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January 4, 2022

Advanced Underground Utilities Inc.
PO Box 309
Puyallup, WA 98372
Sumner, Washington 98390

Attn: E.J. Fernandez
(253) 988-2449
ej@auuinc.com

Soils Report
Proposed Contractor's Yard
320 Todd Road NE
Puyallup, Washington
PN: 0420222005
Doc ID: AdvancedUndergroundUtilities.ToddRdNE.SR

INTRODUCTION

This *soils report* addresses the feasibility of onsite infiltration of stormwater for the proposed contractor's yard to be constructed on the above referenced parcel in the City of Puyallup, Washington. The site location is shown on the attached Site Location Map, Figure 1.

Our understanding of the project is based on our email correspondence with you; our December 13, 2022 site visit and subsurface explorations; our experience in the area; and our understanding of the City of Puyallup (the City) development codes. The site is currently developed with an existing single-family residence, detached garage/shop, driveway, and associated utilities. We understand that you propose to develop the site as a contractor's yard. We were not provided with a site plan prior to the preparation of this document.

PURPOSE & SCOPE

The purpose of our services was to evaluate the surface and subsurface conditions across the site as a basis for providing geotechnical recommendations and design criteria for the proposed residence. Specifically, the scope of services for this project included the following:

1. Reviewing the available geologic, hydrogeologic, and geotechnical data for the site area;
2. Exploring surface and subsurface conditions across the site by monitoring the excavation of two test pit explorations, completing three hand auger explorations, and installing three drive point piezometers in the hand auger explorations to a maximum depth of 10 feet below existing site grades;
3. Performing monitoring of groundwater levels during the prescriptive wet season (December 21, 2022 through March 21, 2023) as stated by the City;
4. Providing our opinion about the feasibility of onsite infiltration in accordance with the *2019 Stormwater Management Manual for Western Washington* (SWMMWW), including a preliminary design infiltration rate based on grain size analysis, as applicable; and,

5. Preparing this *Soils Report* that satisfies the 2019 SWMMWW requirements and summarizes our site observations and conclusions, and our geotechnical recommendations, along with the supporting data.

The above scope of work was summarized in our *Proposal for Geotechnical Engineering Services* dated November 9, 2022. We received written authorization to proceed from you on November 9, 2022; however, we were asked not to move forward with our groundwater monitoring program by you on December 15, 2022.

SITE CONDITIONS

Surface Conditions

The site is located at 320 Todd Road NE in Puyallup, Washington, in an area of existing residential and commercial development. According to the Pierce County GIS website, the site is irregular in shape and measures about 293 to 377 feet long (north to south) by about 197 feet wide (east to west) and encompasses approximately 1.5 acres. The site is bounded by existing residential development to the west, Wapato Creek to the east and south, and by Todd Road NE to the north.

Based on topographic information obtained from Pierce County GIS and our site observations the ground surface of the site is relatively level. The southeast corner of the site slopes down to the southeast and continues off site at approximately 10 percent over a height of about 8 to 10 feet. The total topographic relief of the site is on the order of 6 feet. The existing site configuration and topography are shown on Figure 2.

Vegetation across the site generally consists of maintained grass, ornamental plants and shrubs surrounding the residence and a few coniferous trees. As stated, Wapato Creek is located southeast and south of the site, flowing from northeast to southwest. Flowing water was not observed during our initial site visit.

Site Soils

The Natural Resource Conservation Service (NRCS) Web Soil Survey maps the site as being underlain by Pilchuck fine sand (29A) and Puyallup fine sandy loam (31A) soils. These soils are derived from alluvium, form on slopes of 0 to 3 percent, are considered to have a "slight" erosion hazard when exposed, and are included in hydrologic soils group A. An excerpt of the NRCS soils map for the site vicinity is included as Figure 3.

Site Geology

According to the draft *Geologic Map of the Puyallup Quadrangle, Washington* (Troost et al., in review) the site is mapped as being underlain by Holocene alluvium (Qal). Alluvial soils were generally deposited in the last 10,000 years and typically consist of normally consolidated, stratified deposits of sand, silt, clay, and occasional peat. The alluvium soils mapped at the site was deposited along the Puyallup River channel. The existing topography, as well as the surficial and shallow subsurface soils in the area, are the result of fluvial action, including down-cutting by the river, channel meandering and migration, and flood deposits. An excerpt from the geologic map is included as Figure 4.

Subsurface Explorations

On December 13, 2022, field representatives from GeoResources visited the site and excavated three hand augers and two test pits at select locations across the site to depths of 10 feet below the existing ground surface, logged the subsurface conditions encountered, and obtained representative soil samples.

Hand Augers

A field representative form our office continuously monitored the explorations, maintained logs of the subsurface conditions encountered, obtained representative soil samples, and observed pertinent site features. Soil densities presented on the logs were estimated based on the difficulty of excavation and our experience. Stainless steel drive point piezometers (DPPs) were installed in each hand auger exploration. Each hand auger was then backfilled with the excavated soil.

Test Pits

The test pits were excavated by a medium sized track-mounted excavator operated by a licensed earthwork contractor working for you. Our field representative logged the subsurface conditions encountered in each test pit and obtained representative soil samples. Soil densities presented on the logs were estimated based on the difficulty of excavation and our experience. The test pits were backfilled with excavated soil and tamped in place, but not otherwise compacted.

The number and locations of the explorations were selected in the field based on project information provided by you at the time of excavation, our understanding of the proposed development, consideration for underground utilities, existing site conditions, and current site usage. 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. Based on our experience in the area and extent of prior explorations in the area, it is our opinion that the soils encountered in the explorations are generally representative of the soils at the site.

The soils encountered were visually classified in accordance with the Unified Soil Classification System (USCS) and ASTM D2488. The approximate locations of our explorations are indicated on the attached Site & Exploration Plan, Figure 2. The USCS is included in Appendix A as Figure A-1, while the descriptive logs of our test pits and hand augers are included as Figures A-2 and A-3.

Subsurface Conditions

Our explorations encountered relatively uniform subsurface conditions that, in our opinion, confirmed the mapped stratigraphy. Logs of explorations are available in Appendix A.

- *Topsoil:* At the locations explored, we encountered approximately 0.5 to 1 foot of topsoil/sod
- *Alluvium:* Underlying the topsoil, our explorations encountered brown to gray sandy silt, silty sand, and sand with silt in a loose to medium dense/medium stiff, moist condition to the full depths explored. Orange iron oxide-staining (mottling) was observed throughout the excavations.

Laboratory Testing

Geotechnical laboratory tests were performed on the soils retrieved from our hand auger and test pit explorations. Laboratory testing included visual soil classification per ASTM D2488 and ASTM D2487, moisture content determinations per ASTM D2216, and grain size analyses per ASTM D6913 standard procedures. The results of the laboratory tests are included in Appendix B.

TABLE 2:
LABORATORY TEST RESULTS FOR ON-SITE SOILS

Sample	Soil Type /Classification	Lab ID Number	Gravel Content (percent)	Sand Content (percent)	Silt/Clay Content (percent)	D10 Ratio (mm)
TP-1, S-2, D:4.5 - 8'	Sandy SILT (ML)	103680	0.0	13.6	86.4	< 0.075
TP-2, S-1, D: '2	Sandy SILT (ML)	103681	0.0	33.3	66.7	< 0.075
HA-1, S-1	Sandy SILT (ML)	103682	0.0	46.1	53.9	< 0.075

Groundwater Conditions

No groundwater seepage was observed at the time of our site explorations. However, mottling was observed in all explorations from approximately 0.5 to 10 feet below the ground surface. It is our opinion that the mottling encountered is indicative of high fines content of the site soils. We anticipate fluctuations in the local groundwater levels will occur in response to precipitation patterns, off-site construction activities, and site utilization. As such, water level observations made at the time of our field investigation may vary from those encountered during the construction phase.

Based on our review of locatable water well logs in the site vicinity, we estimate that regional groundwater occurs approximately 4 to 14 feet below the ground surface. As stated, three DPPs were installed across the site on December 13, 2022 to depths of about 10 feet below the ground surface. We have not yet received your approval to perform wet season (December 21-March 21) groundwater monitoring.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of our site evaluation, it is our opinion that there is limited potential for shallow onsite infiltration of stormwater runoff generated by the proposed development within the alluvium soils. The feasibility of shallow infiltration will depend on the results of wet season groundwater monitoring and the proposed facility configuration. Further discussion regarding the feasibility of onsite infiltration is included below.

Infiltration Recommendations

The soils at the site generally consist of mottled sandy silt and silty sand alluvium soils. Based on the site configuration and our subsurface explorations, it is our opinion that the use of shallow BMPs for onsite infiltration of the stormwater runoff generated by the proposed development may be feasible from a geotechnical standpoint provided vertical and horizontal setbacks can be met. However, given the high fines content of the alluvium soils, infiltration will be limited. Additionally,

groundwater seepage was not encountered at the time of our explorations and monitoring has not been performed during the wet season (December 21 – March 21).

Low Impact Development (LID) BMPs

LID infiltration BMPs such as pervious pavement could be considered to manage stormwater for this project. Per the 2019 SWMMWW, Volume V, Chapter 5, BMP T5.15, the use of permeable pavement is infeasible if saturated conditions would be created within 1 foot of the bottom elevation of the lowest layer and the seasonal high groundwater table or an underlying impermeable/low permeable layer.

LID systems for water quality require Cation Exchange Capacity (CEC) of at least 5 mEq/100g and a minimum organic content of 1 percent in order for the native soils to be used as a treatment layer beneath water quality facilities, such as permeable pavement. CEC and organic content testing may be completed under a separate scope at your request.

Infiltration BMPs

Per the 2019 SWMMWW, Volume V, Chapter 4, BMP T5.10A, downspout infiltration is feasible on sites where 3 feet or more of permeable soil from the proposed final grade to the seasonal high-water table is available, and/or at least 1 foot of clearance from the bottom elevation of the infiltration trench to the seasonal high groundwater table is available.

Design Infiltration Rate

The design infiltration rate was determined based on the soil grain size analysis method as outlined in the 2019 SWMMWW, Volume V, Chapter 5.4, and in accordance with ASTM D6913. The alluvium deposits should be considered glacially unconsolidated and a type A soil. Based on our gradation analyses, we recommend a design infiltration rate of 0.2 inches per hour for the alluvial soils. Appropriate factors of safety for site variability (1.0), test method (0.4 for grain size analysis), and degree of influent control to prevent siltation and bio-buildup (0.9) have been applied to this value in accordance with the 2019 SWMMWW. Our calculations are included in Appendix C.

We recommend that confirmation in-situ infiltration testing be completed at the time of construction to verify the design infiltration rates. Because the alluvium deposit is considered non-glacially consolidated, the EPA Falling test method should be appropriate.

Construction Considerations

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. Verification infiltration testing should also be performed at the time of construction to verify the recommended infiltration rates for infiltration facilities such as infiltration trenches and permeable pavements per the 2019 SWMMWW.

Appropriate design, construction and maintenance measures will be required to ensure the infiltration rate can be effectively maintained over time. Appropriate temporary erosion and sediment control methods should be included in the project plans and specifications to minimize the potential for fines contamination of infiltration facility utilized at the site. To further reduce the potential for fines migration, 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.

Additional measures may also be taken during construction to minimize the potential of fines contamination of the proposed infiltration system, such as utilizing an alternative storm water management location during construction or leaving the bottom of the permanent systems 1 to 2 feet high, and subsequently excavating to the finished grade once the site soils have been stabilized. All contractors working on the site (builders and subcontractors) should divert sediment laden stormwater away from proposed infiltration facilities during construction and landscaping activities. No concrete trucks should be washed or cleaned, and washout areas should not be within the vicinity of the proposed infiltration facilities. After construction activities have been completed, periodic sweeping of the paved areas will help extend the life of the infiltration system.

LIMITATIONS

We have prepared this report for use by Advanced Underground Utilities Inc. and E.J. Fernandez for use in the permitting and 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 subsurface explorations and 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.

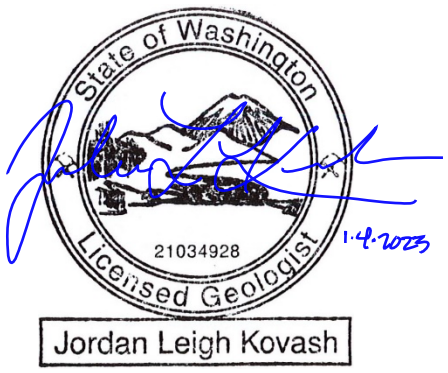
If there are any changes in the loads, grades, locations, configurations or type of facilities to be constructed, the conclusions and recommendations presented in this report may not be fully applicable. If such changes are made, we should be given the opportunity to review our recommendations and provide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

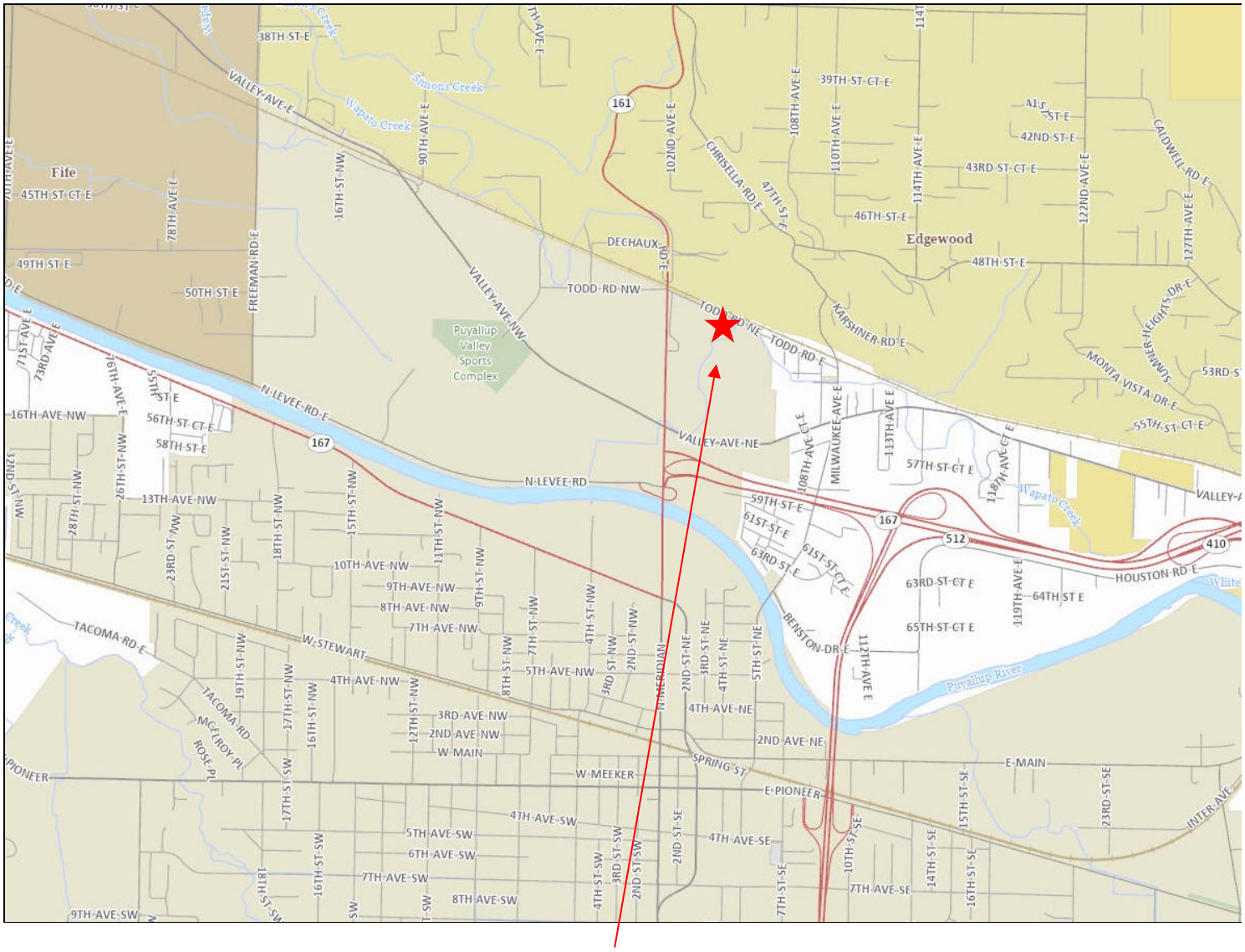
Karsten L. Rempel
Staff Geologist



Jordan L. Kovash, LG
Project Geologist

Eric W. Heller, PE, LG
Senior Geotechnical Engineer

JLK:EWH:KLR/klr
Doc ID: AdvanceUndergroundUtilities.ToddRdNE.SR
Attachments: Figure 1: Site Location Map
Figure 2: Site & Exploration Map
Figure 3: NRCS Soils Map
Figure 4: Geologic Map
Appendix A – Subsurface Explorations
Appendix B – Laboratory Test Results
Appendix C – Massman Calculations



Approximate Site Location

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

Not to Scale

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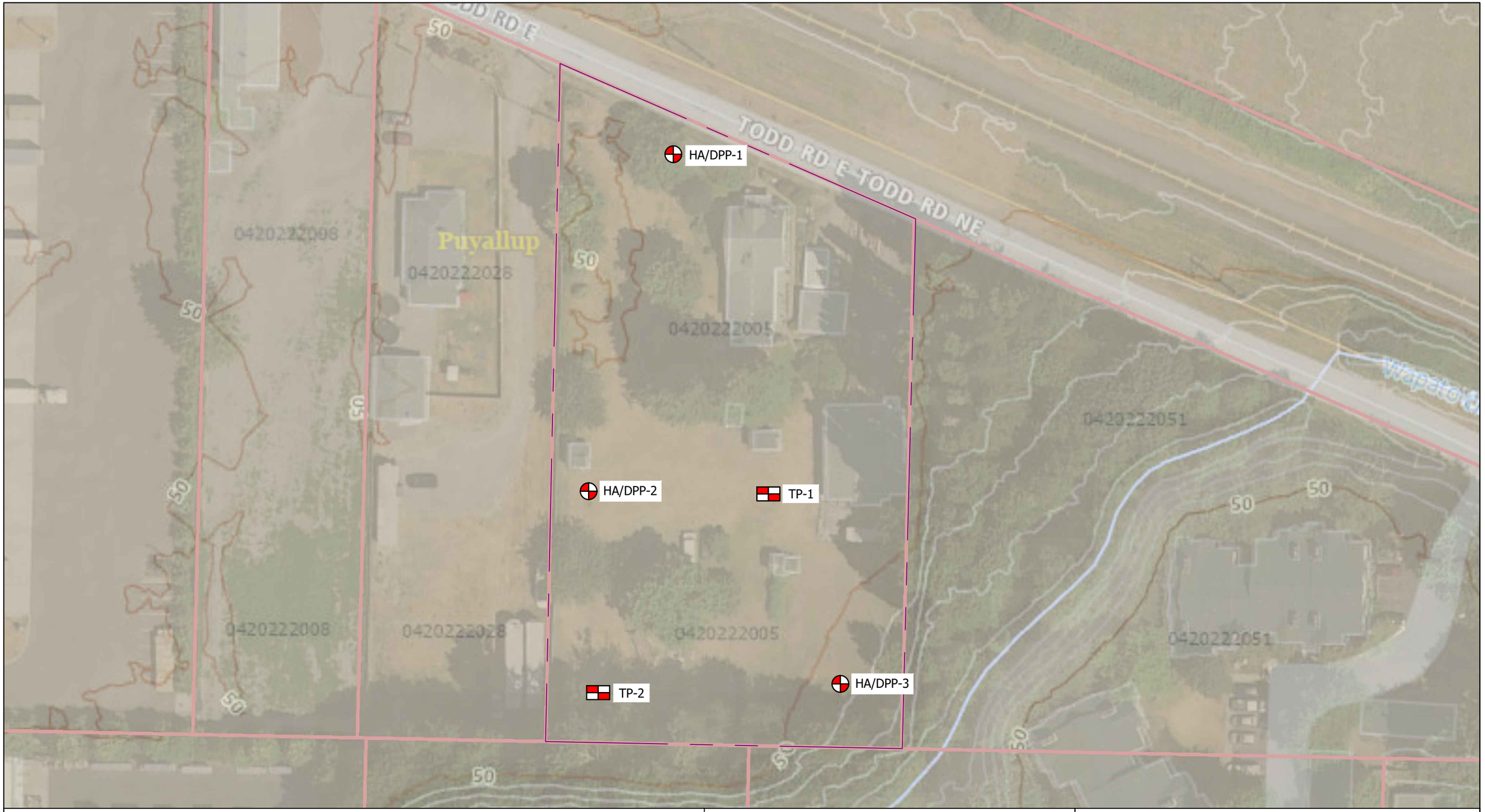
Site Location Map

Proposed Contractor's Yard
320 Todd Road NE
Puyallup, Washington
PN: 0420222005

Doc ID: AdvanceUndergroundUtilities.ToddRdNW	Jan. 2023	Figure 1



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

0 50 100
Scale:1" = 50'

HA/DPP Hand auger/Drive Point Piezometer number and approximate location

TP Test pit number and approximate location

This is not a survey.

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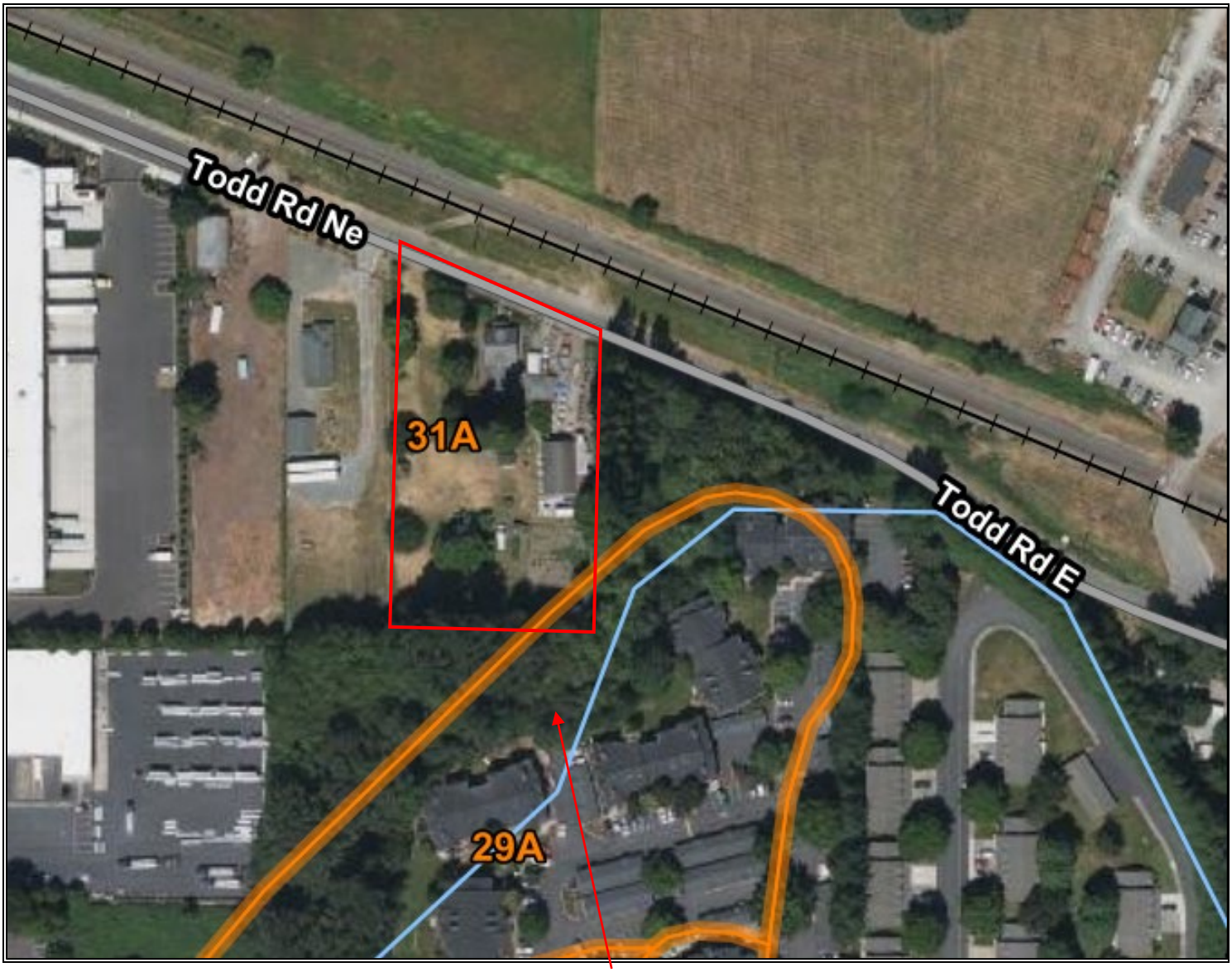
Site & Exploration Map

Proposed Contractor's Yard
320 Todd Road Northeast
Puyallup, Washington
PN: 0420222005

DocID: AdvanceUndergroundUtilities.ToddRdNW	Jan 2023	Figure 2



Approximate Site Location

Figure 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
29A	Pilchuck fine sand	Alluvium	0 - 3	Slight	A
31A	Puyallup fine sandy loam				

Not to Scale

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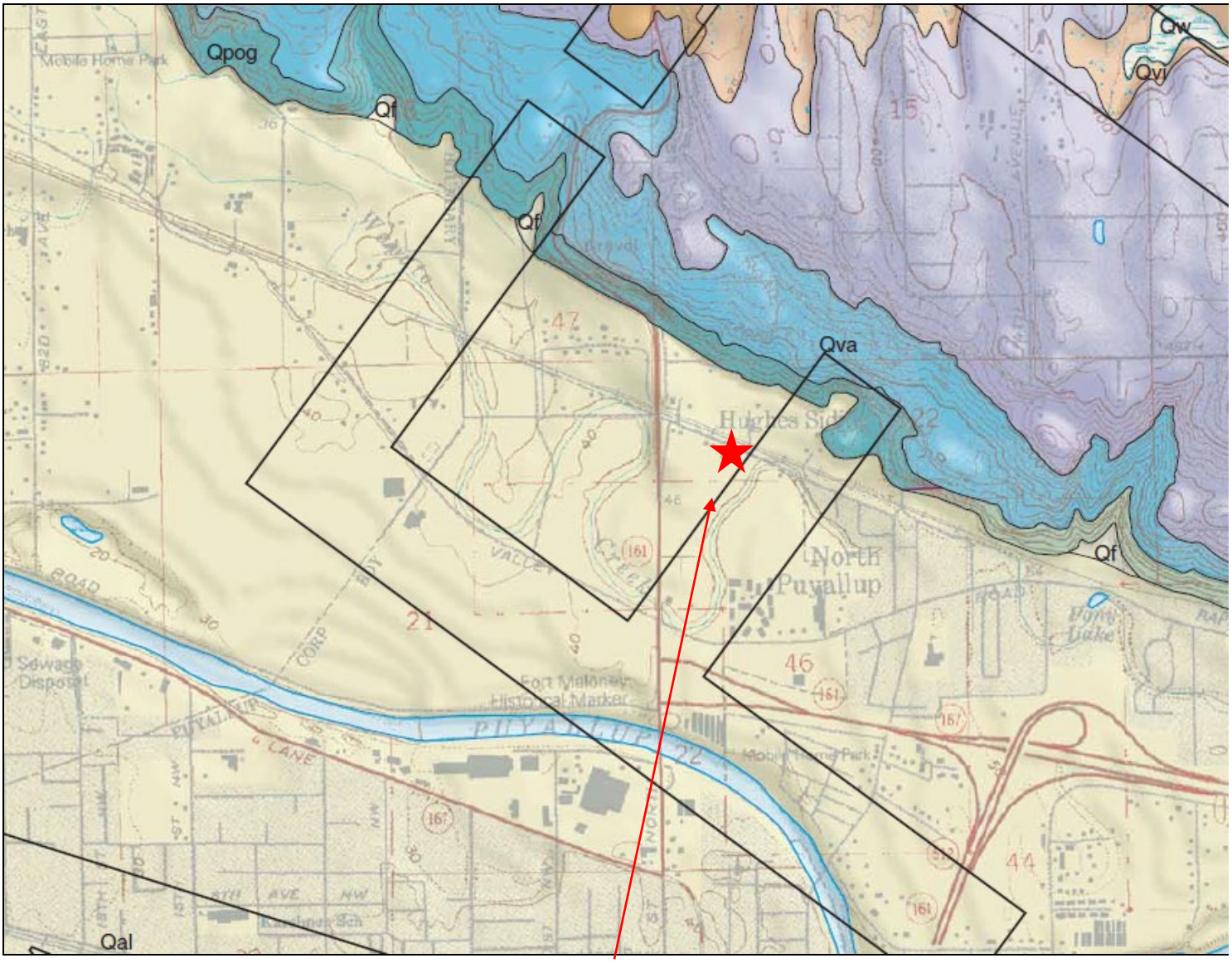
NRCS Soils Map

Proposed Contractor's Yard
320 Todd Road NE
Puyallup, Washington
PN: 0420222005



Approximate Site Location

An excerpt from the draft *Geologic Map of the Puyallup Quadrangle, Washington* by K.G. Troost (in review)

Symbol	Geologic Unit
Qal	Alluvium (Holocene)
Qpog	Pre-Fraser continental glacial drift

N W E S

Not to Scale

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Geologic Map

Proposed Contractor's Yard
320 Todd Road NE
Puyallup, Washington
PN: 0420222005

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 D6913.
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 Contractor's Yard
320 Todd Road NE
Puyallup, Washington
PN: 0420222005

Test Pit TP-1

Location: Eastern central portion of parcel
Approximate Elevation: 50’

Depth (ft)			Soil Type	Soil Description
0	-	0.5	-	Topsoil
0.5	-	2.0	ML	Brown, orange iron oxide-stained fine sandy SILT (medium stiff, moist) (alluvium)
2.0	-	4.0	SP-SM	Light gray, orange iron oxide-stained SAND with silt (loose, moist) (alluvium)
4.0	-	5.5	ML	Brown, orange iron oxide-stained SILT (medium stiff, moist) (alluvium)
5.5	-	7.5	SP-SM	Gray, orange iron oxide-stained SAND with silt (loose, moist) (alluvium)
7.5	-	10.0	SM	Gray, orange iron oxide-stained silty SAND, silt lenses (loose, moist) (alluvium)

Terminated at 10.0 feet below the existing ground surface.
Orange Iron oxide staining (mottling) observed throughout excavation.
No caving observed at the time of excavation.
No groundwater seepage observed.

Test Pit TP-2

Location: SW portion of parcel
Approximate Elevation: 50’

Depth (ft)			Soil Type	Soil Description
0	-	1.0	-	Topsoil
1.0	-	6.0	ML	Light gray, orange iron oxide-stained fine sandy SILT (medium stiff, moist)
6.0	-	8.0	SM	Gray, orange iron oxide-stained silty fine SAND (loose, moist)
8.0	-	9.5	ML	Gray, orange iron oxide-stained sandy SILT (medium stiff, moist)
9.5	-	10.5	SP-SM	Gray, orange iron oxide-stained SAND with silt (loose, moist)

Terminated at 10.5 feet below the existing ground surface.
Orange Iron oxide staining (mottling) observed throughout excavation.
No caving observed at the time of excavation.
No groundwater seepage observed.

Logged by: AES **Excavated on: December 13, 2022**

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Test Pit Logs

Proposed Contractor’s Yard
320 Todd Road NE
Puyallup, Washington
PN: 0420222005

Drive Point Piezometer DPP-1

Location: Northern portion of parcel
Approximate Elevation: 50'

Depth (ft)			Soil Type	Soil Description
0	-	1.0	-	Topsoil
1.0	-	6.0	ML	Brown to gray, orange iron oxide-stained fine sandy SILT (medium stiff, moist) (alluvium)
6.0	-	7.0	SP-SM	Gray, orange iron oxide-stained SAND with silt (loose, moist) (alluvium)

Hand auger terminated at 7.0 feet below the existing ground surface.
Orange Iron oxide staining (mottling) observed throughout excavation.
No caving observed at the time of excavation.
No groundwater seepage observed.
Drive point piezometer installed to 10.0 feet below existing grades.

Drive Point Piezometer DPP-2

Location: West portion of parcel
Approximate Elevation: 50'

Depth (ft)			Soil Type	Soil Description
0	-	1.0	-	Topsoil

Hand auger terminated at 1.0 feet below the existing ground surface.
Drive point piezometer installed to 10.0 feet below existing grades.

Drive Point Piezometer DPP-3

Location: SE portion of parcel
Approximate Elevation: 50'

Depth (ft)			Soil Type	Soil Description
0	-	1.0	-	Topsoil

Hand auger terminated at 1.0 feet below the existing ground surface.
Drive point piezometer installed to 10.0 feet below existing grades.

Logged by: AES **Excavated on: December 13, 2022**

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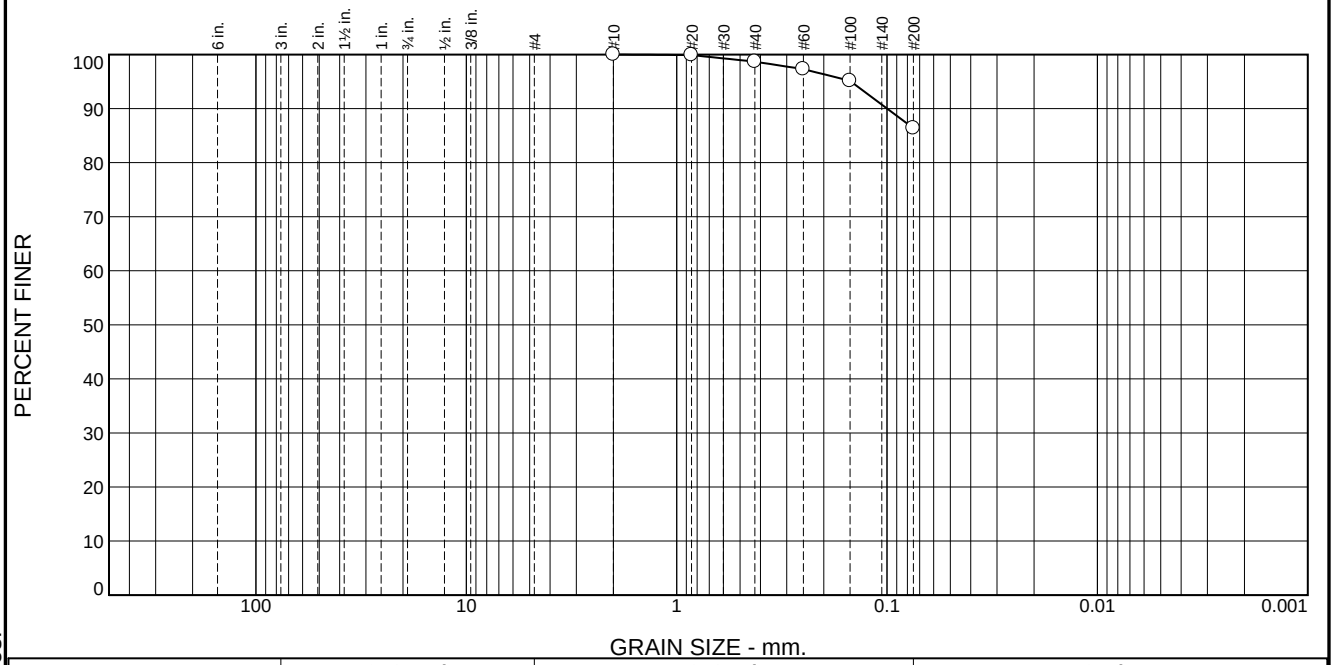
Drive Point Piezometer Logs

Proposed Contractor's Yard
320 Todd Road NE
Puyallup, Washington
PN: 0420222005

Appendix B

Laboratory Test Results

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	1.3	12.3	86.4	

Test Results (ASTM D 6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#10	100.0		
#20	99.9		
#40	98.7		
#60	97.3		
#100	95.1		
#200	86.4		

* (no specification provided)

Material Description

Sandy SILT (ML)

Atterberg Limits (ASTM D 4318)

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

Classification

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

Coefficients

D_{90}= 0.0999 D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Natural Moisture: 38.2%

Date Received: 12/13/22 **Date Tested:** 12/22/22

Tested By: MAW

Checked By: JLK

Title: PM

Location: TP-1, S-2 **Date Sampled:** 12/13/22
Sample Number: 103680 **Depth:** 4.5-5.5'

GeoResources, LLC

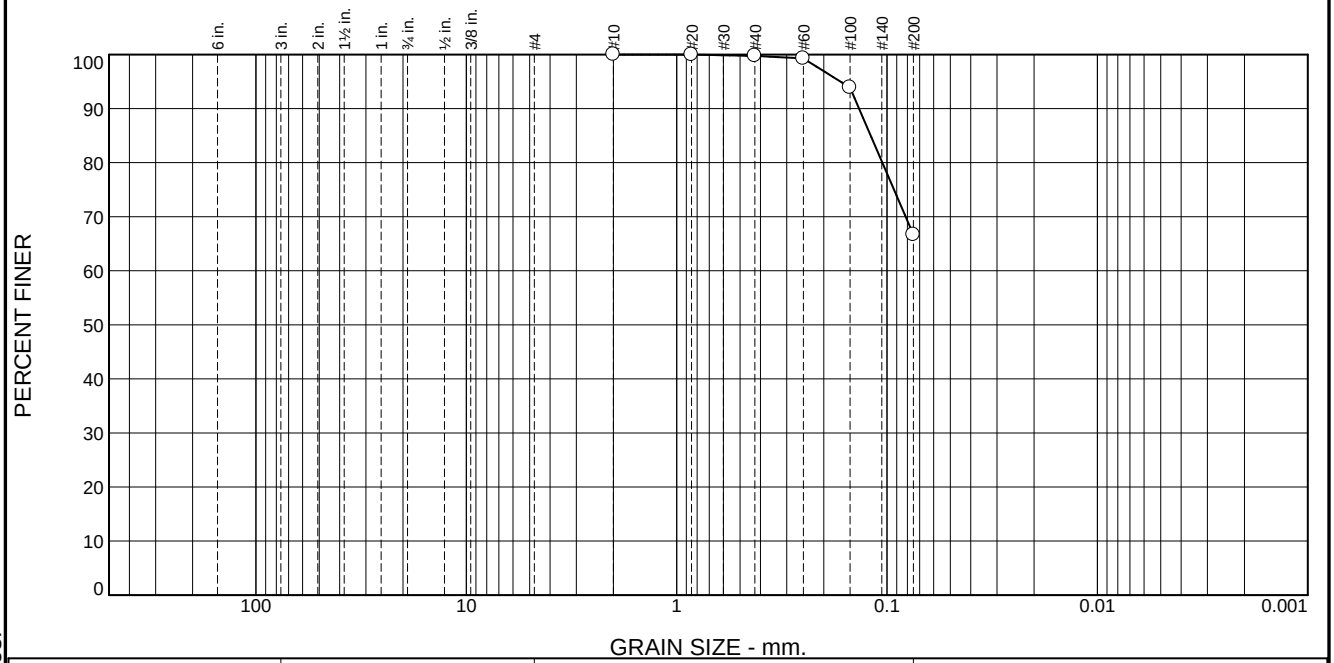
Fife, WA

Client: Advanced Underground Utilities Inc.
Project: Proposed Contractor's Yard

Project No: AdvancedUndergroundUtilities.ToddRdNE **Figure** B-1

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

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.3	33.0	66.7	

Test Results (ASTM D 6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#10	100.0		
#20	100.0		
#40	99.7		
#60	99.3		
#100	93.9		
#200	66.7		

* (no specification provided)

Material Description

Sandy SILT (ML)

Atterberg Limits (ASTM D 4318)

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

Classification

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

Coefficients

D_{90}= 0.1358 D_{85}= 0.1196 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Natural Moisture: 23.3%

Date Received: 12/13/22 **Date Tested:** 12/22/22

Tested By: MAW

Checked By: JLK

Title: PM

Location: TP-2, S-1
Sample Number: 103681 **Depth:** 2'

Date Sampled: 12/13/22

GeoResources, LLC

Fife, WA

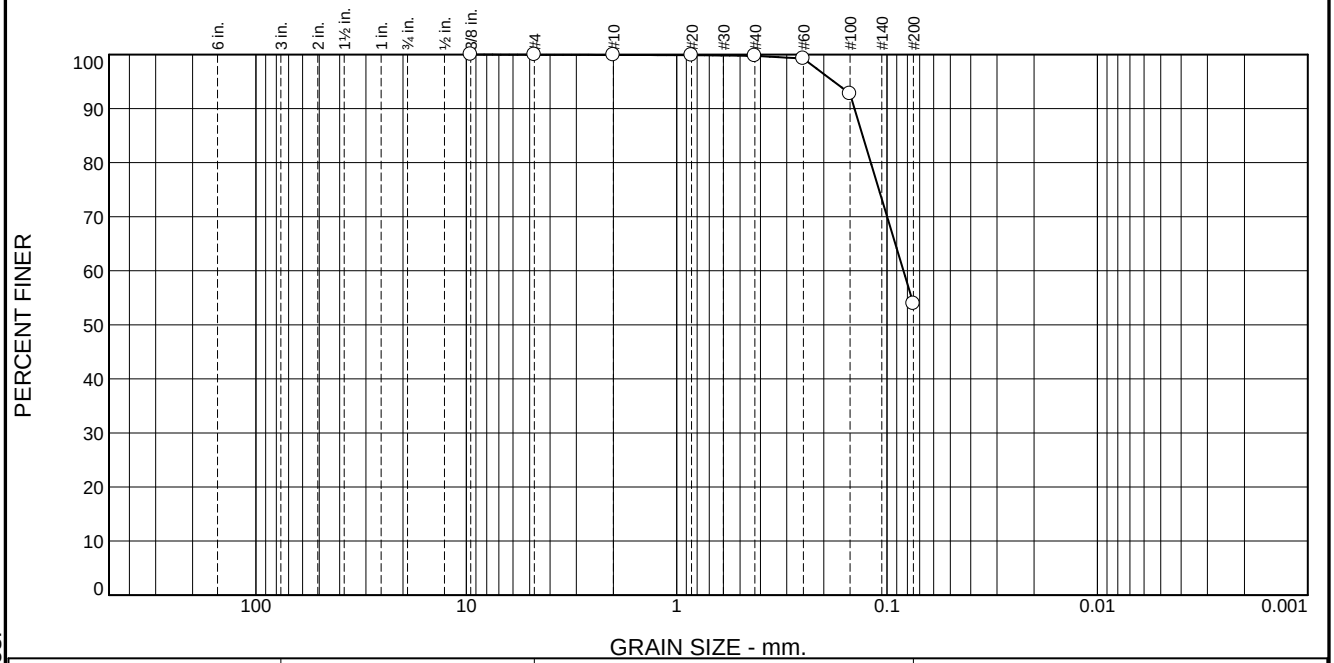
Client: Advanced Underground Utilities Inc.
Project: Proposed Contractor's Yard

Project No: AdvancedUndergroundUtilities.ToddRdNE **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:** _____

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	0.1	45.9	53.9	

Test Results (ASTM D 6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.375	100.0		
#4	100.0		
#10	99.9		
#20	99.9		
#40	99.8		
#60	99.2		
#100	92.7		
#200	53.9		

* (no specification provided)

Material Description

Sandy SILT (ML)

Atterberg Limits (ASTM D 4318)

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

Classification

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

Coefficients

D_{90}= 0.1428 D_{85}= 0.1306 D_{60}= 0.0836
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Natural Moisture: 20.7%

Date Received: 12/13/22 **Date Tested:** 12/22/22

Tested By: MAW

Checked By: JLK

Title: PM

Location: HA-1, S-1 **Date Sampled:** 12/13/22
Sample Number: 103682 **Depth:** 1-2'

GeoResources, LLC

Fife, WA

Client: Advanced Underground Utilities Inc.
Project: Proposed Contractor's Yard

Project No: AdvancedUndergroundUtilities.ToddRdNF **Figure** B-3

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

Appendix C

Massman Calculations

City of Puyallup - 2019 SWMMWW

AdvancedUndergroundUtilites.ToddRdNE

Puyallup, Washington

Soil Grain Size Analysis Method

Procudure based on 2014 SWMMWW, Volume III

$K_{sat} = 10^{(-1.57 + 1.90D_{10} + 0.015D_{60} - 0.013D_{90} - 2.08F_{fines})}$ (provides Ksat in cm/s)

$K_{sat} = [10^{(-1.57 + 1.90D_{10} + 0.015D_{60} - 0.013D_{90} - 2.08F_{fines})}]*1417$ (provides Ksat in in/hr)

Sample Information				Sieve Data				Unfactored Rate	
I.D.	Test Pit	Depth (ft)	Layer Thickness (ft)	D_{10}	D_{60}	D_{90}	F_{fines}	Individual K_{sat} (cm/s)	Equivalent K_{sat} (in/hr)
103680	TP-1	4.5'-8'	3.5'	0	0.01	0.0999	0.864	0.000	0.607
103681	TP-2	2'	6'	0.020	0.0600	0.3158	0.667	0.001	1.694
103682	HA-1	1'-2'	6'	0.039	0.08	0.1428	0.539	0.002	3.418

Effective Average Hydraulic Conductivity, K_{equiv}

Based on either:

1) Average K_{sat} determined using harmonic mean
2) Lowest conductive layer, if within 5ft of bottom of pond

k_{equiv}=	1.906	Average
	0.607	Lowest
	0.607	To Use

Site Variability & number of location tested (CF_v)

	0.33 to 1.0

Factor to use for calculations: 1

Test Method (CF_t)

	0.4 to 0.75
Large-scale PIT	0.75
Small-scale PIT	0.5
Other small-scale (e.g. Double ring, falling head)	0.4
Grain Size Method	0.4

Factor to use for calculations: 0.4

Degree of influent control to prevent siltation and bio-buildup (CF_m)

	0.90

Factor to use for calculations: 0.9

$I_{design} = I_{measured} * F_{testing} * F_{geometry} * F_{plugging}$ **0.22** in/hr

Preliminary Design Value **0.20** in/hr

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Infiltration Analysis - Outwash

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