

Soils and Geology Report

Buck Bluff Minor Subdivision

Boise County, Idaho

PREPARED FOR:

Ryno Engineering

50 Teds Cabin Road

Horseshoe Bend, Idaho

PREPARED BY:

Innovate Geotechnical

Innovate Geotechnical Project No. 325012

April 2, 2025



April 2, 2025

Ryno Engineering
50 Teds Cabin Road
Horseshoe Bend, ID

Attention: Ryan Haskins

Subject: Soils and Geology Report
Buck Bluff Minor Subdivision
Boise County, Idaho
Innovate Geotechnical Project No. 325012

Ryan,

Submitted herewith is the report of our soils and geology evaluation for the subject site. This report contains the results of our findings and an engineering interpretation of the results with respect to the available project characteristics. This report has been prepared to meet the Soils Report and Geology Report requirements set forth in Boise County Unified Land Use Ordinance adopted February 1, 2024, for a Hillside Subdivision.

On January 30th, 2025, Innovate Geotechnical staff was on-site and completed four (4) test pits up to 9 feet below the existing ground surface. Dynamic cone penetrometer (DCP) testing was also performed. Soil samples were obtained during the field operations and were then transported to our office for further testing.

Based on the findings of the subsurface investigation and other information, geotechnical, geological, and slope stability recommendations are provided. A detailed discussion of observed conditions is presented in this report.

We appreciate the opportunity to work with you on this project. If we can be of further assistance or if you have any questions regarding this project, please do not hesitate to contact us at (208) 484-1090.

Sincerely,
Innovate Geotechnical



Macie Larranaga
Staff Geotechnical Engineer



Seth P. Olsen, P.E.
Senior Geotechnical Engineer

Table of Contents

Attention: Ryan Haskins 1

1.0 INTRODUCTION 3

2.0 PROJECT UNDERSTANDING 3

3.0 SCOPE OF SERVICES 3

4.0 SITE CONDITIONS AND FIELD EVALUATION..... 3

4.1 Surface Conditions..... 4

4.2 Field Evaluation 4

4.3 Subsurface Soil Profile 5

4.4 Geologic Setting..... 6

4.5 Groundwater 6

4.6 Tectonic Setting and Active Faults 6

4.7 Site Subsurface Variations 7

5.0 CONCLUSIONS AND RECOMMENDATIONS 7

5.1 Site Preparation and Earthwork 7

5.2 Structural Fill 8

5.3 Fill Placement and Compaction 8

5.4 Slope Stability and Geologic Risk 9

5.5 Foundation Support..... 9

5.6 Lateral Pressures and Backfill 10

5.7 Floor Slabs 11

5.8 Drainage..... 11

6.0 QUALITY CONTROL..... 12

7.0 LIMITATIONS..... 12

8.0 REFERENCES 12

List of Figures

- Figure 1 – Vicinity Map
- Figure 2 – Site Map

Appendices

- Appendix A – Test Pit Logs
- Appendix B – Laboratory Test Results
- Appendix C – Dynamic Cone Penetrometer Results

1.0 INTRODUCTION

Innovate Geotechnical (IGEO) is pleased to present this report which summarizes the results of our geotechnical engineering evaluation for the Buck Bluff Minor Subdivision in Boise County, Idaho. The project area is located approximately as shown in the Vicinity Map, Figure 1. Our understanding of the project is based on our communications with you and the preliminary plat provided to us.

2.0 PROJECT UNDERSTANDING

The proposed project consists of determining the feasibility of developing and subdividing the 40 acre parcel into 4 residential lots. The property will be accessed from Highway 52 west of the parcel. We understand the slopes present on the property are greater than 15% and therefore require a Soils Report and Geology Report as per the Boise County Unified Land Use Ordinance adopted February 1, 2024, for a Hillside Subdivision.

Our understanding of the project is based on our communications with you and the preliminary plat provided to us.

If the construction conditions are different than we have observed, please notify us so that any appropriate modifications to our conclusions and recommendations contained herein may be made. A site plan is presented in Figure 2.

3.0 SCOPE OF SERVICES

The purpose of our geotechnical engineering evaluation was to provide recommendations for site development based on our site evaluation, laboratory testing, and engineering analyses. Our specific scope of services included:

- Exploration of soil underlying the proposed development by completing 1 septic test pit, 4 soils test pits, collecting samples for testing, and conducting DCP testing.
- Laboratory testing to assess pertinent physical and engineering properties of the soil observed.
- Engineering analysis and preparation of this report.

4.0 SITE CONDITIONS AND FIELD EVALUATION

Existing surface and subsurface conditions associated with the subject property are presented in this section.

4.1 Surface Conditions

The site is located in Boise County, Idaho (see Figures 1 and 2). Topographically, the elevation varies across the site. Generally, drainages flow south and west across the property. The property is approximately 40 acres and will be divided into 4 lots. Primary access to the site is via Highway 52 from the west. In the past, the property has been used as pasture and/or unused with native grasses and sage brush. Rock boulders and outcrops are present in the higher elevations on the property. Photos 1 through 4 present the surface conditions at the site during the time of our evaluation.



Photo 1: Looking North



Photo 2: Looking West



Photo 3: Looking South



Photo 4: Looking East

4.2 Field Evaluation

The subsurface soil conditions were determined by performing four (4) soils test pits (TP-1B and TP-2 through TP-4), one (1) septic test pit (TP-1) and Dynamic Cone Penetrometer testing at the locations shown on Figure 2. Test pits were advanced using a backhoe provided on site. Soil samples were obtained at significant changes of strata and in general accordance with ASTM D-420 and ASTM D-2488. The subsurface conditions observed during the field evaluation are

discussed in Section 4.3. Logs of the explorations, including a description of all soil strata encountered, are presented in Appendix A.

After completion of the field evaluation, soil samples were tested for their engineering properties. The results of the laboratory testing are presented in Appendix B and shown on the boring and test pit logs in Appendix A.

Dynamic Cone Penetrometer (DCP) testing was performed at one of the test pits to assess the in-situ bearing strength characteristics of the subgrade. Results of this testing are presented in Appendix C. Table 1 presents a summary of the explorations performed.

TABLE 1 – Exploration Summary

| Exploration | Approx. Ground Surface Elevation (feet) | Depth (feet) | Approximate Locations | |
|-------------|---|--------------|-----------------------|-------------|
| | | | WGS 84 (degrees) | |
| | | | Latitude | Longitude |
| TP-1* | 2755 | 5.0 | 43.92339° | -116.27007° |
| TP-1B | 2703 | 8.5 | 43.92313 | -116.27098° |
| TP-2 | 2718 | 8.0 | 43.92337° | -116.27197° |
| TP-3 | 2636 | 9.0 | 43.92294° | -116.27300° |
| TP-4 | 2621 | 8.0 | 43.92306° | -116.27370° |

*Septic test pit.

4.3 Subsurface Soil Profile

The results of our field evaluation and our laboratory testing indicate a varied subgrade across the site. In the test pits located at higher elevations of the property, the subsurface profile is primarily made up of decomposed granite predominantly made up of sand with varying amounts of gravel and silt to the full depth explored (approximately 8.5 feet below the existing ground surface). Occasional boulders were also observed in the subsurface and exposed on the surface. The explorations in this area include TP-1, TP-1B and TP-2.

In the lower elevations of the property, the subsurface profile is primarily made up of silty sand to the full depth explored (approximately 9 feet below the existing ground surface). The explorations in this area include TP-3 and TP-4.

The results of the DCP testing in TP-4 indicated loose conditions 2 to 3 feet below the existing ground surface in the location tested. For a detailed description of the soil profiles observed in this evaluation, see the test pit logs in Appendix A. See Figure 2 for the approximate exploration locations.

4.4 Geologic Setting

Idaho Geological Survey, map the area of this site as granodiorite and two-mica granite (Cretaceous). The lithology for the area is described as consisting of granodiorite and granite containing biotite, commonly with muscovite. This description is consistent with what was observed on site as these are parent rocks of the predominantly sandy soils on site.

4.5 Groundwater

Groundwater was not observed in any of test pits during the field evaluation. Numerous factors such as heavy precipitation, irrigation practices, and other unforeseen factors may influence groundwater elevations at the site. The detailed evaluation of these and other factors, which may be responsible for groundwater fluctuations, is beyond the scope of this study.

4.6 Tectonic Setting and Active Faults

The project site is located within a belt of north-south striking faults coincident with the Western Idaho Suture Zone (WISZ). The WISZ is the boundary between Proterozoic continental crust to the east and Paleozoic and Mesozoic accreted terranes to the west (Fleck and Criss, 2004). The project site is between two north-south striking faults: the Squaw Creek fault, mapped approximately 7 miles to the northwest, and the Boise Ridge fault, mapped approximately 13 miles to the east (Breckenridge et al., 2003; U.S. Geological Survey and Idaho Geological Survey, 2022). The Squaw Creek fault is approximately 47 kilometers long. It is an east dipping normal fault and displaces Miocene Columbia River Basalts along most of its length. The slip rate of the Squaw Creek fault is estimated to be less than 0.2 mm/yr (U.S. Geological Survey and Idaho Geological Survey, 2022). Little is known about the age or activity of the Boise Ridge fault system. It is mapped as a discontinuous series of north-south striking, east dipping normal faults. Its location is not well constrained, and mapping is based mostly on linear valleys. (Breckenridge et al., 2003).

According to the findings of our subsurface evaluation and the guidelines of the International Building Code (IBC, 2021) the **Site Classification is D** (IBC, 2021, section 1613).

The following values should be used for site structural coefficients:

| | |
|--|------------------|
| Short Period Spectral Response Acceleration | $S_s = 0.39g$ |
| One Second Period Spectral Response Acceleration | $S_1 = 0.13g$ |
| Short Period Spectral Response Design Acceleration | $S_{DS} = 0.39g$ |
| One Second Period Spectral Design Acceleration | $S_{D1} = 0.21g$ |

Liquefaction of a soil is defined as the condition when a saturated, loose, cohesion-less, (fine sand-type) soils have a sudden, large decrease, in their ability to support loads. This is because

of excessive pore water pressure which develops during a seismic event. Cohesive (clay type) and dense sand and gravel soils typically do not liquefy during a seismic event. Because of the dense sands and gravels on site and the lack of near surface groundwater, it is our opinion that the potential for liquefaction at this site is low under seismic conditions.

4.7 Site Subsurface Variations

Based on the results of the subsurface exploration and our experience, variations in continuity and nature of subsurface conditions should be anticipated. Due to the heterogeneous characteristics of soils, care should be taken in interpolating or extrapolating subsurface conditions between or beyond the explorations. Seasonal fluctuations in groundwater conditions may also occur.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of our site exploration, laboratory testing, and engineering analyses, it is our opinion that the proposed site may be improved as envisioned. Specific recommendations for the proposed improvements are presented in the following sections of this report.

5.1 Site Preparation and Earthwork

5.1.1 Initial Preparation

We recommend that proposed areas for improvements, including areas to receive fill, be prepared by clearing and grubbing of both the surface and subsurface of all debris, deleterious and organic matter, and roots greater than ½ inch diameter. Localized areas of deeper grubbing may be required in some of the drainages on site where vegetation is more dense.

5.1.2 Grading, Excavations, and Subgrade Preparation

Current site grades within the proposed improvements vary. In order to provide uniform bearing conditions for the proposed structures and pavements, we recommend the following site preparation activities:

- Within foundation limits for buildings, the native sandy soils are to be compacted to establish final foundation elevations.
- Within floor-slab limits. The on-site soils should be proof-rolled before placing capillary break material. Floor-slab areas are to be supported by at least 4 inches of properly compacted capillary break material (see Section 5.2.1) to limit impact of near surface moisture levels.

In the event earthwork activities cause excessive subgrade disturbance, replacement with structural fill may be necessary. A greater depth of disturbance of the subgrade soil may be

expected if site preparation work is conducted during periods of wet weather when the moisture content of the soil exceeds optimum. Any soft, loose, wet or otherwise unsuitable soil encountered is to be over-excavated to firm soil, or a depth of 2 feet, whichever is less, and replaced with structural fill, as described below.

5.2 Structural Fill

Soil used to support the foundations is classified as structural fill for the purposes of this report.

5.2.1 Structural Fill

Structural fill shall consist of granular soils free of organics, debris, or other deleterious materials and no particles larger than four inches in maximum dimension. Structural fill shall meet the specifications described below:

- Structural fill placed as embankment fill should consist of sandy and silty soils.
- Structural fill placed below structural foundations to replace soft spots should consist of well-graded, sand and gravel material with no more than 12% passing the #200 sieve. Equivalent specifications may be used if approved by the project geotechnical engineer.
- Structural fill placed as capillary break material below floor slabs should consist of 1 ½ - inch-minus, free-draining, crushed gravel with less than 10 percent passing the U.S. No. 4 sieve and the fines content should not exceed 3 percent.

5.2.2 Use of on-site Soil

The on-site sandy soils observed in our test pits may be reused as structural fill, provided it is reworked and meets the requirements set forth above.

5.3 Fill Placement and Compaction

The various types of compaction equipment have their limitations as to the maximum lift thickness that can be compacted. For example, hand operated equipment is limited to lifts of about four inches and most “trench compactors” have a maximum, consistent compaction depth of about six inches. Large rollers, depending on soil and moisture conditions can achieve compaction at eight to twelve inches. The full thickness of each lift should be compacted to at least the following percentages of the maximum dry density (MDD) as determined by ASTM D-1557:

- | | |
|--|-----|
| 1. Compacted fill/native soils, supporting foundations | 95% |
| 2. Compacted fill/native soils, below floor slabs | 95% |
| 3. Backfill of trenches | |
| a. Below foundations | 95% |
| b. Below pavement | 95% |

c. Others 90%

Field density tests should be performed on each lift as necessary to ensure that compaction is being achieved.

Conditions of the structural fill, site grading fill, and compacted native soil should be evaluated by in-place density tests, visual evaluations, probing and proof-rolling as these materials are prepared to determine compliance with the contract documents and recommendations in this report. Over compaction should be avoided as increased compaction effort will result in lateral pressures higher than those provided in this report.

5.4 Slope Stability and Geologic Risk

While the slopes are steep, no evidence of current soil movement was observed across the property. Furthermore, the sands and gravels and rock outcrops observed on site indicate stable slope conditions. Some minor surficial erosion and slumps may occur, especially during periods of high precipitation. However, we do not anticipate that slope failures will impact the homes below.

For permanent re-worked slopes on the property, we recommend slopes of no more than 2Horizontal : 1Vertical. Shallower slopes may be needed where loose, soft, or otherwise unstable slopes are encountered. Fill placed on existing slopes should be keyed into existing slopes steeper than 3H:1V with horizontal benches having a vertical face approximately 1 foot in height. Slope each bench to drain.

Where necessary, retaining walls may be used on site and we recommend utilizing the lateral earth pressures presented in Section 5.6 for the structural design of the walls.

The site is approximately 7 miles from any mapped faults. As a result, we estimate a minimal risk of fault rupture and we do not feel that geologic hazards pose a risk to developing the site as envisioned.

5.5 Foundation Support

We anticipate that the proposed footings will be established at a minimum elevation of two feet below the existing ground surface. To establish uniform bearing conditions the proposed footings should be established entirely on a specific zone of compacted structural fill or native soils, as described previously.

Foundations may be designed using a maximum allowable bearing pressure of 1,500 psf. In addition to the fill recommendations presented previously in this report, the following recommendations should be implemented:

- Continuous footing widths should be maintained at a minimum of 16 inches.

- Spot footings should be a minimum of 24 inches in width.
- Exterior footings should be placed a minimum of 24 inches below final grade for frost protection, and interior footings shall be placed a minimum of 16 inches below grade.
- Drainage around the site should be created so that water is not allowed to flow into the excavation during or after construction.

The allowable bearing pressure may be increased by 1/3 for temporary loads such as wind and seismic forces.

Based on the preliminary maximum foundation loads, as presented above, and given that the foundations are supported as described in this report, we estimate that total settlement will be less than about 1 inch. Differential settlement is estimated to be less than about ½ of the total settlement. Post-construction settlement should be minor. Loose soil or otherwise unsuitable soil not removed from footing excavations, or disturbance of soil at foundation grade during construction could result in larger settlements than estimated.

5.6 Lateral Pressures and Backfill

All granular backfill material used in the construction of any retaining wall on site should be free from organic and deleterious materials and should conform to structural fill requirements.

We recommend fill material to consist of free-draining granular material with a friction angle of 34 degrees or more and a moist unit weight of 125 pcf. The lateral earth pressure values for the proposed structural fill material are summarized in Table 2.

Table 2 – Lateral Earth Pressure Values

| Earth Pressure State | Lateral Earth Coefficient | | Equivalent Fluid Density (pcf) | |
|----------------------|---------------------------|---------------------------------------|--------------------------------|---------------------------------------|
| | Horizontal Backslope | 3H:1V Backslope; Horizontal Foreslope | Horizontal Backslope | 3H:1V Backslope; Horizontal Foreslope |
| Active | $K_a - 0.28$ | $K_a - 0.41$ | 35 | 51 |
| Passive | $K_p - 3.54$ | $K_p - 10.0$ | 442 | 1250 |
| At-rest | $K_o - 0.44$ | $K_o - 0.63$ | 55 | 78 |

The passive pressure resistance should not be considered effective in the upper 24 inches of the subsurface soil profile. The estimated wall translation for active earth pressure conditions is 0.001H (where H is the height of the wall). The estimated wall translation for passive earth pressure conditions is 0.01H. If soil can be removed or eroded from the wall face, passive resistance should not be relied upon. The ultimate equivalent fluid densities provided in Table 1 are for properly drained backfill and do not include hydrostatic pressures that can develop if groundwater or surface water is trapped behind the retaining walls. In addition, no friction between the wall and the backfill material was used.

Additional earth pressures resulting from loads applied at the ground surface must also be included in the design of the retaining wall. These earth pressures may be generated by surface surcharge loads, point loads, line loads, hydrostatic forces, and strip loads. Seismic considerations may also need to be included in design.

The retaining wall backfill should be compacted to 95% compaction. Over compaction should be avoided as increased compaction effort will result in lateral pressures higher than those provided in this report. Heavy compaction equipment or other construction loads should not be allowed within 3 feet of the walls unless planned for in the structural design. Hand-held or lightweight compaction equipment, such as a vibrating plate, should be utilized within 3 feet of the structure walls and fill lift thickness reduced.

5.7 Floor Slabs

Floor slabs may be supported on structural fill overlying the on-site soils as recommended in the previous sections of this report. We recommend the slab be designed using a modulus of vertical subgrade reaction (k) of 100 pounds per cubic inch (pci).

To retard the upward wicking of moisture beneath the floor slab, we recommend that a capillary break be placed over the subgrade. Therefore, we recommend floor slabs be underlain by a minimum of 4 inches of free-draining crushed rock meeting gradation and compaction specifications described in Section 5.2.1 of this report. Alternate gradation specifications may be used provided they meet the requirements outlined above and are accepted by the geotechnical engineer of record. To help control normal shrinkage and stress cracking, the floor slabs should have the following features:

- Adequate reinforcement for the anticipated floor loads with the reinforcement continuous through interior floor joints
- Frequent crack control joints
- Non-rigid attachment of the slabs to foundation walls and bearing slabs

5.8 Drainage

All soils can experience some volume change when exposed to water, particularly the fat clay and elastic silt soils on the property. Therefore, adequate site drainage is always important. Site grading design and construction should be implemented to assure that all surface water is directed away from the foundation bearing soils. We recommend the following actions be taken:

1. All areas around the buildings should be sloped to provide drainage away from the structures. We recommend a minimum slope of 6 inches in the first 10 feet away from the structure.

2. All roof drainage should be collected in rain gutters with downspouts designed to discharge well beyond the backfill limits or the stormwater drainage system, if applicable.
3. Adequate compaction of the foundation backfill should be provided. We suggest a minimum of 90% of the maximum laboratory density as determined by ASTM D-1557. Water consolidation methods should not be used under any circumstances.
4. Sprinklers should be aimed away from the foundation walls. The sprinkling systems should be designed with proper drainage and be well-maintained. Over watering should be avoided.
5. Other precautions may become evident during construction.

6.0 QUALITY CONTROL

Our recommendations in this report are based on the assumption that adequate quality control testing and observations will be conducted during construction to verify compliance.

7.0 LIMITATIONS

The recommendations provided herein were developed by evaluating the information obtained from the subsurface investigation and our experience in the area. The exploration data reflects the subsurface conditions only at the specific locations at the particular time designated on the logs. Soil and ground water conditions may differ from conditions encountered at the actual exploration locations. The nature and extent of any variation in the explorations may not become evident until during the course of construction. If variations do appear, it may become necessary to re-evaluate the recommendations of this report after we have observed the variation.

Our professional services have been performed, our findings obtained, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. This warranty is in lieu of all other warranties, either expressed or implied.

8.0 REFERENCES

AASHTO Guide for Design of Pavement Structures, American Association of State Highway and Transportation Officials, 1993.

ASTM, American Society for Testing and Materials

IBC, International Building Code, 2021 Edition

Idaho Geologic Survey. <http://www.idahogeology.org/webmap/> Accessed on February 25, 2025.

Idaho Standards for Public Works Construction 2020 Edition.

Fundamentals of Geotechnical Analysis – Dunn, Anderson, and Kiefer (1980)

Essentials of Soil Mechanics and Foundations – David F. McCarthy (2007)

Principles of Foundation Engineering, Braja M. Das. (2004)

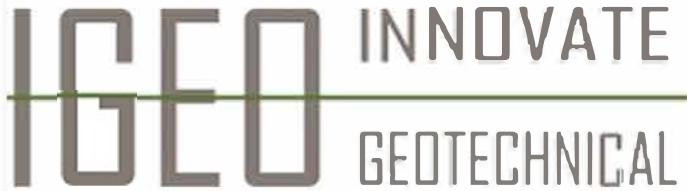
Foundation Engineering – Peck, Hanson, and Thornburn (1994)

ASCE 7 Hazard Tool

U.S. Seismic Design Maps (seismicmaps.org)



Google Earth
Map data © 2013, Imagery © 2013, Google



Vicinity Map

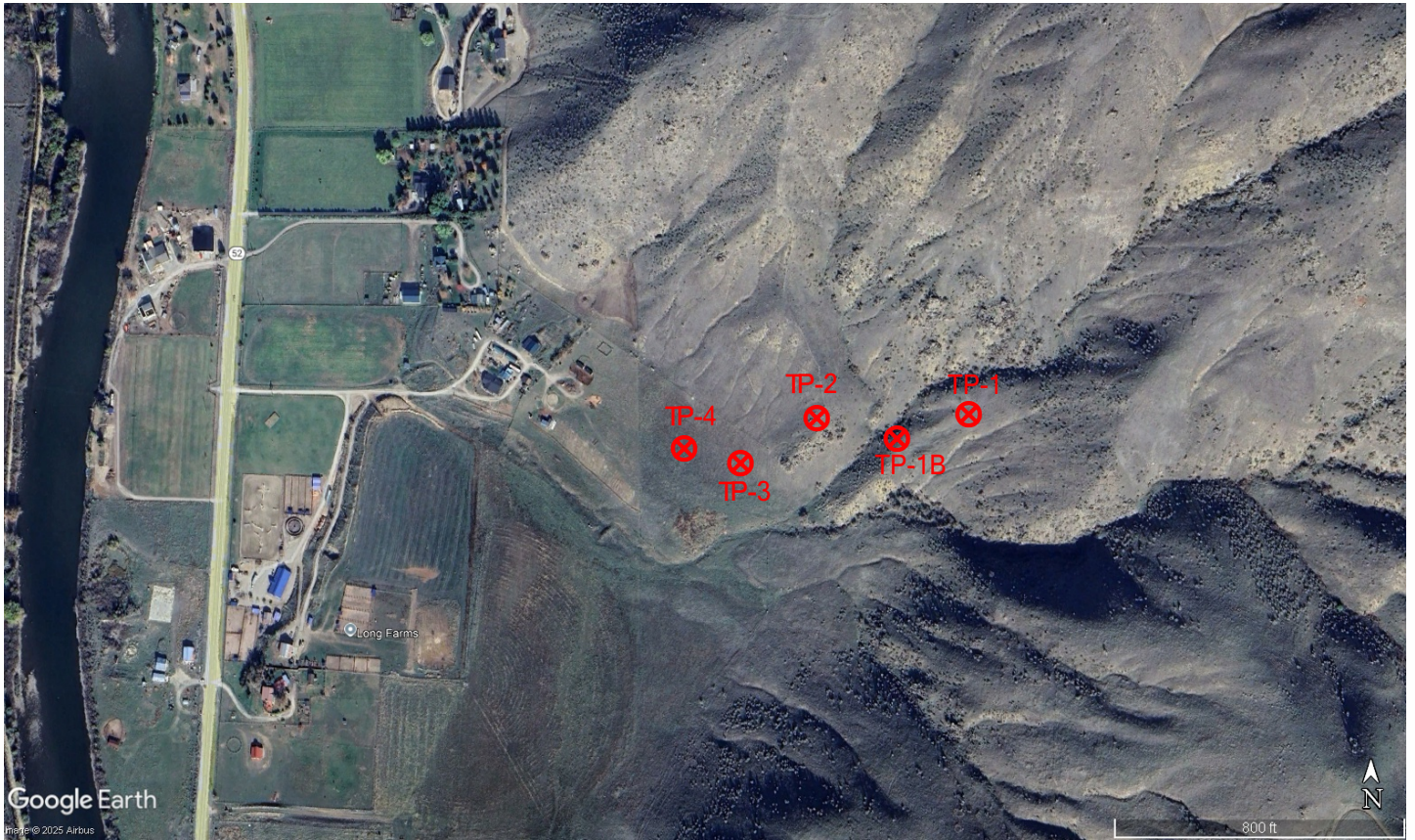
Locations are approximate

 Approximate Site Location

Buck Bluff Subdivision

Date: 11-Feb-25
 Project No: 325012
 Drawn By: M. Larranaga
 Client: Ryno Engineering

Figure:
1



IGEO INNOVATE
 GEOTECHNICAL

Site Plan

Locations are approximate

⊗ Approximate Test Pit Locations

Buck Bluff Subdivision

Date: 11-Feb-25
 Project No: 325012
 Drawn By: M. Larranaga
 Client: Ryno Engineering

Figure:

2

Appendix A

| UNIFIED SOIL CLASSIFICATION SYSTEM | | | | | | | | | | |
|---|--|---|---|--|-------------------|-------------------|---|-------------------------------------|----|---|
| FIELD IDENTIFICATION PROCEDURES | | | | | Graphic Symbol | Letter Symbol | Typical Descriptions | | | |
| Coarse Grained Soils More than half of material is larger than No. 200 sieve size (The No. 200 sieve size is about the smallest particle visible to the naked eye) | Gravels More than half of coarse fraction is larger than No. 4 sieve size (For visual classifications, the 1/4" size may be used as equivalent to the No. 4 sieve size) | Clean Gravels (little or no fines) | Wide range of grain size and substantial amounts of all intermediate particle sizes | | | GW | Well graded gravels, gravel-sand mixtures, little or no fines | | | |
| | | | Predominantly one size of a range of sizes with some intermediate sizes missing | | | GP | Poorly graded gravels, gravel-sand mixtures, little or no fines | | | |
| | | Gravel with Fines (appreciable amount of fines) | Non-plastic fines (for identification procedures see ML below) | | | GM | Silty gravels, poorly graded gravel-sand-silt mixtures | | | |
| | | | Plastic fines (for identification procedures see CL below) | | | GC | Clayey gravels, poorly graded gravel-sand-clay mixtures | | | |
| | Sands More than half of coarse fraction is smaller than No. 4 sieve size (For visual classifications, the 1/4" size may be used as equivalent to the No. 4 sieve size) | Clean Sands (little or no fines) | Wide range of grain size and substantial amounts of all intermediate particle sizes | | | SW | Well graded sands, gravelly sands, little or no fines | | | |
| | | | Predominantly one size of a range of sizes with some intermediate sizes missing | | | SP | Poorly graded sands, gravelly sands, little or no fines | | | |
| | | Sands with Fines (appreciable amount of fines) | Non-plastic fines (for identification procedures see ML below) | | | SM | Silty sands, poorly graded sand-silt mixtures | | | |
| | | | Plastic fines (for identification procedures see CL below) | | | SC | Clayey sands, poorly graded sand-clay mixtures | | | |
| Fine Grained Soils Less than half of material is larger than No. 200 sieve size (The No. 200 sieve size is about the smallest particle visible to the naked eye) | IDENTIFICATION PROCEDURES ON FRACTION SMALLER THAN NO. 4 SIEVE SIZE | | | | | | | | | |
| | Silts and Clays Liquid limit less than 50 | Dry Strength (Crushing Characteristics) None to Slight | Dilatancy (Reaction to Shaking) Quick to Slow | Toughness (Consistency Near Plastic Limit) None | | ML | Inorganic silts and very fine sands, rock flour, silty or clayey fine sand with slight plasticity | | | |
| | | | | | Medium to High | None to Very Slow | Medium | | CL | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays |
| | | | | | Slight to Medium | Slow | Slight | | OL | Organic silts and organic silt-class of low plasticity |
| | Silts and Clays Liquid limit greater than 50 | Dry Strength (Crushing Characteristics) Slight to Medium | Dilatancy (Reaction to Shaking) Slow to None | Toughness (Consistency Near Plastic Limit) Slight to Medium | | MH | Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts | | | |
| | | | | | High to Very High | None | High | | CH | Inorganic clays of high plasticity, fat clays |
| | | | | | Medium to High | None to Very Slow | Slight to Medium | | OH | Organic clays of medium to high plasticity |
| | High Organic Soils | | | | | | PT | Peat and other highly organic soils | | |

- 1) Boundary Classifications: Soils possessing characteristics of two groups are designated by combinations of group symbols. For example GW-GC, well graded gravel-sand mixture with clay binder.
 2) All sieve sizes on this chart are U.S. standard.

| Sampling Methods | | | | | | | | | | | | | | |
|------------------|-----|---------------------------|--|----|-------------|--|----|-----------------------------|--|----|--------------------|--|----|------------|
| | AU | Auger Cuttings | | GB | Grab Sample | | MC | Modified California Sampler | | NR | No Recovery | | RC | Rock Core |
| | SPT | Standard Penetration Test | | SS | Split Spoon | | ST | Shelby Tube | | UD | Undisturbed Sample | | VA | Vane Shear |

| General Notes |
|--|
| 1) In general, Unified Soil Classification Designation presented on the logs were evaluated by visual methods only. Therefore, actual designations (based on laboratory testing) may differ. |
| 2) Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual. |
| 3) Logs represent general soil conditions observed at the point of exploration on the date indicated. |
| 4) No warranty is provided as to the continuity of soil conditions between individual sample locations. |

| Modifiers | | | | | |
|---|---------|--|----------------------|--------|----------------------|
| Fine Grained Soils | | | Coarse Grained Soils | | |
| Granular Portion | | | Granular Portion | | Fine Grained Portion |
| Description | % | | Description | % | Description |
| Trace | 5 - 15 | | Trace | 5 - 15 | Trace |
| With | 15 - 30 | | With | > 15 | With |
| Use Modifier | > 30 | | | | Use Modifier |
| Coarse grained soils with 5 to 12% fines require dual symbols | | | | | |

| Moisture Content | |
|------------------|---|
| Description | Criteria |
| Dry | Absence of moisture, dusty, dry to the touch |
| Damp | Apparent moisture, but below optimum |
| Moist | Damp, no visible water; at or near optimum moisture |
| Very Moist | Above optimum moisture content |
| Wet | Well above optimum moisture content |

| Cementation | |
|-------------|--|
| Description | Criteria |
| Weakly | Crumbles or breaks with handling or slight finger pressure |
| Moderately | Crumbles or breaks with considerable finger pressure |
| Strongly | Will not crumble or break with finger pressure |

| Coarse Grained Soils | | | |
|----------------------|----------------|----------------------|---|
| Apparent Density | SPT (blows/ft) | Relative Density (%) | Field Test |
| Very Loose | < 4 | 0 - 15 | Easily penetrated with 1/2" reinforcing rod pushed by hand |
| Loose | 4 - 10 | 15 - 35 | Difficult to penetrate with 1/2" reinforcing rod pushed by hand |
| Medium Dense | 10 - 30 | 35 - 65 | Easily penetrated a foot with 1/2" reinforcing rod driven by a 5 lb hammer |
| Dense | 30 - 50 | 65 - 85 | Difficult to penetrate a foot with 1/2" reinforcing rod driven by a 5 lb hammer |
| Very Dense | > 50 | 85 - 100 | Penetrated only a few inches with 1/2" reinforcing rod driven by a 5 lb hammer |

| Water Level Symbols | |
|---------------------|--|
| | Water Level (where first encountered) |
| | Water Level (after completion) |

| Fine Grained Soils | | | | |
|--------------------|----------------|--------------------------------|---------------------------------------|---|
| Consistency | SPT (blows/ft) | Torvane | Pocket Penetrometer | Field Test |
| | | Undrained Shear Strength (tsf) | Unconfined Compressive Strength (tsf) | |
| Very Soft | < 2 | < 0.125 | < 0.25 | Easily penetrated several inches by thumb. Squeezes through fingers. |
| Soft | 2 - 4 | 0.125 - 0.25 | 0.25 - 0.5 | Easily penetrated 1" by thumb. Molded by light finger pressure. |
| Firm | 4 - 8 | 0.25 - 0.5 | 0.5 - 1.0 | Penetrated over 1/2" by thumb with slight effort. Molded by strong finger pressure. |
| Stiff | 8 - 15 | 0.5 - 1.0 | 1.0 - 2.0 | Indented about 1/2" by thumb but penetrated only with great effort. |
| Very Stiff | 15 - 30 | 1.0 - 2.0 | 2.0 - 4.0 | Readily indented by thumbnail. |
| Hard | > 30 | > 2.0 | > 4.0 | Indented with difficulty by thumbnail. |

| Stratification | |
|----------------|-----------------------------------|
| Description | Thickness |
| Seam | 1/16" - 1/2" |
| Layer | 1/2" - 12" |
| Occasional | one or less per foot of thickness |
| Frequent | foot of thickness |

Figure:
A-1



Innovate Geotechnical
 2006 E Franklin Rd, Ste 110
 Meridian, Idaho 83642
 Telephone: (208)484-1090

TEST PIT NUMBER TP-1

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 2/26/25 09:43 - C:\USERS\MACIELARRANAGA\ONE DRIVE - INNOVATE GEOTECHNICAL\DOCUMENTS\325012 - BUCK BLUFF SUBDIVISION\BUCK BLUFF SUBDIVISION - TP LOGS.GPJ

CLIENT Ryno Engineering
PROJECT NUMBER 325012
DATE STARTED 1/30/25 **COMPLETED** 1/30/25
EXCAVATION CONTRACTOR Ryno Engineering
EXCAVATION METHOD Excavator
LOGGED BY S. Olsen **CHECKED BY** M. Larranaga
NOTES Approximate Location: 43.92339, -116.27007

PROJECT NAME Buck Bluff Subdivision
PROJECT LOCATION Boise County, Idaho
GROUND ELEVATION 2755 ft **TEST PIT SIZE** inches
GROUND WATER LEVELS:
AT TIME OF EXCAVATION ---
AT END OF EXCAVATION ---
AFTER EXCAVATION ---

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS | | | FINES CONTENT (%) |
|------------|-------------|---|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------------------|
| | | | | | | | | | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | |
| 0.0 | | SILTY SAND, (SM) proposed septic location | | | | | | | | | | |
| 2.5 | | | | | | | | | | | | |
| 5.0 | | POORLY GRADED SAND, (SP) decomposed granite | | | | | | | | | | |

Bottom of test pit at 5.0 feet.



Innovate Geotechnical
 2006 E Franklin Rd, Ste 110
 Meridian, Idaho 83642
 Telephone: (208)484-1090

TEST PIT NUMBER TP-1B

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 2/26/25 09:43 - C:\USERS\MACIELARRANAGA\ONEDRIVE - INNOVATE GEOTECHNICAL\DOCUMENTS\325012 - BUCK BLUFF SUBDIVISION\BUCK BLUFF SUBDIVISION - TP LOGS.GPJ

| | |
|--|---|
| CLIENT <u>Ryno Engineering</u> | PROJECT NAME <u>Buck Bluff Subdivision</u> |
| PROJECT NUMBER <u>325012</u> | PROJECT LOCATION <u>Boise County, Idaho</u> |
| DATE STARTED <u>1/30/25</u> COMPLETED <u>1/30/25</u> | GROUND ELEVATION <u>2703 ft</u> TEST PIT SIZE <u>inches</u> |
| EXCAVATION CONTRACTOR <u>Ryno Engineering</u> | GROUND WATER LEVELS: |
| EXCAVATION METHOD <u>Excavator</u> | AT TIME OF EXCAVATION <u>---</u> |
| LOGGED BY <u>S. Olsen</u> CHECKED BY <u>M. Larranaga</u> | AT END OF EXCAVATION <u>---</u> |
| NOTES <u>Approximate Location: 43.92313, -116.27098</u> | AFTER EXCAVATION <u>---</u> |

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS | | | FINES CONTENT (%) |
|------------|-------------|---|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------------------|
| | | | | | | | | | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | |
| 0.0 | | Furtherest east lot, rock outcropping/boulders throughout, no evidence of slope instability | | | | | | | | | | |
| 2.5 | | SILTY SAND, (SM) brown, dry, medium dense | GB 1 | | | | | | | | | |
| 5.0 | | Dense, harder digging | | | | | | | | | | |
| 7.5 | | POORLY GRADED SAND, (SP) 5 % gravel, 95 % sand, 0.2 % fines, brown, deposited granite | GB 2 | | | | | 4 | | | | 0 |

Bottom of test pit at 8.5 feet.



Innovate Geotechnical
 2006 E Franklin Rd, Ste 110
 Meridian, Idaho 83642
 Telephone: (208)484-1090

TEST PIT NUMBER TP-2

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 2/26/25 09:43 - C:\USERS\MACIELARRANAGA\ONEDRIVE - INNOVATE GEOTECHNICAL DOCUMENTS\325012 - BUCK BLUFF SUBDIVISION\BUCK BLUFF SUBDIVISION - TP LOGS.GPJ

| | |
|---|--|
| CLIENT <u>Ryno Engineering</u> PROJECT NUMBER <u>325012</u> DATE STARTED <u>1/30/25</u> COMPLETED <u>1/30/25</u> EXCAVATION CONTRACTOR <u>Ryno Engineering</u> EXCAVATION METHOD <u>Excavator</u> LOGGED BY <u>S. Olsen</u> CHECKED BY <u>M. Larranaga</u> NOTES <u>Approximate Location: 43.92337, -116.27197</u> | PROJECT NAME <u>Buck Bluff Subdivision</u> PROJECT LOCATION <u>Boise County, Idaho</u> GROUND ELEVATION <u>2718 ft</u> TEST PIT SIZE <u>inches</u> GROUND WATER LEVELS: AT TIME OF EXCAVATION <u>---</u> AT END OF EXCAVATION <u>---</u> AFTER EXCAVATION <u>---</u> |
|---|--|

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS | | | FINES CONTENT (%) |
|------------|------------------|--|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------------------|
| | | | | | | | | | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | |
| 0.0 | | SILTY SAND, (SM) brown, rock outcropping/boulders | | | | | | | | | | |
| 2.5 | [Dotted pattern] | POORLY GRADED SAND WITH GRAVEL, (SP) 20 % gravel, 79 % sand, 1.1 % fines, brown, medium dense to dense | [Hand icon] GB 1 | | | | | 9 | | | | 1 |
| 5.0 | [Dotted pattern] | Decoposed granite | [Hand icon] GB 2 | | | | | | | | | |
| 7.5 | [Dotted pattern] | | | | | | | | | | | |

Bottom of test pit at 8.0 feet.



Innovate Geotechnical
 2006 E Franklin Rd, Ste 110
 Meridian, Idaho 83642
 Telephone: (208)484-1090

TEST PIT NUMBER TP-3

CLIENT Ryno Engineering
PROJECT NUMBER 325012
DATE STARTED 1/30/25 **COMPLETED** 1/30/25
EXCAVATION CONTRACTOR Ryno Engineering
EXCAVATION METHOD Excavator
LOGGED BY S. Olsen **CHECKED BY** M. Larranaga
NOTES Approximate Location: 43.92294, -116.27300

PROJECT NAME Buck Bluff Subdivision
PROJECT LOCATION Boise County, Idaho
GROUND ELEVATION 2636 ft **TEST PIT SIZE** inches
GROUND WATER LEVELS:
AT TIME OF EXCAVATION ---
AT END OF EXCAVATION ---
AFTER EXCAVATION ---

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 2/26/25 09:43 - C:\USERS\MACIELARRANAGA\ONEDRIVE - INNOVATE GEOTECHNICAL DOCUMENTS\325012 - BUCK BLUFF SUBDIVISION\BUCK BLUFF SUBDIVISION - TP LOGS.GPJ

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS | | | FINES CONTENT (%) |
|------------|-------------|--|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------------------|
| | | | | | | | | | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | |
| 0.0 | | Rock outcropping/boulders at higher elevations | | | | | | | | | | |
| 2.5 | | SILTY SAND, (SM) 1 % gravel, 78 % sand, 21 % fines, brown, dry, medium dense | GB 1 | | | | | 10 | | | | 21 |
| 5.0 | | | | | | | | | | | | |
| 7.5 | | 12 % fines, less fines | GB 2 | | | | | 3 | | | | 12 |

Bottom of test pit at 9.0 feet.



Innovate Geotechnical
 2006 E Franklin Rd, Ste 110
 Meridian, Idaho 83642
 Telephone: (208)484-1090

TEST PIT NUMBER TP-4

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 2/26/25 09:43 - C:\USERS\MACIELARRANAGA\ONEEDRIVE - INNOVATE GEOTECHNICAL\DOCUMENTS\325012 - BUCK BLUFF SUBDIVISION\BUCK BLUFF SUBDIVISION - TP LOGS.GPJ

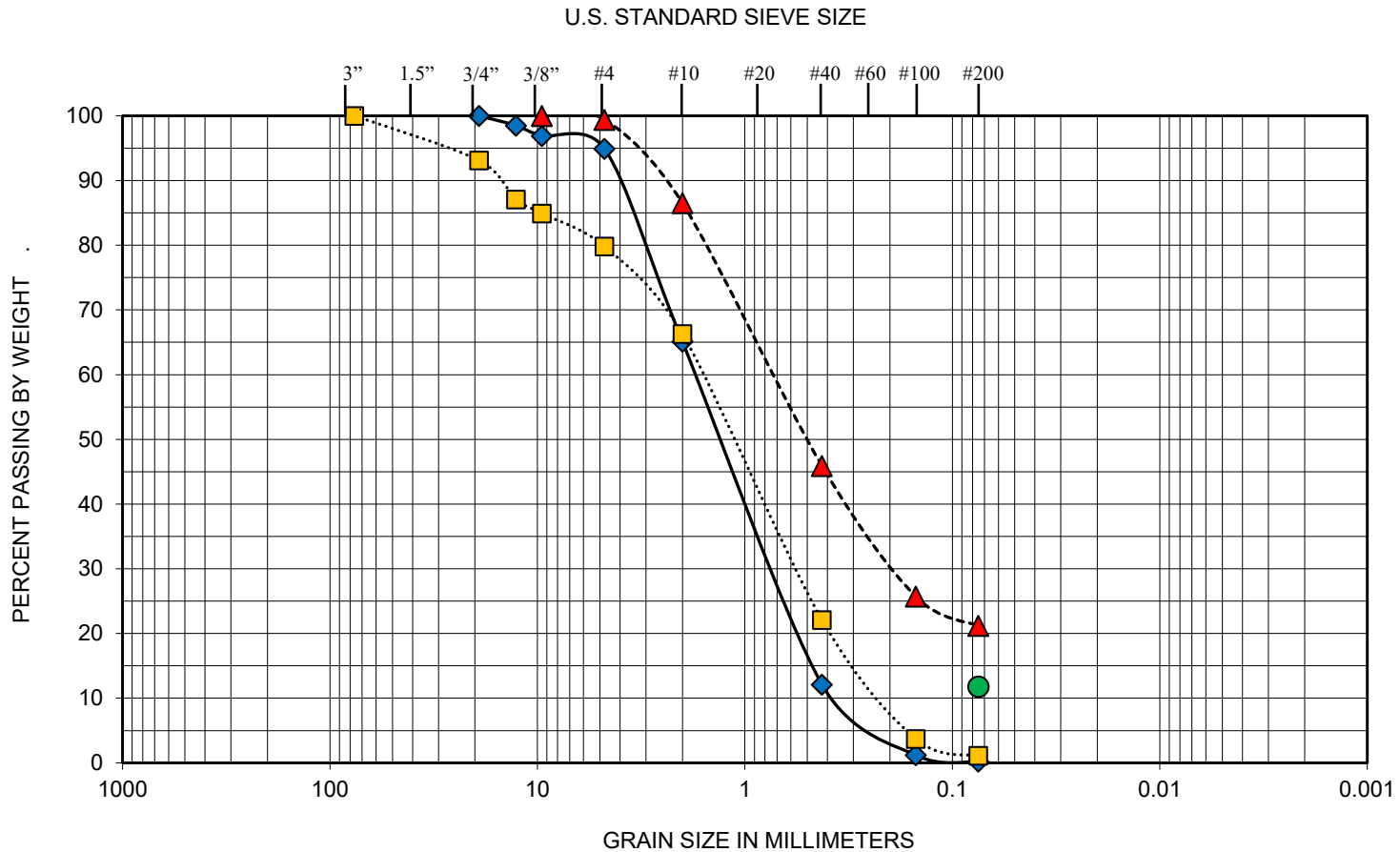
CLIENT Ryno Engineering
PROJECT NUMBER 325012
DATE STARTED 1/30/25 **COMPLETED** 1/30/25
EXCAVATION CONTRACTOR Ryno Engineering
EXCAVATION METHOD Excavator
LOGGED BY S. Olsen **CHECKED BY** M. Larranaga
NOTES Approximate Location: 43.92306, -116.27370

PROJECT NAME Buck Bluff Subdivision
PROJECT LOCATION Boise County, Idaho
GROUND ELEVATION 2621 ft **TEST PIT SIZE** inches
GROUND WATER LEVELS:
AT TIME OF EXCAVATION ---
AT END OF EXCAVATION ---
AFTER EXCAVATION ---

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS | | | FINES CONTENT (%) |
|------------|-------------|--|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------------------|
| | | | | | | | | | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | |
| 0.0 | | | | | | | | | | | | |
| 2.5 | | Brown, moist SILTY SAND, (SM) 16 % fines, loose | GB 1 | | | | | 13 | | | | 16 |
| 5.0 | | | | | | | | | | | | |
| 7.5 | | 2 % gravel, 85 % sand, 13 % fines | GB 2 | | | | | 8 | | | | 13 |

Bottom of test pit at 8.0 feet.

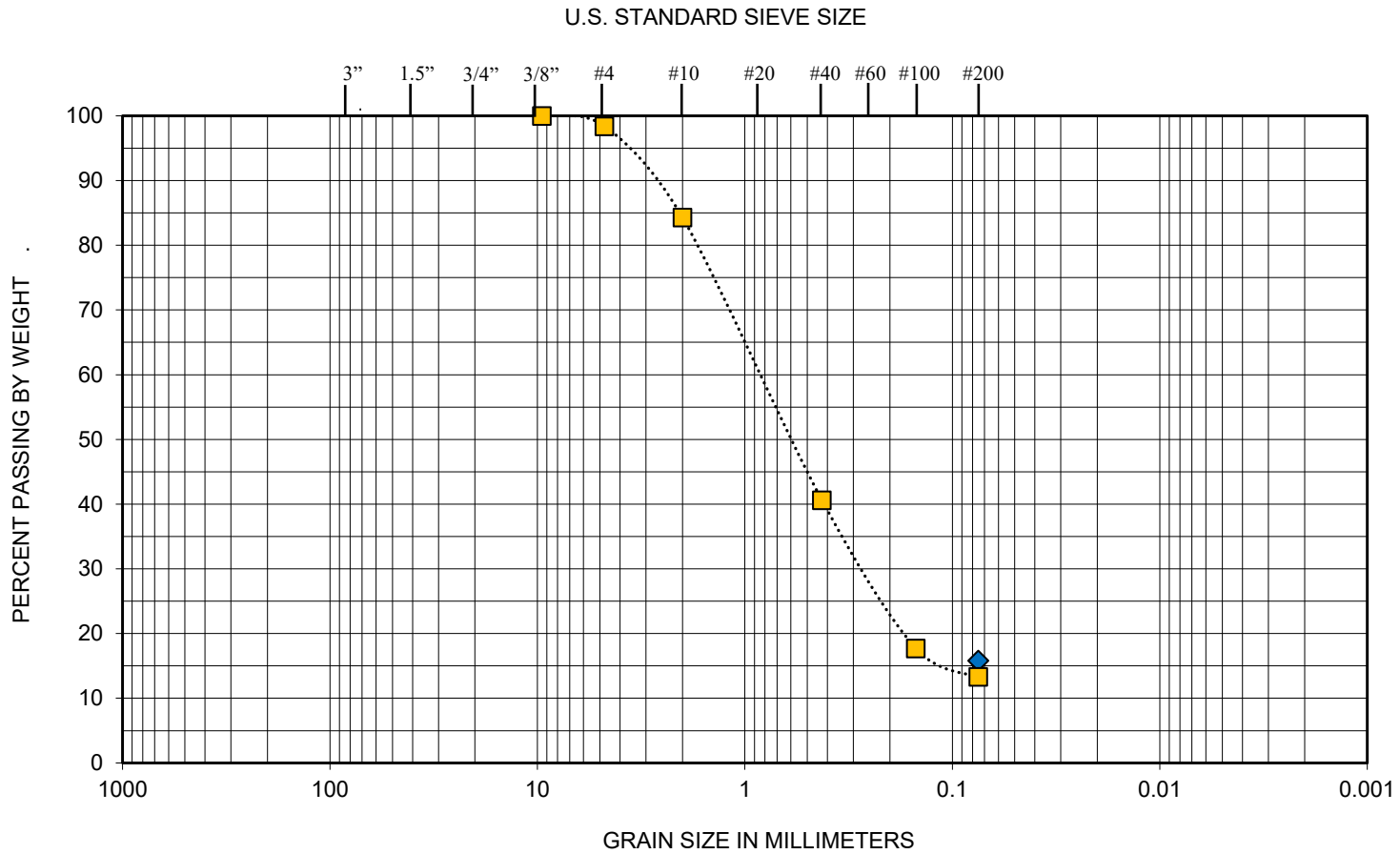
Appendix B



| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---------|--------|------|--------|--------|------|--------------|
| | COARSE | FINE | COARSE | MEDIUM | FINE | |

| Symbol | Boring/ Test Pit | Sample Depth (feet) | Moisture Content (%) | Gravel (%) | Sand (%) | Fines (%) | USCS Class | Soil Classification |
|--------|------------------|---------------------|----------------------|------------|----------|-----------|------------|--------------------------------|
| ◆ | TP-1B | 6 | 3.9 | 5 | 95 | 0.2 | SP | Poorly graded sand |
| ■ | TP-2 | 2 | 9.0 | 20 | 79 | 1.1 | SP | Poorly graded sand with gravel |
| ▲ | TP-3 | 2.5 | 9.6 | 1 | 78 | 21 | SM | Silty sand |
| ● | TP-3 | 8 | 3.2 | - | - | 12 | SM | Silty sand |

| | | |
|--|-------------------------------|--------------------|
| <p>Sieve Analysis Results</p> <p>Boise County, Idaho</p> | Buck Bluff Subdivision | |
| | Date: 2/26/2025 | Figure: B-1 |
| | Project: 325012 | |
| | Client: Ryno Engineering | |



| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---------|--------|------|--------|--------|------|--------------|
| | COARSE | FINE | COARSE | MEDIUM | FINE | |

| Symbol | Boring/ Test Pit | Sample Depth (feet) | Moisture Content (%) | Gravel (%) | Sand (%) | Fines (%) | USCS Class | Soil Classification |
|--------|---------------------|---------------------------|----------------------------|---------------|-------------|--------------|---------------|---------------------|
| ◆ | TP-4 | 2 | 12.7 | - | - | 16 | SM | Silty sand |
| ■ | TP-4 | 6.5 | 7.9 | 2 | 85 | 13 | SM | Silty sand |

| | | |
|--|-------------------------------|------------------------|
| IGEO INNOVATE GEO TECHNICAL Sieve Analysis Results Boise County, Idaho | Buck Bluff Subdivision | |
| | Date: 2/26/2025 | Figure: B-2 |
| | Project: 325012 | |
| | Client: Ryno Engineering | |

Appendix C

IGEO INNOVATE
GEO TECHNICAL