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August 12, 2015

Mr. Scott Gibson
On The Rock 98040, LLC
P.O. Box 956
Mercer Island, Washington 98040

Preliminary Geotechnical Engineering Evaluation
Gibson Three Lot Short Plat
9740 SE 35th Place
Mercer Island, Washington
NGA File No. 929615

Dear Mr. Gibson:

We are pleased to submit the attached report titled "Preliminary Geotechnical Engineering Evaluation – Gibson Three Lot Short Plat – 9740 SE 35th Place – Mercer Island, Washington." Our services were completed in general accordance with the proposal signed by you on June 20, 2015.

The site is currently occupied by an existing single-family residence within the lower northern portion of the property and an existing garage building within the southern portion of the property. The property is generally situated on gently to moderately sloping ground that descends from the eastern portion of the property to the northern portion of the property along Lake Washington. Localized steep slopes exist within the eastern portion of the property. We understand that the proposed development plans consist of subdividing the property into three separate lots within the northern, central, and southern portions of the property and constructing new, multi-level, single-family residences within each of the lots. The existing residence within the northern lot will be removed and a new residence will be constructed within the same approximate location. Final development and grading plans have not been developed; however, we anticipate that retaining walls will be needed for the construction of the residences and support of steep cuts. Final stormwater plans have also not been developed, but we anticipate that stormwater from the lots will be directed to existing systems within the property. We should be retained to review final residence plans, including plans for site grading, retaining walls, and drainage prior to construction.

We recently explored the proposed residence areas and steeper slopes with 12 hand auger explorations extending up to approximately 7.0 feet below the existing ground surface. Our explorations generally encountered competent glacial soils within the central and southern lots, and within portions of the northern lot. However, some of our explorations within the northern lot in the vicinity of the existing residence encountered very loose to loose silty sand with organics that we interpreted as lacustrine deposits.

It is our opinion from a geotechnical standpoint that the site is compatible with the planned development provided that our recommendations are incorporated into the design and construction of this project. We recommend that foundations for the proposed residences in the central and southern lots be designed to utilize conventional spread footings extending down to medium dense or better native soils for bearing capacity and settlement considerations. These soils should generally be encountered approximately one to two feet below the existing ground surface, based on our explorations within these lots.

Based on the loose to very loose lacustrine deposits encountered in our explorations within the northern lot in the vicinity of the existing residence, we preliminarily recommend supporting this residence on a deep foundation system consisting of 4-inch driven pin piles in order to advance the structure loads through the loose upper soils down to more competent native deposits at depth. As an alternative to a deep foundation system, the northern residence foundations could be overexcavated by a minimum of two feet and the overexcavated material replaced with 2- to 4-inch rock spalls. The foundation within the northern lot could be supported directly on the rock spalls and designed as a rigid foundation system to reduce the effects of differential settlement on the structure. These preliminary recommendations for foundation support of the proposed residence within the northern lot are based on limited shallow explorations performed within the vicinity of the existing residence. We recommend that if more in-depth detailed recommendations are needed for the proposed foundation design of the residence within the northern lot that additional explorations be performed within this area. More specific recommendations for foundation design and installation within the northern lot would be provided at that time.

It is also our opinion that the soils that underlie the site and form the core of the site slopes should be stable with respect to deep-seated earth movements, due to their inherent strength and slope geometry. However, there is a potential for shallow sloughing and erosion events to occur on the steeper portions of this site. We recommend that the new residence and light structures such as decks and patios within central lot be set back at least 10 feet from the toe of the steep slopes within the eastern portion of the central lot. We also recommend that the eastern side of the structure within the northern lot be protected against potential slope movement on the uphill side of the residence by incorporating some type of a debris wall on that side. This is further discussed in the attached report. In the attached report, we have also provided general recommendations for site grading, slabs-on-grade, structural fill placement, retaining walls, erosion control, and drainage. These recommendations are preliminary in nature. We should be retained to review and comment on final development plans and observe the earthwork phase of construction.

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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Preliminary Geotechnical Engineering Evaluation
Gibson Three Lot Short Plat
9740 SE 35th Place
Mercer Island, Washington

INTRODUCTION

This report presents the results of our preliminary geotechnical engineering investigation and evaluation of the Gibson Three Lot Short Plat project located at 9740 SE 35th Place 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 preliminary geotechnical recommendations for site development. For our use in preparing this report, you have provided us with a site plan titled "Topographic & Boundary Survey – On The Rock, LLC – 9740 SE 35th Place – Mercer Island, WA 98040," dated April 10, 2015, and an undated, untitled sketch showing the approximate locations of the proposed residences.

The site is currently occupied with an existing single-family residence within the lower northern portion of the property and an existing garage building within the southern portion of the property. The property is generally situated on gently to moderately sloping ground that descends from the southern portion of the property to the northern portion of the property along Lake Washington. Localized steep slopes exist within the eastern portion of the property. We understand that the proposed development plans consist of subdividing the property into three separate lots within the northern, central, and southern portions of the property and constructing new, multi-level, single-family residences within each of the lots. The existing residence within the northern lot will be removed. Final development and grading plans have not been developed; however, we anticipate that retaining walls will be needed for the construction of the residences and support of steep cuts. Final stormwater plans have also not been developed, but we anticipate that stormwater from the lots will be directed to existing systems within the property. The existing site conditions and proposed development areas are shown on the Schematic Site Plan in Figure 2.

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 sloping areas of the site with hand tools.
3. Map the conditions on the slope, and evaluate current slope stability conditions.
4. Perform laboratory testing on soil samples, as needed.
5. Provide general recommendations for temporary and permanent slopes.
6. Provide general recommendations for earthwork and foundation support.
7. Provide general recommendations for steep slope setbacks.
8. Provide general recommendations for slab and pavement subgrade preparation.
9. Provide general recommendations for retaining walls.
10. Provide general recommendations for site drainage and erosion control.
11. Document the results of our findings, conclusions, and recommendations in a written preliminary geotechnical report.

SITE CONDITIONS

Surface Conditions

The site consists of a roughly rectangular-shaped parcel covering approximately 1.58 acres. The property is currently occupied with a single-family residence with a daylight basement within the northern, lower portion of the property and a garage/shop within the upper, southern portion of the property. The site generally slopes gently to moderately down from the southern portion of the property to the northern portion of the property at gradients in the range of approximately 5 to 11 degrees (9 to 19 percent). The site also slopes gently to steeply from the eastern property line to the northwest at gradients in the range of 9 to 28 degrees (16 to 53 percent). A relatively level to gently sloping bench area is located to the north of the existing residence along the shore of Lake Washington. The site layout is shown on the Site Plan in Figure 2. A profile of the site slopes through the lots and proposed development areas are shown on Cross Section A-A’, B-B’ and C-C’ in Figures 3 through 5.

The site is bordered to the north by Lake Washington, to the east and west by residential properties, and to the south by SE 35th Place. The site is generally covered with grass, scattered trees, underbrush, and landscaping vegetation. We did not observe significant signs of surficial slope movement or groundwater seepage emitting from the site slopes during our July 17, 2015 site visit.

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 Qvt (Vashon Till) and Qvrl (Recessional Lacustrine Deposits). The Vashon Till is described as a compact diamict of silt, sand and subrounded to well-rounded gravel, glacially transported and deposited under ice. The recessional lacustrine deposits are described as silt and clay with local sand layers, peat, and other organic sediments. In general, we encountered silty fine to medium sand with varying amounts of gravel soils within our explorations performed within the central, southern and the eastern portion of the northern lot that we interpreted as native Vashon Till soils. In our exploration performed within the western portion of the northern lot, we encountered silty fine sand with organics that that we interpreted as recessional lacustrine deposits.

Explorations: The subsurface conditions within the vicinity of the proposed development areas and the steep slopes were explored with 12 hand auger explorations. The approximate locations of our explorations are shown on the Site Plan in Figure 2. A geologist from Nelson Geotechnical Associates, Inc. (NGA) was present during the explorations, examined the soils and geologic conditions encountered, obtained samples of the different soil types, and maintained logs of the explorations. The soils were visually classified in general accordance with the Unified Soil Classification System presented in Figure 6. The logs of our explorations are attached to this report and presented as Figures 7 through 9. We present a brief summary of the subsurface conditions in the following paragraphs. For a detailed description of the subsurface conditions, the logs should be reviewed.

All of our hand augers encountered approximately 0.2 to 1.0 feet of surficial topsoil. Underlying the topsoil in Hand Auger 2, we encountered approximately 2.5 feet of loose to medium dense, dark brown gray silty fine to medium sand with gravel that we interpreted as undocumented fill. Underlying the undocumented fill in Hand Auger 2 and the topsoil in Hand Augers 1, 3 through 7, and 9 through 11, we encountered loose to very dense, brown-gray silty fine to medium sand with gravel soils that we interpreted as native weathered and unweathered glacial till soils. Hand Augers 1 through 7 and 9 through 11 were all terminated within the native glacial till soils at depths in the range of 1.5 to 4.5 feet below the existing ground surface.

Underlying the surficial topsoil within Hand Augers 8 and 12 within the northern lot, we encountered very loose to loose, dark gray silty fine to medium sand with organic debris and trace gravel that we interpreted as native recessional lacustrine deposits mapped for the site. Hand Augers 8 and 12 were terminated within the native recessional lacustrine deposits at a depth of 7.0 feet below the existing ground surface.

Hydrologic Conditions

Groundwater seepage was not encountered in our explorations. However, wet soil conditions were encountered within our explorations within the northern lot. If groundwater were to be encountered, we would interpret this water to be perched water. Perched water occurs when surface water infiltrates through less dense, more permeable soils, and accumulates on top of a relatively low permeability material. 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 mostly 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.

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 eastern site slopes are considered stable with respect to deep-seated slope failures. However, the overlying loose surficial materials located on the site slopes have the potential for shallow sloughing failures during seismic events. Such events should not affect the planned residences provided the foundations are located and debris protection systems are designed 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 Kitsap silt loam, 2 to 8 percent slopes (KpB). This soil is listed as having a slight to moderate hazard of water erosion. These soils should have a low 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 lots are generally situated on gently to moderately sloping ground with localized steep northwest-facing slopes along the eastern portion of the property with gradients in the range of approximately 9 to 28 degrees (16 to 53 percent). We did not observe evidence of significant slope instability during our investigation, such as deep-seated landsliding.

The core of the site slopes is inferred to consist primarily of medium dense or better native glacial deposits. An inclination of up to 28 degrees on the site slopes indicates high strength and internal friction angle within the underlying soils. Relatively shallow sloughing failures as well as surficial erosion are natural processes and should be expected on the steeper slopes within the property during extreme weather conditions. It is our opinion that while there is potential for erosion, soil creep, and shallow failures within the loose surficial soils on the slopes, there is not a significant potential for deep-seated slope failure under current site conditions. Proper site grading, drainage, and foundation placement as recommended in this report should help reduce the impact of such events on the planned improvements. We recommend incorporating a debris structure into the eastern upslope side of the residence foundation within the northern lot to help protect the residence against potential failures within the slope above.

CONCLUSIONS AND RECOMMENDATIONS

General

It is our opinion that the preliminary planned developments within the property are feasible from a geotechnical standpoint. It is also our opinion that the soils that underlie the site and form the core of the site slopes should be stable with respect to deep-seated earth movements, due to their inherent strength and slope geometry. However, there is a potential for shallow sloughing and erosion events to occur on the steeper slopes within the site. The frequency and severity of such events will be greatly impacted by weather conditions and human activity on the slope. Proper setbacks, erosion and drainage control measures, along with long-term maintenance of the slope and drainage systems as recommended in this report, should reduce this potential. We recommend that we review the plans after they have been developed.

Our explorations indicate that central and southern lots are generally underlain by medium dense or better native glacial till soils at shallow depths. The native glacial soils encountered in these lots should provide adequate support for foundation and slab loads. We recommend that the structures be designed utilizing shallow conventional foundations. Footings should extend through any undocumented fill or loose soil, and be founded on the underlying medium dense or better native soil, or structural fill extending to these soils. The medium dense or better soil should typically be encountered approximately one to two feet below the existing ground surface, based on our explorations.

Our explorations also indicate that the northern lot within the vicinity of the existing residence is underlain by very loose to loose recessional lacustrine soils. In our opinion, the soils that may underlie the existing and proposed residence within the northern lot are likely not feasible to provide adequate support for foundation and slab loads utilizing conventional foundations. Based on our explorations, we preliminarily recommend that the proposed residence within the northern lot be supported on a deep foundation system consisting of 4-inch driven pin piles in order to advance the structure loads through the loose upper soils down to more competent native deposits at depth. As an alternative to a deep foundation system, the northern residence foundation excavation could be overexcavated by a minimum of two feet and replaced with 2- to 4-inch rock spalls. The foundation within the northern lot could be supported directly on the rock spalls and designed as a rigid foundation system to reduce the effects of differential settlement on the structure. These preliminary recommendations for foundation support of the proposed residence within the northern lot are based on limited shallow explorations performed within the vicinity of the existing residence. We recommend that if more in-depth detailed recommendations are needed for the proposed foundation design of the residence within the northern lot that additional deep explorations be performed within this area. More specific recommendations for foundation design and installation could be provided at that time.

To protect the residence within the central lot against potential failures on the slope above the proposed residence, we recommend that the residence be set back at least 10 feet from the toe of the steeper portion of the slope within the eastern portion of the central lot. We should be retained to review final residence location within the central lot.

We understand that the proposed residence within the northern lot will likely be constructed along the toe of the steep slope located along the eastern side of the northern lot. The steep slope descends down from the neighboring residence within the neighboring property to the east. At the time this report was prepared, specific grading plans were not available for the proposed development. We anticipate that steep cuts may be needed along the eastern property line in close proximity to the steep slope along the east side of the proposed residence. If safe temporary excavations cannot be accomplished in accordance with the recommendations provided within this report, alternative temporary shoring measures may need to be incorporated within the proposed plan to minimize potential issues impacting the neighboring property and residence to the east of the northern residence. We recommend that NGA be retained to review the proposed grading plans prior to finalizing the design, and provide alternative recommendations as needed.

In addition, we recommend that the eastern upslope portions of the residence foundation within the northern lot be designed as debris walls and extend a minimum of three feet above finished ground surface to protect the structure against potential failures on this slope. This is intended to provide a catchment measure should any sloughing debris travel towards the residence during extreme weather or as a result of an earthquake. Alternatively, a separate debris protection structure could also be utilized.

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 should not be stockpiled near or on sloping ground or be allowed to encroach on the slopes. Also, 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. We recommend that the trees on the slope be evaluated by a certified arborist, and hazardous trees on the slope that may endanger the residences be removed prior to residence construction. The slopes should be monitored on an on-going basis, especially during the wet season, for any signs of instability, and corrective actions promptly taken should any signs of instability be observed.

The surficial soils encountered on this site are considered moisture-sensitive and could disturb when wet. To lessen the potential impacts of construction on the slopes and to reduce cost overruns and delays, we recommend that construction take place during the drier summer months. If construction takes place during the rainy months, additional expenses and delays should be expected. 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.

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 the roof and yard drains be collected and tightlined to a suitable discharge point. 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.

Erosion Control and Slope Protection Measures

The erosion hazard for the on-site soils is listed as slight to moderate, 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.

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.

If wet conditions are encountered, 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.

Structure Setbacks

Uncertainties related to building along steep slopes are typically addressed by the use of building setbacks. The purpose of the setback is to establish a “buffer zone” between the structure and the top of the slope so that ample room is allowed for normal slope recession during a reasonable life span of the structure. In a general sense, the greater the setback distance, the lower the risk of slope failures impacting the structure. From a geological standpoint, the setback dimension is based on the slope’s physical characteristics, such as slope height, surface angle, material composition, and hydrology. Other factors such as historical slope activity, rate of regression, and the type and desired life span of the development are important considerations as well.

We recommend that the residence within central lot be setback a minimum of 10 feet from the toe of the steep slope within the eastern portion of the lot. Also, the residence within the northern lot should incorporate a debris protections feature, depending on its proximity to the steep slope.

We should be retained to evaluate the residence foundation setback distances and subgrade soil prior to placing foundation forms. Any proposed development within the setback area or on the slope should be the subject of a specific geotechnical evaluation. Under no circumstances should water be allowed to concentrate on the slopes, during or after construction.

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 water 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 since they are continuously at the job site, able to observe the soil and groundwater conditions encountered, and able to monitor the nature and condition of the 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 in the medium dense or better on-site soils within the central, southern and eastern portion of the northern lot be no steeper than 1.5 Horizontal to 1 Vertical (1.5H:1V). We also recommend that temporary cuts within the loose lacustrine soils within the northern lot be no steeper than 2H:1V. 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. We should specifically review all plans for grading near or on steep slopes for this project.

Foundation Support

Central and Southern Lots

Conventional shallow spread foundations should be placed on medium dense or better native soils, or be supported on structural fill or rock spalls extending to those soils. Medium dense soils should be encountered approximately one to two feet below the existing ground surface based on our explorations. Where undocumented fill or less dense soils are encountered at footing bearing elevation, the subgrade should be over-excavated to expose suitable bearing soil. If footings are supported on structural fill, the fill zone should extend outside the edges of the footing a distance equal to one-half of the depth of the over-excavation below the bottom of the footing.

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 2012 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.

For foundations constructed as outlined above, we recommend an allowable design bearing pressure of not more than 2,000 pounds per square foot (psf) be used for the design of footings founded on the medium dense or better native soils or structural fill extending to the competent native 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 ½-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 or better soils or compacted fill should be placed against the footing. We recommend that the upper one-foot of soil be neglected when calculating the passive resistance.

Northern Lot

Pin Piles: We recommend that the proposed residence within the northern lot be supported on 4-inch pin piles to transfer foundation loads through the upper loose lacustrine soils to the underlying native competent materials. Our explorations did not encounter any significant debris within the existing fill, however some organics were encountered that have the possibility to impede some of the piles. There should be contingencies in the budget and design for additional/relocated piles to replace piles that may be obstructed by debris. We also recommend that excavation equipment be available on site during pile installation so that shallow obstructions can be removed from the planned pile locations.

We recommend that the four-inch pipe piles be utilized and should be driven using a tractor-mounted hydraulic hammer, with an energy rating of at least 1,100 foot-lb. For this pile and hammer size, we recommend a design capacity of eight tons for each pile driven to refusal. The refusal criterion for this pile and hammer size is defined as less than one-inch of movement during 15 seconds of continuous driving at a rate of 550 blows per minute or higher. We recommend using galvanized schedule 40 pipe for the 4-inch pin piles. Maintaining these recommendations for minimum hammer size and refusal criteria is essential for obtaining a successful outcome.

Final pile depths should be expected to vary somewhat and will depend on the depth of the loose material, the nature of the underlying competent soils, and groundwater conditions. Our explorations performed as a part of this evaluation are shallow and are considered limited in nature. Additional deep explorations will be required to provide accurate recommendations on anticipated depths of the piles if needed for budgeting purposes. At a minimum, the pin piles should penetrate a minimum of five feet into the competent native glacial soils below the fill material in order to develop the design capacity. Piles that do not meet this minimum embedment criterion should be rejected, and replacement piles should be driven after consulting with the structural engineer regarding the new pile locations. The piles should be spaced a minimum of three feet apart to avoid a grouping effect on the piles.

Due to the relatively small slenderness ratio of pin piles, maintaining pin pile confinement and lateral support is essential in preventing pile buckling. Pin piles should be suitably embedded into the reinforced concrete. The structural engineer should design the connections of the piles to the foundations.

Vertically driven pin piles do not provide meaningful lateral capacity. Due to the rigid pile support, friction between the foundation and subgrade soil should not be considered as resisting lateral pressures on this structure. We recommend that all lateral loads be resisted on battered pin piles and/or passive resistance on the below-grade portions of the foundations. The upper foot of soil should be neglected when calculating the passive resistance. We recommend using an equivalent fluid density of 150 pcf for calculating the passive resistance.

Rock Spalls: As an alternative, we also recommend that the northern residence foundation can be over-excavated by at least two feet and be replaced with 2- to 4-inch rock spalls. The rock spalls should extend at least two feet beyond the perimeter of the proposed foundation. The ground improvements are intended to improve foundation support and reduce the potential for differential settlement. We also recommend that the residence foundation be designed as a heavily reinforced raft or mat. A raft or mat foundation is a combined footing and slab that usually covers the entire area beneath a building and supports all walls and columns. For this project, the raft would be used to minimize differential settlement over the loose surficial soils.

Building foundations should extend at least 18 inches below the lowest adjacent finished ground surface for frost protection and bearing capacity considerations. Footings should be sized based on the anticipated loads and allowable soil bearing pressure, and should conform to current IBC guidelines. Water should not be allowed to accumulate in footing excavations. All loose or disturbed soil should be removed from the foundation excavation prior to placing concrete.

For the reinforced raft foundation design, we recommend a Modulus of Subgrade Reaction of no more than 200 pounds per cubic inch be used for the recommended two-foot thick layer of 2- to 4-inch rock spalls overlying the soft to medium stiff native soils.

For foundations constructed as outlined above, we recommend an allowable design bearing pressure of not more than 1,000 pounds per square foot (psf) be used for the building structural mat design if placed on at least two feet of rock spalls. A representative of NGA should evaluate the foundation excavation and rock fill placement. Depending on the moisture content of the soil exposed in the bottom of the foundation excavation, it may be useful to place a layer of geofabric or geogrid over the bottom of the excavation prior to placing the rock fill. This determination will be made at the time of construction. 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, and for snow loading. The rock fill and structurally reinforced mat foundation should significantly reduce the potential for problems associated with differential settlement.

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, compacted fill should be placed against the footing. We recommend that the upper one-foot of soil be neglected when calculating the passive resistance.

Retaining Walls

We anticipate that retaining walls may be needed along the upslope side of the residences. 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. The debris wall recommended on the uphill eastern side of the residence within northern lot should be designed for an active pressure of 100 pcf.

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 subsurface height of the wall, and do not account for surcharge loads. Additional lateral earth pressures should be considered for surcharge loads acting adjacent to subsurface walls and within a distance equal to the subsurface 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 eight-inch loose lifts and compacting the backfill with small, hand-operated compactors within a distance behind the wall equal to at least one-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. 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.

Slab-on-Grade

Slabs-on-grade should be supported on subgrade soils prepared as described in the **Site Preparation and Grading** subsection of this report. We recommend that all floor slabs be underlain by at least six inches of free-draining gravel with less than three percent by weight of the material passing Sieve #200 for use as a capillary break. We recommend that the capillary break be hydraulically connected to the footing drain system to allow free drainage from under the slab. A suitable vapor barrier, such as heavy plastic sheeting (6-mil minimum), should be placed over the capillary break material. An additional 2-inch thick moist sand layer may be used to cover the vapor barrier. This sand layer is optional and is intended to protect the vapor barrier membrane during construction. We have provided additional recommendations regarding this system in the **Subsurface Drainage** subsection of this report.

Pavements

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.

USE OF THIS REPORT

NGA has prepared this preliminary report for Scott Gibson 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.

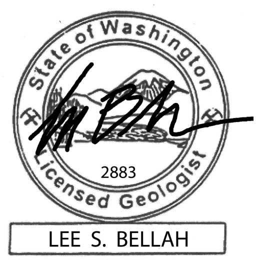
We recommend that NGA be retained to review final plans prior to construction. We also recommend that NGA be retained to provide monitoring and consultation services during construction to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations 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.

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.



Lee S. Bellah, LG
Project Geologist

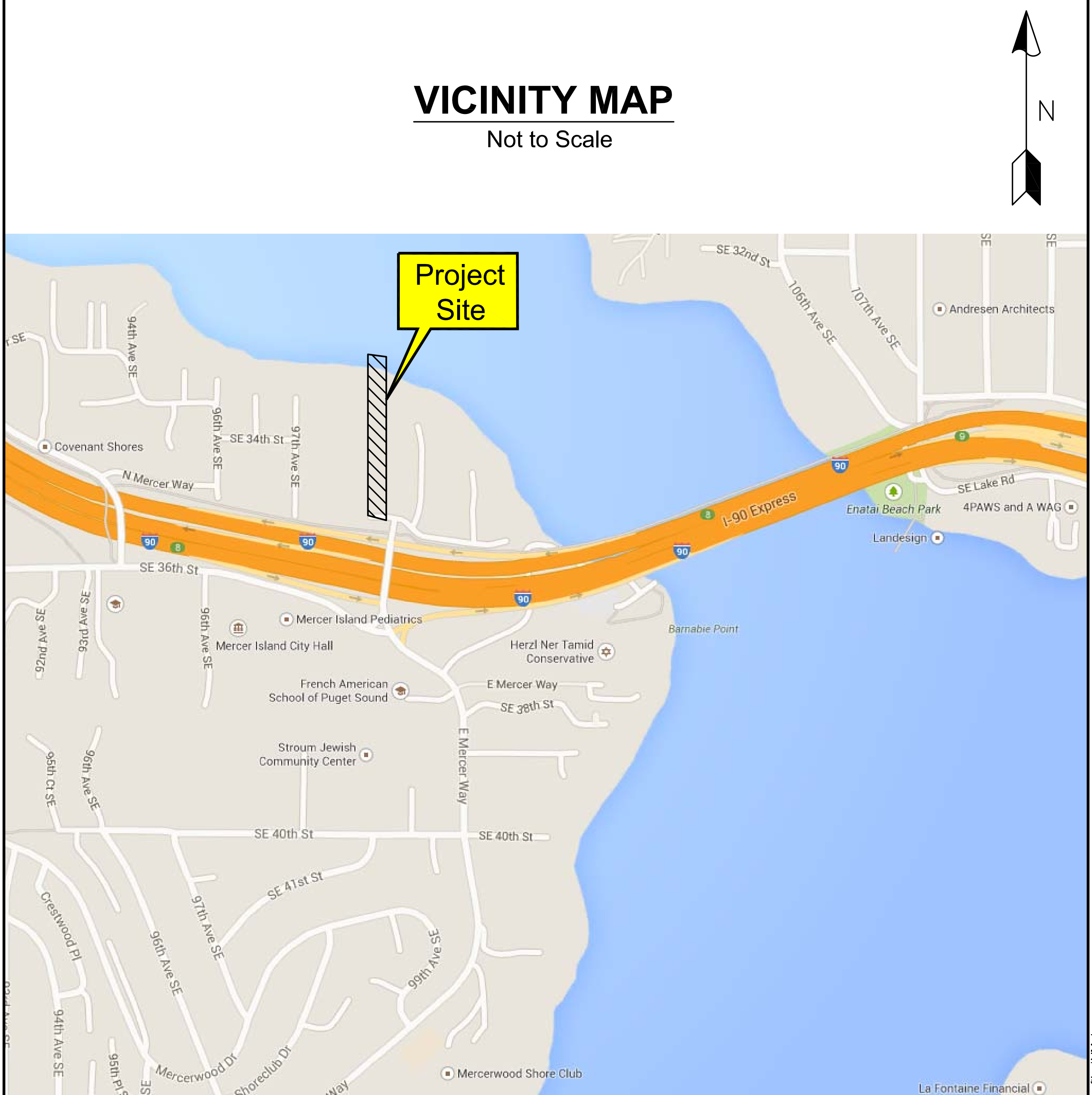
Khaled M. Shawish, PE
Principal

Nine Figures Attached

LSB:KMS:dy

VICINITY MAP

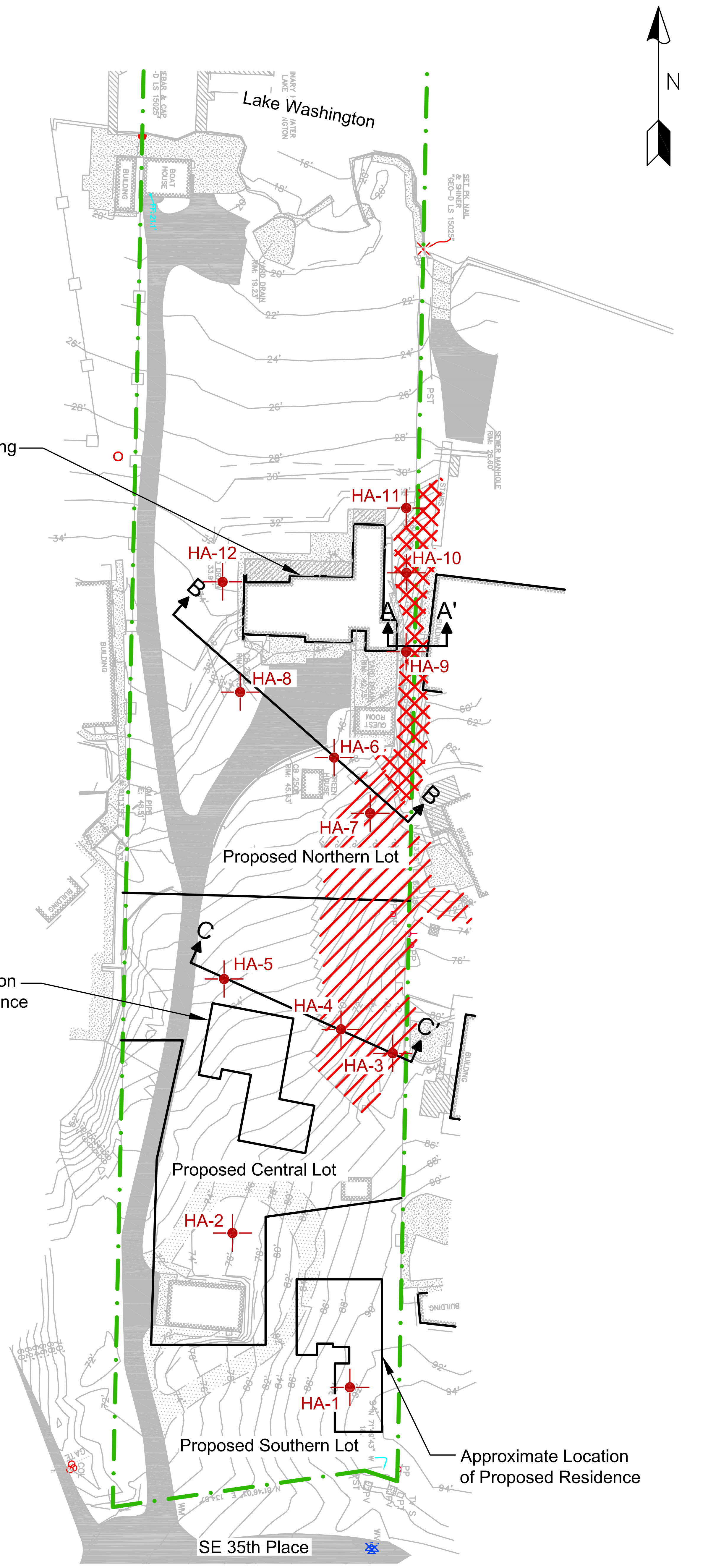
Not to Scale



Mercer Island, WA

Project Number	Gibson Three Lot Short Plat Vicinity Map	Nelson Geotechnical Associates, Inc.	No.	Date	Revision	By	CK
929615		Geotechnical Engineers & Geologists	1	8/5/15	Original	LSB	KMS
Figure 1		17311-135th Ave. NE, A-500 Woodinville, WA 98072 (425) 486-1669 / Fax 481-2510 — Snohomish County (425) 339-1669 Wenatchee/Chelan (509) 665-7696 www.nelsongeotech.com					

NGA Project Folder 2015\929615 Gibson Three Lot Short Plat\Drafting\VM.dwg



LEGEND

- Property line
- HA-1: Number and approximate location of hand auger exploration
- A A': Approximate location of cross-section
- Approximate extent of steep slopes 30%-39.99%
- Approximate extent of steep slopes >40%

0 60 120

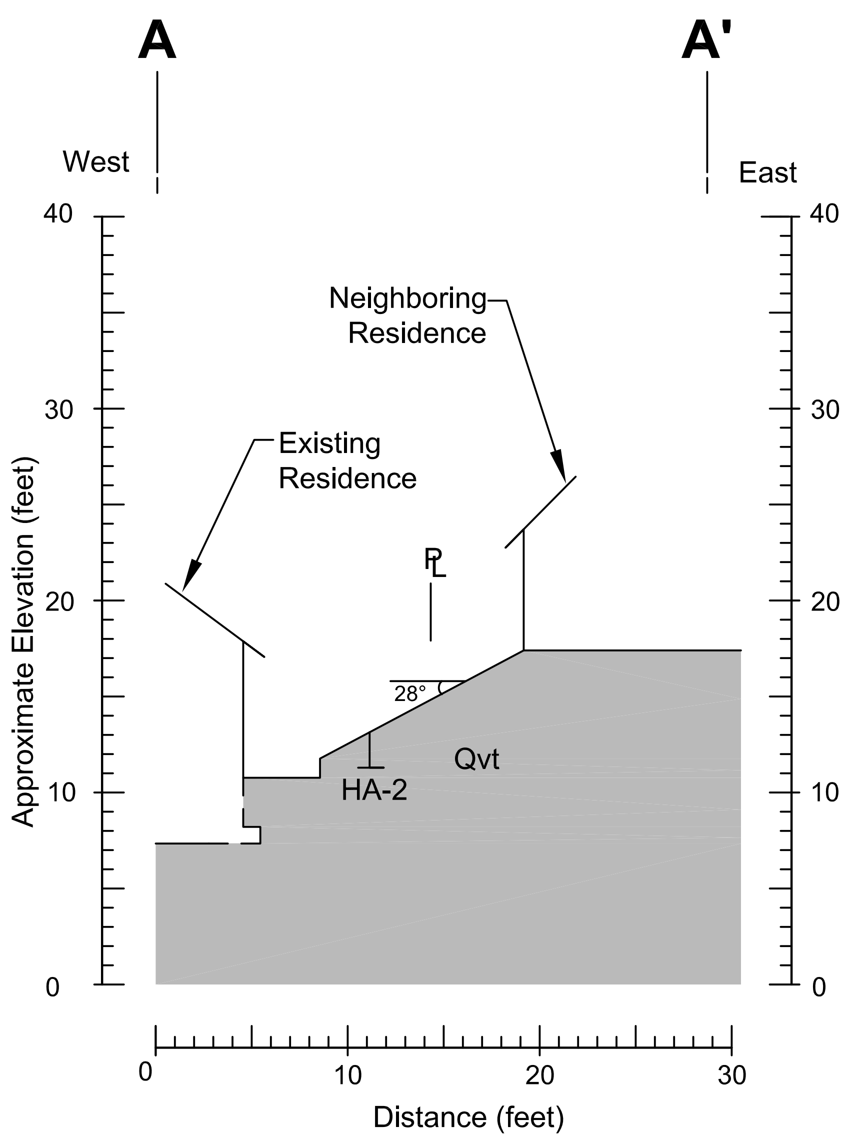
Scale: 1 inch = 60 feet

Reference: Site Plan based on topo survey titled "Topographic & Boundary Survey – On The Rock, LLC – 9740 SE 35th Place S.E. – Mercer Island, WA 98040", dated April 10, 2015

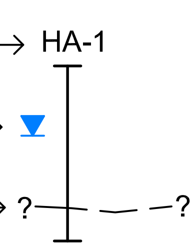
2015 NGA Project Folders\929615 Gibson Three Lot Short Plat\Drafting\SP.dwg

Project Number	Gibson Three Lot Short Plat Site Plan	Nelson Geotechnical Associates, Inc.
929615		Geotechnical Engineers & Geologists
Figure 2		17311-135th Ave. NE, A-500 Woodinville, WA 98072 (425) 486-1669 / Fax 481-2510 — Snohomish County (425) 337-1669 Wenatchee/Chelan (509) 665-7696 www.nelsongeotech.com

No.	Date	Revision	By	CK
1	8/5/15	Original	LSB	KMS



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	Gibson Three Lot Short Plat Cross-Section A-A'	Nelson Geotechnical Associates, Inc.
929615		Geotechnical Engineers & Geologists
Figure 3		17311-135th Ave. NE, A-500, Woodinville, WA 98072, (425) 486-1669 / Fax 481-2510; 437 East Penny Road, Wenatchee, WA 98801, (509) 665-7696

No.	Date	Revision	By	CK
1	8/5/15	Original	LSB	KMS

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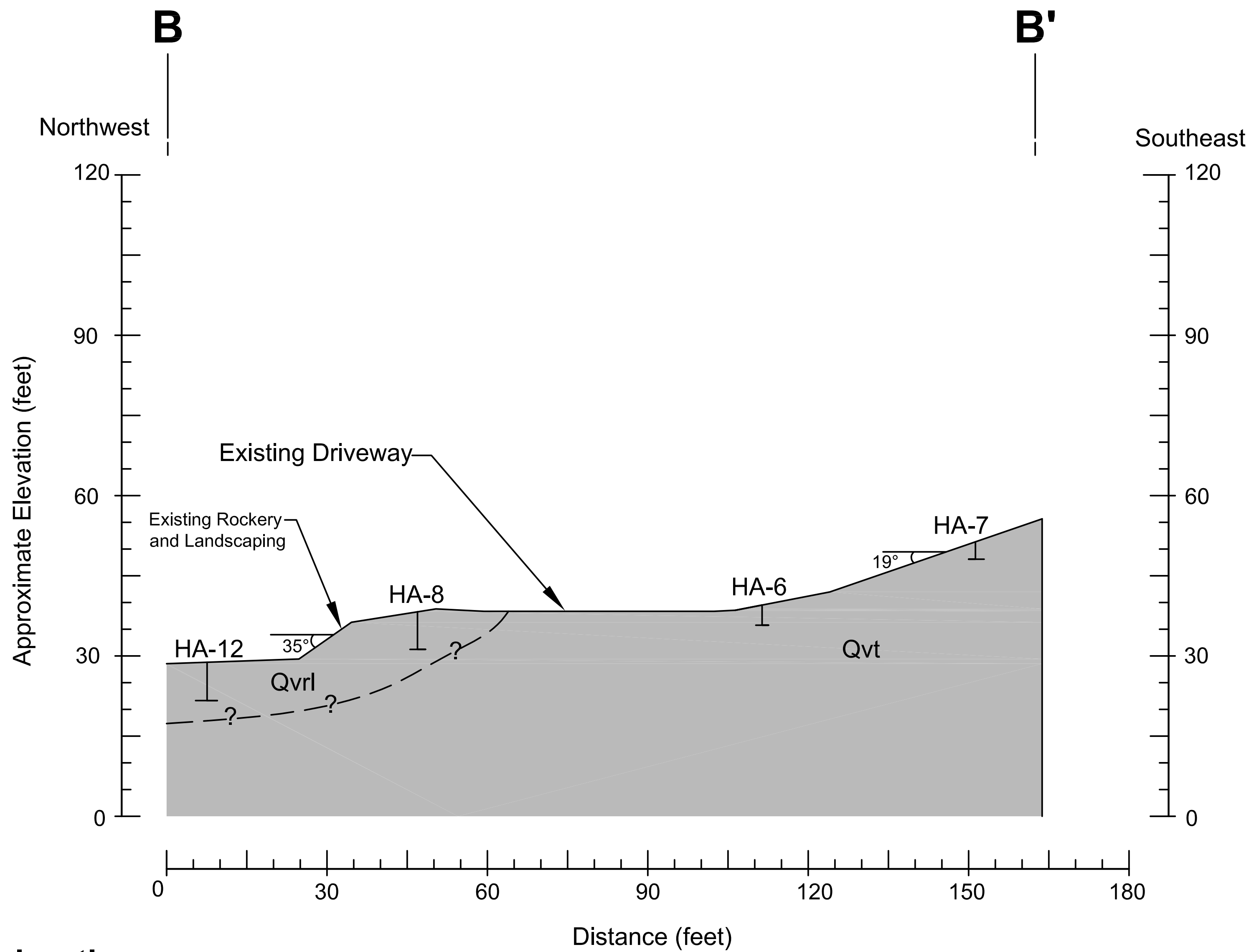

Exploration

Hand Auger Designation → HA-1

Groundwater Level During Exploration →

Geologic Contact (approximate) → ? — — ?

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	Gibson Three Lot Short Plat
929615	Cross-Section B-B'
Figure 4	

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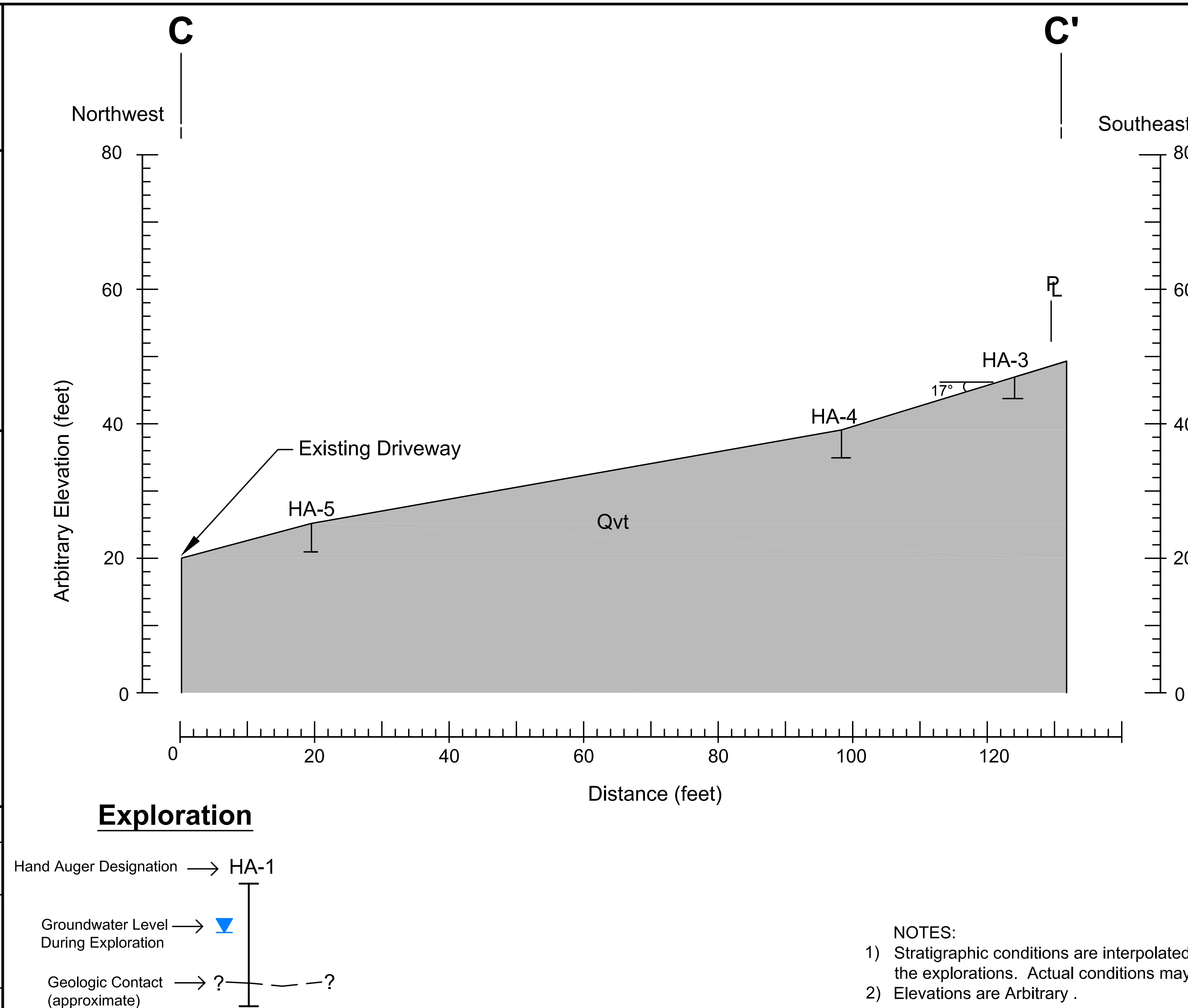
No.	Date	Revision	By	CK
1	8/5/15	Original	LSB	KMS

2015 NGA Project Folders\929615 Gibson Three Lot Short Plat\Drafting\CS.dwg



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

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

Project Number	Gibson Three Lot Short Plat Cross-Section C-C'	Nelson Geotechnical Associates, Inc.
929615		
Figure 5		

NGA
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No.	Date	Revision	By	CK
1	8/5/15	Original	LSB	KMS

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, FLAT 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 929615	Gibson Three Lot Short Plat Soil Classification Chart	Nelson Geotechnical Associates, Inc.	No.	Date	Revision	By	CK
Figure 6			1	8/5/15	Original	LSB	KMS

NGA
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LOG OF EXPLORATION

DEPTH (FEET)	USC	SOIL DESCRIPTION
HAND AUGER ONE		
0.0 – 0.2		TOPSOIL
0.2 – 2.0	SM	LIGHT BROWN FINE TO MEDIUM SAND WITH GRAVEL AND TRACE SILT (LOOSE TO MEDIUM DENSE, MOIST)
2.0 – 4.0	SM	BROWN SILTY FINE TO MEDIUM SAND WITH GRAVEL (DENSE TO VERY DENSE, MOIST)
		SAMPLE WAS COLLECTED AT 4.0 FEET GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED HAND AUGER CAVING WAS NOT ENCOUNTERED HAND AUGER COMPLETED AT 4.0 FEET ON 7/17/15
HAND AUGER TWO		
0.0 – 1.0		TOPSOIL
1.0 – 3.5		DARK BROWN-GRAY SILTY FINE TO MEDIUM SAND WITH GRAVEL AND ORGANICS (LOOSE TO MEDIUM DENSE, MOIST) **(FILL)**
3.5– 4.5	SM	BROWN-GRAY FINE TO MEDIUM SAND WITH SILT (MEDIUM DENSE TO DENSE, MOIST)
		SAMPLE WAS COLLECTED AT 4.0 FEET GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED HAND AUGER CAVING WAS NOT ENCOUNTERED HAND AUGER COMPLETED AT 4.5 FEET ON 7/17/15
HAND AUGER THREE		
0.0 – 0.2		TOPSOIL
0.2 – 1.0	SM	LIGHT BROWN SILTY FINE TO MEDIUM SAND WITH GRAVEL, AND TRACE ORGANICS (LOOSE TO MEDIUM DENSE, MOIST)
1.0 – 3.0	SM	BROWN-GRAY SILTY FINE TO MEDIUM SAND WITH GRAVEL (MEDIUM DENSE TO DENSE, MOIST)
		SAMPLE COLLECTED AT 2.5 FEET GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED HAND AUGER CAVING WAS NOT ENCOUNTERED HAND AUGER COMPLETED AT 3.0 FEET ON 7/17/15
HAND AUGER FOUR		
0.0 – 0.2		TOPSOIL
0.2 – 4.0	SM	BROWN-GRAY SILTY FINE SAND WITH TRACE GRAVEL (DENSE TO VERY DENSE, MOIST)
		SAMPLE COLLECTED AT 4.0 FEET GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED HAND AUGER CAVING WAS NOT ENCOUNTERED HAND AUGER COMPLETED AT 4.0 FEET ON 7/17/15

LOG OF EXPLORATION

DEPTH (FEET)	USC	SOIL DESCRIPTION
HAND AUGER FIVE		
0.0 – 0.2		TOPSOIL
0.2 – 4.0	SM	BROWN-GRAY SAND WITH SILT AND TRACE GRAVEL, AND INTERBEDDED WITH SILTY FINE SANDS (DENSE TO VERY DENSE, MOIST)
		SAMPLE COLLECTED AT 3.0 FEET GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED HAND AUGER CAVING WAS NOT ENCOUNTERED HAND AUGER COMPLETED AT 4.0 FEET ON 7/17/15
HAND AUGER SIX		
0.0 – 0.2		TOPSOIL
0.2 – 1.5	SM	BROWN FINE TO MEDIUM SAND WITH SILT, GRAVEL AND TRACE ORGANICS (LOOSE TO MEDIUM DENSE, MOIST)
1.5 – 3.5	SM	BROWN SILTY FINE TO MEDIUM SAND WITH GRAVEL (MEDIUM DENSE TO DENSE, MOIST)
		SAMPLE COLLECTED AT 3.5 FEET GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED HAND AUGER CAVING WAS NOT ENCOUNTERED HAND AUGER COMPLETED AT 3.5 FEET ON 7/17/15
HAND AUGER SEVEN		
0.0 – 0.2		TOPSOIL
0.2 – 1.5	SM	BROWN-GRAY SILTY FINE TO MEDIUM SAND WITH GRAVEL (VERY DENSE, MOIST)
		SAMPLES WERE NOT COLLECTED GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED HAND AUGER CAVING WAS NOT ENCOUNTERED HAND AUGER MET REFUSAL ON ROCK AT 1.5 FEET ON 7/17/15
HAND AUGER EIGHT		
0.0 – 0.2		TOPSOIL
0.2 – 7.0	SM	DARK BROWN-GRAY SILTY FINE TO MEDIUM SAND WITH GRAVEL AND ORGANICS (LOOSE TO MEDIUM DENSE, MOIST)
		SAMPLE COLLECTED AT 5.0 FEET GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED HAND AUGER CAVING WAS NOT ENCOUNTERED HAND AUGER COMPLETED AT 7.0 FEET ON 7/17/15

LOG OF EXPLORATION

DEPTH (FEET)	USC	SOIL DESCRIPTION
HAND AUGER NINE		
0.0 – 0.2		TOPSOIL
0.2 – 1.5	SM	LIGHT BROWN SILTY FINE TO MEDIUM SAND WITH GRAVEL (MEDIUM DENSE TO DENSE, MOIST)
		SAMPLES WERE NOT COLLECTED GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED HAND AUGER CAVING WAS NOT ENCOUNTERED HAND AUGER COMPLETED AT 1.5 FEET ON 7/17/15
HAND AUGER TEN		
0.0 – 0.2		TOPSOIL AND ORGANICS
0.2 – 1.5	SM	BROWN SILTY FINE TO MEDIUM SAND WITH GRAVEL AND TRACE ORGANICS (LOOSE TO MEDIUM DENSE, MOIST)
		SAMPLES WERE NOT COLLECTED GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED HAND AUGER CAVING WAS NOT ENCOUNTERED HAND AUGER COMPLETED AT 1.5 FEET ON 7/17/15
HAND AUGER ELEVEN		
0.0 – 0.2		TOPSOIL
0.2 – 1.5	SM	BROWN SILTY FINE TO MEDIUM SAND WITH GRAVEL AND TRACE ORGANICS (MEDIUM DENSE, MOIST)
1.5 – 4.0	SM	BROWN SILTY FINE TO MEDIUM SAND (DENSE TO VERY DENSE, MOIST)
HAND AUGER TWELVE		
0.0 – 0.2		TOPSOIL
0.2 – 7.0	SM	DARK BROWN-GRAY SILTY FINE TO MEDIUM SAND WITH GRAVEL AND ORGANICS (LOOSE TO MEDIUM DENSE, MOIST)
		SAMPLES WERE COLLECTED AT 2.0 AND 5.0 FEET GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED HAND AUGER CAVING WAS NOT ENCOUNTERED HAND AUGER COMPLETED AT 7.0 FEET ON 7/17/15