Infiltration Feasibility Assessment

Proposed Twin Lakes Landing 2 Development

Prepared For:

Housing Hope
5830 Evergreen Way
Everett, WA 98203
Attn: Mr. Todd Bullock - NCARB

GEOTEST
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June 8th, 2020
Project No. 19-0543

Housing Hope
5830 Evergreen Way
Everett, WA 98203

Attention: Mr. Todd Bullock – NCARB

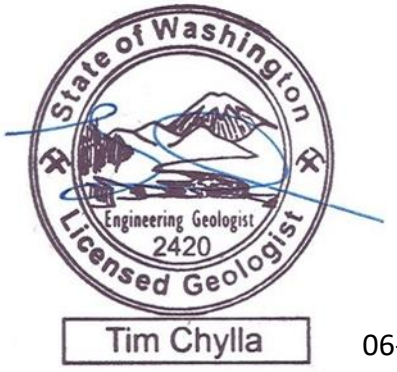
Regarding: Infiltration Feasibility Assessment
Twin Lakes Landing 2 Development
Parcel #: 31052900300100
Property at West End of 164th Street NE
Marysville, WA 98270

Dear Mr. Bullock,

As requested, GeoTest Services, Inc. [GeoTest] is pleased to submit the following infiltration feasibility assessment summarizing the results of our Pilot Infiltration Testing for the Twin Lakes Landing 2 Development project, located at the above referenced address in Marysville, WA (see *Vicinity Map*, Figure 1). This report has been prepared in general accordance with the terms and conditions established in our services agreement dated November 22nd, 2019 and authorized by Mr. Bullock.

We appreciate the opportunity to provide geotechnical services on this project and look forward to assisting you during the construction phase. Should you have any further questions regarding the information contained within the report, or if we may be of service in other regards, please contact the undersigned.

Respectfully,
GeoTest Services, Inc.



06-08-2020

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Senior Engineering Geologist

Enclosure: Infiltration Feasibility Assessment

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PURPOSE AND SCOPE OF SERVICES

The purpose of this evaluation is to provide additional design recommendations that can be incorporated into project development. GeoTest originally presented geotechnical recommendations for this property in a report titled *Twin Lakes Landing 2, Geotechnical Engineering Report*, dated October 10th, 2019. The recommendations presented in the referenced report were for preliminary project planning.

The purpose of our services is to perform an infiltration feasibility assessment for the proposed Twin Lakes Landing 2 development. This was accomplished by conducting 2 Pilot Infiltration Tests (PIT) and monitoring groundwater elevations throughout the wet season by installation of 5 piezometers and recording elevations twice per month from January through April.

PROJECT DESCRIPTION

GeoTest previously prepared a *Geotechnical Engineering Report* for the proposed Twin Lakes Landing 2 project, dated October 10th, 2019. Our report presented initial subsurface soil information regarding the project site but excluded PIT and seasonal groundwater monitoring as part of our contracted services. Now that a Civil plan is in development and facility locations can be anticipated, GeoTest was able to perform PIT to confirm infiltration concepts at the locations of the proposed facilities. GeoTest also installed a representative number of shallow wells or piezometers allowed for the seasonal monitoring of groundwater.

The project site consists of an undeveloped property just north of Gissberg Twin Lakes in Marysville, WA. The property does not currently support any structures, pavements, or other indications of development. The lot is relatively flat and has been previously cleared of native trees and vegetation.

We understand that the proposed improvements will consist of constructing new multi-family residential buildings on the property. New construction will include two-story, wood framed structures with conventional concrete foundations. Final grade modifications are anticipated to remain relatively consistent with existing grades.

GeoTest anticipates that new paved access drives and parking areas will be constructed to the north of the planned buildings. The construction of access roads will result in impervious surfaces that require treatment before being discharged into the stormwater system. We understand that on-site infiltration is likely to include both pervious concrete pavements and raingardens/filter strips to address the infiltration of stormwater on this site.

SITE CONDITIONS

This section includes a description of the general surface and subsurface conditions observed at the project site during the time of our field investigation. Interpretations of site conditions are based on the results and review of available information, site reconnaissance, subsurface explorations, laboratory testing, and previous experience in the project vicinity.

Surface Conditions

The subject property is approximately 3.73 acres on the north side of Twin Lakes Park. Lots to the east and northwest have been developed with multifamily and single-family residences. An undeveloped field lies directly west, and two forested lots lie to the north. Per the Snohomish County Online Parcel Information (SCOPI) service, the parcel number is 31052900300100 and the property does not have a listed street address.

Several feet of fill material (presumably dredged from Twin Lakes) lie on top of the natural ground surface in the eastern half of the property; the lot is otherwise relatively flat. Ground cover consisted mostly of native grasses, weeds, and sparse trees with swaths of mature forest in the center and northern portions of the lot.

Subsurface Soil Conditions

Subsurface soil conditions have been explored by advancing several exploration test pits and borings, as documented in our previous reporting. GeoTest conducted 2 PIT's (PIT- 1 and PIT-2) on March 30th and 31st, 2020 at the direction of the project team. PIT's were performed within the footprint of planned infiltration facilities. The locations of our PIT tests are shown on the *Site and Exploration Plan,* Figure 2.

The subsurface soils encountered during our infiltration testing were in general accordance with previous explorations on the site. In the eastern half of the site, GeoTest observed an approximately 6 to 12-inch thick topsoil horizon underlain by a relict fill horizon that was observed to extend up to 4.5 feet below existing site grades. Underlying the relict fill was native silty sand, grading toward a slightly silty sand with trace gravel, with occasional thin silt/clay interbeds at depth (identified as glacial outwash, commonly referred to as "Marysville Sand"). GeoTest did not observe any dredged fill in explorations west of TP-7 and PIT-2. The native material was interpreted to be representative of Marysville Sand to the full depths explored. See the attached Site and Exploration Map (Figure 2) for the approximate locations of the subsurface explorations.

Image 1. Pilot Infiltration Test 1 excavations exposing 3.5' of dredged fill and relict topsoil overlying slightly gravelly, Marysville Sands with rapid seepage occurring at 6.8' below ground surface (BGS).

General Geologic Conditions

Geologic mapping of the project area was obtained from the Geologic Map of the *Arlington West 7.5-minute Quadrangle* (Minard, JP, 1985) published by the United States Geological Survey. The soils are mapped as recessional outwash commonly known as "Marysville Sand," (unit Qvrm) consisting of sand with occasional fine gravel and areas of silt and clay. The sediments were deposited by meltwater flowing south from the stagnating and receding Vashon glacier. This description closely matches the native soils encountered in our explorations.

These soils are described by the referenced map as silt, sand, sandy pebble gravel, (cobble) gravel, and gravelly sand that occasionally contains organic sediments, peat, wood debris, and detrital wood.

Although the encountered subsurface conditions generally appeared to align with the mapped geologic units, it should be noted that the published soil / geologic material type is representative of regional conditions and some variation between on-site soils and mapped geologic units should be anticipated.

Groundwater

At the time of our subsurface investigation in March 2020, rapid groundwater seepage was observed to be generally between 3 and 6.8 feet BGS in the PIT locations. The groundwater

conditions reported on the subsurface logs are for the specific locations and dates indicated, and therefore may not necessarily be indicative of other locations and/or times.

TABLE 1
Groundwater Elevations in Monitoring Wells MW-1 through MW-3

Measurement Date	Shallow Monitoring Well #1		Shallow Monitoring Well #2		Shallow Monitoring Well #3	
	Depth to Groundwater from TOC (ft)	Groundwater Elevation (ft)	Depth to Groundwater from TOC (ft)	Groundwater Elevation (ft)	Depth to Groundwater from TOC (ft)	Groundwater Elevation (ft)
1/17/2020	2.39	111.46	2.78	111.84	4.11	111.21
2/3/2020	2.45	111.4	2.82	111.8	4.01	111.31
2/17/2020	2.38	111.47	2.76	111.86	4.02	111.3
3/2/2020	2.75	111.1	3.07	111.55	4.3	111.02
3/16/2020	3.07	110.78	3.4	111.22	4.31	111.01
3/31/2020	3.18	110.67	3.08	111.54	4.26	111.06
4/17/2020	3.58	110.24	3.87	110.75	4.61	110.71
4/27/2020	3.45	110.40	3.56	111.06	4.46	110.86
Top of Casing Elevation in ft (TOC)	113.85		114.62		115.32	
Ground Elevation (ft)	112.95		113.10		113.60	

TABLE 2
Groundwater Elevations in Monitoring Wells MW-4, MW-5A, and MW-5B

Measurement Date	Shallow Monitoring Well #4		Shallow Monitoring Well #5A		Shallow Monitoring Well #5B	
	Depth to Groundwater from TOC (ft)	Groundwater Elevation (ft)	Depth to Groundwater from TOC (ft)	Groundwater Elevation (ft)	Depth to Groundwater from TOC (ft)	Groundwater Elevation (ft)
1/17/2020	6.7	110.95	3.18	113.96	-	-
2/3/2020	6.66	110.99	2.39	114.75	-	-
2/17/2020	6.66	110.99	2.22	114.92	4.19	112.34
3/2/2020	6.9	110.75	3.85	113.29	4.56	111.97
3/16/2020	6.91	110.74	4.68	112.46	4.58	111.95
3/31/2020	6.95	110.70	4.66	112.48	4.60	111.93
4/17/2020	7.15	110.50	4.82	112.32	4.92	111.61
4/27/2020	7.05	110.60	Dry	Dry	4.77	111.76
Top of Casing Elevation in ft (TOC)	117.65		117.14		116.53	
Ground Elevation (ft)	116.15		115.95		115.20	

Based on our observations and groundwater elevations observed during multiple site visits, GeoTest estimates that the seasonal groundwater high for this site is at or approaching an elevation of 111.84'. The elevated readings in MW-5A and MW-5B are far out of sync with the other wells, likely due to them not being correctly installed. It is our opinion that these readings should be disregarded.

Groundwater levels are not static, and vary due to surface runoff, precipitation, season, changes in site utilization (both on- and off-site), and other factors. In general, groundwater levels are higher during the wetter winter and spring months.

IN SITU INFILTRATION TEST RESULTS

We conducted Pilot Infiltration Testing at locations PIT-1 and PIT-2 to determine in-situ long term design infiltration rates. PIT testing was conducted using a method in general accordance with the procedure described for in the 2019 SMMWW. Infiltration testing was conducted by discharging water into a flat-bottomed pit of known dimensions. The intent of the PIT's was to allow enough flow into the excavated area to allow the soils in the immediate vicinity of the excavation to become saturated. During introduction of water into the excavation, a water meter was used to monitor and adjust flow rates. Water was brought onto the site using 2½ inch fire hose attached to a City of Marysville hydrant located on an adjacent property to the east. Testing took approximately seven hours, six hours of which consisted of pre-soak and flow stabilization followed by one hour of data collection.

Image 2. Pilot Infiltration Test 1 set up at 2.75' BGS in the southeastern quadrant of the site within the relict topsoil unit.

PIT's at locations PIT-1 and PIT-2 yielded expected infiltration rates due to variable silt contents within the fill soils in the upper 4.5 feet of the site, as well as the presence of thin silt/clay interbeds at depth within the native Marysville Sand. These tests were conducted as falling head tests through native soil and into saturated native soil at depth.

CONCLUSIONS AND RECOMMENDATIONS

Based on the evaluation of the data collected during this investigation, it is our opinion that the subsurface conditions found at the site are suitable for the proposed development, provided the recommendations contained herein are incorporated into the project design. Our subsurface explorations suggest similar subsurface soil conditions as those exposed during our initial investigations in August of 2019. Discussions with the design team suggest that pervious pavement may be a possible strategy for stormwater infiltration. If this stormwater infiltration concept is determined as the best management practice (BMP) for the site, GeoTest recommends these systems be implemented below on-site confining soils where dredged fill overlies a relict topsoil with low permeability. All stormwater from impervious and pervious surfaces should be routed into native Marysville Sand medias via infiltration and slot trenching. Infiltration trenches should consist of a filtering media such as amended soils or on-site topsoil. Due to some expected site variability, slot trenching within infiltration trenches may be needed where design infiltration elevations expose soils such as dredged fill or impermeable relict topsoil.

Stormwater Infiltration Potential

Design Infiltration Rates

Short term infiltration rates in PIT's 1 and 2 were between 0.13 and 1.30 inches per hour, respectively. Using reduction factors in accordance with the 2019 SMMWW, we recommend that a long-term design infiltration rate of 0.05 inches per hour be incorporated into the design of infiltration systems founded either in the upper portion of existing, dredged fill or in systems that have thin silt interbeds below the base of the infiltration facility, while a rate of 0.47 inches per hour can be used in the native Marysville Sand. **Please note that fill soils will be needed to bring up site grades on the western portion of the property. These soils will need to be tested to determine the infiltration rate of the import material.**

Short term infiltration rates in PIT's 1 and 2 were based on falling head infiltration testing with up to 1.44 feet of hydraulic head. Hydraulic head forces water to infiltrate into the native soil by "pushing" water through the annular space between the poorly graded native sand at depth. The use of the infiltration rates presented below assumes that an excavated trench or deepened facility exists that extends through any silt/clay interbeds identified below the facility. GeoTest anticipates that the trench will be lined with a geotextile separation fabric (such as Mirafi 140N or equivalent) and filled with either a preapproved drainage material such as ASTM C33 mound sand or a poorly graded drainage aggregate such as pea gravel. Use of these infiltration rates also

assumes that the stormwater is pre-treated to remove pollutants or is from a point of discharge that does not require pre-treatment. In all cases, provisions in the municipal code for the infiltration of stormwater must be incorporated into the final design.

TABLE 3
Calculated Infiltration Rates Using Hydraulic Head from PIT Testing

Test Pit ID	Infiltration Depth (ft)	Geologic Unit	Uncorrected K_{sat} Infiltration Rate [in/hr]	Corrected K_{sat} Infiltration Rate [in/hr]
PIT-1	2.75	**Relict Topsoil**	**0.13**	**0.05**
PIT-2	1.25	**Weathered Marysville Sand**	**1.30**	**0.47**

Notes:
-Ksat = Initial Saturated Hydraulic Conductivity.
-Correction Factors Used: CFv = 0.80, CFt = 0.50, CFm = 0.9, Total Correction Factor = 0.36.
-Prescribed rates do not require further reductions to account for mounding.

Sizing of an infiltration facility utilizing a trench that hydraulically connects the facility to the groundwater table may use the infiltration rates above within the footprint of the trench itself, but should not use the same infiltration rate for those portions of the facility that extend beyond the footprint of the trench. GeoTest recommends that an infiltration rate of 0.05 inches per hour (the rate obtained in PIT 1) be used for those portions of the facility that extend outside the footprint of the trench.

It is recommended that GeoTest be allowed to view the excavation of any planned infiltration facilities during construction to determine if the subsurface soils within individual facilities are consistent with conditions encountered at our test locations.

Infiltration areas should be protected from construction traffic and compaction activities. Densification of the native soils due to construction activities has the potential to significantly reduce the infiltration capacity of the native soils. We recommend the client and/or contractor consider protecting infiltration area soils from unintended densification by surrounding these areas with temporary construction fencing or similar temporary obstructions.

Stormwater Treatment

The stormwater facilities on-site may require some form of pollutant pretreatment with an amended soil prior to on-site infiltration or offsite discharge. The reuse of on-site topsoil is often the most sustainable and cost-effective method for pollutant treatment purposes. Cation exchange capacities, organic contents, and pH of site subsurface soils were also tested to determine possible pollutant treatment suitability.

Cation exchange capacity, organic content, and pH tests were performed by Northwest Agricultural Consultants on two soil samples collected from the explorations are shown in Table 4 below.

TABLE 4
Cation Exchange Capacity, Organic Content, and pH Laboratory Test Results

Test Pit ID	Sample Depth (ft)	Geologic Unit	Cation Exchange Capacity (meq/100 grams)	Organic Content (%)	pH
PIT-1	3.0	**Relict Topsoil**	**6.1**	**1.56**	**5.6**
PIT-2	1.25	**Topsoil**	**13.3**	**3.55**	**5.2**
PIT-2	2.0	**Weathered Marysville Sand**	**4.7**	**1.07**	**5.7**

Suitability for on-site pollutant treatment is determined in accordance with SSC-6 of the 2019 *SMMWW*. Soils with an organic content of greater than or equal to 1 percent and a cation exchange capacity of greater than or equal to 5 meq/100 grams are characterized as suitable for stormwater treatment. Based on the results shown in Table 4, the near-surface topsoil and underlying native soil appear to be are suitable for stormwater treatment.

On-site soils can be amended (if required) by mixing higher silt content soils or adding mulch (or other admixtures) to elevate the cation exchange capacity and organic contents. On-site amended soil requires additional testing to confirm compliance with ecological regulations. GeoTest is available to perform additional laboratory testing as part of an expanded scope of services if the soil is to be amended. Alternatively, the owner may elect to import amended soils with the desired properties for planned treatment facilities.

Geotechnical Consultation and Construction Monitoring

GeoTest recommends that we be involved in the project design review process. The purpose of the review is to verify that the recommendations presented in this report are understood and incorporated in the design and specifications.

We also recommend that geotechnical construction monitoring services be provided. These services should include observation by GeoTest personnel during structural fill placement, compaction activities and subgrade preparation operations to confirm that design subgrade conditions are obtained beneath the areas of improvement.

Periodic field density testing should be performed to verify that the appropriate degree of compaction is obtained. The purpose of these services is to observe compliance with the design concepts, specifications, and recommendations of this report. In the event that subsurface conditions differ from those anticipated before the start of construction, GeoTest would be pleased to provide revised recommendations appropriate to the conditions revealed during construction.

GeoTest is available to provide a full range of materials testing and special inspection services during construction as required by the local building department and the International Building Code. This may include specific construction inspections on materials such as reinforced concrete, reinforced masonry, wood framing, and structural steel. These services are supported by our fully accredited materials testing laboratories.

USE OF THIS REPORT

GeoTest Services, Inc. has prepared this report for the exclusive use of Housing Hope and their design consultants for specific application to the design of the proposed Twin Lakes Landing Development 2, located off 164th Street NE in Marysville, WA. Use of this report by others is at the user's sole risk. This report is not applicable to other site locations. Our services are conducted in accordance with accepted practices of the geotechnical engineering profession; no other warranty, express or implied, is made as to the professional advice included in this report.

Our site explorations indicate subsurface conditions at the dates and locations indicated. It is not warranted that these conditions are representative of conditions at other locations and times. The analyses, conclusions, and recommendations contained in this report are based on site conditions to the limited depth and time of our explorations, a geological reconnaissance of the area, and a review of previously published USGS geological information for the site. If variations in subsurface conditions are encountered during construction that differs from those contained within this report, GeoTest should be allowed to review the recommendations and, if necessary, make revisions. If there is a substantial lapse of time between submission of this report and the start of construction, or if conditions change due to construction operations at or adjacent to the project site, we recommend that we review this report to determine the applicability of the conclusions and recommendations contained herein.

The earthwork contractor is responsible to perform all work in conformance with all applicable WISHA/OSHA regulations. GeoTest Services, Inc. is not responsible for job site safety on this project, and this responsibility is specifically disclaimed.

REFERENCES

Bakeman, S., Dan, G., Howie, D., Killelea, J., Labib, F., & Ed, O. (n.d.). 2012 Stormwater Management Manual for Western Washington, as Amended in December 2014 (The 2014 SWMMWW) (pp. 1-1042) (United States, Washington State Department of Ecology).

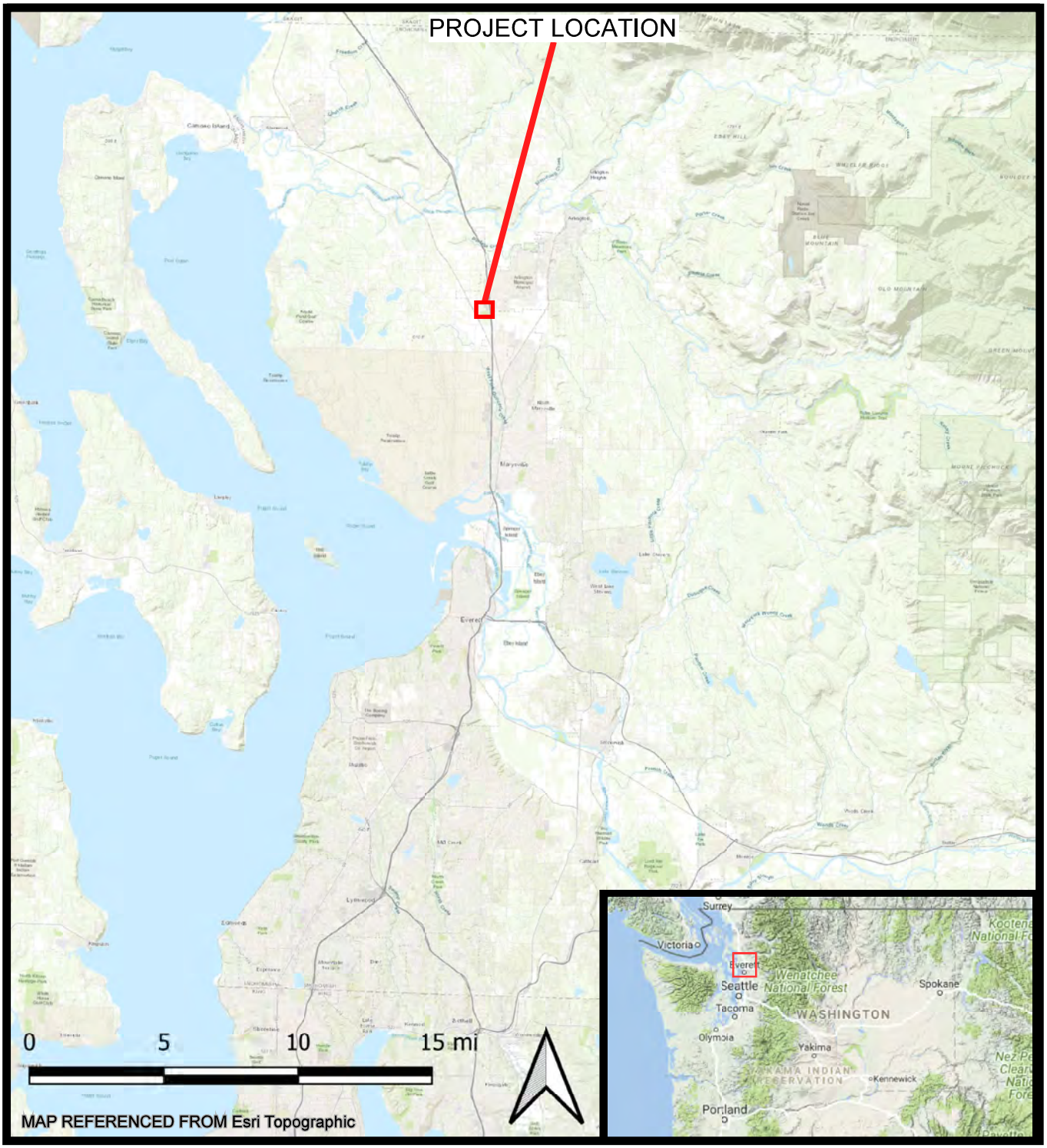
International Building Code (IBC), 2018, 2015. International Code Counsel.

Minard, J.P., 1985, Geologic map of the Snohomish quadrangle, Snohomish County, Washington. U.S. Geological Survey, Miscellaneous Field Studies Map MF-1745, scale 1:24,000.

Marysville Municipal Code, Critical Areas Regulations §§ 22A.020 (2019).

Snohomish County PDS Map Portal, Snohomish County (Washington). Accessed on April 1, 2020.

Washington Interactive Geologic Map. Washington State Department of Natural Resources - Online Web Services. Accessed on August 1, 2020.

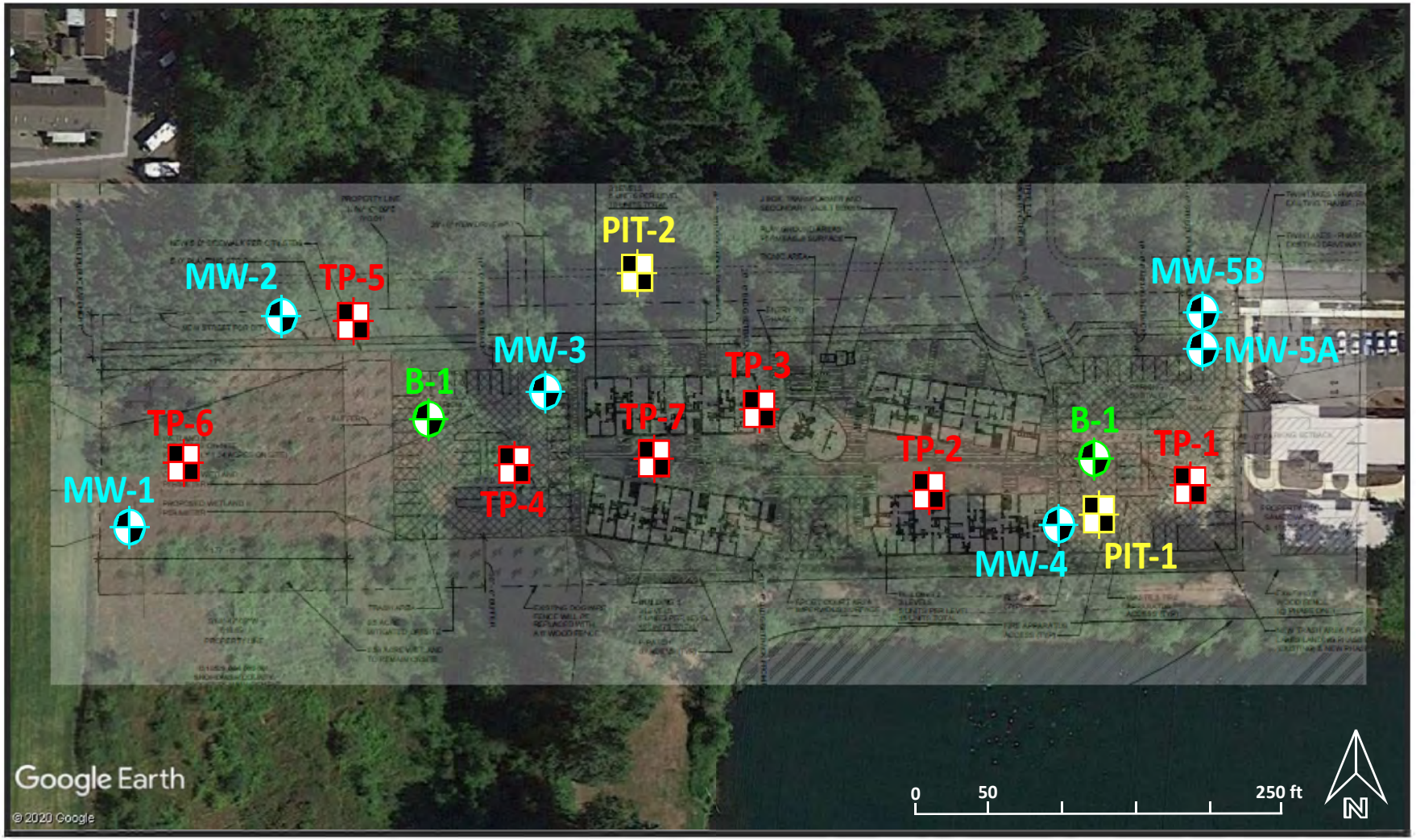


GEOTEST	Date: 4-7-2020	By: TAC	Scale: As Shown

VICINITY MAP
TWIN LAKES LANDING 2
164TH STREET NE
MARYSVILLE, WA 98270

Project
19-0543

Figure
1



LEGEND

- PIT = Approximate Pilot Infiltration Test Location
- MW = Approximate Monitoring Well Location
- TP = Approximate Test Pit Location
- B = Approximate Boring Location

Drawings provided by Dykeman Architecture

GEOTEST

Date: 4-7-2020	By: TAC	Scale: As shown	Project 19-0543

SITE AND EXPLORATION PLAN
TWIN LAKES LANDING 2
164TH STREET NE
MARYSVILLE WA 98270

Figure 2

Soil Classification System

MAJOR DIVISIONS			GRAPHIC SYMBOL	USCS LETTER SYMBOL	TYPICAL DESCRIPTIONS[1][2]
COARSE-GRAINED SOIL (More than 50% of material is larger than No. 200 sieve size)	GRAVEL AND GRAVELLY SOIL (More than 50% of coarse fraction retained on No. 4 sieve)	CLEAN GRAVEL (Little or no fines)		GW	Well-graded gravel; gravel/sand mixture(s); little or no fines
				GP	Poorly graded gravel; gravel/sand mixture(s); little or no fines
		GRAVEL WITH FINES (Appreciable amount of fines)		GM	Silty gravel; gravel/sand/silt mixture(s)
				GC	Clayey gravel; gravel/sand/clay mixture(s)
	SAND AND SANDY SOIL (More than 50% of coarse fraction passed through No. 4 sieve)	CLEAN SAND (Little or no fines)		SW	Well-graded sand; gravelly sand; little or no fines
				SP	Poorly graded sand; gravelly sand; little or no fines
		SAND WITH FINES (Appreciable amount of fines)		SM	Silty sand; sand/silt mixture(s)
				SC	Clayey sand; sand/clay mixture(s)
FINE-GRAINED SOIL (More than 50% of material is smaller than No. 200 sieve size)	SILT AND CLAY (Liquid limit less than 50)			ML	Inorganic silt and very fine sand; rock flour; silty or clayey fine sand or clayey silt with slight plasticity
				CL	Inorganic clay of low to medium plasticity; gravelly clay; sandy clay; silty clay; lean clay
				OL	Organic silt; organic, silty clay of low plasticity
	SILT AND CLAY (Liquid limit greater than 50)			MH	Inorganic silt; micaceous or diatomaceous fine sand
				CH	Inorganic clay of high plasticity; fat clay
				OH	Organic clay of medium to high plasticity; organic silt
	HIGHLY ORGANIC SOIL			PT	Peat; humus; swamp soil with high organic content

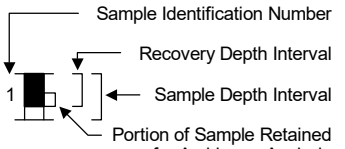
OTHER MATERIALS	GRAPHIC SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
PAVEMENT		AC or PC	Asphalt concrete pavement or Portland cement pavement
ROCK		RK	Rock (See Rock Classification)
WOOD		WD	Wood, lumber, wood chips
DEBRIS		DB	Construction debris, garbage

Notes:
1. Soil descriptions are based on the general approach presented in the *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)*, as outlined in ASTM D 2488. Where laboratory index testing has been conducted, soil classifications are based on the *Standard Test Method for Classification of Soils for Engineering Purposes*, as outlined in ASTM D 2487.
2. Soil description terminology is based on visual estimates (in the absence of laboratory test data) of the percentages of each soil type and is defined as follows:

Primary Constituent: > 50% - "GRAVEL," "SAND," "SILT," "CLAY," etc.
Secondary Constituents: > 30% and ≤ 50% - "very gravelly," "very sandy," "very silty," etc.
> 12% and ≤ 30% - "gravelly," "sandy," "silty," etc.
Additional Constituents: > 5% and ≤ 12% - "slightly gravelly," "slightly sandy," "slightly silty," etc.
≤ 5% - "trace gravel," "trace sand," "trace silt," etc., or not noted.

Drilling and Sampling Key

SAMPLE NUMBER & INTERVAL



SAMPLER TYPE

Code	Description
a	3.25-inch O.D., 2.42-inch I.D. Split Spoon
b	2.00-inch O.D., 1.50-inch I.D. Split Spoon
c	Shelby Tube
d	Grab Sample
e	Other - See text if applicable
1	300-lb Hammer, 30-inch Drop
2	140-lb Hammer, 30-inch Drop
3	Pushed
4	Other - See text if applicable

Groundwater

▽ ATD — Approximate water elevation at time of drilling (ATD) or on date noted. Groundwater levels can fluctuate due to precipitation, seasonal conditions, and other factors.

Field and Lab Test Data

Code	Description
PP = 1.0	Pocket Penetrometer, tsf
TV = 0.5	Torvane, tsf
PID = 100	Photoionization Detector VOC screening, ppm
W = 10	Moisture Content, %
D = 120	Dry Density, pcf
-200 = 60	Material smaller than No. 200 sieve, %
GS	Grain Size - See separate figure for data
AL	Atterberg Limits - See separate figure for data
GT	Other Geotechnical Testing
CA	Chemical Analysis

GEOTEST

Twin Lakes Landing 2
164th Street NE
Marysville, WA 98270

Soil Classification System and Key

Figure A-1

TP-1

SAMPLE DATA				SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): Unknown Excavated By: Dirtworks / BM	
0	TP1-1	d			SP-SM	Medium dense, light brown to orange, dry, slightly silty to silty SAND with occasional gravel and cobble, minor organic content (Dredged Fill / Topsoil)	
2	TP1-2	d			SM	Medium dense, brown to gray, damp, silty SAND (Dredged Fill)	
4	TP1-3	d			SM/OL	Medium dense, dark brown, moist, silty SAND, organic (Relict Topsoil)	
	TP1-4	d			SM	Medium dense, gray, damp to wet, silty SAND (Marysville Sand)	
6	TP1-5	d					
8	TP1-6	d					▽ Moderate groundwater seepage encountered at 8.5 ft.
10							
12							

Test Pit Completed 08/09/19
Total Depth of Test Pit = 9.5 ft.

TP-2

SAMPLE DATA				SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): Unknown Excavated By: Dirtworks / BM	
0	TP2-1	d			SP-SM	Medium dense, light brown to orange, dry, slightly silty to silty SAND with occasional gravel and cobble, minor organic content (Dredged Fill / Topsoil)	
2	TP2-2	d	W = 15 GS		SM	Medium dense, brown to gray, damp, silty SAND (Dredged Fill)	
	TP2-3	d			ML	Stiff, dark brown, damp, sandy SILT (Dredged Fill)	
4	TP2-4	d			SM/OL	Medium dense, dark brown, moist, silty SAND, organic (Relict Topsoil)	
6	TP2-5	d	W = 22 GS		SM	Medium dense, gray, damp, silty SAND (Marysville Sand)	
8	TP2-6	d			CL	Stiff, blue-gray, moist, sandy CLAY	▽ Moderate groundwater seepage encountered at 9.0 ft.
10					SM	Medium dense, gray, wet, silty SAND (Marysville Sand)	
12							

Test Pit Completed 08/09/19
Total Depth of Test Pit = 10.0 ft.

Notes:
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2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

GEOTEST

Twin Lakes Landing 2
164th Street NE
Marysville, Washington

Log of Test Pits

Figure
A-2

TP-3

SAMPLE DATA			SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): Unknown Excavated By: Dirtworks / BM	
0	TP3-1	d			SP-SM	Medium dense, light brown to orange, dry, slightly silty to silty SAND with occasional gravel and cobble, minor organic content (Dredged Fill / Topsoil)	
2	TP3-2	d			SM	Medium dense to dense, brown to gray, damp, silty SAND (Dredged Fill)	
4	TP3-3	d			SM/OL	Medium dense, dark brown, moist, silty SAND, organic (Relict Topsoil)	
6	TP3-4	d			SM	Medium dense, gray, damp to wet, silty SAND (Marysville Sand)	▽ Rapid groundwater seepage encountered at 8.0 ft.
8							
10							
12							

Test Pit Completed 08/09/19
Total Depth of Test Pit = 9.5 ft.

TP-4

SAMPLE DATA			SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): Unknown Excavated By: Dirtworks / BM	
0	TP4-1	d			SP-SM	Loose, dark brown, damp, silty SAND with organics (Topsoil)	
2	TP4-2	d	W = 18 GS		SM	Medium dense, brown to orange, damp, silty SAND (Weathered Marysville Sand)	
4	TP4-3	d	W = 25 GS		SM	Medium dense, gray, damp to wet, silty SAND (Marysville Sand)	▽ Rapid groundwater seepage encountered at 5.0 ft.
6							
8							
10							
12							

Test Pit Completed 08/09/19
Total Depth of Test Pit = 6.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

GEOTEST

Twin Lakes Landing 2
164th Street NE
Marysville, Washington

Log of Test Pits

Figure
A-3

TP-5

SAMPLE DATA			SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): Unknown Excavated By: Dirtworks / BM	
0	TP5-1	d			SP-SM	Loose, dark brown, damp, silty SAND with organics (Topsoil)	
2	TP5-2	d	GS		SM	Medium dense, brown to orange, damp, silty SAND (Weathered Marysville Sand)	
4	TP5-3	d			ML	Stiff, brown to orange, damp, very sandy SILT (Weathered Marysville Sand)	
6					SM	Medium dense, gray, damp to wet, silty SAND (Marysville Sand)	▽ Rapid groundwater seepage encountered at 4.5 ft.
8							
10							
12							

Test Pit Completed 08/09/19
Total Depth of Test Pit = 6.0 ft.

TP-6

SAMPLE DATA			SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): Unknown Excavated By: Dirtworks / BM	
0	TP6-1	d			SP-SM	Loose, dark brown, damp, silty SAND with organics (Topsoil)	
2	TP6-2	d			SM	Medium dense, brown to orange, damp, silty SAND (Weathered Marysville Sand) *Intermittent pockets of silt/clay from 2' to 3'	
4	TP6-3	d	W = 26 GS		SM	Medium dense, gray, damp to wet, silty SAND (Marysville Sand)	▽ Rapid groundwater seepage encountered at 4.5 ft.
6							
8							
10							
12							

Test Pit Completed 08/09/19
Total Depth of Test Pit = 5.5 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

GEOTEST

Twin Lakes Landing 2
164th Street NE
Marysville, Washington

Log of Test Pits

Figure
A-4

TP-7

SAMPLE DATA			SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): Unknown Excavated By: Dirtworks / BM	
0	TP7-1	d			SP-SM	Medium dense, light brown to orange, dry, slightly silty to silty SAND with occasional gravel and cobble, minor organic content (Dredged Fill)	
2	TP7-2	d			SM/OL	Medium dense, dark brown, moist, silty SAND, organic (Relict Topsoil)	
					SM	Medium dense, brown to orange, damp, silty SAND (Weathered Marysville Sand)	
4	TP7-3	d					
6					SM	Medium dense, gray, damp to wet, silty SAND (Marysville Sand)	▽ Rapid groundwater seepage encountered at 5.5 ft.
8							
10							
12							

Test Pit Completed 08/09/19
Total Depth of Test Pit = 6.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

GEOTEST

Twin Lakes Landing 2
164th Street NE
Marysville, Washington

Log of Test Pits

Figure
A-5

B-1

SAMPLE DATA				SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Drilling Method: Hollow-stem Auger Ground Elevation (ft): Unknown Drilled By: Bortec1 Inc. / BM	Water Level
0	B1-1	b	13			SM	Medium dense, light brown to orange, dry, slightly silty to silty SAND with occasional gravel and cobble (Dredged Fill)	
	B1-2	b	10			SP/ SM	Medium dense to dense, gray, damp to wet, clean to very silty SAND with occasional gravel (Marysville Sand)	▽ ATD
	B1-3	b	15					
10	B1-4	b	15					
	B1-5	b	17	W = 19 GS			*clean, medium grained sand	
20	B1-6	b	26					
	B1-7	b	39	W = 12 GS			*slightly silty, medium grained sand	
30	B1-8	b	37					
	B1-9	b	28					
40	B1-10	b	17				*very silty, fine-grained sand	
	B1-11	b	46	W = 21 GS				
50	B1-12	b	38					
	B1-13	b	25					
60	B1-14	b	19					
70								

Boring Completed 08/20/19
Total Depth of Boring = 61.5 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

GEOTEST

Twin Lakes Landing 2
164th Street NE
Marysville, Washington

Log of Boring B-1

Figure
A-6

B-2

Drilling Method: Hollow-stem Auger

Ground Elevation (ft): Unknown

Drilled By: Bortec1 Inc. / BM

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	SOIL PROFILE	GROUNDWATER
0						SM/OL	Loose, brown, slightly damp, silty SAND with organics (Topsoil)	
	B2-1	b	9			SP/SM	Loose to dense, gray, damp to wet, clean to very silty SAND with occasional gravel (Marysville Sand)	ATD
	B2-2	b	13					
	B2-3	b	15					
10	B2-4	b	12				*6 gravel seam in sample	
	B2-5	b	13					
20	B2-6	b	20	W = 23 GS				
	B2-7	b	21					
30	B2-8	b	6	W = 26 GS		ML	Medium to very stiff, gray-brown, moist, sandy SILT (Marysville Sand)	
	B2-9	b	20					
						SM	Dense, gray, damp to wet, silty SAND with occasional gravel (Marysville Sand)	
40	B2-10	b	49					
50								
60								
70								

Boring Completed 08/20/19
Total Depth of Boring = 41.5 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

GEOTEST

Twin Lakes Landing 2
164th Street NE
Marysville, Washington

Log of Boring B-2

Figure
A-7

PIT-1

SAMPLE DATA				SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): Unknown Excavated By: North River Enterprises, LLC\TAC	
0					OL	Loose, dark brown, moist, sandy SILT, organics, rootlets (Topsoil)	
					SM		
	PIT1-1	d				Loose to medium dense, light brown to weathered/mottled tan, damp, very silty SAND, trace rootlets (Dredged Fill)	
2	PIT1-2	d					
	PIT1-3	d	W = 15		SM	Dense, dark brown to black, damp, gravelly, silty SAND, organics (Relict Topsoil)	
	PIT1-4	d	GS				
4					SM	Pilot Infiltration Test 1 conducted @ 2.75' BGS with an area of 32.9 square feet	
	PIT1-5	d			SP/ SM	Medium dense to dense, light tan, damp, silty SAND (Weathered Marysville Sand)	
6						Medium dense, blue to gray, moist, slightly silty SAND, trace gravel (Marysville Sand)	▽ Moderate groundwater seepage encountered at 6.8 ft.
	PIT1-6	d	W = 23 GS			Moderate caving @ 6.75' BGS	
8							
	Test Pit Completed 03/30/20 Total Depth of Test Pit = 8.0 ft.						
10							

PIT-2

SAMPLE DATA				SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): Unknown Excavated By: North River Enterprises, LLC\TAC	
0					OL	Loose, dark brown to black, moist, sandy SILT, organics, organic odor (Topsoil)	
	PIT2-1	d					
	PIT2-2	d	W = 34 GS		SM	Loose to medium dense, mottled orange to light brown, very silty SAND, rootlets (Weathered Marysville Sand)	
2	PIT2-3	d	W = 16 GS		SP/ SM	Pilot Infiltration Test 2 conducted @ 1.25' BGS with an area of 30.5 square feet	▽ Moderate groundwater seepage encountered at 3.0 ft.
	PIT2-4	d			SP	Medium dense to dense, light tan, moist, slightly silty SAND, trace gravel (Weathered Marysville Sand)	
4	PIT2-5	d	W = 17 GS			Medium dense, blue to gray, moist, very gravelly SAND, trace silt, poorly graded (Marysville Sand)	
6						Moderate caving @ 3.5' BGS	
8							
	Test Pit Completed 03/31/20 Total Depth of Test Pit = 8.0 ft.						
10							

Notes:
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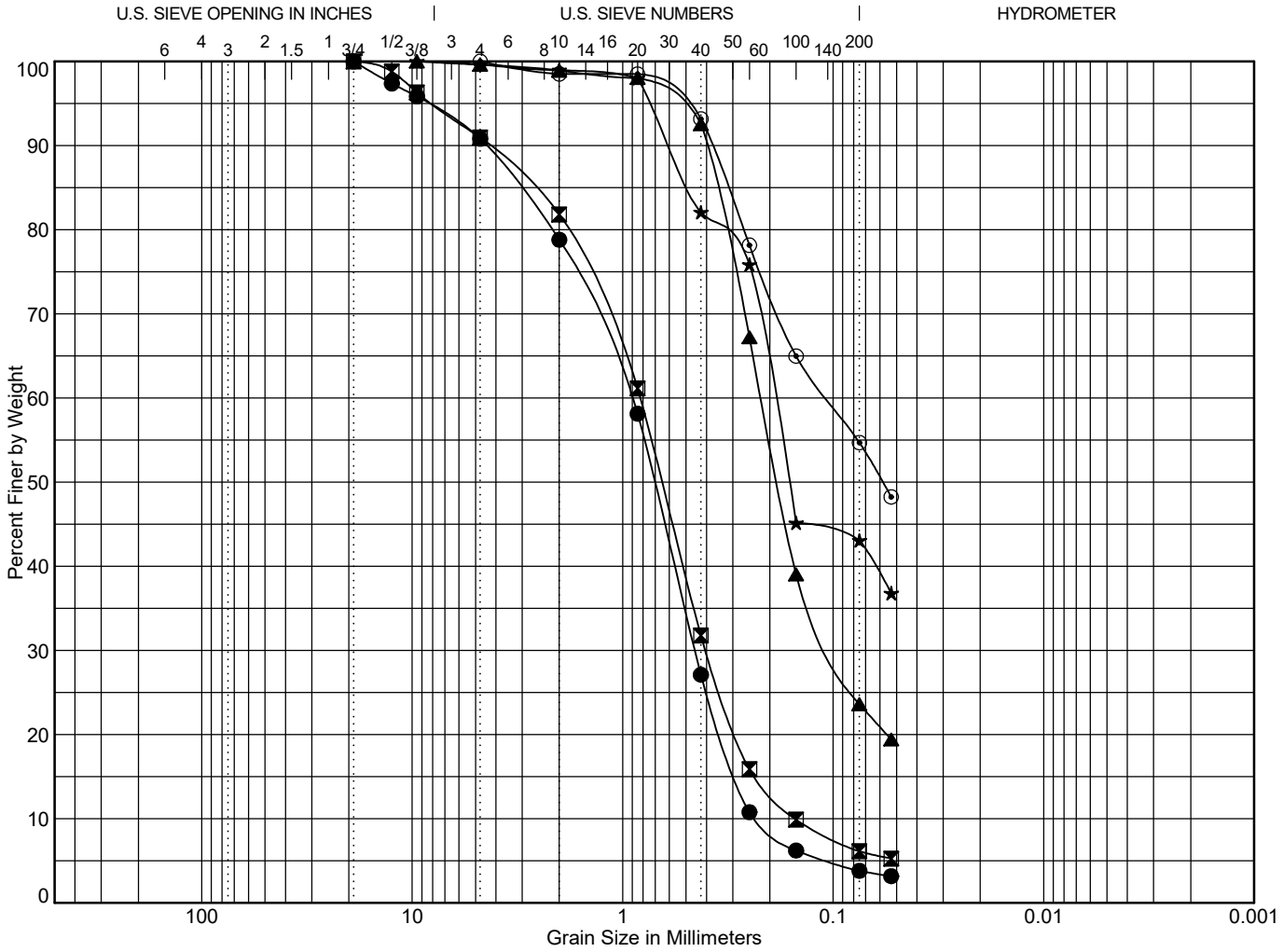
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

GEOTEST

Twin Lakes Landing 2
164th Street NE
Marysville, WA 98270

Log of Test Pits

Figure
A-8



Cobbles	Gravel		Sand			Silt or Clay
	coarse	fine	coarse	medium	fine	

Point		Depth	Classification	LL	PL	PI	C_c	C_u
●	B-1	15.0	Slightly gravelly SAND (SP)				0.98	4.01
⊠	B-1	25.0	Slightly silty, slightly gravelly SAND (SP-SM)				1.28	5.46
▲	B-1	45.0	Silty SAND (SM)					
★	B-2	20.0	Very silty SAND (SM)					
⊙	B-2	30.0	Sandy SILT (ML)					

Point		Depth	D_{90}	D_{60}	D_{50}	D_{30}	D_{10}	%Coarse Gravel	% Fine Gravel	% Coarse Sand	% Medium Sand	% Fine Sand	% Fines
●	B-1	15.0	4.481	0.918	0.709	0.453	0.229	0.0	9.2	12.0	51.7	23.3	3.8
⊠	B-1	25.0	4.341	0.828	0.654	0.401	0.152	0.0	9.0	9.1	50.1	25.6	6.1
▲	B-1	45.0	0.403	0.219	0.183	0.1	0.024*	0.0	0.4	0.7	6.3	69.0	23.6
★	B-2	20.0	0.6	0.192	0.163	0.036*	0.012*	0.0	0.4	0.7	16.9	39.0	43.1
⊙	B-2	30.0	0.38	0.107	0.058	0.02*	0.007*	0.0	0.0	1.5	5.4	38.5	54.7

*Extrapolated from data

$C_c = D_{30}^2/(D_{60} * D_{10})$

$C_u = D_{60}/D_{10}$

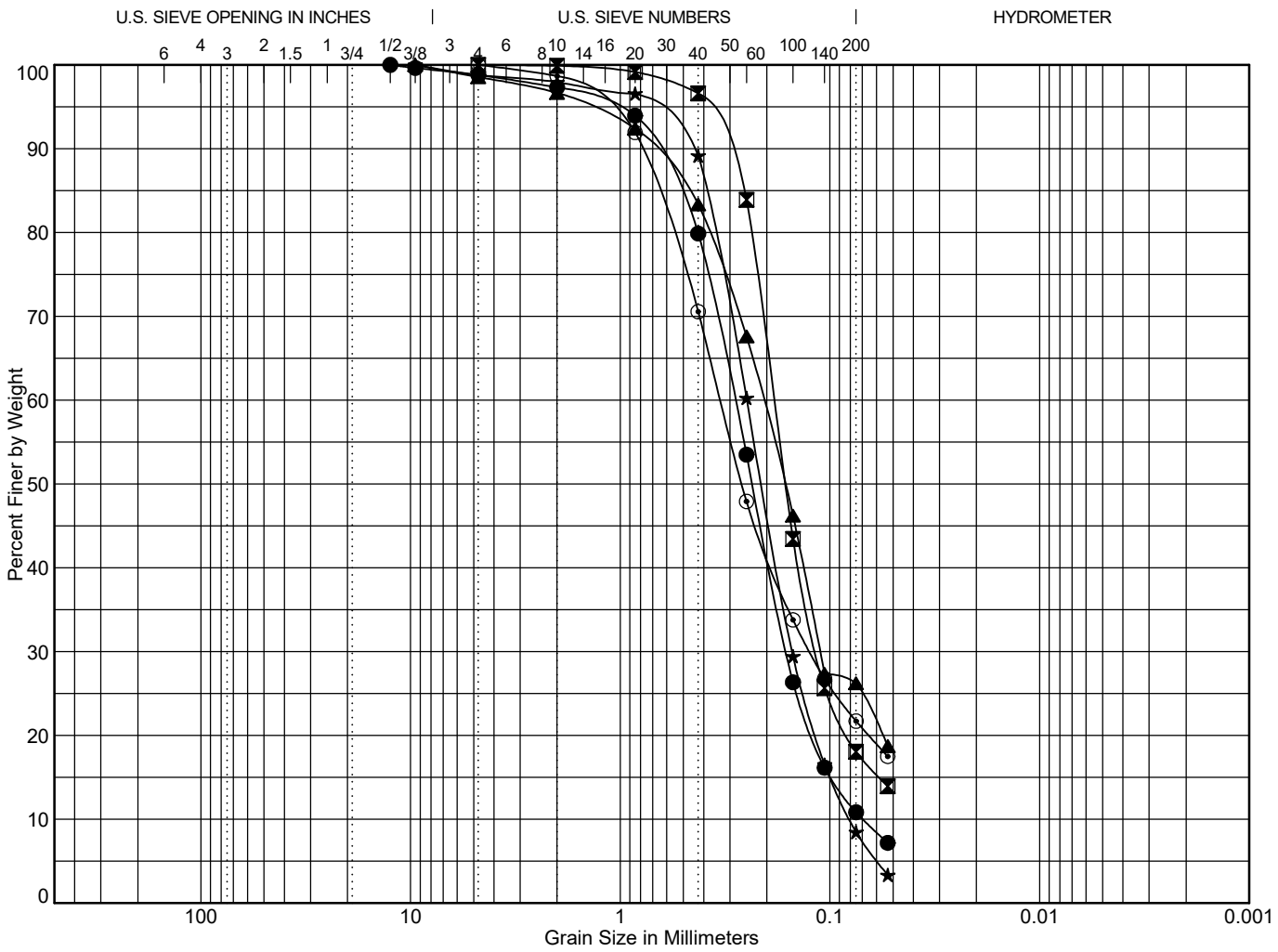
To be well graded: $1 < C_c < 3$ and $C_u > 4$ for GW or $C_u > 6$ for SW

GEOTEST

Twin Lakes Landing 2
164th Street NE
Marysville, Washington

Grain Size Test Data

Figure
B-1



Cobbles	Gravel		Sand			Silt or Clay
	coarse	fine	coarse	medium	fine	

Point		Depth	Classification	LL	PL	PI	C_c	C_u
●	TP-2	2.0	Slightly silty SAND (SP-SM)				1.31	4.11
⊠	TP-2	6.5	Silty SAND (SM)					
▲	TP-4	2.0	Silty SAND (SM)					
★	TP-4	3.5	Slightly silty SAND (SP-SM)				1.15	3.11
⊙	TP-5	2.5	Silty SAND (SM)					

Point		Depth	D_{90}	D_{60}	D_{50}	D_{30}	D_{10}	%Coarse Gravel	% Fine Gravel	% Coarse Sand	% Medium Sand	% Fine Sand	% Fines
●	TP-2	2.0	0.7	0.285	0.234	0.161	0.069	0.0	1.2	1.5	17.5	69.1	10.8
⊠	TP-2	6.5	0.322	0.185	0.163	0.115	0.038*	0.0	0.0	0.1	3.3	78.6	18.0
▲	TP-4	2.0	0.707	0.208	0.164	0.111	0.035*	0.0	1.4	1.9	13.3	57.1	26.2
★	TP-4	3.5	0.459	0.249	0.211	0.151	0.08	0.0	1.2	0.9	8.8	80.7	8.5
⊙	TP-5	2.5	0.798	0.332	0.263	0.124	0.029*	0.0	0.0	1.3	28.1	48.9	21.7

*Extrapolated from data

$C_c = D_{30}^2/(D_{60} * D_{10})$

$C_u = D_{60}/D_{10}$

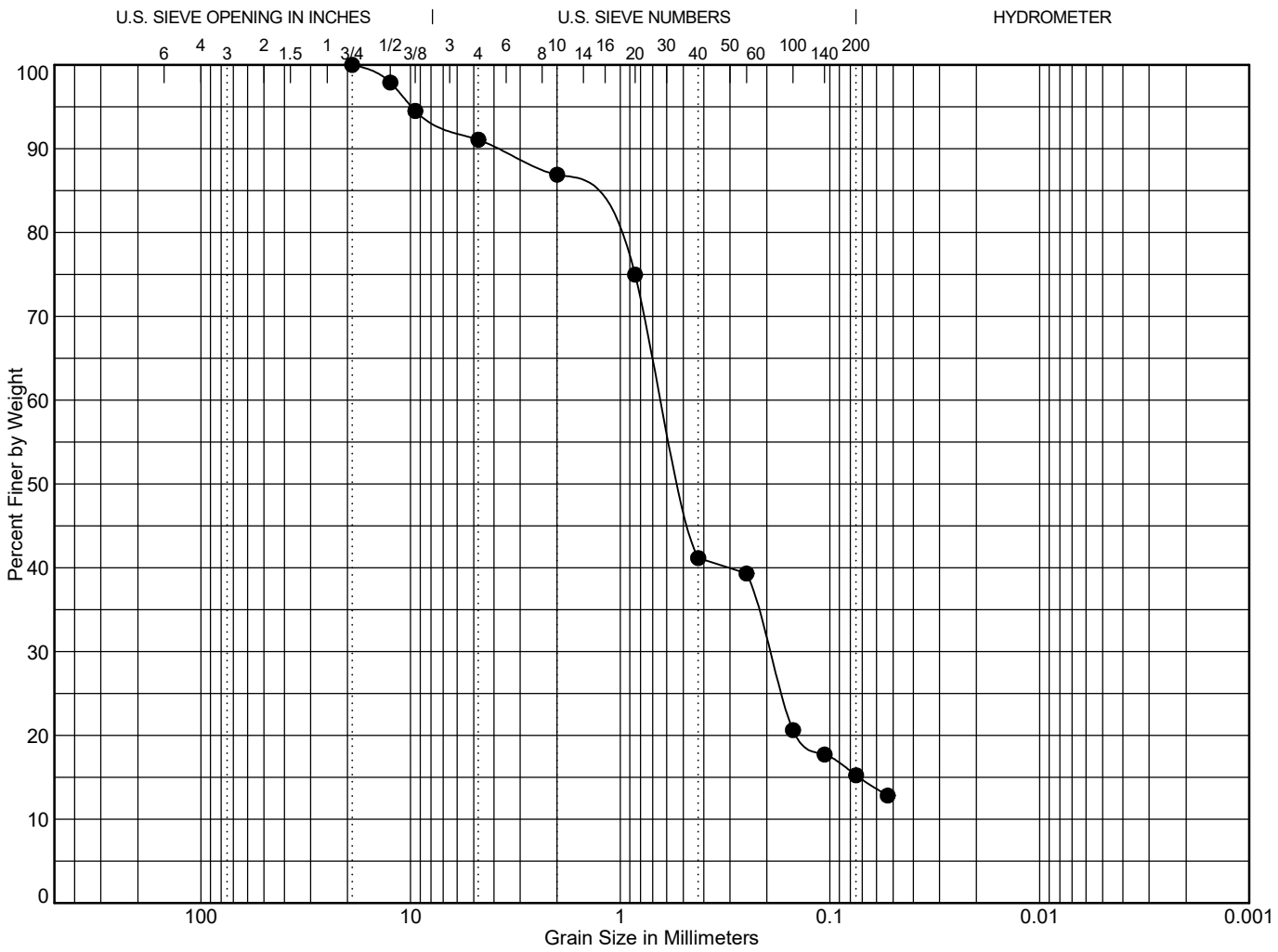
To be well graded: $1 < C_c < 3$ and $C_u > 4$ for GW or $C_u > 6$ for SW

GEOTEST

Twin Lakes Landing 2
164th Street NE
Marysville, Washington

Grain Size Test Data

Figure
B-2



Cobbles	Gravel		Sand			Silt or Clay
	coarse	fine	coarse	medium	fine	

Point	Depth	Classification	LL	PL	PI	C_c	C_u
● TP-6	3.5	Silty, slightly gravelly SAND (SM)					

Point	Depth	D_{90}	D_{60}	D_{50}	D_{30}	D_{10}	%Coarse Gravel	% Fine Gravel	% Coarse Sand	% Medium Sand	% Fine Sand	% Fines
● TP-6	3.5	3.805	0.625	0.509	0.194	0.035*	0.0	8.9	4.2	45.7	25.9	15.2

*Extrapolated from data

$C_c = D_{30}^2/(D_{60} * D_{10})$

$C_u = D_{60}/D_{10}$

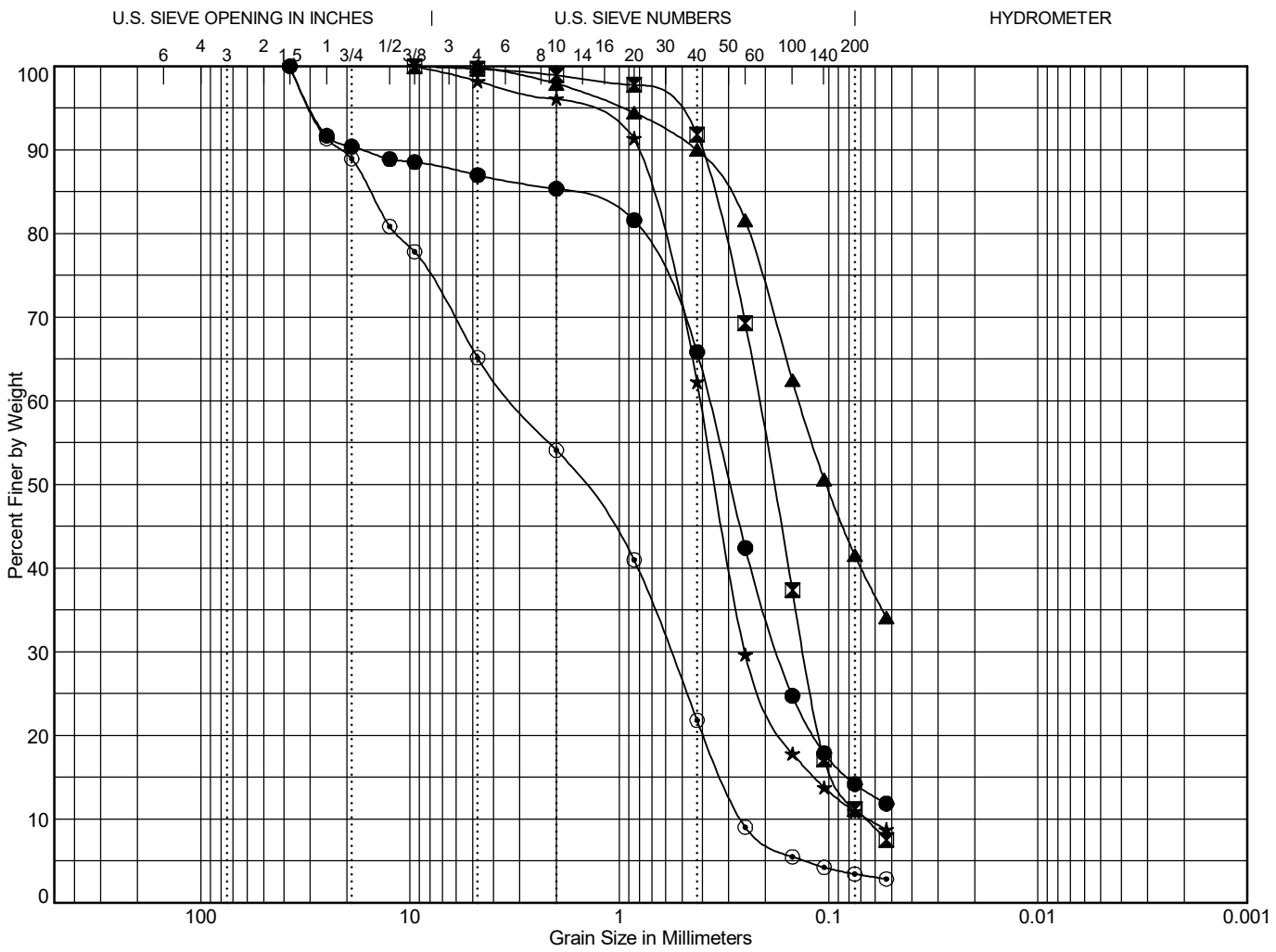
To be well graded: $1 < C_c < 3$ and $C_u > 4$ for GW or $C_u > 6$ for SW

GEOTEST

Twin Lakes Landing 2
164th Street NE
Marysville, Washington

Grain Size Test Data

Figure
B-3



Cobbles	Gravel		Sand			Silt or Clay
	coarse	fine	coarse	medium	fine	

Point		Depth	Classification	LL	PL	PI	C_c	C_u
●	PIT-1	3.0	Gravelly, silty SAND (SM)					
⊠	PIT-1	7.0	Slightly silty SAND, trace gravel (SP/SM)				1.19	3.21
▲	PIT-2	1.3	Very silty SAND (SM)					
★	PIT-2	2.0	Slightly silty SAND, trace gravel (SP/SM)				2.39	6.35
⊙	PIT-2	4.5	Very gravelly SAND, trace silt, poorly graded (SP)				0.40	12.20

Point		Depth	D_{90}	D_{60}	D_{50}	D_{30}	D_{10}	%Coarse Gravel	% Fine Gravel	% Coarse Sand	% Medium Sand	% Fine Sand	% Fines
●	PIT-1	3.0	16.961	0.372	0.297	0.174		9.6	3.4	1.6	19.5	51.6	14.2
⊠	PIT-1	7.0	0.407	0.215	0.183	0.131	0.067	0.0	0.3	0.8	7.0	80.7	11.2
▲	PIT-2	1.3	0.425	0.138	0.103			0.0	0.0	2.1	7.9	48.4	41.6
★	PIT-2	2.0	0.822	0.41	0.348	0.251	0.064	0.0	1.8	2.1	33.9	51.3	10.9
⊙	PIT-2	4.5	21.42	3.174	1.53	0.571	0.26	11.0	23.8	11.1	32.3	18.4	3.4

$C_c = D_{30}^2/(D_{60} * D_{10})$
$C_u = D_{60}/D_{10}$

To be well graded: $1 < C_c < 3$ and $C_u > 4$ for GW or $C_u > 6$ for SW

GEOTEST

Twin Lakes Landing 2
164th Street NE
Marysville, WA 98270

Grain Size Test Data

Figure
B-4

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PAP-Accredited
NAPT

GeoTest Services Inc.
741 Marine Drive
Bellingham, WA 98225

Report: 51279-1-1
Date: April 4, 2020
Project No: 19-0543
Project Name: Twin Lakes Landing 2

Sample ID	pH	Organic Matter	Cation Exchange Capacity
PIT- 1 @ 3.0’	5.6	1.56%	6.1 meq/100g
PIT-2 @ 2.0’	5.7	1.07%	4.7 meq/100g
PIT- 2 @ 1.25’	5.2	3.55%	13.3 meq/100g
Method	**SM 4500-H^+ B**	**ASTM D2974**	**EPA 9081**

REPORT LIMITATIONS AND GUIDELINES FOR ITS USE[1]

Subsurface issues may cause construction delays, cost overruns, claims, and disputes. While you cannot eliminate all such risks, you can manage them. The following information is provided to help:

Geotechnical Services are Performed for Specific Purposes, Persons, and Projects

At GeoTest our geotechnical engineers and geologists structure their services to meet specific needs of our clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of an owner, a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared solely for the client. No one except you should rely on your geotechnical engineer who prepared it. And no one – not even you – should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report is Based on a Unique Set of Project-Specific Factors

GeoTest's geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the clients goals, objectives, and risk management preferences; the general nature of the structure involved its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless GeoTest, who conducted the study specifically states otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

1Information in this document is based upon material developed by ASFE, Professional Firms Practicing in the Geosciences(asfe.org)

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed, for example, from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed construction,
- alterations in drainage designs; or
- composition of the design team; the passage of time; man-made alterations and construction whether on or adjacent to the site; or by natural alterations and events, such as floods, earthquakes or groundwater fluctuations; or project ownership.

Always inform GeoTest's geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.

Subsurface Conditions Can Change

This geotechnical or geologic report is based on conditions that existed at the time the study was performed. Do not rely on the findings and conclusions of this report, whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. Always contact GeoTest before applying the report to determine if it is still relevant. A minor amount of additional testing or analysis will help determine if the report remains applicable.

Most Geotechnical and Geologic Findings are Professional Opinions

Our site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. GeoTest's engineers and geologists review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ – sometimes significantly – from those indicated in your report. Retaining GeoTest who developed this report to provide construction observation is the most effective method of managing the risks associated with anticipated or unanticipated conditions.

1Information in this document is based upon material developed by ASFE, Professional Firms Practicing in the Geosciences(asfe.org)

A Report's Recommendations are Not Final

Do not over-rely on the construction recommendations included in this report. Those recommendations are not final, because geotechnical engineers or geologists develop them principally from judgment and opinion. GeoTest's geotechnical engineers or geologists can finalize their recommendations only by observing actual subsurface conditions revealed during construction. GeoTest cannot assume responsibility or liability for the report's recommendations if our firm does not perform the construction observation.

A Geotechnical Engineering or Geologic Report may be Subject to Misinterpretation

Misinterpretation of this report by other design team members can result in costly problems. Lower that risk by having GeoTest confer with appropriate members of the design team after submitting the report. Also, we suggest retaining GeoTest to review pertinent elements of the design teams plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having GeoTest participate in pre-bid and preconstruction conferences, and by providing construction observation.

Do not Redraw the Exploration Logs

Our geotechnical engineers and geologists prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors of omissions, the logs included in this report should never be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable; but recognizes that separating logs from the report can elevate risk.

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, but preface it with a clearly written letter of transmittal. In that letter, consider advising the contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with GeoTest and/or to conduct additional study to obtain the specific types of information they need or prefer. A pre-bid conference can also be valuable. Be sure contractors have sufficient time to perform additional study. Only then might you be in a position to give contractors the best information available, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

1Information in this document is based upon material developed by ASFE, Professional Firms Practicing in the Geosciences(asfe.org)

In addition, it is recommended that a contingency for unanticipated conditions be included in your project budget and schedule.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering or geology is far less exact than other engineering disciplines. This lack of understanding can create unrealistic expectations that can lead to disappointments, claims, and disputes. To help reduce risk, GeoTest includes an explanatory limitations section in our reports. Read these provisions closely. Ask questions and we encourage our clients or their representative to contact our office if you are unclear as to how these provisions apply to your project.

Environmental Concerns Are Not Covered in this Geotechnical or Geologic Report

The equipment, techniques, and personnel used to perform an environmental study differ significantly from those used to perform a geotechnical or geologic study. For that reason, a geotechnical engineering or geologic report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated containments, etc. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk management guidance. Do not rely on environmental report prepared for some one else.

Obtain Professional Assistance to Deal with Biological Pollutants

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts biological pollutants from growing on indoor surfaces. Biological pollutants includes but is not limited to molds, fungi, spores, bacteria and viruses. To be effective, all such strategies should be devised for the express purpose of prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional biological pollutant prevention consultant. Because just a small amount of water or moisture can lead to the development of severe biological infestations, a number of prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of this study, the geotechnical engineer or geologist in charge of this project is not a biological pollutant prevention consultant; none of the services preformed in connection with this geotechnical engineering or geological study were designed or conducted for the purpose of preventing biological infestations.

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