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Geotechnical Engineering Services Report

Mineral Lake Property Due Diligence
Mineral Lake, Washington

for
YMCA Seattle

March 16, 2021

GeoEngineers
Earth Science + Technology

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Mineral Lake Property Due Diligence
Mineral Lake, Washington

File No. 6565-008-00

March 16, 2021

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EXECUTIVE SUMMARY

The YMCA is in discussions to purchase all or portions of an approximate 2,118-acre privately owned, commercial forest tract adjacent to Mineral Lake, within Lewis County, Washington. The overall project goal is to develop and operate a year-round youth and family camp on the property. Project development is still in the conceptual phase and anticipated site improvements include new buildings and roadway construction for camp facilities, water supply development, wastewater systems and stormwater facilities.

Based on our understanding of the project, our review of subsurface explorations completed as part of this study and our experience, it is our opinion the Mineral Lake property is suitable for camp development as currently envisioned. We do not see any limiting factors that would prohibit overall project design and construction with regard to geotechnical considerations. Project layout and design will need to incorporate geotechnical considerations including, but not limited to, soil type and groundwater conditions, critical areas, seismic design, roadway design and foundation bearing and settlement. In our opinion these geotechnical considerations can be managed through appropriate site layout, engineering design and construction methods.

A preliminary summary of primary geotechnical considerations for the proposed development is provided below.

- Based on recently completed test pits, we have divided subsurface conditions at the site into four soil units for the purposes of design: (1) fill, (2) residual soils, (3) bedrock and (4) glacial drift.
    - Fill encountered appears to consist of reworked native soils (including bedrock) placed during construction of existing access roads.
    - Residual soils are derived from weathered basalt bedrock and consist of significant clay material.
    - Bedrock was encountered below residual soils in some of our explorations and exposed bedrock outcrops were also observed in some areas at the project site. These are indications of shallow depths to bedrock in portions of the site. If shallow bedrock is encountered during site development, we anticipate specialty rock excavation equipment or blasting will be required to excavate.
    - Residual soils and bedrock appear to extend over a larger area than indicated on geologic maps. Consequently, fewer granular glacial drift type soils were encountered than expected from review of the geologic mapping.
    - Glacial drift soils appear to be more favorable for infiltration. Glacial drift was encountered in the lowest elevation test pit excavations adjacent to Mineral Creek.
- Groundwater conditions vary across the site. In our opinion groundwater seepage observed within residual soils at the property are consistent with perched groundwater. What we interpret to be static groundwater was observed within glacial drift soils adjacent to Mineral Creek. We anticipate static groundwater levels adjacent to Mineral Creek are interconnected with water levels in the creek.
- Based on criteria outlined in the Lewis County Code erosion, steep slope, landslide and seismic hazard areas are present at the property and should be reviewed as project design progresses. We anticipate these geotechnical related hazards can be managed through site layout, site grading, horizontal setbacks and other engineering controls.

- In general, it is our opinion the risk of liquefaction within the majority of the site is low. It is our opinion that potentially liquefiable layers could be present adjacent to Mineral Creek. Based on planned construction, we expect that structures can be adequately located and/or designed to mitigate adverse effects from potential liquefaction induced settlements.
- We envision that proposed structures for camp development can be adequately supported on shallow foundations, reinforced mats and slabs-on-grade.
  - Clay soils (e.g., residual deposits encountered in our test pits) are potentially compressible and could consolidate when subjected to new loads such as structures or fill placed to raise site grades. We do not anticipate settlement as controlling factor for design of proposed roadways and lightly loaded camp structures; however, to mitigate settlement risk we recommend heavier structures (e.g., water storage tank) bear on bedrock or dense glacial drift soils.
- We anticipate slow to very slow design infiltration rates within residual soils. We anticipate more favorable rates will be attained within glacial drift soils (adjacent to Mineral Creek). Vertical and horizontal separations (e.g., depth to bedrock, depth to groundwater, distance from water sources, etc.) will likely control septic and stormwater infiltration design.

After purchase of the property is finalized and the proposed camp developments have been sited, we can provide additional considerations, recommendations on further explorations and geotechnical design for specific site development. Ultimately, site and project specific geotechnical design is recommended once initial planning and design has been completed.

This Executive Summary should be used only in the context of the full report for which it is intended.

1.0 INTRODUCTION AND PROJECT UNDERSTANDING

The YMCA is in discussions to purchase and/or develop all or portions of a privately owned, commercial forest tract adjacent to Mineral Lake, within Lewis County, Washington. The overall project goal is to develop and operate a year-round youth and family camp on the property. This report presents the results of our geotechnical engineering due diligence services for the proposed YMCA Mineral Lake Camp.

Our understanding of this project is based on our communications with the YMCA, Heartland LLC and other members of the design team, including our previous and ongoing attendance at design team meetings, review of background documents and preliminary permit discovery application submittals throughout 2020. This also includes review of "YMCA Seattle Mineral Lake Site Due Diligence and Permitting Technical Services" Request For Proposal (RFP) obtained in an electronic mail dated October 30, 2019 and "Mineral Lake Program, version 2" project summary.

Project development is still in the early stages of conceptual planning and design. Property development is anticipated to occur in phases over a period of up to 20 years. It is anticipated that the maximum area of disturbance for the camp and associated site improvements will not exceed a total of about 100 acres; the remaining undeveloped portion of the property will be used for hiking and recreation and will either remain in forestry production or be placed into conservation easements.

Preliminary design considerations focus on portions of the site around Mineral Lake. There are four primary areas being considered for development, including a Camp Entrance west of the lake, a Family Camp located northwest of the lake, a Youth Camp located east of the lake, and a primary road (mostly occupying the existing logging roads) between the Family Camp and the Youth Camp. Currently proposed site improvements include:

- Construction of new structures including a camp lodge, program shelters/classrooms, cabins, staff housing and utility/maintenance. Individual buildings are anticipated to be up to about 9,000 square feet or less and be supported by slab-on-grade and conventional shallow foundations.
- Expansion of the existing access road from Mineral Hill Road for passenger vehicles, delivery trucks and emergency vehicles. A parking lot (or multiple lots) will also be developed to accommodate vehicle traffic.
- Recreational trails throughout the property.
- Water access and up to two dock features near the northern portion of the lake.
- Development of a water supply system for the camp, including a water storage tank (or multiple tanks).
- Wastewater conveyances and septic drainfields.
- Stormwater facilities to collect, treat, infiltrate and/or discharge stormwater.

2.0 PURPOSE AND SCOPE OF SERVICES

Our services have been provided in accordance with our existing agreement with the YMCA of Seattle dated March 4, 2020 and signed March 16, 2020. Details regarding our specific scope of services for the project can be reviewed in our agreement or provided upon request. Our services have been split into three tasks, consisting of:

- Task 100: Phase 1 Environmental Site Assessment
- Task 200: Geotechnical Engineering Services
- Task 300: Environmental Permitting and Sensitive Areas Review

This report summarizes the results of our Task 200 Geotechnical Engineering Services due diligence study. Results of our Task 100 Phase 1 Environmental Site Assessment and Task 300 Environmental Permitting and Sensitive Areas Reviews will be provided in separate letter reports or memorandums, as appropriate.

The purpose of our Task 200 Geotechnical Engineering Services for this due diligence study is to explore subsurface soil and groundwater conditions at the property and use that information to provide our preliminary opinion on the suitability of the property for the proposed camp development. The results of our services will support decisions on potential purchase of the property and future planning.

3.0 SITE CONDITIONS

3.1. Site Vicinity and History

The property is located at the north end of Mineral Lake, approximately 1 mile north-northeast of the town of Mineral, Washington, as shown on the Vicinity Map, Figure 1. The property is currently owned by Forecastle Timber Company LLC and is used for timber production and harvesting. Historically, the site has also been used as a gravel source for construction of access roads on site. The property consists of several parcels, which are grouped into four areas as shown on the Presubmission Package Vicinity Map, Figure 2.

- Area A: Approximately 500 acres along the north and east shorelines of Mineral Lake
- Area B: Approximately 143 acres of forest reserve along the western property boundary
- Area C: Approximately 371 acres for along Mineral Creek and the eastern property boundary
- Area D: Approximately 1,104 acres of forest reserve at the northern property boundary

3.2. Conceptual Development Areas

We understand portions of Area A and Area C described above have been identified by the YMCA and project team for potential camp development, as shown on Presubmission Package Conceptual Development Areas, Figure 3. We, therefore, concentrated our geotechnical services to target these potential development areas.

3.3. Surface Conditions

The property is generally bounded by Nisqually River to the north, Mineral Creek to the east, Mineral Lake and Roundtop Creek to the south and Mineral Hill Road to the west. Adjacent properties generally consist of forested areas and large acreage single-family residences. The unincorporated town of Mineral is located at the southwest end of Mineral Lake.

Predominant site features near the conceptual development areas include the Mineral Lake shoreline, Mineral Creek water frontage and a steep ridge that runs generally east-west through the northern half of the property.

The property is largely undeveloped forest and heavily vegetated, although areas of the site have been clear cut in recent history and are, therefore, sparsely vegetated. Vegetation generally consists of grasses, brush and young to mature trees. Several creek and wetland areas with associated vegetation are also present.

A gravel-surfaced access road serves the property, accessed from Mineral Hill Road at the southwestern corner of the property. A series of smaller gravel-surfaced roads provide additional access throughout the property. Two antenna towers and associated structures are located near the top of the steep ridge in the north-central portion of the site.

Occasional areas of exposed bedrock are present at the site, as observed via satellite imagery and adjacent to access roads while we were on site for test pit excavations. Exposed bedrock appears to be most notably present along steep slope areas. Some areas of bedrock adjacent to access roads show evidence of previous quarry/borrow pit activities.

Numerous streams are present on site, flowing from the higher ridgeline elevations into Mineral Lake, Nisqually River, Mineral Creek and Roundtop Creek.

Ground surface elevations are on the order of Elevation 1,400 feet along the Mineral Lake shoreline, Elevation 1,300 feet at Nisqually River and Mineral Creek. Elevations increase up to about 2,600 feet at the top of the ridge in the north-central portion of the site. A smaller ridge up to about Elevation 2,100 feet is located in the southeast portion of the property, between Mineral Lake and Roundtop Creek. Elevations referenced herein refer to the North American Vertical Datum of 1988 (NAVD 88) and should be considered approximate.

3.4. Literature Review

3.4.1. Geologic Setting

The property is located approximately 20 miles west-southwest of Mount Rainier, an active volcano within the central portion of the Washington State Cascade Mountain Range. Mount Rainier and surrounding foothills generally consist of Tertiary-aged andesitic to basaltic volcanic and volcanoclastic rocks deposited by the accumulation of lava flows and pyroclastic flows. Throughout its history Rainier has produced debris flows and lahars (volcanic mudflows), which have reached as far as Puget Sound. The most recent lava flows occurred about 2,200 years ago and the most recent pyroclastic flows as recently as about 1,100 years ago. Also present in the project area are glacial deposits from alpine glaciation and alluvial deposits in areas surrounding local rivers, creeks and streams.

3.4.2. Geologic Maps

We reviewed published geologic maps of the project vicinity, including “1:100,000-scale Geologic Mapping” available online from the Washington Department of Natural Resources (DNR) Geologic Information Portal (Jackson et al. 2000), the “Geologic Map of Washington State” (Schuster 2005) and our in-house files. For visual reference, a portion of the “1:100,000-scale Geologic Mapping” is reproduced in this report as Geologic Map - 1:100,000-scale, Figure 4.

The maps indicate the higher elevations of the site are underlain by volcanic bedrock consisting of basaltic andesite and flow breccia. Volcanic rock is labelled as Mvba(1) or Tv on the maps reviewed. Unweathered basalt exposures are described as black to greenish black. The upper few feet of basalt can be weathered, typically weathering into clay minerals and gray to moderate yellow-brown in color.

Low-lying elevations of the project area are mapped as glacial drift, labelled as Qap(h) or Qad on the maps reviewed. Glacial drift is generally mapped immediately southwest and east of Mineral Lake, including the area along Mineral Creek. Glacial drift is described as undifferentiated glacial sand, gravel and till, and includes areas of glacial outwash and recent alluvial deposits.

Other geologic units mapped outside of the project area include mass-wasting deposits (Qls) and sedimentary rocks (Ec[2pg]).

3.4.3. Natural Resources Conservation Service (NRCS) Description

The United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Web Soil Survey indicates approximately 21 soil types (not including slope classifications) are mapped within the total property area. No singular soil unit appears to cover more than about 15 percent of the total property surface area. The literature generally describes the soils as derived from andesite, igneous rocks, volcanic ash and glacial till.

3.4.4. Water Well Reports

We were provided two water well reports for review. Copies of these well reports are provided in Appendix B. The well reports include a log of soil types encountered in the borings as well as static water level readings. We understand these wells were completed at the property; however, detailed location or elevation information is not provided on the well reports.

The well report with Ecology Tag ID No. AGE820 indicates "top soil" and "clay with boulders" were encountered to a depth of 13 feet below ground surface (bgs). Soils were underlain by shale to the full depths explored, 203 feet bgs. Static water level is recorded at 23 feet below top of well on January 13, 2002.

The well report with Ecology Tag ID No. AGE821 indicates "clay with boulders" was encountered to a depth of 12 feet bgs. Soil was underlain by shale to a depth of 173 feet bgs, underlain by sandstone to a depth of 243 feet bgs (bottom of boring). Static water level is recorded at 161 feet below top of well on January 4, 2002.

3.5. Subsurface Conditions

3.5.1. Methodology

We explored subsurface conditions at the site by advancing 24 test pit explorations between March 26, 2020 and March 27, 2020. Test pit excavations were advanced using a track-mounted excavator with a toothed-bucket provided and operated by Kelly's Excavating, Inc. under subcontract to GeoEngineers. As previously indicated in Section 3.2 of this report, test pit locations were selected to target conceptual development areas. Approximate test pit locations are shown on the attached Site Plan - Test Pit Overview, Figure 5. Details regarding the subsurface exploration program, including summary logs of the explorations, are provided in Appendix A.

Due to the large site area and our limited time on site, test pit locations are relatively far apart. We anticipate soil conditions in unexplored areas and between our test pit locations are somewhat similar to those observed in nearby test pits as described in this report; however, transitions between dissimilar geologic units will likely be present.

Selected samples from our explorations were tested to evaluate engineering properties and to confirm or modify field classifications. Our testing program consisted of grain-size distribution analyses, hydrometer analyses, percent fines determinations and moisture content determinations. Details and the results of our laboratory testing program are provided in Appendix A.

3.5.2. Soil Conditions

We observed what we interpret to be four general soil units at the site: (1) fill consisting of reworked on-site material, (2) residual soils derived from weathered bedrock, (3) bedrock consisting of basalt or granite and (4) glacial drift. In test pits advanced in vegetated areas, we observed about 3 to 6 inches of surficial forest duff, sod and/or underbrush.

In general, soils in upland areas at the site (e.g., Test Pit Area 1 and higher elevations within Test Pit Area 2) appear to generally consist of varying amounts of residual soils overlying basaltic bedrock. We observed what we interpret to be glacial drift soils in low-lying elevations within Test Pit Area 2, adjacent to Mineral Creek. These observations are generally consistent with the geologic mapping of the site (see Figure 4). However, residual soils and basaltic bedrock encountered in the test pits appear to extend over a larger area than mapped, resulting in fewer glacial drift soils than expected, based on the geologic mapping.

A detailed description of soils observed in the test pits is provided in the sections below.

3.5.3. Test Pit Area 1 (Northwest of Mineral Lake)

3.5.3.1. General

Eight test pits (TP-1.01 through TP-1.08) were located in Test Pit Area 1 in the western project area, immediately northwest of Mineral Lake and near the property entrance off Mineral Hill Road. Test Pit Area 1 is shown in detail on Site Plan - Test Pit Area 1, Figure 6. Ground surface elevation at Area 1 test pit locations varied between about Elevation 1,464 feet (TP-1.05, nearest Mineral Lake) to Elevation 1,783 feet (TP-1.07, approximately 1,000 feet laterally upslope from Mineral Lake).

3.5.3.2. Fill

We observed what we interpret to be fill material in two test pits (TP-1.03 and TP-1.08), which were located adjacent to existing logging roadways. Observed fill thickness was on the order of 1½ to 2 feet. Fill typically consisted of variable amounts of medium dense/stiff clay, sand, gravel and cobbles consistent with reworked native residual soils. We expect that fill in these test pits may have been generated and placed during grading for the logging roads.

3.5.3.3. Residual Soils

Residual soils were observed in all eight test pits in Test Pit Area 1. Residual soils were typically comprised of varying amounts of clay, sand and gravel in a loose/soft to very dense/hard condition. Cobbles and boulders were also occasionally encountered. The density and/or stiffness of residual soils appeared to generally increase with depth. We expect that the variety in composition and gradation of residual soils observed was dependent on the degree of weathering of the soils and underlying bedrock. Five test pits

(TP-1.01 through 1.03, 1.05 and 1.06) were terminated within residual soils at depths between 9 and 14½ feet bgs.

3.5.3.4. Bedrock

What we interpret to be volcanic basalt bedrock was observed below residual soils in three test pits (TP-1.04, TP-1.07 and TP-1.08) at depths between about 9 and 13½ feet bgs. The upper approximate 3 inches of bedrock was in a weathered condition and was able to be ripped with the backhoe. However, intact bedrock was encountered immediately below the weathered zone and could not be ripped using the backhoe. Three test pits (TP-1.04, TP-1.07 and TP-1.08) met practical excavation refusal on intact bedrock at depths ranging from 9¼ to 13¾ feet bgs.

3.5.4. Test Pit Area 2 (Low-Lying Area between Mineral Lake and Mineral Creek)

3.5.4.1. General

Sixteen test pits (TP-2.01 through TP-2.16) were located at Test Pit Area 2 in the eastern project area, generally between Mineral Lake and Mineral Creek. Test Pit Area 2 is shown in detail on Site Plan - Test Pit Area 2, Figure 7. Ground surface elevation at Area 2 locations varied between about Elevation 1,341 feet (TP-2.12, adjacent to Mineral Creek) to Elevation 1,562 feet (TP-2.15, upland area between Mineral Lake and Roundtop Creek).

We observed residual soils were encountered within the highest elevation test pits at Test Pit Area 2, (between Elevation 1,362 and 1,562 feet). Glacial drift soils were encountered at the lower elevation test pits (Elevation 1,341 to 1,361 feet).

3.5.4.2. Fill

Material we interpret to be fill was encountered in one test pit (TP-2.02) in Test Pit Area 2. Fill material consisted of angular rock fragments in a medium dense condition extending from the ground surface to about 3½ feet bgs. Based on the material type and location, we anticipate that the fill consists of native volcanic basalt bedrock processed and placed for logging road construction.

3.5.4.3. Residual Soils

We observed what we interpret to be residual soils in ten test pits (TP-2.01 through TP-2.06 and TP-2.13 through TP-2.16). Residual soils were typically comprised of varying amounts of loose/soft to dense/stiff clay, sand and gravel. We expect that the variety in composition and gradation of residual soils observed was dependent on the degree of weathering of the soils and underlying bedrock.

Residual soils in TP-2.06 were encountered from the ground surface to a depth of approximately 5½ feet and were underlain by glacial drift soils. Residual soils in seven test pits (TP-2.01, TP-2.02, TP-2.05 and TP-2.13 through TP-2.16) extended from the ground surface to depths between approximately 7½ and 12½ feet bgs (full depths explored).

3.5.4.4. Bedrock

What we interpret to be bedrock (volcanic basalt and/or granite) was observed below residual soils in two test pits (TP-2.03 and TP-2.04). The upper approximate 3 to 6 inches of bedrock was in a weathered condition and was able to be ripped with the backhoe. However, intact bedrock was encountered immediately below the weathered zone and could not be ripped using the backhoe. Two test pits (TP-2.03 and TP-2.04) met practical excavation refusal on intact bedrock at depths of 10¾ and 8 feet bgs, respectively.

3.5.4.5. Glacial Drift
What we interpret to be glacial drift was observed in seven test pits (TP-2.06 through TP-2.12) in Test Pit Area 2. Glacial drift was encountered at the ground surface or immediately below a surficial layer of forest duff/underbrush except in TP-2.06, which encountered glacial drift below residual soils.

Glacial drift was generally comprised of loose to dense gravel with varying amounts of silt and sand, as well as occasional layers of silt and sand. Cobbles and boulders were occasionally observed within the glacial drift soils. We interpret glacial drift encountered as recent alluvial deposits from Mineral Creek. TP-2.06 through TP-2.12 were terminated within glacial drift soils at depths between about 8 and 13 feet bgs.

3.5.5. Groundwater Conditions

3.5.5.1. Test Pit Area 1 (Northwest of Mineral Lake)
Groundwater seepage was observed in five out of eight test pits (TP-1.01 through TP-1.05) in Test Pit Area 1 at depths ranging from approximately 4 to 12 feet bgs. Soils underlying observed seepage areas were in a moist condition. Groundwater seepage was not observed in the remaining test pits in Test Pit Area 1 (TP-1.06 through TP-1.08). We also observed occasional mottled soil coloring and iron-oxide staining in the test pits, as noted in the logs, which are indications of fluctuations in the groundwater level.

In our opinion, observations of groundwater seepage in Test Pit Area 1 are consistent with perched groundwater.

3.5.5.2. Test Pit Area 2 (Low-Lying Area between Mineral Lake and Mineral Creek)
Residual soils were encountered to the depths explored in nine out of sixteen test pits in Area 2 (TP-2.01 through TP-2.05 and TP-2.13 through TP-2.16). These test pits were located at higher elevations in Test Pit Area 2 (Elevation 1,362 to 1,562 feet) and distant from Mineral Creek. Groundwater seepage within the residual soils was observed in one test pit (TP-2.13) at 1 foot bgs. Soils underlying the observed seepage area were in a moist condition. We also observed occasional mottled soil coloring and iron-oxide staining in the test pits, as noted in the logs, which are indications of fluctuations in the groundwater level.

Residual soils underlain by glacial drift soils were observed in one test pit (TP-2.06, EL 1357 feet). What we interpret to be static groundwater was observed at a depth of 5 feet bgs at this location. Top of glacial drift soils consisting of gravel was observed at 5.5 feet bgs.

Glacial drift soils were observed in six test pits in Area 2 (TP-2.07 to TP-2.12). These test pits were located at lower elevations in Test Pit Area 2 (Elevation 1,341 to 1,361 feet) and adjacent to Mineral Creek. What we interpret to be static groundwater was observed in each of these test pits at depths between 6 to 11 feet bgs (Elevation 1,332 to 1,352 feet) and extending to the full depths explored.

In our opinion, observations of groundwater seepage within residual soils at Test Pit Area 2 are consistent with perched groundwater. What we interpret to be static groundwater was observed within glacial drift soils and adjacent to Mineral Creek.

3.5.5.3. Discussion
Perched groundwater encountered is likely due to infiltration of surface water that slows or terminates atop underlying less permeable layers of residual soils or bedrock. It is common for perched groundwater to be present near contacts where soil that is more permeable overlies soil that is less permeable (e.g., relatively loose/soft residual soils over bedrock). The quantity and location of perched groundwater, if encountered,

is expected to be dependent on infiltration of surface water. Site grading can affect infiltration and therefore, the quantity and location of perched groundwater.

We anticipate static groundwater adjacent to Mineral Creek are interconnected with water levels in the creek. When creek levels are high water will flow from the creek into the ground; when creek levels are low water will flow from the ground into the creek.

It is not clear whether the groundwater seepage, static groundwater and wet conditions observed in the test pits remain year-round, including throughout the relatively drier summer months. Groundwater levels can fluctuate depending on soil conditions, rainfall amounts, irrigation activities and other factors. We anticipate groundwater levels will generally be highest during the wet season, typically October through May in western Washington.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1. Critical Areas Review

4.1.1. Methodology

We reviewed Lewis County Code Chapter 17.38 "Critical Areas", which classifies and designates critical areas within Lewis County. Specifically, we reviewed site conditions as they relate to (1) erosion hazards, (2) steep slope areas, (3) landslide hazard areas, (4) seismic hazards and (5) volcanic hazards.

4.1.2. Erosion Hazard Areas

Lewis County Code Section 17.38.640 defines erosion hazard areas as "areas that have severe or very severe erosion potential as detailed in the soil descriptions contained in the Web Soil Survey for Lewis County, Washington". For visual reference, erosion hazard at the property as mapped by the NRCS Web Soil Survey is reproduced as Erosion Hazard - NRCS, Figure 8. Erosion hazard at the property as mapped by Lewis County is reproduced in this report as Erosion Hazard Areas - Lewis County, Figure 9. Based on our review of the NRCS and Lewis County maps, a large percentage of the property is mapped as underlain by soils with severe to very severe erosion hazard.

Based on our understanding of the project, we understand site grading and ground disturbing activities will be limited as much as practical. The majority of the property will remain undeveloped and heavily forested, will be used for hiking and recreation and will either remain in forestry production or be placed into conservation easements.

We anticipate erosion hazards can be mitigated through engineering controls such as limited ground disturbance, site grading, planting and other erosion control measures. The presence of erosion hazards, in in our opinion, are not a limiting factor in determining feasibility of the proposed development.

4.1.3. Steep Slope Areas

Steep slope hazard areas are defined in Lewis County Code Section 17.38.650 as areas not mapped as a landslide hazard but with slopes greater than or equal to 35 percent (about 2.9 horizontal:1 vertical) with a vertical relief of 10 feet or more. The presence of a steep slope may indicate potential slope stability problems.

We reviewed provided survey of the property and available online maps of the property. For visual reference, a map available online from Lewis County, which depicts slope grades is reproduced in this report as Steep Slope Areas, Figure 10. In addition, while on site during test pit excavations we observed occasional near-vertical slopes, particularly at areas of exposed bedrock.

In our opinion, steep slope areas at the property can be mitigated through site grading and horizontal offsets. Additional discussion is provided in Section 4.1.4 Landslide Hazard Areas below. Overall, it is our opinion that the presence of landslide hazards is not a limiting factor in determining feasibility of the proposed development and that landslide hazards can be mitigated through proper engineering controls.

4.1.4. Landslide Hazard Areas

4.1.4.1. Landslide Hazard Criteria

Landslide hazard areas are defined in Lewis County Code Section 17.38.650. In particular, the following criteria is included when defining landslide hazard areas:

- Areas subject to previous slope failures, including areas of unstable old or recent landslides.
- Areas with slopes having gradients greater than 80 percent (38.7 degrees) subject to rockfall during seismic shaking.
- Areas that meet the following criteria:
  - Slope greater than 15 percent (8.5 degrees).
  - Hillsides intersecting geologic contacts with a relatively permeable sediment overlying a relatively impermeable sediment or bedrock.
  - Springs or groundwater seepage.
- Areas mapped as landslide hazard areas in maps available from the Washington DNR.

While performing our test pit explorations we observed no evidence of unstable slopes or old or recent deep-seated landslides on site. However, we did observe occasional shallow scarps and tension cracking in areas of the site, particularly within upland areas in the north-central ridge of the property, which are an indication of slope movement and surficial sloughing. We also observed occasional rock debris at the bottom of exposed bedrock areas, which are an indication of rockfall and topple.

We reviewed published online landslide hazard maps provided by the Washington DNR and Lewis County, reproduced as Figure 11 in this report. Our review indicates the site only contains small and isolated areas mapped as landslide hazard areas.

4.1.4.2. Landslide Hazard Discussion

Based on the criteria presented in the Lewis County Code and reproduced in part above, potential landslide hazard areas are present on site. However, based on our observations while on site and the relatively shallow depths to bedrock observed in our test pits within sloped areas, it is our opinion the risk of deep-seated or global failures and instability on site is low. We anticipate landslide hazards at the property can be mitigated through engineering controls such as site grading and horizontal offsets from the toe and crest of landslide hazard areas, or potentially shoring and rock restraint systems.

Existing slopes could experience shallow surficial sloughing over the long term. Sloughing is typically due to natural processes such as seepage, saturation of shallow soils during heavy rain events, decay of roots, or root removal of blown down trees. The magnitude and volume of material involved in shallow surficial sloughing depends on several factors including steepness of slope, time of year, rainfall, and activity of burrowing animals. Because sloughing is a natural process that occurs with or without development, mitigation measures are often limited to monitoring and maintenance.

4.1.5. Seismic Hazard Areas

Seismic hazard areas are addressed in Lewis County Code Section 17.38.660. Our detailed evaluation of seismic and liquefaction hazards at the property are included in Section 4.2.2 below.

4.1.6. Volcanic Hazard

Volcanic hazard areas are addressed in Lewis County Code Section 17.38.670. Volcanic hazards are defined as locations where risk to life and property by a large volcanic event is high, primarily consisting of damage from lahars and near volcano hazards (such as lava flow). Lewis County does not consider volcanic tephra (ash) a volcanic hazard subject to regulation. We reviewed available online maps of the property, which indicates portions of the property adjacent to the Nisqually River and Mineral Creek are mapped as volcanic hazards. For visual reference, a map available online from Lewis County is reproduced in this report as Volcanic Hazards, Figure 12.

Overall, it is our opinion that the presence of volcanic hazards at the site is not a limiting factor in determining feasibility of the proposed development and that volcanic hazards can be mitigated through proper siting and engineering controls.

4.2. Seismic Design Considerations

4.2.1. International Building Code Seismic Design Parameters

4.2.1.1. Design Methodology

We anticipate seismic design of proposed structures will be performed using procedures outlined in the 2018 International Building Code (IBC). Per the 2018 IBC structures shall be designed and constructed to resist the effects of earthquake motions in accordance with American Society of Civil Engineers (ASCE) 7-16.

Soils observed in the test pits varied from soft to stiff clays (residual soils), loose to dense granular soils (glacial drift) and bedrock. Based on conditions observed in our explorations, our review of geologic maps and our experience in the area we anticipate variable near surface soils and depth to bedrock across the property. For preliminary design, analysis and cost estimating we recommend seismic design criteria corresponding to Site Class D (stiff soil).

We should be contacted as project design and building locations advance to determine if a change in Site Class and recommended seismic design criteria are appropriate. In our opinion, Site Class B (rock) or Site Class C (very dense soil and soft rock) may be suitable for some of the structures bearing on intact or weathered bedrock. Site Class F (requiring site response analysis) may be appropriate adjacent to Mineral Creek as liquefiable layers may be present as discussed in the sections below.

4.2.1.2. Seismic Design Criteria

We used map-based values available online as recommended by the United States Geological Survey (USGS) to determine the seismic design spectrum in accordance with ASCE 7-16. We recommend the parameters provided in Table 1 below be used for preliminary design.

TABLE 1. PRELIMINARY SEISMIC DESIGN CRITERIA

2018 IBC (ASCE 7-16) Seismic Design Parameters	
Site Class	D
Spectral Response Acceleration at Short Periods (S_S)	1.12g
Spectral Response Acceleration at 1-Second Periods (S_1)	0.40g
Design Spectral Response Acceleration at Short Periods (S_{DS})	0.79g
Design Spectral Response Acceleration at 1-Second Periods (S_{D1})	null[1]
Design Site Modified Peak Ground Acceleration (PGA_M)	0.54g

Note:

[1] A ground motion hazard analysis may be required in accordance with Section 11.4.8 of ASCE 7-16.

In accordance with ASCE 7-16 Section 11.4.8 a ground motion hazard analysis is required for the site (due to Site Class D site with spectral response acceleration at 1-second periods (S_1) greater than or equal to 0.2). However, an exception is allowed in Section 11.4.8 provided specific requirements are satisfied related to the fundamental period of the structure. Based on our understanding of the conceptual site design, we anticipate proposed structures will be designed such that a ground motion hazard analysis will not be required. We should be contacted if it is determined a ground motion hazard analysis is required for the project.

4.2.2. Liquefaction, Lateral Spreading, and Surface Rupture

4.2.2.1. Liquefaction Potential

Liquefaction refers to a condition where vibration or shaking of the ground, usually from earthquake forces, disturbs the soil structure (i.e., the arrangement of individual soil particles) within saturated and unconsolidated soils. Water in the pore spaces between soil particles will resist the natural tendency of the soils to re-arrange into a denser and more stable state during shaking, resulting in development of excess pore pressures. As porewater pressures increase, soil particles may lose contact with each other and the affected soil deposit may lose much of its stiffness and strength. Liquefaction susceptibility is difficult to predict and not all soils are susceptible to liquefaction. The degree of susceptibility depends in part on the soil grain size. In general, soils most susceptible to liquefaction include loose to medium dense "clean" to silty sands below the water table. However, research and case histories indicate other loose granular soils such as silts and gravels may also be susceptible to liquefaction.

We reviewed the "Liquefaction Susceptibility Map of Lewis County, Washington" (Palmer et al. 2004). We also reviewed a liquefaction susceptibility map available online through Lewis County, reproduced as Liquefaction Susceptibility, Figure 13 in this report. In general, our review indicates the upland areas of the property (north-central and southeast ridge areas) are mapped as bedrock and not liquefiable. The western and eastern site areas adjacent to Mineral Lake and/or Mineral Creek are mapped as having a very low potential for liquefaction.

Based on soil and groundwater conditions observed in our explorations and our interpretation of the regional geology, it is our opinion that the risk for liquefaction is very low in the upland areas of the site underlain by residual soils and shallow bedrock. In the eastern site area adjacent to Mineral Creek, we observed glacial drift soils, including relatively cleaner layers of sand and gravel, as well as static groundwater on the order of 5 to 11 feet bgs. Based on current information, potentially liquefiable layers could be present within glacial drift soils encountered adjacent to Mineral Creek. We anticipate cleaner sand layers encountered in our test pits (e.g., TP-2.07 and TP-2.09) will be most susceptible to liquefaction and the dense gravels encountered have relatively low potential for liquefaction. This should be investigated again once the size and type and location of structures has been determined. Based on proposed development, it is our opinion that the potential for liquefaction is not a controlling factor in determining site development requirements. We anticipate that liquefaction can be mitigated through proper engineering controls.

4.2.2.2. Lateral Spreading Potential

Lateral spreading related to seismic activity typically involves lateral displacement of large, surficial blocks of non-liquefied soil when an underlying soil layer loses strength during seismic shaking. Lateral spreading usually develops in areas where sloping ground or large grade changes (including retaining walls) are present. Based on our understanding of the subsurface conditions, liquefaction risk and current site topography, it is our opinion the risk of lateral spreading is low.

4.2.2.3. Surface Rupture Potential

According to the Washington State DNR Interactive Natural Hazards Map (accessed November 3, 2020), the nearest seismic fault is mapped about 2 miles southwest of the project site and does not appear to trend towards the site. Accordingly, it is our opinion the risk for seismic surface rupture at the site is low.

4.3. Shallow Foundations

4.3.1. General

As the project is in the early phases of planning and design the type, size and location of proposed structures is not available at this time. Based on our understanding of the proposed development at the time of this report and our explorations at the project site, it is our opinion lightly loaded structures (e.g., single- and two-story wood framed structures) can be adequately supported on shallow foundations, reinforced mats and slab-on-grade. For heavier structures (e.g., water storage tank), more stringent bearing surface preparation requirements and settlement analysis may be appropriate such as bearing on bedrock through overexcavation or possibly pile foundations, depending on the thickness of the upper residual units.

4.3.2. Footing Bearing Surface Preparation

We recommend foundations for proposed structures not bear directly on relatively loose soils (including fill, residual and/or glacial drift soils) without improvements. Depending on final development locations, site grading and foundation grade, compaction improvements to existing loose soils could be required. Depending on thickness, some removal and replacement (overexcavation) may also be necessary.

Foundation bearing surfaces should be compacted as necessary to a firm, non-yielding condition. Loose or disturbed materials present at the base of footing excavations must be removed or compacted. If soft or otherwise unsuitable areas are revealed during evaluation, which cannot be compacted to a stable and uniformly firm condition, the following options may be considered: (1) unsuitable soils be moisture conditioned and recompacted; (2) unsuitable soils be overexcavated and replaced with compacted structural fill, as needed; or (3) it may be possible to push, seat, and compact quarry spalls into soft soils to stabilize the surface and build upon.

4.3.3. Allowable Soil Bearing Pressure

For bearing surfaces prepared as described above, we estimate allowable bearing capacities in the range of 2,000 to 4,000 pounds per square foot (psf) will be satisfactory for residual and/or glacial drift soils. For the purposes of preliminary design, we have assumed groundwater may be present at or below the bearing surface elevation and foundation drainage will be provided to prevent the foundation elements from becoming submerged.

Depending on structure type and location, higher bearing pressures are attainable where weathered bedrock deposits exist and/or within intact bedrock. Once structure type and location have been determined we can provide alternative bearing pressure values, depending on the building location. Weathered rock deposits expected at this site can have allowable bearing pressures of 5,000 to 10,000 psf or more. Intact basalt bedrock has at least this amount and likely more. We recommend we review proposed construction and building locations during design to assist and determine if higher bearing pressures are warranted.

These bearing pressures apply to the total of dead and long-term live loads and may be increased by one-third when considering total loads, including earthquake or wind loads. These are net bearing pressures. The weight of the footing and overlying backfill can be ignored in calculating footing sizes.

4.3.4. Foundation Settlement

Shallow foundations can typically experience two types of static (non-seismic) settlement: elastic and consolidation. Elastic (short-term) settlement typically occurs at the time of load placement or shortly thereafter. Consolidation (long-term) settlement may occur for weeks or months after loads are placed, depending on soil type, and is primarily a result of soft fine-grained and/or organic compressible soil. The amount of settlement that could occur during and after site development is dependent on three major factors: (1) the thickness and nature of the compressible soil layers; (2) the loading of the site, including additional fill; and (3) the loading history of the site. Compressible soils generally experience: (1) initial settlements as loads are being applied and (2) consolidation settlements that can continue for weeks or months.

Some soils observed in our test pit explorations (specifically, clay observed within residual soils) may be compressible. We do not anticipate settlement as a controlling factor for design of lightly loaded site improvements (e.g., roadways and single- and two-story wood framed structures). Heavier structures (e.g., water storage tank) are discussed in more detail in Section 4.3.5 of this report.

We can provide more detailed settlement estimates as building type, size, location and foundation grades are determined. Ultimately, additional explorations may be warranted to better define soil characteristics and determine settlements based on actual structure type and loading conditions. It is possible settlement can be mitigated through overexcavation and replacement, pre-loading, or other suitable methods.

4.3.5. Water Storage Tank

We understand current conceptual design a water supply system for the camp includes a water storage tank (or multiple tanks). We understand tank sizing and preferred location has not yet been determined.

For preliminary cost estimating and design we recommend planning for the water storage tank to not bear on residual soils encountered in the test pits due to reduced foundation bearing support and increased risk of foundation settlements on these soils. We anticipate intact bedrock and/or dense glacial drift soils as encountered in the test pits will provide suitable bearing and settlement performance as well as the condition where structural fill extends to these soils.

4.4. Infiltration Feasibility Assessment

4.4.1. General

On-site sewage systems and stormwater infiltrations facilities will be designed in accordance with Lewis County Code. Due to the presence of shallow groundwater and/or depth to bedrock observed in our test pits, it is our opinion maintaining vertical separation below the bottom of facilities will be a primary factor in controlling design of infiltration facilities. We provide preliminary but specific design recommendations for on-site sewage systems and infiltration facilities below.

4.4.2. On-Site Sewage Systems

Currently proposed on-site sewage systems include septic drain fields. We reviewed Lewis County Code Chapter 8.40, which provides design guidelines for these facilities. Based on laboratory grain-size analyses, we provide United States Department of Agriculture (USDA) soil textural classifications for selected soil samples from our test pit excavations in Table 2 below.

TABLE 2. USDA SOIL TEXTURAL CLASSIFICATIONS

Exploration	Sample Depth (feet)	Sample Elevation (feet)	Geologic Unit	USCS Symbol (Description)	USDA Texture
TP-1.02	3.5	1480.5	Residual	SC (clayey sand with occasional gravel)	Very fine sandy loam
TP-1.05	5	1459	Residual	SC (clayey sand with gravel)	Gravelly very fine sandy loam
TP-1.08	7	1746	Residual	SC (clayey sand with gravel)	Gravelly sandy clay loam
TP-2.03	4	1489	Residual	CL (sandy clay)	Loam
TP-2.07	3.5	1354.5	Glacial Drift	GP-GM (gravel with silt, sand & cobble)	Extremely gravelly loamy fine sand
TP-2.10	3.5	1357.5	Glacial Drift	GP-GM (gravel with silt, sand & occ. cobble)	Extremely gravelly loamy fine sand
TP-2.10	8	1353	Glacial Drift	GW-GM (gravel with silt, sand & cobble)	Extremely gravelly loamy fine sand

Based on our review of Lewis County Code, we anticipate that required vertical separation (e.g., depth to groundwater, bedrock, or other restrictive layer) and horizontal separations (e.g., aquifer, spring, surface water, etc.) of on-site sewage systems will need to be considered during design.

4.4.3. Stormwater Infiltration

4.4.3.1. General

Plans to manage stormwater runoff at the site include infiltration facilities. Soils are classified by the NRCS into four Hydrologic Soil Groups (A, B, C and D) based estimates of the soil's runoff potential. Group A is defined as having a low runoff potential (high infiltration rate), while Group D is defined as having high runoff potential (low infiltration rate). For visual reference, a portion of the NRCS Web Soil Survey is reproduced in this report as Hydrologic Soil Group - NRCS, Figure 14.

Chapter 15.45 of the Lewis County Code refers to the latest edition of the Washington State Department of Ecology (Ecology) Stormwater Management Manual for determining and designing stormwater infiltration facilities. Accordingly, we evaluated the infiltration potential of selected soil samples from our test pits using methods outlined in the 2019 Ecology Stormwater Management Manual for Western Washington (SWMMWW).

4.4.3.2. Calculation of Preliminary Infiltration Rates

Typically, the grain-size analysis method is suitable to determine design infiltration rates for soils that have not been consolidated by glacial advance. Based on our experience and test pit explorations at the site, we anticipate that native soils (residual soils and glacial drift) are not glacially consolidated and therefore, the grain-size analysis method is generally acceptable at the project site.

Preliminary initial saturated hydraulic conductivity of the soil sample is calculated based on the soil grain size analysis using the Massmann method. For long-term design infiltration rates, correction factors are applied to reduce the calculated initial saturated hydraulic conductivity. Correction factors in the SWMMWW are based on site variability, number of tests conducted, uncertainty of the test method, and the potential for long-term clogging due to siltation and bio-buildup. We included the correction factors presented in Table 3 below when calculating preliminary long-term infiltrations.

TABLE 3. 2019 ECOLOGY SWMMWW CORRECTION FACTOR SUMMARY

Issue	Partial Correction Factor
Site Variability and Number of Locations Tested (CF_v)	0.33[1]
Uncertainty of Test Method (CF_t)	0.4
Degree of Influent Control to Prevent Siltation and Bio-Buildup (CF_m)	0.9
Total Correction Factor = CF_v x CF_{ty} x CF_m	**CF = 0.12**

Note:

[1] Correction factor for site variability assumed and must be verified for final design.

Table 4 below summarizes our preliminary initial (short-term) and design (long-term) infiltration rates of the selected soil samples with correction factors applied.

TABLE 4. PRELIMINARY INFILTRATION RATE SUMMARY

Exploration	Sample Depth (feet)	Sample Elevation (feet)	Geologic Unit	USCS Soil Type	Percent Fines	$Ksat_i$[1] (in/hr)	$Ksat_d$[2] (in/hr)
TP-1.02	3.5	1,480.5	Residual	SC	37	6.3	0.8
TP-1.05	5	1,459	Residual	SM	20	9.3	1.1
TP-1.08	7	1,746	Residual	SM	25	10.4	1.2
TP-2.03	4	1,489	Residual	CL	60	2.2	0.3
TP-2.07	3.5	1,354.5	Glacial Drift	GP-GM	8	32.1	3.8
TP-2.10	3.5	1,357.5	Glacial Drift	GP-GM	8	34.9	4.1
TP-2.10	8	1353	Glacial Drift	GW-GM	9	25.0	3.0

Notes:

[1] Preliminary initial saturated hydraulic conductivity as determined by the grain-size analysis method presented in the 2019 Ecology SWMMWW without correction factors.

[2] Preliminary long-term design infiltration rate including appropriate correction factors.

Based on our analysis of the selected soil samples, observed soil layering and site topography, we interpret two different infiltration profiles on site.

- Residual soils generally consisting of varying amounts of clay, silt, sand and gravel. These soils were typically observed in the higher elevations of the project site. Preliminary design infiltration rates within residual soil samples obtained ranged from about 0.3 to 1.2 inches per hour based on grain-size analyses. Residual soils were typically underlain by bedrock.
- Glacial drift soils were generally observed in the lower elevations of the site adjacent to Mineral Creek. Glacial drift soils were generally comprised of gravel with varying amounts of silt and sand. Preliminary design infiltration rates within glacial drift soil samples obtained range from approximately 3 to 4.1 inches per hour. Test pits that encountered glacial drift also encountered relatively shallow groundwater, on the order of 5 to 11 feet bgs.

4.4.3.3. Discussion

Note that samples for laboratory grain-size testing were generally selected after visually determined to be most favorable for infiltration. Therefore, the results presented above may not represent the full range of soil types present at the site.

The preliminary rates presented above do not account for soil layering, underlying impermeable layers or groundwater separation as required for final design. In particular, we anticipate depth to bedrock (residual soils, upland areas of site) and depth to groundwater (glacial drift, adjacent to Mineral Creek) will affect design of infiltration facilities.

Our explorations are somewhat limited in number and depth, and we observed varying subsurface conditions. As such, we recommend GeoEngineers review proposed stormwater infiltration facilities after design to confirm the anticipated performance can be achieved based on the soil conditions encountered or to provide additional recommendations. Additional explorations, testing (including Pilot Infiltration Tests [PITs]), or analysis (e.g., infiltration receptor characterization, groundwater mounding analysis, etc.) may be warranted upon review. We also recommend we be retained during construction to observe soil conditions at the base of the infiltration facilities and verify exposed soil conditions are as anticipated for the proposed design.

4.5. Site Development and Earthwork

4.5.1. General

We anticipate site development and earthwork activities on site will include clearing and stripping vegetated areas; site grading; mass fill placement; establishing subgrades for roads, parking areas, and building foundations; and placing and compacting fill and backfill materials. We expect the majority of site grading and earthwork can be accomplished with conventional earthmoving equipment. However, we observed bedrock in some of our explorations and bedrock outcrops were observed in some areas at the project site, indicating shallow depths to rock. Further discussion is presented below on excavation through bedrock. In general, the site development and earthwork sections provided are to allow the design team to consider further construction efforts that may be needed for costing and development analysis. Additional explorations and more site-specific earthwork recommendations could be required in the future.

4.5.2. Clearing, Stripping and Demolition

Existing surfaces should be cleared and stripped of all vegetation and organics prior to site development. Based on conditions observed in our explorations, minimum stripping depths at the site will likely be up to about 12 inches. However, greater stripping depths could be required to remove localized zones of loose or organic-rich soil, especially in areas of the site currently vegetated with large brush or trees. During clearing and stripping, stumps and primary root systems of shrubs and trees should be completely removed. Voids caused by removal of stumps and/or root systems should be backfilled with compacted structural fill. Stripped material should be transported off site or processed and used as fill in landscaping areas.

Based on our explorations we anticipate soils exposed after stripping have a high fines content and, thus, be susceptible to disturbance when wet. Care should be taken to avoid allowing these soils to become saturated and disturbed. We provide recommendations for subgrade protection in the "4.5.8 Subgrade Protection and Wet Weather Considerations" section below.

We observed cobbles and boulders in our explorations. The contractor should be prepared for the presence of cobbles or boulders in areas to be excavated or re-graded. Boulders may be removed from the site or used in landscape areas. Voids caused by boulder removal should be backfilled with structural fill.

Basalt bedrock was also encountered, primarily in the upland areas of the project site. Decomposed and weathered bedrock should be rippable with standard heavy construction equipment, such as excavators with toothed buckets and dozers with ripping teeth. In our explorations, the weathered zone within encountered bedrock was on the order of 3 to 6 inches thick. If excavation of underlying intact bedrock is necessary, specialty rock excavation equipment or rock blasting may be required. Additional considerations on equipment type will be necessary to excavate substantial amounts of the intact basalt.

4.5.3. Temporary Excavations and Cut Slopes

Based on our explorations shallow excavations on site might experience caving, especially if excavations extend near or below the groundwater level. Excavations deeper than 4 feet should be shored or laid back at a stable slope if workers are required to enter. Shoring and temporary slope inclinations must conform to the provisions of Title 296 Washington Administrative Code (WAC), Part N, "Excavation, Trenching and

Shoring." Regardless of the soil type encountered in the excavation shoring, trench boxes or sloped sidewalls will be required under Washington Industrial Safety and Health Act (WISHA). The contract documents should specify that the contractor is responsible for selecting excavation and dewatering methods, monitoring the excavations for safety and providing shoring, as required, to protect personnel and structures.

In general, for preliminary considerations, temporary cut slopes into soils should be inclined no steeper than about 1.5H to 1V (horizontal to vertical). Temporary cut slopes into intact basalt at inclinations may be able to be cut near vertical for excavations less than 20 feet deep. These guidelines assume all surface loads are kept at a minimum distance of at least one-half the depth of the cut away from the top of the slope and seepage is not present on the slope face. Flatter cut slopes will be necessary where seepage occurs or if surcharge loads are anticipated. Temporary covering with heavy plastic sheeting should be used to protect these slopes during periods of wet weather.

As the design progresses, we should review areas where over-steepened slopes are expected to be constructed. Further investigation of rock type, fractures, and quality will need to be completed to verify if near vertical cut slopes can be constructed.

4.5.4. Permanent Cut and Fill Slopes

In general, we recommend permanent slopes be constructed at a maximum inclination of 2H to 1V. Where 2H to 1V permanent slopes are not feasible, protective facings and/or retaining structures should be considered.

Where slope material consists of intact basalt, we recommend a preliminary maximum slope inclination of 1H to 6V for permanent slope construction planning. This guideline assumes less than about 5 feet of soil is present on top the basalt. Ultimately, sloping conditions in the intact basalt may change or require modifications during construction due to dipping planes and fractures in the rock. Further study should be considered once a grading plan has been established. Where soil is present above and around the bedrock, it should be sloped as previously recommended.

These guidelines assume all surface loads are kept at a minimum distance of at least one-half the depth of the cut away from the top of the slope and seepage is not present on the slope face. Flatter cut slopes will be necessary where seepage occurs or if surcharge loads are anticipated. We recommend GeoEngineers review proposed grading plans when they become available to confirm our opinions are appropriate.

To achieve uniform compaction, we recommend fill slopes be overbuilt and subsequently cut back to expose well-compacted fill. Fill placement on existing slopes steeper than 5H to 1V should be benched into the slope face. The configuration of benches depends on the equipment being used and the inclination of the existing slope. Bench excavations should be level and extend into the slope face. Exposed areas should be re-vegetated as soon as practical to reduce potential surface erosion and sloughing. Temporary protection should be used until permanent protection is established.

4.5.5. Groundwater Handling Considerations

As previously discussed, groundwater varies at the project site. Slow to moderate seepage interpreted to be perched groundwater was observed in Test Pit Area 1 within residual soils underlain by basalt bedrock.

We observed what we interpret to be static groundwater within glacial drift soils in Test Pit Area 2. In some cases, particularly within granular glacial drift soils, groundwater seepage caused significant caving within the test pits that prohibited excavation deeper than about 10 feet.

Groundwater handling needs will typically be lower during the late summer and early fall months. In general, we expect shallow perched groundwater will be the primary condition encountered for shallow excavations in the upland site areas and can typically be handled adequately with sumps, pumps, and/or diversion ditches, as necessary. Excavations below the static groundwater level or in areas with heavy groundwater seepage may require additional measures such as well points. We provide additional recommendations further for subsurface explorations, including the installation of monitoring well(s) in order to better quantify the depth to water. Ultimately, we recommend the contractor performing the work be made responsible for controlling and collecting groundwater encountered.

4.5.6. Surface Drainage

Surface water from roofs, driveways and landscape areas should be collected and controlled. Curbs or other appropriate measures such as sloping pavements, sidewalks and landscape areas should be used to direct surface flow away from buildings, erosion sensitive areas and from behind retaining structures. Roof and catchment drains should not be connected to wall or foundation drains.

4.5.7. Subgrade Preparation

Subgrades that will support structures and roadways should be thoroughly compacted to a uniformly firm and unyielding condition on completion of stripping and before placing structural fill or pavement base fill. We recommend subgrades for structures and roadways be evaluated, as appropriate, to identify areas of yielding or soft soil. Probing with a steel probe rod or proof-rolling with a heavy piece of wheeled construction equipment are appropriate methods of evaluation.

If soft or otherwise unsuitable subgrade areas are revealed during evaluation that cannot be compacted to a stable and uniformly firm condition, we recommend: (1) the unsuitable soils be scarified (e.g., with a ripper or farmer’s disc), aerated and recompacted, if practical; or (2) the unsuitable soils be removed and replaced with compacted structural fill, as needed.

4.5.8. Subgrade Protection and Wet Weather Considerations

Site soils encountered in our explorations contain a significant amount of fines and will be susceptible to disturbance during periods of wet weather, sensitive to small changes in moisture and will be susceptible to disturbance from construction traffic when wet or if earthwork is performed during wet weather. When the moisture content of the soil is more than a few percent above the optimum moisture content, the soil can become muddy and unstable and it will be challenging to meet the required compaction criteria. The wet weather season generally begins in October and continues through May in western Washington; however, periods of wet weather can occur during any month of the year. In our opinion, earthwork at the site should take place during the summer months or during periods of extended dry weather. If wet weather earthwork is unavoidable, we offer the following recommendations:

- The ground surface in and around the work area should be sloped so that surface water is directed away from the work area. The ground surface should be graded so that areas of ponded water do not develop. Measures should be taken by the contractor to prevent surface water from collecting in excavations and trenches. Measures should be implemented to remove surface water from work areas.

- Earthwork activities should not take place during periods of heavy precipitation.
- Slopes with exposed soils should be covered with plastic sheeting.
- The contractor should take necessary measures to prevent on-site soils and other soils to be used as fill from becoming wet or unstable. These measures may include the use of plastic sheeting, sumps with pumps and grading. The site soils should not be left uncompacted and exposed to moisture. Sealing exposed soils by rolling with a smooth-drum roller prior to periods of precipitation will help reduce the extent to which these soils become wet or unstable.
- Construction traffic should be restricted to specific areas of the site, preferably areas that are surfaced with working pad materials not susceptible to wet weather disturbance.
- Construction activities should be scheduled so that the length of time that soils are left exposed to moisture is reduced to the extent practical.
- Protective surfacing such as placing asphalt-treated base (ATB) or haul roads made of quarry spalls or a layer of free-draining material such as well-graded pit-run sand and gravel may be necessary to protect completed areas from construction traffic. Typically, minimum gravel thicknesses on the order of 24 inches are necessary to provide adequate subgrade protection.
- Foundation bearing surface protection should also be considered. We provide additional recommendations in the "4.3 Shallow Foundations" section of this report.

4.6. Fill Materials

4.6.1. General

We provide preliminary recommendations below for consideration of fill materials and to provide some guidance should the design team need to consider further construction efforts needed for costing and development analysis. Additional explorations and more site-specific earthwork recommendations will be required in the future once final development plans are determined.

Material used for fill must be free of debris, organic contaminants and rock fragments larger than 6 inches. The workability of material for use as fill will depend on the gradation and moisture content of the soil. Generally, soil with a higher fines content is more sensitive to changes in moisture. Below we provide recommendations for general fill materials we anticipate will be used for this project. We recommend GeoEngineers review contractor submittals for alternate fill materials.

We provide recommendations below for fill materials to be used in dry and wet weather conditions. Dry weather conditions assume that groundwater is controlled and no standing water is present. If standing water is present, wet weather fill material may not be appropriate and alternatives such as quarry spalls should be considered.

If earthwork occurs during a typical wet season, or if the soils are persistently wet and cannot be dried back due to prevailing wet weather conditions, we recommend the use of imported structural fill or select granular fill. Other fill materials, such as crushed rock or quarry spalls, may also be used during wet weather. Budgets should include provisions for import granular fill, especially if construction is planned during the wet weather season. We can provide specific recommendations for imported material specific for its intended use once site development planning is near construction.

4.6.2. On-Site Soil

Based on our experience, the some of the site soils encountered in our test pits (e.g., residual soils and silty layers within glacial drift) contain a significant percentage of fines, are extremely moisture sensitive and will be difficult or impossible to properly compact when wet. In addition, it is possible existing soils will be generated at moisture contents above optimum.

Residual soils encountered in the test pits also typically contained significant amounts of clay and will require specific drying and compaction techniques to be considered for use as a structural fill. In general, we recommend that the use of residual soils as structural fill be avoided. Once site development plans are determined, more specific direction on the use of on-site residual soils could be investigated and considered.

Relatively cleaner layers of glacial drift observed in our test pits may be considered for use as structural fill provided the material:

- Has maximum particle size of 6 inches,
- Is used during extended periods of dry weather,
- Can be adequately moisture conditioned and placed and compacted as recommended,
- Does not contain debris, organics or other deleterious material, and
- Meets any special requirements related to its end use.

4.6.3. Structural Fill

Material used for structural fill should be free of debris, organic contaminants and rock fragments larger than 6 inches in maximum dimension. We recommend structural fill consist of material similar to “Select Borrow” or “Gravel Borrow” as described in Section 9-03.14 of the Washington State Department of Transportation (WSDOT) Standard Specifications.

We recommend crushed rock or select granular fill (described below) be used for structural fill during the wet season. If prolonged dry weather prevails during the earthwork phase of construction, materials with a somewhat higher fines content such as “Select Borrow” or “Gravel Borrow” as described in Section 9-03.14 of the WSDOT Standard Specifications may be acceptable.

4.6.4. Select Granular Fill

Select granular fill should consist of well-graded sand and gravel or crushed rock with a maximum particle size of 6 inches and less than 5 percent fines by weight based on the minus ¾-inch fraction. Organic matter, debris or other deleterious material should not be present. Material with gradation characteristics similar to WSDOT Specification 9-03.9 (Aggregates for Ballast and Crushed Surfacing), or 9-03.14 (Borrow) is also suitable for use as select granular fill, provided the fines content is less than 5 percent (based on the minus ¾-inch fraction) and the maximum particle size is 6 inches.

4.7. Fill Placement and Compaction

4.7.1. General

To obtain proper compaction, fill material should be compacted near optimum moisture content and in uniform horizontal lifts. Lift thickness and compaction procedures will depend on the moisture content and gradation characteristics of the soil and the type of equipment used. Generally, 12-inch thick loose lifts are appropriate for steel-drum vibratory roller compaction equipment. The maximum allowable moisture content varies with the soil gradation and should be evaluated during construction. Compaction should be achieved by mechanical means. During fill and backfill placement, sufficient testing of in-place density should be conducted to verify adequate compaction is being achieved.

4.7.2. Area Fills and Pavement Bases

Fill placed to raise site grades as well as materials under pavements and structural areas should be placed on subgrades prepared as previously recommended. Fill material placed below structures, footings and pavement sections must be compacted to at least 95 percent of the theoretical maximum dry density (MDD) per ASTM International (ASTM) D 1557. In landscaping areas, fill should be compacted to a firm condition that will support construction equipment, as necessary, typically around 85 to 90 percent of the MDD.

5.0 ADDITIONAL INVESTIGATIONS

Depending on the structures proposed and site design, additional explorations may be warranted for final project design. Potential additional geotechnical investigations that may be required or useful for final design are listed below:

- At this time, the project is in the conceptual design phase and proposed structure locations and design are not fully developed. We will provide specific foundation recommendations and settlement estimates once this information is available.
- If structures are planned to be constructed on the intact basalt bedrock, we suggest additional test pits or borings be performed at proposed locations so that the depth and condition of the rock can be observed and planned for. The depth and number of borings will depend on structures being considered. We suggest planning for at least two borings for larger structures, such as water towers. For single-story, wood-framed structures, it is possible that a few test pits around the development area will suffice.
- Where bedrock is to be cut to expose near vertical slopes, we suggest rock coring to investigate rock quality and potential fracturing prior to planning of near vertical slopes for sitework design. This should be especially considered where near vertical slopes will be adjacent to improvements such as roads, building, and other facilities where infrastructure needs to be maintained or where property could be damaged.
- Relatively shallow static groundwater was encountered in test pits in the eastern site area near Mineral Creek. If stormwater infiltration is planned within this area, we anticipate that additional analysis (groundwater mounding) and/or investigations (PITs or groundwater well monitoring) will be required for final design.

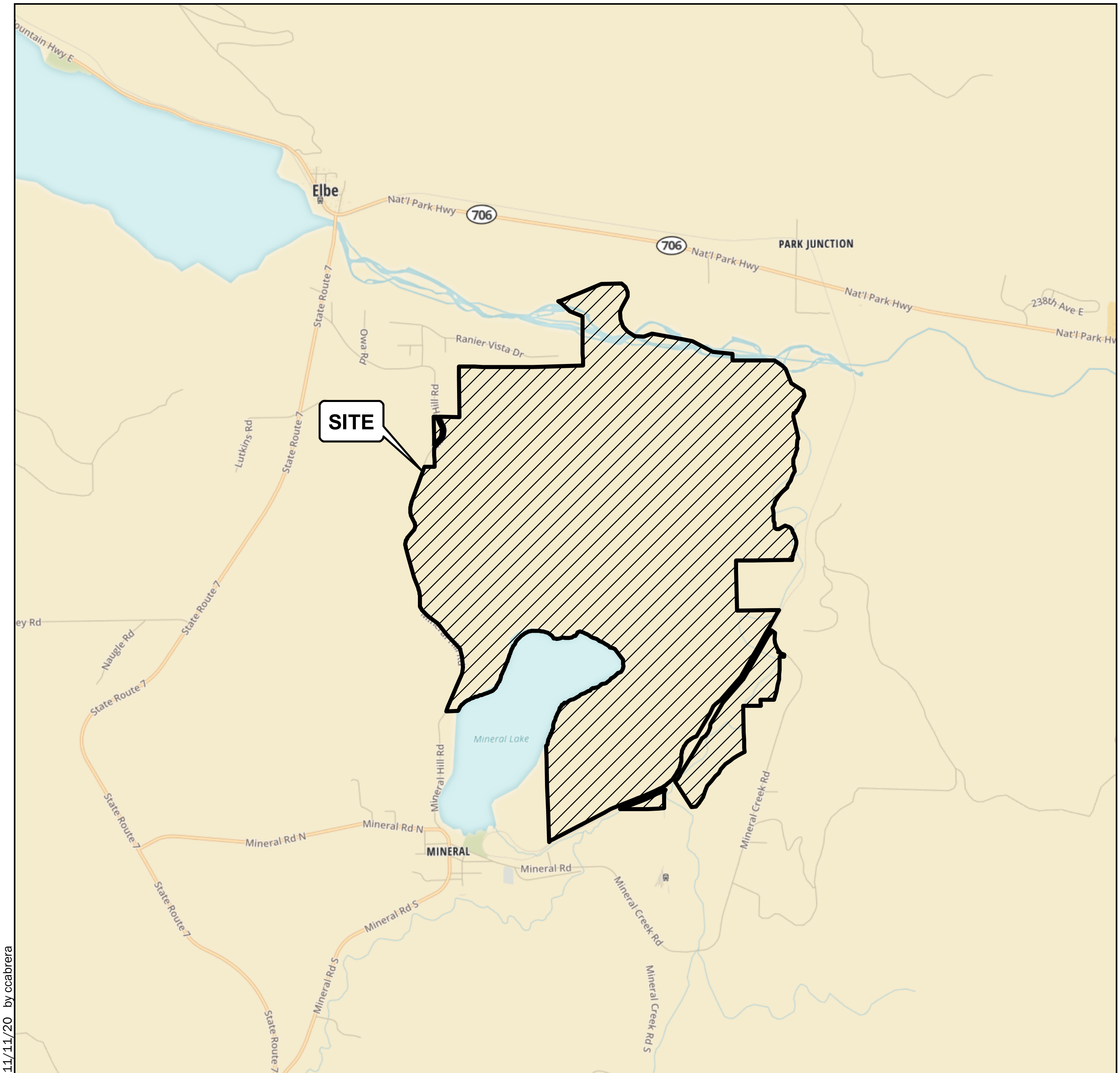
6.0 LIMITATIONS

We have prepared this report for YMCA Seattle for the Mineral Lake Site Due Diligence project in Mineral Lake, Washington. YMCA Seattle may distribute copies of this report to authorized agents and regulatory agencies as may be required for the project.

Our services were provided to assist preliminary site design, including site stabilization, roadway development and design of foundations for structures to be located on or near sloping ground. Our recommendations are intended to improve the overall stability of the site and to reduce the potential for future property damage related to earth movements, drainage or erosion. Qualified engineering and construction practices can help mitigate the risks inherent in construction on slopes, although those risks cannot be eliminated completely. Favorable performance of structures in the near term is useful information for anticipating future performance, but it cannot predict or imply a certainty of long-term performance, especially under conditions of adverse weather or seismic activity.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices for geotechnical engineering in this area at the time this report was prepared. The conclusions, recommendations, and opinions presented in this report are based on our professional knowledge, judgment and experience. No warranty, express or implied, applies to the services or this report.

Please refer to Appendix C titled "Report Limitations and Guidelines for Use" for additional information pertaining to use of this report.



N
W E
S

4,000 0 4,000

Feet

Vicinity Map

Mineral Lake Property Due Diligence
Lewis County, Washington

GEOENGINEERS

Figure 1

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Mapbox Open Street Map, 2016

Projection: NAD 1983 UTM Zone 10N

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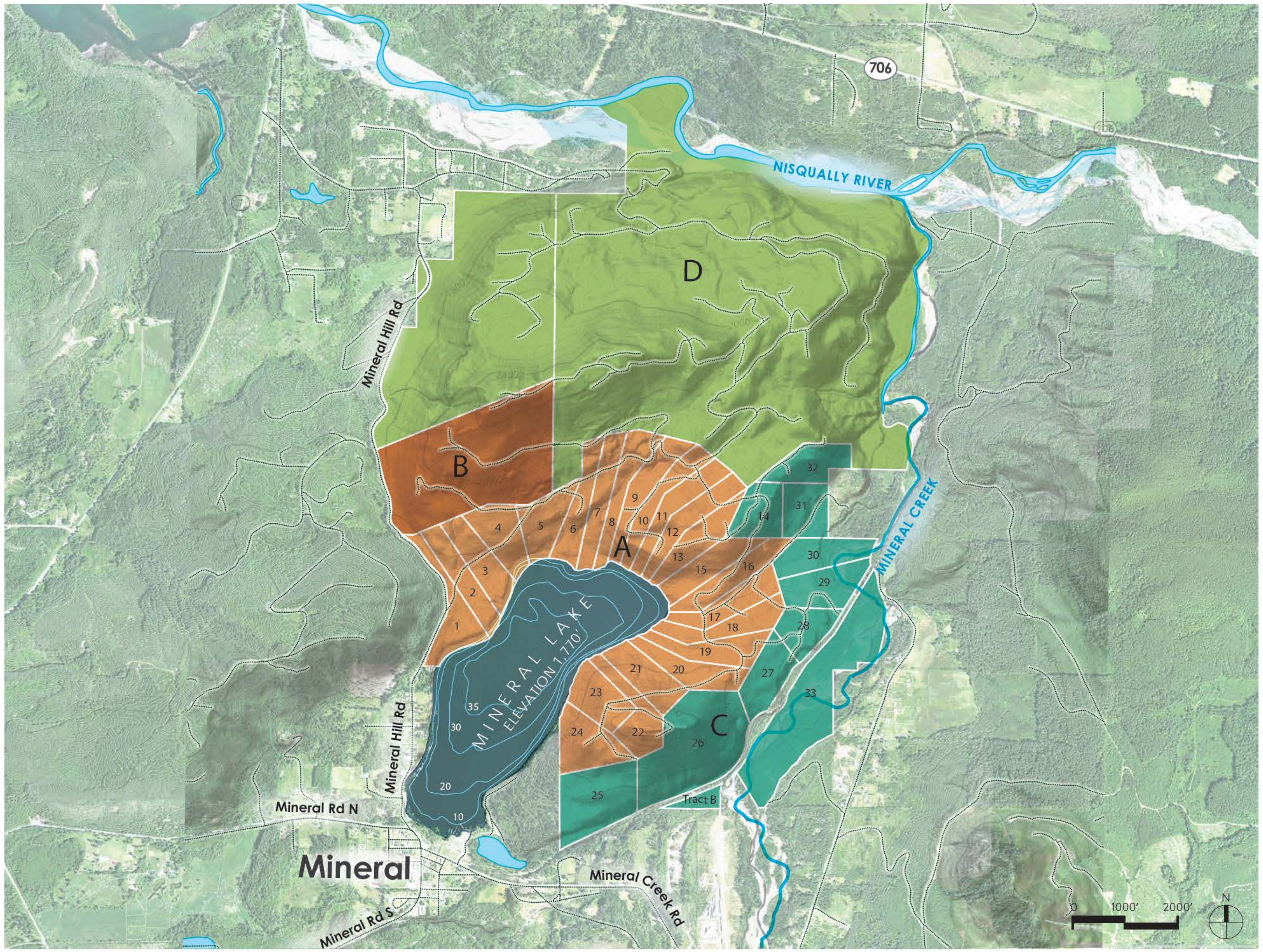
VICINITY MAP



LEGEND

A	PROPERTY Individual Lots (500 Acres)
B	Forest Reserve (143 Acres)
C	Remaining Individual Lots (371 Acres)
D	Forest Reserve (1,104 Acres)
—	Major Roads
····	Forest Service Roads

1

YMCA MINERAL LAKE / **PRESUBMISSION PACKAGE** / MARCH 13, 2020

Notes:
1.This drawing has been prepared by other members of the project team. GeoEngineers cannot warrant or guarantee the accuracy or completeness of information provided or compiled by others.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
Data Source: Presubmission conference submittal package for YMCA Camp Mineral Lake

Presubmission Package Vicinity Map

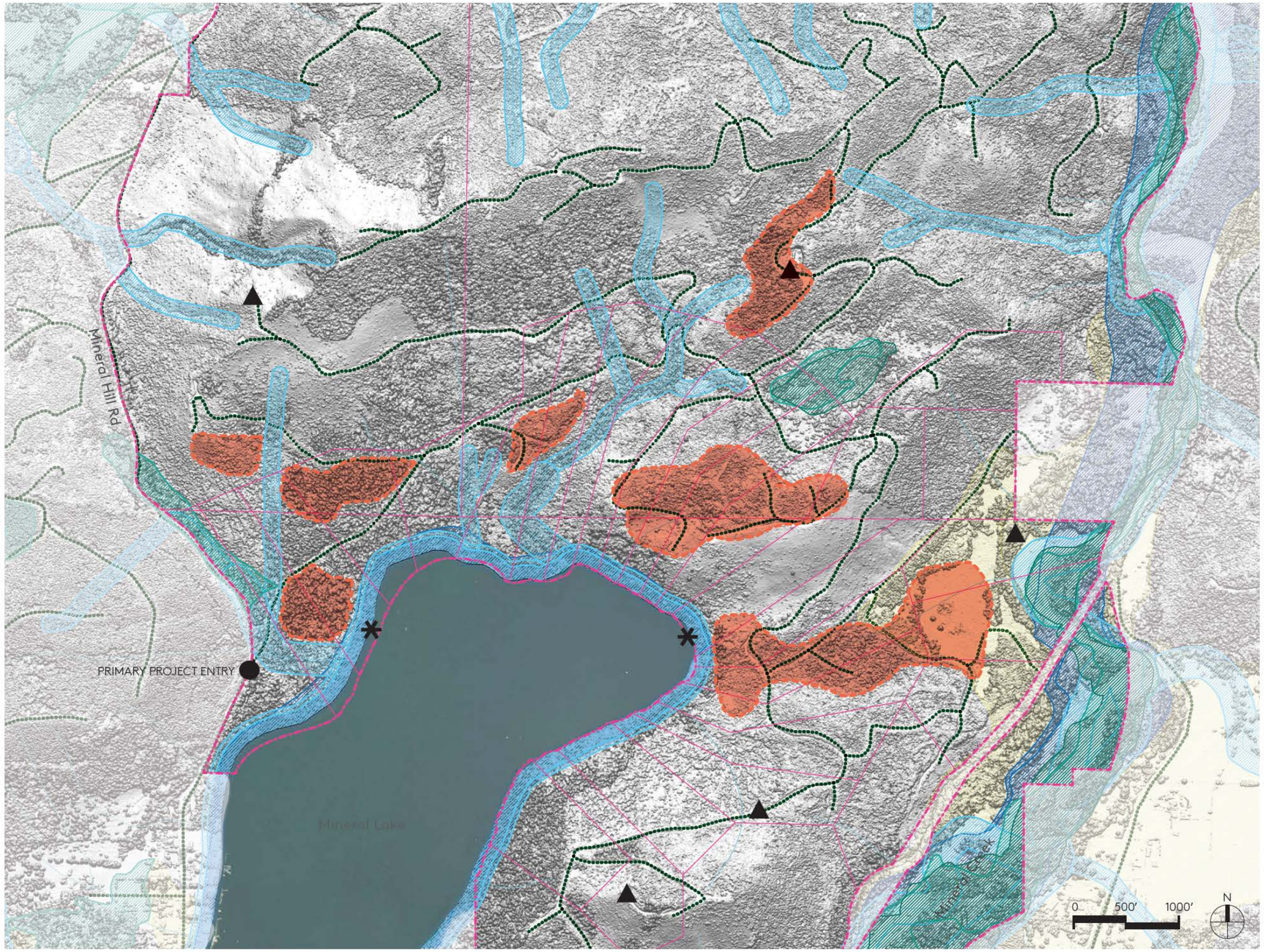
Mineral Lake Property Due Diligence
Lewis County, Washington

GEOENGINEERS

Figure 2

06565-008-00 Date Exported: 11/01/2020

SITE PLAN: CONCEPTUAL DEVELOPMENT AREAS



POTENTIAL DEVELOPMENT AREAS LEGEND

- EXISTING ROADS
- POTENTIAL DEVELOPMENT ZONE
- POTENTIAL LAKE ACCESS
- POTENTIAL SATELLITE RECREATION AREA
- PROPERTY BOUNDARY
- PARCEL LINE
- EXISTING PROPERTY ENTRANCE

*The highest intensity development will be concentrated in the potential development zones with slopes less than or equal to 15%.

2

CRITICAL AREAS LEGEND

- 200' MINERAL LAKE BUFFER
- STREAM BUFFERS
- WETLANDS
- HYDRIC SOILS
- FEMA 100 & 500 YEAR FLOODPLAIN
- CRITICAL AQUIFER RECHARGE AREA

NOTES

Orange regions suggest potential developable zones, however, the area of potential developable zones exceeds the likely built program on the site. For scale reference:

- = SIZE OF A 360'*150' **SOCCER FIELD**
- = SIZE OF A 9000 SQUARE FOOT **DINING HALL**
- = SIZE OF A 2000 SQUARE FOOT **PROGRAM SHELTER**
- = SIZE OF (4) 600 SQUARE FOOT **CABINS**

YMCA MINERAL LAKE / **PRESUBMISSION PACKAGE** / MARCH 13, 2020

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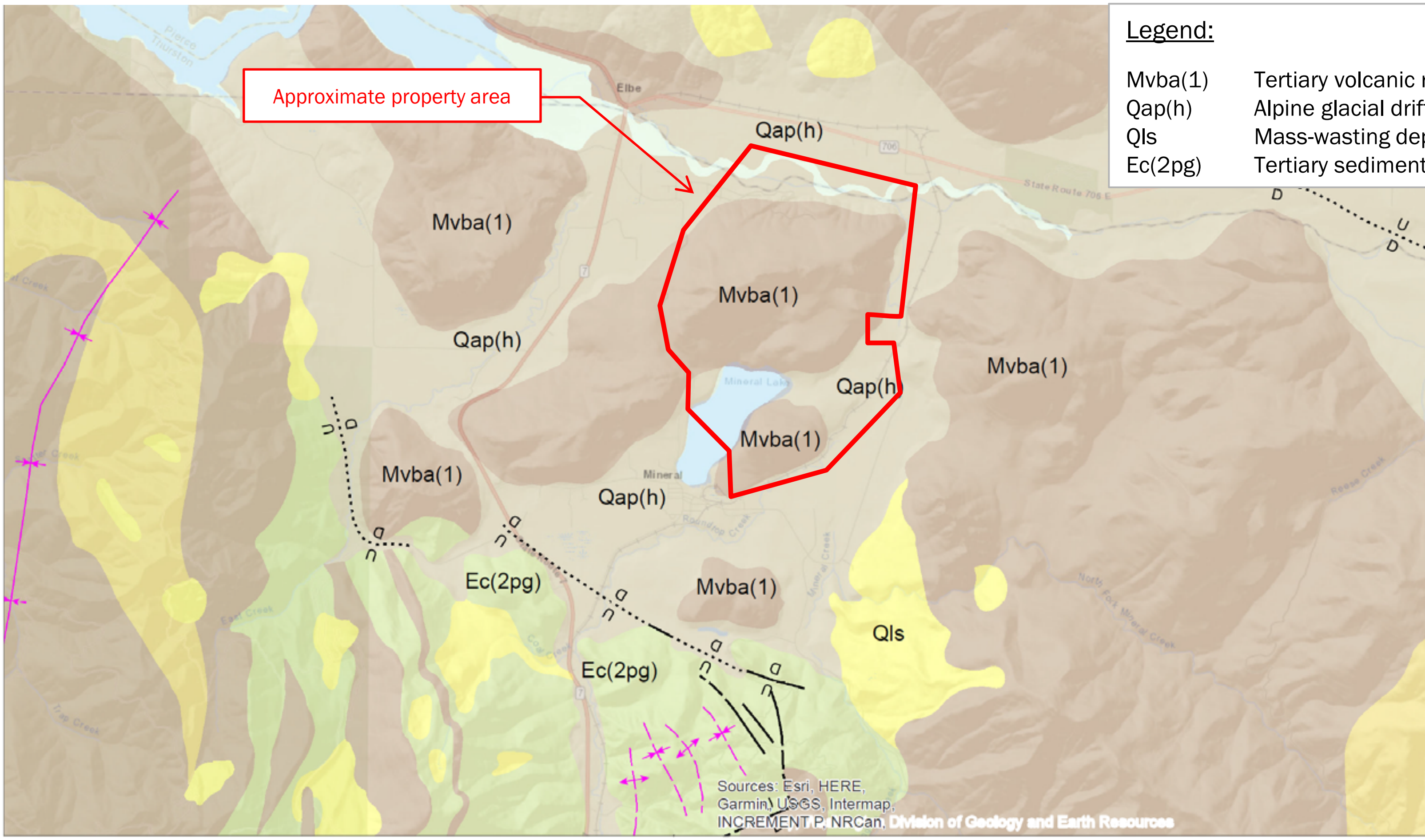
Data Source: Presubmission conference submittal package for YMCA Camp Mineral Lake

Presubmission Package Conceptual Development Areas	
Mineral Lake Property Due Diligence Lewis County, Washington	
GEOENGINEERS	**Figure 3**

06565-008-00 Date Exported: 11/01/2020

06565-008-00 Date Exported: 11/06/2020



Legend:

Mvba(1)	Tertiary volcanic rocks
Qap(h)	Alpine glacial drift (Hayden Creek drift)
Qls	Mass-wasting deposits
Ec(2pg)	Tertiary sedimentary deposits or rocks

0 0.75 1.5 3 Miles

N

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES
WASHINGTON GEOLOGICAL SURVEY

Geology Portal

Geologic Map - 1:100,000-scale

Mineral Lake Property Due Diligence
Lewis County, Washington

GEOENGINEERS

Figure 4

Notes:
1.This drawing has been prepared by online resources provided by the Washington State Department of Natural Resources. GeoEngineers cannot warrant or guarantee the accuracy or completeness of information provided or compiled by others.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Washington State Department of Natural Resources Geology Portal

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: ESRI Clarity

Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Legend

Test Pit Location (GeoEngineers, 2020)

N W E S

500 0 500
Feet

Site Plan - Test Pit Overview

Mineral Lake Property Due Diligence
Lewis County, Washington

GEOENGINEERS

Figure 5

P:\6\6565008\GIS\MXD\656500800200_F05_SitePlan_Overview.mxd Date Exported: 11/11/20 by ccabrera

P:\6\6565008\GIS\MXD\656500800\0200_F06_SitePlan_PlanArea1.mxd Date Exported: 11/11/20 by ccabrera

Notes:
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Data Source: ESRI Clarity

Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Legend

Test Pit Location (GeoEngineers, 2020)

N W E S

300 0 300

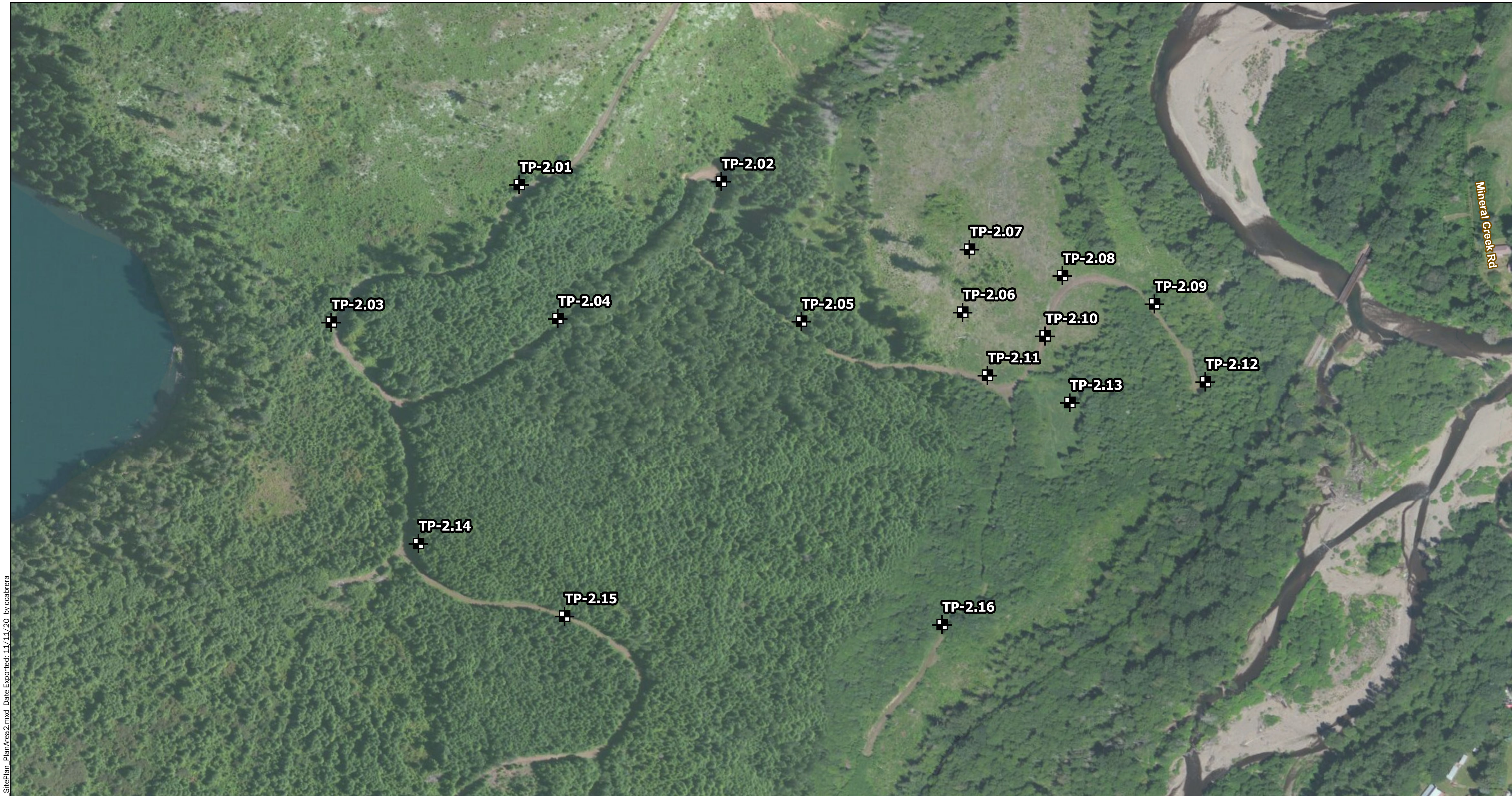
Feet

Site Plan - Test Pit Area 1

Mineral Lake Property Due Diligence
Lewis County, Washington

GeoEngineers

Figure 6



Notes:
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Data Source: ESRI Clarity

Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Legend

Test Pit Location (GeoEngineers, 2020)

N W E S

300 0 300

Feet

Site Plan - Test Pit Area 2

Mineral Lake Property Due Diligence
Lewis County, Washington

GeoEngineers

Figure 7

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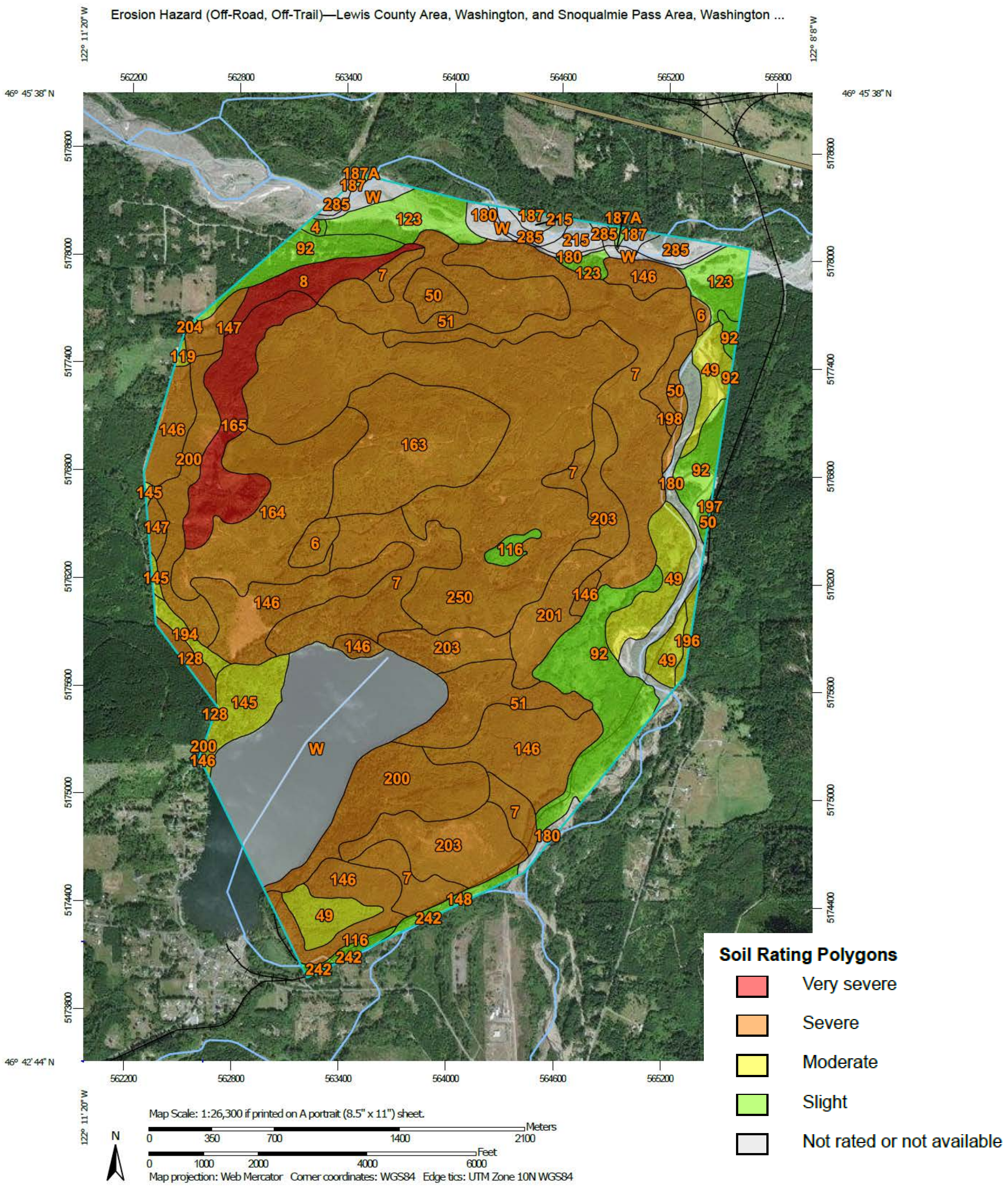

Notes:

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Data Source: NRCS Web Soil Survey

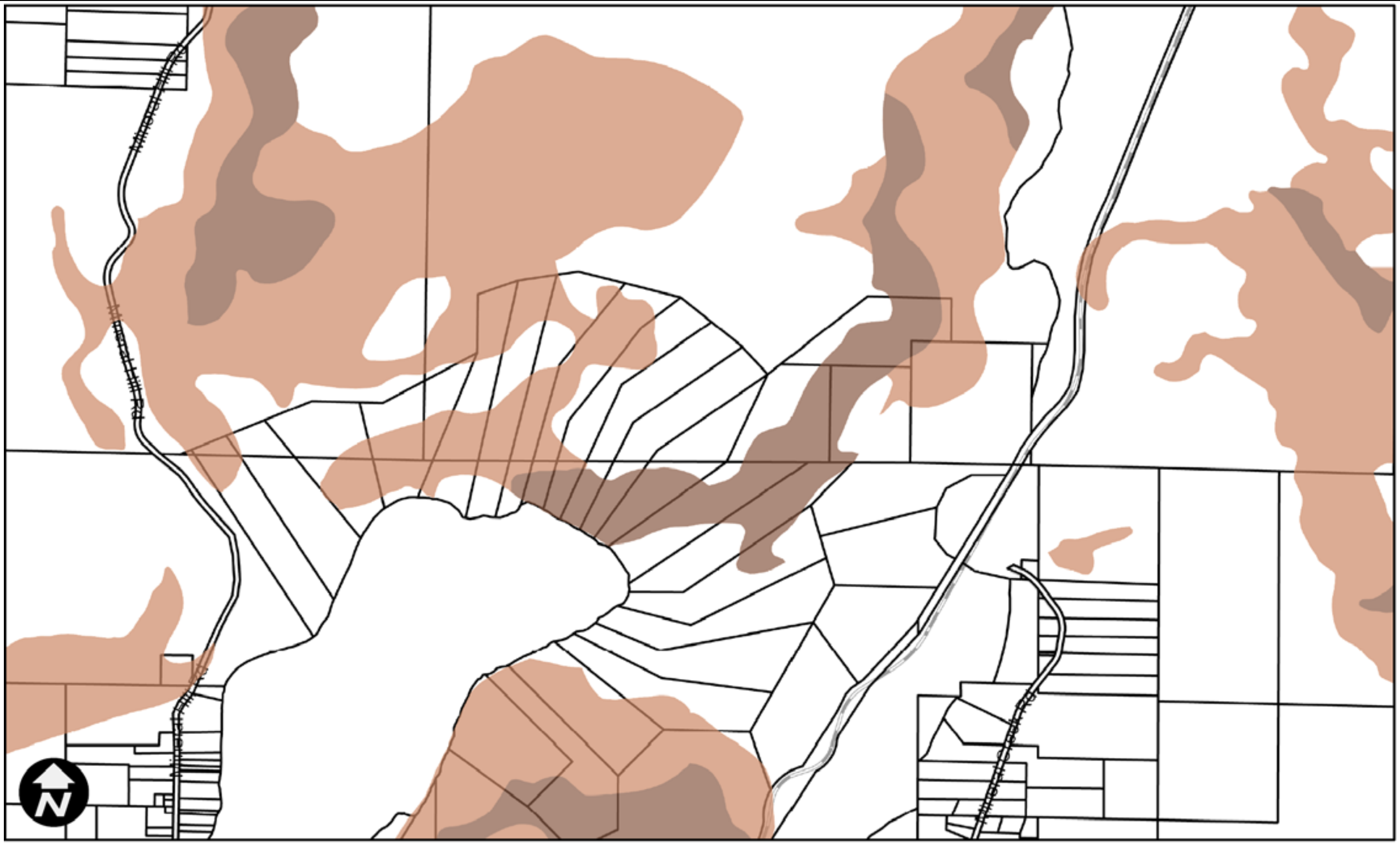
Erosion Hazard - NRCS

Mineral Lake Property Due Diligence
Lewis County, Washington

GEOENGINEERS

Figure 8

06565-008-00 Date Exported: 11/08/2020



Erosion Hazard Areas – Lewis County

Mineral Lake Property Due Diligence
Lewis County, Washington

GEOENGINEERS

Figure 9

Notes:

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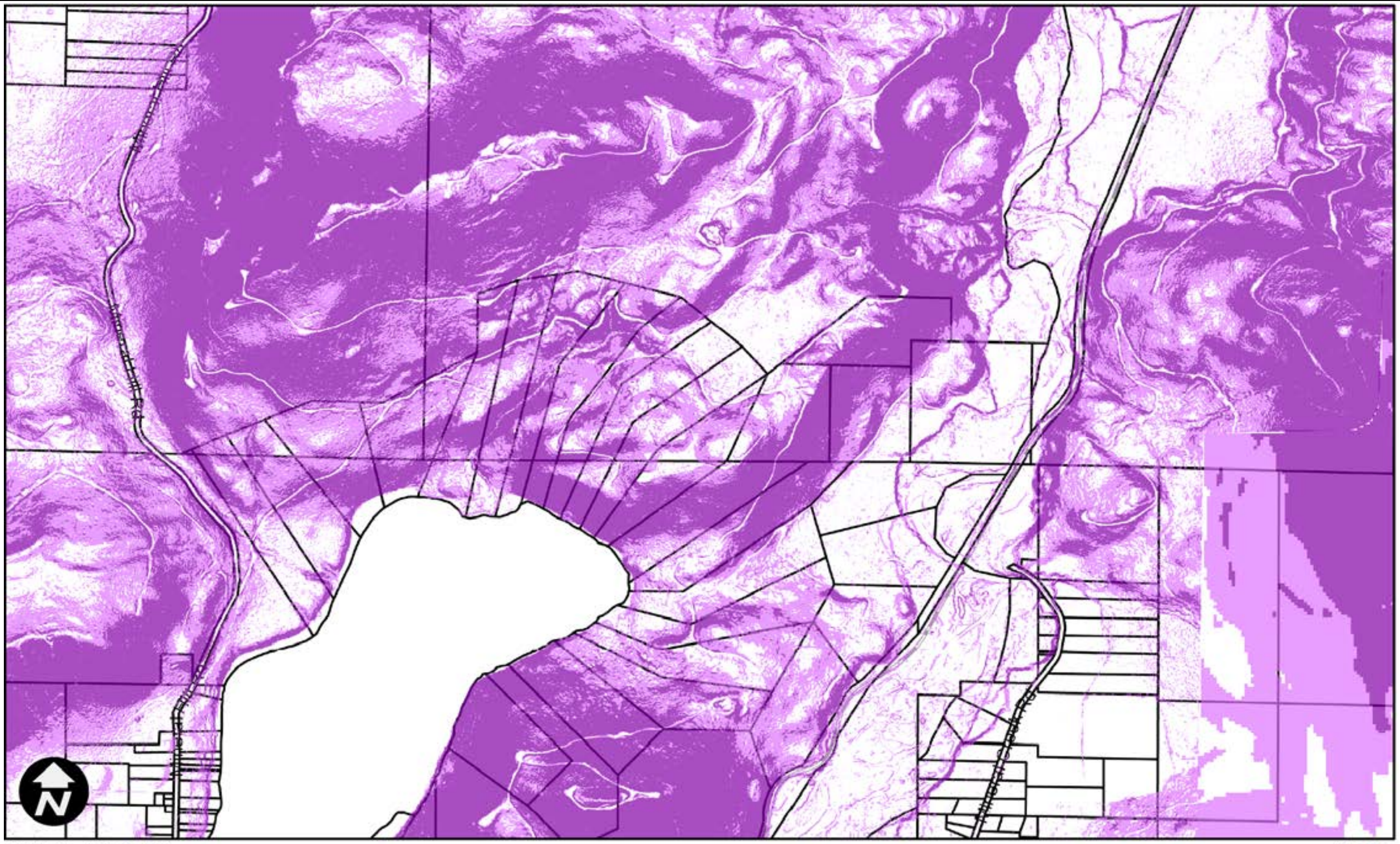
Data Source: Lewis County GIS Web Map

06565-008-00 Date Exported: 11/08/2020



11/9/2020, 11:12:32 AM

1:18,056

Slopes 15%+ (lidar)

- 15 - 35%
- 35% and greater

Slopes 15%+ (no lidar)

- 15 - 35%
- 35% and greater
- Parcels

0 800 1,600 3,200 ft

NAD 1983 StatePlane Washington South FIPS 4602 Feet

LEWIS COUNTY — est. 1845 —

Lewis County G.I.S.

Notes:

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Data Source: Lewis County GIS Web Map

Steep Slope Areas

Mineral Lake Property Due Diligence
Lewis County, Washington

GEOENGINEERS

Figure 10

Landslide Hazard Areas

Mineral Lake Property Due Diligence
Lewis County, Washington

GeoEngineers

Figure 11

Notes:
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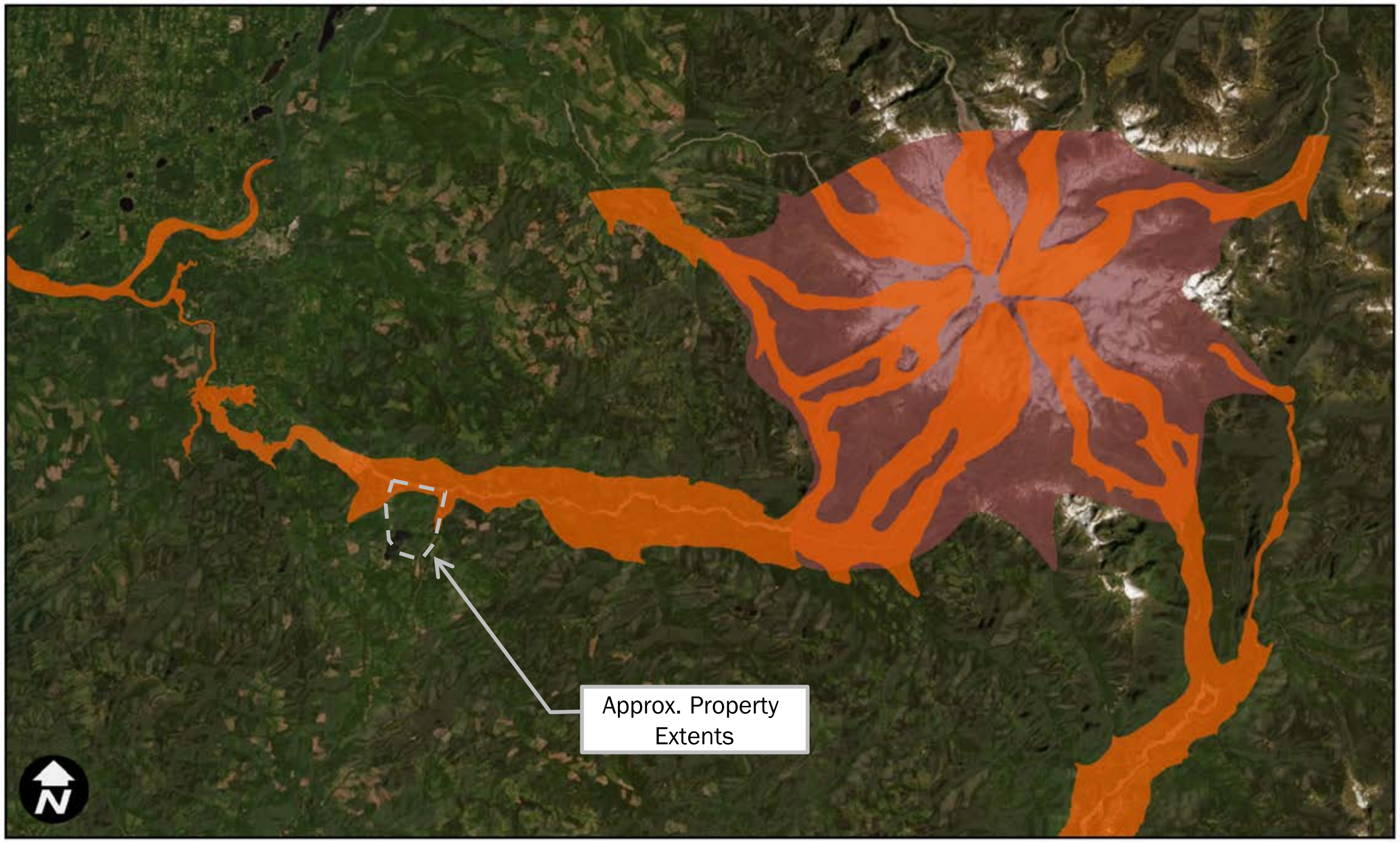
Data Source: Lewis County GIS Web Map



11/20/2020, 1:55:50 PM

1:288,895

0 13,000 26,000 52,000 ft

NAD 1983 StatePlane Washington South FIPS 4602 Feet

Volcanic Hazards

- Lahars
- Near-volcano hazards
- Regional lava flows

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community |© Lewis County GIS

LEWIS COUNTY
est. 1845

Lewis County G.I.S.

Notes:

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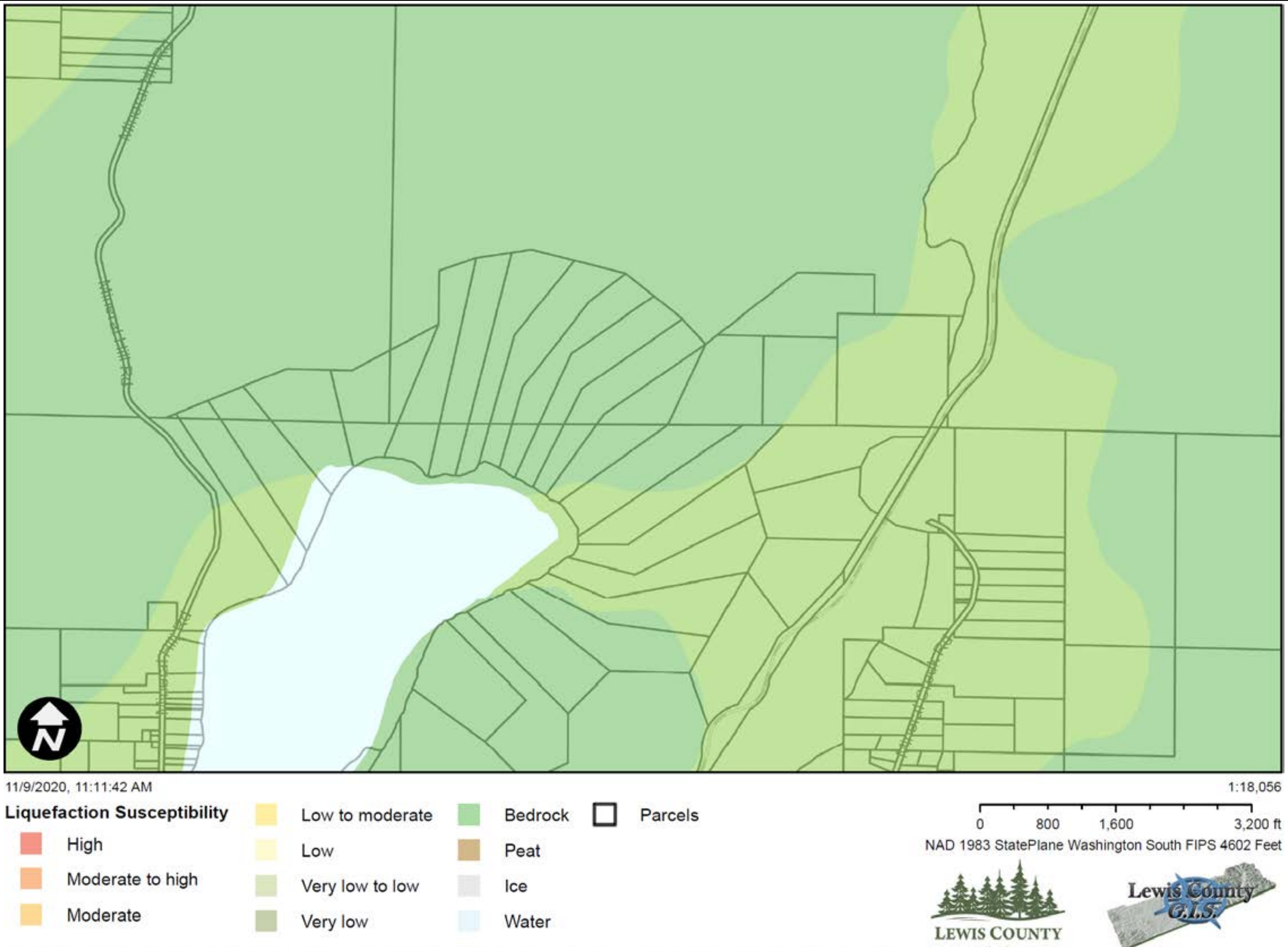
Data Source: Lewis County GIS Web Map

Volcanic Hazards

Mineral Lake Property Due Diligence
Lewis County, Washington

GEOENGINEERS

Figure 12



Liquefaction Susceptibility

Mineral Lake Property Due Diligence
Lewis County, Washington

GEOENGINEERS

Figure 13

Notes:

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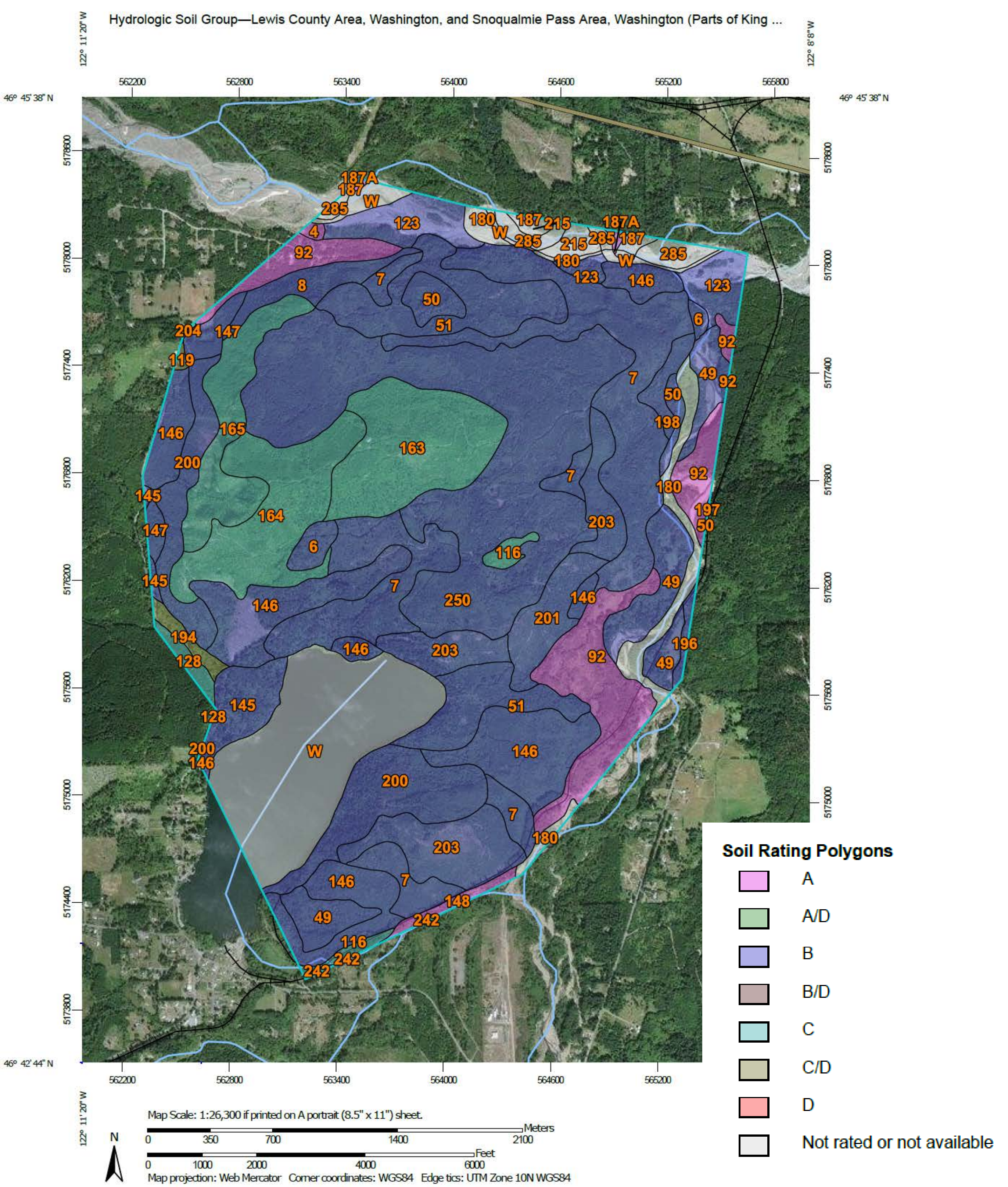
Data Source: Lewis County GIS Web Map



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Data Source: NRCS Web Soil Survey

Hydrologic Soil Group

Mineral Lake Property Due Diligence
Lewis County, Washington

GEOENGINEERS

Figure 14

06565-008-00 Date Exported: 11/08/2020

APPENDIX A
Subsurface Explorations and Laboratory Testing

APPENDIX A
SUBSURFACE EXPLORATIONS AND LABORATORY TESTING

Subsurface Explorations

Soil and groundwater conditions at the site were explored by observing 24 test pit excavations on March 26 and March 27, 2020. Locations of the test pits were determined via an electronic tablet with global positioning system (GPS) software and are shown on the Site Plan - Test Pit Overview, Figure 5, as well as detailed views on Figure 6 and Figure 7. The locations and elevations of the explorations should be considered approximate.

Test pit excavations were performed using an excavator provided and operated by Kelly's Excavating, Inc. under subcontract to GeoEngineers. Test pits extended to depths between approximately 8 and 14½ feet below surrounding grade. After each test pit was completed, the excavation was backfilled using the generated material and compacted using the bucket of the excavator.

During the exploration program our field representative obtained soil samples, classified the soils, maintained a detailed log of each exploration and observed groundwater conditions. The soils were classified visually in general accordance with ASTM International (ASTM) D 2488. Figure A-1 includes a Key to Exploration Logs. Summary logs of the explorations are included as Figures A-2 through A-25. The densities noted on the test pit exploration logs are based on the difficulty of excavation, observations of caving and our experience and judgment. Samples were retained in sealed plastic bags to prevent moisture loss.

Laboratory Test Results

Soil samples obtained from the explorations were transported to GeoEngineers laboratory. Representative soil samples were selected for laboratory tests to evaluate pertinent geotechnical engineering characteristics of the soils and refine our field classification, as necessary. The following paragraphs provide a description of the tests performed.

Moisture Content (MC)

The moisture content of selected samples was determined in general accordance with ASTM Test Method D 2216. The test results are used to aid in soil classification and correlation with other pertinent engineering soil properties. Test results are presented on the exploration logs corresponding to the sample tested.

Sieve Analysis (SA)

Sieve analyses were performed on selected samples in general accordance with ASTM Test Method D 6913. This test method covers the quantitative determination of the distribution of particle sizes in soils. Typically, the distribution of particle sizes larger than 75 micrometers (μm) is determined by sieving. The results of the tests were used to verify field soil classifications. Figures A-26 and A-27 present the results of our sieve analyses.

Hydrometer Analysis (HA)

Hydrometer analyses were performed on selected samples in general accordance with ASTM Test Method D 422. This test method covers the quantitative determination of the distribution of particle sizes in soils.

Typically, the distribution of particle sizes smaller than 75 µm is determined by a sedimentation process using a hydrometer. The hydrometer analysis alone determines the distribution of particle sizes smaller than 2 millimeters (mm). The results of the tests were used to verify field soil classifications and determine pertinent engineering characteristics. Figure A-26 includes the results of our hydrometer analyses.

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% RETAINED ON NO. 200 SIEVE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS
				SP	POORLY-GRADED SANDS, GRAVELLY SAND
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% PASSING NO. 200 SIEVE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS, ROCK FLOUR, CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS AND SILTS OF MEDIUM TO HIGH PLASTICITY
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: Multiple symbols are used to indicate borderline or dual soil classifications

ADDITIONAL MATERIAL SYMBOLS

SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
	AC	Asphalt Concrete
	CC	Cement Concrete
	CR	Crushed Rock/ Quarry Spalls
	SOD	Sod/Forest Duff
	TS	Topsoil

Groundwater Contact

Measured groundwater level in exploration, well, or piezometer

Measured free product in well or piezometer

Graphic Log Contact

Distinct contact between soil strata

Approximate contact between soil strata

Material Description Contact

Contact between geologic units

Contact between soil of the same geologic unit

Sampler Symbol Descriptions

2.4-inch I.D. split barrel

Standard Penetration Test (SPT)

Shelby tube

Piston

Direct-Push

Bulk or grab

Continuous Coring

Blowcount is recorded for driven samplers as the number of blows required to advance sampler 12 inches (or distance noted). See exploration log for hammer weight and drop.

"P" indicates sampler pushed using the weight of the drill rig.

"WOH" indicates sampler pushed using the weight of the hammer.

Laboratory / Field Tests

%F	Percent fines
%G	Percent gravel
AL	Atterberg limits
CA	Chemical analysis
CP	Laboratory compaction test
CS	Consolidation test
DD	Dry density
DS	Direct shear
HA	Hydrometer analysis
MC	Moisture content
MD	Moisture content and dry density
Mohs	Mohs hardness scale
OC	Organic content
PM	Permeability or hydraulic conductivity
PI	Plasticity index
PL	Point load test
PP	Pocket penetrometer
SA	Sieve analysis
TX	Triaxial compression
UC	Unconfined compression
VS	Vane shear

Sheen Classification

NS	No Visible Sheen
SS	Slight Sheen
MS	Moderate Sheen
HS	Heavy Sheen

NOTE: The reader must refer to the discussion in the report text and the logs of explorations for a proper understanding of subsurface conditions. Descriptions on the logs apply only at the specific exploration locations and at the time the explorations were made; they are not warranted to be representative of subsurface conditions at other locations or times.

Key to Exploration Logs

GeoEngineers

Figure A-1

Date Excavated	3/27/2020	Total Depth (ft)	13.5	Logged By	CJL	Excavator	Kelly's Excavating	See "Remarks" section for groundwater observed
				Checked By	SST	Equipment	Komatsh PC120	Caving not observed

Surface Elevation (ft)	1508	Easting (X)	1219648	Coordinate System	WA State Plane South
Vertical Datum	NAVD88	Northing (Y)	514365	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
1508	0				CL	Dark brown to black sandy clay with trace organic matter (roots up to ¼ inch) (stiff, moist) (residual soils)			
1507.5	0.5				SC	Light brown clayey fine to medium sand with occasional gravel (medium dense, moist)			
1504.3	3.7					Grades to brown-gray with iron-oxide staining			
1500.8	7.2					Grades to with fractured rock approximately 1 inch in size			
1500	8					Grades to without fractured rock			Minor groundwater seepage observed at 8 feet
1496.5	11.5				CL	Gray clay with trace sand and organic matter (decomposed roots) (stiff, moist)			
1496	12	▯	1						
1494.5	13.5								

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Topographic Survey. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-1.01

GEOENGINEERS

Project: Mineral Lake Property Due Diligence
Project Location: Lewis County, Washington
Project Number: 6565-008-00

Date Excavated 3/27/2020	Total Depth (ft) 11.5	Logged By CJL Checked By SST	Excavator Kelly's Excavating Equipment Komatsh PC120	See "Remarks" section for groundwater observed See "Remarks" section for caving observed

Surface Elevation (ft) 1484 Vertical Datum NAVD88	Easting (X) 1219956 Northing (Y) 514239	Coordinate System WA State Plane South Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0				CL	Dark brown to black sandy clay with trace organic matter (roots up to ½ inch) (stiff, moist) (residual soils)			
1483	1				SC	Gray with iron-oxide staining clayey fine to medium sand with occasional gravel (medium dense, moist)			
1482	2								
1481	3								
1480	4		1 SA/HA				34	37	
1479	5								
1478	6								
1477	7								
1476	8								Moderate caving observed at 8 feet Moderate groundwater seepage observed at 8½ feet
1475	9					Grades with rock fragments, dense			
1474	10								
1473	11								

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Topographic Survey. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-1.02

GEOENGINEERS

Project: Mineral Lake Property Due Diligence
Project Location: Lewis County, Washington
Project Number: 6565-008-00

Figure A-3
Sheet 1 of 1

Date Excavated	3/27/2020	Total Depth (ft)	14.5	Logged By	CJL	Excavator	Kelly's Excavating	See "Remarks" section for groundwater observed
				Checked By	SST	Equipment	Komatsh PC120	See "Remarks" section for caving observed

Surface Elevation (ft)	1533	Easting (X)	1219686	Coordinate System	WA State Plane South
Vertical Datum	NAVD88	Northing (Y)	514599	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
1533	0				GC	Brown clayey fine to coarse gravel with sand and cobbles (medium dense, moist) (fill)			Reworked residual soils
1531	2				CL	Light brown with iron-oxide staining sandy clay (medium stiff, moist) (residual soils)			
1526	7				SC	Light gray with iron-oxide staining clayey fine to medium sand with occasional gravel (medium dense, moist)			
1523	10								Minor caving observed at 10 feet
1521	12					Grades to with fractured rock			Minor groundwater seepage observed at 12 feet
	14.5					Grades to with weathered rock			

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Topographic Survey. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-1.03

GeoEngineers

Project: Mineral Lake Property Due Diligence
Project Location: Lewis County, Washington
Project Number: 6565-008-00

Date Excavated	3/27/2020	Total Depth (ft)	13.75	Logged By	CJL	Checked By	SST	Excavator	Kelly's Excavating	Equipment	Komatsh PC120

See "Remarks" section for groundwater observed
Caving not observed

Surface Elevation (ft)	1489	Easting (X)	1220118	Coordinate System	WA State Plane South
Vertical Datum	NAVD88	Northing (Y)	514541	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0				WD	3 inches underbrush			
1488	1				CL	Gray with iron-oxide staining sandy clay (medium stiff, moist) (residual soils)			
1487	2								
1486	3					Grades to light brown-gray			
1485	4								
1484	5								
1483	6								Minor groundwater seepage observed at 6 feet
1482	7				SC	Brown-gray clayey fine to medium sand with occasional gravel (medium dense, moist)			
1481	8								
1480	9								
1479	10								
1478	11								Moderately cemented
1477	12								
1476	13		1		CL	Gray sandy clay with trace gravel (very stiff, moist)			
					BEDROCK	Brown-gray fractured basalt (bedrock)			

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Topographic Survey. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-1.04

GeoEngineers

Project: Mineral Lake Property Due Diligence
Project Location: Lewis County, Washington
Project Number: 6565-008-00

Figure A-5
Sheet 1 of 1

Date Excavated	3/27/2020	Total Depth (ft)	9	Logged By	CJL	Excavator	Kelly's Excavating	See "Remarks" section for groundwater observed
				Checked By	SST	Equipment	Komatsh PC120	See "Remarks" section for caving observed

Surface Elevation (ft)	1464	Easting (X)	1220318	Coordinate System	WA State Plane South
Vertical Datum	NAVD88	Northing (Y)	514363	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0				WD	3 inches underbrush			
1463	1				SC	Dark brown clayey fine to medium sand with occasional gravel and trace organic matter (fine roots) (medium dense, moist) (residual soils)			
1462–1460	1–4				CL	Light gray with occasional iron-oxide staining sandy clay (medium stiff, moist)			Moderate groundwater seepage observed at 4 feet Occasional caving observed at 4 feet
1459–1455	4.5–9	5	1 SA/HA		SC	Orange-gray with iron-oxide staining clayey fine to coarse sand with gravel (very dense, moist)	43	20	

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Topographic Survey. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-1.05

GeoEngineers

Project: Mineral Lake Property Due Diligence
Project Location: Lewis County, Washington
Project Number: 6565-008-00

Date Excavated	3/27/2020	Total Depth (ft)	14.5	Logged By CJL Checked By SST	Excavator Kelly's Excavating Equipment Komatsh PC120

Groundwater not observed
Caving not observed

Surface Elevation (ft) Vertical Datum	1487 NAVD88	Easting (X) Northing (Y)	1220374 514703	Coordinate System Horizontal Datum	WA State Plane South NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
1487	0				WD	6 inches underbrush			
1486.5	0.5				CL	Light brown with occasional iron-oxide staining sandy clay (medium stiff, moist) (residual soils)			
1482	5								14-inch boulder at 5 feet
1481.5	5.5				CL	Dark brown sandy clay with occasional gravel and weathered rock fragments (hard, moist)			
1480	7								Moderately to heavily cemented
1479	8	▯	1						
1478	9					Grades to very stiff			Less cemented
1475	12				SC	Gray clayey fine to medium sand with gravel (dense, moist)			Moderately cemented
1474	13					Grades to very dense			Heavily cemented
1473	14	▯	2						

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Topographic Survey. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-1.06

GeoEngineers

Project: Mineral Lake Property Due Diligence
Project Location: Lewis County, Washington
Project Number: 6565-008-00

Date Excavated	3/27/2020	Total Depth (ft)	9.25	Logged By CJL Checked By SST	Excavator Kelly's Excavating Equipment Komatsh PC120	Groundwater not observed Caving not observed

Surface Elevation (ft) 1783 Vertical Datum NAVD88	Easting (X) 1220113 Northing (Y) 515626	Coordinate System WA State Plane South Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
1783–1782	0–1				CL	Dark brown sandy clay with organic matter (underbrush) and occasional gravel (soft, moist) (residual soils)			
1782–1778	1–5				CL	Brown-gray sandy clay with occasional gravel (medium stiff, moist)			
1778–1774	5–9	▯ (at 7–7.5)	1		SC	Light brown clayey fine to coarse sand with occasional gravel and cobbles (medium dense, moist)			
1774	9–9.25				BEDROCK	Brown-gray fractured basalt (bedrock)			

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Topographic Survey. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-1.07

GeoEngineers

Project: Mineral Lake Property Due Diligence
Project Location: Lewis County, Washington
Project Number: 6565-008-00

Date:11/23/20 Path:P:\6\6565008\GINT\656500800.GPJ DBLibrary/Library:GEOENGINEERS_DF_STD_US_JUNE_2017.GLB/GEI8_TESTPIT_1P_GEOTEC_%F

Date Excavated	3/26/2020	Total Depth (ft)	13.75	Logged By CJL Checked By SST	Excavator Kelly's Excavating Equipment Komatsh PC120	Groundwater not observed Caving not observed

Surface Elevation (ft) Vertical Datum	1753 NAVD88	Easting (X) Northing (Y)	1220592 515658	Coordinate System Horizontal Datum	WA State Plane South NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
1753	0				CL	Dark brown sandy clay with occasional gravel, cobbles and boulders and trace organic matter (wood) (medium stiff, moist) (fill)			Reworked residual soils
1751	1.5				SC	Light brown clayey fine to coarse sand with gravel and occasional cobbles and boulders (medium dense, moist) (residual soils)			
1748	5		1						
1746	7		2 SA/HA			Grades to somewhat sandier	29	25	
1742	11								14-inch boulder
	13.5				BEDROCK	Brown-gray fractured basalt (bedrock)			

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Topographic Survey. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-1.08

GEOENGINEERS

Project: Mineral Lake Property Due Diligence
Project Location: Lewis County, Washington
Project Number: 6565-008-00

Figure A-9

Date Excavated	3/26/2020	Total Depth (ft)	8	Logged By	CJL	Excavator	Kelly's Excavating	Groundwater not observed
				Checked By	SST	Equipment	Komatsh PC120	Caving not observed

Surface Elevation (ft)	1557	Easting (X)	1224650	Coordinate System	WA State Plane South
Vertical Datum	NAVD88	Northing (Y)	514424	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
					DUFF	6 inches forest duff			
1556	1				SC	Dark brown clayey fine to medium sand with trace organic matter (roots up to 1 inch diameter) (medium stiff, moist) (residual soils)			
1555	2								
1554	3				CL	Light brown sandy clay with occasional gravel (medium dense, moist)			
1553	4								
1552	5								
1551	6					Grades to with gravel, stiff			
1550	7								12-inch boulder at 7 feet (fractured bedrock?)
1549	8								

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Topographic Survey. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-2.01

GEOENGINEERS

Project: Mineral Lake Property Due Diligence
Project Location: Lewis County, Washington
Project Number: 6565-008-00

Date Excavated	3/26/2020	Total Depth (ft)	12	Logged By	CJL	Excavator	Kelly's Excavating	Groundwater not observed
				Checked By	SST	Equipment	Komatsh PC120	Caving not observed

Surface Elevation (ft)	1389	Easting (X)	1225278	Coordinate System	WA State Plane South
Vertical Datum	NAVD88	Northing (Y)	514434	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0				SOD	6 inches sod			Reworked native basalt appears related to adjacent road construction
1388	1				CR	Dark brown angular rock fragments (medium dense, moist) (fill)			
1387	2								
1386	3								
1385	4				CL	Dark brown sandy clay with occasional gravel and bedrock fragments and trace organic matter (tree roots) (stiff, moist) (residual soils)			
1384	5	▥	1						
1383	6								
1382	7								
1381	8					Grades to brown-gray with occasional iron-oxide staining			
1380	9								
1379	10								
1378	11								
1377	12	▥	2						

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Topographic Survey. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-2.02

GeoEngineers

Project: Mineral Lake Property Due Diligence
Project Location: Lewis County, Washington
Project Number: 6565-008-00

Date Excavated	3/26/2020	Total Depth (ft)	10.75	Logged By	CJL	Excavator	Kelly's Excavating	Groundwater not observed
				Checked By	SST	Equipment	Komatsh PC120	Caving not observed

Surface Elevation (ft)	1493	Easting (X)	1224066	Coordinate System	WA State Plane South
Vertical Datum	NAVD88	Northing (Y)	513996	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0				WD	6 inches underbrush			
1492	1				SC	Dark brown clayey fine to medium sand with gravel and occasional 1-inch roots (loose, moist) (residual soils)			
1491	2				CL	Light tan sandy clay with trace organic matter (charred wood) (medium stiff, moist)			
1490	3								
1489	4		1 SA/HA				47	60	
1488	5								
1487	6								
1486	7								
1485	8								
1484	9					Grades to stiff			
1483	10		2						
	10.75				BEDROCK	Gray fractured basalt (bedrock)			

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Topographic Survey. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-2.03

GeoEngineers

Project: Mineral Lake Property Due Diligence
Project Location: Lewis County, Washington
Project Number: 6565-008-00

Figure A-12
Sheet 1 of 1

Date Excavated	3/26/2020	Total Depth (ft)	8	Logged By	CJL	Excavator	Kelly's Excavating	Groundwater not observed
				Checked By	SST	Equipment	Komatsh PC120	Caving not observed

Surface Elevation (ft)	1454	Easting (X)	1224769	Coordinate System	WA State Plane South
Vertical Datum	NAVD88	Northing (Y)	514007	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0				WD	6 inches underbrush			
1453	1				SC	Dark brown clayey fine to medium sand with occasional gravel and trace organic matter (roots to 1 inch diameter) (loose, moist) (residual soils)			
1452	2				CL	Brown-gray with trace iron-oxide staining sandy clay with gravel (medium stiff, moist)			
1451	3	▯	1						
1450	4								
1449	5					Grades to stiff			
1448	6				SC	Orange clayey fine to medium sand (dense, moist)			
1447	7	▯	2						
1446	8	▯	3		BEDROCK	Orange-gray fractured basalt and granite (bedrock)			

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Topographic Survey. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-2-04

GEOENGINEERS

Project: Mineral Lake Property Due Diligence
Project Location: Lewis County, Washington
Project Number: 6565-008-00

Date Excavated	3/26/2020	Total Depth (ft)	12.5	Logged By	CJL	Excavator	Kelly's Excavating	Groundwater not observed
				Checked By	SST	Equipment	Komatsh PC120	Caving not observed

Surface Elevation (ft)	1376	Easting (X)	1225527	Coordinate System	WA State Plane South
Vertical Datum	NAVD88	Northing (Y)	513999	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
1376	0				WD	6 inches underbrush			
1375.5	0.5				CL	Light tan with iron-oxide staining sandy clay (soft, moist) (residual soils)			
1371	5	▥	1						
1369	7					Grades to gray, stiff			
1364	12	▥	2			Grades to with coarse sand			

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Topographic Survey. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-2.05

GeoEngineers

Project: Mineral Lake Property Due Diligence
Project Location: Lewis County, Washington
Project Number: 6565-008-00

Date Excavated	3/26/2020	Total Depth (ft)	9.5	Logged By	CJL	Excavator	Kelly's Excavating	See "Remarks" section for groundwater observed
				Checked By	SST	Equipment	Komatsh PC120	See "Remarks" section for caving observed

Surface Elevation (ft)	1357	Easting (X)	1226028	Coordinate System	WA State Plane South
Vertical Datum	NAVD88	Northing (Y)	514027	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0				SOD	6 inches sod			
1356	1				CL	Light tan with iron-oxide staining sandy clay (soft, moist) (residual soils)			
1355	2								
1354	3								
1353	4								
1352	5								Moderate groundwater seepage observed at 5 feet
1351	6				GP-GM	Brown-gray fine to coarse gravel with silt, sand and cobbles (dense, wet) (glacial drift)			Minor caving observed at 6 feet
1350	7								
1349	8								
1348	9		1						

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Topographic Survey. Vertical approximated based on Topographic Survey.

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Log of Test Pit TP-2.06

GeoEngineers

Project: Mineral Lake Property Due Diligence
Project Location: Lewis County, Washington
Project Number: 6565-008-00

Date Excavated	3/26/2020	Total Depth (ft)	8	Logged By	CJL	Checked By	SST	Excavator	Kelly's Excavating	Equipment	Komatsh PC120	See "Remarks" section for groundwater observed Caving not observed

Surface Elevation (ft)	1358	Easting (X)	1226049	Coordinate System	WA State Plane South
Vertical Datum	NAVD88	Northing (Y)	514223	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0				SOD	6 inches sod			
1357	1				SM	Dark brown silty fine to medium sand with gravel (medium dense, moist) (glacial drift)			
1356	2								
1355	3				GP-GM	Brown fine to coarse gravel with silt, sand and cobbles (medium dense, moist)			
1354	4		1 / SA				10	8	
1353	5				SP	Brown fine to coarse sand with trace silt (medium dense, moist)			
1352	6				GP-GM	Brown fine to coarse gravel with sand, cobbles and silt (medium dense, wet)			Moderate groundwater seepage observed at 6 feet
1351	7								
1350	8								

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Topographic Survey. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-2.07

GEOENGINEERS

Project: Mineral Lake Property Due Diligence
Project Location: Lewis County, Washington
Project Number: 6565-008-00

Date Excavated	3/27/2020	Total Depth (ft)	10.5	Logged By	CJL	Excavator	Kelly's Excavating	See "Remarks" section for groundwater observed
				Checked By	SST	Equipment	Komatsh PC120	Caving not observed

Surface Elevation (ft)	1358	Easting (X)	1226338	Coordinate System	WA State Plane South
Vertical Datum	NAVD88	Northing (Y)	514141	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
1358	0				SM	Dark brown silty fine to medium sand with gravel and trace organic matter (roots up to ½ inch diameter) (loose, moist) (glacial drift)			
1357	0.5				GP-GM	Brown fine to coarse gravel with silt, sand and cobbles (medium dense, moist)			
1355	3				GP-GM	Brown fine to coarse gravel with sand, cobbles and trace silt (dense, moist)			Increased cobbles compared to above
1354	4		1						
1349	9					Grades to wet			Moderate groundwater seepage observed at 9 feet
1347.5	10.5								

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Topographic Survey. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-2.08

GEOENGINEERS

Project: Mineral Lake Property Due Diligence
Project Location: Lewis County, Washington
Project Number: 6565-008-00

Date Excavated	3/27/2020	Total Depth (ft)	13	Logged By CJL / Checked By SST	Excavator Kelly's Excavating / Equipment Komatsh PC120

See "Remarks" section for groundwater observed
See "Remarks" section for caving observed

Surface Elevation (ft)	1343	Easting (X)	1226624
Vertical Datum	NAVD88	Northing (Y)	514053
Coordinate System	WA State Plane South	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
1343	0				WD	3 inches underbrush			
					SM	Light brown silty fine to medium sand with gravel (medium dense, moist) (glacial drift)			
1340	2.5–3	■	1						
1339	4				GP-GM	Brown fine to coarse gravel with silt, sand and cobbles (medium dense, moist)			
1337	5.5–6	■	2						
1336	7					Grades to with occasional boulders, dense			
1334	9				SP	Brown fine to coarse sand with trace silt (dense, moist)			Occasional caving observed at 9 feet
1333	10					Grades to wet			
1332	10.5–11	■	3						
1332	11				GP-GM	Brown fine to coarse gravel with silt, sand and cobbles (dense, wet)			Slow groundwater seepage observed at 11 feet
1330	13								

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Topographic Survey. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-2.09

GeoEngineers

Project: Mineral Lake Property Due Diligence
Project Location: Lewis County, Washington
Project Number: 6565-008-00

Date Excavated	3/26/2020	Total Depth (ft)	12	Logged By CJL Checked By SST	Excavator Kelly's Excavating Equipment Komatsh PC120	See "Remarks" section for groundwater observed See "Remarks" section for caving observed

Surface Elevation (ft) Vertical Datum	1361 NAVD88	Easting (X) Northing (Y)	1226284 513953	Coordinate System Horizontal Datum	WA State Plane South NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0–0.5				SOD	6 inches underbrush/sod			
1360	1				SM	Dark brown silty fine to medium sand with gravel and occasional cobbles (medium dense, moist) (glacial drift)			Rounded gravel and cobbles
1359–1354	1.5–7.5				GP-GM	Brown fine to coarse gravel with silt and sand and occasional cobbles (dense, moist)			
1357	3.5–4		1 SA				10	8	
1353–1349	7.5–12				GW-GM	Brown fine to coarse gravel with silt, sand and cobbles (dense, moist)			
1353	8–8.5		2 SA				12	9	
1351	10								Increased cobbles
1350	11					Grades to wet			Moderate to heavy groundwater seepage observed at 11 feet Moderate caving observed at 11 feet

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Topographic Survey. Vertical approximated based on Topographic Survey.

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Log of Test Pit TP-2.10

GeoEngineers

Project: Mineral Lake Property Due Diligence
Project Location: Lewis County, Washington
Project Number: 6565-008-00

Date Excavated 3/27/2020	Total Depth (ft) 10	Logged By CJL Checked By SST	Excavator Kelly's Excavating Equipment Komatsh PC120	See "Remarks" section for groundwater observed Caving not observed

Surface Elevation (ft) 1359 Vertical Datum NAVD88	Easting (X) 1226105 Northing (Y) 513831	Coordinate System WA State Plane South Horizontal Datum NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
1358	0–1				SM	Dark brown silty fine to medium sand with gravel and trace organic matter (roots) (loose, moist) (glacial drift)			
1357–1356	1–4	▯	1		ML	Brown sandy silt with occasional gravel and cobbles (medium stiff, moist)			
1355–1349	4–10				GP-GM	Brown fine to coarse gravel with silt, sand and cobbles (dense, moist)			
1351	8					Grades to wet			Moderate groundwater seepage observed at 7½ feet Increased cobbles
1350	9					Grades to with occasional boulders			

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Topographic Survey. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-2.11

GeoEngineers

Project: Mineral Lake Property Due Diligence
Project Location: Lewis County, Washington
Project Number: 6565-008-00

Date Excavated	3/27/2020	Total Depth (ft)	10	Logged By	CJL	Excavator	Kelly's Excavating	See "Remarks" section for groundwater observed
				Checked By	SST	Equipment	Komatsh PC120	See "Remarks" section for caving observed

Surface Elevation (ft)	1341	Easting (X)	1226781	Coordinate System	WA State Plane South
Vertical Datum	NAVD88	Northing (Y)	513811	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0				SM	Dark brown silty fine to medium sand with gravel and trace organic matter (roots) (medium dense, moist) (glacial drift)			
1340	1				GP-GM	Brown fine to coarse gravel with silt, sand and cobbles (medium dense, moist)			
1339	2								
1338	3				GP-GM	Brown fine to coarse gravel with silt, sand and cobbles (medium dense, moist)			
1337	4		1						
1336	5								
1335	6								Increased cobbles
1334	7					Grades to with boulders, dense			
1333	8								Moderate groundwater seepage observed at 8 feet
1332	9					With 12- to 14-inch boulder			Significant caving observed at 9 feet
1331	10								

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Topographic Survey. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-2.12

GeoEngineers

Project: Mineral Lake Property Due Diligence
Project Location: Lewis County, Washington
Project Number: 6565-008-00

Date Excavated	3/27/2020	Total Depth (ft)	11	Logged By CJL Checked By SST	Excavator Kelly's Excavating Equipment Komatsh PC120

See "Remarks" section for groundwater observed
See "Remarks" section for caving observed

Surface Elevation (ft) Vertical Datum	1362 NAVD88	Easting (X) Northing (Y)	1226361 513746	Coordinate System Horizontal Datum	WA State Plane South NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0				CL	Dark brown sandy clay with trace organic matter (fine roots) (soft, wet) (residual soils)			
1361	1				CL	Brown with iron-oxide staining sandy clay (medium stiff, moist)			Slow groundwater seepage observed at 1 foot
1360	2								Minor caving observed at 2 feet
1359	3								
1358	4								
1357	5								
1356	6								
1355	7					Grades to light gray			
1354	8								
1353	9					Grades to stiff			
1352	10				OL	Dark brown organic silt with organic matter (soft, moist)			
1351	11								

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Topographic Survey. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-2.13

GEOENGINEERS

Project: Mineral Lake Property Due Diligence
Project Location: Lewis County, Washington
Project Number: 6565-008-00

Date Excavated 3/26/2020	Total Depth (ft) 7.5	Logged By CJL Checked By SST	Excavator Kelly's Excavating Equipment Komatsh PC120	Groundwater not observed Caving not observed

Surface Elevation (ft) 1531 Vertical Datum NAVD88	Easting (X) 1224336 Northing (Y) 513308	Coordinate System WA State Plane South Horizontal Datum NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0				WD	6 inches underbrush			
1530	1				SC	Dark brown clayey fine to medium sand with trace organic matter (roots to ½ inch diameter) (loose, moist) (residual soils)			
1529	2				CL	Orange-brown sandy clay with trace organic matter (roots) (medium stiff, moist)			
1528	3								
1527	4								
1526	5					Grades to with occasional gravel			
1525	6								
1524	7								

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Topographic Survey. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-2.14

GeoEngineers

Project: Mineral Lake Property Due Diligence
Project Location: Lewis County, Washington
Project Number: 6565-008-00

Date Excavated	3/26/2020	Total Depth (ft)	10	Logged By	CJL	Excavator	Kelly's Excavating	Groundwater not observed
				Checked By	SST	Equipment	Komatsh PC120	Caving not observed

Surface Elevation (ft)	1562	Easting (X)	1224791	Coordinate System	WA State Plane South
Vertical Datum	NAVD88	Northing (Y)	513082	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
1562	0				WD	6 inches underbrush			
1561	0.5–1				CL	Brown sandy clay with occasional gravel and cobbles (stiff, moist) (residual soils)			Angular rock fragments
1557	5		1						
1552	10								

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Topographic Survey. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-2.15

GeoEngineers

Project: Mineral Lake Property Due Diligence
Project Location: Lewis County, Washington
Project Number: 6565-008-00

Date Excavated	3/26/2020	Total Depth (ft)	11.5	Logged By	CJL	Excavator	Kelly's Excavating	Groundwater not observed
				Checked By	SST	Equipment	Komatsh PC120	Caving not observed

Surface Elevation (ft)	1413	Easting (X)	1225964	Coordinate System	WA State Plane South
Vertical Datum	NAVD88	Northing (Y)	513056	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0				WD	6 inches underbrush			
1412	1				SC	Dark brown clayey fine to medium sand with gravel and trace organic matter (roots to 2 inches diameter) (loose, moist) (residual soils)			
1411	2				CL	Light tan sandy clay (stiff, moist)			
1410	3								
1409	4								
1408	5								
1407	6								Angular rock fragments at 6½ feet
1406	7								
1405	8								
1404	9								
1403	10								
1402	11								

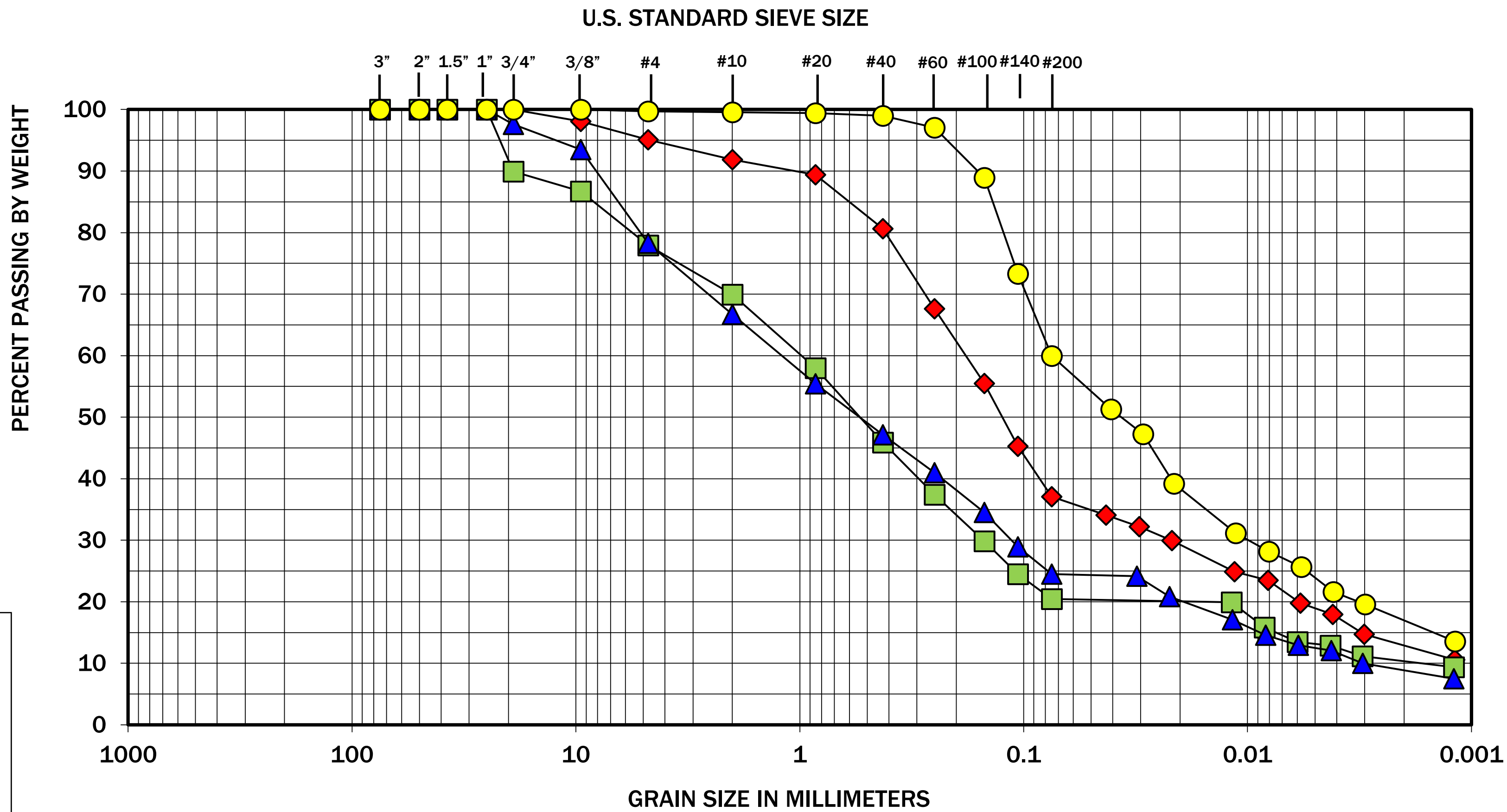
Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Topographic Survey. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-2.16

GEOENGINEERS

Project: Mineral Lake Property Due Diligence
Project Location: Lewis County, Washington
Project Number: 6565-008-00

Figure A-25
Sheet 1 of 1



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Symbol	Test Pit Number	Depth (feet)	Moisture (%)	Soil Description
◆ (red diamond)	TP-1.02	3.5	34	Clayey fine to medium sand (SC)
■ (green square)	TP-1.05	5	43	Clayey fine to medium sand with gravel (SC)
▲ (blue triangle)	TP-1.08	7	29	Clayey fine to coarse sand with gravel (SC)
● (yellow circle)	TP-2.03	4	47	Sandy clay (CL)

AASHTO ACCREDITED

Note: This report may not be reproduced, except in full, without written approval of GeoEngineers, Inc. Test results are applicable only to the specific sample on which they were performed, and should not be interpreted as representative of any other samples obtained at other times, depths or locations, or generated by separate operations or processes.

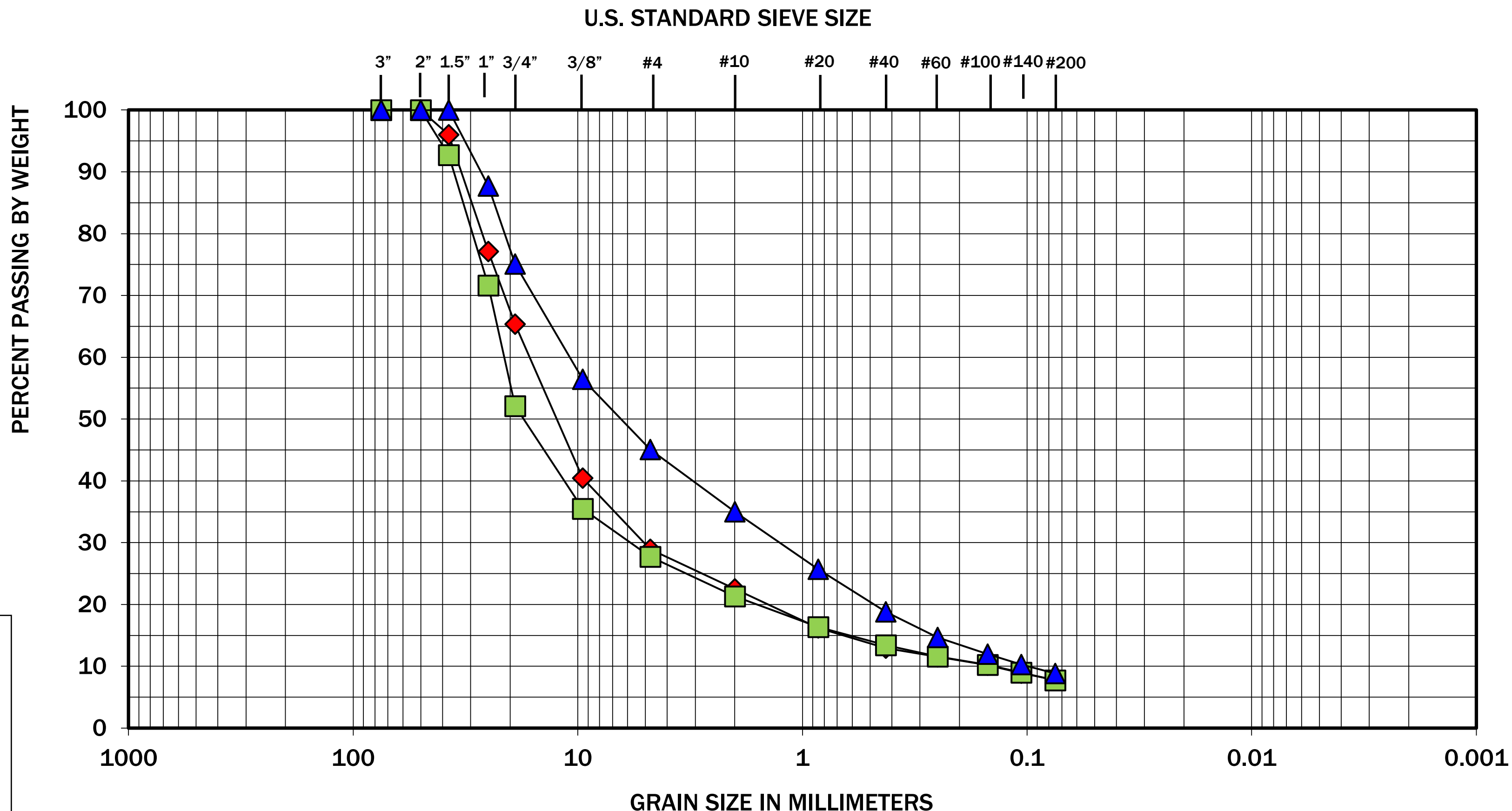
The grain size analysis results were obtained in general accordance with ASTM C 136. GeoEngineers 17425 NE Union Hill Road Ste 250, Redmond, WA 98052

GeoEngineers

Sieve Analysis Results

Mineral Lake Property Due Diligence
Lewis County, Washington

Figure A-26



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Symbol	Test Pit Number	Depth (feet)	Moisture (%)	Soil Description
◆ (red diamond)	TP-2.07	3.5	10	Fine to coarse gravel with silt and sand (GP-GM)
■ (green square)	TP-2.10	3.5	10	Fine to coarse gravel with silt and sand (GP-GM)
▲ (blue triangle)	TP-2.10	8	12	Fine to coarse gravel with silt and sand (GW-GM)

The grain size analysis results were obtained in general accordance with ASTM C 136. GeoEngineers 17425 NE Union Hill Road Ste 250, Redmond, WA 98052

Sieve Analysis Results

Mineral Lake Property Due Diligence
Lewis County, Washington

GEOENGINEERS

Figure A-27

APPENDIX B
Water Well Reports

WATER WELL REPORT

Original & 1st copy - Ecology, 2nd copy - owner, 3rd copy - driller

CURRENT Notice of Intent No. W132141

Unique Ecology Well ID Tag No. AGE 820

Water Right Permit No. N/A

Construction/Decommission ("x" in circle)
☒ Construction
○ Decommission ORIGINAL CONSTRUCTION Notice of Intent Number 108523

Property Owner Name Weyerhaeuser Real Estate Devel. Co.

Well Street Address Off Weyerhaeuser Rd. 730

City Mineral County: Lewis

Location SE 1/4- 1/4 SW 1/4 Sec 34 Twn 15N R 5 (EWM) or WWM circle one

Lat/Long: (s,t,r still REQUIRED) Lat Deg ____ Lat Min/Sec ____ Long Deg ____ Long Min/Sec ____

Tax Parcel No. ____

PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other ____

TYPE OF WORK: Owner's number of well (if more than one) ____
☒ New Well ☐ Reconditioned Method ☐ Dug ☐ Bored ☐ Driven
☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 6 inches, drilled 203 ft.
Depth of completed well 203 ft.

CONSTRUCTION DETAILS
Casing Installed: ☒ Welded 6" Diam from +3 ft. to 18 ft.
☒ Liner installed 4" Diam from 10 ft. to 203 ft.
☐ Threaded ____" Diam from ____ ft. to ____ ft.

Perforations: ☒ Yes ☐ No
Type of perforator used Grinder
SIZE of perfs 1/4 in by 2 in and no of perfs 40 from 193 ft. to 203 ft.

Screens: ☐ Yes ☒ No ☐ K-Pac Location ____
Manufacturer's Name ____
Type ____ Model No. ____
Diam ____ Slot Size ____ from ____ ft. to ____ ft.
Diam ____ Slot Size ____ from ____ ft. to ____ ft.

Gravel/Filter packed: ☐ Yes ☒ No ☐ Size of gravel/sand ____
Materials placed from ____ ft. to ____ ft.

Surface Seal: ☒ Yes ☐ No To what depth? 18 ft.
Materials used in seal Bentonite
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? ____ Depth of strata ____
Method of sealing strata off ____

PUMP: Manufacturer's Name ____
Type: ____ H.P. ____

WATER LEVELS: Land-surface elevation above mean sea level ____ ft.
Static level 23 ft. below top of well Date 1/13/02
Artesian pressure ____ lbs. per square inch Date ____
Artesian water is controlled by ____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes, by whom? ____
Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.
Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.
Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.
Recovery data (time taken as zero when pump turned off)(water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test ____
Bailer test ____ gal./min. with ____ ft. drawdown after ____ hrs.
Airtest 1.5 gal./min with stem set at 190 ft. for 1 hrs.
Artesian flow ____ g.p.m. Date 1/13/02
Temperature of water ____ Was a chemical analysis made? ☐ Yes ☒ No

CONSTRUCTION OR DECOMMISSION PROCEDURE
Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. Indicate all water encountered. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
Top soil	0	6
Clay with boulders	6	13
Shale	13	23
Fractured shale - wb - 1gt/min	23	98
Fractured shale - wb 1gt/min	98	195
Fractured shale - wb 1gal/min	195	203

RECEIVED
JAN 23 2002
Washington State
Department of Ecology

Start Date 1/7/02 Completed Date 1/13/02

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee Name (Print) Daniel L. Rayton
Driller/Engineer/Trainee Signature [signature]
Driller or Trainee License No. 2120

If trainee, licensed driller's Signature and License no. ____

Drilling Company Moerke & Sons Pump & Drilling
Address 1286 NW Maryland Ave
City, State, Zip Chehalis, WA 98532
Contractor's Registration No. MOERKSP072N5 Date 1/14/02

WATER WELL REPORT

Original & 1st copy - Ecology, 2nd copy - owner, 3rd copy - driller

Construction/Decommission ("x" in circle)
(X) Construction
( ) Decommission ORIGINAL CONSTRUCTION Notice of Intent Number 108524

CURRENT Notice of Intent No. W132140
Unique Ecology Well ID Tag No. AGE821
Water Right Permit No. N/A
Property Owner Name Weyerhaeuser Real Estate Devel. Co.
Well Street Address Off Weyerhaeuser Rd. #733
City Mineral County: Lewis
Location NE 1/4-1/4 SW 1/4 Sec 34 Twn 15N R 5 (EWM) or WWM (circle one)
Lat/Long: (s,t,r still REQUIRED) Lat Deg ____ Lat Min/Sec ____ Long Deg ____ Long Min/Sec ____
Tax Parcel No. ____

PROPOSED USE: [X] Domestic [ ] Industrial [ ] Municipal [ ] DeWater [ ] Irrigation [ ] Test Well [ ] Other

TYPE OF WORK: Owner's number of well (if more than one) 1
[X] New Well [ ] Reconditioned [ ] Deepened
Method: [ ] Dug [ ] Bored [ ] Driven [ ] Cable [X] Rotary [ ] Jetted

DIMENSIONS: Diameter of well 6 inches, drilled 243 ft.
Depth of completed well 243 ft.

CONSTRUCTION DETAILS
Casing Installed: [X] Welded 6" Diam from +2 ft. to 18 ft
[X] Liner installed 4" Diam from 12 ft to 243 ft
[ ] Threaded ____" Diam from ____ ft to ____ ft

Perforations: [X] Yes [ ] No
Type of perforator used Grinder
SIZE of perfs 1/4 in by 2 in and no of perfs 4 from 233 ft. to 243 ft.

Screens: [ ] Yes [X] No [ ] K-Pac Location ____
Manufacturer's Name ____
Type ____ Model No. ____
Diam ____ Slot Size ____ from ____ ft to ____ ft.
Diam ____ Slot Size ____ from ____ ft to ____ ft.

Gravel/Filter packed: [ ] Yes [X] No [ ] Size of gravel/sand ____
Materials placed from ____ ft to ____ ft.

Surface Seal: [X] Yes [ ] No To what depth? 18 ft
Materials used in seal Bentonite
Did any strata contain unusable water? [ ] Yes [X] No
Type of water? ____ Depth of strata ____
Method of sealing strata off ____

PUMP: Manufacturer's Name ____
Type ____ H.P ____

WATER LEVELS: Land-surface elevation above mean sea level ____ ft.
Static level 161 ft. below top of well Date 1/4/02
Artesian pressure ____ lbs per square inch Date ____
Artesian water is controlled by ____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level.
Was a pump test made? [ ] Yes [X] No If yes, by whom? ____
Yield: ____ gal./min. with ____ ft drawdown after ____ hrs.
Yield: ____ gal./min. with ____ ft drawdown after ____ hrs.
Yield: ____ gal./min. with ____ ft drawdown after ____ hrs.
Recovery data (time taken as zero when pump turned off)(water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test ____
Bailer test ____ gal./min. with ____ ft drawdown after ____ hrs.
Airtest .75 gal./min. with stem set at 180 ft for 1 hrs.
Artesian flow ____ g.p.m. Date 1/4/02
Temperature of water ____ Was a chemical analysis made? [ ] Yes [X] No

CONSTRUCTION OR DECOMMISSION PROCEDURE
Formation. Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. Indicate all water encountered. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
Clay with boulders	0	12
Shale Gray	12	169
Shale Red	169	173
Sandstone Hard	173	186
Sandstone Hard 2 gal./min	186	187
Sandstone Hard Gray	187	216
Sandstone Soft Red	216	219
wb - 30 gal/min		
Sandstone Hard	219	243

RECEIVED
JAN 23 2002
Washington State Department of Ecology

Start Date 12/26/01 Completed Date 1/4/02

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

[X] Driller [ ] Engineer [ ] Trainee Name (Print) Daniel L. Rayton
Driller/Engineer/Trainee Signature [signature]
Driller or Trainee License No. 2120
If trainee, licensed driller's Signature and License no. ____

Drilling Company Moerke & Sons Pump & Drilling
Address 1286 NW Maryland Ave
City, State, Zip Chehalis, WA 98532
Contractor's Registration No. MOERKSP072N5 Date 1/15/02

APPENDIX C
Report Limitations and Guidelines for Use

APPENDIX C
REPORT LIMITATIONS AND GUIDELINES FOR USE[1]

This appendix provides information to help you manage your risks with respect to the use of this report.

Read These Provisions Closely

It is important to recognize that the geoscience practices (geotechnical engineering, geology and environmental science) rely on professional judgment and opinion to a greater extent than other engineering and natural science disciplines, where more precise and/or readily observable data may exist. To help clients better understand how this difference pertains to our services, GeoEngineers includes the following explanatory "limitations" provisions in its reports. Please confer with GeoEngineers if you need to know more how these "Report Limitations and Guidelines for Use" apply to your project or site.

Geotechnical Services are Performed for Specific Purposes, Persons and Projects

This report has been prepared for YMCA Seattle and for the Project(s) specifically identified in the report. The information contained herein is not applicable to other sites or projects.

GeoEngineers structures its services to meet the specific needs of its clients. No party other than the party to whom this report is addressed may rely on the product of our services unless we agree to such reliance in advance and in writing. Within the limitations of the agreed scope of services for the Project, and its schedule and budget, our services have been executed in accordance with our Agreement with YMCA Seattle signed March 16, 2020 and generally accepted geotechnical practices in this area at the time this report was prepared. We do not authorize, and will not be responsible for, the use of this report for any purposes or projects other than those identified in the report.

A Geotechnical Engineering or Geologic Report is based on a Unique Set of Project-Specific Factors

This report has been prepared for the Mineral Lake Property Due Diligence project located in Mineral Lake, Washington. GeoEngineers considered a number of unique, project-specific factors when establishing the scope of services for this project and report. Unless GeoEngineers specifically indicates otherwise, it is important not to rely on this report if it was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

For example, changes that can affect the applicability of this report include those that affect:

- the function of the proposed structure;
- elevation, configuration, location, orientation or weight of the proposed structure;

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[1] Developed based on material provided by ASFE, Professional Firms Practicing in the Geosciences; www.asfe.org.

- composition of the design team; or
- project ownership.

If changes occur after the date of this report, GeoEngineers cannot be responsible for any consequences of such changes in relation to this report unless we have been given the opportunity to review our interpretations and recommendations. Based on that review, we can provide written modifications or confirmation, as appropriate.

Environmental Concerns are Not Covered

Unless environmental services were specifically included in our scope of services, this report does not provide any environmental findings, conclusions, or recommendations, including but not limited to, the likelihood of encountering underground storage tanks or regulated contaminants.

Information Provided by Others

GeoEngineers has relied upon certain data or information provided or compiled by others in the performance of our services. Although we use sources that we reasonably believe to be trustworthy, GeoEngineers cannot warrant or guarantee the accuracy or completeness of information provided or compiled by others.

Subsurface Conditions Can Change

This geotechnical or geologic report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by man-made events such as construction on or adjacent to the site, new information or technology that becomes available subsequent to the report date, or by natural events such as floods, earthquakes, slope instability or groundwater fluctuations. If more than a few months have passed since issuance of our report or work product, or if any of the described events may have occurred, please contact GeoEngineers before applying this report for its intended purpose so that we may evaluate whether changed conditions affect the continued reliability or applicability of our conclusions and recommendations.

Geotechnical and Geologic Findings are Professional Opinions

Our interpretations of subsurface conditions are based on field observations from widely spaced sampling locations at the site. Site exploration identifies the specific subsurface conditions only at those points where subsurface tests are conducted or samples are taken. GeoEngineers reviewed field and laboratory data and then applied its professional judgment to render an informed opinion about subsurface conditions at other locations. Actual subsurface conditions may differ, sometimes significantly, from the opinions presented in this report. Our report, conclusions and interpretations are not a warranty of the actual subsurface conditions.

Geotechnical Engineering Report Recommendations are Not Final

We have developed the following recommendations based on data gathered from subsurface investigation(s). These investigations sample just a small percentage of a site to create a snapshot of the subsurface conditions elsewhere on the site. Such sampling on its own cannot provide a complete and accurate view of subsurface conditions for the entire site. Therefore, the recommendations included in this report are preliminary and should not be considered final. GeoEngineers' recommendations can be finalized only by observing actual subsurface conditions revealed during construction. GeoEngineers cannot assume responsibility or liability for the recommendations in this report if we do not perform construction observation.

We recommend that you allow sufficient monitoring, testing and consultation during construction by GeoEngineers to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes if the conditions revealed during the work differ from those anticipated, and to evaluate whether earthwork activities are completed in accordance with our recommendations. Retaining GeoEngineers for construction observation for this project is the most effective means of managing the risks associated with unanticipated conditions. If another party performs field observation and confirms our expectations, the other party must take full responsibility for both the observations and recommendations. Please note, however, that another party would lack our project-specific knowledge and resources.

A Geotechnical Engineering or Geologic Report Could Be Subject to Misinterpretation

Misinterpretation of this report by members of the design team or by contractors can result in costly problems. GeoEngineers can help reduce the risks of misinterpretation by conferring with appropriate members of the design team after submitting the report, reviewing pertinent elements of the design team's plans and specifications, participating in pre-bid and preconstruction conferences, and providing construction observation.

Do Not Redraw the Exploration Logs

Geotechnical engineers and geologists prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. The logs included in a geotechnical engineering or geologic report should never be redrawn for inclusion in architectural or other design drawings. Photographic or electronic reproduction is acceptable, but separating logs from the report can create a risk of misinterpretation.

Give Contractors a Complete Report and Guidance

To help reduce the risk of problems associated with unanticipated subsurface conditions, GeoEngineers recommends giving contractors the complete geotechnical engineering or geologic report, including these "Report Limitations and Guidelines for Use." When providing the report, you should preface it with a clearly written letter of transmittal that:

- advises contractors that the report was not prepared for purposes of bid development and that its accuracy is limited; and
- encourages contractors to confer with GeoEngineers and/or to conduct additional study to obtain the specific types of information they need or prefer.

Contractors are Responsible for Site Safety on Their Own Construction Projects

Our geotechnical recommendations are not intended to direct the contractor's procedures, methods, schedule or management of the work site. The contractor is solely responsible for job site safety and for managing construction operations to minimize risks to on-site personnel and adjacent properties.

Biological Pollutants

GeoEngineers' Scope of Work specifically excludes the investigation, detection, prevention or assessment of the presence of Biological Pollutants. Accordingly, this report does not include any interpretations, recommendations, findings or conclusions regarding the detecting, assessing, preventing or abating of Biological Pollutants, and no conclusions or inferences should be drawn regarding Biological Pollutants as they may relate to this project. The term "Biological Pollutants" includes, but is not limited to, molds, fungi, spores, bacteria and viruses, and/or any of their byproducts.

A Client that desires these specialized services is advised to obtain them from a consultant who offers services in this specialized field.