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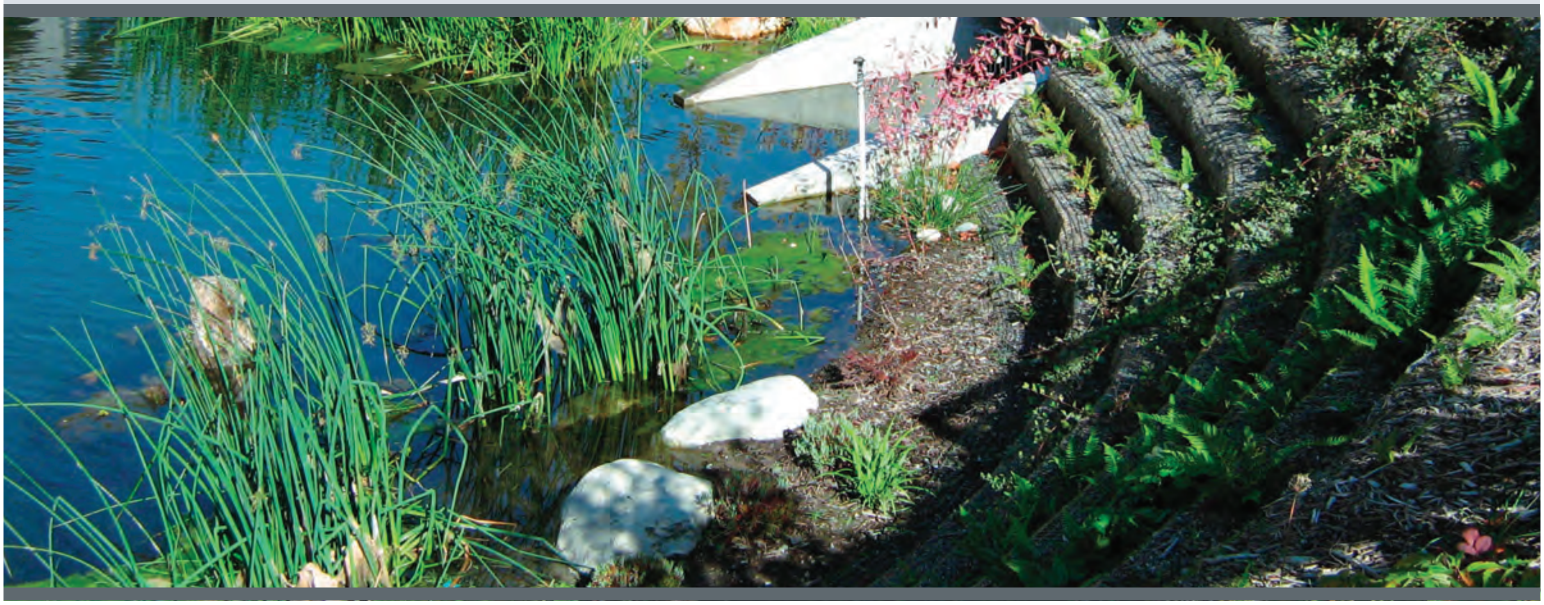

Subsurface Exploration, Geologic Hazard, Infiltration Feasibility, and Preliminary Geotechnical Engineering Report

PSD - SOUTH HILL SITE
Puyallup, Washington

Prepared For:

PUYALLUP SCHOOL DISTRICT

Project No. 20210394E001
November 29, 2021

Associated Earth Sciences, Inc.
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earth sciences
incorporated

November 29, 2021
Project No. 20210394E001

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

Attention: Mr. Brady Martin

Subject: Subsurface Exploration, Geologic Hazard, Infiltration Feasibility, and Preliminary Geotechnical Engineering Report
PSD - South Hill Site
14th Street Place SW
Puyallup, Washington

Dear Mr. Martin:

We are pleased to present the enclosed copy of the referenced report. This report summarizes the results of tasks including subsurface exploration, geologic hazard analysis, infiltration feasibility assessment, and geotechnical engineering, and offers preliminary recommendations for design of the project.

We have enjoyed working with you on this study and are confident that the preliminary recommendations presented in this report will aid in the successful completion of your project. Please contact me if you have any questions or if we can be of additional help to you.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington

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

KDM/ld - 20210394E001-002

SUBSURFACE EXPLORATION, GEOLOGIC HAZARD, INFILTRATION FEASIBILITY, AND PRELIMINARY GEOTECHNICAL ENGINEERING REPORT

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I. PROJECT AND SITE CONDITIONS

1.0 INTRODUCTION

This report presents the results of Associated Earth Sciences, Inc.'s (AESI's) subsurface exploration, geologic hazard analysis, preliminary geotechnical engineering, and stormwater infiltration feasibility study for the proposed project in Puyallup, Washington. Our recommendations are preliminary in that the project is in the early design phase. The site location is shown on the "Vicinity Map," Figure 1. The approximate locations of explorations completed for this study are shown on the "Existing Site and Exploration Plan," Figure 2. Interpretive exploration logs of subsurface explorations completed for this study are included in Appendix A.

1.1 Purpose and Scope

The purpose of this study is to provide subsurface soil and groundwater data to be utilized in the preliminary design of the proposed South Hill Site project. Our study included reviewing selected available geologic literature, advancing eight exploration borings (EB-1W through EB-8), and performing a geologic study of subsurface sediment and groundwater conditions. Geotechnical engineering studies were completed to develop recommendations for site preparation, flexible and rigid pavement sections, structural fill, erosion control, and to provide infiltration feasibility recommendations. This report summarizes our current fieldwork and offers preliminary design recommendations based on our present understanding of the project.

1.2 Authorization

Authorization to proceed with this study was given to AESI by means of District Purchase Order CP3655 dated October 15, 2021. Our study was accomplished in general accordance with our proposal dated October 8, 2021. This report has been prepared for the exclusive use of the Puyallup School District (PSD) and its agents for specific application to this project. Within the limitations of scope, schedule, and budget, our services have been performed in accordance with generally accepted geotechnical engineering and engineering geology practices in effect in this area at the time our report was prepared. No other warranty, express or implied, is made.

2.0 PROJECT AND SITE DESCRIPTION

The site known as Parcel B is located along 14th Street Place SW just north of 39th Avenue NW in Puyallup, Washington as shown on Figure 2, "Existing Site and Exploration Plan." Roughly rectangular in shape, the site encompasses about 4.8 acres. The site is bounded to the north by a stormwater pond associated with the Costco store to the east of the site, to the south by commercial property and undeveloped Parcel A, to the west by PSD property, and to the east by 14th Street Place SW.

AESI previously completed a "Subsurface Exploration and Geotechnical Engineering Report" dated May 30, 2018 for the Logistics Center Warehouse (LSC) Addition immediately to the west of the subject site. We also completed a "Subsurface Exploration, Infiltration Testing, and Design Infiltration Rate Determination" dated June 21, 2018 for the LSC Addition. AESI performed geotechnical monitoring during construction of the addition and a stormwater infiltration trench.

AESI previously completed a "Subsurface Exploration and Geotechnical Engineering Report" dated June 17, 2019 for the LSC-Kessler Center southwest of the subject site. We also completed a "Subsurface Exploration, Infiltration Testing, and Design Infiltration Rate Determination" dated December 18, 2019 for the LSC-Kessler Center. AESI performed geotechnical monitoring during construction of the addition, bioretention facility, and infiltration trenches.

Topography on the site is dominated by a large mound composed of fill soils reportedly associated with construction of the Costco store across the street according to the PSD. Surface elevations surrounding the mound range from about 355 feet in the northwestern corner, to about 372 feet in the southeastern corner. The top of the mound is about elevation 380 feet. An approximate 10-foot-high slope is present on the eastern site boundary. Vegetation across the site generally consists of tall grasses and occasional Scotch broom. No surface water features were observed at the time of our site visit.

Based on discussions with TCF Architecture and review of conceptual plans, we understand that development of Parcel B will involve using the fill mound to level the site and create a new paved parking area for district school buses relocated from the downtown maintenance facility site. We understand that project plans will include infiltration of stormwater. Project plans are still in the conceptual stages but based on discussions with the project civil engineer, stormwater will be captured and then conveyed to infiltration trenches for disposal. Favorable infiltration conditions were encountered on the adjacent property where the LSC Warehouse Addition (AESI, May 2018) and also on the nearby LSC- Kessler Center are located (AESI, June 2019). We further understand that future improvements being considered include a direct connection from the new bus parking area to 14th Street Place NW.

3.0 SITE EXPLORATION

Our field explorations were conducted in October 2021 and included advancing eight exploration borings, one of which was completed as a groundwater monitoring well (EB-1W). The existing site conditions, and the approximate locations of subsurface explorations referenced in this study, are presented on the "Existing Site and Exploration Plan" (Figure 2). The various types of sediments, as well as the depths where the characteristics of the sediments changed, are indicated on the exploration logs presented in Appendix A. The depths indicated on the logs where conditions changed may represent gradational variations between sediment types. If changes occurred between sample intervals in our exploration borings, they were interpreted. Our explorations were approximately located in the field by measuring from known site features depicted on the aerial photograph used as a basis for Figure 2.

The conclusions and recommendations presented in this report are based on the explorations completed for this study. The number, locations, and depths of the explorations were completed within site and budgetary constraints. Because of the nature of exploratory work below ground, extrapolation of subsurface conditions between field explorations is necessary. It should be noted that differing subsurface conditions may be present due to the random nature of deposition and the alteration of topography by past grading and/or filling. The nature and extent of variations between the field explorations may not become fully evident until construction. If variations are observed at that time, it may be necessary to re-evaluate specific recommendations in this report and make appropriate changes.

3.1 Exploration Borings

For this study, eight exploration borings were performed by Advance Drill Technologies, Inc., an independent firm working under subcontract to AESI. The borings were completed by advancing both a 3.25- and 4.25-inch, inside-diameter hollow-stem auger using a track-mounted drill. During the drilling process, samples were generally obtained at 2½- to 5-foot-depth intervals. After completion of drilling, each borehole was backfilled with bentonite chips, and the surface was patched with concrete or sod.

Disturbed, but representative samples were obtained by using the Standard Penetration Test (SPT) procedure in accordance with *ASTM International* (ASTM) D-1586. This test and sampling method 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 is known as the Standard Penetration Resistance (“N”) or blow count. If a total of 50 is recorded within one 6-inch interval, the blow count is recorded as the number of blows for the corresponding number of inches of penetration. The resistance, or N-value, provides a measure of the relative density of granular soils or the relative consistency of cohesive soils; these values are plotted on the attached exploration boring logs.

The borings were continuously observed and logged by a geologist from our firm. The samples obtained from the split-barrel sampler were classified in the field and representative portions placed in watertight containers. The samples were then transported to our laboratory for further visual classification and testing. The exploration logs presented in Appendix A are based on the field observations, drilling action, and laboratory test results.

3.2 Monitoring Well

A groundwater monitoring well was installed by Advance Drill Technologies, Inc. in conjunction with our exploration borings in exploration boring EB-1W. The well consists of a 2-inch-diameter polyvinyl chloride (PVC) Schedule-40 well casing with threaded connections, the lower 10 feet of which is finely-slotted (0.020-inch machine slot) well screen to allow water inflow. The annular space around the well screen was backfilled with clean sand, and the upper portion of annulus was sealed with bentonite chips and concrete. An above-grade steel monument was placed over the top of the wellhead for protection. The as-built configuration is illustrated on the boring log in Appendix A. The well was dry at the time of drilling. After installation, an AESI representative developed the well by adding water and documenting that the well remained dry.

4.0 SUBSURFACE CONDITIONS

4.1 Regional Geology and Soils Mapping

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 consist of 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. We did not encounter coarse-grained sand and gravel sediments.

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 which is formed from the weathering of sandy outwash. Finer-grained Kitsap loam soils formed from the weathering of lacustrine sediments are mapped nearby. Our interpretation of the soils encountered in our explorations is in somewhat agreement with the regional soils mapping in that we encountered fine-grained glaciolacustrine sediments in several explorations below the fill mound.

4.2 Site Stratigraphy

Subsurface conditions at the project site were inferred from the field explorations accomplished for this study, visual reconnaissance of the site, and review of selected applicable geologic literature. Our subsurface explorations confirmed the presence of Vashon-age deposits in the proposed project 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 ice-contact sediments, 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.

Topsoil

Organic-rich brown topsoil was observed at the ground surface in all borings completed where native sediments were present at ground surface elevation (EB-2, EB-6, EB-7, and EB-8). The observed thicknesses of topsoil ranged between 4 and 6 inches at the boring locations and are shown on the exploration logs. Fill over relic topsoil was also observed in EB-1W at a depth of approximately 7 feet below existing ground surface elevation. Existing topsoil should be stripped from structural areas and exported or reused in landscape applications if specifically permitted by project specifications.

Fill

Fill soils (those not naturally placed), were observed in borings EB-1W, EB-3, EB-4, EB-5, and EB-6. The observed fill thicknesses ranged between 1 foot (EB-5) and 29 feet (EB-3). Figure 2 includes the observed fill depths at each of the exploration locations. The fill generally consisted of loose to medium dense, moist, light brown to brown, fine to medium sand with variable silt content and variable gravel content. Organics (wood pieces) and faint organic odors were observed in the fill at the locations of borings EB-3 and EB-4. Existing fill may require remedial preparation below new pavement areas. Excavated existing fill material is potentially suitable for reuse in structural fill applications if such reuse is specifically allowed by project plans and specifications, if excessively organic and any other deleterious materials are removed, and if moisture content is adjusted (by aeration or cement amendment) to allow compaction to the specified level and to a firm and unyielding condition. Existing fill is not suitable for infiltration of stormwater and will be difficult to reuse during wet weather.

Vashon Recessional Lacustrine Sediments

Immediately below the surficial topsoil and/or fill, in all borings except EB-3, we observed 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 22.5 feet (EB-1W), 9 feet (EB-2), 39 feet (EB-4), 7.5 feet (EB-5), 12.5 (EB-7), and 18.5 (EB-8). We did not observe the bottom of the lacustrine deposit in EB-6.

Vashon Ice-Contact (Melt-Out Till) Sediments

In exploration borings EB-2, EB-4, EB-5, EB-7, and EB-8 we observed a thin layer of sediments interpreted as ice-contact deposits below the Vashon recessional lacustrine sediments and above the Vashon advance outwash. The sediments were generally an unsorted mixture of silty fine sand to sandy silt with variable amounts of coarser sands and gravel, and ranged from medium dense to dense/hard. This material was differentiated from the underlying Vashon advance outwash observed onsite based on fines content (siltier) and composition (unsorted, diamict). This material is not recommended for use as an infiltration receptor due to its variable density and generally high silt content. Vashon ice-contact sediments are suitable for reuse in structural fill applications if allowed by project specifications and if the moisture content is adjusted to allow compaction to a firm and unyielding condition at the specified level.

Vashon Advance Outwash

In exploration borings EB-1W, EB-2, EB-3, EB-5, and EB-7 we observed dense sand and gravel with variable silt content that we interpret to be Vashon advance outwash. Advance outwash deposits were encountered at depths of 22.5 feet (EB-1W), 12.5 feet (EB-2), 29 feet (EB-3), 13 feet (EB-5), and 17.5 feet (EB-7). The advance outwash continued beyond the termination of each boring where it was observed. 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. Where permeable and unsaturated, these sediments are suitable for stormwater infiltration.

4.3 Hydrology

AESI has studied groundwater conditions for the adjacent LSC Warehouse and LSC Kessler PSD projects for infiltration design. There is historical information on shallow and deep groundwater conditions in the site vicinity. Site groundwater consists of two general water-bearing zones: (1) perched water in the recessional lacustrine deposits and advance outwash deposits, and (2) deeper groundwater in the regional Vashon advance aquifer. The recessional lacustrine sediments are expected to be intermittently wet at the base of the unit if the ice-contact/ melt-out till layer is present.

Most of the exploration borings did not encounter groundwater at the time of drilling, consistent with the expected lowered groundwater conditions present in the fall season. Perched groundwater was observed in exploration boring EB-1W at the time of drilling (October 2021) in the advance outwash at a depth of approximately 45 feet below ground surface, perched above a siltier layer with the advance outwash formation.

Perched water occurs when surface water infiltrates down through relatively permeable soils, such as existing fill, recessional deposits, or coarser-grained advance outwash strata and becomes trapped or "perched" atop a comparatively low-permeability barrier such as the melt-out till deposits. When water becomes perched, it may travel laterally and may follow flow paths related to permeable zones that may not correspond to ground surface topography.

EB-1W was completed as a groundwater monitoring well at approximately 90 feet deep to monitor groundwater fluctuations throughout the year. The well was dry at the time of installation and 1 week after installation. Water level monitoring is ongoing within well EB-1W. The monitoring program is intended to document that there is adequate vertical separation from the base of potential stormwater infiltration systems and the aquifer contained at depth in the Vashon advance outwash deposits.

It should be noted that the presence and quantity of groundwater will largely depend on the soil grain-size distribution, topography, seasonal precipitation, site use, on- and off-site land usage, and other factors. Explorations for the current study were conducted in October 2021. However, there is historical groundwater level monitoring data the LCS site during 2018 to 2020.

4.4 Laboratory Testing

As a part of our geotechnical study, we completed six grain-size analyses, two Modified Proctor tests, and two organic content determinations in accordance with ASTM procedures. Copies of the laboratory testing reports are included in Appendix B.

II. GEOLOGIC HAZARDS AND MITIGATIONS

We reviewed the Washington State Department of Natural Resources (DNR) Geologic Information Portal[1], Pierce County Public GIS,[2] and City of Puyallup Public GIS[3]. Steep slopes associated with the fill stockpile that would be classified as a landslide hazard per the City of Puyallup code were identified on the site but are exempt from City code requirements. 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. Geologic hazards are described in further detail below.

5.0 LANDSLIDE HAZARDS AND MITIGATIONS

The topography of the site is undulating to relatively flat with a fill mound that has an approximate height of 20 to 25 feet and slopes steeper than 40 percent. The *Puyallup Municipal Code* Section 21.06 states that a landslide hazard area is any area with a slope of 40 percent or steeper and with a vertical relief of 10 or more feet except areas composed of bedrock. Per the code definition, the fill mound would be classified as a landslide hazard area; however, based on recent AESI discussions with City staff, we understand that the City does not consider the mound a landslide hazard because it is a man-made feature comprised of uncontrolled fill, thus no mitigation is warranted. An approximate 10-foot-tall slope is present along the east side of the site descending from 14th Street Place SW. We interpret the slope to be associated with the construction of 14th Street Place SW and is likely comprised of fill. This slope will not be impacted by the planned site improvements and will remain unchanged.

6.0 SEISMIC HAZARDS AND MITIGATIONS

The following discussion is a more general assessment of seismic hazards that is intended to be useful to the project design team in terms of understanding seismic issues, and to the structural engineer for preliminary design.

All of Western Washington is at risk of strong seismic events resulting from movement of the tectonic plates associated with the Cascadia Subduction Zone (CSZ), where the offshore Juan de

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[1] https://www.dnr.wa.gov/geologyportal
[2] PublicGIS (pierce.wa.us)
[3] Public Data Viewer (arcgis.com)

Fuca plate subducts beneath the continental North American plate. The site lies within a zone of strong potential shaking from subduction zone earthquakes associated with the CSZ. The CSZ can produce earthquakes up to magnitude 9.0, and the recurrence interval is estimated to be on the order of 500 years. Geologists infer the most recent subduction zone earthquake occurred in 1700 (Goldfinger et al., 2012[4]). Three main types of earthquakes are typically associated with subduction zone environments: crustal, intraplate, and interplate earthquakes. Seismic records in the Puget Sound region document a distinct zone of shallow crustal seismicity (e.g., the Seattle Fault Zone). These shallow fault zones may include surficial expressions of previous seismic events, such as fault scarps, displaced shorelines, and shallow bedrock exposures. The shallow fault zones typically extend from the surface to depths ranging from 16 to 19 miles. A deeper zone of seismicity is associated with the subducting Juan de Fuca plate. Subduction zone seismic events produce intraplate earthquakes at depths ranging from 25 to 45 miles beneath the Puget Lowland including the 1949, 7.2-magnitude event; the 1965, 6.5-magnitude event; and the 2001, 6.8-magnitude event) and interplate earthquakes at shallow depths near the Washington coast including the 1700 earthquake, which had a magnitude of approximately 9.0. The 1949 earthquake appears to have been the largest in this region during recorded history and was centered in the Olympia area. Evaluation of earthquake return rates indicates that an earthquake of the magnitude between 5.5 and 6.0 is likely within a given 20-year period.

Generally, there are four types of potential geologic hazards associated with large seismic events: 1) surficial ground rupture, 2) seismically induced landslides, 3) liquefaction, 4) ground motion. The potential for each of these hazards to adversely impact the proposed project is discussed below.

6.1 Surficial Ground Rupture

The nearest known fault traces to the subject property are possible southern branches of the Tacoma Fault Zone, referred to as Lineaments "C" and "D" (Sherrod et al., 2003[5]) approximately 7 miles northwest and northeast of the site. The geophysical datasets indicate that the vertical displacement of this fault increases to the west. Evidence of uplift or subsidence is recorded in marshes along inlets of southern Puget Sound near Lynch Cove, Burley, North Bay, and Wollochet Bay. This movement suggests a seismic event associated with the Tacoma Fault approximately 1,100 years ago, with up to 3 meters of displacement. Data pertaining to the Tacoma Fault is limited, with studies still ongoing. The recurrence interval of movement along this fault system is still unknown, although it is hypothesized to be in excess of 1,000 years. Due to the suspected

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[4] Goldfinger, C., Nelson, C.H., Morey, A.E., Johnson, J.E., Patton, J.R., Karabanov, E., Gutierrez-Pastor, J., Eriksson, A.T., Gracia, E., Dunhill, G., Enkin, R.J, Dallimore, A., and Vallier, T., 2012, *Turbidite Event History—Methods and Implications for Holocene Paleoseismicity of the Cascadia Subduction Zone*: U.S. Geological Survey Professional Paper 1661–F, 170 .

[5] Sherrod, B.L. Nelson, A.R., Kelsey, H.M., Brocher, T.M., Blakely, R.J., Weaver, C.S., Rountree, N.K., Rhea, S.B., and Jackson, B.S., 2003, *The Catfish Lake Scarp, Allyn, Washington: Preliminary Field Data and Implications for Earthquake Hazards Posed by the Tacoma Fault*, U.S. Geological Survey (USGS) Open File Report 03-0455.

long recurrence interval, and the distance from mapped fault traces, the potential risk to the project from surficial ground rupture is considered to be low during the expected life of the project. We are available to discuss mapped faulting further on request.

6.2 Seismically Induced Landslides

As stated above, slopes associated with the fill mound present at the site meet the City code definition of a landslide hazard; however, because they are man-made features comprised of uncontrolled fill and will be removed, the code does not apply. The existing 10-foot-tall steep slope on the east side of the site that descends from 14th Street Place SW will not be impacted by the proposed site development. No detailed quantitative assessment of slope stability was completed as part of this study.

6.3 Liquefaction

Liquefaction is a process through which unconsolidated soil loses strength as a result of vibrations, such as those which occur during a seismic event. During normal conditions, the weight of the soil is supported by both grain-to-grain contacts and by the fluid pressure within the pore spaces of the soil below the water table. Extreme vibratory shaking can disrupt the grain-to-grain contact, increase the pore pressure, and result in a temporary decrease in soil shear strength. The soil is said to be liquefied when nearly all of the weight of the soil is supported by pore pressure alone. Liquefaction can result in deformation of the sediment and settlement of overlying structures. Areas most susceptible to liquefaction include those areas underlain by very soft to stiff, non-cohesive silt and very loose to medium dense, non-silty to silty sands with low relative densities, accompanied by a shallow water table.

The project is not expected to have substantial risk of damage due to liquefaction because substantial deposits of loose saturated granular sediments were not observed. A detailed liquefaction hazard analysis was not performed as part of this study, and none is warranted based on existing subsurface data, in our opinion.

6.4 Ground Motion/Seismic Site Class (2018 *International Building Code*)

Any structural designs associated with the proposed project should follow 2018 *International Building Code* (IBC) standards. We recommend that the project be designed in accordance with Site Class "D" in accordance with the 2018 IBC, and the publication *American Society of Civil Engineers* (ASCE) 7 referenced therein, the most recent version of which is ASCE 7-16.

7.0 EROSION HAZARDS AND MITIGATIONS

According to the *City of Puyallup Municipal Code* a site is classified as having an erosion hazard if identified by the U.S. Department of Agriculture's Natural Resources Conservation Service (USDA NRCS) or identified by a special study as having a "moderate to severe," "severe," or "very severe" erosion potential. According to the USDA NRCS, the site soils are classified as part of the Indianola Series on 0 to 5 percent slopes. These soils are identified as having a slight susceptibility to erosion and therefore would not be classified as an erosion hazard. As mentioned previously, there are steeper man-made slopes present on the site associated with the fill mound and grading for 14th Street Place SW.

Due to the variable silt content in the shallow subsurface soils, project plans should include implementation of temporary erosion controls in accordance with local standards of practice. In our opinion, implementation of the following recommendations should be adequate to address the Washington State Department of Ecology (Ecology) and City of Puyallup requirements for management of erosion hazards.

The Ecology Construction Storm Water General Permit requires weekly Temporary Erosion and Sedimentation Control (TESC) inspections, turbidity monitoring and pH monitoring for all sites 1 or more acres in size that discharge stormwater to surface waters of the state. Because we anticipate that the proposed project will require disturbance of more than 1 acre, we anticipate that these inspection and reporting requirements will be triggered. The following recommendations are related to general erosion potential and mitigation.

Best management practices (BMPs) should include but not be limited to:

1. Construction activity should be scheduled or phased as much as possible to reduce the amount of earthwork activity that is performed during the winter months.

2. The winter performance of a site is dependent on a well-conceived plan for control of site erosion and stormwater runoff. The site plan should include ground-cover measures, access roads, and staging areas. The contractor should be prepared to implement and maintain the required measures to reduce the amount of exposed ground.

3. TESC measures for a given area to be graded or otherwise worked should be installed soon after ground clearing. The recommended sequence of construction within a given area after clearing would be to install TESC elements and perimeter flow control prior to starting grading.

4. During the wetter months of the year, or when large storm events are predicted during the summer months, each work area should be stabilized so that if showers occur, the

work area can receive the rainfall without excessive erosion or sediment transport. The required measures for an area to be "buttoned-up" will depend on the time of year and the duration the area will be left unworked. During the winter months, areas that are to be left unworked for more than 2 days should be mulched or covered with plastic. During the summer months, stabilization will usually consist of seal-rolling the subgrade. Such measures will aid in the contractor's ability to get back into a work area after a storm event. The stabilization process also includes establishing temporary stormwater conveyance channels through work areas to route runoff to the approved treatment/ discharge facilities.

5. All disturbed areas should be revegetated as soon as possible. If it is outside of the growing season, the disturbed areas should be covered with mulch, as recommended in the erosion control plan. Straw mulch provides a cost-effective cover measure and can be made wind-resistant with the application of a tackifier after it is placed.

6. Surface runoff and discharge should be controlled during and following development. Uncontrolled discharge may promote erosion and sediment transport. Under no circumstances should concentrated discharges be allowed to flow over the top of steep slopes.

7. Soils that are to be reused around the site should be stored in such a manner as to reduce erosion from the stockpile. Protective measures may include, but are not limited to, covering with plastic sheeting, the use of low stockpiles in flat areas, or the use of silt fences around pile perimeters.

It is our opinion that with the proper implementation of the TESC plans and by field-adjusting appropriate mitigation elements (BMPs) during construction, the potential adverse impacts from erosion hazards on the project may be mitigated.

III. PRELIMINARY DESIGN RECOMMENDATIONS

8.0 INTRODUCTION

Our explorations indicate that, from a geotechnical engineering standpoint, the property is suitable for the proposed development provided the recommendations contained herein are properly followed. The subject site is underlain in places by a layer of existing fill that is variable in thickness and density. Existing fill or loose soils may warrant remedial preparation where occurring below paving. AESI should be allowed to review the final project plans once they have been developed to update our recommendations, as necessary.

8.1 Site Preparation

Areas of planned paving should be prepared by stripping existing vegetation and topsoil, and excavating to planned paving subgrade elevation. The resulting subgrade should then be evaluated visually, compacted, and proof-rolled. Exposed soils are expected to consist of existing fill or recessional lacustrine sediments depending on the location and finished subgrade elevation. Areas with organic or deleterious material, or areas that yield during proof-rolling should receive additional preparation tailored to proof-rolling results and field conditions at the time of construction.

8.2 Site Drainage and Surface Water Control

The site should be graded to prevent water from ponding in construction areas and/or flowing into excavations. Exposed grades should be crowned, sloped, and smooth drum-rolled at the end of each day to facilitate drainage. Accumulated water must be removed from subgrades and work areas immediately prior to performing further work in the area. Equipment access may be limited, and the amount of soil rendered unfit for use as structural fill may be greatly increased if drainage efforts are not accomplished in a timely sequence. If an effective drainage system is not utilized, project delays and increased costs could be incurred due to the greater quantities of wet and unsuitable fill, or poor access and unstable conditions.

We do not anticipate the need for extensive dewatering in advance of excavations. However, the contractor should be prepared to intercept any groundwater seepage entering the excavations and route it to a suitable discharge location. Groundwater was not encountered in any of our explorations at shallow depths. Explorations were completed during the end of the seasonal dry weather and wetter conditions may be present at the time of construction. Perched groundwater should be expected during the wetter, winter months.

8.3 Subgrade Protection

If construction will proceed during the winter, we recommend the use of a working surface of sand and gravel, crushed rock, or quarry spalls to protect exposed soils, particularly in areas supporting concentrated equipment traffic. In winter construction staging areas and areas that will be subjected to repeated heavy loads, a minimum thickness of 12 inches of quarry spalls or 18 inches of pit run sand and gravel is recommended. If subgrade conditions are soft and silty, a geotextile separation fabric, such as Mirafi 500X or approved equivalent, should be used between the subgrade and the new fill. Construction of working surfaces from advancing fill pads could be used to avoid directly exposing the subgrade soils to vehicular traffic.

8.4 Proof-Rolling and Subgrade Compaction

Following the recommended clearing, site stripping, planned excavation, and any overexcavation required to remove existing fill, the stripped subgrade should be proof-rolled with heavy, rubber-tired construction equipment, such as a fully-loaded tandem-axle dump truck. Proof-rolling should be performed prior to structural fill placement or pavement section construction. The proof-roll should be monitored by the geotechnical engineer so that any soft or yielding subgrade soils can be identified. Any soft/loose, yielding soils should be removed to a stable subgrade. The subgrade should then be scarified, adjusted in moisture content, and recompacted to the required density. Proof-rolling should only be attempted if soil moisture contents are at or near optimum moisture content. Proof-rolling of wet subgrades could result in further degradation. Low areas and excavations may then be raised to the planned finished grade with compacted structural fill. Subgrade preparation and selection, placement, and compaction of structural fill should be performed under engineering-controlled conditions in accordance with the project specifications.

8.5 Overexcavation/Stabilization

Construction during extended wet weather periods could create the need to overexcavate exposed soils if they become disturbed and cannot be recompacted due to elevated moisture content and/or weather conditions. Even during dry weather periods, soft/wet soils, which may need to be overexcavated, may be encountered in some portions of the site. If overexcavation is necessary, it should be confirmed through continuous observation and testing by AESI. Soils that have become unstable may require remedial measures in the form of one or more of the following:

1. Drying and recompaction. Selective drying may be accomplished by scarifying or windrowing surficial material during extended periods of dry and warm weather.

2. Removal of affected soils to expose a suitable bearing subgrade and replacement with compacted structural fill.

3. Mechanical stabilization with a coarse crushed aggregate compacted into the subgrade, possibly in conjunction with a geotextile.

4. Soil/cement admixture stabilization.

8.6 Wet Weather Conditions

If construction proceeds during an extended wet weather construction period and the moisture-sensitive site soils become wet, they will become unstable. Therefore, the bids for site grading operations should be based upon the time of year that construction will proceed. It is expected that in wet conditions additional soils may need to be removed and/or other stabilization methods used, such as a coarse crushed rock working mat to develop a stable condition if silty subgrade soils are disturbed in the presence of excess moisture. The severity of construction disturbance will be dependent, in part, on the precautions that are taken by the contractor to protect the moisture- and disturbance-sensitive site soils. If overexcavation is necessary, it should be confirmed through continuous observation and testing by a representative of our firm.

8.7 Temporary and Permanent Slopes

In our opinion, stable construction slopes should be the responsibility of the contractor and should be determined during construction. For estimating purposes, however, we anticipate that temporary, unsupported cut slopes in the existing fill or loose to medium dense native deposits can be made at a maximum slope of 1.5H:1V (Horizontal:Vertical) or flatter. Temporary slopes in dense to very dense sediments may be planned at 1H:1V. As is typical with earthwork operations, some sloughing and raveling may occur, and cut slopes may have to be adjusted in the field. If groundwater seepage is encountered in cut slopes, or if surface water is not routed away from temporary cut slope faces, flatter slopes will be required. In addition, WISHA/OSHA regulations should be followed at all times. Permanent cut and structural fill slopes that are not intended to be exposed to surface water should be designed at inclinations of 2H:1V or flatter. All permanent cut or fill slopes should be compacted to at least 95 percent of the modified Proctor maximum dry density, as determined by ASTM D-1557, and the slopes should be protected from erosion by sheet plastic until vegetation cover can be established during favorable weather.

8.8 Frozen Subgrades

If earthwork takes place during freezing conditions, all exposed subgrades should be allowed to thaw and then be recompacted prior to placing subsequent lifts of structural fill or paving components. Alternatively, the frozen material could be stripped from the subgrade to reveal unfrozen soil prior to placing subsequent lifts of fill or paving components. The frozen soil should not be reused as structural fill until allowed to thaw and adjusted to the proper moisture content, which may not be possible during winter months.

9.0 STRUCTURAL FILL

All references to structural fill in this report refer to subgrade preparation, fill type and placement, and compaction of materials, as discussed in this section. If a percentage of compaction is specified under another section of this report, the value given in that section should be used.

9.1 Subgrade Compaction

After stripping, planned excavation, and any required overexcavation have been performed to the satisfaction of the geotechnical engineer, the exposed ground in areas to receive fill should be recompacted to a firm and unyielding condition as determined by the geotechnical engineer. If the subgrade contains silty soils and too much moisture, adequate recompaction may be difficult or impossible to obtain and should probably not be attempted. In lieu of recompaction, the area to receive fill should be blanketed with washed rock or quarry spalls to act as a capillary break between the new fill and the wet subgrade. Where the exposed ground remains soft and further overexcavation is impractical, placement of an engineering stabilization fabric may be necessary to prevent contamination of the free-draining layer by silt migration from below. After recompaction of the exposed ground is approved, or a free-draining rock course is laid, structural fill may be placed to attain desired grades.

9.2 Structural Fill Placement

Structural fill is defined as non-organic soil, acceptable to the geotechnical engineer, placed in maximum 8-inch loose lifts, with each lift being compacted to 95 percent of the modified Proctor maximum density using ASTM D-1557 as the standard. For on-site utility trench backfill**,** we recommend the structural fill standard described above. In the case of roadway and utility trench filling within City rights-of-way, the backfill should be placed and compacted in accordance with current City of Puyallup codes and standards. The top of the compacted fill should extend horizontally outward a minimum distance of 3 feet beyond the locations of the roadway edges before sloping down at an angle of 2H:1V.

The contractor should note that any proposed fill soils must be evaluated by AESI prior to their use in fills. This would require that we have a sample of the material 72 hours in advance to perform a Proctor test and determine its field compaction standard.

Soils in which the amount of fine-grained material (smaller than the No. 200 sieve) is greater than approximately 5 percent (measured on the minus No. 4 sieve size) should be considered moisture-sensitive. Use of moisture-sensitive soil in structural fills should be limited to favorable dry weather conditions. The native and existing fill soils present onsite contained variably high amounts of silt and are considered moisture-sensitive. Therefore, we anticipate that the use of on-site soils as structural fill may require moisture-conditioning to achieve proper compaction. For non-structural applications, the on-site material is generally considered suitable, as long as it is free of vegetation, topsoil, and any other deleterious materials. In addition, construction equipment traversing the site when the soils are wet can cause considerable disturbance.

9.3 Reuse of Site Soils for Structural Fill

We understand that the existing on-site fill stockpile is being considered for reuse as structural fill to achieve desired site grades. Based on our observations during drilling and laboratory testing results, it is our opinion that the fill has the potential for reuse, provided the recommendations contained herein are properly followed. The fill stockpile has an approximate thickness of 25 to 29 feet, at the highest elevations. During drilling of borings EB-3 and EB-4 located within the fill stockpile, we observed the soil samples collected every 5 feet with SPT methods and cuttings brought up by the auger. The soils generally were a mixture of gravelly, silty sand with variable organic content. Upon completion of the borings within the fill, we collected bulk samples from the soil cuttings that were transported to our Kirkland laboratory for further testing. Modified Proctor (ASTM D-1557), grain-size and organic content analysis tests were completed. Our testing results indicated that the fill soils have a field moisture ranging from 14 to 21 percent. Based on our Modified Proctor analysis of the existing fill from the stockpile, optimum moisture for compaction ranges from 7 to 9 percent. Our grain-size analysis indicates that the fill soils contain a fines portion, ranging from 23 to 24 percent. Our organic matter analysis indicates that the soils contain less than 2 percent organics.

In our opinion, reuse of the fill stockpile will be difficult due to high natural moisture content and high fines content even in dry weather. The high moisture content soils will require moisture-conditioning before placement and compaction. That could involve adding cement or aeration to dry them out in favorable weather conditions, usually between late June to early September. The high fines content of the fill soils will make them more difficult to place and compact in months having wet weather. Overall, the organic components of the bulk samples fell below 2 percent; however, during drilling we did observe larger organic matter. If larger organic material is present it will need to be removed prior to fill placement.

9.4 Wet Weather Structural Fill

If fill is placed during wet weather or if proper compaction cannot be obtained, a select import material consisting of a clean, free-draining gravel and/or sand should be used. Free-draining fill consists of non-organic soil with the amount of fine-grained material limited to 5 percent by weight when measured on the minus No. 4 sieve fraction with at least 25 percent retained on the No. 4 sieve.

9.5 Compaction Testing

A representative from our firm should observe the stripped subgrade and be present during placement of structural fill to observe the work and perform a representative number of in-place density tests. In this way, the adequacy of the earthwork may be evaluated as filling progresses, and any problem areas may be corrected at that time. It is important to understand that taking random compaction tests on a part-time basis will not assure uniformity or acceptable performance of a fill. As such, we are available to aid in developing a suitable monitoring and testing program.

10.0 PAVEMENT AND SIDEWALK RECOMMENDATIONS

The recommended pavement sections in this report section are for on-site driveway and parking areas, and are not applicable to right-of-way improvements. If any new paving of public streets is required, we should be allowed to offer situation-specific recommendations.

Pavement and sidewalk areas should be prepared in accordance with the “Site Preparation” section of this report. Soft or yielding areas should be overexcavated to provide a suitable subgrade and backfilled with structural fill.

10.1 Conventional Pavement Sections

We understand that conventional (impermeable) flexible (asphalt concrete) pavements might be used in new bus parking areas and driveways, whereas conventional rigid (cement concrete) pavements might be used for sidewalks 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 bus 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 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

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

Bus Parking 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 Parking and Access Driveways

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

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 Washington State Department of Transportation (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).

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.

11.0 INFILTRATION FEASIBILITY

We understand that project plans will include infiltration of stormwater. Project plans are still in the conceptual stages but based on discussions with the project civil engineer, stormwater will be captured and then conveyed to infiltration trenches for disposal.

We reviewed subsurface information from our current geotechnical evaluation of the site and our previous geotechnical evaluations associated with the adjacent LSC Warehouse (AESI, May 2018) and LSC-Kessler Center (AESI, June 2019). Site soils consist of a variable thickness layer of silt and silty fine sand (Vashon recessional lacustrine sediments), an intermittent perching layer of ice-contact melt-out till sediments, overlying coarse-grained sand and gravel (Vashon advance outwash sediments).

Shallow infiltration opportunities are limited by the fine-grained Vashon recessional lacustrine sediments. Limited infiltration testing was conducted on the LSC Kessler site in the Vashon recessional lacustrine sediments and the field infiltration rates ranged from 1.4 to 2.6 inches per hour. After accounting for correction factors, planning-level design infiltration rates would be on the order of 0.25 to 0.5 inches per hour for shallow facilities situated in the Vashon recessional lacustrine sediments.

Moderate depth infiltration opportunities are present in the coarser-grained Vashon advance outwash sediments. The depth to the top of the Vashon advance outwash ranged from 12.5 (EB-2) to 22.5 (EB-1W). Infiltration testing was conducted on the LSC Warehouse and LSC Kessler sites in the Vashon advance outwash and the field infiltration rates ranged from 28 to 42 inches per hour. For planning considerations, the recommended long-term design infiltration rates for the adjacent facilities were 5 inches per hour. Locating and constructing infiltration trenches with a variable base depth can be challenging and additional subsurface exploration and infiltration testing will be required for facilities planned in the Vashon advance outwash.

Puyallup Municipal Code, Chapter 21.10.040, adopts as their stormwater management manual the 2014 Washington State Department of Ecology *Stormwater Management Manual for Western Washington* (Ecology Manual). The Ecology Manual requires site-specific exploration and testing for infiltration design to assess site suitability criteria for drawdown time (infiltration rate) and separation from perching layers.

Design-specific infiltration facility geotechnical recommendations should be made once a design is available and will include additional facility-specific explorations, field infiltration testing, design infiltration rate, estimation of seasonal groundwater high, and considerations for site and subgrade preparation, overflow path, and protection of the facility. These activities are not included in our current scope of work. We are available to assist in planning for facility location and depth.

12.0 PROJECT DESIGN AND CONSTRUCTION MONITORING

We are available to provide additional geotechnical/hydrogeologic consultation as the project design develops and possibly changes from that upon which this report is based. We recommend that AESI perform a geotechnical review of the plans prior to final design completion. In this way, we can confirm that our recommendations have been correctly interpreted and implemented in the design. The City of Puyallup may require a plan review by the geotechnical engineer as a condition of permitting.

We recommend that AESI be retained to provide geotechnical special inspections during construction, and preparation of a final summary letter when construction is complete. The City of Puyallup may require such geotechnical special inspections. The integrity of the earthwork depends on proper site preparation and construction procedures. In addition, engineering decisions may have to be made in the field in the event that variations in subsurface conditions become apparent.

We have enjoyed working with you on this study and are confident these recommendations will aid in the successful completion of your project. If you should have any questions or require further assistance, please do not hesitate to call.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington

STEPHEN A. SIEBERT
STATE OF WASHINGTON
30329
REGISTERED
PROFESSIONAL ENGINEER

11/29/21

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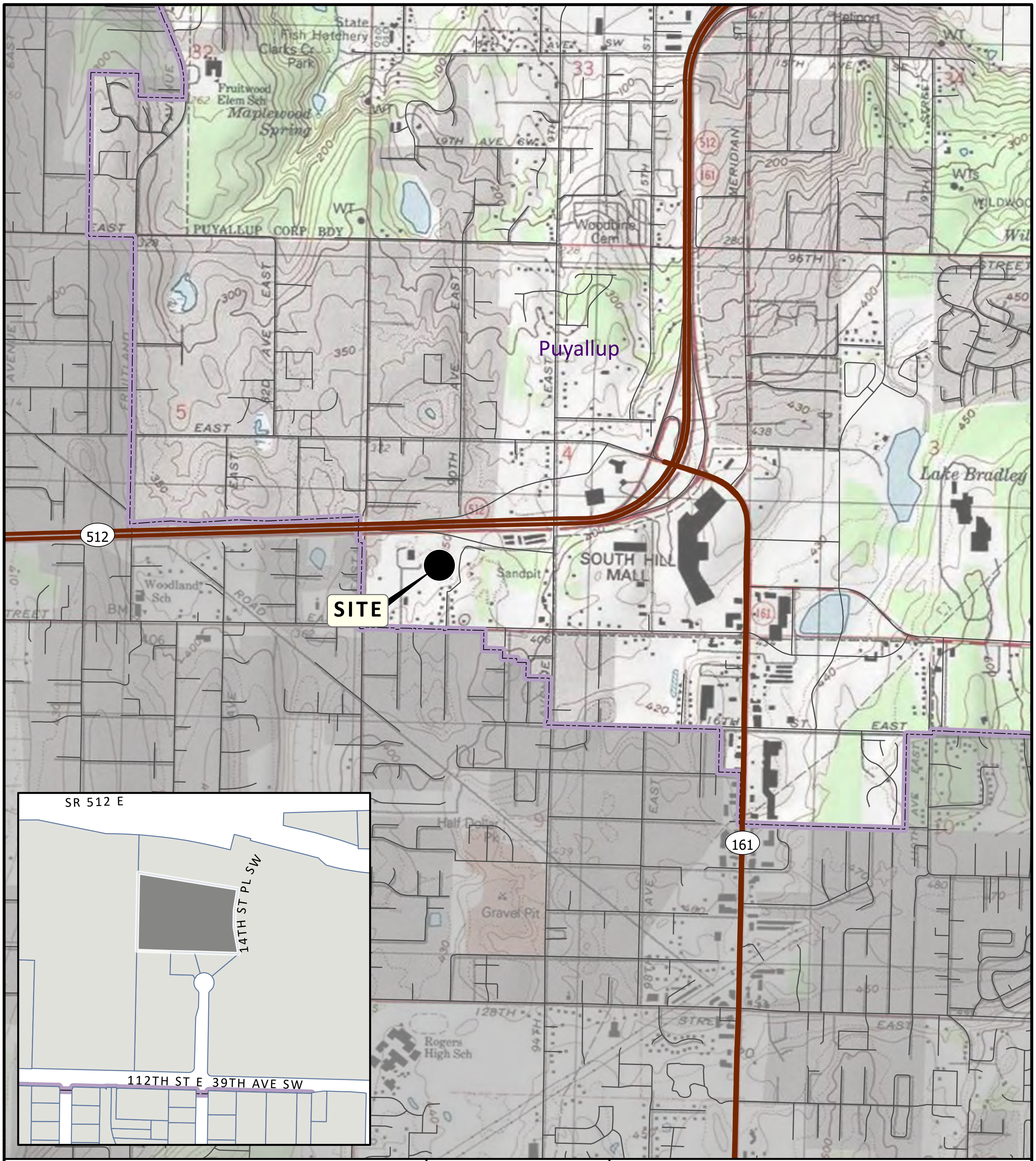
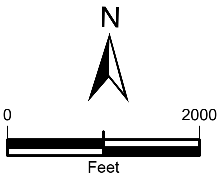
Associate Geotechnical Engineer

Attachments:	Figure 1.	Vicinity Map
	Figure 2.	Existing Site and Exploration Plan
	Appendix A.	Exploration Logs
	Appendix B.	Laboratory Test Results





DATA SOURCES / REFERENCES:
USGS: 7.5' SERIES TOPOGRAPHIC MAPS, ESRI/I-CUBED/NGS 2013
PIERCE CO: STREETS, CITY LIMITS, PARCELS, PARKS 2/21

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

PUYALLUP SD - SOUTH HILL SITE
PUYALLUP, WASHINGTON

PROJ NO.	DATE:	FIGURE:
20210394E001	11/21	1

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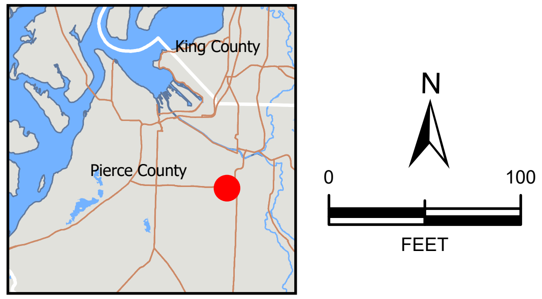
LEGEND

▭	SITE
●	EXPLORATION BORING, DEPTH OF FILL
▲	MONITORING WELL, DEPTH OF FILL
▭	PARCEL
∿	CONTOUR 10 FT
∿	CONTOUR 2 FT

DATA SOURCES / REFERENCES:
LIDAR: WATERHSED SCIENCES, INC. FOR PIERCE COUNTY
DELIVERY 2 FLOWN 12/10, GRID CELL SIZE IS 3'.
CONTOURS FROM LIDAR
PIERCE CO: STREETS, CITIES, 2/21, PARCELS 8/21
AERIAL: WORLD IMAGERY, ESRI, DIGITAL GLOBE 3/3/21

LOCATIONS AND DISTANCES SHOWN ARE APPROXIMATE



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EXISTING SITE AND EXPLORATION PLAN

PUYALLUP SD - SOUTH HILL SITE
PUYALLUP, WASHINGTON

PROJ NO.	DATE:	FIGURE:
20210394E001	11/21	2

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APPENDIX A

Exploration Logs

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Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
20210394E001	EB-1W	1 of 4

Project Name PSD- South Hill Site
Elevation (Top of Well Casing) 362.31
Water Level Elevation 45 Dry (10/27/2021)
Drilling/Equipment Advance / D-50 Track Mount H.S.A.
Hammer Weight/Drop 140# / 30

Location Puyallup, WA
Surface Elevation (ft) ~360
Date Start/Finish 10/20/21,10/21/21
Hole Diameter (in) 4.25 i.d.
Well Tag # BMM 300

Depth (ft)	WELL CONSTRUCTION	Blows/ 6"	DESCRIPTION
	Above Grade monument Concrete 0 to 1 foot		**Fill**
	Bentonite chips/grout 1 to 75 feet		
		12 17 12	Moist, grayish brown, silty, fine SAND, some broken gravel; unsorted (SM).
5		6 6 9	Upper 6 inches: Moist, grayish brown, silty, fine SAND, some coarse sand; unsorted (SM). Lower 12 inches: Moist, gray, silty, fine SAND; massive; alternating layers of dark brown organics and light brown sand (SM).
			Topsoil ?
		5 5 7	Moist, dark brown to reddish brown, silty, fine SAND, trace medium to coarse sand, trace gravel; organics observed; unsorted (SM).
			Vashon Recessional Lacustrine
10	2-inch I.D. PVC casing 0 to 79.6 feet	3 2 3	Moist, reddish brown with iron oxide staining, silty, fine SAND, trace medium to coarse sand, trace gravel; pockets of clean sand; unsorted (SM).
		4 4 4	Moist, light brown with iron oxide staining, fine sandy, SILT, trace medium to coarse sand; massive (ML).
15		4 4 5	Moist, light brown, fine SAND, some silt; faintly stratified; massive (SM-SP).
20		3 4 6	Very moist, light brown, fine sandy, SILT, some medium sand; massive (ML).
			Vashon Advance Outwash

Sampler Type (ST):

▯	2" OD Split Spoon Sampler (SPT)	▯	No Recovery	M - Moisture	**Logged by:** ART
▯	3" OD Split Spoon Sampler (D & M)	▮	Ring Sample	▽ Water Level ()	**Approved by:** JHS
☐	Grab Sample	▯	Shelby Tube Sample	▼ Water Level at time of drilling (ATD)	

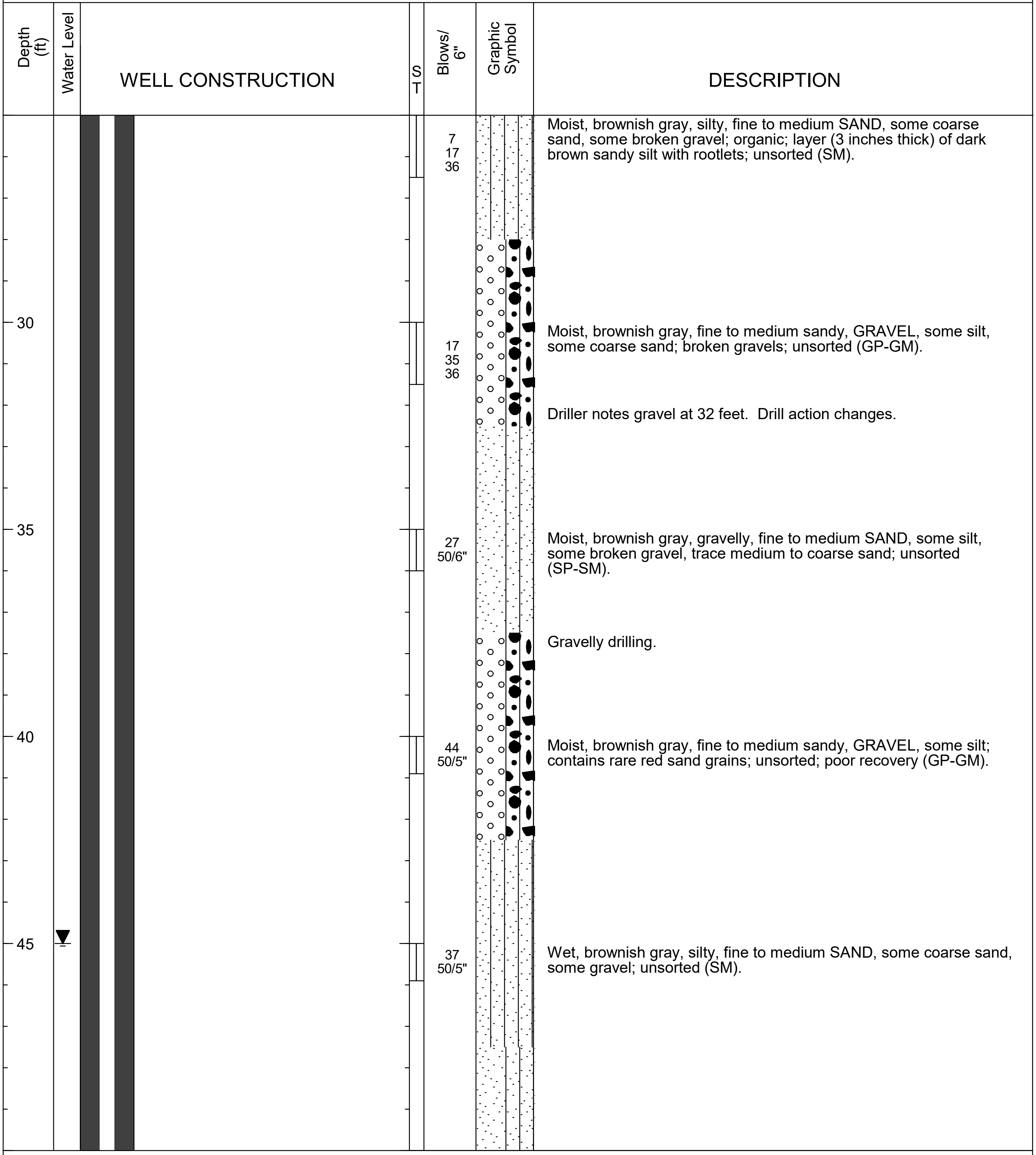
Geologic & Monitoring Well Construction Log

associated earth sciences incorporated

Project Number	Well Number	Sheet
20210394E001	EB-1W	2 of 4

Project Name PSD- South Hill Site
Elevation (Top of Well Casing) 362.31
Water Level Elevation 45 Dry (10/27/2021)
Drilling/Equipment Advance / D-50 Track Mount H.S.A.
Hammer Weight/Drop 140# / 30

Location Puyallup, WA
Surface Elevation (ft) ~360
Date Start/Finish 10/20/21,10/21/21
Hole Diameter (in) 4.25 i.d.
Well Tag # BMM 300



Depth (ft)	Water Level	Blows/ 6"	DESCRIPTION
		7 17 36	Moist, brownish gray, silty, fine to medium SAND, some coarse sand, some broken gravel; organic; layer (3 inches thick) of dark brown sandy silt with rootlets; unsorted (SM).
30		17 35 36	Moist, brownish gray, fine to medium sandy, GRAVEL, some silt, some coarse sand; broken gravels; unsorted (GP-GM).
			Driller notes gravel at 32 feet. Drill action changes.
35		27 50/6"	Moist, brownish gray, gravelly, fine to medium SAND, some silt, some broken gravel, trace medium to coarse sand; unsorted (SP-SM).
			Gravelly drilling.
40		44 50/5"	Moist, brownish gray, fine to medium sandy, GRAVEL, some silt; contains rare red sand grains; unsorted; poor recovery (GP-GM).
45	▼	37 50/5"	Wet, brownish gray, silty, fine to medium SAND, some coarse sand, some gravel; unsorted (SM).

Sampler Type (ST):

▯	2" OD Split Spoon Sampler (SPT)	▯	No Recovery	M	- Moisture	**Logged by:**	ART
▯	3" OD Split Spoon Sampler (D & M)	▮	Ring Sample	▽	Water Level ()	**Approved by:**	JHS
✋	Grab Sample	▧	Shelby Tube Sample	▼	Water Level at time of drilling (ATD)		

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Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
20210394E001	EB-1W	3 of 4

Project Name PSD- South Hill Site
Elevation (Top of Well Casing) 362.31
Water Level Elevation 45 Dry (10/27/2021)
Drilling/Equipment Advance / D-50 Track Mount H.S.A.
Hammer Weight/Drop 140# / 30

Location Puyallup, WA
Surface Elevation (ft) ~360
Date Start/Finish 10/20/21,10/21/21
Hole Diameter (in) 4.25 i.d.
Well Tag # BMM 300

Depth (ft)	Water Level	WELL CONSTRUCTION	S T	Blows/ 6"	Graphic Symbol	DESCRIPTION
				43 50/6"		Moist, brownish gray, fine to medium SAND, some silt, some broken gravel; unsorted (SP-SM).
55				50/4"		Moist, brownish gray, fine to medium SAND, trace to some silt contains rare red sand grains; unsorted; poor recovery due to random large gravel (SP).
60				50/2"		No recovery.
65				36 42 50/3"		Very moist, brownish gray, medium to coarse SAND, some fine sand, some silt, trace gravel; unsorted (SP-SM).
70				50/1"		Very moist, brownish gray, silty, fine to medium SAND; poor recovery due to gravel (SM).

Sampler Type (ST):

▯	2" OD Split Spoon Sampler (SPT)	▯	No Recovery	M - Moisture	**Logged by:** ART
▯	3" OD Split Spoon Sampler (D & M)	▮	Ring Sample	▽ Water Level ()	**Approved by:** JHS
▯	Grab Sample	▯	Shelby Tube Sample	▼ Water Level at time of drilling (ATD)	

associated earth sciences incorporated

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
20210394E001	EB-1W	4 of 4

Project Name PSD- South Hill Site
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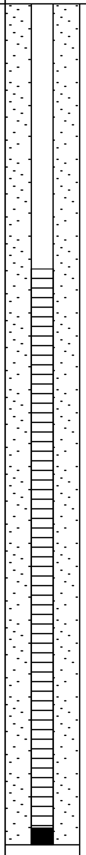

Depth (ft)	WELL CONSTRUCTION	Blows/ 6"	DESCRIPTION
		32 50/5"	Very moist, brownish gray, fine to coarse SAND, some silt, trace gravel; unsorted (SP-SM).
	Sand pack 75 to ~90 feet		
80		46 50/4"	As above; more gravel; coarsens with depth.
85	2-inch I.D. PVC well screen 0.020-inch slot width 79.6 to 89.6 feet	50/4"	Moist, brownish gray, fine to medium SAND, some silt, trace broken gravel; unsorted; poor recovery (SP-SM).
90		50/5"	Moist, grayish brown, silty, fine SAND, some broken gravel; unsorted; poor recovery (SM).
95			

Boring terminated at 90.5 feet
Well completed at 89.6 feet on 10/21/21.
Perched water at 45 at the time of drilling. Well was dry at time of insallation and on 10/27/21.

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: ART
Approved by: JHS

associated earth sciences incorporated

Exploration Boring

Project Number	Exploration Number	Sheet
20210394E001	EB-2	1 of 2

Project Name: PSD- South Hill Site
Location: Puyallup, WA
Driller/Equipment: Advance / D-50 Track Mount H.S.A.
Hammer Weight/Drop: 140# / 30

Ground Surface Elevation (ft): ~357
Datum: NAVD88
Date Start/Finish: 10/21/21,10/21/21
Hole Diameter (in): 3.75 i.d.

Depth (ft)	S T	Samples	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot (10 20 30 40)	Other Tests
			Topsoil - 6 inches					
			Vashon Recessional Lacustrine					
5		S-1	Moist, light brown, silty, fine SAND; faint stratification; massive (SM).			4 4 4	8	
			Vashon Ice Contact / Melt-out Till Gravel at 9 feet.					
10		S-2	Moist, brownish gray, silty, fine SAND, some medium sand, some broken gravel; layer (0.5 inches thick) of dark organics observed; unsorted; blowcounts overstated (SM).			22 18 20	38	
			Vashon Advance Outwash					
15		S-3	Moist, brownish gray, silty, fine SAND, some medium to coarse sand, some broken gravel; coarsens with depth; cleaner sand towards bottom of sampler; unsorted (SM).			16 28 31	59	
20		S-4	Moist, brownish gray, fine to medium sandy, GRAVEL, some silt, some coarse sand; broken gravel (GP-GM).			18 47 50/5"	50/5"	
			Gravelly drill action.					

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: ART
Approved by: JHS

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Exploration Boring

Project Number	Exploration Number	Sheet
20210394E001	EB-2	2 of 2

Project Name PSD- South Hill Site
Location Puyallup, WA
Driller/Equipment Advance / D-50 Track Mount H.S.A.
Hammer Weight/Drop 140# / 30

Ground Surface Elevation (ft) ~357
Datum NAVD88
Date Start/Finish 10/21/21,10/21/21
Hole Diameter (in) 3.75 i.d.

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot 10 20 30 40	Other Tests
	◫	S-5		Moist, brownish gray to light gray, fine to medium SAND, some silt, some coarse sand, some gravel; unsorted (SM).			50/6"	▲50/6"	
30	◫	S-6		Moist, brownish gray, fine to medium SAND, some silt, some coarse sand, trace gravel; unsorted (SP-SM).			28 50/5"	▲50/5"	
				Bottom of exploration boring at 30.9 feet No groundwater encountered.					
35									
40									
45									

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: ART
Approved by: JHS

associated earth sciences incorporated

Exploration Boring

Project Number 20210394E001

Exploration Number EB-3

Sheet 1 of 2

Project Name PSD- South Hill Site
Location Puyallup, WA
Driller/Equipment Advance / D-50 Track Mount H.S.A.
Hammer Weight/Drop 140# / 30

Ground Surface Elevation (ft) ~376
Datum NAVD88
Date Start/Finish 10/21/21,10/21/21
Hole Diameter (in) 3.75 i.d.

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot 10 20 30 40	Other Tests
				Fill					
				Gravelly drilling.					
5		S-1		Moist, gray, silty, gravelly, fine SAND, some medium to coarse sand, contains broken gravel; faint organic odor; unsorted (SM).			12 9 12	▲31	
				Gravelly drilling.					
10		S-2		Moist, gray, silty, gravelly, fine SAND, some medium to coarse sand; contains broken gravel; small dark brown organic pieces observed; unsorted (SM).			7 9 9	▲18	
15		S-3		Moist, dark brown to brown, silty, gravelly, fine SAND, trace medium to coarse sand; organics throughout; faint organic odor; unsorted (SM).			12 13 10	▲23	
20		S-4		Moist, dark gray to bluish gray, silty, fine SAND; organics throughout; unsorted (SM).			7 9 12	▲21	
				Fill / Weathered Vashon Advance Outwash ?					

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: ART
Approved by: JHS

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Exploration Boring

Project Number	Exploration Number	Sheet
20210394E001	EB-3	2 of 2

Project Name PSD- South Hill Site
Location Puyallup, WA
Driller/Equipment Advance / D-50 Track Mount H.S.A.
Hammer Weight/Drop 140# / 30

Ground Surface Elevation (ft) ~376
Datum NAVD88
Date Start/Finish 10/21/21,10/21/21
Hole Diameter (in) 3.75 i.d.

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot 10 20 30 40	Other Tests
		S-5		Moist, dark to light brown with slight oxidation, silty, fine SAND, trace gravel; occasional organics (rootlets and larger pieces); unsorted (SM).			5 7 7	14	
				Vashon Advance Outwash Driller reports gravel at 29 feet.					
30		S-6		Moist, brown to light brown, silty, fine SAND, some medium sand, some broken gravel; unsorted (SM).			14 23 19	42	
35		S-7		Moist, grayish brown, fine to medium SAND, some silt, some coarse sand, trace gravel; coarsens with depth; unsorted (SP-SM).			18 20 22	42	
40		S-8		Moist, grayish brown to brownish gray, silty, fine to medium SAND, trace coarse sand; broken gravel observed; unsorted; poor recovery (SM).			25 28 20	48	
				Bottom of exploration boring at 41.5 feet No groundwater encountered.					
45									

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)

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Approved by: JHS

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Exploration Boring

Project Number	Exploration Number	Sheet
20210394E001	EB-4	1 of 2

Project Name: PSD- South Hill Site
Location: Puyallup, WA
Driller/Equipment: Advance / D-50 Track Mount H.S.A.
Hammer Weight/Drop: 140# / 30
Ground Surface Elevation (ft): ~382
Datum: NAVD88
Date Start/Finish: 10/21/21,10/21/21
Hole Diameter (in): 3.75 i.d.

Depth (ft)	S T	Samples	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot	Other Tests
			Fill					
5		S-1	Moist, dark brownish gray, silty, gravelly, fine SAND, some medium to coarse sand, trace organics; faint organic odor; unsorted (SM).			7 8 12	20	
10		S-2	Moist, dark brownish gray to greenish gray, silty, gravelly, fine SAND; occasional organics; unsorted (SM).			3 4 4	8	
15		S-3	Moist, bluish gray, silty, fine SAND, trace broken gravel; organics throughout; banding (1 inch thick) of dark brown organics; unsorted (SM).			3 3 4	7	
20		S-4	Moist, dark brown to bluish brown, silty, fine SAND; abundant organics; organic odor; unsorted (SM).			3 4 5	9	

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: ART
Approved by: JHS

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Exploration Boring

Project Number	Exploration Number	Sheet
20210394E001	EB-4	2 of 2

Project Name PSD- South Hill Site
Location Puyallup, WA
Driller/Equipment Advance / D-50 Track Mount H.S.A.
Hammer Weight/Drop 140# / 30
Ground Surface Elevation (ft) ~382
Datum NAVD88
Date Start/Finish 10/21/21,10/21/21
Hole Diameter (in) 3.75 i.d.

Depth (ft)	ST	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot	Other Tests
		S-5		As above.			5 6 9	15	
				Driller reports gravel at 27 feet.					
				Vashon Recessional Lacustrine					
30		S-6		Moist, light brown with slight mottling, silty, fine SAND ranges to sandy, SILT, trace coarse sand; faintly stratified otherwise massive (SM).			5 5 5	10	
35		S-7		Very moist, light brown with iron oxide staining, silty, fine SAND to fine sandy, SILT, trace gravel; faintly stratified otherwise massive (SM-ML).			3 4 5	9	
				Vashon Ice Contact / Melt-out Till					
40		S-8		Moist, grayish brown, silty, fine SAND, trace broken gravel; till-like (SM).			5 10 12	22	
				Bottom of exploration boring at 41.5 feet No groundwater encountered.					
45									

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)

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Exploration Boring

Project Number	Exploration Number	Sheet
20210394E001	EB-5	1 of 1

Project Name PSD- South Hill Site
Location Puyallup, WA
Driller/Equipment Advance / D-50 Track Mount H.S.A.
Hammer Weight/Drop 140# / 30

Ground Surface Elevation (ft) ~359
Datum NAVD88
Date Start/Finish 10/22/21,10/22/21
Hole Diameter (in) 3.75 i.d.

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot	Other Tests
				Fill					
		S-1		Moist, grayish brown, silty, fine SAND; dark organic banding; unsorted (SM).			2 5 9	14	
				Vashon Recessional Lacustrine					
				Lower 6 inches: Moist, light brown with iron oxide staining, silty, fine SAND; faintly stratified otherwise massive (SM).					
5		S-2		Moist, brownish gray with iron oxide staining, silty, fine SAND ranging to fine sandy, SILT, trace gravel; occasional organics observed; faintly stratified otherwise massive (SM).			5 4 5	9	
				Vashon Ice Contact / Melt-out Till					
10		S-3		Moist, brownish gray, silty fine SAND ranges to fine sandy, SILT, some broken gravel, trace medium to coarse sand; till-like (SM-ML).			5 11 11	22	
				Vashon Advance Outwash					
				Driller reports gravel.					
15		S-4		Moist, brownish gray, fine to medium sandy, GRAVEL, some silt, some coarse sand; contains broken gravel; unsorted (GP-GM).			12 22 22	44	
20		S-5		No recovery; due to gravel.			29 44 50/5"	50/5"	
				Bottom of exploration boring at 21.4 feet No groundwater encountered.					

Blows/Foot: 10 20 30 40

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)

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Exploration Boring

Project Number	Exploration Number	Sheet
20210394E001	EB-6	1 of 1

Project Name: PSD- South Hill Site
Location: Puyallup, WA
Driller/Equipment: Advance / D-50 Track Mount H.S.A.
Hammer Weight/Drop: 140# / 30

Ground Surface Elevation (ft): ~352
Datum: NAVD88
Date Start/Finish: 10/22/21,10/22/21
Hole Diameter (in): 3.75 i.d.

Depth (ft)	ST	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot 10 20 30 40	Other Tests
				Fill / Topsoil ?					
5		S-1		Moist, brown to dark brown, silty, fine SAND, trace medium sand; rootlets observed; dark organic banding throughout; unsorted (SM).			2 2 2	▲4	
				Vashon Recessional Lacustrine					
10		S-2		Very moist, light brown iron oxide staining, silty, fine SAND to fine sandy, SILT; faintly stratified otherwise massive (SM-ML).			8 4 6	▲10	
				Gravelly drilling at 12 feet.					
15		S-3		As above; very moist.			2 2 2	▲4	
20		S-4		As above; greater gravel content in tip.			9 7 11	▲18	
				Bottom of exploration boring at 21.5 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)

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Exploration Boring

Project Number	Exploration Number	Sheet
20210394E001	EB-7	1 of 1

Project Name: PSD- South Hill Site
Location: Puyallup, WA
Driller/Equipment: Advance / D-50 Track Mount H.S.A.
Hammer Weight/Drop: 140# / 30
Ground Surface Elevation (ft): ~358
Datum: NAVD88
Date Start/Finish: 10/22/21,10/22/21
Hole Diameter (in): 3.75 i.d.

Depth (ft)	ST	Samples	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot	Other Tests
			Topsoil - 6 inches					
			Vashon Recessional Lacustrine					
		S-1	Moist, dark brown, silty, fine SAND, trace medium sand; rootlets observed; unsorted; poor recovery (SM).			5 4 4	8	
5		S-2	Moist, light brown with iron oxide staining, fine sandy, SILT, trace medium sand, trace gravel, trace rootlets; faintly stratified otherwise massive (ML).			3 3 3	6	
10		S-3	Moist, light brown with iron oxide staining, silty, fine SAND; faintly stratified otherwise massive (SM).			2 3 2	5	
			Vashon Ice Contact / Melt-out Till					
15		S-4	Moist, brownish gray, silty, fine SAND ranges to sandy, SILT, some broken gravel, trace coarse sand; unsorted (SM-ML).			10 13 15	28	
			Vashon Advance Outwash Driller reports gravel 17.5 feet.					
20		S-5	Moist, brownish gray, fine to medium SAND, some silt, some broken gravel, trace coarse sand, contains gravel (SP-SM).			15 16 17	33	
			Bottom of exploration boring at 21.5 feet No groundwater encountered.					

Blows/Foot: 10 20 30 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)

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Exploration Boring

Project Number	Exploration Number	Sheet
20210394E001	EB-8	1 of 1

Project Name PSD- South Hill Site
Location Puyallup, WA
Driller/Equipment Advance / D-50 Track Mount H.S.A.
Hammer Weight/Drop 140# / 30

Ground Surface Elevation (ft) ~359
Datum NAVD88
Date Start/Finish 10/22/21,10/22/21
Hole Diameter (in) 3.75 i.d.

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot 10 20 30 40	Other Tests
				Topsoil - 6 inches					
				Vashon Lacustrine Recessional Outwash					
	◫	S-1		Moist, light brown with iron oxide staining, silty, fine SAND to fine sandy, SILT; faintly stratified otherwise massive (SM-ML).			3 3 1	▲4	
5	◫	S-2		As above; less iron oxide staining.			3 4 3	▲7	
10	◫	S-3		Moist, light brown, silty, fine SAND; massive (SM).			3 4 3	▲7	
15	◫	S-4		Very moist, light brown with iron oxide banding, silty, fine SAND to fine sandy, SILT; massive (SM-ML).			1 2 3	▲5	
				Vashon Ice Contact / Melt-out Till					
20	◫	S-5		Very moist, brownish gray, silty, fine SAND, some broken gravel; coarsens with depth (SM).			13 21 19	▲40	
				Bottom of exploration boring at 21.5 feet No groundwater encountered.					

Sampler Type (ST):

◫ 2" OD Split Spoon Sampler (SPT)
◫ 3" OD Split Spoon Sampler (D & M)
✋ Grab Sample

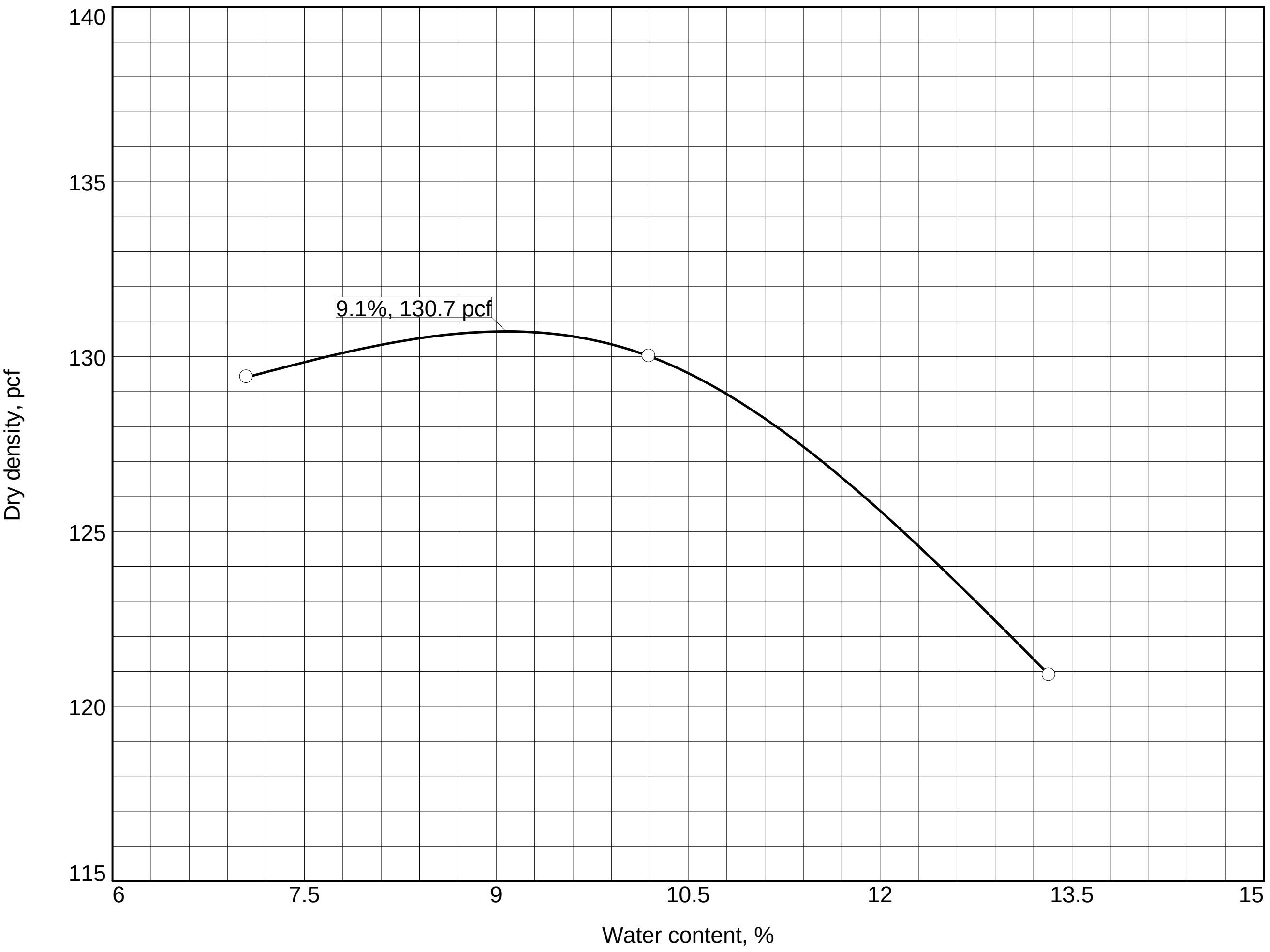
☐ No Recovery
◧ Ring Sample
▨ Shelby Tube Sample

M - Moisture
∇ Water Level ()
▼ Water Level at time of drilling (ATD)

Logged by: ART
Approved by: JHS

APPENDIX B

Laboratory Test Results



Test specification: ASTM D 1557-91 Procedure C Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	**AASHTO**						

TEST RESULTS	**MATERIAL DESCRIPTION**
Maximum dry density = 130.7 pcf Optimum moisture = 9.1 %	

Project No. 20210394 E001 **Client:** Puyallup SD

Project: Puyallup SD - South Hill Site

Date: 10/27/2021

○ **Location:** Onsite - Fill **Sample Number:** EB-3

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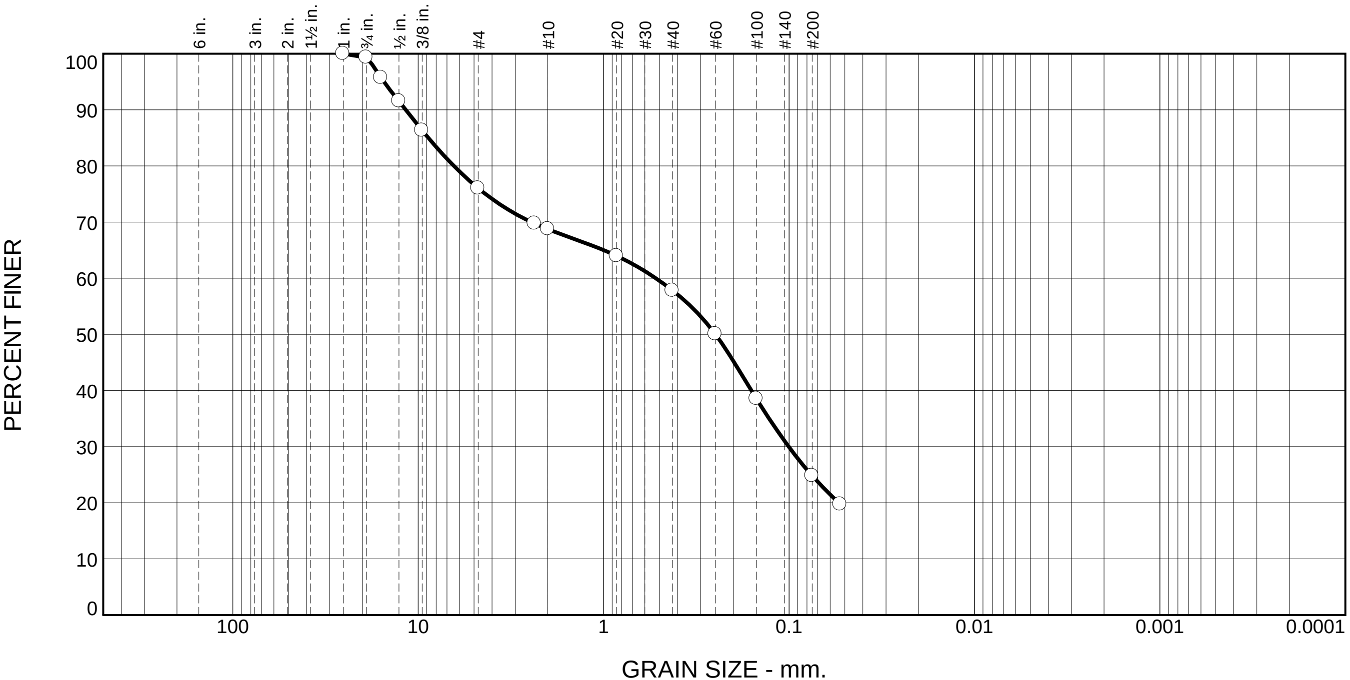
Remarks:

Figure

Tested By: CI **Checked By:** ART/SS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.7	23.3	7.3	10.9	33.0	24.8	

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1"	100.0		
3/4"	99.3		
5/8"	95.7		
1/2"	91.5		
3/8"	86.3		
#4	76.0		
#8	69.8		
#10	68.7		
#20	64.0		
#40	57.8		
#60	50.1		
#100	38.5		
#200	24.8		
#270	19.7		

* (no specification provided)

Material Description

gravelly, silty SAND

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=**

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-2-4(0)

Coefficients

D_{90}= 11.6660 D_{85}= 8.8174 D_{60}= 0.5234
D_{50}= 0.2493 D_{30}= 0.1005 D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 10/26/2021 **Date Tested:** 11/1/2021

Tested By: CI

Checked By: ART/SS

Title:

Location: Onsite - Fill
Sample Number: EB-3

Date Sampled: 10/21/2021

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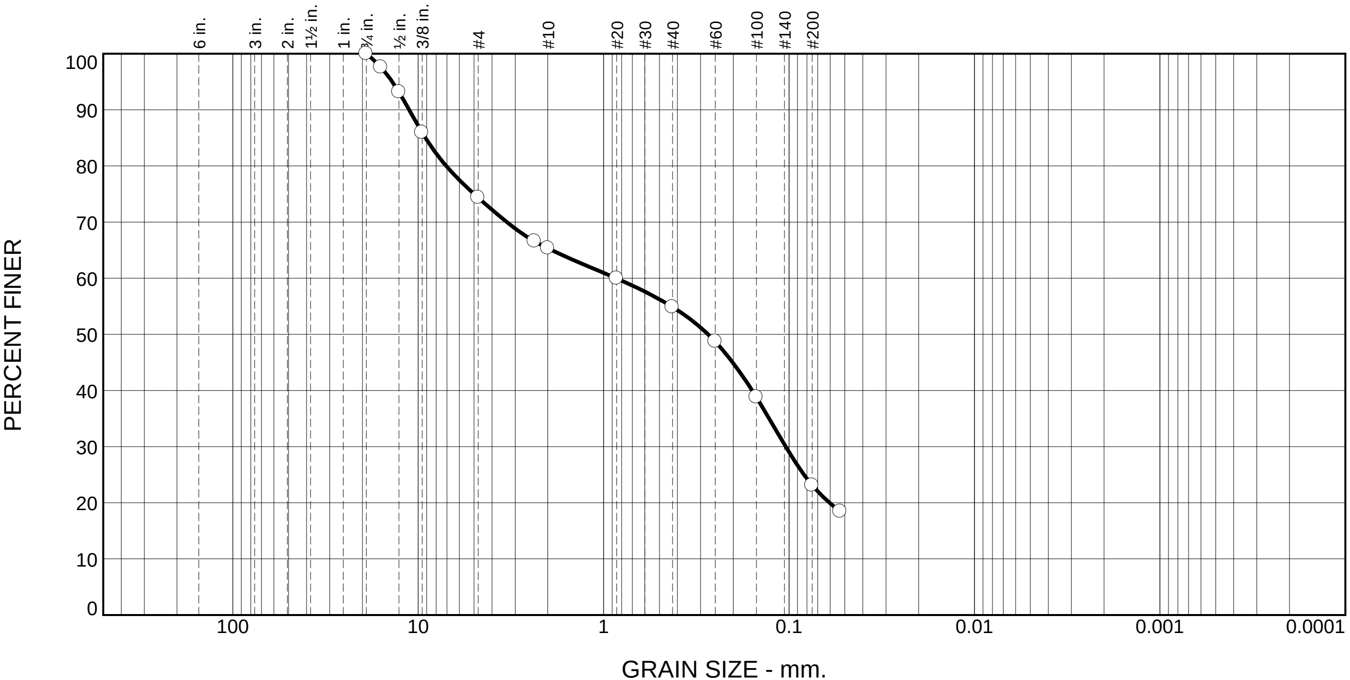
Client: Puyallup SD

Project: Puyallup SD - South Hill Site

Project No: 20210394 E001 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	25.6	9.1	10.4	31.8	23.1	

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3/4"	100.0		
5/8"	97.6		
1/2"	93.2		
3/8"	85.9		
#4	74.4		
#8	66.6		
#10	65.3		
#20	60.0		
#40	54.9		
#60	48.7		
#100	38.8		
#200	23.1		
#270	18.4		

* (no specification provided)

Material Description

gravelly, silty SAND

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=**

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-2-4(0)

Coefficients

D_{90}=	11.1908	D_{85}=	9.1470	D_{60}=	0.8567
D_{50}=	0.2732	D_{30}=	0.1043	D_{15}=	
D_{10}=		C_u=		C_c=	

Remarks

Date Received: 10/26/2021 **Date Tested:** 11/1/2021

Tested By: CI

Checked By: ART/SS

Title:

Location: Onsite - Fill
Sample Number: EB-4

Date Sampled: 10/21/2021

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Client: Puyallup SD
Project: Puyallup SD - South Hill Site

Project No: 20210394 E001 **Figure**

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Moisture, Ash, and Organic Matter of Peat and Other Organic Soils - ASTM 2974

Date Sampled 10/21/2021	**Project** South Hill Site	**Project No.** 20210394 E001		**Soil Description** fill
Tested By CI	**Location** Puyallup, WA	**EB/EP No.** EB	**Depth**	

Moisture Content

Sample ID	**EB-3**
Wet Weight + Pan	**705.00**
Dry Weight + Pan	**625.00**
Weight of Pan	**245.00**
Weight of Moisture	**80.00**
Dry Weight of Soil	**380.00**
% Moisture	**21.05**

Organic Matter and Ash Content

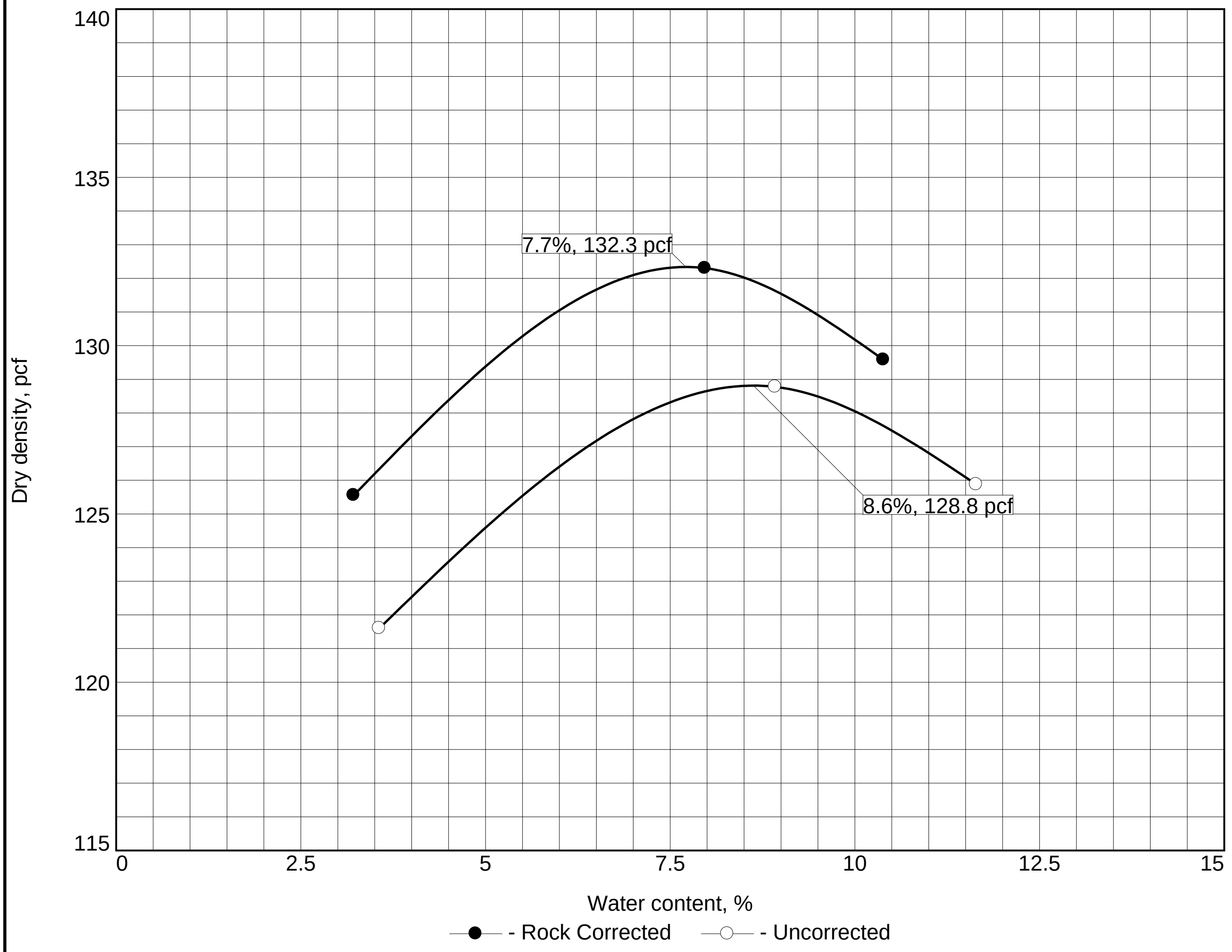
Dry Soil Before Burn + Pan	**625.00**
Dry Soil After Burn + Pan	**620.00**
Weight of Pan	**245.00**
Wt. Loss Due to Ignition	**5.00**
Actual Wt. Of Soil After Burn	**375.00**
% Organics	**1.32**

Moisture Content

Sample ID	**EB-4**
Wet Weight + Pan	**620.00**
Dry Weight + Pan	**575.00**
Weight of Pan	**250.00**
Weight of Moisture	**45.00**
Dry Weight of Soil	**325.00**
% Moisture	**13.85**

Organic Matter and Ash Content

Dry Soil Before Burn + Pan	**575.00**
Dry Soil After Burn + Pan	**570.00**
Weight of Pan	**250.00**
Wt. Loss Due to Ignition	**5.00**
Actual Wt. Of Soil After Burn	**320.00**
% Organics	**1.54**



Test specification: ASTM D 1557-91 Procedure C Modified
ASTM D4718-15 Oversize Corr. Applied to Each Test Point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
							11.3	

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 132.3 pcf	128.8 pcf	
Optimum moisture = 7.7 %	8.6 %	

Project No. 20210394 E001 **Client:** Puyallup SD
Project: Puyallup SD - South Hill Site
Date: 10/28/2021
○ **Location:** Onsite - Fill **Sample Number:** EB-4

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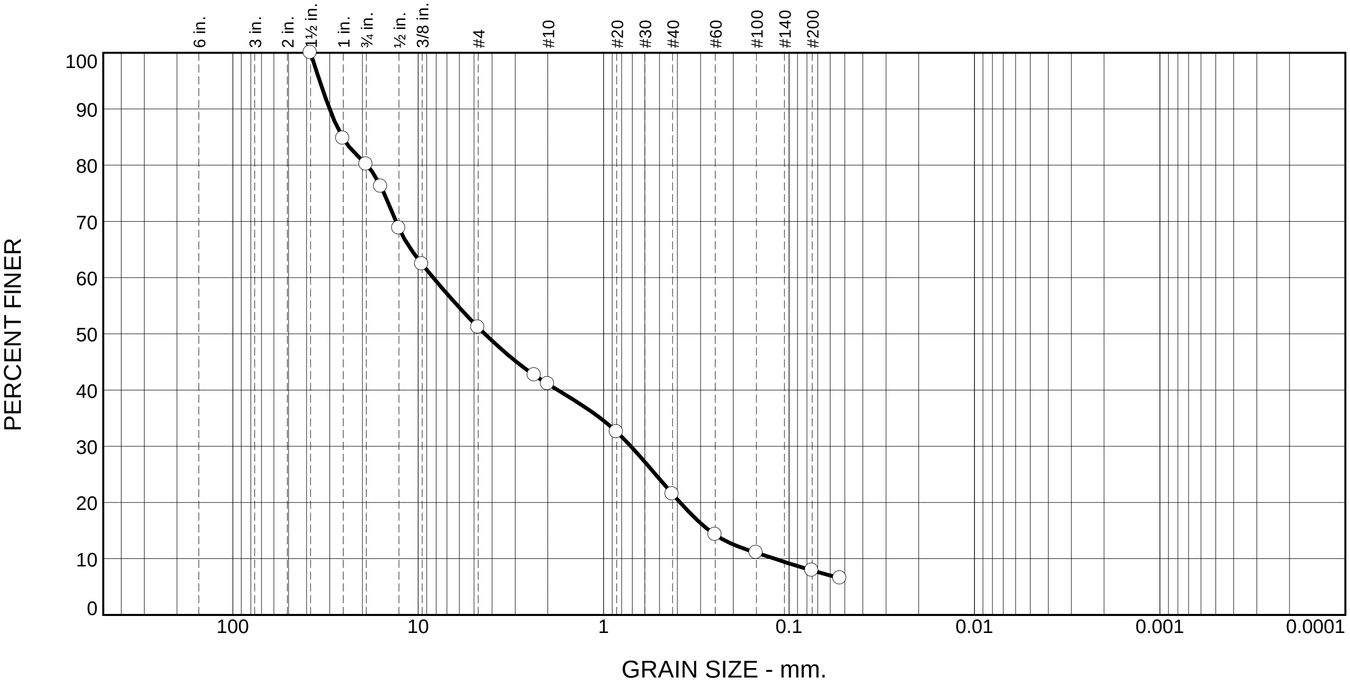
Remarks:

Figure

Tested By: CI **Checked By:** ART/SS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	19.9	28.9	10.1	19.6	13.6	7.9	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5"	100.0		
1"	84.8		
3/4"	80.1		
5/8"	76.2		
1/2"	68.8		
3/8"	62.4		
#4	51.2		
#8	42.6		
#10	41.1		
#20	32.5		
#40	21.5		
#60	14.3		
#100	11.1		
#200	7.9		
#270	6.5		

* (no specification provided)

Material Description

very sandy GRAVEL, some silt

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=**

Classification

USCS (D 2487)= GP-GM **AASHTO (M 145)=** A-1-a

Coefficients

D_{90}= 30.0469	D_{85}= 25.6377	D_{60}= 8.3018
D_{50}= 4.3746	D_{30}= 0.7131	D_{15}= 0.2688
D_{10}= 0.1197	C_u= 69.34	C_c= 0.51

Remarks

Date Received: 10/26/2021 **Date Tested:** 11/2/2021

Tested By: CI

Checked By: ART/SS

Title:

Location: Onsite - Outwash
Sample Number: EB-1W **Depth:** 30'
Date Sampled: 10/20/2021

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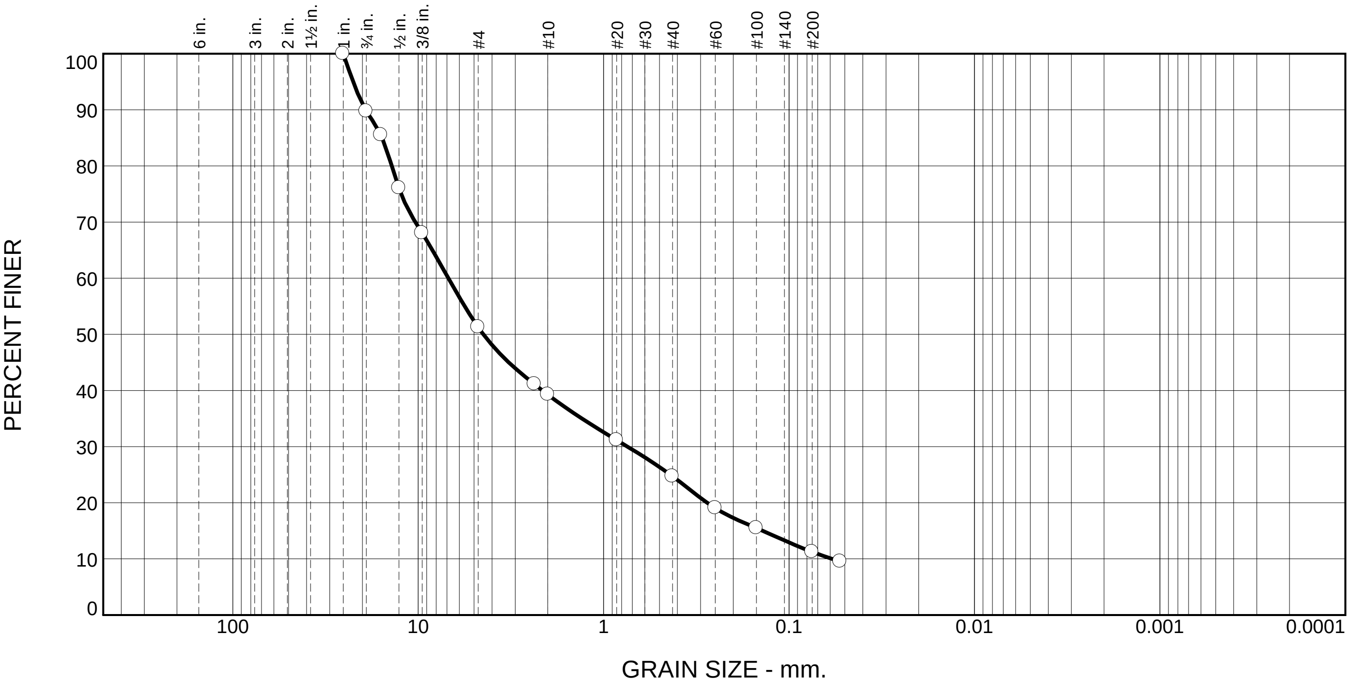
Client: Puyallup SD
Project: Puyallup SD - South Hill Site

Project No: 20210394 E001 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	10.3	38.4	12.0	14.6	13.5	11.2	

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1"	100.0		
3/4"	89.7		
5/8"	85.5		
1/2"	76.0		
3/8"	68.1		
#4	51.3		
#8	41.1		
#10	39.3		
#20	31.1		
#40	24.7		
#60	19.0		
#100	15.5		
#200	11.2		
#270	9.5		

* (no specification provided)

Material Description

very sandy GRAVEL, some silt

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=**

Classification

USCS (D 2487)= GW-GM **AASHTO (M 145)=** A-1-a

Coefficients

D_{90}=	19.2567	D_{85}=	15.6335	D_{60}=	6.8755
D_{50}=	4.4527	D_{30}=	0.7445	D_{15}=	0.1386
D_{10}=	0.0585	C_u=	117.48	C_c=	1.38

Remarks

Date Received: 10/26/2021 **Date Tested:** 11/2/2021

Tested By: CI

Checked By: ART/SS

Title:

Location: Onsite - Outwash

Sample Number: EB-2 **Depth:** 20'

Date Sampled: 10/21/2021

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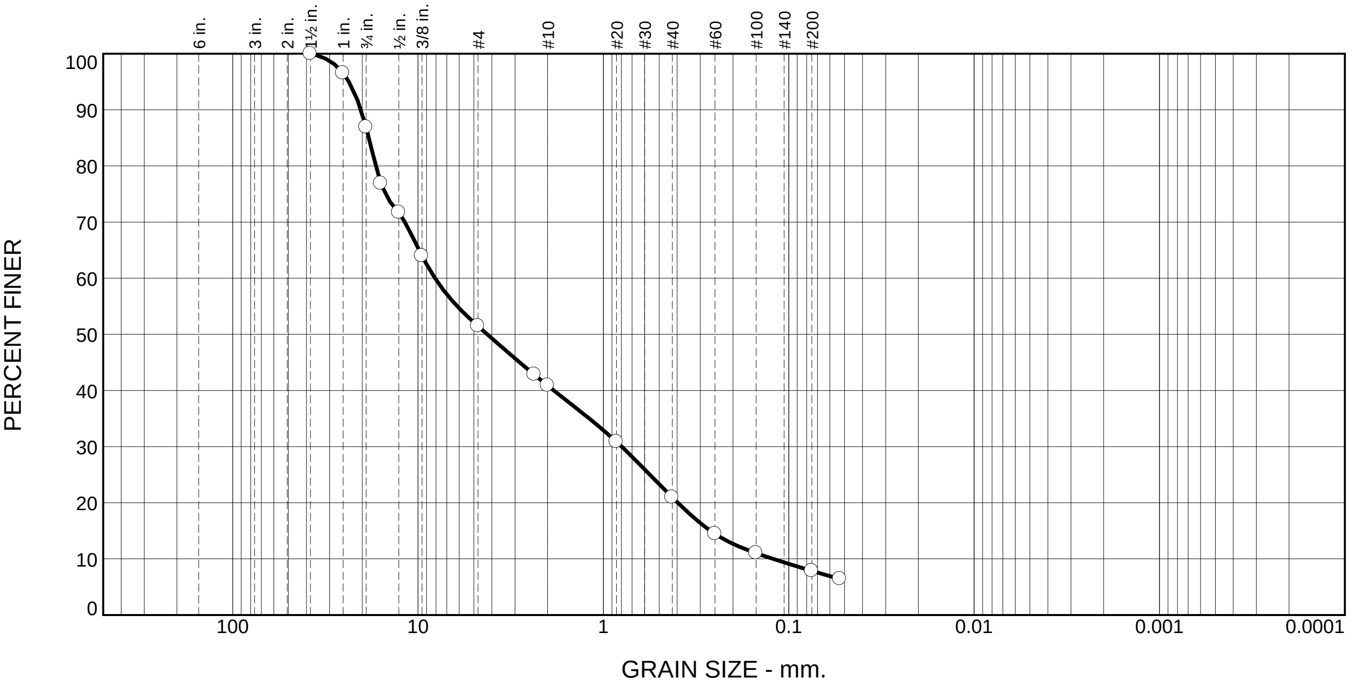
Client: Puyallup SD

Project: Puyallup SD - South Hill Site

Project No: 20210394 E001 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	13.1	35.4	10.6	19.9	13.1	7.9	

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5"	100.0		
1"	96.5		
3/4"	86.9		
5/8"	76.9		
1/2"	71.7		
3/8"	64.0		
#4	51.5		
#8	42.8		
#10	40.9		
#20	30.9		
#40	21.0		
#60	14.5		
#100	11.0		
#200	7.9		
#270	6.4		

* (no specification provided)

Material Description

very sandy GRAVEL, some silt

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=**

Classification

USCS (D 2487)= GP-GM **AASHTO (M 145)=** A-1-a

Coefficients

D_{90}= 20.3223	D_{85}= 18.4222	D_{60}= 8.0993
D_{50}= 4.2312	D_{30}= 0.7975	D_{15}= 0.2644
D_{10}= 0.1216	C_u= 66.63	C_c= 0.65

Remarks

Date Received: 10/26/2021 **Date Tested:** 11/2/2021

Tested By: CI

Checked By: ART/SS

Title:

Location: Onsite - Outwash
Sample Number: EB-5 **Depth:** 15'
Date Sampled: 10/22/2021

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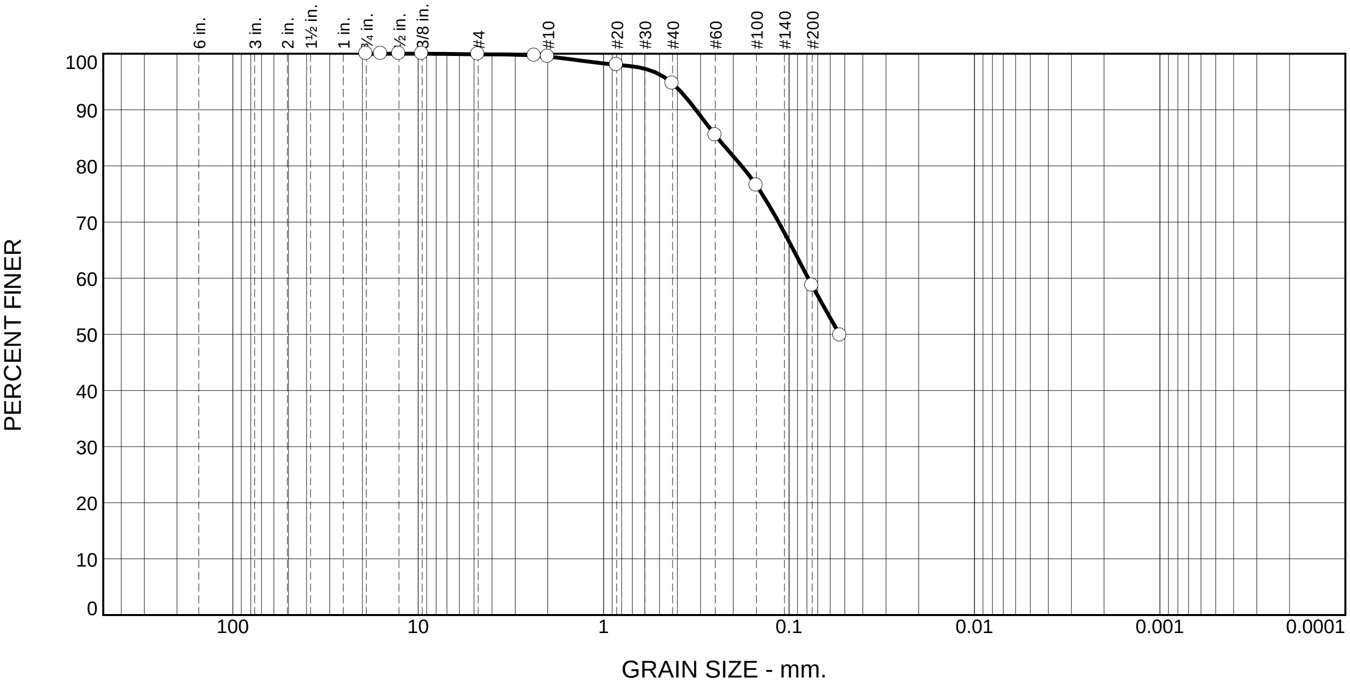
Client: Puyallup SD
Project: Puyallup SD - South Hill Site

Project No: 20210394 E001 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.1	0.4	4.8	36.0	58.7	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3/4"	100.0		
5/8"	100.0		
1/2"	100.0		
3/8"	100.0		
#4	99.9		
#8	99.7		
#10	99.5		
#20	98.0		
#40	94.7		
#60	85.5		
#100	76.6		
#200	58.7		
#270	49.8		

* (no specification provided)

Material Description

very sandy SILT, trace gravel

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=**

Classification

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

Coefficients

D_{90}=	0.3182	D_{85}=	0.2431	D_{60}=	0.0788
D_{50}=	0.0534	D_{30}=		D_{15}=	
D_{10}=		C_u=		C_c=	

Remarks

Date Received: 10/26/2021 **Date Tested:** 11/2/2021

Tested By: CI

Checked By: ART/SS

Title:

Location: Onsite - Lacustrine

Sample Number: EB-7 **Depth:** 5'

Date Sampled: 10/22/2021

associated earth sciences incorporated

Client: Puyallup SD

Project: Puyallup SD - South Hill Site

Project No: 20210394 E001 **Figure**