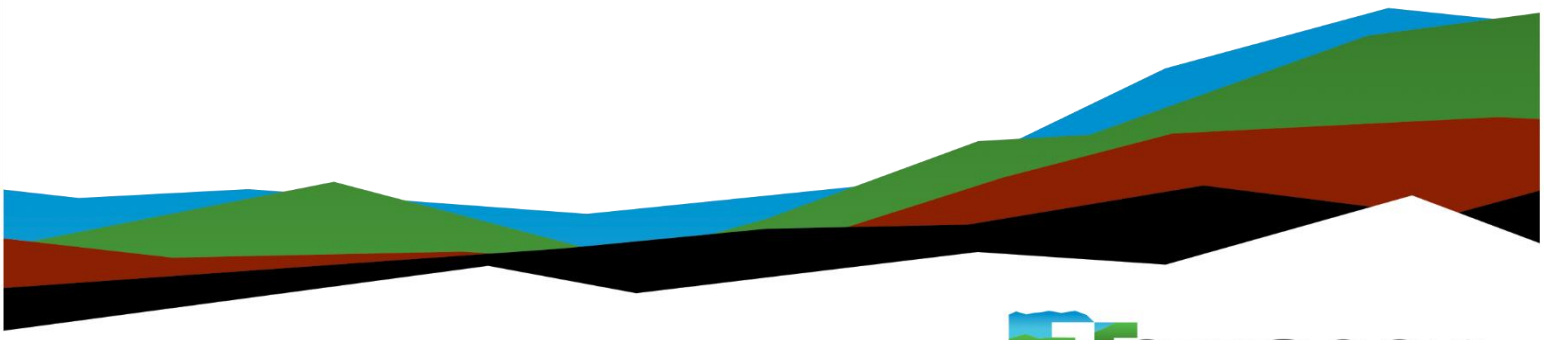
Pryor Health Center - Foundation Improvements

Geotechnical Engineering Report

November 27, 2024 | Terracon Project No. 26245031

Prepared for:

K.F. Davis Engineering Inc.
530 La Gonda Way, Suite E
Danville, California 94526



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November 27, 2024

K.F. Davis Engineering Inc.
530 La Gonda Way, Suite E
Danville, California 94526

Attn: Lesa Durham, President
P: (925) 743-8884
E: lesa.durham@KFDE.com

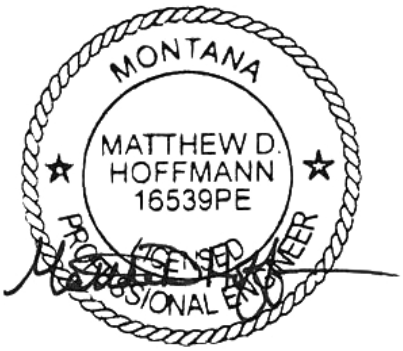
Re: Geotechnical Engineering Report
Pryor Health Center - Foundation Improvements
148 Pryor Gap Road
Pryor, Montana
Terracon Project No. 26245031

Dear Ms. Durham:

We have completed the scope of Geotechnical Engineering services for the above referenced project in general accordance with Terracon Proposal No. P26245031 dated July 18, 2024 and subsequent signed Work Order #172-24-22, signed September 19, 2024. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations 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



Hudson Dorian, E.I.T.
Field Engineer

Matthew D. Hoffmann, P.E.
Principal | Office Manager

Table of Contents

Introduction **1**
Project Description **1**
Site Conditions **3**
Geotechnical Characterization **4**
Seismic Site Class **5**
Corrosivity **6**
Geotechnical Overview **6**
Earthwork **7**
Demolition 7
Site Preparation 8
Subgrade Preparation 8
Existing Fill 10
Excavation 10
Soil Stabilization 10
Fill Material Types 12
Fill Placement and Compaction Requirements 14
Utility Trench Backfill 14
Grading and Drainage 15
Earthwork Construction Considerations 16
Construction Observation and Testing 16
Shallow Foundations **17**
Design Parameters – Compressive Loads 17
Design Parameters – Overturning and Uplift Loads 18
Construction Adjacent to Existing Building 19
Foundation Construction Considerations 20
Micropile Foundations **20**
Micropile Design 21
Pile Load Testing 22
Micropile Construction Considerations 23
Below-Grade Structures **25**
Lateral Earth Pressures **25**
Design Parameters 25
Subsurface Drainage for Below-Grade Walls 27
Frost Considerations **27**
General Comments **28**

Figures

GeoModel

Attachments

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

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 Terracon 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.

Introduction

This report presents the results of our subsurface exploration and Geotechnical Engineering services performed for the proposed renovations of the Pryor Health Clinic at 148 Pryor Gap Road in Pryor, Montana. The purpose of these services was to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Seismic site classification per IBC
- Site preparation and earthwork
- Demolition considerations
- Dewatering considerations
- Foundation design and construction
- Lateral earth pressure
- 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	On July 3, 2024, Ms. Lesa Durham of KFDE submitted a request for proposal through email, including a general description of the planned development and a set of civil and structural drawings for the planned additions.

Item	Description
Project Description	The project includes a series of improvements to the Pryor Health Center: a revision to the entryway; a new elevator pit, the existing foundation to be reinforced/supported with micropiles where the existing foundation is anticipated to be undermined by the addition of the elevator pit; a new set of attic access stairs on the eastern face of the structure; and a replacement air conditioner (AC) unit pad to the north of the building. Based on the site plan drawings, the new entryway is planned to be slab-on-grade with continuous footings, the attic-access stairway supported on isolated and continuous footings, the new AC unit pad is to be slab-on-grade, and the elevator pit is to be slab-on-grade.
Finished Floor Elevation	The finished floor elevations were not provided. The finished floor elevation of the entrance improvements is assumed to be no more than 1 to 2 feet from existing grade, matching that of the existing structure. The finished floor elevation of the elevator pit is planned to be on the order of 4 feet below the existing basement slab, and approximately 13 feet below existing grade.
Maximum Loads	Anticipated foundation loads were not provided. In the absence of information provided by the design team, we have used the following loads in estimating settlement based on our experience with similar projects. ▪ Columns: 50 kips ▪ Walls: 3 kips per linear foot (klf) ▪ Mats/Slabs: 150 pounds per square foot (psf) Estimated design loads for the proposed micropiles (MP 1 to 4) were provided by the client, as follows (maximum loads, accounting for dead, live, and snow loading). ▪ MP 1: 22.7 kips ▪ MP 2: 64.7 kips ▪ MP 3: 27.3 kips ▪ MP 4: 24.2 kips
Grading/Slopes	Proposed finished grade elevation for the additions is anticipated to be the same as the current structure.
Below-Grade Structures	The existing structure features a basement. In the proposed additions, an elevator pit with sump basin is planned to extend below the existing floor of the basement, with a floor elevation 4 feet below the floor elevation of the basement slab.

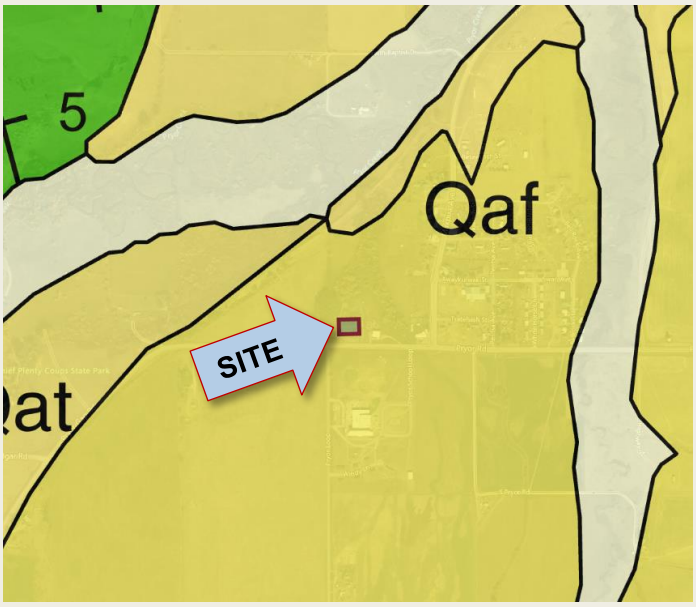
Item	Description
Free-Standing Retaining Walls	None stated, assumed to be outside of scope of services.
Pavements	None stated, assumed to be outside of scope of services.
Building Code	2021 IBC

Terracon should be notified if any of the above information is inconsistent with the planned construction, 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
Parcel Information	The project is located at 148 Pryor Gap Road in Pryor, Montana. The project includes three areas of interest, on the northern, eastern and southern sides of the Pryor Health Center. Latitude/Longitude (approximate) 45.42833°N, 108.53683°W See **Site Location**
Existing Improvements	The project improvements are within the grounds of the Pryor Health Center, adjacent to the existing main structure, paved parking lots, and landscaped areas.
Current Ground Cover	Exterior concrete flatwork and/or landscaped grass and foliage.
Existing Topography	The property slopes gently towards the northeast, towards a drainage ditch, with an overall elevation change up to 4 feet within the working area around the structure.

Item	Description
Geology	Based on the Montana Bureau of Mines and Geology (MBMG) Geologic Map of the Bridger Quadrangle1, the site sits within an alluvial fan deposit, characterized by poorly-sorted deposits of gravel, sand, silt, and clay, with variable thickness. An excerpt is provided below. 

1. Lopez, D.A., 2000, Geologic map of the Bridger 30' x 60' quadrangle, Montana: Montana Bureau of Mines and Geology Geologic Map 58, 1 sheet, scale 1:100,000.

We also collected photographs at the time of our site visits. Representative photos are provided in our **Photography Log**.

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 Materials**	Asphalt, base course and topsoil encountered depending on boring location; Borings B-1 and B-2 we advanced through asphalt pavement, B-3 in a landscaped area.
2	**Fill**	Lean clay with gravel encountered in Boring B-1 over organic clay, grey-brown to black-brown.
3	**Clay**	Clay soils with variable gravel and sand content, encountered at all three boring locations.
4	**Organic Clay**	Organic clay soil, grey-brown to black-brown, roots throughout with an organic odor, encountered within 5 feet of ground surface at Borings B-1 and B-2 (trace).
5	**Sand and Gravel**	Sand and Gravel soils with variable fines content, tan-brown to red-brown to grey-tan, loose to dense above 30 feet below ground surface, then very dense.

The borings were advanced dry using the hollow-stem auger (HSA) drilling technique that allowed short term groundwater observations to be made while drilling. Groundwater was encountered between 7 to 10 feet below ground surface (bgs), from 4,060 to 4,063 feet elevation above mean sea level (MSL). Groundwater conditions may be different at the time of construction due to seasonal variations in rainfall, runoff, and other conditions not apparent at the time of drilling. Long-term groundwater monitoring was outside the scope of services for this project.

Seismic Site Class

The 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, our professional opinion is for that a **Seismic Site Classification of D** be considered for the project. Subsurface explorations at this site were extended to a maximum depth of 50.5 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 soluble sulfate, electrical resistivity, and pH 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	Sample Depth (feet)	Soil Description	Soluble Sulfate (%)	Electrical Resistivity (Ω-cm)	pH
B-1	3 - 5	Lean Clay	0.0035	1,500	8.1

Results of soluble sulfate testing can be classified in accordance with ACI 318 – Building Code Requirements for Structural Concrete. Numerous sources are available to characterize corrosion potential to buried metals using the parameters above. ANSI/AWWA is commonly used for ductile iron, while threshold values for evaluating the effect on steel can be specific to the buried feature (e.g., piling, culverts, welded wire reinforcement, etc.) or agency for which the work is performed. Imported fill materials may have significantly different properties than the site materials noted above and should be evaluated if expected to be in contact with metals used for construction. Consultation with a NACE certified corrosion professional is recommended for buried metals on the site.

Mapping by the NRCS includes qualitative severity of corrosion to concrete and steel. Based on this source, the near-surface materials are rated “Moderate” for corrosion to concrete and “High” for corrosion of steel.

Geotechnical Overview

Our geotechnical exploration was conducted for the proposed renovations to the IHS Pryor Health Center building in Pryor, Montana. Three borings were advanced to depths between 16.5 and 50.5 feet bgs. The original location of the borings, shown in the proposal, had to be adjusted for practical access; this most affected Boring B-1, which had to be moved from beside the existing clinic to the parking lot. As-drilled boring locations are shown in the attached **Exploration Plan**. This report addresses the geotechnical recommendations for the proposed micropile foundation system that will support the portion of the existing foundation for the construction of the elevator pit, and the shallow foundation system to be used for the new entryway, elevator pit, attic access stairway, and the replacement foundation pad for the air conditioner units.

The subsurface generally consisted of alluvial soils in moderately thick (2-5 feet) layers, overlying dense gravel extending to the maximum depth of exploration, as stated in the **Geotechnical Characterization** section.

We believe a micropile foundation system will be feasible at this site, bearing into the very dense gravel soils, discussed in further detail in the **Micropile Foundations** section. We also believe that the exterior improvements (entryway, attic stairs, AC unit pad) can be supported on shallow foundation systems as proposed. Both are conditional to the implementation of our recommendations in the design and construction phases of this project.

In the vicinity of the proposed attic staircase (east of the existing structure) weak sandy clay soils are anticipated to be present at the planned bearing elevation. It is recommended that these soils be overexcavated to more reliable gravel with clay and sand, with engineered fill used to backfill up to bearing elevation, discussed in the **Subgrade Preparation** section.

The recommendations contained in this report are based upon the results of field and laboratory testing (presented in the **Exploration Results**), engineering analyses, and our current understanding of the proposed project. The **General Comments** section provides an understanding of the report limitations.

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 and floor slabs.

Demolition

The proposed additions will be constructed within and adjacent to the existing Pryor Health Clinic building. The current entryway will be significantly modified, requiring the removal of the existing ramp and stairway. It is assumed that the existing foundation of the ramp and stairway will be excavated out prior to construction of the replacement features. The attic access stairway will be constructed in the location of existing sidewalk slabs, which will need to be removed.

The basement of the structure will need to be significantly adjusted for the new elevator pit, requiring cutting of the existing floor slab and removal of soils beneath existing footings to the planned bearing elevation of the elevator pit slab. It has been assumed that measures will be implemented to provide the necessary support to the structure

before this process begins, which may include the installation of the proposed micropiles in conjunction with other temporary measures to prevent undermining of the existing structure foundations.

Any utilities within the proposed location of the additions will need to be removed prior to construction. It has been assumed that a more detailed survey of the existing utility lines is included in the pre-construction planning.

Site Preparation

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

Subgrade Preparation

For the proposed elevator pit and column footing slab, it is anticipated that the elevation for the bottom of the elevator pit slab will be within the layer of silty gravel with sand, which sits over a layer of silty sand with gravel. It is recommended that this soil be scarified to a minimum depth of 12 inches and recompacted to a minimum of 98% of the maximum dry density, as determined by ASTM D689.

During our subsurface exploration, groundwater was encountered around 10 feet bgs (4,063 feet MSL) in the parking lot directly in front of the clinic building. Based on the plan drawings, it was estimated that the floor of the basement was 9 feet below ground surface of the parking lot, and that the bottom of the existing footings were approximately 11 feet bgs. We recommend a minimum 3 feet of vertical separation between the bottom of new footings and the groundwater table, in order to prevent increased settlement and softening of bearing surface. At the time of report preparation, it was unknown how the existing clinic building mitigated the proximity of groundwater to the estimated bearing elevation, either through an impermeable perimeter boundary, a sump and pump system, or by other means. Whatever means are currently in place should be evaluated and adjusted in respect to accommodate the new lowest bearing elevation of the structure, the bottom of the elevator pit slab. The contractor should be prepared to perform construction dewatering for construction of at least the elevator pit, depending on the groundwater table at time of construction. Based on groundwater elevation, the use of waterstop at construction joints and waterproofing membrane attached to foundation walls below groundwater elevation should be considered.

For the proposed new entryway, three distinct bearing elevations were proposed according to the site plans; the ramp and stairway, the ‘landing’, and the covered extension. The ramp and stairway will bear at approximately at 4,069.5 feet MSL, the landing will bear at approximately 4,065 feet MSL, and the covered extension will bear

at approximately 4,063 feet MSL. Based on Boring B-1, the ramp and stairway are anticipated to bear onto medium stiff clay, the landing onto dense, poorly graded gravel with clay and sand, and the covered extension onto medium dense, silty gravel with sand. In the boring location, organic clays were encountered near the anticipated bearing elevation of the ramp and stairway, denoted by a specific, sharp odor and black coloration. We do not recommend that footings bear on or over organic clay deposits; if this soil is encountered during excavation in the planned location of a foundation element, it should be removed to the depth of the next reliable bearing stratum and replaced with Structural Fill. As much of the new construction in this vicinity will take place within previously developed areas, it is not considered likely that organic soils will be encountered, but precaution should still be taken.

For the proposed attic access stairs, based on the nearby Boring B-2, the foundation footings are anticipated to bear into lean clay, at approximately 4,067 feet MSL. This soil is anticipated to cause a larger degree of settlement due to consolidation; although the loading is anticipated to be low, the soil is not heavily consolidated. Since this layer was only found to be 2.5 feet thick onsite, we recommend this soil be overexcavated to the depth of the poorly graded gravel with clay and sand beneath and replaced with Structural Fill.

For the proposed AC pad, it is anticipated that the slab-on-grade foundation will bear approximately 1 foot below existing grade, within the near-surface clayey gravel or sandy lean clay (based on the nearby Boring B-3). Although these strata appeared reasonably stiff during the site investigation, their clay content may pose a risk of shrink-swell movement, leading to damage of the slab. Thus, it is recommended that these soils be overexcavated down to the depth of the clayey gravel with sand or poorly graded gravel with clay and sand, approximately 4 to 5 feet bgs, which are anticipated to be less susceptible to shrink and swell movements.

All exposed areas which will receive fill, once properly cleared and benched where necessary, should be scarified to a minimum depth of 10 inches, moisture conditioned as necessary, and compacted per the compaction requirements in 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. Structural Fill placement should follow the recommendations included in the **Earthwork Construction Considerations** section.

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.

Existing Fill

As the elevator pit is planned to be constructed within the footprint of the existing health clinic building, it is anticipated that engineered fill materials, if previously used below the slab and/or footings of the existing health clinic building, may be encountered in the process of excavation to the planned bearing elevation of the elevator pit. These materials may be reused as engineered fill for the new construction, following review by the Geotechnical Engineer provided they meet the gradation criteria referenced in the Fill Material Types section of this report. Even if the existing engineered fill met the criteria when placed during the initial construction, the fill should be reevaluated; infiltration of fines into the material or mixing of the soils during excavation may alter the gradation of the material, and thus its suitability as engineered fill. If reuse is in consideration, excavated existing engineered fill should be properly sorted and stored separately from the natural subgrade soils.

Excavation

We anticipate that excavations for the proposed construction can be accomplished with conventional earthmoving equipment. The bottom of excavations should be thoroughly cleaned of loose soils and disturbed materials prior to backfill placement and/or construction.

The largest obstacle to excavation for this rehabilitation project will be the limited space available in the basement of the clinic. It was not known at the time of report preparation how much the existing clinic building would be modified or deconstructed for the renovations (i.e. how much vertical space will be available, how equipment can be conveyed into the basement of the structure, etc.). For this reason, arrangements should be made for the use of smaller, hand-propelled excavation and compaction equipment. Proper engineering controls, administrative controls, and personal protective equipment should be in place if gas-powered equipment is to be used in the basement area, in accordance with the Occupational Safety and Health Association (OSHA) 29 CFR, Subpart S “Underground Construction, Caissons, Cofferdams, and Compressed Air”, Subpart D, “Occupational Health and Environmental Controls”, and Subpart AA, “Confined spaces in Construction”, as applicable.

Soil Stabilization

To reduce potential settlement of structures due to loose or soft subgrade soils, soil improvement or stabilization methods can be implemented. Methods of subgrade improvement, as described below, could include scarification, moisture conditioning and recompaction, removal of unstable materials and replacement with granular fill (with or without geosynthetics), and chemical stabilization. The appropriate method of improvement, if required, would be dependent on factors such as schedule, weather, the

size of area to be stabilized, and the nature of the instability. More detailed recommendations can be provided during construction as the need for subgrade stabilization occurs. Performing site grading operations during warm seasons and dry periods would help reduce the amount of subgrade stabilization required.

If the exposed subgrade is found to be unstable by the geotechnical engineer, it could be stabilized using one of the methods outlined below.

- **Scarification and Recompaction** - It may be feasible to scarify, dry, and recompact the exposed soils. The success of this procedure would depend primarily upon favorable weather and sufficient time to dry the soils. Stable subgrades likely would not be achievable if the thickness of the unstable soil is greater than about 1 foot, if the unstable soil is at or near groundwater levels, or if construction is performed during a period of wet or cool weather when drying is difficult.
- **Structural Fill** - The use of Structural Fill gravel is a common procedure to improve subgrade stability. Typical undercut depths would be expected to range from about 24 to 48 inches below finished subgrade elevation, but recommended depth is dependent on site conditions and anticipated loading. The use of high modulus geotextiles (i.e., engineering fabric or geogrid) could also be considered after underground work such as utility construction is completed. Equipment should not be operated above the fabric or geogrid until one full lift of Structural Fill is placed above it. The maximum particle size of granular material placed over geotextile fabric or geogrid should not exceed 1-1/2 inches.
- **Chemical Modification** - Improvement of subgrades with portland cement or class C fly ash could be considered for improving unstable soils. Chemical modification should be performed by a pre-qualified contractor having experience with successfully stabilizing subgrades in the project area on similar sized projects with similar soil conditions. Results of chemical analysis of the additive materials should be provided to the geotechnical engineer prior to use. The hazards of chemicals blowing across the site or onto adjacent property should also be considered. Additional testing would be needed to develop specific recommendations to improve subgrade stability by blending chemicals with the site soils. Additional testing could include, but not be limited to, determining the most suitable stabilizing agent, the optimum amounts required, the presence of sulfates in the soil, and freeze-thaw durability of the subgrade.

Further evaluation of the need and recommendations for subgrade stabilization can be provided during construction as the geotechnical conditions are exposed.

Fill Material Types

Fill required to achieve design grade should be classified as Structural Fill and general fill. Structural Fill is material used below, or within 5 feet horizontally of structures, pavements. General fill is material used to achieve grade outside of these areas.

Reuse of On-Site Soil: Excavated on-site soil may be selectively reused as engineered fill, provided they meet the gradation requirements stated in this section. Portions of the on-site soil have an elevated fines content and will be sensitive to moisture conditions (particularly during seasonally wet periods) and may not be suitable for reuse when above optimum moisture content.

Material property requirements for on-site soil for use as general fill and Structural Fill are noted in the table below:

Property	General Fill	Structural Fill
Composition	Free of deleterious material	Free of deleterious material
Maximum particle size	6 inches (or 2/3 of the lift thickness)	3 inches
Fines content	Not limited	Less than 12% Passing No. 200 sieve
Plasticity	Not limited	Maximum plasticity index of 10
GeoModel Layer Expected to be Suitable[1]	1, 2, 3, 5	5

1. Based on subsurface exploration. Actual material suitability should be determined in the field at time of construction.

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)
Structural Fill[2]	GW, GP, SW, SP, and dual (GM/SM) symbols	Below foundation elevation, below slab areas, and as replacement backfill
Crushed Base Course	Montana Public Works Standard Specifications (MPWSS), 7th Ed, Section 02235, ¾ or 1-½ inch minus	Leveling course below slabs and above Structural Fill
Non-Frost Susceptible Fill (NFS) [3]	GP, GW, SP, SW	Below exterior flatwork critical to project to mitigate frost-action

1. Structural and general fill should consist of approved materials free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. 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.
2. Structural Fill, defined as imported aggregate, should meet the following criteria outlined below:

Gradation	Percent Finer by Weight (ASTM C136)
1 ½”	100
No. 4	30-60
No. 200	12 (max)
Liquid Limit	25 (max)
Plastic Index	10 (max)

3. Non-Frost Susceptible Fill should have no more than 5 percent passing the No. 200 sieve

Fill Placement and Compaction Requirements

Structural and general fill should meet the following compaction requirements.

Item	Structural Fill	General Fill
Maximum Lift Thickness	8 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]	98% of max. below foundations and interior floor slabs 95% of max. above foundations	92% of max.
Water Content Range [1]	Low plasticity cohesive: -2% to +3% of optimum Granular: -3% to +3% of optimum	As required to achieve min. compaction requirements

1. Maximum density and optimum water content as determined by the standard Proctor test (ASTM D 698).
2. If the granular material is a coarse sand or gravel, or of a uniform size, or has a low fines content, compaction comparison to relative density may be more appropriate. In this case, granular materials should be compacted to at least 70% relative density (ASTM D 4253 and D 4254). Materials not amenable to density testing should be placed and compacted to a stable condition observed by the Geotechnical Engineer or representative.

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 2:1 projection from existing foundations without engineering review of shoring requirements and geotechnical observation during construction.

On-site materials, with the exception of the organic clay layer (GeoModel layer 4) 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. Compaction of initial lifts should be accomplished with hand-operated tampers or other lightweight compactors. Where trenches are placed beneath slabs or footings, the backfill should satisfy the gradation and plasticity index requirements of engineered fill discussed in this report. Flooding or jetting for placement and compaction of backfill is not recommended.

For low permeability subgrades, utility trenches are a common source of water infiltration and migration. Utility trenches penetrating beneath foundation footings should be effectively sealed to restrict water intrusion and flow through the trenches, which could migrate below the building. The trench should provide an effective trench plug that extends at least 5 feet from the face of the building exterior. The plug material should consist of cementitious flowable fill (MPWSS 7th Ed. Section 02222) or low permeability clay. The trench plug material should be placed to surround the utility line. If used, the clay trench plug material should be placed and compacted to comply with the water content and compaction recommendations for Structural Fill stated previously in this report.

Grading and Drainage

All grades must provide effective drainage away from the additions during and after construction and should be maintained throughout the life of the structure. Water retained next to the footings of the additions 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 building and the footings of any new additions to the structure.

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

Earthwork Construction Considerations

Shallow excavations for the proposed structure 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. 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.

The groundwater table could affect overexcavation efforts, especially for overexcavation and replacement of lower strength soils. A temporary dewatering system consisting of sumps with pumps may be necessary to achieve the recommended depth of overexcavation depending on groundwater conditions at the time of construction and any current dewatering measures in place. The design and implementation of a temporary dewatering system is the sole responsibility of the contractor.

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 pavements), 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, until approval has been received from the Geotechnical Engineer prior to placement of additional lifts. 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

Primarily, the geotechnical concerns for this project focus on minimizing potential for differential settlement between the existing health clinic building and any new additions planned. For the elevator pit, it is understood that this will be mitigated by the use of micropiles, the performance of which will depend on the final design of the micropiles and proper execution of the installation process, which are recommended to be installed firmly bearing into the very dense gravel layer encountered near 4,042 feet MSL. The exterior additions will be reliant on shallow foundations, bearing onto near-surface sand and gravel soils. The performance of these additions will be dependent on quality earthwork operations (excavation and preparation of the subgrade, along with use of replacement Structural Fill as recommended) and construction of the foundation elements. Based on a review of the design drawings provided by the client, we believe that the proposed use of shallow foundations will be suitable for the planned additions. We recommend the use of the design parameters stated in the following table, provided that the recommendations in the **Earthwork** section are incorporated.

Design Parameters – Compressive Loads

Item	Description
Maximum Net Allowable Bearing Pressure [1, 2, 3]	3,000 psf – strip and isolated spread foundations bearing upon Structural Fill extending to properly-prepared native sand and gravel soils 500 psf – slab-on-grade/mat foundations bearing upon Structural Fill extending to

Item	Description
	properly-prepared native sand and gravel soils (i.e. AC pad)
Minimum Foundation Dimensions	Per IBC 1809.7
Ultimate Passive Resistance[4] (equivalent fluid pressures)	280 pcf (Native Clay) 440 pcf (Native Sand) 460 pcf (Native Gravel) 500 pcf (Structural Fill)
Sliding Resistance [5]	0.45 allowable coefficient of friction - granular material
Minimum Embedment below Finished Grade [6]	Exterior footings in unheated areas: 42 inches Interior footings in heated areas: 24 inches
Estimated Total Settlement from Structural Loads [2]	Less than about 3/4 inches
Estimated Differential Settlement [2, 7]	About 1/2 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 that exterior grades are no steeper than 20% within 10 feet of structure.
2. Values provided are for maximum loads noted in **Project Description**. Additional geotechnical consultation will be necessary if higher loads are anticipated.
3. Unsuitable or soft soils should be overexcavated and replaced per the recommendations presented in **Earthwork**.
4. Use of passive earth pressures require the sides of the excavation for the spread footing foundation to be nearly vertical and the concrete placed neat against these vertical faces or that the footing forms be removed and compacted Structural Fill be placed against the vertical footing face. Assumes no hydrostatic pressure.
5. Can be used to compute sliding resistance where foundations are placed on suitable soil/materials. Frictional resistance for granular materials is dependent on the bearing pressure which may vary due to load combinations. For fine-grained materials, lateral resistance using cohesion should not exceed ½ the dead load.
6. 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 structure.
7. Differential settlements are noted for equivalent-loaded foundations and bearing elevation as measured over a span of 50 feet.

Design Parameters – Overturning and Uplift Loads

Shallow foundations subjected to overturning loads should be proportioned such that the resultant eccentricity is maintained in the center-third of the foundation (e.g., e < b/6,

where b is the foundation width). This requirement is intended to keep the entire foundation area in compression during the extreme lateral/overturning load event. Foundation oversizing may be required to satisfy this condition.

Uplift resistance of spread footings can be developed from the effective weight of the footing and the overlying soils with consideration to the IBC basic load combinations.

Item	Description
Average Soil Moist Unit Weight	120 pcf
Soil Effective Unit Weight[1]	58 pcf
Soil weight included in uplift resistance	Soil included within the prism extending up from the top perimeter of the footing at an angle of 20 degrees from vertical to ground surface

1. Effective (or buoyant) unit weight should be used for soil above the foundation level and below a water level. The high groundwater level should be used in uplift design as applicable.

Construction Adjacent to Existing Building

We understand that, inherently, some of the planned additions are to be built directly adjacent to the existing structure; specifically, the new entryway and attic access stairway. Differential settlement between the new foundation elements and the existing hospital building, and associated flatwork, is expected to approach the magnitude of the total settlement of the addition. Expansion joints should be provided between the existing building and the proposed additions to accommodate differential movements between previous and new construction.

New footings should bear at or near the bearing elevation of immediately adjacent existing foundations. Depending upon their locations and current loads on the existing footings, footings for the new addition could cause settlement of adjacent walls. To reduce this concern and risk, clear distances at least equal to the new footing widths should be maintained between the addition's footings and footings supporting the existing building where the space is available.

It was noted that several of the planned foundation elements will directly abut the existing foundation, based on the design drawings. It is understood that the slab for the new covered entryway will be pinned into the existing foundation with a smooth dowel, utilizing the foundational support of the existing structure. With proper jointing, it is anticipated that this design will properly accommodate the anticipated differential movement. The attic access stairs appear to bear on new footings, separate to the existing structure, but bearing directly adjacent to the existing foundation wall. The design drawings do not indicate if these are to be pinned to the existing structure. Even

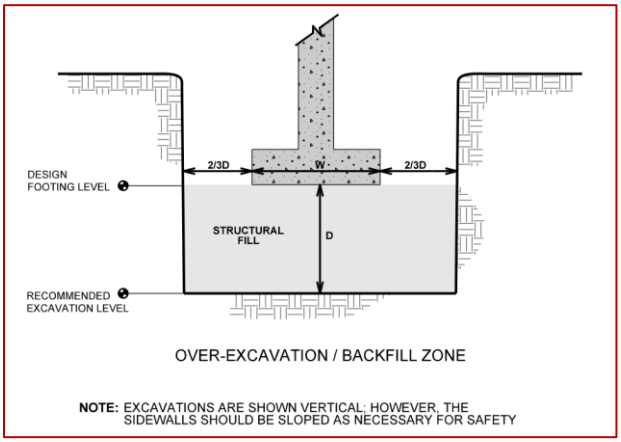
though the anticipated axial loads are comparatively low for this addition, the existing foundation wall should be evaluated for resistance to the additional lateral earth pressure imposed by the footing.

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.

Sensitive soils exposed at the surface of footing excavations may require surficial compaction with hand-held dynamic compaction equipment prior to placing Structural Fill, steel, and/or concrete. Should surficial compaction not be adequate, construction of a working surface consisting of either crushed stone or a lean concrete mud mat may be required prior to the placement of reinforcing steel and construction of foundations.

Overexcavation for Structural Fill placement below footings should be conducted as shown below. The overexcavation should be backfilled up to the footing base elevation, with Structural Fill placed, as recommended in the **Earthwork** section.



Micropile Foundations

It is understood that the currently planned means of providing support to potentially undermined footings around the elevator pit is though the use of four micropiles. The benefit of a micropile system is the smaller diameter (less than 12 inches) of the advancing system (typically an auger, driven or vibrating tooling such as a down-the-

hole hammer, or rotary drilling system) used to clear space for the micropiles, potentially allowing for easier drilling through the upper gravel strata (compared to larger drilled shafts). The equipment utilized for micropile construction also allows for closer construction activities in closer proximity to existing foundations/structures than typical drilled shaft units as well as some units have low-head capabilities specific to working in existing structures/basements. Micropiles are installed by a specialty contractor that will also at times provide design of their systems. If the contractor is a design-build firm, they will ultimately be the responsible party for the micropile design and provide a design that meets the capabilities and equipment of the installation contractor. The following sections include basic recommendations for micropile foundations, primarily based on the Federal Highway Administration (FHWA) publication *Micropile Design and Construction*.

Micropile Design

For this application, micropiles should consist of a high-strength (Grade 75) epoxy-coated bar that is installed using a casing-advance air-rotary system (such as TUBEX or ODEX, or other systems) where the hole is drilled full depth, and the bar (with centralizers) would be installed to the full depth of the hole and grouted in-place. The micropile bar would extend up to an elevation that would allow the bar to be integrated into the reinforcing steel of the structural floor slab. The design of the connection or interaction of the micropile and foundation structural element should be completed by the Structural Engineer of Record.

The small diameter of the anticipated grout column (on the order of 8 inches) provides much less lateral support than a drilled shaft, but where a structure is buried or where the lateral loads are not believed to be significant (as anticipated for support of the health clinic's existing foundations adjacent the elevator pit), the foundation system will be employed to support (primary) vertical loads with little or no load applied laterally. Preliminary soil design parameters are provided below in the **Micropile Design Summary** table for the design of micropile foundations. The values presented for allowable grout-to-ground bond strengths include a factor of safety. Discussion of micropile foundations is included in the following sections.

Micropile Design Summary [1]

Elevation (feet)	Stratigraphy [2]		Grout-to-Ground Allowable Bond Strength (psi) [3]
	No.	Material	
4061.5 - 4056.5 [4]	5	Silty Gravel with Sand	0
4056.5 - 4053.0	5	Silty Sand with Gravel	6

Micropile Design Summary [1]

Elevation (feet)	Stratigraphy [2]		Grout-to-Ground Allowable Bond Strength (psi) [3]
	No.	Material	
4053.0 - 4043.0	5	Poorly Graded Gravel with Clay and Sand and Poorly Graded Sand with Gravel	8
4043.0 - 4022.5	5	Poorly Graded Gravel with Clay and Sand (Very Dense)	12

1. Design capacities are dependent upon the method of installation, and quality control parameters. The values provided are estimates and should be verified by field testing when installation protocol have been finalized.
2. See **Geotechnical Characterization** for more details on stratigraphy. Approximate elevations presented are based on information obtained during the field investigation and site plan documents provided by the client.
3. Values are determined based on the FHWA typical ultimate grout-to-ground bond strength values with an applied factor of safety of 2.5. Applicable for compressive, non-seismic loading only, for "Type A" micropiles (Gravity grouted/non-pressure-grouted micropiles). Reduce to 2/3 of values shown for uplift loading. Effective weight of micropile can be added to uplift load capacity.
4. Assumed to provide a minimum 5-foot bond breaker to allow for tensioning.

A minimum micropile diameter of 8 inches (the full diameter of the grouted boring) should be used, assuming a minimum #10 Grade 75 bar size is used (minimum for a 25-kip micropile). We recommend a target elevation of 4,042 feet MSL, to reach the very dense gravel strata, in order to achieve the minimum required capacity stated in the project documents.

Post-construction settlements of micropiles designed and constructed as described in this report are estimated to on the order of 0.5 inch or less. Differential settlement between individual shafts is expected to be ½ to ⅔ of the total settlement.

Pile Load Testing

We recommend that, before production drilling, at least two micropiles be installed in representative locations for load verification testing. This will confirm the contractor's equipment and installation methods are capable of achieving the ultimate grout-to-soil bond values assumed in the design. Test micropiles should be tested to two times the design load, suitably reinforced to resist those loading conditions. Verification testing should be conducted on 'sacrificial' micropiles, not intended for use in the final structure.

The FHWA guidelines recommend that about 5 percent of permanent production micropiles be proof tested up to 1.6 times the design load. Similar to the pre-production tests, this will help to confirm the contractor's consistent capability to install piles able to carry the design load without significant, long-term deflection. Testing should be completed in accordance with sections 7.3 and 7.4 of the FHWA guidelines. Terracon is available to aid in the development of load testing specifications, and we recommend that Terracon monitor all micropile installation and testing. The owner may elect to omit production testing if a small number of installations are planned, provided that the pre-production testing performed satisfactorily.

Micropile Construction Considerations

The borings encountered saturated sand and gravel layers below approximately 4,063 feet MSL. To prevent collapse of the sidewalls and to control groundwater seepage, the use of a full-depth, temporary steel casing (ODEX or TUBEX) should be anticipated for construction of the micropile foundations. Significant seepage should also be anticipated when micropile borings penetrate the water-bearing sand/gravel soil. The micropile installation contractor and foundation design engineer should be informed of these risks. Withdrawal of the temporary casing can begin following initial grout placement when grout has been installed by tremie methods until the temporary casing is full. During temporary micropile casing withdrawal, care should be exercised to maintain a full column of neat cement grout inside the casing to resist earth and hydrostatic pressures present on the casing exterior. Temporary casing extraction should be at a slow, uniform rate, with the pull in line with the center of the micropile. Water or loose soil should be removed from the bottom of the excavations prior to placement of the neat cement micropile grout.

Care should be taken to not disturb the sides and bottom of the excavation during construction. Neat cement grout should be placed as soon as possible after the micropile boring is completed and the micropile bar (inclusive of centralizers) has been inserted into the micropile boring. Drilling of micropile holes should not take place closer than five micropile diameters to adjacent micropile borings until the neat cement grout in the adjacent micropile has been in place for a minimum of 24 hours or initial set.

Per International Building Code (IBC), micropiles and deep foundations require full time observation of installation/construction. Detailed records of each micropile should be maintained by the Geotechnical Engineer (or representative) during construction. Record dates; weather conditions; and times of starting drilling, completing of drilling, inspecting, and any testing. Include record of grout volume placed in relationship to the calculated volume of the hole.

Neat cement grout should be placed from the bottom of the micropile to the top of the micropile in a uniform continuous operation without segregating the mixed materials.

When neat cement grout is placed below water, or in the dry to depths greater than 15 feet, the neat cement grout should be placed by one or more tremie pipes, 1 inch or less in diameter, so that the grout displaces the water within the casing progressively from the bottom, rising uniformly to the surface. Initial placement of the neat cement grout should begin with the tremie pipe no more than 6 inches above the bottom of the micropile boring. Subsequent to initial grout placement, where neat cement grout is placed until all water and cuttings and then full-strength grout are brought to the surface, the discharge end of the tremie pipe should be maintained at a depth of at least 10 feet into the grout during placement, and should be maintained at this depth throughout the pour. It is anticipated that the micropiles will extend below the groundwater table, so the contractor should expect groundwater seepage and prepare construction plans accordingly.

The tremie pipe used to deposit the neat cement grout beneath the water should be constructed so that it is watertight, is essentially rigid (including steel or reinforced rubber piping) and would readily discharge the neat cement grout. The discharge end of the tremie shall be constructed to prevent water intrusion and permit the free flow of neat cement grout during placement operations. The tremie pipe should have sufficient weight so that it would rest on the shaft bottom before the start of concrete placement. The length of the tremie pipe should be sufficient to extend to the bottom of the excavation. The flow of neat cement grout should be continuous, and the neat cement grout in the tremie should maintain a continuous, positive pressure differential at all times to prevent water intrusion into the micropile grout.

The equipment used to place grout in the micropile shall be such that the volume of grout placed in the micropile could be measured to within 1/2 cubic foot. The measurement device should be attached to the placement equipment, and may consist of a volumetric measure or some type of counter to measure strokes on the concrete pump. A documented calibration less than three months old shall be provided to the geotechnical engineer for review and approval at least 21 days prior to placement of any concrete.

The grout shall consist only of potable water and Type V cement. The mix design reports shall be submitted for review not less than 28 days prior to the beginning of micropile production, and the proposed mix design reports shall include the unconfined compressive strength of the proposed grout as a function of water-cement ratio. During construction, each batch of grout, whether field-mixed or plant-mixed, shall be evaluated for unit weight (in pounds per gallon) or specific gravity to verify that the grout is within the established water-cement ratio limits immediately prior to placement.

The micropile installation process should be performed under the direction of the Geotechnical Engineer. The Geotechnical Engineer should document the micropile installation process including soil and groundwater conditions encountered, consistency with expected conditions, and details of the installed micropiles.

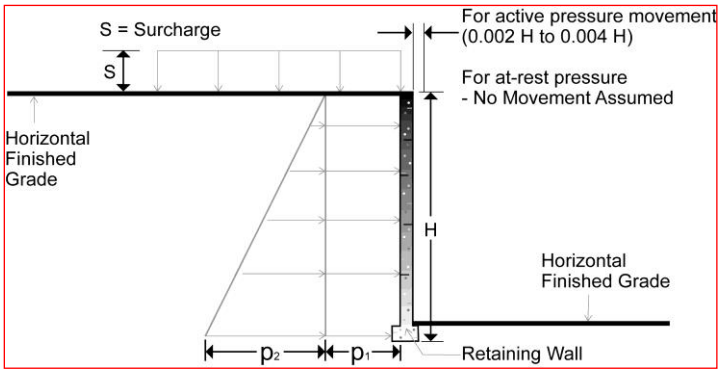
Below-Grade Structures

Besides the existing basement, the elevator pit and sump pit are planned to extend below the current floor elevation of the structure. For the other additions, the attic-access stairway and new entryway, only foundation elements are planned below existing grade.

Lateral Earth Pressures

Design Parameters

Structures with unbalanced backfill levels on opposite sides should be designed for earth pressures at least equal to values indicated in the following table. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction, and/or compaction and the strength of the materials being restrained. Two wall restraint conditions are shown in the diagram below. Active earth pressure is commonly used for design of free-standing cantilever retaining walls and assumes wall movement. The "at-rest" condition assumes no wall movement and is commonly used for basement walls, loading dock walls, or other walls restrained at the top. The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls (unless stated).



Lateral Earth Pressure Design Parameters

Earth Pressure Condition [1]	Coefficient for Backfill Type [2]	Surcharge Pressure [3] p_1 (psf)	Equivalent Fluid Pressures (psf) [2,4]	
			Unsaturated [5]	Submerged [5]
Active (Ka)	Structural Fill - 0.25 Native Sand and Gravels - 0.27	(0.25)S (0.27)S (0.41)S	(31)H (33)H (47)H	(78)H (78)H (84)H

Lateral Earth Pressure Design Parameters

Earth Pressure Condition [1]	Coefficient for Backfill Type [2]	Surcharge Pressure [3] p_1 (psf)	Equivalent Fluid Pressures (psf) [2,4]	
			Unsaturated [5]	Submerged [5]
	Native Clays – 0.41			
At-Rest (Ko)	Structural Fill - 0.40 Native Sand and Gravels - 0.43 Native Clays – 0.58	(0.40)S (0.43)S (0.58)S	(50)H (51)H (66)H	(87)H (87)H (93)H

1. For active earth pressure, wall must rotate about base, with top lateral movements 0.002 H to 0.004 H, where H is wall height. For passive earth pressure, wall must move horizontally to mobilize resistance. Fat clay or other expansive soils should not be used as backfill behind the wall.
2. Uniform, horizontal backfill, with a maximum unit weight of 125 pcf for Structural Fill and native gravels, 115 pcf for native clays, and 120 pcf for native sands.
3. Uniform surcharge, where S is surcharge pressure.
4. Loading from heavy compaction equipment is not included.
5. To achieve "Unsaturated" conditions, follow guidelines in **Subsurface Drainage for Below-Grade Walls** below. "Submerged" conditions are recommended when drainage behind walls is not incorporated into the design.

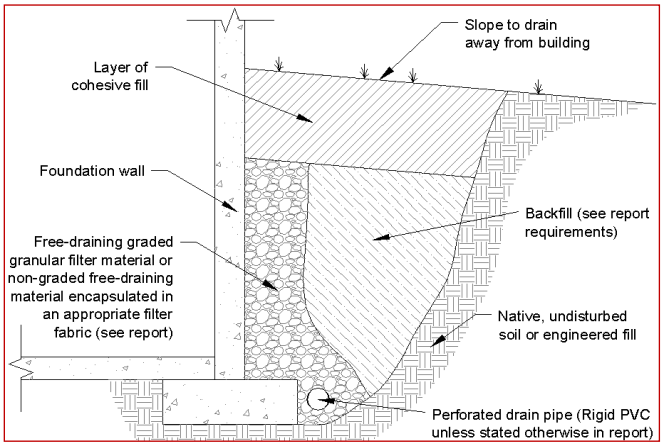
Backfill placed against structures should consist of granular soils or low plasticity cohesive soils. For the granular values to be valid, the granular backfill must extend out and up from the base of the wall at an angle of at least 45 degrees from vertical for the active case.

Footings, floor slabs or other loads bearing on backfill behind walls may have a significant influence on the lateral earth pressure. Placing footings within wall backfill and in the zone of active soil influence on the wall should be avoided unless structural analyses indicate the wall can safely withstand the increased pressure. This will likely be necessary for the existing basement wall on the east side of the structure, adjacent to the planned locations of the attic access stair foundation footings.

The lateral earth pressure recommendations given in this section are applicable to the design of rigid retaining walls subject to slight rotation, such as cantilever, or gravity type concrete walls. These recommendations are not applicable to the design of modular block - geogrid reinforced backfill walls (also termed MSE walls). Recommendations covering these types of wall systems are beyond the scope of services for this assignment. However, we would be pleased to develop a proposal for evaluation and design of such wall systems upon request.

Subsurface Drainage for Below-Grade Walls

A perforated rigid plastic drain line installed behind the base of walls and extends below adjacent grade is recommended to prevent hydrostatic loading on the walls. The invert of a drain line around a below-grade building area or exterior retaining wall should be placed near foundation bearing level. The drain line should be sloped to provide positive gravity drainage to daylight or to a sump pit and pump. The drain line should be surrounded by clean, free-draining granular material having less than 5% passing the No. 200 sieve, such as No. 57 aggregate. The free-draining aggregate should be encapsulated in a filter fabric. The granular fill should extend to within 2 feet of final grade, where it should be capped with compacted cohesive fill to reduce infiltration of surface water into the drain system.



Frost Considerations

The soils on this site are frost susceptible, and small amounts of water can affect the performance of the slabs on-grade and flatwork. 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 building and slabs, and toward the site drainage system.
- Install drains around the perimeter of the building, stoops, and below exterior slabs, 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 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

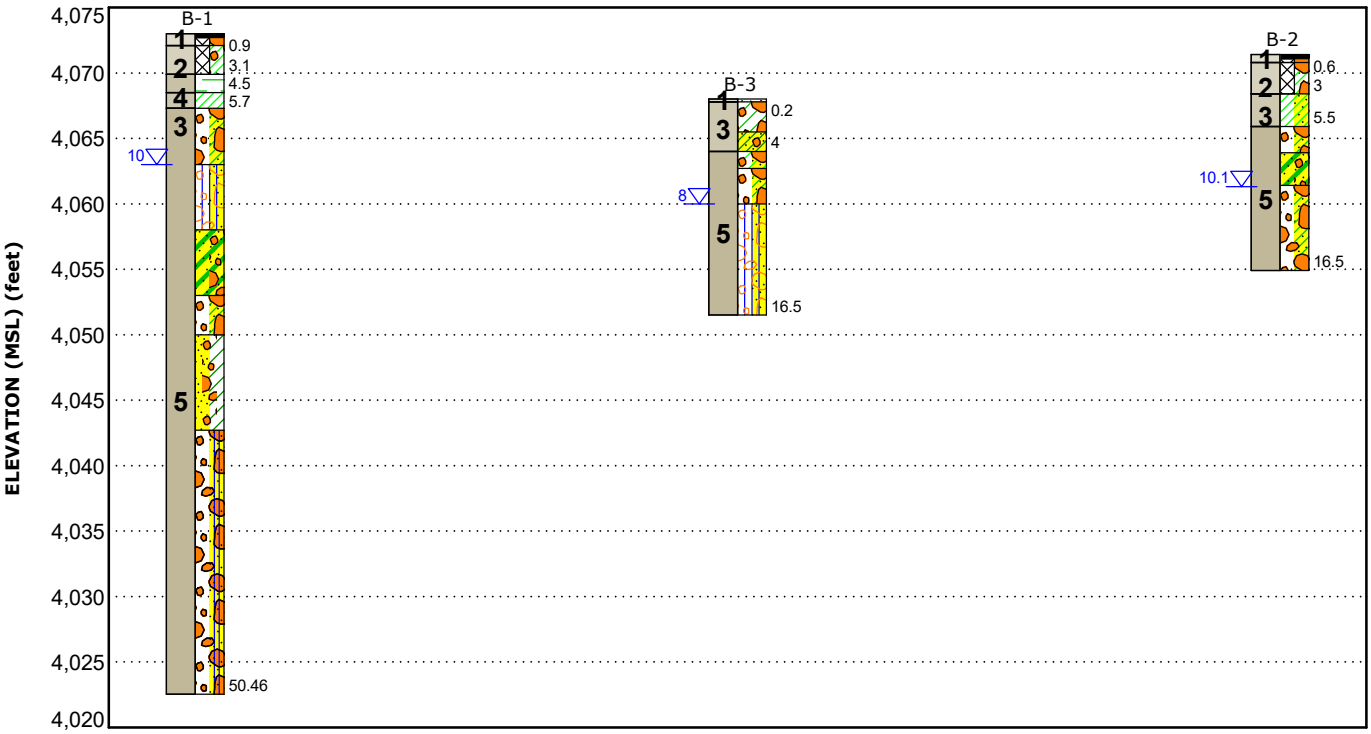
Contents:

GeoModel

Indian Health Services Pryor Health Center Foundation Improvements
148 Pryor Gap Road | Pryor, MT
Terracon Project No. 26245031

Terracon
2110 Overland Ave Ste 124
Billings, MT

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 Materials**	Asphalt, base course and topsoil encountered depending on boring location; Borings B-1 and B-2 we advanced through asphalt pavement, B-3 in a landscaped area.
2	**Fill**	Lean clay with gravel encountered in Boring B-1 over organic clay, grey-brown to black-brown.
3	**Clay**	Clay soils with variable gravel and sand content, encountered at all three boring locations.
4	**Organic Clay**	Organic clay soil, grey-brown to black-brown, roots throughout with an organic odor, encountered within 5 feet of ground surface at Borings B-1 and B-2 (trace).
5	**Sand and Gravel**	Sand and Gravel soils with variable fines content, tan-brown to red-brown to grey-tan, loose to dense above 30 feet below ground surface, then very dense.

Legend

- Asphalt
- Lean Clay with Gravel
- Lean Clay
- Silty Gravel with Sand
- Poorly-graded Sand with Clay and Gravel
- Gravelly Lean Clay
- Topsoil
- Sandy Lean Clay with Gravel
- Poorly-graded Gravel with Sand
- Organic Silt
- Poorly-graded Gravel with Clay and Sand
- Clayey Sand with Gravel
- Poorly-graded Gravel with Silt and Sand
- Lean Clay with Sand
- Clayey Gravel
- Clayey Gravel with Sand

▽ First Water Observation

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time.
Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

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

Field Exploration

Number of Borings	Approximate Boring Depth (feet)	Location
1	50.5	Building front (elevator pit)
2	16.5	North and east building sides (AC pad and attic stairs, respectively)

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 95% submittal drawing for the Irrigation Ditch to Pipe Plan prepared by KFDE on April 26, 2024, documented as Sheet C-1. If elevations and a more precise boring layout are desired, we recommend borings be surveyed.

Subsurface Exploration Procedures: Our exploration was completed on September 30, 2024, when we advanced the borings with a subcontracted truck-mounted BK-81 drill rig operated by HazTech Drilling. The borings were advanced using continuous, hollow-stem flight augers. In general, four samples were obtained in the upper 10 feet of each boring and at intervals of 5 feet thereafter. In the thin-walled tube sampling procedure, a thin-walled, seamless steel tube with a sharp cutting edge was pushed hydraulically into the soil to obtain a relatively undisturbed sample. 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. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. We observed and recorded groundwater levels during drilling and sampling; groundwater levels observed are shown on the attached boring logs. For safety purposes, all borings were backfilled with auger cuttings after their completion. Pavements were patched with cold-mix asphalt, as appropriate.

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 Distribution
- One-Dimensional Consolidation and Swell
- Unconfined Compressive Strength

The laboratory testing program 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.

Other Testing: Soil analytical testing for water soluble and pH were performed by Energy Laboratories in Helena, Montana. Their report with testing results is included in the attachments.

Photography Log

Front (south) of Pryor Health Clinic, showing area of original planned location of Boring B-1 (stake, center-right of photo).

East side of health clinic, general area of planned attic access stairway and Boring B-2, looking south-southwest.

Back (north) of health clinic, general area of planned AC pad and Boring B-3 (stake, left side of photo), looking northwest towards utility connections.

Drilling Boring B-1, looking east-southeast; boring moved due to physical access issues to original location.

Site Location and Exploration Plans

Contents:

Site Location Plan
Exploration Plan

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-1 through B-3)
Atterberg Limits
Grain Size Distribution
Consolidation/Swell
Unconfined Compressive Strength
Energy Labs corrosivity Testing Report (8 pages)

Note: All attachments are one page unless noted above.

Indian Health Services Pryor Health Center Foundation Improvements
148 Pryor Gap Road | Pryor, MT
Terracon Project No. 26245031

Terracon
2110 Overland Ave Ste 124
Billings, MT

Boring Log No. B-1

Location: See Exploration Plan

Latitude: 45.4282° Longitude: -108.5371°

Model Layer	Depth (Ft.)	Elevation: 4073.0 (Ft.) +/-	Field Test Results	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
1	0.3	**ASPHALT**, 3.5 inches of asphalt concrete pavement	4072.7				
1	0.9	**BASE COURSE; POORLY GRADED GRAVEL WITH SAND (GP)**, brown, moist	4072.1	8-4-4 N=8	20.4		
2	3.1	**FILL; LEAN CLAY WITH GRAVEL (CL)**, subangular to subrounded gravels, brown-grey, dry to moist	4069.9	5-6-10 N=16	18.3		
4	4.5	**ORGANIC CLAY (OL)**, grey-brown to black-brown, dry to moist, very stiff, organic odor, roots	4068.5				
3	5.7	**LEAN CLAY (CL)**, grey to brown, dry to moist, stiff	4067.3	3-6-22 N=28	16.9		
5	10.0	**POORLY GRADED GRAVEL WITH CLAY AND SAND (GP-GC)**, subangular to subrounded gravels, tan-grey to brown, dry, dense	4063	10-13-20 N=33	5.9		
5	15.0	**SILTY GRAVEL WITH SAND (GM)**, subangular to subrounded gravels, tan-brown to red-brown, saturated, medium dense	4058	12-12-6 N=18	13.6		
5	20.0	**SILTY SAND WITH GRAVEL (SM)**, fine to medium grained, tan-brown to red-brown, saturated, dense	4053	11-19-21 N=40	13.3	NP	30
5	23.0	**POORLY GRADED GRAVEL WITH CLAY AND SAND (GP-GC)**, subangular to subrounded gravels, tan-brown to red-brown, saturated, dense	4050	15-15-18 N=33	11.8		
5	30	**POORLY GRADED SAND WITH CLAY AND GRAVEL (SP-SC)**, fine to medium grained, tan-brown to red-brown, saturated, dense		9-17-17 N=34	16.0		

Depth (Ft.) — Water Level Observations — Sample Type

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 a topographic site plan.

Water Level Observations
Groundwater table encountered at 10 feet below surface during drilling

Drill Rig
BK-81

Hammer Type
Automatic

Driller
P. Bray / HazTech

Logged by
H. Dorian

Boring Started
09-30-2024

Boring Completed
09-30-2024

Notes

Advancement Method
4 1/4" Hollow-Stem Auger

Abandonment Method
Boring backfilled with Auger Cuttings
Surface capped with asphalt

Indian Health Services Pryor Health Center Foundation Improvements
148 Pryor Gap Road | Pryor, MT
Terracon Project No. 26245031

Terracon
2110 Overland Ave Ste 124
Billings, MT

Boring Log No. B-1

Location: See Exploration Plan

Latitude: 45.4282° Longitude: -108.5371°

Depth (Ft.) Elevation: 4073.0 (Ft.) +/-

Model Layer	Graphic Log	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Unconfined Compressive Strength (psf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
5		30.3 / 4042.7 **POORLY GRADED GRAVEL WITH SILT (GP-GC)**, subrounded to angular gravels, dark brown to grey, saturated, very dense, tended to heave between 5 and 13.5 inches			14-28-50/6"		13.0			
		35			19-50/5"		19.6			
		increased grinding and auger resistance								
		40			50/5"		13.4			
		45			45-50/3"		11.5			
		more clayey, solid auger cuttings								
		50.5 / 4022.54			50/6"		12.5			
		Boring Terminated at 50.5 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 a topographic site plan.

Water Level Observations
Groundwater table encountered at 10 feet below surface during drilling

Drill Rig
BK-81

Hammer Type
Automatic

Driller
P. Bray / HazTech

Logged by
H. Dorian

Boring Started
09-30-2024

Boring Completed
09-30-2024

Notes

Advancement Method
4 1/4" Hollow-Stem Auger

Abandonment Method
Boring backfilled with Auger Cuttings
Surface capped with asphalt

Indian Health Services Pryor Health Center Foundation Improvements
148 Pryor Gap Road | Pryor, MT
Terracon Project No. 26245031

Terracon
2110 Overland Ave Ste 124
Billings, MT

Boring Log No. B-2

Location: See Exploration Plan

Latitude: 45.4284° Longitude: -108.5366°

Depth (Ft.) Elevation: 4071.4 (Ft.) +/-

Model Layer	Graphic Log	Depth (Ft.)	Elevation (Ft.)	Description	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Unconfined Compressive Strength (psf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
1		0.3	4071.1	**ASPHALT**, 4 inches of asphalt concrete pavement									
2		0.6	4070.8	**BASE COURSE; POORLY GRADED GRAVEL WITH CLAY AND SAND (GP-GC)**, subrounded to subangular gravel, dark brown, moist				5-6-5 N=11		10.1			
		3.0	4068.4	**FILL; GRAVELLY LEAN CLAY (CL)**, brown, moist, stiff									
3		5.5	4065.9	**LEAN CLAY WITH SAND (CL)**, tan-brown, moist, seam of organic clay 1/2 to 1 inch thick at interface between overlying gravel layer.	5				1960	16.2	102	32-16-16	85
5		7.5	4063.9	**POORLY GRADED GRAVEL WITH CLAY AND SAND (GP-GC)**, white-grey to brown, dense				14-20-26 N=46		20.9			
		10.0	4061.4	**CLAYEY SAND WITH GRAVEL (SC)**, tan-brown, moist, medium dense				6-6-7 N=13		12.1			
				POORLY GRADED GRAVEL WITH CLAY AND SAND (GP-GC), tan to orange-brown, saturated, medium dense	10	▽		7-10-14 N=24		7.9			
		16.5	4054.9	saturated, increased sand content, fine to medium grained	15			5-5-15 N=20		17.4			
				Boring Terminated at 16.5 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 a topographic site plan.

Water Level Observations
▽ Groundwater table encountered at 10 feet below surface during drilling

Drill Rig
BK-81

Hammer Type
Automatic

Driller
P. Bray / HazTech

Logged by
H. Dorian

Boring Started
09-30-2024

Boring Completed
09-30-2024

Notes

Advancement Method
4 1/4" Hollow-Stem Auger

Abandonment Method
Boring backfilled with Auger Cuttings
Surface capped with asphalt

Terracon
2110 Overland Ave Ste 124
Billings, MT

Boring Log No. B-3

Location: See Exploration Plan

Latitude: 45.4286° Longitude: -108.5370°

Depth (Ft.) Elevation: 4068.0 (Ft.) +/-

Model Layer	Graphic Log	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Unconfined Compressive Strength (psf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
1		0.2 **TOPSOIL**, 2 inches of topsoil, black-brown 4067.8								
3		**CLAYEY GRAVEL (GC)**, grey, dry to moist, medium dense			8-8-6 N=14		11.7			
		2.5 4065.5								
		SANDY LEAN CLAY (CL), trace gravel, grey-tan to light brown, dry, very stiff			5-11-15 N=26		15.4			
		4.0 4064								
		CLAYEY GRAVEL WITH SAND (GC), subrounded to subangular, red-brown to brown, dry to moist								
		5.3 4062.7			13-22-20 N=42		6.3			
		POORLY GRADED GRAVEL WITH CLAY AND SAND (GP-GC), subrounded to subangular, grey-tan to red-brown, dry to moist, dense								
		8.0 4060	▽		9-6-5 N=11		14.1			
5		**SILTY GRAVEL WITH SAND (GM)**, subrounded to subangular, red-brown, saturated, loose, seams of clay throughout			8-4-5 N=9		11.1			
		medium dense			6-8-6 N=14		15.6			
		16.5 4051.5								
		Boring Terminated at 16.5 Feet								

5 10 15

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 a topographic site plan.

Water Level Observations
▽ Groundwater table encountered at 8 feet below surface during drilling

Drill Rig
BK-81

Hammer Type
Automatic

Driller
P. Bray / HazTech

Logged by
H. Dorian

Boring Started
09-30-2024

Boring Completed
09-30-2024

Notes

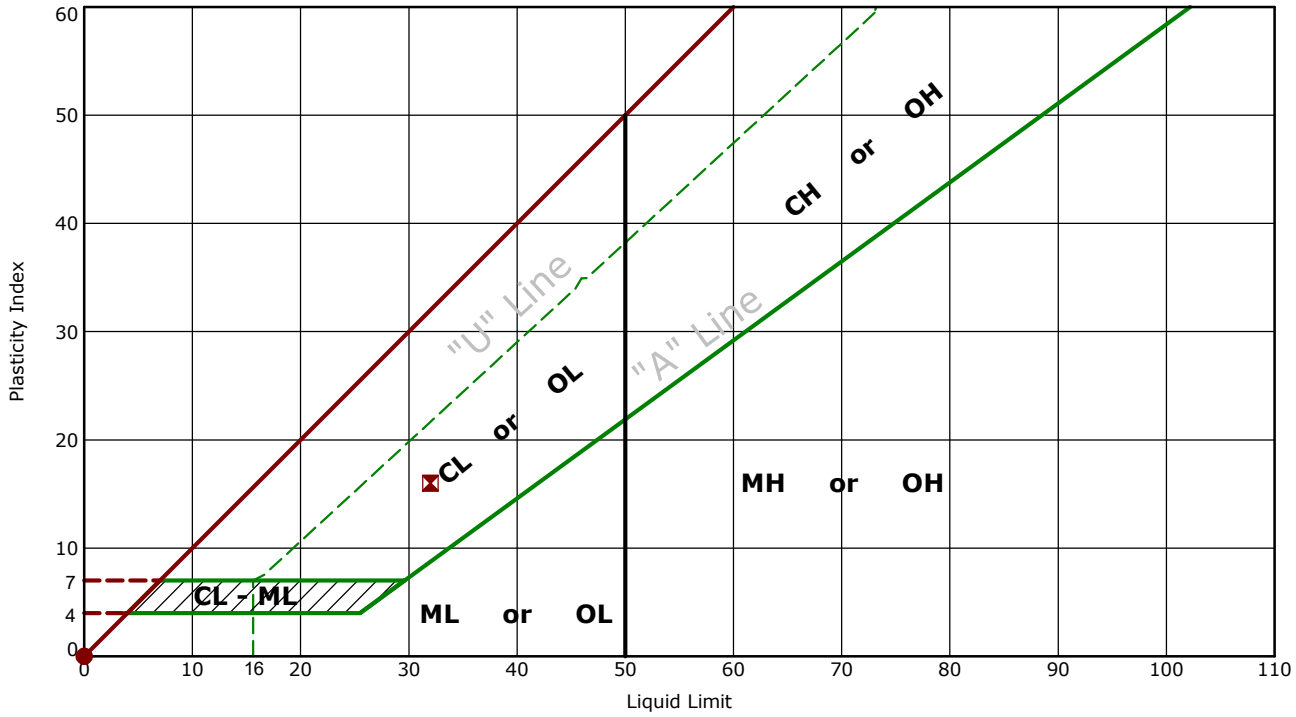
Advancement Method
4 1/4" Hollow-Stem Auger

Abandonment Method
Boring backfilled with Auger Cuttings

Terracon
2110 Overland Ave Ste 124
Billings, MT

Atterberg Limit Results

ASTM D4318



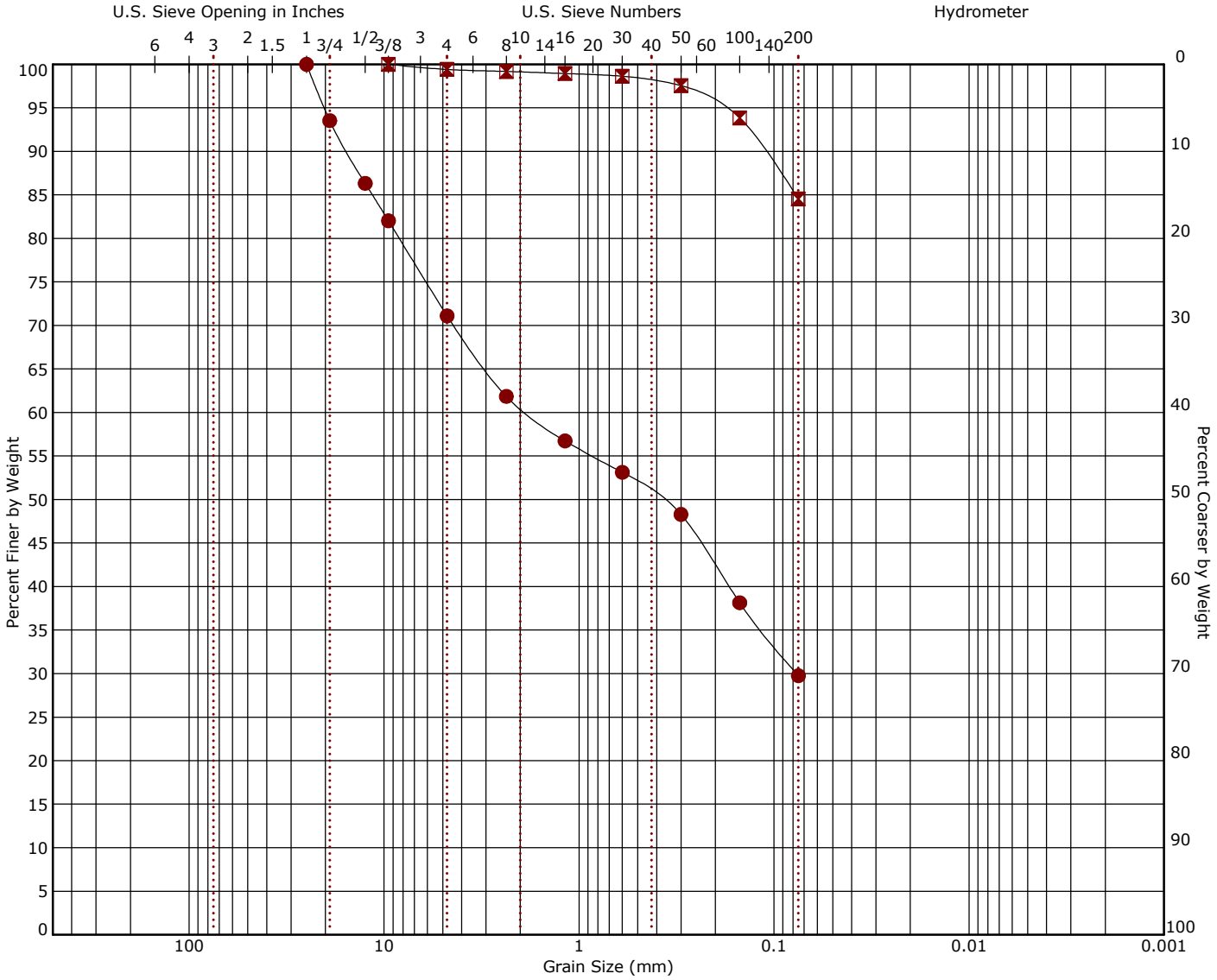
	Boring ID	Depth (Ft)	LL	PL	PI	Fines	USCS	Description
●	B-1	15 - 16.5	NP	NP	NP	29.8	SM	SILTY SAND with GRAVEL
⊠	B-2	3 - 5	32	16	16	84.5	CL	LEAN CLAY with SAND

Indian Health Services Pryor Health Center Foundation Improvements
148 Pryor Gap Road | Pryor, MT
Terracon Project No. 26245031

Terracon
2110 Overland Ave Ste 124
Billings, MT

Grain Size Distribution

ASTM D422 / ASTM C136 / AASHTO T27



Cobbles	Gravel		Sand			Silt or Clay
	coarse	fine	coarse	medium	fine	

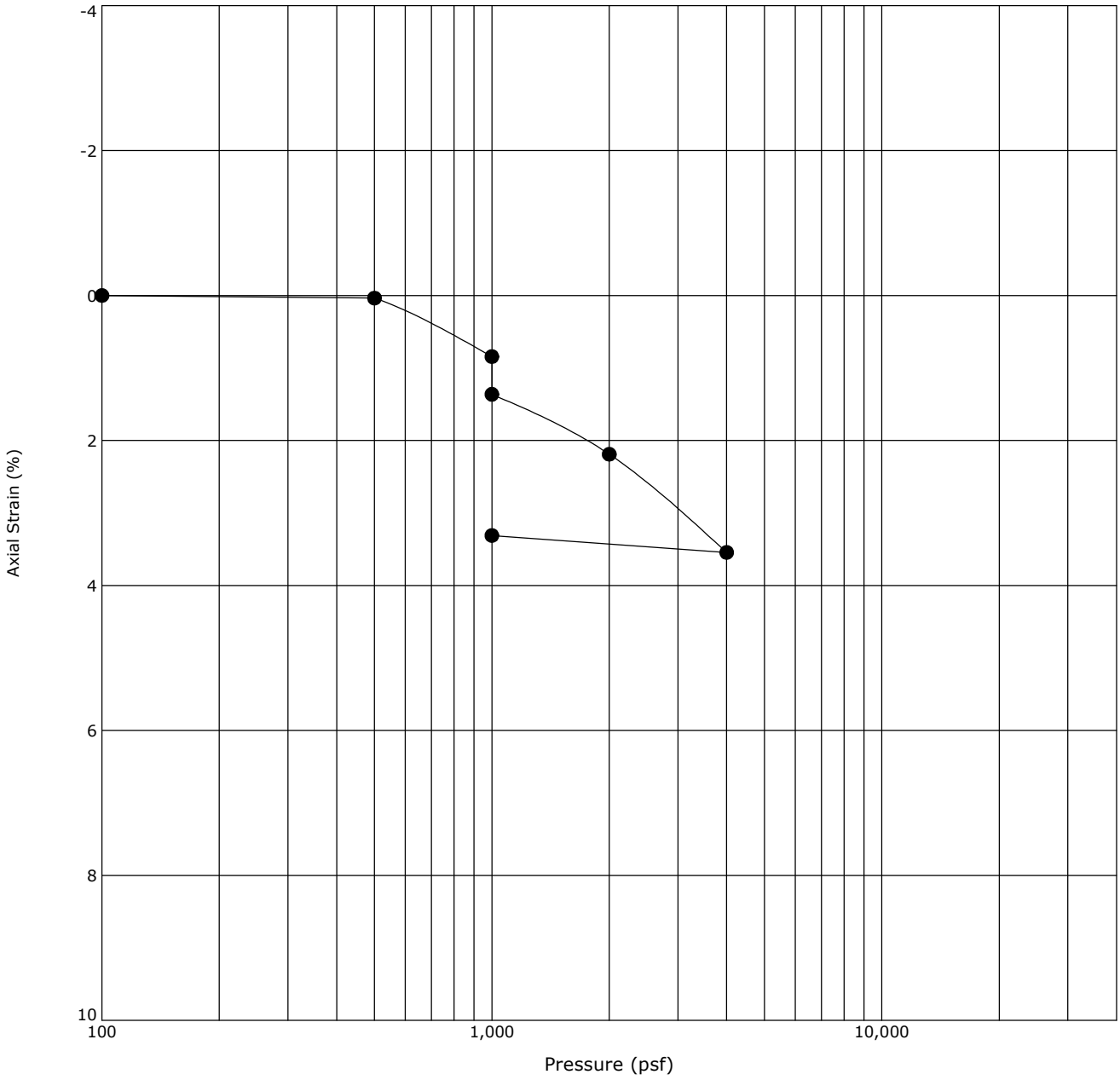
Boring ID	Depth (Ft)	Description	USCS	LL	PL	PI	Cc	Cu
B-1	15 - 16.5	SILTY SAND with GRAVEL	SM	NP	NP	NP		
B-2	3 - 5	LEAN CLAY with SAND	CL	32	16	16		

Boring ID	Depth (Ft)	D_{100}	D_{60}	D_{50}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Fines	%Silt	%Clay
B-1	15 - 16.5	25	1.837	0.383	0.076		0.0	28.9	41.3	29.8		
B-2	3 - 5	9.5					0.0	0.6	14.9	84.5		

2110 Overland Ave Ste 124
Billings, MT

One-Dimensional Swell or Collapse

ASTM D4546



Boring ID		Depth (Ft)	Description	USCS	γ_d(pcf)	WC (%)
●	B-2	3 - 5	LEAN CLAY with SAND (CL)	CL	103	16.2

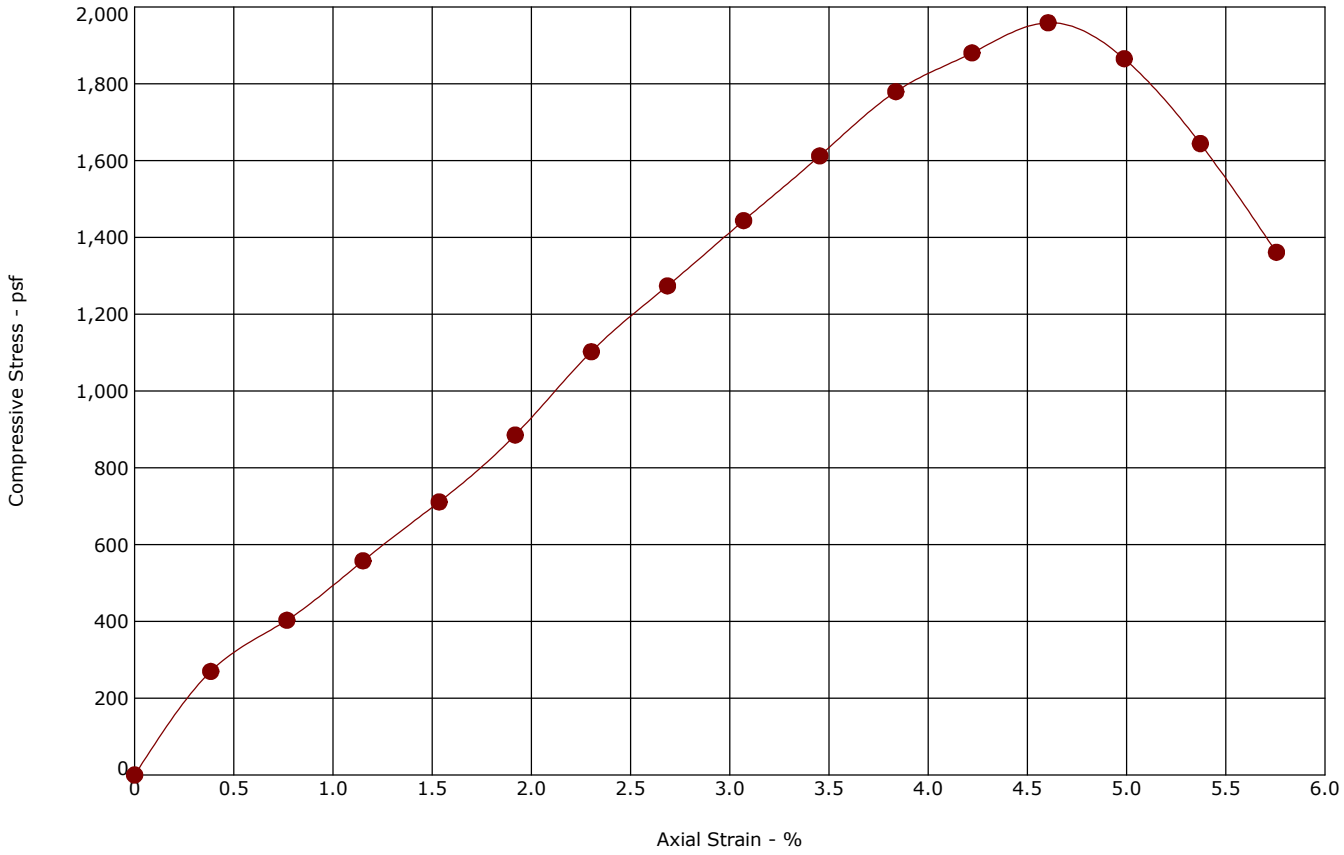
Notes: Sample inundated at 1,000 psf, immediate collapse of 0.52% observed.

Indian Health Services Pryor Health Center Foundation Improvements
148 Pryor Gap Road | Pryor, MT
Terracon Project No. 26245031

Terracon
2110 Overland Ave Ste 124
Billings, MT

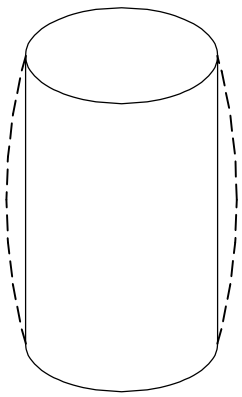
Unconfined Compression Test

ASTM D2166



Boring ID	Depth (Ft)	Sample type	LL	PL	PI	Fines (%)	Description
B-2	3 - 5	Shelby Tube	32	16	16	84.5	LEAN CLAY with SAND(CL)

Specimen Failure Mode



Failure Mode: Bulge (dashed)

Specimen Test Data

Moisture Content (%):	16.2
Dry Density (pcf):	102
Diameter (in.):	2.85
Height (in.):	5.21
Height / Diameter Ratio:	1.83
Calculated Saturation (%):	67.44
Calculated Void Ratio:	0.65
Assumed Specific Gravity:	2.7
Failure Strain (%):	4.60
Unconfined Compressive Strength (psf):	1959
Undrained Shear Strength (psf):	979
Strain Rate (in/min):	0.0540
Remarks:	

ANALYTICAL SUMMARY REPORT

October 24, 2024

Terracon Consultants
2110 Overland Ave Ste 124
Billings , MT 59102-6440

Work Order: B24101207 Quote ID: B5647

Project Name: 11-15 Pryor Foundation 26245031

Energy Laboratories Inc Billings MT received the following 1 sample for Terracon Consultants on 10/14/2024 for analysis.

Lab ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
B24101207-001	B-1 Corrosivity [3-5]Feet	09/30/24 14:40	10/14/24	Soil	Conductivity, Saturated Paste Extract Anions, Saturated Paste Extract pH, Saturated Paste DI Water Soil Extract ASA10-3 Saturated Paste Extraction ASA Resistivity Anions, Saturated Paste Extract Saturation Percentage

The analyses presented in this report were performed by Energy Laboratories, Inc., 1120 So. 27th Street, Billings, MT 59101, unless otherwise noted. Any exceptions or problems with the analyses are noted in the report package. Any issues encountered during sample receipt are documented in the Work Order Receipt Checklist.

The results as reported relate only to the item(s) submitted for testing. This report shall be used or copied only in its entirety. Energy Laboratories, Inc. is not responsible for the consequences arising from the use of a partial report.

Energy Laboratories, Inc. verifies the reported results for the analysis has been technically reviewed and approved for release.

If you have any questions regarding these test results, please contact your Project Manager.

Sonya Mallett
Soil Department Supervisor

Digitally signed by
Sonya Mallett
Date: 2024.10.24 11:47:26 -06:00

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client: Terracon Consultants
Project: 11-15 Pryor Foundation 26245031
Lab ID: B24101207-001
Client Sample ID: B-1 Corrosivity [3-5]

Report Date: 10/24/24
Collection Date: 09/30/24 14:40
DateReceived: 10/14/24
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	8.1	s.u.		0.1		ASA10-3	10/22/24 16:55 / srm
Conductivity, sat. paste	0.7	mmhos/cm		0.1		ASA10-3	10/22/24 16:55 / srm
Saturation	40.9	%		0.1		USDA27a	10/24/24 10:39 / srm
Sulfate	84	mg/L		1		E300.0	10/24/24 05:29 / caa
Sulfate	35	mg/kg		1		E300.0	10/24/24 11:41 / srm
RESISTIVITY OF SOIL							
Resistivity, Sat. Paste	1500	ohm-cm		1		A2510 B	10/22/24 16:55 / srm

Report Definitions:
RL - Analyte Reporting Limit
QCL - Quality Control Limit
MCL - Maximum Contaminant Level
ND - Not detected at the Reporting Limit (RL)

QA/QC Summary Report

Prepared by Billings, MT Branch

Work Order: B24101207 **Report Date:** 10/24/24

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: **A2510 B**										Batch: R431003
Lab ID: **B24101210-002A DUP**	Sample Duplicate					Run: MISC-SOIL_241022A				10/22/24 16:55
Resistivity, Sat. Paste		1030	ohm-cm	1.0						
Lab ID: **LCS-2410221655**	Laboratory Control Sample					Run: MISC-SOIL_241022A				10/22/24 16:55
Resistivity, Sat. Paste		140	ohm-cm	1.0	116	70	130			

Qualifiers:

RL - Analyte Reporting Limit

ND - Not detected at the Reporting Limit (RL)

QA/QC Summary Report

Prepared by Billings, MT Branch

Work Order: B24101207 **Report Date:** 10/24/24

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: **ASA10-3**										Batch: 194407
Lab ID: **B24101210-002A DUP**	Sample Duplicate					Run: MISC-SOIL_241022A				10/22/24 16:55
pH, sat. paste		7.50	s.u.	0.10				0.0	10	
Lab ID: **LCS-2410221655**	Laboratory Control Sample					Run: MISC-SOIL_241022A				10/22/24 16:55
pH, sat. paste		7.10	s.u.	0.10	101	90	110			

Qualifiers:

RL - Analyte Reporting Limit

ND - Not detected at the Reporting Limit (RL)

QA/QC Summary Report

Prepared by Billings, MT Branch

Work Order: B24101207 **Report Date:** 10/24/24

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E300.0										Batch: 194407
Lab ID: MB-194407	Method Blank					Run: IC METROHM 2_241021A				10/24/24 01:32
Sulfate		ND	mg/L	0.09						
Lab ID: LCS-194407	Laboratory Control Sample					Run: IC METROHM 2_241021A				10/24/24 01:49
Sulfate		2290	mg/L	5.0	115	70	130			
Lab ID: B24101402-002AMS	Sample Matrix Spike					Run: IC METROHM 2_241021A				10/24/24 03:13
Sulfate		10400	mg/L	5.3	104	70	130			
Lab ID: B24100767-001ADUP	Sample Duplicate					Run: IC METROHM 2_241021A				10/24/24 04:04
Sulfate		927	mg/L	1.0				0.4	30	

Qualifiers:

RL - Analyte Reporting Limit

ND - Not detected at the Reporting Limit (RL)

QA/QC Summary Report

Prepared by Billings, MT Branch

Work Order: B24101207 **Report Date:** 10/24/24

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: **USDA27a**										Batch: 194407
Lab ID: **B24101210-002ADUP**	Sample Duplicate					Run: MISC-SOIL_241024C				10/24/24 10:39
Saturation		46.5	%	0.10				4.2	20	
Lab ID: **LCS-2410241039**	Laboratory Control Sample					Run: MISC-SOIL_241024C				10/24/24 10:39
Saturation		36.0	%	0.10	98	80	120			

Qualifiers:

RL - Analyte Reporting Limit

ND - Not detected at the Reporting Limit (RL)

Work Order Receipt Checklist

Terracon Consultants

B24101207

Login completed by: Danielle N. Harris
Date Received: 10/14/2024

Reviewed by: lleprowse
Received by: DNH

Reviewed Date: 10/16/2024
Carrier name: Hand Deliver

Shipping container/cooler in good condition?	Yes ☐	No ☐	Not Present ☑
Custody seals intact on all shipping container(s)/cooler(s)?	Yes ☐	No ☐	Not Present ☑
Custody seals intact on all sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☐	No ☑	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time? (Exclude analyses that are considered field parameters such as pH, DO, Res Cl, Sulfite, Ferrous Iron, etc.)	Yes ☑	No ☐	
Temp Blank received in all shipping container(s)/cooler(s)?	Yes ☐	No ☑	Not Applicable ☐
Container/Temp Blank temperature:	21.2°C No Ice		
Containers requiring zero headspace have no headspace or bubble that is <6mm (1/4").	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☐	No ☐	Not Applicable ☑

Standard Reporting Procedures:

Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH, Dissolved Oxygen and Residual Chlorine, are qualified as being analyzed outside of recommended holding time.

Solid/soil samples are reported on a wet weight basis (as received) unless specifically indicated. If moisture corrected, data units are typically noted as –dry. For agricultural and mining soil parameters/characteristics, all samples are dried and ground prior to sample analysis.

The reference date for Radon analysis is the sample collection date. The reference date for all other Radiochemical analyses is the analysis date. Radiochemical precision results represent a 2-sigma Total Measurement Uncertainty.

For methods that require zero headspace or require preservation check at the time of analysis due to potential interference, the pH is verified at analysis. Nonconforming sample pH is documented as part of the analysis and included in the sample analysis comments.

Trip Blanks and/or Blind Duplicate samples are assigned the earliest collection time for the associated requested analysis in order to evaluate the holding time unless specifically indicated.

Contact and Corrective Action Comments:

The sample identification indicated on the container is B-2 at 3-5 feet corrosivity and on the chain of custody it is B-1 at 3-5 feet corrosivity. Proceeded with the sample identification as indicated on the chain of custody. DNH 10/14/24

Chain of Custody & Analytical Request Record

ENERGY LABORATORIES — Trust our People. Trust our Data.

www.energylab.com

Account Information *(Billing information)*

Company/Name	Terracon Consultants
Contact	Chris LaRance
Phone	(406) 656-3072
Mailing Address	2110 Overland Ave, Ste 124
City, State, Zip	Billings, MT 59102
Email	chris.larance@terracon.com
Receive Invoice	☐ Hard Copy ☑ Email
Receive Report	☐ Hard Copy ☑ Email
Purchase Order	
Quote	
Bottle Order	

Report Information *(if different than Account Information)*

Company/Name	
Contact	
Phone	
Mailing Address	
City, State, Zip	
Email	
Receive Report	☐ Hard Copy ☐ Email

Special Report/Formats:
☐ LEVEL IV ☐ NELAC ☐ EDD/EDT *(contact laboratory)* ☐ Other_____

Comments

Project Information

Project Name, PWSID, Permit, etc.	IHS Bryan Foundation 26245031
Sampler Name	Hudson Dorian
Sampler Phone	(406) 371-9854
Sample Origin State	MT
EPA/State Compliance	☑ Yes ☐ No
Lab provided preservatives were used	☑ Yes ☑ No

MINING CLIENTS, please indicate sample type.
*If ore has been processed or refined, call before sending.
☐ Byproduct 11 (e)2 material ☐ Unprocessed ore (NOT ground or refined)*

Matrix Codes
A - Air
W - Water
S - Soils/Solids
V - Vegetation
B - Bioassay
O - Other
DW - Drinking Water

All turnaround times are standard unless marked as RUSH.
Energy Laboratories MUST be contacted prior to RUSH sample submittal for charges and scheduling – See Instructions Page

	Sample Identification (Name, Location, Interval, etc.)	Collection Date	Collection Time	Number of Containers	Matrix (See Codes Above)	pH	minimum resistivity	Soluble sulfates (%)	See Attached	RUSH TAT	ELI LAB ID (Laboratory Use Only)
1	B-1 @ 3-5' CORROSIVITY	9/30/24	14:40	1	S	✓	✓	✓			B2410207
2											
3											
4											
5											
6											
7											
8											
9											
10											

Custody Record MUST be signed	Relinquished by (print)	Date/Time	Signature	Received by (print)	Date/Time	Signature
	Hudson T Dorian	10/14/24 16:17				
	Relinquished by (print)	Date/Time	Signature	Received by Laboratory (print)	Date/Time	Signature
				Danielle Harris	10/14/24 1623	

LABORATORY USE ONLY

Shipped By	Cooler ID(s)	Custody Seals Y N C B	Intact Y N	Receipt Temp °C	Temp Blank Y N	On Ice Y N	Payment Type CC Cash Check_____	Amount $	Receipt Number *(cash/check only)*

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested.
This serves as notice of this possibility. All subcontracted data will be clearly notated on your analytical report.

ELI-COC-06/08 v.2

Supporting Information

Contents:

General Notes
Unified Soil Classification System

Note: All attachments are one page unless noted above.

Terracon
2110 Overland Ave Ste 124
Billings, MT

General Notes

Sampling	Water Level	Field Tests
Shelby Tube Split Spoon	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.	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

Relative Density	Standard Penetration or N-Value (Blows/Ft.)
Very Loose	0 - 3
Loose	4 - 9
Medium Dense	10 - 29
Dense	30 - 50
Very Dense	> 50

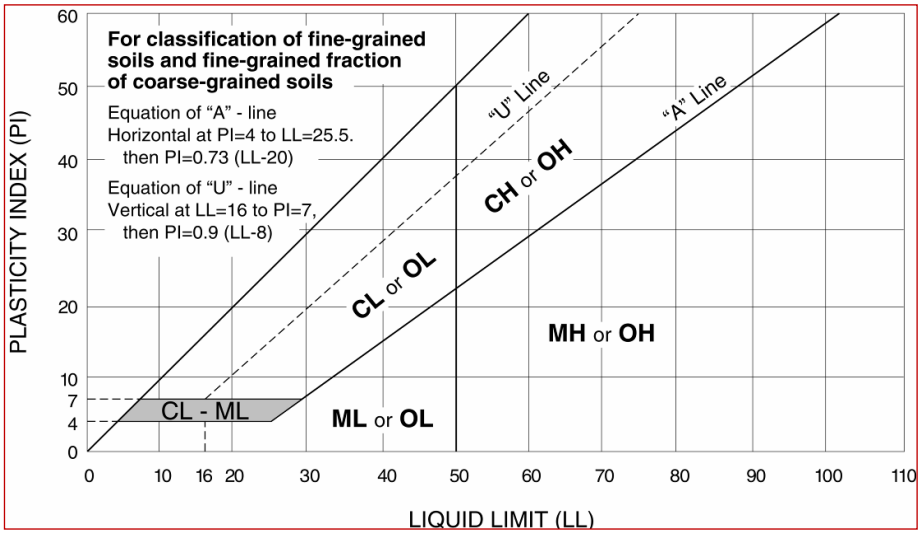
Consistency of Fine-Grained Soils
(50% or more passing the No. 200 sieve.)
Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance

Consistency	Unconfined Compressive Strength Qu (psf)	Standard Penetration or N-Value (Blows/Ft.)
Very Soft	less than 500	0 - 1
Soft	500 to 1,000	2 - 4
Medium Stiff	1,000 to 2,000	4 - 8
Stiff	2,000 to 4,000	8 - 15
Very Stiff	4,000 to 8,000	15 - 30
Hard	> 8,000	> 30

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. 4 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.