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February 8, 2017

Mr. Ben Zhang
9800 Harbour Place
Suite 205 and 206
Mukilteo, Washington 98275

Supplemental Geotechnical Engineering Letter
**Zhang Family Residence**
**7908 – 53rd Avenue West**
**Mukilteo, Washington**
NGA Project No. 9365B16

Dear Mr. Zhang:

This letter summarizes our supplemental geotechnical evaluation of the proposed Zhang Family Residence located at 7908 - 53rd Avenue West in Mukilteo, Washington, as shown on the Vicinity Map in Figure 1.

## INTRODUCTION

We previously prepared a geotechnical engineering evaluation for this site dated June 16, 2016. As a part of this previous evaluation, the proposed development plan consisted of removing the existing residence and constructing a new single-family residence within the same general location along with associated driveways and underground utilities. We now understand that the proposed development plan will also include subdividing the property into three separate lots and constructing two additional single-family residences within the upper eastern portion of the site, immediately east of the originally planned residence. The two new residences are proposed to be located as close as 50 feet from the top of a steep east-facing ravine slope within the lower eastern portion of the property which was not evaluated as a part of our previous report. The new planned layout is shown in Figure 2.

We also understand that stormwater generated within the site is proposed to be directed to on-site infiltration systems, if feasible. Such systems may include rain gardens and/or pervious pavements within the upper central-portion of the property. The City of Mukilteo utilizes the 2014 WSDOE Stormwater Management Manual for Western Washington manual to determine the design of infiltration or detention facilities. According to this manual, long-term design infiltration rates for this site are to be determined by performing on-site infiltration testing consisting of the Small Pilot Infiltration Test (PIT). We have been requested to perform an on-site infiltration test to further evaluate the infiltration capacity of the on-site soils, for use in designing the new stormwater control systems within the property. We have also been requested to evaluate the existing eastern portion of the property and provide our opinions and recommendations regarding the proposed development within this area.

## RECENT OBSERVATIONS

### Surface Conditions

The property is a generally rectangular-shaped parcel covering approximately 3.78 acres. The existing residence and the proposed development portion of the site consist of a relatively level to gently sloping upper bench area. A steep west-facing slope descends from the western portion of the bench area to railroad tracks and the Puget Sound below as discussed in our previous report. The eastern portion of the development area slopes gently down from the central portion of the site to the top of a steep east-facing ravine slope. A paved access driveway for the neighboring properties to the north is located along the top of the steep east-facing slope. The steep east-facing ravine slope descends from the eastern side of the driveway to a creek below at gradients in the range of 37 to 40 degrees (75 to 84 percent) to a creek at the base of the ravine area as shown on Cross Section A-A' in Figure 3. The overall height of the steep to very steep ravine slope is approximately 150 feet. The steep east-facing slope is generally vegetated with young to mature trees and dense underbrush. We did not observe any standing water within the site or groundwater seepage emitting from the steep slope during our site visit on January 13, 2017. We did not observe signs of recent slope movement; however, we did observe some exposed soils and areas lacking mature vegetation on the east-facing steep slope, indicative of past shallow surficial sloughing events.

### Subsurface Conditions

**Geology:** The geologic units for this area are shown on the Distribution and Description of Geologic Units in the Mukilteo Quadrangle, Washington, by James P. Minard (USGS, 1982). The site is mapped as Vashon Till (Qvt) with Advance Outwash (Qva) and Whidbey Formation (Qw) mapped within the steep slope area located to the west of the site. The Vashon till is described a non-sorted mixture of clay, silt, sand, pebbles, cobbles, and boulders. The advance outwash is described as mostly clean, gray, pebbly sand and the Whidbey formation is described as mostly very compact, medium- to coarse-grained,

oxidized cross-bedded sand. Our past and most recent explorations generally encountered medium dense or better, silty sand with gravel, consistent with the description of Vashon Till at depth.

**Explorations:** The subsurface conditions within the site were explored on January 13, 2017 by performing seven hand auger explorations and one infiltration pit with hand tools. The approximate locations of our most recent 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 4. The logs of our explorations are attached to this letter and are presented as Figures 5 and 6. We present a brief summary of the subsurface conditions encountered in the explorations in the following paragraph. For a detailed description of the subsurface conditions, the exploration logs should bc reviewed.

In all of our recent explorations, we encountered approximately 0.2 to 2.0 feet of surficial organic soils and topsoil. Underlying the surficial soils in Infiltration Pit 1 and Hand Augers 6 and 7, we encountered approximately 1.0 to 3.5 feet of loose to medium dense dark brown to gray-brown silty fine to medium sand with gravel and varying amounts of gravel, organics, and debris that we interpreted as undocumented fill soils. Underlying the surficial soils in Hand Augers 1 through 5, and the undocumented fill soils in Infiltration Pit 1 and Hand Augers 6 and 7, we encountered medium dense to dense light brown to orange-brown silty fine to medium sand with gravel that we interpreted as native glacial till soils. All of our recent explorations were terminated within the native glacial till soils at depths in the range of 2.0 to 5.0 feet below the existing ground surface. Groundwater seepage was not encountered in our most recent explorations.

As a part of our previous evaluation, we conducted drilled borings within the western portion of the property. Our previous explorations encountered medium dense to very dense, native glacial till soils at depth similar to the most recent explorations. We did not encounter groundwater seepage within the past explorations to the depths explored.

## CONCLUSIONS AND RECOMMENDATIONS

### General

It is our opinion, that the proposed development within the eastern portion of the property is feasible from a geotechnical standpoint. It is also our opinion that the soils that underlie the site and form the core of the eastern steep slopes should be stable with respect to deep-seated earth movements, due to their inherent strength and slope geometry. However, there is a significant potential for shallow sloughing and erosion events to occur on the steep slope along the eastern side of the site. Proper erosion and drainage control measures, along with long-term maintenance of the slope and drainage systems as recommended in our previous report, should reduce this potential but not fully eliminate it. We recommend that we review the plans after they have been developed.

Our explorations within the eastern portion of the site indicate that the site is generally underlain by medium dense to very dense native glacial soils at depth. The native soils should provide adequate support for foundation and slab loads. We recommend that the structures be designed utilizing shallow 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 two to three feet below the existing ground surface throughout the site with some potential localized areas of deeper loose soils in unexplored areas of the site.

It is our opinion that a proposed eastern residence building setback of 50 feet from the top of steep east-facing slope is adequate at this time to protect the structure against potential failures on the slope. We also recommend that the downhill residence foundation lines be embedded a minimum of two feet into the medium dense or better native glacial till soils, and that no significant grading is performed within the setback area.

We also performed on-site infiltration testing based on the 2014 WSDOE Stormwater Management Manual for Western Washington. One small pilot infiltration test (PIT) was performed within the central portion of the property. The infiltration pit encountered silty fine to medium sand with gravel that we interpreted as native glacial till soils. Based on our on-site testing, it is our opinion that the native glacial till soils encountered within the property are not conducive to traditional infiltration systems. However, shallow low-impact design infiltration systems in the form of pervious pavements, bio swales, or rain gardens may be feasible at specific areas within the site depending on the final layout. This should be further discussed with the civil engineer. Due to the medium dense to very dense native glacial soils encountered within our explorations, we recommend that any shallow infiltration systems installed on the

site have an overflow component directed to an approved location. We understand that such systems may consist of HDPE pipes that are directed to flow down the steep slopes within the western and eastern sides of the property. This is further discussed in the **Stormwater Infiltration** subsection of this report.

All of the recommendations provided in our previous report could be applied to the proposed development within the eastern portion of the property, and should be included in the overall site design. We should note that we did not evaluate the existing access driveway for stability or ability to handle the increased traffic and potential five truck access. Depending on such factors, it may be prudent to have us specifically evaluate the driveway. In any case, the driveway and area before the driveway and the slope should be monitored regularly for any signs of instability, and corrective actions promptly taken should any such signs be observed.

## Stormwater Infiltration

**General:** The 2014 WSDOE Stormwater Management Manual for Western Washington was utilized to determine the long term design infiltration rate of the site soils. According to this manual, on-site infiltration testing consisting of the Small-Scale Pilot Infiltration Test (PIT) was used to determine the long-term design infiltration rates. The subsurface soils generally consisted of silty sand with varying amounts of gravel and cobbles that we interpreted as native glacial till soils.

We conducted one infiltration test within the site as shown on the attached Site Plan in Figure 2. Infiltration Pit 1 was located in the central portion of the property to the east of the proposed western residence. After the infiltration pit was excavated, it was filled with 12-inches of water and this level was maintained for approximately six hours for the soaking period of the test.

After the 6-hour soaking period was completed, the water level was maintained at approximately 12-inches for one hour for the steady-state period. The flow rate for Infiltration Pit 1 stabilized at 0.046 gallons per minute (2.76 gallons per hour). This equated to an approximate infiltration rate of 0.365 inches per hour. The water was shut off after the steady-state period and monitored every 15 minutes for one hour. After one hour, the water level within the pit had dropped 0.313-inches, resulting in an field measured infiltration rate of 0.313 inches per hour. In accordance with the Table 3.3.1 of the 2014 WSDOE Stormwater Management Manual for Western Washington Volume III, correction factors of 0.50, 0.50, and 0.9 for $CF_v$, $CF_t$, $CF_m$, respectively were applied to the field measured infiltration rate. A total correction factor of 0.225 was applied to the measured field infiltration rate to determine the long-term design infiltration rate. The 0.313 inches per hour rate obtained from the falling head period of the test was utilized as the overall measured field infiltration rate.

Using the above correction factor, we calculated a long-term design infiltration rate of approximately 0.07 inches per hour. Based on the extremely slow infiltration rate obtained from our on-site infiltration testing and relatively silty nature of the site soils, it is our opinion that the native glacial till soils encountered within the property are not conducive to traditional infiltration systems. However, shallow low-impact design infiltration systems in the form of pervious pavements, bio swales, or rain gardens may be feasible at specific areas within the site depending on the final layout. These areas would include the upper central portion of the property. We do not recommend the use of low-impact design stormwater systems on the tops of the steep slopes and the residences. All runoff from impervious surfaces between the structures and steep slopes should be directed to flow into an approved discharge system and not into on-site infiltration systems. This should be further discussed with the civil engineer. Any low-impact design systems within the property could incorporate the recommended long-term design infiltration rate into the overall system design. However, we recommend that any shallow infiltration systems installed on the site incorporate an overflow component into the system that is directed to an approved detention/outfall system.

## Site Drainage

**Surface Drainage:** Final site grades should allow for drainage away from the top of the slopes and away from the planned structures. 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 and top of the slopes. Runoff generated on this site should be collected and routed into a permanent discharge system away from the steep slopes. This should include all downspouts and footing drains, and runoff generated on all hard surfaces and yards areas. Under no circumstances should water be allowed to flow uncontrolled over the steep slopes. Water should not be allowed to collect in any area where footings or slabs are to be constructed. Stormwater handling plans were not developed when this report was prepared and therefore we should be retained to review such plans during final design.

We understand that stormwater generated on this site may be directed into HDPE tightline pipes that are directed to flow down the steep western and eastern slopes within the property. In our opinion, this should be feasible. We recommend that main catch basins for the slope pipes be setback a minimum of 25 feet from the top of the steep slopes. From the main catch basin, the outfall pipe should be connected and constructed to maintain positive flow down the surface of the steep slopes to a dissipater tee located at the toe of the steep slopes. The dissipater tee could consist of the same HDPE pipe as the main pipe with ½-inch diameter holes drilled in it at 6-inch on center to further dissipate the flow and should extend a minimum of two feet on each side of the main HDPE pipe. The diffuser pad should consist of a layer of 4- to 8-inch rock spalls placed to further disperse the flow from the dissipater tee, armor the slope,

further minimize erosion effects, and to hold the diffuser tee in place. The pipe should lie directly on the ground surface and be anchored using metal posts and pipe wraps to minimize lateral movement. The number of anchors and locations should be determined for adequate pipe support. The pipe should be sized by the civil engineer based on the anticipated flow to be handled within the pipe system. NGA should be retained to evaluate the drainage systems as they are 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 away from the slope.

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 four-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.

### Pervious Pavement

Pervious pavement may be utilized for the proposed driveway areas associated with the residences within the central portions of the site. We recommend that the pavement subgrade be over-excavated and replaced with a minimum of 18 inches of clean pit run. The pervious pavement section should be supported directly on the pit run. The pit run layer should help facilitate infiltration, but will also aid in providing a "storage" medium for infiltrating water. This layer should only be lightly compacted. The long-term design infiltration rate of 0.07 inches per hour can be used for the underlying native glacial soils. The pervious pavement section should be a minimum of 4-inches thick.

The subgrade below the pit run should be stripped of grass, topsoil, and undocumented fill material to expose weathered native glacial soils prior to placing the pit run. These soils should generally be encountered approximately one to three feet below the existing ground surface. The subgrade below the pit run layer should be scarified to a depth of six inches and graded level. The exposed subgrade should not be heavily compacted, as these conditions may reduce the infiltration capability of this material. Also, construction traffic on the exposed subgrade should be avoided. We should be retained to observe subgrade preparation prior to placing the pit run layer.

Regular maintenance of the pervious pavement is very important. It would be prudent for the client to have a plan in place for periodic maintenance to help maintain the performance of the pavement. The pavement should be thoroughly swept and pressure-washed periodically to minimize siltation.

## USE OF THIS LETTER

This letter was prepared for Mr. Ben Zhang and his agents, for use in planning and budgeting the above-referenced project only. This letter may be used for bidding and estimating purposes, but our letter, conclusions, and interpretations should not be construed as a warranty of the subsurface conditions. The subsurface conditions between explorations may vary. A contingency for varying conditions should be incorporated into the 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 the design and 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 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.

***NELSON GEOTECHNICAL ASSOCIATES, INC.***

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 letter was prepared. No other warranty, expressed or implied, is made. Our observations, findings, and opinions are a means to identify and reduce the inherent risks to the owner.

o-o-o

We appreciate the opportunity 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**


Exp. July 28, 2017

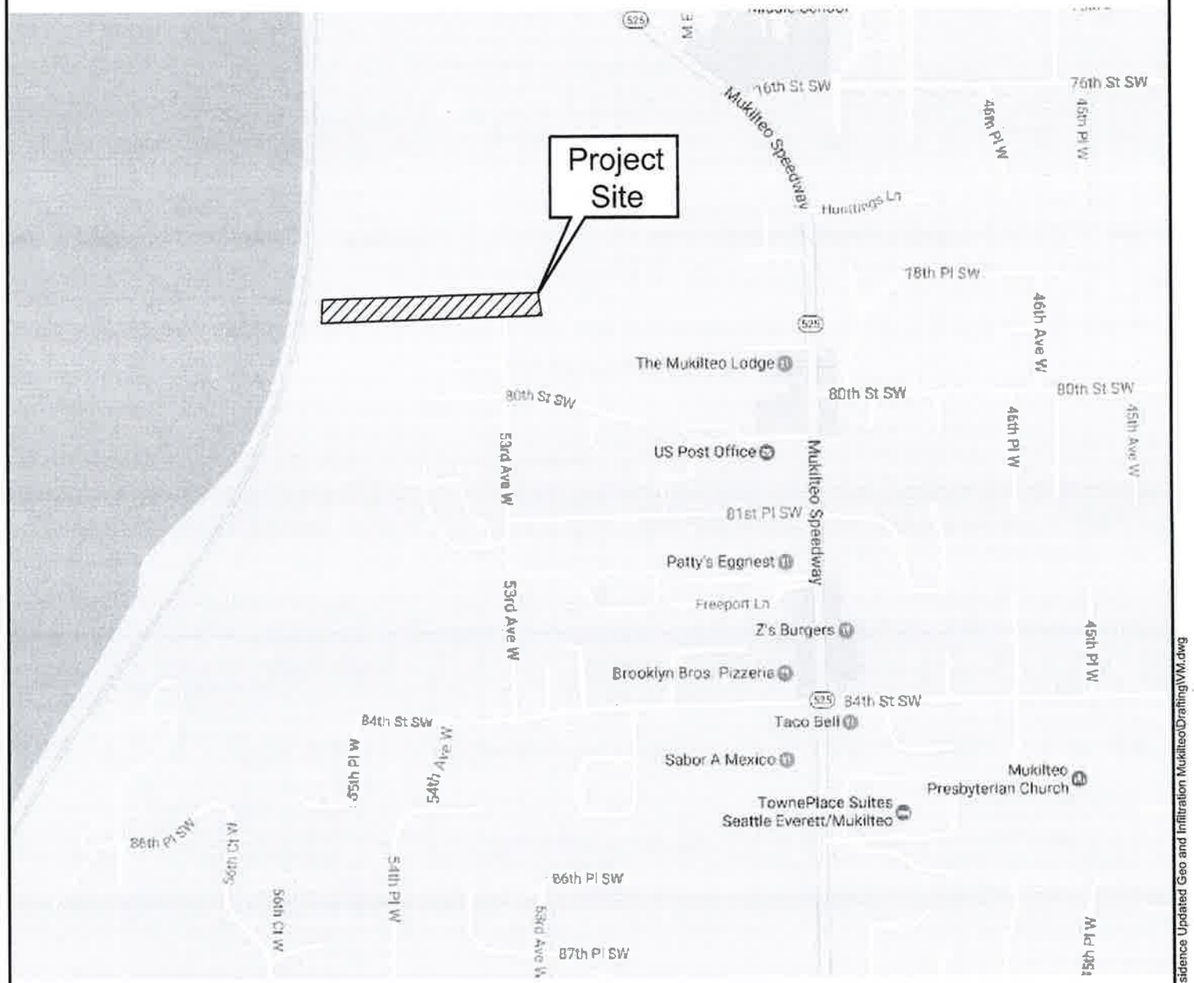
Khaled M. Shawish, PE
**Principal**

LSB:KMS:dy

Attachments: Six Figures

# VICINITY MAP

Not to Scale




## Mukilteo, WA

| Project Number | Zhang Family Residence Infiltration Vicinity Map | NELSON GEOTECHNICAL ASSOCIATES, INC. NGA GEOTECHNICAL ENGINEERS & GEOLOGISTS | No. | Date | Revision | By | CK |
|---|---|---|---|---|---|---|---|
| 9365B16 | | | 1 | 1/12/17 | Original | DPN | ABR |
| 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 | | | | | |

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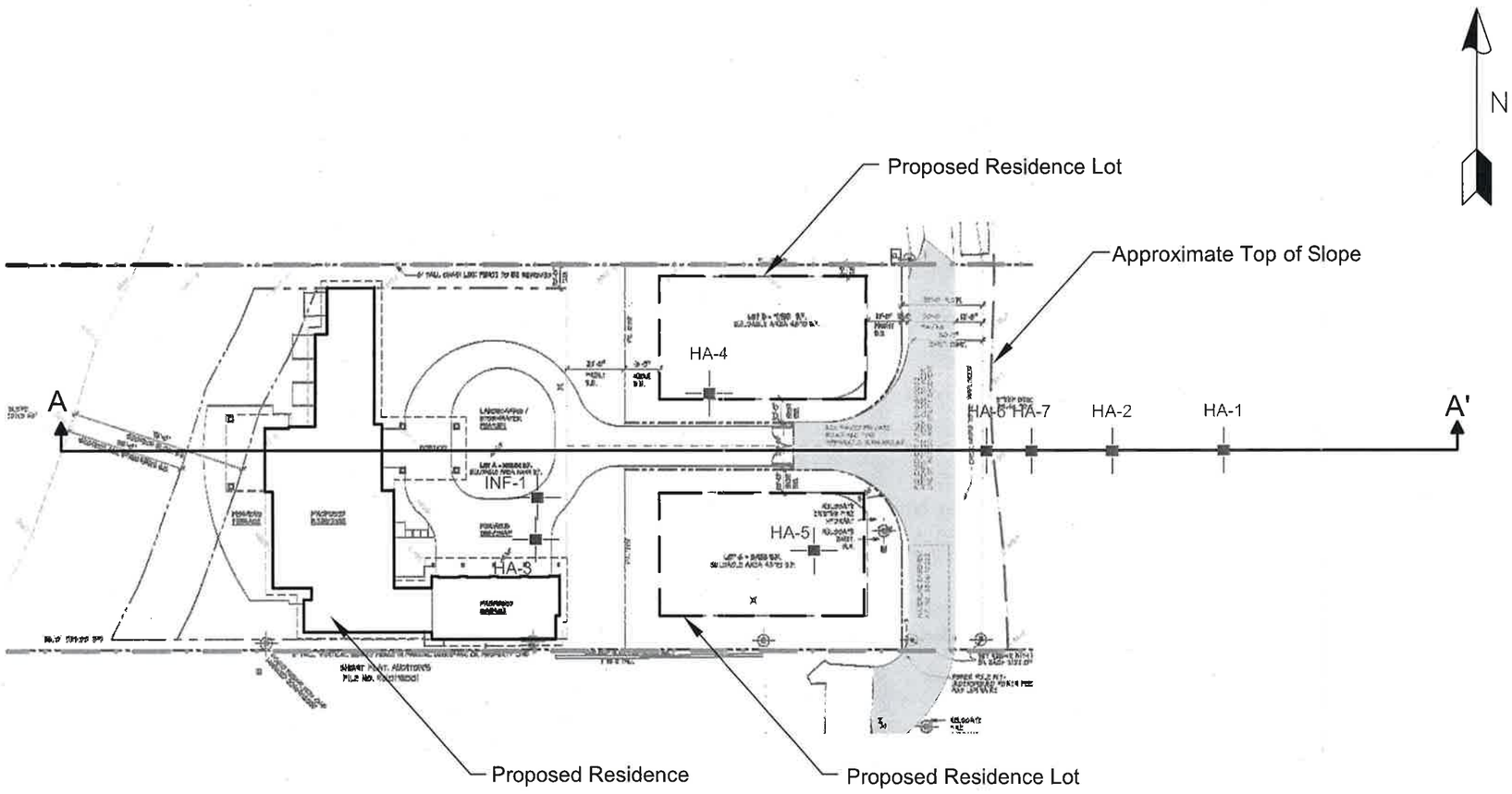
# Site Plan




## LEGEND

- Property line
- INF-1 — Number and approximate location of infiltration test pit
- HA-1 — Number and approximate location of hand auger
- A — A' — Approximate location of cross-section

0 60 120

Scale: 1 inch = 60 feet

Reference: Site plan based on a plan dated September 16, 2016 titled "Zhang Family LLC," prepared by Fred Baxter & Associates.

| No. | Date | Revision | By | CK |
|---|---|---|---|---|
| 1 | 2/1/17 | Original | DPN | |

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Zhang Family Residence Infiltration
Site Plan

Project Number 9356B16

Figure 2

Project Number 9365B16

Figure 3

Zhang Family Residence
Infiltration
Cross-Section A-A'

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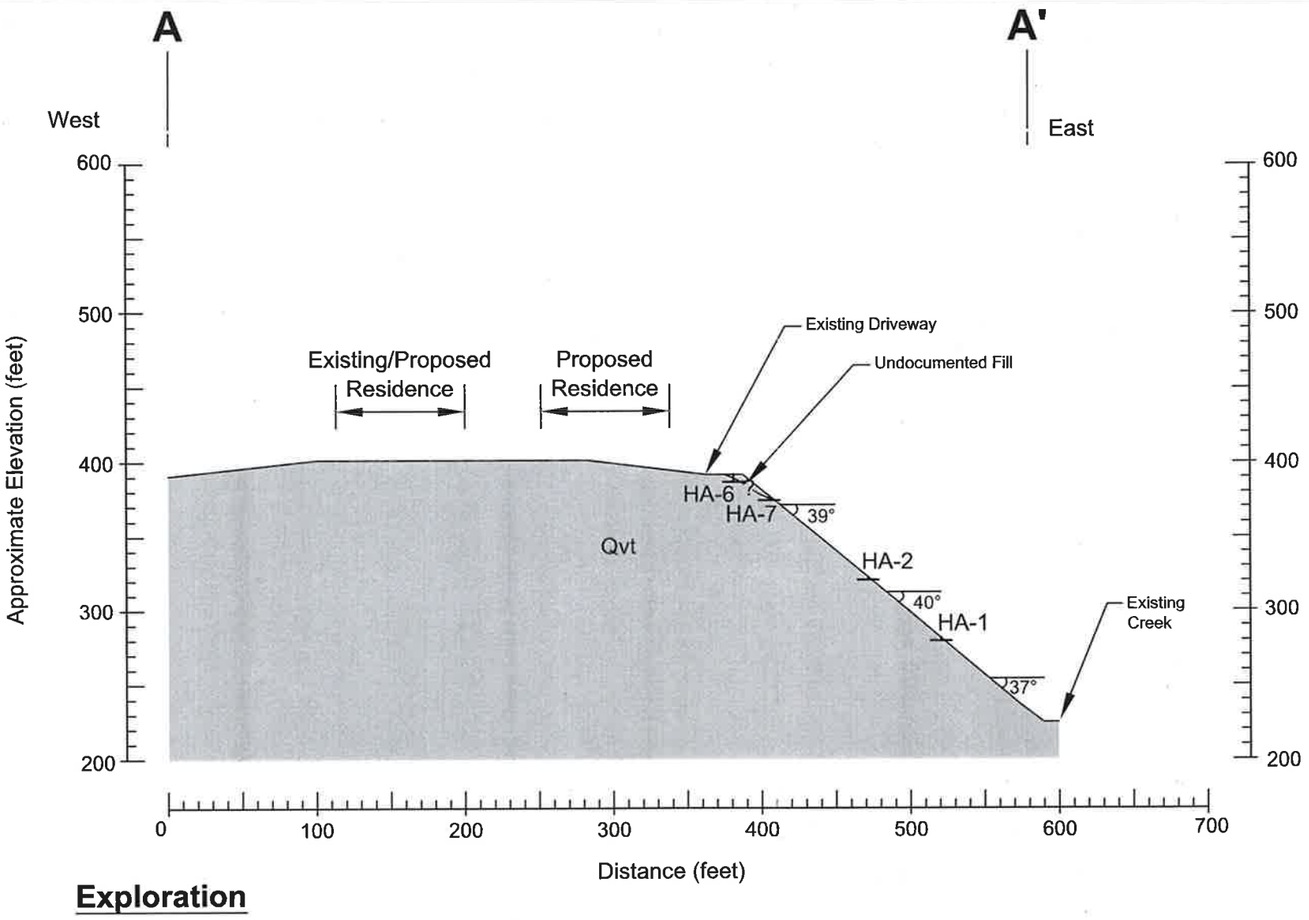
|---|---|---|---|---|
| 1 | 1/12/17 | Original | DPN | ABR |




## 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.

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# UNIFIED SOIL CLASSIFICATION SYSTEM

| MAJOR DIVISIONS | | | GROUP SYMBOL | GROUP NAME |
|---|---|---|---|---|
| COARSE - GRAINED SOILS<br><br>MORE THAN 50 % RETAINED ON NO. 200 SIEVE | GRAVEL<br><br>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<br><br>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<br><br>MORE THAN 50 % PASSES NO. 200 SIEVE | SILT AND CLAY<br><br>LIQUID LIMIT LESS THAN 50 % | INORGANIC | ML | SILT |
| | | | CL | CLAY |
| | | ORGANIC | OL | ORGANIC SILT, ORGANIC CLAY |
| | SILT AND CLAY<br><br>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 9365B16 | Zhang Family Residence Infiltration Soil Classification Chart | NELSON GEOTECHNICAL ASSOCIATES, INC. NGA GEOTECHNICAL ENGINEERS & GEOLOGISTS | No. | Date | Revision | By | CK |
| Figure 4 | | 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 | 1 | 1/12/17 | Original | DPN | ABR |

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# LOG OF EXPLORATION

| DEPTH (FEET) | USC | SOIL DESCRIPTION |
|---|---|---|
| **INFILTRATION PIT ONE** | | |
| 0.0 – 0.5 | | BEAUTY BARK AND TOPSOIL |
| 0.5 – 1.5 | | DARK BROWN TO ORANGE-BROWN, SILTY FINE TO MEDIUM SAND WITH GRAVEL, ROOTS, ORGANICS, AND CHARCOAL (LOOSE TO MEDIUM DENSE, MOIST) (**FILL**) |
| 1.5 – 3.5 | SM | ORANGE-BROWN TO GRAY-BROWN, SILTY FINE TO MEDIUM SAND WITH GRAVEL AND TRACE IRON-OXIDE WEATHERING (MEDIUM DENSE TO DENSE, MOIST) |
| | | SAMPLES WERE NOT COLLECTED<br>GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED<br>INFILTRATION PIT CAVING WAS NOT ENCOUNTERED<br>INFILTRATION PIT COMPLETED 3.5 FEET ON 1/6/17 |
| **HAND AUGER ONE** | | |
| 0.0 – 1.0 | | DARK BROWN, SILTY FINE TO MEDIUM SAND WITH GRAVEL AND TRACE ROOTS (LOOSE TO MEDIUM DENSE, MOIST) (**TOPSOIL**) |
| 1.0 – 2.0 | SM | GRAY-BROWN, SILTY FINE TO MDEIUM SAND WITH GRAVEL, AND TRACE IRON-OXIDE STAINING (LOOSE TO MEDIUM DENSE, MOIST) |
| | | SAMPLES WERE NOT COLLECTED<br>GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED<br>HAND AUGER CAVING WAS NOT ENCOUNTERED<br>HAND AUGER COMPLETE AT 2.0 FEET ON 1/6/17 |
| **HAND AUGER TWO** | | |
| 0.0 – 1.0 | | DARK BROWN, SILTY FINE TO MEDIUM SAND WITH GRAVEL AND TRACE ROOTS (LOOSE TO MEDIUM DENSE, MOIST) (**TOPSOIL**) |
| 1.0 – 2.0 | SM | GRAY-BROWN, SILTY FINE TO MDEIUM SAND WITH GRAVEL, AND TRACE IRON-OXIDE STAINING (LOOSE TO MEDIUM DENSE, MOIST) |
| | | SAMPLES WERE NOT COLLECTED<br>GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED<br>HAND AUGER CAVING WAS NOT ENCOUNTERED<br>HAND AUGER COMPLETE AT 2.0 FEET ON 1/6/17 |
| **HAND AUGER THREE** | | |
| 0.0 – 2.0 | | BEAUTY BARK UNDERLAIN BY DARK BROWN SILTY FINE TO MEDIUM SAN WITH GRAVEL, ROOTS, AND WOOD DEBRIS (LOOSE TO MEDIUM DENSE, MOIST) **(TOPSOIL)** |
| 2.0 – 4.0 | SM | LIGHT BROWN, SILTY FINE TO MEDIUM SAND WITH GRAVEL, TRACE IRON-OXIDE STAINING AND ROOTS (MEDIUM DENSE TO DENSE, MOIST) |
| | | SAMPLE WAS COLLECTED 4.0 FEET<br>GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED<br>HAND AUGER CAVING WAS NOT ENCOUNTERED<br>HAND AUGER MET REFUSAL AT 4.0 FEET ON 1/6/17 |

## LOG OF EXPLORATION

| DEPTH (FEET) | USC | SOIL DESCRIPTION |
|---|---|---|
| **HAND AUGER FOUR** | | |
| 0.0 – 0.2 | | LEAVES, BARK, AND TOPSOIL |
| 0.2 – 2.0 | SM | DARK BROWN, SILTY FINE TO MEDIUM SAND WITH GRAVEL, ORGANICS, AND ROOTS (MEDIUM DENSE TO DENSE, MOIST) |
| 2.0 – 3.5 | SM | LIGHT BROWN TO ORANGE-BROWN, SILTY FINE TO MEDIUM SAND WITH GRAVEL AND IRON-OXIDE WEATHERING (MEDIUM DENSE TO DENSE, MOIST) |
| | | SAMPLE WAS COLLECTED 3.5 FEET<br>GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED<br>HAND AUGER CAVING WAS NOT ENCOUNTERED<br>HAND AUGER MET REFUSAL AT 3.5 FEET ON 1/6/17 |
| **HAND AUGER FIVE** | | |
| 0.0 – 0.2 | | LEAVES AND UNDERBRUSH |
| 0.2 – 1.5 | | TAN TO DARK BROWN, SILTY FINE TO MEDIUM SAND WITH GRAVEL, ORGANICS, AND ROOTS (MEDIUM DENSE TO DENSE, MOIST) (**TOPSOIL**) |
| 1.5 – 3.5 | SM | LIGHT BROWN TO ORANGE-BROWN, SILTY FINE TO MEDIUM SAND WITH GRAVEL AND IRON-OXIDE WEATHERING (MEDIUM DENSE TO DENSE, MOIST) |
| | | SAMPLE WAS COLLECTED 3.5 FEET<br>GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED<br>HAND AUGER CAVING WAS NOT ENCOUNTERED<br>HAND AUGER MET REFUSAL AT 3.5 FEET ON 1/6/17 |
| **HAND AUGER SIX** | | |
| 0.0 – 0.2 | | LEAVES AND GRASS |
| 0.2 – 1.0 | | DARK BROWN, SILTY FINE TO MEDIUM SAND WITH GRAVEL, ORGANICS, AND ROOTS (MEDIUM DENSE TO DENSE, MOIST) (**TOPSOIL**) |
| 1.0 – 4.5 | | GRAY-BROWN, FINE TO MEDIUM SAND WITH SILT, ORGANICS, ROOTS, AND WOOD DEBRIS (MEDIUM DENSE TO DENSE, MOIST) (**FILL**) |
| 4.5 – 5.0 | SM | ORANGE-BROWN, SILTY FINE TO MEDIUM SAND WITH GRAVEL AND IRON-OXIDE WEATHERING (MEDIUM DENSE TO DENSE, MOIST) |
| | | SAMPLE WAS COLLECTED 5.0 FEET<br>GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED<br>HAND AUGER CAVING WAS NOT ENCOUNTERED<br>HAND AUGER MET REFUSAL AT 5.0 FEET ON 1/6/17 |
| **HAND AUGER SEVEN** | | |
| 0.0 – 0.2 | | LEAVES AND UNDERBRUSH |
| 0.2 – 2.7 | | GRAY-BROWN TO DARK BROWN, SILTY FINE TO MEDIUM SAND WITH GRAVEL, ORGANICS, AND ROOTS (MEDIUM DENSE TO DENSE, MOIST) (**FILL**) |
| 2.7 – 3.0 | SM | ORANGE-BROWN, SILTY FINE TO MEDIUM SAND WITH GRAVEL AND IRON-OXIDE WEATHERING (MEDIUM DENSE TO DENSE, MOIST) |
| | | SAMPLE WAS COLLECTED 3.0 FEET<br>GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED<br>HAND AUGER CAVING WAS NOT ENCOUNTERED<br>HAND AUGER COMPLETED AT 3.0 FEET ON 1/6/17 |