GEO Group Northwest, Inc.
Geotechnical Engineers, Geologists
& Environmental Specialists

July 25, 2024 G-5440

Ms. Diana Tang
375 Mt Olympus Dr NW
Issaquah, WA 98027
dianatangd@gmail.com

Subject: **GEOTECHNICAL REPORT**
PROPOSED LOT SUBDIVISION
375 MT OLYMPUS DR NW
ISSAQUAH, WASHINGTON

Dear Ms. Tang:

In accordance with our April 4, 2024 contract with you we have prepared the following geotechnical report for the proposed development.

SITE AND PROJECT DESCRIPTION

The project site consists of a 1.6-acre lot at the subject address and having the King County parcel number: 282406-9017 as shown on the attached **Plate 1 - Vicinity Map**. The lot is currently occupied by a single-family residence which was constructed in 1990.

GEO Group Northwest has been provided with a topographic survey by Encompass Engineering and Surveying which illustrates existing development/topographic conditions and is attached as **Plate 2 – Topographic Survey**. The subject property is located on the flanks of Squak Mountain. Therefore, much of the property consists of sloping areas which generally face toward the northwest and west, with a likely previously graded gently sloping to flat area located just south of the existing residence. The on-site sloping areas generally consist of an area of moderate slopes at the southeast and moderate to steep slopes at the west.

Based upon a site plan by Encompass Engineering and Surveying which is attached as **Plate 3 – Site Plan** we understand that the plan is to subdivide the parcel into three lots and construct residences at the two new southern lots (Lot 2 & 3). Presumably the existing residence will remain at the north (Lot 1). The site plan indicates that the potential structure areas include a 50-ft by 70-ft structure at Lot 2 and a 50-ft by 48-ft structure at Lot 3. Per the Encompass steep slope delineation, the new building at Lot 3 is to be located having a minimum steep slope buffer of 10-feet and structure setback of 15-feet, for a total of 25-feet. Steep slope buffer/setbacks are not shown on for the building at Lot 2, however, from scaling we can see that the Lot 2 building is located no closer than 87-feet from the Encompass delineated steep slope areas.

SITE OBSERVATIONS

At the time of our subsurface investigation and prior to that when we arranged for the public utility locate, we observed that there is a slight depression at the south gently sloping to flat yard area. Also, at the depression area there is a roughly 2-foot diameter hole with a depth of around 1-foot. Both the depression area and apparently associated hole are located as shown on the attached **Plate 2 – Topographic Survey**. The depression boundary has a distinct semi-circular shape with the low side being at the inside of the semi-circle. Estimated grade drop from outside the semi-circle to inside is on the order of 6-inches to 1-foot.

GEOLOGIC CONDITIONS

The geologic map[1] for the site indicates that the subject lot is underlain by Quaternary aged Vashon Till (Qvt). Vashon Till reportedly consists of a mixture of silt, sand and gravel (diamicton) deposited by the glacial ice during the most recent period of glaciation. These soils were consolidated by glacial ice.

SUBSURFACE CONDITIONS

GEO Group Northwest explored the subsurface soil and groundwater conditions by excavating five exploratory test pits on May 31, 2024. The test pits were labeled TP-1 through TP-5 and their approximate locations are shown on the attached **Plate 2 – Topographic Survey and Plate 3 – Site Plan**.

The underlying soils encountered at the test pits TP-1, TP-3, TP-4 and TP-5 appear to be glacially consolidated gravelly silty SAND to sandy SILT below depths of 1 to 1.5-feet below ground surface (bgs). This soil deposit exhibited some cementation at the TP-4 pit at a depth of 1.5-feet and at the TP-5 pit at a depth of 1-foot. Loose to medium dense silty soils were observed overlying the glacially consolidated dense soils.

At the test pit TP-2 an apparent significant area of overlying fills was encountered and we anticipate that the fills are associated with the ground depression and ground hole previously described. At the test pit TP-2 variable very loose to medium dense gravelly silty SAND and

[1] "Geologic Map of the Issaquah 7.5' Quadrangle, King County, Washington", USGS, Booth et al, 2006.

gravelly sandy SILT with cobbles and wood, plastic and brick debris were observed and inferred to the bottom of the test pit. Slight seepage was first noted when the test pit reached a depth of 7-feet below ground surface (bgs) and large wood pieces were observed. As the excavator dug deeper suddenly a large volume of water rushed into the pit filling to the 6-foot depth, before eventually subsiding again to the 7-foot level. We speculate that the water rushing into the pit indicates that the excavating uncovered a permeable cavity made up of wood debris and loose soils likely due to historic site grading. The presence of standing water in the pit made it impossible to accurately log the soils at the pit below the seepage level.

As noted above substantial perched groundwater seepage potentially related to a filled depression was encountered at a depth of 7-feet bgs at the TP-2 location. Groundwater seepage conditions were not observed at the test pit locations TP-1, TP-3, TP-4 and TP-5.

The results of our subsurface investigation are shown on the attached **Appendix A – Test Pit Logs and USCS Soil Legend.**

GEOLOGIC HAZARD AREA EVALUATION

GEO Group Northwest has reviewed the City of Issaquah Critical Area Regulations Chapter 18.802 of the municipal code regarding the proposed development. From this review we note the following potential geologic hazard areas, and have prepared a discussion for each below:

Coal Mine Hazard Area

Significant coal mine workings underlie the lower flanks of Squak Mountain. We have reviewed publicly available mapping regarding those historic mines and note that the mines did not extend below the northern portion of the mountain's flanks, where the subject site is located. Therefore, it is our opinion that the Coal Mine Hazard is not present at the subject site.

Erosion Hazard Area

The code section defines erosion hazard areas as those having the following:

"Erosion hazard area" means areas containing soils which, according to the USDA Soil Conservation Service, the 1973 King County Soils Survey and any subsequent revisions or additions thereto, may experience severe to very severe erosion hazard. This group of soils includes, but is not limited to, the following when they occur on slopes of 15 percent or greater: Alderwood gravelly sandy loam (AgD), Alderwood-Kitsap (Akf), Beausite gravelly sandy loam

(BeD and BeF), Kitsap silt loam (Kpd), Oval gravelly sand loam (OvD and OvF), Ragnar fine sandy loam (RaD), Ragnar-Indianola Association (RdE), and any occurrence of river wash (Rh).

Based upon the online mapping tool "USDA Websoil Survey" the soils at the site are mapped as containing Kitsap Silt Loam KpC (8 to 15% slopes) and Kitsap Silt Loam KpD (15 to 30% slopes). From the topographic survey there are moderate to steep slopes at the west portion of the site, those slopes fall into the KpD category and steeper. Per the USDA mapping the K factor (whole soil) for erosion susceptibility is 0.39 on a scale ranging from 0.02 to 0.69. Additionally, the land management description of erosion susceptibility for both off-road and road condition is moderate. The overlying loose soils observed at the site, if located at steep inclinations and denuded of vegetation, present moderate erosion risks. The proposed project does not include development at the steep slope area. Accordingly, it is our opinion that the subject site does not qualify as an Erosion Hazard area, however, we do recommend that standard erosion control Best Management Practices are used in order to mitigate erosion impacts during the proposed development. We recommend that erosion control mitigation strategies such as silt fences, plastic sheeting covering at temporary bare soils and stockpiles and jute netting installation at steep slopes are implemented in accordance with the Conclusions and Recommendations section of this report.

Steep Slope Hazard Area

The code section defines steep slope hazard areas per the following:

"Steep slope hazard area" means ground that rises at an inclination of 40 percent or more within a vertical elevation change of at least 20 feet (a vertical rise of 20 feet or more for every 50 feet of horizontal distance). A slope is delineated by establishing its toe and top and measured by averaging the inclination over at least 10 feet of vertical relief.

The project surveyor has provided a survey which is attached as **Plate 2 – Topographic Survey**. The survey delineates two Steep Slope Hazard areas located at the west side of the site.

Per our measurements of slope inclinations based upon the survey contours, the west slope area has slope inclinations ranging from 35 to 46 percent with perhaps an average or median somewhere around 40 percent. We note that GIS mapping indicates that the west slope area extends off-site to the developed area at the adjacent west parcel having an approximate slope height of 55-feet and similar moderate to steep inclinations such as shown via the contours on the topographic survey. We suggest that perhaps the Steep Slope Hazard delineation line should be located at the 300-foot contour "top of slope", however, this is speculative as we do not have data showing the full extent of the 280-foot elevation contour. Presumably the surveyor has delineated the regulated steep slope area in accordance with the code definition.

Steep Slope Hazard areas are located at the site and the proposed building development at Lot 3 is to be located at 25-feet or greater from the Encompass delineated Steep Slope area. It is our opinion that the 25-foot combined buffer and setback from the delineated steep slope area is acceptable provided that the development is implemented in accordance with the recommendations contained herein, especially that the building is founded on the underlying medium dense to dense glacially consolidated site soils and the drainage collection facilities are directed to discharge at an approved location, not at steep slopes or within 25-feet of the steep slopes (buffer and setback distance combined).

Landslide Hazard Area

The code section defines a landslide as the following:

"Landslide" means the downslope movement of a mass of soil, rock, debris or organic materials under the effects of gravity, and also the landform that results from such movement. A landslide occurs when the downslope component of forces (driving forces) acting on the slope exceeds that resistance of the material underlying the slope (resisting forces). Driving forces can be increased by changes to slope geometry (e.g., erosion or excavating material from the slope), or by increased loading on the slope (e.g., placing fill on the slope or earthquake shaking). Resisting forces can be reduced by mechanical and chemical weathering of the material underlying the slope which weaken the material, and by increased/raised groundwater/pore water pressure levels in the slope. Landslides may be shallow (at or near the ground surface, i.e., only a few feet thick) or deep seated (several tens to hundreds of feet thick) and may occur extremely rapidly, in seconds, minutes or hours, or slow to extremely slow, on-going processes occurring over days, months, years and centuries. Temporal physical changes to the environment such as storms, earthquakes, undercutting and erosion by streams, and/or activities of humans can trigger landslides.

And the Landslide Hazard Area is:

"Landslide hazard area" means an area subject to severe risk of landslide.

Based upon our review of the geologic mapping and mapping which is available at the WA DNR Geologic Portal GEO Group Northwest is not aware of historical sliding at the subject site. The

WA DNR Geologic Portal Lidar mapping and the associated paper[2], a copy of the map which is attached as **Plate 4 – Lidar Mapping**, suggests that there may have been a landslide located just southwest of the subject site. The potential/assumed landslide features are assigned the identification number of #6160. We note that the metadata associated with this particular feature indicate that the slide occurred in 1997, but we have not been able to identify how that age determination was made. The Lidar datasets used for the study are from 2003 to 2016 and the metadata indicates that field verification did not occur. Without field documentation of the landslide at time of occurrence it is our opinion that the Lidar feature, although it may be indicative of slope movement, could have occurred at any time between the present day and glacial retreat 14,000 years before present. It appears that the 1997 landslide occurrence date may potentially correlate with the southerly extension of Mt. Quarry Dr NW, near the southeast corner of the subject property.

We have reviewed public records for the development at the adjacent west parcel, which is occupied by Thompson Townhomes listed in the attached **Appendix B – Thompson Townhomes Documents – Reference List**. From that information we understand that some slope/soil movement occurred during the townhouse development in 1998-1999 at an area which we understand may be at or near the toe of the 55-foot tall steep slope, the crest of which is located at the west portion of the subject site. There were apparently three instances of documented slope movement. The largest failure destroyed the stormwater system. Two smaller soil slumps occurred at fills located below the Building #1. We understand there were also concerns regarding building stability due to differential settlement. Underpinning and basement wall tiebacks were installed presumably to mitigate risks related to the soil movement/settlement at the area near Building #1. From the publicly available information which we have been able to review the location of the detention pipes at the time of the sliding appears to have been located at a proposed driveway turnaround / mailbox area (cul-de-sac). It is inferred from the studies by others that the primary cause of ground movement at the detention pipe location is related to poor compaction of the fills, resultant crushing damage to the detention pipes and subsequent detention pipe leakage. A repair was recommended to remove the fills/pipes, bench the slope, install subsurface drains, change the detention pipe location and re-build the fill embankment with structural fills. The records which we reviewed do not document whether or not, or how this particular slide was repaired, however, we did visit the Thompson Townhomes site at the time of our subject site investigation and note that at the driveway turnaround / mailbox area there is a rock covered slope at the toe of the 55-foot tall west slopes at the subject site and no apparent visual signs of ground movement when viewed from the private driveway.

[2] "Landslide Inventory of Western King County, Washington", WA DNR, WA Geological Survey, Mickelson et al, Jan. 2019.

Perhaps the rock-covered slope area is the area where the slope movement occurred and was subsequently repaired.

The landslide documentation which we reviewed for the Thompson Townhomes development suggests that sub-standard fill compaction occurred which is a primary causal factor related to the apparent soil settlement and slope movement. Once movement occurred than damage occurred to the drainage structures, which likely further worsened the movement and complicated the repair. In summary, it appears that the documented historical landslides in the subject site vicinity were generally human-caused and potentially avoidable through proper planning and construction implementation; they do not appear to be particularly related to the in-situ or natural subsurface conditions

In general, the underlying glacial till soils at the subject site are relatively stable as they have significant in-place strength due to glacial consolidation. Based upon our site investigation and review of landslide history in the subject site vicinity it is our opinion that the subject site does not qualify as Landslide Hazard Area.

Seismic Hazard Area

The code defines a seismic hazard area per the following:

"Seismic hazard area" means an area subject to severe risk of earthquake damage as a result of seismically induced settlement or lateral spreading. These conditions may occur in areas underlain by cohesionless soils of low density usually in association with a shallow groundwater table.

Based upon our site investigation, significant liquefaction and lateral spreading soil/groundwater conditions were not encountered at the site, such that it is our opinion that the subject site does not qualify as a Seismic Hazard Area.

Based upon the subsurface investigation it is our opinion that the overlying 100-foot thickness of soils at the project site may be characterized as Site Class C soil (Very Dense Soil and Soft Rock) and may be designed accordingly for seismic loads per the IBC. According to an online Seismic Hazard tool the seismic coefficients are as follows:

$S_s = 1.323$ $S_1 = 0.457$

The anticipated site modified peak ground acceleration for the design seismic scenario is 0.678g.

CONCLUSIONS AND RECOMMENDATIONS

Based upon our subsurface investigation the proposed residential development is acceptable for the subject site soil conditions, however, it is anticipated that over-excavation and replacement with compacted structural fill will be necessary at the building pad for Lot #3. Detailed recommendations for implementing the building pad improvement are provided below in the section titled: **Building Pad Improvement**.

We recommend that the new buildings are constructed having a minimum non-disturbance steep slope buffer of 10-feet from the top of the steep slope area, that the building setback from that buffer is 15-feet (total = 25-ft) and that all building foundations are constructed on top of the underlying medium dense to dense apparent glacially consolidated soils or compacted structural fills which are placed on top of the competent soils. Over-excavation and replacement with compacted structural fill may be necessary at the building pad for Lot #3, as discussed in the **Building Pad Improvement** section.

We recommend that the following recommendations and design parameters be incorporated into the design for the development.

Site Preparation and General Earthwork

The proposed development areas should be stripped and cleared of surface vegetation, organic soils (topsoil), loose soils and fill debris.

Silt fences should be installed around areas disturbed by construction activity to prevent sediment-laden surface runoff from being discharged off-site. Exposed soils that are subject to erosion should be compacted and covered with plastic sheeting. Stockpiled soils should be covered with plastic sheeting if work is done during wet weather in order to mitigate off-site sedimentation risks.

The site soils include silty soils which are moisture sensitive and difficult to compact to meet structural fill relative density requirements. Therefore, we recommend that if structural fills are necessary that they consist of free-draining imported granular material as described in the Structural Fill section of this report. Due to the site soil moisture sensitivity, we recommend the use of construction pads and construction access roads for equipment. We recommend that a construction pad for the building or construction access roadways consist of a minimum 6-inch thickness of clean crushed rock with a layer of filter fabric such as Mirafi 500X placed on top of the non-yielding and competent medium dense to dense native site soils. Alternatively, the crushed rock may have a minimum thickness of 12-inches without the layer of filter fabric.

Temporary Excavation Slopes and Permanent Slopes

Under no circumstances should temporary excavation slopes be greater than the limits specified in local, state and national government safety regulations. Temporary cuts greater than four feet in height should be sloped at an inclination no steeper than 1H:1V (Horizontal:Vertical) in the overlying loose soils. If seepage is encountered at the excavation than the maximum slope inclination for such temporary excavation slopes should be no steeper than 2.5H:1V and GEO Group Northwest should be on-site to observe and provide updated recommendations as necessary. For temporary excavations within the underlying dense and cemented glacial till soils the excavations may have near vertical inclinations, under the observation of the geotechnical engineer.

No grading should occur at steep slope areas or their non-disturbance buffers. Groundcover vegetation is recommended to remain and be maintained as necessary at the non-disturbance steep slope buffer.

We recommend that permanent graded slopes shall be sloped no steeper than 4H:1V and that any fills placed at these areas where inclinations are steeper than 5H:1V are compacted to meet the structural fill compaction requirements.

Structural Fill

All fill material used to achieve design site elevations below the building areas and below non-structurally supported slabs, parking lots, sidewalks, driveways, and patios, should meet the requirements for structural fill. During wet weather conditions, material to be used as structural fill should have the following specifications:

1. Be free draining, granular material containing no more than five (5) percent fines (silt and clay-size particles passing the No. 200 mesh sieve);

2. Be free of organic material and other deleterious substances, such as construction debris and garbage;

3. Have a maximum size of three (3) inches in diameter.

All fill material should be placed at or near the optimum moisture content. The optimum moisture content is the water content in soil that enables the soil to be compacted to the highest dry density for a given compaction effort.

Based upon our subsurface investigation the overlying site soils consist of silty soils which are difficult to compact to meet structural fill compaction requirements. We recommend that free-draining granular fill material meeting the specifications noted above is imported for use as structural fill, especially if work is to be performed during a period of wet weather. If structural fills or non-structural fills are placed below the perched groundwater seepage level they shall be 2-inch clean crushed rock, exclusively.

Structural fill should be placed in thin horizontal lifts not exceeding ten inches in loose thickness. Structural fill under building areas (including foundation and slab areas) and behind earth reinforced retaining walls should be compacted to at least 92 percent of the maximum dry density, as determined by ASTM Test Designation D-1557-91 (Modified Proctor).

Structural fill under driveways, parking lots and sidewalks should be compacted to at least 90 percent maximum dry density, as determined by ASTM Test Designation D-1557-91 (Modified Proctor). Fill placed within 12-inches of finish grade should meet the 92% requirement.

We recommend that GEO Group Northwest, Inc., be retained to evaluate the suitability of structural fill material and to monitor the compaction work during construction for quality assurance of the earthwork.

Building Pad Improvement

Based upon the subsurface investigation and the location of the mapped depression area it appears that over-excavation and removal of loose soils and organic material may be necessary at the northwest corner of the lot #3 building pad. The overlying loose soils and organic materials which were observed at the test pit TP-2 are not acceptable for foundation support and must be removed if observed to be located within the building pad areas. Loose soils should be excavated until the competent soils are encountered and then structural fill may be placed, compacted and approved in order to fill the excavation back up to the proposed footing/slab subgrade elevation. Structural fills shall be placed and compacted in accordance with the report section titled Structural Fill. Fills which are placed below the perched groundwater seepage zone shall consist of 2-inch clean crushed rock, exclusively. We recommend that all foundation subgrades and structural fill placement/compaction are approved by GEO Group Northwest at the time of construction, prior to the foundation/slab pour, in order to confirm that the subgrades have been properly prepared.

Over-excavation trenches at footing areas should be widened as necessary in order to develop a structural fill zone which provides adequate support at all spread footing areas. Typically, this is done by extending the trench outward from the outside edge of the perimeter footing by 1-foot horizontal for every 1-foot below the footing elevation in over-excavation necessary. In order to insure, that the over-excavation depth and width is appropriate we recommend that GEO Group Northwest is on-site at the time of over-excavation in order to view conditions and provide updated recommendations as necessary.

Spread Footing Foundations

The proposed new building foundations may consist of conventional spread footings bearing on top of the underlying medium dense to dense competent native glacially consolidated site soils or on compacted structural fill which is placed and compacted on top of these competent soils. The competent glacially consolidated site soils were encountered at depths ranging from 1 to 1.5- feet below ground surface at the test pits TP-1, TP-3, TP-4 and TP-5. The competent soils were not encountered at the test pit TP-2. Therefore, over-excavation is anticipated to be necessary to prepare building subgrades at a portion of the lot #3 building pad. Prior to placing foundations at lot #3 we recommend that the building pad is prepared in accordance with the earlier report section titled: **Building Pad Improvement** and that the geotechnical engineer is retained to approve of the over-excavated subgrade areas.

Individual spread footings may be used for supporting columns and strip footings for bearing walls. Our recommended minimum design criteria for foundations bearing on the medium dense to dense competent and native glacially consolidated soils or on compacted structural fill placed on top of these soils are as follows:

- Allowable bearing pressure, including all dead and live loads
  - Medium dense to dense glacially consolidated soils = 2,000 psf
  - Compacted structural fill on top of the medium dense to dense glacially consolidated soils = 2,000 psf
- Minimum depth to bottom of perimeter footing below adjacent final exterior grade = 18 inches

- Minimum depth to bottom of interior footings below top of floor slab = 18 inches

- Minimum width of wall footings = 16 inches

- Minimum lateral dimension of column footings = 24 inches

- Estimated post-construction settlement = 1/4 inch

- Estimated post-construction differential settlement; across building width = 1/4 inch

A one-third increase in the above allowable bearing pressures can be used when considering short-term transitory wind or seismic loads.

Lateral loads can also be resisted by friction between the foundation and the supporting compacted fill subgrade or by passive earth pressure acting on the buried portions of the foundations. For the latter, the foundations must be poured "neat" against the existing undisturbed soil or be backfilled with a compacted fill meeting the requirements for structural fill. Our recommended parameters are as follows:

- Passive Pressure (Lateral Resistance)
  - 350 pcf equivalent fluid weight for compacted structural fill
  - 350 pcf equivalent fluid weight for native dense soil.

- Coefficient of Friction (Friction Factor)
  - 0.35 for compacted structural fill
  - 0.35 for native dense soil

We recommend that footing drains be placed around all perimeter footings. The footing drains should be configured as described in the **Drainage Considerations** section of this report.

Conventional Basement Retaining Walls

Based upon the site plan we assume that conventional concrete basement retaining walls may be proposed for the below-grade portions at the new buildings. Permanent retaining walls restrained horizontally on top (such as basement walls) are considered unyielding and should be designed for a lateral soil pressure under the at-rest condition; while conventional reinforced concrete walls free to rotate on top should be designed for an active lateral soil pressure.

Active Earth Pressure
Conventional reinforced concrete walls that are designed to yield an amount equal to 0.002 times the wall height, should be designed to resist the lateral earth pressure imposed by an equivalent fluid with a unit weight of 35 pcf for level backfill.

At-Rest Earth Pressure
Walls supported horizontally by floor slabs are considered unyielding and should be designed for lateral soil pressure under the at-rest condition. The design lateral soil pressure should have an equivalent fluid pressure of 40 pcf for level backfill.

Seismic Surcharge
For the anticipated design seismic event a horizontal surcharge load of 8H psf should be applied;

Passive Earth Pressure
350 pcf equivalent fluid weight for compacted structural fill and native undisturbed soil;

Base Coefficient of Friction
0.35 for compacted structural fill and native undisturbed soil;

To prevent the buildup of hydrostatic pressure behind permanent concrete basement or conventional retaining walls, we recommend that a vertical drain mat, such as Miradrain 6000 or equivalent, be used to facilitate drainage behind such walls. The drain mat core should be placed against the wall(s) with the filter fabric side facing the backfill. The drain mat should extend from near the finished surface grade down to the footing drain system. Additionally, all backfill placed between the excavation slopes or temporary shoring and the new basement/retaining walls should consist of free-draining fills having less than 5% passing the No. 200 sieve. We recommend that a waterproofing layer is installed between the drainage mat layer and the concrete wall, for moisture protection at all basement wall locations.

The top 12 inches of backfill behind retaining or basement walls should consist of compacted and relatively impermeable soil. This cap material can be separated from the underlying more granular drainage material by a geotextile fabric, if desired. Alternatively, the surface can be sealed with asphalt or concrete paving. Where possible the ground surface should be sloped to drain away from the wall.

GEO Group Northwest, Inc., recommends that backfill material which will support structures or improvements (such as patios, sidewalks, driveways, etc.) behind permanent concrete retaining walls and basement walls be placed and compacted consistent with the structural fill specifications in the **Structural Fill** section of this report.

Slab-on-Grade Concrete Floors

Slab-on-grade concrete floors may be constructed directly on top of the competent medium dense to very dense in-situ site soils or on top of compacted structural fills placed on top of the competent site soils provided that the subgrade is not yielding at the time of concrete pour. Slab-on-grade floors should not be constructed on top of the overlying loose soils, organic soils or on top of wet yielding soils. Based upon the subsurface investigation over-excavation may be necessary at slab subgrade areas, particularly at the Lot #3 building envelope in accordance with the report section titled: **Building Pad Improvement**.

We recommend that we are retained to observe the condition of the slab subgrades prior to the concrete pour to verify that they consist of medium dense soils and are non-yielding. A proof-roll by large construction equipment may be used to evaluate the condition of slab subgrade areas. Over-excavation and replacement with compacted structural fill may be necessary if loose or yielding soils are encountered at the slab subgrade. If structural fills are to be placed at these areas then they should be compacted in accordance with the specifications in the section titled: Structural Fill.

To avoid moisture build-up on the subgrade, slab-on-grade concrete floors should be placed on a capillary break, which is in turn placed on the prepared subgrade. The capillary break should consist of a minimum of a six (6) inch thick layer of free-draining crushed rock or gravel containing no more than five (5) percent finer than the No. 4 sieve.

To reduce moisture vapor transmission through the slab we recommend installing a minimum 10-mil thick vapor retarder, such as Moistop Ultra® 10, by Fortifiber Building Systems Group®, between the capillary break and concrete floor slab. Moistop Ultra 10 is a polyolefin film with a water vapor permeance of 0.02 perms. It is puncture and tear resistant, meets ASTM E-1745 Class A, B and C requirements for underslab vapor retarders and is suitable for residential and commercial applications. Boots are available for sealing around pipes, conduit and other penetrations. We recommend these be installed in accordance with the manufacturers' recommendations.

Drainage Considerations

We recommend that footing drains be installed at the perimeter of the new foundation areas. Footing drains are recommended to consist of a minimum 4-inch diameter perforated rigid PVC pipe laid in a bed of gravel and surrounded with gravel and separated from finer grained material with a layer of filter fabric, such as Mirafi 180N. The footing drain pipes should be tightlined to the stormwater drainage system and downspout drains shall not drain into the footing drain piping. Drainage shall not be allowed to discharge at the steep slope area or within 25-feet of the steep slope area (steep slope non-disturbance buffer plus structural setback). It is recommended that the drainage is discharged at an approved location.

ADDITIONAL SERVICES

We recommend that GEO Group Northwest Inc. be retained to perform a general plan review of the final design and specifications for the proposed development to verify that the earthwork and foundation recommendations have been properly interpreted and implemented in the design and in the construction documents. We also recommend that GEO Group Northwest Inc. be retained to provide monitoring and testing services for geotechnically-related work during construction. This is to observe compliance with the design concepts, specifications or recommendations and to allow design changes in the event subsurface conditions differ from those anticipated prior to the start of construction. We anticipate that geotechnical construction monitoring inspections may be necessary for the following construction tasks:

1. Foundation subgrades and building pad preparation including over-excavation and structural fill placement at areas where loose/unsuitable soils are encountered;

2. Structural fill placement and compaction;

3. Subsurface drainage installation;

4. Slab-on-grade floor subgrade preparation observation/approval;

LIMITATIONS

This report has been prepared for the specific application to this site for the exclusive use of Diana Tang and her authorized representatives. Any use of this report by other parties is solely at that party's own risk.

Our findings and recommendations stated herein are based on field observations, our experience and judgement. The recommendations are our professional opinion derived in a manner consistent with the level of care and skill ordinarily exercised by other members of the profession currently practicing under similar conditions in this area and within the budget constraint. No warranty is expressed or implied. In the event that soil conditions not anticipated in this report are encountered during site development, GEO Group Northwest, Inc., should be notified and the above recommendations should be re-evaluated.

If you have any questions, please do not hesitate to contact us.

Sincerely,
GEO GROUP NORTHWEST, INC.

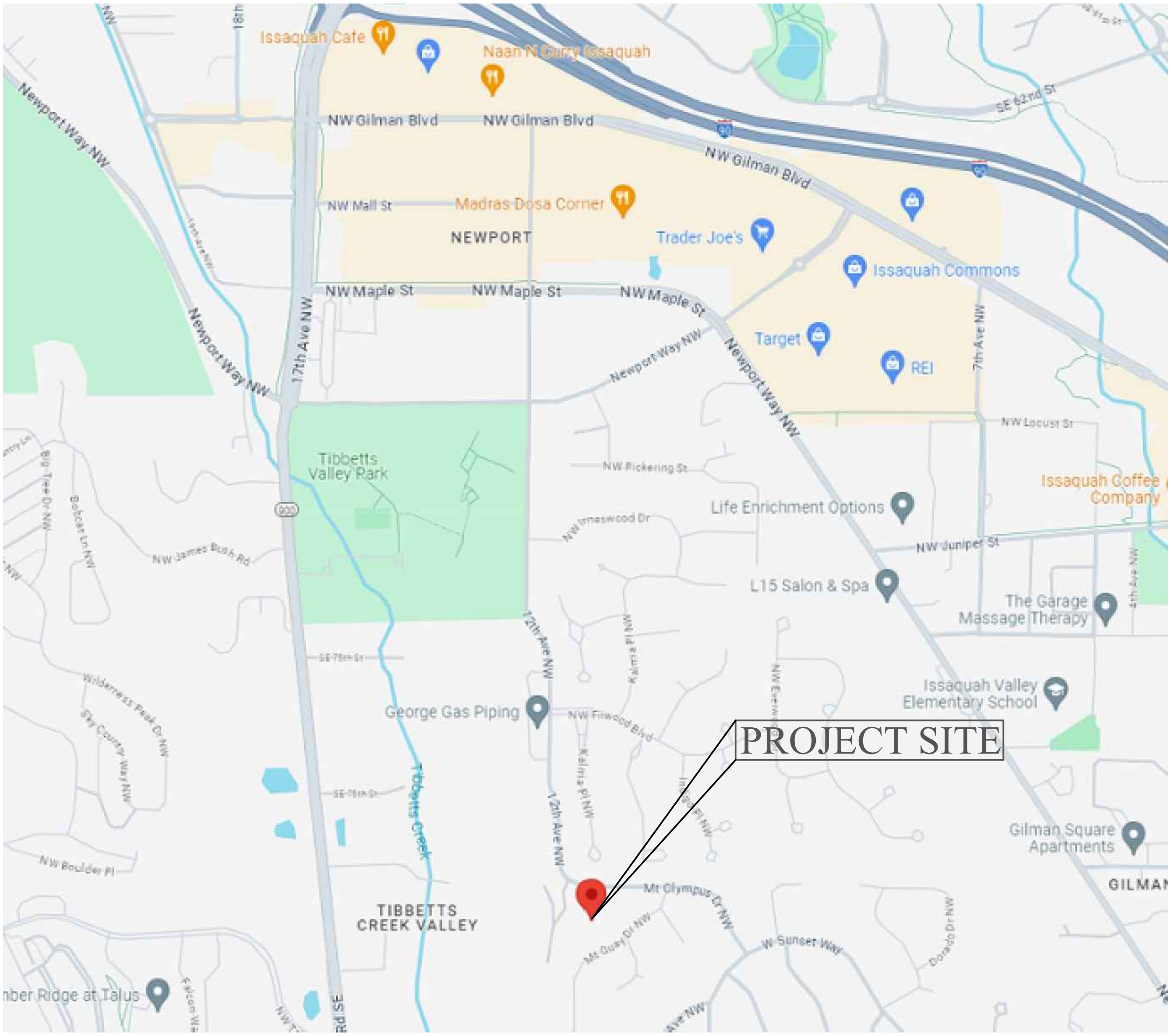
Adam Gaston
Project Engineer

7-25-2024

William Chang, P.E.
Principal

Attachments:
- Plate 1 – Vicinity Map
- Plate 2 – Topographic Survey
- Plate 3 – Site Plan
- Plate 4 – Lidar Mapping

- Appendix A – Test Pit Logs and USCS Soil Legend
- Appendix B – Thompson Townhomes Documents - Reference List

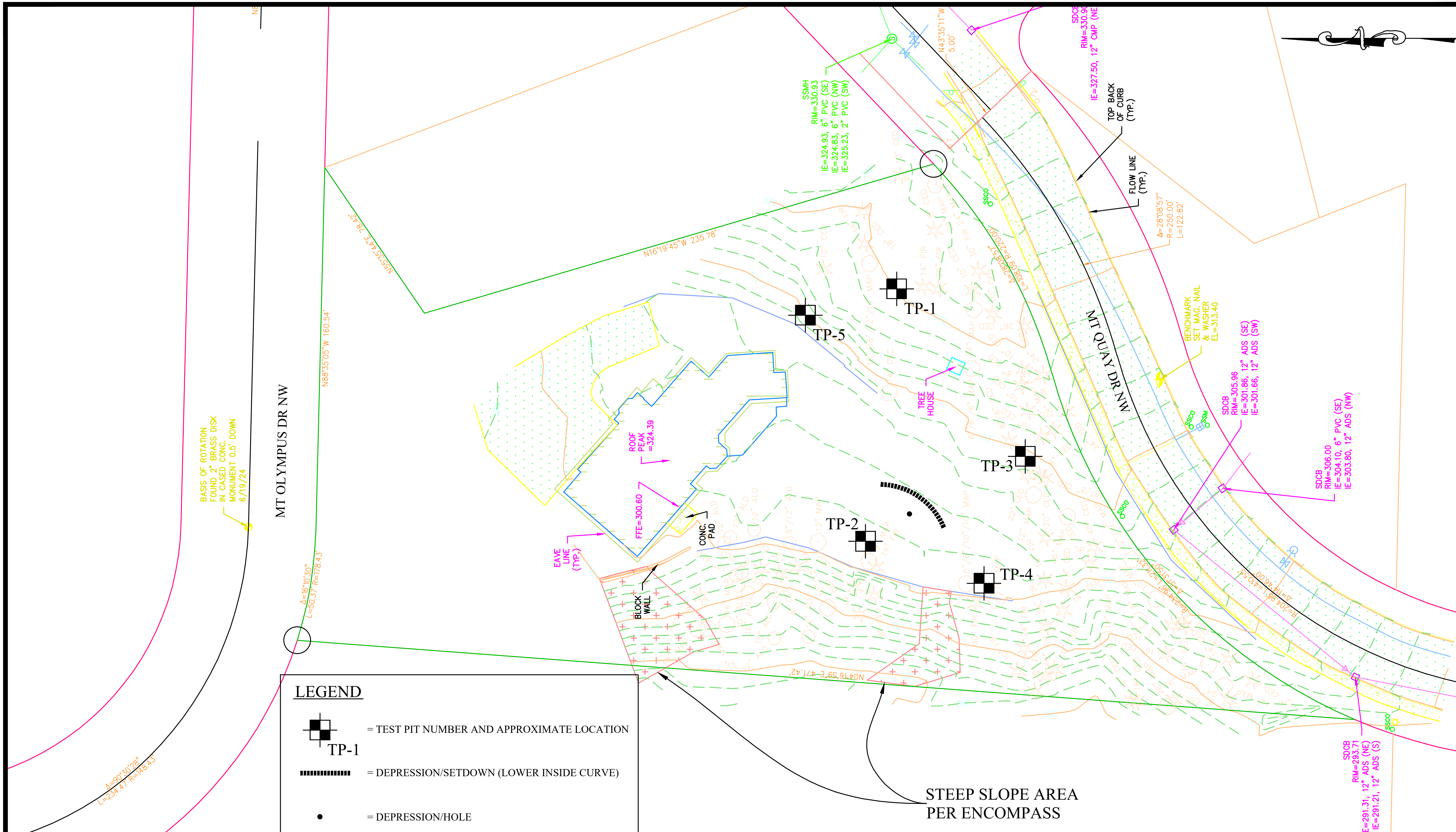


GEO
Group Northwest, Inc.
13705 Bel-Red Rd, Bellevue, WA 98005
Phone 425/649-8757 FAX 425/649-8758
Email info@geogroupnw.com

VICINITY MAP

375 MT OLYMPUS DR NW
ISSAQUAH, WASHINGTON

SCALE: NTS	DATE: 6-28-24	MADE: AG	JOB NO.: G-5440	PLATE: 1



LEGEND

TP-1	= TEST PIT NUMBER AND APPROXIMATE LOCATION
▮▮▮▮▮▮▮▮	= DEPRESSION/SETDOWN (LOWER INSIDE CURVE)
•	= DEPRESSION/HOLE

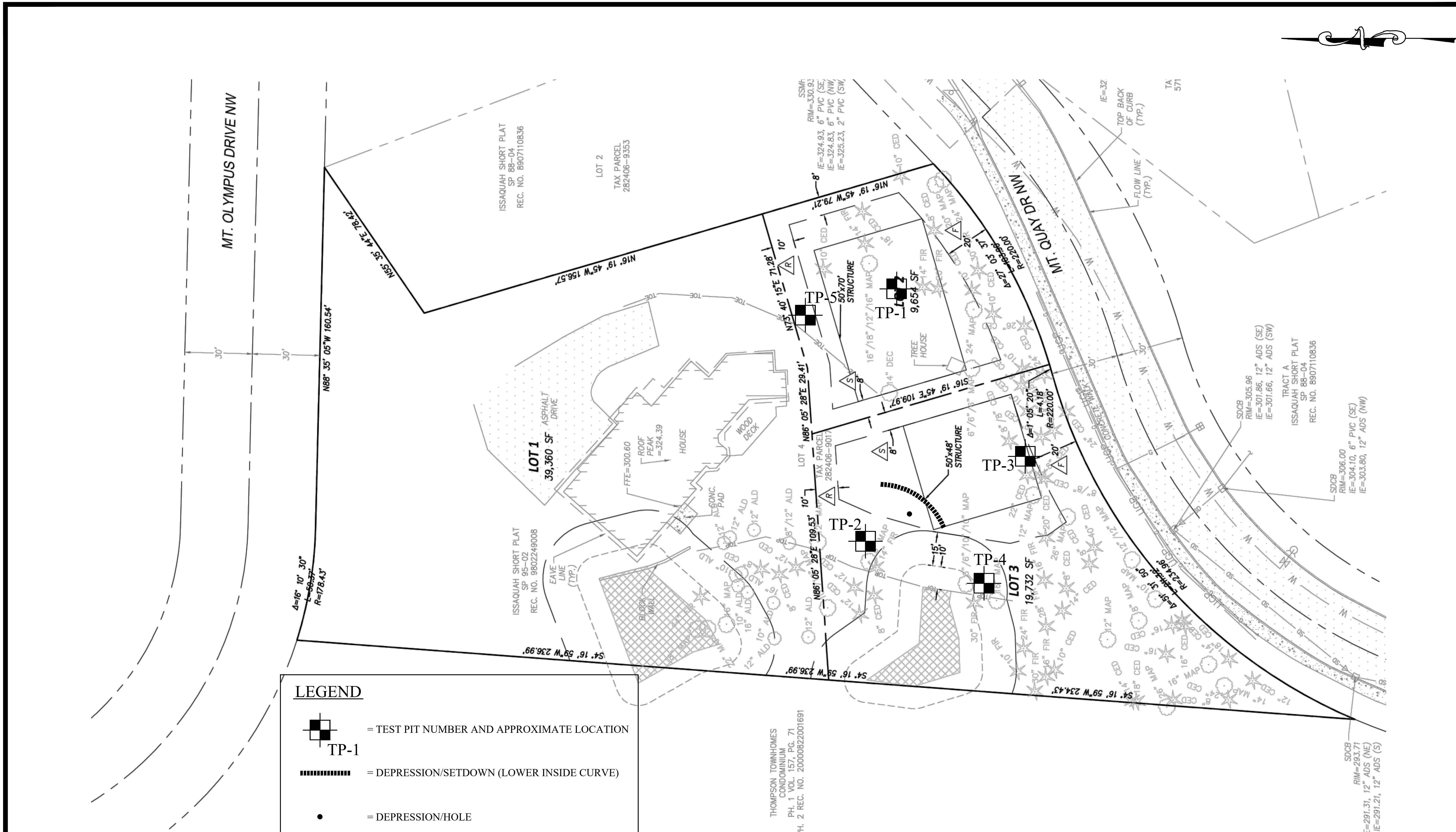
BASED UPON THE TOPOGRAPHIC SURVEY BY ENCOMPASS ENGINEERING & SURVEYING, JOB NO. 24619, 6-25-2024.

GEO Group Northwest, Inc.

13705 Bel-Red Rd, Bellevue, WA 98005
Phone 425/649-8757 FAX 425/649-8758
Email info@geogroupnw.com

TOPOGRAPHIC SURVEY
PROPOSED RESIDENCE
375 MT OLYMPUS DR NW
ISSAQUAH, WASHINGTON

PROJECT #: G-5440
DATE: 7-24-2024
DRAWN: AG
CHECKED: WC
SCALE: 1" = 40'
PLATE: 2



LEGEND

= TEST PIT NUMBER AND APPROXIMATE LOCATION (TP-1)

= DEPRESSION/SETDOWN (LOWER INSIDE CURVE)

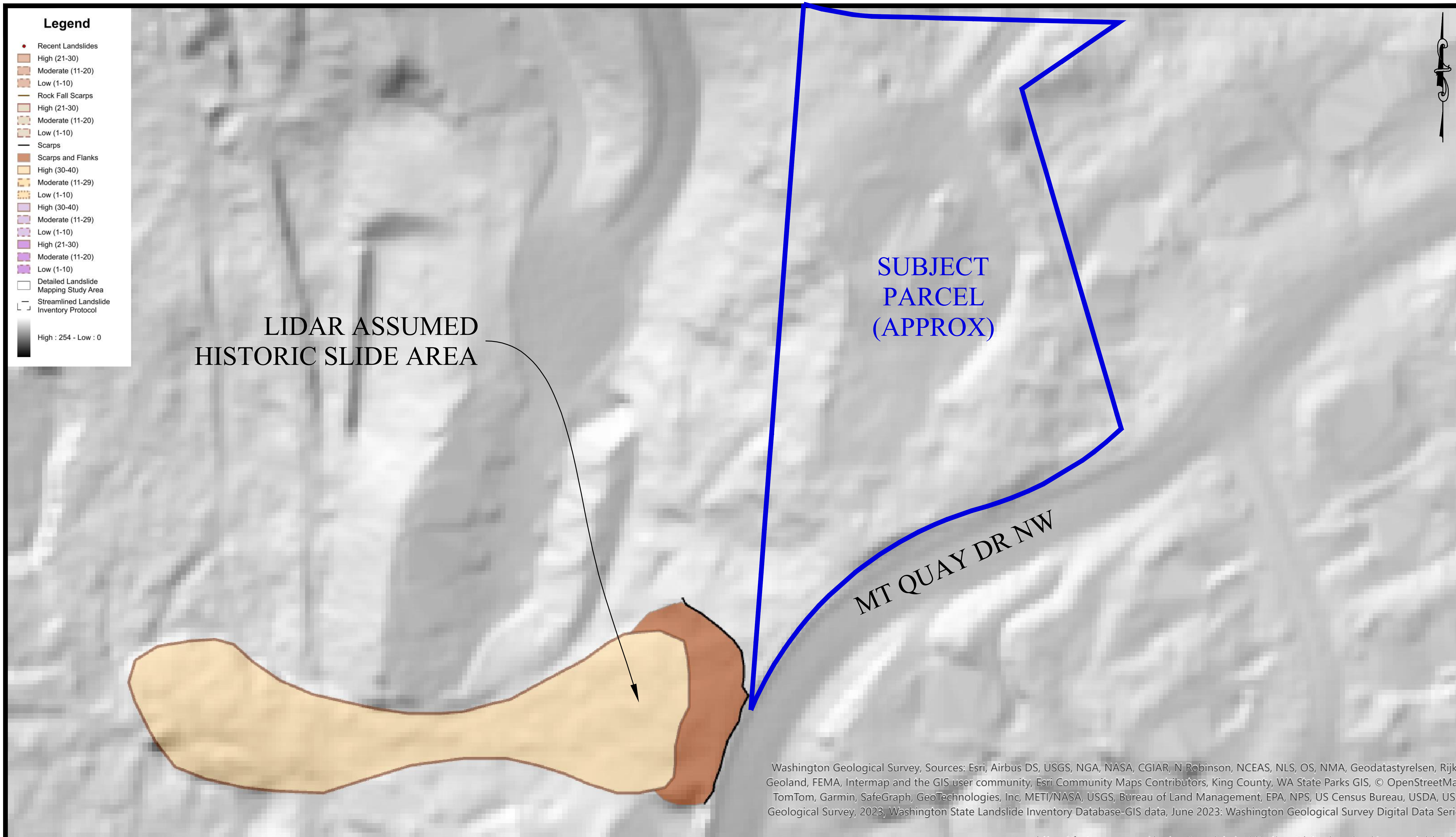
= DEPRESSION/HOLE

BASED UPON THE SITE PLAN BY ENCOMPASS ENGINEERING & SURVEYING, JOB NO. 24619, 6-26-2024.

GEO Group Northwest, Inc.
13705 Bel-Red Rd, Bellevue, WA 98005
Phone 425/649-8757 FAX 425/649-8758
Email info@geogroupnw.com

SITE PLAN
PROPOSED RESIDENCE
375 MT OLYMPUS DR NW
ISSAQUAH, WASHINGTON

PROJECT #: G-5440
DATE: 7-24-2024
DRAWN: AG
CHECKED: WC
SCALE: 1" = 40'
PLATE: 3



BASED UPON THE ONLINE WA DNR GEOLOGIC MAPPING PORTAL LIDAR DATA AS DOWNLOADED 7-9-24.

GEO Group Northwest, Inc.
13705 Bel-Red Rd, Bellevue, WA 98005
Phone 425/649-8757 FAX 425/649-8758
Email info@geogroupnw.com

LIDAR MAPPING
PROPOSED RESIDENCE
375 MT OLYMPUS DR NW
ISSAQUAH, WASHINGTON

PROJECT #: G-5440
DATE: 7-9-2024
DRAWN: AG
CHECKED: WC
SCALE~ 1" = 60'
PLATE: 4

APPENDIX A

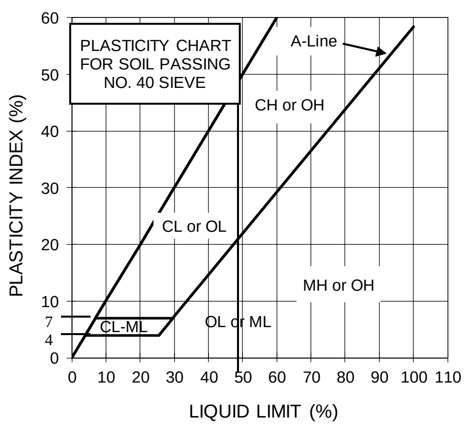
TEST PIT LOGS & USCS SOIL LEGEND

G-5440

LEGEND OF SOIL CLASSIFICATION AND PENETRATION TEST

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

MAJOR DIVISION			GROUP SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA		
COARSE-GRAINED SOILS More Than Half by Weight Larger Than No. 200 Sieve	GRAVELS (More Than Half Coarse Grains Larger Than No. 4 Sieve)	CLEAN GRAVELS (little or no fines)	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURE, LITTLE OR NO FINES	DETERMINE PERCENTAGES OF GRAVEL AND SAND FROM GRAIN SIZE DISTRIBUTION CURVE	Cu = (D60 / D10) greater than 4 Cc = (D302) / (D10 * D60) between 1 and 3	
			GP	POORLY GRADED GRAVELS, AND GRAVEL-SAND MIXTURES LITTLE OR NO FINES		NOT MEETING ABOVE REQUIREMENTS	
		DIRTY GRAVELS (with some fines)	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES		CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW "A" LINE. or P.I. LESS THAN 4
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES	COARSE GRAINED SOILS ARE CLASSIFIED AS FOLLOWS:		ATTERBERG LIMITS ABOVE "A" LINE. or P.I. MORE THAN 7
	SANDS (More Than Half Coarse Grains Smaller Than No. 4 Sieve)	CLEAN SANDS (little or no fines)	SW	WELL GRADED SANDS, GRAVELLY SANDS, LIITLE OR NO FINES		Cu = (D60 / D10) greater than 6 Cc = ($D30^2$) / (D10 * D60) between 1 and 3	
			SP	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	< 5% Fine Grained: GW, GP, SW, SP	NOT MEETING ABOVE REQUIREMENTS	
		DIRTY SANDS (with some fines)	SM	SILTY SANDS, SAND-SILT MIXTURES	> 12% Fine Grained: GM, GC, SM, SC	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW "A" LINE with P.I. LESS THAN 4
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES	5 to 12% Fine Grained: use dual symbols		ATTERBERG LIMITS ABOVE "A" LINE with P.I. MORE THAN 7
FINE-GRAINED SOILS More Than Half by Weight Smaller Than No. 200 Sieve	SILTS (Below A-Line on Plasticity Chart, Negligible Organic)	Liquid Limit < 50%	ML	INORGANIC SILTS, ROCK FLOUR, SANDY SILTS OF SLIGHT PLASTICITY			
		Liquid Limit > 50%	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOIL			
	CLAYS (Above A-Line on Placticity Chart, Negligible Organic)	Liquid Limit < 30%	CL	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, CLEAN CLAYS			
		Liquid Limit > 50%	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS			
	ORGANIC SILTS & CLAYS (Below A-Line on Placticity Chart)	Liquid Limit < 50%	OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY			
		Liquid Limit > 50%	OH	ORGANIC CLAYS OF HIGH PLASTICITY			
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS			



SOIL PARTICLE SIZE

FRACTION	U.S. STANDARD SIEVE			
	Passing		Retained	
	Sieve	Size (mm)	Sieve	Size (mm)
SILT / CLAY	#200	0.075		
SAND				
FINE	#40	0.425	#200	0.075
MEDIUM	#10	2	#40	0.425
COARSE	#4	4.75	#10	2
GRAVEL				
FINE		19	#4	4.75
COARSE		76		19
COBBLES	76 mm to 203 mm			
BOULDERS	> 203 mm			
ROCK FRAGMENTS	> 76 mm			
ROCK	>0.76 cubic meter in volume			

GENERAL GUIDANCE OF SOIL ENGINEERING PROPERTIES FROM STANDARD PENETRATION TEST (SPT)

SANDY SOILS				SILTY & CLAYEY SOILS		
Blow Counts N	Relative Density %	Friction Angle ϕ, degree	Description	Blow Counts N	Unconfined Strength q_u, tsf	Description
0 - 4	0 -15		Very Loose	< 2	< 0.25	Very soft
4 - 10	15 - 35	26 - 30	Loose	2 - 4	0.25 - 0.50	Soft
10 - 30	35 - 65	28 - 35	Medium Dense	4 - 8	0.50 - 1.00	Medium Stiff
30 - 50	65 - 85	35 - 42	Dense	8 - 15	1.00 - 2.00	Stiff
> 50	85 - 100	38 - 46	Very Dense	15 - 30	2.00 - 4.00	Very Stiff
				> 30	> 4.00	Hard

GEO Group Northwest, Inc.
Geotechnical Engineers, Geologists, & Environmental Scientists
13240 NE 20th Street, Suite 10 Bellevue, WA 98005
Phone (425) 649-8757 Fax (425) 649-8758

PLATE A1

TEST PIT NO. TP-1

LOGGED BY AG **TEST PIT DATE:** 5/31/2024

DEPTH ft.		USCS	SOIL DESCRIPTION	SAMPLE No.	Water %	OTHER TESTS/ COMMENTS
		SM	Dark brown to tan gravelly and silty SAND with some cobbles, moist, loose to medium dense	S-1		Probe 5-6" Probe 6-16" Probe 3-7" Probe 1-3" Probe 1-2" Probe <1"
5		SM/ ML	Tan gravelly silty SAND with some cobbles, moist, dense (apparent unweathered till) - becoming gravelly sandy SILT below around 3.5-ft depth			
10 15			- Total depth of test pit = 6 ft below ground surface (bgs) - Perched groundwater seepage not encountered - Competent native apparent undisturbed cemented unweathered glacial till at a depth of 1.5 feet bgs			

TEST PIT NO. TP-2

LOGGED BY AG **TEST PIT DATE:** 5/31/2024

DEPTH ft.		USCS	SOIL DESCRIPTION	SAMPLE No.	Water %	OTHER TESTS/ COMMENTS
		SM/ ML	Dark brown to tan gravelly silty SAND becoming gravelly sandy SILT with occassional cobbles and debris, moist, variable very loose to medium dense (FILL)	S-1		Probe 8-18" Probe <18" Probe 12-16" Probe 8-14"
				S-2		
5			- significant wood within soil matrix at 5-8-ft depth	S-3		Probe 6-8"
				S-4		
						Probe >12"
10 15			- Total depth of test pit =9 feet below ground surface (bgs) - Apparent perched groundwater seepage at 7-ft bgs - Plastic debris at 2.5-ft bgs and 4-ft bgs, brick at 1-ft bgs - Wood debris between 5 and 8-ft bgs - Could not log soil below 8-ft as water rushed in and filled to 6-feet presumably from a larger wood/fill area, likely located south of TP			

GEO Group Northwest, Inc.
Geotechnical Engineers, Geologists, & Environmental Scientists

TEST PIT LOGS

PROPOSED LOT SUBDIVISION
375 MT OLYMPUS DR NW
ISSAQUAH, WASHINGTON

JOB NO. G-5440	DATE 7/3/24	PLATE A2

TEST PIT NO. TP-3

LOGGED BY AG **TEST PIT DATE:** 5/31/2024

DEPTH ft.		USCS	SOIL DESCRIPTION	SAMPLE No.	Water %	OTHER TESTS/ COMMENTS
		SM	Dark brown to tan gravelly silty SAND, moist, loose	S-1		Probe 4-14" Probe 4-12" Probe 2-6" Probe 3-4" Probe 1-2"
5		SM/ ML	Tan gravelly silty SAND with some cobbles, moist, dense (apparent unweathered till) - becoming gravelly sandy SILT below around 3-ft depth	S-2 S-3 S-4		Probe 1" Probe 1-2" Probe 2-3" Probe 2-4" Probe 1-3"
10 15			- Total depth of test pit = 8 ft below ground surface (bgs) - Perched groundwater seepage not encountered - Competent native apparent undisturbed cemented unweathered glacial till at a depth of 1.5 feet bgs			

TEST PIT NO. TP-4

LOGGED BY AG **TEST PIT DATE:** 5/31/2024

DEPTH ft.		USCS	SOIL DESCRIPTION	SAMPLE No.	Water %	OTHER TESTS/ COMMENTS
		SM	Dark brown to tan gravelly silty SAND with a boulder, moist, loose to medium dense	S-1		Probe 6-12" Probe 6-10" Probe 1-2"
5		SM/ ML	Tan gravelly silty SAND becoming gravelly sandy SILT with some cobbles, moist, cementation at 1.5-ft, dense - becoming gravelly silty SAND at 6-ft bgs	S-2 S-3		Probe <1" Probe 2-3" Probe <1"
10 15			- Total depth of test pit = 7 ft below ground surface (bgs) - Perched groundwater seepage not encountered - Competent native apparent undisturbed cemented unweathered glacial till at a depth of 1.5 feet bgs			

GEO Group Northwest, Inc.
Geotechnical Engineers, Geologists, & Environmental Scientists

TEST PIT LOGS

PROPOSED LOT SUBDIVISION
375 MT OLYMPUS DR NW
ISSAQUAH, WASHINGTON

JOB NO. G-5440	DATE 7/3/24	PLATE A3

TEST PIT NO. TP-5

LOGGED BY AG **TEST PIT DATE:** 5/31/2024

DEPTH ft.		USCS	SOIL DESCRIPTION	SAMPLE No.	Water %	OTHER TESTS/ COMMENTS
		SM	Forest duff and gravelly silty SAND, moist, loose			Probe 1-2"
		SM/ ML	Tan gravelly silty SAND / sandy SILT with some cobbles, moist, dense, competent & cemented at 1-ft (till)			Probe <1"
5			- Total depth of test pit = 3 ft below ground surface (bgs) - Groundwater seepage not observed - Competent native apparent undisturbed unweathered glacial till at 1-ft bgs			
10						
15						

TEST PIT NO.

LOGGED BY **TEST PIT DATE:**

DEPTH ft.		USCS	SOIL DESCRIPTION	SAMPLE No.	Water %	OTHER TESTS/ COMMENTS
5						
10						
15						

GEO Group Northwest, Inc.
Geotechnical Engineers, Geologists, & Environmental Scientists

TEST PIT LOGS

PROPOSED LOT SUBDIVISION
375 MT OLYMPUS DR NW
ISSAQUAH, WASHINGTON

JOB NO. G-5440	DATE 7/3/24	PLATE A4

APPENDIX B

THOMPSON TOWNHOMES DOCUMENTS

REFERENCE LIST

G-5440

"Thompson Residence – Site Plan", Thompson Land & Engineering, 1 pg, 7-1-89.

"City of Issaquah, Planning Department, Administrative Review – Notice of Decision", 16 pgs, Nov 8, 1996.

"Short Plat No. 95-02, Issaquah, Washington", Cramer Northwest Inc., pg 1, 11-3-97.

"Thompson Townhomes", The Highridge Corporation, Sheets L1 & L2, 5-13-99.

"Thompson & Horizon Short Plat SEPA", pdf collection of documents, 29 pgs, various dates.

"City of Issaquah, Department of Development Review, Administrative Review – Notice of Action", RE: Thompson Short Plat, SP 8-04, 6-28-89.

"Building 2 Subsurface Exploration, Thompson Townhomes, Mount Olympus Drive Northwest, Issaquah, Washington", Earth Consultants Inc., April 14, 1999

"RE: Townhome Project", James Eaton, P.E., June 19, 1996.

"Response to Geotech Report (dated 8/3/99) from Earth Consultants Inc, Thompson Townhomes, BLD97-00195", City of Issaquah, Aug. 16, 1999.

"RE: July 1999 Slope Movement, 12th Avenue NW Townhomes, Issaquah, Washington", Golder Associates, July 21, 1999.

"July 1999 Slope Movement, Thompson Townhomes, Mount Olympus Drive Northwest, Issaquah, Washington", Earth Consultants Inc., July 20, 1999.

"Responses to City of Issaquah Comments, Thompson Townhomes, Mt Olympus Drive Northwest, Issaquah, Washington", Earth Consultants Inc., Aug 27, 1999.

"Additional Slope Stability Analysis and Testing, Thompson Townhomes, Mt Olympus Drive Northwest, Issaquah, Washington", Earth Consultants Inc., Aug 3, 1999.

"Geotechnical Opinion, Basement Wall Drainage, Building 3, Thompson Townhomes, Mt Olympus Drive, Issaquah, Washington", Creative Engineering Options, Aug 21, 2000.

"Geotechnical Engineering Services, Review of Thompson Townhomes Development, Issaquah, Washington, File No. 0252-028-00", Geoengineers, July 24, 2000.

"Geotechnical Slope Stability Evaluation, Building Pad 2, Thompson Townhomes, Mt Olympus Drive, Issaquah, Washington", Creative Engineering Options, July 6, 2000.

"Basement Wall Drainage, Building 3, Mt Olympus Drive, Issaquah, Washington", Creative Engineering Options, April 26, 2000.

"RE: Thompson Townhomes, 377 12^{th} Ave W, Issaquah, WA", Davies Drilling, Sept. 6, 1999.

"Final Monitoring Report, Building 2- Anchor Installation, Thompson Townhomes, Mt Olympus Drive, Issaquah, Washington", Creative Engineering Options, April 10, 2000.

"Geotechnical Opinion, Building 2 Underpinning, Thompson Townhomes, Mt Olympus Drive NW, Issaquah, Washington", Creative Engineering Options, Nov. 19, 1999.

"Response to letter dated 9/16/99, Thompson Townhomes, Bld 97-00155", City of Issaquah Building Department, Oct. 1, 1999.

"Geotechnical Opinion, Pile Cap to Anchor Details, Building 2 Underpinning, Thompson Townhomes, Mount Olympus Drive NW, Issaquah, Washington", Creative Engineering Options, Nov. 3, 1999.

"Geotechnical Engineering Services, Review of Thompson Townhomes Development, Issaquah, Washington, File No. 0252-028-00", Geoengineers, Oct. 4, 1999.

"Geotechnical Engineering Services, Review of Thompson Townhomes Development, Issaquah, Washington, File No. 0252-028-00", Geoengineers, Oct. 25, 1999.

"Geotechnical Evaluation and Recommendations, Building 2 Underpinning and Lateral Restraint, Thompson Townhomes, Mount Olympus Drive NW, Issaquah, Washington", Creative Engineering Options, Oct. 11, 1999.

"RE: Permit No. B97-00155 Geotechnical Issues and Revisions to Foundation System', City of Issaquah Building Department, Nov. 4, 1999.

"Preliminary Slope Stabilization Recommendations, Thompson Townhomes, Mount Olympus Drive Northwest, Issaquah, Washington", Earth Consultants, Job: E-8234-1, Feb. 2, 1999.

"Summary of Construction Monitoring Services, Thompson Townhomes Slope Reconstruction, Mount Olympus Drive Northwest, Issaquah, Washington", Earth Consultants Inc., Mar. 22, 1999.

"Final Letter, Thompson Townhomes, Building 1, Mount Olympus Drive Northwest, Issaquah, Washington", Earth Consultants, Inc., Mar, 22, 1999.