates were actually unchanged from No Action Alternative conditions.

Several non-motorized hazard locations would be improved with Alternative 1.

Conclusion

After careful study and consideration of public and agency comments received on the Draft EIS (contained in Volume 2 of the FEIS), the co-lead agencies concluded that Alternative 1 would not meet the adopted purpose and need for the I-405 Corridor Program. In the best professional judgment of agency staff, this alternative is not a reasonable alternative to achieve the purpose and need because of its inability to provide meaningful long-term improvement in general purpose mobility, freight mobility, or reduction in foreseeable traffic congestion. Although it is likely that an aggressive pricing strategy could reduce VMT by about 15 percent based on national experiences, as discussed under operational impacts in Section 3.12.4.2 above, without roadway expansion, Alternative 1 would:

- accommodate a minimal amount of the increased peak-period person travel demand in 2020;
- have minimal effect on reliability of travel time for general traffic;
- not be expected to reduce travel times for either general purpose or 3+ HOVs;
- not provide truck freight mobility improvements in the corridor;
- not reduce congestion; and
- provide no meaningful improvement in overall safety on I-405 or other study area facilities.

Because it provides little benefit beyond that resulting from the No Action Alternative, Alternative 1 is not considered a cost-effective solution for potential implementation.

3.12.4.3 Alternative 2: Mixed Mode with HCT/Transit Emphasis

Alternative 2 emphasizes transit through implementation of a physically separated, fixed-guideway HCT system and major expansion of bus transit service, similar to Alternative 1. It also emphasizes improved mobility for other travel modes by providing HOV and general purpose roadway improvements on I-405 and connecting arterials. One general_purpose lane each direction is added to I-405. Alternative 2 also includes a TDM package of strategies.

Construction Impacts

The fixed-guideway HCT and bus transit construction impacts for Alternative 2 are similar to Alternative 1. Alternative 2 also includes adding one lane in each direction on I-405 and would require modifications to some bridges and interchanges, although most of the construction activity could be focused within the I-405 right-of-way. Construction would require some temporary narrowing of lanes and shoulders. Temporary detours and lane closures would be allowed during non-peak hours. Although efforts would be made to maintain the existing number of lanes during construction, most traffic control measures would result in some decrease in capacity and increases in roadway congestion during the construction periods. In Alternative 2, the freeway widening construction could extend over a 6- to 8-year period ending after 2010. Construction within any given 5-mile segment of freeway would likely be limited to a 3- to 4-year period, during which localized impacts to connecting arterials and interchanges would be sequenced. The HCT system construction period could extend until 2018. Arterial improvements would occur throughout the 2005 to 2015 period.

There would be anticipated construction impacts on traffic resulting from the reduction of lane capacity along I-405. The analyses suggest that spillover traffic to parallel arterial routes would occur during the construction period, primarily during evenings, nights, and weekends. Parallel arterials, such as Coal Creek Parkway, Bellevue Way, 148th Ave, SR 202, and Lake Washington Boulevard, would likely experience some traffic increases. There would also be the potential for short-term increases in local street cut-through traffic to avoid construction-related traffic impacts such as interchange or arterial connection closures. Implementation of an expanded TDM program and transit service would be essential to provide mobility choices to travelers during construction.

Operational Impacts

Transportation operational impacts are defined with respect to three categories of criteria:

1. Mobility impacts: Travel demand by mode, travel times, compatibility
2. Congestion impacts: Hours of congestion, system performance
3. Safety impacts: High accident locations; accident rates

The key findings from the technical studies are identified in the following sections.

Mobility Impacts

Mobility was evaluated using six performance measures.

Criterion: Serve as Much of the 2020 Peak Period Travel Demand Within the Corridor as Possible

In Alternative 2, the corridor handles 15 to 20 percent more demand than the No Action Alternative. As a result, some traffic would shift from other corridors to I-405.

P.M. Peak-Period Person Volumes by Mode Across 3 Screenlines

The peak person demand in Alternative 2 increases by 15 to 20 percent compared with No Action Alternative conditions. Most of the increase in demand occurs in response to the added lanes on I-405 and the increase in travelers using transit and the fixed-guideway HCT system. There is a 7 to 10 percent reduction in demand on north-south parallel arterials in Bellevue and Renton.

Daily and P.M. Peak Period Traffic Volumes by Types of Vehicles (SOVs, HOVs, and Trucks)

The peak vehicle demand is virtually unchanged from No Action conditions. Daily traffic volumes along I-405 are shown along with other action alternatives in Figure 3.12-2. Daily traffic volumes along I-405 increase by 25 to 60 percent, compared to the No Action Alternative volumes. The greatest traffic increases are south of I-90, with increases of 40 to 60 percent.

Daily Traffic Volume Shifts between Facilities

Alternative 2 produces small shifts in travel patterns within the I-405 corridor. About one-third of the I-405 growth can be attributed to a demand shift from the I-5/SR99 corridor. Over half of the growth is attributable to changing travel patterns and generally longer trips in the study area.

Other effects of induced travel associated with Alternative 2 are expected to be minimal.

Criterion: Improve Reliability of Travel Times for all Modes

The general traffic travel time reliability in Alternative 2 would be better than the No Action Alternative. When the general_purpose lanes (one in each direction) are added, those sections of I-405 would be constructed to current design standards, enhancing safety and reducing incidents that slow down traffic. Improvements to accident and congestion "hot spots" along I-405 would also help reduce delays due to incidents. The hours of congestion would be shorter than under the No Action Alternative conditions, improving the traveler's ability to predict travel times. These effects would also improve freight reliability. Transit reliability would be enhanced by fixed-guideway HCT system that would operate on an exclusive right-of-way similar to Alternative 1. HOV (3+) travel time predictability would improve due to additional HOV direct access ramps.

Criterion: Provide Flexibility to Accommodate Post-2020 Travel Demands

Available Capacity in 2020

As described in Alternative 1, the transit system would have substantial capacity to serve additional persons after 2020 by adding more vehicles to meet future demand.

Conversely, Alternative 2 would have minimal available roadway capacity remaining after 2020. Although the alternative could accommodate 2020 person demands that are up to 15 percent higher than the No Action Alternative, this alternative would not accommodate the total demand within the corridor. By 2030, daily traffic volumes within the study area would use up this limited available capacity.

Potential for Adaptability

Alternative 2 is similar to Alternative 1.

Criterion: Reduce Travel Times for all Modes Door-to-Door Compared with Current Conditions

General_Purpose Traffic

The travel times for general_purpose travel under Alternative 2 would be reduced. As shown in Table 3.12-4 travel time for the seven trips decreases on average from one to seven minutes, resulting in a 6 to 9 percent improvement over the No Action Alternative travel times.

HOVs

The travel times for HOVs (3+) under Alternative 2 conditions would not change substantially from the No Action Alternative. There may be one or two minutes of travel time reduction for certain trips as shown in Table 3.12-5.

Transit

Alternative 2 would improve transit travel times considerably compared to the No Action Alternative. As shown in Tables 3.12-6 and 3.12-7, the transit travel time reductions for the seven trips are almost the same as Alternative 1. Similarly, most of the travel time improvements are due to reductions in in-vehicle transit times. Walk access times also decrease due to more transit routes and more frequent service.

Freight

Alternative 2 would improve truck freight travel times and mobility. The alternative contains a directional SR 167/I-405 interchange, connecting freeway improvements, some arterial capacity improvements, and one additional GP or auxiliary lane in each direction on I-405 – all positive for freight movement. Like Alternative 1, this alternative could have negative impacts on the rail freight movements along the BNSF.

Criterion: Reduce the Share of Peak-Period and Daily Trips Made by Single-Occupant Vehicles

Taken as a whole, the transit and TDM strategies contained in Alternative 2 could reduce peak-period SOV trips by 10 percent. The TDM program would also provide major financial and service incentives to encourage ridesharing. It is estimated that these incentives could result in a 20 to 30 percent additional increase in transit use, and 10 percent increase in HOV 3+. Transit ridership is similar to Alternative 1 (if pricing is not included).

Criterion: Provide Effective Connections to Regional and Local Transportation Systems

As with Alternative 1, this alternative would provide excellent connections among the urban centers with the fixed-guideway HCT system. The compatibility with the regional HOV system would be much improved under this alternative. Freeway-to-freeway HOV direct access connections would be added at I-5 in Tukwila, SR 167 in Renton, I-90, SR 520, SR 522, and I-5 in Lynnwood. HOVs would then have exclusive lanes to travel between the I-405 HOV system and other HOV systems.

In addition to adding one general_purpose lane on I-405 in each direction, this alternative assumes that segments of the freeways connecting with I-405, such as I-90, SR 520, SR 522, and I-5, would be improved to ensure adequate interchange ramp capacity. Therefore, the compatibility with the regional general_purpose transportation network, including truck freight movements, would be much better than the No Action Alternative.

Overall, this alternative would have higher levels of compatibility with local transportation plans. Actions would be taken to improve arterials in the vicinity of the I-405 interchanges, and the configuration and capacity of I-405 interchanges would be improved. Those improvements are designed to match the added general_purpose capacity on I-405 with arterial capacity. Together, these improvements would enhance general_purpose traffic, including truck movement. Many of the existing and anticipated incompatibility problems identified in the No Action Alternative would be addressed in the proposed improvements in this alternative.

Since most of the arterial improvements in this alternative have been previously adopted in the local transportation plans, actions to implement those improvements would make this alternative more compatible with local transportation plans.

Congestion Impacts

Criterion: Reduce Congestion on Study Area Freeways and Arterials Below Current Levels

The capacity improvements proposed in Alternative 2 would reduce the hours of traffic congestion on most segments of I-405, compared with the No Action Alternative.

Average I-405 congestion levels would be around six hours per day, which is similar to current levels. The average congestion total for all roads would be slightly better than the No Action Alternative. Table 3.12-8 shows the projected hours of congestion for Alternative 2, compared with the No Action Alternative and action alternatives.

As shown in Table 3.12-9, before the effects of TDM strategies are considered, the study area VMT would increase by up to 8 percent (+1 percent regionally), while changes in VHT are very small. The TDM program included in Alternative 2 was estimated to result in a 3 to 6 percent daily VMT reduction, which would offset the VMT increase created by the added capacity on I-405. Changes in VHT due to the TDM program, although not estimated, could be expected to show a similar reduction.

Average speeds in the study area are shown in Table 3.12-10. Alternative 2 results in an increase in average speed on I-405 during all time periods, while overall study area speeds improve slightly and regional average speeds are virtually unchanged.

Alternative 2 adds capacity to I-405 and provides some reduction in study area traffic congestion, compared with the No Action Alternative. In addition, this alternative assumes that capacity of some arterials in the study area would be expanded. Therefore, this alternative would slightly reduce the magnitude of the concurrency problems that the local jurisdictions would face in the future. However, the concurrency improvement would be fairly limited since considerable unmet travel demand remains and few arterial improvements are included with this alternative.

Safety Impacts

Criterion: Improve the Safety for All Modes Above Current Levels

Alternative 2 would improve 60 percent of the high accident locations (HALs) on I-5, I-90, I-405, including 80 percent of the HALs on I-405 and 19 percent of the HALs on local streets. See Table 3.12-11.

The system-wide effect of improvements under Alternative 2 is a slight decrease in the number of accidents, despite a greater amount of travel in the corridor. The decrease can be attributed to geometric improvements on I-405 provided by the addition of the general purpose lanes, the basic improvements package, and the shift of traffic from arterial routes to I-405.

Several potentially hazardous locations for pedestrians and bicycles would be improved with Alternative 2.

3.12.4.4 Alternative 3: Mixed Mode Emphasis

This alternative emphasizes mobility improvements through implementation of a bus rapid transit (BRT) system, substantial expansion of bus transit service, and substantial HOV and general purpose roadway improvements on I-405 and connecting arterials. Two additional lanes in each direction replace the auxiliary and climbing lanes contained in the No Action Alternative. Alternative 3 includes a bus rapid transit system using the existing HOV lanes on I-405, I-90, and SR 520. Selected arterial missing links would be completed together with planned arterial capacity improvements of local jurisdictions.

Construction Impacts

The process of adding two lanes in each direction on I-405 would increase the duration and extent of impacts to traffic throughout the study area. Construction would require rebuilding or modifying most bridges and interchanges. Construction would require some temporary narrowing of lanes and shoulders. Temporary detours and lane closures would be allowed during non-peak hours. Although efforts would be made to maintain the existing number of lanes during construction, most traffic control measures would result in some decrease in capacity and increases in roadway congestion during the construction periods.

During the construction period, travel time reliability for general traffic would be difficult to manage. However, extensive use of evening, night, and weekend construction times and innovative construction techniques would help maintain reliability during these periods.

Parallel arterial facilities such as Coal Creek Parkway, Bellevue Way, 148th Ave, SR 202, and Lake Washington Boulevard would likely experience some traffic increases. There would also be the potential for short-term increases in local street cut-through traffic to avoid construction-related traffic impacts such as interchange or arterial connection closures.

Depending on funding, the freeway widening construction in Alternative 3 could extend over a 10- to 12-year period. Construction within any given 5-mile segment of freeway would likely be limited to a 3- to 4- year period, during which localized impacts to connecting arterials and interchanges would be sequenced. Impacts to travelers would vary according to the specific location, time, and length of their trip.

The bus rapid transit system portion of Alternative 3 can begin service in the short term on the existing HOV lanes and can provide opportunities to accommodate the corridor person demand that is affected during freeway construction. Implementation of an expanded TDM program and local transit service would also be essential to provide mobility choices to travelers during major construction along I-405. The north-south arterial improvements included in Alternative 3 could also occur earlier in the construction period to provide some traffic relief to persons affected by the freeway construction.

Operational Impacts

Transportation operational impacts are defined with respect to three categories of criteria:

1. Mobility impacts: Travel demand by mode, travel times, compatibility
2. Congestion impacts: Hours of congestion, system performance
3. Safety impacts: High accident locations; accident rates

The key findings from the technical studies are identified in the following sections.

Mobility Impacts

Mobility was evaluated by using six criteria.

Criterion: Serve as Much of the 2020 Peak-Period Travel Demand Within the Corridor as Possible

P.M. Peak-Period Person Volumes by Mode Across 3 Screenlines

On average, the peak person demand in Alternative 3 increases by 25 to 30 percent compared with No Action Alternative conditions. Demand on I-405 would increase by up to 75 percent on some segments. Most of the increase in demand occurs due to the added freeway capacity and expanded transit service.

Daily and P.M. Peak Period Traffic Volumes by Types of Vehicles (SOVs, HOVs, and Trucks)

The peak vehicle demand in Alternative 3 increases by 30 percent compared with No Action Alternative conditions. Daily traffic volumes along I-405 are shown along with other action alternatives in Figure 3.12-2. Demand increases 66 percent at Bothell and Bellevue screenlines and doubles in Renton.

Daily Traffic Volume Shifts between Facilities

The major widening of I-405 in Alternative 3 results in substantial increases in peak-period travel demand across the three screenlines within the study area. Most of this growth shows up on I-405 itself. Of the total increase in I-405 daily traffic (compared to the No Action Alternative), up to 45 percent can be attributed to changing travel patterns and somewhat longer trips being made. Another major source for trip growth on I-405 is a shift in travel from the general I-5/SR 99 corridor through Seattle. This shift represents 30 to 35 percent of the I-405 demand increase and results in about a 3 percent reduction in north/south travel within Seattle. Lesser traffic shifts occur from the parallel north/south arterials in the I-405 corridor (10 to 15 percent of daily I-405 volume increase) and from east King County facilities (5 to 10 percent). A related effect of the widening of I-405 is the increase in travel demand on roadways connecting to I-405. Increases of around 10 percent were estimated on the east/west arterials and freeways (e.g., SR 520, I-90) that provide primary access to I-405.

Over 90 percent of the added trips on I-405 would have trip lengths in excess of 10 miles, with almost 60 percent being over 30 miles in length.

The substantial increase in roadway capacity provided in Alternative 3 could result in shifts in land use patterns and study area trip making. A test was made to determine the land use effects of the improved accessibility provided by Alternative 3. Section 3.13 (Land Use) documents the results of this analysis, which showed that Alternative 3 causes some clustering of development patterns within the study area but does not affect the overall growth assumed by local and regional plans. In the short run after implementation (prior to 2020), the substantial improvement in mobility provided by Alternative 3 could result in an increase in the number of discretionary trips made within the corridor. By 2020 and beyond, these effects are expected to be minimal in comparison with the high growth in overall study area and regional trips produced.

Criterion: Improve Reliability of Travel Times for all Modes

This alternative would provide higher levels of general traffic travel time reliability than the No Action Alternative. The expansion of I-405 mainline capacity under this alternative would improve general reliability. <u>While I-405 would handle a higher proportion of the corridor travel demand, e</u>ach mainline section would be reconstructed to current standards, and many interchanges along I-405 would be upgraded to meet standards. As a result, this alternative would greatly improve the ability to manage incidents<u> and provide additional opportunities for vehicles on the freeway to bypass those incidents. Several north-south arterials would also be improved to provide motorists with better travel options should I-405 become blocked or slowed</u>. The duration of traffic congestion would also be reduced, leading to better travel time reliability for both general traffic and freight.

HOV (3+) travel time predictability would improve due to additional HOV direct access ramps that allow HOVs to bypass congestion.

The bus rapid transit system in Alternative 3 would take advantage of the extensive HOV facilities to provide reliable bus travel times. This good reliability is dependent upon managing the demand in the HOV lanes by restricting their use to three-or-more-person carpools.

Criterion: Provide Flexibility to Accommodate Post-2020 Travel Demands

Available Capacity in 2020

Alternative 3 would have available corridor person capacity remaining after 2020. Alternative 3 would accommodate 2020 person demand that is up to 25 percent higher than No Action Alternative conditions.

The bus rapid transit element of Alternative 3 would have capacity to serve additional persons after 2020. Once built, the BRT would operate at up to 30 percent of the new capacity. The BRT system can easily respond to increased demand by adding more buses. A BRT system should be able to meet additional post-2020 ridership demand in the corridor provided that additional bus equipment and operating revenues are available; park-and-ride and transit center capacity are sufficient; and speed and reliability performance criteria are met running in a predominantly HOV lane ROW environment. Long-term demand may require transit center expansion and reserved bus lanes and curb space in urban centers.

I-405 congestion levels would improve to better than current conditions in 2020 with the added capacity provided in Alternative 3. By 2030, however, daily traffic volumes within the study area would use up most of this capacity.

Potential for Adaptability

Alternative 3 contains a BRT system that offers limited post-2020 opportunities for physical facility expansion within the I-405 ROW. However, lane designation and user group management modifications, including the introduction of a high-occupancy/toll (HOT) lane, offer long-range BRT system enhancement opportunities. In addition, ITS innovations would help to maximize the efficiency for present and future systems.

Criterion: Reduce Travel Times for all Modes Door-to-Door Compared with Current Conditions

General Purpose Traffic

Compared with the No Action Alternative travel times, Alternative 3 would substantially reduce travel times for the general purpose traffic, including freight. The travel time reduction would be from 11 to 16 percent (from 7 to 12 minutes). Most general traffic travel times would still remain longer than the 1995 trips times (Table 3.12-4).

HOVs

The travel times for HOVs (3+) under Alternative 3 conditions would not change considerably from No Action. There may be one or two minutes of travel time reduction for certain trips (Table 3.12-5).

Transit

Alternative 3 would improve transit travel times considerably compared to the No Action Alternative, as shown in Tables 3.12-6 and 3.12-7. Most of the travel time improvements are due to reductions in in-vehicle transit times. Walk access times also decrease due to more transit routes and more frequent service.

<u>Freight</u>

<u>Alternative 3 would provide significant capacity increases in the highway system that would be beneficial to truck freight movement. This alternative is similar to Alternative 2 except that it</u>

contains two additional GP lanes in each direction on I-405 and more arterial capacity improvements. Truck travel time reliability would improve and delay would be reduced. Along with Alternative 4, this alternative is the most positive for freight movement. Since HCT (bus rapid transit) would be confined to the freeway lanes in Alternative 3, rail freight movement would not be affected.

Criterion: Reduce the Share of Peak-Period and Daily Trips Made by Single-Occupant Vehicles

Taken as a whole, the transit and TDM strategies contained in Alternative 3 could result in a reduction of peak-period single-occupant trips in the 10 percent range (refer to Table 3.12-12: I-405 TDM Program Effectiveness). Daily transit ridership along the BRT segments in Alternative 3 is similar to that shown for the HCT segments of Alternative 2.

The TDM program effects in Alternative 3 would be similar to Alternative 2. It is estimated that the combination of additional vanpools and carpooling incentives could result in up to an additional 10 percent increase in HOV 3+ mode share and a 20 to 30 percent additional increase in peak-period transit use.

Criterion: Provide Effective Connections to Regional and Local Transportation Systems

Overall, the transit system compatibility with the regional system is much better in Alternative 3 than under the No Action Alternative.

This alternative assumes that the urban centers would be served by a bus rapid transit system using the HOV lanes and direct HOV access interchanges. These HOV interchanges would also allow interface with the regional passenger rail network. The freeway-to-freeway direct HOV ramp connections would also be provided. The general_purpose traffic capacity of I-405 would be expanded substantially under this alternative, as well as the connecting freeway capacity. As a result, the compatibility with the regional general_purpose transportation network would be better than under the No Action Alternative.

Overall, this alternative would have high levels of compatibility with local transportation plans. The compatibility problems existing under the No Action Alternative would be reduced or largely eliminated. General_purpose traffic, including truck freight movement, would be improved substantially. Since many of the arterial improvements in this alternative have been adopted in the local transportation plans, actions to implement those improvements would make this alternative more compatible with local transportation plans. Key arterial "missing links" would be added or improved to provide better roadway connectivity within the study area. Some additional arterial projects would need to be integrated into local plans.

Congestion Impacts

Criterion: Reduce Congestion on Study Area Freeways and Arterials Below Current Levels

Alternative 3 would reduce the hours of traffic congestion substantially as shown in Table 3.12-8. In the southern sections of I-405, the hours of congestion would be shortened by up to seven hours a day between SR 167 and I-5. Most of the segments in the north section would operate with less than five hours of congestion, which would be better than conditions today.

When hours of traffic congestion for all the I-405 segments are averaged, five hours of congestion are projected, two hours less than the No Action Alternative and better than current conditions. Average hours of congestion on arterials and other freeways also improve by one hour a day. The average congestion total for all roads would improve to levels similar to current conditions.

Table 3.12-9 shows that before the effects of TDM strategies are considered, the study area VMT would increase by up to 13 percent (+2 percent regionally). Regional VMT would increase about 1 percent, although regional VHT would decrease. The TDM program would result in reducing daily VMT by 3 to 6 percent. This reduction would offset part of the VMT increase created by the substantial added capacity provided on I-405 and connecting facilities. Although not estimated, VHT reductions could be expected to be similar to those shown for VMT.

As shown in Table 3.12-10, average speeds on I-405 and in the study area improve substantially in the corridor, but only slightly region-wide.

The capacity expansions on I-405 assumed in Alternative 3 would shift some traffic back to I-405 from the arterials. Additional arterial capacity would also be provided. As a result, the levels of service on the freeway and arterial system are expected to improve, compared with the No Action Alternative. These actions would assist local jurisdictions to better manage their concurrency problems. Since Alternative 3 would take several years to implement, short-term concurrency issues would remain.

Safety Impacts

Criterion: Improve the Safety for All Modes Above Current Levels

Alternative 3 would improve 60 percent or 36 of the high accident locations (HALs) on I-5, I-90, I-405, and state routes, including 80 percent of the HALs on I-405 and 19 percent of the HALs on local streets (Table 3.12-11). The addition of two general purpose (GP) lanes and other basic improvements would generally improve the geometrics of the freeway corridor.

Accidents and accident rates with Alternative 3 would decrease slightly, despite a 15 percent increase in vehicle miles traveled. System-wide, while accidents would increase on I-405 due to the greater volumes, there would be a net reduction in total accidents in the study area and accident rates. This results from a shift in traffic away from more hazardous arterial streets.

Several nonmotorized hazard locations would be improved with Alternative 3.

3.12.4.5 Alternative 4: General Capacity Emphasis

This alternative emphasizes general purpose capacity by providing one additional lane in each direction on I-405, improving major interchanges, and constructing a new four-lane I-405 express roadway consisting of two lanes in each direction with limited access points. In addition, there would be an expansion of major arterial routes and connections to I-405. Limited transit service expansion and the core TDM strategies would also be included.

Construction Impacts

The addition of six lanes of roadway capacity in the I-405 corridor in Alternative 4 would have substantial impacts on traffic compared to the other alternatives because of the extensive use of grade- and barrier-separated alignments, especially in the southern segment between Tukwila and I-90. Downtown Bellevue would be less of a problem because the express lanes could be on BNSF right-of-way. However, overall there would be more lane miles of existing roadways that would be exposed to construction, which could extend for up to 15 years with completion around 2020.

The higher costs and more extensive and complex designs would result in longer periods of traffic impacts during construction. Construction would require some temporary narrowing of lanes and shoulders. Temporary detours and lane closures would be allowed during non-peak hours. Partial roadway closures would also be expected during certain times during reconstruction of interchanges and connections to the express roadway. However, extensive use of evening, night, and weekend construction times and innovative construction techniques would help maintain reliability during these periods.

Construction within any given 5-mile segment of freeway would likely be limited to a 4- to 5-year period, during which localized impacts to connecting arterials and interchanges would be sequenced. Impacts to travelers would vary according to the specific location, time, and length of their trip. It is possible that portions of the express roadway could be constructed first to serve as a bypass route during reconstruction of the I-405 mainline.

The magnitude and duration of the construction activities for Alternative 4 suggest that spillover traffic to parallel arterial routes would occur. Parallel arterials such as Coal Creek Parkway, Bellevue Way, 148th Ave, SR 202, and Lake Washington Boulevard would likely experience traffic increases. There would also be the potential for short-term increases in local street cut-through traffic to avoid construction-related traffic impacts. Implementation of an expanded TDM program and transit service would be essential to provide mobility choices to travelers during construction. The North-South arterial improvements included in Alternative 4 could also occur earlier (e.g., 2006-2012) in the construction period to provide some traffic relief to persons affected by the freeway construction.

Operational Impacts

Transportation operational impacts are defined with respect to three categories of criteria:

1. Mobility impacts: Travel demand by mode, travel times, compatibility
2. Congestion impacts: Hours of congestion, system performance
3. Safety impacts: High accident locations; accident rates

The key findings from the technical studies are identified in the following sections.

Mobility Impacts

Mobility was evaluated using six performance measures.

Criterion: Serve as Much of the 2020 Peak-Period Travel Demand Within the Corridor as Possible

P.M. Peak Period Person Volumes by Mode Across 3 Screenlines

The major widening of I-405 in Alternative 4, including the express roadway, would result in substantial increases in peak-period travel demand across the three screenlines. Most of this growth shows up on I-405 itself. On average, the peak person demand in Alternative 4 increases by 30 to 35 percent compared with No Action conditions. Person demand on I-405 (including the express roadway) increases about 70 percent in downtown Bellevue, and over 80 percent at the Renton and Bothell screenlines. Most of the increase comes from non-carpools (SOVs and 2-person carpools) using the additional lanes in this alternative.

Daily and P.M. Peak Period Traffic Volumes by Types of Vehicles (SOVs, HOVs, and Trucks)

On average, the peak-period vehicle demand increases by 38 percent, and daily traffic volumes by 60 to 130 percent compared to the No Action Alternative. Daily traffic volumes along I-405 are shown along with other action alternatives in Figure 3.12-2.

Daily Traffic Volume Shifts between Facilities

Travel shifts in Alternative 4 were found to be similar to Alternative 3. However, Alternative 4 has unique features due to the express roadway. This results in changing trip patterns and mobility within the study area that contribute to an increase in trip lengths along I-405. Over 90 percent of the added trips on I-405 (compared to the No Action condition) would have trip lengths in excess of 10 miles, with over 50 percent being more than 30 miles in length. From 20 to 30 percent of the express roadway demand are trips passing through the study area. This is a much higher proportion of through trips than the No Action Alternative condition.

The substantial increase in roadway capacity provided in Alternative 4 could influence shifts in study area trip-making. In the short run after implementation (prior to 2020), the substantial improvement in mobility provided by Alternative 4 could result in an increase in the number of discretionary trips (i.e., part of induced travel) made within the corridor. By 2020 and beyond, these effects are expected to be minimal in comparison with the high growth in overall study area and regional trips produced.

Criterion: Improve Reliability of Travel Times for all Modes

Alternative 4 improves general traffic travel time compared to the No Action Alternative. Most segments of I-405 would be reconstructed to add one additional travel lane plus a four-lane expressway. Current design standards would be used to design the roadway facilities. The express roadway could be designed and managed to operate with high levels of service to minimize travel time delays and increase reliability. General_purpose traffic, including freight, would benefit from these improvements.

Transit would continue to operate in the HOV lanes. The transit travel time reliability could be maintained at existing levels, depending upon how the lanes are managed to avoid overcrowding. HOV (3+) reliability would benefit from the addition of HOV freeway-to-freeway ramps.

Criterion: Provide Flexibility to Accommodate Post-2020 Travel Demands

Available Capacity in 2020

Alternative 4 would have available capacity remaining after 2020. Alternative 4 would accommodate 2020 person demands that are up to 30 percent higher than No Action conditions, and equal to or greater than the 2020 theoretical unconstrained demand. This capacity is created by the equivalent of three general_purpose lanes added in each direction along I-405. Transit capacity increases would keep pace with corridor growth, but would provide minimal excess capacity after 2020. However, additional transit capacity could be provided beyond 2020 given the same provisos as stated for Alternative 3.

The expansion of I-405 with Alternative 4 could greatly reduce traffic congestion on I-405 in 2020. However, overall study area congestion levels would still be similar to current traffic conditions. By 2030, daily traffic volumes within the study area would use up most of this available capacity for further person volume growth within the corridor.

Potential for Adaptability

The I-405 capacity expansion would provide the opportunity to manage the express roadway for different user groups, such as for a high-occupancy/toll (HOT) facility. Additional expansion of I-405 could not be readily accommodated without major redesign or property acquisition. The alternative includes several applications of intelligent transportation systems (ITS) that would continue to maximize the efficiency of the current system.

Criterion: Reduce Travel Times for all Modes Door-to-Door Compared with Current Conditions

General_Purpose Traffic

Alternative 4 shows the greatest improvement in general_purpose traffic travel time among the action alternatives. The general traffic travel times would improve by 11 to 20 percent compared to No Action conditions throughout the study area. The general traffic travel times under Alternative 4 would remain 3 to 11 minutes longer than 1995 travel times. However, for trips focused directly along I-405 such as Bellevue CBD to Federal Way/Kent, Renton to Mill Creek, and Bellevue CBD to Edmonds/Lynnwood, travel times could be expected to improve similar to or better than current travel times (Table 3.12-4).

HOVs

The travel times for HOVs (3+) under Alternative 4 conditions would not change substantially from No Action. There may be one or two minutes of travel time reduction for certain trips (Table 3.12-5).

Transit

The transit travel time improvements in Alternative 4 are relatively modest. For both walk-and-ride access and park-and-ride access, the transit travel times under this alternative would be shortened by one to nine minutes, compared with the No Action Alternative (Tables 3.12-6 and 3.12-7).

Freight

Alternative 4 is similar to Alternative 3 in terms of providing improved truck freight mobility within the corridor. Depending upon the management tool used, the express lanes could have the capability of further reducing travel times and improving reliability for longer-distance truck trips. The BNSF line is preserved for rail freight movement in this alternative.

Criterion: Reduce the Share of Peak-Period and Daily Trips Made by Single-Occupant Vehicles

Taken as a whole, the transit and TDM strategies contained in Alternative 4 could result in a reduction of peak-period single-occupant trips in the 10 percent range. These effects are comparable with the results of Alternatives 2 and 3.

The TDM program effects in Alternative 4 would be similar to Alternative 2. It is estimated that the combination of additional vanpools and carpooling incentives could result in up to a 10 percent increase in HOV (3+) mode share compared to the results shown above. Alternative 4 contains substantial TDM strategies to encourage and support transit use. It is estimated that these incentives could result in a 20 to 30 percent increase in peak-period transit usage, although these levels would be lower than the transit usage in Alternatives 1, 2, and 3.

Criterion: Provide Effective Connections to Regional and Local Transportation Systems

Alternative 4 would connect the existing I-405 HOV lanes with the regional HOV system using direct freeway-to-freeway HOV ramps. Since fewer exclusive transit facilities would be provided, the compatibility of Alternative 4 with the regional transit system would not be as good as Alternatives 1, 2, or 3. The express lanes would be connected with the regional freeways with new ramps and would match regional general_purpose traffic systems.

Overall, Alternative 4 would have high levels of compatibility with local transportation plans similar to Alternatives 2 and 3. The compatibility problems existing in the No Action Alternative would be reduced or largely eliminated. Since many of the arterial improvements in this alternative have been adopted in the local transportation plans, actions to implement those improvements would make this alternative more compatible with local transportation plans. Key arterial "missing links" would be added or improved to provide better roadway connectivity within the study area. Some additional arterial projects would need to be integrated into local plans.

Congestion Impacts

Criterion: Reduce Congestion on Study Area Freeways and Arterials Below Current Levels

The hours of traffic congestion with facility improvements in Alternative 4 are the same as or slightly less than Alternative 3. The hours of congestion would improve substantially over the No Action Alternative as shown in Table 3.12-8.

Along I-405, the average hours of congestion would be cut from seven to four hours, a major improvement from the No Action Alternative and current conditions. The hours of congestion for other freeways and arterials would be reduced by 1 to 2 hours. On a system-wide basis, Alternative 4 would reduce congestion to four hours, which is similar to current conditions.

Table 3.12-9 summarizes the changes in VMT and VHT for Alternative 4. Before the effects of TDM strategies are considered, the study area VMT would increase up to 16 percent (+2 percent regionally). Although the study area VHT would increase by around 2 percent, it would decrease regionally. The TDM program was estimated to reduce daily VMT 3 to 6 percent.

Since I-405 and study area VMT increase much more than VHT under this alternative, there is a substantial improvement in overall vehicle speeds within the corridor. Regional average speeds improve slightly. Average travel speeds are shown in Table 3.12-10.

Alternative 4 would perform similar to Alternative 3 with regard to addressing the concurrency problems facing local jurisdictions. With the identified facility investments on I-405 and the arterial system, the resulting levels of traffic congestion would be improved and local jurisdictions would be better able to manage their concurrency problems. Since Alternative 4 would likely require the longest implementation time, the concurrency issues may not be substantially addressed for several years.

Safety Impacts

Criterion: Improve the Safety for All Modes Above Current Levels

Alternative 4 would improve 62 percent of the total high accident locations (HALs) on I-5, I-90, I-405, with 80 percent of the HALs on I-405 improved, and 19 percent of the HALs on local streets improved.

Accidents and accident rates with Alternative 4, shown in Table 3.12-11, could be expected to reduce slightly, despite the 20 percent increase in study area VMT that occurs with this alternative. The improvement in accidents with Alternative 4 can be attributed to the shift of traffic from arterial routes to I-405 and the geometric improvements provided by the new construction of additional lanes. Also, a greater percentage of total traffic using a safer freeway system would result in a lower overall accident rate.

Express Lane Demand Management

A sensitivity test was run to determine if demand for the express roadway could be managed using a pricing mechanism. The test assumed that a toll would be charged on a per-mile basis, with varying rates during the A.M., P.M., and off-peak periods. The analysis did not assume a variable rate by user type (e.g., HOV, freight, SOV), although this could be an option.

Overall, the volumes on the express lanes were reduced by 30 to 40 percent. A relatively small shift in volume occurred back to the mainline I-405 (less than 10 percent). The resulting volumes along I-405 with tolls would be similar to the volumes forecasted for Alternative 3. The forecasts showed a small diversion of traffic back to the I-5 corridor.

These results would indicate that the effects of tolling the express roadway on I-405 would cause minimal changes in regional travel patterns or corridor demands. One conclusion could be that trips removed from the express roadway due to tolls would show up as shorter trips within the study area, or trips rerouted to other destinations. Additional analysis of the toll sensitivities to travel behavior and trip patterns would be necessary should the toll concept be advanced further within the I-405 Corridor Program.

3.12.4.6 Preferred Alternative

The Preferred Alternative emphasizes mobility improvements through implementation of a bus rapid transit (BRT) system, substantial expansion of local bus service, and HOV and general purpose roadway improvements on I-405 and connecting arterials. Up to two additional lanes in each direction replace the auxiliary and climbing lanes contained in the No Action Alternative. The Preferred Alternative includes a bus rapid transit system using HOV lanes and direct access on I-405. Selected arterial missing links would be completed together with the planned arterial capacity improvements of local jurisdictions. A corridor-wide TDM program is recommended to provide incentives for carpooling, vanpooling, and transit.

Construction Impacts

The process of adding two lanes in each direction on I-405 would increase the duration and extent of impacts to traffic throughout the study area. Construction would require rebuilding or modifying most bridges and interchanges. Construction would require some temporary narrowing of lanes and shoulders. Temporary detours and lane closures would occur. Although efforts would be made to maintain the existing number of lanes during construction, most traffic control measures would likely result in some decrease in capacity and increases in roadway congestion during the construction periods.

Parallel arterials such as Coal Creek Parkway, Bellevue Way, 148th Avenue, SR 202, and Lake Washington Boulevard would likely experience some traffic increases. There would also be the potential for short-term increases in local street traffic to avoid construction-related traffic impacts such as interchange or arterial connection closures.

The number of years required for the freeway widening construction in the Preferred Alternative will be highly dependent on funding availability. Construction within any given segment of freeway would likely be limited to a 3- to 4-year period, during which localized impacts to connecting arterials and interchanges would be sequenced. Impacts to travelers would vary according to the specific location, time, and length of their trip.

During the construction period, travel time reliability for general traffic would be difficult to manage. However, extensive use of evening, night, and weekend construction times and innovative construction techniques would help maintain reliability during these periods. The bus transit system portion of the Preferred Alternative can also begin service in the short term on the existing HOV lanes and can provide opportunities to accommodate the corridor travel demand that is affected during freeway construction. Implementation of an expanded TDM program and local transit service would also be essential to provide mobility choices to travelers during major construction along I-405. The north-south arterial improvements included in the Preferred Alternative could also occur earlier in the construction period to provide some traffic relief to persons affected by the freeway construction.

Operational Impacts

Transportation operational impacts are defined with respect to three categories of criteria:

1. Mobility impacts: Travel demand by mode, travel times, compatibility
2. Congestion impacts: Hours of congestion, system performance
3. Safety impacts: High accident locations, accident rates

The key findings from the technical studies are identified in the following sections.

Mobility Impacts

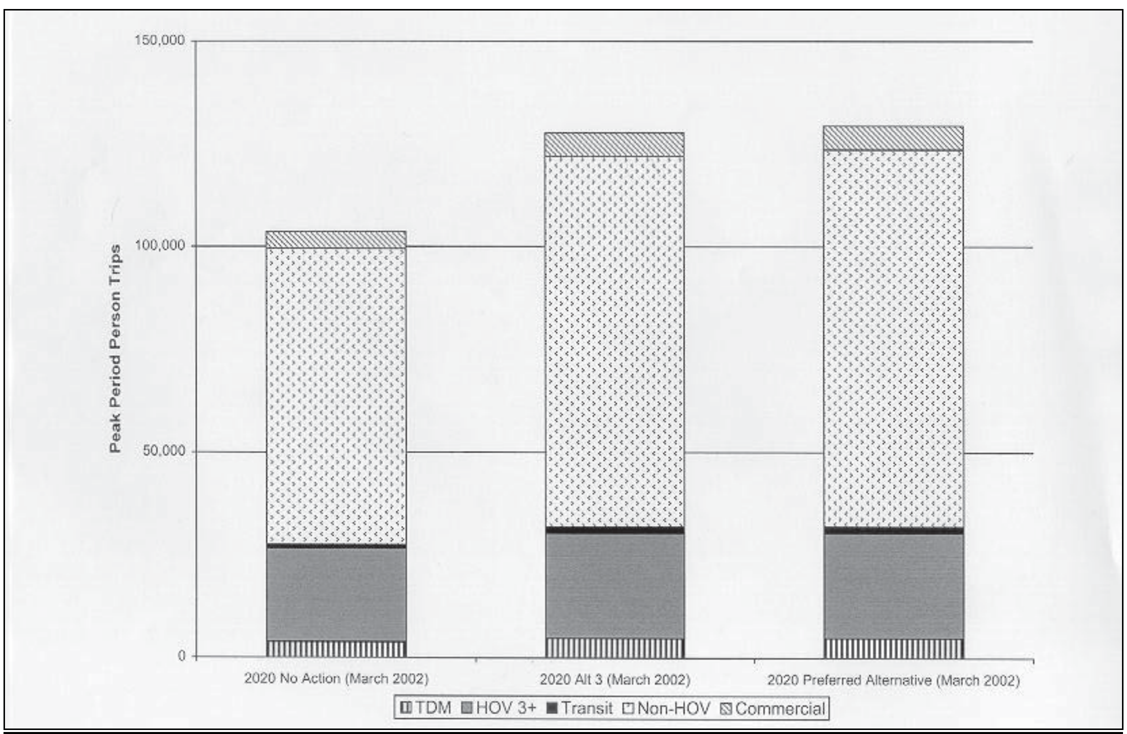
Mobility was evaluated by using six criteria.

Criterion: Serve as Much of the 2020 Peak-Period Travel Demand Within the Corridor as Possible

P.M. Peak-Period Person Volumes by Mode Across 3 Screenlines

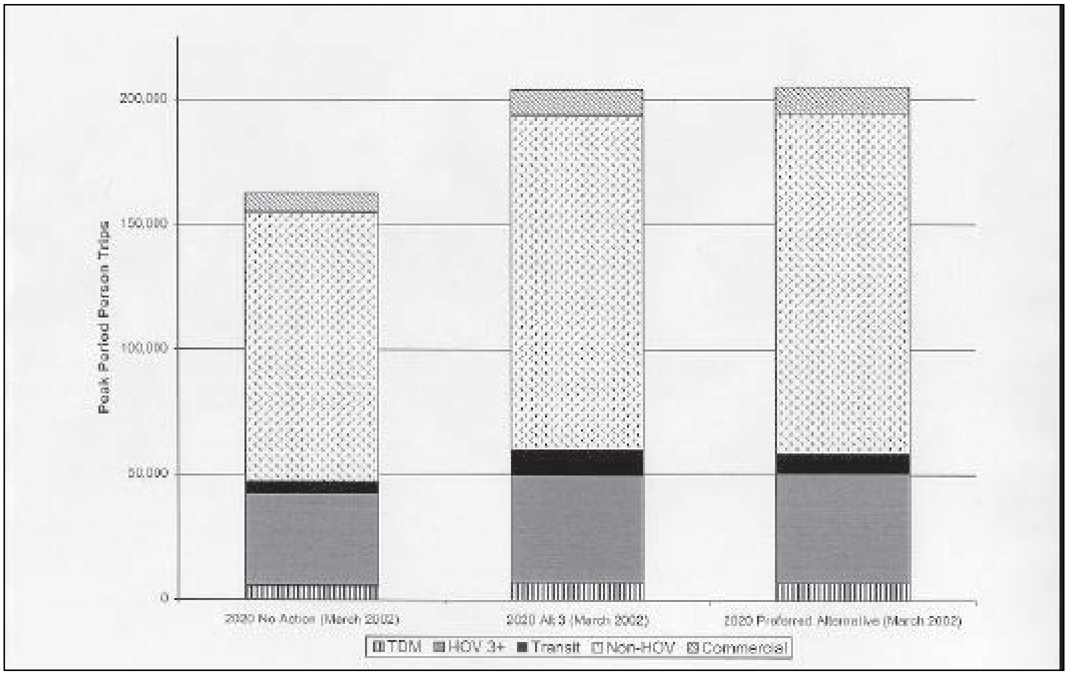
On average, the peak person demand in the Preferred Alternative increases by around 25 percent compared with No Action Alternative conditions and is virtually unchanged from Alternative 3. These trends are shown in Figures 3.12-4A, 3.12-4B, and 3.12-4C. Person demand on I-405 would increase by 55 percent on average and up to 75 percent on some segments, as in Alternative 3. Most of the increase in demand occurs due to the added freeway capacity and expanded transit service.

Figure 3.12-4A: Peak Period Person Demand Comparisons for Preferred Alternative: Bothell Screenline



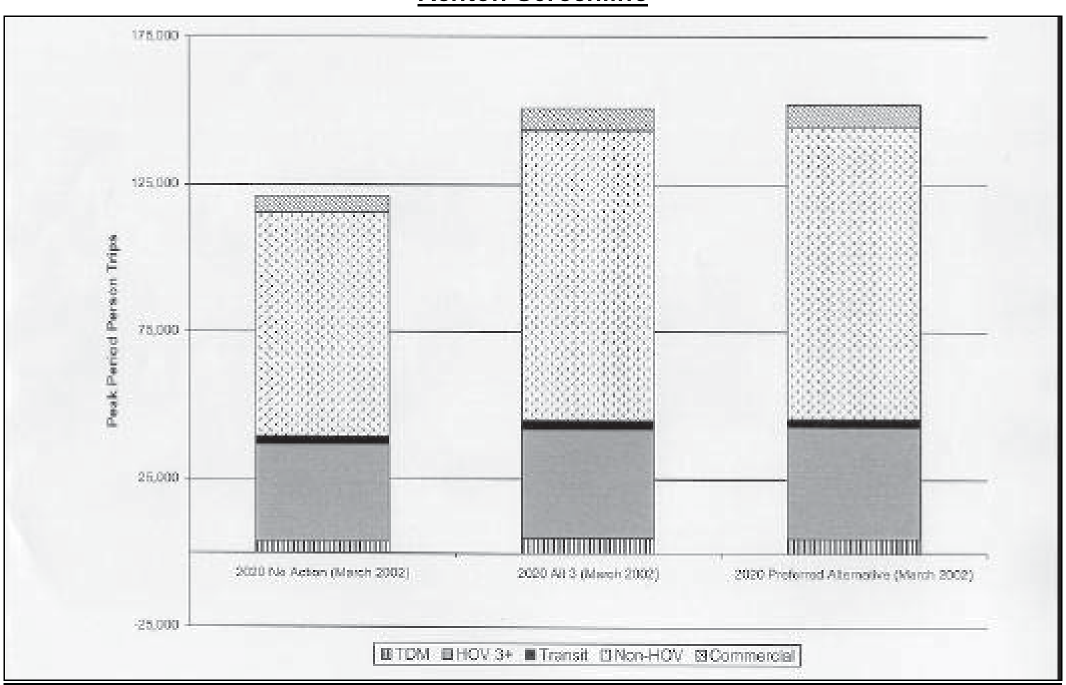
Source: PSRC Model, Parsons Brinckerhoff

Figure 3.12-4B: Peak Period Person Demand Comparisons for Preferred Alternative: Bellevue Screenline



Source: PSRC Model, Parsons Brinckerhoff

Figure 3.12-4C: Peak Period Person Demand Comparisons for Preferred Alternative: Renton Screenline

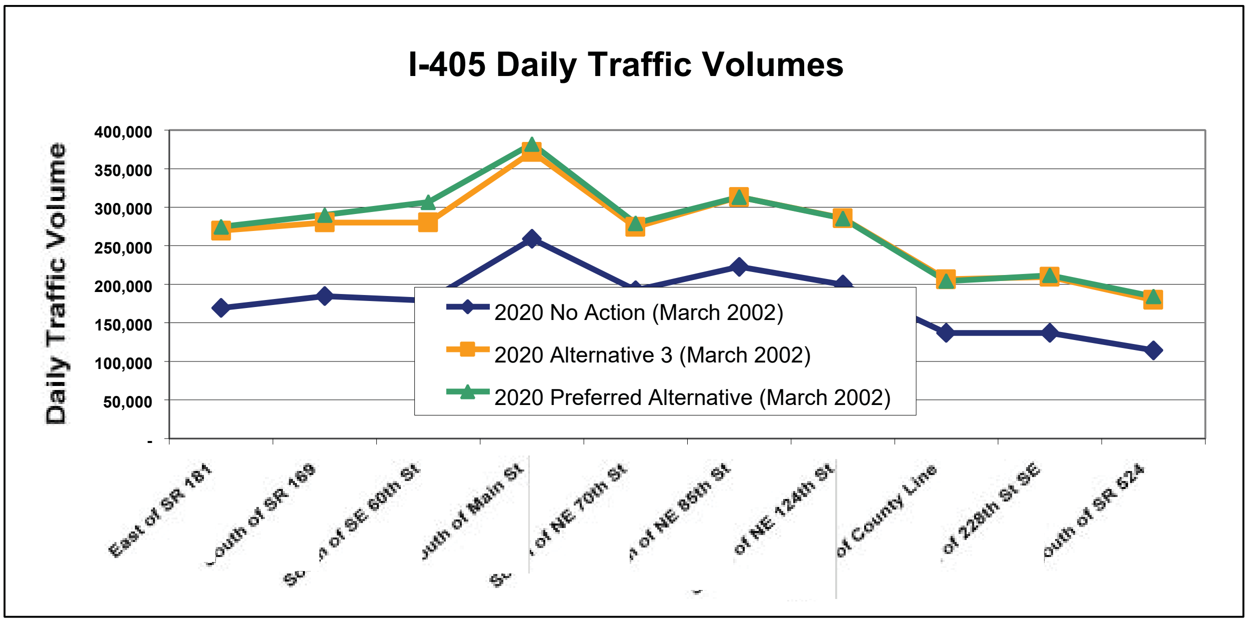


Source: PSRC Model, Parsons Brinckerhoff

Daily and P.M. Peak Period Traffic Volumes by Types of Vehicles (SOVs, HOVs, and Trucks)

The peak vehicle demand across the screenlines in the Preferred Alternative increases by 27 percent compared with No Action Alternative conditions. Figure 3.12-5 compares the daily traffic volumes along I-405 for the Preferred Alternative, No Action Alternative, and Alternative 3. Daily vehicle demand on I-405 increases by around 55 percent at the Bothell and Bellevue screenlines and by over 70 percent in Renton. The highest volumes remain in downtown Bellevue, where the Preferred Alternative adds substantial capacity in collector-distributor lanes combined with one additional through lane on I-405.

Figure 3.12-5: I-405 Daily Traffic Volume Comparisons for Preferred Alternative



Source: PSRC Model

Daily Traffic Volume Shifts between Facilities

The major widening of I-405 in the Preferred Alternative results in substantial increases in peak-period travel demand across the three screenlines within the study area. These results are comparable with the findings from Alternative 3, with the exception that the Preferred Alternative shifts a slightly greater amount of travel from the I-5/SR 99 corridor through Seattle. The daily volumes in north/south travel within Seattle were shown be reduced by 5 to 8 percent, compared with around a 4 to 5 percent reduction with Alternative 3. The net reduction along I-5 was 15,000 to 20,000 vehicles per day. Some of this shift can be attributed to the effects of the additional auxiliary lanes along I-405 to the south of I-90 and improved accessibility along the length of I-405. A related effect of the widening of I-405 is the increase in travel demand on roadways connecting to I-405. Increases of around 10 percent were estimated on the east/west arterials and freeways (e.g., SR 520, I-90) that provide primary access to I-405.

Trip lengths for the Preferred Alternative will be the same as Alternative 3.

Criterion: Improve Reliability of Travel Times for all Modes

The Preferred Alternative would provide higher levels of general traffic travel time reliability than the No Action Alternative. The expansion of I-405 mainline capacity under this alternative would improve general traffic reliability. While I-405 would handle a higher proportion of the corridor travel demand, each mainline section would be reconstructed to current standards, and many interchanges along I-405 would be upgraded to meet standards. As a result, this alternative would greatly improve the ability to manage incidents and provide additional opportunities for vehicles on the freeway to bypass those incidents. The Preferred Alternative also includes additional use of auxiliary and hill-climbing lanes in the heavily traveled section of I-405 between I-90 and SR 900. These actions will provide improved reliability in that section of I-405 compared with Alternative 3. Several north-south arterials would be improved to provide motorists with better travel options should I-405 become blocked or slowed. The duration of traffic congestion would also be reduced, leading to better travel time reliability for both general traffic and freight.

HOV (3+) and transit travel time predictability would improve due to additional HOV direct access ramps that allow HOVs and transit to bypass congestion. Transit will also have exclusive access to certain stations within the bus rapid transit system, together with transit priority treatments on key arterial routes. The reliability of HOV/transit travel along I-405 is dependent upon managing the demand in the HOV lanes by restricting their use to three-or-more-person carpools.

The Preferred Alternative also includes a provision for a 4-foot buffer that could separate the HOV lane from the general traffic lanes. A buffer separation would improve transit and HOV travel time reliability and safety. The buffer and potential for future managed lanes along I-405 provides maximum flexibility for WSDOT to maintain reliability of travel for HOV and transit vehicles.

Criterion: Provide Flexibility to Accommodate Post-2020 Travel Demands

Available Capacity in 2020

The Preferred Alternative would have available corridor travel capacity remaining after 2020. The Preferred Alternative would accommodate 2020 person demand that is up to 25 percent higher than No Action Alternative conditions.

The bus rapid transit element of the Preferred Alternative would operate at up to 45 percent of available capacity in 2020. The BRT system would be able to meet additional post-2020 ridership demand in the corridor by providing additional bus equipment, and park-and-ride and transit center capacity improvements. Additional transit exclusivity could also be provided after 2020 to meet demand.

I-405 congestion levels would improve to better than current conditions in 2020 with the added capacity provided in the Preferred Alternative. By 2030, however, daily traffic volumes within the study area would likely use up most of this capacity, unless other transportation facilities are developed in the region.

Potential for Adaptability

The Preferred Alternative contains a BRT system that offers limited post-2020 opportunities for physical facility expansion within the I-405 right-of-way. However, the 4-foot buffer strip and provision for a future managed lane option within the corridor could offer long-range BRT system enhancement opportunities. In addition, ITS innovations would help to maximize the efficiency for present and future systems.

Criterion: Reduce Travel Times for all Modes Door-to-Door Compared with Current Conditions

General Purpose Traffic

Compared with the No Action Alternative travel times, the Preferred Alternative would substantially reduce travel times for the general purpose traffic, including freight. The travel time reduction would be from 7 to 14 percent (from 4 to 10 minutes). These travel time changes are very similar to the results for Alternative 3 as shown in Table 3.12-13.

Table 3.12-13: General Traffic Travel Time Comparisons for Preferred Alternative (P.M. Peak Period)

	General Traffic[a] Travel Time (Minutes)				
Trips	2020 No Action (March 2002)	2020 Alternative 3 (March 2002)	2020 Preferred Alternative	Change from NA[b]	Change from Alternative 3
Bellevue CBD to Federal Way/Kent	71	63	61	-10	-2
Renton to Mill Creek	74	66	65	-9	-1
Bellevue CBD to Edmonds/Lynnwood	50	43	43	-7	0
Tukwila/Sea-Tac to Redmond/Overlake	49	44	43	-6	-1
Issaquah/Cougar Mtn. to Bothell/Kenmore	54	49	49	-5	0
Issaquah/Cougar Mtn. to Federal Way/Kent	67	63	62	-5	0

[a] Single occupant vehicles, 2-person carpools, trucks
[b] Change compared to 2020 No Action Alternative (March 2002)
Source: Puget Sound Regional Council (PSRC) Model, Parsons Brinckerhoff

HOVs

The travel times for HOVs (3+) under the Preferred Alternative conditions would be very similar to the No Action Alternative and Alternative 3 results as shown in Table 3.12-14.

Table 3.12-14: HOV Traffic Travel Time Comparisons for Preferred Alternative (P.M. Peak Period)

	HOV 3+ Travel Time (Minutes)				
Trips	2020 No Action (March 2002)	2020 Alternative 3 (March 2002)	2020 Preferred Alternative	Change from NA[a]	Change from Alternative 3
Bellevue CBD to Federal Way/Kent	41	40	40	-1	0
Renton to Mill Creek	49	49	49	0	0
Bellevue CBD to Edmonds/Lynnwood	36	36	36	0	0
Tukwila/Sea-Tac to Redmond/Overlake	38	38	38	0	0
Issaquah/Cougar Mtn. to Bothell/Kenmore	42	42	42	0	0
Issaquah/Cougar Mtn. to Federal Way/Kent	48	48	48	0	0

[a] Change compared to 2020 No Action Alternative (March 2002)
Source: Puget Sound Regional Council (PSRC) Model, Parsons Brinckerhoff

Transit

Transit travel times were revalidated during the development of the Preferred Alternative forecasts and resulted in considerably higher travel time estimates for all transit trips. However, the relative travel time changes between the No Action Alternative and the Preferred Alternative are similar to those previously reported for Alternative 3. The Preferred Alternative would improve transit travel times by up to 21 percent compared to the No Action Alternative, as shown in Tables 3.12-15 and 3.12-16. Actual transit travel time savings are in the 10- to 16-minute range for park-and-ride access, and up to a 12- to 22-minute range for walk access trips. Much of the travel time improvements are due to reductions in in-vehicle transit times. Walk access times also decrease due to added transit routes and more frequent service. The small variations in transit travel times between Alternative 3 and the Preferred Alternative are due to changes in transit routes and service levels.

Table 3.12-15: Transit (Walk-and-Ride) Travel Time Comparisons for Preferred Alternative (P.M. Peak Period)

Trips	Transit Travel Time with Walk-and-Ride Access (Minutes)				
	2020 No Action (March 2002)	2020 Alternative 3 (March 2002)	2020 Preferred Alternative	Change from NA[a]	Change from Alternative 3
Bellevue CBD to Federal Way/Kent	113	96	99	-14	3
Renton to Mill Creek	149	137	138	-11	1
Bellevue CBD to Edmonds/Lynnwood	101	91	92	-9	1
Tukwila/Sea-Tac to Redmond/Overlake	128	117	115	-13	-2
Issaquah/Cougar Mtn. to Bothell/Kenmore	156	133	135	-21	2
Issaquah/Cougar Mtn. to Federal Way/Kent	164	153	154	-10	1

[a] Change compared to 2020 No Action Alternative (March 2002)
Source: PSRC Model, Parsons Brinckerhoff

Table 3.12-16: Transit (Park-and-Ride) Travel Time Comparisons for Preferred Alternative (P.M. Peak Period)

Trips	Transit Travel Time with Park-and-Ride Access (Minutes)				
	2020 No Action (March 2002)	2020 Alternative 3 (March 2002)	2020 Preferred Alternative	Change from NA[a]	Change from Alternative 3
Bellevue CBD to Federal Way/Kent	98	86	88	-10	2
Renton to Mill Creek	133	120	121	-12	1
Bellevue CBD to Edmonds/Lynnwood	95	76	79	-16	3
Tukwila/Sea-Tac to Redmond/Overlake	115	106	105	-10	-1
Issaquah/Cougar Mtn. to Bothell/Kenmore	135	117	119	-16	2
Issaquah/Cougar Mtn. to Federal Way/Kent	147	135	135	-12	0

[a] Change compared to 2020 No Action Alternative (March 2002)
Source: PSRC Model, Parsons Brinckerhoff

Freight

The Preferred Alternative provides significant capacity increases in the system that would be beneficial to truck freight travel time and reliability. Truck travel time savings would be comparable to general traffic conditions shown in Table 3.12-13. Rail freight movements would not be affected along the BNSF rail line.

Criterion: Reduce the Share of Peak-Period and Daily Trips Made by Single-Occupant Vehicles

HOV usage in the Preferred Alternative increases by around 15 percent compared with the No Action Alternative. Transit usage at all three screenlines also increases in the Preferred Alternative at levels comparable to Alternative 3. Figure 3.12-6 illustrates the transit usage of the BRT system. Highest ridership forecasts include over 30,000 daily riders across Lake Washington (on SR 520 and I-90) and 15,000+ riders through Bellevue. BRT segments into Kirkland, Redmond, and north Renton carry ridership in the 5,000 to 10,000 daily range, with volumes tapering off outside of these central portions of the study area. Along SR 520 to the west of I-405, transit volumes are highest across Lake Washington. Volumes on SR 520 decrease to the east of Bellevue Way where major cross-lake routes join the corridor from Bellevue and Kirkland. These results are similar to the HCT ridership in Alternatives 1 and 2 and the BRT system analyzed in Alternative 3.

Combined P.M. peak-period mode shares for HOV and transit at the three screenlines are 24 percent, compared with 26 percent in the No Action Alternative. Although HOV/transit persons increase by 18 percent overall, the total screenline person volumes increase by 25 percent due to the expansion of person capacity in the corridor. This results in the slight reduction in HOV/transit mode share (as a percent), even though the actual number of HOV/transit persons increases. These findings are comparable to those reported for Alternative 3.

The TDM program effects in the Preferred Alternative would be similar to Alternatives 2 and 3. It is estimated that the combination of additional vanpools and carpooling incentives could result in up to an additional 10 percent increase in HOV 3+ mode share and a 20 to 30 percent additional increase in peak-period transit use. Overall, the combination of the transit and TDM strategies contained in the Preferred Alternative could result in a reduction of corridor peak-period single-occupant trips in the 10 percent range.

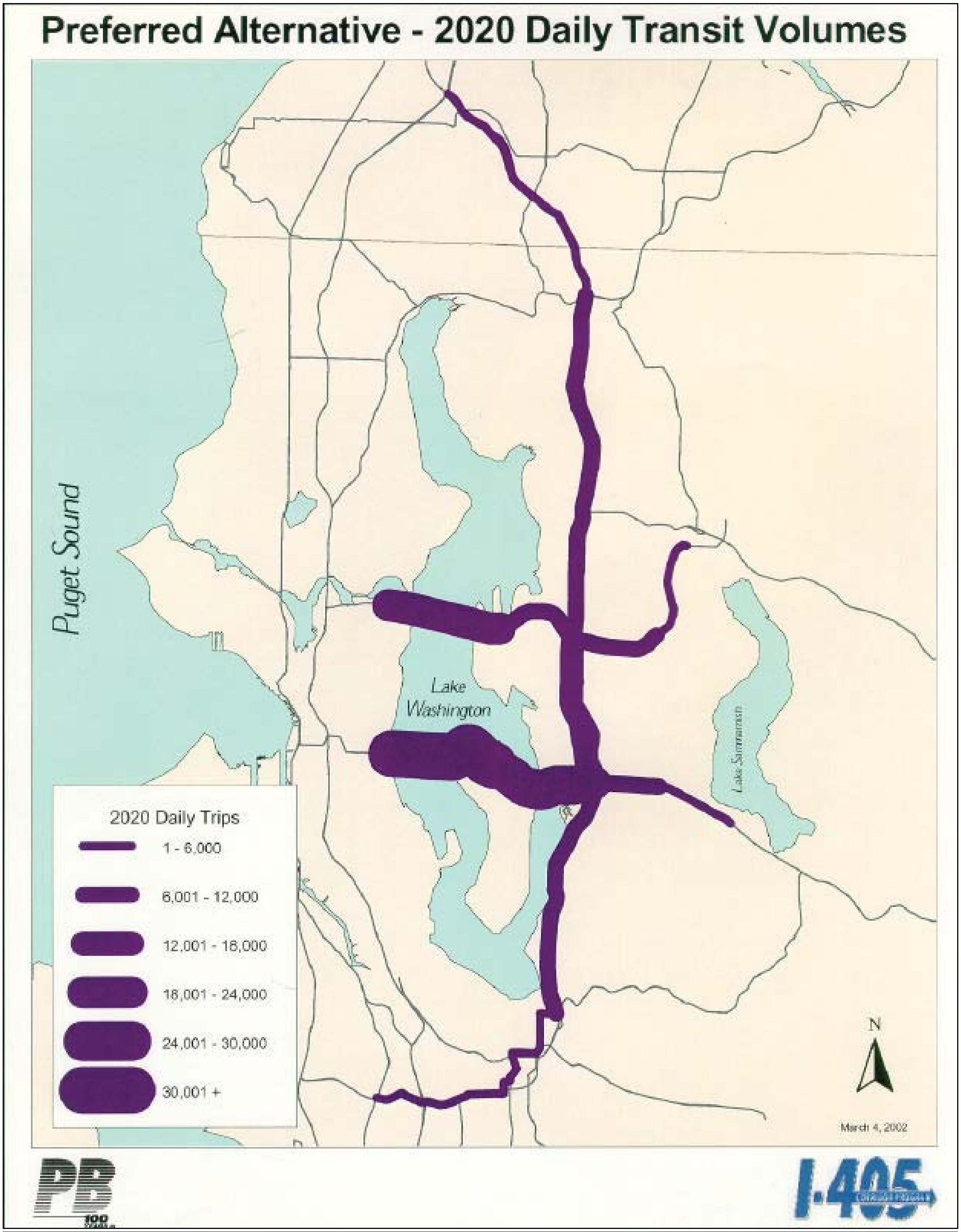
Criterion: Provide Effective Connections to Regional and Local Transportation Systems

Overall, the transit system compatibility with the regional system is much better in the Preferred Alternative than under the No Action Alternative and is comparable with Alternative 3.

This alternative assumes that the urban centers would be served by a bus rapid transit system using the HOV lanes and direct HOV access interchanges. These HOV interchanges would also allow interface with the regional passenger rail network. The freeway-to-freeway direct HOV ramp connections would also be provided. The general purpose traffic capacity of I-405 would be expanded substantially under this alternative, as well as the connecting freeway capacity. As a result, the compatibility with the regional general purpose transportation network would be better than under the No Action Alternative.

The compatibility problems existing under the No Action Alternative would be reduced or largely eliminated. General purpose traffic, including truck freight movement, would be improved substantially. Since many of the arterial improvements in this alternative have been adopted in the local transportation plans, actions to implement those improvements would make this alternative more compatible with local transportation plans. Key arterial ”missing links” would be added or improved to provide better roadway connectivity within the study area. Some of the identified arterial projects would need to be integrated into local plans.

Figure 3.12-6: 2020 Daily Transit Volumes for Preferred Alternative



Congestion Impacts

Criterion: Reduce Congestion on Study Area Freeways and Arterials Below Current Levels

The Preferred Alternative would reduce the hours of traffic congestion substantially as shown in Table 3.12-17. In the southern sections of I-405, the hours of congestion would be shortened by up to seven hours a day between SR 167 and I-5. Most of the segments in the north section would operate with less than five hours of congestion, which would be better than conditions today. Congestion is reduced, compared with Alternative 3, in the I-405 section between NE 44th Street and I-90. This is primarily due to auxiliary and hill-climbing lanes added to this section as part of the Preferred Alternative. There is also an improvement in congestion through Kirkland due to slight shifts in travel patterns, possibly caused by added arterial capacity in the Sammamish River valley.

When hours of traffic congestion for all the I-405 segments are averaged, four hours of congestion are projected, two hours less than the No Action Alternative and one hour less than Alternative 3. Average hours of congestion on arterials and other freeways also improve by one hour a day. The average congestion total for all roads would improve to levels similar to current conditions.

Table 3.12-17: Hours of Traffic Congestion by I-405 Segment for Existing, No Action, and Preferred Alternative

I-405 Segment	Hours of Congestion and the Change from No Action Alternative				
	1999[a]	No Action (NA)[a]	Alternative 3[a]	Preferred Alternative[b]	Change from NA[c]
I-5 to SR 167	12	13	6	6	-7
SR 167 to NE Park Dr.	10	14	10	11	-3
NE Park Dr. to 44th [d]	7	8	5	5	-3
44th to I-90 [d]	10	9	10	5	-4
I-90 to SR 520	9	8	5	5	-3
SR 520 to NE 85th St.	5	5	4	5	0
NE 85th Street to NE 124th St.	5	9	5	3	-6
NE 124th St. to SR 522	4	8	5	5	-3
SR 522 to SR-527 [d]	4	6	0	1	-5
SR 527 to I-5 [d]	0	2	0	0	-2
Average of I-405	7	7	5	4	-3
Average of Other Freeways	3	5	4	4	-1
Average of Arterials	3	5	4	4	-1
Average of All Facilities	4	5	4	4	-1

[a] Data from DEIS table 3.12-8
[b] Preferred Alternative results were normalized to be comparable to DEIS data.
[c] Change compared to No Action Alternative
[d] Segments split from original data
Source: Puget Sound Regional Council (PSRC) Model, Mirai Associates

Table 3.12-18 shows that the study area vehicle miles of travel (VMT) would increase by up to 12 percent (+2 percent regionally), before the effects of TDM strategies are considered. Study area vehicle hours of travel (VHT) would increase about 2 percent, while regional VHT would increase slightly. The TDM program could result in reducing daily VMT by 3 to 6 percent. The TDM reduction would offset part of the VMT increase created by the added capacity provided on I-405 and connecting facilities. Although not estimated, VHT reductions due to TDM strategies could be expected to be similar to those shown for VMT.

Table 3.12-18: VMT and VHT Comparisons for Preferred Alternative

Alternative	VMT (Daily)		VHT (Daily)	
	Study Area (trips within)	Region-wide	Study Area (trips within)	Region-wide
2020 No Action Alternative (Mar 2002)	23,927,000	102,770,000	834,000	3,389,000
2020 Alternative 3 (Mar 2002)	26,356,000	104,274,000	848,000	3,367,000
Change vs. No Action Alternative (%)	10.2%	1.5%	1.7%	-0.6%
2020 Preferred Alternative (Mar 2002)	26,680,000	104,459,000	853,000	3,366,000
Change vs. No Action Alternative (%)	11.5%	1.6%	2.3%	0.7%

Source: PSRC Model

As shown in Table 3.12-19, average speeds on I-405 and in the study area improve substantially in the corridor, but only slightly region-wide. Overall travel speeds are higher than reported in the DEIS due to changes in modeling procedures described previously.

Table 3.12-19: Average Travel Speeds Comparisons for Preferred Alternative

Alternative	Average Speeds in mph (A.M. Peak Period/P.M. Peak Period/Daily)		
	I-405	Study Area (Trips Within)	Region-Wide
2020 No Action Alternative (Mar 2002)	42/30/38	31/23/29	32/26/30
2020 Alternative 3 (Mar 2002)	51/37/47	34/26/31	33/26/31
2020 Preferred Alternative (Mar 2002)	52/38/47	34/26/31	33/26/31

Source: PSRC Model

The Preferred Alternative actions would assist local jurisdictions to better manage level of service and concurrency. The capacity expansions on I-405 assumed in the Preferred Alternative would shift some traffic back to I-405 from the arterials. The Preferred Alternative also adds more arterial capacity than was considered in Alternative 3. Since the Preferred Alternative would take several years to implement, short-term concurrency issues would remain.

Safety Impacts

Criterion: Improve the Safety for All Modes Above Current Levels

The Preferred Alternative would be similar to Alternative 3 in improving high accident locations (HALs) on I-5, I-90, I-405, and other state routes. The addition of two general purpose (GP) lanes and other basic improvements would generally improve the geometrics of the freeway corridor. The inclusion of a buffer separation between the GP and HOV lanes would result in safer operations for transit and HOV, while also providing better travel time reliability.

Accidents rates in the study area would improve with the Preferred Alternative in comparison with No Action. Total accidents would increase by 1 percent, even though vehicle miles traveled would increase by 18 percent. Injury accidents would decrease slightly due to a shift in traffic away from more hazardous arterial streets (Table 3.12-20).

Several nonmotorized hazard locations would be improved with the Preferred Alternative.

Table 3.12-20: Study Area Accident Comparison for the Preferred Alternative (March 2020)

Alternative	Total Accidents (per million VMT)	Injury Accidents (per million VMT)	Fatal Accidents (per 100 million VMT)
No Action Alternative	13,689 (1.99)	7,951 (1.15)	51 (0.63)
Alternative 3	16,500 (1.70)	7,623 (0.96)	50 (0.63)
Preferred Alternative	13,861 (1.71)	7,835 (0.96)	51 (0.63)

Source: PSRC Model, Mirai Associates

3.12.5 Mitigation Measures

3.12.5.1 Construction

The No Action Alternative involves no additional construction beyond what is planned and committed within the corridor. Beside the usual and customary detours and other construction scheduling set for these projects, no additional mitigation is anticipated.

Each of the action alternatives and the Preferred Alternative will require mitigation of construction impacts. Efforts in all cases will be made to maintain existing traffic lanes during construction.

Roadway Construction

Depending on the specific project element for each of the action alternatives and the Preferred Alternative, one or more construction mitigation measures will be employed for roadway construction where appropriate, such as:

- Providing a construction traffic manager and traffic management team with full-time responsibilities to develop traffic management plans that minimize traffic delays and disruptions. Public input would be sought in developing the traffic management plans. This team would be in place throughout the design and construction phases of the project. Responsibilities would include:
  - Coordinating traffic control with local agencies and other transportation projects in the region.
  - Coordinating construction activities with transit agencies, police, fire, and emergency service providers.
  - Disseminating information to local businesses and the general public regarding construction activities, roadway closures, and alternative modes of travel through direct mail, radio, and other advertising such as roadway signs, transit billboards, etc.
  - Holding community information and status report meetings prior to and/or during construction.

- Maintaining a construction information hotline to resolve problems and respond to questions from the public regarding construction activities.
- Implementing TDM and transit investments necessary to provide alternative means and routes for travel in the impacted sections prior to roadway construction.
- Maintaining an HOV lane for transit and carpool utilization throughout construction zones.
- Enhancing intelligent transportation system (ITS) facilities and systems in advance of and during construction to inform the public, reduce demand, and manage traffic flow.

- Implementing transportation system management (TSM) and transportation demand management (TDM) strategies aimed at increasing vehicle occupancy and reducing travel demand.
- Sequencing construction packages to assure related systems in corridor segments are complementary, for example widening an arterial prior to widening an adjacent freeway section.
- Utilizing construction experts to evaluate methods that can shorten contract duration and minimize impacts during the design phase.
- Providing monetary incentives to contractors to shorten construction times, and monetary penalties for exceeding allowed time.
- Allowing full-time road closures to speed construction when appropriate.
- Providing construction staging areas and access to work sites that minimize disruption to general traffic.
- Leasing existing parking lots for park-and-ride use to assist with local access and advance the implementation of additional park-and-ride facilities.
- Restricting lane closures and construction activities that impact traffic during peak commuter hours.
- Utilizing moveable barriers for lane closures where appropriate to allow full roadway utilization during peak periods.
- Restricting construction activities during peak holiday travel periods.
- Maintaining access to local business and residences.

Construction Duration

- Maintaining 5-year construction duration for the major project segments, where possible.

Construction Techniques:

- Considering outside widening first to allow for shifting of traffic.
- Doing all widening on one side or the other of centerline.
- Using contra flow lanes.
- Considering closure of cross-freeway traffic in interchanges while maintaining ramp movements.

- Temporarily narrowing existing lanes and shoulders to provide work zones.
- Building in width needed for maintaining traffic early in the design process.

Transit Construction

Construction of the major transit elements (fixed-guideway) of Alternatives 1 and 2 may involve work on the BNSF Railroad right-of-way, as well as on the I-405 freeway adjacent arterial network. Unlike roadway construction, HCT sections would most likely be opened at one time. Park-and-ride facilities would be dispersed throughout the study area with shorter-term impacts. Methods to lessen traffic impacts for HCT segments include the methods described above for roadways, and would also include:

- Delivering roadbed materials and other components by rail and/or truck using the HCT right-of-way when feasible.
- Using standard designs and construction methods for stations that result in quick completion.
- Allowing for road closures during non-peak periods to complete critical segments faster.

3.12.5.2 Operations

Because the No Action Alternative does not include transportation effects beyond the baseline projects, it would not require operations mitigation beyond that already incorporated into these planned and programmed projects.

Each of the action alternatives improves overall transportation performance, to varying degrees, relative to the No Action Alternative. No additional transportation operations mitigation is required to meet the objectives embodied in each of the action alternatives.

This page left intentionally blank.

3.13 LAND USE

3.13.1 Studies and Coordination

For this programmatic analysis, the land use impacts evaluation required a regional viewpoint. In order to accomplish that, the Puget Sound Regional Council (PSRC) land use forecasting model (DRAM/EMPAL) was used because the study area is located within the four counties covered by the PSRC: Snohomish, King, Pierce, and Kitsap. This forecasting model is used by the PSRC to develop and update its Metropolitan Transportation Plan (MTP). State law requires the transportation elements of local comprehensive plans to be certified as consistent with the MTP. (See the *I-405 Corridor Program Draft Land Use Expertise Report* [DEA, 2001a] herein incorporated by reference, for a more detailed discussion of the assumptions in the modeling process.)

The PSRC model results project employment, population, and household growth in numbers and geographical areas over the next 20 years based on comprehensive plans. Specifically, PSRC prepares regional forecasts of population and employment and allocates them to the Forecast Analysis Zones (FAZs) using the DRAM/EMPAL model. The county forecast totals are not controlled, but are aggregations of the FAZs. The Regional Council's forecasts are consistent with the Office of Fiscal Management's minimum and maximum projections. Applying the I-405 Corridor Program effects to this model necessitated adding the proposed transportation improvements to the DRAM/EMPAL model in the form of increased access and mobility. In addition, King County, Snohomish County, and the PSRC were consulted in order to gain an understanding of issues related to projected growth and planned land use changes. The results of this modeling are discussed in Section 3.23.3.5.

3.13.2 Land Use and Transportation Plans and Policies

Land use in the study area is managed through comprehensive plans prepared for each jurisdiction and guided by countywide planning policies adopted in accordance with the GMA (RCW 36.70A). *VISION 2020* (PSRC, 1995), the *Destination 2030* Metropolitan Transportation Plan, and the countywide and multi-county planning policies are reflective of the GMA mandates and are intended to foster consistency between the local plans. Land use management is accomplished through the development regulations and capital improvement programs of each jurisdiction. The relationship of the proposed action to land use plans and policies is discussed in greater detail in the *I-405 Corridor Program Draft Land Use Plans and Policies Report* (DEA, 2001b) herein incorporated by reference. The key policies are contained in the GMA, Metropolitan Transportation Plan, *VISION 2020*, Sound Move/Sound Transit, King County and Snohomish County countywide planning policies, Puget Sound Regional Council multi-county planning policies, and local comprehensive plans.

The GMA establishes the underlying framework for local governments as well as state and regional agencies to coordinate their respective comprehensive plans and transportation planning efforts. The GMA contains specific provisions to ensure that most of the region's future growth is accommodated in or immediately adjacent to areas that are already urban in character. Existing rural areas, critical areas, and resource lands must be protected. It requires the region's four counties and the local jurisdictions to cooperatively create well-defined urban growth areas (UGAs) for this purpose.

King, Snohomish, Pierce, and Kitsap counties have all complied with GMA requirements to develop and adopt countywide planning policies (CWPPs). These CWPPs provide specific policy direction to the counties and their cities in the creation of UGAs and the preparation of their individual comprehensive plans to accommodate the 20 years' population growth projection allocated to them by OFM. These policies include important provisions that:

- Promote growth and higher development densities in Urban Centers in the UGAs;
- Discourage development and the extension of urban services and/or infrastructure in rural areas; and
- Promote high-capacity multimodal infrastructure that connects Urban Centers.

It is important to realize that there is a distinct difference between the overall Urban Growth Area, which provides the boundary for long-term growth, and the Urban Centers, which are focal points of high density and transportation infrastructure.

The key to the Urban Centers involves strengthening and revitalizing existing centers for new community focus and regional transportation hubs. The *I-405 Corridor Program Draft Land Use Expertise Report* (DEA, 2001a) describes the specific Urban Centers that are within the study area.

The Puget Sound Regional Council has adopted multi-county planning policies as provided by GMA that coordinate and reinforce the CWPPs prepared by the four counties. The PSRC has also adopted *VISION 2020* and the *Destination 2030* Metropolitan Transportation Plan to guide and coordinate the region's growth. *VISION 2020* serves as the regional long-range growth management, economic development, and transportation strategy. It established a multiple-center approach to development that promotes a jobs/housing balance and plans for needed transportation improvements, specifying that transportation improvements should occur at the same time as employment and population growth to implement the concurrency requirements of GMA.

The MTP was initially adopted in 1995. The MTP is a long-range plan to guide transportation investments in the central Puget Sound region. It includes specific provisions relevant to the I-405 Corridor Program, including policies to support development of dense centers and a greater mix of land uses connected by a network of transit and non-motorized modes of travel. *Destination 2030* is the 2001 update to the MTP. *Destination 2030* is focused on implementation options and is intended to be consistent with the multi-county planning policies. The MTP focuses growth into the UGA, which is consistent with *VISION 2020*, the I-405 Corridor Program objectives, and the Trans-Lake Washington Project objectives. Key components of the MTP that tie into these objectives include regional transportation pricing strategies, expansion of the freeway HOV lane system, development of arterial HOV systems, facilities for pedestrians and bicycles, travel demand management actions, and establishment of a high-capacity transit system within congested corridors that connect Urban Centers.

In association with local jurisdictions and the state, King County is in the process of identifying and developing a regional arterial network (RAN) system connecting urban corridors. The RAN would consist of a system of regionally important arterials that serve as major transit, freight, and/or general mobility corridors. Twenty-eight RAN corridors are included in the I-405 study area.

All of the local jurisdictions in the I-405 Corridor Program study area have adopted comprehensive plans in accordance with requirements of GMA, their respective CWPPs, and the PSRC multi-county planning policies. These comprehensive plans include a transportation element that has been reviewed and certified by the PSRC as conforming to the transportation planning elements of the GMA, *VISION 2020*, and *Destination 2030*. There are 80 adopted comprehensive plans in the Puget Sound region, 74 of which have certified transportation elements. The transportation elements require that key infrastructures be built or planned for within a 6-year time frame. The I-405 Corridor Program alternatives are generally consistent with the MTP and supportive of the applicable jurisdictional local transportation plans.

3.13.3 Methodology

To evaluate each alternative's potential effects on growth and development, projected future land use was examined based on year 2020 PSRC forecasts and comprehensive plans for jurisdictions in the study area. Since some of the proposed transportation improvements would affect more than one land use type, the most environmentally sensitive land use types were used to characterize impacts.

In order to provide a programmatic analysis for the potential effects on adjacent land uses, a table of projected 2020 land uses (Appendix C) was generated that lists the proposed projects and the adjacent land uses. The land use types closest to an undisturbed natural setting were considered most sensitive, followed by residential uses, and then commercial and industrial uses.

Direct impacts to land use are those land use changes that would occur as a localized effect of construction and operation of proposed transportation improvements. These impacts, including right-of-way acquisition, displacements, and proximity effects, were evaluated by comparing individual transportation improvements with generalized future land use types compiled and mapped in the geographic information system (GIS). Acquisition of land for right-of-way when surrounding land uses would not be changed was not considered a substantial land use impact. Analyses of right-of-way acquisitions and displacements are presented in detail in the *I-405 Corridor Program Draft Right-of-Way and Displacement Expertise Report* (DEA, 2001c) and in Section 3.14.

3.13.4 Affected Environment

Land use in the study area has undergone substantial change as transportation has improved accessibility. In the past 50 years there has been a steady transition from forest agriculture to rural/suburban and then to suburban and urban with identifiable Urban Centers. What were once "bedroom" communities, such as Bellevue and Redmond, have been transformed into major employment and commercial centers. The long-term growth trend has been population dispersion outward from Seattle and, later, from Eastside (east of Lake Washington) cities eastward into agricultural and forested areas. Growth has also taken place throughout the I-405 corridor due to businesses' accessibility to the transportation system and workers' accessibility to residential areas.

At the regional level, the counties in the central Puget Sound region (King, Kitsap, Pierce, and Snohomish counties) have coordinated planning activities through the Puget Sound Regional Council. Passage of the GMA in 1990 brought about the designation of UGAs, areas where growth was to be concentrated as a means of controlling urban sprawl. The GMA directs local jurisdictions to develop plans to accommodate the 20-year population growth projected by OFM and allocated to each jurisdiction. The intent of the UGA is to channel investments in infrastructure within the already built-up areas, especially cities, and discourage growth in rural areas. Generally, growth outside the UGA boundaries is constrained by very low-density zoning and restrictions on the extension of urban utilities and services. Growth management planning in the study area and the region is discussed in detail in the *I-405 Corridor Program Land Use Plans and Policies Report* (DEA, 2001b).

Several sources were examined to determine whether or not there is land capacity within the study area to contain employment and population growth to at least the year 2020 within the current UGA boundary. In consultation with PSRC, it was determined that designated UGAs within King County could absorb all of the growth forecasted to take place until at least 2020 (Blain, 2000). Similarly, it was determined that designated UGAs within Snohomish and Pierce counties have the capacity to absorb their forecasted growth.

King County government and other local jurisdictions within the county monitor land capacity for residential land development (Growth Management Planning Council, April 1997) as part of their long range planning process. The most recent residential land capacity analysis (King County, 2000) indicated that there is land available for 120,000 new residential units and 200,000 multifamily units. During the period from 1997 to 2020, the projected demand for single-family units is 113,000 and for multi-family units is 145,000. These numbers indicate that the study area can absorb the growth. Some potential capacity constraints may be relieved by redevelopment of some areas at higher densities or increasing the densities where properties are currently underutilized. Residential land availability is substantially greater relative to demand in Snohomish County.

3.13.5 Direct Impacts

Analysis of direct land use impacts (right-of-way acquisitions and displacements) is presented in Section 3.14 and is briefly summarized for each action alternative below. This report acknowledges the potential for direct impacts on some existing land uses; however, until the project-level design and environmental analysis, documentation, and review are accomplished, the specific direct impacts cannot be known. The direct impacts of the No Action Alternative projects are, or will be, addressed in the environmental analysis, documentation, and review conducted for those projects.

3.13.5.1 Alternative 1: HCT/TDM Emphasis

This alternative emphasizes reliance on fixed-guideway high-capacity transit (HCT) within the study area and substantial expansion of bus transit service. Alternative 1 includes 109 projects ranging from basic improvements on I-405 to HCT. Many of the projects in Alternative 1 require purchase of land for new right-of-way. Forty-eight of the Alternative 1 projects may have some impacts during construction activities. Please refer to Section 3.14 and the *I-405 Corridor Program Draft Right-of-Way and Displacements Expertise Report* (DEA, 2001c) for a more detailed description. The localized potential direct impacts are generally limited to the HCT, I-405 improvement projects, arterial HOV improvements, and park-and-rides. Table C.2 in Appendix C shows the types of land uses that could experience localized direct impacts.

3.13.5.2 Alternative 2: Mixed Mode with HCT/Transit Emphasis

Alternative 2 emphasizes a fixed-guideway HCT system and substantial expansion of bus transit service, similar to Alternative 1. It also emphasizes improved mobility for other travel modes by providing HOV and general purpose roadway improvements on I-405 and connecting arterials.

Alternative 2 includes 162 projects ranging from basic improvements to I-405 to HCT and a number of arterial projects. Many of the projects in Alternative 2 require purchase of land for new right-of-way, and 63 of the Alternative 2 projects may have impacts on existing or future land use activities. The localized potential direct impacts are generally limited to the HCT, I-405 improvement projects, arterial HOV improvements, arterial projects, and park-and-rides. Table C.3 in Appendix C details by project the type of land use that could experience localized direct impacts.

3.13.5.3 Alternative 3: Mixed Mode Emphasis

Alternative 3 emphasizes mobility improvements for all travel modes through implementation of a bus rapid transit system, substantial expansion of bus transit service and HOV facilities, and two general purpose lanes on I-405 in each direction and associated arterial improvements.

Many of the projects in Alternative 3 require acquisition of land for new right-of-way, and 56 of the Alternative 3 projects may support focusing growth within the local Urban Centers. The localized potential direct impacts are generally limited to the I-405 improvement projects, arterial HOV improvements, and park-and-rides. Table C.4 in Appendix C details by project the type of land use that could experience localized direct impacts.

3.13.5.4 Alternative 4: General Capacity Emphasis

Alternative 4 emphasizes general purpose and HOV capacity by providing one additional lane in each direction on I-405 and a four-lane express roadway.

Many of the projects in Alternative 4 require purchase of land for new right-of-way, and 27 of 116 projects in Alternative 4 may impact existing or future land use activities. The localized potential direct impacts are generally limited to the I-405 improvement projects, arterial HOV improvements, and park-and-rides. Table C.5 in Appendix C details by project the type of land use that could experience localized direct impacts.

3.13.5.5 Preferred Alternative

The Preferred Alternative, similar to Alternative 3, is a multimodal solution that emphasizes development of a bus rapid transit system, substantial expansion of transit service and station capacity, improved arterial HOV capacity for transit, additional park-and-ride capacity, new transit centers and capacity improvements, freeway HOV and BRT direct access ramps, completion of the HOV freeway-to-freeway ramps along I-405, a variety of pedestrian and bicycle connections, addition of up to two general purpose lanes in each direction on I-405, and connecting arterial improvements.

Alternative 3 is the basis for the Preferred Alternative, and the land use modeling results of Alternative 3 reflect those expected under the Preferred Alternative. Thus, the Preferred Alternative would support planned growth in the Urban Centers by providing the necessary infrastructure to enhance planned connectivity and concentration of growth.

This growth is:

1. Projected by PSRC;
2. Planned by the regional and local jurisdictions under state and regional GMA polices; and
3. Supported by PSRC's certification of the county and local transportation plans.

Additionally, the multimodal elements of the Preferred Alternative exemplify the regional multimodal approach called for in the Multicounty Planning Policies. These elements include general purpose lanes, HOV lanes, a bus rapid transit system, direct access ramps for HOV and BRT, pedestrian connections and overpasses, bicycle lanes, and TDM strategies.

The expansion of I-405 capacity would draw the regional traffic from the arterials back to I-405. It provides a regional accessible corridor that supports the PSRC forecasted growth without adverse impacts to the rural areas. The Preferred Alternative would be an important catalyst to obtain regional goals emphasizing density and transit supportive land use in the Urban Centers.

3.13.6 Consistency with Key Land Use and Transportation Plans and Policies

The following section summarizes and expands the review of consistency with adopted plans and policies. The *I-405 Corridor Program Draft Land Use Plans and Policies Expertise Report* (DEA, 2001b) provides further analysis regarding the county and city policies.

3.13.6.1 Regional Consistency – VISION 2020 and Destination 2030 Metropolitan Transportation Plan (Update)

All of the action alternatives, including the Preferred Alternative, contain transportation improvements that are consistent with and support the intent of *VISION 2020* and *Destination 2030*, the Metropolitan Transportation Plan. Specifically, as a comprehensive and long-range program of regional transportation investments, the I-405 Corridor Program Preferred Alternative typifies the response called for in the transportation and land use policies. *VISION 2020* and *Destination 2030* include policies that support the development of dense Urban Centers and a greater mix of land uses with a multimodal transportation system. The I-405 Corridor Program action alternatives support a focused growth pattern within the urban growth area through enhancement of the multimodal transportation system and improved mobility within and between designated Urban Centers.

The transportation improvement projects and strategies contained in the Preferred Alternative respond to projected and planned growth under *VISION 2020* and *Destination 2030*. With the Spring 2002 update of the MTP, the PSRC refined *Destination 2030* to fully reflect and incorporate the transportation improvements contained in the I-405 Corridor Program Preferred Alternative. The following discussion examines consistency of the Preferred Alternative with the Multicounty Planning Policies.

The Preferred Alternative has the highest level of consistency among the action alternatives with the following primary policy areas:

1. Regional (*VISION 2020* and *Destination 2030*) and local comprehensive land use and transportation plans;
2. Providing the transportation infrastructure to Urban Centers as the core elements of the UGA; and
3. Consistency and support of overall GMA policies.

RG-1 Urban Growth Areas – *Locate development in urban growth areas to conserve natural resources and enable efficient provision of services and facilities. Within urban growth areas, focus growth in compact communities and centers in a manner that uses land efficiently, provides parks and recreation areas, is pedestrian-oriented, and helps strengthen communities. Connect and serve urban communities with an efficient, transit-oriented, multimodal transportation system.*

The transportation investments proposed by the Preferred Alternative are focused exclusively within the urban growth area to support efficient access and improved mobility within and between the designated Urban Centers, Activity Centers, and Industrial/Manufacturing Centers. Development of a new bus rapid transit system is a key element of this investment package. This is supported by a substantial increase in local bus transit service (approximately 75 percent above the current King County 6-Year Pplan), improved arterial HOV priority for transit, additional park-and-ride capacity, new transit centers and capacity improvements, freeway HOV and BRT direct access ramps, completion of the HOV freeway-to-freeway ramps along I-405, and a variety of pedestrian and bicycle connections. This combination of investments will advance the Eastside transportation system and land use patterns toward a much more efficient, transit-oriented, and multimodal emphasis as envisioned by *VISION 2020*, *Destination 2030*, and the Multicounty Planning Policies.

This multimodal emphasis, combined with an expanded package of aggressive TDM measures, intelligent transportation system improvements, truck freight traffic improvements, and general purpose improvements on I-405, SR 167, and adjoining segments of freeways that connect to I-405 will provide the mobility improvements needed to help accommodate planned growth and development within the urban areas consistent with adopted regional and local land use plans. These focused investments inside the urban growth area will also help local jurisdictions and the designated Urban Centers to absorb growth and increase density of households and employment while meeting their requirements under the GMA's concurrency guidelines, rather than allowing pressure to increase for unplanned development at the urban fringe or in rural areas outside the urban growth boundary.

RC-2 Contiguous and Orderly Development Policy – *Coordinate provision of public facilities and services to support development and to implement local and regional growth planning objectives. Provide public facilities and services in a manner that is efficient, cost-effective, and conserves resources. Emphasize inter-jurisdictional planning to coordinate plans and implementation activities to achieve consistency.*

The action alternatives were generally based on the priorities of *VISION 2020*, *Destination 2030*, and the Multicounty Planning Policies. The proposed freeway lanes and adjacent arterial elements contained in Alternatives 2, 3, and 4, and the Preferred Alternative provide improved access and reduced congestion for local and regional trips. The substantial new investment in high-capacity transit contained in Alternatives 1, 2, and 3, and the Preferred Alternative, coupled with proposed arterial HOV lanes and the addition of direct access and queue bypasses for the buses, improve the reliability and travel time for the transit users.

In particular, the combination of freeway and arterial improvements, HOV improvements, TDM programs, BRT high-capacity transit, and HOV and BRT direct access ramps contained in the Preferred Alternative provides a well-integrated system of cost-effective public facilities that support regional and local planning objectives.

Facilities and services in the I-405 Corridor Program alternatives can reduce or eliminate anticipated local roadway “concurrency” deficiencies under the GMA. Alternatives 1 and 2 are likely not sufficient to fully offset future needs for mobility improvement and congestion relief. The Preferred Alternative provides the highest level of benefit in accommodating continuous and orderly development by congestion reduction, air quality improvement, HOV reliability, and improved urban accessibility of the action alternatives analyzed.

RF-3 Regional Capital Facilities Policy – *Strategically locate public facilities and amenities in a manner that adequately considers alternatives to new facilities (including demand management), implements regional growth planning objectives, maximizes public benefit, and minimizes and mitigates adverse impacts.*

The action alternatives were generally designed to advance the objectives of PSRC policies, countywide planning policies, *Destination 2030*, and local comprehensive transportation plans. Some of the key components of the MTP related to I-405 are direct access ramps to existing freeway HOV lanes, development of arterial HOV systems, facilities for pedestrians and bicycles, travel demand management actions, intelligent transportation system improvements and establishment of a high-capacity transit system along congested corridors that connect the designated Urban Centers.

Regional capital facilities and the overall development of the core Urban Centers are called for in the Multicounty Planning Policies. A specific example of a city undertaking capital improvements to emphasize its Urban Center is the City of Renton. The City is partnering with transit agencies and private developers to construct mixed-use developments, which are transit-supportive land in the City's designated Urban Center. However, these initiatives may not adequately respond to market demand and could be less successful if the local and regional users do not have effective and reliable access to the center. The I-405 Corridor Program Preferred Alternative's transit emphasis coupled with improvements to SR-167 and local arterials are necessary to improve such access and mobility to complement the transportation needs of this high density, mixed-use development.

The capacity of the existing transportation network within the study area is a limiting factor when considering increased development densities. Furthermore, GMA's concurrency requirements mandate adequate infrastructure be in place within six years of any new development that increases traffic congestion to unacceptable levels as defined by the level of service adopted by each jurisdiction. The Preferred Alternative includes the balanced system of multimodal transportation improvements that best accommodates the projected growth in the UGA. The BRT system proposed in Alternative 3 and the Preferred Alternative is expected to provide ridership and mobility benefits similar to the fixed-guideway HCT system in Alternatives 1 and 2, but at a substantially lower cost.

RH-4 Housing Policy – *Provide a variety of choices in housing types to meet the needs of all segments of the population. Achieve and sustain an adequate supply of low-income, moderate-income and special needs housing located throughout the region.*

The action alternatives would not improve the housing supply; however, they would expand and improve the range of multimodal options providing access to existing and planned residential and mixed-use areas in the I-405 corridor. The transportation investments contained in the Preferred Alternative are expected to encourage and accommodate greater density within the UGA and designated Urban Centers. This is necessary to justify greater levels of transit service and higher-order HCT technologies in the long term, which can also support improved supplies of low-income, moderate-income, and special needs housing. In the nearer term, the BRT system proposed in the Preferred Alternative is more flexible than the fixed-guideway HCT systems; thus it can provide greater responsiveness to the needs of emerging residential areas, especially those providing affordable housing at higher densities. Additionally, there are bicycle and pedestrian crossings in all of the alternatives that focus on promoting connectivity and preventing isolation of neighborhoods within the corridor program.

RR-5 Rural Areas Policy – *Preserve the character of identified rural areas by protecting and enhancing the natural environment, open space and recreational opportunities, and scenic and historic areas; supporting small-scale farming and forestry uses; and permitting low-density residential living and cluster development maintained by rural levels of service. Support cities and towns in rural areas as locations for a mix of housing types, urban services, cultural activities, and employment that serves the needs of rural areas.*

PSRC and GMA policies generally do not support additional growth in the designated rural areas, but direct higher densities within much of the I-405 corridor study area and its Urban Centers, Activity Centers, and Industrial/Manufacturing Centers.

Alternative 3 and the Preferred Alternative provide the best opportunities to preserve the character of the rural areas by focusing multimodal transportation investments well within the UGA to increase connectivity and mobility within and between the designated centers. This helps reduce pressure for unplanned development at the urban fringe or in rural areas outside the urban growth boundary. These targeted transportation investments also help local jurisdictions and the designated Urban Centers to accommodate planned growth and increase density of households and employment while meeting their requirements under the GMA's concurrency guidelines.

RO-6 Open Space, Resource Protection, and Critical Areas Policy - *Use rural and urban open space to separate and delineate urban areas and to create a permanent regional greenspace network. Protect critical areas, conserve natural resources, and preserve lands and resources of regional significance.*

The Preferred Alternative has fewer overall wetlands impacts than Alternatives 2, 3, and 4, and fewer stream encroachments than Alternatives 2 and 4. The protection and preservation of these critical areas are a high priority of all the action alternatives. As the I-405 Corridor Program progresses, project designs will be completed with avoidance as a priority, and mitigation measures could include enhancement or consideration of additional passive open space uses.

RE-7 Economics – *Foster economic opportunity and stability, promote economic well being, and encourage vitality and family wage jobs while managing growth. Support effective and efficient mobility for people, freight, and goods that is consistent with the region's growth and transportation strategy. Maintain region-wide information about past and present economic performance. Assess future economic conditions that could affect the central Puget Sound region.*

The Preferred Alternative would foster economic opportunity and stability in the I-405 corridor and region by providing effective and efficient mobility for people, freight, and goods that is consistent with the Multicounty Planning Policies and the region's growth and transportation strategy. The transportation investments proposed by the Preferred Alternative are focused exclusively within the urban growth area to support efficient access and improved mobility for the identified Urban Centers, Activity Centers, and Industrial/Manufacturing Centers. The strong multimodal emphasis, combined with an expanded package of aggressive TDM measures, intelligent transportation system improvements, truck freight improvements, and general purpose improvements on I-405, SR 167, and connecting freeways will provide the mobility improvements needed to accommodate planned employment and housing growth within the urban areas consistent with adopted regional and local land use plans and concurrency requirements. These focused investments in the urban growth area will also most satisfactorily address the time-sensitive goods movement, airport access, and commute trip needs of the growing concentration of I-405 corridor high technology businesses and employees that play an increasingly vital role in the region's economy.

FT-8 Transportation – *Develop a transportation system that emphasizes accessibility, includes a variety of mobility options, and enables the efficient movement of people, goods, and freight, and information.*

The Preferred Alternative best meets the directive of this policy to emphasize accessibility and provide a variety of efficient mobility options. It incorporates the most complete array of multimodal elements called for by the Multicounty Planning Policies. These include general-purpose lanes, arterial HOV lanes, a bus rapid transit system, direct access ramps for freeway HOV and BRT, freight mobility improvements, connecting arterial improvements, pedestrian connections and overpasses, bicycle lanes, and TDM strategies. This dual multimodal and aggressive TDM emphasis will provide the mobility improvements needed to help accommodate planned growth and development within the urban areas consistent with adopted regional and local land use plans. It also will provide a high level of transit service to encourage the transit and pedestrian-oriented land uses needed to fully implement the network of Urban and Activity Centers called for in *VISION 2020* and local comprehensive plans.

3.13.6.2 Consistency With King County County-Wide Planning Policies

As an example of one supportive policy, King County County-Wide Planning Policy LU-46 states:

> The system of Urban Centers shall form the land use foundation for a regional high-capacity transit system. Urban Centers should receive very high priority for the location of high-capacity transit stations and/or transit service.

The HCT system proposed in the Preferred Alternative and Alternatives 1, 2 and 3 would connect and serve the major Activity Centers in the study area, and would connect west across Lake Washington to Seattle.

There is detailed discussion and review of the regional and local policies in the *I-405 Corridor Program Draft Land Use Plans and Policies Expertise Report* (DEA, 2001b).

3.13.7 Mitigation Measures

Mitigation measures for direct impacts are identified in Section 3.14 of this EIS. Because the action alternatives would generally support the concentration of employment and household growth within the UGA in support of adopted land use plans and policies, no further mitigation measures are required.

3.14 DISPLACEMENTS AND RIGHT-OF-WAY ACQUISITION

3.14.1 Studies and Coordination

New right-of-way areas were estimated using different methods depending on the availability of information. For the I-405 mainline, aerial photos with right-of-way lines depicted for some of the projects were used. For those areas where right-of-way needs were not depicted on aerial photos (most of the arterials and the pedestrian/bicycle improvements), proposed roadway cross sections showing existing improvements and proposed improvements were reviewed. Additionally, in areas where neither of the foregoing was available, assumptions were made based upon right-of-way acquisition experience.

Displacements of residential housing and business establishments were estimated for the I-405 mainline by referring to the aerial photos.

In order to estimate right-of-way and displacement costs, a search of the real estate market was conducted. The data were studied and analyzed on the basis of price paid per square foot of site (land) area, for both unimproved and improved properties. The study included sales along the entire I-405 corridor, which encompasses a variety of markets.

Given the programmatic level of this study and the lack of detail inherent in the estimated right-of-way areas, a value was assigned for each of four categories of properties: Residential unimproved, residential improved, non-residential unimproved, and non-residential improved. Identifying properties in these categories facilitated the residential and non-residential ("business") relocation/reestablishment aspects (displacements) consistent with the Uniform Relocation Act.

3.14.2 Methodology

Aerial photos were reviewed for the I-405 mainline. Project areas requiring right-of-way were calculated by scaling the various projects from approximately 1 inch = 200 feet photos. The right-of-way area calculated was expanded where appropriate when it appeared a structure was within the acquisition. The areas were categorized by square feet as residential unimproved, residential improved, non-residential unimproved, and non-residential improved. The estimated total number of parcels as well as the estimated number of residential relocations and business relocations was calculated. The numbers were summed by project and alternative.

Where proposed roadway cross sections were available, the existing right-of-way was estimated based on the width of the existing improvements plus 10 feet. All existing right-of-way was assumed to be at least 60 feet wide, which is recognized as the standard right-of-way width in the study area. The proposed right-of-way was estimated from the cross sections by adding the width of the proposed improvements plus 10 feet to account for the additional area needed for construction and maintenance. To determine additional right-of-way needs, the existing estimated width was subtracted from the proposed estimated width, and the difference was multiplied by length to arrive at square footage. This area was summed by project and alternative.

For the remaining right-of-way needs, primarily non-roadway site easements and BNSF rail line, areas were calculated based upon standard site area sizes for the type of improvement, i.e., park-and-ride lots, transit centers, transit stations, etc., or in the case of BNSF, an existing 100-foot-wide right-of-way. Once again, these areas were summed by project and alternative.

This methodology was used at the programmatic level to estimate the number of affected parcels. It is highly likely that the parcel count as well as estimated numbers and locations of displacements would change at the final design stage.

The I-405 corridor real estate market was researched on a broad basis and in four categories: 1) residential unimproved properties, 2) residential improved properties, 3) non-residential unimproved properties, and 4) non-residential improved properties. Cost data were gathered from a variety of commercial sources for sales in these four categories; the common denominator in all categories was square footage. Data included improved properties, which were included in the cost analysis on the basis of price paid per square foot. This analysis resulted in estimated values per square foot for each category of properties included in this study. These unit values are:

- Residential unimproved - $25.00 per square foot
- Residential improved - $35.00 per square foot of land
- Non-residential unimproved - $32.00 per square foot
- Non-residential improved - $100.00 per square foot
- BNSF right-of-way - $30.00 per square foot

The estimated unit values must be increased to account for additional costs associated with acquisition, relocation, administrative expenses, administrative settlements, and legal costs. To arrive at an estimated total cost to account for these additional expenses a multiplier is typically used. Typical multipliers of 1.5 - 2.0 are normal when applied to all acquisitions. A multiplier of up to 3.0 has been found applicable when improved properties with relocation are acquired. For the purposes of this FEIS a multiplier of 2.5 has been applied to the estimated costs for improved residential and non-residential properties. Therefore the costs of acquisition, relocation, administration, and administrative settlement and legal costs for residential improved properties has been estimated to be $90.00 per square foot of site area; the cost of acquisition, relocation, administration, and administrative settlement and legal costs of non-residential improved properties is estimated to be $250.00 per square foot of site area.

The analyses in this section are based on the *I-405 Corridor Program Draft Right-of-Way and Displacements Expertise Report* (DEA, 2001) herein incorporated by reference.

3.14.3 Affected Environment

The environment affected by displacements and right-of-way acquisition is discussed in the Land Use subsection (see Section 3.13.4).

3.14.4 Impacts

3.14.4.1 No Action Alternative

The construction and operational impacts of the committed projects in the No Action Alternative are assumed to occur with or without the I-405 Corridor Program. These impacts are, or will be, addressed in the project-level environmental analysis, documentation, and review conducted for those projects.

3.14.4.2 Alternative 1: HCT/TDM Emphasis

All of the displacement and right-of-way acquisition impacts for this alternative are considered to be construction impacts; there are no operational impacts.

The total additional right-of-way required for Alternative 1 is estimated at 25 million square feet, or approximately 580 acres (Table 3.14-1). Using the aerial photos depicting the improvements along the I-405 mainline for Alternative 1, an estimated 150 parcels would need to be acquired. For the remainder of the improvements, excluding the HCT project area within existing BNSF right-of-way, the number of parcels was estimated by calculating the parcel size based on the average parcel size for all acquisitions depicted on the aerial photographs. It is estimated that Alternative 1 would require approximately 1,000 right-of-way acquisitions. The HCT projects located on BNSF right-of-way are excluded from the parcel calculations because its unique size and shape would skew the estimate of affected parcels. Existing BNSF right-of-way accounts for approximately 12,800,000 square feet of acquisition area in Alternative 1. Total right-of-way cost including acquisition and relocation is estimated to be $934,781,000.

Table 3.14-1: Summary of Action Alternative Right-of-Way Acquisition and Displacements

Alternative Number	Acquisition (million square feet / acres)	No. of Parcels	Displaced Units (Residential / Non-Residential)	Estimated Cost
1	25 / 580	1,000	260 / 30	$934,781,000
2	34 / 770	1,600	450 / 100	$1,335,645,000
3	17 / 400	1,400	330 / 110	$973,044,000
4	19 / 440	1,300	280 / 80	$1,145,589,000
Preferred Alt.	31 / 730	1,600	400 / 150	$1,398,450,000

Total approximate displacements for Alternative 1 were 260 residential and 30 business relocations.

3.14.4.3 Alternative 2: Mixed Mode with HCT/Transit Emphasis

All of the displacement and right-of-way acquisition impacts for this alternative are considered to be construction impacts; there are no operational impacts.

The total additional right-of-way required for Alternative 2 is estimated at 34 million square feet, or approximately 770 acres (Table 3.14-1). Using the aerial photos depicting the improvements along the I-405 mainline for Alternative 2, an estimated 450 parcels would need to be acquired. For the remainder of the improvements, excluding the HCT project area within existing BNSF right-of-way, the number of parcels was estimated by calculating the parcel size based on the average parcel size for all acquisitions depicted on the aerial photographs. It is estimated that Alternative 2 would require approximately 1,600 right-of-way acquisitions. The HCT projects located on BNSF right-of-way are excluded from the parcel calculations because its unique size and shape would skew the estimate of affected parcels. Existing BNSF right-of-way accounts for approximately 12,800,000 square feet of acquisition area in Alternative 2. Total right-of-way cost including acquisition and relocation is estimated to be $1,335,645,000.

Total approximate displacements for Alternative 2 are 450 residential and 100 business relocations.

3.14.4.4 Alternative 3: Mixed Mode Emphasis

All of the displacement and right-of-way acquisition impacts for this alternative are considered to be construction impacts; there are no operational impacts.

The total additional right-of-way required for Alternative 3 is estimated at 17 million square feet, or approximately 400 acres (Table 3.14-1). Using the aerial photos depicting the improvements along the I-405 mainline for Alternative 3 an estimated 540 parcels would need to be acquired. For the remainder of the improvements, the number of parcels was estimated by calculating the parcel size based on the average parcel size for all acquisitions depicted on the aerial photographs. It is estimated that Alternative 3 would require approximately 1,400 right-of-way acquisitions. Total right-of-way cost including acquisition and relocation is estimated to be $973,044,000.

Total approximate displacements for Alternative 3 are 330 residential and 110 business relocations.

3.14.4.5 Alternative 4: General Capacity Emphasis

All of the displacement and right-of-way acquisition impacts for this alternative are considered to be construction impacts; there are no operational impacts.

The total additional right-of-way required for Alternative 4 is estimated at 19 million square feet, or approximately 440 acres (Table 3.14-1). Using the aerial photos depicting the improvements along the I-405 mainline for Alternative 4 an estimated 697 parcels would need to be acquired. For the remainder of the improvements, the number of parcels was estimated by calculating the parcel size based on the average parcel size for all acquisitions depicted on the aerial photographs. It is estimated that Alternative 4 would require approximately 1,300 right-of-way acquisitions. Total right-of-way cost including acquisition and relocation is estimated to be $1,145,589,000.

Total approximate displacements for Alternative 4 are 280 residential and 80 business relocations.

3.14.4.6 Preferred Alternative

All of the displacement and right-of-way acquisition impacts for this alternative are considered to be construction impacts; there are no operational impacts.

The total additional right-of-way required for the Preferred Alternative, which includes certain projects not included in Alternative 3, is estimated at 31 million square feet, or approximately 730 acres (Table 3.14-1). Using the aerial photos depicting the improvements along the I-405 mainline for the Preferred Alternative, an estimated 736 parcels would need to be acquired. For the remainder of the improvements, the number of parcels was estimated by calculating the parcel size based on the average parcel size for all acquisitions depicted on the aerial photographs. It is estimated that the Preferred Alternative would require approximately 1,600 right-of-way acquisitions. Total right-of-way cost including acquisition and relocation is estimated to be $1,398,450,000.

Total approximate displacements for the Preferred Alternative are 400 residential and 150 business relocations.

3.14.5 Mitigation Measures

WSDOT will make all attempts to avoid acquiring properties or displacing residents. Where avoidance is not reasonable or feasible, regulations will be followed to minimize impacts.

The right-of-way acquisition program in the state of Washington parallels that of the Federal Government when federal funds are involved. The controlling authority may be found in the Uniform Relocation Assistance and Real Property Policies Act of 1970, as amended (42 USC 4601 *et seq.*), hereinafter Uniform Act, and the regulations promulgated thereunder by FHWA at 49 CFR Part 24.

This law requires that all property proposed for acquisition be appraised at its fair market value (FMV), and that the property owner be offered at least FMV for the purchase of the property. In the event of a disagreement, WSDOT has provisions for an administrative settlement. Property owners are also entitled to a cost to cure any damages to the property resulting from a project (if the damaged property is not actually acquired).

Further, if the acquisition actually takes or effectively renders useless property on which there is a residence or a business, the Uniform Act requires relocation assistance to the property owner and tenants.

Benefits for displaced business can include moving costs reimbursement, re-establishment costs, and/or fixed schedule move options. The eligibility and amounts of these benefits will be determined at the time of displacement.

In the event acquisition of public facilities is necessary, the Uniform Act contains provisions for "functional replacement" of the facility.

Given the programmatic nature of this FEIS, impacts to specific properties cannot be identified at this time. However, during the project-specific design stage, analysis of mitigation to individual property acquisitions will be undertaken.

This page left intentionally blank.

3.15 SOCIAL IMPACTS

3.15.1 Studies and Coordination

Applicable plans and policies were obtained from each of the affected jurisdictions in the study area for the purpose of characterizing study area cities. Descriptions were developed of each jurisdiction in the affected area based mainly on comprehensive plan information. In some cases, follow-up communication occurred with individual jurisdictions to obtain supplemental descriptions or to clarify existing information. Noise, visual, traffic, land use, and displacement impacts were all determined in separate analyses reported in this EIS.

The I-405 Corridor Program alternatives were evaluated for compliance with Executive Order 12898, which requires that "each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations," as well as with the corresponding U.S. Department of Transportation Order 5610.2 and the FHWA Order 6640.23. The analysis concluded that no high and adverse human health or environmental effects of the project are expected to fall disproportionately on minority or low-income populations. The program is therefore consistent with the policy established in EO 12898 and FHWA Order 6640.23. The analysis is documented in the *I-405 Corridor Program Draft Environmental Justice Expertise Report* (CH2M HILL, 2001a) herein incorporated by reference, and is summarized in Appendix G (Environmental Justice) of this EIS.

3.15.2 Methodology

The social impacts analysis assesses the potential impacts of the alternatives and their major elements on community cohesion and social interaction. Community cohesion refers to a community's ability to function and be recognized as a singular unit; social interaction refers to accessibility within and around the neighborhood.

The impact assessment was performed through inspections of the locations of proposed transportation improvements compared with neighborhood locations, and reviews of other discipline studies conducted for the I-405 Corridor Program, specifically displacements, land use, traffic and transportation, noise, and visual/aesthetics. Results from these analyses were broken down geographically by city as well as by major element (within the alternatives) and given values based on the severity of the impacts and their physical relationship to the city using best professional judgement.

The cumulative effects of these impacts on jurisdictions as a whole would depend on the location and severity of the all impacts. For example, a high increase in traffic on I-405 (and the noise and visual impacts that may accompany it) may have a low overall social effect if that section of I-405 is located on the fringes of existing neighborhoods. Conversely, a moderate increase in traffic and noise on a neighborhood arterial could cumulatively have a higher social impact due to multiple environmental effects and the physical barrier that the improved road could represent. Substantial social impacts are judged to occur if a combination of environmental effects has more than a moderate impact on community cohesion. This would happen if displacements, land use changes, and additional traffic created severe physical or implied separation between major neighborhood components. It would also occur if noise and visual impacts were severe enough to impair community character to the point that the community could not function as a unified entity. Substantial impacts to social interaction would occur if increases in neighborhood traffic or if the scale of physical improvements to roadways prevented neighborhood residents from efficient inter- and intra-neighborhood movement, thereby severely impacting travel patterns and accessibility.

The analyses in this section are based on the *I-405 Corridor Program Draft Social Expertise Report* (CH2M HILL, 2001) herein incorporated by reference.

3.15.3 Affected Environment

3.15.3.1 Bothell

The city of Bothell is located northeast of Seattle and lies within both King and Snohomish counties. The city covers roughly 12 square miles and supports a population of about 28,350. Bothell is home to large employers such as Microsoft and PRECOR, and sustains a healthy environment for high-tech businesses and retail. It is also home to the University of Washington Bothell Branch Campus/Cascadia Community College. The median household income in 1997 was $58,800, and in 1999 the city contained approximately 6,439 single-family residences and 3,305 multi-family residences.

There are many well-established neighborhoods along I-405, SR 522, and the Bothell-Everett Highway. Each neighborhood has a subarea plan that describes the intended land uses and expectations for future uses.

I-405 runs diagonally from the southeast corner to the northwest corner of Bothell. I-405 acts as a line separating neighborhoods to the east and west of the interstate. Along the southeast portion of I-405, neighborhoods have planned for higher densities, from 11 to 15 residential units per acre, intermixed with areas of Office-Professional, Neighborhood Business, and Community Business. Further north, higher densities are discouraged to preserve the distinct character provided by single-family residences.

In the I-405/Bothell-Everett Highway (Mill Creek) interchange area, the single-family neighborhoods are mostly concentrated to the east and north of I-405, with more intensive multi-family uses (up to 11 to 15 units per acre) to the west and south of the Interstate.

The Bothell-Everett Highway connects the northern segment of I-405 and north Bothell to the Bothell central business district (CBD). The predominant uses around the highway are Office-Professional, Community Business, General Community, and high-density residential areas (from 5 to 15 units per acre). Some of the areas are not yet developed, but are zoned for high-density residential use. Near the city center, the highway passes through the center of established high-density residential uses. As the highway progresses northward, it becomes a dividing line for different land uses.

Along SR 522, which connects the Bothell CBD to I-405 near the eastern border of the city, Office-Professional, General Commercial, some Light Industrial (closer to I-405), High-Density Residential (11 to 15 units per acre), and Open Space uses are all intermingled. The residential areas along SR 522 are smaller in general and distinctly clustered either to the north or south of the highway. The high-density developments serve as buffers to well-established lower-density areas (2 to 5 units per acre) which lie further north and south of SR 522.

3.15.3.2 Kenmore

Kenmore is located along the northern shore of Lake Washington and encompasses 6.1 square miles. Although Kenmore is a relatively new city, incorporated in 1998, its population has grown steadily to roughly 16,890 people in 2000. Kenmore has mostly a service-oriented economy, with major employers such as Bastyr University and Kenmore Air Harbor.

Kenmore is comprised of well established neighborhoods. The 1997 median annual household income in Kenmore was $66,900. This area is fairly affluent and has nearly three times more single-family homes than multi-family homes, approximately 5,523 units and 1,549 units, respectively.

The city of Kenmore is divided into two distinct north and south sections by SR 522. SR 522 connects the Kenmore CBD to I-405, a few miles to the east. Most of the property along SR 522 and in central Kenmore is zoned Regional Business and Industrial. Towards the eastern and western points of the city along SR 522, the area's zones range from Residential-4 (4 units per acre), to Residential-24 (24 units per acre and up to 36 units per acre with added density bonuses). With few exceptions, most of the residential areas are already developed and established on either side of SR 522.

3.15.3.3 Woodinville

The city of Woodinville is located in north central King County, north of Redmond and east of Kirkland. SR 202 is the main road through the Sammamish Valley and runs from southwest Woodinville to Redmond. The other main highway through Woodinville is SR 522, which passes through the northwest corner of the city towards Monroe. The SR 522/I-405 interchange is approximately 1.5 miles to the west of the Woodinville CBD.

Woodinville is a relatively new city (incorporated in 1993) that is very much like a microcosm of the Puget Sound area. Agriculture, commerce, and industry flourish on the valley floor and residential neighborhoods decorate the valley sides and adjacent plateaus. The population of Woodinville in 2000 is estimated to be 10,280, and the median household income in 1997 was $72,000. In 1999 there were approximately 2,459 single-family residences and 1,885 multi-family residences within the city.

Neighborhoods in Woodinville are naturally delineated by the geographical features in the area. Much of Woodinville has a rural atmosphere, but downtown Woodinville is rapidly developing into a cohesive, pedestrian-oriented retail area with nearby higher-density residential development and light industrial areas. Woodinville plans to develop a strong Urban Center character.

The areas near the major transportation corridors differ in their uses. SR 522 serves as a defining boundary between General Business, Industrial, and Residential areas. Residential areas to the west of SR 522 are well-established, and are tied into the development continuing in the city of Bothell to the west. Along SR 202, industrial activities are the main focus. Outlying these areas are medium-density residential neighborhoods. SR 202 also serves as a south gateway into the city with tourist attractions provided by the wineries, brewery, and hotel in the "tourist district" along the Sammamish River.

3.15.3.4 Redmond

The city of Redmond encompasses just over 16 square miles. The city borders the city of Kirkland on the west and an unincorporated section of the Sammamish Plateau on the east. SR 520 runs from the southwest corner to the city's CBD. Redmond supports a population of 44,020, which has increased 254 percent from 1970 to 1993. Within Redmond there is a diverse and growing economic base including high-tech firms such as Microsoft Corporation and light industry. From 1970 to 1993, the number of businesses located in Redmond increased 708 percent, totaling 3,190 firms. In 1999, Redmond employed roughly 90,000 workers.

Redmond has several distinct neighborhoods where parks and businesses intermingle with multi-family developments. Redmond has generally succeeded in conserving agricultural lands and rural areas while improving mobility for people and goods given the increasing pressures on housing and transportation. The City of Redmond wishes to protect its historical background and natural setting, while shaping itself into a "healthy and dynamic suburban community" (City of Redmond Comprehensive Plan, 1999).

Redmond is a fairly affluent community in which the median annual household income in 1997 was roughly $69,000. The housing units in Redmond are more or less equally split between single-family dwellings (10,083 units) and multi-family dwellings (8,990 units) (1999 data). There are many low-to-moderate-density residential areas around SR 520 as it progresses from the southwest corner of Redmond into the city center. These areas are well-established neighborhoods with many connecting roads to developments northward.

Other major arterials such as Willows Road, which connects the CBD to the northwest corner of the city, serve as a boundary between high-density residential neighborhoods and business park and city center uses. In the easternmost area of Redmond along the Redmond–Fall City Road (SR 202), low-to-moderate-density and high-density developments are clustered around the road. Other high-density residential areas are along Avondale Road to the northeast and in the Sammamish Valley just north of the CBD.

3.15.3.5 Kirkland

The city of Kirkland covers approximately 11 square miles and is located north of Bellevue and west of Redmond, along the eastern shore of Lake Washington. Kirkland is one of the older cities on the Eastside, incorporated in 1905. The current population is roughly 45,090, and residents have a median household income of $62,900 (1997 data). Kirkland includes a well-planned, diverse business community that includes many art galleries and restaurants in the CBD which provide the city with a well-established arts center, professional services, high-tech firms, and a strong retail sector.

Kirkland is primarily a residential community and has over 30 public parks interspersed within residential areas. A vast majority of Kirkland is designated as low-density residential. The housing includes 9,961 single-family residential units and 11,187 multi-family residential units. The high-density units are mostly located in the CBD and the Totem Lake area near the I-405/NE 124th Street interchange.

I-405 spans the city from the southern border north of SR 520 to the north central border at Kingsgate (unincorporated King County). The uses along the interstate include parks and open space, low-density residential, limited medium-density residential, and to the north, the commercial areas in the Totem Lake area. Along the major arterials branching off from I-405 are minor commercial areas and neighborhoods.

3.15.3.6 Bellevue

Bellevue is the fifth largest city in Washington with a population of 106,400. The median annual household income in 1997 was $67,100. Bellevue is located south of Kirkland and north of Newcastle. Bellevue's natural amenities include tree-covered hillsides, streams, smaller lakes, large wetlands, and the Lake Washington shoreline.

Bellevue is the financial, retail, and office center of the Eastside. The largest employers include Microsoft, Overlake Hospital, and Puget Sound Energy. The vibrant downtown is home to many more businesses. Bellevue's CBD is a compact mixed-use hub with places to live, shop, play, and work. Bellevue allows high-intensity residential development in the downtown area in order to facilitate its desire for a convenient, livable urban environment.

Over half of all land in Bellevue is dedicated to residential uses. Currently there are 25,633 single-family units and 22,718 multi-family units in the City. Housing ranges from residential estates on an acre or more to downtown mid-rise condominiums and apartments. Bellevue has concentrated higher density residential land uses near its Urban Center and along transportation corridors in order to provide adequate densities that would support future high-capacity transit service.

I-405 passes from the southwest corner of Bellevue to the northern border with Kirkland. I-90 spans the lower half of the City and connects the Eastside with Seattle via Mercer Island. SR 520 passes through the northern part of the city, also connecting the Eastside to Seattle. There are several major arterials in Bellevue such as Coal Creek Parkway, Bellevue Way SE, and Bellevue-Redmond Road.

Prominent uses along I-405 include single-family residential, commercial, multi-family residential, light industrial, and office. In the single-family areas to the south, the densities on both sides of the interstate range from 1 to 5 units per acre. I-405 travels through the southwest corner of the single-family area. However, individual neighborhoods are not divided by I-405 and established developments lie either east or west of the interstate. From the I-90 interchange northward, the most common uses bordering the interstate are commercial, multi-family residential, and light industrial.

Along I-90 in Bellevue, the major uses include commercial and light industrial. There are few high-density multi-family zones in this area. Most of the uses along SR 520 in Bellevue are light industrial, commercial, and office-oriented. There are few residential areas along Bellevue's section of SR 520 and along Bellevue-Redmond Road. The largest residential communities are mainly located in the eastern half of the city.

3.15.3.7 Newcastle

Newcastle was recently incorporated and encompasses 4.4 square miles. Newcastle is located in the foothills east of Lake Washington south of Bellevue and north of Renton. Currently, the population of 8,645 is small relative to the cities in the vicinity, but growing at an expected rate of approximately 12 percent in the next 10 years. I-405 runs parallel to the northwest border of the city.

Newcastle serves primarily as a "bedroom community" with its predominant land use being single-family residential. Its close proximity to Renton to the south, Bellevue to the north, and Seattle to the west provide many employment opportunities outside of the city. There is currently little land within Newcastle suitable for the development of large-scale commerce and industry.

Historically, Newcastle has been oriented toward single-family homes. In 1999 there were approximately 2,623 single-family homes and only 968 multi-family units. Approximately 85 percent of all the city's households fall into the middle- to upper-income levels; the 1997 median annual household income in Newcastle was $88,700. There is limited land available for future development, with most occurring to the east of Coal Creek Parkway, and the mature development (consisting of single-family residential areas) already established to the west of Coal Creek Parkway.

The neighborhoods located closest to I-405 are zoned for medium-density single-family residential (4 units per acre). Further east to Coal Creek Parkway, the area is zoned more intensively with high-density single-family residential (6 units per acre). The multi-family zoned areas with higher allowed densities are found intermittently along Coal Creek Parkway and in one area along the western border of the city. The high-density residential uses along Coal Creek Parkway are distinctly separated into neighborhoods on either side of the parkway. From SE 64th Avenue to approximately SE 72nd Street, Lake Washington Boulevard divides the neighborhoods in the northwest corner of Newcastle. This area is predominantly categorized as medium-density residential.

3.15.3.8 Renton

Renton is located south of Newcastle, northeast of Tukwila and the I-405/I-5 interchange, and along the southeast shore of Lake Washington. On the east it is bordered by unincorporated King County. The city includes 10,867 acres and has a population of 50,052 (2000 Census). Renton is a well-established city with an economy that is diversified, yet still highly dependent on Boeing. There are 1,721 employers representing 45,882 jobs. Boeing is the largest employer in Renton, representing 36 percent of jobs. Other employers include Multiple Zones, Wizards of the Coast, K&L Distributors, and PACCAR. Median household income in 1997 was $53,200.

Renton is a community that provides a variety of stable single-family and multi-family neighborhoods, most of which are located in the hills east of the I-405 corridor. Provisions for housing include 11,170 single-family and 12,399 multi-family units. The largest land use in terms of percentage of land area is single-family residential. However, Renton continues to benefit from a diverse industrial base and increased office development located in the Green River Valley and adjacent to the south shore of Lake Washington. Renton's downtown is one of 14 Urban Centers in the region, and won awards through the PSRC for its downtown revitalization efforts. Commercial areas outside the downtown core include multi-family areas as well as suburban commercial establishments.

I-405 runs through the western half of Renton and up through the northwest corner of the city. Several state highways contribute to Renton's internal arterial system, including SR 900, SR 169, SR 515, and SR 167. Highway 169 connects I-405 in downtown Renton to Maple Valley east of the city. Highway 167 runs south from the CBD past I-405 to the Kent valley. Renton's Urban Center is located north and west of I-405. Office development is increasing in the Green River Valley and adjacent on the south shore of Lake Washington. To the east of I-405, uses are predominantly residential. These developments are mostly located on the hills that overlook I-405. Residential single-family areas also are located in the hills to the east above SR 167.

Highway 169 is bounded on both sides by low-density residential uses. Most of the area along this highway is still in a residential rural character except for a few small developments. These rural areas are preserving Renton's open space and agricultural land and protecting environmentally sensitive and critical areas.

3.15.3.9 Tukwila

Tukwila is located southwest of Lake Washington and is surrounded by Renton to the east, Kent to the south, SeaTac to the west, and Seattle to the north. Tukwila is a regional crossroads with the I-5/I-405 interchange at the heart of the city. State Routes 599 and 518 serve the eastern portions of the city, and SR 181 serves the southeast. The city is a major retail and manufacturing center for South King County with large employers such as Boeing, NC Machinery, and Kenworth Truck Company. The total employment for the city (52,141) is roughly three times the city population (14,870). The median annual household income in 1997 was $47,500.

Tukwila has much more land devoted to commercial and manufacturing developments than residential areas. In 1999 there were approximately 3,319 single-family units and 4,241 multi-family units in Tukwila. The residential areas are divided into distinct segments by freeways, arterials, hillsides, and the Green River, all of which tend to isolate the neighborhoods.

Most of the residential areas in Tukwila are located north of I-405/SR 518. Along I-405 and SR 518, most of the uses are restricted to high-density residential and office, or a combination of the two, in a mixed-use setting. Beyond the multi-family areas are low-density residential areas, all of which are close to and highly impacted by arterials prominent in the area.

There is one low-density residential sector south of SR 518 and west of I-5. This area is disconnected from other uses within the city limits but lies in very close proximity to the interstates.

3.15.3.10 Kent

The city of Kent is located in South King County and is bordered by Tukwila to the north, SeaTac and Des Moines to the west, and Auburn and Federal Way to the south. Areas east of the city are unincorporated except for the small city of Covington. Kent encompasses 29 square miles and has a population of 73,140. The city is highly business-oriented with the state's highest concentration of industrial space. The biggest employers include Sysco Food Services, Continental Mills, and Sun Sportswear, and the total employment for the city was 59,212 in 1999.

The neighborhoods in Kent consist of older, more traditional residential neighborhoods in the central area and newer development on the outskirts. There are 12,855 single-family units and 19,296 multi-family units in Kent. Most of the single-family areas support a density of 3 units per acre. Kent is currently reviewing potential annexation sites in the northeast corner above the city limits in unincorporated King County, and if annexed, these areas would support higher urban residential densities of 4 to 12 units per acre. This could increase traffic volumes and congestion along the arterials in the surrounding areas.

The major transportation corridors running through the city include SR 516, which connects to I-5 in the west, and SR 167 which runs from north-central to south-central Kent. The predominant uses along SR 167 are manufacturing and industrial, with a few sections of low-density single-family units. The southern section along the highway is planned for agricultural uses. The major residential areas are found east of SR 167 behind a buffer of industrial, city center, and commercial uses and clustered around small commercial and mixed use areas.

3.15.3.11 King County

King County is the 12th most populous county in the nation with a population of over 1.6 million people. King County spans the eastern shore of Puget Sound from Richmond Beach to Federal Way, including Vashon Island, and covers approximately 2,200 square miles eastward to Chelan and Kittitas counties. King County is bordered to the north by Snohomish County, to the west by Kitsap County, and to the south by Pierce County. King County's biggest employers are the Boeing Company, the University of Washington, and Microsoft Corporation. The 1997 median annual household income for households in King County was roughly \$45,300 to \$53,200. Housing in 1997 included 430,603 single-family units and 269,088 multi-family units.

Like several other counties in Washington State, King County has experienced major growth in the last 20 years. Since 1980, the county's population has grown by almost 20 percent, resulting in increased pressures on Urban Centers, housing, and the environment. Growth is also expected to increase by roughly 10 percent in the next 10 years. The King County Growth Management Planning Council has designated certain areas within the county as Urban Growth Areas. These areas are planned to accommodate much of the county's expected household and employment growth for the next 20 years and include unincorporated areas between Bothell and Kirkland, east of Redmond, east of Lake Sammamish, and east of Newcastle and Renton.

3.15.3.12 Snohomish County

Snohomish County lies north of King County and south of Skagit County and covers 2,090 square miles. The 1998 population was recorded as 568,100, which equates to a 22 percent growth rate since 1990, making Snohomish the third most populous county in the state. Snohomish County is characterized by a well-established manufacturing economy with a growing service sector, similar to the changing economies of many counties in Western Washington.

Much of the unincorporated area of Snohomish County north of Bothell and the north I-5/I-405 interchange is zoned for differing density residential uses. This area also lies within Snohomish County's designated Urban Growth Area (UGA), which will provide the necessary densities for future growth. The existing facilities and urban development character in incorporated and unincorporated areas will support growing employment and household growth demands. In the UGA, community character will be defined and enhanced within the variety of land uses for that area to create connected, identifiable neighborhoods. These areas will remain UGA as long as they maintain the ability to provide sufficient facilities, such as transportation systems.

The I-5/I-405 interchange area currently lacks a definable community character. Although the area is UGA, the specific future uses of the area are uncertain due to simultaneous influences from the incorporated areas of Bothell, Briar, Mill Creek, and Lynnwood. This area will need boundaries within specified jurisdictions so that a definable character can be maintained, while preserving the character of outlying areas.

3.15.4 Impacts

The impact assessment was performed through inspections of the locations of potential displacement, land use, traffic, noise and visual/aesthetic impacts relative to residential areas. Low social impacts involve minor environmental impacts far from residential areas while high social impacts involve multiple environmental impacts near residential neighborhoods.

3.15.4.1 No Action Alternative

Construction Impacts

Construction impacts are short-term, temporary impacts that will end once construction has finished. These impacts include construction-related noise and traffic that could hinder neighborhood travel patterns or temporarily fragment a community.

The No Action Alternative involves no additional construction beyond what is planned and committed within the corridor. These construction activities would generate neighborhood impacts (primarily from temporary traffic changes and noise impacts) independent of the I-405 Corridor Program. The impacts from these projects are or will be addressed within the environmental analysis, documentation, and for the individual projects.

Operational Impacts

Operational impacts are those that would have long-lasting effects on community cohesion or social interaction. These can include separating adjoining residential areas, isolating portions of the neighborhood, creating barriers within a neighborhood, and changing the historical character of the neighborhood.

The No Action Alternative would have the greatest long-term social impact because of worsening traffic conditions and associated noise and accessibility impacts. Although there would be substantially fewer projects (that could create physical barriers to social interactions) in the No Action Alternative than in the action alternatives, congested conditions within neighborhoods could discourage interactions. Throughout the northern and central areas of the corridor, increases in traffic from the No Action Alternative would hinder social interaction.

Cities in the northern corridor area (Bothell, Woodinville, and Kirkland) would experience low to moderate impacts to community cohesion. Bothell and Woodinville would experience moderate traffic impacts, hindering inter- and intra-neighborhood movement. The traffic impacts are primarily responsible for the overall moderate level of impact to community cohesion in Bothell and Woodinville, as well as in unincorporated Snohomish County. Kenmore would have higher traffic impacts, resulting in a moderate level of impact to community cohesion. Aside from traffic impacts in these areas, there would only be limited land use, noise, and visual impacts.

There are few projects in the No Action Alternative that could create additional physical barriers to social interaction; therefore, no substantial impact is anticipated. The majority of the projects would be on SR 524, SR 522, and I-405 and would not affect movement within or between communities in the northern corridor area. However, widespread congested conditions within neighborhoods could discourage interactions.

Cities in the central corridor area (Kirkland, Redmond, Bellevue, and Newcastle) would also experience low to moderate impacts to community cohesion. Traffic congestion would have the greatest impact on community cohesion, particularly in Redmond, Kirkland, and Bellevue.

Redmond and Bellevue would also have low-level localized land use impacts; overall these two cities would have moderate to low community cohesion impacts. Kirkland would have low-level noise impacts, but would not have noticeable land use and visual impacts; overall, Kirkland would receive low impacts to community cohesion. Traffic impacts in unincorporated King County would result in low community cohesion impacts.

Arterial improvements in Redmond could create additional physical barriers to social interaction; however, the scale of improvements is not likely to hinder inter-neighborhood movement. No other cities have projects that would create barriers to social interaction.

Traffic congestion would be the only impact to community cohesion in the southern corridor area. Increasing traffic would impact Renton and Kent, resulting in low levels of community cohesion impacts overall. Tukwila would have no impacts.

Since there would be substantially fewer projects in the No Action Alternative than the action alternatives, there would be no additional physical barriers to social interaction created. However, congested conditions within neighborhoods could discourage interactions.

3.15.4.2 Alternative 1: HCT/TDM Emphasis

Construction Impacts

This alternative would have the least impact to existing traffic during construction compared to other action alternatives because much of the HCT alignment is separated from existing roadways. Construction on arterials may encourage traffic to detour onto residential neighborhood roads. Visual construction impacts could include the presence of construction equipment and workers, materials, debris, signage, and staging areas that would reduce the visual quality in the construction zone. Temporary lighting may be employed for nighttime construction of some improvements. Intermittent construction noise would occur throughout the construction period, with most noise generated from construction vehicles and activities such as pile driving. Impacts would be widely dispersed across the corridor. Heavier construction impacts would occur in areas where more improvements are planned to occur, such as Kirkland, Bellevue, and Redmond. Construction impacts would mostly pose a temporary inconvenience to social interaction.

Operational Impacts

Overall effects on community cohesion and social interaction would be low for each of the action alternatives, and each would have less impact than the No Action Alternative. In the action alternatives, most proposed improvements would occur in existing major transportation corridors. This would restrict many of the social impacts to the edges of existing neighborhoods, lessening the overall impact. Improvements that would occur on neighborhood arterials, such as HOV improvements, would not be substantial enough to alter intra-neighborhood travel patterns. This would be particularly true since the action alternatives would divert traffic off of neighborhood arterials and onto highways. In nearly all cases, social impacts revealed a balance between traffic improvements and low-level noise, displacement, visual, and land use impacts.

Alternative 1 would have low impacts to neighborhood community cohesion throughout the corridor. Cities such as Bellevue, Redmond, and Renton would face the greatest potential for impacts due to traffic and land use influences. Other cities, such as Kent and Bothell, would have negligible impacts from the proposed improvements.

Cities in the northern corridor area would see slightly positive or slightly negative impacts to community cohesion. Community cohesion in Bothell would be slightly better with Alternative 1. There would be an overall improvement in traffic conditions because transportation improvements would funnel traffic off of neighborhood arterials and onto highways, improving intra- and inter-neighborhood movement. Noise impacts would be isolated mainly to the I-405 corridor, away from residential areas. There would be no displacements in Bothell, and land use impacts would only be associated with growth around high-capacity transit stations.

Kenmore and Woodinville would have low impacts to community cohesion, primarily because of the potential for changes in land use patterns. These two cities would experience the same displacements, noise, and traffic impacts as in the No Action Alternative. This is largely because the only improvements proposed within their jurisdictions are along SR 522, which is mostly commercial and residential. Unincorporated parts of Snohomish County outside of these jurisdictions would be affected in a manner similar to the incorporated cities; changes in land uses would represent the most likely impact to community cohesion, although the magnitude of impact would be low since changes would only occur in isolated areas. Unincorporated Snohomish County would not see any changes in traffic volumes over the No Action Alternative.

Improvements contained in Alternative 1 would primarily occur on highways and arterials that, to some extent, already act as physical barriers; proposed improvements are not expected to increase physical separation. In Bothell and unincorporated Snohomish County, proposed improvements would occur in existing highway corridors along the perimeter of existing neighborhoods, avoiding physical neighborhood separation. These improvements are not expected to create physical barriers to social interaction above current conditions in the I-405 and SR 527 corridors. Improvements to SR 522 in Kenmore and Woodinville are not expected to impact movements between existing neighborhoods to the north and south of the highway.

Cities in the central corridor area would consistently receive greater impacts than in other parts of the corridor; however, the level of their impacts over the No Action Alternative would be low. Unincorporated portions of King County (north of Kirkland) are the only areas that would have slightly beneficial impacts to community cohesion. This would be caused by an improvement in traffic volumes in the neighborhoods surrounding I-405 and no increase in noise and displacements. Newcastle, because its neighborhoods are mostly located in the hills above the I-405 corridor away from the proposed improvements, would have the same displacement, noise, and traffic impacts as in the No Action Alternative. Transit-supportive land uses could change the character of some areas near the corridor, but this would be expected to have a low impact on overall cohesion.

A heavy concentration of improvements in Bellevue and Kirkland would improve mobility within these jurisdictions without allowing large amounts of noise to spill out of the I-405 corridor and into the neighborhoods that flank the interstate. I-405 improvements in Bellevue would displace approximately 26 residences; however, these would occur along the periphery of existing neighborhoods and would have a low impact on community cohesion. Major view corridors in Kirkland and Bellevue would receive low or no additional impacts over the No Action Alternative. Low-level land use and traffic impacts in Redmond would occur south and west of its neighborhoods. There would be low impacts to community cohesion there.

Overall, proposed improvements in the central corridor area occur mostly within the I-405 corridor; these improvements are not expected to present a barrier to social interaction, assuming that connections across the corridor would be preserved. Arterial HOV improvements in Redmond and Kirkland have the potential to act as increased barriers between existing neighborhoods; however, pedestrian crossings across these streets would be preserved and the function of the streets as major arterials would not change from existing conditions.

Community cohesion impacts for cities in the southern corridor area would increase slightly as the number of proposed improvements increases, but would not rise above a low level of impact. Most proposed improvements in Alternative 1 would be constructed in the city of Renton; however, there would be neither a positive nor negative traffic impact in terms of its effect on community cohesion. Renton would have low land use and displacement impacts. These would be mainly along the I-405 commercial areas of Renton. Tukwila and Kent, each with a limited number of proposed improvements within their respective city limits, would be mostly unaffected beyond the level of No Action Alternative impacts. Both cities would have land use impacts that would be localized and would have only a low impact on overall community cohesion.

The improvements proposed in Alternative 1 are not expected to greatly affect social interaction between or within neighborhood areas in the hills east of I-405. Most Alternative 1 improvements in the southern corridor area would be located in or around the commercial and light industrial areas near I-405 in Renton. Social interaction between the neighborhoods within Kent and Tukwila would have a low probability of being impacted by these improvements, due to a limited number of improvements and the distance between the improvements and existing neighborhoods.

Some social interaction impacts may be offset over the long term by the presence of high-capacity transit stations. The establishment of transit systems can encourage greater investment by property owners at station areas. Development oriented toward transit is typically also oriented toward pedestrian interaction within communities. Faster, more reliable, and more frequent transit service can also increase access to community facilities and employment opportunities, benefiting all residents of neighborhoods with stations. In Alternative 1, stations would be concentrated in the central corridor area, most notably in Bellevue, but stations could also be built in Kent, Tukwila, Bothell, and Woodinville.

3.15.4.3 Alternative 2: Mixed Mode with HCT/Transit Emphasis

Construction Impacts

Net effects to neighborhoods in Alternative 2 would be comparable to Alternative 1. Although construction impacts would be widespread, Bothell, Kirkland, Bellevue, and Renton would likely have the most construction impacts due to the number of proposed improvements within their jurisdictions. Construction impacts affecting traffic would be similar to Alternative 1; most traffic control measures would result in a decrease in capacity and increase in system-wide roadway congestion. There would be slightly more construction noise than in Alternative 1.

Operational Impacts

Alternative 2 would have the lowest social impact throughout the corridor, but would not be substantially better than the other three action alternatives. More cities would see an improvement over the No Action Alternative operational conditions in this alternative than in the other alternatives. Similar to Alternative 1, changes in land uses have the greatest potential to disrupt existing community cohesion. This would be offset by area-wide traffic improvements. Bellevue would have the most impacts of all cities; Kenmore, Woodinville, Newcastle, and unincorporated parts of King and Snohomish counties would have slightly beneficial impacts.

In Alternative 2, cities in the northern corridor area would have mostly positive impacts on community cohesion compared to the No Action Alternative and Alternative 1. All northern cities, as well as unincorporated Snohomish County, would see an overall improvement in traffic conditions. Traffic studies for this alternative show that traffic would move from neighborhood arterials onto nearby highways and I-405, improving community cohesion. Community cohesion in Bothell would be slightly better in Alternative 2 versus the No Action Alternative; however, Bothell would be the only northern city in Alternative 2 with negative impacts. There would be low levels of noise, displacement, land use, and visual impacts; each of these impacts would be confined to the I-405 corridor and would not impact neighborhoods established deeper within the city.

Kenmore, Woodinville, and unincorporated Snohomish County would experience the same displacement, noise, and traffic impacts as in the No Action Alternative. This is largely because the only improvements proposed within their jurisdictions are along SR 522, which is mostly commercial and residential. Unincorporated parts of Snohomish County outside of these jurisdictions would be affected in a manner similar to the incorporated cities. Changes in land uses would represent the most likely effect on community cohesion, although the magnitude of impact would be low since changes would only occur in isolated areas and most neighborhoods in the unincorporated areas are not as well defined. Unincorporated Snohomish County would not see any changes in traffic volumes over the No Action Alternative.

Alternative 2 would have limited impacts to social interaction in the northern corridor area. Proposed improvements would occur in existing highway corridors along the perimeter of existing neighborhoods in Bothell and Snohomish County and are most heavily concentrated in commercial areas. These improvements are not expected to create physical barriers to social interaction above current conditions in the I-405 and SR 527 corridors. Improvements to SR 522 in Kenmore and Woodinville are not expected to impact movements between existing neighborhoods to the north and south of the highway.

In the central corridor area, the cities of Redmond and Newcastle would have no additional impacts, while Kirkland and Bellevue would have a low level of additional impacts over the No Action Alternative. Unincorporated portions of King County would have slightly beneficial effects on community cohesion. King County would only have low impacts in regard to land uses that could be influenced by high-capacity transit operation. There would be no additional displacement or noise impacts in Redmond and Newcastle. Both of these cities would have traffic benefits offset by possible low-level land use impacts for a net impact to community cohesion that would be similar to No Action conditions. A heavy concentration of improvements in Bellevue and Kirkland would improve mobility within these jurisdictions without allowing large amounts of noise to substantially spill out of the I-405 corridor and into the neighborhoods that flank the interstate. I-405 improvements in Bellevue would displace approximately 36 residences and 12 business along I-405. Significant view corridors in Kirkland and Bellevue would receive a low-level of impact over the No Action Alternative, reducing the potential for community cohesion and social interaction impacts. Since these impacts would occur primarily along the perimeter of existing neighborhoods, community cohesion impacts would be low.

Overall, proposed improvements in the central corridor area would occur mostly within the I-405 corridor; these are not expected to present a barrier to social interaction assuming that connections across the corridor would be preserved. Improvements to Coal Creek Parkway (in

Newcastle) and Willows Road (in Redmond) would represent the only inter-neighborhood improvements that could slightly increase physical separation between neighborhoods.

Community cohesion impacts for cities in the southern corridor area would slightly increase over No Action conditions. Most proposed improvements in Alternative 2 would be constructed in the city of Renton; however many of these would occur near downtown, away from residential areas. Renton would have low land use and displacement impacts, mainly along the I-405 commercial areas of Renton, resulting in low impacts to community cohesion. Traffic in Renton would improve, while noise impacts would not be above those resulting from the No Action Alternative. Overall, Renton's neighborhoods, mostly south and east of the most intensive improvements, would not be greatly affected. Tukwila and Kent, each with a limited number of proposed improvements within their respective city limits, would be mostly unaffected beyond the level of No Action Alternative impacts. Both cities would have low-level land use impacts that would be localized near proposed HCT improvements, and therefore would have only a low impact on overall community cohesion.

Most Alternative 2 improvements would be located in or around the commercial and light industrial areas near I-405, although some arterial improvements in Kent could have low-level traffic impacts. Social interaction between the neighborhoods within Kent and Tukwila would have a low probability of being affected by these improvements, due to the low number of proposed improvements.

Some social interaction impacts may be offset over the long term by the presence of high-capacity transit stations. Transit-oriented development could stimulate increased interaction within communities. Neighborhood residents also would benefit from improved access. Alternative 2 would include the same number of stations in the same cities as in Alternative 1.

3.15.4.4 Alternative 3: Mixed Mode Emphasis

Construction Impacts

The scale of proposed improvements (particularly on I-405) in Alternative 3 would increase the duration and extent of construction impacts throughout the corridor. The duration of traffic impacts will more than double compared to Alternatives 1 and 2 because of the additional lane miles that would be under construction. Noise levels would be roughly the same as in Alternatives 1 and 2; however, most noise would be associated with I-405 improvements. There would be no construction noise in the HCT corridor.

Operational Impacts

Alternative 3 would have slightly lower impacts on neighborhood community cohesion than Alternative 2. Land use, displacement, and visual impacts would each have roughly the same potential to disrupt existing neighborhood connections; however, the overall effect on community cohesion throughout the affected area would still be low. Bellevue and Kirkland would likely have the greatest impacts, due to a heavy concentration of improvements within their respective jurisdictions. Cities farther away from I-405, such as Redmond and Woodinville, would see only a slight improvement over the No Action Alternative conditions.

Cities in the northern corridor area, as well as unincorporated Snohomish County, would mostly see very slight positive impacts or no change in community cohesion. Bothell, the one exception, would have low-level displacement, noise, land use, and visual impacts in combination with traffic improvements. There would be a greater shift in traffic off of neighborhood arterials and onto highways than in Alternatives 1 and 2, improving intra- and inter-neighborhood movement, but also increasing noise impacts. Similar to other alternatives, these impacts would be isolated mainly along the I-405 corridor at the periphery of existing neighborhoods.

Kenmore would have community cohesion impacts comparable to those found in the No Action Alternative. Similar to Alternative 2, Kenmore would have improved traffic conditions and localized land use impacts. Woodinville would be affected in a manner similar to Kenmore; there would be few proposed improvements and they would occur along existing highways/major arterials. Land use impacts in Woodinville would be low; the net effect of all of the improvements would be a slightly positive impact on Woodinville community cohesion. Unincorporated parts of Snohomish County outside of these jurisdictions would be affected in a manner comparable to the incorporated cities; changes in land uses would represent the most likely impact to community cohesion, although the magnitude of impact would be low since changes would only occur in isolated areas.

Improvements in Alternative 3 are not expected to create physical barriers to social interaction above current conditions in the I-405 corridor. The major improvement proposed in Kenmore and Woodinville along SR 522 would not be expected to affect movements between existing neighborhoods to the north and south of the highway beyond existing conditions. Proposed improvements in Snohomish County would not be extensive enough to jeopardize social interaction between neighborhoods.

Cities in the central corridor area would consistently have greater impacts than in other parts of the affected area; however, the level of their impacts over the No Action Alternative impacts would be low. Kirkland and Bellevue would experience the greatest impacts of any cities in the corridor, largely due to displacement impacts. These two cities would have 46 and 97 total displacements, respectively, occurring primarily near I-405 at the edge of existing neighborhoods. The location of these displacements, as well as land use, noise, and visual impacts, would result in a low level of impact to community cohesion. Redmond and Newcastle would have community cohesion impacts similar to those found in Alternative 2. There would be no additional displacement and noise impacts in these two cities relative to the No Action Alternative, slight traffic improvements, and low land use impacts. Unincorporated portions of King County would have slightly beneficial effects on community cohesion. This would be caused by an improvement in traffic volumes (even greater than Alternatives 1 and 2) in the neighborhoods surrounding I-405 and a general lack of noise and displacement impacts. Transit-supportive land uses could change the character of some areas near the corridor, but this would be expected to have a low impact on overall cohesion.

Overall, proposed improvements in the central corridor area occur mostly within the I-405 corridor; these improvements are not expected to present a barrier to social interaction assuming that connections across the corridor would be preserved. Arterial HOV improvements in Redmond, Kirkland, and Newcastle have the potential to act as increased barriers between existing neighborhoods. However, because these streets are already major arterials, their effect as a physical barrier would not likely increase substantially as a result of these proposed improvements.

Community cohesion impacts for cities in the southern corridor area under Alternative 3 would be similar to those in Alternative 2. Renton would have low land use and displacement impacts, mainly along I-405, resulting in low impacts to community cohesion. Traffic in Renton would improve, while noise impacts would not be above those resulting from the No Action Alternative. Overall, Renton's neighborhoods, mostly south and east of the most intensive improvements, would not be greatly affected. Tukwila, with a limited number of proposed improvements within its city limits, would be mostly unaffected beyond the level of the No Action Alternative impacts. In Kent, there would be low-level traffic and land use impacts, which would result in low community cohesion impacts; most proposed improvements in Kent would occur away from existing neighborhoods.

Most proposed improvements in Alternative 3 would be constructed within the I-405 corridor and along arterials leading to this corridor. Some arterial improvements in the southern corridor area could have social interaction impacts. Social interaction between the neighborhoods within Kent and Tukwila would have a low probability of being affected by these improvements, due to the low number of proposed improvements.

Some social interaction impacts may be offset over the long term by the presence of transit stations. Benefits related to transit stations would be less in Alternative 3 since this alternative would have fewer stations than Alternatives 1 and 2. Stations would be concentrated in Kirkland, Redmond, and Bellevue, offering the greatest benefits to the central corridor area. Stations would also be provided in Bothell, Kent, and Tukwila.

3.15.4.5 Alternative 4: General Capacity Emphasis

Construction Impacts

Alternative 4 would have the longest-term and most extensive construction impacts of all the alternatives. The addition of six lanes of roadway capacity in the I-405 corridor would have substantial impacts to traffic compared to the other alternatives because of the extensive use of grade- and barrier-separated alignments, especially in the southern portion of I-405 between Tukwila and the I-90 interchange. There would be more construction noise in the I-405 corridor under Alternative 4 than any of the other alternatives because of construction of the express roadway. However, because these impacts would be primarily within existing transportation corridors, impact to neighborhoods would not be substantial.

Operational Impacts

The net level of social impact caused by the operation of Alternative 4 improvements would be similar to Alternative 1. Although Alternatives 1 and 4 have the poorest ratings of all of the alternatives in terms of social impacts, they would still only have a low impact on community cohesion. Displacement impacts would have the greatest effect on neighborhoods in this alternative. This would be offset by area-wide improvements in traffic flow. Similar to Alternative 3, Kirkland and Bellevue would experience the greatest impacts due to a high concentration of improvements. Woodinville and Redmond would have net benefits to community cohesion, mainly because of traffic improvements and limited displacement and noise impacts.

In Alternative 4, Bothell would experience low impacts to community cohesion while Kenmore, Woodinville, and unincorporated Snohomish County would experience slight benefits or no additional impact compared to the No Action Alternative. Bothell would have low-level displacement, noise, land use, and visual impacts in combination with traffic improvements. Similar to other alternatives, these impacts would be isolated mainly along the I-405 corridor in

Bothell at the periphery of existing neighborhoods. There would be an even greater shift in traffic off of neighborhood arterials and onto highways—the greatest shift of all the alternatives. However, because of noise and displacements, there would still be a low impact to community cohesion.

Kenmore would have improved traffic conditions and localized land use impacts. The major improvement proposed in Kenmore, along SR 522, would not be expected to impact movements between existing neighborhoods to the north and south of the highway beyond existing conditions. Woodinville would be affected in a manner similar to Kenmore; there would be few proposed improvements, and they would occur along existing highways/major arterials. Land use impacts in Woodinville would be slightly less. Because of this, the net effect would be a slightly positive impact on Woodinville community cohesion. Unincorporated parts of Snohomish County outside of these jurisdictions would experience low impacts due to displacements and a slight improvement in traffic. Combined with no noise and land use impacts above the No Action Alternative level, Snohomish County would experience no additional community cohesion impacts.

Proposed improvements in Alternative 4 are not expected to create physical barriers to social interaction above current conditions in the I-405 and SR 527 corridors. Major improvements proposed in Kenmore and Woodinville, along SR 522, are not expected to affect movements between existing neighborhoods to the north and south of the highway beyond existing conditions. Proposed improvements in Snohomish County would not be extensive enough to jeopardize social interaction between neighborhoods.

In Alternative 4, cities in the central corridor area would experience impacts very similar to Alternative 3. As in Alternative 3, Kirkland and Bellevue would receive the greatest impacts of any cities in the affected area, largely due to displacement impacts. These two cities would have 31 and 72 total displacements, respectively, occurring primarily near the I-405 corridor, at the edge of existing neighborhoods. However, the location of these displacements, as well as land use, noise, and visual impacts, would result in a low level of impact to community cohesion. Although Bellevue would have fewer proposed improvements outside of the I-405 corridor in this alternative compared to the other action alternatives, community cohesion impacts would be roughly the same because of the magnitude of the I-405 improvement impacts. Redmond and Newcastle would also experience community cohesion impacts similar to those found in Alternative 3. There would not be substantial additional displacement and noise impacts in these two cities relative to the No Action Alternative, and there would be slight traffic improvements and low land use impacts. Unincorporated portions of King County would experience slightly beneficial impacts to community cohesion. This would be caused by an improvement in traffic volumes (even greater than Alternatives 1 and 2) in the neighborhoods surrounding I-405 and general lack of noise and displacement impacts.

Unlike other alternatives, several proposed improvements in Kirkland, Redmond, and Newcastle are outside of the immediate I-405 corridor; these improvements could be expected to present a barrier to social interaction if pedestrian and cross-traffic movement across individual arterials is not preserved.

In Alternative 4, cities in the southern corridor area would experience a low level of community cohesion impacts. Renton would have 50 total displacements in this alternative, mainly along the I-405 corridor along the edges of existing neighborhoods. Renton would have low land use and visual impacts, offsetting some of the traffic benefits that would reduce volumes on neighborhood streets. Tukwila, with a limited number of proposed improvements within its city limits, would be mostly unaffected beyond the level of No Action Alternative impacts. There would be low-level displacement and land use impacts; overall Tukwila would experience low impacts to community cohesion. In Kent, there would be low-level traffic and land use impacts, which would result in low community cohesion impacts; most proposed improvements in Kent would occur away from existing neighborhoods.

Most proposed improvements in Alternative 4 would be constructed within the I-405 corridor and along major arterials leading to this corridor. Alternative 4 improvements are not expected to greatly affect the social interaction of Renton neighborhood areas in the hills east of I-405. Some arterial improvements in the southern corridor area could have social interaction impacts, although most of these arterials cross large-parcel commercial and light industrial developments. However, social interaction between the neighborhoods within Kent and Tukwila would have a low probability of being affected by these improvements, since most neighborhoods would be located away from the improvements.

3.15.4.6 Preferred Alternative

Construction Impacts

The scale of proposed improvements (particularly on I-405) in the Preferred Alternative would be similar to that proposed for Alternative 3. The duration of traffic impacts would be slightly greater because of the additional arterial capacity projects that are included. Noise levels would be roughly the same as in Alternative 3; however, additional noise would be expected from the arterial projects, primarily in Tukwila, Redmond, and Bothell.

Operational Impacts

The Preferred Alternative would have impacts on neighborhood community cohesion very similar to Alternative 3. Land use, displacement, and visual impacts would each have roughly the same potential to disrupt existing neighborhood connections; however, the overall effect on community cohesion throughout all cities in the study area would be low. Bellevue, Redmond, and Kirkland would likely have the greatest impacts due to a heavy concentration of improvements within their respective jurisdictions. Areas farther away from I-405, such as Woodinville and unincorporated King County, would see a slight improvement over the No Action Alternative conditions similar to Alternative 3.

Cities in the northern corridor area would have impacts and benefits similar to those described in Alternative 3. The city of Bothell would have slightly higher traffic and noise impacts due to the proposed widening of SR 527. Overall, in the northern corridor, traffic would be shifted off of neighborhood arterials and onto highways, which would improve intra- and inter-neighborhood movement but would also shift the noise impacts. Similar to the other alternatives, these impacts would be isolated mainly along the I-405 corridor at the periphery of existing neighborhoods.

Kenmore would have community cohesion impacts comparable to those found in Alternative 3 and would experience improved traffic conditions and localized land use impacts. Woodinville would be affected in a manner similar to Kenmore; there would be few proposed improvements, and they would occur along existing highways and major arterials. Additional proposed projects, such as the widening of SR 202, would not greatly affect social conditions beyond those described for Alternative 3. Traffic and noise impacts could be somewhat higher near SR 202.

Land use impacts in Woodinville would be low; the net effect of all improvements would be a slightly positive impact on Woodinville community cohesion. Unincorporated parts of Snohomish County outside of these jurisdictions would be affected in a manner comparable to Alternative 3.

Improvements in the Preferred Alternative are not expected to create physical barriers to social interaction above current conditions in the I-405 corridor. The major improvement proposed in Kenmore and Woodinville along SR 522 would not be expected to affect movements between existing neighborhoods to the north and south of the highway beyond existing conditions. Proposed improvements in Snohomish County would not be extensive enough to jeopardize social interaction between neighborhoods.

Cities in the central corridor area would have impacts very similar to Alternative 3; the level of impacts to these cities in excess of the No Action Alternative would be low. There are no additional projects in the Bellevue area compared to Alternative 3 that would have social impacts. Bellevue would remain one of the higher-impacted cities, however, due to displacement impacts. Kirkland could experience less noise and fewer displacements near I-405 compared to Alternative 3 due to smaller proposed improvements to the freeway. For both cities, the location of displacements, as well as land use, noise, and visual impacts, would result in a low level of impact to community cohesion. Newcastle would have community cohesion impacts similar to those found in Alternative 3. Compared to Alternative 3, the Preferred Alternative would include additional projects along I-405 that would have limited impacts to nearby neighborhoods. There would be no additional displacement and noise impacts in this city relative to the No Action Alternative or Alternative 3. The Preferred Alternative would include arterial projects in the city of Redmond that could result in additional traffic, noise, and displacement impacts. Redmond would have a low-level social impact under the Preferred Alternative. Unincorporated portions of King County would experience the same beneficial effects on community cohesion as Alternative 3.

Overall, proposed improvements in the central corridor area occur mostly within the I-405 corridor; these improvements are not expected to present a barrier to social interaction, assuming that connections across the corridor are preserved. Arterial HOV improvements in Redmond, Kirkland, and Newcastle have the potential to act as increased barriers between existing neighborhoods. However, because these streets are already major arterials, their effect as a physical barrier would not likely increase substantially as a result of these proposed improvements.

Community cohesion impacts for cities in the southern corridor area under the Preferred Alternative would be similar to those in Alternative 3. Renton would have the same land use and displacement impacts as well as the same traffic improvements. Noise impacts would be reduced near SR 167 compared to Alternative 3 due to a shortened proposed widening project. Overall, Renton's neighborhoods, mostly south and east of the most intensive improvements, would not be greatly affected. Tukwila, with a limited number of proposed improvements within its city limits, would be mostly unaffected beyond the level of Alternative 3 impacts. Neighborhoods around SR 181 would have noise and potential displacement impacts greater than Alternative 3; however, overall social impacts would still be low. In Kent, there would be low-level traffic and land use impacts similar to Alternative 3, which would result in low community cohesion impacts; most proposed improvements in Kent would occur away from existing neighborhoods.

Most proposed improvements in the Preferred Alternative would be constructed within the I-405 corridor and along arterials leading to this corridor. Some arterial improvements in the southern corridor area could have social interaction impacts. Social interaction between the neighborhoods within Kent and Tukwila, however, would have a low probability of being affected by these improvements due to the low number of proposed improvements.

Some social interaction impacts might be offset over the long term by the presence of transit stations. The Preferred Alternative would have a level of transit benefits similar to Alternative 3. Stations would be concentrated in Kirkland, Redmond, and Bellevue, offering the greatest benefits to the central corridor area. Stations would also be provided in Bothell, Kent, and Tukwila.

3.15.5 Mitigation Measures

3.15.5.1 Construction

Construction mitigation for the No Action Alternative projects is, or will be, addressed through the environmental analysis, documentation, and review completed for those projects. No additional mitigation measures are necessary.

The action alternatives, including the Preferred Alternative, could have impacts that would be locally or regionally substantial, but none that would require mitigation different in degree or kind than that which is proposed for displacements, traffic, noise, visual quality, and land use to help reduce overall impacts on neighborhoods.

3.15.5.2 Operation

Operations mitigation for the No Action Alternative projects is, or will be, addressed through the environmental analysis, documentation, and review completed for those projects. No additional mitigation measures are necessary.

The action alternatives, including the Preferred Alternative, could have impacts that would be locally or regionally substantial, but none that would require mitigation different in degree or kind than that which is proposed for displacements, traffic, noise, visual quality, and land use to help reduce overall impacts on neighborhoods.

3.16 ECONOMIC IMPACTS

3.16.1 Studies and Coordination

Direct economic impacts are impacts that would occur during construction and impacts that would result directly from construction and operation of the alternatives. In the economics analysis, these impacts are characterized as follows:

- Direct property tax impacts: Estimates of the potential impacts to the tax base of local jurisdictions from the loss of taxable property for the project.
- Localized business impacts: Estimates of the relative potential for loss of business revenue to firms located near projects that may be affected negatively by construction and operation of the alternatives.

Construction spending impacts (temporary jobs and income that may result from expenditures during construction) may also occur. These impacts are discussed below, but are not used in the evaluation of alternatives.

Other economic effects may occur in relation to long-term economic development trends. Those trends may include the overall level of economic activity in the region and spatial patterns of development.

In addition, employment, income, and property values in the region may be influenced by changes in mobility and accessibility provided by the alternatives. For example, future levels of congestion could make the region and study area less attractive to other areas of the country to firms seeking to locate or expand operations.

The relative success of industries and firms that are important to the success of the region's economy (e.g., aircraft manufacturing, computer software, biotechnology, forest products) is an important determinant of the level and location of employment and income in the region. The mix of industries in the regional economy also influences travel demand, as some industries (retail and services) tend to result in more trips per employee than other industries (manufacturing).

Information on property taxes was obtained from the King County Department of Assessments and the Snohomish County Assessor's office. Results of DRAM/EMPAL model runs prepared by the PSRC were used in the evaluation of secondary impacts. PSRC and the Washington State Department of Revenue provided information on population, households, employment, and taxes.

Evaluation of the potential effects of tolls and managed lanes will be provided in subsequent project-level environmental analysis, documentation, and review when a proposal has been adequately defined.

3.16.2 Methodology

The economic analyses in this section are based on the *I-405 Corridor Program Draft Economics Expertise Report* (CH2M HILL, 2001) herein incorporated by reference.

3.16.2.1 Property Tax Impacts

Estimates of the loss of taxable property for project right-of-way were prepared. Estimated right-of-way market values, provided in the Displacements report, are used as an estimate of the assessed value of lost property. Each project (or portion of a project) was assigned to a jurisdiction, and average property tax levies for that jurisdiction were used to estimate the amount of property tax revenue that would be affected by the project. These impacts are called direct property tax impacts.

Direct property tax impacts are a general measure of the fiscal impact to jurisdictions. While specific estimates of all tax impacts to jurisdictions from the project (such as sales and parking) were not possible, direct property tax impacts provide a rough indicator of the magnitude of fiscal impacts that may result from an alternative. Possible long-term effects of the project are discussed as secondary impacts.

3.16.2.2 Localized Business Impacts

Reductions in the business revenue of firms affected by construction can result both from overall congestion that affects freight mobility, and from the localized impacts of restricted access, reduced parking, dust, and noise. Overall congestion would depend on the number of lane miles affected during construction and the specific methods used during construction (which are unknown at this time). Localized impacts would be most severe in alternatives with relatively more improvements to arterials and other roads that currently provide direct access to businesses. For this report, the localized business impacts of alternatives were evaluated using professional judgement after a review of aerial photos combined with local knowledge.

3.16.2.3 Construction Spending Impacts

One potential benefit from the alternatives is the potential for a temporary increase in jobs and income in the region resulting from construction spending. Expenditures during construction would result in demand for construction materials and jobs. These expenditures are considered direct impacts. These direct impacts lead to secondary impacts as the output of firms in other industries increases to supply the demand for inputs to the construction industry. Finally, wages paid to workers in construction trades or supporting industries are spent on other goods and services; these are referred to as induced impacts. Direct, secondary, and induced impacts may occur in the region from construction of the projects within an alternative. In the evaluation of impacts, construction spending impacts are not evaluated specifically. Instead they should be recognized as a general impact that will vary roughly in proportion to the construction cost of the alternatives.

3.16.2.4 Regional Economic Development

Changes in regional economic development that may result from each alternative are discussed qualitatively based on the results of research into the relationship between transportation investment and economic growth. That research indicates that while the effects are difficult to measure, transportation investment generally has a small positive effect on regional economic output. Business growth associated with highway investment can be attributed to increased productivity through improved access to markets, an increase in available inputs and labor, decreased travel time, and increased mobility throughout a region. A firm's decision to relocate is based in part on the availability of those benefits and can result in decreased prices for consumers, increased wages for workers, and greater product innovation.

Congestion is a problem faced by both individuals and firms in their desire to seek out markets to buy and sell goods and services. Congestion is often cited as an important factor in firms' decisions to locate in an area and in the locational decisions of highly skilled workers. While congestion is a cost that is passed on to consumers, market density provides substantial cost savings that can also be passed on. This contradicts the assumption that congestion is always undesirable for firms and individuals. Some businesses, such as retail establishments, might derive benefits from congestion because consumers frequent the establishment to escape the congested roadway. On the other hand, firms that rely heavily on the distribution of goods and services are more likely to be adversely impacted by high levels of congestion. Thus, the extent to which congestion affects economic activity is dependent on a host of other related factors and is difficult to generalize.

Transportation investment can also influence the spatial pattern of regional growth. Potential changes in spatial growth patterns are presented based on results from the Puget Sound Regional Council's DRAM/EMPAL activity model. This model simulates some of the basic locational dynamics among and within geographic sub-areas of the region, given conditions or forecasts for the region as a whole. The models are spatial interaction models that are based on household demand for residential sites and the transportation accessibility of locations to jobs and residences within the urban area, subject to regional control totals. They predict a future-year distribution of population, households, jobs, and land use for a set of base-year conditions, zone-to-zone travel costs, and regional totals. When travel times between zones change in different alternatives, subject to land use constraints, different spatial patterns of growth result. The results of the model runs for each alternative were used to comment qualitatively about the potential for changes in economic development and growth patterns resulting from the alternatives.

3.16.3 Affected Environment

3.16.3.1 Population, Households, and Employment

Historic and forecast population, housing, and employment are shown in Table 3.16-1. As shown, approximately 564,400 people lived within the corridor in 1997, an increase of about 56,000 since 1990. By 2020, the population of the corridor is expected to reach nearly 765,000, an increase of more than 200,000 people from 1997. On a percentage basis, population is projected to grow at a rate similar to that of recent years (forecast annual growth from 1997 to 2020 of 1.6 percent versus 1.5 percent from 1990 to 1997).

Table 3.16-1: Population, Employment, and Housing in Corridor

	Year			Average Annual Growth	
	1990	1997	2020	1990-1997	1997-2020
Population	508,600	564,400	764,700	1.6%	1.5%
Households	195,800	219,300	325,300	1.7%	2.1%
Employment[a]	323,200	408,600	552,700	3.8%	1.5%

[a] Excludes resources (agriculture, forestry, fishing, and mining) and construction.
Source: Puget Sound Regional Council

Households in the corridor are forecasted to increase by 106,000, from about 219,300 in 1997 to 325,300 in 2020. The forecasted annual rate of household formation from 1997 to 2020, 2.1 percent, is greater than the recent past (1.7 percent from 1990 to 1997) and is also greater than the forecast annual rate of population growth. This means that number of persons per household is forecast to decline. This is relevant because travel demand typically correlates more closely to household formation than population.

As of 1997, approximately 408,600 employees were employed at businesses located within the corridor. From 1990 to 1997, employment grew at a rather rapid rate of 3.8 percent per year, on average. By 2020, an additional 144,000 people are forecast to be employed within the corridor, which translates into a more moderate average annual growth rate of 1.5 percent.

Some insight into trends in the corridor's economic base can be gained by examining historic and forecasted employment by industry. The service sectors will continue to be an increasingly large proportion of the corridor's economy, increasing from a 31 percent share of employment in 1990 to a 44 percent share in 2020. Most of the relative decline comes from the manufacturing sector; in fact, fewer workers are forecasted to be employed in manufacturing in 2020 than in 1990.

Population and households in the corridor have declined slightly as a percent of the four-county Puget Sound region total in recent years, in part because the corridor's housing stock is relatively high-priced. In the years ahead, the percentage of the region's population and households within the corridor is forecast to remain about what it is today.

The trend to increased service employment at the expense of manufacturing is evident throughout the region, although the corridor's share of total regional manufacturing is expected to decline from 31.5 percent in 1997 to 29.2 percent in 2020. This has implications for travel demand as, in general, manufacturing facilities generate fewer trips per employee than retail or service businesses. Retail businesses generally produce the most trips of all the business types, and the I-405 corridor has a greater share of four-county retail employment than total employment. Thus, we can expect somewhat greater travel demand per employee within the corridor compared to the rest of the region.

3.16.3.2 Major Employers

The largest private-sector employers located on the Eastside include three of the largest companies in the state: Boeing, Microsoft, and Paccar. The Eastside is defined to be a bit larger than the I-405 corridor boundaries and includes the cities of Bellevue, Bothell, Issaquah, Kirkland, Mercer Island, Redmond, Renton, and Woodinville. The Boeing Company employs over 21,000 people at its complex in Renton, and an additional 2,700 employees at the other locations on the Eastside. Microsoft employs approximately 10,900 people at its Redmond campus headquarters and various other locations in the corridor. Hospitals and other health care organizations provide jobs for over 4,500 people. Evergreen Hospital Medical Center and Overlake Hospital Medical Center employ 1,600 each, while Valley Medical Center in Renton and Group Health Cooperative of Puget Sound add approximately 1,400 and 900 jobs, respectively. The telecommunication industry continues to grow with the boom of the Internet and personal communication services technology. Combined, AT&T Corp., US West Communications, and Western Wireless Corp. employ a total of over 3,000 people on the Eastside.

The Eastside is known as a high technology center with many fast-growing technology-based companies. Recent estimates by the PSRC indicate that 58 percent of the high tech employment in King, Pierce, and Snohomish counties is located within the I-405 corridor, and from 1995 to 1998, high tech employment within the study boundaries grew by 38 percent.

3.16.4 Impacts

3.16.4.1 No Action Alternative

Direct Property Tax Impacts

The direct effects of the No Action Alternative on property tax receipts are or will be evaluated as part of environmental analysis, documentation, and review for the individual projects contained therein.

Localized Business Impacts

Under the No Action Alternative, there would be relatively little impact on local businesses during construction because of the relatively few committed transportation improvements in this alternative.

Regional Economic Development

Under the No Action Alternative, the extent to which congestion could adversely affect overall growth is uncertain. Current research indicates that overall levels of employment and income in the region are not expected to change substantially based on the level of congestion on the regional road network. However, there is a point at which congestion can influence firms and workers to locate elsewhere. Several major employers in the region have recently indicated that current congestion levels are becoming a major negative factor when weighing where to establish new facilities to meet projected business growth.

The Growth Management Act (GMA) requires local jurisdictions to adopt and enforce concurrency ordinances precluding approval of a proposed development if that development would cause the level-of-service of a transportation facility to fall below the jurisdiction's adopted standard, unless transportation improvements or strategies to accommodate the impacts of the development are made within six years the development. The local jurisdictions in the I-405 study area are facing serious traffic concurrency problems. If these issues are not adequately addressed by 2020, it is likely that projected growth would not be realized as planned. This could occur due to the effects of concurrency regulations limiting development or due to individual businesses and workers choosing to relocate outside of the study area or region to avoid the effects of congestion.

The existing concurrency problems in most of the local jurisdictions would be exacerbated in the future under the No Action Alternative. The analysis results show virtually every jurisdiction within the study area would reach or exceed concurrency levels by 2020. The land use analysis (Section 3.13) shows that the No Action Alternative may contribute to unintended growth and development outside the I-405 study area and urban growth area, partially due to impaired transportation accessibility.

3.16.4.2 Alternative 1: HCT/TDM Emphasis

Direct Property Tax Impacts

There would be some fiscal impacts to jurisdictions from implementation of any of the action alternatives. None of these impacts are expected to be substantial from an economic perspective.

The estimated direct property tax impacts of the 4 action alternatives due to the loss of taxable property for project right-of-way are shown in Table 3.16-2.

Table 3.16-2: Direct Property Tax Impact of Action Alternatives on Affected Jurisdictions

Jurisdiction	2000 Assessed Value	Total Property Tax Collected within Each Jurisdiction [a]	Property Tax Loss as a Percentage of Total Property Tax Collections of Each Jurisdiction				Preferred Alternative
			Alt 1	Alt 2	Alt 3	Alt 4	
Regional Total	**$106,087,816,772**	**$1,386,424,742**	**0.3%**	**0.4%**	**0.4%**	**0.6%**	**Minor increase from Alternative 3**
Bellevue	$14,980,866,542	$171,133,093	0.7%	0.7%	0.6%	0.4%	Minor increase from Alternative 3
Bothell	$1,407,617,139	$19,263,237	2.4%	4.3%	4.2%	7.3%	Minor increase from Alternative 3
Issaquah	$1,406,998,956	$17,934,291	0.1%	0.1%	0.0%	0.0%	Similar to Alternative 3
Kenmore	$1,458,279,815	$20,578,229	0.0%	0.0%	0.0%	0.0%	Minor decrease from Alternative 3
Kent	$6,468,268,324	$91,186,236	0.0%	0.0%	0.0%	0.0%	Similar to Alternative 3
Kirkland	$5,181,359,025	$62,003,605	0.4%	1.9%	1.5%	3.1%	Similar to Alternative 3
Lynnwood	$2,632,186,036	$33,069,469	0.8%	0.9%	0.0%	0.0%	Similar to Alternative 3
Medina	$1,240,200,931	$12,189,364	0.0%	0.0%	0.0%	0.0%	Similar to Alternative 3
Mercer Island	$4,230,744,382	$44,619,842	0.0%	0.0%	0.0%	0.0%	Similar to Alternative 3
Mill Creek	$962,012,640	$13,834,319	0.0%	0.0%	0.0%	0.5%	Minor increase from Alternative 3
Newcastle	$775,438,023	$9,784,884	1.0%	1.8%	2.5%	2.1%	Minor increase from Alternative 3
Redmond	$6,213,635,958	$73,611,454	0.5%	0.5%	0.2%	0.3%	Minor increase from Alternative 3
Renton	$4,513,567,131	$60,107,866	1.2%	1.4%	1.5%	1.9%	Minor increase from Alternative 3
Sammamish	$3,810,373,196	$51,676,329	0.0%	0.0%	0.0%	0.0%	Similar to Alternative 3
SeaTac	$2,690,612,418	$36,368,534	0.0%	0.0%	0.0%	0.0%	Similar to Alternative 3
Unincorporated Snohomish County	$17,260,864,432	$240,392,059	0.0%	0.0%	0.3%	0.5%	Similar to Alternative 3
Tukwila	$2,747,207,313	$37,842,575	0.6%	0.8%	0.2%	2.0%	Minor increase from Alternative 3
Woodinville	$1,286,776,207	$17,892,321	0.0%	0.1%	1.0%	1.0%	Similar to Alternative 3
Unincorporated King County	$26,820,808,304	$372,937,037	0.0%	0.1%	0.1%	0.1%	Similar to Alternative 3

[a] Total property tax collected includes levies for county and local government operations, schools, water, hospital, libraries, emergency medical services, flood, fire, and other. Estimated by multiplying 2000 assessed value by the average levy ($/$1,000 value) in each jurisdiction.
Source: Washington State Department of Revenue: http://dor.wa.gov/reports/proptax00/tables/table21-s.xls

The right-of-way required for the projects would consist of developed and vacant parcels that are zoned for various land uses and designated either taxable or tax-exempt property. The taxable property acquired would be removed from the jurisdiction's tax roles. To the extent this impact would be measurable, tax levies would increase in order to collect budgeted funds, or expenditures on public services would decline. In the long run, second-order fiscal impacts would be likely to occur as a result of shifts in regional growth patterns resulting from the transportation improvements.

Alternative 1 would have the lowest direct property tax impacts of the action alternatives. Impacts would be somewhat less than those of Alternatives 2 and 3 and much less than those of Alternative 4.

As shown in Table 3.16-2, the taxable property in the right-of-way acquisitions for Alternative 1 would account for less than one percent of the property taxes collected in the affected jurisdictions. The property tax impact in the City of Bothell would represent approximately two percent of the total property tax collected within the City. The property tax impact for the cities of Newcastle and Renton would account for approximately one percent of the total property taxes collected in the cities. All of the other affected jurisdictions would be likely to have direct property tax impacts of less than one percent.

Localized Business Impacts

It is anticipated that there would be some localized impacts to businesses from implementation of any of the action alternatives. None of these impacts is expected to be substantial from an economic perspective.

Alternative 1 would have the fewest localized business impacts of the action alternatives. Construction impacts would include development of the fixed-guideway high-capacity transit system (HCT), and a series of basic improvements to I-405 including improved interchanges, auxiliary lanes, and increased on-ramp capacity, all emphasizing limited widening options. There would be localized impacts associated with temporary restricted access for both customers and business suppliers in the form of temporary or partial road or lane closures and reroutes along I-405, which may result in short-term potential revenue losses for the affected businesses. Total construction impacts along arterials would be limited compared to the other action alternatives.

Compared to the other alternatives, the most direct impacts of Alternative 1 would be those associated with the fixed-guideway HCT system in the area from SeaTac to Renton's central business district. Expanding the HCT system in this area would require the acquisition of right-of-way not contained within the existing Burlington Northern Santa Fe Railroad (BNSF) right-of-way. Much of the right-of-way that would be used in this area is found along arterials. Construction within this arterial right-of-way would likely have a greater impact to businesses than to businesses that abut I-405.

The degree to which fixed-guideway HCT would affect the livelihood of the surrounding businesses would depend also on whether the system is constructed at-grade, elevated, or within a tunnel. For sections of the HCT system represented by a tunnel, the potential loss of revenue to businesses along the route would be limited. Negative impacts to local businesses would be most substantial for at-grade sections, followed by elevated sections of the system.

Regional Economic Development

Alternative 1 and the other I-405 Corridor Program action alternatives would assist local jurisdictions in the I-405 study area to better manage their long-term concurrency problems. The areas identified for focused growth (e.g. Kirkland/Redmond and Newcastle/Renton/Kent) would be better able to accommodate this planned growth consistent with adopted land use plans. Existing businesses may be more likely to remain within the study area and/or expand operations, while new businesses and workers could be accommodated within a more functional transportation system.

3.16.4.3 Alternative 2: Mixed Mode with HCT/Transit Emphasis

Direct Property Tax Impacts

Alternative 2 would have somewhat greater property tax impacts than Alternative 1, similar impacts to Alternative 3 and the Preferred Alternative, and fewer impacts than Alternative 4.

As shown in Table 3.16-2, the direct property tax impact in the City of Bothell would represent approximately four percent of the total property tax collected within the City. The direct property tax impacts to the cities of Kirkland, Newcastle, and Renton would account for approximately one percent of the total property taxes collected in the cities. All of the other affected jurisdictions would have direct property tax impacts of less than one percent.

Localized Business Impacts

Alternative 2 would result in greater impacts to local businesses than Alternative 1, but fewer impacts than Alternative 3, the Preferred Alternative, or Alternative 4. Construction impacts affecting local business activity would be likely from the development of the fixed-guideway HCT system, basic improvements to I-405, improvements to arterials, construction of high-occupancy vehicle (HOV) arterials in and around the urban centers throughout the I-405 corridor, and expanding I-405 by one lane in each direction.

Most of the transit improvements would use the existing capacity of transit lanes and rail lines, with the exception of the area between SeaTac and Renton's central business district, the impacts of which would be similar to those discussed above for Alternative 1. There would be localized impacts associated with temporary restricted access for both customers and business suppliers in the form of temporary or partial road or lane closures and reroutes along I-405, which may result in short-term potential revenue losses for the affected businesses.

This alternative would include construction of one additional general purpose or auxiliary lane in each direction of I-405. The area most affected in this expansion would be in Kirkland from NE 70th Street to NE 124th Street. Some businesses within the right-of-way of I-405 would be relocated and others along the surrounding arterials would be affected. Construction impacts on these arterials would be greater than impacts associated with I-405 improvements, and would be greater than would be experienced in Alternative 1. Businesses located along arterials may sustain negative access impacts from temporary lane closures or detours that do not allow direct access to businesses. For a business that relies on traffic volume and convenience of access for its customer base, even a short-term revenue loss could be very detrimental to the livelihood of a business.

Regional Economic Development

The effects of Alternative 2 on economic development with the central Puget Sound region and I-405 corridor would be similar to those described for Alternative 1.

3.16.4.4 Alternative 3: Mixed Mode Emphasis

Direct Property Tax Impacts

Alternative 3 would have somewhat greater property tax impacts than Alternative 1, impacts similar to Alternative 2 and the Preferred Alternative, and fewer impacts than Alternative 4.

As shown in Table 3.16-2, the direct property tax impacts in the City of Bothell would represent approximately four percent of the total property tax collected within the City. Alternative 3 would impact the total property taxes collected in Newcastle by over two percent. The property tax impact for the cities of Kirkland and Renton would account for approximately one percent of the total property taxes collected in the cities. All of the other affected jurisdictions would have direct property tax impacts of less than one percent.

Localized Business Impacts

Alternative 3 would have greater localized business impacts than Alternatives 1 and 2, but less than Alternative 4. There would be substantial construction impacts to businesses as a result of basic I-405 improvement projects, new arterials, HOV arterials and interchanges, and construction of two additional general purpose lanes in each direction of I-405. Many of the construction impacts along the arterials discussed as part of Alternative 2 would also be present along these arterials.

Alternative 3 would have greater impacts to local businesses located along arterials than would the other action alternatives. Businesses would be impacted by grade separations of arterial improvements throughout the I-405 corridor and into surrounding areas. Some businesses along arterials in Redmond, Kirkland, and Bellevue may be cut off from market and consumer access and may be forced to cease operation or relocate as HOV arterials are expanded into established business sectors or in areas where a business serves a certain niche that may not exist elsewhere.

The two additional general purpose lanes would extend along the entire I-405 corridor. This would result in some impacts to businesses that are currently located on nearby arterials or at the interchanges that would accompany this expansion.

Regional Economic Development

The effects of Alternative 3 on economic development with the central Puget Sound region and I-405 corridor would be similar to those described for Alternative 1.

3.16.4.5 Alternative 4: General Capacity Emphasis

Direct Property Tax Impacts

Alternative 4 would have the largest direct property tax impact of the alternatives.

As shown in Table 3.16-2, direct property tax impacts in the City of Bothell would represent approximately seven percent of the total property tax collected within the City. Alternative 3 would impact property taxes collected in Kirkland by over three percent. The property tax impact for the cities of Newcastle, Tukwila, and Renton would account for approximately two percent of the total property taxes collected in the cities. The City of Woodinville would experience an estimated one percent reduction to overall property tax collections. All of the other affected jurisdictions would have direct property tax impacts of less than one percent.

Localized Business Impacts

Alternative 4 would result in the greatest potential impacts to local businesses. Construction impacts would include basic improvements to I-405, new arterials, and the addition of one general purpose and two express lanes in each direction and the associated access locations.

Alternative 4 would result in fewer impacts to businesses along arterials than would Alternative 3, but more impacts than Alternatives 1 or 2. The largest impact to local businesses would occur along the extensive right-of-way that would be acquired to expand the arterials. Businesses located within the right-of-way would have to relocate and some businesses along arterials in Kirkland and Tukwila could be impacted from grade separations and could be cut off from market and consumer access.

The impact that differentiates Alternative 4 from the other action alternatives would be the construction of the new express lanes and one added general purpose lane in each direction along the I-405 corridor. The areas most likely affected by the new lanes would be along State Route (SR) 522 to SR 527 in Bothell and Snohomish County, and in Kirkland. There would be substantial localized impacts near expressway access locations in the business districts of Renton, Tukwila, and Kirkland.

Regional Economic Development

The effects of Alternative 4 on economic development with the central Puget Sound region and I-405 corridor would be similar to those described for Alternative 1.

3.16.4.6 Preferred Alternative:

Direct Property Tax Impacts

The Preferred Alternative would have property tax impacts on the overall region that are slightly higher than those of Alternative 3. Individual communities might experience a minor increase or decrease in direct impacts due to the differences in projects when compared to Alternative 3. The increases, however, are not expected to be substantial.

As shown in Table 3.16-2, the direct property tax impacts associated with the Preferred Alternative for the following cities are expected to increase slightly when compared to Alternative 3: Bellevue, Kirkland, Newcastle, Bothell, Kent, Redmond, Mill Creek, Tukwila, and Renton. The total property tax impact for the City of Kenmore will likely decrease due to the removal of projects under the Preferred Alternative. All other affected jurisdictions would experience property tax impacts that are similar to Alternative 3.

Localized Business Impacts

The Preferred Alternative would have localized business impacts that are somewhat greater than those of Alternative 3. The largest impact to local businesses would occur along the right-of-way that would be acquired to expand the arterials. Businesses located within the right-of-way would have to relocate, and some businesses along arterials in Kirkland, Redmond, Bothell, and Tukwila could be impacted by grade separations that would reduce access and visibility.

Compared to Alternative 3, the expanding arterial capacity would result in a slight improvement in mobility and access for businesses in some areas of Redmond, Bothell, Woodinville, and Tukwila.

Regional Economic Development

The effects of the Preferred Alternative on economic development with the central Puget Sound region and I-405 corridor would be similar to those described for Alternative 3.

3.16.5 Mitigation Measures

Mitigation for the No Action Alternative projects are or will be addressed through the environmental analysis, documentation, and review completed for those projects. No additional mitigation measures are necessary.

Although the effects on business may be locally substantial, none of the action alternatives would have regionally substantial adverse economic impacts that would require mitigation.

3.17 RECREATIONAL RESOURCES

3.17.1 Studies and Coordination

The local jurisdictions in the I-405 study area have adopted park elements in their comprehensive plans, which define the level of service for park facilities and the policies for development and protection of the parks. These policies will be instrumental in any type of mitigation measure/plan for public parklands that may be taken because of project effects (property acquisitions, traffic detours, limited access, noise, dust/air quality effects, etc.). Local comprehensive plans were examined in order to gain an understanding of the local plans and policies for recreational facilities.

This analysis evaluated only the potential for effects within the corridor on public parks and trails. Because the analysis was conducted at a programmatic level and the specific locations of potential property acquisitions and constructive uses have not been identified, an accurate assessment of loss of park functions was not completed during this phase. The approach evaluated the number and approximate physical acreage of parks/recreational facilities impacted.

A final preliminary Section 4(f) evaluation, with greater detail on the type of effects to the park facilities, is located in Appendix H, Final Preliminary Section 4(f) Evaluation. Subsequent design work on the specific I-405 Corridor Program projects will provide the detail needed to define additional avoidance and specific mitigation measures to be incorporated into the designs.

The public parks and trails that were evaluated included state, county and city regional, sub-regional, and neighborhood facilities. Regional and sub-regional park functions include water access, recreational facilities for bicycles, pedestrian access, group functions, and nature interpretation. Neighborhood park functions are passive and provide visual/aesthetic areas for a walk and/or small group functions. Neighborhood/passive parks typically include some recreational facilities for limited group sports and a play area for children. Public parks and trails were not differentiated based on their funding sources. This could be required at the project-specific environmental analysis, documentation, and review stages.

3.17.2 Methodology

The locations of recreational facilities, public parks and trails were compiled onto a 1"=1600' map using GIS. Improvement project design concept plans were then overlaid onto the map. Improvements were evaluated for effects on park facilities when any portion of the improvement overlapped the parkland boundary or when the park facility was within one-quarter mile of the improvements. These recreational resources were then field verified for potential effects. Further details are presented in Appendix H – Final Preliminary Section 4(f) Evaluation, herein incorporated by reference. The approximate linear distance that projects and parklands overlapped was multiplied by the approximate depth by which projects might be expanded into parklands. This provided a conservative estimate of parkland effects in acres. This qualitative estimate was limited by the lack of design detail as well as actual right-of-way widths. Design information for fixed-guideway HCT elements was less detailed than design information for roadways.

The site-specific information on the public parks and trails was obtained from local comprehensive plans, park plans, and follow-up site visits. This information was used to determine which park facilities could be affected by the improvements.

The analyses in this section are based on the *I-405 Corridor Program Draft Recreation and Section 4(f) Resources Expertise Report* (DEA, 2001) herein incorporated by reference.

3.17.3 Affected Environment

There are 405 public parks, trails, and sports facilities within the entire study area. There are several different types of parks and trails in the study area. Figure 3.17-1 shows the locations of these features. Parks are frequently classified in terms of the geographic area of attraction of their user group as regional, sub-regional, and neighborhood parks.

Regional parks and trails in the study area, but not necessarily directly or indirectly affected, include:

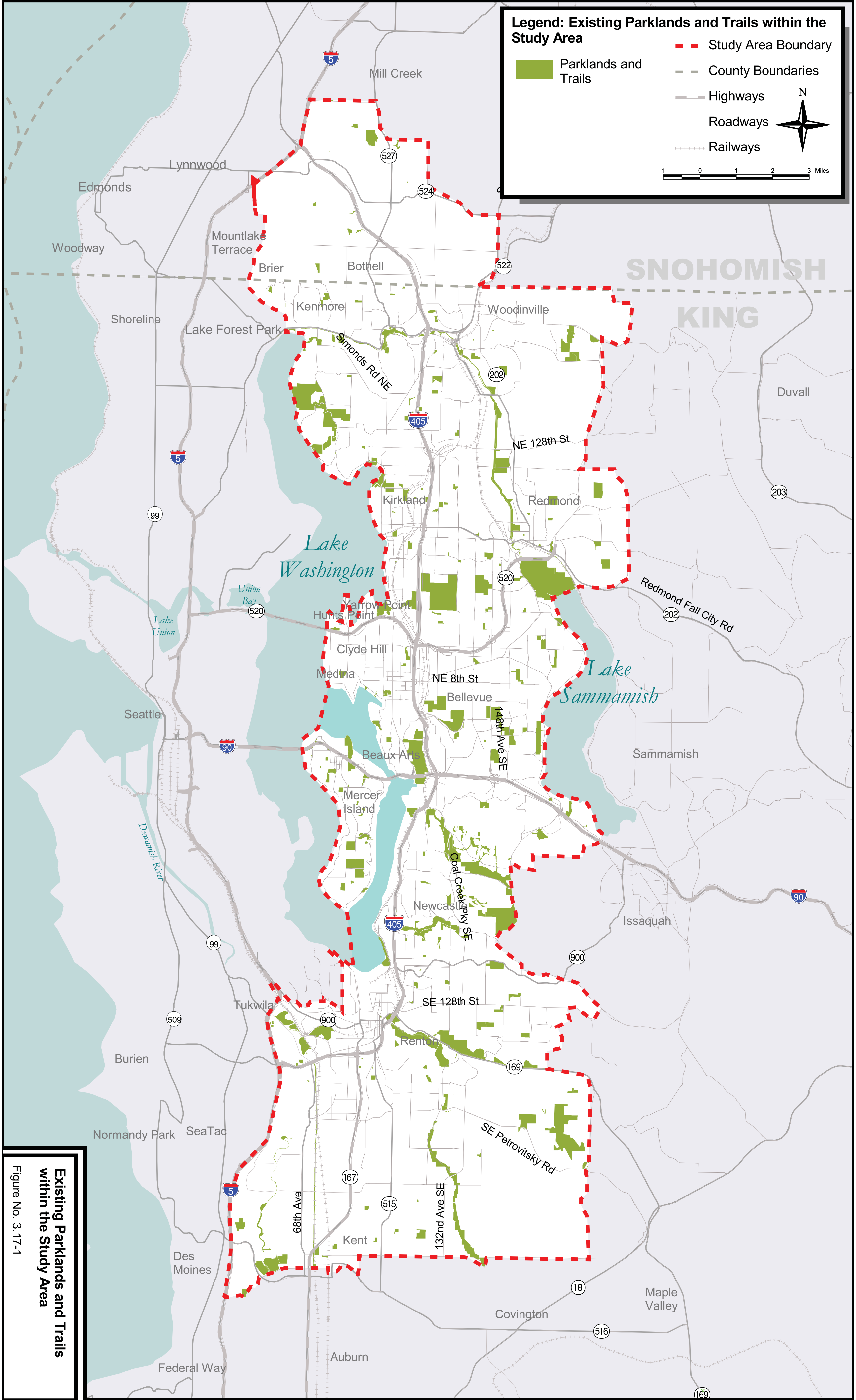
- Gene Coulon Park – Renton (active uses, boat ramps, natural focus areas, swimming areas, restaurants, outdoor concerts, passive areas)
- Coal Creek Park – Newcastle (passive uses, trails, gathering areas, natural focus areas)
- Sammamish River Trail – Redmond, Woodinville, Bothell, and King County (passive uses, pedestrian/bicycle and equestrian trails, gathering areas)
- Marymoor Park – Redmond (active uses, passive uses, trails, off-leash dog area, gathering areas, bicycle facilities, natural focus areas)
- May Creek Park – Newcastle and Renton (passive uses, trails, gathering areas)

Sub-regional parks in the study area but not necessarily directly or indirectly affected, include:

- Mercer Slough Nature Park – Bellevue (passive natural trails, interactive facilities)
- Cedar River Interpretive Trail and Park – Renton (passive trail, gathering areas, link to other parks)
- Interurban Trail – Renton and Tukwila (trail, link to other parks/cities)
- Kenmore Park – King County (passive, active gathering areas)

Passive-use neighborhood parks are recreational, social resources, and natural resources (drainage/habitat) for various neighborhoods. Examples include:

- Spinney Homestead Park – Kirkland
- Welcome Park – Redmond
- Arthur Johnson Park – Redmond
- Watershed Park – Kirkland
- North Rose Hill Woodlands Park – Kirkland
- Forbes Lake Park – Kirkland
- Bear Creek Park – Redmond



Existing Parklands and Trails within the Study Area

Figure No. 3.17-1

This page left intentionally blank.

3.17.4 Impacts

Potential effects of the alternatives on study area parks and trails within a quarter-mile of the improvements were field verified. Those determined to have potential effects after field verification are summarized in Table 3.17-1.

Table 3.17-1: Potentially Affected and Affected Recreational Resources

Alternative	Number of Recreational Resources	Acres of Recreational Resources
No Action Alternative	2	< 1
Alternative 1: HCT/TDM Emphasis	14	< 1
Alternative 2: Mixed Mode with HCT/Transit Emphasis	18	2
Alternative 3: Mixed Mode Emphasis	12	2
Alternative 4: General Capacity Emphasis	11	2
Preferred Alternative	12	2

The number of potentially affected parks and trails are discussed in the following sections and discussed in detailed in Appendix H — Final Preliminary Section 4(f) Evaluation. In situations where parks, acquired or developed with assistance from the Land and Water Conservation Fund, (LWCF) would be impacted by the I-405 corridor improvements, Section 6(f)(3) consultation would be initiated with the Interagency Committee for Outdoor Recreation (IAC).

3.17.4.1 No Action Alternative

Under the No Action Alternative there are two public parks and trails and less than 1 acre of potentially impacted recreational land.

Construction Impacts

Potential construction effects to the public parks and trails range from temporary erosion/sedimentation to dust, noise, and temporary access issues. These temporary effects are related to construction vehicles, potential interim traffic detours, and general construction activity. The greatest effects could occur to Sammamish River Trail and Marymoor Park. Best management practices (BMPs) would reduce the impact of dust and sediment on both parks.

In general, construction methods could be modified to avoid or limit construction-related impacts by implementing BMPs, as approved and used by WSDOT, and other appropriate measures. For example, project design could be modified to avoid or limit physical alterations and/or visual or long-term air and noise impacts. A traffic control (auto and pedestrian) program could be implemented to lessen impacts to park functions during construction.

Operational Impacts

Potential operational effects of the No Action Alternative would occur. Some of the operational effects could be related to property acquisition and others to long-term noise, air or visual quality effects. Acquisitions would occur to one of the regional parks: Sammamish River Trail. Acquisitions constitute an important impact on the parks, and replacement or enhancement of the lost park functions would need to be evaluated in project-specific evaluations. Other long-term effects could occur to both parks. Any mitigation would be addressed to continued operational functions, with minimal disruption.

3.17.4.2 Alternative 1: HCT/TDM Emphasis

Alternative 1 could affect 14 public parks and trails and approximately 1 acre of recreational lands.

Construction Impacts

Potential construction effects to the public parks and trails could include erosion, dust, noise, temporary access issues, and removal of established vegetation. These temporary effects are related to construction vehicles, potential interim traffic detours, and general construction activity. The greatest construction effects could occur within the Mercer Slough Nature Park and Sammamish River Trail resulting from the I-90/I-405 widening and other road and ramp improvements. Best management practices (BMPs) can reduce the impact of dust and sediment.

In general, construction methods could be modified to avoid or limit construction-related impacts by implementing BMPs, as approved and used by WSDOT, and other appropriate measures. For example, project design could be modified to avoid or limit physical alterations and/or visual, atmospheric, or long-term noise impact. A traffic control (auto and pedestrian) program could be implemented to lessen impacts to park functions during construction.

Operational Impacts

The potential operational effects of Alternative 1 would be similar to the No Action Alternative, except that 14 parks could be impacted. Some of the operational effects could be related to property acquisition and others to long-term noise, air or visual quality effects. Acquisitions would occur to two regional parks: Mercer Slough Nature Park and Sammamish River Trail. Acquisitions constitute an important impact on the parks, and replacement or enhancement of the lost park functions would need to be evaluated in project-specific evaluations. Other long-term effects could occur to all 14 parks. Any mitigation would be addressed to continued operational functions, with minimal disruption.

3.17.4.3 Alternative 2: Mixed Mode with HCT/Transit Emphasis

Alternative 2 could affect 18 public parks and approximately 2 acres of recreational lands.

Construction Impacts

Potential construction effects are similar to those of the other action alternatives. The greatest effects could occur at Mercer Slough Nature Park, resulting from the HOV project from I-90 to I-405, and to a lesser extent Cedar River Interpretive Trail and Park and Sammamish River Trail.

These effects to the 18 public parks and trails could include erosion, dust, noise, temporary access issues and general construction activity. Dust and noise would be related to construction vehicles, potential interim traffic detours, and general construction activity. BMPs would reduce the impact of dust and sediment.

In general, construction methods could be modified to avoid or limit construction-related impacts by implementing BMPs, as approved and used by WSDOT, and other appropriate measures. For example, project design could be modified to avoid or limit physical alterations and/or visual, atmospheric, or long-term noise impact. A traffic control (auto and pedestrian) program could be implemented to lessen impacts to park functions during construction.

Operational Impacts

The potential operational effects of Alternative 2 on recreational resources would be similar to the other action alternatives, except that 18 parks could be impacted. Some of the operational effects could be related to property acquisition and others to long-term noise, air or visual quality effects. Acquisitions would occur to two regional parks: Mercer Slough Nature Park and Sammamish River Trail. Acquisitions constitute an important impact on the parks, and replacement or enhancement of the lost park functions would need to be evaluated in project-specific evaluations. Other long-term effects could occur to all 14 parks. Any mitigation would be addressed to continued operational functions, with minimal disruption.

3.17.4.4 Alternative 3: Mixed Mode Emphasis

Alternative 3 could affect 12 public parks and approximately 2 acres of recreational lands.

Construction Impacts

Construction effects are similar to those of the other action alternatives. Most effects are expected to be at Mercer Slough Nature Park, and to a lesser extent at Cedar River Interpretive Trail and Park and Sammamish River Trail, resulting mostly from the HOV project connecting I-90 to I-405 and improvements on I-405 and ramps at SR 169, respectively. Potential construction effects to the public parks and trails range from erosion, dust, noise, temporary access issues and removal of vegetation. Dust and noise would be related to the construction vehicles, potential interim traffic detours, and general construction activity. BMPs would reduce the impact of dust and sediment.

In general, construction methods could be modified to avoid or limit construction-related impacts by implementing BMPs, as approved and used by WSDOT, and other appropriate measures. For example, project design could be modified to avoid or limit physical alterations and/or visual, or long-term noise and air impacts. A traffic control (auto and pedestrian) program could be implemented to lessen impacts to park functions during construction.

Operational Impacts

The potential operational effects of Alternative 3 would be similar to the other action alternatives, except that 12 parks could be impacted. Some of the operational effects could be related to property acquisition and others to long-term noise, air or visual quality effects. Acquisitions would occur to three regional parks: Mercer Slough Nature Park, Cedar River Interpretive Trail and Park, and Sammamish River Trail. Acquisitions constitute an important impact on the parks, and replacement or enhancement of the lost park functions would need to be evaluated in project-specific evaluations. Other long-term effects could occur to all 12 parks. Any mitigation would be addressed to continued operational functions, with minimal disruption.

3.17.4.5 Alternative 4: General Capacity Emphasis

Alternative 4 could affect 11 public parks and approximately 2 acres of recreational lands.

Construction Impacts

Construction effects are similar to those of the other action alternatives. Most effects are expected to three parks: Mercer Slough Nature Park, Cedar River Interpretive Trail and Park, and Sammamish River Trail, resulting from the HOV project connecting I-90 to I-405 and improvements on I-405 and ramps at SR 169, respectively.

Construction effects to the public parks and trails include erosion, dust, noise and temporary access issues. Dust and noise would be related to the construction vehicles, potential interim traffic detours, and general construction activity. BMPs would reduce the impact of dust and sediment.

In general, construction methods could be modified to avoid or limit construction-related impacts by implementing BMPs, as approved and used by WSDOT, and other appropriate measures. For example, project design could be modified to avoid or limit physical alterations, and/or visual, or long-term noise and air impact. A traffic control (auto and pedestrian) program could be implemented to lessen impacts to park functions during construction.

Operational Impacts

The potential operational effects of Alternative 4 would be similar to the other action alternatives, except that 11 parks could be impacted. Some of the operational effects could be related to property acquisition and others to long-term noise, air or visual quality effects. Acquisitions would occur to three regional parks: Mercer Slough Nature Park, Cedar River Interpretive Trail and Park, and Sammamish River Trail. Acquisitions constitute an important impact on the parks, and replacement or enhancement of the lost park functions would need to be evaluated in project-specific evaluations. Other long-term effects could occur to all 11 parks. Any mitigation would be addressed to continued operational functions, with minimal disruption.

3.17.4.6 Preferred Alternative

Twelve public parks and approximately 2 acres of recreational lands could be potentially affected by the Preferred Alternative.

Construction Impacts

Construction effects for the Preferred Alternative would be nearly the same as those of Alternative 3. Alternative 4 has one less park affected, however Alternatives 1 and 2 have 14 and 18 parks, respectively.

Operational Impacts

The operational impacts of the Preferred Alternative would be nearly the same as those of Alternatives 2, 3, and 4, with acquisition of approximately the same acres in the same three parks at nearly the same locations.

3.17.5 Mitigation Measures

The mitigation measures will include avoidance (for example, shifting the improvements to one side of the right-of-way), mitigation (for example, improvement in trails with lighting under expanded overpasses) and, if necessary, potential replacement of elements in the park. The baseline mitigation measures to reduce impacts would be temporary erosion/sedimentation control, water quality measures, replacement (or enhancement of functions) of parkland/trail due to acquisitions, protection of important trees, project design to reduce the area of effects, and realignment of affected trails. Additionally, defined traffic control (auto and pedestrian) measures to lessen the effects to the park functions during construction will be considered during project design.

This page intentionally left blank.

3.18 PUBLIC SERVICES

3.18.1 Studies and Coordination

Evaluation of public services impacts was based on a review and analysis of local jurisdiction public facility plans (see Public Services references). Evaluation criteria included assessment of changes in vehicular access patterns that may affect response times for police, fire, and emergency services; changes to school bus routing; and changes in demand levels for public services.

3.18.2 Methodology

The approach to analysis included review of the capital facilities plan elements of local jurisdictions to assess the potential effects the five alternatives could have on the provision of public services. The locations of public service facilities were mapped based on existing data to assist in this assessment (Figure 3.18-1).

Counties and cities in the region bear the primary responsibility for the provision of police services. Cities and fire districts have the primary responsibility for providing fire protection and emergency medical response services. Public and private hospitals have the primary responsibility for providing major medical services. School districts have the primary responsibility for providing public, K-12 educational services. Additional K-12 educational services are provided by private schools and religious institutions. The Washington State Growth Management Act requires that King and Snohomish counties and their respective cities adopt comprehensive plans that include a capital facilities element. This element addresses the need to provide adequate public services. These plans are required to include the location of all existing and proposed capital facilities, a forecast of the future need for such facilities, and at least a six-year plan to finance these needed facilities. Other portions of state law also require school districts and fire districts to develop and maintain capital facility plans to ensure they will be capable of meeting their future public service obligations.

Additionally, planning guidelines for traffic and access control in disaster situations were reviewed. These guidelines incorporate provisions in several FEMA publications, including *Transportation Planning Standards for the Evacuation of Large Populations* (CPG2-15), *Objectives for Local Emergency Management* (CPG 1-5), and *Guide for Development of State and Local Emergency Operations Plans* (CPG 1-8). The primary objectives of these guidelines can be summarized as follows: during an emergency, access control must be established as quickly as possible to prevent additional people from entering the hazard area. Once access control has been achieved, available resources should be assigned to traffic control functions to expedite evacuation of people from the affected area.

As noted later in the discussion of the operational impacts, the proposed roadway and other transportation improvements would be designed to eliminate many existing traffic flow problems and improve transportation safety. In addition, planned intelligent transportation system improvements would also include enhanced capability to facilitate movement of emergency vehicles through congested areas and improve existing incident response in the corridor during any type of disaster-related emergency. These improvements would also increase the ability to control and direct the movement of all vehicles in the corridor during an emergency and assist in facilitating an evacuation effort.

The analyses in this section are based on the *I-405 Corridor Program Draft Public Services Expertise Report* (DEA, 2001) herein incorporated by reference.

3.18.3 Affected Environment

Within the study area there are two counties, nine cities, 150 public and private schools, 13 fire stations, and 4 full-service hospitals. Public services evaluated include police and fire protection, medical and emergency services, and schools. Figure 3.18-1 shows the locations of public facilities.

3.18.4 Impacts

3.18.4.1 No Action Alternative

Under the No Action Alternative, which includes 54 projects, no public services would be substantially adversely impacted as a result of these projects. These 54 projects are also included in each of the action alternatives.

Construction Impacts

During construction, accidents or medical incidents in the construction areas could require emergency medical services and police/fire service response. However, no substantial impacts to public services are anticipated. In some instances, detour route contingency plans would need to be developed and implemented to address temporary road closures and/or lane restrictions.

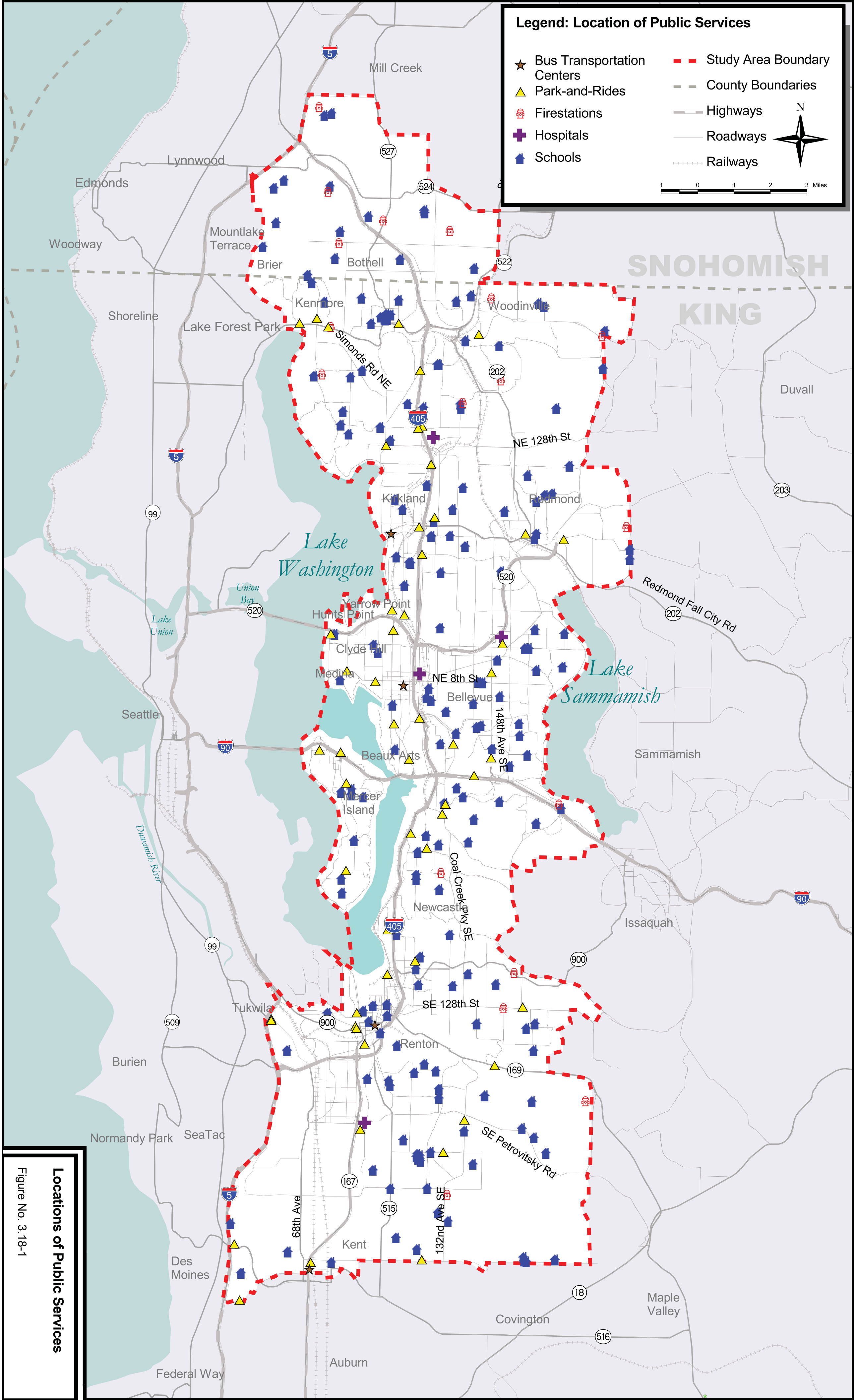
Operational Impacts

During operation, increased use of new and improved roadway elements and transit facilities would slightly increase the potential for accidents. Some increase in theft and/or vandalism also could occur at new or expanded transit centers and parking areas. However, no substantial police, fire/emergency medical response, or hospital operational impacts are anticipated, since the roadway and other transportation improvements would be designed to eliminate many existing traffic flow and transportation safety problems. Planned intelligent transportation system improvements would also include enhanced capability to facilitate movement of emergency vehicles through congested areas and improve existing incident response in the corridor.

Transit facilities would also be designed with safety and security features to protect commuters. Emergency vehicles, school buses, and school vans would also derive substantial mobility benefits from the interchange improvements, arterial links, and high-occupancy vehicle facilities to be constructed by this alternative. Overall pedestrian and bicycle safety would also be enhanced by the non-motorized transportation system improvements to be constructed by this alternative.

3.18.4.2 Alternative 1: HCT/TDM Emphasis

Under Alternative 1, which includes 109 projects ranging from basic improvements on I-405 to high-capacity transit, no public services would be substantially adversely impacted as a result of these projects.



Locations of Public Services

Figure No. 3.18-1

This page intentionally left blank.

Construction Impacts

During construction, accidents or medical incidents in the construction areas could require emergency medical services and police/fire service response. However, no substantial impacts to public services are anticipated. In some instances, detour route contingency plans would need to be developed and implemented to address temporary road closures and/or lane restrictions.

Operational Impacts

During operation, increased use of new and improved roadway elements and transit facilities would slightly increase the potential for accidents. Some increase in theft and/or vandalism also could occur at new or expanded transit centers and parking areas. However, no substantial police, fire/emergency medical response, or hospital operational impacts are anticipated, since the roadway and other transportation improvements would be designed to eliminate many existing traffic flow and transportation safety problems. Planned intelligent transportation system improvements would also include enhanced capability to facilitate movement of emergency vehicles through congested areas and improve existing incident response in the corridor.

Transit facilities would also be designed with safety and security features to protect commuters. Emergency vehicles, school buses, and school vans would also derive substantial mobility benefits from the interchange improvements, arterial links, and high-occupancy vehicle facilities to be constructed by this alternative. Overall pedestrian and bicycle safety would also be enhanced by the non-motorized transportation system improvements to be constructed by this alternative.

3.18.4.3 Alternative 2: Mixed Mode with HCT/Transit Emphasis

Under Alternative 2, which includes 162 projects ranging from basic improvements on I-405 and the addition of one additional general purpose lane on I-405 to high-capacity transit and a number of arterial projects, no public services would potentially be substantially adversely impacted as a result of these projects.

Construction Impacts

During construction, accidents or medical incidents in the construction areas could require emergency medical services and police/fire service response. However, no substantial impacts to public services are anticipated. In some instances, detour route contingency plans would need to be developed and implemented to address temporary road closures and/or lane restrictions.

Operational Impacts

During operation, increased use of new and improved roadway elements and transit facilities would slightly increase the potential for accidents. Some increase in theft and/or vandalism also could occur at new or expanded transit centers and parking areas. However, no substantial police, fire/emergency medical response, or hospital operational impacts are anticipated, since the roadway and other transportation improvements would be designed to eliminate many existing traffic flow and transportation safety problems. Planned intelligent transportation system improvements would also include enhanced capability to facilitate movement of emergency vehicles through congested areas and improve existing incident response in the corridor.

Transit facilities would also be designed with safety and security features to protect commuters. Emergency vehicles, school buses, and school vans would also derive substantial mobility benefits from the interchange improvements, arterial links, and high-occupancy vehicle facilities to be constructed by this alternative. Overall pedestrian and bicycle safety would also be enhanced by the non-motorized transportation system improvements to be constructed by this alternative.

3.18.4.4 Alternative 3: Mixed Mode Emphasis

Under Alternative 3, which includes 152 projects ranging from basic improvements on I-405 and the addition of two general purpose lanes on I-405 to high-capacity transit and a number of arterial projects, no public services would be substantially adversely impacted as a result of these projects.

Construction Impacts

During construction, accidents or medical incidents in the construction areas could require emergency medical services and police/fire service response. However, no substantial impacts to public services are anticipated. In some instances, detour route contingency plans would need to be developed and implemented to address temporary road closures and/or lane restrictions.

Operational Impacts

During operation, increased use of new and improved roadway elements and transit facilities would slightly increase the potential for accidents. Some increase in theft and/or vandalism also could occur at new or expanded transit centers and parking areas. However, no substantial police, fire/emergency medical response, or hospital operational impacts are anticipated, since the roadway and other transportation improvements would be designed to eliminate many existing traffic flow and transportation safety problems. Planned intelligent transportation system improvements would also include enhanced capability to facilitate movement of emergency vehicles through congested areas and improve existing incident response in the corridor.

Transit facilities would also be designed with safety and security features to protect commuters. Emergency vehicles, school buses, and school vans would also derive substantial mobility benefits from the interchange improvements, arterial links, and high-occupancy vehicle facilities to be constructed by this alternative. Overall pedestrian and bicycle safety would also be enhanced by the non-motorized transportation system improvements to be constructed by this alternative.

3.18.4.5 Alternative 4: General Capacity Emphasis

Under Alternative 4, which includes 116 projects ranging from basic improvements on I-405 and the addition of express lanes and major interchanges on I-405 to high-capacity transit and a number of arterial projects, no public services would be substantially adversely impacted as a result of these projects.

Construction Impacts

During construction, accidents or medical incidents in the construction areas could require emergency medical services and police/fire service response. However, no substantial impacts to public services are anticipated. In some instances, detour route contingency plans would need to be developed and implemented to address temporary road closures and/or lane restrictions.

Operational Impacts

During operation, increased use of new and improved roadway elements and transit facilities would slightly increase the potential for accidents. Some increase in theft and/or vandalism also could occur at new or expanded transit centers and parking areas. However, no substantial police, fire/emergency medical response, or hospital operational impacts are anticipated, since the roadway and other transportation improvements would be designed to eliminate many existing traffic flow and transportation safety problems. Planned intelligent transportation system improvements would also include enhanced capability to facilitate movement of emergency vehicles through congested areas and improve existing incident response in the corridor.

Transit facilities would also be designed with safety and security features to protect commuters. Emergency vehicles, school buses, and school vans would also derive substantial mobility benefits from the interchange improvements, arterial links, and high-occupancy vehicle facilities to be constructed by this alternative. Overall pedestrian and bicycle safety would also be enhanced by the non-motorized transportation system improvements to be constructed by this alternative.

3.18.4.6 Preferred Alternative

The Preferred Alternative, similar to Alternative 3, is a multimodal solution that emphasizes development of a bus rapid transit system, substantial expansion of transit service and station capacity, addition of two general-purpose lanes in each direction on I-405, and connecting arterial improvements. No public services would be substantially adversely impacted as a result of these projects.

Construction Impacts

During construction, accidents or medical incidents in the construction areas could require emergency medical services and police/fire service response. However, no substantial impacts to public services are anticipated. In some instances, detour route contingency plans would need to be developed and implemented to address temporary road closures and/or lane restrictions.

Operational Impacts

During operation, increased use of new and improved roadway elements and transit facilities would slightly increase the potential for accidents. Some increase in theft and/or vandalism also could occur at new or expanded transit centers and parking areas. However, no substantial police, fire/emergency medical response, or hospital operational impacts are anticipated, since the roadway and other transportation improvements would be designed to eliminate many existing traffic flow and transportation safety problems. Planned intelligent transportation system improvements would also include enhanced capability to facilitate movement of emergency vehicles through congested areas and improve existing incident response in the corridor.

Transit facilities would also be designed with safety and security features to protect commuters. Emergency vehicles, school buses, and school vans would also derive substantial mobility benefits from the interchange improvements, arterial links, and high-occupancy vehicle facilities to be constructed by this alternative. Overall pedestrian and bicycle safety would also be enhanced by the non-motorized transportation system improvements to be constructed by this alternative.

3.18.5 Mitigation Measures

Potential mitigation measures for public services proposed as part of all alternatives include developing contingency plans for temporary interruptions of access or services and contacting police, fire, emergency, and school transportation service providers to address possible temporary disruptions in service during construction, and to ensure that emergency and school transportation access would be maintained.

3.19 UTILITIES

3.19.1 Studies and Coordination

3.19.1.1 Approach to Analyses

Major utility installations, such as City of Seattle water transmission lines from the Tolt and Cedar River watersheds and Puget Sound Energy (PSE) and Seattle City Light power transmission towers, are factors in the evaluation of the corridor alternatives. Existing major utilities have been identified throughout the study area from agency GIS information. This information was compared to maps of improvements proposed under each alternative, and areas of potential conflict were identified.

Consideration was given to the type of work proposed, particularly on the arterials, to distinguish between improvements requiring excavation, such as pavement widening and lane additions, and TDM measures restricted to restriping and/or new traffic control devices.

The utilities analyses in this section are based on the *I-405 Corridor Program Draft Utilities Expertise Report* (HNTB, 2001), herein incorporated by reference.

3.19.1.2 Coordination with Agencies and Jurisdictions

The primary data source on existing utilities located within the I-405 right-of-way is the WSDOT database of utility franchises and permits. Utility operators are required to secure either a franchise or a permit prior to locating an overhead cable or underground cable, pipe, or line inside the public right-of-way. These applications are reflected in the WSDOT listing.

Because of the limitations of using the WSDOT listings alone, GIS information in either electronic files or hard copy was collected from individual utilities to show exact facility locations and sizes, where these data were not shown with sufficient details in the WSDOT database.

Future planning is documented in municipal comprehensive plans generated under the state's Growth Management Act (GMA) and in some internal utility plans.

3.19.2 Methodology

3.19.2.1 Water and Sewer

Most of the water and sewer systems along the I-405 corridor are managed by municipalities. The cities with utility jurisdiction along the corridor include Tukwila, Renton, Seattle, Bellevue, Kirkland, Redmond, Woodinville, and Bothell. In each case, the public works departments have provided as-built and/or GIS information in electronic or hard copy. King County has a major sewer trunk line through the corridor, and GIS information and as-built information on it was collected.

For projections to the 2020 design year, each city's planning section was contacted to obtain available information on future infrastructure expansions.

3.19.2.2 Electric Power

PSE prepared hard copy maps showing locations of power lines 115 kilovolts and larger along the I-405 corridor. This information was converted to GIS. PSE maintains an internal planning document outlining future development.

The Snohomish Public Utility District provided a CAD drawing showing existing transmission and distribution line locations. The current 7-year plan and 20-year plan were reviewed for utility projects affected by I-405 corridor improvements.

3.19.2.3 Fuel Pipelines

Olympic Pipeline Company (OPLC) provided as-built plans and GIS of their fuel distribution facilities. Natural gas line locations were provided by PSE showing locations of high-pressure gas lines and smaller gas lines. The high-pressure gas lines along the I-405 corridor were entered into GIS.

3.19.3 Affected Environment

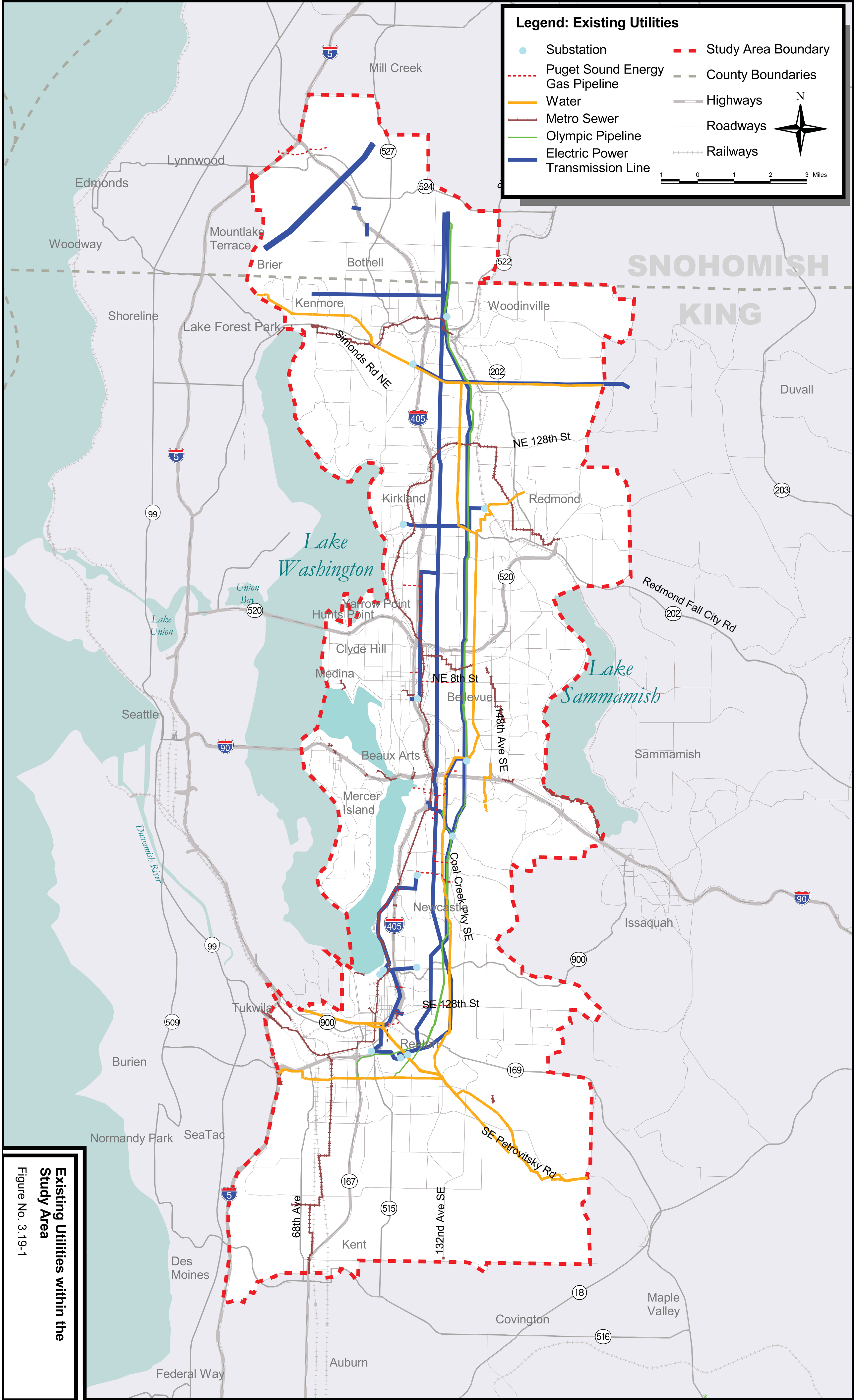
Major water, sanitary sewer, electric power, and fuel utilities are shown on Figure 3.19-1. A detailed identification of the utility segments that cross or are adjacent to portions of the study area where alternatives are being analyzed is included in the *I-405 Corridor Program Draft Utilities Expertise Report* (HNTB, 2001).

3.19.4 Impacts

The potential impacts of each alternative on utilities are summarized below for water pipelines of 36" and larger diameter, sewer lines of 48" and greater diameter, heavy electrical transmission lines (115 kv), and fuel pipelines (Tables 3.19-1, 3.19-2, 3.19-3, and 3.19-4, respectively).

Table 3.19-1: Number of Major Water Pipelines Affected by Alternative

Type of Improvement	No Action Alternative	Alternative 1 HCT/TDM Emphasis	Alternative 2 Mixed Mode with HCT/Transit Emphasis	Alternative 3 Mixed Mode Emphasis	Alternative 4 General Capacity Emphasis	Preferred Alternative
Arterial Committed Projects	3	3	3	3	3	3
Arterial Interchange Improvements	1	1	3	3	2	2
Basic I-405 Improvements	0	4	4	1	4	1
High-Capacity Transit (Fixed-Guideway)	0	3	3	0	0	0
Park-and-Rides	0	2	2	2	2	2
Transit Centers	0	1	1	1	0	1
I-405 General Purpose Lanes	0	0	3	3	3	3
I-405 Express Lanes	0	0	0	0	3	0
Connecting Freeway Improvements	0	0	2	3	3	3
Arterial Capacity and Improvements	0	0	5	6	7	6
Pedestrian and Bicycle	0	3	3	3	2	3
Total	**4**	**17**	**29**	**25**	**29**	**24**



Existing Utilities within the Study Area

Figure No. 3.19-1

This page intentionally left blank.

Table 3.19-2: Number of Major Sewer Lines Affected by Alternative

Type of Improvement	No Action Alternative	Alternative 1 HCT/TDM Emphasis	Alternative 2 Mixed Mode with HCT/Transit Emphasis	Alternative 3 Mixed Mode Emphasis	Alternative 4 General Capacity Emphasis	Preferred Alternative
Arterial Committed Projects	2	2	2	2	2	2
HOV Committed Projects	1	1	1	1	1	1
Arterial Interchange Improvements	1	1	4	4	4	4
HOV Improvements	0	8	12	12	3	10
Basic I-405 Improvements	0	6	6	1	6	1
High-Capacity Transit (Fixed-Guideway)	0	7	7	0	0	0
Park-and-Rides	0	3	3	3	3	3
Transit Centers	0	3	3	3		3
I-405 General Purpose Lanes	0	0	6	6	6	5
I-405 Express Lanes	0	0	0	0	8	0
Connecting Freeway Improvements	0	0	1	1	1	1
Arterial Capacity and Improvements	0	0	5	6	7	4
Pedestrian and Bicycle	0	5	5	5	3	4
Total	**4**	**32**	**55**	**44**	**44**	**38**

Table 3.19-3: Number of Major Fuel Pipelines Affected by Alternative

Type of Improvement	No Action Alternative	Alternative 1 HCT/TDM Emphasis	Alternative 2 Mixed Mode with HCT/Transit Emphasis	Alternative 3 Mixed Mode Emphasis	Alternative 4 General Capacity Emphasis	Preferred Alternative
HOV Committed Projects	1	1	1	1	1	1
Arterial Interchange Improvements	1	1	2	2	2	2
HOV Improvements	0	3	3	3	3	5
Basic I-405 Improvements	0	2	2	2	2	1
High-Capacity Transit (Fixed-Guideway)	0	6	6	0	0	0
Transit Centers	0	1	1	1		0
I-405 General Purpose Lanes	0	0	5	5	5	4
I-405 Express Lanes	0	0	0	0	8	0
Connecting Freeway Improvements	0	0	1	2	2	2
Arterial Capacity and Improvements	0	0	5	7	7	6
Pedestrian and Bicycle	0	2	2	2	0	2
Total	**2**	**16**	**28**	**25**	**30**	**23**

Table 3.19-4: Number of Electrical Transmission Lines Affected by Alternative

Type of Improvement	No Action Alternative	Alternative 1 HCT/TDM Emphasis	Alternative 2 Mixed Mode with HCT/Transit Emphasis	Alternative 3 Mixed Mode Emphasis	Alternative 4 General Capacity Emphasis	Preferred Alternative
Arterial Committed Projects	3	3	3	3	3	3
HOV Committed Projects	4	4	4	4	4	4
Arterial Interchange Improvements	1	1	3	4	4	5
HOV Improvements	0	5	5	5	0	3
Basic I-405 Improvements	0	6	6	1	6	2
High-Capacity Transit (Fixed-Guideway)	0	7	7	0	0	0
I-405 General Purpose Lanes	0	0	6	6	6	5
I-405 Express Lanes	0	0	0	0	6	0
Connecting Freeway Improvements	0	0	1	2	3	2
Arterial Capacity and Improvements	0	0	3	3	4	4
Pedestrian and Bicycle	0	2	2	2	0	2
Total	**8**	**27**	**40**	**30**	**36**	**30**

3.19.4.1 No Action Alternative

Construction Impacts

Utility issues considered in analyses of these potential impacts include the relocation of existing utilities; coordination with cities, utility districts, and public utilities to prevent interruptions of service; and the mitigation of unavoidable service interruptions because of lack of alternate means of supply during the downtime required to relocate lines.

As shown in Tables 3.19-1, 3.19-2, 3.19-3, and 3.19-4, the No Action Alternative would affect the fewest utilities of any alternative.

Operational Impacts

Operation of the No Action Alternative is not anticipated to have any direct effect on the major utilities described in this section.

3.19.4.2 Alternative 1: HCT/TDM Emphasis

Construction Impacts

Alternative 1 would affect the fewest utilities of any action alternative (Tables 3.19-1, 3.19-2, 3.19-3, and 3.19-4).

Operational Impacts

Operation of Alternative 1 is not anticipated to have any direct effect on the major utilities described in this section.

3.19.4.3 Alternative 2: Mixed Mode with HCT/Transit Emphasis

Construction Impacts

Alternative 2 would affect the greatest number of water pipelines, sewer lines, and electrical transmission lines (Tables 3.19-1, 3.19-2, 3.19-3, and 3.19-4).

Operational Impacts

Operation of Alternative 2 is not anticipated to have any direct effect on the major utilities described in this section.

3.19.4.4 Alternative 3: Mixed Mode Emphasis

Construction Impacts

Alternative 3 would affect more utilities than Alternative 1 but fewer than Alternatives 2 and 4 (Tables 3.19-1, 3.19-2, 3.19-3, and 3.19-4).

Operational Impacts

Operation of Alternative 3 is not anticipated to have any direct effect on the major utilities described in this section.

3.19.4.5 Alternative 4: General Capacity Emphasis

Construction Impacts

Alternative 4 would affect the second highest number of utilities of any alternative (Tables 3.19-1, 3.19-2, 3.19-3, and 3.19-4). It would affect the highest number of fuel pipelines.

Operational Impacts

Operation of Alternative 4 is not anticipated to have any direct effect on the major utilities described in this section.

3.19.4.6 Preferred Alternative

Construction Impacts

The Preferred Alternative would affect more major utilities than Alternative 1, and fewer than Alternatives 2, 3, and 4 (Tables 3.19-1, 3.19-2, 3.19-3, and 3.19-4).

Operational Impacts

Operation of the Preferred Alternative is not anticipated to have any direct effect on the major utilities described in this section.

3.19.5 Mitigation Measures

Mitigation for the No Action Alternative improvements is, or will be, addressed through the environmental analysis, documentation, and review completed for those improvements.

For the action alternatives, conflicts with utilities would be avoided through project design where feasible. Where avoidance is not feasible, typical utility impact mitigation would include relocation of the above-ground utilities.

This page left intentionally blank.

3.20 VISUAL QUALITY

3.20.1 Studies and Coordination

The visual quality analysis evaluated the potential change in visual quality for each major transportation element of the proposed alternatives. To accomplish this, the analysis selected key viewpoints within the affected area and then identified typical visual impacts in the context of these key viewpoints. This section describes those impacts, the landscape character, and the viewer groups within the study area, including their sensitivity and location. Potential mitigation measures are described, including ways to avoid or minimize visual quality impacts as well as ways to restore and enhance visual quality.

Methodology and criteria were jointly determined and agreed upon by the Washington Department of Transportation and David Evans and Associates, Inc. (DEA). The methodology follows the Federal Highway Administration's *Visual Impact Assessment for Highway Projects* (FHWA-HI-88-054) manual. In addition, the comprehensive plans were examined for each of the municipalities along I-405 to gain an understanding of their urban design goals.

3.20.2 Methodology

Aesthetics is concerned with both the character of visual experience and its quality. Visual quality has both viewer and visual resource components, and its interpretation can be subjective. Nonetheless, there is clear public agreement that the visual resources of certain landscapes have inherently high visual quality. One set of proven evaluative measures to assess visual quality includes three components: vividness, intactness, and unity.

For the I-405 Corridor Program, these three measures were evaluated through quantitative and qualitative analysis as described below:

- *Vividness* measures the memorability of landscape components as they combine in striking and distinctive visual patterns. There are four elements of vividness (Land form – VL; Water form – VW; Vegetative form – VV; and Man-made form – VM) that may be present or affect the landscape. The distinctiveness or quality of a specific element within a landscape scene defines this element. The ratings range from 1 to 7, with a rating of 7 being a high degree of vividness.
- *Intactness* measures the integrity of visual patterns and the extent to which the landscape is free from visually encroaching elements. This factor can be present in well-kept urban and rural landscapes, as well as natural settings. In a predominantly natural environment, manmade development can be an additive element that does not necessarily encroach on its visual setting. Predominantly man-made landscapes may also have strong visual character. The absence of encroaching features, or eyesores, contributes to high visual intactness in either setting. A rating of 7 indicates a landscape that is highly intact and contains no subtractive disruptions.
- *Unity* measures the visual coherence and compositional harmony of the landscape considered as a whole. One aspect of this criterion is the unity between manmade and natural pattern elements, and usually attests to the careful design of individual components in the landscape. A rating of 7 represents a landscape with a coherent, harmonious visual pattern.

The analyses in this section are based on the *I-405 Corridor Program Draft Visual Resources Expertise Report* (DEA, 2001), herein incorporated by reference.

3.20.3 Affected Environment

3.20.3.1 Existing Visual Environment

The I-405 corridor begins in the south at the I-5 intersection in Tukwila, crosses over the industrial valley through Renton, and is carved into the west-facing banks of Lake Washington from Renton through downtown Bellevue and into east Kirkland. North of Kirkland, the highway traverses several hills and then crosses valleys where commercial and urban development has concentrated, until intersecting with I-5 again near Lynnwood. The general character of the views changes from highly man-made in the south end of the corridor, to mostly vegetated in the north section. The most urban views are through Bellevue. The project area has views of important regional landforms in all directions, including Lake Washington, the Cascade Mountains, Mount Rainier, the Olympic Mountains, and the Seattle and Bellevue skylines. The I-405 corridor viewshed is described in more detail in the *I-405 Corridor Program Draft Visual Resources Expertise Report* (DEA, 2001).

According to the *Roadside Classification Plan* (WSDOT, 1996) for I-405, the section from milepost 0.00 to 5.80 is classified *semiurban* as it passes through Tukwila and Renton. Milepost 5.80 to 10.50 is classified *rural*, between Renton and Coal Creek Parkway. The highway is *semiurban* again through the Factoria area and I-90 interchange from milepost 10.50 to 12.98. The classification changes to *urban* through Bellevue from milepost 12.98 to 14.48, changing back to *semiurban* just before the interchange with SR 520, from milepost 14.48 to 21.38 through Kirkland. The remainder of I-405 from milepost 21.38 to its intersection with I-5 at milepost 30.29 is classified *rural*. The *Roadside Classification Plan* was used as the basis for recommended mitigation components.

3.20.3.2 Viewer Characteristics

Visual experience is a combination of visual resources and viewer response. Visual perception is the basic act of seeing or recognizing an object, but physical conditions can affect perception. As observer distance increases, the ability to see the details of an object decreases. As observer speed increases, the breadth of lateral vision decreases and the observer tends to focus more along the line of travel.

Viewer groups may be differentiated by physical factors that modify perception. A basic distinction can be made between views *from* the road (highway users) and views *to* the road (highway neighbors). Viewshed mapping can further categorize these viewer groups by viewer exposure: the physical location of each viewer group, the number of people in each group, and the duration of their view.

The receptivity of different viewer groups to the visual environment and its elements is not equal. This variable receptivity is viewer sensitivity, and is strongly influenced by visual preference. Viewer sensitivity modifies visual experience directly by viewer activity and awareness, and indirectly by values, opinions, and preconceptions.

Viewer activities such as driving in heavy commuter traffic or through a construction zone can distract an observer from much of the visual environment, whereas driving for pleasure can encourage one to look at the view more closely and in greater detail. Viewer awareness is heightened by visual change such as entering a city, cresting a hill, or the sudden appearance of water or a mountain. Measures that modify viewer exposure, such as selective clearing or screening, may also be employed to deliberately modify viewer awareness.

Local values and goals indirectly modify viewer experience by shading view expectations and aspirations. Viewers may be particularly sensitive to the visual resources of a particular landscape because of its cultural significance or other unique feature, such as the timber railroad trestle in the Wilburton area of Bellevue.

3.20.3.3 Views From the Facility

Highway users generally have reduced visual acuity and a narrowed cone of vision as they concentrate on driving tasks. The I-405 corridor intersects with I-5 twice and crosses over I-90. Most travelers entering the Seattle metropolitan area from the east, north, or south must pass through these interchanges. The variety of visual experiences of the I-405 traveler includes forested areas that open into panoramic views of valleys and urban landscapes. Periodic views of Mt. Rainier, the Cascade range, Lake Washington, and the Seattle and Bellevue skylines occur as the motorist journeys through the corridor.

Principal groups that have views from the facility are local, commuter, and tourist traffic. Tourists and vehicle passengers (non-drivers) have the highest viewer sensitivity but low view frequency. Local traffic is considered moderately sensitive because of higher view frequency, which makes the viewers sensitive to any changes to their usual view. Commuters, somewhat inured and perhaps indifferent to the view by repetition, have lower viewer sensitivity. All individual views from the roadway are of relatively short duration due to the movement of the viewer; however view duration is variable with the season and climatic conditions.

3.20.3.4 Views Toward the Facility

Groups that have views toward the facility generally take in a wider vista, with the highway a component of the larger landscape. Views toward the roadway are from adjacent residential and commercial areas, and from travelers on I-5, I-90, and ten state arterial highways.

Within the project study area, the principal groups likely to view the projects and exhibit *high* viewer sensitivity include:

- Persons engaged in recreation at existing park and trail sites.
- Residents of predominantly single-family areas.
- Residents of predominantly multi-family areas (with correspondingly taller structures).
- Teachers, children, and parents at existing schools and associated playfields (generally located in residential areas).

These viewers are more sensitive to changes in their view because they are exposed to the view more frequently and for relatively longer periods. The opening or restricting of existing views due to new construction may also positively or negatively affect property values. In areas where the road is cut into the slope, views would be affected more by adding aerial structure than by widening the existing roadway.

Viewer groups likely to exhibit moderate or low viewer sensitivity include the following, listed in order of decreasing sensitivity:

- Travelers along existing arterial streets, highways, and freeways that traverse the study area.
- Employees and visitors in existing office and hotel centers in the urban cores of each city.
- Employees and visitors in existing commercial, distribution, transportation, and industrial businesses.

These groups are concentrated primarily in the city centers. Views from a superior viewing position (above the roadway elevation) typically would be affected less by adding aerial structures than by widening the existing roadway due to the perspective of the viewer.

3.20.3.5 Key Views

Key views were selected to represent the range of views within the I-405 corridor. The view selection process included field reconnaissance of the corridor under several climatic conditions, and review of the plans and policies of the cities of Tukwila, Renton, Newcastle, Bellevue, Kirkland, and Bothell. The potential impacts to visual resources were identified for the 21 major transportation elements and are discussed below in the Impacts section.

The key view locations from the roadway are mapped in Figure 3.20-1. Key view locations toward the roadway are mapped in Figure 3.20-2. Key view photographs are provided in Appendix D, and roadway sections are provided in Appendix E. Photographs in Appendix D were taken using a variety of shutter speeds, lenses, and lens focal lengths to better illustrate the described view.

3.20.4 Impacts

Of the more than 20 major transportation elements that comprise the action alternatives, ten were found to have notable impacts on visual resources in the I-405 corridor. (Refer to Appendix A [I-405 Corridor Program - Major Elements of Alternatives] for a more detailed description of these major transportation elements.) Table 3.20-1 summarizes the potential impacts associated with these ten elements. The alternatives producing the noted impacts are listed in the second column.

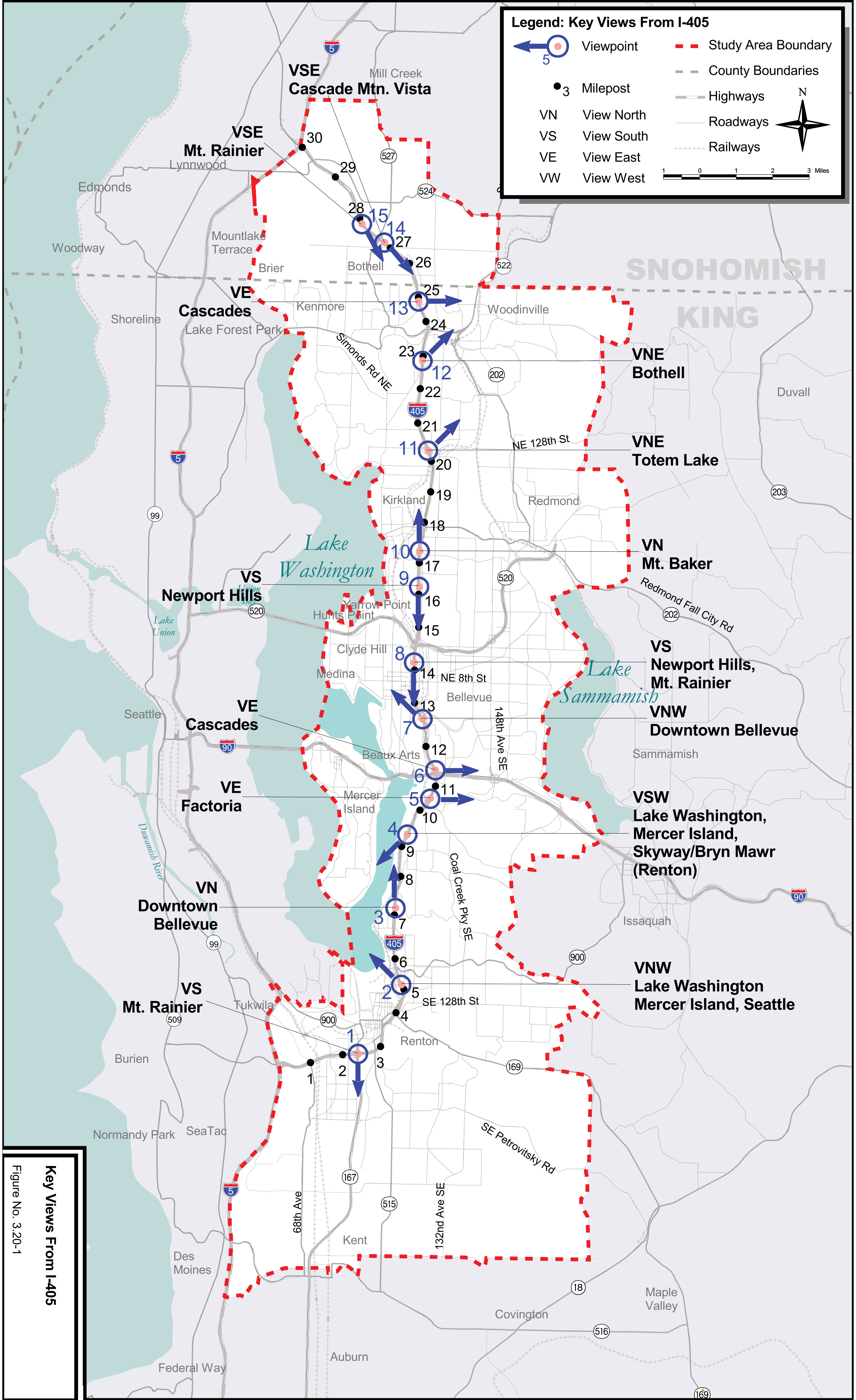
3.20.4.1 No Action Alternative

Construction Impacts

Most construction impacts to visual resources are considered to be temporary and relatively short-lived. Temporary visual impacts include the presence of construction equipment and workers, materials, debris, signage, and staging areas that would reduce the visual quality in the construction zone. Temporary lighting may be employed for nighttime construction of some project elements. Detours or lane shifts demand greater driver attention and distract the highway user from views outside the construction activity.

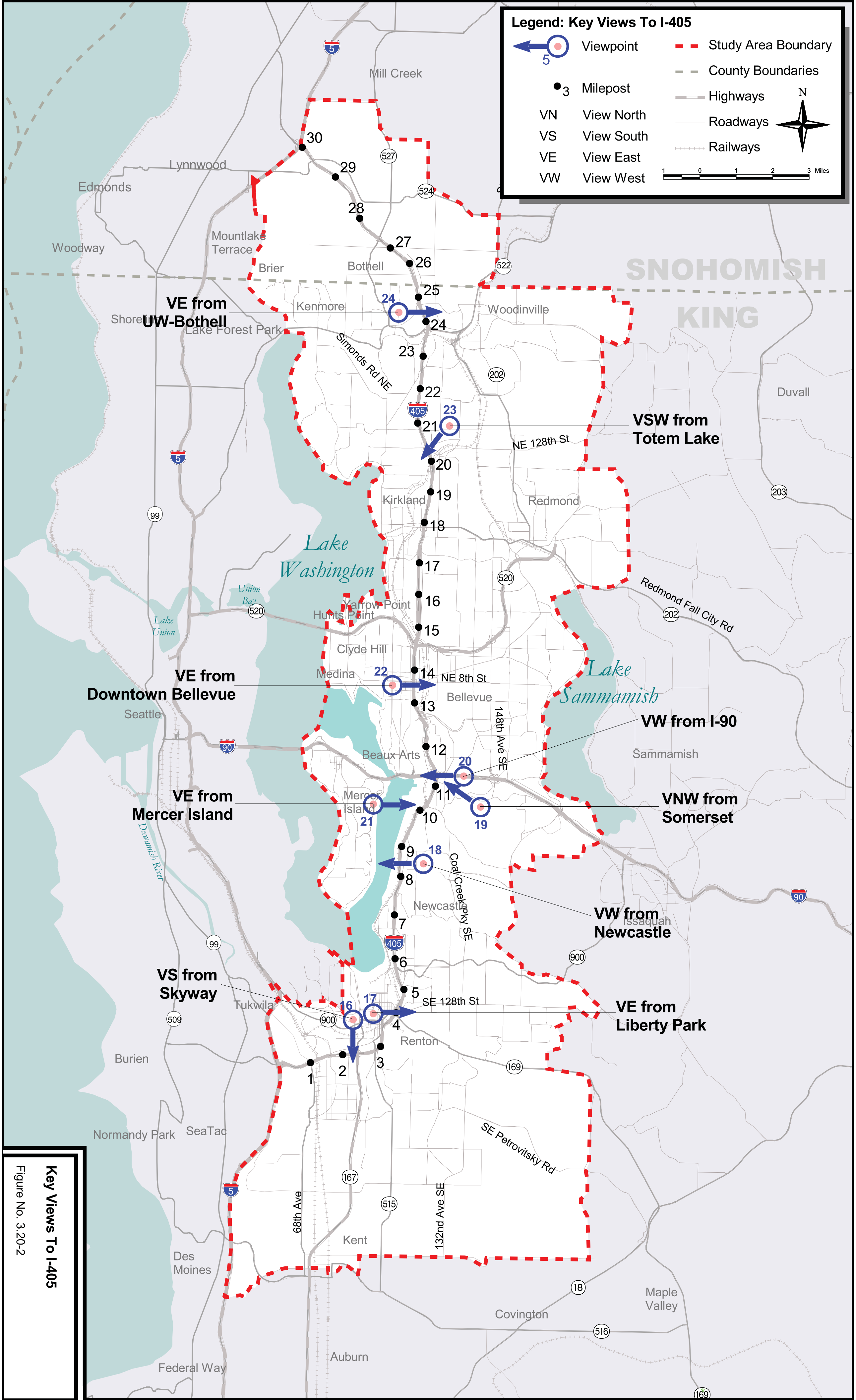
Operational Impacts

The baseline projects contained in the No Action Alternative would result in long-term visual impacts independent of the I-405 Corridor Program, and the effects of those projects are, or will be, addressed through the environmental analysis, documentation, and review completed for the individual projects.



Key Views From I-405
Figure No. 3.20-1

This page intentionally left blank.



Key Views To I-405

Figure No. 3.20-2

This page intentionally left blank.

Table 3.20-1: Potential Visual Impacts and Mitigation Measures

Element	Alternatives	Potential Impacts	Mitigation[a]
4. Physically Separated, Fixed-Guideway High-Capacity Transit (HCT)	1, 2	• Overhead structure for aerial alignment. • Catenary poles and overhead wires. • Station shelter architecture and lighting. • Barrier, retaining, or acoustical walls. • Additional pavement. • Headlight glare.	• Use at-grade or underground alignment at high quality viewpoints. • Use vegetative screening. • Use consistent and interesting architectural style. • Provide landscaped median between road and HCT alignments. • Screen nighttime glare sources.
7. HOV Express Lanes with Direct Access Ramps	No Action, 1, 2, 3, 4, Preferred Alternative	• Additional pavement. • Overpasses or underpasses. • Barrier or retaining walls. • Additional ramp structures.	• Avoid overpasses that may block views at key viewpoints. • Use architectural treatments on concrete surfaces of walls and structures. • Reduce mass of ramp structures.
8. Additional Park-and-Ride Capacity	No Action, 1, 2, 3, 4, Preferred Alternative	• Additional pavement. • Glare from light fixtures. • More parked cars. • Removal of existing vegetation. • Multi-level parking structure.	• Use screening perimeter landscaping. • Screen nighttime glare sources. • Provide interior landscaping, especially tree canopy cover. • Use consistent and interesting architectural character. • Provide pedestrian plazas at transit stops. • Provide pavement changes, textures, or scoring for interest.
9. Additional Transit Center Capacity	No Action, 1, 2, 3, 4, Preferred Alternative	• Additional pavement. • Glare from light fixtures. • More parked cars. • Removal of existing vegetation. • Multi-level parking structure. • New retail/residential mixed-use buildings.	• Use screening perimeter landscaping • Provide interior landscaping, especially tree canopy cover. • Use consistent and interesting architectural character. • Provide pedestrian plazas at transit stops. • Provide pavement changes, textures, or scoring for interest. • Screen nighttime glare sources • Encourage shared parking for mixed-use projects.
10. One General Purpose Lane Each Direction	2, 4	• Additional pavement. • Additional ramp structures. • Additional headlight glare. • Removal of existing vegetation. • Elevated structure for viaduct. • Barrier or retaining walls. • Cut/fill slopes.	• Revegetate in accordance with existing vegetation and the *Roadside Classification Plan*. • Screen nighttime glare sources. • Enhance desirable views by selective removal of vegetation where applicable. • Grade slopes to blend with the natural topography. • Reduce mass of ramp structures. • Reduce height and scale of walls where practical.

Element	Alternatives	Potential Impacts	Mitigation[a]
11. Two General Purpose Lanes Each Direction	3, Preferred Alternative	• Additional pavement. • Additional headlight glare. • Removal of existing vegetation. • Elevated structure for viaduct. • Barrier or retaining walls. • Cut/fill slopes.	• Revegetate in accordance with existing vegetation and the *Roadside Classification Plan*. • Screen nighttime glare sources. • Enhance desirable views by selective removal of vegetation where applicable. • Grade slopes to blend with the natural topography. • Reduce mass of ramp structures. • Reduce height and scale of walls where practical.
12. Collector-Distributor Lanes on I-405	2, 3, 4, Preferred Alternative	• Additional pavement. • Additional headlight glare. • Removal of existing vegetation. • Elevated structure for viaduct • Barrier or retaining walls. • Cut/fill slopes.	• Revegetate in accordance with existing vegetation and the *Roadside Classification Plan*. • Enhance desirable views by selective removal of vegetation where applicable. • Grade slopes to blend with the natural topography. • Reduce height and scale of walls where practical.
13. Two Express Lanes Each Direction	4	• Additional pavement. • Additional headlight glare. • Removal of existing vegetation. • Elevated structure for viaduct • Barrier or retaining walls. • Cut/fill slopes.	• Revegetate in accordance with existing vegetation and the *Roadside Classification Plan*. • Enhance desirable views by selective removal of vegetation where applicable. • Grade slopes to blend with the natural topography. • Reduce height and scale of walls where practical.
16. Improve Connecting Freeway Capacity to I-405.	2, 3, 4, Preferred Alternative	• Additional pavement. • Additional headlight glare. • Removal of existing vegetation. • Additional ramps. • Additional barrier or retaining walls. • Cut/fill slopes.	• Revegetate in accordance with existing vegetation and the *Roadside Classification Plan*. • Enhance desirable views by selective removal of vegetation where applicable. • Grade slopes to blend with the natural topography. • Reduce height and scale of walls where practical.
21. Corridor Pedestrian and Bicycle Improvements.	1, 2, 3, 4, Preferred Alternative	• Wider overpasses. • Pedestrian bridges.	• Revegetate in accordance with existing vegetation and the *Roadside Classification Plan*. • Enhance desirable views by selective removal of vegetation where applicable. • Grade slopes to blend with the natural topography. • Reduce height and scale of walls where practical.

[a] For additional mitigation measures see Section 3.20.5.

Under the No Action Alternative, nine projects would affect visual resources and views to or from I-405. No expansion of I-405 is included in this alternative, although a new ramp and arterial widening would have some impact to views. This alternative also includes park-and-ride capacity expansions and additional transit center capacity. These projects include additional paving, ramps, structures, walls, or barriers. They may also include removal of existing vegetation, and additional headlight glare from vehicles using additional lanes and ramps.

3.20.4.2 Alternative 1: HCT/TDM Emphasis

Construction Impacts

Construction impacts for Alternative 1 would be similar to those described for the No Action Alternative.

Operational Impacts

Alternative 1 includes five major elements that may affect visual resources: physically separated, fixed-guideway high-capacity transit, HOV express with direct-access ramps, park-and-ride capacity expansions, transit center capacity improvements, and pedestrian and bicycle improvements. Table 3.20-1 summarizes the potential impacts associated with each of these major elements. These improvements include additional paving, ramps, structures, walls, or barriers. They may also include removal of existing vegetation, and additional headlight glare from trains or buses using a dedicated right-of-way. Transit alignments below grade would have less visual impact than aerial or at-grade portions of the route.

3.20.4.3 Alternative 2: Mixed Mode with HCT/Transit Emphasis

Construction Impacts

Construction impacts for Alternative 2 would be similar to those described for the No Action Alternative.

Operational Impacts

Alternative 2 includes eight major elements that may affect visual resources: physically separated, fixed-guideway high-capacity transit, HOV express with direct-access ramps, park-and-ride capacity expansions, transit center capacity improvements, one general purpose lane in each direction on I-405, I-405 collector-distributor lanes, capacity improvements on freeways connecting to I-405, and pedestrian and bicycle improvements. Table 3.20-1 summarizes the potential impacts associated with each of these major elements. These improvements include additional paving, ramps, structures, walls, or barriers. They may also include removal of existing vegetation, and additional headlight glare from additional traffic.

3.20.4.4 Alternative 3: Mixed Mode Emphasis

Construction Impacts

Construction impacts for Alternative 3 would be similar to those described for the No Action Alternative.

Operational Impacts

Alternative 3 includes seven elements that may affect visual resources: HOV express lanes with HOV direct-access ramps, park-and-ride capacity expansions, transit center capacity improvements, two general purpose lanes in each direction on I-405, I-405 collector-distributor lanes, capacity improvements on freeways connecting to I-405, and pedestrian and bicycle improvements. Table 3.20-1 summarizes the potential impacts associated with each of these major elements. These improvements include additional paving, ramps, structures, walls, or barriers. They may also include removal of existing vegetation, and additional headlight glare from additional traffic.

3.20.4.5 Alternative 4: General Capacity Emphasis

Construction Impacts

Construction impacts for Alternative 4 would be similar to those described for the No Action Alternative.

Operational Impacts

Alternative 4 includes eight elements that may affect visual resources: HOV express lanes with direct-access ramps, park-and-ride capacity expansions, transit center capacity improvements, one general purpose lane in each direction on I-405, I-405 collector-distributor lanes, two express lanes in each direction in the I-405 corridor, capacity improvements on freeways connecting to I-405, and pedestrian and bicycle improvements. Table 3.20-1 summarizes the potential impacts associated with each of these major elements. These improvements include additional paving, ramps, structures, walls, or barriers. They may also include removal of existing vegetation, and additional headlight glare from additional traffic.

3.20.4.6 Preferred Alternative

Construction Impacts

Construction impacts for the Preferred Alternative would be similar to those described for the No Action Alternative.

Operational Impacts

Operational impacts for the Preferred Alternative would be similar to those described for Alternative 3.

3.20.5 Mitigation Measures

Where appropriate and practicable, mitigation measures such as the following will be employed to partially or fully mitigate the adverse visual impacts of the major transportation elements of the alternatives:

- Realigning or modifying routes to avoid or reduce impacts on scenic visual resources and/or sensitive viewing groups.
- Minimizing clearing for construction, preserving existing stands of mature trees.
- Planting appropriate vegetation within the project right-of-way to preserve and restore the rural, semiurban, or urban character of existing views where appropriate according to the *Roadside Classification Plan* (WSDOT, 1996).
- Screening views of the roadway, elevated structures, retaining walls, noise walls, and other project features from areas with high viewer sensitivity.

- Grading slopes to blend with the natural topography by softening slope transitions, substituting earth berms for noise walls where practical, and limiting cut and fill slopes to 3:1 horizontal to vertical for optimal revegetation survival.
- Employing wide-span bridge crossings of local streets, trails, streams, and wetlands to minimize view obstruction and shading.
- Enhancing the architectural design of project features such as retaining walls and noise walls, including stepping and battering walls to reduce apparent height, using a consistent design vocabulary throughout the corridor, using lighter weight materials for spans to produce reduced structural silhouettes, applying texture to the concrete surfaces to reduce apparent scale, and applying concrete sealants for uniform color and to limit graffiti damage.
- Shielding roadway light fixtures to minimize glare and ambient light spillover into adjacent residential areas.
- Replacing street trees to provide screening for high quality visual resources and high viewer sensitivity.
- Acquiring sufficient right-of-way, where feasible and reasonable, for planting at the base of retaining walls, on the highway side of noise walls, and at other locations that adjoin areas of high viewer sensitivity.
- Designing gateway markers at the visual entrances to each city along the corridor appropriate to community urban design goals, in concurrence with local jurisdictions.
- Use of low ground covers and deciduous trees with high canopies at parking lots to balance visibility, security, and buffering.
- Providing perimeter fencing and landscape buffering around parking and transit center lots.
- Darkening concrete surfaces to aid in reducing reflective sunlight glare.
- Planting medians (where they exist) and the perimeters of parking lots to reduce headlight glare onto oncoming traffic or adjacent properties.

This page left intentionally blank.

3.21 HISTORIC, CULTURAL, AND ARCHAEOLOGICAL RESOURCES

3.21.1 Studies and Coordination

A cultural resources analysis was conducted to evaluate the effects of each alternative (at a programmatic level) on prehistoric and historic properties and potential historic properties.

The cultural resources analysis included a review of:

- Archaeological sites (known and recorded prehistoric and historic)
- Archaeological (prehistoric) high probability areas (modeled from literature, maps, and other sources, without conducting actual archaeological field surveys)
- Buildings and structures (historic built environment)
- Traditional cultural properties (TCPs)
- Properties listed in, or determined eligible for listing in, the Washington Register of Historic Places and/or the National Register of Historic Places
- Properties that may be eligible for listing in the Washington Register of Historic Places and/or the National Register of Historic Places
- Potential effects of the project alternatives on historic properties or potential historic properties in or near the area of potential effects of the project alternatives

The specific data measures and data sources were:

- National Register of Historic Places on file at the Washington State Office of Archaeology and Historic Preservation (OAHP)
- National Register of Historic Places (NRHP) Evaluation Criteria A-D, Section 106 of the National Historic Preservation Act (NHPA)
- Washington Register of Historical Places (WRHP) (on file at OAHP)
- Determinations of Eligibility (on file at OAHP)
- Archaeological site inventory files (on file at OAHP)
- Traditional Cultural Property files (some on file at OAHP but most are in confidential Tribal archives)
- Inventory forms on file with the King County Historic Preservation Program
- Lists of heritage resources on file with local jurisdictions (cities, counties) and historical societies
- Tribal input on TCPs. Meetings have been conducted with the federally recognized Muckleshoot Tribe. The federally recognized Snoqualmie Tribe and Yakama Indian Nation have been contacted, as have been the Duwamish Tribe and Kikiallus Tribe, which are not federally recognized.
- GIS mapping of historic built environment based on tax assessors' offices in coordination with David Evans and Associates, Inc. City and/or county tax assessors in each jurisdiction were contacted to provide data or maps illustrating tax lots with standing buildings/structures

whose construction dates are 1960 or earlier. The data output and maps were organized by decade time blocks (pre-1900, 1900-1910, etc.).

The cultural resources impacts evaluation was conducted using information supplied by federal, state, and local agencies. Representatives were contacted, interviews were conducted, and information (including reports) was obtained from these agencies. The following agencies were contacted:

- Archaeological site and archaeological probability area modeling consultation: Dr. Robert Whitlam, State Archaeologist (OAHP)
- Historic resource consultation: Mr. Greg Griffith, Deputy, State Historic Preservation Officer (SHPO) (OAHP)
- Area of Potential Effect (APE) defined by Mr. Kwadwo Fordjour/WSDOT in consultation with Dr. Allyson Brooks, State Historic Preservation Officer (SHPO) (OAHP)
- The cities of Lynnwood, Bothell, Kirkland, Redmond, Bellevue, Renton, Woodinville, Issaquah, Tukwila, Kenmore, Newcastle, Mercer Island, and Kent were contacted to secure lists of locally recognized cultural resource landmarks.

3.21.2 Methodology

In consultation with the Washington SHPO, the I-405 Corridor Program developed an approach to consider cultural resources (archaeological properties, traditional cultural properties, and properties of the historic built environment) at a program level, consistent with the programmatic evaluation in the EIS. Data collection and analyses were preliminary by design, and are not intended to provide a project-level environmental analysis, documentation, and review. Since compliance with Section 106 of the National Historic Preservation Act requires lead federal agencies to take into consideration the effect of a project on properties listed in, or eligible for listing in, the National Register of Historic Places, it was agreed that formal compliance with Section 106 would take place during subsequent project-level environmental analysis, documentation, and review. In the interim, absent any commitment to move forward with the construction of specific transportation facilities, there is not any undertaking that the SHPO must review under the Section 106 process.

Consideration of potential project impacts to cultural resources at this programmatic level of analysis fulfills both the spirit and intent of Section 106 to take into consideration, at the earliest possible time, the potential effects of the proposal on eligible historic properties. Consistent with this approach, WSDOT is currently engaging in government-to-government consultation with federally recognized and non-recognized Native American Tribes to facilitate "early consultation" under the revised Section 106 regulations.

The APE was used to focus data collection efforts within the study area. Collected data (except confidential archaeological and ethnological resource data) were entered into the project geographic information system (GIS) map layers to facilitate comparative analysis between the alternatives. The level of detail and measures to compare cultural resources among the alternatives included:

- Presence (tabulated number) of known/recorded historic properties (number of NRHP, WRHP, local landmark properties)

- Presence (tabulated number) of potential historic properties (number of pre-1960 constructed buildings and structures based on tax assessor maps)
- Presence of archaeological high probability areas
- Presence (tabulated number) of known/recorded archaeological sites
- Presence (tabulated number) of known/recorded TCPs

Federally recognized Tribes that have been contacted by WSDOT are the Muckleshoot, Snoqualmie, and Yakama Indian Nation. The Duwamish Tribe and Kikiallus Tribe, which are not federally recognized, also have been contacted. WSDOT will conduct government-to-government consultations with local Tribes and will encourage the Tribes to provide information as to the location(s) of culturally sensitive areas (TCPs) that should be avoided.

David Evans and Associates, Inc. (DEA) secured tax assessor data from King County and Snohomish County showing the locations of all buildings in the project area constructed prior to 1960. The collected data were organized in accordance with building tax lot plots that were color coded in ten-year build increments: pre-1900, 1900-1910, 1910-1920, etc. These data enabled the cultural resource team to identify older buildings and structures throughout the project area and to tabulate, with some degree of accuracy, raw numbers of tax lots that might hold potentially eligible historic properties. As suggested by the SHPO, a minimum age threshold of 40 years was selected to allow a ten-year "study period" for the I-405 corridor; normally, only buildings 50 years of age or older meet the minimum age threshold to be considered as potential historic properties.

Collected data were entered in the project GIS map layer(s) and then superimposed over the alternatives to facilitate quantitative and qualitative comparison. At this level of analysis, the cultural resource team used their collective best professional judgement to distinguish which alternative is more or less likely to endanger (or "take" or "constructively use") historic properties. In this fashion, the number of potential impacts was compared between alternatives. It should be noted that this programmatic level of analysis does not include formal historic register eligibility evaluation of the historic properties.

No systematic field surveys were undertaken either to identify the presence of archaeological sites or to field-check tax assessor data on pre-1960 constructed buildings and structures. Such systematic field surveys will be conducted in project-level analyses at a later date, as needed.

Archaeological high probability areas were modeled using both existing site location information and review of topographic maps to discern areas of greater likelihood of Native American occupation and use. The high probability areas were superimposed over the project alternatives to facilitate comparative analysis.

The analyses in this section are based on the *I-405 Corridor Program Draft Cultural Resources Expertise Report* (CH2M HILL, 2001), herein incorporated by reference.

3.21.2.1 Historic Properties

For the purposes of this study assumptions were made with regard to historic properties and the potential impacts each alternative might have on them. It was beyond the scope of this investigation to conduct an inventory of every property located within or adjacent to each route of every project element associated with the alternatives. This investigation compares the *potential* impacts of each alternative. This was accomplished by making the following assumptions:

- Any building or structure over 50 years old has the *potential* to be NRHP eligible. Most buildings and structures over 50 years of age would probably not be NRHP eligible, but it can be safely said that greater numbers of properties over 50 years of age are likely to hold greater numbers of properties eligible for listing on the NRHP. Thus, by comparing the numbers of buildings 50 years of age or older between each alternative, the *potential* for cultural resource impacts can be compared between alternatives.
- Each project element in each alternative will affect all the properties along its length. Actually, many of the projects will not affect adjacent properties. However, specific impacts to properties are impossible to determine without the specific project-level plans and footprints. It is assumed that specific project-level investigations will be conducted when environmental permitting for actual projects proceeds.

3.21.2.2 Archaeological Properties

Most of the project study area is fully urbanized and very little of it has been subject to archaeological investigation. As with the historic properties above, conducting actual archaeological surveys of every project for each alternative is impracticable. The following assumptions are made in order to compare the *potential* impacts of each alternative:

- Any recorded archaeological site in the project area is eligible for listing in the NRHP.
- Areas adjacent to water courses or lakes are High Probability Areas (HPAs) for archaeological sites. That is, they are areas more likely to contain archaeological remains in comparison to other areas lacking water or water-associated resources important in Native American subsistence economies.

The impact analysis assumes that the identified historic properties and potential historical properties may be subject to possible harm from future I-405 related transportation projects, and, more importantly, it assumes these future projects will involve a federal regulatory nexus (permitting, funding assistance, etc.). When a federal regulatory nexus is present, Section 106 (16 USC 470f) of the NHPA requires federal agencies, prior to implementing an "undertaking" (e.g., issuing a federal permit), to consider the effects of the undertaking on historic properties and to afford the Advisory Council on Historic Preservation (ACHP) and the SHPO a reasonable opportunity to comment on any undertaking that would adversely affect properties eligible for listing on the NRHP.

Under the NHPA, a resource is significant if it meets the NRHP listing criteria at 36 CFR 60.4:

> The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association and:
>
> - that are associated with events that have made a significant contribution to the broad patterns of our history, or
> - that are associated with the lives of persons significant in our past, or
> - that embody the distinctive characteristics of a type, period, or method of construction,

or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction, or

- that have yielded, or may be likely to yield, information important in prehistory or history.

Impacts commonly associated with construction projects include acquisition of land and improvements, loss of access, and changes in land use in the vicinity. Short-term impacts during construction include temporary impairment of access, increased noise levels, increased dust and emissions, visual obstructions, and disruption of established traffic patterns. Such impacts (or "effects"), in the parlance of the federal regulations, are considered to be harmful to cultural resources (they are "adverse").

The Advisory Council's regulations implementing Section 106 of the National Historic Preservation Act created a process by which federally assisted undertakings are reviewed for their "effect" on properties listed on the NRHP or properties determined to be eligible for listing. The Criteria of Effect and Adverse Effect are applied to determine whether a proposed action could affect the property and whether those effects should be considered adverse. If the undertaking could change in any way the characteristics that qualify the property for inclusion in the NRHP, for better or for worse, it is considered to have an effect. If the undertaking could diminish the integrity of such characteristics, it is considered to have an adverse effect.

Given the extensive geographical area encompassed by the I-405 alternatives, it would be impractical to conduct project-specific cultural resource inventories for each project, and it is not within the scope of this EIS to evaluate impacts for each project. Therefore, this investigation seeks to compare the *potential* cultural resource impacts of each alternative. As stated previously, this was done under the following assumptions:

- All historic properties over 50 years of age are potentially eligible for listing in the NRHP.
- All project facilities adjacent to historic properties over 50 years of age will affect those properties.
- All recorded archaeological sites are eligible for listing in the NRHP.
- All project facilities adjacent to recorded archaeological sites will affect those sites.
- Areas adjacent to water courses or lakes are more likely to contain archaeological sites than other areas.

Predicting the likelihood of I-405 project impacts to archaeological sites in areas largely unsurveyed by professional archaeologists is problematic, particularly with the highly urbanized and developed nature of the study corridor. For this report, it was decided that the most meaningful way to predict potential archaeological sites and impacts to them was by examining U.S. Geological Survey maps to determine which alternatives had the most projects crossing, or lying directly adjacent to, surface water bodies. Because of these limitations, no quantitative analysis is attempted here. Rather, a simple qualitative comparison is made between alternatives.

The five major water bodies in the project study area are a general guide to areas having a higher likelihood of containing buried archaeological sites. Each alternative was examined to develop a list of all intersections with and approaches to these water features. Once the complete list was compiled, the alternatives were compared.

There are numerous creek, stream, and lake crossings within the I-405 project study area, many of which would, with more exhaustive analysis, merit HPA designation.

3.21.3 Affected Environment

This section provides an overview of the major cultural resources in the study corridor, including regional and local cultural resources and the locations of historic properties, potential historic properties, and archaeological high probability areas (whose numbers and/or mapped geographic footprints were used as data measures for the cultural resources evaluation). A detailed discussion of these elements is included in the *I-405 Corridor Program Draft Cultural Resources Expertise Report* (CH2M HILL, 2001).

3.21.3.1 Prehistoric Archaeological Sites and High Probability Areas

The prehistory of Puget Sound is poorly known due to a lack of systematic, broad regional research. Most archaeological research has focused on the edges of Puget Sound and its major tributaries, and the urban areas have received only limited investigation. The I-405 project area is located within the southern Puget Sound archaeological study area (Wessen, 1985). This archaeological study area encompasses all of King County and most of northwestern Washington. Several hundred cultural resource surveys have been conducted within this study area, with most efforts focused in King, Pierce, and Snohomish counties. Hundreds of prehistoric sites have been recorded throughout these counties, including shell middens, lithic scatters (the remains of chipped stone tools and tool manufacturing debris), and wet sites (sites in water-saturated areas). Indian burials have been found in association with some of the shell middens. Archaeological sites within the southern Puget Sound area date between 11,000 and 250 years B.P. (before present) (Wesson, 1985; Thompson and Stilson, 1988).

Only three previously recorded archaeological sites appear to have the potential to be affected by project elements contained within any of the proposed alternatives. In the I-405 corridor, large areas have never been systematically searched, on the ground, for the presence of archaeological sites. Because many large tracts of land are now thoroughly modified from their original historic condition (either through logging, land-clearing and subsequent agricultural use, or mass grading for residential/commercial development), it may never be possible to fully inventory the archaeological resources that were once present (or might still be present). Nevertheless, construction projects in the I-405 project area, and in adjacent areas of Puget Sound, have encountered archaeological sites not otherwise known/recorded prior to their inadvertent discovery.

Archaeologists employ many variables to help them predict where archaeological sites are likely to be found. The most obvious and the most commonly employed predictor is distance to water. Human settlement, even in the lush, wet Pacific Northwest, is restricted to areas where water is available in some quantity. Fresh water is required for drinking and other domestic purposes, while rivers and ocean waters provide important sea mammal, fish, or shellfish resources. In prehistoric Puget Sound, streams, rivers, lakes, and the sound were the main transportation arteries, although some overland trails were used.

Delineation of archaeological high probability areas (HPAs) entails a great deal of educated guesswork. Because little systematic archaeological survey work has been conducted in the I-405 project area, the number of known/recorded archaeological sites is few. In project areas that have been subject to greater levels of professional archaeological survey activity, it is often possible to "model" or "predict" likely locations for archaeological sites. The main function of modeling archaeological HPAs is to take into consideration those factors or variables that might help predict where archaeological sites might be located so that proper measures can be taken in advance of construction to maximize opportunities to detect and preserve these ever–vanishing, non-renewable cultural resources. Based on what is known from the locations of recorded archaeological sites in the I-405 project area, and in immediate adjacent areas of greater Puget Sound, some reasonable conclusions can be drawn concerning the location of archaeological HPAs.

Since the I-405 study area has no alternatives directly on the Puget Sound, most of the water courses are streams and inland lakes. The simplistic method to predict where archaeological sites might be located in the study area is to examine each project location that crosses or runs adjacent to a stream, river, or lake. By comparing the relative frequency of water course approaches, the relative likelihood of encountering archaeological sites can be compared between alternatives. It is conceded that this is an over-simplified and less than complete method to predict the frequency of archaeological sites. Such variables as soil types, vegetation, elevation, and slope are not considered here; employing all of these variables in a predictive model is beyond the scope of this investigation and would require project-level information not yet developed.

The designated HPAs in the I-405 study corridor include the western shores of Lake Sammamish, the eastern shores of Lake Washington, the shorelines of Mercer Island (which is surrounded by Lake Washington), and the main water courses (Green River, Cedar River, and Sammamish River). These designated HPAs, by virtue of their location, also encompass all of the major protected lake coves, river-lake estuaries (with marsh/wetland habitats), and spawning rivers for lake-locked (non-marine/freshwater) salmonids (such as those exploited in the Sammamish River). HPAs of lesser sensitivity, such as smaller streams and creeks and small inland lakes, cannot be easily screened against the project alternatives within the constraints of the map scales used in this analysis. If nothing else, this analysis probably understates the magnitude of HPAs present in the I-405 project area because these lesser-order water courses cannot be considered here.

3.21.3.2 Regional Ethnography

For several thousand years before the arrival of Euroamerican settlers, Native Americans hunted and fished the Puget Sound area. When Euroamericans arrived, central Puget Sound was home to several native groups – all having ties to the Seattle and Eastside areas through land use and intermarriage. Local Puget Sound Salish tribes included the Snohomish, Snoqualmie, Duwamish, and Sammamish River people who were bound together by common culture and lifeways. The Suquamish, who occupied the west side of Puget Sound, followed a subsistence regime similar to the Duwamish, and both of these groups are closely tied through intermarriage (Haeberlin 1918). Native peoples referred to as Green River (or White River) Indians, along with some Duwamish and others, reside today on the Muckleshoot Indian Reservation near Auburn. These upriver groups lived generally to the southeast of the Duwamish and their culture was more adapted to the riverine environments, but they too procured food from the rich shellfish beds of Elliott Bay (Hart Crowser 1998:K-5).

3.21.4 Impacts

The following sections summarize the impacts of each alternative on cultural resources and mitigation measures that can be implemented to reduce or prevent adverse impacts. If mitigation measures are implemented, the level of impact will probably be reduced below the level of significance.

Table 3.21-1 below lists all the previously inventoried historic properties that are adjacent to the project alternatives. Many of these historic properties are included in local, state, or national historic lists and/or registers. Thus, impacts to these properties are more likely to require mitigation. Table 3.21-2 lists the three previously recorded archaeological sites adjacent to projects associated with an alternative. Table 3.21-3 lists the numbers of buildings over 40 years of age in each alternative. Table 3.21-4 lists potential impacts to archaeological high probability areas (HPAs).

Table 3.21-1: Potential Impacts to Registered Historic Properties

			Alternative					
City	Site	Status[a]	1	2	3	4	No Action	Preferred
Renton	0242; 45-KI-211 Renton Coal Mine Hoist Foundation	SR	x	x	x	x		x
Renton	0360 Renton Substation, Snoqualmie Falls Power Company.	SR	x	x	x	x		x
Tukwila	0355 James Nelsen House	SR	x	x	x	x		x
Bothell	0043 Bothell Lake Forest Park Highway	SR	x	x	x	x		x
Bothell	0103 Justice William White House	NR		x	x	x		x
Woodinville	0039; 45-KI-221H Hollywood School	SR, LM		x	x	x		x
Woodinville	0084 Hollywood Farm/Stimson House	SR, NR, LM		x		x		
Bothell	KC 0037; 45-KI-217H W.A. Hannan Home	SR	x	x	x	x	x	x
Bothell	0241 Elliott Farm	LM			x	x		x
Bothell	0038; 45-KI-216H Beckstrom Log Cabin	SR	x	x	x	x	x	x
Bothell	0040 Bothell Schoolhouse	SR	x	x	x	x	x	x
Bellevue	45-KI-467 Union Hill Road Site			x	x	x		x
Bellevue	45-KI-262H Wilburton RR Bridge Trestle	SR	x	x	x			x
Mercer Is.	45-KI-229H Lacey Murrow Floating Bridge		x	x	x			x
Bothell	45-KI-218H Bothell Lake Forest Park Brick Highway			x	x	x		x
Bothell	45-KI-219H Bothell's First Schoolhouse		x	x	x	x	x	x
Renton	45-KI-285 Rail Road Grade		x	x	x	x		x
Renton	45-KI-209 Renton Fire Station		x	x	x	x		x
Lynnwood	Alderwood Manor	Local		x	x	x		x
Lynnwood	Irwin House	Elig. NR		x	x	x		x
Redmond	Turple House and Barn	Elig. NR	x	x	x	x	x	x
Redmond	Eric E. Olson House	Elig. NR	x	x	x	x	x	x
Redmond	Merrilegs Farm	Elig. NR	x	x	x	x	x	x
Kirkland	Sutthoff House	LM	x	x	x	x	x	x
Kirkland	French House	LM	x	x	x	x	x	x
Kent	L.V. Moll and Clark Grocery	Local		x	x	x		x
Kent	Leroy Titus House	Local		x	x	x		x
Kent	Desmet House	Local		x	x	x		x
Kent	Harmon House	Local		x	x	x		x
Kent	Peter Saar Cemetery	Local		x	x	x		x

[a]SR = State Register; NR = National Register Elig.; NR = eligible for NR; LM = Landmark; Local = Local register

Table 3.21-2: Potential Impacts to Registered Archeological Resources

City	Site	Alternative 1	2	3	4	No Action	Preferred
Bellevue	45-KI-467 *Union Hill Road Site*		x	x	x		x
Renton	45-KI-6	x	x	x	x		x
Renton	45-KI-438 *White Lake Site*			x	x		x

Table 3.21-3: Possible Impacts to Potentially Historic Properties

	Alternative					
	1	2	3	4	No Action	Preferred
Total (Pre-1960)	189	284	298	292	96	312
Pre-1930[a]	22	33	36	36	20	52

[a]Included in total.
Note: Numbers derived by tax lot analysis.

Table 3.21-4: Potential Impacts to Archaeological High Probability Areas

Project Intersections Near High Probability Areas	Alternative 1	2	3	4	No Action	Preferred
NE Bothell Way paralleling the Sammamish River to Woodinville		x	x	x		x
I-405 crossing of Sammamish River at Woodinville	x	x	x	x		x
SR 202 crossing of Sammamish River at Woodinville	x	x	x	x	x	x
Parallel west side floodplain of Sammamish River to NE Redmond Way	x	x	x	x	x	x
Parallel east side floodplain of Sammamish River to NE Redmond Way			x	x		x
SR 520 crossing of Sammamish River near NE Redmond Way	x	x	x	x		x
Parallel Lake Washington on Lake Washington Blvd.	x	x	x	x	x	x
I-405 parallel to Mercer Slough and Lake Washington	x	x	x	x		x
I-90 crossing of Lake Washington	x	x				
Rainier Ave. Improvement parallel to Cedar River		x	x			x
Logan Ave. Improvement parallel to Cedar River		x	x	x		x
I-405 crossing of Cedar River at Renton	x	x	x	x		x
140th Ave. SE crossing of Cedar River			x	x		x
I-405 crossing of Green River at South Center	x	x	x	x		x
I-5 (SR 599) crossing of Green River at Interurban Ave.		x	x	x		x
Crossing of Sammamish River slightly north of SR520		x	x	x		x
Second crossing of Green River south of I-405 South Center	x	x				
Crossing of Sammamish River at NE 124th Street	x	x	x	x	x	x
Improvement along West Shore of Mercer Slough	x	x	x	x	x	x
Crossing of Sammamish River north of NE 90th Street	x	x	x	x	x	x

Table 3.21-4 includes intersections and near approaches (within ¼ mile) of all the alternative projects to the five main water features: Lake Washington, Lake Sammamish, the Sammamish River, the Cedar River, and the Green River.

It is acknowledged that the levels of significance of the HPA intersections listed in Table 3.21-4 are unequal. For example, a project that runs parallel to a stream has a greater chance of encountering archaeological sites than one that crosses a stream. However, they are treated equally in our analysis. Acreage calculations are not possible at this programmatic level of analysis. While this analysis is not rigorous, it provides a general guide to areas where buried archaeological sites are more likely to be encountered.

3.21.4.1 No Action Alternative

The No Action Alternative has the potential to affect historic properties. However, based on the data summarized in the tables above, the No Action Alternative is the least likely alternative to adversely affect historic properties, or it would probably affect fewer properties than any of the action alternatives. The numbers of properties in each category are dramatically lower than in the action alternatives. No previously recorded archaeological sites appear to be affected by this alternative. This alternative encroaches on 6 of 20 identified archaeological high probability areas (HPAs). If the mitigation measures discussed in Section 3.21.6 are implemented, the impacts to cultural resources could be reduced to less than significant levels.

3.21.4.2 Alternative 1: HCT/TDM Emphasis

This alternative is expected to affect considerably fewer recorded properties than Alternatives 2, 3, and 4 and the Preferred Alternative, and it would have the lowest potential effect on properties over 50 years of age of the action alternatives. This alternative could encroach on 13 of 20 identified archaeological HPAs. If the mitigation measures discussed below are implemented, the impacts to cultural resources could be reduced to less than significant levels.

3.21.4.3 Alternative 2: Mixed Mode with HCT/Transit Emphasis

This alternative is expected to affect the second highest number of recorded properties, and has the fourth highest number of properties over 50 years of age that potentially would be affected. Two of the three previously recorded archaeological sites could be affected by projects in this alternative. This alternative could encroach on 18 of 20 identified HPAs. If the mitigation measures discussed below are implemented, the impacts to cultural resources could be reduced to less than significant levels.

3.21.4.4 Alternative 3: Mixed Mode Emphasis

This alternative is expected to affect the highest number of recorded historic sites, and has the second highest number of properties over 50 years of age that potentially would be affected. All three previously recorded archaeological sites could be affected by projects in this alternative. This alternative could encroach on 18 of 20 identified HPAs. If the mitigation measures discussed below are implemented, the impacts to cultural resources could be reduced to less than significant levels.

3.21.4.5 Alternative 4: General Capacity Emphasis

This alternative is expected to affect one fewer recorded historic site than Alternative 2, but has the third highest number of properties over 50 years of age that potentially would be affected.

All three previously recorded archaeological sites could be affected by this alternative. This alternative could encroach on 17 of 20 identified HPAs. If the mitigation measures discussed below are implemented, the impacts to cultural resources could be reduced to less than significant levels.

3.21.4.6 Preferred Alternative

The Preferred Alternative is expected to affect the same number of recorded historic sites as Alternative 3, and it has the highest number of properties over the age of 50 years that potentially would be affected. All three previously recorded archaeological sites could be affected by projects in this alternative. This alternative could encroach on 18 of 20 identified HPAs. If the mitigation measures discussed below are implemented, the impacts to cultural resources could be reduced to less than significant levels.

3.21.5 Mitigation Measures

Mitigation measures that can be applied to reduce the impacts of the alternatives on cultural resources are discussed in this section. Actual mitigation measures that will be implemented (either prior to or during construction and/or operation of the various alternatives and/or their individual elements) will be determined as appropriate, consistent with the kind of cultural resource affected (archaeological site, historic building, etc.) and the magnitude of the actual impact to the resource (removal/relocation of historic building, trenching through an archaeological site, etc.).

The purpose of mitigation measures, with respect to cultural resources, is to reduce harm caused by the construction and/or operation of alternatives. At this programmatic level of analysis, potential mitigation measures are identified that might contribute to meeting federal, state, and local regulations. If the mitigation measures identified here are implemented, then the potential impacts associated with the projects could be substantially reduced.

Only historic properties that are listed in, or are determined to be eligible for listing in, the NRHP (or the WRHP) would be subject to mitigation measures required by the SHPO. On the local level, individual cities and/or counties with discretionary (SEPA or other) project review authority, might also require implementation of appropriate mitigation measures to reduce harmful project effects on historic properties important only on the local level.

Since many of the historic properties identified through background research have not been evaluated, it is not possible to determine how many historic properties would ultimately qualify for mitigation measures (in the event alternatives would adversely affect them). For example, Table 3.21-3 lists numbers of pre-1960 buildings/structures within the estimated footprints of the various alternatives. Until actually investigated as part of a project-level environmental analysis, documentation, and review, the actual number of federal, state or locally eligible historic properties that might require mitigation cannot be determined.

3.21.5.1 General Mitigation Measures

Archaeological Resources

General mitigation measures for archaeological resources may include archaeological monitoring, subsurface testing, and data recovery. Archaeological monitoring may be warranted for areas where construction is scheduled in areas of high probability for containing archaeological sites (but which exhibit no outward indications that such sites are actually present). Archaeological monitoring may also be warranted where pre-construction subsurface testing is not feasible.

Subsurface testing (e.g., "presence/absence" testing) may be warranted for areas that have a high probability for containing archaeological deposits, but that exhibit no outward indications of such deposits and where subsurface testing is feasible. Archaeological sites that are determined to be of sufficient importance to be eligible for listing in the NRHP might be subject to "data recovery" requirements (controlled archaeological excavations subject to SHPO review) if project-related impacts cannot be avoided. Archaeological sites determined to be ineligible for NRHP listing, through formal subsurface testing, are most often not subject to data recovery requirements.

Historic Buildings and Structures

General mitigation measures for anticipated impacts on historic resources include, but are not limited to:

- Designing the project to avoid or limit physical alteration, visual, atmospheric, or long-term noise impacts;
- Relocating historic resources to appropriate new sites; and/or
- Modifying construction methods to avoid or limit construction-related impacts.

Once project design development begins, a review process to refine specific project elements can be undertaken in order to minimize visual and other impacts on historic resources and improve design compatibility with the historic setting and character of individual resources and historic districts. This review process includes:

- Consult with the State Historic Preservation Officer on project design elements that may damage, alter, or obscure views of an NRHP listed or eligible historic resource,
- Obtain review and approval by the city historic preservation officer, King or Snohomish county historic preservation agencies, or other appropriate local review boards, for project design elements that may damage, alter, or obscure views of a designated local landmark or special review district.

Where operational noise and vibration impacts on historic resources are identified, potential mitigation measures, including noise walls, may be effective or appropriate if there are no harmful associated visual impacts. Consideration also will be given to other sound-reduction approaches such as landscape buffers.

When impacts cannot be adequately and practicably avoided, and it is necessary to acquire and remove a historic resource, in some cases the resource may be moved to another site or, less frequently, the resource may be demolished. The relocation or demolition of a historic resource requires complete review and approval by the SHPO and/or county or city landmark preservation board (or similar authority) and must meet established standards for documentation, site selection, and relocation methods.

Where construction-related impacts may include physical damage to a building, the introduction of short-term audible, visual, and atmospheric elements that are out of character with the historic resource, or the obstruction of access to the property, the modification of construction methods to avoid or limit these impacts will be examined. Mitigation measures to minimize construction-related impacts include, but are not limited to:

- Using rigid support of excavation structures (shoring) to minimize movement of the ground;
- Underpinning the building prior to excavation;
- Stabilizing the ground through cementitious or chemical grouts, freezing the ground, or other techniques;
- Protecting facades of nearby historic buildings from the accumulation of excessive dirt or cleaning in an appropriate manner at the conclusion of construction;
- Maintaining access to historic properties, except for unavoidable short periods, during construction;
- Locating temporary construction sheds, barricades, and material storage areas so as to avoid obscuring views of historic properties; and/or
- Complying with local noise restrictions for construction and equipment operation.

In those cases where historic buildings and structures are subject to adverse effects (including removal or demolition) mitigation will include such measures as recording the contributing buildings, structures, and other features associated with the endangered historic property in accordance with the standards of the Washington SHPO and local consulting parties regarding both requirements and repository, as appropriate. Finished documentation packages would be provided to the Washington SHPO and local consulting parties.

Appropriate mitigation will be developed in consultation with SHPO and interested local parties during environmental analysis, documentation and review for individual projects.

Ethnographic/Native American Cultural Resources

At this programmatic level of analysis, it is difficult to ascertain if any ethnographic/Native American cultural resources (or "Traditional Cultural Properties") would be affected by the alternatives or by specific project elements that make up the alternatives. During future project-level environmental analysis, documentation, and review, the presence/absence of tribal cultural resources will be determined in consultation with local Indian tribes. Government-to-government consultations between WSDOT, FHWA and the local Indian tribes have not yet resulted in an inventory of tribal cultural resources in the project area. However, WSDOT has initiated a cultural resources study for urban corridor projects, including the I-405 Corridor Program, and will further identify tribal cultural resources and mitigation measures.

This page left intentionally blank.

3.22 HAZARDOUS MATERIALS AND WASTES

3.22.1 Studies and Coordination

Environmental agency records were obtained through EDR, Inc., a database service that searches current federal and state agency databases. The search area included a 2-mile search radius along the linear I-405 corridor, including east-west corridors SR 520 (from Lake Washington to SR 202), I-90 (from Mercer Island to Lake Sammamish), and north-south corridor SR 167 (from I-405 to SR 18). This information has been relied on; independent verification of the database was not performed. The EDR, Inc. data sources for this analysis included the following state and federal environmental agency records:

- Federal National Priority List (NPL) Site List and Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) List
- Federal Resource Conservation and Recovery Act (RCRA) Treatment, Storage, and Disposal (TSD) Facilities List
- Federal RCRA Corrective Action Report (CORRACTS, identifies RCRA corrective action activity)
- Federal RCRA Generators List
- Federal Emergency Response Notification System (ERNS) List
- Washington State's List of Waste Sites Identified for Investigation or Remediation (NPL and CERCLIS Equivalents)
- Washington State's Landfill or Solid Waste Site Lists
- Washington State's Leaking Underground Storage Tank (UST) Lists
- Washington State's Registered UST Lists

Because of the programmatic approach to assessment of hazardous materials and waste impacts in the I-405 corridor, no specific coordination with state and federal agencies was conducted. This coordination is deferred until more specific project information is available for the alternatives. Coordination with these agencies would be needed on a project-specific basis if hazardous material or waste impacts are identified and mitigation measures need to be addressed.

3.22.2 Methodology

Information from environmental regulatory agency databases was obtained through the use of a geographically indexed database search. Findings were plotted on a map of the I-405 corridor. A key map and 48 area maps that locate identified sites are included in Appendix C of the *I-405 Corridor Program Draft Hazardous Materials and Wastes Technical Memorandum* (CH2M HILL, 2001) (on compact disk) herein incorporated by reference.

General impacts due to construction and operation were addressed. General expected right-of-way acquisition areas and expected areas of construction where soils, groundwater, or sediments could be disturbed were used, along with general distribution of mapped sites from agency database records, to characterize relative impacts. Expected construction areas were assumed to be approximately equal to new impervious surface areas calculated by David Evans and

Associates, Inc. (DEA) for each alternative (as reported in Table 3.5-2 in the Water Resources section of the EIS). The disturbance of soils, groundwater, or sediments in areas where contamination is present could result in a release of contaminants. General secondary and cumulative impacts were addressed corridor-wide for each alternative. Impacts were evaluated based on best professional judgement and provided in relative terms (low, medium, high) for this programmatic analysis. General mitigation measures were developed for types of impacts identified.

3.22.3 Affected Environment

3.22.3.1 Summary of Standard Federal and State Environmental Record Review

Federal NPL Site List and CERCLIS List

Four NPL sites were identified within the searched area. These include:

- Midway Landfill, 24808 Pacific Highway South, Kent
- Kent Highlands Landfill, 240th & Military Road, Kent
- Western Processing Co., Inc., 7215 South 196th Street, Kent
- PACCAR, Inc., 1400 North 4th Street, Renton

Five CERCLIS sites were identified within the searched area. These include the above four NPL sites and:

- JH Baxter & Co., Inc., 5015 Lake Washington Boulevard N., Renton

In addition, there were 23 CERCLIS sites designated "No Further Remedial Action Planned" (NFRAP) in the search area. Information on these sites is included in Appendix C of the *I-405 Corridor Program Draft Hazardous Materials and Wastes Technical Memorandum* (CH2M HILL, 2001).

3.22.3.2 Federal RCRA TSD Facilities List

There were no RCRA TSD facilities identified within the search area. However, there were eight sites identified with RCRA Corrective Action activity, including:

- Honeywell International, Inc., 15001 NE 36th Street, Redmond
- Boeing Renton, 800 North 6th Street, Renton
- Liquid Waste Disposal Co., 7113 South 196th, Kent
- BSB Diversified CO., Inc., 8202 South 200th Street, Kent
- Burlington Environmental Inc., 20245 77th Avenue South, Kent
- Boeing A&M Space Center, 20403 68th Avenue South, Kent
- Van Waters & Rogers, Inc., 8201 South 212th Street, Kent
- Boeing Kent Benaroya, 20651 84th Avenue South, Kent

3.22.3.3 Federal RCRA Generators List

There are 1,448 RCRA small quantity generators (SQGs) of hazardous waste identified within the search area, and 84 RCRA large quantity generators (LQGs) of hazardous waste. SQGs generate less than 100 kg/month of non-acute hazardous waste. LQGs generate at least 1,000 kg/month of non-acute hazardous waste or 1 kg/month of acutely hazardous waste. Additional information on these sites is included in the data report in Appendix C of the *I-405 Corridor Program Draft Hazardous Materials and Wastes Technical Memorandum* (CH2M HILL, 2001).

3.22.3.4 Federal ERNS List

There are 87 sites with Emergency Response Notification System (ERNS) records within the searched area. The Emergency Response Notification System is maintained by the U.S. Environmental Protection Agency (USEPA). ERNS records and stores information on reported releases of oil and hazardous substances. Additional information on these sites is included in the data report in Appendix C of the *I-405 Corridor Program Draft Hazardous Materials and Wastes Technical Memorandum* (CH2M HILL, 2001).

3.22.3.5 Washington State's Confirmed or Suspected Contaminated Sites List

There are 129 Confirmed or Suspected Contaminated Sites List (CSCL) sites within the searched area. These sites have been identified by the Department of Ecology (Ecology) as having confirmed or unconfirmed contaminated environmental media. Environmental media include soil, groundwater, surface water, sediment, and air. Contaminants identified at these sites include one or more of the following:

- Petroleum hydrocarbons
- Volatile organic compounds (halogenated and unhalogenated)
- Semivolatile organic compounds (including polynuclear aromatic hydrocarbons [PAHs])
- Metals
- Polychlorinated biphenyls (PCBs)
- Pesticides/herbicides
- Conventional pollutants (e.g., pH, ammonia, etc.)

Additional information on these sites is included in the data report in Appendix C of the *I-405 Corridor Program Draft Hazardous Materials and Wastes Technical Memorandum* (CH2M HILL, 2001).

In addition, there are 180 sites identified on the Washington State Independent Cleanup Report (ICR) list within the project area. These include sites where reports on site cleanup actions have been received by Ecology. These cleanup actions have been conducted independently by the owners or operators at these sites and may not have approval from Ecology. Additional information on these sites is included in the data report in Appendix C of the *I-405 Corridor Program Draft Hazardous Materials and Wastes Technical Memorandum* (CH2M HILL, 2001).

3.22.3.6 Washington State's Landfill or Solid Waste Site Lists

Based on the information provided, three solid waste facilities or landfills were identified within the search area:

- Fruhling Wood Waste Landfill, 310 Poppy Road, Snohomish County
- Waste Management of Seattle, 13225 NE 126th Place, Kirkland
- Rabanco Black River Transfer Station, 200 112th Avenue NE, Tukwila

3.22.3.7 Washington State's Leaking UST Lists

There are 490 leaking USTs identified within the search area. Additional information on these sites is included in the data report in Appendix C of the *I-405 Corridor Program Draft Hazardous Materials and Wastes Technical Memorandum* (CH2M HILL, 2001).

3.22.3.8 Washington State's Registered UST Lists

There are 1,071 registered USTs identified within the search area. Additional information on these sites is included in the data report in Appendix C of the *I-405 Corridor Program Draft Hazardous Materials and Wastes Technical Memorandum* (CH2M HILL, 2001).

3.22.4 Impacts

3.22.4.1 All Alternatives

Construction Impacts

Construction impacts include encounters or releases of contaminants to the environment by ground-disturbing or dewatering activities. Based on a review of environmental agency information, potential types of hazardous substance contamination that could be encountered during project construction include petroleum-contaminated soil, surface water, and groundwater; and USEPA priority pollutants, organic compounds (volatile and semivolatile compounds and pesticides), metals, and PCBs in soil, groundwater, and surface water. If this contamination is not managed properly in accordance with existing regulations, there is a potential impact to human health and ecological receptors.

If the construction phase of these alternatives includes any building or structure demolition, hazardous materials including asbestos, lead-based paint, and PCBs may be present in these structures. Release of these hazardous materials during demolition would be a concern.

Underground storage tanks (USTs) and leaking USTs (LUSTs) have been identified in agency databases for areas adjacent to the alternatives. In addition, unidentified or abandoned USTs may be present, particularly in older residential areas.

Contaminated materials may be encountered in areas with known contamination, in areas where recorded activities such as hazardous waste generation or storage of fuel in USTs have the potential to have impacted soils or groundwater, or in other areas not identified in the environmental database search. In such a case, the possible environmental impacts might include the following:

- Potential release of contaminated air emissions (dust and volatile organic compounds), contaminated soil, surface water, and groundwater during construction
- Potential alteration of contaminated groundwater plume(s) and generation of contaminated water during dewatering activities
- Potential alteration of contaminant migration pathways due to excavation and other construction activities

Should electrical transformers require relocation during construction, a potential impact during removal and relocation would be a release of transformer fluid that might contain PCBs.

An additional potential impact common to the alternatives would be the release of a hazardous substance during construction. For example, fuels and oils needed for heavy equipment operation and maintenance might be spilled within the project area—a hazard common to all construction projects. Cleanup of the spilled material and disposal of wastes from cleanup, including contaminated soil, might add additional time and costs to construction operations. Large spills of hazardous materials during construction might also require emergency response agency intervention.

Although the impacts listed above would be potential impacts during construction of the alternatives, actions included under each of the alternatives being evaluated would need to be addressed at a project-specific level. No substantial impacts have been identified during this programmatic analysis. These impacts were determined to be not substantial because there are existing regulations and standard procedures that protect human health and the environment. For this programmatic analysis, it is assumed that there would be compliance with these regulations, and standard procedures, such as conducting environmental site assessments and hazardous material surveys prior to right-of-way acquisition or construction, would be used.

Operational Impacts

For the specific projects completed for each alternative, if contamination of soil, groundwater, surface water, or sediment is identified, or if cleanup alternatives selected include long-term onsite treatment of soils or groundwater, there may be a potential risk to public health for persons on the site.

There is a potential for release to the environment of hazardous substances used or transported during routine operation and maintenance of the corridor. Shipping of hazardous materials by motor vehicles is regulated under the authority of the USDOT through CFR 49. The proposed improvements would be consistent with requirements for shipment of hazardous materials because they are designed to eliminate many existing traffic flow and transportation safety impediments that pose danger to vehicles transporting any type of hazardous waste materials.

For all cases, the acquisition of an easement or title to properties with potential environmental contamination could create substantial long-term environmental liability or management concerns. Longer-term environmental liabilities might include financial responsibility for cleanup of onsite contamination or for remediation activities necessitated by offsite migration of hazardous substances.

It is recognized that maintenance facilities are needed for the transit vehicles. These maintenance facilities could store petroleum or hazardous materials and generate hazardous waste. Impacts from these maintenance facilities, or expansion of existing facilities, have not been evaluated for this programmatic analysis as no specific action is identified. This analysis would need to be performed at the project-level.

No substantial operational impacts were identified during this programmatic analysis based on relative comparison of operational impacts for the major elements of the alternatives. A relative comparison of the alternatives to consider the potential for release of hazardous substances used or transported to the environment indicates that the impacts of the No Action Alternative and various action alternatives are similar. More specific evaluation of impacts would need to be performed at the project-level analysis.

3.22.4.2 Action Alternatives

Construction Impacts

As developed in the *I-405 Corridor Program Draft Hazardous Materials and Wastes Technical Memorandum* (CH2M HILL, 2001), relative comparison of impacts (low, medium, high) during construction for the major elements and segments of the I-405 corridor alternatives was prepared based on general expected areas of construction, along with general area development type and proximity of sites identified in the regulatory agency database search. Expected construction areas were assumed to be approximately equal to new impervious surface areas calculated by David Evans and Associates, Inc. (DEA) for specific actions for each of the alternatives. The disturbance of soils, groundwater, or sediments in construction areas where contamination is present could result in a release of contaminants.

With these assumptions, the alternatives with larger construction areas (in particular, those with construction in areas where sites identified by the environmental agency database search are concentrated or in areas in the vicinity of substantially contaminated sites identified on the NPL and CERCLIS lists) are expected to have greater construction impacts. Based on the limited information available in terms of design for actions within the alternatives, Alternative 4, General Capacity, has the greatest expected construction area, followed closely by the Preferred Alternative and Alternative 3, Mixed Mode. These alternatives have a similar sum of actions where there is a relatively high impact; this sum is greater than those for the other alternatives. It is expected that these alternatives would have greater construction impacts than Alternative 1, HCT/TDM, and the No Action Alternative. Alternative 2, Mixed Mode with HCT/Transit, has an expected construction area less than the Preferred Alternative and Alternatives 3 and 4, and greater than Alternative 1 and the No Action Alternative.

More specific evaluation of impacts would need to be performed at the project-level analysis.

Operational Impacts

A relative comparison of the alternatives to consider the potential for release of hazardous substances used or transported to the environment indicates that the impacts of the various action alternatives are similar to those for the No Action Alternative.

3.22.5 Mitigation Measures

Mitigation measures can be taken to control, mitigate, or eliminate the impacts discussed above. Environmental regulations in place require the appropriate management of contaminated media such as soil or groundwater, require strict control and management of hazardous wastes, and establish criteria for transportation of hazardous substances.

Although hazardous material and waste impacts have only been identified at the programmatic level, the following mitigation measures will apply where appropriate to the project.

- Acquire additional information regarding the nature and extent of contamination at the identified sites for specific project actions. This information can be obtained through research of publicly available data, and by conducting Phase I environmental site assessments and Phase II environmental site investigations.
- Conduct modified environmental site assessments or transaction screening evaluations for sites located adjacent to the project sites and rights-of-way. Even sites not located within a

project area or right-of-way could have adverse impacts on the design and construction of the project due to offsite migration of contaminants. The site assessment would include a review of existing environmental conditions with a focus on the potential for offsite contamination by groundwater or surface water.

- Conduct additional studies to determine if asbestos-containing materials or lead-based paint are present in structures prior to demolition activities. If structures to be demolished are found to contain these substances, applicable regulations pertaining to the handling and disposal of these materials will be followed. An approved contractor will be designated to conduct the abatement portion of the demolition for the buildings that contain asbestos or lead-based paint. Regular onsite inspection would increase conformance to federal, state, and local regulations and guidelines.
- Conduct additional studies to locate undocumented underground storage tanks and fuel lines prior to construction. Areas of concern include current and former residential and commercial structures as well as fuel tanks associated with former industrial sites. Underground storage tanks located within the project site would be permanently decommissioned and properly removed before general construction activities are started, if applicable.
- Identify any utilities that need to be relocated. Electrical transformers containing oil, considered a hazardous substance under state regulations, will be handled carefully in order to avoid a release or accidental spill during the relocation of transformers.
- Design projects to help prevent additional future release of toxics to the environment.
- Phase construction activities in concert with any needed cleanup activities to avoid contaminated areas. Communication among the responsible parties and the regulatory agencies, and coordination of schedules, would lessen environmental impacts.
- Implement construction techniques that minimize disturbance to the subsurface and prevent the transport of contaminants to uncontaminated areas. These techniques will address installation of piling, dewatering activities, site grading and excavation, and stormwater pollution prevention.
- Prepare a comprehensive Hazardous Substance Management Plan and a worker Health and Safety Plan that would minimize the effects of identified and unanticipated hazardous substance impacts from contaminated soil and groundwater.
- Require contractors selected to do the construction work to follow careful construction practices to protect against hazardous material spills from routine equipment operation during construction. Contractors will be required to submit a Spill Prevention, Control, and Countermeasure Plan for WSDOT projects as required by WSDOT Standard Specification 1-07.15. The contractor also will be required to be familiar with proper hazardous material storage and handling and know emergency procedures, including proper spill notification and response requirements.

This page left intentionally blank.

3.23 CUMULATIVE AND SECONDARY EFFECTS

The Council on Environmental Quality's regulations implementing NEPA define cumulative effects as the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions (40 CFR Section 1508.7). Indirect, or secondary, impacts are defined as effects that are caused by the action and are later in time or further removed in distance, but are still reasonably foreseeable (40 CFR Section 1508.8). For the I-405 Corridor Program, the actions evaluated here are the proposed programmatic transportation improvements throughout the I-405 corridor in combination with past, present, and future land use development and other relevant non-project actions primarily within the four-county central Puget Sound region comprised of King, Kitsap, Pierce, and Snohomish counties. The evaluation of cumulative and secondary (indirect) effects described here relied on the CEQ publication, "Considering Cumulative Effects Under the National Environmental Policy Act" (January 1997) and the USEPA guidance, "Consideration of Cumulative Impacts in EPA Review of NEPA Documents" (May 1999b) which are incorporated herein by reference.

3.23.1 Scope of Cumulative Effects Analysis

Scoping for the cumulative effects analyses was conducted to identify: (1) important cumulative effects issues; (2) critical resources that should be evaluated for potential cumulative effects; (3) geographic (spatial) boundaries for evaluating potential effects; (4) temporal (time frame) boundaries for each analysis; and (5) relevant past, present, and future actions that could affect the resources, ecosystems, and human communities of concern. This scoping ensured that the analyses were focused on those effects that were truly meaningful, and is consistent with guidelines that recommend cumulative effects analyses "count what counts."

Scoping for the cumulative effects analyses relied on information gained throughout the I-405 Corridor Program EIS process. The scope of the analyses was based on public and agency input requested during formal scoping meetings early in the EIS process; informal input received from the public and agencies as a result of public meetings; responses to I-405 Corridor Program newsletters and questionnaires; feedback from the Steering, Citizens, and Executive committees; the results of prior research and technical analyses of direct and secondary effects conducted as part of the I-405 Corridor Program EIS discipline studies; and review comments received on the I-405 Corridor Program Draft EIS.

3.23.1.1 Critical Resources

Critical resources scoped for detailed evaluation of cumulative effects included: air quality; energy; surface water; wetlands; fish and aquatic habitat; and farmlands. These were scoped based on their heightened importance within the central Puget Sound region and/or I-405 corridor and their potential for substantial cumulative effects related to proposed I-405 Corridor Program improvements in combination with other foreseeable actions. Several reviewing agencies questioned whether energy and farmlands rose to the level that they should be scoped for analysis of potential cumulative effects. After further consideration it was agreed that analysis of these two elements would be included.

3.23.1.2 Geographic Boundaries

Geographic boundaries for evaluating potential cumulative effects were identified for each critical resource based on a number of factors. First, a geographic boundary for each resource analysis was identified by expanding the area of analysis to the point at which all potentially significant cumulative effects would be captured, and beyond which the resource would not be substantially affected. For analyses of natural environment elements such as fish and aquatic habitat, the most meaningful natural boundary (in this case, the affected watershed[s]) was then identified and used as the geographic boundary for analyses. This does not mean that substantial cumulative effects were necessarily found to occur within these geographic units. Where natural boundaries were not meaningful, such as for energy, a different analytical boundary was selected that would be meaningful. The regulatory interests of agencies with jurisdiction also influenced some analytical boundaries, such as for air quality.

3.23.1.3 Temporal Boundaries

Similar to the geographic boundaries for evaluating potential cumulative effects, temporal boundaries also were identified for each resource analysis depending on the accumulation characteristics of the effects being assessed and the regulatory interests of agencies with jurisdiction. For most analyses of critical resources, year 2030 was selected as the future temporal boundary because it is the horizon year for *Destination 2030*, the 2001 update of the Metropolitan Transportation Plan, and it encompasses *VISION 2020*, the region's long-range growth management, economic development, and transportation strategy. As discussed below, implementation of *VISION 2020* and the planned land use development that would result are by far the most consequential reasonable foreseeable actions that overlap geographically and temporally with the I-405 Corridor Program alternatives.

The cumulative effects of the No Action Alternative, which assumes implementation of *VISION 2020* and programmed and funded transportation improvements, were identified as the most meaningful baseline for comparing potential cumulative effects of the action alternatives on critical resources, ecosystems, and human communities of concern.

3.23.1.4 Framework for Cumulative Effects Analyses

The 2001 update of the Metropolitan Transportation Plan (MTP), referred to as *Destination 2030*, includes many of the transit, freeway, and arterial improvements contained in the I-405 Corridor Program Draft EIS action alternatives. With the Spring 2002 update of the MTP, the Puget Sound Regional Council (PSRC) refined *Destination 2030* to fully reflect and incorporate the transportation improvements contained in the I-405 Corridor Program Preferred Alternative. The environmental effects of these I-405 Corridor Program improvements and all other proposed transportation investments in the region were reviewed at a programmatic level in the *Final EIS for Destination 2030, The Metropolitan Transportation Plan for the Central Puget Sound Region* (Puget Sound Regional Council, May 2001b), which is incorporated here by reference. The potential cumulative effects of these improvements are re-evaluated here in slightly different combinations than in *Destination 2030* (as the I-405 Corridor Program Draft EIS action alternatives), and they are combined with some transportation improvements that were not included in *Destination 2030* prior to its update in Spring 2002. Thus, the *Final EIS for Destination 2030* provides a useful point of reference for assessing the magnitude and significance of the I-405 Corridor Program alternatives.

The Puget Sound Regional Council (PSRC) 20-year projections of growth in households and employment within the central Puget Sound region provided a partial basis for evaluating the geographic distribution of potential cumulative effects on critical resources, ecosystems, and human communities. In order to accomplish this, the PSRC land use forecasting model (DRAM/EMPAL) was used because the study area is located within the four counties covered by the PSRC. This is the forecasting model used by the PSRC to develop and update the *Destination 2030* MTP. For the I-405 Corridor Program forecasts and analyses, the proposed transportation improvements contained within each Draft EIS alternative were entered into the DRAM/EMPAL model in the form of increased access and mobility. King County, Snohomish County, and the PSRC were consulted extensively in order to gain an understanding of modeling inputs and results.

The potential effects of other notable and reasonably foreseeable transportation investments on the scoped critical resources were considered cumulatively with the projects and actions contained in *Destination 2030* and the PSRC land use forecasting model. The other transportation investments that were addressed in the cumulative analysis are identified and described in Section 3.23.2, which follows. It was not feasible to code these other investments for inclusion in the DRAM/EMPAL model runs because they were not adequately defined at such early stages of planning. Instead, the effects of these improvements were considered using best professional judgement based upon the general project descriptions that were available at the time the secondary and cumulative effects analyses were conducted. Because of the programmatic level of analysis and the overwhelming influence of the DRAM/EMPAL-modeled cumulative actions, this approach is believed to be reasonable and appropriate.

The cumulative and secondary effects of the Preferred Alternative were not modeled by the PSRC because the modeling analyses conducted previously for the Draft EIS alternatives revealed that the results would not be meaningfully different for the Preferred Alternative than for Alternative 3. This is because the two alternatives are very similar and because the overall magnitude of modeled secondary and cumulative effects are relatively insensitive to the transportation improvements contained in the action alternatives.

3.23.2 Relationship to Metropolitan Transportation Plan and Other Regional Actions

3.23.2.1 Metropolitan Transportation Plan

Destination 2030 is the 2001 update of the 1995 Metropolitan Transportation Plan (MTP). *Destination 2030,* the transportation element of *VISION 2020*, emphasizes an integrated multimodal transportation system and describes the regionally significant modal components of that system. The MTP serves as a planning tool used to identify regional transportation problems and analyze and develop regional solutions, and it serves as a focus for required state and regional transportation system performance monitoring, particularly for the federally mandated congestion management system. In Spring 2002, *Destination 2030* was updated and refined by the PSRC to fully reflect and incorporate the transportation improvements contained in the I-405 Corridor Program Preferred Alternative.

Destination 2030 supports a balanced multimodal transportation system that provides options to users, but the plan recognizes that capacity enhancements are needed to improve mobility on the region's roadways. Under *Destination 2030*, vehicle miles traveled (VMT) is expected to increase by 45 percent and population by 50 percent over the next 30 years. To address this growth, the plan calls for an aggressive program of transportation investments. With these investments, the growth in travel demand can be accommodated with relatively minor impacts on system performance, such as a 2 percent increase in congestion (P.M. peak) in 2030.

The Metropolitan Transportation System (MTS), which is the system component of *Destination 2030*, includes the following major elements.

Roadways. The roadway and high-occupancy vehicle (HOV) systems are integral components of the region's transportation system and will continue to be into the foreseeable future. Individual streets and roads do not function independently, but rather form a network through which traffic flows and connects to regional freeways. *Destination 2030* includes improvements on principal arterials and arterial HOV lanes, and it adds general purpose and HOV lane miles to the interstate and state route system in the four-county region.

Transit. The transit component is comprised of major regional transit services and facilities that provide public transportation access between major regional activities centers, connecting designated Urban Centers and major regional employment locations. Regional transit services can provide an alternate travel mode in congested corridors. In addition to the region's planned fixed-guideway HCT (light rail and commuter rail) and passenger-only ferry service, transit services are also represented by the transportation facilities they use – general purpose lanes, HOV lanes, and exclusive transit rights-of-way. Regional transit facilities include major park-and-ride lots, transit centers, and ferry terminals.

Non-Motorized Transportation System. This component of the MTS includes pedestrian improvement zones located in designated Urban Centers and regional transit station areas including bus, rail, and ferry facilities.

3.23.2.2 I-405 Corridor Program Improvements Contained in Destination 2030

All of the core projects and strategies in the four Draft EIS action alternatives developed for the I-405 Corridor Program are included in *Destination 2030*. In addition, the PSRC refined *Destination 2030* in Spring 2002 to fully reflect and incorporate the transportation improvements contained in the I-405 Corridor Program Preferred Alternative. These adopted transportation improvement projects and strategies are in response to the planned growth under the existing jurisdictional comprehensive plans, which in turn conform to the regional planned growth under *VISION 2020*.

The I-405 Corridor Program alternatives do not include all the HCT facilities that are included in *Destination 2030.* Links completing the HCT network around the region, such as north to Everett by 2030, are not included. Alternatives 1 and 2 do include the following fixed-guideway HCT routes and stations: Seattle to Issaquah across Mercer Island/I-90; SeaTac to Totem Lake in the I-405 corridor; and Bellevue to Redmond. The HCT facilities that are not included in the action alternatives are ones beyond the 2020 horizon of the I-405 Corridor Program; however, the action alternatives would accommodate implementation of these future HCT facilities during the 2020 to 2030 time period. With some project elements, such the bus rapid transit system in Alternative 3 and the Preferred Alternative, the I-405 Corridor Program improvements could actually serve as a transitional solution that could enhance implementation of a more intensive or higher-order HCT system in the corridor in the future.

In addition, the MTP uses HOV 2+, while the I-405 Corridor Program study uses HOV 3+ in the alternatives. Analysis showed that the HOV use along I-405 does not vary much among the study alternatives since the number of HOV lanes remains constant across alternatives. HOV 3+ use ranges from 3 to 4 percent of vehicles in the north end, and up to 10 percent in the south end of the corridor.

Appendix B identifies the projects within each alternative for the I-405 Corridor Program. The lists of projects included in *Destination 2030* are found in Appendix 9 – Project List and the Supplemental *Destination 2030* Project List of *Destination 2030*.

Other notable, reasonably foreseeable federal, non-federal, and private actions identified during scoping that could be cumulative with the I-405 Corridor Program action alternatives include the following, which are discussed in greater detail below:

- Trans-Lake Washington Project
- I-90 HOV transit improvements and lane additions between I-5 and I-405
- Sound Transit future investments
- *VISION 2020* proposed long-term regional land use plan

3.23.2.3 Trans-Lake Washington Project

WSDOT and Sound Transit have moved into the environmental analysis, documentation, and review phase of the Trans-Lake project to study options for crossing Lake Washington in the SR 520 corridor. In this phase, the recommendations from the study committee, as well as alternatives suggested by other community members, agencies, and advocacy groups, will be evaluated to determine the recommendations' value in improving mobility, their impacts on the environment and affected communities, and the steps that may need to be taken to avoid or mitigate negative impacts or to add positive impacts. An EIS will be prepared as part of the review process. The environmental analysis, documentation, and review process is expected to conclude in 2003. HCT across Lake Washington north of I-90 is not included in the I-405 Corridor Program or *Destination 2030*; the HCT is on the I-90 facility from the I-405 Interchange to downtown Seattle in Alternatives 1 and 2.

3.23.2.4 I-90 Transit Improvements and Lane Additions

HCT is assumed to operate along I-90 from Seattle to Issaquah by 2020 in the I-405 Corridor Program Alternatives 1 and 2, and in *Destination 2030*. A Sound Transit study is currently looking at ways to improve transit on the I-90 Lake Washington bridges. It is not clear at this point if I-90 will convert the reversible express lanes to two-way transit operation, or whether they will remain as reversible lanes.

3.23.2.5 Sound Transit Future Investments

Since 1996, Sound Transit has been implementing Sound Move, the first phase of the voter-approved regional transit long-range vision that includes regional bus service, HOV access improvements, park-and-ride lots, and commuter rail and light rail. Except for commuter and light rail facilities, a variety of these regional HCT investments are being implemented along the I-405 corridor. The majority of Sound Move commitments programmed for the I-405 corridor should be completed by 2006, the original completion year for Phase I. All Sound Move commitments are included in *Destination 2030* and the I-405 Corridor Program alternatives.

Sound Transit began Phase II planning in mid-2001 and expects technical work to continue over several years to enable a Phase II public vote. A Phase II public vote is necessary to build a new set of proposed regional HCT improvements beyond 2006. Assuming a positive vote outcome, the plan would provide additional (but as yet unspecified) HCT facilities and services to east King County jurisdictions within the I-405 corridor. The I-405 Corridor Program FEIS is a programmatic source of potential HCT-related projects to be included in a future Phase II implementation plan proposal.

In the I-405 Corridor Program Alternatives 1 and 2, HCT was assumed to operate as a center-to-center fixed-guideway system utilizing BNSF and I-405 right-of-way along the length of I-405, with extensions to Redmond via SR 520 and to Issaquah via I-90 corridor alignments. Alternative 3 assumes that the high-capacity transit element would take the form of an advanced bus rapid transit system, primarily using HOV lanes, operating on I-405, SR 520, and I-90.

3.23.2.6 VISION 2020

Destination 2030 functions as the transportation element of *VISION 2020*. *VISION 2020* describes a regional land use pattern consistent with and supportive of the state's GMA (Growth Management Act) policies. *Destination 2030* provides the regional transportation system to support the planned growth. With the Spring 2002 update of the MTP, *Destination 2030* fully reflects the transportation improvements contained in the I-405 Corridor Program Preferred Alternative. The local comprehensive plans for cities in the study area were developed within the framework of *VISION 2020*. The alternatives for the I-405 study are consistent with all local jurisdictions' adopted land use zoning. The I-405 Corridor Program action alternatives are consistent with GMA in that they support implementation of the envisioned regional land use pattern.

3.23.3 Land Use, Development, and Transportation in the Region and Study Area

3.23.3.1 Regulatory Trends

Through the late 1980s and 1990s, new regulatory policies at the state, regional, and local levels were enacted that defined the boundaries within which growth would be accommodated and the amount of density that each city will need to accommodate over a 20-year horizon.

Washington State Growth Management Act

Before the GMA was adopted in 1990, there was little statewide or regional direction on growth, and a growth pattern of continual sprawl into rural areas. The Act defined urban and rural growth areas (UGAs), designated Urban Centers (which came about through *VISION 2020* and Countywide Planning Policies), established density targets in those Urban Centers, and established minimum levels of services on statewide infrastructure. For further detail see Section 3.13 and the *I-405 Corridor Program Draft Land Use Plans and Policies Expertise Report* (DEA, 2001a).

VISION 2020

The Puget Sound Regional Council (PSRC) adopted the update of *VISION 2020* in 1995. *VISION 2020* serves as a long-range growth management, economic, and transportation strategy.

It establishes a multiple-center approach to development that promotes a jobs/housing balance and plans for needed transportation improvements, specifying that improvements should occur at the same time as employment growth to implement the infrastructure concurrency requirements of GMA. *VISION 2020* focuses growth into the Urban Growth Area (UGA) defined by each county. The Metropolitan Transportation Plan (MTP) was adopted in 1995 as the transportation element of *VISION 2020*.

Metropolitan Transportation Plan

As noted above, the MTP was initially adopted in 1995. The MTP is a long-range plan to guide transportation investments in the central Puget Sound region. It includes specific provisions relevant to the I-405 corridor, including policies to support development of dense centers and a greater mix of land uses, connected by a network of transit and non-motorized modes of travel. Key components of the MTP include regional transportation pricing strategies, freeway and arterial HOV systems, facilities for pedestrians and bicycles, travel demand management, and establishment of high-capacity transit modes along congested corridors that connect Urban Centers. The Puget Sound Regional Council updated the 1995 MTP in a revised plan titled *Destination 2030* in May 2001. In Spring 2002, *Destination 2030* was updated and refined by the PSRC to fully reflect and incorporate the transportation improvements contained in the I-405 Corridor Program Preferred Alternative.

As an integral part of *VISION 2020*, *Destination 2030* has the same emphasis on coordinated city, county, port, and transit agency plans, and adopted multi-county and countywide planning policies. *Destination 2030* takes into account the different growth patterns in the region and calls for focused growth in the Urban Centers. It also acknowledges implementation of a light rail system in the 2010 horizon with subsequent phases. *Destination 2030* takes an important step in calling for reduction of congestion points and includes many of the I-405 corridor improvements within the 2010 and 2030 horizons. The plan took the existing list of projects from the MTP and revised them based on PSRC modeling. It also includes a 2001–2010 "action strategy," which calls for a regional phasing plan to determine which transportation projects should be built first for the best land use effect.

County-Wide Planning Policies

King County, Pierce County, and Snohomish County, working with the local cities, took the lead in developing and adopting County-Wide Planning Policies (CWPP), which integrated land use planning with transportation planning policies. Cities, including the Eastside cities within the I-405 study area, adopted the CWPP as one regional implementation tool of the GMA and *VISION 2020* policies.

The CWPP establish the Urban Center concept, which is beginning to take form within the designated UGA. Some of the Urban Centers are in the I-405 corridor area and planned infrastructure improvements will affect their long-term viability.

All of the local jurisdictions in the I-405 Corridor Program study area have adopted comprehensive plans in accordance with requirements of GMA, the CWPP, and the PSRC Multi-county Planning Policies. These comprehensive plans include transportation elements that are reviewed and certified by the PSRC as conforming to the transportation planning elements of the GMA, *VISION 2020*, and the MTP. There are 80 adopted comprehensive plans in the Puget Sound region, 74 of which have certified transportation elements. The concurrency requirements of transportation elements require that key infrastructures be built or planned for within a 6-year time frame of any proposed development. The I-405 Corridor Program alternatives are generally supportive of the applicable jurisdictional local transportation plans.

3.23.3.2 Historical Land Use Changes and Trends

The Puget Sound region has experienced tremendous growth in two large cycles, one in the 1960s and another in the 1980s and 1990s. The Puget Sound region is still growing in 2001, with annual growth rates projected at 1.1 to 2.0 percent out to 2030 (PSRC, 2001a). Prior to the 1970s there was strong growth in the region with federal spending on aviation, expansion of military installations, import/export services, and related industrial goods. In the mid-1970s, the growth slowed and the Puget Sound region felt the "brakes" of the economy. In the mid-1980s, the region experienced a revival of the economy with the arrival of Microsoft and the "high-tech" industry, increased spending on military technology with Boeing, and an upturn in the national economy. While the growth rate was substantial in the 1960s, the current predominant Eastside land uses did not emerge until the 1980s when the area transitioned from rural/suburban, to suburban/urban with identifiable Urban Centers.

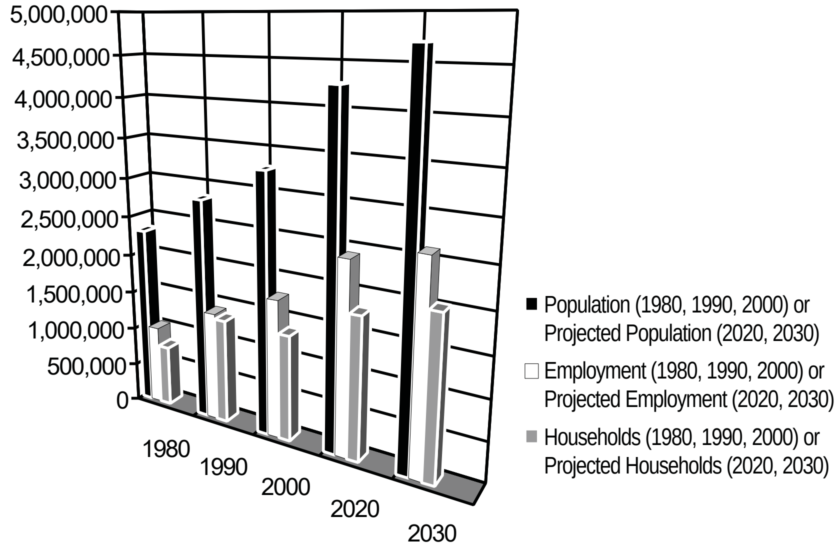
The Eastside (communities east of Lake Washington) began the Twentieth Century as a rural area. Development did not begin in earnest until after the completion of the first Lake Washington floating bridge across Mercer Island in 1940. The bridge dramatically decreased the time it took to travel between Seattle and the Eastside. During the next twenty years the previously rural Eastside was transformed into a major suburb of Seattle, with development focused in Bellevue and the other neighborhoods having easy access to U.S. 10 (now I-90). The second major phase in the contemporary development of the Eastside began when the second Lake Washington floating bridge was completed in 1963. The opening of SR 520 facilitated access and development in the 1970s and early 1980s of the northern and northeastern portions of the Eastside areas that had previously been difficult to access from Seattle. During the period the Eastside also became an important location for businesses and jobs, which increased 400 percent between 1960 and 1980.

The first businesses were retail, serving the needs of the residents, but from 1990 to 1997 the population increased by nearly 60,000 people and employment increased by 80,000 jobs as major international companies like Microsoft located on the Eastside and Boeing, the Eastside's biggest employer, expanded. Roadways were expanded and built in response to the employment and population growth. The land use plans and zoning currently approved for the Eastside anticipate considerable development over the next 30 years as well.

In the 1990s, towns that were once "bedroom" communities, such as Bellevue and Redmond, were transformed into major employment and commercial centers. The long-term regional growth trend has been toward population dispersion outward from Seattle and, late in the 1990s, from the Eastside cities eastward into agricultural and forested areas.

The I-405 corridor experienced the greatest growth between 1980 and 2000 as reflected in Figure 3.23-1. The growth that took place in employment and households was above the regional average.

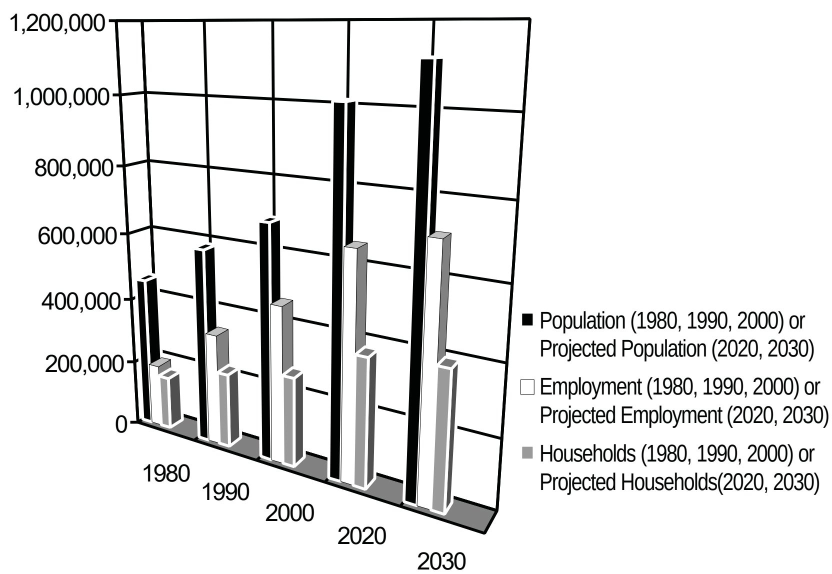
Figure 3.23-1: Population, Employment, and Household Trends from 1980 to 2000 and Projections at 2020 and 2030, I-405 Study Area



Between 2000 and 2030 the region is projected to add about 1.5 million people, 780,000 new households, and 700,000 new jobs. The population in the region is expected to grow at an annual rate of 1.2 percent over the next 30 years, a substantial slowdown from the 2.0 percent pace of the 1960-00 period. By 2030, the population, as shown in Figure 3.23-2 is expected to reach 4.7 million, a 44 percent increase from the 2000 level.

Figure 3.23-2: Population, Employment, and Household Trends from 1980 to 2000 and Projections at 2020 and 2030, Puget Sound Region

(King, Kitsap, Pierce, and Snohomish)



The trend of declining household size is expected to continue in the future, but at a more moderate pace. The updated forecasts project that, by 2030, there will be two million households in the region, a 50 percent increase above the 2000 total. The region's average household size is expected to be 2.3 people per household by the year 2030, down from the 2000 level of 2.5 persons per household (2001 MTP Baseline Technical Report – June 2000).

In the 1990s, aerospace was a major sector of the Puget Sound area's employment and economic base. In 1999, aerospace employment represented 40 percent of the total manufacturing sector jobs. Yet while aerospace was a substantial factor in the economy, the pre-packaged software industry accounted for 13 percent of the region's earnings in 1999. Recent forecasts indicate a shift in the regional economy to a new and growing sector – trade and service industries.

The forecast for 2030 economic performance will be tied to the growth in the trade and service industries. Projections suggest that trade and services will be the main growth sectors at an annual growth rate of about 1 percent or more between 2000 and 2030. The region is projected to have 1.5 million trade and service jobs, about 58 percent of all employment forecast through the year 2030 (2001 MTP Baseline Technical Report – June 2000).

3.23.3.3 Regional Land Use Trends and Growth

Summary of Population and Housing Trends in the Region

The Puget Sound region has experienced substantial growth in population during the past four decades. In the 1980s, the annual growth rate was approximately 2 percent with an estimated population of 2.7 million in 1990. The actual population ended up at more than 3 million in 1990, due to the in-migration drawn by a strong economy.

The substantial growth of in-migration of people took place between 1988 and 1989, when nearly 50,000 more people moved into this region than moved out. This exceeded the region's average of 20,000 for the previous 5 years. Population projections (Figure 3.23-2) indicate that by 2030, nearly 5 million people will be living within the region.

The housing trends are shown in Figure 3.23-2 from 1980 to 2030 for the region. Between 1995 and 1997 the number of residential units permitted increased regionally, with the number in King and Snohomish counties rising the fastest. Pierce and Kitsap counties experienced increases in permits from 1995 to 1996, but in 1997 fell 6 and 18 percent, respectively. Permits for single-family housing continued at a high level during the late 1990s and constituted the largest share of residential dwelling units.

The Growth Management Act (GMA), as discussed in regulatory trends, led to the establishment of the Urban Growth Area (UGA), a boundary for growth and designation of Urban Centers to absorb the growth. The UGA is likely to become denser as an additional million people populate the Puget Sound region by 2020. By the year 2030, a total of 1.7 million additional people are forecast to live in the region (Central Puget Sound region - Growth Context Paper - PSRC Oct. 1999).

The UGA requires an effective transportation infrastructure to provide access to the employment centers as well as the low-density suburban areas. The suburban areas are attractive due to lower land costs, but are often remote from employment opportunities. When housing is developed near employment centers, it may not be affordable to local employees, who then look further out – an ongoing development trend in east King County.

Summary of Employment in the Region

The Puget Sound region has experienced continued growth of both the manufacturing (aerospace and aviation) and service-oriented (software, computer technologies, and biotechnology) economic sectors. The I-405 corridor has a mix of both sectors, with aerospace manufacturing concentrated in the Kent and Renton areas and the software/high technology firms in Redmond, Bellevue, and the central and eastern areas. Both sectors generate high volumes of traffic on the freeway system.

Location analysis of selected industry clusters in the central Puget Sound region shows that certain industry groups tend to concentrate within particular parts of the region. Concentration of particular types of employment activity offer opportunities to examine transformations in the economic geography and travel behavior associated with different employment patterns, as discussed below (Central Puget Sound Region - Growth Context Paper - PSRC Oct. 1999).

In 1998, there were 190 aerospace firms in the region employing over 112,000 persons. The Boeing Company employs nearly 100,000 of these employees. Aerospace is concentrated, even after recent transfers among facilities, in south Seattle, Renton, Everett, and the Kent Valley. Non-Boeing aerospace employment (around 15,000 employees) tends to be located near the existing Boeing facilities.

Software firms employed nearly 30,000 persons in 1998. There were over 900 firms, 93 percent of which are small firms employing fewer than 50 employees. Half of all software employment is with Microsoft and 17 percent of the employment is with firms employing fewer than 50 employees. This has been an extremely high growth industry during the 1990s, with employment increasing by over 400 percent. These firms are primarily concentrated in downtown Seattle, Bellevue, Redmond, and to a lesser degree in other parts of east King County.

Biotechnology employment is concentrated primarily in downtown Seattle and around the University of Washington; some employment is located in the "high tech corridor" along I-405 in north King County and in Snohomish County. In 1998, biotechnology had an employment of 8,500 in 323 firms.

Temporary agency employment has seen high growth since 1990. Employment increased from 16,800 to 37,500. The size of temporary employment firms has increased much faster than the number of firms. These firms are highly concentrated and are primarily located in downtown Seattle and Bellevue.

These employment patterns and locations provide an insight into the many different pressures on the I-405 corridor to provide the means of movement of goods and people.

3.23.3.4 I-405 Study Area Land Use Trends and Growth

Summary of Population and Housing Trends in the I-405 Study Area

The I-405 area experienced substantial growth in the 1980s as shown in Figure 3.23-1. The projections for the I-405 study area in population growth, assuming an annual growth rate in the range of 1.4 to 2.0 percent, increase from 687,300 in 2000 to 1,010,500 in 2020 and 1,116,300 by 2030.

The household growth in the study area is expected to continue with a greater proportion living in multi-family units in the Urban Centers. Assuming an annual growth rate in the range of 0.5 percent to 1.2 percent, the households would increase from 265,200 in 2000 to 369,300 in 2020 and 390,500 by 2030. On a broader eastside view, PSRC forecasts indicate a growth rate in 2000 at 1.7 percent and dropping to 0.7 percent in 2030 for single-family households. The growth rate for multi-family units is forecast to range from 3.6 percent in 2000 to 0.7 percent in 2020, rising back up to 1.7 percent by 2030.

As discussed previously, the I-405 corridor has transitioned from a rural/suburban community into an urban area, focusing the continued growth into the Urban Centers of Bellevue, Redmond, Tukwila, Kirkland, and Renton. At the same time, the transportation infrastructure of I-405, SR 520, I-90, and the associated east/west major arterials are at capacity during peak hours.

The land use pattern in the I-405 corridor has followed the regional patterns, with focused employment centers and low-density suburban expansion outside of the downtown cores of Bellevue, Redmond, and Kirkland. Large residential subdivisions served by major arterials have experienced growth, with a parallel growth in the downtown cores of the eastside cities.

Summary of Employment in the I-405 Study Area

The I-405 study area, in comparison to the Puget Sound region (Figure 3.23-2), has grown at a greater pace in employment in the 1990s (Figure 3.23-1), and estimates project continued growth in the employment base. Projections, assuming an annual growth rate in the range of 0.8 to 1.5 percent, show employment rising from 462,300 in 2000 to 653,000 in 2020 and 708,400 by 2030.

The land use pattern on the Eastside is dependent upon the automobile. The potential for reducing single occupant vehicle trips and congestion is addressed in *Destination 2030* and the I-405 Corridor Program by continuing to develop HOV modes. Strategies include HOV priority lanes, high-capacity transit improvements (increased bus service and light rail), expanded commute trip reduction programs, and transportation demand management programs.

3.23.3.5 Results of DRAM/EMPAL Modeling for Region and Study Area

The PSRC land use forecasting model (DRAM/EMPAL) covers the four-county central Puget Sound region of Snohomish, King, Pierce, and Kitsap counties. This forecasting model is used by the PSRC to develop and update the MTP, including *Destination 2030*. State law requires the transportation elements of local comprehensive plans to be certified as consistent with the MTP. See the *I-405 Corridor Program Draft Land Use Expertise Report* (DEA, 2001b) for a more detailed discussion of the assumptions in the modeling process.

Based on the above trends, it was important in analyzing cumulative effects to view the population, employment, and households within the context of the regional plans, and therefore the PSRC model was utilized on small geographic areas known as forecast analysis zones (FAZ). The model projected employment and household growth within the FAZ geographical areas over the next 20 years. The basis for the projections is generated by PSRC from the regional forecasts of population and employment, which are allocated to the Forecast Analysis Zones (FAZs) using the DRAM/EMPAL model. The county forecast totals are not controlled, but are aggregations of the FAZs. The Regional Council's forecasts are consistent with the OFM's minimum and maximum projections.

Each county and its cities are mandated by GMA to work collaboratively to plan for the coordinated accommodation of this projected growth in their respective comprehensive plans and ensuing implementation actions. Evaluating the I-405 Corridor Program alternatives necessitated adding the proposed transportation improvements (for example, miles of additional I-405 freeway general_purpose lanes) to the DRAM/EMPAL model in the form of increased access and mobility. In addition, King County, Snohomish County, and the PSRC were consulted in order to gain an understanding of issues related to projected growth and planned land use changes.

The results of the modeling were used to identify the cumulative effects, if any, on pressure for growth and development within the forecast analysis zones. Changes in mobility and accessibility within the study area could influence the locational preferences of individuals, businesses, and households. The sum of these individual preferences regarding where people live and work translates into changes in pressure for growth and assumed development activities, as regulated by local comprehensive plans and zoning codes. These potential development activities are the cumulative effects from the I-405 Corridor Program combined with other regional corridor programs. When the action alternatives are compared to the No Action Alternative, there is a nominal range of decreases and increases in pressure for growth and development. This is assumed to be influenced by variations in the way each alternative enhances access to different portions of the I-405 corridor.

Destination 2030 includes many of the I-405 Corridor Program, SR 520, I-90, and SR 522 improvements. The cumulative effects of these transportation improvements on land use could be positive, with growth in population, employment, and households locating in the Urban Centers and in-fill development along the I-405 corridor where it is planned to occur.

The No Action Alternative does show a 24 percent increase in the projected growth from 2000 to 2020, but that is still within the range of projected growth for the region and the area, as defined by PSRC modeling. The No Action Alternative is an existing element within the PSRC model, as it includes existing and committed transportation projects.

The I-405 Corridor Program alternatives are compatible with existing regional and local land use plans, which already address growth.

It is important to remember that the No Action Alternative includes the committed projects that are likely to be built in the near future, and therefore are used for comparison purposes. The DRAM/EMPAL model forecasts the changes of the No Action Alternative from 2000 to 2020, and the action alternatives are compared to the No Action Alternative at 2020. These changes in pressures are detailed in the following sections, by county, FAZ maps, and detailed tables for each alternative.

No Action Alternative

The No Action Alternative could influence potential limited, localized effects in the form of increased pressure for growth in households outside of the Urban Growth Area. Figure 3.23-3 shows the existing land use in the study area and Figures 3.23-4 and 3.23-5, based on the PSRC model, show the projected growth of employment and households that are forecast to take place by 2020 under the No Action Alternative. Table 3.23-1 lists areas of increase in employment and households in the central Puget Sound region. The employment growth within the study area is expected to occur along the I-405 corridor and throughout Seattle, the Sammamish

Plateau, Kent Valley, Pierce County, North Bend, and Snoqualmie. Some household growth would occur outside of the UGA in south Snohomish County, east King County, northwest Pierce County, and Kitsap County.

Table 3.23-1: No Action Alternative Areas of Projected Increase in Employment and Households

Regional Jurisdictions	Local Jurisdiction with Employment Growth over 3000 Employees in 2020	Local Jurisdiction with Household Growth over 3000 units in 2020
Snohomish County	Everett and Lynnwood	Lynnwood, Mill Creek, Mukilteo
King County	Kirkland, Redmond, Bellevue, Issaquah, Newcastle, Renton, Tukwila, SeaTac, Kent, Auburn, and Federal Way	Woodinville, Redmond, Bothell, Carnation, Bellevue, Issaquah, Tukwila, SeaTac, Kent, Auburn, Covington, Federal Way
Pierce County	Algona, Pacific, Tacoma, Lakewood	Puyallup, Algona, Pacific, Bonney Lake, Sumner, Lakewood

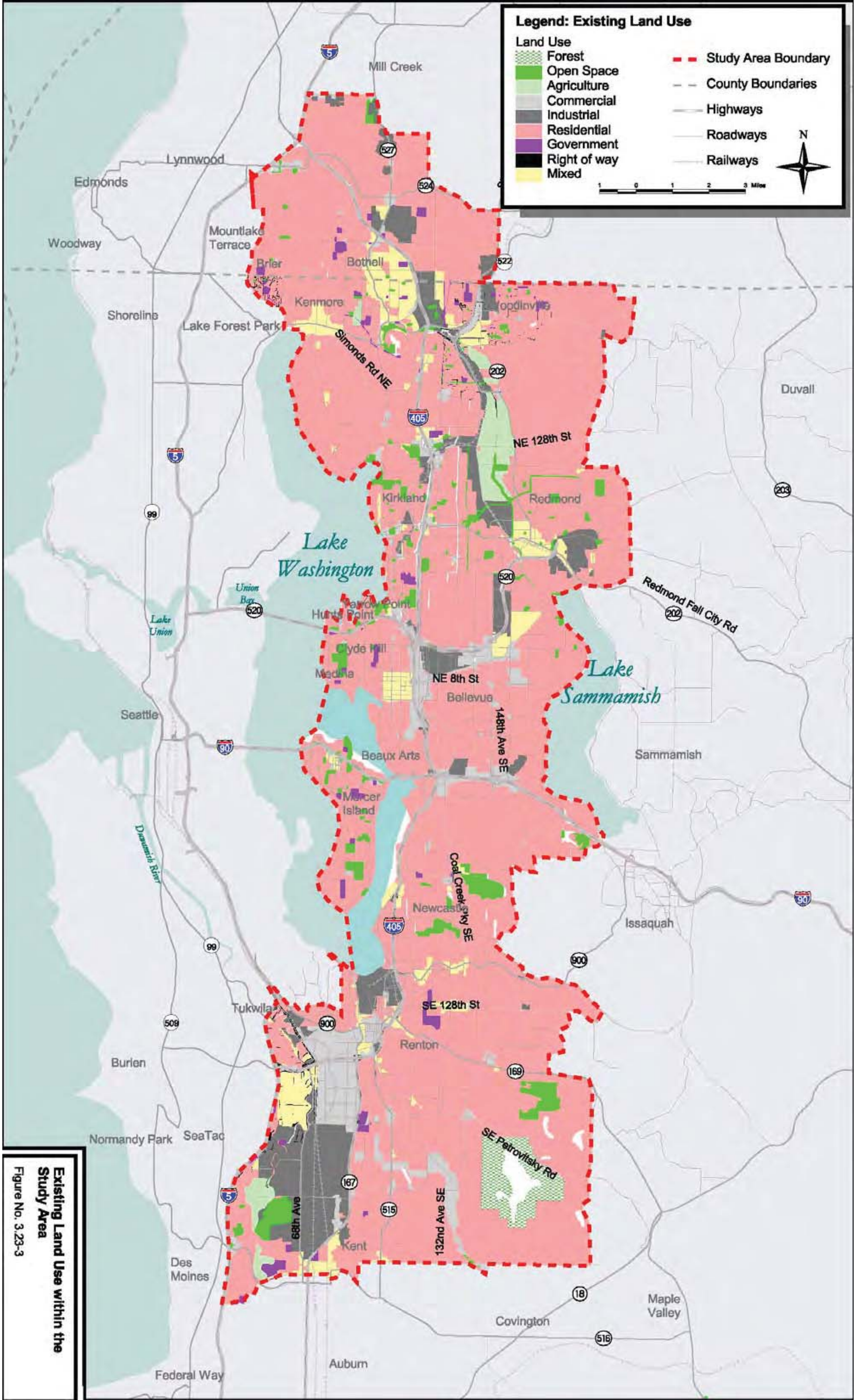
Despite pressure for additional growth on the fringe outside of the UGA, substantial growth (Figures 3.23-4 and 3.23-5) still would occur within designated Urban Centers. The designated Urban Centers that are expected to receive the highest level of employment growth are Everett, Lynnwood, Redmond, Bellevue, Tukwila/South Center, Kent, SeaTac, Auburn, and Federal Way.

The designated Urban Centers that would receive the highest level of household growth are Lynnwood, Redmond, Tukwila/South Center, SeaTac, Kent, Federal Way, and Puyallup.

Table 3.23-2 shows current and projected employment and households in 2020 for the counties and study area. It is important to note that the 2020 regional growth projections for the No Action Alternative are nearly the same (within 2 percent) as those for the action alternatives, indicating that there is very little change in overall pressure for growth and development among the alternatives.

Table 3.23-2: No Action Alternative Projected Changes in Employment and Households

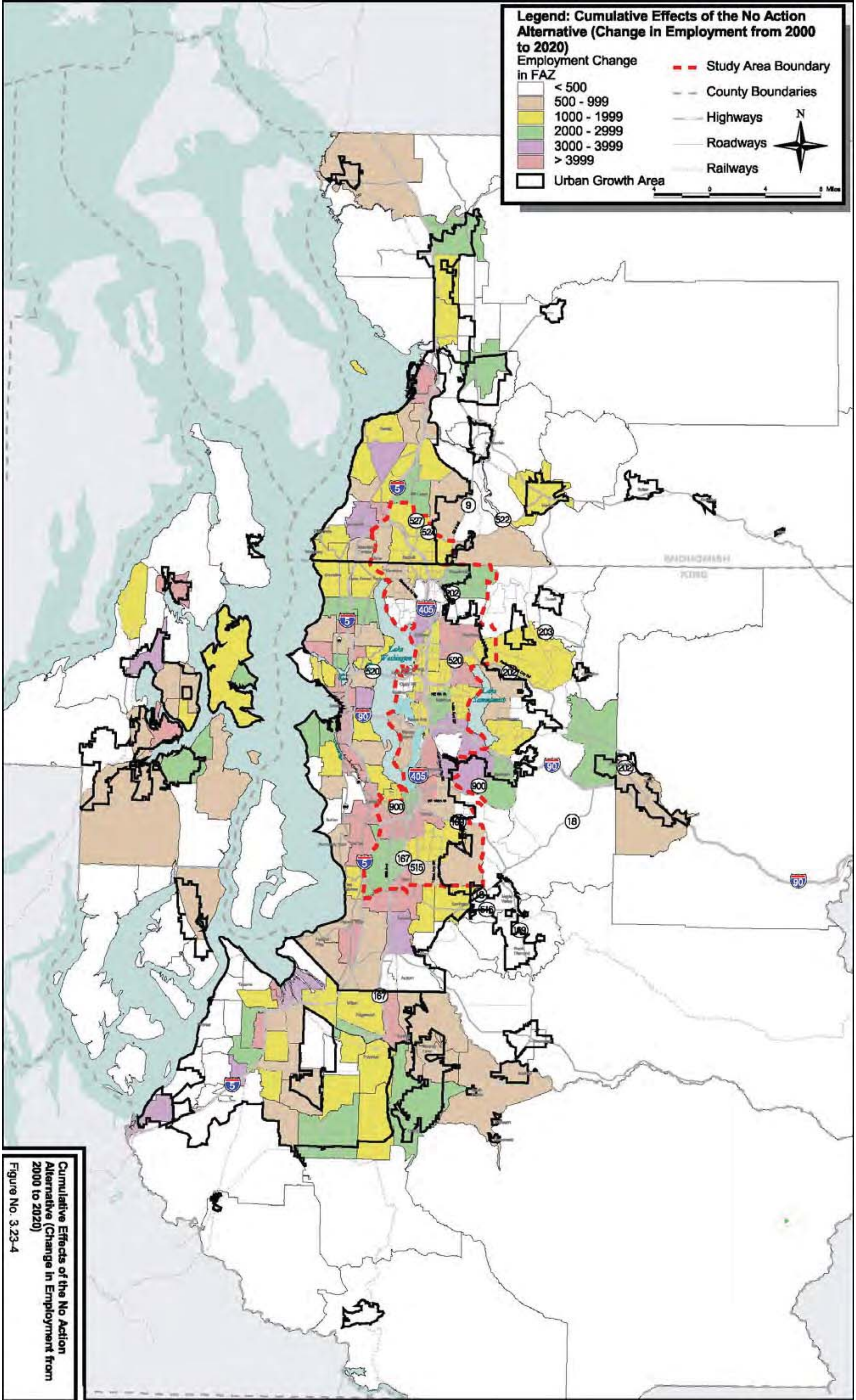
Location	Employment				Households			
	2000	2020	Change	Percent Change	2000	2020	Change	Percent Change
	(a)	(b)	(b)-(a)	2000-2020	(a)	(b)	(b)-(a)	2000-2020
King County	1,180,564	1,474,469	293,905	24.9	741,167	967,180	226,013	30.5
Kitsap County	90,962	120,954	29,992	33.0	96,257	137,421	41,164	42.8
Pierce County	294,393	365,085	70,692	24.0	272,835	348,078	75,243	27.6
Snohomish Co.	233,289	300,568	67,279	28.8	227,522	334,335	106,813	46.9
Regional Total	1,799,208	2,261,076	461,868	25.7	1,337,781	1,787,014	449,233	33.6
Study Area	**447,936**	**576,335**	**128,399**	**28.7**	**270,037**	**360,603**	**90,566**	**33.5**



Existing Land Use within the Study Area

Figure No. 3.23-3

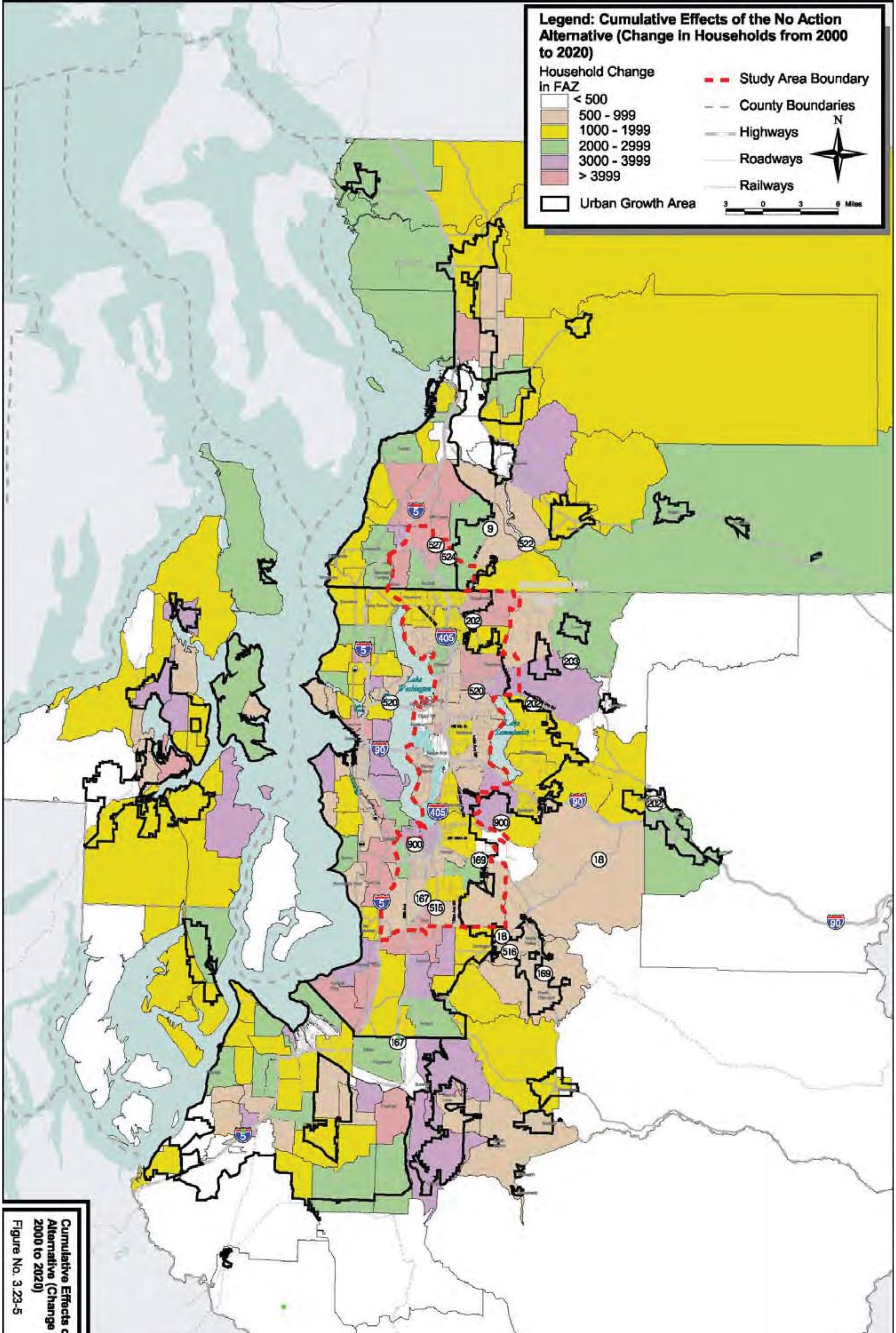
This page left intentionally blank.



Cumulative Effects of the No Action Alternative (Change in Employment from 2000 to 2020)

Figure No. 3.23-4

This page left intentionally blank.



Cumulative Effects of the No Action Alternative (Change in Households from 2000 to 2020)
Figure No. 3.23-5

This page left intentionally blank.

Another cumulative effect of the No Action Alternative is the effect on land use and transportation concurrency. For a detailed discussion on concurrency, please see the *Draft Land Use Plan and Policies Expertise Report* (DEA, 2001a). The local jurisdictions in the I-405 study area are facing serious traffic concurrency problems. If those issues are not managed effectively and addressed adequately by 2020, it is possible that the planned growth might not be able to be accommodated by local jurisdictions. The existing concurrency problems in most of the local jurisdictions would be exacerbated in the future under the No Action Alternative.

The average traffic level of service was calculated for jurisdictions within the I-405 study area. The results show virtually every jurisdiction within the study area would reach or exceed currently adopted transportation concurrency levels by 2020, including:

- Tukwila (Southcenter area)
- Renton (most areas)
- Newcastle (western portion)
- Bellevue (downtown, Factoria, Bel-Red)
- Mercer Island
- Kirkland (most areas)
- Redmond (western portions, including Overlake)
- Bothell (Snohomish County portion)
- Mill Creek (most areas)
- Lynnwood (most areas)

If concurrency cannot be achieved, growth would be expected to disperse elsewhere within or outside of the study area where it can be permitted and allowed under comprehensive plan policies.

This could exacerbate pressure for growth in rural areas outside the UGA or premature growth at the urban fringe of the UGA. If allowed to occur by local land use agencies, this pattern of growth would have potential cumulative effects such as increased demand on the transportation infrastructure, demand on public services, adverse impacts on the environment, vehicular congestion, and long-term increases in the cost of providing public services.

Alternative 1: HCT/TDM Emphasis

Compared to the No Action Alternative growth projections, under Alternative 1 the I-405 corridor could experience a slightly greater concentration of employment within the study area and a greater number of households within the designated Urban Centers and around the HCT stations within the corridor. See Table 3.23-3 for general county numbers, and Table 3.23-4 for a breakdown by geographic areas.

Table 3.23-3: Alternative 1 Changes in Employment and Households from the No Action Alternative

Location	2020 Employment				2020 Households			
	No Action Alternative (a)	Alternative 1 (b)	Change (b) – (a)	Percent Change From No Action Alternative	No Action Alternative (a)	Alternative 1 (b)	Change (b) – (a)	Percent Change From No Action Alternative
King County	1,474,469	1,471,969	-2,500	-0.2	967,180	965,682	-1,498	-0.2
Kitsap County	120,954	120,921	-33	0.0	137,421	137,543	122	0.1
Pierce County	365,085	364,995	-90	0.0	348,078	348,063	-15	0.0
Snohomish Co.	300,568	303,204	2,636	0.9	334,335	335,855	1,520	0.5
Regional Total	2,261,076	2,261,089	13	0.0	1,787,014	1,787,143	129	0.0
Study Area	**576,335**	**575,882**	**-453**	**-0.1**	**360,603**	**360,573**	**-30**	**0.0**

Note: The percent difference of "0.0" reflects rounding due to significant numbers in the FEIS.

Table 3.23-4: Alternative 1 Changes in Employment and Households by Area and County

Geographic Area	Employment	Households
Change from the No Action Alt. @ 2020	(Fig.3.23-6)	(Fig.3.23-7)
PIERCE COUNTY		
Fircrest / Lakewood	-10	20
Parkland / Spanaway	-4	1
Puyallup / Frederickson	-10	-5
Sumner / Bonney Lake	-13	-10
Tacoma Eastside	-9	5
Tacoma South	-20	-6
Tacoma North End	-16	-4
Tacoma CBD	3	1
Port of Tacoma / NE Tacoma / Fife	-4	5
Gig Harbor / Longbranch	-5	-4
Ft. Lewis / McCord / Dupont	-1	-14
SE Pierce County	-1	-4
Pierce County TOTAL	**-90**	**-15**
KING COUNTY		
Federal Way	-14	4
Auburn	-9	-20
Enumclaw	0	18
Tahoma / Raven Heights	-1	-7
Soos Creek	18	13
Kent	1431	628
Highline / Des Moines / SeaTac	-1437	-642
Tukwila	7	10
Renton / Skyway	95	20
Newcastle	-69	-426
Issaquah / E. Sammamish	13	0
Mercer Island	-1	-6
Bellevue	-3328	-1550
Point Cities	24	134
Kirkland Area	2961	2242

Geographic Area	Employment	Households
Change from the No Action Alt. @ 2020	(Fig.3.23-6)	(Fig.3.23-7)
Redmond Area	50	92
Northshore	-2106	-1803
Bothell	2	1
Seattle South	-16	-38
Seattle CBD	-52	-1
Seattle Central	-14	-55
Seattle North	-44	-96
Shoreline	-8	-12
Snoqualmie Valley	0	4
External Zones King	0	1
Vashon Island	-1	-9
King County TOTAL	**-2500**	**-1498**
SNOHOMISH COUNTY		
Edmonds / Esperance	-5	-14
Mountlake Terrace	0	-6
Lynwood Area	2652	1532
Mill Creek	0	-4
Clearview / Cathcart / Maltby	3	4
Paine Field Area	-5	5
Snohomish / Monroe	-1	-12
Lake Stevens Area	0	-4
Mukilteo / SW Everett	0	-3
Everett South	-2	7
Everett Central	-7	-4
Marysville / Arlington	0	16
SE Snohomish	1	13
NE Snohomish	0	-3
NW Snohomish	0	-7
Snohomish County TOTAL	**2636**	**1520**
KITSAP COUNTY		
Port Orchard / Southworth	42	245
Keyport / Central Kitsap	-5	-20
Silverdale / Bangor	-16	-22
Poulsbo / Kingston	-15	-30
Bremerton Area	-31	-34
Bainbridge Island	-8	-17
Kitsap County TOTAL	**-33**	**122**

Figure 3.23-6 shows projected employment under Alternative 1. Employment growth could result along the I-405 and SR 167 corridors where new fixed-guideway HCT and TDM strategies would be implemented.

Figure 3.23-7 shows projected households under Alternative 1. On a sub-regional level, Alternative 1 could influence pressure on Renton, Kent, Kirkland, and Lynnwood regarding additional employment and housing. The household growth could take place around the Urban

Centers with an improved range of multimodal transportation choices to regional employment centers, coupled with the future station area planning and implementation of Sound Transit's Sound Move program. This trend is supported by, and in support of, regional and local plans and implementation programs which call for transit-supportive land uses.

However, since Alternative 1 would not reduce the levels of traffic congestion in much of the study area, compared to the No Action Alternative, it would not be effective in addressing the concurrency problems at the local level. The increased pressure for employment and population growth described above would need to be matched with local actions to maintain adequate transportation levels of service. Without effective transportation improvements, projected growth might not be realized as planned and development could disperse to less suitable areas outside the Urban Centers and UGA.

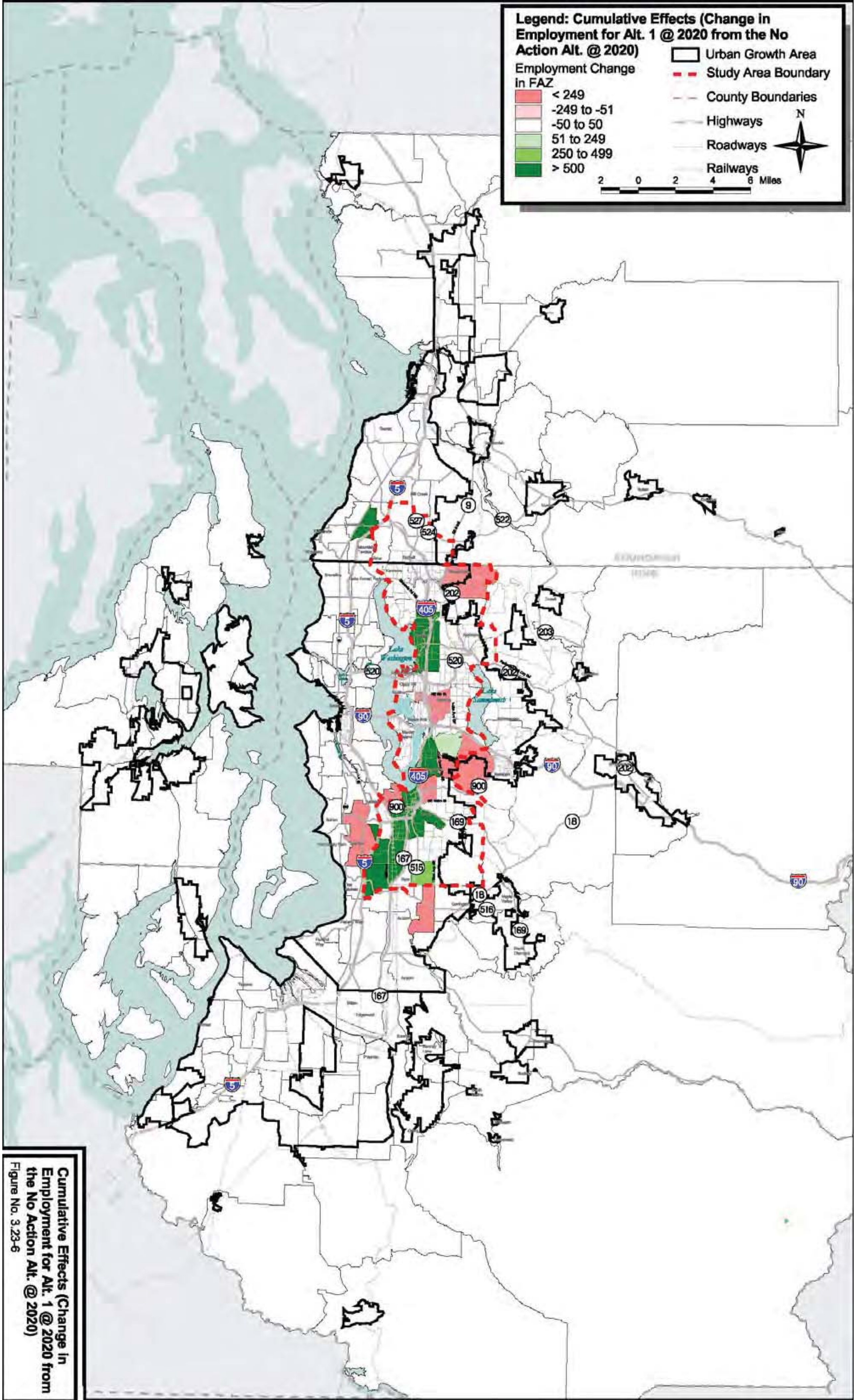
Alternative 2: Transit Emphasis

Compared to the No Action Alternative, pressure for growth in employment would be expected to increase in the I-405 corridor and decrease for City of Seattle, Pierce County, and, to a lesser degree, Kitsap County. Figure 3.23-8 shows the projected employment pattern in the region under Alternative 2. The future employment is forecast to increase in the northeastern and southern portions of the I-405 corridor, specifically in Redmond, Kirkland, Renton, Kent, Tukwila, and the Monroe UGA. See Table 3.23-5 for the county changes, and Table 3.23-6 for the breakdown by geographic areas.

Table 3.23-5: Alternative 2 Changes in Employment and Households from the No Action Alternative

	2020 Employment				2020 Households			
	No Action Alternative	Alternative 2	Change	Percent Change From No Action Alternative	No Action Alternative	Alternative 2	Change	Percent Change From No Action Alternative
Location	(a)	(b)	(b) – (a)		(a)	(b)	(b) – (a)	
King County	1,474,469	1,473,785	-684	0.0	967,180	966,821	-359	0.0
Kitsap County	120,954	120,068	-886	-0.7	137,421	135,956	-1,465	-1.1
Pierce County	365,085	363,894	-1,191	-0.3	348,078	347,789	-289	-0.1
Snohomish Co.	300,568	303,343	2,775	0.9	334,335	336,574	2,239	0.7
Regional Total	2,261,076	2,261,090	14	0.0	1,787,014	1,787,140	126	0.0
Study Area	**576,335**	**579,866**	**3,351**	**0.6**	**360,603**	**364,554**	**3,951**	**1.1**

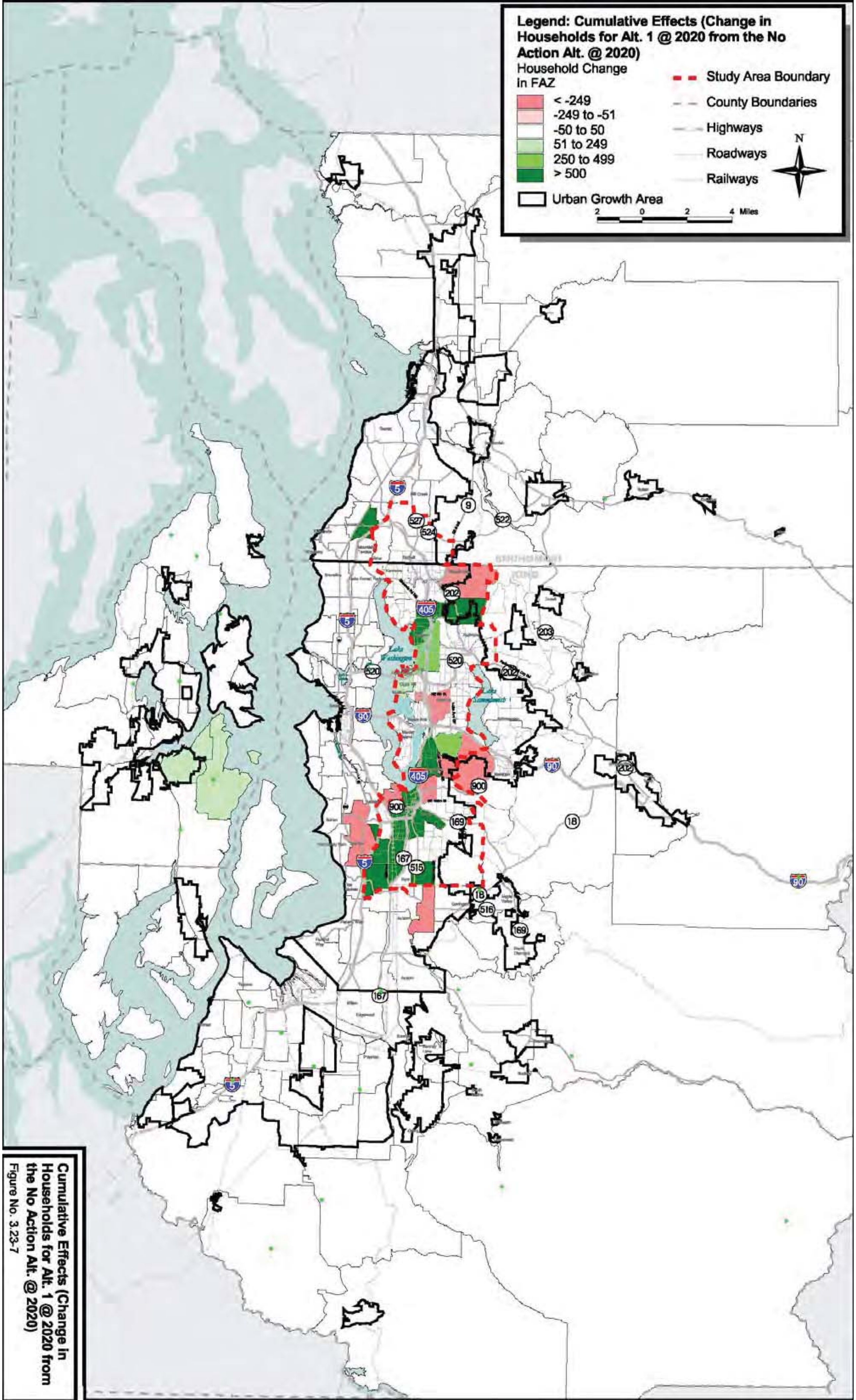
Note: The percent difference of "0.0" reflects rounding due to significant numbers in the FEIS.



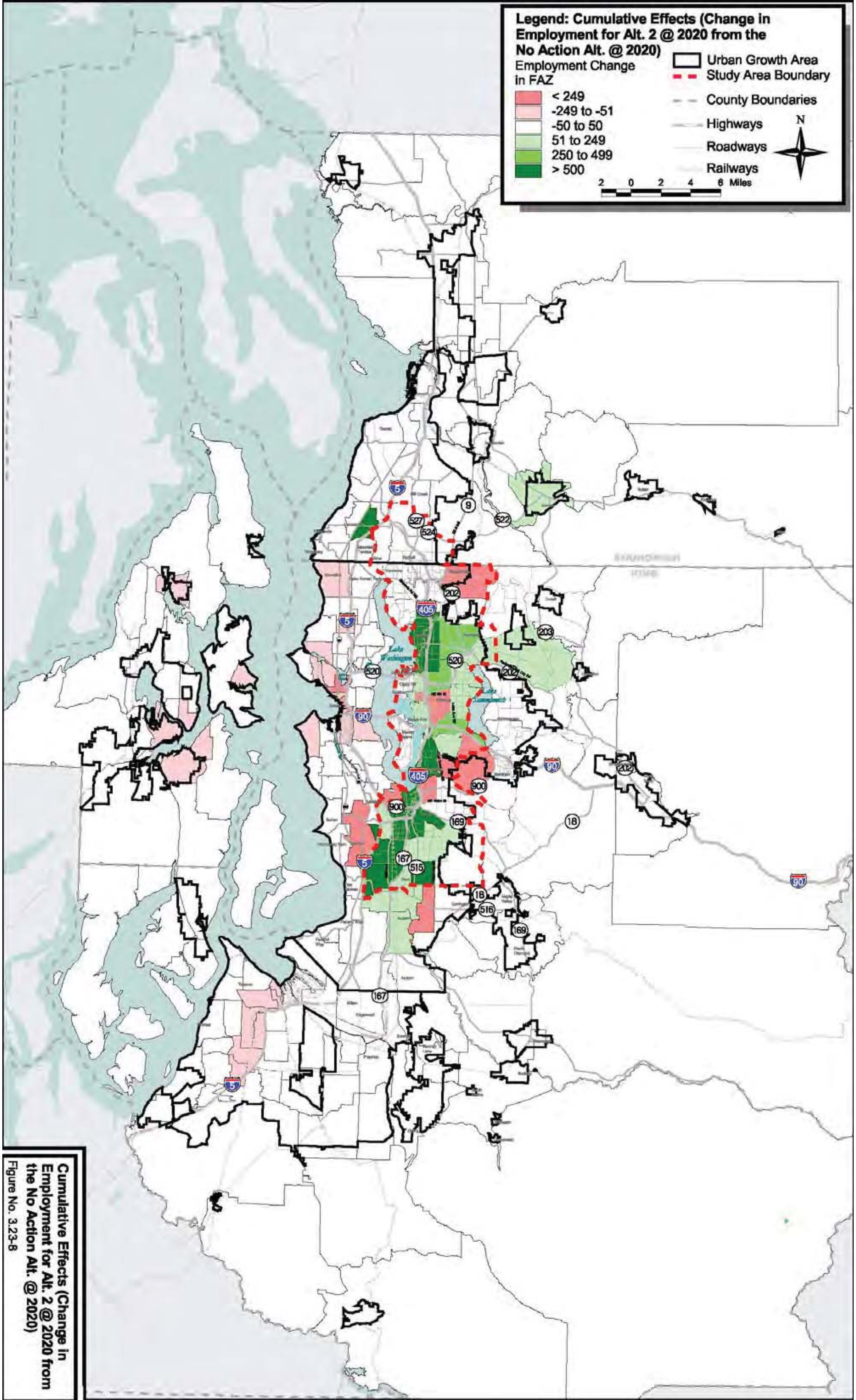
Cumulative Effects (Change in Employment for Alt. 1 @ 2020 from the No Action Alt. @ 2020)

Figure No. 3.23-6

This page left intentionally blank.



Cumulative Effects (Change in Households for Alt. 1 @ 2020 from the No Action Alt. @ 2020)
Figure No. 3.23-7



Cumulative Effects (Change in Employment for Alt. 2 @ 2020 from the No Action Alt. @ 2020)

Figure No. 3.23-8

This page left intentionally blank.

Table 3.23-6: Alternative 2 Changes in Employment and Households by Area and County

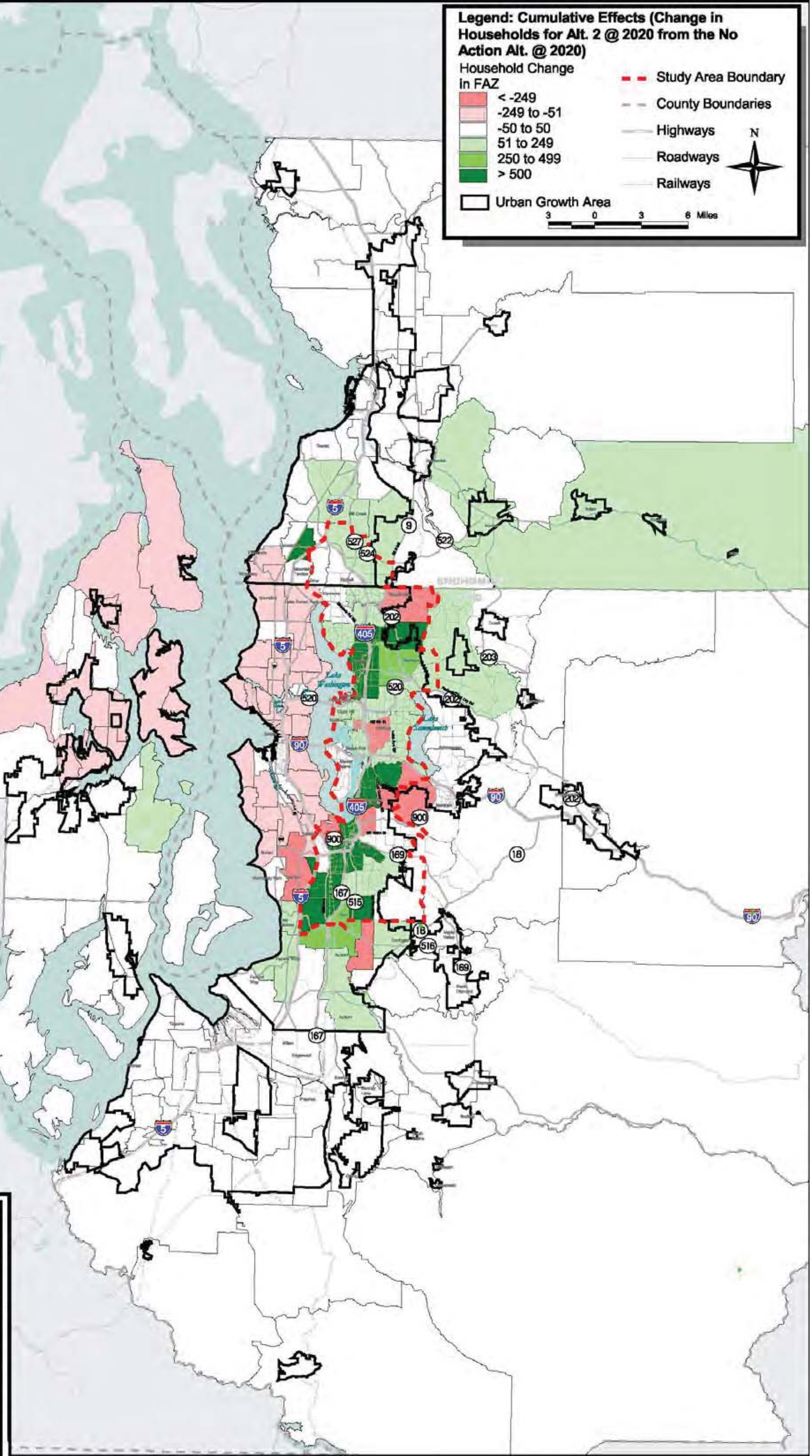
Geographic Area	Employment	Households
Change from the No Action Alt. @ 2020	(Fig.3.23-8)	(Fig.3.23-9)
PIERCE COUNTY		
Fircrest / Lakewood	-185	-92
Parkland / Spanaway	-75	-82
Puyallup / Frederickson	-146	-60
Sumner / Bonney Lake	-19	158
Tacoma Eastside	-87	-2
Tacoma South	-186	-13
Tacoma North End	-161	-56
Tacoma CBD	-220	-8
Port of Tacoma / NE Tacoma / Fife	-45	44
Gig Harbor / Longbranch	-46	-114
Ft. Lewis / McCord / Dupont	-12	-16
SE Pierce County	-9	-48
Pierce County TOTAL	**-1191**	**-289**
KING COUNTY		
Federal Way	-42	211
Auburn	97	292
Enumclaw	-9	28
Tahoma / Raven Heights	0	14
Soos Creek	273	690
Kent	1653	1026
Highline / Des Moines / SeaTac	-1515	-896
Tukwila	74	-43
Renton / Skyway	552	479
Newcastle	-37	-240
Issaquah / E. Sammamish	78	40
Mercer Island	50	23
Bellevue	-1657	-722
Point Cities	36	154
Kirkland Area	3374	2580
Redmond Area	555	803
Northshore	-1902	-1357
Bothell	47	89
Seattle South	-350	-769
Seattle CBD	-799	-265
Seattle Central	-528	-1021
Seattle North	-515	-1149
Shoreline	-93	-259
Snoqualmie Valley	-16	-49
External Zones King	2	-3
Vashon Island	-11	-15
King County TOTAL	**-683**	**-359**
SNOHOMISH COUNTY		
Edmonds / Esperance	-53	-168
Mountlake Terrace	-6	-13

Geographic Area	Employment	Households
Change from the No Action Alt. @ 2020	(Fig.3.23-8)	(Fig.3.23-9)
Lynwood Area	2604	1567
Mill Creek	57	160
Clearview / Cathcart / Maltby	72	262
Paine Field Area	33	131
Snohomish / Monroe	96	104
Lake Stevens Area	-11	-61
Mukilteo / SW Everett	9	11
Everett South	22	147
Everett Central	-7	-3
Marysville / Arlington	-49	-22
SE Snohomish	27	226
NE Snohomish	-5	-40
NW Snohomish	-14	-62
Snohomish County TOTAL	**2775**	**2239**
KITSAP COUNTY		
Port Orchard / Southworth	-72	6
Keyport / Central Kitsap	-70	-234
Silverdale / Bangor	-63	-308
Poulsbo / Kingston	-165	-283
Bremerton Area	-431	-488
Bainbridge Island	-85	-158
Kitsap County TOTAL	**-886**	**-1465**

The overall pattern of change in households under Alternative 2 would be similar to that in Alternative 1, although additional pressure for household growth may occur in the Mill Creek, Lynnwood, and Bothell areas in the north, and additionally in Renton, Kent, Federal Way, and to the south in Bonney Lake/Sumner. Figure 3.23-9 shows the projected pattern of households under Alternative 2. It is projected that the number of households would increase in south Snohomish County, Redmond, Kirkland, Kent, Auburn, and Federal Way. It is expected that the Urban Centers (Canyon Park, Lynnwood, SeaTac, Kent, and Federal Way) would absorb much of the growth.

In Alternative 2, the Urban Centers and future HCT stations would likely become stronger focal points for growth in employment and households, based on adopted land use strategies of the region, and in relation to transit-oriented development (TOD). TOD would be likely in the Urban Centers and in the corridor between the centers regardless of the timing of light rail, as it is regional policy and an economic tool for local jurisdictions.

The overall effects under Alternative 2 would be similar to Alternative 1, except that Alternative 2 would add capacity to I-405 and provide some reduction in study area traffic congestion. This would support local jurisdictions in getting closer to meeting concurrency requirements in a manner that would facilitate the clustering of growth and development within Urban Centers and the UGA. Alternative 2 would conform to local plans to help reduce the spillover or continued pattern of growth outside of the UGA; however, the increased pressure for employment and population growth would still need to be matched with local actions to



Cumulative Effects (Change in Households for Alt. 2 @ 2020 from the No Action Alt. @ 2020)
Figure No. 3.23-9

This page left intentionally blank.

maintain adequate transportation levels of service. Without effective transportation improvements, projected growth might not be realized as planned and development could disperse to less suitable areas outside the Urban Centers and UGA.

Alternative 3: Mixed Mode Emphasis

Compared to the No Action Alternative, pressure for employment and housing growth would be expected to increase in the study area and UGA in Alternative 3. This would support planned development in designated Urban Centers and around the HCT stations. Alternative 3, as shown in Table 3.23-7 (changes at the county level) and Table 3.23-8 (breakdown by geographic areas), would have effects similar to Alternative 2, but with increased pressure for employment and households within the corridor. From a regional perspective, the added capacity on I-405, the BRT system, increased reliance on HOV projects, arterial improvements, and implementation of TDM strategies would create improved accessibility to those portions of the I-405 corridor already planned for higher urban densities.

Table 3.23-7: Alternative 3 Changes in Employment and Households from the No Action Alternative

	2020 Employment				2020 Households			
Location	No Action Alternative (a)	Alternative 3 (b)	Change (b) – (a)	Percentage Change From No Action Alternative	No Action Alternative (a)	Alternative 3 (b)	Change (b) – (a)	Percent Change From No Action Alternative
King County	1,474,469	1,474,905	436	0.0	967,180	967,883	703	0.1
Kitsap County	120,954	119,289	-1,665	-1.4	137,421	134,539	2,882	-2.1
Pierce County	365,085	363,257	-1,828	-0.5	348,078	346,729	1,349	-0.4
Snohomish Co.	300,568	303,650	3,082	1.0	334,335	338,008	3,673	1.1
Regional Total	2,261,076	2,261,101	25	0.0	1,787,014	1,787,159	145	0.0
Study Area	**576,335**	**582,455**	**6,120**	**1.1**	**360,603**	**367,600**	**6,997**	**1.9**

Note: The percent difference of "0.0" reflects rounding due to significant numbers in the FEIS.

Table 3.23-8: Alternative 3 Changes in Employment and Households by Area and County

Geographic Area	Employment	Households
Change from the No Action Alt. @ 2020	(Fig.3.23-10)	(Fig.3.23-11)
PIERCE COUNTY		
Fircrest / Lakewood	-310	-358
Parkland / Spanaway	-115	-190
Puyallup / Frederickson	-179	-156
Sumner / Bonney Lake	-32	165
Tacoma Eastside	-148	-119
Tacoma South	-290	-57
Tacoma North End	-256	-206
Tacoma CBD	-326	-47

Geographic Area	Employment	Households
Change from the No Action Alt. @ 2020	(Fig.3.23-10)	(Fig.3.23-11)
Port of Tacoma / NE Tacoma / Fife	-78	5
Gig Harbor / Longbranch	-68	-261
Ft. Lewis / McCord / Dupont	-17	-51
SE Pierce County	-10	-74
Pierce County TOTAL	**-1829**	**-1349**
KING COUNTY		
Federal Way	-94	192
Auburn	165	496
Enumclaw	-17	34
Tahoma / Raven Heights	0	10
Soos Creek	371	1019
Kent	1729	1213
Highline / Des Moines / SeaTac	-1506	-926
Tukwila	205	-50
Renton / Skyway	765	701
Newcastle	-20	-105
Issaquah / E. Sammamish	132	154
Mercer Island	81	35
Bellevue	-518	-70
Point Cities	46	183
Kirkland Area	3757	2921
Redmond Area	784	1170
Northshore	-1737	-921
Bothell	79	188
Seattle South	-552	-1256
Seattle CBD	-1325	-389
Seattle Central	-897	-1578
Seattle North	-821	-1855
Shoreline	-135	-342
Snoqualmie Valley	-30	-33
External Zones King	5	-2
Vashon Island	-30	-86
King County TOTAL	**437**	**703**
SNOHOMISH COUNTY		
Edmonds / Esperance	-69	-159
Mountlake Terrace	-7	-8
Lynwood Area	2679	1691
Mill Creek	150	635

Geographic Area	Employment	Households
Change from the No Action Alt. @ 2020	(Fig.3.23-10)	(Fig.3.23-11)
Clearview / Cathcart / Maltby	125	513
Paine Field Area	57	284
Snohomish / Monroe	168	234
Lake Stevens Area	-8	-47
Mukilteo / SW Everett	23	41
Everett South	41	217
Everett Central	-21	4
Marysville / Arlington	-74	-65
SE Snohomish	41	417
NE Snohomish	-1	-23
NW Snohomish	-22	-61
Snohomish County TOTAL	**3082**	**3673**
KITSAP COUNTY		
Port Orchard / Southworth	-187	-426
Keyport / Central Kitsap	-106	-375
Silverdale / Bangor	-305	-535
Poulsbo / Kingston	-260	-487
Bremerton Area	-678	-809
Bainbridge Island	-129	-250
Kitsap County TOTAL	**-1665**	**-2882**

Figures 3.23-10 and 3.23-11 show the differences in the projected pattern of employment and households under Alternative 3. The projected pressure for growth would be similar to Alternative 2, but with greater forecast employment and households in the northern and southern portions of the I-405 corridor.

Alternative 3 is similar to Alternative 2 in that the Urban Centers and the transit stations would become stronger focal points for growth in employment and households. There are two areas within the corridor area (Kirkland/Redmond and Renton/Kent/Auburn) that would be expected to experience greater pressure for growth in employment and households as seen under Alternative 3 (Figures 3.23-10 and 3.23-11). Alternative 3 could enhance planned growth within key portions of the UGA planned for higher density development. This alternative supports regional policies seeking to create connectivity, density, and TOD to reduce growth impacts outside the UGA. The growth pattern associated with Alternative 3, when compared to the No Action Alternative, suggests that overall it may result in lessening of growth pressures on lands outside the UGA or premature development on the fringes of the UGA.

Alternative 3 provides for greater implementation of projects that are supportive of *Destination 2030* policies and locally adopted comprehensive plans than the No Action Alternative or Alternatives 1, 2, or 4. All of these regional and local policies call for the improvement of the regional transportation infrastructure and reduction in traffic congestion. The capacity expansions on I-405 included in Alternative 3 would shift some traffic onto I-405 from the arterials and provide reduction in study area traffic congestion. Thus, this alternative would provide a better opportunity for local agencies to meet concurrency standards, implement clustering of development, and increase density within the Urban Centers, and a transportation infrastructure within the UGA that serves a need as stated under the Growth Management Act.

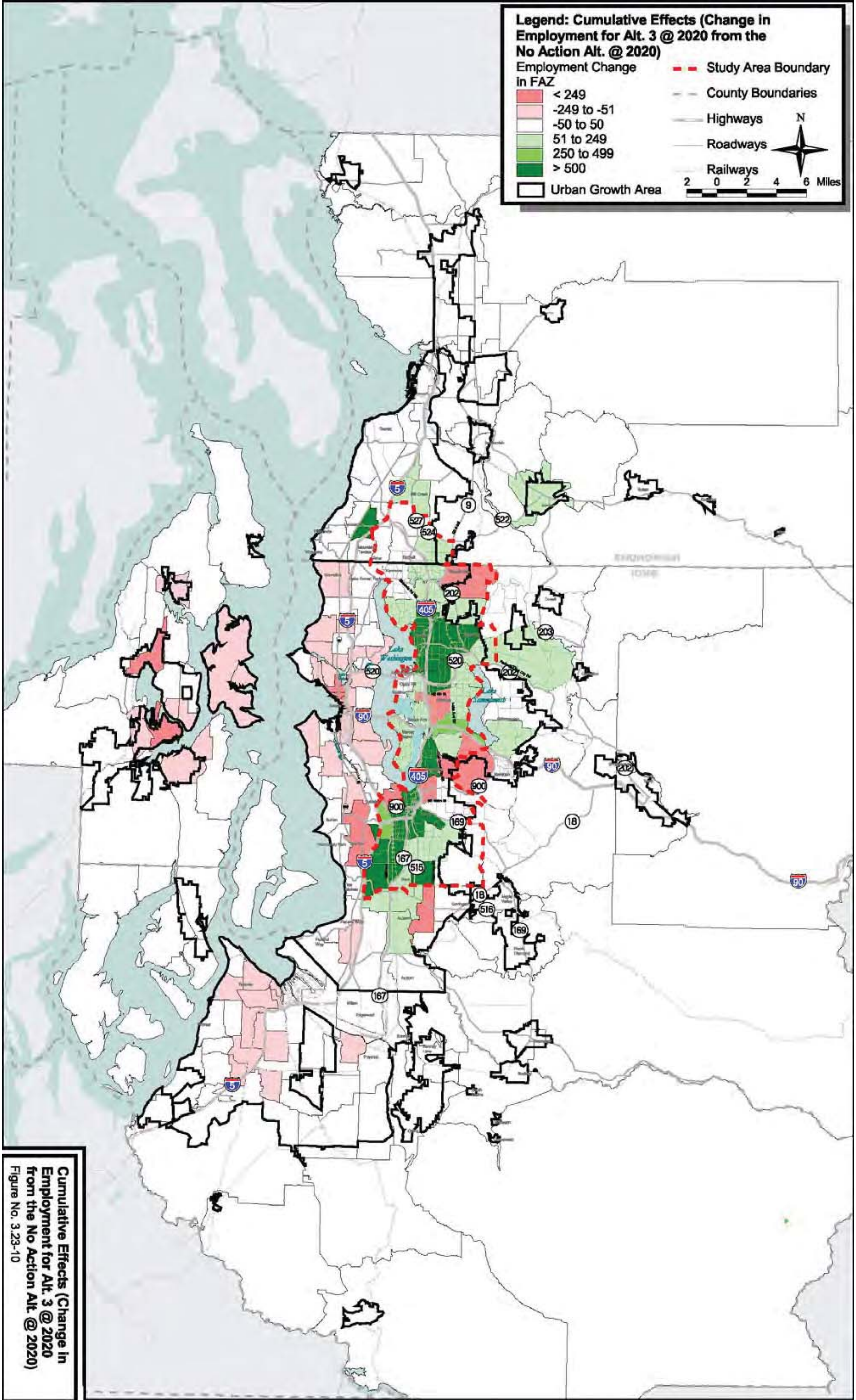
Alternative 4: Roadway Capacity Emphasis

Under Alternative 4, as shown in Table 3.23-9, pressure for employment and housing would be expected to increase in the I-405 corridor as compared to the No Action Alternative. Figure 3.23-12 shows the projected employment pattern in the region under Alternative 4. As shown in Table 3.23-10, additional pressure in the Kirkland, Redmond, Lynnwood, and Renton/Kent Valley area would be expected partially due to increased accessibility. Alternative 4 is forecast to result in less employment outside of the UGA compared to the No Action Alternative condition.

Table 3.23-9: Alternative 4 Changes in Employment and Households from the No Action Alternative

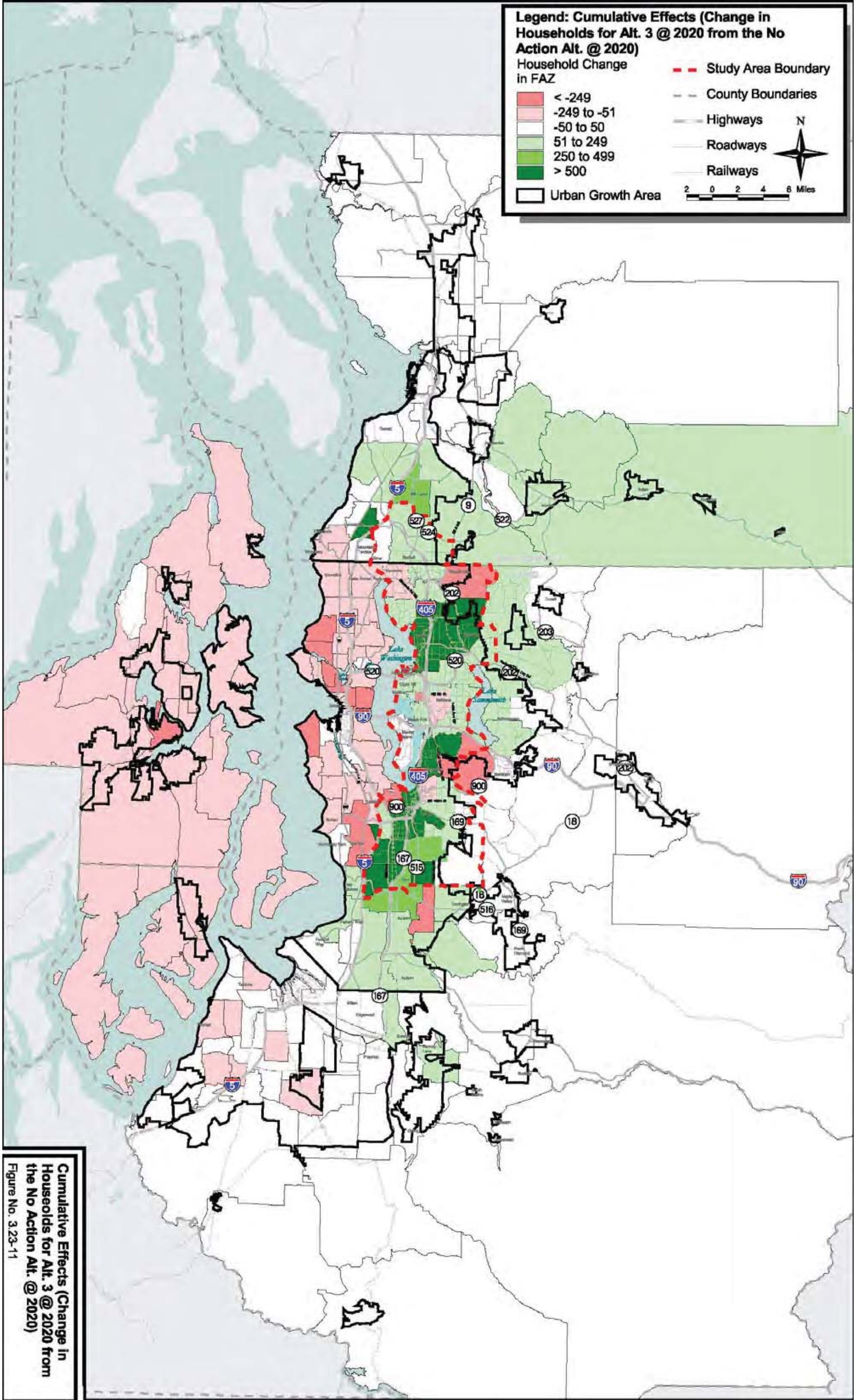
Location	2020 Employment				2020 Households			
	No Action Alternative (a)	Alternative 4 (b)	Change (b) – (a)	Percent Change From No Action Alternative	No Action Alternative (a)	Alternative 4 (b)	Change (b) – (a)	Percent Change From No Action Alternative
King County	1,474,469	1,474,966	497	0.0	967,180	966,953	-227	0.0
Kitsap County	120,954	119,076	-1,878	-1.6	137,421	134,410	-3,011	-2.2
Pierce County	365,085	362,941	-2,144	-0.6	348,078	346,376	-1,702	-0.5
Snohomish Co.	300,568	304,111	3,543	1.2	334,335	339,399	5,064	1.5
Regional Total	2,261,076	2,261,094	18	0.0	1,787,014	1,787,138	124	0.0
Study Area	**576,335**	**583,044**	**6,709**	**1.2**	**360,603**	**368,218**	**7,615**	**2.1**

Note: The percent difference of "0.0" reflects rounding due to significant numbers in the FEIS.



Cumulative Effects (Change in Employment for Alt. 3 @ 2020 from the No Action Alt. @ 2020)
Figure No. 3.23-10

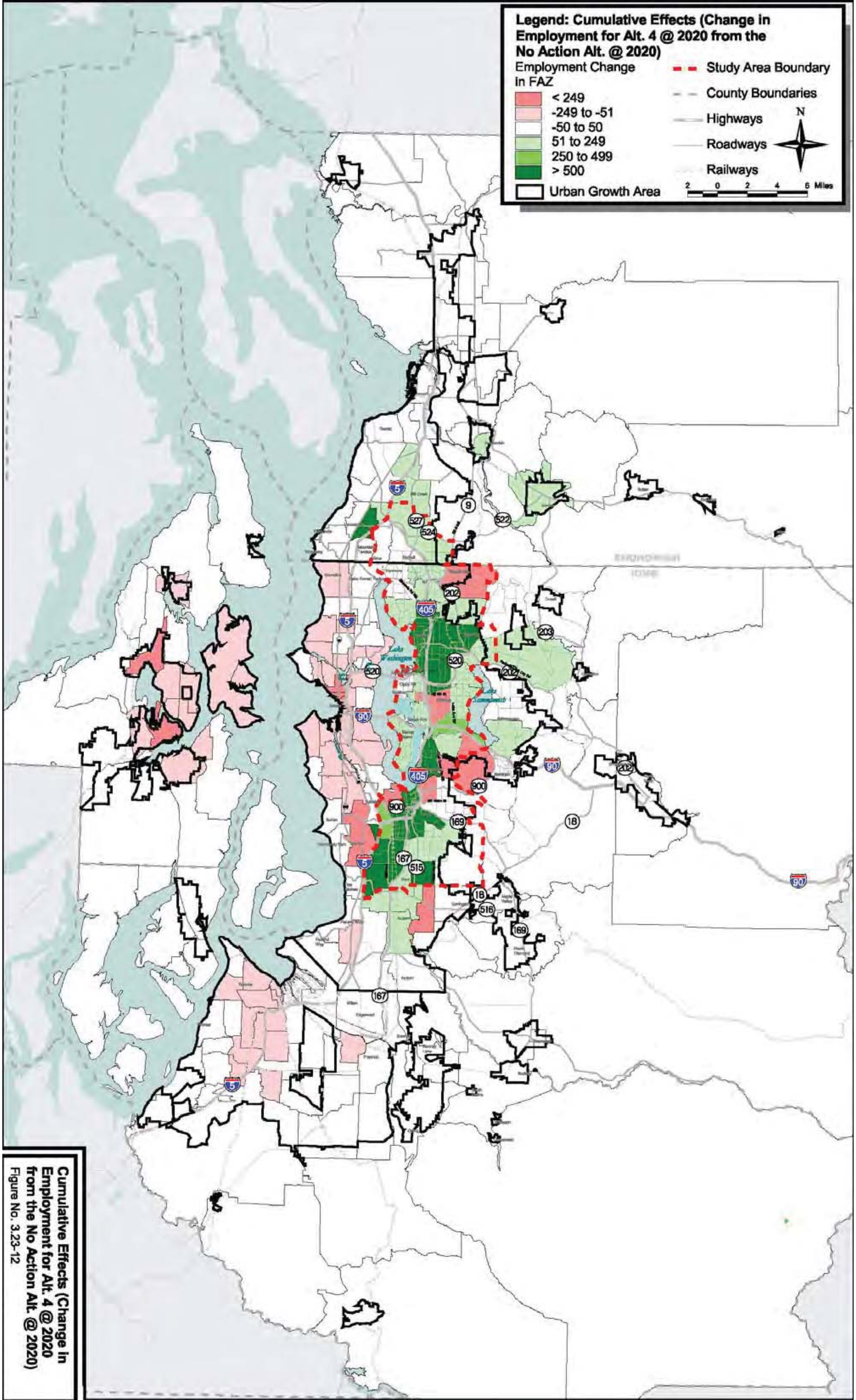
This page left intentionally blank.



Cumulative Effects (Change in Househoulds for Alt. 3 @ 2020 from the No Action Alt. @ 2020)

Figure No. 3.23-11

This page left intentionally blank.



Cumulative Effects (Change in Employment for Alt. 4 @ 2020 from the No Action Alt. @ 2020)
Figure No. 3.23-12

This page left intentionally blank.

Table 3.23-10: Alternative 4 Changes in Employment and Households by Area and County

Geographic Area	Employment	Households
Change from the No Action Alt. @ 2020	(Fig.3.23-12)	(Fig.3.23-13)
PIERCE COUNTY		
Fircrest / Lakewood	-346	-374
Parkland / Spanaway	-137	-251
Puyallup / Frederickson	-222	-209
Sumner / Bonney Lake	-70	52
Tacoma Eastside	-166	-128
Tacoma South	-335	-72
Tacoma North End	-297	-239
Tacoma CBD	-372	-37
Port of Tacoma / NE Tacoma / Fife	-85	-5
Gig Harbor / Longbranch	-83	-301
Ft. Lewis / McCord / Dupont	-18	-37
SE Pierce County	-13	-101
Pierce County TOTAL	**-2144**	**-1702**
KING COUNTY		
Federal Way	-104	240
Auburn	116	415
Enumclaw	-28	-6
Tahoma / Raven Heights	-6	12
Soos Creek	390	1040
Kent	1754	1252
Highline / Des Moines / SeaTac	-1529	-1086
Tukwila	342	-19
Renton / Skyway	902	795
Newcastle	-19	-138
Issaquah / E. Sammamish	141	128
Mercer Island	91	31
Bellevue	-483	-123
Point Cities	47	180
Kirkland Area	3796	2969
Redmond Area	828	1236
Northshore	-1691	-854
Bothell	88	212
Seattle South	-649	-1548
Seattle CBD	-1464	-514
Seattle Central	-1002	-1957
Seattle North	-836	-1963
Shoreline	-103	-302
Snoqualmie Valley	-51	-106
External Zones King	7	-7
Vashon Island	-39	-114
King County TOTAL	**498**	**-227**
SNOHOMISH COUNTY		
Edmonds / Esperance	-53	-105
Mountlake Terrace	2	40

Geographic Area	Employment	Households
Change from the No Action Alt. @ 2020	(Fig.3.23-12)	(Fig.3.23-13)
Lynwood Area	2823	1889
Mill Creek	241	1090
Clearview / Cathcart / Maltby	141	596
Paine Field Area	89	388
Snohomish / Monroe	196	288
Lake Stevens Area	2	26
Mukilteo / SW Everett	30	55
Everett South	86	331
Everett Central	17	38
Marysville / Arlington	-59	-10
SE Snohomish	44	449
NE Snohomish	1	16
NW Snohomish	-17	-27
Snohomish County TOTAL	**3543**	**5064**
KITSAP COUNTY		
Port Orchard / Southworth	-152	-156
Keyport / Central Kitsap	-125	-435
Silverdale / Bangor	-355	-623
Poulsbo / Kingston	-301	-555
Bremerton Area	-793	-945
Bainbridge Island	-152	-297
Kitsap County TOTAL	**-1878**	**-3011**

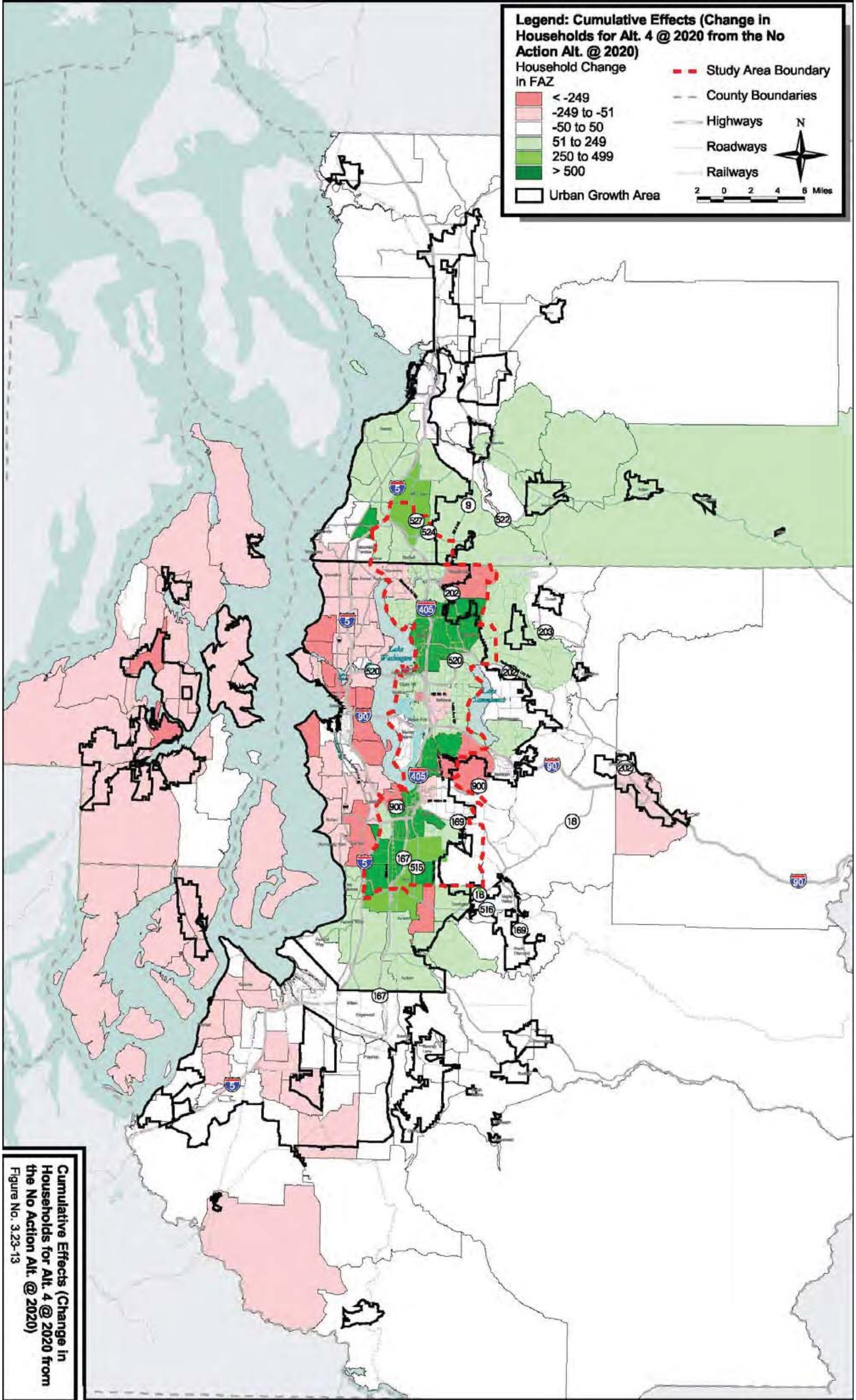
Figure 3.23-13 shows the projected household pattern in the region. The number of households is forecast to increase within the UGA compared to the No Action Alternative, but there also could be more growth at the outer edges of the UGA or premature development on the fringes of the UGA.

The forecast growth pattern under Alternative 4 when compared to the No Action Alternative suggests a different trend for pressure to occur outside of the UGA, which also could result in increased growth pressure on the fringe areas of the UGA not currently designated for higher urban densities. This would be considered a negative impact on land use outside of the UGA, and is not as consistent with the policies of *VISION 2020* and subsequently *Destination 2030*.

Alternative 4 would perform similar to Alternative 3 with regard to addressing the long-term concurrency problems facing local jurisdictions. The capacity expansions on I-405 included in Alternative 4 would shift traffic onto I-405 from the arterials and reduce study area traffic congestion. This would improve opportunities relative to Alternatives 1 and 2 for clustering of development and increasing density within the Urban Centers and the UGA without triggering limitations under concurrency ordinances.

Preferred Alternative

Compared to the No Action Alternative, employment and household growth would be expected to increase in the study area and UGA under the Preferred Alternative. This would support planned development in designated Urban Centers and around the HCT stations. The overall effects under the Preferred Alternative would be similar to Alternative 3. As in Alternative 3,



Cumulative Effects (Change in Households for Alt. 4 @ 2020 from the No Action Alt. @ 2020)
Figure No. 3.23-13

This page left intentionally blank.

Urban Centers and the transit stations would become stronger focal points for growth in employment and households. Alternative 3 and the Preferred Alternative also provide the best opportunities to reduce pressure for unplanned development at the urban fringe or in rural areas outside the UGA.

The Preferred Alternative includes the balanced system of multimodal transportation improvements that best accommodates the projected growth in the UGA. The transportation investments proposed by the Preferred Alternative are also focused exclusively within the UGA to support efficient access and improved mobility within and between the designated Urban Centers, Activity Centers, and Industrial/Manufacturing Centers. The Preferred Alternative would provide the highest level of benefit in accommodating continuous and orderly development by congestion reduction, air quality improvement, HOV reliability, and improved urban accessibility of the action alternatives analyzed.

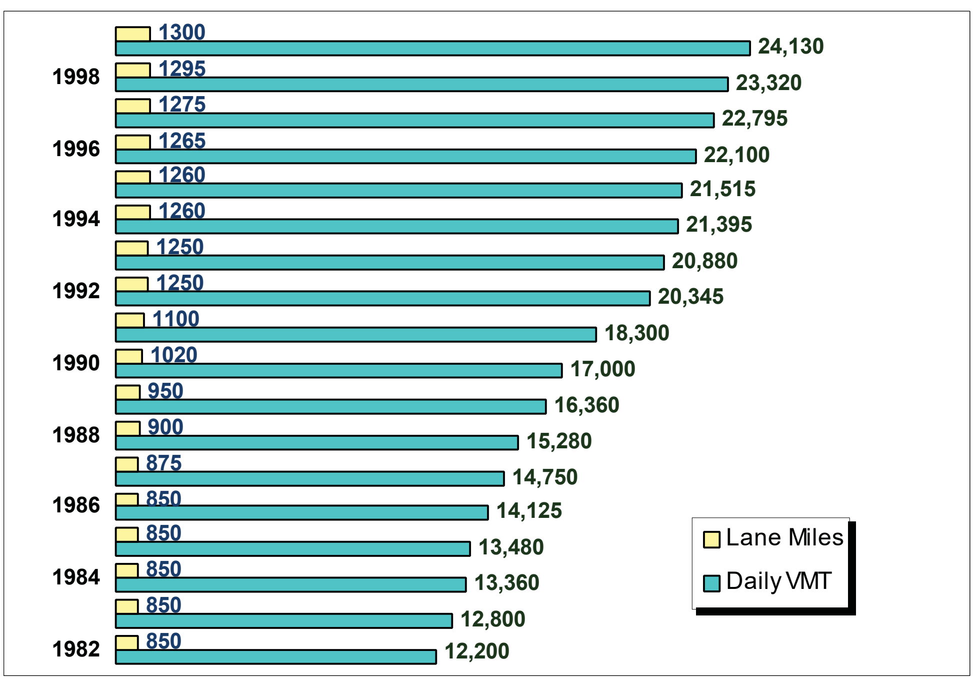
3.23.3.6 Traffic and Transportation

Roadway Network

The I-405 corridor is one of many transportation corridors within the regional network of roadways connecting communities throughout the Puget Sound. The four-county region has more than 11,400 lane miles. The I-405 corridor study area has about 13 percent of the region's roadways. Because of the relatively sparse roadway network in the I-405 study area (about 1,500 lane-miles in the 250-square-mile area), there is greater reliance on state highways to serve non-regional trips than would normally be the case. Interstate 405 is the transportation backbone of the study area, and travel demand within the study area is heaviest on I-405 itself.

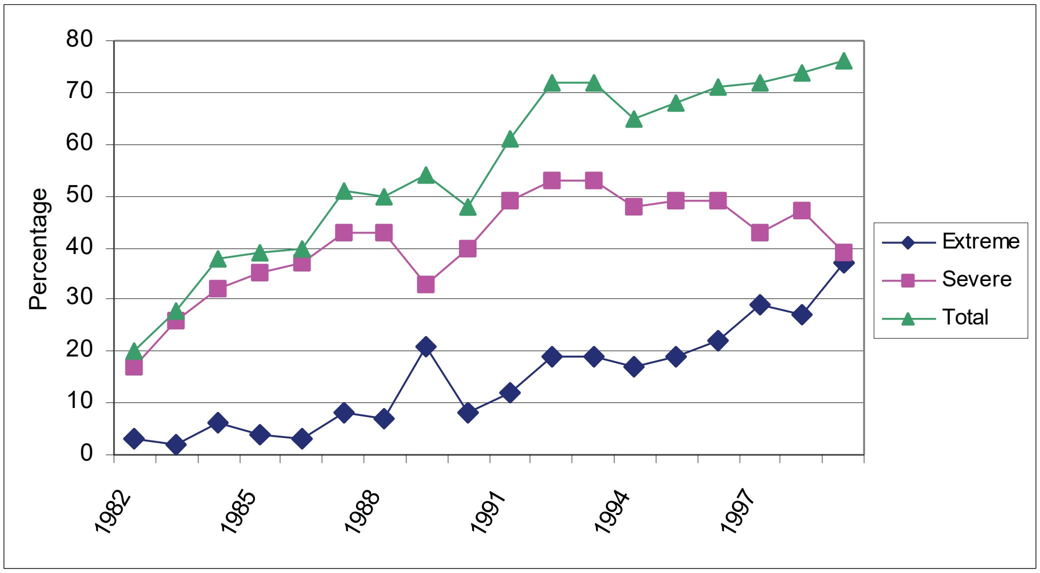
Figure 3.23-14 shows the growth of freeway lane miles and daily VMT in the region over the past 20 years. Figure 3.23-15 shows the result, increasing percentage of lanes with peak period congestion. Extreme congestion continues to increase each year, as the freeways have become more crowded during the peak hours.

Figure 3.23-14: Growth in Freeway Region-wide Daily VMT (000's) and Freeway Lane Miles 1982-1999



Source: Texas Institute Mobility Data for Seattle-Everett, 2001 Urban Mobility Study

Figure 3.23-15: Percent of Peak Period Travel in Severe or Extreme Congestion (1982-1999)



Source: Texas Institute Mobility Data for Seattle-Everett, 2001 Urban Mobility Study

Traffic Volumes and Travel Demand

In evaluating the regional cumulative effects of the I-405 Corridor Program, the forecasts for population, employment, and travel demand in the corridor were compared to forecasts for the four-county central Puget Sound region. Several observations were made. As the Eastside has grown, traffic volumes have increased dramatically. From 1970 to 1999, the average daily traffic on I-405 north of I-90 increased nearly five-fold, growing from 41,000 to 198,000 cars per day. The roadway network has not expanded at the same rate, resulting in increased congestion on all the roads, especially on the I-405 freeway.

While the entire corridor experienced almost a 400 percent increase in traffic volumes from 1970-1999, various sections of I-405 show different rates of traffic growth. From 1980 to 2000, the increase in the corridor was 150 percent, as capacity was reached on several sections of I-405. Table 3.23-11 presents a historical summary of the average annual daily traffic on selected arterials and state roads in the I-405 Corridor Program study area.

Table 3.23-11: Average Annual Daily Traffic on Selected Arterial and State Roads in I-405 Study Area (1965 to 1999)

Measurement Location	1965	1970	1975	1980	1985	1990	1995 baseline	1999
I-405 north of I-90	24,400[a]	41,000[a]	53,400[a]	80,100[a]	115,400[a]	137,600[c]	164,832	198,000[c]
I-405 north of SR 520	12,100[a]	33,400[a]	48,400[a]	76,400[a]	107,400[a]	146,800[c]	152,174	178,000[c]
I-405 north of SR 522	N/A	15,000[a]	20,300[a]	37,200[a]	52,700[a]	88,400[c]	92,822	94,000[c]
I-405 south of I-90	24,000	N/A	N/A	76,000[c]	115,400[c]	129000	116,525	168,000[c]
SR 522 west of I-405	N/A	N/A	N/A	21,500[c]	24,800[c]	30000	32,000[c]	38,000[c]
SR 908 east of I-405 (Rose Hill)	N/A	N/A	N/A	24,800[c]	28,300[c]	30000	31,000[c]	46,300[d]
148th Ave SE north I-90	N/A	15,000[a]	18,400[a]	22,600[a]	30,200[a]	N/A	N/A	39,700[e]
Lake Wa Blvd north of SR 520	2,200[a]	11,800[a]	11,700[a]	23,000[a]	27,500[a]	N/A	N/A	N/A
I-90 Mercer Island Bridge	17,900[b] 42,892[a]	48,352[a]	48,655[a]	52,283[a]	68,500[a]	112,400[c]	128,000[c]	121,000[c]
SR 520 Lake Wash. Bridge	22,998[a]	37,744[a]	47,544[a]	72,130[a]	99,500[a]	97,700[c]	100,000[c]	110,000[c]

a Eastside Transportation Program, Background Report, October 1988, p. 4.
b Number of vehicles in 1961, Puget Sound Regional Transportation Study
c WSDOT Annual Traffic Report, 1983, 1985, 1991, 1994, 1996
d City of Kirkland, 1999 traffic counts
e City of Bellevue , 2000 traffic counts

The forecasts for VMT and VHT in the study area are expected to follow the region's forecasted trend of a greater than 50 percent increase between 1999 and 2020. Table 3.23-12 presents the historical growth in VMT and VHT for the I-405 study area from 1980 to 2000, including the 2020 No Action Alternative, and the growth for the four-county region during the same time period.

Table 3.23-12: VMT and VHT for Study Area and Region

Alternative	VMT (Daily)		VHT (Daily)	
	Study Area (trips within)	Region-wide	Study Area (trips within)	Region-wide
1980	9,322,000	39,500,000	359,800	1,411,000
1990	14,962,400	63,400,000	529,100	2,075,000
1995	16,346,000	69,412,000	586,000	2,295,000
2020 No Action Alternative	22,510,000	100,571,000	1,156,000	3,948,000
Change vs. 1995 (%)	37.7%	44.9%	97.3%	72.0%
Alternative 1	22,563,000	100,497,000	1,155,000	3,941,000
Change vs. No Action Alternative (%) Change vs. 1995	0.2% 38.0%	-0.1% 44.7%	-0.1% 97.2%	-0.2% 71.7%
Alternative 2	24,215,000	101,560,000	1,164,000	3,922,000
Change vs. No Action Alternative (%) Change vs. 1995	7.6% 48.1%	1.0% 46.3%	0.7% 98.6%	–0.7% 70.9%
Alternative 3	25,346,000	102,263,000	1,170,000	3,907,000
Change vs. No Action Alternative (%) Change vs. 1995	12.6% 55.0%	1.7% 47.3%	1.2% 99.7%	-1.0% 70.2%
Alternative 4	26,208,000	102,730,000	1,184,000	3,903,000
Change vs. No Action Alternative (%) Change vs. 1995	16.4% 60.3%	2.1% 48.9%	2.4% 102.0%	-1.14% 70.1%
2020 No Action Alternative (Mar 2002)*	23,927,000	102,770,000	834,000	3,389,000
2020 Preferred Alternative (Mar 2002)*	26,208,000	104,459,000	853,000	3,366,000
Change vs. No Action Alternative (%)*	11.5%	1.6%	2.3%	0.7%

Source: PSRC Model

* Compared with updated travel forecasts. (See Section 3.12)

Without accounting for the potential effects of TDM, VMT in the study area is expected to increase under each alternative. Alternatives 3 and 4 show the largest increases in the study area VMT (13 percent and 16 percent, respectively). The Preferred Alternative shows around a 12 percent increase. Regional VMT increases by 1 to 2 percent for Alternatives 2 through 4, while Alternative 1 reduces regional VMT slightly. When the TDM program is included in the action alternatives, study area VMT could be reduced for each of the action alternatives by 5 percent or more.

Study area VHT decreases slightly with Alternative 1 (not including TDM effects). Alternatives 2, 3, and 4 and the Preferred Alternative result in increases in VHT because of the additional travel within the corridor. Regional VHT decreases with most alternatives, up to slightly more than 1 percent under Alternative 4. The effects are most pronounced during the P.M. peak period. Region-wide VHT increases slightly with the Preferred Alternative. The TDM program could further reduce study area VHT for each of the action alternatives.

Trips in the study area are forecasted to increase by 50 percent between 1999 and 2020, similar to the regional increase. For the year 2020, the trip pattern percentages in the region are expected to be similar to those currently in the region. In the I-405 Corridor Program study area, the relative shares of each trip purpose are expected to be similar in 2020 to those currently in the corridor. Trip distribution, i.e., where trips are going to and coming from in relation to the study area, is also forecasted to change very little by year 2020 in the I-405 corridor. More than 55 percent of daily trips begin and end within the study area, with the remaining 45 percent of trips beginning or ending outside the study area. Over 70 percent of the total daily person-trips are less than 10 miles within the study area; less than 10 percent of the trips are over 30 miles in length. These trip patterns are expected to continue in the corridor in the year 2020, although there could be a slightly higher percentage of trips averaging over 30 miles in length.

Performance of I-405 Corridor Program Improvements in the Region

As previously discussed, the I-405 Corridor Program study area includes 21 percent of the regional population, and produces about 24 percent of the region's trips. This percentage has held relatively constant for the past 30 years and is forecasted to continue for the next 30 years given the current plans and policies in the region. As part of the second level screening for the four action alternatives, the travel demand model was used to examine the effects of improvements by forecasting performance measures such as transit ridership, highway congestion, traffic volumes, and mode share shifts on I-405 and the study area. The transportation performance measures for the region in *Destination 2030* include the cumulative effects of the more prominent transportation improvements proposed in the I-405 Corridor Program, as noted above. Table 3.23-13 provides a comparison of performance measures.

Table 3.23-13: Performance Measures for *Destination 2030* (Regional) and I-405 Study Area

	Destination 2030 (MTP)[a]	1995 Baseline[b]	2020 No Action[b]	Alternative 1[b]	Alternative 2[b]	Alternative 3[b]	Alternative 4[b]	Preferred Alternative[c]
VMT (daily total) Region-wide	93,562,322	69,412,000	100,571,000	100,497,000	101,560,000	102,263,000	102,730,000	104,459,000
VMT (daily total) Study area	N/A	16,346,000	22,510,000	22,563,000	24,215,000	25,346,000	26,208,000	26,208,000
VHT (daily) Region-wide	3,226,300	2,295,000	3,948,000	3,941,000	3,922,000	3,907,000	3,903,000	3,366,000
VHT (daily) Study area	N/A	586,000	1,156,000	1,155,000	1,164,000	1,170,000	1,184,000	1,184,000
Mode Share - all trips (weekday)								
SOV	55%	99%	96.00%	96.00%	96.00%	95.00%	96.00%	96.00%
2+ Carpool	39%	Included above	Included above	Included above	Included above	Included above	Included above	Included above
3+ Carpool		1%	2%	2%	2%	2%	2%	2%
Transit	5%	1%	2%	2%	2%	3%	2%	2%
Mode Share – commute								
SOV	56%	95%	84%	83%	83%	83%	83%	83%
2+ Carpool	32%	Included above	Included above	Included above	Included above	Included above	Included above	Included above
3+ Carpool	Included above	2%	9%	9%	9%	9%	9%	9%
Transit	12%	3%	7%	8%	8%	8%	8%	8%
Average Speeds in MPH								
A.M. Peak	35	30	26	26	27	28	29	34
P.M. Peak	32	24	13	13	13	14	14	26
Daily	34	28	19	20	21	22	22	31

a Source: *Destination 2030* adopted May 24, 2001 (Metropolitan Transportation Plan for the Central Puget Sound Region); Technical Appendix 8: *Destination 2030* System Performance.
b Source: *I-405 Corridor Program Draft Transportation Expertise Report* (Mirai and DEA, 2001), February 2001.
c Forecasts for Preferred Alternative used an updated modeling base. Refer to Section 3.12 for description. Results may not be directly comparable with other action alternatives.

3.23.4 Cumulative and Secondary Effects on Critical Resources

3.23.4.1 Air Quality

National Regulatory Perspective

Actions proposed as part of the I-405 Corridor Program will be subject to regulations of numerous agencies at several jurisdictional levels. Existing regulations establish standards and/or thresholds that affect the level of impact and mitigation associated with these actions. A description of regulations known to affect the impacts of the I-405 Corridor Program is provided here and within similar sections under the other scoped critical resources to provide a better understanding of the context and extent of anticipated impacts.

In response to the Clean Air Act, the U.S. Environmental Protection Agency (USEPA) established National Ambient Air Quality Standards (NAAQS) for various pollutants—known as "criteria" pollutants—that adversely affect human health and welfare. The major transportation-related criteria pollutants are (See Table 3.1-1 in Section 3.1):

- Ozone (O_3) and its precursors, volatile organic compounds (VOC) and oxides of nitrogen (NO_x);
- Particulate matter (PM); and
- Carbon monoxide (CO).

In July 1997, USEPA issued revised standards for ozone and particulate matter that reflect improved understanding of the health effects of these pollutants. The new 8-hour ozone standard is more stringent than the old standard and will replace the 1-hour standard as the old standard is met. Two new $PM_{2.5}$ standards (annual and 24-hour standards) were added to the existing standards for PM_{10}. The new standards focus on fine particles under 2.5 microns in diameter, which are believed to be most closely associated with acute health effects. The new standards were recently upheld by the U.S. Supreme Court.

Areas that do not meet the NAAQS have been designated as non-attainment areas. These areas must submit air quality plans, known as State Implementation Plans (SIPs), showing how they will attain the standards. If they do not meet these and other requirements, they face Clean Air Act required sanctions and other penalties, including possible loss of highway funds. Metropolitan planning organizations and the U.S. Department of Transportation must ensure that transportation plans, programs, and projects conform to these SIPs. Air quality maintenance areas are regions that have recently attained compliance with the NAAQS. These areas must develop and submit air quality maintenance plans (AQMPs) showing how they will continue to stay within the standards.

Emission Trends

Fuel combustion by motor vehicles and other sources releases carbon dioxide (CO_2), which is a "greenhouse gas" that traps heat within the earth's atmosphere. CO_2 is not directly harmful to human health and is not a criteria pollutant. Significant progress has been made in reducing criteria air pollutant emissions from motor vehicles and improving air quality since the 1970s, even as vehicle travel has increased rapidly. Nationally, the 1996 air quality levels (the most recent at the time of publication) are the best on record for all six criteria pollutants. The air is noticeably cleaner than in 1970, and all criteria pollutant emissions from motor vehicles are less than they were in 1970, despite a more than doubling of vehicle miles of travel. Still, challenges remain. Based on monitored data, approximately 46 million people in the U.S. reside in counties that did not meet the air quality standard for a least one NAAQS pollutant in 1996 (adapted from USEPA, 1999a).

Nationwide, air pollutant emissions from motor vehicles have dropped considerably since 1970. VOC emissions (also referred to as hydrocarbon (HC) emissions) are down 58 percent, NO_x emissions are down 3 percent, PM_{10} emissions are down 38 percent, and CO emissions are down 40 percent. These reductions in emissions have occurred along with increasing population, economic growth, and vehicle travel (USEPA, 1999a).

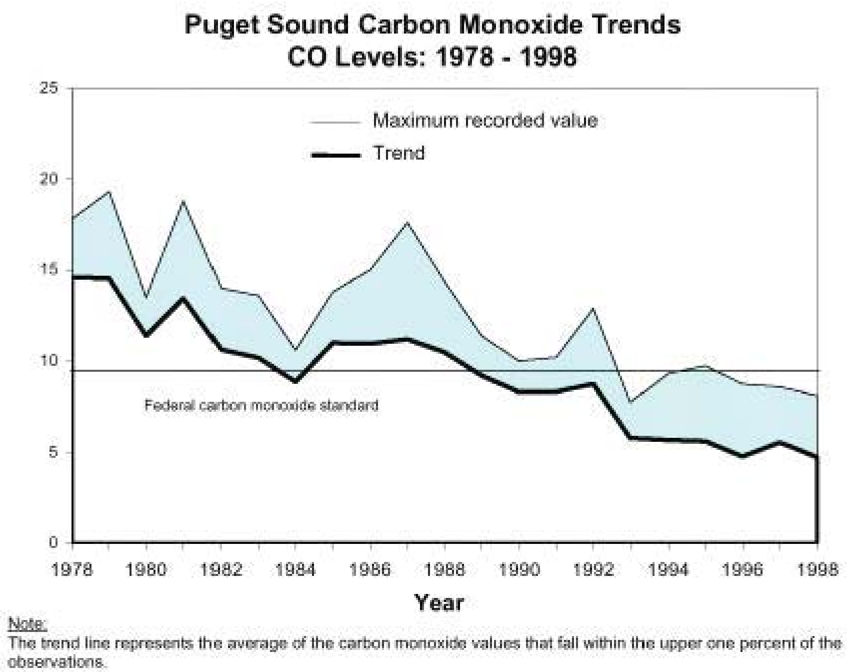
Regional Regulation

Air quality in the project area is regulated locally by the Washington State Department of Ecology (Ecology), and Puget Sound Clean Air Agency (PSCAA). The I-405 corridor lies within ozone and CO maintenance areas managed under the provisions of AQMPs for ozone and CO. The current plans were developed by PSCAA and Ecology and approved by the USEPA in 1996. Any regionally significant transportation project in the Puget Sound air quality maintenance areas must conform to the AQMPs. Conformity is evaluated by the local metropolitan planning organization (MPO), the Puget Sound Regional Council.

Regional Air Pollution Trends

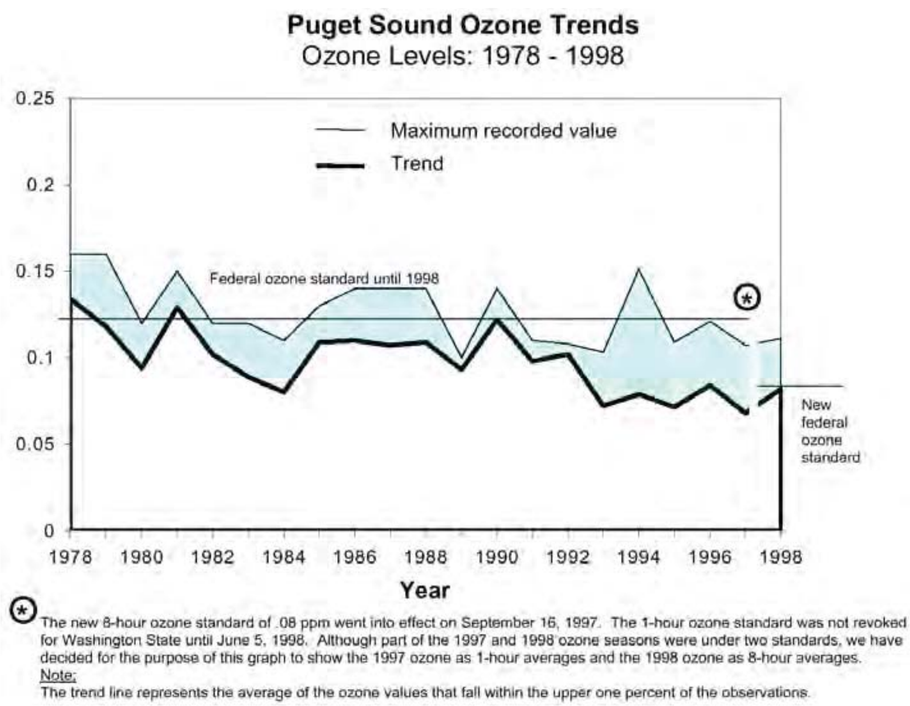
Regional pollutant trends have generally followed the national patterns over the last 20 years. While the average weekday vehicle miles traveled in the central Puget Sound region has increased from 30 million miles in 1981 to 65 million in 1999 (PSRC, 2000), the emissions of pollutants associated with transportation sources has decreased. Carbon monoxide is the criteria pollutant most closely tied to transportation, with over 90 percent of the CO emissions in the Puget Sound urban areas coming from transportation sources. Regionally, maximum measured CO concentrations have decreased over the past 20 years (Figure 3.23-16). Other transportation pollutants have followed similar but less pronounced trends (Figure 3.23-17 and Figure 3.23-18).

Figure 3.23-16: Central Puget Sound Region Carbon Monoxide Trends



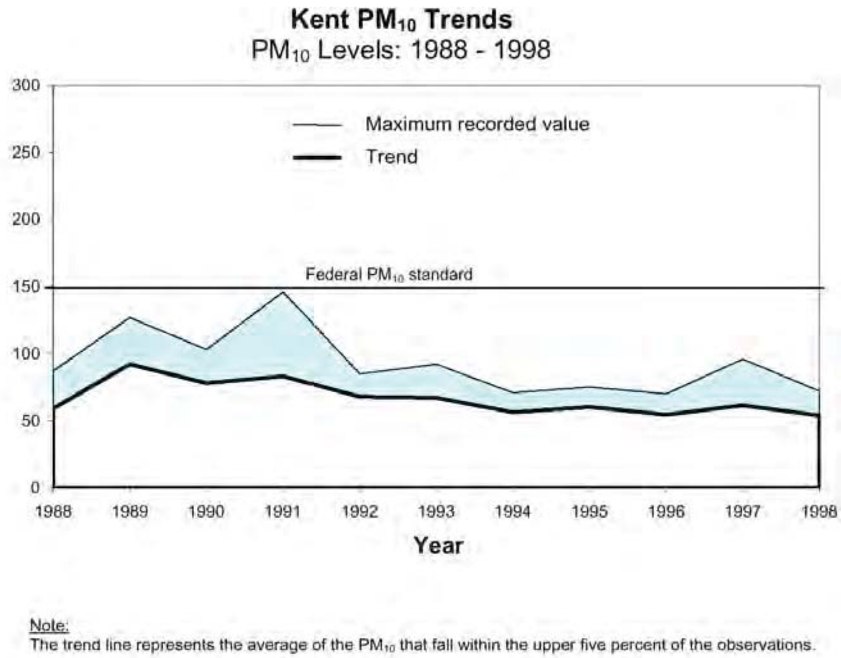
Source: Ecology, 1999.

Figure 3.23-17: Central Puget Sound Region Ozone Trends



Source: Ecology, 1999.

Figure 3.23-18: Kent Valley Particulate Matter Trends



Source: Ecology, 1999.

The historical trends toward improvement in air quality are growing increasingly difficult to maintain. The 1998 update to the 2020 MTP forecast 2020 CO emissions of 1,311 metric tons of CO per winter day and HC and NOx emissions of 148 and 186 metric tons per summer day compared to motor vehicle emission budgets of 1,358 metric tons of CO per winter day and 225 and 239 metric tons of HC and NOx per summer day (PSRC, 1998). These values and modeling procedures are consistent with the analysis completed for the I-405 Corridor Program EIS.

More recently, PSRC has revised the regional emission analysis to evaluate the air quality effects of *Destination 2030*, the new MTP for the central Puget Sound region through 2030. The new analysis includes updates to reflect new USEPA emission requirements, including the Tier II Gasoline/Sulfur Rule. The revised emission budget from the latest AQMP and the modeling of emission trends for *Destination 2030* completed in 2001 are shown in Table 3.23-14.

Table 3.23-14: *Destination 2030* Air Pollutant Emission Projections (metric tons per day)

Pollutant	AQMP Budget	2010 PSRC MTP Forecast	2020 PSRC MTP Forecast	2030 PSRC MTP Forecast
Carbon monoxide	1,497	860	718	735
Hydrocarbons	248	164	171	202
Nitrogen oxides	263	206	199	217

Source: PSRC, 2001

From the *Destination 2030* analysis, none of the future transportation emissions scenarios is expected to exceed the AQMP transportation emissions budgets. The downward trend in CO is expected to continue for the region through 2020, but is expected to begin increasing again by

2030. For ozone, the future trend is not as positive. Hydrocarbon emissions, which largely drive ozone formation in the central Puget Sound region, are projected to increase between 2010 and 2020.

Cumulative and Secondary Effects of I-405 Corridor Program Alternatives

Regional emissions for each of the alternatives for the I-405 Corridor Program were modeled using a methodology and assumptions consistent with the 1998 MTP update. The analysis methodology included the cumulative effects on transportation emissions of planned transportation improvements throughout the central Puget Sound region. The newer (2001a) *Destination 2030* modeling results are not directly comparable to the I-405 Corridor Program analysis or to the older MTP analysis; however, the trends viewed in the *Destination 2030* analysis would tend to be applicable to the range of alternatives. *Destination 2030* assumes substantial transit, freeway, and arterial improvements within the I-405 corridor. Because the results from the I-405 Corridor Program analysis reflect older planning and emission assumptions than those used for *Destination 2030*, and the newer assumptions result in a substantial reduction in predicted CO emissions relative to the older assumptions, the actual 2020 regional CO emissions for each of the alternatives are expected to be substantially lower than modeled in the I-405 Corridor Program analysis. This is a positive effect.

No Action Alternative

Regional transportation air pollutant emissions modeled for 2020 under the No Action Alternative (Table 3.23-15) were modeled to be slightly greater than those modeled by PSRC for their 1998 MTP Plan update (PSRC, 1998). The minor difference between the modeling scenarios is a result of other transportation projects planned outside the I-405 corridor that have been included in the PSRC model for the MTP.

Table 3.23-15: 2020 Air Pollutant Emissions for the Alternatives (metric tons per day)

Pollutant	2020 No Action Alternative	2020 Alternative 1 HCT/TDM	2020 Alternative 2 Transit	2020 Alternative 3 Mixed	2020 Alternative 4 Roadway	2020 Preferred Alternative
Carbon monoxide	1,315	1,313	1,302	1,294	1,256	1,260 to 1,290
Hydrocarbons	143	143	143	142	139	139 to 142
Nitrogen oxides	182	182	184	186	181	181 to 186

Source: Parsons Brinckerhoff, 2000

Comparing the results of the No Action Alternative evaluation to those of the *Destination 2030* analysis suggests that CO levels in both 2010 and 2030 would be higher than those in 2020. While conformity to the MTP and TIP can not be determined without including the alternative in the official PSRC analysis, emissions are not expected to exceed the transportation CO budget. Emissions of other criteria pollutants are also not expected to exceed the AQMP budgets in any year out to 2030.

Alternative 1: HCT/TDM Emphasis

Regional transportation air pollutant emissions for 2020 for Alternative 1 (Table 3.23-15) are expected to be slightly less than for the No Action Alternative. As a result of shifting person-trips from the congested I-405 corridor under the No Action Alternative to high-capacity transit, there would be a small regional decrease in VMT relative to the No Action Alternative, resulting in a minor emissions reduction. The difference in emissions between Alternative 1 and the No Action Alternative for other years would be similar to that modeled for 2020. As under the other alternatives, CO levels in both 2010 and 2030 are expected to be higher than those in 2020, but emissions are not expected to exceed the transportation CO budget in any year. Emissions of other criteria pollutants are also not expected to exceed the AQMP budgets in any year out to 2030.

Alternative 2: Transit Emphasis

Regional transportation air pollutant emissions for 2020 for Alternative 2 (Table 3.23-15) are expected to be slightly less than for the No Action Alternative and Alternative 1 for CO and slightly higher for NO_x. While VMT would increase relative to the No Action Alternative, average speed would also increase, resulting in decreased emissions per mile traveled relative to the No Action Alternative. Regional emissions modeled for Alternative 2 are generally lower than those modeled for the No Action Alternative. The difference in emissions between Alternative 2 and the other alternatives for other years would be similar to that modeled for 2020. As under the other alternatives, CO levels in both 2010 and 2030 are expected to be higher than those in 2020, but emissions are not expected to exceed the transportation CO budget in any year. Emissions of other criteria pollutants are also not expected to exceed the AQMP budgets in any year out to 2030.

Alternative 3: Mixed Mode Emphasis

Regional transportation air pollutant emissions for 2020 for Alternative 3 (Table 3.23-15) are expected to be less than for the No Action Alternative and Alternatives 1 and 2 for CO and slightly higher for NO_x. While VMT would increase relative to the No Action Alternative, average speed would increase substantially, resulting in decreased emissions per mile traveled relative to the No Action Alternative. Regional emissions modeled for Alternative 3 are generally lower than those modeled for the No Action Alternative. As under the other alternatives, CO levels in both 2010 and 2030 are expected to be higher than those in 2020, but emissions are not expected to exceed the transportation CO budget in any year. Emissions of other criteria pollutants are also not expected to exceed the AQMP budgets in any year out to 2030.

Alternative 4: Roadway Capacity Emphasis

Regional transportation air pollutant emissions for 2020 for Alternative 4 (Table 3.23-15) are expected to be less than for the other alternatives. The substantial increase in capacity in the I-405 corridor under Alternative 4 would result in a shift in traffic from the I-5 corridor. While VMT would increase relative to the No Action Alternative, average speed would increase substantially, resulting in decreased emissions per mile traveled relative to the No Action Alternative. As under the other alternatives CO levels in both 2010 and 2030 are expected to be higher than those in 2020, but emissions are not expected to exceed the transportation CO budget in any year. Emissions of other criteria pollutants are also not expected to exceed the AQMP budgets in any year out to 2030.

Preferred Alternative

Regional transportation air pollutant emissions for 2020 for the Preferred Alternative (Table 3.23-15) are expected to be between those for Alternatives 3 and 4. The substantial increase in capacity in the I-405 corridor under the Preferred Alternative would result in a shift in traffic from the I-5 corridor. While VMT would increase relative to the No Action Alternative, average speed would increase substantially, resulting in decreased emissions per mile traveled relative to the No Action Alternative.

In the Spring of 2002, PSRC refined the MTP adopted in 2001 (*Destination 2030*) to fully reflect and incorporate the transportation improvements contained in the Preferred Alternative. The revised modeling runs show regional emissions below the emission budgets for all pollutants in 2010, 2020, and 2030. PSRC's modeling demonstrates that air quality in the Puget Sound Region, including implementation of the Preferred Alternative, would conform to the regional air quality maintenance plans.

3.23.4.2 Energy

Energy consumption from transportation is a function of vehicle fuel economy, vehicle miles traveled, and operating conditions.

Fuel Economy

Since the early 1970s, USEPA has analyzed light vehicle fuel economy data. Fuel economy continues to be a major area of public and policy interest for several reasons, including:

1. Fuel economy is directly related to carbon dioxide emissions, the most prevalent pollutant associated with global warming. Light vehicles contribute about 20 percent of all U.S. carbon dioxide emissions.
2. Light vehicles account for approximately 40 percent of all U.S. oil consumption. Crude oil, from which nearly all light vehicle fuels are made, is considered to be a finite natural resource.
3. Fuel economy is directly related to the cost of fueling a vehicle and is of greater interest when oil and gasoline prices rise, as has happened recently.

Since 1988, average new light vehicle fuel economy has declined 1.9 miles per gallon (mpg), i.e., more than seven percent, primarily because light truck market share has increased and because fuel economy has been traded off for increased vehicle weight and performance (USEPA, 2000).

Fleet-wide improvement in new light vehicle fuel economy occurred from the middle 1970s through the late 1980s, but it has been consistently falling since then. Viewed separately, the average fuel economy for new cars has been essentially flat over the last 15 years, varying only from 27.6 mpg to 28.6 mpg. Similarly, the average fuel economy for new light trucks has been largely unchanged for the past 20 years, ranging from 20.1 mpg to 21.6 mpg (USEPA, 2000).

The increasing market share of light trucks, which have lower average fuel economy than cars, accounts for much of the decline in fuel economy of the overall new light vehicle fleet. Growth in the light truck market has been led recently by the explosive popularity of sport utility vehicles (SUVs). SUV sales have increased by more than a factor of ten from 2 percent of the overall market in 1975 to 20 percent of the market in 2000. Over the same period, the market share for vans doubled from 4.5 to 9 percent, and for pickup trucks, grew from 13 to 17 percent. For model year 2000, cars average 28.1 mpg, vans 22.5, pickups 20.1, and SUVs 20.0 (USEPA, 2000).

More efficient technologies, such as engines with more valves and more sophisticated fuel injection systems, and transmissions with lockup torque converters and extra gears, continue to penetrate the new light vehicle fleet. The trend has clearly been to apply these new technologies to increase average new vehicle weight, power, and performance while maintaining fuel economy.

While historical trends over the last 10 to 15 years reflect a lack of progress in fuel economy, new technologies used in hybrid vehicles change the horizon for fuel economy projections and indicate that improvements on the order of 100 to 200 percent may be possible (USEPA, 2000). Recent developments suggest various potential pathways for possible future fleetwide fuel economy improvements, including voluntary commitments by some manufacturers to improve the fuel economy of certain portions of their fleets by as much as 25 percent.

Travel Patterns

In the 1980s VMT increased nearly three times faster than population and jobs. In the eight years from 1981 to 1989, the population of the central Puget Sound region increased 15 percent, the number of employed persons increased 34 percent, and the amount of automobile traffic, measured by total VMT, increased 71 percent (PSRC, 2000). More recently, traffic in the central Puget Sound region has grown at a similar rate to population and employment. Between 1989 and 1999, population grew 19 percent and employment grew 27 percent, while VMT increased a comparable 26 percent.

The regional daily VMT in 1999 was 65 million miles per weekday (PSRC, 2000). The regional daily VMT is expected to increase to 79 million miles per weekday by 2010, but then level off to 94 million miles per weekday by 2030 under the *Destination 2030* plan (PSRC, 2001a).

Cumulative and Secondary Effects of I-405 Corridor Program Alternatives

Energy use in the Puget Sound region would vary between the alternatives depending on the VMT and travel operations under each of the alternatives (Table 3.23-16). The values calculated are for the I-405 Corridor Program study area and include the influence of other projects in the Puget Sound region. Fuel consumption is expected to decrease between 2020 and 2030 as a result of programs under the *Destination 2030* plan; the relative differences in energy consumption among the alternatives are expected to remain the same.

Table 3.23-16: Energy Consumption for Motor Vehicles

Alternative	Daily Study Area Vehicle Miles Traveled (2020)	Study Area Average Speed (mph)	Fuel Consumption Rate (gallons per mile)	Gasoline Consumption in Liters (gallons)
No Action Alternative	22,510,000	19	0.042	3,577,000 (945,000)
1: HCT/TDM	22,563,000	20	0.041	3,501,000 (925,000)
2: Mixed Mode with HCT	24,215,000	21	0.040	3,668,000 (969,000)
3: Mixed Mode	25,346,000	22	0.039	3,740,000 (988,000)
4: General Capacity	26,208,000	22	0.039	3,868,000 (1,022,000)
Preferred Alternative	25,697,000	22	0.039	3,793,000 (1,002,000)

3.23.4.3 Surface Water

Past Conditions

The rivers and major lakes in the study area have been extensively altered due to development during the past century. For instance, in 1916 Lake Washington was lowered by 16 feet as a result of construction of a ship canal and locks to allow ship passage between Puget Sound and the lake. To assure adequate water for the newly constructed ship locks, the Cedar River was diverted into the south end of Lake Washington. Before 1916, the Cedar River discharged directly to the Black River, and Lake Washington discharged to the Duwamish through the Black River. The Duwamish was formed by the confluence of the Green and Black rivers. The Black was a short, low-gradient river, and Lake Washington had no other outlet. The Green River lost another significant source of water early last century when the White River (located just south of the study area) was permanently diverted south into the Puyallup River.

The riverbeds of both the lower Green River and the Sammamish River have been extensively lowered and channelized for flood control purposes. These rivers have lost the formerly extensive connection they once had with their respective floodplains and wetlands.

As development increased around Lake Washington in the 1950s, a number of sewage treatment plants were constructed and began discharging to the lake. By the 1960s, a definite trend in declining water quality was documented in the lake. Nutrient levels in the lake increased. Lake water clarity declined and nuisance algae blooms became a regular occurrence. The citizens in the region voted to create the Municipality of Metropolitan Seattle (King County). During the 1960s, two large, regional sewage treatment plants were constructed and municipal wastewater discharges to Lake Washington were completely eliminated. Dramatic improvements in lake water quality resulted. By the 1970s Lake Washington stood as a world-wide example of water quality restoration.

One of the two King County wastewater treatment plants was constructed in Renton and initially discharged treated effluent to the Green-Duwamish River. This resulted in water quality problems (ammonia and dissolved oxygen) during periods of low flow. In the 1980s, a long outfall pipe was constructed to convey treatment plant effluent directly to Puget Sound. River quality improved as a result.

Much of the sewer system serving the older urban areas of Seattle carries both sanitary wastes and storm runoff. This type of system is termed a combined sewer system. During periods of heavy rainfall and runoff, the pipe capacity of some of these combined systems can be exceeded. When this happens, the system discharges excess, untreated sewage directly to water bodies. These combined sewer overflows occur primarily downstream of the study area, in the Duwamish River and Elliott Bay and along the ship canal, west of Lake Washington. Over the past several decades the local municipalities and King County have installed a series of projects to eliminate or reduce the magnitude and frequency of combined sewer overflows. This program is scheduled to meet the state goal of one overflow event per year within the next decade.

The streams within the study area have also undergone considerable change. Most of the development within the stream basins has occurred in the past 50 years. There have been some declines in the quality of the streams. These include the typical pollutants associated with urban development: nitrogen, phosphorus, oil and grease, coliform bacteria, and detectable levels of some herbicides and pesticides. However, the more serious and pervasive effects upon streams have been physical. Direct stream impacts resulting from past development include bank armoring and widening for flood control. Local landowners have commonly cleared, armored, re-routed, or otherwise modified streams passing through their properties to achieve a variety of highly localized and uncoordinated effects. In the past, it was common practice to route a stream into an underground culvert for hundreds or even thousands of feet in order to pass under a highway or through a commercially valuable piece of real estate.

Many forested areas within the study area have been replaced by a high percentage of impervious area. Much of the riparian canopy has been removed, along with large instream wood. Streams now typically experience higher peak flows than they historically did. As a result, channel scouring and widening are common. Channel scour and bank erosion often lead to heavy sedimentation in low-gradient and downstream sections, particularly at stream mouths. Reduced infiltration in the basin reduces long-term water storage; summer streamflows are often considerably reduced, as well. Reduced forest canopy along many of the streams results in elevated summer stream temperatures.

By the 1970s there was recognition among the local municipalities that some form of stormwater controls for new development was needed. The Section 208 Areawide Wastewater Management Plans produced by King and Snohomish counties in the mid-1970s clearly demonstrated the deleterious effects that both urban and agricultural runoff were having on water quality. It was at this time that the concept of best management practices (BMPs) for control of stormwater runoff became well established. Some of the first stormwater utilities in the country were established in the central Puget Sound region, including Bellevue and King County. Stormwater detention, which limits increases in peak runoff that otherwise would result from new construction, began to be required in portions of the study area. The publishing of the landmark *Puget Sound Water Quality Management Plan* in the late 1980s gave further impetus to urban stormwater management.

In 1990, King County published its *Surface Water Design Manual*, which contained more stringent detention requirements and a requirement for stormwater treatment aimed at reducing suspended solids (sediment). In 1992, Ecology published the *Stormwater Management Manual for the Puget Sound Basin*. Stormwater detention and water quality treatment were mandated for all projects within areas draining to the Puget Sound Basin. In 1998, King County updated its stormwater management requirements. A higher level of stormwater management was prescribed for sensitive water bodies. Control of flow durations (not just peak flows) was now required. A higher level of water quality treatment was required for sensitive receiving waters. Ecology will publish a revised stormwater manual this year containing similar requirements. The new state stormwater management requirements will be extended to all of western Washington (i.e., that part of the state lying west of the crest of the Cascade Mountain Range).

Table 3.23-17 shows a simplified tabulation of the stormwater detention volume required for the development of one acre of forested land into one acre of impervious surface, such as a road, parking lot or rooftop. Prior to the early 1990s, there was no regional standard method for calculating detention. The then commonly used detention calculation method was used for Table 3.23-17.

Table 3.23-17: Detention Volumes Typically Required in the Study Area Over the Past 25 Years

Timeframe	Geographic Coverage	Detention Volume[a] (cu ft)	Size of Typical 4-ft Deep Pond (sq ft)
Pre-1970s	Sporadic	Varied	Varied
1980s	King County, several cities	1,800	1,080
1990s	Puget Sound Basin	11,750[b]	3,950
2001 +	Western Washington	15,800	5,170

[a] Stormwater detention volume required for development of 1 acre of forested land into 1 acre of impervious surface.

[b] 15,000 ft^3 with commonly applied safety factor.

Within the past several decades, a number of regulatory programs have evolved that control stormwater and restrict direct disturbance of water bodies. The 1987 revisions to the Clean Water Act placed new emphasis on the requirement for larger cities and counties to obtain permits for stormwater discharges. (By 2003, Phase 2 of this program will require smaller municipalities to also obtain stormwater discharge permits, greatly expanding the federal requirements for stormwater management.) The 1990 Growth Management Act required cities and counties in the study area to, among other things, define, map, and protect (environment- and hazard-related) sensitive areas. This led to the establishment of buffers of various widths around streams, lakes, and wetlands. These buffers typically range from 25 to 100 feet from the edge of the stream or wetland. Within these buffers new development or disturbance is restricted. Where disturbance is unavoidable, mitigation may be required.

The State Department of Fish and Wildlife must issue a Hydraulic Project Approval (HPA) for any project that proposes to disturb any area within the ordinary high water mark of a stream or lake. These HPAs typically control the amount of allowable disturbance and set seasonal time limits to minimize interference with fish using the stream. They also contain requirements for restoration after construction and frequently attach mitigation requirements. Recent revisions to the State's Shoreline Management Act also restrict the level of disturbance or manipulation allowed along the shores of the major marine and freshwater bodies. At the federal level, the U.S. Army Corps of Engineers often reviews projects for wetland effects or effects upon navigable waters under Section 404 of the Clean Water Act. Here too, restoration and mitigation requirements are typically placed upon projects where stream or wetland disturbance is unavoidable.

Numerous stream restoration projects have been constructed in virtually all of the streams within the study area and many more are planned. Many of these projects are funded by the local municipalities, either through direct capital improvement projects or through grants. An example of the latter is the King County Water Works Program, which has committed millions of dollars to local business and education partnerships for stream restoration projects. The state has been an important contributor through the Centennial Fund and the Salmon Recovery Board. The state Department of Fish and Wildlife and Department of Transportation have ongoing programs for culvert upgrades. The U.S. Army Corps of Engineers also has contributed significantly to restoration measures along the rivers and larger streams. The state is split into 62 large watersheds known as Water Resource Inventory Areas (WRIAs). The state is encouraging and funding watershed assessments for each of these WRIAs. WRIA studies are underway for WRIA 8 (Cedar-Sammamish [Lake Washington]) and WRIA 9 (Green-Duwamish), parts of which are within the I-405 corridor. Among other things, these studies will culminate in prioritized lists of stream and watershed restoration projects. This will help guide future federal, state, and local expenditures for stream restoration projects.

Future Trends

The regulatory programs briefly summarized above assure that the rate of hydrologic and water quality degradation in developing areas will be greatly reduced from those which historically occurred.

Low-impact development is an emerging approach for reducing the runoff impacts of development. This approach emphasizes narrow streets, efficient layout, dispersed runoff, and retention of a large percentage of undisturbed land (typically 65 percent). An alternative form of low-impact development is high-rise condominiums and mixed retail-residential developments that are appearing in the most densely developed areas of the study area: downtown Bellevue and Kirkland. By concentrating many residents in a small area, these types of development minimize additional impact upon stream basins. While effective in reducing the level of impact of urban development, it is not at all clear whether there is any set of practical measures that can entirely avoid the hydrologic impacts of urban development. Research in the central Puget Sound region and elsewhere suggests that substantial stream impacts can occur with as little as 10 percent impervious area across a basin. This corresponds to about one house per 5 acres, a level associated with rural development.

Few of the regulatory programs discussed above address existing development. State and local stormwater regulations contain specific requirements for adding stormwater runoff controls to redevelopment of existing, developed areas. However there are also exclusions that are allowed. With few exceptions (state highways are notable exceptions), there are no requirements for the retrofit of stormwater controls to existing development. Given the relatively slow rate of large-scale redevelopment typical of existing urbanized areas and the difficulty of incorporating effective stormwater control measures in densely developed areas, it is unlikely that the hydrologic conditions of the urbanized portions of streams in the study area will greatly improve within the 2030 timeframe. With continued growth in the study area, it is likely that stream conditions in the I-405 corridor will continue to decline.

Future water resource conditions in the study area are difficult to predict with any accuracy. Stormwater regulations will undoubtedly continue to evolve. Two areas of evolution that seem reasonably assured are stricter treatment requirements for runoff from construction sites and more widespread application of proprietary stormwater treatment devices such as swirl concentrators and filters. With regard to the latter, there has, to date, been only limited experience in their application, regionally. As verifiable performance data become available and stormwater treatment requirements for targeted pollutants, such as nutrients and heavy metals, become more prevalent, installation of advanced stormwater treatment devices is likely to increase dramatically. Given their need for relatively high levels of maintenance, local stormwater utility budgets will rise as well.

There is a debate going on that may greatly affect long-term expenditures for stream and watershed protection. While a primary focus of these expenditures is restoring fish habitat, many projects also benefit the streams themselves. Funds can be spent in an effort to restore degraded streams to their former hydrologic and water quality conditions. However, monies can also be spent to protect streams and the watersheds that currently support important fish runs. Easements or land purchases can be made to enhance buffers, protect sensitive areas, and preserve large portions of watersheds from future development. Which of these approaches (or possibly a hybrid) will emerge in the coming years is not possible to predict at this time. The basic strategy of watershed protection versus stream restoration will likely be heavily influenced by the National Marine Fisheries Service chinook recovery strategy, which is still several years from completion.

Large-scale inter-basin transfers of water are not common in this region. The use of Green River water by the City of Tacoma (which lies largely within or near the Puyallup River Basin) is a notable exception, as is the Tolt River supply for the City of Seattle. Since the state long ago declared most of the rivers in the region fully-appropriated, inter-basin transfers have not been encouraged in recent decades. There are two inter-basin transfers currently under consideration. The recently formed Cascade Water Alliance is proposing to transfer water from the White River, immediately south of the project area, for municipal use among cities and water districts east and south of Lake Washington. A proposal for transfer of water from the Snoqualmie River Basin near North Bend has also emerged in recent years. As continued population increases in the region place pressure on existing water supplies, further proposals for inter-basin transfers will likely be made.

Municipal wastewater reuse, extensive in some arid portions of the country, has seen only limited application in the Puget Sound region. Both of the regional wastewater treatment plants discussed early in this section use only limited amounts of reclaimed water for local irrigation and some industrial use. This situation seems to be changing. A third regional wastewater treatment plant, called Brightwater, is proposed to be located somewhere within or near the northern portion of the study area, near the King-Snohomish county line. Substantial water reclamation is planned when this plant comes online in 2010. Other possible reclamation projects are under consideration. For instance, King County is considering a reclamation project to irrigate farms and a golf course in the Sammamish River Valley. It seems likely that water reuse will play a much larger future role in the regional water supply.

Cumulative and Secondary Effects of I-405 Corridor Program Alternatives

The I-405 corridor is continuing to experience the rapid growth that is occurring throughout much of the central Puget Sound region. Between 2000 and 2020, the population within the corridor is projected to grow by more than 200,000. Households within the study area will increase by about 90,600 while employment will increase by about 128,400. Relatively large increases in households are projected in virtually all of the FAZs within the study area, so this analysis deals with general surface water impact across the entire study area. Several factors are used to convert these numbers into equivalent impervious surface area. A medium-low (average) housing density of 4 homes per acre with an impervious factor of 40 percent is conservatively assumed. Each new employee is assumed to occupy roughly 500 square feet of new impervious area. Employee building-occupancy typically falls within the range of 200-500 square feet per employee. The upper end of this range was adopted for this analysis and assumed to include access/parking area.

This analysis is summarized in Table 3.23-18. There is an estimated increase of about 9,000 acres of impervious surface associated with the projected new housing. The projected new employment would result in nearly 1,500 acres of new impervious surface. Combined, the future growth in the study area is estimated to result in an additional 10,500 acres of new impervious surface. By comparison, the current impervious surface area within the study area is about

43,000 acres. Cumulative development, including the proposed I-405 Corridor Program improvements, would increase this to around 53,500 acres, a 25 percent increase. Overall, impervious area coverage in the study area would increase from the current 32 percent to 40 percent.

Table 3.23-18: Cumulative Increase in Impervious Area within the Study Area: 2000 to 2020

Housing increase:	90,600 units
Homes per acre:	4
New housing coverage:	90,600/4 = 22,650 acres – medium-low density
Impervious coverage by medium-low density housing:	40%
22,650 acres x 0.40 =	9,060 acres
Employment increase:	128,400 employees (commercial and industrial)
500 square feet (0.0115 acre) per employee	
128,400 x 0.0115 =	1,474 acres
Impervious area	
Existing impervious area within study area:	43,000 acres
New impervious area:	9,060 + 1,474 = 10,534 acres
Total future impervious area: 43,000 + 10,534 =	53,500 acres (rounded)
Future increase in impervious area:	43,000 + 10,500 = 1.25 → 25% increase
Impervious area as a percentage of the total study area	
Study area:	134,000 acres
Current impervious area:	43,000/134,000 = 32%
Future impervious area:	53,500/134,000 = 40%

Even with implementation of stormwater detention and treatment measures for all new development, increases in pollutant loads and substantial changes in existing hydrology are likely to occur in many of the streams draining the I-405 corridor. In particular, reductions in seasonal base flows and associated increases in summer stream temperature may result. The cumulative effect upon water resources is therefore judged to be substantial and adverse.

The amount of new impervious area contributed by the I-405 Corridor Program ranges from 166 acres for the No Action Alternative to 908 acres for Alternative 4. Thus the I-405 Corridor Program can be expected to contribute between 1 to 8 percent of the area's new impervious surface over the next 20 years.

The temperature and heavy metals impacts to Springbrook Creek (discussed in Section 3.5) are likely to be further aggravated due to other development occurring within this basin.

Alternative 1 would result in modest cumulative effects related to additional development in the following basins: Middle Swamp, Sammamish River, Juanita, East Lake Washington, Lower Cedar, Springbrook, and Upper Soos. The Bear and Kelsey creek basins would experience modest beneficial reductions in baseline development. Just beyond the project area boundaries, the Lower Soos Creek and Lower Issaquah creek basins would also experience reduced development, as would the drainages around Sea-Tac Airport.

Alternative 2 would influence a slight increase in pressure for growth in the same basins mentioned under Alternative 1, as well as in North Creek Basin.

Alternative 3 would contribute to substantially greater cumulative effects within the study area, compared to Alternatives 1 and 2. Pressure for growth would occur in the Juanita, Forbes, and

Sammamish River basins. In the southern portion of the project area, the Lower Cedar and Soos Creek basins would also experience pressure for additional growth. Cumulative effects would also occur outside of the project area. The upper portions of North and Swamp creek basins, Upper Soos Creek Basin and the Green River, and the Lower White River south of Auburn would all experience modest additional pressure for growth. Pressure for minor growth would occur in the Lower Skykomish and Snohomish river basins within Snohomish County.

Basins experiencing decreased pressure for growth under Alternative 3 would be the same as mentioned under Alternative 1. The Bear and South Kelsey creek basins would experience modest reductions in pressure for growth. Just beyond the project area boundaries, the Lower Soos Creek and Lower Issaquah Creek basins would also experience reduced pressure growth, as would the drainages around Sea-Tac Airport. In addition, basins in central and western Seattle would experience somewhat lower levels of pressure for growth, as well as the City of Bremerton in Kitsap County. Given the relatively high level of existing development in these two cities, reduced levels of new pressure for growth are unlikely to translate into substantial changes in hydrologic conditions within the urbanized basins.

Cumulative effects on the basins under Alternative 4 would be similar to those under Alternative 3. Slightly higher pressure for growth effects would occur in the basins north and south of the project area. These include North and Swamp creek basins in the north and the Lower Green River, Soos Creek, and Lower White River basins in the south. Compared to Alternative 3, this alternative would further reduce pressure for growth in basins located in the Seattle area and the more populated portions of Kitsap County such as Bremerton. As stated earlier, these reduced growth pressure effects are not likely to result in substantial improvements in the current hydrologic conditions of these areas, given their relatively high degree of existing development.

Cumulative effects on the basins under the Preferred Alternative would be similar to those under Alternative 3. Slightly higher pressure for growth effects would occur north and south of the study area. The reduced growth pressure effects in the study area similar to Alternative 3 are not likely to result in substantial improvements in the current hydrologic conditions of these areas, given their relatively high degree of existing development.

3.23.4.4 Wetlands

Regulatory Trends

Wetlands have not been recognized historically for their ecological importance. Many of these areas were filled, dredged, or developed to make the land useful for housing, industry, and agriculture. Between 1780 and 1980, the state of Washington lost an estimated 31 percent of its wetlands. Since that time, wetlands have been identified as providing important economic and environmental functions, such as protection from floodwaters, filtering sediment and pollutants, and providing spawning areas for commercially important fish as well as habitat for many important species of plants and wildlife.

In 1989, Washington adopted state goals for no net loss of acreage or ecological function of wetlands. These goals reflect the Clean Water Act, federal legislation that prohibits the discharge of soil into waters of the United States unless authorized by a permit issued under Section 404 of the Act. The U.S. Army Corps of Engineers (USACOE) has authority over such actions and requires the permittee to restore, create, enhance, or preserve nearby wetlands as compensation for the damage. This means of compensatory mitigation is intended to comply with the general goals of the Clean Water Act and the specific goal of “no net loss” of wetlands. Several regulations have been enacted on a federal and local level to achieve these goals.

The Washington State Growth Management Act was passed in 1990 to address environmental, land use, and sustainable economic development issues related to unplanned growth in specific areas. In 1991, an amendment to the GMA required all counties and cities to adopt regulations for controlling development pressures on wetlands and other critical areas. These critical or sensitive areas ordinances provide restrictions on wetland and stream disturbance and are continually evolving as regulating agencies gain further understanding of the consequences related to these types of disturbance.

Because wetlands provide habitat for several endangered species, the federal Endangered Species Act of 1973 inspired further regulation of impacts to specific types of wetland resources. As the numbers of species listed for protection increase, the extent of protection is evolving and directly connected to growth and subsequent habitat disturbance.

Wetland Resource Trends

Urbanization is the primary cause of wetland loss within the central Puget Sound region and the I-405 corridor. According to a 1998 Washington State Department of Natural Resources publication, more than 90 percent of the wetlands in urban areas in Washington have been lost. Despite the goal of “no net loss,” studies show that these goals are not being met. The magnitude of impacts to wetland functions is unknown. Primary wetland functions lost in the study area are due to an increase of impervious surfaces and a decrease in overall wetland area and functional capability. These functions primarily include fish and wildlife habitat, stormwater retention, and sediment and toxics retention.

The lack of available data on wetland loss and replacement as a result of compensatory mitigation makes it difficult to determine the extent of ecological impacts due to wetland loss. However, as research and expertise develop in the field of wetland ecology, the rate of wetland loss is decreasing while the effectiveness of wetland restoration and replacement activities is increasing.

Ongoing and Proposed Programs for Wetlands Protection and Restoration

Future trends in wetland regulation are likely to focus on compensatory mitigation requirements. Although there has been a great deal of progress in the last 20 years, the goal of no net loss for wetland function has not been accomplished. The degree to which wetland loss is taking place is unknown because not enough data are available to make this determination. Regulatory agencies are expected to develop procedures to track the success and completion of mitigation efforts as this information becomes increasingly more valuable to maintain effective regulatory practices. The focus of mitigation efforts is moving towards emphasizing the replacement of wetland functions, rather than replacement of wetland area. In addition, research and publications show strong indication that mitigation banking is becoming a more favored means of mitigating wetland loss.

Based on preliminary findings from a wetland mitigation banking study released by the Environmental Law Institute, great expansion in mitigation banking has occurred as new states have developed banking programs. The study shows that in 1992, “banks existed in only 17 states, but today, active or pending banks exist in 41 states.” As time allows further analysis of the ecological trends in wetlands and associated ecosystems, regulatory agencies will continue to respond to these issues.

Ongoing programs occurring on a local level include proposed revisions to King County's sensitive areas code as well as other codes that regulate sensitive areas such as the clearing and grading code and the shoreline code. Revisions include modifications of definitions, exemptions, and mitigation as well as permit requirements. Snohomish County is also preparing to propose changes to its critical areas code.

Cumulative and Secondary Effects of I-405 Corridor Program Alternatives

Cumulative effects could occur as a result of the increased pressure for growth and development within the Urban Centers along the I-405, SR 167, and I-90 corridors and reduced pressure in rural areas outside the study area. Thus, effects on wetlands could be reduced outside the UGA relative to the more urbanized areas within the study area.

In contrast, the No Action Alternative would result in the continuation of pressure for growth in rural areas or at the fringe of the UGA. If allowed to occur by local land use regulatory agencies, that pattern of growth would have the potential to influence some impacts on wetlands from inside the UGA to outside the UGA or from more urbanized areas within the study area to the less developed fringe portions of the UGA.

Under the No Action Alternative, future growth in employment and households, and resulting development, is forecasted to be concentrated in Seattle, southwest Snohomish County, Tukwila, Federal Way, Woodinville, and Bothell. While the more central of these areas are nearer build-out, cumulative effects may pose a threat to high-quality wetlands in the southwest Snohomish County and Woodinville areas where more undeveloped land occurs.

Cumulative effects due to implementation of any of the action alternatives would be similar. Under Alternative 1, pressure for growth increases in the Kent, Renton, and Redmond areas. Wetlands are common in these areas, and cumulative effects could be expected.

Pressure for growth occurring under Alternative 2 would be similar to that under Alternative 1, with greater pressure in the wetlands-rich southwest portion of the study area and the Redmond area, and some added growth pressure on parts of Bellevue. In addition, this alternative shows some pressure for growth in the northern tip of the study area, where high priority wetlands are concentrated. Cumulative effects could be more pronounced in these areas under Alternative 2.

Pressure for growth toward the southwestern, Redmond, and northern portions of the study area would increase under Alternative 3. Cumulative effects could be expected to increase accordingly.

Pressure for growth under Alternative 4 would increase in the northern and south central parts of the study area. Potential cumulative effects on the dense wetlands of these areas would be highest of all action alternatives.

Cumulative effects under the Preferred Alternative would be similar to those under Alternative 3. Slightly higher pressure for growth effects would occur north and south of the study area. The growth pressure effects in the study area are not likely to result in substantial effects to wetlands.

If cumulative effects on high priority wetlands were weighted most heavily, wetland effects would be greatest for Alternative 2 and least for the No Action Alternative and Alternative 1. High priority wetlands near the growth areas of Alternative 1 occur in Kent between SR 167 and

I-405 and in Woodinville. High priority wetlands near the growth areas of Alternative 3 and the Preferred Alternative occur in Redmond, west of SR 202 and east of the railroad tracks. High priority wetlands near the growth areas of Alternative 4 occur in Redmond and Kent.

The most notable potential cumulative wetland effects associated with construction and development would occur through increases in impervious surfaces, potentially altering runoff volumes and the timing of flood pulses. Project-level design would partially address these issues by designing stormwater control structures to minimize hydrologic effects. Hydrologic effects cannot be completely avoided, as increases in impervious surfaces result in increased stormwater volumes. Alternatives with greater quantities of impervious surface would potentially have a greater effect on wetland hydrology and biologic functions.

3.23.4.5 Fish and Aquatic Habitat

Regulatory Trends

There has been a longstanding trend in Washington and the study area of increasing regulation of fish harvesting and habitat alteration. In 1949, the state legislature passed a law now known as the "Hydraulic Code" giving the WDFW jurisdiction over activities in or near state waters (RCW 75.20.100-160). Although the law has been amended occasionally since it was originally enacted, the basic authority has been retained.

The law requires that any person, organization, or government agency wishing to conduct any construction activity in or near state waters must do so under the terms of a permit called the Hydraulic Project Approval (HPA) issued by the WDFW. State waters include all marine waters and fresh waters of the state.

The Growth Management Act addresses the negative consequences of unprecedented population growth and suburban sprawl in Washington State. The GMA requires all cities and counties in the state to conduct planning for growth and protection of sensitive areas, and has more extensive requirements for the largest and fastest-growing counties and cities in the state. Its requirements include guaranteeing the consistency of transportation and capital facilities plans with land use plans. The GMA also required definition of Urban Growth Areas (UGAs) which would absorb increased population and economic growth, thus relieving environmental pressure on rural areas that contain the most viable fish habitat. Local regulations and policies established in response to the Act often include protection of stream and wetland salmon habitat.

In the 1980s and 1990s, all local municipal jurisdictions in the I-405 study area adopted some form of sensitive areas ordinance. These ordinances typically establish restrictions on disturbance of aquatic habitat including stream disturbance, wetland filling, and buffer encroachment.

Puget Sound chinook salmon and bull trout are listed as “threatened” under the federal Endangered Species Act (ESA). The Puget Sound/Strait of Georgia coho salmon is currently a “candidate” species for federal listing.

The National Marine Fisheries Service (NMFS), in conjunction with state and local jurisdictions as documented in the Federal Register (50 CFR Part 223) issued on July 10, 2000, identified 13 programs and criteria for future programs for which it is not necessary and advisable to impose ESA Section 9(a)(1) prohibitions because they contribute to conserving the Evolutionarily Significant Unit (ESU) upon which listed species rely. These programs and criteria for future programs are commonly referred to as Section 4(d) rules. NMFS can provide ESA coverage through Section 4(d) rules, Section 10 research and enhancement permits, incidental take permits, or through Section 7 consultations with federal agencies. WSDOT and the cooperating agencies propose to work with NMFS to identify and modify project-specific actions that could result in the take of listed species on the program as a whole through the programmatic Biological Assessment process. WSDOT is pursuing a similar consultation process with the U.S. Fish and Wildlife Service (USFWS), even though USFWS has indicated they might wait until project-level details have been documented before entering into consultation with WSDOT. Potential impacts to listed species will be fully addressed during the consultation process with both federal agencies, but as mentioned above, this discussion may occur on the programmatic level with NMFS and the project level with USFWS.

Fish Population Trends

Agencies including the NMFS and the WDFW have tracked population trends for anadromous salmonids. Although fish populations naturally fluctuate in response to factors such as climate variations, nearly all native salmonid populations in the region have undergone a severe declining trend since the human population began rapidly increasing over the past century.

Chinook salmon runs for the overall Puget Sound evolutionarily significant unit (ESU) have declined from the recorded peak of 690,000 fish in 1908, to the most recent average of approximately 160,000 fish, leading to the federal "threatened" listing for this species as described previously. The "threatened" Puget Sound chinook salmon ESU "species" is composed of over twenty chinook salmon "stocks" specific to various watersheds draining to Puget Sound. This includes the two stocks within the study area specific to the Cedar River/Lake Washington and Green River watersheds.

The Cedar River/Lake Washington chinook salmon stocks are at or near historic minimums. An escapement (number of fish returning to spawn annually) goal of 1,200 fish was established by the WDFW based on historic escapement data. This goal has been met only three times since 1973, and the 1997 escapement was only 227 fish, or one-sixth of the goal (NMFS, 2000).

The Green River summer/fall chinook population is composed of both naturally spawning fish and hatchery production. Naturally spawning fish include both wild, native salmon and "strays" from hatchery stock. The downward population trend typical of many Puget Sound stocks is not apparent for Green River stocks. The escapement goal had been set at 5,800 fish in the 1970s. Annual spawning escapement (number of fish returning to spawn) has averaged about 5,700 fish during 1968-1977, and 7,280 fish during 1988-1997 (WRIA 9, 2001).

Under the federal Endangered Species Act (ESA), bull trout are listed as “threatened”. Bull trout are known to occur in both of the two major watersheds that compose the study area, but spawning has been documented only in locations far upstream of the study area (WDFW, 1998). The WDFW current GIS database shows bull trout presence in the study area to be limited to the mainstem Green River (WDFW, 2000). Other sources have documented bull trout presence within the study area in the Cedar River and Lake Washington (USFWS, 1999; USFWS, 2000). Bull trout were not found in the Sammamish River basin during a specific one-year bull trout survey of Lake Sammamish (USFWS, 1999; WDFW, 1998).

The 1996 Sustainable Fisheries Act amended federal fisheries management regulations to require identification and conservation of habitat that is "essential" to federally managed fish species. Essential habitat is defined as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The Pacific Fishery Management Council (PFMC) is the body responsible to review relevant habitat issues in the Pacific Northwest, including the study area. The PFMC has designated Essential Fish Habitat (EFH) for the Pacific salmon fishery, federally managed groundfish, and coastal pelagic fisheries (NMFS, 1999a; PFMC, 1999). Federal agencies must consult with NMFS on all activities, or proposed activities, authorized, funded, or undertaken by the agency that may adversely affect EFH.

The Pacific salmon management unit includes chinook (*Oncorhynchus tshawytscha*), coho (*Oncorhynchus kisutch*), and pink salmon (*Oncorhynchus gorbuscha*). This designation is not limited to listed species. The EFH designation for the Pacific salmon fishery includes all those streams, lakes, ponds, wetlands, and other water bodies currently or historically accessible to salmon in Washington, Oregon, Idaho, and California, except above the impassible barriers identified by PFMC (1999). In the estuarine and marine areas, proposed designated EFH for salmon extends from nearshore and tidal submerged environments within state territorial waters out to the full extent of the exclusive economic zone offshore of Washington, Oregon, and California north of Point Conception (PFMC, 1999).

The west coast groundfish management unit includes 83 species that typically live on or near the bottom of the ocean. Species groups include skates and sharks, rockfish, flatfish, and groundfish.

The west coast pelagic management unit includes the pacific sardine (*Sardinops sagax*), pacific chub *(Scomber japonicus*), northern anchovy (*Engraulis mordax*), jack mackerel (*Trachurus symmetricus*), and market squid (*Loligo opalescens*). These fish are primarily associated with the open ocean and coastal areas (PFMC, 1998).

The EFH designation for groundfish and coastal pelagics is defined as those waters and substrate necessary to ensure the production needed to support a long-term sustainable fishery. The marine extent of groundfish and coastal pelagic EFH includes those waters from the nearshore and tidal submerged environment within Washington, Oregon, and California state territorial waters out to the exclusive economic zone (370. 4 km [231.5 miles]) offshore between Canada and the Mexican border.

The Washington State Salmonid Stock Inventory (WDFW, 1992) identifies five salmonid stocks within the study area as "depressed": Cedar River sockeye, Lake Washington beach sockeye, Lake Washington/Sammamish tributary sockeye, Lake Washington/Sammamish tributary coho, and Lake Washington winter steelhead. A depressed stock is defined as "one whose production is below expected levels, based on available habitat and natural variation in survival rates, but above where permanent damage is likely." Escapement for each of these stocks is on a declining trend (WDFW, 1992). Any cumulative adverse effects of the I-405 Corridor Program projects would be likely to contribute to such declining trends.

Detailed information on the current state of fish populations and habitats is presented under the "affected environment" in Section 3.8, and in the *I-405 Corridor Program Draft Fish and Aquatic Habitat Expertise Report* (DEA, 2001c).

Cumulative and Secondary Effects of I-405 Corridor Program Alternatives

In comparing the I-405 Corridor Program alternatives, the No Action Alternative scenario is identical to the baseline conditions for the study area. This is because the baseline conditions do not reflect current conditions, but instead assume completion of currently committed projects.

Based on these estimates, planned growth in human populations and land use development will undoubtedly increase the likelihood of substantial unavoidable adverse cumulative effects to fish habitat and populations. Transportation programs included in *Destination 2030*, including I-405, I-5, and Trans-Lake Washington programs, are expected to increase pressure for growth along major transportation corridors within the UGA, thus relieving pressure and reducing adverse effects on the rural areas that contain the most functional fish habitat. All of the action alternatives for the I-405 Corridor Program would influence pressure for growth in this manner. However, since the proposed I-405 Corridor Program improvements are only a portion of the overall MTP, the differences among the I-405 action alternatives would not alter the overall cumulative effect of the MTP and planned growth and development to a meaningful degree.

One quantitative way to compare potential cumulative effects among alternatives is to compare each alternative's share of the projected total new impervious surface created. As described previously, new impervious surface is the most reliable predictor of aquatic habitat degradation. By this measure, Alternative 4 would have the greatest cumulative effect, creating 24 percent of new roadway miles in the study area. Alternatives 2 and 3 would have much lower levels of cumulative effects, creating 13 percent and 16 percent of new roadway miles, respectively. Alternative 1 would have the lowest impact, creating 4 percent of new roadway miles.

Cumulative effects under the Preferred Alternative would be similar to those under Alternative 3. Slightly higher pressure for growth effects would occur north and south of the study area. The growth pressure effects in the study area are not likely to result in substantial effects to fish.

In contrast, the No Action Alternative (baseline condition) would result in the continuation of pressure for growth in rural areas or at the fringe of the UGA. If allowed to occur by local land use regulatory agencies, that pattern of growth would have the potential to shift effects on fish and aquatic habitat from inside the UGA to outside the UGA or from more urbanized areas within the study area to the less developed fringe portions of the UGA. Under the No Action Alternative, future growth in employment and households and resulting development is forecast to be concentrated in Seattle, southwest Snohomish County, Tukwila, Federal Way, Woodinville, and Bothell. While the first four of these areas are nearer build-out, cumulative effects may pose a threat to fish and aquatic habitat, particularly in the southwest Snohomish County and Woodinville areas.

None of the action alternatives would contribute substantially to altering the negative trends in salmon populations discussed in Section 3.8.5.2. After several tens of thousands of years of sustained viability through natural fluctuations, the recent sharp downward trend in salmon populations has corresponded to the rapid increase in human population. The high rate of population growth has driven all of the acute adverse impact mechanisms in the study area and the Puget Sound ESU, including, most notably, habitat alteration. Because the human population of the Puget Sound ESU is expected to increase by well over one million in the next 30 years, reverses in the decline of salmonid populations cannot reliably be assumed, regardless of which I-405 Corridor Program alternative is implemented.

3.23.4.6 Farmlands

Farmland Trends

Prime farmlands in Washington have decreased about 5 percent in the 1982 to 1997 time period, mostly because of urban development, transportation, and rural residential development. Most of the losses have occurred in counties other than King and Snohomish. Trends in western Washington are expected to continue, and gains and losses in eastern Washington (the Columbia Basin) likely will create a balance. Since 1959, almost 60 percent of King County's prime agricultural land has been lost to urban and suburban development. Of the 100,000 acres available for farming 40 years ago, today only 42,000 acres remain in agriculture. However, the amount of agricultural land has stabilized due, in large part, to a variety of federal regulations and county policies and initiatives to conserve these commercially viable resource-based lands (King County, 2001).

Agricultural lands and farming provide many benefits to the citizens of King County including scenic open space, a connection to cultural heritage, fresh local foods, and a diverse economy. In 1992, farmers in King County produced over $84 million in agricultural sales. Commercial agricultural production, however, has declined by 30 percent in gross sales since 1978. All indicators of farmlands and agricultural activity in King County have been decreasing.

Between 1987 and 1992 (the latest year for which figures are available), the number of farms and orchards, the total amount of land devoted to farming, and the income of agricultural production all decreased within the county. The average size of farms in the county remained stable at about 36 acres. The rate of farmland loss is decreasing, however, with 22 percent of farm acreage lost between 1987 and 1992, but only 2 percent lost between 1992 and 1997. See Figures 3.23-19 and 3.23-20 for illustrations of the count of farms and acreage devoted to farming between 1982 and 1997 in King County.

Figure 3.23-19: Census Count of Farms

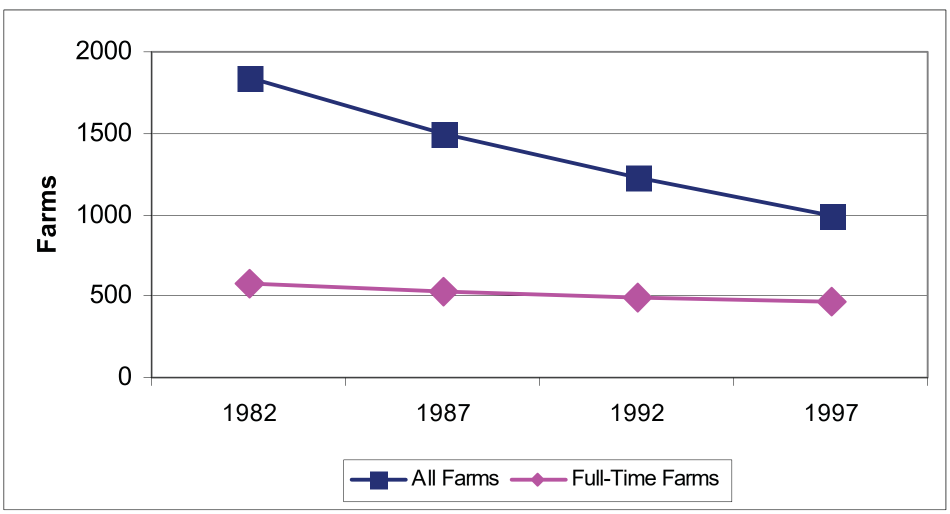
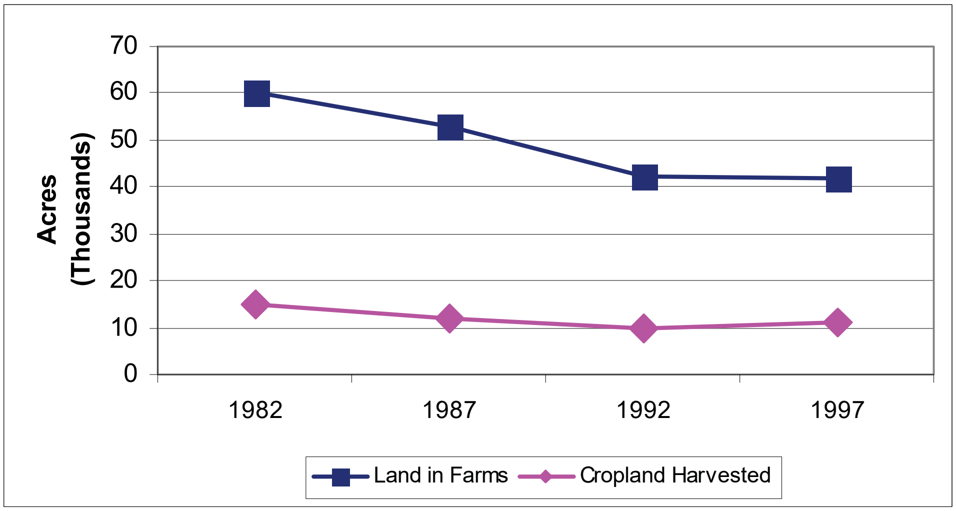


Figure 3.23-20: Land in Farming Use



In other parts of the central Puget Sound region the farmlands picture is mixed. Both Snohomish County farmland acreage and number of farms are decreasing more rapidly than in King County. Pierce County farmland and farms continue to decrease, but only moderately, while in Kitsap County the farms are rapidly increasing in number and size. Overall, the future trend in preservation of farmlands is expected to remain constant due to regulatory influence.

Regulatory Trends

The only farmlands in the I-405 Corridor Program study area, the Sammamish Valley farmlands, are not considered "prime" farmlands and therefore are not governed by the federal Farmland Protection Policy Act. They are, however, governed by local regulations, including the Washington State Growth Management Act. To meet the GMA requirement to maintain and enhance agricultural lands, several methods and programs were established. Detailed strategies were included in the King County Comprehensive Plan, which addresses agricultural lands both within and outside of the King County Urban Growth Area (UGA).

Within the UGA, in 1995 King County established Agricultural Production Districts (APDs) to preserve designated farmland. Agricultural Production Districts present the least number of land use conflicts for agriculture, contain agricultural support activities, and provide the best environment for farming in King County. King County has committed to maintaining Agricultural Production District parcels in or near the UGA fringe because of their high production capabilities, their proximity to markets, and their value as open space. The five Agricultural Production Districts within King County are: the Sammamish Valley (where program improvements are expected), the Snoqualmie Valley, the Lower Green River Valley, the Upper Green River Valley, and the Enumclaw Plateau. The Comprehensive Plan requires use of multiple strategies to protect farmlands within the UGA, such as agricultural zoning, minimum parcel size, limits on new construction, and limits on road and utility construction.

The County has developed specific incentives to encourage agricultural activities in the remaining prime farmlands. In 1979, the Farmland Preservation Program (FPP) became the first voter-approved measure in the nation to protect farmland in a metropolitan area. By purchasing the development rights with public funds, the FPP keeps farmland open and available through covenants that restrict development and limit the properties' uses exclusively for agriculture and open space. The covenants "run with the land" in perpetuity so the land is protected regardless of ownership. Under the FPP, the County owns the development rights; however, the lands remain in the private ownership of over 200 property owners. The County cannot sell or remove its interest in FPP lands with the exception of conveying public road or utility easements.

In 1995, the County approved an additional $3 million for the purchase of additional development rights under the Farmland Preservation Program. In October 1999, the County formally recognized the 20th anniversary of the Farmland Preservation Program and its success to date in preserving over 12,800 acres of farmland for the generations of today and tomorrow. FPP lands lie mostly within Agricultural Protection Districts.

Outside the UGA, the most intensive efforts to preserve agricultural lands in King County are concentrated in the rural areas. The Growth Management Act requires that urban development occur within the UGA, and that rural development remain contained and controlled to protect natural resources uses such as farming. In addition, King County refrains from providing an urban level of infrastructure and services to the rural area. Improvements to the transportation system by King County and Washington State to serve the designated Rural Area are limited to improvements needed for safety and environmental quality. Improvements to existing interstate or state highways, King County roads in the Rural Area, and new connections between the UGAs that pass through Rural Areas, are designed to avoid pressure to convert to urban uses. King County does not construct and opposes the construction by other agencies of any new arterials or freeways in the Rural Area or Natural Resource Lands except in rare circumstances.

In addition to infrastructure restrictions, King County has also developed a market-based approach to preserve farmland outside the UGA. Through the Transfer of Development Credits Program, individuals sell the right to develop their land, but development takes place at another, more appropriate location. The agricultural land must then remain in a natural state.

Future trends expected in agricultural land policy include the following:

- Government budgetary pressure: The pressure to control budget expenses will likely continue to increase. Agricultural conservation has generally not done well in competition with other budget objectives. However, one recent study found that suburban residents' willingness to pay for the conservation of agricultural lands is considerable (Long, 1999). This is the case in King County, where the Farmlands Preservation Program is publicly financed.

- Rising income and population shift from rural to urban and suburban areas: Ervin (1998) cites government surveys which show the majority of the public want to preserve agricultural lands. This is consistent with the demands of relatively wealthy urban King County residents for greenspace and outdoor recreation areas. Unavailability of land may force the public to choose between preservation of private farmland and acquisition and development of land for active recreational use.

- Increasing public attention to and understanding of environmental protection and greenspace issues: The public increasingly understands the role open space and natural areas play in environmental protection and wildlife conservation. This contrasts with their perception of farming as an industrialized activity and a source of pollution. However, in King County, most farms are under 50 acres, which may contribute to their image as natural lands rather than industrial areas.

- Public demand for organic and locally produced food: Primarily for health reasons, organic foods have captured increasing market share. Certified organic cropland in the United States more than doubled from 1992 to 1997, and two organic livestock sectors, eggs and dairy, grew even faster (Economic Research Service, 2001). Rising income, worries about food-borne illness, and the adoption of the Organic Foods Production Act of 1990 can be expected to fuel this increase. Public perception of foods grown locally as safer and more palatable may explain the public's willingness to preserve local farmland.
- Increasing use of market mechanisms and public/private partnerships to preserve agricultural lands: King County is a national leader in the use of market mechanism to preserve agricultural land. Through the Transfer of Developments Credits Program, the market drives individual farm owners to sell their development rights, thus transferring development to more appropriate areas of the county. Critics of this market-based approach note that the haphazard preservation of small parcels will not save land in a way that makes it feasible to farm profitably (Ervin, 1998). However, given the public's preference for market-driven solutions, the use of this type of program is likely to continue or increase.
- Streamlined regulatory process: Washington State is already beginning to experiment with streamlining multiple, often conflicting environmental programs. The hope is that streamlined processes would decrease the costs of participating in farmland preservation programs. Again, the public's desire for reduced government makes this trend likely to expand and continue, although the involvement of multiple government agencies at local, state, and federal levels makes the challenge considerable.

Cumulative and Secondary Effects of the I-405 Corridor Program Alternatives

Several key factors are important to note in the evaluation of cumulative effects on farmlands:

- No prime farmlands are located in the I-405 Corridor Program study area.
- Farmlands in the corridor are protected by the FPP, but are allowed to be converted.
- Regulations have slowed the conversion of farmlands.
- All of the I-405 Corridor Program alternatives are compatible with existing regional and local land use plans that already address planned growth.

All of the effects on farmlands within the I-405 Corridor Program study area are in the Sammamish Valley region. The effects all result from road widening improvements, which have a linear impact on farmlands without affecting the majority of the farms or causing additional fragmentation of local farms.

Cumulative effects on farmlands within the study area are a result of assumed increases in pressure for development relative to other parts of the study area in and near the Sammamish Valley farmlands. For those farmlands not converted, the increased pressure for development could result in an increase in adjacent land uses that are not compatible with agriculture, reduction or loss of the economic and business infrastructure necessary to support viable agricultural uses, and increased impervious surface run-off that could effect the additional farmlands. Again, these farmlands are low quality farmlands of statewide or local importance only, and are not federal prime or unique farmlands.

Effects on farmlands outside the UGA could be reduced relative to the more urbanized areas within the study area because of the decreased development pressures there and because of the emphasis on the FPPA and the King County FPP, that protect all potentially affected farms from development and conversion to other land uses.

The No Action Alternative could result in somewhat greater pressure for growth in rural areas or at the fringe of the UGA than the action alternatives, although the difference would be small. If allowed to occur by local land use regulatory agencies, that pattern of development would have the potential to influence some additional effects on farmlands outside the study area. Under the No Action Alternative, planned growth in employment and households and resulting development is forecasted to be concentrated in Seattle, southwest Snohomish County, Tukwila, Federal Way, Woodinville, and Bothell. While the more central of these areas are nearer build-out, farmlands located closest to the southwest Snohomish County and Woodinville areas may experience some cumulative effects from this growth.

Under the No Action Alternative, two areas of farmland would potentially be directly affected. Widening improvements could impinge on a total of 5.9 acres of farmland. In addition, 4,000 households with associated development could contribute to the effects on the Sammamish Valley farmlands. No prime or unique farmlands would be affected during construction or operation.

Cumulative effects under Alternative 1 would be the same as those discussed under the No Action Alternative.

Under Alternative 2, two areas of protected farmland potentially would be directly affected beyond those identified in the No Action Alternative. Improvements could impinge on a total of 6.1 acres of farmland. This effect is nearly as low as for the No Action Alternative and Alternative 1. In addition, 4,500 households with associated development could contribute to the effects on the Sammamish Valley farmlands. No prime or unique farmlands would be affected during construction or operation.

Under Alternative 3, three areas of protected farmland potentially would be directly affected beyond those identified in the No Action Alternative. The improvements could impinge on a total of 12.9 acres of farmland. This level of impact is about midway between the best- and worst-ranked action alternatives. In addition, 4,500 households with associated development could contribute to the effects on the Sammamish Valley farmlands. No prime or unique farmlands would be affected by construction or operation.

Alternative 4 includes seven areas of farmland potentially directly affected beyond those identified in the No Action Alternative. These improvements could impinge on a total of 20.1 acres of farmland. In addition, 4,500 households with associated development could contribute to the effects on the Sammamish Valley farmlands. No prime or unique farmlands would be affected during construction or operation.

Cumulative effects under the Preferred Alternative would be similar to those under Alternative 4. The Preferred Alternative includes seven areas of farmland potentially directly affected beyond those identified in the No Action Alternative. These improvements could impinge on a total of approximately 20 acres of farmland. Slightly higher pressure for growth effects would occur north and south of the study area. The growth pressure effects in the study area are not likely to result in substantial effects to farmlands.

3.23.5 Conclusion

The analysis of cumulative and secondary effects indicates that planned growth in population and employment, as expressed through *VISION 2020* and *Destination 2030*, and the development that will be associated with this growth are by far the most substantial actions affecting the magnitude and severity of cumulative effects in the central Puget Sound region and I-405 corridor. Although the *direct* effects of the I-405 Corridor Program alternatives are expected to be substantial for some critical resources such as fish and aquatic habitat, their incremental contribution to overall *cumulative* effects within the region would generally be very small when compared to the combined effects of other past, present, and reasonably foreseeable future actions.

The I-405 Corridor Program alternatives that are expected to have greater direct impacts on the scoped critical resources would also have greater cumulative effects; however, for the reasons discussed above, the differences in cumulative effects among the alternatives would be minor relative to the overall level of cumulative effect anticipated due to other past, present, and reasonably foreseeable future actions. In addition, proposed mitigation for direct effects coupled with other federal, state, and local permitting and preservation activities will reduce any cumulative and secondary effects.

The review of potential cumulative and indirect effects also shows the following:

- The daily VMT in the central Puget Sound region is expected to increase to 79 million miles per weekday by 2010, but then level off to 94 million miles per weekday by 2030 under the *Destination 2030* plan (PSRC, 2001a).
- Hydrocarbon emissions, which largely drive ozone formation in the central Puget Sound region, are projected to increase between 2010 and 2020.
- Cumulative and secondary effects on air pollutant emission levels in 2020 are very similar under all of the alternatives, and are not expected to be substantial.
- While historical trends over the last 10 to 15 years reflect a lack of progress in fuel economy, new technologies used in hybrid vehicles indicate improvements on the order of 100 to 200 percent may be possible (USEPA, 2000).
- Fuel consumption is expected to decrease between 2020 and 2030 as a result of programs under the *Destination 2030* plan.
- Cumulative and secondary effects on fuel consumed due to operation of surface transportation are similar under all alternatives, and are not expected to be substantial. The I-405 Corridor Program action alternatives could contribute up to 9 percent of the increase in fuel consumption in the region over the next 20 years.
- Recent and anticipated regulatory programs assure that the rate of hydrologic and water quality degradation in developing areas will be greatly reduced from those that historically occurred.
- The relatively slow rate of large-scale redevelopment in urbanized areas and the difficulty of incorporating effective stormwater control measures in densely developed areas makes it unlikely that the hydrologic conditions of the urbanized portions of streams in the study area will greatly improve within the 2030 timeframe.

- Even with implementation of stormwater detention and treatment measures for all new development, increases in pollutant loads and reductions in seasonal base flows and associated increases in summer stream temperature may occur in many of the streams draining the I-405 corridor. This is expected to be a substantial adverse cumulative effect.
- Cumulative and secondary effects on surface water are similar under all alternatives, with the I-405 Corridor Program improvements potentially contributing between 1 and 8 percent of the new impervious surface in the study area over the next 20 years.
- Planned household and employment growth is estimated to result in a 26 percent increase in impervious coverage in the study area over the next 20 years.
- More than 90 percent of the wetlands in urban areas in Washington have been lost. Despite the goal of "no net loss," studies show that these goals are not being met.
- Cumulative and secondary effects on wetlands within the more urbanized study area and UGA could increase as a result of greater pressure for growth and development within the Urban Centers along the I-405, SR 167, and I-90 corridors. This would be partially offset by a reduction in impacts on wetlands in rural areas outside the UGA resulting from reduced pressure for growth and development in those areas.
- Cumulative and secondary effects on wetlands are similar under all action alternatives, and are not expected to be substantial.
- Nearly all native salmonid populations in the region have experienced a severe declining trend since the human population began rapidly increasing over the past century.
- Planned population growth and land use development in the central Puget Sound region will increase the likelihood of substantial adverse cumulative effects to fish habitat and populations.
- Transportation programs included in *Destination 2030*, including the I-405 Corridor Program action alternatives, are expected to increase pressure for growth along major transportation corridors within the UGA, thus relieving pressure and reducing adverse effects on the rural areas that contain the most functional fish habitat.
- None of the action alternatives would contribute substantially to altering the negative trends in salmon populations in the central Puget Sound region. Reverses in the decline of salmonid populations cannot reliably be assumed, regardless of which I-405 Corridor Program alternative is implemented.
- Cumulative and secondary effects on farmlands are nearly identical under all of the alternatives, and are not expected to be substantial.

3.24 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Implementing any of the alternatives would require a commitment of natural, human, and fiscal resources. In all of these categories, irreversible and irretrievable commitments of resources would occur. Commitments would increase considerably from the No Action Alternative to the action alternatives, with Alternative 4 requiring the greatest commitment of resources overall. The Preferred Alternative would require a lower level of commitments than Alternative 4, but a greater level than the No Action Alternative and Alternatives 1, 2, and 3.

The proposed transportation facilities would involve a long-term conversion of land resources, potentially including residential, commercial, and farm lands, to provide right-of-way to accommodate new freeway improvements, transit facilities, arterial widening, and stormwater treatment and detention facilities. Although these facilities conceivably could be converted to other land uses at some time in the future, these is no reason to expect that such a conversion would be necessary or desirable. Thus, such land conversion is considered to be an irreversible and irretrievable commitment.

Fossil fuels (diesel and gasoline), electricity (and the resources used to generate it), lubricants, and construction materials, such as steel, aluminum, cement, aggregate, and bituminous material, would be used in varying amounts for construction and operation of all alternatives. These materials are generally in sufficient supply, and their commitment to the I-405 Corridor Program improvements would not have an adverse effect on their continued availability. Although construction materials are not generally retrievable, there is a market for recyclable metals and use of recycled concrete is growing. Requirements for aggregate and fill material would use resources located at existing and potentially new sites in the region. Available resources at some of these sites could be expended; however, specific locations and quantities have not been identified at this stage in the planning process. Subsequent environmental analysis, documentation, and review for these sites will be conducted as needed.

Some biological resources would be irreversibly and irretrievably converted to transportation use with construction of the proposed facilities. Wetlands would be filled, aquifer recharge areas would be reduced, and areas of wildlife habitat would be lost. However, wetland losses that cannot be avoided or further minimized could be offset by compensatory mitigation at other locations within the corridor.

In terms of human resources, large amounts of labor would be used in preparation, fabrication, and construction of the I-405 corridor improvements. Labor is generally not considered to be a resource in short supply, and commitment to the project would not have an adverse effect on continued availability. Facility construction would require a substantial expenditure of public funds. Funds devoted to the I-405 corridor improvements would not be available to other competing public or private uses.

The proposed commitment of natural, physical, human, and fiscal resources is based on the purpose and need for the I-405 Corridor Program, which recognizes that businesses, employees, and residents in the I-405 corridor and region would benefit substantially from additional transportation choices and improved mobility in the I-405 corridor. These benefits would include greater accessibility, improved reliability and safety of the transportation system, and travel time and fuel savings, as well as provisions for improvement of air quality and protection or enhancement of water quality and fish-bearing streams. These benefits are anticipated to outweigh the commitment of resources to construct and operate the transportation improvements.

This page intentionally left blank.

3.25 THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Implementation of any of the alternatives would result in local short-term impacts and uses of resources, while providing long-term transportation improvements in the I-405 corridor and the region consistent with state, regional, and local land use and transportation plans and policies.

Short-term construction effects of the I-405 Corridor Program improvements would include the generation of construction jobs, construction-related noise and particulate air pollution, traffic delays, and local detours. These short-term effects, however, would yield facilities with long-term benefits to the local area and region by improving through-traffic flow, promoting more efficient local traffic circulation, expanding transit accessibility, and reducing associated air pollutant emissions.

Short-term soil erosion and water quality impacts also may result during and shortly after construction, although landscaping, erosion controls, and other mitigation measures would be incorporated to minimize impacts. In the long term, the addition of new stormwater facilities in the I-405 corridor would provide peak flow reductions and water quality improvements that would be expected to result in a net beneficial effect on receiving waters, wetlands, and aquatic life in the corridor. Associated reductions in stream channel erosion and in non-point pollution from roadway surfaces could enhance the long-term productivity of aquatic habitats along the corridor. Fish and wildlife dependent on these resources would benefit from these enhancements.

Many small areas within the I-405 corridor may be used temporarily for construction-related activities such as construction staging and temporary access roads. These areas would be restored in order to minimize long-term effects on biological productivity. At waterway crossings, stream banks affected by construction would be returned to original contours when possible, and the riparian area would be revegetated using native plants for long-term stabilization and maintenance or enhancement of productivity.

Wetland functions, such as water quality improvement, flood storage, and biological support, would be reduced locally due to conversion of wetlands to transportation facility uses. However, wetland mitigation would be designed to replace lost wetland functional values over the long-term so that corridor-wide wetland functions are maintained or enhanced. Proposed improvements would eliminate the long-term agricultural productivity of any farmlands converted to transportation uses.

Construction of any of the alternatives would have the short-term effect of displacement and relocation of some residences and businesses in the corridor. There may be some initial, relatively minor reduction in property tax revenues for these jurisdictions due to the loss of residential and commercial properties (although many of the displacements could be expected to relocate within the same jurisdiction). In the long term, the action alternatives would be consistent with maintaining and enhancing the long-term productivity of the area.

The I-405 Corridor Program action alternatives are consistent with comprehensive planning by state, regional, and local agencies responsible for maintaining orderly development and infrastructure within their areas of jurisdiction. The proposed improvements would be compatible with the population and employment that the growing areas in the corridor and region are expected to receive. These improvements would benefit residents along the corridor by providing more efficient access to local services, facilities, and employment, and by improving transit and general traffic movement throughout the region.

The proposed action alternatives would result in increased safety to motorists, bicyclists, and pedestrians and more efficient vehicle movement through the area. By improving personal and freight mobility, enhancing reliability, increasing accessibility, and decreasing travel time, the proposed I-405 Corridor Program improvements would enhance long-term productivity within the corridor and region.

4. REFERENCES

1. PURPOSE AND NEED FOR ACTION

Washington State Transportation Center and Washington State Department of Transportation. 1999. *Central Puget Sound Freeway Network Usage and Performance, 1999 Update.*

2. DESCRIPTION OF ALTERNATIVES

David Evans and Associates, Inc. and Mirai Associates. August 2000. *I-405 Corridor Program: Alternatives Report (Draft).* Submitted to Washington State Department of Transportation. Bellevue, Washington.

Washington State Department of Transportation. January 2000. *Corridor Needs Study for East King County.*

3.1 AIR QUALITY

Associated General Contractors of Washington. 1997. *Guide to Handling Fugitive Dust from Construction Projects.* Seattle, Washington.

Code of Federal Regulations. 1997. 40 CFR Part 93 *Determining Conformity of Federal Actions to State or Federal Implementation Plans.* Washington, D.C.

Dolan et al. 2000. *Results of an Extensive Multi-year PM10 Monitoring and Field Inspection Program for the Construction of the Central Artery/Tunnel Project.* Air and Waste Management Association, June 2000 Conference.

Erlich, P.R., A.H. Erlich, and J.P Holdren. 1977. *Ecoscience: Population, resources and environment.* W. H. Freeman and Company. San Francisco.

Mirai Associates and David Evans and Associates, Inc. April 2001. *I-405 Corridor Program Draft Transportation Expertise Report.* Bellevue, Washington.

National Research Council. 1992. *Rethinking the Ozone Problem in Urban and Regional Air Pollution.* Washington, D.C.

Parsons Brinckerhoff. April, 2001. *I-405 Corridor Program Draft Air Quality Expertise Report.*

Puget Sound Clean Air Agency, (formally Puget Sound Air Pollution Control Agency). 1993. *Regulation 1 of the Puget Sound Air Pollution Control Agency.* Seattle, Washington.

Puget Sound Clean Air Agency, (formally Puget Sound Air Pollution Control Agency). 1997. *Techniques for Improving Project Level Conformity Analyses in the Puget Sound Metropolitan Area.* Seattle, Washington.

Puget Sound Clean Air Agency. 1999. *Final Report of the Puget Sound Clean Air Agency PM2.5 Stakeholder Group.* Seattle, Washington.

Puget Sound Regional Council. 1995. *Guidebook for Conformity and Air Quality Analysis Assistance for Nonattainment Areas.* Seattle, Washington.

Puget Sound Regional Council. 1998. *Metropolitan Transportation Plan, 1998 Progress Report.* Seattle, Washington.

U.S. Environmental Protection Agency. 1992. *Automobiles and Carbon Monoxide.* Fact Sheet Number EPA-400-F-92-005. Ann Arbor, Michigan.

U.S. Environmental Protection Agency. 1993. *Motor Vehicle-Related Air Toxics Study.* Report Number EPA-420-R-93-005. Ann Arbor, Michigan.

U.S. Environmental Protection Agency. 1994. *Users Guide to Mobile5.* Report Number EPA-AA-AQAB-94-01. Ann Arbor, Michigan.

U.S. Environmental Protection Agency. 1995. *Compilation of Air Pollutant Emission Factors.* Fifth Edition (AP-42).

Washington Administrative Code. 1996. Chapter 173-420. *Conformity of Transportation Activities to Air Quality Implementation Plans.* Olympia, Washington.

Washington State Department of Ecology. 1999. *1988 Air Quality Data Summary.* Air Quality Program. Olympia, Washington.

Wayne, Richard. 1991. *Chemistry of Atmospheres.* Oxford University Press. Oxford, England.

3.2 NOISE

Entech Northwest. 2000. *Sound Transit Park-and-Ride Study.*

HMMH. 1995. *Description of FTA General Noise Assessment Spreadsheet.* Technical Memorandum from Harris Miller Miller & Hanson to Federal Transit Administration. Burlington, MA.

King County Department of Assessments. December 2000. Residential Parcel File database. Seattle, Washington.

Parsons Brinckerhoff. April, 2001. *I-405 Corridor Program Draft Noise Expertise Report.*

U.S. Department of Transportation, Federal Highway Administration. 1973. *Fundamentals and Abatement of Highway Traffic Noise.* Washington D.C.

U.S. Department of Transportation, Federal Highway Administration. 1982. "Procedures for Abatement of Highway Traffic Noise and Construction Noise." *Federal-Aid Highway Program Manual.* Volume 7, Chapter 7, Section 3. Washington, D.C.

U.S. Department of Transportation, Federal Highway Administration. 1996. *Measurement of Highway-Related Noise.* Washington D.C.

U.S. Department of Transportation, Federal Highway Administration. 1998. *FHWA Traffic Noise Model User's Guide.* Washington D.C.

U.S. Department of Transportation, Federal Transit Administration. 1995. *Transit Noise and Vibration Impact Assessment.* Washington D.C.

U.S. Environmental Protection Agency. 1971. *Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances.* Washington, D.C.

U.S. Environmental Protection Agency. 1974. *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*. Report Number 550/9-74-004.

Washington Administrative Code. 1989. Chapter 173-60. *Maximum Environmental Noise Levels*. Olympia, Washington.

Washington State Department of Transportation. March 1999. *Traffic Noise Analysis and Abatement Policy and Procedures*. Olympia, Washington.

Washington State Department of Transportation. April 2000. *Coordinated FTA – FHWA Sound Transit Noise Analysis And Abatement Policy And Procedures.* Position Paper. Shoreline, Washington.

3.3 ENERGY AND NATURAL RESOURCES

California Department of Transportation. 1983 and 1993. *Energy and Transportation Systems*.

Institute of Transportation Engineers. 1982. *ITE Transportation Planning Manual*.

Parsons Brinckerhoff. April, 2001. *I-405 Corridor Program Draft Energy Technical Memorandum.*

U.S. Department of Energy. 1998. *Monthly Energy Review Online*.

U.S. Department of Transportation. 1980. *Procedure for Estimating Highway User Costs, Fuel Consumption, and Air Pollution*.

3.4 GEOLOGY AND SOILS

Blakely, R.J. 2000. *Hunting for faults: an application of aeromagnetic and gravity methods.* Summary of a paper presented at Seattle 2000 Civil Engineering Conference and Exposition, Seattle, Washington, October 20, 2000.

Blakely, R.J., R.E. Wells, C.S. Weaver, and S.Y. Johnson. 1999. *Tectonic setting and earthquake hazards of the Seattle Fault, Washington; implications from high-resolution aeromagnetic data.* Malone, Steve D. (chairperson) (University of Washington, Geophysics Program, Seattle, Washington, United States), SSA-99 94th annual meeting; meeting abstracts, *Seismological Research Letters*, 70 (2), p. 219, 1999. Meeting: SSA-99, 94th annual meeting, Seattle, Washington, United States, May 3-5, 1999.

Brocher, T.M. 2000. *Crustal faults and sedimentary basins in Puget Sound – evidence from seismic surveys.* Summary of a paper presented at Seattle 2000 Civil Engineering Conference and Exposition, Seattle, Washington, October 20, 2000.

Building Seismic Safety Council. 1997. *NEHRP (National Earthquake Hazards Reduction Program) Recommended Provisions for Seismic Regulations for New Buildings and Other Structures.* Federal Emergency Management Agency.

CH2M HILL. 1998. *Clearview Water Supply Project, Geotechnical Report.* Prepared for the Clearview Group. Bellevue, Washington.

CH2M HILL. 2001a. *I-405 Corridor Program Draft Geology and Soils Expertise Report.* Bellevue, Washington.

City of Redmond. 2000. *GIS Format Sensitive Areas Maps.* To accompany Redmond Community Development Guide.

Debose, A., and M.W. Klungland. 1983. *Soil Survey of Snohomish County Area, Washington*. U.S. Department of Agriculture.

EQE International. 2000. *Port to Port Transportation Corridor Earthquake Vulnerability – Draft Report.*

Galster, R.W., and W.T. Laprade. 1991. Geology of Seattle, Washington, United States of America. *Bulletin of the Association of Engineering Geologists*, Volume XXVIII, No. 3, August 1991.

GeoEngineers. 1991. *Snohomish County Tomorrow, Critical Areas Planning Project.* 24"x 36" maps prepared for Snohomish County.

Hart Crowser. June 1986. *I-90 Seattle Access Test Pile Program.* Submitted to the Washington State Department of Transportation.

Hoblitt, J.S., J.S. Walder, C.L. Driedger, K.M. Scott, P.T. Pringle, and J.W. Vallance. 1998. *Volcano Hazards from Mount Rainier, Washington, Revised.* U.S. Geological Survey Open-File Report 98-428.

Huckell/Weinman Associates, Inc. 1993. *Pioneer Aggregates Mining Facility and Reclamation Plan, Final EIS.* Submitted by Lonestar Northwest to City of DuPont and Washington State Department of Ecology.

Johnson, S.Y., S.V. Dadisman, J.R. Childs, and W.D. Stanley. 1999. Active tectonics of the Seattle Fault and central Puget Sound, Washington; implications for earthquake hazards, *Geological Society of America Bulletin*, 111 (7), p. 1042-1053, chart, geol. sketch maps.

King County. 1999. *Sensitive Areas Folio Maps.* To accompany King County Code, Section 21A.

Minard, J.P. 1985. Geologic map of the Bothell quadrangle. U.S. Geological Survey Miscellaneous Field Studies Map MF-1747.

Snyder, D.E., P.S. Gale, and R.F. Pringle. 1973. *Soil Survey King County Area, Washington.* U.S. Department of Agriculture, Soil Conservation Service.

Waitt, R.B., L.G. Mastin, and J.E. Beget. 1995. *Volcanic-Hazard Zonation for Glacier Peak Volcano, Washington.* U.S. Geological Survey Open-File Report 95-499.

Washington Aggregates & Concrete Association. 2000. Promotional materials and web site. Bellevue, Washington.

Whyley, P.J. and R.W. Sarsby. May 1992. *Ground Borne Vibrations from Piling.* Ground Engineering, May 1992, pp. 32-37.

Wiss, J.F. September 1974. V*ibrations During Construction Operations.* American Society of Civil Engineers, Journal of the Construction Division, Vol. 100, No. CO3, pp. 239-246.

Wong, I., A. Sparks, B. Metcalfe, D. Wright, K. Stokoe, and J. Yount. 1999. *Probabilistic seismic hazard analysis and ground shaking microzonation maps for the Seattle, Washington, Metropolitan Area: Characterization of the Near-Surface Geology (Year 1).* Final Technical Report submitted to the U.S. Geological Survey under the National Earthquake Hazards Reduction Program.

3.5 WATER RESOURCES

Bank, Fred G., et al. 1995. *National Evaluation of Water Quality Issues for Highway Planning.* http://www.fhwa.dot.gov/environment/WQNATEVL.htm, Federal Highway Administration, McLean, VA.

Beckett, Alison. 2000. *2000 Washington State Water Quality Assessment Section 305b Report.* Appendix A. Publication No. 00-10-058. Washington State Department of Ecology, Olympia, Washington.

Booth, D.B. 2000. *Forest Cover, Impervious Surface Area, and the Mitigation of Urbanization Impacts in King County, Washington.* Center for Urban Water Resources Management, Department of Civil and Environmental Engineering, University of Washington.

CH2M HILL. 2001a. *I-405 Corridor Program Draft Surface Water Resources Expertise Report.* Bellevue, Washington.

CH2M HILL. 2001b. *I-405 Corridor Program Draft Groundwater Resources Expertise Report.* Bellevue, Washington.

City of Bellevue. Bellevue Storm and Surface Water Utility. 1986. *Coal Creek Basin Plan and Draft Environmental Impact Statement.* Bellevue, Washington.

City of Kent Environmental Engineering Section. 1995. *Comprehensive Fisheries Assessment of the Springbrook, Mill and Garrison Creek Watershed for the City of Kent.* Kent, Washington.

City of Renton. May 1999. *City of Renton Water System Plan*, Appendix Q, Wellhead Protection Plan.

David Evans and Associates, Inc. 2001a. *I-405 Corridor Program Draft Fish and Aquatic Habitat Expertise Report.* Bellevue, Washington.

David Evans and Associates, Inc. 2001b. *I-405 Corridor Program Draft Wetlands Expertise Report.* Bellevue, Washington.

David Evans and Associates, Inc. 2001c. *I-405 Corridor Program Fish and Watershed Summary Report.* Bellevue, Washington.

Driscoll, E.D., et al. 1990. *Pollutant Loadings and Impacts from Highway Stormwater Runoff.* U.S. Department of Transportation, Federal Highway Administration. Pub. No. FHWA-RD-88-006. McLean, VA.

Dupuis, T.V., et al. March 30, 1985. *Effects of Highway Runoff on Receiving Waters: Vol. III, Resource Document for Environmental Assessments.* U.S. Department of Transportation, Federal Highway Administration, Rpt. # FHWA/RD-84/064.

Garland, D. Washington Department of Ecology Northwest Region. February 26, 2001. Personal communication. Bellevue, Washington.

Entranco Engineers, Inc. 1981. *Lyons Creek Watershed Comprehensive Drainage Plan for Mountlake Terrace and Lake Forest Park.* Mountlake Terrace, Washington. Bellevue, Washington.

George, Phil. WSDOT Area 5 Maintenance Section. February 26, 2001. Personal communication. Bellevue, Washington.

Goldstein, Libby S. 1982. *Little Bear Creek Stream Resource Inventory Technical Report.* Municipality of Metropolitan Seattle. Seattle, Washington.

Goldstein, Libby S. 1982. *Sammamish River Resource Inventory Technical Report.* Municipality of Metropolitan Seattle. Seattle, Washington.

Harper-Owes Company. 1982. *Cedar River Resource Inventory.* Municipality of Metropolitan Seattle. Seattle, Washington. Bellevue, Washington.

Hartley, David, and Jeff Burkey. January 26, 2000. Personal communication. King County Department of Natural Resources.

Harza. 1995. *Comprehensive Fisheries Assessment of the Springbrook, Mill and Garrison Creek Watershed for the City of Kent.* Bellevue, Washington.

Hill, K., E. Botsford, and D. Booth. 2000. *A Rapid Land Cover Classification Method for Use in Urban Watershed Analysis.* Center for Urban Water Resources Management, Department of Civil and Environmental Engineering, University of Washington.

King County. 1992. *Draft Bear Creek Basin Plan.* Seattle, Washington.

King County Department of Natural Resources. 1998. *King County Surface Water Design Manual.* Seattle, Washington.

King County Department of Public Works. 1990. *Proposed Soos Creek Basin Plan and Final Environmental Impact Statement.* Seattle, Washington.

King County Natural Resources and Parks Division. 1987. *Basin Plan Review: 1980 May Creek Basin Plan.* Seattle, Washington.

King County Natural Resources and Parks Division. 1987. *Basin Plan Review: 1986 Swamp Creek Basin Stormwater Planning Study.* Seattle, Washington.

King County Natural Resources and Parks Division. 1987. *Basin Plan Review: 1987 Juanita Creek Basin Plan.* Seattle, Washington.

King County Surface Water Management Division. 1989. *Bear Creek Basin: Current and Future Conditions Analysis.* Seattle, Washington.

Kramer, Chin & Mayo (KCM). 1978. *Forbes Creek Rehabilitation Plan.* Seattle, Washington.

Matsuda, Robert I. 1969-1971. *Water Quality and Ecological Survey of the Big Soos Creek System.* Municipality of Metropolitan Seattle, Seattle, Washington.

May, C.W., R.R. Homer, J.R. Karr, B.W. Mar, and E.B. Welch. 1997. *Effects of Urbanization on Small Streams in the Puget Sound Lowland Ecoregion.* Watershed Protection Techniques. Vol. 2, No. 4:483-494.

Safe Drinking Water Act. 1974.

R2 Resources Consultants. 2000. *Tri-County Urban Issues ESA Study-Guidance Document.* Redmond, Washington.

Redmond-Bear Creek Ground Water Advisory Committee. February 1999. *Redmond-Bear Creek Valley Ground Water Management Plan.*

Snohomish County. 1998. Title 24 Drainage. Everett, Washington.

Snohomish County Public Works, Surface Water Management. 1994. *North Creek Watershed Management Plan.* Everett, Washington.

Snohomish County Public Works, Surface Water Management. 1994. *Swamp Creek Watershed Management Plan.* Everett, Washington.

Thomas, B.E., J.M. Wilkinson, and S.S. Embrey. 1997. *The Ground-Water System and Ground-Water Quality in Western Snohomish County*, Washington. U.S. Geological Survey Water-Resources Investigations Report 96-4312.

Tri-County Proposal for Stormwater Management. http://www.salmoninfo.org/tricounty/framework.html

U.S. Department of the Interior, Fish and Wildlife Service. 1999. *Environmental Assessment/Final Environmental Impact Statement for the Proposed Issuance of a Permit to Allow Incidental Take of Threatened and Endangered Species: Cedar River Watershed Draft Habitat Conservation Plan.* Seattle, Washington.

U.S. Geological Survey. 1999. *Water Resources Data for Washington: Water Year 1998.* Tacoma, Washington.

Vaccaro, J.J., A.J. Hansen, Jr., and M.A. Jones. 1998. *Hydrogeologic Framework of the Puget Sound Aquifer System, Washington and British Columbia.* U.S. Geological Survey Professional Paper 1424-D.

Washington Department of Ecology. 1992. *Stormwater Management Manual for the Puget Sound Basin.* Olympia, Washington.

Washington Department of Ecology. 2000. *Final 1998 303(d) List of Impaired and threatened Water Bodies.* Available from the Department's web site. Olympia, Washington.

Washington Department of Ecology. August 2001. *Stormwater Management Manual for Western Washington.* Olympia, Washington.

Washington State Department of Transportation. 1988. *Highway Water Quality Manual.* Document M22-15. Olympia, Washington.

Washington State Department of Transportation. 1995. *Highway Runoff Manual.* Document M31-16. Olympia, Washington.

Washington State Department of Transportation. 2000. *Highway Stormwater Facilities.* Unpublished data. Northwest Region, Seattle, Washington.

Woodward, D.G, F.A. Packard, N.P. Dion, and S.S. Sumioka. 1995. *Occurrence and Quality of Ground Water in Southwestern King County, Washington.* U.S. Geological Survey Water-Resources Investigations Report 92-4098.

3.6 WETLANDS

CH2M HILL. 2001a. *I-405 Corridor Program Draft Surface Water Resources Expertise Report.* Bellevue, Washington.

CH2M HILL. 2001b. *I-405 Corridor Program Draft Groundwater Resources Expertise Report.* Bellevue, Washington.

CH2M HILL. 2001. *I-405 Corridor Program Draft Geology and Soils Expertise Report.* Bellevue, Washington.

City of Bellevue. 1987. *City of Bellevue Sensitive Areas Notebook.*

City of Bothell. 1990. City of Bothell Critical Areas Map.

City of Kent. 1990. *City of Kent Wetland Inventory Report.*

City of Kirkland. 1998. *City of Kirkland Streams, Wetlands, and Wildlife Study.*

City of Redmond. 1997. City of Redmond Sensitive Areas Map.

City of Renton. 1994. *City of Renton Wildlife Corridor Study.*

City of Tacoma. 2002. *2002 Draft Near-Term Action Agenda for Salmon Habitat Conservation in the Greater Lake Washington Watershed.* See the following web-site to obtain a CD version: Tacoma HCP – http://www.ci.tacoma.wa.us/water/system/m_system_habitat_cons.htm

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. *Classification of Wetlands and Deepwater Habitats of the United States.* Office of Biological Services, Fish and Wildlife Service, U.S. Department of the Interior, FWS/OBS-79/31.

David Evans and Associates, Inc. 1996. *SR 405 HOV Lanes – Bothell to Swamp Creek Environmental Analysis.* Bellevue, Washington.

David Evans and Associates, Inc. 2001a. *I-405 Corridor Program Draft Wetlands Expertise Report.* Bellevue, Washington.

David Evans and Associates, Inc. 2001b. *I-405 Corridor Program Draft Fish and Aquatic Habitat Expertise Report.* Bellevue, Washington.

David Evans and Associates, Inc. 2001. *I-405 Corridor Program Draft Floodplain Expertise Report.* Bellevue, Washington.

David Evans and Associates, Inc. 2001. *I-405 Corridor Program Draft Land Use Expertise Report.* Bellevue, Washington.

David Evans and Associates, Inc. 2001. *I-405 Corridor Program Draft Land Use Plans and Policies Expertise Report.* Bellevue, Washington.

David Evans and Associates, Inc. 2001. *I-405 Corridor Program Draft Upland Vegetation, Habitat, and Wildlife Expertise Report.* Bellevue, Washington.

David Evans and Associates, Inc. 2002. *I-405 Corridor Program Errata and Addenda to Expertise Reports.* Bellevue, Washington.

King County. 1990. King County Sensitive Areas Map Folio.

King County Department of Development and Environmental Service. 1998. *Environmentally Sensitive Areas.*

National Marine Fisheries Service. 1996. NMFS Pathways and Indicators Analysis (NMFS, 1996)- "*Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale, NMFS, 1996),*" http://www.nwr.noaa.gov/1salmon/salmesa/4ddocs/4dpacket.html

Null, W., G. Skinner, and W. Leonard. 2000. *Wetland Functions Characterization Tool for Linear Projects.* Washington State Department of Transportation.

Parsons Brinckerhoff. 2001. *I-405 Corridor Program Draft Noise Expertise Report.*

Sammamish River Action Plan. http://dnr.metrokc.gov/wrias/8/near-term-action-agenda.htm

Snohomish County. 1996. Snohomish County Stream and Wetland Inventory.

Snohomish County Department of Planning and Development Service. 1996. Snohomish County Code.

Snohomish County Public Works Department and WSDOT, 2000. *Mitigation Site Identification and Cooperative Planning in Swamp and North Creek Watersheds.* Prepared for the EPA, EPA Agreement No. 826901-01, 27pp.

U.S. Department of Agriculture, Soil Conservation Service. 1973. *King County Washington Soil Survey*.

U.S. Department of Agriculture, Soil Conservation Service. 1983. *Snohomish County Washington Soil Survey*.

U.S. Department of Agriculture, Natural Resources Conservation Service. 1998. *Field indicators of hydric soils in the United States.*

U.S. Department of the Interior, Fish and Wildlife Service. 1993. National Wetlands Inventory.

Washington State Department of Ecology. 1993. *Washington State Wetland Rating System.* Olympia, Washington.

Washington State Department of Fish and Wildlife. 2000. *Priority Habitats and Species Database.* http://www.wa.gov/wdfw/hab/phslist.htm

Washington State Department of Transportation. 2000. *Best Professional Judgment Tool.* http://www.wsdot.wa.gov/eesc/environmental/programs/biology/docs/bpjtool.pdf

Washington State Department of Transportation. 2001. *Environmental Procedures Manual*: Volumes 1 and 2. Olympia, Washington. Available on the worldwide web: http://wsdot.wa.gov/eesc/environmental/prgrams/regcomp/ProceduresManual/start.pdf.

WRIA Early Action Mitigation Studies Plan - See the following web sites:
WRIA 8 - http://dnr.metrokc.gov/wrias/8/near-term-action-agenda.htm
WRIA 9 - http://dnr.metrokc.gov/Wrias/9/NTAA/

3.7 WILDLIFE, HABITAT, AND UPLAND THREATENED AND ENDANGERED SPECIES

Castelle, A.J., C. Conolly, M. Emers, E.D. Metz, S. Meyer, M. Witter, S. Mauermann, T. Erickson, S.S. Cooke. 1992. *Wetland Buffers: Use and Effectiveness.* Adolfson Associates, Inc., Shorelands and Coastal Zone Management Program. Washington State Department of Ecology, Olympia, Washington.

City of Bellevue, Department of Planning and Community Development. *Comprehensive Land Use Plan*. Map dated 24 February 2000.

City of Bothell. *City of Bothell Comprehensive Plan*. 30 June 1997.

City of Newcastle. Department of Planning and Land Use Services. 16 June 1997. *Comprehensive Plan.*

City of Redmond. City of Redmond Planning Department. May 1995. *City of Redmond Planning Commission's Recommended Comprehensive Plan.*

City of Renton, Neighborhoods and Strategic Planning. Comprehensive Plan Land Use Map. Map dated 12 October 1999.

City of Tukwila. 4 December 1995. *Comprehensive Land Use Plan.*

David Evans and Associates, Inc. 2001a. *I-405 Corridor Program Draft Wetlands Expertise Report.* Bellevue, Washington.

David Evans and Associates, Inc. 2001b. *I-405 Corridor Program Draft Fish and Aquatic Habitat Expertise Report.* Bellevue, Washington.

David Evans and Associates, Inc. 2001. *I-405 Corridor Program Draft Land Use Expertise Report.* Bellevue, Washington.

David Evans and Associates, Inc. 2001. *I-405 Corridor Program Draft Land Use Plans and Policies Expertise Report.* Bellevue, Washington.

David Evans and Associates, Inc. 2001. *I-405 Corridor Program Draft Upland Vegetation, Habitat, and Wildlife Expertise Report.* Bellevue, Washington.

Franklin, Jerry F. and C.T. Dyrness. 1973. *Natural Vegetation of Oregon and Washington.* General Technical Report PNW-8. U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 417 p. Portland, OR.

Grubb, T.G. 1976. *A Survey and Analysis of bald eagle nesting in Western Washington.* Masters Thesis. University of Washington, Seattle, Washington.

Snohomish County. January 2000. *Snohomish County GMA Comprehensive Plan.*

U.S. Department of the Interior, Fish and Wildlife Service. 1986. *Recovery Plan for the Pacific bald eagle*. USFWS, Portland, Oregon. 160 pp.

Washington State Department of Fish and Wildlife. 2000. *Priority Habitats and Species Program.* Olympia, Washington.

3.8 FISH, AQUATIC HABITAT, AND THREATENED AND ENDANGERED SPECIES

CH2M HILL. 2001a. *I-405 Corridor Program Draft Surface Water Resources Expertise Report.* Bellevue, Washington.

CH2M HILL. 2001b. *I-405 Corridor Program Draft Geology and Soils Expertise Report.* Bellevue, Washington.

City of Renton and King County. 2001. Final Adopted May Creek Basin Action Plan.

David Evans and Associates, Inc. 2001a. *I-405 Corridor Program Draft Fish and Aquatic Habitat Expertise Report.* Bellevue, Washington.

David Evans and Associates, Inc. 2001b. *I-405 Corridor Program Draft Wetlands Expertise Report.* Bellevue, Washington.

David Evans and Associates, Inc. 2001c. *Fish Summary and Mitigation Report for the I-405 Corridor Program*.

David Evans and Associates, Inc. 2002. *I-405 Corridor Program Errata and Addenda to Expertise Reports.* Bellevue, Washington.

Grette, G.B. and E.O. Salo. 1986. *The Status of Anadromous Fishes of the Green/Duwamish River System*. Evans-Hamilton, Inc. Seattle, Washington.

Kerwin, J. 2001. *Salmon and Steelhead Habitat Limiting Factors Report for the Cedar – Sammamish Basin (Water Resource Inventory Area 8).* Washington Conservation Commission. Olympia, WA.

Kerwin, J. and T. Nelson. 2000. *Habitat Limiting Factors and Reconnaissance Assessment Report, Green/Duwamish and Central Puget Sound Watersheds (WRIA 9 and Vashon Island).* Washington Conservation Commission and the King County Department of Natural Resources.

King County. 1993. *Cedar River current and future conditions report.* King County Department of Public Works: Surface Water Management Division. 450 pp.

King County. 1999. GIS data. CD-ROM.

King County. 2000a. *Habitat limiting factors and reconnaissance report executive summary*: WRIA 9. King County Department of Natural Resources. 902 pp.

King County. 2000b. *WRIA 9 Factors of Decline Subcomittee Direction for 2000.*

King County. 2001a. *Reconnaissance assessment report*: WRIA 8. King County Department of Natural Resources. Unpublished draft.

King County. 2001b. King County Salmon Recovery internet site. http://www.metrokc.gov/exec/esa

King County Department of Natural Resources. 2000. *Literature Review and Recommended Sampling Protocol for Bull Trout in King County*. KCDNR. Seattle, WA. June, 2000.

May, C. 1996. *Assessment of Cumulative Effects of Urbanization on Small Streams in the Puget Sound Lowland Ecoregion: Implications for Salmonid Resource Management.* University of Washington. Doctoral Dissertation. 383 p.

National Marine Fisheries Service. 1999a. Federal Register, National Oceanic and Atmospheric Administration, 50 CFR Parts 223 and 224, *Endangered and Threatened Species; Threatened Status for Three Chinook Salmon Evolutionarily Significant Units in Washington and Oregon, and Endangered Status of One Chinook Salmon ESU in Washington*; Final Rule. March 24, 1999. Department of Commerce. Washington D.C.

National Marine Fisheries Service. 1999b. Federal Register, National Oceanic and Atmospheric Administration, 50 CFR Part 660. Department of Commerce, Washington D.C.

Pacific Fisheries Management Council. 1998. Amendment 8 to the Northern Anchovy Fishery Management Plan. *Essential Fish Habitat, Coastal Pelagic Species.* Pacific Fisheries Management Council. Portland, Oregon.

Pacific Fisheries Management Council. 1999. Amendment 14 to the Pacific Coast Salmon Plan. Appendix A. *Identification and Description of Essential Fish Habitat, Adverse Impacts, and Recommended Conservation Measures for Salmon.* Pacific Fisheries Management Council. Portland, Oregon.

Tabor, R. and B. Footen. 2000. *Predation of Juvenile Salmon by Littoral Fishes in the Lake Washington-Lake Union Ship Canal, Preliminary Results.* Prepared by U.S. Fish and Wildlife Service and Muckleshoot Indian Tribe. Lacey, WA, and Auburn, WA, respectively.

U.S. Army Corps of Engineers, Seattle District. 1997. *Green/Duwamish River Ecosystem Restoration General Investigation: Reconnaissance Report.* U.S. Army Corps of Engineers, Seattle District. Seattle, WA.

WDFW and WWTIT. 1994. 1992 Washington State – Salmon and Steelhead Stock Inventory – Appendix One – Puget Sound Stocks – South Puget Sound Volume. Olympia, WA.

Warner, E. and R. Fritz. 1995. *The Distribution and Growth of Green River Chinook Salmon (Oncorhynchus tshawytscha) and Chum Salmon (Oncorhynchus keta) Outmigrants in the Duwamish Estuary as a Function of Water Quality and Substrate.* Muckleshoot Indian Tribe – Fisheries Department – Water Resources Division. Auburn, WA.

Washington Department of Ecology. 2000a. *State of Washington Alternative Mitigation Policy Guidance for Aquatic Permitting Requirements from the Departments of Ecology and Fish and Wildlife.* February 10, 2000 memorandum. Olympia, Washington.

Washington Department of Ecology. August 2001. *Stormwater Management Manual for Western Washington.* Olympia, Washington.

Washington Department of Fish and Wildlife and Western Washington Treaty Tribes. 1994. *1992 Washington State Salmonid Stock Inventory*, South Puget Sound. Olympia, Washington.

Washington Department of Fish and Wildlife. 1998. *1998 Washington State Salmonid Stock Inventory, Bull Trout and Dolly Varden Appendix*. Olympia, Washington.

Washington Department of Fish and Wildlife. 2000a. Streamnet GIS database.

Washington Department of Fish and Wildlife. 2000. *Progress Performance Report for Fish Passage Inventory, Corrections, and Project Evaluation*. Olympia, Washington.

Watershed Company. 1998. *Kirkland's Streams, Wetlands, and Wildlife Study*. City of Kirkland, Washington Dept. Planning and Community Development.

Wydoski, R.S., and R.R. Whitney. 1979. *Inland Fishes of Washington*. University of Washington Press, Seattle, Washington.

3.9 FARMLAND

David Evans and Associates, Inc. 2001. *I-405 Corridor Program Draft Farmland Expertise Report.* Bellevue, Washington.

David Evans and Associates, Inc. 2001. *I-405 Corridor Program Draft Land Use Expertise Report.* Bellevue, Washington.

Herring, Judy. Personal Communication. 8 November 2000.

King County. 1998. King County GIS, Comprehensive Plan Agricultural Layer.

3.10 FLOODPLAINS

David Evans and Associates, Inc. 2001. *I-405 Corridor Program Draft Floodplain Expertise Report.* Bellevue, Washington.

Federal Emergency Management Agency. National Flood Insurance Program. Flood Insurance Rate Maps (FIRM) for King County, Washington, and Incorporated Areas. Maps dated May 16, 1995, and November 8, 1999.

Federal Emergency Management Agency. National Flood Insurance Program. Flood Insurance Rate Maps (FIRM) for Snohomish County, Washington, and Incorporated Areas. Maps dated November 8, 1999.

King County. 2000 King County web site. *www.metrokc.gov*. January, 17, 2002

King County. 1999. DDES Information Bulletin #38 Flood Insurance and FEMA.

Washington Department of Fish and Wildlife. March 3, 1999. *Fish Passage Design at Road Culverts: A design manual for fish passage at road crossings.*

Washington State Department of Transportation. April 19, 1997. *Hydraulics Manual.* M 23-03.

3.11 SHORELINES

City of Bellevue Shoreline Master Program.

City of Bothell Shoreline Master Program.

City of Kenmore Shoreline Master Program.

City of Kent Shoreline Master Program.

City of Kirkland Shoreline Master Program.

City of Newcastle Shoreline Master Program.

City of Redmond Shoreline Master Program.

City of Renton Shoreline Master Program.

City of Tukwila Shoreline Master Program.

City of Woodinville Shoreline Master Program.

David Evans and Associates, Inc. 2001. *I-405 Corridor Program Draft Shorelines Expertise Report.* Bellevue, Washington.

King County Shoreline Master Program.

Snohomish County Shoreline Master Program.

Washington Administrative Code. 1998. *Shoreline Management Act - Lakes Constituting Shorelines of the State.*

Washington Administrative Code. 1998. *Shoreline Management Act - Streams and Rivers Constituting Shorelines of the State.*

3.12 TRANSPORTATION

BRW, Inc., March 1998, *Mobility Action Priorities: Eastside Transportation Partnership.* Final Report.

CH2M HILL. February 1989. *Alternatives Report: Eastside Transportation Program.* KJS Associates, Inc.

David Evans and Associates, Inc., and Mirai Associates. August 2000. *I-405 Corridor Program: Alternatives Report (Draft).* Submitted to Washington State Department of Transportation. Bellevue, Washington.

DeCorla-Souza, Patrick. Spring, 2000. *Induced Highway Travel: Transportation Policy Implications for Congested Metropolitan Areas.* Transportation Quarterly, Vol 54: No.2 p.18. Eno Transportation Foundation, Inc., Washington D.C.

Dowling Associates, October 1994. Effects of Increased Highway Capacity on Travel Behavior. Final Report.

Eastside Jurisdictions (Renton, Bothell, Kirkland, Bellevue), Miscellaneous traffic and accident data records, 1995-1999.

Eastside Transportation Partnership. November 1989. *Recommendations: Eastside Transportation Program.*

Ishimaru, John M. and Mark E. Hallenbeck. March 1999. *Central Puget Sound Freeway Network Usage and Performance*, Washington State Transportation Center, University of Washington.

Metropolitan King County Council. May 10, 2000. KCCP-2000 Transportation Committee Draft Policy Recommendations.

Mirai Associates and David Evans and Associates, Inc. April 2001. *I-405 Corridor Program Draft Transportation Expertise Report.* Bellevue, Washington.

Puget Sound Regional Council. May 25, 1995. *1995 Metropolitan Transportation Plan: The Transportation Element of VISION 2020, the Region's Adopted Growth and Transportation Strategy.*

Puget Sound Regional Council. May 28, 1998. *1998 Progress Report: 1995 Metropolitan Transportation Plan.*

Puget Sound Regional Council. 2000. *2001 Update Metropolitan Transportation Plan: Baseline Technical Report.*

Puget Sound Regional Council. March 15, 2001. *Draft Destination 2030: Metropolitan Transportation Plan for the Central Puget Sound Region, Executive Summary.*

Sound Transit. May 31, 1996. *Sound Move – The 10-Year Regional Transit System Plan.*

Washington State Department of Transportation. *Central Puget Sound Freeway Network Usage and Performance-1999 Update*, Volume 1, Draft, available in the Washington State Transportation Center internet web site. http://depts.washington.edu/trac/

Washington State Department of Transportation. 1999-2018. *The State Highway System Plan* (Second Printing).

Washington State Department of Transportation and Mirai Associates. August 1999. *I-405 Corridor Program: Relevant Transportation Plans, Projects and Programs* - Working Papers #12 and #26, Submitted to Washington State Department of Transportation.

Washington State Department of Transportation. Traffic Accident Database, 1994-1996. Obtained from WSDOT data office.

3.13 LAND USE

Blain, Larry. 2000. Personal communication with Larry Blain, principal planner, Puget Sound Regional Council. September 12, 2000.

Bureau of the Census. March 1994. *Current Population Reports: Population Projections for States by Age, Sex, Race, and Hispanic Origin: 1993 to 2020.*

Conway, Dick. September 15, 2000. Personal communication with Dick Conway, regional economist and president of Dick Conway & Associates.

David Evans and Associates, Inc. 2001a. *I-405 Corridor Program Draft Land Use Expertise Report.* Bellevue, Washington.

David Evans and Associates, Inc. 2001b. *I-405 Corridor Program Draft Land Use Plans and Policies Expertise Report.* Bellevue, Washington.

David Evans and Associates, Inc. 2001c. *I-405 Corridor Program Draft Right-of-Way and Displacements Expertise Report.* Bellevue, Washington.

Growth Management Planning Council (King County). April 1997. *Residential Land Capacity Report.* Draft Report to the Land Capacity Task Force.

King County. 2000. *The 2000 Annual Growth Report: A Report on Growth and Development Trends in King County, Its Cities and Planning Areas.*

Puget Sound Regional Council. March 1986. *DRAM 85/EMPAL 85 Activity Model System: Development, Structure, and Application in the Puget Sound Region.*

Puget Sound Regional Council. September 1994. *Metropolitan Transportation Plan Technical Report: MTP-12*. The Regional Transportation Modeling Process.

Puget Sound Regional Council. 1995. *VISION 2020*, 1995 Update.

Puget Sound Regional Council. September 1997. *Regional Economic and Demographic Data Base, Modeling, and Forecasting*: Data Base for Puget Sound Region Specification of STEP97 Long-Range Forecasts for Puget Sound. Prepared by Dick Conway & Associates.

Puget Sound Regional Council. February 1998. *Industrial Land Supply and Demand in the Central Puget Sound Region.* Prepared by the University of Washington Center for Community Development and Real Estate.

Puget Sound Regional Council. 1999. *1999 Population and Employment Working Forecasts.*

Spencer, Gregory. September 14, 2000. Personal communication with Gregory Spencer, demographer, Forecasting Division, U.S. Bureau of the Census.

Washington State Office of Financial Management. December 1996. *Forecast of the State Population: November 1996.*

3.14 DISPLACEMENTS AND ROW ACQUISITION

Comps, Inc. database.

David Evans and Associates, Inc. 2001. *I-405 Corridor Program Draft Right-of-Way and Displacements Expertise Report.* Bellevue, Washington.

Northwest Multiple Listing Service.

King County. Washington County Assessors parcel data.

Snohomish County. Washington County Assessors parcel data.

3.15 SOCIAL IMPACTS

CH2M HILL. 2001a. *I-405 Corridor Program Draft Environmental Justice Expertise Report.*

CH2M HILL. 2001. *I-405 Corridor Program Draft Social Expertise Report.*

City of Bellevue. 1999. *City of Bellevue Comprehensive Plan*.

City of Bothell. 1996. *City of Bothell Comprehensive Plan*.

City of Kenmore. 2000. *Draft City of Kenmore Comprehensive Plan*.

City of Kent. May 2000. City of Kent Comprehensive Land Use Map.

City of Kent. 1996. *City of Kent Comprehensive Plan*.

City of Kirkland. December 1998. City of Kirkland Comprehensive Land Use Map.

City of Kirkland. 1999. *City of Kirkland Comprehensive Plan*.

City of Newcastle. 1997. *City of Newcastle Comprehensive Plan*.

City of Redmond. 1999. *City of Redmond Comprehensive Plan*.

City of Renton. 2000. *City of Renton Comprehensive Plan*.

City of Tukwila. 1995. City of Tukwila Zoning Map.

City of Tukwila. 1995 *City of Tukwila Comprehensive Plan*.

City of Woodinville. 1996. *City of Woodinville Comprehensive Plan*.

Economic Development Council of Seattle and King County. 1999. *City Profiles*.

King County. 1994. *King County-Wide Planning Policies.*

King County. 1998. *Office of Regional Policy and Planning 1998 Annual Growth Report.*

Smith, Jeff, City of Bothell. October 30, 2000. Phone conversation with Alene Wilson, CH2M HILL.

Snohomish County. 2000. *Snohomish County General Policy Plan*.

Snohomish County. 2000. *Washington State Office of Financial Management; Snohomish County Information*.

3.16 ECONOMICS

Transportation and the Economy: National and State Perspectives. Washington, D.C.

Cambridge Systematics, Inc. June 1994. *Impact of Urban Congestion on Business.* National Cooperative Highway Research Program Project 2-17(5). Transportation Research Board, National Research Council, Washington, D.C.

CH2M HILL. 2001. *I-405 Corridor Program Draft Economics Expertise Report.*

City of Renton. 2000. City Statistics. Available at: http://www.ci.renton.wa.us/attract/citystat.htm.

David Evans and Associates, Inc. 2001. *I-405 Corridor Program Draft Right-of-Way and Displacements Expertise Report.* Bellevue, Washington.

David Evans and Associates, Inc. 2001. *I-405 Corridor Program Draft Land Use Expertise Report.* Bellevue, Washington.

Eberts, Randall W. July 1999. *How Levels of Investment in Transportation Affect Economic Health.* W.E. Upjohn Institute for Employment Research.

ECONorthwest. 1999. *Issue Papers.* Blue Ribbon Commission on Transportation.

Federal Highway Administration. 1992. *Assessing the Relationship Between Transportation Infrastructure and Productivity*.

Forkenbrock, David; Norman Foster. August 1996. Highways and business location decisions. *Economic Development Quarterly*. Volume 10, No. 3.

Grant, David A. January 6, 1999. Land, labor woes drive Genie east; lack of affordable sites, tight work force prompt Redmond firm to expand to Moses Lake. *Eastside Journal* on-line. Available at: http://www.eastsidejournal.com/ejbiz_archive/djt66083.html.

Ishaq, Nadiri M.; Theofanis P. Mamuneas. 1996. *Contribution of Highway Capital to Industry and National Productivity Growth*. Apogee Research Inc., Federal Highway Administration.

Keane, Thomas F. 1996. *The Economic Importance of the National Highway System*, Public Roads On-Line: http://www.tfhrc.gov/pubrds/spring96/p96sp16.htm.

King County Department of Assessments. 2000. *2000 Codes and Levies: King County Taxing Districts.*

Litman, Todd and Felix Laube. 1999. *Automobile Dependency and Economic Development.* Victoria Transport Policy Institute and Institute for Science and Technology Policy.

Munnell, Alicia. November 1990. "How does public infrastructure affect regional economic performance?" *New England Economic Review.*

Puget Sound Business Journal. December 24-31, 1997. Largest private-sector employers on the Eastside. p. 41.

Puget Sound Business Journal. January 24-29, 1999. Largest private-sector employers in the Puget Sound Region. p. 24.

Puget Sound Regional Council. 1997, 1999. *Population and Employment Forecasts.*

Puget Sound Regional Council. 2000. *DRAM85/EMPAL85 Model Results.*

Snohomish County Assessor's Office. 2000. *Snohomish County Assessor's Annual Report for 2000 Taxes*: http://www.co.snohomish.wa.us/assessor/report2000.htm.

Transportation Research Board. 1997. *Macroeconomic Analysis of the Linkages Between Transportation Investments and Economic Performance*. National Cooperative Highway Research Program Report 389.

Transportation Research Board. 1998. *Research on the Relationship Between Economic Development and Transportation Investment*. National Cooperative Highway Research Report 418.

Transportation Research Board. 1999. *Economic Trends and Multimodal Transportation Requirements*. National Cooperative Highway Research Program Report 421. National Academy Press, Washington, DC.

UCLA Extension. December 7-9, 1997. Summary of proceedings from "Transportation and the Economy," UCLA Extension Public Policy Program Annual Symposium Series. UCLA Conference Center, Lake Arrowhead, CA.

Washington State Department of Revenue. 2000. *Part 1: Senior Taxing District Levies Due in 2000*: http://dor.wa.gov/reports/proptax00/tables/table21-s.xls.

Washington State Department of Revenue. 1999. *Covered Employment and Wages by Industry*.

Washington State Department of Transportation. 1996. *The Potential for Freight Productivity Improvements Along Urban Corridors*.

Weisbrod, Glen. 1996. *Distinguishing Wide and Local Area Business Impacts of Transportation Investments*. Transportation Research Record No. 1552, Transportation Research Board. National Academy Press.

Weisbrod, Glen and Frederick Treyz. October 1998. Productivity and accessibility: bridging project specific and macroeconomic analyses of transportation investments. *Journal of Transportation and Statistics*. Volume 1, Number 3. p. 65-79.

3.17 RECREATIONAL RESOURCES

City of Newcastle Comprehensive Plan – Parks, Trials and Open Space Element, 6/16/97.

City of Redmond Comprehensive Plan – Parks and Recreation Element, 5/95.

City of Bellevue Comprehensive Plan – Parks, Open Space and Recreation Element, 4/7/97.

City of Bothell Comprehensive Plan – Parks and Recreation Element, 6/97.

City of Woodinville Comprehensive Plan – Parks and Recreation Element, 7/98 (amended).

City of Tukwila Comprehensive Plan – Parks and Recreation Element, 12/4/95.

City of Kirkland Comprehensive Plan – Parks and Recreation Element.

City of Renton Comprehensive Plan – Land Use Element (Parks/Open Space) Element 2/20/95 (amended 7/98).

David Evans and Associates, Inc. 2001. *I-405 Corridor Program Draft Recreation and Section 4(f) Resources Expertise Report.* Bellevue, Washington.

King County Comprehensive Plan – Parks and Recreation Element, 12/99 (amended).

Snohomish County Comprehensive Plan – Parks and Recreation Element, 1/2000.

3.18 PUBLIC SERVICES

City of Newcastle Comprehensive Plan - Capital Facilities Element, 6/16/97.

City of Redmond Comprehensive Plan - Capital Facilities Element, 5/95.

City of Bellevue Comprehensive Plan - Capital Facilities Element, 4/7/97.

City of Bothell Comprehensive Plan – Capital Facilities Element, 6/97.

City of Woodinville Comprehensive Plan – Capital and Public Facilities Element, 7/98 (amended).

City of Tukwila Comprehensive Plan – Capital Facilities Element, 12/4/95

City of Kirkland Comprehensive Plan – Capital Facilities Element, 1999.

City of Mercer Island Comprehensive Plan – Capital Facilities Element, October 1994, Amended 1998.

City of Renton Comprehensive Plan – Capital Facilities Element, 7/27/98 (amended).

David Evans and Associates, Inc. 2001. *I-405 Corridor Program Draft Public Services Expertise Report.* Bellevue, Washington.

Federal Emergency Management Agency. July, 1984. *Objectives for Local Emergency Management* (CPG 1-5)

Federal Emergency Management Agency. September 1984. *Transportation Planning Standards for the Evacuation of Large Populations* (CPG2-15)

Federal Emergency Management Agency. September 1990. *Guide for Development of State and Local Emergency Operations Plans* (CPG 1-8)

King County Comprehensive Plan – Facilities and Services Element, 12/99 (amended).

Snohomish County Comprehensive Plan – Capital Facilities Element, 1/2000.

3.19 UTILITIES

Blackburn, Bruce. 2000. City of Bothell Public Utilities Sanitary. Personal communication, January 18.

Broden, Pat. 2000. City of Tukwila Water/Sanitary Sewer. Personal communication, January 18.

Cox, Ed. 2000. King County Metro Sewer. Personal communication, November 22.

Gambill, Bob. 2000. City of Seattle Public Works Department. Personal communication, January 25.

Gray, Chris. 2000. WSDOT Utilities Department. Personal communication, January 20.

Gross, Kevin. 2000. City of Newcastle. Personal communication, January 18.

HNTB Corporation, Inc. 2001. *I-405 Corridor Program Draft Utilities Expertise Report.*

Jodock, Jim. 2000. Snohomish Public Utilities Department. Personal communication, November 27.

Maloney, Pam. 2000. Utility Planning Manager, City of Bellevue. Personal communication, January 18.

McFarlane, Glenn. 2000. AT&T/TCI. Personal communication, January 19.

Nietfeld, Sam. 2000. Planner, Snohomish Public Utilities Department. Personal communication, January 19.

O'Neil, Shaun. 2000. King County Metro Sewer. Personal communication, November 22.

Otto, Rick. 2000. City of Renton Public Utilities. Personal communication, January 18.

Reed, Kathy. 2000. Olympic Pipe Line Co. Personal communication, November 22.

Schwartz, Bob. 2000. City of Seattle Public Utilities. Personal communication, November 22.

Steiger, Ray. 2000. Project Manager, City of Kirkland Public Utilities. Personal communication, January 18.

Van Nort, Jason. 2000. Puget Sound Energy. Personal communication, November 22.

Williamson, Greg. 2000. Office Manager, Alderwood Water and Sewer District. Personal communication, January 18.

3.20 VISUAL QUALITY

Anderson, Sally; MacLaren, Beth, Landscape Architects; WSDOT. 2000. Personal Communication during meeting at WSDOT offices, September 5, 2000.

City of Bellevue. 1997. Comprehensive Plan.

City of Bothell. 1997. Comprehensive Plan.

City of Kirkland. 1999. Comprehensive Plan.

City of Renton. 1998. Comprehensive Plan.

City of Tukwila. 1995. Comprehensive Plan.

David Evans and Associates, Inc. 2001. *I-405 Corridor Program Draft Visual Resources Expertise Report.* Bellevue, Washington.

Federal Highway Administration. *Visual Impact Assessment for Highway Projects* (FHWA-HI-88-054). U.S. Department of Transportation.

Washington State Department of Transportation. June 1, 1996. *Roadside Classification Plan.* M 25-31

3.21 HISTORIC, CULTURAL, AND ARCHAEOLOGICAL RESOURCES

Bagley, C. 1929. *History of King County, Washington.* S.J. Clarke Publishing Company, Chicago.

Ballard, A.C. 1929. *Mythology of Southern Puget Sound.* University of Washington Publications in Anthropology 3(2):31-150, Seattle.

Beason, T. 2000. Farm Country: Family plots thrived until postwar growth replaced them with roads and homes. In, *A Hidden Past: An Exploration of Eastside History.* The Seattle Times, Seattle, Washington.

Berger [Louis] and Associates. 1993. *Phase IA Cultural Resource Investigations of Proposed Federal Detention Center Sites, King County, Washington.* National Archaeological Data Base Document No. 1334021 on file, Office of Archaeology and Historic Preservation, Lacey.

Blukis-Onat, A.R., L.A. Bennett, and J.L. Hollenbeck. 1980. *Cultural Resource Overview and Sample Survey of the Skagit Wild and Scenic River*. Institute of Cooperative Research, Seattle. Report on file, Mt. Baker-Snoqualmie National Forest.

Burkitt, J. 2000a. Issaquah: One man's industrial adventures shaped the Eastside's oldest city. In, *A Hidden Past: An Exploration of Eastside History*. The Seattle Times, Seattle, Washington.

Burkitt, J. 2000b. Eastsiders in Exile: More than 400 local Japanese Americans were sent to internment camps. In, *A Hidden Past: An Exploration of Eastside History*. The Seattle Times, Seattle, Washington.

Campbell, S.K. 1981. *The Duwamish No. 1 Site: A Lower Puget Sound Shell Midden*. Office of Public Archaeology, University of Washington, Seattle, Research Report 1.

CH2M HILL. 2001. *I-405 Corridor Program Draft Cultural Resources Expertise Report.*

Chatters, J.C. 1981. *Archaeology of the Sbabadid Site, 45-KI-51, King County, Washington*. Office of Public Archaeology, University of Washington, Seattle.

Chatters, J.C. 1987. *Tualdad Altu (45-KI-59): A 4th Century Village on the Black River, King County, Washington*. Report on file, Office of Archaeological and Historic Preservation, Lacey, Washington.

Corsaletti, L.T. 2000. Black Diamonds: By the 1870s Newcastle was the center of a bustling mining economy. In, *A Hidden Past: An Exploration of Eastside History*. The Seattle Times, Seattle, Washington.

Corsaletti, L.T. 2000. The Wild, Wild East: Shoot-'em-up robberies were big news locally during the Roaring '20s. In, *A Hidden Past: An Exploration of Eastside History*. The Seattle Times, Seattle, Washington.

Corsaletti, L.T. 2000. Mercer Island: The island's rich history includes Native American folklore and colorful pioneers. In, *A Hidden Past: An Exploration of Eastside History*. The Seattle Times, Seattle, Washington.

Denny, E.I. 1909. *Blazing the Way: True Stories, Songs and Sketches of Puget Sound and other Pioneers*. Rainier Printing Company, Seattle.

Dudley, B. 2000. Redmond: The McRedmond family prevailed in a decades-long feud over the town's name. In, *A Hidden Past: An Exploration of Eastside History*. The Seattle Times, Seattle, Washington.

Dudley, B. 2000. War comes home: World War II brought jobs, an influx of people and a preview of future prosperity. In, *A Hidden Past: An Exploration of Eastside History*. The Seattle Times, Seattle, Washington.

Ervin, K. 2000. A Battle for Overlake: The 13-year development war set the stage for a shift to a high-tech economy. In, *A Hidden Past: An Exploration of Eastside History*. The Seattle Times, Seattle, Washington.

Forsman, L.A. 1994. *Assessing Traditional Cultural Properties in Urban Settings: An Example from the Duwamish River Valley in Southern Puget Sound: Alki Transfer/CSO (Combined Sewage Outfall) Transfer Project, Traditional Cultural Properties Assessment*. Paper presented at the 47th Annual Northwest Anthropological Conference, Spokane, Washington.

Forsman, L.A., D.E. Lewarch, and L.L. Larson. 1997. *Denny Way/Lake Union Combined Sewer Overflow Control Project, Seattle, King County, Cultural Resources Assessment*. Report on file, Office of Archaeology and Historic Preservation, Lacey, Washington.

Green, S.J. 2000. Woodinville: A neglected graveyard in the middle of the city is a link to a forgotten past. In, *A Hidden Past: An Exploration of Eastside History*. The Seattle Times, Seattle, Washington.

Grindeland, S. 2000. Lost towns: Coal and lumber towns that once shored up the local economy have vanished. In, *A Hidden Past: An Exploration of Eastside History*. The Seattle Times, Seattle, Washington.

Grindeland, S. 2000. The railroads: Freeways of commerce from the 1880s to the late 1940s. In, *A Hidden Past: An Exploration of Eastside History*. The Seattle Times, Seattle, Washington.

Grindeland, S. 2000. Liquor and lust: This was the frontier, with plenty of rowdy men and illicit enterprises. In, *A Hidden Past: An Exploration of Eastside History*. The Seattle Times, Seattle, Washington.

Grindeland, S. 2000. Celebrations: Eastsiders have always known how to throw a good party. In, *A Hidden Past: An Exploration of Eastside History*. The Seattle Times, Seattle, Washington.

Grindeland, S. 2000. History on the fly: For decades airports dotted the Eastside to support a high interest in aviation. In, *A Hidden Past: An Exploration of Eastside History*. The Seattle Times, Seattle, Washington.

Grindeland, S. 2000. Defending the Eastside: World War II volunteers and Cold War missile sites played key military roles. In, *A Hidden Past: An Exploration of Eastside History*. The Seattle Times, Seattle, Washington.

Grindeland, S. 2000. Time traveling: Take an afternoon to tour the history that lingers around the Eastside. In, *A Hidden Past: An Exploration of Eastside History*. The Seattle Times, Seattle, Washington.

Haeberlin, H. 1918. *SbeTeTDA'Q, a Shamanistic Performance of the Coast Salish*. American Anthropologist 20(3):248-257.

Hart Crowser, Inc. 1998. *Football/Soccer Stadium and Exhibition Center Project: Appendix K, Cultural and Archaeological Resources Technical Report*. Report on file, Historical Research Associates, Inc., Seattle, Washington.

Harrington, J.P. ca. 1909. *John P. Harrington Papers*. National Anthropological Archives, Smithsonian Institution. Reel 15: 1907-1957 on microfilm, Suzzallo Library, University of Washington, Seattle.

King, T.F. 2000. *Federal Planning and Historic Places: The Section 106 Process*. Alta Mira Press, Walnut Creek, California.

Lane, B. 1975. *Identity, Treaty Status and Fisheries of the Tulalip Tribes of Indians.* Report prepared for the US Department of the Interior and the Tulalip Tribe of Indians. Ms on file at Special Collections, Allen Library, University of Washington, Seattle.

Lane, B. 1975. *Identity and Treaty Status of the Duwamish Tribe of Indians.* Report prepared for the U.S. Department of the Interior and the Duwamish Tribe. Ms on file at Special Collections, Allen Library, University of Washington, Seattle.

Larson, L.L., and D.E. Lewarch. 1995. *The Archaeology of West Point, Seattle, Washington: 4,000 Years of Hunter-Fisher-Gatherer Landuse in Southern Puget Sound*. Report on file, Office of Archaeology and Historic Preservation, Lacey, Washington.

Lewarch, D.E., M.J. Madson and L.A. Forsman. 2000. *Marymoor Park Baseball Field Rehabilitation Project, King County, Washington, Archaeological Resources Assessment.* Report on file, Office of Archaeology and Historic Preservation, Lacey, Washington.

Lindblom, M. 2000. The old schools: Frontier students waded through mud and endured the whip for an education. In, *A Hidden Past: An Exploration of Eastside History*. The Seattle Times, Seattle, Washington.

Lindblom, M. 2000. Hops and dreams: A short-lived boom in the 1880s left a long legacy in the Snoqualmie Valley. In, *A Hidden Past: An Exploration of Eastside History*. The Seattle Times, Seattle, Washington.

McOmber, J.M. 2000. Meydenbauer whalers: Bellevue was one of the last active whaling ports in the United States. In, *A Hidden Past: An Exploration of Eastside History*. The Seattle Times, Seattle, Washington.

McOmber, J.M. 2000. Bellevue: The early planner's vision: Bellevue would be everything Seattle wasn't. In, *A Hidden Past: An Exploration of Eastside History*. The Seattle Times, Seattle, Washington.

Office of Archaeology and Historic Preservation [OAHP]. 1987. *Resource Protection Planning Process, Paleoindian Study Unit.* RP3 Document Prepared for the Washington State Department of Community Development. Office of Archaeology and Historic Preservation, Lacey, Washington.

Office of Archaeology and Historic Preservation [OAHP]. 1987. *Resource Protection Planning Process, Southern Puget Sound Study Unit*. RP3 Document Prepared for the Washington State Department of Community Development. Office of Archaeology and Historic Preservation, Lacey, Washington.

Reang, P. 2000. People of the moon: The Snoqualmies were once one of the largest and most feared tribes in the area. In, *A Hidden Past: An Exploration of Eastside History*. The Seattle Times, Seattle, Washington.

Reid, K.C. 1992. Paleoenvironmental context. In, R. Schalk and R. Taylor (eds.) *The Archaeology of Chester Morse Lake: Investigations for the Cedar Falls Improvement Project*. Center for Northwest Anthropology, Department of Anthropology, Project Report No. 19, Washington State University, Pullman.

Ruby, R.H., and J.A. Brown. 1992. *A Guide to the Indian Tribes of the Pacific Northwest.* University of Oklahoma Press, Norman.

Smith, M.W. 1940. *The Puyallup-Nisqually.* Columbia University Press Contributions to Anthropology, Volume 32. Columbia University Press, New York.

Solomon, C. 2000. Great escapes: The Eastside was the place to be on a sunny Saturday in the early 1900s. In, *A Hidden Past: An Exploration of Eastside History*. The Seattle Times, Seattle, Washington.

Thompson, G., and M. L. Stilson. 1988. Letter to Fred Grimm, Triad Development, reporting findings of a cultural resource survey for the Signature Point Apartment Complex, near Kent, Washington. Report on file, Washington Office of Archaeology and Historic Preservation, Olympia, Washington.

Tobin, C.C., and L.F. Pendergrass. 1993. *Bellevue Historic and Cultural Resources Survey*. Report on file, Office of Archaeology and Historic Preservation, Lacey, Washington, and City of Bellevue Design and Development Department, Bellevue, Washington.

URS Corporation and BOAS, Inc. 1987. *The Duwamish No. 1 Site 1986 Data Recovery*. Report on file, Office of Archaeology and Historic Preservation, Lacy, Washington.

U.S. Department of the Interior. 1992. *The Secretary of the Interior's Standards for the Treatment of Historic Properties*. National Park Service, Washington, D.C.

Vinh, T. 2000. Bothell: Rooted in logging and farming, it became one of the Eastside's liveliest towns. In, *A Hidden Past: An Exploration of Eastside History*. The Seattle Times, Seattle, Washington.

Waterman, T.T. 1922. The geographical names used by the Indians of the Pacific Coast. *The Geographical Review*, Volume 12. The American Geographical Society, New York.

Waterman, T.T. ca. 1920. *Puget Sound Geography*. Manuscript 1864 on file, National Anthropological Archives, Smithsonian Institution, Washington, D.C.

Wessen, G. 1985. *Resource Protection Planning Process, Southern Puget Sound Study Unit: Identification Component.* Report on file, Washington Office of Archaeology and Historic Preservation, Olympia, Washington.

Whitely, P. 2000. Before the bridges: Until 1950, most Eastsiders crossing Lake Washington traveled by ferry. In, *A Hidden Past: An Exploration of Eastside History*. The Seattle Times, Seattle, Washington.

Whitely, P. 2000. Changing channels: Decades of dredging turned the winding Sammamish River into a straight ditch. In, *A Hidden Past: An Exploration of Eastside History*. The Seattle Times, Seattle, Washington.

Whitely, P. 2000. Getting on the Map: The desire to cross Snoqualmie Pass led to the creation of many Eastside roads. In, *A Hidden Past: An Exploration of Eastside History*. The Seattle Times, Seattle, Washington.

Whitely, P. 2000. Kirkland: Peter Kirk's vision, a steel mill supporting a city of 40,000, was never realized. In, *A Hidden Past: An Exploration of Eastside History*. The Seattle Times, Seattle, Washington.

Whitely, P. 2000. Unlocking the lake: The lowering of Lake Washington brought unexpected changes to the Eastside. In, *A Hidden Past: An Exploration of Eastside History*. The Seattle Times, Seattle, Washington.

3.22 HAZARDOUS MATERIALS AND WASTES

CH2M HILL. 2001. *I-405 Corridor Program Draft Hazardous Materials and Wastes Technical Memorandum.*

David Evans & Associates, Inc. October 23, 2000. *EIS Alternatives Impervious Surface*. Bellevue, Washington.

Environmental Data Resources. November 7, 2000. *Area/Corridor Study I-405 EIS, King County, Washington*. 2,463 pp.

3.23 CUMULATIVE EFFECTS

Council on Environmental Quality. January, 1997. *Considering Cumulative Effects Under the National Environmental Policy Act.*

David Evans and Associates, Inc. 2001a. *I-405 Corridor Program Draft Land Use Plans and Policies Expertise Report.* Bellevue, Washington.

David Evans and Associates, Inc. 2001b. *I-405 Corridor Program Draft Land Use Expertise Report.* Bellevue, Washington.

David Evans and Associates, Inc. 2001c. *I-405 Corridor Program Draft Fish and Aquatic Habitat Expertise Report.* Bellevue, Washington.

Eastside Jurisdictions (Renton, Bothell, Kirkland, Bellevue), Miscellaneous traffic and accident data records, 1995-1999.

Ervin, David E. 1998. *Visions Of Agricultural Conservation Policy Beyond 2002: Implications For Partnerships.* WP98-9. Center for Agriculture in the Environment.

King County. June, 2001. *Executive Recommended King County Comprehensive Plan 2000.* http://www.metrokc.gov/exec/orpp/compplan/2000/#rlan.

King County. 2001. *Salmon and Steelhead Habitat Limiting Factors in Water Resource Inventory Area 9 – Green River.*

King County Growth Management Planning Council. December 31, 1995. *Countywide Planning Policies.* Seattle, WA.

Long, Lela. April, 1999. *Saving Open Spaces: Public Support For Farmland Protection.* http://www.farmlandinfo.org/cae/sos/policy.html. American Farmland Trust Center for Agriculture in the Environment.

Mirai Associates and David Evans and Associates, Inc. 2001. *I-405 Corridor Program Draft Transportation Expertise Report.*

National Marine Fisheries Service 2000. *Draft Lake Washington Chinook Salmon (O.Tshawytcha) Recovery Plan* (Unpublished Draft).

Pierce County Regional Council. September 19, 1996. *County-Wide Planning Policies for Pierce County, Washington.*

Puget Sound Regional Council. 1998. *Metropolitan Transportation Plan, 1998 Progress Report.*

Puget Sound Regional Council. October 1999. *Growth Context Paper*.

Puget Sound Regional Council. June 2000. *2001 Update MTP Baseline Technical Report.* http://www.psrc.org/datapubs/pubs/mtp/baseline.pdf

Puget Sound Regional Council. August 2000. *Puget Sound Trends: Growth in Traffic and Vehicle Miles Traveled.*

Puget Sound Regional Council. May 2001a. *Destination 2030 Metropolitan Transportation Plan for the Central Puget Sound Region, "Technical Appendix 8"*.

Puget Sound Regional Council. May 10, 2001b. *Final Environmental Impact Statement for Destination 2030, the Metropolitan Transportation Plan for the Central Puget Sound Region.*

Snohomish County Tomorrow Steering Committee. February 4, 1993. *Countywide Planning Policies for Snohomish County.*

U.S. Department of Agriculture. Washington Agricultural Statistics Service. 1997. 1997 Census Of Agriculture County Profile.

U.S. Department of Agriculture Economic Research Service. April, 2001. *Harmony Between Agriculture And The Environment: Current Issues.* http://www.ers.usda.gov/emphases/harmony/issues/organic/organic.html

U.S. Environmental Protection Agency. March, 1999a. *Transportation Air Quality.*

U.S. Environmental Protection Agency. May, 1999b. *Consideration of Cumulative Impacts in EPA Review of NEPA Documents.* http://es.epa.gov/oeca/ofa/cumula.html

U.S. Environmental Protection Agency. December 2000. *Light-Duty Automotive Technology and Fuel Economy Trends 1975 through 2000.*

Washington State Department of Ecology. April, 1999. *1998 Washington State Air Quality Report.* Publication 98-213. Olympia, Washington.

Washington State 2001. "Access Washington" web site: http://access.wa.gov/

5. GLOSSARY

100-year flood. The flood having a one percent chance of being equaled or exceeded in magnitude in any given year. Contrary to popular belief, it is not a flood occurring once every 100 years.

100-year floodplain. The area adjacent to a stream or lake which is subjected to inundation by waters having a flood probability of exceedance of one percent in any given year, as determined by standard statistical and hydrologic methods.

Abatement. Reducing the degree or intensity of, or eliminating, pollution.

Air contaminant. Any particulate matter, gas, or combination thereof, other than water vapor. (See 'air pollutant').

Air emissions. Gas emitted into the air from industrial and chemical processes, such as ozone, carbon monoxide, nitrogen oxide, nitrogen dioxide, sulfur dioxide and others.

Air monitoring. (See 'monitoring').

Air pollutant. Any substance in air that could, in high enough concentration, harm man, other animals, vegetation, or material. Pollutants may include almost any natural or artificial composition of airborne matter capable of being airborne. They may be in the form of solid particles, liquid droplets, gases, or in combination thereof. Generally, they fall into two main groups: (1) those emitted directly from identifiable sources and (2) those produced in the air by interaction between two or more primary pollutants, or by reaction with normal atmospheric constituents, with or without photoactivation. Exclusive of pollen, fog, and dust, which are of natural origin, about 100 contaminants have been identified and fall into the following categories: solids, sulfur compounds, volatile organic chemicals, nitrogen compounds, oxygen compounds, halogen compounds, radioactive compounds, and odors.

Air quality criteria. The levels of pollution and lengths of exposure above which adverse health and welfare effects may occur.

Air quality standards. The level of pollutants prescribed by regulations that may not be exceeded during a given time in a defined area.

Air toxics. Any air pollutant for which a national ambient air quality standard (NAAQS) does not exist (i.e., excluding ozone, carbon monoxide, PM_{10}, sulfur dioxide, nitrogen oxide) that may reasonably be anticipated to cause cancer, developmental effects, reproductive dysfunctions, neurological disorders, heritable gene mutations, or other serious or irreversible chronic or acute health effects in humans.

Airborne particulates. Total suspended particulate matter found in the atmosphere as solid particles or liquid droplets. Chemical composition of particulates varies widely, depending on location and time of year. Airborne particulates include: windblown dust, emissions from industrial processes, smoke from the burning of wood and coal, and motor vehicle or non-road engine exhausts.

Ambient air quality standards. (See 'Criteria Pollutants' and 'National Ambient Air Quality Standards').

Ambient air. Any unconfined portion of the atmosphere; open air, surrounding air.

Ambient monitoring. All forms of monitoring conducted beyond the immediate influence of a discharge pipe or injection well and may include sampling of sediments and living resources. Generally refers to sampling in the field, such as a stream or other water body, or the atmosphere.

Ambient temperature. Temperature of the surrounding air (or other medium). For example, temperature of the room where a gas chlorinator is installed.

Area source. Any small source of non-natural air pollution that is released over a relatively small area but which cannot be classified as a point source. Such sources may include vehicles and other small engines, small businesses, and household activities.

Arterial. A major street that primarily serves through traffic, but also provides access to abutting properties. Arterials are often divided into principal and minor classifications depending on number of lanes, connections made, volume of traffic, nature of traffic, speeds, interruptions (access functions) and length.

Asbestos. A mineral fiber that can pollute air or water and cause cancer or asbestosis when inhaled. USEPA has banned or severely restricted the use of asbestos in manufacturing and construction.

Associated wetlands. Wetlands which are in proximity to and either influence or are influenced by tidal waters or a land or stream subject to the Shoreline Management Act.

Attainment area. An area considered to have air quality as good as or better than the national ambient air quality standards as defined in the Clean Air Act. An area may be an attainment area for one pollutant and a non-attainment area for others.

Attenuation. The process by which a compound is reduced in concentration over time, through absorption, adsorption, degradation, dilution, and/or transformation.

Average sound level. See L_{eq}.

Average vehicle occupancy. The average number of persons in vehicles on given transportation facilities.

A-weight. A standard frequency weighting to simulate the response of the human ear.

Background level. In air pollution control, the concentration of air pollutants in a definite area during a fixed period of time prior to the starting up or on the stoppage of a source of emission under control. In toxic substances monitoring, the average presence in the environment, originally referring to naturally occurring phenomena.

Base-year flood. A flood having a one percent chance of occurrence in any one year.

Best available control technology (BACT). The application of the most advanced methods, systems, and techniques for eliminating or minimizing discharges and emissions on a case-by-case basis as determined by USEPA. BACT represents an emission limit based on the maximum degree of reduction of each pollutant as described in regulations under the Clean Air Act (CAA). The determination of BACT takes into account energy, environmental, economic effects, and other costs.

Best available technology economically achievable (BATEA). Originally described under Section 304(b)(2)(B) of the Clean Water Act, this level of control is generally described as the best technology currently in use and includes controls on toxic pollutants.

Best management practices (BMPs). Methods that have been determined to be the most effective, practical means of preventing or reducing pollution from non-point sources.

Bus rapid transit. An express, or limited stop, rubber-tired transit system operating predominately in roadway managed lanes (e.g. HOV 3+, HOT lanes, etc.)

Calibration check. A check for variations between the measured level and a reference level - no adjustment is made to the system.

Calibration. Adjustment of the system so that the measured sound level agrees with a reference sound source.

Capacity. The maximum sustained traffic flow of a transportation facility, expressed in passenger cars per hour per lane, under prevailing traffic and roadway conditions in a specified direction.

Capacity-related projects. Projects that increase the number of vehicles or people that can be served by a transportation facility.

Carbon dioxide. A colorless, odorless gas produced by burning fossil fuels, sometimes referred to as a green house gas because it contributes to earth warming.

Carbon monoxide (CO). A colorless, odorless, poisonous gas produced by incomplete fossil fuel combustion.

Carboxyhemoglobin. Hemoglobin in which the iron is bound to carbon monoxide (CO) instead of oxygen.

Carcinogenic or carcinogen. Capable of causing cancer. A suspected carcinogen is a substance that may cause cancer in humans or animals but for which the evidence is not conclusive.

Catalytic converter. An air pollution abatement device that removes pollutants from motor vehicle exhaust, either by oxidizing them into carbon dioxide and water or reducing them to nitrogen and oxygen.

Centers. Compact, well-defined areas to which a mix of higher-density growth or intensive land uses will be directed, connected and served by an efficient, transit-oriented, multimodal transportation system.

Climate change. This term is commonly used interchangeably with "global warming" and "the greenhouse effect," but is a more descriptive term. Climate change refers to the buildup of man-made gases in the atmosphere that trap the sun's heat, causing changes in weather patterns on a global scale. The effects include changes in rainfall patterns, sea level rise, potential droughts, habitat loss, and heat stress. The greenhouse gases of most concern are carbon dioxide, methane, and nitrous oxides.

Collector-distributor lanes. Freeway lanes serving single or multiple interchanges that are physically separated from general freeway lanes. The purpose of collector-distributor lanes is to separate the through traffic from the traffic entering and exiting the freeway.

Concentration. The relative amount of a substance mixed with another substance. An example is five parts per million of carbon monoxide in air or 1 milligram/liter of iron in water.

Concurrence points. Key milestones within the "Reinventing NEPA" process for which formal written concurrence must be received from participating agencies.

Concurrency. A provision of the Washington State Growth Management Act (GMA) that requires local jurisdictions to adopt and enforce ordinances precluding approval of a proposed development if that development would cause the level-of-service of a transportation facility to fall below the jurisdiction's adopted standard, unless transportation improvements or strategies to accommodate the impacts of the development are made within six years (concurrent with) the development.

Congestion. A condition characterized by unstable traffic flows that prohibit movement on a transportation facility at optimal legal speeds. Recurring congestion is caused by constant excess volume compared with capacity. Nonrecurring congestion is caused by unusual or unpredictable events such as traffic accidents.

Consensus points. Decision points within the "Reinventing NEPA" process where substantial agreement (not necessarily unanimity) must be reached with the participating agencies.

Continuity. Continuity is the uninterrupted flow of pattern elements, maintenance of visual relationships between immediately connected or related landscape components or features.

Criteria pollutants. The 1970 amendments to the Clean Air Act required USEPA to set National Ambient Air Quality Standards for certain pollutants known to be hazardous to human health. USEPA has identified and set standards to protect human health and welfare for six pollutants: ozone, carbon monoxide, total suspended particulates, sulfur dioxide, lead, and nitrogen oxide. The term, "criteria pollutants" derives from the requirement that USEPA must describe the characteristics and potential health and welfare effects of these pollutants. It is on the basis of these criteria that standards are set or revised.

Cultural significance. Specific landscape settings may be significant because of cultural values; the setting must be at least briefly examined in its regional and national contexts to determine if it is culturally significant. Three general criteria are: uniqueness, commemoration, and designation.

Cumulative effect. The effects on the environment that result from the incremental consequences of an action when added to other past, present, and reasonably foreseeable future actions.

C-weight. A standard frequency weighting that simulates the response of the human ear to high amplitude (loud) noise.

Degradation. Chemical or biological breakdown of a complex compound into simpler compounds.

Designated pollutant. An air pollutant which is neither a criteria nor hazardous pollutant, as described in the Clean Air Act, but for which new source performance standards exist. The Clean Air Act does require states to control these pollutants, which include acid mist, total reduced sulfur (TRS), and fluorides.

Detector. The rms (root-mean-square) detector used to collect data.

Diffusion. The movement of suspended or dissolved particles from a more concentrated to a less concentrated area. The process tends to distribute the particles more uniformly.

Direct impact. The impact on the environment that is caused by an action and occurs at the same time and place.

Dispersion model. A mathematical prediction of how pollutants from a discharge or emission source will be distributed in the surrounding environment under given conditions of wind, temperature, humidity, and other environmental factors.

Dispersion. The process by which a substance or chemical spreads and dilutes in water or gas.

Distance zones. Three conventional terms in painting (foreground, middle ground, background) which can be helpful in describing distance relationships:

> **Foreground (0 to ¼-½ mile).** That area which can be designated with clarity and simplicity not possible in middle and background because the observer is a direct participant. He can have the impressions of immediate details – bark pattern, boulder forms, or degraded parts. This is a zone of important linkage because it sets a tone of quality or its absence. Intensity of color and its value will be at a maximum level, lacking the effect of color diminution due to atmospheric scattering of light rays. At a greater distance, the intensification of aerial perspective becomes an important means of discrimination.
>
> **Middleground (¼-½ to 3-5 miles).** A critical area for two reasons. This is where

the parts of the landscape can be seen to join together, where hills become a range or trees make a forest. This is also where manmade changes may be revealed as sitting comfortably upon the landscape, or where conflicts of form, color, shape, or scale show up. Colors will be unmistakable but they will be more blue, softer than those of the foreground. Some of the sharpness of value contrasts will be reduced.

Background (3-5 to infinite miles). That area where distance effects are primarily explained by aerial perspective. Surfaces of land forms will lose detail distinctions, emphasis will be on outline or edge, with background becoming an effective foil against which foreground or background is more clearly seen – a figure-ground relationship. Silhouettes and ridges of one land mass against another are the conspicuous visual part of the background with skyline the strongest line of all.

Districts. The medium-to-large sections of the city, conceived of as having two-dimensional extent, which the observer mentally enters "inside of", and which are recognizable as having some common, identifying character. Always identifiable from the inside, they are also used for exterior reference if visible from the outside.

Dosage/dose. The actual quantity of a chemical administered to an organism or to which it is exposed. In terms of monitoring exposure levels, the amount of a toxic substance taken into the body over a given period of time. (See 'Noise Dose').

Emission factor. The relationship between the amount of pollution produced and the amount of raw material processed. For example, an emission factor for a blast furnace making iron would be the number of pounds of particulates per ton of raw materials.

Emission standard. The maximum amount of air polluting discharge legally allowed from a single source, mobile or stationary.

Emission. Pollution discharged into the atmosphere from smokestacks, other vents, and surface areas of commercial or industrial facilities and from residential and mobile sources.

EMME/2. Regional transportation model for the Puget Sound region.

Energy average (noise). The energy average of two or more quantities expressed on a common decibel scale differs from the arithmetic average of the quantities. Thus, the energy average of 60 dB and 70 dB is 67.4 dB, in contrast to the arithmetic average of 65 dBA.

Enhanced Inspection and Maintenance (I&M). An improved automobile inspection and maintenance program – aimed at reducing automobile emissions – that contains, at a minimum, more vehicle types and model years, tighter inspection, and better management practices. It may also include annual computerized or centralized inspections – under-the-hood inspection – for signs of tampering with pollution control equipment, and increased repair waiver cost.

Environment. The sum of all external conditions affecting the life, development, and survival of an organism.

Environmental Assessment (EA). A preliminary written environmental analysis required by NEPA to determine whether a federal activity such as building airports or highways would significantly affect the environment; may require preparation of a more detailed environmental impact statement.

Environmental exposure. Human exposure to pollutants originating from facility emissions. Threshold levels are not necessarily surpassed, but low-level chronic pollutant exposure is one of the most common forms of environmental exposure. (See 'threshold level').

Environmental impact statement (EIS). A document that identifies and analyzes, in detail, environmental impacts of a proposed action. As a tool for decision-making, the EIS describes positive and negative effects and lists alternatives for an undertaking.

Environmental justice. The fair treatment of people of all races, cultures, incomes, and educational levels with respect to the development and enforcement of environmental laws, regulations, and policies. Fair treatment implies that no population should be forced to shoulder a disproportionate share of exposure to the negative effects of pollution due to lack of political or economic strength.

Environmental mitigation measures. Measures taken to reduce adverse effects on the environment, which are usually implemented under the State Environmental Policy Act (SEPA) or the National Environmental Policy Act (NEPA).

Environmental monitoring. The process of measuring or collecting environmental data.

Evolutionarily significant unit (ESU). A designation used by the National Marine Fisheries Service for certain local salmon populations or ?runs?

which are treated as individual species under this act. This is equivalent to the USFWS “Distinct Population Segment” classification.

Exposure. The amount of radiation, noise, or other pollutant present in a given environment that represents a potential health threat to living organisms.

Express lane. Physically separated freeway lanes with limited interchanges, typically no more than one every 3-4 miles.

Farmland of Statewide or Local Importance. Farmland, other than prime or unique farmland, that is of statewide or local importance for the production of food, feed, fiber, forage, or oilseed crops, as determined by the state or local government agency or agencies, using USDA guidelines.

Federal Motor Vehicle Control Program. All federal actions aimed at controlling pollution from motor vehicles by such efforts as establishing and enforcing tailpipe and evaporative emission standards for new vehicles, testing methods development, and guidance to states operating inspection and maintenance programs.

FEMA floodway. The channel of a river or other watercourse and the adjacent land areas that must be unconfined or unobstructed either vertically or horizontally to provide for the discharge of the base year flood (usually 100-year).

Finding of No Significant Impact (FONSI). A document prepared by a federal agency showing why a proposed action would not have a significant impact on the environment and thus would not require preparation of an environmental impact statement. A FONSI is based on the results of an environmental assessment.

Flood fringe. In FEMA, it is that portion of the floodplain outside the floodway that is inundated by flood waters in which encroachment is permissible. In King County, it is the area outside the zero-rise floodway that is covered by standing flood waters during the 100-year flood. It is the area generally associated with standing water rather than rapidly flowing water.

Floodplains. Lowlands that are relatively flat which are subject to flooding in any given year.

Fossil fuel. Fuel derived from ancient organic remains, e.g., peat, coal, crude oil, and natural gas.

Freeboard. The vertical distance from the material surface to the top of the sides in a truck.

Fuel efficiency. The proportion of the energy released on combustion of a fuel that is converted into useful energy.

Fugitive emissions. Air pollutants released to the air other than those from stacks or vents; typically small releases from leaks in plant equipment such as valves, pump seals, flanges, sampling connections, etc.

General purpose (GP) lane. A freeway or arterial lane available for use by all traffic.

Geographic Information System (GIS). Digital computer mapping, overlays, and spatial data analysis.

Global warming. See definition for **Climate change**.

Greenhouse effect. The warming of the Earth's atmosphere attributed to a build-up of carbon dioxide or other gases; some scientists think that this build-up allows the sun's rays to heat the Earth, while infrared radiation makes the atmosphere opaque to a counterbalancing loss of heat.

Growth Management Act (GMA). Washington State legislation passed in 1990 and subsequently amended that requires long-range comprehensive plans prepared by cities and counties to be balanced with supporting transportation infrastructure (RCW 36.70A).

Hazardous air pollutants. Air pollutants that are not covered by ambient air quality standards but which, as defined in the Clean Air Act, may reasonably be expected to cause or contribute to irreversible illness or death. Such pollutants include asbestos, beryllium, mercury, benzene, coke oven emissions, radionuclides, and vinyl chloride.

High-capacity transit (HCT). Transit systems operating, in whole or part, on a fixed-guideway dedicated right-of-way or freeway/express facility, designed to carry a large number of riders at higher speeds than conventional transit. Examples include express bus on HOV lanes, passenger ferry service, and light and heavy rail systems.

High-occupancy vehicle (HOV). A vehicle carrying two or more people. The minimum number of vehicle occupants required to qualify for HOV lane use may vary depending on the congestion levels and capacity of the HOV lane and the surrounding road system.

High-occupancy/toll lane (HOT lane). Signifies a lane (typically on a freeway) that is managed to restrict use by different modes through the use of time-of-day tolls.

Hydric soil. Soils that are formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part.

Hydrocarbons (HC). Chemical compounds that consist entirely of carbon and hydrogen. Hydrocarbons contribute to air pollution problems like smog.

IMPACT. FEMA's project looking at transportation lifelines between the Port of Tacoma and Port of Seattle.

Impervious surface area. Surfaces through which water cannot percolate.

In-kind wetland mitigation. A type of wetland mitigation designed to replace the lost vegetation and hydrology with the same type of vegetation and hydrology.

Indoor air pollution. Chemical, physical, or biological contaminants in indoor air.

Induced travel. Increase in total VMT resulting from increased capacity excluding other effects such as population growth.

Intactness. The integrity of visual order in the natural and man-built landscape, and the extent to which the landscape is free from visual encroachment.

Intermodal. Accommodation or interconnection of various transportation modes both for the movement of people and goods.

Intelligent transportation systems (ITS). The application of advanced technology to current transportation problems, including incident detection, signal coordination, real-time information, and other technology.

Inversion. An atmospheric condition caused by increasing temperature with elevation, resulting in a layer of warm air preventing the rise of cooler air trapped beneath. This condition prevents the rise of pollutants that might otherwise be dispersed. Trapping pollutants near the ground increases ozone to harmful levels.

Jurisdiction. A municipal government agency such as a city or county. As appropriate, the term "jurisdiction" also includes federal and state agencies and federally recognized tribes.

Lakes of state-wide significance. Those lakes, whether natural, artificial, or a combination thereof, with a surface acreage of one thousand acres or more measured at the ordinary high-water mark.

Landscape form. A landform or landcover mass composed of heterogeneous visual elements, but distinguished from surrounding areas by overall form, pattern, and edge. Landscape forms have physical dimensions and a specific location. They also often have names: Bunker Hill is a named landform mass; Boston is a named area of landcover.

Landscape type. An area of landform plus landcover forming a distinct, homogeneous component of a landscape, differentiated from other areas by its degree of slope plus a single pattern of landcover. A landscape type is a unique segment of the environment. This segment or portion of the environment can be separated from other segments on the basis of the landcover and the landform. Any landscape type can be subdivided into unique landscape sub-types, through definition of the desired homogeneity of the landscape type. For example, a forest is composed of different tree types, and each tree is itself made up of branches, a trunk, foliage, and so on.

Landscape unit. An area or volume of distinct landscape character which forms a spatially enclosed unit at ground level; it may include more than one landscape type; outdoor room.

Latent demand. Increase in total VMT resulting from increasing capacity to serve existing demand that is not otherwise served.

L_{dn}. The day/night sound level. This is a daily average noise level that ranks noise that occurs during the night more heavily, adding 10dBA to noise levels between 10 P.M. and 7 A.M.

L_{eq}. Equivalent sound level. The level of a constant sound which in a given time period has the same energy as does a time-varying sound.

$L_{eq(h)}$. L_{eq} measured over a one-hour period. See L_{eq}.

Level of service (LOS). A gauge for evaluating system performance for roadways, transit, non-motorized, and other transportation modes. For example, roadway measures of level of service often assign criteria based on volume-to-capacity ratios.

L_{max}. Maximum sound level, in decibels. It is the maximum value of the noise level which occurs during the single event.

L_{min}. Minimum sound level, in decibels. It is the minimum value of the noise level which occurs during the single event.

L_n. The A-weighted sound level, in decibels, that is exceeded n percent of the time in a given interval of time. For example, L_{10} is the A-weighted sound level exceeded 10 percent of the time over the given interval, usually 1 hour. The default L_n percentages are 10, 30, 50, 70, and 90. L_{00} is the same as the maximum sound level since it was the level exceeded 0 percent of the time.

Local values and goals. The landscape setting and its visual resources may be valued by local viewer groups for reasons not evident in an assessment based strictly on visual resources and not widely known outside the community.

Logarithm. The exponent that indicates the power to which a number must be raised to produce a given number. For example: if $B^2 = N$, the 2 is the logarithm of N (to the base B), or $10^2 = 100$ and $\log_{10} 100 = 2$. Also abbreviated to "log."

Major stationary sources. Term used to determine the applicability of Prevention of Significant Deterioration (PSD) and new source regulations. In a nonattainment area, any stationary pollutant source with potential to emit more than 100 tons per year is considered a major stationary source. In PSD areas the cutoff level may be either 100 or 250 tons, depending upon the source.

Metropolitan Transportation Plan (MTP). A detailed long-range plan for future investments in the central Puget Sound region's regional transportation system, including roads, transit, marine (state ferries), freight and goods, non-motorized transportation, and aviation. For state planning purposes, the MTP is the region's Regional Transportation Plan.

Microgram (µg). One-millionth of a gram.

Mitigation measures. Actions taken to reduce adverse effects on the environment, usually implemented under the State Environmental Policy Act (SEPA) and/or the National Environmental Policy Act (NEPA).

Mitigation banking. The act of creating net gain in wetlands to be drawn upon to offset several small wetland losses from several off-site sites or projects. A mitigation bank is a property that has been protected in perpetuity, and approved by appropriate county, state and federal agencies, expressly for the purpose of providing compensatory mitigation in advance of authorized impacts. The compensatory mitigation may be through restoration, creation, and/or enhancement of wetlands, and the preservation of adjacent wetland or stream buffers and other habitats.

Mobile source. Any non-stationary source of air pollution such as cars, trucks, motorcycles, buses, airplanes, locomotives.

Mode. A particular form of travel. Typically transportation modes include driving alone (single-occupancy vehicle), carpooling (high-occupancy vehicle), non-motorized (walking, jogging, biking), or riding transit or high-capacity transit (light rail or commuter rail).

Mode split. The percentage of persons using different travel modes typically described for autos, transit, and non-motorized modes.

Modeling. Use of mathematical equations to simulate and predict real events and processes.

Molecular diffusion. Process whereby molecules of various gases tend to intermingle and eventually become uniformly dispersed.

Monitoring. Periodic or continuous surveillance or testing to determine the level of compliance with statutory requirements and/or pollutant levels in various media or in humans, plants, and animals.

Multimodal. Concerning or involving more than one transportation mode.

National Ambient Air Quality Standards (NAAQS). Standards established by USEPA that apply to outside air quality throughout the country.

National Emissions Standards for Hazardous Air Pollutants (NESHAPs). Emission standards set by USEPA for an air pollutants not covered by NAAQS that may cause an increase in deaths or serious, irreversible, or incapacitating illness. Primary standards are designed to protect human health, secondary standards to protect public welfare.

Nitric oxide (NO). A gas formed by combustion under high temperature and high pressure in an internal combustion engine; changes into nitrogen dioxide in the ambient air and contributes to photochemical smog.

Nitrogen dioxide (NO_2). The result of nitric oxide combining with oxygen in the atmosphere; major component of photochemical smog.

Nitrogen oxide (NO_x). Product of combustion from transportation and stationary sources and a major contributor to the formation of ozone in the troposphere and to acid deposition.

Noise dose. Noise dose is the percentage of time that a person is exposed to noise that is potentially damaging to hearing. Zero represents no exposure and 100 or more represents complete exposure. It is calculated by dividing the actual time of exposure by the allowed time of exposure. The allowed time of exposure is determined by the criterion duration and by the sound level (the higher the level, the shorter the allowed time). The sound levels must be measured with A-weighting in frequency and slow-exponential weighting in time.

Non-attainment area. Area that does not meet one or more of the National Ambient Air Quality Standards for the criteria pollutants designated in the Clean Air Act.

Non-motorized. Generally referring to bicycle, pedestrian, and other modes of transportation not involving a motor vehicle.

Nonconformance. A deficiency in a characteristic, documentation, or procedure that renders the quality of an item or activity unacceptable or indeterminate; nonfulfillment of a specified requirement.

National Wetlands Inventory (NWI). A series of maps developed by the U.S. Fish and Wildlife Service mapping wetlands nationwide.

Observer viewpoint. A point from which a select view is analyzed and/or evaluated. Analogous concept: Landscape control point.

Odor threshold. The lowest concentration of a substance in air that can be smelled. Odor thresholds are highly variable because of the differing ability of individuals to detect odors.

Opacity. The amount of light obscured by particulate pollution in the air; clear window glass has zero opacity, a brick wall is 100 percent opaque. Opacity is an indicator of changes in performance of particulate control systems.

Organic chemicals/compounds. Animal or plant-produced substances containing mainly carbon, hydrogen, nitrogen, and oxygen.

Occupational Safety and Health Act of 1970 (OSHA). A law designed to protect the health and safety of industrial workers and also the operators of water supply systems and treatment plants. OSHA also refers to the federal and state agencies which administrate the OSHA regulations.

Ordinary High Water Mark (OHWM). The visible line on the banks where the presence and action of waters are so common as to leave a mark upon the soil or vegetation: Provided, that in any area where the ordinary high water line cannot be found the ordinary high water line adjoining saltwater shall be the line of mean higher high water and the ordinary high water line adjoining freshwater shall be the elevation of the mean annual flood.

Out-of-kind wetland mitigation. A type of wetland mitigation designed to replace the lost vegetation and hydrology with a different type of wetland vegetation and/or hydrology.

Oxidation-reduction (redox). A chemical reaction consisting of an oxidation reaction in which a substance loses or donates electrons, and a reduction reaction in which a substance gains or accepts electrons. Redox reactions are always coupled because free electrons cannot exist in solution and electrons must be conserved.

Oxidizing agent. Any substance, such as oxygen (O_2) or chlorine (Cl_2), that will readily add (take on) electrons. The opposite is a reducing agent.

Oxygenated fuels. Gasoline which has been blended with alcohols or ethers that contain oxygen in order to reduce carbon monoxide and other emissions.

Ozone (O_3). A form of oxygen found in two layers of the atmosphere, the stratosphere and the troposphere. In the stratosphere (the atmospheric layer 7 to 10 miles or more above the earth's surface) ozone is a natural form of oxygen that provides a protective layer shielding the earth from ultraviolet radiation. In the troposphere (the layer extending up 7 to 10 miles from the earth's surface), ozone is a chemical oxidant and major component of photochemical smog. It can seriously impair the respiratory system and is one of the most widespread of all the criteria pollutants for which the Clean Air Act required USEPA to set standards. Ozone in the troposphere is produced through complex chemical reactions of nitrogen oxides (which are among the primary pollutants emitted by combustion sources), hydrocarbons released into the atmosphere through the combustion, handling and processing of petroleum products and sunlight.

Particulate. A very small solid suspended in air or water which can vary widely in size, shape, density, and electrical charge.

Parts per million (ppm). Parts per million parts, a measurement of concentration on a weight or volume basis. This term is equivalent to milligrams per liter (mg/L), which is the preferred term.

Peak period. The period of the day during which the maximum amount of travel occurs. It may be specified as the morning (A.M.) or afternoon or evening (P.M.) peak, depending on the facility.

Peak weighting. The weighting of the peak sound detector. Possible selections are C (weighted) or U (unweighted). Peak weighting is independent of the RMS weighting on most noise meters.

Peak sound. Peak is the maximum sound level during a given time interval when the normal frequency and time weighting is NOT used. The instrument has a peak detector that responds rapidly to changing sound levels, unlike the normal time weighting of the instrument.

Persistence. Refers to the length of time a compound stays in the environment, once introduced. Persistence can range from less than a second to indefinitely.

Photochemical oxidants. Air pollutants formed by the action of sunlight on oxides of nitrogen and hydrocarbons.

PHS. Priority Habitats and Species, a series of maps developed by the Washington Department of Fish and Wildlife mapping wildlife resources statewide.

$PM_{2.5}$. A new standard for measuring the amount of solid or liquid matter suspended in the atmosphere, i.e. the amount of particulate matter less than 2.5 micrometers in diameter. See also PM_{10}.

PM_{10}. A standard for measuring the amount of solid or liquid matter suspended in the atmosphere, i.e. the amount of particulate matter less than 10 micrometers in diameter; smaller PM_{10} particles penetrate to the deeper portions of the lung, affecting sensitive population groups such as children and individuals with respiratory ailments.

Pollutant Standard Index (PSI). Measure of adverse health effects of air pollution levels in major cities.

Pollutant. Generally, any substance introduced into the environment that adversely affects the usefulness of a resource.

Pollution. Any substances in water, soil, or air that degrade the natural quality of the environment, offend the senses of sight, taste, or smell, or cause a health hazard. The usefulness of the natural resource is usually impaired by the presence of pollutants and contaminants.

Precursor. In photochemistry, a compound antecedent to a volatile organic compound (VOC). Precursors react in sunlight to form ozone or other photochemical oxidants.

Prime farmland. Land that has the best combination of physical and chemical characteristics for producing food, feed, fiber, forage, oilseed, and other agricultural crops with minimum inputs of fuel, fertilizer, pesticides, and labor, and without intolerable soil erosion. Prime farmland may include land currently used as cropland, pastureland, rangeland, or forestland. It does not include land already in or committed to urban development or water storage.

Principal arterial. A street that serves primarily long trips, connecting to freeways and important activity centers. Free-flow speeds typically range between 35 and 45 mph.

Puget Sound Regional Council (PSRC). The Metropolitan Planning Organization (MPO) and Regional Transportation Planning Organization (RTPO) for the central Puget Sound region. The MPO/RTPO is the legally mandated forum for cooperative transportation decision-making in a metropolitan planning area.

Receptor. An organism that receives, may receive, or has received environmental exposure to a chemical.

Record of Decision (ROD). A document prepared by a federal agency presenting the basis for the decision reached after completion of the Final EIS, summarizing any mitigation measures that will be incorporated into the project, and documenting any required Section 4(f) approval.

Reformulated gasoline. Gasoline with a different composition from conventional gasoline (e.g., lower aromatics content) that reduces air pollutants.

Refueling emissions. Emissions released during vehicle refueling.

Roadway prism. The cross-section of disturbed area in a roadway including the full extent of any cuts or fills.

RMS weighting. A sound detector converts a sound signal into a useful form by first squaring the signal, then taking the mean value, and then taking the square root (root-mean-square). During this process, certain frequencies can be selectively attenuated (weighted), such as A-weighting and C-weighting, so the resultant level better corresponds to human hearing.

Scale. Visual scale is the apparent size relationships between landscape components or features and their surroundings.

Screenline. An imaginary line crossing roadways and other transportation facilities, and used as a reference point for measuring or reporting travel volumes.

Secondary impact. The impact on the environment that is caused by an action and occurs later in time or is farther removed in distance, but is still reasonably foreseeable. Generally, these impacts are induced by the initial action.

Section 106. National Historic Preservation Act, Section 106.

Section 4(f). Department of Transportation Act (23 USC, Section 138 – formerly 49 USC 1653(f)).

State Environmental Policy Act (SEPA) State legislation passed in 1974, which establishes an environmental review process for all development projects and major planning studies, prior to taking any action on these projects. SEPA permits early coordination to identify and mitigate any significant issues or impacts which may result from a project or study.

Shorelands. Lands which extend landward two hundred feet as measured on a horizontal plane from the ordinary high water mark of a water body.

Shorelines. All of the water areas of the state, including reservoirs, and their associated wetlands, together with the lands underlying them, except:

- Shorelines of state-wide significance;
- Shorelines on segments of streams upstream of a point where the mean annual flow is 20 cubic feet per second or less, and the wetlands associated with such upstream segments; and
- Shorelines on lakes less than 20 acres in size and wetlands associated with such small lakes.

Shorelines of state-wide significance. The following shorelines of the state:

a) The area between the ordinary high-water mark and the western boundary of the state from Cape Disappointment on the south to Cape Flattery on the north, including harbors, bays, estuaries, and inlets;

b) Those areas of Puget Sound and adjacent saltwaters and the Strait of Juan de Fuca between the ordinary high-water mark and the line of extreme low tide as follows:

- *Nisqually Delta* - from DeWolf Bight to Tatsolo Point;
- *Birch Bay* - from Point Whitehorn to Birch Point;
- *Hood Canal* - from Tala Point to Foulweather Bluff;
- *Skagit Bay and adjacent area* - from Brown Point to Yokeko Point; and
- *Padilla Bay* - from March Point to William Point.

c) Those areas of Puget Sound and the Strait of Juan de Fuca and adjacent saltwaters north to the Canadian line and lying seaward from the line of extreme low tide;

d) Those lakes, whether natural, artificial or a combination thereof, with a surface acreage of 1,000 acres, or more, measured at the ordinary high-water mark;

e) Those natural rivers or segments thereof, as follows:

- Any east of the crest of the Cascade Range downstream of a point where the annual flow is measured at 200 cubic feet per second, or more, or those portions of rivers east of the crest of the Cascade Range downstream from the first 300 square miles of drainage area, whichever is longer;
- Any west of the crest of the Cascade Range downstream of a point where the mean annual flow is measured at 1,000 cubic feet per second, or more;

f) Those wetlands associated with (a), (b), (d), and (e).

Shorelines of the state. Means the total of all "shorelines" and "shorelines of state-wide significance" within the state as defined above.

Sightline. The unobstructed line of sight between an observer and a viewed object.

Single-occupant vehicle (SOV). A vehicle with only one occupant (i.e., the driver).

Slope. An area of landform surface differentiated from other areas by its degree of slope. It is a component of landforms but not limited in place or extent. Examples: cliff, gentle slope, flat plain.

Smog. Dust, smoke, or chemical fumes that pollute the air and make hazy, unhealthy conditions (literally, the word is a blend of smoke and fog). Automobile, truck, bus, and other vehicle exhausts and particulates are usually trapped close to the ground, obscuring visibility and contributing to a number of respiratory problems.

Sound exposure (SE). Sound exposure is the total sound energy of the actual sound during a given time interval. Unlike sound exposure level, however, it is not expressed in dB, but in Pascal squared - seconds.

Sound exposure level (SEL). The level of a steady sound, one second long, that contains the same energy as the actual (unsteady) sound over the total measurement duration (elapsed time). It is expressed in decibels. It is related to L_{eq}, but with all the energy squeezed into a one-second period as opposed to being spread over the stated period.

Sound Move. Sound Transit's ten-year (1996 to 2006) regional transit system plan for implementing commuter rail, light rail, and regional express bus services and HOV facility development in parts of Snohomish, King and Pierce counties.

Sound pressure level or noise level (**SPL**). Sound pressure level, in decibels, is an A-weighted sound pressure level as measured using the slow dynamic characteristic for sound level meters specified in ASA S1.4-1971, American Standard Specification for General Purpose Sound Level Meter, or latest revision thereof. The A-weighting characteristic modifies the frequency response of the measuring instrument to account approximately for the frequency characteristics of the human ear.

Stable air. A motionless mass of air that holds instead of dispersing pollutants.

Stage II controls. Systems placed on service station gasoline pumps to control and capture gasoline vapors during refueling.

Standards. Limits on the amount of pollutants or emissions produced. USEPA establishes minimum standards, but states are allowed to be stricter.

State Implementation Plan (SIP). USEPA approved state plan for the establishment, regulation, and enforcement of air pollution standards.

Stratosphere. The portion of the atmosphere 10 to 25 miles above the earth's surface.

Streams which constitute shorelines. (Western Washington) Streams from the point at which the stream reaches a mean annual flow of 20 cubic feet per second down to the mouth of said stream or river (provided that the stream falls at said point within the jurisdiction of chapter 90.58 RCW).

Superfund. The program operated under the legislative authority of CERCLA and SARA that funds and carries out USEPA solid waste emergency and long-term removal and remedial activities. These activities include establishing the National Priorities List, investigating sites for inclusion on the list, determining their priority, and conducting and/or supervising the cleanup and other remedial actions.

Tailpipe standards. Emissions limitations applicable to engine exhausts from mobile sources.

Threshold level (noise). ANSI S1.25 defines threshold as a sound level below which the dosimeter produces little or no dose accumulation as specified in this standard. The threshold should be selected to be within the dynamic range of the instrument. The current OSHA threshold is 80 dB.

Time-weighted average (TWA). This is the level of a constant sound over a stated period using a stated exchange rate that is equivalent to the actual (unsteady) sound over the sample period. If the stated exchange rate is 3dB, then the time weighted average is the same as the average sound level (L_{eq}).

Title VI. The Civil Rights Act of 1964 that prohibits discrimination based on race, color, national origin and sex in the provision of benefits and services.

Total suspended particles (TSP). A method of monitoring particulate matter by total weight.

Toxic chemical. Any chemical listed in USEPA rules as "Toxic Chemicals Subject to Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986."

Toxic pollutants. Materials that cause death, disease, or birth defects in organisms that ingest or absorb them. The quantities and exposures necessary to cause these effects can vary widely.

Transit-oriented development (TOD). A land use pattern that emphasizes clustered transit-intensive land uses with higher densities of development. It typically is focused along high-capacity transit routes, and is designed to encourage modes of travel other than the private automobile by locating residential, commercial, and employment development in close proximity to each other.

Transportation demand management (TDM). Institutional and operational methods to reduce travel demand on the transportation system. TDM strategies are usually implemented to support the use of HOVs, and typically include carpool, vanpool, and public transit programs.

Transportation system management (TSM). The application of construction, operational, and regulatory or legislative actions to provide the most cost-effective use of existing transportation facilities.

Troposphere. The layer of the atmosphere closest to the earth's surface.

Unconstrained person volumes. The potential demand for persons traveling along a corridor without considering traffic congestion constraints.

Unique farmland. Land other than prime farmland that is used for the production of specific high-value food and fiber crops. It has the special combination of soil quality, location, growing season, and moisture supply to economically produce sustained high quality or high yields of specific crops when treated and managed according to acceptable farming methods. Examples of such crops include lentils, nuts, annual cropped white wheat, cranberries, fruits, and vegetables.

Unity. The degree to which the visual resources of the landscape join together to form a coherent, harmonious visual pattern. Unity refers to the compositional harmony or intercompatibility between landscape elements.

Vehicle miles traveled (VMT). A measure of the extent of motor vehicle operation; the total number of vehicle miles traveled within a specific geographic area over a given period of time.

View. A scene observed from a given vantage point.

Viewer awareness. A viewer's receptivity to the visual character of the landscape can be affected by elements and relationships in the landscape setting itself or by expectations about the setting. Visual experience contrary to expectation may be suppressed or heightened, depending on the degree of disagreement.

Viewer exposure. The degree to which viewers are exposed to a view by their physical location, numbers viewing, and duration of view.

Viewer groups. Classes of viewers differentiated by their visual response to the highway and its setting; response is affected by viewer activity, awareness, and values.

Viewer response. Measures of viewer response to change in visual resources include viewer exposure, viewer sensitivity, cultural significance, and local values.

Viewer sensitivity. The viewer's variable receptivity to the elements within the environment that he is viewing, affected by viewer activity and awareness. A person cannot readily notice every object and all the attributes of the objects that compose the total visual environment.

Viewshed.

1) All the surface areas visible from an observer's viewpoint.

2) Surface areas from which a critical object of viewpoint is seen.

Existing and Topographic Viewsheds:

a) Existing viewshed: The area normally visible from an observer's viewpoint, including the screening effects of intermediate vegetation and structures.

b) Topographic viewshed: The area which would be visible from a viewpoint based on landform alone, without the screening effects of vegetation and structures.

Composite Viewsheds:

a) Definition: Composite of overlapping areas visible from:
   - A continuous sequence of viewpoints along a road.
   - A network of viewpoints surrounding a road (or object).

b) The visual corridor: Each visually and spatially distinct experience.

Visual assessment units. A portion of the area visible or potentially visible from a highway project or from which the highway project may be seen; to be useful in visual assessment, it should be identified on the basis of visual distinctions, such as landscape unit boundaries.

Visual character. The visual character of a landscape is formed by the order of the patterns composing it. The elements of these patterns are the form, color, line, and texture of the landscape's visual resources. Their interrelationships can be objectively described in terms of dominance, diversity, continuity, and so on.

Visual corridor. A continuous succession of visually and spatially distinct experiences.

Visual impact. The degree of change in visual resources and viewer response to those resources caused by highway development and operations.

Visual quality. While many factors contribute to a landscape's visual quality, they can ultimately be grouped under three headings: vividness, intactness and unity.

Visual resources. The appearance of the features that make up the visible landscape. Includes the land, water, vegetative, animal, and other features.

Vividness. The memorability of the visual impression received from contrasting landscape elements as they combine to form a striking and distinctive visual pattern.

Volatile organic compounds (VOC). Any organic compound which evaporates readily to the atmosphere. VOCs contribute significantly to photochemical smog production and certain health problems.

Wetland buffer. The upland area surrounding wetlands which serves to moderate biological and physical alteration of the wetland. The buffer widths are determined by the local agency with jurisdiction.

Wetland category. A ranking of wetlands, typically one through four, by the wetland functions and values. Ranking systems vary by jurisdiction. The highest ranking wetlands are category one, while the lowest are category four.

Wetland function. The physical and biological support roles wetlands provide such as stormwater peak flow attenuation, groundwater recharge, etc.

Wetland mitigation. Creation, enhancement, or restoration of wetlands to compensate for wetland alterations.

Wetland value. Societal worth placed on wetland attributes and qualities, e.g., the value of flood water storage relative to other means of controlling floods.

Wetland. Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

Zero-rise floodway. The channel of a river or other watercourse and that portion of the adjoining floodplain necessary to discharge the 100-year flood flow without increasing the 100-year flood elevation by more than 0.01 foot. The boundaries of the floodplains as shown on the flood insurance rate maps are considered the boundaries of the zero-rise floodway unless otherwise delineated by a special study.

This page left intentionally blank.

6. AGENCY COORDINATION

6.1 REINVENTING NEPA PILOT PROCESS

The I-405 Corridor Program is a national demonstration pilot study for "Transportation Decision Making Process Improvement." The revised decision making process (typically referred to as "Reinventing NEPA") was developed cooperatively by state and federal agencies to evaluate and improve application of the NEPA process, and is jointly sponsored by WSDOT and FHWA.

Two of the more notable differences between the Reinventing NEPA process and the existing transportation decision-making process are that: (1) the Reinventing NEPA process moves NEPA decision-making to the early stages of long-range planning for transportation projects; and (2) the Reinventing NEPA process introduces three "concurrence" points and nine "consensus" points at key milestones and decision points in the NEPA process to ensure increased communication and coordination with affected agencies and jurisdictions. The meaning of these concurrence and consensus points is explained in greater detail below.

Agencies with jurisdiction include resource, regulatory, and jurisdictional agencies that have the ability to stop or deny a project either through a permit action or project objection with regulatory weight. These agencies have chartered responsibilities to review the I-405 Corridor Program status at each decision point. For the I-405 Corridor Program, it was agreed that this would include all members of the I-405 Corridor Program Steering Committee.

Agency *concurrence* is defined as a formal written determination by agencies with jurisdiction that the program information is adequate for the current phase of the process. There are three concurrence points in the process: (1) purpose and need statement; (2) selection of alternatives to advance for detailed study in the Draft EIS; and (3) selection of the Preferred Alternative and mitigation concept in the Final EIS.

At each concurrence point the agencies with jurisdiction have responsibilities to approve, deny, or comment on the decisions at hand. Gaining concurrence means that the program may proceed to the next phase without modification. Each agency with jurisdiction agrees not to revisit its previous concurrence unless there is substantial new information or substantial changes have been made to the proposal, the environment, or laws and regulations. Concurrence does not mean that a permit necessarily will be issued upon completion of the EIS.

A written determination of concurrence with the Statement of Purpose and Need for the I-405 Corridor Program was received from each participating agency with jurisdiction during the fall of 1999. Written confirmation of concurrence with the range of alternatives to advance for detailed study in the Draft EIS was received from each participating agency with jurisdiction during the summer and fall of 2000. For the latter concurrence point, several agencies with jurisdiction attached comments to their concurrence identifying specific areas of concern.

In March 2002, concurrence on the preferred alternative and mitigation concept was requested from the 22 local, state, and federal agencies with jurisdiction. For this last concurrence point, co-lead agencies requested written confirmation of concurrence on the major elements of the I-405 Corridor Program Preferred Alternative and the Mitigation Concept (see Appendix J in the FEIS), as well as agreement to pursue in good faith the amendments of transportation plans and programs in order to implement the I-405 Preferred Alternative and Corridor Environmental

Program. Response on the concurrence package was requested by April 2002. By the time this Final EIS was prepared for printing, concurrence with comment was received from 19 of the 22 agencies.

The nine *consensus* points occur at key milestones dispersed throughout the NEPA process. Consensus is less formal than the concurrence discussed previously and typically addresses issues that are important, but less weighty than those requiring concurrence. Consensus is defined as substantial agreement among the agencies with jurisdiction; it does not require unanimity about a decision. In all cases, agreement must be strong enough that the Steering Committee is committed to implementing the decision.

Consensus points occur at the following milestones in the Reinventing NEPA process:

- Statement of Purpose and Need (draft and final)
- Initial screening criteria for alternatives
- Fatal flaw elimination of alternatives
- Identification of additional data needs
- Second-level screening of alternatives
- Alternatives to include in Draft EIS
- Decision to publish Draft EIS
- Preferred Alternative in Final EIS
- Decision to publish Final EIS

A chronology of all substantive agency involvement during the I-405 Corridor Program process, including Steering Committee meetings and resolution of concurrence and consensus points by the agencies with jurisdiction, is included in Table 6-1.

6.2 I-405 CORRIDOR PROGRAM CHRONOLOGY

The following process chronology details key milestones during the I-405 Corridor Program since initiation of the study in spring of 1999 (Table 6-1). It includes the dates and subject of coordination with the Executive, Steering, and Citizen committees; agencies with jurisdiction; local jurisdictions; and public (including scoping and open houses); as well as the preparation or issuance of working papers, newsletters, and informational materials.

Table 6-1: I-405 Study Chronology

Meeting, Workshop, Report/Memo, Public Information Materials	Subject	Date
Stakeholder and Community Groups Interviews	Interviews were conducted to identify issues and interview committee members	December 1998
Stakeholder and Community Groups Interviews	Interviews were conducted to identify issues and interview committee members	January 1999
Stakeholder and Community Groups Interviews	Interviews were conducted to identify issues and interview committee members	April 1999

Meeting, Workshop, Report/Memo, Public Information Materials	Subject	Date
Stakeholder and Community Groups Interviews	Interviews were conducted to identify issues and interview committee members	May 1999
Memorandum	I-405 Corridor Program Environmental Impact Statement Proposed Study Area	May 1999
Memorandum	Draft I-405 Corridor Program Approach to Integration of MIS Analyses with NEPA and SEPA Environmental Review	May 1999
Project Website	Website designed for Project; ultimate source for I-405 Program information of all types; all agendas and meetings minutes posted; major reports and correspondence posted	July 1999
Working Paper	WP # 3 - Research on National Examples	July 1999
Executive Committee Meeting	Discussed role and responsibilities of committee; reviewed project decision process; organizational structure; project schedule and overview	July 8, 1999
Memorandum	Proposed Level of Definition and Analysis of Environmental Elements For Corridor Draft EIS	July 1999
Working Papers:	WP #11 - Background Documents Findings	July 1999
	WP # 22 - Engineering Design Conditions	July 1999
	WP #23 - Safety	July 1999
	WP #24 - Environmental Overview	July 1999
	WP #25 - Economic Profile	July 1999
	WP # 1,2 - Public Involvement Plan	August 1999
	WP # 9 - Alternatives Analysis Process	August 1999
	WP # 7 - Approach for Environmental Review	August 1999
Memorandum	Summary of Concurrence Points	August 26, 1999
Steering Committee Meeting	Reviewed public involvement plan; reviewed background report; discussed Purpose and Need Statement; reviewed environmental process; discussed operating issues	August 11, 1999
Executive Committee Meeting	Reviewed public involvement plan; reviewed background report; discussed Purpose and Need Statement; approved selection process and criteria for committee membership; discussed operating issues	August 24, 1999
Working Papers:	WP # 19 Transportation Demand Management	August 1999
	WP # 12, 26 - Relevant Transportation Plans, Projects and Programs	August 1999
	WP # 5 - Legal Authority of State	August 1999
	WP # 9 - Alternative Analysis Process	August 1999
Memorandum	Summary of Concurrency Points	August 26, 1999
Telephone Hotline	Hotline activated for communities and general public	September 1999
Press Release	Inviting qualified candidates to be considered for Membership	September 1999

Meeting, Workshop, Report/Memo, Public Information Materials	Subject	Date
Steering Committee Meeting	Refined and reached closure on Purpose and Need Statement (Reinventing NEPA consensus point #1); reviewed of alternatives analysis process; reviewed project/schedule milestones; update on public involvement; reviewed Citizen Committee charter	September 8, 1999
Concurrence Point #1	I-405 Corridor Program Reinventing NEPA Concurrence Point #1: Statement of Purpose and Need	September 1999
Executive Committee Meeting	Approved refined Purpose and Need Statement; Appointed 31 members to the Citizen Committee 9 slots left for additional members; Approved Citizen Committee Charter; Review Alternative Analysis Process	September 21, 1999
Working Papers:	WP # 14 – East King County GIS Data Overview	September 1999
	WP # 10 - Travel Forecasting Methodology	September 1999
	WP # 13 - Community Issues Summary	September 1999
	WP # 4,6 - Corridor Decision Framework	September 1999
	WP # 18 - Existing Freight Conditions	September 1999
	WP # 8 - Cost and Benefit Analysis Methodology	September 1999
	WP # 28 - Intelligent Transportation Systems	September 1999
	WP # 7 - Draft Study Plan for I-405 Corridor Program Draft EIS	October 1999
Determination of Significance	Issued SEPA Determination of Significance	October 4, 1999
Notice of Intent	Issued NEPA Notice of Intent	October 4, 1999
Project Newsletter #1	Distributed to general public; describes Corridor Program; invitation to scoping meetings	October 1999
News Release	Invitation to public scoping meetings	October 1999
Steering Committee Meeting	Review Travel Market Summary; Introduction to Screening Criteria; Input for Alternative Concepts and Strategies	October 6, 1999
Citizen Committee Meeting	Project Kick-off Bus Tour	October 9, 1999
Workshop	Criteria and Objectives Workshop	October 14, 1999
Executive Committee Meeting	Review of Public Involvement Activities; Review of Background Condition-Travel Markets; Review of Alternatives Development and Screening	October 19, 1999
Public Scoping Open House	Renton Public Scoping Open House	October 19, 1999
Public Scoping Open House	Kirkland Public Scoping Open House	October 21, 1999
Citizen Committee Meeting	Alternatives Development Workshop; Identification of Key Issues; Identification of Concepts	October 26, 1999
Study Plan for Draft EIS	Draft Study Plan for I-405 Corridor Program Draft EIS	October 1999
Agency Scoping and Steering Committee Meeting	Review NEPA/SEPA EIS Study Process; NEPA/SEPA EIS Technical Studies; Review Alternatives Development and Screening Criteria	November 10, 1999

Meeting, Workshop, Report/Memo, Public Information Materials	Subject	Date
Executive Committee Meeting	Review results from Public Open Houses; Review Citizens Workshop; Review screening criteria; Review concepts to date; Review I-695 Impacts; Approved Problem Statement, Principles and Objectives	November 16, 1999
Steering Committee Meeting	Approve first-level screening criteria (Reinventing NEPA consensus point #2); Review Trucking Survey Summary; Review Freight Analysis results; Review findings from first-level screening.	December 8, 1999
Delphi Survey Process	Steering and Citizen Committees participated in a Delphi Process to shape consensus on the seven solution packages.	December 1999
Resource Agency Meeting	Agency meeting re: corridor themes and second-level criteria and screening	January 11, 2000
Citizen Committee Meeting	Joint Meeting to discuss details within each theme packages and forward information to Executive Committee	January 12, 2000
Steering Committee Meeting	Joint Meeting to discuss details within each theme packages and forward information to Executive Committee (Reinventing NEPA consensus point #3)	January 12, 2000
Executive Committee Meeting	Reviewed first-level screening results; Discussed second-level screening process; reviewed feedback from joint meeting of Steering and Citizen Committees; approved recommended themes	January 25, 2000
Working Papers:	WP # 15, 16, 17 - Existing Transportation Conditions	February 2000
Steering Committee Meeting	Agree on second-level screening criteria and data needs (Reinventing NEPA consensus point #4);Unconstrained Modeling Results; Discussion on Process for possible Theme 8	February 9, 2000
Community Presentation	Renton City Council	February 14, 2000
Workshop	TDM Workshop; Discussion on TDM strategies and core assumptions	February 17, 2000
Community Presentation	Kirkland Alliance of Neighborhoods	March 1, 2000
Executive Committee Workshop	Review second-level screening criteria; public involvement approach; and unconstrained demand	March 1, 2000
Community Presentation	Bothell City Council	March 6,2000
Citizen Committee Meeting	Review preliminary second-level screening results; Finalize second-level screening criteria and data needs; Discuss process for selecting the alternatives	March 8, 2000
Steering Committee Meeting	Bicycle Club Presentation; TDM Workshop Summary; Review of Alternatives Development Process; Approve second-level screening criteria (Reinventing NEPA consensus point #5)	March 8, 2000
Resource Agency Meeting	Agency meeting re: second-stage environmental screening data and evaluations	March 14, 2000
Community Presentation	South County Area Transportation Board (SCATBd)	March 14, 2000
Community Presentation	BDA/Bellevue Chamber Joint Transportation Meeting	March 14, 2000
Community Presentation	Renton Chamber of Commerce	March 16, 2000
Executive Committee Meeting	Review process for selecting alternatives; Preliminary second-level screening illustrations; Major study trade-offs and issues	March 21, 2000
Community Presentation	Freight Mobility Roundtable	March 25, 2000

Meeting, Workshop, Report/Memo, Public Information Materials	Subject	Date
Community Presentation	Sound Transit	March 27, 2000
Community Presentation	Renton Blue Ribbon Commission	March 27, 2000
Community Presentation	Greater Seattle Chamber of Commerce	March 29, 2000
Community Presentation	City of Seattle – Transportation Group	April 4, 2000
Newsletter	Update on the Corridor Program; presents the 7 themes	April 2000
Steering Committee Meeting	Review second-level screening results; Discussion on shaping the alternatives	April 5, 2000
Community Presentation	Port of Seattle	April 7, 2000
Citizen Committee Meeting	Reviews Second-Level Screening Results	April 11, 2000
Community Presentations	Neighborhood Network South	April 12,2000
Community Presentation	Redmond Chamber of Commerce	April 12, 2000
Community Presentation	Eastside Transportation Partnership (ETP)	April 14, 2000
Community Presentation	1000 Friends of Washington	April 14, 2000
Community Presentation	Woodinville City Council	April 17, 2000
Media Kit	Project progress report- ; fact sheets, and newsletters distributed to Local and Regional Media	April 2000
Public Open House	Review and gather feedback on community preferences for the seven-, themes	April 18, 2000
Community Presentation	Kirkland Chamber of Commerce	April 19, 2000
Community Presentation	South Snohomish Communities	April 20, 2000
Executive Committee Meeting	Review Second-Level Screening Results; review recommendations from Steering and Citizen Committee; Discuss Shaping the Alternatives	April 25, 2000
Community Presentations	Kennydale Neighborhood Association	April 25, 2000
Community Presentation	Renton City Management Association	April 26, 2000
All Committees Meeting	All committee meeting to shape the Alternatives	April 27, 2000
Community Presentation	SW King County Chamber of Commerce	May 2, 2000
Community Presentation	Kirkland City Council	May 2, 2000
Community Presentation	Redmond City Council	May 9, 2000
Steering Committee Meeting	Reviewed, Discussed and recommended preliminary alternatives	May 9, 2000
Citizen Committee Meeting	Reviewed, Discussed and recommended preliminary Alternatives	May 9, 2000
Community Presentation	Bridle Trails Community Group	May 21, 2000
Executive Committee Meeting	Review Citizen and Steering Committee recommendations; Approve the three Alternatives for I-405 Corridor	May 23, 2000
Community Presentation	Issaquah Kiwanis Club	May 31, 2000

Meeting, Workshop, Report/Memo, Public Information Materials	Subject	Date
Resource Agency Meeting	Agency meeting re: potential addition of Fourth Alternative to range of action alternatives for Draft EIS	June 9, 2000
Executive and Steering Committees Joint Meeting	Discussion on adding the Fourth Alternative	June 14, 2000
Community Presentation	Houghton Community Council	June 19, 2000
Community Presentation	Kenmore City Council	June 19, 2000
Community Presentation	Renton Highlands Community Council	June 22, 2000
Jurisdictional Staff Workshop Central Corridor	Staff from jurisdictions in the central portion of the corridor provided more detail to the Alternatives	June 28, 2000
Resource Agency Meeting	Agency meeting re: definition and potential impacts of proposed Fourth Alternative	July 6, 2000
Jurisdictional Staff Workshop South and North Corridor	Staff from jurisdictions in the north, south, and central portion of the corridor provided more detail to the Alternatives	July 11, 2000
Executive and Steering Committees Joint Meeting	Discuss and take action on the Fourth Alternative; Discuss citizen committee membership proposal (Reinventing NEPA consensus point #6)	July 14, 2000
Concurrence Point #2	I-405 Corridor Program Reinventing NEPA Concurrence Point #2: Range of alternatives to advance for detailed study in Draft EIS	July 20, 2000
Executive and Citizen Committee Joint Meeting	Discuss proposed approach to selecting Preferred Alternative; Review Jurisdiction and Agency Workshops	July 25, 2000
Executive and Citizen Committee Joint Meeting	Discuss proposed approach to selecting Preferred Alternative; Review Jurisdiction and Agency Workshops	July 25, 2000
Steering Committee	Related Projects Coordination; Environmental Process Status; Alternatives Definition; Schedule Update	September 5, 2000
Community Presentation	Renton City Council	September 11, 2000
Citizen Committee	Schedule Update; Related Projects Coordination; Environmental Process Status; Alternatives Definition	September 12, 2000
Community Presentation	Sound Transit Open House	September 25, 2000
Workshop for Committee Members	Brown Bag Workshop – Citizen Committee Open Discussion	October 4, 2000
Steering Committee	Decision Process for Preliminary Preferred Alternative; Key Issues Discussion; Evaluation Criteria	October 5, 2000
Community Presentation	Bellevue Chamber/BDA	October 10, 2000
Citizen Committee	Decision Process for Preliminary Preferred Alternative; Discuss Key Issues; Develop Evaluation Criteria	October 18, 2000
Community Presentation	Kirkland Transportation Commission	October 25, 2000
Executive Committee	Review & Discuss Decision Process for Preliminary Preferred Alternative; Review and Discuss Recommendations from Steering and Citizen Committees; Recommend Preliminary Preferred Evaluation Criteria	October 31, 2000

Meeting, Workshop, Report/Memo, Public Information Materials	Subject	Date
Community Presentation	Kirkland Sound Transit Open House	November 9, 2000
Community Presentation	Renton HOV Access Project Open House	November 14, 2000
All Committees Meeting	Discuss Project Issues and Share Viewpoints; Review and Discuss Transportation Analysis Results; Identify Additional Information Needs or Issues	November 15, 2000
Review conference for Steering Committee	Review conference on Draft EIS Expertise Reports	November 20, 2000
Review conference for Steering Committee	Review conference on Draft EIS Expertise Reports	November 27, 2000
Community Presentation	Snohomish County Council	November 27, 2000
Community Presentation	Eastgate Sound Transit Open House	November 28, 2000
Commission Presentation	Washington State Transportation Commission	November 30, 2000
Committee Members Workshop	Brown Bag - Transportation and Environmental Results Follow-Up	December 7, 2000
All Committees Meeting	Review and Discuss Environmental and Cost-Benefit Analysis Results; Identify Additional Information Needs or Issues; Prepare for Preliminary Preferred Recommendation	December 14, 2000
Community Presentation	Bellevue Transportation Commission	December 14, 2000
Review conference for Steering Committee	Review conference on Draft EIS Expertise Reports	December 15, 2000
Review conference for Steering Committee	Review conference on Draft EIS Expertise Reports	December 18, 2000
Steering Committee	Decision Process for Preliminary Preferred; Transportation and Environmental Criteria Analysis Follow Up; Discussion on Preliminary Preferred Alternative	December 19, 2000 (afternoon)
Citizen Committee	Decision Process for Preliminary Preferred; Transportation and Environmental Criteria Analysis Follow Up; Discussion on Preliminary Preferred Alternative	December 19, 2000 (evening)
Review conference for Steering Committee	Review conference on Draft EIS Expertise Reports	December 20, 2000
Community Presentation	Bothell City Council	January 2, 2001
Community Presentation	Renton City Council	January 8, 2001
Community Presentation	Bellevue City Council	January 8, 2001
Community Presentation	Eastside Transportation Partnership	January 12, 2001
Workshop for Committee Members	Benefit-Cost Results	January 14, 2001
Community Presentation	SCAT Board	January 16, 2001
Community Presentation	Renton Transportation Committee	January 16, 2001
Steering Committee	Review Benefit-Cost Analysis Summary; Review Committee Worksheet Responses; Discussion and Recommendations on Preliminary Preferred Alternative	January 18, 2001 (afternoon)

Meeting, Workshop, Report/Memo, Public Information Materials	Subject	Date
Citizen Committee	Review Benefit-Cost Analysis Summary; Review Committee Worksheet Responses; Discussion and Recommendations on Preliminary Preferred Alternative	January 18, 2001 (evening)
Community Presentation	Renton City Council	January 22, 2001
Community Presentation	Redmond City Council	January 23, 2001
Community Presentation	Associated General Contractors	January 24, 2001
Executive Committee	Review Benefit-Cost Analysis Summary; Review Committee Worksheet Responses; Discussion and Recommendations on Preliminary Preferred Alternative	January 25, 2001
News Release	Preliminary Preferred Alternative Selection	January 26, 2001
Community Presentation	Kirkland City Council	February 6, 2001
Community Presentation	Bellevue Downtown Association	February 13, 2001
Community Presentation	Trans-Lake Washington Project	February 14, 2001
Tribal Presentation	Muckleshoot Tribe	February 26, 2001
Resource Agency	FTA	February 27, 2001
Workshop for Committee Members	Managed Lanes; Legislative Activities	February 27, 2001
Community Presentation	Central Houghton Neighborhood Association	March 7, 2001
Community Presentation	Freight Mobility Round Table	March 9, 2001
Community Presentation	Kirkland Alliance of Neighborhoods	March 14, 2001
Sound Transit Workshop	Sound Transit Bus Rapid Transit Brown Bag Meeting	March 12, 2001
Editorial Board Presentation	Eastside Journal	March 15, 2001
Editorial Board Presentation	Seattle Times	March 20, 2001
Public Open House	Bothell EIS Open House	March 20, 2001
Public Open House	Renton EIS Open House	March 22, 2001
Community Presentation	Renton Chamber of Commerce	March 26, 2001
Committee Members Workshop	Transit Discussion Meeting; Central Core HCT Options; Bus Rapid Transit	March 28, 2001
Community Presentation	Newcastle City Council	April 3, 2001
Community Presentation	Kirkland City Council	April 3, 2001
Community Presentation	SW KC Chamber of Commerce: Tukwila Government Affairs	April 3, 2001
Steering Committee	EIS Status; Survey Findings; Legislative Update; Preliminary Preferred Alternative Refinements	April 5, 2001
Community Presentation	Woodinville City Council	April 9, 2001
Community Presentation	1000 Friends of Washington	April 12, 2001

Meeting, Workshop, Report/Memo, Public Information Materials	Subject	Date
Community Presentation	Eastside Transportation Partnership	April 13, 2001
Community Presentation	League of Women Voters	April 17, 2001
Citizen Committee	Survey Findings; Legislative Update; Preliminary Preferred Alternative Refinements	April 17, 2001
Executive Committee	EIS Status; Survey Findings; Legislative Update; Preliminary Preferred Alternative Refinements	April 24, 2001
Community Presentation	Woodridge Community Council	April 26, 2001
Community Presentation	Renton Open House	April 26, 2001
Community Presentation	Redmond TMA	May 2, 2001
Community Presentation	Issaquah Chamber of Commerce	May 10, 2001
Community Presentation	CREW	May 12, 2001
Steering Committee	Preferred Alternative Development; Implementation Plan; Legislative Review	May 16, 2001
Executive Committee	Preferred Alternative Development; Implementation Plan; Legislative Review	May 30, 2001
Community Presentation	Eastside Transportation Partnership (ETP)	June 8, 2001
Community Presentation	Seattle Chamber of Commerce	June 12, 2001
Steering Committee	EIS Finalization; Preferred Alternative Development; Decision to publish Draft EIS (Reinventing NEPA consensus point #7)	June 12, 2001
Community Presentation	Bellevue Rotary	June 19, 2001
Community Presentation	Renton Highland Community Association	June 28, 2001
Executive Committee	Preferred Alternative Development	June 28, 2001
Community Presentation	Kennydale Neighborhood Association	July 25, 2001
Community Presentation	Snohomish County Council	August 6, 2001
Community Presentation	Newcastle City Council	August 7, 2001
Executive Committee	Environmental Focus; Preferred Alternative Development	August 16, 2001
Citizen Committee	Environmental Focus; Preferred Alternative Development	August 22, 2001
Steering Committee	Environmental Focus; Preferred Alternative Development	August 22, 2001
Steering Committee	Managed Lanes; Preferred Alternative Development	September 11, 2001
Citizen Committee	Managed Lanes; Preferred Alternative Development	September 13, 2001
Public Hearing	Northshore Senior Center	September 18, 2001
Public Hearing	Renton Senior Center	September 19, 2001
Public Hearing	Bellevue Regional Library	September 20, 2001
Executive Committee	Managed Lanes; Preferred Alternative Development	September 25, 2001

Meeting, Workshop, Report/Memo, Public Information Materials	Subject	Date
Steering Committee	Preferred Alternative Development	October 16, 2001
Citizen Committee	Preferred Alternative Development	October 23, 2001
Executive Committee	Preferred Alternative Development	October 30, 2001
All Committees Meting	Draft EIS Public Comment review	October 30, 2001
Steering Committee	Preferred Alternative Recommendation (Reinventing NEPA consensus point #8)	November 8, 2001
Citizen Committee	Preferred Alternative Recommendation	November 8, 2001
Executive Committee	Preferred Alternative Recommendation	November 16, 2001
Community Presentation	Rose Hill Neighborhood Assoc	January 9, 2002
Steering Committee	Preferred Alternative Description, Implementation Plan Overview	January 9, 2002
Executive Committee	Preferred Alternative Description, Implementation Plan Overview	January 17, 2002
Community Presentation	Renton Transportation Commission	January 17, 2002
Community Presentation	King Country Employee Trans	February 7, 2002
Community Presentation	SW KC Chamber of Commerce	February 8, 2002
Steering Committee	Environmental Mitigation Strategy	February 12, 2002
Community Presentation	King County Council Transportation Committee	February 27, 2002
Executive Committee	Environmental Mitigation Strategy	February 28, 2002
Community Presentation	Renton Committee of the Whole	March 4, 2002
Steering Committee	Draft Recommendation Report, Identification of Preferred Alternative in Final EIS	March 12, 2002
Community Presentation	Woodinville Chamber of Commerce	March 21, 2002
Concurrence Point #3	I-405 Corridor Program Reinventing NEPA Concurrence Point #3: Preferred Alternative and Mitigation Concept in Final EIS	April 5, 2002
Executive Committee	Draft Recommendation Report	April 2, 2002

6.3 AGENCY SCOPING

An agency scoping meeting for the I-405 Corridor Program NEPA/SEPA EIS was conducted on November 10, 1999, with affected jurisdictions, resource and regulatory agencies, and other members of the I-405 Corridor Program Steering Committee. The purpose of the meeting was to review the study process, examine the preliminary range of alternatives, discuss the scope and detail of technical studies that would be necessary to evaluate the alternatives, and receive comments and data from the participants.

Comments that were received addressed nearly every element of the environment. Issues identified through agency scoping include the following:

Air Quality

- Consider $PM_{2.5}$ and ozone in the study
- Clarify that a conformity analysis would not be part of the EIS

Noise

- Consider increasing the measurement points for noise model calibration to more than 25
- Clarify how construction noise would be treated in the EIS

Energy

- Consider reporting energy in units that can be compared across alternatives on a passenger basis

Soils and Slides

- Recommended additional sources of data for soils and geologic hazard areas

Surface Water Quality and Quantity

- Recommended reporting surface water resources included on 303d List
- Recommended qualitative plume-loading analysis
- Recommended consideration of potential effects on water temperatures
- Consider potential effects on stormwater quantity and quality
- Consider stormwater conveyance and retrofits as part of overall mitigation plan, including issues related to fish passage
- Consider anticipated changes in water quality standards

Groundwater

- Consider referencing King County groundwater information and, if available, management plans

Wetlands

- Recommended examination of potential effects on more than just Category I wetlands

Fish and Aquatic Habitat

- Provided notice that bull trout have recently been listed by U.S. Fish and Wildlife Service

Land Use

- Clarify that zoning would not be addressed in the EIS

Floodplains

- Recommended examination of potential effects on flood storage

Displacements

- Clarify that estimates of displacements will be based on approximations of potential areas affected by improvements

Social Impacts

- Clarify that the EIS would attempt to identify opportunities to improve "livability" in affected communities

Economic Impacts

- Clarify whether long-term changes in employers, employment, and related work trips (as it affects telecommuting and transportation demand management) will be addressed in the EIS
- Clarify whether least-cost planning will be addressed in the EIS

Utilities

- Consider potential effects on local and regional utilities

Traffic and Transportation

- Recommend that the EIS consider SR 518 because of its physical relationship to I-405 and the importance of its connection to SeaTac Airport
- Recommend that the EIS consider a range of alternatives that includes other means to address travel demand besides adding more than two lanes in each direction on I-405
- Recommend that the EIS evaluate increasing the speed and efficiency of the bus transit system
- Recommend that the EIS consider all affected transit operating agencies

Each comment was recorded, advanced into development of the methodologies that guided the analysis of technical issues, and considered in the EIS.

This page left intentionally blank.

7. PUBLIC INVOLVEMENT

Public input to the I-405 Corridor Program is an essential element of the environmental analysis, documentation, and review process. The purpose of the public involvement program is to build local and regional consensus leading to decisions about major I-405 investments. The public involvement program seeks to establish informed public consent for a strategy to improve mobility in the I-405 corridor.

A comprehensive public involvement and information program was developed and implemented at the onset of the decision-making and environmental analysis process. A public involvement plan, with specific goals and activities, was produced and made available for public review. A wide range of activities and resources has been available to incorporate public participation in the program. These include newsletters, public and agency briefings, project web site, media outreach, and public meetings and forums. The project web site has served as a communication nexus, providing current information and a complete record of all project documents for easy public access.

Public input has contributed to the decision-making and evaluation process including scoping, determination of which alternatives should be advanced for further evaluation in the Environmental Impact Statement (EIS), and in the selection of a preliminary preferred alternative prior to the Draft EIS, and selection of the Preferred Alternative in the Final EIS.

The public involvement during the review period for the Draft EIS included three (north, central, and south corridor) public hearings in addition to numerous other public outreach activities. The public meetings were held to receive comments and answer questions about the project in accordance with requirements of the National Environmental Policy Act. Please refer also to Appendix G of the FEIS for a description of public involvement activities that were targeted to low-income and minority groups.

7.1 PUBLIC INVOLVEMENT PLAN

The I-405 Corridor Program public involvement plan was designed to give as many stakeholders and members of the public as possible the opportunity to participate in the I-405 evaluation and decision-making process. First, the outreach elements in the public involvement plan alert the public to the program, its purpose and need, and how they can participate. Informational elements enable members of the public to understand the program vision, goals, and objectives, as well as the issues and the decision-making process. The interactive components of the plan provide stakeholders with opportunities to participate and provide input into the process.

The goals for the public involvement plan are:

- Provide all parties with a clear understanding of mobility problems on I-405;
- Instill confidence that the I-405 Corridor Program can accomplish something meaningful, but with the understanding that it does require tough choices to be made;
- Give the various stakeholder groups opportunities for meaningful dialogue and creative problem-solving;
- Disseminate information to the public in a clear and timely manner about issues related to the I-405 Corridor Program;

- Make program information easily accessible to anyone interested at any time;
- Provide as much quantitative information as possible about the program and the alternatives under consideration;
- Deliver program information to target audiences in the most efficient and cost-effective manner possible; and
- Receive, review, and document all public input.

There were a number of ways for the public to get more information during the EIS process:

- Sign up for the project mailing or e-mail list to receive the program newsletter and information;
- Call the project information line at (206) 464-5878;
- Visit the project web site for updates, news and technical information: http://www.wsdot.wa.gov/I-405;
- Schedule a presentation for an organization;
- Attend public meetings/forums; and
- Attend any of the program's Executive, Steering or Citizen Committee meetings.

The I-405 Corridor Program's public involvement process has been inclusive of all members of the public. All meetings for the project have conformed to all Americans with Disabilities Act requirements, and materials are available in formats accessible to everyone.

A summary of public involvement activities that were conducted by the I-405 Corridor Program in support of the EIS and decision-making process is presented below.

7.2 PROJECT COMMITTEES

An unprecedented partnership of federal, state, and local elected officials, agency staff, and private citizens has guided decision-making for the I-405 Corridor Program. Nearly 100 federal, state, regional, and local agency representatives and environmental, business, and local citizen representatives have served on one of three committees:

- The **Executive Committee** provides vision, policy, and oversight in the development of the I-405 Corridor Program. Committee membership includes community and agency leaders representing local and county government, Puget Sound Regional Council, Washington State Transportation Commission, Washington State Department of Transportation (WSDOT), United States Department of Transportation (USDOT), Sound Transit, and the State Legislature. The committee interacts with and receives input and recommendations from the Citizen Committee, Steering Committee, and project management team.
- The **Steering Committee**, composed of senior staff from the affected agencies, is responsible for providing guidance to the project and process, and guiding the project management team. The Steering Committee makes recommendations to the Executive Committee and seeks their strategic counsel.

- The **Citizen Committee,** made up of public volunteers representing a wide range of interests all along the corridor, was primarily responsible for providing advisory input to the Executive Committee at key points during the development and evaluation of corridor alternatives. Committee members worked with their communities to reach out and involve them in the decision-making process. The Citizen Committee concluded its advisory work in Fall 2001 following the development of recommendations for the Preferred Alternative. The Executive Committee gave considerable weight to the recommendations provided by the Citizen Committee.

The committees interacted with each other through joint meetings and other communication methods. All committee meetings were open to the public and included time for public comment. Meeting information was posted on the I-405 Corridor Program's web site for public review.

As of April 2002, the three program committees had met collectively over 80 times, including formal meetings and informal information sharing and discussion forums.

7.3 FORMAL PUBLIC MEETINGS

Five public meetings on EIS scoping and alternatives selection were held in the following communities:

Scoping Meetings: 59 people attended

October 19, 1999	Renton
October 21, 1999	Kirkland

Initial Alternative Concepts Open House: 71 people attended

April 18, 2000	Redmond

Alternatives and Preliminary Preferred Alternative Open Houses: 80 people attended

March 20, 2001	Bothell
March 22, 2001	Renton

Public Hearings on Draft EIS: 200 people attended

September 18, 2001	Bothell
September 19, 2001	Renton
September 20, 2001	Bellevue

To announce the Draft EIS hearings, news releases were sent to news media and display ads were published twice in all regional and local newspapers serving the I-405 corridor.

7.4 PUBLIC SCOPING – SUGGESTIONS AND ISSUES

More than 150 suggestions for transportation improvements were received through public scoping for the I-405 Corridor Program. Suggestions covered a wide range of physical and non-construction solutions that affected all travel modes and were dispersed throughout the study area and beyond. Each suggestion was recorded, considered, and evaluated either independently or as part of one or more themes during the screening process employed to develop the range of EIS alternatives.

Issues identified through public scoping frequently involved the following:

- Mobility for commuters, truck freight, and non-motorized vehicles;
- Travel times and travel speeds;
- HOV lanes and HOV definition;
- Lane balance;
- Traffic safety and accident reduction;
- Incident management and response;
- Local and express bus transit service;
- High-capacity transit, including light rail, commuter rail, monorail, bus rapid transit, and emerging technologies;
- Arterials, continuity, and system capacity;
- Tolls and managed lane concepts;
- Environmental quality, including especially air quality, noise, fish, pedestrian-oriented development and land use planning, cut-through traffic in neighborhoods, potential for displacements, and construction impacts;
- Environmental mitigation, especially using sound walls and lids on freeway sections; and
- Project costs and potential construction schedules.

All recorded comments were considered during development of the EIS scope and as part of the methodology reports that guided the analysis of technical issues in the EIS.

7.5 PUBLIC INFORMATION MATERIALS

7.5.1 Newsletters

Six newsletters (Fall 1999, Spring 2000, Fall 2000, Spring 2001, Summer 2001, and Winter 2002) containing project information, public meeting announcements, and related were distributed to residents, businesses, and public information centers such as libraries and city halls in and around the study area. An additional 5,000 people received the newsletters by being on project mailing lists. The primary purpose of the newsletter was to report the status of the I-405 Corridor Program and explain the environmental analysis, documentation, and review process with special emphasis on the opportunities for public input on the alternatives being considered. The newsletter also helped publicize and promote the use of the project web site, info line, and other input and information opportunities.

Two of the newsletters contained questionnaires developed to provide ongoing quantitative feedback at key points in the EIS process; approximately 300 were returned in the fall of 2000 and over 200 more were returned as of April 2001.

Additional public announcements are planned for upcoming project milestones, including the release of the Final EIS and Record of Decision.

7.5.2 Project Updates

Project updates were sent to a list of key corridor neighborhood, business, and civic organizations, and community television stations to report on progress and developments related to the I-405 Corridor Program. The list also included elected officials, media, and parties who requested notification. Since the project inception, four project updates have been distributed.

7.6 SPEAKERS BUREAU, AGENCY BRIEFINGS, AND IN-PERSON BRIEFINGS

Program staff gave over 150 presentations to interested organizations and community groups as of April 2002. Extensive outreach efforts were made, and efforts continue to identify special populations that would like a presentation and to provide input. Informational materials such as PowerPoint presentations, display materials, overheads, newsletters, and questionnaires were made available to attendees at each presentation. Presentations have included service organizations, chambers of commerce, civic groups, neighborhood organizations, and government agencies (county councils, city councils, and planning organizations). Feedback from these presentations was passed to the program decision-makers.

Program staff has been available since October 1999 to provide in-person briefings to interested officials. These briefings with key elected federal, state, and local officials were routinely held both formally and informally, and are ongoing.

7.7 PROGRAM WEB SITE: COMMUNICATION NEXUS

All project information is available on the I-405 Corridor Program's web site: http://www.wsdot.wa.gov/I-405. Everyone, including the general public, members of the Program's committees, and media have access to all available materials at any time. All program advertising and materials developed for distribution promote the web site as the ultimate source for I-405 Corridor Program information of all types. The web site provides:

- Inter- and intra-committee coordination;
- Full and cost-effective access by public, media, and committee members to technical information;
- Complete on-line program archives; and
- A tool for consensus building between committee members and public. The web site also contains interactive features: an e-mail link for residents to note concerns or ask questions about the program and the opportunity to answer online surveys and questionnaires, and give feedback.

7.8 MEDIA COVERAGE

Program information, issues, concerns and opportunities, and public meetings were widely and openly discussed in numerous regional and community newspapers, radio, and television with a general audience in the region. As of April 2002, more than 125 print, radio, and television stories had been generated in regional, local, and neighborhood media outlets. In addition to cultivating media coverage for the project, the staff also regularly disseminated program information by:

- Providing letters to the editor;
- Giving presentations to editorial boards with major print media;
- Providing media kits at key milestones; and
- Issuing news releases.

7.9 PUBLIC OPINION SURVEY

A random-sample regional telephone survey (1,200 persons) was conducted in February 2001 to provide an understanding of the representative opinions of corridor residents for proposed solutions, as well as the basis for their thinking. The survey was of sufficient sample size to allow for analysis by subregion. Results of the survey are available from WSDOT.

7.10 PROGRAM DATABASE

Beginning with existing databases of stakeholders in the study vicinity, a comprehensive contacts database for the I-405 Corridor Program was created. This database was augmented by contacts established throughout the duration of the program from a variety of sources, including contacts made via web site, e-mail, telephone info-line, questionnaire returns, and participants at all workshops and other events. Information was sent to the database contacts at key project milestones. Contact categories included neighborhood, civic, and business organizations, jurisdictional public information staff, news media, and community television contacts.

7.11 FUTURE PUBLIC REVIEW AND INVOLVEMENT

Following issuance of the Final EIS and a Record of Decision, the program will continue widespread public involvement and information efforts, including additional newsletters, conducting media outreach, updating the I-405 Corridor Program web site, and continuing to provide speakers and presentations throughout the corridor.

8. AUTHORS AND PRINCIPAL CONTRIBUTORS

8.1 GUIDANCE AND REVIEW

Name/Title	Education	Years Exper.	Co-Lead Agency
Dan Drais, Community Planner	J.D., University of Virginia Law School: A.B., Dartmouth College	13	FTA
Steve Kennedy, AICP, Senior Environmental Planner	M.U.P., Urban and Regional Planning, University of Oregon; B.A., Urban Studies, Occidental College	22	Sound Transit
Paul W. Krueger, Environmental Specialist	M.L.A., Landscape Architecture, University of Washington; B.A., Art History, Beloit College	6	WSDOT
Jim Leonard, P.E., Urban Transportation and Environmental Engineer	M.B.A., University of Puget Sound; B.A., The Evergreen State College	41	FHWA
Ann Martin, Principal Transportation Planner	B.S., Environmental Science, Washington State University	26	King County
Christina Martinez, Environmental Specialist	B.S., Environmental Science, Western Washington University	3	WSDOT

8.2 EDUCATION AND EXPERIENCE OF PREPARERS

Name	Education	Years Exper.	Final EIS Role
Ronald Q. Anderson, P.E.	M.S., Civil Engineering, Washington State University; B.S., Civil Engineering, Washington State University	34	Principal in Charge and Quality Assurance
Mark Assam, AICP	Community Planning Certificate, University of Washington; B.S., Biology, University of Washington	11	Assist Management of Selected Discipline Studies
Cynthia L. Baker, AICP	M.S., Soils, University of Washington; B.S., Biology, University of Denver	25	Manage Discipline Studies; Co-author EIS

Jim Bard	Ph.D., Anthropology, University of California, Berkeley; M.A., Anthropology, University of California, Berkeley; B.A., Anthropology, University of California, Berkeley	31	Historic, Cultural, and Archaeological Resources
Mike Behn	B.A., Planning, Public Policy, and Management, University of Oregon	3	Neighborhood and Social Impacts
Dan Benson	Coursework, University of San Diego	25	Displacements and Right-of-Way
Paul Bergman	B.A., Political Science Seattle University	7	Manage Public Information and Outreach Program
Anjali Bhagat, EIT	B.S., Civil Engineering, University of Washington	3	Noise Analysis Technical Support
Michael Booth, AICP	B.A., Urban Planning, Seattle Pacific University; A.A., Political Science, North Seattle Community College	14	Recreation, Section 4(f), Land Use, Public Services
Rita Brogan	Doctoral Program, Higher Educ, Administration University of Washington MA., Communications Theory & Methodology University of Washington BA., Editorial Journalism University of Washington	30	Public Information and Outreach Strategy Development
Cynthia Callahan	B.S., Environmental Science, Central Washington University	8	Upland Vegetation, Habitat, and Wildlife
Nick Ching EIT	B.S., Civil Engineering, University of Washington	2	GIS Analyses
Connie Corpuz	B.A., Psychology, University of Washington; Washington Real Estate License	24	Displacements and Right-of-Way
Wynnlee Crisp	M.B.A., General Management, University of Washington; M.S., Natural Resources Management, University of Alaska - Fairbanks; B.S., Biology and Chemistry, Ball State University	28	Environmental Justice
Karen Dawson, P.E.	M.S., Civil Engineering (Geotechnical), Oregon State University; B.S., Civil Engineering, Oregon State University; B.S., Forest Engineering, Oregon State University	13	Geology and Soils

Youssef Dehghani, P.E.	Ph.D., Civil Engineering, New York University at Buffalo; M.S., Civil Engineering, University of Oklahoma; B.S., Civil Engineering, Tehran Polytechnic University	29	Senior Technical Advisor and Quality Control
Dennis Derickson	M.U.P., Urban Planning, University of Washington; B.A., Urban Planning, University of Washington	30	Public Services
Mark Epstein, L.A.	M.L.A., Landscape Architecture, University of Washington; B.S., Natural Resources - Environmental Design, University of Michigan	12	Visual Quality
Carlos Espindola-Osorno	M.S., Civil Engineering, University of Illinois at Urbana-Champaign; B.S., Civil Engineering, Universidad Nacional Autonoma de Mexico	4	Noise Analysis Technical Support and Travel Forecasting
Bret C. Forrester	B.S., Wildlife Biology, Central Washington University	12	Upland Wildlife and Habitat
Leslee A. Golding (Gilmore)	B.S., Fisheries Science, University of Washington, School of Fisheries	5	Wetlands
Brian Hall	M.S., Resource Analysis/GIS, St. Mary's University of Minnesota; B.S., Field Biology Luther College	3	GIS/Figures
Richard Jack	M.S., Wetland Ecology, University of Maine; B.A., Environmental Studies, Middlebury College	8	Wetlands Analyses
Natarajan Janarthanan	Ph.D., Civil Engineering, University of Washington; M.S., Civil Engineering, University of Calgary; B.E., Engineering, India	20	Travel Forecasts and Analysis
Matt Jones	B.S., Biology, Middle Tennessee State University	2	Farmlands; Fisheries Technical Assistance
Michael Lapham	M.S., Urban and Regional Science, Portland State University; B.S., Urban Geography, University of Washington	3	Traffic Forecasts and Analysis
Anthony Lickteig	B.A., Economics, University of Kansas	15	Freight Mobility

John Macklin	M.S., Forest Ecology, University of Washington; B.B.A., Data Process Analysis, University of Texas	12	Fisheries and Aquatic Habitat
Michael Mariano, P.E.	M.S., Civil Engineering, University of Washington; B.S., Civil Engineering, University of Washington	30	Freight Mobility
Marian Allen- McDermott	M.S., Geology, Duke University; B.S., Geology, University of Rochester	13	Hazardous Materials and Wastes
Keith McGowan, AICP	M.U.P., Urban and Regional Planning, University of Oregon; Doctoral Study, Management Science, University of Washington; M.S., Recreation and Park Admin., University of Oregon; B.S., Forest Management, Louisiana State University	21	Environmental Manager; Direct Discipline Studies and Co-author EIS
Tom Noguchi	M.S., Civil Engineering, University of Washington; B.S., Civil Engineering; Drexler	22	Multimodal Transportation
Dan Pitzler	M.A., Economics, University of Washington; B.A., Economics, Western Washington University	16	Economics and Benefit-Cost Analysis
Kurt Playstead	B.S., Business Economics, Willamette University	2	Economics and Benefit-Cost Analysis
Robbie Quinto, EIT	B.S., Civil Engineering, University of Washington	5	Utilities
Jeff Randall	Ph.D., Hydrology, Univ. of Arizona; M.S., Hydrology, Univ. of Arizona; B.S., Geology, Indiana University	29	Groundwater
Sarah Richards	M.S., Environmental Engineering, University of Michigan; B.S., Chemical Engineering, Carnegie-Mellon University	16	Groundwater
Donald Samdahl, P.E.	M.S., Civil Engineering, Northwestern University; B.S., Civil Engineering, Purdue University	25	Corridor Manager and Transportation

Mark Scheibe, P.E.	M.S., Civil Engineering, Northwestern University; B.S., Civil Engineering, Santa Clara	29	Lead Transit Planning
Peter Smith, AICP	M.S., Transportation Systems Manage., University of Washington; B.A., Urban Planning, University of Washington	23	Utilities
Dean Smith	J.D., Seattle University School of Law; B.S., Natural Resources, New Mexico State University	25	Right-of-Way Displacements
Lawrence Spurgeon	M.S.E., Environmental Engineering, University of Washington; University of California, Berkeley	7	Air, Noise, and Operations Research
Cathy Strombom, AICP	M.C.R.P., Harvard University; M.A., Maths, Whitman College	28	Lead Travel Forecasting
Peter Sturtevant	M.S., Water Resources Management, University of Washington; B.A., Biology, University of California at San Diego	26	Surface Water Resources
Scott A. Swarts	B.S., Environmental Science Western Washington University	9	Wetlands
Bob Swope, AICP	M.S., Urban Planning, University of Arizona; M.A., Latin American Studies, University of New Mexico; B.A., Political Science, Pennsylvania State University	27	Assist Management of Selected Discipline Studies
Wendy Taylor P.E.	M.S., Urban Planning, Georgia State University; B.S., Civil Engineering, Lafayette College	17	Utilities
Suzanne Tomassi	M.S., Fisheries and Wildlife Biology, Michigan State University; B.S., Biology, Stockton State College	8	Wetlands; Upland Vegetation Technical Assistance
Scott Williams	Civil Engineering Technology, Shoreline Community College	18	Freight Mobility
John Young, EIT	B.S., Civil Engineering, Georgia Institute of Technology; B.A., Writing, Johns Hopkins University	20	Utilities

8.3 TECHNICAL EDITING AND DOCUMENT PRODUCTION

Technical Editing

Ellen Bancroft

Document Production

Yiing Boardman

Vickie Elwell

Mary Jo Reynolds

9. AGENCIES, ORGANIZATIONS, AND PERSONS TO WHOM COPIES OF THE DRAFT EIS WERE SENT

*(Note: *Asterisk means recipient received Executive Summary, not Draft EIS.)*

Elected Officials

Senator Maria Cantwell*
Senator Patty Murray*
Congresswoman Jennifer Dunn (District 8, Washington)*
Congressman Jay Inslee (District 1, Washington)*
State Senator Bill Finkbeiner (District 45)*
State Senator Jim Horn (District 41)*
State Senator Stephen Johnson (District 47)*
State Senator Jeanine Long (District 44)*
State Senator Rosemary McAuliffe (District 1)*
State Senator Dan McDonald (District 48)*
State Senator Julia Patterson (District 33)*
State Senator Margarita Prentice (District 11)*
State Senator Pam Roach (District 31)*
State Senator Dino Rossi (District 5)*
State Senator Paull Shin (District 21)*
State Representative Glenn Anderson (District 5)*
State Representative Ida Ballasiotes (District 41)*
State Representative Jack Cairnes (District 47)*
State Representative Eileen L. Cody (District 11)*
State Representative Mike Cooper (District 21)*
State Representative Jeanne Edwards (District 1)*
State Representative Luke Esser (District 48)*
State Representative Christopher Hurst (District 31)*
State Representative Fred Jarrett (District 41)*
State Representative Karen Keiser (District 33)*
State Representative Kathy Lambert (District 45)*
State Representative John Lockwood (District 44)*
State Representative Joe Marine (District 21)*
State Representative Al O'Brien (District 1)*
State Representative Cheryl Pflug (District 5)*
State Representative Dan Roach (District 31)*
State Representative Laura Ruderman (District 45)*
State Representative Shay Schual-Berke, M.D. (District 33)*
State Representative Geoff Simpson (District 47)*
State Representative Steve Van Luven (District 48)*
State Representative Velma Veloria (District 11) *
King County Executive, Ron Sims*
King County Council Chair, Pete von Reichbauer*
Snohomish County Executive, Bob Drewel*

Snohomish County Council Chair, Dave Somers*
Beaux Arts Village Mayor Chuck Lowry*
Bellevue Mayor Chuck Mosher*
Bothell Mayor Mike Noblet*
Clyde Hill Mayor George Martin*
Hunts Point Mayor Fred McConkey*
Issaquah Mayor Ava Frisinger*
Kenmore Mayor Dick Taylor*
Kent Mayor Jim White*
Kirkland Mayor Larry Springer*
Lynnwood Mayor Tina Roberts-Martinez*
Medina Mayor Daniel Becker*
Mercer Island Deputy Mayor Bryan Cairns*
Newcastle Mayor Sonny Putter*
Redmond Mayor Rosemarie M. Ives*
Renton Mayor Jesse Tanner*
SeaTac Mayor Shirley Thompson*
Tukwila Mayor Steven Mullett*
Woodinville Mayor Randy Ransom*
Yarrow Point Mayor Jeanne Berry*

Federal Agencies
Advisory Council on Historic Preservation
Bureau of Indian Affairs
Federal Emergency Management Agency
Federal Railroad Administration
National Marine Fisheries Service
Natural Resources Conservation Service
U.S. Army Corps of Engineers, Seattle District
U.S. Department of Commerce
U.S. Department of the Interior
U.S. Environmental Protection Agency, Region 10
U.S. Fish and Wildlife Service

Tribes
Duwamish Tribe
Kikiallus Indian Nation
Muckleshoot Tribe
Snoqualmie Tribe
The Tulalip Tribes
Yakama Nation

State Agencies
Governor's Office of Indian Affairs
Interagency Committee for Outdoor Recreation

Northwest Indian Fisheries Commission
Office of Attorney General
State Parks and Recreation Commission
Washington Energy Office
Washington State Department of Trade and Economic Development
Washington State Department of Ecology
Washington State Department of Fish and Wildlife
Washington State Department of Health
Washington State Department of Natural Resources
Washington State Office of Archaeology and Historic Preservation
Washington State Patrol
Washington Utilities and Transportation Commission

Regional Agencies
Economic Development Council of Seattle and King County
Puget Sound Clean Air Agency
Puget Sound Regional Council
Puget Sound Water Quality Action Team

Counties
Kitsap County
Pierce County
Snohomish County

Ports
Port of Everett
Port of Seattle
Port of Tacoma

Transit Agencies
Community Transit
King County Transit (King County)

Local
Beaux Arts Village
City of Bellevue
City of Bothell
City of Clyde Hill
City of Hunts Point
City of Issaquah
City of Kenmore
City of Kent
City of Kirkland
City of Lynnwood
City of Medina

City of Mercer Island
City of Mill Creek
City of Newcastle
City of Redmond
City of Renton
City of SeaTac
City of Tukwila
City of Woodinville
City of Yarrow Point
Town of Brier

Railroads and Rail Service
Amtrak
Burlington Northern Santa Fe Railroad
Spirit of Washington Dinner Train
Union Pacific Railroad

Utilities
AT&T Communications*
Alderwood Water and Sewer District*
Bonneville Power Administration*
King County Wastewater Treatment Division*
Level Three Communications*
MCI Communications*
Olympic Pipeline Company*
Puget Sound Energy*
Qwest*
Seattle Public Utilities*
Sprint*
TCI Cable*
Verizon*
Woodinville Water District*

School Districts
Bellevue School District
Edmonds School District
Issaquah School District
Kent School District
Lake Washington School District
Mercer Island School District
Northshore School District
Renton School District
Tukwila School District

Community Centers
Crossroads Community Center
Highland Community Center
Issaquah Community Center
Kent Commons
North Bellevue Community Senior Center
North Kirkland Community Center
Northshore Senior Center
Northwest Community Center
Old Redmond Schoolhouse Community Center
Renton Community Center
Tukwila Community Center
Woodinville Community Center

Community Organizations
Bellevue Chamber of Commerce
Bridle Trails Community Club
Kennydale Neighborhood Association
Kent Chamber of Commerce
Kirkland Chamber of Commerce
Mercer Island Chamber of Commerce
Northshore Chamber of Commerce
Renton Chamber of Commerce
South Snohomish County Chamber of Commerce
Southwest King County Chamber of Commerce
Woodinville Chamber of Commerce
Montlake Community Club

Interest Groups
1000 Friends of Washington
American Automobile Association
Cascade Bicycle Club
Eastside Transportation Committee
League of Women Voters
Little Bear Creek Protective Association
People for Modern Transit
Audubon Society, East Lake Washington Chapter
Snohomish County Citizens for Improved Transportation
Transportation Choices Coalition
Washington Association of Rail Passengers
Washington Environmental Council
Washington State Historical Society
Washington Trucking Association
Smart Growth

I-405 Corridor Program Executive Committee Members
Councilmember Pam Carter, City of Tukwila
Councilmember Sants Contreras, City of Kirkland
Councilmember Randy Corman, City of Renton
Councilmember Barbara Cothern, Snohomish County
Commissioner Aubrey Davis, Washington State Transportation Commission
Councilmember Grant Degginger, City of Bellevue
Deputy Regional Administrator David Dye, Washington State Department of Transportation
Board Vice President Bob Edwards, Puget Sound Regional Council
Senator Jim Horn
Division Administrator Daniel Mathis, Federal Highway Administration
Representative Christopher Hurst
Mayor Rosemarie Ives, City of Redmond
Commissioner George Kargianis, Washington State Transportation Commission
Councilmember Connie Marshall, City of Bellevue
Councilmember Joan McBride, City of Kirkland
Board Member Rob McKenna, Sound Transit
Mayor Steven Mullet, City of Tukwila
Regional Administrator John Okamoto, Washington State Dept. of Transportation, Northwest Region
Senator Julia Patterson
Councilmember Dick Paylor, City of Bothell
Representative Cheryl Pflug
Senator Margarita Prentice
Mayor Sonny Putter, City of Newcastle
Executive Ron Sims, King County
Councilmember Dave Somers, Snohomish County
Deputy Director Harold Taniguchi, King County Department of Transportation

I-405 Corridor Program Steering Committee Members
Gail D'Allessio, Beaux Arts Village
Goran Sparrman, City of Bellevue
Kim Becklund, City of Bellevue*
Bernard van de Kamp, City of Bellevue
Eddie Lowe, City of Bothell
Mitch Wasserman, City of Clyde Hill
Fred McConkey, City of Hunts Point
Bob Sokol, City of Kenmore
Don Wickstrom, City of Kent
Jim Arndt, City of Kirkland
Bill Vlcek, City of Lynnwood
Doug Schulze, City of Medina
Debra Symmonds, City of Mercer Island
Kevin Gross, City of Newcastle
Don Cairns, City of Redmond
Sandra Meyer, City of Renton

Gregg Zimmerman, City of Renton
Jim Morrow, City of Tukwila
Mick Monken, City of Woodinville
Joe Seet, City of Woodinville
Leonard F. Newstrum, Town of Yarrow Point
Johannes Kurz, Snohomish County
John Anderson, Puget Sound Clean Air Agency
Kevin Murphy, Puget Sound Regional Council
Peter Beaulieu, Puget Sound Regional Council
John Sindzinski, Community Transit
Bill Barlow, Community Transit
Brian O'Sullivan, Sound Transit
Barbara Gilliland, Sound Transit*
Jim Leonard, Federal Highway Administration
Sharon Love, Federal Highway Administration
John Witmer, Federal Transit Administration
Dan Drais, Federal Transit Administration
Tom Gibbons, National Marine Fisheries Service*
Jack Kennedy, U.S. Army Corps of Engineers
Nancy Brennan-Dubbs, U.S. Fish and Wildlife Service*
Jonathon Freedman, U.S. Environmental Protection Agency
Allyson Brooks, Washington State Office of Archaeology and Historic Preservation
Sandra Manning, Washington State Department of Ecology
Therese Swanson, Washington State Department of Ecology
Phil Fordyce, Washington State Department of Transportation, Northwest Region*
Chris Rose, Washington State Transportation Commission
Terra Hegy, Washington Department of Fish and Wildlife
Ann Martin, King County Department of Transportation

I-405 Corridor Program Citizen Committee Members

Doug Baker*
Sue Baugh*
Norm Proctor*
Bob Blayden*
Kim Browne*
Mary-Alyce Burleigh*
Emilio Cantu*
Craig Chang*
Steve Coleman*
Paul Cowles*
Norma Cugini*
Jim Cusick*
Sharon Eklund*
Patrick Ewing*
Kemper Freeman*

Tom Gilchrist*
Corrine Hensley*
Jim Hill*
Linda Holman*
Peter Hurley*
Mike Hurst*
John Jackson*
Jay Lawley*
Carmen Lefebvre*
Bill Linton*
John McGarvey*
K.C. McNeil*
Phil Miller*
Bill Moritz*
Nina Odell*
Dale Potter*
Janet Ray*
John Resha*
Dennis Robertson*
Thomas Tochterman*
Kevin Wallace*
Liz Warman*
Roland White*
Ken Williams*

Libraries
Edmonds Library
Lynnwood Library
Mountlake Terrace Library
King County Library System/Bellevue Regional Library
Bothell Regional Library
Fairwood Library
Issaquah Library
Kenmore Library
Kent Regional Library
Kingsgate Library
Kirkland Library
Lake Hills Library
Maple Valley Library
Mercer Island Library
Newport Way Library
Redmond Library
Renton Public Library
Sammamish Library
Seattle Libary

Skyway Library
Tukwila Library
University of Washington-Suzallo Library
Valley View Library
Woodinville Library

Media
Daily Journal of Commerce*
Eastside Journal*
KCPQ TV*
KCTS TV*
KING Broadcasting*
KIRO Broadcasting*
KKMO Radio*
KNWX Radio*
KOMO TV*
KSTW TV*
KUOW Radio*
Seattle Post-Intelligencer*
Seattle Times*

Other
Foster & Associates
Clear Channel Entertainment
Huckell Weinman and Associates
Foster, Pepper & Shefelman
HDR Engineering
HNTB
Dave Russell
Dave Asher
Dan Brea
Emil King
Margaret Kitchell
Warren Yee
Don Padelford
George Hadley

This page left intentionally blank.

10. ABBREVIATIONS AND ACRONYMS

AASHTO American Association of State Highway and Transportation Officials

ACHP Advisory Council on Historic Preservation

ADA Americans with Disabilities Act

ADT Average daily traffic

AIRFA American Indian Religious Freedom Act

A.M. Ante meridian (before noon)

APA Aquifer protection area

APD Agricultural Production District

APE Area of potential effects

AQMA Air quality maintenance area

AQMP Air quality maintenance plan

ARA Aquifer recharge area

ARPA Archaeological Resources Protection Act

BACT Best available control technology

BATEA Best available technology economically achievable

bgs Below ground surface

BLM Bureau of Land Management

BMP Best management practice

BNSF Burlington Northern Santa Fe Railroad

B.P. Before present

BPA Bonneville Power Administration

BROTS Bellevue-Redmond-Overlake Transportation Study

BRT Bus rapid transit

BTU British thermal unit

CAA Clean Air Act

CAAA Clean Air Act Amendments

CARA Critical aquifer recharge area

CBD Central business district

CEQ Council on Environmental Quality

CERCLIS Comprehensive Environmental Response, Compensation, and Liability Information System

cfr Calculated fixed radius

CFR Code of Federal Regulations

CO Carbon monoxide

CO_2 Carbon dioxide

COD Chemical oxygen demand

CONEKC East King County Corridor Study

CSCSL Confirmed or Suspected Contaminated Sites List

CTR Commuter trip reduction

CWA Clean Water Act (Section 404)

CWPP County-Wide Planning Policies

DDES King County Department of Development and Environmental Services

DEA David Evans and Associates, Inc.

DEIS Draft Environmental Impact Statement

DNR Washington State Department of Natural Resources

DOH Washington State Department of Health

DOT Department of Transportation

DRAM/EMPAL Disaggregated Residential Allocation Model/Employment Allocation Model

EA Environmental Assessment

Ecology Washington State Department of Ecology

EDNA Environmental Designation for Noise Abatement

EIS Environmental impact statement

EMME/2	Regional transportation model for the Puget Sound region
EO	Executive Order
ERNS	Emergency Response Notification System
ESA	Endangered Species Act
ETP	Eastside Transportation Partnership's Mobility Action Program
FAZ	Forecast analysis zone
FEIS	Final environmental impact statement
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FONSI	Finding of No Significant Impact
FIRES	Finance, insurance, real estate, and other services
FPP	(King County) Farmland Preservation Program
FPPA	Farmland Protection Policy Act
FTA	Federal Transit Administration
FTANOISE	The FTA Transit Noise Assessment Spreadsheet Model
FWS	Fish & Wildlife Service
GIS	Geographic information system
GMA	Washington State Growth Management Act
GP	General purpose
HABS	Historic American Buildings Survey
HAER	Historic American Engineering Record
HAL	High-accident location
HAP	Hazardous air pollutant
HC	Hydrocarbon
HCT	High-capacity transit
HEC-RAS	Hydrologic Engineering Center River Analysis System
HMMH	Harris Miller Miller and Hanson, Inc.
HOT	High-occupancy/toll
HOV	High-occupancy vehicle
HP	High priority
HPA	High probability area (archaeologically sensitive area)
I/C	Interchange
I/M	Inspection/maintenance
ICR	Independent cleanup report
ITE	Institute of Transportation Engineers
ITS	Intelligent transportation systems
IWG	Interagency Working Group on Environmental Justice
$\mathbf{L_{eq}}$	Equivalent sound level
$\mathbf{L_{max}}$	Maximum sound level
$\mathbf{L_{min}}$	Minimum sound level
LQG	Large quantity generator
LUST	Leaking underground storage tank
MCP	Multimodal Corridor Project
µg	Microgram
mg/L	Milligrams per liter
MOA	Memorandum of agreement
MOU	Memorandum of understanding
MTP	Metropolitan Transportation Plan
MVM	Million vehicle miles
NAC	Noise abatement criteria
NAGPRA	Native American Graves Protection and Repatriation Act
NAAQS	National Ambient Air Quality Standards
NESHAPs	National Emissions Standards for Hazardous Air Pollutants
NEPA	National Environmental Policy Act of 1969

NFRAP	No Further Remedial Action Planned
NHDS	WDNR Natural Heritage Data System
NHPA	National Historic Preservation Act of 1966, as amended
NL	Noise level
NMFS	National Marine Fisheries Service
NO	Nitric oxide
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides
NPL	National Priority List
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
O&M	Operations and maintenance
O_2	Oxygen
O_3	Ozone
OAHP	Office of Archaeology and Historic Preservation
OAQPS	Office of Air Quality Performance Standards
OFM	Office of Financial Management (Washington State)
OHWM	Ordinary high water mark
OSHA	Occupational Safety and Health Act of 1970
PAHs	Polynuclear aromatic hydrocarbons
PCBs	Polychlorinated biphenyls
PDEIS	Preliminary draft environmental impact statement
PHS	Priority habitat species
P.M.	Post meridian (after noon)
PM	Particulate matter
PM_{10}	Particulate matter less than 10 micrometers in diameter
$PM_{2.5}$	Particulate matter less than 2.5 micrometers in diameter
PPA	Preliminary Preferred Alternative
ppm	Parts per million
PSCAA	Puget Sound Clean Air Agency (the local air pollution authority)
PSE	Puget Sound Energy
PSI	Pollutant Standard Index
PSRC	Puget Sound Regional Council (the local metropolitan planning organization)
RAN	Regional arterial network
RCP	Regionwide congestion pricing
RCRA	Resource Conservation and Recovery Act
RCW	Revised Code of Washington
RM	River mile
RMS	Root-mean-square
ROW	Right-of-way
RTID	Regional Transportation Investment District
SCA	Sanitary control area
SCS	U.S. Soil Conservation Service
SE	Sound exposure
Section 106	National Historic Preservation Act, Section 106
Section 4(f)	Dept. of Transportation Act (23 USC, Section 138 – formerly 49 USC 1653(f))
SEL	Sound exposure level
SEPA	State Environmental Policy Act
SHPO	State Historic Preservation Officer
SHSP	State Highway System Plan
SIP	State Implementation Plan
SMA	Shoreline Management Act
SOV	Single occupancy vehicle
SPCC	Spill prevention, countermeasure, and control
SPL	Sound pressure level
SQG	Small quantity generator

SSA	Sole source aquifer
SR	State route
TAZ	Transportation analysis zone
TCP	Traditional cultural property
TDM	Transportation demand management
THPO	Tribal Historical Preservation Officer
TIA	Total impervious area
TIP	Transportation improvement program/plan
TMA	Transportation management association
TOD	Transit-oriented development
TSD	Treatment, storage, and disposal
TSP	Total suspended particulates
TRAC	Washington State Transportation Center
TRS	Total reduced sulfur
UGA	Urban Growth Area
US	United States
USACOE	U.S. Army Corps of Engineers
USDOT	U.S. Department of Transportation
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UST	Underground storage tank
uwpk	Unweighted peak level
VHT	Vehicle hours of travel
VMT	Vehicles miles traveled
VOC	Volatile organic compound
WAC	Washington Administrative Code
WDFW	Washington State Department of Fish and Wildlife
WHPA	Wellhead protection area
WHPP	Wellhead Protection Program
WRHP	Washington Register of Historic Places
WRIA	Water Resource Inventory Area
WSDOT	Washington State Department of Transportation
WTCU	Wholesale trade, transportation, communication, and utilities

11. LIST OF I-405 CORRIDOR PROGRAM DISCIPLINE STUDIES

Errata and addenda have been prepared for several of the I-405 Corridor Program draft technical expertise reports to identify important modifications since the reports were prepared. Because not all of the modifications may be contained in the errata and addenda, the information in the Final EIS is understood to supersede any discrepancies with the expertise reports and technical memoranda that may not be covered in the errata and the addenda.

Draft Air Quality Expertise Report, April 2001, Parsons Brinckerhoff

Draft Cultural Resources Expertise Report, April 2001, CH2M HILL

Draft Economics Expertise Report, April 2001, CH2M HILL

Draft Energy Technical Memorandum, April 2001, Parsons Brinckerhoff

Draft Environmental Justice Expertise Report, April 2001, CH2M HILL

Draft Farmland Expertise Report, April 2001, David Evans and Associates, Inc.

Draft Fish and Aquatic Habitat Expertise Report, April 2001, David Evans and Associates, Inc.

- *Errata for Fish and Aquatic Habitat Expertise Report*

Draft Floodplain Expertise Report, April 2001, David Evans and Associates, Inc.

Draft Geology and Soils Expertise Report, April 2001, CH2M HILL

Draft Groundwater Resources Expertise Report, April 2001, CH2M HILL

Draft Hazardous Materials and Wastes Technical Memorandum, April 2001, CH2M HILL

Draft Land Use Expertise Report, April 2001, David Evans and Associates, Inc.

Draft Land Use Plans and Policies Expertise Report, April 2001, David Evans and Associates, Inc.

- *Addendum for Land Use Plans and Policies Expertise Report*

Draft Noise Expertise Report, April 2001, Parsons Brinckerhoff

Draft Public Services Expertise Report, April 2001, David Evans and Associates, Inc.

Draft Recreation and Section 4(f) Resources Expertise Report, April 2001, David Evans and Associates, Inc.

Draft Right-of-Way and Displacements Expertise Report, April 2001, David Evans and Associates, Inc.

Draft Shorelines Expertise Report, April 2001, David Evans and Associates, Inc.

Draft Social Expertise Report, April 2001, CH2M HILL

Draft Surface Water Resources Expertise Report, April 2001, CH2M HILL

- *Errata for Surface Water Resources Expertise Report*

Draft Transportation Expertise Report, April 2001, Mirai Associates and David Evans and Associates, Inc.

- *Addendum and Errata for Transportation Expertise Report*

Draft Upland Vegetation, Habitat, and Wildlife Expertise Report, April 2001, David Evans and Associates, Inc.

- *Errata for Upland Vegetation, Habitat, and Wildlife Expertise Report*

Draft Utilities Expertise Report, April 2001, HNTB Corporation, Inc.

Draft Visual Resources Expertise Report, April 2001, David Evans and Associates, Inc.

Draft Wetlands Expertise Report, April 2001, David Evans and Associates, Inc.

- *Addendum for Wetlands Expertise Report*