October 2, 2020 G-5244

Ms. Tomoko Lumpkin
c/o Ms. Danielle Rawson
Suyama Peterson Deguchi
8601 – 8th Avenue S.
Seattle, Washington 98108

Subject: Geotechnical Engineering Study
Proposed Residence
5401 W. Mercer Way
Mercer Island, Washington

Dear Ms. Lumpkin:

GEO Group Northwest, Inc. is pleased to present our geotechnical engineering report for the construction of a new residence at the above-subject location on Mercer Island, Washington. Our services were provided per our proposal dated August 7, 2020, and authorized on August 27, 2020.

SITE DESCRIPTION

The project site is located in a residential area on Mercer Island, Washington, as illustrated in Plate 1 – Site Location Map. The project site consists of a rectangular-shaped lot which is 11,600 square feet in size. The site has gently to moderately sloped, west-facing topography. The site is developed with an existing single-story residence with an attached carport. A wood deck is present on the west side of the house, and a concrete paver patio area is located south of the house. The site configuration, topography, and existing improvements are illustrated in Plate 2 – Site Plan.

PROPOSED RESIDENCE

We were provided with preliminary plans for a proposed new residence that will replace the existing residence on the site. According to the plans, the residence will have a main floor and a daylight basement. Also, new deck will be constructed off the west side of the new residence. The preliminary layout of the proposed residence is illustrated in Plate 3 – Proposed Residence Layout.

GEOLOGIC OVERVIEW

According to published geologic mapping for the area[1], surface soils at the site consist of non-glacial deposits older than the Vashon Stade of the Fraser Glaciation (the most recent glaciation in the Seattle area). These deposits typically consist of interbedded or intermixed gravel, sand, silt, clay and organic materials, and were subsequently over-consolidated by the advance of the Puget Lobe glacier.

The geologic map also indicates the presence of a layer of mass wastage deposits overlying the mapped soils. These deposits typically consist of relatively loose colluvium or landslide debris having indistinct morphology (colluvium is a term applied to loose, incoherent, deposits occurring on or below slopes and having accumulated due to gravity).

SITE INVESTIGATION

Surface Conditions

A geologist from our firm completed a reconnaissance of the visible soil and topographic conditions at the site. We observed that the site features were essentially similar to those indicated in the plans that were provided to us. We also observed no indications of soil instability or movement or of water seepage or springs on the property.

[1] Troost, K.G., and A.P. Wisher, Geologic Map of Mercer Island, Washington, December 2006.

Subsurface Exploration

A geologist from our firm oversaw the drilling of two exploratory soil borings (B-1 and B-2) at the site. The borings were completed by using a manually-portable drilling rig equipped with hollow-stem augers. The boring locations are indicated in Plate 2 – Site Plan.

We recorded the soil conditions encountered in the borings, and checked for the presence of groundwater or seepage in the borings during drilling. Soil density or consistency was evaluated by performing standard penetration tests at multiple depths in the borings during drilling. Samples of the soil encountered were collected for examination and for moisture content testing at our office. Logs of the conditions encountered in the borings are provided in Attachment A to this report.

Findings

The soils encountered in boring B-1 typically consisted of loose silt and sandy silt to a depth of approximately 12 feet bgs, underlain by a layer of wet fine sand, and then unsaturated medium dense to dense silt and lesser sandy silt to silty sand to the bottom of the boring a depth of approximately 21 feet bgs. Soils encountered in boring B-2 were generally similar to those found in boring B-1. The observed soil conditions are generally consistent with geologic map information that notes a layer of relatively loose deposits underlain with relatively dense native soils.

GEOLOGIC CRITICAL AREAS REVIEW

We reviewed available geologic critical areas information on the City of Mercer Island Department of Information and Geographic Services website. According to information from the website, no known landslides are identified on the project site or on adjacent property. The information indicates, however, that the project site has potential landslide, erosion, and seismic hazard critical areas. The delineation of the landslide and erosion critical areas is illustrated in Plate 4 – Critical Areas Mapping. The seismic hazard critical area delineation encompasses the project site and surrounding properties, and is not shown in the plate. No steep slope critical areas are indicated to be present on the site.

Evaluation of Potential Landslide Hazard

Slopes with inclinations greater than 15 percent grade are present in the western part of the site and continuing along the southern and east parts, as illustrated in Plate 2 – Site Plan. Slope areas steeper than 40 percent grade are limited to an area in the southwest part of the site and have a maximum height of 7 feet (and therefore do not meet the criteria for steep slope critical areas). As noted above, no indications of soil instability or springs were observed on the site. Water seepage noted in the borings appears to be located within narrow sandy lenses in the otherwise very silty soils.

It is our opinion that the proposed location of the new residence presents minimal risk to the stability of the site, and that there is minimal risk of damage to proposed residence due to slope instability, provided that the recommendations, including pipe pile support for the proposed residence, presented below are properly implemented during project design and construction.

Evaluation of Seismic Hazard

In our opinion, the site has minimal susceptibility to soil liquefaction or lateral soil spreading due to seismic events, based on the absence of a continuous groundwater table and the presence of predominantly unsaturated, fine-grained (silt) subsurface soils.

Evaluation of Soil Erosion Hazard

In our opinion, the potential for significant soil erosion at the site is low, because of the fine-grained character of the near surface soils and the existing developed and landscaped conditions. Provided that proper temporary and permanent post-construction erosion and sediment controls such as landscaping are implemented for the project, it is our opinion that the risk of significant soil erosion at the site will be minimal. We have provided recommendations regarding temporary erosion control below in this report, for consideration and use in project design and construction.

SITE STABILITY EVALUATION

Based on the findings from our site reconnaissance and subsurface investigation and our review of geologic and critical areas information as described in this report, it is our opinion that the site is stable in its existing condition. As noted above, no indications of soil instability or erosion, or observation of springs were observed on the site. Water seepage noted in the borings appears to be located within narrow sandy lenses in the otherwise very silty soils.

SITE SEISMIC DESIGN CLASSIFICATION

In our opinion, the project site can be assigned Seismic Site Class D (Medium Dense Soil Profile), per Section 1613.5 of the 2015 International Building Code. Our determination is based upon the findings from our subsurface investigation activities and our knowledge and understanding of the typical deeper subsurface soil conditions in the site vicinity.

RECOMMENDATIONS

In our opinion, soils at the proposed basement floor elevation for the new residence are anticipated to be loose and will not be acceptable for supporting conventional footing foundations. Based on the findings from the soil borings completed for this study, medium dense to dense soils that are suitable for supporting footings are expected to be present at depths of approximately 17 feet below existing ground surface. For this reason, we recommend that the new residence be supported on small-diameter steel pipe piles connected to a system of concrete grade beams. We also recommend that the bottom floors of the residence be structurally supported via connection to the grade beam system and/or via support directly from pipe piles. Our recommendations regarding these and other geotechnical aspects of design and construction of the proposed residence are presented below in the following sections of this report.

Building Support

In our opinion, the proposed residence can be supported on a system of driven small-diameter steel pipe piles (also known as pin piles). The piles are driven until the resistance of the subsurface soils sufficiently retards or terminates the advancement of the piles; this condition typically is called “refusal”.

The depth at which refusal is achieved is dependent upon the specific combination of pipe and driving hammer that are used, and the characteristics of the subsurface soils that the pile encounters. The following table presents design criteria for commonly-available combinations of driving hammers and pipe sizes. The allowable bearing capacities include a factor of safety of 2.

Pipe Pile Design Criteria

Pipe Diameter	Pipe Wall Thickness	Hammer Weight Class	Hammer Type	Refusal Criteria*	Allowable Capacity
2 inch	Schedule 80	90 pound	jackhammer	60 sec/inch	3 tons
2 inch	Schedule 80	140 pound	jackhammer	60 sec/inch	3 tons
3 inch	Schedule 40	650 pound	TB225†	12 sec/inch	6 tons**
3 inch	Schedule 40	850 pound	TB325†	10 sec/inch	6 tons**
4 inch	Schedule 40	850 pound	TB325†	16 sec/inch	10 tons**
4 inch	Schedule 40	1100 pound	TB425†	10 sec/inch	10 tons**
6 inch	Schedule 40	2000 pound	TB725†	12 sec/inch	15 tons**

* = Maximum penetration rate to be sustained through at least 3 time cycles of continuous driving.
† = Teledyne hydraulic hammer model number, or equivalent.

The soil conditions encountered in the borings for our investigation are considered to be potentially corrosive due to the presence of water seepage which may vary over time in degree or presence. Therefore, it is our opinion that the piles should consist of galvanized pipe.

We estimate that the maximum settlement of the pipe piles should be one-quarter (1/4) inch or less. No reduction in the pile capacities is required if the pile spacing is at least three times the pile diameter. A one-third increase in the above allowable pile capacities can be used when considering short-term transitory wind or seismic loads.

By themselves, pipe piles do not generate lateral capacities. Lateral forces can be resisted by the passive earth pressures developed from friction between footings and a prepared subgrade, or from using battered pipe piles or helical anchors. An allowable passive soil pressure of 300 pcf equivalent fluid weight, and coefficient of friction of 0.30 for the prepared subgrade and the footings can be used for lateral resistance.

The performance of pipe piles is dependent on how and to what bearing stratum the piles are installed. Since a completed pile in the ground cannot be observed, it is critical that judgment and experience be used as a basis for determining the driving refusal and acceptability of a pile. Therefore, we recommend that we monitor the pile installation operation, collect and interpret installation data and verify achievement of pile driving refusal. We also suggest that the contractor's equipment and installation procedures be reviewed by us prior to pile installation to help mitigate problems which may delay the progress of the work.

Slab-on-Grade Floors

We recommend that slab-on-grade floors be supported on competent native soils or on structural fill that is placed on a subgrade of competent soils. Alternatively, the floors can be structurally supported by connection to adjacent footings and reinforcement with a grid of #4 steel rebar having 12" spacing on center, or be supported on a grid of small-diameter pile piles having 5-foot spacing on center. Structurally supported floors should be designed by a structural engineer.

To avoid moisture build-up on the subgrade, floor slabs should be placed on a capillary break, which is in turn placed on the prepared subgrade. The capillary break should consist of a layer, at least 6 inches thick, of free-draining crushed rock or gravel containing no fines and no more than five percent material finer than a No. 4 sieve. A vapor barrier should be placed over the capillary break to reduce upward transmission of water vapor through the slab, if such transmission is undesirable.

Conventional Concrete Basement and Retaining Walls

The following recommendations regarding conventional concrete basement walls and retaining walls are provided below for use in the event of construction of conventional concrete basement or retaining walls up to approximately 10 feet in height. If higher walls are planned, please contact us to review and possibly modify the following recommendations.

Basement walls and conventional retaining walls 3.5 feet or more in height should be supported on small-diameter pipe piles as discussed in the foundation recommendations presented above in this report, and should be designed by a structural engineer.

Conventional concrete retaining walls which are free to rotate on top (unrestrained) are considered capable of yielding and should be designed using an active earth pressure. Concrete retaining walls which are restrained horizontally at the top (such as basement walls) are considered unyielding and should be designed using an at-rest earth pressure. Our recommended soil engineering parameters for retaining wall design are as follows:

Active Earth Pressure

- 35 pcf, equivalent fluid pressure, for level ground behind the walls;
- 50 pcf, equivalent fluid pressure, for wall backslope of 2H:1V

At-Rest Earth Pressure

- 45 pcf, equivalent fluid pressure, for level ground behind the walls;
- 60 pcf, equivalent fluid pressure, for wall backslope of 2H:1V

Passive Earth Pressure

- 300 pcf, equivalent fluid pressure, for undisturbed, medium dense native soil or structural fill, and level ground in front of the wall for a distance of two times the wall height;

Base Friction

- 0.35 for competent, native soil or structural fill

Surcharge loads imposed on walls due to driveways and traffic (including that during construction), upward sloping ground, or other conditions that could impose loads against the walls, should be added to the active and at-rest earth pressures stated above. Also, downward sloping ground in proximity to the walls should be evaluated, as it may have the effect of reducing the value of the allowable passive earth pressure stated above.

To prevent the buildup of hydrostatic pressure behind conventional basement or retaining walls, we recommend that a vertical drain mat, such as Miradrain 6000 or similar product, be used to facilitate drainage adjacent to the wall. The drain mat should extend from near the finished surface grade, downward to the bottom of the wall. A drainage collection pipe consisting of rigid 4”-diameter perforated PVC pipe surrounded with gravel and geotextile filter fabric (Mirafi 140NL, or equivalent) can be laid alongside the base of the wall and sloped to an acceptable tightline connection. In addition to the drain mat, we recommend that a zone of free-draining backfill material at least 12 inches wide should be placed against the matted wall. This backfill should extend downward to the drainage collection pipe. A layer of non-woven geotextile filter fabric should separate the free-draining backfill material from the adjacent soils or fills.

The top 12 inches of the fill behind the wall can consist of topsoil if desired. This material can be separated from the underlying more granular drainage material by a geotextile fabric, if desired. Alternatively, the surface can be sealed with asphalt or concrete paving. Nearby final grades should be sloped to drain away from the wall, or other measures (such as strip or ribbon drains) should be used to intercept surface water that flows toward the wall.

The backfill for conventional concrete retaining walls should be compacted to a dense condition to mitigate the potential for later ground settlement or excessive saturation. Wall backfill that also will support structures or slab should be placed and compacted as structural fill. We recommend that restrained walls not be backfilled until their restraint has been completed, unless approved by the project structural engineer. The compacting machinery that is used should be compatible with the wall's resistance capacity against the temporary loading effects produced by operation of the machinery. In this respect, the contractor should exercise care if heavy machinery such as a vibratory roller or hoe pack is used.

Surface Drainage

During construction, water should not be allowed to stand in areas where footings, slabs, or pavements are to be constructed. We recommend that ground surfaces be sealed at the end of the day by tracking over them with a piece of construction equipment or by compacting them, to reduce the potential for moisture infiltration which can degrade soil quality.

We recommend that storm water drainage from building roof areas and driveways be collected into a tightline system that conveys the water to an approved discharge location. Storm water should not be allowed to develop into concentrated flows on the ground surface, because concentrated flow can lead to soil erosion and rutting. Final site grades should direct surface water away from buildings.

Subsurface Drainage

We recommend footing drains should be installed alongside perimeter foundations and basement walls. The drains should consist of a 4-inch minimum diameter, perforated, rigid PVC drain pipe laid at the bottom of the footing or wall with the perforations facing downward. The drain line should be bedded on, surrounded by, and covered with a washed rock or gravel. The drain rock and pipe also should be wrapped with a layer of durable non-woven geotextile fabric.

The footing drain lines should be sloped at sufficient gradient to generate flow and should be tight-lined to an appropriate stormwater discharge location or collection sump system. The subsurface drainage lines should not be connected to roof downspout or other surface drainage lines.

Grading and Earthwork

Site Clearing and Erosion Control

The area where construction work will be performed should be cleared of vegetation, topsoil, organics, debris, and any other deleterious materials that are found. These materials should be hauled off site or used for landscaping, as appropriate; they should not be used as structural fill or retaining wall backfill for the project.

Temporary erosion and sedimentation controls (TESCs) should be installed as part of site clearing activities. TESCs for the project can include using silt fences, check dams, straw mulch, hay bales, and a stabilized construction entrance. The silt fences or other barrier controls should be placed along the cross-slope and down-slope boundaries of the disturbed areas to prevent sediment-laden runoff from being discharged off site. Exposed soils, including stockpiled soils, should be covered with plastic sheeting when they are not being worked.

Excavations and Slopes

Temporary excavation slopes should not be greater than the limits specified in local, state and federal government safety regulations. Temporary cuts which are greater than 4 feet in height typically can be sloped at inclinations up to 1H:1V (Horizontal: Vertical). In situations where water seepage or other adverse conditions are observed, temporary cuts in these soils may need to be made at shallower inclinations where recommended by the geotechnical engineer. If adequate space is not available to maintain open cuts per the recommendations in this report, engineered support may be required to provide lateral support to such excavations. Permanent unreinforced slopes at the site should be inclined no steeper than 2.5H:1V.

Surface runoff should not be allowed to flow over the top of slopes into excavations. During wet weather, exposed slopes should be covered with plastic sheeting to prevent erosion or softening. We recommend that a GEO Group Northwest representative be on site during excavation of cut slopes to verify anticipated geologic conditions and to evaluate slope stability, particularly if groundwater seepage, caving soils, or debris are encountered.

Subgrade Preparation

After the completion of site clearing and excavation, soils in areas to receive structural fill, concrete slabs, sidewalks, or pavements, should be prepared to a firm, unyielding condition. The prepared subgrade should be observed and approved by the geotechnical engineer. Any detected soft spots or disturbed areas should be compacted or excavated and replaced with compacted structural fill or crushed rock as directed by the geotechnical engineer.

Structural Fill

Structural fill is typically defined as earthen material that is placed below buildings (including foundations and on-grade slab floors), sidewalks, driveways, or other structures, and provides support to those structures. Soils that meet the material specifications for structural fill as presented below in this report, or are otherwise approved by the geotechnical engineer, can be used for structural fill. Material which is stored on site for later use as structural fill should be covered with plastic sheeting to protect it from moisture if its usability is sensitive to its moisture content. Structural fill material should be placed and compacted in accordance with the recommendations provided below or as otherwise approved by the geotechnical engineer during construction.

Fill Material Specifications

All materials to be used as structural fill should not contain rocks or lumps larger than 3 inches in its greatest dimension. During wet weather, the material should be granular in character, with a fines content (passing a #200 sieve) of less than 5 percent. All material should be placed at or near its optimum moisture content. If the material is too wet to be compacted to the required degree, it will be necessary to dry the material by aeration (which may be difficult) or replace the material with an alternative suitable material in order to achieve the recommended compaction.

Compaction Specifications

Structural fill material under exterior slabs or pavements should be compacted to at least 90 percent of its maximum dry density, except for the top 12 inches of the material, which should be compacted to at least 95 percent of its maximum dry density as determined by ASTM D1557.

Structural fill material should be spread and compacted in lifts that are 10 inches or less in thickness in an un-compacted state. The compacted fill material should be field tested by using ASTM Designations D2922 and D3017, Nuclear Probe Method, to verify that the required degree of compaction has been achieved.

LIMITATIONS

This report has been prepared for the specific application to this site for the exclusive use of Ms. Tomoko Lumpkin, and her authorized assignees or agents. Any other use of this report is solely at the user's own risk. We recommend that this report be included in its entirety in the project contract documents for reference during construction.

Our findings and recommendations stated herein are based on field observations, our experience with similar projects, and our professional judgment. The recommendations presented in this letter are our professional opinion derived in a manner consistent with the level of care and skill ordinarily exercised by other members of the profession currently practicing under similar conditions in this area and within the project schedule and budget constraints. No warranty is expressed or implied. In the event that site conditions are found to differ from those described in this report, we should be notified so that the relevant recommendations in this report can be re-evaluated and modified if appropriate.

CLOSING

We appreciate this opportunity to provide you with geotechnical engineering services. Please feel free to contact us if you have any questions.

GEO Group Northwest, Inc.

Sincerely,

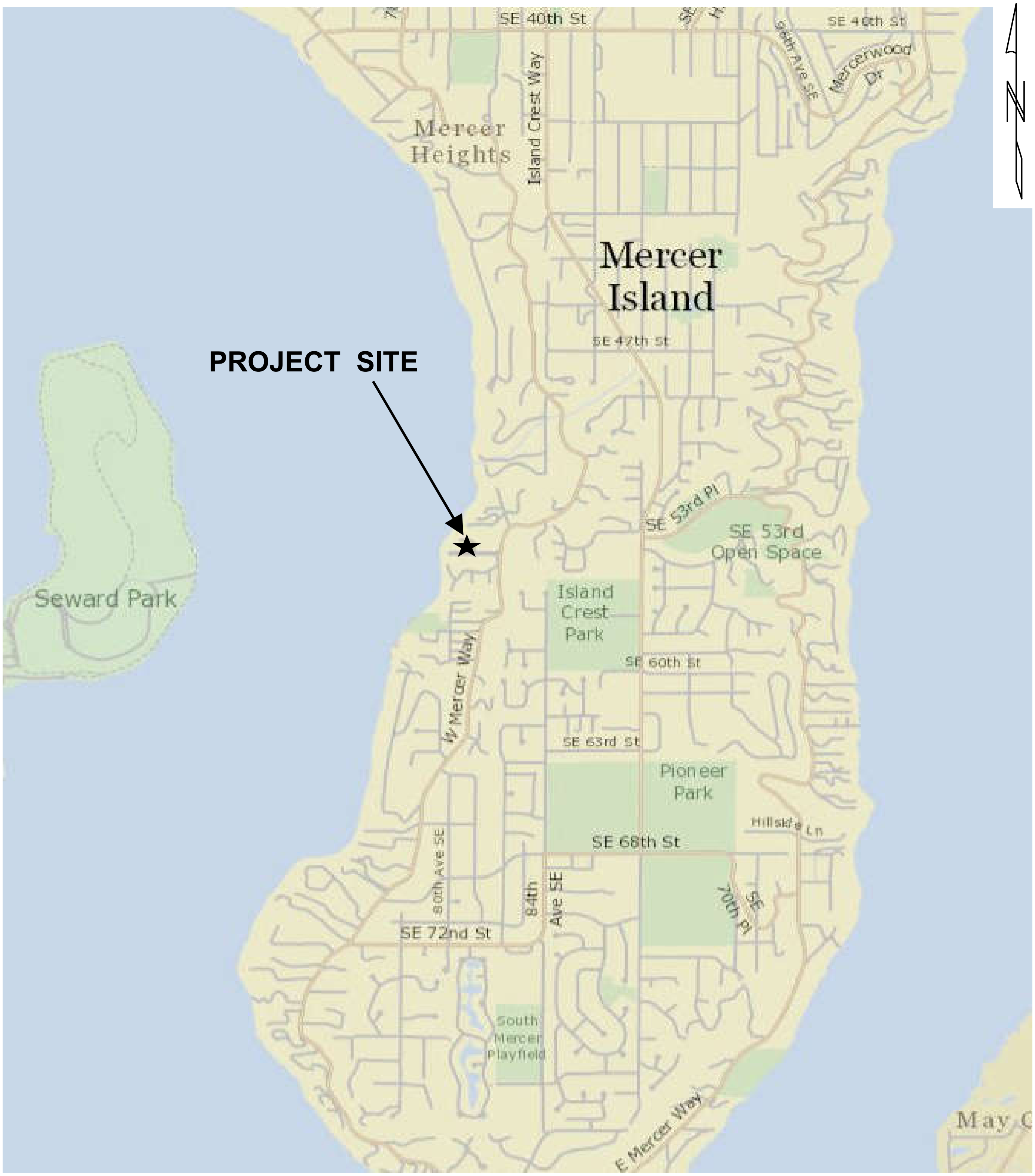
GEO Group Northwest, Inc.

Keith Johnson
Project Geologist

William Chang, PE
Principal Engineer

Plates and Attachments:

Plate 1 – Site Location Map
Plate 2 – Site Plan
Plate 3 – Proposed Residence Layout
Plate 4 – Critical Areas Mapping
Attachment A – Boring Logs



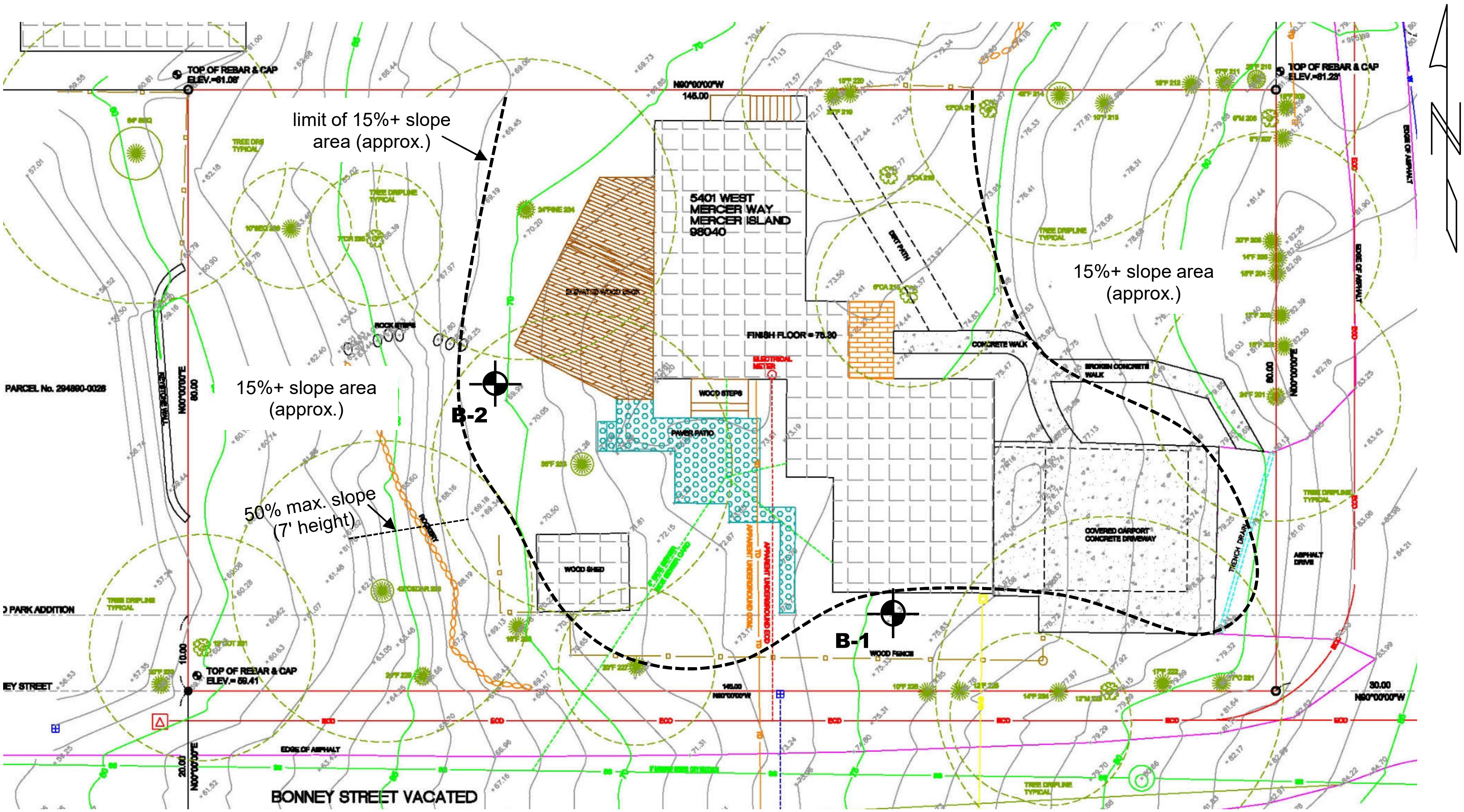
Source: King County GIS, 2019.

GEO Group Northwest, Inc.
Geotechnical Engineers, Geologists, & Environmental Scientists

SITE LOCATION MAP

PROPOSED NEW RESIDENCE
5401 W. MERCER WAY
MERCER ISLAND, WASHINGTON

SCALE: 1" = 2000'	**DATE:** 9/28/2020	**MADE:** KJ	**CHKD:** WC	**JOB NO:** G-5244	**PLATE** 1



0 20 40

SCALE: 1 INCH = 20 FEET

LEGEND

B-1 EXPLORATORY SOIL BORING LOCATION (TYP.)

Source: Site Plan, 5401 West Mercer Way, Mercer Island, Washington, by TJC Land Surveying and Mapping, dated 8/14/19.

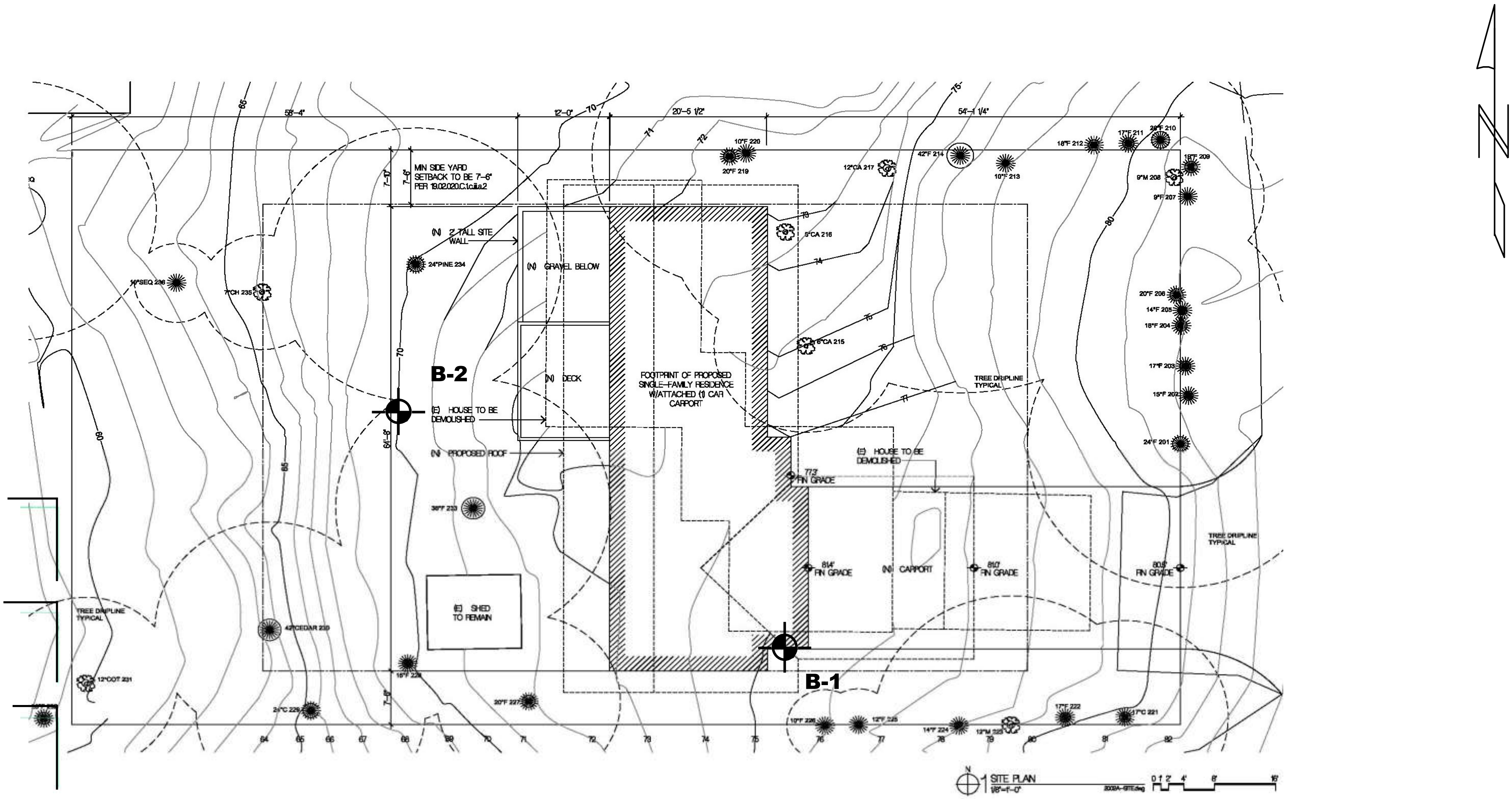
GEO Group Northwest, Inc.

Geotechnical Engineers, Geologists, & Environmental Scientists

SITE PLAN

PROPOSED NEW RESIDENCE
5401 W. MERCER WAY
MERCER ISLAND, WASHINGTON

SCALE:	1" = 20'	DRAWN:	KJ	CHECKED:	WC	DATE:	9/28/2020	PROJECT NO.:	G-5244	PLATE	2



0	20	40

SCALE: 1 INCH = 20 FEET

LEGEND

B-1 EXPLORATORY SOIL BORING LOCATION (TYP.)

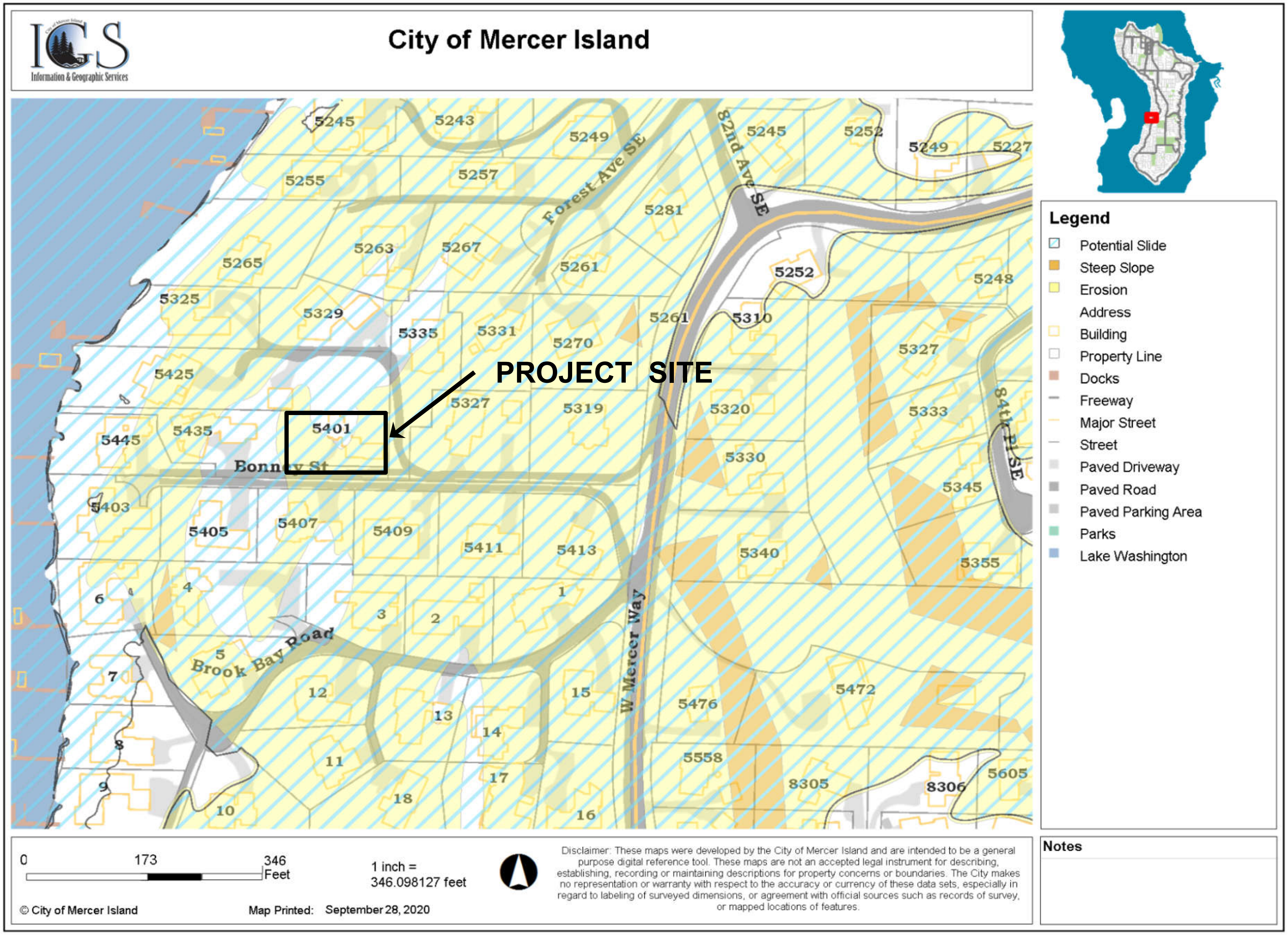
Source: Title Sheet, Project Info, Site + Vicinity Plan; Progress Set Sheet TS-1 (preliminary); by Suyama Peterson Deguchi, dated 8/6/20.

GEO Group Northwest, Inc.

Geotechnical Engineers, Geologists, & Environmental Scientists

PROPOSED RESIDENCE LAYOUT
PROPOSED NEW RESIDENCE
5401 W. MERCER WAY
MERCER ISLAND, WASHINGTON

SCALE:	1" = 20'	DRAWN:	KJ	CHECKED:	WC	DATE:	9/28/2020	PROJECT NO.:	G-5244	PLATE	3



Source: City of Mercer Island Information and Geographic Services, September 2020.

GEO Group Northwest, Inc.

Geotechnical Engineers, Geologists, & Environmental Scientists

CRITICAL AREAS MAPPING

PROPOSED NEW RESIDENCE

5401 W. MERCER WAY

MERCER ISLAND, WASHINGTON

SCALE:	As shown	**DRAWN:**	KJ	**CHECKED:**	WC	**DATE:**	9/28/2020	**PROJECT NO.:**	G-5244

PLATE 4

ATTACHMENT A

G-5244

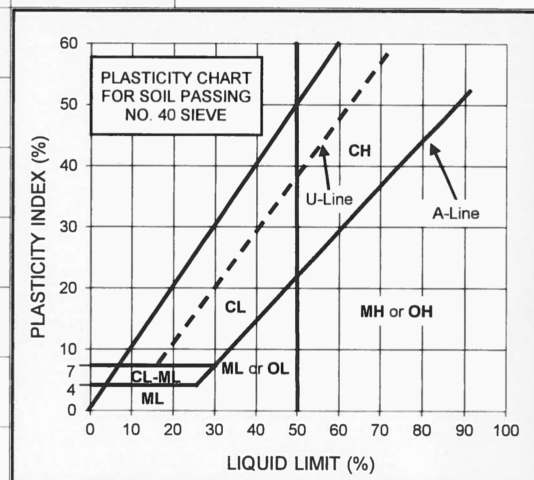
BORING LOGS

GEO Group Northwest, Inc.

SOIL CLASSIFICATION & PENETRATION TEST DATA EXPLANATION

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

MAJOR DIVISION			GROUP SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA	
COARSE-GRAINED SOILS	GRAVELS (More Than Half Coarse Fraction is Larger Than No. 4 Sieve)	CLEAN GRAVELS (little or no fines)	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURE, LITTLE OR NO FINES	CONTENT OF FINES BELOW 5%	Cu = (D60 / D10) greater than 4 Cc = $(D30)^2$ / (D10 * D60) between 1 and 3
			GP	POORLY GRADED GRAVELS, AND GRAVEL-SAND MIXTURES LITTLE OR NO FINES		CLEAN GRAVELS NOT MEETING ABOVE REQUIREMENTS
		DIRTY GRAVELS (with some fines)	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	GM: ATTERBERG LIMITS BELOW "A" LINE. or P.I. LESS THAN 4
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES		GC: ATTERBERG LIMITS ABOVE "A" LINE. or P.I. MORE THAN 7
More Than Half by Weight Larger Than No. 200 Sieve	SANDS (More Than Half Coarse Fraction is Smaller Than No. 4 Sieve)	CLEAN SANDS (little or no fines)	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	CONTENT OF FINES BELOW 5%	Cu = (D60 / D10) greater than 6 Cc = $(D30)^2$ / (D10 * D60) between 1 and 3
			SP	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES		CLEAN SANDS NOT MEETING ABOVE REQUIREMENTS
		DIRTY SANDS (with some fines)	SM	SILTY SANDS, SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW "A" LINE with P.I. LESS THAN 4
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE "A" LINE with P.I. MORE THAN 7
FINE-GRAINED SOILS	SILTS (Below A-Line on Plasticity Chart, Negligible Organics)	Liquid Limit < 50%	ML	INORGANIC SILTS, ROCK FLOUR, SANDY SILTS OF SLIGHT PLASTICITY		
		Liquid Limit > 50%	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOIL		
	CLAYS (Above A-Line on Plasticity Chart, Negligible Organics)	Liquid Limit < 50%	CL	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, CLEAN CLAYS		
Less Than Half by Weight Larger Than No. 200 Sieve		Liquid Limit > 50%	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS		
	ORGANIC SILTS & CLAYS (Below A-Line on Plasticity Chart)	Liquid Limit < 50%	OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
		Liquid Limit > 50%	OH	ORGANIC CLAYS OF HIGH PLASTICITY		
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS		



SOIL PARTICLE SIZE

FRACTION	U.S. STANDARD SIEVE			
	Passing		Retained	
	Sieve	Size (mm)	Sieve	Size (mm)
SILT / CLAY	#200	0.075		
SAND				
FINE	#40	0.425	#200	0.075
MEDIUM	#10	2.00	#40	0.425
COARSE	#4	4.75	#10	2.00
GRAVEL				
FINE	0.75"	19	#4	4.75
COARSE	3"	76	0.75"	19
COBBLES	76 mm to 203 mm			
BOULDERS	> 203 mm			
ROCK FRAGMENTS	> 76 mm			
ROCK	>0.76 cubic meter in volume			

GENERAL GUIDANCE FOR ENGINEERING PROPERTIES OF SOILS, BASED ON STANDARD PENETRATION TEST (SPT) DATA

SANDY SOILS				SILTY & CLAYEY SOILS		
Blow Counts N	Relative Density, %	Friction Angle ϕ, degrees	Description	Blow Counts N	Unconfined Strength q_u, tsf	Description
0 - 4	0 -15		Very Loose	< 2	< 0.25	Very soft
4 - 10	15 - 35	26 - 30	Loose	2 - 4	0.25 - 0.50	Soft
10 - 30	35 - 65	28 - 35	Medium Dense	4 - 8	0.50 - 1.00	Medium Stiff
30 - 50	65 - 85	35 - 42	Dense	8 - 15	1.00 - 2.00	Stiff
> 50	85 - 100	38 - 46	Very Dense	15 - 30	2.00 - 4.00	Very Stiff
				> 30	> 4.00	Hard

GEO Group Northwest, Inc.
Geotechnical Engineers, Geologists, & Environmental Scientists
13240 NE 20th Street, Suite 10 Bellevue, WA 98005
Phone (425) 649-8757 Fax (425) 649-8758

PLATE A1

BORING NO. B - 1

Logged By: GD
Drilled By: CN Drilling
Date Drilled: 9/11/2020
Surface Elev. 75'

Depth ft.	Elevation	USCS Code	Description	Sample Loc.	Sample No.	SPT Blow Counts	Water Content %	Other Tests/ Comments
		Fill	GRAVEL, with silt and sand, gray, dry, very dense, fill					
		ML	Sandy SILT, brown, damp, stiff; some subrounded gravel, some oxidation weathering.	I		4,8,7 (N=15)	25.9	
5		ML	Sandy SILT, brown, moist/wet, med stiff; some subrounded gravel, some oxidation staining.	I		4,3,3 (N=6)	40.0	
		ML	Sandy SILT, gray-brown, moist, soft; some subrounded gravel, some oxidation staining, interbedded silt and sand lenses.	I		1,1,2 (N=3)	47.4	At approx. 10' to 14': Inferred water seepage between sample locations, based on wet soil cuttings and water in drill hole.
10		ML	Sandy SILT, brown, moist/wet med stiff; some sand lenses, some oxidation weathering.	I		1,2,3 (N=5)	40.8	
		SP	SAND, grayish-brown, wet, med dense; trace silt, some oxidation staining.	I		5,5,5 (N=10)	32.9	
15		ML/SM	SILT & Sandy SILT, grayish-brown, moist, stiff; interbedded silt & sandy silt, some oxidation staining.	I		2,5,8 (N=13)	24.0	
		ML	SILT, gray-brown, damp, very stiff; trace sand, some localized laminations, some oxidation weathering.	I		5,9,14 (N=23)	35.9	
20		ML	SILT, brown-gray, damp, very stiff; some oxidation weathering.	I		8,12,18 (N=30)	31.0	
25			Depth of boring: 21.5 feet. Drilling Method: Hollow-stem auger. Sampling Method: 2"-O.D. standard penetration test sampler driven with 140 lb. hammer and cathead. Apparent water seepage encountered between approximately 10' and 14' during drilling.					

LEGEND: I 2" O.D. SPT Sampler; II 3" O.D. California Sampler

▽ Water Level noted during drilling
▼ Water Level measured at later time, as noted

GEO Group Northwest, Inc.
Geotechnical Engineers, Geologists, & Environmental Scientists

BORING LOG

PROPOSED SINGLE-FAMILY RESIDENCE
5401 W MERCER WAY
MERCER ISLAND, WASHINGTON

JOB NO. G-5244 **DATE** 10/1/2020 **PLATE** A2

BORING NO. B - 2

Logged By: GD — Date Drilled: 9/11/2020 — Surface Elev. 69'

Drilled By: CN Drilling

Depth ft.	Elevation	USCS Code	Description	Sample Loc.	Sample No.	SPT Blow Counts	Water Content %	Other Tests/ Comments
		Fill	at 2", landscaping fabric at 6", concrete pipe & washed drain rock fill					
		SM	Silty SAND, gray-brown, damp, medium dense; some subrounded gravel, some roots.	I		7,8,9 (N=17)	10.4	
5		ML	Sandy SILT, brown, damp, med stiff; some subrounded gravel, some oxidation staining.	I		3,4,4 (N=8)	33.1	
		ML	Sandy SILT, brown, moist, med stiff; some subrounded gravel, some oxidation staining.	I		3,3,7 (N=10)	38.8	
10		ML	Sandy SILT, brown, moist/wet, med stiff; some oxidation weathering, poor recovery.	I		1,3,6 (N=9)	41.8	At approx. 10' to 17': Inferred water seepage between sample locations, based on wet soil cuttings and water in drill hole.
			NO RECOVERY	I		2,3,6 (N=9)		
15		SP-SM	SAND & Silty SAND, gray-brown, wet, medium dense; interbedded sand & silty sand, some oxidation staining.	I		5,5,6 (N=11)	24.1	
		ML	SILT, gray-brown, damp, hard; some oxidation weathering.	I		8,11,22 (N=33)	21.1	
20		ML	SILT, brown-gray, damp, hard; some oxidation weathering.	I		11,16,19 (N=35)	25.0	
25			Depth of boring: 21.5 feet. Drilling Method: Hollow-stem auger. Sampling Method: 2"-O.D. standard penetration test sampler driven with 140 lb. hammer and cathead. Apparent water seepage encountered between approximately 10' and 17' during drilling.					

LEGEND: I 2" O.D. SPT Sampler; II 3" O.D. California Sampler; ▽ Water Level noted during drilling; ▼ Water Level measured at later time, as noted

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BORING LOG

PROPOSED SINGLE-FAMILY RESIDENCE
5401 W MERCER WAY
MERCER ISLAND, WASHINGTON

JOB NO. G-5244 **DATE** 10/1/2020 **PLATE** A3