Trans-Lake Washington Study

Technical Report

Vol. 2 Appendices 1-9

Trans-Lake Washington Study

Draft

Transportation Demand Management Strategy
Discussion and Effectiveness Estimates

Prepared for

Washington State Department of Transportation

Office of Urban Mobility

March 1999

Trans-Lake Washington Study Team

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Trans-Lake Washington Study

Overview of Travel Forecasting Methodology

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October 12,1999

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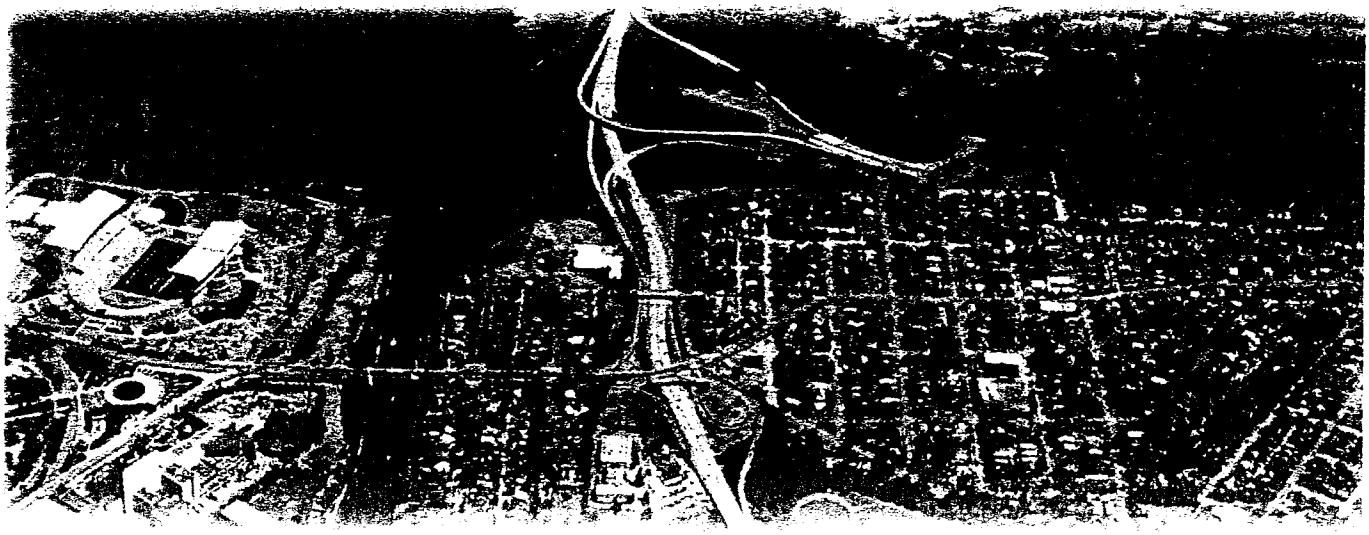
Appendix 1
Concept Descriptions and Evaluation Approach



TRANSIT CONCEPT DESCRIPTIONS

Rail Concepts

Concept T-1
Light Rail around the Lake (SR 522) - Vicinity I-405 to I-5

This alignment would have a terminus at I-405 and follow the SR 522 corridor to tie in to Sound Transit's Roosevelt Station near NE 65th Street. The I-405 origin could tie in directly with the University of Washington Branch Campus (currently under construction) or at a nearby transit station which could ultimately tie in with different transit solutions on the I-405 corridor. The following options have been suggested for the SR 522 corridor:

- elevated monorail
- elevated high speed (not feasible)
- surface light rail with tunneling at various locations

There may be segments which could be developed outside the existing right-of-way. General rail station locations could be at the corridor's two termini, Bothell, Kenmore, and Lake City, with probable stations between at community focal points, particularly if an option which included street cars was developed.

Concept T-2
Rail along I-90 Corridor - Overlake/Redmond to I-90 and to Seattle

a) From Seattle east across the I-90 center roadway via Mercer Island to the south, Bellevue Park and Ride, next to downtown Bellevue, east across I-405 along the Bel-Red Road corridor to Overlake, with a terminus at the Overlake Transit center at approximately 140th Ave. NE and SR 520 or Redmond Town Center.

b) Alternatively, from Seattle east on I-90 to the Issaquah area with potential stops at Mercer Island, south Bellevue, Factoria, Eastgate, and Issaquah.

The following rail alternatives have been suggested for further study along this corridor:

- elevated monorail
- elevated high speed (along the I-90 corridor only)
- surface light rail

Concept T-3
Rail along SR 520 Corridor - Redmond to Seattle

A passenger rail line connecting the University District/University of Washington and Eastside communities would extend from I-5 to Redmond and terminate in the vicinity of SR 202. Various geographical challenges are presented along this potential route to include grade differentials, structural constraints (I-405 interchange), and Lake Washington. The following rail alternatives have been recommended for further study and could in concert provide service to Seattle along the SR 520 route:

- elevated monorail
- surface light rail no new bridge
- surface light rail on new bridge
- submerged tube across lake subway (Redmond to Seattle tunnel)
- high speed elevated rail
- convert 2 lanes to rail

General station locations along SR 520 could be near Redmond Town Center, Avondale, 148th Ave. NE, Bellevue Way, Montlake Blvd.

Concept T-4

Light Rail from U-District to Kirkland/Redmond

This concept would tie into Sound Transit's Link alignment at the University and progress through the University District along the general alignment of SR 513 (Mountlake Blvd.) to the Sand Point area. From there, Lake Washington would be crossed, (bridge or submerged tube) to Kirkland where a general alignment may follow SR 908 (Central Way, N.E. 85th, Redmond-Kirkland Rd., or along SR 520) to a terminus in Redmond near the town center. General station locations may include the University District; University Village; the vicinity of Sand Point; downtown Kirkland; I-405; Willows Rd. vicinity; and Redmond town center area. Option: use BN right-of-way to rejoin the SR 520 / Overlake corridor at South Kirkland.

Concept T-5

Rail Station at I-5 Roanoke (SR 520) interchange

A rail station could be located near the west end of SR 520 where it would tie directly to Sound Transit's I-5 light rail line. This station would serve as an intermodal transfer station for travelers to and from the Eastside of Lake Washington. The transfer station location would be dependent on the final Sound Transit I-5 light rail alignment and could be influenced by the level of anticipated utilization.

Concept T-17

Personal Rapid Transit

Personal rapid transit (PRT) is a fully automated system of vehicles capable of operation without human drivers that are captive to a reserved guideways. The guideways can be located aboveground, at ground level or underground. Small vehicles would be available for exclusive use by an individual (PRT) or a small group (GRT), typically 1 to 6 passengers, traveling together by choice and available 24 hours a day. Vehicles would be able to use all guideways and stations on a fully coupled PRT network. Direct origin to destination service would be available, without a necessity to transfer or stop at intervening stations. Passengers could use the PRT service on demand rather than on fixed schedules.

A variation of this concept integrates personal auto convenience and efficiency of PRT. It utilizes small- and medium-sized electric vehicles that can be manually operated on the conventional roadway system as well as on PRT system. The vehicles are capable of entering onto the guideway from existing roads. While traveling on the guideway, operation would be fully automated. This combination of integrated operating modes would provide the user with the ability to reach the vast majority of destinations in a large metropolitan region.

Ferry Concepts

Note: Passenger-only ferry concepts could also be passenger and bus only as an option.

Concept T-6

Passenger Ferry Service - Kirkland to Sand Point

Provide passenger ferry service across Lake Washington from Kirkland to Sand Point. Eastside express bus service would link the park-and-ride lots at NE 85th St., NE 70th St., and Kingsgate to the ferry terminal in Kirkland. Westside express bus service would link Sand Point to the NE 65th Street/I-5 HOV/Park and Ride complex. Local improvements could include bicycle/pedestrian paths or additional roadway widths for bicycle access to the ferry landing from major arterials such as Market St., NE 85th St., NE 68th St., and Lake Washington.

Concept T-7

Passenger Ferry Service - Kirkland to University of Washington and/or Downtown Seattle

Passenger ferry service for cross-lake commuters, particularly focused on University of Washington commuters. Because this service would primarily serve the University of Washington students and employees, a shuttle service from the ferry terminal to circulate Stevens Way on campus would be an integral part of the ultimate concept. Passengers destined for downtown would be able to disembark the shuttle on Montlake Blvd. NE and utilize Metro bus service to their final destination.

Concept T-8

Ferry Service Kirkland to Madison Park

Re-introduce the cross-lake ferry system from Kirkland to Madison Park. At Madison Park, ferry commuters would reach Seattle by:

- Another option would be to provide express bus service from Madison Park to Seattle during the peak periods and install arterial transit/HOV lanes with signal priority and/or queue jumps to ensure reliable bus schedules.
- Potentially enter a transit tunnel (similar to the downtown Seattle bus tunnel) that would connect to downtown Seattle.

In Kirkland, shuttle service would be required to park and ride lots near I-405 at NE 85th and NE 70th. Expansion of these lots may also be required.

Bus/Transit Concepts

Concept T-9

Improved Express Service

This concept increases express bus service between Downtown Seattle, the University District and the Eastside. Typical improvements would include increased frequency of service for existing routes (especially during the peak periods) and the creation of new express routes to attract additional commuters. Additional improvements could include expanded coverage of areas serviced by express routes.

Concept T-10

Improved "Reverse Commute" service (SR 520)

This concept would increase the level of transit service for those commuters living in Seattle and working in the Eastside in areas such as downtown Bellevue and Redmond. Currently, the vast majority of trips for bus routes traveling the SR 520 bridge corridor serve the primary commute pattern from Bellevue to Downtown Seattle or the University District in the AM peak period. Return trips to the Eastside are only provided in the PM peak period. As a result, commuters wishing to travel from Seattle to the Eastside in the AM peak and returning in the PM have a relatively small number of options that often require a transfer either in Downtown Seattle or the University District.

The improved "reverse commute" service option would provide additional service between park and ride lots in the Seattle area and major employment centers in the Eastside, such as Microsoft, downtown Redmond, and downtown Bellevue. This could be accomplished either through the addition of return trips on existing routes or through the creation of new routes.

Concept T-11
Improved Transit Service:
a. Misc. Transit Service Improvements
b. General service improvements (shuttles, loop routes, amenities, better regular network, Eastside circulator)

This concept would attempt to induce a mode shift to transit through an overall increase in transit service levels and customer satisfaction. Rather than just increasing the frequency on existing routes, the concept includes more comprehensive service enhancements such as improved rider amenities, shuttles, loop routes, an Eastside circulator route, etc. The concept seeks to eliminate or diminish many of the other disincentives to transit ridership outside of service frequency. Examples of improvements could include improved bus shelters; shuttle and loop service better suited to the suburban environment of the Eastside; and guaranteed ride home programs for emergencies. The assumption is that the combination of all these general improvements would together offer enough incentive to generate a significant mode shift from SOV to transit in the SR 520 corridor.

Concept T-13
Convert Two Lanes of SR 520 to Bus Use

This concept would convert the operation of one lane of traffic in each direction from general purpose to bus-only. The concept could be implemented either for the entire day or during the peak periods only. The implementation could include barrier separation or signing and striping only. The conversion to bus-only operation would create dramatic time savings for transit when compared to the general purpose lanes due to the combination of reduced capacity for general purpose vehicles on the bridge and transit only operation in the adjacent lanes.

Concept T-14
Transit Priority on SR 522

This concept seeks to improve SR 522 as a viable alternative to SR 520 by decreasing the travel time of transit vehicles traveling between the Eastside and Seattle via SR522 through the use of transit signal priority. The concept would include transit or HOV lanes on SR522 combined with priority at traffic signals along the route. The transit/HOV lanes could allow transit vehicles to bypass the existing congestion on SR522 — especially through the Bothell and Lake City areas. Signal priority is typically implemented in two general forms:

- A transit queue jump (allowing the bus to enter the intersection first after a red light to bypass general purpose traffic); or
- Additional green time for the bus movement through the modification of signal timing based on the automatic detection of transit vehicles as they approach the intersection.

Transit lanes currently exist only in portions of this corridor. The technology for transit signal priority has been in operation for a number of years and can be considered a proven and stable technology.

Concept T-15
Connect Park and Ride Lots to Activity Centers

This concept would expand or refocus transit service to address demand between Park and Ride lots and major activity centers. The restructured or enhanced service would require an expansion of the service fleet, and expansion of the Park and Ride lots within the regional system.

Concept T-16
Bus-Only Lanes on I-5 and in Dedicated Rights-of-Way

This concept would provide travel time advantages for transit through the construction of bus-only lanes on I-5 and other dedicated rights-of-way. The assumption is that transit travel time savings would result in mode shift away from SOV towards transit usage. Specific examples of potential bus-only lanes include:

- **Bus-only ramp lanes between the I-5 express lanes and SR520.** This connection would provide direct access from the Convention Center bus station in Downtown Seattle to SR 520 via the express lanes. Significant time savings would accrue to the buses traveling between Downtown Seattle and the Eastside as they would be able to avoid congestion on I-5 and the SR520/I-5 ramps.
- **Bus-only lanes on I-5.** A bus-only lane on this facility would provide increased mobility for buses moving up and down the I-5 corridor. This would facilitate additional travel time savings for buses making trips between Seattle and the Eastside via I-5 and I-405 by expediting the trip accessing a trans-lake route. This concept would significantly improve trans-lake routes (see Concepts R-1.1, R-2, R-6).

Concept T-17
Personal Rapid Transit

Personal rapid transit (PRT) is a fully automated system of vehicles capable of operation without human drivers that are captive to a reserved guideways. The guideways can be located aboveground, at ground level or underground. Small vehicles would be available for exclusive use by an individual (PRT) or a small group (GRT), typically 1 to 6 passengers, traveling together by choice and available 24 hours a day. Vehicles would be able to use all guideways and stations on a fully coupled PRT network. Direct origin to destination service would be available, without a necessity to transfer or stop at intervening stations. Passengers could use the PRT service on demand rather than on fixed schedules.

A variation of this concept integrates personal auto convenience and efficiency of PRT. It utilizes small- and medium-sized electric vehicles that can be manually operated on the conventional roadway system as well as on PRT system. The vehicles are capable of entering onto the guideway from existing roads. While traveling on the guideway, operation would be fully automated. This combination of integrated operating modes would provide the user with the ability to reach the vast majority of destinations in a large metropolitan region.

ROADWAY CONCEPT DESCRIPTIONS

I-90 Corridor

Concept R-1
Provide bi-directional HOV lanes along the existing center roadway

Area/Termini: I-90 between the I-405 and I-5 Interchanges
NOTE: Current analysis is being performed by Sound Transit addressing operational options on I-90.
Description: Provide permanent bi-directional HOV lanes along the existing center roadway that is currently used as reversible lanes between the I-405 Interchange and the West Entrance to the Mt. Baker Tunnels in Seattle. These lanes would tie into the existing mainline HOV lanes at both ends of the center roadway. Some modification of ramps connection would be required.

Concept R-2
Use I-90 Center Roadway for Heavy Trucks

Area/Termini: I-90 between Issaquah and the Port of Seattle.
Description: Provide a 'Truck Express' lane in each direction on I-90. Consider adding new lanes or a 'take a lane' option. Under the 'take a lane' option, assign existing center roadway for exclusive use by heavy trucks (freight). Provide for direct connection to port area for this traffic via Atlantic Street and Royal Brougham Way, while minimizing truck-weaving conflicts at the ends of the center roadway for non-port truck traffic. Eliminate and/or shift the center roadway HOV lanes to the existing general purpose bridge decks.

Concept R-3
Remove I-90 Flammable Materials Exclusion

Description: Alter current flammable cargo exclusion from I-90 by permitting transport of these materials during late-night or off-peak hours, in conjunction with restricting combustible cargo traffic to I-90 center roadway.

SR 520 Corridor

Concept R-4
Add HOV lanes in each direction to SR 520

Area/Termini: SR 520 between I-405 and I-5
HOV lanes would be added to SR 520 from I-5 on the west to the terminus of HOV lanes on the eastern leg of SR 520, including upgrading of currently sub-standard HOV lanes. Connections to current or projected HOV capacity on I-5 and I-405 would be provided, along with provision for interchange connections at all appropriate locations such as Lake Washington Blvd. (in Bellevue and Seattle), Montlake Blvd., 108th Avenue NE, 92nd Avenue NE, 84th Ave. NE, 124th Avenue NE, West Lake Sammamish Blvd., and SR 202. Two possible approaches for providing this capacity are:

- Put HOV lanes on new bridge parallel to existing bridge and widen land segments.
- Incorporate HOV lanes in reconstruction of bridge and widen land segments.

Concept R-5
Add 1 HOV lane and 1 General Purpose Lane in each direction to SR 520

Area/Termini: SR 520 between I-405 and I-5

As with R-2 above, HOV lanes would be added to SR 520 from I-5 on the west to the terminus of HOV lanes on the eastern leg of SR 520, including upgrading of currently sub-standard HOV lanes. Connections to current or projected HOV capacity on I-5 and I-405 would be provided, along with provision for interchange connections at all appropriate locations such as Lake Washington Blvd. (in Bellevue and Seattle), Montlake Blvd., 108th Avenue NE, 92nd Avenue NE, 84th Avenue NE, 124th Avenue NE, 148th Avenue NE, West Lake Sammamish Blvd., and SR 202. Since general purpose capacity on SR 520 is largely two lanes from SR 202 to I-5, a third general purpose lane would need to be added in each direction. Alternatives suggested for providing this capacity include:

- Entirely new bridge structures at surface and widening on land (8 lanes total)
- Reconfigure existing bridge structure to 3FP / 1 HOV and construct a new parallel structure, with widening on land.
- Provide capacity via a tube or tunnel across the lake, widening on land.
- Double-deck existing bridge, widening on land.

Alternatively, general purpose capacity expansion could be restricted to the section of SR 520 east of either Lake Washington Blvd. (Bellevue) or I-405.

Concept R-6
Add 1 HOV lane and 2 General Purpose lanes in each direction
Description/Assumptions:

Area/Termini: SR 520 between SR 202 and I-5

Provide HOV lanes and four general purpose lanes in each direction. As with R-2 above, HOV lanes would be added to SR 520 from I-5 on the west to the terminus of HOV lanes on the eastern leg of SR 520, including upgrading of currently sub-standard HOV lanes. Connections to current or projected HOV capacity on I-5 and I-405 would be provided, along with provision for interchange connections at all appropriate locations such as Lake Washington Blvd. (in Bellevue and Seattle), Montlake Blvd., 108th Avenue NE, 92nd Avenue NE, 84th Avenue NE, 124th Avenue NE, 148th Avenue NE, West Lake Sammamish Blvd., and SR 202. Since general purpose capacity on SR 520 is largely two lanes from SR 202 to I-5, a third and fourth general purpose lane would need to be added in each direction. Alternatives suggested for providing this capacity include:

- Entirely new bridge structures at surface and widening on land (10 lanes total)
- Reconfigure existing bridge structure to 3 GP / 1 HOV and construct a new parallel structure, with widening on land
- Provide capacity via a tube or tunnel across lake, widening on land
- Double-deck existing bridge, widening on land
- Provide capacity by tube or tunnel.

Alternatively, general purpose capacity expansion could be restricted to the section of SR 520 east on either Lake Washington Blvd. (Bellevue) or I-405.

The existing right-of-way along the SR-520 corridor varies greatly; +600 ft wide at interchanges and as narrow as 66 ft wide at the Partage Bay Viaduct. In general terms, the corridor is approximately 200 ft wide from I-5 to I-405 and about 300 ft wide from I-405 to Redmond.

Widening to a total of one HOV lane and four general-purpose lanes in each direction would take up a total right-of-way width of approximately 300 ft. This width accommodates standard shoulder and lane widths, but a median barrier would separate east and westbound traffic. A minimum of 120 ft and as much as 240 ft of additional right-of-way width would be required.

Widening for one HOV lane and 6 general-purpose would take up a total right-of-way width of approximately 260. A minimum of 80 ft and as much as 200 ft of right-of-way width would be required. Depending on topography, retaining walls would be required in lieu of cut/fill slopes to maintain narrow widths identified above.

Concept R-7
Convert 1 General Purpose Lane in each Direction to HOV on SR 520
Description/Assumptions:

Area/Termini: SR 520 between I-405 and I-5

Description: Convert 1 general-purpose lane in each direction into an HOV lane. Modify interchange ramps at Lake Washington Blvd. (in Bellevue and Seattle), 108th Ave. NE, 92nd Ave. NE, 84th Ave. NE, and Montlake Blvd. NE (SR 513) to include special HOV lanes and metering of the general purpose on-ramp lanes. This concept would probably require the addition of HOV lanes on I-5 and I-405.

Concept R-8
Convert All General Purpose Lanes on the 520 Bridge to Transit/HOV
Description/Assumptions:

Area/Termini: SR 520 between I-405 and I-5

Description: Incorporate restrictions on SR 520 to allow HOV and transit usage only between Montlake Blvd. NE (SR 513) and 92 Ave. NE (in Clyde Hill. Provide appropriate striping and signage in advance of restricted areas to properly channel non-eligible traffic off of SR 520. Also furnish applicable enforcement infrastructure such as visual monitoring equipment and side bays for law enforcement vehicles.

Concept R-9:
Provide Vehicle Refuge/Shoulders on SR 520

(a) Add Shoulders To Existing Bridge

(b) Develop vehicle Pullouts on the Existing Bridge

Area/Termini: SR 520 between I-405 and I-5

Description:

(a) Widen the existing bridge to accommodate full-width (per Federal Highway and WSDOT standards) inside and outside shoulders. Re-configure lanes at both ends of the bridge to properly align with expanded bridge carriageway.

(b) Construct vehicle pull-outs on the Evergreen Point Bridge at 300-meter intervals on each side with sufficient lengths to accommodate 1 tractor-trailer vehicle and 1 emergency vehicle, in order to reduce lane blockages during emergency situations. Also provide the deceleration and acceleration tapers to allow vehicles to enter and leave pullouts safely. Both options would require retrofitting the existing pontoons with new pontoons.

Concept R-10
Provide Barrier Separated HOV lanes on SR 520
Description/Assumptions:

(a) Provide Peak-Period Reversible Lanes

(b) Widen Evergreen Point Bridge to Provide Reversible HOV Lane

Area/Termini: SR 520 between I-405 and I-5

Description:

(a) Widen SR 520 (including the existing bridges) to accommodate peak period reversible center lanes. No intermediate access or egress will be provided between I-405 and I-5. The lanes will terminate far enough in advance (or beyond) I-5 and I-405 to safely accommodate weaving movements, or could tie into HOV lane additions on I-5. Modification of the interchanges at Lake Washington Blvd. (in Bellevue and Seattle), 108th Ave. NE, 92nd Ave. NE, 84th Ave. NE, and Montlake Blvd. NE (SR 513) also will be necessary.

(b) Widen Evergreen Point Bridge to accommodate a fifth lane to be dedicated for HOV usage only. This lane would be reversible in order to handle peak traffic flows in both directions. Fixed or moveable lane barriers would be installed to safely separate adjacent lanes of opposing traffic.

Concept R-11
Provide Barrier Separated Express lanes on SR 520
Description/Assumptions:

Description: Widen SR 520 to provide barrier separated express lanes. A direct connection to the I-5 express lanes would function only in the direction in which those on I-5 that are operating. A connection with I-405 would require either dropping the SR 520 express lanes, or adding express lanes to I-405.

Concept R-12
Connect SR 520 to I-5 Express/HOV Lanes
Description/Assumptions:

Area/Termini: SR 520 between Portage Bay and I-5
Description: Provide direct connections between SR 520 and the express/HOV lanes on I-5. The express/HOV lanes lane extensions onto SR 520 from I-5 will begin/end far enough in advance/beyond I-5 in order to accommodate safe weaving movements.

Concept R-13:
Improve Mercer St. Connection to SR 520
Description/Assumptions:

Area/Termini: I-5 Corridor between Mercer St. and SR 520.
Description: Provide direct HOV and/or express lane access (underground or elevated) between Mercer St. and SR 520. Also eliminate the 'Mercer weave' (Mercer to I-5 to SR 520 and vice versa) with mainline I-5 movements by re-constructing general-purpose lane on and off-ramps to enter and exit from the right lanes of I-5.

Concept R-45:
Improve *the* Montlake to I-5 Connection
Description/Assumptions:

Area/Termini: SR 520 corridor between Montlake Blvd. and I-5.
Description: Construct a westbound drop-add (merge/exit) lane extending full length of the Portage Bay viaduct, from Montlake Blvd. to the Harvard/Roanoke exit. This concept would to enable smoother traffic flow in this area by providing more room weaving movements as vehicles enter and exit the main traffic stream. The viaduct/bridge would have to be modified when adding a lane. The existing right of way is only 66 ft. wide through the Portage Bay area. Additional right-of way would have to be purchased.

Concept R-14:
Restrict Lake Washington Blvd. (in Seattle) on-ramp to HOV usage only.
Description/Assumptions:

Area/Termini: SR 520/Lake Washington Blvd. (Seattle) On-ramp
Description: Restrict Lake Washington Blvd. on-ramp to HOV usage only. An option could be to limit this to peak periods only.

Concept R-15:
Provide Direct HOV Access between UW and SR 520
Description/Assumptions:

Area/Termini: SR 520/Montlake Blvd. (SR 513) Interchange

Description: Provide a direct HOV connection between the major UW area arterial streets (Montlake Blvd. and Pacific St.) and SR 520 that would avoid the Montlake Bridge congestion and closures associated with overheight vessels traveling through the Montlake cut (ship canal). Connections could be made via a bridge or tunnel. A bridge from the UW area to SR 520 would be required to have the vertical clearance necessary to accommodate all Montlake cut vessel traffic. A bridge would serve multiple destinations: the UW Hospital/lower campus, the main campus, Husky Stadium Major re-alignment of Pacific St. and Montlake Blvd. Reconstruction of the SR 520/Montlake Blvd. interchange would be required. A tunnel would surface in the vicinity of NE 45th Street to serve University Village and Children's Orthopedic Hospital via surface streets.

Concept R-16:
Install Ramp Metering at On-Ramps east of I-405

Area/Termini: SR 520 between I-405 and SR 202
Description: Install ramp metering at all on-ramps between I-405 and SR 202 in order to regulate traffic flows and improve capacity along the SR 520 corridor between I-405 and I-5.

Concept R-17:
Close Access to SR 520 from the Montlake area during peak periods

Area/Termini: SR 520 between I-405 and SR 202
Description: Close SR 520 on-ramps in during peak periods. The Montlake interchange (eastbound and westbound) and the Lake Washington Blvd. interchange (eastbound) will be included in the closure.

Concept R-43:
Provide Access to SR 520 from E. Madison St.

Area/Termini: New alignment from E. Madison St. at 23dr Ave. E. to SR 520
Description: Keep and improve the ramps in the Washington Park Arboretum, but provide access only via a tunnel under the Arboretum from E. Madison Street. This concept would require arterial street improvement and possibly realignment along E. Madison St. to the tunnel entrance. Changes to the Arboretum ramps would also be required.

SR 522 Corridor

Concept R-18
Convert SR 522 to Limited Access

Area/Termini: SR 522 from I-5 to I-405
Description: Provide a limited access freeway along the entire route of SR 522. Improve major at-grade intersections with grade-separated roadways. Provide full Interchanges in the vicinity of N. 80th St., N. 95th St., Northgate Way, Roosevelt Way, NE 145th St. (SR 523), NE Ballinger Way (SR 104), Jaunita Dr. NE, and 98th Ave. NE. Eliminate minor at-grade intersections by constructing cul-de-sacs and frontage roads for local traffic. Tie into existing limited access portions of SR 522 at I-5 and I-405.

Concept R-19
Eight-Lane SR 522
Description/Assumptions:

Area/Termini: SR 522 from I-5 to I-405
Description: Widen the existing SR 522 alignment to include 8 lanes and retain as a primary arterial. Provide new sections of alignment to keep the new 8-Lane roadway alignment segregated from the current Lake City Way alignment between NE 125th St.

Concept R-20
Add HOV Lanes to SR 522

Area/Termini: SR 522 from I-5 to I-405
Description: Widen the existing SR 522 alignment to include HOV lanes and retain as a primary arterial. Widen and convert existing transit lanes to HOV lanes by adding bus pullouts.

Concept R-21
Implement Improved Access Control

Area/Termini: SR 522 from I-5 to I-405
Description: Provide better access control by installing a median to substantially reduce left turn movements, and by consolidating driveways. This could be as extensive as converting major at-grade intersections to grade-separated interchanges and convert minor intersections to right-in, right-out status. Incorporate U-turn movements along corridor.

Concept R-22
Continuous Transit Lanes on SR 522

Area/Termini: SR 522 from I-5 to I-405
Description: Widen SR 522 (where needed) to provide a continuous eastbound and westbound transit lanes on SR 522. Transit lanes will be aligned with exiting transit lanes that currently run eastbound from Lake City to Kenmore and westbound from Kenmore to Mountlake Terrace.

Concept R-44
Improve N 145th St. Corridor - Between I-5 and SR 522

Area/Termini: I-5 to SR 522
Improve existing east-west arterial capacity on N 145th St. to provide better access to routes that lead across/around the Lake Washington. Expand capacity by adding additional general-purpose lanes, upgrading primary collector roadways to arterials, improving intersections, access control (medians), driveway consolidation, and signal interconnection. This concept would also include a new urban diamond interchange at I-5

Kirkland to Sand Point Bridge/Tube

Concept R-23
New Highway Corridor

Area/Termini: I-5 to I-405 (through Kirkland/Sand Point)
Description: Construct new limited-access highway corridor (with HOV lanes as an option) from Seattle to Redmond via a Kirkland to Sand Point Bridge/Tube spanning Lake Washington. Interchanges at I-5 and I-405 would be developed, and alignment options considered under further evaluation.

Concept R-24
New Bridge to Connect to Existing Arterial Roadways

Area/Termini: I-5 to I-405 (through Kirkland/Sand Point)
Description: Construct a new Bridge/Tube from Kirkland to Sand Point. Connect to existing arterial streets in Kirkland and Seattle. Provide additional capacity on feeder arterial roads at both ends of the Bridge/Tube to accommodate increased traffic flows.

Other New Corridors

Concept R-25
New East-West Highway (County Line) Corridor between I-5 and I-405

Description: Develop a new highway corridor north of Seattle separate from the existing SR 522 corridor. The limited-access freeway (with HOV lanes) would be an eastward extension of SR 104 from I-5 along NE 244th St. to I-405. Full or partial intermediate interchanges would be constructed at Cedar Way, Brier Road (55th Ave. NE), Locust Way (61st Pl. NE), Meridian Ave. (80th Ave. NE), and SR 520).

Concept R-26
New Corridor - North-South freeway between I-5 and Lake Washington

This concept proposes a new freeway corridor through a highly developed area, similar to the original R.H. Thomson expressway idea from years ago. (further description forthcoming)

I-5 Corridor

Concept R-27
Olive Way to SR 520 HOV Connection

Description: Create an HOV-priority connection between Olive Way and SR 520 by providing an additional mainline alignment and ramps along I-5 between the Olive Way interchange and the eastbound SR 520 ramps. Ramps would be constructed to facilitate HOV and Transit movements from downtown generators and eastbound SR 520. The new HOV alignment will be separated from general-purpose I-5 movements.

Concept R-28
HOV Lanes across Ship Canal Bridge

Description: Widen the Ship Canal Bridge to accommodate HOV lanes in both directions. Provide connections to existing HOV lanes north and south of the bridge.

Concept R-29
Widen I-5 through Downtown Seattle

Description: Widen I-5 through downtown Seattle to include 4 general-purpose lanes and 1 HOV lane in each direction. Major reconstruction of the under-crossing at the Convention Center and modifications to the existing general purpose/express lane connection at Yesler Way will be required. Widening of Ship Canal Bridge to allow for the additional lanes will also be necessary.

Widening only through downtown to four general-purpose and one HOV lanes in each direction will not completely solve congestion problems along the I-5 corridor. To effectively address congestion issues, widening would be required from north to south to points where to an equivalent number of lanes exist. The matching point on the north is in Northgate and on the south is just south of the I-90 interchange. Extensive reconstruction would be required. Major elements of the reconstruction are: Widen the ship canal bridge one lane in each direction, widen under the Washington State Convention Center and Freeway Park. Significant interchange modifications would be required at I-90, SR-520, and at the north end of northbound and southbound C.D. lane connections. Lane additions in the south bound direction are at the following locations: one lane Northgate to SR-520, one lane Senica St. to Marion St., two lanes from Marion St. to just south of the I-90 interchange. Lane additions in the northbound direction are required in the following locations: one lane I-90 to Cherry, two lanes Cherry to Madison St., and one lane Madison to Northgate. Such lane additions have significant impact to Seattle surface streets as well as several existing high-rise buildings.

Concept R-47
Improve *the* I-5 Connection to the University District
Description/Assumptions:

Area/Termini: On NE 45th between I-5 and the University District.
Description: The University District is the second highest destination to the Seattle CBD. Improving the I-5 interchange at NE 45th would enable better traffic flows to/from the University District and the Wallingford neighborhood. Improving traffic flows in and around this interchange may offer relief to congestion on I-5 Ship Canal bridge deck, the SR 520 interchange, as well as on streets in this vicinity. An HOV access ramp into the University District at N.E.45th would speed trips into this urban center. Adding on street AM/PM HOV lanes on NE 45th to the Campus and to the vicinity of Montlake /SR 520 would also provide an alternative to driving. Adding a transit circulator could expedite the transit trips.

Concept R-48
All-day Two-way HOV on I-5
Description/Assumptions:

Area/Termini: I-5 between Northgate and Downtown Seattle.
Description: Provide all-day two-way HOV lanes on I-5 from Northgate to the Seattle central business district. The HOV lanes would offer speedy, reliable north-south service to transit and 2+ carpools.

I-405 Corridor

Concept R-30
Add One General Purpose Lane in each Direction to I-405

Area/Termini: I-405 between I-90 and SR 520
Description: Add one general-purpose lane in each direction along I-405. Reconstruct existing roadway, bridges and ramps to accommodate the widening. Entirely rebuild interchanges within downtown Bellevue, at SR 520, and at SR 522 modify all other interchanges.

This concept is very similar to Alternative No. 1 found in the I-405 Multimodal Corridor Project: Technical report, April 1998. Modeling results of Alternative No.1 indicate that impacts on I-405 general purpose lanes are as follows: 11 percent reduction in delay, 1 mph average travel speed increase, 11 percent increase in vehicle miles of travel, and a 2 percent increase in congested lane-miles. Other reported impacts are worse air quality and significant right-of-way requirements.

Concept R-31
Add 2 General Purpose Lanes in each Direction to I-405

Area/Termini: I-405 between I-90 and SR 520
Description: Add two general-purpose lanes in each direction along I-405. Reconstruct existing roadway, bridges and ramps to accommodate the widening. Entirely rebuild all interchanges within the proposed area.

This concept is very similar to Alternative No. 2 found in the I-405 Multimodal Corridor Project: Technical report, April 1998. Modeling results of Alternative No.2 indicate that impacts on I-405 general purpose lanes are as follows: 22 percent reduction in delay, 2 mph average travel speed increase, 21 percent increase in vehicle miles of travel, and a 6 percent increase in congested lane-miles. Other reported impacts are worse air quality and significant right-of-way requirements

Concept R-32
Express/HOV Lanes on I-405

a) Add Express Lanes through Bellevue and Kirkland
b) Add Median HOV Lanes with Direct Access

Area/Termini:

a) I-405 between I-90 and NE 124th St.
b) I-405 between I-90 and SR 520

Description:

a) Construct reversible express lanes along I-405. Begin the express lanes at the I-90 interchange and provide access points in downtown Bellevue and at 85th Street in Kirkland only. Reconstruct existing roadway, bridges and interchanges to allow express lanes either in the center of the freeway or along a separate alignment to SR 520.
b) Shift the existing HOV to the inside (median) lanes of I-405 and provide direct access ramps at major interchanges. Modify existing overpasses and underpasses to accommodate the direct access ramp movements. Add signalized intersections on overpasses and underpasses to allow HOV vehicles to have protected movements between the arterial roadways and the freeway.

Concept R-33
Expand Eastside North-South Arterial Roadways

Area/Termini: All Eastside North-South Arterial Roads between I-90 and the Snohomish County I-5/I-405 Interchange

Description: Improve existing north-south Eastside arterial capacity to promote distribution of traffic flows along the I-405 corridor. Expand capacity by adding additional general-purpose lanes, upgrading primary collector roadways to arterial roads, improving intersections, access control (medians), driveway consolidation, and signal interconnection. Enhance north-south access between I-90, SR 520, SR 522 and I-5 by improving some or all of the following arterial roads: Bellevue Way, Lake Washington Blvd./Market Street, Juanita Way, Simonds Road NE from Kenmore to 100th Ave. NE and on 100th Ave. NE to Kirkland, 132nd Ave. NE, 148th Ave. NE, 156th Ave. NE, SR 527, and SR 202.

Concept R-34
Build Eastside Arterial HOV lanes

Area/Termini: All Eastside Arterial Roadways between I-90 and the I-5/I-405 Interchange

Description: Improve existing north-south Eastside arterial HOV capacity. Expand capacity by adding HOV lanes, improving intersections for HOV (including pre-emptive signal treatments), access control (medians), driveway consolidation, and signal interconnection. Enhance north-south HOV access between I-90, SR 520, SR 522 and I-5 by improving the following arterial roads: Bellevue Way, Lake Washington Blvd./Market Street, 100th Ave. NE, Juanita Way, 148th Ave. NE, 156th Ave. NE, SR 527, and SR ***202.***

Concept R-35
HOV Ramp Enhancements

Area/Termini: All Limited-Access Highway Corridors in the Study Area

Description: Convert selected existing freeway ramps to allow peak hour only HOV access (i.e. prohibit SOV usage). Construct HOV bypass and metered ramps in all corridors. These options on the concept could be integrated into the existing/programmed HOV lane system, or become supplemental to HOV lane concepts in the Trans-Lake corridors.

Concept R-36
ITS (Intelligent Transportation Systems)

a) Improved Traveler Information Systems
b) Use of "Smart Road" Technology on SR 520

Area/Termini:

a) All Limited-Access Highway Corridors in the Study Area
b) SR 520

Description:

a) Enhance existing Traveler Information Systems. Construct additional Variable Message Boards to supplement the existing signs along all corridors. Improve radio and TV coverage that allows continuous traffic/accident information. Link construction and accident data into WSDOT's 'Seattle Traffic' internet site and expand the internet site to include congestion data on major arterial roadways and at major intersections.
b) Use "Smart Road" technologies along the SR 520 corridor to reduce headways, improve safety and enhance capacity. Among the technologies that could be incorporated would include: congestion pricing/automated usage monitoring and invoicing, vehicle robotics, collision warning, and guidance devices.

Regional Issues and Other Concepts

Concept R-37
Complete HOV System and Add Direct Access

Area/Termini: All Highway Corridors in the Study Area

Description: Complete HOV system on all study corridors to create a seamless HOV lane system. Widen roadways (where needed to accommodate the addition of HOV lanes) and shift existing outside HOV lanes to inside (median) lane locations. Provide direct access from arterial streets to HOV lanes and provide direct HOV to HOV connections at all freeway interchanges.

Concept R-38
Eliminate HOV lanes

Area/Termini: All Limited-Access and Primary Arterial Highway Corridors in the Study Area

Description: Remove all HOV restrictions from all freeway and arterial road corridors, converting them to general-purpose use. Re-stripe all HOV lanes, reconfigure existing direct access ramps, and remove HOV bypass lanes on on-ramps.

Concept R-39
Emergency Floating Bridge Plan (I-90 and SR 520 Floating Bridges)

Area/Termini: Entire Study Area

Description: Prepare plan to accommodate negative impacts on mobility and traffic movement in the event that either of the I-90 or SR 520 floating bridges sinks. Develop a Congestion Mitigation Plan (including emergency alternate routes), and coordinate with transit and carpooling agencies to increase HOV usage.

Concept R-40
HOV Lane Use by Non-HOV Vehicles

b) Free SOV Usage during Off-peak Periods
c) Commercial Usage during Off-peak Periods

Area/Termini: All Limited-Access Highway Corridors in the Study Area

Description:

b) Allow SOVs free use of HOV lanes during off-peak times. Sign each HOV corridor to indicate restricted hours for SOV usage. Peak hours would be set separately for each corridor based on the traffic volumes and commuting patterns.
c) Allow commercial vehicles free use of HOV lanes during off-peak times. Sign each HOV corridor to indicate restricted hours for SOV usage. Peak hours would be set separately for each corridor based on the traffic volumes and commute patterns.

Concept R-41
Ingress/Egress on Opposite Sides of the Freeway (in each direction)

Area/Termini: All Limited-Access Highway Corridors in the Study Area
Description: Reconfigure existing interchanges to allow inside (median) and outside entrances and exits to reduce weaving movements and increase capacity. Endeavor to balance entering and exiting volumes through strategic spacing of the access points, as well as traffic movements on connecting arterial streets.

Concept R-42
Do Nothing

Area/Termini: All Corridors in the Study Area
Description: Complete currently funded network improvements only, and undertake only routine and periodic maintenance activities in the future.

Concept R-46
Paid HOV Lane Use by SOV Vehicles during Non-Peak Hours

Area/Termini: All Limited-Access Highway Corridors in the Study Area
Description:
Allow SOVs paid use of HOV lanes during off-peak times through the provision of toll booths, toll cards, or electronic transponder devices which would automatically bill registered users. The high occupancy toll (HOT)/transit lane would allow access for general purpose vehicles with payment of a toll. Barrier separation of the HOT lane and general-purpose lanes provides a means of enforcement. Other enforcement measures might include visual monitoring equipment and highway patrol assistance. Peak hours would be set separately for each corridor based on the traffic volumes and commuting patterns.

TRANSPORTATION DEMAND MANAGEMENT (TDM) AND LAND USE CONCEPTS

Incentives for CTR/Ridesharing

These concepts would involve the creation of additional incentives to encourage commuters to commute to work or school via transit, high occupancy vehicles (HOVs), or non-motorized modes of transportation.

Concept D-1
Parking Cash Out

This concept would involve offering a financial incentive to employees to consider using alternative modes of transportation. Employees who currently subsidize their employee parking could be required to offer employees an equal cash benefit if they choose not to drive alone to work. California, for example, has a law similar to this in place.

Concept D-2
Transit Subsidies

This concept would involve reducing and/or simplifying transit pricing to attract additional transit riders traveling across Lake Washington. Options could include reducing transit fares and passes for the entire King County Metro/Sound Transit systems; or partially or fully subsidizing transit passes or "flex-passes" in designated employment or activity centers. In addition, employers could offer employees who do use transit or other alternative modes with a "Guaranteed Ride Home" in case of emergency.

Concept D-3
Vanpool Subsidies

This concept would involve subsidizing the cost of vanpools (maintenance, fuel, parking, etc.) to decrease the number of single occupancy vehicles using SR 520. Vanpools may be particularly useful for trips not easily served by transit. A related ridesharing incentive is to provide vanpools and carpools with premium parking spaces at worksites.

Concept D-4
Other Monetary Incentives

Other monetary incentives to encourage the use of alternative modes of transportation include paying employees who drive to work to take extra passengers, or paying employees to use alternative modes of transportation. These programs could be paid for by the employer, or fully or partially subsidized. Another financial incentive to encourage transit use is to work with retail establishments to offer retail discounts to those who have transit passes. The U-PASS program, for example, includes retail discounts to U-PASS holders.

Concept D-16
Require More Employers to Implement CTR Programs

This concept would extend Commute Trip Reduction program requirements to employers with fewer employees. This would apply to employers within the study area. The law requires offices and plants that employ at least 100 day-shift workers to monitor how their employees get to work and to distribute information on alternatives to driving alone. The state law also set CTR goals: a 15 percent reduction in drive-alone commuting at the affected work sites by January 1995, 25 percent by January 1997, 35 percent by January 1999. By requiring offices and plants that employ less than 100 day-shift workers, more people would likely select modes other than SOV for commuting.

Concept D-17
Free Transit Service Across the Lake

This concept could take many forms but essentially would seek to create a mode shift from SOV to transit in the SR520 corridor by eliminating the fare for transit riders. Examples of the types of options that could be investigated for this concept include the following: free service between specific transit stops near the SR520 bridge, free service for all riders on bus routes using the SR520 bridge (regardless of where they get on the bus), or free service for all riders on bus routes using the SR520 bridge during the peak period. Equity, operations and enforcement issues would have to be addressed.

Other TDM Concepts

Concept D-5
Ration the Use of SR 520 and Other Facilities

This concept would involve rationing the use of SR 520 and other facilities through a number of possible mechanisms, including fee-based mechanisms and others not based on fees. Tolls (see Concept D-10) or congestion pricing (see Concept D-11) for SOVs could ration use of SR 520 (and possibly other facilities) by pricing some SOVs off of the system or into alternative modes of transportation. Alternatively, all registered vehicles could be required to purchase a vehicle pass/sticker that indicates which days of the week the vehicle is eligible to use SR 520. The cost of the pass could vary according to how many days a week the person wants to use the vehicle on SR 520. Carpools/vanpools could be provided with free or reduced passes. This system would require a significant enforcement effort.

Mechanisms not based on fees could include rationing SR 520 (and possibly other facilities) by license plate numbers. A portion of single occupancy vehicles (SOVs) — for example, those with license plates begin with odd numbers — could be restricted from using SR 520 on certain days of the week. The remaining SOVs — those with license plates that begin with even numbers — could be restricted from using SR 520 on other days of the week. Alternatively, all vehicles, upon registration, could be provided with some type of sticker that indicates which days of the week the vehicle can be used (on SR 520 or other facilities). A significant enforcement effort would also be required to implement this concept.

Concept D-6
Employer Provide Alternative Work Hours

This concept would involve encouraging or providing incentives to employers (e.g., via tax incentives) to offer or mandate alternative work hours for employees. The alternative work hours could include a compressed work week, flextime, or staggered work hours. A compressed work week schedule could allow some or all employees to work more hours per day, but fewer days per week (e.g., four ten-hour days per week). A compressed work week helps move the commute hours for some employees slightly out of the peak hours of travel, but more importantly eliminates some work trips. A flextime program allows employees to set their schedules to work earlier or later hours (e.g., work 6:00 am to 3:00 p.m. or 10:00 am to 7:00 p.m.). Flextime can help to move some work trips out of the peak periods of travel, thereby reducing congestion during peak periods.

Employers can offer the compressed work week or flex time to all employees, or offer them as an incentive to encourage employees to use alternative modes of transportation. Because many employees want to work alternative hours, employers could restrict the use of alternative work hours to those employees who commute to work using alternative modes of transportation.

An employer can also implement staggered work hours, in which the employer has designated shifts (6:00 am to 3:00 p.m.; 7:00 am to 4:00 p.m., etc.) so that employees arrive and leave at different times throughout the day. Employees could also be required to work one weekend day instead of a weekday. Staggered work hours can help to move some work trips out of the peak periods of travel, thereby reducing congestion during peak periods.

Transportation Pricing Concepts

Concept D-7
One Dollar Per Gallon Gas Tax

For this concept, the assumption is an increase in the gas tax of one dollar per gallon. The one dollar increase would be in addition to the current state fuel tax of 23 ¢ per gallon, and the federal gasoline tax of 18.3 ¢ per gallon. This concept involves reducing demand for travel by increasing the "out-of-pocket" cost of driving. The gas tax could be increased on a statewide basis or possibly on a local basis. In either case legislation would be required to increase the gas tax by one dollar.

Concept D-8
Parking Pricing

This concept involves reducing demand for SOV travel by increasing the "out-of-pocket" cost of driving through increasing the cost of parking. Employees who currently subsidize their employee parking could be required to offer employees an equal cash incentive if they choose not to drive alone to work (see Concept D-1). In addition, there could be regional coordinated efforts to encourage employers to voluntarily combine an increase in the price of parking with a travel allowance that employees could use either to pay for parking, to purchase a transit pass, or (for those who walk or bike to work) to buy new shoes or bike equipment. Alternatively, employers could voluntarily implement paid parking on their work-sites with the proceeds used to fund incentives for those who commute using alternative modes of transportation. In employment areas where most parking is already being priced (e.g., CBDs) as well as locations where parking is not currently priced, parking tax increases could potentially be implemented to encourage parking providers to increase the cost of parking.

Concept D-9
Tolls

This concept involves charging vehicles to cross the bridges (the existing bridges and new bridges if built). One version of this concept could include only charging tolls on general purpose lanes (not HOV lanes). Charging tolls would increase out-of-pocket expenses for drivers and encourage use of alternative modes of transportation, thereby reducing demand for the use of the bridges. The assumption is that vehicles would only be charged going one direction, and that the majority of vehicles would have their tolls paid automatically so that they would not have to stop to pay the toll. Tolls can be paid automatically through a pre-paid "Smart Card" that is installed in vehicles' windshields. Vehicles are automatically charged the toll as they drive at nearly full speed under a card reader. Systems like this are in place on many bridges and toll roads throughout the U.S. and the world. Where tolls are automatically read, HOVs could be provided with their own lane where they would not be charged a toll. This HOV toll-free lane would require enforcement, which could possibly include barrier separation from general purpose lanes. A manual toll booth might still be required for those who don't have a "Smart Card."

Concept D-10
Congestion Pricing

This concept involves charging vehicles to cross the SR 520 bridge (the existing bridge and/or a new bridge if built), with the toll varying according to congestion levels or time of day. The tolls could be higher when congestion is severe, and lower or zero when there is little or no congestion. The goal would be to reduce demand for travel during the most congested periods of the day by shifting some travel to the non-peak periods of demand,

or by shifting SOVs into alternative modes of transportation. Vehicles could also be charged according to how many miles they travel (in a day, year or other timeframe). The assumption is that the majority of vehicles would have their tolls paid automatically so that they don't have to stop to pay the toll. Tolls can be paid automatically through a pre-paid "Smart Card" that is installed in vehicles' windshields. Vehicles are then automatically charged the toll as they drive at nearly full speed under a card reader. A manual toll booth might still be required for those who don't have a "Smart Card."

Land Use Concepts

Concept D-11
Promote Jobs / Housing Balance

This concept involves land use/zoning changes or the provision of tax incentives or disincentives to encourage housing and employment centers to be located closer to each other and closer to areas that can be well-served by transit. Zoning changes can be implemented to locate new housing in areas that will minimize transportation needs (e.g., close to employment centers and transit). Another option is to reward those who live close to where they work by providing them a subsidized property tax or rent rebate. A related concern is to ensure that affordable housing is provided in the area. This new affordable housing could be encouraged through the use of tax incentives that stipulate that the new housing must be "affordable" and located in designated urban villages or near transit centers. Fees or fines could potentially be levied against municipalities that allow land uses that violate regional growth strategies.

Concept D-12
Strict Enforcement of Concurrency

This concept involves enforcing concurrency so that development is commensurate with infrastructure. This could include a growth moratorium in areas that have inadequate transportation systems. It could also use state and local tax revenues that flow from growth to assist in financing public infrastructure (including transportation) that a growing region needs to remain economically healthy.

This concept could also involve designating a regional agency or organization to distribute funds (e.g., MVET revenues or fuel tax revenues) or levy fines to municipalities according to the municipalities' land use practices and patterns relative to regional land use/growth goals.

Concept D-13
Increased Land Use Density in Centers

Denser development is generally more easily served by transit or non-motorized forms of transportation. This concept involves using either financial incentives or interjurisdictional education and coordination efforts to increase land use density by locating more housing and employment in designated urban centers that are well-served by transit.

Concept D-14
Intergovernmental Strategies

This concept involves developing additional intergovernmental strategies to promote livable communities; reduce congestion; protect rural areas, open spaces, and forests; and promote urban centers. These intergovernmental strategies could build off of and expand upon the Vision 2020, GMA and PSRC efforts already underway in the region to address these issues.

Concept D-15
Maximize Transit Oriented Development

Transit oriented development involves locating development so that residents and/or employment sites can be more easily served by transit. This usually means locating jobs and housing closer to each other, and ideally locating both of them near transit facilities. This concept could include providing significant tax benefits to developers that locate housing near major employment centers and transit facilities; or that locate employment centers near major housing areas and transit facilities.

ENHANCEMENT CONCEPT DESCRIPTIONS

Bike/Pedestrian Concepts

Alternatives under this heading include suggested modifications to existing facilities to service the pedestrian and bicycle commuters. Any new transit or roadway concept brought forward as a solution, would likely include bike/pedestrian concepts as a component of the solution:

Concept E-1

Adding a bicycle lane to SR 520

Description: would begin on the west side of Lake Washington in the University District where it would connect to the Burk-Gilman Trail and trails in the Arboretum. Connections on the east side of the lake would be near the 405/520 interchange where the trail would meet with the proposed BNSF railroad trail, and the planned regional SR 520 trail, east of I-405. A bicycle/pedestrian path across the SR 520 bridge could be accomplished in two ways:

a) **Restriping the existing SR 520 bridge** to allow additional space for bicycles and barrier, thereby eliminating one traffic lane.

b) **If a new bridge were constructed,** the bike/pedestrian path would be incorporated into the structure. Widening the existing bridge is not possible because permanent additions to the existing structure are not feasible.

Concept E-2

A complete sidewalk system along all arterials and SR 522

Description: would require a program where gaps are identified, prioritized, and constructed when funding is obtained. Local policy should require new arterial street construction and development within the study area to include sidewalks.

Concept E-3

Provisions for pedestrian/bicycle access to the I-90 bike path

Description: would complete a seamless pedestrian/bicycle system from the east side of Lake Washington to the Seattle area. Significant additions along the I-90 corridor would include a segment from I-405 through Bellevue, then east to connect to the planned East Lake Sammamish trail.

Concept E-4
Construct pedestrian/bicycle facilities that are separate from roadways.
Description: This could be accomplished by:

- Placing a concrete barrier between the vehicle and pedestrian/bicycle traffic.
- Constructing the pedestrian/bicycle path separate from the roadway. This would require purchasing additional right-of-way in many areas.

Concept E-5
Privately or Publicly operated shuttle for bicycles
Description: A bicycle shuttle across the SR 520 bridge would entail an operator providing an area on each side of the bridge where bicyclists could transfer to a bus-type shuttle to transport them and their bikes across the lake. Logical locations for the transfers would occur at park and ride lots, but could be expanded to shopping centers and/or church parking lots. A similar service is currently provided by Metro, and it is anticipated that a specialized service catering solely to bike traffic would have minimal use.

Environmental Enhancements and Mitigations

Concept E-6
Protect parks, arboretum, and nature preserves near (SR 520)
Affected sites along the SR 520 corridor include Montlake Playfield, Washington Park Arboretum, Wetherill Nature Preserve, Bridle Crest Trail, and Marymoor Park. Methods of protecting these areas might include: restrictions to right-of-way acquisition, mitigating noise impacts, provide water quality improvements, and address air quality concerns. Furthermore, careful sensitivity toward visual impacts such as elevated on- and off-ramps and elevated rail structures must be considered within close proximity to these and other areas.

Concept E-7
Noise Regulations
Description:

- Restrict use of sirens along corridors sensitive to noise within the study area. Such an action would require a joint coordination effort between municipalities and emergency services operating within the study area. Guidelines under which emergency services and law enforcement operates would have to be addressed.
- Restrict the use of compression breaks by heavy vehicles during certain hours of the day. Prohibit the use of these breaks through areas where houses are within a certain decibel range. This method of reducing noise would require legislative action. A willingness of municipalities to cooperate is needed if such policies were applicable to the entire study area.

Concept E-8
Noise Walls
Construct noise walls to mitigate the noise impacts of highway use (where houses are within a certain decibel range). Walls are from 10 to 20 feet tall and could create visual impacts.

Concept E-9
Sound Absorption Road Surface
Extend SR 520 sound absorption road surface to extend from I-5 to I-405. New roads could be constructed with the surface. Existing roads that don't have sound-absorbing qualities would require an overlay with the material, complete pavement reconstruction, or on structures this may not be possible because they were not designed to support the additional weight.

Concept E-10
Visual Enhancements and Mitigations

Options under this heading are intended to address aesthetics effects for adjacent neighborhoods and drivers on major corridors as well as for local residents.

a) Landscaping of roadside and median areas of major corridors provide a pleasant environment for drivers. The addition of planters with low maintenance shrubs and flowers along streets with lower speed can add to the quality of life in neighborhoods. Maintenance of landscaped areas, including irrigation, should be considered a component of this concept.

b) Trees can act to screen the visual impacts of roads and traffic from neighborhoods through which they pass. Maintenance of trees should be considered a component of this concept.

Concept E-11
Mitigation/Enhancements - Lids

This concept would depress and cover existing or new roadways to eliminate noise in adjacent communities, and/or to restore a community's cohesion across a roadway. Additional enhancements could include parks and recreational facilities, or possibly include "air space leases" for public or private building facilities (i.e. convention center).

Other Enhancement Concepts

Concept E-12
Public boat access at ends of SR 520 bridge

Public road access facilities would be constructed at either or both ends of the SR 520 bridge. (Such a facility was included as mitigation/enhancement in the I-90 project, located on Mercer Island at the west end of the East Channel Bridge.)

Concept E-13
Fishing pier at bridge (SR 520)

A fishing pier would be constructed at or near the bridge.

Concept E-14
Eliminate Unused Arboretum Ramps

Remove unused ramps constructed as part of the R.H. Thomson Expressway/SR 520 Interchange. This could reduce the visual impacts along the SR 520 corridor and traffic impacts to surrounding neighborhoods.

Concept E-15
Traffic Calming

Construct effective traffic calming features on local streets and roads adjacent to the high-speed/ high-traffic volume corridors. The traffic calming features could be part of the "toolkit" to reduce impacts upon the neighborhoods. Traffic calming features might include traffic circles, speed humps, landscaping, stricter enforcement, forced turns, traffic diverters, and others.

3. Solution Evaluation Criteria (Draft)

SOLUTION EVALUATION – EFFECTIVENESS PERFORMANCE MEASURES

Criteria		Notes/Comments	Methodology
1. Congestion Reduction		What is the impact on congestion on both freeways and arterials? *These two separate performance measures will be combined to form a complete evaluation of the solution, both from a location specific and system perspective.*	Peak period volume/capacity ratio, Peak period level of service at critical locations
2. Demand Management/ Reduction	*Shift in Mode*	What is the shift from a lower occupancy to a higher occupancy mode? Does the solution serve major transit markets? Does the solution provide access to HOV/transit, pedestrian, bicycle, and/or ferries? *These three separate performance measures will be combined to form a complete evaluation of the solution, both from a location specific and system perspective.*	Changes in mode split across major screenlines or to/from activity centers (location specific), and % change in transit ridership (system)
	Shift in Time	Is there a shift in the time of travel?	Peak spreading (shift to non-peak)
	Overall Demand Reduction	Are some trips eliminated altogether?	Reduction in total trips (person or vehicle) and/or Vehicle Miles Travelled

Criteria		Notes/Comments	Methodology
3. Enhancing Mobility	*Mobility for commuters/other travelers*	Does the solution reduce travel time to/from major centers? Does it provide additional person/vehicle-carrying capacity in the corridor? How many of the person trips are likely to be accommodated by the solution (how much of the available capacity is used)? *These three separate performance measures will be combined to form a complete evaluation of the solution, both from a location specific and system perspective.*	Travel time by mode to/from activity centers Additional corridor capacity (person or vehicle trips) Person through-put (demand)
	Transit Usage	What share of travel market is within a certain distance to the travel route?	Qualitative assessment of the travel market ridership potential
	Freight and goods movement	Does the solution enhance or detract from freight and goods movement?	Qualitative difference in travel time for freight/goods movement along major corridors
4. Safety		Does the solution improve safety for travelers through geometric characteristics?	Qualitative assessment of potential reduction in incidents
5. Maintenance of Speed and Reliability	*Highway speed and reliability*	If a non-recurrent incident does occur, does the solution maintain the speed and reliability within the corridor?	Qualitative assessment of duration of congestion associated with an incident
	HOV/transit speed and reliability	If an incident does occur, does the solution maintain the speed and reliability of HOV/transit?	Qualitative assessment of probability of on-time service

Criteria		Notes/Comments	Methodology
6. System Interface	*Continuity*	Does the solution fill missing links in the highway or HOV/transit system?	Qualitative assessment of effectiveness of solution in filling missing links
	Compatibility	How compatible is the solution with the rest of the regional transportation system?	Qualitative assessment of how compatible the solution is to the rest of the regional transportation system
7. Consistency with Land Use Policies/Plans		Is the solution consistent with existing land use plans or policies?	Qualitative assessment - scale from does not support to significant support
8. Promotes Sustainable Development		Does the solution support/promote sustainable development? **To be rated by Study Committee using qualitative measure**	Qualitative assessment that takes into account the solution's contribution to the jobs/housing balance
9. Public Support (new criterion)		Would the general public support the solution? **To be rated by Study Committee using qualitative measure**	Qualitative assessment that takes into account the public support element

SOLUTION EVALUATION – IMPACTS PERFORMANCE MEASURES

Criteria		Notes/Comments	Methodology
1. Neighborhoods	*Displacements*	General descriptions showing newly constructed facilities developed at the concept level will be refined on aerial photos at 1:200.	The approximate number of residential and business displacements will be counted. Results will be ranked by range of impacts (e.g., 0-10, 25-50, 50-100, 100-250, >250).
	Cut-thru traffic	Quantitative modeling of local travel behavior would require EIS level of analysis.	Qualitative meaure of the changes expected. Results will include: Significant improvement, improvement, no change, deterioration, significant deterioration.
	Back-up traffic	Quantitative modeling of local travel behavior would require EIS level of analysis.	Qualitative assessment of the changes expected. Results will include: Significant improvement, improvement, no change, deterioration, significant deterioration.
	Community Cohesiveness	Transportation facilities can divide neighborhoods. Enhancements such as lids would be included with solutions.	Qualitative meaure of the changes expected. Results will be ranked relative to each other on a scale of 1 to 5.
	Noise	Noise impacts result from the coincidence of a noise source with activities sensitive to noise. In general higher traffic volumes and speeds create more noise. Industrial land uses are considered the least sensitive to noise; residential areas and parts the most sensitive.	Solutions will be considered by major segment. New sources or increases in traffic by type (auto, bus, train, etc.) will be paired with the type of adjacent land use. The least impact would be for low traffic increases near industrial areas. The greatest impact would be for large traffic increases near residential areas or parks. Results will be ranked relative to each other on a scale of 1 to 5.

Criteria		Notes/Comments	Methodology
3. Air Quality		Regional air quality impacts result from changes in total vehicle traffic. Conformance with air quality requirements is provided by the Metropolitan Transportation Plan and State Implementation Plan.	Qualitative assessment of the changes in total regional vehicle miles traveled (VMT) compared to the Metropolitan Transportation Plan. Results will be ranked relative to each other on a scale of 1 to 5.
4. Water Quality		Water quality impacts result from increases in impervious surface (pavement), which increases runoff volume, and increases in vehicular volume, which increases the amount of pollutants. The potential for impacts is greatest on or near a water body.	Solutions will be considered by major segment. Changes in traffic volume will be paired with changes in impervious surface and proximity to water bodies. Results will be ranked relative to each other on a scale of 1 to 5.
5. Natural Resources	*Critical Areas*	Critical areas include wetlands, wildlife habitat, and other areas designated by local jurisdictions.	The acres of critical areas directly affected will be calculated using GIS. Results will be ranked by range of impacts (e.g., 0-5, 5-25, 25-75, 75-150, >150).
	Sensitive Species	Sensitive species include plants and animals listed or proposed for listing by state and federal agencies.	The number of sensitive species within ¼ mile of a new facility will be counted and described. Results will be ranked relative to each other on a scale of 1 to 5.
	Parks and Refuges	Public parks and wildlife refuges are protected as by Section 4(f) of the Transportation Act.	The acres of parks or refuges directly affected will be calculated using GIS. Similar areas within ¼ mile will be noted. Results will be ranked relative to each other on a scale of 1 to 5.

Criteria		Notes/Comments	Methodology
6. Visual Quality		Transportation facilities can become major visual features in local and regional landscapes.	Qualitative assessment of the changes from existing conditions. Results will include: No change, insignificant alteration, noticeable change, deterioration, significant deterioration.
7. Businesses	*Accessibility*	Quantitative modeling of local travel behavior would require EIS level of analysis.	Qualitative assessment of the changes expected. Results will include: Significant improvement, improvement, no change, deterioration, significant deterioration.

SOLUTION EVALUATION - COST PERFORMANCE MEASURES

Criteria		Notes/Comments	Methodology
1. Capital Costs	*Construction Cost*		Total cost range of solution (e.g., very high = >$3B, high = $1B to $3B, etc…) based upon detailed cost calculations and uncertainty of estimates
	Right of Way Costs		Total cost range of solution (e.g., very high =>$3B, high = $1B to $3B, etc…) based upon detailed cost calculations and uncertainty of estimates
2. Operation and Maintenance Costs			Total cost range of solution (e.g., very high =>$3B, high = $1B to $3B, etc…) based upon detailed cost calculations and uncertainty of estimates

4. Concept Evaluation Criteria

CONCEPT EVALUATION - EFFECTIVENESS PERFORMANCE MEASURES

T= Transit Concept Category

R= Roadway Concept Category

D= Demand Management/Land Use Concept Category

E= Enhancements Concept Category ***(The mitigation and improvements proposed with enhancements will be assessed for the benefits they provide.)***

Criteria		Notes/Comments	Methodology	T	R	D	E
1. Congestion Reduction		What is the impact on congestion on both freeways and arterials?	Qualitative assessment of estimated potential to reduce congestion , 1- 5 scale		X	X	
2. Demand Management/ Reduction	*Shift in Mode*	What is the shift from a lower occupancy to a higher occupancy mode? Does the concept serve major transit markets? *These two separate performance measures will be combined to form a complete evaluation of the concept.*	Qualitative assessment of potential to provide changes in mode split, and Qualitative assessment of encouraged use of non-SOV trips (walk, transit)	X	X	X	
	Shift in Time	Is there a shift in the time of travel?	Qualitative assessment of the potential of peak spreading (shift to non-peak)			X	
	Overall Demand Reduction	Are some trips eliminated altogether?	Qualitative assessment of potential to reduce trips (person or vehicle)			X	

Criteria		Notes/Comments	Methodology	T	R	D	E
3. Enhancing Mobility	*Mobility for commuters/other travelers* *Transit Usage*	Does the concept reduce travel time to/from major centers? Does it provide additional person/vehicle-carrying capacity in the corridor? How many of the person trips are likely to be accommodated by the concept (how much of the available capacity is used)?	Qualitative assessment of estimate to improve mobility (incorporates travel time, corridor, and person through-put) Qualitative assessment of ridership potential	X	X		
4. System Interface	*Continuity*	Does the concept/solution fill missing links in the highway or HOV/transit system?	Does the concept fill a missing link, Yes/No?	X	X		X
	Compatibility	How compatible is the solution with the rest of the regional transportation system?	Qualitative assessment of the concept's compatibility with the regional transportation system	X	X		

CONCEPT EVALUATION - IMPACTS PERFORMANCE MEASURES

Criteria		Notes/Comments	Methodology	T	R	D	E
1. Neighborhoods	*Displacements*	Aerial photos at 1:200 showing newly constructed facilities will be prepared for each concept.	The approximate number of residential and business displacements will be assessed. Results will be ranked by range of impacts (e.g., 0-10, 25-50, 50-100, 100-250, >250).	X	X		
	Cut-thru traffic	Quantitative modeling of local travel behavior would require EIS level of analysis.	Qualitative assessment of the changes expected. Results will include: Significant improvement, improvement, no change, deterioration, significant deterioration.	X	X		
	Back-up traffic	Quantitative modeling of local travel behavior would require EIS level of analysis.	Qualitative assessment of the changes expected. Results will include: Significant improvement, improvement, no change, deterioration, significant deterioration.	X	X		
	Community Cohesiveness	Transportation facilities can divide neighborhoods. Enhancements such as lids would be included with solutions.	Qualitative assessment of the changes expected. Results will be ranked relative to each other on a scale of 1 to 5.	X	X		X
	Noise	Noise impacts result from the coincidence of a noise source with activities sensitive to noise	Qualitative assessment of new sources of noise and the sensitivity of adjacent land uses. Results will be ranked relative to each other on a scale of 1 to 5.	X	X		

Criteria		Notes/Comments	Methodology	T	R	D	E	
5. Natural Resources	*Critical Areas*	Critical areas include wetlands, wildlife habitat, and other areas designated by local jurisdictions.	The acres of critical areas directly affected will be assessed using GIS. Results will be ranked by range of impacts (e.g., 0-5, 5-25, 25-75, 75-150, >150).	X	X			
	Sensitive Species	Sensitive species include plants and animals listed or proposed for listing by state and federal agencies.	The number of sensitive species within ¼ mile of a new facility will be assessed. Results will be ranked relative to each other on a scale of 1 to 5.	X	X			
	Parks and Refuges	Public parks and wildlife refuges are protected as by Section 4(f) of the Transportation Act.	The acres of parks or refuges directly affected will be assessed using GIS. Similar areas within ¼ mile will be noted. Results will be ranked relative to each other on a scale of 1 to 5.	X	X			
6. Visual Quality		Transportation facilities can become major visual features in local and regional landscapes.	Qualitative assessment of the changes from existing conditions. Results will include: No change, insignificant alteration, noticeable change, deterioration, significant deterioration.					X
7. Businesses	*Accessibility*	Quantitative modeling of local travel behavior would require EIS level of analysis.	Qualitative assessment of the changes expected. Results will include: Significant improvement, improvement, no change, deterioration, significant deterioration.	X	X			

CONCEPT EVALUATION - COST PERFORMANCE MEASURES

Criteria		Notes/Comments	Methodology	T	R	D	E
1. Capital Costs	*Construction Cost*	Incorporates rough estimate of right-of-way costs	1-5 scale that captures ranges of potential costs (low cost = $2.5M to $5M, moderate = $10M to $25M, etc…)	X	X		X

5. Concepts To Be Further Evaluated

CATEGORY: Transit

CONCEPTS TO BE FURTHER EVALUATED

Concept	Effectiveness	Impacts	Cost	Comments
Rail Concepts				
T-2 Rail along I-90 Corridor	◕	◑	◔	Currently under review by Sound Transit.
T-3 Rail along SR-520 Corridor	◕	◔	◔	Would appear to have a sizeable potential ridership. Needs study of patronage, costs and impacts.
T-4 Light Rail from U-District to Kirkland/Redmond	◕	○	○	With service to two urban centers, would clearly have good ridership potential. Potential costs and impacts of right-of-way and operations need further study.
T-5 Rail Station at I-5 Roanoke (SR-520) Interchange	◔	◕	◑	Would serve an established transit ridership. Needs further analysis of potential travel time benefit and site feasibility.
Ferry Concepts				
T-7 Passenger Ferry Service– Kirkland to University of Washington and/or Downtown Seattle	◔	◕	◕	Predicted to have the best potential of the Trans-Lake ferry routes.
Bus/Transit Concepts				
T-9 Improved Express Service	◔	●	◕	Requires more study of how highway conditions affect travel times. Sound Transit has Regional Express services to be implemented under Sound Move.
T-10 Improved "Reverse commute" service (SR-520)	◔	●	◕	Needs further evaluation of potential travel markets served. Some reverse commute routes may receive improved services as Sound Transit implements its Regional Express program.
T-11 Improved Transit Service	○	●	◕	Needs further analysis of how general transit amenities affect Trans-Lake transit ridership.
T-14 Transit Priority on SR-522	◔	◕	◕	Potential transit speed and reliability benefit. Currently being assessed in a study by the Office of Urban Mobility, and undergoing public comment.
T-15 Connect Park and Ride Lots to Activity Centers	○	◑	◕	Needs further analysis of how improved service could benefit Trans-Lake travel. Metro's 6-year plan update may address connections in some locations.
T-16 Bus-Only Lanes on I-5 and in Dedicated Right-of-Ways	◔	◕	◑	Transit travel times have potential to improve. Further study needed of impacts to highway operations and potential right-of-way costs and impacts.

Rating Key

○ Worst ◔ ◑ ◕ ● Best

CATEGORY: **ROADWAYS/TSM**

Concept	Effectiveness	Impacts	Cost	Comments
I-90 Corridor				
R-1 Provide Bi-Directional HOV Lanes along the existing center roadway	◑	◕	◕	Currently under study by Sound Transit.
R-2 Use I-90 Center Roadway for Heavy Trucks	○	◑	◑	Could improve freight mobility. Requires analysis of operational impacts to general traffic and HOVs.
SR-520 Corridor				
R-4 Add HOV Lanes in each direction to SR-520	◕	◔	◔	Could improve HOV travel times and increase HOV use. Needs further operational analysis, and assessment of right-of-way impacts and costs.
R-5 Add One HOV Lane and One General Purpose Lane in each Direction to SR-520	●	○	○	Added lanes would improve effectiveness, but the increased right-of-way would have higher costs and impacts than R-4. Further analysis of effects on I-5 needed.
R-7 Convert One General Purpose Lane in each Direction to HOV on SR-520	◔	◑	◕	Lower effectiveness is predicted because the loss of general capacity would increase regional congestion and travel.
R-9 Provide Vehicle Refuge/Shoulder on SR-520	◑	◕	◑	Traveler reliability would improve.
R-11 Provide Barrier Separated Express Lanes on SR-520	◑	◔	◔	Requires more study of how express lanes could affect SR 520 travel in both directions. I-5 connections also need further study.
R-12 Connect SR-520 to I-5 Express/HOV Lanes	◕	◕	◕	Requires more analysis of I-5 operational issues.
R-13 Improve Mercer St. Connection to SR-520	◔	◑	◑	Requires more analysis of I-5 operational issues, and more information on potential costs, impacts.
R-15 Provide Direct HOV Access between UW and SR-520	◔	◑	◑	Could provide travel time benefits to transit and HOV users. Needs study of traffic effects and other impacts and costs.
R-15a Provide Direct SOV Access between UW and SR-520	◔	◑	◑	Could provide travel time benefits to general users. Needs study of traffic effects and other impacts and costs.
R-16 Install Ramp Metering at On-Ramps East of I-405	◔	●	●	Needs more study to quantify benefit to highway operations and assess effect to local street networks. Some ramp meters are being implemented in this area as part of current HOV project.
R-45 Improve the Montlake to I-5 Connection	◑	◕	◕	Moderate mobility improvements. Requires more detail to assess impacts versus mobility benefits.

Rating Key

○ ◔ ◑ ◕ ●

Worst — Best

Concept	Effectiveness	Impacts	Cost	Comments
SR-522 Corridor				
R-20 Add HOV Lanes to SR-522	◑	◕	◕	Could improve mode share and HOV travel times. Similar options for SR 522 are being assessed by WSDOT, and are now undergoing public comment.
R-21 Implement Improved Access Control	◔	◕	●	Could improve facility operations. This concept is also assessed in WSDOT's study of SR 522.
R-22 Continuous Transit Lanes on SR-522	◔	◕	◕	Similar study background to R-20 and R-21. Further review can provide more information on mobility benefits and constraints.
R-44 Improve N 145th St. Corridor–Between I-5 and SR-522	◔	◑	◑	Could improve I-5/SR 522 interchange operation.
Kirkland to Sand Point Bridge/Tube				
R-23 New Bridge from I-5 to I-405	●	○	○	Would markedly increase Trans-Lake travel capacity. More study needed of costs and impacts of a new corridor in established urban areas.
R-24 New Bridge to Connect to Existing Arterial Roadways	◕	◔	◔	Additional capacity across the lake could improve Trans-Lake mobility. Further study needed of costs, impacts, and effects on local street networks.
I-5 Corridor				
R-27 Olive Way to SR-520 HOV Connection	◔	●	●	Could provide some HOV operational benefit. More study of I-5 operations required.
R-28 HOV Lane across Ship Canal Bridge	◔	◕	◑	Would address an existing gap in HOV system. Needs further study of overall benefit, and more detail on how it would connect to other HOV facilities.
R-29 Widen I-5 through Downtown Seattle	◑	○	○	Detailed operational analysis of I-5 needed to better judge effectiveness versus costs and impacts.
R-47 Improve the I-5 Connection to the University District	◔	◕	◕	Could improve I-5/SR 520 interchange operations.
R-48 All-day Two-way HOV on I-5	◕	◔	○	Appears to be effective compared to costs and impacts. Needs further operational analysis.
I-405 Corridor				
R-30 Add One General Purpose Lane in Each Direction to I-405	◔	◑	◔	Needs further review of relative benefits, compared to impacts and costs. Similar options studied by WSDOT in the I-405 study, and may be again assessed in the I-405/I-605 study.

Rating Key

○ Worst ◔ ◑ ◕ ● Best

CATEGORY: ROADWAYS/TSM

Concept	Effectiveness	Impacts	Cost	Comments
R-31 Add Two General Purpose Lanes in each Direction to I-405	◔	◔	◔	Needs further review of relative benefits, compared to impacts and costs. Similar options were studied by WSDOT in the I-405 study, and may be again assessed in the I-405/I-605 study.
R-32 Express/HOV Lanes on I-405	◑	◑	◑	Could improve movement through Bellevue. More study needed of costs and impacts of required right-of-way. Some direct access elements are included in *Sound Move*.
R-33 Expand Eastside North-South Arterial Roadways	◔	◑	◔	Could improve travel north and south. More study needed to quantify benefit to Trans-lake travel in comparison to costs and impacts.
R-34 Build Eastside Arterial HOV Lanes	◔	◑	◔	May benefit Eastside travel. More study needed of benefit to Trans-lake travel. Costs and local impacts need more study.
R-35 HOV Ramp Enhancement	○	◑	●	Could improve travel times for HOV users. Needs evaluation of costs and effect to general traffic.
R-36 ITS (Intelligent Transportation Systems)	◔	●	●	Further review needed to provide estimates of how ITS may benefit travel in the Trans-Lake region.
Regional Issues and Other Concepts				
R-37 Complete HOV System and Add Direct Access	●	◑	◔	Seamless HOV system would be effective in improving mode share and providing time and reliability benefits.
R-39 Emergency Floating Bridge Plan (I-90 and SR-520)	●	●	◕	There are currently no emergency plans in place.
R-42 Do Nothing	○	◕	●	Requires further study as an option and as a point of comparison to other concepts.
R-46 Paid HOV Lane Use by SOV Vehicles during Non-Peak Hours	◔	◕	◑	May be effective during mid-day. Raises regional policy issues.

Note: TDM and Enhancement concepts were not screened. All are recommended to continue for further study.

Rating Key

○ Worst ◔ ◑ ◕ ● Best

6. Concepts Not Recommended

CATEGORY: **Transit**

Concept:

T-1
Light Rail around the Lake (SR-522)

Area/Termini:

Vicinity I-405 to I-5 via SR-522

Description:

This alignment would follow the SR-522 corridor from I-405 to tie in to Sound Transit's Roosevelt Station near NE 65th Street. The I-405 origin could tie in directly with the UW Branch Campus or at a nearby transit station which could ultimately tie in with different transit solutions on the I-405 corridor. The following options have been suggested for the SR-522 corridor:

- elevated monorail
- elevated high speed (not feasible)
- surface light rail with tunneling at various locations

There may be segments which could be developed outside the existing right-of-way. General rail station locations could be at the corridor's two termini, Bothell, Kenmore, and Lake City, with probable stations between at community focal points, particularly if an option which included street cars was developed.

Evaluation results: Insufficient ridership relative to high cost

		RATING
Effectiveness:	The potential ridership in the corridor would not be high enough to support an investment in 11 miles of light rail. There are 1,250 to 3,350 transit riders today on SR-522. Comparable sections of the Central Link light rail project have ridership projections of 14,000 to 20,000. Development potential along the corridor is limited. Travel times for light rail on SR-522 would not be competitive with auto, and similar to existing bus. Measures to improve light rail speeds would worsen overall mobility in the corridor.	◔
Impacts:	There is little right-of-way available on SR-522, and businesses and residences line much of the roadway. An expanded right-of-way would have unavoidable impacts on existing properties.	○
Cost:	For the 11-mile corridor, costs may be $500 to $600 million.	○
Recommendation:	Drop from further evaluation.	X

Rating Key

○ Worst ◔ ◑ ◕ ● Best

CATEGORY: **Transit**

Concept:

T-6
Passenger Ferry Service

Area/Termini:

Kirkland to Sand Point

Description:

Provide passenger ferry service across Lake Washington from Kirkland to Sand Point. Eastside express bus service would link the park-and-ride lots at NE 85th St., NE 70th St., and Kingsgate to the ferry terminal in Kirkland. Westside express bus service would link Sand Point to the NE 65th Street/I-5 HOV/Park and Ride complex. Local improvements could include bicycle/pedestrian paths or additional roadway widths for bicycle access to the ferry landing from major arterials such as Market St., NE 85th St., NE 68th St., and Lake Washington.

Evaluation results: Limited market and long total travel time would not be competitive with other transit modes

		RATING
Effectiveness:	There is limited ridership for ferry service between Kirkland and Sandpoint. Currently, fewer than 5,000 people take transit from the Eastside study area districts considered within the market shed for such service (Kirkland, Totem Lake, and Redmond) to downtown Seattle, the University District and northwest Seattle combined. Travel times and reliability would not be competitive other modes. Most riders would have to transfer on one or both ends of the trip. With transfers and travel times, the average travel time would be 50 to 70 minutes, compared to 30 to 40 minutes for bus.	○
Impacts:	Probable shoreline and neighborhood impacts, especially on the Sandpoint side. In Kirkland, parking impacts would be expected.	◕
Cost:	High costs relative to impacts and low effectiveness.	◑
Recommendation:	Drop from further evaluation:	X

Rating Key

○ ◔ ◑ ◕ ●
Worst Best

December 9, 1998

CATEGORY: Transit

Concept:

T-8

Ferry Service Kirkland to Madison Park

Area/Termini:

Kirkland to Madison Park (Seattle)

Description:

Re-introduce the cross-lake ferry system from Kirkland to Madison Park. At Madison Park, ferry commuters would reach Seattle Metro bus. Potentially, express bus service could be provided from Madison Park to Seattle during the peak periods and install arterial transit/HOV lanes with signal priority and/or queue jumps to ensure reliable bus schedules. Potentially buses could enter a transit tunnel (similar to the Downtown Seattle bus tunnel) that would connect to downtown Seattle. In Kirkland, shuttle service would be required to park and ride lots near I-405 at NE 85th and NE 70th. Expansion of these lots may also be required.

Evaluation results: Limited market and long total travel time would not be competitive with other transit modes

		RATING
Effectiveness:	Low ridership potential, because Madison Park is not a major origin or destination for Trans-Lake travel, and a trip to downtown would require a transfer. Currently, 3,600 transit trips occur daily between the Kirkland, Totem Lake, and Redmond areas and downtown. A trip by ferry with transfers to downtown would take about 60 minutes, versus 30 minutes by bus.	○
Impacts:	Shoreline and neighborhood impacts could occur at Madison Park. Parking impacts would be expected in Kirkland.	◑
Cost:	High costs relative to impacts and effectiveness.	◕
Recommendation:	Drop from further evaluation.	X

Rating Key

○ ◔ ◑ ◕ ●

Worst Best

December 9, 1998

CATEGORY: Transit

Concept:

T-13

Convert Two Lanes of SR-520 to Bus Use

Area/Termini:

SR-520 between I-5 and SR-202

Description:

This concept would convert the operation of one lane of traffic in each direction from general purpose to bus-only. The concept could be implemented either for the entire day or during the peak periods only. The implementation could include barrier separation or signing and striping only. The conversion to bus-only operation would create dramatic time savings for transit when compared to the general purpose lanes due to the combination of reduced capacity for general purpose vehicles on the bridge and transit only operation in the adjacent lanes.

Evaluation results: Decrease on overall mobility

		RATING
Effectiveness:	Overall mobility would worsen by most measures. Converting two lanes of SR 520 to bus-only lanes would cause significantly more congestion on SR-520 and on the approaches to the bridge. The reduced capacity for general purpose traffic on SR-520 would cause even longer queues to form on both I-405 and I-5. There would be a reduction of 2000 vehicles per hour of general purpose capacity in each direction under this scenario. Any increase in transit ridership would be minimal given the small travel time savings and likelihood that buses would also be affected by the congestion on the approaches to the bridge.	○
Impacts:	Impacts to surrounding areas from diverted traffic.	◑
Cost:	Relatively low cost	◕
Recommendation:	Drop from further evaluation.	X

Rating Key

○ ◔ ◑ ◕ ●

Worst Best

December 9, 1998

CATEGORY: Transit

Concept:

T-17
Personal Rapid Transit

Area/Termini:

Trans-Lake Study Area

Description:

Personal rapid transit (PRT) is a fully automated system of vehicles capable of operation without human drivers that are captive to a reserved guideways. The guideways can be located aboveground, at ground level or underground. Small vehicles would be available for exclusive use by an individual (PRT) or a small group (GRT), typically 1 to 6 passengers, traveling together by choice and available 24 hours a day. Vehicles would be able to use all guideways and stations on a fully coupled PRT network. Direct origin to destination service would be available, without a necessity to transfer or stop at intervening stations. Passengers could use the PRT service on demand rather than on fixed schedules.
A variation of this concept integrates personal auto convenience and efficiency of PRT. It utilizes small- and medium-sized electric vehicles that can be manually operated on the conventional roadway system as well as on PRT system. The vehicles are capable of entering onto the guideway from existing roads. While traveling on the guideway, operation would be fully automated. This combination of integrated operating modes would provide the user with the ability to reach the vast majority of destinations in a large metropolitan region.

Evaluation results: Technology not suitable to regional transportation needs

		RATING
Effectiveness:	PRT is most applicable to circulation within activity centers due rather than regional corridors with dispersed origins and destinations. A system for Trans-Lake would have low effectiveness because of low capacity, low travel speeds, and delays transitioning from the regional system. The capacity of PRT systems is approximately 5,000 persons per hour per direction or less, and their speed is generally 40 km/h [25 mph] or less. The technology is under development now with no guarantee what may be available in the future. The right-of-way and guideways are not compatible with the regional transit system. The option for personal autos specifically designed for PRT guideways would have low effectiveness for similar reasons of low speeds and capacities, and would require more right-of-way to access the system.	○
Impacts:	Right-of-way impacts are most similar to light rail, although access points would have higher impacts.	◔
Cost:	Costs are uncertain given unknown technology; likely very high per-person-per mile, especially with the private auto option.	○
Recommendation:	Consider dropping from further consideration pending comments from the study committee.	?

Rating Key

○ ◔ ◑ ◕ ● (Worst … Best)

December 9, 1998

CATEGORY: Transit

Concept:

T-18
SR-520: Automated Highway

Area/Termini:

SR-520 between I-5 and SR-202

Description:

All vehicles (SOV and HOV) would be equipped with special equipment to enable them to be controlled automatically while traveling on SR-520. Vehicles *without* special equipment would be excluded. Vehicles entering the automated highway corridor would need to be checked for proper operation, and then control would be transferred to a central computer that would maintain merging, speed and spacing to maximize per-lane capacity. If additional vehicles are transported, widening of I-405 and I-5 would be needed to accommodate increased traffic.

Evaluation results: High risk and minimal potential for effectiveness.

		RATING
Effectiveness:	Federally sponsored research into automated highways has suggested that the throughput benefits are likely to be much less than originally anticipated. The risk of failure, difficulties of transitioning to an automatically controlled highway, and uncertain willingness of drivers to accept automatic control suggest that the potential effectiveness is more than balanced by additional risk	◔
Impacts:	Some potential for increased safety, but also risk of catastrophic failure. Right-of-way and new construction required for access ramps, check out lanes and transition lanes increase costs. Capacity increases less than originally thought due to loss of capacity for transition lanes. Long implementation times due to expense of vehicles and fleet turnover rates.	◔
Cost:	High public costs to develop control systems and infrastructure and to widen intersecting freeways or equip them similarly. High private costs to provide special in-vehicle control equipment. Equity issues related to restricted use to those who can afford the in-vehicle equipment.	○
Recommendation:	Drop from further evaluation	X

Rating Key

○ Worst ◔ ◑ ◕ ● Best

December 9, 1998

CATEGORY: ROADWAYS/TSM

Concept:
R-3
Remove I-90 Flammable Materials Exclusion

Area/Termini:
I-90 between I-405 to I-5

Description: Alter current flammable cargo exclusion from I-90 by permitting transport of these materials during late-night or off-peak hours, in conjunction with restricting combustible cargo traffic to I-90 center roadway.

Evaluation results: Little or no effect on Trans-Lake mobility

		RATING
Effectiveness:	This concept would have little to no effect on Trans-Lake mobility, because capacity is not an issue during off-peak time periods. There is not a clear tie between this concept and other aspects of the problem statement.	○
Impacts:	Little or no impacts.	●
Cost:	Low cost.	●
Recommendation:	Drop from further evaluation.	X

CATEGORY: ROADWAYS/TSM

Concept: R-6
Add 1 HOV lane and 2 General Purpose lanes in each direction

Area/Termini: SR-520 between SR-202 and I-5

Description: HOV lanes would be added to SR-520 with connections to current or projected HOV capacity on I-5 and I-405, along with provision for interchange connections at all appropriate locations. Since general purpose capacity on SR-520 is largely two lanes from SR-202 to I-5, a third and fourth general purpose lane would need to be added in each direction. Alternatives include:

- Entirely new bridge structures at surface and widening on land (10 lanes total)
- Reconfigure existing bridge structure and construct a new parallel structure, with widening on land
- Provide capacity via a tube or tunnel across lake, widening on land
- Double-deck existing bridge, widening on land
- Provide capacity by tube or tunnel.

Alternatively, general purpose capacity expansion could be restricted to the section of SR-520 east of either Lake Washington Blvd. (Bellevue) or I-405 provided other improvements provide Trans-Lake mobility.

Evaluation results: Very high impacts and costs; other similar concepts adding fewer lanes should be retained and evaluated

		RATING
Effectiveness:	This concept would theoretically add significant capacity to the SR 520 corridor (an estimated 2000 vehicles-per-hour per lane, each way, or 2200 persons per hour), but this level of use could not occur without substantial widening to I-5 and I-405. The concept would not be expected to improve HOV or transit use, or support TDM strategies because the additional capacity would attract more general purpose travel.	◕
Impacts:	Significantly more right-of-way would be required than for R4 and R5. The minimum needed is at least 120 ft, and the average would be 240 ft. The existing roadway right-of-way is as narrow as 66 feet in places, and an average of 200 ft west of I-405 and 300 ft to the east. Widening would cause significant displacements and other unavoidable impacts in many resource areas, including neighborhoods, air quality, water quality, and noise and vibration.	○
Cost:	The cost of adding three lanes in each direction across Lake Washington on SR 520 is substantially more than the cost of the eight-lane option (R-5) or adding two lanes in each direction (R-4). Widening I-5 and I-405 would further increase costs.	○
Recommendation:	Consider dropping from further evaluation pending comments from the Study Committee.	?

Concept:

R-8
Convert All General Purpose Lanes on the 520 Bridge to Transit/HOV

Area/Termini:

SR-520 between I-405 and I-5

Description:

Incorporate restrictions on SR-520 to allow HOV and transit usage only between Montlake Blvd. NE (SR-513) and 92 Ave. NE (in Clyde Hill. Provide appropriate striping and signage in advance of restricted areas to properly channel non-eligible traffic off of SR-520. Also furnish applicable enforcement infrastructure such as visual monitoring equipment and side bays for law enforcement vehicles.

Evaluation results: Diverted general-purpose vehicles would worsen overall mobility

		RATING
Effectiveness:	Overall Trans-Lake mobility would worsen because a significant portion of the 7,000 general purpose vehicles traveling at peak hours on SR 520 would be diverted to other roadways, adding to congestion on I-5, I-405, I-90 and SR 522. All trucking would need to be rerouted. Currently, approximately 7,550 people use HOV or transit across SR 520 during peak hours, but more analysis would be required to accurately estimate how many general purpose travelers this concept would shift to HOV or transit.	○
Impacts:	Traffic diverted from SR-520 would have substantial impacts on local roadways and the regional transportation system.	○
Cost:	Moderate cost due to increase transit service.	◑
Recommendation:	Drop from further evaluation.	X

CATEGORY: ROADWAYS/TSM

Concept: R-10
Provide Reversible Barrier Separated HOV lanes on SR-520

Area/Termini: SR-520 between I-405 and I-5

Description: a) Widen SR-520 (including the existing bridges) to accommodate peak period reversible center lanes. No intermediate access or egress will be provided between I-405 and I-5. The lanes will terminate far enough in advance (or beyond) I-5 and I-405 to safely accommodate weaving movements, or could tie into HOV lane additions on I-5. Modification of the interchanges at Lake Washington Blvd. (in Bellevue and Seattle), 108th Ave. NE, 92nd Ave. NE, 84th Ave. NE, and Montlake Blvd. NE (SR-513) also will be necessary.

b) Widen Evergreen Point Bridge to accommodate a fifth lane to be dedicated for HOV usage only. This lane would be reversible in order to handle peak traffic flows in both directions. Fixed or moveable lane barriers would be installed to safely separate adjacent lanes of opposing traffic.

Evaluation results: Small benefit relative to impacts and cost

		RATING
Effectiveness:	SR 520 currently has balanced traffic flows at peak periods and throughout the day, but this concept would benefit only those people who travel from the Eastside to Seattle in the AM peak, returning at the PM peak. (To be compatible with the I-5 Express lanes, SR 520 express traffic would need to be westbound in the AM, and eastbound in the PM.)	○
Impacts:	The right-of-way requirements would cause similar impacts as R6.	◔
Cost:	High cost relative to impacts and effectiveness.	◔
Recommendation:	Drop from further evaluation	X

Concept:

R-14
Restrict Lake Washington Blvd. (in Seattle) on-ramp to HOV usage only.

Area/Termini:

SR-520/Lake Washington Blvd. (Seattle) On-ramp

Description:

Restrict Lake Washington Blvd. on-ramp to HOV usage only. An option could be to limit this to peak periods only.

Evaluation results: Small improvements in overall effectiveness; substantial congestion in Montlake

		RATING
Effectiveness:	Transit and HOV usage would not significantly increase, and diverted traffic would worsen conditions on local streets and at other ramps. Additional analysis would be needed to measure effectiveness in reducing cut through traffic. The eastbound on-ramp from Lake Washington Boulevard has 815 vehicles at the AM-peak, and 445 in the evening. Diverted traffic would likely go to Montlake, doubling volumes there and causing significant queuing. Transit/HOV use at Lake Washington Boulevard would not be more than currently at Montlake ramps, which is 120 to 155 vehicles per hour in an area with higher levels of transit usage.	○
Impacts:	Impacts localized to the Montlake area.	◕
Cost:	Relatively low cost	●
Recommendation:	Consider dropping from further evaluation pending comment from the Study Committee.	?

CATEGORY: ROADWAYS/TSM

Concept:

R-17
Close Access to SR-520 from the Montlake area during peak periods

Area/Termini:

SR-520 between I-405 and SR-202

Description:

Close SR-520 on-ramps in during peak periods. The Montlake interchange (eastbound and westbound) and the Lake Washington Blvd. interchange (eastbound) will be included in the closure.

Evaluation results: Loss of access to University area with extensive local congestion; limited Trans-Lake benefit

		RATING
Effectiveness:	This would have significant travel impacts to two markets: 1) Eastside – UW (to and from the east), and 2) Seattle – UW (to and from the west). Approximately 50,000 vehicles per day would divert to different routes in Seattle, causing extensive local congestion. Conditions could be severely aggravated at other access points to SR 520, I-5 or SR 522.	○
Impacts:	Significant economic and social impacts would result from removing a primary access point to the University District, one of the region's designated urban centers. Neighborhood impacts include reduced access, and increased congestion and cut-through traffic.	◑
Cost:	Relatively low cost.	●
Recommendation:	Drop from further evaluation.	X

Concept:

R-18
Convert SR-522 to Limited Access

Area/Termini:

SR-522 between I-5 and I-405

Description:

Provide a limited access freeway along the entire route of SR-522. Improve major at-grade intersections with grade-separated roadways. Provide full Interchanges in the vicinity of N. 80th St., N. 95th St., Northgate Way, Roosevelt Way, NE 145th St. (SR-523), NE Ballinger Way (SR-104), Jaunita Dr. NE, and 98th Ave. NE. Eliminate minor at-grade intersections by constructing cul-de-sacs and frontage roads for local traffic. Tie into existing limited access portions of SR-522 at I-5 and I-405.

Evaluation results: Small benefit to Trans-Lake travel with extensive business and community impacts

		RATING
Effectiveness:	The existing SR 522 is an eleven-mile long, five-lane arterial with multiple traffic signals, connecting I-405 with I-5. Travel patterns reflected in the PSRC regional travel model show that because of its location at the north end of the lake, SR 522 can attract at best only 10% more Trans-Lake trips than it does today (16%), for a total of 26% (all other trips would have to go too far out of their way to use the facility). Savings in travel time would be 5 to 15 minutes, and capacity could double, but local circulation and access would have to be replaced with new roadways.	◑
Impacts:	Business and community impacts would result along much of the 11-mile corridor as properties lose or have reduced access to SR 522, and as the highway becomes more of a neighborhood barrier. Affected land uses include commercial, industrial and multi-family housing. Noise, air quality and water quality impacts would increase with higher traffic volumes.	○
Cost:	High cost from right-of-way and relocation.	○
Recommendation:	Drop from further evaluation.	X

CATEGORY: ROADWAYS/TSM

Concept:

R-19
Eight-Lane SR 522

Area/Termini:

SR-522 between I-5 and I-405

Description:

Widen the existing SR-522 alignment to include 8 lanes and retain as a primary arterial. Provide new sections of alignment to keep the new 8-Lane roadway alignment segregated from the current Lake City Way alignment between NE 125th St.

Evaluation results: Small benefit to Trans-Lake travel relative to high impacts and cost

		RATING
Effectiveness:	As in R-18, travel patterns reflected in the PSRC regional travel model show SR 522 can attract a maximum of 10% more of the total trips across or around the lake, or a total of 26%. While this concept would increase capacity by 70% to 80% and reduce travel time by 2 to 9 minutes through the corridor, it would not significantly relieve problems on other Trans-Lake routes.	◔
Impacts:	Significant business and community impacts due to the additional right-of-way required along 11 miles of corridor in an urbanized area. Affected land uses include commercial, industrial and multi-family housing.	○
Cost:	High cost from right-of-way relocation.	◔
Recommendation:	Drop from further evaluation.	X
Note:	Already considered and screened out of the SR-522 Multimodal project because of impacts and inconsistency with regional goals.	

Concept:
R-25
New East-West Highway

Area/Termini:
County Line Corridor between I-5 and I-405

Description:
Develop a new highway corridor north of Seattle separate from the existing SR-522 corridor. The limited-access freeway (with HOV lanes) would be an eastward extension of SR-104 from I-5 along NE 244th St. to I-405. Full or partial intermediate interchanges would be constructed at Cedar Way, Brier Road (55th Ave. NE), Locust Way (61st Pl. NE), Meridian Ave. (80th Ave. NE), and SR-520).

Evaluation results: Small benefit to Trans-Lake travel relative to high impacts and cost

		RATING
Effectiveness:	The northern location of this facility would not make it attractive to most Trans-Lake travelers, attracting a maximum of 13 to 17% of total trips. Approximately 16% of total Trans-Lake trips are currently carried by SR 522, and SR 522 could attract at most 26% of the trips. (See R-18 and R-19) A new east-west freeway at the County line would likely split this maximum "north end" share of total trips with SR 522.	◔
Impacts:	Significant environmental and community impacts would occur. Displacements, assuming a 300 foot ROW and based on future land use designations for the corridor, could include 113 acres of residential use property and 50 acres of mixed use.	○
Cost:	High cost from right-of-way and relocation.	○
Recommendation:	Consider dropping from further consideration pending comments from the study committee	?

CATEGORY: ROADWAYS/TSM

Concept:

R-26
New Corridor - North-South freeway between I-5 and Lake Washington

Area/Termini:

Seattle east of I-5

Description:

This concept proposes a new freeway corridor through a highly developed area, similar to the original R.H. Thomson expressway idea from years ago.

Evaluation results: Little benefit to Trans-Lake travel with high impacts and costs

		RATING
Effectiveness:	This new corridor through a heavily urbanized area of Seattle would have significant costs, high levels of environmental impacts, would provide little benefit to Trans-Lake travel because it would not improve east-west mobility.	○
Impacts:	Severe impacts to Madrona Park, Montlake, Ravenna, and other highly developed areas in Seattle.	○
Cost:	High cost due to right-of-way and relocation.	○
Recommendation:	Drop from further evaluation.	X

Concept:

R-38
Eliminate HOV lanes

Area/Termini:

All Limited-Access and Primary Arterial Highway Corridors in the Study Area

Description:

Remove all HOV restrictions from all freeway and arterial road corridors, converting them to general-purpose use. Re-stripe all HOV lanes, reconfigure existing direct access ramps, and remove HOV bypass lanes on on-ramps.

Evaluation results:

		RATING
Effectiveness:	HOV lanes are integral to the MTP and Sound Transit plans for express bus service. Elimination of HOV lanes would expose express buses and other HOVs to congested traffic creating a disadvantage to shifting from SOV to HOV use. Vehicle occupancy would go down, resulting in more vehicles using the existing number of lanes.	○
Impacts:	Regional air quality is impacted by congestion. If air quality were reduced below federal Clean Air Act standards resulting from the conversion of HOV lanes, stricter measures to improve air quality would be imposed.	◑
Cost:	5% to 30 % of state, county and municipalities' transportation budget comes from federal funds. If air quality regulations are not met agencies could be sanctioned, making them ineligible from receiving transportation funding. The state could also be required to return the federal funds used for HOV construction. The removal of HOV restrictions would violate a mandate from the FHWA that came with the funds used for most of the region's HOV lanes. Violations of federal air quality standards can also preclude the use of federal funds.	◕
Recommendation:	Drop from further evaluation.	X

Concept:

R-40
HOV Lane Use by Non-HOV Vehicles

Area/Termini:

All Limited-Access Highway Corridors in the Study Area

Option:

a) Allow SOVs free use of HOV lanes during off-peak times. Sign each HOV corridor to indicate restricted hours for SOV usage. Peak hours would be set separately for each corridor based on the traffic volumes and commuting patterns.

b) Allow commercial vehicles free use of HOV lanes during off-peak times. Sign each HOV corridor to indicate restricted hours for SOV usage. Peak hours would be set separately for each corridor based on the traffic volumes and commute patterns.

Evaluation results: Low effectiveness due to increasing peak periods

		RATING
Effectiveness:	Off-peak periods will become steadily smaller in the future, reducing the effectiveness of this concept. Commercial-only use of HOV lanes has operational problems associated with having large, slow-moving vehicles in the inside (left) lane, which typically operates at higher speeds. Free SOV use in off-peak periods is common in other parts of the country, but it does not address the problem of peak-period congestion for Trans-Lake travel.	○
Impacts:	Some impacts from toll facilities.	◕
Cost:	Moderate costs for enforcement.	◑
Recommendation:	Consider for further evaluation pending comment by the Study Committee.	?

CATEGORY: ROADWAYS/TSM

Concept:

R-43:
Provide Access to SR 520 from E. Madison St.

Area/Termini:

New alignment from E. Madison St. at 23dr Ave. E. to SR-520

Description:

Keep and improve the ramps in the Washington Park Arboretum, but provide access only via a tunnel under the Arboretum from E. Madison Street. This concept would require arterial street improvement and possibly realignment along E. Madison St. to the tunnel entrance. Changes to the Arboretum ramps would also be required.

Evaluation results: *Tunnels will be considered in the development of enhancements*

		RATING
Effectiveness:	Overall usage would not increase. The east bound on-ramp from Lake Washington Boulevard has 815 vehicles at the AM-peak and 445 in the evening.	○
Impacts:	Tunnel portals would have impacts to Madison Park and Arboretum.	◕
Cost:	Tunnel would be expensive due to high water table near Lake Washington.	○
Recommendation:	Drop from further evaluation.	X

Rating Key

○ Worst ◔ ◑ ◕ ● Best

Concept:

R-41
Ingress/Egress on Opposite Sides of the Freeway (in each direction)

Area/Termini:

All Limited-Access Highway Corridors in the Study Area

Description:

Reconfigure existing interchanges to allow inside (median) and outside entrances and exits to reduce weaving movements and increase capacity. Endeavor to balance entering and exiting volumes through strategic spacing of the access points, as well as traffic movements on connecting arterial streets.

Evaluation results: Increased weaving conflicts would reduce safety and throughput

		RATING
Effectiveness:	The HOV lanes are, or soon will be, on the median side lanes on I-405. The use of median ingress/egress will increase the number of HOV/non-HOV conflicts. It also will induce weaving in the general-purpose lanes, and force reconstruction of the arterial network. This reconstruction may put intersections in undesirable locations, such as in the middle of a structure.	○
Impacts:	Some impacts from new ramp structures.	◑
Cost:	Moderate to low cost.	◕
Recommendation:	Drop from further evaluation.	X

Trans-Lake Washington Study

Appendix 2
Solution Set Definitions

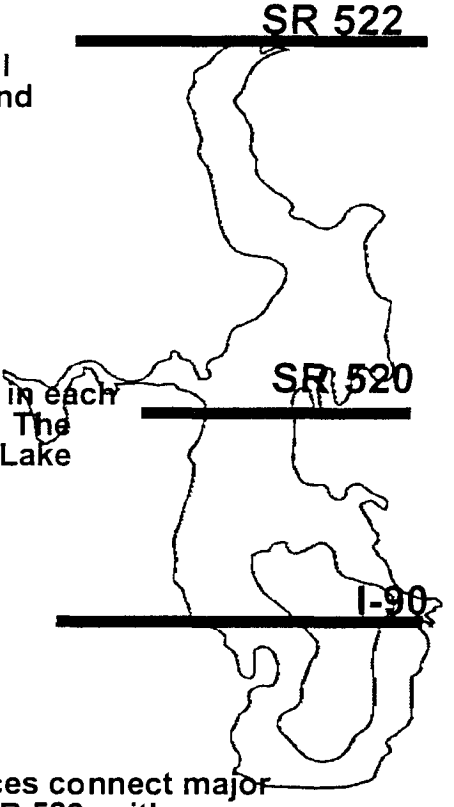
Preliminary Definitions of Solution Sets

Conceptual design details of key elements of each solution set, as considered in transportation, environmental and cost evaluations.

Originally distributed to committee March 15, 1999, and revised and updated for Evaluation Materials in May 1999.

No Action: Key Elements

- SR 522 Adds Limited Transit Priority Improvements. Generally, two general purpose lanes are in each direction, and transit only lanes would be in various segments of the corridor.



- SR 520, east of NE 104th, has one HOV in each direction currently under construction. The westbound HOV lane from NE 104th to Lake Washington would remain.

- I-90 would retain its current (1999) configuration with reversible express lanes.

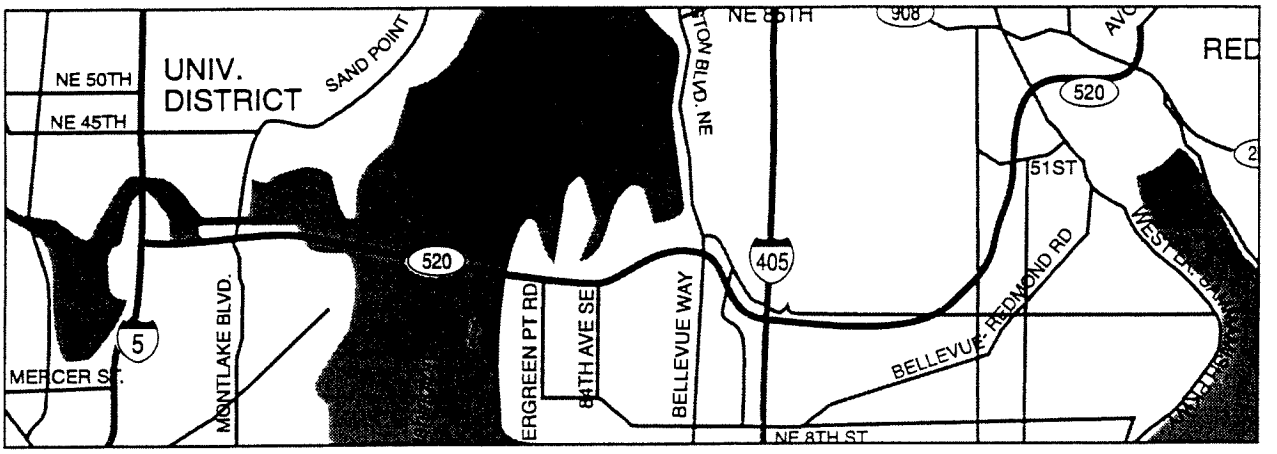
- Regional Express and Local Bus Services connect major centers in region via SR 520, I-90 and SR 522, with average frequencies between 7 and 12.5 minutes at peaks. Local transit service levels increase slightly above current levels.

- Moderate-level TDM programs and land use plans support a shift from single-occupant vehicle use to alternative modes such as transit.

Revised March 15, 1999

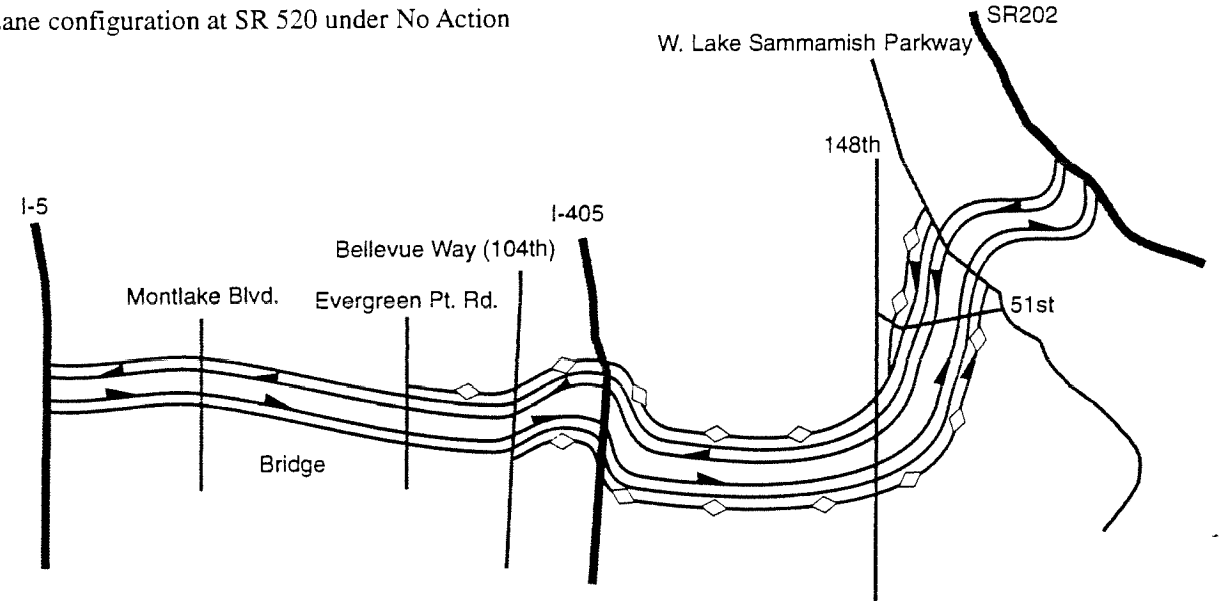
Trans-Lake Washington Study

Discussion Draft 3.12.99



The SR520 improvements would include only the HOV lanes that are currently funded and under construction from approximately Bellevue Way to West Lake Sammamish Parkway. The existing Westbound HOV lane from 104th to Evergreen Point Road would remain. A new interchange will be constructed at NE 40th St.

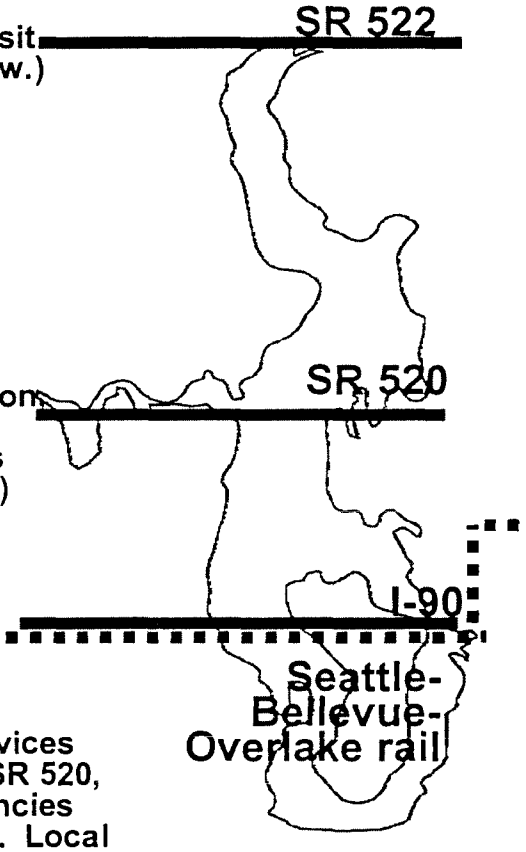
Lane configuration at SR 520 under No Action



No Action
SR 520 Funded Improvements

MTP '98: Key Elements

- SR 522 Adds Transit Lanes and Transit Priority Improvements. (Details follow.)
- SR 520 adds one HOV in each direction with direct connection to I-5 express lanes, and HOV-to-HOV direct access connections to I-405. (Details follow.)
- I-90 includes light rail to Bellevue and Overlake. (Details follow.)
- Regional Express and Local Bus Services connect major centers in region via SR 520, I-90 and SR 522, with average frequencies between 7 and 12.5 minutes at peaks. Local transit service increases about 20% above current levels.
- Aggressive-level TDM programs and land use plans support shifts from single-occupant vehicle use. (Details in separate TDM discussion paper.)
- Neighborhood Enhancements, Mitigation, and Non-Motorized facilities remain to be determined.



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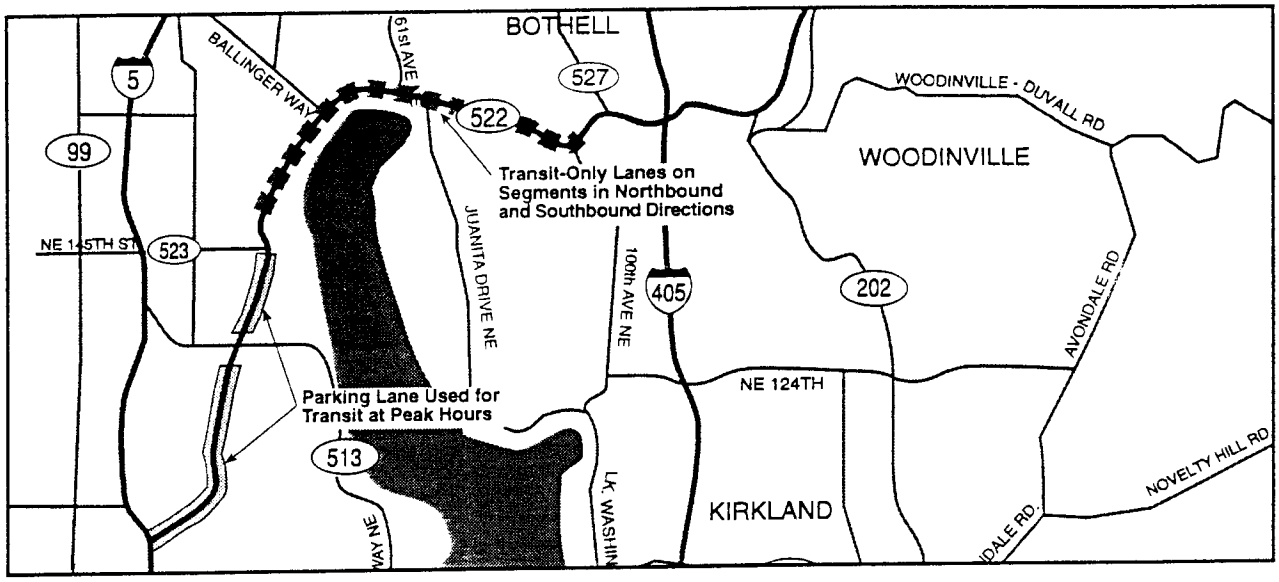


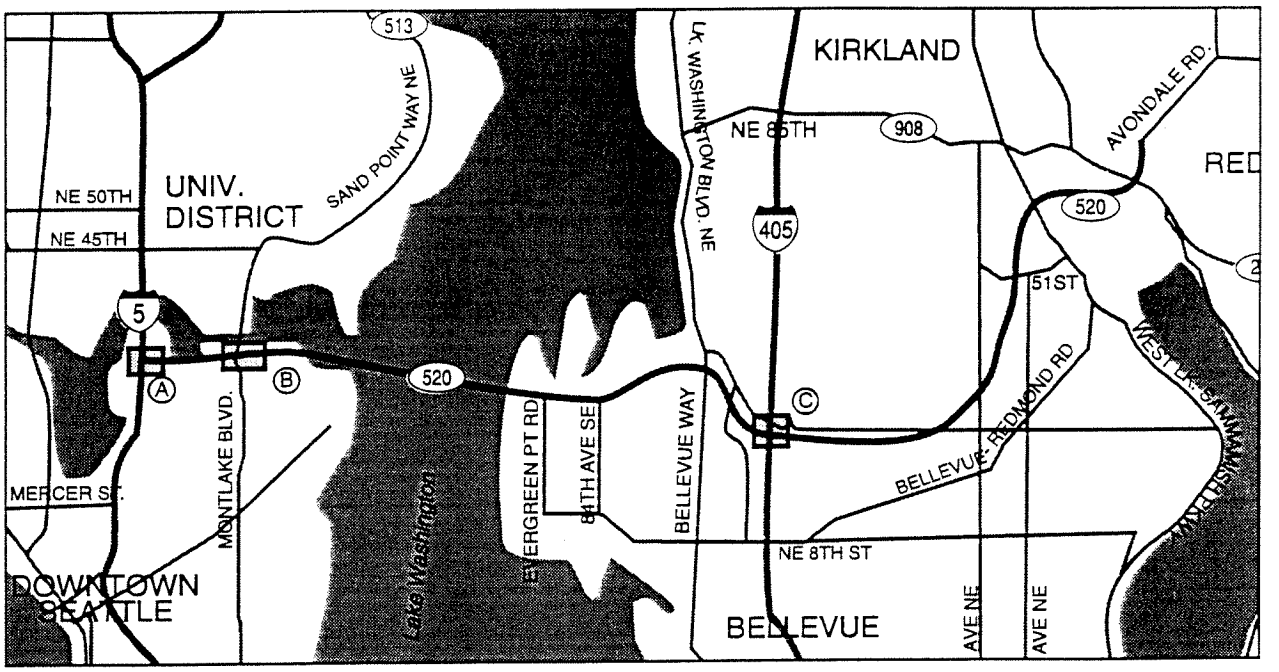
As in No Action, the SR 522 corridor would have two general purpose lanes in each direction, with a transit-only lane northbound from NE 16th Street to 73rd Avenue NE (just east of Juanita Drive NE/68th Avenue NE), and a southbound transit-only lane from 73rd Avenue NE to SR 523 (NE 145th Street).

In MTP '98, the transit-only lane would be extended from 73rd Avenue NE to downtown Bothell. North and South of the Lake City business district, a parking lane would be used during peak hours as a transit-only queue bypass. Traffic signals would give priority to transit vehicles throughout the corridor.

MTP '98
SR 522 with Transit Priority and Transit Bypass Lanes

Trans-Lake Washington Study

Discussion Draft 3.12.99



Interchange Improvement Diagram provided

One HOV lane would be added to each direction of SR520 between I-5 and W. Lk. Sammamish Parkway. The project would include:

Detail A: Direct connection between SR520 HOV lanes and I-5 express lanes
Detail B: Interchange modifications at Montlake including a relocated transit station
Detail C: Interchange modifications at I-405, including direct access HOV ramps

Information on the Mercer Street Interchange on I-5, with improved connections to SR520, is shown in a separate project figure.

Note: HOV lanes are shifted from the right side to the left (median) side of the roadway throughout the corridor.

MTP '98
SR 520 with added HOV Lanes

Trans-Lake Washington Study

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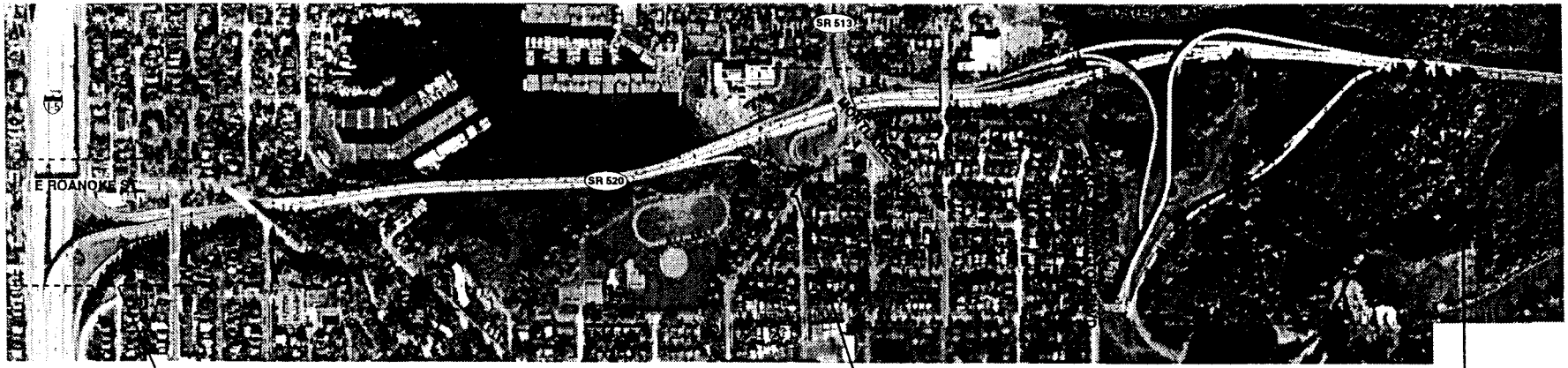
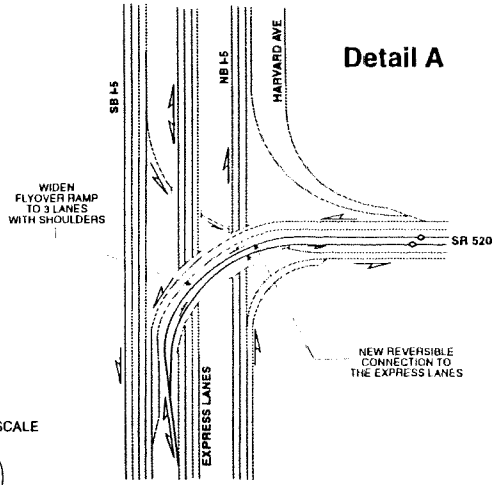
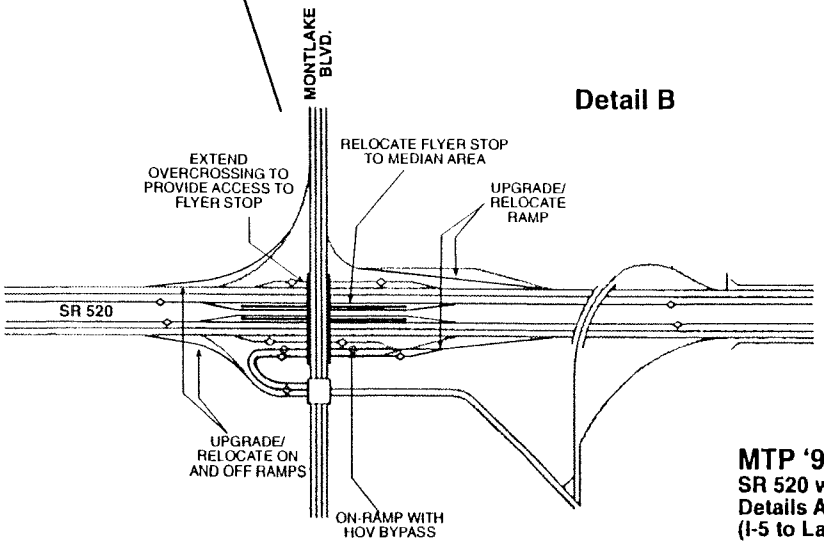
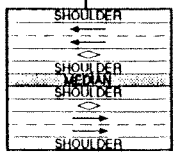








MTP '98 Typical Lane Configuration

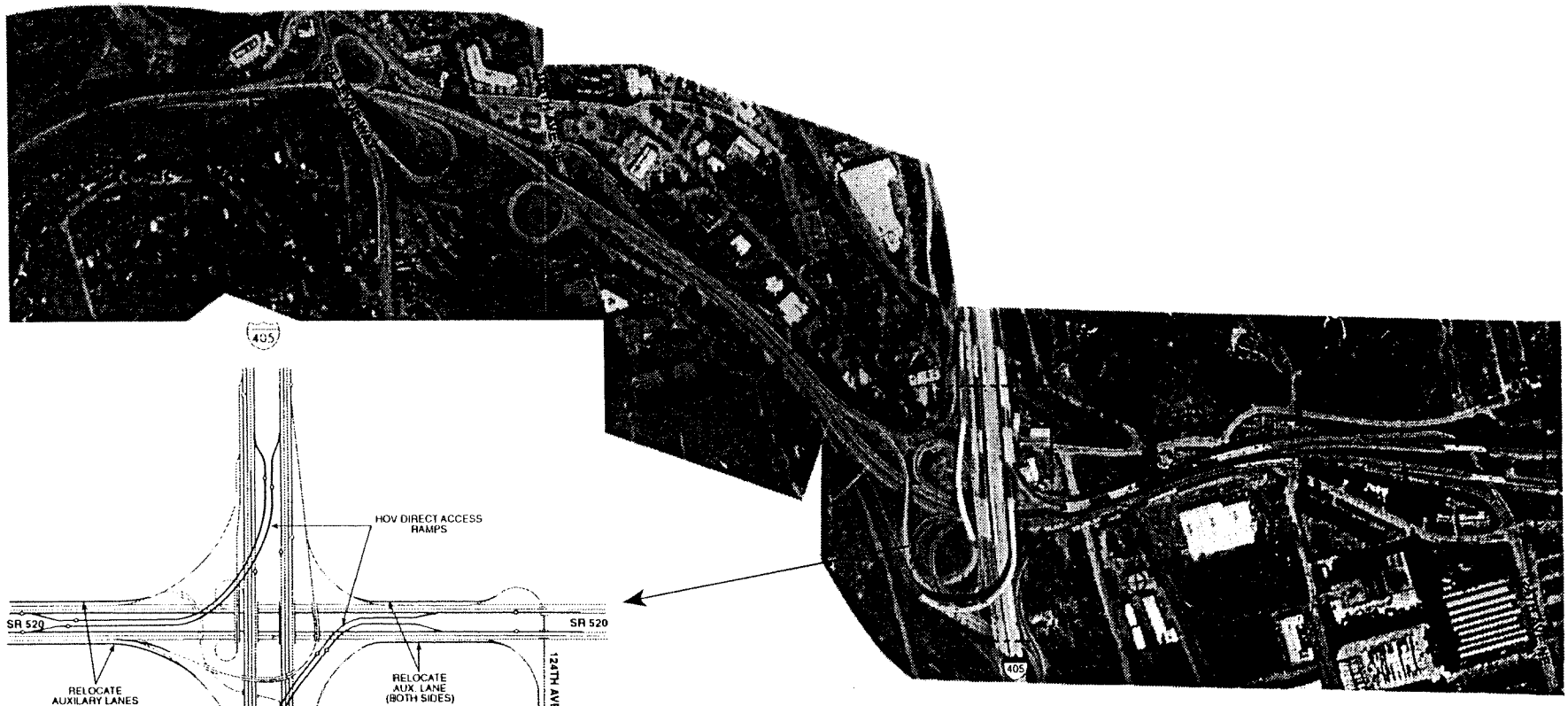
NOT TO SCALE

N

MTP '98
SR 520 with Added HOV Lanes
Details A and B
(I-5 to Lake Washington)

Trans-Lake Washington Study

Discussion Draft 3.12.99

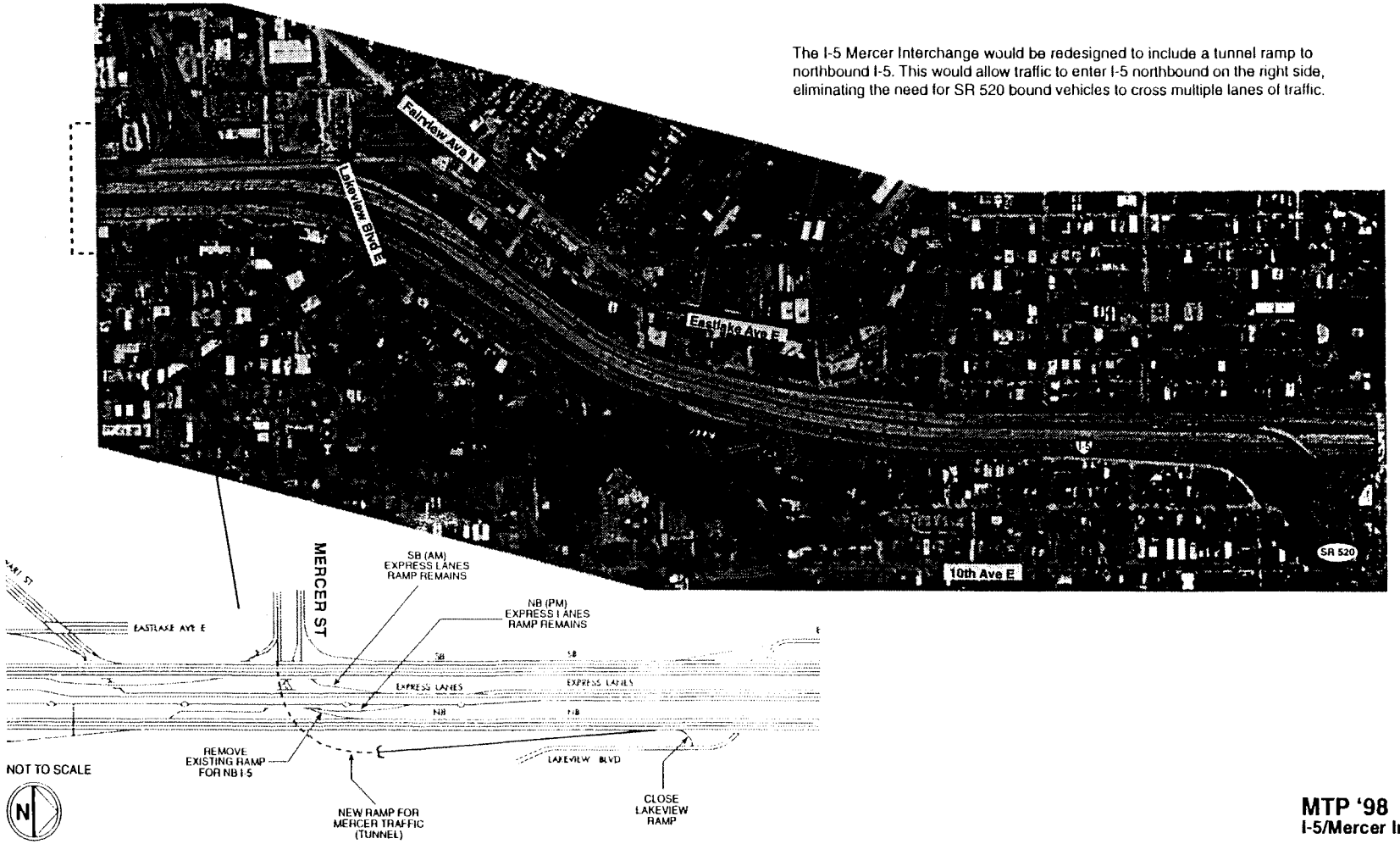


MTP '98
SR 520 with Added HOV Lanes
Detail C
(Lake Washington to 124th Ave NE)

Trans-Lake Washington Study

Discussion Draft 3.12.99

The I-5 Mercer Interchange would be redesigned to include a tunnel ramp to northbound I-5. This would allow traffic to enter I-5 northbound on the right side, eliminating the need for SR 520 bound vehicles to cross multiple lanes of traffic.



MTP '98
I-5/Mercer Interchange

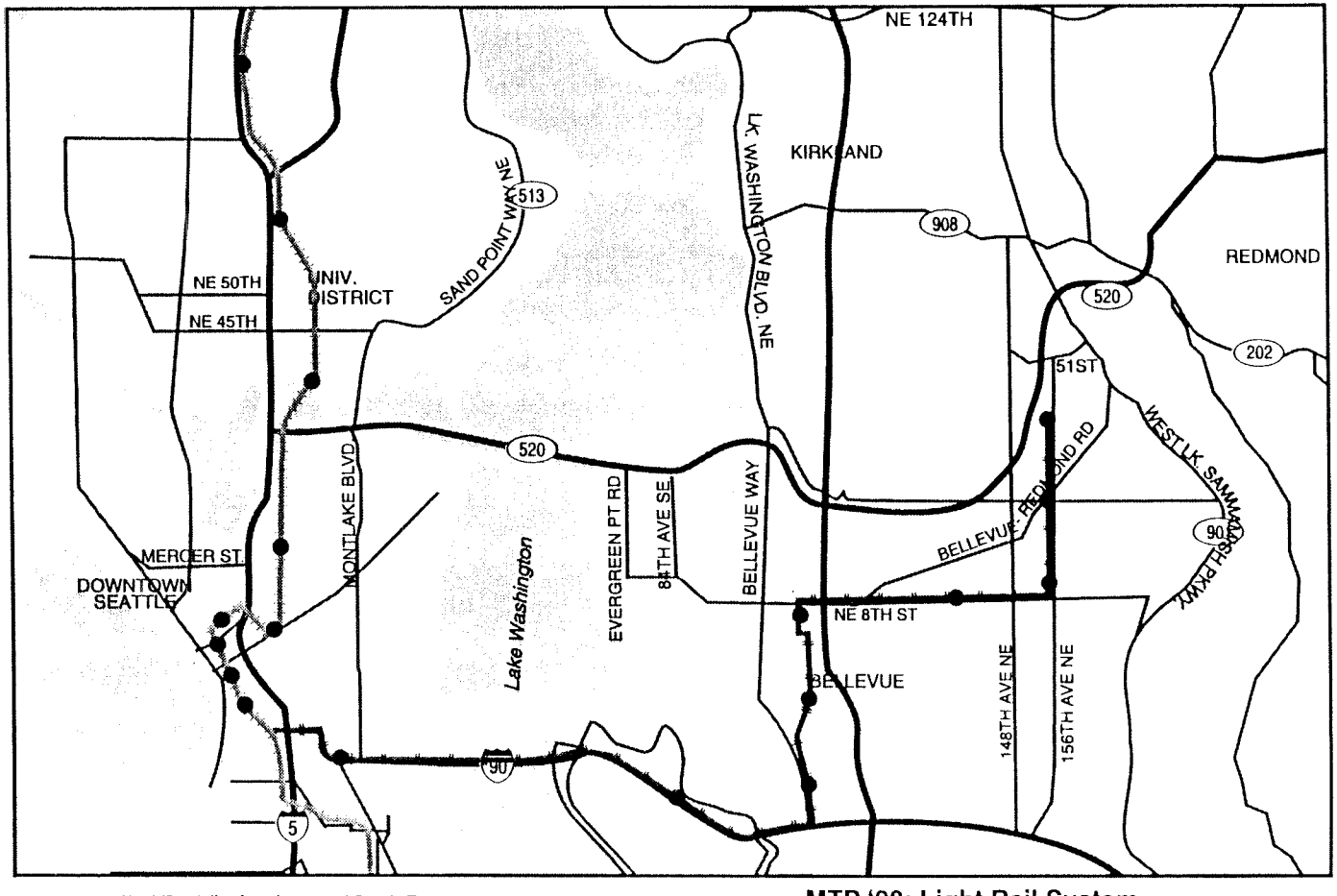
Trans-Lake Washington Study

Discussion Draft 3.12.99

Downtown Seattle to Downtown Bellevue to Overlake. The route would be from downtown Seattle on the I-90 center roadway, and then along major arterials to Bellevue and Overlake. The route from I-90 to Bellevue is along Bellevue Way SE, the route from downtown Bellevue to Overlake is along NE 8th Street to Crossroads (at 156th Avenue NE), and along 156th Avenue NE from Crossroads to Overlake. Eastside stations are assumed at Mercer Island, South Bellevue, Wilburton, Bellevue Transit Center, Bellevue East (NE 8th Street & 140th Avenue NE), Crossroads, Overlake (156th Avenue NE & NE 24th Street), and Microsoft.

Under MTP '98, the eastern corridor would connect to the north/south lines of the regional light rail system, which would include a line from Downtown Seattle north (to University District, Northgate, and Lynnwood) and from Downtown Seattle to Sea-Tac, Federal Way, and Tacoma.

In light rail, MTP '98 differs from earlier versions, which had shown an I-405 line as well; that corridor is still under consideration regionally, but it is no longer anticipated to be completed in a year 2020 system.



North/South line from Lynnwood-Seattle-Tacoma

MTP '98: Light Rail System
Downtown Seattle to Downtown Bellevue to Overlake

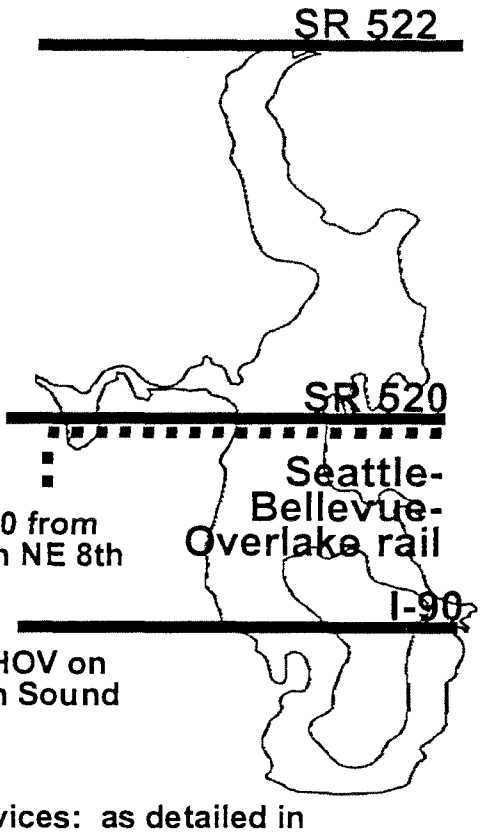
NOTE: Example routes proposed for evaluation purposes only. Future route decisions may vary.

Last Revised: 02/15/99

MTP "Flipped": Key Elements

renamed from"MTP Modified"

- **SR 522: As detailed in MTP***
- **SR 520 adds one HOV (as detailed in MTP))**
- **A light rail line generally along SR 520 from downtown Seattle to Bellevue, and on NE 8th to Overlake. (Details follow)**
- **I-90 would have a continuous 2-way HOV on the center roadway. (Details based on Sound Transit study.)**



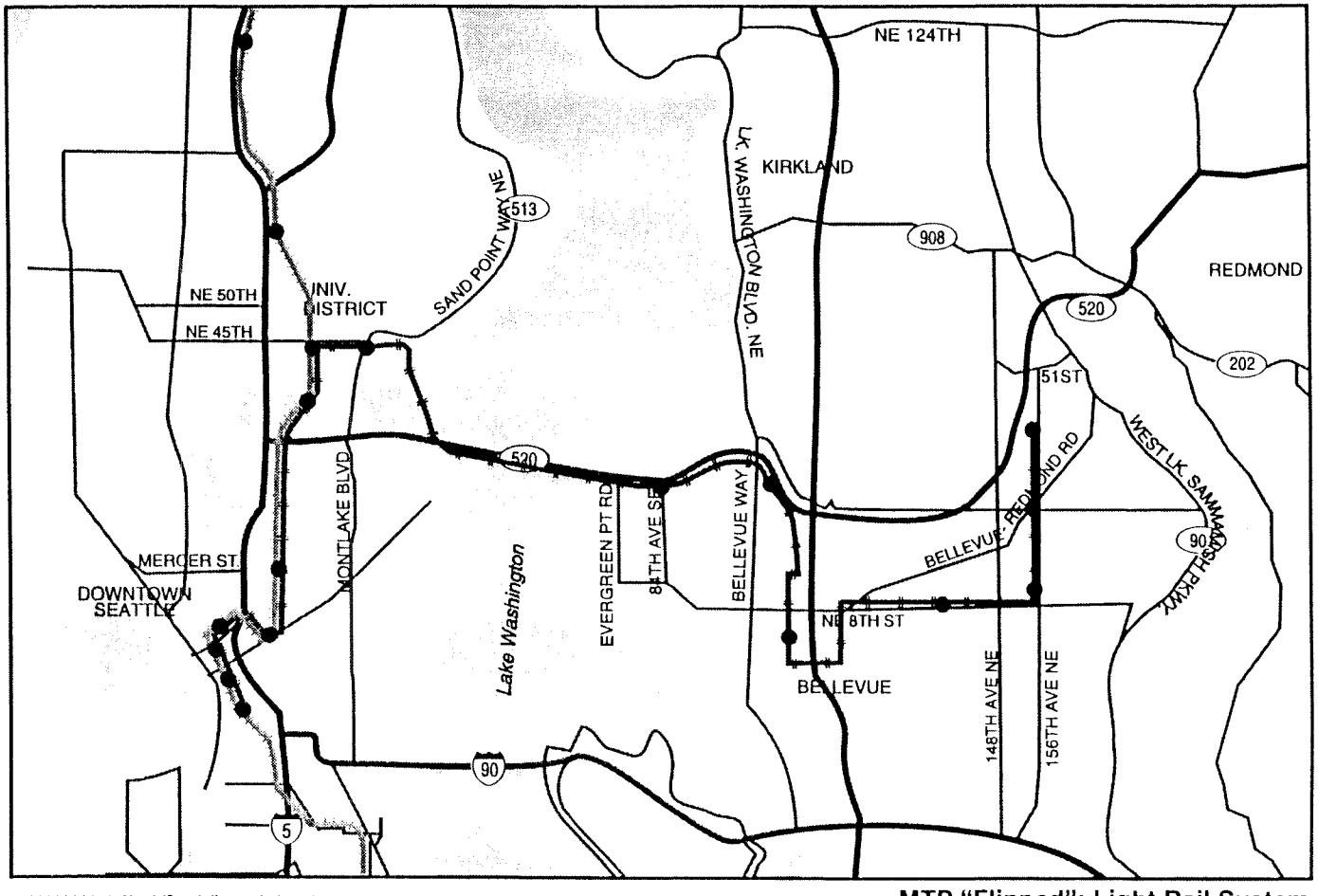
- **Regional Express and Local Bus Services: as detailed in MTP '98**
- **TDM and land use: as detailed in MTP '98**
- **Neighborhood Enhancements, Mitigation, and Non-Motorized facilities remain to be determined.**

** Committee members recommended continuous HOV treatment on SR 522 and SR 523. This treatment is included in the Roadway/Bus solution set.*

Revised March 15, 1999

Trans-Lake Washington Study

Downtown Seattle to University District to Downtown Bellevue to Overlake. From downtown Seattle, the route coincides with the North line under Capitol Hill to the University District. It then branches east and remains in a tunnel under the UW campus to NE 45th Street near University Village. It then heads south through UW property to transition to a tube and cross the navigation channel, and then turns east to cross Lake Washington on a floating structure beside SR-520. Reaching land, it would follow the south edge of the SR-520 right-of-way to the Bellevue Way N.E. interchange, then follows several arterials to reach the Bellevue Transit Center. The route from downtown Bellevue to Overlake is along NE 8th Street to Crossroads, and along 156th Avenue NE from Crossroads to Overlake. North Seattle and Eastside stations would be at Pacific, University Village, Points, North Bellevue (SR-520 & 108th Avenue NE), Bellevue Transit Center, Bellevue East (NE 8th Street & 140th Avenue NE), Crossroads (NE 8th Street & 156th Avenue NE), Overlake (156th Avenue NE & NE 24th Street), and Microsoft (156th Avenue NE & NE 36th Street).



North/South line as in MTP '98

NOTE: Example routes proposed for evaluation purposes only.
Future route decisions may vary.

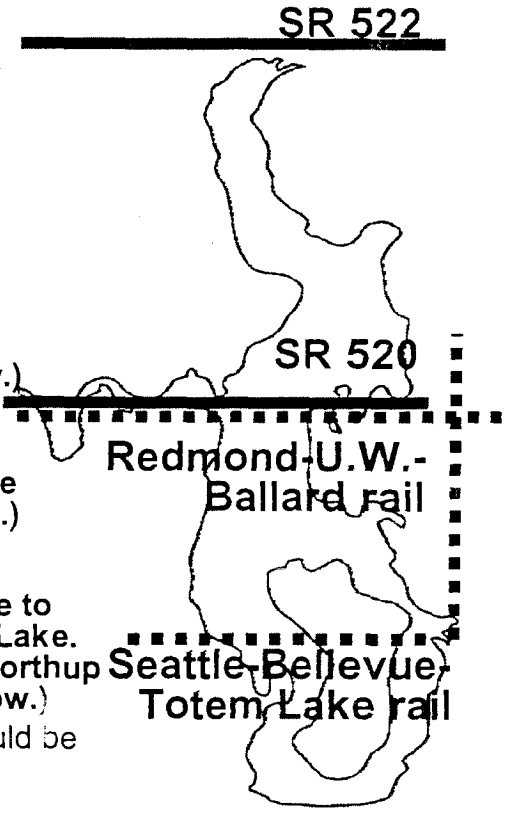
MTP "Flipped": Light Rail System
Downtown Seattle to University District to Downtown Bellevue to Overlake

Last Revised: 03/15/99

Roadway/Rail: Key Elements

(formerly "Everything A")

- SR 522 includes Transit Lane and Transit Priority treatments, with grade-separation at two intersections. (Details follow.)

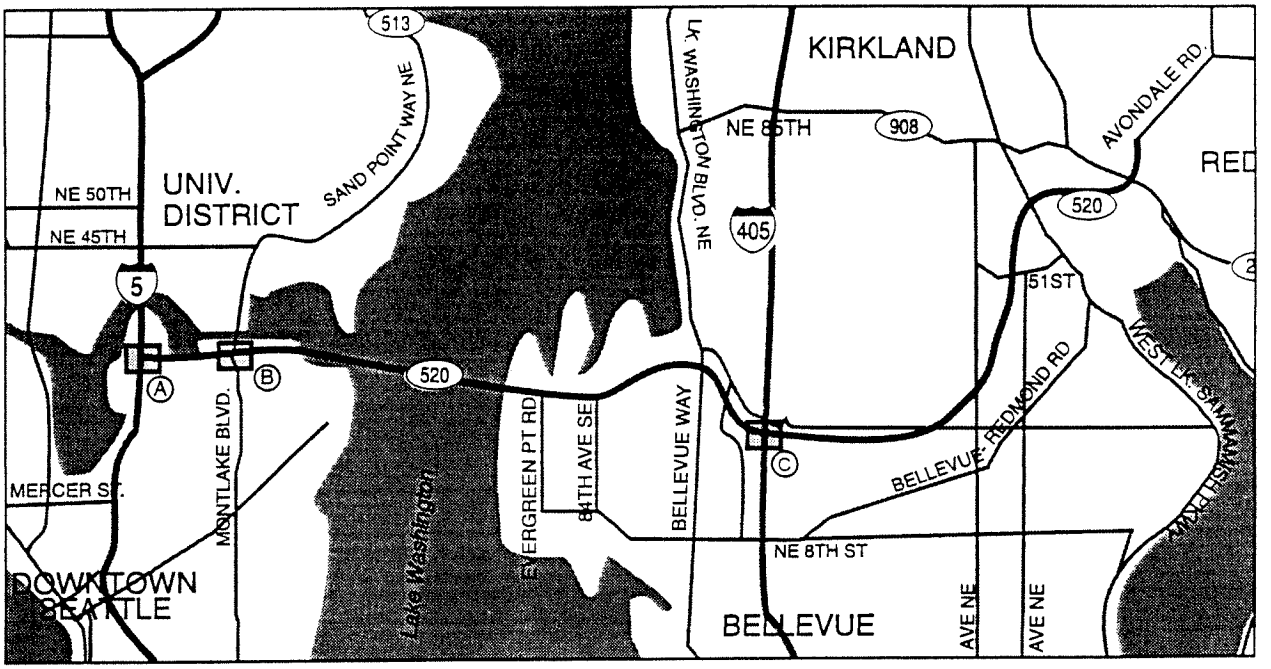


- SR 520 adds one GP in each direction, with no new HOV. New access to the Mercer area is provided. (Details follow.)
- Light rail from downtown Redmond to University District to Ballard, with a lake crossing beside SR 520. (Details follow.)
- Light rail on I-90 from downtown Seattle to downtown Bellevue to Kirkland/Totem Lake. Transfers to Redmond-Ballard line at Northup Way/NE 116th Avenue NE. (Details follow.)
  - I-90 center lanes across the lake would be replaced by rail.
- Where light rail service coincides with Regional Express and Local Bus Services, bus routes will feed to light rail for Trans-Lake crossings. Other routes and service levels would be the same as MTP.
- TDM and land use programs are the same as MTP.
- Neighborhood Enhancements, Mitigation, and Non-Motorized facilities remain to be determined.

Revised March 15, 1999

Trans-Lake Washington Study

Discussion Draft 3.12.99



Interchange Improvement Diagram provided

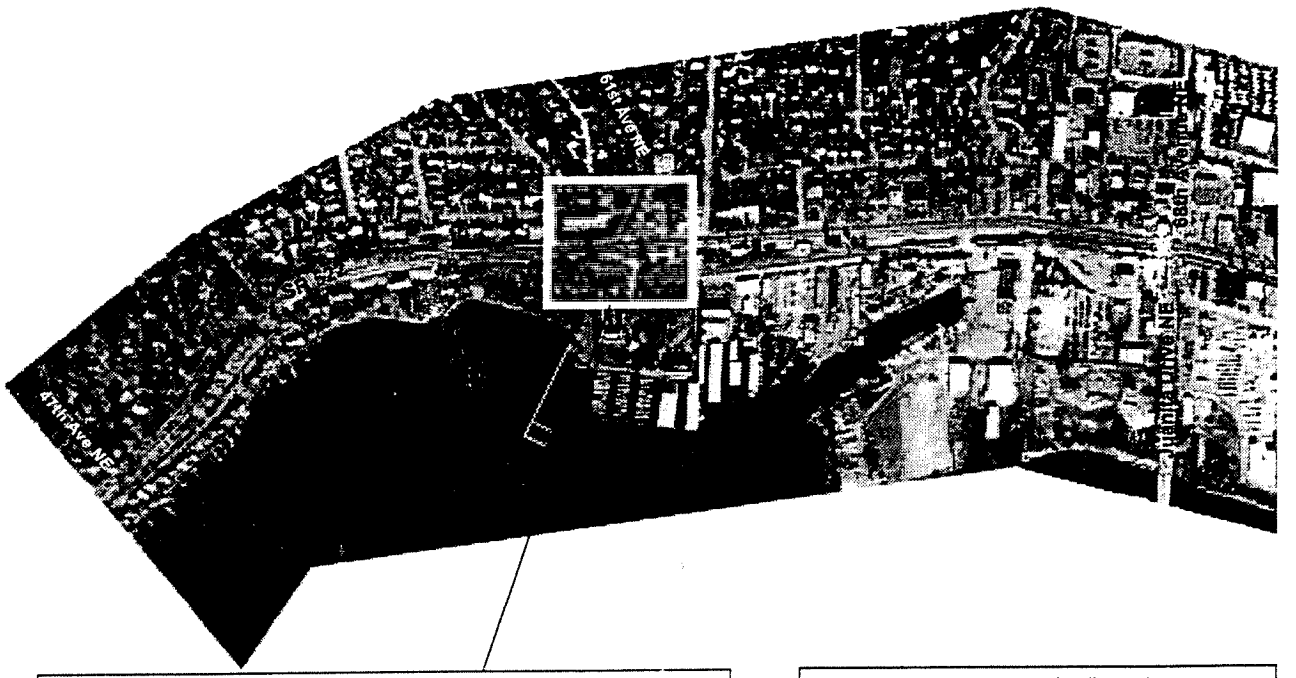
One general purpose lane would be provided in each direction, with no new HOV lanes. The improvements under this scenario include:

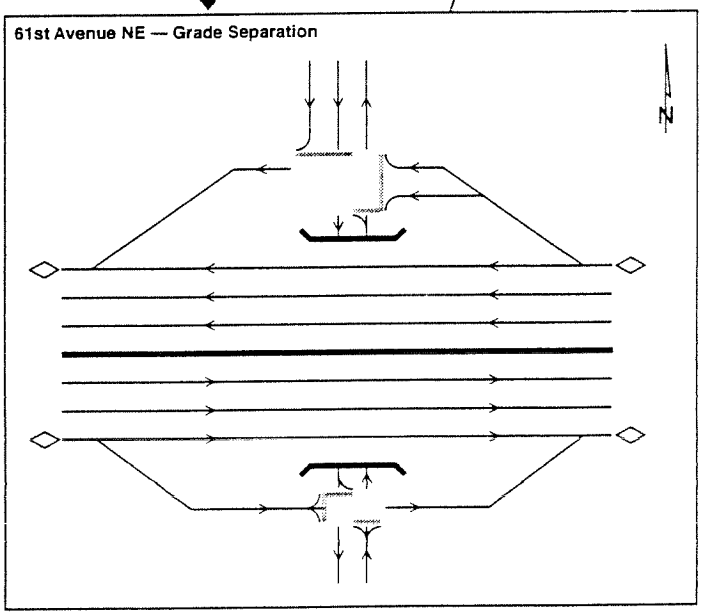
- A direct connection between the Mercer area and SR 520, with no other modifications to Mercer Interchange (Detail A).
- A reconfigured Montlake interchange, including a new connection to Pacific serving all traffic between SR 520 and the University area. Traffic to and from the Montlake area south of SR 520 would have modified connections (Detail B).
- The I-405/SR 520 interchange would have minor changes from No Action (Detail C).

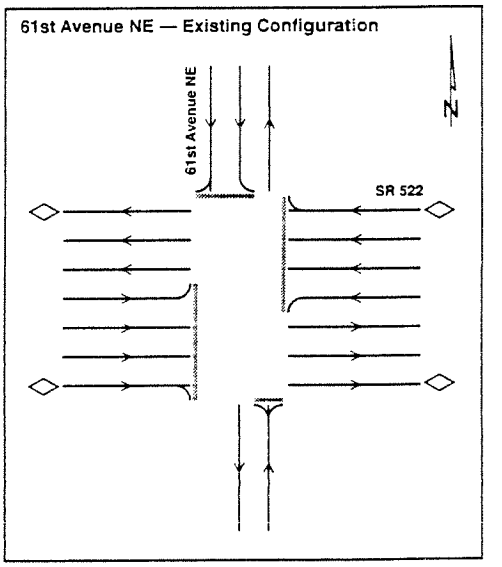
Roadway/Rail
SR 520 with added General Purpose Lane

Trans-Lake Washington Study

Discussion Draft 3.12.99







NOT TO SCALE

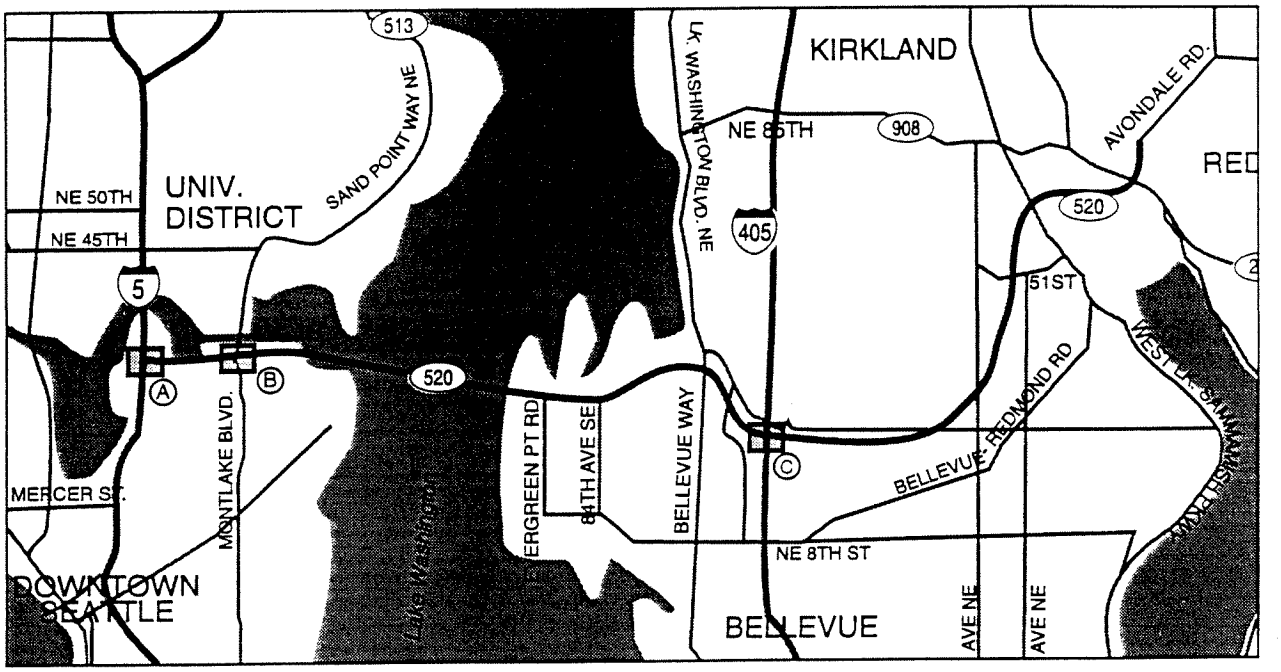
N

Roadway/Rail

SR 522 and SR 523 Grade Separator
Detail C (61st Avenue NE Grade Separator)

Trans-Lake Washington Study

Discussion Draft 3.12.99



Interchange Improvement Diagram provided

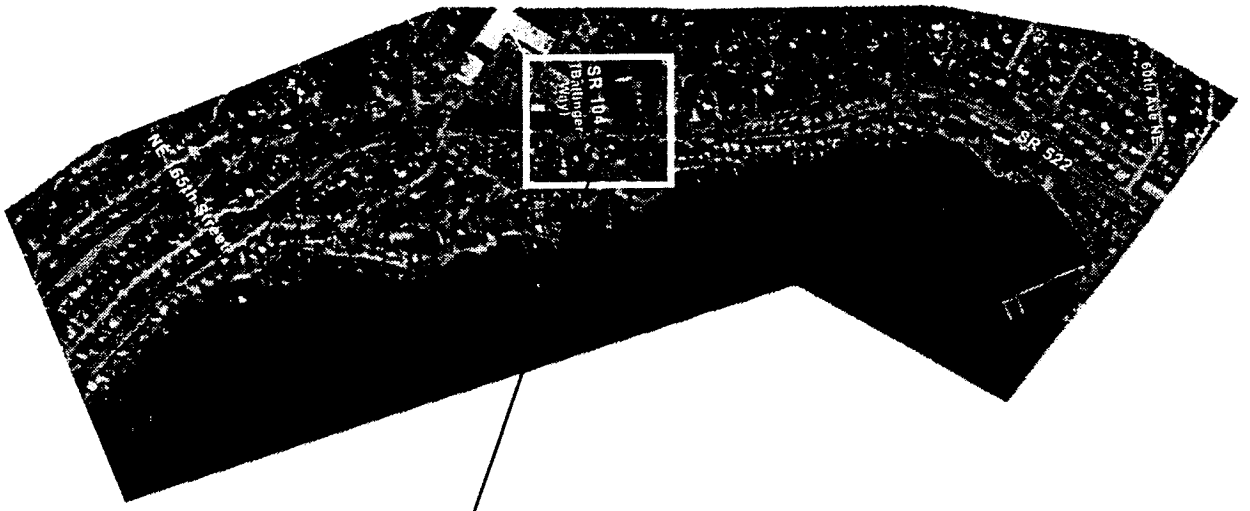
One general purpose lane would be provided in each direction, with no new HOV lanes. The improvements under this scenario include:

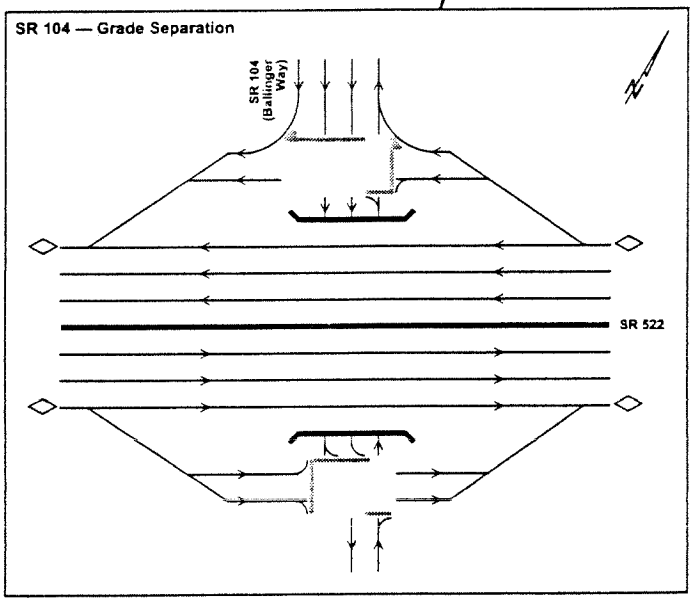
- A direct connection between the Mercer area and SR 520, with no other modifications to Mercer Interchange (Detail A).
- A reconfigured Montlake interchange, including a new connection to Pacific serving all traffic between SR 520 and the University area. Traffic to and from the Montlake area south of SR 520 would have modified connections (Detail B).
- The I-405/SR 520 interchange would have minor changes from No Action (Detail C).

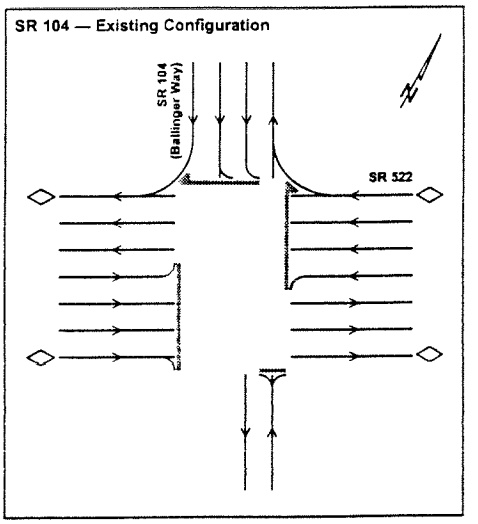
Roadway/Rail
SR 520 with added General Purpose Lane

Trans-Lake Washington Study

Discussion Draft
3.12.99







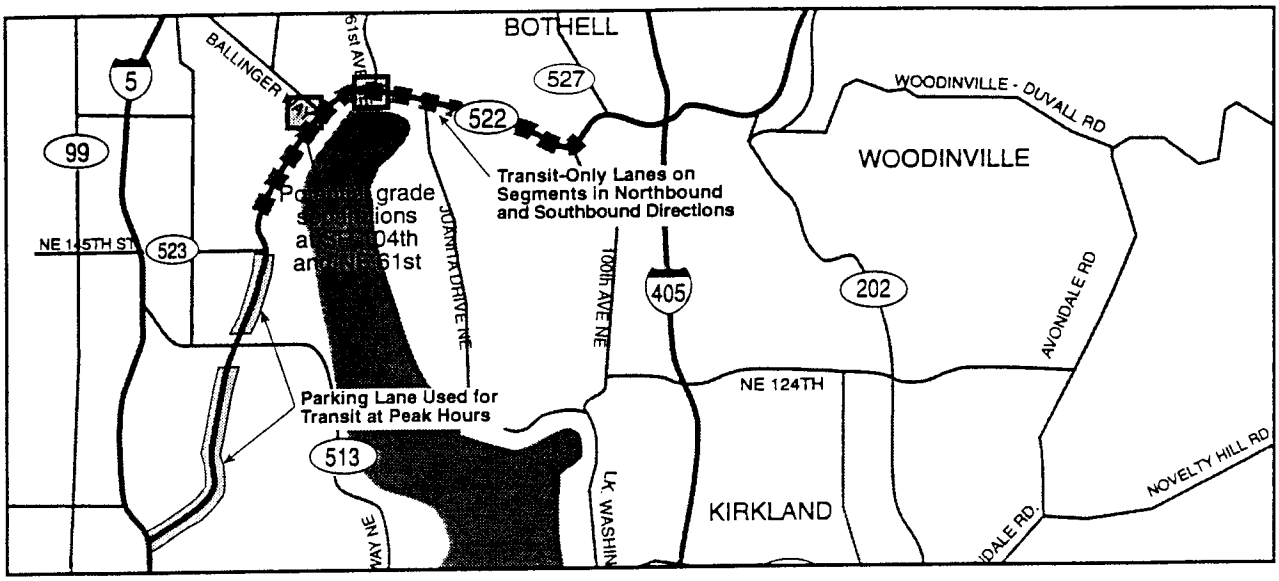
NOT TO SCALE

N

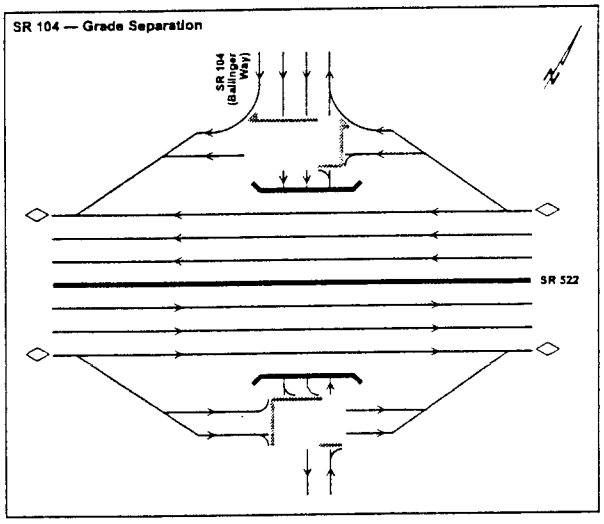
Roadway/Rail
SR 522 and SR 523 with Grade Separation
Detail B (Grade Separation at SR 104)

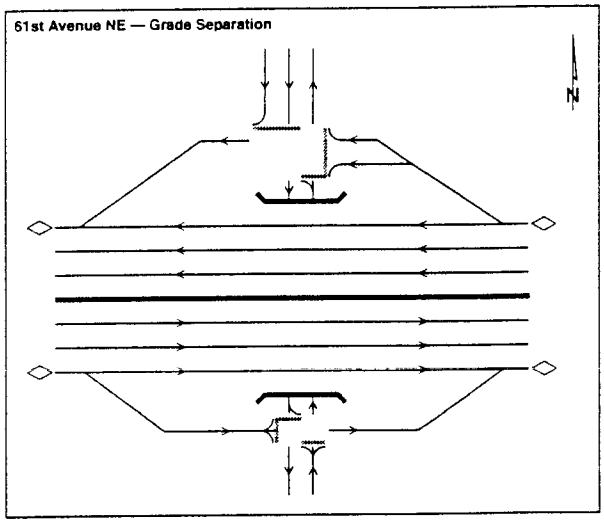
Trans-Lake Washington Study

Discussion Draft 3.12.99



This package of improvements has the same transit lanes and transit priority signal systems as considered in MTP '98, but it also would consider grade separating the intersections, at SR 104 and at NE 61st. The grade separated intersections would be as shown below.



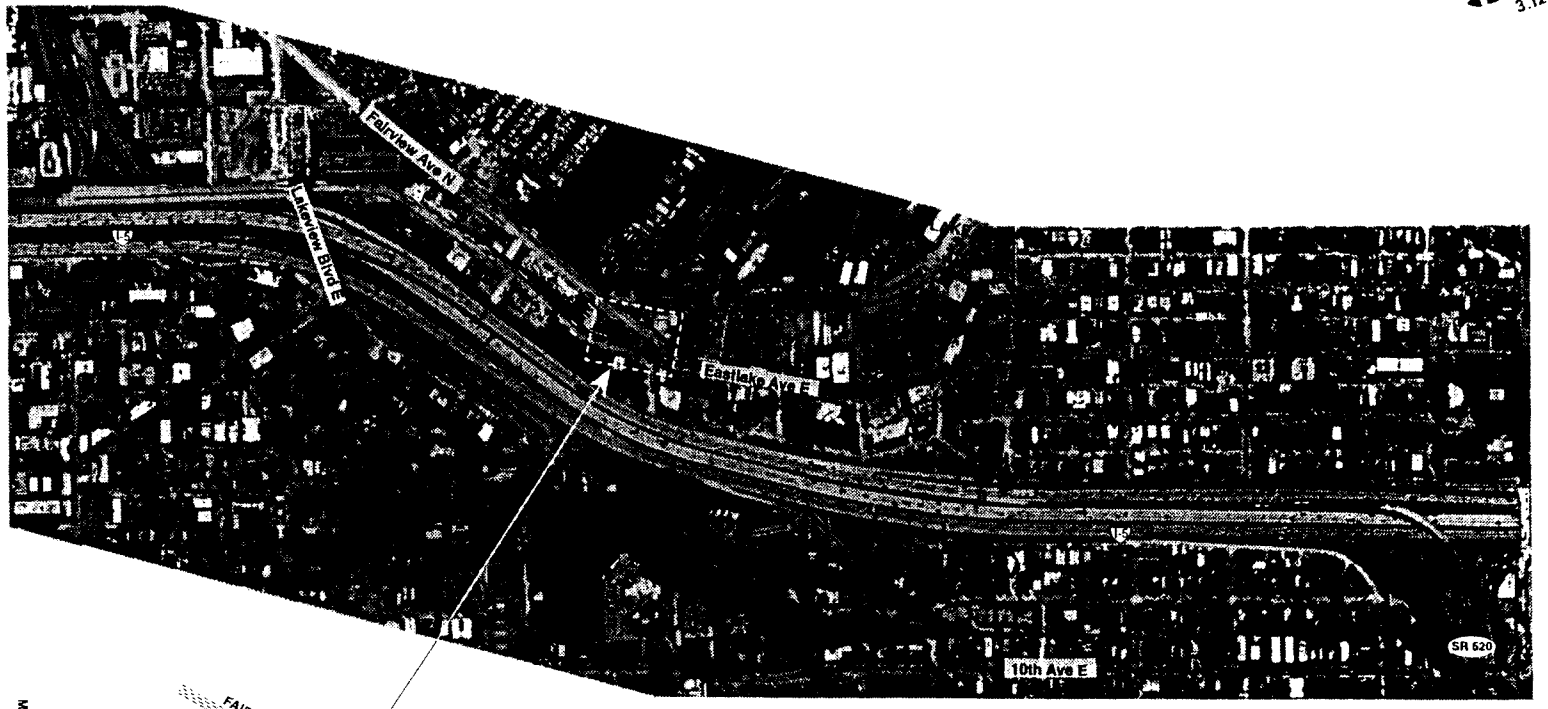


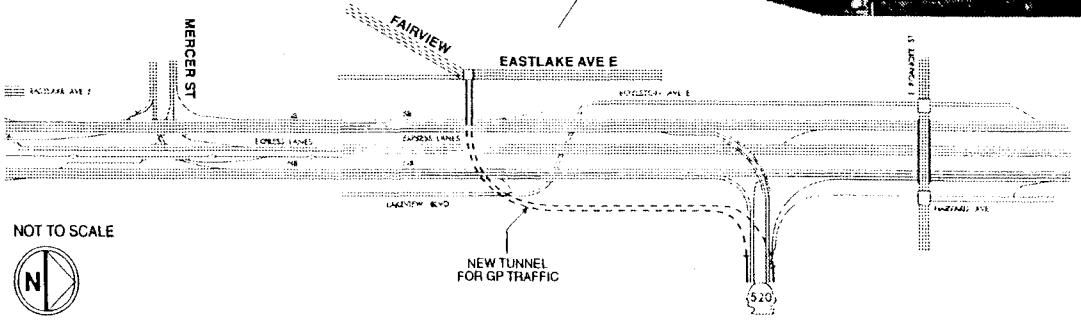
Roadway/Rail

SR 522 Transit Priority, Transit Lanes and Grade Separated Intersections

Trans-Lake Washington Study

Discussion Draft 3.12.99





NOT TO SCALE

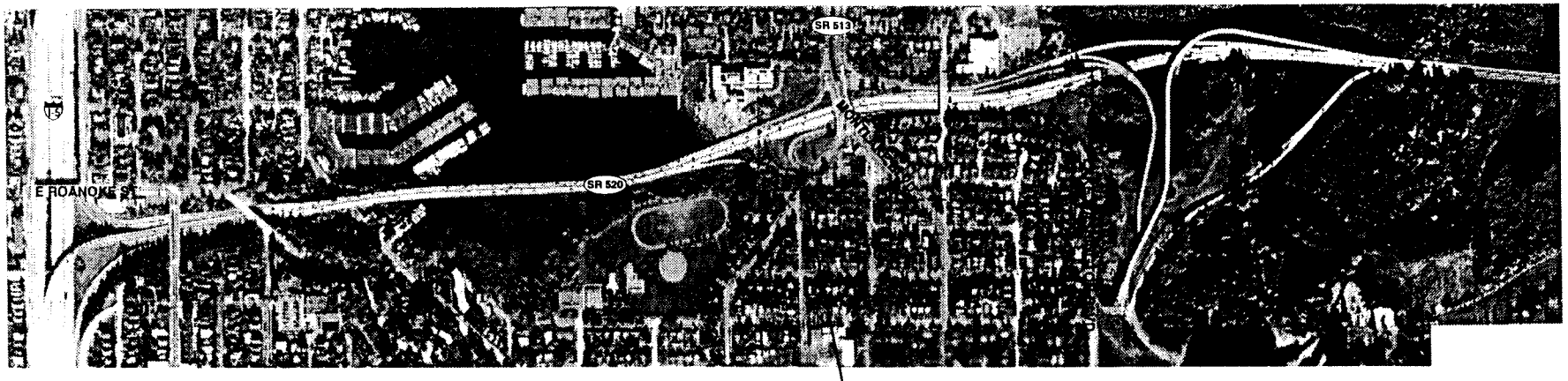
N

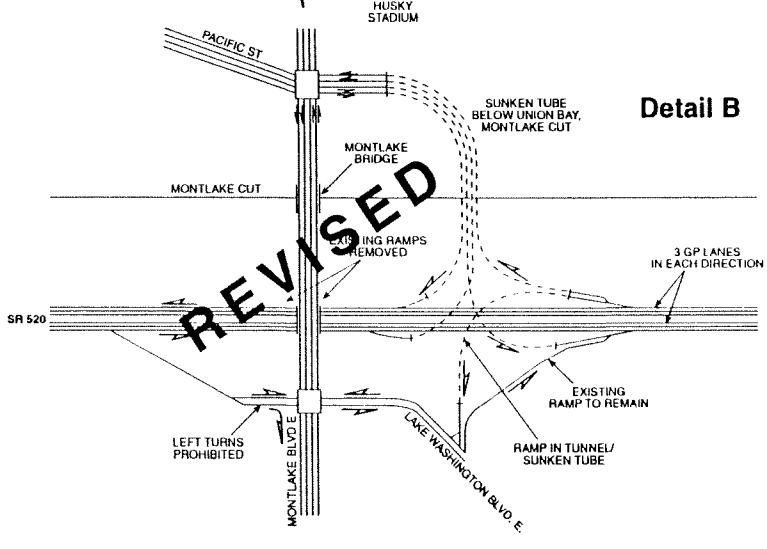
Roadway/Rail

SR 520 with added General Purpose Lane Detail A (Direct Connection from SR 520 to Mercer area)

Trans-Lake Washington Study

Discussion Draft 3.12.99





REVISED

Detail B

Revised: See the following detail of 4/1/99

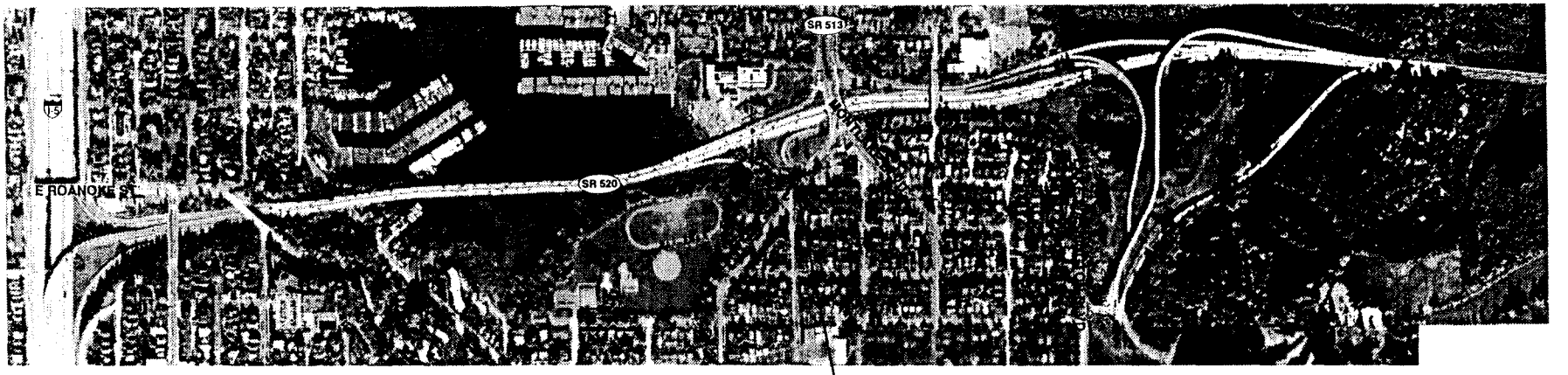
NOT TO SCALE

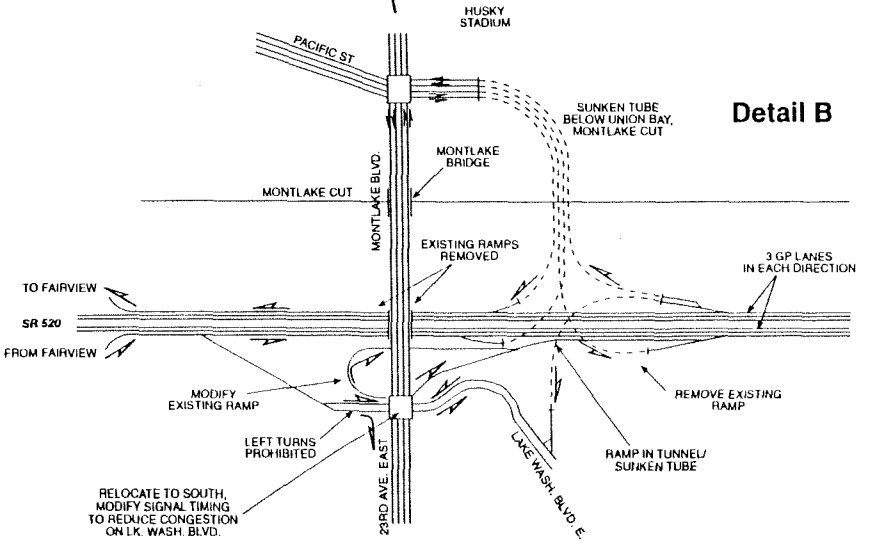
N

Roadway/Rail
SR 520 with Added General Purpose Lane
Detail B (I-5 to Lake Washington)

Trans-Lake Washington Study

Revised Draft 4.1.99





Detail B

NOTE: This detail was revised as a result of committee input on 3-12-99 discussion draft, reviewed in a committee meeting on 3-24-99. Some adjustments or revisions to this design concept detail would occur if the SR520 with added GP lane project is chosen for further consideration

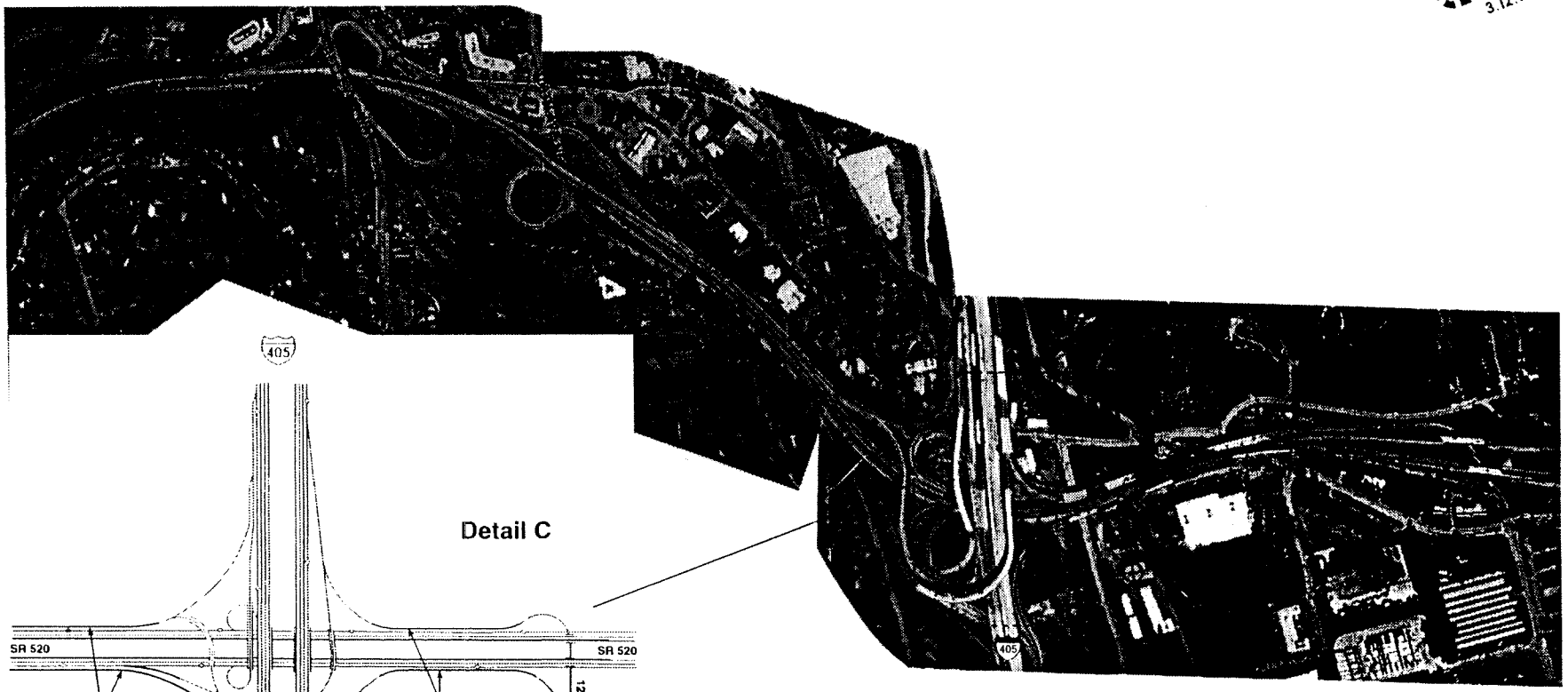
NOT TO SCALE

N

Roadway/Rail
SR 520 with Added General Purpose Lane
Detail B (I-5 to Lake Washington)

Trans-Lake Washington Study

Discussion Draft 3.12.99



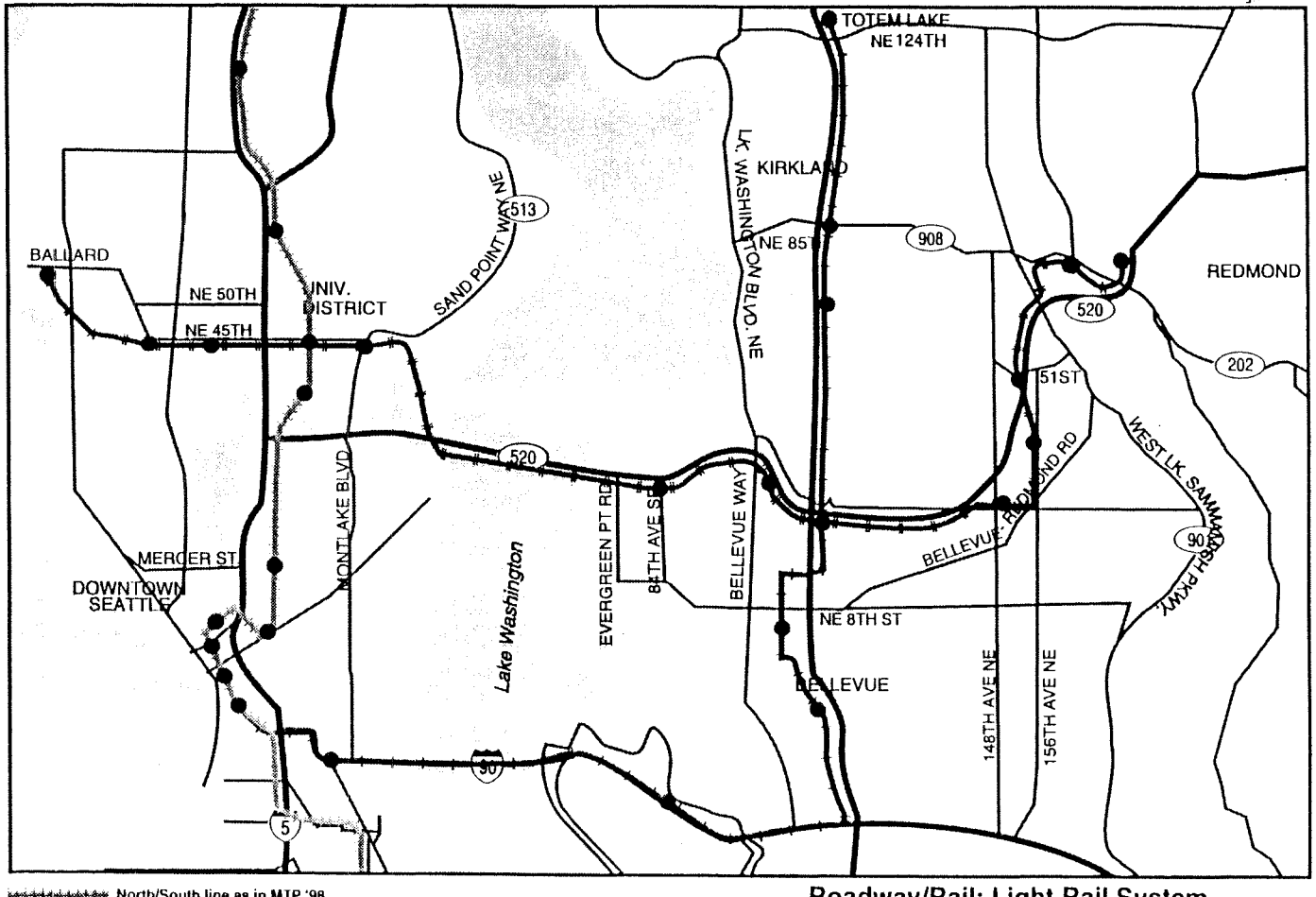
Roadway/Rail
SR 520 with Added General Purpose Lane
Detail C (Lake Washington to 124th Ave NE)

Trans-Lake Washington Study

Discussion Draft 3 12 99

Downtown Seattle to Downtown Bellevue to Kirkland/Totem Lake. From downtown Seattle the route would proceed across the lake via the I-90 center roadway. The route from I-90 to Bellevue is generally near I-405, using arterials and the BNSF right-of-way to the Bellevue Transit Center. Leaving downtown Bellevue, the route crosses I-405 and travels north along the east side of the freeway to NE 128th Street, near Totem Lake. Eastside stations would be at Mercer Island, Wilburton, Bellevue Transit Center, Northup (transfer to Redmond/Ballard line), Houghton, Kirkland and Totem Lake.

Downtown Redmond to University District to Ballard. The route would begin in Kirkland, crosses to SR 520, and is generally along SR 520 until it crosses under I-405. This section of the route would use BNSF right-of-way, existing roadways, and short sections of new right-of-way. The route is then along SR 520 to Lake Washington, where a variety of at-grade, aerial and tunnel facilities would be needed. The lake crossing would be on a floating structure parallel to SR-520 and connects via a tube and tunnel to the University District. It would then follow a route generally along 45th Street to Ballard. Stations would be at Bear Creek, Redmond Town Center, NE 51st Street, Microsoft, Overlake, Northup (transfer to Seattle-Totem Lake line), North Bellevue, Points, University Village, NE 45th Street, Wallingford, Woodland Park and Ballard.



North/South line as in MTP '98

NOTE: Example routes proposed for evaluation purposes only. Future route decisions may vary.

Roadway/Rail: Light Rail System

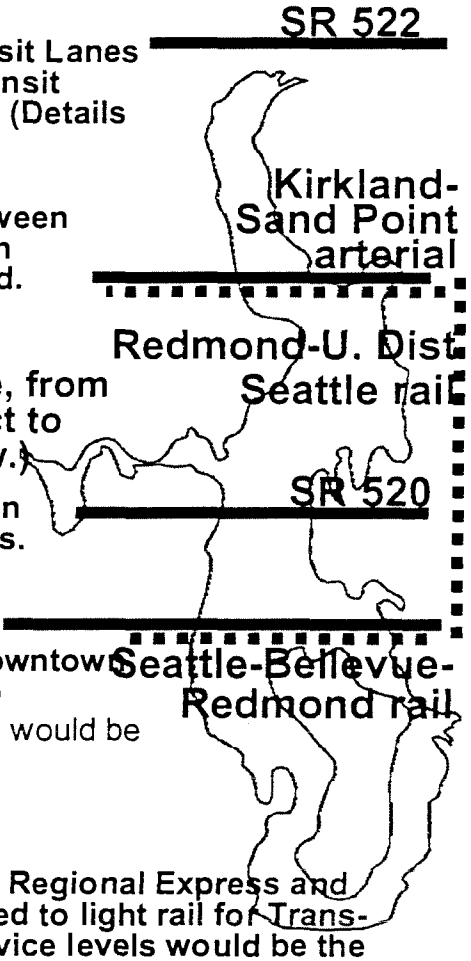
- Downtown Seattle to Downtown Bellevue to Kirkland/Totem Lake
- Downtown Redmond to University District to Ballard

Last Revised: 03/15/99

New Crossing: Key Elements

(formerly "Everything B")

- SR 522 adds Transit Priority and Transit Lanes from I-405 to SR 523. SR 523 adds transit priority treatments from SR 522 to I-5. (Details follow.)
- New four lane arterial connection between Sand Point Way NE at NE 85th Street in Seattle, and NE 124th Street in Kirkland. (Details follow.)
- Light rail on new arterial's bridge, from downtown Redmond to U. District to downtown Seattle. (Details follow.)
- SR 520 adds one HOV in each direction and would connect to I-5 express lanes. (As detailed in MTP.)
- Light rail from downtown Seattle to downtown Bellevue to Redmond. (Details follow.)
  - Forecasts assume I-90 center lanes would be replaced by rail.

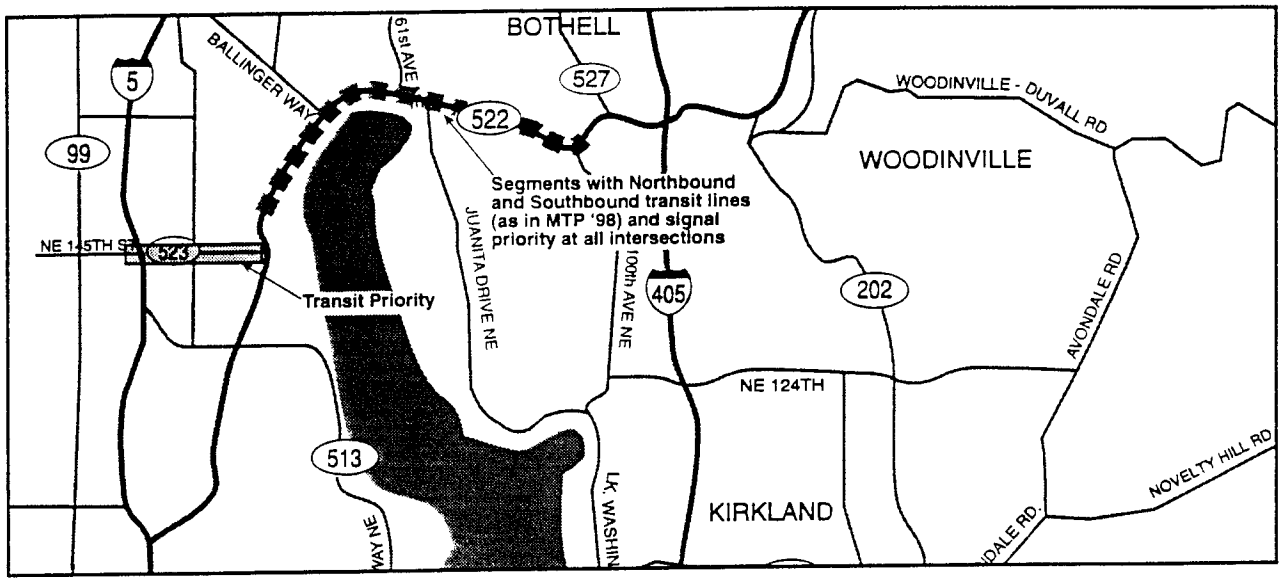


- Where light rail service coincides with Regional Express and Local Bus Services, bus routes will feed to light rail for Trans-Lake crossings. Other routes and service levels would be the same as MTP.
- TDM and land use programs are the same as MTP.
- Neighborhood Enhancements, Mitigation, and Non-Motorized facilities remain to be determined.

Revised March 15, 1999

Trans-Lake Washington Study

Discussion Draft 3.12.99



As in No Action, the SR 522 corridor would have two general purpose lanes in each direction, with a transit-only lane northbound from NE 16th Street to 73rd Avenue NE (just east of Juanita Drive NE/68th Avenue NE), and a southbound transit-only lane from 73rd Avenue NE to SR 523 (NE 145th Street).

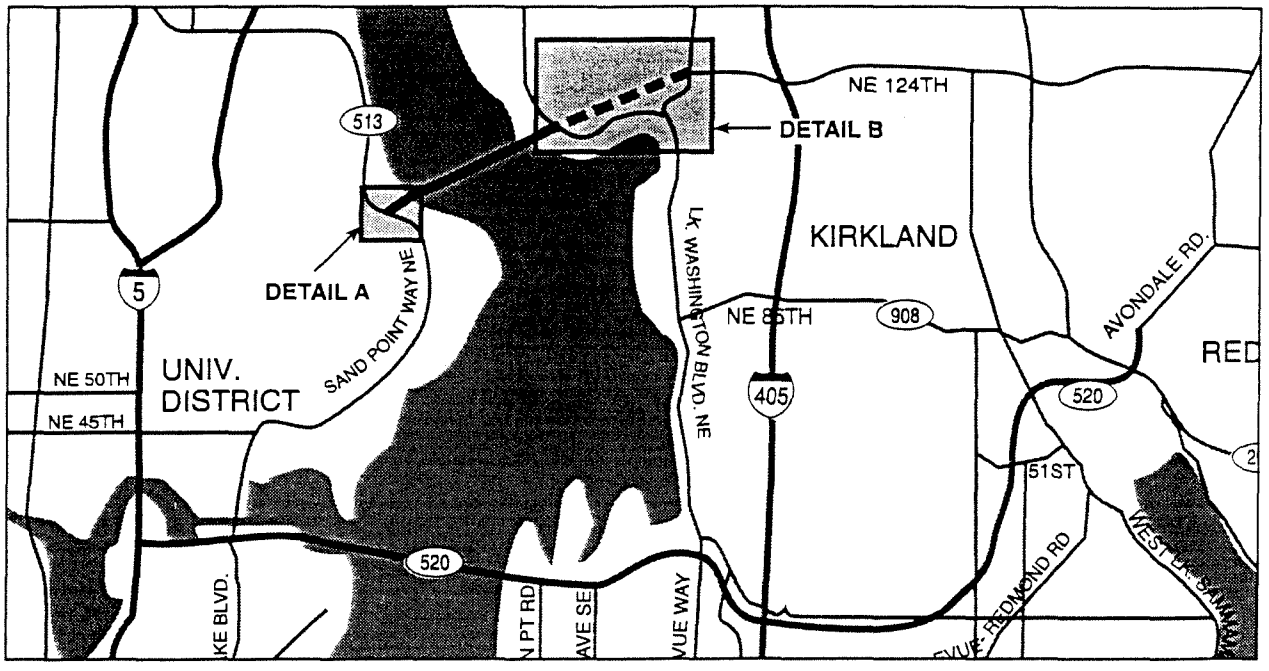
As in MTP '98, the transit-only lane would be extended from 73rd Avenue NE to downtown Bothell. In addition, traffic signals would give transit vehicles priority along SR 523 and on SR 522 from SR 523 to I-405.

New Crossing

SR 522 with Transit Priority and Transit Bypass Lanes, and SR 523 with Transit Priority

Trans-Lake Washington Study

Discussion Draft 3.15.99



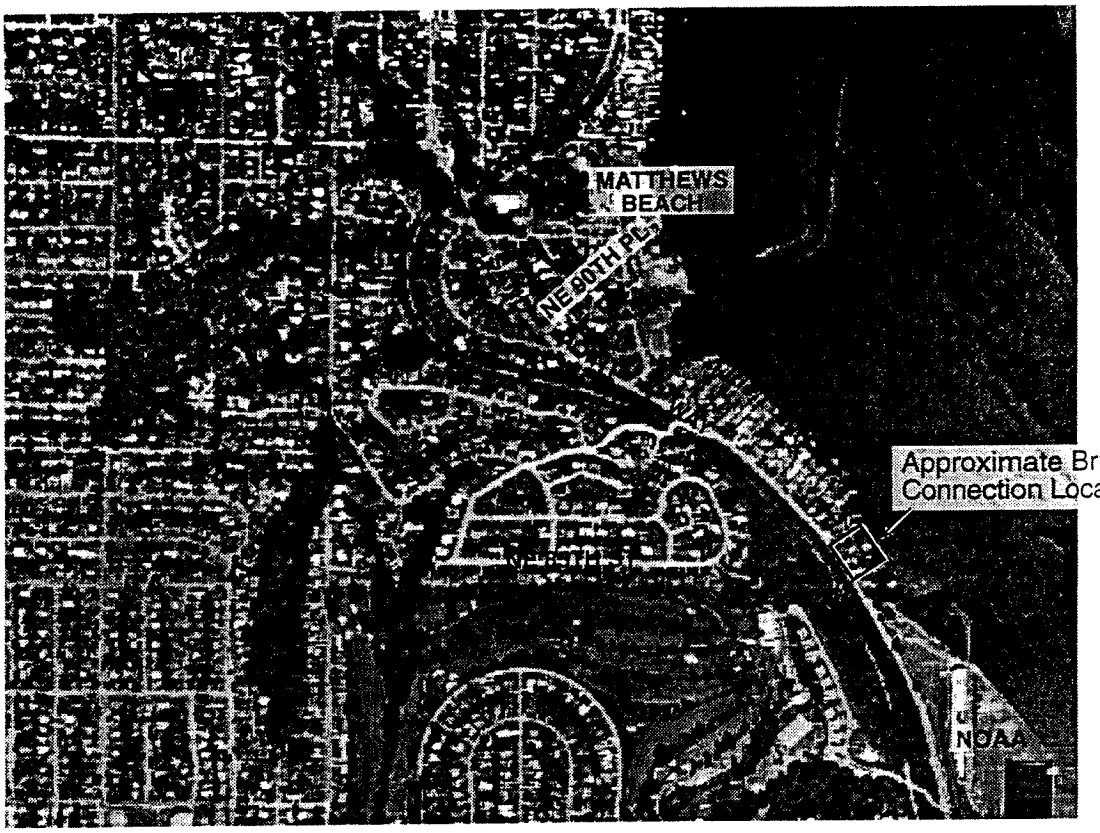
A four-lane arterial connecting Sand Point Way in Seattle, just north at the NOAA facility, and NE 124th Street in Kirkland. A floating bridge would be required, which would also provide a crossing for light rail. A tunnel would be used on the Eastside, to provide the right-of-way needed for the arterial and light rail, in a connection to NE 124th Street. The Seattle side connection is shown in Detail A, and Detail B shows the Eastside portals and connection. Segments of Sand Point Way and NE 124th Street would need to be widened.

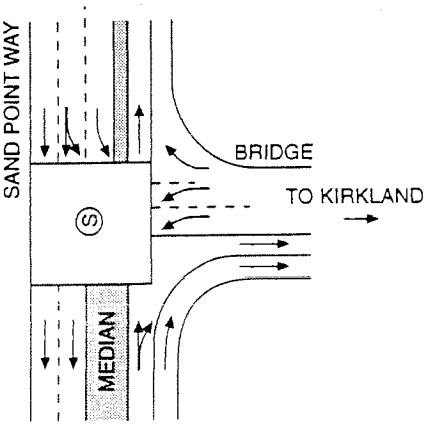
New Crossing

Kirkland to Sand Point Arterial

Trans-Lake Washington Study

Discussion Draft
3.12.99





New Crossing

Kirkland to Sand Point Arterial

Detail A (Arterial connection to Sand Point Way)

Trans-Lake Washington Study

Discussion Draft
3.12.99

A Tunnel connection between
124th Avenue NE to
Potential NE 124th St
Tunnel Portal Location

Potential tunnel portal would be below
NE Juanita Drive and would transition to an
elevated structure and then to a Floating Bridge

NOT TO SCALE

N

New Crossing

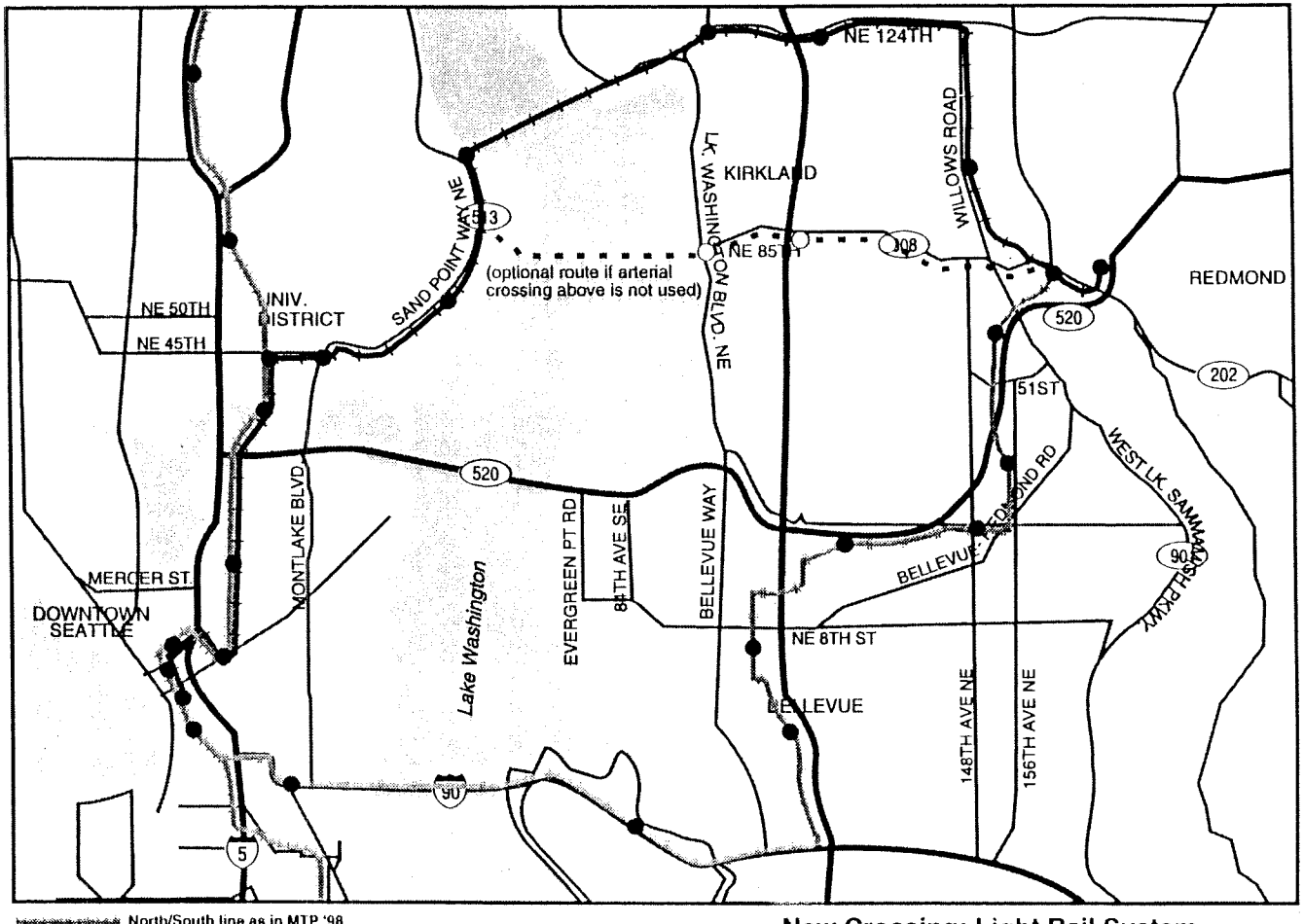
Kirkland to Sand Point Arterial
Detail B (Eastside Tunnel Portals and Connections)

Trans-Lake Washington Study

Discussion Draft 3.12.99

Downtown Seattle to Downtown Bellevue to Redmond. From Downtown Seattle the route is on the I-90 center roadway, and from I-90 to Bellevue is generally near I-405, using arterials and the BNSF right-of-way to the Bellevue Transit Center. Leaving downtown Bellevue, the route crosses to the east side of I-405 and then follows BNSF, existing roadways, and sections of new right-of-way to the south side of SR-520. The route is then generally near SR 520, with some sections along arterial roadways until near NE 51st, then continuing to Redmond along a combination of new, BNSF and arterial rights-of-way. Eastside stations would be at Mercer Island, Wilburton, Bellevue Transit Center, Northup, Overlake, Microsoft, NE 51st Street, Redmond Town Center and Bear Creek.

Downtown Seattle to University District to Kirkland to Redmond. From Downtown Seattle the route would coincide with the North line, under Capitol Hill to the University District. The route would then branch east in a tunnel under the UW campus to NE 45th Street near University Village. The route would continue along SR-513 (Sand Point Way NE) to approximately NE 85th Street. The alignment would turn east to a floating structure (also used by the arterial crossing alternative in this solution set) across Lake Washington, and land near Juanita Drive NE. The alignment would proceed northeast in a tunnel and then on arterials to the BNSF right-of-way and, proceed to Redmond. North Seattle and Eastside stations would be at Pacific, University Village, Sand Point/NOAA, Juanita, Totem Lake, Willows, Redmond Town Center and Bear Creek. (An alternative alignment, if an arterial crossing is not used, would place the bridge south of Magnuson Park and would cross to downtown Kirkland, then follow SR-908 (NE 85th Street) to Redmond. Stations on east side would include Downtown Kirkland, Rose Hill, and 140th Avenue NE, Redmond Town Center, and Bear Creek.



North/South line as in MTP '98

NOTE: Example routes proposed for evaluation purposes only. Future route decisions may vary.

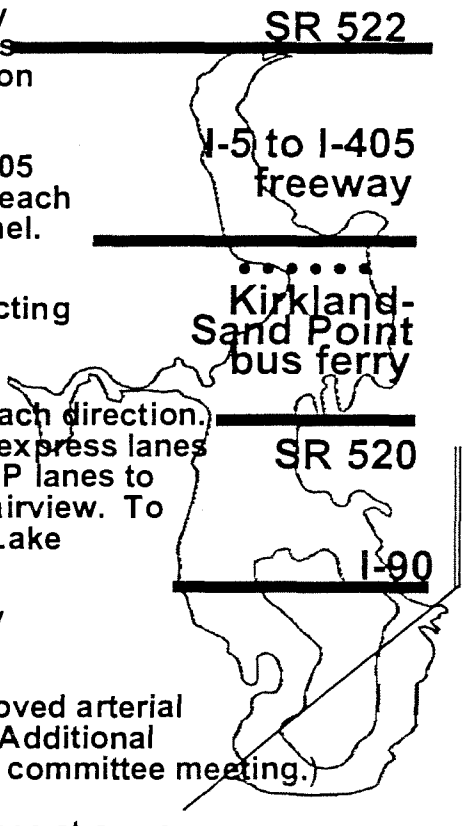
New Crossing: Light Rail System

- Downtown Seattle to Downtown Bellevue to Redmond
- Downtown Seattle to University District to Kirkland to Redmond

Last Revised: 03/16/99

Roadway/Bus: Key Elements

- SR 522 includes an HOV lane each way from I-405 to SR 523, grade separations at two intersections, and an HOV lane on SR 523. (Details follow.)*
- A new freeway connection between I-405 and I-5. Provide two GP and one HOV each way; Freeway assumed to be in a tunnel. (Details follow.)
- A bus and passenger only ferry connecting Kirkland to Sand Point. (Details follow.)
- SR 520 adds one HOV and one GP in each direction. At I-5, HOV lanes would connect to I-5 express lanes (which would operate two-way). The GP lanes to arterials in U. District and at Mercer/ Fairview. To the east, GP and HOV terminate at W. Lake Sammamish Blvd. (details follow.)
- I-90 would have continuous 2-way HOV operations on the center roadway.
- In Bellevue, on 148th Avenue NE, improved arterial connection between SR 520 and I-90. (Additional information to be provided at March 24 committee meeting.)
- Regional Express and Local Bus Services at same levels as MTP, with restructuring to provide feeder service to SR 520 corridor and continue express bus routes on I-90.
- TDM and Land Use programs the same as MTP
- Neighborhood Enhancements, Mitigation, and Non-Motorized facilities remain to be determined.

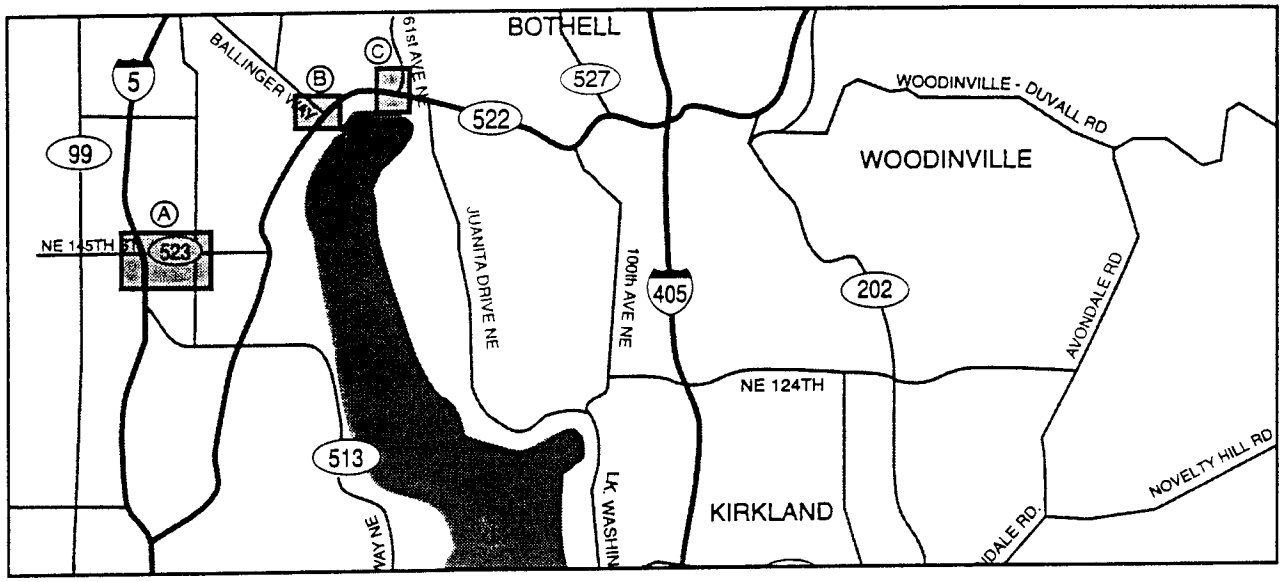


Revised March 17, 1999

* *SR 522 improvements described incorrectly in March 15 version.*

Trans-Lake Washington Study

Discussion Draft 3.12.99



Interchange Improvement Diagram provided

The SR 522 corridor would have two general purpose lanes in each direction, with HOV lanes added from I-405 to SR 523(assumed as an outside HOV lane). On SR 523, HOV lanes would be added, with a direct-connection ramp to I-5 HOV lanes(Detail A). Grade separations would be provided on SR 522 at SR 104 (Detail B) and 61st Avenue NE(Detail C).

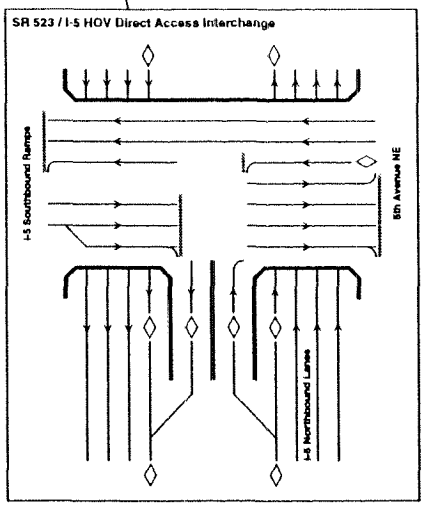
Roadway/Bus

SR 522 and 523 with HOV lanes

Trans-Lake Washington Study

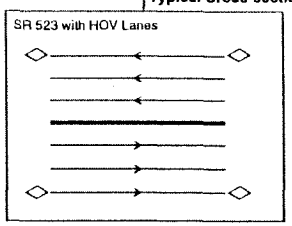
Discussion Draft 3.12.99

SR 523 / I-5 HOV Direct Access Interchange



Typical Cross-section

SR 523 with HOV Lanes



NOT TO SCALE

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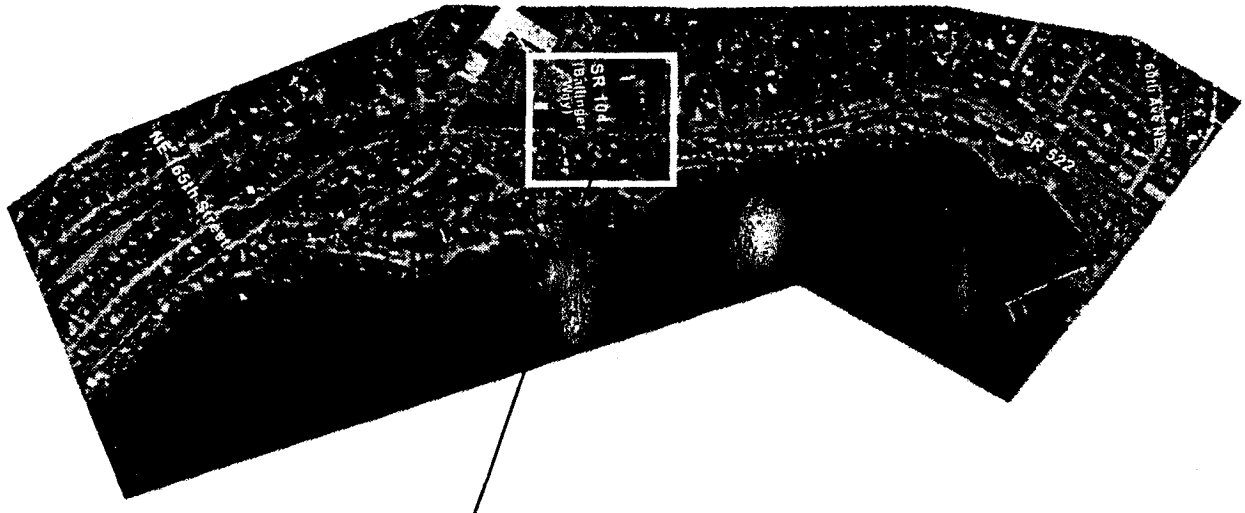
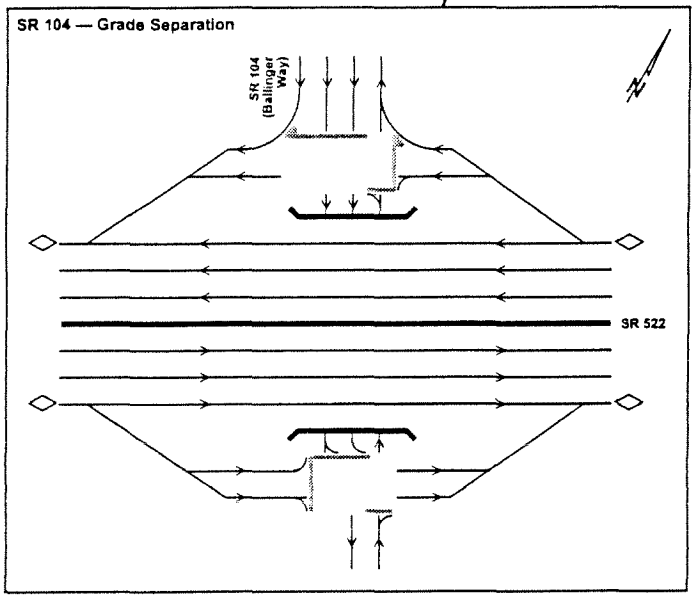
Roadway/Bus

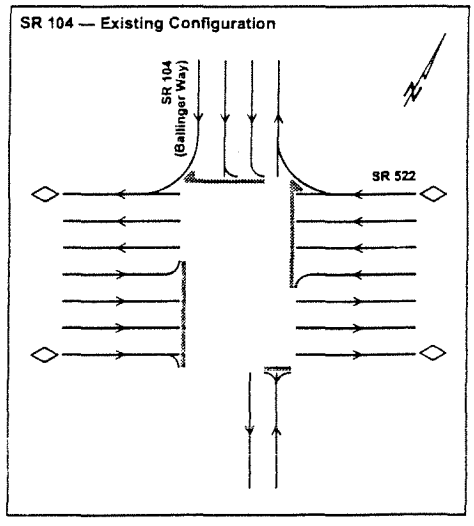
SR 522 and SR 523 with HOV Lanes
Detail A (SR 523 Segment)

Trans-Lake Washington Study

Discussion Draft
3.12.99







NOT TO SCALE

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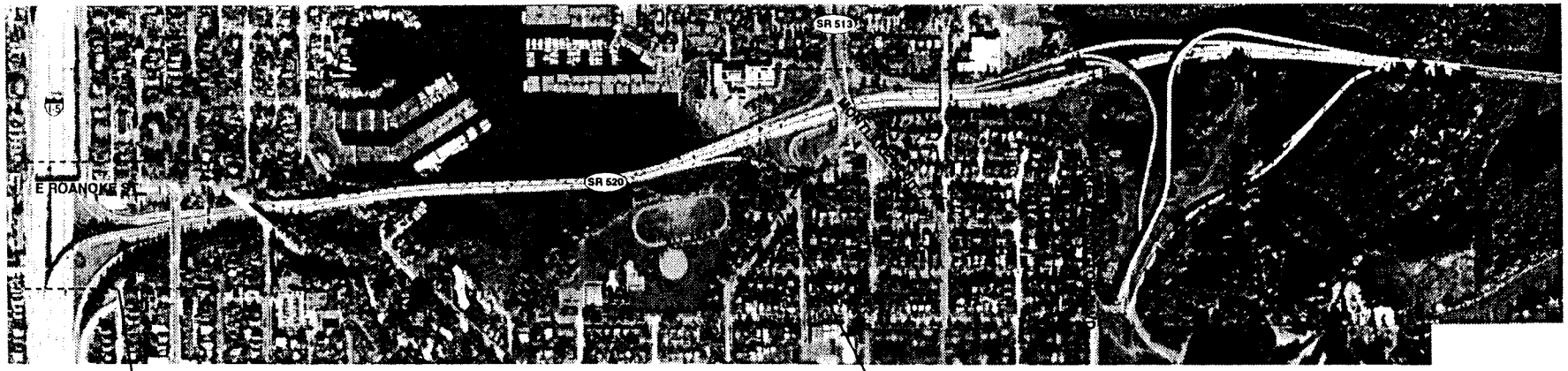
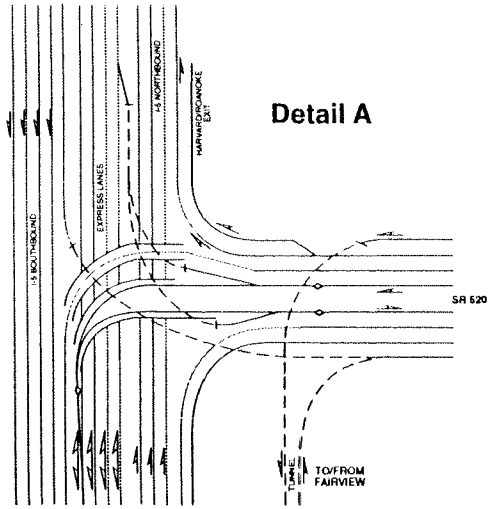
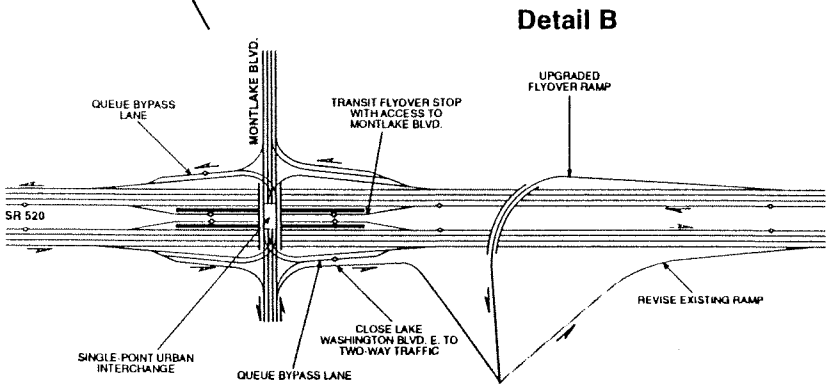
Roadway/Bus
SR 522 and SR 523 with Grade Separation
Detail B (SR 522 Grade Separation at SR 104)

Trans-Lake Washington Study

Discussion Draft 3.12.99







NOT TO SCALE

N

Roadway/Bus
SR 520 with added HOV and General Purpose
Details A and B (I-5 to Lake Washington)

Trans-Lake Washington Study

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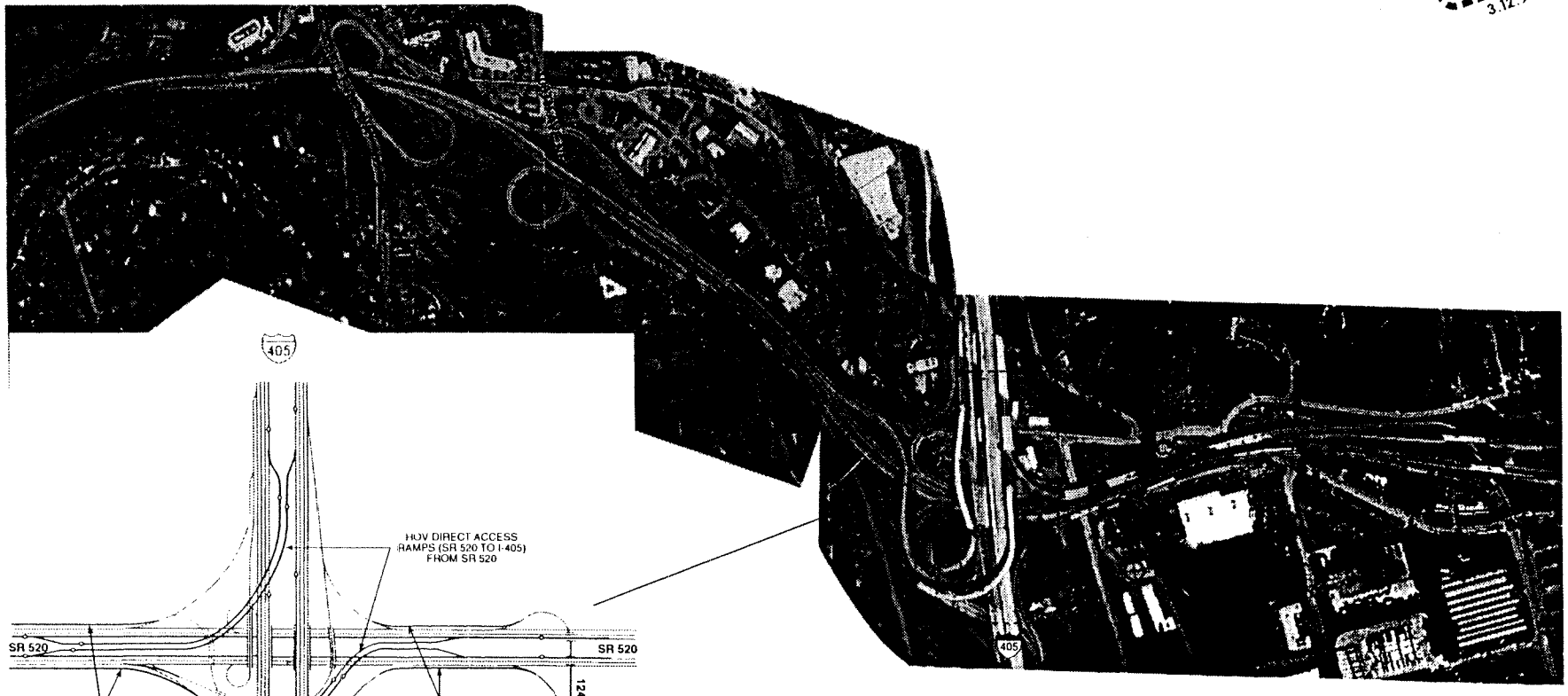
3.12.99

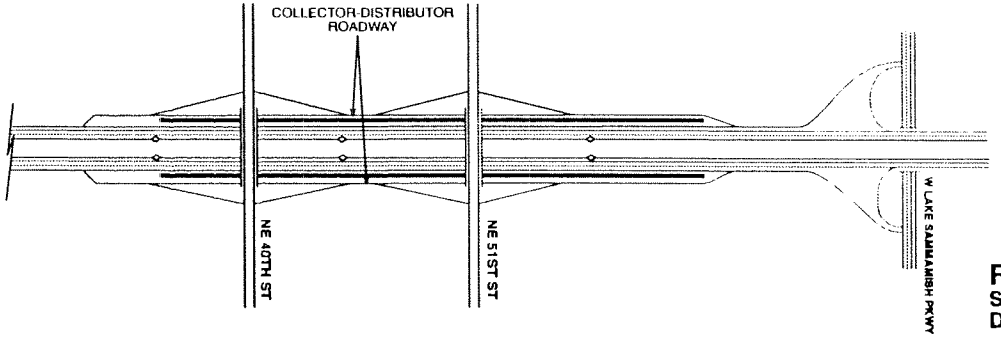


Roadway/Bus

SR 520 with Added HOV and General Purpose Lane
Detail C (Lake Washington to 124th Ave NE)

Trans-Lake Washington Study

Discussion Draft 3.12.99



NOT TO SCALE

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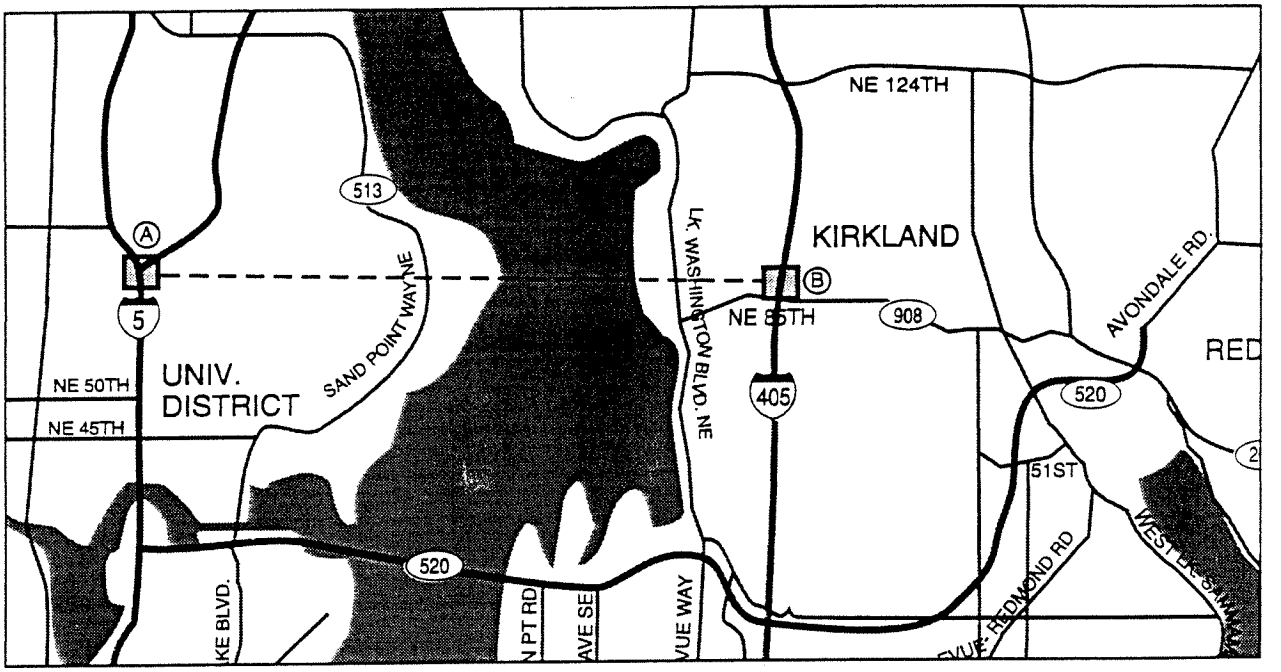
Roadway/Bus
SR 520 with added HOV and General Purpose Lanes
Detail D (124th NE to West Lake Sammamish Parkway)

Trans-Lake Washington Study

Discussion Draft 3.12.99



New 6 lane Freeway - I-5 to I-405
(Tunnel Option)

• 2 GP lanes and 1 HOV lane in each direction

I-5 Connections (Detail A)
- Direct reversible connection for WB HOV to SB Express lanes and NB Express lanes to EB HOV
- GP conections to/from I-5 mainline North and South
- Collector-distributors between NE 70th St area and NE 85th St along I-5

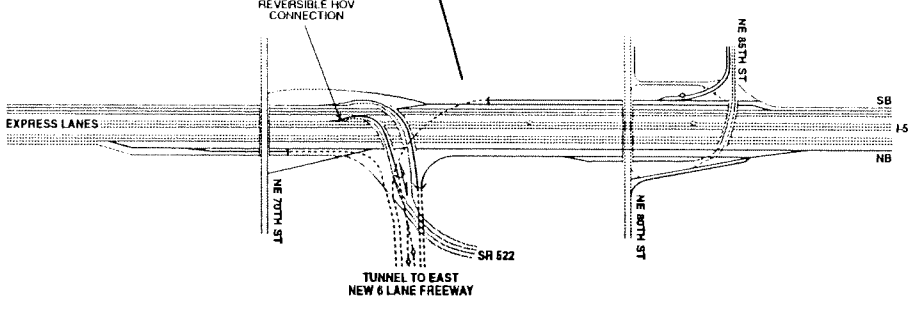
I-405 Connections (Detail B)
- Direct HOV to HOV connections; all directions
- GP connections to/from I-405 mainline North and South
- 2 lane collector-distributor from NE 70th St. Interchange through NE 85th St.

SR 513
- On-off ramps at SR 513 to/from the South

Roadway/Bus
New 6 Lane Freeway
I-5 to I-405

Trans-Lake Washington Study

Discussion Draft 3.12.99



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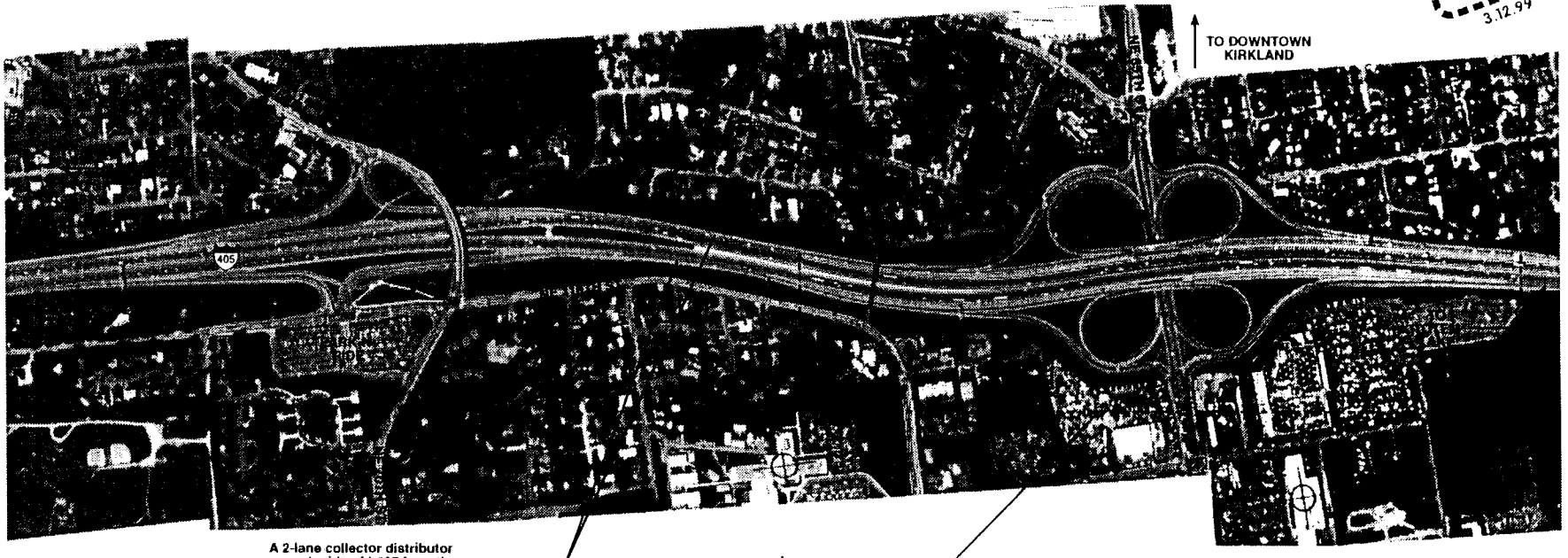
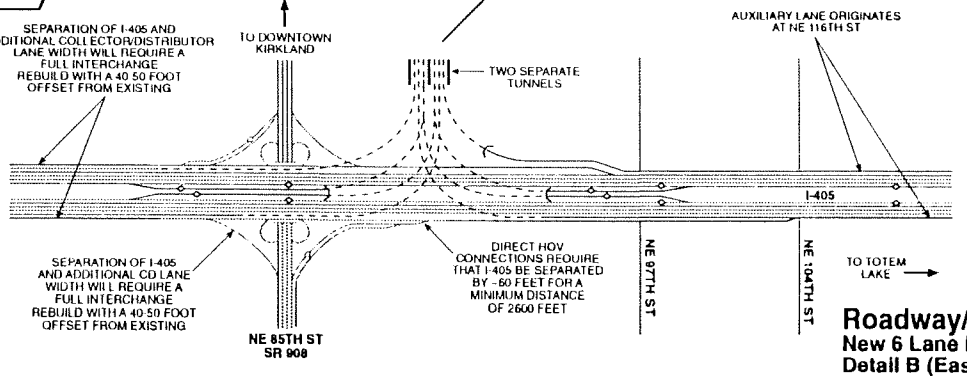
Roadway/Bus

New 6 Lane Freeway, I-5 to I-405
Detail A (I-5 Tunnel Portal)

Trans-Lake Washington Study

Discussion Draft 3.12.99





NOT TO SCALE

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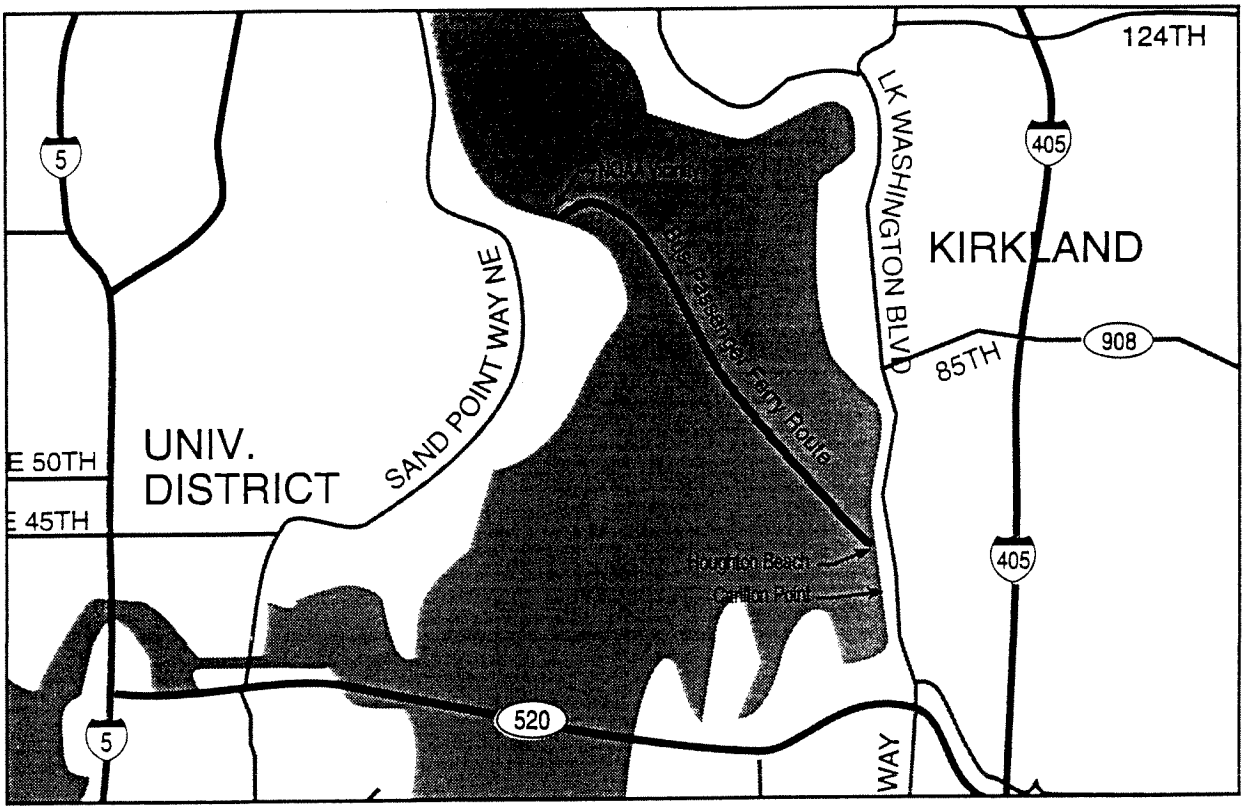
Roadway/Bus

New 6 Lane Freeway, I-5 to I-405

Detail B (Eastside Terminus)

Discussion Draft 3.12.99



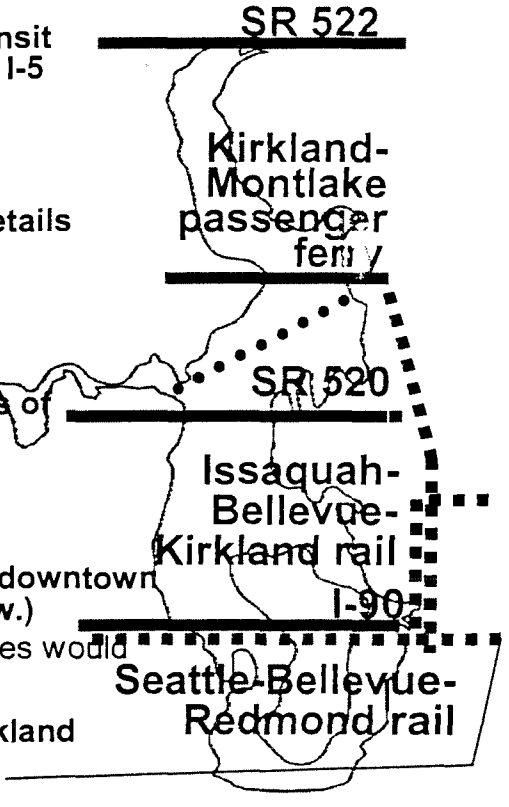
Bus transit and passenger service would be provided between Kirkland and Sand Point with continued transit service to the University of Washington.
In Kirkland, potential sites would be near Houghton Beach Park/Carillon Point off of Lake Washington Boulevard and is located approximately 1 mile south of the Kirkland City Center. The Seattle landing is assumed near the Sand Point NOAA Facility, at the north end of Sand Point near the National Oceanic and Atmospheric Administration (NOAA) offices, near Sand Point Way. Crossing times would be approximately 20 minutes, with frequencies of 30 minutes at peak periods. Loading and unloading times, and travel times on transit between a traveler's start and end points would be factors for average travel time.

Roadway/Bus: Bus-Passenger Ferry Route

Kirkland - Sand Point Bus and Passenger Ferry

Maximize Alternatives: Key Elements

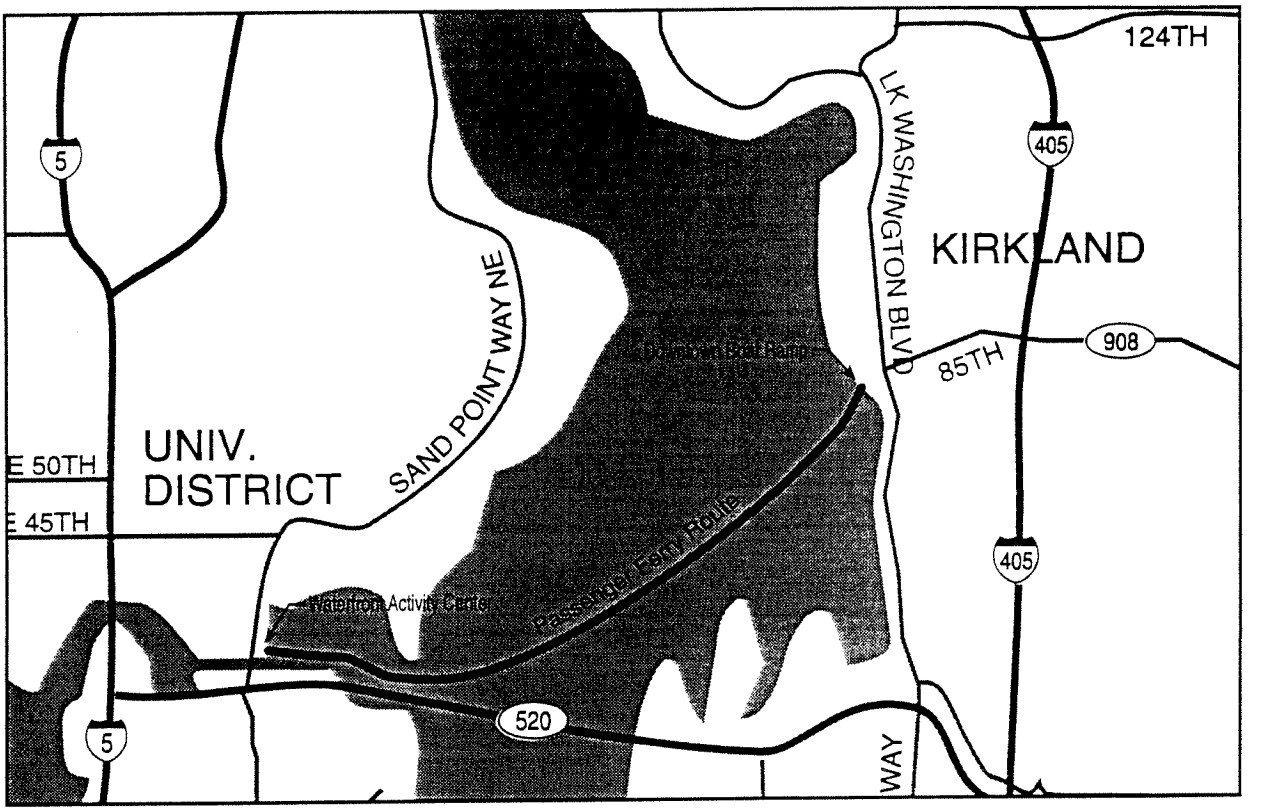
- SR 522 Adds Transit Lanes and Transit Priority Improvements from I-405 to I-5 (same as MTP)
- Passenger-only ferry connecting downtown Kirkland to Montlake. (Details follow.)
- At the system level, SR 520 will be considered as defined in No Action with no new HOV lanes. The effects of converting one GP to HOV in each direction will be examined as a separate option.
- Light rail from downtown Seattle to downtown Bellevue to Redmond. (Details follow.)
  - Forecasts assume I-90 center lanes would be replaced by rail.
- Issaquah-Bellevue to downtown Kirkland rail (Details follow.)



- Where light rail service coincides with Regional Express and Local Bus Services, bus routes will feed to light rail for Trans-Lake crossings. Other routes and service levels would be the same as MTP.
- Very aggressive TDM programs and land use plans to support shifts from single-occupant vehicle use. Includes use of congestion-pricing measures. (Details in TDM discussion paper.)
- Neighborhood Enhancements, Mitigation, and Non-Motorized facilities remain to be determined.

Revised March 15, 1999

Trans-Lake Washington Study



Passenger-only service would be provided between Kirkland and the University of Washington. In Kirkland, the Downtown Boat Launch is the assumed landing, which is adjacent to downtown commercial and residential areas. In Seattle, the University of Washington Waterfront Activities Center (WAC) is assumed, which is located immediately east and adjacent to Husky Stadium, and within walking distance of the Campus Sports facilities, the Health Sciences Complex, and the Central Campus. Crossing times would be approximately 25 minutes, with frequencies of one hour at peak periods. In considering door-to-door travel times, wait time, transit transfer, and walking time would be factors.

Maximize Alternatives: Passenger Only Ferry Route

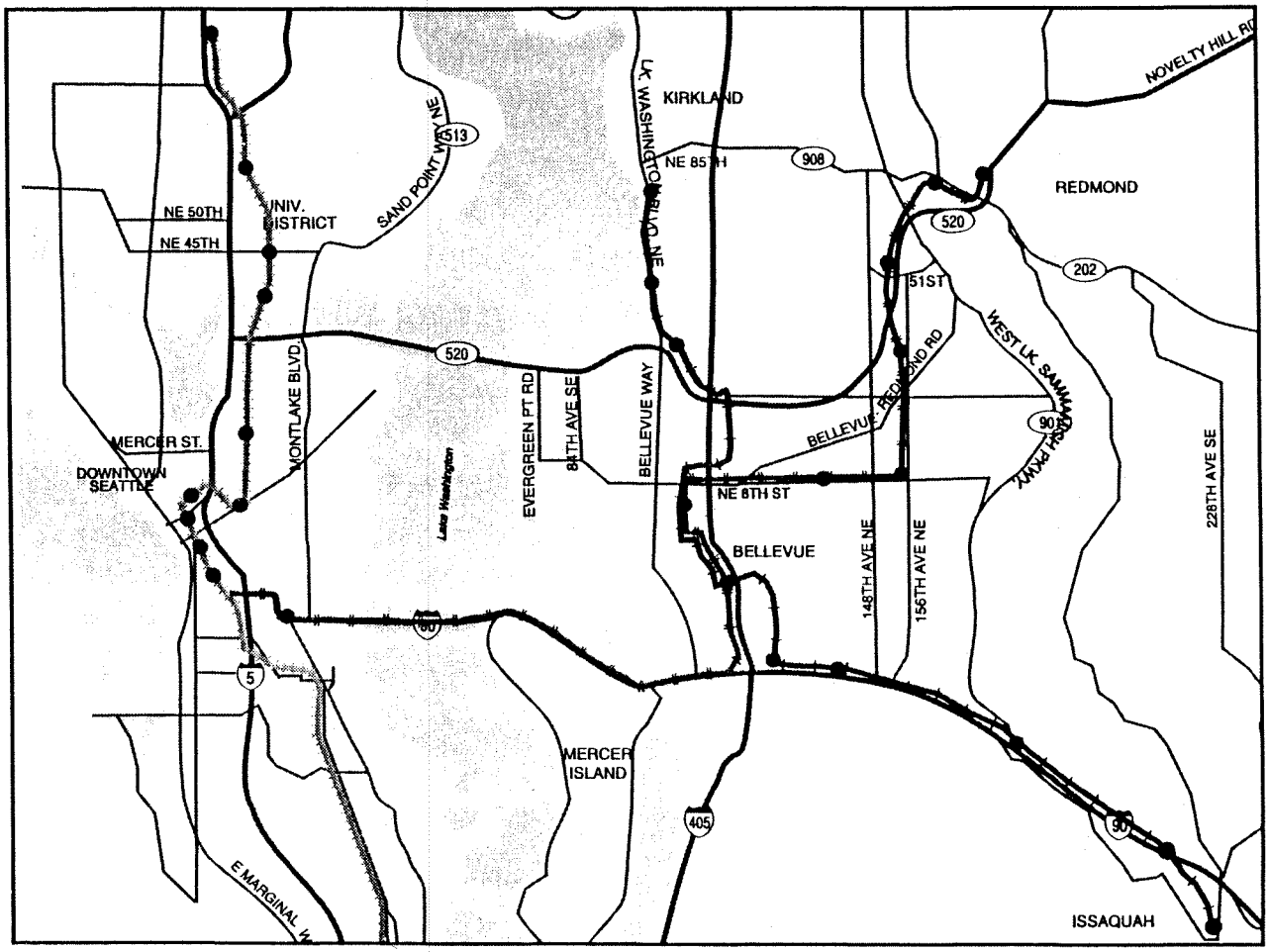
Downtown Kirkland to University of Washington

Last Revised: 03/15/99

Trans-Lake Washington Study

Downtown Seattle to Downtown Bellevue to Redmond. The route is along the I-90 center roadway to South Bellevue. Fromand then is generally near I-405, using arterials and the BNSF right-of-way to the Bellevue Transit Center. From downtown Bellevue to Overlake, the route is generally along NE 8th Street to Crossroads, and along 156th Avenue NE from Crossroads to SR-520. The route continues to Bear Creek, ending south of NE Union Hill Road on the west side of SR-520. Eastside stations would be at Mercer Island, Wilburton (transfer to Issaquah-Kirkland line), Bellevue Transit Center (transfer to Issaquah-Kirkland line), Bellevue East, Crossroads, Overlake, Microsoft, NE 51st Street, Redmond Town Center and Bear Creek.

Issaquah to Downtown Bellevue to Kirkland. The route would begin in Issaquah and then cross to the I-90 median to east of Richards Road. It would then follow arterials to SE 8th Street, and then turn north to reach the Bellevue Transit Center. It then crosses I-405 to reach the BNSF right-of-way, then follows NE Northup Way to SR-908 (Lake Washington Boulevard NE). It would then follow Lake Washington Boulevard NE to Kirkland Avenue. Stations would be at Downtown Issaquah, Issaquah West, Lakemont, Eastgate, Factoria, Wilburton (transfer to Seattle-Redmond line), Bellevue Transit Center (transfer to Seattle-Redmond line), South Kirkland, Houghton Beach, and Downtown Kirkland.



North/South line as in MTP '98

NOTE: Example routes proposed for evaluation purposes only. Future route decisions may vary.

Maximize Alternatives: Light Rail System

- Downtown Seattle to Downtown Bellevue to Redmond
- Issaquah to Downtown Bellevue to Kirkland

Last Revised: 03/15/99

Trans-Lake Washington Study

Appendix 3
Transportation Demand Management
Draft Approach

Evergreen Point Floating Bridge

Passenger Ferry/Bus Ferry Concepts Paper

Trans-Lake Tunnel Crossings Concept Paper

Executive Summary

The purpose of this report is to define the Transportation demand management (TDM) strategies that should be incorporated into Trans-Lake solution sets, and to assess the likely effectiveness of those measures. TDM strategies are targeted at managing or reducing travel demand rather than increasing the supply of transportation facilities. Six broad categories of TDM Strategies were examined as part of this report: TDM Support Infrastructure, Employer-Based Strategies, Vanpooling, Alternative Transportation Products and Services, Financial Disincentives to Driving Alone, and Land Use Strategies. For the Trans-Lake Study, a two-level strategy for incorporating TDM into the solution sets has been developed. The first or base level would only be included in all solution sets. The second, more aggressive level of TDM would be added to the Maximize Alternatives solution set.

The base level TDM strategy would include the following two basic elements:

(1) **A subregional agreement among all jurisdictions within the Trans-Lake study area to adopt performance goals for reducing travel.** This agreement would be implemented by amendment to local jurisdiction comprehensive plans, which would identify specific policies and actions to achieve those goals. Monetary incentives for jurisdictions meeting the SOV travel reduction goals would be provided for projects that promote alternative travel modes. The monetary incentives could be coupled with monetary penalties for jurisdictions failing to meet the SOV travel reduction goals or for jurisdictions failing to make reasonable progress towards meeting the goals. Each jurisdiction would be given the flexibility to implement TDM strategies appropriate to their specific situation. The potential effectiveness of each solution set is summarized in Table 1 and the specific TDM strategies to be considered for implementation are summarized in Tables 2 and 3 later in this document. These strategies would be used as a starting point for each jurisdiction to determine the specific strategies to implement. This process would require a new Memorandum of Agreement among Trans-Lake study area jurisdictions. This could also involve new State- or County-wide legislative action to formally establish the system for providing monetary incentives and enforcing monetary penalties.

(2) **Actively pursue regional and State actions to increase funding support for TDM activities.** Specific TDM strategies to pursue in this category include:

- Capital costs for additional vanpools.
- Operating cost subsidies for existing and future vanpool services.
- Increased subsidies to support business and occupation tax credits for implementing TDM programs.
- Funding for demonstration projects in the land use area to implement transit-oriented development or other innovative efforts.
- Funding for parking cash-out programs.
- Funding for possible expansion of the Commute Trip Reduction (CTR) program to include a greater number of employers.

TABLE 1. ESTIMATED TRIP AND VMT REDUCTION FOR EACH SOLUTION SET COMPARED TO NO ACTION.

Solution Set	VMT Reduction	Peak Period Travel Reduction	Daily Travel Reduction
MTP '98	3 to 5%	2 to 4%	1 to 3%
MTP Flipped	3 to 5%	2 to 4%	1 to 3%
Roadway-Rail	1 to 2%	0 to 1%	0 to 1%
New Crossings	1 to 2%	0 to 1%	0 to 1%
Roadway-Bus	0	0	0
Maximize Alternatives	Up to 20%	Up to 15%	Up to 10%

The second level of TDM strategies would include all of the strategies contained in the base package, plus the following additional strategies:

1. Expanding CTR to include all employers, regardless of size.

2. Establishing a dedicated funding source for a greatly expanded vanpool program to fund additional vehicles and subsidize operating costs.

3. Implementing free or reduced cost rail and/or bus service on Trans-Lake Washington corridors.

4. Implementing two specific financial disincentives to driving alone:

   - Increased parking costs within all study area employment centers by $0.50/hour. Regional or local legislative action would likely be required to implement this strategy.

   - Congestion pricing on all existing Trans-Lake corridors (I-90, SR-520, SR-522). This system would be implemented using automatic vehicle identification transponders to identify and record the presence of a vehicle at a single location on each roadway. This system would also record the time when a vehicle was passing over this location to allow for higher charges during congested time periods. HOVs in this system would be charged a greatly reduced fee or not be charged at all. A base charge of $1.00/trip was assumed with higher charges up to $5.00/trip during peak travel periods. To balance demand among the three Trans-Lake corridors, different prices could be charged on each corridor.

The effectiveness of the two TDM strategy levels was estimated and compared to the No Action Solution Set. With the No Action Solution Set, there would continue to be some emphasis on TDM strategies similar to existing programs currently in place. Effectiveness of the base TDM strategy level varies among the solution sets. The base level TDM package results in lower trip and VMT reductions compared to No Build for solution sets with additional general purpose vehicle capacity. With the second level of TDM strategies added to the Maximize Alternatives solution set, trip and VMT reductions increase substantially. Table 1 summarizes the potential trip and VMT reduction estimates for each solution set compared to the No Action solution set.

Introduction

Transportation demand management (TDM) strategies are targeted at managing or reducing travel demand rather than increasing the supply of transportation facilities. They may include programs to shift demand from single-occupant vehicles to other modes such as transit and ridesharing, to shift demand to off-peak periods, or to eliminate the demand for the trip altogether. This memo lays out a two-level strategy for TDM. The first or base level would be included in all the solution sets. The second level would be added to the base strategies for the Maximize Alternatives Solution Set.

TDM is not new to the region or to the Trans-Lake Washington study area. The 1995 Metropolitan Transportation Plan assumes an aggressive TDM program that would accomplish a substantial reduction in the rate of growth in vehicle trips over the next two decades. However, the region is still moving toward actually identifying, implementing and funding all the envisioned programs. In November 1998 a TDM Action Strategy was endorsed by the Regional Council's Transportation and Growth Management Policy Boards as the framework to guide the region's efforts in TDM. Regional transportation staff developed this strategy over the past two years. As the introduction to their strategy states " The next step is to develop a work program to carry the strategy forward". Including these strategies in the Trans-Lake solutions is one way of moving these strategies from theory to reality. If TDM strategies are not implemented, regional traffic delays are anticipated to be considerably worse than is forecasted by the MTP.

Comprehensive land use plans that promote development patterns that reduce land consumption, vehicle trips and air pollution are a key TDM strategy. This pattern of spatial development, along with supportive design guidelines and zoning regulations, is what we call " land use" as a TDM strategy.

Land use within the study area is planned and regulated by the various local governments within the study area. Each city and town has a comprehensive land use plan and map which describes how it desires growth and redevelopment to occur over the next 20 years. These plans were prepared in the 1994-5 timeframe to comply with the state's Growth Management Act requirements. Overarching the local plans is the Puget Sound Regional Council's *VISION 2020 1995 Update*, which established the generalized vision for growth management and transportation for the entire central Puget Sound region. Nesting inside of VISION 2020 but also overarching the local government plans within the Trans-Lake Study Area are King County's Countywide Planning Policies. Any Study Committee recommendations about revisions to VISION 2020 and Countywide Planning Policies would need to be adopted by PSRC and King County; recommendations about revisions to local land use plans and regulations would need to be implemented by the local jurisdictions in the study area.

The Growth Management Act allows amendments to be made to comprehensive plans no more frequently than once a year. The first major revision cycle is coming up in the next several years. GMA requires that no later than September 1, 2002, King County must review and evaluate how growth has actually occurred versus what the various local plans envisioned for the county, and based on its findings, propose amendments to the county-wide planning policies and city comprehensive plans. Also by September 1, 2002, the cities must review and, if needed, revise their comprehensive plans and regulations. As part of this upcoming review, the local governments must calculate their buildable lands and determine whether there are sufficient suitable lands to accommodate the countywide housing and employment projections. They must also determine the actual density of housing that has been constructed and the actual amount of land developed for commercial and industrial uses within the urban growth area since the adoption of the plans. These data will answer many of the questions about whether the densities discussed below are achievable under current zoning, or whether rezoning would be

required. A copy of a future housing density map reflecting information in local comprehensive plans is included as an attachment to this report.

The upcoming review cycle for VISION 2020, the Countywide Planning Policies and the local comprehensive plans is fortuitous because it means that any TDM and land use strategy recommendations made by the Study Committee will be timely—being made at the beginning of the review cycle. The Study Committee recommendations could be packaged in the form of a recommendation that local governments include a transportation demand management element in their revised comprehensive plans to meet a performance goal such as automobile VMT or trip reductions. With this requirement, local governments would be given the flexibility to implement a tailored package strategies specific to their community. For example, Oregon law now requires in Metropolitan Planning Areas of more than 1 million population that plans be designed to achieve a 10 percent reduction in automobile vehicle miles traveled per capita by the end of a 20 year planning period. Alternative performance standards are also allowed under certain conditions.

To facilitate the discussion in this document, TDM strategies have been organized into the following categories:

- TDM support infrastructure and public mode support measures
- Vanpooling
- Employer-based strategies
- Alternative transportation products and services
- Financial disincentives to driving alone
- Land use strategies

All of these strategies would be available to local jurisdictions for implementation.

Base TDM Level (Applies to MTP '98, MTP Flipped, Roadway/Rail, New Crossings, and Roadway/Bus Solution Sets)

At the base TDM level, existing TDM programs and facilities and planned strategies that are reasonably foreseeable are assumed to be in place throughout the Trans-Lake study area. All of the ongoing TDM activities throughout the Trans-Lake study area would continue, including CTR. This base level is very similar to the strategies included in the MTP. In addition, the base level TDM strategy would include the following basic elements: (1) **A subregional agreement among all jurisdictions within the Trans-Lake study area to adopt performance goals for reducing travel.** This agreement would likely be part of local jurisdiction comprehensive plans. Monetary incentives for jurisdictions meeting the SOV travel reduction goals to provide increased funding for projects that promote alternative travel modes. The monetary incentives could be coupled with monetary penalties for jurisdictions failing to meet the SOV travel reduction goals or for jurisdictions failing to make reasonable progress towards meeting the goals. Each jurisdiction would be given the flexibility to implement TDM strategies appropriate to their specific situation. A description of individual TDM strategies, along with estimated effectiveness, are provided later in the document. A list of possible strategies and potential effectiveness is summarized in Table 2. These strategies would be used as a starting point for each jurisdiction to determine the specific strategies to implement. This process would require a new Memorandum of Agreement among Trans-Lake study area jurisdictions. This could also involve new State- or County-wide legislative action to formally establish the system for providing monetary incentives and enforcing monetary penalties. (2) **Actively pursue regional and state actions to increase funding support for TDM activities.** Specific TDM strategies to pursue in this category include:

- Capital costs for additional vanpools.
- Operating cost subsidies for existing and future vanpool services.
- Increased subsidies to support business and occupation tax credits for implementing TDM programs.
- Funding for demonstration projects in the land use area to implement transit-oriented development or other innovative efforts.
- Funding for parking cash-out programs.
- Funding for possible expansion of the Commute Trip Reduction (CTR) program to include a greater number of employers.

Many of the TDM elements at this level are consistent with the Adopted TDM Action Strategy for the Central Puget Sound Region developed by the Regional TDM Advisory Committee (November 1998). The following generally describes the specific optional elements included in the Base TDM level.

TDM Support Infrastructure and Public Mode Support Measures

Description

The TDM support infrastructure varies among the five solution sets with the Base TDM Level. Any transit facility or service improvements, HOV lanes, and nonmotorized facilities included in these strategies are important to provide alternatives to single-occupant vehicle travel. These facilities and other support measures are the backbone of any comprehensive TDM strategy.

Implementation

TDM support infrastructure is implemented by local jurisdictions, often in conjunction with federal or statewide agency cooperation and grant money. In some cases, state or regional agencies are the implementing agency. One method to ensure increased and regular funding for these types of projects would be to establish a regional commitment for using a dedicated portion of federal Nextea money.

Vanpooling

Description

This TDM strategy has been one of the most successful strategies over the last 20 years. There is potential for additional growth, particularly in suburban areas with lower levels of transit service. Vanpooling in the Trans-Lake study area could be expanded in many ways, including incentives and financing programs for additional owner-operated vanpools; increased marketing and promotion of vanpool services; and, organizing a regional or subregional vanpool operators consortium to provide cooperative van maintenance, driver training and insurance premiums. The different solution sets would have a somewhat different emphasis on expanding current vanpooling activity and programs. Solutions sets with added HOV facilities on Trans-Lake corridors such as the MTP or MTP Flipped Solution sets would be the best candidates for an increased vanpooling emphasis.

Implementation

An expanded vanpool program would most likely be implemented by local transit operators with support from local jurisdictions and private sector employers. A state or regional funding source could be established to subsidize capital and operating costs.

Employer-Based Strategies

Description

This category includes numerous individual strategies, many of which are implemented as part of the State CTR requirements or as conditions of approval for development projects. Strategies in this category include transportation management associations; alternative work schedules; parking management; facility amenities (bicycle parking, showers, and pedestrian walkways); carpool, vanpool, and transit subsidies; and guaranteed ride home programs. CTR is assumed to continue to be applicable for employers with 100 or more employees. The different solution sets would also have a different emphasis in this TDM category. Solutions sets with added rail transit facilities on Trans-Lake corridors would be complemented by transit shuttles between major employment/residential centers and rail stations and pedestrian-oriented development around station areas. Solution sets with added HOV facilities would be complemented by carpool, vanpool, and transit subsidies and guaranteed ride home programs.

Implementation

Employer-based programs are primarily implemented through CTR and local jurisdiction development regulations. CTR is monitored by local transit operators with support from local jurisdictions. Implementation of a higher level commitment to TDM would be achieved through a required trip reduction element in local comprehensive plans. This would include specific trip reduction thresholds that are tied to regional transportation funding programs.

Alternative Transportation Products and Services

Description

This category includes any innovative TDM that may not have a long record of implementation success. Items in this category include car sharing, work location exchange programs, customized transit services, internet ride-matching, instant carpooling, and programs targeted for nonwork trips (shopping, recreation, and school trips). The base package of TDM strategies does not include any substantial dedicated funding for these types of strategies, however, some in-kind support for administrative and marketing costs could be available. Most of these strategies are oriented toward the solution sets with an emphasis on added HOV facilities.

Implementation

Funding for these innovative transportation products and services could be provided at the statewide or regional level on a demonstration project basis. This would be an effective method for the region to establish the cost-effectiveness of new strategies prior to implementing them on a more extensive basis.

Financial Disincentives to Driving Alone

The base TDM strategy does not include any financial disincentives to driving alone, except for possible transit or rideshare subsidies and modest parking charges in the major employment centers under employer-based strategies.

Land Use: Mixed Use Centers—Jobs/Housing Balance

Description

This strategy provides for a mixture of office, retail, commercial, and residential development within business districts and activity centers, all within walking distance of transit services. A compact center makes access and circulation more efficient. Where a diverse mix of uses exists, people are more likely to rely on transit, walking, carpools, or cycling as their transportation mode choice. Mixing uses allows several trips to be "chained." Ridesharers, transit users, bikers, and pedestrians are able to run errands from employment sites without reliance on automobiles. With housing located in the center, as well as nearby, some people will be able to walk to work.

Implementation

To achieve this mix, new comprehensive plan policies and zoning regulations that encourage complementary uses may have to be adopted by cities and towns in the Trans-Lake Study area to replace regulations that require single-use development. Rezoning near the centers to allow increased residential densities may also be needed. To ensure that density targets are met, the zone could also set minimum development densities.

Currently designated urban centers in the Trans-Lake Study Area are Bellevue downtown, Redmond downtown, and in Seattle—Northgate, University District, First Hill/Capitol Hill, and Seattle downtown. VISION 2020 suggests that urban centers have at least 10 dwellings per acre, and larger centers should have 15 or more dwellings per acre. (In comparison, LUTRAQ Mixed-Use Centers ranged from 12 to 50 units per acre.) VISION 2020 also suggests that each center have a minimum of 15,000 employees at 25 employees per gross acre. Currently, only the Seattle urban centers meet or exceed the VISION 2020 housing density guidelines. Neither Redmond, with plans to achieve housing density of 6.4 dwellings per acre in its urban centers, nor Bellevue, with plans to achieve housing density of 8.5 dwellings per acre in its urban center, will meet the VISION 2020 guidelines. Redmond Downtown, at plans for 20.2 employees per acre, will approach but not reach the employment density guideline of 25 employees per acre. Bellevue Downtown and the Seattle urban centers already meet the employee density guidelines.

Land Use: Transit-Oriented Development

Description

Transit-oriented development (TOD) means a mix of residential, retail, and office uses and a supporting network of roads, bicycles, and pedestrian ways focused on a major transit stop—all designed to support a high level of transit use. In the Trans-Lake Study Area, TOD would be situated around light-rail stations, express-bus stops, and ferry termini. Generally the retail uses would support the local commuter—dry cleaners, grocery store, drug store, day-care facilities, coffee shop. In TOD, design elements that encourage transit use are important. These include sidewalks and bike/jog trails separated

from roadways, well-marked pedestrian crossings, and a welcoming environment with human features such as shade trees and storefronts opening onto the street.

Implementation

Comprehensive plan policies and zoning regulations may have to be changed to require transit-friendly design around designated transit stations; an overlay zone with special design guidelines would be one way to ensure transit-friendly development.

Rezoning near the TOD center to allow increased residential densities may also be needed. To ensure that density targets are met, the zone could also set minimum development densities. For example, Oregon's LUTRAQ Project aimed for residential densities on average of 15 units per acre in TODs outside of mixed use centers, and densities on average of 8 units per acre in neighborhoods within 10 minutes by feeder bus of the TOD centers.

Public investments such as open space, parks, sidewalks, and bikeways in the near TOD centers would be another tool to encourage development/redevelopment that is transit-friendly. Local government preparation of sub-area plans for TOD centers with accompanying environmental review would both specify the kind of development wanted and make it easier/cheaper/faster for developers who propose projects that company with the subarea plans.

Land Use: Residential Density Increases

Description

A certain level of housing density is required before most modes of public transit can be cost effectively provided. At least one study suggests that transit usage may be insupportable below a threshold level of about 12 dwellings per net acre. Very little of the Trans-Lake Study Area is currently planned at the level of density. Increased density can be achieved by allowing mother-in-law apartments, accessory units, zero-lot line construction, smaller lots, flexibility in building on small infill lots, increased portion dedicated to multiple family development, and through planned unit developments.

Implementation

As suggested above in the discussion about urban centers and TOD centers, increased residential density is part of the formula for successfully moving people from SOVs to transit, bikes, and walking for work and nonwork trips. To accomplish increased densities, especially in those areas within easy access of rail, bus, and ferry lines, local governments within the Trans-Lake Study Area would need to revise their comprehensive plans and zoning regulations to allow some of all of the techniques mentioned above for increasing residential densities.

Land Use: Employment Center Density Increases

Description

Employment areas with enough employee density draw transit services, or conversely, major transit lines are good locations for employment centers. With convenient transit service, more employees go to work by transit. The relationship between employment density and mode choice is nonlinear, with little reduction in SOV mode share at densities of less than 30 employees per gross acre. SOV mode split

drops to less than 50 percent at employment densities of greater than 125 employees per gross acre. This type of employment center is tall buildings with substantial lot coverage. What it is not is the campus development and single-story office and manufacturing parks common to the study area.

Along with the increased employee density, transit use could be encouraged by increasing transit availability, link shuttles, and reduced parking availability/increased parking costs.

Implementation

VISION 2010 guideline suggest 25 employees per acre for urban centers. This should be revised upward to at least 50 employees per acre to achieve a transition from SOV to transit and other modes. VISION 2020 may also need to be revised to establish suggested densities for employment centers outside the urban centers. Local governments may have to revise comprehensive plan policies and zoning regulations to allow greater lot coverage, increase height allowances, and reduce parking requirements> Density minimums could be established to ensure that the employment center develops/redevelops at the intended density, and maximum parking spaces could be established to ensure that SOVs are not encouraged. Reducing minimum parking requirements would lower costs to the developer.

Estimated Effectiveness of Base TDM Strategies

The estimated effectiveness of both individual and combined packages of TDM strategies can be difficult to predict. This difficulty stems from the fact that empirical evidence on the cause and effect of demand management strategies is limited and there is little to no implementation experience on many of the strategies included in this analysis. The difficulty in predicting effectiveness for packages or groups of TDM strategies is further complicated by a lack of definitive evidence on how different combinations of TDM strategies work together. In some cases, the effectiveness of two TDM strategies can be added together. In other cases, the effectiveness of two strategies would be duplicative, resulting in little to no additional effectiveness when a second strategy is added.

Another difficulty associated with estimating effectiveness of a package of TDM strategies is that the resulting VMT or trip reduction effects can apply to a subarea, corridor, or the entire region. In addition, some strategies have the potential for reducing only work trips (approximately 20 percent of overall regional trips) while others apply to all trips made in a region. For these reasons, the implementation context must be carefully considered to avoid overestimating the effects from a package of TDM strategies.

Despite these limitations, estimated ranges of possible vehicle-miles traveled (VMT) or travel demand reductions have been prepared for each individual TDM strategy and are shown in Table 2. These estimates are largely based on prior work prepared by the Puget Sound Regional Council as part of the MTP and by the WSDOT Office of Urban Mobility in their "Guide for Including TDM Strategies in Major Investment Studies and in Planning for Other Transportation Projects," August 1996. Estimated qualitative cost ranges for implementing each strategy are also provided. Implementation costs for each strategy can vary widely depending on the size of the program and area of application.

In addition to the effectiveness estimates for individual strategies, Table 3 summarizes the base package of TDM strategies included in each of the solution sets and a combined range of effectiveness for each. The travel demand forecasts for the No Action solution sets already assume a base level VMT reduction over the next 20 years to reflect the effects of TDM. Therefore, TDM strategy effectiveness for other solution sets is expressed as a percent increase or decrease from the No Action solution set. Effectiveness estimates are presented as subarea VMT reductions, peak period travel reduction on Trans-Lake

Corridors, and daily travel reduction on Trans-Lake Corridors. Overall VMT and travel demand is estimated to decrease by only a small amount compared to the No Action solution set for the Roadway-Rail, New Crossings, and Roadway-Bus solution sets. This occurs because of the increase in general-purpose vehicle capacity in these solution sets.

Substantial Increase Over Base TDM Level (Applies to Maximize Alternatives Solution Set)

All of the strategies included in the Base TDM package would be included in this package along with the following additional elements. An unprecedented level of TDM is assumed, including substantial changes in the basic price structure for using various transportation modes.

- **TDM Support Infrastructure.** This package includes additional rail and HOV facilities on Trans-Lake corridors.

- **Employer-Based Strategies.** CTR would be expanded *to include all employers* regardless of size. Funding support would be provided to form additional transportation management associations (TMAs) within the major employment centers. These additional TMAs would help small employers to pool resources to achieve greater effectiveness.

- **Vanpooling.** A dedicated funding source would be provided for a greatly expanded vanpooling program compared to the Base TDM package. This program would fund both capital and operating costs for additional vanpools in the Trans-Lake study area to fully satisfy the vanpool demand after the pricing strategies are implemented.

- **Alternative Transportation Products and Services.** Funding for this program would be increased over levels assumed in the Base TDM package. Free or reduced cost rail and/or bus service on Trans-Lake Washington routes and telecommuting support would be considered in addition to the strategies listed in the Base TDM package.

- **Financial Disincentives to Driving Alone.** Two specific financial disincentives to driving alone would be implemented:

  - Increased parking costs within all study area employment centers by $0.50/hour. Regional or local legislative action would likely be required to implement this strategy.

  - Congestion pricing on all existing Trans-Lake corridors (I-90, SR-520, SR-522). This system would be implemented using automatic vehicle identification transponders to identify and record the presence of a vehicle at a single location on each roadway. This system would also record the time when a vehicle was passing over this location to allow for higher charges during congested time periods. HOVs in this system would be charged a greatly reduced fee or not be charged at all. A base charge of $1.00/trip was assumed with higher charges up to $5.00/trip during peak travel periods. To balance demand among the three Trans-Lake corridors, different prices could be charged on each corridor.

Land Use Strategies. No change from the base TDM level; however, with implementation of the financial disincentives to driving alone mentioned above, there would be a greater market-based incentive in place to achieve a greater level of implementation.

TABLE 2. ESTIMATED EFFECTIVENESS AND COST FOR INDIVIDUAL TDM STRATEGIES

TDM Strategy	Potential Effectiveness	Implementation Cost
TDM Support Infrastructure and Programs		
HOV Facilities	Up to 1.5% VMT reduction in affected corridor	High
Rail Transit Facilities	Up to 5% VMT reduction in affected corridor	Very High
Park-and-Ride Lots	0-0.5% VMT reduction	Moderate
Transit Service	Up to 2.5% VMT reduction in affected corridor	Moderate
Transit Fare Subsidies	Up to 2.5% regional VMT reduction	Moderate
Nonmotorized Facilities	0-0.2% VMT reduction	Low-High
Vanpooling		
Vanpool Service	Up to 8% commute VMT reduction at each employment site	Moderate
Vanpool Fare Subsidy	Up to 2.5% additional commute VMT reduction	Low-Moderate
Employer-Based Strategies		
Monetary Incentives	2-20% trip reduction at site	Low-Moderate
Alternative Work Schedules	Up to 1% regional VMT reduction	Low
Guaranteed Ride Home Programs	Little to no reduction unless combined with other strategies	Low
Parking Management (Including Parking Cash-Out)	0-20% trip reduction rate at site	Low
Facility Amenities	Little to no reduction unless combined with other strategies	Low
Transportation Management Associations	6-7% commute trip reductions	Low-Moderate
Alternative Transportation Products and Services		
Car Sharing	Limited experience to date	Low
Internet Ride-Matching	Up to 2% VMT reduction	Low
Work Location Exchange Programs	Up to 2% commute VMT reduction	Low to Moderate
Instant Carpooling	Up to 2% commute VMT reduction	Low
Nonwork Trip Programs	Limited experience to date	Low-Moderate
Financial Disincentives to Driving Alone		
Fuel Pricing	Up to 6% VMT reduction	Low-Moderate
Congestion Pricing	Up to 10% VMT reduction	Moderate
Parking Pricing or Cash Out	Up to 7% VMT reduction	Low

TABLE 2. ESTIMATED EFFECTIVENESS AND COST FOR INDIVIDUAL TDM STRATEGIES

TDM Strategy	Potential Effectiveness	Implementation Cost
Land Use Strategies		
Mixed-Use Development/Jobs-Housing Balance	Subarea VMT reduction up to 10%	Low-Moderate
Transit and Pedestrian Oriented Design	Limited reductions unless combined with other strategies	Moderate
Residential Density Increases	Household VMT reductions up to 10%	Moderate
Employment Center Density Increases	SOV work trip reduction up to 50%	Moderate

TABLE 3. COMBINED TDM STRATEGY EMPHASIS AND VMT INCREASE/DECREASE FOR EACH SOLUTION SET

TDM Strategy	MTP '98	MTP Flipped	Roadway/Rail	New Crossings	Roadway-Bus	Maximize Alternatives
TDM Support Infrastructure and Programs						
HOV Facilities	●	◑	○	○	●	●
Rail Transit Facilities	◑	◑	●	●	○	◑
Park-and-Ride Lots	◑	◑	◑	◑	◑	◑
Transit Service	●	●	◑	◑	◑	●
Transit Fare Subsidy	○	○	○	○	○	◑
Nonmotorized Facilities	◑	◑	◑	◑	◑	◑
Vanpooling						
Vanpool Service	◑	◑	○	○	◑	●
Vanpool Fare Subsidy	○	○	○	○	○	●
Employer-Based Strategies						
Monetary Incentives	◑	◑	○	○	○	●
Alternative Work Schedules	◑	◑	◑	◑	◑	●
Guaranteed Ride Home Programs	◑	◑	◑	◑	◑	●
Parking Management	◑	◑	○	○	○	●
Facility Amenities	◑	◑	◑	◑	◑	●
Transportation Management Associations	◑	◑	◑	◑	◑	●

Alternative Transportation Products and Services

TABLE 3. COMBINED TDM STRATEGY EMPHASIS AND VMT INCREASE/DECREASE FOR EACH SOLUTION SET

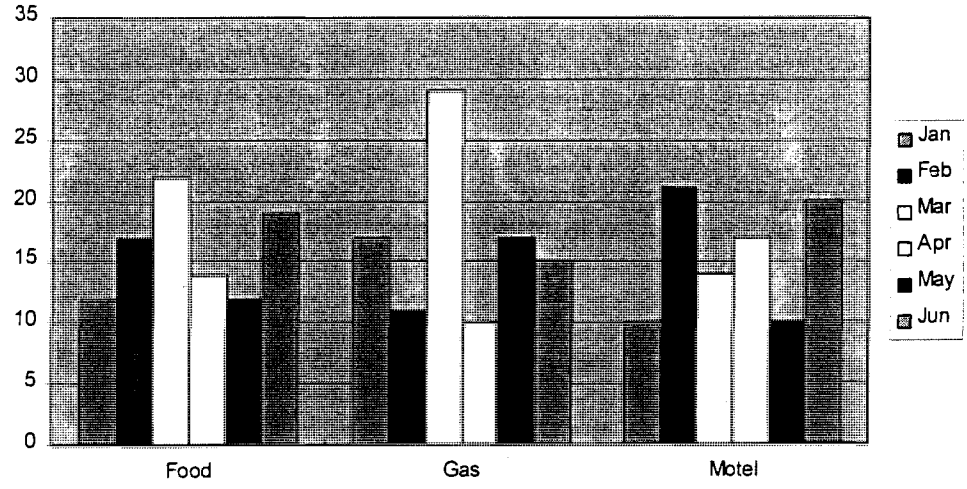
TDM Strategy	MTP '98	MTP Flipped	Roadway/Rail	New Crossings	Roadway-Bus	Maximize Alternatives
Car Sharing	◑	◑	◑	◑	◑	●
Internet Ride Matching	◑	◑	◑	◑	◑	●
Work Location Exchange Programs	◑	◑	◑	◑	◑	●
Instant Carpooling	◑	◑	◑	◑	◑	●
Nonwork Trip Programs	◑	◑	◑	◑	◑	●
Financial Disincentives to Driving Alone						
Fuel Pricing	○	○	○	○	○	○
Congestion Pricing	○	○	○	○	○	●
Parking Pricing or Cash Out	◑	◑	○	○	○	●
Land Use Strategies						
Development Impact Mitigation	◑	◑	◑	◑	◑	●
Mixed Use Development	◑	◑	◑	◑	◑	●
Transit/Pedestrian-Oriented Design	◑	◑	◑	◑	◑	●
Residential Density Increases	◑	◑	◑	◑	◑	●
Employment Center Density Increases	◑	◑	◑	◑	◑	●
Onsite Amenities	◑	◑	◑	◑	◑	●
Effectiveness Compared to No Action						
Subarea VMT Reduction	3-5%	3-5%	1-2%	1-2%	0	Up to 20%

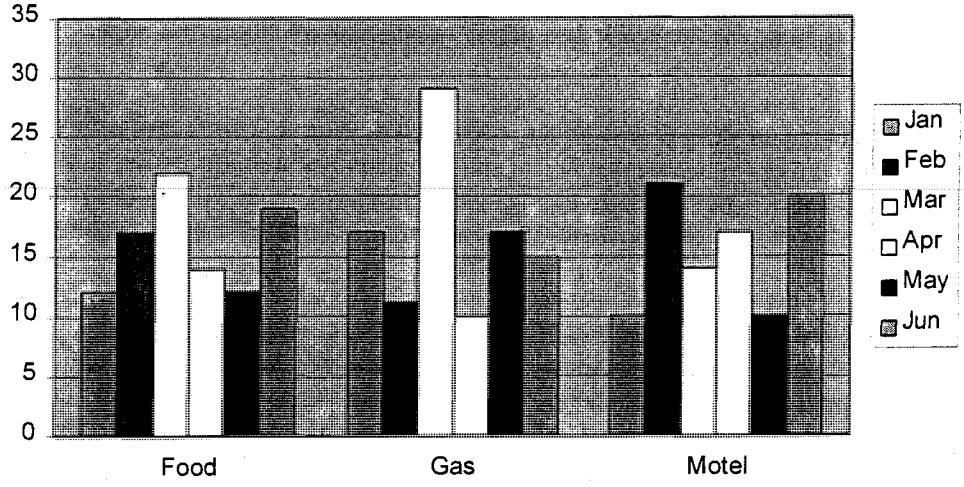
TABLE 3. COMBINED TDM STRATEGY EMPHASIS AND VMT INCREASE/DECREASE FOR EACH SOLUTION SET

TDM Strategy	MTP '98	MTP Flipped	Roadway/Rail	New Crossings	Roadway-Bus	Maximize Alternatives
Peak Period Travel Reduction on Trans-Lake Corridors	2-4%	2-4%	0-1%	0-1%	0	Up to 15%
Daily Travel Reduction on Trans-Lake Corridors	1-3%	1-3%	0-1%	0-1%	0	Up to 10%

○ Little to No Emphasis ◑ Moderate Emphasis ● High Emphasis

Attachment





Pricing

Options to Reduce Vehicle Miles Traveled

A recently published report titled "Road Relief—Tax and Pricing Shifts for a Fairer, Cleaner, and Less Congested Transportation System in Washington State" Energy Outreach Center, 1998 provides a comprehensive summary of various pricing strategies and their potential effectiveness. Information from this report is summarized below. This information was used to identify the most promising pricing strategies to be included with the Maximize Alternative Strategies Solution set. See Table 4 and Figures 1 and 2 for a summary of the different pricing option effects on vehicle miles traveled and net government revenue.

Fuel Pricing

This strategy would raise vehicle fuel costs to more accurately reflect the true cost of operating motor vehicles. Raising state motor fuel taxes or fees has significant limitations as a strategy for alleviating the negative impacts of automobile use as drivers can respond in ways that undermine the increased fuel costs. For example, drivers can change to more fuel-efficient vehicles or purchase their fuel in a

neighboring jurisdiction with lower or no fuel price increases. However, the pricing strategies described below could still effectively cause reductions in vehicle miles traveled. For the Trans-Lake Washington study, fuel pricing strategies have not been assumed at this time. Any of these strategies would likely require legislative action at the State level; however, local governments also have the ability to implement modest fuel pricing increases.

- **Increase Motor Vehicle Fuel Tax.** The primary virtue of an increase in motor vehicle fuel taxes is its minimal transition and transaction cost, since the collection system is already in place. Washington's constitution currently restricts motor vehicle fuel tax revenues to highway purposes.

- **Extend Retail Sales Tax to Motor Vehicle Fuel.** Extending retail sales taxes to fuel would add approximately 10 cents per gallon, resulting in an estimated $282 million in additional annual state and local general tax revenues. Exempting vehicle fuel from sales tax distorts markets by making automobile transport cheap relative to goods that bear general sales tax, such as housing and clothing.

- **Carbon Tax.** This tax is based on the carbon emission of fossil fuels. Since roadway transportation fuel represents around half of household direct carbon-based energy consumption, total revenues and energy conservation impacts from this tax would be roughly double motor vehicle fuel impacts alone.

- **Increase the Hazardous Substances Tax.** Washington collects a hazardous substances tax of 0.7 percent of wholesale value on the sale of such products, including petroleum products. Because revenues from the Hazardous Substances Tax are not dedicated to roadways, the tax is a potential way of raising fuel taxes without the risk of generating additional vehicle travel *through* increased highway capacity.

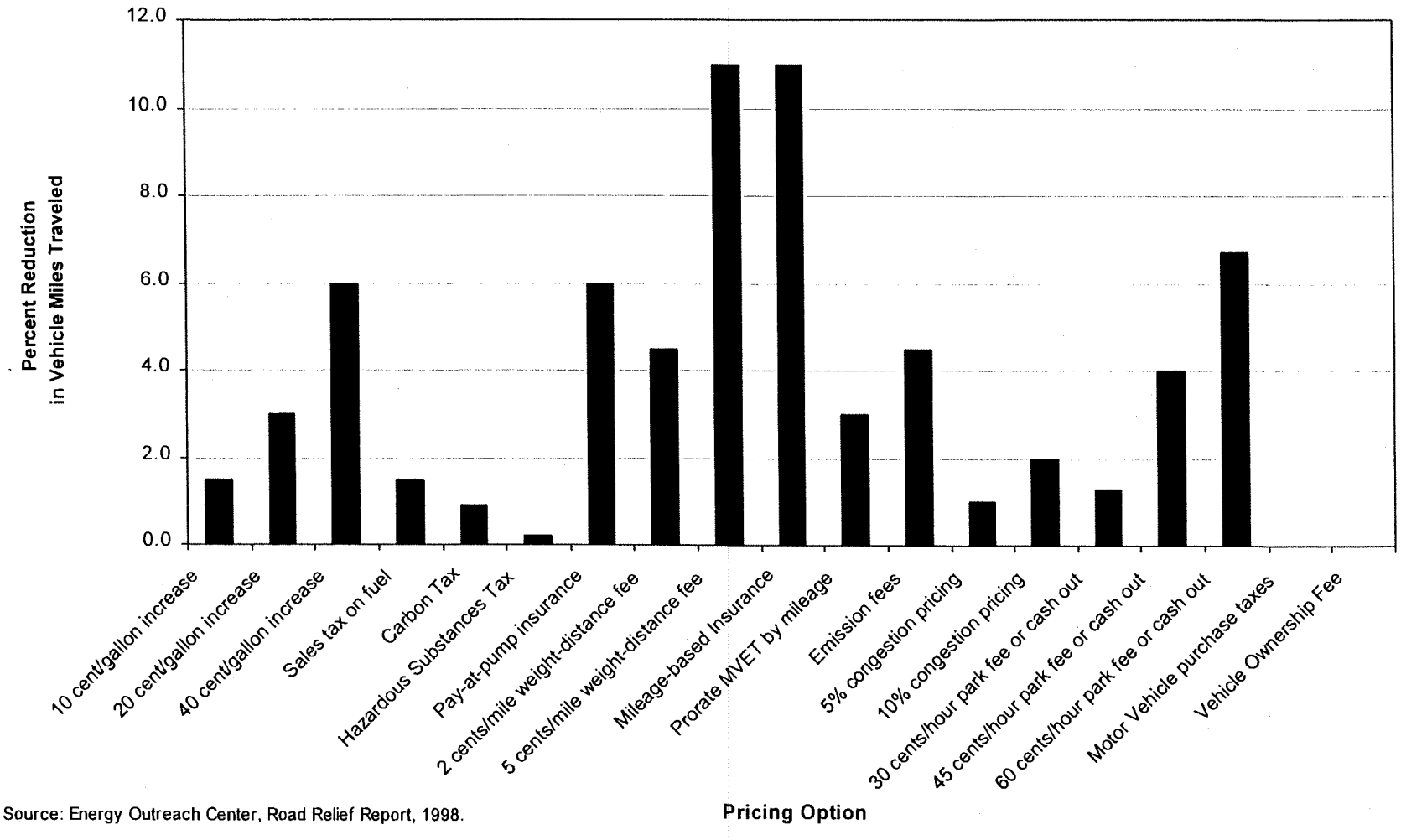
- **Pay-at-the-Pump Vehicle Insurance.** This would provide automatic basic liability coverage through a fuel surcharge of 30 to 60 cents per gallon. Some drawbacks of this proposal include having insurance payments related only to fuel consumption and not risk factors, it does not replace the need for private insurance, and it could cause significant cross-border fuel sales if implemented in only one state. Since the entire charge would offset current payments for liability insurance, there is no incremental revenue to government, and no net cost change to the average vehicle owner.

TABLE 4. SUMMARY OF PRICING OPTIONS

Option	Estimated Percent VMT Reduction	Net Statewide Annual Revenue (millions)
Fuel Pricing		
Increase Motor Vehicle Fuel Tax		
10 cent/gallon increase	1.5	$286
20 cent/gallon increase	3.0	$541
40 cent/gallon increase	6.0	$972
Retail Sales Tax on Fuel	1.5	$282
Carbon Tax	0.9	$323
Increase Hazardous Substances Tax	0.2	$124
Pay-at-Pump Vehicle Insurance	6.0	$0
Mileage Charges		
Weight-Distance Fees		
2 cents/mile fee	4.5	$987
5 cents/mile fee	11.0	$2,308
Mileage-Based Vehicle Insurance	11.0	$0
Prorate MVET by Mileage	3.0	$0
Emission Fees	4.5	$977
Road/Congestion Pricing		
5% Congestion Pricing	1.0	$211
10% Congestion Pricing	2.0	$418
Parking Management		
30 cents/hour park fee or cash out	1.3	$25
45 cents/hour park fee or cash out	6.7	$125
60 cents/hour park fee or cash out	6.7	$125
Motor Vehicle Purchase Taxes	0.0	$586
Vehicle Ownership Fee	0.0	$1,144

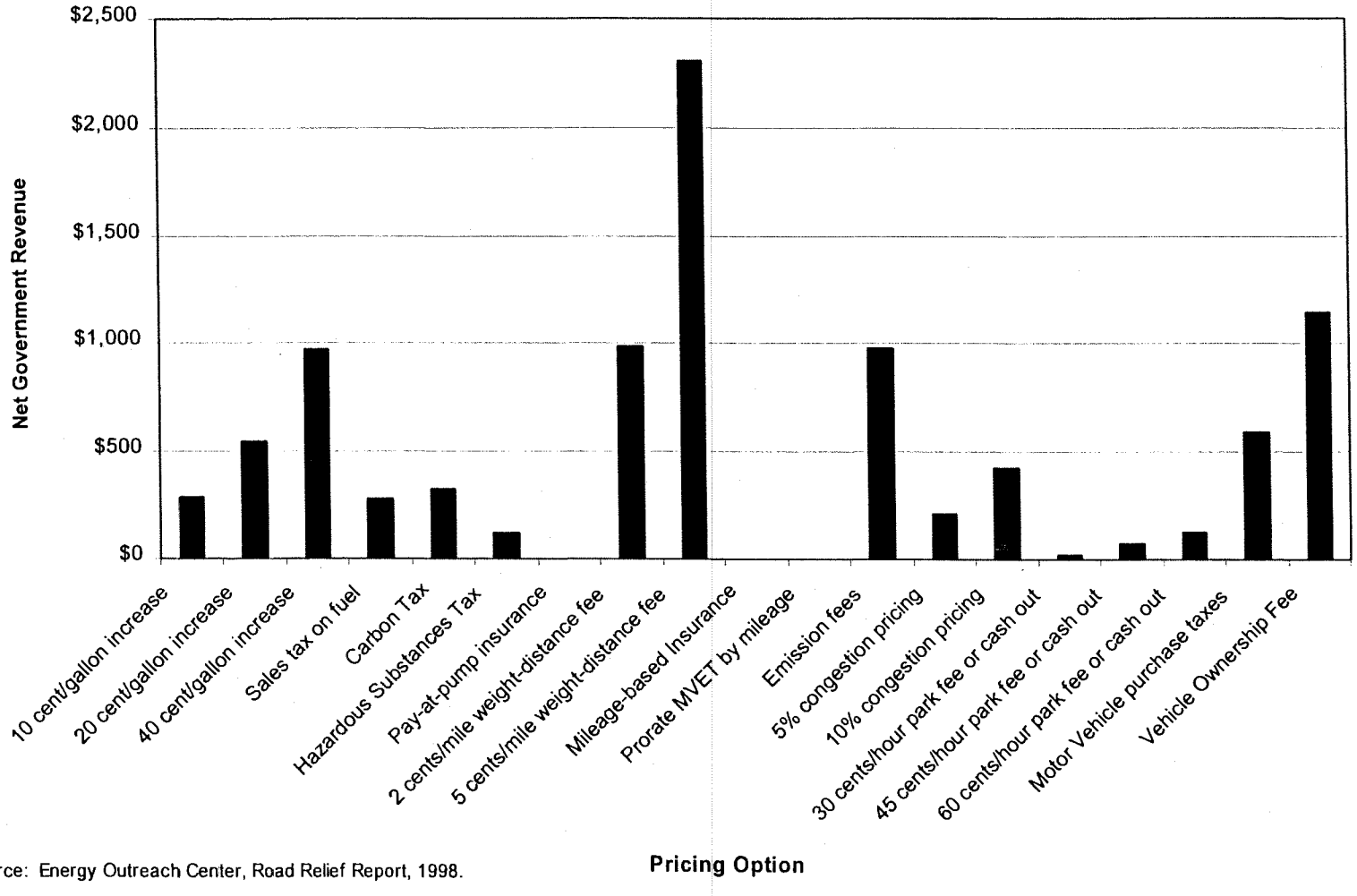
Source: Energy Outreach Center, Road Relief Report, 1998

Estimated VMT reduction by Pricing Option



Source: Energy Outreach Center, Road Relief Report, 1998.

Estimated Net Government Revenue by Pricing Option



Source: Energy Outreach Center, Road Relief Report, 1998.

Mileage Charts

Mileage charges are vehicle use fees based on miles driven, derived from odometer readings. Mileage charges can be tailored to reflect the various impacts of driving that correspond to factors such as vehicle weight, risk factors, emissions, and even when and where vehicles are driven. Mileage charges can capture more of the social costs from driving than fuel taxes because most of these costs (i.e., congestion, accidents, noise, emission) vary more closely with miles driven than with fuel consumed.

- **Weight Distance Fees.** This fee is based on the product of a vehicle's weight-class charge multiplied by its distance driven. There could be two types of weight-distance fees; one to reimburse governments for roadways facilities and services currently funded out of general taxes, and one to reimburse state and local governments for the rent and property tax value of land devoted to roadway right-of-way.

- **Mileage Based Vehicle Insurance.** This would convert insurance from a fixed cost into a variable cost that increases with vehicle use, with liability and collision insurance to be sold in *distance*-based units. This per-mile fee would incorporate all rating factors, such as driver accident and moving violation history, vehicle type and geographic territory.

- **Prorate the Motor Vehicle Excise Tax by Mileage.** This would provide a further incentive to reduce vehicle miles traveled in an effort to maintain affordable vehicle registration fees.

- **Emission Fees.** This fee would charge motorists in proportion to the estimated pollution produced by a vehicle. Charges could be based on average emission rates for each vehicle class, or on pollution rates measured in a periodic test of each vehicle.

- **Road/Congestion Pricing.** Road pricing would toll vehicle use on specific roads, with higher tolls imposed during congested periods. This strategy can be implemented with conventional toll booths or an electronic automatic vehicle identification (AVI) system. The AVI system would automatically record the presence of a vehicle passing established control points in the system. With this type of system, variable pricing rates for different types of vehicles and travel during different times of the day could be implemented.

Other Pricing Strategies

In addition to fuel and mileage, there are many other pricing strategies that could be priced differently so as to be more visible to the driver. With more visible vehicle operating costs, drivers could choose to reduce their vehicle miles traveled.

- **Parking Management.** Some possible strategies include converting minimum parking requirements in zoning laws to maximum allowances; granting design flexibility to developers/building owners who charge for parking including parking "cash-out" (offering cash equivalent of parking subsidies if other modes of travel used) as part of employee commute trip reduction programs; using parking revenue as a source of local funds or tax reductions; encouraging shared and zoned parking; and taxing parking.

- **Motor Vehicle Purchase Taxes.** This strategy would develop a "rebate" program with special taxes on fuel-*in*efficient or high-polluting vehicles with the revenue funding rebates on efficient, lower-pollution vehicles. Also, there would be an additional $2,500 per vehicle purchase tax to replace local general taxes as a funding source for local roadways. This tax would ensure that only vehicle

owners would carry roadway costs, instead of the general public. However, this strategy would cause virtually no reduction in vehicle use as the cost would be included in the price of a vehicle, instead discouraging the purchase of new vehicles.

- **Vehicle Ownership (Registration and Licensing) Charges/Taxes.** This strategy would increase the annual motor vehicle excise tax by $250 per vehicle to replace local general taxes as a funding source for local roadways. Increasing this tax would have no direct effect on vehicle travel. A potential problem with this increase is that it would add to the incentive to register vehicles outside the state, where such charges are less.

Trans-Lake Washington Study

Evergreen Point Bridge Approach

September 1998

Purpose

The purpose of this memorandum is (1) discuss and define the existing condition of the bridge, and (2) identify the Department's preservation and maintenance project currently in progress, and (3) determine WSDOT's plans for enhancements or ultimate replacement of the existing bridge, and (4) determine whether additional study is required under the Trans-Lake study in order to address the three other items.

Background

To establish the baseline assumptions regarding the Evergreen Point Floating Bridge for the Trans-Lake Washington Study, two working sessions were conducted with representatives from the Washington State Department of Transportation (WSDOT). The first working session was held at WSDOT Northwest Region in Shoreline on July 7, 1998, and the second was conducted at WSDOT's Olympia Service Center in Olympia on July 21, 1998. This memorandum documents the outcome of those working sessions, and proposes working assumptions for the Trans-Lake Washington Study related to the condition of the Evergreen Point Floating Bridge and future plans for its preservation or replacement.

Current Bridge Condition

As a result of damage to the floating bridge pontoons and anchor cables during the 1993 Inaugural Day storm and a subsequent storm in December of 1995, WSDOT convened a consultant "expert panel" to review the condition of the bridge, and to recommend actions to strengthen and preserve it. As a result of this assessment, WSDOT is currently spending $16 million to strengthen the pontoons and to perform seismic improvements to the approaches to the floating bridge. Including the current $16 million contract, a total of $26 million has been spent since 1995 on rehabilitation contracts. Work is estimated to be complete in September 1999 which, combined with prior rehabilitation contracts, will strengthen the structure to withstand 20-year storm event (77 mph wind velocity) at this specific location on Lake Washington.

The expert review panel advised that the floating portion of the Evergreen Point Bridge will have an estimated service life (i.e. life expectancy) of 20 to 25 years following completion of this bridge strengthening contract. They also advised that there are no feasible actions to further extend the life of the bridge beyond the estimated 20-25 year service life, or to strengthen the existing bridge to withstand greater than a 20-year storm event without sustaining damage. This is primarily due to the fact that more is known today about the specific weather conditions affecting the floating bridge than was known at the time it was designed. According to the expert panel, the current strengthening efforts will essentially maximize the service life of the bridge.

The estimated service life could be reduced if the bridge experiences wind speeds above 50 mph several times over a number of years. If the bridge was exposed to the 100-year storm (92 mph wind velocity), it is highly likely that the bridge would be damaged beyond repair. Storms with a 20- to 50-year recurrence interval would damage the bridge. However, with this level storm it is likely that the bridge could be repaired and reopened to traffic with some reduction in estimated service life.

According to WSDOT Bridge Engineers, the existing bridge is supporting the maximum weight it can handle, and cannot be modified to accept additional weight or widening.

Preservation and Replacement: the State Highway System Plan

The Washington State Department of Transportation (WSDOT) regularly updates the *State Highway System Plan*, which identifies and prioritizes highway needs and plans for the next 20 years. Currently, the Highway System Plan identifies the need for approximately $26 million over the next 20 years for maintenance, preservation, and inspection of the Evergreen Point Bridge. In addition, seismic retrofit work focused on the fixed portion of the bridge is in progress or will be completed within the same period.

As was discussed above, upon completion of current floating bridge rehabilitation and retrofit construction contracts, WSDOT estimates that the remaining service life of the floating portion of the bridge will be approximately 20 to 25 years. Strengthening of the existing floating portion of the bridge to withstand a more severe storm than a 20 year storm event has been determined to be not feasible. Extending the life of the bridge beyond the 25 year service life anticipated once the current strengthening is completed is also not feasible.

Because it is estimated that the existing bridge will not need to be replaced within 20 years, its replacement is not included in the current 20 year Highway System Plan, but replacement of the floating portions of the bridge will need to occur shortly after the 20 year timeframe addressed in the plan. The next major update to the Highway System Plan will occur in Year 2003 or 2004. Depending on the Trans-Lake Washington Study findings, and barring any severe storm or seismic events affecting the condition of the bridge, the cost to replace of the floating portions of the SR 520 bridge will be included in the next update to the *State Highway System Plan.*

Proposed Working Assumptions for the Trans-Lake Washington Study

- The No Action Alternative should assume that SR 520 across Lake Washington will support two travel lanes in each direction. The existing bridge and pontoons are not anticipated to be replaced during the next 20 years, but will need to be replaced shortly thereafter.

- All new facilities, including replacement of existing floating bridge sections, would meet current WSDOT Design Standards, including standard shoulders, and would be built to accommodate a 100 year storm event.

- Replacement of the floating portions of the SR 520 bridge will be included in the next update to the 20 year *State Highway System Plan*, unless the results of the Trans-Lake Washington Study call for other improvements to the bridge that would occur within 20 years.

- Depending on the Trans-Lake Washington Study findings and recommendations for the SR 520 Corridor, WSDOT may consider preparing a replacement floating bridge design to have on the shelf and ready for construction should the bridge be damaged beyond repair before the bridge is scheduled for replacement. This *"risk mitigation"* measure would allow a replacement bridge to be in service a year faster than it would take otherwise.

- The existing pontoon structure is not capable of supporting any significant additional loading or widening; it is not feasible to extend the life of the current pontoons beyond 25 years, and it is not feasible to strengthen the existing bridge to withstand greater than a 20 year storm event without sustaining damage.

Additional Analysis Needed During the Trans-Lake Washington Study

An original purpose for this analysis was to determine whether additional work is needed during the Trans-Lake Washington Study to advise the Department of Transportation about preservation and replacement options and risks under a "No Action" scenario. As a result of the investigation and meetings with WSDOT staff, it is concluded that no additional support is needed from the consultant team to address this issue as part of the Trans-Lake Washington Study.

Passenger Ferry / Bus Ferry

Informational Report

Trans-Lake Washington Study

The ferries Mercer *and* Leschi, *pictured here in a 1928 Asahel Curtis photograph, carried passengers and vehicles between Kirkland, Seattle, and Mercer Island.*

Trans-Lake Washington Study

Executive Summary – Preliminary Discussion Draft

Passenger Ferry / Bus Ferry Concept

Two potential types of ferry service are currently being evaluated. A passenger-only ferry would provide service between Kirkland and the University of Washington. A Bus/Passenger ferry would provide service between Kirkland and Sand Point. Bus transit service to support either the passenger-only or the bus/passenger ferry would connect the terminal to a potential light rail system along Lake Washington Boulevard, the park-and-ride system via express service, and provide local feeder routes.

Potential 2020 ferry market

The Kirkland/Eastside to University of Washington travel market has been identified as the market most appropriately served by ferry service. Based on 1995 PSRC mode share data and 2020 travel demand forecasts, total peak hour ferry trips are estimated at 500 for the year 2020. The actual number of ferry riders will depend on the ferry service travel time competitiveness with other modes and the amount of time sacrifice riders will endure for the opportunity of aesthetically superior over-water travel.

Potential landing locations

Four potential sites on each side of Lake Washington are currently being evaluated for potential terminal landing locations.

West Terminus	East Terminus
UW – Marine Sciences (p/o)	Downtown Kirkland (p/o)
UW – Stadium/Waterfront Activities Center (p/o)	Vicinity of Settler's Landing Park (p/o)
Sand Point – Magnuson Park boat launch	Vicinity of Houghton Beach Park
Sand Point – NOAA vicinity/Pontiac Bay	Vicinity of Carillon Point

(p/o) – passenger-only location

Evaluation Components

As part of the ferry concept development, both vessel technology and landing locations are being evaluated. Ferry vessels for passenger-only service must be capable of at least 30 knots in the open water and provide seating capacity for 200 passengers. Vessels for bus/passenger service must be capable of 15 knots in the open water and be able to transport up to eight 40-foot transit coaches and 100 to 200 additional passengers.

Potential landing locations are being evaluated based on the following factors:

Landing Location Evaluation Factors

Impact to critical areas/existing uses	Opportunity for use of existing pier/dock
Sufficient area available for terminal construction	Pedestrian accessibility
Navigable location	Sufficient area available for bus staging area
Well connected to roadway/transit network	

Potential Ferry Service Configurations

Four potential terminal landing combinations are currently being evaluated.

Passenger-only	Bus/passenger
Downtown Kirkland ***to*** UW – Marine Sciences	Vicinity of Houghton Beach Park ***to*** NOAA Vicinity
Settler's Park vicinity ***to*** UW – Marine Sciences	Vicinity of Carillon Point ***to*** NOAA Vicinity
Downtown Kirkland ***to*** UW – Waterfront Activities Center	Vicinity of Houghton Beach Park ***to*** Magnuson Park boat launch vicinity
Settler's Park vicinity ***to*** UW – Waterfront Activities Center	Vicinity of Carillon Point ***to*** Magnuson Park boat launch vicinity

Preliminary Findings

Preliminary analysis indicates that the preferred route for passenger-only service would be between Downtown Kirkland and the University of Washington's Waterfront Activities Center. The preliminary preferred route for a potential bus/passenger ferry would be between Kirkland in the vicinity of Houghton Beach Park and the vicinity of the NOAA facility on the north end of Sand Point. The following table identifies the preliminary issues/advantages/disadvantages for these locations.

Location	Advantages	Disadvantages
Passenger-only		
University of Washington-Waterfront Activities Center *Union Bay*	Open area for terminal development. Close to Health Sciences and Campus Sports Facilities	Potential impacts to fish habitat Increased traffic impacts along Montlake Ave. 5 mph speed limit on Union Bay Depth limits 10 minute walk to central campus/LINK station Conflicts with Recreational uses in Union Bay
Downtown Kirkland *Moss Bay*	Opportunity to modify existing dock Maximize market penetration for downtown Kirkland Good connection to freeway/P&R system	Traffic impacts to downtown Kirkland Impact to existing lakefront activities Highly developed site
Bus/Passenger		
Sand Point-NOAA *Pontiac Bay*	Underutilized Facility Potentially Available for Redevelopment Good access to Sand Point Way/UW Avoids critical species habitat	Requires Transit to UW Impact to other uses (NOAA) Potential conflict with City of Seattle planning
Kirkland-Houghton Park	Direct route to UW Good connection to freeway/P&R system	Section 4f. concerns with the park space South of downtown Traffic impact to Lake Washington Boulevard

Next Steps

Complete conceptual terminal layout and cost estimates

Further investigate issues relating to preliminary preferred routes
Investigate current proposals for privately-provided ferry service across Lake Washington
Continued review of prior study

[redacted]

TRANS-LAKE TUNNEL CROSSING CONCEPTS

Summary

The following tunnel options were evaluated to provide general traffic lanes, HOV lanes and LRT lines across Lake Washington:

Bored Tunnels are suitable for the land access tunnels of Alignments A and B. To use bored tunnels under the lake is expected to be possible, but would be pushing limits of pressure on large size shield tunnel boring construction, though this is still to be confirmed with manufacturers.

Immersed Tunnels would also be exposed to large pressures from the deep water of the Lake. In addition, the slopes near each shore are about 16%, which would require that the transition from water to land tunnel would be away from the shore in deep water. Immersed tunnels at the depth required are beyond what has been done to date.

Floating Tunnels have not been built to date, but are within the technical capabilities. They would be located perhaps 30 to 40 feet below the water level to allow passage of ships over the top. The floating tunnels could be anchored in a manner similar to that of a floating bridge. This type of tunnel is the most promising for the conditions at the potential Trans-Lake crossings.

Three alignments have been considered. Alignments A and B are located north of SR520 and Alignment C would utilize the SR520 corridor. The depth of the lake is in the range of 170 to 200 feet at these crossing locations. The two northern alignments would require that the approaches be constructed as tunnels also, because the approaches would be located under established residential neighborhoods.

While no cost estimates have been completed yet it is clear that crossing Lake Washington with a tunnel or tunnels will be very expensive. It is likely that the SR520 corridor has the advantage, because it does not require the long approach tunnels. Also if one of the northern alignments is selected, the existing or a similar floating bridge would still be needed to maintain the SR520 traffic corridor.

Preliminary Conclusions:

Of all the tunnel options considered the floating tunnel appears to be the most promising solution. The costs of a floating tunnel is expected to be about twice the cost of a floating bridge. The cross section of any tunnel option needs to be very carefully determined, reducing the

shoulder width could result in very substantial savings. The northern alignments would be considerably more expensive than the SR520 corridor, because they require that the approaches to be tunneled under the residential neighborhoods, while SR520 would largely be surface roads.

TYPES OF TUNNELS

Immersed Tunnels

This type of tunnel is usually constructed off site in sections the sections and individually floated to the site. There, ballast is added and the section is lowered to its final position in a shallow bed excavated in the lake bottom. A protective cover of gravel and rip rap is usually placed on top of the tunnel but may not be needed at the depths proposed. This construction imposes some limitations and special requirements on the tunnel configuration. The tunnel must initially float, therefore there is a maximum thickness for the walls and slabs. The individual segments must have temporary bulkheads, a seal to allow removal of the bulkhead and provisions to permanently join the segments.

Rectangular concrete immersed tunnels for four traffic lanes can be provided in very shallow water, for three lanes in deeper water, and only two lanes when it becomes very deep. The depth of Lake Washington in the area of the proposed crossings is between 170 and 200 feet, with the ground sloping at a rate of about 15% to 18% from the shore. At this depth the water pressure is high, making a rectangular tunnel configuration inefficient, therefore it is likely that a circular tunnel with its high resistance to uniform pressure would most likely to be selected. Such a tunnel could be either steel or concrete.

There would seem to be no reason to fully bury the tunnel at this depth, so excavation to half depth or so would be sufficient to hold these tunnels in position. It has also been proposed for some locations that underwater tunnels be placed on underwater dikes or piles to support the tunnel above existing bed level.

Construction at these great depths including excavation, formation of the foundation and backfilling will be a challenge for any immersed tunnel. Once the steep slope to the shore is reached, the problem of construction method for transition to the inland section needs to be resolved and is a major challenge due to the depth at which it occurs. Perhaps a full length bored tunnel solution would be preferable, since that would solve the construction method for the whole tunnel.

Floating Tunnels

Seattle is already familiar with the concept of floating bridges. A floating tunnel is very similar. The tunnel can either be heavier than water and suspended beneath pontoons, or it can be lighter than water and tethered down. Sufficient reserve uplift and strength would be maintained so that the loss of a pontoon or of buoyancy is not catastrophic. In concept, it is very similar to an immersed tunnel, except that it is subject to dynamic loads and movements. Although no floating tunnel has yet been built, the principles used are all well proven. Such a tunnel would be

located only as deep as necessary to provide clearance over the top for shipping. Such a crossing is at an advanced stage of design for the very deep Høgsfjord in Norway[1], and is being considered for other locations around the world. Great interest has been shown internationally in the concept of floating tunnels[2], including one for the Straits of Messina.

There should be no problem in providing multi-celled concrete rectangular tunnels to take the necessary traffic. The light rail would be separated from the general traffic. Like the floating bridges, a floating tunnel should be able to reach the surface not far from the shore, minimizing the overall length of the crossing. For the Lake Washington crossings a buoyant tunnel tied down by anchors is better suited, so that nothing is visible on the surface. A tunnel suspended from pontoons would be equally applicable, but pontoons would be visible which might be considered a visual distraction..

Anchors for a floating bridge essentially resist horizontal forces due to wind and current. Anchors for a submerged tunnel have to resist buoyancy and current forces only. Such anchors can be a simpler variant of those used for offshore floating oil platforms.

Bored Tunnels

Tunnels in soft ground or mixed with rock are usually constructed using shielded tunnel boring machines. Shields with a diameter of about 46.5 feet were used for the Tokyo Bay Tunnel, Japan, and for the Elbe Tunnel, Hamburg, Germany. These are the largest soft ground tunnels ever built by this method. Using this size of shield would accommodate two lanes and with shoulder or three lanes without shoulders. While current US practice is to provide full shoulders on bridges, it is unusual to provide full standard shoulders in tunnels, because of the disproportional savings that can be achieved by keeping the size of the tunnel to a minimum.

The 200 feet of water in Lake Washington results in high pressures (6 tons per square foot), though it should be possible to design the shield accordingly. This would be a world class tunnel project with significant challenges. In comparison, the for the Tokyo Bay tunnel the water depth was 27.5 m (90 feet), and the overburden on the tunnels was 16 m (52 ft), well below the depth needed for Lake Washington.

It is likely that the LRT would be located in a separate tunnel with a dividing wall with emergency doors. In case of emergency, evacuation could be through the doors to another train on the other track.

For the land approaches it may be possible to use a sequential excavation technique to mine the tunnels, often referred to NATM (New Austrian Tunneling Method). A detailed study of the geotechnical conditions at the site would be required to assess the viability of this method, which

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[1] State-of-the-Art Report, second edition, International Tunneling Association Immersed and Floating Tunnels Working Group, Pergamon, 1997

[2] State-of-the-Art Report, first edition, International Tunneling Association Immersed and Floating Tunnels Working Group, Pergamon, 1993, and also the second edition referenced above.

utilizes open face excavation followed immediately by stabilizing the tunnel with soil anchors and shotcrete. Ground modification such as chemical grouting or ground freezing is also often required prior to excavation. If feasible, it could be more cost effective than bored tunnels. The NATM method would not be applicable to cross under the lake.

If feasible, it would be more cost effective than bored tunnels. The NATM method would not be suitable to cross under the lake.

Tunnel Construction Facilities

Floating bridges and tunnels, and immersed tunnels will either have to be fabricated at some point within the lake, or else will have to be designed to fit within the locks that give access to the lake. If fabricated outside the lake, the length and width possible will dictate whether a single structure or multiple structures will be required. Draft limitations may mean that some structures cannot be completed until the lake is reached. Within the lake, multiple structures would not be a problem, however it may be difficult to locate a suitable, large enough site. Sufficient space would need to be available at the shorelines to construct the transition from the lake to the land sections and the ventilation facilities.

Bored tunnels would need access shafts for construction and for ventilation close to the shore and at about one-mile intervals on land. During construction of any form of crossing, the needed working areas will need to identified.

Comparison of Bored, Immersed and Floating Tunnels

To sum of the above, in lieu of a floating bridge the most attractive solution for all three alignments would be a floating tunnel, even though no such tunnel has been completed at this time. Though it would be innovative, it is within current technology.

If an immersed tunnel were pursued it would represent a record depth.

Bored tunnels are a viable option for the approaches to the lake crossing. As a lake crossing, bored tunnels would be exposed to very high pressure. We are not aware of any tunnels that have been built at the proposed diameters at these pressures.

OTHER ISSUES

Transition from Lake to Land

Immersed tunnels would have to transition to bored tunnel at great depth. This would be done without dewatering, and would be some distance from the shore. Such a transition at that depth would be innovative, having never been done before. Shallower transitions have been done before, such as the 63rd Street Tunnel in New York, and for BART in San Francisco. Transition from a floating tunnel to a fixed structure would be done at a shallow depth, or could even occur above water.

Seismic Considerations

Of particular concern in a seismic event would be soil that might liquefy. Appropriate measures to alleviate such an occurrence would need to be taken to ensure tunnel and/or anchor stability. A floating tunnel would be relatively unaffected by a seismic event except at the transitions to fixed structures. A concept design for a hydro-pneumatic seismic joint[3] for a floating Messina Strait Tunnel[4] has already been proposed and would be suitable for use at Lake Washington. Seismic joints have been provided at each end of the BART tunnels in San Francisco and have performed well in past earthquakes.

A zone at which tunnels might be affected by earthquakes is where either the soil properties change, for example entering a rock foundation from soft material, or where the section properties of the tunnel change, such as at portals, or at ventilation buildings or shafts, or at element joints. It is important to allow the flexibility that the earthquake deformations demand, yet joints must not open up to allow inundation, neither opening longitudinally nor transversely.

Ventilation Requirements

For LRT in its own tunnel, emergency ventilation is required to enable occupants to escape in case of fire. Other ventilation is not required if a central wall is provided, since the vehicles should ventilate the tunnels sufficiently by their piston effect.

Sufficient space is easily provided in a circular 3-lane traffic tunnel for ventilation at intervals of at least 5,000 ft, with all three lanes in use. Detailed calculations have not been carried out to check whether ventilation for a minimum size tunnel (45 feet diameter) could stretch to 10,000 feet intervals. The worst scenario would be that the tunnel diameter would need to be slightly increased.

Rectangular tunnels can be designed to provide the areas necessary for ventilating a crossing two miles long, although the ventilation ducts might become large towards the ends of the upgrades. Calculations are necessary for each individual scheme, and the duct sizes are tailored to each tunnel.

Tunnel Boring Machine Size

As discussed previously, current shielded tunnel machines sizes can be tailored for twin LRT, 2-lane or 3-lane. It might be preferable, in view of the high external water pressures, for smaller tunnels to be used, since experience exists with them under high pressures. Discussions with individual shield manufacturers should be able to determine their capabilities more accurately.

A shield for a tunnel of about 59 feet diameter is being developed in Japan, but one or two years of development is needed before even the first trial. Such a tunnel would accommodate either three lanes plus shoulders, or four lanes without shoulders.

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[3] Manuelyan, R., "A Proposed Hydropneumatic Solution for Long Crossings", Parsons Brinckerhoff – RD-1 Flexible Support Systems, September 1996.

[4] Gursoy, A., "Land Connections for Submerged Floating Tunnels", Proceedings of the International Conference on Submerged Floating Tunnels, Sandnes, Norway, 1996.

Cross Section and Shoulders

The cross section needs to be carefully assessed for each case. For the floating tunnel it is possible to provide the full width needed, with interior walls separating eastbound and westbound traffic as well as LRT. The elements must be tailored to fit the Ballard Lock, since they would most likely be fabricated outside the lake.

Multiple tunnels would be required for the bored and perhaps for the immersed tunnels. The use of full shoulders combined with three general traffic lanes, an HOV lane and a light rail track in one tube is most improbable. Multiple tubes would be needed. Each tube will need its own shoulders, so that the overall cost will sky-rocket. Shoulders used on tunnels elsewhere, should be used as a guide. For the I-93 tunnels through Boston, FHWA has approved design criteria which provide shoulders that are not much wider than marginal strips. These criteria were adapted for the Tunnel Study the Gowanus Expressway in New York and as shown below, shoulder width and vertical clearances would be considered sub-standard for normal conditions.

Sample Highway Tunnel Design Criteria (Gowanus Tunnel Study)

Classification:	Urban Interstate (I-278)
Level of Service:	D
Design Speed:	100 km/h (62 mph)
Stopping Sight Distance:	210 m (689 ft)
Horizontal Curve:	Desirable radius 435 m (1,427 ft)
Maximum Superelevation:	6%
Maximum Grade:	4%
Minimum Grade:	0.25% within tunnel
	0.50% in the open, subject to rainfall
Minimum Cross Slope:	1% within tunnel
	2% in the open, subject to rainfall
Lane Width:	3.6 m (11.8 ft)
Minimum Shoulders:	0.3 m (1 ft) left and right
HOV Lane Buffer:	0 m (0 ft) minimum
Vertical Clearance:	4.4 m (14.44 ft)
Clearance for signs:	0.8 m (2.62 ft)
Safety Walk:	0.9 m (2.95 ft) width one side only
	2 m (6.56 ft) headroom

Concrete or Steel Shell

Immersed tunnels are constructed as reinforced concrete elements with or without a steel shell. The selection is based on the basis of available construction facilities, draft, schedule, and cost. The result can differ from project to project. One advantage of a steel outer shell is that it can yield and cover large internal cracks without leaking. A steel shell structure could be fabricated in a shipyard.

The similar materials to an immersed tunnel would be appropriate for a floating tunnel.

Bored tunnels are constructed with a initial liner plate, either steel or precast concrete, followed by a waterproofing membrane and a cast in place concrete liner.

Protection from Ships Above

Ship impact must be avoided for floating tunnels. Direct impact would be avoided by placing floating tunnels sufficiently deep to be well clear of keels and propellers.

Immersed tunnels are designed to resist sunken ship loads and anchor impacts. Such loads should not be an issue for Lake Washington. Tunnels in the shallows may need rock protection to avoid direct ship impact.

ALIGNMENTS

Three alignments have been considered at this conceptual stage.

Alignment A

This alignment starts at the I-5 / SR522 interchange, runs east under NE 75th Street to Sand Point Way NE where it turns towards NE. At the north end of Magnuson Park it meets the shoreline and crosses the lake to a point north of Juanita Bay and continues to I-405.

I-5 to Lake Tunnel	2.9 miles tunnel
Lake Crossing	1.2 miles
Lake to I-405 Tunnel	2.7 miles
Total length	6.8 miles

The maximum depth of the lake is approximately 170 feet.

Alignment B

This alignment starts at the I-5 at NE 65th Street, runs east under NE 65th Street to the shoreline at the south end of Magnuson Park. It crosses the lake to a point north of downtown Kirkland and continues to meet I-405 north of NE132nd Street.

I-5 to Lake Tunnel	3.3 miles
Lake Crossing	1.7 miles
Lake to I-405 Tunnel	1.3 miles
Total length	6.3 miles

The maximum depth of the lake is approximately 190 feet.

Alignment C

This alignment follows the existing SR 520 corridor. The west approaches are on surface from I-5 to the Arboretum, widened to accommodate the additional lanes. The new lake crossing would have to be on new alignment, probably swinging to the north of the existing floating bridge. On the east side the existing corridor would again be utilized with appropriate improvements.

I-5 to Lake at Grade	1.7 miles
Lake Crossing	2.0 miles
Lake to I-405 at Grade	3.1 miles
Total length	6.8 miles

The maximum depth of the lake is approximately 200 feet.

Alignment A and B Tunnels

The lake sides generally fall off at about 16%, with a drop of about 160 ft at this rate existing on each side. For an immersed tunnel, the use of an open-cut excavation of this magnitude underwater near the shore would not seem to be realistic, combined with the need at some point to transition to deep tunnel. The transition from immersed to bored tunnel would therefore reduce the immersed tunnel length to no more than about 4,000 ft. A better solution than an immersed tunnel might be to consider a bored tunnel for the whole distance, though cost could well be prohibitive.

A floating tunnel with approaching bored tunnels appears to be the best solution at this location.

Lane Configuration in Tunnel

Option 1 would have two general purpose lanes and one HOV lane in each direction.
With the approaches in bored tunnels, there would be several possible arrangements. Without shoulders, there would be one tunnel in each direction for the three lanes.
With shoulders, there would be one tunnel each way for the two general traffic lanes. The HOV lanes would be one tunnel with sub-standard shoulders, because there would be need for a median barrier. In the floating tunnel the lanes could be combined in one or two tubes.
Option 2 would have the same 2 +1 lanes as Option 1 plus one LRT line each way.
The configurations described above still apply. In addition there would be a separate LRT tunnel, if necessary with a central dividing wall.

Alignment C

Most of the comments on Alignments A and B apply to Alignment C, i.e. the floating tunnel appears to be the most promising of the tunnel options. The approaches would be following the existing alignment of SR 520 with improvements as required to carry the additional lanes from I-5 to I-405.
To build a floating tunnel while maintaining traffic on the existing floating bridge will require a detailed study. The new floating tunnel would probably swing to the north and in a curved alignment would stay clear of the existing bridge, so that it could remain operational until the new crossing would carry traffic. At both ends the alignment would tie in with the existing alignment. Near the ends there would have to be a staged construction to allow the traffic to be diverted from the existing to a partly completed new crossing.
An option to be studied at the western end would be to create an artificial island near the tip of the Arboretum, bring a floating tunnel to the surface and then continue it on a low-level trestle bridge. If the sight of a new bridge is unacceptable, even though the existing bridge is there, the tunnel could be continued as an immersed tunnel until such time as it may be permitted to reach the surface. If a tunnel continues through the shallow water, considerable cost savings would result in establishing a ventilation building close to the edge of the shallows. Another option would be to construct the tunnel through the shallows in cofferdam, probably saving considerable sums in the process. In addition to the above technical considerations, the environmental impacts will clearly be important in this very sensitive area.

Lane Configuration in Tunnel

Two lane configuration options were considered for Alignment C.
Option 3 would have three general purpose lanes and one HOV lane in each direction.
For a floating tunnel Option 3 without shoulders it may be possible to have a four-lane tunnel for each direction, possibly divided into two cells by a center wall or columns. With shoulders, the general traffic and HOV lanes would ha· e to placed in four two-lane tunnels, to stay within the width of the Ballard locks.
Option 4 would have the same 3 +1 lanes as Option 3 plus one LRT line each way.
Option 4 is similar to Option 3 except that the extra LRT lines ought to be housed in a separate tunnel, if necessary with central dividing wall.