PanGEO INCORPORATED

Engineering Consultants

July 14, 2020
File No. 20-224

Mr. Mike Edelbrock
MICKELO CONSTRUCTION LLC
16731 Tye Street SE
Monroe, WA 98272

Subject: **Geotechnical Report**
16731 Tye Street SE
Monroe, WA

Dear Mr. Edelbrock,

As requested, PanGEO Inc. completed a geotechnical evaluation of the property located at 16731 Tye Street SE in Monroe, Washington (see Figure 1) regarding your plan to construct a new shop building on the site.

Our service scope included reviewing readily available geologic data, conducting a test pit program, and formulating the conclusions presented below.

SITE DESCRIPTION

The parcel is located on the north side of Tye Street SE in Monroe. As shown on Figure 2, the 1.19-acre parcel has a rectangular footprint with a frontage of about 150 feet on Tye Street SE. The parcel is about 300 feet deep, south to north, and is essentially level.

The property is currently an open yard area for the storage of construction equipment and materials (see Plate 1). The site is covered with a layer of crushed rock fill. The site is bordered on the east and west by light industrial / commercial buildings, and by open ground to the north. We understand that you wish to construct an 80 by 100-foot, steel framed, single story shop and office building on the south side of the parcel.

Plate 1- Yard area of the planned shop and office building.

SUBSURFACE CONDITIONS

As part of our study we reviewed geologic maps of the area to better understand the subsurface conditions at the site. In addition, we reviewed on-line databases and in-house records to determine if previous subsurface investigations have been performed in the vicinity of the site.

SITE GEOLOGY

The project area is contained within the Maltby Quadrangle. The Geologic Map of the Maltby Quadrangle (Allen, et al, 2017) shows the project area at the boundary between a peat bog and recessional outwash deposit. Allen et al, (2017) describe the recessional outwash as consisting of sand and pebble to cobble gravel, gray to tan, loose to medium dense, and weakly to well stratified. However, the eastward extension of this same unit into the nearby Monroe Quadrangle (Dragovich, et al, 2011) is described as alluvium. An earlier mapping of the Maltby Quadrangle (Minard, 1985) also describes the unit as alluvium.

SUBSURFACE EXPLORATIONS

Subsurface conditions at the site were explored with four test pits which were excavated at the locations shown on Figure 2 using a trackhoe supplied by Mickelo Construction, LLC. An engineering geologist from our office was present throughout the field exploration program to observe the test pit excavations, extract soil samples as needed, and to document the soil conditions observed. The soils were described in the field in general accordance with ASTM D

2488-00, following the guidelines of the Unified Soil Classification System, as shown on Figure 3. Summary logs from the borings are presented in Figures 4 to 7.

SUBSURFACE CONDITIONS

Based on the test pits, the parcel is underlain by up to nearly a foot of crushed rock base material supported on a geotextile fabric. This in turn is underlain to a depth of roughly 6½ feet by medium dense to dense, brown to gray, silty, gravelly fine sand fill with cobbles. The fill contained scattered amounts of concrete, wood and metal debris. The uppermost native soil was a bed of soft, brown peat, roughly 1 to 1½ feet thick. At depth the test pits encountered loose to medium dense, non-plastic to slightly plastic silt, with some fine sand.

GROUNDWATER

Groundwater was not encountered in the test pits, which were excavated to a maximum depth of 9½ feet. We anticipate that groundwater could be present at a shallower depth during the wet winter months.

GEOTECHNICAL DESIGN RECOMMENDATIONS

SEISMIC DESIGN PARAMETERS

The design parameters for the site should be in conformance with the 2018 edition of the International Building Code (IBC). which specifies a design earthquake having a 2% probability of occurrence in 50 years (return interval of 2,475 years). In our opinion, Site Class D is suitable for use in seismic design

LIQUEFACTION EVALUATION

Regional geologic maps indicate that the site is underlain by recessional outwash deposits or alluvium. These deposits are typically loose to medium dense. As such, when submerged, these soils may be susceptible to liquefaction. However, since the water table at the site is likely at a depth of 10 feet or more, we believe that any potential liquefaction of the underlying alluvium or glacial outwash sediments would have minor effects on the performance of the proposed building (i.e. differential settlements at the ground surface on the order of about 1-inch or less). Consequently, in our opinion, the potential occurrence of liquefaction would not adversely affect the performance of the proposed building.

FOUNDATIONS

The building may be supported on conventional strip and individual footings bearing on existing fill soil that has been compacted to a dense and unyielding condition with a Ho-Pac or jumping jack compactor. If for any reason the existing fill cannot be compacted to a dense and unyielding condition, the footing should be over-excavated by 12 inches, and brought back to grade with 2 lifts of compacted structural fill. The foundations may be designed for an allowable bearing pressure of 2,000 psf with a one-third increase for seismic or transient loads. All footings should be founded a minimum distance of 18 inches below the finished exterior grade for perimeter footings and 12 inches below the finished floor slab for interior footings. All strip footings should have a minimum width of 18 inches and all individual footings should have a minimum width of 24 inches. Any footing over excavation should extend at least 6 inches beyond the face of the footings. Footing excavations should be observed by PanGEO to confirm that the footing subgrade has been adequately prepared.

Lateral forces from wind or seismic loading may be resisted by the combination of passive earth pressures acting against the embedded portions of the footings and by friction acting on the base of the foundations. Passive resistance values may be determined using an equivalent fluid weight of 350 pounds per cubic foot (pcf). This value includes a factor safety of at least 2, assuming that compacted structural fill will be placed adjacent to the sides of the footings. A coefficient friction of 0.5 may be used to determine the frictional resistance at the base of the footings. This coefficient includes a factor safety of approximate 1.5.

Footings designed in accordance with the above may experience total settlements of 1 inch under static loading with differential settlement between adjacent columns of about ½ inch. Most settlement should occur during construction.

FLOOR SLABS

Conventional slab on grade construction may be used for the floor slabs. The floor slab may be supported on the existing, dense, crushed rock surfacing, provided the material is clean enough to provide a capillary break function, as described below. All fill underlying the floor slabs should be compacted to firm and unyielding condition with a vibratory roller or HoPac prior to the construction of the floor slab. All floor slabs should be constructed on a minimum 6-inch thick capillary break consisting of free-draining, crushed rock or well-graded gravel compacted to a firm and unyielding condition. The capillary break material should have no more than 10 percent passing the No. 4 sieve and less than 5 percent by weight of the material passing the U.S. Standard No. 100 sieve. City of Seattle Type 22 material meets this gradation requirement. We

also recommend that a 10-mil polyethylene vapor barrier be placed below the slab. Based on the above, the floor slab may be designed using a modulus of subgrade reaction of 150 pci.

STRUCTURAL FILL

WSDOT Gravel Borrow (9-03.14(1)) should be used for structural fill as needed. The structural fill should be moisture conditioned to within about 3 percent of optimum moisture content, placed in loose, horizontal lifts less than 8 inches in thickness, and systematically compacted to a dense and relatively unyielding condition and to at least 95 percent of the maximum dry density, as determined using test method ASTM D 1557.

PAVEMENTS

We recommend using 4" of HMA for any new pavement over the existing crushed rock surfacing. The underlying subgrade should be proof rolled to a dense and unyielding condition before placing the HMA. Any soft areas in the subgrade should be over excavated and replaced with compacted crushed surfacing base course (CSBC) (WSDOT 9-03.9(3)c). Material within the pavement prism should be compacted to 95% of the material's maximum dry density, as determined using test method ASTM D 1557.

EROSION AND DRAINAGE CONSIDERATIONS

The crushed rock surfacing at the site is not susceptible to surface erosion and, therefore, will not require any remedial measures to address erosion control or drainage.

Any paving at the site should be sloped to direct surface runoff away from the building to a suitable outlet. Roof downspouts should also be tightlined to a suitable outlet. Because of the depth of the water table, footing drains are not required for the building foundations.

WET WEATHER EARTHWORK RECOMMENDATIONS

General recommendations relative to earthwork performed in wet weather or in wet conditions are presented below:

- Earthwork should be performed in small areas to minimize subgrade exposure to wet weather. Excavation or the removal of unsuitable soil should be followed promptly by the placement and compaction of clean structural fill. The size and type of construction equipment used may have to be limited to prevent soil disturbance.

- During wet weather, the allowable fines content of the structural fill should be reduced to no more than 5 percent by weight based on the portion passing ¾-inch sieve. The fines should be non-plastic.

- The ground surface within the construction area should be graded to promote run-off of surface water and to prevent the ponding of water.

- Bales of straw and/or geotextile silt fences should be strategically located to control erosion and the movement of soil. Erosion control measures should be installed along all the property boundaries.

- Excavation slopes and soils stockpiled on site should also be covered with plastic sheets.

ADDITIONAL SERVICES

To confirm that our recommendations are properly incorporated into the design and construction of the proposed project, PanGEO should be retained to conduct a review of the final project plans and specifications, and to monitor the construction of geotechnical project elements, such as:

- Review final project plans and specifications;

- Verify implementation of erosion control measures;

- Verify adequacy of prepared footing subgrades;

- Confirm the adequacy of the compaction of structural backfill;

- Other consultation as may be required during construction.

Conditions encountered during construction may differ from the assumptions and recommendations described in this report. Consequently, differing site conditions may require modifications to the recommendations presented in this report.

CLOSURE

We have prepared this report for your use for the proposed site improvements. The recommendations contained in this report are based on a review of available geologic and

geotechnical information, a subsurface test pit program, and on 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 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.

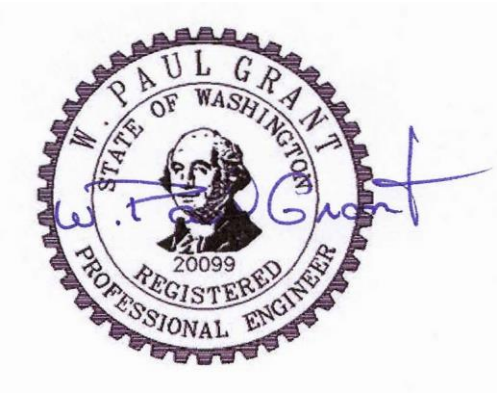
This report has been prepared for planning and design purposes for specific application to the proposed project in accordance with the generally accepted standards of local practice at the time this report was written. No warranty, express or implied, is made.

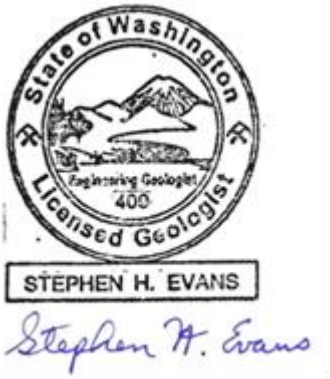
This report may be used only by the client and for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both off and on-site), or other factors including advances in our understanding of applied science, may change over time and could materially affect our findings. 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.

Please call with any questions on this evaluation.

Sincerely,





W. Paul Grant, P.E.
Principal Geotechnical Engineer

Stephen H. Evans, L.E.G.
Senior Engineering Geologist

Attachments:

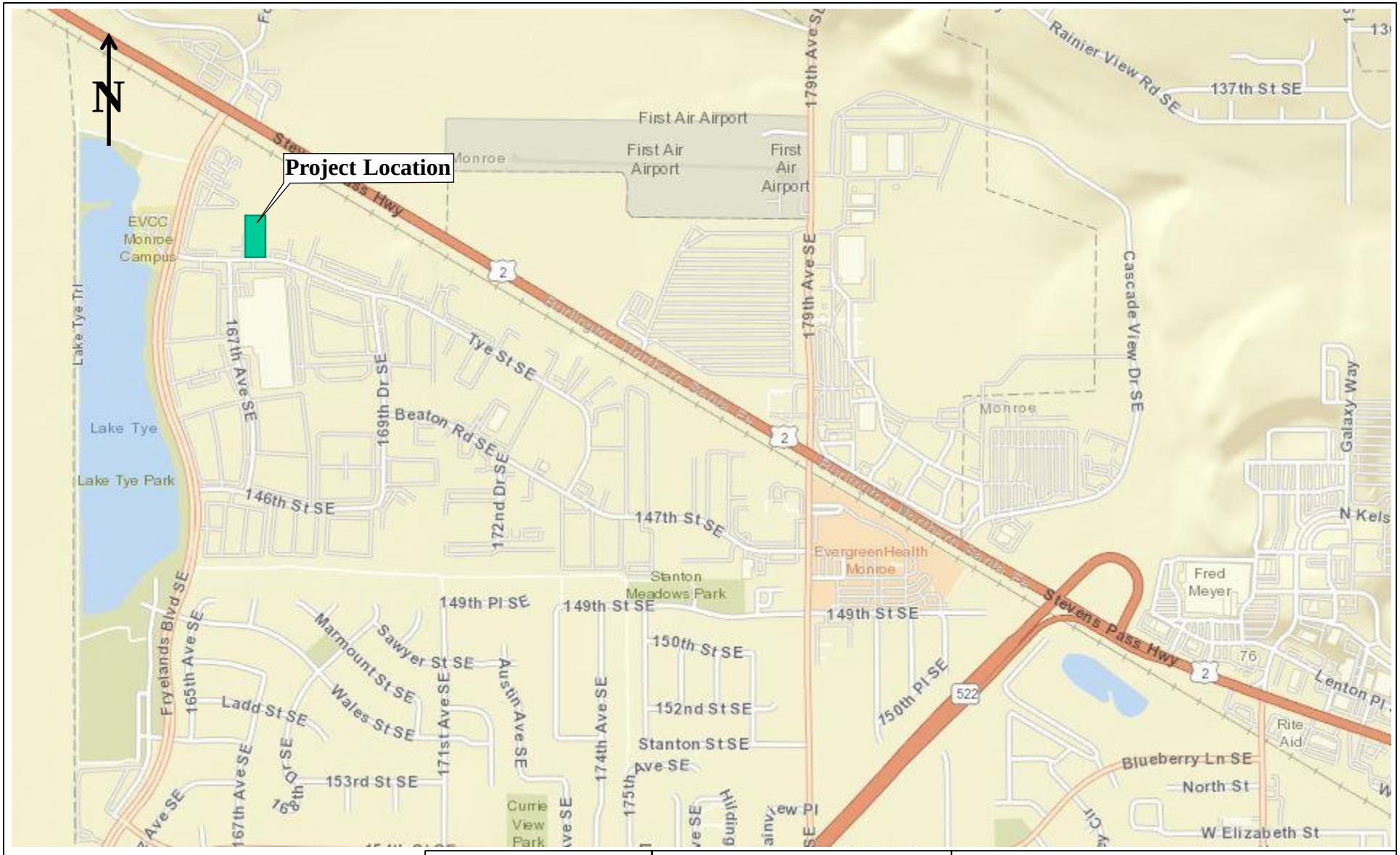
Figure 1 – Vicinity Map
Figure 2 – Site and Exploration Plan
Figure 3 – Terms and Symbols for Boring and Test Pit Logs
Figure 4 – Log of Test Pit No. TP-1
Figure 5 – Log of Test Pit No. TP-2
Figure 6 - Log of Test Pit No. TP-3
Figure 7 – Log of Test Pit No. TP-4

References:

Allen, M. D.; Mavor, S. P.; Tepper, J. H.; Nesbitt, E. A.; Mahan, S. A.; Cakir, Recep; Stoker, B. A.; Anderson, M. L., 2017, *Geologic map of the Maltby 7.5-minute quadrangle, Snohomish and King Counties, Washington*: Washington Geological Survey Map Series 2017-02.

Dragovich, J.D., Anderson, M.L., Mahan, S.A., Koger, C.J., Jennifer H. Saltonstall, J.H., MacDonald, J.H, Jr., Wessel, G.R., Stoker, B.A., Bethel, J.P., Labadie, J.E., Cakir, R., Bowman, J.D., and DuFrane, S.A., 2011, *Geologic Map of the Monroe 7.5-minute Quadrangle, King and Snohomish Counties, Washington*: Washington Division of Geology and Earth Resources Open File Report 2011-1.

Minard, J.P., 1985, *Geologic map of the Maltby Quadrangle, Snohomish and King Counties, Washington*: U.S.G.S. Miscellaneous Field Studies Map MF-1746.



Map not to Scale
Base Map from
Washington DNR

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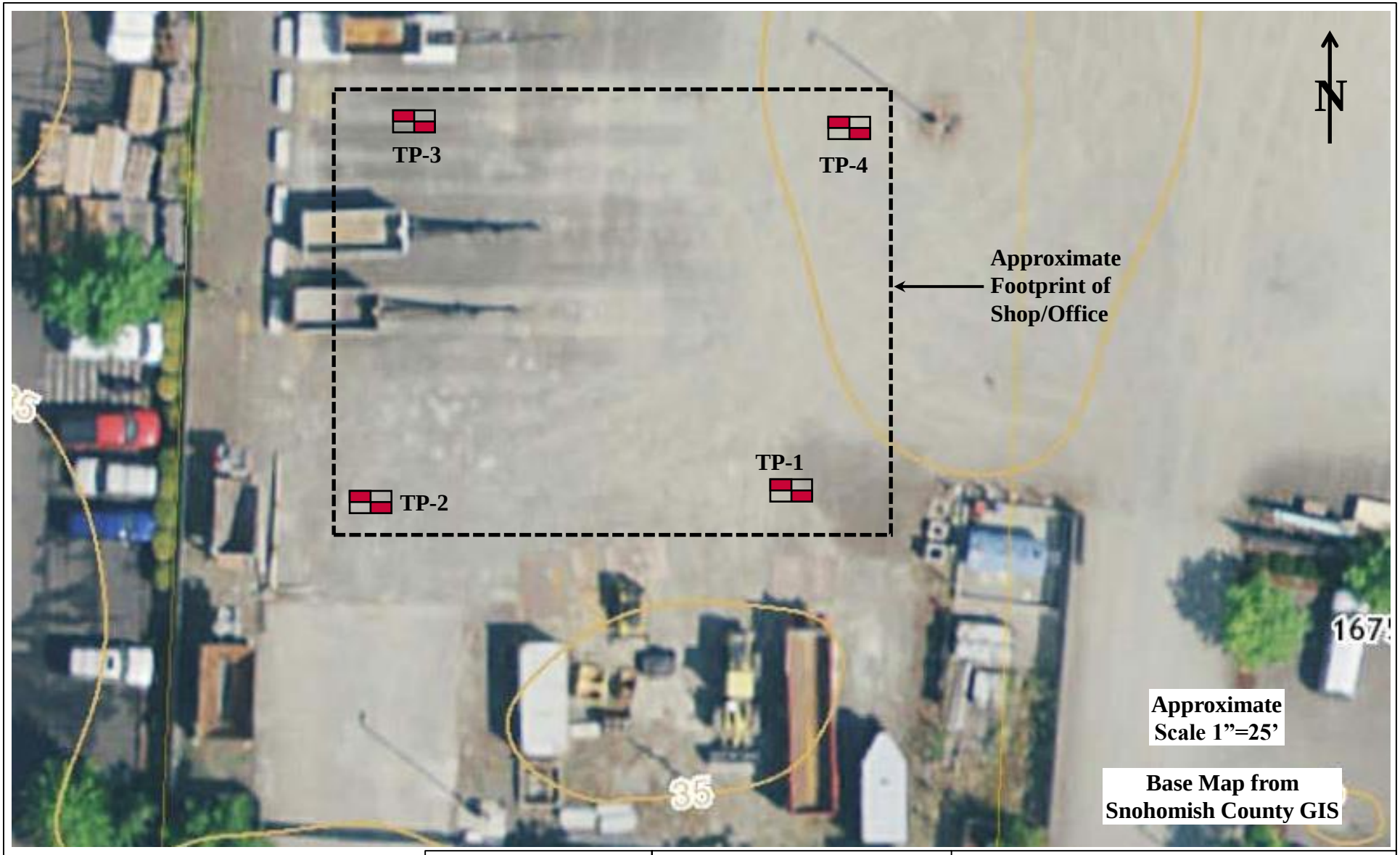
Proposed Shop and Office
16731 Tye Street SE
Monroe, WA

VICINITY MAP

Project No.	Figure No.
20-224.000	1



Legend:

TP-1 PanGEO Test Pit

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16731 Tye Street SE
Monroe, WA

SITE AND EXPLORATION PLAN

Project No.	Figure No.
20-224.000	2

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

Laminated: Layers of soil typically 0.05 to 1mm thick, max. 1 cm

Lens: Layer of soil that pinches out laterally

Interlayered: Alternating layers of differing soil material

Pocket: Erratic, discontinuous deposit of limited extent

Homogeneous: Soil with uniform color and composition throughout

Fissured: Breaks along defined planes

Slickensided: Fracture planes that are polished or glossy

Blocky: Angular soil lumps that resist breakdown

Disrupted: Soil that is broken and mixed

Scattered: Less than one per foot

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

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Terms and Symbols for Boring and Test Pit Logs

Figure 3

Test Pit No. TP-1 Approximate ground surface elevation: 35 feet		
Depth (ft)	**UNIT**	**Material Description**
0 – 0.75	FILL	Dense, gray CRUSHED ROCK base, with geotextile separating fill from underlying fill.
0.75 – 6.5	FILL	Medium dense to dense, dark gray grading to brown, silty, gravelly, fine SAND with cobbles: moist, non-plastic to slightly plastic fines, occasional debris. - 2' becoming cobbly
6.5 – 8.0	PEAT	Soft, dark brown, organic PEAT
8.0 – 9.5	ALLUVIUM	Loose to medium dense, gray, SILT: wet, some fine sand, homogeneous, non-plastic.
TP-1 was terminated approximately 9.5 feet below ground surface on June 24, 2020. Groundwater seepage was not observed.		

Figure 4

Test Pit No. TP-2 Approximate ground surface elevation: 35 feet		
Depth (ft)	**UNIT**	**Material Description**
0 – 0.6	FILL	Dense, gray CRUSHED ROCK base, with geotextile separating fill from underlying fill.
0.6 – 1.4	FILL	Medium dense to dense, brown, silty, gravelly, fine SAND: slightly moist, non-plastic to slightly plastic fines, with cobbles.
1.4 – 6.6	FILL	Medium dense, gray, silty, gravelly, fine SAND with cobbles: slightly moist, trace of debris, layered.
6.6 – 7.3	PEAT	Soft, brown, organic PEAT.
7.3 – 7.5	ALLUVIUM	Loose to medium dense, light brown SILT with clay: very moist, slightly plastic, trace to some fine sand, laminated, homogeneous.
TP-2 was terminated approximately 7.5 feet below ground surface on June 24, 2020. Groundwater seepage was not observed.		

Figure 5

Test Pit No. TP-3 Approximate ground surface elevation: 35 feet		
Depth (ft)	**UNIT**	**Material Description**
0 – 0.9	FILL	Dense, gray CRUSHED ROCK base, with geotextile separating fill from underlying fill.
0.9 – 6.5	FILL	Medium dense to dense, gray, silty, gravelly, fine SAND with cobbles: moist, non-plastic to slightly plastic fines, layered. - 2.4' grassy organics - 5' wood
6.5 – 7.7	PEAT	Soft, dark brown, organic PEAT.
7.7 – 8.0	ALLUVIUM	Loose to medium dense, light green gray SILT: wet, some fine sand, homogeneous, non-plastic to slightly plastic.
TP-3 was terminated at approximately 8.0 feet below ground surface on June 24, 2020. Groundwater seepage was not observed.		

Figure 6

Test Pit No. TP-4 Approximate ground surface elevation: 35 feet		
Depth (ft)	**UNIT**	**Material Description**
0 – 0.5	FILL	Dense, gray CRUSHED ROCK base, with geotextile separating fill from underlying fill.
0.5 – 6.3	FILL	Dense, brown, silty, gravelly, fine SAND with cobbles: slightly moist, non-plastic to slightly plastic fines, layered, breaks in shards, metal debris.
6.3 – 7.4	PEAT	Soft, dark brown, organic PEAT, large wood chunk.
7.4 – 8.2	ALLUVIUM	Loose to medium dense, light green gray SILT: very moist, trace to some fine sand, homogeneous, non-plastic to slightly plastic, layered.
TP-4 was terminated at approximately 8.4 feet below ground surface on June 24, 2020. Groundwater seepage was not observed.		

Figure 7