REPORT OF GEOTECHNICAL EXPLORATION

KUM & GO #2293

NORTH PINERY PARKWAY AND BAYOU GULCH ROAD
PARKER, CO

PREPARED FOR
ENTITLEMENT AND ENGINEERING SOLUTIONS, INC.

September 16, 2022
Olsson Project No. 022-03197

olsson®

September 16, 2022

Entitlement and Engineering Solutions, LLC
Attn: Ms. Mary Kasal
501 S Cherry Street
Denver, CO 80246

Re: Report of Geotechnical Exploration
Kum & Go #2293
Parker, Colorado
Olsson Project No. 022-03197

Dear Ms. Kasal,

Olsson has completed the geotechnical engineering report for the above referenced project. The enclosed report summarizes our understanding of the project, presents the findings of the field exploration and laboratory tests, discusses the observed subsurface conditions, and based on those conditions, provides geotechnical engineering recommendations for the Kum & Go project.

We appreciate the opportunity to provide our geotechnical engineering services for this project. If you have any questions or need further assistance, please contact us at your convenience.

Respectfully submitted,
Olsson, Inc.

Preston Mills, P.E. .....Kellen Petersen

Associate Engineer.....Senior Geotechnical Engineer

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APPENDICES

Kum & Go Fact Sheet

Store # **2293**

Project address: **North Pinery Parkway and Bayou Gulch Road, Parker, Colorado** Date: **09/16/2022**

Engineer: **Preston Mills, P.E.** Phone #: **303-237-2072**

SITE PREPARATION

Is building demolition necessary (Y/N):	**No**	
Are below grade structures known to exist (basements, crawlspaces, UST's) (Y/N/U):	**No**	
Above or below ground utility demolition/relocation (Y/N/U):	**Unknown**	
Is shoring anticipated during construction (Y/N):	**No**	
Old fill encountered that will require rework (Y/N):	**No**	
Estimated topsoil stripping depth (in):	**2-6**	**Loose Sand/Gravel**
Scarification thickness (in):	**12**	
Proofrolling (Y/N): Where feasible. Not recommended in areas of fuel lines or UST installation	**Yes**	**See Report**
Highest recorded groundwater depth from existing grade (ft):	**Not Encountered**	
Lowest recorded groundwater depth from existing grade (ft):	**Not Encountered**	
Unsuitable or unstable soil identified during exploration (Y/N):	**No**	
Exterior pavement subgrade preparation thickness (in):	**12**	
Pavement underslab drainage system recommended (Y/N):	**No**	
Additional pavement subgrade recommendations necessary (Y/N):	**No**	
Do available reports indicate the site was utilized by others prior to Kum & Go (Y/N):	**No**	

Additional Comments: On-site soils appear suitable for reuse as structural fill with proper preparation. Olsson should be contacted if the FFE varies from the provided 6081.0 feet. Documented fill has been placed across much of the site resulting from mass grading of the lot in 2019.

STRUCTURAL FILL

On site soils suitable for reuse? (Y/N):	**Yes**	**See Report**
Import Fill Soils Maximum Liquid Limit (%):	**45**	
Import Fill Soils Maximum Plastic Limit (%):	**25**	
Maximum Swell Potential (%):	**1% at 500 psf Surcharge**	
Maximum Particle Size (in):	**3**	
Recommended lift thickness (in):	**4 to 8**	**See Report**

FOUNDATION DESIGN/FLOOR SLAB

Recommended Building Foundation Type:	**Shallow Spread (or Trench Type) Foundations**	
Finish Floor Elevation (ft):	**6081.0**	
Recommended Frost Depth (in):	**36**	
Are overexcavation and structural fill recommended below shallow foundations? (Y/N):	**No**	**Surface Compaction**
Is surcharge or preload necessary to prepare the building pad (Y/N):	**No**	
Net allowable soil bearing pressure (psf):	**3,000**	
Minimum column footing width dimensions (in):	**24**	
Minimum continuous footing width dimensions (in):	**18**	
Are perimeter foundation drains recommended for the building (Y/N)	**No**	
Floor slab subgrade preparation thickness (in):	**12**	

****This Fact Sheet only provides a limited overview of the report and is subject to any and all clarifications, conditions, contingencies, limitations and/or qualifications that may exist in the body of the report. The information contained in this Fact Sheet is provided pursuant to Client's request and is provided solely for the convenience of Client and neither Client nor any other party can rely solely on this Fact Sheet. Client and any other party using this report must review the entire report and interpret the information contained in this Fact Sheet in conjunction with the remainder of the report.**

Created by: Preston Mills, P.E.

1. PROJECT UNDERSTANDING

1.1. GEOTECHNICAL SCOPE

This Report of Geotechnical Exploration was requested and authorized by Ms. Mary Kasal of Entitlement and Engineering Solutions Inc. for the purpose of evaluating existing subsurface conditions and providing geotechnical design recommendations for the new Kum & Go #2293 building, signs, and pavements.

The scope of this geotechnical exploration included:

- Site reconnaissance and review of soil and geologic subsurface information from the United States Department of Agriculture's (USDA) Natural Resource Conservation Service (NRCS).
- Review of the project site concept plan entitled "Conceptual Site Plan" completed by EES and dated 05/18/2022.
- Review of the revised project site concept plan and grading plan entitled "Preliminary Site & Utility Plan" completed by EES and dated 8/22/2022.
- Review of density testing results from the report entitled "Trails at Crowfoot, Filings 1 and 9" completed by CTL Thompson, Inc. and dated March 14, 2019.
- Drilling and sampling of ten (10) soil test borings extending to depths of approximately 10.5 to 25.5 feet below existing grades.
- Laboratory testing (as noted in the appendices) of soil samples obtained during the field operations.
- Preparation of this Report of Geotechnical Exploration presenting the soil test borings, laboratory test results, and a summary of our engineering evaluations and recommendations.

1.2. SITE LOCATION AND DESCRIPTION

The 1.40-acre Kum & Go project site is situated in the southeast quadrant of the intersection of Bayou Gulch Road and North Pinery Parkway in Parker, Colorado. The elevation survey indicates the site has about 12 feet of grade change, sloping from an elevation of 6,073 feet in the northeast corner to 6,085 feet in the southwest corner. Based on the grading plan provided by EES, a finished floor elevation of 6081.0 feet was used for this report and cut/fill depths on the order of 3.5 feet or less are anticipated to achieve final design grades across the site. If the finished floor elevation varies from these provided values, ***Olsson*** should be contacted immediately to review and/or revise the recommendations provided in this report.

Review of readily available aerial images obtained from Historic Aerials and Google Imagery indicates the site was vacant between 1955 and 2018. In 2018, commercial and residential development including mass grading and roadway construction began on and around the site and continues until present day.

1.3. PROJECT INFORMATION

We understand the new Kum & Go facility will include an approximately 3,968-square foot, single-story, slab on grade building utilizing light gauge steel framework and brick veneer to be located on the western portion of the lot facing east. New automobile fuel pump islands with an overhead canopy will be positioned east of the new building. The underground storage tanks (UST) will be positioned in the area east of the pump islands. Parking areas will be constructed south and east of the building. Access to the facility will be provided by one entrance from North Pinery Pkwy and two entrances from the south via a private access road connecting to Alpine Phlox to the east and Bayou Gulch Road to the south.

Based on our experience with the Kum & Go V1 Bistro building design, ***Olsson*** understands maximum live and dead loads for the new building will be on the order of 60 kips each for isolated column, 1.5 klf for continuous walls, and 100 psf for floor slabs.

Olsson understands that the type and design of canopy support foundations will be determined by the Canopy Manufacturer/Installer based on their review of the contents of this geotechnical report and the soil conditions encountered at the time of foundation installation. ***Olsson*** will provide recommendations for canopy foundation design, subgrade improvements, or stabilization of canopy foundation subgrades if requested by Kum & Go.

2. EXPLORATORY AND TEST PROCEDURES

2.1. FIELD EXPLORATION

An ATV-mounted drill rig utilizing solid-stem continuous augers was used to complete ten (10) soil borings for this project. Soil boring depths and locations were selected by ***Olsson*** and approved by Mary Kasal of EES during the proposal phase of this project. The soil boring locations and depths may have been modified or shifted in the field, if necessary, to avoid known underground or overhead utilities, existing structures, site features, public right-of-way, or areas of limited access. Refer to the *Boring Location Map* in *Appendix A* and the *Boring Logs* in *Appendix B* for the final locations and depths of each boring.

Relatively undisturbed and split-barrel soil samples were obtained at 2.5- to 5-foot depth intervals during the drilling process. Soil samples designated as “SS” were obtained in general accordance with ASTM D1586 (Penetration Test and Split-Barrel Sampling of Soils). Soil samples designated as "MC" on the boring logs were obtained in general accordance with ASTM D3550 (Thick Wall, Ring-Lined, Split-Barrel, Drive Sampling of Soils) with a Modified California Barrel Sampler. The “MC” sampler was driven to a 12-inch depth, as it can only sample a maximum 16-inches of soil. Recovered samples were sealed in plastic containers or sampling tubes, labeled, and protected for transportation to the laboratory for testing.

2.2. LABORATORY TESTING

Per the laboratory scope and sample conditions, tests were completed to evaluate the engineering properties of recovered soil samples. Moisture content and density tests were completed to determine the existing moisture state and unit weight of subsurface soils. Full gradations and P-200s were completed to determine the ratio of fines (clay and silt) to sands and gravels. Atterberg Limits were completed to help classify samples with more cohesion to determine the soil plasticity. A corrosion series was performed to determine the potential for sulfate attack on concrete and corrosion of buried metal pipes. One-dimensional swell/consolidation testing was performed on nine select samples. Proctor and R-value tests were performed on a bulk sample collected in pavement areas to determine pavement subgrade characteristics. Laboratory tests were conducted in general accordance with current ASTM test procedures. A summary of the laboratory test results is presented in *Appendix C*.

3. Subsurface Conditions

3.1. Area Geology

Based on the U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS) soil survey data, the project site is mapped in Fondis-Kutch association unit (5 to 15 percent slopes). The Fondis-Kutch association unit is described as linear Eolian deposits over coarse-silty outwash. The Fondis-Kutch association unit is categorized as hydrologic group C.

Based on a review of USGS Geologic Mapping by Tweto and Ogden (1979), the project site is most likely underlain by Quaternary Older gravels and alluvium. This unit is characterized by the presence of unconsolidated coarse-detrital sand and gravel.

By review of Potentially Swelling Soil and Rock in the Front Range Urban Corridor mapping by Hart (1972), the project site is situated in an area described as having a moderate swell potential with the possibility of higher swelling layers below the sand and gravel layers.

3.2. Test Borings and Laboratory Summary

Note that modifications to the site plan were made after the borings for the originally proposed Kum & Go site were drilled in June 2022. The main modifications included relocation of the underground storage tanks to the south of their original location and an access road was added to the south of the project site.

Soil stratification, as shown on the boring logs, represents soil conditions at the specific boring locations; however, variations may occur between or beyond the borings. The stratification lines represent the approximate boundary between soil types, but the actual transition between soil layers may be gradual. Approximately 2 to 6 inches of loose sand and gravel fill was encountered at the surface in each boring and fill materials from the mass grading operations were encountered below the surficial layer in all of the borings except for B-8 and B-9. The fill material appears to have been placed in a controlled manner with field testing and documentation performed by CTL Thompson, Inc.

Borings B-1, B-2, and B-3 were drilled in the proposed building footprint. B-1 encountered fill consisting of clayey sand to 12.5 feet, overlying native lean clay to 16 feet, underlain by claystone extending to the termination depth. B-2 encountered fill consisting of clayey sand to 5.5 feet overlying native lean clay with sand to a depth of 13 feet, underlain by claystone extending to the termination depth. B-3 encountered fill consisting of clayey sand to 8.0 feet overlying native lean clay to 12.5 feet, underlain by claystone extending to the termination depth.

Borings B-4 and B-5 were drilled within the proposed pump islands and canopy area. Boring B-4 encountered clayey sand fill to a depth of 12.5 feet, overlying native lean clay to 22.5 feet, underlain by claystone to the termination depth. Boring B-5 encountered clayey sand fill to a depth of 5.5 feet, overlying claystone to 17.5 feet, underlain by sandstone to the termination depth.

Boring B-6 was drilled within the originally proposed UST excavation. Clayey sand fill was encountered to a depth of 12.5 feet which was underlain by claystone to the termination depth.

Boring B-7 was drilled near the proposed northwest monument sign location and B-8 was drilled near the proposed southwest monument sign location. Boring B-7 encountered sandy lean clay fill to a depth of 12.5 feet overlying claystone to the termination depth. Boring B-8 encountered claystone throughout the boring to the termination depth.

Pavement borings B-9 and B-10 were drilled in the proposed southeast and northeast pavement areas. B-9 encountered native clayey sand to 3.0 feet underlain by claystone extending to the termination depth. Boring B-9 encountered clayey sand fill for the entire explored depth of both boring.

3.3. Soil Properties

Table 1: Summary of Soil Properties

Fill – with varying sand, clay, and gravel contents, various shades of brown and gray, moist

USCS Classification	Dry Density (pcf)	Moisture Content (%)	Saturation (%)	LL / PI (%)	P-200 (%)	SPT "N" Values (bpf)
SC, CL	101.1 – 130.2	6.7 – 22.9	55.9 – 85.4	37 - 44 / 18 - 26	20.6 – 67.3	10 – 50+

Native – with varying amounts of sand, gravel, and clay, stiff to hard, various shades of brown, moist

USCS Classification	Dry Density (pcf)	Moisture Content (%)	Saturation (%)	LL / PI (%)	P-200 (%)	SPT "N" Values (bpf)
CL	112.6 – 120.9	10.9 – 14.9	64.6 – 82.3	43 – 44 / 25 – 28	82.8	16 – 40

Claystone – moderately to highly weathered, various shades of brown and gray, moist

USCS Classification	Dry Density (pcf)	Moisture Content (%)	Saturation (%)	LL / PI (%)	P-200 (%)	SPT "N" Values (bpf)
Claystone	109.4 – 114.4	9.6 – 18.0	75.5 – 83.9	N/T	50.9 – 83.7	26 – 50+

N/T = Not Tested

Sandstone – strongly cemented, various shades of gray, moist

USCS Classification	Dry Density (pcf)	Moisture Content (%)	Saturation (%)	LL / PI (%)	P-200 (%)	SPT "N" Values (bpf)
Sandstone	N/T	N/T	N/T	N/T	N/T	50+

N/T = Not Tested

3.4. Groundwater Summary

Free water was not encountered in any of the borings completed during this exploration. Free or perched groundwater is not expected to widely impact site grading, earthwork, shallow building construction, UST installation, or utilities. If groundwater is encountered during excavation, the contractor should be adequately prepared for dewatering and/or shoring, where applicable.

It should be noted that groundwater levels (perched or otherwise) typically fluctuate with seasonal variations in precipitation, runoff, snowmelt, irrigation demands, or other factors that may differ from those at the time of the drilling operations. *Section 4.4* of this report addresses general groundwater or drainage concerns as applicable to the site design and earthwork as we now understand them.

3.5. Corrosivity of Soils

The results of the water-soluble sulfate, pH, chloride, and resistivity testing are summarized as follows:

Table 2: Soil Corrosion Testing Summary

Test/Sample Location	Sulfate (% mass)	Relative Degree of Sulfate Attack	Chloride (% mass)	pH	Soil resistivity (ohms-cm)
B-3 GB-1 1-3'	N/D	Negligible	0.0138	7.94	1736

N/D = Not Detected – Concentration below equipment detection limit of 0.1% mass

The resistivity value indicates that the soils may be severely corrosive to buried metal. A mechanical/electrical designer, experienced with local building code requirements and local practice, should review the laboratory test results presented above and determine if corrosion protection of buried utility lines is required and how it is to be implemented.

Laboratory results indicate a negligible risk of sulfate attack for concrete exposed to soils on this site. No specific cement type is required per ACI 201.2R, based on the sulfate levels less than 0.10 percent by mass. To help control superficial damage in concrete exposed to prolonged moisture or high groundwater, the water/cement ratio should not exceed 0.50. Refer to *Appendix C, Summary of Laboratory Test Results* for additional information. An experienced designer should review these results and evaluate the suitability of proposed designs based on the corrosivity test results.

3.6. Evaluation of On-Site Soils

Laboratory test results show that the onsite sand and lean clay soils have low collapse potential, with collapse results between 0.3% to 0.4% at inundation pressures ranging from 500 psf to 1,000 psf, and low to moderate swell potential with swell results of 0.1% to 3.3% at inundation pressures ranging from 200 psf to 1,000 psf. Laboratory test results for claystone bedrock indicates moderate swell potential, with swell results of 2.1% to 3.7% at inundation pressures ranging from 1,000 psf to 2,000 psf. Results of the collapse and swell testing are shown in Table 3, below. Based on the encountered soil conditions, a shallow foundation system should be suitable for the proposed building, provided the exposed foundation subgrades are surface compacted after excavation and the recommendations in this report are followed.

TABLE 3. LABORATORY SWELL TEST RESULTS

Test/Sample Location	Material	In-situ moisture (%)	In-situ dry density (pcf)	Inundation pressure (psf)	Percent swell (+) or collapse (-) (%)	Swell pressure (psf)
B-1 @ 3.5’	SC	10.8	115.7	500	-0.3	N/A
B-2 @ 6.0’	CL	10.9	115.8	1,000	1.0	2,915
B-3 @ 1.0’	SC	8.0	121.6	200	0.1	215
B-4 @ 6.0’	SC	19.1	101.1	1,000	-0.3	N/A
B-5 @ 9.0’	Claystone	15.2	109.2	1,000	3.7	6,405
B-6 @ 9.0’	SC	11.3	110.6	1,000	-0.4	N/A
B-7 @ 14.0’	Claystone	15.8	110.3	2,000	2.8	4,125
B-8 @ 9.0’	Claystone	14.3	114.2	1,000	2.1	8,000
B-9 @ 1.0’	CL	14.9	112.6	200	3.3	4,470

N/A= Not Applicable

The magnitude of volume change of the soil depends on various factors including soil composition, in-situ moisture content, in-situ density, and the change in moisture content. Care should be taken to prevent as much surface water infiltration into the subsurface materials as possible to reduce the swell or collapse potential.

Based on laboratory test results from areas sampled during this exploration, the on-site sand and lean clay soils appear suitable for reuse as structural fill with proper processing, moisture conditioning, and compaction.

Groundwater was not encountered in any of the borings drilled during our field exploration. Groundwater may fluctuate seasonally or with precipitation events. If groundwater is encountered during earthwork and/or construction activities the excavations should be adequately dewatered during these operations. The design, operation, and maintenance of the dewatering system during construction is the responsibility of the contractor.

4. SITE PREPARATION

4.1. GENERAL SITE PREPARATION

As noted, documented fill materials from the mass grading operations were encountered below the surficial layer in all the borings except for B-8 and B-9. The fill materials encountered, where identified on the boring logs, appear to have been placed in a controlled manner. While it appears that the structural fill is suitable for support of the proposed structures and pavements, we recommend an ***Olsson*** representative be present during grading operations to confirm that conditions across the site are consistent with the soils encountered in our borings. If inconsistencies are identified in the field, ***Olsson*** should be contacted to determine if additional recommendations are needed.

All topsoil, vegetation, major root systems, organic soils, and any loose, soft, or otherwise unsuitable or deleterious material encountered within the construction area should be stripped and removed from the site. If desired, suitable topsoil could be stockpiled onsite for later use in landscaping or non-loaded areas. Site clearing, grubbing, and stripping should be completed during periods of dry weather. Operating heavy equipment on the site during periods of wet weather could result in excessive pumping and rutting of the subgrade soils.

After grubbing, stripping, rough grading, and any excavations or over-excavations are complete, but prior to site grading and placement of structural fill, the exposed subgrade should be prepared by scarifying, moisture conditioning and compacting the upper 12 inches as recommended in *Section 4.2*. If bedrock is encountered at the base of any excavation, these materials should be surface compacted as opposed to scarified. In the southwest corner of the project site (near B-8), claystone was encountered near the ground surface. We recommend that any claystone encountered at the ground surface maintain a 2-foot buffer between the bottom of any pavements and the claystone. This may be accomplished by excavating 2 feet of the claystone bedrock, surface compacting the claystone bedrock, and backfilling with structural fill placed in accordance with *Section 4.2.*

After scarifying, moisture conditioning, and compacting, we recommend the subgrade be proofrolled wherever equipment access is feasible. Proofrolling may be accomplished with a fully loaded, tandem axle dump truck or other equipment with a minimum gross weight of 20 tons. Proofrolling aids in delineating soft or loose areas that may exist below subgrade level. Unsuitable areas identified by visual observation or proofrolling should be improved by compaction in-place or by overexcavation and replacement of the unsuitable or unstable soil or debris with compacted structural fill. We recommend that a full-time ***Olsson*** representative be on-site during all proofrolling and earthwork operations and during construction to observe and document uniform and stable subgrade conditions prior to placing new structural fill, foundations, floor slabs, or pavements. Construction scheduling often involves grading and paving by separate contractors and can involve a time lapse between the end of grading operations and the commencement of paving. Disturbance, desiccation, or wetting of the subgrade soils between grading and paving can result in deterioration of the previously completed subgrade. The final prepared

subgrade should be proofrolled again immediately prior to placing new pavements. Granular subgrade soils lacking adequate cohesive binder may rut or roll under construction equipment traffic. In these areas, the geotechnical engineer may elect to eliminate the proofrolling requirement.

4.2. STRUCTURAL FILL

Based on the results of our subsurface investigation, the on-site sand and lean clay soils appear suitable for reuse as general fill, structural fill, or utility backfill on this site. Excavated claystone bedrock should not be used as structural fill but may be reused in non-structural areas and green space. Imported fill materials, if required, should be low plasticity, non-expansive, cohesive material with a liquid limit less than 45, a plasticity index less than 20, having at least 25 percent passing the #200 sieve, and having a maximum swell potential of 1% under a 500 psf surcharge. If alternate borrow materials are considered, we recommend the contractor provide supplier gradation and/or laboratory plasticity and swell documentation to ***Olsson*** for review and approval prior to site delivery. Additional laboratory testing and documentation by ***Olsson*** geotechnical engineers will be required prior to the consideration or acceptance of imported fill materials.

Suitable fill materials should be placed in thin lifts. Lift thickness depends on the type of compaction equipment, but in general, lifts of 4 to 8-inch loose measurement are recommended. Soils should be compacted using equipment of appropriate size and type to achieve the requirements of this report. A self-propelled, vibratory sheepsfoot roller is generally recommended for compacting cohesive (clay and clayey) soils encountered on-site. For any cohesionless (sand or gravel) soils, a self-propelled, smooth drum roller is generally recommended for compaction. Wheel rolling using rubber-tired equipment is not an acceptable method of compaction and should not be allowed. Within small excavations, such as in footing trenches, utility trenches, or around manholes, “Wacker-Packers” or “Rammax” compactors for cohesive soils or vibrating plate compactors for granular soils (where allowed by the geotechnical engineer) can be used to achieve the specified compaction. Lift thicknesses should be reduced to 4 inches in small fill areas requiring hand-operated equipment. To achieve proper compaction of granular cushion materials, the stone should have the individual stone facets properly oriented using a plate compactor, jumping jack, or other vibratory compaction device.

During grading operations, representative samples of general and structural fill materials should be initially and periodically checked via laboratory testing to document that the previously mentioned soil parameters are maintained. An ***Olsson*** representative should regularly observe and monitor the excavation and grading operations and perform field density tests to document that the specified moisture and compaction requirements are being achieved. Full time field observation, moisture/density testing, and swell testing are recommended during the excavation, and replacement operations below and around the building, canopy, trash enclosure, and UST areas.

TABLE 4: STRUCTURAL FILL RECOMMENDATIONS

Areas of Fill Placement	Minimum Compaction (ASTM D698 Standard Proctor)	Moisture Content (Percent of Optimum)
Structural Fill – On-site or import soils placed below and within 10 feet of the building, (including entrance slabs and exterior slabs adjacent to the building) trash enclosure, canopies, and signs	95% Standard Proctor (ASTM D698)	-2 to +2 percent for cohesionless soils or -1 to +3 percent for non-expansive cohesive soil or 0 to +4 percent for claystone in non-structural areas or *As necessary to obtain density for cohesionless gravelly soil
Granular Subgrade/Drainage Course – Cohesionless gravelly materials such as No. 57 stone or equivalent to be placed directly below the	*95% Standard Proctor (ASTM D698)	
Utility Trenches – Cohesive backfill structural fill soils placed within new utility trenches.	95% Standard Proctor (ASTM D698)	
Underground Storage Tank Trench – On-site or imported structural fill or backfill soils within the UST trench	**95% Standard Proctor (ASTM D698)	
Pavement Subgrade – Structural fill soils below areas of new pavement	95% Standard Proctor (ASTM D698)	
Sidewalk Subgrade – Structural fill soils below areas of new sidewalks	95% Standard Proctor (ASTM D698)	
Non-Structural Fill – On-site soils beneath non-loaded landscape/grass areas	92% Standard Proctor (ASTM D698)	
Claystone in Non-Structural Areas and Green Space – processed to a soil consistency with no particles larger than 3" diameter	95% Standard Proctor (ASTM D698)	

*May be substituted with 65% "relative density" in accordance with ASTM D4253 and D4252
**Not to exceed tank manufacturer recommendations.

Granular fill materials may not produce a definable moisture-density curve when tested in accordance with ASTM D698 (Standard Proctor). Such materials could alternatively be compacted to a minimum of 65 percent Relative Density as determined by ASTM D4253 (Standard Test Methods for Minimum Index Density and Unit Weight of Soils Using a Vibratory Table) and D4254 (Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculations of Relative Density).

The moisture content for imported fill soils at the time of compaction should generally be maintained between the ranges specified above. More stringent moisture limits may be necessary with certain soils, and some adjustments to moisture contents may be necessary to achieve compaction in accordance with project specifications.

4.3. UTILITIES

New underground utilities should be installed in accordance with local building codes. Utility trench backfill should consist of compacted structural fill placed in accordance with *Section 4.2* of this report. Where utilities will penetrate the footprint of the building, it is recommended that a utility trench "plug" be constructed that extends at least 5 feet beyond the building perimeter. The trench plug should consist of non-expansive backfill materials having at least 50 percent passing the #200 sieve, to provide a moisture barrier to the soils within the influence zone of the new building. In addition, flexible connections should be used wherever possible.

Granular pipe bedding for new utilities is acceptable, but the remaining trench should be backfilled and compacted using the pre-approved, imported cohesive structural fill soils or on-site cohesive soils (blended as necessary) originally removed from the trench.

Water should be prevented from entering utility trenches before, during, and after construction. Excavations should not remain open if rain is anticipated. Excavations should be backfilled as soon as possible with approved structural fill to reduce the potential for moisture infiltration or sidewall sloughing.

4.4. DRAINAGE AND GROUNDWATER CONSIDERATIONS

Groundwater was not encountered during our field exploration. Consequently, groundwater or saturated soil conditions are not anticipated to widely impact site grading, earthwork, shallow foundations, flatwork, or construction of underground fuel tanks, or utilities at depths shallower than 20 feet. If water is encountered during construction, the contractor should be adequately prepared to dewater excavations.

Water should not be allowed to collect near foundations, floor slabs, or in areas of new pavements, either during or after construction. As applicable, provisions should be made to quickly remove accumulating seepage water or storm water runoff from excavations. Undercut or excavated areas should be sloped toward one corner to allow rainwater or surface runoff to be quickly collected and gravity drained or pumped from construction areas. Subgrade soils that are exposed to precipitation or runoff should be evaluated by the geotechnical engineer prior to the placement of new fill, reinforcing steel, or concrete, to determine if corrective action is required.

To minimize concerns related to improper or inadequate drainage away from foundation bearing subgrades or from cohesive backfill materials used in utility or foundation trenches, we provide the following general recommendations:

- Site grading should provide efficient drainage of rainfall or surface runoff away from new structures and pavements.
- Roof drains from the new building and canopies should be collected and discharged directly to the storm sewer or directed to a down gradient location away from structures and pavements.

- External hose connections in unpaved areas should incorporate splash blocks to prevent localized flooding of foundation bearing or backfill soils. External hose connections should have cut-off valves inside the building to prevent accidental or unauthorized use.
- Maintenance personnel should be informed of the potential concerns associated with excessive watering near the building.

Although groundwater was not encountered during our field investigation, groundwater may fluctuate seasonally or with precipitation events. If groundwater is encountered during earthwork and/or construction activities the excavations will need to be adequately dewatered during these operations. The design, operation, and maintenance of the dewatering system during construction is the responsibility of the contractor.

4.5. Construction Equipment Mobility

On-site or imported soils may be susceptible to softening under construction equipment traffic during periods of wet weather. Reducing equipment mobility problems and managing soft surface soils will be dependent on the severity of the circumstances, the soil types, the season in which construction is performed, and prevailing weather conditions.

Some general guidelines for reducing equipment mobility problems and addressing potential soft and wet surface soils are as follows:

- Optimize surface water drainage at the site during construction.
- Whenever possible, wait for dry weather conditions to prevail and do not operate construction equipment on the site during wet conditions. Rutting the surface soils will aggravate the condition and accelerate subgrade disturbance.
- Disk or scarify wet surface soils during periods of favorable weather to accelerate drying. Temporarily compact loose subgrade soils if rain is forecast to promote site drainage and reduce moisture infiltration.
- Use construction equipment that is well-suited for the intended job under the existing site conditions. Heavy rubber-tired equipment typically requires better site conditions than light, track-mounted equipment.
- Implement a construction schedule that realistically allows for rain days. Pressure to perform earthwork under a tight schedule is frequently counterproductive.

If requested, ***Olsson*** can help determine a cost-effective approach for stabilizing unsuitable soils at the time of construction.

4.6. TEMPORARY SLOPES AND EXCAVATIONS

Due to the granular nature of the subsurface soils, shoring may be necessary to provide support during excavation or backfilling operations and provide sidewall stability. Contractors experienced with local soil and groundwater should review the subsurface conditions and soil properties within this report and select their means, methods, and potential shoring needs accordingly.

Construction site safety is the responsibility of the general contractor. The contractor shall also be solely responsible for the means, methods, techniques, sequencing, and operations during construction. ***Olsson*** is providing the following information solely as a service to EES. Under no circumstances should ***Olsson***'s provision of the following information be construed to mean that we are assuming responsibility for construction site safety or the contractor's activities. Such responsibility is not implied and should not be inferred.

The contractor should be aware that slope height, slope inclination, and excavation depths (including utility trench excavations) should in no case exceed those specified in local, state, or federal safety regulations, e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations. Such regulations are strictly enforced, and if not followed, the owner, the contractor, or earthwork or utility subcontractors could be liable for substantial penalties. The contractor is responsible for reviewing this geotechnical report, determining the appropriate OSHA slope criteria for the soil conditions encountered, and implementing it during construction. Soils encountered in construction excavations may vary significantly across the site. Our soil classifications are based solely on the materials encountered in the widely spaced borings. The contractor should verify that similar soil conditions exist throughout the proposed areas of excavation. If different subsurface conditions are encountered at the time of construction, ***Olsson*** recommends that they be contacted to re-evaluate existing site conditions.

Temporary slopes steeper than 5H:1V should be properly benched prior to placement of new fill. As an alternative to flatter and benched temporary slopes, vertical excavations can be temporarily shored. The contractor should be responsible for the design of temporary shoring in accordance with applicable regulatory requirements. Permanent fill and cut slopes at the site should not exceed 3H:1V. Where steeper slopes are planned, additional analysis should be performed once grading plans have been developed.

Stockpiles of soils and equipment should not be placed within a horizontal distance equal to one-half the excavation depth, from the edge of the excavation. If excavations, including utility trenches, are extended to depths of more than 20 feet, OSHA requires that the side slopes of such excavations be designed by a professional engineer registered in the state where construction is occurring.

5. BUILDINGS AND STRUCTURES

5.1. SHALLOW FOUNDATION DESIGN

The site appears suitable for supporting the lightly loaded Kum & Go building on conventional shallow spread or trench type foundations bearing in the existing sandy fill soils. However, it is critical that that the foundation excavations be evaluated as discussed herein to document that the fill materials present across the building are consistent with the conditions encountered in the borings. Once documented, we recommend the exposed foundation subgrade be surface compacted to densify any loose material that develops during excavation operations.

Shallow foundations bearing on the surface compacted existing fill material may be designed using a net allowable soil bearing pressure of up to 3,000 pounds per square foot (psf). The net allowable bearing capacity can be increased by 1/3 for transient loadings (short term loading such as wind load or seismic load) when used with the alternative basic load combinations of Section 1605.3.2 of IBC 2018. These design recommendations are based on the anticipated maximum structural loads noted in *Section 1.3* of this report.

Building footings should have minimum dimensions in accordance with local building codes. ***Olsson*** recommends minimum dimensions of 18 inches for continuous footings and 24 inches for isolated column footings to minimize the potential for localized bearing failure. Perimeter footings and footings in unheated areas should bear at a minimum depth of 36 inches below the lowest adjacent final ground surface for frost protection per Parker Building Code requirements. Interior footings in heated areas can bear as shallow as necessary below the floor slab.

The use of the recommended design bearing pressure is contingent on having prepared foundation subgrades observed by an ***Olsson*** geotechnical engineer or his/her authorized field representative prior to placing new structural fill, reinforcing steel, or concrete to document that the subgrade soils and conditions are consistent with the bearing subgrade requirements of this report. Additionally, we recommend bearing subgrades be hand probed before placing reinforcing steel or concrete to identify soft, loose, or otherwise unsuitable conditions.

The total post-construction settlement for the new Kum & Go building with foundations less than 5 feet wide designed and constructed as recommended above is anticipated to be 1-inch with differential movement limited to less than ½-inch over 50 feet or between adjacent columns. To reduce the effects of differential movement, floating floor slabs with expansion joints, independent from wall and column loads, will be important in minimizing the potential cracking that can occur along and around foundation systems. Floor slab control joints should be used to reduce potential damage due to shrinkage cracks. Additionally, exterior veneers should be installed to allow abutting pavements and sidewalks to move independently.

Lateral resistance of the foundations will be achieved through a combination of base shear resistance mobilized at the footing-subgrade interface and passive earth pressure acting on the vertical faces of the footings at right angles to the direction of applied load. A friction coefficient value of 0.35 can be used between the on-site soil and the foundation concrete for base shear and sliding resistance. Passive earth pressure resistance can be calculated using parameters provided in *Section 5.6*. For foundations subjected to both uplift and lateral forces, the base friction should be neglected in the calculations.

The uplift resistance for the shallow foundation is developed by the dead load at the footing, and the weight of the soil directly above the footing. The weight of the soil can be calculated using the unit weight of the soil and the volume of a prismatic failure block with vertical faces above the footing edges.

After foundation subgrades have been observed and evaluated by an ***Olsson*** representative, concrete should be placed as soon as possible to avoid subjecting the exposed soils to drying, wetting, or freezing conditions. If foundation subgrade soils are subjected to such conditions, the geotechnical engineer should be contacted to reevaluate the foundation bearing materials. It will not be acceptable for the contractor to place lean concrete, flowable fill, or other types of "mud mat" below shallow foundations unless specifically directed by the geotechnical engineer.

If primarily granular fill soils are used within the upper 3 feet of the building subgrade, the use of formed spread foundations and stemwalls should be anticipated.

5.2. Monument Signs

Based on the results of our exploration and provided the recommendations in this report are followed, the site is suitable for the support of shallow foundations for the monument signs in the northwest and southwest corners of the site.

For the monument sign located at the southwest corner of the site, the shallow foundations are anticipated to bear on claystone bedrock. At the base of this excavation, the claystone bedrock should be surfaced compacted before placing concrete. These shallow spread foundations bearing on surface compacted claystone bedrock may be designed using a net allowable soil bearing pressure of up to 3,000 pounds per square foot (psf) with an estimated total movement on the order of 1.5 inches. If an estimated total movement on the order of 1.0 inches is needed, we recommend that this foundation be supported on at least 3 feet of structural fill which may be accomplished by a 36-inch overexcavation and replacement with structural fill and surface compacting the exposed claystone per *Sections 4.1* and *4.2.*

For the monument sign located in the northwest corner of the site, the shallow foundations will bear on sandy lean clay soils. These shallow spread foundations may be designed using a net allowable soil bearing pressure of up to 3,000 psf with an estimated total movement on the order of 1.0 inches.

5.3. Seismic Classification

Per the International Building Code (IBC), soils within the upper 100 feet determine the seismic structural design criteria for the project site. The soil shear strengths and blow counts (N values) were estimated based on the results of the laboratory testing program, field exploration, and the assumed soil properties on the undocumented soils below the lowest boring. For this project site, we recommend using a Site Class D (stiff soil profile) in accordance with 2018 IBC. This recommendation is based on the soil conditions encountered in the borings during the exploration and our assumption that the encountered soils continue beyond the drilled depth to the full 100 feet. A seismic survey to 100 feet depth could be performed if the design engineers require a more site-specific seismic classification.

5.4. Floor Slab Design

We recommend the floors slab be supported on 12 inches of prepared subgrade which may be accomplished by scarifying and recompacting the upper 12 inches of exposed subgrade soils per *Section 4.1.* If the floor slab areas are disturbed by construction equipment traffic between the time of initial grading and concrete placement, rework and recompaction, will be required. If unstable soils are encountered which cannot be adequately densified in place, these soils should be removed and replaced with suitable structural fill. We also recommend a free draining, 4-inch thick granular leveling and drainage course consisting of No. 57 stone meeting ASTM C33 specifications, or equivalent, be installed beneath the concrete floor slab above the subgrade for uniform support and to act as a capillary break. If these recommendations are followed the building floor slab may be designed using a subgrade modulus (“k” value) of 110 psi/in.

Lightly loaded interior partition walls (applying less than 0.75 klf) may be supported directly on the slab on grade floor, although, depending on the floor slab design and the specific wall loads, it may be appropriate to increase the floor slab reinforcement or provide a thickened slab cross section below interior walls. For interior walls with loads greater than 0.75 klf, ***Olsson*** recommends that a footing be installed, independent from the floor slab, to properly distribute the wall loads to the underlying soil and reduce the potential for floor slab damage.

Based on our experience with other Kum & Go projects, it may be appropriate to provide a sealed polyethylene vapor barrier between the new floor slab and granular drainage materials to reduce moisture infiltration. The decision to place a vapor barrier in direct contact with the slab or beneath the layer of granular fill should be made by the design engineer after considering the moisture sensitivity of new flooring materials or finishes and installed per the current American Concrete Institute (ACI) standards and recommendations. The long-term performance of the slab-on-grade will greatly depend on the minimizing moisture variations in the subgrade soils, the recommendations provided in *Section 4.4* should be followed.

5.5. Exterior Slabs and Sidewalks

Considering the encountered conditions during our exploration below and around the building footprint, the standard Kum & Go "turn-down" design for approach and entrance slabs should be appropriate. The standard Kum & Go design for exterior sidewalks adjacent to the building includes 12 inches of compacted crushed aggregate directly below the slabs. Refer to the applicable Kum & Go construction or design drawings for specific details. To minimize future moisture accumulation within this granular layer, providing a panel or trench drain extending to a gravity discharge point away from the building or pavements could be considered. At a minimum, we recommend regularly scheduled crack and joint sealing between slabs, pavements, and the building to reduce potential moisture infiltration.

Olsson recommends that new sidewalks located away from the Kum & Go building be supported by a minimum 12 inches of structural fill which can be achieved by scarifying the upper 12 inches of sidewalk subgrade, moisture conditioning as necessary, and compacting to a minimum 95 percent of the materials Standard Proctor maximum dry density at the applicable materials moisture content provided in *Section 4.2*. If the pavement areas are disturbed by construction equipment traffic between the time of initial grading and concrete placement, rework and recompaction, following the recommendations of this report, will be required.

Prepared subgrades should extend a minimum of 1-foot beyond each edge of sidewalk, where feasible. Improper subgrade preparation such as inadequate vegetation removal, failure to identify soft or unstable areas, and inadequate or improper compaction can also produce non-uniform subgrade support and cause unacceptable post-construction movement. Additionally, if clay is utilized as fill material, subgrades could be frost susceptible. If these soils become very moist or saturated and freeze, slab heaving is possible. Positive grading to direct surface drainage away from sidewalks will help limit the potential for moisture infiltration of slab subgrade soils and subsequent frost related heaving. At a minimum, we recommend regularly scheduled crack and joint sealing between slabs, pavements, and the building to reduce potential moisture infiltration.

5.6. Lateral Earth Pressures

The lateral earth pressure recommendations given in the following paragraphs are applicable to the design of rigid retaining walls subject to slight rotation, such as cantilever, or gravity type concrete walls. These recommendations are not applicable to the design of modular block - geogrid reinforced backfill and/or gravity block walls. Recommendations covering these types of wall systems are beyond the scope of services for this assignment.

The maximum toe pressure for below grade walls should not exceed the bearing capacity recommended in this report for shallow spread foundations. The parameters are based on the understanding that retained soils will be similar in composition to the on-site soils encountered during this exploration.

Walls that are unrestrained at the top and are free to deflect or rotate may be designed for "active" earth pressure conditions. Active earth pressures are commonly used for design of free-standing cantilever retaining walls. The "passive" earth pressure condition should be used to evaluate the resistance of soils to lateral loads. Table 5 presents recommended values of earth pressure coefficients based on our experience with soils in the area. Equivalent fluid densities are frequently used for the calculation of lateral earth pressures and are therefore provided in Table 5.

TABLE 5: EARTH PRESSURE PARAMETERS

Condition	Soil Type	Equivalent Fluid Density*	
		Moist Condition	Saturated Condition**
Active (K_a)	Low plasticity cohesive materials	45 pcf	85 pcf
	Cohesionless granular materials	40 pcf	80 pcf
At Rest (K_0)	Low plasticity cohesive materials	70 pcf	100 pcf
	Cohesionless granular materials	60 pcf	90 pcf
Passive (K_p)	Low plasticity cohesive materials	330 pcf	220 pcf
	Cohesionless granular materials	340 pcf	230 pcf

* Assumed level backfill.

**Saturated equivalent fluid density values include hydrostatic pressure. Value would need to be adjusted if water is above ground surface.

The following assumptions were made:

- The equivalent fluid densities in Table 5 do not include the effects of surcharge loading.
- For active earth pressures, the wall must rotate about the base, with top lateral movements ranging from 0.2 to 0.4 percent of the wall height.
- The wall must move horizontally to mobilize passive resistance.
- In-situ soil backfill has a maximum unit weight of 120 pcf.
- Horizontal backfill is compacted to 95 percent of standard Proctor maximum dry density.
- Heavy equipment and other concentrated load components are not included.
- No hydrostatic pressure acting on the wall.
- Passive pressure in the frost zone should be ignored.
- No safety factor is included.

Backfill placed against structures should consist of granular soils or low plasticity cohesive soils. For the granular values to be valid, the granular backfill must extend out from the base of the wall at an angle of at least 45 degrees and 60 degrees from vertical for the active and passive cases, respectively. To calculate the resistance to sliding, an ultimate coefficient of friction value of 0.35 should be used where the footing bears on soil.

To intercept infiltrating surface water behind the wall, we recommend a perimeter drain be installed at the foundation level and/or weep holes be placed at regular intervals along the wall. The drain line should

be sloped to provide positive gravity drainage and should be surrounded by free-draining granular material graded to prevent the intrusion of fines, or an alternative free-draining granular material encapsulated with suitable filter fabric. A minimum 2-foot wide section of free-draining granular fill should be used for backfill above the drain line and adjacent to the wall and should extend to within 2 feet of final grade. The granular backfill should be capped with compacted cohesive fill to minimize infiltration of surface water into the drain system.

5.7. Underground Fuel Tanks

The existing on-site soils appear suitable to support the UST and associated components. Based on our laboratory results, sand and clay soils removed from the UST excavation appear suitable to be reused as structural fill at the site. Excavated claystone bedrock should not be used in structural fill but may be used in non-structural areas.

- Excavated on-site soils and the overlying imported structural fill materials should be replaced with approved backfill of proper size and gradation. Granular backfill materials should meet ASTM C33 requirements for quality and soundness.
- Backfill suppliers should provide sieve analysis documentation that the materials meet these requirements.
- Backfill materials should be kept dry and free of ice or snow in freezing conditions.

Typical backfill material for new fuel tank installation consists of free-draining naturally rounded aggregates (pea gravel) with a maximum ¾-inch particle size and no more than 5 percent passing a #8 sieve. Crushed and washed stone with a maximum angular particle size of ½ inches and no more than 5 percent passing the #8 sieve can also be used. If material which meets these typical specifications is not locally available, the tank manufacturer should be contacted for information or approval of alternate materials and installation instructions.

Tank backfill materials should be compacted carefully to prevent tank damage; however, if new pavements will cover the backfill materials, adequate compactive efforts must be applied to prevent future settlement and pavement damage. If new pavements will be placed over the new underground fuel tanks, we recommend that the backfill be compacted to a minimum 95 percent of the materials Standard Proctor (ASTM D698) maximum dry density.

These backfill recommendations are provided as a general guideline for underground fuel tank applications. They are not intended to supersede the material recommendations or installation requirements of a specific tank manufacturer. We recommend that the manufacturer's recommendations be reviewed and followed, as appropriate, for the surface covering proposed, the tank type selected, and the site conditions anticipated by the installation contractor. In addition, since the UST is close to an overhead canopy, the excavations for the UST will affect the canopy and vice versa; therefore, the UST installation contractor and the canopy contractor should coordinate their excavation and construction activities.

Groundwater was not encountered during our field observation. Consequently, groundwater is not anticipated to adversely impact site grading, earthwork, shallow building construction, or UST installation. If free water is encountered during construction, the contractor should follow an applicable local and state dewatering plan. The installation contractor is responsible for the design of shoring or benching of excavation sidewalls as applicable for their selected means and methods.

6. PAVEMENTS

6.1. PAVEMENT SUBGRADE PREPARATION

It is important that pavement subgrade support be relatively uniform, with no abrupt changes in the degree of support. Non-uniform pavement support can occur at the transition from cut to fill areas, as a result of varying soil moisture contents or soil types, or where improperly placed utility backfill has been placed across or through areas to be paved. Improper subgrade preparation such as inadequate vegetation removal, failure to identify soft or unstable areas by proofrolling, and inadequate or improper compaction can also produce non-uniform subgrade support.

We recommend that pavements be supported by a minimum 12 inches of soils that have been prepared as structural fill in accordance with *Sections 4.1* and *4.2.* If bedrock is exposed after grading has occurred, these materials should be surface compacted as opposed to scarified. In the southwest corner of the project site (near B-8), claystone was encountered near the ground surface. We recommend that any claystone encountered at the ground surface maintain a 2-foot buffer between the bottom of any pavements and the claystone. This may be accomplished by excavating 2 feet of the claystone bedrock, surface compacting the claystone bedrock, and backfilling with structural fill placed in accordance with *Section 4.2.*

Pavement subgrade moisture content at the time of compaction should be maintained between -1 and +3 percent of optimum for cohesive soils or between -2 and +2 percent of optimum for non-cohesive soils. The range of acceptable moisture contents for imported fill materials should be determined during laboratory Proctor testing of specific on-site materials prior to earthwork.

The final pavement subgrade should be tested for compaction and proofrolled immediately prior to pavement placement in accordance with *Section 4.1*. Unsuitable or unstable areas should be reworked as necessary to provide a uniform, moisture conditioned, and compacted subgrade. If clean sands are encountered at the surface, the geotechnical engineer may elect to eliminate proofrolling recommendations in accordance with *Section 4.1*. If proofrolling is not performed, the subgrade should be evaluated by hand-probing to determine consistency across the pavement areas.

It is recommended the prepared subgrades extend a minimum of 12 inches outside the pavements, where feasible. A representative of the geotechnical engineer should be present during subgrade preparation to observe, document, and test compaction of the materials at the time of placement or rework. In order to minimize disturbance, heavy and/or repetitive construction traffic should be controlled, especially during periods of wet weather.

The final grades across this site should account for some post construction movement of exterior pavements due to moisture related shrink/swell or freeze/thaw cycles. To minimize this movement, it is recommended that the paved areas be designed with the maximum grades practical to further reduce the potential for ponding water. Our estimation of total movement is dependent on the grading plan

incorporating positive drainage to reduce surface water infiltration of pavement subgrades. To increase pavement life and reduce the potential for heaving, a pavement maintenance program is recommended to regularly clean out and seal control joints and cracks that may develop.

6.2. Pavement Design – Site Parking and Drive Areas

Note that the recommendations presented herein are intended for the parking lot only. We did not perform any borings along the access drive to the south and additional exploration will be needed to confirm these recommendations are applicable for the new roadway. For Kum & Go stores, the daily traffic is relatively consistent and predictable, and primarily consists of passenger cars, beverage, food, and fuel delivery trucks, and trash trucks. Based on the information provided by Kum & Go, the traffic volume for standard duty consists of 1,250 passenger cars and pickups per day, four (4) 3-axle, single-unit, delivery trucks per day, one (1) 3-axle, single-unit, trash truck every 2 days, and two (2) 5-axle, single trailer, fuel tanker per day. Based on this traffic volume, an 18-kip Equivalent Single Axle Load ($ESAL_{18}$) value of approximately 122,500 is estimated for the pavement design life of 20 years for rigid pavements.

The pavement section recommended here has been developed according to the AASHTO Guide for Design of Pavement Structures (1993) guidelines and is based on an estimated modulus of subgrade reaction (k) of 79 pci corresponding to a laboratory tested R-value of 7 for a soil subgrade and $ESAL_{18}$ value as indicated above. Other design parameters include reliability of 85 percent, combined standard error of 0.35 for concrete, initial design serviceability index of 4.2, and design terminal serviceability index of 2.25. In addition, we assumed drainage factor of 0.9 and load transfer factor of 3.6 assuming plain/unreinforced jointed concrete pavement.

Olsson recommends that rigid concrete pavement be used in areas designated for heavily loaded trucks, lanes, or concentrated lanes of repetitive traffic, or in non-designated areas that could experience turning truck traffic. For this project site, the following Portland cement pavement section is recommended. If the recommendations in this report are followed, a design life of 20 years should be anticipated. Due to the variability of fill materials, aggregate base is recommended below pavements.

Table 6: Concrete Pavement

Depth (in)	Material Designation	Material Specification
6.0		Concrete: CDOT Section 412 Portland Cement Concrete Pavement
12.0		Minimum prepared subgrade thickness: In accordance with *Sections 4.1 and 4.2* of this report.

7. LIMITATIONS

The conclusions and recommendations presented in this report are based on the information available regarding the proposed construction, the results obtained from our soil test borings and sampling procedures, the results of the laboratory testing program, and our experience with similar projects. The soil test borings represent a very small statistical sampling of subsurface soils, and it is possible that conditions may be encountered during construction that are substantially different from those indicated by the soil test borings. In these instances, adjustments to design and construction may be necessary. This geotechnical report is based on the site plan and information provided to ***Olsson*** and our understanding of the project as noted in this report. Changes in the location or design of new structures and/or pavements could significantly affect the conclusions and recommendations presented in this geotechnical report. ***Olsson*** should be contacted in the event of such changes to determine if the recommendations of this report remain appropriate for the revised site design.

This report was prepared under the direction and supervision of a Professional Engineer registered in the State of Colorado employed by ***Olsson***. The conclusions and recommendations contained herein are based on generally accepted, professional geotechnical engineering practices at the time of this report, within this geographic area. No warranty, express or implied, is intended or made. This report has been prepared for the exclusive use of Entitlement and Engineering Solutions, Inc., and their authorized representatives for specific application to the proposed project. ***Olsson*** appreciates the opportunity to provide our services on this project and look forward to working with you during construction. Should you have any questions, please do not hesitate to contact us.

Respectfully submitted,

Olsson, Inc.

APPENDIX A

Site Location Map
Boring Location Plan

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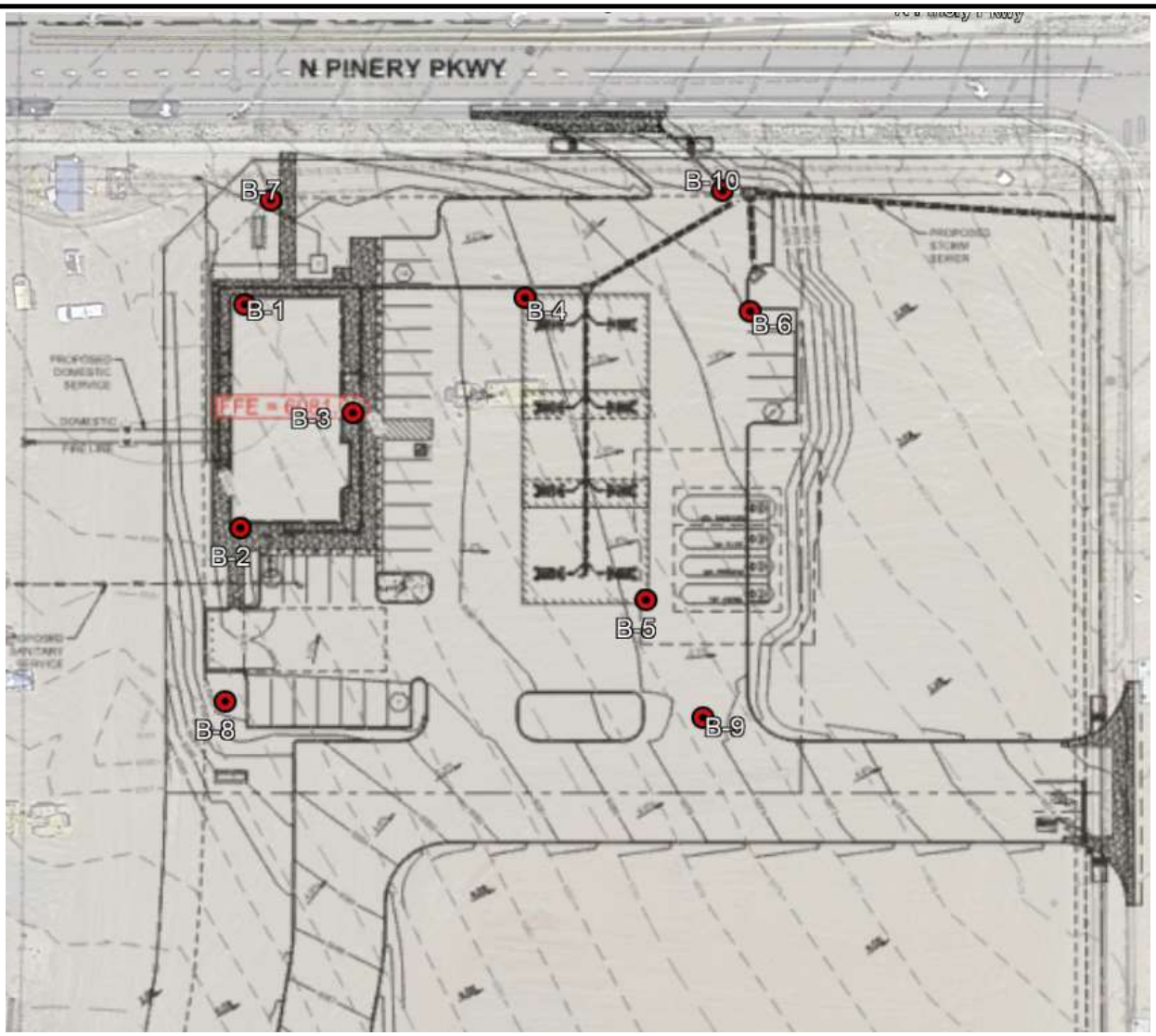
	Site Location Map
Scale: nts	**Kum & Go Store # 2293** **Parker, Colorado**
Project: 022-03197	
Approved by: PJM	
Date: 6/22/2022	



Boring	Depth	Approximate Coordinates	
B-1	25.5	39.458929° N	104.783639° W
B-2	25	39.458689° N	104.783644° W
B-3	25.3	39.458813° N	104.783491° W
B-4	25	39.458937° N	104.783258° W
B-5	25.5	39.458612° N	104.783094° W
B-6	25.5	39.458922° N	104.782952° W
B-7	20.5	39.459042° N	104.783603° W
B-8	19.5	39.458503° N	104.783665° W
B-9	10.5	39.458480° N	104.783017° W
B-10	10.5	39.459052° N	104.782990° W

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Boring Location Plan

Scale: nts
Project: 022-03197
Approved by: PJM
Date: 9/01/2022

Kum & Go Store # 2293
Parker, Colorado

APPENDIX B

Symbols and Nomenclature
Boring Logs

SYMBOLS AND NOMENCLATURE

DRILLING NOTES

DRILLING AND SAMPLING SYMBOLS

SS:	Split-Spoon Sample (1.375" ID, 2.0" OD)	HSA:	Hollow Stem Auger	NE:	Not Encountered
U:	Thin-Walled Tube Sample (3.0" OD)	CFA:	Continuous Flight Auger	NP:	Not Performed
CS:	Continuous Sample	HA:	Hand Auger	NA:	Not Applicable
BS:	Bulk Sample	CPT:	Cone Penetration Test	% Rec:	Percent of Recovery
MC:	Modified California Sampler	WB:	Wash Bore	WD:	While Drilling
GB:	Grab Sample	FT:	Fish Tail Bit	IAD:	Immediately After Drilling
SPT:	Standard Penetration Test Blows per 6.0"	RB:	Rock Bit	AD:	After Drilling
		PP:	Pocket Penetrometer	CI:	Cave-In

DRILLING PROCEDURES

Soil samples designated as "U" samples on the boring logs were obtained in using Thin-Walled Tube Sampling techniques. Soil samples designated as "SS" samples were obtained during Penetration Test using a Split-Spoon Barrel sampler. The standard penetration resistance 'N' value is the number of blows of a 140 pound hammer falling 30 inches to drive the Split-Spoon sampler one foot. Soil samples designated as "MC" were obtained in using Thick-Walled, Ring-Lined, Split-Barrel Drive sampling techniques. Recovered samples were sealed in containers, labeled, and protected for transportation to the laboratory for testing.

WATER LEVEL MEASUREMENTS

Water levels indicated on the boring logs are levels measured in the borings at the times indicated. In relatively high permeable materials, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels is not possible with only short-term observations.

SOIL PROPERTIES & DESCRIPTIONS

Descriptions of the soils encountered in the soil test borings were prepared using Visual-Manual Procedures for Descriptions and Identification of Soils.

PARTICLE SIZE

Boulders	12 in. +	Coarse Sand	4.75mm-2.0mm	Silt	0.075mm-0.005mm
Cobbles	12 in.-3 in.	Medium Sand	2.0mm-0.425mm	Clay	<0.005mm
Gravel	3 in.-4.75mm	Fine Sand	0.425mm-0.075mm		

COHESIVE SOILS

Consistency	Unconfined Compressive Strength (Qu) (tsf)
Very Soft	<0.25
Soft	0.25 – 0.5
Firm	0.5 – 1.0
Stiff	1.0 – 2.0
Very Stiff	2.0 – 4.0
Hard	> 4.0

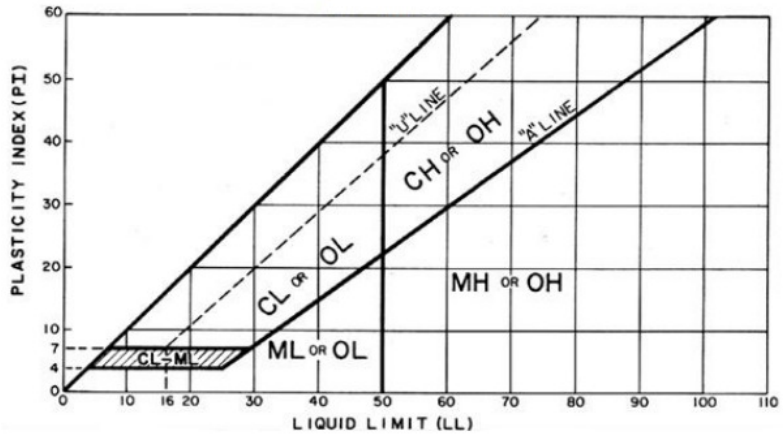
COHESIONLESS SOILS

Relative Density	'N' Value
Very Loose	0 – 3
Loose	4 – 9
Medium Dense	10 – 29
Dense	30 – 49
Very Dense	≥ 50

COMPONENT %

Description	Percent (%)
Trace	<5
Few	5 - 10
Little	15 - 25
Some	30 - 45
Mostly	50 - 100

PLASTICITY CHART



ROCK QUALITY DESIGNATION (RQD)

Description	RQD (%)
Very Poor	0 – 25
Poor	25 – 50
Fair	50 – 75
Good	75 – 90
Excellent	90 – 100

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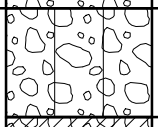
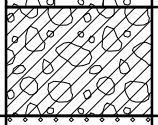
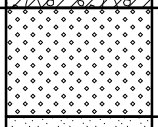
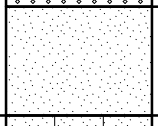
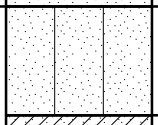
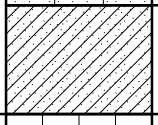
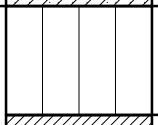
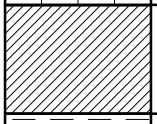
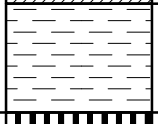
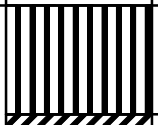
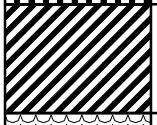
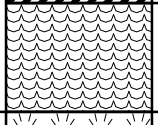
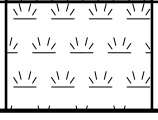
SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

BOREHOLE REPORT NO. B-1

Sheet 1 of 1

PROJECT NAME: Kum & Go Store #2293	CLIENT: Entitlement and Engineering Solutions LLC
PROJECT NUMBER: 022-03197	LOCATION: Parker, Colorado

Split Spoon ☒ | Modified California Sampler ⋈

MATERIAL DESCRIPTION

: X: 3202261.79 **Y**: 1592841.642

APPROX. SURFACE ELEV. (ft): 6081.0

ELEVATION (ft)	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
6080	0								
		SS 1		12-15-15 N=30		8.9			P-200 = 20.6%
		MC 2		8-10		10.8	115.7	37/18	Collapse @ 500 psf: 0.3%
6075	5								
		SS 3		7-6-8 N=14		14.1			
		MC 4		8-10		15.6	112.9		
6070	10								
		MC 5		13-18					PP = >4.5
6065	15								
		MC 6		46-50/4"					PP = >4.5
6060	20								
		SS 7		16-16-28 N=44					PP = >4.5
	25								

FILL — 0.3'

3 inches of loose sand and gravel

CLAYEY SAND

trace 1 inch subangular gravel, grayish tan, moist (SC) [FILL]

grades to 1/4 inch subangular gravel

12.5'

LEAN CLAY

trace sand and 1/8 inch subrounded gravel, very stiff, brown, moist (CL) [NATIVE]

16.0'

CLAYSTONE

moderately weathered, yellowish brown, moist

grades to with reddish gray mottling

25.5'

BASE OF BORING AT 25.5 FEET

WATER LEVEL OBSERVATIONS	
WD	▽ Not Encountered
IAD	▼ Not Encountered
AD	▼ Not Performed

OLSSON, INC.
5180 SMITH ROAD
DENVER, COLORADO 80216

STARTED:	6/8/22	FINISHED:	6/8/22
DRILL CO.:	ODELL	DRILL RIG:	CME 55
DRILLER:	ODELL	LOGGED BY:	M. ALMAND
METHOD: CONTINUOUS FLIGHT AUGER			

BOREHOLE REPORT NO. B-2

Sheet 1 of 1

PROJECT NAME	CLIENT
Kum & Go Store #2293	Entitlement and Engineering Solutions LLC
PROJECT NUMBER	**LOCATION**
022-03197	Parker, Colorado

Modified California Sampler ⊠ Split Spoon ⊠

MATERIAL DESCRIPTION

: X: 3202261.068 **Y**: 1592754.217

APPROX. SURFACE ELEV. (ft): 6083.0

ELEVATION (ft)	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
	0								
		MC 1		5-12		11.4	122.0		
6080									
	5	SS 2		7-9-8 N=17		13.0			
		MC 3		7-9		10.9	115.8	43/25	Swell @ 1000 psf: 1.0%PP = >4.5
6075									
	10	SS 4		8-8-10 N=18		13.1			P-200 = 82.8% PP = >4.5
6070									
	15	MC 5		32-50/5"					PP = >4.5
6065									
	20	SS 6		29-47-50/4"					PP = >4.5
6060									
	25	MC 7		28-50/6"					PP = >4.5

FILL — *0.3'*

4 inches of loose sand and gravel

CLAYEY SAND

with 1/4 inch subangular gravel, grayish tan, moist (SC) [FILL]

5.5'

LEAN CLAY WITH SAND

trace 1/8 inch subrounded gravel, stiff, brown, moist (CL) [NATIVE]

grades to very stiff

13.0'

CLAYSTONE

moderately weathered, yellowish brown with reddish gray mottling, moist

grades to blocky

25.0'

BASE OF BORING AT 25.0 FEET

WATER LEVEL OBSERVATIONS	
WD	▽ Not Encountered
IAD	▼ Not Encountered
AD	▼ Not Performed

OLSSON, INC.
5180 SMITH ROAD
DENVER, COLORADO 80216

STARTED:	6/8/22	FINISHED:	6/8/22
DRILL CO.:	ODELL	DRILL RIG:	CME 55
DRILLER:	ODELL	LOGGED BY:	M. ALMAND
METHOD: CONTINUOUS FLIGHT AUGER			

BOREHOLE REPORT NO. B-3

Sheet 1 of 1

PROJECT NAME	CLIENT
Kum & Go Store #2293	Entitlement and Engineering Solutions LLC
PROJECT NUMBER	**LOCATION**
022-03197	Parker, Colorado

Modified California Sampler | Grab Sample | Split Spoon

MATERIAL DESCRIPTION

: X: 3202303.91 **Y**: 1592799.722

APPROX. SURFACE ELEV. (ft): 6080.5

ELEVATION (ft)	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
6080	0								
		MC 1		18-19		8.0	121.6		Swell @ 200 psf: 0.1%
		GB 1							
		SS 2		7-8-11 N=19		11.4			P-200 = 23.0%
6075	5								
		SS 3		5-4-8 N=12		11.3			
		MC 4		17-23		12.0	120.9		PP = >4.5
6070	10								
		SS 5		15-16-20 N=36					PP = >4.5
6065	15								
		MC 6		33-50/3"					PP = >4.5
6060	20								
		SS 7		20-30-50/4"					PP = >4.5
	25								

FILL — 0.3'

3 inches of loose sand and gravel

CLAYEY SAND

trace 3/4 inch subangular gravel, grayish tan, moist (SC) [FILL]

grades to decreased sand content

8.0'

LEAN CLAY

trace 1/4 inch subrounded gravel and sand, hard, brown, moist (CL) [NATIVE]

12.5'

CLAYSTONE

highly weathered, yellowish brown with red mottling, moist

grades to moderately weathered, with interbedded sandstone

grades to without interbedded sandstone — 25.3'

BASE OF BORING AT 25.3 FEET

WATER LEVEL OBSERVATIONS	
WD	▽ Not Encountered
IAD	▼ Not Encountered
AD	▼ Not Performed

OLSSON, INC.
5180 SMITH ROAD
DENVER, COLORADO 80216

STARTED:	6/8/22	FINISHED:	6/8/22
DRILL CO.:	ODELL	DRILL RIG:	CME 55
DRILLER:	ODELL	LOGGED BY:	M. ALMAND
METHOD: CONTINUOUS FLIGHT AUGER			

BOREHOLE REPORT NO. B-4

Sheet 1 of 1

PROJECT NAME	CLIENT
Kum & Go Store #2293	Entitlement and Engineering Solutions LLC
PROJECT NUMBER	**LOCATION**
022-03197	Parker, Colorado

Modified California Sampler ⊠ Split Spoon ⊠

MATERIAL DESCRIPTION

: X: 3202369.339 **Y**: 1592845.404

APPROX. SURFACE ELEV. (ft): 6077.0

ELEVATION (ft)	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
	0								
6075		MC 1		10-10		11.3	121.2		
	5	SS 2		6-5-7 N=12		12.3			P-200 = 23.9%
6070		MC 3		8-9		19.1	101.1	44/26	Collapse @ 1000 psf: 0.3%
	10	SS 4		4-5-7 N=12		13.0			
6065									
	15	MC 5		14-19					PP = >4.5
6060									
	20	SS 6		9-9-14 N=23					PP = >4.5
6055									
	25	MC 7		20-32					PP = >4.5

FILL — 0.2'

2 inches of loose sand and gravel

CLAYEY SAND

with 1/4 inch subangular gravel, grayish tan, moist (SC) [FILL]

grades to with claystone fragments

grades to without claystone fragments

LEAN CLAY — 12.5'

trace 1/8 inch subrounded gravel and sand, very stiff, brown, moist (CL) [NATIVE]

CLAYSTONE — 22.5'

moderately weathered, blocky, yellowish brown with reddish gray mottling, moist

BASE OF BORING AT 25.0 FEET — 25.0'

WATER LEVEL OBSERVATIONS	
WD	▽ Not Encountered
IAD	▼ Not Encountered
AD	▼ Not Performed

OLSSON, INC.
5180 SMITH ROAD
DENVER, COLORADO 80216

STARTED:	6/8/22	FINISHED:	6/8/22
DRILL CO.:	ODELL	DRILL RIG:	CME 55
DRILLER:	ODELL	LOGGED BY:	M. ALMAND
METHOD: CONTINUOUS FLIGHT AUGER			

BOREHOLE REPORT NO. B-5

Sheet 1 of 1

PROJECT NAME: Kum & Go Store #2293	CLIENT: Entitlement and Engineering Solutions LLC
PROJECT NUMBER: 022-03197	LOCATION: Parker, Colorado

Split Spoon ☒ Modified California Sampler ⋈

MATERIAL DESCRIPTION

: X: 3202416.577 **Y**: 1592727.397

APPROX. SURFACE ELEV. (ft): 6077.5

ELEVATION (ft)	MATERIAL DESCRIPTION		GRAPHIC LOG	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
	FILL	***0.3'***		0								
	3 inches of loose sand and gravel				SS 1		8-9-10 N=19		11.3			P-200 = 26.0%
6075	***CLAYEY SAND***											
	with 1/4 inch subangular gravel, grayish tan, moist (SC) [FILL]				MC 2		7-9		10.3	120.1		
		5.5'		5								
	CLAYSTONE				SS 3		11-13-14 N=27		16.3			PP = >4.5
6070	*highly weathered, yellowish brown with red mottling, moist*											
					MC 4		15-21		15.2	109.2		Swell @ 1000 psf: 3.7%PP = >4.5
				10								
6065												
				15	SS 5		25-45-50/3"					PP = >4.5
	grades to moderately weathered, with interbedded sandstone											
6060		***17.5'***										
	SANDSTONE											
	strongly cemented, fine to coarse grained, whitish gray, moist				MC 6		50/5"					
				20								
6055												
				25	SS 7		20-30-45 N=75					
		25.5'										

BASE OF BORING AT 25.5 FEET

WATER LEVEL OBSERVATIONS	
WD	▽ Not Encountered
IAD	▼ Not Encountered
AD	▼ Not Performed

OLSSON, INC.
5180 SMITH ROAD
DENVER, COLORADO 80216

STARTED:	6/8/22	FINISHED:	6/8/22
DRILL CO.:	ODELL	DRILL RIG:	CME 55
DRILLER:	ODELL	LOGGED BY:	M. ALMAND
METHOD: CONTINUOUS FLIGHT AUGER			

BOREHOLE REPORT NO. B-6

Sheet 1 of 1

PROJECT NAME: Kum & Go Store #2293

CLIENT: Entitlement and Engineering Solutions LLC

PROJECT NUMBER: 022-03197

LOCATION: Parker, Colorado

Split Spoon | Modified California Sampler

MATERIAL DESCRIPTION

: X: 3202455.778 **Y**: 1592840.623

APPROX. SURFACE ELEV. (ft): 6074.0

ELEVATION (ft)	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
	0								
		SS 1		10-6-7 N=13		10.5			
6070		MC 2		12-14		9.5	124.5		
	5								
		SS 3		6-7-10 N=17		16.9			
6065									
		MC 4		6-8		11.3	110.6	41/26	Collapse @ 1000 psf: 0.4%
	10								
6060		SS 5		10-12-14 N=26		11.2			P-200 = 58.7%
	15								
6055									
		MC 6		32-50/4"					
	20								
6050									
		SS 7		18-30-41 N=71					PP = >4.5
	25								

FILL — 0.3'

3 inches of loose sand and gravel

CLAYEY SAND

with 1/4 inch subangular gravel, grayish tan, moist (SC) [FILL]

grades to with claystone fragments

grades to without claystone fragments

12.5'

CLAYSTONE

moderately weathered, reddish brown, moist

25.5'

BASE OF BORING AT 25.5 FEET

WATER LEVEL OBSERVATIONS	
WD	Not Encountered
IAD	Not Encountered
AD	Not Performed

OLSSON, INC.
5180 SMITH ROAD
DENVER, COLORADO 80216

STARTED:	6/8/22	FINISHED:	6/8/22
DRILL CO.:	ODELL	DRILL RIG:	CME 55
DRILLER:	ODELL	LOGGED BY:	M. ALMAND
METHOD: CONTINUOUS FLIGHT AUGER			

BOREHOLE REPORT NO. B-7

Sheet 1 of 1

PROJECT NAME	CLIENT
Kum & Go Store #2293	Entitlement and Engineering Solutions LLC
PROJECT NUMBER	**LOCATION**
022-03197	Parker, Colorado

Modified California Sampler ⊠ Split Spoon ⊠

MATERIAL DESCRIPTION

: X: 3202271.63 **Y**: 1592882.88

APPROX. SURFACE ELEV. (ft): 6079.5

ELEVATION (ft)	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
	0								
		MC 1		18-16		6.7	130.2		PP = >4.5
6075	5	SS 2		4-5-9 N=14		22.9			P-200 = 67.3% PP = >4.5
		MC 3		7-10		9.4			PP = >4.5
6070	10	SS 4		6-6-9 N=15					PP = >4.5
6065	15	MC 5		24-36		15.8	110.3		Swell @ 2000 psf: 2.8%PP = >4.5
6060	20	SS 6		18-19-26 N=45					PP = >4.5

FILL — 0.3'

4 inches of loose sand and gravel

SANDY LEAN CLAY

with 1/4 inch subangular gravel, grayish tan, moist (CL) [FILL]

grades to with claystone fragments

CLAYSTONE — 12.5'

moderately weathered, blocky, yellowish brown with red mottling, moist

BASE OF BORING AT 20.5 FEET — 20.5'

WATER LEVEL OBSERVATIONS	
WD	▽ Not Encountered
IAD	▼ Not Encountered
AD	▼ Not Performed

OLSSON, INC.
5180 SMITH ROAD
DENVER, COLORADO 80216

STARTED:	6/8/22	FINISHED:	6/8/22
DRILL CO.:	ODELL	DRILL RIG:	CME 55
DRILLER:	ODELL	LOGGED BY:	M. ALMAND
METHOD: CONTINUOUS FLIGHT AUGER			

BOREHOLE REPORT NO. B-8

Sheet 1 of 1

PROJECT NAME: Kum & Go Store #2293	CLIENT: Entitlement and Engineering Solutions LLC
PROJECT NUMBER: 022-03197	LOCATION: Parker, Colorado

Split Spoon ☒ Modified California Sampler ⋈

MATERIAL DESCRIPTION

: X: 3202255.673 **Y**: 1592686.425

APPROX. SURFACE ELEV. (ft): 6085.5

ELEVATION (ft)	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
6085	0								
		SS 1		12-17-24 N=41		16.1			P-200 = 83.7% PP = >4.5
		MC 2		16-26		14.7	114.4		PP = >4.5
6080	5								
		SS 3		11-16-17 N=33		15.3			PP = >4.5
		MC 4		24-50/5"		14.3	114.2		Swell @ 1000 psf: 2.1%PP = >4.5
6075	10								
6070	15	SS 5		16-25-36 N=61					PP = >4.5
		MC 6		50/6"					PP = >4.5

FILL — *0.5'*

6 inches of loose sand and gravel

CLAYSTONE

moderately weathered, reddish brown with gray mottling, moist

grades to yellowish brown with reddish gray mottling

19.5'

BASE OF BORING AT 19.5 FEET

WATER LEVEL OBSERVATIONS	
WD	▽ Not Encountered
IAD	▼ Not Encountered
AD	▼ Not Performed

OLSSON, INC.
5180 SMITH ROAD
DENVER, COLORADO 80216

STARTED:	6/8/22	FINISHED:	6/8/22
DRILL CO.:	ODELL	DRILL RIG:	CME 55
DRILLER:	ODELL	LOGGED BY:	M. ALMAND
METHOD: CONTINUOUS FLIGHT AUGER			

BOREHOLE REPORT NO. B-9

Sheet 1 of 1

PROJECT NAME	CLIENT
Kum & Go Store #2293	Entitlement and Engineering Solutions LLC
PROJECT NUMBER	**LOCATION**
022-03197	Parker, Colorado

Modified California Sampler ⊠ Split Spoon ⊠

MATERIAL DESCRIPTION

: X: 3202438.697 **Y**: 1592679.491

APPROX. SURFACE ELEV. (ft): 6077.5

ELEVATION (ft)	GRAPHIC LOG	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
		0								
			MC 1		13-19		14.9	112.6	44/28	Swell @ 200 psf: 3.3%PP = >4.5
6075										
		5	SS 2		9-9-9 N=18		9.6			P-200 = 50.9%
			MC 3		28-39		14.8			PP = >4.5
6070										
		10	SS 4		12-19-42 N=61		18.0			PP = >4.5

FILL — 0.3'

3 inches of loose sand and gravel

SANDY LEAN CLAY

trace 1/8 inch subrounded gravel, very stiff, brown, moist (CL) [NATIVE] — 3.0'

CLAYSTONE

moderately weathered, blocky, yellowish brown with red mottling, moist

BASE OF BORING AT 10.5 FEET — 10.5'

WATER LEVEL OBSERVATIONS	
WD	▽ Not Encountered
IAD	▼ Not Encountered
AD	▼ Not Performed

OLSSON, INC.
5180 SMITH ROAD
DENVER, COLORADO 80216

STARTED:	6/8/22	FINISHED:	6/8/22
DRILL CO.:	ODELL	DRILL RIG:	CME 55
DRILLER:	ODELL	LOGGED BY:	M. ALMAND
METHOD: CONTINUOUS FLIGHT AUGER			

olsson

BOREHOLE REPORT NO. B-10

Sheet 1 of 1

PROJECT NAME	CLIENT
Kum & Go Store #2293	Entitlement and Engineering Solutions LLC
PROJECT NUMBER	**LOCATION**
022-03197	Parker, Colorado

Modified California Sampler ⊠ Split Spoon ⊠

MATERIAL DESCRIPTION

: X: 3202444.675 **Y**: 1592887.887

APPROX. SURFACE ELEV. (ft): 6073.5

ELEVATION (ft)	GRAPHIC LOG	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
		0								
			MC 1		28-26					
6070										
			SS 2		8-6-6 N=12					
		5								
			MC 3		8-11					
6065										
		10	SS 4		3-6-4 N=10					

FILL — ***0.3'***

4 inches of loose sand and gravel

CLAYEY SAND

with 1/4 inch subangular gravel, with claystone and sandstone fragments, grayish tan, moist (CL) [FILL]

10.5'

BASE OF BORING AT 10.5 FEET

WATER LEVEL OBSERVATIONS	
WD	▽ Not Encountered
IAD	▼ Not Encountered
AD	▼ Not Performed

OLSSON, INC.
5180 SMITH ROAD
DENVER, COLORADO 80216

STARTED:	6/8/22	FINISHED:	6/8/22
DRILL CO.:	ODELL	DRILL RIG:	CME 55
DRILLER:	ODELL	LOGGED BY:	M. ALMAND
METHOD: CONTINUOUS FLIGHT AUGER			

APPENDIX C

Summary of Laboratory Test Results

OLSSON, INC.
5180 SMITH ROAD
DENVER, COLORADO 80216

SUMMARY OF LABORATORY RESULTS

PROJECT NAME: Kum & Go Store #2293
PROJECT NUMBER: 022-03197
CLIENT: Entitlement and Engineering Solutions LLC
PROJECT LOCATION: Parker, Colorado

BORING NUMBER	SAMPLE I.D.	SAMPLE DEPTH (ft)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	SATURATION (%)	UNCONFINED STRENGTH (tsf)	STRAIN (%)	ATTERBERG LIMITS			P-200	USCS CLASS.
									LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX		
B-1	SS-1	1.0 - 2.5'	8.9									20.6	
B-1	MC-2	3.5 - 4.5'	10.8	115.7	0.457	63.8			37	19	18		
B-1	SS-3	6.0 - 7.5'	14.1										
B-1	MC-4	9.0 - 10.0'	15.6	112.9	0.492	85.4							
B-2	MC-1	1.0 - 2.0'	11.4	122.0	0.382	80.8							
B-2	SS-2	3.5 - 5.0'	13.0										
B-2	MC-3	6.0 - 7.0'	10.9	115.8	0.456	64.6			43	18	25		
B-2	SS-4	9.0 - 10.5'	13.1									82.8	
B-3	MC-1	1.0 - 2.0'	8.0	121.6	0.386	55.9							
B-3	SS-2	3.5 - 5.0'	11.4									23.0	
B-3	SS-3	6.0 - 7.5'	11.3										
B-3	MC-4	9.0 - 10.0'	12.0	120.9	0.395	82.3							
B-4	MC-1	1.0 - 2.0'	11.3	121.2	0.390	78.4							
B-4	SS-2	3.5 - 5.0'	12.3									23.9	
B-4	MC-3	6.0 - 7.0'	19.1	101.1	0.667	77.3			44	18	26		
B-4	SS-4	9.0 - 10.5'	13.0										
B-5	SS-1	1.0 - 2.5'	11.3									26.0	
B-5	MC-2	3.5 - 4.5'	10.3	120.1	0.403	69.0							
B-5	SS-3	6.0 - 7.5'	16.3										
B-5	MC-4	9.0 - 10.0'	15.2	109.2	0.544	75.5							
B-6	SS-1	1.0 - 2.5'	10.5										
B-6	MC-2	3.5 - 4.5'	9.5	124.5	0.354	72.6							
B-6	SS-3	6.0 - 7.5'	16.9										
B-6	MC-4	9.0 - 10.0'	11.3	110.6	0.524	58.2			41	15	26		
B-6	SS-5	14.0 - 15.5'	11.2									58.7	
B-7	MC-1	1.0 - 2.0'	6.7	130.2	0.295	61.1							
B-7	SS-2	3.5 - 5.0'	22.9									67.3	
B-7	MC-3	6.0 - 7.0'	9.4										
B-7	MC-5	14.0 - 15.0'	15.8	110.3	0.528	80.8							
B-8	SS-1	1.0 - 2.5'	16.1									83.7	

OLSSON, INC.
5180 SMITH ROAD
DENVER, COLORADO 80216

SUMMARY OF LABORATORY RESULTS

PROJECT NAME: Kum & Go Store #2293
PROJECT NUMBER: 022-03197
CLIENT: Entitlement and Engineering Solutions LLC
PROJECT LOCATION: Parker, Colorado

BORING NUMBER	SAMPLE I.D.	SAMPLE DEPTH (ft)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	SATURATION (%)	UNCONFINED STRENGTH (tsf)	STRAIN (%)	ATTERBERG LIMITS			P-200	USCS CLASS.
									LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX		
B-8	MC-2	3.5 - 4.5'	14.7	114.4	0.474	83.9							
B-8	SS-3	6.0 - 7.5'	15.3										
B-8	MC-4	9.0 - 9.9'	14.3	114.2	0.476	80.8							
B-9	MC-1	1.0 - 2.0'	14.9	112.6	0.496	81.3			44	16	28		
B-9	SS-2	3.5 - 5.0'	9.6									50.9	
B-9	MC-3	6.0 - 7.0'	14.8										
B-9	SS-4	9.0 - 10.5'	18.0										

OLSSON, INC.
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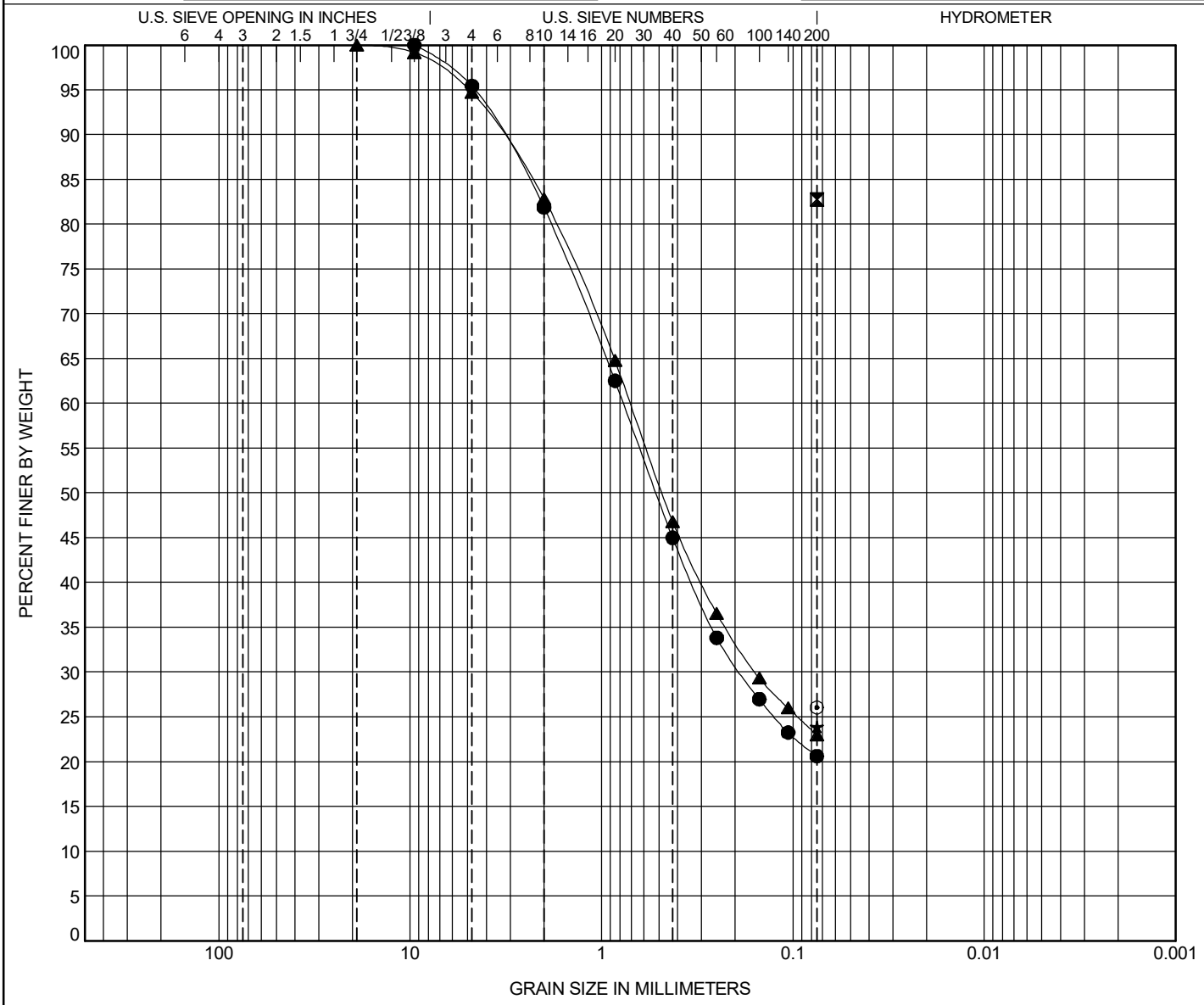
DENVER, COLORADO 80216

GRAIN SIZE DISTRIBUTION

PROJECT NAME: Kum & Go Store #2293 **CLIENT:** Entitlement and Engineering Solutions LLC

PROJECT NUMBER: 022-03197 **PROJECT LOCATION:** Parker, Colorado



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring No.	Sample ID	Depth (ft)	Classification	LL	PL	PI	Cc	Cu
● B-1	SS-1	1.0 - 2.5	Clayey sand (SC)					
⊠ B-2	SS-4	9.0 - 10.5	Lean clay with sand (CL)					
▲ B-3	SS-2	3.5 - 5.0	Clayey sand (SC)					
★ B-4	SS-2	3.5 - 5.0	Clayey sand (SC)					
⊙ B-5	SS-1	1.0 - 2.5	Clayey sand (SC)					

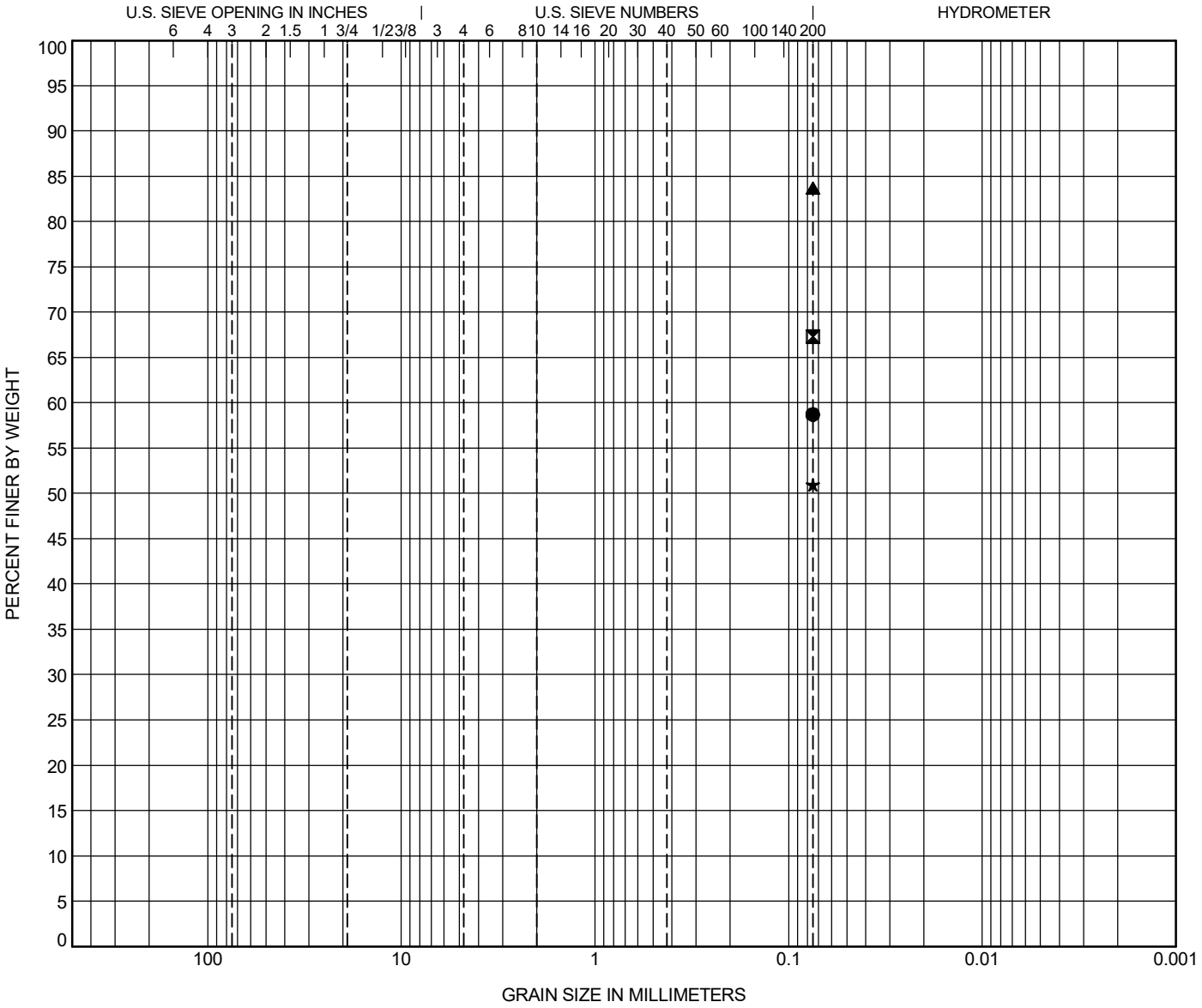
Boring No.	Sample ID	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-1	SS-1	9.5	0.77	0.188		4.6	74.8	20.6	
⊠ B-2	SS-4	0.075						82.8	
▲ B-3	SS-2	19	0.707	0.157		5.3	71.8	23.0	
★ B-4	SS-2	0.075						23.9	
⊙ B-5	SS-1	0.075						26.0	

OLSSON, INC.
5180 SMITH ROAD, UNIT F
DENVER, COLORADO 80216

GRAIN SIZE DISTRIBUTION

PROJECT NAME: Kum & Go Store #2293 **CLIENT:** Entitlement and Engineering Solutions LLC

PROJECT NUMBER: 022-03197 **PROJECT LOCATION:** Parker, Colorado



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring No.	Sample ID	Depth (ft)	Classification	LL	PL	PI	Cc	Cu
● B-6	SS-5	14.0 - 15.5	Claystone					
⊠ B-7	SS-2	3.5 - 5.0	Claystone					
▲ B-8	SS-1	1.0 - 2.5	Lean clay with sand (CL)					
★ B-9	SS-2	3.5 - 5.0						

Boring No.	Sample ID	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-6	SS-5	0.075						58.7	
⊠ B-7	SS-2	0.075						67.3	
▲ B-8	SS-1	0.075						83.7	
★ B-9	SS-2	0.075						50.9	

OLSSON, INC.
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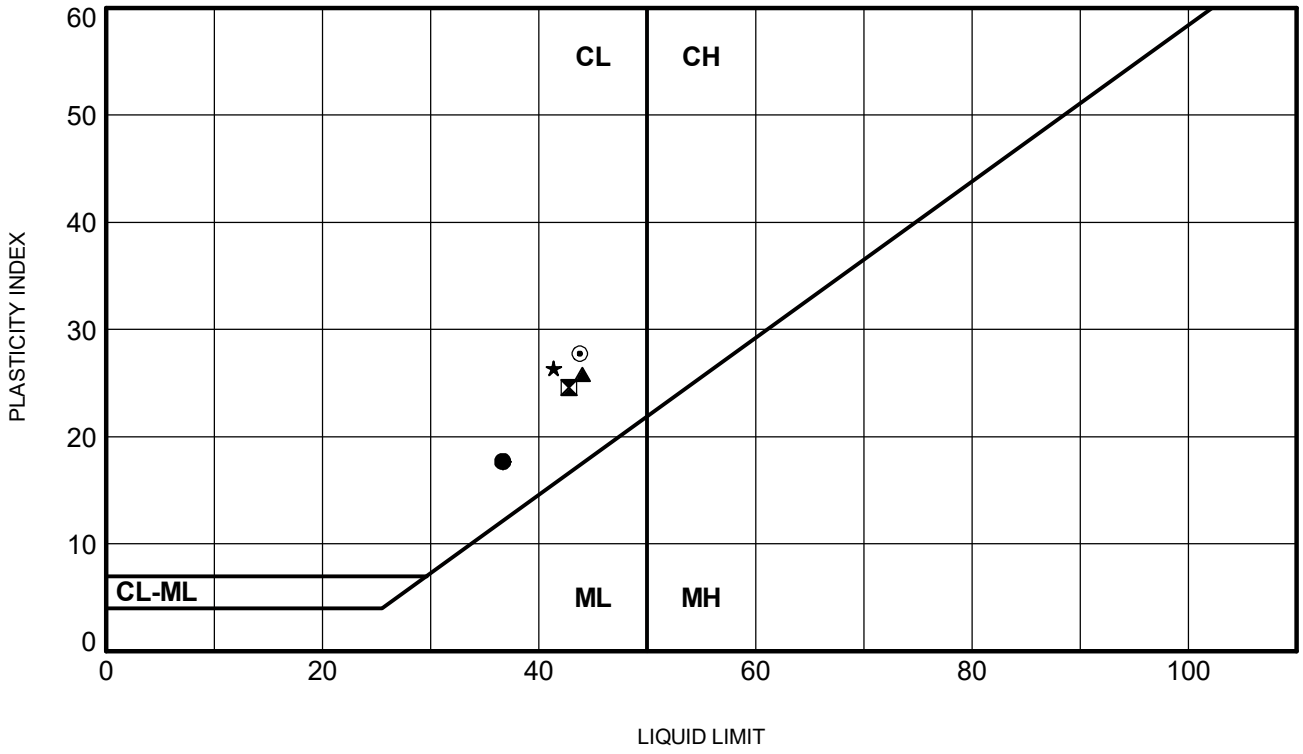
DENVER, COLORADO 80216

ATTERBERG LIMITS RESULTS

PROJECT NAME: Kum & Go Store #2293 **CLIENT:** Entitlement and Engineering Solutions LLC

PROJECT NUMBER: 022-03197 **PROJECT LOCATION:** Parker, Colorado



Boring No.	Sample ID	Depth (ft)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Fines (%)	Classification (USCS)
● B-1	MC-2	3.5 - 4.5	37	19	18		
⊠ B-2	MC-3	6.0 - 7	43	18	25		
▲ B-4	MC-3	6.0 - 7	44	18	26		
★ B-6	MC-4	9.0 - 10	41	15	26		
⊙ B-9	MC-1	1.0 - 2	44	16	28		

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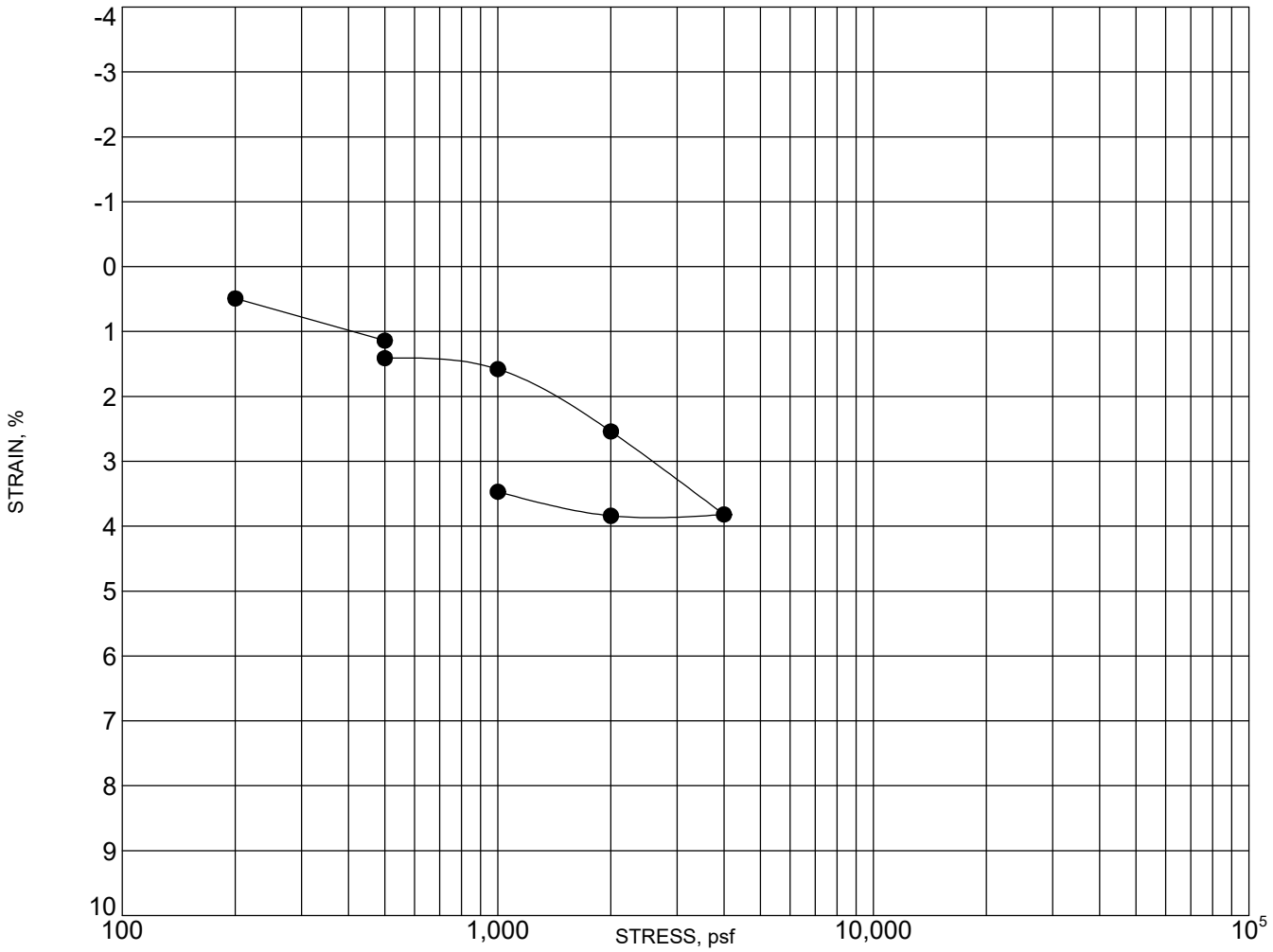
DENVER, COLORADO 80216

SWELL / CONSOLIDATION TEST

PROJECT NAME: Kum & Go Store #2293 **CLIENT:** Entitlement and Engineering Solutions LLC

PROJECT NUMBER: 022-03197 **PROJECT LOCATION:** Parker, Colorado



Boring No: B-1

Sample ID: MC-2

Sample Depth: 3.5 - 4.5'

Start Date: 6/15/2022

Technician: N. RASMUSSEN

Apparatus: DNV Swell F

Specific Gravity: 2.7

Initial Water Content (%): 10.8

Final Water Content (%): 14.7

Initial Dry Density (pcf): 115.7

Initial Void Ratio: 0.456

Final Void Ratio: 0.160

Initial Degree of Saturation (%): 69.9

Final Degree of Saturation (%): 100

Est. Preconsolidation Stress (psf):

Laboratory Water Type: Distilled Water

Test Procedure Method: C

Interpretation Procedure: NA

Stress at Inundation (psf): 500

Specimen Trimming Method: Ring Sampler

ATTERBERG LIMITS

LL	PL	PI	Classification
37	19	18	

Sample Description: Clayey Sand, Grayish Tan

Notes: Consolidation (500 psf Surcharge): 0.3%

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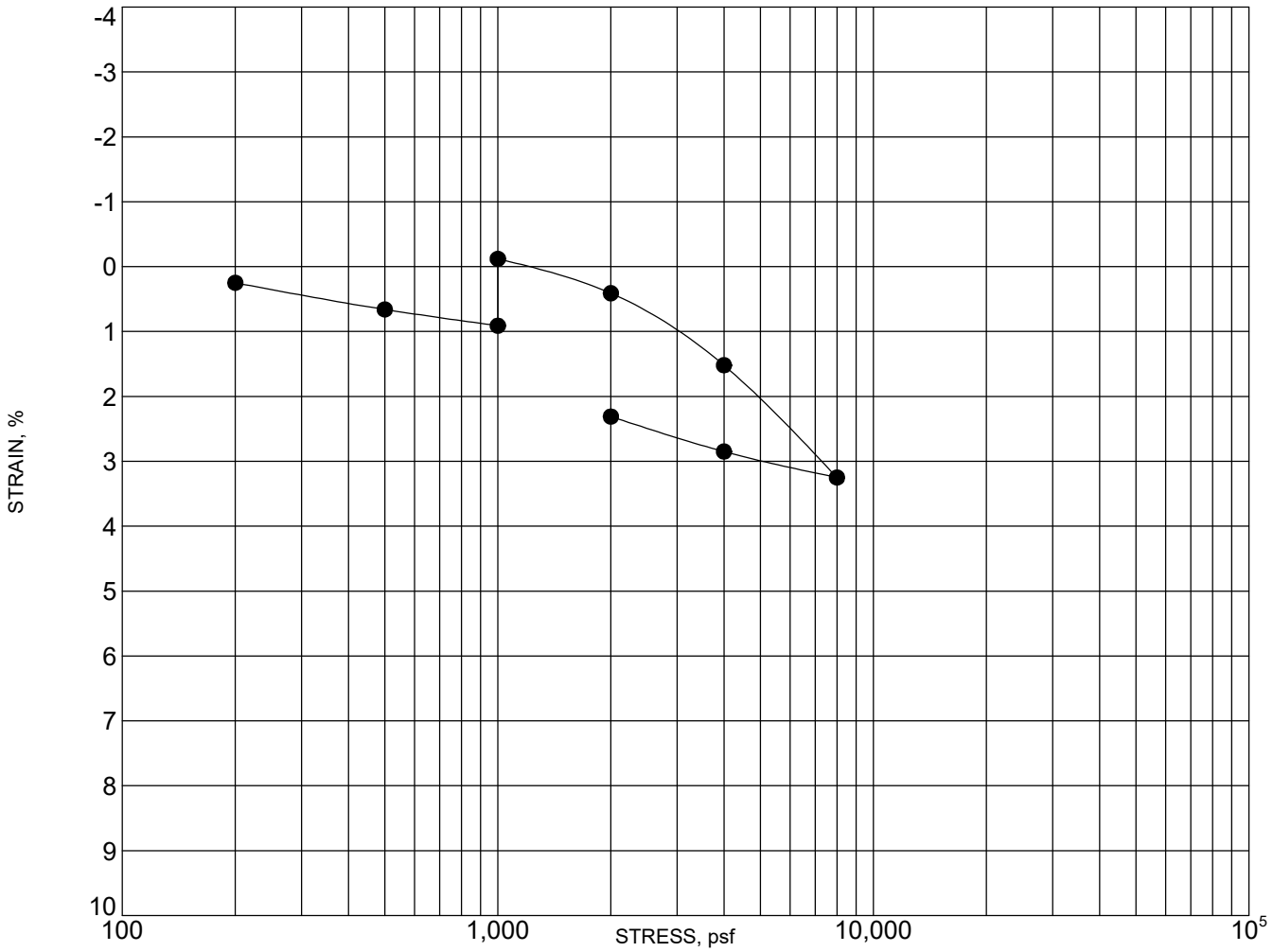
SWELL / CONSOLIDATION TEST

PROJECT NAME: Kum & Go Store #2293 **CLIENT:** Entitlement and Engineering Solutions LLC

PROJECT NUMBER: 022-03197 **PROJECT LOCATION:** Parker, Colorado



Boring No: B-2

Sample ID: MC-3

Sample Depth: 6.0 - 7.0'

Start Date: 6/15/2022

Technician: N. RASMUSSEN

Apparatus: DNV Swell H

Specific Gravity: 2.7

Initial Water Content (%): 10.9

Final Water Content (%): 17.3

Initial Dry Density (pcf): 115.8

Initial Void Ratio: 0.455

Final Void Ratio: 0.445

Initial Degree of Saturation (%): 64.6

Final Degree of Saturation (%): 100

Est. Preconsolidation Stress (psf):

Laboratory Water Type: Distilled Water

Test Procedure Method: C

Interpretation Procedure: NA

Stress at Inundation (psf): 1000

Specimen Trimming Method: Ring Sampler

ATTERBERG LIMITS

LL	PL	PI	Classification
43	**18**	**25**	

Sample Description: Lean Clay with Sand, Brown

Notes: Swell Potential (1000 psf Surcharge): 1.0%
Swell Pressure: 2,915 psf

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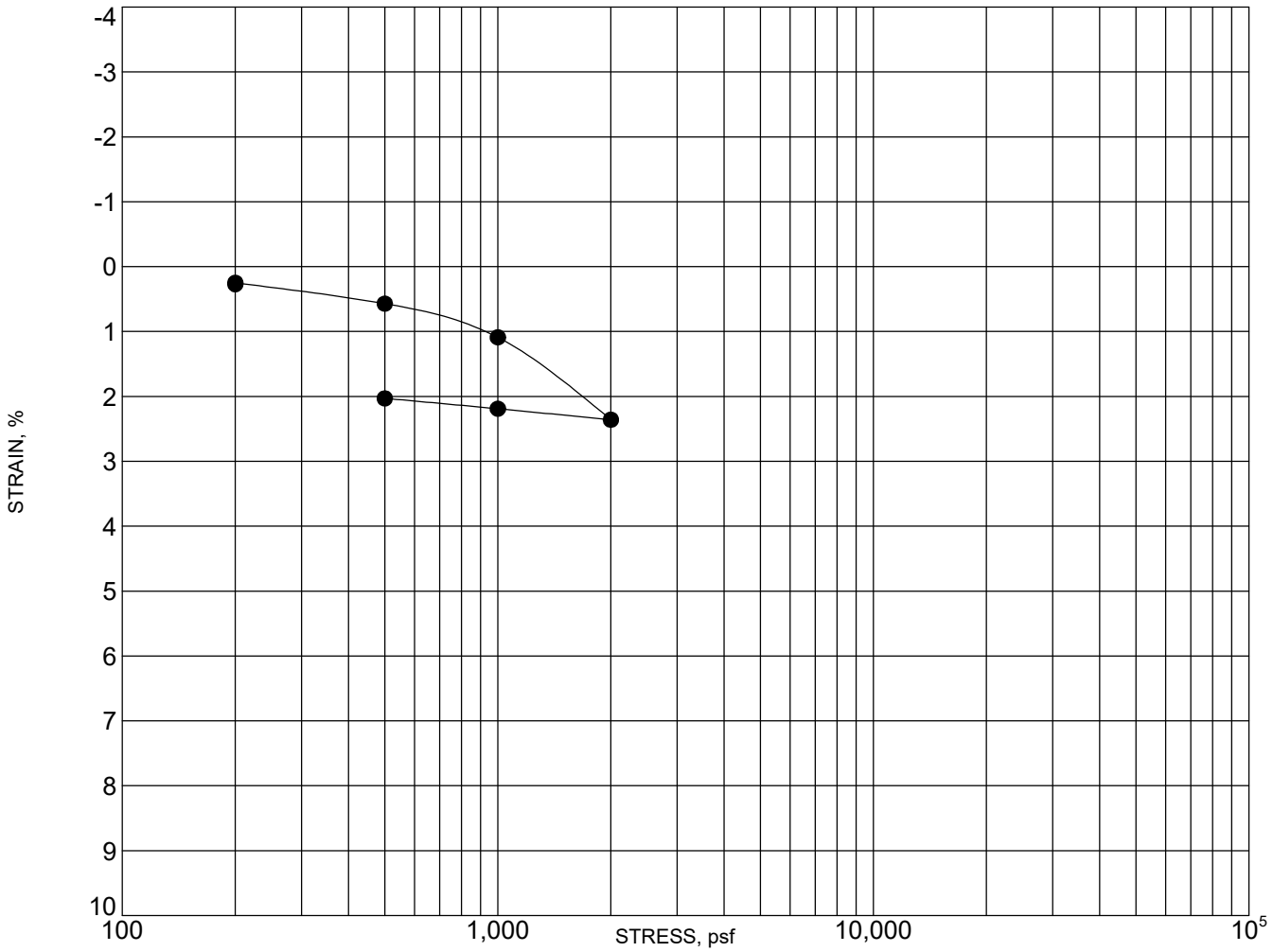
DENVER, COLORADO 80216

SWELL / CONSOLIDATION TEST

PROJECT NAME: Kum & Go Store #2293 **CLIENT:** Entitlement and Engineering Solutions LLC

PROJECT NUMBER: 022-03197 **PROJECT LOCATION:** Parker, Colorado



Boring No: B-3

Sample ID: MC-1

Sample Depth: 1.0 - 2.0'

Start Date: 6/15/2022

Technician: N. RASMUSSEN

Apparatus: DNV Swell G

Specific Gravity: 2.7

Initial Water Content (%): 8.0

Final Water Content (%): 13.0

Initial Dry Density (pcf): 121.6

Initial Void Ratio: 0.385

Final Void Ratio: 0.377

Initial Degree of Saturation (%): 55.7

Final Degree of Saturation (%): 93.4

Est. Preconsolidation Stress (psf):

Laboratory Water Type: Distilled Water

Test Procedure Method: C

Interpretation Procedure: NA

Stress at Inundation (psf): 200

Specimen Trimming Method: Ring Sampler

ATTERBERG LIMITS

LL	PL	PI	Classification

Sample Description: Clayey Sand, Grayish Tan

Notes: Swell Potential (200 psf Srucharge): 0.1%
Swell Pressure: 215 psf

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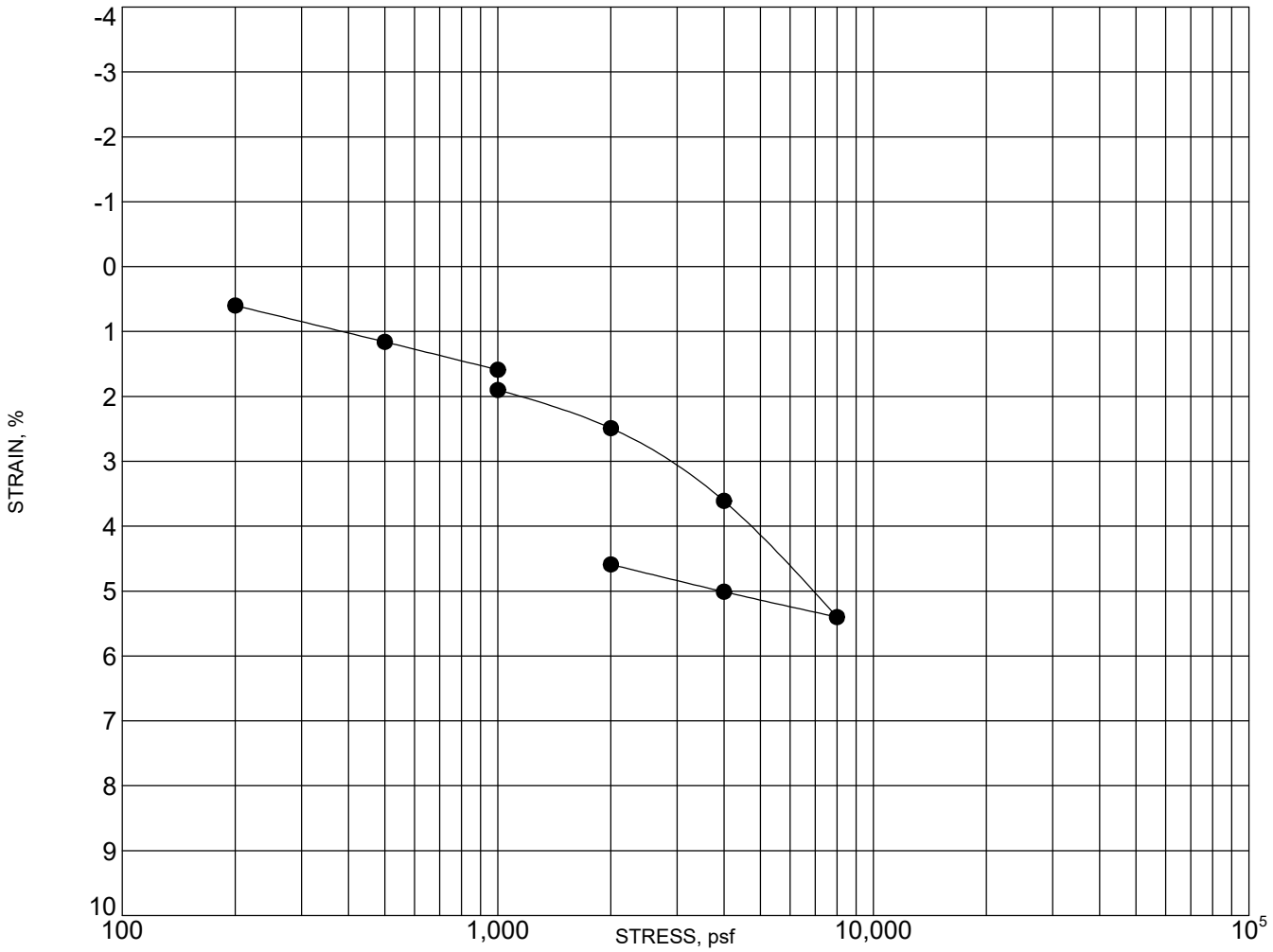
DENVER, COLORADO 80216

SWELL / CONSOLIDATION TEST

PROJECT NAME: Kum & Go Store #2293 **CLIENT:** Entitlement and Engineering Solutions LLC

PROJECT NUMBER: 022-03197 **PROJECT LOCATION:** Parker, Colorado



Boring No: B-4

Sample ID: MC-3

Sample Depth: 6.0 - 7.0'

Start Date: 6/15/2022

Technician: N. RASMUSSEN

Apparatus: DNV Swell I

Specific Gravity: 2.7

Initial Water Content (%): 19.1

Final Water Content (%): 22.2

Initial Dry Density (pcf): 101.1

Initial Void Ratio: 0.667

Final Void Ratio: 0.594

Initial Degree of Saturation (%): 77.3

Final Degree of Saturation (%): 100

Est. Preconsolidation Stress (psf):

Laboratory Water Type: Distilled Water

Test Procedure Method: C

Interpretation Procedure: NA

Stress at Inundation (psf): 1000

Specimen Trimming Method: Ring Sampler

ATTERBERG LIMITS

LL	PL	PI	Classification
44	**18**	**26**	

Sample Description: Clayey Sand, Grayish Tan

Notes: Consolidation (1000 psf Surcharge): 0.3%

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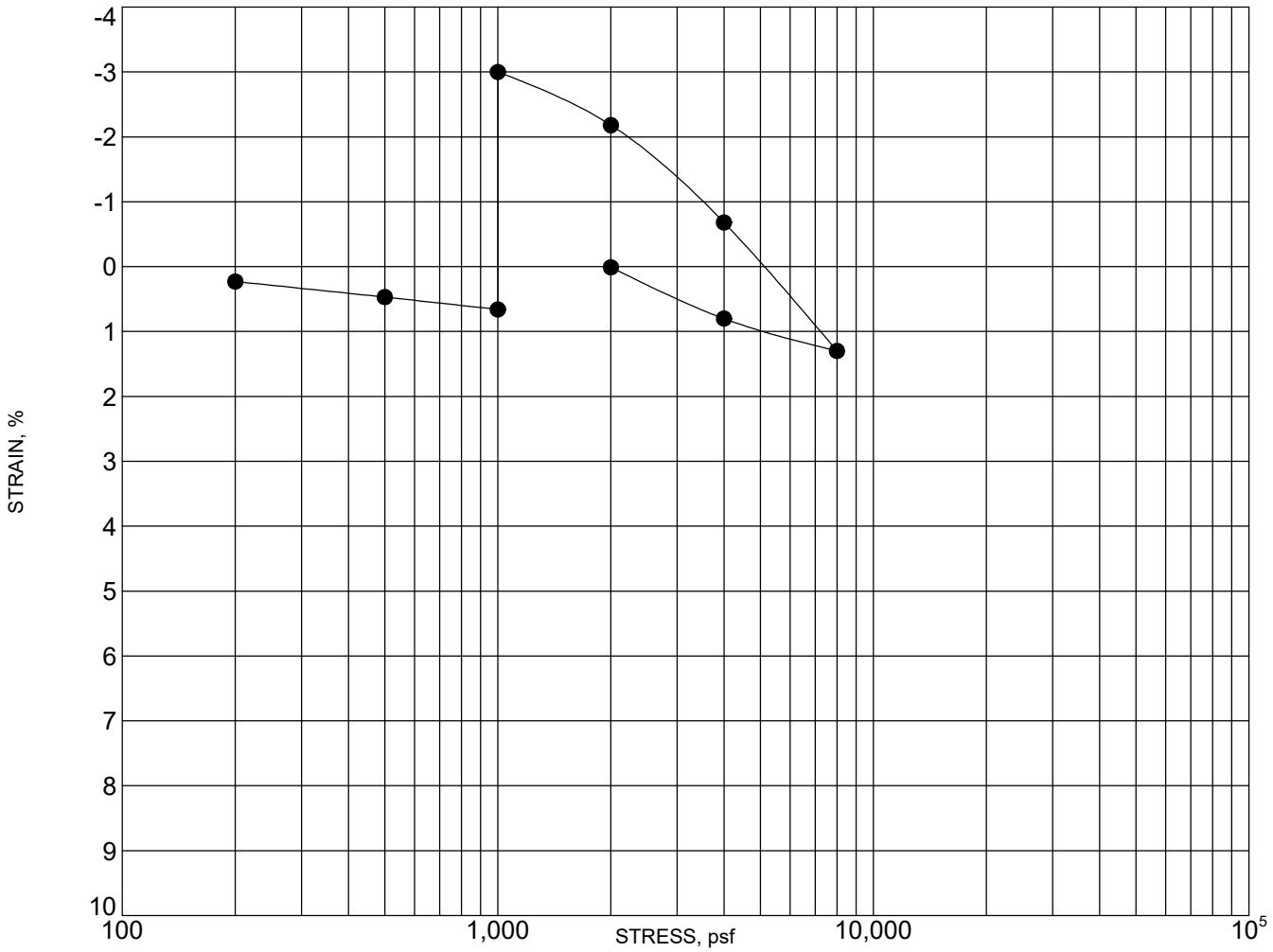
SWELL / CONSOLIDATION TEST

PROJECT NAME: Kum & Go Store #2293 **CLIENT:** Entitlement and Engineering Solutions LLC

PROJECT NUMBER: 022-03197 **PROJECT LOCATION:** Parker, Colorado



Boring No: B-5

Sample ID: MC-4

Sample Depth: 9.0 - 10.0'

Start Date: 6/15/2022

Technician: N. RASMUSSEN

Apparatus: DNV Swell J

Specific Gravity: 2.7

Initial Water Content (%): 15.2

Final Water Content (%): 22.4

Initial Dry Density (pcf): 109.2

Initial Void Ratio: 0.542

Final Void Ratio: 0.564

Initial Degree of Saturation (%): 75.7

Final Degree of Saturation (%): 100

Est. Preconsolidation Stress (psf):

Laboratory Water Type: Distilled Water

Test Procedure Method: C

Interpretation Procedure: NA

Stress at Inundation (psf): 1000

Specimen Trimming Method: Ring Sampler

ATTERBERG LIMITS

LL	PL	PI	Classification

Sample Description: Claystone, Yellowish Brown

Notes: Swell Potential (1000 psf Surcharge): 3.7%
Swell Pressure: 6,405 psf

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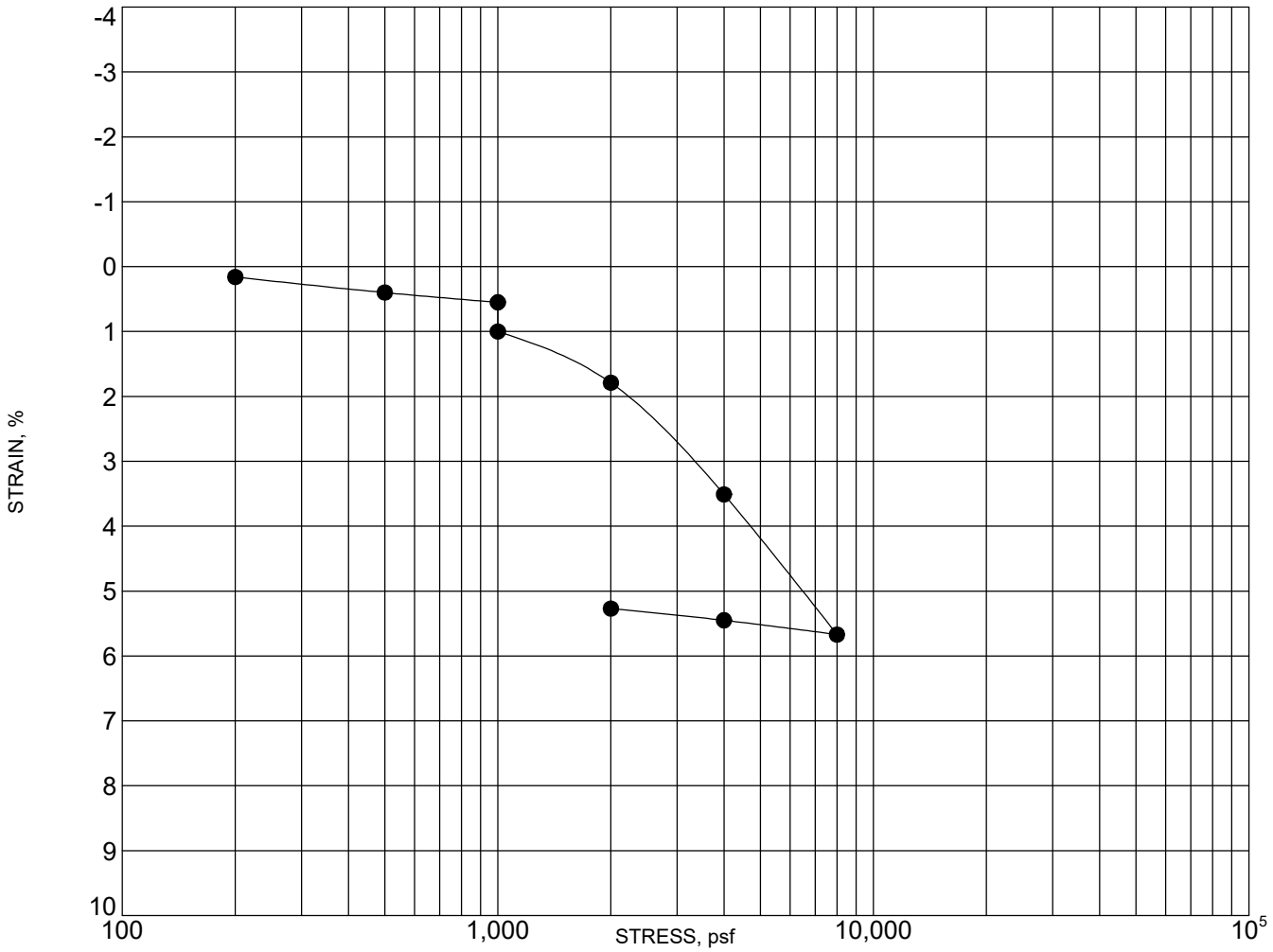
DENVER, COLORADO 80216

SWELL / CONSOLIDATION TEST

PROJECT NAME: Kum & Go Store #2293 **CLIENT:** Entitlement and Engineering Solutions LLC

PROJECT NUMBER: 022-03197 **PROJECT LOCATION:** Parker, Colorado



Boring No: B-6

Sample ID: MC-4

Sample Depth: 9.0 - 10.0'

Start Date: 6/15/2022

Technician: N. RASMUSSEN

Apparatus: DNV Swell K

Specific Gravity: 2.7

Initial Water Content (%): 11.3

Final Water Content (%): 16.2

Initial Dry Density (pcf): 110.6

Initial Void Ratio: 0.523

Final Void Ratio: 0.476

Initial Degree of Saturation (%): 58.3

Final Degree of Saturation (%): 91.9

Est. Preconsolidation Stress (psf):

Laboratory Water Type: Distilled Water

Test Procedure Method: C

Interpretation Procedure: NA

Stress at Inundation (psf): 1000

Specimen Trimming Method: Ring Sampler

ATTERBERG LIMITS

LL	PL	PI	Classification
41	15	26	

Sample Description: Clayey Sand, Grayish Tan

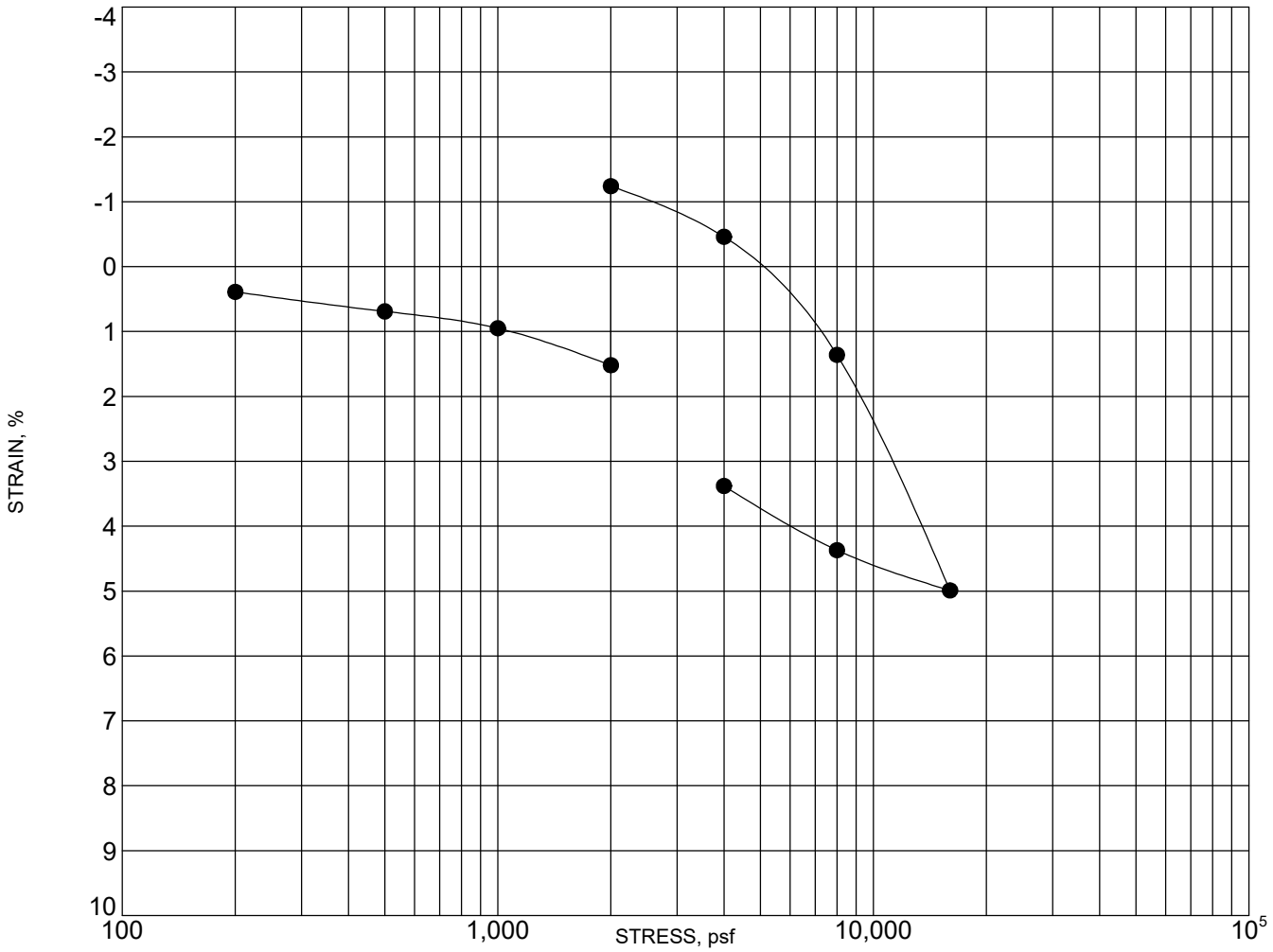
Notes: Consolidation (1000 psf Surcharge): 0.4%

OLSSON, INC.
5180 SMITH ROAD, UNIT F
DENVER, COLORADO 80216

SWELL / CONSOLIDATION TEST

PROJECT NAME: Kum & Go Store #2293 **CLIENT:** Entitlement and Engineering Solutions LLC

PROJECT NUMBER: 022-03197 **PROJECT LOCATION:** Parker, Colorado



Boring No: B-7

Sample ID: MC-5

Sample Depth: 14.0 - 15.0'

Start Date: 6/15/2022

Technician: N. RASMUSSEN

Apparatus: DNV Swell L

Specific Gravity: 2.7

Initial Water Content (%): 15.8

Final Water Content (%): 21.5

Initial Dry Density (pcf): 110.3

Initial Void Ratio: 0.528

Final Void Ratio: 0.486

Initial Degree of Saturation (%): 80.6

Final Degree of Saturation (%): 100

Est. Preconsolidation Stress (psf):

Laboratory Water Type: Distilled Water

Test Procedure Method: C

Interpretation Procedure: NA

Stress at Inundation (psf): 2000

Specimen Trimming Method: Ring Sampler

ATTERBERG LIMITS

LL	PL	PI	Classification

Sample Description: Claystone, Yellowish Brown

Notes: Swell Potential (2000 psf Surcharge): 2.8%
Swell Pressure: 4,125 psf

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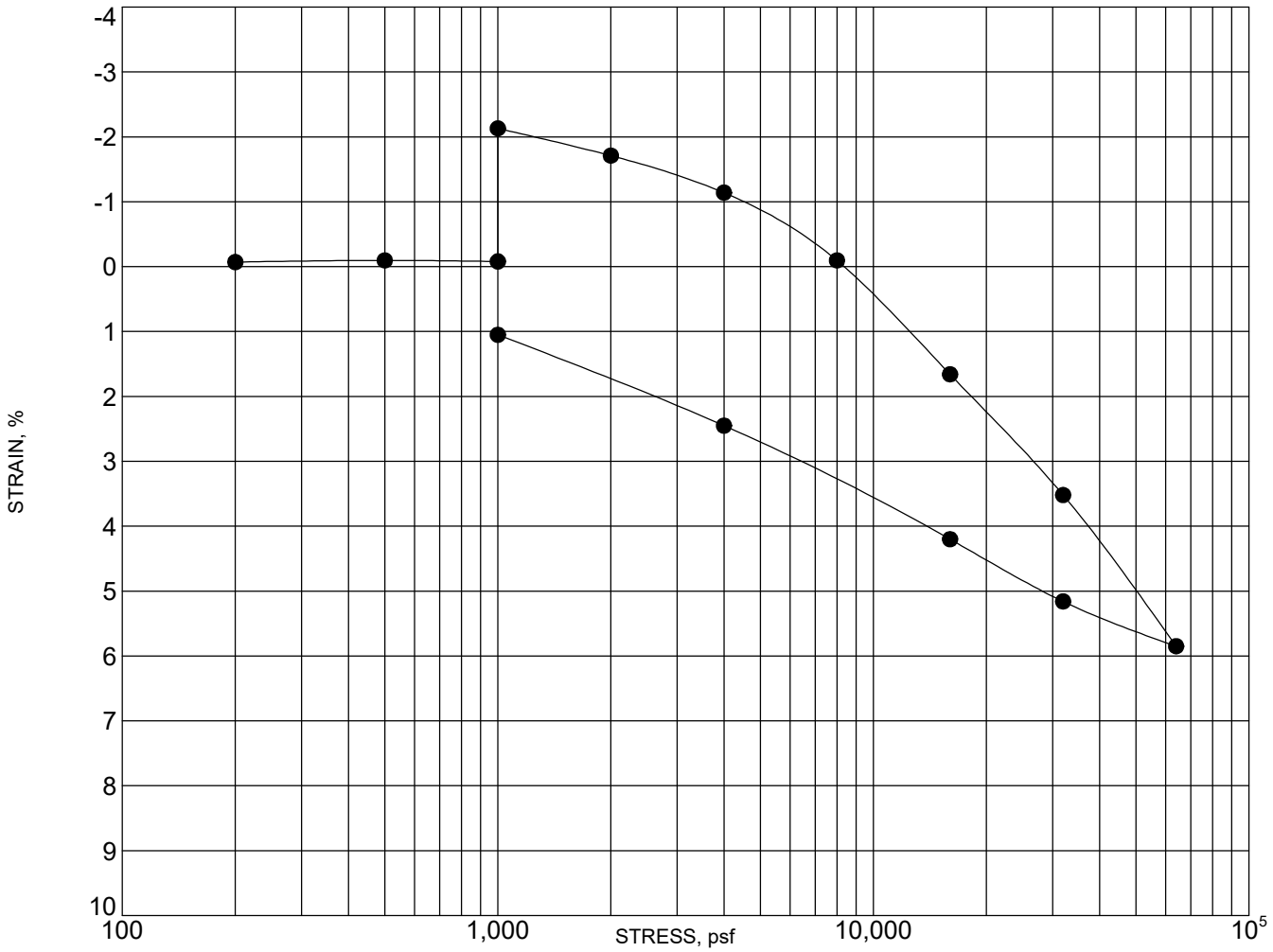
DENVER, COLORADO 80216

SWELL / CONSOLIDATION TEST

PROJECT NAME: Kum & Go Store #2293 **CLIENT:** Entitlement and Engineering Solutions LLC

PROJECT NUMBER: 022-03197 **PROJECT LOCATION:** Parker, Colorado



Boring No: B-8
Sample ID: MC-4
Sample Depth: 9.0 - 9.9'
Start Date: 6/15/2022
Technician: N. RASMUSSEN
Apparatus: Geo-Comp 63
Specific Gravity: 2.7

Initial Water Content (%): 14.3
Final Water Content (%): 19.8
Initial Dry Density (pcf): 114.2
Initial Void Ratio: 0.480
Final Void Ratio: 0.490
Initial Degree of Saturation (%): 85.7
Final Degree of Saturation (%): 100

Est. Preconsolidation Stress (psf):
Laboratory Water Type: Distilled Water
Test Procedure Method: C
Interpretation Procedure: NA
Stress at Inundation (psf): 1000
Specimen Trimming Method: Ring Sampler

ATTERBERG LIMITS

LL	PL	PI	Classification

Sample Description: Claystone, Yellowish Brown

Notes: Swell Potential (1000 psf Surcharge): 2.1%
Swell Pressure: 8,000 psf

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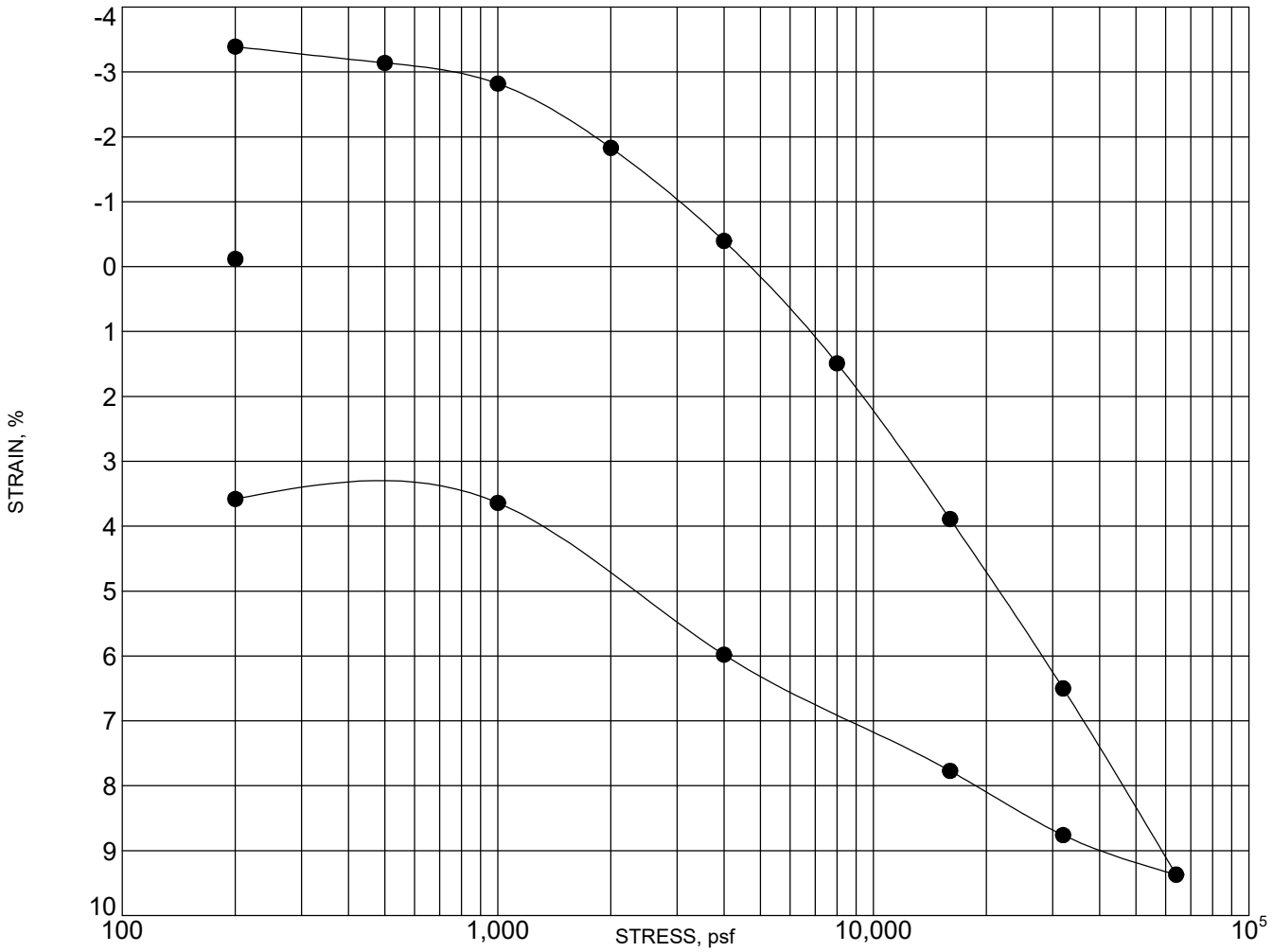
DENVER, COLORADO 80216

SWELL / CONSOLIDATION TEST

PROJECT NAME: Kum & Go Store #2293 **CLIENT:** Entitlement and Engineering Solutions LLC

PROJECT NUMBER: 022-03197 **PROJECT LOCATION:** Parker, Colorado



Boring No: B-9

Sample ID: MC-1

Sample Depth: 1.0 - 2.0'

Start Date: 6/15/2022

Technician: N. RASMUSSEN

Apparatus: Geo-Comp 64

Specific Gravity: 2.7

Initial Water Content (%): 14.9

Final Water Content (%): 16.8

Initial Dry Density (pcf): 112.6

Initial Void Ratio: 0.500

Final Void Ratio: 0.440

Initial Degree of Saturation (%): 81.3

Final Degree of Saturation (%): 100

Est. Preconsolidation Stress (psf):

Laboratory Water Type: Distilled Water

Test Procedure Method: C

Interpretation Procedure: NA

Stress at Inundation (psf): 200

Specimen Trimming Method: Ring Sampler

ATTERBERG LIMITS

LL	PL	PI	Classification
44	16	28	

Sample Description: Sandy Lean Clay, Brown

Notes: Swell Potential (200 psf Surcharge): 3.3%
Swell Pressure: 4,470 psf

5180 Smith Road
Denver, CO 80216
TEL 303.237.2072
FAX 303.237.2659
www.olsson.com

Soil Corrosion Suite

Project Information	
Project Name:	Kum & Go Store # 2293
Project Number:	022-03197
Client Name:	Entitlement and Engineering Solutions LLC
Project Location:	Parker, Colorado
Sample and Test Information	
Sample Location:	B-3 Bulk Bag 1-3 feet
Sample Description:	Clayey Sand, Grayish Tan
Laboratory Technician:	Matt Almand
Date Tested:	6/21/2022

Test Results

Water Soluble Sulfate (Colorado Procedure CP-L-2103)

Dilution	Reading	Concentration, mg/L	Concentration, % mass
100:1	0	N/D	N/D

*N/D - Not Detected - Concentration below equiptment detection limit of 0.1% mass

Water Soluble Chloride (Colorado Procedure CP-L-2104)

Dilution	Concentration, ppm	Concentration, % mass
3	138	0.0138

pH (ASTM G51)

pH Meter Reading
7.94

Electrical Resistivity (ASTM G57, -#10)

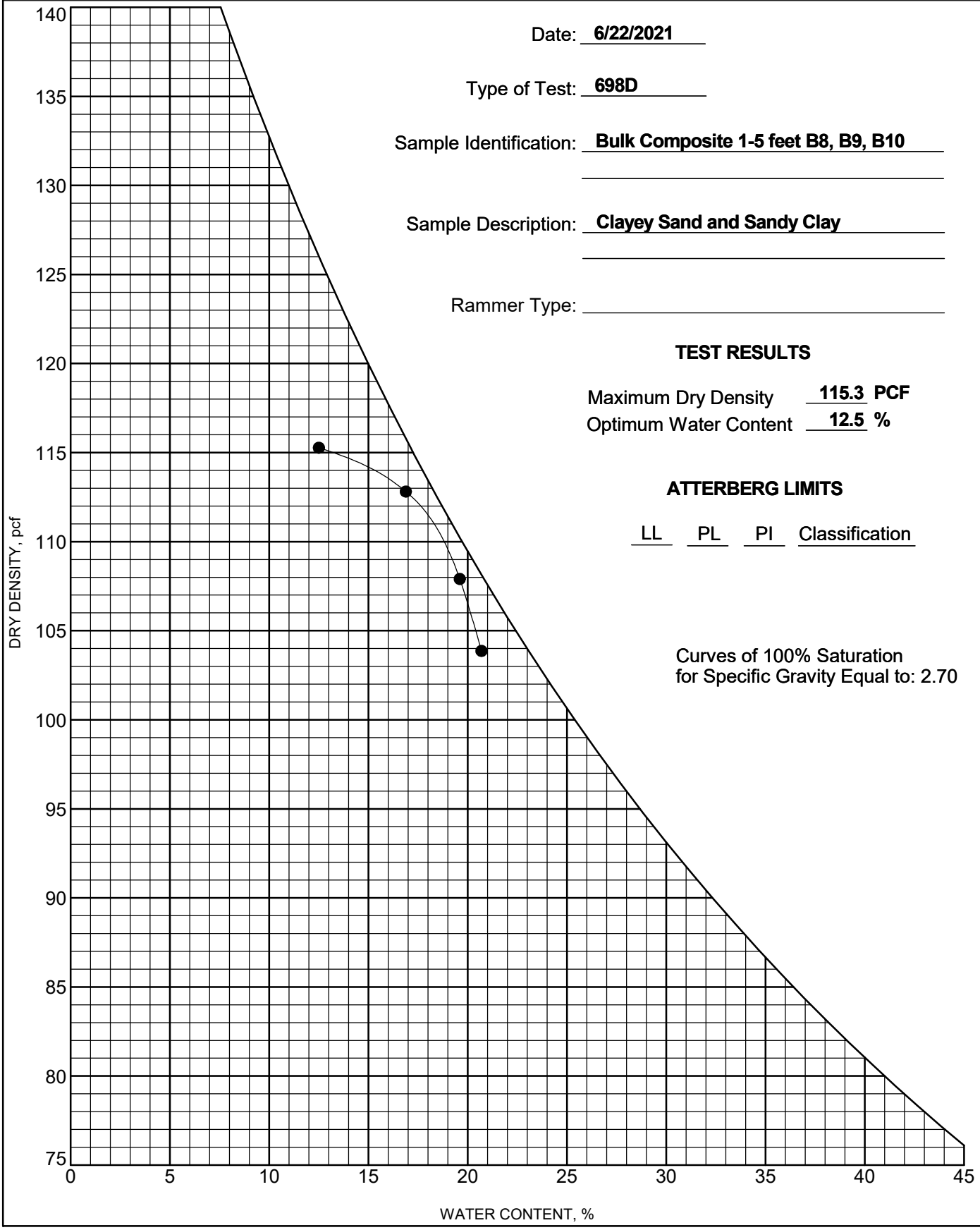
Temperature (°C)	Readings (ohm*cm)	Temp Correction (ohm*cm)	
20	2290	2548	
20	1560	1736	**Lowest Resistivity (ohm*cm)**
20	1880	2092	1736

Sample portion passing the #10 sieve used in testing. Each reading performed after additional water was added.

OLSSON, INC.
5180 SMITH ROAD, UNIT F
DENVER, COLORADO 80216

MOISTURE-DENSITY RELATIONSHIP

PROJECT NAME: Kum & Go Store #2293
CLIENT: Entitlement and Engineering Solutions LLC
PROJECT NUMBER: 022-03197
PROJECT LOCATION: Parker, Colorado



Date: **6/22/2021**

Type of Test: **698D**

Sample Identification: **Bulk Composite 1-5 feet B8, B9, B10**

Sample Description: **Clayey Sand and Sandy Clay**

Rammer Type:

TEST RESULTS

Maximum Dry Density **115.3** **PCF**
Optimum Water Content **12.5** **%**

ATTERBERG LIMITS

LL	PL	PI	Classification

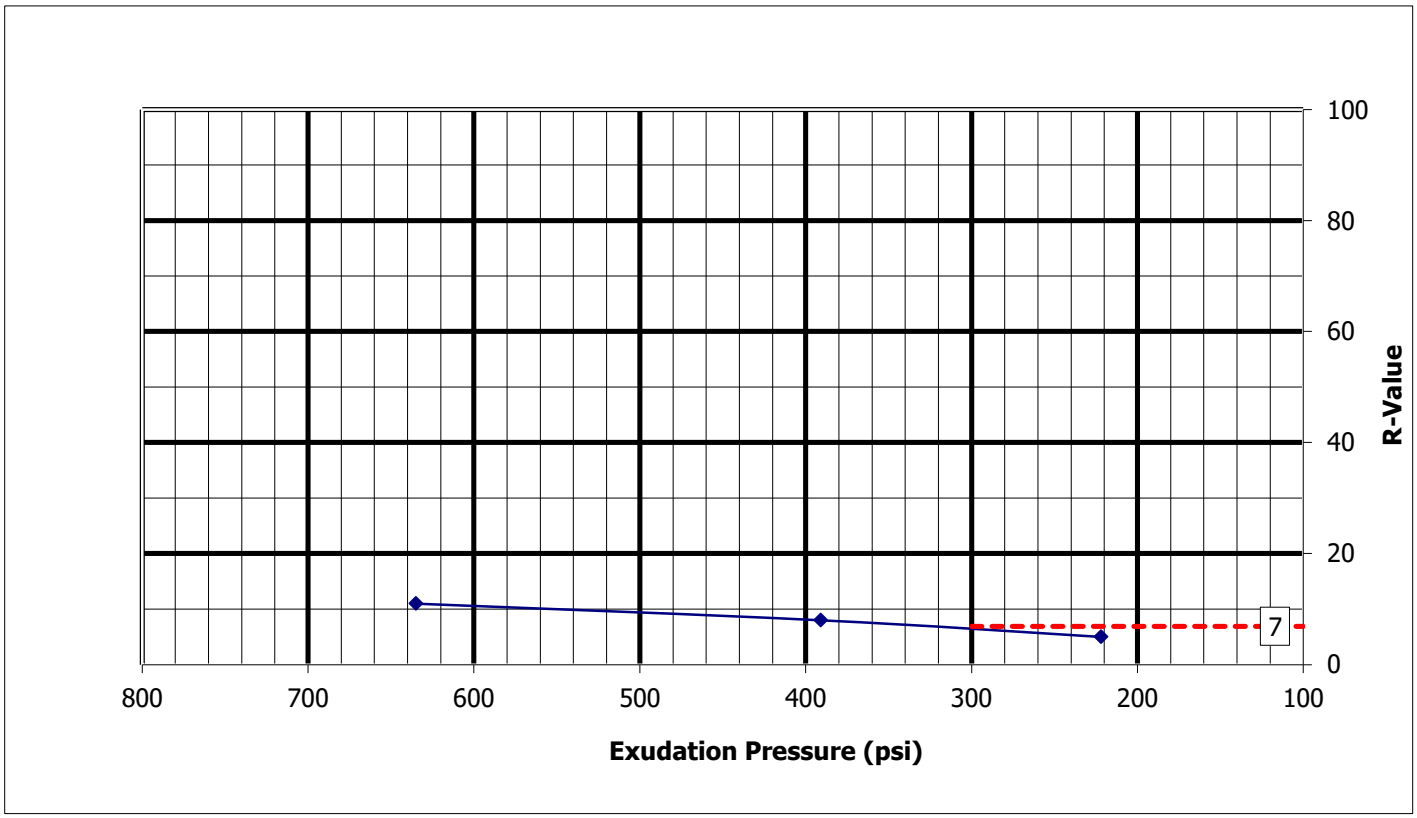
Curves of 100% Saturation
for Specific Gravity Equal to: 2.70

CESARE, INC. Geotechnical Engineers & Construction Materials Consultants | CMT TECHNICAL SERVICES

AASHTO ACCREDITED

R-VALUE TEST GRAPH (ASTM D2844)

Project Number:	22.021, Olsson	Date:	29-Jun-22
Project Name:	General Lab Testing 2022 (Olsson Project No. 022-03197)	Technician:	J. Weinerth
Lab ID Number:	222803	Reviewer:	G. Hoyos
Sample Location:	Composite: B-8, B-9, B-10 at 1 to 5 feet		
Visual Description:	SAND, clayey, brown		



R-Value @ Exudation Pressure 300 psi: 7

Specification:

CDOT Pavement Design Manual, 2011.
Eq. 2.1 & 2.2, page 2-3.

$S_1 = [(R-5)/11.29]+3$ **S_1= 3.17**

$M_R = 10^{[(S_1+18.72)/6.24]}$ **M_R= 3,219**

M_R = Resilient Modulus, psi

S_1 = the Soil Support Value

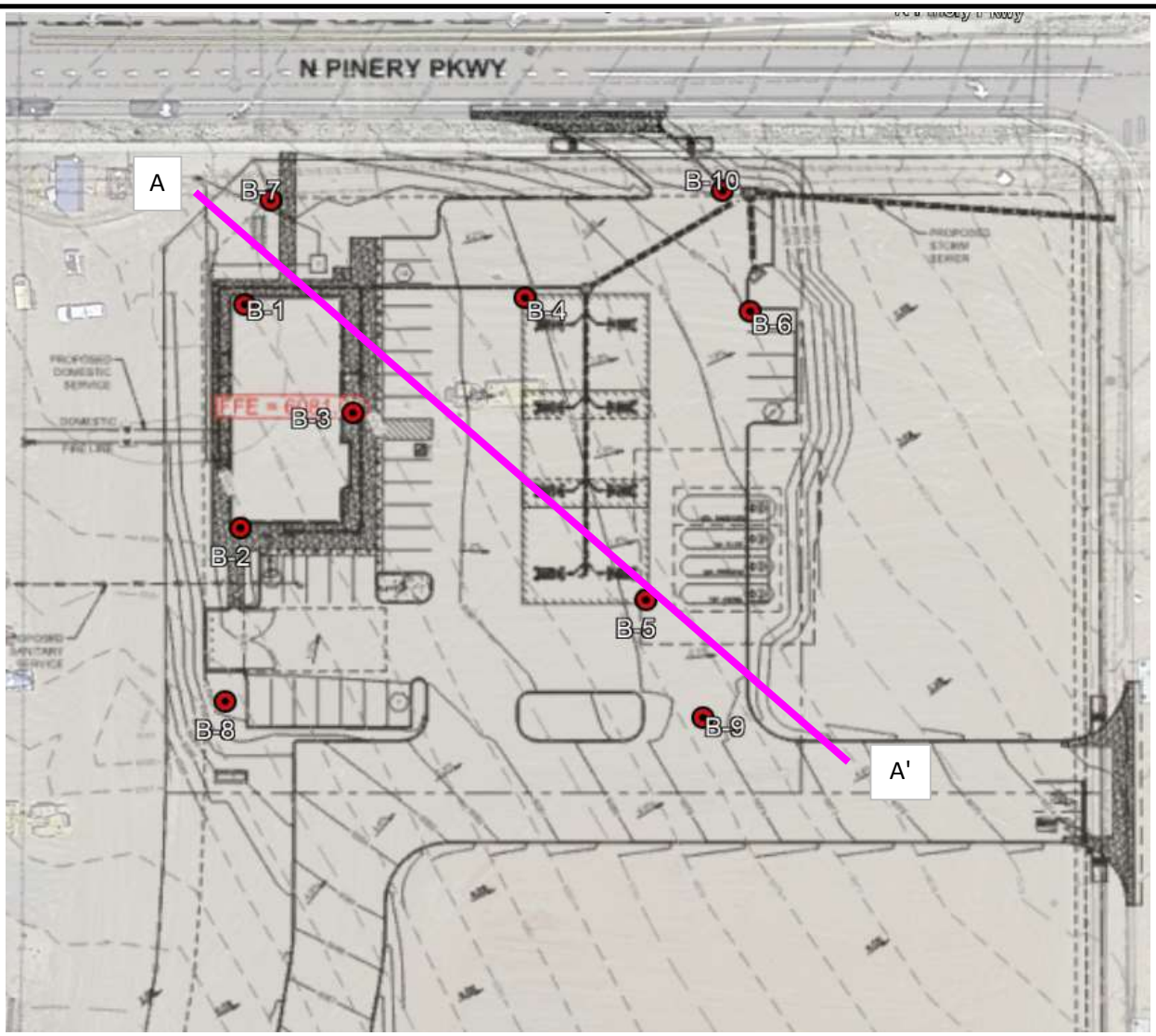
R = the R-Value obtained

Test Specimen:	1	2	3
Moisture Content, %:	15.2	17.5	20.1
Expansion Pressure, psi:	0.06	0.03	-0.12
Dry Density, pcf:	118.9	115.1	109.3
R-Value:	11	8	5
Exudation Pressure, psi:	635	391	222

Note: The R-Value is measured; the M_R is an approximation from correlation formulas.

APPENDIX D

Geologic Cross Section Location Plan
Geologic Profile



Boring	Depth	Approximate Coordinates	
B-1	25	39.458929° N	104.783639° W
B-2	25	39.458689° N	104.783644° W
B-3	25	39.458813° N	104.783491° W
B-4	25	39.458937° N	104.783258° W
B-5	25	39.458612° N	104.783094° W
B-6	25	39.458922° N	104.782952° W
B-7	20	39.459042° N	104.783603° W
B-8	20	39.458503° N	104.783665° W
B-9	10	39.458480° N	104.783017° W
B-10	10	39.459052° N	104.782990° W

Approximate location of geologic cross section

olsson

Geologic Cross Section Location Plan

Scale: nts
Project: 022
Approved by: PJM
Date: 9/01/2022

Kum & Go Store # 2293
Parker, Colorado

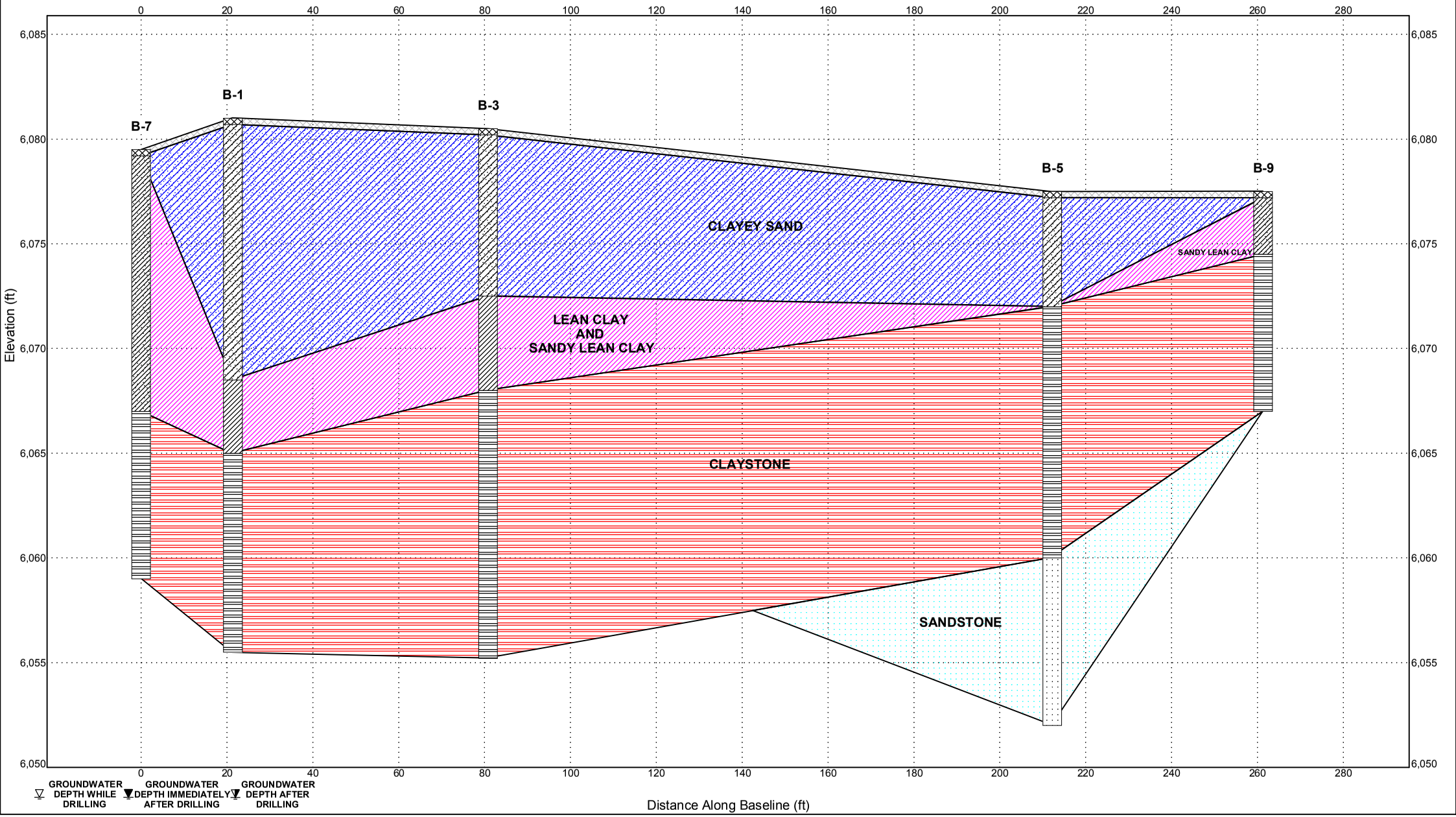
OLSSON, INC.
5180 SMITH ROAD
DENVER, COLORADO 80216

GEOLOGIC PROFILE
Kum & Go Store #2293

USCS Clayey Sand | USCS Low Plasticity Clay | Claystone | Sandstone

PROJECT NAME Kum & Go Store #2293
PROJECT NUMBER 022-03197
CLIENT Entitlement and Engineering Solutions LLC
PROJECT LOCATION Parker, Colorado

NOTE: Soil stratification, as shown on the geologic profile, represents soil conditions at the boring locations: however, variations may occur between or around the boring locations.



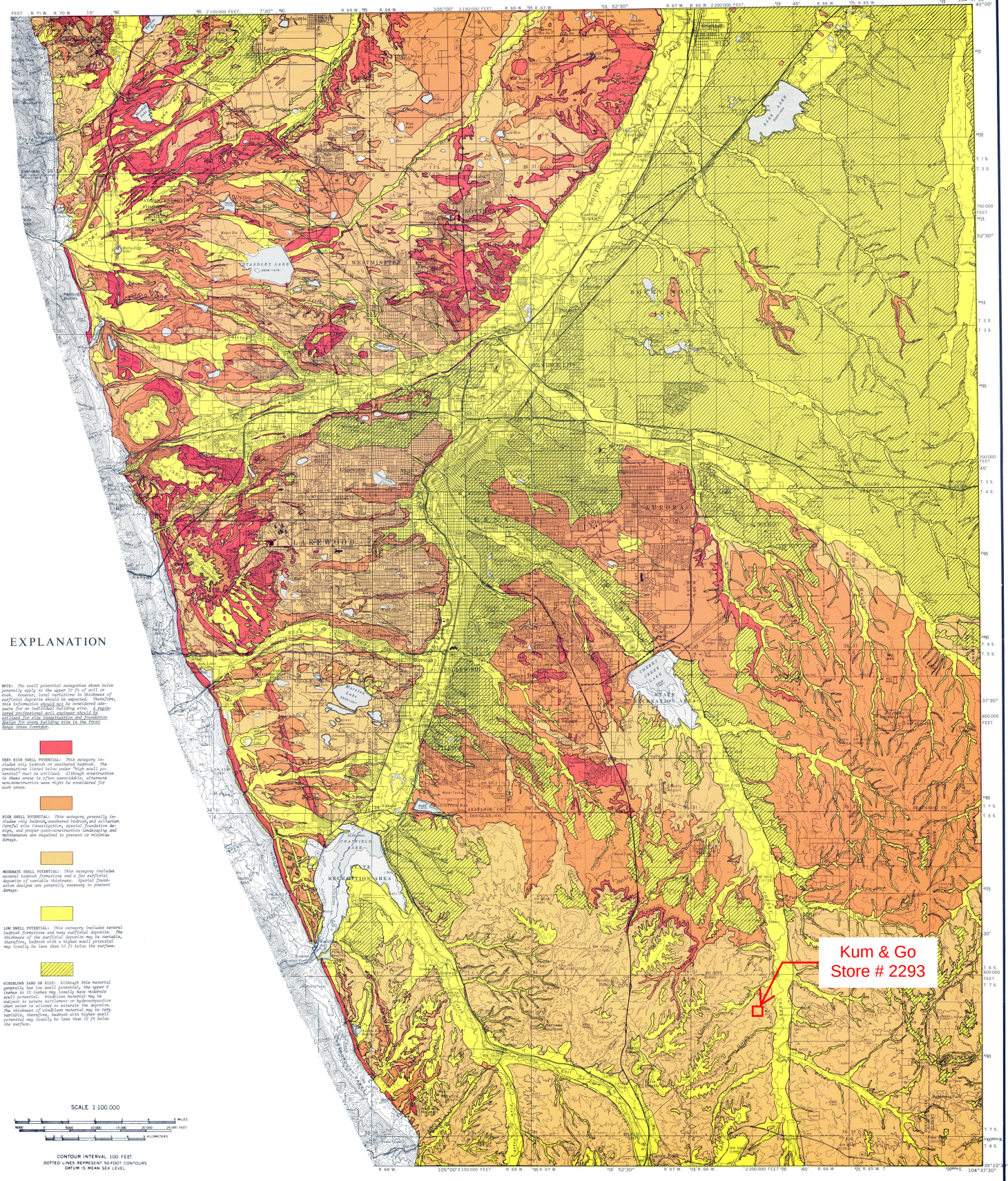
APPENDIX E

Potentially Swelling Soil and Rock Map

DEPARTMENT OF NATURAL RESOURCES
COLORADO GEOLOGICAL SURVEY
JOHN W. ROLD, DIRECTOR

Prepared in cooperation with the
UNITED STATES GEOLOGICAL SURVEY

GREATER DENVER AREA
COLORADO



Map edited and published by the
Colorado Geological Survey, 1973-1974

Base map from U. S. Geological Survey, 1972

CARTOGRAPHICS: JAMES A. BARNES

DECLINATION AT CENTER OF SHEET

POTENTIALLY SWELLING SOIL AND ROCK IN THE FRONT RANGE URBAN CORRIDOR, COLORADO

BY
Stephen S. Hart

INDEX TO USGS 7.5' QUADRANGLES

FRONT RANGE URBAN CORRIDOR
SHEET 2 OF 4