GRANITE ENGINEERING GROUP

Geotechnical Engineering Report
O'Reilly Auto Parts Store
Reata Ridge Dr
Parker, Colorado
GEG Project No. 24-152

October 30, 2024

GRANITE ENGINEERING GROUP

A Report Prepared for:

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1. INTRODUCTION

1.1 General

Granite Engineering Group, Inc. (GEG) has completed the subsurface exploration and geotechnical engineering evaluation for the proposed O'Reilly Auto Parts store located at the northeast corner of Reata Ridge Drive and Declan Drive in Parker, Colorado. The general location of the project site is presented on Figure A-1, Site Location Plan in Appendix A.

This report includes our recommendations related to the geotechnical aspects of the project design and construction. The conclusions and recommendations presented in this report are based on the subsurface information encountered at the locations of our exploration, preliminary information provided to us by Solid Ground Consulting Engineers, PLLC and the provision and requirements outlined in the Limitations section of this report.

1.2 Project Information

Based on the information provided, we understand that the proposed structure is to be a single-story Pre-Engineered Metal Building (PEMB) with a footprint area of approximately 7,000 square feet (SF) with parking lots. Loading conditions are not provided to us but we expect the building will be lightly loaded.

A grading plan was not available at the time of writing the report. It appeared that the site was previously graded, and it is assumed that minor cut and fill (2 feet or less) will be required to reach the final grade.

If the type of construction and loading information is to vary significantly from the above descriptions, GEG should be notified immediately in order to re-evaluate our recommendations, if required. Once the final design such as a grading plan is established, GEG should be allowed to review the engineering recommendations.

1.3 Purpose and Scope

The purpose of our study was to evaluate the subsurface conditions at the location of the proposed construction and provide geotechnical engineering recommendations for the design and construction of the proposed building and pavements. Our scope of services consisted of the following:

- Review available mapped geology at the site.

- Arrange for the underground utility locate.
- Conduct a subsurface exploration to evaluate the subsurface conditions. The subsurface exploration included three (3) geotechnical borings within the proposed building footprint, and three (3) geotechnical borings in the proposed pavement area. The approximate boring locations are shown on Figure A-2, Boring Location Plan in Appendix A.
- Perform laboratory testing on soil/bedrock samples obtained from the subsurface exploration to evaluate engineering characteristics.
- Prepare a report that presents the results of encountered site and subsurface conditions, laboratory testing, geotechnical engineering analyses, geotechnical feasibility, design and construction recommendations for the proposed structure foundation system, pavement thickness design, and earthwork recommendations.

Conclusions and recommendations presented herein are based on our limited site explorations and the subsurface conditions encountered at our boring locations during the time of our exploration. Our findings, conclusions, and recommendations should not be extrapolated to other areas of the site or used for other projects without our prior review. Additionally, they should not be used if the site has been altered or if more than three (3) years have elapsed since the date of our final report without our prior review to determine if they remain valid.

2. SUBSURFACE EXPLORATION

2.1 Field Exploration

Our field exploration program consisted of advancing a total of six (6) borings at the project site as shown on Figure A-2, Boring Location Plan in Appendix A. The boring locations were established in the field by GEG personnel by using a hand-held GPS unit with accuracy of approximately 10 feet. The boring locations should be considered accurate only to the degree implied by the method used to define them. Table 2-1 presents a summary of the boring locations and depths.

Table 2-1 Summary of Boring Locations and Depths

Boring ID	GPS Coordinates	Maximum Exploration Depth (ft)
B-01 (Building)	39.4780613, -104.7565115	14.5
B-02 (Building)	39.4782627, -104.7562812	15
B-03 (Building)	39.4782013, -104.7564274	15

Boring ID	GPS Coordinates	Maximum Exploration Depth (ft)
P-01 (Pavement)	39.4780373, -104.7566544	14.5
P-02 (Pavement)	39.4779809, -104.7563546	14.5
P-03 (Pavement)	39.4782764, -104.7566299	15

The borings were advanced with a truck mounted CME-45B drill rig equipped with 4-inch diameter, solid-stem, continuous-flight augers. Three (3) borings were drilled in the planned store area to depths of approximately 15 feet below the existing ground surface (bgs), and three (3) borings were drilled in the planned pavement areas to depths of about 15 feet bgs.

Sampling was performed at about 2.5-foot intervals within the top 10 feet, and at 5-foot intervals thereafter to the terminated depth. Samples were collected by driving a Modified California (MC) split barrel sampler into the strata with a 140-pound hammer falling 30-inches.

The Modified California (MC) sampler is a 2.5-inch O.D., 2.0-inch ID (1.95-inch ID with liners), split barrel sampler with internal liners, performed in accordance with ASTM D3550. The MC Sampler “Penetration Resistance” refers to the sum of all blows required to drive the sampler the drive length of the final 12 inches or portion thereof. The MC penetration resistance represents the consistency or relative density of the strata.

The boring logs along with the key to the logs are presented in Appendix B.

2.2 Laboratory Testing

Representative soil/bedrock samples were selected for laboratory testing that was completed in accordance with industry standards and consistent with local practice. Laboratory soil testing included:

- Description and identification of soils (visual-manual procedure)
- Natural moisture-density;
- Gradation analysis;
- Atterberg limits;
- One-dimensional swell/consolidation test;
- Analytical tests including water soluble sulfates and chlorides; soil resistivity; pH.

Results of the laboratory tests are shown on the boring logs and are presented in the Laboratory Summary in Appendix C.

3. SITE AND SUBSURFACE CONDITIONS

3.1 Site Conditions

The site is located at the northeast corner of Reata Ridge Drive and Declan Drive in Parker, Colorado. The site is a vacant lot and was previously graded, making it fairly flat. It is believed that the site was graded as staging area during the development of the site. Gravel fill was observed from the aerial photo and on-site during field exploration. Commercially zoned areas exist to the northwest on the northern portion of Stroh Rd, while residentially zoned areas exist to the northeast on the northern portion of Stroh Rd. Undeveloped and vacant land exists to all other directions of the project site.

3.2 Geologic Setting

Review of the “Geologic Map of the Castle Rock North Quadrangle, Douglas County, Colorado” by Jon P. Thorson 2005, indicates the proposed site is located within the Facies unit five (TKda5) from the early to middle Eocene. While review of “A Spatial Database of Bedding Attitudes” compiled by Theodore R. Brandt, David W. Moore, and Kyle E. Murray 2024 to accompany “Geologic Map of the Greater Denver Area, Front Range Urban Corridor, Colorado” by Donald E. Trimble and Michael N. Machette, indicates that the site is located on the Dawson and Arapahoe Formations (TKda) from the Paleocene and Upper Cretaceous. This consist of Arkosic sandstone, siltstone, claystone and (or) minor amounts of conglomerate. Where Denver Formation intertongues and punches out to the south and east the unit is called the Dawson Formation which can be up to 2,000 feet thick and forms a majority of the bedrock between Denver and Colorado Springs.

The WebSoil Survey provided by Natural Resources Conservation Service (NRCS) indicates that the surficial soil at the site is Sampson loam. The top 9 inches of the Sampson loam consists of loam, from 9 to 28 inches below the surface consists of clay loam, from 28 to 38 inches consists of loam, and from 38 to 60 inches bgs is silt loam.

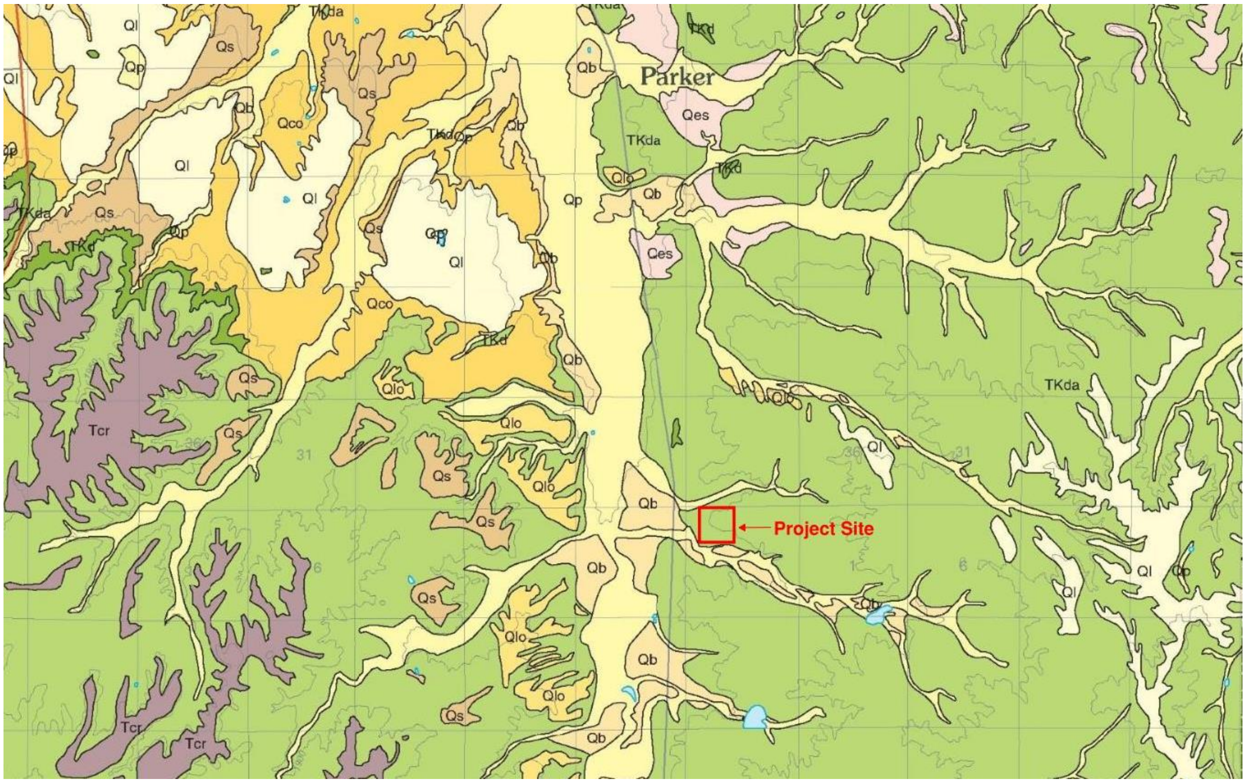


Figure 3-1. Geologic Map

3.3 Subsurface Conditions

The subsurface conditions encountered in the borings are generally consistent with the mapped geology. All the borings encountered sand with varying amounts of clay, silt and gravel, and lean clay with varying amounts of sand. The overburden soils were tan, brown, gray, orange, and red in color. The sandy soils were loose to dense in relative density while the clay soils were medium stiff to hard in consistency. All borings except for B-01, P-01 and P-02 terminated in the overburden soils at depths of about 15 feet bgs.

Beneath the overburden soils, claystone was encountered at depths of about 13.5 to 14 feet bgs and extended to the boring termination depths of about 15 feet bgs in B-01 and P-02. In P-01, sandstone was encountered at depth of about 2 feet and extended to 5 feet bgs. The sandstone was underlain by claystone to the boring termination depth of about 15 feet bgs. The bedrock was moderately to slightly weathered and medium hard to hard.

The boring logs in Appendix B present detailed results of the subsurface exploration.

3.4 Groundwater

All borings were dry during drilling and at the completion of drilling. Groundwater observations are representative of conditions at the time of our field exploration, and therefore may not be indicative of groundwater levels at other times of the year or at other locations across the site. Groundwater conditions may fluctuate with seasonal precipitation, site grading and improvements, and local irrigation practices.

4. Construction Recommendations

4.1 Geotechnical Feasibility

Subsurface conditions encountered at the site during the field exploration did not find conditions that would preclude the construction of the project as planned provided the conclusions and recommendations presented in the following sections are incorporated into the project design.

The recommendations submitted herein are based, in part, upon data obtained from our subsurface exploration. The nature and extent of subsurface variations that may exist at the proposed project site will not become evident until construction. If variations appear evident, then the recommendations presented in this report should be evaluated. In the event that any changes in the nature, design, or location of the proposed project are planned, the conclusions and recommendations contained in this report will not be considered valid unless the changes are reviewed, and our recommendations modified in writing.

4.2 Primary Geotechnical Concerns

4.2.1 Swell Potential of Foundation Soils

The overburden soils and bedrock at the site have swell potential ranging from 0.4 to 1.2 percent under surcharge pressures of 200 pounds per square foot (psf) and a swell pressure up to 900 psf. These materials are generally classified as low risk category by Colorado Association of Geotechnical Engineers (CAGE) for slab performance and foundation movement.

Potentially expansive soils will require particular attention in the design and construction. Expansive soils are stable at current and constant moisture conditions. Upon drying, these soils will shrink, which would cause settlement of foundation and slab-on-grade. Upon wetting, these soils could increase in volume and cause movement and damage. The amount of movement and/or damage is dependent on the subgrade preparation, availability of water due to landscape irrigation and surface drainage, and the structural tolerances to movement.

4.3 Construction Considerations

4.3.1 Site Preparation and Grading

Site preparation and earthwork operations should be performed in accordance with applicable codes, safety regulations and other local, state, or federal guidelines. Earthwork on the project should be observed and evaluated by GEG. The evaluation of earthwork should include observation and testing of subgrade preparation, foundation bearing soils and other geotechnical conditions exposed during project construction.

Areas within the limits of construction should be stripped and cleared of surface vegetation, topsoil, and any debris. All surface and subsurface features from past site use should be removed full depth. Stripped materials consisting of vegetation, organic materials and debris should be wasted from the site or used to revegetate landscaped areas after completion of grading operations. Exposed surfaces should be free of mounds and depressions in order to promote uniform compaction.

Following initial stripping and grading, all exposed areas which will receive fill or support structures, once properly cleared, should be scarified to a minimum depth of 8 inches, moisture conditioned, and compacted according to Section 4.3.4 of this report. Following any required undercutting and moisture conditioning, and prior to placement of structural/engineered fill, it is recommended that the subgrade be proof rolled. Proof rolling of the subgrade aids in identifying soft or disturbed areas. Soft and unsuitable areas identified by proof rolling should be undercut and replaced with structural fill. Proof rolling can be accomplished through the use of a loaded, tandem-axle dump truck or similar equipment providing equivalent subgrade loading.

Suitable engineered or structural fill should be placed to design grade as soon as practical after reworking the subgrade to avoid moisture changes in the underlying soils. Fill material should be placed on a horizontal plane and placed in loose lifts not to exceed 8 inches thick, unless otherwise accepted by GEG. The moisture content and compaction of subgrade soil and engineered/structural fill should be maintained until slab construction.

Based upon the subsurface conditions encountered, subgrade soils exposed during construction are anticipated to be stable. However, the stability of the subgrade may be affected by precipitation, repetitive construction traffic and other factors. If unstable conditions are encountered or develop during construction, stability may be improved by scarifying and drying the subgrade soils. Over-excavation of wet zones and replacement with structural fill or crushed rock may be necessary. If areas are found to be unsuitable for re-work, additional stabilization will be required. If additional stabilization is required, GEG should be contacted to evaluate the conditions in the field, and a suitable stabilization method can be provided. In addition, any soft and/or wet areas exposed during the excavation may need to be stabilized prior to the placement of new fill to create a stable, firm construction platform. A typical stabilization method may include utilizing gravel with the combination of geo-grid to create a stable base. Other stabilization methods may also be appropriate.

4.3.2 Excavation and Trench Construction

Excavations into the on-site soils/bedrock will encounter a variety of conditions. All excavations must comply with the applicable local, State, and Federal safety regulations, and particularly with the excavation standards of the Occupational Safety and Health Administration (OSHA). Construction site safety, including excavation safety, is the sole responsibility of the Contractor as part of its overall responsibility for the means, methods, and sequencing of construction operations. GEG recommendations for excavation support are provided for the Client’s sole use in planning the project, in no way do they relieve the Contractor of its responsibility to construct, support, and maintain safe slopes. Under no circumstances should the following recommendations be interpreted to mean that GEG is assuming responsibility for either construction site safety or the Contractor’s activities.

We believe the subgrade soil and bedrock encountered at this site will classify as a Type C material, using OSHA criteria. OSHA requires that unsupported cuts be no steeper than 1½H:1V for Type C material for unbraced excavations up to 20 feet in height. In general, we believe that these slope ratios will be temporarily stable under unsaturated conditions. Flattened slopes may be required if excavations encounter groundwater, or the slopes will be exposed for an extended period of time. Please note that the Contractor’s OSHA-qualified “competent person” must make the actual determination of soil type and allowable sloping in the field.

The soil encountered by the proposed excavations may vary significantly across the site. The preliminary classifications presented above are based solely on the materials encountered in widely spaced exploratory test borings. The contractor should confirm that similar conditions exist throughout the proposed area of excavation.

As a safety measure, it is recommended that all vehicles and soil piles be kept to a lateral distance equal to at least the depth of the excavation from the crest of the slope. The exposed slope face should be protected against the elements and monitored by the contractor on at least a daily basis.

4.3.3 Structural Fill Requirements

Based on our laboratory test results, the on-site clay and sand soils, and sandstone/claystone bedrock may be utilized as engineered fill placed beneath shallow foundations and slabs on-grade elements if they are properly over-excavated, moisture conditioned and compacted. The over-excavated clay and sand soils and bedrock should have particle sizes smaller than 2 inches. Additional imported structural fill, if required, should consist of non-expansive granular material meeting the following criteria:

Table 4-1 Imported Structural Fill Criteria

Gradation Requirements	
Standard Sieve Size	Percent Passing
2 inches	100
No. 200	10 – 30
Plasticity Requirements (Atterberg Limits)	
Liquid Limit	30 or less
Plasticity Index	6 or less

We recommend that a qualified representative of GEG visit the site during excavation and during placement of the engineered/structural fill to confirm the soils exposed in the excavations are consistent with those encountered during our subsurface exploration and that proper foundation subgrade preparation and placement are performed.

All fill placed on this site should be compacted according to the recommendations in Section 4.3.4 of this report. Fill to be placed at this site during leveling/grading operations should be placed under controlled conditions. A sample of any imported fill material, if required, should be submitted to GEG for approval and testing at least 3 days prior to stockpiling at the site.

4.3.4 Compaction Requirements

Fill materials should be placed in horizontal lifts compatible with the type of compaction equipment being used, moisture conditioned, and compacted in accordance with the criteria shown in Table 4-2.

Table 4-2 Subgrade Preparation and Fill Placement Criteria

Fill Location	Material Type	Percent Compaction (ASTM Method)	Moisture Content
Foundation, Floor Slab and Pavement Subgrade Soils	On Site Clay, Clayey Sand and Claystone – Engineered Fill	95 minimum (ASTM D698)	0 to +3 % of OMC
Foundation, Floor Slab and Pavement Subgrade Soils	On Site Silty Sand and Sandstone – Engineered Fill and Imported Structural Fill	95 minimum (ASTM D1557)	± 2 % of OMC
Trench Backfill	On Site Clay, Clayey Sand and Claystone – Engineered Fill	92 minimum (ASTM D698)	0 to +3 % of OMC
Trench Backfill	On Site Silty Sand and Sandstone – Engineered Fill and Imported Structural Fill	92 minimum (ASTM D1557)	± 2 % of OMC
Aggregate Base (ABC)	Imported CDOT Class 6 ABC	95 minimum (ASTM D1557)	± 2 % of OMC

OMC= Optimum Moisture Content determined from Proctor Test

Fill should be placed in level lifts not exceeding 8-inches in loose thickness and compacted to the specified percent compaction to produce a firm and unyielding surface. If field density tests indicate the required percent compaction has not been obtained, the fill material should be reconditioned as necessary and re-compacted to the required percent compaction before placing any additional material.

4.3.5 Utility Trench Backfill

On-site soils/bedrock may be utilized as backfill material in utility trenches provided the backfill is essentially free of plant matter, organic soil, debris, trash, other deleterious matter and rock particles larger than 2-inches. Backfill should be placed in lifts of 8-inches or less in loose thickness and compacted with appropriate trench equipment. Utility trench backfill should be compacted as recommended in Section 4.3.4 of this report.

4.3.6 Drainage Considerations

Positive drainage should be provided during construction and maintained throughout the life of the proposed project. The proper design of drainage should include prevention of ponding water on or immediately adjacent to the structures. Surface features that could retain water in areas adjacent to the structures should be eliminated. Backfill against any kind of structures and in utility line trenches should be well compacted and free of all construction debris to reduce the possibility of moisture infiltration and migration. Concentrated runoff should be avoided in areas susceptible to erosion and slope instability. Slopes and other stripped areas should be protected against erosion by re-vegetation or other methods.

4.3.7 Construction in Wet or Cold Weather

Grading fill, structural fill or other fill should not be placed on frosted or frozen ground, nor should frozen material be placed as fill. Frozen ground should be allowed to thaw or be completely removed prior to placement of fill. A good practice is to cover the compacted fill with a "blanket" of loose fill to help prevent the compacted fill from freezing or provide heating elements inside the building if it will be left unattended for an extended period of time.

Concrete and asphalt structures should not be constructed on frozen soil. Frozen soil should be completely removed from beneath the concrete elements, or thawed, scarified and re-compacted. The amount of time passing between excavation or subgrade preparation and placing concrete should be minimized during freezing conditions to prevent the prepared soils from freezing. Blankets, soil cover, or heating as required may be utilized to prevent the subgrade from freezing.

4.3.8 Corrosion Potential and Concrete Type

Analytical testing was completed on a select sample obtained between depths of about 1 and 2 feet bgs in Boring B-01. The test results are summarized in Table 4-3.

Table 4-3 Analytical Test Results

Sample	Materials	Water Soluble Sulfates, %	Water Soluble Chlorides, %	pH	Resistivity, ohm.cm
B-01 @ 1'	Clayey Sand	ND	0.015	6.56	660

ND – not detectable

The concentration of water-soluble sulfate measured in the sample obtained from the boring was less than 0.1 percent. The concentration of water-soluble sulfate represents a Class 0 degree of sulfate attack on concrete exposed to the existing foundation soil. The degree of attack is based on a range of Class 0 (negligible) to Class 3 (very severe) as described in the American Concrete Institute (ACI) Standard 201.2R, "Guide to Durable Concrete".

Results of soluble sulfate testing indicate that ASTM C150 Type I or II or equivalent Portland cement should be specified for all project concrete on and below grade.

The pH and electrical resistivity were also tested for the selected sample of the existing foundation soil from the geotechnical borings. The test results measured a pH value of 6.56, and resistivity measurement had a value of 660 ohm-centimeters for the selected soil sample. Corrosion of buried metal is an electrochemical process in which the amount of metal loss due to corrosion is directly proportional to the flow of electrical current (DC) from metal into the soil. As resistivity decreases, the corrosivity of the soil increases. The following table provides a correlation between soil resistivity and corrosivity towards ferrous metal.

Table 4-4 Resistivity and Corrosivity Categories

Resistivity in Ohm-centimeters	Corrosivity Category
0 to 1,000	Severely Corrosive
1,000 to 2,000	Corrosive
2,000 to 10,000	Moderately Corrosive
Greater than 10,000	Mildly Corrosive

Based on the laboratory and field resistivity test results, the existing soils are anticipated to be severely corrosive to unprotected iron or steel pipe. A qualified corrosion engineer should review this data to determine the appropriate corrosion protection measures at the site.

5. Foundation Design Recommendations

The site appears suitable for the proposed construction based upon geotechnical conditions encountered in the borings. Based on subsurface exploration, and geotechnical engineering analyses, the proposed building may be supported on a spread footing foundation system bearing on native soils or properly over-excavated, moisture conditioned and recompacted engineered/structural fill. Design and construction details for the recommended foundation system are given for Allowable Stress Design (ASD).

5.1 Undocumented Fill

The sire was previously used as staging areas for the development of the areas. Gravel fill was observed from aerial photo and also on-site during field exploration. It did not appear that other undocumented fill was placed previously. However, undocumented fill maybe encountered during the mass grading for the site development. If undocumented fill is observed during mass grading, they should be removed and replaced with properly compacted structure fill materials.

5.2 Shallow Foundations

The proposed building may be supported on shallow spread and strip footings that are founded in the native soils or properly compacted engineered or structural fill materials. Sandstone was encountered at a depth of about 2 feet bgs in Boring P-01. If sandstone bedrock is exposed in foundation excavations, sandstone bedrock should be over-excavated to a depth of at least 12 inches below the bottom of the shallow foundations and replaced with properly compacted engineered or structural fill materials.

Shallow foundations founded in the native soils or engineered or structural fill should be designed using the maximum allowable bearing pressures of 2,000 psf and 1,600 psf for spread footings and strip wall footings, respectively. The recommended allowable bearing pressures are based on a factor of safety (F.O.S.) of approximately three (3) with respect to shear failure of the foundation bearing materials. A one third increase in the allowable bearing pressure may be used for the maximum allowable bearing pressure for temporary loading conditions including wind or seismic conditions.

The lateral capacity of the footings may be derived from passive resistance along the vertical face of the footings, and friction between the bottom of the footings and the foundation soils. An allowable passive resistance using an equivalent fluid pressure of 140 pounds per cubic foot (pcf) (F.O.S. of 2) may be used for the design. An allowable coefficient of friction of 0.2 (F.O.S. of 1.5) between the bottom of the footings and the foundation bearing material can be used for sliding. We recommend the upper 3 feet of the soils to be neglected in the passive resistance calculations.

Continuous wall footing should have a minimum width of 18 inches, and isolated spread footings should have a minimum width of 24 inches.

All exterior footings and footings founded in the unheated portions of the structure should be supported at a minimum of 36 inches below the final exterior grade to provide protection against frost penetration. Interior footings should bear a minimum of 12 inches below finished grade. Finished grade is the lowest adjacent exterior grade for perimeter footings and floor level for interior footings.

Footing should be proportioned to reduce differential foundation movement. Proportioning on the basis of equal total movement is recommended; however, proportioning to relative constant dead load pressure will also reduce differential movement between adjacent footings. Total movement is estimated to be on the order of 1 inch or less. Differential movement is anticipated to be on the order of ¾ of the estimated total movement. Additional foundation movements could occur if water from any source infiltrates the foundation soils, therefore, proper drainage should be provided in the design and during construction.

Footings, foundations, and masonry walls should be reinforced as necessary to reduce the potential for distress caused by differential foundation movement. The use of joints at openings or other discontinuities and at periodic intervals on long masonry walls is recommended.

Foundation excavations should be observed by the geotechnical engineer or engineer's representative. If the soil conditions encountered differ significantly from those presented in this report, supplemental recommendations will be required.

5.3 Floor Slab Design and Construction

As discussed in Section 4.2.1, the foundation soils are classified as low risk category. To mitigate the swell potential of the existing subgrade soil and to provide uniform slab support, it is recommended to perform moisture conditioning to a minimum depth of 2 feet measured from the finished subgrade, or 2 feet below the existing ground surface, whichever is deeper. The over-excavation and replacement with engineered or structural fill should also extend a minimum of 10 feet laterally beyond the edge of the proposed building. The engineered fill can consist of on-site clay, sand and bedrock and should be properly moisture conditioned and compacted in accordance with Sections 4.3.3 and 4.3.4 of this report.

If imported structural fill materials are used to replace the existing foundation soils, the surface of the exposed soils beneath the structural fill should be crowned under the middle of the building and sloped downward to the edge of the building perimeter, where an underdrain system should be installed. The purpose is to reduce the accumulation of water through the permeable granular materials above the low-permeable underlying materials.

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 properly prepared engineered or structural fill. If a higher modulus of subgrade reaction is required, consideration could be given to constructing the floor slab section on a granular base course.

Additional floor slab design and construction recommendations are as follows:

- Landscaped irrigation and roof run-off should be minimized or eliminated adjacent to the foundation system and the building.
- 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.
- Interior trench backfill placed beneath slabs should be compacted in accordance with recommended specifications outlined herein.
- In areas subjected to normal loading, a minimum 2-inch layer of sand over 6-inch of aggregate base course should be placed beneath interior slabs. For heavy loading, re-evaluation of slab and/or base course thickness may be required.
- If moisture-sensitive floor coverings are used on interior slabs, consideration should be given to the use of vapor barriers to minimize potential vapor rise through the slab.
- Floor slabs should not be constructed on frozen subgrade.
- Other design and construction considerations, as outlined in Section 302.1 R of the "ACI Design Manual", are recommended.

5.4 Exterior Slab

Exterior slabs-on-grade and flatwork constructed on the existing foundation soils will have a low risk of movement. The risk of movement for exterior slabs-on-grade and flatwork can be reduced to a lower level if the subgrade materials are scarified, moisture conditioned and re-compacted to a minimum depth of 8 inches. If less risk of movement is desired, the existing foundation soils should be treated to a minimum depth of 2 feet.

5.5 Seismicity

Based upon the geologic setting, subsurface soil conditions, and low seismic activity in this region, liquefaction potential at this site is estimated to be low. The subsurface soil profiles correspond with Site Class D of the 2015 IBC.

The intermediate values from 2015 IBC used to obtain the design parameters are provided below.

Table 5-1. Design Acceleration for Short Periods

S_S	F_a	S_{MS} ($S_{MS} = F_aS_s$)	S_{DS} (S_{DS} = 2/3 S_{MS})
0.174 g	1.6	0.278 g	0.185 g

S_S = The mapped spectral accelerations for short periods (U.S. Geological Survey Web Page, 2019)
F_a = Site coefficient from Table 1613.5.3(1), 2015 IBC
S_{MS} = The maximum considered earthquake spectral response accelerations for short periods
S_{DS} = 5-percent damped design spectral response acceleration at short periods

Table 5-2. Design Acceleration for 1-Second Period

S_1	F_v	S_{M1} ($S_{M1} = F_vS_1$)	S_{D1} (S_{D1} = 2/3 S_{M1})
0.057 g	2.4	0.138 g	0.092 g

S_1 = The mapped spectral accelerations for 1-second period (U.S. Geological Survey Web Page, 2019)
F_v = Site coefficient from Table 1613.5.3(2), 2015 IBC
S_{M1} = The maximum considered earthquake spectral response accelerations for 1-second period
S_{D1} = 5-percent damped design spectral response acceleration at 1-second period

6. Pavement Thickness Recommendations

The pavement thickness design was performed in general accordance with the AASHTO 1993 pavement design guidelines.

6.1 Anticipated Pavement Subgrade

The anticipated pavement subgrade materials encountered in our borings consist of lean clay, clayey sand, silty sand or bedrock. Based on the material types encountered, an R-value of 8 was used for design. Design Resilient Modulus (Mr) was calculated based on R-value on conversion. A Mr value of 3,336 psi and a modulus of subgrade reaction (K) value of 82 pci were used for the pavement thickness design.

The pavement should not be placed directly on the bedrock. If bedrock is exposed, it should be over-excavated and scarified to a minimum depth of 8 inches, moisture conditioned, and recompacted in accordance with Section 4.3.4 prior to the placement of pavement structure.

6.2 Traffic Loading

Design traffic loading assumes 500 passenger cars and pickups and one 5-axle trucks per day, and two dumpster trucks per week. This information was used to calculate the Average Annual Daily Traffic (AADT) and estimate the 18-kip Equivalent Single Axle Loads (ESAL) for a 20-year design period for asphalt pavement and concrete pavement. Based on these assumptions, an

ESAL of 27,910 is used for the flexible pavement design and 39,682 is used for rigid pavement design.

Recommended pavement sections are presented below in Table 6-1.

Table 6-1. Recommended Minimum Pavement Sections

Pavement Area	Minimum Asphaltic Concrete (AC) Design Thickness	Minimum Portland Cement Concrete (PCC) Design Thickness
New Pavement	- 4.5 inches HMA - 6.0 inches Aggregate Base - 8 inches Compacted Subgrade	- 5.0 inches PCC - 6.0 inches Aggregate Base - 8 inches Compacted Subgrade
Dumpster Pad/Fire Lane	N/A	- 6.0 inches PCC - 6.0 inches Aggregate Base - 8 inches Compacted Subgrade

HMA= Hot Mix Asphalt PCC= Portland Cement Concrete

We recommend PCC be placed in trash/dumpster areas or other areas where large/heavy trucks frequently stop or turn.

6.3 Pavement Materials

6.3.1 Base Course

We recommend Coarse Aggregate Type Class 6 to be used for the aggregate base materials. The material should be placed in a uniform layer without segregation of size and compacted in loose lifts not to exceed 8-inches. The material should be compacted as recommended in Section 4.3.4 of this report.

6.3.2 Hot Mix Asphalt

Hot mix asphalt materials, placement procedures, and testing should follow MGPEC Pavement Design Standards and Construction Specification Manual. We recommend PG 64-28 HMA binder with Grading S or SX aggregate, and gyration of 75 for pavement sections.

6.3.3 Portland Cement Concrete

The Portland Cement Concrete (PCC) shall conform to the requirements for Portland Cement Concrete Pavement, have a minimum 28-day flexural strength of at least 650 pounds per square inch (psi), and have a required minimum 28-day compressive strength of 4,500 psi.

6.4 Drainage

Proper drainage is of paramount importance in pavement performance. To avoid distress to pavement from wet, soft subgrade soils, we recommend the maintenance of good drainage away from all pavements. Possible water sources include storm runoff, irrigation of landscaping adjacent to the pavement and localized groundwater seepage, among others. Joints in the pavement or at asphalt/concrete interfaces should be sealed. Any cracks or openings in the finished pavement surface should be sealed and/or repaired as quickly as possible.

6.5 Pavement Maintenance

Annual maintenance generally refers to crack filling and general surface sealers. We recommend implementation of an at least annual if not more frequent flatwork/pavement crack sealing program. This is very important to prevent surface water (especially from slow infiltration from sources such as snow melt and surface run-off) from entering cracks and wetting the subgrade. Any cracks or openings in the finished pavement surface should be sealed and/or repaired as quickly as possible.

7. LIMITATIONS

The findings and recommendations presented in this report are based upon data obtained from borings, field observations, laboratory testing, our understanding of proposed construction, and other sources of information referenced in this report. It is possible that subsurface conditions may vary between or beyond the locations explored. If subsurface conditions are encountered during construction that differ from those described herein, GEG should be notified immediately in order for a review to be made and any supplemental recommendations provided. If the scope of the proposed construction, including the proposed loads or structural locations, changes from that described in this report, the conclusions and recommendations contained in this report are not considered valid unless the changes are reviewed, and the conclusions of this report are modified or approved in writing, by GEG.

This report was prepared in in a manner consistent with that level of care and skill ordinarily exercised by other members of GEG's profession practicing in the same locality, under similar conditions and at the date the services were provided. GEG makes no other representation, guarantee, or warranty, express or implied, regarding the services, communication (oral or written), report, opinion, or instrument of service provided.

The scope of services for this subsurface exploration and geotechnical report did not include environmental assessments or evaluations regarding the presence or absence of wetlands or hazardous substances in the soil, surface water, or groundwater at this site.

The recommendations provided in this report are based on the assumption that an adequate program of tests and observations will be conducted by GEG during the construction phase in order to evaluate compliance with our recommendations. The scope of our services did not include any environmental assessment or exploration for the presence of hazardous or toxic materials in the soil, surface water, groundwater or air, on, below or around this site.

This report may be used only by the Client and the registered design professional in responsible charge and only for the purposes stated for this specific engagement within a reasonable time from its issuance, but in no event later than three (3) years from the date of the report.

Appendix A

FIGURE A-1: SITE LOCATION PLAN

FIGURE A-2: BORING LOCATION PLAN

PROJECT NO.	24-152
DRAWN:	10/22/2024
DRAWN BY:	JT
CHECKED BY:	HML
FILE NAME:	
O'Reilly in Parker	

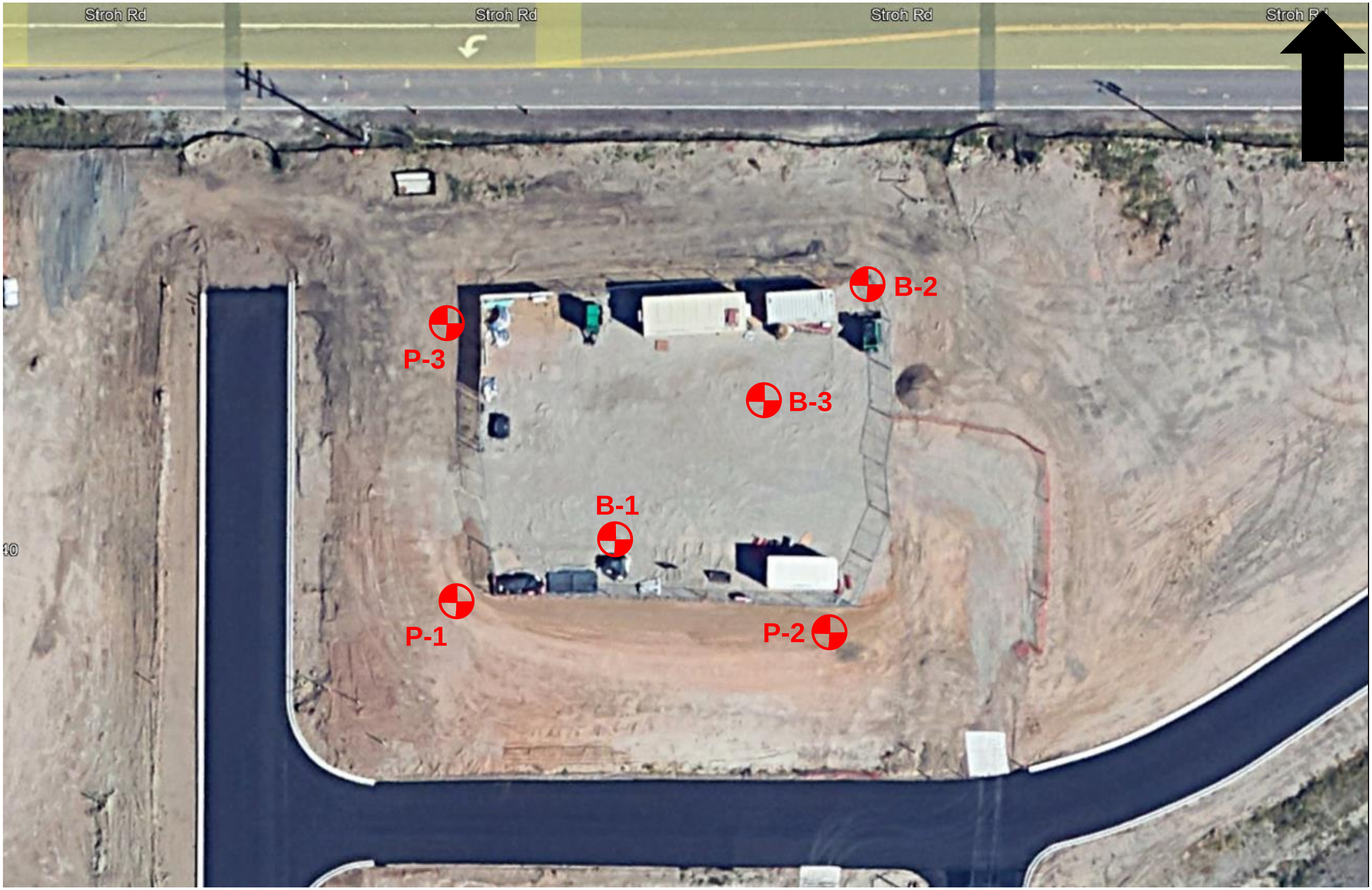
GRANITE ENGINEERING GROUP

SITE LOCATION PLAN

24-152 ES O'Reilly Auto Parts
Parker, CO

FIGURE

A-1



GRANITE ENGINEERING GROUP

PROJECT NO.	24-152
DRAWN:	10/22/2024
DRAWN BY:	JT
CHECKED BY:	HML
FILE NAME:	
O'Reilly in Parker	

BORING LOCATION PLAN

24-152 ES O'Reilly Auto Parts
Parker, CO

FIGURE

A-2

Appendix B

KEY TO BORING LOGS

BORING LOGS

Legend for Symbols Used on Borehole Logs

Sample Types

Modified California Sampler (2.5 inch OD, 2.0 inch ID)

Lithology Symbols (see Boring Logs for complete descriptions)

- USCS Low Plasticity Clay
- USCS Clayey Sand
- USCS Silty Sand
- USCS Poorly-graded Sand
- Claystone
- Sandstone

Lab Test Standards

Moisture Content	ASTM D2216
Dry Density	ASTM D7263
Sand/Fines Content	ASTM D421, ASTM C136, ASTM D1140
Atterberg Limits	ASTM D4318
AASHTO Class.	AASHTO M145, ASTM D3282
USCS Class.	ASTM D2487

(Fines = % Passing #200 Sieve
Sand = % Passing #4 Sieve, but not passing #200 Sieve)

Other Lab Test Abbreviations

pH	Soil pH (AASHTO T289-91)
S	Water-Soluble Sulfate Content (AASHTO T290-91, ASTM D4327)
Chl	Water-Soluble Chloride Content (AASHTO T291-91, ASTM D4327)
S/C	Swell/Consolidation (ASTM D4546)
UCCS	Unconfined Compressive Strength (ASTM D2166)
R-Value	Resistance R-Value (ASTM D2844)
DS (C)	Direct Shear cohesion (ASTM D3080)
DS (phi)	Direct Shear friction angle (ASTM D3080)
Re	Electrical Resistivity (AASHTO T288-91)
PtL	Point Load Strength Index (ASTM D5731)

Notes

1. "Penetration Resistance" on the Boring Logs refers to the uncorrected N value for SPT samples only, as per ASTM D1586. For samples obtained with a Modified California (MC) sampler, drive depth is 12 inches, and "Penetration Resistance" refers to the sum of all blows. Where blow counts were > 50 for the 3rd increment (SPT) or 2nd increment (MC), "Penetration Resistance" combines the last and 2nd-to-last blows and lengths; for other increments with > 50 blows, the blows for the last increment are reported.
2. The Modified California sampler used to obtain samples is a 2.5-inch OD, 2.0-inch ID (1.95-inch ID with liners), split-barrel sampler with internal liners, as per ASTM D3550. Sampler is driven with a 140-pound hammer, dropped 30 inches per blow.
3. "ER" for the hammer is the Reported Calibrated Energy Transfer Ratio for that specific hammer, as provided by the drilling company.

GRANITE ENGINEERING GROUP

Project Name: O'Reilly Auto Parts Store Parker, Colorado

Project Number: 24-152 Boring No.: **B-01**

Boring Began: 10/21/2024
Boring Completed: 10/21/2024
Drilling Method(s): Solid-Stem Auger (4" OD)
Driller: Custom Auger Drilling-Fred, Gilbert
Drill Rig: CME 45
Hammer Type: Cathead and rope, ER: 60%

Total Depth: 14.5 ft
Ground Elevation:
Coordinates: Lat: 39.4780613 Long: -104.7565115
Location: Parker, CO
Logged By: JT
Final By:

Weather Notes: Cloudy, cool
Inclination from Horiz.: Vertical
Night Work: ☐

Groundwater Levels: Not Observed			
Symbol			
Depth	dry	-	-
Date	10/21/24	-	-

Elevation (feet)	Depth (feet)	Sample Type/ Advancement Method	Blows per 6 in	Penetration Resistance	Lithology	Material Description	Moisture Content (%)	Dry Density (pcf)	Gravel Content (%)	Sand Content (%)	Fines Content (%)	Liquid Limit	Plasticity Index	AASHTO & USCS Classifi-cations	Field Notes and Other Lab Tests
						0.0 - 4.0 ft. CLAYEY SAND, SC, tan-gray-brown-rust, medium plasticity, moist, medium dense.									
			11-11	22			16.4		3	63	33.7	35	14	A-2-6 (1) SC	pH=6.56 S=0% Chl=0.015% Re=660ohm·cm
			18-21	39		**4.0 - 13.5 ft. SANDY LEAN CLAY**, CL, tan-gray-brown-rust, medium plasticity, moist, hard.	8.7		2	47	50.9	35	15	A-6 (5) CL	
	5														
			17-16	33			12.4	112.5							S/C=0.8% @ 200 psf
			16-24	40											
	10														
			50/5"	50/5"		**13.5 - 14.5 ft. CLAYSTONE**, grey, slightly weathered, hard.									

Bottom of Hole at 14.5 ft.

GEO GRANITE ENGINEERING GROUP	Project Name: O'Reilly Auto Parts Store Parker, Colorado	PAGE 1 of 1
	Project Number: 24-152	Boring No.: **B-02**

Boring Began: 10/21/2024
Boring Completed: 10/21/2024
Drilling Method(s): Solid-Stem Auger (4" OD)
Driller: Custom Auger Drilling-Fred, Gilbert
Drill Rig: CME 45
Hammer Type: Cathead and rope, ER: 60%

Total Depth: 15.0 ft
Ground Elevation:
Coordinates: Lat: 39.4782627 Long: -104.7562812
Location: Parker, CO
Logged By: JT
Final By:

Weather Notes: Cloudy, cool
Inclination from Horiz.: Vertical
Night Work: ☐

Groundwater Levels: Not Observed			
Symbol			
Depth	dry	-	-
Date	10/21/24	-	-

Elevation (feet)	Depth (feet)	Sample Type/ Advancement Method	Blows per 6 in	Penetration Resistance	Lithology	Material Description	Moisture Content (%)	Dry Density (pcf)	Gravel Content (%)	Sand Content (%)	Fines Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	AASHTO & USCS Classifi-cations	Field Notes and Other Lab Tests
						0.0 - 2.0 ft. SILTY SAND, SM, brown-tan and reddish orange, medium plasticity, moist, medium dense.									
			7-11	18			24.1		1	60	39.3	41	14	A-7-6 (2) SM	
						2.0 - 12.0 ft. SANDY LEAN CLAY, CL, brown and gray, low plasticity, moist, very stiff to stiff.									
			10-10	20			12.3	97.8							S/C=-1.9% @ 200 psf
	5														
			12-14	26			17.2								
			5-7	12											
	10														
						12.0 - 15.0 ft. CLAYEY SAND, SC, light brown, low plasticity, moist, medium dense.									
			9-9	18											
	15					Bottom of Hole at 15.0 ft.									

GEG Granite Engineering Group

Project Name: O'Reilly Auto Parts Store, Parker, Colorado

Project Number: 24-152 *Boring No.:* **B-03**

Boring Began: 10/21/2024
Boring Completed: 10/21/2024
Drilling Method(s): Solid-Stem Auger (4" OD)
Driller: Custom Auger Drilling-Fred, Gilbert
Drill Rig: CME 45
Hammer Type: Cathead and rope, ER: 60%

Total Depth: 15.0 ft
Ground Elevation:
Coordinates: Lat: 39.4782013 Long: -104.7564274
Location: Parker, CO
Logged By: JT
Final By:

Weather Notes: Rainy
Inclination from Horiz.: Vertical
Night Work: ☐

Groundwater Levels: Not Observed			
Symbol			
Depth	dry	-	-
Date	10/21/24	-	-

Elevation (feet)	Depth (feet)	Sample Type/ Advancement Method	Blows per 6 in	Penetration Resistance	Lithology	Material Description	Moisture Content (%)	Dry Density (pcf)	Gravel Content (%)	Sand Content (%)	Fines Content (%)	Liquid Limit	Plasticity Index	AASHTO & USCS Classifications	Field Notes and Other Lab Tests
						0.0 - 15.0 ft. SILTY SAND, SM, red-brown to tan, low plasticity, moist, medium dense to loose.									
			8-11	19											
	5		9-9	18			12.2	109.5	14	57	28.7	36	10	A-2-4 (0) SM	S/C=0.8% @ 200 psf
			8-9	17											
	10		5-5	10											
	15		3-4	7											

Bottom of Hole at 15.0 ft.

GEG
GRANITE ENGINEERING GROUP

Project Name: O'Reilly Auto Parts Store
Parker, Colorado

Project Number: 24-152 *Boring No.:* **P-01**

Boring Began: 10/21/2024
Boring Completed: 10/21/2024
Drilling Method(s): Solid-Stem Auger (4" OD)
Driller: Custom Auger Drilling-Fred, Gilbert
Drill Rig: CME 45
Hammer Type: Cathead and rope, ER: 60%

Total Depth: 14.5 ft
Ground Elevation:
Coordinates: Lat: 39.4780373 Long: -104.7566544
Location: Parker, CO
Logged By: JT
Final By:

Weather Notes: Cloudy, cool
Inclination from Horiz.: Vertical
Night Work: ☐

Groundwater Levels: Not Observed			
Symbol			
Depth	dry	-	-
Date	10/21/24	-	-

Elevation (feet)	Depth (feet)	Sample Type/ Advancement Method	Soil Samples: Blows per 6 in	Soil Samples: Penetration Resistance	Lithology	Material Description	Moisture Content (%)	Dry Density (pcf)	Gravel Content (%)	Sand Content (%)	Fines Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	AASHTO & USCS Classifi-cations	Field Notes and Other Lab Tests
						0.0 - 2.0 ft. CLAYEY SAND, SC, brownish orange, low plasticity, moist, dense.									
			22-26	48											
						2.0 - 5.0 ft. SANDSTONE, gray+pink and reddish orange, moderately weathered, medium hard.									
			33-50/5"	50/5"			16.5	99.6	0	73	26.7	40	7	A-2-4 (0) SM	S/C=1.1% @ 200 psf
	5					**5.0 - 14.5 ft. CLAYSTONE**, gray+pink and reddish orange, slightly weathered, medium hard to hard.									
			50/6"	50/6"											
			38-50/5.5"	50/5.5"											
	10														
			50/5"	50/5"											

Bottom of Hole at 14.5 ft.

GRANITE ENGINEERING GROUP

Project Name: O'Reilly Auto Parts Store, Parker, Colorado

Project Number: 24-152 *Boring No.:* **P-02**

Boring Began: 10/21/2024
Boring Completed: 10/21/2024
Drilling Method(s): Solid-Stem Auger (4" OD)
Driller: Custom Auger Drilling-Fred, Gilbert
Drill Rig: CME 45
Hammer Type: Cathead and rope, ER: 60%

Total Depth: 14.5 ft
Ground Elevation:
Coordinates: Lat: 39.4779809 Long: -104.7563546
Location: Parker, CO
Logged By: JT
Final By:

Weather Notes: Cloudy, cool
Inclination from Horiz.: Vertical
Night Work: ☐

Groundwater Levels: Not Observed			
Symbol			
Depth	dry	-	-
Date	10/21/24	-	-

Elevation (feet)	Depth (feet)	Sample Type/ Advancement Method	Soil Samples: Blows per 6 in	Soil Samples: Penetration Resistance	Lithology	Material Description	Moisture Content (%)	Dry Density (pcf)	Gravel Content (%)	Sand Content (%)	Fines Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	AASHTO & USCS Classifications	Field Notes and Other Lab Tests
						0.0 - 5.0 ft. CLAYEY SAND, SC, tan to rusty brown, medium plasticity, moist, medium dense to loose.									
		X	8-9	17			12.5	106.3							S/C=1.2% @ 200 psf
		X	4-4	8			15.1		3	49	48.2	39	20	A-6 (6) SC	
	5					**5.0 - 14.0 ft. SANDY LEAN CLAY**, CL, tan-brown and brownish gray, low plasticity, moist, very stiff.									
		X	11-14	25											
	10	X	13-20	33											
		X	50/6"	50/6"		**14.0 - 14.5 ft. CLAYSTONE**, gray-red and tan, slightly weathered, hard.									

Bottom of Hole at 14.5 ft.

GRANITE ENGINEERING GROUP

Project Name: O'Reilly Auto Parts Store Parker, Colorado

Project Number: 24-152

Boring No.: **P-03**

Boring Began: 10/21/2024

Boring Completed: 10/21/2024

Drilling Method(s): Solid-Stem Auger (4" OD)

Driller: Custom Auger Drilling-Fred, Gilbert

Drill Rig: CME 45

Hammer Type: Cathead and rope, ER: 60%

Total Depth: 15.0 ft

Ground Elevation:

Coordinates: Lat: 39.4782764 Long: -104.7566299

Location: Parker, CO

Logged By: JT

Final By:

Weather Notes: Rainy

Inclination from Horiz.: Vertical

Night Work: ☐

Groundwater Levels: Not Observed			
Symbol			
Depth	dry	-	-
Date	10/21/24	-	-

Elevation (feet)	Depth (feet)	Sample Type/ Advancement Method	Soil Samples: Blows per 6 in	Soil Samples: Penetration Resistance	Lithology	Material Description	Moisture Content (%)	Dry Density (pcf)	Gravel Content (%)	Sand Content (%)	Fines Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	AASHTO & USCS Classifi-cations	Field Notes and Other Lab Tests
						0.0 - 3.0 ft. SILTY SAND with GRAVEL, SM, tan, medium plasticity, moist, medium dense.									
			9-9	18			11.3		38	43	19.4	41	15	A-2-7 (0) SM	
						3.0 - 6.0 ft. SANDY LEAN CLAY, CL, brown, low plasticity, moist, stiff.									
	5		5-7	12			16.0	106.4							S/C=0.4% @ 200 psf
						6.0 - 12.0 ft. SILTY SAND, SM, tan, no plasticity, damp, medium dense.									
			8-8	16											
	10		6-8	14											
						12.0 - 15.0 ft. POORLY GRADED SAND, SP, tan, no plasticity, damp, loose.									
	15		4-5	9											

Bottom of Hole at 15.0 ft.

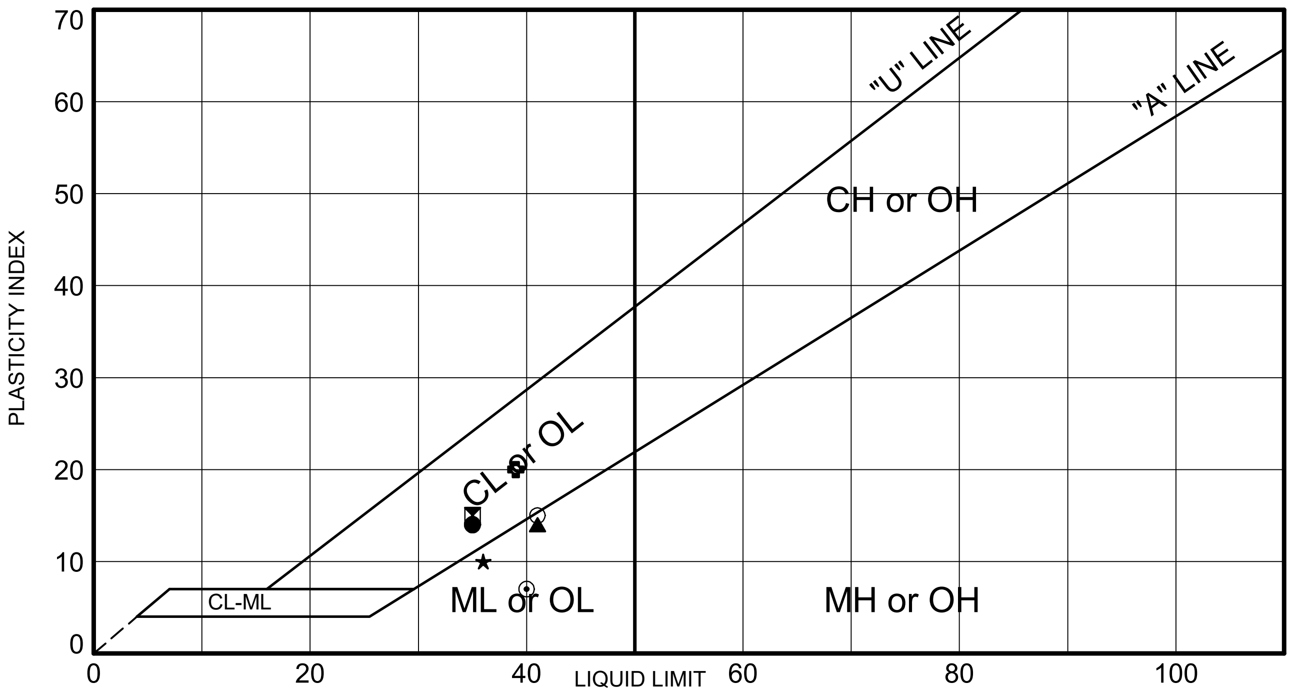
Appendix C

LABORATORY TEST RESULTS

Summary of Laboratory Test Results

Project No: 24-152 Project Name: O'Reilly Auto Parts Store, Parker, Colorado

Sample Location			Natural Moisture Content (%)	Natural Dry Density (pcf)	Gradation			Atterberg			pH	Water Soluble Sulfate (%)	% Swell (+) / Consolidation (-)	Unconf. Comp. Strength (psf)	R-Value	Classification	
Boring No.	Depth (ft)	Sample Type			Gravel > #4 (%)	Sand (%)	Fines < #200 (%)	LL	PL	PI						AASHTO	USCS
B-01	1.0~2.0	MC	16.4		3.0	63.3	33.7	35	21	14	6.56	0.000			--	A-2-6(1)	SC
B-01	4.0~5.0	MC	8.7		2.0	47.1	50.9	35	20	15						A-6(5)	CL
B-01	7.0~8.0	MC	12.4	112.5									0.8% @ 200 psf		--	--	--
B-02	1.0~2.0	MC	24.1		1.0	59.7	39.3	41	27	14						A-7-6(2)	SM
B-02	4.0~5.0	MC	12.3	97.8									-1.9% @ 200 psf		--	--	--
B-02	7.0~8.0	MC	17.2													--	--
B-03	4.0~5.0	MC	12.2	109.5	14.0	57.3	28.7	36	26	10			0.8% @ 200 psf		--	A-2-4(0)	SM
P-01	4.0~5.0	MC	16.5	99.6	0.0	73.3	26.7	40	33	7			1.1% @ 200 psf		--	A-2-4(0)	SM
P-02	1.0~2.0	MC	12.5	106.3									1.2% @ 200 psf		--	--	--
P-02	4.0~5.0	MC	15.1		3.0	48.8	48.2	39	19	20						A-6(6)	SC
P-03	1.0~2.0	MC	11.3		38.0	42.6	19.4	41	26	15						A-2-7(0)	SM
P-03	4.0~5.0	MC	16.0	106.4									0.4% @ 200 psf		--	--	--



	BOREHOLE	DEPTH	LL	PL	PI	Passing #200	USCS Sample Description	AASHTO Class.
●	**B-01**	**1.0**	**35**	**21**	**14**	**34**	**CLAYEY SAND(SC)**	**A-2-6(1)**
⧗	**B-01**	**4.0**	**35**	**20**	**15**	**51**	**SANDY LEAN CLAY(CL)**	**A-6(5)**
▲	**B-02**	**1.0**	**41**	**27**	**14**	**39**	**SILTY SAND(SM)**	**A-7-6(2)**
★	**B-03**	**4.0**	**36**	**26**	**10**	**29**	**SILTY SAND(SM)**	**A-2-4(0)**
⊙	**P-01**	**4.0**	**40**	**33**	**7**	**27**	**SILTY SAND(SM)**	**A-2-4(0)**
✿	**P-02**	**4.0**	**39**	**19**	**20**	**48**	**CLAYEY SAND(SC)**	**A-6(6)**
○	**P-03**	**1.0**	**41**	**26**	**15**	**19**	**SILTY SAND with GRAVEL(SM)**	**A-2-7(0)**

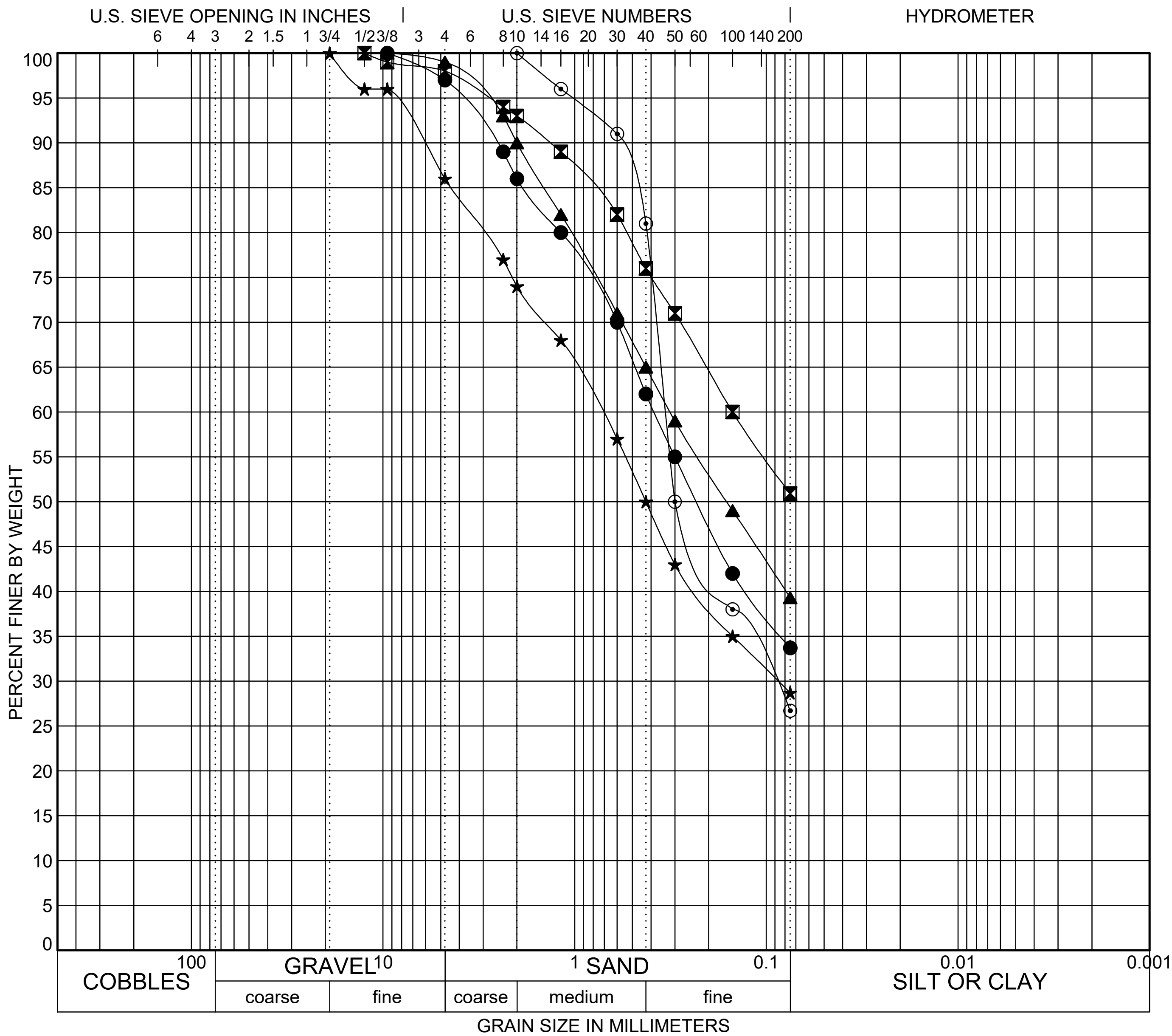
GRANITE ENGINEERING GROUP

ATTERBERG LIMITS

FIGURE C - 1

Project No. 24-152 Date: 10/28/2024
Drawn By: Lab
Checked By: PM

O'Reilly Auto Parts Store
Parker, Colorado



BOREHOLE		DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	%Gravel	%Sand	%Fines %Silt	%Fines %Clay
●	**B-01**	**1.0**	**A-2-6(1)**	**SC**	**35**	**21**	**14**	**3.0**	**63.3**	**33.7**	
⊠	**B-01**	**4.0**	**A-6(5)**	**CL**	**35**	**20**	**15**	**2.0**	**47.1**	**50.9**	
▲	**B-02**	**1.0**	**A-7-6(2)**	**SM**	**41**	**27**	**14**	**1.0**	**59.7**	**39.3**	
★	**B-03**	**4.0**	**A-2-4(0)**	**SM**	**36**	**26**	**10**	**14.0**	**57.3**	**28.7**	
⊙	**P-01**	**4.0**	**A-2-4(0)**	**SM**	**40**	**33**	**7**	**0.0**	**73.3**	**26.7**	

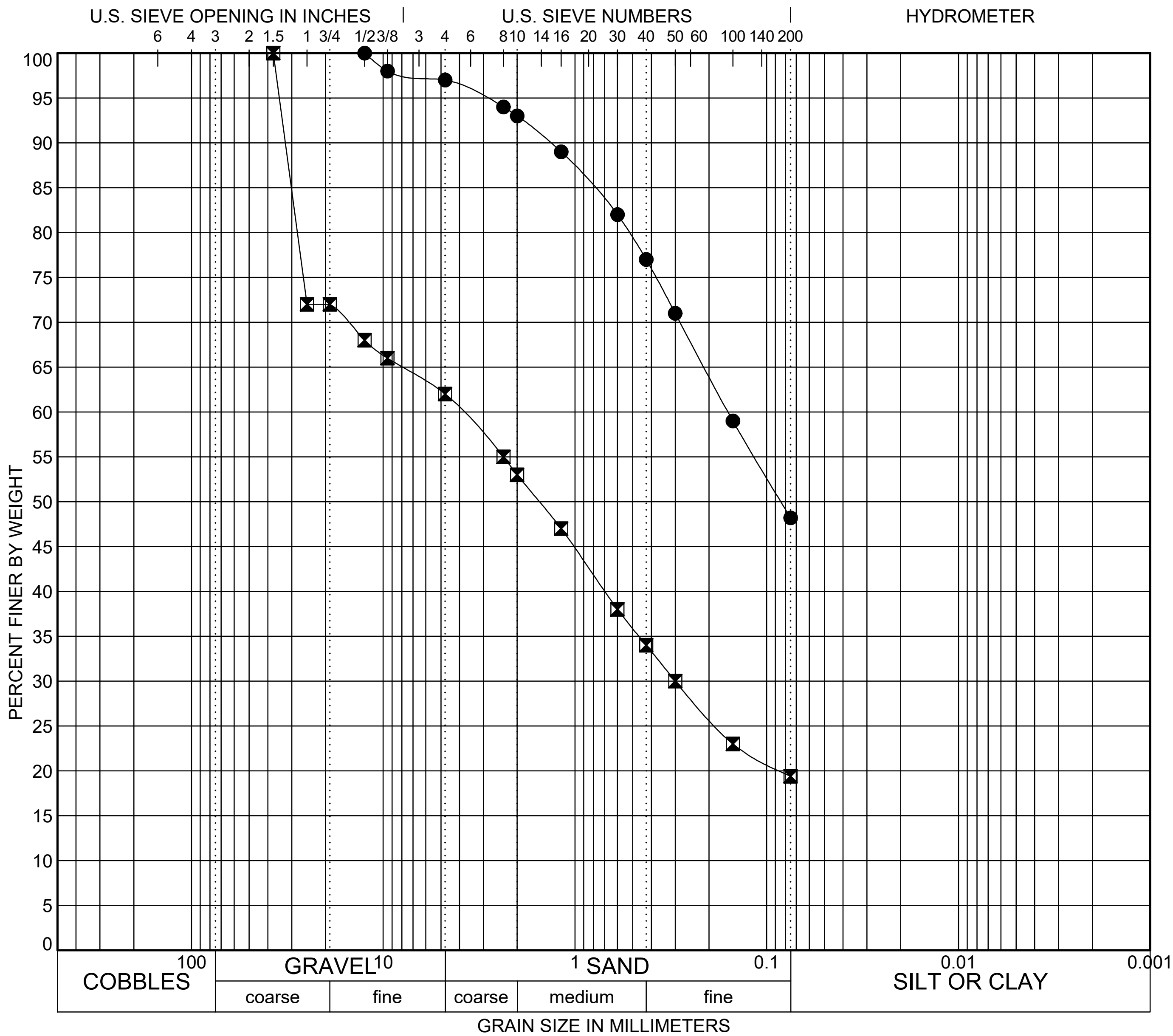
GRANITE ENGINEERING GROUP

SIEVE ANALYSIS

FIGURE C- 2

Project No. 24-152 Date: 10/28/2024
Drawn By: Lab
Checked By: PM

O'Reilly Auto Parts Store
Parker, Colorado



BOREHOLE		DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	%Gravel	%Sand	%Fines %Silt	%Fines %Clay
●	**P-02**	**4.0**	**A-6(6)**	**SC**	**39**	**19**	**20**	**3.0**	**48.8**	**48.2**	
⊠	**P-03**	**1.0**	**A-2-7(0)**	**SM**	**41**	**26**	**15**	**38.0**	**42.6**	**19.4**	

GRANITE ENGINEERING GROUP

SIEVE ANALYSIS

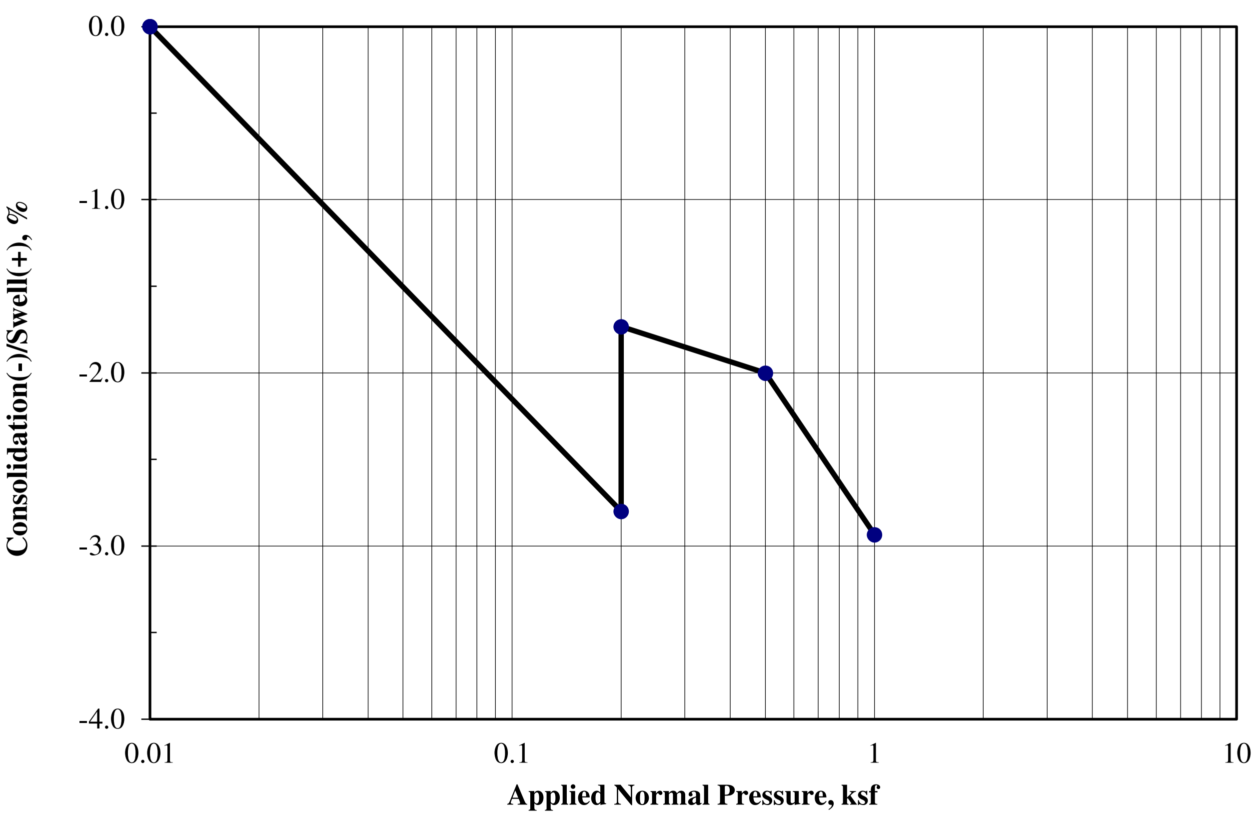
FIGURE

C- 3

Project No. 24-152 Date: 10/28/2024
Drawn By: Lab
Checked By: PM

O'Reilly Auto Parts Store
Parker, Colorado

SWELL/CONSOLIDATION TEST - ASTM D 4546



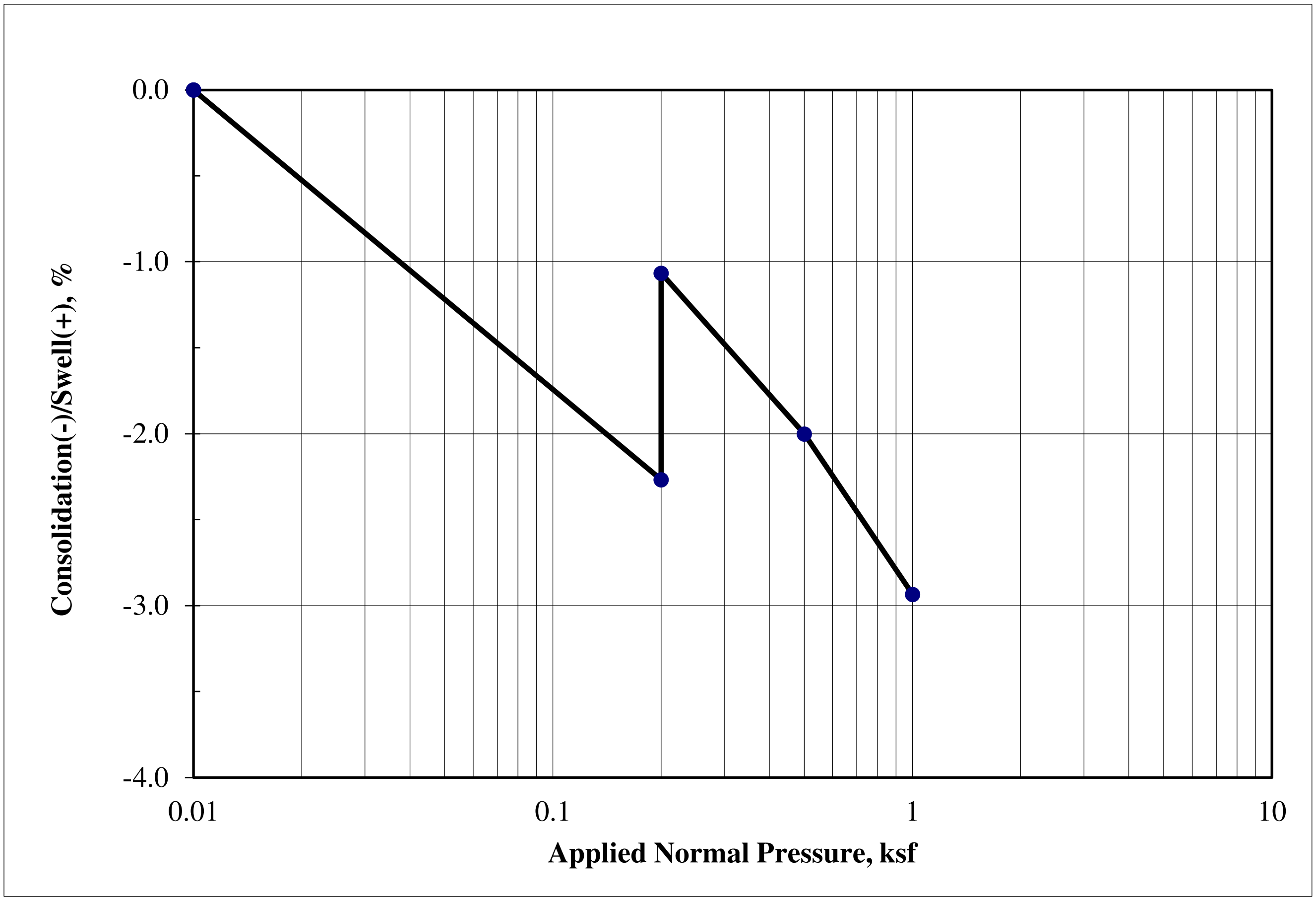
Boring ID	P-01
Sample Depth (ft)	4'
Date Sampled	10/21/2024

Swell/ Consolidation (%)	1.1
Natural Moisture Content (%)	16.5
Saturated Moisture Content (%)	27.6
Dry Density (pcf)	99.6

GRANITE ENGINEERING GROUP

Project No.	24-152	Date:	10/18/2022	**SWELL/ CONSOLIDATION TEST RESULTS**	**FIGURE**
Report By:	HML			O'Reilly Auto Parts Store	**C-4**
Checked By:	XC			Parker, Colorado	

SWELL/CONSOLIDATION TEST - ASTM D 4546



Boring ID	P-02
Sample Depth (ft)	1'
Date Sampled	10/21/2024

Swell/ Consolidation (%)	1.2
Natural Moisture Content (%)	12.5
Saturated Moisture Content (%)	30.7
Dry Density (pcf)	106.3

GEG
GRANITE ENGINEERING GROUP

Project No.	24-152	Date:	10/18/2022
Report By:	HML		
Checked By:	XC		

SWELL/ CONSOLIDATION TEST RESULTS

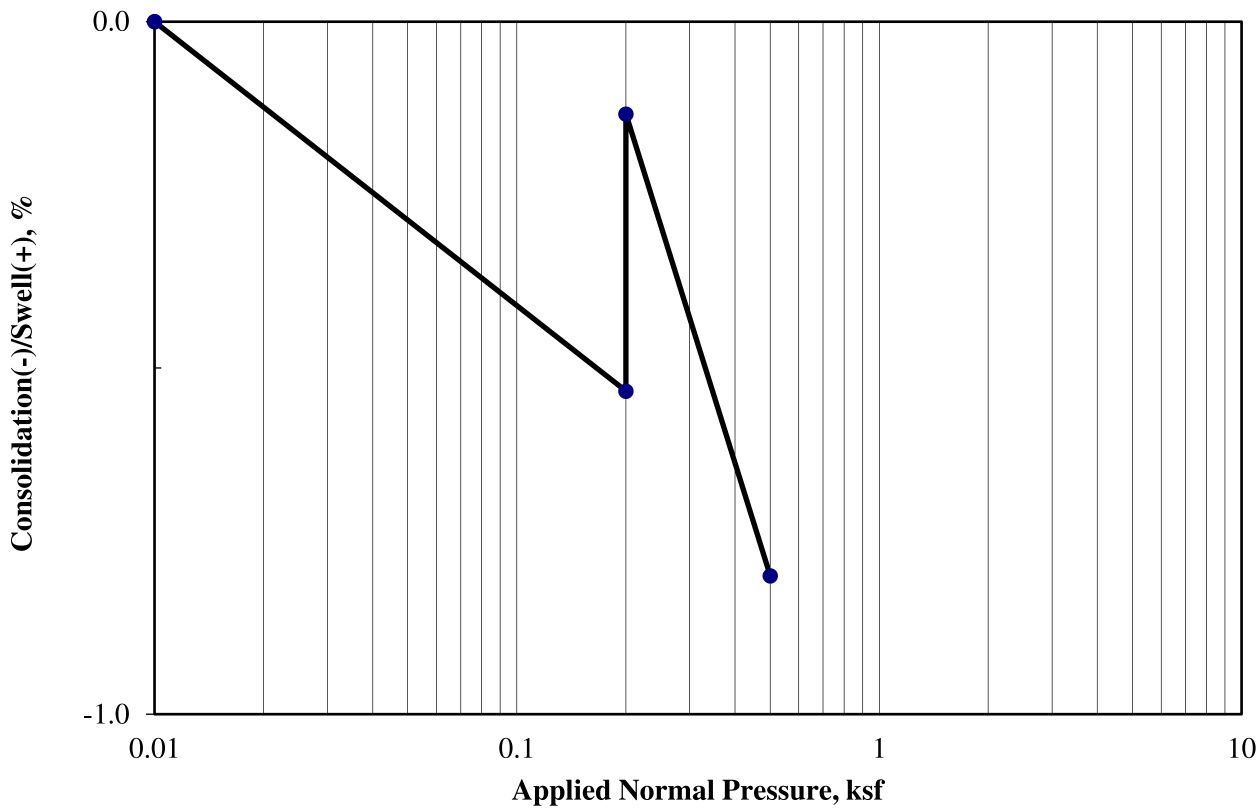
O'Reilly Auto Parts Store

Parker, Colorado

FIGURE

C-5

SWELL/CONSOLIDATION TEST - ASTM D 4546



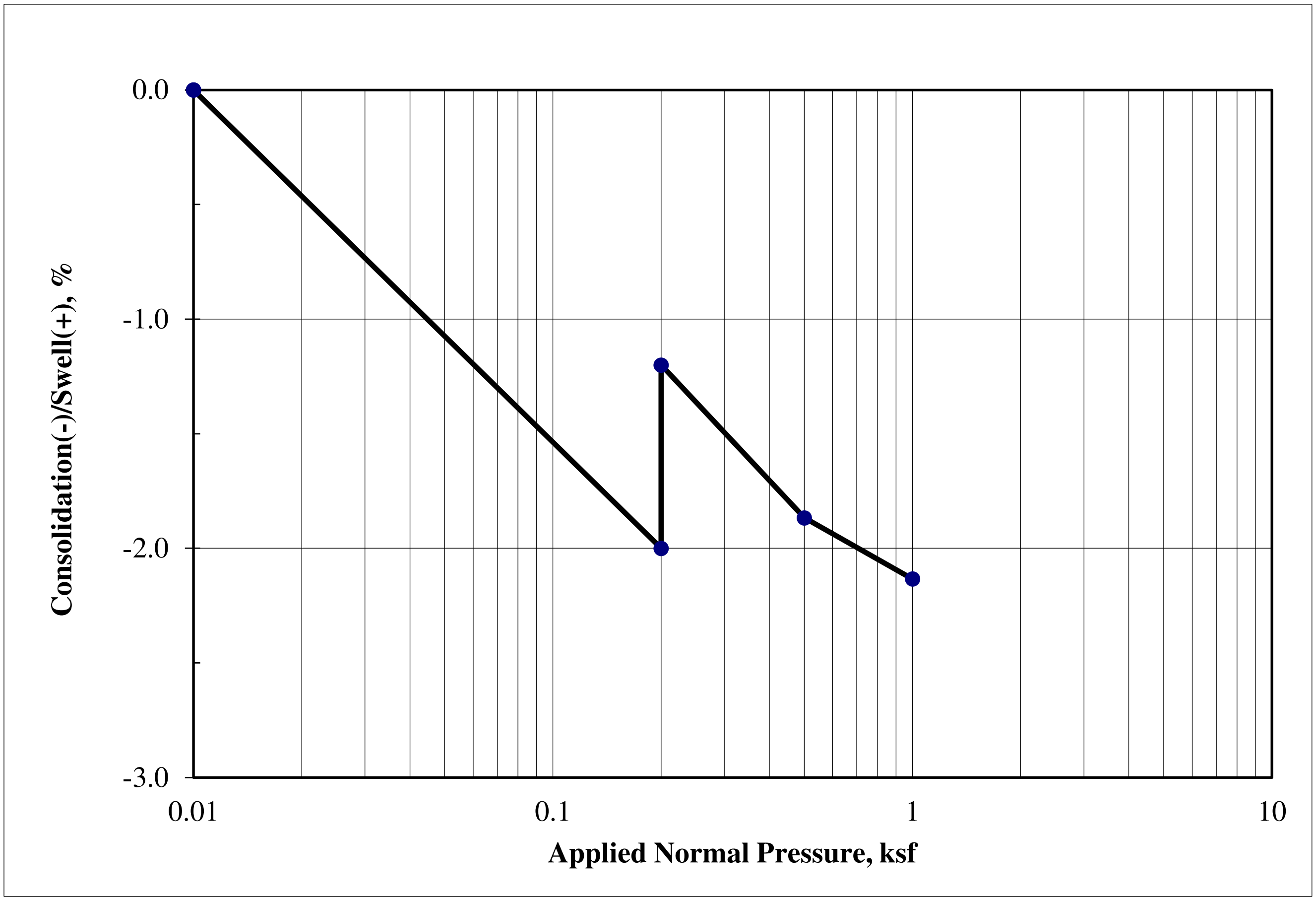
Boring ID	P-03
Sample Depth (ft)	4'
Date Sampled	10/21/2024

Swell/ Consolidation (%)	0.4
Natural Moisture Content (%)	16
Saturated Moisture Content (%)	19.7
Dry Density (pcf)	106.4

GRANITE ENGINEERING GROUP

Project No.	24-152	Date:	10/18/2022	**SWELL/ CONSOLIDATION TEST RESULTS**	**FIGURE**
Report By:	HML			O'Reilly Auto Parts Store	**C-6**
Checked By:	XC			Parker, Colorado	

SWELL/CONSOLIDATION TEST - ASTM D 4546



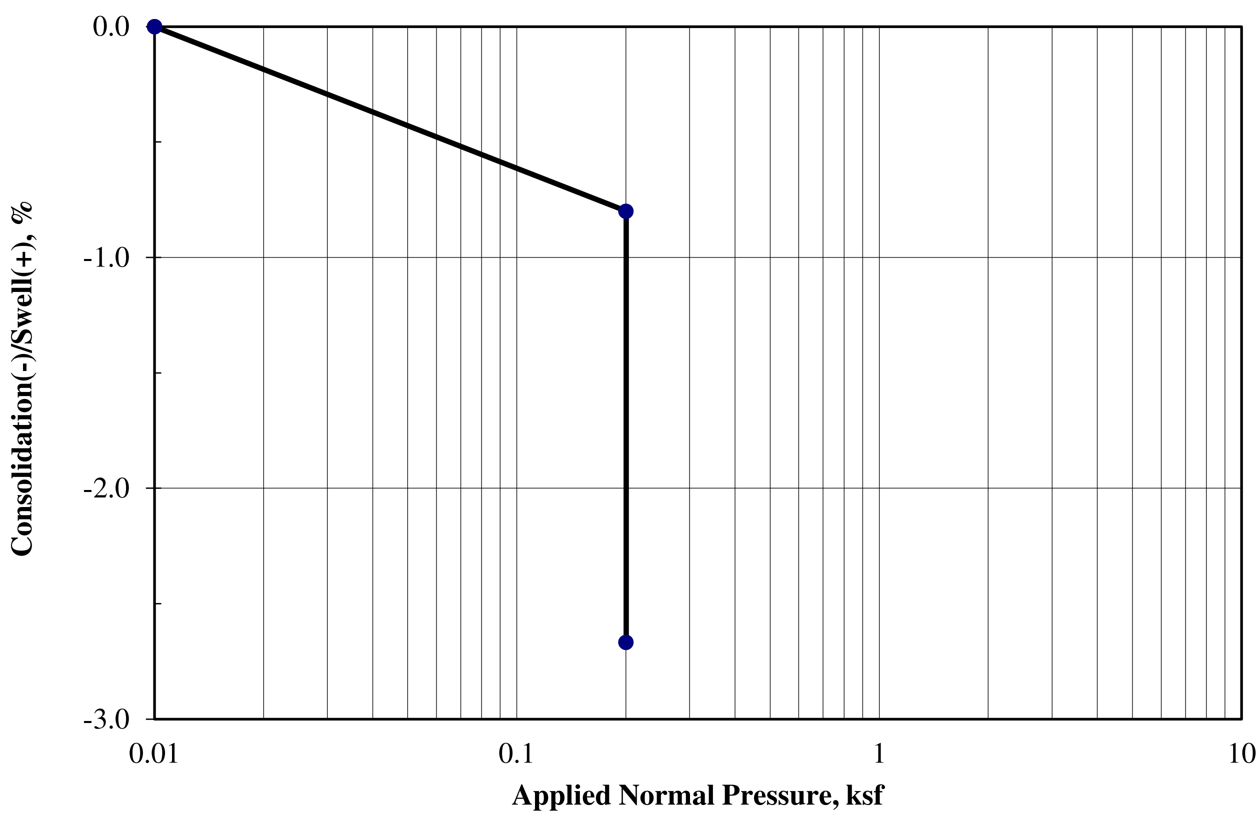
Boring ID	B-01
Sample Depth (ft)	7'
Date Sampled	10/21/2024

Swell/ Consolidation (%)	0.8
Natural Moisture Content (%)	12.4
Saturated Moisture Content (%)	23
Dry Density (pcf)	112.5

GRANITE ENGINEERING GROUP

Project No. 24-152 Date: 10/18/2022	**SWELL/ CONSOLIDATION TEST RESULTS**	**FIGURE**
Report By: HML	O'Reilly Auto Parts Store	**C-7**
Checked By: XC	Parker, Colorado	

SWELL/CONSOLIDATION TEST - ASTM D 4546



Boring ID	B-02
Sample Depth (ft)	4'
Date Sampled	10/21/2024

Swell/ Consolidation (%)	-1.9
Natural Moisture Content (%)	12.3
Saturated Moisture Content (%)	22.1
Dry Density (pcf)	97.8

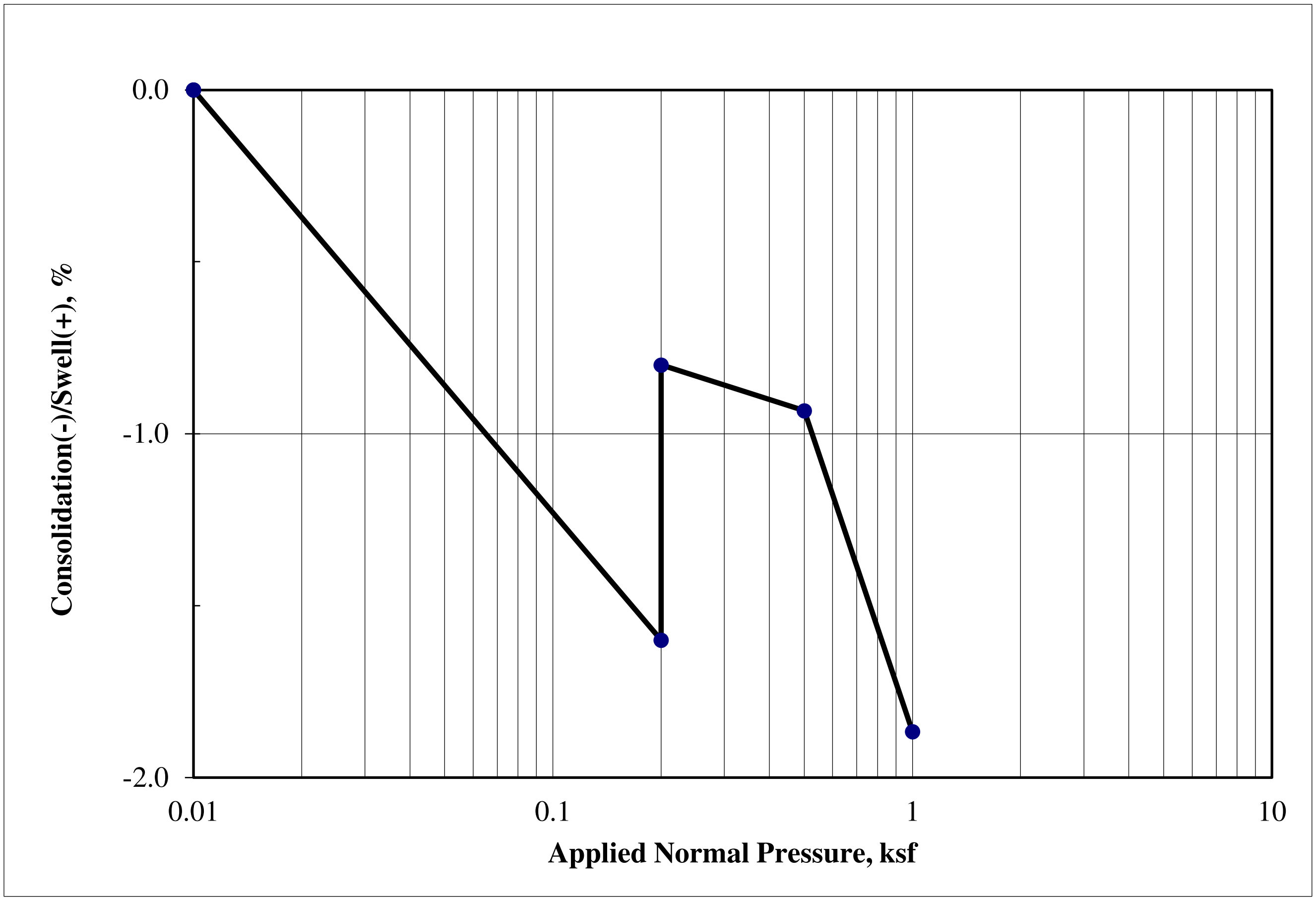
GRANITE ENGINEERING GROUP

Project No.	24-152	Date:	10/18/2022	**SWELL/ CONSOLIDATION TEST RESULTS**
Report By:	HML			O'Reilly Auto Parts Store
Checked By:	XC			Parker, Colorado

FIGURE

C-8

SWELL/CONSOLIDATION TEST - ASTM D 4546



Boring ID	B-03
Sample Depth (ft)	4'
Date Sampled	10/21/2024

Swell/ Consolidation (%)	0.8
Natural Moisture Content (%)	12.2
Saturated Moisture Content (%)	24.4
Dry Density (pcf)	109.5

GRANITE ENGINEERING GROUP

Project No.	24-152	Date:	10/18/2022	**SWELL/ CONSOLIDATION TEST RESULTS**	**FIGURE**
Report By:	HML			O'Reilly Auto Parts Store	**C-9**
Checked By:	XC			Parker, Colorado	

Corrositivity Suite Report

Project No. 24-152

Project Name: O'Reilly in Parker

Sample ID B-01 @ 1'

Lab Number

Test	Results	Method
pH	6.56	ASTM G51
Resistivity	660Ω	ASTM G57
Sulfate- Water Soluble	0%	CP-L 2103
Chloride- Water Soluble	0.015%	CP-L 2104

Appendix D

PAVEMENT DESIGN OUTPUTS

WinPAS

Pavement Thickness Design According to

1993 AASHTO Guide for Design of Pavements Structures

American Concrete Pavement Association

Flexible Design Inputs

Project Name: 24-152 O'Reilly Auto Parts Store
Route:
Location: Parker, CO
Owner/Agency:
Design Engineer:

Flexible Pavement Design/Evaluation

Structural Number	2.70		**Subgrade Resilient Modulus**	3,336.00	**psi**
Total Flexible ESALs	27,910		**Initial Serviceability**	4.50	
Reliability	90.00	**percent**	**Terminal Serviceability**	2.00	
Overall Standard Deviation	0.44				

Layer Pavement Design/Evaluation

Layer Material	Layer Coefficient	Drainage Coefficient	Layer Thickness	Layer SN
Asphalt Cement Concrete	0.44	1.00	4.50	1.98
Crushed Stone Base	0.12	1.00	6.00	0.72
			ΣSN	2.70

Tuesday, October 29, 2024 8:46:38AM Engineer:CC

WinPAS

Pavement Thickness Design According to

1993 AASHTO Guide for Design of Pavements Structures

American Concrete Pavement Association

Rigid Design Inputs

Project Name:	24-152 O'Reilly Auto Parts Store
Route:	
Location:	Parker, CO
Owner/Agency:	
Design Engineer:	

Rigid Pavement Design/Evaluation

Concrete Thickness	4.84	**inches**	**Load Transfer Coefficient**	4.20	
Total Rigid ESALs	39,682		**Modulus of Subgrade Reaction**	82	**psi/in.**
Reliability	90.00	**percent**	**Drainage Coefficient**	1.00	
Overall Standard Deviation	0.44		**Initial Serviceability**	4.50	
Flexural Strength	650	**psi**	**Terminal Serviceability**	2.00	
Modulus of Elasticity	3,400,000	**psi**			

Modulus of Subgrade Reaction (k-value) Determination

Resilient Modulus of the Subgrade	0.0
Unadjusted Modulus of Subgrade Reaction	0
Depth to Rigid Foundation	0.00
Loss of Support Value (0,1,2,3)	0.0

Modulus of Subgrade Reaction	82	**psi/in.**