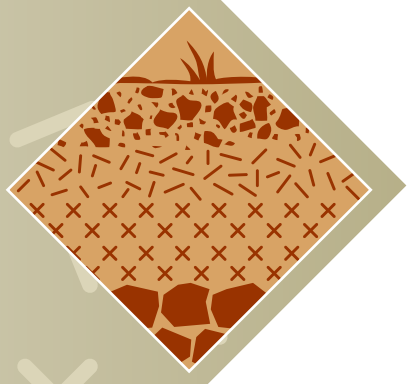
19 January 2006

SR 520 Bridge Replacement and HOV Project Draft EIS

6-Lane Alternative Options

Addendum to Geology and Soils Discipline Report



Washington State Department of Transportation

SoundTransit

U.S. Department of Transportation Federal Highway Administration

SR 520 Bridge Replacement
and HOV Project EIS
6-Lane Alternative Options

Addendum to Geology and Soils Discipline Report

Prepared for

Washington State Department of Transportation
Federal Highway Administration
Sound Transit

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January 19, 2006

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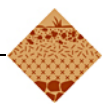
Attachments

List of Exhibits

Acronyms and Abbreviations

AASHTO	American Association of State Highways and Transportation Officials
cy	cubic yards
GIS	Geographic Information System
LF	linear feet
WSDOT	Washington State Department of Transportation



Introduction

This Addendum to the *Geology and Soils Discipline Report* (Appendix H of the *Draft SR 520 Bridge Replacement and HOV Project Environmental Impact Statement* [Draft EIS]) (Parametrix et al. 2005) describes the affected environment and environmental consequences of the three options to the original 6-Lane Alternative. Two of these options are in Seattle and one is on the Eastside.

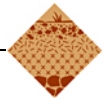
What are the key points of this report?

The difference in effects on geology and soils produced by the three options compared to the original 6-Lane Alternative are difficult to quantify at this stage in design development. The changes in effects from either the Second Montlake Bridge or South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast options would be so minor as to be unquantifiable. Changes in effects due to construction of the Pacific Street Interchange option would be greater, but are not easily quantifiable because of the limited definition of subsurface conditions and very conceptual nature of the design at this stage.

For the Pacific Street Interchange option, all of the potential effects on geology and soils (with the exception of potential liquefaction beneath the northbound lanes of Montlake Boulevard north of Husky Stadium and sports-related structures) could be mitigated but would add cost and complexity to the proposed project. Following are some of the more important considerations:

- Congestion of the underground in the vicinity of the proposed lowering and reconfiguration of the Pacific Street/Montlake Boulevard intersection and the new Pacific Street interchange ramps could require reconstruction or modification of some existing basement walls. Fortunately, the subsurface conditions in this area are relatively favorable for this kind of work—groundwater is likely to be below most of the excavations and compressible sediments are not anticipated.

- A sump may be needed at the Pacific Street/Montlake Boulevard intersection to collect seasonal high groundwater. The effects of the sump on groundwater probably would be localized within relatively thin layers of fill, trench backfill, and weathered glacial till.



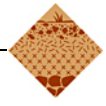
- Widening of the west side of Montlake Boulevard may require relocation of utilities at the base of a steep slope (more expensive shoring, increased potential for dewatering) and construction of walls in highly variable materials (much may be man-made fills of variable strength), with the added burden of maintaining some temporary pedestrian crossings and limiting the duration of detouring traffic along the Burke-Gilman Trail.
- Widening the east side of Montlake Boulevard may require preloading, construction of reinforced embankments, or other measures to mitigate against long-term settlement; all these measures would be complicated by utility relocation issues and maintaining access to the existing parking areas and playfields.
- The subsurface conditions in the area encompassed by this option are highly varied and will require more frequent subsurface exploration, more complicated laboratory testing, and more intensive geotechnical engineering analyses for design than a typical section of roadway.

What options are being considered in this addendum?

6 Lanes with Pacific Street Interchange Option

This option would remove the Montlake interchange along SR 520 and would construct a new interchange at Pacific Street, just east of the Montlake interchange. Exhibit 1 shows the proposed lane configuration for this option.

The new interchange would be primarily located over the WSDOT-owned peninsula near the Washington Park Arboretum. A new on- and off-ramp to and from the north would extend to Pacific Street at the University of Washington. A column-supported ramp of four general-purpose lanes (two lanes in each direction) extending over Union Bay (referred to as the Union Bay Bridge in this addendum) from the new interchange would touch down at the University of Washington Husky Stadium parking lot before joining the intersection of Pacific Street and Montlake Boulevard. At that intersection, the roadway would be lowered 8 to 10 feet from the existing elevation to provide vehicle-only access. The intersection would be covered to allow pedestrian access above and away from vehicular traffic.



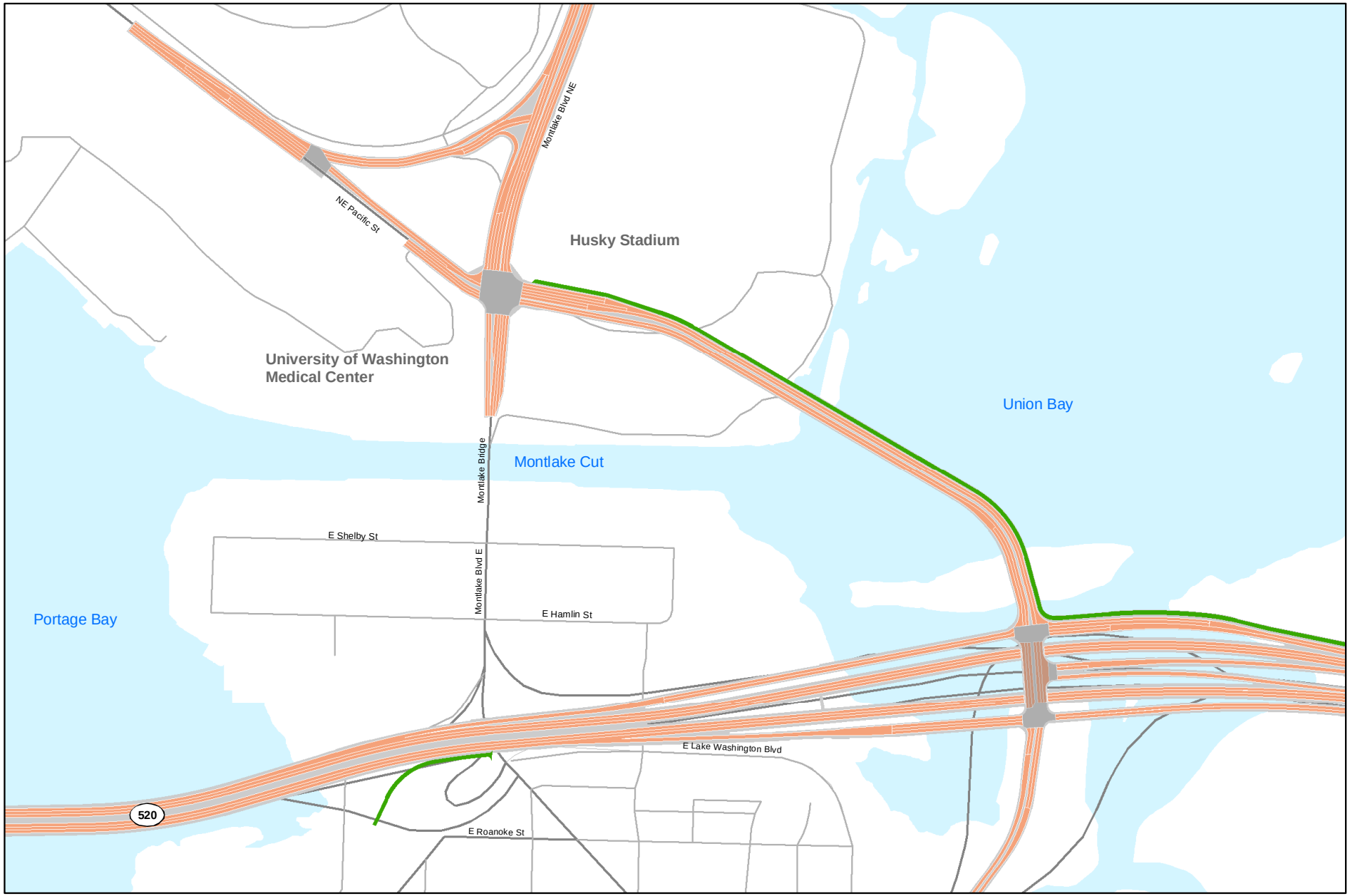


Exhibit 1. **Lane Configuration of the 6 Lanes with Pacific Street Interchange Option**

SR 520 Bridge Replacement and HOV Project

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The roadway on Montlake Boulevard north of Pacific Street would be widened to the east until just south of Northeast 45th Street. The navigational channel crossed by the new Union Bay Bridge would be the same width as the existing Union Bay reach (175 feet), with a vertical clearance of either 70 or 110 feet.[1] Columns would be placed just outside the width of the ship canal to not block boat traffic.

Ramps to and from Lake Washington Boulevard would still be included in this option; however, their footprint would be slightly different from the original 6-Lane Alternative. The ramp connections to and from Lake Washington Boulevard and to and from the Union Bay Bridge would construct a full diamond interchange, as opposed to a partial diamond interchange under the original 6-Lane Alternative. This full diamond interchange would provide more access to and from Lake Washington Boulevard. No access to or from SR 520 would be provided at Montlake Boulevard.

From Montlake Boulevard to I-5, SR 520 would be six lanes wide (three in either direction). The profile of the Portage Bay Bridge would not differ under this option from the original 6-Lane Alternative. Buses would access SR 520 via the Union Bay Bridge through the University area, providing for a more direct connection between buses and the proposed Sound Transit North Link Station at Husky Stadium. Instead of connecting to the Montlake interchange as in the original 6-Lane Alternative, the bicycle/pedestrian path would follow the Union Bay Bridge from SR 520 and would end at the Pacific Street interchange, close to the Burke-Gilman Trail.

Second Montlake Bridge Option

The intent of the Second Montlake Bridge option is to narrow the SR 520 footprint through the Montlake neighborhood, while providing for transit (bus) access from SR 520 to the University of Washington. Exhibit 2 shows the propose lane configuration for this option, which would be the same as the No Montlake Freeway Transit Stop option, except that it would also include a second Montlake bridge across the Montlake Cut. This bridge would be a parallel bascule (draw) bridge

[1] The establishment of a new governing clearance would prevent any vessel with a higher clearance requirement from traveling east from the Montlake Cut to Lake Washington north of the Evergreen Point Bridge. Before establishing a new governing clearance, the Coast Guard will consider whether vessels requiring a higher clearance have an essential use in north Lake Washington. Two vessels with a vertical clearance higher than 70 feet are known to travel this part of the lake. No vessels with a vertical clearance higher than 110 feet travel this part of the lake.

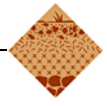

Exhibit 2. **Lane Configuration of the Second Montlake Bridge Option**

SR 520 Bridge Replacement and HOV Project

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located just east of the existing Montlake Bridge. One bridge would carry northbound traffic, and one would carry southbound traffic.

South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast Option

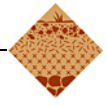
The intent of the South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast option is to improve access for buses to the South Kirkland Park-and-Ride from eastbound SR 520 and from the South Kirkland Park-and-Ride to westbound SR 520. This option, which is shown in Exhibit 3, would add a new transit/HOV-only westbound on-ramp from 108th Avenue Northeast and a new transit/HOV-only eastbound off-ramp to 108th Avenue Northeast.

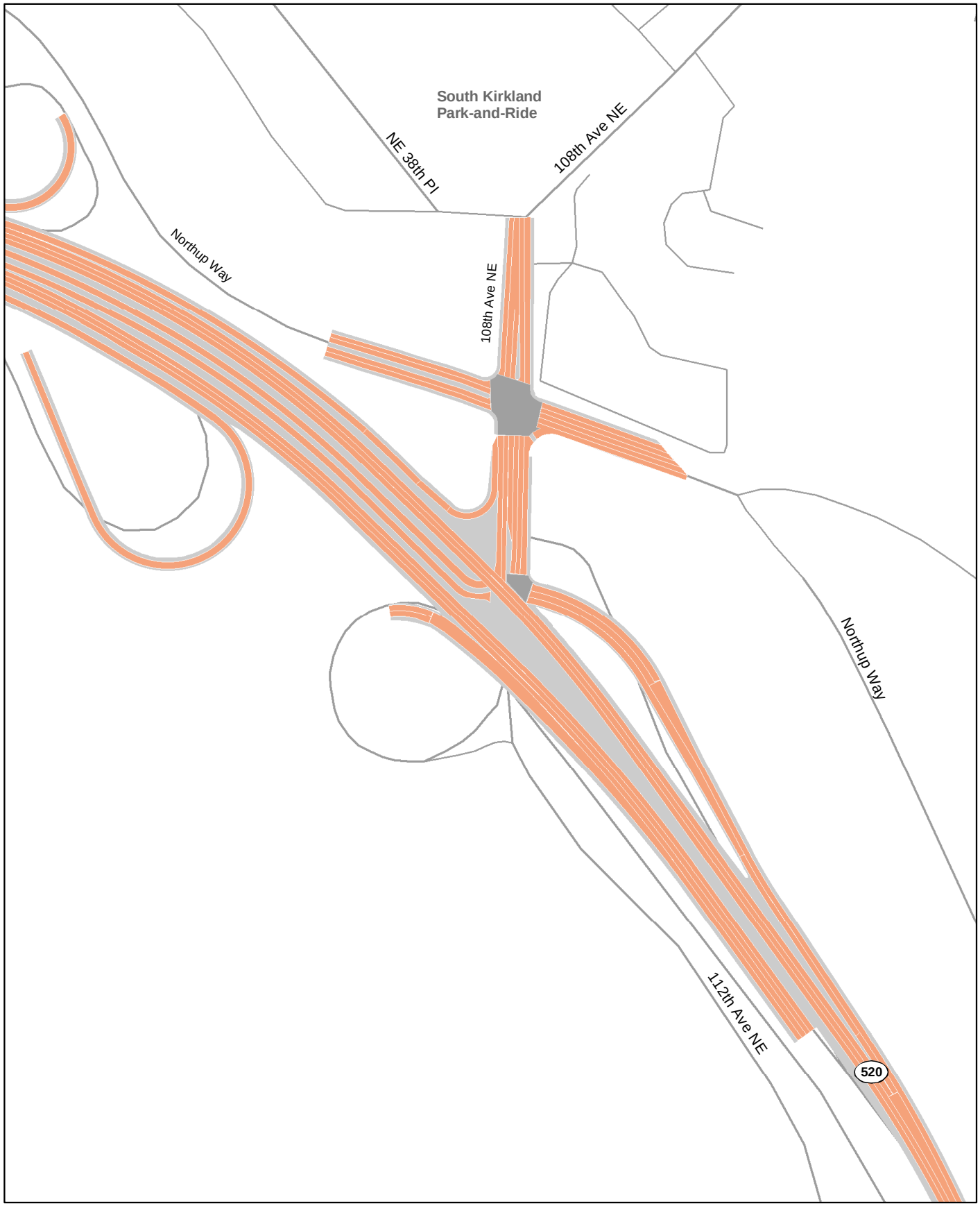
The footprint of SR 520 east of Bellevue Way would be widened slightly to accommodate the new ramps. Both 108th Avenue Northeast and Northup Way would be widened and improved under this option. One lane would be added to 108th Avenue Northeast between the eastbound on-ramp and 38th Place Northeast. Along with the additional through lane on 108th Avenue Northeast, the northbound leg of the 108th Avenue Northeast/Northup Way intersection would be channelized to include two exclusive left-turn lanes, a through lane, and a shared through/right-turn lane.

There is also a possibility for adding a westbound second left-turn lane at the 108th Avenue Northeast/Northup Way intersection to facilitate clearing the left-turn queue and serving a higher number of westbound left-turn and through trips.

What additional information was collected for this analysis?

Additional subsurface information collected by the geology and soils discipline team for this analysis consisted of geotechnical reports, boring logs, geologic mapping, surficial soils mapping, geologic hazard mapping, and the information provided in Exhibit 4.





Option Lane Configuration
Shoulders and Barriers
Intersections

N

0 125 250 500 Feet

Exhibit 3. **Lane Configuration for the South Kirkland Park-and-Ride Transit Access - 108th Avenue Northeast Option**
SR 520 Bridge Replacement and HOV Project

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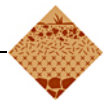
Exhibit 4. Information Collected for Semi-Quantitative Analysis

Information	Used as a Measure of:
Earthwork volume	Relative construction disturbance
	Permanent change in topography
	Net sand and gravel required for embankment
	Net sand and gravel for all uses
Length of cut walls, bridge abutments, and stormwater detention facilities parallel to slope contours in steep slope hazard areas and potential restrictions on underground faculties behind walls	Permanent stabilizing effects
Embankment area within mapped liquefaction areas	Potential for liquefaction stabilization
Embankment area within mapped recent alluvium (Qyal)	Potential for long-term settlement
Length of cut walls and bridge abutments in glacial outwash and recent alluvial soils	Potential for short-term, localized lowering of groundwater table
	Potential for permanently lowering groundwater outside of right-of-way
Mainline distance through mapped erosion hazards	Potential for erosion of exposed soil during construction
Numbers of new permanent shafts and temporary piles	Potential for temporary noise, vegetation disturbance, water quality reduction from spills
	Potential for permanent and temporary loss of habitat



Affected Environment

How was the information collected?

For the Pacific Street Interchange option, the geology and soils discipline team collected additional subsurface information for the area between SR 520 and Northeast 45th Street along the Montlake Boulevard corridor. Approximately 80 geotechnical reports or memoranda, summarized in Attachment 1, were collected from the Seattle Geologic Mapping project archives (University of Washington 2005). The discipline team did not collect any additional subsurface information for the Second Montlake Bridge and the South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast options because information collected for the original 6-Lane Alternative covered these areas.

The Geographic Information System mapping of surficial geology and geologic hazards, which was used for the *Geology and Soils Discipline Report* analyses, was extended to the north along the Montlake Boulevard corridor to cover the new Pacific Street Interchange option.

What are the subsurface conditions in the new project areas?

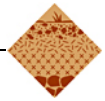
The mapped surficial geology of the area north of the current Montlake interchange is shown in Exhibit 5. Mapped geologic hazard areas are shown in Exhibit 6.

Second Montlake Bridge Option

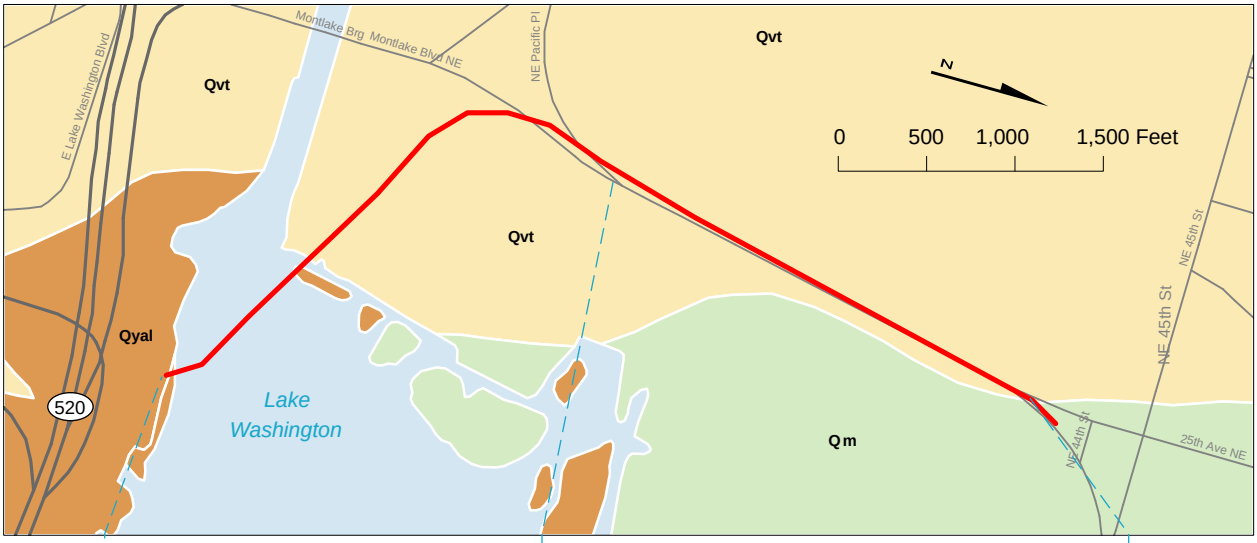
The second Montlake bridge would be founded on glacial till.

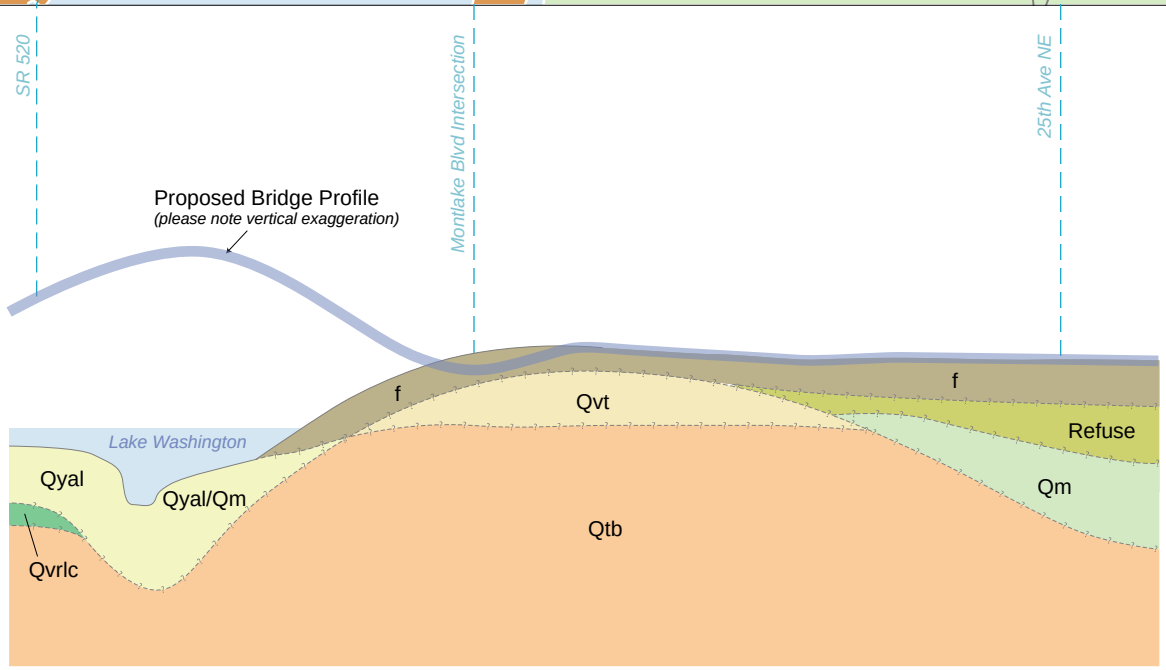
6 Lanes with Pacific Street Interchange Option

The proposed Pacific Street interchange would be founded on deep foundations extending through at least 50 feet of loose or very soft recent alluvium or marsh deposits. As the Union Bay Bridge crosses the bay, the depth of loose or soft sediments would increase to perhaps 70 or 80 feet (see the schematic profile in Exhibit 5). Where the bridge meets the shoreline north of the Montlake Cut, several feet of fill overlying very dense glacial till are anticipated.



Surficial Geology Map





Schematic Subsurface Profile

f	Fill *(varies from medium dense, well-graded sand and gravel to loose silty and clayey sands)*
Refuse	Municipal Solid Waste
Qyal	Younger Alluvium *(may also include areas of peat)*
Qm	Marsh/Peat/Bog Deposits *(included because there is a thick layer of peat in Lake Washington and Portage Bay)*
Qvt	Vashon Glacial Till
Qtb	Transitional Beds and Older Glacial Deposits
Qvrlc	Vashon Recessional Lacustrine Clay

0
100
Approximate Vertical Scale in Feet

0 1,000
Approximate Horizontal Scale in Feet

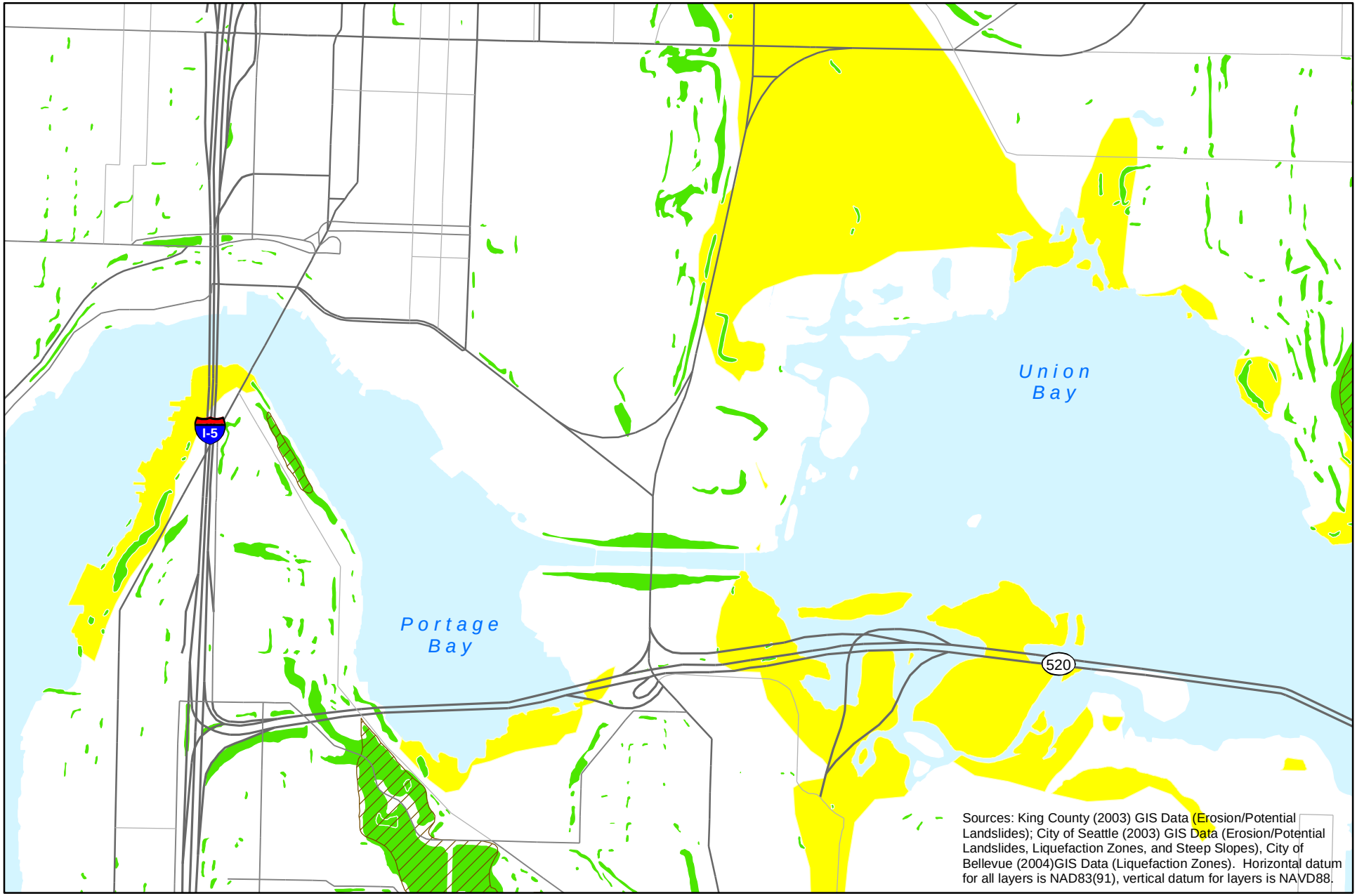
NOTES:

Schematic subsurface profile shows generalized geologic conditions based on borings that are generally at least 100 feet east of Montlake Boulevard, and offset by at least 100 feet from the bridge and roadway alignment in other locations.

SOURCE:
Surficial Geology Map: King County GIS Data, 2003 based on Booth et al. (2002).
Schematic Subsurface Profile: CH2M HILL (2005).

Exhibit 5. **Surficial Geology in the Project Area**

SR 520 Bridge Replacement and HOV Project



Sources: King County (2003) GIS Data (Erosion/Potential Landslides); City of Seattle (2003) GIS Data (Erosion/Potential Landslides, Liquefaction Zones, and Steep Slopes), City of Bellevue (2004)GIS Data (Liquefaction Zones). Horizontal datum for all layers is NAD83(91), vertical datum for layers is NAVD88.

Erosion/Potential Landslide Area

Steep Slope

Liquefaction Zone

N

0 500 1,000 Feet

Exhibit 6. **Geologic Hazard Areas**

SR 520 Bridge Replacement and HOV Project

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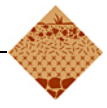
The Pacific Street/Montlake Boulevard intersection would likely be underlain by 10 to 20 feet of fill that is underlain by glacial till. North of the intersection, Montlake Boulevard passes over the boundary between glacial till (with various depths of fill from the extensive development in the area) to the west of the roadway and fill to the east of the roadway. Near Husky Stadium, the fill can be up to 30 feet deep, underlain by 5 to 10 feet of medium dense recessional outwash, then glacial till. Roughly 1,000 feet to the north, borings for some of the athletic facilities indicated approximately 35 feet of loose sand and silt fill over loose native sand, silt, and clay, with a bearing layer of hard clay at elevation -25 to -40 (approximately 110 to 120 feet below the existing grade of Montlake Boulevard). Continuing to the north, the areas currently used for parking and playfields are underlain by fill over upwards of 35 feet of municipal solid waste, over soft marsh deposits of clay and peat. The boundary between the suitable glacial till foundation soils to the west of Montlake Boulevard and the fill, landfill, and marsh deposits to the east is unclear from the conceptual level study completed to date.

The uncertainty of the suitable/unsuitable foundation boundary is illustrated by the disagreement between the geologic maps (and geologic hazard maps. The geologic maps show the boundary between the till and marsh deposits to be on the east side of Montlake Boulevard. The geologic hazard maps show some liquefaction areas on the west side of Montlake Boulevard (suggesting that Montlake Boulevard is underlain by recent alluvium or possibly marsh deposits instead of glacial till). Without developing cross-sections, plotting existing subsurface information, and possibly supplementing the information with new borings all along the proposed Montlake Boulevard widening, it is not possible to completely define the subsurface conditions in this area. The schematic profile shown in Exhibit 5 is intended to show the “likely worst-case” conditions for settlement of embankment widening to the east over loose fill and soft sediments.



Potential Effects of the Project

What methods were used to evaluate effects?

The geology and soils discipline team used the same methods described in the *Geology and Soils Discipline Report* to evaluate semi-quantitative effects for this additional analysis. The team evaluated qualitative effects were evaluated by examining site-specific subsurface information and assumed postulating the types of foundation support that would be needed.

What are the effects of the 6 Lanes with Pacific Street Interchange option?

Qualitative and semi-quantitative effects of the 6 Lanes with Pacific Street Interchange option compared to the original 6-Lane Alternative are presented in Exhibit 7.

What are the effects of the Second Montlake Bridge option?

The geology- and soils-related effects of the Second Montlake Bridge option relative to the original 6-Lane Alternative are as follows:

- The total roadway width at the east end of Portage Bay and the west end of Union Bay would be reduced. The variability in liquefiable areas at these locations based on the difference between the geologic map and the geologic hazard map would be greater than the measured difference between options; therefore, the change cannot be quantified. There will, however, be slightly less liquefaction stabilization and less risk of long-term settlement due to construction of embankment over compressible soils.

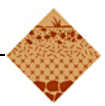


Exhibit 7. Qualitative and Semi-Quantitative Changes in Effects for the 6 Lanes with Pacific Street Interchange Option Compared to the Original 6-Lane Alternative

Potential Effect	Comparative Measure	Comments About Measure	Change Relative to the Original 6-Lane Alternative
Permanent Effects			
Changes in topography	Cut and fill volume.	Visual impact might be a more important measure, but difficult to measure quantitatively.	Similar changes (i.e., wall heights) along SR 520 in vicinity of Montlake Blvd. crossing, but width of lowered section is smaller than for original 6-Lane Alternative. Fill widths at bridge approaches are slightly smaller. Pacific Street Interchange option would add minor cuts and fills along Montlake Blvd. Would reduce excavation by 62,000 cy. Would reduce embankment by 9,000 cy.
Loss of topsoil	Estimated volume of topsoil removed.	Not a complete measure of the potential effect because quality topsoil would probably be reused on the proposed project or sold for use in the region.	Not measured.
Potential slope stabilizing effects	Length of walls (including lid support walls) and bridge abutments perpendicular to slope contours in landslide hazard areas.	Length of wall or structure is more appropriate than area or other quantitative measure because slope would have to be stabilized regardless of cut height or volume of soil removed. This is a relatively crude measure because the existing factor of safety against slope movement is unknown.	Would add about 2,200 LF (Adds 70%)
Underground facilities located immediately behind retaining walls	Length of walls (including lid support walls) and bridge abutments perpendicular to slope contours in landslide hazard areas.	Same as above.	Would add about 2,200 LF (Adds 70%)
Potential stabilizing effects in liquefaction hazard areas	Embankment footprint in liquefaction hazard. areas	Length of roadway through mapped liquefaction hazards could be more appropriate since stabilizing the roadway would have the same effect on neighboring properties regardless of the area, but area does have an effect on water	Not possible to quantify at this time. Option would reduce total roadway width at the east end of Portage Bay and the west end of Union Bay; the variability in liquefiable areas here based on the difference between the geologic map and the geologic hazard map is greater than the measured difference between options. Similarly, the option would add roadway width over potentially liquefiable material along Montlake Boulevard between Husky

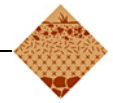


Exhibit 7. Qualitative and Semi-Quantitative Changes in Effects for the 6 Lanes with Pacific Street Interchange Option Compared to the Original 6-Lane Alternative

Potential Effect	Comparative Measure	Comments About Measure	Change Relative to the Original 6-Lane Alternative
		quality. Presumes that the existing condition might liquefy and all liquefied soil might move or otherwise contribute to temporary reduction in water quality.	Stadium and 25th Avenue Northeast, but the variability between the geologic map and the hazard map is greater than the total quantity.
Long-term settlement below roadway fill sections	Surface area over areas mapped as recently deposited alluvium (Qyal) where elevation of roadway would be higher than at present.	Mapping as recent alluvium does not necessarily mean compressible silt, clay, or highly organic material (could be primarily sandy), but it's the best relative comparison at this stage of the project.	Same as for liquefaction, above.
Groundwater flow or elevation changes	Lane miles of excavation and bridge.	See *Water Resources Discipline Report* its addendum for additional discussion.	Negligible – Cut walls along west side of Montlake Boulevard are in Qvt or fill over Qvt. Cut walls at Pacific/Montlake intersection are in fill over till and may be above the seasonal groundwater.
Bridge failure or damage due to wind or earthquake loading	Lane miles of existing bridges below current AASHTO wind or seismic standards. Risk of failure or damage over the next 20 years. Risk of failure or damage over the next 50 years.		No change.
Imported sand and gravel resources	Net embankment, net sand and gravel for all uses (structures, pavements, and embankments).	Reuse of onsite material potentially reduces some of the need for imported material.	Would use 170,000 tons more sand and gravel. (Adds 11%)
Temporary Effects			
Earth-related construction disturbance	Total cut and fill volume.	These effects potentially include dust, noise, and minor erosion—and represent secondary effects of construction.	Would reduce total cut and fill by 71,000 cy. (Reduces 13%)

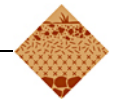
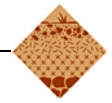


Exhibit 7. Qualitative and Semi-Quantitative Changes in Effects for the 6 Lanes with Pacific Street Interchange Option Compared to the Original 6-Lane Alternative

Potential Effect	Comparative Measure	Comments About Measure	Change Relative to the Original 6-Lane Alternative
Erosion of exposed soil where vegetation has been removed	Mainline distance through mapped erosion hazard areas.	The product of potentially exposed soil area and duration of exposure might be a better indicator, but it is very difficult to calculate at this stage of design development.	Would add about 2,200 LF. (Adds 50%)
Potential for slope movement during construction	Length of walls in cut and bridge abutments perpendicular to slope contours in landslide hazard areas	Cut volume or wall area within hazard areas might be a slightly better indicator, but not possible to calculate at this stage of design development.	Would add about 2,200 LF. (Adds 50%)
Space and disturbance associated with demolition of existing structures	Volume of concrete removed	These effects potentially include dust, noise, and vibration – and represent secondary effects of construction.	No change.
Bridge construction over water	Estimated numbers of new permanent shafts, numbers of temporary piles	These effects potentially include noise, vegetation disturbance, potential for water quality reduction from spills, loss of habitat due to supports for temporary work bridges. They also represent secondary effects of construction.	Would reduce number of permanent 10-foot-diameter shafts by 32. Would add four 25’ x 25’ piers. Would add about 300 temporary piles.
Short-term, localized lowering of groundwater table	Length of retaining walls in cuts and bridge abutments in glacial outwash and recent alluvial soils	See *Water Resources Discipline Report* (Appendix T to the Draft EIS) and its addendum for additional discussion.	Negligible changes.

AASHTO = American Association of State Highways and Transportation Officials
cy = cubic yards
LF = linear feet



- The second Montlake bridge would be founded on glacial till, which is very strong and generally an excellent foundation material. However, the slopes along Montlake Cut are relatively steep, so there would be an increased risk of erosion. The length of work area parallel to the steep slope contours would only be about 120 feet, so the risk of increased erosion would be relatively small.
- Earthwork would be reduced because of the narrower footprint along SR 502 through the Montlake area.

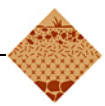
What are the effects of the South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast option?

The footprint of the westbound SR 520 to northbound Bellevue Way off-ramp would be slightly larger than with the original 6-Lane Alternative. The cut catch line, or wall, would come to the edge of the right-of-way, which abuts a parking lot on the adjacent property. The soils in this area are mapped as glacial till, so walls or cuts should be relatively easy to construct.

The westbound SR 520 to northbound Bellevue Way off-ramp would also place slightly more fill on potentially soft or liquefiable soils.

The footprint of the 108th Avenue Northeast interchange would be slightly larger and involve slightly wider fills to the north of the existing embankments. The soils in this area are anticipated to be suitable for spread footings, so the effect of the fill would likely be limited to the change in topography.

This option would add approximately 60,000 cubic yards (about 10 percent of original 6-Lane Alternative) of earthwork to the proposed project. However, the earthwork would be nearly balanced, so that the net change would be approximately 6,000 cubic yards of excess excavation, assuming dry weather construction and staging that would allow material reuse. Other quantifiable geology- and soils-related changes would be very small relative to the accuracy of the calculations, and therefore can be described as negligible.



Mitigation

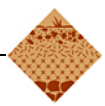
What are the mitigation measures for the 6 Lanes with Pacific Street Interchange option?

All of the mitigation measures described for the original 6-Lane Alternative would be applied to the 6 Lanes with Pacific Street Interchange option. Potential mitigation options that differ from the original 6-Lane Alternative are discussed below.

If there are soft, compressible soils beneath the eastern lanes of the widened Montlake Boulevard and fill is required to meet the existing roadway grade, it is possible that the area would be preloaded so that most of the anticipated settlement would occur prior to final grading and surfacing. Though unlikely (because the fill is relatively small and the depth of poor soil is likely to be small near this material boundary), if the foundation soils are very weak, mitigation measures similar to one of the following would be implemented to prevent foundation bearing failures:

- The embankment would be built in stages, with the embankment height at each stage limited by the strength of the fill, and consolidation and strength gain under the new load monitored to determine when it is safe to add addition embankment height.
- The subgrade and, possibly, embankment could be reinforced with a geogrid to prevent a foundation failure.
- Light-weight materials could be used to construct the embankment.

The pedestrian bridges across Montlake Boulevard would probably be founded on deep foundations on the east side to limit settlement. These foundations would also be designed to withstand lateral loads from lateral spreading of any liquefiable soils present. Pile foundations would eliminate the need for special soil disposal if any of the foundations were located above municipal refuse. Pedestrian bridge foundations on the west side of Montlake Boulevard would be founded on spread footings or deep foundations; a site-specific study and subsurface exploration would be needed to determine conditions.



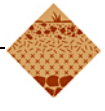
The subgrade beneath any widened portions of Montlake Boulevard subject to damage from liquefaction, but otherwise protected from long-term settlement, would not be improved to resist liquefaction. WSDOT's current policy is to allow the relatively quickly and inexpensively repairable damage to non-structural portions of roadways to occur during an earthquake, unless improvement is specially required as part of a lifeline access strategy.

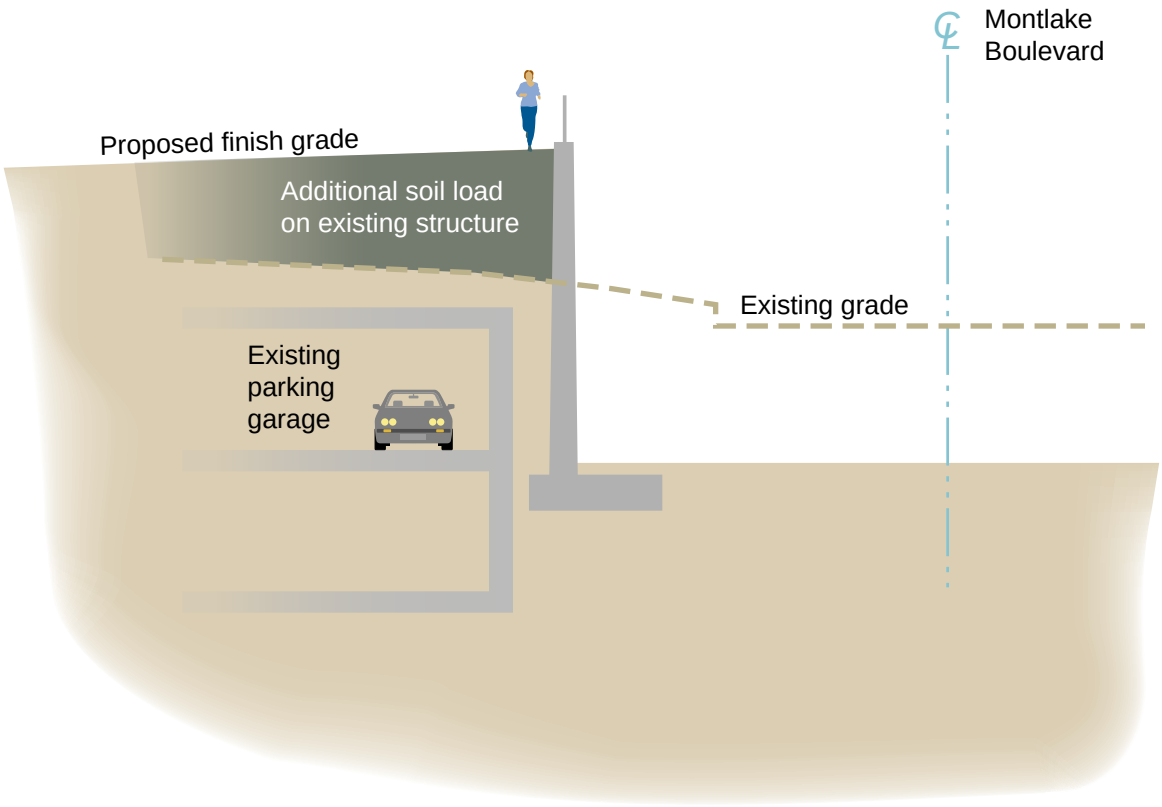
The area beneath Montlake Boulevard and Pacific Street contains existing and proposed underground structures. The eastern wall of the Triangle underground parking garage, which is bounded on all sides by either Pacific Place, Pacific Street, or Montlake Boulevard extends to approximately the line of the retaining wall that would support the cut for the lowered Pacific Street/Montlake Boulevard intersection. It is possible that a portion of the east wall and roof system for the parking garage would have to be reconstructed to withstand the new soil loads and loss of lateral support (Exhibit 8). The proposed Sound Transit North Link Light Rail station also would be constructed close to this intersection. Coordination between the projects would be needed during final design and either the SR 520 project designed to avoid impacts to the rail station or the station designed to be able to withstand additional loads from the proposed SR 520-related grading at the intersection.

Potential slope destabilizing effects due to temporary cuts for retaining wall construction and utility relocation at the base of the steep slope would be mitigated by (1) checking the slope stability with temporary cuts and requiring monitored shoring where the factor of safety is insufficient, and (2) limiting the length of open excavations where necessary to take advantage of strength in the third dimension, limit the impact of sloughing if it were to occur, and minimize the area subject to water infiltration at a given time.

What are the mitigation measures for the Second Montlake Bridge option?

Mitigation for the Second Montlake Bridge option would be similar to that described for the original 6-Lane Alternative.





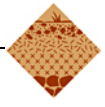
NOTES:
Structure outlines are conceptual only.
Drawing not to scale.

Exhibit 8. **Schematic of Potential Shared Wall with the University of Washington Triangle Parking Garage**

SR 520 Bridge Replacement and HOV Project

What are the mitigation measures for the South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast option?

Mitigation for the South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast option would be similar to that described for the original 6-Lane Alternative. In addition, a retaining wall may be needed between the parking lot and the westbound SR 520 to northbound Bellevue Way off-ramp. Depending on the off-ramp design, a temporary easement could be required for construction of the wall.

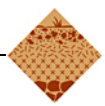


References

Booth, D.B., R.A. Haugerud, and J.B. Sacket. 2002. *Geologic Map of King County, Washington*.

CH2M HILL. 2005. *Geology and Soils Discipline Report*. Appendix H of the *Draft SR 520 Bridge Replacement and HOV Project*. Prepared for the Washington State Department of Transportation.

University of Washington (UW), 2005. "GeoMapNW at the University of Washington." http://geomapnw.ess.washington.edu/sgmp



Attachment 1

Subsurface Information Collected to Evaluate Seattle Project Area Options

Exhibit 1-1. Subsurface Information Collected to Evaluate Conditions for 6 Lanes with Pacific Street Interchange and Second Montlake Bridge Options

Document ID	Consultant	Document Name	Date
274	Shannon and Wilson	Subsurface Investigation, Utility Tunnel Extension - 1975, Hall Health Center and Johnson Hall	March 11, 1975
275	Terra Associates, Inc.	Geotechnical Engineering Report, Indoor Tennis Facility	April 23, 1987
277	Dames and Moore	Report of Geotechnical Investigation, Proposed Physics/Astronomy Building	October 16, 1990
279	RZA AGRA, Inc.	Subsurface Exploration and Geotechnical Engineering Report, University of Washington Boiler No. 4 Replacement	February 1993
286	Rittenhouse-Zeman and Associates, Inc.	Geotechnical Review Comments, Proposed Stack Addition	May 3, 1989
589	Hart-Crowser and Associates, Inc.	Subsurface Exploration and Geotechnical Engineering Study, Proposed Addition to the Intramural Athletics Building	July 23, 1981
590	Shannon and Wilson	Geotechnical Report-West Stands Reconstruction, Husky Stadium	June 24, 1988
591	AGRA	Subsurface Exploration and Preliminary Geotechnical Engineering Report, ICA Soccer and Baseball Field Development	May 1996
693	Hart-Crowser and Associates, Inc.	Soils and Foundation Engineering Study, Proposed Biological Sciences Facility	January 24, 1978
694	Roger Lowe Associates, Inc.	Soil and Foundation Investigation, Proposed Neutron Therapy Building	March 6, 1981
695	Converse Consultants NW	Geotechnical Design Report, Proposed Health Sciences K-Wing Addition	October 10, 1990
696	Shannon and Wilson	Geotechnical Report, University of Washington Medical Center, Linear Accelerator NN145D Replacement	September 1995
786	Dames and Moore	Report of Soils Investigation, Proposed Freezer Box Addition	September 30, 1977
2782	Shannon and Wilson	Geotechnical Report for Seismic Upgrade, South Campus Parking Garage	January 1996
3286	Seattle Engineering Department	NE Pacific Street HOV	April 3, 1989
3502	Shannon and Wilson	Phase 2 NE 45th Street Viaduct	March 1992
3688	Shannon and Wilson	Geotechnical Report, ICA Women's Softball Facility	July 1993

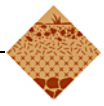


Exhibit 1-1. Subsurface Information Collected to Evaluate Conditions for 6 Lanes with Pacific Street Interchange and Second Montlake Bridge Options

Document ID	Consultant	Document Name	Date
3844	Rittenhouse-Zeman and Associates, Inc.	Subsurface Exploration, Physical Plant Offices Addition	December 19, 1980
3901	Shannon and Wilson	Fuel Oil Storage Tank	November 1971
3907	Rittenhouse-Zeman and Associates, Inc.	Proposed Chiller Building and Cooling Tower	October 1975
3928	Milbor-Pita, Inc.	Subsurface Exploration and Geotechnical Engineering Study for UW Chiller No. 7 Addition Project	May 1996
5383	Metropolitan Engineers	Final Report, Soils Investigation University Regulator	May 1974
6042	Geo-Recon, Inc.	Intramural Athletic Building, Seismic Profiles	September 1963
8266	Shannon and Wilson	Geotechnical Report, IMA Sports Field No. 3	March 2001
8303	Converse Consultants NW	Geotechnical Design Report, Proposed Radiation Waste Facility/B-Wing	October 19, 1990
8307	Converse Consultants NW	Geotechnical Design Report, Health Services GHI Wind Additions	April 9, 1990
8317	AGRA	Limited Geotechnical Report, Outdoor Practice Facility	April 3, 2000
8350	Shannon and Wilson	Soils Boring Mountain Climbing Practice Facility	February 11, 1972
8351	Shannon and Wilson	Proposed Tennis Courts Intramural Project Area	April 26, 1968
8352	Shannon and Wilson	Foundation Study, Hall Health Center Addition	December 4, 1973
8354	Earth Consultants, Inc.	Soil and Foundation Investigation, Proposed Addition to Hec Edmundson Pavilion	July 26, 1976
8355	Roger Lowe Associates Earth Sciences	Final Report Site Investigation Proposed Continuing Education Center	January 7, 1977
8359	Roger Lowe Associates	Soil and Foundation Investigation, Proposed Neutron Therapy Building	March 6, 1981
8361	Earth Engineers, Inc.	Geotechnical Engineering Study Roberts Hall Underground Building	August 13, 1984
8362	Shannon and Wilson	Geotechnical Report, University of Washington Stadium Expansion	June 4, 1982
8367	Dames and Moore	Report Test Borings to Check Sewer Location, Proposed Pedestrian Overpass	June 18, 1970
8368	Metropolitan Engineers	Rehabilitation North Interceptor, Phase III	April 1970 and June 1975

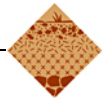


Exhibit 1-1. Subsurface Information Collected to Evaluate Conditions for 6 Lanes with Pacific Street Interchange and Second Montlake Bridge Options

Document ID	Consultant	Document Name	Date
8371	Shannon and Wilson	Foundation Investigation Auxiliary Air System, Kirsten Wind Tunnel	May 13, 1970
8372	Dames and Moore	Report of Soils Investigation, Proposed Pedestrian Overpass	October 16, 1969
8373	Dames and Moore	Report of Soils Investigation, Proposed Zoology Building	March 1968
8376	Dames and Moore	Report of Preliminary Soils Investigation, Proposed Printing Plant Building	April 25, 1967
8377	Shannon and Wilson	Report on Foundation Investigation for Proposed Utility Tunnel Extensions, Central Campus and MRCD Complex	January 10, 1966
8378	Dames and Moore	Report of Soils Investigation, Proposed Oceanography Building, Unit II	May 10, 1966
8379	Dames and Moore	Report of Soils Investigation, Proposed Health Sciences Teaching Increment, Phase I	July 23, 1969
8380	Shannon and Wilson	Foundation Investigation, Project X	November 1964
8381	Dames and Moore	Report of Preliminary Soils Investigation, Proposed Electrical Receiving Station	February 25, 1969
8383	Dames and Moore	Report of Additional Soils Investigation, Proposed Zoology Building	August 21, 1968
8387	Dames and Moore	Report of Soils Investigation, Support of Floor Slab, Edmundson Pavilion	July 21, 1966
9594	Shannon and Wilson	Ravenna Creek Storm Drainage Project, NE 45th Street Diversion	March 1994
9657	Shannon and Wilson	Geotechnical Report, Intramural Activities Building Expansion	February 5, 2001
9658	Dames and Moore	Report of Geotechnical Investigation, Oceanography Building 2122	June 27, 1996
9663	Shannon and Wilson	Report on Foundation Studies, New Arts and Science Building and Garage	November 1963
9665	Shannon and Wilson	Foundation Investigation, Residence Hall Unit IV	August 1963
9670	Shannon and Wilson	Phase II, Foundation Investigation, Power Plant Expansion - 1967	April 21, 1967
9671	Shannon and Wilson	University of Washington Physical Plan Services Building, Phase II	July 14, 1969
9672	Shannon and Wilson	Report on Foundation Investigation, Cooling Towers	October 1963
9673	Shannon and Wilson	Report on Union Bay Reclaimed Land	September 29, 1966

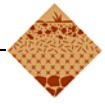
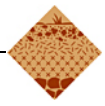


Exhibit 1-1. Subsurface Information Collected to Evaluate Conditions for 6 Lanes with Pacific Street Interchange and Second Montlake Bridge Options

Document ID	Consultant	Document Name	Date
9674	Dames and Moore	Foundation Evaluation and Review of Existing Data, Proposed Intramural Athletics Building	January 25, 1965
9675	Shannon and Wilson	Intramural Athletic Building	October 9, 1964
9676	Dames and Moore	Report of Soils Investigation, Revised Location, Proposed Intramural Athletics Building	June 7, 1965
9682	Shannon and Wilson	Foundation Investigation, Proposed Athletic Department Office Building	July 1962
9687	Shannon and Wilson	Geotechnical Report, University of Washington Golf Driving Range	September 2001
9689	Shannon and Wilson	Foundation Investigation for Proposed Utilities Tunnels	July 1963
9695	Seattle Engineering Department	NE 44th Street Pavement Settlement	November 21, 1989
9717	Seattle Engineering Department	NE 45th Street Viaduct East Approach Replacement	May 12, 1972
9775	Dames and Moore	Proposed Intramural Athletics Building and Final Location of Intramural Athletics Building	May 1965 and July 1965
9776	Pacific Testing Laboratories	University of Washington Athletic Area Extension	October 14, 1965
9787	Shannon and Wilson	University of Washington Engineering Classroom - Library	September 1, 1966
9797	Seattle Engineering Department	East 45th Street Viaduct Foundation Data	August 1939
9932	Dames and Moore	Report of Foundation Investigation, Proposed New Scientific Stores Addition	June 25, 1970
9933	Geolabs, Inc.	South Campus Center	September 1971
9934	Pacific Testing Laboratories	Subgrade Investigation, Teaching Hospital and Ultimate Hospital Development, Division of Health Sciences	March 26, 1952
9936	AESI	Site and Exploration Plan, Husky Stadium Expansion	January 1986
10229	Shannon and Wilson	Radiation Therapy and Hospital Clinic	April 27, 1970
13630	Shannon and Wilson	Foundation Investigation for East Approach Replacement, NE 45th Street Viaduct	July 12, 1974
14373	Shannon and Wilson	Plans Review, Conibear Shellhouse Renovation and Addition	August 28, 2003



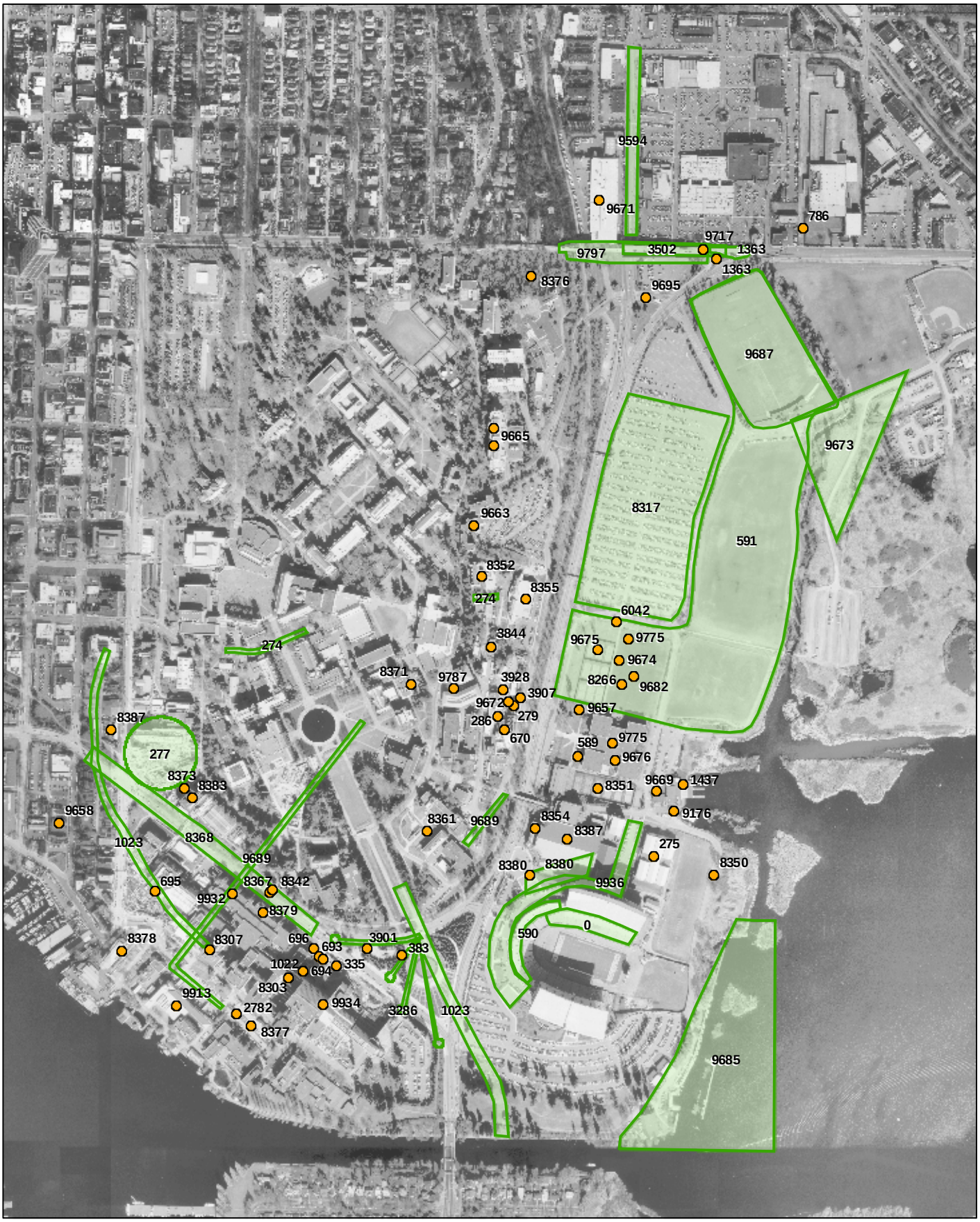


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Exhibit 1-2. **Report Locations**

SR 520 Bridge Replacement and HOV Project

File Path: P:\Parametrix\168395\180171 SR 520 Bridge Replacement\GIS\Layouts\Addendum\Geology\ReportLocations.mxd, Date: December 7, 2005 9:02:37 AM