PanGEO
INCORPORATED
Geotechnical & Earthquake
Engineering Consultants

October 2, 2014
(Revised October 29, 2014)
File No. 14-226

Mr. Derek Doke
5209 Lake Washington Blvd. NE, Suite 100
Kirkland, WA 98033

Subject: **Geotechnical Feasibility Study**
Proposed Newport Way Townhome Development
Newport Way NE & NW Oakcrest Drive, Issaquah, Washington

Dear Mr. Doke,

This report summarizes the results of our geotechnical feasibility study for the above-referenced project in Issaquah, Washington. Our geotechnical feasibility study was performed in general accordance with our mutually agreed scope of work outlined in our proposal dated September 10, 2014, which was subsequently approved by you on September 12, 2014. Our service scope included reviewing readily available geologic map and geotechnical data in the site vicinity, conducting a site reconnaissance, excavating six test pits, and preparing this report to present our preliminary geotechnical findings. Please note that our current study is limited in scope and preliminary in nature, and is not intended for the final design of the project. Additional geotechnical field exploration and analysis will be required to provide geotechnical design recommendation in the final design stage of the project.

SITE AND PROJECT DESCRIPTION

The subject property is an approximately 8.4-arce vacant parcel located near the intersection of Newport Way NE and NW Oakcrest Drive SE in the City of Issaquah, Washington (see Vicinity Map, Figure 1). The existing grade in the western/southwestern portions of the site descends from southwest to northeast with gradients of approximately 10 to 15 percent. The eastern portion of the site is generally flat. Based on review of topographic map and King County iMap,

3213 Eastlake Ave E Ste B
Seattle, WA 98102
T. (206) 262-0370
F. (206) 262-0374

there are two streams crossing the site along the approximately north and east property lines (see Figure 2). The site is currently heavily vegetated with bushed and trees.

Based on the information you provided to us, we understand that the potential buildable area of the site is approximately 70,000 square feet, located near the west and south site boundary along Newport Way NE (see Figure 3). We also understand that you are currently conducting a feasibility study to develop the site. Details of the proposed development are not available at the time this report is prepared. However, we understand that the scope of the proposed development may include up to 36 towmhomes with associated infrastructure and utilities.

The intent of our geotechnical feasibility study is to provide preliminary geotechnical engineering opinions to assist you with your feasibility study. The conclusions and opinions presented in this report are based on our understanding of the proposed development, which is in turn based on the project information provided. If the above project descriptions and information is incorrect, or the project information changes, we should be consulted to review the opinions and recommendations contained in the study and make modifications, if needed.

SUBSURFACE EXPLORATIONS

Six test pits (TP-1 through TP-6) were excavated at the site on September 15, 2014, to explore the general subsurface conditions in the defined potential buildable areas of the site. The approximate test pit locations were taped from existing site features and are indicated on Figure 3. The test pits were excavated to depths of about 10 to 12 feet below the existing ground surface using an excavator owned and operated by Northwest Excavating, Inc., of Mill Creek, Washington.

An engineer from PanGEO was present during the field exploration to observe the test pit excavations, obtain representative samples, and to describe and document the soils encountered in the explorations. Summary test pit logs are included in Appendix A of this report. The relative in-situ density of cohesionless soils, or the relative consistency of fine-grained soils was estimated from the excavating action of the excavator, and the stability of the test pit sidewalls. The stratigraphic contacts indicated on the test pit logs represent the approximate depth to boundaries between soil units. Where soil contacts were gradual or undulating, the average depth of the contact was recorded in the logs. Actual transitions between soil units may be more

gradual or occur at different elevations. After each test pit was logged, the excavation was backfilled with the excavated soils and the surface was tamped and re-graded smooth.

SUBSURFACE CONDITIONS

SITE GEOLOGY

According to the geology maps of the area (The Geologic Map of King County, Washington: scale 1:100,000, Booth, D. B., Troost, K. A., and Wisher, A. P., 2007), the project area is underlain by Alluvium (Qal). Alluvium (Qal) typically consists of horizontally bedded, sand, silt, and gravel deposited by streams and running water. However, we understand that the project area and vicinity had been re-graded extensively due to prior construction of roadways and housing developments. As such, undocumented fill may be present at the site.

SOIL CONDITIONS

The test pits completed at the site generally encountered fill. Alluvium was encountered below the fill at one test pit (TP-1) location. A detailed description of the generalized soil units encountered in the test pits is presented below.

> ***Unit 1: Fill*** – Fill was encountered below the topsoil in all test pits, and extended to about 9 feet in TP-1 and to the bottom of TP-2 through TP-6, which were terminated at about 10 to 12 feet. Fill generally consist of loose to medium dense, damp to moist, silty sand, gravelly sand, and sandy gravel with some cobbles.
>
> ***Unit 2: Alluvium*** – Below the fill in test pit TP-1, medium dense, moist to very moist, brown-gray, silty fine sand with some sandy silt interbeds was encountered from 9 and extended to the bottom of the test pit at about 12 feet. We interpret this unit as the mapped Alluvium. This unit was not encountered in other test pits.

GROUNDWATER CONDITIONS

Groundwater seepage was encountered at about 8 feet in TP-6 during our exploration. Groundwater seepage was not encountered in other test pits. It should be noted that groundwater elevations are likely to vary depending on the season, local subsurface conditions, and other factors. Groundwater levels are normally highest during the winter and early spring.

PRELIMINARY GEOTECHNICAL FINDINGS

Based on the results of our limited study, in our opinion, the proposed townhome development in the defined buildable areas of the subject site appears feasible from a geotechnical engineering standpoint. The following sections present our general opinions and recommendations for the earthwork and foundations. Additional geotechnical field exploration and analysis will be required to provide design-level geotechnical design recommendation in the design stage of the project.

SITE CLEARING AND PREPARATION

Site preparation includes striping and clearing of surface vegetation, and excavating to the design subgrade. Site preparation should begin with the removal of surface vegetation within the proposed improvement areas (i.e. building pads and roadway areas), and excavating to the design subgrade. Based on our site exploration, we anticipate stripping depths of about 12 to 24 inches at the site. Organic rich silt/clay soil and other deleterious materials, if encountered during stripping, should also be removed as part of stripping operation.

Following site stripping/clearing and excavations, the exposed soil should be proof-rolled to check the soft/loose soils. Organic rich soil, if observed at the exposed subgrade, should also be over-excavated. The soft/loose soils detected during proof-rolling operation and cannot be re-compacted to a dense and unyielding condition should be over-excavated and backfilled with structural fill.

MATERIAL REUSE

In our opinion, on-site gravelly sand and sandy gravel may be used as a source of structural fill and backfill, provided they have similar gradation as WSDOT Gravel and Select Borrow and can be com to a dense conditions. Imported structural fill, if needed, should consist of well-grade, granular material, such as WSDOT Gravel Borrow, Crushing Surface Base Course, or approved equivalent.

TEMPORARY EXCAVATIONS

In general, we anticipate site excavations to encounter loose to medium dense silty sand, gravelly sand, and sandy gravel. All temporary excavations should be performed in accordance with Part

N of WAC (Washington Administrative Code) 296-155. The contractor is responsible for maintaining safe excavation slopes and/or shoring. Excavations more than a total of 4 feet deep should be properly shored or sloped. For planning purposes, it is our opinion that temporary excavations may be sloped as steep as 1H:1V, but should be re-evaluated in the field during construction based on actual observed soil conditions. The temporary excavation and slope conditions should be observed by a qualified geotechnical engineer.

TEMPORARY/PERMANENT SLOPES

Permanent cut and fill slopes should be graded no steeper than 2H:1V. Erosion control measures such as erosion-control mats and/or vegetations should be applied to the permanent slopes as soon as feasible.

BUILDING FOUNDATIONS

Based on the results of our preliminary exploration, it is our opinion that shallow foundations are likely feasible to support the townhomes. However, the footings should be sized using a relatively low bearing pressure. In addition, limited footing over-excavation (i.e. 12 inches) and structural backfill will be needed to provide an adequate bearing surface for the footings in some areas. The detailed foundation design recommendations will be developed in the design stage after additional field explorations are conducted.

ADDITIONAL SERVICES

As previously indicated, additional explorations will be required in the design stage after preliminary site development plans are developed. The additional geotechnical exploration will likely include test pits, borings, or a combination of both. Design-level geotechnical analysis will need to be performed to evaluate site stability, building foundations, retaining walls, and other geotechnical aspects of the project. To confirm that our recommendations are properly incorporated into the design and construction of the proposed development, PanGEO should also be retained to conduct a review of the final project plans and specifications, and to monitor the construction of geotechnical elements. The City of Issaquah, as part of the permitting process, will also require geotechnical construction inspection services.

CLOSURE

We have prepared this report for Derek Doke and the project design team. Recommendations contained in this report are based on a site reconnaissance, a subsurface exploration program, review of pertinent subsurface information, and our understanding of the project. The study was performed using a mutually agreed-upon scope of work.

Variations in soil conditions may exist between the locations of the explorations and the actual conditions underlying the site. The nature and extent of soil variations may not be evident until construction occurs. If any soil conditions are encountered at the site that are different from those described in this report, we should be notified immediately to review the applicability of our recommendations. Additionally, we should also be notified to review the applicability of our recommendations if there are any changes in the project scope.

The scope of our work does not include services related to construction safety precautions. 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. Additionally, the scope of our work specifically excludes the assessment of environmental characteristics, particularly those involving hazardous substances. We are not mold consultants nor are our recommendations to be interpreted as being preventative of mold development. A mold specialist should be consulted for all mold-related issues.

This report has been prepared for planning and design purposes for specific application to the proposed project in accordance with the generally accepted standards of local practice at the time this report was written. No warranty, express or implied, is made.

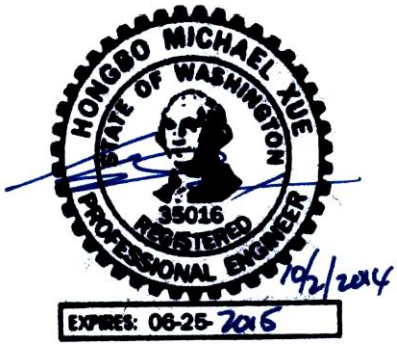
This report may be used only by the client and for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both off and on-site), or other factors including advances in our understanding of applied science, may change over time and could materially affect our findings. Therefore, this report should not be relied upon after 24 months from its issuance. PanGEO should be notified if the project is delayed by more than 24 months from the date of this report so that we may review the applicability of our conclusions considering the time lapse.

It is the client's responsibility to see that all parties to this project, including the designer, contractor, subcontractors, etc., are made aware of this report in its entirety. The use of

information contained in this report for bidding purposes should be done at the contractor's option and risk. Any party other than the client who wishes to use this report shall notify PanGEO of such intended use and for permission to copy this report. Based on the intended use of the report, PanGEO may require that additional work be performed and that an updated report be reissued. Noncompliance with any of these requirements will release PanGEO from any liability resulting from the use this report.

We appreciate the opportunity to be of service.

Sincerely,



Michael H. Xue, P.E.
Senior Geotechnical Engineer

Siew L. Tan, P.E
Principal Geotechnical Engineer

Attachments:

Figure 1	Vicinity Map
Figure 2	Site Aerial Map
Figure 2	Site and Exploration Plan

Appendix A:	**Summary Test Pit Logs – Current Exploration**
Figure A-1	Terms and Symbols for Boring and Test Pit Logs
Figures A-2 thru A-9	Logs of Test Pits TP-1 through TP-8

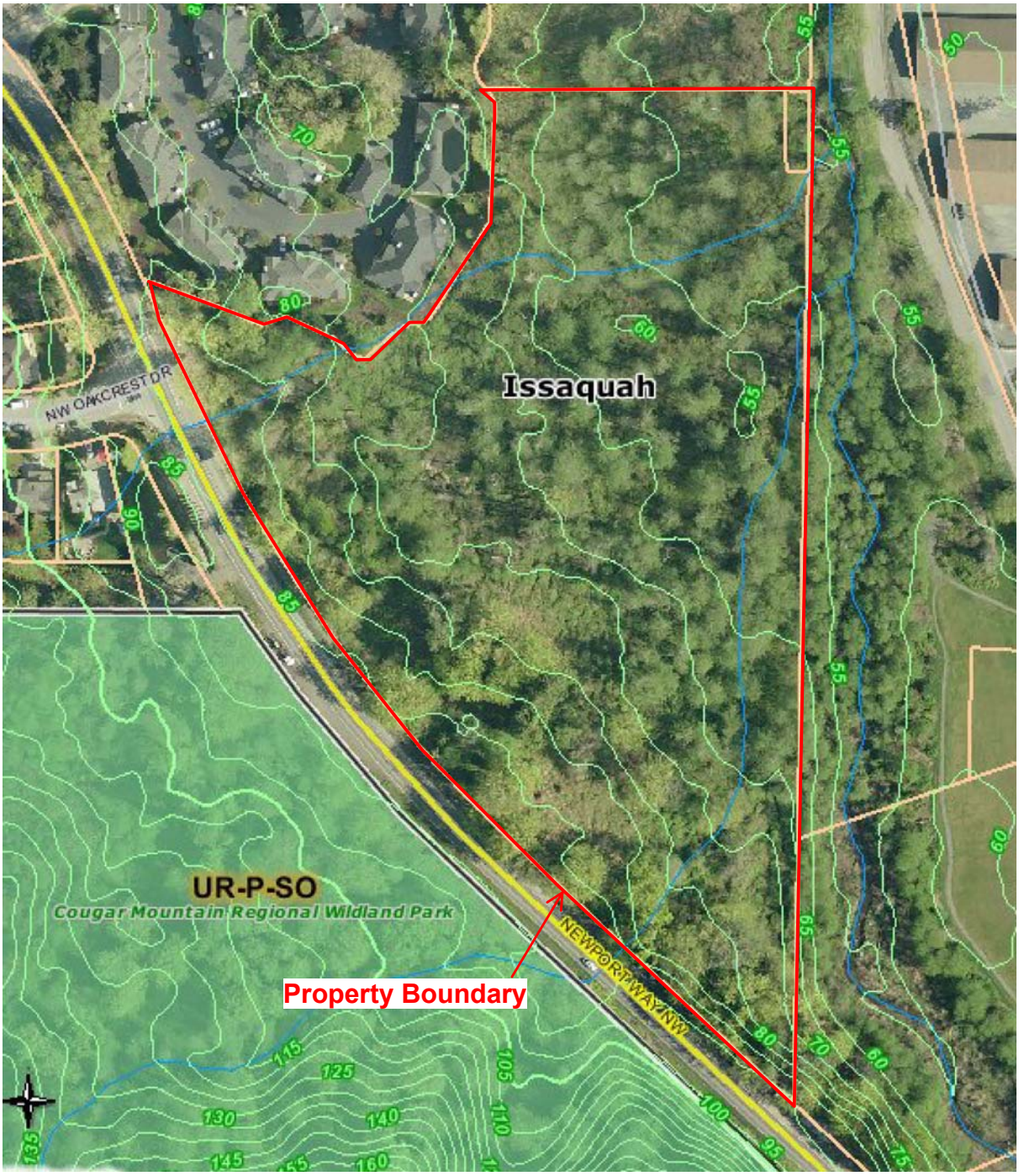
N

Reference: Google Terrain Map

NTS

PanGEO INCORPORATED	**Proposed Newport Way Townhome Development Newport Way NW & NW Oakcrest Drive Issaquah, Washington**	**VICINITY MAP**
		Project No. 14-226 — Figure No. 1

Fig1_vicinity.ppt 10/1/2014(1:12 PM) MHX



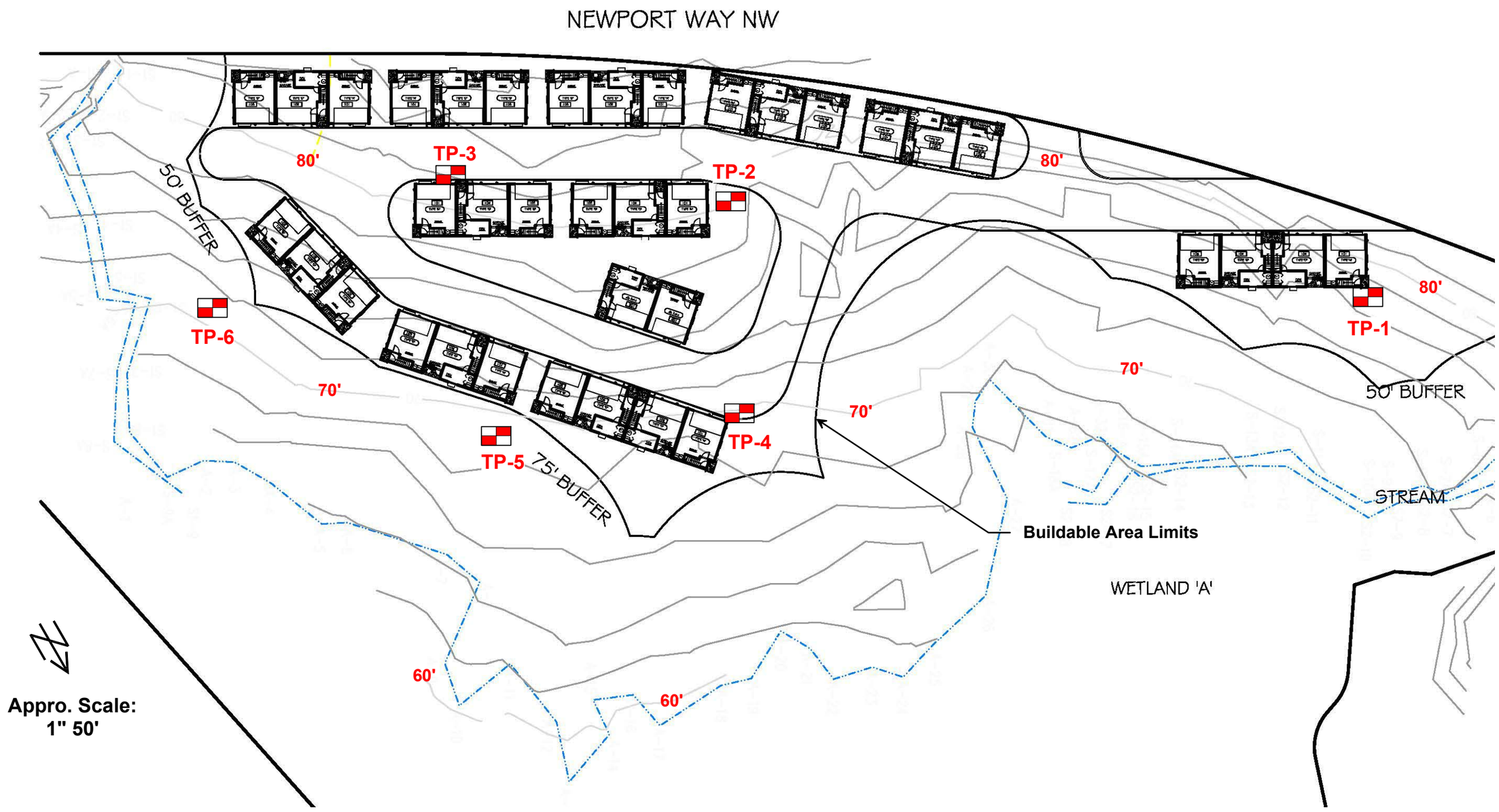
N

NTS

Reference: King County iMaple Map

PanGEO INCORPORATED	**Proposed Newport Way Townhome Development Newport Way NW & NW Oakcrest Drive Issaquah, Washington**	**SITE AERIAL MAP**
		Project No. **14-226** / Figure No. **2**

11-181 Vicinity Map.grf 10/1/14 (17:48) AAE



Legend:

TP-1 Approx. Test Pit Location

Note:
Basemap modified from Partial Preliminary Site Plan prepared by Morgan Design Group LLC dated August 28, 2014.

PanGEO INCORPORATED

Proposed Newport Way Townhome Development
Newport Way NW &
NW Oakcrest Drive
Issaquah, Washington

SITE AND EXPLORATIONS PLAN

Project No.	Figure No.
14-226	3

Original Contours.grf 10/1/14 (17:38) AAE

APPENDIX A

SUMMARY TEST PIT LOGS

RELATIVE DENSITY / CONSISTENCY

SAND / GRAVEL			SILT / CLAY		
Density	SPT N-values	Approx. Relative Density (%)	Consistency	SPT N-values	Approx. Undrained Shear Strength (psf)
Very Loose	<4	<15	Very Soft	<2	<250
Loose	4 to 10	15 - 35	Soft	2 to 4	250 - 500
Med. Dense	10 to 30	35 - 65	Med. Stiff	4 to 8	500 - 1000
Dense	30 to 50	65 - 85	Stiff	8 to 15	1000 - 2000
Very Dense	>50	85 - 100	Very Stiff	15 to 30	2000 - 4000
			Hard	>30	>4000

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS		GROUP DESCRIPTIONS	
Gravel 50% or more of the coarse fraction retained on the #4 sieve. Use dual symbols (eg. GP-GM) for 5% to 12% fines.	GRAVEL (<5% fines)	GW	Well-graded GRAVEL
		GP	Poorly-graded GRAVEL
	GRAVEL (>12% fines)	GM	Silty GRAVEL
		GC	Clayey GRAVEL
Sand 50% or more of the coarse fraction passing the #4 sieve. Use dual symbols (eg. SP-SM) for 5% to 12% fines.	SAND (<5% fines)	SW	Well-graded SAND
		SP	Poorly-graded SAND
	SAND (>12% fines)	SM	Silty SAND
		SC	Clayey SAND
Silt and Clay 50%or more passing #200 sieve	Liquid Limit < 50	ML	SILT
		CL	Lean CLAY
		OL	Organic SILT or CLAY
	Liquid Limit > 50	MH	Elastic SILT
		CH	Fat CLAY
		OH	Organic SILT or CLAY
Highly Organic Soils		PT	PEAT

Notes: 1. Soil exploration logs contain material descriptions based on visual observation and field tests using a system modified from the Uniform Soil Classification System (USCS). Where necessary laboratory tests have been conducted (as noted in the "Other Tests" column), unit descriptions may include a classification. Please refer to the discussions in the report text for a more complete description of the subsurface conditions.

2. The graphic symbols given above are not inclusive of all symbols that may appear on the borehole logs. Other symbols may be used where field observations indicated mixed soil constituents or dual constituent materials.

DESCRIPTIONS OF SOIL STRUCTURES

Layered:	Units of material distinguished by color and/or composition from material units above and below	Fissured:	Breaks along defined planes
Laminated:	Layers of soil typically 0.05 to 1mm thick, max. 1 cm	Slickensided:	Fracture planes that are polished or glossy
Lens:	Layer of soil that pinches out laterally	Blocky:	Angular soil lumps that resist breakdown
Interlayered:	Alternating layers of differing soil material	Disrupted:	Soil that is broken and mixed
Pocket:	Erratic, discontinuous deposit of limited extent	Scattered:	Less than one per foot
Homogeneous:	Soil with uniform color and composition throughout	Numerous:	More than one per foot
		BCN:	Angle between bedding plane and a plane normal to core axis

COMPONENT DEFINITIONS

COMPONENT	SIZE / SIEVE RANGE	COMPONENT	SIZE / SIEVE RANGE
Boulder:	> 12 inches	Sand	
Cobbles:	3 to 12 inches	Coarse Sand:	#4 to #10 sieve (4.5 to 2.0 mm)
Gravel		Medium Sand:	#10 to #40 sieve (2.0 to 0.42 mm)
Coarse Gravel:	3 to 3/4 inches	Fine Sand:	#40 to #200 sieve (0.42 to 0.074 mm)
Fine Gravel:	3/4 inches to #4 sieve	Silt	0.074 to 0.002 mm
		Clay	<0.002 mm

TEST SYMBOLS

for In Situ and Laboratory Tests listed in "Other Tests" column.

ATT	Atterberg Limit Test
Comp	Compaction Tests
Con	Consolidation
DD	Dry Density
DS	Direct Shear
%F	Fines Content
GS	Grain Size
Perm	Permeability
PP	Pocket Penetrometer
R	R-value
SG	Specific Gravity
TV	Torvane
TXC	Triaxial Compression
UCC	Unconfined Compression

SYMBOLS

Sample/In Situ test types and intervals

- 2-inch OD Split Spoon, SPT (140-lb. hammer, 30" drop)
- 3.25-inch OD Spilt Spoon (300-lb hammer, 30" drop)
- Non-standard penetration test (see boring log for details)
- Thin wall (Shelby) tube
- Grab
- Rock core
- Vane Shear

MONITORING WELL

- Groundwater Level at time of drilling (ATD)
- Static Groundwater Level
- Cement / Concrete Seal
- Bentonite grout / seal
- Silica sand backfill
- Slotted tip
- Slough
- Bottom of Boring

MOISTURE CONTENT

Dry	Dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water

PanGEO INCORPORATED
Phone: 206.262.0370

Terms and Symbols for Boring and Test Pit Logs

Figure A-1

TEST PIT LOGS

Test Pit No. TP-1 Approximate ground surface elevation: 77 feet Ground Surface Conditions: Blackberry and Ivy	
Depth (ft)	Material Description
0 – 2	Loose, damp, dark brown to brown, silty SAND with trace gravel, some roots and organics (Topsoil).
2 – 5	Loose to medium dense, damp, brown, gravelly SAND with some silt, some iron oxide staining (Fill).
5 – 9	Medium dense, moist, brown, sandy GRAVEL with some silt and trace cobbles (Fill).
9 – 12	Medium dense, moist, brown-gray, silty fine SAND with some sandy SILT, very moist at 10 feet deep (Alluvium).
	Test Pit terminated approximately 12 feet below ground surface. No groundwater seepage was observed during excavation. No caving was observed.

Test Pit No. TP-2

Approximate ground surface elevation: 79 feet

Ground Surface Conditions: Blackberry and Ivy

Depth (ft)	Material Description
0 – 2	Loose, damp, dark brown, silty SAND with trace gravel, some roots and organics (Topsoil).
2 – 5	Loose to medium dense, damp, brown, silty SAND with some gravel (Fill).
5 – 7	Medium dense, moist, brown, gravelly SAND with some silt and trace cobbles, some iron oxide staining (Fill).
7 – 10	Medium dense, moist, brown-gray, sandy GRAVEL with some silt and cobbles 4" – 6" diameter in size (Fill).
	Test Pit terminated approximately 10 feet below ground surface. No groundwater seepage was observed during excavation. No caving was observed.

FIGURE A-3

Test Pit No. TP-3

Approximate ground surface elevation: 82 feet

Ground Surface Conditions: Blackberry and Ivy

Depth (ft)	Material Description
0 – 1½	Loose, damp, dark brown, silty SAND with some gravel, roots, and organics (Topsoil).
1½ – 7	Loose to medium dense, damp, brown, sandy GRAVEL with some silt, some cobbles, some iron oxide staining (Fill).
7 – 10	Dense, damp to moist, brown, sandy GRAVEL with some silt and cobbles 4" – 6" diameter in size (Fill).
	Test Pit terminated approximately 10 feet below ground surface. No groundwater seepage was observed during excavation. Minor caving was observed between 6 and 10 feet.

FIGURE A-4

Test Pit No. TP-4 Approximate ground surface elevation: 70 feet Ground Surface Conditions: Blackberry and Ivy	
Depth (ft)	Material Description
0 – 1½	Loose, damp, dark brown, silty SAND with some gravel, roots, and organics (Topsoil).
1½ – 6	Loose to medium dense, damp, brown, sandy GRAVEL with some silt and cobbles, 3 boulders up to 2 feet diameter in size (Fill).
6 – 8	Medium dense, damp to moist, brown-gray, silty SAND with trace gravel (Fill).
8 – 11	Dense, damp to moist, brown-gray, silty sandy GRAVEL with some cobbles 4" – 6" diameter in size (Fill).
	Test Pit terminated approximately 11 feet below ground surface. No groundwater seepage was observed during excavation. No caving was observed.

FIGURE A-5

Test Pit No. TP-5 Approximate ground surface elevation: 69 feet Ground Surface Conditions: Blackberry and Ivy	
Depth (ft)	Material Description
0 – 1½	Loose, damp, dark brown, silty SAND with some gravel, roots, and organics (Topsoil).
1½ – 6	Loose to medium dense, damp, brown, sandy GRAVEL with some silt, trace cobbles 4” – 6” diameter in size, trace iron oxide staining (Fill).
6 – 10	Medium dense, moist, brown, silty sandy GRAVEL with some cobbles 4” – 6” diameter in size, very moist at 10 feet (Fill).
	Test Pit terminated approximately 10 feet below ground surface. No groundwater seepage was observed during excavation. Minor caving was observed between 8 and 10 feet.

Test Pit No. TP-6 Approximate ground surface elevation: 71 feet Ground Surface Conditions: Blackberry and Ivy	
Depth (ft)	Material Description
0 – 2	Soft, moist to wet, dark gray, organic SILT / PEAT, some roots (Topsoil).
2 – 5	Loose, moist, brown, gravelly SAND with some silt and trace cobbles, some iron oxide staining (Fill).
5 – 10	Medium dense, moist to wet, brown-gray, silty sandy GRAVEL with some cobbles (Fill).
	Test Pit terminated approximately 10 feet below ground surface. Moderate groundwater seepage was observed at 8 feet. Moderate caving was observed below 5 feet.

Date Test Pits Excavated: *September 15, 2014*
Test Pits Logged by: *JC*