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GEOTECHNICAL ENGINEERING STUDY
PROPOSED TRANSPORTATION FACILITY IMPROVEMENTS
10850 E. WOODMEN ROAD
PEYTON, COLORADO

Prepared By:
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12/14/23
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Project No. 23-2-218

December 14, 2023

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SUMMARY

1. The generalized upper subsurface profile included approximately 8 inches to 3 feet of man-placed fill consisting of silty sand with gravel and well graded sand with gravel, followed by predominantly native granular soils which extended to depths between 7.5 to 13.5 feet. The granular soils were underlain by 2.5 to 5.5-foot thick layers of sandy lean clay in three of the borings, beginning at depths between 7 and 9.5 feet. Sandstone and/or claystone bedrock was encountered below the overburden soils, beginning at depths between 8 and 13.5 feet, and extending to the 20-foot depths explored.

2. With proper site preparation, shallow spread footing foundations with slab-on-grade floor construction should be feasible. Proper site preparation should include complete removal of existing fills where present within the proposed building footprint, down to the native granular soils and replacement with suitable compacted nonexpansive fill.

3. Based on the properties of the native granular soils and existing fill encountered, it is our opinion they would be suitable for reuse as nonexpansive fill (minus any deleterious materials) if sufficiently processed and moisture conditioned. The “Site Grading” section of the report provides additional discussion.

4. At the time of drilling, groundwater was encountered in each of the borings at depths ranging from 7 to 18 feet. When the borings were checked 7 days later, groundwater was encountered in each of the borings at depths between 6 and 6.9 feet. Fluctuations in the water level may occur with time, particularly during wetter seasons and after precipitation events.

5. Depending on the depth of excavation planned and the time of year that construction occurs, dewatering will likely be necessary for portions of the site during construction. The “Excavation Considerations” section of the report provides additional discussion.

PURPOSE AND SCOPE OF STUDY

This report presents the results of a geotechnical engineering study for the proposed transportation facility improvements located at 10850 E. Woodmen Road in Peyton, Colorado. The project site is shown on Fig. 1. This study was conducted in accordance with the scope of work in our Proposal C23-314, dated November 9, 2023, to develop recommendations for foundations and floor slabs, and other geotechnical considerations related to the proposed construction.

This report has been prepared to summarize the data obtained during this study and to present our conclusions and recommendations based on the proposed construction and the subsurface conditions encountered. Design parameters and a discussion of geotechnical engineering considerations related to the proposed construction are included in the report.

We previously prepared a geotechnical engineering study for the transportation facility (Project No. 002-261, dated February 28, 2001). Information from the 2001 study was referenced when developing the recommendations presented herein.

PROPOSED CONSTRUCTION

We understand the proposed construction will include the following new building structures:

- Building addition to north side of existing garage, 125'x55',
- Covered parking building, 200'x80', and
- Barn building, 200'x80'.

Each of the structures will consist of a single-story metal building with a slab-on-grade floor and no basement level. No new pavements are anticipated. We have assumed site grading in the areas of the proposed construction will be negligible, with construction occurring at the approximate existing grades. If the proposed construction is significantly different from that described above or depicted in this report, we should be notified to reevaluate the recommendations contained in this report.

SITE CONDITIONS

The subject site is bound by Bent Grass Meadows Drive to the east, a self-storage facility to the north, vacant land with high-voltage transmission lines to the west, and the Woodmen Frontage Road to the south. The southern portions of the property included a warehouse/garage with a fueling area, several smaller buildings and storage areas, and the district central office building with employee parking areas. The northern portion of the property included material storage and school bus parking space. Five concrete crosspans run north to south in the bus parking area, with light poles running adjacent to the concrete. An additional concrete crosspan separates the south end of the bus parking area from an employee parking area. The topography of the site is nearly level, with a slight slope down to the south. The entire property is generally devoid of vegetation.

FIELD EXPLORATION

The field exploration of subsurface conditions consisted of drilling a total of six borings on November 30, 2023. The boring locations were approximated by using a handheld GPS unit, and the approximate locations are shown on Fig. 1. The boring logs and corresponding legend and notes are presented on Figs. 2 and 3, respectively.

The borings were drilled with 4-inch diameter continuous flight augers and were logged by a representative of Kumar & Associates, Inc. Samples of the soils and bedrock were taken with either a 2-inch I.D. California sampler or a 1 3/8-inch I.D. split spoon sampler. The samplers were driven into the various strata with blows from a 140-pound hammer falling 30 inches. Penetration resistance values, when properly evaluated, provide an indication of the relative density or consistency of the soils. Depths at which the samples were taken and the penetration resistance values are shown on the boring logs.

LABORATORY TESTING

Samples obtained from the exploratory borings were visually classified in the laboratory by the project engineer and samples were selected for laboratory testing. Laboratory testing included index property tests such as in-situ moisture content and dry unit weight, grain size analysis, and Atterberg limits. Additional testing performed included swell-consolidation testing and concentration of water soluble sulfates. The testing was conducted in general accordance with recognized test procedures, primarily those of the American Society for Testing of Materials (ASTM). Results of the laboratory testing program are shown on Figs. 2, 4 through 7, and are summarized on Table I.

SUBSURFACE CONDITIONS

The generalized upper subsurface profile included approximately 8 inches to 3 feet of man-placed fill consisting of silty sand with gravel and well graded sand with gravel, followed by predominantly native granular soils which extended to depths between 7.5 to 13.5 feet. The granular soils were underlain by 2.5 to 5.5-foot thick layers of sandy lean clay in three of the borings, beginning at depths between 7 and 9.5 feet. Sandstone and/or claystone bedrock was encountered below the overburden soils, beginning at depths between 8 and 13.5 feet, and extending to the 20-foot depths explored.

The following subsurface descriptions are of a generalized nature to highlight the soil types encountered in the borings drilled for this study. The boring logs should be reviewed for more detailed information.

<u>Existing Fill</u>: The fill was encountered in each of the borings and extended to depths between approximately 8 inches and 3 feet. The fill consisted of silty sand with gravel (SM) and well-graded sand with gravel (SW-SM), and appeared dry, and tan, brown, and pink in color. Our study did not determine the exact lateral or vertical extent of the fill.

<u>Native Granular Soils</u>: Granular soil types, to include clayey sand (SC), silty sand (SM), and poorly to well-graded sand with varied amounts of silt (SP, SW, SP-SM, SW-SM) were encountered below the fill, and extending to depths between 7.5 feet and 13 feet. The granular soils included occasional gravel, appeared slightly moist to wet, and varied from tan to brown in color. Sampler penetration blow counts indicate the soils are medium dense.

Native Clay Soils: The granular soils were underlain by 2.5 to 5.5-foot thick layers of sandy lean clay in Borings 2, 5, and 6, beginning at depths between 7 and 9.5 feet. The clay appeared moist and varied from brown to light gray in color. Sampler penetration blow counts indicate the soils are medium stiff to very stiff. Swell-consolidation test results presented on Fig. 4 indicate the tested sample of sandy lean clay had a low swell potential after wetting under a 1 ksf surcharge.

Bedrock: Sandstone and/or claystone bedrock was encountered below the overburden soils in each of the borings, beginning at depths between 8 and 13.5 feet and extending to the maximum 20-foot depth explored. The sandstone was poorly cemented, moist to wet, and tan to light gray in color. The claystone was moist and gray in color. Sampler penetration blow counts indicates the materials range from hard to very hard.

Groundwater: At the time of drilling, groundwater was encountered in each of the borings at depths ranging from 7 to 18 feet. When the borings were checked 7 days later, groundwater was encountered in each of the borings at depths between 6 and 6.9 feet. The borings were backfilled with auger cuttings upon completion of these measurements. Fluctuations in the water level may occur with time, particularly during wetter seasons and after precipitation events.

GEOTECHNICAL CONSIDERATIONS

With proper site preparation, shallow spread footing foundations with slab-on-grade floor construction should be feasible. Given the unknown placement history of the existing fill, it is our opinion that the fill should be considered unsuitable for support of the proposed construction. Foundations and floor slabs placed on uncontrolled fill can experience large total and differential movement resulting structural distress, particularly if debris or loose zones are present within the existing fill zone. Because of this, we recommend complete removal of existing fills where present within the proposed building footprint, down to the native granular soils and replacement with compacted structural fill. The intent of this recommendation is to provide a low risk of settlement relative movement beyond about 1-inch in magnitude.

Based on the properties of the native granular soils and existing fill encountered, it is our opinion they would be suitable for reuse as nonexpansive fill (minus any deleterious materials) if sufficiently processed and moisture conditioned. The “Site Grading” section of the report provides additional discussion.

Drilled footings or helical piers may also be utilized, depending on the owners’ preferences. Because of the relatively shallow groundwater and presence of granular soils, casing and/or dewatering would likely be required to facilitate drilled footing construction. Recommendations for these alternatives can be provided upon request.

FOUNDATION RECOMMENDATIONS

Spread Footings: The design and construction criteria presented below should be observed for a spread footing foundation system. The construction details should be considered when preparing project documents.

1. Any areas of existing fill, loose or soft material encountered within the foundation excavation should be removed and replaced with suitable nonexpansive fill. New structural fill should extend down from the edges of the foundations at a minimum 1 horizontal to 1 vertical projection.

2. Footings supported on the properly compacted structural fill as recommended herein should be designed for an allowable soil bearing pressure of 2,000 psf.

3. Fill placed for support of foundations should meet the material and compaction criteria presented in the “Site Grading” section of the report.

4. Spread footings should have a minimum footing width of 16 inches for continuous footings and of 24 inches for isolated pads.

5. Exterior footings and footings beneath unheated areas should be provided with adequate soil cover above their bearing elevation for frost protection. Placement of foundations at least 30 inches below the exterior grade is typically used in this area.

6. Criteria for the lateral resistance of a spread footing placed on native granular soils or properly compacted structural fill is presented in the “Foundation Walls & Retaining Structures” section of this report.

7. Continuous foundation walls should be reinforced top and bottom to span an unsupported length of at least 10 feet.

8. Care should be taken when excavating the foundations to avoid disturbing the supporting materials. Excavation methods that reduce soil disturbance, such as hand excavation or careful soil removal with a backhoe positioned outside of the excavation may be required.

9. Granular foundation soils should be densified with a smooth vibratory compactor prior to placement of formwork and reinforcing steel.

10. A representative of the geotechnical engineer should confirm proper subgrade preparations have been met prior to placing foundation formwork. Loose disturbed material should be removed from the foundation subgrade prior to placement of concrete. Placement of structural fill should be observed and tested by a representative of the geotechnical engineer. In addition, representatives of the geotechnical and/or structural engineer should check reinforcement placement immediately prior to concrete placement.

SEISMIC DESIGN CRITERIA

Using estimated shear wave velocities for the subgrade materials encountered based on standard penetration testing, calculations indicate a design Site Class C per the International Building Code (IBC). Based on the subsurface profile and site seismicity, liquefaction is not a design consideration.

FLOOR SLABS

The native granular soils or reconditioned fill are suitable to support light to moderately loaded slab-on-grade construction. The following measures should be taken to reduce the damage which could result from movement should the underslab materials be subjected to moisture changes.

1. Existing fill encountered below the floor slab should be overexcavated entirely and replaced with suitable nonexpansive fill.

2. Fill placed for support of floor slabs should meet the material and compaction criteria presented in the “Site Grading” section of the report.

3. Floor slabs should be separated from all bearing walls and columns with expansion joints which allow unrestrained vertical movement.

4. Floor slabs should not extend beneath exterior doors or over foundation grade beams, unless saw cut at the beam after construction.

5. Floor slab control joints should be used to reduce damage due to shrinkage cracking. The appropriate joint spacing is dependent on slab thickness, concrete aggregate size and slump, and should be consistent with recognized guidelines such as those of the Portland Cement Association (PCA) or American Concrete Institute (ACI). The joint spacing and any requirements for slab reinforcement should be established by the designer based on experience and the intended slab use.

6. The subsurface conditions encountered at the site indicate shallow groundwater exists at the site below the slab level. We therefore recommend use of vapor retarder below the slab, especially if moisture sensitive coverings are used on the slab. However, the use of the vapor retarder should made by the owner/client and should be based on the use of the structures and space above as recommended by the applicable code requirements. If vapor retarder is used, special precautions may be required to prevent differential curing problems which could cause the slabs to warp. This topic is addressed by ACI 302.1R. A minimum 2-inch sand layer between the concrete and the vapor retarder is sometimes used for this purpose with precautions to prevent water intrusion into the sand layer.

7. All plumbing lines should be tested before operation. Where plumbing lines or other slab protrusions enter through the floor, a positive bond break should be provided. Flexible connections should be provided for slab-bearing mechanical equipment.

The precautions and recommendations itemized above will not prevent the movement of floor slabs if the underlying expansive materials are subjected to alternate wetting and drying cycles. However, the precautions should reduce the damage if such movement occurs.

FOUNDATION WALLS AND RETAINING STRUCTURES

Foundation walls and retaining structures which are laterally supported and can be expected to undergo only a moderate amount of deflection should be designed for a lateral earth pressure computed on the basis of an equivalent fluid unit weight of 55 pcf for backfill consisting of the on-site granular soils, or 50 pcf if an imported CDOT Class I structural backfill is used. Cantilevered retaining structures which can be expected to deflect sufficiently to mobilize the full active earth pressure condition should be designed for a lateral earth pressure computed on the basis of an equivalent fluid unit weight of 45 pcf for backfill consisting of the on-site granular soils, or 40 pcf for CDOT Class I structural backfill.

All foundation and retaining structures should be designed for appropriate hydrostatic and surcharge pressures such as adjacent buildings, traffic, construction materials and equipment. The pressures recommended above assume drained conditions behind the walls and a horizontal backfill surface. The buildup of water behind a wall or an upward sloping backfill surface will increase the lateral pressure imposed on a foundation wall or retaining structure.

The lateral resistance of a foundation or retaining wall footing placed on undisturbed native granular soils or properly compacted structural fill material will be a combination of the sliding resistance of the foundation on the foundation materials and passive earth pressure against the side of the footing. Resistance to sliding at the bottoms of the footings may be calculated based on an allowable coefficient of friction of 0.3. Passive pressure against the sides of the footings may be calculated using an allowable equivalent fluid unit weight of 180 pcf.

The onsite soils are suitable for use as wall backfill. Imported granular wall back fill, if used, should meet the requirements of a CDOT Class I structural backfill with less than 20% passing the No. 200 sieve. Proposed material should be approved by the geotechnical engineer prior to use.

The backfill behind foundation and retaining walls should be sloped from the base of the wall at an angle of at least 45 degrees from the vertical. Backfill should be placed in uniform lifts and compacted to the criteria presented in the “Site Grading” section of the report. Care should be taken not to overcompact the backfill since this could cause excessive lateral pressure on the walls. Some settlement of deep foundation wall backfills will occur even if the material is placed properly.

UNDERDRAIN SYSTEM

Based on our understanding that there will be no basements or below grade space, it is our opinion an underdrain system will not be necessary for the proposed buildings. If the proposed construction differs from our assumptions, we should be consulted to reevaluate the recommendations for an underdrain in these areas.

SURFACE DRAINAGE

Proper surface drainage is very important for acceptable performance of the development during construction and after the construction has been completed. The following recommendations should be used as guidelines and changes should be made only after consultation with the geotechnical engineer.

1. Excessive wetting or drying of the foundation and slab subgrades should be avoided during and after construction.

2. Care should be taken when compacting around the foundation walls to avoid damage to the structure.

3. The ground surface surrounding the exterior of the building should be sloped to drain away from the foundation in all directions. We recommend a minimum slope of 6 inches in the first 10 feet in unpaved areas. Site drainage beyond the 10-foot zone should be designed to promote runoff and reduce water infiltration. A minimum slope of 3 inches in the first 10 feet is recommended in the paved areas. These slopes may be changed as required for handicap access points in accordance with the Americans with Disabilities Act.

4. Ponding of water should not be allowed on backfill material or within 10 feet of the foundation walls, whichever is greater.

5. Roof downspouts and drains should discharge well beyond the limits of all backfill.

6. Lawn sprinkler heads and landscaping which requires typical irrigation should be located at least 10 feet from foundation walls.

7. Plastic membranes should not be used to cover the ground surface adjacent to foundation walls. A pervious geotextile may be used to inhibit weed growth.

SITE GRADING

We recommend the following criteria be used when preparing the site grading plans.

<u>Fill Material Specifications</u>: The following material specifications are presented for fills on the project site.

1. *Structural Fill*: The on-site fill and native soils should generally be suitable for reuse as compacted fill, including structural fill beneath foundations, floor slabs, exterior flatwork and pavements. Imported structural fill, if required, should consist of nonexpansive granular soil material having a maximum of 40% passing the No. 200 sieve, and a maximum plasticity index of 15. New fill should extend down from the edge of foundations at a minimum 1:1 horizontal to vertical projection.

2. *Utility Trench Backfill*: Materials excavated from the utility trenches may be used for trench backfill above the pipe zone fill provided they do not contain unsuitable material or particles larger than 4 inches.

3. *Material Suitability*: All fill material should be free of vegetation, brush, sod, trash and debris, and other deleterious substances, and should not contain rocks or lumps having a diameter of more than 4 inches.

4. *Subgrade Preparation*: The ground surface shall be stripped of vegetation/organics prior to fill placement. The resulting ground surface should be scarified to a depth of 12 inches, moisture conditioned as necessary, and compacted in a manner specified below for the subsequent layers of fill. Loose or unstable soils shall be removed, where present, in order to provide a stable platform prior to placement of fill.

5. *Overexcavation*: As discussed in the "Geotechnical Engineering Considerations" section, we recommend the existing fill encountered below foundation and floor slab bearing elevations be overexcavated in its entirety, moisture conditioned, and placed back properly compacted. New structural fill should extend down from the edges of the foundations at a 1 horizontal to 1 vertical projection. We should be consulted at the time of excavation to assist the contractor in determining the limits of overexcavation required.

<u>Compaction Requirements</u>: A representative of the geotechnical engineer should observe fill placement operations on a full-time basis. We recommend the following minimum compaction criteria be used on the project.

Area	Percentage of Standard Proctor Maximum Dry Density (ASTM D 698)
Foundation Subgrade	98%
Floor Slab Subgrade	95%
Foundation Wall Backfill	95%
Beneath Pavement Areas/Exterior Flatwork/Utility Trenches	95%
Landscape and Other Misc. Overlot Fill Areas	95%
Compaction of granular soils should be achieved at a moisture content within +/- 2% of the optimum. Cohesive materials should be placed at a moisture content within 0% to +3% of the optimum.	

Subgrade Stabilization: Unstable subgrade may be encountered during subgrade preparations. A layer of lean concrete or crushed aggregate may be placed in the bottom of excavations prior to fill or concrete placement. If properly installed, this "mud mat" will reduce disturbance of the native materials caused by construction operations. All disturbed foundation soils should be removed and replaced with compacted crushed aggregate.

Other methods to stabilize the subgrade include scarifying/ripping the subgrade and allowing it to dry, using a relatively thick layer of cobble size angular rock in combination with the crushed aggregate, or by using a Type 2 biaxial geogrid in combination with a Class 6 aggregate. Where coarse angular rock is used, the rock should be layered and pressed into the subgrade with a backhoe positioned outside of the excavation. Layering should continue until the subgrade begins to firm.

Specific stabilization requirements should be evaluated at the time of construction. We are unable to accurately predict or quantify areas where unstable subgrade conditions may occur, however, we recommend this work activity, if required, be included as a line item in the bid schedule to avoid cost overruns.

WATER SOLUBLE SULFATES

The concentration of water soluble sulfates measured in a sample obtained from the exploratory borings was 0.02%. This concentration of water soluble sulfate represents a Class 0 severity of exposure to sulfate attack on concrete exposed to these materials. The degree of attack is based on a range of Class 0 to Class 3 severity of exposure as presented in ACI 201. Based on the laboratory data and our experience, we believe special sulfate resistant cement will not be required for concrete exposed to the on-site soils.

EXCAVATION CONSIDERATIONS

In our opinion, the overburden soils and near surface bedrock encountered in the exploratory borings drilled for this study can be excavated with heavy-duty construction equipment. Ripper teeth or other means may be required for excavations that extend into bedrock. It is possible that localized, harder lenses of bedrock may be encountered within the excavation in portions of the site. If harder lenses of rock are encountered, hydraulic chiseling may be required, particularly in confined excavations such as trench cuts. Excavated slopes may soften or loosen due to construction traffic and erode from surface runoff. Measures to keep surface runoff from excavation slopes, including diversion berms, should be considered.

We assume that the temporary excavations will be constructed by overexcavating the slopes to a stable configuration where enough space is available. All excavations should be constructed in accordance with OSHA requirements, as well as state, local and other applicable requirements. Excavations generally will extend through man placed fill soils, natural granular soils, and sandstone or claystone bedrock. The natural soils and man-placed fill soils will likely classify as a Type C soil, requiring temporary slopes no steeper than 1.5:1 H to V for excavations up to 20 feet. The bedrock will likely classify as a Type B soil requiring temporary slopes no steeper than 1:1. Excavations encountering groundwater will require much flatter side slopes than those allowed by OSHA or require temporary shoring. Temporary shoring may also be necessary in any areas where there is insufficient lateral space to construct slopes at the required inclination. The contractor's competent person should evaluate the soils at the time of excavation, and make adjustments as necessary based on the conditions observed.

Construction Dewatering: Groundwater was encountered at depths between 6 feet and 6.9 feet in each of the borings. Depending on the depth of excavation planned and the time of year that construction occurs, dewatering will likely be necessary for portions of the site during construction. Assuming properly designed slopes are excavated, we anticipate dewatering for small areas may be achieved using a system of trenches and sumps around the perimeter of the base of the excavation. The trenches should be sloped to the sumps where water can be pumped from the excavation. The sumps should be installed below the foundation elevations to avoid loss of supporting capacity of the soils. This system will intercept and remove water seeping from the excavated slope, but will not be effective in dewatering the remaining soil subgrade in the base of the excavation. The base of the excavation will be wet and unstable. Discussion on stabilizing the base of the excavation is presented in the "Site Grading" section of this report.

If larger amounts of water are encountered, or if larger areas require dewatering, we anticipate groundwater inflow can be controlled using closely-spaced well points, or more widely spaced dewatering wells. Dewatering should be done in advance of excavation below the proposed base of the excavation, and must be maintained through the time period the excavation is open. Any failure of dewatering system may result in soil disturbance and could contribute to excess post construction settlement. The dewatering system should be properly designed, installed and maintained by an experienced dewatering contractor. The bottom and sides of the excavation may become unstable if the groundwater level is not maintained at a sufficient depth below the bottom of the excavation. The dewatering system should be capable of maintaining a groundwater level at least 3 feet below the bottom of the excavation. Dewatering should continue until construction and associated backfilling extends well above the groundwater table. Selection of a dewatering system should be the responsibility of the contractor.

DESIGN AND SUPPORT SERVICES

Kumar & Associates, Inc. should be retained to review the project plans and specifications for conformance with the recommendations provided in this report. We are also available to assist the design team in preparing specifications for geotechnical aspects of the project and, if necessary, perform additional studies to accommodate any changes in the proposed construction.

We recommend that Kumar & Associates, Inc. be retained to provide observation and testing services to document that the requirements of the plans and specifications are being followed during construction, and to identify possible variations in subsurface conditions from those encountered in this study.

LIMITATIONS

This study has been conducted for exclusive use by the client for geotechnical related design and construction criteria for the project. The conclusions and recommendations submitted in this report are based upon the data obtained from the exploratory borings at the locations indicated on Fig. 1 or as described in the report, and the proposed type of construction. This report may not reflect subsurface variations that occur, and the nature and extent of variations across the site may not become evident until site grading and excavations are performed. If during construction, fill, soil, rock or water conditions appear to be different from those described herein, Kumar & Associates, Inc. should be advised at once so that a re-evaluation of the recommendations presented in this report can be made. Kumar & Associates, Inc. is not responsible for liability associated with interpretation of subsurface data by others.

The scope of services for this project does not include any environmental assessment of the site or identification of contaminated or hazardous materials or conditions. If the owner is concerned about the potential for such contamination, other studies should be undertaken.

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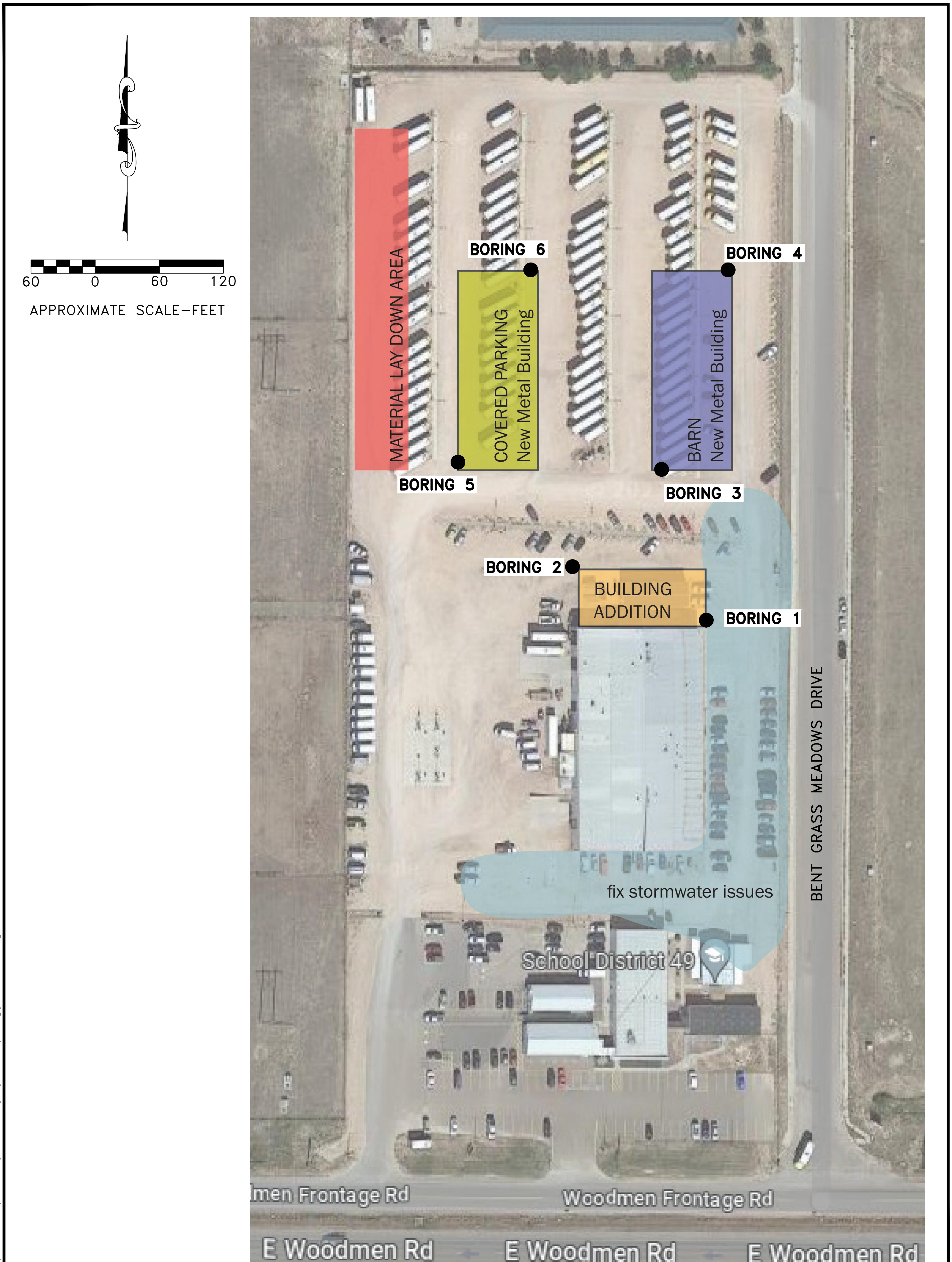

23–2–218	Kumar & Associates	LOCATION OF EXPLORATORY BORINGS	Fig. 1

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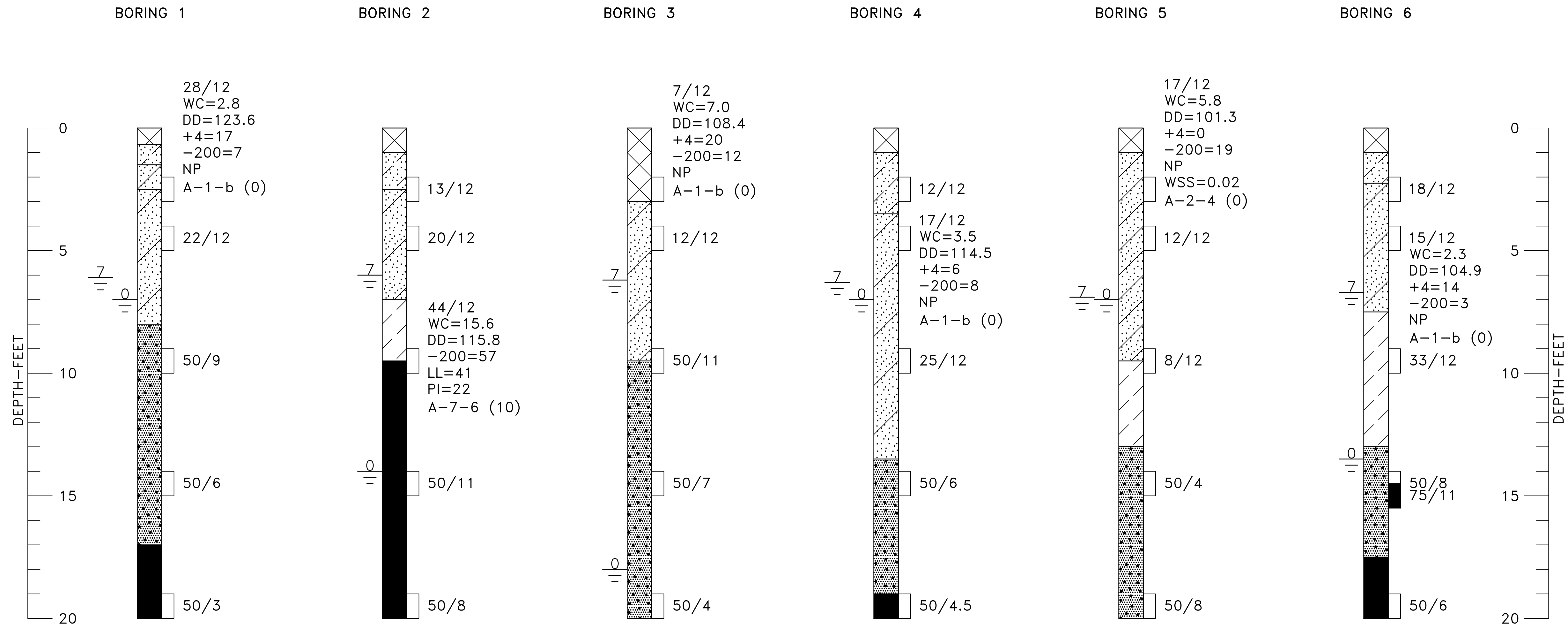

23−2−218	Kumar & Associates		LOGS OF EXPLORATORY BORINGS	Fig. 2

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LEGEND

FILL: SILTY SAND WITH GRAVEL (SM), AND WELL-GRADED SAND WITH GRAVEL (SW-SM), DRY, TAN, BROWN, AND PINK.

CLAYEY SAND (SC), MEDIUM DENSE, SLIGHTLY MOIST TO MOIST, BROWN.

SILTY SAND (SM), WITH OCCASIONAL GRAVEL, MEDIUM DENSE, SLIGHTLY MOIST TO WET, TAN.

POORLY TO WELL GRADED SAND WITH VARIED AMOUNTS OF SILT (SP, SW, SP-SM, SW-SM), WITH OCCASIONAL GRAVEL, MEDIUM DENSE, SLIGHTLY MOIST TO WET, TAN TO BROWN.

SANDY LEAN CLAY (CL), MEDIUM STIFF TO VERY STIFF, MOIST, BROWN TO LIGHT GRAY.

SANDSTONE BEDROCK, POORLY CEMENTED, HARD TO VERY HARD, MOIST TO WET, TAN TO LIGHT GRAY.

CLAYSTONE BEDROCK, HARD TO VERY HARD, MOIST, GRAY.

DRIVE SAMPLE, 2-INCH I.D. CALIFORNIA LINER SAMPLE.

DRIVE SAMPLE, 1 3/8-INCH I.D. SPLIT SPOON STANDARD PENETRATION TEST.

28/12 DRIVE SAMPLE BLOW COUNT. INDICATES THAT 28 BLOWS OF A 140-POUND HAMMER FALLING 30 INCHES WERE REQUIRED TO DRIVE THE SAMPLER 12 INCHES.

7 DEPTH TO WATER LEVEL AND NUMBER OF DAYS AFTER DRILLING MEASUREMENT WAS MADE.

NOTES

1. THE EXPLORATORY BORINGS WERE DRILLED ON NOVEMBER 30, 2023 WITH A 4-INCH-DIAMETER CONTINUOUS-FLIGHT POWER AUGER.

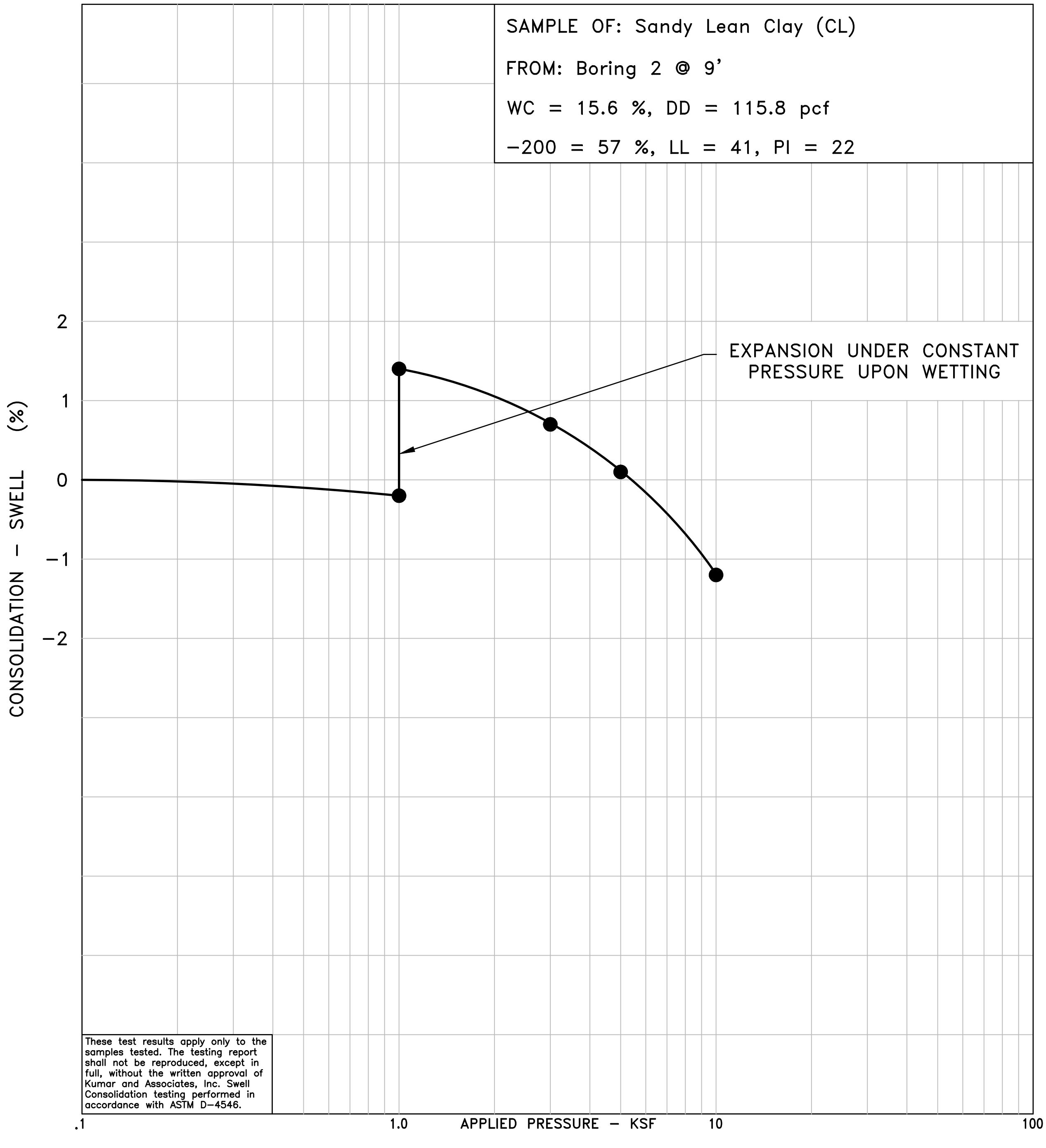
2. THE LOCATIONS OF THE EXPLORATORY BORINGS WERE APPROXIMATED WITH A HANDHELD GPS DEVICE AND SHOULD BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE METHOD USED.

3. THE ELEVATIONS OF THE EXPLORATORY BORINGS WERE NOT MEASURED AND THE LOGS OF THE EXPLORATORY BORINGS ARE PLOTTED TO DEPTH.

4. THE LINES BETWEEN MATERIALS SHOWN ON THE EXPLORATORY BORING LOGS REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN MATERIAL TYPES AND THE TRANSITIONS MAY BE GRADUAL.

5. GROUNDWATER LEVELS SHOWN ON THE LOGS WERE MEASURED AT THE TIME AND UNDER CONDITIONS INDICATED. FLUCTUATIONS IN THE WATER LEVEL MAY OCCUR WITH TIME.

6. LABORATORY TEST RESULTS:
   WC = WATER CONTENT (%) (ASTM D2216);
   DD = DRY DENSITY (pcf) (ASTM D2216);
   +4 = PERCENTAGE RETAINED ON NO. 4 SIEVE (ASTM D6913);
   -200= PERCENTAGE PASSING NO. 200 SIEVE (ASTM D1140);
   LL = LIQUID LIMIT (ASTM D4318);
   PI = PLASTICITY INDEX (ASTM D4318);
   NP = NON-PLASTIC (ASTM D4318);
   A-1-b (0) = AASHTO CLASSIFICATION (GROUP INDEX) (AASHTO M 145).



23-2-218	Kumar & Associates	SWELL-CONSOLIDATION TEST RESULTS	Fig. 4

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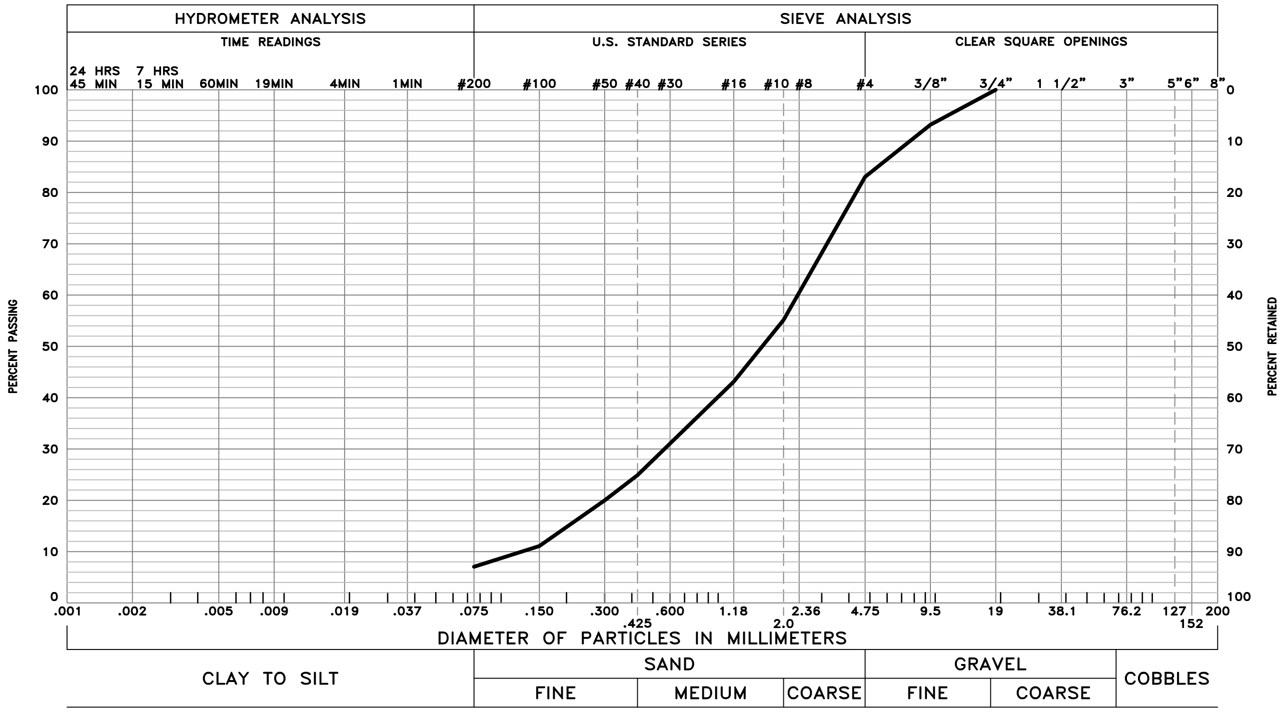
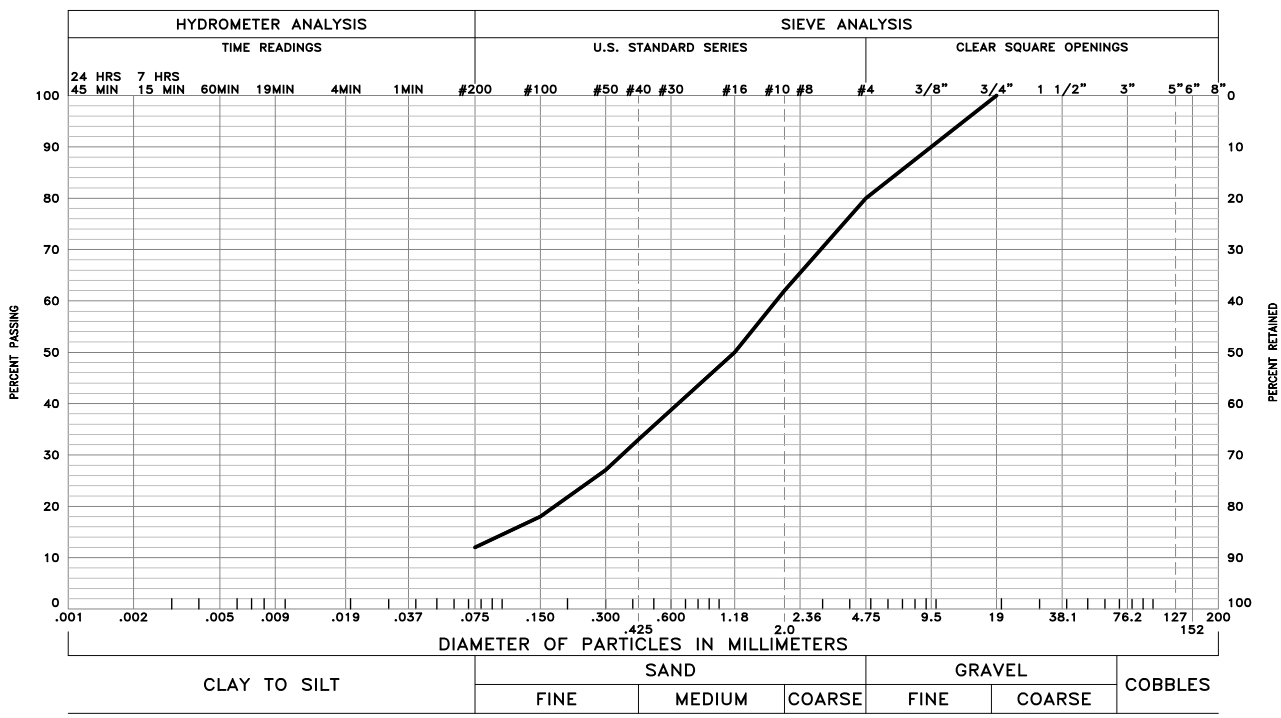


GRAVEL 17 % SAND 76 % SILT AND CLAY 7 %

LIQUID LIMIT – PLASTICITY INDEX NP

SAMPLE OF: Well Graded Sand with Silt and Gravel (SW–SM) FROM: Boring 1 @ 2'



GRAVEL 20 % SAND 68 % SILT AND CLAY 12 %

LIQUID LIMIT – PLASTICITY INDEX NP

SAMPLE OF: Fill: Well Graded Sand with Silt and Gravel (SW–SM) FROM: Boring 3 @ 2'

These test results apply only to the samples which were tested. The testing report shall not be reproduced, except in full, without the written approval of Kumar & Associates, Inc. Sieve analysis testing is performed in accordance with ASTM D6913, ASTM D7928, ASTM C136 and/or ASTM D1140.

23–2–218	Kumar & Associates	GRADATION TEST RESULTS	Fig. 5

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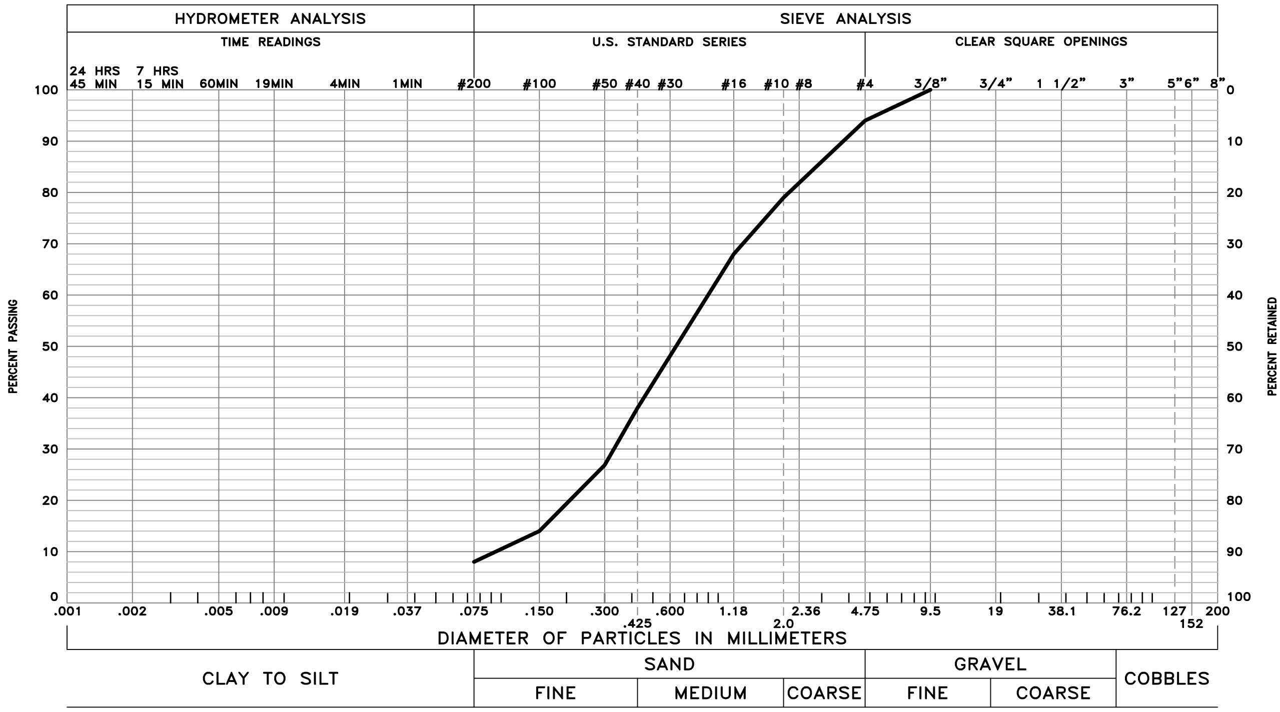
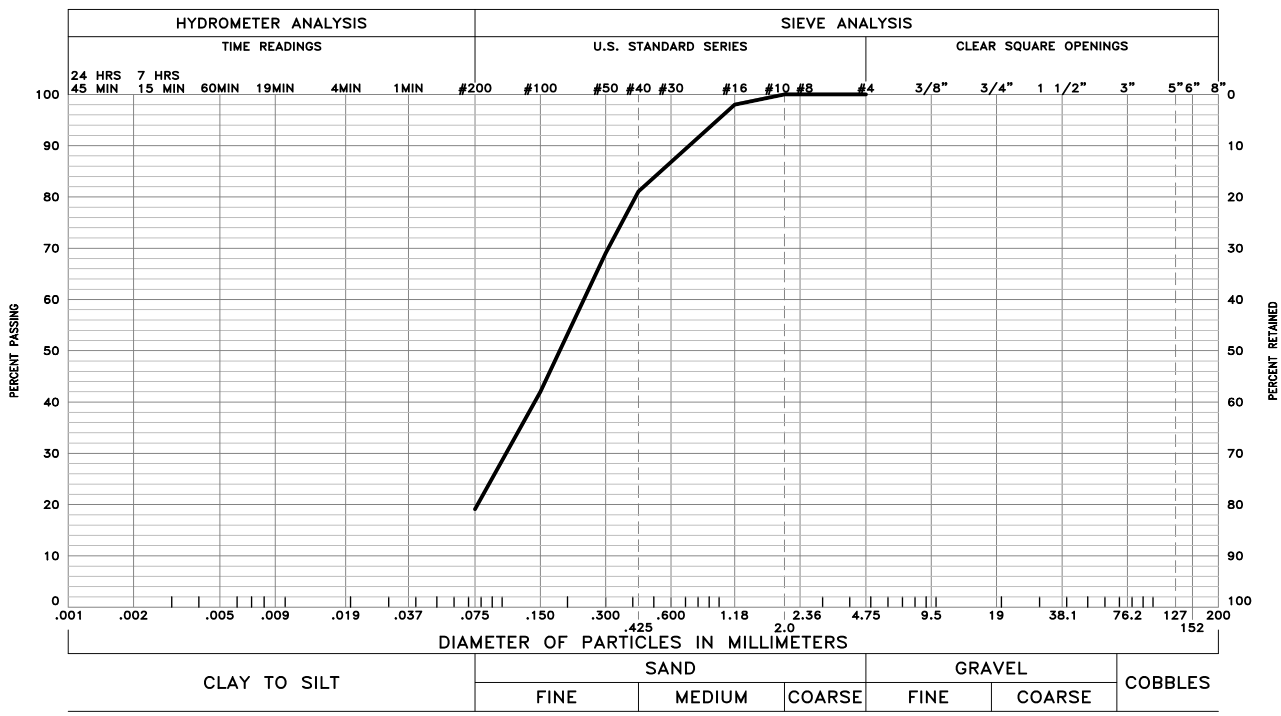


GRAVEL 6 % SAND 86 % SILT AND CLAY 8 %

LIQUID LIMIT – PLASTICITY INDEX NP

SAMPLE OF: Well Graded Sand with Silt (SW–SM) FROM: Boring 4 @ 4'



GRAVEL 0 % SAND 81 % SILT AND CLAY 19 %

LIQUID LIMIT – PLASTICITY INDEX NP

SAMPLE OF: Silty Sand (SM) FROM: Boring 5 @ 2'

These test results apply only to the samples which were tested. The testing report shall not be reproduced, except in full, without the written approval of Kumar & Associates, Inc. Sieve analysis testing is performed in accordance with ASTM D6913, ASTM D7928, ASTM C136 and/or ASTM D1140.

23–2–218	Kumar & Associates	GRADATION TEST RESULTS	Fig. 6

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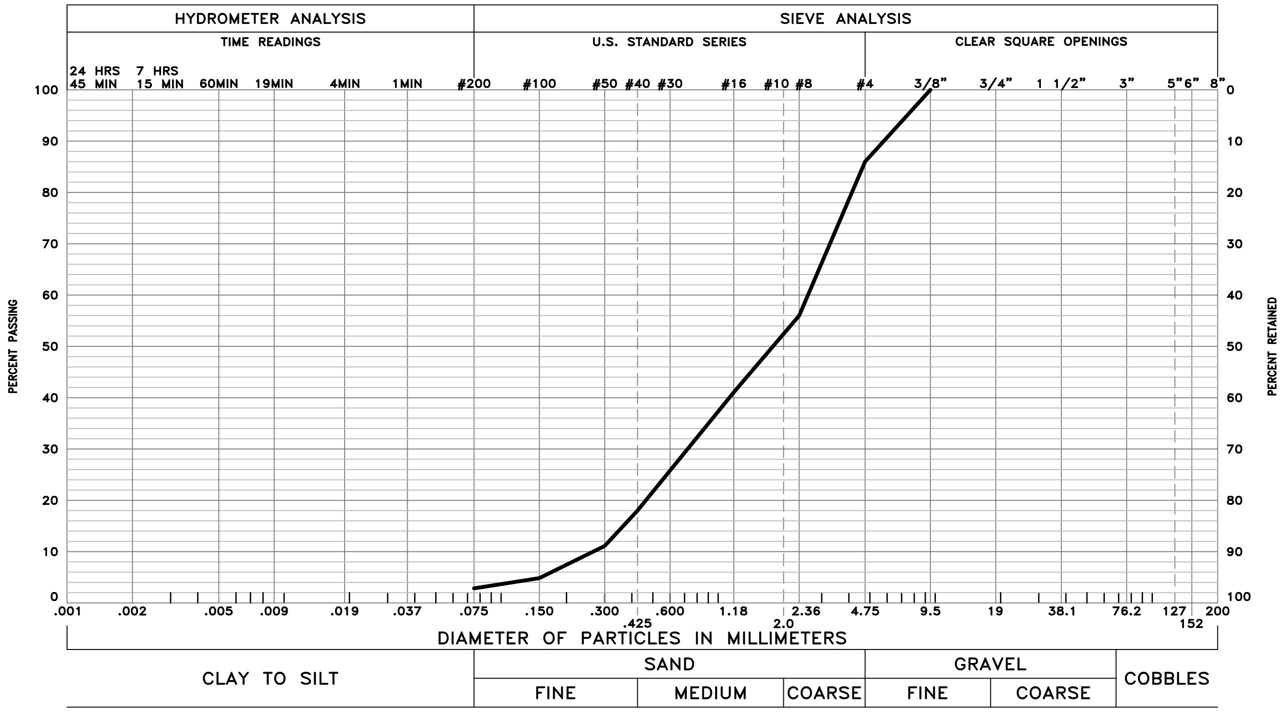

GRAVEL 14 % SAND 83 % SILT AND CLAY 3 %

LIQUID LIMIT – PLASTICITY INDEX NP

SAMPLE OF: Poorly Graded Sand (SP) FROM: Boring 6 @ 4'

These test results apply only to the samples which were tested. The testing report shall not be reproduced, except in full, without the written approval of Kumar & Associates, Inc. Sieve analysis testing is performed in accordance with ASTM D6913, ASTM D7928, ASTM C136 and/or ASTM D1140.

23–2–218	Kumar & Associates	GRADATION TEST RESULTS	Fig. 7

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Kumar and Associates, Inc.

TABLE I

SUMMARY OF LABORATORY TEST RESULTS

Project No.: 23-2-218

Project Name: D49 Transportation Facility

Date Sampled: 11/30/2023

Date Received: 12/1/2023

SAMPLE LOCATION		DATE TESTED	NATURAL MOISTURE CONTENT (%)	NATURAL DRY DENSITY (pcf)	GRADATION		PERCENT PASSING NO. 200 SIEVE	ATTERBERG LIMITS		WATER SOLUBLE SULFATES (%)	AASHTO CLASSIFICATION (Group Index)	SOIL OR BEDROCK TYPE (Unified Soil Classification)
BORING	DEPTH (ft)				GRAVEL (%)	SAND (%)		LIQUID LIMIT	PLASTICITY INDEX			
1	2'	12/6/23	2.8	123.6	17	76	7		NP		A-1-b (0)	Well Graded Sand w/Silt & Gravel (SW-SM)
2	9'	12/6/23	15.6	115.8			57	41	22		A-7-6 (10)	Sandy Lean Clay / Claystone
3	2'	12/6/23	7.0	108.4	20	68	12		NP		A-1-b (0)	Fill: Well Graded Sand w/Silt & Gravel (SW-SM)
4	4'	12/6/23	3.5	114.5	6	86	8		NP		A-1-b (0)	Well Graded Sand w/Silt (SW-SM)
5	2'	12/6/23	5.8	101.3	0	81	19		NP	0.02	A-2-4 (0)	Silty Sand (SM)
6	4'	12/6/23	2.3	104.9	14	83	3		NP		A-1-b (0)	Poorly Graded Sand (SP)