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May 24, 2019

1st DRT Review
PLPSP20230080
Oct 2023

Eagle Works LLC
2504 – 43rd Street East
Puyallup, WA 98374
rick@harvestrealtyinc.com

The preliminary design documents have been reviewed and contain both markups that must be addressed prior to landuse approval and markups that can be addressed at time of civil application. Markups that contain a document reference inside of brackets [ ] will be noted in the Action Items of the DRT Letter and must be resolved prior to landuse approval. Markups that do not contain the bracketed reference may be addressed with the civil permit application.

Soils Report: Infiltration Feasibility
Proposed Multi-Family Development
xxx – 5th Street Southeast
Puyallup, Washington
PN: 0419036002, -6003
Doc ID: EagleWorksLLC.5thStreetSE.SR

INTRODUCTION

This soils report addresses the feasibility of the site soils to support the infiltration of stormwater runoff generated by the proposed residential development to be constructed at xxx – 5th Street in the City of Puyallup located in Pierce County, Washington. The general site location is shown on the Site Location Map, Figure 1.

Our understanding of the project is based on our conversations with you, our review of available published geologic literature for the site area, our March 13, 2019 site visit and subsurface explorations, our understanding of City of Puyallup development requirements, and our experience in the area. We understand that the site is currently undeveloped and that you propose to construct a 46-unit multi-family apartment complex at the site that likely would include driveways, parking lots and associated utilities. A site plan was not provided to us at the time of this report.

Because of the proposed amount of new hard surface, the City of Puyallup is requiring that a site-specific soils report be prepared in accordance with the 2012 Stormwater Management Manual for Western Washington (SWMMWW) with the 2014 Amendments.

Currently adopted manual is the 2019 Ecology Manual.

SCOPE

The purpose of our services was to evaluate the surface and subsurface conditions at the site as a basis for providing our opinion on the feasibility of infiltration for the proposed development in order to satisfy the City of Puyallup requirements. Specifically, our scope of services for the project included the following:

1. Conducting a geologic reconnaissance of the site area;
2. Reviewing the available geotechnical, geologic and hydrogeologic data for the site area;
3. Observing the excavation of 9 test pit explorations, and sampling the observed soils for subsequent laboratory testing, as deemed necessary;
4. Performing up to 2 grain size analysis on representative select soil samples from the explorations;
5. Determining a preliminary infiltration rate based on the grain size analysis, if appropriate;

6. Preparing this *Soils Report* summarizing our site observations and conclusions, along with the supporting data.

The above scope of work was completed in accordance with our *Proposal for Services* dated March 13, 2019. We received notice to proceed on the same day.

Site Conditions

As stated, the site is located at xxx – 5th Street Southeast in the City of Puyallup of Pierce County, Washington, within an area of existing residential and commercial development. The site consists of two parcels that when combined are generally rectangular in shape, measures about 340 feet deep (north to south) by 330 feet wide (east to west) and encompasses about 2.68 acres. The site is bounded by an office building to the north, a parking lot and office building to the east, an apartment complex to the west, and residential development to the south. As previously stated, the site is currently undeveloped.

The site is located on the north margin of the Puyallup-South Hill glacial upland area. Based on information obtained from Pierce County PublicGIS and our site observations, the site slopes up towards the southeast, generally getting steeper towards the southeast portion. The northwest to southwest portion of the site is flat to gently sloping up towards the southeast at less than 3 percent. The slopes in the southeastern portion slope up at a steeper inclination of 10 to 14 percent before transitioning to about 4 to 6 percent in the southeastern corner. The total topographic relief across the parcel is on the order of about 15 feet. The existing site configuration and topography is shown on the Site and Exploration Map, Figure 2.

Vegetation at the site consists of immature growth forestland, primarily maple to douglas fir trees with an understory of blackberries, ferns, and smaller saplings. No surface erosion, seeps, springs, or evidence of slope instability was observed at the time of our site visit.

Site Soils

The USDA Natural Resource Conservation Service (NRCS) Web Soil Survey maps the site and surrounding areas as being underlain by Everett very gravelly sandy loam (13B) soils. The Everett soils are derived from sandy and gravelly glacial outwash and are included in hydrologic soils group A. The 13B soil type forms on slopes of 0 to 8 percent and have a "slight" erosion hazard when exposed. Our subsurface explorations generally confirm the NRCS map for the site. A copy of the NRCS Soil Survey Map for the site and surrounding area is included as Figure 3.

Geologic Conditions

The draft *Geologic Map of the Puyallup 7.5-Minute Quadrangle, Washington* (Troost et Al.) maps the site as being underlain by recessional outwash ($Qvsb_4$). These glacial outwash soils were generally deposited during the Vashon stage of the Fraser Glaciation, some 12,000 to 15,000 years ago. The recessional deposits typically consist of a poorly-sorted, lightly-stratified mixture of sand and gravel that may locally contain silt and clay that were deposited by meltwater streams issuing from the retreating ice mass. The $Qvsb_4$ deposits are part of the Bradley Channel, a subunit of Steilacoom gravel, outwash flood channel deposits. The recessional outwash is considered to be normally consolidated and generally exhibits moderate strength and compressibility characteristics where undisturbed. An excerpt of the above referenced geologic map is included as Figure 4.

Subsurface Explorations

On March 13, 2019, a representative from GeoResources, LLC (GeoResources) visited the site and observed two groundwater monitoring ports and seven previously excavated test pits to depths of approximately 5 to 10 feet below the existing ground surface, logged the subsurface conditions encountered in each test pit, and obtained representative soil samples. The test pits and the groundwater monitoring ports were excavated by a licensed operator on a small track-mounted excavator working for you. Table 1, below, summarizes the approximate locations, surface elevations, and termination depths of the test pits and groundwater monitoring ports.

TABLE 1:
APPROXIMATE LOCATIONS, ELEVATIONS, AND DEPTHS OF EXPLORATIONS

Test Pit/ Monitoring Port Number	Functional Location	Surface Elevation[1] (feet)	Termination Depth (feet)	Termination Elevation (feet)
MP-1	Northwestern portion of site	410	10	400
MP-2	Northwestern portion of site	410	10	400
TP-1	Northeastern portion of site	410	5	405
TP-2	Middle of site	410	5	405
TP-3	Northwestern portion of site	410	5	405
TP-4	North central portion of site	410	5	410
TP-5	Northeast portion of site	415	5	410
TP-6	Northeast portion of site	415	5	410
TP-7	Southeast portion of site	418	5	413

Notes:
Elevation datum: Pierce County GIS (NAVD 88)

The specific number, locations, and depths of the explorations were selected by you. Representative soil samples obtained from the test pits and groundwater monitoring ports were placed in sealed plastic bags and then taken to a laboratory for further examination and testing as deemed necessary.

The subsurface explorations excavated as part of this evaluation indicate the subsurface conditions at specific locations only, as actual subsurface conditions can vary across the site. Furthermore, the nature and extent of such variation would not become evident until additional explorations are performed or until construction activities have begun.

The approximate locations and numbers of our test pits are shown on the attached Site and Exploration Map, Figure 2. The soils encountered were visually classified in general accordance with the Unified Soil Classification System (USCS) and ASTM D: 2488. The USCS is included in Appendix A as Figure A-1, while the descriptive logs of our test pits are included as Figure A-2 through A-6.

Subsurface Conditions

Our test pits and the monitoring ports encountered relatively uniform subsurface conditions that generally confirmed the mapped stratigraphy at the site. Our test pit explorations encountered

0.3 to 2 feet of gravelly black topsoil over 0.8 to 4 feet of reddish-brown to gray, poorly to well-graded gravel with variable amounts of sand and cobbles, that appeared to be in a medium dense, moist condition. We interpret these surficial soils as recessional glacial outwash deposits. At depths of 2.5 to 5 feet in monitoring ports MP-1, MP-2, test pits TP-1, TP-5, TP-6, and TP-7, a dense to very grey silty sand with gravel and cobbles that appeared consistent with glacial till was encountered underlying the shallow recessional outwash. Although not encountered in all test pit explorations, we anticipate the glacial till underlies the outwash deposits across the site. It also appears that the glacial till is encountered at shallower depths towards the upslope, southeast direction.

Monitoring Port MP-1, test pit TP-1, and TP-2 encountered about 0.5 to 1.7 feet of reddish-brown sandy silt with gravel that we interpret to be undocumented fill. The fill was generally encountered in the central portion of the site. The soils appeared to be in a loose, moist condition. Table 2, below, summarizes the approximate thicknesses, depths, and elevations of selected soil layers.

Clarify-These elevations do not agree with the elevations contained in the Mounding Analysiis. [Soils Report; Pg 4 of 22]

TABLE 2:
APPROXIMATE THICKNESS, DEPTHS, AND ELEVATION OF SOIL TYPES ENCOUNTERED IN EXPLORATIONS

Exploration Number	Thickness of Topsoil (feet)	Thickness of Recessional Outwash (feet)	Thickness of Weathered Glacial Till (feet)	Depth to Undisturbed Glacial Till (feet)	Elevation of Undisturbed Glacial Till (feet)
MP-1	2	3	N/E	5	405
MP-2	½	3½	N/E	5	405
TP-1	¼	1½	N/E	3½	406½
TP-2	½	3½	N/E	N/E	N/E
TP-3	½	4½	N/E	N/E	N/E
TP-4	1	4	N/E	N/E	N/E
TP-5	1	1½	N/E	2½	412½
TP-6	½	¾	N/E	1¼	413¾
TP-7	½	1½	N/E	2	416

Groundwater Conditions

We observed mottling in the lower portion of the shallow recessional outwash deposits, and significant mottling of the upper portion of the glacial till deposits. Mottling is generally indicative of a seasonal or fluctuating high perched groundwater table that typically develops when the vertical infiltration of precipitation through a more permeable soil is slowed at depth by a deeper, denser, less permeable soil type, such as glacial till. We anticipate fluctuations in the local groundwater levels will occur in response to precipitation patterns, off-site construction activities, and site utilization. Table 3 summarizes the approximate depths and elevations of groundwater and mottling observed at the time of our explorations.

TABLE 3:
APPROXIMATE DEPTHS, AND ELEVATION OF GROUNDWATER ENCOUNTERED IN EXPLORATIONS

Exploration Number	Depth to Mottling (feet)	Depth to Groundwater (feet)	Elevation of Groundwater (feet)	Dated Encountered
MP-1	5	N/E	N/E	ATD (5/11/2019)
MP-2	5	N/E	N/E	ATD (5/11/2019)
TP-1	3½	N/E	N/E	ATD (5/11/2019)
TP-2	4	N/E	N/E	ATD (5/11/2019)
TP-3	N/E	N/E	N/E	ATD (5/11/2019)
TP-4	N/E	N/E	N/E	ATD (5/11/2019)
TP-5	1	N/E	N/E	ATD (5/11/2019)
TP-6	½	N/E	N/E	ATD (5/11/2019)
TP-7	½	N/E	N/E	ATD (5/11/2019)

Notes: Elevation datum: Pierce County GIS data N/E: Not encountered
ATD = At time of drilling/digging

Laboratory Testing

Geotechnical laboratory tests were performed on select samples retrieved from the test pits to determine soil index and engineering properties encountered. Laboratory testing included visual soil classification per ASTM D: 2488 and grain size analyses per ASTM D: 422 standard procedures. The results of the laboratory tests are included in Appendix B.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of our site reconnaissance, subsurface explorations and laboratory test results, the use of downspout infiltration, bioretention, or permeable pavement BMP's to address stormwater runoff and flow control generated by the proposed development is feasible, provided adequate separation from the underlying glacial till and seasonal high groundwater can be maintained. The deeper glacial till (hardpan) underlying the site at depth will not support infiltration.

Downspout Infiltration

Based on our site observations and subsurface explorations, it is our opinion that stormwater infiltration via a trench type system is feasible within the northwestern and southwestern portions of the site. Per the Volume 3.1.1 of the 2012 SWMMWW, downspout infiltration is considered feasible on lots or sites if 3 feet or more of permeable soil from the proposed final grade to the seasonal high ground water table exists and at least 1 foot of clearance from the expected bottom elevation of the infiltration trench or dry well to the seasonal high ground water table can be met. Given that a typical downspout trench depth is 2 feet below the existing ground surface, the minimum separation between the bottom of the infiltration facility and seasonal high groundwater or impermeable layer can be met in the northwest to southwest portions; therefore, onsite infiltration of stormwater is feasible in the

northwest to southwest portions. A basin type system may be feasible within the northwestern to southwestern portions with a mounding analysis. Per Volume 3.3.7 of the 2012 SWMMWW, basins require 5 feet of separate, or 3 feet with a mounding analysis. As stated previously, glacial till was encountered at 5 feet below existing grade in the northwestern portion of the site. Based on the subsurface conditions encountered in the vicinity of the test pits TP-5, TP-6 and TP-7, the minimum separation requirements cannot be met. We recommend alternative stormwater management options such as dispersion be considered in the northeast to southeast portions.

All appropriate and pertinent setback criteria per the 2012 SWMMWW should be considered prior to the selection of a stormwater management BMP.

Permeable Pavement

Per Volume V BMP T5.15, permeable pavement is not feasible if seasonal high ground water or an underlying impermeable/low permeable layer would create saturated conditions within 1-foot of the bottom of the storage course. The granular nature of the upper surficial soils in the northwestern and southwestern portion allow for the support of permeable pavement.

Soil Grain Size Analysis Method

Since the soils are part of the Steilacoom Gravel, the use of the Grain Size method per the 2012 SWMMWW, Volume III 3.3.6 used by the City of Puyallup may be used to determine infiltration rates.

Based on our grain size analysis and in accordance with the 2012 SWMMWW, we recommend a long-term design infiltration rate of 7 inches per hour be used to design infiltration facilities in the upper gravelly soils where infiltration is feasible. Appropriate correction factors for test method and plugging have been applied to these values, but the project civil engineer should include a correction factor for geometry.

We recommend that a representative from our firm be onsite at the time of excavation of the proposed infiltration facilities to verify that the soils encountered during construction are consistent with the soils observed in our subsurface explorations, and if the vertical separation requirements could be met. In-situ infiltration testing should also be performed at the time of construction to verify the recommended infiltration rate per the 2012 SWMMWW.

Appropriate design, construction and maintenance measures will be required to ensure the infiltration rate can be effectively maintained over time. It should be noted that special care is required during the grading and construction periods to avoid fine sediment contamination of the infiltration system. This may be accomplished by using an alternative storm water management location during construction or leaving the bottom of the systems 1 to 2 feet high, and subsequently excavating to the finished grade once the driveways are paved and landscaping is installed. All contractors working on the site (builders and subcontractors) should be advised to avoid “dirty” stormwater flowing to the site’s stormwater system during construction and landscaping. No concrete trucks should be washed or cleaned on-site.

Suspended solids could clog the underlying soil and reduce the infiltration rate. To reduce potential clogging of the infiltration systems, the infiltration system should not be connected to the stormwater runoff system until after construction is complete and the site area is landscaped, paved or otherwise protected. Temporary systems may be utilized through construction. Periodic sweeping of the paved areas will help extend the life of the infiltration system.

All proposed infiltration facilities should be designed and constructed in accordance with the 2012 SWMMWW. All minimum separation, setback requirements and infeasibility criteria per 2012 SWMMWW should be considered prior to the selection, design and location of any stormwater facility for the proposed development.

LIMITATIONS

We have prepared this report for use by Eagle Works LLC and other members of the design team for use in the design of a portion of this project. The data used in preparing this report and this report should be provided to prospective contractors for their bidding or estimating purposes only. Our report, conclusions and interpretations are based on our subsurface explorations, data from others and limited site reconnaissance, and should not be construed as a warranty of the subsurface conditions.

Variations in subsurface conditions are possible between the explorations and may also occur with time. A contingency for unanticipated conditions should be included in the budget and schedule. Sufficient monitoring, testing and consultation should be provided by our firm during construction to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes should the conditions revealed during the work differ from those anticipated, and to evaluate whether earthwork and foundation installation activities comply with contract plans and specifications.

The scope of our services does not include services related to environmental remediation and construction safety precautions. Our recommendations are not intended to direct the contractor's methods, techniques, sequences or procedures, except as specifically described in our report for consideration in design.

If there are any changes in the loads, grades, locations, configurations or type of facilities to be constructed, the conclusions and recommendations presented in this report may not be fully applicable. If such changes are made, we should be given the opportunity to review our recommendations and provide written modifications or verifications, as appropriate.

◆ ◆ ◆

We have appreciated the opportunity to be of service to you on this project. If you have any questions or comments, please do not hesitate to call at your earliest convenience.

Respectfully submitted,
GeoResources, LLC

Erik Fina, GIT
Staff Geologist in Training

State of Washington
Engineering Geologist
925
Licensed Geologist
5/24/2019
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Keith S. Schembs, LEG
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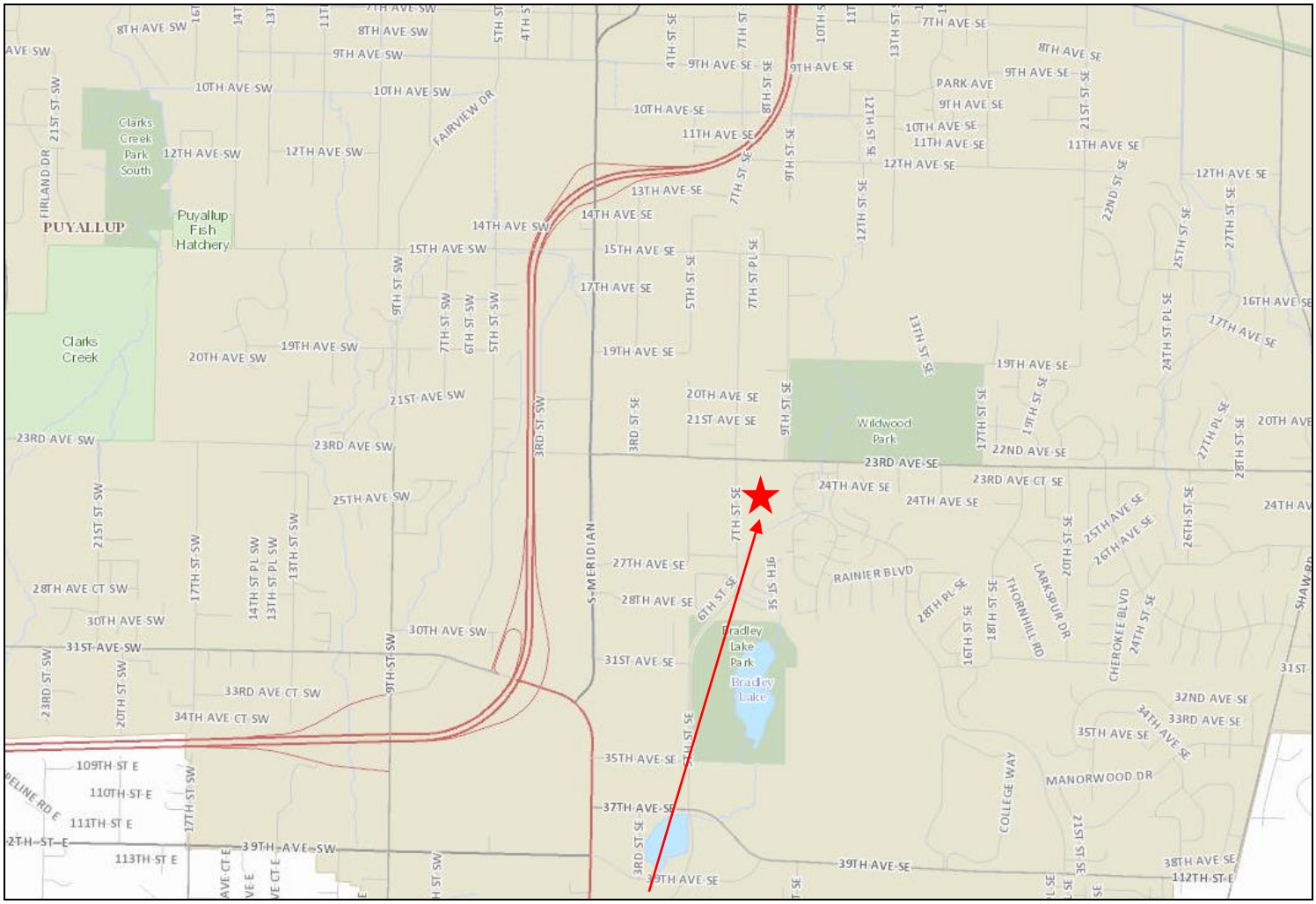
5/24/2019

Neil A. Ferguson, PE
Project Engineer

EJF:KSS:NAF/ejf
Doc ID: EagleWorksLLC.5thStSE.SR
Attachments:
Figure 1: Site Location Map
Figure 2: Site and Exploration Map
Figure 3: NRCS Soils Map
Figure 4: USGS Geologic Map
Appendix A: Subsurface Explorations
Appendix B: Laboratory Results



Approximate Site Location

Map created from Pierce County Public GIS (https://matterhornwab.co.pierce.wa.us/publicgis/)

Not to Scale

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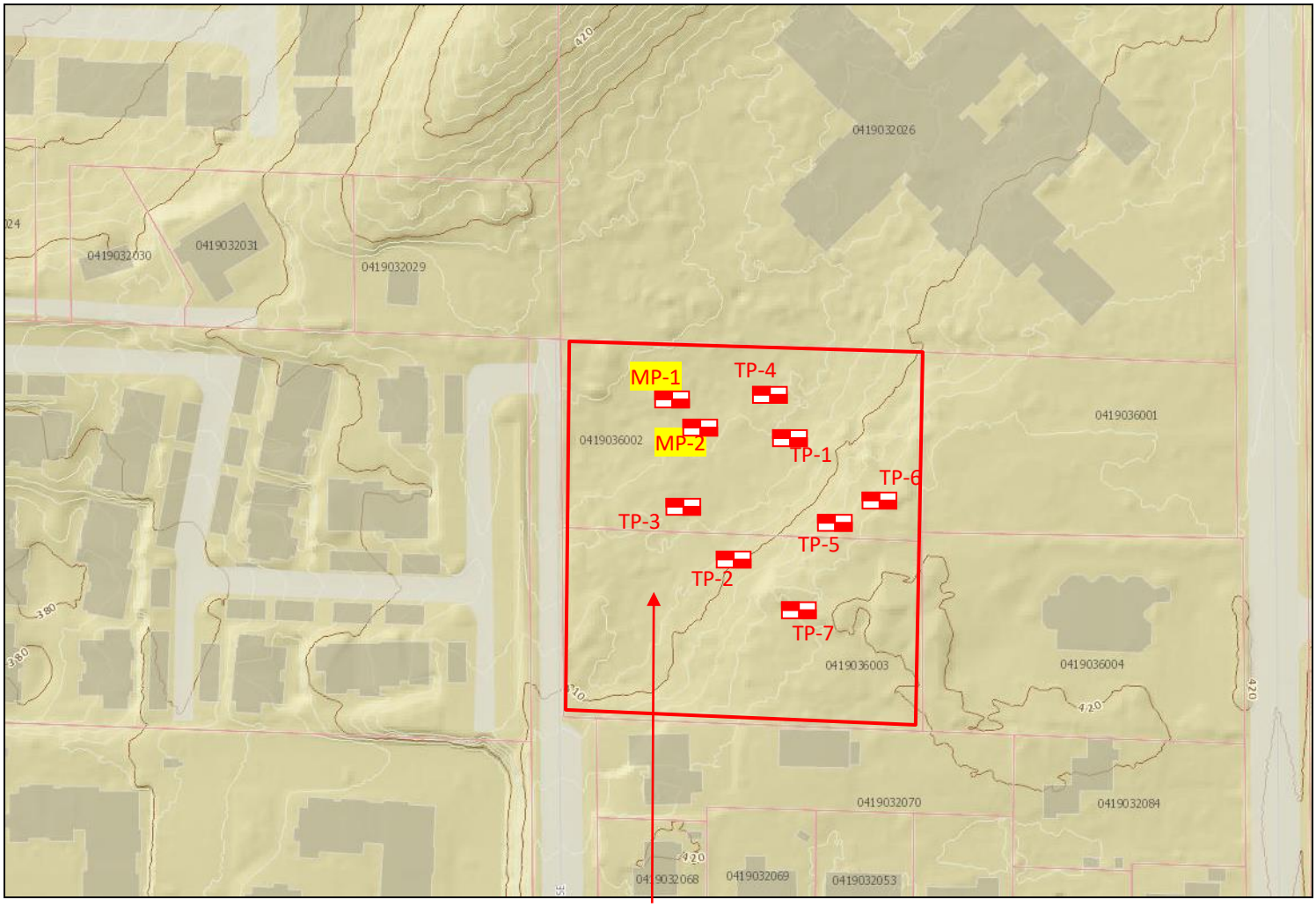
Site Location Map

Proposed Single Family Residence
xxx – 5th Street Southeast
Puyallup, WA
PN: 041903-6002, -6003

DocID: EagleWorksLLC.5thStSE	May 2019	Figure 1



Approximate Site Location

Map created from Pierce County Public GIS (https://matterhornwab.co.pierce.wa.us/publicgis/)

Approximate location and number of test pit

N
W
E
S

Not to Scale

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Site & Exploration Map

Proposed Single Family Residence
xxx – 5th Street Southeast
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PN: 041903-6002, -6003

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Approximate Site Location

Map created from Web Soil Survey (http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx)

Soil Type	Soil Name	Parent Material	Slopes (%)	Erosion Hazard	Hydrologic Soils Group
13B	Everett very gravelly sandy loam	Sandy and gravelly glacial outwash	0 to 8	Slight	A
13C			8 to 15	Slight to Moderate	
20B	Kitsap silt loam	Glaciolacustrine deposits	2 to 8	Slight	C/D

N W E S

Not to Scale

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NRCS Soils Map

Proposed Single Family Residence
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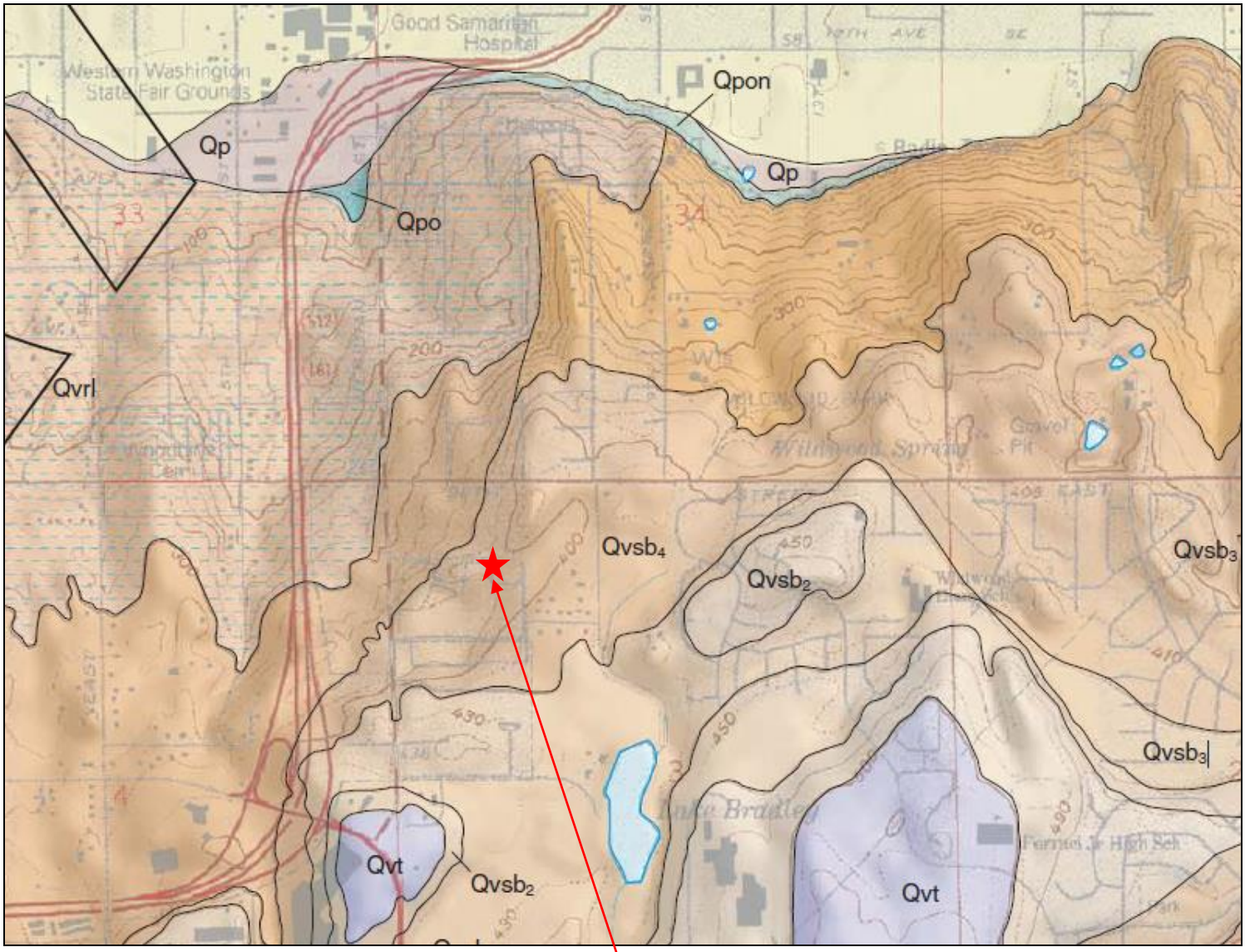
Puyallup, WA
PN: 041903-6002, -6003



Approximate Site Location

An excerpt from the draft *Geologic Map of the Puyallup 7.5-minute Quadrangle, Washington*, by Troost, K.G.

$Qvsb_4$	Steilacoom Gravel – Bradley Channel
$Qvsb_3$	Steilacoom Gravel – Bradley Channel
$Qvsb_2$	Steilacoom Gravel – Bradley Channel
Qvt	Vashon glacial till

Not to Scale

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USGS Geologic Map

Proposed Single Family Residence
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DocID: EagleWorksLLC.5thStSE	May 2019	Figure 4

Appendix A

Subsurface Explorations

SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE GRAINED SOILS More than 50% Retained on No. 200 Sieve	GRAVEL More than 50% Of Coarse Fraction Retained on No. 4 Sieve	CLEAN GRAVEL	GW	WELL-GRADED GRAVEL, FINE TO COARSE GRAVEL
			GP	POORLY-GRADED GRAVEL
		GRAVEL WITH FINES	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SAND More than 50% Of Coarse Fraction Passes No. 4 Sieve	CLEAN SAND	SW	WELL-GRADED SAND, FINE TO COARSE SAND
			SP	POORLY-GRADED SAND
		SAND WITH FINES	SM	SILTY SAND
			SC	CLAYEY SAND
FINE GRAINED SOILS More than 50% Passes No. 200 Sieve	SILT AND CLAY Liquid Limit Less than 50	INORGANIC	ML	SILT
			CL	CLAY
		ORGANIC	OL	ORGANIC SILT, ORGANIC CLAY
	SILT AND CLAY Liquid Limit 50 or more	INORGANIC	MH	SILT OF HIGH PLASTICITY, ELASTIC SILT
			CH	CLAY OF HIGH PLASTICITY, FAT CLAY
		ORGANIC	OH	ORGANIC CLAY, ORGANIC SILT
HIGHLY ORGANIC SOILS			PT	PEAT

NOTES:

1. Field classification is based on visual examination of soil in general accordance with ASTM D2488-90.
2. Soil classification using laboratory tests is based on ASTM D2487-90.
3. Description of soil density or consistency are based on interpretation of blow count data, visual appearance of soils, and or test data.

SOIL MOISTURE MODIFIERS:

Dry- Absence of moisture, dry to the touch

Moist- Damp, but no visible water

Wet- Visible free water or saturated, usually soil is obtained from below water table

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Unified Soils Classification System

Proposed Single Family Residence
xxx – 5th Street Southeast
Puyallup, WA
PN: 041903-6002, -6003

GW Monitoring Port MP-1

Location: Northwestern portion
Approximate Elevation: 410'

Depth (ft)			Soil Type	Soil Description
0	-	2.0	-	Dark brown topsoil
2.0	-	5.0	GP-GM	Reddish brown poorly graded GRAVEL with sand and silt, roots, light iron-oxide staining/discoloration (loose to medium dense, moist) (Weathered Recessional Outwash - Steilacoom Gravel)
5.0	-	10.0	SM	Dark grey silty SAND with gravel and cobbles, iron-oxide staining/discoloration at contact (dense to very dense, moist) (Undisturbed Glacial Till)

Terminated at 10.0 feet below ground surface.
Mottling observed at 5.0 feet at time of excavation.
No caving observed at the time of excavation.
No groundwater seepage observed.

GW Monitoring Port MP-2

Location: Northwestern portion
Approximate Elevation: 410'

Depth (ft)			Soil Type	Soil Description
0	-	0.5	-	Black topsoil
0.5	-	1.5	ML	Reddish brown sandy SILT with gravel (loose, moist) (Undocumented Fill?)
1.5	-	5.0	GP	Brown poorly graded GRAVEL with sand and cobbles (medium dense, moist) (Recessional Outwash - Steilacoom Gravel)
5.0	-	10.0	SM	Dark grey silty SAND with gravel and cobbles, iron-oxide staining/discoloration at contact (very dense, moist) (Undisturbed Glacial Till)

Terminated at 10.0 feet below ground surface.
Mottling observed at 5.0 feet at time of excavation.
No caving observed at the time of excavation.
No groundwater seepage observed.

Logged by: EJF **Excavated on: March 13, 2019**

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Groundwater Monitoring Port Logs

Proposed Single Family Residence
xxx – 5th Street Southeast
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Test Pit TP-1

Location: Northeastern portion
Approximate Elevation: 410'

Depth (ft)			Soil Type	Soil Description
0		0.3	-	Black topsoil, mantled by forest duff
0.3	-	2.0	ML	Reddish brown sandy SILT with gravel (loose, moist) (Undocumented Fill?)
2.0	-	3.5	GP-GM	Reddish brown poorly graded GRAVEL with sand and silt, roots, light iron oxide staining/discoloration (loose to medium dense, moist) (Weathered Recessional Outwash - Steilacoom Gravel)
3.5	-	5.0	SM	Grey silty SAND with gravel and cobbles (very dense, moist) (Undisturbed Glacial Till)

Terminated at 5.0 feet below ground surface.
Mottling observed from 3.5 to 5.0 feet at time of excavation.
No caving observed at the time of excavation.
No groundwater seepage observed.

Test Pit TP-2

Location: Southwestern portion
Approximate Elevation: 410'

Depth (ft)			Soil Type	Soil Description
0	-	0.5	-	Black topsoil
0.5	-	1.0	ML	Reddish brown sandy SILT with gravel (loose, moist) (Undocumented Fill?)
1.5	-	5.0	GW	Reddish brown well graded GRAVEL with sand and cobbles, light iron oxide staining/discoloration (medium dense, moist) (Weathered Recessional Outwash - Steilacoom Gravel)

Terminated at 5.0 feet below ground surface.
Mottling observed from 4.0 to 5.0 feet at time of excavation.
No caving observed at the time of excavation.
Static groundwater levels observed at 2 feet below ground surface.

Logged by: EJF **Excavated on: March 13, 2019**

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Test Pit Logs
Proposed Single Family Residence
xxx – 5th Street Southeast
Puyallup, WA
PN: 041903-6002, -6003

Test Pit TP-3

Location: Northwestern portion
Approximate Elevation: 410'

Depth (ft)			Soil Type	Soil Description
0	-	0.5	-	Dark brown topsoil
0.5	-	1.0	SP	Reddish brown poorly graded GRAVEL with sand and cobbles, roots, light iron-oxide staining/discoloration (loose to medium dense, moist) (Weathered Recessional Outwash - Steilacoom Gravel)
1.0	-	5.0	SM	Grey poorly graded GRAVEL with sand and cobbles (medium dense, moist) (Recessional Outwash - Steilacoom Gravel)

Terminated at 5.0 feet below ground surface.
No mottling observed at time of excavation.
No caving observed at the time of excavation.
No groundwater seepage observed.

Test Pit TP-4

Location: Northern portion
Approximate Elevation: 410'

Depth (ft)			Soil Type	Soil Description
0	-	1.0	-	Black topsoil
1.0	-	2.5	SP	Reddish brown poorly graded GRAVEL with sand, silt and cobbles, roots, light iron-oxide staining/discoloration (loose to medium dense, moist) (Weathered Recessional Outwash - Steilacoom Gravel)
2.5	-	5.0	SM	Grey poorly graded GRAVEL with sand and cobbles (medium dense, moist) (Recessional Outwash - Steilacoom Gravel)

Terminated at 5.0 feet below ground surface.
No mottling observed at time of excavation.
No caving observed at the time of excavation.
No groundwater seepage observed.

Logged by: EJF **Excavated on: March 13, 2019**

Test Pit TP-5

Location: Northeastern portion
Approximate Elevation: 415'

Depth (ft)			Soil Type	Soil Description
0	-	1.0	-	Black topsoil
1.0	-	2.5	GP	Reddish brown poorly graded GRAVEL with sand, silt and cobbles, roots, light iron-oxide staining/discoloration (medium dense, moist) (Weathered Recessional Outwash - Steilacoom Gravel)
2.5	-	5.0	SM	Grey silty SAND with gravel and cobbles, iron-oxide staining/discoloration (dense, moist) (Glacial Till)

Terminated at 5.0 feet below ground surface.
Mottling observed from 1.0 to 5.0 feet at time of excavation.
No caving observed at the time of excavation.
No groundwater seepage observed.

Test Pit TP-6

Location: Northeastern portion
Approximate Elevation: 415'

Depth (ft)			Soil Type	Soil Description
0	-	0.5	-	Black topsoil
0.5	-	1.2	GP	Reddish brown poorly graded GRAVEL with sand, silt and cobbles, roots, light iron-oxide staining/discoloration (medium dense, moist) (Weathered Recessional Outwash - Steilacoom Gravel)
1.2	-	5.0	SM	Grey silty SAND with gravel and cobbles, iron-oxide staining/discoloration (dense, moist) (Glacial Till)

Terminated at 5.0 feet below ground surface.
Mottling observed from 0.5 to 5.0 feet at time of excavation.
No caving observed at the time of excavation.
No groundwater seepage observed.

Logged by: EJF **Excavated on: March 13, 2019**

Test Pit TP-7

Location: Southeastern portion
Approximate Elevation: 418'

Depth (ft)			Soil Type	Soil Description
0	-	0.5	-	Black topsoil
0.5	-	2.0	GP	Reddish brown poorly graded GRAVEL with sand, silt and cobbles, roots, light iron-oxide staining/discoloration (medium dense, moist) (Weathered Recessional Outwash - Steilacoom Gravel)
2.0	-	5.0	SM	Grey silty SAND with gravel and cobbles, iron-oxide staining/discoloration (dense, moist) (Glacial Till)

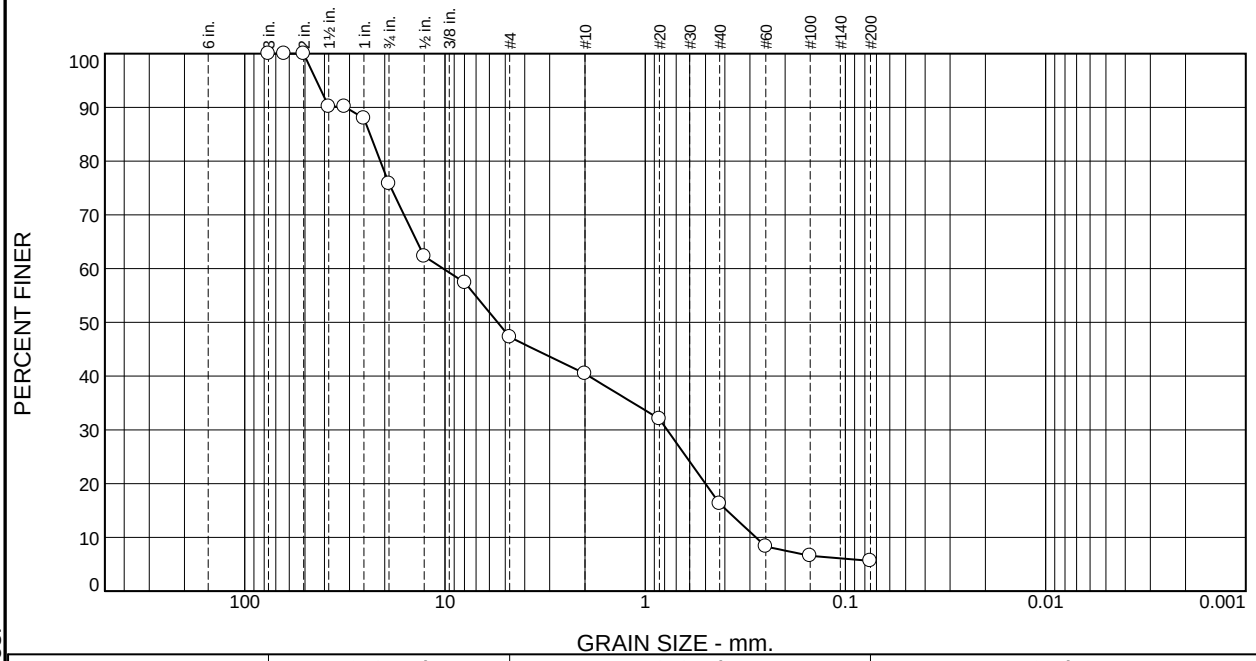
Terminated at 5.0 feet below ground surface.
Mottling observed from 0.5 to 5.0 feet at time of excavation.
No caving observed at the time of excavation.
No groundwater seepage observed.

Logged by: EJF **Excavated on: March 13, 2019**

Appendix B

Laboratory Results

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	24.2	28.5	6.9	24.1	10.7	5.6	

Test Results (ASTM D 422 & ASTM C 117)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3.0	100.0		
2.5	100.0	100.0	
2.0	100.0	75.0 - 100.0	
1.5	90.1		
1.25	90.1		
1	88.0		
.75	75.8		
.5	62.3		
.3125	57.4		
#4	47.3	22.0 - 100.0	
#10	40.4		
#20	32.0		
#40	16.3		
#60	8.3		
#100	6.6		
#200	5.6	0.0 - 10.0	

* Pierce County Trench Backfill

Material Description

poorly graded gravel with silt and sand

Atterberg Limits (ASTM D 4318)

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

Classification

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

Coefficients

D_{90}= 31.2741 D_{85}= 23.6789 D_{60}= 10.2112
D_{50}= 5.4615 D_{30}= 0.7768 D_{15}= 0.3905
D_{10}= 0.2801 C_u= 36.46 C_c= 0.21

Remarks

Date Received: 03/13/2019 **Date Tested:** 03/28/2019

Tested By: EJF

Checked By:

Title:

Location: GW Monitoring Port MP-1/S-1 **Date Sampled:** 03/13/2019
Sample Number: 097147 **Depth:** 3'-4'

GeoResources, LLC

Fife, WA

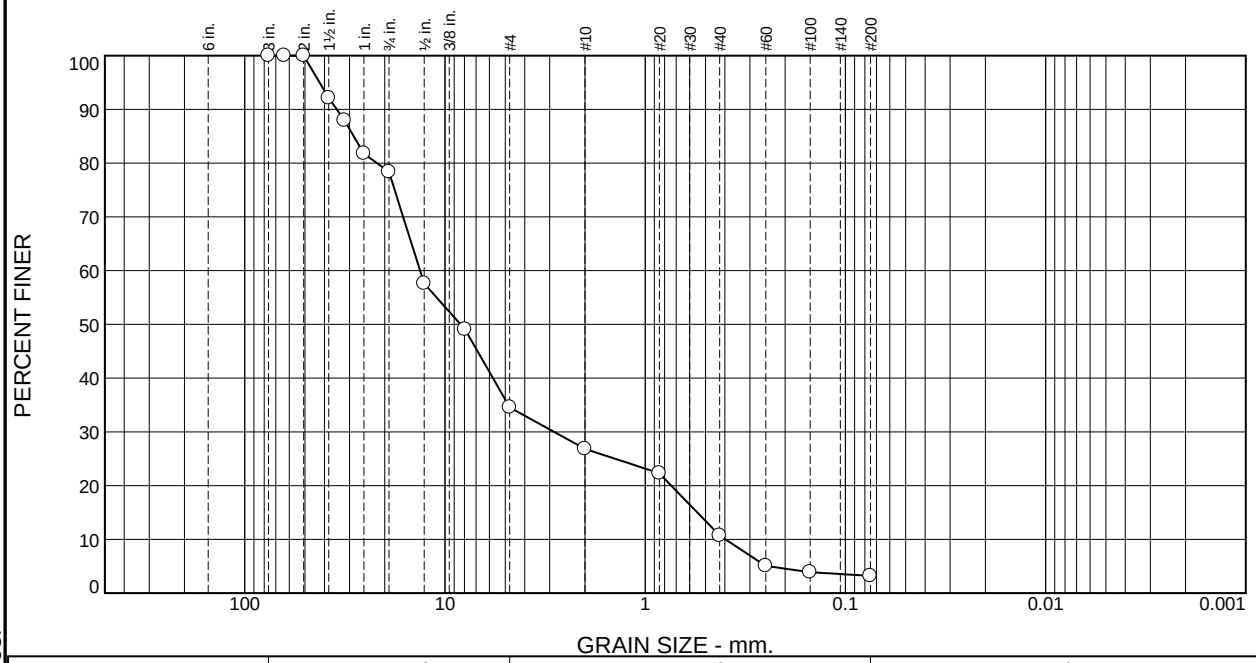
Client: Eagle Works LLC
Project: EagleworksLLC.5thStSE

Project No: **Figure** B-1

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicitive of apparently identical samples.

Tested By: _____ **Checked By:** _____

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	21.6	43.9	7.7	16.1	7.5	3.2	

Test Results (ASTM D 422 & ASTM C 117)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3.0	100.0		
2.5	100.0	100.0	
2.0	100.0	75.0 - 100.0	
1.5	92.1		
1.25	87.9		
1	81.8		
.75	78.4		
.5	57.6		
.3125	49.1		
#4	34.5	22.0 - 100.0	
#10	26.8		
#20	22.3		
#40	10.7		
#60	5.1		
#100	3.9		
#200	3.2	0.0 - 10.0	

* Pierce County Trench Backfill

Material Description

well-graded gravel with sand

Atterberg Limits (ASTM D 4318)

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

Classification

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

Coefficients

D_{90}= 34.7418 D_{85}= 28.5504 D_{60}= 13.3087
D_{50}= 8.3629 D_{30}= 2.8524 D_{15}= 0.5493
D_{10}= 0.3977 C_u= 33.46 C_c= 1.54

Remarks

Date Received: 03/13/2019 **Date Tested:** 03/28/2019

Tested By: EJF

Checked By:

Title:

Location: Test Pit TP-2/S-1 **Date Sampled:** 03/13/2019
Sample Number: 097153 **Depth:** 3'-5'

GeoResources, LLC

Fife, WA

Client: Eagle Works LLC
Project: EagleworksLLC.5thStSE

Project No: **Figure** B-2

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicitive of apparently identical samples.

Tested By: _____ **Checked By:** _____