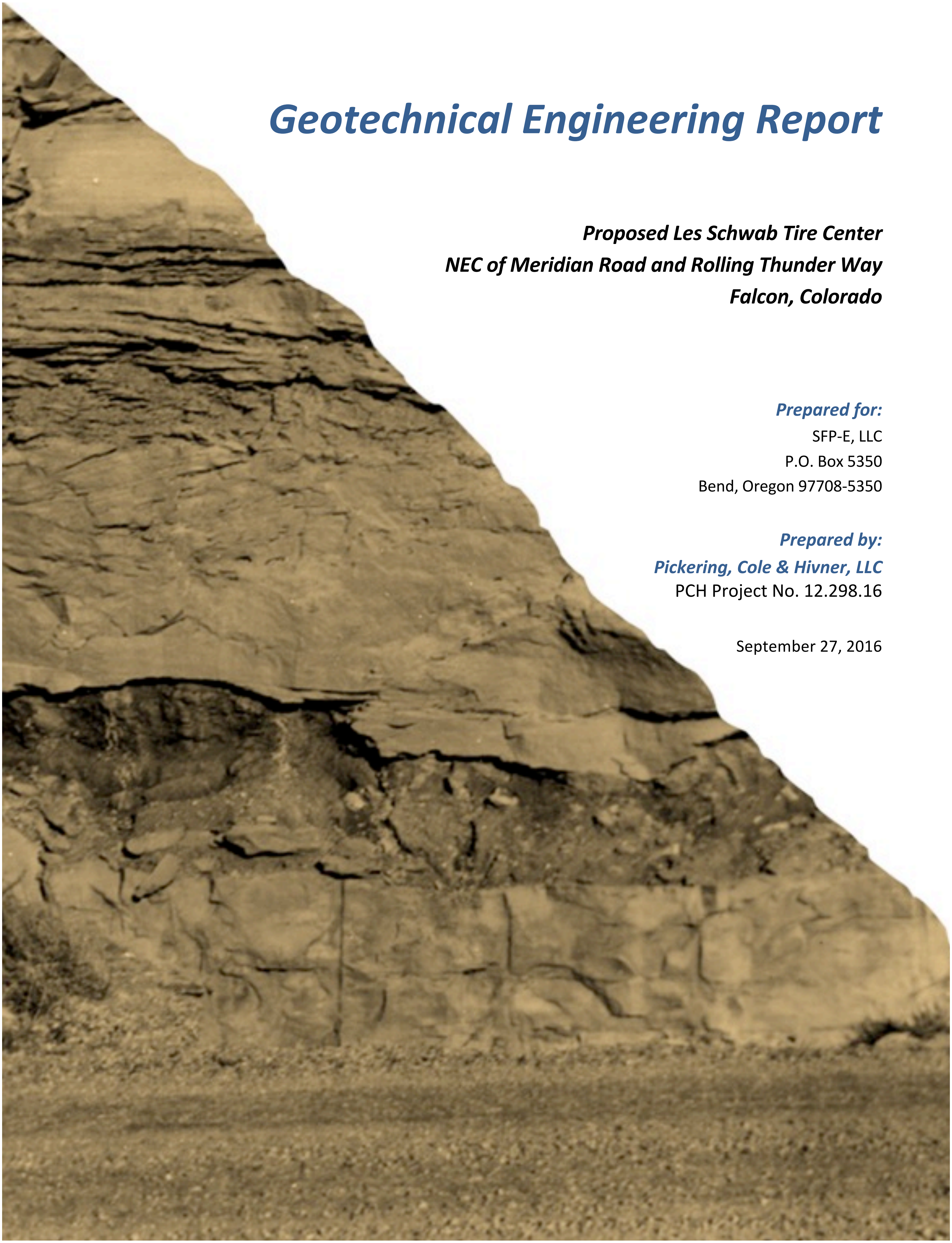
Geotechnical Engineering Report

Proposed Les Schwab Tire Center
NEC of Meridian Road and Rolling Thunder Way
Falcon, Colorado

Prepared for:
SFP-E, LLC
P.O. Box 5350
Bend, Oregon 97708-5350

Prepared by:
Pickering, Cole & Hivner, LLC
PCH Project No. 12.298.16

September 27, 2016



September 27, 2016

SFP-E, LLC
P.O. Box 5350
Bend, Oregon 97708-5350

Attn: Mr. Matt Hannigan

Re: Geotechnical Engineering Report
Proposed Les Schwab Tire Center
NEC of Meridian Road and Rolling Thunder Way
Falcon, Colorado
PCH Project No. 12.298.16

Pickering Cole & Hivner, LLC (PCH) has completed a geotechnical engineering investigation for the proposed Les Schwab Tire Center to be located at the northeast corner of the above-referenced intersection in Falcon, Colorado. This study was performed in general accordance with our proposal number P12.333.16, executed August 10, 2016.

This geotechnical summary should be used in conjunction with the entire report for design and/or construction purposes. It should be recognized that specific details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled General Comments should be read for an understanding of the report limitations.

- **Subsurface Conditions:** The soils at the site consist of silty to clayey sands, fine to coarse sands, and varying layers of lean clays. Sedimentary claystone bedrock was encountered below the sands/clays at depths ranging from about 13 to 18 feet below existing site grades. The bedrock extended to the depths explored. Groundwater was encountered in our building borings immediately after drilling at depths ranging from about 10 to 15 feet below existing site grades. The shallow pavement borings were dry at that time. When checked about three weeks later, ***groundwater was encountered in the deeper borings at depths ranging from about 4 to 7-½ feet below existing site grades***. The shallow pavement borings remained dry at that time. Other specific information regarding the lithology encountered is noted on the attached Boring Logs.

- **Shallow Groundwater and Below-Grade Construction:** As discussed, groundwater was encountered at the site at depths ranging from about 4 to 7-½ feet below existing site grades. As currently planned the northeast portion of the building will include below-grade maintenance pits (maximum of about 7 feet below planned FFE). ***We recommend construction be limited to excavation depths as high as practical in these areas in order to reduce the potential for water intrusion, as well as to minimize encountering potentially soft/unstable soil conditions during construction.***

We recommend these maintenance pit areas be designed as water-tight structures, designed for buoyancy and hydrostatic pressures. Waterproofing consultants should be contacted for recommendations regarding the design and construction of water-tight below-grade foundations. As an alternative, subsurface drainage systems can be installed to collect subsurface water and maintain dry interior conditions. At a minimum, the drainage system would include installation of a perimeter drain system around and below the foundations of these below grade areas which would empty into the storm sewer or a sump pit where collected water could be discharged via a submersible pump.

- **Foundations and Floor Slabs:** Based on the information obtained from our subsurface exploration and laboratory testing of selected samples, the site appears suitable for proposed development. The native sand/clay soils encountered near foundation bearing elevations are considered suitable for support of conventional spread footing foundations and slab-on-grade floors at the site. However, areas of soft, unstable or low-density soils may also be encountered in the foundation excavations and may require the need for removal and recompaction/replacement prior to foundation and floor slab construction. Therefore, it is imperative that the soils exposed in foundation excavations be observed by the geotechnical engineer to confirm or modify our recommendations.

- **Pavement Design and Structural Sections**: Design of pavements for the project is based on the procedures outlined in the 1993 *Guideline for Design of Pavement Structures* by the American Association of State Highway and Transportation Officials (AASHTO) using an assumed traffic volume.

  Light-duty pavements for automobile parking areas should include a minimum of 5-½ inches of asphalt concrete or, alternately, 5 inches of Portland cement concrete. Paved access drives should be paved with 6-½ inches of asphalt concrete. Heavy-duty pavements such as for driveway entrances, drive isles, heavy truck parking, and other areas where trucks will park and turn should include a minimum of 6 inches of Portland cement concrete.

We appreciate being of service to you in the geotechnical engineering phase of this project, and are prepared to assist you during the construction phases as well. Please do not hesitate to contact us if you have any questions concerning this report or any of our testing, inspection, design and consulting services.

Sincerely,
Pickering, Cole & Hivner, LLC

Glenn D. Ohlsen, P.E.
Project Engineer

Andrew J. Garner, P.E.
Senior Project Manager

COLORADO REGISTERED PROFESSIONAL ENGINEER
ANDREW J. GARNER
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9/27/16

Copies to: Addressee (1 PDF copy)

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PROPOSED LES SCHWAB TIRE CENTER
NEC of MERIDIAN ROAD and ROLLING THUNDER WAY
FALCON, COLORADO

PCH Project No. 12.298.16
September 27, 2016

INTRODUCTION

This report contains the results of our geotechnical engineering exploration for the proposed Les Schwab Tire Center to be located at the northeast corner of the intersection of Meridian Road and Rolling Thunder Way in Falcon, Colorado.

The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil and bedrock conditions
- Groundwater conditions
- Foundation design and construction
- Lateral earth pressures
- Floor slab design and construction
- Pavement structural sections
- Earthwork
- Drainage

The recommendations contained in this report are based upon the results of field and laboratory testing, engineering analyses, our experience with similar subsurface conditions and structures, and our understanding of the proposed project.

PROJECT INFORMATION

We understand that the project will include the development of an approximate 2.5-acre site at the referenced intersection. Development will include construction of a new single-story Les Schwab Tire Center building encompassing approximately 11,878 square feet. We assume construction will include either load bearing CMU or light-gauge steel framed superstructure along with interior steel columns supporting a metal roof system. Reinforced concrete foundations will support the structures. The interior of the structures will include a conventional slab-on-grade with some bays having a recessed slab. Portions of the slab will bear approximately 6-½ to 7 feet below finished floor elevation (FFE). Maximum wall and column loads are anticipated to be on the order of about 3 to 5 kips per lineal foot and 100 to 200 kips, respectively. We assume that a majority of the site is near rough construction grade, slightly below planned FFE.

Other major site development will include the installation of underground utilities, construction of a trash enclosure, as well as the construction of private asphalt or concrete paved parking areas and site landscape improvements.

If our understanding of the project, or assumptions above, is not accurate, or if you have additional useful information, please inform us as soon as possible.

SITE EXPLORATION PROCEDURES

The scope of the services performed for this project included site reconnaissance by a field engineer, a subsurface exploration program, laboratory testing and engineering analysis.

Field Exploration: As part of this study, we investigated the subsurface conditions on the site with a total of six (6) test borings. Borings were advanced to depths of about 25 to 35 feet below existing site grades with a truck-mounted drilling rig utilizing 4-inch diameter, solid stem auger.

A lithologic log of each boring was recorded by our field representative during the drilling operations. At selected intervals, samples of the subsurface materials were obtained by driving modified California barrel samplers. Penetration resistance measurements were obtained by driving the sample barrel into the subsurface materials with a 140-pound automatic hammer falling 30 inches. The penetration resistance value is a useful index to the consistency, relative density or hardness of the materials encountered.

Groundwater measurements were made in each boring at the time of site exploration and about three weeks later. Borings were loosely backfilled with the auger cuttings upon completion of groundwater measurements.

Laboratory Testing: Samples retrieved during the field exploration were returned to the laboratory for observation by the project geotechnical engineer, and were classified in general accordance with the Unified Soil Classification System described in Appendix C. Samples of bedrock were classified in general accordance with the general notes for Rock Classification. At that time, an applicable laboratory-testing program was formulated to determine engineering properties of the subsurface materials. Following the completion of the laboratory testing, the field descriptions were confirmed or modified as necessary, and Boring Logs were prepared. These logs are presented in Appendix A.

Laboratory test results are presented in Appendix B. These results were used for the geotechnical engineering analyses and the development of foundation and earthwork recommendations. Laboratory tests were performed in general accordance with the applicable local or other accepted standards.

Selected soil and bedrock samples were tested for the following engineering properties:

- Water content
- Dry density
- Consolidation/Swell
- Grain size
- Plasticity Index
- Water-soluble sulfates

SITE CONDITIONS

The site is located at the northeast corner of Meridian Road and Rolling Thunder Way in Falcon, Colorado. The site is generally bordered by Meridian Road to the northwest, Rolling Thunder Way/Old Meridian Road to the southwest, and currently undeveloped lots and asphalt-paved private access roads in the other directions. In general, the surrounding area consists of commercial/retail development. At the time of our field exploration, the ground surface at the site was covered with a low to moderate growth of grass and weeds. The site was generally level, with a slight slope downwards to the south. We anticipate that cuts and fills of up to about 1 to 3 feet could be required to bring the site to construction grades and to provide positive site drainage.

SUBSURFACE CONDITIONS

Geology: Surficial geologic conditions at (or in the vicinity of) the site, as mapped by the U.S. Geological Survey (USGS) ([1]Scott, et al, 1976) and ([2]Madole, R.F., 2003), consist of Eolian Sand of Holocene and Pleistocene Age. These materials are typically described as sand, sandy silt, and sandy clay. Bedrock underlying the surface units consists of the Dawson Formation of Paleocene and Upper Cretaceous Age. This formation generally includes sandstone, claystone and conglomerate.

The site is located just east of mapping completed by the Colorado Geological Survey ([3]Hart, 1972) for potentially swelling soil and bedrock. However, areas of "Low Swell Potential" were mapped to the west of the site. Potentially expansive materials in this category generally include bedrock and some surficial soils.

Due to the gently sloping nature of the site, the potential for other geologic hazards at the site is anticipated to be low. Seismic activity in the area is anticipated to be low, and the property should be relatively stable from a structural standpoint. With proper site grading around proposed structures, erosional problems at the site should be reduced.

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[1] Scott, G.R., Taylor, R.B., Epis, R.C., and Wobus, R.A., 1976, ***Geologic Map of the Pueblo 1 Degree x 2 Degree Quadrangle, South-Central Colorado,*** United States Geological Survey, Map MF-775.

[2] Madole, R.F., 2003, ***Geologic Map of the Falcon, NW 7.5 Minute Quadrangle, El Paso County, Colorado,*** United States Geological Survey, Map OF03-08.

[3] Hart, Stephen S., 1972, ***Potentially Swelling Soil and Rock in the Front Range Urban Corridor, Colorado***, Colorado Geological Survey, Sheet 3 of 4.

Soil and Bedrock Conditions: The soils at the site consist of silty to clayey sands, fine to coarse sands, and varying layers of lean clays. Sedimentary claystone bedrock was encountered below the sands/clays at depths ranging from about 13 to 18 feet below existing site grades. The bedrock extended to the depths explored. Other specific information regarding the lithology encountered is noted on the attached Boring Logs.

Field and Laboratory Test Results: Field test results indicate that the sand soils vary from medium dense to dense in relative density. The clay soils are very stiff to hard in consistency. Laboratory test results indicate that the clayey soils and claystone bedrock at the site exhibit low expansive potential when inundated in our laboratory.

Groundwater Conditions: Groundwater was encountered in our building borings immediately after drilling at depths ranging from about 10 to 15 feet below existing site grades. The shallow pavement borings were dry at that time. ***When checked about three weeks later, groundwater was encountered in the deeper borings at depths ranging from about 4 to 7-½ feet below existing site grades.*** The shallow pavement borings remained dry at that time.

Based upon review of U.S. Geological Survey Maps ([4]Hillier, et al, 1980), regional groundwater beneath the project area is expected to be encountered in unconsolidated alluvial deposits or in the Dawson Aquifer at depths generally greater than 20 feet below present ground surface.

Zones of perched and/or trapped groundwater, where not already present, may also occur at times in the subsurface soils overlying bedrock, on top of the bedrock surface or within permeable fractures in the bedrock materials. The location and amount of perched water is dependent upon several factors including hydrologic conditions, type of site development, irrigation demands on or adjacent to the site, fluctuations in water features, seasonal and weather conditions.

The possibility of groundwater fluctuations should be considered when developing design and construction plans for the project.

ENGINEERING RECOMMENDATIONS

Geotechnical Considerations: The site appears suitable for the proposed construction as long as the recommendations included herein are incorporated into the design and construction aspects of the project. Based on our borings, the site should be suitable for the proposed construction, however, the presence of relatively shallow groundwater may impact both the design and construction of the project.

As discussed, groundwater was encountered at the site at depths ranging from about 4 to 7-½ feet below existing site grades. As currently planned the northeast portion of the building will include below-

[4]Hillier, Donald E.; and Hutchinson, E. Carter, 1980, ***Depth to Water Table (1976-1977) in the Colorado Springs-Castle Rock Area, Front Range Urban Corridor, Colorado***, United States Geological Survey, Map I-857-H.

grade maintenance pits (maximum of about 7 feet below planned FFE). ***We recommend construction be limited to excavation depths as high as practical in these areas in order to reduce the potential for water intrusion, as well as to minimize encountering potentially soft/unstable soil conditions during construction.***

We recommend these maintenance pit areas be designed as water-tight structures, designed for buoyancy and hydrostatic pressures. Waterproofing consultants should be contacted for recommendations regarding the design and construction of water-tight below-grade foundations. As an alternative, subsurface drainage systems can be installed to collect subsurface water and maintain dry interior conditions. At a minimum, the drainage system would include installation of a perimeter drain system around and below the foundations of these below grade areas which would empty into the storm sewer or a sump pit where collected water could be discharged via a submersible pump.

Design and construction recommendations for the foundation system and other earth-connected phases of the project are outlined below.

Foundation Design and Construction: Due to the presence of non- to low expansive soils, spread footing foundations are considered acceptable for support of the structure on this site. Based on the borings advanced on the site, we believe that the native soils will be suitable for support of foundations; however, it is possible that soft, unstable, or low-density soils may also be present, particularly for foundations approaching the groundwater level. ***The geotechnical engineer responsible for special inspections should be contacted to observe and evaluate the suitability of the soils beneath foundation excavations at the site, prior to forming for footing construction. If any areas of soft, unstable or low-density soils are observed, removal and recompaction/replacement will be required.***

The following foundation design criteria may be used for the structural design of foundations:

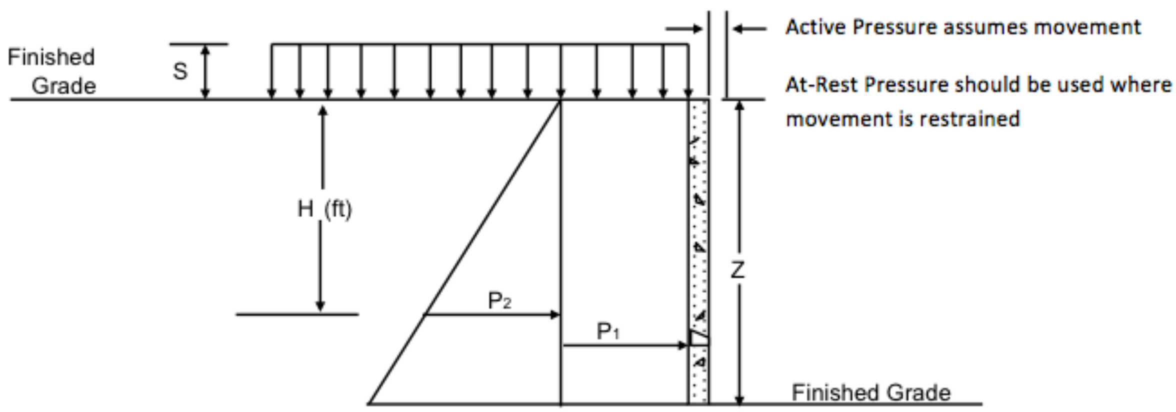
Criteria	Design Value
Bearing Strata	Undisturbed native sand/clay soils or properly compacted fill materials approved by the Geotechnical Engineer
Maximum net allowable bearing pressure[1]	2,000 psf
Min. depth below grade, exterior wall footings[2]	36 inches
Min. depth below grade, interior footings[2]	12 inches
Estimated maximum total foundation movement[3]	1 inch
Estimated maximum differential foundation movement[3]	½ to ¾ inch

1. The design bearing pressure above applies to dead loads plus one-half of design live load conditions. The design bearing pressure may be increased by 1/3 when considering total loads that include wind or seismic conditions.
2. Finished grade is the lowest adjacent grade for perimeter footings and floor level for interior footings.

3. Based on assumed structural loads. Footings should be proportioned to apply relative constant dead load pressure in order to reduce differential movement between adjacent footings.

Foundation movements could occur if water from any source infiltrates the foundation soils; therefore, proper drainage should be provided in the final design and during construction. Failure to maintain proper surface drainage could result in excessive soil-related foundation movement.

Lateral Earth Pressures: Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction, wetting of backfill materials, and/or compaction and the strength of the materials being restrained. Loads that should be considered by the structural engineer on walls are shown below.



Active earth pressure is commonly used for design of freestanding cantilever retaining walls and assumes wall movement. The "at-rest" condition assumes no wall rotation. Walls with unbalanced backfill levels on opposite sides (i.e. basement walls) should be designed for earth pressures at least equal to those indicated in the following table. The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls.

EARTH PRESSURE COEFFICIENTS

Earth pressure conditions	Coefficient for backfill type	Equivalent fluid pressure, pcf	Surcharge pressure P_1, psf	Earth pressure P_2, psf
Active (Ka)	On-site clayey soils - 0.38	45	(0.38)S	(45)H
At-Rest (Ko)	On-site clayey soils - 0.54	65	(0.54)S	(65)H
Passive (Kp)	On-site clayey soils – 2.3	275	---	---

Conditions applicable to the above conditions include:

- for active earth pressure, wall must rotate about base, with top lateral movements 0.01 Z to 0.02 Z, where Z is wall height

- for passive earth pressure, wall must move horizontally to mobilize resistance
- uniform surcharge, where S is surcharge pressure
- in-situ soil backfill weight a maximum of 120 pcf
- horizontal backfill, compacted to at least 95 percent of standard Proctor maximum dry density
- loading from heavy compaction equipment not included
- ***no groundwater acting on wall***
- no safety factor included
- ignore passive pressure in frost zone

Backfill placed against structures may consist of the on-site soils processed to a soil-like consistency with maximum particle sizes on the order of 4 to 6 inches. The design equivalent fluid pressures may be reduced if the imported granular soils are used. To calculate the resistance to sliding, a value of 0.35 may be used as the ultimate coefficient of friction between the footing and the underlying soil. If utilizing passive pressure for resistance, a coefficient of 0.30 should be used.

We recommend a perimeter drain be installed at the foundation level to control the water level behind any basement/below-grade walls. ***If this is not possible or if the below-grade space is being designed to be watertight, then combined hydrostatic and lateral earth pressures should be calculated for lean clay backfill using an equivalent fluid weighing 90 and 100 pcf for active and at-rest conditions, respectively***. These pressures do not include the influence of surcharge, equipment or floor loading, which should be added. Heavy equipment should not operate within a distance closer than the exposed height of retaining walls to prevent lateral pressures more than those provided.

Below-grade Construction: As discussed, groundwater (perched water) was encountered at the site at depths ranging from about 4 to 7-½ feet below existing site grades. As currently planned the northeast portion of the building will include below-grade maintenance pits (maximum of about 7 feet below planned FFE). ***We recommend construction be limited to excavation depths as high as practical in these areas in order to reduce the potential for water intrusion, as well as to minimize encountering potentially soft/loose soil conditions during construction.***

Based on the limited size of the maintenance pits, we believe it is prudent to construct these below-grade areas to be water-tight. This would include waterproofing the foundation and walls of the pits and designing the pits for buoyancy forces and hydrostatic lateral loading conditions below groundwater depth. Waterproofing consultants should be contacted for recommendations regarding the design and construction of water-tight below-grade foundations.

As an alternative, installation of a perimeter drainage system is recommended around the perimeter of these below-grade spaces. The drainage system should include a trench in which a perforated pipe is placed, sloped at a minimum 1/8 inch per foot to a suitable outlet, such as the storm sewer or a sump and pump system.

In our opinion, the drainage system should consist of a minimum 4-inch diameter perforated or slotted pipe, embedded in free-draining gravel, placed in a trench at least 12 inches in width. The edge of the trench should be sloped at a 1:1 slope beginning at the bottom outside edge of the footing. The trench should not be cut vertically at the edge of the footing. Gravel should extend a minimum of 2 to 3 inches beneath the bottom of the pipe and at least 6 inches above the pipe. The gravel should be encapsulated in a filter fabric prior to placement of foundation backfill. A general detail of this system is included herein. If the pits are designed to be water-tight, the drain system would not be required.

Seismic Considerations: Based on the soil conditions encountered in the test holes drilled on the site, we estimate that a Site Class D is appropriate for the site according to the 2009 International Building Code (Table 1613.5.2). This parameter was estimated based on extrapolation of data beyond the deepest depth explored, using methods allowed by the code. Actual shear wave velocity testing/analysis and/or exploration to 100 feet was not performed.

Floor Slab Design and Construction: The existing, non- to low expansive soils at the site are generally considered suitable for support of the floor slab. Some movement of a slab-on-grade floor system is still possible should the subgrade soils become elevated in moisture content. We estimate that total slab movement will be about 1-inch. If movement cannot be tolerated, we should be contacted to provide alternatives for additional subgrade preparation or the use of a structural floor system.

To reduce potential slab movements, the subgrade soils should be prepared as outlined in the "Earthwork" section of this report and adequate surface drainage needs to be maintained.

For structural design of concrete slabs-on-grade, a modulus of subgrade reaction of 100 pounds per cubic inch (pci) may be used for floors supported on the on-site soils. Additional floor slab design and construction recommendations are as follows:

- Positive separations and/or isolation joints should be provided between slabs and all foundations, columns or utility lines to allow independent movement.

- Control joints should be provided in slabs to control the location and extent of cracking.

- A minimum 2-inch void space should be constructed above or below non-bearing partition walls placed on the floor slab. If this void space is constructed as a slip joint at the top of the wall, some minor drywall cracking could occur due to slab movement, prior to mobilization of this joint. Special framing details should be provided at doorjambs and frames within partition walls to avoid potential distortion. Partition walls should be isolated from suspended ceilings.

- Interior trench backfill placed beneath slabs should be compacted in accordance with recommended specifications outlined below.

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

- Floor slabs should not be constructed on frozen subgrade.

- Other design and construction considerations, as outlined in Section 302.1R of the *ACI Design Manual*, are recommended.

Private Pavement Thickness Design and Construction: Design of private pavements for the project is based on the procedures outlined in the 1993 *Guideline for Design of Pavement Structures* by the American Association of State Highway and Transportation Officials (AASHTO). The AASHTO design method takes into account several variables, including subgrade soil and traffic conditions. We assume that there will be no new pavements in the public right-of-way. If public roadway construction is to be included in the project, additional geotechnical investigation and a formal pavement design may be required for those improvements.

- **Subgrade Soil:** The on-site sandy and clayey soils are considered to generally provide good to poor pavement support, respectively. We estimated a design R-value of 5 for flexible pavement (asphalt) thickness design based on the properties of the poorer clayey soils. Likewise, modulus of subgrade reaction (K-value) of 100 pounds per cubic inch (pci) was used for design of rigid concrete pavements.

- **Assumed Traffic:** We assume that pavements associated with the project will include private drive lanes, driveways, fire lanes, and surface parking for automobiles and light trucks. We assume that private pavements will be surfaced with either asphalt concrete or Portland cement concrete. Any improvements to adjacent public roadways will need to be designed and constructed according to the governing standards.

  Based on our experience with similar projects, the following traffic criteria were used for determining pavement thicknesses using a design life of 20 years:

  - Driveways and parking stalls - maximum daily traffic of 1,000 cars per day (equivalent single-axle loads, ESAL's of 22,000)
  - Main site access drives and fire lanes – up to 5 trips/day by single-axle delivery trucks per day, 1 combined-axle truck per day and 1 trash truck per day, plus maximum daily traffic of 1,000 cars per day (73,000 ESAL's)

The owner should review these assumptions, and we should be contacted to confirm or modify these resulting pavement sections, if needed.

- **Pavement Sections:** For flexible pavement design a drainage coefficient of 1.0, a terminal serviceability index of 2.0, and an inherent reliability of 85 percent were used. Using, the appropriate ESAL values, environmental criteria and other factors, the design structural numbers (SN) of the pavement sections were determined on the basis of the 1993 AASHTO design equation.

  In addition to the flexible pavement design analyses, a rigid pavement design analysis was completed based upon AASHTO design procedures. Along with soil and traffic conditions, rigid pavement design is based on the Modulus of Rupture of the concrete, and other factors previously outlined. A modulus of rupture of 600 psi (working stress 450 psi) was used for pavement concrete. The rigid pavement thickness for each traffic category was determined on the basis of the AASHTO design equation.

  We have considered full depth-asphalt paving, a composite section with asphalt concrete over aggregate base course, and full depth rigid concrete sections. Alternatives for flexible and rigid pavements are summarized for each traffic area as follows:

Traffic Area	Alternative	Private Pavement Thickness (Inches)		
		Asphalt Concrete (AC)	Aggregate Base Course (ABC)	Portland Cement Concrete (PCC)
Automobile Parking and Standard-Duty Automobile and Light Truck Parking Only	A	5-½	--	--
	B	4	6	--
	C	--	--	5
Main Access Drives, and Heavy-Duty areas Private Drives, Fire Lanes, Delivery truck access	A	6-½	--	--
	B1	4	9	--
	B2	4-½	7	--
	B3	5	6	--
	C	--	--	6

  A minimum 6-inch thickness of Portland cement concrete pavement is recommended at the location of dumpsters where trash trucks park and load, and should be considered in other areas with heavy truck traffic. Each alternative should be investigated with respect to current material availability and economic conditions.

- **Subgrade Preparation:** We recommend the pavement areas be rough graded and then thoroughly proof rolled with a loaded tandem axle dump truck, water truck, or other heavy equipment approved by the observing engineer prior to final grading and paving. Particular attention should be paid to high traffic areas that were rutted and disturbed earlier and to areas where backfilled trenches are located. Areas where unsuitable conditions are located should be repaired by removing and replacing the materials with properly compacted engineered fills.

At a minimum, in order to provide a more uniform subgrade for site pavements, we recommend that all pavements be constructed on a minimum of 12 inches of properly moisture conditioned and recompacted on-site soils. Confirmation of the moisture content and compaction level of the subgrade soils should be confirmed just prior to paving.

- **Pavement Materials:** Aggregate base course (if used on the site) should consist of a blend of sand and gravel which meets strict specifications for quality and gradation. Use of materials meeting Colorado Department of Transportation (CDOT) Class 5 or 6 specifications is recommended for base course. Aggregate base course should be placed in lifts not exceeding 6 inches and compacted to a minimum of 95 percent of the standard Proctor density (ASTM D698).

  Asphalt concrete should be composed of a mixture of aggregate, filler and additives (if required) and approved bituminous material. The asphalt concrete should conform to approved mix designs stating the Hveem properties, optimum asphalt content, and job mix formula and recommended mixing and placing temperatures. Aggregate used in asphalt concrete should meet particular gradations. Material meeting CDOT Grading S or SX specifications or equivalent is recommended for asphalt concrete. Mix designs should be submitted prior to construction to verify their adequacy. Asphalt material should be placed in maximum 3-inch lifts and compacted within a range of 92 to 96 percent of the theoretical maximum (Rice) density (ASTM D2041) or 95 percent Hveem density (ASTM D1560, D1561).

  Where rigid pavements are used, the concrete should meet CDOT Class P requirements and be obtained from an approved mix design with the following minimum properties:

  - Modulus of Rupture @ 28 days .... 600 psi minimum
  - Strength Requirements .... ASTM C94
  - Cement Type .... Type II Portland
  - Entrained Air Content .... 6 to 8%
  - Concrete Aggregate .... ASTM C33 and CDOT Section 703

  Concrete should be deposited by truck mixers or agitators and placed a maximum of 90 minutes from the time the water is added to the mix. Other specifications outlined by CDOT should be followed.

  Longitudinal and transverse joints should be provided as needed in concrete pavements for expansion/contraction and isolation. The location and extent of joints should be based upon the final pavement geometry. Sawed joints should be cut within 24 hours of concrete placement and should be a minimum of 25 percent of slab thickness plus 1/4 inch. All joints should be sealed to prevent entry of foreign material and doweled where necessary for load transfer.

- **Compliance:** Recommendations for pavement design and construction presented depend upon compliance with recommended material specifications. To assess compliance, observation and testing should be performed under the observation of the geotechnical engineer.

- **Pavement Performance:** Future performance of pavements constructed on the subgrade at this site will be dependent upon several factors, including:

  - Maintaining stable moisture content of the subgrade soils.
  - Providing for a planned program of preventative maintenance.

  The performance of all pavements can be enhanced by minimizing excess moisture, which can reach the subgrade soils. The following recommendations should be considered at minimum:

  - Site grading at a minimum 2 percent grade onto or away from pavements.
  - Water should not be allowed to pond behind curbs.
  - Compaction of any utility trenches for landscaped areas to the same criteria as the pavement subgrade.
  - Sealing all landscaped areas in or adjacent to pavements to minimize or prevent moisture migration to subgrade soils.
  - Placing compacted backfill against the exterior side of curb and gutter.
  - Placing curb, gutter and/or sidewalk directly on subgrade soils without the use of base course materials.

  Preventative maintenance should be planned and provided for an ongoing pavement management program in order to enhance future pavement performance. Preventative maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment.

  Preventative maintenance consists of both localized maintenance (e.g. crack sealing and patching) and global maintenance (e.g. surface sealing). Preventative maintenance is usually the first priority when implementing a planned pavement maintenance program and provides the highest return on investment for pavements.

Earthwork:

General Considerations: The following presents recommendations for site preparation, excavation, subgrade preparation and placement of engineered fills on the project.

All earthwork on the project should be observed and evaluated by the geotechnical engineer contracted for special inspection services. The evaluation of earthwork should include observation and testing of engineered fills, subgrade preparation, foundation bearing soils and other geotechnical conditions exposed during the construction of the project.

Site Preparation: Strip and remove existing vegetation and other deleterious materials from proposed building and pavement areas. All exposed surfaces should be free of mounds and depressions that could prevent uniform compaction. Stripped materials consisting of vegetation and organic materials should be wasted from the site or used to revegetate landscaped areas or exposed slopes after completion of grading operations.

The site should be initially graded to create a relatively level surface to receive fill and to provide for a relatively uniform thickness of fill beneath proposed building structures. All exposed areas that will receive fill, once properly cleared, should be scarified to a minimum depth of 8 to 12 inches, conditioned to near optimum moisture content and compacted.

Perched groundwater and/or soft subgrade soils may be encountered in foundation excavations. Stabilization of these materials will be required prior to foundation construction, if encountered. Stabilization would likely include placing or “crowding” larger-sized crushed gravel or recycled concrete into the high moisture content, weak clay soils in order to provide for a stable base. We estimate that the amount of aggregate required to build a stable base may be on the order of 18 to 24 inches in thickness. The thickness of this gravel layer may be reduced using a layer bi-axial (or trixial) geogrid reinforcement below the gravel. The removed clays should be replaced with engineered fill consisting of imported granular soils. Engineered fills should be placed as described below. ***The geotechnical engineer contracted for special inspection services should be contacted during excavation to provide further guidance based on actual site conditions.***

It is anticipated that excavations for the proposed construction can be accomplished with conventional, heavy-duty earthmoving equipment. The stability of the site subgrade may also be affected by precipitation, repetitive construction traffic, or other factors. If unstable conditions are encountered or develop during construction, workability may be improved by scarifying and aeration. Overexcavation of wet zones and replacement with granular materials may be necessary.

Subgrade Preparation: The engineer should evaluate foundation subgrade soils in order to confirm or modify our recommendations for the bearing soils. All subgrade soils below new fill, slab-on-grade floors, exterior PCC flatwork, and pavements should be scarified to a minimum depth of 12 inches, moisture conditioned and compacted as discussed below just prior to construction of these elements.

Fill Materials: Clean on-site soils or approved imported materials may be used as fill material. Imported soils (if required) should conform to the following:

Gradation	Percent finer by weight (ASTM C136)
6”	100
3"	70-100
No. 4 Sieve	50-100
No. 200 Sieve	20-50

- Liquid Limit .... 35 (max)
- Plasticity Index .... 15 (max)
- Maximum expansive potential (%)* 1.0

*Measured on a sample compacted to approximately 95 percent of the ASTM D698 maximum dry density at about optimum water content. The sample is confined under a 500 psf surcharge and submerged.

Compaction Requirements: Engineered fill for site development and grading should be placed and compacted in horizontal lifts, using equipment and procedures that will produce recommended moisture contents and densities throughout the lift. Fill soils should be placed and compacted according to the following criteria:

Item	Description
Fill Lift Thickness	8 to 12 inches or less in loose thickness
Compaction Requirements	Clayey soils: 95% of standard Proctor dry density (ASTM D698) Non-plastic sands: 95% of modified Proctor dry density (ASTM 1557)
Moisture Content	Clayey soils: Optimum to +4% above optimum moisture content Optimum to +2% above optimum in pavement areas Non-plastic sands: -2% below to +2% above optimum

At a minimum, fill soils placed for any sub-excavation fill, site grading, utility trench backfill and foundation backfill should be tested to confirm that earthwork is being performed according to our recommendations and project specifications. Subsequent lifts of fill should not be placed on previous lifts if the moisture content or dry density is determined to be less than specified.

Excavation and Trench Construction: Caving sand soils may be encountered in excavations during construction. The individual contractor(s) should be made responsible for designing and constructing stable, temporary excavations as needed to maintain stability of both the excavation sides and bottom. All excavations should be sloped or shored in the interest of safety following local and federal regulations, including current OSHA excavation and trench safety standards.

The soils to be penetrated by the proposed excavations may vary significantly across the site. The contractor should verify that similar conditions exist throughout the proposed area of excavation. If different subsurface conditions are encountered at the time of construction, the actual conditions should be evaluated to determine any excavation modifications necessary to maintain safe conditions.

As a safety measure, it is recommended that all vehicles and soil piles be kept to a minimum lateral distance from the crest of the slope equal to no less than the slope height. The exposed slope face should be protected against the elements.

As discussed, shallow groundwater was encountered at depths ranging from 4 to 7-½ feet below existing site grades. Where excavations penetrate the groundwater, temporary dewatering will be required during excavation, foundation work and backfilling operations for proper construction. Pumping from sumps may be utilized to control water within the excavations.

Additional Design and Construction Considerations:

Exterior Slab Design and Construction: Flatwork will be subject to movement, particularly when bearing on backfill soils adjacent to the foundation and underground utility lines. The amount of movement will be related to the compactive effort used when the fill soils are placed and future wetting of the subgrade soils. The potential for damage would be greatest where exterior slabs are constructed adjacent to the building or other structural elements.

To reduce the potential for damage, we recommend:

- exterior slabs in critical areas be supported on a zone of recompacted soils.
- Supporting of flatwork at building entrances and other critical areas on haunches attached by the building foundations.
- placement of effective control joints on relatively close centers and isolation joints between slabs and other structural elements.
- provision for adequate drainage in areas adjoining the slabs.
- use of designs which allow vertical movement between the exterior slabs and adjoining structural elements.

Underground Utility Systems: All underground piping within or near the proposed structure should be designed with flexible couplings, so minor deviations in alignment do not result in breakage or distress. Utility knockouts in foundation walls should be oversized to accommodate differential movements.

It is strongly recommended that a representative of the geotechnical engineer provide full-time observation and compaction testing of trench backfill within building and pavement areas.

Concrete Corrosion Protection: Water-soluble sulfate concentrations of select samples ranged up to 400 parts per million (ppm). ACI rates the measured concentrations as being a low to moderate risk of concrete sulfate attack. Based on these results, Type II Portland cement (or equivalent) should be used for concrete on and below grade. Project concrete should be designed in accordance with the provisions of the *ACI Design Manual*, Section 318, Chapter 4.

Surface Drainage: All grades must be adjusted to provide positive drainage away from the structures during construction and maintained throughout the life of the proposed project. Infiltration of water into utility or foundation excavations must be prevented during construction. Landscaped irrigation adjacent to the foundation system should be minimized or eliminated.

Water permitted to pond near or adjacent to the perimeter of the structure (either during or post-construction) can result in significantly higher soil movements than those discussed in this report. As a result, any estimations of potential movement described in this report cannot be relied upon if positive drainage is not obtained and maintained, and water is allowed to infiltrate the fill and/or subgrade.

Exposed ground (unpaved, landscaped areas) should be sloped at a minimum of 5 to 10 percent grade for at least 5 feet beyond the perimeter of the building/structure, where possible. Swales sidewalk chases, area drains may be required to facilitate drainage. Backfill against footings, exterior walls and in utility and sprinkler line trenches should be well compacted and free of all construction debris to reduce the possibility of moisture infiltration. After building construction and prior to project completion, we recommend that verification of final grading be performed to document that positive drainage, as described above, has been achieved.

Flatwork will be subject to post construction movement due to soil heave/settlement and frost action. Maximum grades practical should be used for paving and flatwork to prevent areas where water can pond. In addition, allowances in final grades should take into consideration post-construction movement of flatwork, particularly if such movement would be critical. Where paving or flatwork abuts the structure, care should be taken that joints are properly sealed and maintained to prevent the infiltration of surface water.

Planters located adjacent to the structure should preferably be self-contained. Landscaping in close proximity to the foundation should be limited to well-maintained and timed drip irrigation only. Sprinkler mains and spray heads should be located a minimum of 5 feet away from the building line.

Roof drains should discharge on pavements or be extended away from the structure a minimum of 5 feet through the use of splash blocks or downspout extensions. A preferred alternative is to have the roof drains discharge to storm sewers by solid pipe or daylighted to a detention pond or other appropriate outfall.

GENERAL COMMENTS

PCH should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. PCH should also be retained to provide testing and observation during the excavation, grading, foundation and construction phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project 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.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes are planned in the nature, design, or location of the project as outlined in this report, the conclusions and recommendations contained in this report shall not be considered valid unless PCH reviews the changes, and either verifies or modifies the conclusions of this report in writing.

APPENDIX A

BORING LOCATION DIAGRAM
BORING LOGS

1
PROPOSED BORING LOCATIONS

BORING LOCATION DIAGRAM
LES SCHWAB TIRE CENTER
FALCON, COLORADO
PCH PROJECT NO. 12.298.16

PCH
Pickering, Cole, & Hivner, LLC
1070 W. 124th Ave., Suite 300
Westminster, CO 80234
(303) 996-2999

Pickering, Cole, & Hivner
1070 W. 124 Avenue, Suite 300
Westminster, CO. 80234
Telephone: 303.996.2999

BORING NUMBER 1

CLIENT SFP-E, LLC c/o Galloway

PROJECT NAME Les Schwab Tire Center - Falcon, CO

PROJECT NUMBER 12.298.16

PROJECT LOCATION Meridian Rd. & Rolling Thunder Way

DATE STARTED 8/17/16 **COMPLETED** 8/17/16

GROUND SURFACE ELEV. Not Provided **PROPOSED ELEV.** Not Provided

DRILLING CONTRACTOR Elite Drilling

SURFACE CONDITIONS Low to moderate growth of grass and weeds

DRILLING METHOD CME-55/Solid Stem Auger

GROUND WATER LEVELS:

HAMMER TYPE Automatic

∇ **DURING DRILLING** 15.00 ft

LOGGED BY SM **CHECKED BY** AG

▼ **AFTER DRILLING** 7.50 ft - 9/6/16

GRAPHIC LOG (depth, ft)	MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
0–7	**FINE to COARSE SAND with SILT**, varies trace clay, brown, light brown, white, moist, medium dense	5	SW-SM	CB	100	30 / 12	5.8	121	
7–17	**CLAYEY SAND**, grey to bluish-grey, moist to wet, medium dense (▼ 7.5 ft)	10	SC	CB	100	38 / 12	11.1	123	+0.3/500
	(∇ 15 ft)	15	SC	CB	100	46 / 12	12.1	124	
17–35	**CLAYSTONE BEDROCK**, varies sandy, brown, dark brown, grey, calcareous, moist to wet, very hard	20	-	CB	100	50 / 7	11.7	125	
		25	-	CB	100	50 / 6	10.1	127	
		30	-	CB	100	50 / 4	11.5	126	
		35	-	CB	100	50 / 6	15.6	117	

Approximate bottom of borehole at 35.0 feet.

BORING NUMBER 2

Pickering, Cole, & Hivner
1070 W. 124 Avenue, Suite 300
Westminster, CO. 80234
Telephone: 303.996.2999

CLIENT SFP-E, LLC c/o Galloway
PROJECT NAME Les Schwab Tire Center - Falcon, CO
PROJECT NUMBER 12.298.16
PROJECT LOCATION Meridian Rd. & Rolling Thunder Way
DATE STARTED 8/17/16 **COMPLETED** 8/17/16
GROUND SURFACE ELEV. Not Provided **PROPOSED ELEV.** Not Provided
DRILLING CONTRACTOR Elite Drilling
SURFACE CONDITIONS Low to moderate growth of grass and weeds
DRILLING METHOD CME-55/Solid Stem Auger
GROUND WATER LEVELS:
HAMMER TYPE Automatic
▽ **DURING DRILLING** 10.00 ft
LOGGED BY SM **CHECKED BY** AG
▼ **AFTER DRILLING** 7.50 ft - 9/6/16

GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
	CLAYEY SAND, varies to Silty Sand, dark brown, light brown, white, grey, calcareous, moist to wet, medium dense to dense	0							
			SC	CB	100	23 / 12	6.9	126	-0.2/200
		5	SM	CB	100	25 / 12	4.1	117	
	▼								
	▽	10	SC	CB	100	50 / 9	8.3	134	
13	**CLAYSTONE BEDROCK**, varies sandy, grey to bluish-grey, moist, hard to very hard								
		15	-	CB	100	50 / 9	10.9	119	+0.6/1000
		20	-	CB	100	50 / 5	12.2	126	
25		25	-	CB	100	50 / 3	10.7	128	

Approximate bottom of borehole at 25.0 feet.

Pickering, Cole, & Hivner
1070 W. 124 Avenue, Suite 300
Westminster, CO. 80234
Telephone: 303.996.2999

BORING NUMBER 3

CLIENT SFP-E, LLC c/o Galloway
PROJECT NAME Les Schwab Tire Center - Falcon, CO
PROJECT NUMBER 12.298.16
PROJECT LOCATION Meridian Rd. & Rolling Thunder Way
DATE STARTED 8/17/16 **COMPLETED** 8/17/16
GROUND SURFACE ELEV. Not Provided **PROPOSED ELEV.** Not Provided
DRILLING CONTRACTOR Elite Drilling
SURFACE CONDITIONS Low to moderate growth of grass and weeds
DRILLING METHOD CME-55/Solid Stem Auger
GROUND WATER LEVELS:
HAMMER TYPE Automatic
▽ **DURING DRILLING** 11.00 ft
LOGGED BY SM **CHECKED BY** AG
▼ **AFTER DRILLING** 5.00 ft - 9/6/16

GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
	SILTY to CLAYEY SAND, brown, grey to bluish-grey, moist, medium dense to dense	0							
	▼	5	SM	CB	100	25 / 12	9.5	118	
		10	SM	CB	100	50 / 12	9.5	127	
	▽								
13	**CLAYSTONE BEDROCK**, varies sandy, grey to bluish-grey, moist, very hard								
		15	-	CB	100	50 / 6	9.4	123	+0.4/1000
		20	-	CB	100	50 / 6	11.1	125	
25		25	-	CB	100	50 / 4	10.5	123	

Approximate bottom of borehole at 25.0 feet.

Pickering, Cole, & Hivner
1070 W. 124 Avenue, Suite 300
Westminster, CO. 80234
Telephone: 303.996.2999

BORING NUMBER 4

CLIENT SFP-E, LLC c/o Galloway
PROJECT NAME Les Schwab Tire Center - Falcon, CO
PROJECT NUMBER 12.298.16
PROJECT LOCATION Meridian Rd. & Rolling Thunder Way
DATE STARTED 8/17/16 **COMPLETED** 8/17/16
GROUND SURFACE ELEV. Not Provided **PROPOSED ELEV.** Not Provided
DRILLING CONTRACTOR Elite Drilling
SURFACE CONDITIONS Low to moderate growth of grass and weeds
DRILLING METHOD CME-55/Solid Stem Auger
GROUND WATER LEVELS:
HAMMER TYPE Automatic
▽ **DURING DRILLING** 11.00 ft
LOGGED BY SM **CHECKED BY** AG
▼ **AFTER DRILLING** 4.00 ft - 9/6/16

GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
	CLAYEY SAND, dark brown, moist, medium dense	0							
	▼	5	SC	CB	100	29 / 12	9.8	117	
7	**LEAN CLAY with SAND**, grey to bluish-grey, moist, very stiff to hard								
		10	CL	CB	100	32 / 12	10.7	122	+1.8/500
	▽								
		15	CL	CB	100	50 / 8	10.6	117	+0.1/1000
18	**CLAYSTONE BEDROCK**, varies sandy, brown, grey to bluish-grey, olive, dry to moist, hard to very hard								
		20	-	CB	100	50 / 6	11.1	125	
		25	-	CB	100	50 / 3	10.8	125	
		30	-	CB	100	50 / 9	18.1	112	
35		35	-	CB	100	50 / 3	10.9	121	

Approximate bottom of borehole at 35.0 feet.

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Telephone: 303.996.2999

BORING NUMBER P1

CLIENT SFP-E, LLC c/o Galloway
PROJECT NAME Les Schwab Tire Center - Falcon, CO
PROJECT NUMBER 12.298.16
PROJECT LOCATION Meridian Rd. & Rolling Thunder Way
DATE STARTED 8/17/16 **COMPLETED** 8/17/16
GROUND SURFACE ELEV. Not Provided **PROPOSED ELEV.** Not Provided
DRILLING CONTRACTOR Elite Drilling
SURFACE CONDITIONS Low to moderate growth of grass and weeds
DRILLING METHOD CME-55/Solid Stem Auger
GROUND WATER LEVELS:
HAMMER TYPE Automatic
DURING DRILLING None
LOGGED BY SM **CHECKED BY** AG
AFTER DRILLING None - 9/6/16

GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
		0							
3	**SILTY SAND**, brown, light brown, white, tan, dry to moist, medium dense		SM	CB	100	20 / 12	4.6	122	
5	**SANDY LEAN CLAY**, bluish-grey, dry to moist, very stiff	5	CL	CB	100	34 / 12	4.6	116	

Approximate bottom of borehole at 5.0 feet.

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Westminster, CO. 80234
Telephone: 303.996.2999

BORING NUMBER P2

CLIENT SFP-E, LLC c/o Galloway
PROJECT NAME Les Schwab Tire Center - Falcon, CO
PROJECT NUMBER 12.298.16
PROJECT LOCATION Meridian Rd. & Rolling Thunder Way
DATE STARTED 8/17/16 **COMPLETED** 8/17/16
GROUND SURFACE ELEV. Not Provided **PROPOSED ELEV.** Not Provided
DRILLING CONTRACTOR Elite Drilling
SURFACE CONDITIONS Low to moderate growth of grass and weeds
DRILLING METHOD CME-55/Solid Stem Auger
GROUND WATER LEVELS:
HAMMER TYPE Automatic
DURING DRILLING None
LOGGED BY SM **CHECKED BY** AG
AFTER DRILLING None - 9/6/16

GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
		0							
2	**SANDY LEAN CLAY**, dark brown, grey to bluish-grey, moist								
	SILTY SAND, white, tan, dry to moist, medium dense		SM	CB	100	23 / 12	8.7	115	-0.1/200
5		5	SM	CB	100	18 / 12	12.1	121	

Approximate bottom of borehole at 5.0 feet.

APPENDIX B

LABORATORY TEST RESULTS

Pickering, Cole, & Hivner
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Telephone: 303.996.2999

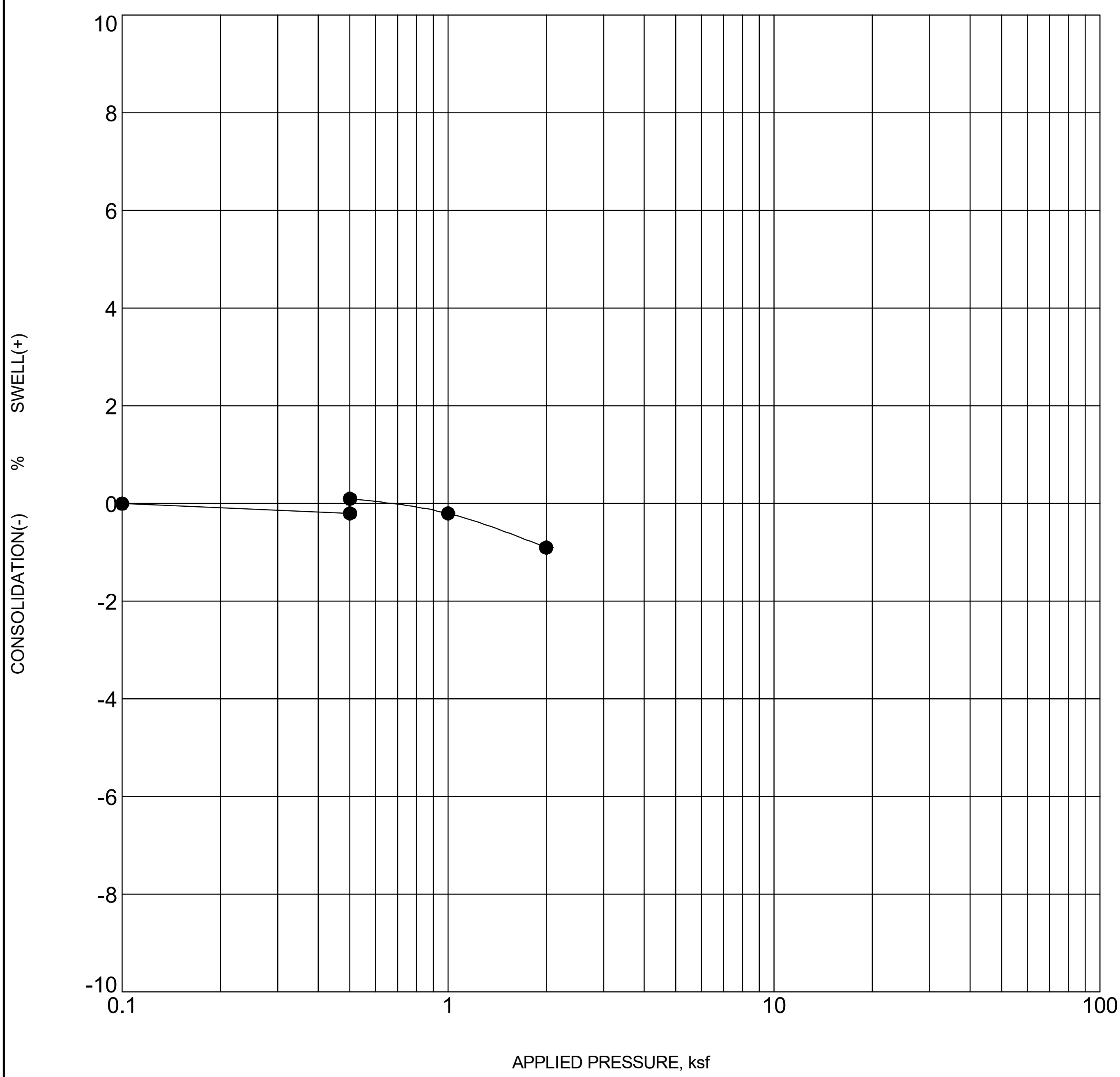
SWELL/CONSOLIDATION TEST

CLIENT SFP-E, LLC c/o Galloway

PROJECT NAME Les Schwab Tire Center - Falcon, CO

PROJECT NUMBER 12.298.16

PROJECT LOCATION Meridian Rd. & Rolling Thunder Way



BOREHOLE	DEPTH	Classification	γ_d	MC%
● 1	9.0	CLAYEY SAND	123	11

Note: Water Added to Sample at 500 psf.

Date: 9/6/16

Pickering, Cole, & Hivner
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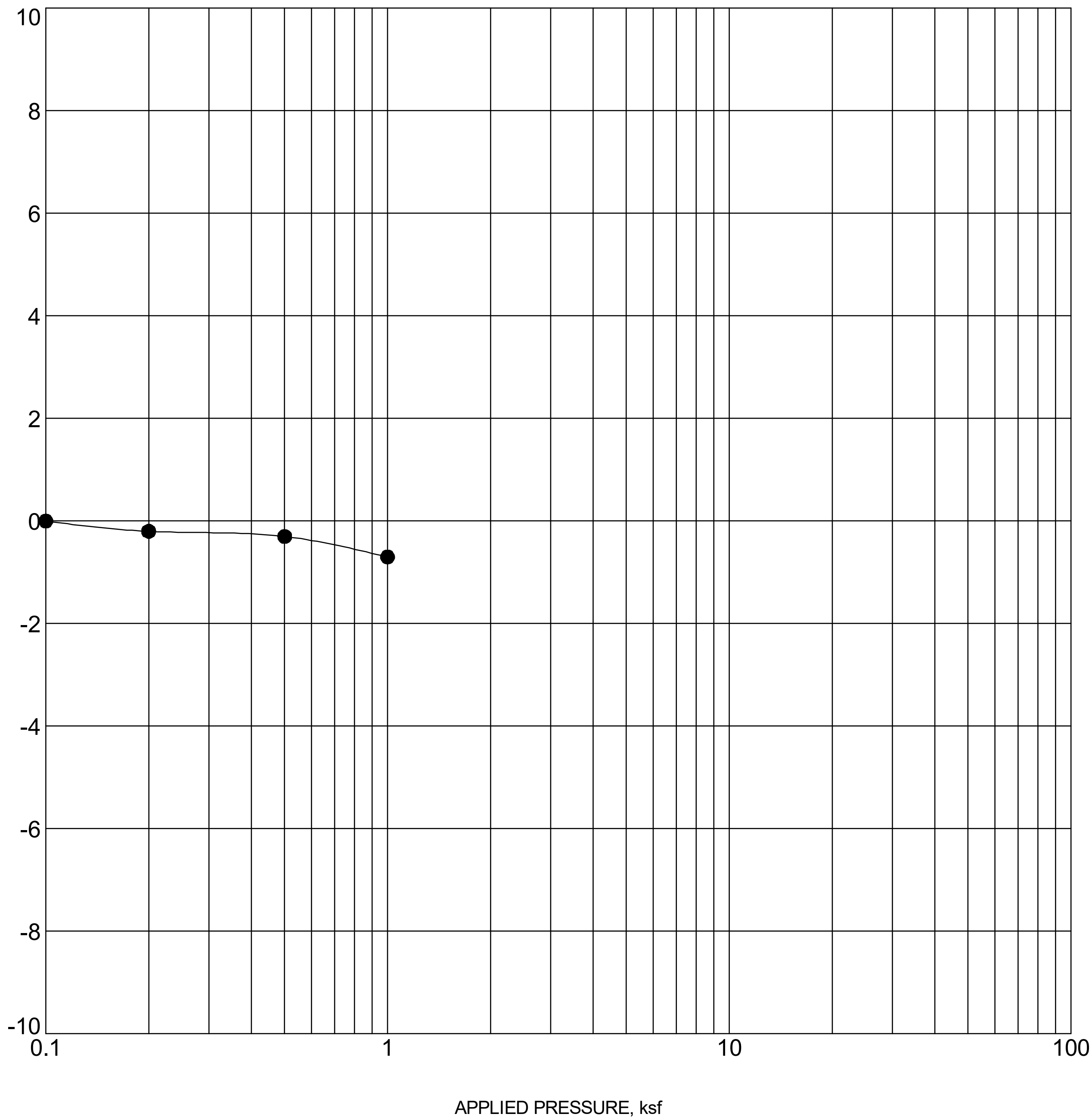
SWELL/CONSOLIDATION TEST

CLIENT SFP-E, LLC c/o Galloway
PROJECT NAME Les Schwab Tire Center - Falcon, CO
PROJECT NUMBER 12.298.16
PROJECT LOCATION Meridian Rd. & Rolling Thunder Way



BOREHOLE	DEPTH	Classification	γ_d	MC%
● 2	2.0	CLAYEY SAND	126	7

Note: Water Added to Sample at 200 psf.

Date: 9/6/16

Pickering, Cole, & Hivner
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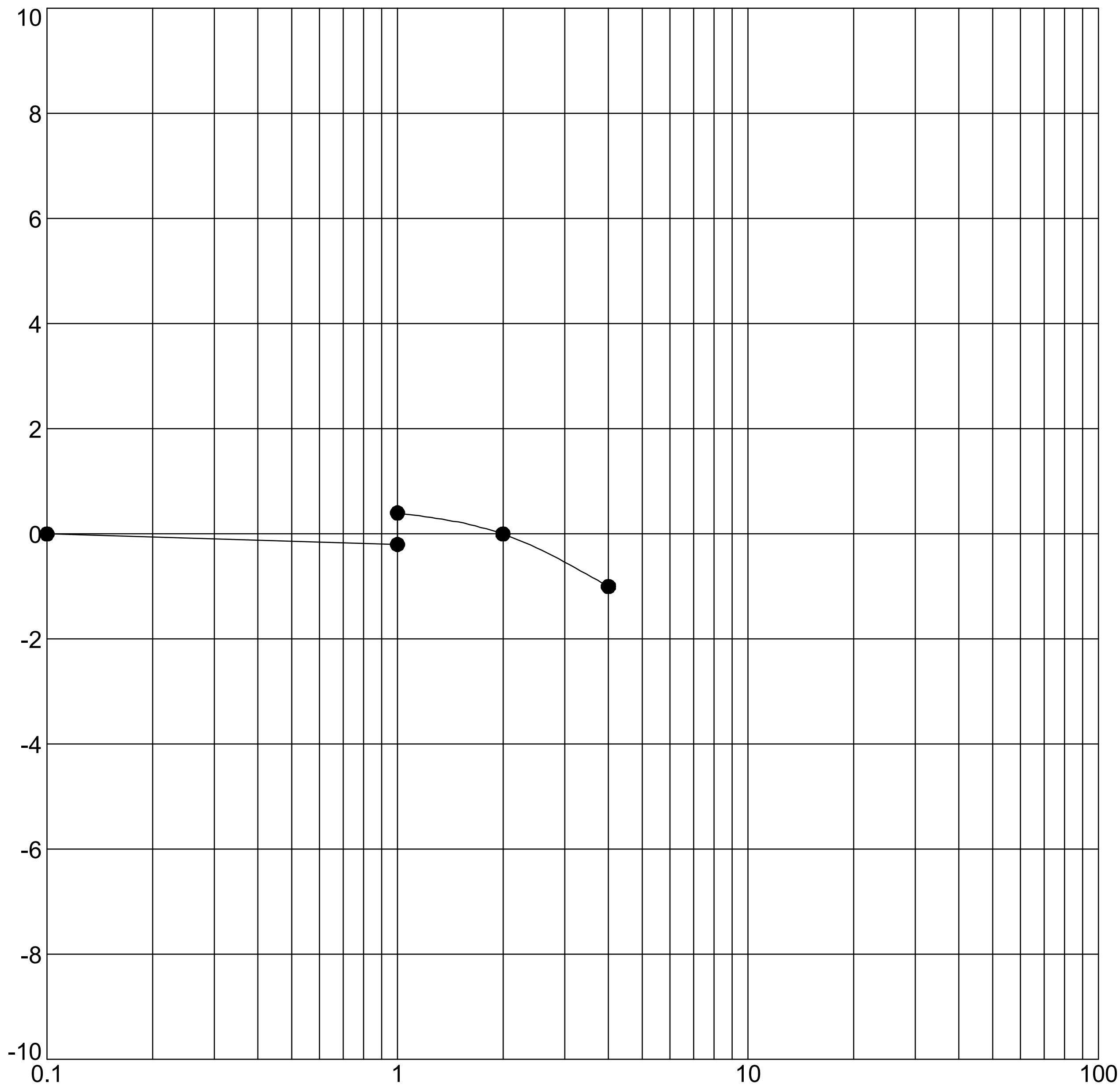
Westminster, CO. 80234
Telephone: 303.996.2999

SWELL/CONSOLIDATION TEST

CLIENT SFP-E, LLC c/o Galloway
PROJECT NAME Les Schwab Tire Center - Falcon, CO
PROJECT NUMBER 12.298.16
PROJECT LOCATION Meridian Rd. & Rolling Thunder Way



BOREHOLE	DEPTH	Classification	γ_d	MC%
● **2**	**14.0**	**CLAYSTONE BEDROCK**	**119**	**11**

Note: Water Added to Sample at 1000 psf. **Date: 9/6/16**

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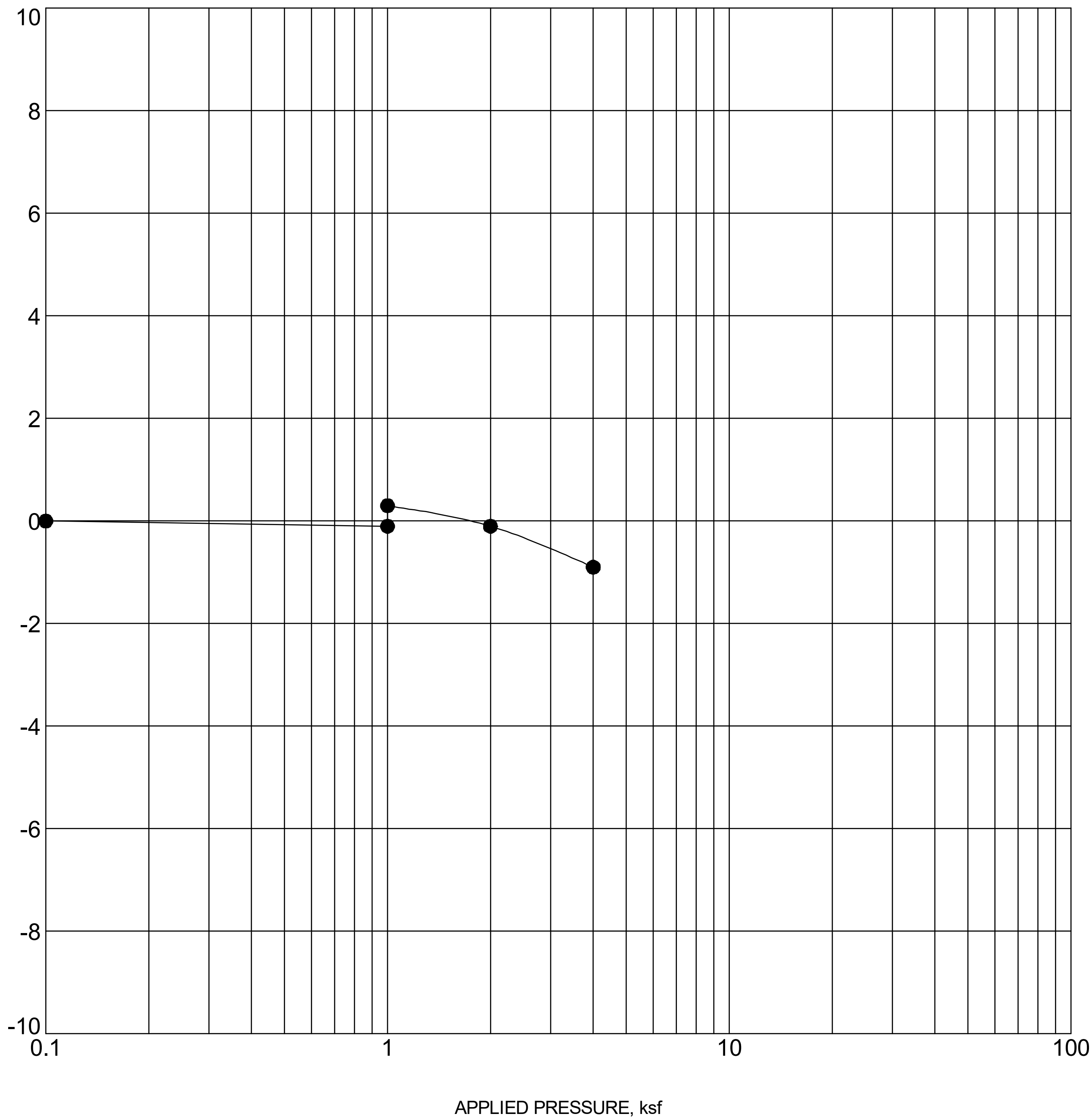
SWELL/CONSOLIDATION TEST

CLIENT SFP-E, LLC c/o Galloway

PROJECT NAME Les Schwab Tire Center - Falcon, CO

PROJECT NUMBER 12.298.16

PROJECT LOCATION Meridian Rd. & Rolling Thunder Way



BOREHOLE	DEPTH	Classification	γ_d	MC%
● 3	14.0	**CLAYSTONE BEDROCK**	123	9

Note: Water Added to Sample at 1000 psf.

Date: 9/6/16

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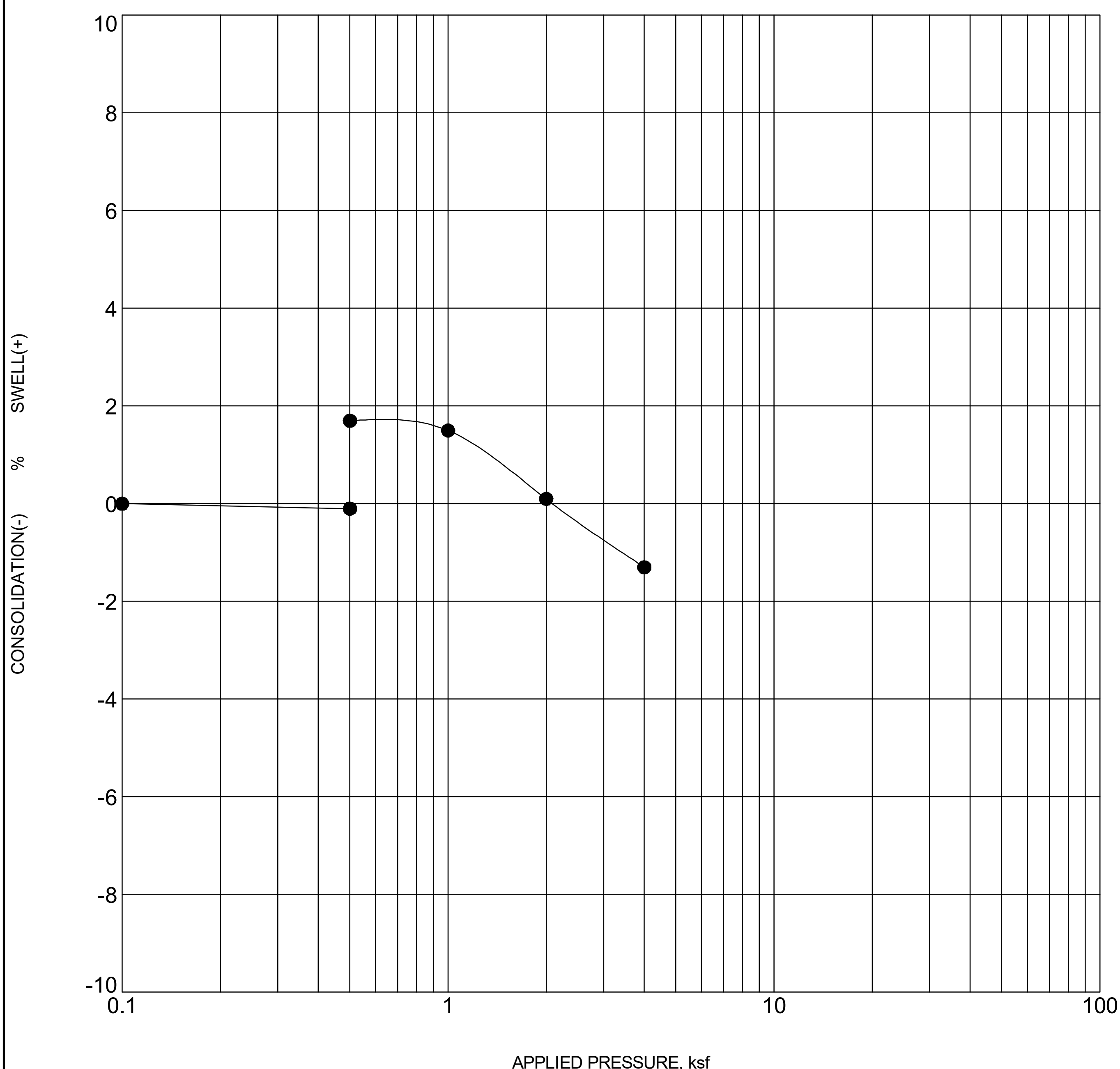
SWELL/CONSOLIDATION TEST

CLIENT SFP-E, LLC c/o Galloway

PROJECT NAME Les Schwab Tire Center - Falcon, CO

PROJECT NUMBER 12.298.16

PROJECT LOCATION Meridian Rd. & Rolling Thunder Way



BOREHOLE	DEPTH	Classification	γ_d	MC%
● **4**	**9.0**	**SANDY LEAN CLAY(CL)**	**122**	**11**

Note: Water Added to Sample at 500 psf.

Date: 9/6/16

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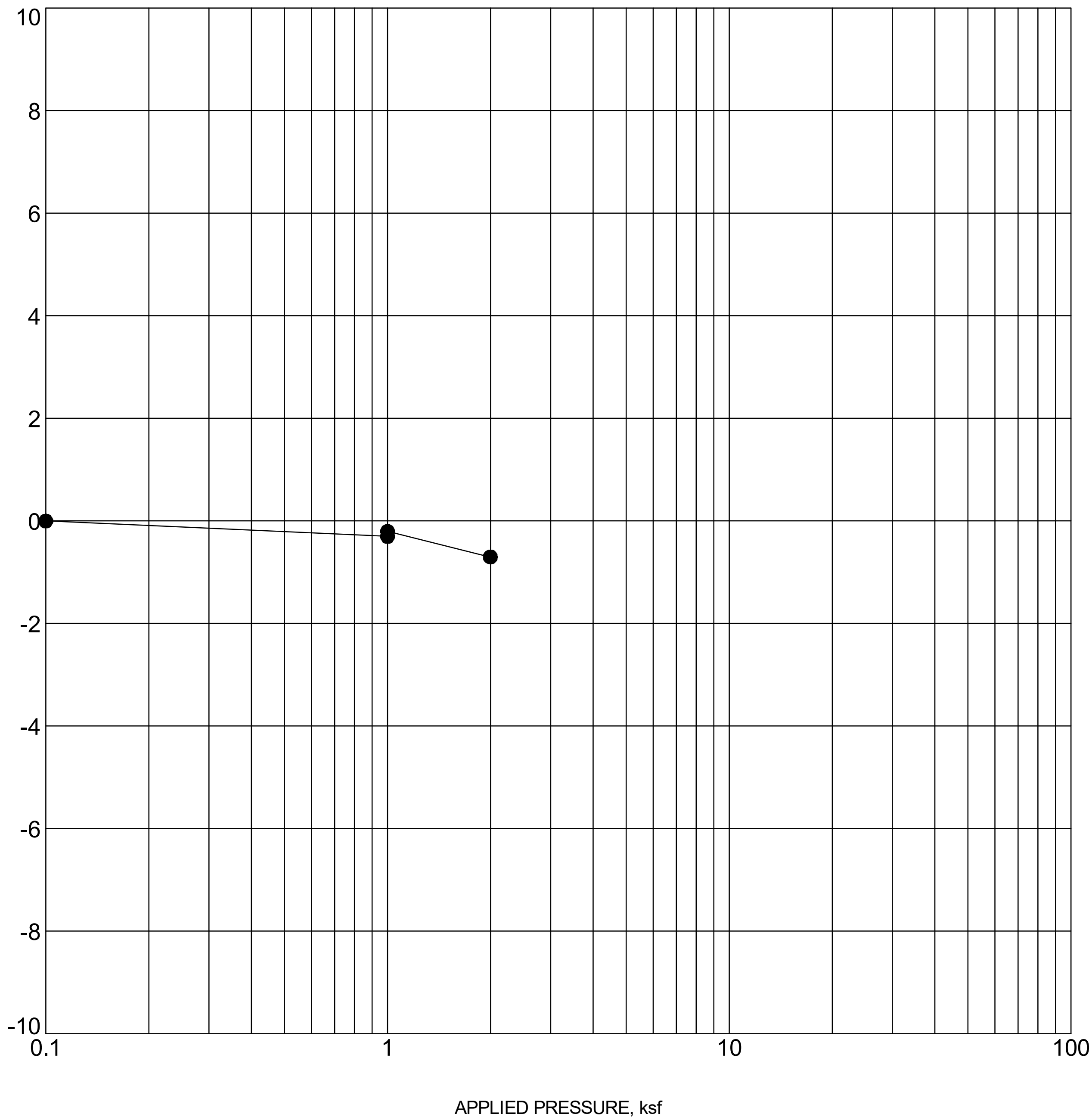
SWELL/CONSOLIDATION TEST

CLIENT SFP-E, LLC c/o Galloway

PROJECT NAME Les Schwab Tire Center - Falcon, CO

PROJECT NUMBER 12.298.16

PROJECT LOCATION Meridian Rd. & Rolling Thunder Way



BOREHOLE	DEPTH	Classification	γ_d	MC%
● 4	14.0	LEAN CLAY with SAND	117	11

Note: Water Added to Sample at 1000 psf.

Date: 9/6/16

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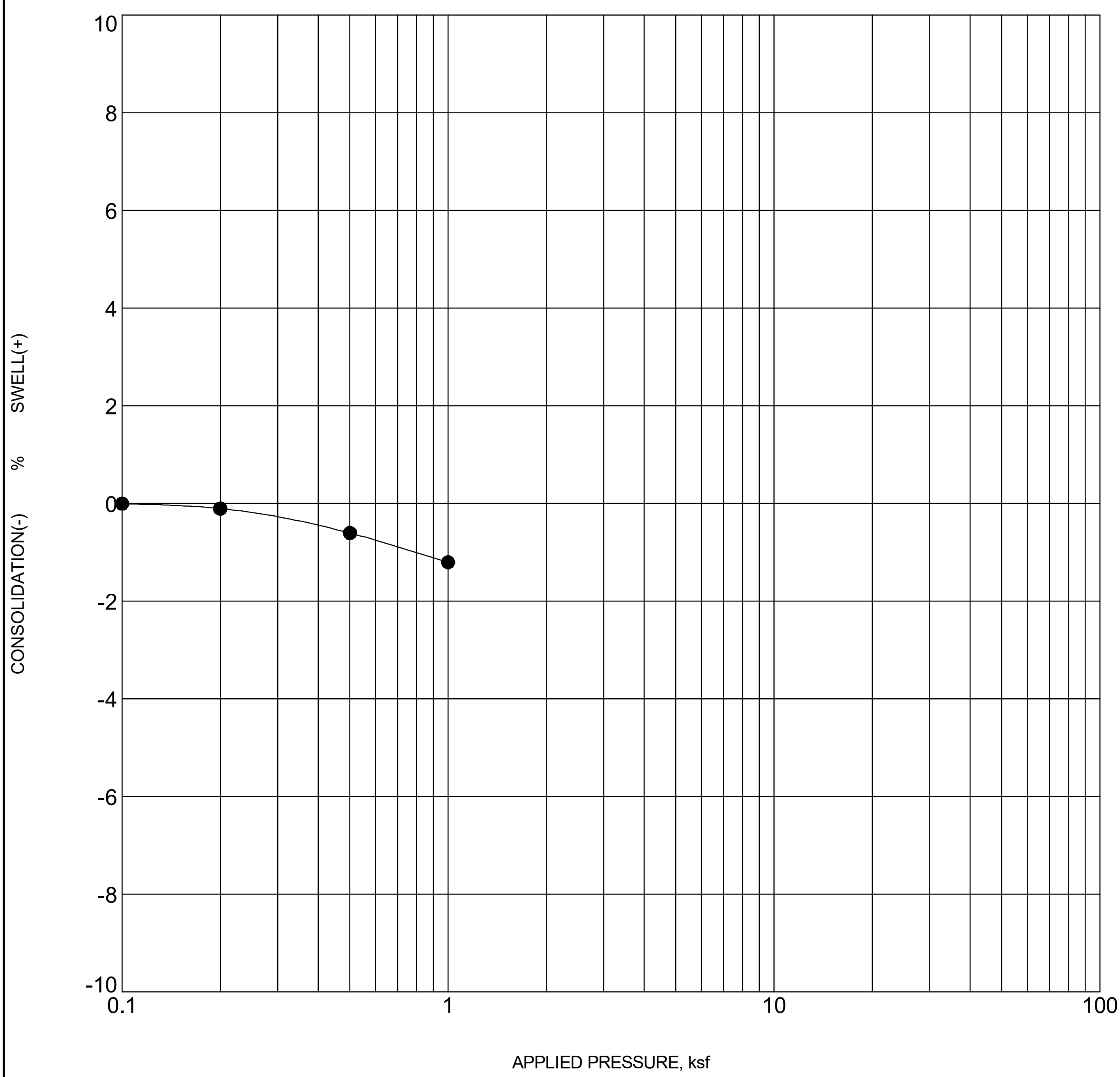
SWELL/CONSOLIDATION TEST

CLIENT SFP-E, LLC c/o Galloway
PROJECT NAME Les Schwab Tire Center - Falcon, CO
PROJECT NUMBER 12.298.16
PROJECT LOCATION Meridian Rd. & Rolling Thunder Way



BOREHOLE	DEPTH	Classification	γ_d	MC%
● **P2**	**2.0**	**SILTY SAND(SM)**	**115**	**9**

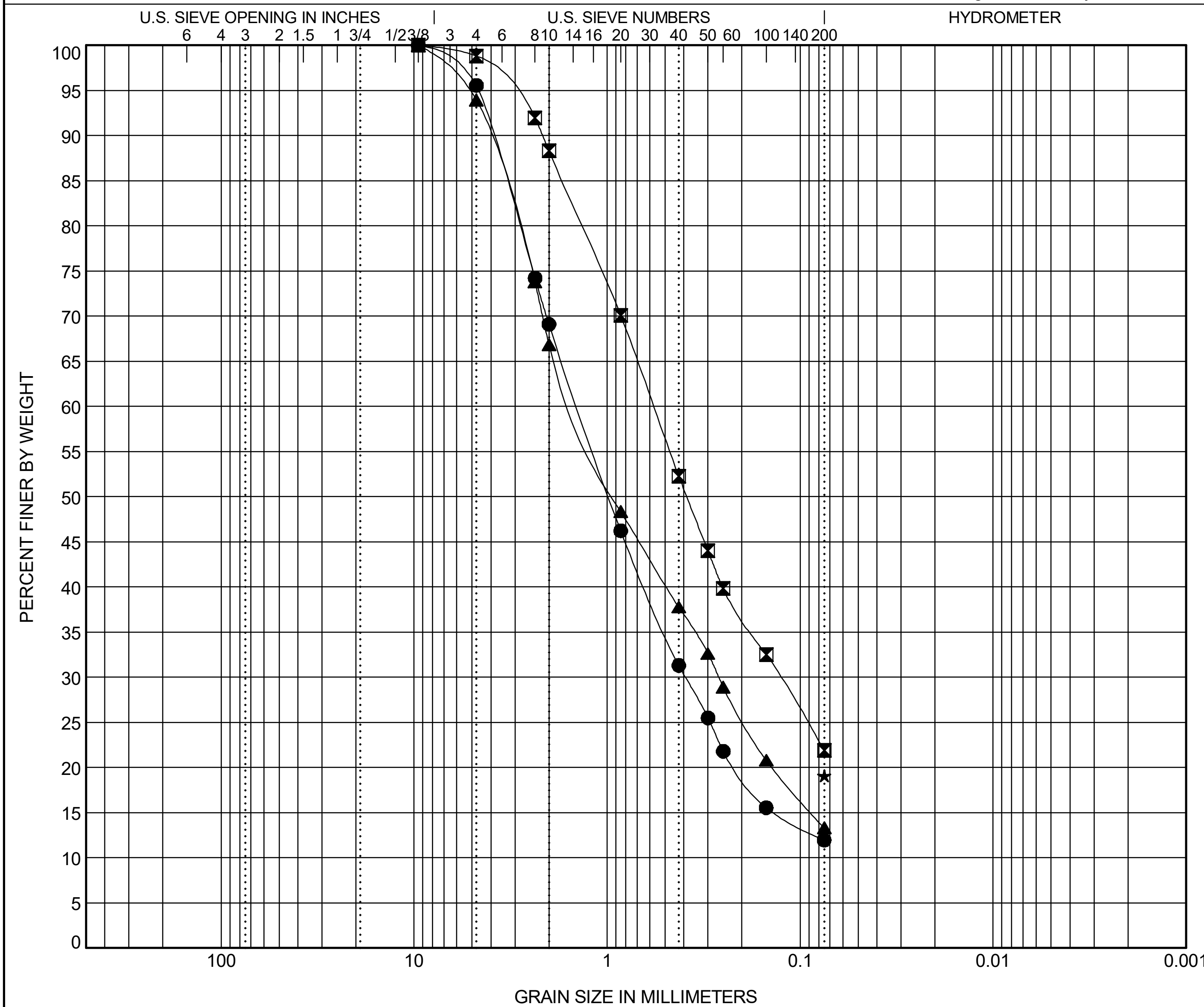
Note: Water Added to Sample at 200 psf. **Date: 9/6/16**

Pickering, Cole, & Hivner
1070 W. 124 Avenue, Suite 300
Westminster, CO. 80234
Telephone: 303.996.2999

GRAIN SIZE DISTRIBUTION

CLIENT SFP-E, LLC c/o Galloway **PROJECT NAME** Les Schwab Tire Center

PROJECT NUMBER 12.298.16 **PROJECT LOCATION** Meridian Rd. & Rolling Thunder Way - Falcon, CO



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	**1**	**4.0**	**WELL-GRADED SAND with SILT(SW-SM)**	**NP**	**NP**	**NP**	**2.11**	**27.68**
⊠	**3**	**9.0**	**SILTY SAND(SM)**	**NP**	**NP**	**NP**		
▲	**P1**	**2.0**	**SILTY SAND(SM)**	**NP**	**NP**	**NP**		
★	**P2**	**2.0**	**SILTY SAND(SM)**	**NP**	**NP**	**NP**		

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**1**	**4.0**	**9.5**	**1.423**	**0.393**		**4.4**	**83.6**	**12.0**	
⊠	**3**	**9.0**	**9.5**	**0.574**	**0.127**		**1.2**	**76.9**	**21.9**	
▲	**P1**	**2.0**	**9.5**	**1.456**	**0.264**		**6.1**	**80.6**	**13.3**	
★	**P2**	**2.0**	**0.075**						**19.1**	

GRAIN SIZE - GINT STD US LAB.GDT - 9/26/16 10:07 - C:\USERS\PUBLIC\DOCUMENTS\BENTLEY\GINT\PROJECTS GEO 2016\12.298.16 LES SCHWAB - FALCON.GPJ

Pickering, Cole, & Hivner
1070 W. 124 Avenue, Suite 300
Westminster, CO. 80234
Telephone: 303.996.2999

SUMMARY OF LABORATORY RESULTS

CLIENT SFP-E, LLC c/o Galloway

PROJECT NUMBER 12.298.16

PROJECT NAME Les Schwab Tire Center - Falcon, CO

PROJECT LOCATION Meridian Rd. & Rolling Thunder Way

Borehole	Depth	Soil Description	Water Content (%)	Dry Density (pcf)	Swell (+) or Consolidation (-)/ Surcharge (%/psf)	Water Soluble Sulfates (ppm)	Passing #200 Sieve (%)	Atterberg Limits		
								Liquid Limit	Plastic Limit	Plasticity Index
1	4	FINE to COARSE SAND with SILT	5.8	121.4			12	NP	NP	NP
1	9	CLAYEY SAND	11.1	122.9	+0.3/500					
1	14	CLAYEY SAND	12.1	124.2						
1	19	CLAYSTONE BEDROCK	11.7	125.0						
1	24	CLAYSTONE BEDROCK	10.1	127.5						
1	29	CLAYSTONE BEDROCK	11.5	125.7						
1	34	CLAYSTONE BEDROCK	15.6	117.2						
2	2	CLAYEY SAND	6.9	126.2	-0.2/200	0				
2	4	CLAYEY SAND	4.1	117.5						
2	9	CLAYEY SAND	8.3	134.1						
2	14	CLAYSTONE BEDROCK	10.9	118.6	+0.6/1000					
2	19	CLAYSTONE BEDROCK	12.2	125.8						
2	24	CLAYSTONE BEDROCK	10.7	127.7						
3	4	CLAYEY SAND to SILTY SAND	9.5	117.9						
3	9	SILTY SAND(SM)	9.5	127.1			22	NP	NP	NP
3	14	CLAYSTONE BEDROCK	9.4	123.2	+0.4/1000					
3	19	CLAYSTONE BEDROCK	11.1	125.1						
3	24	CLAYSTONE BEDROCK	10.5	123.3						
4	4	CLAYEY SAND	9.8	117.3						
4	9	SANDY LEAN CLAY(CL)	10.7	122.4	+1.8/500	400	70	39	22	17
4	14	LEAN CLAY with SAND	10.6	117.3	+0.1/1000					
4	19	CLAYSTONE BEDROCK	11.1	124.7						
4	24	CLAYSTONE BEDROCK	10.8	124.9						
4	29	CLAYSTONE BEDROCK	18.1	111.8						
4	34	CLAYSTONE BEDROCK	10.9	121.1						
P1	2	SILTY SAND (SM)	4.6	122.5			13	NP	NP	NP
P1	4	SANDY LEAN CLAY	4.6	115.9						
P2	2	SILTY SAND(SM)	8.7	115.0	-0.1/200		19	NP	NP	NP
P2	4	SILTY SAND	12.1	121.2						

APPENDIX C

GENERAL NOTES

PERIMETER DRAIN DETAIL

PCH

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon - 1⅜" I.D., 2" O.D., unless otherwise noted	HS:	Hollow Stem Auger
ST:	Thin-Walled Tube – 2.5" O.D., unless otherwise noted	PA:	Power Auger
RS:	Ring Sampler - 2.42" I.D., 3" O.D., unless otherwise noted	HA:	Hand Auger
CB:	California Barrel - 1.92" I.D., 2.5" O.D., unless otherwise noted	RB:	Rock Bit
BS:	Bulk Sample or Auger Sample	WB:	Wash Boring or Mud Rotary

The number of blows required to advance a standard 2-inch O.D. split-spoon sampler (SS) the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches is considered the "Standard Penetration" or "N-value". For 2.5" O.D. California Barrel samplers (CB) the penetration value is reported as the number of blows required to advance the sampler 12 inches using a 140-pound hammer falling 30 inches, reported as "blows per inch," and is not considered equivalent to the "Standard Penetration" or "N-value".

WATER LEVEL MEASUREMENT SYMBOLS:

WL:	Water Level	WS:	While Sampling
WCI:	Wet Cave in	WD:	While Drilling
DCI:	Dry Cave in	BCR:	Before Casing Removal
AB:	After Boring	ACR:	After Casing Removal

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.

DESCRIPTIVE SOIL CLASSIFICATION: Soil classification is based on the Unified Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

FINE-GRAINED SOILS			COARSE-GRAINED SOILS			BEDROCK		
(CB) Blows/Ft.	(SS) Blows/Ft.	Consistency	(CB) Blows/Ft.	(SS) Blows/Ft.	Relative Density	(CB) Blows/Ft.	(SS) Blows/Ft.	Consistency
< 3	0-2	Very Soft	0-5	< 3	Very Loose	< 24	< 20	Weathered
3-5	3-4	Soft	6-14	4-9	Loose	24-35	20-29	Firm
6-10	5-8	Medium Stiff	15-46	10-29	Medium Dense	36-60	30-49	Medium Hard
11-18	9-15	Stiff	47-79	30-50	Dense	61-96	50-79	Hard
19-36	16-30	Very Stiff	> 79	> 50	Very Dense	> 96	> 79	Very Hard
> 36	> 30	Hard						

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Terms of Other Constituents	Percent of Dry Weight
Trace	< 15
With	15 – 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75 mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 Sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Terms of Other Constituents	Percent of Dry Weight
Trace	< 5
With	5 – 12
Modifiers	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1-10
Medium	11-30
High	30+

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification: Group Symbol	Soil Classification: Group Name[B]
Coarse Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[C]	Cu ≥ 4 and 1 ≤ Cc ≤ 3[E]	GW	Well graded gravel[F]
			Cu < 4 and/or 1 > Cc > 3[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 1 > Cc > 3[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 on or above "A" line[J]	CL	Lean clay[K,L,M]
			PI < 4 or plots below "A" line[J]	ML	Silt[K,L,M]
		Organic	**Liquid limit - oven dried** / **Liquid limit - 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	Liquid limit - oven dried / Liquid limit - 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-in. (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] $Cu = D_{60}/D_{10}$ $\quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

[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.

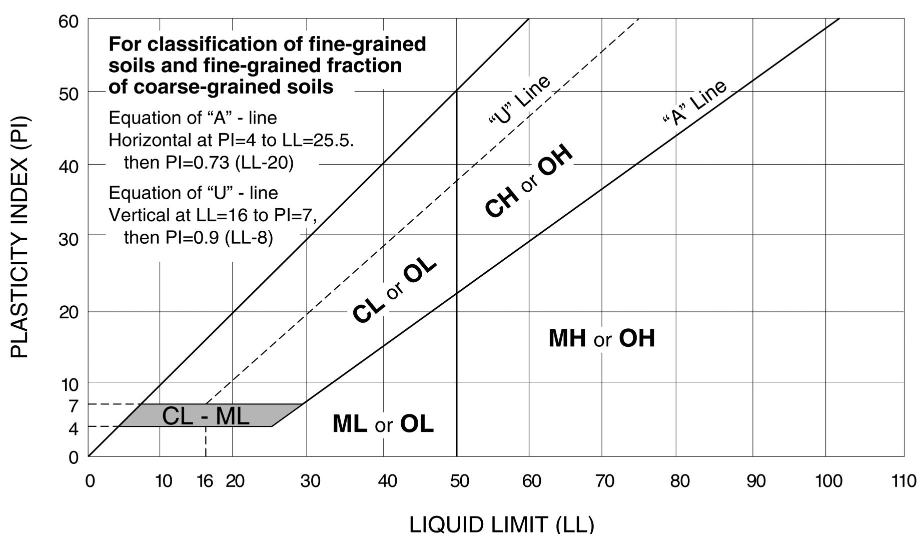
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[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.



ROCK CLASSIFICATION
(Based on ASTM C-294)

Sedimentary Rocks

Sedimentary rocks are stratified materials laid down by water or wind. The sediments may be composed of particles or pre-existing rocks derived by mechanical weathering, evaporation or by chemical or organic origin. The sediments are usually indurated by cementation or compaction.

Chert Very fine-grained siliceous rock composed of micro-crystalline or cyrptocrystalline quartz, chalcedony or opal. Chert is various colored, porous to dense, hard and has a conchoidal to splintery fracture.

Claystone Fine-grained rock composed of or derived by erosion of silts and clays or any rock containing clay. Soft massive and may contain carbonate minerals.

Conglomerate Rock consisting of a considerable amount of rounded gravel, sand and cobbles with or without interstitial or cementing material. The cementing or interstitial material may be quartz, opal, calcite, dolomite, clay, iron oxides or other materials.

Dolomite A fine-grained carbonate rock consisting of the mineral dolomite [$CaMg(CO_3)_2$]. May contain noncarbonate impurities such as quartz, chert, clay minerals, organic matter, gypsum and sulfides. Reacts with hydrochloric acid (HCL).

Limestone A fine-grained carbonate rock consisting of the mineral calcite ($CaCO_3$). May contain noncarbonate impurities such as quartz, chert, clay minerals, organic matter, gypsum and sulfides. Reacts with hydrochloric acid (HCL).

Sandstone Rock consisting of particles of sand with or without interstitial and cementing materials. The cementing or interstitial material may be quartz, opal, calcite, dolomite, clay, iron oxides or other material.

Shale Fine-grained rock composed of or derived by erosion of silts and clays or any rock containing clay. Shale is hard, platy, of fissile may be gray, black, reddish or green and may contain some carbonate minerals (calcareous shale).

Siltstone Fine grained rock composed of or derived by erosion of silts or rock containing silt. Siltstones consist predominantly of silt sized particles (0.0625 to 0.002 mm in diameter) and are intermediate rocks between claystones and sandstones and may contain carbonate minerals.

ROCK CLASSIFICATION
(Based on ASTM C-294)

Metamorphic Rocks

Metamorphic rocks form from igneous, sedimentary, or pre-existing metamorphic rocks in response to changes in chemical and physical conditions occurring within the earth's crust after formation of the original rock. The changes may be textural, structural, or mineralogic and may be accompanied by changes in chemical composition. The rocks are dense and may be massive but are more frequently foliated (laminated or layered) and tend to break into platy particles. The mineral composition is very variable depending in part on the degree of metamorphism and in part on the composition of the original rock.

Marble A recrystallized medium- to coarse-grained carbonate rock composed of calcite or dolomite, or calcite and dolomite. The original impurities are present in the form of new minerals, such as micas, amphiboles, pyroxenes, and graphite.

Metaquartzite A granular rock consisting essentially of recrystallized quartz. Its strength and resistance to weathering derive from the interlocking of the quartz grains.

Slate A fine-grained metamorphic rock that is distinctly laminated and tends to split into thin parallel layers. The mineral composition usually cannot be determined with the unaided eye.

Schist A highly layered rock tending to split into nearly parallel planes (schistose) in which the grain is coarse enough to permit identification of the principal minerals. Schists are subdivided into varieties on the basis of the most prominent mineral present in addition to quartz or to quartz and feldspars; for instance, mica schist. Greenschist is a green schistose rock whose color is due to abundance of one or more of the green minerals, chlorite or amphibole, and is commonly derived from altered volcanic rock.

Gneiss One of the most common metamorphic rocks, usually formed from igneous or sedimentary rocks by a higher degree of metamorphism than the schists. It is characterized by a layered or foliated structure resulting from approximately parallel lenses and bands of platy minerals, usually micas or prisms, usually amphiboles, and of granular minerals, usually quartz and feldspars. All intermediate varieties between gneiss and schist and between gneiss and granite are often found in the same areas in which well-defined gneisses occur.

ROCK CLASSIFICATION
(Based on ASTM C-294)

Igneous Rocks

Igneous rocks are formed by cooling from a molten rock mass (magma). Igneous rocks are divided into two classes (1) plutonic, or intrusive, that have cooled slowly within the earth; and (2) volcanic, or extrusive, that formed from quickly cooled lavas. Plutonic rocks have grain sizes greater than approximately 1 mm, and are classified as coarse- or medium-grained. Volcanic rocks have grain sizes less than approximately 1 mm, and are classified as fine-grained. Volcanic rocks frequently contain glass. Both plutonic and volcanic rocks may consist of porphyries that are characterized by the presence of large mineral grains in a fine-grained or glassy groundmass. This is the result of sharp changes in rate of cooling or other physico-chemical conditions during solidification of the melt.

Granite — Granite is a medium- to coarse-grained light-colored rock characterized by the presence of potassium feldspar with lesser amounts of plagioclase feldspars and quartz. The characteristic potassium feldspars are othoclase or microcline, or both; the common plagioclase feldspars are albite and oligoclase. Feldspars are more abundant than quartz. Dark-colored mica (biotite) is usually present, and light-colored mica (muscovite) is frequently present. Other dark-colored ferromagnesian minerals, especially honblende, may be present in amounts less than those of the light-colored constituents.

Quartz-Monzonite and Grano-Diorite — Rocks similar to granite but contain more plagioclase feldspar than potassium feldspar.

Basalt — Fine-grained extrusive equivalent of gabbro and diabase. When basalt contains natural glass, the glass is generally lower in silica content than that of the lighter-colored extrusive rocks.

LABORATORY TEST
SIGNIFICANCE AND PURPOSE

TEST	SIGNIFICANCE	PURPOSE
California Bearing Ratio	Used to evaluate the potential strength of subgrade soil, subbase, and base course material, including recycled materials for use in road and airfield pavements.	***Pavement Thickness Design***
Consolidation	Used to develop an estimate of both the rate and amount of both differential and total settlement of a structure.	***Foundation Design***
Direct Shear	Used to determine the consolidated drained shear strength of soil or rock.	***Bearing Capacity, Foundation Design, and Slope Stability***
Dry Density	Used to determine the in-place density of natural, inorganic, fine-grained soils.	***Index Property Soil Behavior***
Expansion	Used to measure the expansive potential of fine-grained soil and to provide a basis for swell potential classification.	***Foundation and Slab Design***
Gradation	Used for the quantitative determination of the distribution of particle sizes in soil.	***Soil Classification***
Liquid & Plastic Limit, Plasticity Index	Used as an integral part of engineering classification systems to characterize the fine-grained fraction of soils, and to specify the fine-grained fraction of construction materials.	***Soil Classification***
Permeability	Used to determine the capacity of soil or rock to conduct a liquid or gas.	***Groundwater Flow Analysis***
pH	Used to determine the degree of acidity or alkalinity of a soil.	***Corrosion Potential***
Resistivity	Used to indicate the relative ability of a soil medium to carry electrical currents.	***Corrosion Potential***
R-Value	Used to evaluate the potential strength of subgrade soil, subbase, and base course material, including recycled materials for use in road and airfield pavements.	***Pavement Thickness Design***
Soluble Sulfate	Used to determine the quantitative amount of soluble sulfates within a soil mass.	***Corrosion Potential***
Unconfined Compression	To obtain the approximate compressive strength of soils that possess sufficient cohesion to permit testing in the unconfined state.	***Bearing Capacity Analysis for Foundations***
Water Content	Used to determine the quantitative amount of water in a soil mass.	***Index Property Soil Behavior***

REPORT TERMINOLOGY
(Based on ASTM D653)

Allowable Soil Bearing Capacity — The recommended maximum contact stress developed at the interface of the foundation element and the supporting material.

Alluvium — Soil, the constituents of which have been transported in suspension by flowing water and subsequently deposited by sedimentation.

Aggregate Base Course — A layer of specified material placed on a subgrade or subbase usually beneath slabs or pavements.

Backfill — A specified material placed and compacted in a confined area.

Bedrock — A natural aggregate of mineral grains connected by strong and permanent cohesive forces. Usually requires drilling, wedging, blasting or other methods of extraordinary force for excavation.

Bench — A horizontal surface in a sloped deposit.

Caisson (Drilled Pier or Shaft) — A concrete foundation element cast in a circular excavation which may have an enlarged base. Sometimes referred to as a cast-in-place pier or drilled shaft.

Coefficient of Friction — A constant proportionality factor relating normal stress and the corresponding shear stress at which sliding starts between the two surfaces.

Colluvium — Soil, the constituents of which have been deposited chiefly by gravity such as at the foot of a slope or cliff.

Compaction — The densification of a soil by means of mechanical manipulation

Concrete Slab-on-Grade — A concrete surface layer cast directly upon a base, subbase or subgrade, and typically used as a floor system.

Differential Movement — Unequal settlement or heave between, or within foundation elements of structure.

Earth Pressure — The pressure exerted by soil on any boundary such as a foundation wall.

ESAL — Equivalent Single Axle Load, a criteria used to convert traffic to a uniform standard, (18,000 pound axle loads).

Engineered Fill — Specified material placed and compacted to specified density and/or moisture conditions under observations of a representative of a geotechnical engineer.

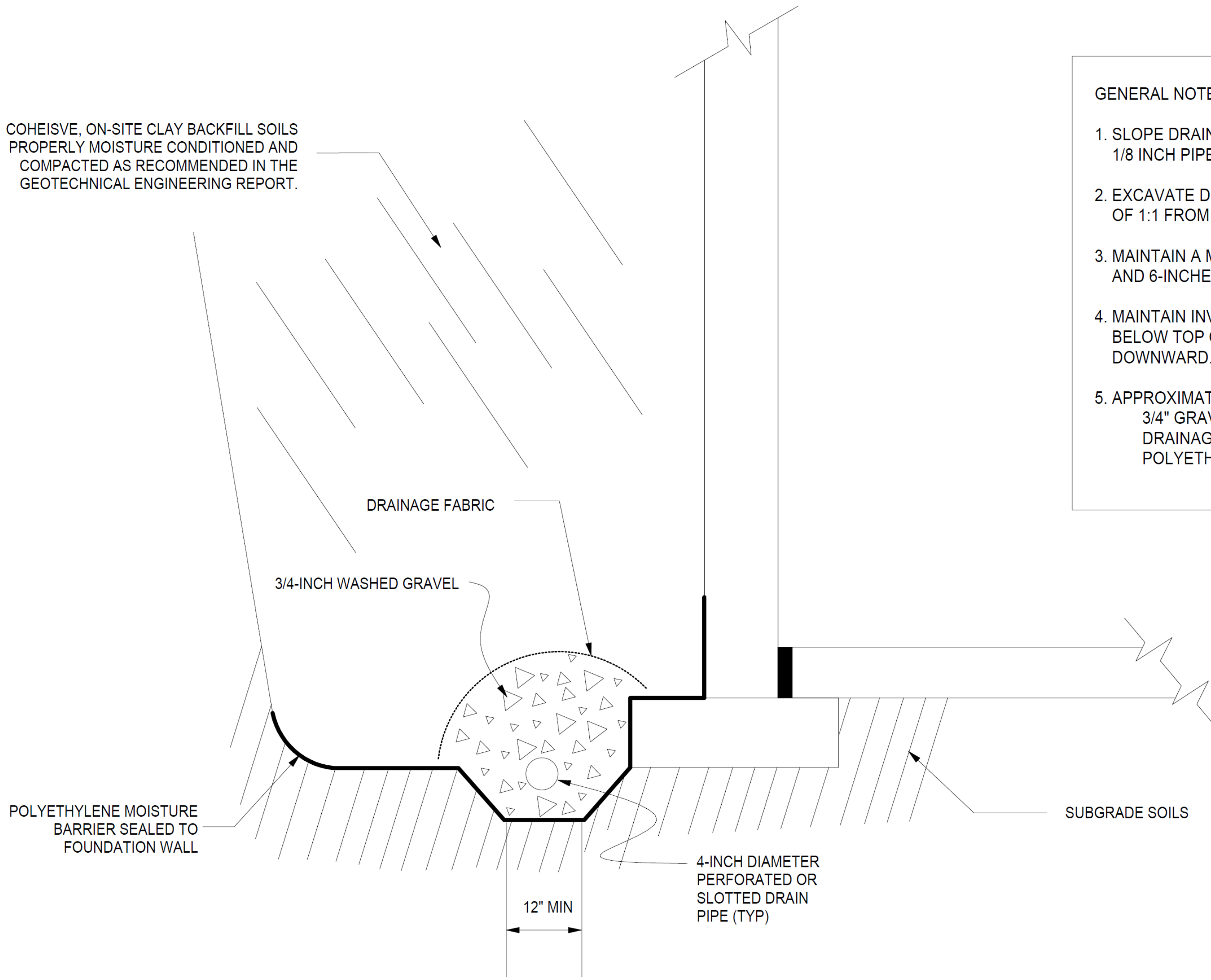
Equivalent Fluid — A hypothetical fluid having a unit weight such that it will produce a pressure against a lateral support presumed to be equivalent to that produced by the actual soil. This simplified approach is valid only when deformation conditions are such that the pressure increases linearly with depth and the wall friction is neglected.

Existing Fill (or Man-Made Fill) — Materials deposited throughout the action of man prior to exploration of the site.

Existing Grade — The ground surface at the time of field exploration.

REPORT TERMINOLOGY
(Based on ASTM D653)

Expansive Potential	The potential of a soil to expand (increase in volume) due to absorption of moisture.
Finished Grade	The final grade created as a part of the project.
Footing	A portion of the foundation of a structure that transmits loads directly to the soil.
Foundation	The lower part of a structure that transmits the loads to the soil or bedrock.
Frost Depth	The depth at which the ground becomes frozen during the winter season.
Grade Beam	A foundation element or wall, typically constructed of reinforced concrete, used to span between other foundation elements such as drilled piers.
Groundwater	Subsurface water found in the zone of saturation of soils or within fractures in bedrock.
Heave	Upward movement.
Lithologic	The characteristics which describe the composition and texture of soil and rock by observation.
Native Grade	The naturally occurring ground surface.
Native Soil	Naturally occurring on-site soil, sometimes referred to as natural soil.
Optimum Moisture Content	The water content at which a soil can be compacted to a maximum dry unit weight by a given compactive effort.
Perched Water	Groundwater, usually of limited area maintained above a normal water elevation by the presence of an intervening relatively impervious continuous stratum.
Scarify	To mechanically loosen soil or break down existing soil structure.
Settlement	Downward movement.
Skin Friction (Side Shear)	The frictional resistance developed between soil and an element of the structure such as a drilled pier.
Soil (Earth)	Sediments or other unconsolidated accumulations of solid particles produced by the physical and chemical disintegration of rocks, and which may or may not contain organic matter.
Strain	The change in length per unit of length in a given direction.
Stress	The force per unit area acting within a soil mass.
Strip	To remove from present location.
Subbase	A layer of specified material in a pavement system between the subgrade and base course.
Subgrade	The soil prepared and compacted to support a structure, slab or pavement system.



GENERAL NOTES:

1. SLOPE DRAIN TRENCH AND PIPE AT A MINIMUM OF 1/8 INCH PIPE PER LINEAL FOOT TO SUITABLE OUTFALL.
2. EXCAVATE DRAIN TRENCH AT A MAXIMUM SLOPE OF 1:1 FROM EDGE OF FOOTING.
3. MAINTAIN A MINIMUM OF 3-INCHES OF GRAVEL BELOW AND 6-INCHES ABOVE DRAIN PIPES.
4. MAINTAIN INVERT OF DRAIN PIPE A MINIMUM OF 6 INCHES BELOW TOP OF FOOTING. PERFORATIONS SHOULD BE FACING DOWNWARD.
5. APPROXIMATE QUANTITIES (PER LINEAL FOOT):
   - 3/4" GRAVEL - 1 1/2 CUBIC FT.
   - DRAINAGE FABRIC - 2 SQUARE FT.
   - POLYETHELENE - 6 SQUARE FT.

NOT TO SCALE

TYPICAL EXTERIOR
PERIMETER DRAIN DETAIL
FOOTING FOUNDATION

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