GEOLOGY AND SOILS DISCIPLINE REPORT
Poplar Way Extension Bridge, Phase II
Lynnwood, Washington

HWA Project No. 2012-121-21

Prepared for
Perteet Inc.

April 3, 2014

HWA GEOSCIENCES INC.

- *Geotechnical Engineering*
- *Hydrogeology*
- *Geoenvironmental Services*
- *Inspection & Testing*

HWA GEOSCIENCES INC.
Geotechnical & Pavement Engineering • Hydrogeology • Geoenvironmental • Inspection & Testing

April 3, 2014
HWA Project No. 2012-121-21

Perteet Inc.
2707 Colby Avenue, Suite 900
Everett, Washington 98201

Attention: Mr. Carl Einfeld, P.E.

Subject: **GEOLOGY AND SOILS DISCIPLINE REPORT**
Poplar Way Extension Bridge, Phase II
Lynnwood, Washington

Dear Mr. Einfeld:

As requested, HWA GeoSciences Inc. (HWA) completed the geology and soil discipline report for the Poplar Way Overcrossing Project, Phase II in Lynnwood, Washington. We appreciate the opportunity to provide geotechnical engineering services on this project. If you have any questions regarding this report or require additional information or services, please contact the undersigned at your convenience.

Sincerely,
HWA GEOSCIENCES INC.

Donald J. Huling, P.E.
Geotechnical Engineer

Steven E. Greene, L.G., L.E.G.
Principal Engineering Geologist

21312 30th Drive SE
Suite 110
Bothell, WA 98021.7010

Tel: 425.774.0106
Fax: 425.774.2714
www.hwageo.com

TABLE OF CONTENTS

LIST OF FIGURES (FOLLOWING TEXT)

GEOLOGY AND SOILS DISCIPLINE REPORT
POPLAR WAY EXTENSION BRIDGE, PHASE II
LYNNWOOD, WASHINGTON

1.0 SUMMARY

This Geology and Soil discipline report describes the geologic conditions present along the project alignment of the Poplar Way Overcrossing Project (PWOP) and the anticipated construction and operational effects of the PWOP on the geology and soil environment. The PWOP will consist of constructing a new bridge over Interstate 5 (I-5) to connect Poplar Way to Alderwood Mall Boulevard to the north. This discipline report addresses a Build Alternative and a No Build Alternative. The Build Alternative consists of constructing a bridge that is approximately 600-feet long that would consist of 6 travel lanes with bike lanes and sidewalks on both sides.

The PWOP is located in east-central Lynnwood, Washington astride the I-5 corridor south of the Alderwood Mall. The geology encountered generally consists of glacially overridden deposits locally overlain by various thicknesses of recent native soils (deposited by natural geologic processes) or fills (deposited by man).

The geologic hazard with the greatest potential to affect the PWOP is erosion of soils exposed during construction.

The proposed four span bridge is to be founded on spread footings at the north and south abutments and drilled shafts at the interior pier locations. The project will require raising grade at the intersection of 196th Street SW and Poplar Way by about 5 feet. The intersection of Alderwood Mall Boulevard and 33rd Avenue West may be raised as much as 8 feet. Retaining walls will be needed at both intersections to facilitate the grade changes. Retaining walls will also be needed at the bridge abutments. The alignment of the Interurban trail will be altered to extend under the proposed roadway to maintain traffic along the trail. The subject trail undercrossing is to consist of a three-sided precast concrete box culvert supported on spread footings. Most of the major construction effects identified for the build alternative relate to temporary control of excavations. Mitigation measures identified herein and in the final design will be implemented during construction in accordance with the approved plans and specifications using Best Management Practices specified by the City of Lynnwood.

The geology and soils-related operational effects of the build alternative identified are due to increased storm water flow generated by the drainage of the new bridge structure. Site specific mitigation measures identified during the design process would be used to address specific effects to adjacent facilities as appropriate. The identified effects can be mitigated by proper construction methods.

2.0 PROJECT DESCRIPTION

City of Lynnwood proposes to construct a new bridge over I-5 to connect Poplar Way to the south with Alderwood Mall Boulevard to the north. A vicinity map showing the project location is presented in Figure 1. The proposed bridge is to be approximately 600 feet long and will consist of 6 travel lanes with bike lanes and sidewalks on both sides. The proposed four span bridge is to be founded on spread footings at the north and south abutment and drilled shafts at the interior pier locations.

The project will require raising grade at the intersection of 196th Street SW and Poplar Way by about 5 feet. The intersection of Alderwood Mall Boulevard and 33rd Avenue West may be raised as much as 8 feet. Retaining walls will be needed at both intersections to make the grade changes. Retaining walls will also be needed at the bridge abutments.

It is our understanding that the Interurban trail will be routed under the proposed roadway to maintain traffic along the trail. The subject undercrossing is to consist of a three-sided precast concrete box culvert supported on spread footings.

In addition to bridge construction, we understand that this project will include pavement construction and overlays along Poplar Way, 196th Street SW, Alderwood Mall Boulevard and 33rd Avenue West.

A Schematic depicting the project layout is shown on Figure 2.

2.1 PURPOSE AND NEED

The Lynnwood City Center Access Study identified this bridge as an alternative to the 196th Street SW crossing at I-5, and as the most significant solution for congestion relief in the City Center along 196th Street SW, and around Alderwood Mall and Alderwood Mall Parkway. This project is one of the highest priority projects identified by the Lynnwood City Center Access Study.

2.2 AFFECTED ENVIRONMENT AND EFFECTS

The following section describes the existing geologic conditions (topography and stratigraphy; and erosion, landslide, and seismic hazards) that may affect or be affected by the Poplar Way Extension Project. The known presence or potential for encountering contaminated soils during construction is also considered.

2.2.1 No Build Alternative

Under the No Build alternative the project would not be built and traffic congestion would likely continue to increase in the local area. The effects and potential impacts to soils and geology from construction would not exist. The effects and impacts of operations of the unmodified urban transportation features would remain the same as they are now.

2.2.2 Build Alternative

Under the Build alternative, excavations would be made for bridge foundations, fills would be placed for bridge approaches, retaining walls constructed to support fills, drilled shafts would be installed for interior bridge piers, and arterial roadways would be re-paved. Some of the excavation and fill placement will occur on sloping areas. Potential soils & geology-related operational impacts most likely consist of erosion and increased storm water runoff.

3.0 METHODOLOGY

The purpose of this Soils & Geology Discipline report is to identify soil and geologic conditions and associated potential hazards, assess the potential effects of the project with respect to soils and geology, and if found appropriate, identify measures to mitigate potential adverse effects.

Geologic and Soil conditions were reviewed because the project would involve movement and alteration of soil materials. Understanding the local geologic and soils conditions in the project area is necessary to understand and limit potential environmental effects.

Information was collected from the Snohomish County Critical Areas Ordinance, Snohomish County Landscape Imaging (SnoScape), Washington Department of Natural Resources (WDNR), Snohomish County Soil Survey (National Resource Conservation Service: NRCS, 1979), and United States Geological Survey (USGS). In addition, project files and draft geotechnical reports prepared by HWA pertaining to the Poplar Way Overcrossing Project were reviewed. During the course of our field activities conducted during the geotechnical investigation required for the project, we examined site conditions, and conducted a subsurface exploration program (HWA, 2013a).

If the potential for effects to these resources was found, recommended BMP’s, were developed for each effect identified. The recommended BMP’s were selected based on experience with similar projects and accepted industry standard engineering practices.

4.0 AFFECTED ENVIRONMENT

4.1 TOPOGRAPHY

The project corridor extends across all lanes of I-5 to connect the intersections of Poplar Way and 196th Street SW and the intersection of Alderwood Mall Boulevard and 33rd Avenue West, as shown on Figure 1. The existing topography along the proposed bridge alignment is relatively flat with the exception of existing fill embankments at each end of the proposed bridge structure.

4.2 REGIONAL GEOLOGY

During the Vashon stade, from approximately 20,000 to 13,000 years ago, the Puget lobe of the Cordilleran continental ice sheet advanced south from western British Columbia, filling the

Puget Sound lowland with an approximate maximum 3,000-foot thickness of ice at the latitude of Lynnwood. During advance of the ice, the sedimentary environment of lakes distant from the ice front transitioned from non-glacial to glacial. As the ice approached, glacial flour (silt and clay) was deposited in areas of slack water. Next, advance outwash consisting mostly of clean sand with pebbles was deposited in broad fans by meltwater emanating from the glacier. As the advancing glacier overrode the advance outwash, a layer of lodgment till was deposited at the base of the ice. The till consists of an unsorted, non-stratified mixture of silt, sand, gravel, clay, and boulders. Due to the weight of the ice, the lodgment till, advance outwash, glaciolacustrine, and older non-glacial terrestrial deposits have been over-consolidated to a very dense or hard condition. Post-glacial geomorphic processes have included mass-wasting of steep slopes, alluvial reworking of sediments, and formation of wetlands in poorly drained areas.

4.3 Local Geology

General geologic information for the project area is published in the *Preliminary Surficial Geologic Map of the Edmonds East and Edmonds West Quadrangles* (Smith, 1975). This map indicates that the near surface deposits across the project corridor consist of Vashon Glacial Till. The soils along the I-5 corridor are shown as Modified Land in association with the construction of the I-5 freeway (see Figure 3).

Based on our subsurface exploration program, the project site is underlain by a series of glacial till-like soils that are subsequently underlain by coarse-grained advance outwash that transitions to finer-grained advance outwash at depth. Thin layers of weathered soil and fill were encountered near the surface in specific areas across the site (HWA, 2013a). Descriptions of the geologic units mapped at the surface of the project area are presented in Exhibit 1.

Exhibit 1 Surficial Geology in the Study Area

Unit Designation	Geologic Unit	Description
Ml	Modified land	Fill soils associated with the construction of the Interstate Freeway. Materials consist of reworked native soils that are typically composed of silty sand with gravel that is medium dense to dense.
Qvt	Glacial Till	Lodgement till laid down along the base of glacial ice. Composed of gravelly silty sand to gravelly sandy silt that often contains cobbles and boulders and is very dense.

4.4 SOILS

According to the USDA Soil Survey for Snohomish County (1983, NRCS-online web soil survey) the predominant soils in the study area consist of Alderwood-Urban Land Complex, 8 to 15 percent slopes (map symbol 6) and Urban Land (map symbol 78). The site soils map is depicted on Figure 4.

The Alderwood-Urban Land Complex, 8 to 15 percent slopes, is composed of approximately 60% Alderwood gravelly sandy loam, 25% Urban land, and 15% Everett, Indianola, Kitsap and Ragnar soils. The Alderwood soils form on till plains and are moderately deep and moderately well drained. Permeability is moderately rapid above the cemented (hardpan) layer and very slow through it. Runoff is slow and erosion hazard is slight. Urban land consists of areas covered by streets, buildings, parking areas and other structures that obscure or alter the surface soil such that classification is not possible.

4.5 SURFACE WATER AND GROUND WATER

Ground water was encountered during our explorations (HWA, 2013) at depths ranging from 9 to 45 feet below ground surface. Based on our explorations and a review of explorations by others, we believe that two distinct ground water tables exist across the project site. The upper ground water table consists of perched water trapped on top of the relatively impermeable glacial till-like soil. We believe this perched ground water table to be seasonal in nature with the highest ground water level expected during and after the wet winter months.

The more prominent ground water table, encountered across the project site, is associated with the advance outwash soils present at depth. Our explorations indicate that the ground water within the advance outwash is under significant artesian pressure. The soil conditions encountered in our explorations indicate that this artesian pressure is caused by a series of scattered water bearing sand seams within the overlying glacial till-like soils that are hydraulically connected to the advance outwash. We expect that water bearing sand lenses will be encountered throughout the glacial till-like soils across the site.

4.6 GEOLOGIC HAZARDS

The City of Lynnwood Environmentally Critical Areas Ordinance (*COL Municipal Code Section 17.10*) is intended to fulfill Washington State's Growth Management Act (Chapter 36.70A RCW) requiring all cities and counties to identify critical areas within their jurisdictions and to formulate development regulations for their protection. Among the critical areas designated by the Washington State Growth Management Act are geologically hazardous areas, classified as such because of their potential susceptibility for earthquake, sliding, erosion, or other geologic events.

Geologically hazardous areas are defined under the City of Lynnwood Code, *Section 17.10.030.G* as those areas that:

1. Have naturally occurring slopes of 40 percent or more;
2. Other areas which the City has reason to believe are geologically unstable due to factors such as landslide, seismic or erosion hazard.

These areas may not be suitable for development consistent with public health and safety concerns without conducting specific studies during the design and permitting process.

4.6.1 Seismicity

The project is located in a region where numerous small to moderate earthquakes and occasional large magnitude quakes have occurred in recorded history. Since the 1850s, over 25 earthquakes of Magnitude 5.0 or greater have occurred in the Puget Sound region. Much of this seismicity is the result of plate tectonics; the result of continual relative movement and collision between tectonic plates. In this region the plates include the Juan de Fuca Plate and the North American Plate. As these plates collide, the Juan de Fuca Plate is being driven (subducted) to the northeast, beneath the North American Plate. The result of the relative plate movement is east-west compression, clockwise rotation, shearing, and north-south compression of the earth's crust along the leading edge of the North American Plate (Wells et al, 1998). The earthquakes in Western Washington occur in three distinct settings: shallow, crustal earthquakes that occur in the North American plate; deep, Wadati-Benioff zone earthquakes within the subducted oceanic crust (Juan de Fuca plate); and offshore, subduction zone earthquakes, where the brittle portions of the Juan de Fuca and North American Plate are in contact.

Shallow Crustal Zone: Most historical earthquakes in the region have occurred within the shallow crustal zone at depths of about 12 miles or less. Shallow crustal earthquakes have not typically occurred along faults recognized and mapped by geologists over the past 170 years. Until recently (over the past 30 years) it had been assumed that shallow crustal events within the Puget Sound region would be relatively small and of limited magnitude (less than 6.0), however, research over the past 20 years indicates that these previously identified faults are capable of producing a earthquakes with magnitudes up to 7.5. The closest shallow crustal seismogenic structure capable of producing a significant earthquake is the South Whidbey Island Fault Zone (SWIF). The South Whidbey Island Fault Zone is a northwest trending structure along the southwest flank of the Everett basin. The SWIF was mapped previously using borehole data, magnetic or gravity potential field anomalies, and marine seismic reflection surveys. The SWIF consists of three subparallel, northwest trending strands extending from near Vancouver Island to the north Puget lowland. According to recent studies (Sherrod et al., 2008), the southeastward extension of the fault crosses the northeastern margin of the Seattle basin and merges with Seattle fault and other active structures, suggesting that the SWIF extends a minimum of 150 km, from near Victoria to east of Seattle. The fault passes through heavily populated regions between the cities of Seattle and Everett, Washington concealed beneath a thick mantle of young glacial deposits and vegetation. As such, the project area lies about 5 miles north of the inferred SWIF zone. Kelsey and Sherrod (2001) conducted paleoseismology studies on the northeastern fault on Whidbey Island and concluded that the SWIF ruptured approximately 3,000 years ago causing 2.5 meters in displacement of a salt marsh on Whidbey Island. Johnson et. al. (1996) describes three seismic events greater than Magnitude 3.5 along the SWIF since 1970; two of Magnitude 4.7 and 3.8 (near Admiralty Inlet), and one of Magnitude 3.7 (near the southern end of Whidbey Island). Ruptures on the fault are expected to occur at depths of 15 to 27 kilometers. Johnson, et al. (1996) suggests that the SWIF is capable of producing a Magnitude 7.3 earthquake.

Deep Intra-Plate Zone. Historical earthquake damage in the Puget Sound region has resulted from deep intraplate zone earthquakes, with the 1949 Olympia earthquake, 1965 Seattle-Tacoma earthquake, and 2001 Nisqually earthquake events creating the most damage. According to the University of Washington, the Nisqually Earthquake information clearing house website (http://www.ce.washington.edu/~nisqually/index.html), the February 28, 2001 Nisqually earthquake (Magnitude 6.8) caused damage to roads, port facilities, business and residential structures including, settlements, cracks, embankment and bridge abutment failures.

Interplate Zone: Geologic and geophysical evidence also indicates that large subduction zone earthquakes (Magnitude 8 to 9) can occur along the Washington and Oregon coast. The paleoseismic record suggests five or six subduction zone events have occurred over the last 3,500 years (Atwater, 1987). Tree ring data and Japanese historical records date the latest subduction zone earthquake to 1700 (Jacoby et al, 1997). The duration of shaking for a subduction zone quake could be several minutes.

Geophysical investigations suggest that earthquakes may also occur from a network of faults beneath the Puget Sound Basin.

4.6.2 Faulting

The nearest potentially active fault is the South Whidbey Island Fault (SWIF) which lies approximately 10 miles north of the project site. Recent field evidence suggests that the south Whidbey Island Fault Zone has been active during Holocene (recent) time. Rupture of the ground surface and vertical offset within the subject site is not anticipated. A fault location map for the Puget Area is shown on Figure 5.

4.6.3 Liquefaction and Lateral Spreading

When shaken by an earthquake, loose, saturated sandy soils lose strength and temporarily behave as if they were liquid when the water pressure in the pore spaces nears the level sufficient to separate the soil grains from each other. This phenomenon is known as liquefaction. The seismically induced loss of strength can result in failure of the ground surface, which is typically expressed as lateral spreads, surface cracks, and settlement. Buildings and other structures founded on or in potentially liquefiable soils may settle, tilt, move laterally, or collapse. The degree of liquefaction depends on the consistency and density of the soils, grain size distribution of the soil, and the magnitude of the seismic event.

Based on the very dense nature of the glacial till and advance outwash soils encountered along the project alignment, liquefaction is not considered to be potential hazard that could impact this project. A portion of the Liquefaction Map for Snohomish County including the project location is shown on Figure 5

4.6.4 Landslide-Steep Slope Hazards

Areas of potential slope instability are limited to existing slope embankments facing I-5 (See Figure 6). These slopes, however, are not naturally occurring and were made during construction of the interstate freeway, as such are wholly comprised of cut native soils or composites with compacted fill soils placed over cut native soils under controlled conditions. Results of our project exploration program indicate that fills associated with the construction of I-5 are well compacted, medium dense to dense granular soils. Native glacially consolidated soils exposed within the same areas are dense to very dense. Consequently, the local soils conditions are not considered to be conducive to deep-seated sliding and not a potential hazard that could impact this project.

4.6.5 Erosion Hazards

Erosion hazard areas are defined by the City of Lynnwood Ordinance 2598 Chapter 17.10.030(E) as those areas containing soils which, according to the USDA Soil Conservation Service Soil Survey, have severe to very severe erosion hazard potential. The general site surface soils consist of Alderwood-Urban Land Complex, 8 to 15% slope soils that have only a slight susceptibility to erosion.

4.6.6 Hazardous Materials

A phase 1 environmental site assessment with limited soils sampling was conducted at the project site (HWA, 2013b). Historical research indicates the subject property has consisted of street and right-of-way since the early 1940’s. The first developed use of the subject property was a secondary street along the alignment of the modern 196th Street Southwest in the 1940’s. Interstate 5 was constructed through the proposed project alignment in the 1960s. Development in the surrounding area was initially residential and agricultural, with urban and commercial development beginning in the 1960’s.

The Phase I assessment revealed two recognized environmental conditions (RECs) in connection with the subject property, as follows:

- Petroleum odors were noted in shallow fill soils along 196th Street SW during a pavement condition assessment. The source or extent of these petroleum-affected soils was not determined. The soils are located in the vicinity of a listed underground storage tank (UST) site.
- There is a potential for soil contamination at parcel 00372600100407, located northeast of the intersection of 33rd Avenue West and Alderwood Mall Boulevard. A review of

public files and/or communication with the property owner or representative will be necessary to assess it the affected soils are within the proposed project alignment.

Although RECs were found, HWA did not recommend a Phase II ESA at the subject property because the planned site improvements are mostly above grade, requiring little excavation or grading, with the exception of retaining walls and bridge piers. Construction of the overcrossing will primarily involve raising the grade at the north and south approaches, although subsurface construction will be required for retaining walls and bridge piers.

Due to the nature of the project alignment as a historic roadway there is a potential to encounter shallow petroleum-affected soils from accidental releases or former roadway impacts (e.g., oiled road beds). As such, construction specifications should include provisions for safe handling, characterization, transportation, and disposal of petroleum-contaminated soils, if encountered during subsurface activities.

5.0 CONSTRUCTION EFFECTS AND MITIGATION

Construction effects are primarily related to earthworks and occur during construction or within a short time after. The potential geology and soils related effects of the build alternative would generally be related to effects of earthworks on existing features, such as structures and utilities.

5.1 No Build Alternative

No construction is proposed for the No Build alternative, thus there are no anticipated effects. Refer to Section 6.0 for operational and continued maintenance effects likely to occur for the No Build alternative.

5.2 Build Alternative

The following sections present discussions of different types of construction effects and related mitigation measures for the Build Alternative during construction.

5.2.1 Erosion and Sediment Transport

Impact Surface areas within the vicinity of the bridge approaches and foundation areas would be stripped of all existing pavement, structures, vegetation, organic soils and debris. The debris generated from stripping would be removed from the site area. The resulting bare soil surfaces would have a high potential for erosion if exposed during the rainy season or in the presence of surface water. Areas disturbed by construction in this way are likely to be subject to increased erosion unless control measures are in place. In addition, construction traffic moving over disturbed ground could sink, dislodge, and carry surface soils onto adjacent roadways or haul routes unless best management practices (BMP's) are implemented.

Mitigation Erosion control measures include vegetative and structural controls. Structural controls would primarily be used because the site is highly developed and/or adjacent to a major interstate freeway. Structural controls consist of means other than vegetation to prevent sediment from leaving the construction area, such as; silt fences, ditches, berms, tire wash facilities, etc. Proposed mitigation measures would comply with storm water design and treatment procedures in the current version of the City of Lynnwood's Storm water Management Code and those of WSDOT, where applicable. The erosion and sediment control measures should be in place before any clearing, grading or construction.

5.2.2 Stability of Temporary Excavations

Impact The contractor has control over factors during construction that are critical to the stability of the excavation slopes. Such factors include the amount of slope opened at one time, the length of time the slope is left open, and when the slope is left open in terms of weather conditions. Exposure of personnel within confined or deep excavations and risk of movement and settlement of nearby roadways, structures and utilities located adjacent to or beneath temporary cut slopes is the Contractor's responsibility. In addition, construction equipment working adjacent to the top of shoring walls may cause wall movement and ground settlement.

Mitigation Proper construction procedures should be used to install temporary shoring for excavations. For planning and estimating purposes, it should be assumed that temporary excavations exceeding 4 feet in depth must be sloped, benched or shored, according to Part N of Section 196-155 of the Washington Administrative Code (WAC). Construction should proceed as rapidly as feasible, to limit the time temporary excavations are open. During wet weather, runoff water should be prevented from entering excavations, and should be collected and disposed of outside the construction limits. Heavy construction equipment, building materials, and surcharge loads such as excavated soil should not be allowed within 1/2 the slope height from the top of any excavation.

Time and the presence of seepage and/or precipitation can significantly reduce the stability of temporary unsupported cut slopes. Therefore, all temporary slopes should be protected from erosion by installing a surface water diversion ditch or berm at the top of the slope and by covering the cut face with well-anchored plastic sheets. In addition, the contractor should monitor the stability of all temporary cut slopes and adjust the construction schedule and slope inclination accordingly.

5.2.3 Fill Embankments

Impact Approximately 5 to 20 feet of new fill may be placed and compacted within the bridge approach areas. Use of unsuitable soils (those containing debris or organics), fill placement during wet weather, or improper fill placement and compaction methods could result in excessive settlement of the fill over time, regardless of subsurface conditions. Excessive settlement would cause damage to facilities that are supported by the fill, such as the roadway or utilities.

Mitigation Suitable fill materials would be used to construct the fills. For structural fill the material should consist of sand and gravel with a low percentage of fines (less than 30 percent). During periods of wet weather, material with less than 5 percent fines may be required for use as structural fill. Structural fill would be densely compacted to the criteria required by the City of Lynnwood and WSDOT, as appropriate.

5.2.4 Eastern Approach Retaining Wall Construction

Impact The eastern approach ramp for the Poplar Way I-5 overcrossing bridge will require raising grade several feet requiring a taller retaining wall than the existing soil nail wall that is currently in place. Removal of the existing wall is not recommended since it currently retains slopes below the existing 196th Street overcrossing, creating the potential for embankment settlement and damage to the overlying structure.

Mitigation To avoid removal of the existing soil nail wall, a new soldier pile wall will be constructed in front the existing wall. The narrow space between the two walls will be backfilled with controlled density fill. The area above the existing wall and behind the new wall will be backfilled with properly compacted structural fill.

5.2.5 Interurban Trial Overcrossing

Impact The western approach ramp of the Poplar Way I-5 overcrossing will pass over the alignment of the Interurban trail. The trail undercrossing is to consist of a three-sided precast concrete box culvert supported on spread footings. In order to accommodate the trail tunnel, an excavation will be required between the western trail edge and Alderwood Mall Boulevard. The excavation could encroach and potentially create serious traffic impacts along Alderwood Mall Boulevard if it was constructed as an un-shored cut slope.

Mitigation In order to minimize the potential impact to existing transportation features and local traffic during construction, portions of the excavation for the trail undercrossing will be shored by a soldier pile wall, where appropriate. It is likely that portions of this wall would be temporary and will be removed when tunnel construction is complete. Other portions, typically those extending beyond either end of the tunnel, will serve as permanent wing walls.

5.2.6 Soil Stockpiles

Impact During construction soil material may be temporarily stored on site in stockpiles. Without proper management stockpiles may be placed over existing structures that could be damaged by loading or induced settlement. Surficial soils contained in stockpiles have a high potential for erosion during periods of wet weather if not protected.

Mitigation On site stockpiles would be covered to prevent erosion and sediment transport. Stockpiles would not be located over utilities or pavements that could be damaged from loads or settlement caused by the stockpiles.

5.2.7 Drainage in Construction Areas

Impact Improper handling of stormwater during construction could result in an impact to local stormwater quality.

Mitigation The development and implementation of an approved storm water pollution prevention plan (SPPP) would serve to reduce, eliminate or prevent the potential for storm water contamination from construction activity.

5.2.8 Pavements

Impact Construction activities and traffic could result in unintended damage to existing pavements adjacent to the project site.

Mitigation Construction traffic would be routed to City approved haul routes, which include roadways capable of handling heavy loading. In areas where construction traffic cannot be re-routed onto suitable roadways, existing roadways would either have to be improved prior to construction or repaired following construction. To reduce dust during hauling, the loads would be covered during transport.

5.2.9 Hazardous Materials

Impact Potential project effects from contamination include the following:

- Cleanup Liability – If soil or ground water contamination is present on land acquired by the City for this project, the City may be considered a potentially liable party by the Department of Ecology for cleanup actions. This potential is considered low due to the minor impacts anticipated and minor property acquisitions planned.
- Worker Safety and Public Health - Contaminated soil and ground water may be encountered during construction, potentially exposing workers and the public. Potential exposure of site workers and the public can occur through all routes of exposure (direct contact / dermal, ingestion, and inhalation). Contaminated soil effects on construction activities are expected to be relatively minor.
- Construction hazardous materials impacts - Other potential effects of contamination during site construction activities include spills of hazardous materials used for construction or used by construction equipment, such as petroleum fuels, lubricants, antifreeze, paints, coatings, concrete products, etc.

Mitigation Potential mitigation measured for contamination related issues include the following:

- Cleanup Liability impacts may be mitigated via administrative settlements with the State (e.g., Agreed Order and/or Consent Decree), or cost recovery actions from third parties or property sellers. Cleanup liability can also be negotiated prior to and as part of property transactions. These measures are not anticipated due to the relatively minor anticipated impacts.

- Worker Safety and Public Health – Worker and public health and safety mitigation measures include compliance with applicable health and safety regulations, site monitoring, worker training, protective equipment, health and safety plans and procedures. Project plans and specifications will include all existing site assessment data, as well as provisions for handling of contaminated media, health and safety requirements and procedures.
- Construction hazardous materials impacts – These potential impacts will be mitigated by requiring contractors to develop and implement a Spill Prevention Control and Countermeasures Plan (SPCC). The SPCC includes measures for avoiding and responding to spills or releases during construction.

6.0 OPERATIONAL EFFECTS AND MITIGATION

Operational effects are those that will occur over the long term operation of the proposed new transportation features.

6.1 NO BUILD ALTERNATIVE

The No Build alternative does not involve a change in the current configuration of the project and therefore no change in current operations and maintenance of the urban transportation features would occur.

6.2 BUILD ALTERNATIVE

Impact The build alternative results in the creation of a new structure thereby increasing the local amount of impervious surface able to generate storm water run off that would need to be conveyed to the appropriate treatment and disposal facilities throughout the operational life of the structure.

Mitigation Review of local facilities capacity to accommodate the additional stormwater volume estimated to be generated from this structure would be conducted during the project design. Consideration to up-sizing local conveyance and disposal facilities will be given during the design process as necessary.

We appreciate the opportunity to provide geotechnical and geoenvironmental services on this project. Should you have any questions or comments, or if we may be of further service, please do not hesitate to call.

Sincerely,

HWA GEOSCIENCES INC.

Donald J. Huling, P.E.
Geotechnical Engineer

Steven E. Greene, L.G., L.E.G.
Principal Engineering Geologist

7.0 REFERENCES

Atwater, B.F., Musynu-Rokkaku, S., Satake, K., Tsuji, Y., Ueda, K., and D.K. Yamaguchi, 2005, *The Orphan Tsunami of 1700.* USGS.

Atwater, B.F., 1987, Evidence for Great Holocene Earthquakes Along the Outer Coast of Washington State, Science. 1987 May 22; 236(4804):942-4.

Blakley, R.J., 2002. *Location, Structure and Seismicity of the Seattle Fault Zone, Washington: Evidence from Aeromagnetic Anomalies,* Geologic Mapping, and Seismic-Reflection Data. GSA Bulletin, V. 114, no. 2. February 2002.

Goldfinger, C., C.H. Nelson, A.A. Morey, J.E. Johnson, J.R. Patton, E. Karabanov, J. Guitierrez-Pastor, A. T. Eriksson, E. Garcia, G. Dunhill, R.J. Enkin, A. Dallimore, and T. Vallier, 2012, *Turbidite Event History-Methods and Implications for Holocene Paleoseismicity of the Cascadia Subduction Zone*, U.S. Geological Survey: Professional Paper 1661-F.

Gower, H. D., Yount, J. C., Crosson, R. S., 1985, *Seismotectonic Map of the Puget Sound Region, Washington*, U.S. Geological Survey: Miscellaneous Investigations Series Map I-1613.

HWA GeoSciences Inc., 2013a, *Draft Geotechnical Engineering Report; Poplar Way Overcrossing Project, Lynnwood, Washington*. Prepared for Perteet Inc. on June 6, 2013.

HWA GeoSciences Inc., 2013b, *Draft Phase 1 Environmental Site Assessment: City of Lynnwood, Poplar Way Overcrossing Project, Lynnwood, Washington*. Prepared for Perteet Inc, on June, 30, 2013.

Jacoby, G. C., D. E. Bunker, and B. E. Benson, 1997, Tree-ring evidence for an A.D. 1700 Cascadia Earthquake in Washington and northern Oregon, Geology, November 1997, Vol. 25, no. 11, 999-1002.

Johnson, S.V., et al., 1994. *Origin and Evolution of the Seattle Fault and Seattle Basin, Washington*. GEOLOGY, V. 22, p 71-74, January 1994.

Johnson, S. Y., C. J. Potter, J. M. Armentrout, J.J. Miller, C. A. Finn and C. S. Weaver, 1996, The Southern Whidbey Island Fault: An active structure in the Puget Lowland, Washington, Geol. Soc. Am. Bull., 108, 334-354.

Kelsey, H. M., and Sherrod, B. L., 2001, Investigation of late Holocene fault displacement on the southern Whidbey Island fault zone in the northern Puget lowland: Collaborative Research between Humboldt State University and the U.S. Geological Survey, Earthquake Loss Reduction Products, Cascadia: NEHRP Annual Report, External Grant award number 00HQGR0067, 6 p.

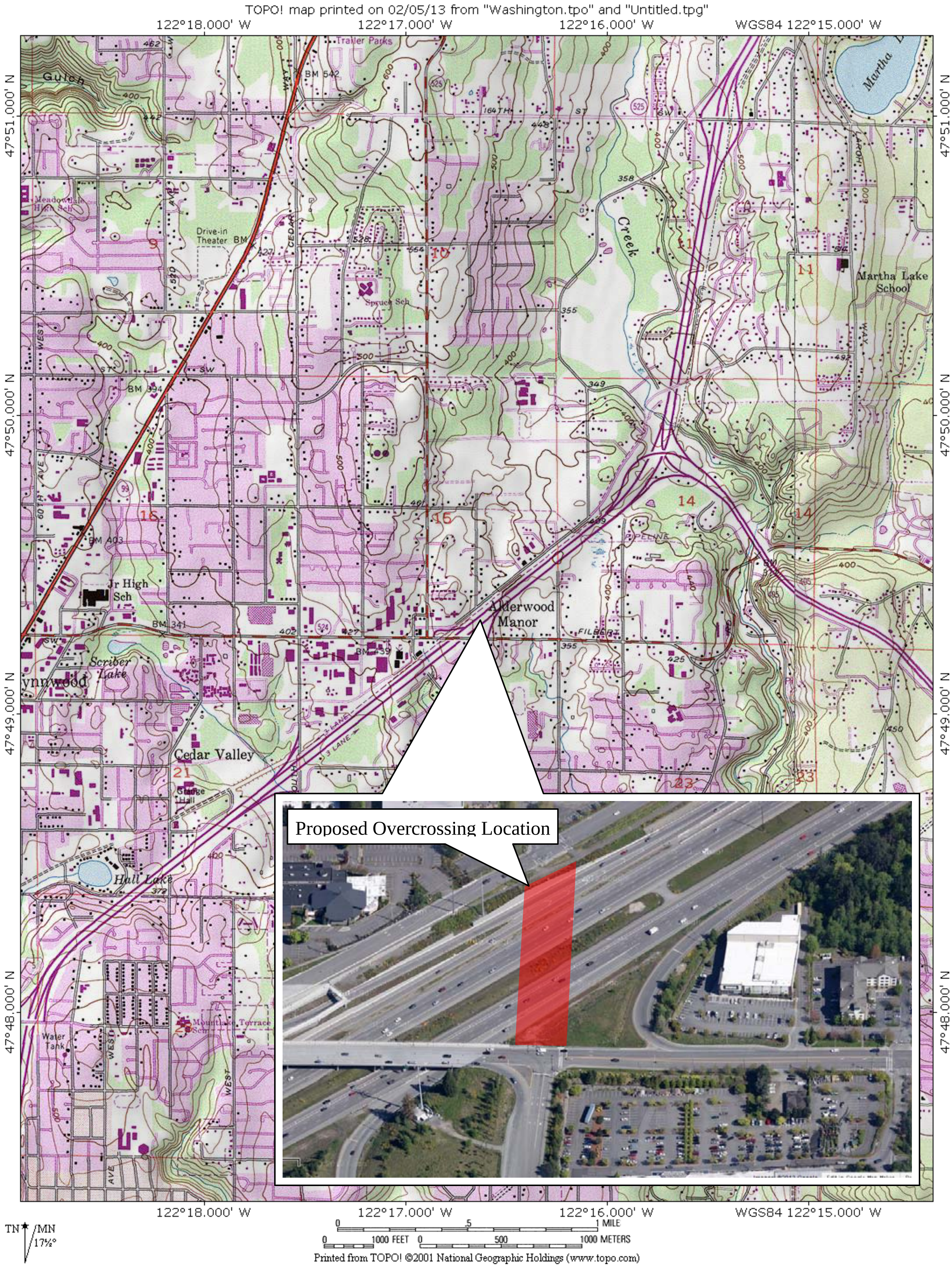
Palmer, S. P., 2004, Liquefaction Susceptibility Map of Snohomish County, Washington.

Sherrod B.L., 2001, Evidence for Earthquake-induced subsidence≈1100 yr ago in coastal marshes of Southern Puget Sound, Washington, Geol. Soc. Am. Bull., 113, 1299-1311.

Sherrod B. L., R. J. Blakely, C. S. Weaver, H. M. Kelsey, E. Barnett, L. Liberty, K. L. Meagher, and K. Pape, 2008, Finding Concealed Active Faults: Extending the Southern Whidbey Island Fault across the Puget Lowland, Washington, Journal of Geophysical Research, Vol. 113, B05313.

U.S.D.A., Soil Conservation Service, 1983, *Soil Survey of Snohomish County Area, Washington*, 197 p.

Wells, RE, C.S. Weaver, and R.J. Blakley, 1998, Fore-Arc Migration in Cascadia and its Neotectonic Significance. Geology 26(8): 759-762.



HWA GEOSCIENCES INC.

PROJECT SITE & VICINITY MAP

GEOLOGY & SOILS DISCIPLINE REPORT
POPLAR WAY OVERCROSSING PROJECT
PHASE II
LYNNWOOD, WASHINGTON

FIGURE NO. **1**

PROJECT NO. 2012-121

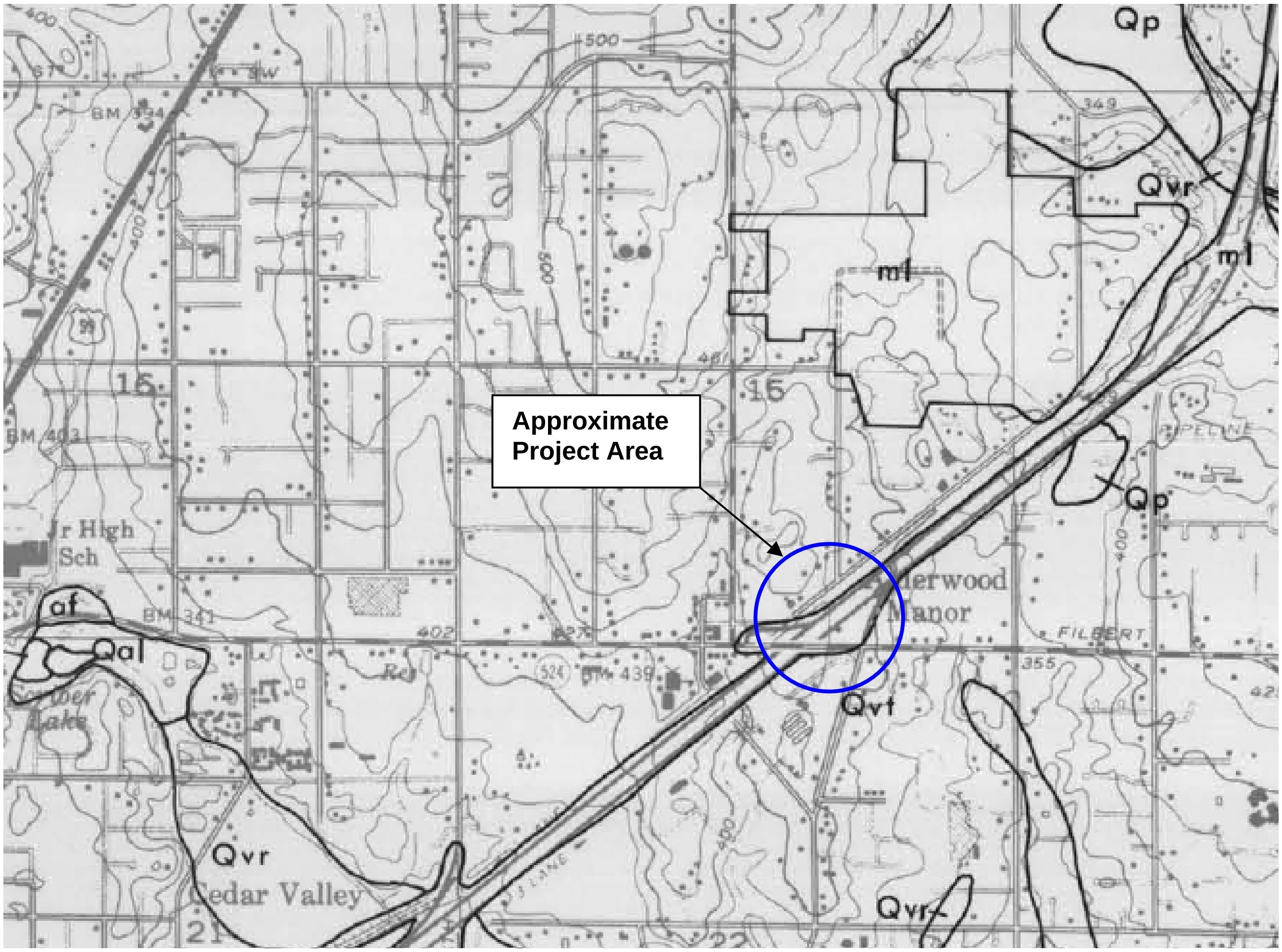
PROJECT LAYOUT SCHEMATIC

GEOLOGY & SOILS DISCIPLINE REPORT
POPLAR WAY OVERCROSSING PROJECT
PHASE II
LYNNWOOD, WASHINGTON

HWA GEOSCIENCES INC.

FIGURE NO.
2

PROJECT NO.
2012-121



Map Symbol	Unit Description
af	Artificial Fill
ml	Modified Land
Qp	Peat Deposits
Qal	Quaternary Alluvium
Qvr	Vashon Recessional Outwash
Qvt	Vashon Glacial Till

NORTH

Map portion taken from: Smith, 1975.

HWA GEOSCIENCES INC.

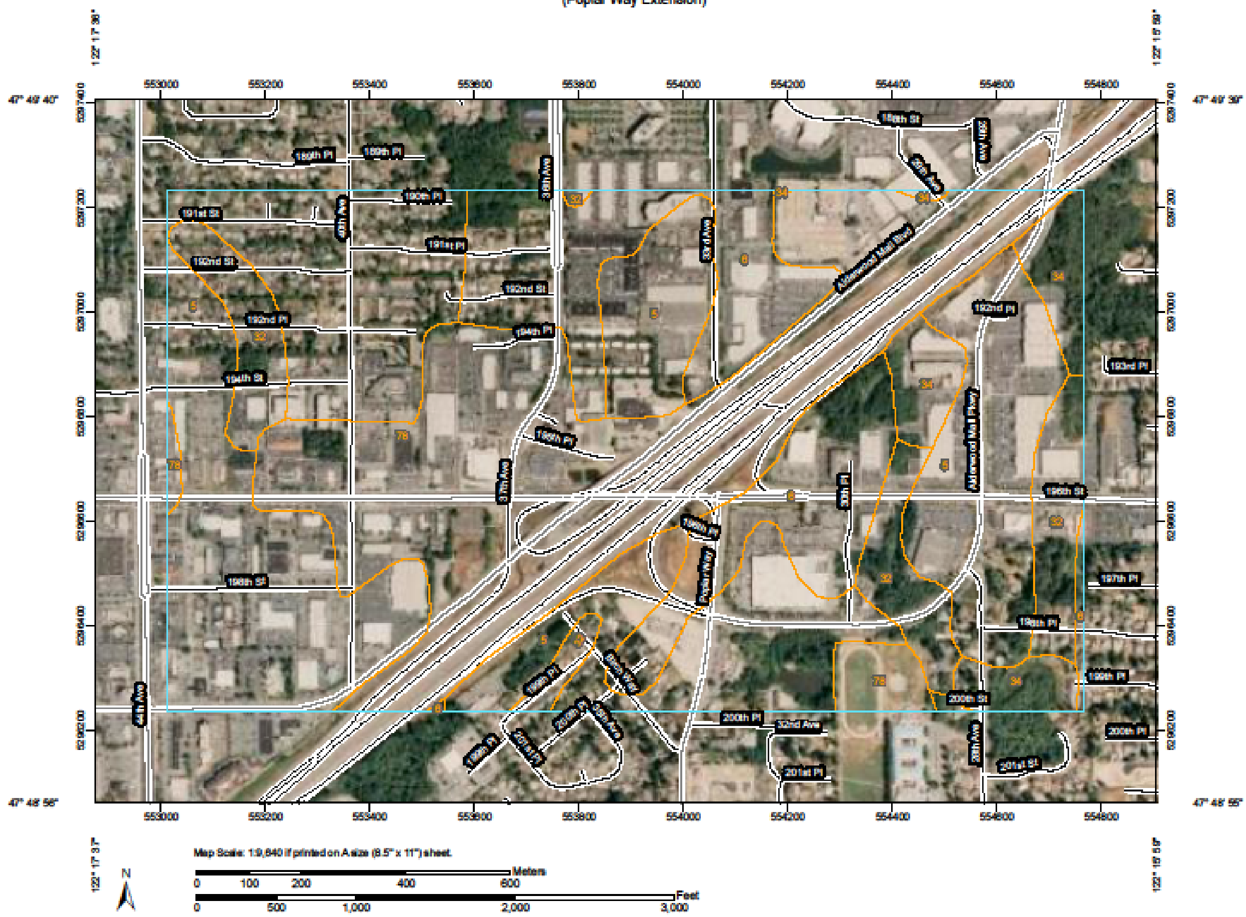
GEOLOGIC MAP

GEOLOGY & SOILS DISCIPLINE REPORT
POPLAR WAY OVERCROSSING PROJECT
PHASE II
LYNNWOOD, WASHINGTON

FIGURE NO.
3

PROJECT NO.
2011-121

Soil Map—Snohomish County Area, Washington
(Poplar Way Extension)



USDA Natural Resources Conservation Service

Web Soil Survey
National Cooperative Soil Survey

6/24/2013
Page 1 of 3

Map Symbol Legend	**Soil Unit Description**
5	**Alderwood-Urban Land Complex, 2 to 8 percent slopes**
6	**Alderwood-Urban Land Complex, 8 to 15 percent slopes**
32	**McKenna gravelly silt loam 0 to 8 percent slopes**
34	**Mukilteo Muck**
78	**Urban Land**

Map Portion Taken from: NCRS-On-line Web Soil Survey.

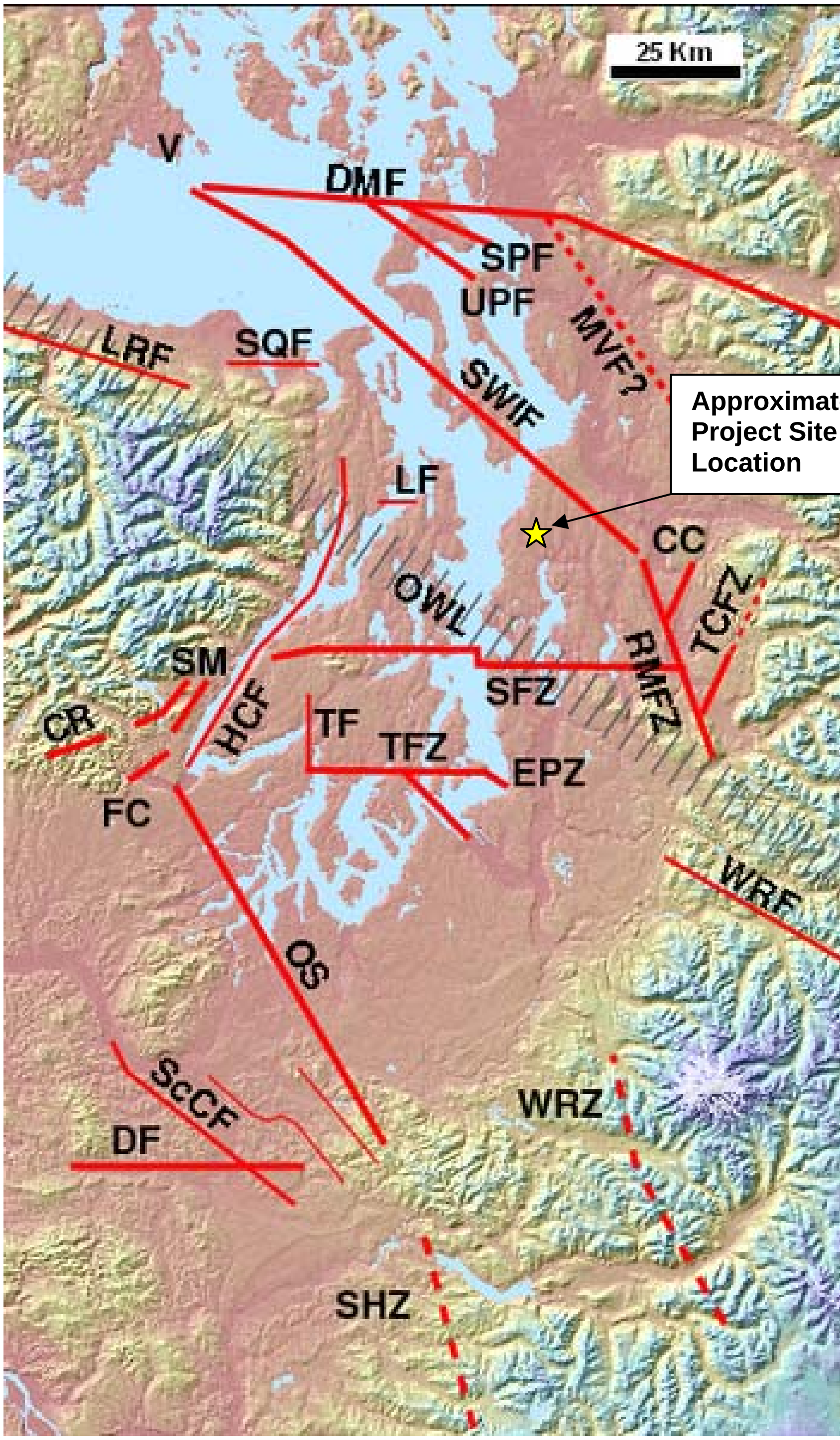
HWA GEOSCIENCES INC.

SOILS MAP

GEOLOGY & SOILS DISCIPLINE REPORT
POPLAR WAY OVERCROSSING PROJECT
PHASE II
LYNNWOOD, WASHINGTON

FIGURE NO.
4

PROJECT NO.
2012-121



Map Symbol Legend	**Fault Name**
SWIF	South Whidbey Island Fault
SFZ	Seattle Fault Zone
OWL	Olympic-Wallowa Lineament

NORTH

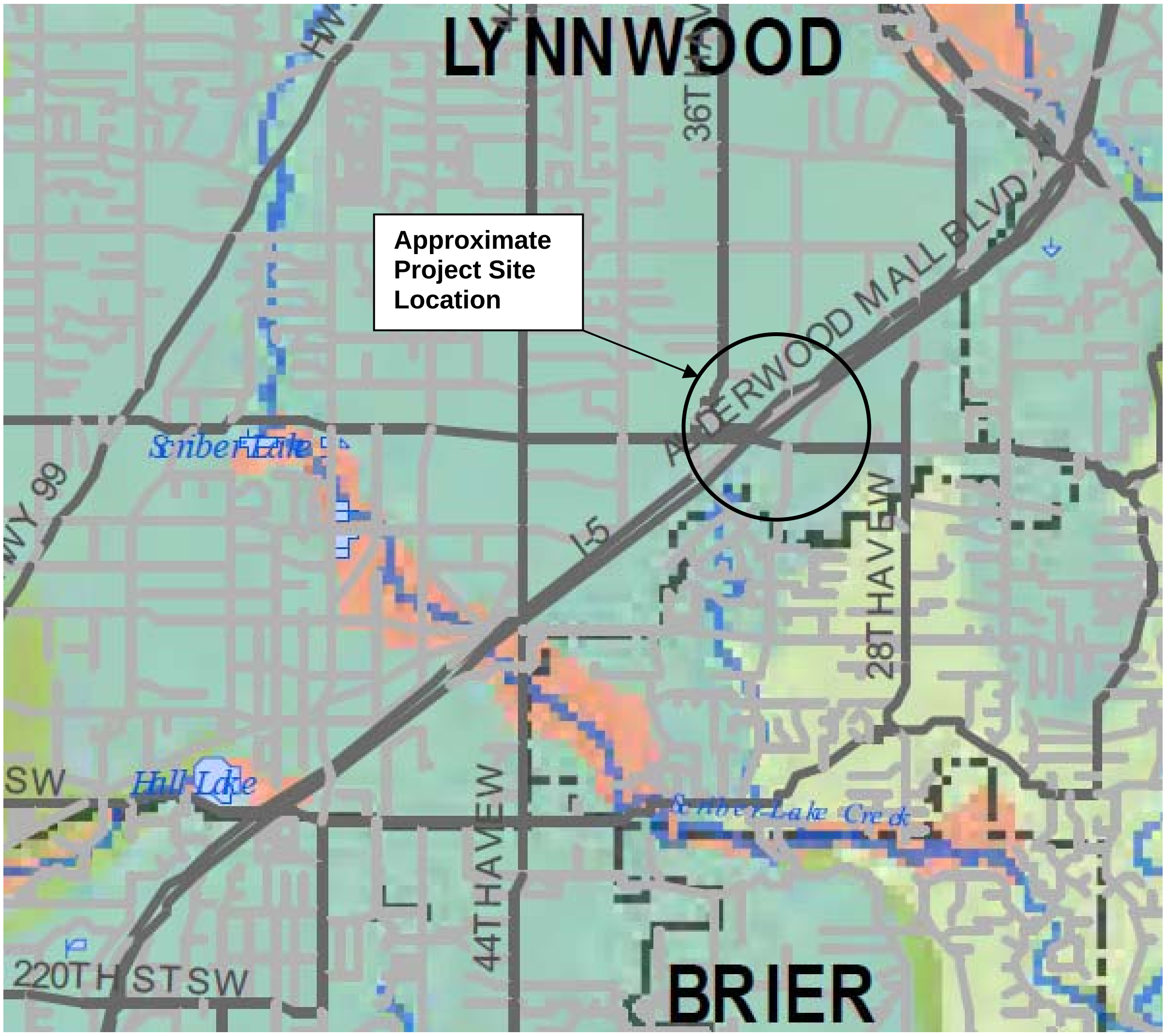
HWA GEOSCIENCES INC.

FAULT LOCATION MAP

GEOLOGY & SOILS DISCIPLINE REPORT
POPLAR WAY OVERCROSSING PROJECT
PHASE II
LYNNWOOD, WASHINGTON

FIGURE NO. 5

PROJECT NO. 2012-121



Liquefaction Susceptibility

Low

Very Low to Low

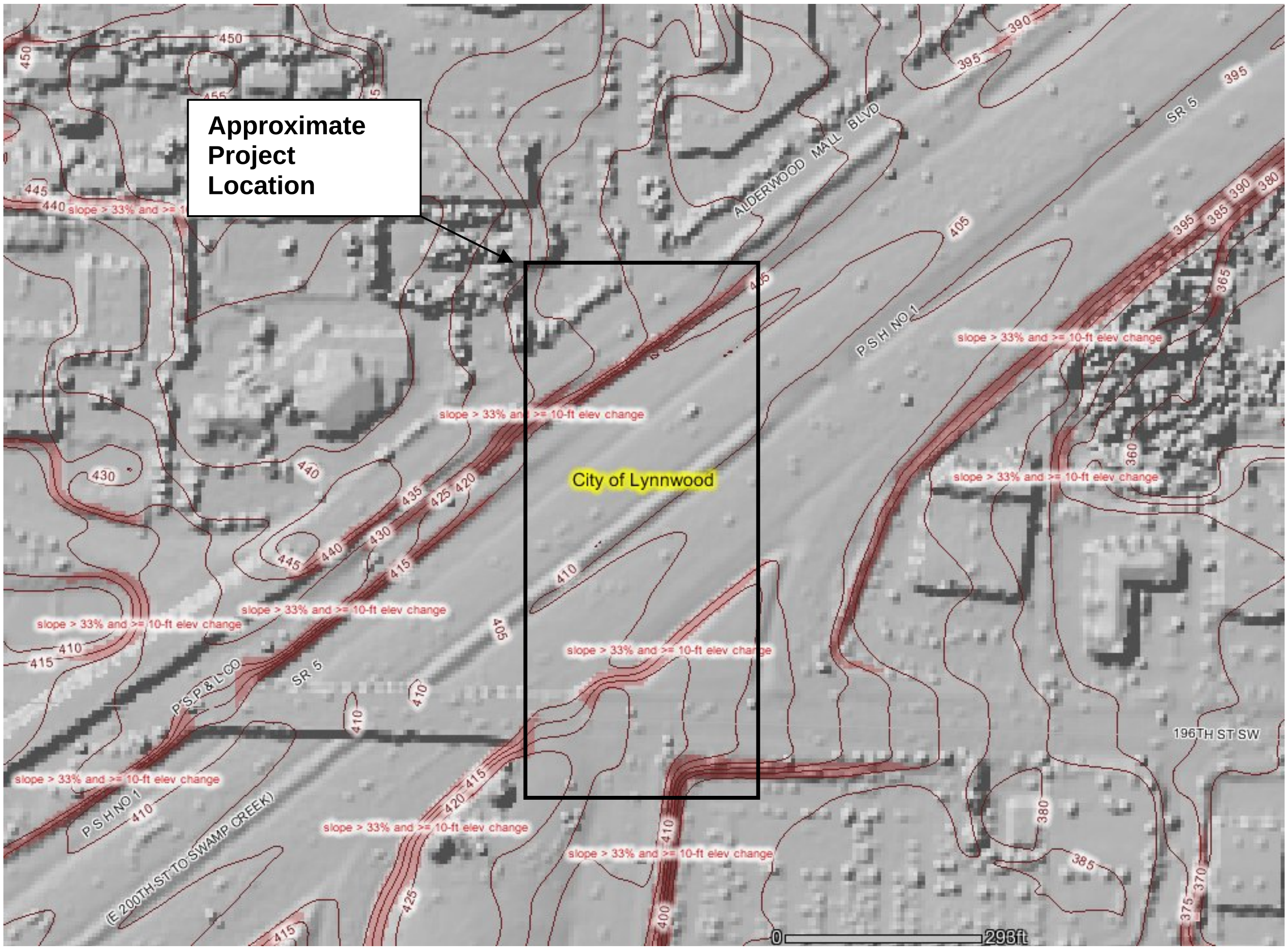
Very Low

NORTH

Map Portion Taken From: Snohomish County Liquefaction Susceptibility Map (WDNR, 2009)

HWA GEOSCIENCES INC.

LIQUEFACTION SUSCEPTIBILITY POTENTIALMAP		FIGURE NO. **6**
GEOLOGY & SOILS DISCIPLINE REPORT POPLAR WAY OVERCROSSING PROJECT PHASE II LYNNWOOD, WASHINGTON		PROJECT NO. 2012-121



NORTH

Map Portion Taken From: Snohomish County Landscape Imaging (SnoScape, on-line)

HWA GEOSCIENCES INC.

STEEP SLOPE HAZARD MAP

GEOLOGY & SOILS DISCIPLINE REPORT
POPLAR WAY OVERCROSSING PROJECT
PHASE II
LYNNWOOD, WASHINGTON

FIGURE NO.
7

PROJECT NO.
2012-121