

SECTION 023213 - GEOTECHNICAL REPORT

PART 1 GENERAL

1.1. SECTION INCLUDES

- A. Geotechnical Investigation - Prineville Airport USFS Airbase Prineville, Oregon - February 1, 2018.
- B. Geotechnical Investigation - Memorandum - dated November 8, 2018.

END OF SECTION 023213



Geotechnical Investigation

**Prineville Airport
USFS Airbase**

Prineville, Oregon

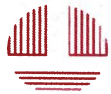
Prepared for:

**Precision Approach Engineering, Inc.
Corvallis, Oregon**

February 1, 2018

*Professional
Geotechnical
Services*

Foundation Engineering, Inc.



Foundation Engineering, Inc.

Professional Geotechnical Services

Tracy May, P.E.
Precision Approach Engineering, Inc.
5125 SW Hout Street
Corvallis, Oregon 97333

February 1, 2018

**Prineville Airport
USFS Airbase
Geotechnical Investigation
Prineville, Oregon**

Project 2171109

Dear Mr. May:

We have completed the requested geotechnical investigation for the above-referenced project. Our report includes a description of our work, a discussion of the site conditions, a summary of laboratory testing, and a discussion of engineering analyses. Recommendations for site preparation, foundation design and construction, and the construction of new pavements are enclosed.

It has been a pleasure assisting you with this phase of your project. Please do not hesitate to contact us if you have any questions or if you require further assistance.

Sincerely,

FOUNDATION ENGINEERING, INC.

A handwritten signature in blue ink, appearing to read "Matt Mason", is written above the printed name.

Matthew D. Mason, P.E.
Project Engineer

MDM/JCH/wg
enclosures

A handwritten signature in blue ink, appearing to read "Jonathan C. Huffman", is written above the printed name.

Jonathan C. Huffman, P.E., G.E.
Senior Engineer



GEOTECHNICAL INVESTIGATION

PRINEVILLE AIRPORT USFS AIRBASE PRINEVILLE, OREGON

BACKGROUND

A new U.S. Forest Service (USFS) Airbase facility is planned at the Prineville Airport. Preliminary plans indicate the facility will be located northeast of the airport. The facility will include a building, a training yard with rappel towers, landside parking lots, and driveways, helipads, and taxilanes. Access to the new facility will be provided from a new road extending east from Tom McCall Road and a taxilane near the east end of Runway 10-28. The project location is shown on Figure 1A (Appendix A). Figure 2A (Appendix A) shows a layout of the site.

Precision Approach Engineering, Inc. (PAE) is the prime engineering consultant for the project and will provide airside pavement design and other civil design services. Foundation Engineering, Inc. was retained by PAE to perform the subsurface investigation, conduct laboratory testing, and provide recommendations for subgrade preparation associated with construction of new pavement and foundation design for the new building and rappel tower.

Foundation Engineering completed a geotechnical investigation for the Runway 10-28 rehabilitation project in 2008 and an investigation in 2016 for new aprons and beacon tower. In addition, the current investigation is being completed in conjunction with the investigation for a tie-down apron between the USFS facility and Runway 10-28. Information from those investigations has been used to supplement the current work, where appropriate. The following sections summarize our work.

FIELD EXPLORATION

We completed field explorations on December 13 and 14, 2017. The explorations included twenty-five borings (BH-6 through BH-30) drilled using a trailer-mounted drill rig equipped with ± 4 -inch and 8-inch diameter solid-stem augers. The drilling was completed concurrently with the explorations for the proposed tie-down apron and the borings were numbered sequentially with those explorations (i.e., BH-1 through BH-5 were drilled for the apron). PAE surveyed the boring locations, which are shown on Figure 2A.

The borings extended to maximum depths ranging from ± 1.3 to 10 feet below the ground surface. Borings that were drilled shallower than 10 feet were discontinued after reaching practical drilling refusal on the surface of the underlying bedrock.

Representative soils samples were obtained at select depths by collecting the drill cuttings. At BH-27, a sample was obtained at a depth of ± 2.5 to 4 feet by driving a split-spoon sampler. The Standard Penetration Test (SPT), which is run when the

split-spoon is driven, provides an indication of the relative stiffness or density of the soils. Upon completion, the borings were backfilled with the drill cuttings.

The boreholes were continually logged during drilling. The final logs (Appendix B) were prepared based on a review of the field logs, laboratory test results, and an examination of the soil samples in our office. Table 1B (Appendix B) provides a summary of the estimated ground surface elevations, drilling depths, and estimated bedrock surface elevations at each borehole location.

DISCUSSION OF SITE CONDITIONS

The following sections provide a summary of the surface and subsurface conditions encountered in the borings. More specific details of the subsurface conditions are provided on the summary logs (Appendix B).

Surface Conditions

Prineville Airport is located on a high plateau west of the city center. The terrain across the site is relatively flat. Available survey information indicates the surface elevation typically slopes very gently down to the east. Prior to our site visit, a ± 12 -foot tall mound of fill had been stockpiled east of BH-17. The approximate location is identified on Figure 2A. The stockpile consists of primarily sandy silt with trace gravel, which is similar to the shallow soils encountered across the site. We assume the fill was likely generated from grading work during previous airport projects.

The planned USFS Airbase facility will be located northeast of the airport. The project site is presently undeveloped exception for a few unpaved trails. The ground surface is primarily covered with short grass, fescue, sagebrush, and short juniper or pine trees. Scattered, cobble to boulder-sized basalt fragments were observed on the ground surface. Additionally, potential bedrock outcropping (or possible large, buried boulders) were scattered throughout the site. The site is underlain by bedrock at relatively shallow depths, as discussed below.

Subsurface Conditions

The explorations encountered similar subsurface conditions across the project area, which typically included a layer of silty sand to sandy silt underlain by basaltic bedrock. Additional details of the individual layers are provided below.

Sandy Silt to Silty Sand

The surficial soils across the site consist of primarily brown, stiff sandy silt. Medium dense silty sand was also encountered at varying locations and depths. The silt is typically non-plastic or has low plasticity. The sand is typically fine or fine to medium-grained. The soil was dry to damp at the time of the exploration.

Within the project area, the sandy silt and silty sand typically extends to depths ranging from ± 1.3 to 5 feet, where it is underlain by basaltic bedrock. Deeper soil deposits were encountered in BH-10, BH-18, BH-19, BH-20, and BH-21. At BH-19 and BH-21,

the soil stratum extended to ± 8.5 feet. At BH-10, BH-18, and BH-20, the soil extended below ± 10 feet (the maximum depth of the boring). Most of the borings where the deeper soil profile was encountered are located within the northeast quadrant of the property (see Figure 2A).

As noted above, the existing fill stockpile adjacent to BH-17 appears to consist of material consistent with the sandy silt to silty sand encountered elsewhere across the site.

Bedrock

All the explorations except for BH-10, BH-18, and BH-20 terminated on basaltic bedrock of the Deschutes Formation. Drilling encountered practical refusal on the bedrock surface. No rock samples were obtained from the borings. However, bedrock outcrops scattered across the site indicate the bedrock are typically slightly to moderately weathered, soft to medium hard (R2 to R3), and vesicular. The basalt surface was encountered at depths ranging from ± 1.3 to 8.5 feet in the borings. The bedrock surface elevation of each boring location is summarized in Table 1B.

The Deschutes Formation basalt extends to depths ranging from tens to hundreds of feet below the ground surface within the vicinity of the airport. Deep borings (extending to a maximum depth of ± 90 feet) completed by others at the landfill north of the airport indicate the basalt is soft (R2) within the upper ± 1 to 2.5 feet, then typically becomes less weathered and hard (R4).

Ground Water

No ground water was observed in any of the current explorations for the USFS facility or the planned tie-down apron.

Most of our explorations completed for previous projects across the airport also did not encounter ground water. The only exception is one pavement core (completed in 2016) that was located southwest of Runway 10-28, near the recently-completed run-up apron. Ground water at that location was encountered at ± 4.5 feet and was likely perched on the underlying bedrock.

Based on our current and previous exploration, we anticipate shallow ground water is not common. However, during periods of heavy rain, ground water may perch at shallow depths on the bedrock surface due to its low permeability. Ground water, if present, may also be localized in some areas due to the undulating surface of the underlying bedrock.

LABORATORY TESTING

Index Tests

The laboratory work included natural water content determinations, Atterberg limits tests, and mechanical sieve and hydrometer analyses to classify the soils and estimate their overall engineering properties. The results of the index tests are summarized on Table 1C and on Figures 1C and 2C (Appendix C).

The Atterberg limits tests were completed on bulk samples obtained from TP-17 (S-17-1) and TP-22 (S-22-1). The test results for S-17-1 indicated the sample is non-plastic (i.e., PI value very close or equal to zero) with a resulting FAA/USCS classification of ML (i.e., low plasticity silt). The results for S-22-1 indicated the sample has a liquid limit (LL) of 50, a plasticity index (PI) of 16, and a resulting FAA/USCS classification of ML. The PI value of sample S-22-1 indicates low to medium plasticity. In general, most other samples obtained during the exploration were non-plastic or have a low plasticity.

Mechanical sieve and hydrometer analyses were completed on bulk samples S-17-1 and S-22-1. The results are generally consistent with the Atterberg limits tests, indicating primarily fine-grained soils (i.e., silt and clay-sized particles) with $\pm 35\%$ to 45% fine to medium sand.

Moisture-Density and CBR Tests

Standard Proctor moisture-density curves (ASTM D698) were developed for bulk samples S-17-1 and S-22-1. The results are summarized in Figures 3C and 5C (Appendix C). The test results for S-17-1 indicate a maximum dry density of 98.7 pcf at an optimum moisture content of 18%. The test results for S-22-1 indicate a maximum dry density of 76.4 pcf at an optimum moisture content of 30.5%. The current test results bound the range of results observed from previous testing at the airport.

California Bearing Ratio (CBR, ASTM D1883) tests were also completed on samples S-17-1 and S-22-1 using the results from the compaction tests. The CBR results are summarized in Figures 4C and 6C (Appendix C). For S-17-1, a CBR value of 9.4 was recorded for the sample compacted to 95% relative compaction. For S-22-1, a CBR value of 4.5 was recorded for the sample compacted to 95% relative compaction.

Foundation Engineering previously completed moisture-density and CBR testing for a geotechnical investigation for the Runway 10-28 rehabilitation project in 2008 and for the apron and beacon tower project in 2016. We also completed testing for the current tie-down apron project that is located adjacent to the USFS facility. Results from those tests are summarized in Table 2C (Appendix C). The tests were completed on predominantly sandy silt (ML) with one test completed on silty sand (SM). The test results indicated maximum dry densities ranging from ± 76.4 to 98.7 pcf at optimum moisture contents ranging from $\pm 18.0\%$ to 30.5%. CBR values ranging from 1.5 to 9.4 were recorded for these samples.

The past and current CBR test results indicate a relatively wide range in values, even with similar sample material (i.e., sandy silt or silty sand). We attribute the variable results to the moisture-sensitive nature of the subgrade, particularly within the confines of the CBR testing procedure. Additional discussion and recommendations for a design CBR value are provided in the following section.

DISCUSSION OF GEOTECHNICAL CONSIDERATIONS AND DESIGN REQUIREMENTS - AIRSIDE PAVEMENTS

The following section provides pavement design recommendations associated with the new taxiways and helipads servicing the USFS facility. PAE will complete the pavement design and determine the required pavement section thicknesses.

Discussion of Subgrade Conditions

The explorations typically encountered subgrade consisting of sandy silt with FAA/USCS classification ML. Silty sand (FAA/USCS classification SM) was also encountered in some areas. Appendix A of the 2016 FAA Pavement Advisory (AC 150/5320-6F) indicates that soil classified as SM or ML is fair to good foundation material when not subject to frost action. Appendix A indicates the potential for frost action can range from slight to very high and drainage can range from fair to poor. Frost-susceptibility and drainage are discussed in subsequent sections of this report.

Basaltic bedrock was typically encountered at relatively shallow depths (i.e., ± 1.3 to 5 feet) across most of the site. The bedrock surface was deeper in the northeast quadrant of the site (i.e., ± 8.5 feet to greater than ± 10 feet). Depending on the final grades and the thickness of the new pavement section, bedrock may comprise a portion of the pavement subgrade for the planned improvements.

Subgrade Preparation and Parameters for New Pavement Design

The pavement subgrade will consist predominantly of silty sand to sandy silt, and may include areas where the pavement section is underlain directly by bedrock. The minimum pavement section will be predicated on the properties of the sandy silt. Where bedrock is encountered at the subgrade elevation, the base rock thickness may be reduced to limit the need for bedrock excavation. However, we recommend providing at least 4 inches of base rock between the bedrock and AC wearing course.

The laboratory testing indicated CBR values of 4.5 and 9.4 for subgrade samples compacted to 95% relative compaction (based on ASTM D698). Previous tests on similar subgrade at the site indicated CBR values ranging from 1.5 and 6.7. As discussed above, we believe the range in CBR values is reflective of the moisture-sensitive nature of the soil. With proper moisture control and compactive effort, the subgrade performance should be significantly better than what is indicated by the lower-bound test results. Based on the current and previous test results and observation of the subgrade materials, we recommend assuming a CBR value of 4 for designing new pavements. This value corresponds to a k-value of ± 84 pci for rigid pavement design, based on correlations provided in the 2016 FAA Pavement Advisory (AC 150/5320-6F).

Subgrade preparation for new pavements should follow all necessary requirements for Item P-152, as summarized in the most recent FAA Standard Specifications for construction of Airports Circular (AC no. 150/5370-10). The recommended CBR design value provided herein assumes the subgrade will be compacted to a minimum

of 95% relative compaction (based on the maximum dry density of ASTM D 698) prior to placing subbase and base rock. The predominantly silt subgrade is moisture-sensitive. Therefore, we recommend compacting it at or slightly dry of optimum moisture to reduce the risks of pumping. The prepared subgrade should be backfilled with base rock or subbase as soon as practical to limit moisture fluctuations (i.e., wetting or drying).

Where bedrock is exposed at the subgrade elevation, subgrade compaction will not be necessary. Subgrade preparation in these areas should include excavating the rock as required to provide a minimum of 4 inches of base rock beneath the AC and removing any soft soil from the rock surface. Preparation should also include close inspection of the bedrock surface and confirmation that no large voids (e.g., large vesicles or lava tubes) are present that would affect the performance of the new pavement.

Frost Considerations

The silty sand to sandy silt subgrade corresponds to a FAA/USCS soil classification of SM to ML. The percentage of soil finer than 0.02 mm is greater than 15%. Therefore, A FG-4 FAA frost group classification is appropriate. FG-4 subgrade is considered highly frost-susceptible.

Complete mitigation of the risk of detrimental frost heave typically requires overexcavation and replacement of frost-susceptible soils below the depth of frost penetration. The local building code in Crook County indicates a frost penetration depth of ± 18 inches. FAA (2016) indicates limited subgrade frost penetration may be used where FG-4 soil is present. This includes providing non-frost-susceptible material to at least 65% of the frost penetration depth (± 12 inches).

In some portions of the site, excavations to this depth may extend to bedrock. The bedrock is not considered frost-susceptible. Therefore, excavating below the bedrock surface to mitigate frost concerns is not necessary. Providing drainage to prevent the accumulation of water in the subgrade is also beneficial to reduce the risk of frost heave.

Site Drainage

The pavement will be underlain by predominantly silty sand to sandy silt with FAA/USCS classification ranging from SM to ML, followed by moderately weathered basalt. The 2016 FAA Pavement Advisory (AC 150/5320-6F), Appendix A, indicates the drainage characteristics of these soils have fair to poor drainage characteristics.

The 2013 FAA Surface Drainage Design Advisory Circular (AC 150/5320-5D), Figure G-3, suggests a coefficient of permeability, k , for sandy silt in the range of 10^{-8} cm/sec, which corresponds to practically impermeable soil. Other texts report a larger range and generally higher permeability. We anticipate the permeability of the sandy silt will be significantly higher than 10^{-8} cm/sec. However, the underlying bedrock is expected to be practically impermeable (unless large cracks or vesicles

are present in the bedrock). Therefore, we believe it is reasonable to assume a k value of 10^{-8} cm/sec for evaluating drainage alternatives.

Construction Considerations

Site Stripping

For construction of the new pavements, we recommend assuming a nominal stripping depth of 2 inches to remove the bulk of the organics. Deeper stripping depths may be required in isolated areas to remove deeper roots or other deleterious materials.

Construction Timing

We recommend completing the earthwork during the dry summer months (typically July through September), when it should be practical to adjust the moisture content of the soil to near optimum and compact the subgrade. The contractor may still experience pumping problems and have difficulty achieving adequate compaction in the summer if the soils have not adequately dried.

The silty sand to sandy silt will be moisture-sensitive and will soften considerably when wet. Compaction of the subgrade will not be practical during wet weather. Therefore, if construction during wet weather is necessary, it will likely require completely removing the overlying soils where bedrock is shallow. Where rock is deeper, ± 18 to 24 inches of subbase and/or base rock over a separation geotextile would likely be required to prevent subgrade pumping. Geogrid could also be used to help reinforce the pavement section over soft soils. The actual recommended fill thickness and use of geogrid would depend on the subgrade density and moisture content, and the depth to bedrock.

Bedrock Excavation

Basalt was encountered across the site at varying depths. The subsurface explorations indicate an undulating rock surface with bedrock depths ranging from ± 1.3 to greater than ± 10 feet below the current ground surface. Observed bedrock depths and estimated elevations are summarized in Table 1B.

Our explorations using a small, trailer-mounted drill encountered practical drilling refusal at the bedrock surface. The basalt surface is typically slightly to moderately weathered and vesicular. The relative hardness of the rock near the surface appeared to range from soft to medium hard (R2 to R3). However, we anticipate the rock will become less weathered and harder with depth. We believe it would be prudent to assume a rock hardness of R4 for the bedrock below the weathered surface. The rock description sheet included in Appendix B provides a summary of rock hardness classifications.

If rock excavation was required as part of recent construction projects at the airport, the details from that excavation work should be made available for contractors bidding on this project to better identify the range of expected rock hardness and appropriate excavation techniques (e.g., digging, ripping and/or blasting).

Fill Materials and Compaction

The observed on-site fill includes a ± 12 -foot tall soil stockpile located immediately east of BH-17. The fill consists of predominantly sandy silt with trace gravel. This material may be used to raise the site grade, if required, during dry weather conditions only. This material should not be considered as a substitute for a subbase material. The fill should be placed and compacted as described below.

Base rock for the new pavements should consist of $\frac{3}{4}$ or 1-inch minus, clean (i.e., less than 5% passing the No. 200 sieve), well-graded, crushed gravel or rock conforming to FAA P-209 requirements. Subbase material should consist of free-draining sand, gravel, rock, asphalt grindings, or mixtures of the above that are free of plastic clay and organic matter that conforms to FAA P-154 requirements.

All fill should be placed in level lifts not exceeding 12 inches and compacted to a minimum of 95% relative compaction. The maximum dry density of ASTM D 698 should be used as the standard for estimating relative compaction. The moisture content of the fill should be adjusted to within $\pm 2\%$ of its optimum value prior to compaction. Efficient compaction of fine-grained soils (where appropriate) will typically require the use of a padfoot or kneading roller to achieve the required compaction. Granular fill (sand, rock or gravel) and sand or non-plastic silt subgrade will compact most efficiently with a smooth drum, vibratory roller. Field density tests should be run frequently to confirm adequate compaction of the base rock, subbase, and subgrade. Adequate compaction of fill materials, which are too coarse or too variable for density testing, should be evaluated by observation of the compaction method and proof-rolling with a loaded dump truck or other approved heavy construction vehicle.

ENGINEERING ANALYSIS AND DESIGN RECOMMENDATIONS - USFS FACILITY

The following sections summarize our engineering analyses and provides design recommendations for the USFS facility, including building structures and landside pavements. The site is underlain at shallow depths by basaltic bedrock. Therefore, we assume the new airbase building and rappel tower will be supported on shallow foundations (i.e., spread footings or mat).

Seismic Design Criteria

A design spectral acceleration response spectrum for the site was developed in accordance with the Oregon Structural Specialty Code (OSSC) 2014, which is based on International Building Code (IBC) 2012 Section 1613. The design maximum considered earthquake ground motion maps in IBC 2012 are based on modified USGS 2008 maps with a 1% probability of exceedance in 50 years (i.e., a $\pm 4,975$ -year return period) for design spectral accelerations. The modifications include factors to adjust the spectral accelerations to account for directivity and risk.

Based on subsurface profile encountered in the explorations, we have concluded a Site Class B (Rock) is appropriate for design. The seismic design parameters and OSSC response spectrum are shown on Figure 3A (Appendix A).

We believe the risk of liquefaction is negligible due to the presence of shallow bedrock, the stiffness, and limited thickness of the surficial soil, and the absence of persistent ground water.

Building Foundations

Bearing Capacity and Settlement

Borings BH-28 and BH-29 were located within the footprint of the planned USFS building, and BH-27 was located near the proposed rappel tower. The subsurface profile encountered at these locations consists of stiff sandy silt to a depth of ± 2 to 4 feet, followed by bedrock. We did not encounter high plasticity (i.e., expansive) clay, organic soil, construction debris, or other deleterious materials within the explorations.

Based on the subsurface conditions encountered, we recommend assuming an allowable bearing pressure of 2,500 lbs/ft² (psf) for designing shallow, spread or continuous footings and/or mat foundations. This bearing pressure is predicated on the estimated bearing strength of the sandy silt, and may be increased significantly, if needed, for footings that extend to bedrock. The design bearing pressure assumes a typical factor of safety of 3. A one-third increase in this allowable bearing pressure may be assumed for transient (i.e., wind and seismic) loading. Settlement associated with the allowable bearing pressure is expected to be $\pm \frac{1}{2}$ inch or less.

For all footings underlain by native soils (i.e., sandy silt or silty sand), we recommend the footings be underlain by a minimum of 6 inches of compacted crushed gravel or rock meeting the requirements for Base Rock, as defined below. The granular fill should also extend at least 6 inches beyond the footprint of the foundations. Foundation excavations should be completed with an excavator equipped with a smooth-edged bucket, operating outside of the excavation to limit disturbance to the foundation soils. Base Rock beneath the footings may be eliminated where the footing excavations extend to bedrock.

Sliding Coefficient and Passive Resistance

A sliding coefficient of 0.5 is recommended for footings poured on compacted granular fill or directly on bedrock.

Passive resistance of the soil in front of the footings was calculated as an equivalent fluid density equal to $\gamma * K_p$, where γ is the unit weight of the soil and K_p is the passive earth pressure coefficient. We calculated an equivalent fluid density of ± 350 pcf for the ultimate passive resistance (assuming drained conditions).

The base sliding resistance will develop with very small translational movement. However, development of the full passive resistance in front of the buried footings would likely require excessive translation of the footings. Assuming small movements (on the order of a fraction of an inch), we recommend using one-third of the ultimate passive resistance in combination with the base friction. Therefore, a coefficient of friction of 0.5 and an allowable passive resistance of ± 115 pcf are recommended for design.

Slab-on-Grade

If slab-on-grade floors are planned for the new building, we recommend the structure be underlain by a minimum of 12 inches of compacted granular fill. If designed and constructed as recommended herein, a modulus of subgrade reaction of 200 lb/in³ (pci) is recommended for floor slab design.

Landside Pavements – Access Roads and Parking Lot

New landside pavements will include an access road extending west from Tom McCall Road and parking lot to service the new USFS facility. We understand the access road is being designed per City of Prineville requirements for an Industrial Street. The standard pavement section for an Industrial Street includes 4 inches of AC over 10 inches of compacted Base Rock. We anticipate this section will be adequate for the anticipated traffic, provided it is constructed over subgrade prepared to the same requirements as the airside pavements.

Based on the City of Prineville minimum requirements, Crook County, and the Oregon Department of Transportation Pavement Design Guide (ODOT, 2011), the following pavement section and mix design is recommended for the access road and parking lot:

- 4 inches of Level 2, ½-inch Dense-Graded HMAC Wearing Course with PG 64-28 binder. The AC should be placed in two equal lifts.
- 10 inches of Base Rock. Base Rock should conform to the material requirements of either ODOT 2018 Standard Specifications for Construction for ¾-inch minus Base Aggregate (ODOT Section 02630.10) or FAA Item P-209.

For cost considerations, the design team may consider reducing the AC thickness in area with limited traffic (e.g., parking stalls or areas with no truck access). For these areas, 3 inches of AC should suffice.

If bedrock is encountered shallower than 14 inches below the planned AC surface, the base rock thickness should be reduced, as needed, to limit rock excavation. However, we recommend providing a minimum of 4 inches of Base Rock beneath the AC.

CONSTRUCTION RECOMMENDATIONS – USFS AIRBASE & RAPPEL TOWER

Earthwork Materials and Compaction Recommendations

1. Base Rock should consist of durable, ¾ or 1-inch minus, clean (i.e., less than 5% passing the #200 U.S. Sieve), well-graded, crushed gravel or rock.

The Base Rock defined herein should conform to the material requirements of the ODOT 2018 Standard Specification for Construction, Section 02630.10. Alternatively, it may be specified based on FAA Item P-209 standards.

2. Drain Rock should consist of 1 to 2-inch, clean (i.e., less than 2% passing the #200 sieve), open-graded gravel or rock.
3. Separation Geotextile should consist of a woven geotextile with Mean Average Roll Value (MARV) strength properties meeting the requirements of an AASHTO M 288-17 Class 2 geotextile. The geotextile should have a permittivity greater than 0.1 sec^{-1} and an Apparent Opening Size (AOS) less than 0.6 mm.
4. Filter Fabric should consist of a non-woven geotextile meeting the requirements of an AASHTO M 288-17 Class 2 Subsurface Drainage Geotextile. The fabric should have a maximum average roll value apparent opening size (AOS) of 0.22 mm and a permittivity greater than 0.1 sec^{-1} based on soil with greater than 50% fines.
5. Compact all fill in loose lifts not exceeding 12 inches. Thinner lifts (maximum 6 inches) may be required if light or hand-operated equipment is used. Compact all fill to a minimum of 95% relative compaction, unless otherwise specified. The maximum dry density of ASTM D 698 should be used as the standard for estimating relative compaction, unless otherwise specified. The moisture content of the fill should be adjusted to within $\pm 2\%$ of its optimum value prior to compaction.

Field density tests should be run frequently to confirm adequate compaction of the fill and subgrade. Fill that is too coarse or variable for density testing should be proof-rolled using a loaded, 10-yd³ dump truck or other approved vehicle. Areas of pumping or deflection observed beneath the truck wheels should be moisture-conditioned (during dry weather only) and recompacted. If moisture-conditioning is impractical, loose or soft subgrade soils should be overexcavated and replaced with compacted Base Rock and proof-rolled again.

Foundation Design

6. Place the base of all footings at least 18 inches below the exterior finish grade. Provide a minimum of 6 inches of compacted Base Rock beneath the footings underlain by stiff sandy silt or bedrock. The Base Rock may be eliminated beneath footings that extend to bedrock.
7. Design all footings using an allowable bearing pressure of 2,500 psf with a factor of safety of 3. This value may be increased by one-third for short-term seismic loads.
8. Assume the foundations could experience total settlements of up to $\pm \frac{1}{2}$ inch. This estimate assumes all disturbed (i.e., loose or soft) soils will be removed from beneath new footings and slabs. A representative of Foundation Engineering should be on-site at the time of construction to confirm the suitability of the foundation conditions.

9. Design the new structures assuming the seismic parameters provided in Figure 3A (Appendix A).
10. Use a modulus of subgrade reaction, k_s , of 200 lb/in³ (pci) for floor slab design. This value assumes the floor slab will be constructed on a building pad consisting of at least 12 inches of compacted Base Rock underlain by compacted, native soils (i.e., sandy silt or silty sand) or bedrock. Reinforce the floor slabs to resist cracking and warping. Provide a suitable vapor barrier under the slab that is compatible with the proposed floor covering and the method of slab curing.

Site Preparation

11. Strip the existing ground ± 2 to 4 inches or as required to remove roots and sod. Deeper grubbing may be needed under any existing trees. Dispose of all strippings outside of construction areas, including pavements.
12. Grade the building footprint as required to accommodate a minimum 12-inch thick building pad. Where bedrock is encountered at the foundation elevation, the Base Rock thickness may be reduced to limit the need for bedrock excavation. Prior to placing fill, moisture-condition and compact the subgrade as recommended in Item 5.

Subgrade compaction will not be practical if site preparation occurs during wet weather. In that case, the building pad thickness should be increased to at least 18 inches (or to bedrock) and should be placed over undisturbed (i.e., uncompacted) subgrade. The actual recommended fill thickness will depend on the stiffness and/or density of the subgrade and the presence of shallow bedrock. A representative of Foundation Engineering should be present at the time of construction to confirm the subgrade conditions and determine if any additional excavation is needed.

13. Proof-roll the subgrade using a 10-yd³ dump truck or approved heavy construction vehicle prior to constructing the building pad. Any subgrade observed to be soft or pumping should be moisture-conditioned and recompacted (during dry weather only) or overexcavated and replaced with compacted Base Rock.
14. Use Base Rock to construct the building pad. A minimum building pad thickness of 12 inches is recommended for dry weather construction. This should be increased to at least 18 inches for wet weather construction. Place the fill in compacted lifts as recommended in Item 5.
15. Trench as required for the footings. All footing excavations should extend at least 6 inches below the bottom of the footings to allow placement of a leveling course of compacted Base Rock. Where bedrock

is encountered at the foundation elevation, the Base Rock thickness may be reduced to limit the need for bedrock excavation.

The Base Rock should extend at least 6 inches beyond the edges of the footings. A representative of Foundation Engineering should be present at the time of construction to confirm the suitability of the foundation soils and determine if any additional excavation is needed.

16. Grade the finished ground surface surrounding the building to promote runoff away from the foundations.

Drainage for Buildings

17. Install a foundation drain along the perimeter of the new buildings. The drain should consist of a 3 or 4-inch diameter, perforated or slotted, PVC pipe. The flowline of the pipe should be set near the base of the footings. The pipe should be bedded in at least 4 inches of Drain Rock and backfilled with Drain Rock to within 6 inches of the ground surface. The entire mass of Drain Rock should be wrapped in Filter Fabric that laps at least 12 inches at the top.
18. Provide clean-outs at appropriate locations for future maintenance of the drainage system.
19. Discharge the water from the drain system into the nearest catch basin, manhole or storm drain.

Subgrade Preparation and Pavement Construction – Landside Parking and Driveways

20. Strip the existing ground ± 2 to 4 inches or as required to remove roots and sod. Deeper grubbing may be needed under any existing trees. Dispose of all strippings outside of construction areas.
21. Grade the pavement areas to the planned subgrade elevation. Moisture-condition and compact the subgrade as recommended in Item 5 prior to placing fill.
22. Place a Separation Geotextile on the prepared subgrade that meets the requirements specified in Item 3. The Separation Geotextile should be laid smooth, without wrinkles or folds, in the direction of construction traffic. Overlap adjacent rolls a minimum of 2 feet. Pin fabric overlaps or place the granular fill in a manner that will not separate the overlap during construction. Seams that have separated will require removal of the granular fill to establish the required overlap.
23. Place the Base Rock in loose lifts. Compact the Base Rock as recommended in Item 5.
24. Proof-roll the completed Base Rock with an approved construction vehicle prior to paving. Overexcavate any areas of Base Rock pumping or deflection and replace with additional Base Rock.

25. Place and compact the AC to the requirements of either ODOT Section 00744, FAA P-401, or P-403 (based on recommendations from PAE).

DESIGN REVIEW/CONSTRUCTION OBSERVATION/TESTING

We should be provided the opportunity to review all drawings and specifications that pertain to site preparation and fill placement. Site preparation for new pavements and foundations will require field confirmation of the subgrade conditions. Mitigation of pumping subgrade and fill will also require engineering review and judgment. That judgment should be provided by one of our representatives. We recommend we be retained to provide the necessary construction observations.

VARIATION OF SUBSURFACE CONDITIONS, USE OF THIS REPORT AND WARRANTY

The analysis, conclusions and recommendations contained herein assume the soil and bedrock profiles encountered in the borings are representative of the site conditions. The above recommendations assume we will have the opportunity to review final drawings and be present during construction to confirm the assumed subgrade conditions. No changes in the enclosed recommendations should be made without our approval. We will assume no responsibility or liability for any engineering judgment, inspection or testing performed by others.

This report was prepared for the exclusive use of Precision Approach Engineering, Inc. and their design consultants for the Prineville Airport – USFS Airbase project in Prineville, Oregon. Information contained herein should not be used for other sites or for unanticipated construction without our written consent. This report is intended for planning and design purposes. Contractors using this information to estimate construction quantities or costs do so at their own risk. Our services do not include any survey or assessment of potential surface contamination or contamination of the soil or ground water by hazardous or toxic materials. We assume that those services, if needed, have been completed by others.

Our work was done in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made.

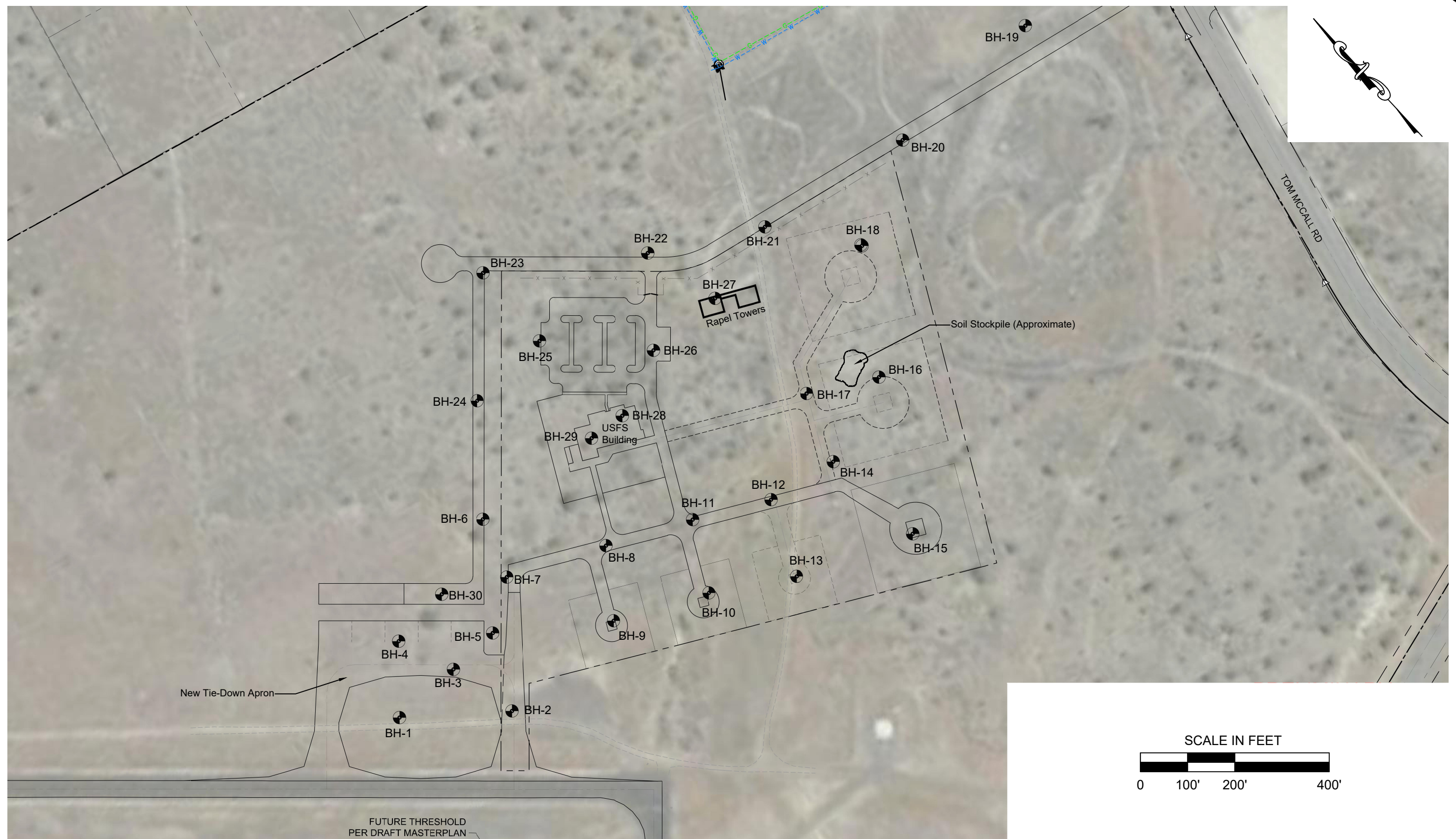
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- ASTM, 2014, *Standard Test Methods for CBR (California Bearing Ratio) of Laboratory-Compacted Soil*: American Society for Testing and Materials (ASTM), Standard D1883, vol. 04.08.
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- City of Prineville, 2013, *Standards and Specifications*.
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- FAA, 2014, *Standards for Specifying Construction of Airports Advisory Circular*: AC No. 150/5370-10G, Federal Aviation Administration.
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- Oregon Department of Transportation, 2018; *Oregon Standard Specifications for Construction*, Highway Division.



Appendix A

Figures



Notes:

1. Base map with surveyed borehole locations was provided by PAE.
2. BH-1 through BH-5 were completed for the 2018 New Tie-Down Apron project. BH-6 through BH-30 were completed for the 2018 USFS Airbase project.
3. See report for a discussion of subsurface conditions.



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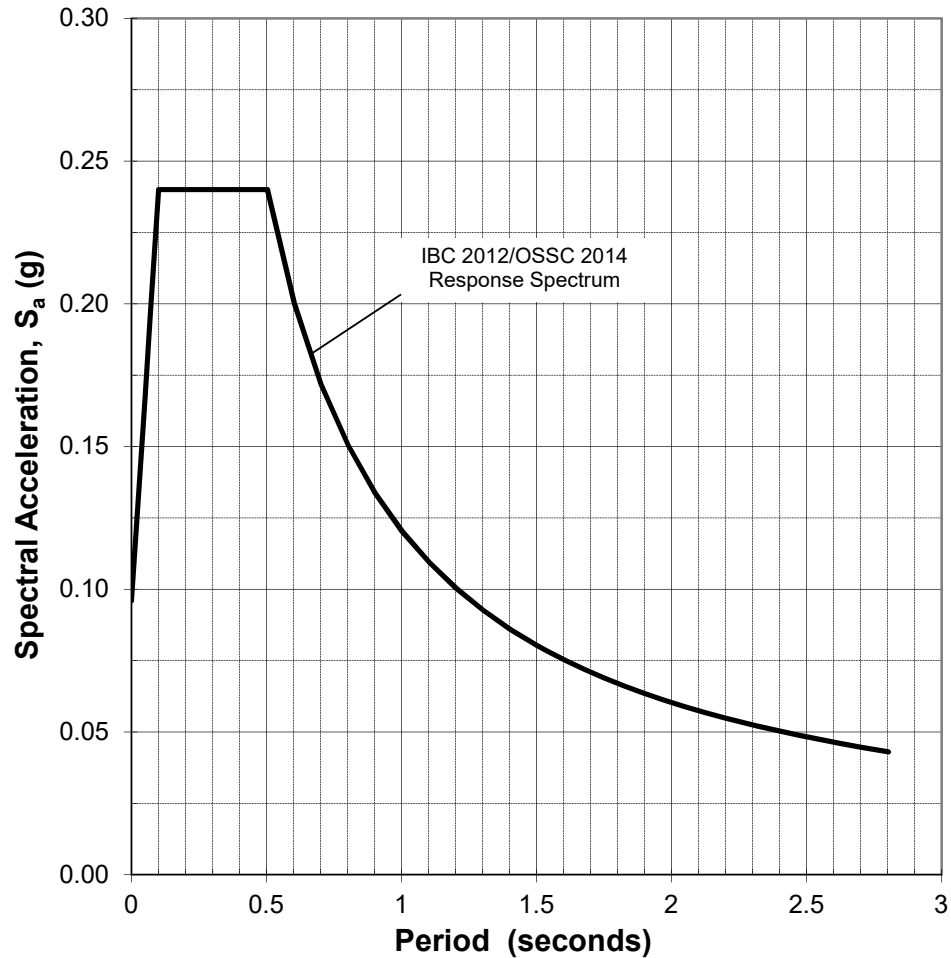
DATE JAN 2018
DWN. mdm
APPR. _____
REVIS. _____
PROJECT NO.
2171109

SITE LAYOUT AND BOREHOLE LOCATIONS
PRINEVILLE AIRPORT

USFS AIRBASE
PRINEVILLE, OREGON

FIGURE NO.

2A



Notes:

1. The Design Response Spectrum is based on IBC 2012 Section 1613.
2. The following parameters are based on the modified USGS 2008 maps provided in IBC 2012/OSSC 2014:

Site Class= B	Damping = 5%		
$S_S = 0.36$	$F_a = 1.00$	$S_{MS} = 0.36$	$S_{DS} = 0.24$
$S_1 = 0.18$	$F_v = 1.00$	$S_{M1} = 0.18$	$S_{D1} = 0.12$
3. S_S and S_1 values indicated in Note 2 are the mapped, risk-targeted maximum considered earthquake spectral accelerations for 1% probability of exceedence in 50 years.
4. F_a and F_v were established based on IBC 2012, Tables 1613.3.3(1) and 1613.3.3(2) using the selected S_S and S_1 values. S_{DS} and S_{D1} values include a 2/3 reduction on S_{MS} and S_{M1} as discussed in IBC 2012 Section 1613.3.4.
5. Site location is: Latitude 44.2887, Longitude -120.8941.

FIGURE 3A
IBC 2012/OSSC 2014 SITE RESPONSE SPECTRUM
Prineville Airport - USFS Airbase
Prineville, Oregon
Project 2171109



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Appendix B

Boring Logs

Foundation Engineering, Inc.

Table 1B. Summary of Bedrock Depths and Elevations

Exploration	¹ Surface Elevation (feet)	² Depth to Bedrock (feet)	³ Bedrock Elevation (feet)	Location Notes
BH-6	± El. 3233.8	± 2.0	± El. 3231.8	Access Road (proposed)
BH-7	± El. 3232.7	± 2.4	± El. 3230.3	Taxilane (proposed)
BH-8	± El. 3232.0	± 1.6	± El. 3230.4	Taxilane (proposed)
BH-9	± El. 3232.4	± 3.7	± El. 3228.7	Helipad (proposed)
BH-10	± El. 3230.0	> 10	n/a	Helipad (proposed)
BH-11	± El. 3227.9	± 2.2	± El. 3225.7	Taxilane (proposed)
BH-12	± El. 3226.7	± 4.0	± El. 3222.7	Taxilane (proposed)
BH-13	± El. 3229.7	± 5.0	± El. 3224.7	Helipad (proposed)
BH-14	± El. 3226.5	± 4.5	± El. 3222.0	Taxilane (proposed)
BH-15	± El. 3233.9	± 2.0	± El. 3231.9	Helipad (proposed)
BH-16	± El. 3228.2	± 3.9	± El. 3224.3	Helipad (proposed)
BH-17	± El. 3225.6	± 3.8	± El. 3221.8	Taxilane (proposed)
BH-18	± El. 3222.8	> 10	n/a	Helipad (proposed)
BH-19	± El. 3221.9	± 8.5	± El. 3213.4	Access Road (proposed)
BH-20	± El. 3222.2	> 10	n/a	Access Road (proposed)
BH-21	± El. 3223.8	± 8.5	± El. 3215.3	Access Road (proposed)

- Notes:**
1. Ground surface elevations were surveyed by Precision Approach Engineering, Inc.
 2. Drilling refusal in the borings occurred at the bedrock surface. Bedrock was not encountered in BH-10, BH-18, and BH-20.
 3. Bedrock elevations were estimated based on the estimated surface elevation and the measured depth of the bedrock surface.

Table 1B. Summary of Bedrock Depths and Elevations (Continued)

Exploration	¹ Surface Elevation (feet)	² Depth to Bedrock (feet)	³ Bedrock Elevation (feet)	Location Notes
BH-22	± El. 3227.5	± 2.7	± El. 3224.8	Access Road (proposed)
BH-23	± El. 3229.9	± 2.0	± El. 3227.9	Access Road (proposed)
BH-24	± El. 3232.5	± 2.6	± El. 3229.9	Access Road (proposed)
BH-25	± El. 3231.0	± 1.9	± El. 3229.1	Parking (proposed)
BH-26	± El. 3227.9	± 1.3	± El. 3226.6	Parking (proposed)
BH-27	± El. 3225.4	± 4.0	± El. 3221.4	Rappel Towers (proposed)
BH-28	± El. 3229.3	± 2.0	± El. 3227.3	USFS Building (proposed)
BH-29	± El. 3229.2	± 2.5	± El. 3226.7	USFS Building (proposed)
BH-30	± El. 3235.2	± 3.2	± El. 3232.0	Parking (proposed)

- Notes:**
1. Ground surface elevations were surveyed by Precision Approach Engineering, Inc.
 2. Drilling refusal in the borings occurred at the bedrock surface. Bedrock was not encountered in BH-10, BH-18, and BH-20.
 3. Bedrock elevations were estimated based on the estimated surface elevation and the measured depth of the bedrock surface.

DISTINCTION BETWEEN FIELD LOGS AND FINAL LOGS

A field log is prepared for each boring or test pit by our field representative. The log contains information concerning sampling depths and the presence of various materials such as gravel, cobbles, and fill, and observations of ground water. It also contains our interpretation of the soil conditions between samples. The final logs presented in this report represent our interpretation of the contents of the field logs and the results of the sample examinations and laboratory test results. Our recommendations are based on the contents of the final logs and the information contained therein and not on the field logs.

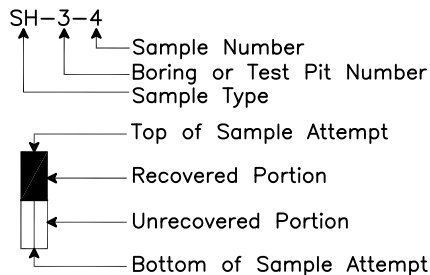
VARIATION IN SOILS BETWEEN TEST PITS AND BORINGS

The final log and related information depict subsurface conditions only at the specific location and on the date indicated. Those using the information contained herein should be aware that soil conditions at other locations or on other dates may differ. Actual foundation or subgrade conditions should be confirmed by us during construction.

TRANSITION BETWEEN SOIL OR ROCK TYPES

The lines designating the interface between soil, fill or rock on the final logs and on subsurface profiles presented in the report are determined by interpolation and are therefore approximate. The transition between the materials may be abrupt or gradual. Only at boring or test pit locations should profiles be considered as reasonably accurate and then only to the degree implied by the notes thereon.

SAMPLE OR TEST SYMBOLS



- S - Grab Sample
- SS - Standard Penetration Test Sample (split-spoon)
- SH - Thin-walled Shelby Tube Sample
- C - Pavement Core Sample
- CS - Rock Core Sample

- ▲ Standard Penetration Test Resistance equals the number of blows a 140 lb. weight falling 30 in. is required to drive a standard split-spoon sampler 1 ft. Practical refusal is equal to 50 or more blows per 6 in. of sampler penetration.
- Water Content (%).

UNIFIED SOIL CLASSIFICATION SYMBOLS

- | | |
|------------|---------------------|
| G - Gravel | W - Well Graded |
| S - Sand | P - Poorly Graded |
| M - Silt | L - Low Plasticity |
| C - Clay | H - High Plasticity |
| Pt - Peat | O - Organic |

FIELD SHEAR STRENGTH TEST

Shear strength measurements on test pit side walls, blocks of soil or Shelby tube samples are typically made with Torvane or Field Vane shear devices.

TYPICAL SOIL/ROCK SYMBOLS

- | | | |
|----------|--------|-----------|
| Concrete | Sand | Basalt |
| Organics | Gravel | Sandstone |
| Clay | Silt | Siltstone |

WATER TABLE

- Water Table Location
- (1/31/16) Date of Measurement



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SYMBOL KEY

BORING AND TEST PIT LOGS

Explanation of Common Terms Used in Soil Descriptions

Field Identification	Cohesive Soils			Granular Soils	
	SPT*	S _u ** (tsf)	Term	SPT*	Term
Easily penetrated several inches by fist.	0 – 2	< 0.125	Very Soft	0 – 4	Very Loose
Easily penetrated several inches by thumb.	2 – 4	0.125–0.25	Soft	4 – 10	Loose
Can be penetrated several inches by thumb with moderate effort.	4 – 8	0.25 – 0.50	Medium Stiff	10 – 30	Medium Dense
Readily indented by thumb but penetrated only with great effort.	8 – 15	0.50 – 1.0	Stiff	30 – 50	Dense
Readily indented by thumbnail.	15 – 30	1.0 – 2.0	Very Stiff	> 50	Very Dense
Indented with difficulty by thumbnail.	>30	> 2.0	Hard		

* SPT N-value in blows per foot (bpf)

** Undrained shear strength

Term	Soil Moisture Field Description
Dry	Absence of moisture. Dusty. Dry to the touch.
Damp	Soil has moisture. Cohesive soils are below plastic limit and usually moldable.
Moist	Grains appear darkened, but no visible water. Silt/clay will clump. Sand will bulk. Soils are often at or near plastic limit.
Wet	Visible water on larger grain surfaces. Sand and cohesionless silt exhibit dilatancy. Cohesive soil can be readily remolded. Soil leaves wetness on the hand when squeezed. Soil is wetter than the optimum moisture content and above the plastic limit.

Term	PI	Plasticity Field Test
Non-plastic	0 – 3	Cannot be rolled into a thread at any moisture.
Low Plasticity	3 – 15	Can be rolled into a thread with some difficulty.
Medium Plasticity	15 – 30	Easily rolled into thread.
High Plasticity	> 30	Easily rolled and re-rolled into thread.

Term	Soil Structure Criteria
Stratified	Alternating layers at least ¼ inch thick.
Laminated	Alternating layers less than ¼ inch thick.
Fissured	Contains shears and partings along planes of weakness.
Slickensided	Partings appear glossy or striated.
Blocky	Breaks into small lumps that resist further breakdown.
Lensed	Contains pockets of different soils.

Term	Soil Cementation Criteria
Weak	Breaks under light finger pressure.
Moderate	Breaks under hard finger pressure.
Strong	Will not break with finger pressure.



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COMMON TERMS
SOIL DESCRIPTIONS

Explanation of Common Terms Used in Rock Descriptions

Field Identification		UCS (psi)	Strength	Hardness (ODOT)
Indented by thumbnail.	R0	< 100	Extremely Weak	Extremely Soft
Crumbles under firm blows with geological hammer, can be peeled by a pocket knife.	R1	100–1,000	Very Weak	Very Soft
Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with geological hammer.	R2	1,000–4,000	Weak	Soft
Cannot be scraped or peeled with a pocket knife, specimen can be fractured with a single blow of geological hammer.	R3	4,000–8,000	Medium Strong	Medium Hard
Specimen requires more than one blow of geological hammer to fracture it.	R4	8,000–16,000	Strong	Hard
Specimen requires many blows of geological hammer to fracture it.	R5	>16,000	Very Strong	Very Hard

Term	Weathering Field Identification
Fresh	Crystals are bright. Discontinuities may show some minor surface staining. No discoloration in rock fabric.
Slightly Weathered	Rock mass is generally fresh. Discontinuities are stained and may contain clay. Some discoloration in rock fabric.
Moderately Weathered	Significant portions of rock show discoloration and weathering effects. Crystals are dull and show visible chemical alteration. Discontinuities are stained and may contain secondary mineral deposits.
Highly Weathered (Predom. Decomp.)	Rock can be excavated with geologist's pick. All discontinuities exhibit secondary mineralization. Complete discoloration of rock fabric. Surface of core is friable and usually pitted due to washing out of highly altered minerals by drilling water.
Decomposed	Rock mass is completely decomposed. Original rock "fabric" may be evident (relict texture). May be reduced to soil with hand pressure.

Spacing (meters)	Spacing	Spacing Term	Bedding/Foliation
< 0.06	< 2 in.	Very Close	Very Thin (Laminated)
0.06 – 0.30	2 in. – 1 ft.	Close	Thin
0.30 – 0.90	1 ft. – 3 ft.	Moderately Close	Medium
0.90 – 3.0	3 ft. – 10 ft.	Wide	Thick
> 3.0	> 10 ft.	Very Wide	Very Thick (Massive)

Vesicle Term	Volume
Some vesicles	5 – 25%
Highly vesicular	25 – 50%
Scoriaceous	> 50%

Stratification Term	Description
Lamination	<1 cm (0.4 in.) thick beds
Fissile	Preferred break along laminations
Parting	Preferred break parallel to bedding
Foliation	Metamorphic layering and segregation of minerals

RQD %	Designation	RQD %	Designation
0 – 25	Very Poor	75 – 90	Good
25 – 50	Poor	90 – 100	Excellent
50 – 75	Fair		

Rock Quality Designation (RQD) is the cumulative length of intact pieces 4 inches or longer excluding breaks caused by drilling and handling divided by run length, expressed as a percentage.



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COMMON TERMS ROCK DESCRIPTIONS

Comments	Depth, Feet	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
No seepage or ground water encountered to the limit of exploration.	1-	S-6-1						Sandy SILT, trace gravel (ML); brown, non-plastic, dry, stiff, fine sand, fine subrounded gravel.
	2-						Practical drilling refusal encountered at ±2 feet on basalt. BOTTOM OF BORING	
	3-							
	4-							
	5-							
	6-							
	7-							
	8-							
	9-							
	10-							

Project No.:2171109

Surface Elevation:3233.8 feet (Approx.)

Date of Test Pit:December 13, 2017

Boring Log: BH- 6

Prineville Airport

USFS Airbase

Prineville, Oregon

Comments	Depth, Feet	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
No seepage or ground water encountered to the limit of exploration.	1-	S-7-1						Sandy SILT, trace gravel (ML); brown, non-plastic, dry, stiff, fine sand, fine subrounded gravel.
	2-							Practical drilling refusal encountered at ±2.4 feet on basalt. BOTTOM OF BORING
	3-							
	4-							
	5-							
	6-							
	7-							
	8-							
	9-							
	10-							
<div>Project No.: 2171109</div> <div>Surface Elevation: 3232.7 feet (Approx.)</div> <div>Date of Test Pit: December 13, 2017</div> <div>Boring Log: BH- 7</div> <div>Prineville Airport</div> <div>USFS Airbase</div> <div>Prineville, Oregon</div>								

Comments	Depth, Feet	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
No seepage or ground water encountered to the limit of exploration.	1-	S-8-1					<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>	Sandy SILT (ML); brown, non-plastic, dry, stiff, fine sand.
	2-							Practical drilling refusal encountered at ±1.6 feet on basalt. BOTTOM OF BORING
	3-							
	4-							
	5-							
	6-							
	7-							
	8-							
	9-							
	10-							

Project No.:2171109

Surface Elevation:3232.0 feet (Approx.)


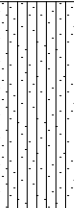
Date of Test Pit:December 14, 2017

Boring Log: BH- 8

Prineville Airport

USFS Airbase

Prineville, Oregon

Comments	Depth, Feet	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
No seepage or ground water encountered to the limit of exploration.	1-	S-9-1						Sandy SILT (ML); brown, non-plastic, dry, stiff, fine sand.
	2-							
	3-							
	4-							
	5-							
	6-							
	7-							
	8-							
	9-							
	10-							
								Practical drilling refusal encountered at ±3.7 feet on basalt. BOTTOM OF BORING

Project No.:	2171109	Boring Log: BH- 9 Prineville Airport USFS Airbase Prineville, Oregon
Surface Elevation:	3232.4 feet (Approx.)	
Date of Test Pit:	December 14, 2017	

Comments	Depth, Feet	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
No seepage or ground water encountered to the limit of exploration.	1-	S-10-1						Sandy SILT (ML); brown, non-plastic, dry, stiff, fine sand.
	2-							
	3-	S-10-2						
	4-							
	5-							
	6-							Silty SAND (SM); brown, non-plastic silt, damp, medium dense, fine sand.
	7-	S-10-3						
	8-							
	9-							
	10-							
								BOTTOM OF BORING
<div> <div>Project No.: 2171109</div> <div>Surface Elevation: 3230.0 feet (Approx.)</div> <div>Date of Test Pit: December 14, 2017</div> </div> <div> <div>Boring Log: BH-10</div> <div>Prineville Airport</div> <div>USFS Airbase</div> <div>Prineville, Oregon</div> </div>								

Comments	Depth, Feet	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
No seepage or ground water encountered to the limit of exploration.	1-	S-11-1						SILT, some sand (ML); brown, low plasticity, dry, stiff, fine sand.
	2-							Practical drilling refusal encountered at ±2.2 feet on basalt. BOTTOM OF BORING
	3-							
	4-							
	5-							
	6-							
	7-							
	8-							
	9-							
	10-							

Project No.:2171109

Surface Elevation:3227.9 feet (Approx.)



Date of Test Pit:December 14, 2017

Boring Log: BH-11

Prineville Airport

USFS Airbase

Prineville, Oregon

Comments	Depth, Feet	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
No seepage or ground water encountered to the limit of exploration.	1-	S-12-1						Silty SAND (SM); brown, non-plastic silt, dry, medium dense, fine sand.
	2-							
	3-							
	4-	S-12-2						SILT, trace sand (ML); brown, low plasticity, damp, stiff, fine sand. Practical drilling refusal encountered at ±4 feet on basalt. BOTTOM OF BORING
	5-							
	6-							
	7-							
	8-							
	9-							
	10-							

Project No.: 2171109

Surface Elevation: 3226.7 feet (Approx.)

Date of Test Pit: December 14, 2017

Boring Log: BH-12

Prineville Airport

USFS Airbase

Prineville, Oregon

Comments	Depth, Feet	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
No seepage or ground water encountered to the limit of exploration.	1-	S-13-1						Silty SAND (SM); brown, non-plastic silt, dry, medium dense, fine sand.
	2-							
	3-							
	4-	S-13-2						SILT, some sand (ML); brown, low plasticity, damp, stiff, fine sand.
	5-						Practical drilling refusal encountered at ±5 feet on basalt.	
	6-						BOTTOM OF BORING	
	7-							
	8-							
	9-							
	10-							

Project No.:2171109

Surface Elevation:3229.7 feet (Approx.)

Date of Test Pit:December 14, 2017

Boring Log: BH-13

Prineville Airport

USFS Airbase

Prineville, Oregon

Comments	Depth, Feet	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
No seepage or ground water encountered to the limit of exploration.	1-	S-14-1	<div></div>				<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>	Sandy SILT (ML); brown, non-plastic, dry, stiff, fine sand.
	2-							
	3-							
	4-							
	5-							
	6-							
	7-							
	8-							
	9-							
	10-							
								Practical drilling refusal encountered at ±4.5 feet on basalt. BOTTOM OF BORING

Project No.: 2171109

Surface Elevation: 3226.5 feet (Approx.)

Date of Test Pit: December 13, 2017

Boring Log: BH-14

Prineville Airport

USFS Airbase

Prineville, Oregon

Comments	Depth, Feet	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
No seepage or ground water encountered to the limit of exploration.	1-	S-15-1						Sandy SILT (ML); brown, non-plastic, dry, stiff, fine sand.
	2-						Practical drilling refusal encountered at ±2 feet on basalt.	
	3-						BOTTOM OF BORING	
	4-							
	5-							
	6-							
	7-							
	8-							
	9-							
	10-							

Project No.:2171109

Surface Elevation:3233.9 feet (Approx.)

Date of Test Pit:December 13, 2017

Boring Log: BH-15

Prineville Airport

USFS Airbase

Prineville, Oregon

Comments	Depth, Feet	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
No seepage or ground water encountered to the limit of exploration.	1-	S-16-1						Sandy SILT (ML); brown, non-plastic, dry, stiff, fine sand.
	2-							
	3-							
	4-						Practical drilling refusal encountered at ±3.9 feet on basalt. BOTTOM OF BORING	
	5-							
	6-							
	7-							
	8-							
	9-							
	10-							

Project No.:2171109

Surface Elevation:3228.2 feet (Approx.)

Date of Test Pit:December 13, 2017

Boring Log: BH-16

Prineville Airport

USFS Airbase

Prineville, Oregon

Comments	Depth, Feet	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
No seepage or ground water encountered to the limit of exploration.	1-	S-17-1						Sandy SILT (ML); brown, non-plastic, dry, stiff, fine sand.
	2-							
	3-						Practical drilling refusal encountered at ±3.8 feet on basalt. BOTTOM OF BORING	
	4-							
	5-							
	6-							
	7-							
	8-							
	9-							
	10-							

Project No.: 2171109

Surface Elevation: 3225.6 feet (Approx.)

Date of Test Pit: December 14, 2017

Boring Log: BH-17

Prineville Airport

USFS Airbase

Prineville, Oregon

Comments	Depth, Feet	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
No seepage or ground water encountered to the limit of exploration.	1-	S-18-1						Sandy SILT (ML); brown, non-plastic, dry, stiff, fine sand.
	2-							
	3-							
	4-							SILT, trace sand (ML); brown, low plasticity, dry, stiff, fine sand.
	5-	S-18-2						
	6-							
	7-	S-18-3						Sandy SILT (ML); light brown, non-plastic, dry, stiff, fine sand.
	8-							
	9-							
	10-							BOTTOM OF BORING
<div> <div>Project No.: 2171109</div> <div>Surface Elevation: 3222.8 feet (Approx.)</div> <div>Date of Test Pit: December 13, 2017</div> </div> <div> Boring Log: BH-18 Prineville Airport USFS Airbase Prineville, Oregon </div>								

Comments	Depth, Feet	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
No seepage or ground water encountered to the limit of exploration.	1-	S-19-1						Sandy SILT, trace gravel (ML); brown, non-plastic, dry, stiff, fine sand, fine subrounded gravel.
	2-							
	3-							
	4-							SILT, trace sand (ML); brown, low plasticity, dry, stiff, fine sand.
	5-	S-19-2						
	6-							
	7-							Sandy SILT (ML); light brown, non-plastic, dry, stiff, fine sand.
	8-							
	9-							Practical drilling refusal encountered at ±8.5 feet on basalt.
	10-							BOTTOM OF BORING
<div> <div>Project No.: 2171109</div> <div>Surface Elevation: 3221.9 feet (Approx.)</div> <div>Date of Test Pit: December 13, 2017</div> </div> <div> Boring Log: BH-19 Prineville Airport USFS Airbase Prineville, Oregon </div>								

Comments	Depth, Feet	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
No seepage or ground water encountered to the limit of exploration.	1-	S-20-1						SILT, some sand (ML); brown, non-plastic, dry, stiff, fine sand.
	2-							
	3-							
	4-	S-20-2						
	5-							
	6-							
	7-	S-20-3						
	8-							
	9-							
	10-							
BOTTOM OF BORING								
Project No.: 2171109 Surface Elevation: 3222.2 feet (Approx.) Date of Test Pit: December 13, 2017								
Boring Log: BH-20 Prineville Airport USFS Airbase Prineville, Oregon								

Comments	Depth, Feet	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
No seepage or ground water encountered to the limit of exploration.	1-	S-21-1						Sandy SILT (ML); brown, non-plastic, dry, stiff, fine sand.
	2-							
	3-							
	4-	S-21-2						
	5-							
	6-							
	7-							
	8-							
	9-							
	10-							
Practical drilling refusal encountered at ±8.5 feet on basalt. BOTTOM OF BORING								
Project No.: 2171109 Surface Elevation: 3223.8 feet (Approx.) Date of Test Pit: December 13, 2017								
Boring Log: BH-21 Prineville Airport USFS Airbase Prineville, Oregon								

Comments	Depth, Feet	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
No seepage or ground water encountered to the limit of exploration.	1-	S-22-1						Sandy SILT (ML); brown, non-plastic, dry, stiff, fine to medium sand.
	2-							
	3-						Practical drilling refusal encountered at ±2.7 feet on basalt.	
	4-						BOTTOM OF BORING	
	5-							
	6-							
	7-							
	8-							
	9-							
	10-							

Project No.:2171109

Surface Elevation:3227.5 feet (Approx.)

Date of Test Pit:December 13, 2017

Boring Log: BH-22

Prineville Airport

USFS Airbase

Prineville, Oregon

Comments	Depth, Feet	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
No seepage or ground water encountered to the limit of exploration.	1-	S-23-1						Sandy SILT (ML); brown, non-plastic, dry, stiff, fine sand.
	2-						Practical drilling refusal at ±2 feet on basalt.	
	3-						BOTTOM OF BORING	
	4-							
	5-							
	6-							
	7-							
	8-							
	9-							
	10-							

Project No.:2171109

Surface Elevation:3229.9 feet (Approx.)

Date of Test Pit:December 13, 2017

Boring Log: BH-23

Prineville Airport

USFS Airbase

Prineville, Oregon

Comments	Depth, Feet	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
No seepage or ground water encountered to the limit of exploration.	1-	S-24-1						Sandy SILT, trace gravel (ML); brown, non-plastic, dry, stiff, fine sand, fine subrounded gravel.
	2-							
	3-						Practical drilling refusal encountered at ±2.6 feet on basalt. BOTTOM OF BORING	
	4-							
	5-							
	6-							
	7-							
	8-							
	9-							
	10-							

Project No.:2171109

Surface Elevation:3232.5 feet (Approx.)

Date of Test Pit:December 13, 2017

Boring Log: BH-24

Prineville Airport

USFS Airbase

Prineville, Oregon

Comments	Depth, Feet	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
No seepage or ground water encountered to the limit of exploration.	1-	S-25-1						Sandy SILT (ML); brown, non-plastic, dry, stiff, fine sand.
	2-							Practical drilling refusal encountered at ±1.9 feet on basalt.
	3-							BOTTOM OF BORING
	4-							
	5-							
	6-							
	7-							
	8-							
	9-							
	10-							

Project No.:2171109

Surface Elevation:3231.0 feet (Approx.)



Date of Test Pit:December 14, 2017

Boring Log: BH-25

Prineville Airport

USFS Airbase

Prineville, Oregon

Comments	Depth, Feet	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
No seepage or ground water encountered to the limit of exploration.	1-	S-26-1						Sandy SILT, scattered organics (ML); brown, low plasticity, dry, stiff, organics consist of roots up to ±¼-inch diameter.
	2-							Practical drilling refusal encountered at ±1.3 feet on basalt.
	3-							BOTTOM OF BORING
	4-							
	5-							
	6-							
	7-							
	8-							
	9-							
	10-							

Project No.: 2171109

Surface Elevation: 3227.9 feet (Approx.)






Date of Test Pit: December 14, 2017

Boring Log: BH-26

Prineville Airport

USFS Airbase

Prineville, Oregon

Comments	Depth, Feet	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
No seepage or ground water encountered to the limit of exploration. SPT at ±2.5 to 4 feet: 4-6-6; N = 12	1-	S-27-1						Sandy SILT (ML); brown, non-plastic, dry, stiff, fine sand.
	2-							
	3-	SS-27-2						Practical drilling refusal encountered at ±4 feet on basalt. BOTTOM OF BORING
	4-							
	5-							
	6-							
	7-							
	8-							
	9-							
	10-							

Project No.: 2171109

Surface Elevation: 3225.4 feet (Approx.)

Date of Test Pit: December 14, 2017

Boring Log: BH-27

Prineville Airport

USFS Airbase

Prineville, Oregon

Comments	Depth, Feet	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
No seepage or ground water encountered to the limit of exploration.	1-	S-28-1						Sandy SILT (ML); brown, non-plastic, dry, stiff, fine sand.
	2-						Practical drilling refusal encountered at ±2 feet on basalt.	
	3-						BOTTOM OF BORING	
	4-							
	5-							
	6-							
	7-							
	8-							
	9-							
	10-							

Project No.:2171109

Surface Elevation:3229.3 feet (Approx.)

Date of Test Pit:December 14, 2017

Boring Log: BH-28

Prineville Airport

USFS Airbase

Prineville, Oregon

Comments	Depth, Feet	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
No seepage or ground water encountered to the limit of exploration.	1-	S-29-1						Sandy SILT (ML); brown, non-plastic, dry, stiff, fine sand.
	2-							
	3-							
	4-							
	5-							
	6-							
	7-							
	8-							
	9-							
	10-							
Practical drilling refusal at ±2.5 feet on basalt. BOTTOM OF BORING								

Project No.: 2171109

Surface Elevation: 3229.2 feet (Approx.)

Date of Test Pit: December 14, 2017

Boring Log: BH-29

Prineville Airport

USFS Airbase

Prineville, Oregon

Comments	Depth, Feet	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
No seepage or ground water encountered to the limit of exploration.	1-	S-30-1	<div></div>				<div></div>	Sandy SILT (ML); brown, non-plastic, dry, stiff, fine sand.
	2-							
	3-							
	4-							
	5-							
	6-							
	7-							
	8-							
	9-							
	10-							
Practical drilling refusal encountered at ±3.2 feet on basalt. BOTTOM OF BORING								

Project No.: 2171109

Surface Elevation: 3235.2 feet (Approx.)

Date of Test Pit: December 13, 2017

Boring Log: BH-30

Prineville Airport

USFS Airbase

Prineville, Oregon



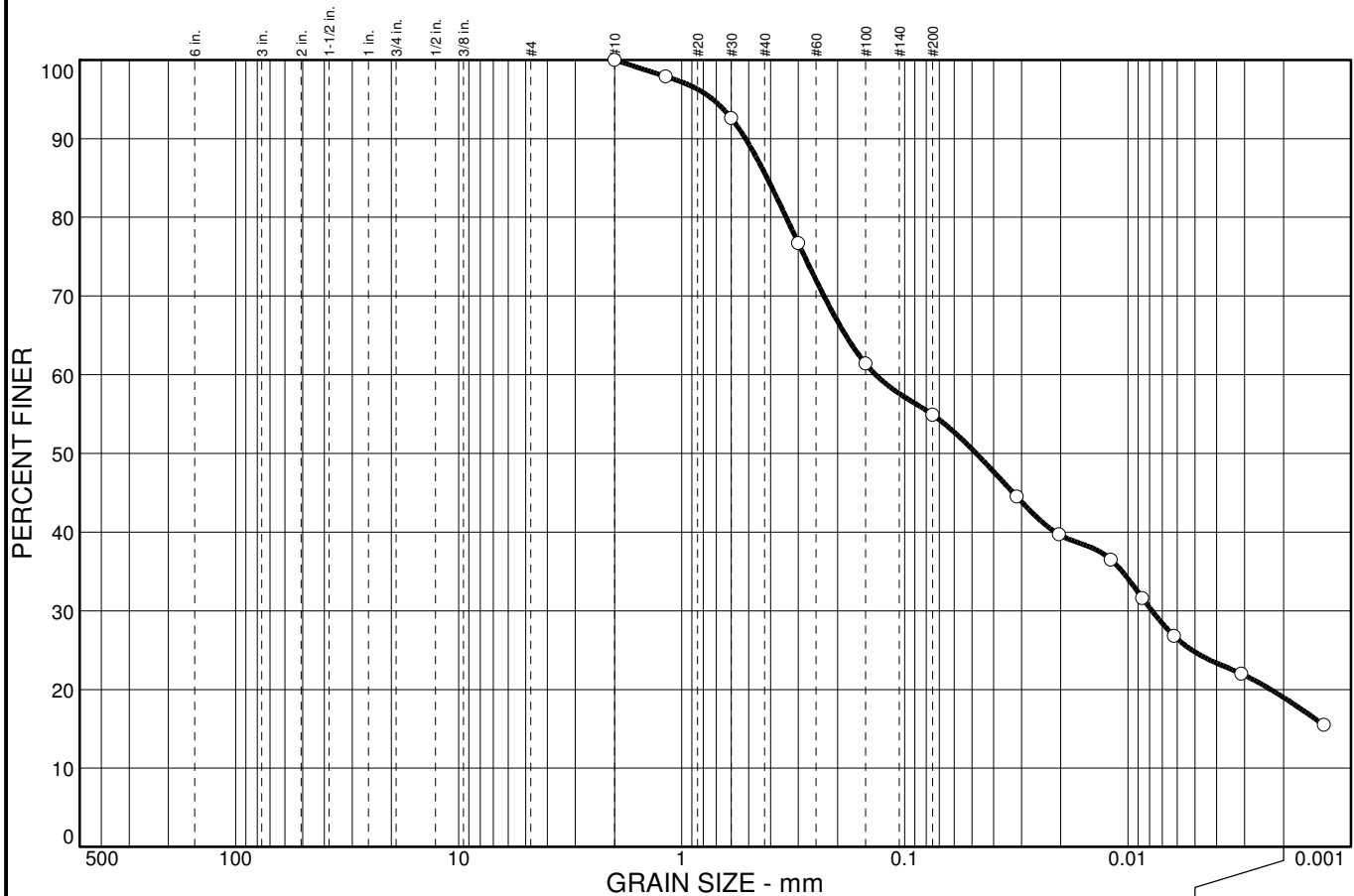
Appendix C

Laboratory Test Results

Table 1C. Natural Water Contents, Percent Fines & Atterberg Limits

Sample Number	Sample Depth (feet)	Moisture Content (percent)	% Fines	LL	PL	PI	USCS Classification
S-6-1	0.0 – 1.5	10.2					
S-13-1	0.5 – 2.0	15.7					
S-16-1	0.5 – 2.0	12.9					
S-17-1	0.0 – 3.0	20.1	54.9	21	-	NP	ML
S-18-1	0.5 – 2.0	20.0					
S-19-1	0.5 – 2.0	21.0					
S-22-1	0.0 – 2.5	38.0	65.4	50	34	16	ML
S-23-1	0.5 – 2.0	19.3					
S-24-1	0.5 – 1.5	14.2					
S-30-1	1.0 – 2.0	10.8					

Sieve Analysis ASTM D 422



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	14.4	30.7	35.9	19.0

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#16	97.9		
#30	92.6		
#50	76.7		
#100	61.4		
#200	54.9		

* (no specification provided)

Material Description

Brown, sandy SILT

Atterberg Limits

PL= LL= 21.0 PI= NP

Coefficients

D₈₅= 0.414 D₆₀= 0.135 D₅₀= 0.0479
D₃₀= 0.0078 D₁₅= D₁₀=
C_u= C_c=

Classification

USCS= ML AASHTO= A-4(0)

Remarks

Sample No.: S-17-1

Location:

Source of Sample: 7393

Date: 12/13 - 12/14

Elev./Depth: 0.0 - 3.0'

FEI Testing & Inspection, Inc.

Corvallis, OR

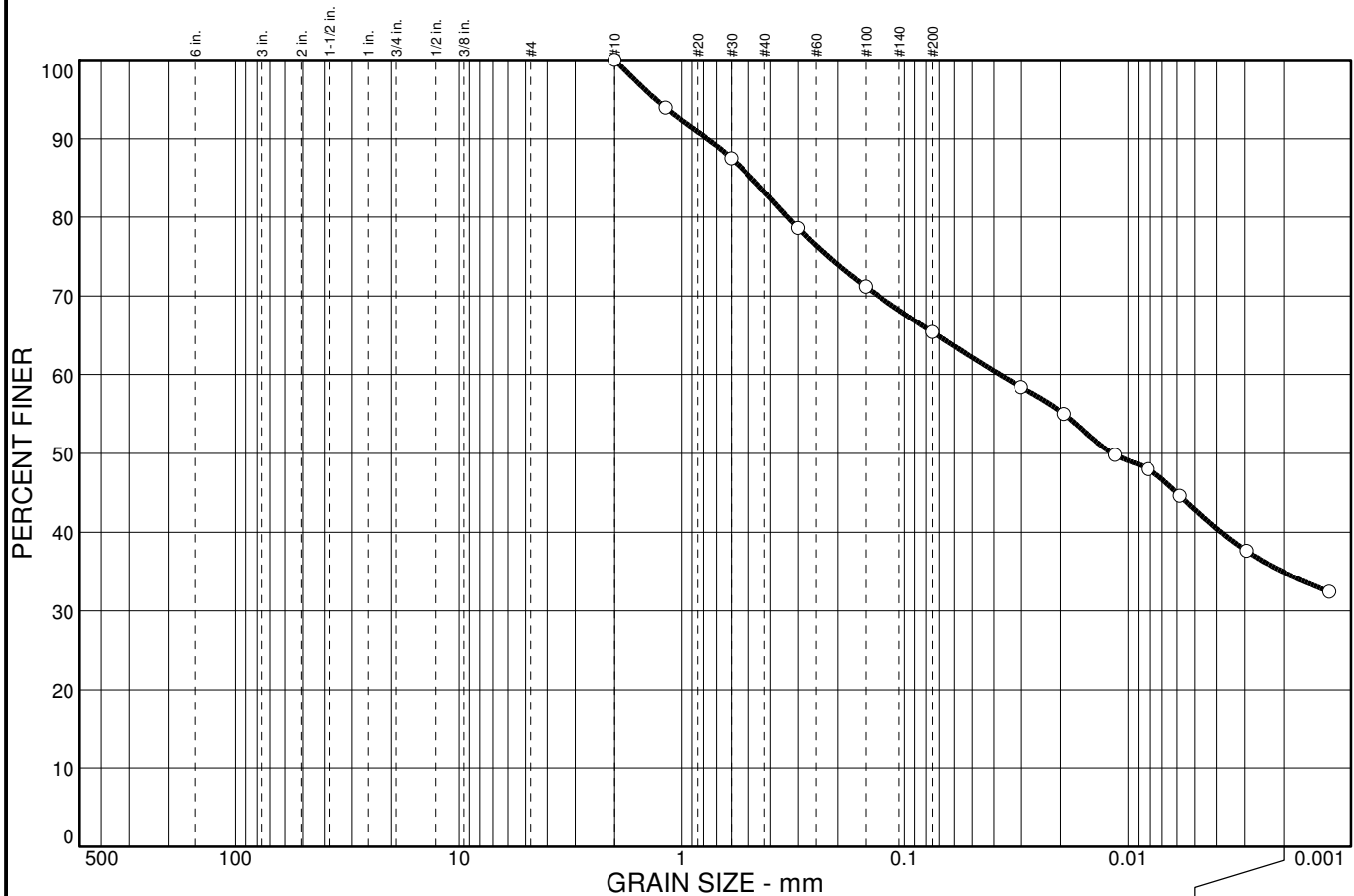
Client: Foundation Engineering, Inc; Project 2171109

Project: Prineville Airport USFS Airbase

Project No: 2176001-638

Figure 1C

Sieve Analysis ASTM D 422



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	16.8	17.8	30.5	34.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#16	93.9		
#30	87.5		
#50	78.6		
#100	71.2		
#200	65.4		

* (no specification provided)

Material Description

Brown, sandy SILT

Atterberg Limits

PL= 34 LL= 50 PI= 16

Coefficients

D₈₅= 0.487 D₆₀= 0.0375 D₅₀= 0.0117
D₃₀= D₁₅= D₁₀=
C_u= C_c=

Classification

USCS= ML AASHTO= A-4(0)

Remarks

Sample No.: S-22-1

Location:

Source of Sample: 7393

Date: 12/13 - 12/14

Elev./Depth: 0.0 - 2.5'

FEI Testing & Inspection, Inc.

Corvallis, OR

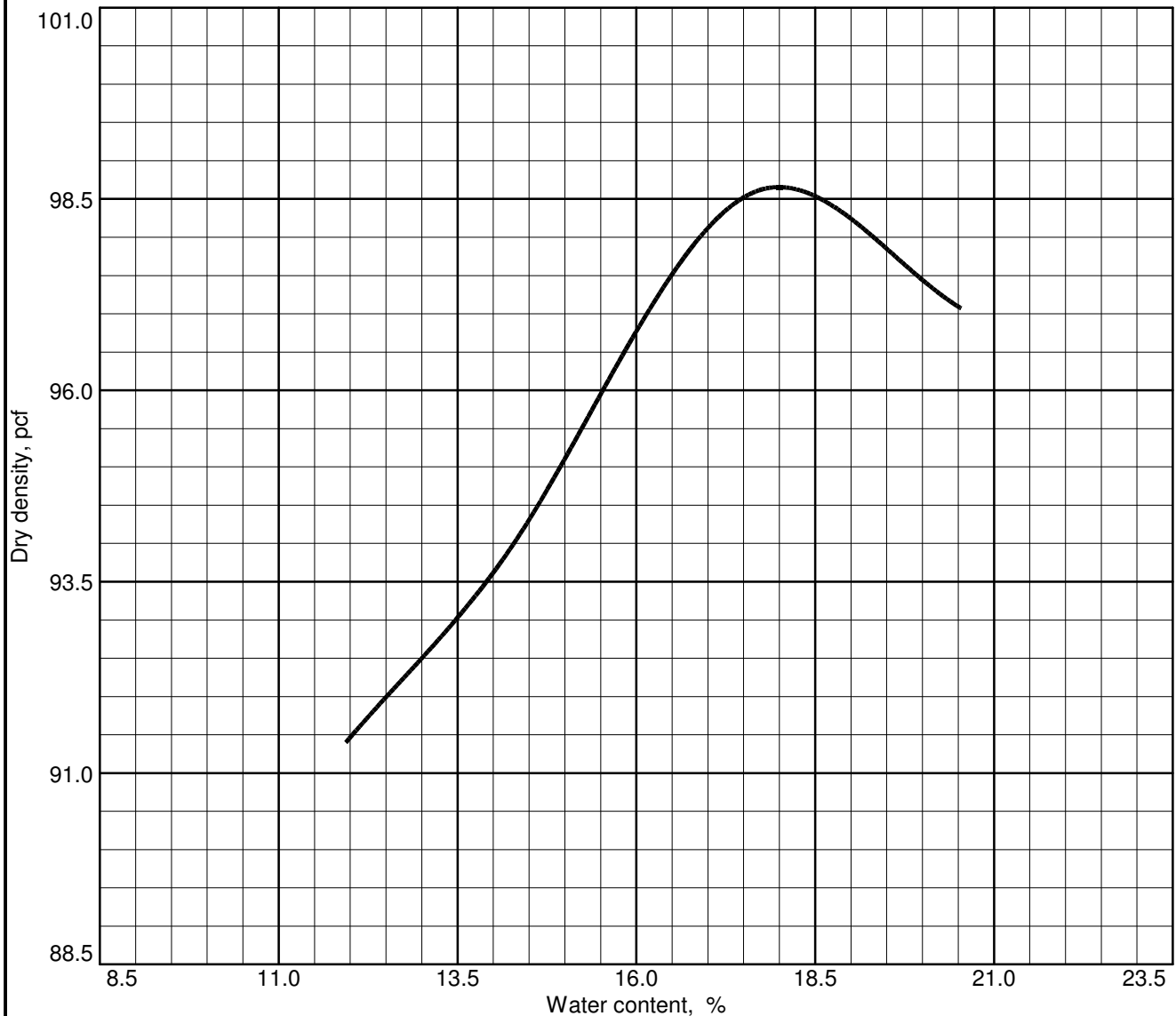
Client: Foundation Engineering, Inc; Project 2171109

Project: Prineville Airport USFS Airbase

Project No: 2176001-638

Figure 2C

MOISTURE - DENSITY RELATIONSHIP TEST



Test specification: ASTM D 698-00a Method A Standard

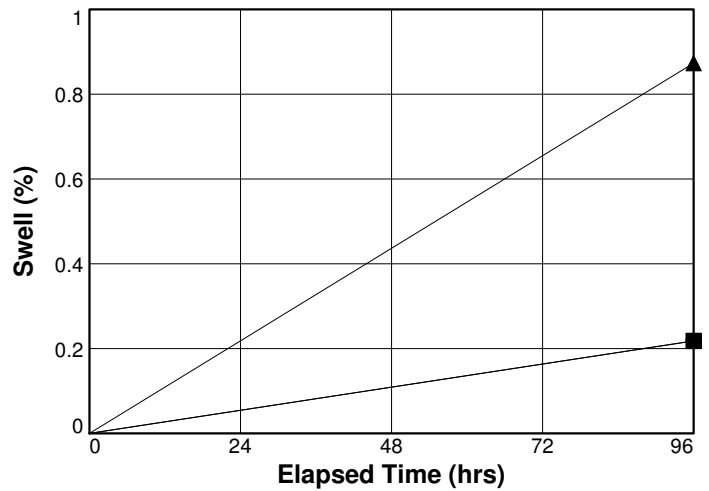
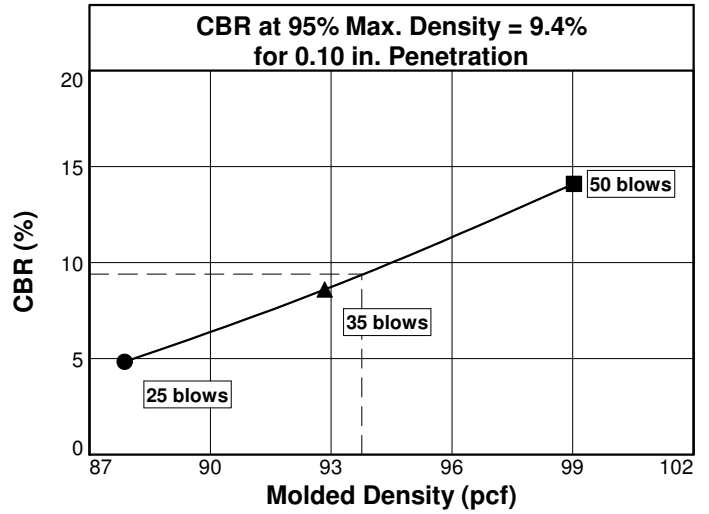
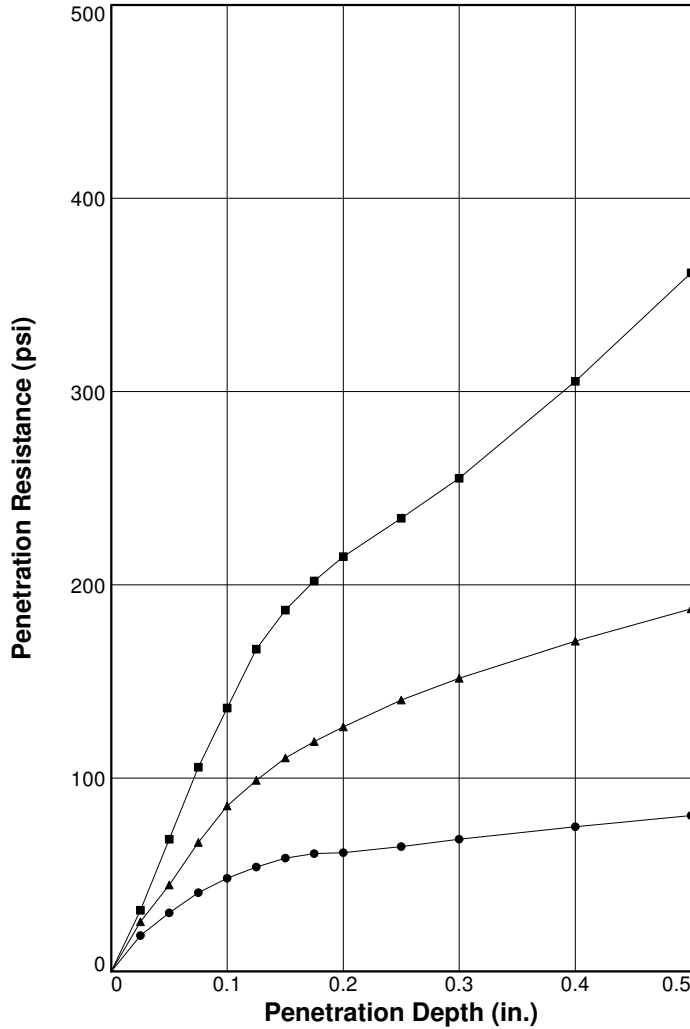
Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
0.0 - 3.0'	ML		20.1				0.0	54.9

TEST RESULTS		MATERIAL DESCRIPTION
Maximum dry density = 98.7 pcf Optimum moisture = 18.0 %		Brown, sandy SILT
Project No. 2176001-638 Client: Foundation Engineering Project: Prineville Airport USFS Airbase Date: 12-27-2017 ● Source: 7393 Sample No.: S-17-1 Elev./Depth: 0.0 - 3.0'		Remarks: <

Figure 3C

BEARING RATIO TEST REPORT

ASTM D 1883-05



	Molded			Soaked			CBR (%)		Linearity Correction (in.)	Surcharge (lbs.)	Max. Swell (%)
	Density (pcf)	Percent of Max. Dens.	Moisture (%)	Density (pcf)	Percent of Max. Dens.	Moisture (%)	0.10 in.	0.20 in.			
1 ○	87.9	89.1	19.7	87.7	88.8	30.5	4.8	4.1	0.000	28	0.2
2 △	92.8	94	19.3	92.0	93.2	26.8	8.6	8.4	0.000	28	0.9
3 □	99.0	100.3	18.0	98.8	100.1	23.6	14.1	14.4	0.004	28	0.2
Material Description							USCS	Max. Dens. (pcf)	Optimum Moisture (%)	LL	PI
Brown, sandy SILT							ML	98.7	18.0	21.0	NP

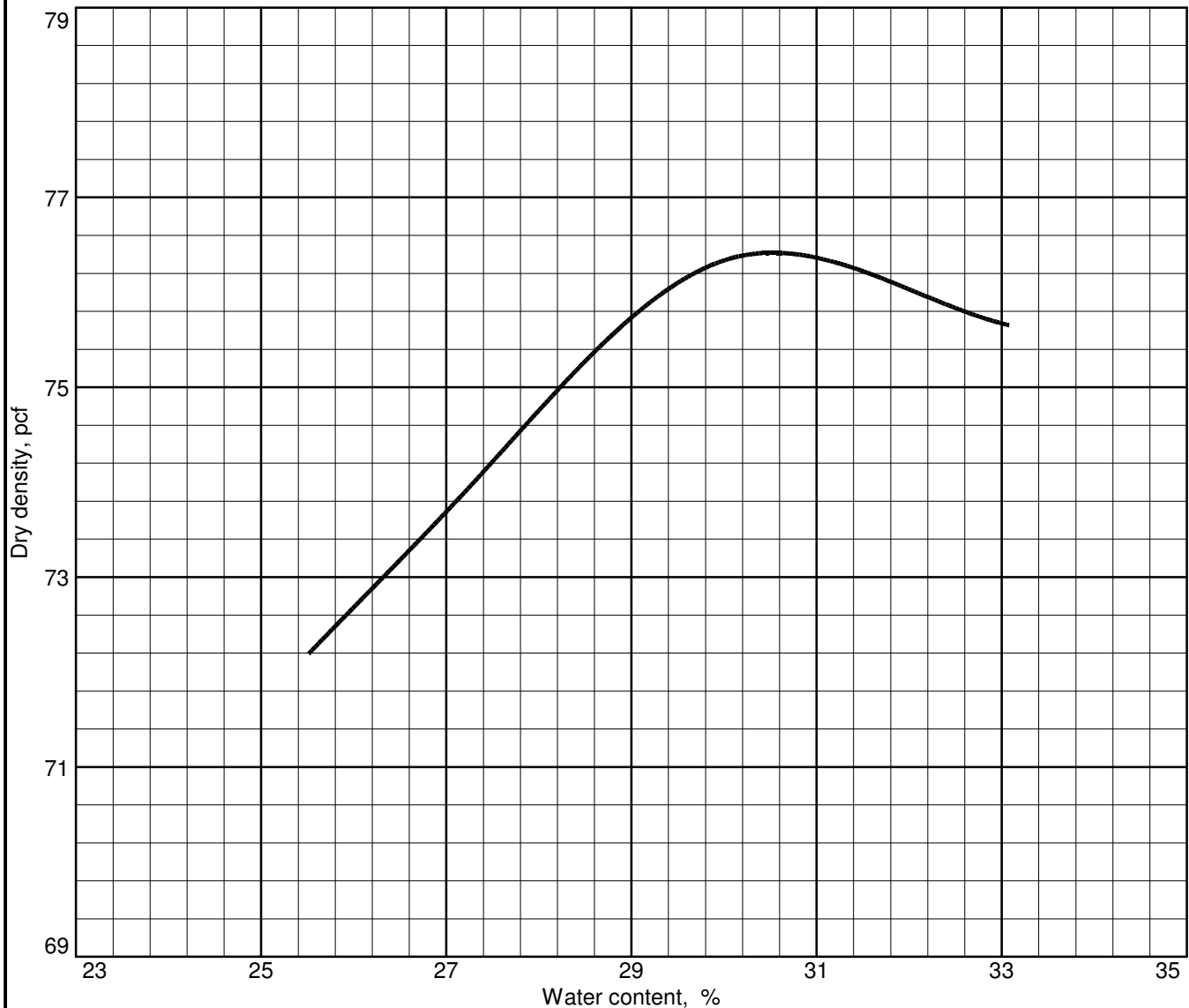
Project No: 2176001-638
Project: Prineville Airport USFS Airbase
Source of Sample: 7393 **Depth:** 0.0 - 3.0'
Sample Number: S-17-1
Date: 12/13 - 12/14 2017

BEARING RATIO TEST REPORT
 FEI Testing & Inspection, Inc.
 Corvallis, OR

Test Description/Remarks:

Figure 4C

MOISTURE - DENSITY RELATIONSHIP TEST



Test specification: ASTM D 698-00a Method A Standard

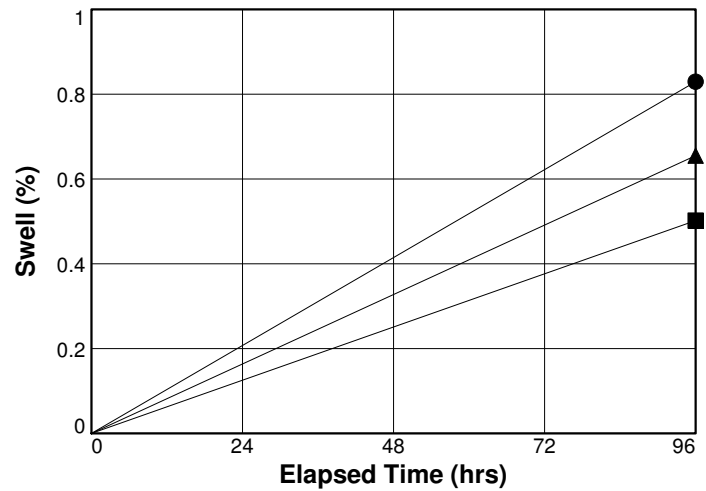
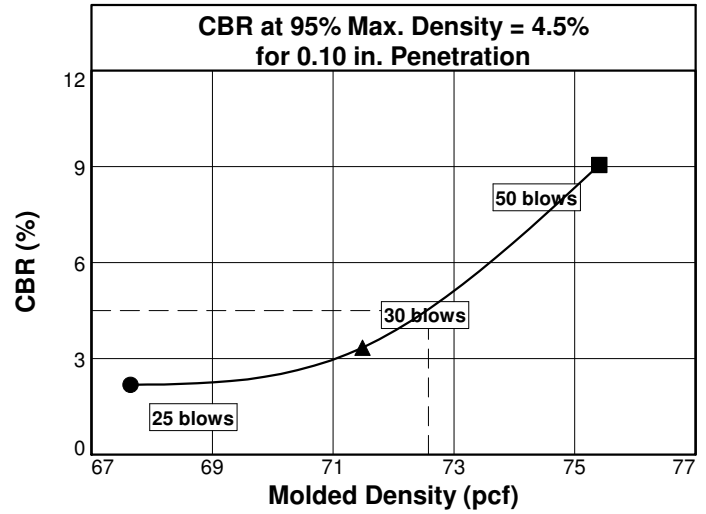
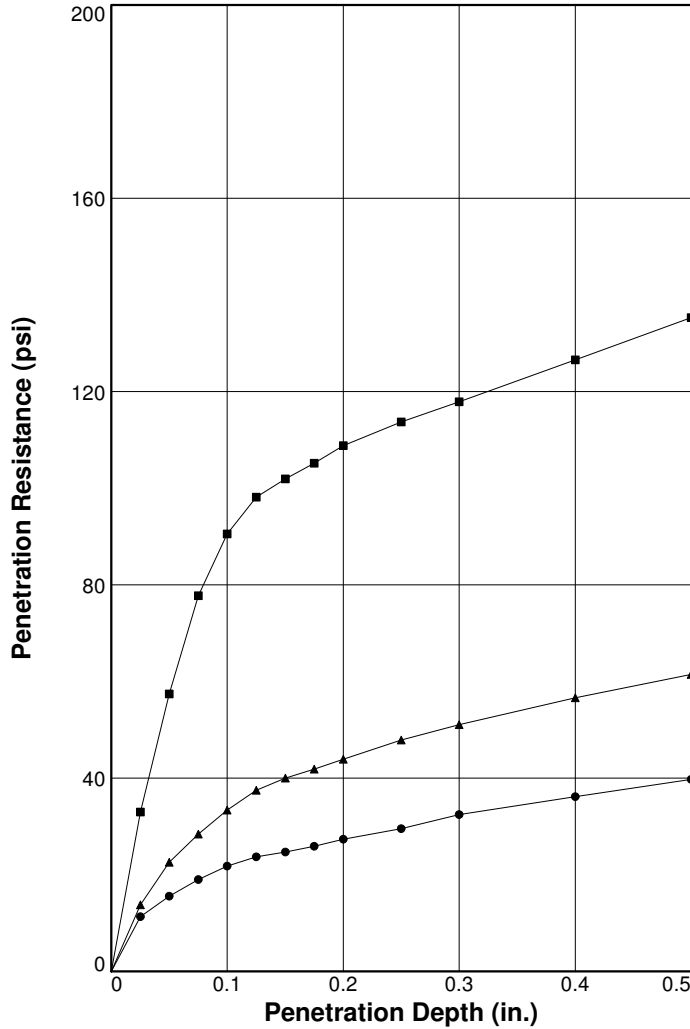
Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
0.0 - 2.5'	ML		38.0		50	16	0.0	65.4

TEST RESULTS			MATERIAL DESCRIPTION		
Maximum dry density = 76.4 pcf			Brown, sandy SILT		
Optimum moisture = 30.5 %					
Project No. 2176001-638 Client: Foundation Engineering Project: Prineville Airport USFS Airbase <div>Date: 12-27-2017</div> <div>● Source: 7393 Sample No.: S-22-1 Elev./Depth: 0.0 - 2.5'</div>			Remarks:		
MOISTURE - DENSITY RELATIONSHIP TEST FEI Testing & Inspection, Inc. Corvallis, OR					
			Figure 5C		

Figure 5C

BEARING RATIO TEST REPORT

ASTM D 1883-05



	Molded			Soaked			CBR (%)		Linearity Correction (in.)	Surcharge (lbs.)	Max. Swell (%)
	Density (pcf)	Percent of Max. Dens.	Moisture (%)	Density (pcf)	Percent of Max. Dens.	Moisture (%)	0.10 in.	0.20 in.			
1 ○	67.6	88.5	32.9	67.1	87.8	49.0	2.2	1.8	0.000	28	0.8
2 △	71.5	93.6	33.3	71.0	93	46.9	3.3	2.9	0.000	28	0.7
3 □	75.4	98.7	33.1	75.0	98.2	41.2	9.1	7.3	0.000	28	0.5
Material Description							USCS	Max. Dens. (pcf)	Optimum Moisture (%)	LL	PI
Brown, sandy SILT											
							ML	76.4	30.5	50	16

Project No: 2176001-638

Project: Prineville Airport USFS Airbase

Source of Sample: 7393 **Depth:** 0.0 - 2.5'

Sample Number: S-22-1

Date: 12/13 - 12/14 2017

BEARING RATIO TEST REPORT
FEI Testing & Inspection, Inc.
Corvallis, OR

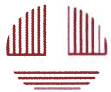
Test Description/Remarks:

Figure 6C

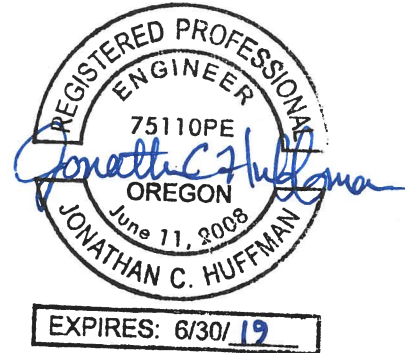
**Table 2C. Summary of Moisture-Density and CBR Test Results
Current and Previous Prineville Airport Projects**

Project	Sample Number	^{1,3} Maximum Dry Density (pcf)	^{1,3} Optimum Moisture Content (%)	LL	PI	Fines (%)	USCS	^{2,3} CBR Value
USFS Airbase (2018)	S-17-1	98.7	18.0	21	NP	54.9	ML	9.4
	S-22-1	76.4	30.5	50	16	65.4	ML	4.5
New Tie-Down Apron (2018)	S-3-1	95.6	19.5	26	6	56.6	ML	5.9
New Aprons and Beacon Tower (2016)	S-1-1	97.5	19.9	-	-	53.4	ML	5.0
	S-2-1	97.3	22.0	-	-	55.8	ML	2.0
Runway 10-28 (2008)	S-5-1	86.5	30.2	-	NP	40.1	SM	1.5
	S-6-1	93.0	23.1	-	-	57.2	ML	6.7

- Notes:**
1. Maximum dry density and optimum moisture content are based on the results of ASTM D698.
 2. CBR values are based on samples compacted to 95% relative compaction based on the results of ASTM D698.
 3. Maximum dry density and optimum moisture for S-1-1 includes an oversize correction.



Date: November 8, 2018
To: Tracy May, P.E.
Precision Approach Engineering, Inc.
From: Jonathan C. Huffman, P.E., G.E.
Subject: Addendum to Geotechnical Investigation
Project: Prineville Airport – USFS Airbase
Project 2171109



This memorandum has been prepared at your request to address items in the geotechnical report which the design team identified for review in consideration of reducing project costs.

BACKGROUND

A new U.S. Forest Service (USFS) Airbase facility is planned at the Prineville Airport. The facility will include a building, a training yard with rappel towers, landside parking lots, and driveways, helipads and taxilanes. Access to the new facility will be provided from a new road extending east from Tom McCall Road and a taxilane near the east end of Runway 10-28.

Precision Approach Engineering, Inc. (PAE) is the prime engineering consultant for the project, Anderson Perry & Associates, Inc. (AP) is the civil designer, and Steele Associates Architects, LLC is the project architect. Foundation Engineering, Inc. was retained by PAE as the geotechnical consultant. We completed a geotechnical investigation, the results of which are summarized in a report dated February 1, 2018.

The design team is currently evaluating options to reduce overall costs for the project. Based on discussions with PAE and AP, we understand elements from the geotechnical report include 1) the design pavement section for landside pavements, 2) use of a separation geotextile beneath new pavements, and 3) the thickness of granular fill (i.e., Base Rock) used to construct building pads beneath new slabs. These items are addressed below.

DISCUSSION OF ALTERNATIVE DESIGN AND RECOMMENDATIONS

Pavement Section

The geotechnical report recommended a pavement section for new landside pavements (i.e., access road, driveways, and parking lots) that include 4 inches of asphaltic concrete (AC) over 9 inches of Base Rock. Materials and construction recommendations are summarized in the report. The pavement section thickness was predicated on the City of Prineville minimum standard for an Industrial Road. Our assumption for the new road meeting this criterion was based on previous conversations with the design team. It is not based on design traffic loading (i.e., ADT or ADTT) since that information is not available.

We understand the design team has reviewed the expectation for pavement loading and determined it is not necessary to construct the new pavements to meet the minimum standard for an Industrial Road. Instead the pavement section will include 3 inches of AC over 10 inches of Base Rock.

We recommend all other materials and construction specifications are followed as defined in the geotechnical report. The report recommended reducing the Base Rock thickness to a minimum of 4 inches where bedrock is encountered to limit excavation into bedrock. This recommendation is still valid with the revised pavement section.

Separation Geotextile

For new pavements, the geotechnical report recommended placing a separation geotextile between the Base Rock and subgrade. We understand this item will likely be eliminated due to the cost considerations.

The separation geotextile is most beneficial where pavements are underlain by fine-grained soil (e.g., silt), which is present to varying depths across the site. It is much less beneficial if the pavement is underlain by bedrock, which is also present. The geotextile limits intrusion of the fine-grained subgrade into the base rock, which can affect drainage (reducing the pavement life over time) and the ability to efficiently compact the base rock (at the time of construction).

If pavement construction occurs during dry weather when the silt subgrade can be efficiently compacted, there is minimal risk of construction-phase issues arising by omitting the geotextile. Over the life of the pavement, there could be some reduction in pavement performance, but it cannot be quantified in terms of pavement life or similar metrics.

Granular Fill (Base Rock) Beneath Slabs

The geotechnical report recommended providing 12 inches of compacted granular fill (Base Rock) to construct building pads beneath slabs. Where bedrock is encountered, we recommended reducing the Base Rock thickness to limit the need for bedrock excavation. The design team requested limiting the building pad thickness to 6 inches.

The recommended fill thickness of 12 inches for building pads is intended to provide a stable working surface where the slab is underlain by fine-grained soil (i.e., silt). It is not required for loading concerns on the soil. If construction occurs during dry weather when the subgrade can be efficiently moisture-conditioned and compacted, it may be practical to reduce the Base Rock thickness to 6 inches. However, reducing the Base Rock thickness will increase the risk of subgrade disturbance to some degree, even during dry weather. Consequently, areas of the building pad could become disturbed and require overexcavation and replacement with a thicker Base Rock section. The extent of this risk is primarily predicated on the contractors means and methods, the weather, and exposure of the building pad to construction traffic.

We anticipate the discussion of the above items meets your present needs. Unless specifically addressed herein, all other items pertaining to geotechnical elements of this project should reference the geotechnical report dated February 1, 2018. Please do not hesitate to contact us with any additional questions.

