PanGEO INCORPORATED
Geotechnical & Earthquake Engineering Consultants

March 22, 2022
Project No. 22-026

Lauren and Eli Brumbaugh
4124 83rd Avenue SE
Mercer Island, WA 98040

Subject: Infiltration Test Report
4124 83rd Avenue Southeast
Mercer Island, Washington

Dear Lauren and Eli:

As requested, PanGEO, Inc. completed an infiltration testing program at the above-referenced site. We excavated two test pits at the site to about 5 to 7 feet deep on January 20, 2022. At the time of excavation and infiltration testing, test pit PIT-1 at the front yard encountered light groundwater seepage at the test depth of five feet which resulted in exfiltration of water and zero infiltration within the Vashon till unit. In test pit TP-2 at the back yard, perched groundwater seepage was encountered between three and four feet beneath the ground surface, within a surficial fill unit. Due to the observed groundwater conditions at time of testing, it is our opinion that infiltration of surface water is not feasible at this site and other stormwater BMPs should be considered.

We appreciate the opportunity to be of service. Please call if you have any questions.

Sincerely,

Johnny Chen

Johnny C. Chen, P.E.
Senior Geotechnical Engineer

3213 Eastlake Avenue E, Ste B
Seattle, WA 98102
Tel (206) 262-0370

TABLE OF CONTENTS

LIST OF ATTACHMENTS

INFILTRATION TEST REPORT
4124 83RD AVENUE SOUTHEAST
MERCER ISLAND, WASHINGTON

1.0 INTRODUCTION

PanGEO completed an infiltration evaluation of the site soil at 4124 83rd Avenue Southeast in Mercer Island, Washington. Our service scope consisted of reviewing readily available geologic and geotechnical data, observing the excavation of two test pits, performing Small Pilot Infiltration Test (PIT), and providing the infiltration evaluation in this report.

2.0 SITE AND PROJECT DESCRIPTION

The project site is located at 4124 83rd Avenue Southeast in Mercer Island, Washington (see Figure 1, Vicinity Map). The site is a rectangular shaped parcel and approximately 14,078 square feet in size. It is bordered by 83rd Avenue Southeast to the west, and existing single-family residences to the other three sides. The site is currently occupied by a single-story house with crawlspace and attached garage at the approximate center of the property (see Figure 2, Site and Exploration Plan).

We understand that you plan to either add-on and renovate to the existing residence or demolish the existing residence and build another in the approximate center portion of the property. We also understand that infiltration will be used to dispose surface water from impervious areas, if feasible. Based on the information provided by your civil engineer, the proposed infiltration facility may be located at the front or back yard of the proposed residence with a design bottom approximately five feet below the existing grade, if feasible.

3.0 SUBSURFACE EXPLORATIONS

Two test pits (PIT-1 and TP-2) were excavated at the project site on January 20, 2022. PIT-1 was excavated to 5 feet for infiltration testing. TP-2 was initially excavated to about 5 feet for infiltration testing, then excavated to about 7 feet deep after perched groundwater conditions were encountered. The approximate test pit locations are shown on the attached Figure 2, Site and Exploration Plan.

A geologist from PanGEO was present during the field explorations to observe the test pit excavation, document the soil samples obtained from the borings, and perform the infiltration

tests. The summary test pit logs are included in Appendix A as Figures A-2 and A-3. The soil samples were described using the system outlined on Figure A-1.

4.0 SUBSURFACE CONDITIONS

4.1 SITE GEOLOGY

Based on review of *The Geologic Map of Mercer Island* (Troost and Wisher, 2006), the project site is underlain by Vashon Till (Geologic Map Unit *Qvt*). Vashon till is described by Troost and Wisher as dense to very dense, heterogeneous mixture of silt, sand, and gravel laid down at the base of an advancing glacial ice sheet. Vashon till is generally very dense in its undisturbed state and presents low infiltration feasibility.

4.2 SOIL CONDITIONS

The subsurface conditions encountered in the test borings are quite consistent, and we interpret as fill overlaying Vashon till. A general description of the soil units encountered in the test borings is presented below. A more detailed description of the soils encountered in the test borings can be found on the summary boring logs located in Appendix A.

Unit 1: Fill – A surficial layer of fill was encountered in both test pits completed at the site. Approximately 1½ feet of fill consisted of loose silty sand with trace gravels and roots was encountered in test pit PIT-1. In test pit TP-2, the fill was about 5½ foot thick and consisted of loose to medium dense silty sand and gravel with an increase of cobble and wood debris. This soil unit was disrupted and heavily reworked. We interpreted this soil unit as fill.

Unit 2: Vashon Till – Medium dense to dense silty sand with trace gravel was encountered below the fill and extended to the bottom of test borings at about 5 and 7 feet deep. The upper portion of this unit was iron-oxide stained and slightly diamict. This soil unit appears to be consistent with the mapped Vashon till.

4.3 GROUNDWATER

Groundwater was encountered in both test pits during excavation. Test pit PIT-1 encountered light groundwater seepage at the infiltration test depth of about 5 feet below the existing grade. Test pit PIT-2 encountered moderate perched groundwater seepage at about 3 to 4 feet below the existing grade within the surficial fill.

It should be noted that there will be fluctuations in groundwater conditions depending on the season, amount of rainfall, surface water runoff, and other factors. Generally, the water level is higher and seepage rates are greater in the wetter, winter months (typically October through May).

5.0 INFILTRATION TESTING AND CONCLUSIONS

The field infiltration test was conducted in general accordance with the procedure for the Small Pilot Infiltration Test (PIT) as outlined in the *2012 Stormwater Management Manual for Western Washington, as Amended in December 2014* (SMMWW). In general, the test consisted of the following procedure:

- A test pit was excavated to the approximate design bottom of the proposed infiltration facility with a minimum bottom area of at least 12 square feet.
- The test pit was pre-soaked by maintaining a water level of about 12 inches above the bottom of the pit for at least 6 hours.
- At the end of the pre-soak period, a flow meter was used to monitor the amount of water needed to maintain a constant head of 12 inches for at least one hour and until at least a point at which a constant volume of water per time unit was achieved.
- At the end of the constant head test, we measured the falling head infiltration rate by shutting off the water flow and recording the drop in water level over regular time intervals for one hour or until all the water has infiltrated.

During our initial test pitting procedures at the target depth of the proposed infiltration facility at test pit PIT-1, we observed light groundwater seepage at about 5 feet below the existing grade. During the pre-soak period of the infiltration test, water at the source was turned off and the level of water in the test pit continued to rise, resultant of exfiltration of groundwater into the PIT-1. At test pit PIT-2 location, groundwater seepage was encountered at about 3 to 4 feet below the existing grade, which is above the bottom of proposed infiltration facility. Therefore, based on the subsurface conditions, it is our opinion that infiltration of surface water is not feasible at this site and other stormwater BMPs should be considered for this project.

6.0 LIMITATIONS

We have prepared this report for use by Nicole and Stephan Donaldson and the project team. Recommendations contained in this report are based on a site reconnaissance, a subsurface exploration program, review of pertinent subsurface information, and our understanding of the project. The study was performed using a mutually agreed-upon scope of work.

This report may be used only by the client and for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both off and on-site), or other factors including advances in our understanding of applied science, may change over time and could materially affect our findings. Therefore, this report should not be relied upon after 24 months from its issuance. PanGEO should be notified if the project is delayed by more than 24 months from the date of this report so that we may review the applicability of our conclusions considering the time lapse.

Within the limitation of scope, schedule and budget, PanGEO engages in the practice of geotechnical engineering and endeavors to perform its services in accordance with generally accepted professional principles and practices at the time the Report or its contents were prepared. No warranty, express or implied, is made.

We trust that the information outlined in this letter meets your need at this time. Please call if you have any questions.

Sincerely,

PanGEO, Inc.

Spenser P. Scott, L.G.
Project Geologist

Chien-Lin (Johnny) Chen, P.E.
Senior Geotechnical Engineer

7.0 LIST OF REFERENCES

Troost, K.G., Wisher, A. P., 2006, *The Geologic Map of Mercer Island, Washington;* scale 1:12,000.

Washington State Department of Ecology. *2012 Stormwater Management Manual for Western Washington, as Amended in December 2014 (The 2014 SWMMWW),* Publication Number 14-10-055.

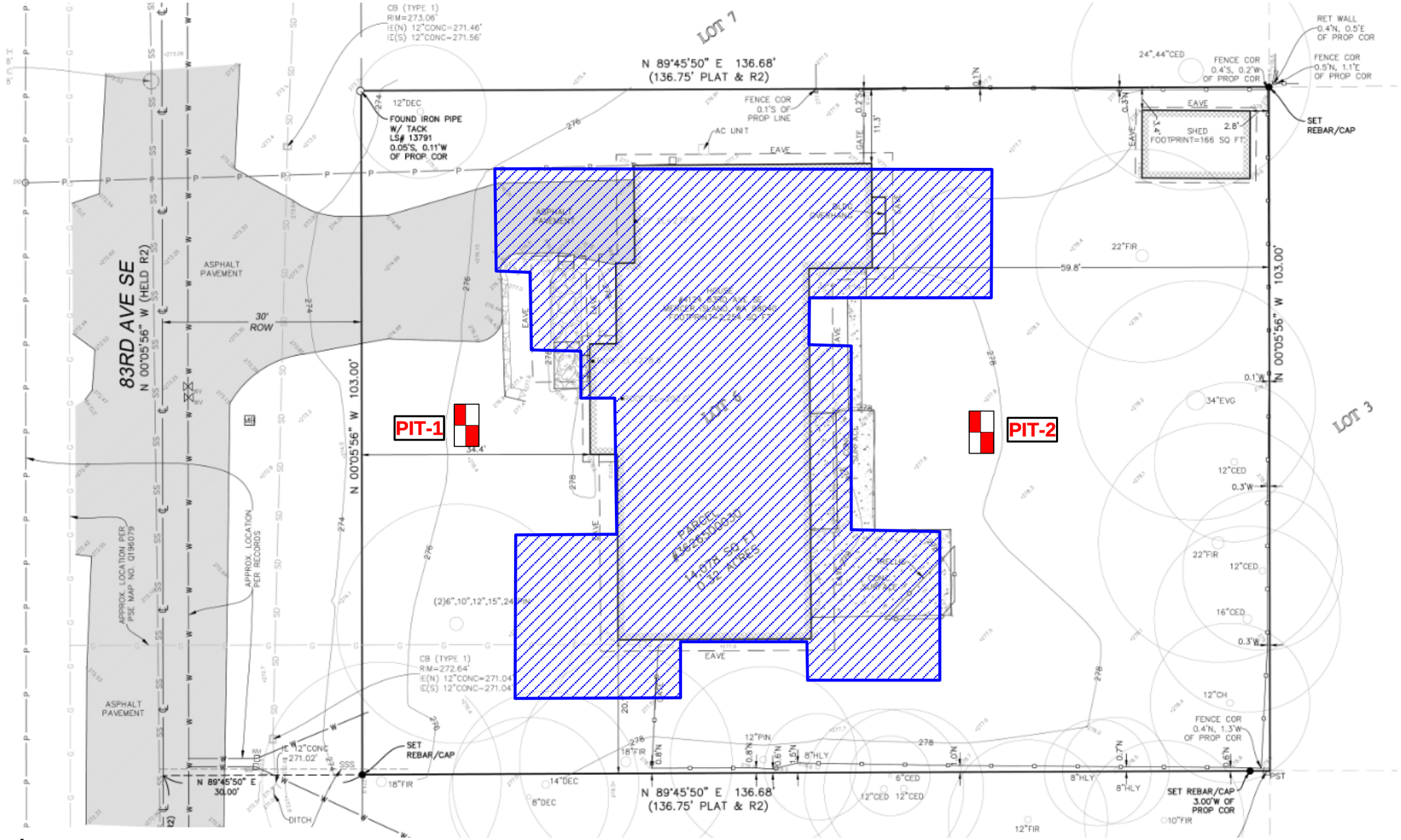
Base Map: ESRI Topographic

NORTH

Not to Scale

PanGEO INCORPORATED	**Infiltration Test** **4124 83rd Avenue Southeast** **Mercer Island, Washington**	**VICINITY MAP**	
		Project No. **22-026**	Figure No. **1**

22-026 Fig 1 - Vicinity Map.grf 3/23/22 (10:57:31) SPS



Legend:

Approximate Test Pit Location
PanGEO, Inc., January 2022

Approximate Proposed Building

Approx. Scale:
1 inch = 15 feet

Base map modified from Topographic & Boundary Survey by Terrane, dated May 21, 2021

PanGEO INCORPORATED

Infiltration Test
4124 83rd Avenue Southwest
Mercer Island, Washington

SITE AND EXPLORATION PLAN

Project No. **22-026**

Figure No. **2**

22-026 Fig 2 Site and Exploration Plan.grf 3/23/22 (11:00:13) SPS

APPENDIX A

SUMMARY TEST PIT LOGS

RELATIVE DENSITY / CONSISTENCY

SAND / GRAVEL			SILT / CLAY		
Density	SPT N-values	Approx. Relative Density (%)	Consistency	SPT N-values	Approx. Undrained Shear Strength (psf)
Very Loose	<4	<15	Very Soft	<2	<250
Loose	4 to 10	15 - 35	Soft	2 to 4	250 - 500
Med. Dense	10 to 30	35 - 65	Med. Stiff	4 to 8	500 - 1000
Dense	30 to 50	65 - 85	Stiff	8 to 15	1000 - 2000
Very Dense	>50	85 - 100	Very Stiff	15 to 30	2000 - 4000
			Hard	>30	>4000

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS		GROUP DESCRIPTIONS	
Gravel 50% or more of the coarse fraction retained on the #4 sieve. Use dual symbols (eg. GP-GM) for 5% to 12% fines.	GRAVEL (<5% fines)	GW	Well-graded GRAVEL
		GP	Poorly-graded GRAVEL
	GRAVEL (>12% fines)	GM	Silty GRAVEL
		GC	Clayey GRAVEL
Sand 50% or more of the coarse fraction passing the #4 sieve. Use dual symbols (eg. SP-SM) for 5% to 12% fines.	SAND (<5% fines)	SW	Well-graded SAND
		SP	Poorly-graded SAND
	SAND (>12% fines)	SM	Silty SAND
		SC	Clayey SAND
Silt and Clay 50%or more passing #200 sieve	Liquid Limit < 50	ML	SILT
		CL	Lean CLAY
		OL	Organic SILT or CLAY
	Liquid Limit > 50	MH	Elastic SILT
		CH	Fat CLAY
		OH	Organic SILT or CLAY
Highly Organic Soils		PT	PEAT

Notes: 1. Soil exploration logs contain material descriptions based on visual observation and field tests using a system modified from the Uniform Soil Classification System (USCS). Where necessary laboratory tests have been conducted (as noted in the "Other Tests" column), unit descriptions may include a classification. Please refer to the discussions in the report text for a more complete description of the subsurface conditions.

2. The graphic symbols given above are not inclusive of all symbols that may appear on the borehole logs. Other symbols may be used where field observations indicated mixed soil constituents or dual constituent materials.

DESCRIPTIONS OF SOIL STRUCTURES

Layered: Units of material distinguished by color and/or composition from material units above and below

Laminated: Layers of soil typically 0.05 to 1mm thick, max. 1 cm

Lens: Layer of soil that pinches out laterally

Interlayered: Alternating layers of differing soil material

Pocket: Erratic, discontinuous deposit of limited extent

Homogeneous: Soil with uniform color and composition throughout

Fissured: Breaks along defined planes

Slickensided: Fracture planes that are polished or glossy

Blocky: Angular soil lumps that resist breakdown

Disrupted: Soil that is broken and mixed

Scattered: Less than one per foot

Numerous: More than one per foot

BCN: Angle between bedding plane and a plane normal to core axis

COMPONENT DEFINITIONS

COMPONENT	SIZE / SIEVE RANGE	COMPONENT	SIZE / SIEVE RANGE
Boulder:	> 12 inches	Sand	
Cobbles:	3 to 12 inches	Coarse Sand:	#4 to #10 sieve (4.5 to 2.0 mm)
Gravel		Medium Sand:	#10 to #40 sieve (2.0 to 0.42 mm)
Coarse Gravel:	3 to 3/4 inches	Fine Sand:	#40 to #200 sieve (0.42 to 0.074 mm)
Fine Gravel:	3/4 inches to #4 sieve	Silt	0.074 to 0.002 mm
		Clay	<0.002 mm

TEST SYMBOLS

for In Situ and Laboratory Tests listed in "Other Tests" column.

ATT	Atterberg Limit Test
Comp	Compaction Tests
Con	Consolidation
DD	Dry Density
DS	Direct Shear
%F	Fines Content
GS	Grain Size
Perm	Permeability
PP	Pocket Penetrometer
R	R-value
SG	Specific Gravity
TV	Torvane
TXC	Triaxial Compression
UCC	Unconfined Compression

SYMBOLS

Sample/In Situ test types and intervals

- 2-inch OD Split Spoon, SPT (140-lb. hammer, 30" drop)
- 3.25-inch OD Spilt Spoon (300-lb hammer, 30" drop)
- Non-standard penetration test (see boring log for details)
- Thin wall (Shelby) tube
- Grab
- Rock core
- Vane Shear

MONITORING WELL

- Groundwater Level at time of drilling (ATD)
- Static Groundwater Level
- Cement / Concrete Seal
- Bentonite grout / seal
- Silica sand backfill
- Slotted tip
- Slough
- Bottom of Boring

MOISTURE CONTENT

Dry	Dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water

PanGEO INCORPORATED
Phone: 206.262.0370

Terms and Symbols for Boring and Test Pit Logs

Figure A-1

Test Pit No. PIT-1

Approximate ground surface elevation (NAVD88): 276 feet

Coordinates (Washington State Plane - North): 211676, 1296136

Depth (ft)	Material Description
0 – 1½	Approximate 6-inch topsoil above loose, brown to dark brown, silty SAND; trace gravel and cobble, roots and rootlets; disrupted texture, non-plastic, moist **[Fill]**
1½ – 3½	Medium dense, orange-brown to gray-brown, silty SAND; trace gravel and cobble; slightly diamict texture; non-plastic, moist • *Increasing moisture and sand content with depth*
3½ – 5	Dense, gray, silty SAND; trace gravel, iron-oxide staining; non-plastic, very moist **[Qvt – Vashon Till]**

Photo PIT-1 : Shows PIT-1 at approximately 5 feet in depth during infiltration testing

Light groundwater seepage was encountered at approximately 5 feet below grade during explorations.

Test Pit No. TP-2

Approximate ground surface elevation (NAVD88): 278 feet

Coordinates (Washington State Plane - North): 211668, 1296217

Depth (ft)	Material Description
0 – 2	Approximate 12-inch topsoil above loose to medium dense, brown to dark brown, silty SAND; trace gravel and cobble, roots and rootlets; disrupted, till-like texture, non-plastic, moist
2 – 5½	Medium dense, orange-brown, silty SAND; trace gravel and cobble, trace rootlets; slightly diamict texture; heavily reworked; non-plastic, moist to wet • *Moderate groundwater seepage from 3 to 4 feet below grade* **[Fill]**
5½ – 7	Dense, gray-brown, silty SAND; trace gravel, iron-oxide staining; slightly diamict texture; non-plastic, very moist **[Qvt – Vashon Till]**

Photo TP-2 : Shows TP-2 at approximately 7 feet in depth

Moderate perched groundwater seepage was encountered at approximately 3 to 4 feet below grade during explorations.

Date of Excavations: January 20, 2022

Excavations Logged by: S. Scott