GEOTECH
CONSULTANTS, INC.

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November 17, 2020

JN 20343

Bruce and Ann Vanderwall
7179 Holly Hills Drive
Mercer Island, Washington 98040
via email: brucevanderwall@comcast.net

Subject: **Transmittal Letter – Geotechnical Engineering Study**
Proposed Deck Addition to the Existing Residence
7179 Holly Hill Drive
Mercer Island, Washington

Dear Mr. and Mrs. Vanderwall:

Attached to this transmittal letter is our geotechnical engineering report for the proposed deck addition project to be constructed in 7179 Holly Hill Drive in Mercer Island, Washington. The scope of our services consisted of exploring site surface and subsurface conditions, and then developing this report to provide recommendations for general earthwork and design considerations for foundations, retaining walls, subsurface drainage, and slope considerations. This work was authorized by your acceptance of our proposal, P-10694, dated September 3, 2020.

The attached report contains a discussion of the study and our recommendations. Please contact us if there are any questions regarding this report, or for further assistance during the design and construction phases of this project.

Respectfully submitted,

GEOTECH CONSULTANTS, INC.

D. Robert Ward, P.E.
Principal

DRW:kg

GEOTECHNICAL ENGINEERING STUDY
Proposed Deck Addition
7179 Holly Hill Drive
Mercer Island, Washington

This report presents the findings and recommendations of our geotechnical engineering study for the site of the proposed deck addition onto the western side of the existing residence project to be located in Mercer Island.

We were provided with architectural plans and a topographic map. The architectural plans were developed by Conrad Romano Architects dated August 20, 2020 while the topographic map was prepared by TJR Surveying dated August 18, 2015. Based on this information, we understand that the project will consist of new decks off the northwestern and southwestern sides of the existing residence. A terrace, at the grade of the existing basement, is proposed under the northwestern deck. In addition, a sitting wall is proposed at the terrace level west of the deck and terrace. This wall is proposed to be located about 2 to 5 feet east of the top of an existing steep slope (discussed in the following section of this report).

If the scope of the project changes from what we have described above, we should be provided with revised plans in order to determine if modifications to the recommendations and conclusions of this report are warranted.

SITE CONDITIONS

SURFACE

The Vicinity Map, Plate 1, illustrates the general location of the site in the west-central portion of Mercer Island. The somewhat four-sided site has frontage on its eastern side along Holly Hill Drive and on its western side along Lake Washington. The site is long in the east-west direction, and the site slopes downslope to west (toward the lake). Approximately the eastern three-quarters percent of the site, slopes only gently to moderately downward to the west. A driveway enters the property at the eastern end of the site, while the large, existing residence is located in the central portion of the site (and the eastern side of the gentle to moderate portion of the site). The residence has a basement that daylights to the west. A large, main-level deck is located at the western edge of the residence. There is a flat area, with a grade similar to the basement level of the residence, below and adjacent to the western edge of the deck; this flat area borders the top of a steep slope that is approximately 25 feet tall. The inclination of the slope is approximately 50 to 60 percent. A flat yard is mostly located between the base of the steep slope and Lake Washington, and it appears that an excavation into the base of slope was made when the lower yard was created. The slope is mostly covered with grass and landscaping, and we did not observe any indications of instability of this slope.

SUBSURFACE

The subsurface conditions were explored by drilling two test borings at the approximate locations shown on the Site Exploration Plan, Plate 2. Our firm also observed the drilling of six test borings two residential lots to the south of the subject site in 2016. Our exploration program was based on the proposed construction, anticipated subsurface conditions and those encountered during exploration, and the scope of work outlined in our proposal.

The test borings were drilled on November 12, 2020 using a small track-mounted, hollow-stem auger drill. Samples were taken at approximate 5-foot intervals with a standard penetration sampler. This split-spoon sampler, which has a 2-inch outside diameter, is driven into the soil with a 140-pound hammer falling 30 inches. The number of blows required to advance the sampler a given distance is an indication of the soil density or consistency. A geotechnical engineer from our staff observed the drilling process, logged the test borings, and obtained representative samples of the soil encountered. The Test Boring Logs are attached as Plates 3 and 4.

Soil Conditions

The test borings were drilled in the flat area on the western side of the residence. The upper soil revealed in the test borings consists of approximately 3.5 to 5 feet of loose, unengineered fill soil. Native, silty sand with gravel soil was revealed below the fill soils. The upper few feet of the native soil was in a loose condition, but then became dense to very dense at depths of approximately 5 to 8 feet below the ground surface; this soil is known geologically as glacial till. This dense to very dense soil was revealed to the maximum explored depth of approximately 20 feet.

As noted earlier, our firm observe the drilling of 6 test borings two residential lots south of the subject site in 2016. Very dense glacial till was also revealed at that site. About 2 to 6 feet of loose soil was revealed near the ground surface. Thus, the soil conditions in the two onsite test boring is very similar to the southern site.

Groundwater Conditions

No groundwater seepage was observed in the test borings, although they were left open for only a short time period. It should be noted that groundwater levels vary seasonally with rainfall and other factors, with higher and greater groundwater levels typically in the winter and spring months. We do not expect a large amount of groundwater at the site, but some groundwater could be revealed perched in this months on top of the dense to very dense glacial till.

The stratification lines on the logs represent the approximate boundaries between soil types at the exploration locations. The actual transition between soil types may be gradual, and subsurface conditions can vary between exploration locations. The logs provide specific subsurface information only at the locations tested. Where a transition in soil type occurred between samples in the borings, the depth of the transition was interpreted. The relative densities and moisture descriptions indicated on the test boring logs are interpretive descriptions based on the conditions observed during excavation drilling.

SEISMIC CONSIDERATIONS

In accordance with the International Building Code (IBC), the site class within 100 feet of the ground surface is best represented by Site Class Type C (Very Dense Soil). As noted in the USGS website, the mapped spectral acceleration value for a 0.2 second (S_s) and 1.0 second period (S_1) equals 1.48g and 0.51g, respectively.

The IBC and ASCE 7 require that the potential for liquefaction (soil strength loss) during an earthquake be evaluated for the peak ground acceleration of the Maximum Considered Earthquake (MCE), which has a probability of occurring once in 2,475 years (2 percent probability of occurring in a 50-year period). The MCE peak ground acceleration adjusted for site class effects (F_{PGA}) equals 0.76g. The soils beneath the site are not) susceptible to seismic liquefaction under the ground motions of the MCE because of their dense nature and/or the absence of near-surface groundwater.

Sections 1803.5 of the IBC and 11.8 of ASCE 7 require that other seismic-related geotechnical design parameters (seismic surcharge for retaining wall design and slope stability) include the potential effects of the Design Earthquake. The peak ground acceleration for the Design Earthquake is defined in Section 11.2 of ASCE 7 as two-thirds (2/3) of the MCE peak ground acceleration, or 0.51g.

CONCLUSIONS AND RECOMMENDATIONS

GENERAL

CONCLUSIONS AND RECOMMENDATIONS, AND CRITICAL AREAS INFORMATION

The two test borings drilled near the top of the steep western slope in the area of the proposed development revealed that the core soil of the site is dense to very dense, glacial till. Due to its high shear strength, glacial till soil is extremely well suited to support building loads and is very resistant to slope instability. However, approximately 5 to 8 feet of loose soil was revealed at the ground surface overlying the glacial till soil. Settlement of the structures could occur if the structure loads were founded on the loose upper soil, and thus we recommend that the foundations for the deck and sitting wall structures be placed on or into the glacial till. For the light building loads of this project and the relatively shallow depths of loose upper soil, we believe that driven pipe piles should be used as the foundations of the structures. These piles can be adequately embedded into the glacial till soil.

Although the core of the steep western is the dense to very dense glacial till, there is some potential of movement of the shallow, near-surface soil, especially during periods of extreme precipitation. This is a potential of all steep slopes in the Puget Sound area. However, if there is any movement of the near-surface soils, it is our opinion that the structures will remain stable because the pipe piles will be embedded into the core, glacial till soil.

Discussion of Critical Areas/Geologically Hazardous Areas (MICC 19.07)

As noted above, per the Mercer Island GIS, the site is shown to be in an Erosion Hazard Area and potentially a Landslide Hazard Area. These are known as Geologically Hazard Areas per MICC. A discussion as it relates to these two hazard areas is given below.

Landslide Hazard Areas: There are several criteria for being a Landslide Hazard Area based on the MICC. The first four criteria are as follow:

1. Areas of historic failures.
2. Areas with all three of the following characteristics:
    a. Slopes steeper than 15 percent; and

b. Hillsides intersecting geologic contacts with a relatively permeable sediment overlying a relatively impermeable sediment or bedrock; and
c. Springs or ground water 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.

In our professional opinion, none of these criteria are met for this site. Although there are areas on the site that are steeper than an inclination of 15 percent, two other criteria regarding soil conditions and groundwater are not met.

There is a fifth criteria with regards to Landslide Hazard areas: Steep Slopes -- any slope that is 40 percent or greater measured over a 30-foot horizontal run. As noted earlier, there is a steep slope, inclined at about 50 to 60 percent and having a height of approximately 25 feet, just west of the existing residence and the project area. For Steep Slopes, the default buffer is the height of the slope, although buffers should be either 25 feet or 75 feet for Steep Slopes where there is a potential for either a shallow or deep landslide. As noted earlier, the core of the site consists of very competent, glacial till soil with only relatively shallow loose soil over them; because of this, there is only a potential for a shallow landslide and not a deep landslide. Therefore, the 25-foot buffer applies. In addition, a buffer as tall as the height of the slope is recommended in the MICC; since the slope is about 25 feet tall, again the 25-foot buffer applies.

For this project, structures are proposed within the buffer (but not on the Landslide Hazard Area itself. Per the MICC (ss), an Alteration of "associated buffers may occur if a critical area study…" finds that numerous requirements of the MICC are met. We have listed those numerous requirements below, followed by our responses (*in italics*) as to how the requirements are met in our professional opinion. The Alteration:

a. Will not adversely impact other critical areas. *The steep western slope is an Erosion Hazard Area (noted in a following section of this report), and there is a Seismic Hazard Area noted in the Mercer Island GIS system at the base of the slope. It is very common to install proper erosion control measures at the top of the slope on the downslope side of the proposed development, and also the slope will not be disturbed for this development, thus the Erosion Hazard Area will not be affected. Again, because the slope will not be disturbed, the flat yard area at the base of the steep slope, which is the Seismic Hazard Area, will not be disturbed. No other critical areas are nearby.*
b. Will not adversely impact the subject property or adjacent properties. *All of the structure loads will be embedded into the very competent, very stable glacial till soil and very little excavation is planned for this project, thus the project will not adversely affect the property or adjacent property.*
c. Will mitigate impacts to the geologically hazardous area consistent with best available science to the maximum extent reasonably possible such that the site is determined to be safe. *We believe that, but using the piles to support the structure load so that the loads are embedded into the very competent glacial till, best available science is being used and the site is safe in our professional opinion.*
d. Includes the landscaping of all disturbed areas outside of building footprints and installation of hardscape prior to final inspection. *This will be included in the final project plans.*

The Alteration of Landslide Hazard Areas requires that a geotechnical professional provides a statement of risk matching one of several statements. Our **statement of risk** is as follows:

Provided the recommendations in this report are followed: construction practices are proposed for the alteration that would render the development as safe as if it were not located in a geologically hazardous area and do not adversely impact adjacent properties

Erosion Hazard Area: Essentially nearly all slopes on Mercer Island steeper than 15 percent, meet the MICC's criteria for an Erosion Hazard Area. Although much of the proposed development area is relatively flat (less than a 15-percent inclination), the steep western slope is an Erosion Hazard Area. No buffers are needed per the MICC for Erosion Hazard Areas, nor do we believe any are needed for this project. Excavation and construction of the project can readily be accomplished without adverse to the site and surrounding properties by exercising care and being proactive with the maintenance and potential upgrading of the erosion control system through the entire construction process. Proper erosion control implementation will be important to prevent adverse impacts to the site and neighboring properties. The temporary erosion control measures needed during the site development will depend heavily on the weather conditions that are encountered during the site work. One of the most important considerations, particularly during wet weather, is to immediately cover any bare soil areas to prevent accumulated water or runoff from the work area from becoming silty in the first place. Any cut slopes and soil stockpiles should be covered with plastic during wet weather. Soil stockpiles should be minimized. Following rough grading, it may be necessary to mulch or hydroseed bare areas that will not be immediately covered with landscaping or an impervious surface.

Summary: Based on the information provided above, it is our professional opinion from a geotechnical engineering standpoint that the project is very suitable provided the recommendations in this report are followed, and that the project will not destabilize or negatively affect the existing steep western slope, and other Critical Areas, or neighboring properties.

The erosion control measures needed during the site development will depend heavily on the weather conditions that are encountered. We anticipate that a silt fence will be needed around the downslope sides of any cleared areas. Existing pavements, ground cover, and landscaping should be left in place wherever possible to minimize the amount of exposed soil. Rocked staging areas and construction access roads should be provided to reduce the amount of soil or mud carried off the property by trucks and equipment. Wherever possible, the access roads should follow the alignment of planned pavements. Trucks should not be allowed to drive off of the rock-covered areas. Cut slopes and soil stockpiles should be covered with plastic during wet weather. Following clearing or rough grading, it may be necessary to mulch or hydroseed bare areas that will not be immediately covered with landscaping or an impervious surface. On most construction projects, it is necessary to periodically maintain or modify temporary erosion control measures to address specific site and weather conditions.

Geotech Consultants, Inc. should be allowed to review the final development plans to verify that the recommendations presented in this report are adequately addressed in the design. Such a plan review would be additional work beyond the current scope of work for this study, and it may include revisions to our recommendations to accommodate site, development, and geotechnical constraints that become more evident during the review process.

We recommend including this report, in its entirety, in the project contract documents. This report should also be provided to any future property owners so they will be aware of our findings and recommendations.

PIPE PILES

Several different pile sizes are available for this project, including 2, 3, and 4-inch sizes.

A 2-inch-diameter pipe pile driven with a minimum 90-pound jackhammer or a 140-pound Rhino hammer to a final penetration rate of 1-inch or less for one minute of continuous driving may be assigned an allowable compressive load of 3 tons. Extra-strong steel pipe should be used. The site soils are not highly organic and are not located near saltwater. As a result, they do not have an elevated corrosion potential. Considering this, it is our opinion that standard "black" pipe can be used, and corrosion protection, such as galvanizing, is not necessary for the pipe piles. Subsequent pipe sections should be connected together using threaded or slip couplers, or by welding. If slip couplers are used, they must fit snugly into the ends of the pipes. This can require that shims or beads of welding flux be applied to the couplers.

Three- or 4-inch-diameter pipe piles driven with a 850- or 1,100- or 2,000-pound hydraulic jackhammer to the following final penetration rates may be assigned the following compressive capacities. As a minimum, Schedule 40 pipe should be used.

INSIDE PILE DIAMETER	FINAL DRIVING RATE (850-pound hammer)	FINAL DRIVING RATE (1,100-pound hammer)	FINAL DRIVING RATE (2,000-pound hammer)	ALLOWABLE COMPRESSIVE CAPACITY
3 inches	10 sec/inch	6 sec/inch	2 sec/inch	6 tons
4 inches	16 sec/inch	10 sec/inch	4 sec/inch	10 tons

Note: The refusal criteria indicated in the above table are valid only for pipe piles that are installed using a hydraulic impact hammer carried on leads that allow the hammer to sit on the top of the pile during driving. If the piles are installed by alternative methods, such as a vibratory hammer or a hammer that is hard-mounted to the installation machine, numerous load tests to 200 percent of the design capacity would be necessary to substantiate the allowable pile load. The appropriate number of load tests would need to be determined at the time the contractor and installation method are chosen.

Lateral loads may be resisted by passive earth pressure acting on the vertical, embedded portions of the foundation. For this condition, the foundation must be either poured directly against relatively level, undisturbed oil or surrounded by level structural fill. We recommend using a passive earth pressure of 300 pounds per cubic foot (pcf) for this resistance. We recommend a safety factor of at least 1.5 for the foundation's resistance to lateral loading, when using the above ultimate passive value. If lateral resistance in addition to the passive soil pressure is required, we recommend driving battered piles in the same direction as the applied lateral load. The lateral capacity of a battered pile is equal to one-half of the lateral component of the allowable compressive load. The allowable vertical capacity of battered piles does not need to be reduced if the piles are battered steeper than 1:5 (Horizontal:Vertical). For the seat wall structure, which will be located near the top of the steep slope, we recommend that all of the piles be batter down the slope to provide lateral stability to the structure.

EXCAVATIONS AND SLOPES

Temporary excavation slopes should not exceed the limits specified in local, state, and national government safety regulations. Also, temporary cuts should be planned to provide a minimum 2 to 3 feet of space for construction of foundations, walls, and drainage. Temporary cuts to a maximum overall depth of about 4 feet may be attempted vertically in unsaturated soil, if there are no indications of slope instability. However, vertical cuts should not be made near property boundaries, or existing utilities and structures. Based upon Washington Administrative Code (WAC) 296, Part N, the upper 6 to 7 feet of soil at the subject site would generally be classified as Type B. Therefore, temporary cut slopes greater than 4 feet in height should not be excavated at an inclination steeper than 1:1 (Horizontal:Vertical), extending continuously between the top and the bottom of a cut.

The above-recommended temporary slope inclination is based on the conditions exposed in our explorations, and on what has been successful at other sites with similar soil conditions. It is possible that variations in soil and groundwater conditions will require modifications to the inclination at which temporary slopes can stand. Temporary cuts are those that will remain unsupported for a relatively short duration to allow for the construction of foundations, retaining walls, or utilities. Temporary cut slopes should be protected with plastic sheeting during wet weather. It is also important that surface runoff be directed away from the top of temporary slope cuts. Cut slopes should also be backfilled or retained as soon as possible to reduce the potential for instability. Please note that loose soil can cave suddenly and without warning. Excavation, foundation, and utility contractors should be made especially aware of this potential danger. These recommendations may need to be modified if the area near the potential cuts has been disturbed in the past by utility installation, or if settlement-sensitive utilities are located nearby.

Water should not be allowed to flow uncontrolled over the top of any temporary or permanent slope. All permanently exposed slopes should be seeded with an appropriate species of vegetation to reduce erosion and improve the stability of the surficial layer of soil.

LIMITATIONS

The conclusions and recommendations contained in this report are based on site conditions as they existed at the time of our exploration and assume that the soil and groundwater conditions encountered in the test borings are representative of subsurface conditions on the site. If the subsurface conditions encountered during construction are significantly different from those observed in our explorations, we should be advised at once so that we can review these conditions and reconsider our recommendations where necessary. Unanticipated conditions are commonly encountered on construction sites and cannot be fully anticipated by merely taking samples in test borings. Subsurface conditions can also vary between exploration locations. Such unexpected conditions frequently require making additional expenditures to attain a properly constructed project. It is recommended that the owner consider providing a contingency fund to accommodate such potential extra costs and risks. This is a standard recommendation for all projects.

The recommendations presented in this report are directed toward the protection of only the proposed structure from damage due to slope movement. Predicting the future behavior of steep slopes and the potential effects of development on their stability is an inexact and imperfect science that is currently based mostly on the past behavior of slopes with similar characteristics. Landslides and soil movement can occur on steep slopes before, during, or after the development of property. The owner of any property containing, or located close to steep slopes must ultimately accept the possibility that some slope movement could occur, resulting in possible loss of ground. However, if the recommendations in this report are followed, such movement will not affect the new structures.

This report has been prepared for the exclusive use of Bruce and Ann Vanderwall and their representatives, for specific application to this project and site. Our conclusions and recommendations are professional opinions derived in accordance with our understanding of current local standards of practice, and within the scope of our services. No warranty is expressed or implied. The scope of our services does not include services related to construction safety precautions, and our recommendations are not intended to direct the contractor's methods, techniques, sequences, or procedures, except as specifically described in our report for consideration in design. Our services also do not include assessing or minimizing the potential for biological hazards, such as mold, bacteria, mildew and fungi in either the existing or proposed site development.

ADDITIONAL SERVICES

In addition to reviewing the final plans, Geotech Consultants, Inc. should be retained to provide geotechnical consultation, testing, and observation services during construction. This is to confirm that subsurface conditions are consistent with those indicated by our exploration, to evaluate whether earthwork and foundation construction activities comply with the general intent of the recommendations presented in this report, and to provide suggestions for design changes in the event subsurface conditions differ from those anticipated prior to the start of construction. However, our work would not include the supervision or direction of the actual work of the contractor and its employees or agents. Also, job and site safety, and dimensional measurements, will be the responsibility of the contractor.

During the construction phase, we will provide geotechnical observation and testing services when requested by you or your representatives. Please be aware that we can only document site work we actually observe. It is still the responsibility of your contractor or on-site construction team to verify that our recommendations are being followed, whether we are present at the site or not.

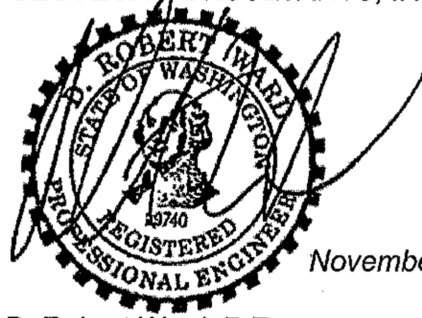
The following plates are attached to complete this report:

Plate 1	Vicinity Map
Plate 2	Site Exploration Plan
Plates 3 - 4	Test Boring Logs

We appreciate the opportunity to be of service on this project. Please contact us if you have any questions, or if we can be of further assistance.

Respectfully submitted,

GEOTECH CONSULTANTS, INC.



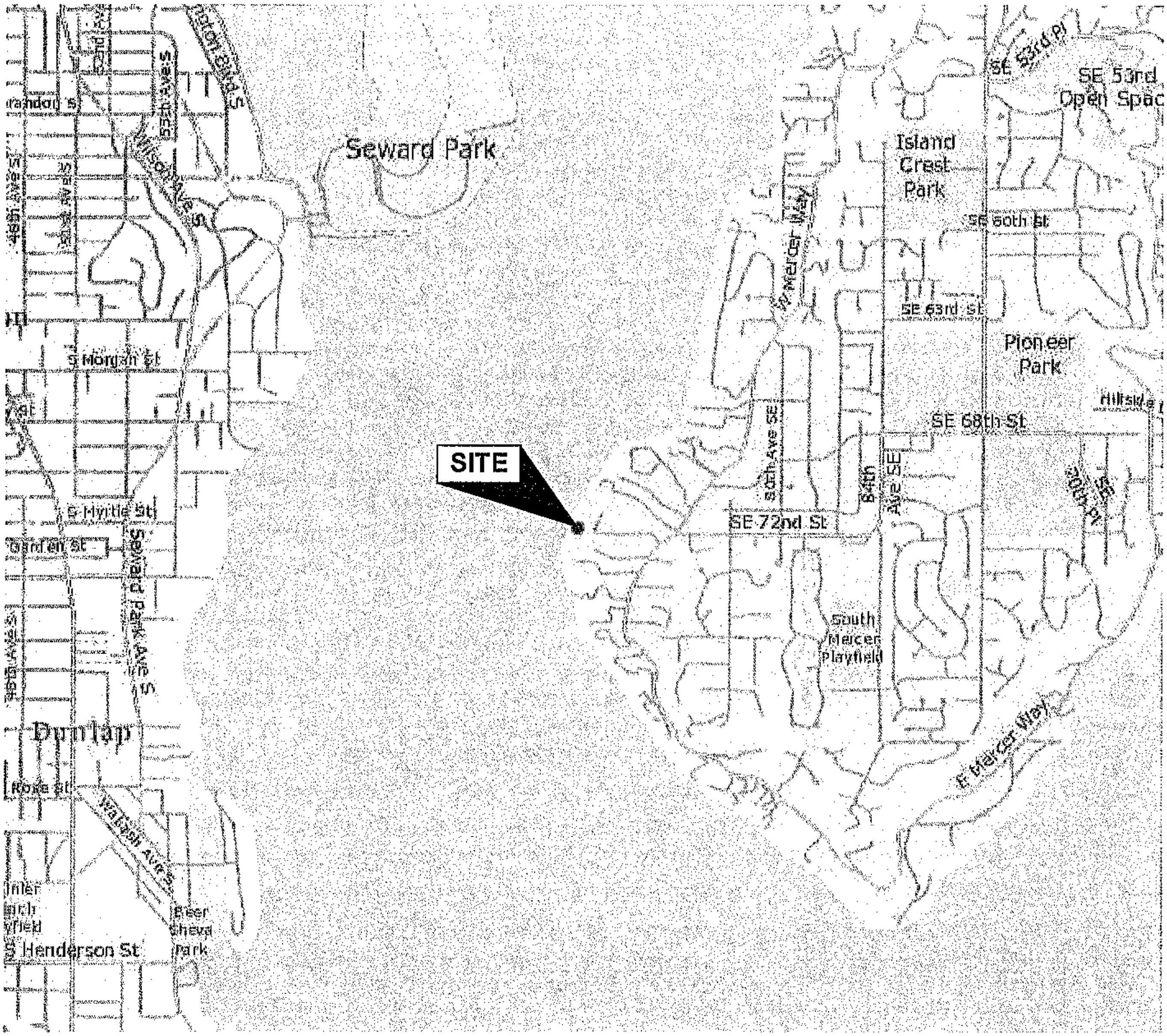
November 17, 2020

D. Robert Ward, P.E.
Principal

cc: **Conrad Romano Architects** - Erik Voris
via email: erik@conardromano.com

DRW:kg

NORTH



(Source: King County iMap)

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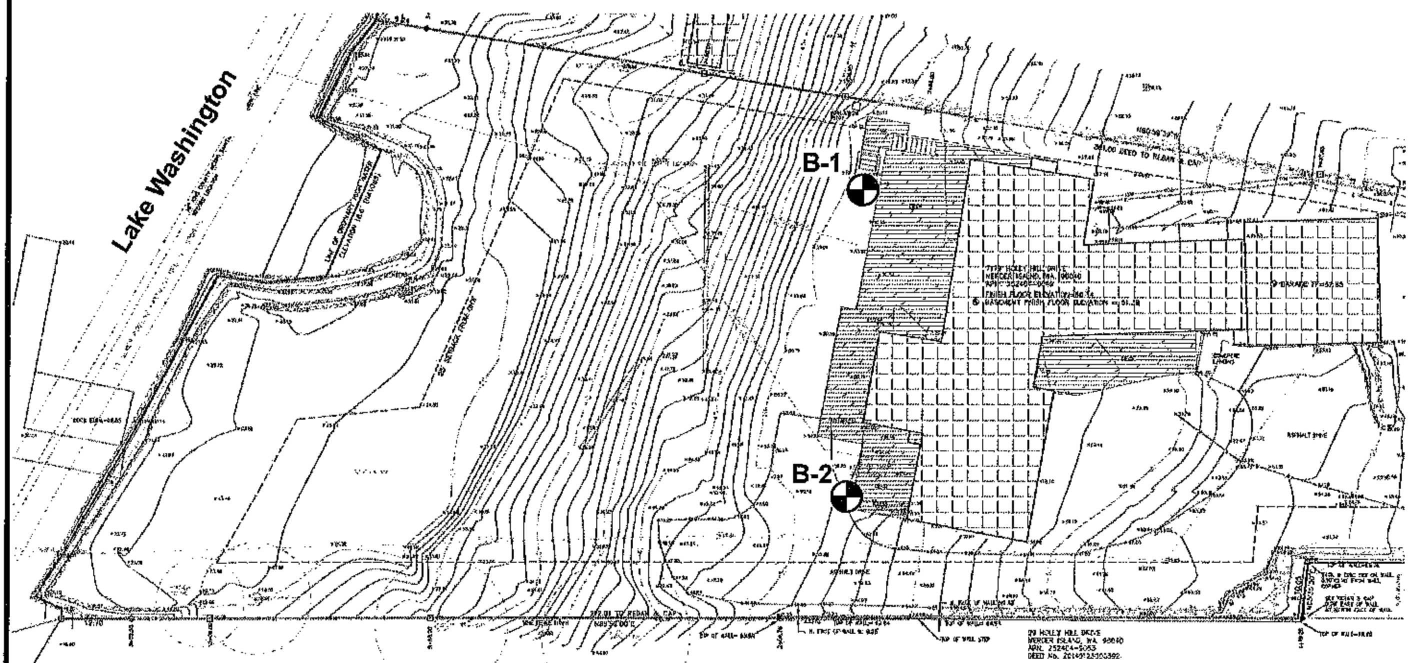
VICINITY MAP
7179 Holly Hill Drive
Mercer Island, Washington

Job No:	Date:		Plate:
20343	Nov. 2020		1

NORTH



Legend:

Test Boring Location

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SITE EXPLORATION PLAN

7179 Holly Hill Drive
Mercer Island, Washington

Job No:	Date:		Plate:
20343	Nov. 2020	No Scale	2

BORING 1

Elevation ±50 feet

Depth (ft.)	Moisture	Water Table	Blows per Foot	Sample	USCS	Description
0–5					FILL	Topsoil Brown mottled orange, slightly gravelly, very silty SAND, fine-grained, moist, jumbled, loose **(FILL)**
5			8	1	SM	Gray mottled orange, slightly gravelly, silty SAND, fine-grained, moist, loose
			30	2	SM	-becomes gray and gray-brown mottled orange, slightly cemented, dense
10			61	3	SM	-becomes gray mottled orange, cemented, very dense **(Glacial Till)**
15			50/5"	4	SM	
20			95/11"	5	SM	

* **Test boring was terminated at 21.5 feet on November 12, 2020.**
* **No groundwater seepage was observed during drilling.**

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TEST BORING LOG

7179 Holly Hill Drive
Mercer Island, Washington

Job	Date:	Logged by:	Plate:
20343	Nov. 2020	MKM	3

BORING 2

Depth (ft.)	Moisture	Water Table	Blows per Foot	Sample	USCS	Description (Elevation ±51 feet)
					FILL	Topsoil
						Dark-brown silty SAND with organics, fine-grained, moist, loose **(FILL)**
					SM	Brown mottled orange, silty SAND with roots, fine-grained, moist, loose
5			67	1		-becomes gray and gray-brown with trace rust, slightly gravelly, very dense **(Glacial Till)** -with small black specks
			76	2		-with a thin dark-brown layer at tip
10			19	3		-with thin clean sand seams, becomes dense (Blow counts slightly understated) -becomes very moist at tip
						-driller noted increased drilling difficulty
15			50/6"	4		-becomes gray mottled orange, very dense -becomes blue-gray
			50/4"	5		-becomes very silty, with thin angular sand seams
20						
25						

* **Test boring was terminated at 18.8 feet on November 12, 2020 due to auger refusal.**

* **No groundwater seepage was observed during drilling.**

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TEST BORING LOG

7179 Holly Hill Drive
Mercer Island, Washington

Job	Date:	Logged by:	Plate:
20343	Nov. 2020	MKM	4