

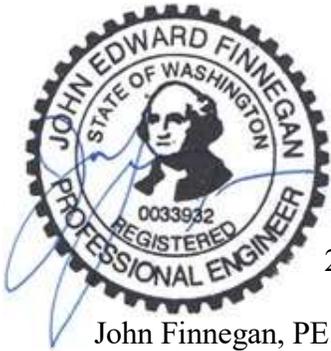
Geotechnical Engineering Report  
Legacy Ridge Phase F  
Spokane County, WA

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2/28/2025

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**CONTENTS**

**CONTEXT** **1**

*Project Considerations*..... **1**

*Location*..... **1**

*Scope*..... **1**

**ENCOUNTERED CONDITIONS** **2**

*Subsurface Conditions*..... **2**

*Surface and Groundwater Hydrology*..... **3**

**CONCLUSIONS** **3**

**RECOMMENDATIONS** **4**

*Seismic Considerations*..... **4**

*Earthwork*..... **4**

*Flexible Pavements* ..... **7**

*Stormwater Drainage Considerations*..... **8**

*Additional Services*..... **8**

**FIELD EXPLORATION** **9**

*DCP Testing* ..... **9**

*Test Pits* ..... **9**

*Probe Borings*..... **9**

*Soil Samples* ..... **9**

*Soil and Rock Classification*..... **9**

*Location*..... **10**

**LABORATORY ANALYSIS** **10**

*Index Parameters* ..... **10**

*Chemical Parameters*..... **10**

**LIMITATIONS** **11**

**REFERENCES** **11**

**EMBEDDED TABLES**

**Table 1. Seismic Design Parameters** .....**4**

**Table 2. Fill Materials**.....**6**

**Table 3. Flexible Pavement Compaction and Recommended Materials Summary** .....**7**

**ATTACHED FIGURES**

- Figure 1: Vicinity Map**
- Figures 2-1 to 2-6: Site Plan & Profiles**
- Figure 3: Guide to Soil & Rock Descriptions**
- Figures 4-1 to 4-10: Test Pit & Probe Logs**
- Figures 5-1 to 5-7: Dynamic Cone Penetrometer Logs**
- Figure 6: Laboratory Summary**
- Figure 7: Grain Size Distribution Results**
- Figure 8: Keying & Benching Detail**
- Appendix: Important Information about Your Geotechnical-Engineering Report**

## **CONTEXT**

This geotechnical engineering report (GER) presents the results of geotechnical exploration and analysis for the proposed improvements. These services were contracted with MTK Management, LLC., represented by Robert H. Tomlinson, and coordinated with Whipple Consulting Engineers (WCE), represented by Todd R. Whipple, PE, President.

### ***Project Considerations***

The project remains as described in *Legacy Phase F – Geohazard Evaluation Preliminary Report* dated December 23, 2024. Development of the residential lots will require cuts and fills up to approximately 40 and 20 feet, respectively, as shown in plans provided by WCE dated July 17, 2024. Drawings also indicate that maximum permanent slope inclinations of 2 horizontal to 1 vertical (2H:1V) are planned. Paved residential streets will be constructed; information pertaining to anticipated traffic loads was not provided at the time of this report.

WCE provided a copy of a draft letter addressed to City of Liberty Lake (COLL) Planning, Engineering & Building Services – dated January 31, 2025 – requesting a “*Reasonable Use Exception (RUE) for the approved preliminary plat (2014.PL0003) and approved Minor Map Modification of Legacy Ridge West. This RUE is necessary to develop the remainder of the originally approved plat and to implement the approved Minor Map Modification, whereby, excess lots were added to that portion of the plat known as Legacy F.*”

### ***Location***

The site is in the SW ¼ of the NE ¼ of Section 21, Township 25 North, Range 45 East, Willamette Meridian. A physical address is not currently assigned. The project area is directly north of the Saltese Uplands Conservation Area. The location is shown in the *Vicinity Map* and *Site Plan*.

### ***Scope***

This geotechnical evaluation involved exploration of surface and subsurface conditions to provide geotechnical parameters required for others to design and construct. We endeavored to conduct these services in accordance with generally accepted geotechnical engineering practices as outlined in proposal S241121, dated January 21, 2025. The following scope was completed:

- Explored subsurface conditions in 6 test pits and 4 probe borings;
- Advanced 7 Kessler® dynamic cone penetrometer (DCP) soundings;
- Characterized the encountered subsurface conditions;
- Performed laboratory testing on representative soil samples;
- Prepared calculations pertaining to flexible pavement layer thicknesses and stormwater drainage; and,
- Prepared this report presenting the exploration results as well as conclusions and recommendations.

Foundation recommendations for homes or other buildings are beyond the scope of services for this report, other than providing the prescriptive minimum setback in the ICC Residential Code. The setback can be evaluated on a site-specific basis by a qualified professional. Additional information including drawings that show building configurations with anticipated footing elevations and structural loads would be required to provide site-specific foundation recommendations for each structure, which is not included in this scope of services.

Construction inherently entails risk, and this project is not an exception. The purpose of this study is to reduce risks related to subjects in our scope to levels generally accepted for similar projects designed with the benefit of similar geotechnical study.

### ***ENCOUNTERED CONDITIONS***

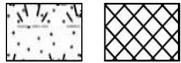
The physical setting and surface conditions are described in the previous *Geohazard Evaluation Preliminary Report*.

#### ***Subsurface Conditions***

Conditions encountered in the explorations are described in the *Logs* in accordance with methods described in *Field Exploration*. The following groups of subsurface materials were differentiated based on characteristics relevant to this project:

##### *topsoil & existing fill*

*Log symbols:*



*Topsoil* consisting of silty sand with gravel, cobbles, and organics was observed at the ground surface; thickness ranged from approximately 6 to 24 inches.

*Existing fill* consisting chiefly of gravel and sand with varying amounts of silt and cobbles was encountered in Test Pit 5 (TP-5), TP-6, and TP-7 beginning at the ground surface and extending to depths ranging from 1.5 to 6 feet; thickest in TP-5. Boulders were occasionally observed; some upwards of 3-foot diameter. *Existing fill* appeared to have been generated from onsite materials and used to construct pre-existing primitive road embankments and soil berms related to previous use of the property as a ski resort.

##### *silty, clayey sand*

*Log symbol:*



*Silty, clayey sand* was observed beneath the *topsoil* and *existing fill* ranging in thickness of 1 to 2 feet. Fines content (percent passing the US #200 sieve) was 36 percent and the plasticity index was 4 in one representative sample tested. The moisture content was below the plastic limit. Cobbles and boulders were observed in the stratum.

##### *gneiss*

*Log symbol:*



*Gneiss* was encountered beginning at depths ranging from 0 to 6 feet and consisted of highly to slightly weathered metasedimentary rock. In TP-1 and TP-3, a 360-horsepower, 55-ton excavator equipped with a toothed bucket was able to dig up to 21 feet into *gneiss* before the reach was maximized. Digging refusal occurred in stronger, less weathered zones within 3 to 11 feet from the top of *gneiss* at other test pit locations.

An 11-ton, 176-horsepower rock drill advanced probe borings to a maximum depth of 59 feet. The

average drilling rates into *gneiss* ranged from 15 to 22 seconds per foot; slower rates were observed in Probe Boring 9 (PB-9) and PB-11. A down-hole camera was used to view the bore hole walls once drilling was completed. Weathering appeared to vary from slightly weathered to fresh, and discontinuity spacing ranged from closely to widely spaced.

### ***Surface and Groundwater Hydrology***

Surface water was not observed onsite, and groundwater was not encountered in the explorations. Two water well reports for wells constructed within 1,000 feet west of the southwest corner of the site were obtained from the Washington State Department of Ecology website. The reports describe rock extending to depths greater than 800 feet and list static groundwater levels of 300 and 600 feet at the time of construction. Groundwater could potentially be encountered, such as in seeps emanating from joints in the rock mass.

## **CONCLUSIONS**

Based on the encountered conditions described above, we conclude the site is suited for the proposed development provided the recommendations in this report are implemented.

### **Earthwork.**

Records of compaction required to verify placement of *existing fill* materials were not provided nor readily available. Thus, *existing fill* may pose a settlement hazard if left untreated. Fortunately, the thickness and extent of it appears to be limited and settlement risk can be mitigated by removing it from areas where structures and pavements are proposed and, if necessary, replacing it with compacted structural fill with proper verification.

Ripping, rock-breaking hammers, and blasting of *gneiss* will likely be necessary to establish subgrade elevations in areas of cut.

Current plans indicate that building pads will be constructed in areas of the site where slopes are generally less than 40 percent, as shown in *Figure 2-1*.

The encountered *silty, clayey sand* may be reused as structural fill, but the elevated fines contents could make the soil moisture-sensitive, which could result in difficulty reaching the required moisture content range for compaction and therefore difficult to compact. Likewise, excavated *gneiss* and *existing fill* may be reused as structural fill provided oversize particles are screened out prior to placement. *Topsoil* should not be reused as structural fill due to the presence of organic materials.

**Setback.** Unless evaluated on a site-specific basis, the ICC Residential Code minimum foundation setback is the lesser of 40 feet or one third of the slope height.

### **Pavements.**

The City of Liberty Lake (COLL) Engineering Design Standards, *Section 3.2, Part Q – Pavement Section Thickness* states the minimum flexible pavement section for local access streets shall be 3 inches of asphalt (HMA) over 6 inches of crushed surfacing (CS) regardless of thicknesses computed by design procedures. The required minimum flexible pavement layer thicknesses will be adequate considering the encountered conditions and proposed use of the site.

A subgrade resilient modulus ( $M_R$ ) of approximately 9,700 pounds per square inch (psi) is

anticipated to be suitable for use in flexible pavement layer calculations provided the *Earthwork* recommendations in this report are implemented.

**Stormwater Drainage.**

Subsurface infiltration of stormwater runoff is not considered feasible due to the lack of thick, extensive, permeable soil and presence of *gneiss*. Per the RUE request letter, “*Stormwater [runoff] will be directed downslope into existing pond infiltration systems, generally north of Kramer Road, designed to handle runoff efficiently without impacting adjacent properties or the environment.*”

**RECOMMENDATIONS**

The recommendations presented throughout this chapter are intended to provide economically feasible criteria at normally accepted risk levels. More conservative design parameters can be used if lower risks are preferred. Specifically, the design should incorporate the following recommendations concerning earthwork, flexible pavements, and stormwater drainage.

***Seismic Considerations***

The recommended seismic site class designation is Site Class C “*Very Dense Soil and Soft Rock.*” Spectral response acceleration parameters, adjusted for Site Class C, were calculated using USGS, U.S. Seismic Design Web Services through the ASCE 7 Hazard Tool (ASCE, 2025). The values of predicted earthquake ground motion for short period structural elements (0.2 second spectral response acceleration, S<sub>s</sub>) and for long period structural elements (1.0 second spectral response acceleration, S<sub>1</sub>) are provided in the table below. The design parameters (SDS and SD1) are equal to 2/3 of the maximum earthquake spectral response accelerations (SMS and SM1).

**Table 1. Seismic Design Parameters**

Site Class	Latitude	Longitude	PGA	S <sub>s</sub>	S <sub>1</sub>	S <sub>DS</sub>	S <sub>D1</sub>
C	47.652	-117.118	0.142g	0.316g	0.111g	0.274g	0.111g

\*Code Reference: (ASCE 7-16)

The site-modified peak ground acceleration (PGA<sub>M</sub>) is 0.178g. Due to the presence of *gneiss*, absence of groundwater, and low probability of high ground acceleration, the liquefaction potential is considered negligible.

***Earthwork***

**Site preparation.** Strip vegetation, *topsoil*, and other non-soil materials in construction areas so that mineral soil lacking concentrated organics is exposed. Remove and replace *existing fill* with approved and compacted fill materials in areas where buildings and pavements will be constructed. Grade surfaces that will receive fill no steeper than 8 percent. Where *gneiss* is not exposed after initial site preparation, and a foot or more of soil remains, scarify the subgrade to a minimum depth of 12 inches, such as by ripping with a dozer, bring the soil moisture to within approximately 2 percent of optimum content, and compact<sup>1</sup> the subgrade to a minimum 92 percent of maximum dry unit weight (MDUW). Determine MDUW and optimum moisture contents for fill materials in accordance with the Modified Proctor Method ASTM D-1557.

<sup>1</sup> Compacting with a 16-ton or larger (static weight), vibrating pad-footed roller and at least 6 passes is considered an effective way to improve subgrade soil strength to depths of approximately 2 to 4 feet in areas where benching is not required.

**Keying and benching.** Where embankment fill is to be placed on slopes steeper than 5 horizontal to 1 vertical (5H:1V), the base of the fill should be tied into firm and unyielding *gneiss* by keying and benching, as shown in *Figure 8*. Excavate benches into the sloping embankment foundation in 2- to 4-foot vertical increments at widths no less than 10 feet. Excavate a minimum 15-foot-wide key into the toe of the fill slope. Compact surfaces according to the preceding recommendations. If *existing fill* or *silty, clayey sand* are encountered in benching excavations, remove them so that *gneiss* is exposed in the subgrade and use the excavated soil as structural fill to re-establish subgrade elevations, if necessary.

**Temporary slopes.** As previously mentioned in *Project Considerations*, cuts and fills up to 40 and 20 feet, respectively, are proposed. Due to varying construction methods and conditions, temporary slopes should be the responsibility of the contractor. The encountered soils are consistent with Type C materials for which Washington Industrial Safety and Health Act (WISHA) specifies a maximum inclination of 1½H:1V in the temporary condition. Due to the weathered state and variation of foliation plane dip angles, *gneiss* should be considered a Type B material for which the maximum temporary slope inclination is 1H:1V.

**Permanent slopes.** Maximum permanent cut and fill slope angles of 2H:1V are recommended except where potentially submerged in drainage basins where slopes should be no steeper than 3H:1V. Protect completed surfaces as soon as possible with mechanical or bio-technical erosion control.

Cuts in *gneiss* that are proposed to result in a permanent slope steeper than 1H:1V should be evaluated by a geotechnical engineer on a case-by-case basis.

**Protection of subgrade.** Following compaction of subgrade, protect surfaces from degradation during inclement weather. Protection measures include erosion control maintenance, preventing tracking of soil and rock offsite, and preventing driving on wet subgrade soil. Reduce frost penetration in freezing weather by leaving surfaces of soil un-compacted if left for an extended duration, or by covering soils with a temporary loose, insulating layer of soil that can be easily graded off.

**Fill material.** The encountered soils, with the exception of *topsoil*, are suitable for re-use as structural and embankment fill. If imported materials are required, the generally recommended fill materials and uses are shown in the table below.

**Table 2. Fill Materials**

Soil Fill Product	Allowable Use
<b>Non-Structural Fill</b>	<ul style="list-style-type: none"> <li>• Areas not supporting structures (typically landscaped areas)</li> <li>• Soils should not contain particles larger than 12 inches median diameter and be reasonably free of deleterious items (wood, metal, plastic, trash, etc.)</li> </ul>
Select Borrow: WSDOT SS <sup>2</sup> Section 9-03.14(2)	<ul style="list-style-type: none"> <li>• Fills within structure footprints and paved areas to meet subgrade elevations</li> <li>• Over-excavations</li> <li>• Utility trench backfill above bedding course</li> </ul>
Class B Gravel Backfill for Foundations: WSDOT SS 9-03.12(1)B	<ul style="list-style-type: none"> <li>• Slab-on-grade aggregate</li> <li>• Structural fill below foundations, where required.</li> </ul>
Gravel Backfill for Walls: WSDOT SS 9-03.12(2)	<ul style="list-style-type: none"> <li>• Foundation and retaining wall backfill where required.</li> </ul>
Bedding Course: WSDOT SS 9-03.12(3)	<ul style="list-style-type: none"> <li>• Backfill for utility and pipe zone bedding</li> </ul>

Contact us to review alternative material selections. Structural fill should extend beyond footings a minimum distance equal to the fill depth.

**Fill Placement.** Compact embankment and structural fill to at least 92 percent of MDUW, except within the top 24 inches of final subgrade elevations where compaction should be increased to 95 percent. The maximum allowable lift thickness should be selected based on the compaction equipment used but not exceeding 12 inches. Maximum soil particle size should be the lesser of 4 inches or 1/3 of the lift height. Do not place fill in a frozen condition or on uncompacted frozen subgrade.

**Verification and application.** These earthwork recommendations apply to embankment fill, structural fill, backfill against footings, and backfill of utility trenches. Retain a qualified earthwork technician present during fill placement operations to observe and test each lift of fill. A representative of the Geotechnical Engineer is best suited to provide such testing.

We recommend in-place density testing in accordance with ASTM D-6938 (nuclear density methods) at the following minimum frequencies:

- Subgrade and embankment/structural fill for roads and building pads – 2 tests per 2,000 square feet or fraction thereof per lift;
- Subgrade and base course materials for roads – at least one in-place density test per 100 lineal feet per lane, per lift;
- Subgrade and base course materials for curbs and sidewalks – at least one in-place density test per 100 lineal feet per fill lift; and,
- Utility trench backfill – at least one in-place density test per 5 feet of depth per 100 lineal feet of trench.

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<sup>2</sup> Washington State Department of Transportation Standard Specifications

**Flexible Pavements**

Traffic information was not provided. We used the 1993 AASHTO Guide for Design of Pavement Structures and Spokane County Design Standards to calculate a total design-life traffic load that can be imparted on a flexible pavement section consisting of 3 inches of HMA over 6 inches of CS before terminal serviceability is reached. The following parameters were used in calculations:

- Design life: 20 years
- M<sub>R</sub>: 9,700 psi
- Reliability: 75 percent
- Initial serviceability: 4.20
- Terminal serviceability: 2.00
- Standard deviation: 0.45
- HMA structural coefficient: 0.42
- Granular base structural coefficient: 0.14
- HMA drainage coefficient: 1.0
- Base drainage coefficient: 0.95
- Structural number: 2.06

Based on the above parameters, 153,900 equivalent single-axle loads (ESALs) can be applied to a flexible pavement section consisting of 3 inches HMA over 6 inches CS over compacted soil subgrade, or *gneiss*, before exceeding the pavement lifespan.

The recommended minimum flexible pavement section and materials are summarized in the table below.

**Table 3. Flexible Pavement Compaction and Recommended Materials Summary**

Layer	Compaction	Recommended Material Specification
3 inches HMA	92% TM	WSDOT SS, Section 9-03.8(6) HMA Proportions of Materials
6 inches CS	95% MDUW	WSDOT SS, Section 9-03.9(3) Crushed Surfacing
Compacted Soil Subgrade	95% MDUW	Silty, clayey sand or embankment fill, scarified to a minimum depth of 12 inches, moisture-conditioned, and compacted to 95% or greater of MDUW
Gneiss Subgrade	NA	Solid, intact rock where subgrade surface is free of loosened oversize particles

TM = Theoretical Maximum Unit Weight  
 NA = Not Applicable

Where *silty, clayey sand* is exposed in pavement subgrades, we recommend installing a layer of

nonwoven stabilization geotextile between gravel base materials and *silty, clayey sand* that meets or exceeds the parameters listed in *WSDOT SS, Section 9-33.2(1), Table 3, Geotextile for Soil Stabilization*.

Use of a thinner flexible pavement section may be feasible if COLL officials determine that deviation from pavement design standards is acceptable. For example, the *Metropolitan Government Pavement Engineers Council (MGPEC) Pavement Design Standards, Chapter 4.1, Section H* provides an equation<sup>3</sup> to estimate 20-year total design ESALs for residential streets which yielded a result of 63,040 ESALs in this case. Based on the same parameters above, a flexible pavement section consisting of 2.5 inches of HMA over 6 inches of CS over compacted soil subgrade, or *gneiss*, would support a total design-life traffic load of 80,900 ESALs.

We recommend crack maintenance regularly to reduce surface water infiltration. Surface and subgrade drainage are critical to the performance of the pavement section.

### ***Stormwater Drainage Considerations***

Surfaces should be graded such that runoff is not allowed to accumulate near structures and pavements.

As previously stated, rapid subsurface infiltration of stormwater runoff is not considered feasible. We recommend directing stormwater runoff to catch basins and conveying it through tightline systems to existing downgradient stormwater drainage structures, as currently proposed. It may be feasible to incorporate evaporation and/or detention ponds into the proposed design to aid in flow control and filter sediment and pollutants. In the event this method for stormwater treatment becomes desirable, we recommend following procedures described in the *Stormwater Management Manual for Eastern Washington (SMMEW), Chapter 6*, for designing such facilities.

### ***Additional Services***

Effective geotechnical services involve cooperation with the owner, designer, and constructor as follows:

1. Preliminary study to assist in planning and to economically adapt the project to its geologic environment.
2. Soil exploration and analysis to characterize subsurface conditions and recommend design criteria.
3. Consultation with the designer to adapt the specific design to the site in accordance with the recommendations.
4. Construction observation to verify the conditions encountered and to make recommendations for modifications as necessary.
5. Construction material testing, quality control, and special inspection.

This report satisfies Items 1 and 2 of the 5-phase endeavor. We are eager to provide assistance with design and construction as appropriate to assist in completing a safe and economical project.

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<sup>3</sup>  $ESAL_{20} = 62,000 + 80(R)$  where R is the number of dwellings (13) serviced by the street.

## **FIELD EXPLORATION**

The fieldwork was conducted by staff geologists Logan Long, GIT, Kaila Savage, and Travis Stevens under the supervision of geotechnical engineer John Finnegan, PE, on February 5 and 6, 2025. The field activities generally consisted of the following:

- Reconnaissance of the site and surrounding area;
- Logging subsurface conditions in 6 test pits and 4 probe borings;
- Recording video footage of bore hole walls utilizing a down-hole camera;
- Advancing 7 Kessler® DCP soundings; and,
- Obtaining bulk samples of encountered materials.

Results are presented in *Figures*.

### **DCP Testing**

Subgrade strength was estimated with a series of DCP tests utilizing a Kessler® DCP which consists of a 17.6-pound slide hammer and rods with 2-inch graduations. The hammer is manually lifted and allowed to fall from a fixed height. Kessler® DCP test results can be correlated to CBR values for estimating relative soil strength for pavement design. The results of DCP penetration per 1-inch intervals are presented in *Figures*.

### **Test Pits**

Test pits were excavated utilizing a track-mounted Komatsu PC490 equipped with a 48-inch, toothed bucket. The total depth to which test pits were excavated was controlled by the limited boom and arm reach of the excavator or digging refusal on strong *gneiss*.

### **Probe Borings**

Probe borings were advanced using a Furukawa HCR900 track-mounted rock drill utilizing a 4-inch-diameter button bit as identified in the *Probe Logs*. Key parameters monitored during drilling – to differentiate soils from rock and estimate relative rock strengths – were whether or not percussion hammering was needed to continuously advance the drill bit and the rates at which borings were advanced. The probe boring system of drilling does not provide typical soil or rock samples. Therefore, characterization of the encountered materials is based on advancement rates and observation of pulverized cuttings. This method of drilling was used due to its similarity with construction methods for rock blasting and thus provides a common method of evaluating excavation characteristics.

Prior to backfilling the boreholes, a GeoVISION™ Dual-Scan camera was used to view and record conditions of the boring walls. The camera system is equipped with two lenses: one to view directly down hole and another to view the boring wall.

### **Soil Samples**

Representative samples of the encountered soils were obtained by collecting material directly from within excavations while 4 feet or less below grade, or by collecting material from the bucket of the excavator.

### **Soil and Rock Classification**

Field descriptions of soils and rock were completed in accordance with the current version of the

Washington State Department of Transportation, *Geotechnical Design Manual* (GDM), M 46-03, except that fines (silt and clay) were described in accordance with ASTM D 2487. *Whereas, the GDM uses the terms ‘silty’ and ‘clayey’ to describe a very broad range of fines from 10 to 49 percent; ASTM D 2487 uses those terms for percentages greater than 12 and the term ‘with’ for fines ranging from 5 to 12 percent, which is typically necessary to describe variations relevant to soil permeability per the SRSM.* A key to the descriptions is provided in *Guide to Soil and Rock Descriptions*.

### ***Location***

**Horizontal & vertical control.** The *Site Plan* was reproduced from plans provided by WCE and is based on measured offsets from existing surface features during the time field work was conducted. Elevations presented in the *Logs* were interpreted from contour intervals shown on the provided plans. Horizontal and vertical locations can be considered accurate to within 5- and 1-foot vertical, respectively, relative to information provided.

## ***LABORATORY ANALYSIS***

Laboratory testing was performed on representative samples of the soils encountered to provide data used in our assessment of soil characteristics.

Tests were conducted, where practical, in accordance with nationally recognized standards (ASTM, AASHTO, etc.), which are intended to model in-situ soil conditions and behavior. The results are presented in *Figures*.

### ***Index Parameters***

**Moisture content – ASTM D2216.** Moisture contents were determined by direct weight proportion (weight of water/weight of dry soil) determined by drying soil samples in an oven until reaching constant weight.

**Gradation – ASTM D6913.** Gradation analysis was performed by the mechanical sieve method. The mechanical sieve method is utilized to determine particle size distribution based upon the dry weight of sample passing through sieves of varying mesh sizes. The results of gradation are provided in *Grain Size Distribution Results*.

**Atterberg Limits – ASTM D4318.** Atterberg limits describe the properties of the fine-grained constituents of soils by relating the water content to the plastic and liquid limits of engineering behavior. As the water content increases, the state of the soil changes from a brittle solid, to a plastic solid, and then to a viscous liquid.

The liquid limit (LL) is the water content above which the soil tends to behave as a viscous liquid. Similarly, the plastic limit (PL) is defined as the water content below which the soil tends to behave as a brittle solid. The plasticity index describes the range of water content over which a soil is plastic and is derived by subtracting the PL from the LL. The soil is classified as “non-plastic” if rolling a 1/8-inch bead is not possible at any water content.

### ***Chemical Parameters***

**pH – AASHTO T289.** The quantified measurement of soil pH (acidity = pH <7) and minimum resistivity are useful variables in determining the potential corrosivity of the soil. Certain clayey soils contain excess acidity that attacks concrete, iron, and buried utilities.

**Organic Content – ASTM D2974.** Organic content is determined by measuring weight loss after subjecting an appropriate mass of soil to burning off organic matter in an ignition muffle furnace. The loss is recorded as a percentage of the dry soil content.

**Cation Exchange Capacity (CEC) – EPA 9081.** Method 9081 is applicable to most soils, including calcareous and noncalcareous soils. The method of cation-exchange capacity by summation should be employed for distinctly acid soils. The soil sample is mixed with an excess of sodium acetate solution, resulting in an exchange of the added sodium cations for the matrix cations. The concentration of displaced sodium is then determined by atomic absorption, emission spectroscopy, or an equivalent means. The results are presented as milliequivalents per 100 grams (meq/100g).

### ***LIMITATIONS***

The conclusions and recommendations presented herein are based upon the results of field explorations and laboratory testing results. They are predicated upon our understanding of the project, its design, and its location as defined by the client. We endeavored to conduct this study in accordance with generally accepted geotechnical engineering practices in this area.

This report presents our professional interpretation of exploration data developed, which we believe meets the standards of the geotechnical profession in this area; we make no other warranties, express or implied. Attached is a document titled “*Important Information About Your Geotechnical Engineering Report*,” which we recommend you review carefully to better understand the context within which these services were completed.

Unless test locations are specified by others or limited by accessibility, the scope of analysis is intended to develop data from a representative portion of the site. However, the areas tested are discrete. Interpolation between these discrete locations is made for illustrative purposes only but should be expected to vary. If a greater level of detail is desired, the client should request an increased scope of exploration.

### ***REFERENCES***

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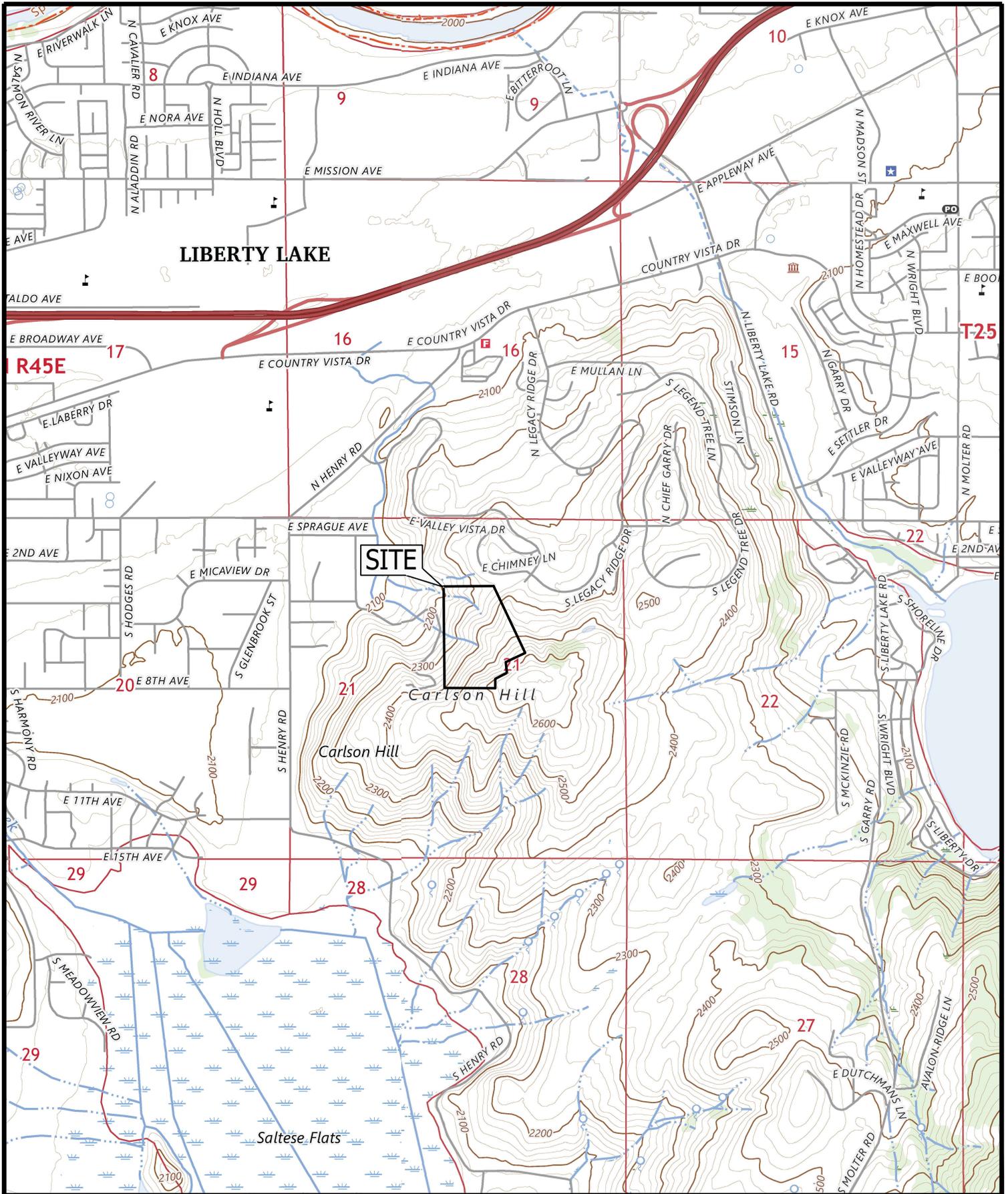
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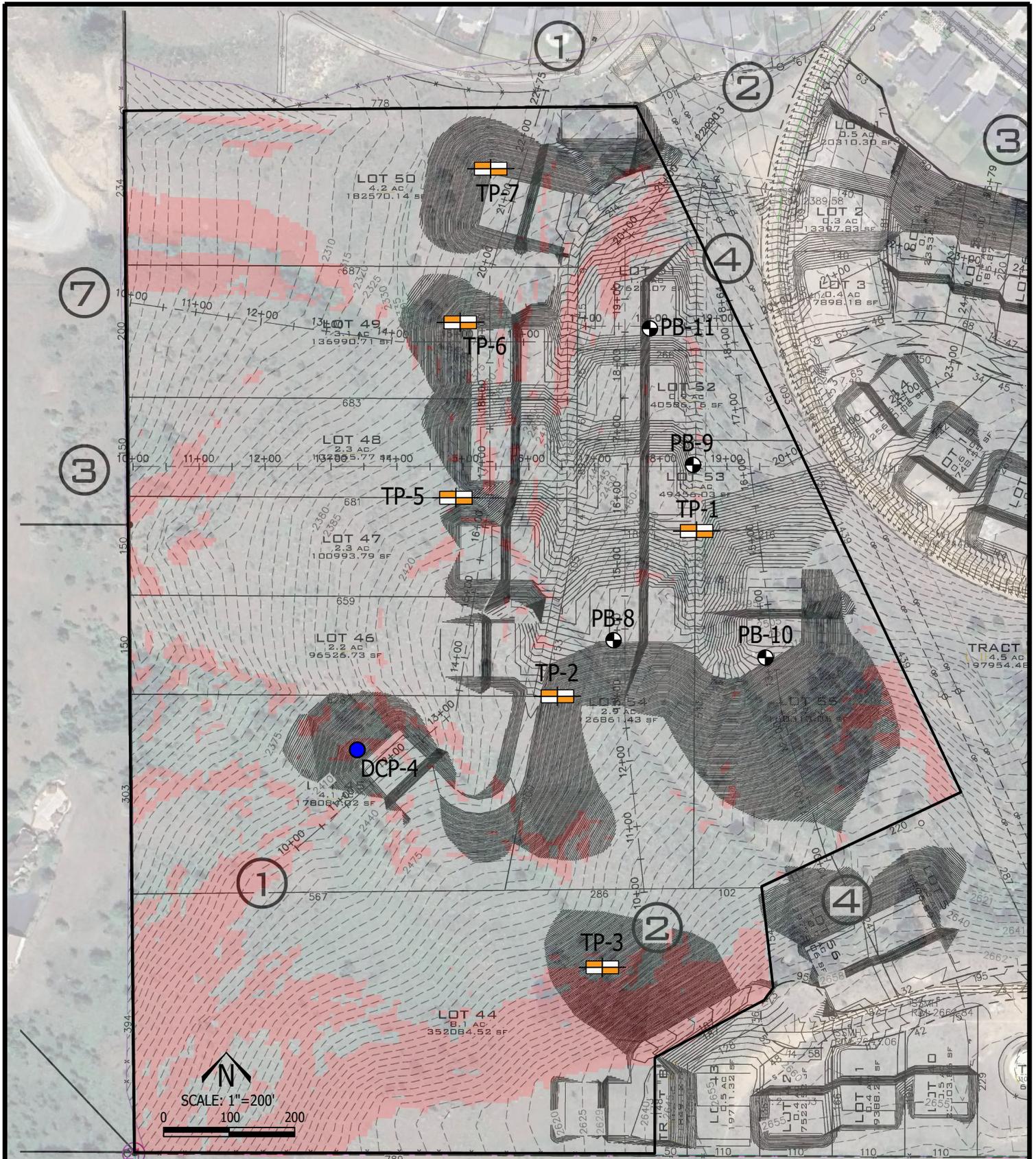


  
 SCALE: 1"=2000'  
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 SECTION 21  
 T 25 N R 45 E  
 USGS 2023


 Budinger  
 & Associates

VICINITY MAP  
 LEGACY PHASE F  
 LIBERTY LAKE, WASHINGTON

FIGURE 1  
 PROJECT NUMBER S241121  
 DATE: 2/2025



BASE PLAN PROVIDED BY WCE (DATED 7/17/2024)  
 SATELLITE IMAGERY PROVIDED BY GOOGLE EARTH (DATED 5/12/2024)

-  PROBE BORING LOCATION (PB-8)
  -  TEST PIT LOCATION (TP-1)
  -  DYNAMIC CONE PENETROMETER LOCATION (DCP-4)
- AREAS LIGHTLY SHADED RED INDICATE SLOPES 40 PERCENT OR GREATER

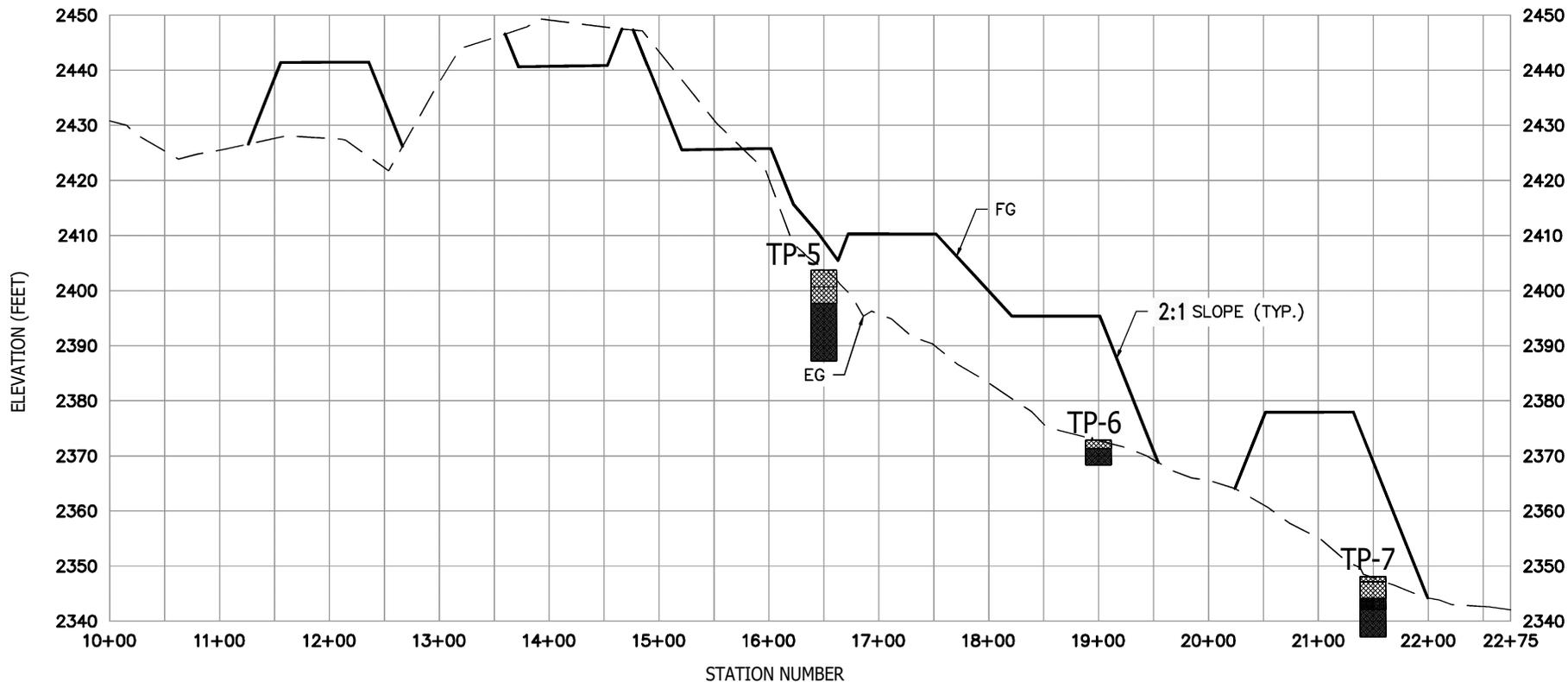
 **Budinger & Associates**

**SITE PLAN**

LEGACY PHASE F  
 LIBERTY LAKE, WASHINGTON

**FIGURE 2-1**

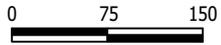
PROJECT NUMBER S241121  
 DATE: 2/2025



LITHOLOGY GRAPHICS

-  TOPSOIL
-  SILTY SAND
-  EXISTING FILL
-  GNEISS

HORIZONTAL SCALE: 1"=150'



VERTICAL EXAGGERATION 5X



Budinger & Associates

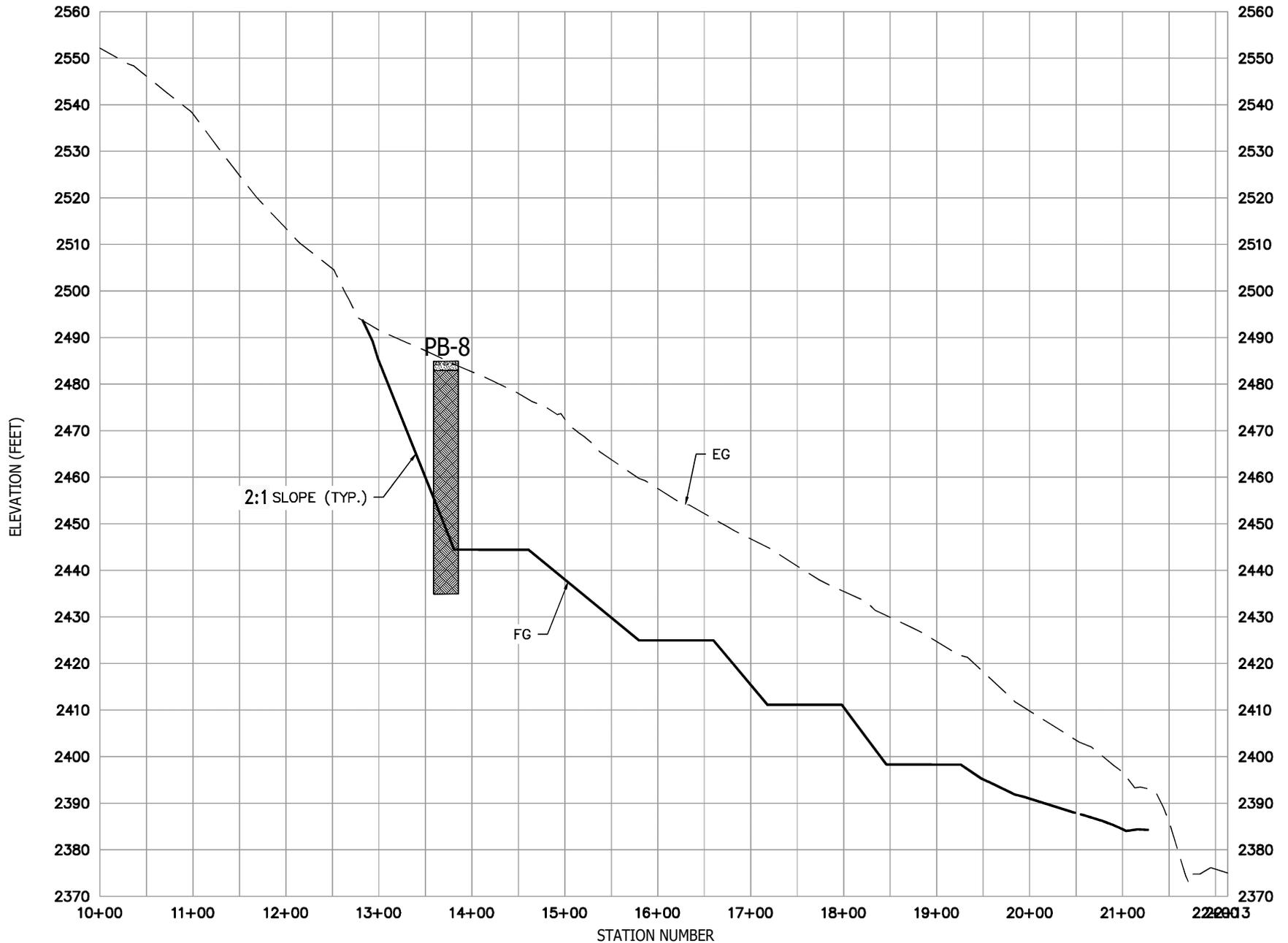
PROFILE SECTION 1

LEGACY PHASE F  
LIBERTY LAKE, WASHINGTON  
BASED ON PLANS PROVIDED BY WCE (DATED 7/17/2024)

FIGURE 2-2

PROJECT NUMBER S241121

DATE: 2/2025



LITHOLOGY GRAPHICS



TOPSOIL



GNEISS

HORIZONTAL SCALE: 1"=150'



VERTICAL EXAGGERATION 5X



Budinger & Associates

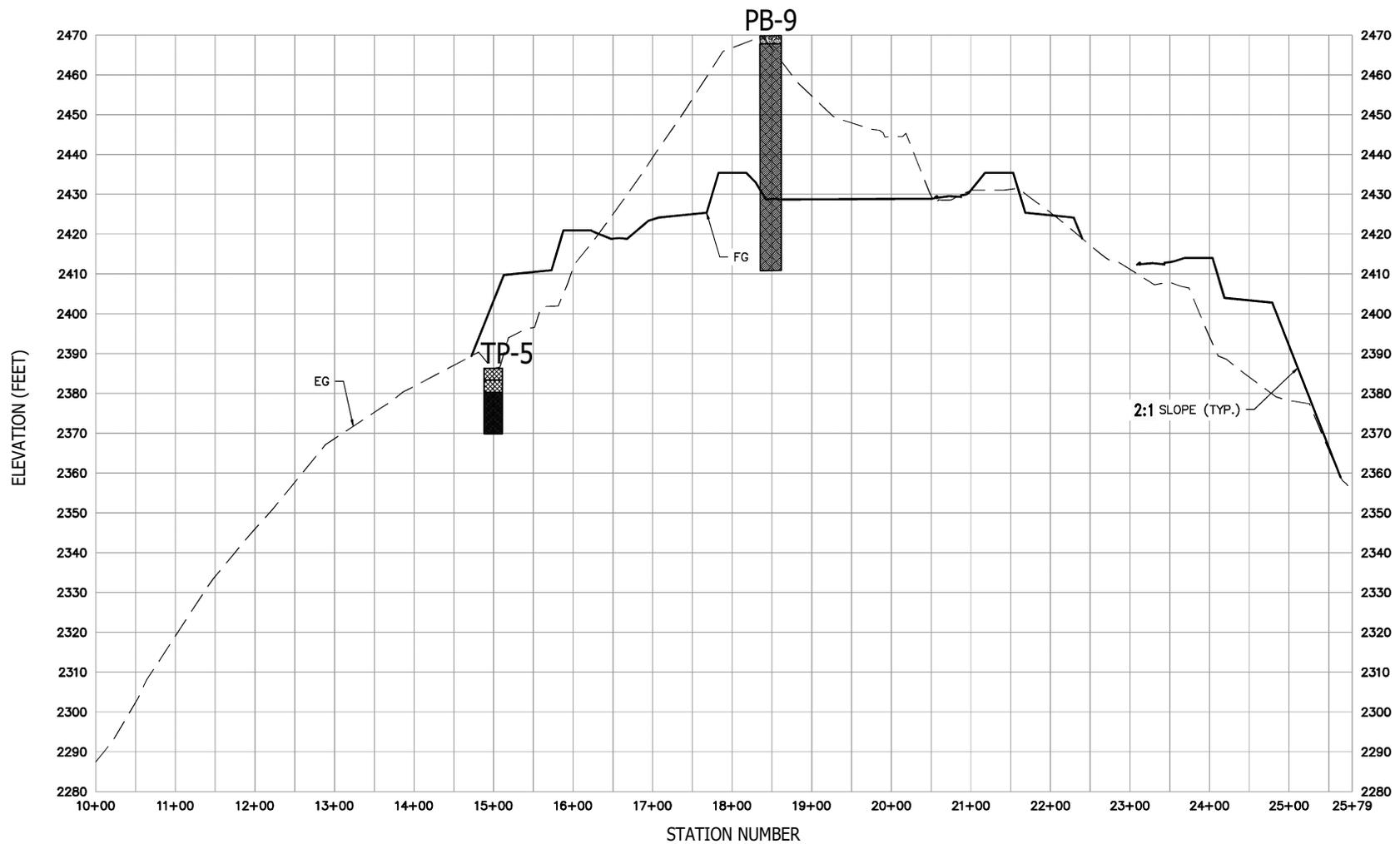
PROFILE SECTION 2

LEGACY PHASE F  
LIBERTY LAKE, WASHINGTON  
BASED ON PLANS PROVIDED BY WCE (DATED 7/17/2024)

FIGURE 2-3

PROJECT NUMBER S241121

DATE: 2/2025



LITHOLOGY GRAPHICS



TOPSOIL

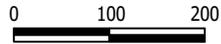


EXISTING FILL



GNEISS

HORIZONTAL SCALE: 1"=200'



VERTICAL EXAGGERATION 5X



Budinger & Associates

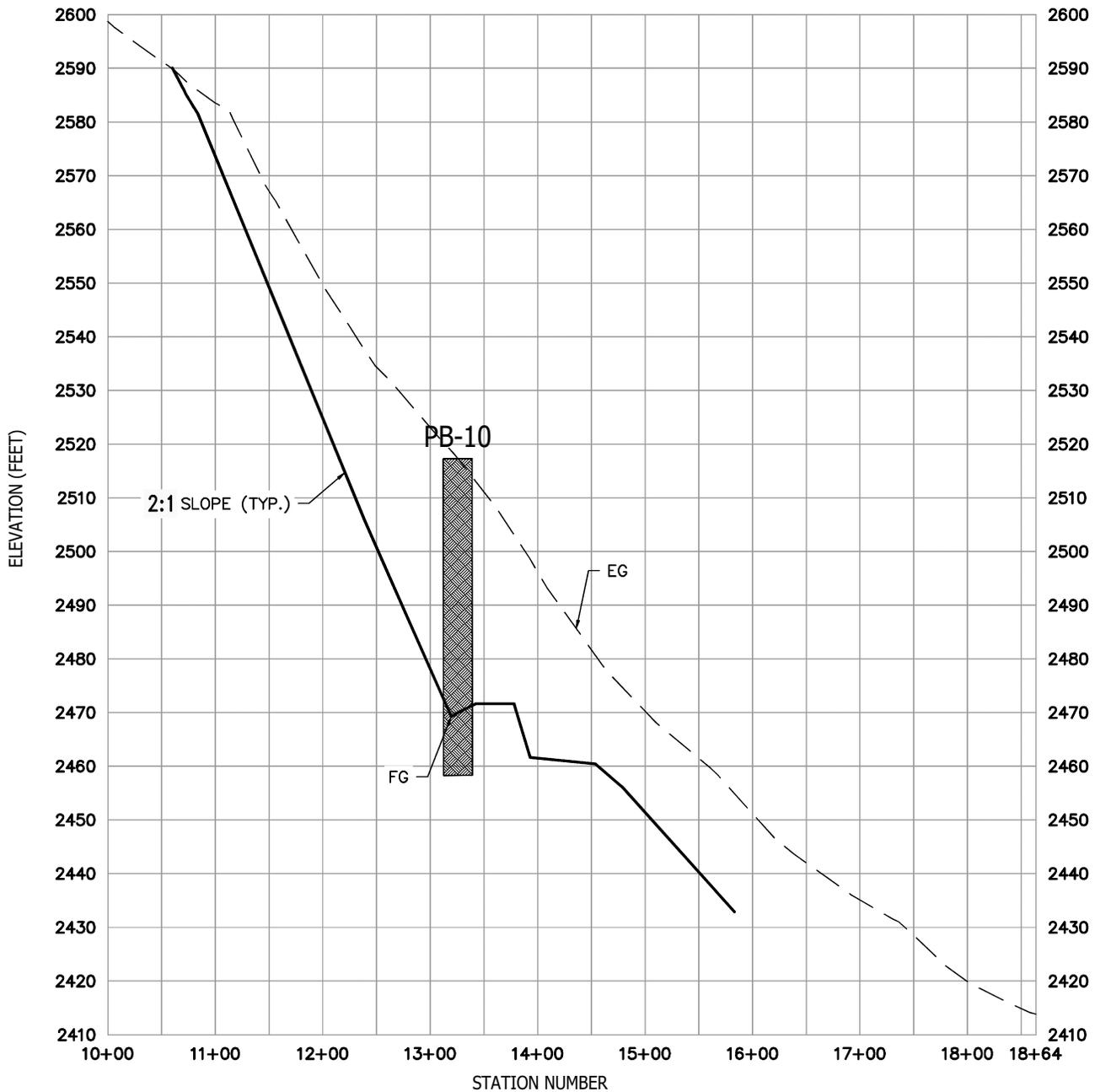
PROFILE SECTION 3

LEGACY PHASE F  
LIBERTY LAKE, WASHINGTON  
BASED ON PLANS PROVIDED BY WCE (DATED 7/17/2024)

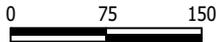
FIGURE 2-4

PROJECT NUMBER S241121

DATE: 2/2025



HORIZONTAL SCALE: 1"=150'



VERTICAL EXAGGERATION 5X

LITHOLOGY GRAPHIC



GNEISS



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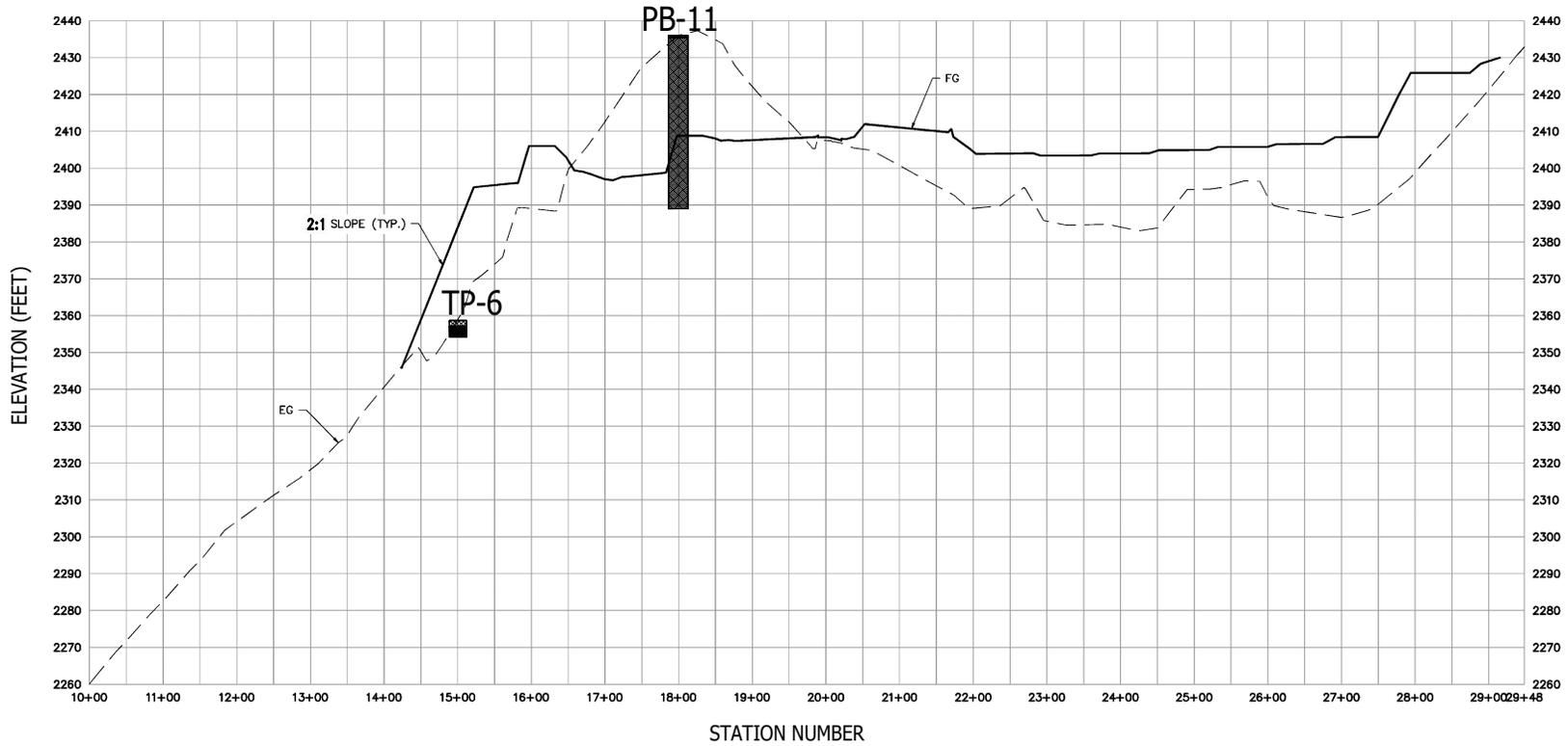
PROFILE SECTION 4

LEGACY PHASE F  
LIBERTY LAKE, WASHINGTON  
BASED ON PLANS PROVIDED BY WCE (DATED 7/17/2024)

FIGURE 2-5

PROJECT NUMBER S241121

DATE: 2/2025



LITHOLOGY GRAPHICS



TOPSOIL

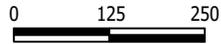


EXISTING FILL



GNEISS

HORIZONTAL SCALE: 1"=250'



VERTICAL EXAGGERATION 5X



Budinger & Associates

PROFILE SECTION 7

LEGACY PHASE F  
LIBERTY LAKE, WASHINGTON  
BASED ON PLANS PROVIDED BY WCE (DATED 7/17/2024)

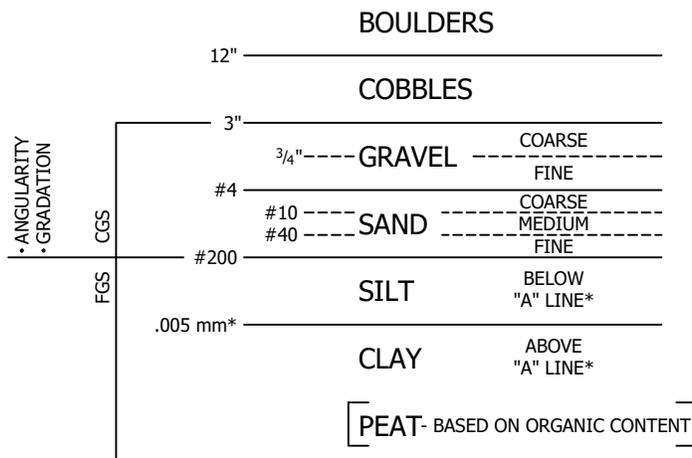
FIGURE 2-6

PROJECT NUMBER S241121

DATE: 2/2025

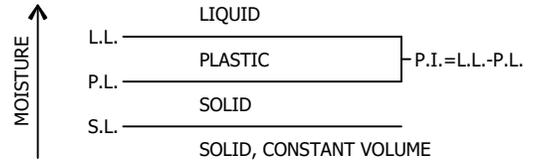
# GUIDE TO SOIL & ROCK DESCRIPTIONS

## SOIL CLASSIFICATION

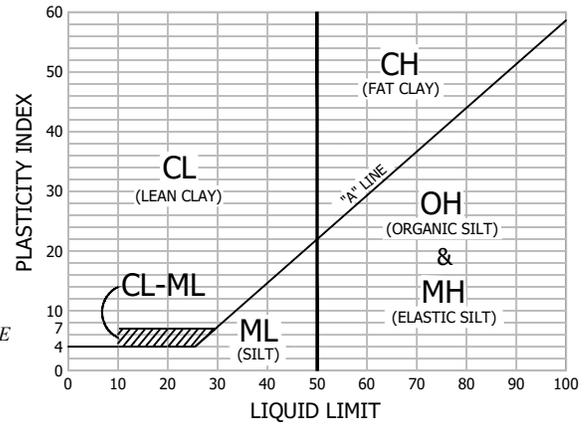


\* SEE PLASTICITY CHART  
 CGS - COARSE GRAINED SOIL - MORE THAN 50% RETAINED ON A #200 SIEVE  
 FGS - FINE GRAINED SOIL - 50% MORE PASSES, #200 SIEVE  
 FINES - PORTION FINER THAN #200 SIEVE

## ATTERBERG LIMITS



## PLASTICITY CHART



NOTE - CHART APPLIES TO FGS AND MINUS #40 SIEVE FRACTION OF CGS

## GUIDE TO SOIL DESCRIPTION MODIFIERS, MOISTURE, AND CONDITION PRESENTED ON LOGS

MODIFIER	ESTIMATED PERCENTAGE OF MATERIAL	MOISTURE	SOIL CONDITION
SUFFIX "LY" OR "Y" .....	30% OR MORE FOR COARSE PARTS IN FGS GREATER THAN 12% FOR FINES IN CGS	DRY	CGS:
WITH .....	15% - 29% FOR COARSE PARTS IN FGS 5% - 12% FOR FINES IN CGS	MOIST	VERY LOOSE
		SATURATED OR WET	LOOSE
			MEDIUM DENSE
			DENSE
			VERY DENSE
			FGS:
			VERY SOFT
			SOFT
			MEDIUM STIFF
			STIFF
			VERY STIFF
			HARD

NOTE - VISUAL ESTIMATES OF MATERIAL PERCENTAGES TYPICALLY VARY 0 TO 10% FROM THOSE DETERMINED BY LABORATORY TESTING.

### SAMPLES

- 
- 
- 
- 
- 
- 
- 
- 
- R REFUSAL OF SAMPLE (50+ BLOWS PER 6")

### ROCK WEATHERING

- FRESH
- SLIGHTLY WEATHERED
- MODERATELY WEATHERED
- HIGHLY WEATHERED
- COMPLETELY WEATHERED
- RESIDUAL SOIL

### ROCK CONDITION

- EXTREMELY WEAK
- VERY WEAK
- MODERATELY WEAK
- MODERATELY STRONG
- STRONG
- VERY STRONG



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FIGURE 3

## TEST PIT 1

**Date:** 2-5-25  
**Excavator:** Copenhaver Construction, Inc  
**Equipment:** Komatsu PC 490 LC w/48" bucket  
**Location:** Section Line 4 - STA 15+25; 90 feet Left  
**Surface:** snow, grass and weeds

**Elevation:** 2475 ft  
**Logged by:** L. Long  
**Size of hole:** 8 x 24 feet

TEST RESULTS														
DEPTH	SAMPLES	MOISTURE, COLOR, CONDITION	DESCRIPTION	SOIL LOG	ATTERBERG LIMITS									
					WATER CONTENT ○									
					10	20	30	40	50	60	70	80	90	
0		moist, dark brown	SILTY SAND, with Gravel and Cobbles, coarse to fine, subangular, organics as fine roots, 6 inches of frozen soil (topsoil)		○									
		moist, orangish brown												
		tanish brown to orangish white	SILTY, CLAYEY SAND with Gravel and Cobbles, occasional Boulders, coarse to fine, angular to subangular, organics as fine roots											
5			GNEISS, highly weathered, very weak to moderately weak rock (R1-R2), characteristics are similar to Sand and Gravel with Silt upon excavation											
10					○									
15														
20		orangish white	becoming moderately to slightly weathered, moderately strong to strong (R3-R4), characteristics are similar to Gravel with Silt, Sand, and Cobbles upon excavation  (maximum digging reach)											
25		no free groundwater observed	End of Excavation @ 23 ft											
30														



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### TEST PIT LOGS

### FIGURE 4-1

**Project:** Legacy Phase F  
**Location:** Liberty Lake, WA  
**Number:** S241121

## TEST PIT 2

**Date:** 2-5-25  
**Excavator:** Copenhaver Construction, Inc  
**Equipment:** Komatsu PC 490 LC w/48" bucket  
**Location:** Section Line 2 - STA 13+00; 100 feet Left  
**Surface:** snow, grass and weeds

**Elevation:** 2476 ft  
**Logged by:** L. Long  
**Size of hole:** 7 x 20 feet

					TEST RESULTS									
DEPTH	SAMPLES	MOISTURE, COLOR, CONDITION	DESCRIPTION	SOIL LOG	ATTERBERG LIMITS									
					WATER CONTENT									
0					10	20	30	40	50	60	70	80	90	
	1	moist, dark brown	SILTY SAND with Gravel, coarse to fine, subangular, organics as fine roots, 4 inches of frozen soil (topsoil)											
	2	moist, orangish brown	SILTY, CLAYEY SAND with Gravel, coarse to fine, angular to subangular, organics as fine roots											
	3	orangish brown to tanish orange												
5		orangish white	GNEISS, highly weathered, very weak to moderately weak rock (R1-R2), characteristics are similar to Sand and Gravel with Silt upon excavation becoming moderately to slightly weathered, moderately strong to strong (R3-R4), characteristics are similar to Gravel with Silt, Sand, and Cobbles upon excavation (digging refusal on stronger Gneiss)											
10		no free groundwater observed	End of Excavation @ 9 ft											
15														
20														
25														
30														



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### TEST PIT LOGS

### FIGURE 4-2

**Project:** Legacy Phase F  
**Location:** Liberty Lake, WA  
**Number:** S241121

### TEST PIT 3

**Date:** 2-5-25  
**Excavator:** Copenhagen Construction, Inc  
**Equipment:** Komatsu PC 490 LC w/48" bucket  
**Location:** Proposed Lot 44; central portion of east half  
**Surface:** snow, grass and weeds

**Elevation:** 2560 ft  
**Logged by:** L. Long  
**Size of hole:** 7 x 24 feet

					TEST RESULTS								
DEPTH	SAMPLES	MOISTURE, COLOR, CONDITION	DESCRIPTION	SOIL LOG	ATTERBERG LIMITS								
					WATER CONTENT ○								
0					10	20	30	40	50	60	70	80	90
0	1	moist, dark brown	SILTY SAND with Gravel, coarse to fine, subangular, organics as fine roots, 4 inches of frozen soil (topsoil)										
0	2	moist, orangish brown	SILTY, CLAYEY SAND with Gravel, coarse to fine, angular to subangular, organics as fine roots										
5	3	orangish brown to tanish orange	GNEISS, highly weathered, very weak to moderately weak rock (R1-R2), characteristics are similar to Sand and Gravel with Silt upon excavation										
10													
15	4	orangish brown to greenish gray											
20													
25	5	orangish white	becoming moderately to slightly weathered, moderately strong to strong (R3-R4), characteristics are similar to Gravel with Silt, Sand, and Cobbles upon excavation  (maximum digging reach)										
25		no free groundwater observed	End of Excavation @ 25 ft										
30													



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### TEST PIT LOGS

### FIGURE 4-3

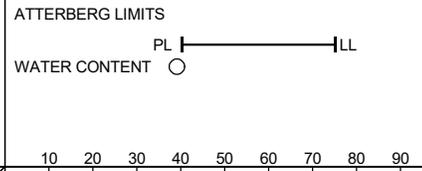
Project: Legacy Phase F  
 Location: Liberty Lake, WA  
 Number: S241121

## TEST PIT 5

**Date:** 2-5-25  
**Excavator:** Copenhaver Construction, Inc  
**Equipment:** Komatsu PC 490 LC w/48" bucket  
**Location:** Section Line 3 - STA 15+00; 50 feet Right  
**Surface:** snow, grass and weeds

**Elevation:** 2405 ft  
**Logged by:** L. Long  
**Size of hole:** 7 x 20 feet

### TEST RESULTS



DEPTH	SAMPLES	MOISTURE, COLOR, CONDITION	DESCRIPTION	SOIL LOG	TEST RESULTS									
0					10	20	30	40	50	60	70	80	90	
		moist, dark to moderate brown	GRAVEL with Sand and Cobbles, coarse to fine, angular to subrounded, organics as fine roots, 9 inches of frozen soil (existing fill)											
		moist, dark to moderate brown	SILTY GRAVEL with Sand and Cobbles, coarse to fine, angular to subangular (existing fill)											
5														
		orangish brown to tanish orange	GNEISS, highly weathered, very weak to moderately weak rock (R1-R2), characteristics are similar to Sand and Gravel with Silt upon excavation											
10														
		orangish white	becoming moderately to slightly weathered, moderately strong to strong (R3-R4), characteristics are similar to Gravel with Silt, Sand, and Cobbles upon excavation (digging refusal on stronger Gneiss)											
15														
		no free groundwater observed	End of Excavation @ 16.5 ft											
20														
25														
30														



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### TEST PIT LOGS

### FIGURE 4-4

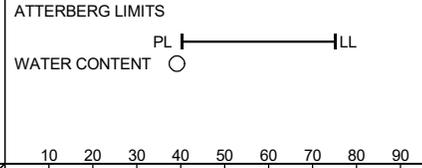
Project: Legacy Phase F  
 Location: Liberty Lake, WA  
 Number: S241121

## TEST PIT 6

**Date:** 2-5-25  
**Excavator:** Copenhaver Construction, Inc  
**Equipment:** Komatsu PC 490 LC w/48" bucket  
**Location:** Section Line 7 - STA 15+00; 30 feet Left  
**Surface:** snow, grass and weeds

**Elevation:** 2360 ft  
**Logged by:** L. Long  
**Size of hole:** 7 x 20 feet

### TEST RESULTS



DEPTH	SAMPLES	MOISTURE, COLOR, CONDITION	DESCRIPTION	SOIL LOG	TEST RESULTS
0					10 20 30 40 50 60 70 80 90
	1	moist, dark brown	SILTY SAND with Gravel and Cobbles, coarse to fine, subangular, organics as fine roots, 9 inches of frozen soil (existing fill)		
	2	tanish orange	GNEISS, moderately to slightly weathered, moderately strong to strong rock (R3-R4), characteristics are similar to Gravel with Silt, Sand, and Cobbles upon excavation (digging refusal on stronger Gneiss)		
5		no free groundwater observed	End of Excavation @ 4.5 ft		
10					
15					
20					
25					
30					



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### TEST PIT LOGS

### FIGURE 4-5

Project: Legacy Phase F  
 Location: Liberty Lake, WA  
 Number: S241121

## TEST PIT 7

**Date:** 2-5-25  
**Excavator:** Copenhaver Construction, Inc  
**Equipment:** Komatsu PC 490 LC w/48" bucket  
**Location:** Section Line 1 - STA 21+50; 45 feet Left  
**Surface:** snow, grass and weeds

**Elevation:** 2350 ft  
**Logged by:** L. Long  
**Size of hole:** 7 x 23 feet

				TEST RESULTS									
DEPTH	SAMPLES	MOISTURE, COLOR, CONDITION	DESCRIPTION	SOIL LOG	ATTERBERG LIMITS								
					PL	LL							
					WATER CONTENT ○								
					10	20	30	40	50	60	70	80	90
0		moist, gray	GRAVEL with Silt and Sand, medium to fine, subrounded, 9 inches of frozen soil (existing fill)										
		moist, dark brown to orangish brown	SILTY, CLAYEY SAND with Gravel, Cobbles and Boulders, coarse to fine, angular to subangular, possible re-worked native soil (existing fill)		○	H							
		moist, orangish brown	SILTY, CLAYEY SAND with Gravel, coarse to fine, angular to subangular, occasional Cobbles										
5		orangish brown to tanish orange	GNEISS, highly weathered, very weak to moderately weak rock (R1-R2), characteristics are similar to Sand and Gravel with Silt upon excavation										
		dark tanish orange	becoming moderately to slightly weathered, moderately strong to strong (R3-R4), characteristics are similar to Gravel with Silt, Sand, and Cobbles upon excavation (digging refusal on stronger Gneiss)										
		no free groundwater observed	End of Excavation @ 11 ft										
10													
15													
20													
25													
30													



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### TEST PIT LOGS

### FIGURE 4-6

**Project:** Legacy Phase F  
**Location:** Liberty Lake, WA  
**Number:** S241121

**PROBE BORING 8**

**Date of Boring:** 2-6-25  
**Driller:** McCallum Rock Drilling  
**Type of Drill:** Furukawa HCR900  
**Location:** Section Line 2 - STA 13+75; 20 feet Left  
**Surface:** snow, grass and weeds

**Elevation:** 2480  
**Logged by:** K. Savage  
**Size of hole:** 4-inch-diameter button bit

DEPTH SAMPLES (% RECOVERY)	MOISTURE, COLOR, CONDITION  <i>(Note: if soil/rock is not highly permeable, determination of depth to groundwater may not be possible )</i>	DESCRIPTION  <i>(Note: descriptions from probe borings are approximate - based only on advancement rate &amp; view of pulverized cuttings)</i>	SOIL LOG	ADVANCEMENT RATE
0				
5	dark brown	SILTY SAND with Gravel (topsoil)		
10		GNEISS, highly to slightly weathered, very weak to moderately strong rock (R1-R3) (hammer percussion required 2 to 4 feet)		2 to 11 feet: 2 minutes, 10 seconds
15		(hammer percussion required 11 to 16 feet)		
20		(hammer percussion required 19 to 23 feet)		
25		(hammer percussion required 23 to 35 feet)		
30		(hammer percussion required 23 to 35 feet)		11 to 23 feet: 3 minutes, 50 seconds
35		(hammer percussion required 23 to 35 feet)		23 to 35 feet: 2 minutes, 48 seconds
40		(hammer percussion required 35 to 47 feet)		
45		(hammer percussion required 35 to 47 feet)		
50		(hammer percussion required 35 to 47 feet)		35 to 47 feet: 2 minutes, 50 seconds
		End of Boring @ 50 ft		
55				
60				
65				

LOGS - ADVANCEMENT S241121.GPJ GINT STD US.GDT 2/20/25



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**PROBE LOGS**

**FIGURE 4-7**

Project: Legacy Phase F  
 Location: Liberty Lake, WA  
 Number: S241121

## PROBE BORING 9

**Date of Boring:** 2-6-25  
**Driller:** McCallum Rock Drilling  
**Type of Drill:** Furukawa HCR900  
**Location:** Section Line 3 - STA 18+50  
**Surface:** snow, grass and weeds

**Elevation:** 2465  
**Logged by:** K. Savage  
**Size of hole:** 4-inch-diameter button bit

DEPTH	SAMPLES (% RECOVERY)	MOISTURE, COLOR, CONDITION <small>(Note: if soil/rock is not highly permeable, determination of depth to groundwater may not be possible)</small>	DESCRIPTION <small>(Note: descriptions from probe borings are approximate - based only on advancement rate &amp; view of pulverized cuttings)</small>	SOIL LOG	ADVANCEMENT RATE
0		dark brown	SILTY SAND with Gravel (topsoil)		
5			GNEISS, highly to slightly weathered, very weak to moderately strong rock (R1-R3)		
10			Driller reports "really hard rock" from 6 to 7 feet		
15			(hammer percussion required 11 to 13 feet)		2 to 11 feet: 3 minutes, 49 seconds
20			(hammer percussion required 14 to 23 feet)		
25			(hammer percussion required 23 to 28 feet)		11 to 23 feet: 3 minutes, 58 seconds
30			(hammer percussion required 30 to 35 feet)		
35			(hammer percussion required 35 to 47 feet)		23 to 35 feet: 3 minutes, 45 seconds
40			(hammer percussion required 47 to 59 feet)		
45			Driller reports rock is "a little harder" from 47 to 59 feet		35 to 47 feet: 3 minutes, 55 seconds
50			(hammer percussion required 47 to 59 feet)		
55					47 to 59 feet: 4 minutes, 01 second
60			End of Boring @ 59 ft		
65					

LOGS - ADVANCEMENT S241121.GPJ GINT STD US.GDT 2/20/25



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### PROBE LOGS

### FIGURE 4-8

Project: Legacy Phase F  
 Location: Liberty Lake, WA  
 Number: S241121

**PROBE BORING 10**

**Date of Boring:** 2-6-25  
**Driller:** McCallum Rock Drilling  
**Type of Drill:** Furukawa HCR900  
**Location:** Section Line 4 - STA 13+25  
**Surface:** snow, grass and weeds

**Elevation:** 2520  
**Logged by:** K. Savage  
**Size of hole:** 4-inch-diameter button bit

DEPTH SAMPLES (% RECOVERY)	MOISTURE, COLOR, CONDITION  <i>(Note: if soil/rock is not highly permeable, determination of depth to groundwater may not be possible )</i>	DESCRIPTION  <i>(Note: descriptions from probe borings are approximate - based only on advancement rate &amp; view of pulverized cuttings)</i>	SOIL LOG	ADVANCEMENT RATE
0				
5		GNEISS, highly to slightly weathered, very weak to moderately strong rock (R1-R3)  (hammer percussion required 0 to 7 feet)		0 to 11 feet: 2 minutes, 59 seconds
10				
15		(hammer percussion required 12 to 21 feet)		
20				
25				
30		(hammer percussion required 25 to 35 feet)		11 to 23 feet: 4 minutes, 9 seconds
35				
40		(hammer percussion required 35 to 47 feet)		
45				
50		(hammer percussion required 47 to 59 feet)		
55		Driller reports "harder rock" beginning at 55 feet		
60		End of Boring @ 59 ft		35 to 47 feet: 3 minutes, 11 seconds
65				47 to 59 feet: 3 minutes, 45 seconds

LOGS - ADVANCEMENT S241121.GPJ GINT STD.US.GDT 2/20/25



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**PROBE LOGS**

**FIGURE 4-9**

Project: Legacy Phase F  
 Location: Liberty Lake, WA  
 Number: S241121

**PROBE BORING 11**

**Date of Boring:** 2-6-25  
**Driller:** McCallum Rock Drilling  
**Type of Drill:** Furukawa HCR900  
**Location:** Section Line 7 - STA 18+00  
**Surface:** snow, grass and weeds

**Elevation:** 2435  
**Logged by:** K. Savage  
**Size of hole:** 4-inch-diameter button bit

DEPTH 0 5 10 15 20 25 30 35 40 45 50 55 60 65	SAMPLES (% RECOVERY)	MOISTURE, COLOR, CONDITION  <i>(Note: if soil/rock is not highly permeable, determination of depth to groundwater may not be possible )</i>	DESCRIPTION  <i>(Note: descriptions from probe borings are approximate - based only on advancement rate &amp; view of pulverized cuttings)</i>	SOIL LOG	ADVANCEMENT RATE
		dark brown	SILTY SAND with Gravel (topsoil)		
			GNEISS, highly to slightly weathered, very weak to moderately strong rock (R1-R3)		
			(hammer percussion required 0 to 11 feet)		0 to 11 feet: 3 minutes, 49 seconds
			Driller reports "very hard rock" from 14 to 26 feet		
			(hammer percussion required 11 to 23 feet)		11 to 23 feet: 4 minutes, 15 seconds
			Driller reports "softer rock" 26 to 30 feet		
			(hammer percussion required 23 to 35 feet)		
			Driller reports "hard rock" 30 to 33 feet		
			Driller reports "softer rock" 33 to 37 feet		
			(hammer percussion required 23 to 35 feet)		23 to 35 feet: 4 minutes, 9 seconds
			Driller reports "very hard rock" from 37 to 47 feet		
			(hammer percussion required 35 to 47 feet)		35 to 47 feet: 5 minutes, 10 seconds
			End of Boring @ 47 ft		

LOGS - ADVANCEMENT S241121.GPJ GINT STD.US.GDT 2/20/25



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**PROBE LOGS**

**FIGURE 4-10**

Project: Legacy Phase F  
 Location: Liberty Lake, WA  
 Number: S241121



## DCP TEST DATA

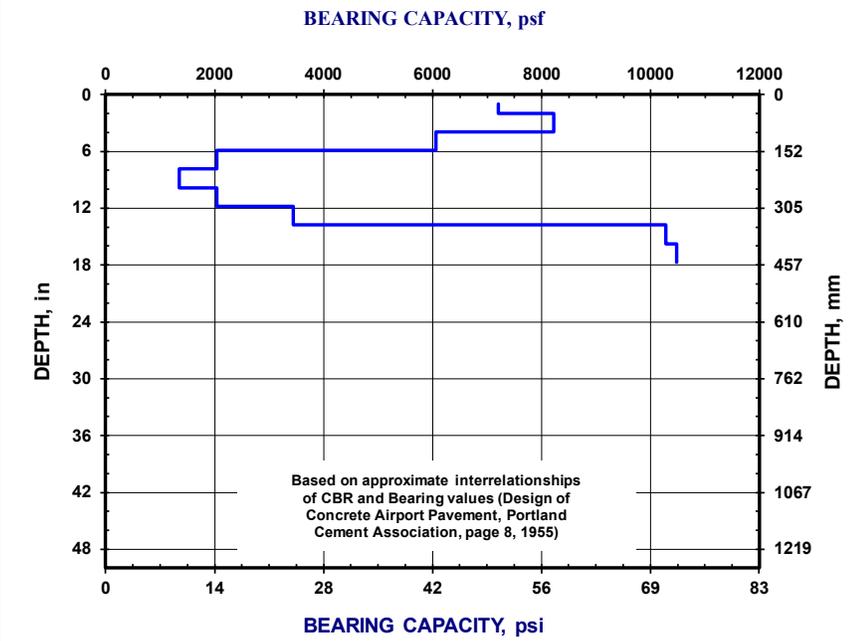
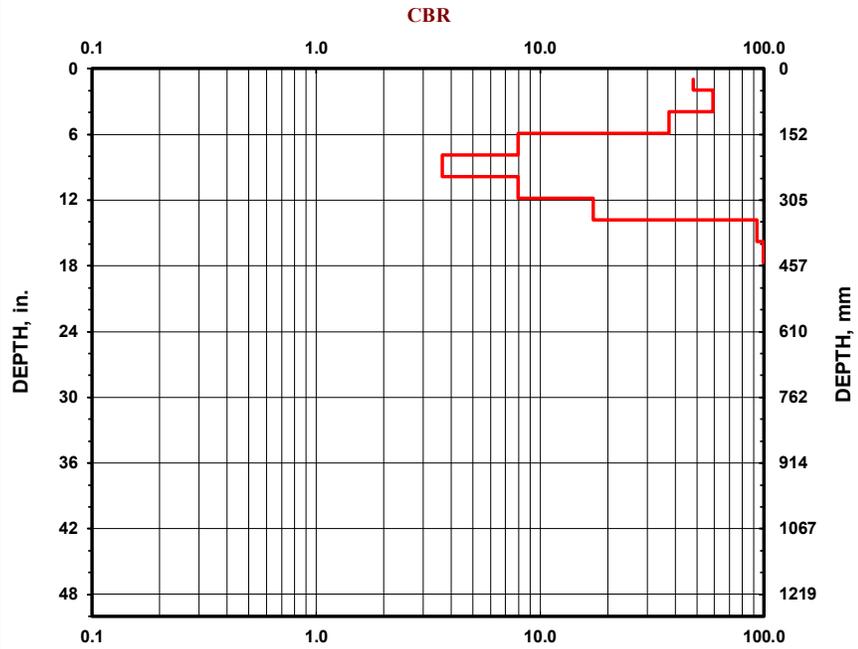
Project: Legacy Phase F  
 Location: TP-2

Date: 5-Feb-25  
 Soil Type(s): Silty Sand

Hammer  
 ○ 10.1 lbs.  
 ● 17.6 lbs.  
 ○ Both hammers used

Soil Type  
 ○ CH  
 ○ CL  
 ● All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
5	25	1
5	50	1
6	75	1
6	100	1
4	125	1
4	150	1
1	175	1
1	200	1
0.5	225	1
0.5	250	1
1	275	1
1	300	1
2	325	1
2	350	1
9	375	1
9	400	1
25	425	1
25	450	1



**Figure 5-2**





## DCP TEST DATA

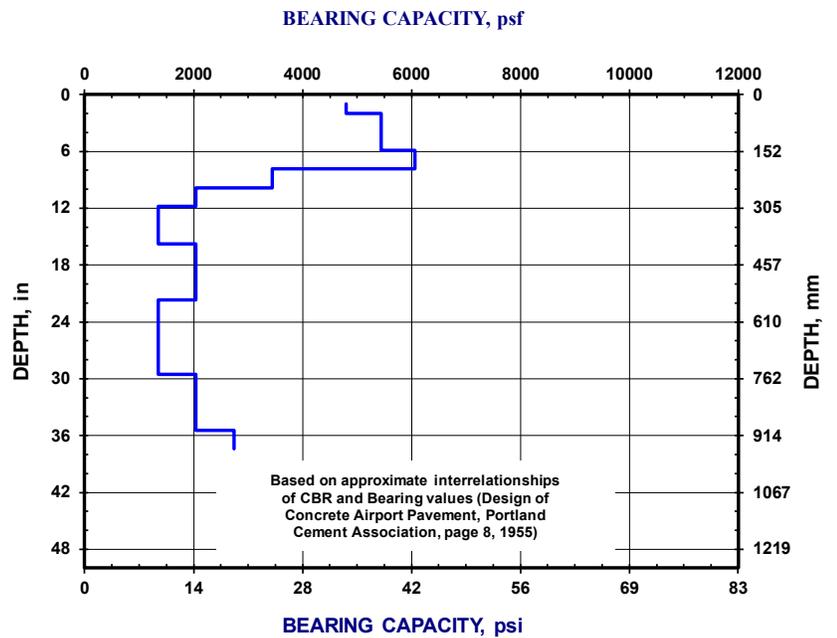
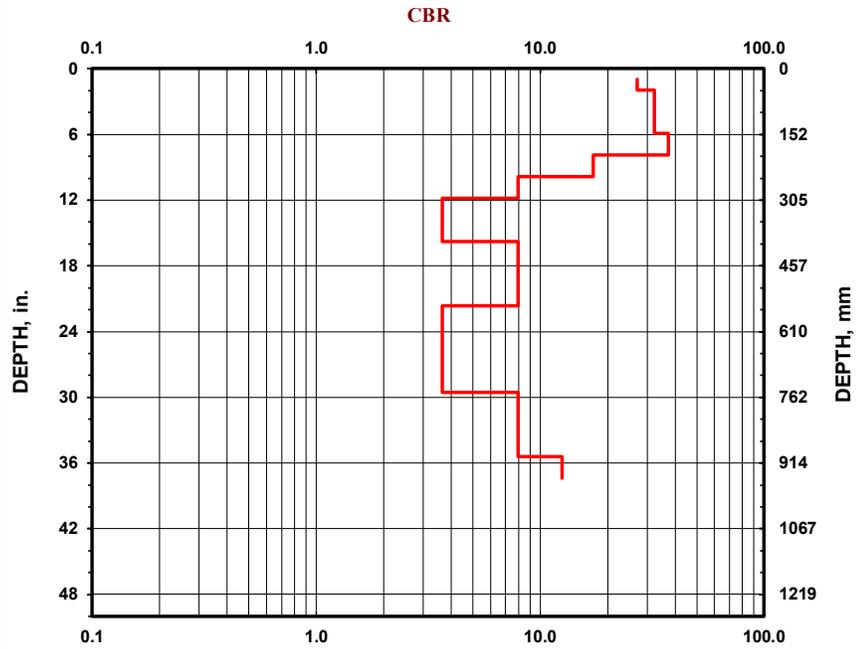
Project: Legacy Phase F  
 Location: TP-5

Date: 5-Feb-25  
 Soil Type(s): Gravel

Hammer  
 ○ 10.1 lbs.  
 ● 17.6 lbs.  
 ○ Both hammers used

Soil Type  
 ○ CH  
 ○ CL  
 ● All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
3	25	1
3	50	1
3.5	75	1
3.5	100	1
3.5	125	1
3.5	150	1
4	175	1
4	200	1
2	225	1
2	250	1
1	275	1
1	300	1
0.5	325	1
0.5	350	1
0.5	375	1
0.5	400	1
1	425	1
1	450	1
1	475	1
1	500	1
1	525	1
1	550	1
0.5	575	1
0.5	600	1
0.5	625	1
0.5	650	1
0.5	675	1
0.5	700	1
0.5	725	1
0.5	750	1
1	775	1
1	800	1
1	825	1
1	850	1
1	875	1
1	900	1
1.5	925	1
1.5	950	1



**Figure 5-5**

## DCP TEST DATA

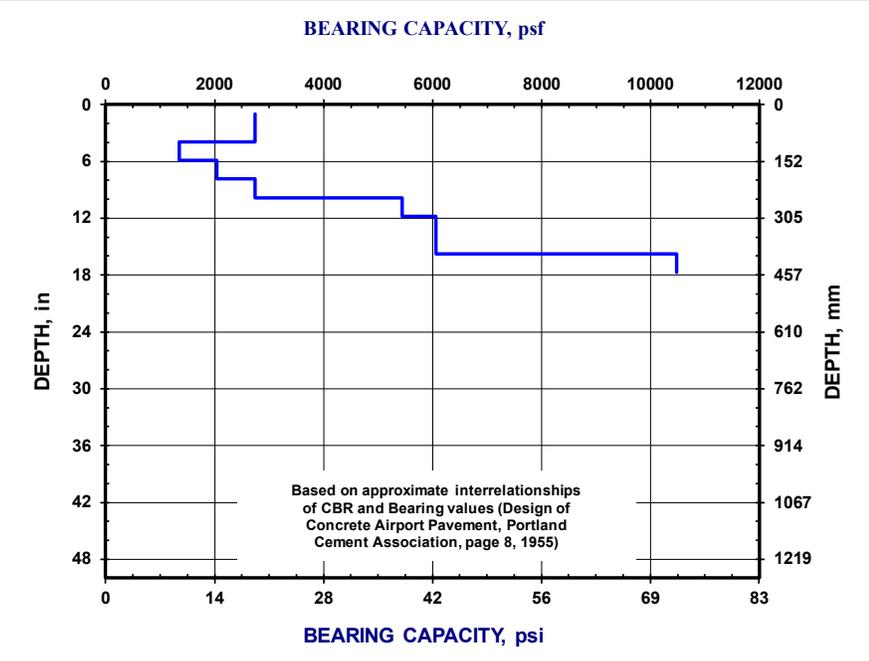
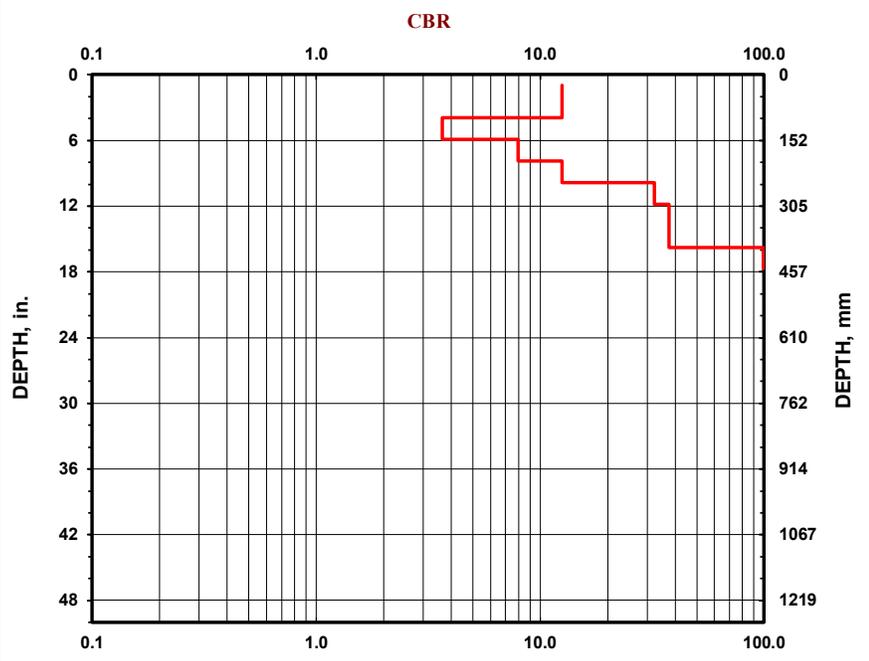
Project: Legacy Phase F  
 Location: TP-6

Date: 5-Feb-25  
 Soil Type(s): Silty Sand

Hammer  
 ○ 10.1 lbs.  
 ● 17.6 lbs.  
 ○ Both hammers used

Soil Type  
 ○ CH  
 ○ CL  
 ● All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
1.5	25	1
1.5	50	1
1.5	75	1
1.5	100	1
0.5	125	1
0.5	150	1
1	175	1
1	200	1
1.5	225	1
1.5	250	1
3.5	275	1
3.5	300	1
4	325	1
4	350	1
4	375	1
4	400	1
25	425	1
25	450	1



**Figure 5-6**

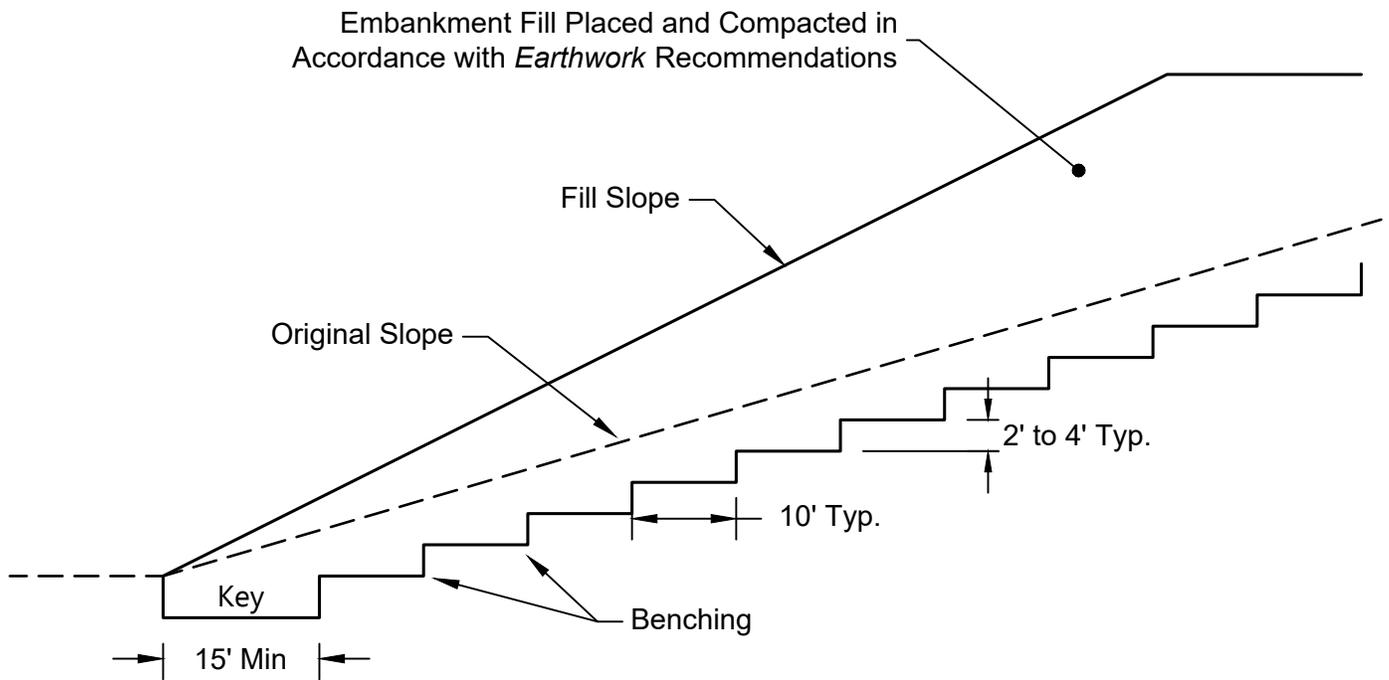


**SOIL MECHANICS  
LABORATORY SUMMARY**

LABORATORY NUMBER TEST PIT NUMBER DEPTH	Units		Test Methods		25-5174	25-5175	25-5176	25-5177	25-5178	25-5179
	TOP	BOTTOM	feet	feet	TP-1	TP-2	TP-5	TP-7	TP-1	TP-5
					1/2	1/2	2	2	10	10
					1	1	3	3	11	11
STRATUM					<i>topsoil</i>		<i>existing fill</i>	<i>silty, clayey sand</i>	<i>gneiss</i>	
MOISTURE CONTENT		%	ASTM D2216		15.7	15.9	5.5	13.7	7.4	7.1
ORGANIC CONTENT		%	ASTM D2974		4.0	3.6				
pH			AASHTO T289		6.0	6.0				
CATION EXCHANGE CAPACITY		meq/100g	EPA 9081		14.2	13.1				
LIQUID LIMIT		%	ASTM D4318					22		
PLASTIC LIMIT		%						18		
PLASTICITY INDEX		%					NP	4	NP	NP
UNIFIED CLASSIFICATION			ASTM D2487				GW	SC-SM	SP-SM	GP-GM
SIEVE ANALYSIS			ASTM D6913							
	3"						100			100
	1 1/2"						71	100		86
S	1"	%					59	94		72
I	3/4"						52	91	100	68
E	1/2"	P					44	89	95	61
V	3/8"	A					40	87	92	58
E	#4	S					29	83	81	48
	#10	S					20	76	63	38
S	#16	I					15	71	54	29
I	#30	N					11	63	42	19
Z	#40	G					9	58	37	15
E	#100						5	43	22	8
	#200						3.4	36	12	5.1

NP = Non Plastic





Budinger  
& Associates

KEYING & BENCHING DETAIL

LEGACY PHASE F  
LIBERTY LAKE, WASHINGTON

FIGURE 8

PROJECT NUMBER S241121

DATE: 2/2025

# Important Information about This

# Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

## Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you — should apply this report for any purpose or project except the one originally contemplated.*

## Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

## Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that 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.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an

assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

## Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by:* the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

## Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

## A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final*, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

## A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly

problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

### **Do Not Redraw the Engineer's Logs**

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

### **Give Constructors a Complete Report and Guidance**

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

### **Read Responsibility Provisions Closely**

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help

others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

### **Environmental Concerns Are Not Covered**

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

### **Obtain Professional Assistance To Deal with Mold**

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold-prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical-engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

### **Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance**

Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your GBC-Member geotechnical engineer for more information.



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