MBGS
Mud Bay Geotechnical Services, LLC
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November 4, 2023 Project No: 2267-KIN

Subject: Foundation Repair Geotechnical Report
9251 SE 46th St,
Mercer Island, WA
Parcel #192300-0320

Dear Rusty Johnson,

Per your request, Mud Bay Geotechnical Services, LLC is providing a geotechnical report for the foundation repair work proposed at the situs address of 9251 SE 46th St, located in Mercer Island, Washington. The scope for this project was to perform a site reconnaissance and subsurface investigation of the parcel and prepare a geotechnical report providing recommendations for the foundation underpinning work. This report provides our assessment of the geologic hazards on-site and recommendations to mitigate foundation settlement within the existing home structure. This is an updated report that supersedes all previous versions for this project.

The purpose of this report is to assist you in meeting the minimum requirements of Mercer Island City Code (MICC) for permitting. This report specifically addresses MICC section 19.07.160, which pertains to the requirements for land development on or near critical areas or their associated hazards. Per MICC 19.07.160 a geotechnical report is required when proposed development or alteration is located within a landslide, seismic, or erosion hazard area. The project site is located within an Erosion, Seismic, and Landslide Hazard Area, as designated by City of Mercer Island Geologic Hazard maps (Figure 1, Hazard GIS Map) and as such the City of Mercer Island has required a geotechnical report pertaining to the retaining wall construction. All statements made in this Geotechnical Report were made to the greatest available accuracy and were based solely on data collected for the specific project.

The analyses, conclusions, and recommendations in this report are based on the information available. These informational resources include: two (2) shallow hand augured borings completed specifically for the subject project, down hole dynamic cone penetrometer testing,

published geologic information for the site, remote data analysis, and our experience with similar soil conditions. The exploratory borings are assumed to be representative of the subsurface conditions where the work will occur. If during construction, subsurface conditions differ from those described in this report, we should be advised immediately so we may reevaluate our recommendations.

SITE LOCATION AND PROJECT DESCRIPTION

Parcel #192300-0320, designated situs address of 9251 SE 46th St in Mercer Island, consists of approximately 0.27 acres within the jurisdiction of the City of Mercer Island. Presently, the property features a two-story, single-family residence with a detached garage and daylight basement stepped into the moderate site grade. The topography of the site grades moderately downslope to the south. Landscaped garden bends and short garden rockery walls border the home structure and parcel. A large deck structure supported by wood piers extends off the eastern side of the home. The approximate site location and parcel boundaries are shown in Figure 2, Site Map.

Based on conversations with the contractor, Matvey Foundation Repair, the structural engineering firm, SFA Design Group and yourself, the client; it is our understanding that the home has experienced foundation settlement across the eastern and southern halves of the home. To permanently stabilize the home, Matvey Foundation Repair in conjunction with a third-party structural engineering firm, SFA Design Group, have proposed the installation of a combination of 3” O.D. push pier foundation elements, 2” O.D. pin piles, helical lateral tiebacks, wall anchors, helical piers, no footing stabilizer systems, and stabilizer systems across the exterior and interior of the home structure. Additionally, carbon fiber crack repair will be used at select locations where the foundation stem wall has experienced cracking, angle-iron sections will be installed at select pier locations and polyurethane foam injection will be utilized for leveling of the home and backfill of the pier foundation elements. The proposed work is displayed in the attached Figure 3, Foundation Repair Plan.

SITE GEOLOGY AND SOILS

As part of this project, available geologic data from the Washington Department of Natural Resources (DNR) available at the 1:100,000-scale was reviewed, and a site-specific geologic map was prepared. The project vicinity geologic map is attached as Figure 4, WA DNR Geologic Map. Figure 4 indicates that the parcel is underlain by *Pleistocene continental glacial till.* The WA DNR characterizes the *Pleistocene continental glacial till* unit as follows: *Pleistocene till and*

outwash clay, silt, sand, gravel, cobbles, and boulders deposited by or originating from continental glaciers; locally includes peat, nonglacial sediments, modified land, and artificial fill. The conditions observed on-site are generally consistent with the mapped geology at the site.

Along with the site geology, soil data available from the United States Department of Agriculture, Natural Resources Conservation Service was also reviewed. This information is presented in the attached Figure 5, USDA Soil Map. The soil mapped on-site is *Unit KpD – Kitsap silt loam, 15 to 30 percent slopes*. The USDA has classified *KpD as* a moderately well-drained material consisting of gravelly to very gravelly sandy loam derived from basal till. Conditions observed at the site are generally consistent with the mapped soils at the site. It should be noted that the slope percentages and composition associated with the mapped soil units are estimates and do not necessarily reflect the true on-site topography or soil characteristics.

SUBSURFACE EXPLORATION

As part of the geotechnical investigation, two (2) shallow hand augured borings were completed. The borings were performed from the existing ground surface at the approximate locations shown in Figure 6, Site Exploration Map.

The boring was completed using a Humboldt Manufacturing model H-4414QC hand auger with a 4-inch diameter bucket tube sampler. In situ testing was performed at selected depths using a Humboldt Manufacturing model H-4202A dynamic cone penetrometer to estimate the density of the soil. The dynamic cone penetrometer uses a 15-lb steel mass falling a height of 20-inches onto an anvil to penetrate a 1.5-inch diameter 45-degree cone tip seated into the bottom of the hole. The penetrometer is driven 2-inches through the upper slough within the boring and the number of blows is recorded, afterwards the number of blows required to achieve a total of 1 ¾ inches of penetration into the undisturbed soil is recorded. The number of blows required to advance the 1 ¾ inches is recorded as the field N-value. This recorded blow count is correlated to the Standard Penetration Test (SPT) field N-value blow count determined in accordance with ASTM D1586, which is the standard in situ test method for determining relative density of cohesionless soils and the consistency of cohesive soils. Samples were removed from the bottom of the hole after the dynamic cone penetration testing was performed to observe the soil material at the approximate depth the test was performed.

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 borings 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 holes were backfilled to the original ground surface using excavated material from the spoil piles.

SUBSURFACE AND GROUNDWATER CONDITIONS

The geotechnical explorations for this foundation underpinning project was designated BH-1-23 and BH-2-23. The borings were completed on March 12, 2023 by Mud Bay Geotechnical Services LLC, personnel.

BH-1-23 was performed off the northeastern side of the northeastern corner of the home near where the proposed foundation repair work will occur. The soil conditions in BH-1-23 consisted of: *dense, moist, tan, silty sand with gravel* ***(SM)*** from grade to a depth of 46 inches below ground surface (bgs). At 46-inches bgs the subsurface conditions transitioned to *moist, grey-brown, well-graded sand with silt and gravel* ***(SW-SM)****.* The fines content was found to decrease in depth, and a final unit of *very dense, moist, grey-brown, well-graded sand with gravel* ***(SW)*** was seen to extend to the base of the boring at 96 inches bgs.

BH-2-23 was performed off the northern side of the northeastern corner of the home near where the proposed foundation repair work will occur. The soil conditions in BH-2-23 consisted of: *loose, moist, tan, silty sand with gravel* ***(SM)*** from grade to a depth of 40 inches below ground surface (bgs). At 40-inches bgs the subsurface conditions transitioned to *dense*, *moist, grey-brown, well-graded sand with silt and gravel* ***(SW-SM)****.* The fines content was found to decrease in depth, and a final unit of *dense, moist, grey-brown, well-graded sand with gravel* ***(SW)*** was seen to extend to the base of the boring at 78 inches bgs.

Groundwater was not encountered during our subsurface explorations of the site. No expressions of subsurface water such as wet areas of the yard or seeps/springing were noted during our site exploration. As a part of this project, well logs made available by the Washington State Department of Ecology for the surrounding vicinity were analyzed to estimate the depth at which groundwater exists in the region. Based on the nearby well logs, it is estimated that the depth to the groundwater table is greater than 30 feet depth and outside the depth of excavation for this project.

GEOLOGIC HAZARD ASSESSMENT

Liquefaction Hazard

The attached Figure 7, Liquefaction Hazard Map, displays liquefaction susceptibility data available from the Washington State Department of Natural Resources. Soil liquefaction is a phenomenon whereby saturated soil deposits temporarily lose strength and behave as a viscous fluid in response to cyclic loading. This phenomenon is most significant in loose, saturated sandy soils with lesser effects experienced in other soil types. Figure 7 indicates the project vicinity has a Very Low liquefaction susceptibility. Based on our observation of dense sand deposits within the upper subsurface and the lack of groundwater, it is our interpretation that the site is at Very Low risk of soil liquefaction.

Landslide Hazard

As part of the investigation of the site, we reviewed landslide hazard mapping and LiDAR imagery, available from the Washington Department of Natural Resources. The DNR landslide data indicates mapped landslide scarps, flanks, and deposits exist within 300-feet of the project location. The nearest mapped landslide complex is positioned approximately 70-feet south of the project location and is associated with the headward failures of a gully drainage feature south of the subject parcel and west of the shoreline of Mercer Island. The WA DNR has categorized this landslide as a pre-historic (> 150 years) complex earth/debris flow with a failure depth of approximately 69 feet and a head scarp height of approximately 80 feet. The DNR Landslide Map has been included with this report as Figure 8, WA DNR Landslide Map.

Furthermore, the City of Mercer Island GIS Portal delineates a landslide scarp running east/west through the southernmost portion of the parcel. Ancient landslide locations verified by test pits have also been documented southwest of the subject parcel. The project vicinity encompassing the entirety of the parcel has also been highlighted as a landslide hazard area. This information can be identified on the Landslide Hazard GIS Map attached to this report as Figure 9.

In addition to WA-DNR landslide hazard mapping, the geomorphology (shape of the land) was analyzed during the site evaluation and compared to the Light Detection and Ranging images (LiDAR) from the Washington State LiDAR Portal. LiDAR is a remote sensing method where light is pulsed down to the surface of the Earth and back to a sensor. Quantum Geographic Information Systems software (QGIS) was used to create a LiDAR derived digital elevation hillshade map with overlying contours lines at two- and ten-foot intervals. This methodology enables bare earth images of the surface to be analyzed for the presence of important geologic landforms. The most

recent available LiDAR images of this site are from 2021 and are attached as Figure 10, QGIS LiDAR & Contour Map. Figure 10 shows that the subject parcel is situated along the northern margin of a glacial till plain and bounded to the south by the previous headward expansion of the gully. From this southern boundary the slopes descend roughly 90 feet to SE 47th St positioned directly below the hillside. The head scarp of the aforementioned pre-historic landslide and top of slope is delineated across the southernmost portion of the subject parcel. The slopes along the southern and eastern margins of the subject parcel appear to have indications of past landslide behavior such as crescentic scarping along the top of slope, benching within the mid-slope, and hummocky terrain.

Using QGIS, the slope percentage values were calculated by making use of the elevation data from the most recent LiDAR data available, *king_county_west_2021*, digital terrain model data sets from 2021. The slope calculations are expressed as a percentage, where the difference of two elevation points (rise) is divided by the distance between them (run) and then multiplied by 100. For reference, a slope percentage of 100% is equal to a 45° slope angle, where the rise is equal to the run. The LiDAR derived digital elevation hillshade map was processed with overlying contour lines at two (2) foot and (10) ten-foot intervals. The slope map for the area is shown in Figure 11, QGIS Slope & Contour Map. Figure 11 indicates that the topography in the western portion of the parcel where the driveway and garage are positioned on-site ranges from 0 to 15 percent. The home structure and remaining eastern majority of the parcel contains slopes ranging from 15 to 40 percent wrapping around the southeastern sides of the property; with some areas increasing to over 40 percent in slope. The difference between the minimum and maximum elevations on-site is approximately 30 feet.

Using QGIS software, a single slope transect profile line was drawn from the northwestern corner of the parcel, through the location of home structure and to the southeast. The transect was drawn orthogonal to the elevation contour lines and was designated Line A-A'. Transect Line A-A' is displayed in the attached Figure 12, Slope Transect and Profile. Figure 12 indicates that the slope rises continuously through moderately hummocky terrain, however the top of slope crests gradually. The remote data analysis of the slopes within the project vicinity displays geomorphological indicators indicative of past mass-wasting activity.

The subject parcel and surrounding vicinity were observed in-situ during our investigation of the site on April 20, 2023, surrounding the structure across the downslope side of the home. From our observations in-situ, the slopes beyond the maintained landscaped areas are densely vegetated. Despite the surrounding geology signaling a large landslide hazard, inspection of the

project site revealed no immediate on-site indicators of local slope instability. There were no immediate signs of slope retrogression such as: cracking, slumping, increased erosion, or channelized runoff in the area.

GEOTECHNICAL RECOMMENDATIONS

Slope Stability

Based on site reconnaissance, subsurface exploration, and a review of the site geology and other readily available information presented previously, in the opinion of Mud Bay Geotechnical Services, LLC the potential for geologic hazard is moderate throughout the property and proposed development area. It is in our opinion that no indications of ongoing slope instability are present however landforms indicating past mass-wasting on-site are within 300 feet of the site were observed. We conclude that the risk of deep-seated landslide is low and the geologic hazard on-site is primarily limited to shallow erosion of any bare or over steepened sections of the slope. It is our opinion that the proposed foundation underpinning work should not serve to increase the risk of geologic hazard on-site. Conversely, fitting the home structure with deep foundation solutions should serve to benefit long-term structure stability on-site. The steep slope and landslide hazard areas should be strictly monitored during the construction phase of the project.

Proper water management is an important aspect of slope stability. Excessive water adds a significant amount of weight to the soil, and can reduce the strength of the soil, which negatively affects slope stability. Furthermore, excessive water can cause settlement by washing away supporting soils and can cause subsidence surrounding a foundation. Care should be taken to control the amount of water being introduced to the slope. If any damaged or broken lines are found, they should be repaired and routed away from the foundation. All gutters and drains should be routinely cleaned and maintained to ensure no excess water is entering the area above the upper top of slope or near the home's foundation. Gutters and drain lines need to be installed on all structures and maintained to ensure the stormwater continuously reaches the lowest point possible on a sloped environment.

Temporary Excavations

Temporary excavations will be necessary to construct the foundation repairs. It is our interpretation that the groundwater table will be greater than the limits of excavation for the subject project. We anticipate that temporary excavation cuts above the groundwater table will be stable at up to 4 feet in height at a vertical inclination, and any remaining height, or any excavation limits below the groundwater table, 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. 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 beyond the scope of services for this report.

Push Pier Systems

Push piers will be used to prevent future settlement and to lift the structure back into a level position. 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 3,000 psi, whichever is deeper. Push piers installed to these criteria should be capable of supporting design loads greater than or equal to 14.5 kips. The contractor should expect the need to use concrete backfill if the piers reach refusal pressure at shallow embedment depth. Load testing should be performed to 2.0 times the design load on a minimum of 3 percent of the push piers in accordance with ASTM Standard D1143-81.

Pin Piles

Two-inch O.D. in piles will also be used as a permanent foundation support at selected locations. The pin piles should consist of galvanized steel, open-ended pipe piles. Based on the limited access at the site, small equipment will be necessary to install the piles. The pin piles should be installed using a 110-pound pneumatic hammer to a minimum depth of 6 feet below the existing ground, or to refusal, whichever is deeper. Refusal is defined as an advancement rate less than or equal to 1 inch within a 60 second period. Larger pneumatic hammers may be used at the contractor's discretion using this same criteria for refusal. Pin piles installed with these minimum requirements should develop allowable (downward) pile capacities equal to or exceeding 8.5 kips.

Helical PIers

Safebase helical piers are proposed for a portion of the foundation repair, consisting of a 2.875-inch pipe piles with 10 and12- inch helix blades. Based on the subsurface explorations performed for the project, helical piers with this geometry installed to a minimum depth of 6 feet and an installation torque of 1,900 psi should be capable of achieving allowable bearing capacities greater than 8,500 kips.

Lateral Helical Tieback Anchors

Lateral helical tieback anchors will be used at selected locations for additional stabilization and resistance from potential lateral movement. Helical tieback anchors consist of screw like anchors that are drilled horizontally into the ground. Typically, these consist of a lead piece with helix plates 10 to 12 inches in diameter that are spaced approximately one foot apart.

We recommend using helical anchors meeting this basic geometry, installed to a minimum length of 20 feet and a minimum torque of 1,500 lb-foot. The anchors should be installed at an inclination of 15 to 30 degrees from horizontal. Helical anchors meeting this basic geometry criteria should be capable of achieving allowable pullout anchor capacities greater than 7.5 kips. Load testing should be performed to 200 percent of the design load on (1) of the helical anchors, in accordance with ASTM Standard D 1143-81.

Wall Anchors

All Safebase wall anchors used should meet the design, material requirements, and installation specifications in the SafeBasements Technical Manual, Version 1.1, dated January 2, 2020 including all supporting documentation included with the manual. Since the anchor location with respect to the top of wall and the inclination is yet to be determined, we recommend that the anchor length be determined by the structural engineer based on Table 2-1 in the Safebasements Technical Manual. Based on the wall geometry we recommend installing the wall anchors with a minimum length of 12 feet at a downward inclination of 5 degrees. Wall anchors installed with this basic geometry criteria should be capable of generating allowable lateral anchor capacities equal to or greater than 8 kips.

Poured In Place Concrete Footings

Poured in placed concrete footings will be used at two locations, as shown on Figure 3. We recommend a minimum embedment of 12 inches for all new shallow concrete footings. Based on the conditions observed in the borings, we recommend excavating a minimum of 2’ of the uppermost loose silty sand with gravel (SM) to a horizontal distance of 6 inches on all sides and backfilling up to the footing elevation with well-compacted crushed gravel such as a crushed surfacing or similar crushed material. Provided that the overexcavation and replacement is performed as recommended, new concrete footings should be capable of supporting loads of at least 2,500 psf with less than or equal to one inch of settlement.

Floor Stabilizer Systems

Based on the conditions observed in the borings, we recommend excavating a minimum of 2' of the uppermost loose silty sand with gravel (SM) to a horizontal distance equal to 1x the stabilizer or stabilizer footing width on all sides and backfilling with well-compacted crushed gravel such as a crushed surfacing or similar crushed material. Installing the proposed Stabilizers with the recommendations provided above should be capable of supporting loads of at least 2,500 psf with less than or equal to one inch of settlement.

Backfill Placement

Some of the work performed as part of the project may require new backfill be placed to return the final ground surface back to the current grade.

The backfill material for the push pier foundations can be reused material from the excavation spoil piles. We recommend hand tamping the foundation repair backfill to a dense condition in 4-inch lifts.

Alternatively, single stage polyurethane could also be used as backfill for the foundations.

Erosion Control

Onsite materials are erodible when exposed on steep slope areas. No excavated material should be placed on the steep slopes. Soil stockpiles and exposed slope areas should be covered during heavy rainfall and siltation fences or other detention devices should be provided as required to control the transport of eroded material. Silt fences should be used as an erosion control measure and to separate the critical area boundary from the work area where disturbance is allowed. Jute, coir, or turf reinforcement mat should be placed on the surface of all exposed ground surfaces and spoil piles, pinned using 9-inch landscaping staples at a 16-inch spacing. The erosion condition adjacent to the structures should be monitored periodically for any signs of surface erosion, degradation, and shallow failures. If significant erosion or failures are observed, then those should be mitigated as soon as possible.

Vegetation should be maintained where disturbance is not necessary as part of construction. Existing bare and disturbed soil areas should be planted immediately with grass and deep-rooted plants and native conifers to help reduce erosion potential.

RECOMMENDED ADDITIONAL SERVICES

Before construction begins, we recommend a copy of the draft plans and specifications prepared for the project be 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 depends 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, perform inspections of push pier installation, lateral helical tieback anchor installation, pin pile installation, helical pier installation, evaluate poured in place concrete footing and stabilizer subgrade conditions, monitor excavations and slope conditions, monitor backfill placement and compaction, temporary and permanent erosion control, 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.

Parcel boundaries reflected in this report and attached maps are interpreted from public Geographic Information Systems portals from your local jurisdiction, and do not reflect surveyed property boundaries. Digitized parcel boundaries reflected in this report are intended to assist in visualization and report comprehension and are not for legal interpretation.

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

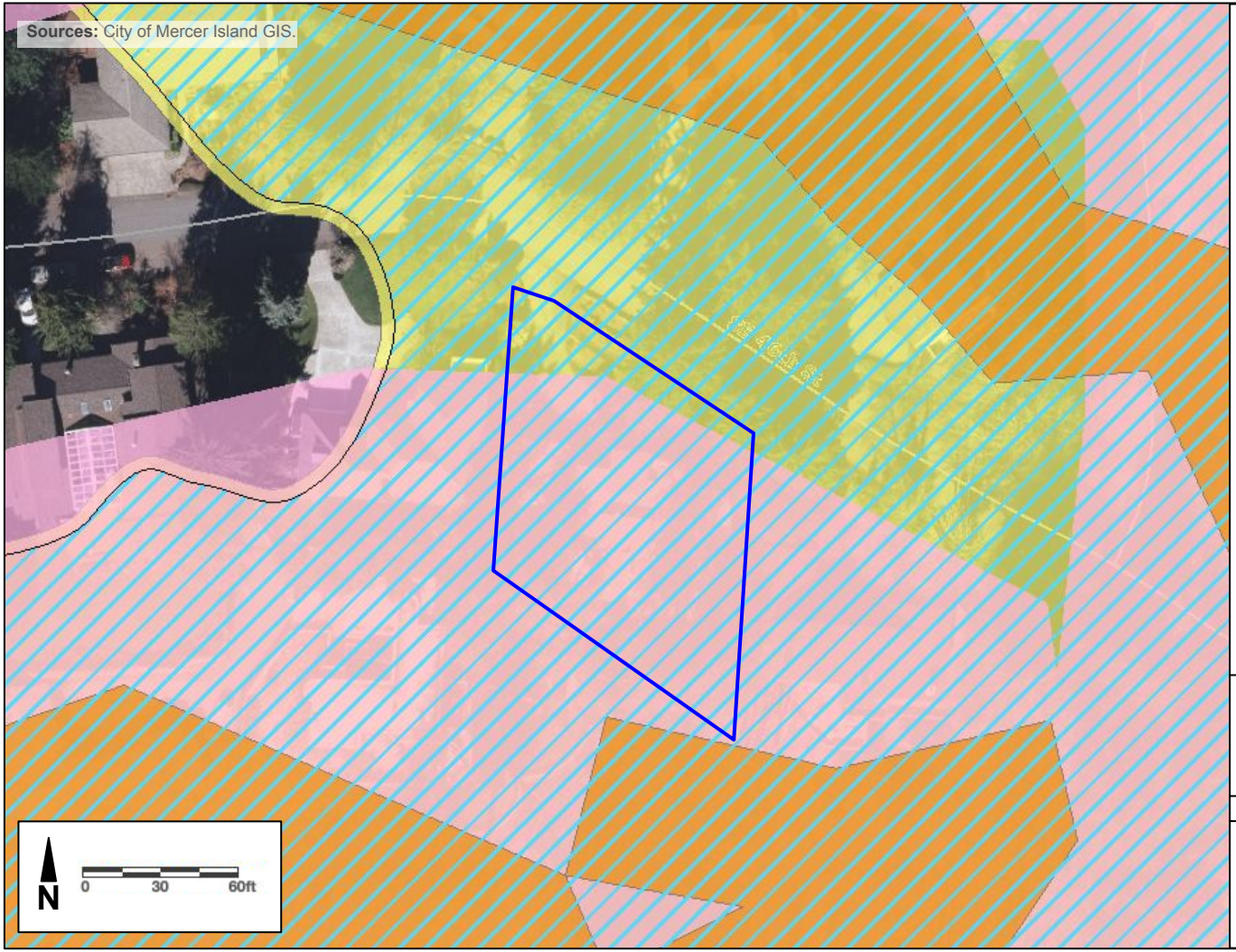
conditions. Actual subsurface conditions can be discovered only during earthwork and construction operations. The distribution, continuity, thickness, and characteristics of identified (and unidentified) subsurface materials may vary considerably from that indicated by the subsurface data. While nothing 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.

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

11/4/2023



Legend

Approximate Parcel Boundary

Hazards

- Potential Slide Area
- Steep Slope Area
- Seismic Area
- Erosion Area

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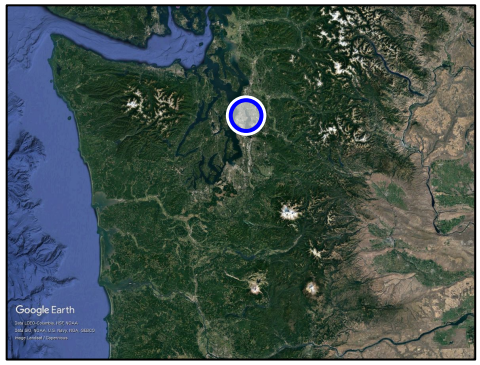
Job #:2267-KIN	Date: April, 2023

Figure 1: Hazard GIS Map
9251 SE 46th St
Mercer Island, WA 98040
Geotechnical Report



Legend

Approximate Site Location

Approximate Parcel Boundary

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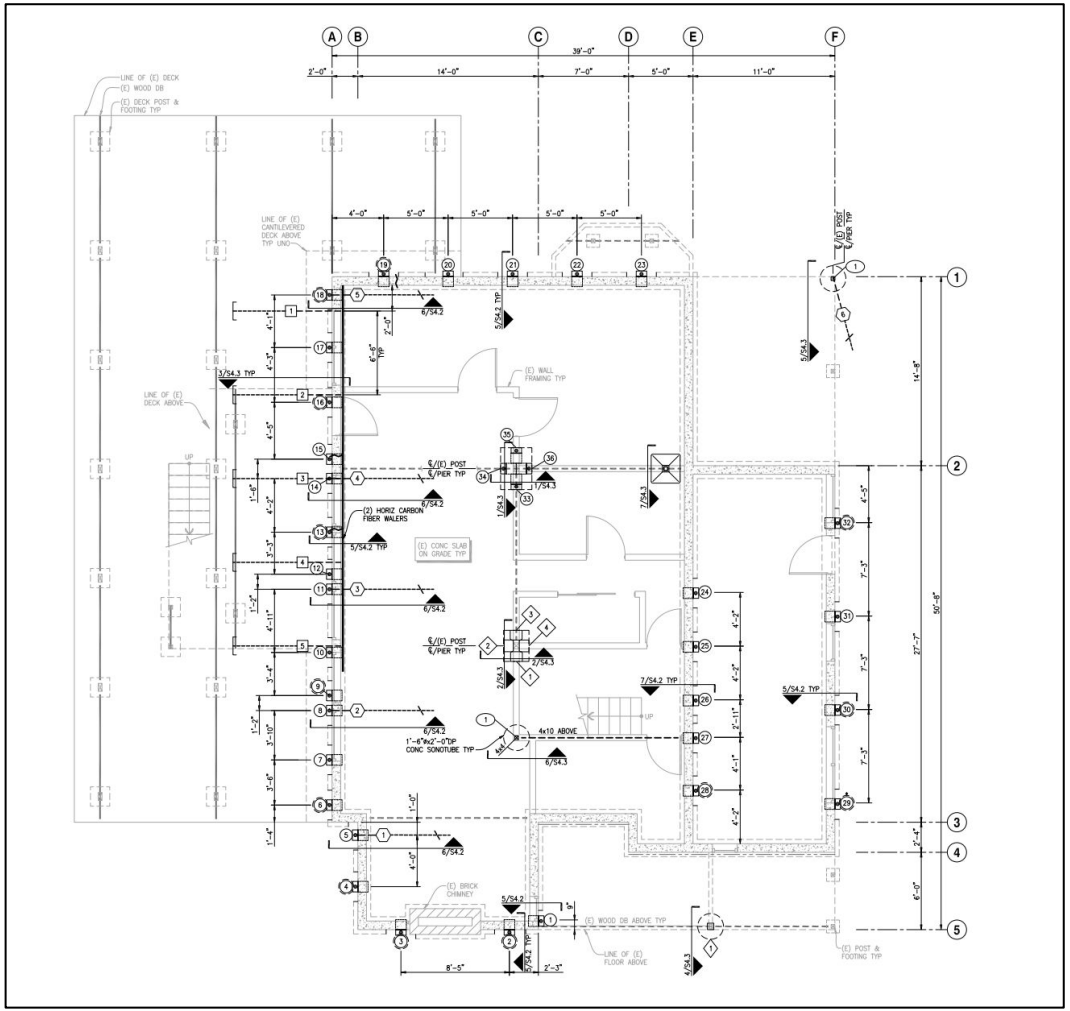
Figure 2: Site Map
9251 SE 46th St
Mercer Island, WA 98040
Geotechnical Report



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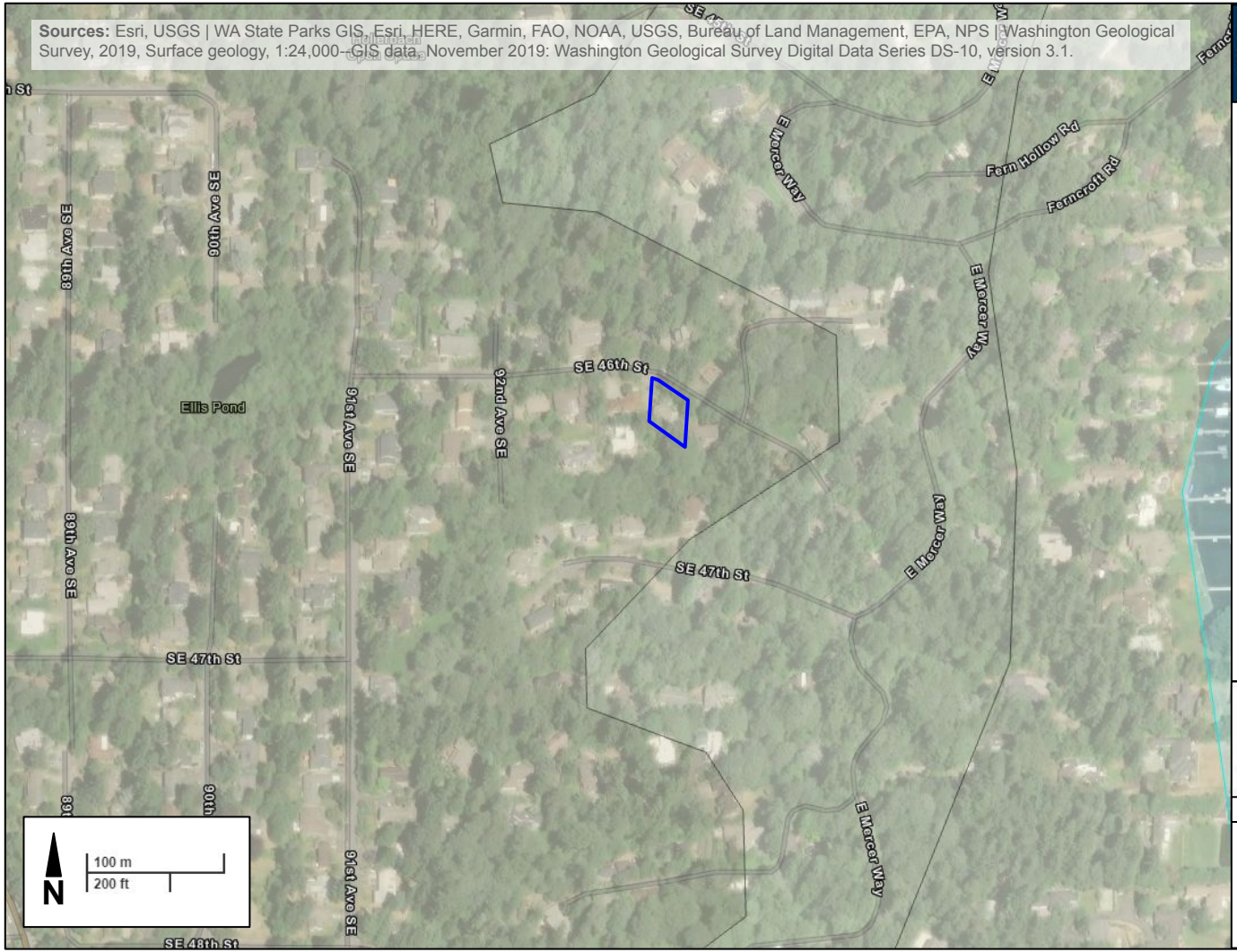
Job #:2267-KIN	Date:Nov, 2023

Figure 3: Foundation Repair Plan
9251 SE 46th St
Mercer Island, WA 98040
Geotechnical Report



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

Legend

Approximate Parcel Boundary

Geologic Units 100k

- Quaternary alluvium
- Pleistocene continental glacial till
- Pleistocene continental glacial drift
- Quaternary bog, marsh, swamp or lake deposits
- Pleistocene glacial and non-glacial deposits

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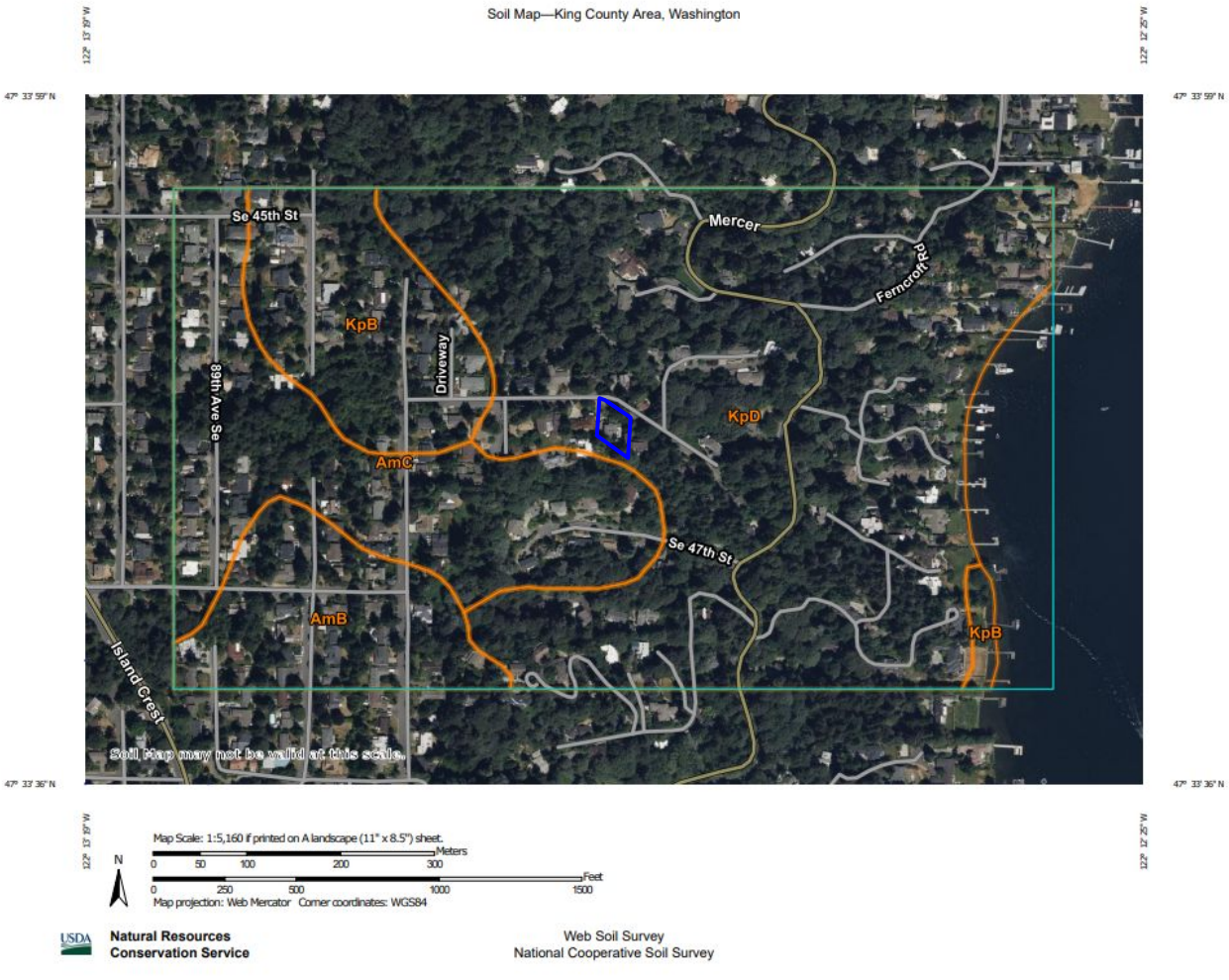
Job #:2267-KIN	Date: April, 2023

Figure 4: WA DNR Geologic Map
9251 SE 46th St
Mercer Island, WA 98040
Geotechnical Report



USDA **Natural Resources Conservation Service**

Legend

Approximate Parcel Boundary

Map Unit Symbol	Map Unit Name
AmB	Arents, Alderwood material, 0 to 6 percent slopes
AmC	Arents, Alderwood material, 6 to 15 percent slopes
KpB	Kitsap silt loam, 2 to 8 percent slopes
KpD	Kitsap silt loam, 15 to 30 percent slopes

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Job #:2267-KIN | Date: April, 2023

Figure 5: USDA Soil Map

9251 SE 46th St
Mercer Island, WA 98040
Geotechnical Report

Legend

Approximate Parcel Boundary

Approximate Boring Location

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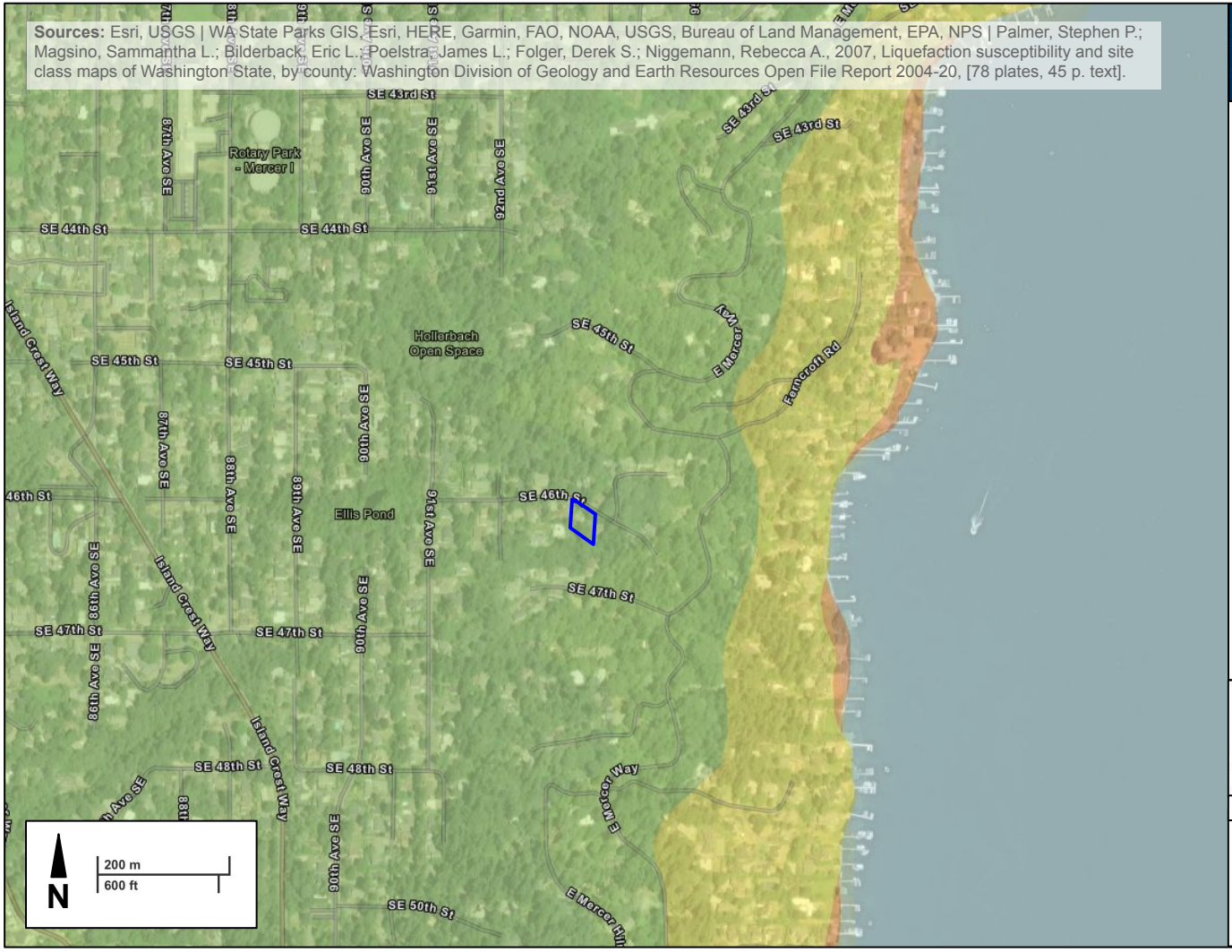
Job #:2267-KIN	Date: April, 2023

Figure 6: Site Exploration Map

9251 SE 46th St
Mercer Island, WA 98040
Geotechnical Report



WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES
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Legend

Approximate Parcel Boundary

Liquefaction Susceptibility

- High
- Moderate to High
- Moderate
- Low to Moderate
- Low
- Very Low to Low
- Very Low
- Bedrock
- Peat

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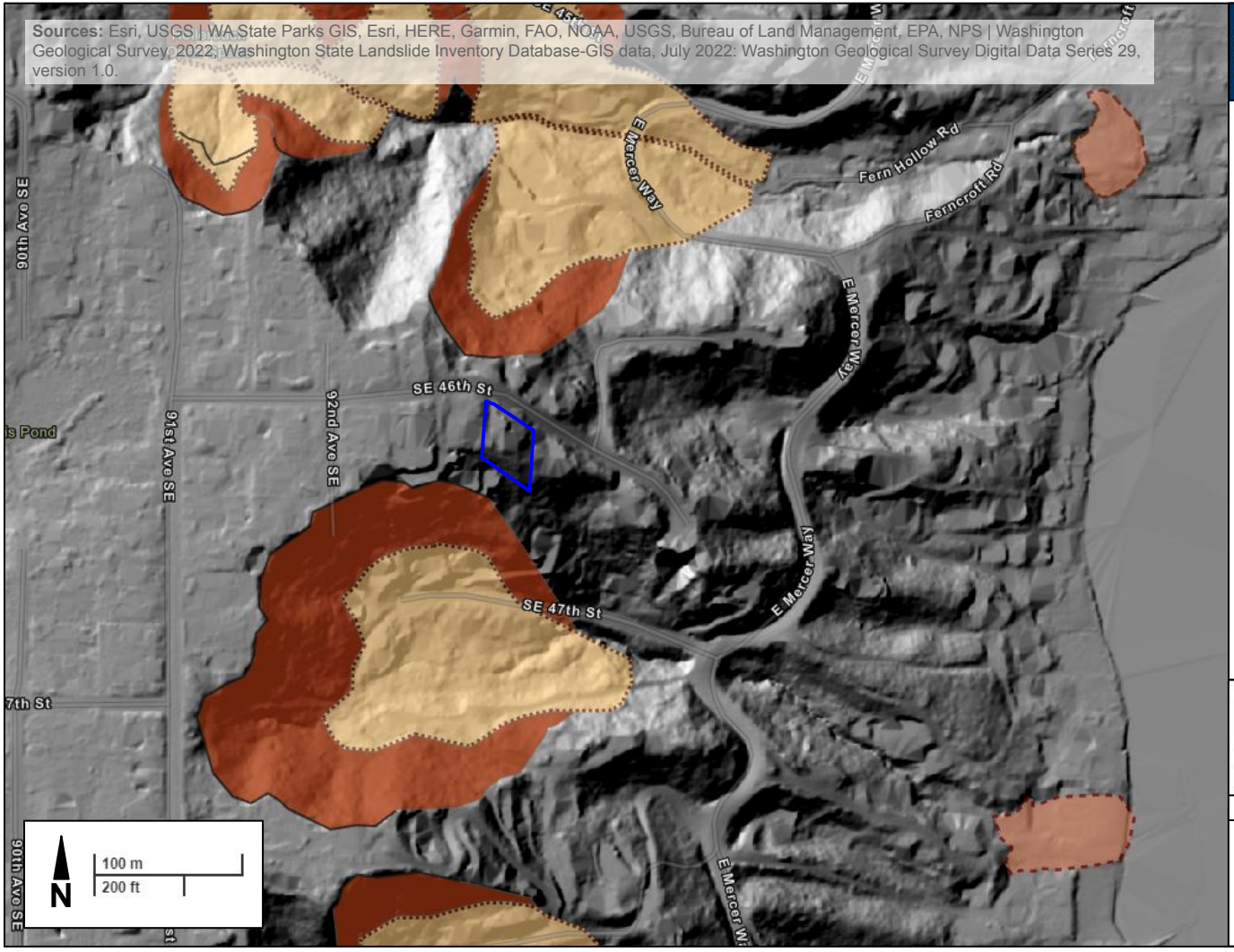
Job #:2267-KIN	Date: April, 2023

Figure 7: Liquefaction Hazard Map
9251 SE 46th St
Mercer Island, WA 98040
Geotechnical Report



WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES
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Legend

- Approximate Parcel Boundary

Landslides

- Scarps
- Scarps and Flanks

Landslide Deposits

- High (30-40)
- Moderate (11-29)
- Low (1-10)

Fans

- High (23-30)
- Moderate (8-22)
- Low (1-7)

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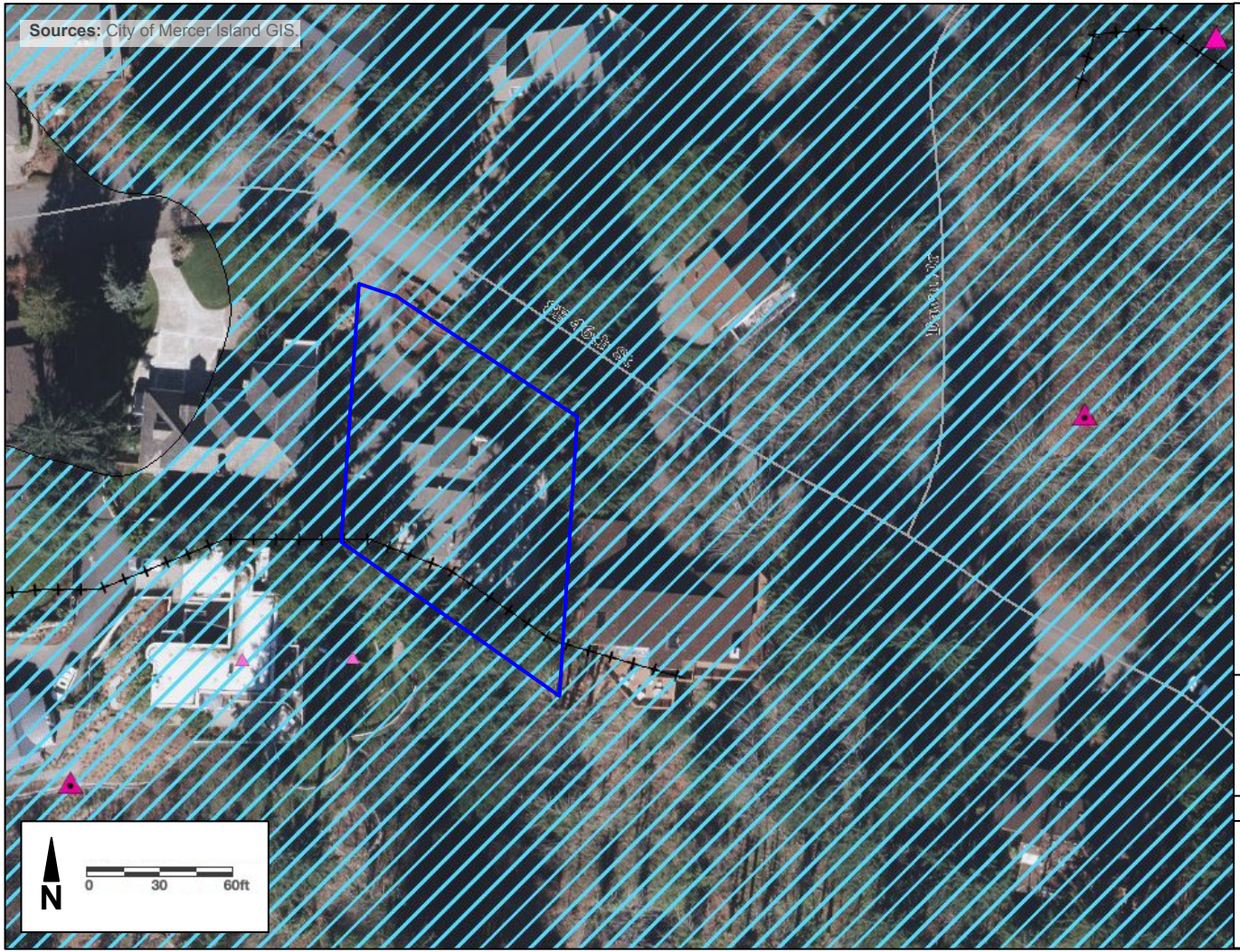
Figure 8: WA DNR Landslide Map
9251 SE 46th St
Mercer Island, WA 98040
Geotechnical Report



Legend

Approximate Parcel Boundary

Landslide Hazard Assessment

Landslide Area

Scarp

Documented Landslide Location

Undocumented Landslide Location

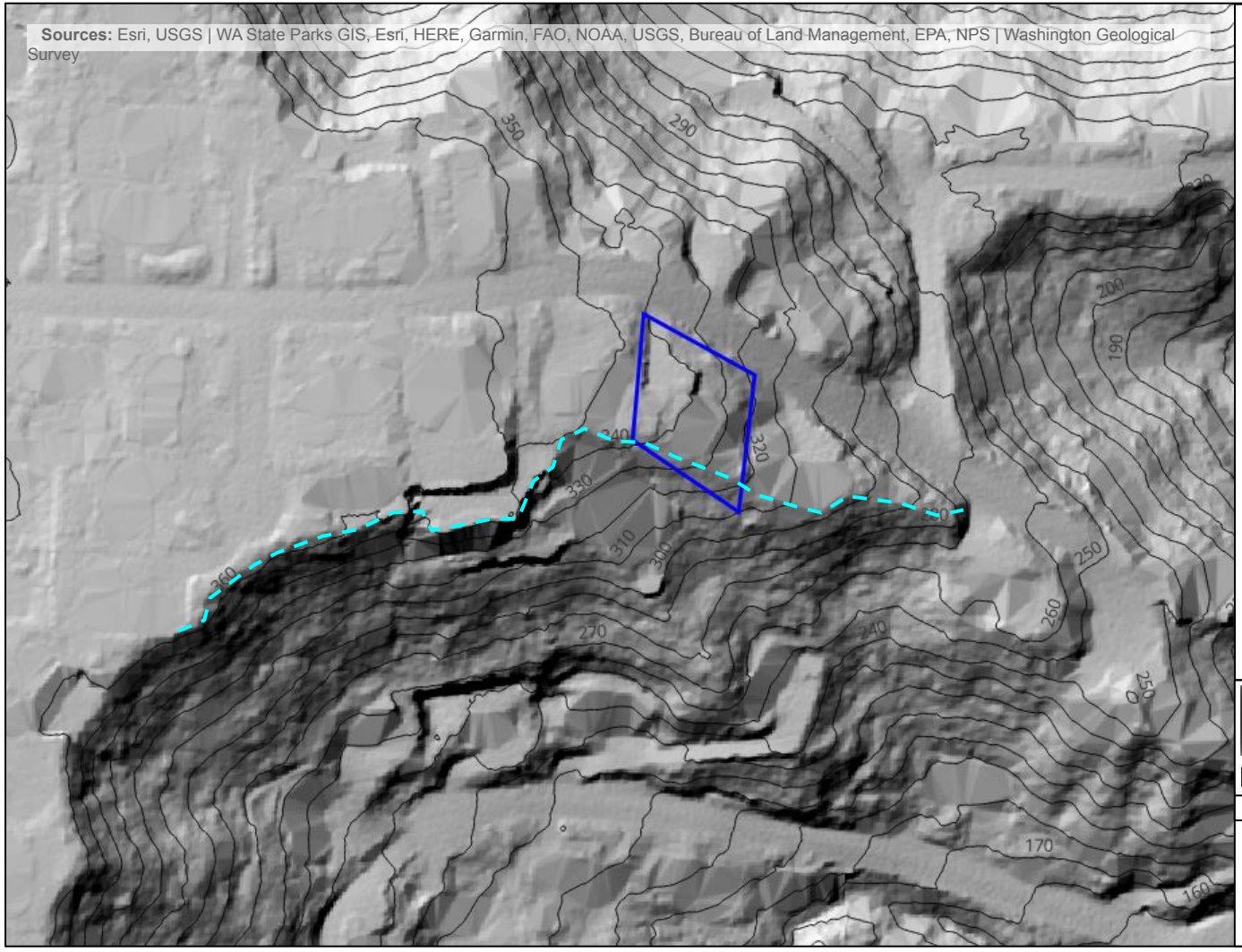
Ancient Slide (Test Pit) Location

MBGS

Mud Bay Geotechnical Services, LLC

Job #:2267-KIN	Date: April, 2023

Figure 9: Landslide Hazard GIS Map
9251 SE 46th St
Mercer Island, WA 98040
Geotechnical Report



Legend

- Approximate Parcel Boundary
- 10’ Contour Line
- Headscarp & Top of Slope

N

0 100 200 ft

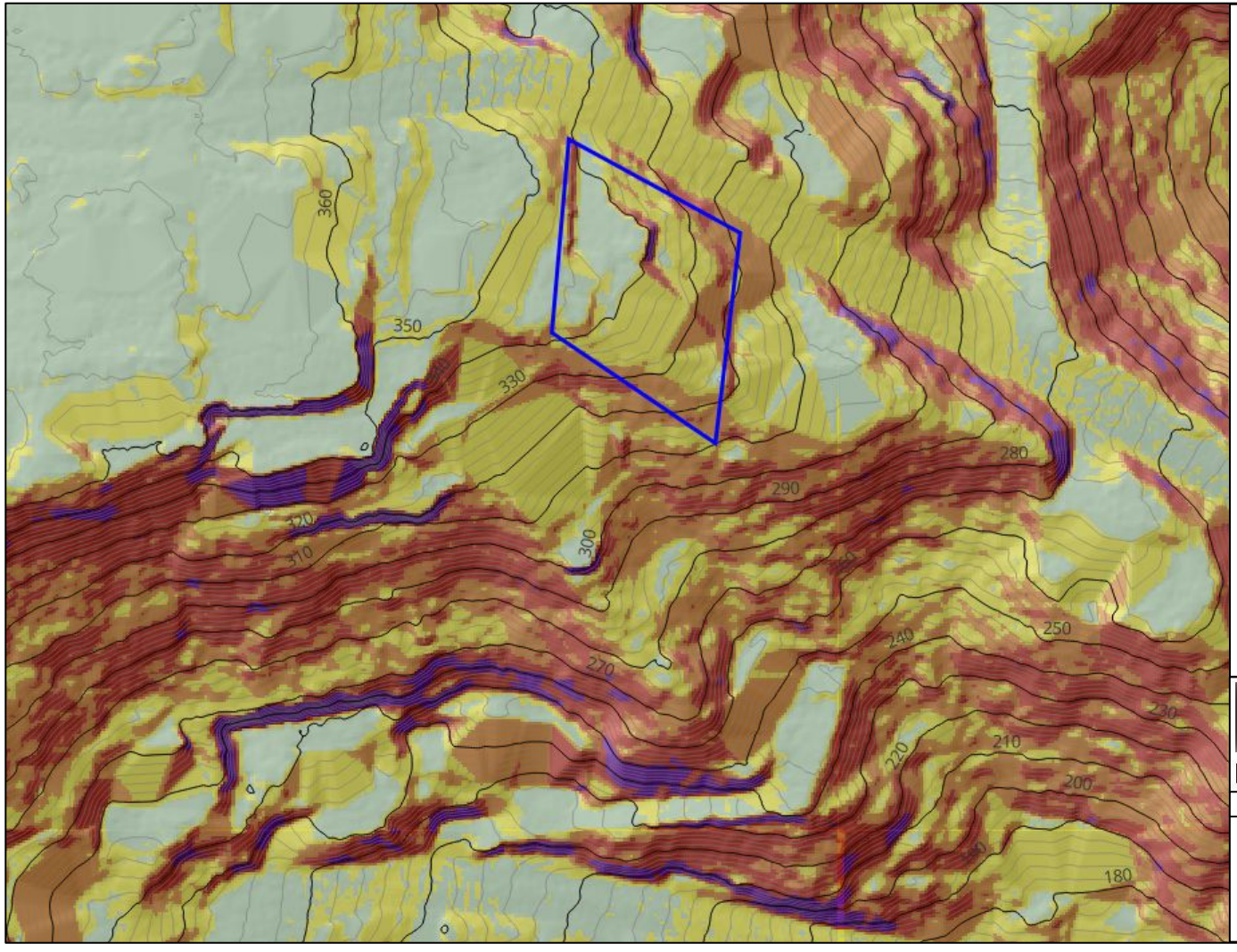
MBGS

Mud Bay Geotechnical Services, LLC

Job #:2267-KIN	Date: April, 2023

Figure 10: QGIS LiDAR & Contour Map

9251 SE 46th St
Mercer Island, WA 98040
Geotechnical Report



Legend

- Approximate Parcel Boundary
- 10’ Contour Line
- 2’ Contour Line

Slope Percentage

- 0-15%
- 15-40%
- 40-60%
- 60-100%
- >100% (45° +)

N

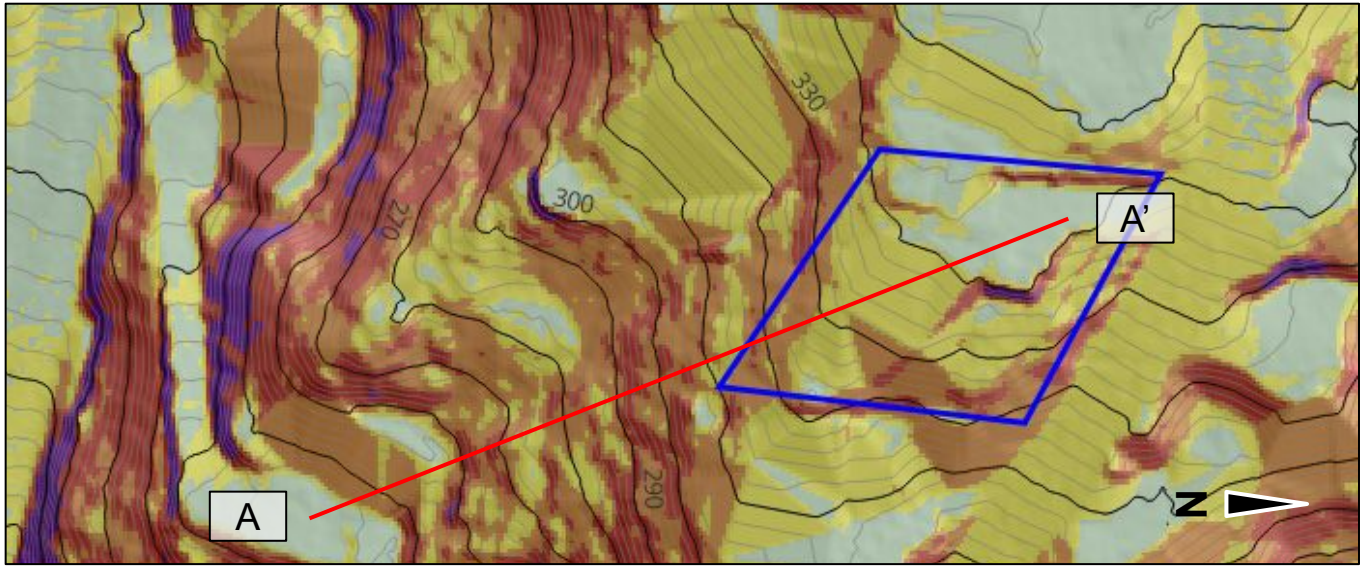
0 75 150 ft

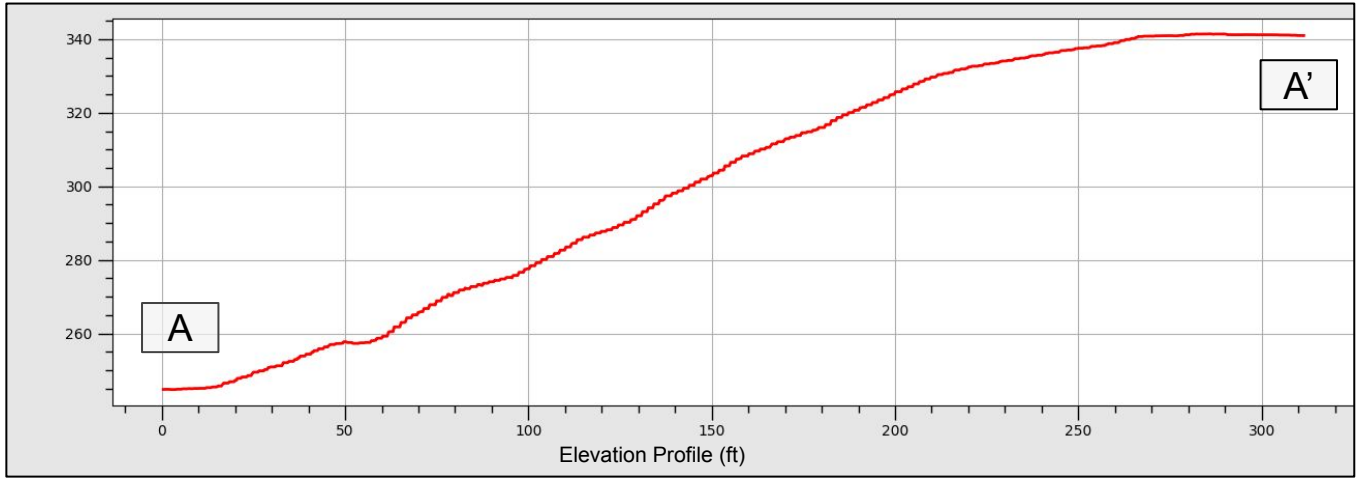
MBGS

Mud Bay Geotechnical Services, LLC

Job #:2267-KIN	Date: April, 2023

Figure 11: QGIS Slope & Contour Map
9251 SE 46th St
Mercer Island, WA 98040
Geotechnical Report





Legend

- Approximate Parcel Boundary
- 10' Contour Line
- 2' Contour Line
- Transect Line A-A'

Slope Percentage

- 0-15%
- 15-40%
- 40-60%
- 60-100%
- >100% (45° +)

MBGS

Mud Bay Geotechnical Services, LLC

Job #:2267-KIN	Date: April, 2023

Figure 12: Slope Transect & Profile
9251 SE 46th St
Mercer Island, WA 98040
Geotechnical Report

APPENDIX A – FINAL BORING LOGS

MBGS Mud Bay Geotechnical Services, LLC	Project: Foundation Repair	Client: Rusty Johnson	Bore No. 1 of 2: BH-1-23
	Project Number: 2267-KIN	Contractor: Matvey Foundation Repair	Equipment: Humboldt H-4414QC Auger
Address: 9251 SE 46th St, Mercer Island, WA 98040	Date: Started: 3/12/2023	Bit Type: Bucket Tube Auger	Diameter: 4 inches
	Date: Completed: 3/12/2023	Hammer Type: Humboldt H-4202A	Fluid: n/a
Logged By: Ted Chow	Date: Backfilled: 3/12/2023	Hammer Weight: 15 lbs	Hammer Drop: 20 inches
Helper: n/a	Groundwater Depth: n/a	Elevation: Existing Surface	Total Depth of Boring: 96 inches
GPS Method: n/a	GPS Coordinates: (± __ ft.)		GPS Elevation: (± __ ft.)

Depth (in.)	Sample Type	Sample Number	Blow Counts (blows/2")	Graphic Log	Lithology **Soil Group Name:** modifier, color, moisture, density/consistency, grain size, other descriptors **Rock Description:** modifier, color, hardness/degree of concentration, bedding and joint characteristics, solutions, void conditions.	Dry Density (pcf)	Moisture Content (%)	Additional Test
31"	☒	S-1	n/a		Moist, tan, silty sand with gravel (SM).			
36"	☒	S-2	n/a		Moist, tan, silty sand with gravel (SM). Charcoal & Mottling.			
40"	☒	S-3	30		Dense, moist, grey-brown, silty sand with gravel (SM).			
46"	☒	S-4	n/a		Transition: Moist, grey-brown, well-graded sand with silt and gravel (SW-SM).			
					Silt content decreasing with depth.			
72"			9					
76"	☒	S-5	n/a		Moist, grey-brown, well-graded sand with gravel (SW).			
96"	☒		REF		Very dense, moist, grey-brown, well-graded sand with gravel (SW).			

Test Pit and Boring Log Symbols

- Standard Penetration Slit Spoon Sampler (SPT)
- California Sampler
- Shelby Tube
- CPP Sampler
- Stabllized Ground water
- Groundwater At time of Drilling
- Bulk/ Bag Sample

Soil Density Modifiers

Gravel, Sand, Non-Plastic Silt		Elastic Silts and Clays	
Blows/2"	Density	Blows/2"	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

MBGS Mud Bay Geotechnical Services, LLC	Project: Foundation Repair	Client: Rusty Johnson	Bore No. 2 of 2: BH-2-23
	Project Number: 2267-KIN	Contractor: Matvey Foundation Repair	Equipment: Humboldt H-4414QC Auger
Address: 9251 SE 46th St, Mercer Island, WA 98040	Date Started: 3/12/2023	Bit Type: Bucket Tube Auger	Diameter: 4 inches
	Completed: 3/12/2023	Hammer Type: Humboldt H-4202A	Fluid: n/a
Logged By: Ted Chow	Backfilled: 3/12/2023	Hammer Weight: 15 lbs	Hammer Drop: 20 inches
Helper: n/a	Groundwater Depth: n/a	Elevation: Existing Surface	Total Depth of Boring: 78 inches
GPS Method: n/a	GPS Coordinates: (± __ ft.)		GPS Elevation: (± __ ft.)

Depth (in.)	Sample Type	Sample Number	Blow Counts (blows/2")	Graphic Log	Lithology **Soil Group Name:** modifier, color, moisture, density/consistency, grain size, other descriptors **Rock Description:** modifier, color, hardness/degree of concentration, bedding and joint characteristics, solutions, void conditions.	Dry Density (pcf)	Moisture Content (%)	Additional Test
28"	☒	S-1	10		Loose, moist, tan, silty sand with gravel (SM).			
36"	☒	S-2	n/a		Moist, tan, silty sand with gravel (SM). Mottling.			
40"			27		Transition: Moist, grey-brown, well-graded sand with silt and gravel (SW-SM).			
					Silt content decreasing with depth.			
60"	☒	S-4	n/a		Moist, grey-brown, well-graded sand with gravel (SW).			
67"			28					
75"	☒	S-5	n/a		Moist, grey-brown, well-graded sand with gravel (SW).			
78"			47					

Test Pit and Boring Log Symbols

- Standard Penetration Slit Spoon Sampler (SPT)
- California Sampler
- Shelby Tube
- CPP Sampler
- Stabllized Ground water
- Groundwater At time of Drilling
- Bulk/ Bag Sample

Soil Density Modifiers

Gravel, Sand, Non-Plastic Silt		Elastic Silts and Clays	
Blows/2"	Density	Blows/2"	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