GEOTECHNICAL REPORT

Mercer Island Residence
3310 – 97th Avenue SE
Mercer Island, Washington

Project No. T-8257

Terra Associates, Inc.

Prepared for:

Northbrook Construction Management
North Bend, Washington

December 16, 2019
Revised January 26, 2021

TERRA ASSOCIATES, Inc.
Consultants in Geotechnical Engineering, Geology
and
Environmental Earth Sciences

December 16, 2019
Revised January 26, 2021
Project No. T-8257

Mr. Ken Brooks
Northbrook Construction Management
13212 – 409th Avenue SE
North Bend, Washington 98045

Subject: Geotechnical Report
Mercer Island Residence
3310 – 97th Avenue SE
Mercer Island, Washington

Dear Mr. Brooks:

As requested, we have conducted a geotechnical engineering study for the subject project. The attached report presents our findings and recommendations for the geotechnical aspects of project design and construction.

In general, the soil conditions observed at the test borings consisted of stiff to hard sandy silt with variable sand and gravel content to the termination of the borings. Although significant depths of organic soil were not observed, a portion of the proposed construction site is currently a planter area that will likely have some amount of organic material that will need to be overexcavated from below building elements. No groundwater was observed during drilling activities; however, mottled soils were observed in the borings.

In our opinion, the soil conditions observed at the site will be suitable for support of the proposed development, provided the recommendations presented in this report are incorporated into project design and construction.

We trust the information presented in this report is sufficient for your current needs. If you have any questions or require additional information, please call.

Sincerely yours,
TERRA ASSOCIATES, INC.

Stephanie King

Stephanie L. King, E.I.T.
Staff Engineer

CAROLYN S. DECKER
47018

Carolyn S. Decker

Carolyn S. Decker, P.E.
Project Engineer

1-26-2021

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Mercer Island Residence
3310 – 97th Avenue SE
Mercer Island, Washington

1.0 PROJECT DESCRIPTION

The project consists of lifting a portion of the existing house and rotating it so the house will face north/northwest to look onto Lake Washington. In addition to the rotation, the current planter area on the north side of the house will be converted into a partially above ground pool/dance floor. New foundations will be constructed under the existing building to support the construction. Based on the grading plans prepared by LPD Engineering, PLLC, grading is expected to be minor ,with cuts and fills from one to five feet.

The structure constructed on the lot is expected to remain a one- to two-story building framed over a crawl space. Foundation loads should be relatively light, in the range of 4 to 6 kips per foot for bearing walls and 50 to 75 kips for isolated columns.

The recommendations in the following sections of this report are based on the design discussed above. If actual features vary or changes are made, we should review the plans in order to modify our recommendations, as needed. We should review final design drawings and specifications to verify our recommendations have been properly interpreted and incorporated into the project design.

2.0 SCOPE OF WORK

On November 18, 2019, we observed soil and groundwater conditions at the site by drilling 1 test boring using a limited-access drill rig to an approximate depth of 21.5 feet; and 3 borings using a portable limited-access acker drill rig to depths of approximately 6.5 to 11.5 feet below existing site grades. Additionally, 6 hand holes were hand-augered within the existing crawl space of the house to depths of 10 to 18 inches below the existing floor slab where the proposed footings are located. Using this data and laboratory testing, we performed analyses to develop geotechnical recommendations for project design and construction. Specifically, this report addresses the following:

- Soil and groundwater conditions.
- Seismic criteria per the 2015 International Building Code (IBC).
- Geologic hazards per the City of Mercer Island Municipal Code.
- Site preparation and grading.
- Relative slope stability.

- Excavations
- Foundation support.
- Slab-on-grade floor support.
- Lateral earth pressures on below-grade walls.
- Drainage
- Utilities

It should be noted, recommendations outlined in this report regarding drainage are associated with soil strength, design earth pressures, erosion, and stability. Design and performance issues with respect to moisture as it relates to the structure environment are beyond Terra Associates, Inc.'s purview. A building envelope specialist or contractor should be consulted to address these issues, as needed.

3.0 SITE CONDITIONS

3.1 Surface

The project site consists of a single tax parcel totaling approximately 0.65 acres located at 3310 – 97th Avenue SE in Mercer Island, Washington. The approximate site location is shown on Figure 1.

The site is currently developed with a one- to two-story, two-part, detached house/storage unit and associated access and landscaping. Site topography consists of a slope that descends from the south to the north with an overall relief of approximately 35 feet. The house is constructed into and on the slope and is currently facing directly north.

3.2 Subsurface

In general, the soil conditions observed at the test borings consisted of four inches of organic topsoil over stiff to hard sandy silt with variable sand and gravel content to the termination of the borings.

The *Geologic Map of Mercer Island, Washington,* by Kathy G. Troost and Aaron P. Wisher (October 2006) maps the site as modified Recessional Lacustrine Deposits (Qvrl). This mapped description is consistent with the native soils we observed in our test borings.

The preceding discussion is intended to be a general review of the soil conditions encountered. For more detailed descriptions, please refer to the Test Boring and Hand Hole logs in Appendix A. The approximate location of the Test Borings and Hand Holes are shown on Figure 2.

3.3 Groundwater

No groundwater was observed within the test borings; however, mottled soils were observed in the outside borings between two and ten feet below current site grades. We would expect that shallow groundwater seepage develops during the normally wet winter months along the contact between the upper sandy silt layers and underlying hard glacial material. Mottling of the upper layer indicates slow fluctuating seepage flows. This occurs as a result of rainfall that infiltrates through the upper weathered soil zone and becomes perched on the underlying hard material. As a result, groundwater seepage will develop and tend to flow laterally along the contact. Locally, such seepage is referred to as interflow.

The occurrence of interflow will fluctuate seasonally with the highest seepage levels occurring during the normally wet winter to late spring months (November to June).

3.4 Geologic Hazards

We evaluated site conditions for the presence of geologic hazards including erosion hazard areas, landslide hazard areas, and seismic hazard areas. Our findings are presented below.

3.4.1 Erosion Hazard Areas

Section 19.16.010 of the Mercer Island Municipal Code (MIMC) defines an erosion hazard as "areas greater than 15 percent slope and subject to a severe risk of erosion due to wind, rain, water, slope, and other natural agents including those soil types and/or areas identified by the U.S. Department of Agriculture's Natural Resources Conservation Service as having a "severe" or "very severe" rill and inter-rill erosion hazard."

The soils observed onsite are classified as Kitsap Silt Loam (KpB) by the United States Department of Agriculture Natural Resources Conservation Service (NRCS), formerly the Soil Conservation Service. With the existing slope gradients, these soils will have a moderate potential for erosion when exposed. Therefore, the site is not categorized as an erosion hazard area per the MIMC. Regardless, erosion protection measures as required by the City of Mercer Island will need to be in place prior to starting grading activities on the site. This would include perimeter silt fencing to contain erosion onsite and cover measures to prevent or reduce soil erosion during and following construction.

3.4.2 Landslide Hazard Areas

Section 19.16.010 of the MIMC defines a landslide hazard as "areas subject to landslides based on a combination of geologic, topographic, and hydrologic factors, including:

1. Areas of historic failures.

2. Areas with all three of the following characteristics:
    a. Slopes steeper than 15 percent.
    b. Hillsides intersecting geologic contacts with relatively permeable sediment overlying a relatively impermeable sediment or bedrock.
    c. Springs or groundwater seepage.

3. Areas that have shown evidence of past movement or that are underlain or covered by mass wastage debris from past movements.

4. Areas potentially unstable because of rapid stream incision and stream bank erosion.

5. Steep Slope. Any slope of 40 percent or greater calculated by measuring the vertical rise over any 30-foot horizontal run."

None of these conditions are present at the site. Therefore, the site is not a landslide hazard as defined by the MIMC in our opinion.

Since part of the proposed construction includes replacing the soil at the toe of the slope with a pool, we completed a slope stability analysis to determine if this could potentially cause some instability. Our analysis was completed at a location designated as Cross-Section A-A' using the computer program Slide 2018. The approximate cross-section location is shown on Figure 2.

Our analysis considered both static and the pseudostatic (seismic) conditions. A horizontal acceleration of 0.28g was used in the pseudostatic analysis to simulate slope performance under earthquake loading. This acceleration is equal to one-half of the peak horizontal ground acceleration with a two-percent in 50-year probability of exceedance as defined by the 2015 International Building Code.

Based on our field exploration, laboratory testing, and previous experience with similar soil types, we chose the following parameters for our analysis:

Table 1 – Slope Stability Analysis Soil Parameters

Soil Type	Unit Weight (pcf)	Friction Angle (Degrees)	Cohesion (psf)
Stiff SILT	110	28	150
Very stiff sandy SILT	115	30	250
Hard sandy SILT	115	35	500

The results of our slope stability analysis, as shown by the lowest safety factors for each condition, are presented in the following table:

Table 2 – Slope Stability Analysis Results

Cross Section	**Minimum Safety Factors**	
	Existing Conditions	***Post Construction***
A-A’	1.80 (Seismic FS = 1.20)	1.86 (Seismic FS = 1.82)

Based on our analysis, the proposed project has no impact on the existing steep slope. Therefore, the site can be constructed as proposed, in our opinion. The results of our analysis are attached in Appendix B.

3.4.3 Seismic Hazard Areas

Section 19.16.010 of the MIMC defines a seismic hazard area as “areas subject to severe risk of damage as a result of earthquake induced ground shaking, slope failure, settlement, soil liquefaction or surface faulting.”

Liquefaction is a phenomenon where there is a reduction or complete loss of soil strength due to an increase in water pressure induced by vibrations. Liquefaction mainly affects geologically recent deposits of fine-grained sand below the groundwater table. Soils of this nature derive their strength from intergranular friction. The generated water pressure or pore pressure essentially separates the soil grains and eliminates this intergranular friction; thus, eliminating the soil’s strength.

Based on the soil and groundwater conditions we observed at the site, the risk for damage resulting from soil liquefication or subsidence during a severe seismic event is negligible in our opinion. Therefore, unusual seismic hazard areas do not exist at the site and design in accordance with local building codes for determining seismic forces would adequately mitigate impacts associated with ground shaking.

3.5 Seismic Design Parameters

Based on soil conditions noted in the subsurface explorations and our knowledge of the area geology, per Chapter 16 of the 2015 International Building Code (IBC), site class “D” should be used in structural design.

3.6 City of Mercer Island Critical Area Requirement

Per Section 19.07.160.B.3, “An evaluation of site-specific subsurface conditions demonstrates that the proposed development is not located in a landslide hazard area or seismic hazard area”. Based on the site topography and soil explorations, the site is not within a landslide hazard area or seismic hazard area. Therefore, it is our opinion that the proposed project can be constructed as designed without negatively impacting the project site, adjacent body of water, or adjacent properties.

4.0 DISCUSSION AND RECOMMENDATIONS

4.1 General

Based on our study, there are no geotechnical considerations that would preclude development of the site as currently planned. The structure can be supported on conventional spread footings bearing on competent inorganic native soils or on new structural fill placed and compacted above the competent soils. Floor slabs can be similarly supported.

The native soils encountered contain a sufficient amount of soil fines and will be difficult to compact as structural fill when too wet. The ability to use these native soils from site excavations as structural fill will depend on its moisture content and the prevailing weather conditions at the time of construction. If grading activities will take place during winter, the owner should be prepared to import clean granular material for use as structural fill and backfill.

The following sections provide detailed recommendations regarding the preceding issues and other geotechnical design and construction considerations. These recommendations should be incorporated into the final design drawings and construction specifications.

4.2 Site Preparation and Grading

To prepare the site for construction, all vegetation and organic surface soils should be stripped and removed from below the new construction/remodeling areas. Although no fill soils were observed during subsurface exploration, fill or organic soils should be anticipated within the upper one to two feet of the current planter area. Soil containing organic material will not be suitable for use as structural fill, but may be used for limited depths in nonstructural areas.

Once stripping operations are complete, cut and fill operations can be initiated to establish desired grades. Prior to placing fill, all exposed bearing surfaces should be observed by a representative of Terra Associates, Inc. to verify soil conditions are as expected and suitable for support of building foundations or placement of structural fill. If unsuitable yielding areas are observed, they should be cut to firm bearing soil and filled to grade with structural fill. If depth of excavation to remove unstable soils is excessive, use of a geotextile fabric such as Mirafi 500X or equivalent in conjunction with structural fill can be considered in order to limit the depth of removal. Our experience has shown, in general, a minimum of 18 inches of a clean, granular structural fill placed and compacted over the geotextile fabric should establish a stable bearing surface.

Our study indicates the site soils contain a sufficient percentage of fines (silt-sized particles) that will make them difficult to compact as structural fill if they are too wet or too dry. The ability to use the native soils as structural fill will depend on their moisture content and the prevailing weather conditions when site grading activities take place. If wet soils are encountered, the contractor will need to dry the soils by aeration during dry weather conditions. Alternatively, the use of an additive such as Portland cement or lime to stabilize the soil moisture can be considered. If the soil is amended, additional Best Management Practices (BMPs) addressing the potential for elevated pH levels will need to be included in the Stormwater Pollution Prevention Program (SWPPP) prepared with the Temporary Erosion and Sedimentation Control (TESC) plan.

If grading activities are planned during the wet winter months, or if they are initiated during the summer and extend into fall and winter, the owner should be prepared to import wet-weather structural fill. For this purpose, we recommend importing a granular soil that meets the following grading requirements:

U.S. Sieve Size	Percent Passing
6 inches	100
No. 4	75 maximum
No. 200	5 maximum*

* Based on the ¾-inch fraction.

Prior to use, Terra Associates, Inc. should examine and test all materials imported to the site for use as structural fill.

Structural fill should be placed in uniform loose layers not exceeding 6 inches and compacted to a minimum of 95 percent of the soil's maximum dry density, as determined by American Society for Testing and Materials (ASTM) Test Designation D-698 (Standard Proctor). The moisture content of the soil at the time of compaction should be within two percent of its optimum, as determined by this ASTM standard. In nonstructural areas, the degree of compaction can be reduced to 90 percent.

4.3 Excavations

All excavations at the site associated with confined spaces, such as utility trenches, must be completed in accordance with local, state, and federal requirements. Based on regulations outlined in the Washington Industrial Safety and Health Act (WISHA), the onsite soils would be classified as Type B soil.

Accordingly, temporary excavations in Type B soils should have their slopes laid back at an inclination of 1:1 (Horizontal:Vertical) or flatter, from the toe to the crest of the slope. All exposed temporary slope faces that will remain open for an extended period of time should be covered with a durable reinforced plastic membrane during construction to prevent slope raveling and rutting during periods of precipitation.

The above information is provided solely for the benefit of the owner and other design consultants and should not be construed to imply that Terra Associates, Inc. assumes responsibility for job site safety. It is understood that job site safety is the sole responsibility of the project general contractor.

4.4 Foundation Support

The building may be supported on conventional isolated or continuous footing foundations bearing on competent native soils or new structural fills placed above competent soils. Foundation subgrades should be prepared as recommended in Section 4.2 of this report. Perimeter foundations exposed to the weather should be at a minimum depth of 18 inches below final exterior grades. Interior foundations can be constructed at any convenient depth below the floor slab.

We recommend designing foundations supported on competent material for a net allowable bearing capacity of 2,000 pounds per square foot (psf) for foundation supported within the upper 3 feet. For foundations that are supported on soils deeper than 3 feet, the bearing capacity can be increased to 3,000 psf. For short-term loads, such as wind and seismic, a one-third increase in this allowable capacity can be used in design. With the anticipated loads and this bearing stress applied, building settlements should be less than one-half inch total and one-quarter inch differential.

For designing foundations to resist lateral loads, a base friction coefficient of 0.35 can be used. Passive earth pressures acting on the side of the footing and buried portion of the foundation stem wall can also be considered. We recommend calculating this lateral resistance using an equivalent fluid weight of 300 pcf. We recommend not including the upper 12 inches of soil in this computation because they can be affected by weather or disturbed by future grading activity. This value assumes the foundation will be constructed neat against competent native soil or backfilled with structural fill as described in Section 4.2 of this report. The values recommended include a safety factor of 1.5.

4.5 Slab-on-Grade Floors

Slab-on-grade floors may be supported on a subgrade as recommended in Section 4.2. Immediately below the floor slab, we recommend placing a four-inch thick capillary break layer composed of clean, coarse sand or fine gravel that has less than three percent passing the No. 200 sieve. This material will reduce the potential for upward capillary movement of water through the underlying soil and subsequent wetting of the floor slab.

The capillary break layer will not prevent moisture intrusion through the slab caused by water vapor transmission. Where moisture by vapor transmission is undesirable, such as covered floor areas, a common practice is to place a durable plastic membrane on the capillary break layer and then cover the membrane with a layer of clean sand or fine gravel to protect it from damage during construction, and to aid in uniform curing of the concrete slab. It should be noted, if the sand or gravel layer overlying the membrane is saturated prior to pouring the slab, it will not be effective in assisting uniform curing of the slab and can actually serve as a water supply for moisture bleeding through the slab, potentially affecting floor coverings. Therefore, in our opinion, covering the membrane with a layer of sand or gravel should be avoided if floor slab construction occurs during the wet winter months and the layer cannot be effectively drained. We recommend floor designers and contractors refer to the current American Concrete Institute (ACI) Manual of Concrete Practice for further information regarding vapor barrier installation below slab-on-grade floors.

4.6 Lateral Earth Pressures on Below-Grade Walls

The magnitude of earth pressure development on retaining walls will partly depend on the quality of the wall backfill. We recommend placing and compacting wall backfill as structural fill as described in Section 4.2 of this report. To guard against hydrostatic pressure development, drainage must be installed behind the wall. A typical wall drainage detail is shown on Figure 3.

With wall backfill placed and compacted as recommended and drainage properly installed, we recommend designing unrestrained walls for an active earth pressure equivalent to a fluid weighing 35 pounds per cubic foot (pcf). For restrained walls, an additional uniform load of 100 psf should be added to the 35 pcf. For evaluation of wall performance under seismic loading, a uniform pressure equivalent to 8H psf, where H is the height of the below-grade portion of the wall should be applied in addition to the static lateral earth pressure. These values assume a horizontal backfill condition and that no other surcharge loading, sloping embankments, or adjacent buildings will act on the wall. If such conditions exist, the imposed loading must be included in the wall design. Friction at the base of foundations and passive earth pressure will provide resistance to these lateral loads. Values for these parameters are provided in Section 4.4 of this report.

4.7 Infiltration Feasibility

Based on our study, it is our opinion that subsurface conditions are generally not favorable for infiltration of site stormwater. The native soils observed at the site contain a high percentage of soil fines that would impede any downward migration of site stormwater. Additionally, mottling was observed that indicates a shallow groundwater table develops at the site during the wet winter months that would further impede any stormwater migration. Even low-impact development (LID) techniques would likely fill up and overtop during rain events and cause minor local flooding. Based on these soil conditions, the stormwater should be managed using a conventional system.

4.8 Drainage

Surface

Final exterior grades should promote free and positive drainage away from the site at all times. Water must not be allowed to pond or collect adjacent to foundations or within the immediate building areas. We recommend providing a positive drainage gradient away from the building perimeters. If this gradient cannot be provided, surface water should be collected adjacent to the structures and directed to appropriate stormwater facilities.

Subsurface

We recommend installing perimeter foundation drains adjacent to exterior shallow foundations. The drains can be laid to grade at an invert elevation equivalent to the bottom of footing grade. The drains can consist of four-inch diameter perforated PVC pipe enveloped in washed pea gravel-sized drainage aggregate. The aggregate should extend six inches above and to the sides of the pipe. Roof and foundation drains should be tightlined separately to the storm drains. All drains should be provided with cleanouts at easily accessible locations.

4.9 Utilities

Utility pipes should be bedded and backfilled in accordance with American Public Works Association (APWA) or local jurisdictional requirements. At minimum, trench backfill should be placed and compacted as structural fill as described in Section 4.2 of this report. As noted, soils excavated onsite should generally be suitable for use as backfill material during dry weather. However, the site soils are fine-grained and moisture sensitive. Therefore, moisture conditioning may be necessary to facilitate proper compaction. If utility construction takes place during the winter, it may be necessary to import suitable wet-weather fill for utility trench backfilling.

5.0 ADDITIONAL SERVICES

Terra Associates, Inc. should review the final design drawings and specifications in order to verify earthwork and foundation recommendations have been properly interpreted and implemented in project design. We should also provide geotechnical service during construction to observe compliance with our design concepts, specifications, and recommendations. This will allow for design changes if subsurface conditions differ from those anticipated prior to the start of construction.

6.0 LIMITATIONS

We prepared this report in accordance with generally accepted geotechnical engineering practices. No other warranty, expressed or implied, is made. This report is the copyrighted property of Terra Associates, Inc. and is intended for specific application to the Mercer Island Residence project in Mercer Island, Washington. This report is for the exclusive use of Northbrook Construction Management and their authorized representatives.

The analyses and recommendations presented in this report are based on data obtained from the onsite subsurface explorations. Variations in soil conditions can occur; the nature and extent of which may not become evident until construction. If variations appear evident, Terra Associates, Inc. should be requested to reevaluate the recommendations in this report prior to proceeding with construction.

REFERENCE: https://www.bing.com/maps

ACCESSED 12/12/19

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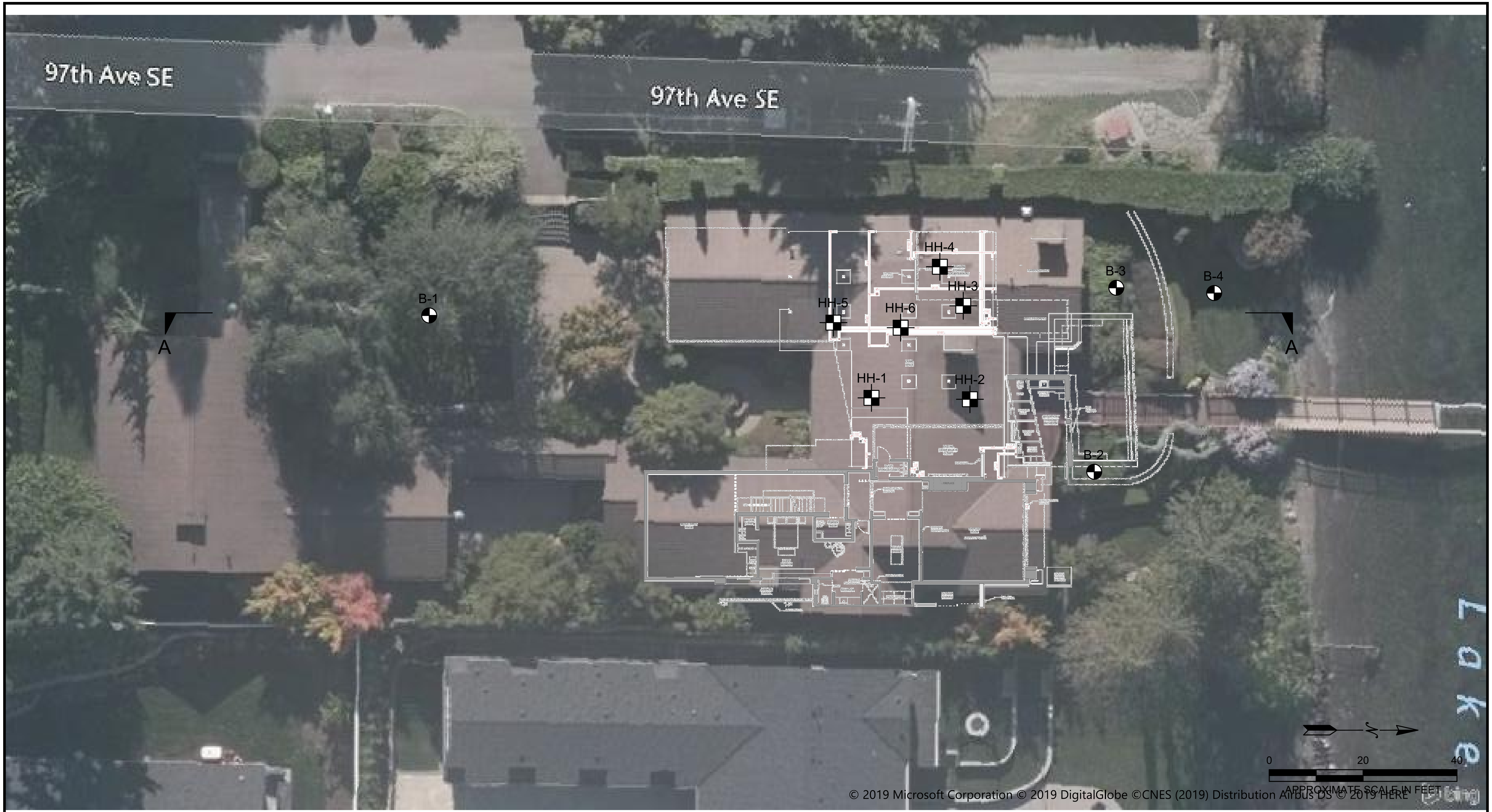
VICINITY MAP
MERCER ISLAND RESIDENCE
MERCER ISLAND, WASHINGTON

Proj.No. T-8257	Date: JAN 2021	Figure 1



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NOTE:

THIS SITE PLAN IS SCHEMATIC. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE. IT IS INTENDED FOR REFERENCE ONLY AND SHOULD NOT BE USED FOR DESIGN OR CONSTRUCTION PURPOSES.

REFERENCE: SITE PLAN PROVIDED BY ROBERT EDSON SWAN.

LEGEND:

⊞ APPROXIMATE HAND HOLE LOCATION

◐ APPROXIMATE BORING LOCATION

APPROXIMATE CROSS SECTION LOCATION

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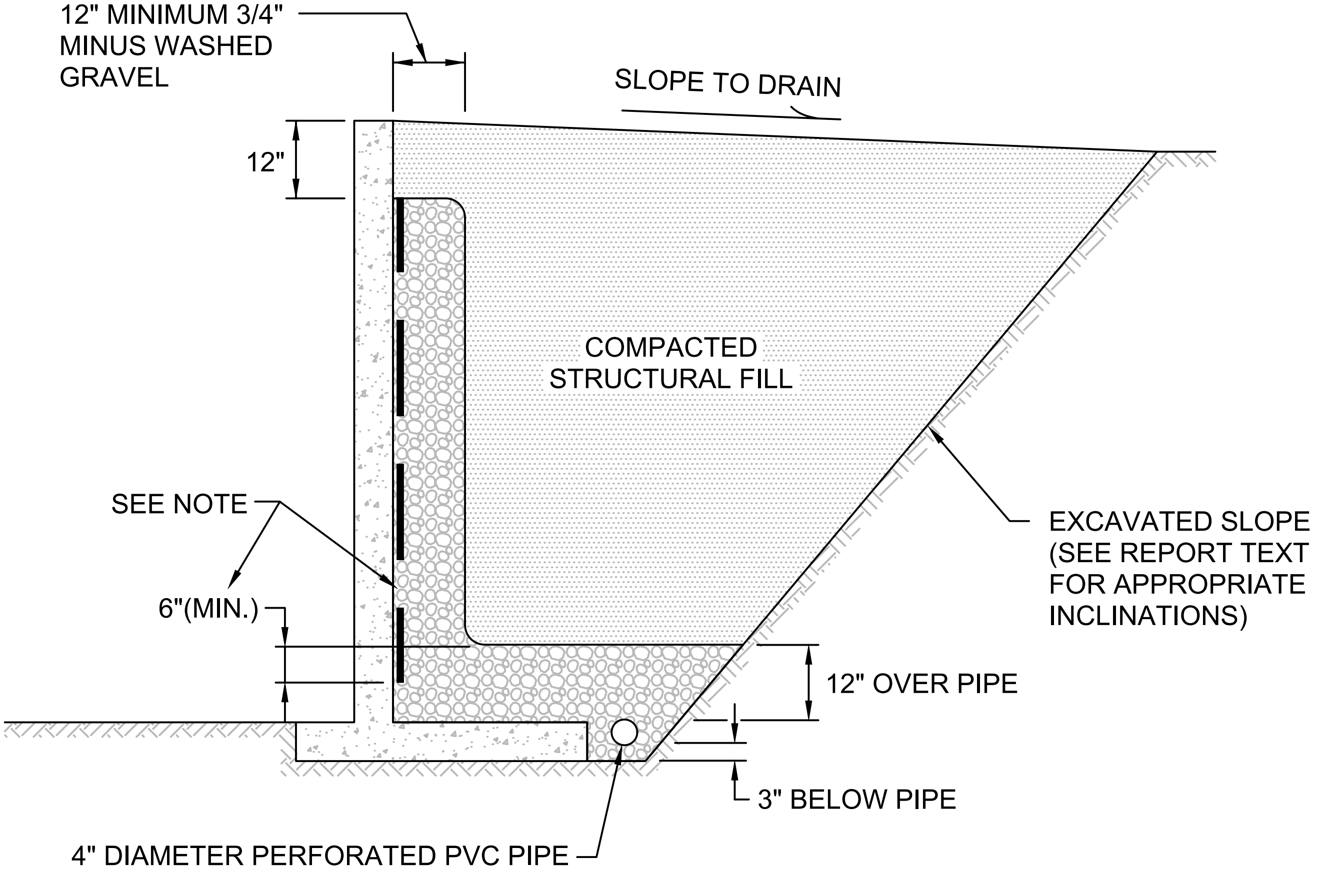
EXPLORATION LOCATION PLAN
MERCER ISLAND RESIDENCE
MERCER ISLAND, WASHINGTON

Proj.No. T-8257	Date: JAN 2021	Figure 2



NOT TO SCALE

NOTE:

MIRADRAIN G100N PREFABRICATED DRAINAGE PANELS OR SIMILAR PRODUCT CAN BE SUBSTITUTED FOR THE 12-INCH WIDE GRAVEL DRAIN BEHIND WALL. DRAINAGE PANELS SHOULD EXTEND A MINIMUM OF SIX INCHES INTO 12-INCH THICK DRAINAGE GRAVEL LAYER OVER PERFORATED DRAIN PIPE.

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TYPICAL WALL DRAINAGE DETAIL
MERCER ISLAND RESIDENCE
MERCER ISLAND, WASHINGTON

Proj.No. T-8257	Date: JAN 2021	Figure 3

APPENDIX A

FIELD EXPLORATION AND LABORATORY TESTING

Mercer Island Residence
Mercer Island, Washington

On November 18, 2019, we completed our site exploration by observing soil and groundwater conditions at 4 test borings and 6 hand holes. The machine operated test borings were performed by using a limited-access drill rig for the south side of the house to a depth of 21.5 feet and a portable smaller machine for the remaining 3 borings north of the house to a maximum depth of 10 feet. Hand holes were dug by using a hand-operated auger to a maximum depth of 1.5 feet below grade. Test boring locations were determined in the field by measurements from existing site features and buildings. The approximate location of the test borings is shown on the attached Exploration Location Plan, Figure 2. Test Boring Logs are attached as Figures A-2 through A-11.

A geotechnical engineer from our office conducted the field exploration. Our representative classified the soil conditions encountered, maintained a log of the test borings and hand holes, obtained representative soil samples, and recorded water levels observed during drilling operations. All soil samples were visually classified in accordance with the Unified Soil Classification System (USCS) described on Figure A-1.

Representative soil samples obtained from the test borings/hand holes were placed in closed containers and taken to our laboratory for further examination and testing. The moisture content of each sample was measured and is reported on the individual Test Boring/Hand Hole Logs. Grain size analyses were performed on selected samples. The results of the grain size analyses are shown on Figure A-12 through A-14.

MAJOR DIVISIONS			LETTER SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS More than 50% material larger than No. 200 sieve size	**GRAVELS** More than 50% of coarse fraction is larger than No. 4 sieve	Clean Gravels (less than 5% fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines.
			GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines.
		Gravels with fines	GM	Silty gravels, gravel-sand-silt mixtures, non-plastic fines.
			GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines.
	SANDS More than 50% of coarse fraction is smaller than No. 4 sieve	Clean Sands (less than 5% fines)	SW	Well-graded sands, sands with gravel, little or no fines.
			SP	Poorly-graded sands, sands with gravel, little or no fines.
		Sands with fines	SM	Silty sands, sand-silt mixtures, non-plastic fines.
			SC	Clayey sands, sand-clay mixtures, plastic fines.
FINE GRAINED SOILS More than 50% material smaller than No. 200 sieve size	**SILTS AND CLAYS** Liquid Limit is less than 50%		ML	Inorganic silts, rock flour, clayey silts with slight plasticity.
			CL	Inorganic clays of low to medium plasticity. (Lean clay)
			OL	Organic silts and organic clays of low plasticity.
	SILTS AND CLAYS Liquid Limit is greater than 50%		MH	Inorganic silts, elastic.
			CH	Inorganic clays of high plasticity. (Fat clay)
			OH	Organic clays of high plasticity.
HIGHLY ORGANIC SOILS			PT	Peat.

DEFINITION OF TERMS AND SYMBOLS

COHESIONLESS

Density	Standard Penetration Resistance in Blows/Foot
Very Loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	>50

COHESIVE

Consistancy	Standard Penetration Resistance in Blows/Foot
Very Soft	0-2
Soft	2-4
Medium Stiff	4-8
Stiff	8-16
Very Stiff	16-32
Hard	>32

I	2" OUTSIDE DIAMETER SPILT SPOON SAMPLER
Ⅱ	2.4" INSIDE DIAMETER RING SAMPLER OR SHELBY TUBE SAMPLER
▼	WATER LEVEL (Date)
Tr	TORVANE READINGS, tsf
Pp	PENETROMETER READING, tsf
DD	DRY DENSITY, pounds per cubic foot
LL	LIQUID LIMIT, percent
PI	PLASTIC INDEX
N	STANDARD PENETRATION, blows per foot

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UNIFIED SOIL CLASSIFICATION SYSTEM
MERCER ISLAND RESIDENCE
MERCER ISLAND, WASHINGTON

Proj.No. T-8257 | Date: JAN 2021 | Figure A-1

LOG OF BORING NO. B-1

Figure No. A-2

Project: Mercer Island Residence **Project No:** T-8257 **Date Drilled:** November 18, 2019

Client: Northbrook Construction Management **Driller:** Boretec **Logged By:** SLK

Location: Mercer Island, Washington **Depth to Groundwater:** N/A **Approx. Elev:** N/A

Depth (ft)	Sample Interval	Soil Description	Consistency/ Relative Density	SPT (N) Blows/foot 10 30 50	Moisture Content (%)
0		(4 inches TOPSOIL)			
		Brown SILT with sand, fine sand, moist, trace gravel, mottled. (ML)	Stiff	13	17.3
5		Light brown SILT, moist, trace sand and gravel, faintly mottled. (ML)	Very Stiff	21	25.3
				24	24.2
		*No gravel observed.			
10		Red/brown SILT, moist, mottled, trace sand. (ML)		32	26
		Gray-brown SILT, moist, trace sand. (ML)		27	27.6
15				28	28.9
20		*Soil becomes gray.		28	27.3
		Boring terminated at 21.5 feet. No groundwater observed.			
25					

NOTE: This borehole log has been prepared for geotechnical purposes. This information pertains only to this boring location and should not be interpeted as being indicative of other areas of the site

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LOG OF BORING NO. B-2

Figure No. A-3

Project: Mercer Island Residence **Project No:** T-8257 **Date Drilled:** November 18, 2019

Client: Northbrook Construction Management **Driller:** Boretec **Logged By:** SLK

Location: Mercer Island, Washington **Depth to Groundwater:** N/A **Approx. Elev:** N/A

Depth (ft)	Sample Interval	Soil Description	Consistency/ Relative Density	SPT (N) Blows/foot 10 30 50	Moisture Content (%)
0		(4 inches TOPSOIL) Gray sandy SILT, fine to medium sand, moist, some gravel, trace organics, mottled. (ML)	Stiff		
	I			11	19.7
		Light brown sandy SILT, fine to medium sand, moist to wet, some gravel, mottled. (ML)			
5	I	*Color trends to gray/brown.	Hard	47	18.9
	I			65	17.7
		Boring terminated at 9 feet due to auger refusal. No groundwater observed.			
10					

NOTE: This borehole log has been prepared for geotechnical purposes. This information pertains only to this boring location and should not be interpeted as being indicative of other areas of the site

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LOG OF BORING NO. B-3

Figure No. A-4

Project: Mercer Island Residence **Project No:** T-8257 **Date Drilled:** November 18, 2019

Client: Northbrook Construction Management **Driller:** Boretec **Logged By:** SLK

Location: Mercer Island, Washington **Depth to Groundwater:** N/A **Approx. Elev:** N/A

Depth (ft)	Sample Interval	Soil Description	Consistency/ Relative Density	SPT (N) Blows/foot 10 30 50	Moisture Content (%)
0		(4 inches TOPSOIL) Brown trending to gray/brown sandy SILT, fine sand, moist to wet, trace organics and rootlets, mottled. (ML)	Stiff	8	21
		Light brown sandy SILT, fine to medium sand, moist, trace gravel, mottled. (ML)			
5			Hard	73	13
		Boring terminated at 6.5 feet due to auger refusal. No groundwater observed.			
10					

NOTE: This borehole log has been prepared for geotechnical purposes. This information pertains only to this boring location and should not be interpeted as being indicative of other areas of the site

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LOG OF BORING NO. B-4

Figure No. A-5

Project: Mercer Island Residence **Project No:** T-8257 **Date Drilled:** November 18, 2019

Client: Northbrook Construction Management **Driller:** Boretec **Logged By:** SLK

Location: Mercer Island, Washington **Depth to Groundwater:** N/A **Approx. Elev:** N/A

Depth (ft)	Sample Interval	Soil Description	Consistency/ Relative Density	SPT (N) Blows/foot 10 30 50	Moisture Content (%)
0		(4 inches TOPSOIL) Gray sandy SILT, fine to coarse sand, moist, some gravel. (ML)			
				40	16.5 16.5
		*Color trends to gray, becomes mottled.			
5		*Soil becomes light brown/gray.	Hard	45	20.6
				57	23.8
		Brown/gray trending to gray SILT with sand, fine sand, moist, mottled. (ML)			
10				63	27.3 27.9
		Boring terminated at 11.5 feet. No groundwater observed.			
15					

NOTE: This borehole log has been prepared for geotechnical purposes. This information pertains only to this boring location and should not be interpeted as being indicative of other areas of the site

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LOG OF HAND HOLE NO. HH-1

FIGURE A-6

PROJECT NAME: Mercer Island Residence **PROJ. NO:** T-8257 **LOGGED BY:** SLK

LOCATION: Mercer Island, Washington **SURFACE CONDITIONS:** Soil **APPROX. ELEV:** N/A

DATE LOGGED: November 18, 2019 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)	USDA Textural
0		Brown SILT with sand and gravel, fine to coarse sand, fine gravel, moist. (ML)	Stiff	15.2	
		Hand hole terminated at 10 inches. No groundwater observed.			
1					
2					

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF HAND HOLE NO. HH-2

FIGURE A-7

PROJECT NAME: Mercer Island Residence **PROJ. NO:** T-8257 **LOGGED BY:** SLK

LOCATION: Mercer Island, Washington **SURFACE CONDITIONS:** Soil **APPROX. ELEV:** N/A

DATE LOGGED: November 18, 2019 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)	USDA Textural
0		Brown sandy SILT, fine to medium sand, moist. (ML)	Stiff	19.2	
1					
		Hand hole terminated at 15 inches. No groundwater observed.		19.9	
2					

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF HAND HOLE NO. HH-3

FIGURE A-8

PROJECT NAME: Mercer Island Residence **PROJ. NO:** T-8257 **LOGGED BY:** SLK

LOCATION: Mercer Island, Washington **SURFACE CONDITIONS:** Soil **APPROX. ELEV:** N/A

DATE LOGGED: November 18, 2019 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)	USDA Textural
0		Brown SILT with sand, fine to medium sand, moist. (ML)			
				21	
			Stiff		
1				19.8	
				20.8	
		Hand hole terminated at 18 inches. No groundwater observed.			
2					

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF HAND HOLE NO. HH-4

FIGURE A-9

PROJECT NAME: Mercer Island Residence **PROJ. NO:** T-8257 **LOGGED BY:** SLK

LOCATION: Mercer Island, Washington **SURFACE CONDITIONS:** Soil **APPROX. ELEV:** N/A

DATE LOGGED: November 18, 2019 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)	USDA Textural
0		Brown silty SAND to sandy SILT, fine to medium sand, moist. (ML, SM)	Stiff to Medium Dense	11.8 11.4	
1					
				8.5	
		Hand hole terminated at 15 inches. No groundwater observed.			
2					

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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FIGURE A-10

LOG OF HAND HOLE NO. HH-5

PROJECT NAME: Mercer Island Residence **PROJ. NO:** T-8257 **LOGGED BY:** SLK

LOCATION: Mercer Island, Washington **SURFACE CONDITIONS:** Soil **APPROX. ELEV:** N/A

DATE LOGGED: November 18, 2019 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)	USDA Textural
0		Brown sandy SILT, fine to medium sand, moist. (ML)			
				13.1	
			Stiff		
				13.2	
1					
		Hand hole terminated at 16 inches. No groundwater observed.		12.3	
2					

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF HAND HOLE NO. HH-6

FIGURE A-11

PROJECT NAME: Mercer Island Residence **PROJ. NO:** T-8257 **LOGGED BY:** SLK

LOCATION: Mercer Island, Washington **SURFACE CONDITIONS:** Soil **APPROX. ELEV:** N/A

DATE LOGGED: November 18, 2019 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)	USDA Textural
0		Brown SILT with sand, fine to medium sand, moist. (ML)	Stiff	15.6	
1					
		Hand hole terminated at 15 inches. No groundwater observed.		14.7	
2					

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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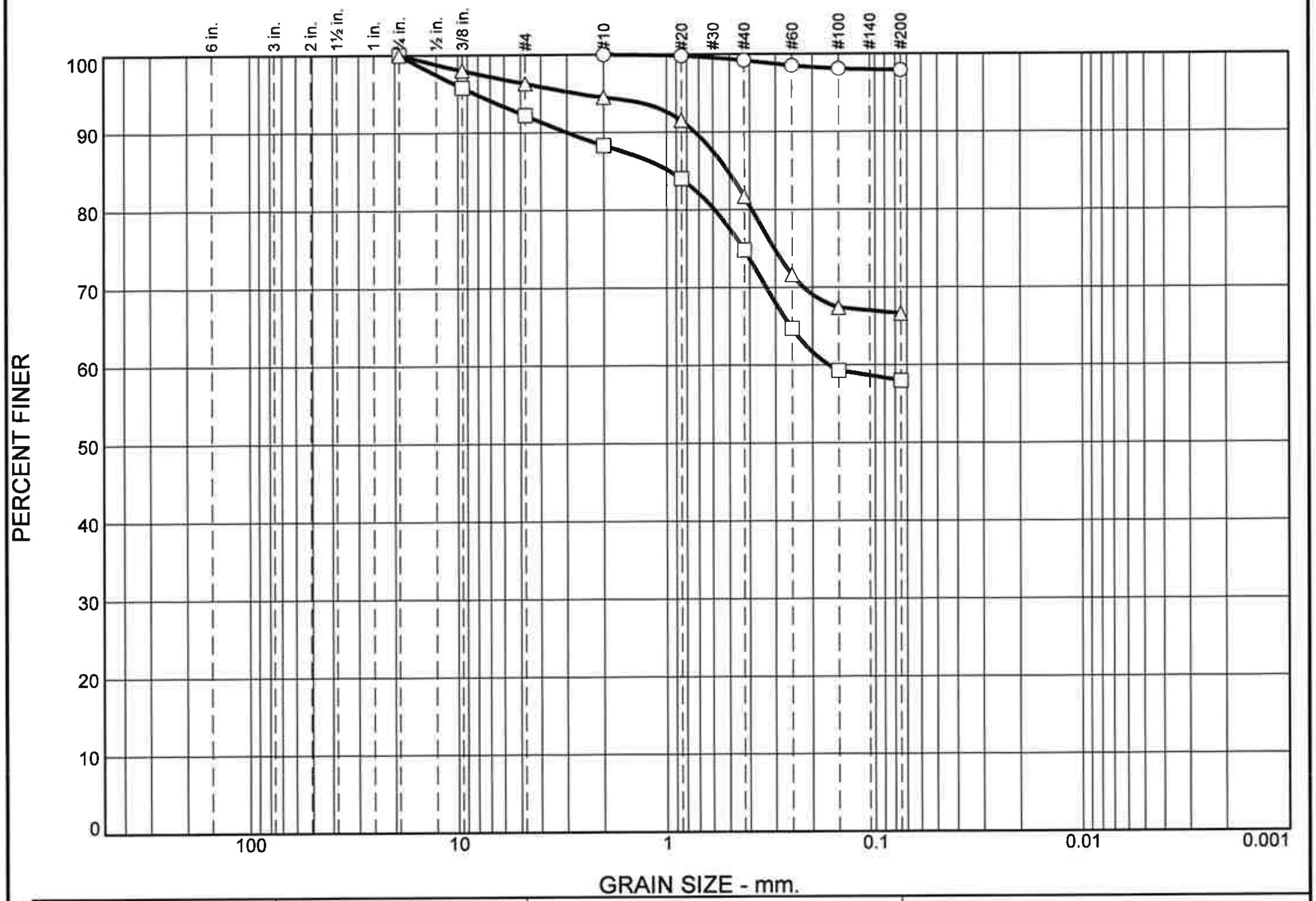
Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	0.8	1.3	97.9	
□	0.0	0.0	7.8	3.9	13.5	16.8	58.0	
△	0.0	0.0	3.7	1.8	12.8	15.1	66.6	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○										
□			0.9691	0.1668						
△			0.5099							

Material Description	USCS	AASHTO
○ SILT	ML	
□ Sandy SILT	ML	
△ Sandy SILT	ML	

Project No. T-8257 **Client:** Northbrook Construction Management

Project: Mercer Island Residence

○ **Location:** B-1 **Depth:** 10 Feet

□ **Location:** B-2 **Depth:** 2.5 Feet

△ **Location:** B-3 **Depth:** 5 Feet

Remarks:

○Tested on December 5, 2019

□Tested on December 5, 2019

△Tested on December 5, 2019

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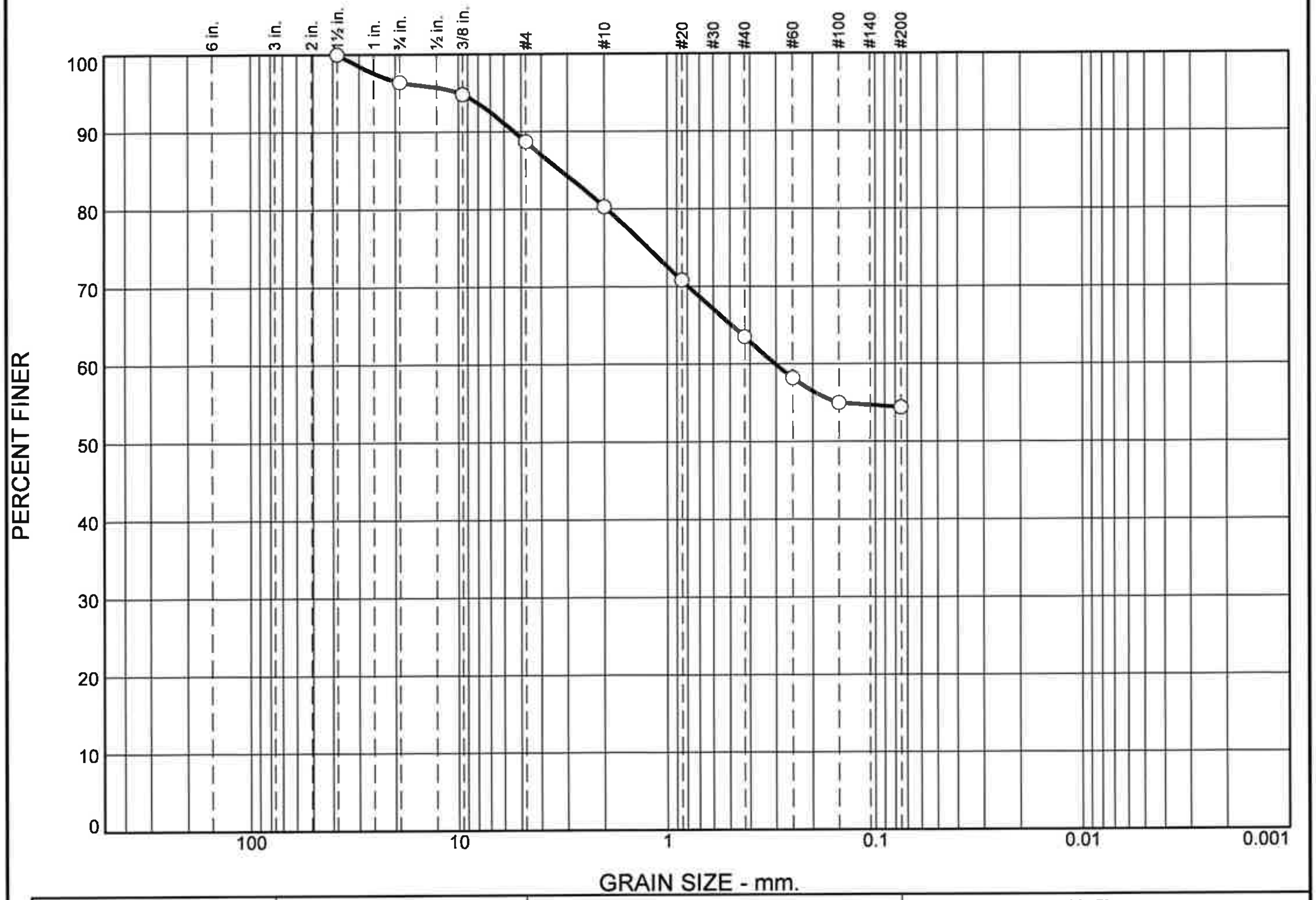
Kirkland, WA

Figure A-12

Tested By: FQ

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	3.6	7.7	8.4	16.8	9.1	54.4	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			3.2384	0.3032						

Material Description	USCS	AASHTO
○ Sandy SILT	ML	

Project No. T-8257 **Client:** Northbrook Construction Management

Project: Mercer Island Residence

○ **Location:** B-4 **Depth:** 5 Feet

Remarks:

○Tested on December 5, 2019

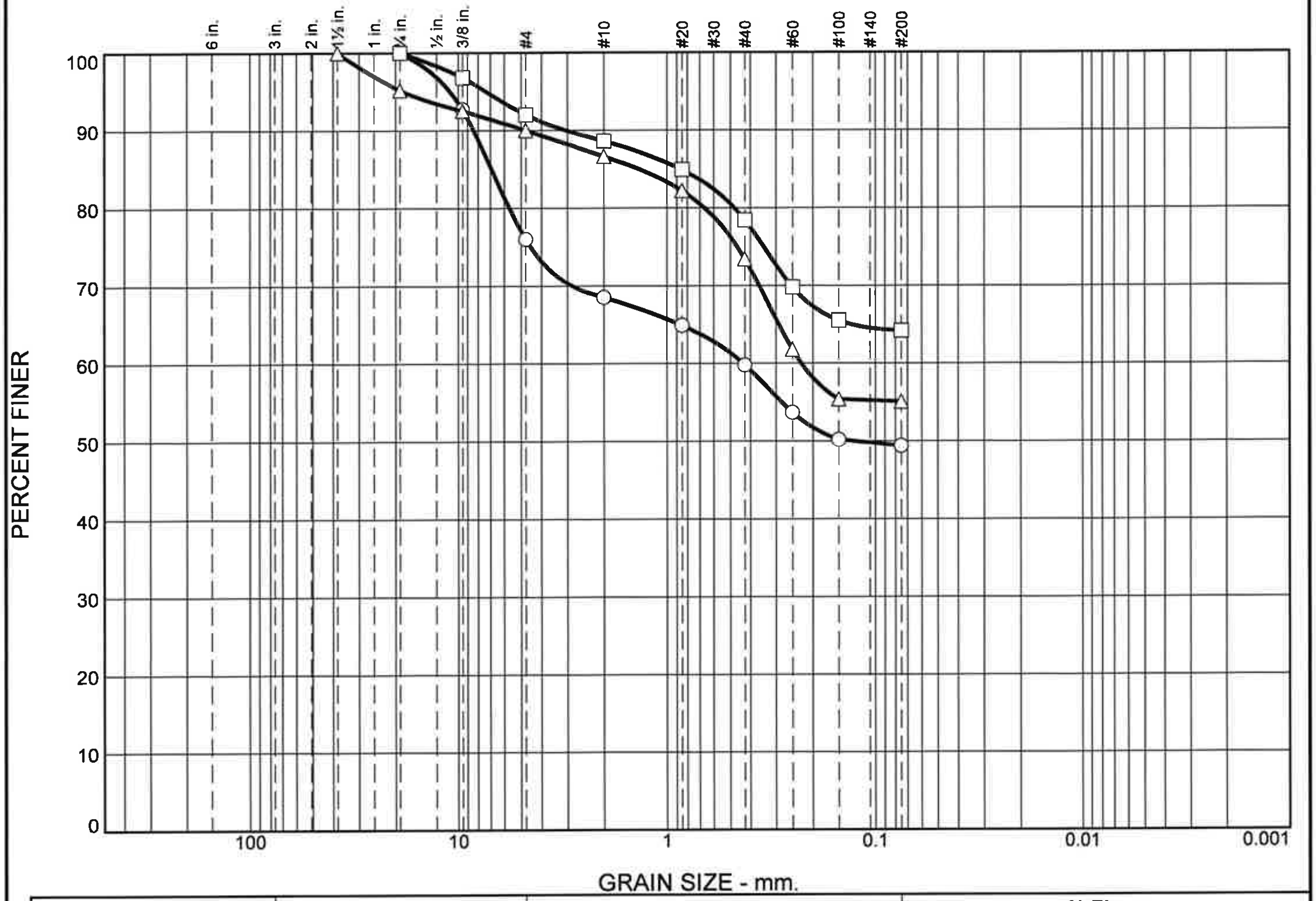
Terra Associates, Inc.

Kirkland, WA

Figure A-13

Tested By: FQ

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	24.0	7.5	8.7	10.4	49.4	
□	0.0	0.0	8.0	3.4	10.2	14.2	64.2	
△	0.0	4.8	5.2	3.4	13.2	18.3	55.1	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			6.8927	0.4332	0.1261					
□			0.8647							
△			1.3612	0.2261						

Material Description	USCS	AASHTO
○ SILT with sand and gravel	ML	
□ SILT with sand	ML	
△ Sandy SILT	ML	

Project No. T-8257 **Client:** Northbrook Construction Management

Project: Mercer Island Residence

○ **Location:** HH-1 **Depth:** 6 Inches
□ **Location:** HH-3 **Depth:** 18 Inches
△ **Location:** HH-5 **Depth:** 10 Inches

Remarks:
○Tested on December 5, 2019
□Tested on December 5, 2019
△Tested on December 5, 2019

Terra Associates, Inc.

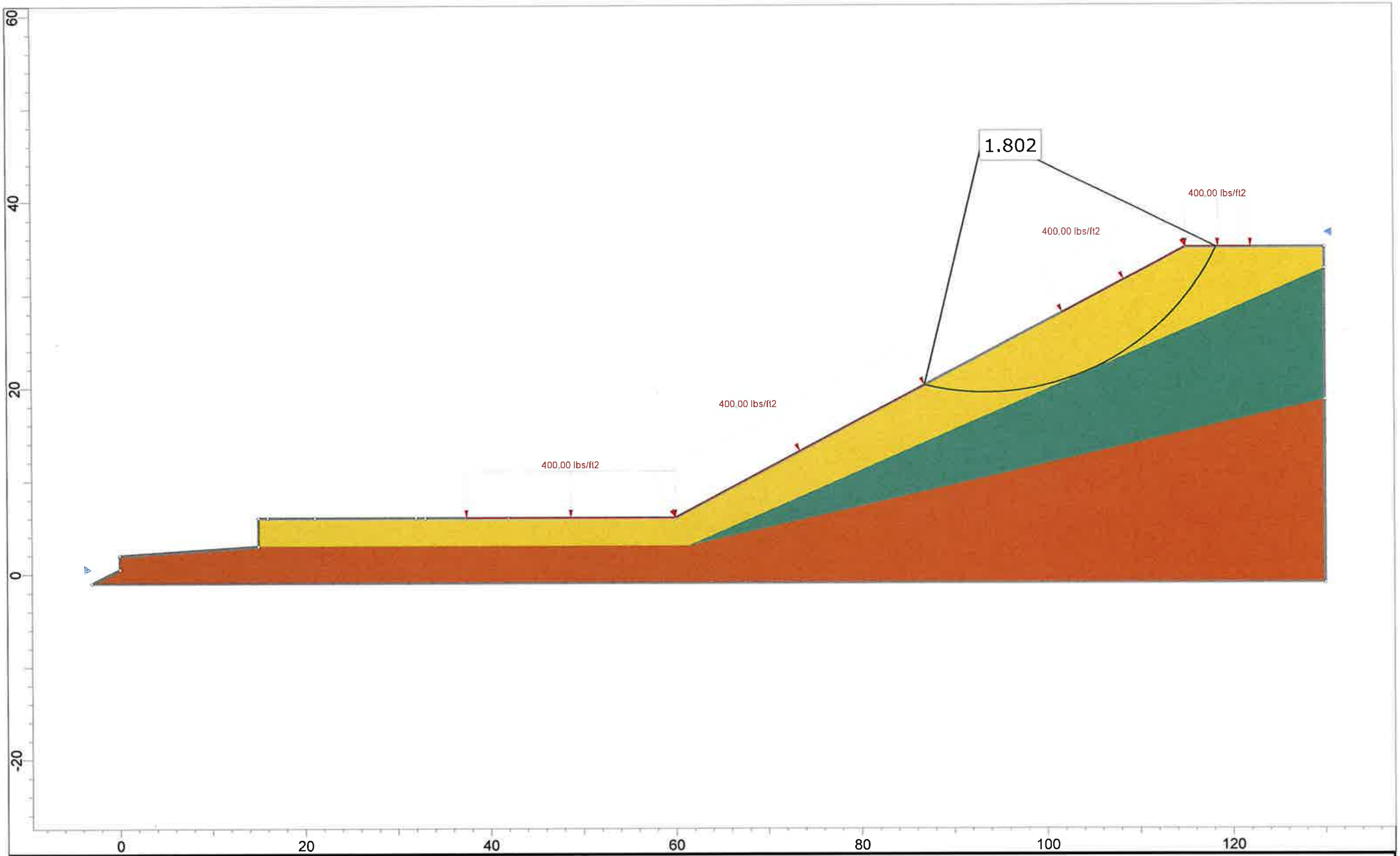
Kirkland, WA

Figure A-14

Tested By: FQ

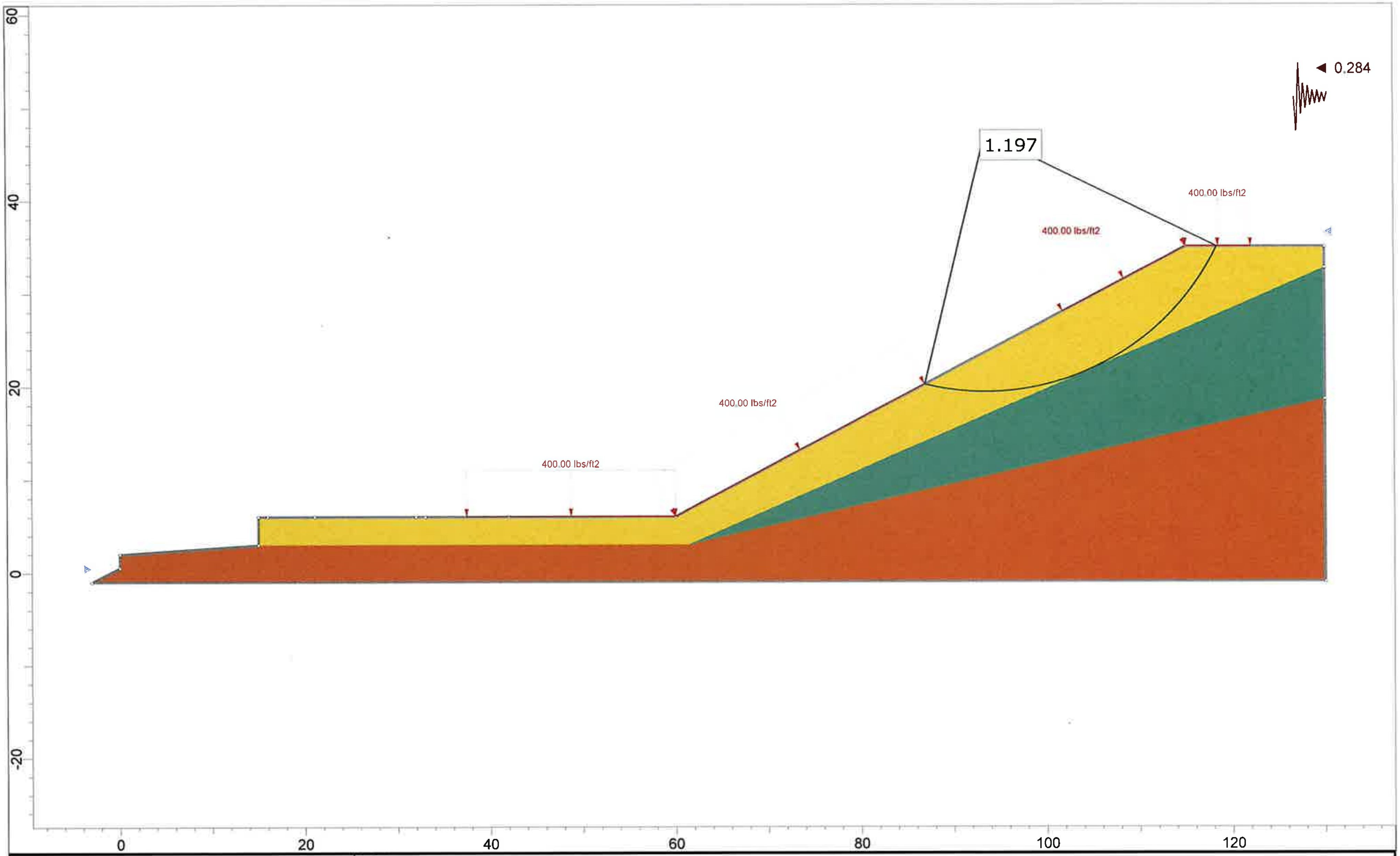
APPENDIX B

RELATIVE SLOPE STABILITY RESULTS



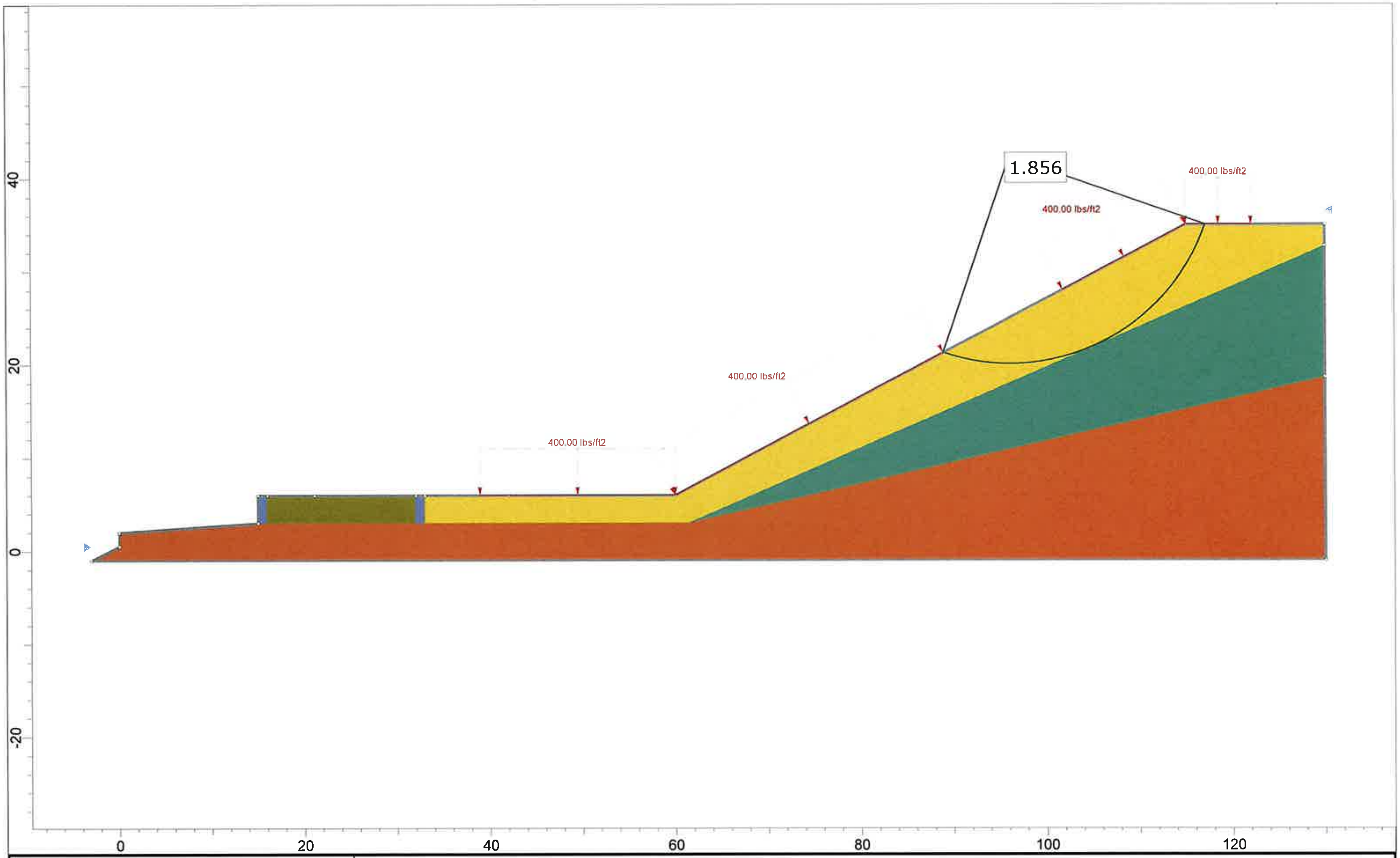
SLIDEINTERPRET 8.008

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description	Mercer Island Residence		
Drawn By	S. King	*Scale*	1:171
Company	Terra Associates, Inc.		
Date	December 12, 2019	*File Name*	existing.slmd



Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description	Mercer Island Residence		
Drawn By	S. King	*Scale*	1:171
Company	Terra Associates, Inc.		
Date	December 12, 2019	*File Name*	existing.slmd

SLIDEINTERPRET 8.008



SLIDEINTERPRET 8.008

Project Mercer Island Residence

Analysis Description Mercer Island Residence

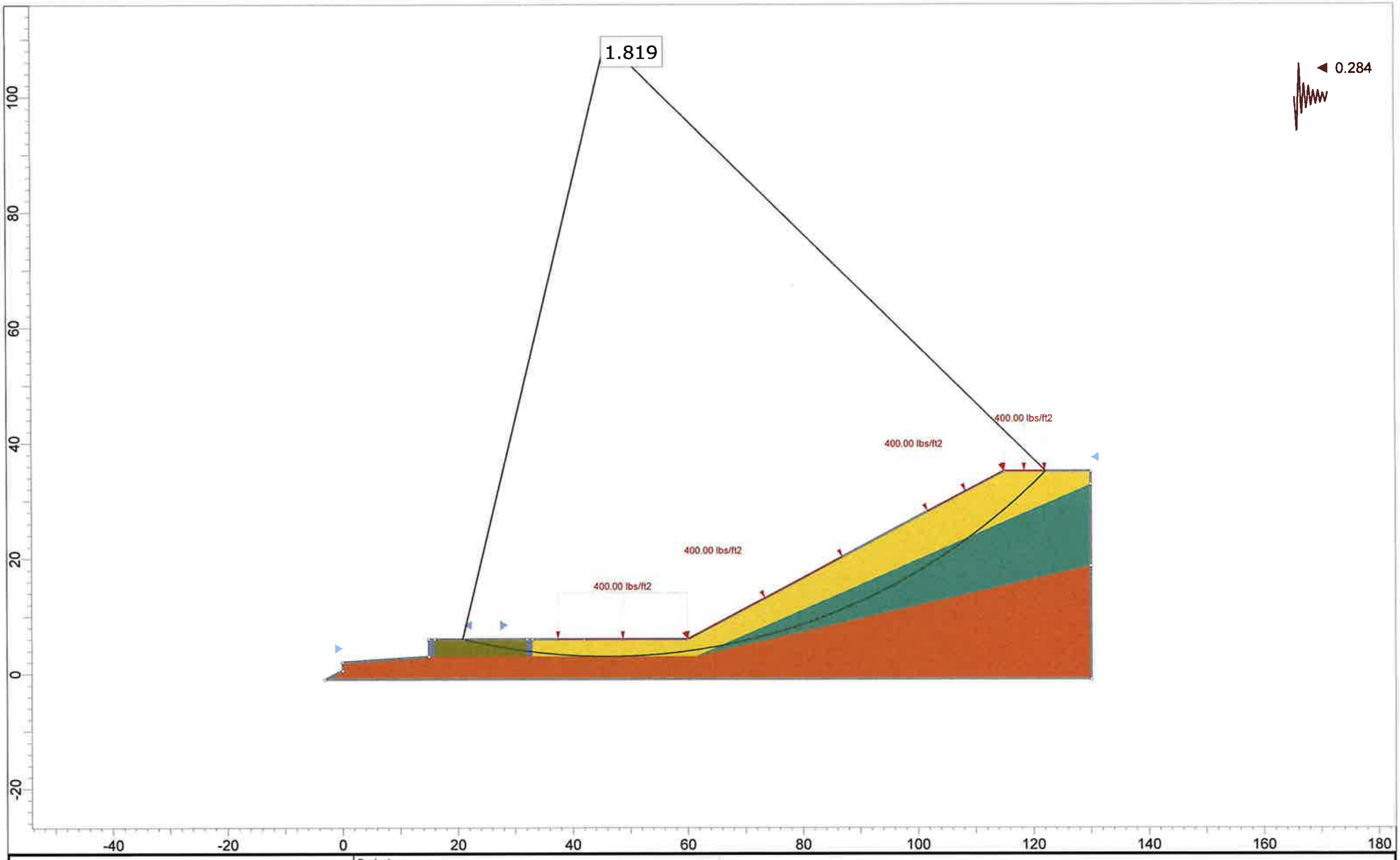
Drawn By S. King

Scale 1:171

Company Terra Associates, Inc.

Date December 12, 2019

File Name existing.slmd



rocscience

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description	Mercer Island Residence		
Drawn By S. King	*Scale* 1:276	*Company*	Terra Associates, Inc.
Date December 12, 2019		*File Name*	existing.slmd

SLIDEINTERPRET 8.008