MN Custom Homes, LLC
3009 112th Ave NE, Suite 100
Bellevue, WA 98004

Attention: Eric Sadler

Subject: Subsurface Exploration, Geologic Hazards Assessment, and Soil Design Recommendations
MN 472 –7119 80th Avenue SE, Mercer Island, Washington

Mr. Sadler:

At your request, South Fork Geosciences has logged the existing subsurface soil explorations on the subject property and performed laboratory soil testing on representative soils samples. The purpose of this study is to provide site-specific soils and geologic information to assess potential geologic hazards and to provide the geotechnical design elements for the proposed development, which consists of demolition of the existing home and construction of a new single-family residence on the subject property.

General Site Conditions
The subject property was rectangular in shape and based on the King County Assessors information the property was 0.34 acres (14,753 square feet) in size. The property sloped gently from the southeast to the northwest and based on visual estimates and available topographic information, the total relief of the property was on the order of 10 feet. There was an existing home in the center of the property with driveways providing access to both SE 72nd Street and 80th Avenue SE. The property was landscaped in a manner consistent with the era of construction (1961). The property was bordered by SE 72nd Street to the south, 80th Avenue SE to the east, and by other residential properties in other directions. We did not observe any signs of standing water, soil settlement, or accelerated erosion during our site reconnaissance.

Soil Conditions/Geologic Setting
South Fork Geosciences was onsite on June 5, 2023 to observe a soil exploration pit (EP-1) excavated with a subcontracted excavator provided by Northwest Trucking and Excavating Co. Inc. We interpret the native soils encountered to be Vashon recessional outwash and Vashon lodgement till sediments. Our geologic interpretation does not agree with the referenced geologic map (Troost & Wisher, 2006) which indicates the surface geology to be Vashon lodgement till. Recessional outwash sediments commonly overlie lodgement till in localized deposits that are not found in regional scale mapping and we attribute our different interpretation to the site-specific nature of our study.

Stratigraphy
<u>Fill</u>
Soils that we interpret to be fill soils were encountered in EP-1 from the ground surface to 2 feet. Structures should not be founded on existing fill soils, but if the new home is located near

the center of the property similar to the location of the existing home, we do not anticipate that significant fill soils will be encountered.

Vashon Recessional Outwash

Underlying the fill soils, sediments we interpret as Vashon recessional outwash were encountered from 2 to 5.5 feet below the ground surface. Recessional outwash sediments often overlie Vashon lodgement till and advance outwash sediments in localized deposits that are below mapping scale. Vashon recessional outwash sediments were deposited in fluvial and lacustrine environments as the Vashon glacial ice sheet receded. These sediments are normally consolidated and are relatively permeable when they have low silt and clay content. The recessional outwash soils encountered are suitable for foundation support.

Vashon Lodgement Till

Vashon lodgement till soils were underlying the recessional outwash soils from 5.5 feet below the ground surface to the total depth explored (7 feet). Vashon lodgement till sediments are a poorly sorted (well graded) mixture of boulders, gravel, sand, silt, and clay that was deposited at the sole of the Vashon glacial ice sheet as the glacial ice advanced. These sediments were overconsolidated by the glacial ice and they are typically dense to very dense and have low permeability. These soils are also suitable for foundation support.

Groundwater Conditions

We did not observe groundwater in the exploration pits performed for this study. Based on our exploration and the topography on and around the subject property, it is our opinion that groundwater will not adversely affect project design.

Geologic Hazards Assessment

Based on our review of relevant geologic resources, the geologic hazard layers in the Mercer Island GIS Portal, the Mercer Island City Code, and our site reconnaissance, there were no conditions present that constitute geologic hazards. As such, there are not any buffers or setbacks to be applied or any other special mitigation for geologic hazards for the proposed development.

Soil Design Recommendations

Soil Design Recommendations Summary

Based the subsurface information obtained, it is our opinion that the native Vashon recessional outwash and lodgement till soils are suitable for support of conventional spread footing foundations and structural fills. For ease of reference, the site-specific soil design values we have determined are shown below:

- Allowable soil bearing capacity of native soils or structural fill over native soils = 2,000 pounds per square foot
- Coefficient of Friction = 0.35
- Passive Equivalent Fluid Pressure = 250 pounds per cubic foot
- Seismic Site Class = C

The above values are allowable and include appropriate factors of safety. This information is presented in more detail in the following sections and these sections should be read to understand the proper context.

Site Preparation and Site Grading

It is likely that structural fill soils will be required to establish grades for the project. Any fill soil placed beneath a foundation, retaining wall, or driveway/parking area must be constructed as a structural fill. In areas that will provide structural support, any existing fill soils or loose soils should be removed and replaced with structural fill as described below.

Structural fill is defined as non-organic soil, placed in horizontal loose lifts, with each lift being compacted to at least 95 percent of the maximum dry density, using the modified Proctor test (ASTM: D1557) as the standard. Prior to placing any structural fill, the exposed soils must either be undisturbed or be compacted to a dense, non-yielding condition and be approved for structural fill placement. In the case of utility trench filling, the backfill should be placed and compacted in accordance with the applicable municipal or utility company standards.

Fill soils should be predominantly free of organics and other deleterious material and should be appropriately moisture conditioned when placed and compacted. Placement and compaction of the structural fill should be monitored by a competent field technician. In situ density testing should be performed during fill placement to verify proper compaction of the fill soil. A sample of the planned structural fill soil will need to be available at least 48 hours prior to compaction verification testing for laboratory analysis.

Foundations

Spread footings founded on medium dense or denser native soils or structural fill (95 percent maximum dry density as determined by Modified Proctor ASTM: D1557) placed atop the native soils may be designed using an allowable bearing pressure of 2,000 pounds per square foot (psf), including both dead and live loads. An increase of one-third may be used for short-term wind or seismic loading. All footings must penetrate to the prescribed bearing stratum, and no footing should be founded in or above loose, organic, or existing fill soils.

Anticipated settlements of spread footings designed as described above may be on the order of ½-inch over the expected lifespan of the structure. Loose or disturbed surface soils, excessive moisture present, or poor foundation subgrade preparation could result in larger settlements.

Lateral Resistance

Lateral loads can be resisted by friction between the foundation and the supporting soils, and/or by passive earth pressure acting on the buried portions of the foundations. The spread footings must be backfilled with structural fill compacted to a dense, non-yielding condition to achieve the passive resistance provided below. The structural fill must extend horizontally outward from the embedded portion of the foundation a distance equal to at least three times the embedment depth over which the passive resistance is applied. We recommend the following design parameters:

- Passive equivalent fluid = 250pounds per cubic foot
- Coefficient of friction = 0.35

The above values are allowable and include appropriate factors of safety.

Seismic Design Considerations

The subject property is not a seismic hazard area, and no special mitigation is required. The following subsections will address the potential risks associated with a seismic event with respect to project design:

In general, there are four elements of hazard associated with large seismic events: ground rupture; seismically induced landslides; liquefaction; and ground motion. The potential for these phenomena to impact the subject property is discussed below.

Ground Rupture

Most large earthquakes in the Puget Sound area are sub-crustal events with epicenters ranging from 50 to 70 kilometers in depth. Based on our review of the USGS Quaternary Fault Map, the subject property lies within the Seattle Fault Zone (SFZ), with two mapped fault strands just south of the subject property. These fault strands are mapped as "moderately constrained location" and surface fault exposure was not mapped on the referenced geologic map. (Troost & Wisher, 2006). Also, research has estimated the recurrence interval on some fault strands of the SFZ to be on the order of 200 to 12,000 years (Johnson, et al., 2016). Based on the lack of evidence of past ground rupture in the immediate vicinity of the subject property, the estimated recurrence interval of the fault strands, and the surficial glacial sediments overlying the bedrock geology, it is our opinion that the probability of ground surface rupture impacting the subject property is low, and no mitigations are necessary.

Seismically Induced Landslides

Due to the flat to gently sloping site conditions on and adjacent to the subject property and the relatively dense native soils present, it is our opinion that the potential for landslides to affect the subject property is very low. No mitigation is necessary.

Liquefaction

Liquefaction is a condition where loose, saturated, fine sands lose their shear strength due to rapid pore pressure build-up when subjected to high intensity cyclic loads that can occur during earthquakes. Due to the unsaturated, medium dense recessional outwash and dense lodgement till soils present, it is our opinion that the liquefaction potential is negligible, and no mitigations are necessary.

Ground Motion

Seismic hazards that will affect the structure would likely be due to the intensity and duration of the ground shaking. The structural design of the project should be consistent with 2018 International Building Code (2018 IBC) guidelines (Section 1613). Based on our estimation of soil properties at depth utilizing available geologic data, Site Class "C" may be used for the design of the project, as defined by ASCE 7 "Minimum Design Loads for Buildings and Other Structures", Chapter 20.

Retaining Walls

Due to the flat to gently sloping topography we do not anticipate that significant retaining walls will be needed for this project. If proposed, South Fork Geosciences should be contacted to review any cast-in-place concrete retaining walls, segmental block walls, or rockeries that are greater than 4 feet in height.

Floor Support

We anticipate that the new home will utilize a combination of slab-on-grade floors and structural/crawl space-type floors. Slab-on-grade concrete floors should be cast atop native soils or structural fill soils. A capillary break layer with a minimum thickness of 4 inches should be placed atop the prepared soil subgrade. The capillary break material should be a gap graded material consisting of pea gravel, ¾-inch washed drain rock, or clean crushed rock with less than 5 percent fines (material passing the No.200 sieve). The capillary break will reduce the potential for moisture wicking through the floor slab. A 10-mil thick plastic vapor barrier should also be placed atop the capillary break material. All concrete placement should follow the guidelines set forth by the American Concrete Institute (ACI). In areas where structural/crawl space-type floors are used the soil surface should be covered with a minimum 10-mil thick moisture barrier.

Drainage Considerations

Foundation Drainage

A perimeter foundation drain should be established to protect the floor slab and internal crawlspace areas from ground water intrusion. The level of the foundation drain should be set at, or slightly below, the base of the footing elevation. The drain should consist of 4-inch diameter, rigid, perforated, PVC drainpipe and should be set to allow for gravity discharge. The drainpipe should be surrounded by a minimum of 6 inches of pea gravel or washed drain rock. Roof drains should not tie into the footing drain but should be collected in a separate, tightline drain. The foundation drain should be set to discharge via gravity to a dispersion pad on the ground surface or to stormwater conveyance. As a standard of practice exterior grades should slope slightly away from foundations.

Site Drainage/Stormwater Management

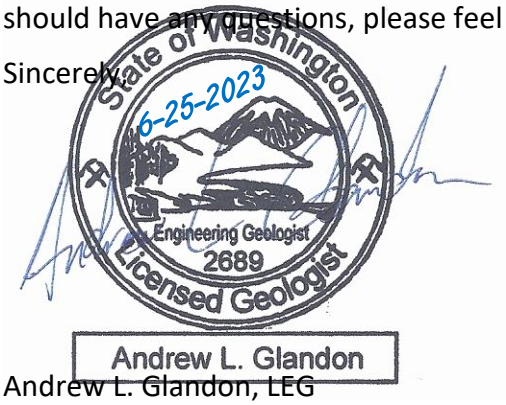
The recessional outwash sediments are relatively permeable, but the underlying dense lodgement till sediments have very low permeability. We presume that the stormwater generated from new impervious surfaces on the project will be dispersed on site or conveyed to nearby stormwater infrastructure in the 80th Avenue SE right of way.

The stormwater drainage design for the project will be designed by the project civil engineer. South Fork Geosciences is available for additional consultation with respect to site drainage, if necessary.

Closure

We trust that this information will aid in the design and permitting of your project. If you should have any questions, please feel free to contact us.

Sincerely,



Andrew L. Glandon, LEG
Engineering Geologist / Owner
South Fork Geosciences, PLLC

Attachments: Soil Exploration Location
Soil Exploration Pit Log
Grain Size Analyses (2 Pages)

References:

"Geologic Map of Mercer Island, Washington", by Kathy G. Troost & Aaron P. Wisher, October 2006, Scale 1:12,000

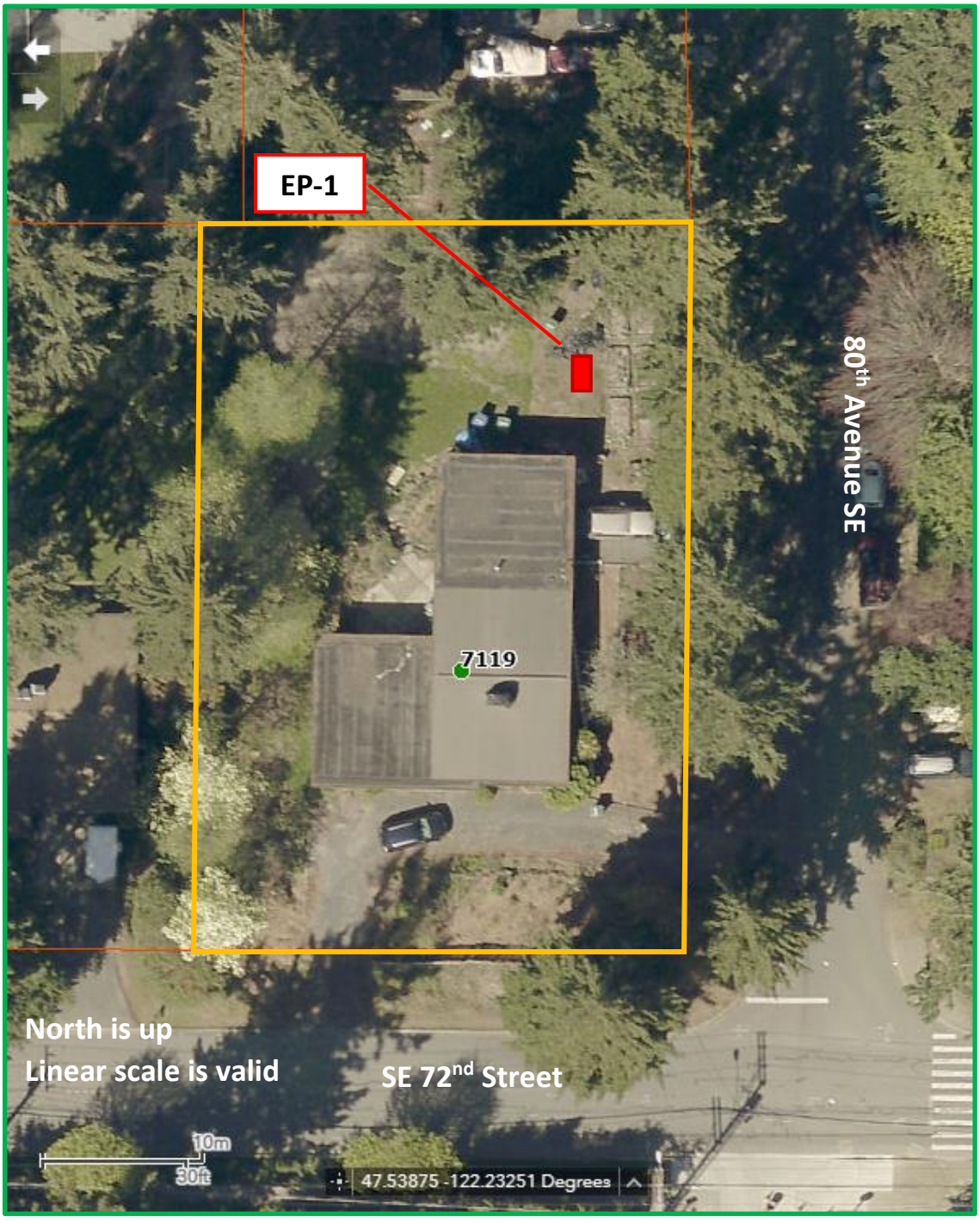
Washington Geologic Information Portal

U.S. Quaternary Faults (arcgis.com)

City Code | Mercer Island, WA | Municode Library

City of Mercer GIS Portal (mercergov.org)

King County Department of Assessments: TPN 9159700050



Source: King County iMap

Soil Exploration Location

Soil Exploration Log

EP-1 **6-5-2023**

	Grass at surface
0-2ft	medium dense, damp, light brown-gray fine to medium SAND with gravel and silt, some roots (SP-SM) [Fill] • Thin paleosol observed at 2 feet
2-5.5	medium dense, damp, light brown fine to medium SAND trace gravel, trace silt (SP) [Vashon Recessional Outwash]
5.5-7ft	dense, damp, gray silty fine to medium SAND with gravel (SM) [Vashon Lodgement Till] • Near zero air voids
Total Depth = 7 feet	No groundwater seepage observed. No caving observed. Sampled at 3.5 and 7 feet.

Professional Service Industries, Inc.
16750 Woodinville Redmond Rd NE Ste 102
Woodinville, WA 98072

Phone: (425) 409-2504

Report No: MAT:07122272-79-S1
Issue No: 1

Material Test Report

Client: SOUTH FORK GEOSCIENCES PLLC
PO BOX 1275
NORTH BEND, WA 98045

CC: ANDY GLANDON

Project: SOUTH FORK GEOSCIENCES T&M
SEATTLE, WA

Approved Signatory: Deborah Priest (Senior Project Engineer)
Date of Issue: 6/9/2023

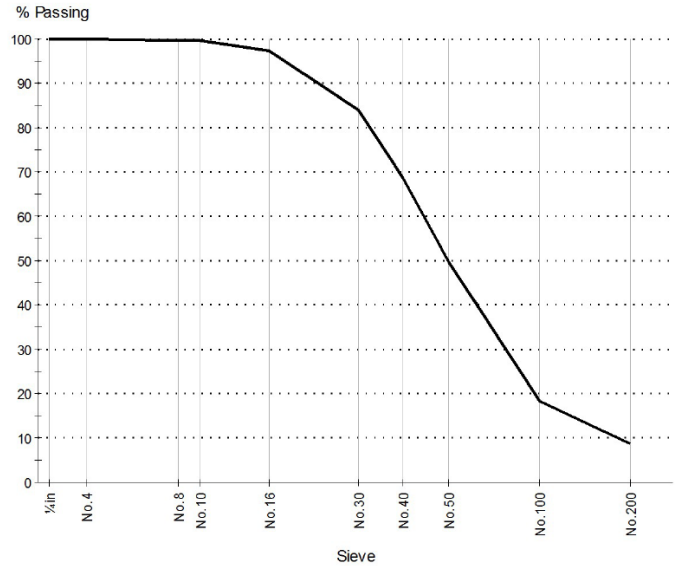
Sample Details

Sample ID:	07122272-79-S1
Client Sample ID:	
Date Sampled:	06/05/23
Sampled By:	Client
Specification:	no specifications
Supplier:	
Source:	
Material:	
Sampling Method:	Stockpile/Trans - ASTM D 75 - 5.3.3
Soil Description:	fine brown soil
General Location:	MN 472 EP-1 -3.5 feet
Location:	MN 472 EP-1 -3.5 feet

Sample Description:

fine brown soil

Particle Size Distribution



COBBLES	GRAVEL		SAND			FINES (8.7%)	
(0.0%)	Coarse (0.0%)	Fine (0.1%)	Coarse (0.3%)	Medium (30.9%)	Fine (60.0%)	Silt	Clay

Grading: ASTM C 136, ASTM C 117

Drying By: Oven
Date Tested: 6/9/2023
Tested By: Kurtis Wahl

Sieve Size	% Passing	Limits
¼in (6.3mm)	100.0	
No.4 (4.75mm)	99.9	
No.8 (2.36mm)	99.7	
No.10 (2.0mm)	99.6	
No.16 (1.18mm)	97.5	
No.30 (600µm)	84.1	
No.40 (425µm)	68.7	
No.50 (300µm)	49.6	
No.100 (150µm)	18.2	
No.200 (75µm)	8.7	

D85: 0.6279 **D60:** 0.3626 **D50:** 0.3022
D30: 0.1946 **D15:** 0.1188 **D10:** 0.0825
Cu: 4.40 **Cc:** 1.27

Professional Service Industries, Inc.
16750 Woodinville Redmond Rd NE Ste D102
Woodinville, WA 98072

Phone: (425) 409-2504

Material Test Report

Report No: MAT:07122272-79-S2
Issue No: 1

Client: SOUTH FORK GEOSCIENCES PLLC
PO BOX 1275
NORTH BEND, WA 98045

CC: ANDY GLANDON

Project: SOUTH FORK GEOSCIENCES T&M
SEATTLE, WA

Approved Signatory: Deborah Priest (Senior Project Engineer)
Date of Issue: 6/9/2023

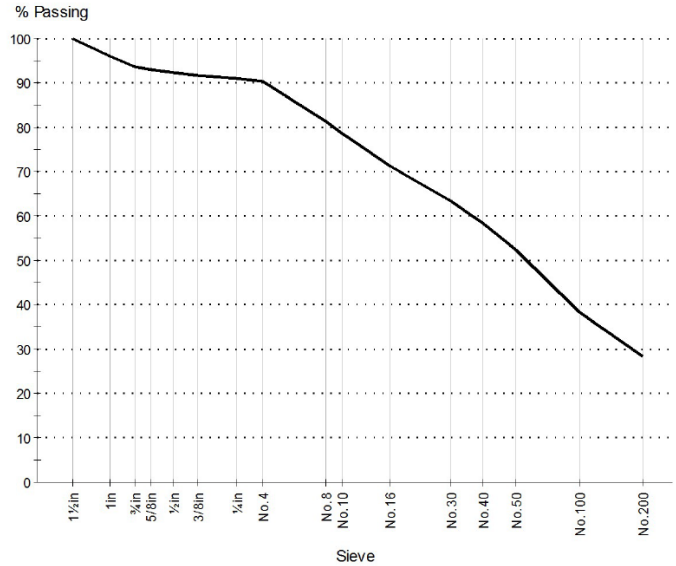
Sample Details

Sample ID:	07122272-79-S2
Client Sample ID:	
Date Sampled:	06/06/23
Sampled By:	Client
Specification:	no specifications
Supplier:	
Source:	
Material:	
Sampling Method:	Stockpile/Trans - ASTM D 75 - 5.3.3
Soil Description:	grey silty soil with rock
General Location:	MN 472 EP-1 -7 feet
Location:	MN 472 EP-1 -7 feet

Sample Description:

grey silty soil with rock

Particle Size Distribution



COBBLES	GRAVEL		SAND			FINES (28.2%)	
(0.0%)	Coarse (6.3%)	Fine (3.4%)	Coarse (11.5%)	Medium (20.5%)	Fine (30.0%)	Silt	Clay

Grading: ASTM C 136, ASTM C 117

Drying By: Oven
Date Tested: 6/9/2023
Tested By:

Sieve Size	% Passing	Limits
1½in (37.5mm)	100.0	
1in (25.0mm)	95.9	
¾in (19.0mm)	93.7	
5/8in (16.0mm)	92.9	
½in (12.5mm)	92.5	
3/8in (9.5mm)	91.8	
¼in (6.3mm)	91.1	
No.4 (4.75mm)	90.3	
No.8 (2.36mm)	81.4	
No.10 (2.0mm)	78.7	
No.16 (1.18mm)	71.4	
No.30 (600µm)	63.5	
No.40 (425µm)	58.2	
No.50 (300µm)	52.2	
No.100 (150µm)	38.4	
No.200 (75µm)	28.2	

D85: 3.1318 **D60:** 0.4778 **D50:** 0.2686
D30: 0.0848 **D15:** N/A **D10:** N/A