



**Mud Bay Geotechnical Services, LLC**

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January 28, 2021

Job: 1376-KIN

Subject: Geotechnical Recommendations for Foundation Stabilization  
9007 SE 44<sup>th</sup> St,  
Mercer Island, WA 98040  
Parcel # 759810-0082

Dear Jeff Garrett,

Per your request, Mud Bay Geotechnical Services LLC. is providing a soils and subsurface conditions report in order to help facilitate the stabilization of the foundation settlement occurring at the subject address, as well as provide recommendations to facilitate the design and construction of the intended foundation retrofitting. This report presents the results of our geotechnical investigation and contains geotechnical recommendations for foundation settlement at the address of 9007 SE 44<sup>th</sup> St, Mercer Island, WA. The analyses, conclusions, and recommendations in this report are based on the information available. These informational resources include: one hand augured boring completed specifically for the subject project, published geologic information for the site, and our experience with similar geologic conditions. The exploratory boring is assumed to be representative of the subsurface conditions where the work will occur. If during construction, subsurface conditions differ from those described in the explorations, we should be advised immediately so we may reevaluate our recommendations.

#### **SITE CONDITIONS AND PROJECT DESCRIPTION**

The address of 9007 SE 44<sup>th</sup> St consists of a single-family residence on a 0.25-acre lot located in Mercer Island, Washington and is designated parcel #759810-0082 by King County. The parcel location is identified on the Site Location Map included as Figure 1 attached to this report. The property is accessed from a long driveway entering from the south via SE 44<sup>th</sup> Street. The parcel is situated amongst an area of urban residential development and built in a region commonly associated with reworked glacial material as on-site fill associated with large-scale urban grading.

should be noted that the material contains a fines content great enough that it is considered to be moisture sensitive. This material may be difficult to compact if exposed to wet weather.

The backfill material should be placed and compacted in lifts no greater than 6 inches and compacted to between 92 and 95 percent of the maximum dry density.

### **RECOMMENDED ADDITIONAL SERVICES**

Before construction begins, we recommend a copy of the draft plans and specifications prepared for the project are made available for review so that we can ensure that the geotechnical recommendations in this report are included in the Contract. Mud Bay Geotechnical Services, LLC is also available to provide geotechnical engineering and construction monitoring services throughout the remainder of the design and construction of the project. The integrity of the geotechnical elements of a project depend on proper site preparation and construction procedures. In addition, engineering decisions may need to be made in the field if conditions are encountered that differ from those described in this report. During the construction phase of the project, we recommend that Mud Bay Geotechnical Services, LLC be retained to review construction proposals and submittals, observe temporary excavation cut stability, observe installation of the push piers, and provide recommendations for any other geotechnical considerations that may arise during construction.

### **INTENDED USE AND LIMITATIONS**

This report has been prepared to assist the client and their consultants in the engineering design and construction of the subject project. It should not be used, in part or in whole for other purposes without contacting Mud Bay Geotechnical Services, LLC for a review of the applicability of such reuse. This report should be made available to prospective contractors for their information only and not as a warranty of ground conditions.

The conclusions and recommendations contained in this report are based on Mud Bay Geotechnical Services, LLC understanding of the project at the time that the report was written and on-site conditions that existed at time of the field exploration. If significant changes to the nature, configuration, or scope of the project occur during the design process, we should be consulted to determine the impact of such changes on the recommendations and conclusions presented in this report.

Site exploration and testing describes subsurface conditions only at the sites of subsurface exploration and at the intervals where samples are collected. These data are interpreted by Mud Bay Geotechnical Services, LLC rendering an opinion regarding the general subsurface conditions. Actual subsurface conditions can be discovered only during earthwork and construction operations. The distribution, continuity, thickness, and characteristics of identified (and unidentified) subsurface materials may vary considerably from that indicated by the subsurface data. While nothing can be done to prevent such variability, Mud Bay Geotechnical Services, LLC is prepared to work with the project team to reduce the impacts of variability on project design, construction, and performance.

A single-family residence is located on the west side of the lot, with a large landscaped backyard on the eastern side, and a small patio area on the southern side of the home. We suspect the home is supported on shallow strip footing foundations. Several large deciduous trees exist on and around the parcel. Water management on the parcel was observed to be in poor condition. Several gutters were noted depositing water directly at the foundation. Other gutters on the home were observed in broken condition and or disconnected. In our experience poor water management can contribute greatly to foundation settlement issues and should be fixed immediately along with proposed foundation repair work.

Based on the proposed Foundation/Pier Layout Plan provided by Matvey, we understand the scope of the project to include the installation of 6, 3-inch push piers on the eastern side of the home. The proposed Foundation/Pier Layout plan has been attached to this report as Figure 2, Matvey Job Details.

### **SITE GEOLOGY AND SOILS**

As part of this project, we reviewed geologic data available at the 1: 100,000 scale and prepared a site-specific geologic map. The project vicinity geologic map is attached as Figure 3, WA DNR Geologic Map. This figure indicates the project location is directly underlain by Pleistocene continental glacial till. Conditions observed at the site are generally consistent with the mapped geology at the site.

Along with the site geology, soil data was also reviewed and is presented in attached Figure 4, USDA Soil Map. The soil in the site vicinity was mapped by the United States Department of Agriculture, USDA, as *Arents, Alderwood material, 6 to 15 percent slopes*. This soil unit is generally characterized by a moderately well-draining gravelly sandy loam. The soil conditions at the site are generally consistent with the USDA mapping. It should be noted the percent slopes associated with the soil mapping are an approximation and do not necessarily reflect the true surface topography.

### **SUBSURFACE EXPLORATION**

As part of the investigation, a site visit was performed on October 24, 2020 to observe the soil conditions on the parcel. One shallow hand boring was completed to characterize the local soils. The boring was completed using a Humboldt Manufacturing model H-4414QC hand auger with a 4-inch diameter bucket tube sampler. Hand auger samples were removed from the bottom of the hole in order to observe the soil material at the approximate depth.

The soil samples were classified visually in the field in general accordance with ASTM D2488, the Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). Once transported back to the office, the samples were re-examined, and the field classifications were modified accordingly. A summary log of the boring is included in Appendix A. Note the soil descriptions and interfaces shown on the log are interpretive, and actual changes may be gradual. Upon completion, the borehole was backfilled to the original ground surface using excavated

material from the spoil piles. The approximate location of the boring is shown on the Site Exploration Map attached as Figure 5 in this report.

### **SUBSURFACE AND GROUNDWATER CONDITIONS**

Based on the conditions observed in the hand auger boring, BH-1-20, the subsurface consists of *very loose, moist, grey-brown, silt with sand and gravel (ML)* from the existing ground surface to a depth of 41 inches below ground surface. This unit was underlain by *medium dense to very dense, moist, grey, silty sand (SM)* from the interface at 41 inches to the final depth of the boring at 62 inches. Groundwater was not encountered within the boring. We do not anticipate the groundwater table to be encountered within the suspected limits of excavation associated with the project. If groundwater conditions encountered during excavation are different from those expected, Mud Bay Geotechnical Services should be notified immediately.

### **GEOLOGIC HAZARD ASSESSMENT**

A review of the available online information was performed to determine the potential for geologic hazards at the site. The landslide hazard mapping inventory available from the Washington State Department of Natural Resources was reviewed for the site location and revealed a mapped deposit or suspected landslide hazard in the proximity of the project location and is shown on Figure 6, WA DNR Landslide Map. The landslide is approximately 0.05 miles away from the parcel location. The location of the nearest landslides are indicative of mass-wasting of the slopes composing the marine bluff environment. Portions of the slope face have undergone erosive channelization of surface runoff which can serve to increase slope instability. As such, these slopes are prone to reactivation as a natural process of physical weathering and erosion. Despite this, the position of the subject parcel relative to the landslide deposits results in a low risk of landslide activity.

Additionally, the site was reviewed for its risk of liquefaction. Soil liquefaction is a phenomenon whereby saturated soil deposits temporarily lose strength and behave as a viscous fluid in response to cyclic loading. Soil types considered at the highest risk of liquefaction during a seismic event are loose sandy soils. Gravel materials can be susceptible to liquefaction if it contains a significant fraction of sand-sized particles and is capped by less permeable material. The on-site conditions are mapped as "low-risk" by both the Washington DNR and King County. On-site soils were not typical of high liquefaction risk, and overall, we agree with the King County assessment.

As a part of this study, LiDAR imagery available from the Washington State Department of Natural Resources was reviewed and a site-specific map is included as Figure 7, WA LiDAR Map (2016). Light detection and ranging (LiDAR) is a remote sensing method that uses pulses of lasers to measure distances from the sensor to the ground surface, resulting in the ability to create three-dimensional models of the topography. This methodology allows for the creation of bare earth models, allowing for the assessment of geologic landforms in the study area. The most recent LiDAR imagery available from the WA DNR is from 2016 and is shown in the attached Figure 7. This map shows the presence of a ravine formation positioned to the southeast of the subject parcel

likely formed through the channelization of surface water runoff flowing downslope to the east, toward Lake Washington. The location of this ravine landform coincides with the mapped landslide deposits shown in Figure 6, indicating consistency across datasets. The position of the parcel of discussion relative to this landform suggests that the parcel is at low risk of landslide within several centuries or millenia.

Based on the above discussion, on-site reconnaissance and subsurface data, online geologic review, and our experience with similar geologic conditions we determine the site to be at a low risk of geologic hazards.

## **GEOTECHNICAL RECOMMENDATIONS**

### **Temporary Excavations**

Temporary excavations will be necessary to place and construct the push piers. We anticipate that temporary excavation cuts up to 4 feet in height will be stable at a vertical inclination, and any remaining height beyond that will be stable at a maximum slope angle of 1H:1V. The ground surface at the top of the temporary cuts should be periodically monitored for vertical movement, cracks, and other signs of instability. If signs of instability are observed, we should be contacted immediately so that we can assist and provide additional geotechnical recommendations. Note that temporary easements may be necessary into adjacent properties in order to construct the temporary excavation cuts. Temporary excavations greater than 4 feet in height and steeper than 1H:1V may require structural shoring to maintain stability. The design of temporary shoring is considered to be beyond the scope of services for this report.

### **Push Pier Foundations**

We understand that six 3-inch diameter, galvanized-steel push piers are proposed to stabilize the existing foundations and reduce the potential for further settlement to occur. All push piers should meet the design and installation specifications in the Push Pier Technical Manual, Third Edition, dated June 20, 2018 including all supporting documentation included with the manual.

BH-1-20 was used to interpret the subsurface conditions. Based on the conditions observed in the boring, we recommend installing the push piers to a minimum depth of 6 feet below the current ground surface, or to a pressure of 2,200 psi, whichever is deeper. Push piers installed to these minimum criteria should be capable of developing allowable capacities greater than 20 kips. Load testing should be performed to 2.0 times the design load on a minimum of 1 push pier in accordance with ASTM Standard D1143-81.

### **Backfill Placement**

Backfill of the temporary excavation cuts used to place the push piers should consist of material meeting the requirements of Common Borrow as described in Section 9-03.14(3) of the WSDOT Standard Specifications. Based on the conditions observed in boring BH-1-20, the onsite material that will be removed for construction meets the requirements for Common Borrow. However, it

We appreciate the opportunity to serve your geotechnical needs on this project and look forward to working with you in the future. Please contact us at your earliest convenience if you have any questions or would like to discuss any of the contents of this report.

Sincerely,

Chris Heathman, P.E.  
Mud Bay Geotechnical Services, LLC



Digitally signed  
by Chris  
Heathman, PE  
Date:  
2021.01.28  
11:49:16 -08'00'



**Legend**

● Site Location

/ Parcel Boundary



**Mud Bay Geotechnical Services, LLC**

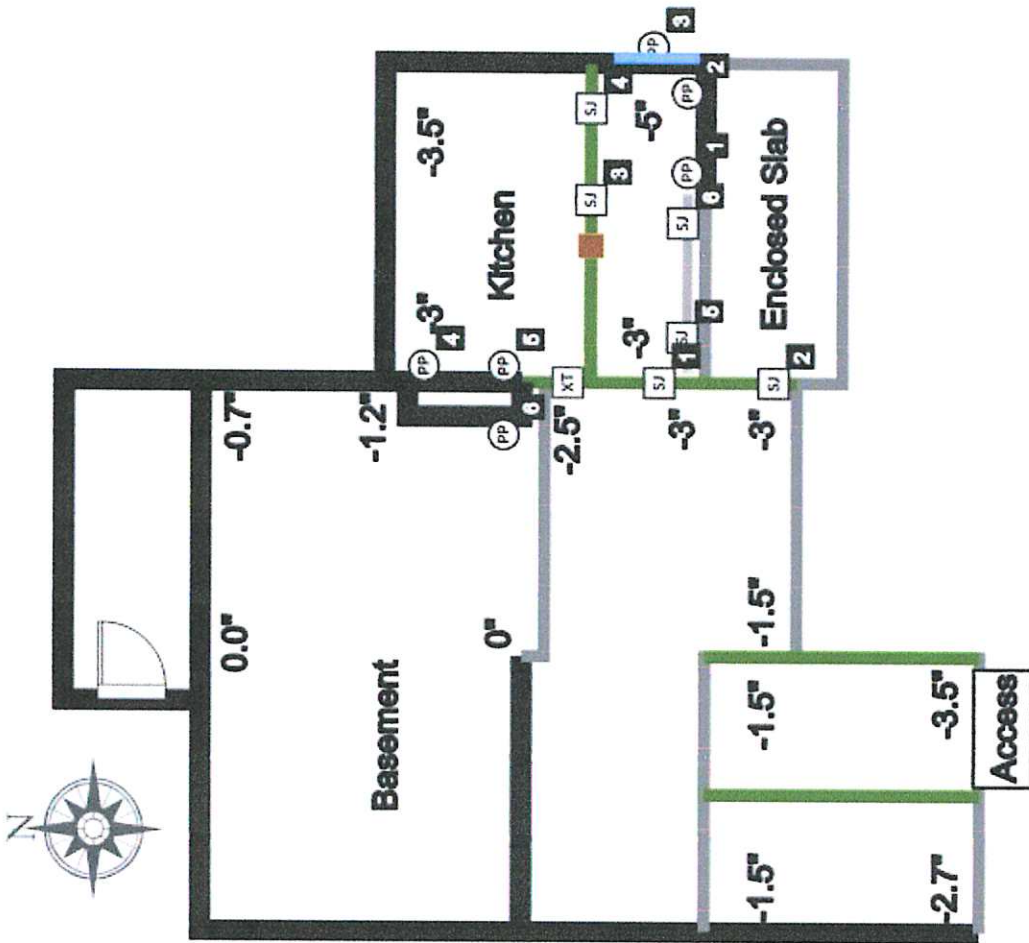
JOB #: 1376-KIN | Date: Dec, 2020

**Figure 1: Site Location Map**

9007 SE 44th St,

Mercer Island, WA 98040

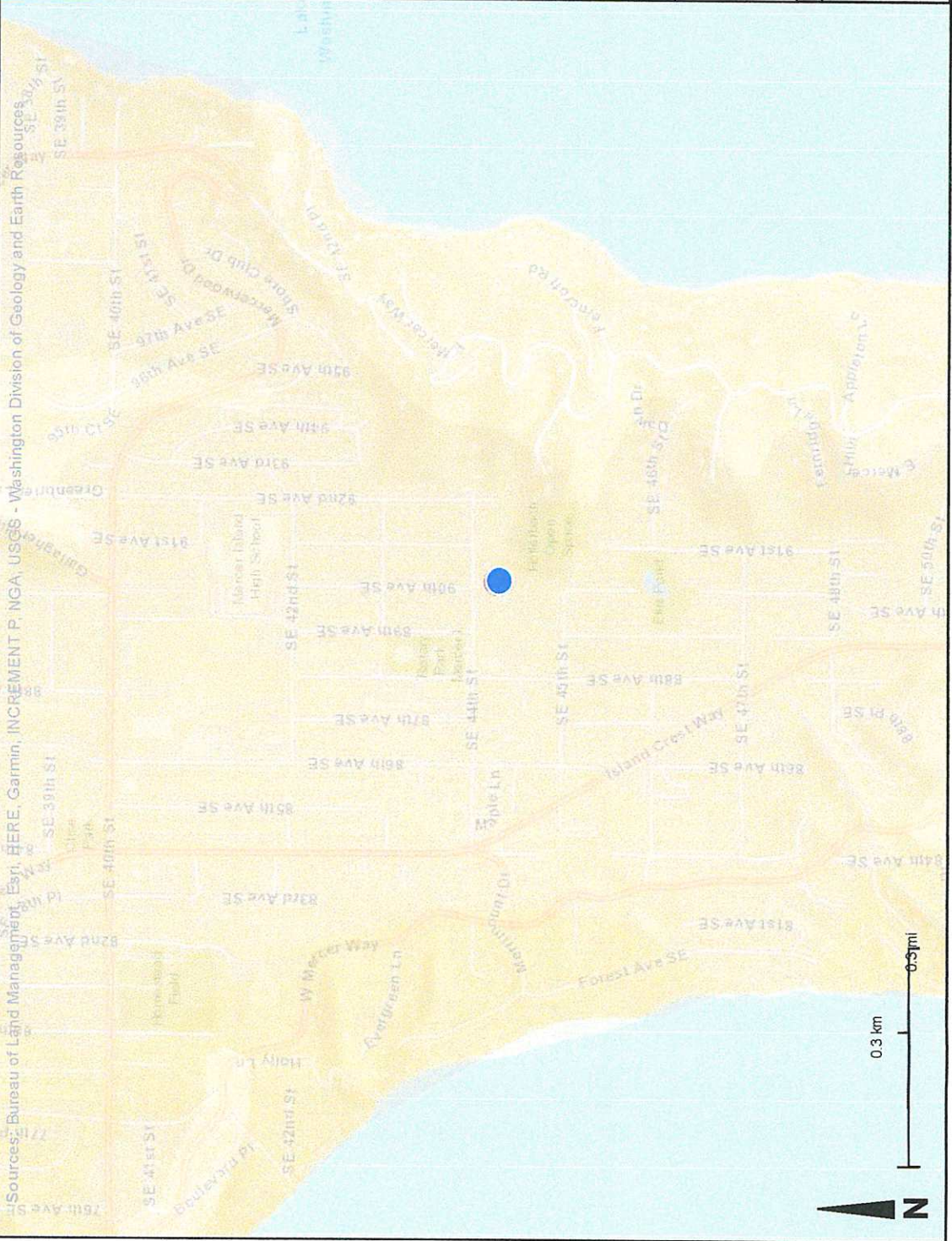
Foundation Repair Geotechnical Report



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**Figure 2: Matvey Job Details**  
 9007 SE 44th St,  
 Mercer Island, WA 98040  
 Foundation Repair Geotechnical Report



**Legend**

● Site Location

**Geologic Units 100k**

- Pleistocene continental glacial drift
- Pleistocene continental glacial till
- Pleistocene glacial and nonglacial deposits
- Water



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**Figure 3: WA DNR Geology Map**

9007 SE 44th St,  
 Mercer Island, WA 98040

Foundation Repair Geotechnical Report



Natural Resources  
Conservation Service

**Legend**

● Site Location

Map Unit Symbol	Map Unit Name
AmC	Arenis, Alderwood material, 6 to 15 percent slopes
KpB	Kilsap silt loam, 2 to 8 percent slopes
KpD	Kilsap silt loam, 15 to 30 percent slopes



Mud Bay Geotechnical Services, LLC

JOB #: 1376-KIN Date: Dec, 2020

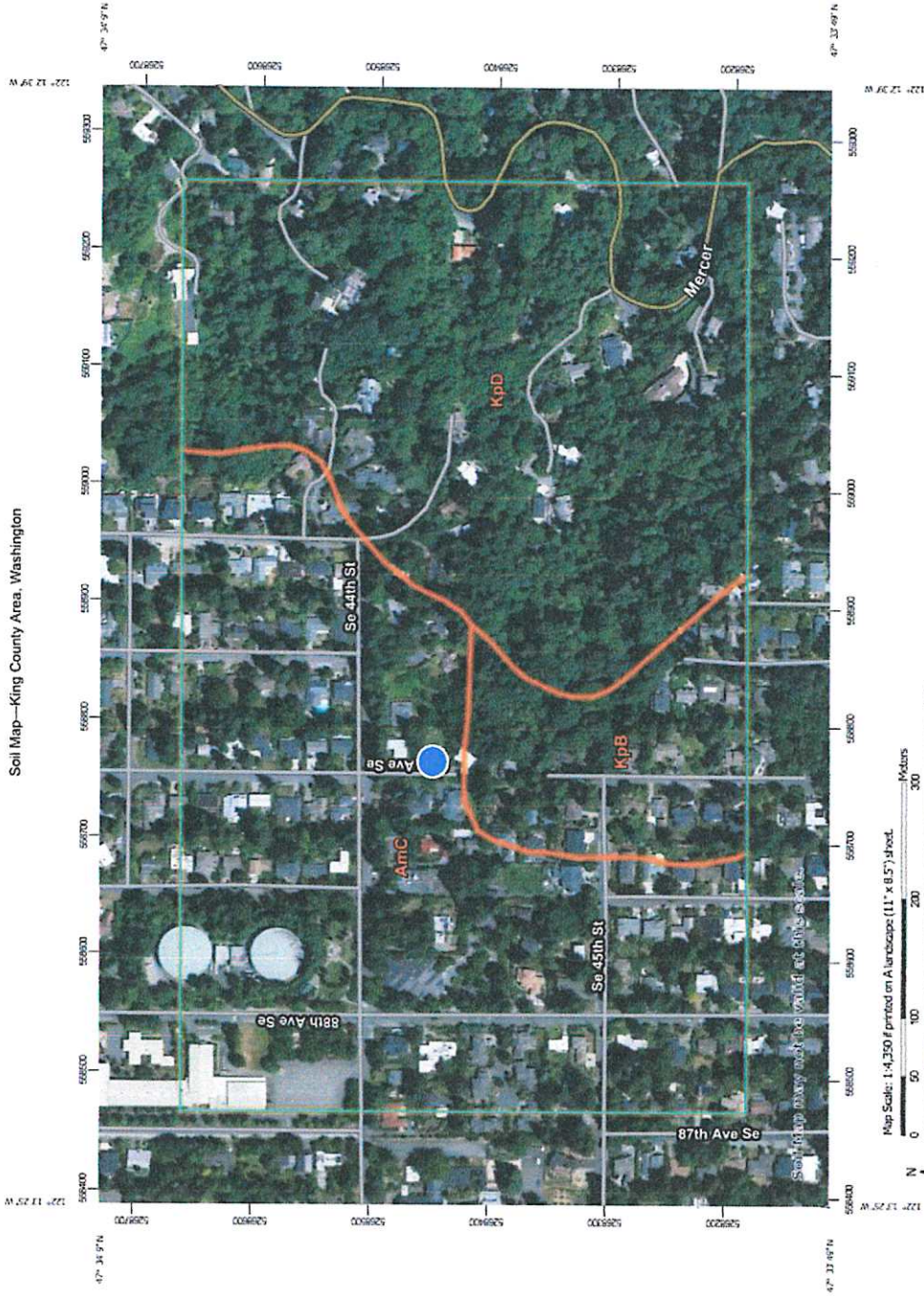
Figure 4: USDA Soil Map

9007 SE 44th St.,

Mercer Island, WA 98040

Foundation Repair Geotechnical Report

Soil Map—King County Area, Washington



Natural Resources  
Conservation Service



Web Soil Survey  
National Cooperative Soil Survey



**Legend**

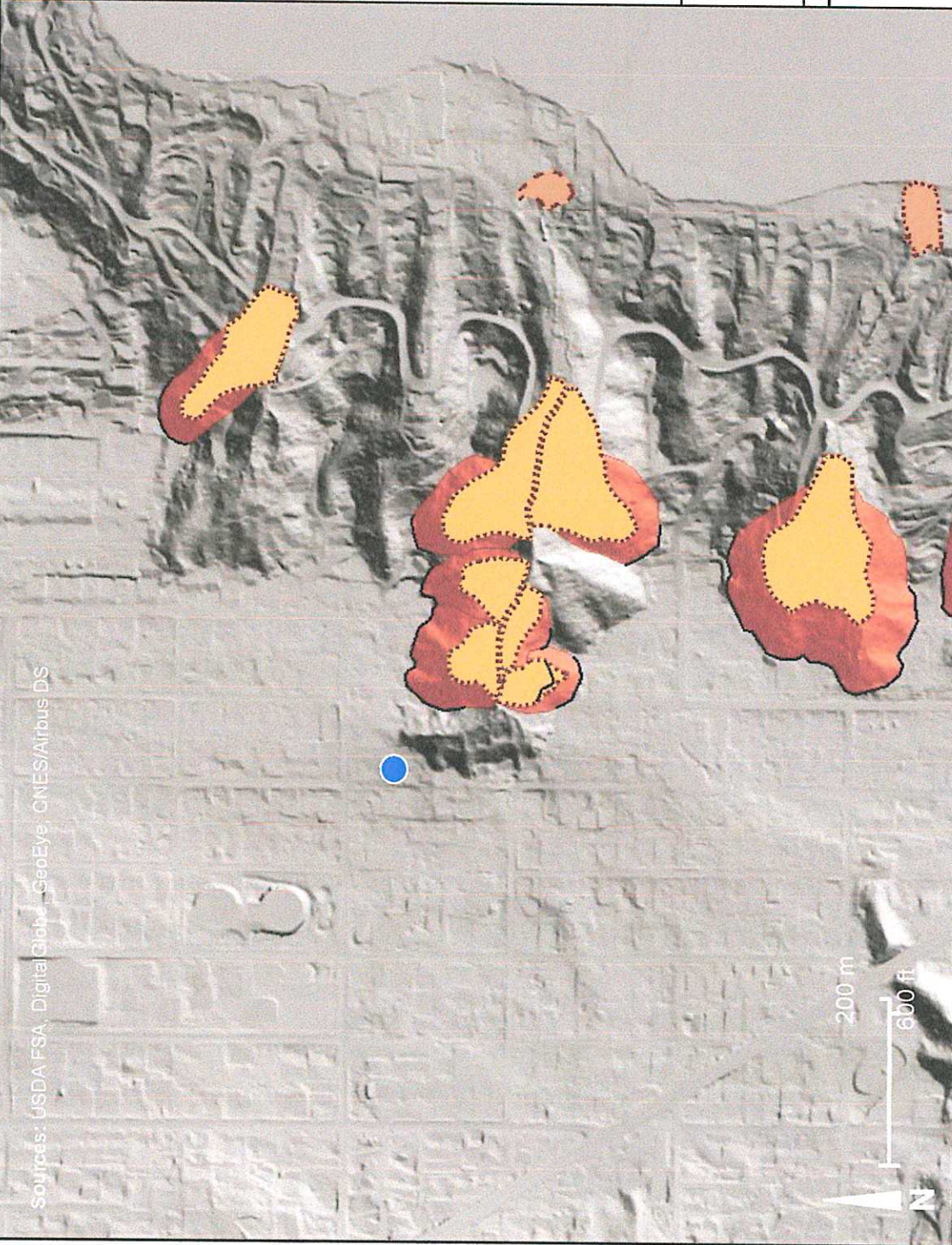
-  Parcel Boundary
-  Boring Location



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**Figure 5: Site Exploration Map**  
9007 SE 44th St,  
Mercer Island, WA 98040  
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Sources: USDA FSA, Digital Globe, GeoEye, CNES/Airbus DS



## Legend

Scarps



Landslide Deposits

- High (30-40)
- Low (1-10)

Scarps and Flanks



Fans

- Moderate (8-22)
- Low (1-7)

Site Location



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**Figure 6: WA DNR Landslide Map**  
 9007 SE 44th St,

Mercer Island, WA 98040  
 Foundation Repair Geotechnical Report



WASHINGTON STATE DEPARTMENT OF  
**NATURAL RESOURCES**  
 DIVISION OF GEOLOGY AND EARTH RESOURCES

# WASHINGTON LIDAR PORTAL



**Legend**



Parcel Boundary

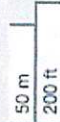


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**Figure 7: WA LiDAR Map (2016)**  
 9007 SE 44th St,  
 Mercer Island, WA 98040

Foundation Repair Geotechnical Report



**APPENDIX A – FINAL BORING LOGS**

 <b>Mud Bay Geotechnical Services, LLC</b>	Project: Foundation Repair	Client: Jeff Garrett	Bore No. 1 of 1: BH-1-20
	Project Number: 1376-KIN	Contractor: Matvey Foundation Repair	Equipment: Humboldt H-4414QC Auger
Address: 9007 SE 44th St, Mercer Island, WA 98040	Date	Bit Type: Bucket Tube Auger	Diameter: 4 inches
	Started: 10/24/2020	Hammer Type: Humboldt H-4202A	Fluid: n/a
Completed: 10/24/2020	Hammer Weight: 15 lbs	Hammer Drop: 20 inches	
Backfilled: 10/24/2020	Groundwater Depth: Not Encountered	Elevation: Existing Surface	Total Depth of Boring: 62 inches
Logged By: Hannah Anderson	GPS Method: n/a	GPS Coordinates: n/a	GPS Elevation: n/a
Helper: n/a			

Depth (in.)	Sample Type	Sample Number	Blow Counts (blows/3/4")	Graphic Log	Lithology	Dry Density (pcf)	Moisture Content (%)	Additional Test
24"	☒	S-1	4		<b>Lithology</b> <b>Soil Group Name:</b> modifier, color, moisture, density/consistency, grain size, other descriptors <b>Rock Description:</b> modifier, color, hardness/degree of concentration, bedding and joint characteristics, solutions, void conditions.			
48"	☒	S-2	13		Very loose, moist, grey-brown, silt with sand and gravel (ML). Mottling present in sample.  At 41 inches transition to a grey silty sand with larger gravels.			
72"	☒	S-3	REF		Medium dense, moist, grey, silty sand (SM).  Very dense, moist, grey, silty sand (SM). Refusal after 1/2 inch penetration.  End of Boring: 62 inches			
96"								

<b>Test Pit and Boring Log Symbols</b> <input checked="" type="checkbox"/> Standard Penetration Slit Spoon Sampler (SPT) <input checked="" type="checkbox"/> California Sampler <input checked="" type="checkbox"/> Shelby Tube <input checked="" type="checkbox"/> CPP Sampler <input checked="" type="checkbox"/> Stabilized Ground water <input checked="" type="checkbox"/> Groundwater At time of Drilling <input checked="" type="checkbox"/> Bulk/ Bag Sample	<b>Soil Density Modifiers</b>			
	Gravel, Sand, Non-Plastic Silt		Elastic Silts and Clays	
	Blows/3/4"	Density	Blows/3/4"	Consistency
0-4	Very Loose	0-1	Very Soft	
5-10	Loose	2-4	Soft	
11-24	Medium Dense	5-8	Medium Stiff	
25-50	Dense	9-15	Stiff	
REF	Very Dense	16-30	Very Stiff	
		31-60	Hard	
		>60	Very Hard	