NELSON GEOTECHNICAL ASSOCIATES, INC.

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October 31, 2022

Kimo Funston
c/o Samuel Luthi
Land Resolutions, Inc.
Via Email: jen@orcalsi.com

Geotechnical Engineering Evaluation
Funston Short Plat Development and Infiltration
12527 – 51st Avenue NE
Marysville, Washington
NGA File No. 1383722

Dear Kimo:

We are pleased to submit the attached report titled ***"Geotechnical Engineering Evaluation – Funston Short Plat Development and Infiltration – 12527 – 51st Avenue NE – Marysville, Washington."*** This report summarizes our observations of the existing surface and subsurface conditions within the property and provides general recommendations for the proposed site development. Our services were completed in general accordance with the proposal signed by you on September 20, 2022.

The property is rectangular in shape and covers 1.24 acres in area. It is currently occupied by a single-family residence and a detached garage. The property is bordered by 51st Avenue NE to the west and by neighboring residential properties to all other sides. Topographically, the site is relatively level. We understand the plans for development include demolition of existing site structures, short platting the site into 5 lots, and construction of new single-family residences on each lot.

We explored the site subsurface soil conditions with five trackhoe excavated test pits one of which was utilized for infiltration testing, we also installed two piezometer monitoring wells in Test Pit 2 and 4. The test pit explorations extended to depths in the range of 5.0 to 10.0 feet below the existing ground surface. Our explorations indicated that the site contains a surficial layer of undocumented fill and/or topsoil underlain by competent, native Marysville sand soils in the range of 2.5 to 4.0 feet below the existing ground surface.

It is our opinion that the proposed site development is feasible from a geotechnical engineering standpoint, provided that our recommendations for site development are incorporated into project plans. We recommend that the new residence structure be founded on medium dense or better native bearing glacial soils for bearing capacity and settlement considerations. These soils should generally be encountered approximately 2.5 to 4.0 feet below the existing ground surface based on our explorations. However, deeper areas of loose soil and/or undocumented fill could exist within other unexplored areas of the site. If undocumented fill is encountered in unexplored areas of the site, it should be removed and replaced with structural fill for foundation and pavement support.

We also performed on-site infiltration testing in accordance with the 2019 Stormwater Management Manual for Western Washington (2019 SWMMWW) that is utilized by the city of Marysville to determine the design infiltration rate and overall system sizing. Our on-site testing consisted of performing one small-scale Pilot Infiltration Test (PIT) within the central western portion of the site. The subsurface soils generally consisted of gray, fine to coarse sand with trace gravel in a medium dense or better condition, that we interpreted as native Marysville sand. Based on our observations, testing in the field, and the lack of silt in the native Marysville sand, it is our opinion that native on-site material is conductive for traditional stormwater infiltration systems.

In the attached report, we have provided general recommendations for erosion control, site grading, temporary and permanent slopes, foundations support, structural fill, slabs-on-grade, and site drainage. We should be retained to review and comment on final development plans and observe the earthwork phase of construction. We recommend that Nelson Geotechnical Associates (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 construction differ from those anticipated, and to evaluate whether or not earthwork and foundation installation activities comply with contract plans and specifications.

It has been a pleasure 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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Geotechnical Engineering Evaluation
Funston Short Plat Development and Infiltration
12527 – 51st Avenue NE
Marysville, Washington

INTRODUCTION

This report presents the results of our geotechnical engineering investigation and evaluation of the planned Funston Short Plat Development and Infiltration project. The project site is located at the address of 12527 – 51St Avenue NE in Marysville, 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 the planned site development.

The property is currently occupied by a single-family residence and a detached garage. Topographically, the site is relatively level. The property is bordered by 51st Avenue NE to the west and by neighboring residential properties to all other sides. The existing site layout is 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 general recommendations for site development. Specifically, our scope of services included the following:

1. Reviewing available soil and geologic maps of the area as well as other relevant geotechnical information, as provided.
2. Exploring the subsurface soil and groundwater conditions within the site using trackhoe-excavated test pits. Excavation services were subcontracted by NGA.
3. Providing long-term design infiltration rates based on on-site Small Pilot Infiltration Testing (PIT) per the 2019 SWMMWW.
4. Performing laboratory grain-size sieve analysis on soil samples, as necessary.
5. Providing recommendations for earthwork and foundation support.
6. Providing recommendations for temporary and permanent slopes.
7. Providing recommendations for subsurface utilities and pavement subgrade preparation.
8. Providing our opinion on stormwater infiltration feasibility.

9. Providing recommendations for infiltration/bioretention system installation.

10. Providing general recommendations for site drainage and erosion control.

11. Documenting the results of our findings, conclusions, and recommendations in a written geotechnical report.

SITE CONDITIONS

Surface Conditions

The site consists of a roughly rectangular-shaped property covering approximately 1.24 acres. The property is currently occupied by a single-family residence and a detached garage. Topographically, the site is relatively level. The site is generally vegetated with grass pasture areas, underbrush and scattered young to mature trees. The property is bordered by 51st Avenue NE to the west and by neighboring residential properties to all other sides. We did not observe any surface water during our explorations on September 27, 2022.

Subsurface Conditions

Geology: The geologic units for this site are shown on The Geologic Map of the Marysville Quadrangle, Snohomish County, Washington, by Minard, J.P. (USGS, 1985). The site is mapped as Marysville sand (Qvrm). The Marysville sand is described as consisting mostly of well-drained, stratified to massive outwash sand, a little fine gravel, and some beds of silt and clay. The soils generally encountered in our explorations consisted of surficial fill soil and topsoil underlain by fine to coarse sand with trace gravel consistent with the description of the native Marysville sand deposits at depth.

Explorations: The subsurface conditions within the site were explored on September 27, 2022 with five trackhoe excavated test pits extending to depths in the range of 5.0 to 10.0 feet below the existing ground surface. The approximate locations of our explorations are shown on the Schematic Site Plan in Figure 2.

A geologist from 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 3. The logs of our explorations are attached to this report and are presented as Figures 4 and 5. We present a brief summary of the subsurface conditions in the following paragraph. For a detailed description of the subsurface conditions, the exploration logs should be reviewed.

At the surface of all of our test pits, we encountered approximately 0.5 to 1.0 feet of brown to light brown, silty, fine to medium sand with roots, which we interpreted as surficial topsoil soils. Underlying the layer of surficial topsoil, we encountered brown, fine to coarse sand with trace gravel and silt, which we interpreted to be undocumented fill extending to depths between 2.5 and 4.0 feet below the existing ground surface. Underlying the undocumented fill, we encountered gray, fine to coarse sand with trace gravel, which we interpreted to be native Marysville sand deposits. All of our explorations were terminated within native soils at depths in the range of 5.0 to 10.0 feet below the existing ground surface.

Hydrogeologic Conditions

We did not encounter groundwater within our explorations throughout the site. If shallow groundwater seepage is encountered during construction, we anticipate this would likely be a perched groundwater condition. 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.

A shallow groundwater table may also be present within the site. During our site visit we installed two piezometers within our explorations in Test Pits 2 and 4, respectfully. We will return to the site to monitor ground water conditions throughout the wet season.

SENSITIVE AREA EVALUATION

Seismic Hazard

We reviewed the 2018 International Building Code (IBC) for seismic site classification for this project. Since competent glacial soils are inferred to underlie the site at depth, the site conditions best fit the IBC description for Site Class D. Table 1 below provides seismic design parameters for the site that are in conformance with the 2018 IBC, which specifies a design earthquake having a two percent probability of occurrence in 50 years (return interval of 2,475 years), and the 2008 USGS seismic hazard maps.

Table 1 – ASCE 7-16 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	1.079	0.385	1.068	Null	0.769	Null

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. Liquefaction is caused by a rise in pore pressures in a loose, fine sand deposit beneath the groundwater table. It is our opinion that the medium dense or better glacial deposits interpreted to underlie the site have a low to moderate potential for liquefaction or amplification of ground motion.

Erosion Hazard

The criteria used for determination of the erosion hazard for affected areas include 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 Snohomish County Area, Washington, by the Soil Conservation Service (SCS), was reviewed to determine the erosion hazard of the native on-site soils. The site soils are mapped as Ragnar fine sandy loam, 0 to 8 percent slopes. The erosion hazard for these soils is listed as moderate. Based on our observations and the material encountered, we would interpret this site as having a low to moderate erosion hazard where the surficial soils are exposed. It is our opinion that the erosion hazard for site soils should be low in areas where the site is not disturbed.

CONCLUSIONS AND RECOMMENDATIONS

General

It is our opinion that the planned development within the site is generally feasible from a geotechnical standpoint. Our explorations indicated that the site was generally underlain by competent native Marysville sand soils. The Marysville sand soils encountered at depth should provide adequate support for foundation, slab, and pavement loads. We recommend that the new residence structures be founded on medium dense or better native bearing glacial soils for bearing capacity and settlement considerations. These soils should generally be encountered approximately 2.5 to 4.0 feet below the existing ground surface based on our explorations. However, deeper areas of loose soil and/or undocumented fill could also exist within unexplored areas of the site. If undocumented fill is encountered in unexplored areas of the site, it should be removed and replaced with structural fill for foundation and pavement support. We recommend that NGA be retained to review proposed grading plans once they are developed and allowed to provide alternative foundation support recommendations as needed.

We also performed on-site infiltration testing based on the 2019 Stormwater Management Manual for Western Washington (2019 SWMMWW) that is utilized by the city of Marysville to determine the design infiltration rate and overall system sizing. Our explorations throughout the site generally encountered topsoil and/or undocumented fill soils underlain by competent native Marysville sand at relatively shallow depths. One small pilot infiltration test (small PIT) was conducted within the central western portion of the site. Based on our observations, results of the Small PIT, and the lack of silt in the native soils encountered at depth, it is our opinion that the native soils are conductive for traditional stormwater infiltration systems. Specifics about the long-term design infiltration are outlined in the **Site Drainage** subsection of this report.

Erosion Control

The erosion hazard for the on-site soils are considered to be low 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. Disturbed areas should be planted as soon as practical and the vegetation should be maintained until it is established. The erosion potential of areas not stripped of vegetation should be low.

The soils encountered on this site are considered moisture-sensitive and will disturb easily when wet. 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, 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.

Site Preparation and Grading

After erosion control measures are implemented, site preparation should consist of stripping the topsoil, undocumented fill and/or loose soils from foundation, slab, pavement areas, and other structural areas, to expose medium dense or better native bearing soils. The stripped soil should be removed from the site or stockpiled for later use as a landscaping fill. Based on our observations, we anticipate stripping depths of approximately 2.5 to 4.0 feet, depending on the specific locations. Additional stripping may be required if areas of deeper undocumented fill and/or loose soil are encountered in unexplored areas of the site.

After site stripping, if the exposed subgrade is deemed loose, it should be compacted to a non-yielding condition and then proof-rolled with a heavy rubber-tired piece of equipment. Areas observed to pump or weave during the proof-roll test should be reworked to structural fill specifications or over-excavated and replaced with properly compacted structural fill or rock spalls. If loose soils are encountered in the pavement areas, 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 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 areas of prepared subgrade.

The site soils are considered to be moisture-sensitive and will disturb easily when wet. We recommend that construction take place during the drier summer months if possible. However, if construction takes place during the wet season, additional expenses and delays should be expected due to the wet conditions. Additional expenses could include the need for placing a blanket of rock spalls on exposed subgrades, construction traffic areas, and paved areas prior to placing structural fill. Wet weather grading will also require additional erosion control and site drainage measures. Some of the on-site soils may be suitable for use as structural fill, depending on the moisture content of the soil at the time of construction. NGA should be retained to evaluate the suitability of all on-site and imported structural fill material during 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 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 in the upper undocumented fill soils be no steeper than 2 Horizontal to 1 Vertical (2H:1V). Temporary cuts in the competent unweathered glacial soils at depth should be no steeper than 1H: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.

Foundation Support

Conventional shallow spread foundations should be placed on medium dense or better native bearing glacial soils or be supported on structural fill or rock spalls extending to those soils. Medium dense or better bearing soils should be encountered approximately 2.5 to 4.0 feet below 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. The over-excavation may be filled with structural fill, or the footing may be extended down to the competent native soils. 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 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.

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 design of footings founded on the medium dense or better native bearing soils or structural fill extending to the competent native 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 1-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 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.

Structural Fill

General: Fill placed beneath foundations, pavement, 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.

Materials: Structural fill should consist of 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 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). Some of the more granular on-site soils may be suitable for use as structural fill, but this will be highly dependent on the moisture content of these soils at the time of construction. We should be retained to evaluate all 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 underlying building areas and pavement subgrade 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 and should be tested.

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. 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 may be used to protect the vapor barrier membrane and to aid in curing the concrete.

Pavements

Pavement subgrade preparation and structural filling 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. The pavement section should be underlain by a stable subgrade. We should be retained to observe the proof-rolling and recommend repairs prior to placement of the asphalt or hard surfaces.

Utilities

We recommend that underground utilities be bedded with a minimum six inches of pea gravel prior to backfilling the trench with on-site or imported material. Trenches within settlement sensitive areas should be compacted to 95% of the modified proctor as described in the **Structural Fill** subsection of this report. Trenches located in non-structural areas should be compacted to a minimum 90% of the maximum dry density. The trench backfill compaction should be tested.

Site Drainage

Infiltration: In accordance with the 2019 SWMMWW, we conducted one Small PIT within Infiltration Pit 1, as shown on the Schematic Site Plan in Figure 2. Infiltration Pit 1 measured 5.0-feet long by 3.5-feet wide by 5.0-feet deep. The hole was filled with approximately 12-inches of water at the beginning of the day for the pre-soak period of the test. During the pre-soak period of the test, additional water was consistently added to the hole to maintain the water level.

After the pre-soak period was completed, the water flow rate into the hole was monitored with a Great Plains Industries (GPI) TM 075 flow meter for one hour for the steady-state period of the test. The flow rate for Infiltration Pit 1 averaged out to be 5.88 gallons per minute (352.8 gallons per hour), which equates to an approximate infiltration rate of 32.34 inches per hour. The water was shut off after the steady-state period and the water level within the pit was monitored. After 20 minutes, the water level within the pit had completely dissipated, resulting in an infiltration rate of 36.0 inches per hour.

It is our opinion that the relatively clean Marysville sand soils encountered at depth within the site are suitable for traditional stormwater infiltration. The granular Marysville sand soils were generally encountered at depths in the range of 2.5 to 4.0 feet below the existing ground surface. We have selected an overall field rate of 32.34 inches per hour obtained from the steady-state portion of the test within Infiltration Pit 1 to be utilized in determining the long-term design infiltration rate for the infiltration systems within the site. We referenced the equation in Chapter 5 (Page 736) of the 2019 SWMMWW that applies the correction factors to the field measured infiltration rate to generate a long-term design infiltration rate. Correction factors of 0.50, 0.80, and 0.90 were utilized in this equation for $F_{testing}$, $F_{geometry}$, $F_{plugging}$, respectively. Using these correction factors, we calculated a long-term design infiltration rate of 11.64 inches per hour; however, in accordance with the 2019 SWMMWW we recommend a long-term design infiltration rate of no more than 10.0 inches per hour be utilized within this site. Minimum separation between any infiltration systems and the high groundwater table is required by the design manual. The groundwater levels should be monitored through the wet season and system configured accordingly.

Surface Drainage: Final site grades should allow for drainage away from the planned residence areas. 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 proposed structures. Runoff generated on this site should be collected and routed into a permanent discharge system. 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 site 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 an approved outlet. We recommend that the residence down spouts and footing drains be tight-lined to an approved 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 tight-lines leading to an approved 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 report for **Kimo Funston** and their agents, for use in the planning and design of the development 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.

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 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.

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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.

Sarah L. Dunn
Staff Geologist II

10/31/2022

Khaled M. Shawish, PE
Principal

FKS:SLD:KMS:sg

Five Figures Attached

VICINITY MAP

Not to Scale

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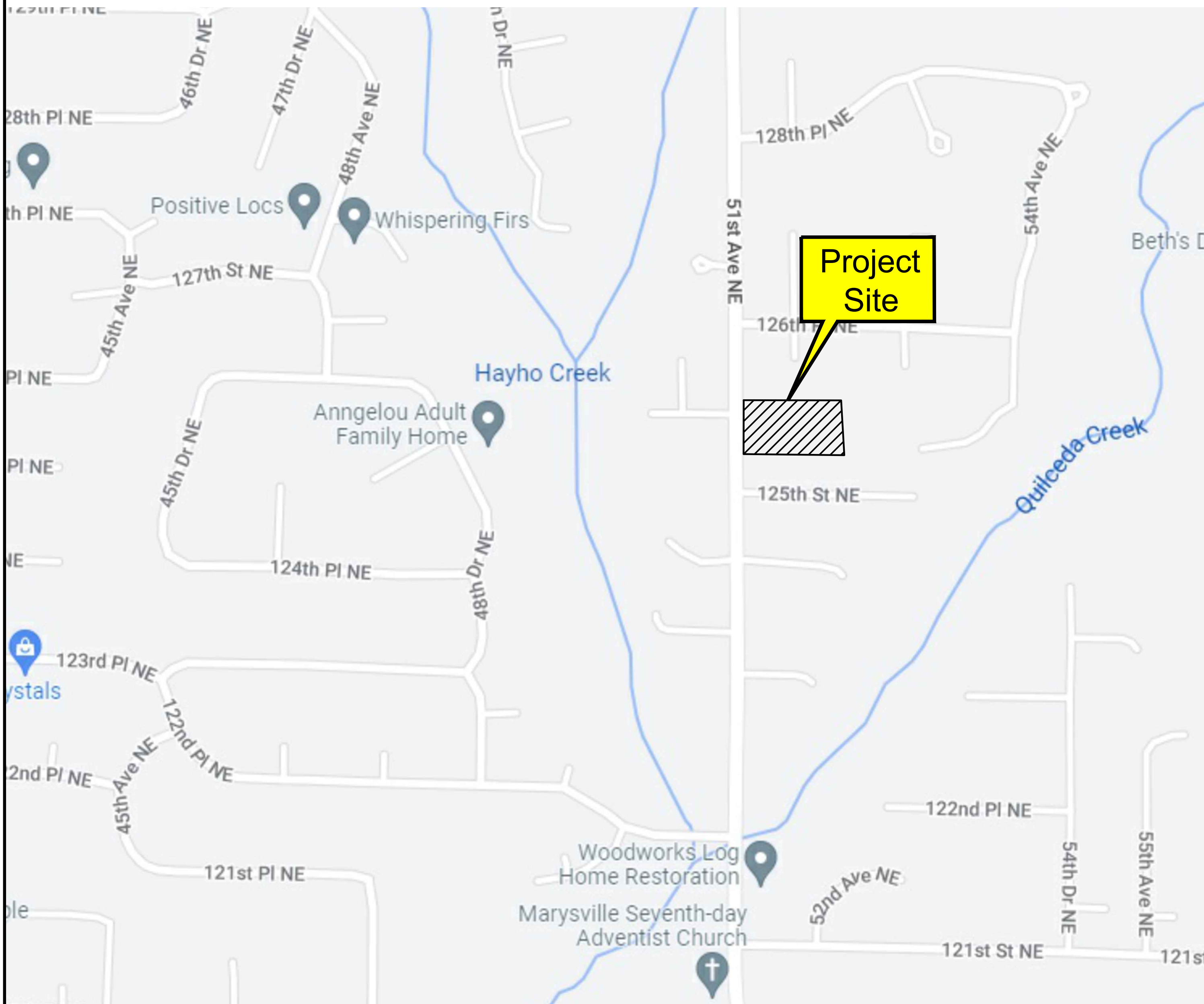

Marysville, WA

Project Number 1383722	Funston Short Plat Vicinity Map	NELSON GEOTECHNICAL ASSOCIATES, INC	No.	Date	Revision	By	CK
Figure 1		**Woodinville Office** 17311-135th Ave. NE, A-500 Woodinville, WA 98072 (425) 486-1669 / Fax: 481-2510 **Wenatchee Office** 105 Palouse St. Wenatchee, WA 98801 (509) 665-7696 / Fax: 665-7692 www.nelsongeotech.com	1	10/6/22	Original	FKS	SLD

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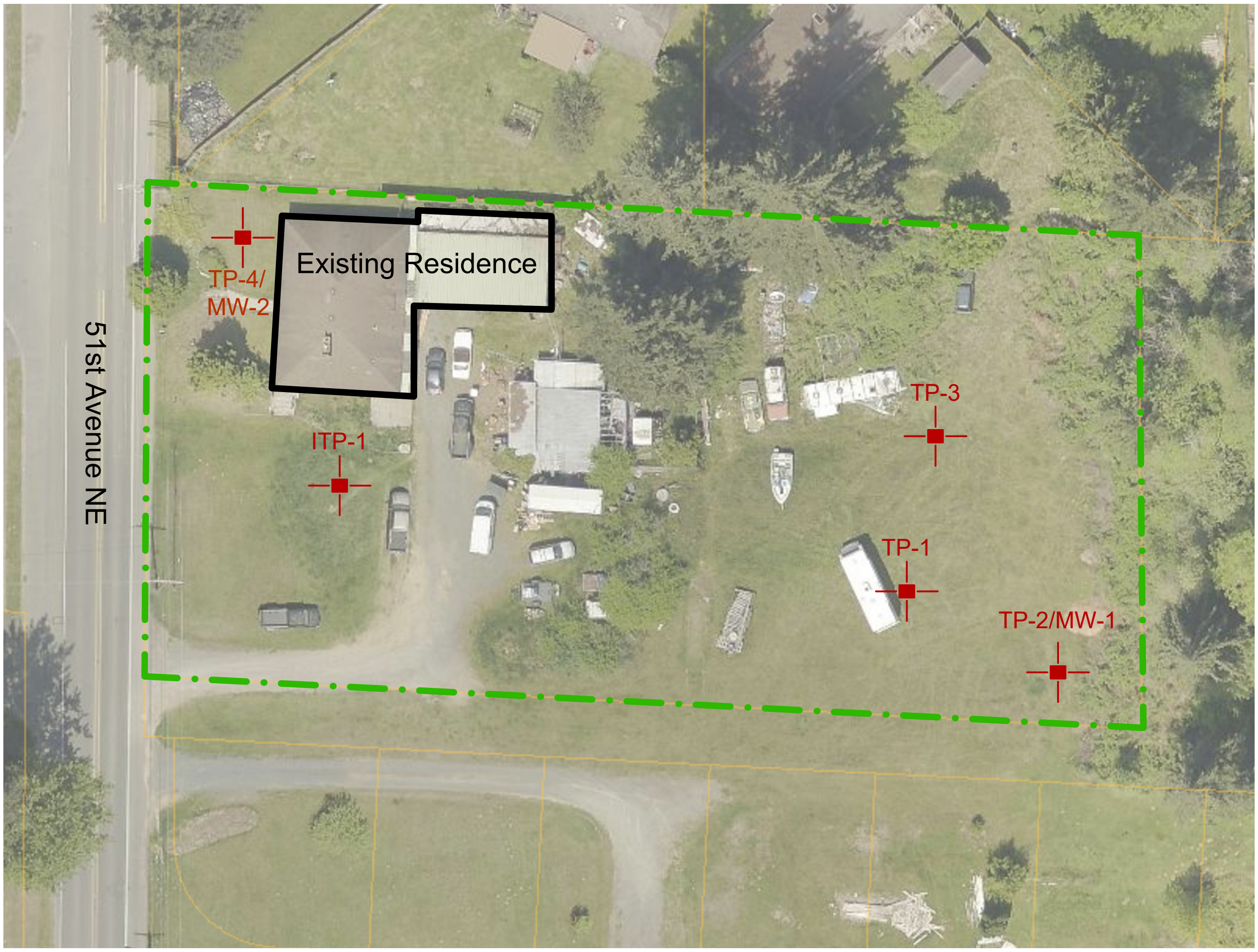
Site Plan



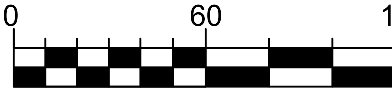
LEGEND

Property line

TP-1 — Number and approximate location of test pit

TP-1 — Number and approximate location of infiltration test pit

MW-1 — Number and approximate location of monitoring well



Scale: 1 inch = 60 feet

Reference: Site Plan based on field measurements, observations, and aerial parcel map review.

Project Number 1383722	Funston Short Plat Site Plan	NELSON GEOTECHNICAL ASSOCIATES, INC	No.	Date	Revision	By	CK
Figure 2		Woodinville Office 17311-135th Ave. NE, A-500 Woodinville, WA 98072 (425) 486-1669 / Fax: 481-2510; Wenatchee Office 105 Palouse St. Wenatchee, WA 98801 (509) 665-7696 / Fax: 665-7692; www.nelsongeotech.com	1	10/6/22	Original	FKS	SLD

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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

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Project Number 1383722	Funston Short Plat Soil Classification Chart	NELSON GEOTECHNICAL ASSOCIATES, INC	No.	Date	Revision	By	CK
Figure 3			1	10/6/22	Original	FKS	SLD

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LOG OF EXPLORATION

DEPTH (FEET)	USCS	SOIL DESCRIPTION
INFILTRATION TEST PIT ONE		
0.0 – 1.0		BROWN TO LIGHT BROWN, SILTY, FINE TO MEDIUM SAND WITH ROOTS (**TOPSOIL / <u>FILL</u>**) (LOOSE, DRY)
1.0 – 2.5		LIGHT BROWN, FINE TO COARSE SAND WITH TRACE GRAVEL AND SILT (LOOSE, DRY) (**<u>FILL</u>**)
2.5 – 5.0	SP	GRAY TO LIGHT GRAY, FINE TO COARSE SAND WITH TRACE GRAVEL (LOOSE TO MEDIUM DENSE, DRY TO MOIST)
		SAMPLES WERE NOT COLLECTED GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 5.0 FEET ON 9/27/2022
TEST PIT ONE		
0.0 – 0.5		BROWN TO LIGHT BROWN, SILTY, FINE TO MEDIUM SAND WITH ROOTS (**TOPSOIL / <u>FILL</u>**) (LOOSE, DRY)
0.5 – 3.0		BROWN, FINE TO COARSE SAND WITH TRACE GRAVEL AND SILT (LOOSE, DRY) (**<u>FILL</u>**)
3.0 – 9.5	SP	GRAY, FINE TO COARSE SAND WITH TRACE GRAVEL (LOOSE TO MEDIUM DENSE, DRY TO MOIST)
		SAMPLES WERE COLLECTED AT 4.75 FEET GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 9.5 FEET ON 9/27/2022
TEST PIT TWO		
0.0 – 0.5		BROWN TO LIGHT BROWN, SILTY, FINE TO MEDIUM SAND WITH ROOTS (**TOPSOIL / <u>FILL</u>**) (LOOSE, DRY)
0.5 – 3.5		BROWN, FINE TO COARSE SAND WITH TRACE GRAVEL AND SILT (LOOSE, DRY) (**<u>FILL</u>**)
3.5 – 8.5	SP	GRAY, FINE TO COARSE SAND WITH TRACE GRAVEL (LOOSE TO MEDIUM DENSE, DRY TO MOIST)
		SAMPLES WERE COLLECTED AT 6.0 FEET GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 8.5 FEET ON 9/27/2022
TEST PIT THREE		
0.0 – 1.0		BROWN TO LIGHT BROWN, SILTY, FINE TO MEDIUM SAND WITH ROOTS (**TOPSOIL / <u>FILL</u>**) (LOOSE, DRY)
1.0 – 4.0		BROWN, FINE TO COARSE SAND WITH TRACE GRAVEL AND SILT (LOOSE, DRY) (**<u>FILL</u>**)
4.0 – 10.0	SP	GRAY, FINE TO COARSE SAND WITH TRACE GRAVEL (LOOSE TO MEDIUM DENSE, DRY TO MOIST)
		SAMPLES WERE COLLECTED AT 8.5 FEET GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 10.0 FEET ON 9/27/2022

LOG OF EXPLORATION

DEPTH (FEET)	USCS	SOIL DESCRIPTION
TEST PIT FOUR		
0.0 – 0.5		BROWN TO LIGHT BROWN, SILTY, FINE TO MEDIUM SAND WITH ROOTS (**TOPSOIL / FILL**) (LOOSE, DRY)
0.5 – 4.0		BROWN, FINE TO COARSE SAND WITH TRACE GRAVEL AND SILT (LOOSE, DRY) (**FILL**)
4.0 – 9.0	SP	GRAY, FINE TO COARSE SAND WITH TRACE GRAVEL (LOOSE TO MEDIUM DENSE, DRY TO MOIST)

SAMPLES WERE COLLECTED AT 8.5 FEET
GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED
TEST PIT CAVING WAS NOT ENCOUNTERED
TEST PIT WAS COMPLETED AT 9.0 FEET ON 9/27/2022