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July 10, 2020

Mr. Ze Wen Hu
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jamesmark2001@gmail.com

Geotechnical Engineering Evaluation
Hu Residence Development
30XX – 69th Avenue SE
Mercer Island, Washington
NGA File No. 11448B20

Dear Mr. Hu:

We are pleased to submit the attached report titled "**Geotechnical Engineering Evaluation – Hu Residence Development – 30XX - 69th Avenue SE – Mercer Island, Washington.**" Our services were completed in general accordance with the proposal signed by you on March 10, 2020.

The property covers an area of approximately 0.19 acres and is currently vacant. The ground surface within the site slopes gently to steeply down from the upper eastern portion of the site to the western portion of the site. The site is bordered to the north, and east by existing residential development, and to the south by a vacant lot, and to the west by 69th Avenue SE. Vegetation within the site consists of grass yard areas and a few trees. A small concrete slab from an old basketball court occupies the south central portion of the site. We understand the entire site is mapped as erosion, landslide and seismic hazard areas by the City of Mercer Island. We understand you are interested in constructing a single family residence on the site, and that you have requested us to explore and evaluate the underlying soils on the site and steep slopes. We should be retained to review final residence plans, including plans for site grading, retaining walls, and drainage prior to construction.

We previously issued a Preliminary Geotechnical Evaluation for the site titled ***"Preliminary Geotechnical Engineering Evaluation – Hu Residence Development – 30XX – 69th Avenue SE – Mercer Island, Washington," dated December 12, 2019.*** Within the report, we explored the proposed residence areas and steeper slopes with five hand-augered explorations. Our previous explorations generally encountered significant surficial undocumented fill underlain by competent glacial soils throughout the property. We were provided preliminary plans for the residence footprint, and at that time we provided preliminary recommendations for deepened foundations, inclusive of drilled piers.

Recent plans indicate a multistory single family residence with an underground garage. We understand with this design, excavations below the existing grade may exceed 20 feet and engineered basement retaining/shoring walls will be required.

We recently performed additional drilling explorations with a portable drill rig on June 8, 2020. The explorations indicated stiff to hard glacial soils at depth, between 7 and 10 feet below the existing ground surface.

It is our opinion from a geotechnical standpoint that the site is compatible with the planned development provided that our recommendations are followed and incorporated into the design and construction of this project. Due to the significant planned excavations and retaining walls, the residence could be supported on traditional foundations. Shoring, temporary or permanent, will need to be incorporated into the design for at least the eastern side of the residence due to the depth of proposed cuts and proximity to neighboring properties. We should note that deeper areas of unstable soils and/or undocumented fill could be encountered in the unexplored areas of the site.

We recommend that NGA be retained to review the geotechnical aspects of the project plans prior to construction. We also recommend that NGA be retained to provide monitoring and consultation services during construction to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes should the conditions revealed during the work differ from those anticipated, and to evaluate whether or not earthwork and foundation installation activities comply with contract plans and specifications.

We appreciate the opportunity to provide service to you on this project. Please contact us if you have any questions regarding this report or require further information.

Sincerely,

NELSON GEOTECHNICAL ASSOCIATES, INC.

Khaled M. Shawish, PE
Principal

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INTRODUCTION

This report presents the results of our preliminary geotechnical engineering investigation and evaluation of the Hu Residence Development project located at 30XX – 69th Avenue SE on Mercer Island, Washington, as shown on the Vicinity Map in Figure 1. The purpose of this study is to explore and characterize the site's surface and subsurface conditions and to provide geotechnical recommendations for site development. For our use in preparing this report, you have provided us with a preliminary schematic site plan.

The property covers an area of approximately 0.19 acres and is currently vacant. The ground surface within the site slopes gently to steeply down from the upper eastern portion of the site to the western portion of the site. The site is bordered to the north, and east by existing residential development, and to the south by a vacant lot, and to the west by 69th Avenue SE. Vegetation within the site consists of grass yard areas and a few trees. A small concrete slab from an old basketball court occupies the south central portion of the site. We understand the entire site is mapped as erosion, landslide and seismic hazard areas by the City of Mercer Island. We understand you are interested in constructing a single family residence on the site, and that you have requested us to explore and evaluate the underlying soils on the site and steep slopes. Based on recent plans, we understand that the residence will likely be multi-level and utilize a daylight basement deep foundation design, with an underground level and garage. Retaining walls are proposed for the residence foundations and along the driveway for access to the underground garage. Based on current plans, we understand retaining walls could reach approximately 12 feet in height, with the tallest proposed for the east side of the residence. We should be retained to review final residence plans, including plans for site grading, retaining walls, and drainage prior to construction.

Final development and grading plans have not been developed; however, we anticipate that shoring will be needed for the construction of the residence and support of steep cuts, particularly along the eastern side of the proposed residence. Final stormwater plans have also not been developed, but it is required by the City of Mercer Island that all stormwater discharged from this lot will be routed to approved discharge systems. The existing site conditions and proposed development areas are shown on the Site Plan in Figure 2.

For our use in preparing this report, we were provided with a site plan titled, "Hu Residence," along with an associated cross section of the proposed residence.

SCOPE

The purpose of this study is to explore and characterize the site surface and subsurface conditions, and provide opinions and recommendations for the proposed site development. Specifically, our scope of services includes the following:

1. Review available soil and geologic maps of the area.
2. Explore the subsurface soil and groundwater conditions within the site and steep slope with two borings, up to 20 feet in depth, using a limited access, hand operated drill rig.
3. Qualitatively refine and additionally map the slope conditions by constructing geological cross sections, as necessary.
4. Perform laboratory analysis on selected soil samples, as needed.
5. Provide our opinions regarding the qualitative stability of the slope.
6. Refine recommendations for earthwork, foundation support, and slabs-on-grade, as needed.
7. Provide recommendations and construction detail for temporary shoring, as warranted.
8. Refine recommendations for retaining walls, as needed.
9. Refine recommendations for slope protection, site drainage, and erosion control.
10. Document the results of our findings, conclusions, and recommendations in a revised version of our previous geotechnical report.

SITE CONDITIONS

Surface Conditions

The property covers an area of approximately 0.19 acres and is currently vacant. The ground surface within the entire site slopes gently to steeply down from the upper eastern portion of the site to the western portion of the property at gradients in the range of approximately 18 to 45 degrees (32.4 to 100 percent). The property consists of a steep, terraced, west-facing slope that descends from the eastern property line to the west side of the property line along 69th Avenue SE, as shown on Cross-Section A-A' and B-B' in Figures 3 and 4. The overall relief of the property including the steep roadcut along 69th Avenue SE is approximately 30 feet. The site is bordered to the north, and east by existing residential development, and to the south by a vacant lot, and to the west by 69th Avenue SE. Vegetation within the site consists of grass yard areas and a few trees. A small concrete slab from an old basketball court occupies the south central portion of the site. No surface water was noted nor was visible seepage seen emitting from site slopes on our site visit on November 1, 2019 or in our additional explorations on June 8, 2020.

Subsurface Conditions

Geology: The Geologic Map of Mercer Island, Washington, by Kathy G. Troost & Aaron P. Wisher, et al. (USGS, October 2006) was reviewed for this site. The site is mapped as Vashon Advance Outwash (Qva) with Lawton Clay (Qvlc) mapped in the immediate vicinity downslope of the property. The Advance Outwash is described as well-sorted sand and gravel deposits with local silt lenses, and grades downward into the Lawton Clay with increasing silt content towards the contact.

The Lawton Clay is describes as a laminated to massive silt, clayey silt, and silty clay with scattered gravel dropstones. In general, we encountered a layer of surficial undocumented fill of varying depths in each of our explorations underlain by oxidized silty fine to medium sand and gravel which we interpreted as native glacial Advance Outwash deposits, slowly grading into a brownish gray to blue silt with fine sand and trace gravel at depth, which we interpreted as native Lawton Clay deposits.

Explorations: The subsurface conditions within the site were explored on June 8, 2020 by completing two geotechnical boreholes to depths of 24.0 and 14.0 feet below the existing surface in the footprint of the proposed residence area. The site was previously explored with on November 1, 2019 with five hand auger borings. The approximate locations of our explorations are shown on the Schematic Site Plan in Figure 2. A geologist from Nelson Geotechnical Associates, Inc. (NGA) was present during the explorations, collected samples of the soils encountered, and maintained a log of the explorations.

A Standard Penetration Test (SPT) was performed on each of the samples during drilling to document soil density at depth. The SPT consists of driving a 2-inch outer-diameter, split-spoon sampler 18 inches using a 140-pound hammer with a drop of 30 inches. The number of blows required to drive the sampler the final 12 inches is referred to as the "**N**" value and is presented on the boring logs. The **N** value is used to evaluate the strength and density of the deposit.

The soils were visually classified in general accordance with the Unified Soil Classification System, presented as Figure 3. The boring logs are presented as Figures 6 and 7. The previous hand auger logs are presented as Figures 8 and 9. We present a brief summary of the subsurface conditions in the following paragraph. For a detailed description of the subsurface conditions, the boring logs should be reviewed.

Boring One revealed a loose layer of surficial silty fine to medium sand with charcoal and silt lenses, which we interpreted as undocumented fill. Underlying the surficial fill, we encountered brown gray sandy silt until an approximate depth of 14.0 feet. We interpreted the brown gray silty sand and sandy silt as native advance outwash soils. Underlying the outwash at depth, we encountered blue gray silt and silty fine sand in a stiff to hard condition that we interpreted as native Lawton Clay deposits. Within Boring Two, we encountered a surficial layer of brown medium to coarse sand with silt, interbedded with a sandy gravel, in a loose condition that we interpreted as undocumented fill soils. Underlying the undocumented fill, we encountered laminated gray to blue gray silt with trace fine sand in a stiff to hard condition that we interpreted as native Lawton Clay deposits. Both explorations were terminated within the stiff to hard native silt at depths of 14.0 to 24.0 feet below the existing surface.

The logs of our hand augers are attached to this report and are presented as Figures 7 and 8, respectively. We present a brief summary of the subsurface conditions in the following paragraph. For a detailed description of the subsurface conditions, the logs of the hand augers should be reviewed.

In Hand Auger One, Two, Four, and Five, we encountered approximately 2.0 to 4.2 feet of surficial topsoil and grass which we interpreted as undocumented fill and/or slope colluvium. Underlying the surficial topsoil in Hand Augers One, Two, and Five, we encountered a layer of silty sand with varying amounts of gravel in s medium dense or better condition, which we interpreted as native outwash deposits. Underlying this in Hand Augers One, Two and Five, we encountered silt with fine to medium sand and trace gravel in a dense condition, which we interpreted as Lawton Clay deposits. In Hand Auger Four, a brown-gray layer of silty fine to medium sand was encountered underlying the surficial fill, with oxide staining and in a loose, wet condition. At depth within Hand Auger Four, we encountered a stiff moist layer of brown gray silt with fine to medium sand, which we interpreted as Lawton Clay deposits. Within Hand Auger Three, we encountered 6.0 feet of a loose mixture of dark brown to brown silty fine to medium sand with blue and gray silt lenses, wood debris, and trace gravel. Hand Auger Three terminated within undocumented fill and/or slope colluvium at a depth of 6.0 feet below the existing ground surface. The remainder of the Hand Augers terminated within native glacial deposits at depths between 3.0 and 6.5 feet below the ground surface.

Hydrogeologic Conditions

Groundwater seepage was not encountered in our explorations on June 8, 2020 or November 1, 2019, however, during our explorations on June 8, 2020 and November 1, 2019, we did note some wet soils between approximately 4.2 and 5.8 feet within Hand Auger Four. If groundwater were to be encountered during construction, we would interpret this water to be perched water. Perched water occurs when surface water infiltrates through less dense, more permeable soils such as the silty sand, and accumulates on top of a relatively low permeability material such as the silt. Perched water does not represent a regional groundwater "table" within the upper soil horizons. Perched water tends to vary spatially and is dependent upon the amount of rainfall. We would expect the amount of perched groundwater to decrease during drier times of the year and increase during wetter periods.

SENSITIVE AREA EVALUATION

Seismic Hazard

We reviewed the 2012 International Building Code (IBC) for seismic site classification for this project. Since competent glacial soils were encountered and interpreted to be underlying the site at depth, the site conditions best fit the IBC description for Site Class D.

Table 1 – 2018 IBC Seismic Design Parameters

Site Class	Spectral Acceleration at 0.2 sec. (g) S_s	Spectral Acceleration at 1.0 sec. (g) S_1	Site Coefficients		Design Spectral Response Parameters	
			F_a	F_v	S_{DS}	S_{D1}
D	1.387	0.534	1.000	1.500	0.925	0.534

The spectral response accelerations were obtained from the USGS Earthquake Hazards Program Interpolated Probabilistic Ground Motion website (2008 data) for the project latitude and longitude.

Hazards associated with seismic activity include liquefaction potential and amplification of ground motion by soft deposits. Liquefaction is caused by a rise in pore pressures in a loose, fine sand deposit beneath the groundwater table. The competent glacial soils interpreted to underlie the site have a low potential for liquefaction or amplification of ground motion.

The medium dense or better native glacial soils interpreted to form the core of the site slopes are considered stable with respect to deep-seated slope failures. However, the overlying loose surficial materials and undocumented fill located on the steeper site slopes are considered unstable and have the potential for shallow sloughing failures during seismic events. Such events should not affect the planned residence provided the foundations are located and constructed in accordance with the recommendations described in this report.

Erosion Hazard

The criteria used for determining the erosion hazard for the site soils includes soil type, slope gradient, vegetation cover, and groundwater conditions. The erosion sensitivity is related to vegetative cover and the specific surface soil types, which are related to the underlying geologic soil units. The Soil Survey of King County Area, Washington, by the Soil Conservation Service (SCS), was reviewed to determine the erosion hazard of the on-site soils. The site surface soils were classified using the SCS classification system as Arents Alderwood material 6 to 15 percent slopes. This soil is listed as having a moderate erosion hazard. It is our opinion that due to the overall steepness of the site slopes, these soils should have a low to moderate hazard for erosion in areas that are not disturbed and where the vegetation cover is not removed.

Landslide Hazard/Slope Stability

The criteria used for evaluation of landslide hazards include soil type, slope gradient, and groundwater conditions. The site composed of a moderately to steeply sloping terraced slope with approximate maximum gradient of 45 degrees (100 percent). We observed evidence of instability within the deep undocumented fill during our investigation. This is shown in Cross-Sections A-A’ and B-B’ in Figures 3 and 4, respectively.

The core of the site slopes below the unstable fill is inferred to consist primarily of medium dense or better native glacial deposits. It is our opinion that advancing the residence foundation elements through the unstable fill and down into the stable material is key to a successful outcome. Proper site grading, drainage, and foundation support, as recommended in this report, should also help reduce the impact of fill instability on the planned improvements.

CONCLUSIONS AND RECOMMENDATIONS

General

It is our opinion, from a geotechnical standpoint, that the site planned development is feasible, provided the recommendations within this report are followed. Our explorations indicated that the site was underlain by a surficial layer of topsoil and undocumented fill, and competent glacial soils at depth within the site. The native glacial soils should provide adequate support for foundation, slab, and pavement loads. The competent bearing soil should typically be encountered approximately seven to ten feet below the existing surface throughout the site, based on our explorations. However, localized areas of undocumented fill may exist in unexplored areas of the site. This condition, if encountered, would require deeper excavations in foundation, slab, and pavement areas to remove the unsuitable soils.

We recommend all foundations and any slab-on-grade planned for the new structures be supported directly on competent native soils slabs. Depending on the overall site grading, tall cuts may be needed to facilitate the construction of the proposed residence. These cuts may not be able to be safely sloped back due to site constraints such as neighboring property lines and utilities. If temporary cuts are not able to be safely sloped as recommended in this report, such as along the eastern side, we recommend that the cuts be shored with a soldier pile shoring retaining wall. If a soldier pile retaining wall is utilized, this wall could be designed as a permanent wall and incorporated into the building structural design. We provided recommendations for temporary and permanent cut slopes in the **Temporary and Permanent Slopes** section of this report. We also provide recommendations for soldier pile shoring walls in the **Soldier Pile Shoring Wall** subsections of this report. We should be retained to work with the structural engineer to complete the design for all shoring systems.

Infiltration within the site is not feasible as determined by the City of Mercer Island. We observed wet soils within one of our explorations one November 1, 2019. Under no circumstances should water be allowed to flow over or concentrate on the site slopes, both during construction, and after construction has been completed. We recommend that stormwater runoff from roof and yard drains be collected and tightlined to an approved discharge point and away from the slope. The slopes should be protected from erosion. We recommend that all disturbed areas be replanted with vegetation to re-establish vegetation cover as soon as possible. Specific recommendations for erosion control are presented in the **Erosion Control and Slope Protection Measures** subsection of this report.

All grading operations and drainage improvements planned as part of this development should be planned and completed in a matter that enhances the stability of the site slopes, not reduces it. Excavation spoils associated with the residence excavations should not be stockpiled near the site slopes or be allowed to encroach on the slopes. Also, all runoff generated within the site should be collected and routed into a permanent discharge system and not be allowed to flow over the slopes. Future vegetation management on the slopes should be the subject of a specific evaluation and a plan approved by the City of Mercer Island. The site slopes should be monitored on an ongoing basis, especially during the wet season, for any signs of instability, and corrective actions promptly taken should any signs of instability be observed. Lawn clipping and any other household trash or debris should never be allowed to reach the slopes.

The soils encountered on this site are considered moisture-sensitive and may disturb easily when wet. We recommend that construction take place during the drier summer months, if possible. If construction is to take place during wet weather, the soils may disturb and additional expenses and delays may be expected due to the wet conditions. Additional expenses could include the need for placing erosion control and temporary drainage measures to protect the slopes, the need for placing a blanket of rock spalls on exposed subgrades and construction traffic areas prior to placing structural fill, and the need for importing all-weather material for structural fill. If construction is performed during the wet weather months, NGA should be retained to provide additional wet weather construction recommendations to limit potential impacts to the site in accordance with the City of Mercer Island requirements.

Erosion Control and Slope Protection Measures

The erosion hazard for the on-site soils is listed as moderate to severe, due to the steepness of the site slopes, but the actual hazard will be dependent on how the site is graded and how water is allowed to concentrate. Best Management Practices (BMPs) should be used to control erosion. Areas disturbed during construction should be protected from erosion. Erosion control measures may include diverting surface water away from the stripped or disturbed areas. Silt fences and/or straw bales should be erected to prevent muddy water from leaving the site or flowing over the slopes. Stockpiles should be covered with plastic sheeting during wet weather. Disturbed areas should be planted as soon as practical and the vegetation should be maintained until it is established. The erosion potential for areas not stripped of vegetation should be low.

Protection of the slope areas should be performed as required by the City of Mercer Island. Specifically, we recommend that the slopes not be disturbed or modified through placement of any fill or removal of the existing vegetation. Trees should not be cut down or removed from the slopes unless a mitigation plan is developed, such as the replacement of vegetation for erosion protection. Vegetation should not be removed from the slopes. Replacement of vegetation should be performed in accordance with City of Mercer Island code. Any proposed development within the steep slope areas should be the subject of a specific geotechnical evaluation.

Site Preparation and Grading

After erosion control measures are implemented, site preparation should consist of stripping any loose soils to expose medium dense or better native soil in foundation, slab-on-grade, and pavement areas. The stripped materials should be removed from the site or stockpiled for later use as landscaping fill. Stockpiles should be kept away from steep slopes and should be covered with plastic during wet weather. Due to the significant cuts planned within this site, temporary/permanent shoring should be implemented as the cuts are being made.

If the exposed subgrade, after site stripping, should appear to be loose, it should be compacted to a non-yielding condition. Areas observed to pump or weave during compaction should be over-excavated and replaced with properly compacted structural fill or rock spalls. If loose soils are encountered in the subgrade, the loose soils should be removed and replaced with rock spalls or granular structural fill. If significant surface water flow is encountered during construction, this flow should be diverted around areas to be developed, and the exposed subgrades should be maintained in a semi-dry condition.

Construction should take place during the drier summer months, if possible. If construction takes place during the rainy months, additional expenses and delays should be expected. If construction is performed during the wet weather months, NGA should be retained to provide additional wet weather construction recommendations to limit potential impacts to the site in accordance with the City of Mercer Island requirements. If wet conditions are encountered or construction is performed during the wet weather months, alternative site stripping and grading techniques might be necessary.

These methods could include using large excavators equipped with wide tracks and a smooth bucket to complete site grading and covering exposed subgrade with a layer of crushed rock for protection. If wet conditions are encountered or construction is attempted in wet weather, the subgrade should not be compacted as this could cause further subgrade disturbance. In wet conditions it may be necessary to cover the exposed subgrade with a layer of crushed rock as soon as it is exposed to protect the moisture sensitive soils from disturbance by machine or foot traffic during construction. The prepared subgrade should be protected from construction traffic and surface water should be diverted around prepared subgrade. Shallow groundwater, if encountered, should be intercepted with cut off drains and routed around the planned grading area, or the groundwater should be controlled with sump-pumps or dewatering systems.

Temporary and Permanent Slopes

Temporary cut slope stability is a function of many factors, including the type and consistency of soils, depth of the cut, surcharge loads adjacent to the excavation, length of time a cut remains open, and the presence of surface or groundwater. It is exceedingly difficult under these variable conditions to estimate a stable, temporary, cut slope angle. Therefore, it should be the responsibility of the contractor to maintain safe slope configurations at all times as indicated in OSHA guidelines for cut slopes.

The following information is provided solely for the benefit of the owner and other design consultants and should not be construed to imply that Nelson Geotechnical Associates, Inc. assumes responsibility for job site safety. Job site safety is the sole responsibility of the project contractor.

For planning purposes, we recommend that temporary cuts be no steeper than 2 Horizontal to 1 Vertical (2H:1V). If temporary cut excavations are not able to achieve the recommended inclinations, particularly along the east side of the residence, we recommend that the cuts be temporarily or permanently shored with a soldier pile shoring wall as discussed in the **Soldier Pile Shoring Wall** subsections of this report, respectively. If significant groundwater seepage or surface water flow were encountered, we would expect that flatter inclinations would be necessary. We recommend that cut slopes be protected from erosion. The slope protection measures may include covering cut slopes with plastic sheeting and diverting surface runoff away from the top of cut slopes. We do not recommend vertical slopes for cuts deeper than four feet, if worker access is necessary. We recommend that cut slope heights and inclinations conform to appropriate OSHA/WISHA regulations.

Permanent cut and fill slopes should be no steeper than 2H:1V. However, flatter inclinations may be required in areas where loose soils are encountered. Permanent slopes should be vegetated and the vegetative cover maintained until established.

Due to the close proximity of the potential temporary excavations and shoring systems to the neighboring properties and structures, we recommend that settlement monitoring survey points be installed on the surrounding structures during construction and monitored at least once a week until it is confirmed that no movement is occurring. We should be retained to discuss wall and surrounding structure monitoring plans as project plans are finalized. Additional photographic and visual pre-existing surveys of the project vicinity and neighboring structures prior to construction activities should also be performed to document existing conditions within the vicinity of the property.

Soldier Pile Shoring Wall

General: A solider pile shoring wall could be utilized to support cut excavations around the proposed structures. A soldier pile wall typically consists of a series of steel H-beams placed vertically at a certain spacing from one another (typically six to ten feet). The beams are usually placed in drilled shafts that are filled with a structural concrete or a lean mix. The concrete shafts are typically embedded below the bottom of the planned excavation a distance equal to one to two times the exposed height of the wall. The steel beams are extended above finished ground surface to provide shoring capabilities for the area to be retained. The beams are typically spanned by pressure treated timber lagging or concrete panels. The H-beam size, shaft diameter, shaft embedment, and pile spacing are dependent on the nature of the soils anticipated to be retained by the wall and the soils at depth, wall height, drainage conditions, and the final geometry.

Wall Design: The shoring wall should be designed by an experienced structural engineer licensed in the State of Washington. The lateral earth pressure acting on the shoring wall will be dependent on the nature and density of the soil behind the wall, structure and traffic loads on the wall, and the amount of lateral wall movement that may occur as material is excavated from the front of the wall. If the shoring wall is free to yield at least one-thousandth of the retained height, an “active” loading condition develops. If the wall is restrained from movement by stiffness or bracing, the wall is considered in an “at-rest” loading condition. Active and at-rest earth pressure can be calculated based on equivalent fluid densities.

The shoring wall should be designed to resist a lateral load resulting from a fluid with a unit weight of 40 and 60 pounds per cubic foot (pcf) for the active and at-rest loading conditions, respectively. An additional uniform surcharge of 8H should be applied to the wall design to account for seismic loading, if the shoring walls are intended to provide permanent support; H in this case is the exposed height of the wall. These loads should be applied across the pile spacing above the excavation line. These loads can be resisted by a passive pressure of 200 pcf on the below grade medium dense or better native glacial soils encountered at depth. The passive pressure should be applied on two-pile diameters under the excavation line. These values of the passive pressure incorporate a factor of safety of 2.0. The upper two feet of pile embedment should be neglected when calculating the passive resistance for the permanent condition. Also, for the permanent condition, the below-grade portion of the wall should be no less than 1.5 times the wall stick-up height (exposed height).

The above loads should be applied on the full center-to-center pile spacing above the base of the exposed portion of the wall. A 50 percent reduction of the active pressure could be applied for the purpose of designing the wall lagging.

The above pressures assume that the on-site soils retained by the shoring wall are not significantly disturbed and that hydrostatic forces are not allowed to build up behind the wall. These values do not include the effects of surcharges other than what is described above. The retained soils should be readily drained and collected water should be routed into a permanent storm system. Adequate gaps should be maintained between the lagging elements to allow for any potential water seepage buildup to flow through the wall.

The wall designer should calculate the predicted wall deflection, including deflection resulting from the below-grade movement of the piles. The predicted deflection values should be confirmed in the field through a survey monitoring program. Also, surrounding structures should be monitored for any adverse effects resulting from shoring wall installation.

We are available to provide shoring details upon request.

Shoring Wall Installation: The shoring wall should be installed by a shoring contractor experienced with this type of system. We anticipate that an open-hole drilling method may prove difficult to achieve for installing the soldier piles in the on-site soils, and therefore we recommend that the shoring contractor have the capability of casing the holes as sloughing and/or water seepage may be encountered. It might be prudent to perform one or more “test” holes to confirm installation conditions prior to finalizing budget and work plans. Any sloughing or water that may collect in the drilled holes should be removed prior to pumping grout. Grout should be readily available on site at the time the holes are drilled and cased.

If groundwater seepage is encountered, we recommend that water be pumped out of the holes and the concrete be tremied from the bottom of the excavations to displace the groundwater to the surface. Extra Portland Cement, or other additives, may also be placed in the excavations to reduce the effects of seepage. The spoils from the soldier pile excavations are expected to be moisture-sensitive materials and should be removed from the site. We should be retained to monitor on site activities during the shoring wall installation on a full-time basis.

Foundations

Conventional shallow spread foundations should be placed on undisturbed medium dense or better native bearing soils. We estimate that medium dense better soils should be encountered between 7.0 and 10.0 feet below the existing ground surface. Where undocumented fill or less dense soils are encountered at footing bearing elevation, the subgrade should be over-excavated to expose suitable bearing soil. In addition, to minimize potential loading from the structure foundations on any neighboring structures, we recommend that structure foundations be setback and deepened to maintain a minimum 1H:1V gradient between the bottom of the structure foundations and the base of any neighboring structures, such as the neighboring retaining walls along the eastern and southern sides of the property.

Footings should extend at least 18 inches below the lowest adjacent finished ground surface for frost protection and bearing capacity considerations. Foundations should be designed in accordance with the 2018 IBC. Footing widths should be based on the anticipated loads and allowable soil bearing pressure. Water should not be allowed to accumulate in footing trenches. All loose or disturbed soil should be removed from the foundation excavation prior to placing concrete. We should be retained to evaluate the foundation subgrade soils and embedment depths prior to placing foundation forms.

For foundations constructed as outlined above, we recommend an allowable bearing pressure of not more than 2,000 pounds per square foot (psf) be used for the footing design for footings founded on the medium dense or better native bearing glacial till soils or structural fill extending to the native competent bearing material. The foundation bearing soil should be evaluated by a representative of NGA. We should be consulted if higher bearing pressures are needed. Current IBC guidelines should be used when considering increased allowable bearing pressure for short-term transitory wind or seismic loads. Potential foundation settlement using the recommended allowable bearing pressure is estimated to be less than one inch total and 1/2-inch differential between adjacent footings or across a distance of about 20 feet, based on our experience with similar projects.

Lateral loads may be resisted by friction on the base of the footing and passive resistance against the subsurface portions of the foundation. A coefficient of friction of 0.35 may be used to calculate the base friction and should be applied to the vertical dead load only. Passive resistance may be calculated as a triangular equivalent fluid pressure distribution. An equivalent fluid density of 200 pounds per cubic foot (pcf) should be used for passive resistance design for a level ground surface adjacent to the footing. This level surface should extend a distance equal to at least three times the footing depth. These recommended values incorporate safety factors of 1.5 and 2.0 applied to the estimated ultimate values for frictional and passive resistance, respectively. To achieve this value of passive resistance, the foundations should be poured "neat" against the native medium dense soils or compacted fill should be used as backfill against the front of the footing. We recommend that the upper one-foot of soil be neglected when calculating the passive resistance.

Retaining Walls

Should basement walls, abutments, bulkheads, wing walls, or any other retaining walls be utilized in development on this site, they should be designed and constructed as outlined hereon. The lateral pressure acting on subsurface retaining walls is dependent on the nature and density of the soil behind the wall, the amount of lateral wall movement which can occur as backfill is placed, wall drainage conditions, and the inclination of the backfill. For walls that are free to yield at the top at least one thousandth of the height of the wall (active condition), soil pressures will be less than if movement is limited by such factors as wall stiffness or bracing (at-rest condition). We recommend that walls supporting horizontal backfill and not subjected to hydrostatic forces, be designed using a triangular earth pressure distribution equivalent to that exerted by a fluid with a density of 40 pcf for yielding (active condition) walls, and 60 pcf for non-yielding (at-rest condition) walls.

These recommended lateral earth pressures are for a drained granular backfill and are based on the assumption of a horizontal ground surface behind the wall for a distance of at least the height of the wall, and do not account for surcharge loads. Additional lateral earth pressures should be considered for surcharge loads acting adjacent to walls and within a distance equal to the height of the wall. This would include the effects of surcharges such as traffic loads, floor slab loads, slopes, or other surface loads. We could consult with the structural engineer regarding additional loads on retaining walls during final design, if needed.

The lateral pressures on walls may be resisted by friction between the foundation and subgrade soil, and by passive resistance acting on the below-grade portion of the foundation. Recommendations for frictional and passive resistance to lateral loads are presented in the **Foundations** subsection of this report.

All wall backfill should be well compacted as outlined in the **Structural Fill** subsection of this report. Care should be taken to prevent the buildup of excess lateral soil pressures due to over-compaction of the wall backfill. This can be accomplished by placing wall backfill in 8-inch loose lifts and compacting the backfill with small, hand-operated compactors within a distance behind the wall equal to at least half the height of the wall. The thickness of the loose lifts should be reduced to accommodate the lower compactive energy of the hand-operated equipment. The recommended level of compaction should still be maintained.

Permanent drainage systems should be installed for retaining walls. Backfill for drainage should consist of free-draining, granular material extending to the surface. Washed rock and pea gravel are acceptable drain materials. Recommendations for these systems are found in the **Subsurface Drainage** subsection of this report. We recommend that we be retained to evaluate the proposed wall drain backfill material and observe installation of the drainage systems.

Pavement

Pavement subgrade preparation and structural fill placement where required, should be completed as recommended in the **Site Preparation and Grading** and **Structural Fill** subsections of this report. The pavement subgrade should be proof-rolled with a heavy, rubber-tired piece of equipment, to identify soft or yielding areas that require repair. We should be retained to observe the proof-rolling and recommend subgrade repairs prior to placement of the asphalt or hard surfaces.

Structural Fill

General: Fill placed beneath foundations, slabs, pavements, or other settlement-sensitive structures should be placed as structural fill. Structural fill, by definition, is placed in accordance with prescribed methods and standards, and is monitored by an experienced geotechnical professional or soils technician. Field monitoring procedures would include the performance of a representative number of in-place density tests to document the attainment of the desired degree of relative compaction. The area to receive the fill should be suitably prepared as described in the **Site Preparation and Grading** subsection prior to beginning fill placement. Sloping ground to receive fill should be benched to maintain fill stability. The benches should be level and have a minimum width of six feet.

Materials: Structural fill should consist of a good quality, granular soil, free of organics and other deleterious material, and be well graded to a maximum size of about three inches. All-weather structural fill should contain no more than five-percent fines (soil finer than U.S. No. 200 sieve, based on that fraction passing the U.S. 3/4-inch sieve). The use of some of the on-site soils as structural fill may be feasible but will be highly dependent on moisture content of the material at the time construction takes place. We should be retained to evaluate proposed structural fill material prior to placement.

Fill Placement: Following subgrade preparation, placement of structural fill may proceed. All filling should be accomplished in uniform lifts up to eight inches thick. Each lift should be spread evenly and be thoroughly compacted prior to placement of subsequent lifts. All structural fill should be compacted to a minimum of 95 percent of its maximum dry density. Maximum dry density, in this report, refers to that density as determined by the ASTM D-1557 Compaction Test procedure. The moisture content of the soils to be compacted should be within about two percent of optimum so that a readily compactable condition exists. It may be necessary to over-excavate and remove wet soils in cases where drying to a compactable condition is not feasible. All compaction should be accomplished by equipment of a type and size sufficient to attain the desired degree of compaction.

Site Drainage

Surface Drainage: Final site grades should allow for drainage away from steep slopes and away from the planned residences. We suggest that the finished ground be sloped at a minimum gradient of three percent for a distance of at least 10 feet away from the building. Runoff generated on this site should be collected and routed into a permanent discharge system such as the existing system within the driveway. This should include all downspouts and runoff generated on all hard surfaces and yards areas. Under no circumstances should water be allowed to flow uncontrolled over the slopes. Water should not be allowed to collect in any area where footings or slabs are to be constructed.

Subsurface Drainage: If groundwater is encountered during construction, we recommend that the contractor slope the bottom of the excavation and collect the water into ditches and small sump pits where the water can be pumped out of the excavation and routed into a suitable outlet. We recommend that the residence down spouts and footing drains be tightlined to an appropriate discharge location.

We recommend the use of footing drains around structures. Footing drains should be installed at least one foot below planned finished floor elevation. The drains should consist of a minimum 4-inch-diameter, rigid, slotted or perforated, PVC pipe surrounded by free-draining material wrapped in a filter fabric. We recommend that the free-draining material consist of an 18-inch-wide zone of clean (less than three-percent fines), granular material placed along the back of walls. Washed rock is an acceptable drain material, or drainage composite may be used instead. The free-draining material should extend up the wall to one foot below the finished surface. The top foot of soil should consist of low permeability soil placed over plastic sheeting or building paper to minimize the migration of surface water or silt into the footing drain. Footing drains should discharge into tightlines leading to an appropriate collection and discharge point with convenient cleanouts to prolong the useful life of the drains. Roof drains should not be connected to wall or footing drains.

CONSTRUCTION MONITORING

We recommend that we be retained to provide construction monitoring services to evaluate conditions encountered in the field with respect to anticipated conditions, to provide recommendations for design changes should the conditions differ from anticipated, and to evaluate whether construction activities comply with contract plans and specifications.

CLOSURE

Based on our understanding of the proposed plans, and provided that the recommendations in this report are strictly followed during construction, the areas disturbed by construction should remain stable. The geologic hazard area will be modified, or the development has been designed so that the risk to the lot and adjacent property is eliminated or mitigated such that the site is determined to be safe meeting the requirements stated in Mercer Island City Code 19.07.060.D.2.a. Therefore, the risk of damage to the proposed development or to adjacent properties from soil instability should be minimal, and the proposed grading and development should not increase the potential for soil movement.

USE OF THIS REPORT

NGA has prepared this preliminary report for Mr. Ze Wen Hu and his agents, for use in the planning and design of the development planned on this site only. The scope of our work does not include services related to construction safety precautions and our recommendations are not intended to direct the contractors' methods, techniques, sequences, or procedures, except as specifically described in our report for consideration in design. There are possible variations in subsurface conditions between the explorations and also with time. Our report, conclusions, and interpretations should not be construed as a warranty of subsurface conditions. A contingency for unanticipated conditions should be included in the budget and schedule. We recommend that we be retained to review the project plans after they have been developed to determine that recommendations in the report were incorporated into project plans.

All people who own or occupy homes on hillsides should realize that landslide movements are always a possibility. The landowner should periodically inspect the slope, especially after a winter storm. If distress is evident, a geotechnical engineer should be contacted for advice on remedial/preventative measures. The probability that landsliding will occur is substantially reduced by the proper maintenance of drainage control measures at the site (the runoff from the roofs should be led to an approved discharge point). Therefore, the homeowner should take responsibility for performing such maintenance. Consequently, we recommend that a copy of our report be provided to any future homeowners of the property if the home is sold.

We recommend that NGA be retained to review final plans prior to construction. We also recommend that NGA be retained to provide monitoring and consultation services during construction to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes should the conditions revealed during the work differ from those anticipated, and to evaluate whether or not earthwork and foundation installation activities comply with contract plans and specifications. We should be contacted a minimum of one week prior to construction activities and could attend pre-construction meetings if requested.

Within the limitations of scope, schedule, and budget, our services have been performed in accordance with generally accepted geotechnical engineering practices in effect in this area at the time this report was prepared. No other warranty, expressed or implied, is made. Our observations, findings, and opinions are a means to identify and reduce the inherent risks to the owner.

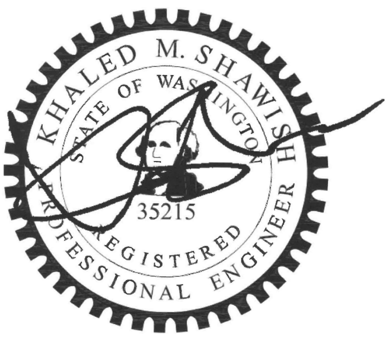
o-o-o

It has been a pleasure to provide service to you on this project. If you have any questions or require further information, please call.

Sincerely,

NELSON GEOTECHNICAL ASSOCIATES, INC.

Katelyn S. Brower, GIT
Staff Geologist



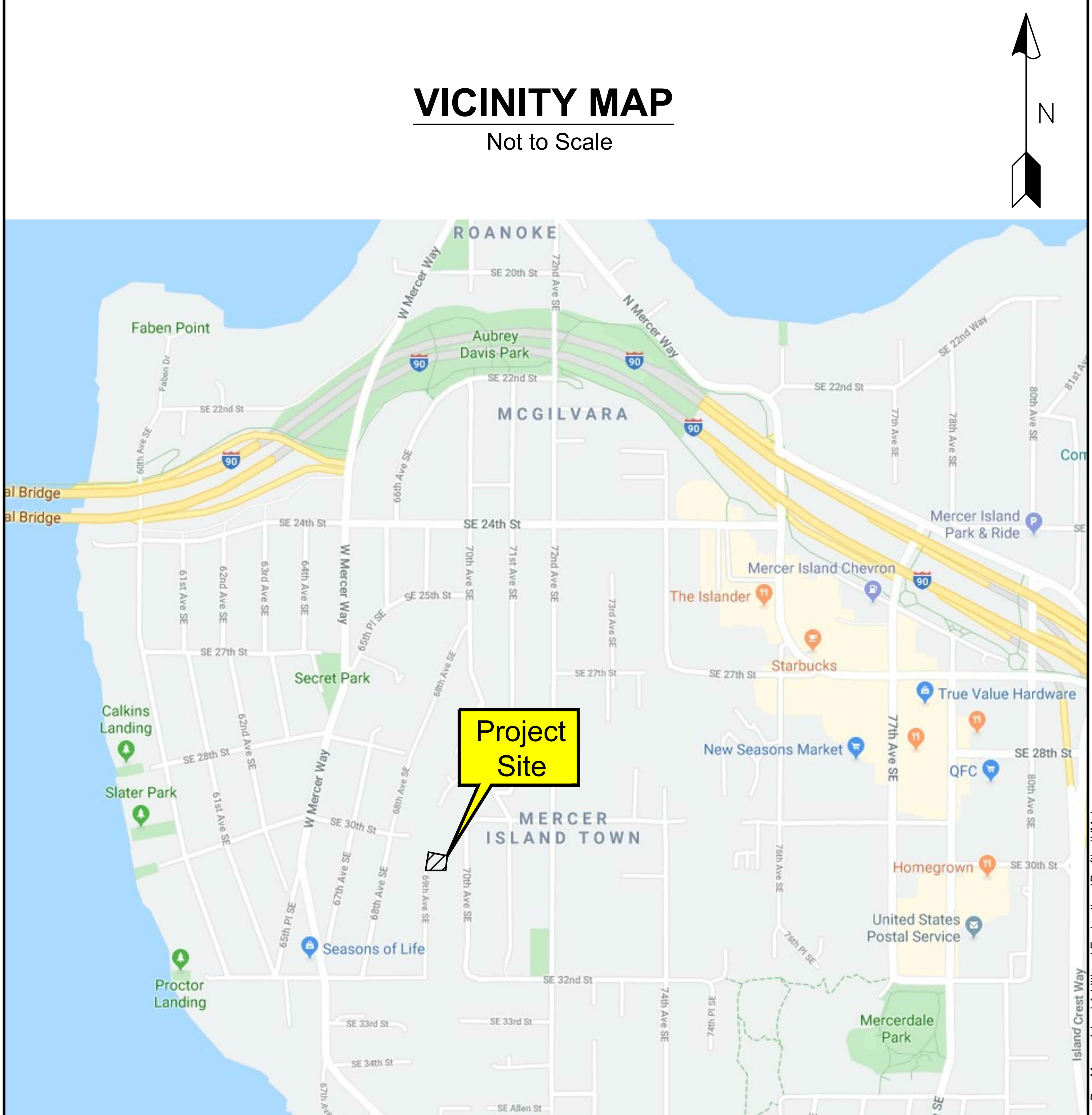
Khaled M. Shawish, PE
Principal

KSB:KMS:dy

Nine Figures Attached

VICINITY MAP

Not to Scale



Mercer Island, WA

Project Number	Hu Residence Development Additional Explorations Vicinity Map	Nelson Geotechnical Associates, Inc.	No.	Date	Revision	By	CK
11448B20		Geotechnical Engineers & Geologists	1	11/20/19	Original	DPN	KSB
Figure 1			2	6/19/20	Revision	DPN	KSB

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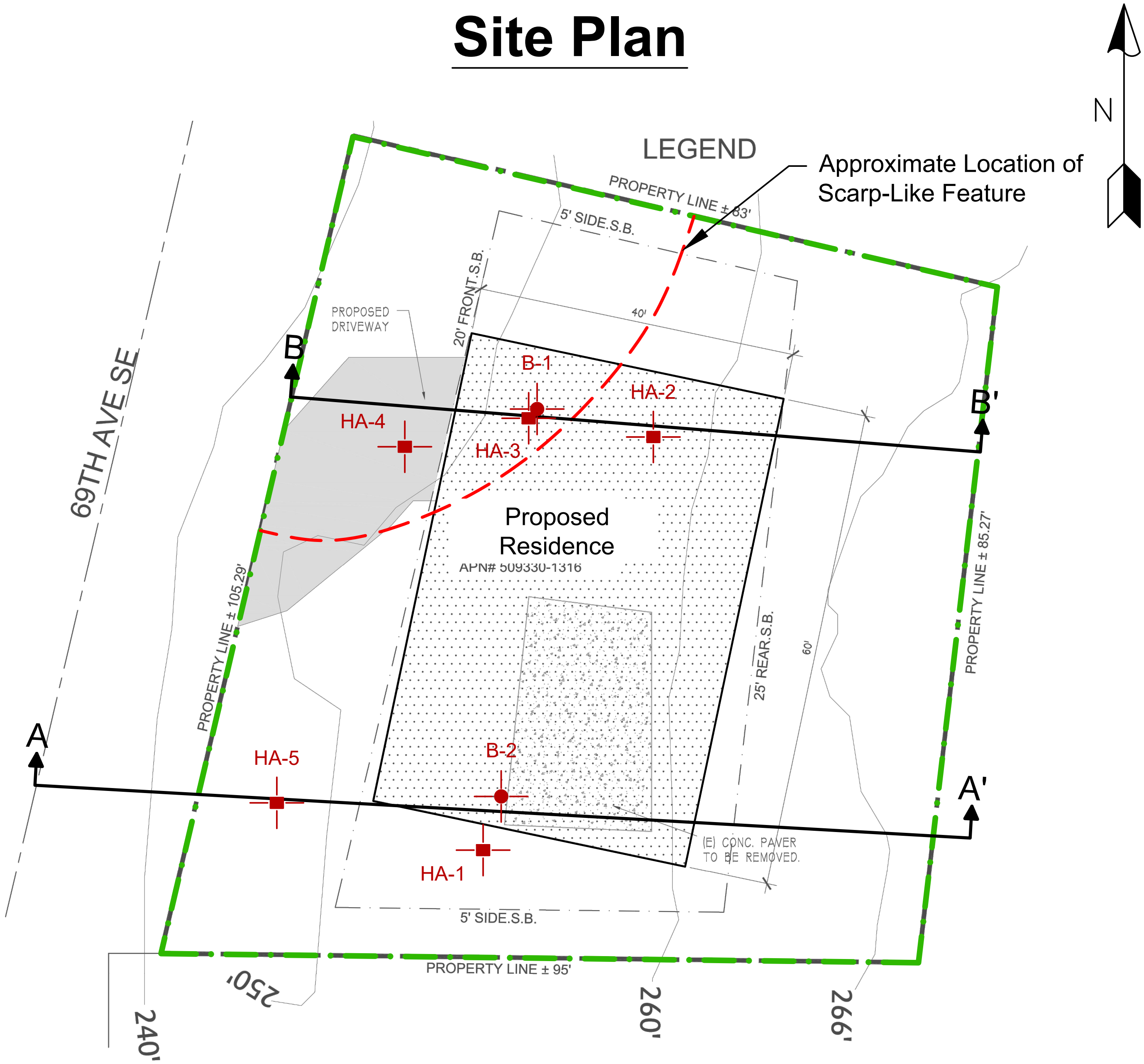
Site Plan



LEGEND

Property line

B-1 — Number and approximate location of boring

HA-1 — Number and approximate location of hand auger

A — A' Approximate location of cross-section

0 20 40

Scale: 1 inch = 20 feet

Reference: Site Plan based on a plan dated June 24, 2018 titled " Site Plan."

Project Number	Hu Residence Development Additional Explorations Site Plan	Nelson Geotechnical Associates, Inc.
11448B20		Geotechnical Engineers & Geologists
Figure 2		

NGA
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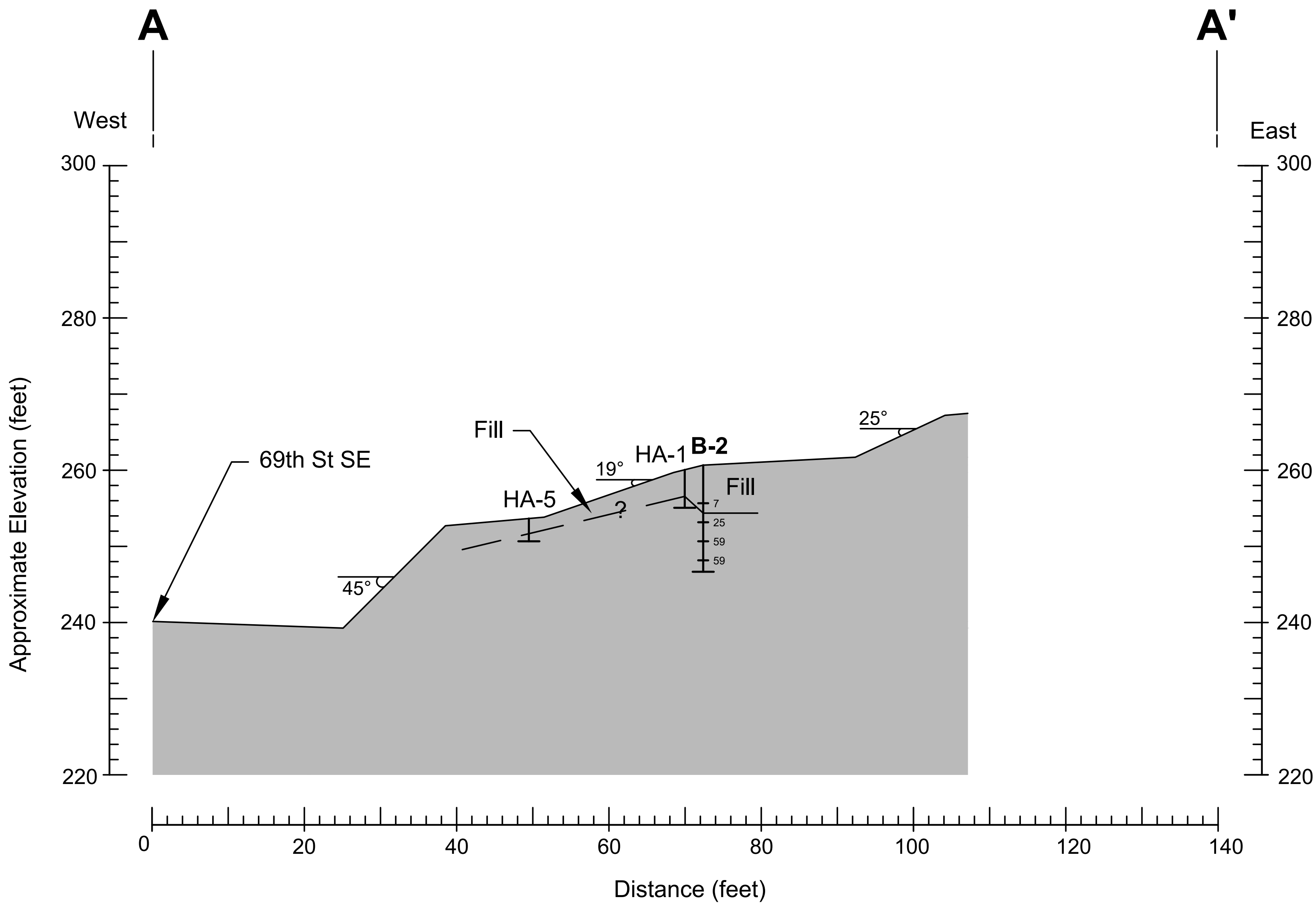
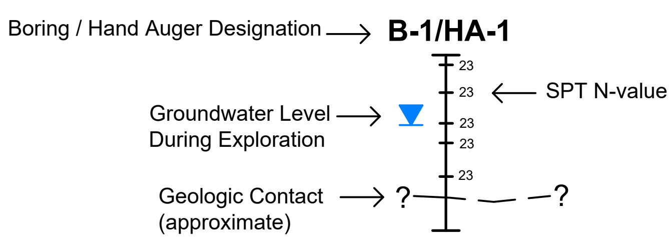


Exploration



NOTES:
1) Stratigraphic conditions are interpolated between the explorations. Actual conditions may vary.
2) Elevations are approximate.

Reference: Cross Section is based on field measurements using a hand-held clinometer and 100-ft tape measure.

Project Number
11448B20
Figure 3

Hu Residence Development
Additional Explorations
Cross-Section A-A'

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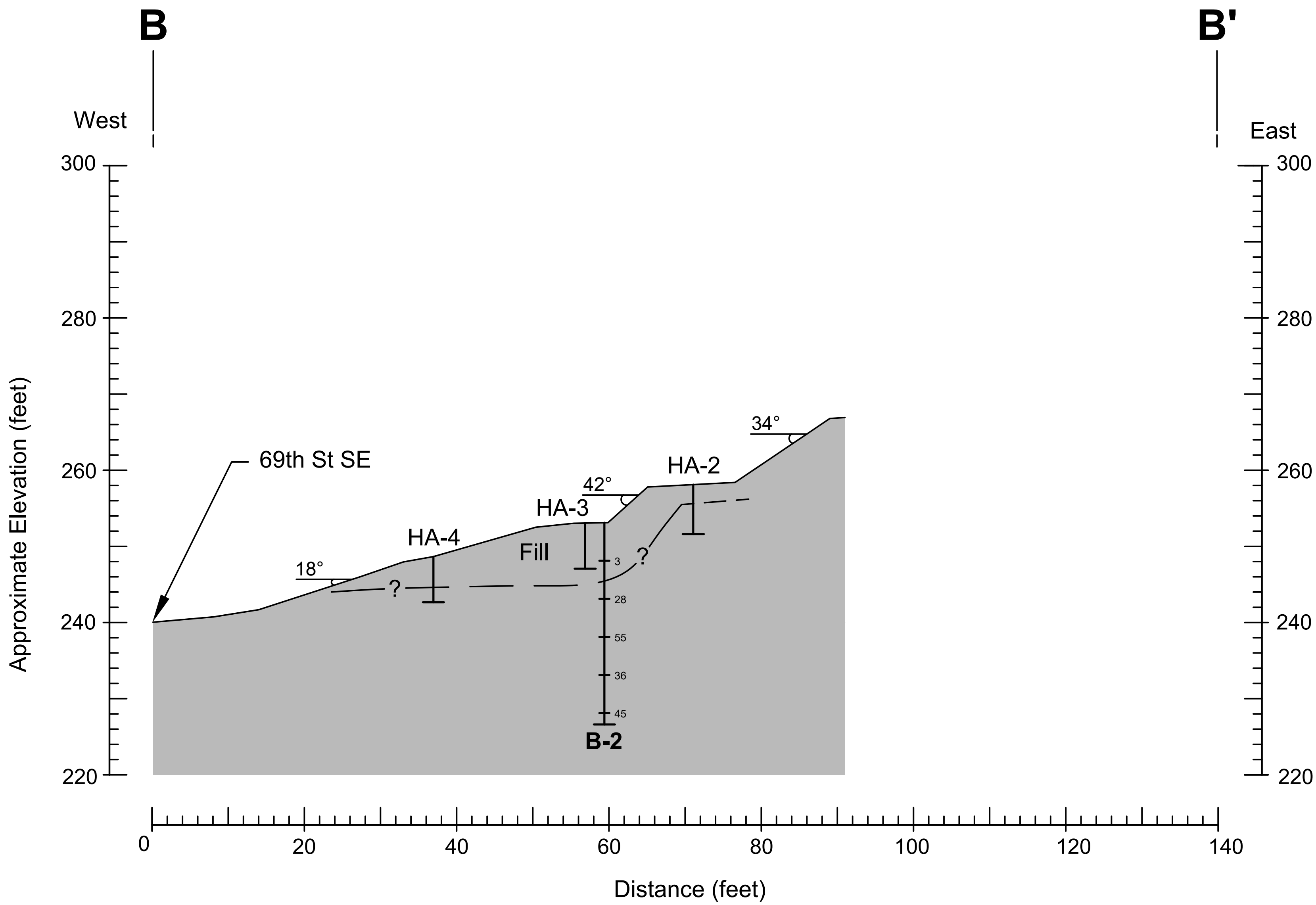
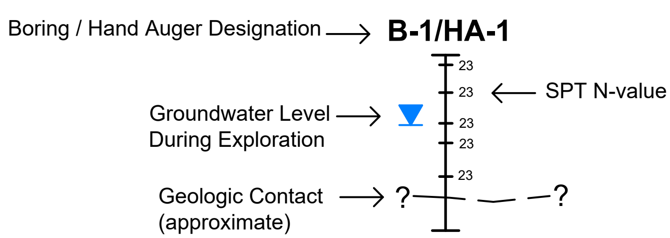


Exploration



NOTES:

1) Stratigraphic conditions are interpolated between the explorations. Actual conditions may vary.
2) Elevations are approximate.

Reference: Cross Section is based on field measurements using a hand-held clinometer and 100-ft tape measure.

Project Number 11448B20

Figure 4

Hu Residence Development
Additional Explorations
Cross-Section B-B'

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No.	Date	Revision	By	CK
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UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE - GRAINED SOILS MORE THAN 50 % RETAINED ON NO. 200 SIEVE	GRAVEL MORE THAN 50 % OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVEL	GW	WELL-GRADED, FINE TO COARSE GRAVEL
			GP	POORLY-GRADED GRAVEL
		GRAVEL WITH FINES	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SAND MORE THAN 50 % OF COARSE FRACTION PASSES NO. 4 SIEVE	CLEAN SAND	SW	WELL-GRADED SAND, FINE TO COARSE SAND
			SP	POORLY GRADED SAND
		SAND WITH FINES	SM	SILTY SAND
			SC	CLAYEY SAND
FINE - GRAINED SOILS MORE THAN 50 % PASSES NO. 200 SIEVE	SILT AND CLAY LIQUID LIMIT LESS THAN 50 %	INORGANIC	ML	SILT
			CL	CLAY
		ORGANIC	OL	ORGANIC SILT, ORGANIC CLAY
	SILT AND CLAY LIQUID LIMIT 50 % OR MORE	INORGANIC	MH	SILT OF HIGH PLASTICITY, ELASTIC SILT
			CH	CLAY OF HIGH PLASTICITY, FAT CLAY
		ORGANIC	OH	ORGANIC CLAY, ORGANIC SILT
HIGHLY ORGANIC SOILS			PT	PEAT

NOTES:

1) Field classification is based on visual examination of soil in general accordance with ASTM D 2488-93.

2) Soil classification using laboratory tests is based on ASTM D 2488-93.

3) Descriptions of soil density or consistency are based on interpretation of blowcount data, visual appearance of soils, and/or test data.

SOIL MOISTURE MODIFIERS:

Dry - Absence of moisture, dusty, dry to the touch

Moist - Damp, but no visible water.

Wet - Visible free water or saturated, usually soil is obtained from below water table

Project Number 11448B20	Hu Residence Development Additional Explorations Soil Classification Chart	NELSON GEOTECHNICAL ASSOCIATES, INC. GEOTECHNICAL ENGINEERS & GEOLOGISTS	No.	Date	Revision	By	CK
Figure 5			1	11/20/19	Original	DPN	KSB
			2	6/19/20	Revision	DPN	KSB

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BORING LOG

B-1

Approximate Ground Surface Elevation: ??

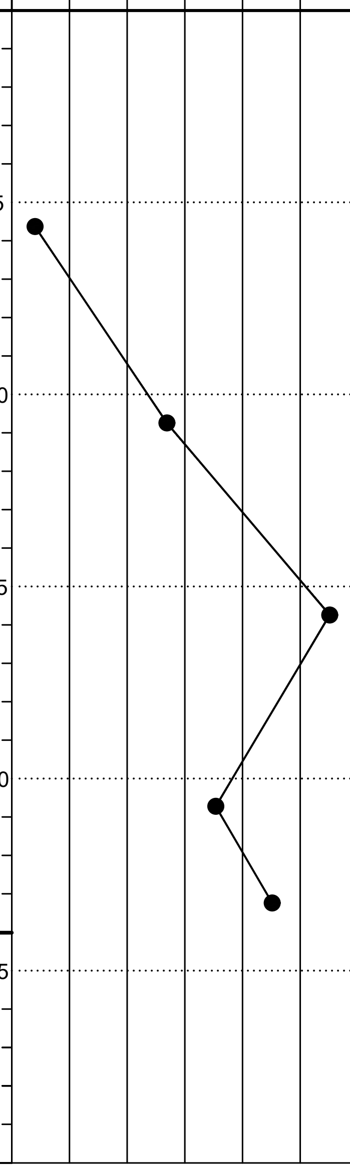
Description	Graphic Log	Group Symbol	Blow Count	Sample Location (Depth in feet)
Brown to gray, silty fine to medium sand with trace gravel (very loose, moist) (**FILL**)			3	5
Brown-gray, mottled sandy silt with iron-oxide staining (stiff, dry to moist)		ML	28	10
Blue-gray, silty fine sand (very dense, moist)		SM	55	15
Blue-gray silt with fine sand (hard, dry to moist)		ML	36	20
Blue-gray, silty fine sand interbedded with blue-gray silt (medium dense, dry to moist)		SM-ML	45	
Boring terminated below existing grade at 24.0 feet on 6/9/20. Groundwater seepage was not encountered during drilling.				25

Penetration Resistance (Blows/foot - ●) 10 20 30 40 50 50+

Moisture Content (Percent - ■) 10 20 30 40 50 50+

Laboratory Testing

Piezometer Installation - Ground Water Data (Depth in Feet)



LEGEND

- Depth Driven and Amount Recovered with 2-inch O.D. Split-Spoon Sampler
- Depth Driven and Amount Recovered with 3-inch Shelby Tube Sampler
- Solid PVC Pipe
- Slotted PVC Pipe
- Monument/ Cap to Piezometer
- * Liquid Limit
- + Plastic Limit
- Concrete
- Bentonite
- Native Soil
- Silica Sand
- Water Level

M	Moisture Content
A	Atterberg Limits
G	Grain-size Analysis
DS	Direct Shear
PP	Pocket Penetrometer Readings, tons/ft
P	Sample Pushed
T	Triaxial

NOTE: Subsurface conditions depicted represent our observations at the time and location of this exploratory hole, modified by engineering tests, analysis and judgement. They are not necessarily representative of other times and locations. We cannot accept responsibility for the use or interpretation by others of information presented on this log.

Project Number 11448B20

Figure 6

Hu Residence Development Additional Explorations Boring Log

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No.	Date	Revision	By	CK
1	6/18/20	Original	DPN	KSB

Logged by: KSB on 6/9/20

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BORING LOG

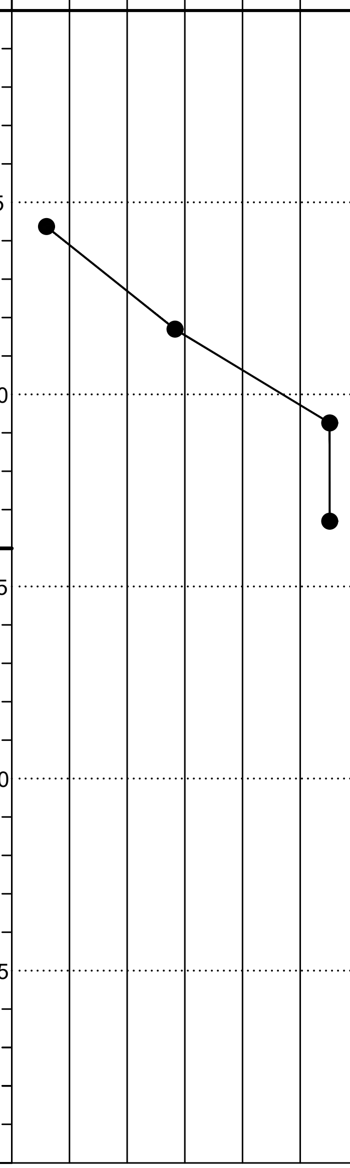
B-2

Approximate Ground Surface Elevation: ??

Description	Graphic Log	Group Symbol	Blow Count	Sample Location (Depth in feet)
Brown, medium to coarse sand with silt interbeded with silty, fine to medium sand with gravel (loose, moist) (**FILL**)			7	5
Gray silt with trace fine sand (stiff, dry to moist)			25	
-becomes hard		ML	59	10
-with iron-oxide staining			59	
Boring terminated below existing grade at 14.0 feet on 6/9/20. Groundwater seepage was not encountered during drilling.				15

Penetration Resistance (Blows/foot - ●): 10, 20, 30, 40, 50, 50+

Moisture Content (Percent - ■): 10, 20, 30, 40, 50, 50+



Laboratory Testing

Piezometer Installation - Ground Water Data (Depth in Feet): 5, 10, 15, 20, 25

LEGEND

- Depth Driven and Amount Recovered with 2-inch O.D. Split-Spoon Sampler
- Depth Driven and Amount Recovered with 3-inch Shelby Tube Sampler
- Solid PVC Pipe
- Slotted PVC Pipe
- Monument/ Cap to Piezometer
- * Liquid Limit
- + Plastic Limit
- Concrete
- Bentonite
- Native Soil
- Silica Sand
- Water Level
- M Moisture Content
- A Atterberg Limits
- G Grain-size Analysis
- DS Direct Shear
- PP Pocket Penetrometer Readings, tons/ft
- P Sample Pushed
- T Triaxial

NOTE: Subsurface conditions depicted represent our observations at the time and location of this exploratory hole, modified by engineering tests, analysis and judgement. They are not necessarily representative of other times and locations. We cannot accept responsibility for the use or interpretation by others of information presented on this log.

Project Number 11448B20

Figure 7

Page 1 of 1

Hu Residence Development
Additional Explorations
Boring Log

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Logged by: KSB on 6/9/20

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LOG OF EXPLORATION

DEPTH (FEET)	USC	SOIL DESCRIPTION
HAND AUGER ONE		
0.0 – 3.5		GRASS, UNDERLAIN BY BROWN SILTY FINE SAND WITH ORGANICS (LOOSE TO MEDIUM DENSE, MOIST) (**FILL**)
3.5 – 4.2	SM	BROWN GRAY TO GRAY SILTY FINE TO MEDIUM SAND WITH TRACE GRAVEL (MEDIUM DENSE TO DENSE, MOIST)
4.2 – 5.0	SM	BROWN GRAY TO GRAY SILTY FINE TO MEDIUM SAND WITH GRAVEL (DENSE, MOIST)
		SAMPLES COLLECTED AT 5.0 FEET GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED HAND AUGER CAVING WAS NOT ENCOUNTERED HAND AUGER ONE MET REFUSAL AT 5.0 FEET ON 11/1/2019
HAND AUGER TWO		
0.0 – 2.5		GRASS, UNDERLAIN BY BROWN SILTY FINE SAND WITH ROOTS, ORGANICS, AND GRAVEL (LOOSE TO MEDIUM DENSE, MOIST) (**FILL**)
2.5 – 5.0	SM-ML	BROWN TO BROWN GRAY SILTY FINE TO MEDIUM SAND WITH SANDY SILT LENSES (MEDIUM DENSE TO DENSE, MOIST TO WET)
5.0 – 6.5	ML	BROWN TO BLUE GRAY SILT WITH FINE SAND AND IRON OXIDE STAINING. (STIFF TO HARD, MOIST TO DRY)
		SAMPLES COLLECTED AT 3.0, 5.0, AND 6.0 FEET GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED HAND AUGER CAVING WAS NOT ENCOUNTERED HAND AUGER TWO MET REFUSAL AT 6.5 FEET ON 11/1/19
HAND AUGER THREE		
0.0 – 6.0		GRASS, UNDERLAIN BY BROWN SILTY FINE TO MEDIUM SAND WITH GRAY LENSES, GRAVEL, TRACE COBBLES, ROOTS. PROBING 6-8” AT DEPTH (LOOSE, MOIST) (**FILL**)
		SAMPLES COLLECTED AT 5.0 FEET GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED HAND AUGER CAVING WAS NOT ENCOUNTERED HAND AUGER TWO MET REFUSAL AT 6.0 FEET ON 11/1/19
HAND AUGER FOUR		
0.0 – 4.2		GRASS, UNDERLAIN BY BROWN SILTY FINE SAND WITH ROOTS, ORGANICS, AND GRAVEL, GRAY LENSES, CHARCOAL, BECOMES WET AT 4.2’, PROBING 6” (LOOSE TO MEDIUM DENSE, MOIST) (**FILL**)
4.2 – 5.8	SM-ML	BROWN GRAY TO GRAY SILTY FINE TO MEDIUM SAND WITH IRON OXIDE STAINING AND CHARCOAL, WITH SMALL BROWN SILT LENSES, PROBING 8-12” (LOOSE, WET TO MOIST)
5.8 – 6.0	ML	BROWN GRAY TO GRAY SILT WITH FINE TO MEDIUM SAND (STIFF/DENSE, DRY TO MOIST)
		SAMPLES COLLECTED AT 5.5 AND 6.0 FEET GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED HAND AUGER CAVING WAS NOT ENCOUNTERED HAND AUGER TWO MET REFUSAL AT 6.0 FEET ON 11/1/19

LOG OF EXPLORATION

DEPTH (FEET)	USC	SOIL DESCRIPTION
HAND AUGER FIVE		
0.0 – 2.0		GRASS, UNDERLAIN BY BROWN SILTY FINE SAND WITH ROOTS, ORGANICS (LOOSE TO MEDIUM DENSE, MOIST) (**FILL**)
2.0 – 3.0	SM	BROWN GRAY TO GRAY SILTY FINE TO MEDIUM SAND WITH GRAVEL, TRACE IRON OXIDE (MEDIUM DENSE TO DENSE, MOIST)
		SAMPLES WERE NOT COLLECTED GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED HAND AUGER CAVING WAS NOT ENCOUNTERED HAND AUGER TWO MET REFUSAL AT 3.0 FEET ON 11/1/19