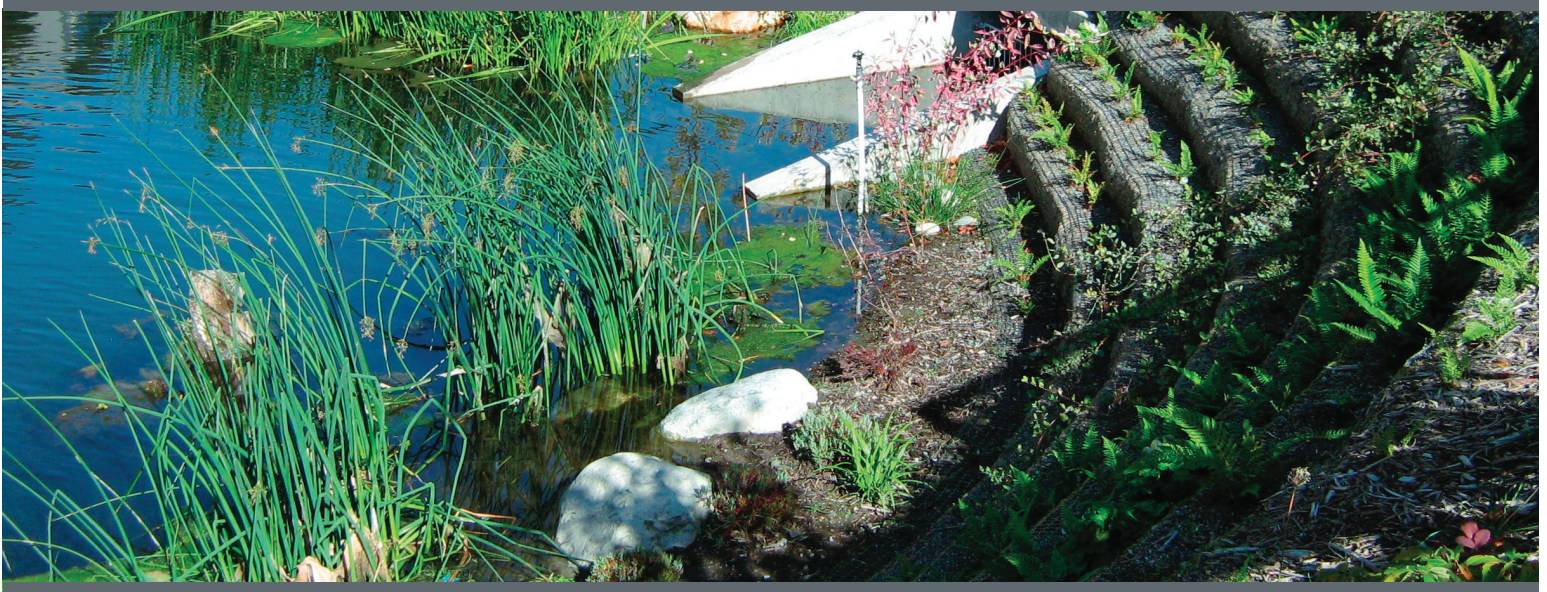




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*Subsurface Exploration and
Geotechnical Engineering Evaluation*

LSC-KESSLER CENTER

Puyallup, Washington

Prepared For:

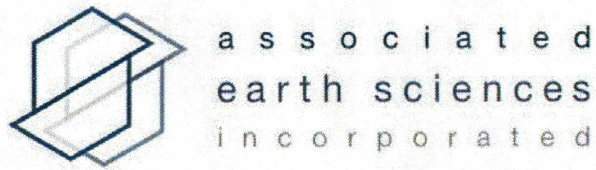
PUYALLUP SCHOOL DISTRICT

Project No. 180090E002

June 17, 2019



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June 17, 2019
Project No. 180090E002

Puyallup School District
323 - 12th Street NW
Puyallup, Washington 98371

Attention: Les Gerstmann

Subject: Subsurface Exploration and Geotechnical Engineering Evaluation
LSC-Kessler Center
1501 - 39th Avenue SW
Puyallup, Washington

Dear Mr. Gerstmann:

Associated Earth Sciences, Inc. (AESI) is pleased to submit this report describing our subsurface exploration and geotechnical engineering evaluation concerning the future Kessler Center at the Puyallup School District's Logistics Support Center (LSC) in Puyallup, Washington. Our services were completed in general accordance with our proposal dated March 14, 2019. We are performing a concurrent infiltration feasibility assessment of the site and will ultimately submit a separate report for that study.

We have enjoyed working with you on this study and are confident that the recommendations presented in this report will aid in the successful completion of your project. If you should have any questions, or if we can be of additional help to you, please do not hesitate to call.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Tacoma, Washington

A handwritten signature in blue ink, appearing to read "Kurt D. Merriman", is written over a horizontal line.

Kurt D. Merriman, P.E.
Senior Principal Geotechnical Engineer

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**SUBSURFACE EXPLORATION AND
GEOTECHNICAL ENGINEERING EVALUATION**

LSC-KESSLER CENTER

Puyallup, Washington

Prepared for:

Puyallup School District

323 - 12th Street NW

Puyallup, Washington 98371

Prepared by:

Associated Earth Sciences, Inc.

1552 Commerce Street, Suite 102

Tacoma, Washington 98402

253-722-2992

June 17, 2019

Project No. 180090E002

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1.0 PROJECT AND SITE DESCRIPTION

The project site consists of the Puyallup School District Logistics Support Center (LSC) complex located in the South Hill area of Puyallup, as shown on the attached “Vicinity Map” (Figure 1). This complex occupies a roughly L-shaped parcel that measures approximately 800 feet by 1,200 feet overall and encompasses about 18 acres. It is visually delineated by Highway 512 on the north, by 39th Avenue SW on the south, by 17th Street SW on the west, and by undeveloped land on the east. Presently, the complex includes a cluster of buildings to the north, a bus storage yard, several paved parking lots, a bus training course, and two stormwater ponds. Our attached “Overall Site Plan” (Figure 2) illustrates the property boundaries and existing features.

Proposed improvement plans call for the construction of the new Kessler Center located in the southern portion of the LSC site along 39th Avenue SW. The project will include the new Kessler Center building, parking areas, and new portable buildings. We understand that the new building will measure about 200 feet by 150 feet in plan view. The site topography is relatively flat so minimal grading is expected, although we do not have a current grading plan. The existing stormwater pond in this area will be backfilled as part of the site grading operations. Our attached “Site and Exploration Plan” (Figure 3) illustrates the proposed development in relation to adjacent existing features.

It should be noted that the Kessler Center project will involve new or enhanced stormwater facilities to accommodate the increased runoff water. Hydrogeologic studies for stormwater infiltration feasibility are currently underway, and will be included as a separate report.

2.0 PURPOSE AND SCOPE

Associated Earth Sciences, Inc. (AESI) performed this study to characterize subsurface conditions below the site, such that we can derive geotechnical conclusions and recommendations concerning the proposed improvements. Our understanding of the project is based on information provided by Puyallup School District representatives and conversations with the civil engineer, Mr. Rick Hand, P.E. (Sitts & Hill Engineers, Inc. [Sitts & Hill]). We are familiar with the site through AESI’s previous site work including:

- Geotechnical study for the warehouse addition titled “Subsurface Exploration and Geotechnical Engineering Evaluation, LSC Warehouse Addition” dated May 30, 2018.
- “Subsurface Exploration, Infiltration Testing, and Design Infiltration Rate Determination” dated June 21, 2018.
- Previous subsurface exploration and reporting for earlier phases of work on the subject site (AESI, September 13, 2005; December 6, 2005; and April 18, 2006).

Our scope of work for the geotechnical evaluation of the Kessler Center included the following tasks. As noted above, we are concurrently performing an infiltration feasibility study, which includes additional scope items not included here.

- Reviewed topographic maps, geologic maps, site layout drawings, aerial photos, survey plans, and other available information pertaining to the site vicinity.
- Performed a visual surface reconnaissance of the site and immediate surroundings.
- Advanced three exploration borings (designated EB-9 through EB-11) to a maximum depth of about 40 feet.
- Visually classified all soil samples obtained from our explorations.
- Analyzed all research and field data in context with the proposed site improvements.
- Conducted a sieve grain-size analysis on a representative sample (EB-9 at 7.5 feet).
- Prepared this report summarizing our geotechnical findings, conclusions, and recommendations.

Figure 2 “Overall Site Map” shows the locations of our subsurface explorations in relation to existing site features and the proposed Kessler Center area. Figure 3, “Proposed Site and Exploration Plan” illustrates the proposed Kessler Center improvements and our subsurface explorations. Appendix A contains our exploration logs.

3.0 FIELD EXPLORATION PROCEDURES

We explored subsurface conditions at the proposed Kessler Center on April 25, 2019. The number, locations, and depths of our explorations were completed within the constraints of surface access, utility conflicts, and project budgets. These explorations supplement our earlier work (AESI, 2005, 2006, and 2018). Our exploration procedures are described below. The various types of sediments, as well as the depths where characteristics of the sediments changed, are indicated on the exploration logs presented in Appendix A. Soil contact depths shown on the logs should be regarded as only an approximation; the actual changes between sediment types are often gradational and/or undulating.

The conclusions and recommendations presented in this report are based, in part, on conditions encountered by our explorations completed for this study. Due to the nature of subsurface exploratory work, it is necessary to interpolate and extrapolate soil conditions between and beyond the field explorations. Differing subsurface conditions could be present

outside the area of the explorations due to the random nature of deposition and the alteration of topography by past grading activities. The nature and extent of any variations between the field explorations might not become fully evident until construction begins. If variations are observed at that time, it could be necessary to modify specific conclusions or recommendations in this report.

3.1 Exploration Borings

All exploration borings were performed by Advance Drill Technologies, Inc., an independent firm working under subcontract to AESI. Each boring was completed by advancing a 7-inch outside-diameter, hollow-stem auger with a track-mounted drill rig (D50). During the drilling process, disturbed but representative soil samples were obtained at 2½- or 5-foot-depth intervals using the Standard Penetration Test (SPT) procedure in accordance with the *American Society for Testing and Materials* (ASTM) specification D-1586. After completion of drilling, each borehole was backfilled with bentonite chips/grout slurry, and the surface was patched with sod.

The SPT testing and sampling procedure consists of driving a standard, 2-inch outside-diameter, split-barrel sampler a distance of 18 inches into the soil with a 140-pound hammer free-falling a distance of 30 inches. The number of blows for each 6-inch interval is recorded, and the number of blows required to drive the sampler the final 12 inches represents the Standard Penetration Resistance (also known as the “N-value”). If a total of 50 blows is reached within one 6-inch interval, the N-value is recorded as 50 blows for the corresponding number of inches of penetration. The N-value provides a measure of the relative density of granular soils or the relative consistency of cohesive soils. Higher N-values correspond to a denser or stiffer soil. Our measured N-values are plotted on the exploration boring logs presented in Appendix A.

All exploration borings were continuously observed and logged by an AESI geologist. The materials obtained from the split-barrel sampler were classified in the field, and representative portions were placed in watertight containers. These soil samples were then transported to our office for further visual classification and/or laboratory testing. All soil descriptions shown on our exploration logs are based on a combination of N-values, drilling action, field observations, and laboratory test results.

4.0 SITE CONDITIONS

The following text sections describe current site conditions, including development features, vegetation, regional and local topography, regional geology, local soils, and local groundwater. Our sources of information include topographic and geologic maps published by the U.S. Geological Survey (USGS), site survey maps prepared by Sitts & Hill Engineers, Inc., and aerial photographs published by Google Earth.

4.1 Development Features

Presently, the overall site is occupied by a cluster of buildings to the north, a bus storage yard, several paved parking lots, a bus training course, and two stormwater ponds. The proposed Kessler Center area consists of a grassy yard and a bus training course that is abutted by 39th Avenue SW. There is an existing stormwater pond on the southern boundary.

4.2 Regional and Local Topography

The project site is located near the eastern edge of an expansive topographic plateau that abuts the Puyallup River valley. Regional surface grades across the plateau are moderately undulating and hummocky, which is typical for a post-glacial landscape. Local surface grades have a very slight gradient down toward the north, and they also descend into a wetland depression situated near the southwestern corner of the site. Surface elevations range from about 345 feet in the southwestern corner, near the neighboring wetland, to about 369 feet in the southeastern corner, near 39th Avenue SW (NAVD 88). Existing grades within the footprint of the proposed Kessler Center building are fairly flat, with an elevation of about 363 to 365 feet. The existing stormwater pond bottom is at about elevation 355.5 feet.

4.3 Regional Geology and Soils

The 2006 draft *Geologic Map of the Puyallup 7.5-Minute Quadrangle* (1:24,000 scale) indicates that the project site is underlain by Vashon-age Steilacoom gravel outburst deposits. These sediments normally comprise loose to medium dense, well-sorted gravels with sands, and variable amounts of silts and cobbles. The total thickness typically ranges from several feet to several tens of feet. Steilacoom gravel is often underlain by dense to very dense, glacial lodgement till, and the geologic map shows lodgement till covering a large portion of the upland to the west of the site.

Review of regional soils mapping available via the Natural Resources Conservation Service (NRCS) Web Soil Survey web application indicates that the subject site is underlain by Indianola loamy sand, Alderwood gravelly sandy loam, and Kitsap silt loam, which originated from sandy outwash, glacial drift, and lacustrine deposits, respectively. Our interpretation of the soils encountered in our explorations is in general agreement with the regional soils mapping.

4.4 Site Geology

Our subsurface explorations confirmed the presence of Vashon-age deposits in the proposed Center area. However, the Steilacoom gravel unit shown on the regional geology map was not encountered. Instead, we observed Vashon-age recessional lacustrine deposits, Vashon-age lodgement till, and Vashon-age advance outwash deposits. In our experience, this deviation from mapped geology is not unusual, because the geology in the project vicinity varies over short distances. The following paragraphs describe the soils observed within the proposed

Kessler Center footprint, and the exploration logs contained in Appendix A provide additional soil information.

Vashon Recessional Lacustrine Deposit: Immediately below the surficial sod and/or fill, all three borings completed within the proposed Kessler Center building footprint encountered a thick deposit of massive to stratified, silty, fine sands and fine, sandy silts. We interpret this deposit to be Vashon recessional lacustrine sediments that were deposited in a lake or other low-energy setting during the retreat of the Vashon ice sheet. These sediments have a low permeability due to a high percentage of fines, and are not typically suitable for concentrated stormwater infiltration. The recessional lacustrine deposit extended to depths of 31 feet (EB-9), 25 feet (EB-10), and 27.5 feet (EB-11).

Vashon Recessional Outwash Deposit: Although we did not encounter any Vashon-age recessional outwash in our recent borings it has been observed in past exploration work on the LSC site. EP-1 through EP-7 all found recessional outwash deposits at depths ranging from 0 to 12 feet (AESI, 2005). Recessional outwash was deposited by retreating glacier meltwater streams. It usually consists of fine to coarse sand and rounded gravels. Meltwater streams flowing away from the glacier as it receded, carried particles that are sorted by size on deposition dependent upon the water flow velocity.

Vashon Lodgement Till Deposit: In borings EB-10 and EB-11 we encountered a thin deposit, 1 to 2½ feet thick, of sediments interpreted to be representative of Vashon lodgement till, directly below the Vashon recessional lacustrine sediments at depths of 25 and 27.5 feet. The lodgement till primarily consisted of dense, slightly moist, grayish brown, unsorted silty fine sand with some gravel. Due to poor sample recovery, and the thinness of the observed unit we tentatively correlate the unsorted silty fine sand with gravel as lodgement till. The sediments could also correlate with a silty lens at the upper surface of the advance outwash unit. Relatively thin layers of lodgement till (1 to 3 feet) were also observed in our past explorations EB-18, EB-24, and EB-25 at depths ranging between 14 and 17 feet (AESI, 2018). Vashon lodgement till was deposited directly from basal, debris-laden, glacial ice during the Vashon Stade of the Fraser Glaciation, approximately 12,500 to 15,000 years ago. The high relative density characteristic of the Vashon lodgement till is due to its consolidation by the massive weight of the glacial ice from which it was deposited. Vashon lodgement till is not recommended for use as an infiltration receptor.

Vashon Advance Outwash Deposit: Exploration borings EB-9, EB-10, and EB-11 encountered dense sands, silty sands, and gravelly sands that we interpret to be Vashon advance outwash. Advance outwash deposits were encountered at depths of 31 feet (EB-9), 30 feet (EB-10), and 30 feet (EB-11) and continued beyond the termination of each boring. Advance outwash was also observed in some of our past explorations EP-18, EP-19, EP-22, EP-23, EP-25, EB-1W, and PD-1 with depths ranging between 13 and 18 feet (AESI, 2018). The Vashon advance outwash consists of sediments that were deposited by meltwater streams that emanated from the advancing Vashon glacier, and were subsequently consolidated by the massive weight of the

glacial ice. These deposits appear to extend across the site in an unsaturated condition to the depth explored. Where permeable and unsaturated, these sediments are suitable for stormwater infiltration.

4.5 Local Groundwater

While drilling EB-9 perched groundwater was encountered in the Vashon recessional lacustrine deposit (Qvrl) at a depth of about 20 feet. We can infer that the groundwater is perched at this depth due to the fact the rest of the boring remained dry and no further groundwater was observed. EB-10 and EB-11 remained dry through the entire advancement of the borings. Past exploration work near the Kessler Center area yielded perched groundwater at depths ranging between 10.5 and 15.5 feet (AESI, 2018). No groundwater was encountered at the time of exploration within the deeper Qva sediments.

It should be noted that the depth of occurrence of groundwater seepage may vary in response to changes in season, amount of precipitation, and on- and off-site land use. Explorations for the current study were conducted in late April 2018.

As part of the work for the adjacent Warehouse Expansion, monitoring well EB-1W was completed within the Vashon advance outwash sediments at a depth of 36 feet and monitoring well EB-2W was completed within the Vashon recessional lacustrine deposits at an elevation approximately equivalent to the base of the western wetland. Monitoring is ongoing. AESI will also install monitoring wells as part of our concurrent infiltration feasibility study for the Kessler Center. Therefore, additional groundwater information will become available at a later date.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Based on our surface reconnaissance, subsurface explorations, and document research, we conclude that the proposed Kessler Center building project is feasible from a geotechnical standpoint, contingent on proper design implementation and construction practices. Our geotechnical conclusions and recommendations concerning general considerations, site preparations, foundations, slab-on-grade floors, drainage systems, pavement sections, and structural fill are presented herein. It should be noted that our conclusions and recommendations concerning on-site stormwater infiltration will be presented in a separate hydrogeologic report.

Specification Codes: The following reference documents are cited for specification purposes within subsequent report sections.

- ASTM: Refers to the latest edition of the *ASTM Book of Standards* published by the American Society for Testing and Materials (ASTM) and ASTM International.

- WSDOT: Refers to the 2016 edition of *Standard Specifications for Road, Bridge, and Municipal Construction* published by the Washington State Department of Transportation (WSDOT).

5.1 General Considerations

We offer the following comments, conclusions, and recommendations concerning general geotechnical design issues affecting the overall project.

Geological Hazards: Our evaluation did not reveal any geological hazards associated with steep slopes, erosion zones, landslide zones, or abandoned landfills in the site vicinity. In addition, we infer that the fine-grained lacustrine deposits and deeper glacial deposits underlying the site represent a negligible hazard with respect to seismically induced liquefaction. Earthquake activity is a widespread hazard throughout Western Washington, but the risk of associated shaking and ground rupture does not appear to be any higher at this site than elsewhere in the region. Consequently, the proposed site improvements are not constrained by any prevailing geological hazards, in our opinion.

Foundation Support: Our subsurface explorations encountered lacustrine sediments ranging from soft to stiff silts and from loose to medium dense sands underlying the proposed Kessler Center footprint. In our opinion, these soils are not well-suited for directly supporting the Kessler Center on conventional spread footings. However, we conclude that spread footings can be used in conjunction with appropriate subgrade improvement measures.

Earthwork Scheduling: Our explorations indicate that most of the near-surface on-site soils comprise silts, silty sands, and sandy silts. These soils are very moisture-sensitive and highly susceptible to disturbance when wet. As such, earthwork should be scheduled for the dry season in order to minimize subgrade problems and to maximize the potential for reusing on-site soils. Greater export and import quantities should be expected during the wet season.

Seismic Site Class: The 2015 *International Building Code* (IBC) assigns a seismic Site Class on the basis of geological conditions prevailing within a depth of 100 feet below the local ground surface. Although our subsurface explorations did not extend to such a depth, we infer from shallower soil observations and from available geologic maps that the subsurface conditions correspond to Site Class "D" as defined by the IBC.

5.2 Site Preparation

Preparation of the project site will involve tasks such as temporary drainage, stripping, cutting, erosion control, and subgrade compaction. The paragraphs below present our geotechnical comments and recommendations concerning these various site issues.

Well Decommissioning: Previous and upcoming field exploration programs for the site include the installation of groundwater monitoring wells. These wells can be used by the future construction contractor to measure on-site groundwater levels before and during earthwork. Once the wells are no longer needed, they should be decommissioned by a licensed well driller in accordance with *Washington Administrative Code* (WAC) 173-160. We recommend that all decommissioning activities be included in the contractor's scope of work.

Temporary Drainage: Any sources of surface or near-surface water that could potentially enter the construction zones should be intercepted and diverted before stripping and excavating activities begin. We tentatively anticipate that a system of temporary swales, berms, or curbs placed around the construction zone will adequately intercept most off-site surface water runoff. Because the selection of an appropriate drainage system will depend on the water quantity, season, weather conditions, construction sequence, and contractor's methods, final decisions regarding temporary drainage details are best made in the field at the time of construction.

Clearing and Stripping: After surface and near-surface water sources have been controlled, the construction zone should be cleared and stripped of all existing sod, topsoil, curbs, pavements, and other surface features. Our exploration borings disclosed about 6 inches of sod and topsoil, but the actual thicknesses could vary considerably from one location to another.

Temporary Cut Slopes: All temporary cut slopes associated with site grading and utility excavations should be suitably inclined to mitigate the potential for sloughing and collapse. For the various soil deposits that will likely be encountered during on-site earthwork, we tentatively infer that the following maximum inclinations (given as a horizontal to vertical, or "H:V" ratio) could be planned. However, appropriate inclinations will depend on the actual soil and groundwater conditions encountered during earthwork. Ultimately, the site contractor must be responsible for maintaining safe excavation slopes that comply with applicable regulations.

Cuts in Loose or Soft Soils:	1.5H:1V
Cuts in Medium Dense or Stiff Soils:	1.0H:1V

Weather Considerations: It should be realized that if the stripping or grading operations proceed during wet weather, greater stripping depths will likely be necessary to remove moisture-sensitive subgrade soil areas that become saturated and disturbed. For this reason, site earthwork should be avoided during periods of wet weather. During the summer months, sprinkling will likely be needed to moisture-condition soils that have become too dry.

Erosion Control Measures: Because stripped surfaces and soil stockpiles are typically a source of runoff sediments, they should be given particular attention. If earthwork occurs during wet weather, we recommend that all stripped surfaces be covered with straw to reduce runoff erosion. Similarly, soil stockpiles and cut slopes should be covered with plastic sheeting for erosion protection. We also recommend that silt fences, berms, and/or swales be maintained

around stripped areas and stockpiles in order to capture runoff water and thereby reduce the downslope sediment transport.

Runoff Water: On-site stormwater runoff water should be conveyed to appropriate temporary detention and treatment facilities, rather than to any permanent infiltration facilities. In order to avoid siltation and fouling of the receptor soils, all permanent infiltration systems must remain offline during construction. We recommend that stormwater runoff not be routed to the new infiltration facilities until the site is stabilized and all runoff water is clear.

5.3 Spread Footings

In our opinion, conventional spread footings could be used for supporting the new Kessler Center building if appropriate subgrade remediation measures are performed. We offer the following comments and recommendations concerning design and construction of spread footings.

Footing Depths and Widths: For frost and erosion protection, the bottoms of all exterior footings should bear at least 18 inches below adjacent outside grades, whereas the bottoms of interior footings need bear only 12 inches below the surrounding slab or crawl-space level. To reduce post-construction settlements, continuous (wall) and isolated (column) footings should be at least 18 and 24 inches wide, respectively. It should be noted, however, that greater depths or widths might be needed for other reasons, as determined by the project structural engineer.

Bearing Provisions: In order to provide adequate and uniform support for new spread footings, we recommend that all footing subgrades be prepared as follows:

1. All existing soils below the new footings should be overexcavated to a minimum depth of 18 inches below the design footing base level. Each overexcavation should also extend laterally outward beyond the footing edges a minimum distance equal to the overexcavation depth, thereby corresponding to a 1H:1V bearing splay.
2. The exposed subgrade at the bottom of each overexcavation should be covered with a separation geotextile, such as Mirafi 500X or 140N. This geotextile should also extend at least 18 inches up the sidewalls.
3. Each overexcavation should be backfilled with granular fill to create bearing pads below the footings. Ideally, these bearing pads would consist of 1¼-inch crushed gravel, 2-inch angular rock ("railroad ballast"), or crushed recycled concrete. Alternatively, the bearing pads could consist of well-graded sand and gravel ("pit run"), which might be less expensive but requires more rigorous compaction. Specifically, pit run bearing pads should be placed in 12-inch-thick (maximum) horizontal lifts and then compacted to a uniform density of at least 95 percent (based on ASTM D-1557).

Bearing Capacities: Based on the bearing provisions described above, we recommend that all footings be designed for the following maximum allowable bearing capacities. These values are stated in pounds per square foot (psf), and they incorporate static and transient (wind or seismic) safety factors of at least 2.0 and 1.5, respectively. Due to the thickness of the native lacustrine deposit, it does not appear economically practical to achieve higher-bearing capacities for this project.

Static Allowable Bearing Capacity:	2,500 psf
Transient Allowable Bearing Capacity:	3,300 psf

Footing Setbacks: For stability purposes, footings should not be placed near steep slopes or steps in the bearing soils. We specifically recommend keeping all footings at least 3 feet behind any slopes, and also behind a 1.0H:1V line extending upward from the toe of any retaining walls. Furthermore, utility trenches, footing trenches, and other excavations should not encroach on a 1.0H:1V influence line extending downward from any existing footing. If the new building location requires localized excavations very close to any existing footings, proper underpinning or shoring should be provided. Upon request, we can supply specific underpinning or shoring recommendations for specific situations at the site.

Footing Settlements: We estimate that total post-construction settlements of properly designed footings bearing on a properly prepared subgrade will not exceed 1 inch. Differential settlements between new foundation elements over horizontal spans on the order of 50 feet could approach $\frac{3}{4}$ inch. In all cases, these settlements would be reduced if the actual design bearing pressures are lower than our recommended maximum allowable pressures.

Footing and Stemwall Backfill: To provide erosion protection and lateral load resistance, we recommend that backfill be placed on both sides of the footings and stemwalls after the concrete has cured. Either on-site or imported granular soils can be used for this purpose. All footing and stemwall backfill soil should be compacted to a uniform density of at least 90 percent (based on ASTM D-1557).

Lateral Resistance: Footings and stemwalls that have been properly backfilled as described above will resist lateral loads by means of both passive earth pressure and base friction. We recommend using the following allowable values. These earth pressures are stated in pounds per cubic foot (pcf), and they incorporate static and transient (wind or seismic) safety factors of at least 1.5 and 1.1, respectively. Allowable base friction, which includes a safety factor of 1.5, can be combined with the respective passive pressure to resist static and transient loads.

Allowable Static Passive Pressure:	270 pcf
Allowable Transient Passive Pressure:	360 pcf
Base Friction Coefficient:	0.35

Subgrade Verification and Construction Monitoring: Footings should never be cast atop loose, soft, organic, or frozen soil, slough, debris, uncontrolled fill, or surfaces covered by standing water. We recommend that the condition of all subgrades be verified by an AESI representative before any concrete is placed. Furthermore, all subgrade remediation work should be continuously monitored and/or tested by an AESI representative.

5.4 Slab-On-Grade Floors

Because floor slabs typically carry a light load in comparison to building foundations, they allow more latitude concerning support options. Nonetheless, a certain degree of subgrade improvement work should be implemented to provide adequate performance. We offer the following comments and recommendations for slab-on-grade floors.

Floor Sections: A conventional slab-on-grade floor section typically comprises a reinforced concrete slab over a vapor retarder over an aggregate base course over a granular subbase course. Assuming that the slab has a conventional thickness on the order of 4 or 5 inches and is subjected to typical loads, we recommend the following underslab layers (top to bottom) and minimum thicknesses for floors in the new Kessler Center.

Vapor Retarder:	10 mils
Base Course:	4 inches
Subbase Course:	12 inches

Subgrade Preparation: After the floor footprint has been excavated as needed to accommodate the above-recommended floor section, the exposed subgrade should be compacted to a firm and unyielding condition using a heavy, static (non-vibratory) roller. Any localized zones of soft, organic-rich, or saturated soils revealed during compaction should be overexcavated and replaced with granular structural fill.

Subbase Course: A subbase course helps to provide more-uniform slab support over variable subgrade conditions, thereby reducing long-term differential settlements. For this purpose, we recommend using a well-graded sand and gravel, such as “Ballast” per WSDOT 9-03.9(1) or “Gravel Borrow” per WSDOT 9-03.14. Other acceptable options include 1¼-inch crushed rock and crushed recycled concrete. In all cases, the subbase should be compacted with a vibratory roller to achieve a uniform density of at least 90 percent (based on ASTM D-1557).

Base Course: The base course serves as both a capillary break layer and a leveling layer for the floor slab. Ideally, the base course would consist of clean, uniform, well-rounded gravel, such as pea gravel, 5/8-inch washed rock, or 7/8-inch washed rock. It would also be acceptable to use a washed, angular gravel or clean, crushed rock for this purpose. In all cases, the base course should be lightly compacted with a static roller or vibratory sled to create a firm, smooth surface.

Vapor Retarder: A vapor retarder consists of heavy-duty plastic sheeting that is placed between the base course and floor slab. In our opinion, a vapor retarder provides a significant benefit by reducing the amount of ground moisture that penetrates the floor slab. We recommend that a vapor retarder be installed beneath all floor areas that will be covered by carpet, wood, tile, or any other moisture-sensitive materials. Vapor retarders can be considered optional for use under bare concrete floors in non-moisture-sensitive rooms. When used, the vapor retarder should be selected on the basis of allowable vapor transmission rates for the planned floor finish materials, and should be installed in strict accordance with the manufacturer's guidelines.

Floor Settlements: If the subgrade and underslab layers are properly constructed, we estimate that total post-construction static settlements of the slab-on-grade floor will not exceed $\frac{3}{4}$ inch under conventional loading conditions. Differential settlements across the length or width of the floor could approach one-half of the actual total settlement.

Subgrade Verification and Construction Monitoring: Floor slab sections should never be placed atop loose, soft, organic-rich, or frozen soil, slough, debris, or surfaces covered by standing water. We recommend that an AESI representative be allowed to monitor all floor slab construction to verify suitable conditions. Our monitoring services would include probings of subgrade soils, observation and testing of underslab fill layers, and a check of layer thicknesses.

5.5 Drainage Systems

In order to reduce the risk of future moisture problems, the new building should be provided with permanent drainage systems. We offer the following recommendations and comments regarding various drainage elements and related features.

Foundation Drains: We recommend that the new building be encircled with perimeter foundation drains to collect exterior seepage water. Each drain should consist of a 4-inch-diameter, rigid, perforated pipe within an envelope of pea gravel or washed rock, extending outward at least 6 inches on all sides of the pipe. The gravel envelope should be wrapped with filter fabric (such as Mirafi 140N) to reduce the migration of fines from the surrounding soils. Ideally, the drain invert would be installed no more than 4 inches above or below the base of the perimeter footings.

Subfloor Drains: Based on the soil and groundwater conditions observed in our site explorations, we currently do not infer a need for drains beneath the floor slabs if the foundation drains are properly installed. However, the final decision regarding the need for subfloor drains should be made at the time of construction, after the floor subgrade has been exposed and the foundation walls have been cast.

Runoff Water: Roof downspouts, parking lot drains, and drains from any other runoff surfaces should not be tied into the perforated piping system of the foundation drains. Instead, the runoff water collected from such sources should be routed through a separate tightline piping

system. Also, final site grades should be sloped so that surface water flows away from the building rather than ponding near the foundation walls.

5.6 Conventional Pavement Sections

We understand that conventional (impermeable) flexible (asphalt concrete) pavements might be used in new car parking areas and driveways, whereas conventional rigid (cement concrete) pavements might be used for the bus loop and/or certain other locations. The following comments and recommendations are given for conventional pavement design and construction purposes.

Soil Design Values: Soil conditions can be defined by a California Bearing Ratio (CBR), which quantitatively predicts the effects of wheel loads imposed on a saturated subgrade. Although our scope of work did not include a CBR test on the surficial site soils, we infer from our observations and limited textural testing that a CBR value on the order of 5 to 8 would likely be appropriate for pavement design purposes. This value corresponds to a subgrade modulus of about 100 to 200 pounds per cubic inch (pci).

Traffic Design Values: Traffic conditions can be defined by a Traffic Index (TI), which quantifies the combined effects of projected car and truck traffic. Although no specific traffic data was available at the time of our analysis, we estimate that a TI of 3.0 to 4.0 would likely be appropriate for the car parking areas. A higher TI of about 5.0 to 6.0 appears appropriate for driveways and other areas that are occasionally or periodically subjected to school buses, delivery trucks, or similar vehicles.

Flexible Pavement Sections: A flexible pavement section typically comprises an asphalt concrete pavement (ACP) over a crushed aggregate base (CAB) over a granular subbase (GSB). Our recommended minimum thicknesses for flexible pavement sections, which are based on the aforementioned design values and a 20-year lifespan, are shown below.

Car Parking Lots and Playgrounds

Asphalt Concrete Pavement (ACP):	2½ inches
Crushed Aggregate Base Course (CAB):	3 inches
Granular Subbase Course (GSB):	6 inches

Bus Loops and Access Driveways

Asphalt Concrete Pavement (ACP):	4 inches
Crushed Aggregate Base Course (CAB):	4 inches
Granular Subbase Course (GSB):	10 inches

Rigid Pavement Sections: A rigid pavement section typically comprises a cement concrete pavement (CCP) over a CAB over a GSB. We recommend the following minimum thicknesses for a rigid pavement section that is subjected to school buses and occasional delivery trucks.

Pavements and slabs that are subjected to frequent truck traffic or to other heavy structural loads would require a special design.

Bus Loops and Access Driveways

Cement Concrete Pavement (CCP):	7 inches
Crushed Aggregate Base Course (CAB):	2 inches
Granular Subbase Course (GSB):	8 inches

Subgrade Preparation: All pavement subgrades should be compacted to a firm and unyielding condition before any pavement layers are placed. We recommend using a heavy vibratory-drum roller for granular (sand and gravel) subgrades. The resulting subgrade condition should then be verified by proof-rolling with a loaded dump truck or other heavy construction vehicle, in the presence of an AESI representative. Any localized zones of soft, organic-rich, or debris-laden soils disclosed during proof-rolling should be overexcavated and replaced with compacted structural fill.

Granular Subbase: A GSB helps to provide more-uniform structural support for a pavement section. For the subject site, we recommend using an imported, well-graded sand and gravel, such as "Ballast" per WSDOT 9-03.9(1) or "Gravel Borrow" per WSDOT 9-03.14. It would also be acceptable to use a crushed recycled concrete, provided that it meets the same general textural criteria as the aforementioned WSDOT materials. In all cases, the GSB should be vibratory-compacted to at least 95 percent based on the modified Proctor maximum dry density (per ASTM D-1557).

Crushed Aggregate Base: We recommend that all CAB material conform to the criteria for "Crushed Surfacing Base Course" or "Crushed Surfacing Top Course" per WSDOT 9-03.9(3). In the interest of using recycled materials from on-site or off-site sources, it would be acceptable to substitute up to 20 percent of the CAB with crushed cement concrete, provided that the final mixture meets the same grain-size criteria as the aforementioned WSDOT material. Regardless of composition, all CAB material should be compacted to at least 95 percent based on the modified Proctor maximum dry density (per ASTM D-1557).

Asphalt Concrete Pavement: We recommend that the ACP aggregate gradation conform to the control points for a ½-inch mix (per WSDOT 9-03.8(6)) and that the binder conform to Performance Grade 58-22 criteria (per WSDOT 9-02.1(4)). We also recommend that the ACP be compacted to a target average density of 92 percent, with no individual locations compacted to less than 90 percent nor more than 96 percent, based on the Rice theoretical maximum density for that material (per ASTM D-2041).

Cement Concrete Pavement: We recommend that the CCP consist of Portland cement concrete with a minimum compressive strength of 4,000 pounds per square inch (psi) and a minimum rupture modulus of 500. We also recommend that the concrete be reinforced with a welded wire mesh, such as W2-6x6, positioned at a one-third depth within the CCP layer.

Pavement Life and Maintenance: It should be realized that conventional asphaltic pavements are not maintenance-free. The foregoing pavement sections represent our minimum recommendations for an average level of performance during a 20-year design life; therefore, an average level of maintenance will likely be required. Furthermore, a 20-year pavement life typically assumes that an overlay will be placed after about 10 years. Thicker asphalt, base, and subbase courses would offer better long-term performance, but would cost more initially; thinner courses would be more susceptible to “alligator” cracking and other failure modes. As such, pavement design can be considered a compromise between a high initial cost and low maintenance costs versus a low initial cost and higher maintenance costs.

5.7 Structural Fill

The term *structural fill* refers to any materials placed under foundations, retaining walls, slab-on-grade floors, sidewalks, pavements, and other such features. Our comments, conclusions, and recommendations concerning structural fill are presented in the following paragraphs.

Soil Moisture Considerations: The suitability of soils used for structural fill depends primarily on their grain-size distribution and moisture content when they are placed. As the fines content (that soil fraction passing the U.S. No. 200 Sieve) increases, soils become more sensitive to small changes in moisture content. Soils containing more than about 5 percent fines (by weight) cannot be consistently compacted to a firm, unyielding condition when the moisture content is more than 2 percentage points above or below optimum.

Structural Fill Materials: For general use, a well-graded mixture of sand and gravel with a low fines content (commonly called “gravel borrow” or “pit-run”) provides an economical structural fill material. For specialized applications, it may be necessary to use a highly-processed material such as crushed rock, quarry spalls, clean sand, granolithic gravel, pea gravel, drain rock, controlled-density fill (CDF), or lean-mix concrete (LMC). Recycled asphalt or concrete, which are derived from pulverizing the parent materials, are also potentially useful as structural fill in certain applications. Soils used for structural fill should not contain any organic matter, debris, environmental contaminants, or individual particles greater than about 6 inches in diameter.

On-Site Soils: We expect that small quantities of on-site soils will be generated by the footing excavations, utility trenches, and other grading activities. Most of the on-site soils will likely consist of native silts, sandy silts, and silty sands (lacustrine sediments). In our opinion, these native soils will be nearly impossible to reuse during the wet season or during rainy weather, and will be difficult to reuse even in dry weather. Smaller quantities of on-site sands and gravelly sands (existing fill) will also be encountered, and we anticipate that these granular soils can be reused as new structural fill over a fairly broad range of weather conditions.

Fill Placement and Compaction: Structural fill materials should be placed in horizontal lifts not exceeding about 12 inches in loose thickness. Unless stated otherwise in this report, we recommend that each lift then be thoroughly compacted with a mechanical compactor to a uniform density of at least 95 percent, based on the modified Proctor maximum dry density (per ASTM D-1557). Compaction is not necessary for certain structural fill materials, such as pea gravel, drain rock, quarry spalls, CDF, and LMC.

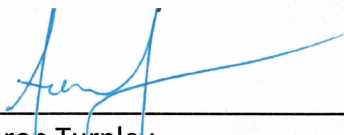
Subgrade Verification and Compaction Testing: Regardless of material or location, all structural fill should be placed over firm, unyielding subgrades prepared in accordance with our various recommendations for site preparation. The condition of all subgrades should be verified by an AESI representative before soil or concrete placement begins. Also, fill soil compaction should be verified by means of in-place density testing, hand-probing, proof-rolling, or other appropriate methods performed during fill placement so that the adequacy of soil compaction efforts may be evaluated as earthwork progresses.

6.0 CLOSURE

AESI has prepared this report for the exclusive use of our client and their agents, for specific application to this project. Within the limitations of scope and schedule, our services have been performed in accordance with generally accepted local geotechnical engineering practices in effect at the time our report was prepared. No other warranty, express or implied, is made.

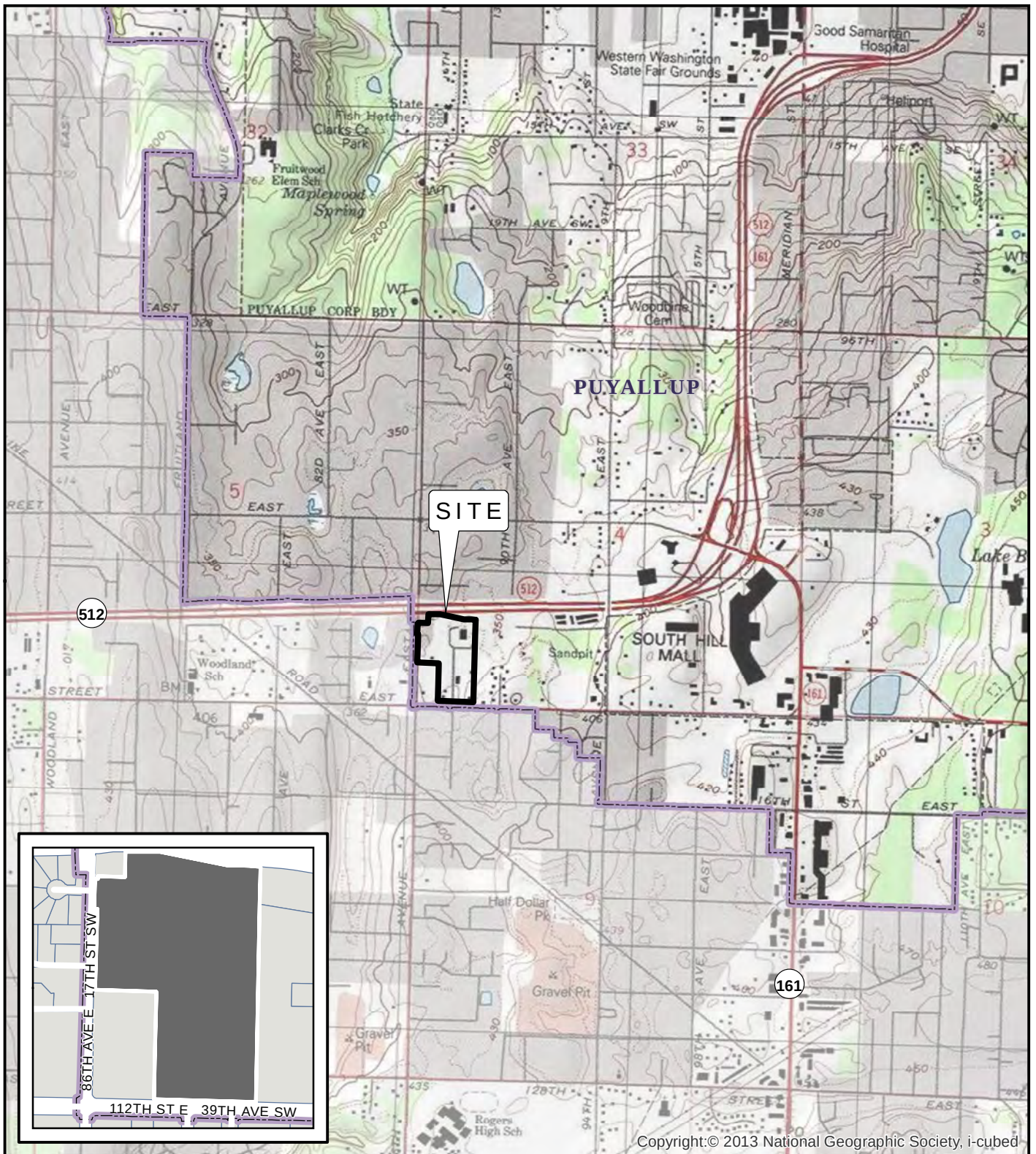
We appreciate the opportunity to be of continued service to you on this project. Should you have any questions regarding this report or other geotechnical aspects of the project, please call us at your earliest convenience.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Tacoma, Washington

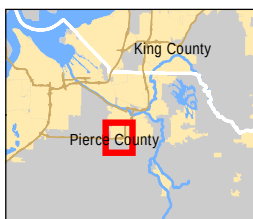
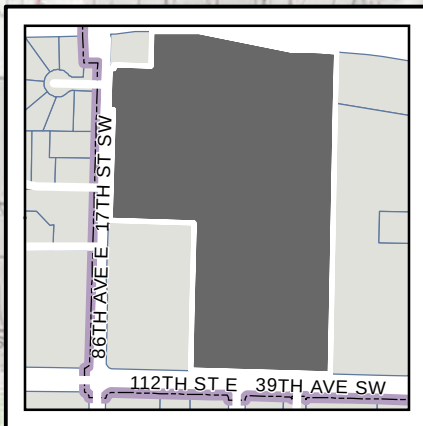


Aaron Turnley
Senior Staff Geologist

Kurt D. Merriman, P.E.
Senior Principal Geotechnical Engineer

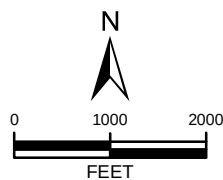


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DATA SOURCES / REFERENCES:
USGS: 7.5' SERIES TOPOGRAPHIC MAPS, ESRI/I-CUBED/NGS 2013
PIERCE CO: STREETS, CITY LIMITS, PARCELS 1/18

LOCATIONS AND DISTANCES SHOWN ARE APPROXIMATE



NOTE: BLACK AND WHITE
REPRODUCTION OF THIS COLOR
ORIGINAL MAY REDUCE ITS
EFFECTIVENESS AND LEAD TO
INCORRECT INTERPRETATION



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VICINITY MAP

LSC - KESSLER CENTER
PUYALLUP, WASHINGTON

PROJ NO.

180090E002

DATE:

5/19

FIGURE:

1

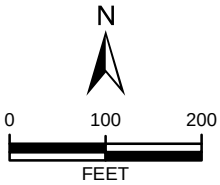


KESSLER CENTER AREA,
DETAIL SHOWN IN FIGURE 3

- SITE
- KESSLER CENTER AREA
- EXPLORATION BORING (2019)
- MONITORING WELL (2018)
- EXPLORATION PIT (2018)
- EXPLORATION PIT (2006)
- EXPLORATION PIT (2005)
- INFILTRATION TEST (2005)
- PIT DRAIN (2018)
- CITY BOUNDARY
- PARCEL
- CONTOUR 10 FT
- CONTOUR 2 FT

DATA SOURCES / REFERENCES:
PIERCE COUNTY 2010/2011, GRID CELL SIZE IS 3'.
WA STATE PLANE SOUTH COORDINATE SYSTEM.
NAD83(1991 HARN), VERTICAL NAVD88 GEOID09.
US SURVEY FEET, CONTOURS FROM LIDAR
PIERCE CO: PARCELS, STREETS 1/18
BING AERIAL, 7/2014

LOCATIONS AND DISTANCES SHOWN ARE APPROXIMATE



BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS
EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION



OVERALL SITE PLAN

LSC - KESSLER BUILDING
PUYALLUP, WASHINGTON

PROJ NO.	180090E002	DATE:	5/19	FIGURE:	2
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APPENDIX A

Field Exploration Logs

Coarse-Grained Soils - More than 50% ⁽¹⁾ Retained on No. 200 Sieve				Terms Describing Relative Density and Consistency			
Gravels - More than 50% ⁽¹⁾ of Coarse Fraction Retained on No. 4 Sieve	≤5% Fines ⁽⁵⁾	GW	Well-graded gravel and gravel with sand, little to no fines	Coarse-Grained Soils	Density	SPT ⁽²⁾ blows/foot	Test Symbols G = Grain Size M = Moisture Content A = Atterberg Limits C = Chemical DD = Dry Density K = Permeability
		GP	Poorly-graded gravel and gravel with sand, little to no fines		Very Loose	0 to 4	
Sands - 50% ⁽¹⁾ or More of Coarse Fraction Passes No. 4 Sieve	≥12% Fines ⁽⁵⁾	GM	Silty gravel and silty gravel with sand	Fine-Grained Soils	Loose	4 to 10	
		GC	Clayey gravel and clayey gravel with sand		Medium Dense	10 to 30	
Sands - 50% ⁽¹⁾ or More of Coarse Fraction Passes No. 4 Sieve	≤5% Fines ⁽⁵⁾	SW	Well-graded sand and sand with gravel, little to no fines		Dense	30 to 50	
		SP	Poorly-graded sand and sand with gravel, little to no fines		Very Dense	>50	
Sands - 50% ⁽¹⁾ or More of Coarse Fraction Passes No. 4 Sieve	≥12% Fines ⁽⁵⁾	SM	Silty sand and silty sand with gravel		Consistency	SPT ⁽²⁾ blows/foot	
		SC	Clayey sand and clayey sand with gravel		Very Soft	0 to 2	
				Component Definitions			
				Descriptive Term	Size Range and Sieve Number		
				Boulders	Larger than 12"		
				Cobbles	3" to 12"		
				Gravel	3" to No. 4 (4.75 mm)		
				Coarse Gravel	3" to 3/4"		
				Fine Gravel	3/4" to No. 4 (4.75 mm)		
				Sand	No. 4 (4.75 mm) to No. 200 (0.075 mm)		
				Coarse Sand	No. 4 (4.75 mm) to No. 10 (2.00 mm)		
				Medium Sand	No. 10 (2.00 mm) to No. 40 (0.425 mm)		
				Fine Sand	No. 40 (0.425 mm) to No. 200 (0.075 mm)		
				Silt and Clay	Smaller than No. 200 (0.075 mm)		
				(3) Estimated Percentage		Moisture Content	
				Component	Percentage by Weight		Dry - Absence of moisture, dusty, dry to the touch
				Trace	<5		Slightly Moist - Perceptible moisture
				Some	5 to <12		Moist - Damp but no visible water
				Modifier (silty, sandy, gravelly)	12 to <30		Very Moist - Water visible but not free draining
				Very modifier (silty, sandy, gravelly)	30 to <50		Wet - Visible free water, usually from below water table
				Symbols			
				Sampler Type	Blows/6" or portion of 6"		
				2.0" OD Split-Spoon Sampler (SPT)	3.0" OD Split-Spoon Sampler		
				Bulk sample	3.25" OD Split-Spoon Ring Sampler		
				Grab Sample	3.0" OD Thin-Wall Tube Sampler (including Shelby tube)		
					Portion not recovered		
				(1) Percentage by dry weight		(4) Depth of ground water	
				(2) (SPT) Standard Penetration Test (ASTM D-1586)		▼ ATD = At time of drilling	
				(3) In General Accordance with Standard Practice for Description and Identification of Soils (ASTM D-2488)		▽ Static water level (date)	
						(5) Combined USCS symbols used for fines between 5% and 12%	

Classifications of soils in this report are based on visual field and/or laboratory observations, which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field or laboratory testing unless presented herein. Visual-manual and/or laboratory classification methods of ASTM D-2487 and D-2488 were used as an identification guide for the Unified Soil Classification System.



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EXPLORATION LOG KEY

FIGURE A1



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Exploration Log

Project Number
180090E002

Exploration Number
EB-9

Sheet
1 of 1

Project Name
LSC - Kessler Center

Location
Puyallup, WA

Driller/Equipment
Advance Drill Technologies / HSA D-50

Hammer Weight/Drop
140# / 30

Ground Surface Elevation (ft)
364

Datum
NAVD 88

Date Start/Finish
4/25/19, 4/25/19

Hole Diameter (in)
7

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot				Other Tests
								10	20	30	40	
		S-1		Grass / Topsoil Crushed Gravel Base - 2 to 4 inches Vashon Recessional Lacustrine Deposit			13 18 6		▲24			
5		S-2		Moist to very moist, orangish brown, silty, fine SAND; organics (SM). Moist, orangish brown with light iron oxide staining, fine sandy, SILT, trace medium to coarse sand (dropstones), trace organics; fine laminae otherwise massive (ML).			2 1 3	▲4				
		S-3		Moist, brownish orange, SILT, trace fine sand, trace organics; trace laminae otherwise massive (ML).			3 2 3	▲5				
		S-4		Moist, brown, fine sandy, SILT; massive (ML).			3 4 6	▲10				X
10		S-5		Moist, brownish gray with trace iron oxide staining, fine sandy, SILT; very fine laminae otherwise massive (ML).			2 3 5	▲8				
15		S-6		Moist, brownish orange, SILT; few fine to medium sand interbeds with iron oxide staining (ML).			2 2 3	▲5				
20		S-7		Wet, brownish gray, SILT, some fine sand; massive (ML).		▼	2 1 3	▲4				
25		S-8		Very moist, brownish gray, sandy, SILT; interbeds of medium to coarse sand with iron oxide staining; fine laminae (ML).			4 3 5	▲8				
30		S-9		Moist, brownish gray, fine silty, SAND; few gravel (dropstones); coarsening down; massive (SM). Driller notes gravel at 31 feet.			3 7 8	▲15				
				Vashon Advance Outwash								
35		S-10		Moist, grayish brown, sandy, GRAVEL, some silt; gravel is broken; sand is mostly fine to medium; gravel is silt coated; only 9 inches of recovery (GW-GM).			10 22 29					▲51
40		S-11		As above; gravel is not silt coated (GW-GM).			31 46 50/4"					▲50/4"
				Bottom of exploration boring at 41.5 feet. Perched groundwater encountered at ~20 feet. Bottom of hole was dry.								

Sampler Type (ST):



2" OD Split Spoon Sampler (SPT)



3" OD Split Spoon Sampler (D & M)



Grab Sample



No Recovery



Ring Sample



Shelby Tube Sample

M - Moisture

▼ Water Level ()

▼ Water Level at time of drilling (ATD)

Logged by: AT

Approved by: JHS

AESIBOR 180090E002.GPJ May 24, 2019



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Exploration Log

Project Number
180090E002

Exploration Number
EB-10

Sheet
1 of 1

Project Name LSC - Kessler Center Ground Surface Elevation (ft) 365.5
Location Puyallup, WA Datum NAVD 88
Driller/Equipment Advance Drill Technologies / HSA D-50 Date Start/Finish 4/25/19, 4/25/19
Hammer Weight/Drop 140# / 30 Hole Diameter (in) 7

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot				Other Tests
								10	20	30	40	
5		S-1		Grass / Topsoil		5						
				Crushed Gravel Base - 4 inches		3	▲6					
				Vashon Recessional Lacustrine Deposit		3						
		S-2		Moist, orangish brown, silty, fine SAND; organics; poor recovery (SM). Moist, brownish orange, SILT, some fine sand, trace medium to coarse sand; organics (ML).		2	▲4					
						1						
10		S-3		Moist, brownish tan, SILT, some fine sand; fine laminae with iron oxide staining otherwise massive (ML).		1	▲5					
						2						
						4						
		S-4		Moist, brownish tan, silty, fine SAND; fine laminae with iron oxide staining otherwise massive; coarsening downward (SM).		2	▲8					
						3						
15						5						
		S-5		Moist, grayish brown, SILT, some fine sand; fine laminae otherwise massive (ML). Moist, grayish brown, silty, fine SAND; massive (SM).		2	▲8					
						2						
						6						
		S-6		Moist, brownish gray, SILT, some fine sand; few interbeds of silt with iron oxide staining (ML).		2	▲6					
20						2						
						2						
						4						
25		S-7		Upper 3 inches: moist, brownish gray, SILT, trace gravel (ML). Vashon Lodgement Till / Vashon Advance Outwash Driller notes gravel at 25 feet. Lower 3 inches: moist, grayish brown with heavy oxidation at contact, silty, GRAVEL, some fine sand; unsorted; 6 inches of recovery (GM).		6					▲36	
						18						
						18						
30				Vashon Advance Outwash								
		S-8		Moist, grayish brown, fine to medium SAND, some gravel, trace silt; 6 inches of recovery (SP).		17						▲55
						24						
						31						
				Bottom of exploration boring at 31.5 feet. No groundwater encountered.								
35												
40												

Sampler Type (ST):



2" OD Split Spoon Sampler (SPT)



No Recovery

M - Moisture



3" OD Split Spoon Sampler (D & M)



Ring Sample

Water Level ()



Grab Sample



Shelby Tube Sample

Water Level at time of drilling (ATD)

Logged by: AT

Approved by: JHS



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Exploration Log

Project Number
180090E002

Exploration Number
EB-11

Sheet
1 of 1

Project Name **LSC - Kessler Center**

Location **Puyallup, WA**

Driller/Equipment **Advance Drill Technologies / HSA D-50**

Hammer Weight/Drop **140# / 30**

Ground Surface Elevation (ft) **363**

Datum **NAVD 88**

Date Start/Finish **4/25/19, 4/25/19**

Hole Diameter (in) **7**

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6" Blows/ft	Blows/Foot				Other Tests
								10	20	30	40	
5		S-1		Grass / Topsoil Crushed Gravel Base - 2 to 4 inches Vashon Recessional Lacustrine Deposit Moist, dark orangish brown with iron oxide staining, silty, fine SAND; organics (SM).			8 6 7	▲13				
		S-2		Moist, brownish tan, SILT, some fine sand; few dropstones otherwise massive (ML).			3 2 6	▲8				
		S-3		Moist, brownish tan, SILT, some fine sand, trace gravel (dropstones); some laminae with iron oxide mottling otherwise massive (ML).			3 3 4	▲7				
10		S-4		Moist, brownish gray, silty, fine SAND to sandy, SILT; silt interbeds with iron oxide staining (SM-ML).			2 5 5	▲10				
15		S-5		Moist, brownish gray, SILT, some fine sand, trace gravel (dropstones); interbeds of medium sand and interbeds of silt; coarsening downward (ML).			3 3 6	▲9				
20		S-6		Moist, brownish tan, SILT, some fine sand, trace gravel; massive (ML).			4 6 7	▲13				
25		S-7		Moist to very moist, brownish tan, SILT, trace gravel; massive (ML).			3 4 5	▲9				
30		S-8		Driller notes gravel at 27.5 feet. Vashon Lodgement Till / Vashon Advance Outwash Upper 3 inches: moist, grayish brown, silty, fine to medium SAND, some gravel; diamict; 6 inches of recovery (SM).			17 14 28				▲42	
35		S-9		Vashon Advance Outwash Moist, grayish brown, fine to medium SAND, some gravel, trace silt; 6 inches of recovery (SP).			13 19 32					▲51
40				Bottom of exploration boring at 36.5 feet. No groundwater encountered.								

Sampler Type (ST):



2" OD Split Spoon Sampler (SPT)



3" OD Split Spoon Sampler (D & M)



Grab Sample



No Recovery



Ring Sample



Shelby Tube Sample

M - Moisture

Water Level ()

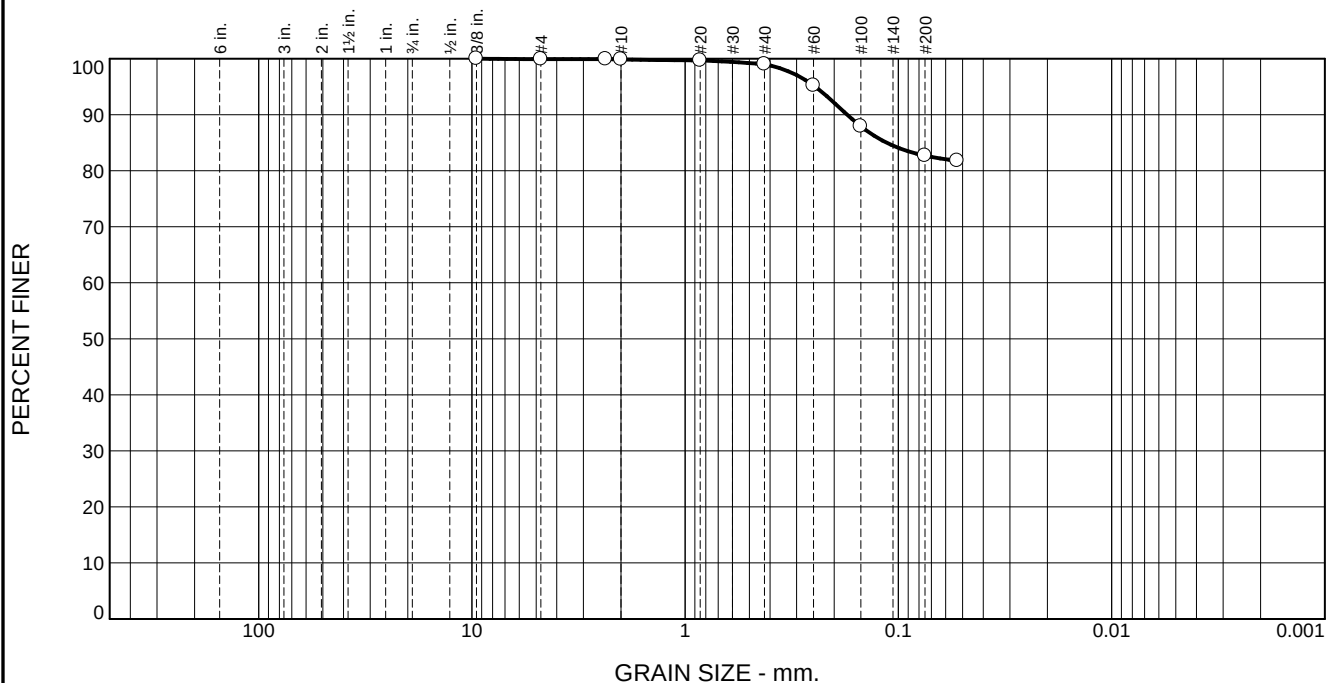


Water Level at time of drilling (ATD)

Logged by: AT

Approved by: JHS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.1	0.0	0.9	16.3	82.7	

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.375	100.0		
#4	99.9		
#8	99.9		
#10	99.9		
#20	99.7		
#40	99.0		
#60	95.2		
#100	87.9		
#200	82.7		
#270	81.8		

* (no specification provided)

Material Description

Sandy SILT trace gravel - Fine sandy silt

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= ML AASHTO (M 145)= A-4(0)

Coefficients

D₉₀= 0.1739 D₈₅= 0.1135 D₆₀=
D₅₀= D₃₀= D₁₅=
D₁₀= C_u= C_c=

Remarks

Date Received: 4/30/19 Date Tested: 4/30/19

Tested By: BP

Checked By: KM

Title:

Location: Onsite

Sample Number: EB-9

Depth: 7.5'

Date Sampled: 4/25/19



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Client: Puyallup School District

Project: Kessler Building

Project No: 180090 E002

Figure