



**COBALT**  
GEOSCIENCES

**Geotechnical Investigation  
Proposed Single Family Residence**

9319 SE 43<sup>rd</sup> Street  
Mercer Island, Washington

April 5, 2019

## Table of Contents

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<b>1.0 INTRODUCTION.....</b>	<b>1</b>
<b>2.0 PROJECT DESCRIPTION.....</b>	<b>1</b>
<b>3.0 SITE DESCRIPTION.....</b>	<b>1</b>
<b>4.0 FIELD INVESTIGATION .....</b>	<b>2</b>
4.1.1 Site Investigation Program .....	2

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<b>5.0 SOIL AND GROUNDWATER CONDITIONS .....</b>	<b>2</b>
5.1.1 Area Geology .....	2
5.1.2 Groundwater .....	2

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<b>6.0 GEOLOGIC HAZARDS .....</b>	<b>3</b>
6.1 Steep Slope Hazard .....	3
6.2 Erosion Hazard .....	3
6.3 Seismic Hazard .....	3

---

<b>7.0 DISCUSSION .....</b>	<b>4</b>
7.1.1 General.....	4

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<b>8.0 RECOMMENDATIONS .....</b>	<b>4</b>
8.1.1 Site Preparation .....	4
8.1.2 Temporary Excavations.....	5
8.1.3 Erosion and Sediment Control.....	6
8.1.4 Foundation Design .....	6
8.1.5 Reinforced Concrete Retaining Walls .....	7
8.1.6 Stormwater Management .....	8
8.1.7 Slab-on-Grade.....	8
8.1.8 Groundwater Influence on Construction .....	9
8.1.9 Utilities .....	9

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<b>9.0 CONSTRUCTION FIELD REVIEWS .....</b>	<b>10</b>
<b>10.0 CLOSURE .....</b>	<b>10</b>

## LIST OF APPENDICES

Appendix A – Statement of General Conditions  
Appendix B – Figures  
Appendix C – Boring Logs

April 5, 2019

## 1.0 Introduction

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In accordance with your authorization, Cobalt Geosciences, LLC (Cobalt) has completed a geotechnical investigation for the proposed single-family residence located at 9319 SE 43<sup>rd</sup> Street in Mercer Island, Washington (Figure 1).

The purpose of the geotechnical investigation was to identify subsurface conditions and to provide geotechnical recommendations for foundation design, stormwater management, earthwork, soil compaction, and suitability of the on-site soils for use as fill.

The scope of work for the geotechnical evaluation consisted of a site investigation followed by engineering analyses to prepare this report. Recommendations presented herein pertain to various geotechnical aspects of the proposed development, including foundation support of the new building and retaining wall design, if necessary.

## 2.0 Project Description

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The project includes construction of a new multi-story residence located in the area of an existing residence. The new residence may incorporate a daylight basement due to existing topography within the property. Associated development will include utilities, driveway, and landscaped areas.

Anticipated building loads are expected to be light and site grading will include cuts and fills on the order of 10 feet or less. We should be notified if the planned construction changes and we should be provided with the final plans when they become available.

## 3.0 Site Description

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The site is located at 9319 SE 43<sup>rd</sup> Street in Mercer Island, Washington (Figure 1). The property consists of one rectangular shaped parcel (No. 5459900050) with a total area of 10,625 square feet.

The property is developed with a single-family residence with daylight basement. A driveway extends onto the property from the north. The property slopes downward from north to south at magnitudes ranging from 5 to 25 percent and relief of about 12 feet.

There is a steep slope extending downward to the south from the south property line. The slope area is part of a larger east-facing ravine system that includes local landslide-affected areas. The upper part of the slope is oversteepened through yard waste placement. Overall, the steep slope has magnitudes of 30 to 50 percent and relief of at least 50 feet. The slope continues downward to the east onto adjacent properties.

The site and adjacent areas are vegetated with grasses, bushes/shrubs, blackberry vines, ferns, ivy, along with sparse deciduous and evergreen trees.

The site is bordered to the north by SE 43<sup>rd</sup> Street, to the east and west by single-family residences, and to the south by a steep slope and residential properties.

April 5, 2019

## 4.0 Field Investigation

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### 4.1.1 Site Investigation Program

The geotechnical field investigation program was completed on March 21, 2019 and included drilling and sampling three auger borings within the property for subsurface analysis. We previously anticipated excavating test pits; however, access was limited to the yard area near the steep slope.

The soils encountered were logged in the field and are described in accordance with the Unified Soil Classification System (USCS).

A Cobalt Geosciences field representative conducted the explorations, collected disturbed soil samples, classified the encountered soils, kept a detailed log of the explorations, and observed and recorded pertinent site features.

The results of the sampling are presented on the boring logs enclosed in Appendix C.

## 5.0 Soil and Groundwater Conditions

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### 5.1.1 Area Geology

The site lies within the Puget Lowland. The lowland is part of a regional north-south trending trough that extends from southwestern British Columbia to near Eugene, Oregon. North of Olympia, Washington, this lowland is glacially carved, with a depositional and erosional history including at least four separate glacial advances/retreats. The Puget Lowland is bounded to the west by the Olympic Mountains and to the east by the Cascade Range. The lowland is filled with glacial and non-glacial sediments consisting of interbedded gravel, sand, silt, till, and peat lenses.

The Geologic Map of Mercer Island, indicates that the site is underlain by Vashon Glacial Till. Further south within the steep slope, there is a mapped landslide scarp and Vashon Advance Outwash.

Vashon Glacial Till consists of a non-sorted mixture of silt, sand, gravel, and cobbles. These materials are nearly impermeable and generally dense to very dense.

#### Explorations

All of the borings encountered approximately 6 inches of grass and topsoil underlain by approximately 3 to 6 feet of loose to medium dense, silty-fine to medium grained sand with gravel (Weathered Glacial Till). These materials were underlain by dense to very dense, silty-fine to medium grained sand with gravel (Glacial Till), which continued to the termination depths of the borings.

### 5.1.2 Groundwater

Groundwater was not encountered in any of the explorations. There is a slight chance that perched groundwater could be encountered between weathered and unweathered glacial till. The volumes of water would be light and within 10 feet of the ground surface.

April 5, 2019

Water table elevations often fluctuate over time. The groundwater level will depend on a variety of factors that may include seasonal precipitation, irrigation, land use, climatic conditions and soil permeability. Water levels at the time of the field investigation may be different from those encountered during the construction phase of the project.

## 6.0 Geologic Hazards

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### 6.1 Steep Slope Hazard

There is a steep slope and landslide hazard area just south of the property. The slope in this area is about 50 feet in height although the area eventually extends easterly and continues downward toward Lake Washington through adjacent properties. The slope in the area of the subject property has magnitudes of 30 to 50 percent and a localized oversteepened top of slope where yard waste was likely placed.

Based on our observations, there is minimal risk of soil movement on the site and adjacent areas at this time and the site appears stable at this time. The underlying glacial till is typically dense to very dense and resistant to large-scale movements. There is no evidence of landslide activity at the site or adjacent areas. The mapped scarp and landslide zone is located further southeast and at least 100 feet from the property.

We recommend a minimum building setback of 25 feet for the new residence from the top of the slope. Once a design plan with finished floor elevations has been prepared, we can provide additional comments and recommendations, if warranted.

Statement of Risk: The alteration is so minor as not to pose a threat to the public health, safety, and welfare.

### 6.2 Erosion Hazard

The Natural Resources Conservation Services (NRCS) maps for King County indicate that the site is underlain by Arents, Alderwood material (6 to 15 percent slopes). These soils would have a slight to moderate erosion potential in a disturbed state, depending on the slope magnitude.

It is our opinion that soil erosion potential at this project site can be reduced through landscaping and surface water runoff control. Typically erosion of exposed soils will be most noticeable during periods of rainfall and may be controlled by the use of normal temporary erosion control measures, such as silt fences, hay bales, mulching, control ditches and diversion trenches. The typical wet weather season, with regard to site grading, is from October 31<sup>st</sup> to April 1<sup>st</sup>. Erosion control measures should be in place before the onset of wet weather.

### 6.3 Seismic Hazard

The overall subsurface profile corresponds to a Site Class *D* as defined by Table 1613.5.2 of the 2015 International Building Code (2015 IBC). A Site Class *D* applies to an overall profile consisting of dense to very dense soils within the upper 100 feet.

April 5, 2019

We referenced the U.S. Geological Survey (USGS) Earthquake Hazards Program Website to obtain values for  $S_s$ ,  $S_i$ ,  $F_a$ , and  $F_v$ . The USGS website includes the most updated published data on seismic conditions. The site specific seismic design parameters and adjusted maximum spectral response acceleration parameters are as follows:

PGA	(Peak Ground Acceleration, in percent of g)
$S_s$	140.7% of g
$S_i$	54.00% of g
$F_A$	1.00
$F_V$	1.50

Additional seismic considerations include liquefaction potential and amplification of ground motions by soft/loose soil deposits. The liquefaction potential is highest for loose sand with a high groundwater table. The relatively dense and very fine grained soil deposits that underlie the site have a low liquefaction potential.

## 7.0 DISCUSSION

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### 7.1.1 General

The site is underlain by weathered and unweathered glacial till. The proposed single-family residence may be supported on a shallow foundation system bearing on medium dense or firmer native soils and structural fill placed on suitable native soils.

The site is underlain by fine-grained glacial till which is nearly impermeable. Furthermore, the site is situated above a steep slope and landslide hazard area. Subsurface runoff from new impervious surfaces could cause downslope sloughing, erosion, spring activity, or other instability. We recommend direct connection of new stormwater devices into City stormwater infrastructure.

## 8.0 Recommendations

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### 8.1.1 Site Preparation

Trees, shrubs and other vegetation should be removed prior to stripping of surficial organic-rich soil and fill. Based on observations from the site investigation program, it is anticipated that the stripping depth will be 6 to 18 inches. Deeper excavations will be necessary below large trees, existing foundation elements and in any areas underlain by undocumented fill materials. It is not uncommon for deeper excavations to be required when construction takes place during the wet grading season, particularly with fine-grained soils.

April 5, 2019

The native soils consist of variable mixtures of silt, sand, and gravel. These soils may be used as structural fill provided they achieve compaction requirements and are within 3 percent of the optimum moisture. These soils may only be suitable for use as fill during the summer months, as they will be above the optimum moisture levels in their current state. These soils are variably moisture sensitive and may degrade during periods of wet weather and under equipment traffic.

Imported structural fill should consist of a sand and gravel mixture with a maximum grain size of 3 inches and less than 5 percent fines (material passing the U.S. Standard No. 200 Sieve). Structural fill should be placed in maximum lift thicknesses of 12 inches and should be compacted to a minimum of 95 percent of the modified proctor maximum dry density, as determined by the ASTM D 1557 test method.

### **8.1.2 Temporary Excavations**

Based on our understanding of the project, we anticipate that the grading could include local cuts on the order of approximately 10 feet or less for foundation and utility placement. Excavations should be sloped no steeper than 1.5H:1V (Horizontal:Vertical) in loose native soils and 1H:1V in medium dense to dense native soils. If an excavation is subject to heavy vibration or surcharge loads, we recommend that the excavations be sloped no steeper than 2H:1V, where room permits. Slightly steeper temporary excavations may be feasible for basement wall construction. We can provide location-specific recommendations during construction.

Temporary cuts should be in accordance with the Washington Administrative Code (WAC) Part N, Excavation, Trenching, and Shoring. Temporary slopes should be visually inspected daily by a qualified person during construction activities and the inspections should be documented in daily reports. The contractor is responsible for maintaining the stability of the temporary cut slopes and reducing slope erosion during construction.

Temporary cut slopes should be covered with visqueen to help reduce erosion during wet weather, and the slopes should be closely monitored until the permanent retaining systems or slope configurations are complete. Materials should not be stored or equipment operated within 10 feet of the top of any temporary cut slope.

Soil conditions may not be completely known from the geotechnical investigation. In the case of temporary cuts, the existing soil conditions may not be completely revealed until the excavation work exposes the soil. Typically, as excavation work progresses the maximum inclination of temporary slopes will need to be re-evaluated by the geotechnical engineer so that supplemental recommendations can be made. Soil and groundwater conditions can be highly variable. Scheduling for soil work will need to be adjustable, to deal with unanticipated conditions, so that the project can proceed and required deadlines can be met.

If any variations or undesirable conditions are encountered during construction, we should be notified so that supplemental recommendations can be made. If room constraints or groundwater conditions do not permit temporary slopes to be cut to the maximum angles allowed by the WAC, temporary shoring systems may be required. The contractor should be responsible for developing temporary shoring systems, if needed. We recommend that Cobalt Geosciences and the project structural engineer review temporary shoring designs prior to installation, to verify the suitability of the proposed systems.

April 5, 2019

### 8.1.3 Erosion and Sediment Control

Erosion and sediment control (ESC) is used to reduce the transportation of eroded sediment to wetlands, streams, lakes, drainage systems, and adjacent properties. Erosion and sediment control measures should be implemented and these measures should be in general accordance with local regulations. At a minimum, the following basic recommendations should be incorporated into the design of the erosion and sediment control features for the site:

- Schedule the soil, foundation, utility, and other work requiring excavation or the disturbance of the site soils, to take place during the dry season (generally May through September). However, provided precautions are taken using Best Management Practices (BMP's), grading activities can be completed during the wet season (generally October through April).
- All site work should be completed and stabilized as quickly as possible.
- Additional perimeter erosion and sediment control features may be required to reduce the possibility of sediment entering the surface water. This may include additional silt fences, silt fences with a higher Apparent Opening Size (AOS), construction of a berm, or other filtration systems.
- Any runoff generated by dewatering discharge should be treated through construction of a sediment trap if there is sufficient space. If space is limited other filtration methods will need to be incorporated.

### 8.1.4 Foundation Design

The proposed single-family residence may be supported on a shallow spread footing foundation system bearing on undisturbed medium dense or firmer native soils or on properly compacted structural fill placed on the suitable native soils. If structural fill is used to support foundations, then the zone of structural fill should extend beyond the faces of the footing a lateral distance at least equal to the thickness of the structural fill.

For shallow foundation support, we recommend widths of at least 18 and 24 inches, respectively, for continuous wall and isolated column footings supporting the proposed structure. Provided that the footings are supported as recommended above, a net allowable bearing pressure of 2,500 pounds per square foot (psf) may be used for design.

A 1/3 increase in the above value may be used for short duration loads, such as those imposed by wind and seismic events. Structural fill placed on bearing, native subgrade should be compacted to at least 95 percent of the maximum dry density based on ASTM Test Method D1557. Footing excavations should be inspected to verify that the foundations will bear on suitable material.

Exterior footings should have a minimum depth of 18 inches below pad subgrade (soil grade) or adjacent exterior grade, whichever is lower. Interior footings should have a minimum depth of 12 inches below pad subgrade (soil grade) or adjacent exterior grade, whichever is lower.

If constructed as recommended, the total foundation settlement is not expected to exceed 1 inch. Differential settlement, along a 25-foot exterior wall footing, or between adjoining column footings, should be less than 1/2 inch. All footing excavations should be observed by a qualified geotechnical consultant.



April 5, 2019

Resistance to lateral footing displacement can be determined using an allowable friction factor of 0.35 acting between the base of foundations and the supporting subgrades. Lateral resistance for footings can also be developed using an allowable equivalent fluid passive pressure of 225 pounds per cubic foot (pcf) acting against the appropriate vertical footing faces (neglect the upper 12 inches below grade in exterior areas).

The allowable friction factor and allowable equivalent fluid passive pressure values include a factor of safety of 1.5. The frictional and passive resistance of the soil may be combined without reduction in determining the total lateral resistance.

Care should be taken to prevent wetting or drying of the bearing materials during construction. Any extremely wet or dry materials, or any loose or disturbed materials at the bottom of the footing excavations, should be removed prior to placing concrete. The potential for wetting or drying of the bearing materials can be reduced by pouring concrete as soon as possible after completing the footing excavation and evaluating the bearing surface by the geotechnical engineer or his representative.

### **8.1.5 Reinforced Concrete Retaining Walls**

The following table, titled **Wall Design Criteria**, presents the recommended soil related design parameters for retaining walls with a level backslope. Contact Cobalt if an alternate retaining wall system is used.

<b>Wall Design Criteria</b>	
“At-rest” Conditions (Lateral Earth Pressure – EFD <sup>+</sup> )	55 pcf (Equivalent Fluid Density)
“Active” Conditions (Lateral Earth Pressure – EFD <sup>+</sup> )	35 pcf (Equivalent Fluid Density)
Seismic Increase for “At-rest” Conditions (Lateral Earth Pressure)	14H* (Uniform Distribution)
Seismic Increase for “Active” Conditions (Lateral Earth Pressure)	7H* (Uniform Distribution)
Passive Earth Pressure on Low Side of Wall (Allowable, includes F.S. = 1.5)	Neglect upper 2 feet, then 225 pcf EFD <sup>+</sup>
Soil-Footing Coefficient of Sliding Friction (Allowable; includes F.S. = 1.5)	0.35

\*H is the height of the wall; Increase based on one in 500 year seismic event (10 percent probability of being exceeded in 50 years),  
<sup>+</sup>EFD – Equivalent Fluid Density

The stated lateral earth pressures do not include the effects of hydrostatic pressure generated by water accumulation behind the retaining walls. Uniform horizontal lateral active and at-rest pressures on the retaining walls from vertical surcharges behind the wall may be calculated using active and at-rest lateral

April 5, 2019

earth pressure coefficients of 0.3 and 0.5, respectively. A soil unit weight of 125 pcf may be used to calculate vertical earth surcharges.

To reduce the potential for the buildup of water pressure against the walls, continuous footing drains (with cleanouts) should be provided at the bases of the walls. The footing drains should consist of a minimum 4-inch diameter perforated pipe, sloped to drain, with perforations placed down and enveloped by a minimum 6 inches of pea gravel in all directions.

The backfill adjacent to and extending a lateral distance behind the walls at least 2 feet should consist of free-draining granular material. All free draining backfill should contain less than 3 percent fines (passing the U.S. Standard No. 200 Sieve) based upon the fraction passing the U.S. Standard No. 4 Sieve with at least 30 percent of the material being retained on the U.S. Standard No. 4 Sieve. The primary purpose of the free-draining material is the reduction of hydrostatic pressure. Some potential for the moisture to contact the back face of the wall may exist, even with treatment, which may require that more extensive waterproofing be specified for walls, which require interior moisture sensitive finishes.

We recommend that the backfill be compacted to at least 90 percent of the maximum dry density based on ASTM Test Method D1557. In place density tests should be performed to verify adequate compaction. Soil compactors place transient surcharges on the backfill. Consequently, only light hand operated equipment is recommended within 3 feet of walls so that excessive stress is not imposed on the walls.

### **8.1.6 Stormwater Management**

We do not recommend utilizing infiltration devices at the site. The site is underlain by glacial till which has a low permeability. We performed an infiltration test in B-2 at a depth of 4 feet below grade. The factored infiltration rate was 0.25 inches per hour. This is below what the Washington State Department of Ecology considers to be feasible.

Furthermore, the site is situated just above a steep slope and landslide hazard area. It is likely that infiltrated runoff would migrate laterally and daylight/emanate from the slope face on downslope properties to the south. This could cause erosion or landslide activity.

Limited dispersion may be feasible provided the flowpath ends at least 15 feet from the top of the slope. We should be provided with stormwater plans in order to determine if our recommendations have been incorporated. If dispersion is not feasible, we recommend direct connection of stormwater devices to City infrastructure.

### **8.1.7 Slab-on-Grade**

We recommend that the upper 12 inches of the existing fill and/or native soils within slab areas be removed and replaced with structural fill compacted to at least 95 percent of the modified proctor (ASTM D1557 Test Method). Deeper excavation may be necessary depending on stability of the underlying subgrade.

April 5, 2019

Often, a vapor barrier is considered below concrete slab areas. However, the usage of a vapor barrier could result in curling of the concrete slab at joints. Floor covers sensitive to moisture typically requires the usage of a vapor barrier. A materials or structural engineer should be consulted regarding the detailing of the vapor barrier below concrete slabs. Exterior slabs typically do not utilize vapor barriers.

The American Concrete Institutes ACI 360R-06 Design of Slabs on Grade and ACI 302.1R-04 Guide for Concrete Floor and Slab Construction are recommended references for vapor barrier selection and floor slab detailing.

Slabs on grade may be designed using a coefficient of subgrade reaction of 180 pounds per cubic inch (pci) assuming the slab-on-grade base course is underlain by at least 18 inches of structural fill placed and compacted as outlined in Section 8.1. A minimum 4-inch thick layer of 5/8 inch clean angular rock should be placed as a capillary break material over the prepared subgrade.

A perimeter drainage system is recommended unless interior slab areas are elevated a minimum of 12 inches above adjacent exterior grades. If installed, a perimeter drainage system should consist of a 4 inch diameter perforated drain pipe surrounded by a minimum 6 inches of drain rock wrapped in a non-woven geosynthetic filter fabric to reduce migration of soil particles into the drainage system. The perimeter drainage system should discharge by gravity flow to a suitable stormwater system.

Exterior grades surrounding buildings should be sloped at a minimum of one percent to facilitate surface water flow away from the building and preferably with a relatively impermeable surface cover immediately adjacent to the building.

### **8.1.8 Groundwater Influence on Construction**

Groundwater was not encountered in the borings. There is a slight chance that perched groundwater could be encountered if earthwork takes place during winter and spring months.

If groundwater is encountered during construction, we anticipate that sump excavations and small diameter pumps systems will adequately de-water short-term excavations, if required. Any system should be designed by the contractor. We can provide additional recommendations upon request.

### **8.1.9 Utilities**

Utility trenches should be excavated according to accepted engineering practices following OSHA (Occupational Safety and Health Administration) standards, by a contractor experienced in such work. The contractor is responsible for the safety of open trenches. Traffic and vibration adjacent to trench walls should be reduced; cyclic wetting and drying of excavation side slopes should be avoided. Depending upon the location and depth of some utility trenches, groundwater flow into open excavations could be experienced, especially during or shortly following periods of precipitation.

In general, fine-grained soils were encountered at shallow depths in the explorations at this site. These soils have variable cohesion and density and will have a tendency to cave or slough in excavations. Shoring or sloping back trench sidewalls is required within these soils in excavations greater than 4 feet deep and is recommended in any excavation deeper than 3 feet.

April 5, 2019

All utility trench backfill should consist of imported structural fill or suitable on site soils. Utility trench backfill placed in or adjacent to buildings and exterior slabs should be compacted to at least 95 percent of the maximum dry density based on ASTM Test Method D1557. The upper 5 feet of utility trench backfill placed in pavement areas should be compacted to at least 95 percent of the maximum dry density based on ASTM Test Method D1557. Below 5 feet, utility trench backfill in pavement areas should be compacted to at least 90 percent of the maximum dry density based on ASTM Test Method D1557. Pipe bedding should be in accordance with the pipe manufacturer's recommendations.

The contractor is responsible for removing all water-sensitive soils from the trenches regardless of the backfill location and compaction requirements. Depending on the depth and location of the proposed utilities, we anticipate the need to re-compact existing fill soils below the utility structures and pipes. The contractor should use appropriate equipment and methods to avoid damage to the utilities and/or structures during fill placement and compaction procedures.

## **9.0 Construction Field Reviews**

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Cobalt Geosciences should be retained to provide part time field review during construction in order to verify that the soil conditions encountered are consistent with our design assumptions and that the intent of our recommendations is being met. This will require field and engineering review to:

- Monitor and test structural fill placement and soil compaction
- Observe bearing capacity at foundation locations
- Observe slab-on-grade preparation
- Observe excavation stability

Geotechnical design services should also be anticipated during the subsequent final design phase to support the structural design and address specific issues arising during this phase. Field and engineering review services will also be required during the construction phase in order to provide a Final Letter for the project.

## **10.0 Closure**

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This report was prepared for the exclusive use of Rouslana Yaroslavsky and her appointed consultants. Any use of this report or the material contained herein by third parties, or for other than the intended purpose, should first be approved in writing by Cobalt Geosciences, LLC.

The recommendations contained in this report are based on assumed continuity of soils with those of our test holes, and assumed structural loads. Cobalt Geosciences should be provided with final architectural and civil drawings when they become available in order that we may review our design recommendations and advise of any revisions, if necessary.

Use of this report is subject to the Statement of General Conditions provided in Appendix A. It is the responsibility of Rouslana Yaroslavsky who is identified as “the Client” within the Statement of General Conditions, and its agents to review the conditions and to notify Cobalt Geosciences should any of these not be satisfied.

**GEOTECHNICAL INVESTIGATION  
MERCER ISLAND, WASHINGTON**



April 5, 2019

Respectfully submitted,

**Cobalt Geosciences, LLC**

***Original signed by:***



Exp. 6/26/2020

Phil Haberman, PE, LG, LEG  
Principal

PH/sc

**APPENDIX A**  
Statement of General Conditions

## **Statement of General Conditions**

**USE OF THIS REPORT:** This report has been prepared for the sole benefit of the Client or its agent and may not be used by any third party without the express written consent of Cobalt Geosciences and the Client. Any use which a third party makes of this report is the responsibility of such third party.

**BASIS OF THE REPORT:** The information, opinions, and/or recommendations made in this report are in accordance with Cobalt Geosciences present understanding of the site specific project as described by the Client. The applicability of these is restricted to the site conditions encountered at the time of the investigation or study. If the proposed site specific project differs or is modified from what is described in this report or if the site conditions are altered, this report is no longer valid unless Cobalt Geosciences is requested by the Client to review and revise the report to reflect the differing or modified project specifics and/or the altered site conditions.

**STANDARD OF CARE:** Preparation of this report, and all associated work, was carried out in accordance with the normally accepted standard of care in the state of execution for the specific professional service provided to the Client. No other warranty is made.

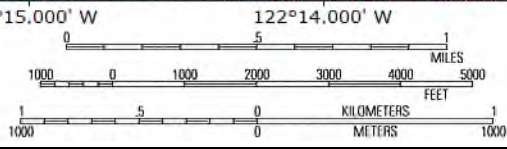
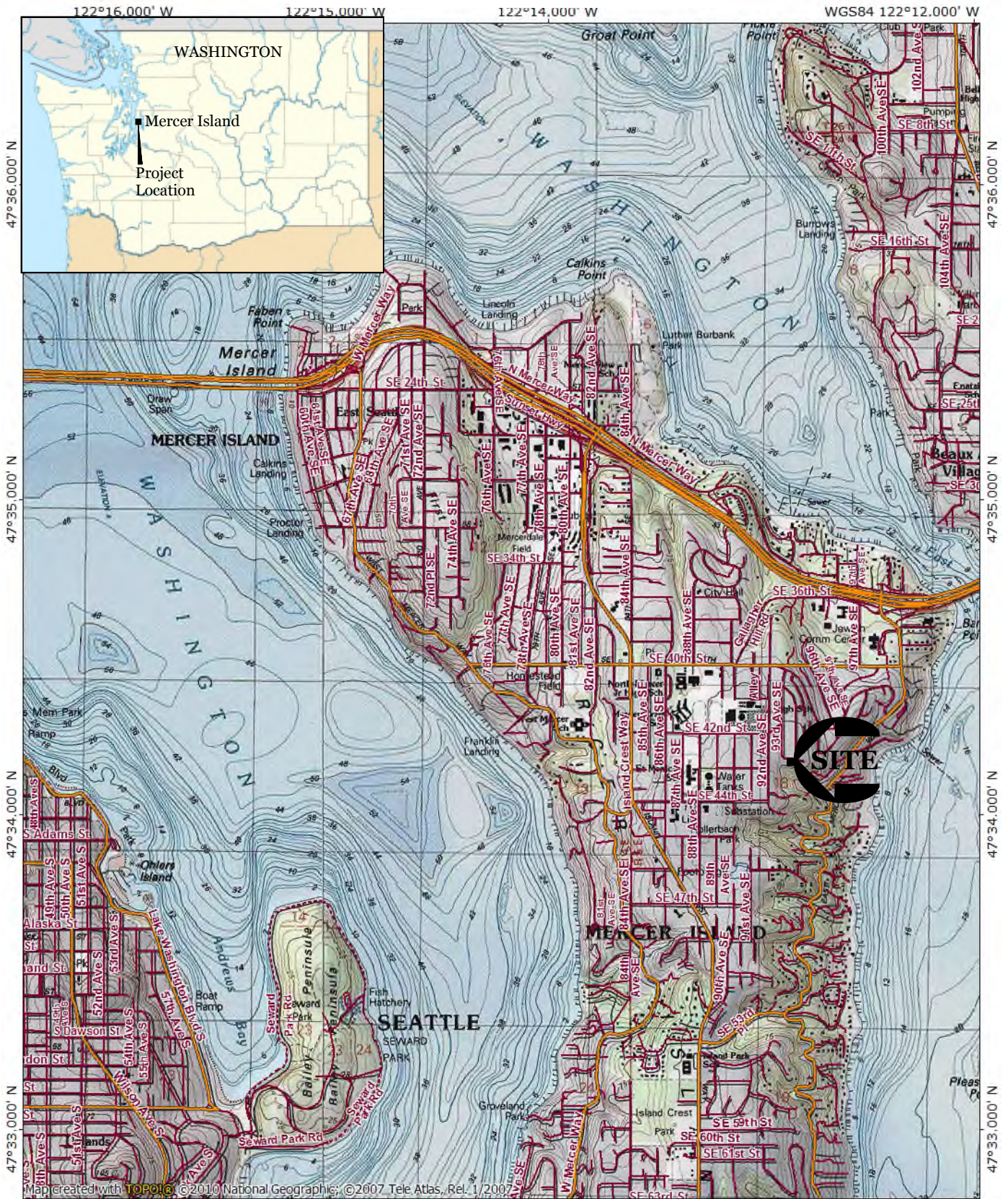
**INTERPRETATION OF SITE CONDITIONS:** Soil, rock, or other material descriptions, and statements regarding their condition, made in this report are based on site conditions encountered by Cobalt Geosciences at the time of the work and at the specific testing and/or sampling locations. Classifications and statements of condition have been made in accordance with normally accepted practices which are judgmental in nature; no specific description should be considered exact, but rather reflective of the anticipated material behavior. Extrapolation of in situ conditions can only be made to some limited extent beyond the sampling or test points. The extent depends on variability of the soil, rock and groundwater conditions as influenced by geological processes, construction activity, and site use.

**VARYING OR UNEXPECTED CONDITIONS:** Should any site or subsurface conditions be encountered that are different from those described in this report or encountered at the test locations, Cobalt Geosciences must be notified immediately to assess if the varying or unexpected conditions are substantial and if reassessments of the report conclusions or recommendations are required. Cobalt Geosciences will not be responsible to any party for damages incurred as a result of failing to notify Cobalt Geosciences that differing site or sub-surface conditions are present upon becoming aware of such conditions.

**PLANNING, DESIGN, OR CONSTRUCTION:** Development or design plans and specifications should be reviewed by Cobalt Geosciences, sufficiently ahead of initiating the next project stage (property acquisition, tender, construction, etc), to confirm that this report completely addresses the elaborated project specifics and that the contents of this report have been properly interpreted. Specialty quality assurance services (field observations and testing) during construction are a necessary part of the evaluation of sub-subsurface conditions and site preparation works. Site work relating to the recommendations included in this report should only be carried out in the presence of a qualified geotechnical engineer; Cobalt Geosciences cannot be responsible for site work carried out without being present.

**APPENDIX B**  
Figures: Vicinity Map, Site Plan





11/15/18

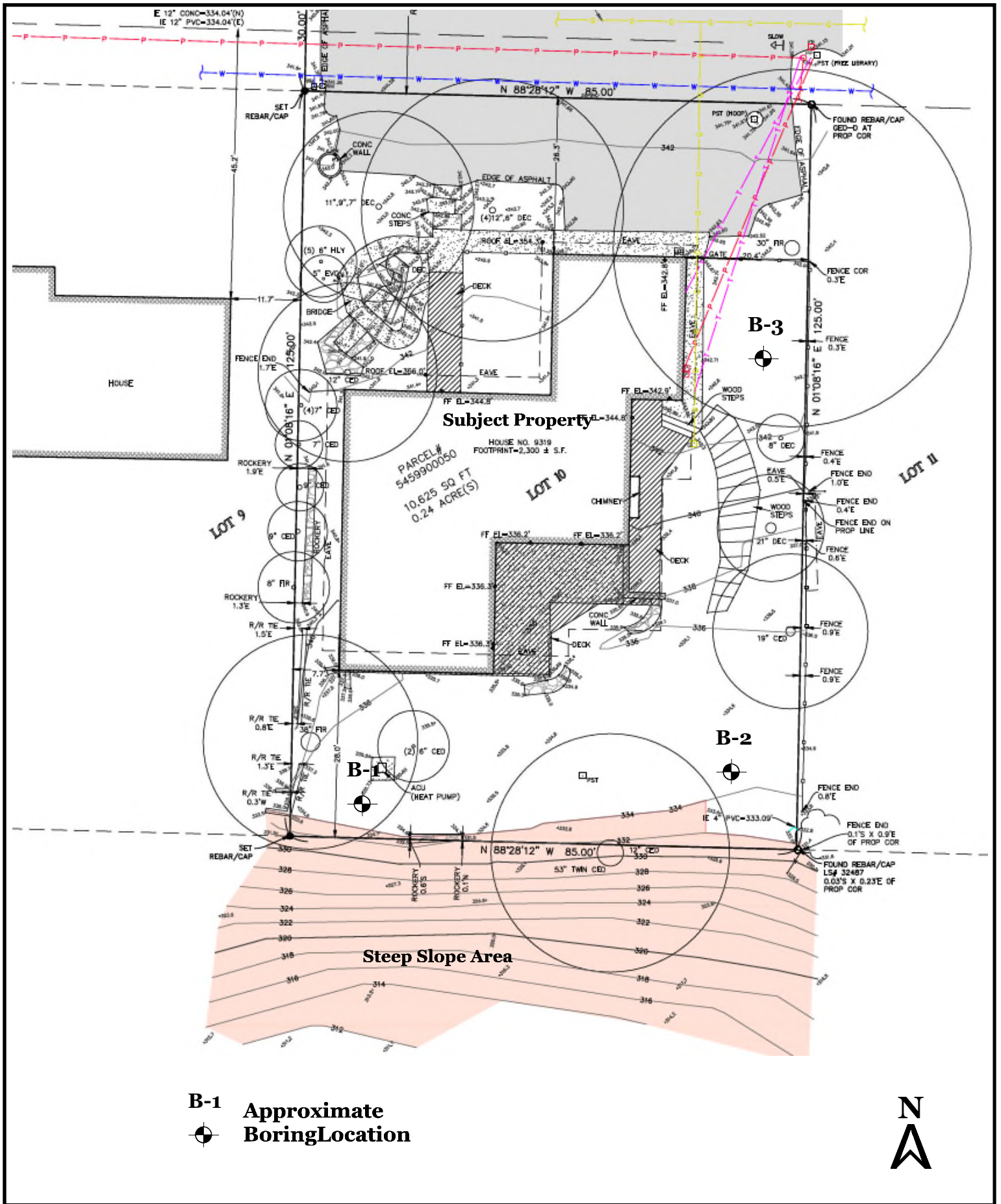


Proposed Residence  
9319 SE 43rd Street  
Mercer Island, Washington

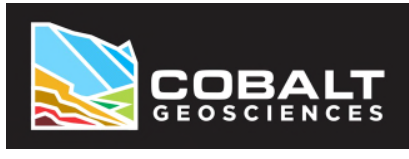
**VICINITY  
MAP  
FIGURE 1**

Cobalt Geosciences, LLC  
P.O. Box 82243  
Kenmore, WA 98028  
(206) 331-1097  
[www.cobaltgeo.com](http://www.cobaltgeo.com)  
[cobaltgeo@gmail.com](mailto:cobaltgeo@gmail.com)





**B-1** Approximate Boring Location



Proposed Residence  
 9319 SE 43rd Street  
 Mercer Island, Washington

**SITE PLAN**  
  
**FIGURE 2**

Cobalt Geosciences, LLC  
 P.O. Box 82243  
 Kenmore, WA 98028  
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**APPENDIX C**  
Boring Logs

## Unified Soil Classification System (USCS)

MAJOR DIVISIONS			SYMBOL	TYPICAL DESCRIPTION	
<b>COARSE GRAINED SOILS</b> (more than 50% retained on No. 200 sieve)	Gravels (more than 50% of coarse fraction retained on No. 4 sieve)	Clean Gravels (less than 5% fines)	GW	Well-graded gravels, gravels, gravel-sand mixtures, little or no fines	
		Gravels with Fines (more than 12% fines)	GP	Poorly graded gravels, gravel-sand mixtures, little or no fines	
		Gravels with Fines (more than 12% fines)	GM	Silty gravels, gravel-sand-silt mixtures	
		Gravels with Fines (more than 12% fines)	GC	Clayey gravels, gravel-sand-clay mixtures	
	Sands (50% or more of coarse fraction passes the No. 4 sieve)	Clean Sands (less than 5% fines)	SW	Well-graded sands, gravelly sands, little or no fines	
		Sands with Fines (more than 12% fines)	SP	Poorly graded sand, gravelly sands, little or no fines	
		Sands with Fines (more than 12% fines)	SM	Silty sands, sand-silt mixtures	
		Sands with Fines (more than 12% fines)	SC	Clayey sands, sand-clay mixtures	
		Silts and Clays (liquid limit less than 50)	Inorganic	ML	Inorganic silts of low to medium plasticity, sandy silts, gravelly silts, or clayey silts with slight plasticity
			Inorganic	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
Organic	OL		Organic silts and organic silty clays of low plasticity		
Silts and Clays (liquid limit 50 or more)	Inorganic		MH	Inorganic silts, micaceous or diatomaceous fine sands or silty soils, elastic silt	
	Inorganic	CH	Inorganic clays of medium to high plasticity, sandy fat clay, or gravelly fat clay		
	Organic	OH	Organic clays of medium to high plasticity, organic silts		
HIGHLY ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor	PT	Peat, humus, swamp soils with high organic content (ASTM D4427)		

Classification of Soil Constituents
<p>MAJOR constituents compose more than 50 percent, by weight, of the soil. Major constituents are capitalized (i.e., SAND).</p> <p>Minor constituents compose 12 to 50 percent of the soil and precede the major constituents (i.e., silty SAND). Minor constituents preceded by "slightly" compose 5 to 12 percent of the soil (i.e., slightly silty SAND).</p> <p>Trace constituents compose 0 to 5 percent of the soil (i.e., slightly silty SAND, trace gravel).</p>

Grain Size Definitions	
Description	Sieve Number and/or Size
Fines	< #200 (0.08 mm)
Sand	#200 to #40 (0.08 to 0.4 mm)
-Fine	#40 to #10 (0.4 to 2 mm)
-Medium	#10 to #4 (2 to 5 mm)
-Coarse	
Gravel	#4 to 3/4 inch (5 to 19 mm)
-Fine	3/4 to 3 inches (19 to 76 mm)
-Coarse	
Cobbles	3 to 12 inches (75 to 305 mm)
Boulders	>12 inches (305 mm)

Relative Density (Coarse Grained Soils)		Consistency (Fine Grained Soils)	
N, SPT, Blows/FT	Relative Density	N, SPT, Blows/FT	Relative Consistency
0 - 4	Very loose	Under 2	Very soft
4 - 10	Loose	2 - 4	Soft
10 - 30	Medium dense	4 - 8	Medium stiff
30 - 50	Dense	8 - 15	Stiff
Over 50	Very dense	15 - 30	Very stiff
		Over 30	Hard

Moisture Content Definitions	
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, from below water table



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Soil Classification Chart

Figure C1

# Log of Auger Boring B-1

Date: March 21, 2019	Depth: 9'	Initial Groundwater: None
Contractor:	Elevation: N/A	Sample Type: Grab
Method: Auger	Logged By: PH    Checked By: SC	Final Groundwater: N/A

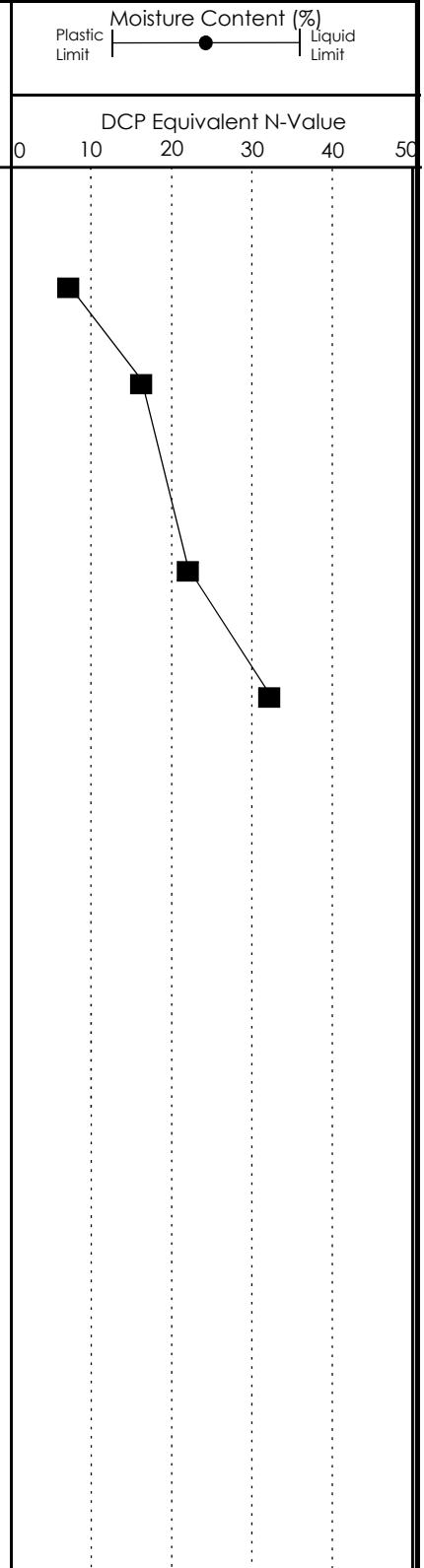
Depth (Feet)	Interval	% Recovery	Blows/6"	Graphic Log	USCS Symbol	Material Description	Groundwater	Moisture Content (%)					
								Plastic Limit	Liquid Limit				
								DCP Equivalent N-Value					
								0	10	20	30	40	50
						Vegetation/Topsoil							
1					SM	Loose to medium dense, silty-fine to medium grained sand with gravel, dark yellowish brown to yellowish brown, moist. (Weathered Glacial Till)							
2	■												
3													
4					SM	Dense to very dense, silty-fine to medium grained sand with gravel, yellowish brown to grayish brown, moist (Glacial Till)							
5	■												
6													
7													
8													
9						End of Auger Boring 9'							
10													

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# Log of Auger Boring B-2

Date: March 21, 2019	Depth: 9'	Initial Groundwater: None
Contractor:	Elevation: N/A	Sample Type: Grab
Method: Auger	Logged By: PH    Checked By: SC	Final Groundwater: N/A


Depth (Feet)	Interval	% Recovery	Blows/6"	Graphic Log	USCS Symbol	Material Description	Groundwater	Moisture Content (%)					
								Plastic Limit	Liquid Limit				
								DCP Equivalent N-Value					
								0	10	20	30	40	50
				Vegetation/Topsoil									
1					SM	Loose to medium dense, silty-fine to medium grained sand with gravel, dark yellowish brown to yellowish brown, moist. (Weathered Glacial Till)							
2	■												
3													
4													
5													
6													
7					SM	Dense to very dense, silty-fine to medium grained sand with gravel, yellowish brown to grayish brown, moist (Glacial Till)							
8	■												
9													
10						End of Auger Boring 9'							



# Log of Auger Boring B-3

Date: March 21, 2019	Depth: 9'	Initial Groundwater: None
Contractor:	Elevation: N/A	Sample Type: Grab
Method: Auger	Logged By: PH    Checked By: SC	Final Groundwater: N/A

Depth (Feet)	Interval	% Recovery	Blows/6"	Graphic Log	USCS Symbol	Material Description	Groundwater	Moisture Content (%)					
								Plastic Limit	Liquid Limit				
								DCP Equivalent N-Value					
								0	10	20	30	40	50
						Vegetation/Topsoil							
1					SM	Loose to medium dense, silty-fine to medium grained sand with gravel, dark yellowish brown to yellowish brown, moist. (Weathered Glacial Till)							
2	■							■					
3													
4													
5					SM	Dense to very dense, silty-fine to medium grained sand with gravel, yellowish brown to grayish brown, moist (Glacial Till)							
6	■												
7													
8													
9						End of Auger Boring 9'							
10													

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