

January 30, 2024
Project No. 23-017

Mr. David Do
4649 Forest Ave SE
Mercer Island, WA 98040

Subject: Geotechnical Services Report
 Beachfront DADU
 4649 Forest Ave SE, Mercer Island, Washington

This report summarizes the results of our geological and geotechnical evaluation of the property located at the above noted address in Mercer Island. The subject property is currently developed with a decades old small beach cottage/shed. According to the Mercer Island geological hazard maps the property is classified as a critical area due to landslide, erosion and seismic hazards. Based on the current plans the existing beach cottage/shed will be demolished and a new 600 square foot DADU will be constructed on the site. Access to the property is via a trail and stairs down the slope to the beach.

Existing Conditions

The subject building site is located at beach level on the far western portion of the overall property. The property begin along the west side of the Forest Ave SE right of way and extends approximately 425 to the west, well beyond the existing shoreline. The upper portion of the property is 85 feet wide in the north-south direction. In the midportion of the site the width slims down to about 20 feet and then near beach level extends back out to about 60 feet wide.

An existing residence is located on the upper portion of the property. Landscaping and stairs and a portion of a steep concrete driveway occupy the midportion of the parcel. Near beach level the parcel is nearly flat and contains the old cottage/shed and a boat dock. The shoreline is protected from erosion with a rockery. The steep concrete driveway leads to the existing residence that is on the adjacent property to the south. This house is located just above beach level and is well down the slope from the existing house on the subject site. The driveway begins on the adjacent property, goes onto subject property, back onto the neighboring property, back on the subject property and then back onto the adjacent property and ends at the neighboring garage.

The entire slope area between Forest Avenue SE at the top and the flat beach area at the bottom is either heavily landscaped with multiple small rockeries and wood walls or covered by the winding concrete driveway. At the toe of the slope, just beyond the concrete driveway, is an approximate 6 foot tall rockery that separate the slope from the level beach area.

Subsurface Conditions

On October 22, 2023, 3 exploration borings – hand augers - were excavated on the subject site. See Figure 1, Site and Exploration Plan for boring locations. The borings generally encountered a small thickness of clean sand overlying silt sediments. The massive silt sediments were observed at a depth of 2.1 feet on the south side of the property, contained an approximate 18 inch layer of medium dense sand and then became all silt below a depth of 5-1/2 feet. On the north side of the property the silt sediments were observed at a depth of 2 feet and extended for the full depth of the boring to 9.5 feet. The hand auger logs are attached with this report.

All of the observed material is likely old landslide deposits from long ago as the property is located at the south end of an area of a large, ancient landslide that begins along Forest Ave SE and extends a significant distance to the north. Reportedly, the residences in this area are generally underlain by 10 to 15 feet of disturbed silt soils overlying hard, glacially consolidated silt soils.

Hydrology

There was no visual observations of any ground water seepage or hydrophilic (water loving) plants on the west facing slope or on the level beach area. Ground water should be expected long term at or near lake elevation. Water levels within the hand borings is at different levels, most likely due to the slow transmission of water within the silt sediments.

Mappings and Other Nearby Studies

According to the Geology Map of Mercer Island, by Troost and Wisner, 2006, the site is mapped as Pre-Olympia fine grained non-glacial deposits (Qponf) overlying Pre-Olympia non-glacial deposits. The beach area where the planned DADU will be located is mapped as Holocene lake deposits (QI). It is our opinion that the mapped lake deposits are reworked old landslide deposits.

Many studies have been conducted by this firm and others along Forest Ave SE and the west side of Mercer Island. Multiple large and small landslides have occurred along this side of the island over the past eons. It is generally thought that most of the large rotational slides occurred when the Puget Sound area deglaciated about 10,000 years ago and the sudden lowering of the impounded water resulted in the destabilization of the slopes. Since then, many much smaller landslides have occurred within these disturbed areas, generally wherever ground water is a continuing issue, where cuts have been made into the disturbed soil and not properly supported, where fill soils have been pushed onto the slopes and where surface water is not properly controlled. We are unaware of any instability of the larger landslide block and the area is fully developed with homes and both surface and ground water have generally been controlled.

Nearby studies where exploration borings have been placed into the near shore environment (lake deposits) have indicated that the materials are generally disturbed silt sediments overlying glacially consolidated silt/clay sediments.

Geologic Hazards

Seismic Hazards

The parcel is located within the Seattle Fault Zone. Generally, there are four types of potential geologic hazards associated with large seismic events: 1) surficial ground rupture; 2) seismically induced landslides; 3) liquefaction; and 4) ground motion.

The risk of ground rupture is low as no fault splays have been recognized within the immediate area.

There is always a risk of seismically induced landslides when dealing with sloping ground. However, the slope above the site is fully developed with 2 homes, a long winding concrete driveway and multiple small landscape walls. Immediately to the east of the planned structure, is an approximately 5 to 6 feet tall rockery. All of these items would have to fail in order to have a potential impact on the planned DADU. The actual building site is nearly level with no potential for slope movement.

The risk of liquefaction is low given the observed soil conditions which are primarily silt sediments. The underlying glacially consolidated sediments are more granular in nature but dense to very dense and not subject to liquefaction.

Based on the encountered site conditions, and the planned construction, it is our opinion that the proposed construction will not be affected by any of these hazards other than ground motion. For this project the structural engineer should follow 2021 International Building Code recommendations for Site Class D soils.

Erosion Hazards

Due to the flat lying nature of the building site there is little potential for erosion from the site provided that best management practices are followed. Any significant erosion would need to come onto the site from the west facing slope area. However, this area is fully developed with little erosion hazard potential. Prior to our field investigation the site was flooded with many thousands of gallons of water from a water main break well up the slope along West Mercer Way. Even though the large volume of water flowed for several hours before it could be stopped, the amount of erosion on the slope area was much less than expected and far less than would ever be created by storm water runoff.

Landslide Hazards

There is no potential for a landslide to occur on the building site. The overall vicinity (extending north, south and east) of the project has had multiple small areas of earth movement in the past and will likely have more small landslides in the future. These slides generally occur where ground

water is an issue, where unregulated landfilling has occurred, where unregulated slope cuts have occurred and where storm water runoff is not well controlled. As such, there will always be some potential for a landslide to occur on the slope area above the site to the east and impact the planned new DADU. However, the slope area above the site has been fully developed for decades, storm water appears to be fully controlled and other than small surficial slides reported and mapped in various locations there has been no reported large scale movement in the area that could impact the new construction.

Conclusions and Recommendations

Based on the results of our site reconnaissance, subsurface investigation and literature review, it is our opinion that the subject building site is located in an area that is underlain ancient landslide debris which overlies glacially consolidated sediments. The bearing soils are fine grained and extremely moisture sensitive. As such they will be easily disturbed, especially during inclement weather conditions. If the bearing soil becomes disturbed during construction, it will be necessary to either remove the disturbed soil or recompact it back to a medium dense or better condition prior to footing concrete placement. If re-compaction is not possible it will be necessary to remove the disturbed soils, import a select granular material such as Type 17 backfill or clean crushed rock, and place it as structural fill up to desired subgrade elevation. Structural fill must be placed in maximum 8 inch thick lifts and each lift compacted to a medium dense or better condition prior to placement of the succeeding lift.

The most significant soil excavation required for this project is the foundation system. It is our understanding that all work will be conducted by hand due to the limited access to the site. Due to the proximity to the nearby lake care must be taken to avoid placing loose soil from the foundation and plumbing excavations into an area that could erode into the lake. Ideally the excavated soil would be removed from the site. However, due to the lack of equipment access that will likely be difficult. If excavated soils remain on the site we recommend they be placed no closer than 25 feet to the lake shore, no thicker than 24 inches, that some type of wall or rockery be constructed to mitigate any risk of the soils being washed into the lake and that they be immediately covered with an erosion control matt until such time as a substantial vegetation cover can be established.

Foundations

The new foundation system should be designed as a rigid box with all structural elements suitably reinforced to withstand potential small areas of weaker soil conditions. All new building foundations must extend down through any existing fill soils or loose native soils to bear on the underlying stiff or better silt sediments that were observed approximately 2 feet below existing grade or on imported Type 17 or crushed rock backfill, if necessary. An allowable soil bearing value of 1,500 psf, a passive earth pressure of 150 pcf and a soil friction factor of 0.35 may be used in the design of these new foundations. The backfill around foundation units must be placed and compacted in lifts to a medium dense or better condition in order for the passive earth pressure

value to apply. Anticipated settlement over a 20 foot span should be less than $\frac{3}{4}$ inch total and $\frac{1}{2}$ inch differential for equally loaded foundations.

Retaining Walls

Based on the existing plans there are no retaining walls required for the project. Should the plans change, we should be contacted to provide geotechnical parameters for the wall design.

Drainage

Storm water from impermeable surfaces, footing drains and wall drains should be collected and discharged into a city approved storm water drainage system. On-site infiltration of storm water is not applicable for this site due to the underlying silt soil.

Erosion

Suitable best management practice (BMP) erosion control measures should be implemented for the project. A silt fence should be installed as per Mercer Island requirements along the north, south and west sides of the site. Soil stockpiles should be covered with plastic sheeting to contain in-situ moisture and prevent storm water runoff. Areas of disturbance should be limited to necessary construction areas. Cleared areas that are not being worked should be covered with thick (minimum 2 inches) straw mulch. Due to the limited access for equipment a rocked construction entrance will not be required. Absolutely no sediment may be allowed to wash into the adjacent lake.

Summary

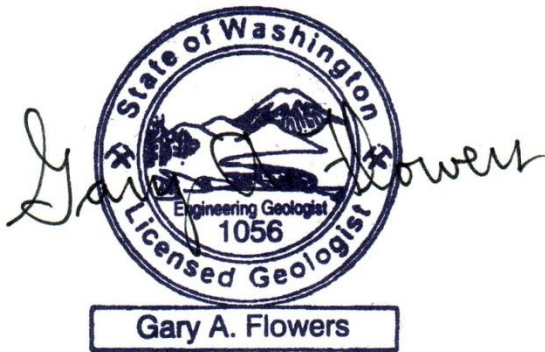
The planned new construction will have no adverse impact on the adjacent steep slope or any adjacent properties or critical areas. The site has been developed for decades with an old beach cottage currently used as a storage shed for beach and water sport necessities. This structure is currently within the buffer area for the shoreline, erosion hazard and landslide hazard areas. The demolition of this existing structure and construction of a somewhat larger, single story, 600 square feet, wood framed structure, will have no adverse impact on these buffer areas provided the recommendations herein are suitably followed.

City required statement of risk – “Construction practices are proposed for the alteration that would render the development as safe as it were not located in a geologically hazardous area and do not adversely impact adjacent properties”.

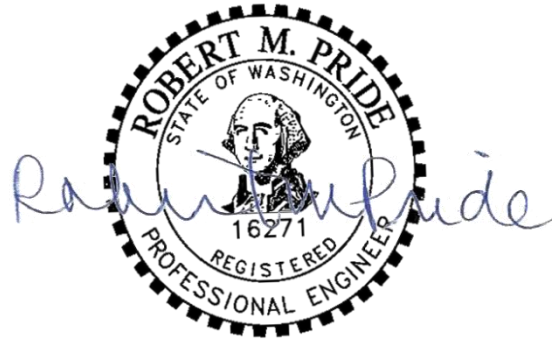
Construction monitoring and consultation services should be provided in order to verify that subsurface conditions are consistent throughout the property and will provide suitable bearing for the new footings. Other construction monitoring activities may be required by city officials.

Our findings and recommendations provided in this report were prepared in accordance with generally accepted principles of engineering geology and geotechnical engineering as practiced in the Puget Sound area at the time this report was submitted. We make no other warranty, either express or implied.

Respectfully submitted,



Gary A. Flowers, P.G., P.E.G.
Principal Engineering Geologist



Robert M. Pride, P.E.
Geotechnical Engineer

Attachments: Hand Auger Logs
Figure 1: Site & Exploration Plan

HAND AUGER LOGS
4649 FOREST AVENUE SE
MERCER ISLAND, WA

HA - 1 Near midpoint on south side of cottage/shed. Approximate elevation 25 feet.

0.0' – 1.3' Medium dense, very moist, brown, medium sand, trace silt
1.3' – 2.0' Medium dense, very moist, brown, gravelly, medium sand, trace silt

Bottom of hole at 2.0' on 10/22/23. Refusal on large gravel. Probing with T-handle soils probe indicates stiff silt/clay below the gravel layer. No groundwater.

HA - 2 Moved 2 feet west from HA-1. Approximate elevation 25 feet.

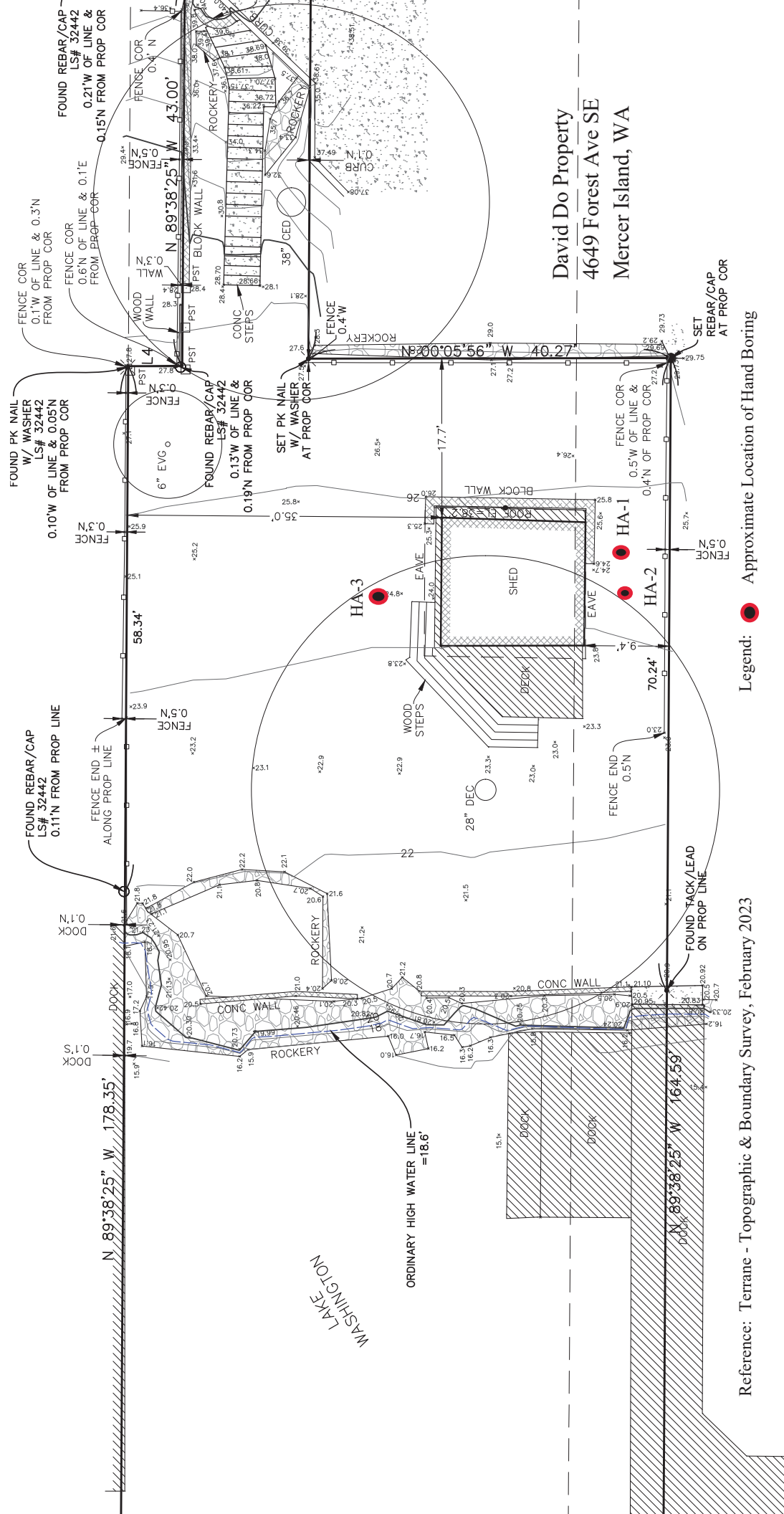
0.0' – 1.3' Medium dense, very moist, brown, medium sand, trace silt
1.3' – 2.1' Medium dense, very moist, brown, gravelly, medium sand, trace silt
2.1' – 4.0' Stiff, moist, gray silt
4.0' – 5.8' Medium dense, moist, medium sand
5.8' – 7.5' Stiff, moist, gray, silt to sandy silt

Bottom of hole at 7.5' on 10/22/23. Water at depth of 4.5'

HA - 3 Near midpoint on north side of cottage/shed. Approximate elevation 25 feet.

0.0' – 1.0' Loose to medium dense, very moist, brown, medium sand, trace silt
1.0' – 1.6' Medium dense, very moist, brown, gravelly, medium sand, trace silt
1.6' – 2.0' Stiff, moist, gray sandy silt
2.0' – 9.5' Stiff, moist, gray, silt to sandy silt

Bottom of hole at 9.5' on 10/22/23. Water at depth of 8.7'



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Legend: ● Approximate Location of Hand Boring

Reference: Terrane - Topographic & Boundary Survey, February 2023