Grand View Property

Geotechnical Engineering Report

Laramie, Wyoming

June 10, 2024 | Terracon Project No. 24245022

Prepared for:

Jones Gillam Renz Architects, Inc.
730 North 9th Street
Salina, Kansas 67401

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June 10, 2024

Jones Gillam Renz Architects, Inc.
730 North 9th Street
Salina, Kansas 67401

Attn: Maggie Gillam
P: (785) 827-0386
E: mgillam@jgrarchitects.com

Re: Geotechnical Engineering Report
Grand View Property
3800 Bill Nye Avenue
Laramie, Wyoming
Terracon Project No. 24245022

Dear Ms. Gillam:

We have completed the scope of Geotechnical Engineering services for the project referenced above in general accordance with Terracon Proposal No. P24245022 dated February 13, 2024. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork, the design and construction of foundations, floor slabs, and pavements for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,

Terracon

ERIC D. BERNHARDT
11167
06/10/2024

Emily Sinnott

Eric D. Bernhardt

Emily Sinnott
Staff Engineer

Eric D. Bernhardt, P.E.
Principal

Table of Contents

Figures

Attachments

Note: This report was originally delivered in a web-based format. **Blue Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the logo will bring you back to this page. For more interactive features, please view your project online at **client.terracon.com**.

Refer to each individual Attachment for a listing of contents.

Report Summary

Topic [1]	Overview Statement [2]
Project Description	The project includes the construction of two, three-story buildings within the designated Overland area. The Overland development site is approximately 1.95 acres, with the proposed buildings occupying approximately 1.13 acres situated on the northern and southern perimeters of the Overland development. The residual parcel of the development has been allocated for the creation of 82 parking stalls, along with a clubhouse, a designated area for trash enclosure and a driveway to facilitate access.
Geotechnical Characterization	Subsurface soil conditions are generally characterized by medium dense to dense sand with vary amounts of silt, clay, and gravel. Surficial material generally consists of about 3 to 10 inches of vegetative soil and root penetration. Groundwater was not encountered to a maximum boring depth of approximately 25.5 feet below existing ground surface.
Earthwork	Based on the subsurface conditions encountered and proposed building construction, our earthwork recommendations consist of the following: ▪ Remove existing fill below the proposed foundations and floor slabs and backfill with properly compacted structural fill, ▪ Remove at least 12-inches of existing fill below pavements and replacement with properly compacted structural fill, and ▪ Existing fill soils can be used for structural or general fill.
Shallow Foundations	Shallow spread footings can be utilized for the proposed project provided the existing fill soils below the foundation are removed and reworked with proper moisture condition and compaction, prepared in accordance with the **Earthwork** section. ▪ Maximum net allowable bearing pressure of 2,500 psf for strip footings up to 4 feet wide ▪ Maximum net allowable bearing pressure of 4,000 psf for square footings up to 7 feet ▪ Minimum embedment depth of 36 inches ▪ Total settlement of about 1 inch

Topic [1]	Overview Statement [2]
Pavements	Based on anticipated traffic data described in this report and with subgrade prepared as noted in the **Earthwork** section of this report, the following presents recommended minimum pavement sections: ■ 4 inches AC over 6 inches ABC in parking/ driveway areas

1. If the reader is reviewing this report as a pdf, the topics above can be used to access the appropriate section of the report by simply clicking on the topic itself.
2. This summary is for convenience only. It should be used in conjunction with the entire report for design purposes.

Introduction

This report presents the results of our subsurface exploration and Geotechnical Engineering services performed for the proposed buildings to be located at 3800 Bill Nye Avenue in Laramie, Wyoming. The purpose of these services was to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Seismic site classification per IBC
- Site preparation and earthwork
- Demolition considerations
- Foundation design and construction
- Floor slab design and construction
- Pavement design and construction
- Frost considerations

The geotechnical engineering Scope of Services for this project included the advancement of test borings, laboratory testing, engineering analysis, and preparation of this report.

Drawings showing the site and boring locations are shown on the **Site Location** and **Exploration Plan**, respectively. The results of the laboratory testing performed on soil samples obtained from the site during our field exploration are included on the boring logs and as separate graphs in the **Exploration Results** section.

Project Description

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Information Provided	Information for this project was provided by Maggie Gillam with JGR via e-mail beginning on February 7, 2024. The following documents were provided: ■ Grand View Heights (GVH) Property, dated 8/19/2022 ■ GVH 9th design, dated 1/09/2024 ■ Preliminary Drawings of the New Apartment Complex Buildings for the GVH property, dated 2/1/2024 ■ Aerial Map of the project site, dated 2/7/2024 ■ Professionally Surveyed Topography Plot, dated 2/26/2024
Project Description	The project includes the construction of two, three-story buildings within the designated Overland area. The Overland development site is approximately 1.95 acres, with the proposed buildings occupying approximately 1.13 acres situated on the northern and southern perimeters of the Overland development. The residual parcel of the development has been allocated for the creation of 82 parking stalls, along with a clubhouse, a designated area for trash enclosure and a driveway to facilitate access.
Proposed Structures	The supplied site plan shows the proposed buildings consisting of two, three-story buildings, a clubhouse, a BBQ/picnic area, and a tot lot (playground).
Building Construction	We anticipate the buildings will be wood and/or steel-framed construction supported on shallow, reinforced concrete, spread footing foundations with a slab-on-grade floor system.
Finished Floor Elevation (FFE)	We understand the FFE of the north building will be approximately 7,346 feet and approximately 7,336 feet for the south building.
Maximum Loads	Anticipated structural loads were not provided at the time of this report. However, based on our experience with similar projects, we assume the following maximum loading conditions: ■ Columns: <100 kips ■ Walls: <3 kips per linear foot (klf) ■ Slabs: <150 pounds per square foot (psf)
Grading/Slopes	We understand final grades will closely correspond to the elevations of existing site features. We assume minimal (less than 6 feet) cuts/fills will be necessary to achieve desired final grade.

Item	Description
Below-Grade Structures	None anticipated for site development.
Pavements	Traffic types and volumes were not provided at the time of this report. We understand rigid (concrete), and flexible (asphalt concrete) sections will be considered for construction with a pavement design period of 20 years.

Terracon should be notified if any of the above information is inconsistent with the planned construction, especially the grading limits, as modifications to our recommendations may be necessary.

Site Conditions

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Location	The project is located at 3800 Bill Nye Avenue in Laramie, Wyoming. Approximate coordinates at the north and south ends of the project area are approximately 41.2961ºN, 105.5467ºW and 41.2952ºN, 105.5467ºW, respectively. See **Site Location**
Existing Improvements	Based on the review of historical aerial imagery (Google Earth Pro) and our site visit, the project site exhibits signs of prior development and has undergone a degree of site grading. There are stockpiles of cobbles, soils, and debris on the site.
Current Ground Cover	Current ground cover consists of mostly native grasses and weeds with some barren ground.
Existing Topography	The project site's elevation slopes down approximately 10 feet towards the southeast corner and the west side of the site.

Geotechnical Characterization

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of the site. Conditions observed at each exploration point are indicated on the individual logs. The individual logs can be found in the **Exploration Results** and the GeoModel can be found in the **Figures** attachment of this report.

As part of our analyses, we identified the following model layers within the subsurface profile. For a more detailed view of the model layer depths at each boring location, refer to the GeoModel.

Model Layer	Layer Name	General Description
1	**Surficial Material**	About 3 to 10 inches of vegetative soil and root penetration. About 3 inches of apparent aggregate base course in Boring Nos. P-03 and P-04.
2	**Existing Fill**	Fine to coarse grain sands with varying amounts of silt, clay, and fine to coarse grained gravel. Reddish brown to red.
3	**Native Soil**	Medium dense to dense sand with varying amounts of silt, clay, and gravel. Fine to coarse grained sand and gravel. Very stiff to hard sandy silt, fine to medium grained. Generally reddish brown to red.

Seismic Site Class

Seismic design requirements for buildings and other structures are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7 and the International Building Code (IBC). Based on the soil properties observed at the site and as described on the exploration logs and results, we recommend a **Seismic Site Classification of D** be considered for the project. Subsurface explorations at this site were extended to a maximum depth of about 25.5 feet. The site properties below the boring depth to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area. Additional deeper borings or geophysical testing may be performed to confirm the conditions below the current boring depth.

Corrosivity

The table below lists the results of laboratory pH, soluble sulfate, sulfides, soluble chloride, RedOx, total salts, and electrical resistivity testing. The values may be used to estimate potential corrosive characteristics of the on-site soils with respect to contact with the various underground materials which will be used for project construction.

Corrosivity Test Results Summary

Boring No.	Sample Depth (feet)	Soil Description	pH	Soluble Sulfate (mg/kg)	Sulfides (mg/kg)	Soluble Chloride (mg/kg)	RedOx (mV)	Total Salts (mg/kg)	Electrical Resistivity[1] (Ω-cm)
B-5	1 to 5	Silty Sand	6.0	23	0	20	+239	1,669	5,225

1. Test performed on a saturated soil sample.

These values serve as crucial indicators for assessing the potential corrosive characteristics of on-site soils concerning their interaction with various underground materials slated for project construction. For detailed results of corrosivity testing conducted on soil samples during exploration, please refer to the Chemical Laboratory Test Results section within the **Exploration and Laboratory Results**.

It is imperative to note that the corrosion information provided is specific to the tested samples. If the actual soil composition in contact with the structures at the site differs from those tested, additional corrosion testing should be considered. It is important to emphasize that Terracon's expertise does not extend to corrosion engineering. Our scope of work was limited to conducting corrosion laboratory tests on selected samples and presenting the results alongside a brief comparison to selected criteria. Should concerns regarding the corrosion of underground utilities and structures persist, it is strongly recommended to engage the services of a qualified corrosion engineer for further evaluation and guidance tailored to the specific needs of this project.

Water Soluble Sulfate

The sulfate concentration measured in the sample is 23 mg/kg which equates to approximately 0.0023 percent. Sulfate concentrations of less than 0.1 percent indicate Class 0 exposure to sulfate attack for concrete in contact with the subsoils, according to the American Concrete Institute (ACI) *Guide to Durable Concrete*. For this level of sulfate concentrations, ACI indicates any type of cement can be used for concrete in contact with the subsoils. Therefore, Type I or IL portland cement should be suitable for concrete on and below grade. However, if there is no or minimal cost differential, use of Type II portland cement (or equivalent) should be considered for additional sulfate resistance of construction concrete. Foundation concrete should be designed in accordance with the provisions of the *ACI Design Manual*, Section 318.

Geotechnical Overview

The geotechnical conditions at this site appear suitable for the proposed construction based upon soils encountered in the test borings, provided the recommendations provided in this report are implemented in the design and construction phases of this project.

The subsurface materials generally consisted of sand with varying amounts of silt, clay, and gravel extending to the maximum depth of the borings. Groundwater was not encountered within the maximum depths of exploration during or at the completion of drilling.

Based on the conditions encountered and estimated load-settlement relationships, the proposed structures can be supported on conventional continuous or spread footings.

Due to the undocumented fill across the site, the foundations should be supported on structural fill. Structural fill for the proposed foundations should incorporate the limits of the foundations plus a lateral distance beyond the outside edge of footings, where space is available. On-site soils are considered suitable to be used as engineered fill materials.

If possible, grading should be performed during the warmer and drier times of the year. If grading is performed during the winter months, an increased risk for possible undercutting and replacement of unstable subgrade will persist. Additional site preparation recommendations, including subgrade improvement and fill placement, are provided in the **Earthwork** section.

Our opinion of pavement section thickness design has been developed based on our understanding of the intended use, assumed traffic, and subgrade preparation recommended herein using methodology contained in NAPA IS-109 “Design of Hot Mix Asphalt Pavements” and adjusted with consideration to local practice. The **Pavements** section includes minimum pavement component thickness.

Existing Fill

Existing fill was encountered to depths of about 1 to 6 feet below the existing ground surface at each boring location. Fill may be present at other locations on the site and extend to depths greater than 6 feet. We are not aware of documentation of the placement of the existing fill under the testing and observation of a geotechnical engineer. Therefore, for the purpose of this report, the existing fill soils are considered undocumented and should be considered uncontrolled. Uncontrolled fills can present a risk of post-construction movement to foundations, floor slabs, and other site improvements supported on or above these materials. Consequently, we recommend existing fills be removed and replaced with engineered fill within the area of the planned improvements prior to placing any new fill or construction.

Support of floor slabs and pavements on or above existing fill materials is discussed in this report. However, even with the recommended construction procedures, an inherent risk remains for the owner that compressible fill or unsuitable material, within or buried by the fill, will not be discovered. This risk of unforeseen conditions cannot be eliminated without completely removing the existing fill but can be reduced by following the recommendations contained in this report.

The lowest risk alternative is complete removal of the fill below pavements and replacement with newly placed, properly compacted engineered fill. However, complete removal of fill materials below proposed pavements will likely be very cost prohibitive. If the Owner is willing to accept the risk of potential movements and poor performance of pavements, partial removal and replacement with newly placed, properly compacted engineered fill could be considered. At a minimum, we recommend over-excavating at least 12-inches of the existing fill below pavements and replacement with newly placed, properly compacted engineered fill.

Earthwork

Earthwork is anticipated to include demolition, clearing and grubbing, excavations, and engineered fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for foundations, floor slabs, and pavements.

Demolition

Demolition of the existing site development should include complete removal of all existing stockpiles of cobbles, soils, and debris on the site. All materials derived from the demolition should be removed from the site.

Our experience suggests a portion of the demolition site features sometimes happens weeks to several months prior to site grading and new construction. Our recommendations for subgrade preparation, fill placement, and other activities associated with earthwork on the project site should be performed during these initial demolition activities. We recommend fill be placed and tested for moisture content and percent compaction during backfill of the excavations made during initial demolition activities. If the fill materials are not properly placed and confirmed with compaction testing, there is an increased risk of movement and poor performance for foundations, floor slabs, pavements or other site features constructed on the fill placed as part of restoring the site after initial demolition.

Existing Fill

As noted in **Geotechnical Characterization**, existing fill was encountered to a depth of about 1 to 6 feet below the existing ground surface at each boring location. These materials may be present at other locations on the site and extend to greater depths. We have no records to indicate the degree of control, and consequently, the fill is considered unreliable for support of foundation loads. Support of floor slabs and pavements on or above existing fill soils is discussed in this report. However, even with the recommended construction procedures, inherent risk exists for the owner that compressible fill or unsuitable material, within or buried by the fill will, not be discovered. This risk of unforeseen conditions cannot be eliminated without completely removing the existing fill but can be reduced by following the recommendations contained in this report. The existing fill soils should be suitable for reuse in new fills and backfill, provided debris, organics and other unsuitable materials are removed. Terracon's services did not include delineating the horizontal or vertical extent of the existing fill material. Therefore, we suggest additional geotechnical exploration and evaluation be conducted at the site prior to construction. At a minimum, a series of excavation test pits/trenches could be excavated on the site to more accurately define the vertical and lateral extent of the fill materials and the composition of the fill.

The lowest risk alternative is complete removal of the fill below pavements and replacement with newly placed, properly compacted engineered fill. However, complete removal of fill materials below proposed pavements will likely be very cost prohibitive. If the Owner is willing to accept the risk of potential movements and poor performance of pavements, partial removal and replacement with newly placed, properly compacted engineered fill could be considered. At a minimum, we recommend over-excavating at least 12-inches of the existing fill below pavements and replacement with newly placed, properly compacted engineered fill.

Site Preparation

Prior to placing fill, existing vegetation, topsoil, and root mats should be removed. Complete stripping of the topsoil should be performed in the proposed building and parking/driveway areas.

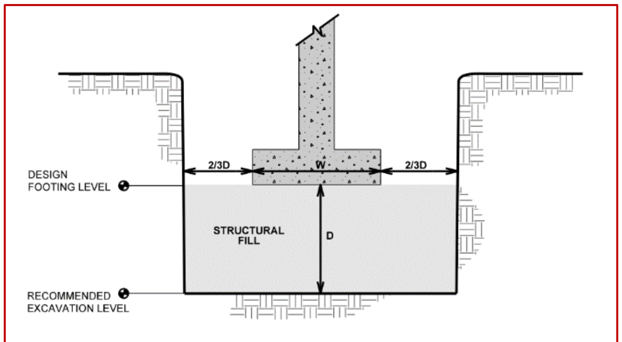
Although no evidence of fill or underground facilities (such as septic tanks, cesspools, basements, and utilities) was observed during the exploration and site reconnaissance, such features could be encountered during construction. If unexpected fills or underground facilities are encountered, such features should be removed, and the excavation thoroughly cleaned prior to backfill placement and/or construction.

If unstable or soft ground conditions develop during earthwork or other construction activities, some method of soil improvement or stabilization will be needed prior to fill placement and/or foundation, floor slab, or pavement construction. A stable subgrade can be defined as the condition in which the subgrade exhibits little to no yielding (less than 1 inch of deflection) under a loaded water truck or tandem-axel dump truck, After stable conditions are achieved, fill placement and/or construction can continue. There are a number of stabilizations methods that can be used to improve the subgrade and depend, in part, on the extent and severity of the unstable soils exposed during construction as well as other factors. These soil stabilization methods are further discussed in the **Soil Stabilization** section of the report. In any event, we feel the appropriate method and level of stabilization should be evaluated and can best be determined on a case-by-case basis during construction once the entire subgrade and overall conditions are exposed.

Subgrade Preparation Below Structural Areas

Subgrade preparation efforts are required to render the site suitable for supporting a shallow foundation system and to mitigate estimated foundation settlement within tolerable limits. Upon completion of demolition, stripping, and complete removal of existing fill, the subgrade soils within the footprint of the proposed structures should be scarified, moisture conditioned as necessary, and compacted per the compaction requirements in the **Fill Placement** and **Compaction Requirements** section of this report. Compacted structural fill soils should then be placed to the proposed design grade and the moisture content and compaction of subgrade soils should be maintained until foundation construction.

Where encountered, existing fill and unsuitable areas of soft/loose subgrade should be over-excavation below and beyond the lateral extents of the proposed foundation systems as generally depicted in the sketch below. The over-excavation activities should be performed under the observation of the Geotechnical Engineer or representative.



OVER-EXCAVATION / BACKFILL ZONE

NOTE: EXCAVATIONS ARE SHOWN VERTICAL; HOWEVER, THE SIDEWALLS SHOULD BE SLOPED AS NECESSARY FOR SAFETY

Based upon the subsurface conditions determined from the geotechnical exploration, subgrade soils exposed during construction are anticipated to be relatively workable; however, the workability of the subgrade may be affected by precipitation, repetitive construction traffic or other factors. If unworkable conditions develop, workability may be improved by scarifying and drying.

Pavement Subgrade Preparation

A critical aspect of pavement performance is subgrade preparation. Subgrade preparation efforts are required in order to render the site suitable for support of pavement sections on this project.

As discussed in the **Geotechnical Overview** section, existing fill was encountered to depths of about 1 to 6 feet below the existing ground surface at each boring location. These materials could extend to greater depths at other locations on this site. Undocumented existing fills can present a risk of post-construction movement to pavements, and other site improvements supported on or above these materials.

If some risk of pavement settlement can be accepted, consideration could be given to supporting pavements on at least 12 inches of reworked (over-excavated, moisture conditioned, and recompacted) existing fill materials. However, if the client cannot accept the risk of pavement settlements, existing fill materials encountered below proposed pavement areas should be completely removed and replaced prior to placement of site grading fills or aggregate base course material. We recommend the compaction procedures follow the **Compaction Requirements** section of this report.

Additionally, prior to pavement operations, we recommend the prepared subgrade be proof-rolled in the presence of the Geotechnical Engineer or representative using heavy construction equipment, such as a loaded water truck or tandem-axel dump truck, to help delineate weak or disturbed areas (greater than 1 inch of deflection) at or near the ground surface. Particular attention should be paid to high traffic areas that were rutted and disturbed earlier and to areas where backfilled trenches are located. Areas delineated by the proof-roll should be over-excavated and replaced with approved fill if the affected materials cannot be moisture conditioned and compacted in place, or the subgrade should be stabilized by other suitable methods as previous described in this report.

Exterior Flatwork and Sidewalk Design and Construction

Exterior concrete flatwork, sidewalk, curb, exterior architectural features, and utilities founded on or in backfill, or the site soils will likely experience some movements due to the volume change of the material and the presence of existing fill. Therefore, to improve the performance of exterior flatwork and sidewalks and reduce the potential for movement, we recommend 12 inches of the existing fill below any exterior flatwork and sidewalk be scarified, moisture conditioned, and recompacted to provide uniform support and reduce the risk of movement. On-site soils are suitable as fill material below exterior flatwork and sidewalks. Potential movement of the subgrade soils below exterior flatwork and sidewalks could also be reduced by:

- Minimizing moisture increases in the backfill;
- Controlling moisture-density during placement of the backfill;
- Using design which allow vertical movement between the exterior features and adjoining structural elements; and
- Placing control joints on relatively close centers.

We recommend the exterior concrete flatwork and sidewalk design be based on local municipality standards and specifications.

Fill Material Types

Engineered fill required to achieve design grade should be classified as structural fill and general fill. Structural fill is material used below, or within 7 feet of structures, pavements, or constructed slopes. General fill is material acceptable for use above foundations as excavation backfill.

On-site soils free of vegetation, organic matter, and other unsuitable materials or import materials approved by Terracon may be used as structural fill or general fill on the site.

Imported Fill Materials: Imported fill materials should meet the following material property requirements. Regardless of its source, compacted fill should consist of approved materials that are free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade.

Soil Type [1]	USCS Classification	Acceptable Parameters (for Structural Fill)
Granular	GW, GP, GM, GC, SW, SP, SM, SC	Maximum particle size of 3 inches Liquid Limit less than 30, Plasticity Index less than 15 Less than 45% passing the No. 200 sieve
Wyoming Department of Transportation (WYDOT) Grade W or L	Varies	

1. A sample of each material type should be submitted to the Geotechnical Engineer for evaluation prior to use on this site. Additional geotechnical consultation should be provided prior to use of uniformly graded gravel on the site.

Fill Placement and Compaction Requirements

Structural and general fill should meet the following compaction requirements.

Item	Structural Fill	General Fill
Maximum Lift Thickness	9 inches or less in loose thickness when heavy, self-propelled compaction equipment is used 4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used	Same as structural fill
Minimum Compaction Requirements [1,2]	At least 98% of the standard Proctor maximum dry density (ASTM D698) for fill/backfill below foundations and floor slabs. At least 95% of the standard Proctor maximum dry density (ASTM D698) for above foundations.	95% of standard Proctor maximum density
Water Content Range [3,4]	Low plasticity cohesive: -2% to +3% of optimum High plasticity cohesive: -1 to +4% of optimum Granular: -3% to +3% of optimum	As required to achieve min. compaction requirements

1. Structural and general fill should be placed and compacted in horizontal lifts, using equipment and procedures that will produce recommended moisture contents and densities throughout the lift. A construction disc or other suitable processing equipment will be needed to thoroughly process the materials and to aid in achieving uniform moisture content throughout the fill.
2. Care should be taken during the fill placement process to avoid zones of dissimilar fill. Improvements constructed over varying fill types are at a higher risk of differential movement compared to improvements over a uniform fill zone.
3. The contractor should expect significant moisture adjustment and processing of the site soils or import materials will be needed prior to or during compaction operations. In particular, the clayey sand encountered is expected to have in-place moisture contents below the soil's optimum moisture content. The contractor should expect considerable moisture adjustment of these soils will be needed prior to or during backfilling operations.
4. Moisture conditioned cohesive soils should not be allowed to dry out. A loss of moisture within these materials will likely result in an increase of the material's swell potential. Subsequent wetting of these material could result in undesirable movements.

Utility Trench Backfill

Any soft or unsuitable materials encountered at the bottom of utility trench excavations should be removed and replaced with structural fill or bedding material in accordance with public works specifications for the utility be supported. This recommendation is particularly applicable to utility work requiring grade control and/or in areas where subsequent grade raising could cause settlement in the subgrade supporting the utility. Trench excavation should not be conducted below a downward 1:1 projection from existing foundations without engineering review of shoring requirements and geotechnical observation during construction.

On-site materials are considered suitable for backfill of utility and pipe trenches from 1 foot above the top of the pipe to the final ground surface, provided the material is free of organic matter and deleterious substances.

Trench backfill should be mechanically placed and compacted as discussed earlier in this report. Where trenches are placed beneath slabs or footings, the backfill should satisfy the gradation and expansion index requirements of engineered fill discussed in this report. Flooding or jetting for placement and compaction of backfill is not recommended.

Grading and Drainage

All grades must provide effective drainage away from the buildings during and after construction and should be maintained throughout the life of the structures. Water retained next to the buildings can result in soil movements greater than those discussed in this report. Greater movements can result in unacceptable differential floor slab and/or foundation movements, cracked slabs and walls, and roof leaks. The roof should have gutters/drains with downspouts that discharge onto splash blocks at a distance of at least 10 feet from the buildings.

Exposed ground should be sloped and maintained at a minimum 5% away from the buildings for at least 10 feet beyond the perimeter of the buildings. Flatter grades may be necessary to transition ADA access requirements for flatwork. After building construction and landscaping have been completed, final grades should be verified to document effective drainage has been achieved. Grades around the structures should also be periodically inspected and adjusted, as necessary, as part of the structures' maintenance program. Where paving or flatwork abuts the structures, a maintenance program should be established to effectively seal and maintain joints and prevent surface water infiltration.

Earthwork Construction Considerations

Excavations for the proposed structures are anticipated to be accomplished with conventional construction equipment. Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of grade-supported improvements such as floor slabs and pavements. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over or adjacent to construction areas should be removed. If the subgrade freezes, desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted prior to floor slab construction.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, and in accordance with any applicable local and/or state regulations.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety or the contractor's activities; such responsibility shall neither be implied nor inferred.

Excavations or other activities resulting in ground disturbance have the potential to affect adjoining properties and structures. Our scope of services does not include review of available final grading information or consider potential temporary grading performed by the contractor for potential effects such as ground movement beyond the project limits. A preconstruction/ precondition survey should be conducted to document nearby property/infrastructure prior to any site development activity. Excavation or ground disturbance activities adjacent or near property lines should be monitored or instrumented for potential ground movements that could negatively affect adjoining property and/or structures.

Construction Observation and Testing

The earthwork efforts should be observed by the Geotechnical Engineer (or others under their direction). Observation should include documentation of adequate removal of surficial materials (vegetation, topsoil, and various debris and stockpiles), evaluation and remediation of existing fill materials, as well as proofrolling and mitigation of unsuitable areas delineated by the proofroll.

Each lift of compacted fill should be tested, evaluated, and reworked, as necessary, as recommended by the Geotechnical Engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency of at least one test for every 2,500 square feet of compacted fill in the building areas and 5,000 square feet in pavement areas. Where not specified by local ordinance, one density and water content test should be performed for every 100 linear feet of compacted utility trench backfill and a minimum of one test performed for every 12 vertical inches of compacted backfill.

In areas of foundation excavations, the bearing subgrade should be evaluated by the Geotechnical Engineer. If unanticipated conditions are observed, the Geotechnical Engineer should prescribe mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

Shallow Foundations

If the site has been prepared in accordance with the requirements noted in **Earthwork**, the following design parameters are applicable for shallow foundations.

Design Parameters – Compressive Loads

Item	Description	
	Square Footing	Strip Footing
Maximum Net Allowable Bearing Pressure [1, 2]	4,000 psf [3]	2,500 psf [3]
Minimum embedment below finished grade [4,5]	36 inches	
Maximum foundation dimensions	7 feet	4 feet (wide)
Estimated Total Settlement from Structural Loads [2]	About 1 inch	
Estimated Differential Settlement [2, 6]	About ½ to ¾ of total settlement	

1. The maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Values assume exterior grades are no steeper than 20% within 10 feet of structures.
2. Values provided are for maximum loads noted in **Project Description**. Additional geotechnical consultation will be necessary if higher loads are anticipated.

Item	Description	
	Square Footing	Strip Footing

3. Provided existing fill is removed and replaced with newly placed structural fill below the foundation elements to provide uniform support and reduce the risk of movement.
4. Unsuitable loose or soft soils should be over-excavated and replaced per the recommendations presented in **Earthwork**.
5. Embedment necessary to minimize the effects of frost and/or seasonal water content variations. For sloping ground, maintain depth below the lowest adjacent exterior grade within 5 horizontal feet of the structures.
6. Differential settlements are noted for equivalent-loaded foundations and bearing elevation as measured over a span of 50 feet.

Foundation Construction Considerations

As noted in **Earthwork**, the footing excavations should be evaluated under the observation of the Geotechnical Engineer. The base of all foundation excavations should be free of water and loose soil, prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Care should be taken to prevent wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed.

Floor Slabs

Design parameters for floor slabs assume the requirements for **Earthwork** have been followed. Specific attention should be given to positive drainage away from the structures and positive drainage of the aggregate base beneath the floor slab. Existing fill was observed at the site to depths of about 1 to 6 feet below existing grade. As previously described, any existing fill present beneath floor slabs should be completely removed and reworked.

Floor Slab Design Parameters

Item	Description
Interior floor system	Slab-on-grade concrete.
Floor Slab Support[1]	Existing fill removed and replaced with newly placed structural fill below the floor slabs to provide uniform support and reduce the risk of movement.

Item	Description
Estimated Modulus of Subgrade Reaction [2]	For limited area loads or concentrated/point loads placed directly on slabs: ■ 150 pounds per square inch per inch (psi/in.) for slabs supported on compacted subgrade consisting of the on-sites oils. ■ 200 psi/in. for slabs supported on at least 6 inches of compacted aggregate base course.

1. Floor slabs should be structurally independent of building footings or walls to reduce the possibility of floor slab cracking caused by differential movements between the slab and foundation.
2. Modulus of subgrade reaction is an estimated value based upon our experience with the subgrade condition, the requirements noted in **Earthwork**, and the floor slab support as noted in this table. It is provided for point loads. For large area loads, the modulus of subgrade reaction would be lower.

The use of a vapor retarder should be considered beneath concrete slabs on grade covered with wood, tile, carpet, or other moisture sensitive or impervious coverings, when the project includes humidity-controlled areas, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

Saw-cut contraction joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations, refer to the ACI Design Manual. Joints or cracks should be sealed with a waterproof, non-extruding compressible compound specifically recommended for heavy duty concrete pavement and wet environments.

Where floor slabs are tied to perimeter walls or turn-down slabs to meet structural or other construction objectives, our experience indicates differential movement between the walls and slabs will likely be observed in adjacent slab expansion joints or floor slab cracks beyond the length of the structural dowels. The Structural Engineer should account for potential differential settlement through use of sufficient control joints, appropriate reinforcing or other means.

Settlement of floor slabs supported on existing fill materials cannot be accurately predicted but could be larger than normal and result in some cracking. Mitigation measures, as noted in **Existing Fill** within **Earthwork**, are critical to the performance of floor slabs. In addition to the mitigation measures, the floor slab can be stiffened by adding steel reinforcement, grade beams, and/or post-tensioned elements.

Floor Slab Construction Considerations

Finished subgrade, within and for at least 10 feet beyond the floor slab, should be protected from traffic, rutting, or other disturbance and maintained in a relatively moist condition until floor slabs are constructed. If the subgrade should become damaged or desiccated prior to construction of floor slabs, the affected material should be removed, and structural fill should be added to replace the resulting excavation. Final conditioning of the finished subgrade should be performed immediately prior to placement of the floor slab support course.

The Geotechnical Engineer should observe the condition of the floor slab subgrades immediately prior to placement of the floor slab support course, reinforcing steel, and concrete. Attention should be paid to high traffic areas that were rutted and disturbed earlier, and to areas where backfilled trenches are located.

Pavements

General Pavement Comments

Pavement designs are provided for the traffic conditions and pavement life conditions as noted in **Project Description** and in the following sections of this report. A critical aspect of pavement performance is site preparation. Pavement designs noted in this section must be applied to the site which has been prepared as recommended in the **Earthwork** section. Our opinion of the pavement section thickness design has been developed based on our understanding of the intended use, assumed traffic, and subgrade preparation recommended herein using methodology contained in ACI 330 “Guide to Design and Construction of Concrete Parking Lots” and NAPA IS-109 “Design of Hot Mix Asphalt Pavements.

Pavement Design Parameters

The design of flexible pavements for the project was based on the procedures of the National Asphalt Pavement Association (NAPA). These design procedures are specific to low-volume (low traffic) pavements such as those that will be constructed at this site.

The design of the recommended pavement sections was based on the following NAPA Criteria:

- NAPA Traffic Class II for main drives, light truck drives, and trash enclosures areas includes a maximum of 27,000 ESAL’s over the design life of the pavement (Medium-Duty): Average Daily Truck Traffic (ADTT)=25,

- A soil characterization of "poor" based on the subsurface soils encountered at the site and expected at pavement subgrade elevation, and
- A pavement design life of 20 years.

Pavement Section Thicknesses

The following table provides the recommend minimum thickness for AC sections:

Asphaltic Concrete Design

Layer	Thickness (inches)
	Traffic Class I [1]
AC[2]	4
Aggregate Base[3]	6
Total	10

1. See **Pavement Design Parameters** for more specifics regarding traffic assumptions.
2. All materials should meet WYDOT (2021) Standard Specifications for Road and Bridge Construction.
3. Requirements specified in **Fill Material Types** section.

Areas for parking of heavy vehicles, concentrated turn areas, and start/stop maneuvers could require thicker pavement sections. Edge restraints (i.e. concrete curbs or aggregate shoulders) should be planned along curves and areas of maneuvering vehicles.

Openings in pavements, such as decorative landscaped areas, are sources for water infiltration into surrounding pavement systems. Water can collect in the islands and migrate into the surrounding subgrade soils thereby degrading support of the pavement. Islands with raised concrete curbs, irrigated foliage, and low permeability near-surface soils are particular areas of concern. The civil design for the pavements with these conditions should include features to restrict or collect and discharge excess water from the islands. Examples of features are edge drains connected to the stormwater collection system, longitudinal subdrains, or other suitable outlets and impermeable barriers preventing lateral migration of water such as a cutoff wall installed to a depth below the pavement structure.

Pavement Maintenance

The pavement section represents minimum recommended thicknesses and, as such, periodic upkeep should be anticipated. Preventive maintenance should be planned and provided for through an on-going pavement management program. Maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Pavement care consists of both localized (e.g., crack and joint sealing and patching) and global maintenance (e.g., surface sealing). Additional engineering consultation is recommended to determine the type and extent of a cost-effective program. Even with periodic maintenance, some movements and related cracking may still occur, and repairs may be required.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

- Final grade adjacent to paved areas should slope down from the edges at a minimum 2%.
- Subgrade and pavement surfaces should have a minimum 2% slope to promote proper surface drainage.
- Install pavement drainage systems surrounding areas anticipated for frequent wetting.
- Install joint sealant and seal cracks immediately.
- Seal all landscaped areas in or adjacent to pavements to reduce moisture migration to subgrade soils.
- Place compacted, low permeability backfill against the exterior side of curb and gutter.
- Place curb, gutter and/or sidewalk directly on clay subgrade soils rather than on unbound granular base course materials.

Frost Considerations

The soils on this site are frost susceptible, and small amounts of water can affect the performance of the slabs on-grade, sidewalks, and pavements. Exterior slabs should be anticipated to heave during winter months. If frost action needs to be eliminated in critical areas, we recommend the use of non-frost susceptible (NFS) fill or structural slabs (for instance, structural stoops in front of building doors). Placement of NFS material in large areas may not be feasible; however, the following recommendations are provided to help reduce potential frost heave:

- Provide surface drainage away from the buildings and slabs, and toward the site drainage system.

- Install drains around the perimeter of the buildings, stoops, below exterior slabs and pavements, and connect them to the site drainage system.
- Grade clayey subgrades so groundwater potentially perched in overlying fill or aggregate base, slope toward a site drainage system.
- Place NFS fill as backfill beneath slabs and pavements critical to the project.
- Place a 3 horizontal to 1 vertical (3H:1V) transition zone between NFS fill and other soils.
- Place NFS materials in critical sidewalk areas.

As an alternative to extending NFS fill to the full frost depth, consideration can be made to placing extruded polystyrene or cellular concrete under a buffer of at least 2 feet of NFS material.

General Comments

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

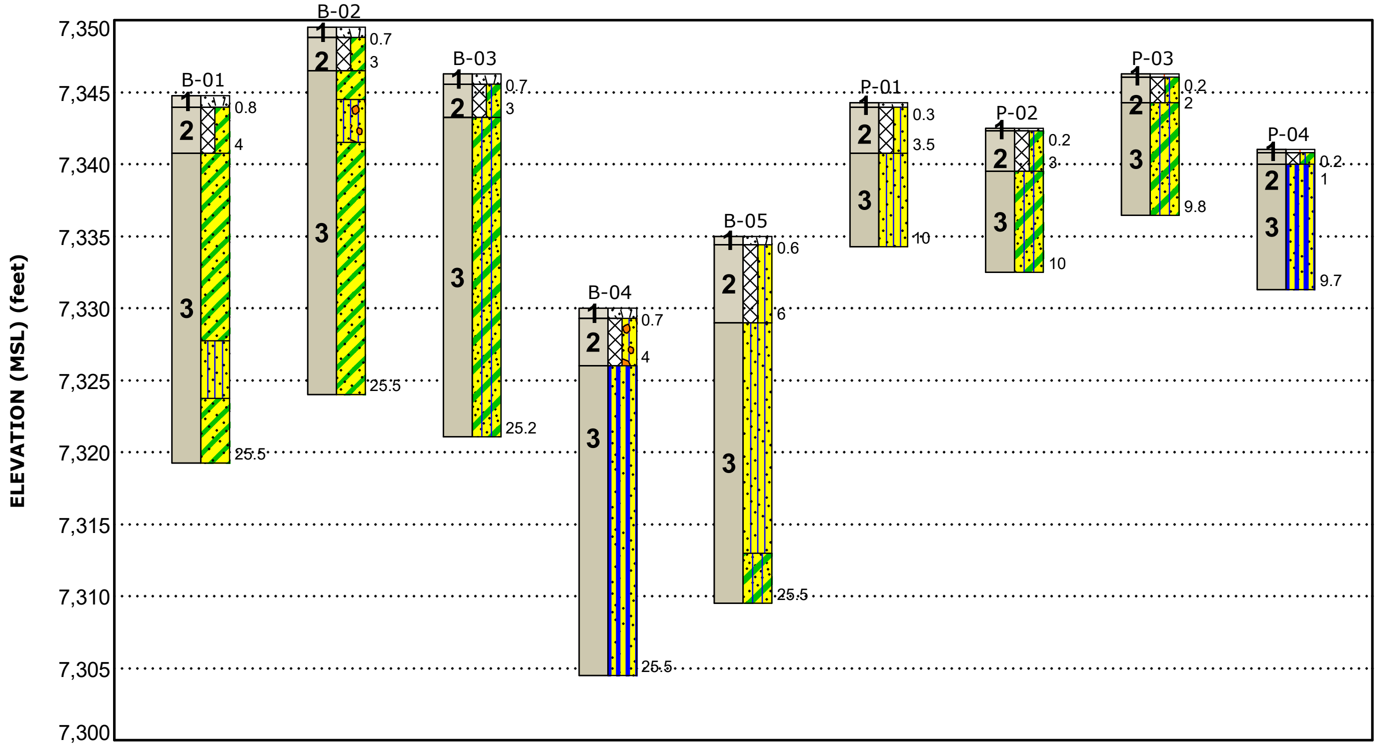
Our services and any correspondence are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly effect excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety and cost estimating including excavation support and dewatering requirements/design are the responsibility of others. Construction and site development have the potential to affect adjacent properties. Such impacts can include damages due to vibration, modification of groundwater/surface water flow during construction, foundation movement due to undermining or subsidence from excavation, as well as noise or air quality concerns. Evaluation of these items on nearby properties are commonly associated with contractor means and methods and are not addressed in this report. The owner and contractor should consider a preconstruction/precondition survey of surrounding development. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

Figures

GeoModel

GeoModel



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	**Surficial Material**	About 3 to 10 inches of vegetative soil and root penetration. About 3 inches of apparent aggregate base course in Boring Nos. P-03 and P-04.
2	**Existing Fill**	Fine to coarse grain sands with vary amounts of silt, clay, and fine to coarse grained gravel. Reddish brown to red.
3	**Native Soil**	Medium dense to dense sand with varying amounts of silt, clay and gravel. Fine to coarse grained sand and gravel. Very stiff to hard sandy silt, fine grained to medium grained. Generally reddish brown to red.

Legend

▨ Vegetative Soil	▨ Clayey Sand
▨ Silty Sand	▨ Silty Sand with Gravel
▨ Silty Clayey Sand	▨ Sandy Silt
▨ Apparent Base Course	

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project.
Numbers adjacent to soil column indicate depth below ground surface.

Attachments

Exploration and Testing Procedures
Site Location and Exploration Plans
Exploration and Laboratory Results
Supporting Information

Exploration and Testing Procedures

Field Exploration

Number of Borings	Approximate Boring Depth (feet)	Location
5	25.5	Building areas
4	About 10	Parking/ driveway areas

Boring Layout and Elevations: Terracon personnel provided the boring layout using handheld GPS equipment (estimated horizontal accuracy of about ±10 feet) and referencing existing site features. Approximate ground surface elevations were obtained by interpolation from the provided topographical map. If ground surface elevations and a more precise boring layout are desired, we recommend borings be surveyed.

Subsurface Exploration Procedures: We advanced the borings with a truck-mounted, drill rig using solid-stem, continuous-flight augers. Four samples were obtained in the upper 10 feet of each boring and at intervals of 5 feet thereafter. Soil sampling was typically performed using modified California barrel and split-barrel sampling procedures. In the split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon was driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. Modified California barrel sampling procedures are similar to standard split spoon sampling procedure; however, blow counts are typically recorded for 6-inch intervals for a total of 12 inches of penetration. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. Additionally, bulk samples were collected at select boring locations from depths of approximately 1 to 5 feet below the ground surface.

We also observed the boreholes while drilling and at the completion of drilling for the presence of groundwater. Groundwater was not observed at these times in the boreholes.

The sampling depths, penetration distances, and other sampling information was recorded on the field boring logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by a Geotechnical Engineer. Our exploration team prepared field boring logs as part of the drilling operations. These field logs included visual classifications of the materials observed during drilling and our interpretation of the subsurface conditions between samples. Final boring logs were prepared from the field logs. The final boring logs represent the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests. The laboratory testing program included the following types of tests:

- Moisture content
- Dry unit weight
- Atterberg limits
- Grain size analysis
- Swell consolidation
- Chemical analysis: pH, sulfates, sulfides, chlorides, RedOx, total salts, and electrical resistivity

The laboratory testing program often included examination of soil samples by an engineer. Based on the results of our field and laboratory programs, we described and classified the soil samples in accordance with the Unified Soil Classification System.

Site Location and Exploration Plans

Contents:

Note: All attachments are one page unless noted above.

Site Location

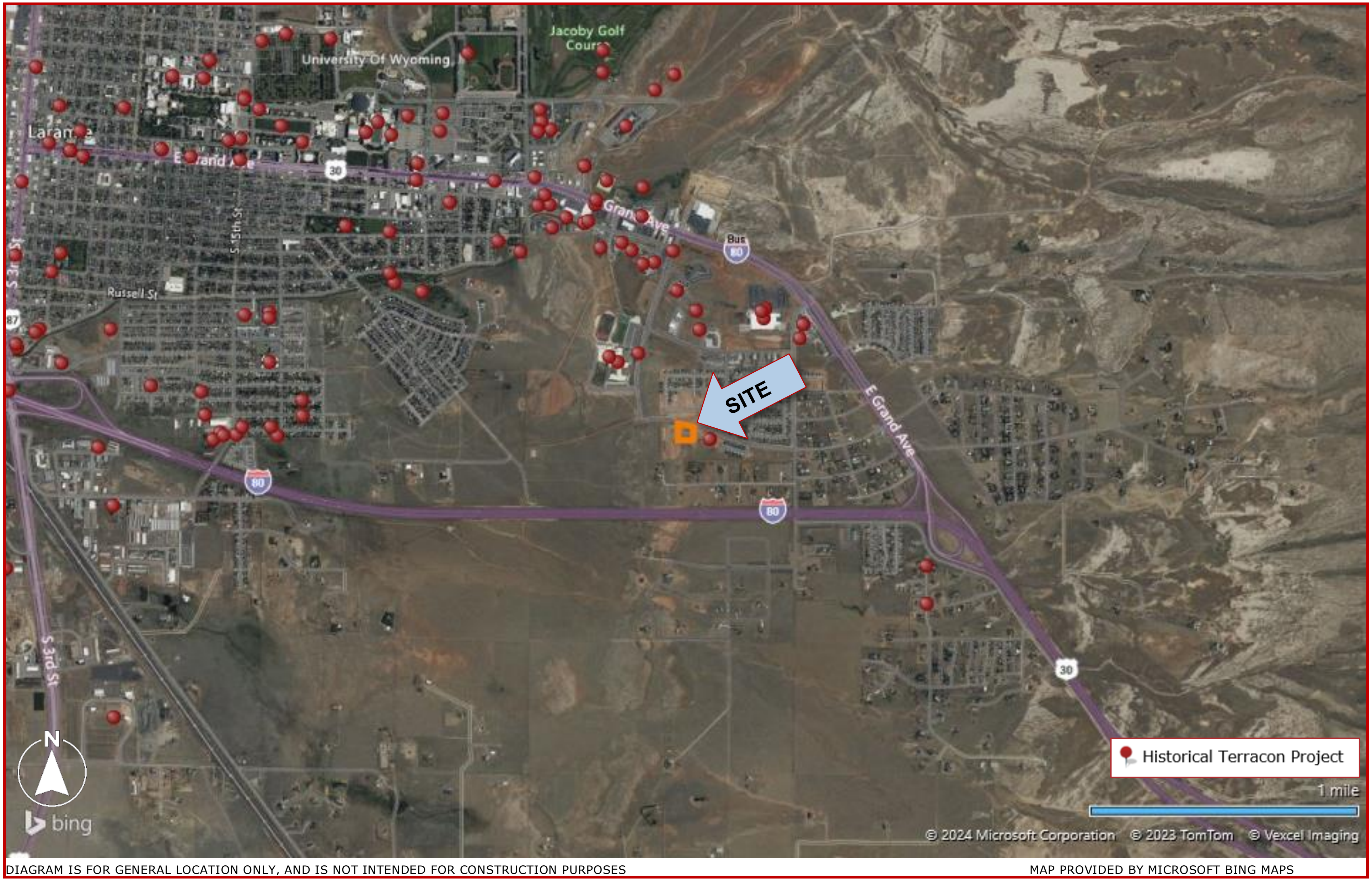


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

Exploration Plan

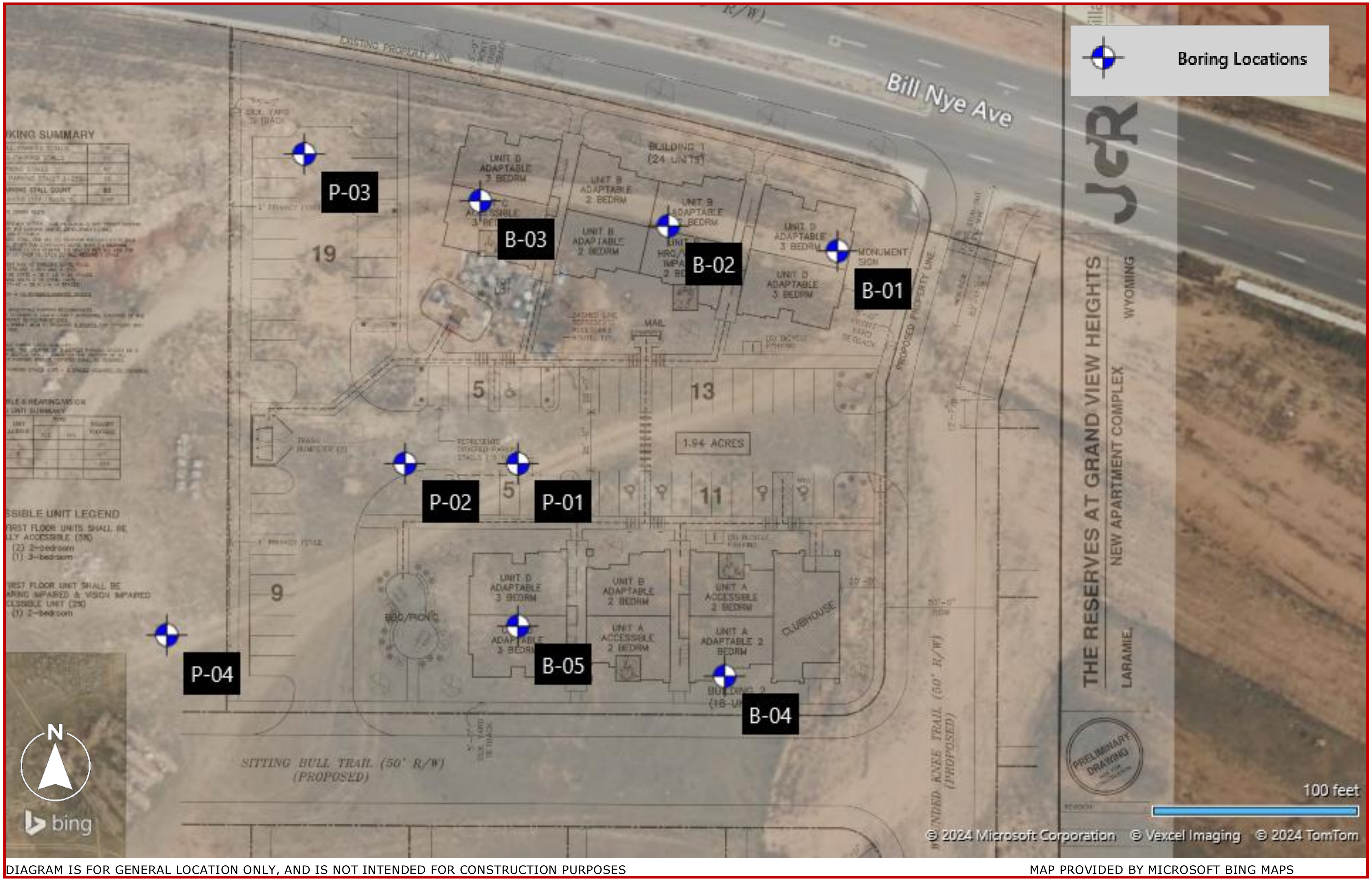


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

Exploration and Laboratory Results

Contents:

Boring Logs (B-01 through P-04)
Atterberg Limits
Grain Size Distribution
Consolidation/Swell
Corrosivity

Note: All attachments are one page unless noted above.

Boring Log No. B-01

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 41.2958° Longitude: -105.5456° Depth (Ft.) Elevation: 7344.75 (Ft.) +/-	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Swell- Consol / Load (%/psf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
1		**VEGETATIVE SOIL**, about 10 inches of root penetration 0.8 7343.95			⊠	3-5-13 N=18		7.8			
2		**FILL - CLAYEY SAND (SC)**, trace silt, fine to medium grained, reddish brown to red 4.0 7340.75			⧓	28/12"		7.9	113		
3		**CLAYEY SAND (SC)**, trace silt, fine to medium grained, reddish brown to red, medium dense to dense	5								
					⊠	7-7-34 N=41		8.3			
			10		⧓	16/12"		7.3	107		
			15		⊠	11-17-19 N=36		9.7			
		17.0 7327.75 **SILTY SAND (SM)**, fine to medium grained, gray, very dense			⧓	50/3"		5.7	100		
			20								
		21.0 7323.75 **CLAYEY SAND (SC)**, fine to coarse grained, reddish brown to red, dense									
		25.5 7319.25	25		⊠	10-14-26 N=40		11.2			
		Boring Terminated at 25.5 Feet									

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).
See Supporting Information for explanation of symbols and abbreviations.
Elevation Reference: Elevations were interpolated from the provided topographic site plan.

Notes

Water Level Observations
None encountered while drilling

Advancement Method
4-inch diameter, solid-stem auger

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Drill Rig
CME 55

Hammer Type
Automatic

Driller
Terracon Consultants Inc.
Hammer Efficiency = 67.7%

Boring Started
04-29-2024

Boring Completed
04-29-2024

Boring Log No. B-02

Location: See Exploration Plan

Latitude: 41.2958° Longitude: -105.5459°

Elevation: 7349.5 (Ft.) +/-

Model Layer	Depth (Ft.)	Description	Elevation	Water Level Observations	Sample Type	Field Test Results	Swell- Consol / Load (%/psf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
1	0.7	**VEGETATIVE SOIL**, about 8 inches of root penetration	7348.8		☒	3-4-6 N=10		10.5			
2	3.0	**FILL - CLAYEY SAND (SC)**, fine to coarse grained, reddish brown to red	7346.5								
3	5.0	**CLAYEY SAND (SC)**, fine to coarse grained, reddish brown to red, medium dense	7344.5		⧓	16/12"	-0.5/500	5.6	104		
	8.0	**SILTY SAND WITH GRAVEL (SM)**, fine to coarse grained sand, fine grained gravel, reddish brown to red, medium dense	7341.5		☒	4-6-9 N=15		7.9		NP	47
	25.5	**CLAYEY SAND (SC)**, trace silt, fine to coarse grained, reddish brown to red, medium dense to dense	7324		⧓	38/12"		7.0			
					☒	10-10-6 N=16		7.6			
		Weak cementation at about 19 feet, very dense			⧓	8-50/2"		6.7	110		
					☒	10-12-24 N=36		9.0			

Boring Terminated at 25.5 Feet

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).
See Supporting Information for explanation of symbols and abbreviations.
Elevation Reference: Elevations were interpolated from the provided topographic site plan.

Notes

Water Level Observations
None encountered while drilling

Advancement Method
4-inch diameter, solid-stem auger

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Drill Rig
CME 55

Hammer Type
Automatic

Driller
Terracon Consultants Inc.
Hammer Efficiency = 67.7%

Boring Started
04-29-2024

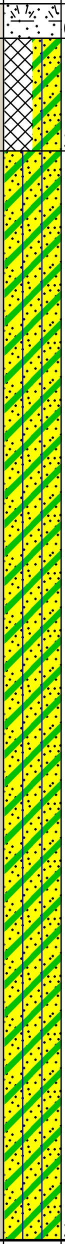
Boring Completed
04-29-2024

Boring Log No. B-03

Location: See Exploration Plan

Latitude: 41.2958° Longitude: -105.5462°

Elevation: 7346.25 (Ft.) +/-



Model Layer	Depth (Ft.)	Description	Elevation
1	0.7	**VEGETATIVE SOIL**, about 9 inches of root penetration	7345.55
2	3.0	**FILL - SILTY CLAYEY SAND (SC-SM)**, trace fine grained gravel, fine to coarse grained sand, reddish brown to red	7343.25
3	25.2	**SILTY CLAYEY SAND (SC-SM)**, trace fine grained gravel, fine to coarse grained sand, reddish brown to red, medium dense to very dense Calcareous nodules at about 6 feet Moderate cementation at about 19 feet	7321.05
		Boring Terminated at 25.2 Feet	

Sample Type	Field Test Results	Water Content (%)	Dry Unit Weight (pcf)
☒	3-5-6 N=11	10.5	
⧓	28/12"	8.6	
☒	9-14-19 N=33	5.6	
⧓	50/6"	7.8	105
☒	50/5"	7.3	
⧓	50/5"	9.0	106
☒	11-22-50/3"	9.0	

Other columns: Water Level Observations; Swell- Consol / Load (%/psf); Atterberg Limits LL-PL-PI; Percent Fines

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).
See Supporting Information for explanation of symbols and abbreviations.
Elevation Reference: Elevations were interpolated from the provided topographic site plan.

Notes

Water Level Observations
None encountered while drilling

Advancement Method
4-inch diameter, solid-stem auger

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Drill Rig
CME 55

Hammer Type
Automatic

Driller
Terracon Consultants Inc.
Hammer Efficiency = 67.7%

Boring Started
04-29-2024

Boring Completed
04-29-2024

Boring Log No. B-04

Location: See Exploration Plan

Latitude: 41.2959° Longitude: -105.5465°

Depth (Ft.) Elevation: 7330 (Ft.) +/-

Model Layer	Graphic Log	Description	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Swell- Consol / Load (%/psf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
1		0.7 **VEGETATIVE SOIL**, about 8 inches of root penetration 7329.3			☒	2-2-2 N=4		7.6			
2		**FILL - SILTY SAND WITH GRAVEL (SM)**, fine to coarse grained sand and gravel, reddish brown to red 4.0 7326			⧓	35/12"		4.2		NP	43
3		**SANDY SILT (ML)**, fine to coarse grained sand, fine grained gravel, reddish brown to red, hard	5								
					☒	14-20-22 N=42		3.5			
		Weak cementation at about 9 feet	10		⧓	70/12"		4.0		NP	52
			15		☒	27-50/5"		10.6			
		Weak cementation at about 19 feet	20		⧓	14-50/5"		11.0	126		
		25.5 7304.5	25		☒	12-19-25 N=44		10.1			
		Boring Terminated at 25.5 Feet									

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).
See Supporting Information for explanation of symbols and abbreviations.
Elevation Reference: Elevations were interpolated from the provided topographic site plan.

Water Level Observations
None encountered while drilling

Drill Rig
CME 55

Hammer Type
Automatic

Driller
Terracon Consultants Inc.
Hammer Efficiency = 67.7%

Notes

Advancement Method
4-inch diameter, solid-stem auger

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Boring Started
04-29-2024

Boring Completed
04-29-2024

Terracon
1505 Old Happy Jack Rd
Cheyenne, WY

Boring Log No. B-05

Location: See Exploration Plan

Latitude: 41.2955° Longitude: -105.5462°

Depth (Ft.) Elevation: 7335 (Ft.) +/-

Model Layer	Graphic Log	Depth (Ft.) / Description / Elevation	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Swell- Consol / Load (%/psf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
1		0.6 **VEGETATIVE SOIL**, about 7 inches of root penetration 7334.4			☒	2-2-2 N=4		9.4			
2		**FILL - SILTY SAND (SM)**, fine to coarse grained sand, fine grained gravel, reddish brown to red	5		⧓	31/12"		3.7		NP	39
		6.0 7329									
3		**SILTY SAND (SM)**, trace clay, fine to coarse grained sand, fine grained gravel, reddish brown to red, medium dense to dense			☒	9-12-14 N=26		9.8			
			10		⧓	26/12"		3.7			
			15		☒	15-19-21 N=40		8.4			
		Calcareous nodules at about 19 feet	20		⧓	43/12"		9.9	120		
		22.0 7313									
		SILTY CLAYEY SAND (SC-SM), fine to coarse grained sand, fine grained gravel, reddish brown to red, dense	25		☒	9-16-18 N=34		9.2			
		25.5 7309.5									
		Boring Terminated at 25.5 Feet									

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).
See Supporting Information for explanation of symbols and abbreviations.
Elevation Reference: Elevations were interpolated from the provided topographic site plan.

Water Level Observations
None encountered while drilling

Drill Rig
CME 55

Hammer Type
Automatic

Driller
Terracon Consultants Inc.
Hammer Efficiency = 67.7%

Notes

Advancement Method
4-inch diameter, solid-stem auger

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Boring Started
04-29-2024

Boring Completed
04-29-2024

Boring Log No. P-01

Location: See Exploration Plan

Latitude: 41.2955° Longitude: -105.5464°

Model Layer	Graphic Log	Depth (Ft.)		Elevation: 7344.25 (Ft.) +/-	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Swell- Consol / Load (%/psf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
1		0.3	**VEGETATIVE SOIL**, about 4 inches of root penetration	7343.95			☒	3-6-9 N=15		11.4			
2		3.5	**FILL - SILTY SAND (SM)**, fine to coarse grained, reddish brown to red	7340.75			⧓	14/12"		3.0			
3			**SILTY SAND (SM)**, trace fine grained gravel and clay, fine to coarse grained sand, reddish brown to red, medium dense to very dense		5		☒	16-29-37 N=66		4.1			
		10.0	Weak cementation at about 9 feet	7334.25	10		⧓	36/12"		6.7			
			Boring Terminated at 10 Feet										

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).
See Supporting Information for explanation of symbols and abbreviations.
Elevation Reference: Elevations were interpolated from the provided topographic site plan.

Water Level Observations
None encountered while drilling

Drill Rig
CME 55

Hammer Type
Automatic

Driller
Terracon Consultants Inc.
Hammer Efficiency = 67.7%

Notes

Advancement Method
4-inch diameter, solid-stem auger

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Boring Started
04-29-2024

Boring Completed
04-29-2024

Grand View Property
3800 Bill Nye Avenue | Laramie, Wyoming
Terracon Project No. 24245022

1505 Old Happy Jack Rd
Cheyenne, WY

Boring Log No. P-02

Location: See Exploration Plan

Latitude: 41.2952° Longitude: -105.5458°

Depth (Ft.) Elevation: 7342.5 (Ft.) +/-

Model Layer	Graphic Log	Depth (Ft.) / Description / Elevation	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Swell- Consol / Load (%/psf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
1		0.2 **VEGETATIVE SOIL**, about 3 inches of root penetration 7342.3									
2		**FILL - SILTY CLAYEY SAND (SC-SM)**, fine to coarse grained, reddish brown to red			☒	3-3-4 N=7		7.4			
		3.0 7339.5									
3		**SILTY CLAYEY SAND (SC-SM)**, trace fine grained gravel, fine to coarse grained sand, reddish brown to red, medium dense to dense			⧓	25/12"		3.5	105		
			5								
					☒	14-20-25 N=45		5.8			
		Weakly cemented lens at about 9 feet			⧓	67/12"		7.7			
		10.0 7332.5	10								

Boring Terminated at 10 Feet

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).
See Supporting Information for explanation of symbols and abbreviations.
Elevation Reference: Elevations were interpolated from the provided topographic site plan.

Water Level Observations
None encountered while drilling

Drill Rig
CME 55

Hammer Type
Automatic

Driller
Terracon Consultants Inc.

Hammer Efficiency = 67.7%

Notes

Advancement Method
4-inch diameter, solid-stem auger

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Boring Started
04-29-2024

Boring Completed
04-29-2024

Terracon
1505 Old Happy Jack Rd
Cheyenne, WY

Boring Log No. P-03

Location: See Exploration Plan

Latitude: 41.2953° Longitude: -105.5462°

Depth (Ft.) Elevation: 7346.25 (Ft.) +/-

Model Layer	Depth (Ft.)	Description	Elevation	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Swell- Consol / Load (%/psf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
1	0.2	**APPARENT BASE COURSE**, about 3 inches	7346.05									
2	2.0	**FILL - SILTY CLAYEY SAND (SC-SM)**, fine to medium grained, reddish brown to red	7344.25			☒	2-2-7 N=9		18.4			
3		**SILTY CLAYEY SAND (SC-SM)**, trace fine grained gravel, fine to coarse grained sand, reddish brown to red, medium dense to very dense				⧗	30/12"		6.3	108		
				5		☒	12-16-23 N=39		7.5			
	9.8	Moderate cementation at about 9 feet	7336.45			⧗	7-50/4"		8.2			

Boring Terminated at 9.8 Feet

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).
See Supporting Information for explanation of symbols and abbreviations.
Elevation Reference: Elevations were interpolated from the provided topographic site plan.

Notes

Water Level Observations
None encountered while drilling

Advancement Method
4-inch diameter, solid-stem auger

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Drill Rig
CME 55

Hammer Type
Automatic

Driller
Terracon Consultants Inc.
Hammer Efficiency = 67.7%

Boring Started
04-29-2024

Boring Completed
04-29-2024

Boring Log No. P-04

Location: See Exploration Plan

Latitude: 41.2953° Longitude: -105.5468°

Model Layer	Graphic Log	Depth (Ft.)	Description	Elevation: 7341 (Ft.) +/-	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Swell- Consol / Load (%/psf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
1		0.2	**APPARENT BASE COURSE**, about 3 inches	7340.8			☒	7-7-6 N=13		7.3			
2		1.0	**FILL - SILTY CLAYEY SAND (SC-SM)**, fine to medium grained, reddish brown to red	7340									
3			**SANDY SILT (ML)**, fine to medium grained sand, reddish brown to red, very stiff to hard				⧓	30/12"		4.1	104		
					5		☒	12-15-25 N=40		6.4			
		9.7	Weak cementation at about 9 feet	7331.3			⧓	30-50/3"		7.0	111		

Boring Terminated at 9.7 Feet

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).
See Supporting Information for explanation of symbols and abbreviations.
Elevation Reference: Elevations were interpolated from the provided topographic site plan.

Water Level Observations
None encountered while drilling

Drill Rig
CME 55

Hammer Type
Automatic

Driller
Terracon Consultants Inc.
Hammer Efficiency = 67.7%

Notes

Advancement Method
4-inch diameter, solid-stem auger

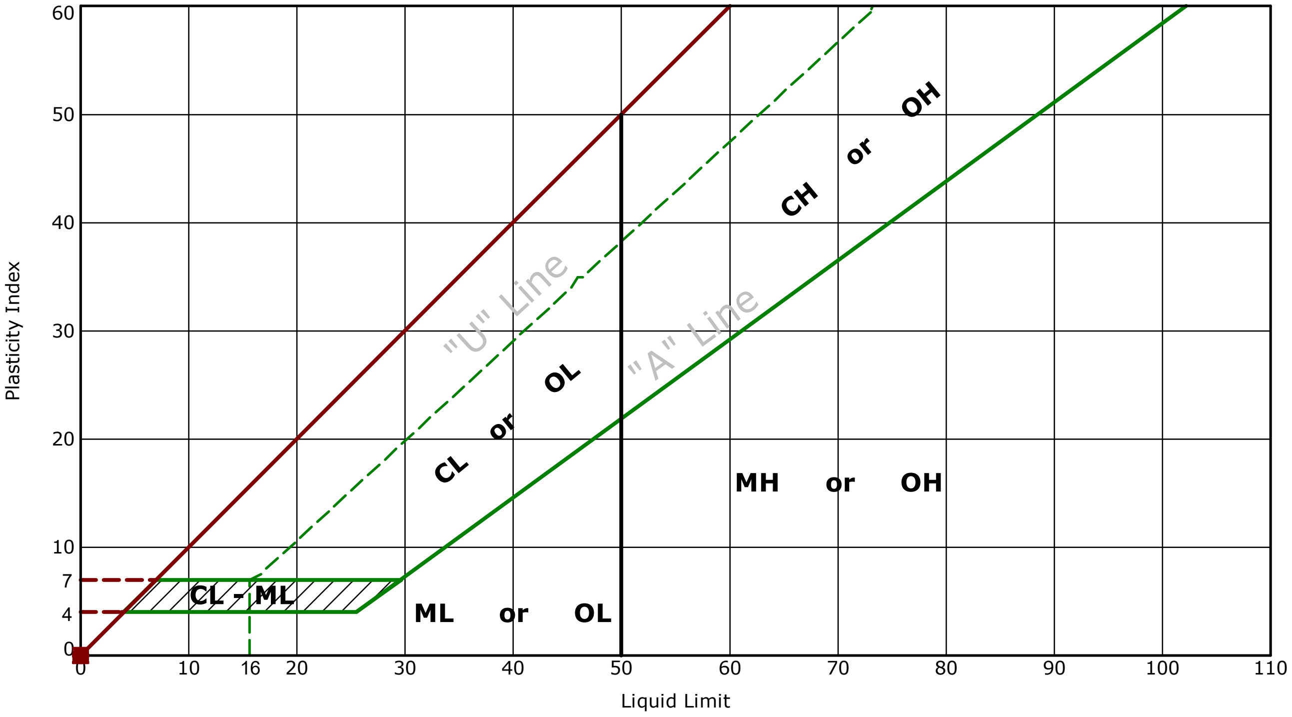
Abandonment Method
Boring backfilled with auger cuttings upon completion.

Boring Started
04-29-2024

Boring Completed
04-29-2024

Atterberg Limit Results

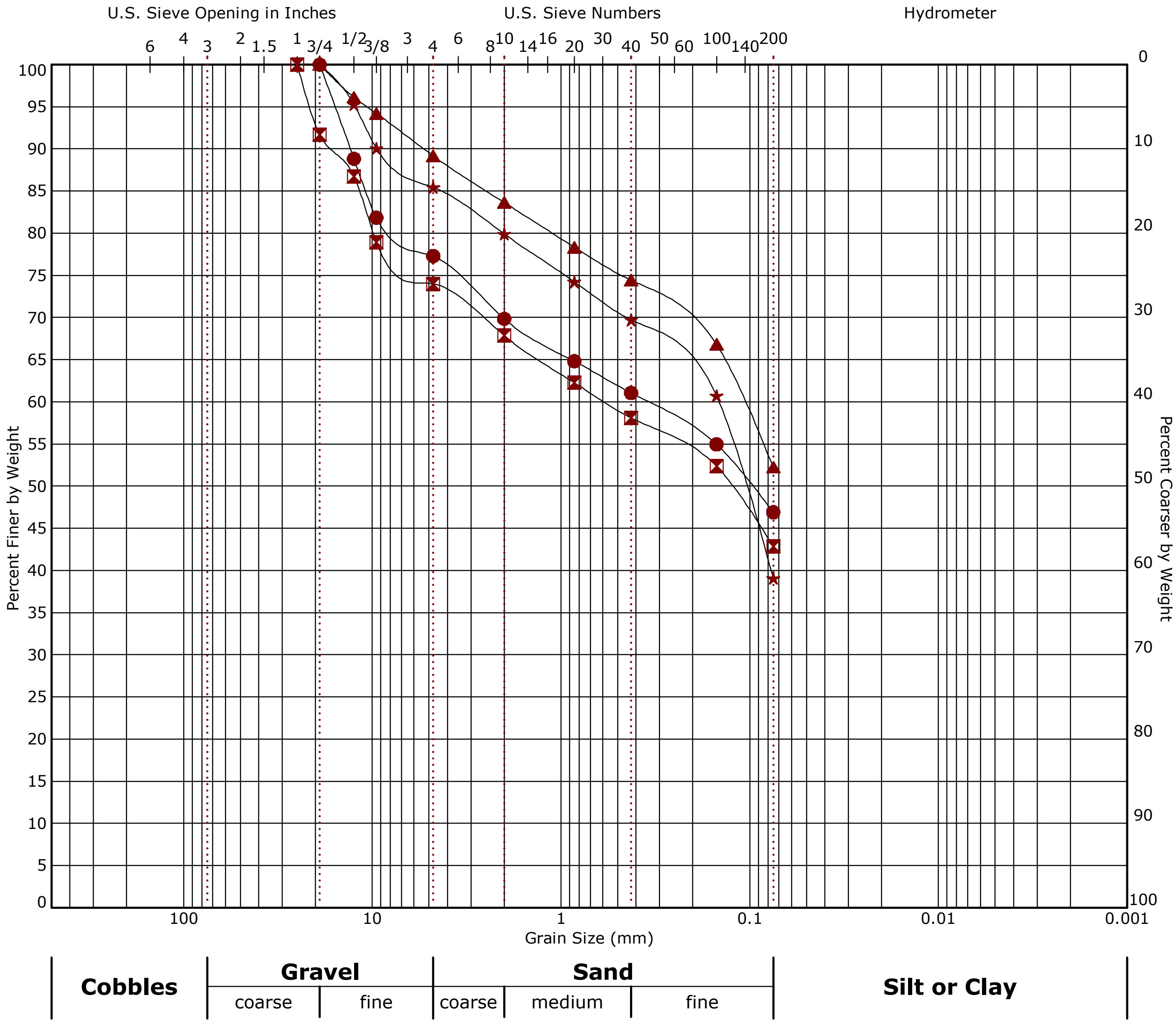
ASTM D4318



	Boring ID	Depth (Ft)	LL	PL	PI	Fines	USCS	Description
●	B-02	6 - 7.5	NP	NP	NP	46.9	SM	SILTY SAND with GRAVEL
☒	B-04	3 - 4	NP	NP	NP	42.9	SM	SILTY SAND with GRAVEL
▲	B-04	9 - 10	NP	NP	NP	52.3	ML	SANDY SILT
★	B-05	3 - 4	NP	NP	NP	39.1	SM	SILTY SAND

Grain Size Distribution

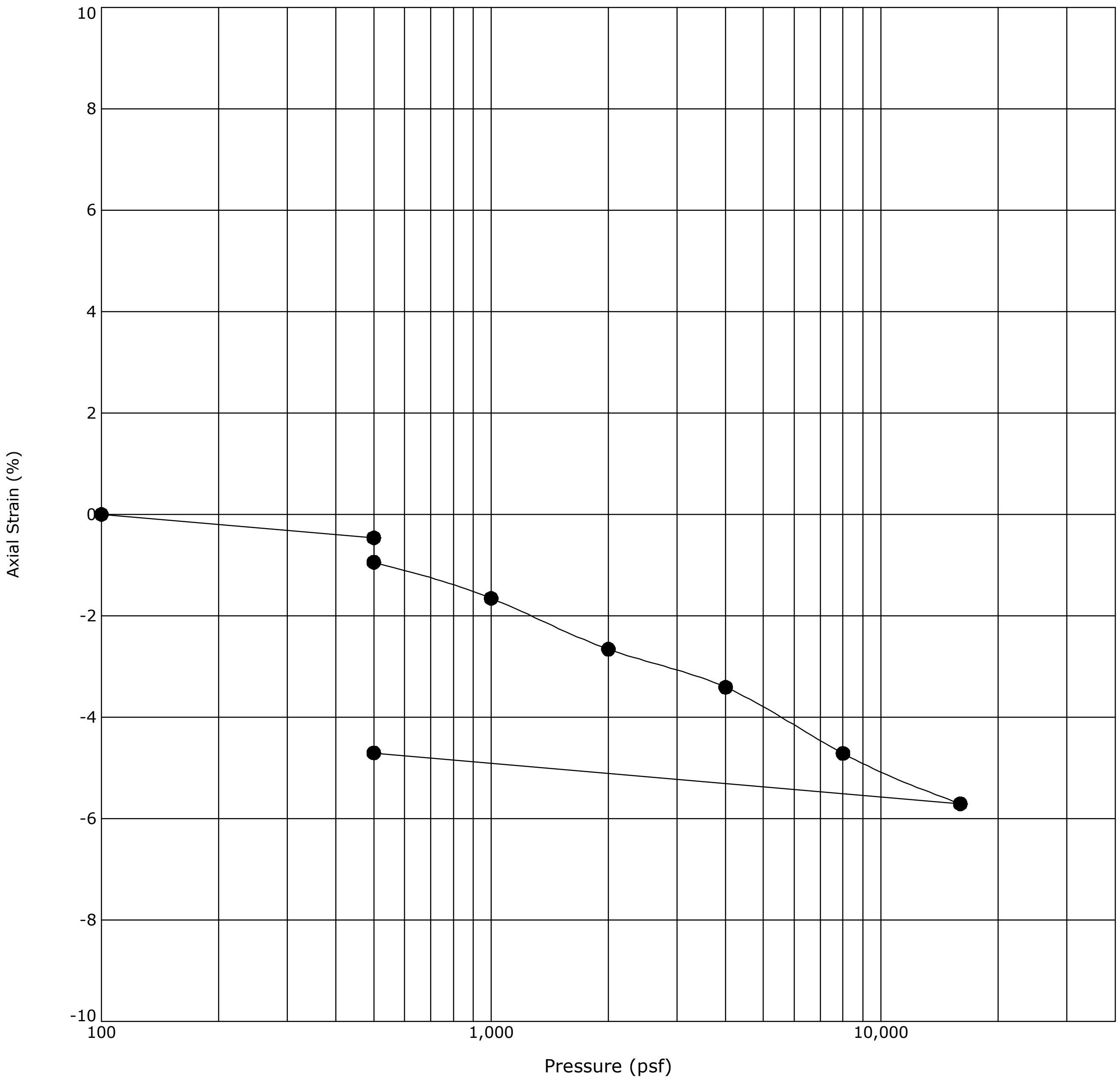
ASTM D422 / ASTM C136



Boring ID		Depth (Ft)	USCS Classification	USCS	AASHTO	LL	PL	PI	Cc	Cu
●	B-02	6 - 7.5	SILTY SAND with GRAVEL	SM	A-4 (0)	NP	NP	NP		
☒	B-04	3 - 4	SILTY SAND with GRAVEL	SM	A-4 (0)	NP	NP	NP		
▲	B-04	9 - 10	SANDY SILT	ML	A-4 (0)	NP	NP	NP		
★	B-05	3 - 4	SILTY SAND	SM	A-4 (0)	NP	NP	NP		

Boring ID		Depth (Ft)	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Fines	%Silt	%Clay
●	B-02	6 - 7.5	19	0.355			0.0	22.7	30.4	46.9		
☒	B-04	3 - 4	25	0.584			0.0	26.0	31.1	42.9		
▲	B-04	9 - 10	19	0.108			0.0	10.8	36.9	52.3		
★	B-05	3 - 4	19	0.147			0.0	14.5	46.4	39.1		

One-Dimensional Swell or Collapse



Boring ID		Depth (Ft)	Description	USCS	γ_d(pcf)	WC (%)
●	B-02	3 - 4	CLAYEY SAND	SC	110	5.2

Notes: Sample exhibited 0.5 percent compression when wetted under an applied pressure of 500 psf

CHEMICAL LABORATORY TEST REPORT

Project Number: 24245022
Service Date: 5/27/2024
Report Date: 5/27/2024

Terracon
1505 Old Happy Jack Road
Cheyenne, Wyoming 82001
(307) 632-9224

Project: Grand View Property

Sample Location	B-5
Sample Depth (ft.)	1-5
pH Analysis, ASTM - G51	6.0
Water Soluble Sulfate (SO4), ASTM C1580 (mg/kg)	23
Sulfides, ASTM - D4658 (mg/kg)	0
Chlorides, ASTM - D512 (mg/kg)	20
RedOx, ASTM - D1498 (mV)	+239
Total Salts, ASTM - D1125 (mg/kg)	1,669
Resistivity, ASTM - G187 (ohm-cm)	5,225

Reviewed By: Seth Winter
Laboratory Supervisor

Supporting Information

Contents:

Note: All attachments are one page unless noted above.

General Notes

Sampling

- Auger Cuttings
- Modified California Ring Sampler
- Standard Penetration Test

Water Level

- ▽ Water Initially Encountered
- ▽ Water Level After a Specified Period of Time
- ▼ Water Level After a Specified Period of Time
- ▨ Cave In Encountered

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

Field Tests

N	Standard Penetration Test Resistance (Blows/Ft.)
(HP)	Hand Penetrometer
(T)	Torvane
(DCP)	Dynamic Cone Penetrometer
UC	Unconfined Compressive Strength
(PID)	Photo-Ionization Detector
(OVA)	Organic Vapor Analyzer

Descriptive Soil Classification

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

Location And Elevation Notes

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

Strength Terms

Relative Density of Coarse-Grained Soils (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance			**Consistency of Fine-Grained Soils** (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance			
Relative Density	**Standard Penetration or N-Value (Blows/Ft.)**	**Ring Sampler (Blows/Ft.)**	**Consistency**	**Unconfined Compressive Strength Qu (psf)**	**Standard Penetration or N-Value (Blows/Ft.)**	**Ring Sampler (Blows/Ft.)**
Very Loose	0 - 3	0 - 5	Very Soft	less than 500	0 - 1	< 3
Loose	4 - 9	6 - 14	Soft	500 to 1,000	2 - 4	3 - 5
Medium Dense	10 - 29	15 - 46	Medium Stiff	1,000 to 2,000	4 - 8	6 - 10
Dense	30 - 50	47 - 79	Stiff	2,000 to 4,000	8 - 15	11 - 18
Very Dense	> 50	≥ 80	Very Stiff	4,000 to 8,000	15 - 30	19 - 36
			Hard	> 8,000	> 30	> 37

Relevance of Exploration and Laboratory Test Results

Exploration/field results and/or laboratory test data contained within this document are intended for application to the project as described in this document. Use of such exploration/field results and/or laboratory test data should not be used independently of this document.

Unified Soil Classification System

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification	
				Group Symbol	**Group Name** [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	Cu≥4 and 1≤Cc≤3 [E]	GW	Well-graded gravel [F]
			Cu<4 and/or [Cc<1 or Cc>3.0] [E]	GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH	GM	Silty gravel [F, G, H]
			Fines classify as CL or CH	GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	Cu≥6 and 1≤Cc≤3 [E]	SW	Well-graded sand [I]
			Cu<6 and/or [Cc<1 or Cc>3.0] [E]	SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH	SM	Silty sand [G, H, I]
			Fines classify as CL or CH	SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots above “A” line [J]	CL	Lean clay [K, L, M]
			PI < 4 or plots below “A” line [J]	ML	Silt [K, L, M]
		Organic:	$\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$	OL	Organic clay [K, L, M, N]
					Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above “A” line	CH	Fat clay [K, L, M]
			PI plots below “A” line	MH	Elastic silt [K, L, M]
		Organic:	$\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$	OH	Organic clay [K, L, M, P]
					Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add “with cobbles or boulders, or both” to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

[E] Cu = D_{60}/D_{10} Cc = $\frac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add “with sand” to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add “with organic fines” to group name.

[I] If soil contains ≥ 15% gravel, add “with gravel” to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add “with sand” or “with gravel,” whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add “sandy” to group name.

[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add “gravelly” to group name.

[N] PI ≥ 4 and plots on or above “A” line.

[O] PI < 4 or plots below “A” line.

[P] PI plots on or above “A” line.

[Q] PI plots below “A” line.