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GEOTECHNICAL ENGINEERING STUDY
PROPOSED LEARNING EXPERIENCE FACILITY
PARDEE STREET AND HESS ROAD
PARKER, CO

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PURPOSE AND SCOPE OF STUDY

This report represents the results of a geotechnical study for the proposed Learning Experience Facility to be located west of Pardee Street and north of Hess Road Avenue in Parker, Colorado. The site location is shown on Figure 1. The study was conducted in accordance with our Proposal No. P8-8-157 dated April 24, 2018 to develop foundation recommendations for the proposed facility.

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.

PROPOSED CONSTRUCTION

The construction will include a single-story building that will have a footprint of approximately 10,000 SF. We assume the building will consist of a steel or wood frame structure with a slab on grade floor. Foundation loads are anticipated to be light to moderate, typical of the proposed construction type. Grading for the proposed construction is anticipated to be moderate, with anticipated maximum cuts and fills of approximately 4 to 5 feet. If the proposed construction is significantly different from that described above or depicted in this report, we should be notified.

SITE CONDITIONS

The site is located on a vacant 1.1 acre parcel west of Pardee Street and north of Hess Road in Parker, Colorado. The facility will be built on Lot 1, Block1 of the Horseshoe Ridge Subdivision. A similar building will be built on Lot 2 to the south. Motsenbocker and Parker Road are located to the east and Jordan Road to the west. Residential homes are located on the north and west sides of the site, and undeveloped land is found on the east and south. Rueter Hess Reservoir is approximately 2 miles west of the site and Salisbury Equestrian Park is about ½ mile to the northeast. The ground surface slopes up moderately to the north end and becomes steeper on the south end. Vegetation consists of native grasses, and weeds.

SUBSURFACE CONDITIONS

The subsurface conditions at the site were explored by drilling four borings in the building footprint and two borings in the pavement area at the approximate locations shown on Figure 2. Graphic logs of the borings are presented on Figure 3, and a legend and notes describing the soils encountered in the borings are presented on Figure 4. The borings were advanced with 4-

inch diameter continuous flight augers powered by a truck mounted drill rig. The borings were logged by a representative of Kumar and Associates.

Samples of the soils were taken with a nominal 2-inch I.D "California" sampler. The sampler was driven into the soils with blows from a 140-pound hammer falling 30 inches. This test is similar to the standard penetration test described by ASTM Method D 1586. Penetration resistance values when properly evaluated, indicate the relative density of cohesionless soils or consistency of cohesive soils. Depths at which the samples were taken and the penetration resistance values are shown on the right side of the logs on Figure 3.

Samples obtained from the borings were returned to our laboratory, visually classified by the project engineer and samples were selected for testing. Laboratory testing included index property tests, such as moisture content (ASTM D 2216), unit weight, grain size analysis (ASTM D 422), liquid and plastic limits (ASTM D 4318), water soluble sulfate analysis (ASTM C 1580) and swell/compression potential (ASTM D 4546). Gradation analysis are shown in Figures 7-8. Laboratory test results are shown to the right side of the logs on Figure 3, Figures 5-8 and are summarized in Table 1.

The soils were fairly uniform for borings 1 and 2. The first 3 feet was sandy clay. This sandy clay can be described as very stiff based on the penetration resistance values and has a moderate density ranging from 110 to 113 pcf with a moisture content ranging from 16.3 to 16.7 percent and possessing medium plasticity. Swell/compression test results show the soils to have low to moderate swell potential, with 0.4 to 3.1 percent expansion when wetted under a 1,000 psf surcharge, Figures 5-6. Clayey sand was found below the sandy clay and extended to depth 17 feet. Densities ranged from 108 to 119 pcf. Moisture contents from 10.7 to 15.2 percent. Based on the penetration resistance values the clayey sand can be described as medium dense to dense. Sandstone bedrock was found at depth 17 feet to the maximum depth drilled, 20 feet. In boring 3 the the upper three feet was a clayey sand overlying silty sand to depth 7 feet that in turn overlies clayey sand to depth 13 feet. Sandstone sandstone was found at depth 13 feet to the maximum depth drilled, 20 feet. The soils in the pavement areas was similar, but the sandy clay sample from P-1 had a swell of 3.1 percent and classifies as a fat clay.

No groundwater was encountered at the time of drilling and was not found later when the borings were backfilled. Groundwater levels can fluctuate during wetter years, due to heavy precipitation or climatic changes.

SEISMIC DESIGN CRITERIA

The site area is known for low seismic activity. The seismic site class is assigned as D due to the unconsolidated soils. The following were taken from the USGS Seismic Risk Maps.

0.2 Second spectral response acceleration S_S		= 0.017g
1.0 Second spectral response acceleration S_1		= 0.056g
Site Class		= D
Site coefficient	F_a	= 1.6 Table 1613.3.3(1)
Site coefficient	F	= 2.4 Table 1613.3.3(2)

WATER SOLUBLE SULFATES

The concentration of water-soluble sulfates in the sample tested was below detection. This concentration of water-soluble sulfates represents a Class 0 severity exposure to sulfate attack on concrete exposed to these materials. The degree of attack is based on a range of Class 0, Class 1, Class 2, and Class 3 severity exposure as presented in ACI 201. Based on the laboratory test results, we believe Type I/II cement, commonly used in this area, is acceptable for concrete exposed to the soil.

GEOTECHNICAL ENGINEERING CONSIDERATIONS

Assuming the footings are about three feet below the ground surface, spread footings will be bearing on the clayey to silty sand and are suitable for the proposed building foundations. However, because of the low to moderate swell potential we recommend that the floor slab subgrade be scarified for a depth of 12 inches, moisture conditioned and recompacted to 95 percent of the maximum standard Proctor density.

FOUNDATIONS

The following details should be followed for spread footings.

1. Footings placed on the native soil or compacted structural fill should be designed for an allowable bearing pressure of 2,500 psf. Settlement is not expected to exceed one inch and differential settlement ¾ inch.
2. The on-site clayey sand soils, minus any deleterious materials and particles greater than 2 inches in size are suitable for use as fill below foundations. Import structural fill, if required, should consist of a minus 2-inch non-expansive, granular soil having a maximum of 35% passing the No. 200 sieve and a maximum plasticity index of 15. The geotechnical engineer should evaluate the suitability of proposed fill materials prior to placement.
3. Lateral resistance of footings may be calculated on the basis of a coefficient of friction of 0.35. Passive resistance of 300 pcf for compacted backfill against the sides of footings may be used. Both values are unfactored.

4. Continuous footings should be at least 16 inches wide and isolated column footings at least 24 inches wide.
5. Continuous foundation walls should be reinforced to span an unsupported length of at least 10 feet.
6. Footings below unheated areas should be below frost depth, taken as 36 inches in this area.
7. The weight of the concrete foundation and soil above the foundation may be used to resist uplift. We recommend a concrete unit weight of 145 pcf and a soil unit weight of 120 pcf be assumed for compacted fill placed above foundations. A factor of safety was not applied to these values. Fill placed over foundations for resistance to uplift should meet the criteria for non-expansive fill discussed in Item #2 above, compacted to a minimum 95% of the standard Proctor maximum dry density within two percent of the optimum moisture content. The resistance to uplift can be increased by widening or deepening the footings to increase the volume of soil above the foundations.
8. Granular foundation soils should be compacted with a smooth vibratory compactor prior to placement of forms or concrete.
9. A representative of the geotechnical engineer should observe all footing excavations prior to forming and concrete placement.

RETAINING AND FOUNDATION WALLS

Foundation walls and retaining structures which are laterally supported and can be expected to undergo only a slight amount of deflection should be designed for a lateral earth pressure computed on the basis of an equivalent fluid unit weight of 50 pcf for backfill consisting of properly compacted, approved, on-site soil. Cantilevered retaining structures which are separate from the building and can be expected to deflect sufficiently to mobilize the full active earth pressure condition should designed for a lateral earth pressure computed on the basis of an equivalent fluid unit weight of 40 pcf for backfill consisting of properly compacted on-site soil. The lateral resistance of retaining wall footings will be a combination of the sliding resistance of the footing on the foundation materials and passive earth pressure against the side of the footing. Care should be taken not to over-compact the wall backfill since this could cause excessive lateral pressures on the walls. Some settlement of foundation wall backfill could occur even if the backfill is placed correctly.

All retaining structures should be designed for appropriate hydrostatic and surcharge pressures such as adjacent footings, traffic, staging 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. An underdrain or weep holes should be provided to prevent hydrostatic pressure buildup behind retaining walls.

FLOORS

A slab-on-grade floor is proposed.

1. To reduce the expansive potential of the upper sandy clay soil, a minimum of 12 inches of the subgrade below the slab should be scarified, moisture conditioned to optimum to +3 percent and compacted to 95 percent of the maximum standard Proctor density. To allow for some slab movement, the following details should be provided. The risk of movement is expected to be low.
2. The upper, on-site, sandy clay soils should not be used as fill below the floor slabs. The clayey sand minus deleterious materials and particles greater than 2 inches in size are suitable for use as fill below floor slabs. Import structural fill, if required, should meet the same requirements as mentioned in the *FOUNDATIONS* section. The geotechnical engineer should evaluate the suitability of proposed fill materials prior to placement.
3. If fill is placed below floor slabs, it should be compacted to at least 95 percent of the maximum standard Proctor density. A modulus of subgrade reaction of 200 pci may be used for the clayey sands or compacted fill.
4. Floor slabs should be separated from all bearing walls and columns with expansion joints which allow unrestrained vertical movement.
5. Slab bearing partitions should have a slip joint of 1½ inches to prevent any heave from pushing up on the upper structure. This gap is important for door trim and wallboard.
6. Floor slab control joints should be used to reduce damage due to shrinkage cracking. Control joint spacing is a function of slab thickness, aggregate size, slump and curing conditions. The requirements for concrete slab thickness, joint spacing and reinforcement should be established by the designer based on experience, recognized design guidelines and the intended slab use. Placement and curing conditions will have an impact on the final concrete slab integrity.
7. A moisture retarder should be used below the slab if a moisture sensitive floor covering is proposed.
8. All plumbing lines should be tested before operation. Where plumbing lines enter through the floor, a positive bond break should be provided. Flexible connections should be provided for slab-bearing mechanical equipment. Flexible connections should allow for at least 2 Inches of vertical movement.

9. Excessive wetting or drying of the floor slab subgrade should be avoided during construction.

The details mentioned will not prevent floor slab movement, but will reduce the effects if it occurs. Minor amounts of movement may be expected due to settlement or heave. If no movement can be tolerated a structurally supported floor system with a 16 inch air space below the slab is recommended.

SITE GRADING

General

The following recommendations should be followed for grading, site preparation, and fill compaction.

1. All import and on-site backfill should be approved by the geotechnical engineer.
2. Where fill is to be placed, loose or otherwise unsuitable material, and topsoil vegetation should be removed prior to placement of new fill.
3. Soils should be compacted with appropriate equipment for the lift thickness placed, typically 8-inches loose, or less.
4. The following compaction requirements should be used:

TYPE OF FILL PLACEMENT	MOISTURE CONTENT	SOIL TYPE - Compaction Percent (ASTM D-698 Proctor)
Below Footings	0 to + 3% of Optimum -2% to +2% of Optimum	Suitable onsite (min – 95%) or Import Fill (min – 95%)
Below Concrete Flatwork, Slabs-on-Grade	0% to +3% of Optimum -2% to +2% of Optimum	Suitable Onsite sandy clay or Import Fill (min – 95%)
Landscape Areas	-2% to +2% of Optimum	Onsite or Import Fill – 85%
Utility Trenches	As they apply to the finished area	

Suitability of On-site Soil

On-site clayey sand are suitable for use as re-compacted fill in all areas provided the moisture and compaction specifications listed above are followed. All fill should be processed so that it does not contain fragments larger than 2 inches. The sandy clay when properly moisture conditioned could be use as fill, but is not preferred.

Import Structural Fill

If import structural fill is needed, such as below footings or floor slabs it should be non-expansive, and should consist of minus 2-inch material having less than 35 percent passing the

No. 200 sieve, a liquid limit less than 30, and a plasticity index less than 15. Import materials should be approved by the geotechnical engineer before placement. CDOT Class 1 Structural Backfill or Class 5 or 6 aggregate base course materials will meet the above specifications, and are suitable as structural fill.

SURFACE DRAINAGE AND MAINTENANCE

The success of foundations, slab-on-grade floors, and concrete flatwork is contingent upon keeping the bearing soils at approximately constant moisture content, and by not allowing surface water a path to the subsurface. Surface drainage should be designed such that water will quickly flow away from the proposed structure. Surface drainage and irrigation practices that reduce the amount of surface water that infiltrates to foundation levels will reduce the amount of settlement or heave of soils that support foundations and concrete flatwork. Positive drainage away from the foundation and avoidance of irrigation near the foundation also reduce areas of excessive wetting of backfill soils. Poor surface drainage or excessive irrigation can lead to increased backfill settlement and higher lateral earth pressures on foundation walls due to increased weight and reduced strength of the backfill.

We recommend the following precautions:

1) Inundation of the foundation excavations and under slab areas should be avoided during construction.
2) Exterior backfill should be adjusted to near optimum moisture and compacted to at least 95% of the SPD in pavement and slab areas and behind foundation walls and to at least 90% of the SPD in landscape areas. Foundation wall backfill should be capped with about 1 to 2 feet of the onsite finer-grained soils to reduce surface water infiltration.
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 8 inches in the first 10 feet in unpaved areas and a minimum slope of 3 inches in the first 10 feet in paved areas. Where necessary to meet ADA criteria the slopes may be adjusted. If settlement occurs, additional backfill should be placed to maintain a positive slope.
4) Outside of 10 feet, we recommend a minimum slope of 2 percent in landscaped areas and 1 percent in hardscapes away from the building.
5) Roof downspouts and drains should discharge well beyond the limits of all backfill.
6) Landscaping which requires regular heavy irrigation should be located at least 5 feet from foundation walls. Consideration should be given to use of xeriscape to reduce the potential for wetting of soils below the building caused by irrigation.

7) Water features shall include an impermeable liner system to mitigate the addition of water to the subsurface, except for detention ponds.

PAVEMENT SECTION DESIGN

A pavement section is a layered system designed to distribute concentrated traffic loads to the subgrade. Performance of the pavement structure is directly related to the physical properties of the subgrade soils and traffic loadings. Soils are represented for pavement design purposes by means of a soil support value for flexible pavements and a modulus of subgrade reaction for rigid pavements. Both values are empirically related to strength. The number and magnitude of wheel loads are major factors for pavement design. The Colorado Department of Transportation's *2014 Pavement Design Manual* and Town of Parker standards were consulted to develop the thickness design presented below.

Subgrade Materials

Based on the results of the field exploration and laboratory testing programs, the dominant upper 3 feet subgrade material at the site is classified as A-7-6 with the maximum group index of 30 in accordance with the American Association of State Highway and Transportation Officials (AASHTO) soil classification system. The subgrade soil would generally be considered to provide a fair to poor subgrade support. Based on the soil type and plasticity index, a default R-Value of 5 corresponding to a resilient modulus of 3,025 psi was used for design.

Swell Mitigation

The upper 3 feet of subgrade material has a potential for expansion under low surcharge pressure. We do believe swell mitigation is necessary. By MGPEC or Town of Parker standards a minimum of 3 feet of the subgrade soils should be moisture treated, however this would be expensive for a parking lot. Assuming the owner can tolerate pavement movement and more frequent maintenance, we suggest that two feet of the subgrade soil be moisture treated to 0 to + 4 percent of optimum moisture and recompacted to 95 percent of the maximum standard Proctor density. As an alternate 12 inches of aggregate base course may be used for mitigation below the pavement section.

Design Traffic

Since anticipated traffic loading information was not available at the time of report preparation, an equivalent 18-kip daily load application (EDLA) of 5 was assumed for combined automobile and occasional delivery truck traffic drive lanes and 3 for the parking stalls.

Asphalt Pavement Section

The following design parameters were used for the asphalt thickness design.

Parameter	Value
Equivalent Single Axle Loads (20 yr. life)	36,500 drive lanes, 21,900 parking stalls
Initial Serviceability	4.5
Terminal Serviceability	2.0
Drainage Coefficient	1.0
R-Value	5
Resilient Modulus	3,025 psi
Reliability	80 %
Overall Deviation	0.45
Asphaltic Concrete Strength Coefficient	0.44
Aggregate Base Course Strength Coefficient	0.12

Using the design AASHTO formula for flexible pavements, a Structural Number (SN) of 2.55 was determined for drive lanes and 2.4 for parking stalls. Based on the Structural Number and the design parameters outlined above, pavement thickness recommendations are presented in the following table.

Pavement Type	Asphaltic Concrete (AC) (inches)	Aggregate Base Course (ABC) Mitigation
Full Depth Section Drive Lanes	5.0	12
Parking Stalls for Autos	5.0	12

Concrete Section

We recommend Portland cement concrete where trash trucks service dumpsters. A concrete section should be 7 inches thick underlain by 12 inches of Class 6 road base. A CDOT P-mix is satisfactory. We do not recommend concrete for the remainder of the pavement due to the expansive potential.

Pavement Materials

The asphalt should consist of a mixture of aggregate, filler and asphalt cement established by a qualified engineer. Asphalt cement with a performance grade of 64-22 is commonly used in this area, and will likely be acceptable for this project. The appropriate asphalt cement content should be determined by the mix design. An S mix should be used on the lower lift, and an S or SX mix (3/4-inch and ½ -inch nominal, respectively) should be used in the top lift.

Aggregate Base Course should conform to the requirements of AASHTO M147 and to Section 703.03 of the Colorado Department of Transportation (CDOT) Standard Specifications for Road and Bridge Construction and should meet Class 6 grading and quality as defined by the CDOT specifications. The aggregate should have a minimum R-value of 78. The asphalt and aggregate base course also should meet any other applicable Town of Parker standards. Materials also should meet the Town of Parker standards.

Subgrade Preparation

Pavement subgrade conditions are projected to generally consist of clay exhibiting Potential for expansion upon wetting. To limit potentially excessive pavement movement due to possible moisture-related expansion of clay, we recommend that the upper 24 inches of the clay underlying pavements should be removed and re-compacted with a moisture content between +2 and +4 percentage points of optimum and re-compacted to at least 95% of the standard Proctor maximum dry density (ASTM D 698).

Proof Roll

Before paving, the subgrade should be proof rolled with a heavily loaded, pneumatic-tired vehicle. The vehicle should have a gross vehicle weight of at least 50,000 pounds with a loaded single axle weight of 18,000 pounds and a tire pressure of 100 psi. Areas which deform excessively under heavy wheel loads are not stable and should be removed and replaced with suitable material to achieve a stable subgrade prior to paving or placement of base course.

Drainage

The collection and diversion of surface drainage away from paved areas is extremely important to the satisfactory performance of pavement. Drainage design should provide for the removal of water from paved areas and prevent the wetting of the subgrade soils.

Maintenance

Periodic maintenance of paved areas is critical to achieve the design life of the pavement. Crack sealing should be performed annually as new cracks appear. Chip seals, fog seals, or slurry seals applied at approximate intervals of 3 to 5 years are usually necessary for asphalt. As conditions warrant, it may be necessary to perform patching and structural overlays at approximate 10 year intervals

DESIGN AND CONSTRUCTION SUPPORT SERVICES

KUMAR and Assoc. should be retained to review the project plans and specifications for conformance with the recommendations provided in our report. We are also available to assist the design team in preparing specifications for geotechnical aspects of the project, and performing additional studies if necessary to accommodate possible changes in the proposed construction. Once the building location has been determined, we should help decide if additional borings are needed.

We recommend that KUMAR and Assoc. be retained to provide construction observation and testing services to document that the intent of this report and the requirements of the plans and specifications are being followed during construction. This will allow us to identify possible variations in subsurface conditions from those encountered during this study and to allow us to re-evaluate our recommendations, if needed. We will not be responsible for implementation of the recommendations presented in this report by others, if we are not retained to provide construction observation and testing services.

LIMITATIONS

This study has been conducted in accordance with generally accepted geotechnical engineering practices in this area for exclusive use by the client for design purposes. The conclusions and recommendations submitted in this report are based upon the data obtained from the widely spaced exploratory borings at the locations indicated on Figure 2, and the proposed type of construction. This report may not reflect subsurface variations that occur between the exploratory borings or at the specific building location, 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 and Assoc. should be advised at once so that a re-evaluation of the

recommendations presented in this report can be made. KUMAR and Assoc. 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.

KUMAR and Assoc.

NOT TO SCALE

18-8-180	Kumar & Associates	VICINITY MAP	Fig. 1

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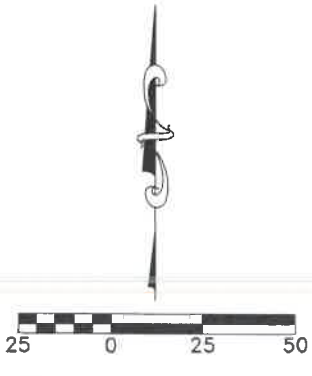

18-8-180	Kumar & Associates	LOCATION OF EXPLORATORY BORINGS	Fig. 2

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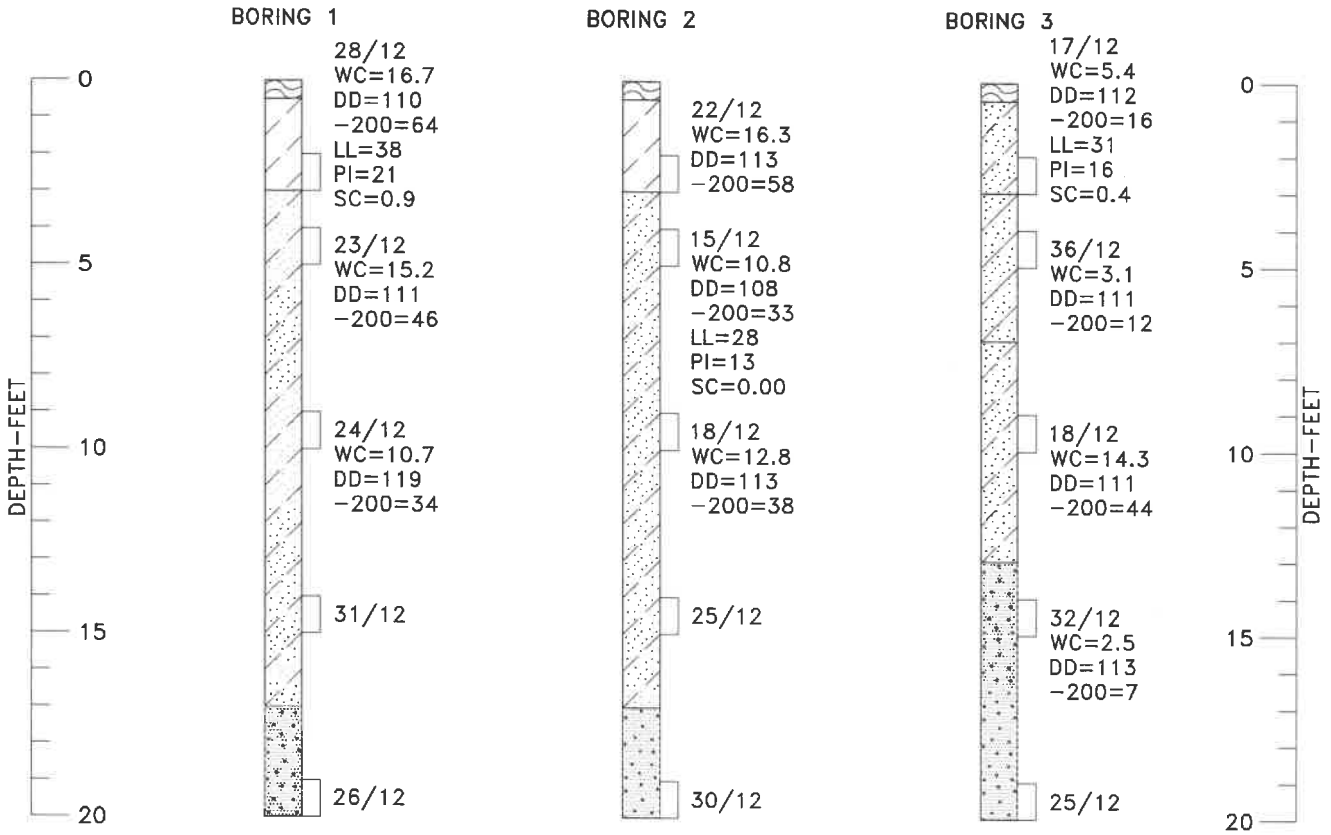

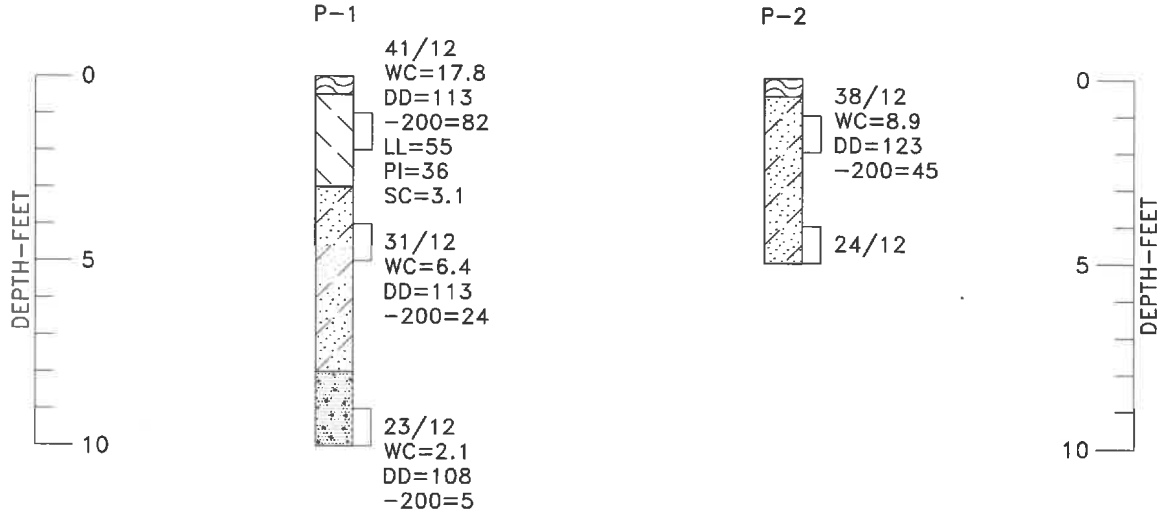

18-8-180	Kumar & Associates	LOGS OF EXPLORATORY BORINGS	Fig. 3

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LEGEND

TOPSOIL.

CLAY (CL), SANDY, VERY STIFF, MEDIUM TO HIGH PLASTICITY, FINE TO COARSE (SAND FRACTION), MOIST, LIGHT BROWN, BROWN.

FAT CLAY (CH), SANDY, HARD, MEDIUM TO HIGH PLASTICITY, FINE TO COARSE (SAND FRACTION), MOIST, LIGHT BROWN.

SAND (SC), CLAYEY, MEDIUM DENSE TO DENSE, LOW TO MEDIUM PLASTICITY, FINE TO COARSE, MOIST, LIGHT BROWN, BROWN, REDDISH BROWN.

SAND (SM), SILTY, DENSE, LOW PLASTICITY, FINE TO COARSE, MOIST, LIGHT BROWN.

SANDSTONE, FIRM TO MEDIUM HARD, LOW TO MEDIUM PLASTICITY, FINE TO COARSE, MOIST, BROWN, WHITE, RED.

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

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.

NOTES

1. THE EXPLORATORY BORINGS WERE DRILLED ON MAY 7, 2018 WITH A 4-INCH DIAMETER CONTINUOUS FLIGHT POWER AUGER.
2. THE LOCATIONS OF THE EXPLORATORY BORINGS WERE MEASURED APPROXIMATELY BY PACING FROM FEATURES SHOWN ON THE SITE PLAN PROVIDED.
3. THE ELEVATIONS OF THE EXPLORATORY BORINGS WERE NOT MEASURED AND THE LOGS OF THE EXPLORATORY BORINGS ARE PLOTTED TO DEPTH.
4. THE EXPLORATORY BORING LOCATIONS SHOULD BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE METHOD USED.
5. THE LINES BETWEEN MATERIALS SHOWN ON THE EXPLORATORY BORING LOGS REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN MATERIAL TYPES AND THE TRANSITIONS MAY BE GRADUAL.
6. GROUNDWATER WAS NOT ENCOUNTERED IN THE BORINGS AT THE TIME OF DRILLING OR WHEN CHECKED # DAYS LATER.
7. LABORATORY TEST RESULTS:
   WC = WATER CONTENT (%) (ASTM D 2216);
   DD = DRY DENSITY (pcf) (ASTM D 2216);
   -200= PERCENTAGE PASSING NO. 200 SIEVE (ASTM D 1140);
   LL = LIQUID LIMIT (ASTM D 4318);
   PI = PLASTICITY INDEX (ASTM D 4318);
   SC = PERCENT SWELL (+) OR CONSOLIDATION (-) UPON WETTING UNDER CONSTANT LOAD (ASTM D 4546, METHOD B).

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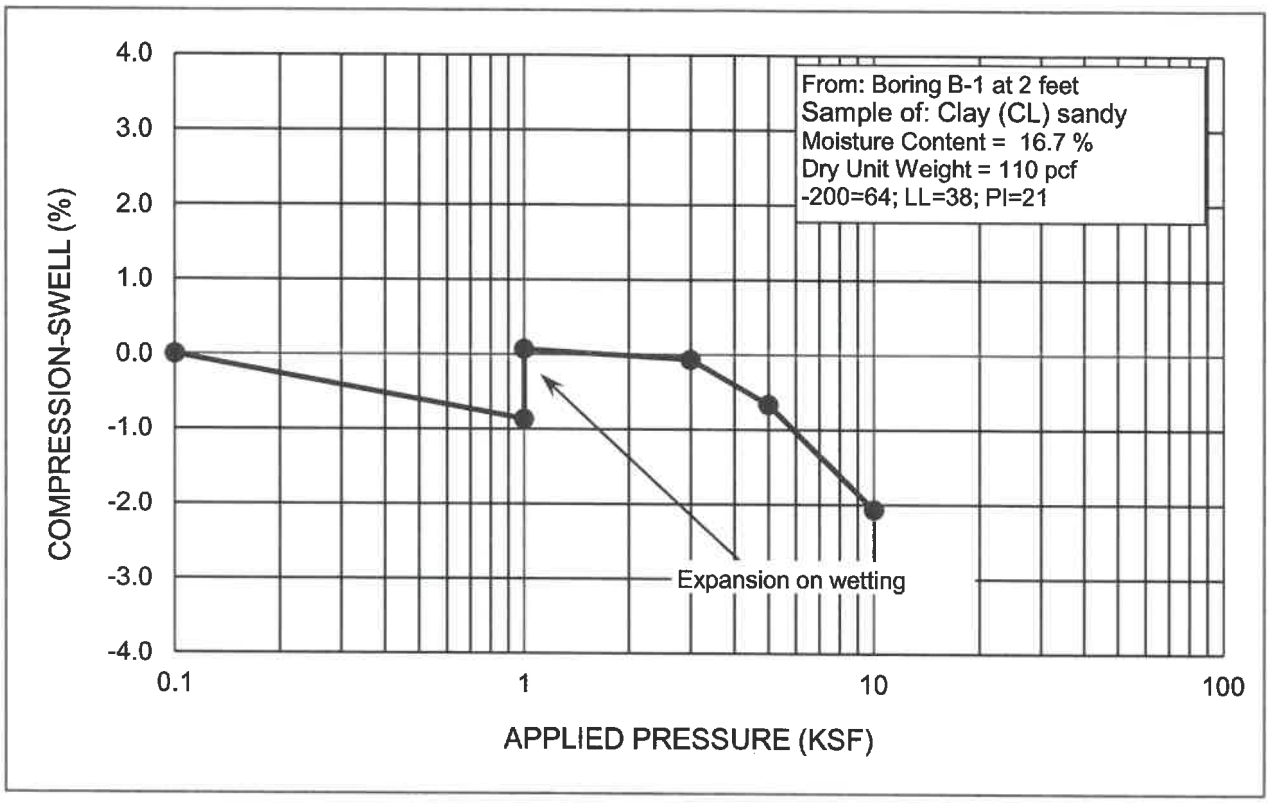
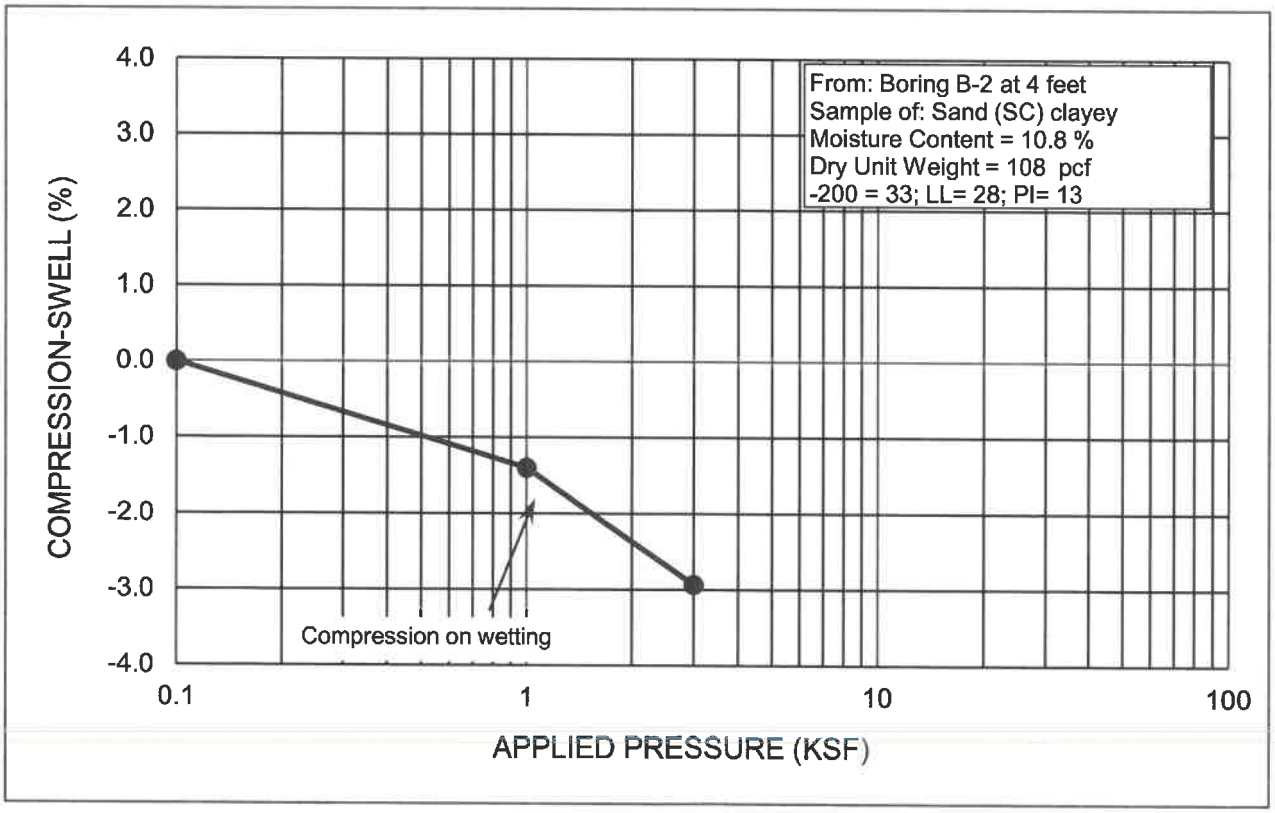
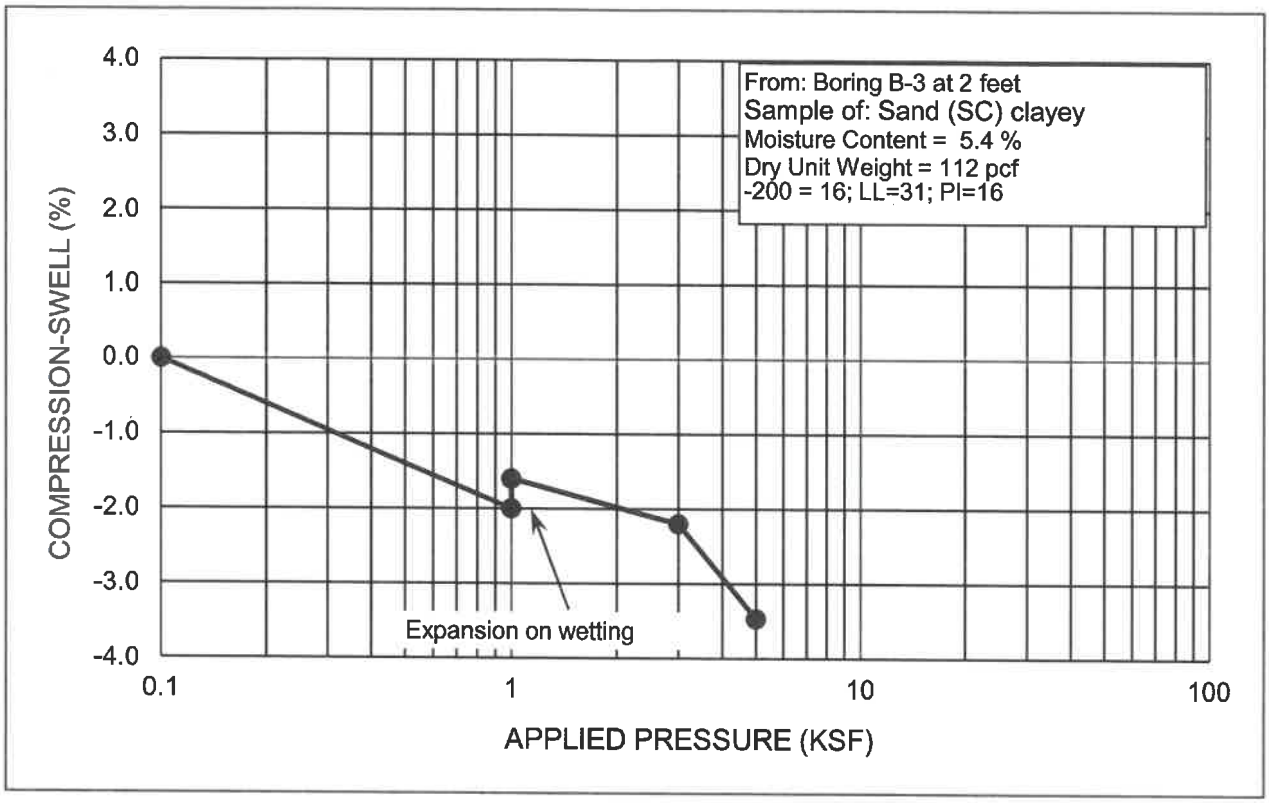
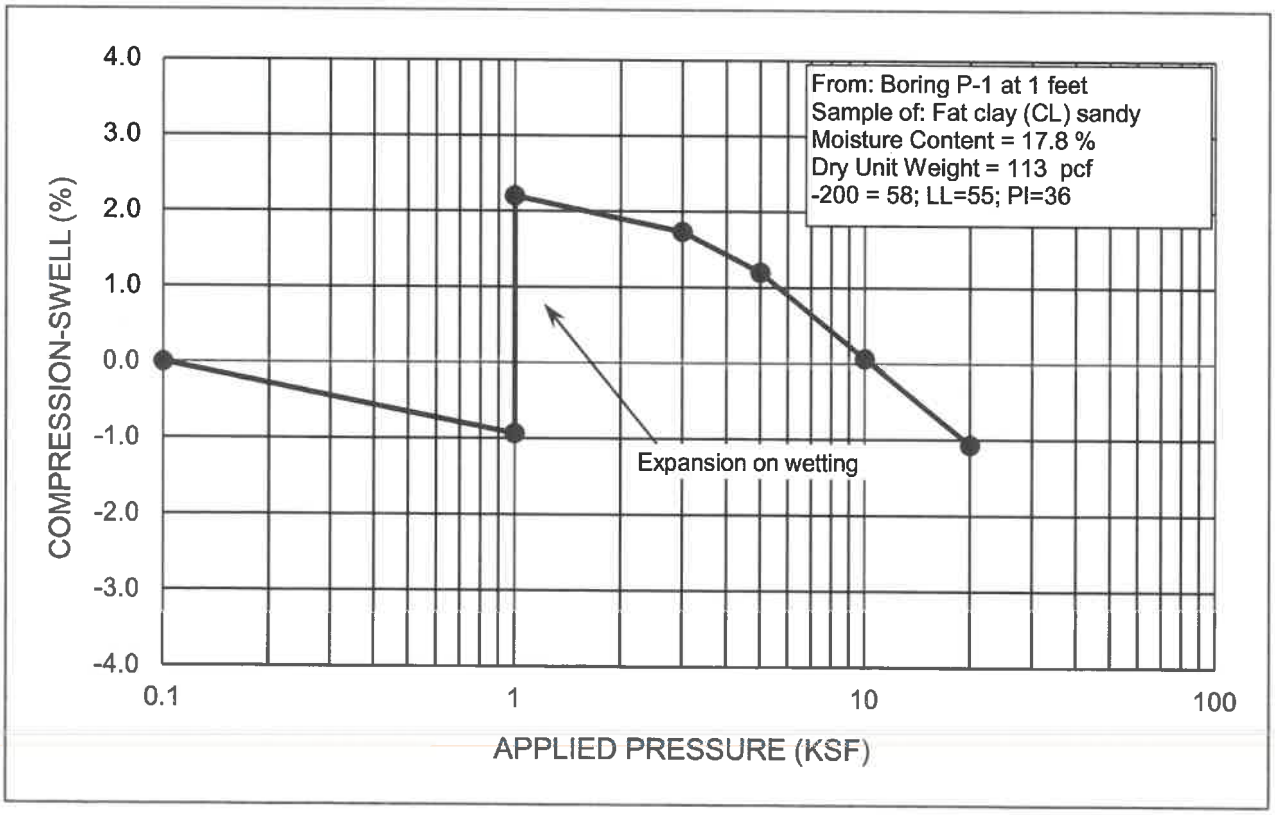


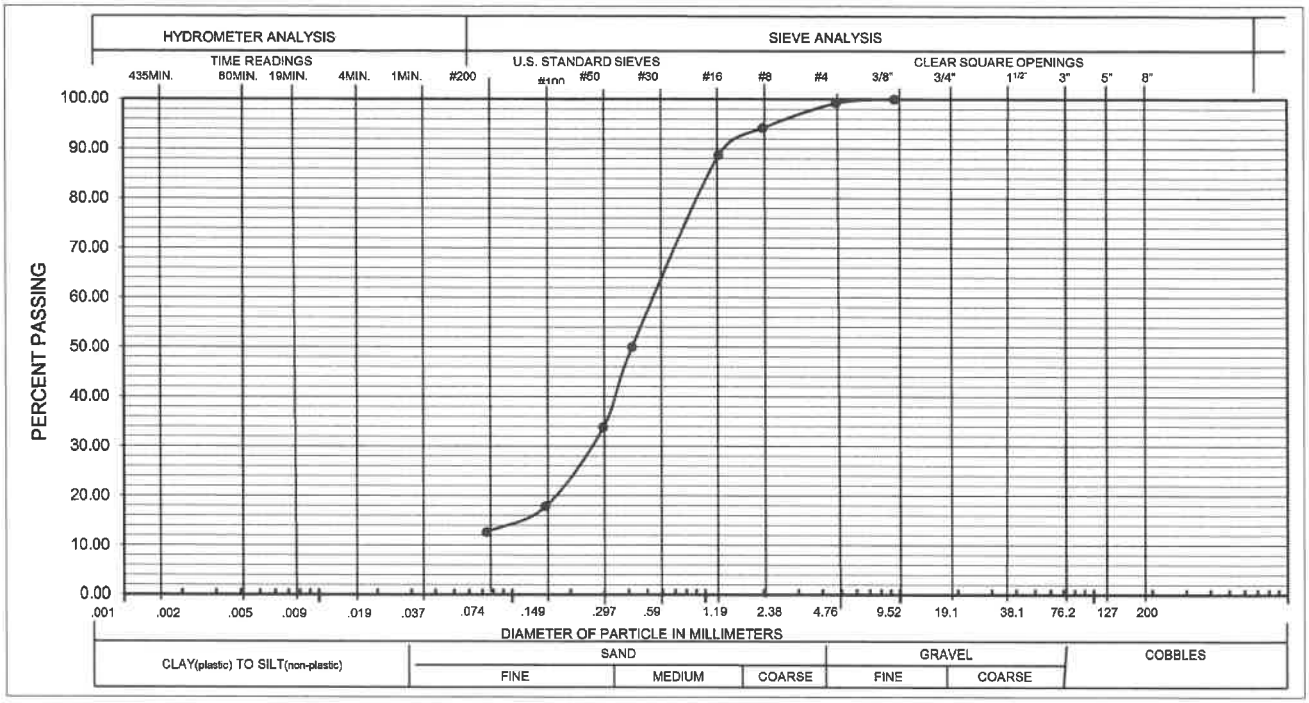


18-8-180	KUMAR & ASSOCIATES	LEARNING EXPERIENCE SWELL-COMPRESSION TEST RESULTS	FIG. 5

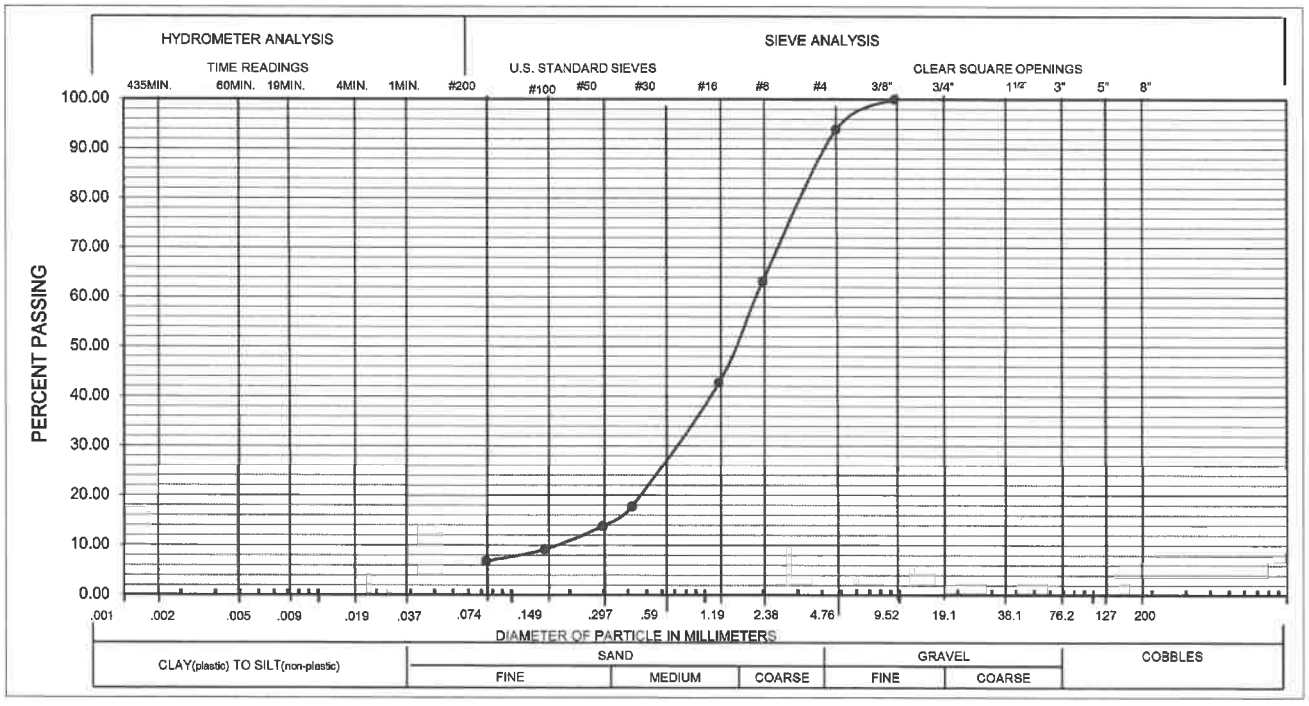




18-8-180	KUMAR & ASSOCIATES	LEARNING EXPERIENCE SWELL-COMPRESSION TEST RESULTS	FIG. 6

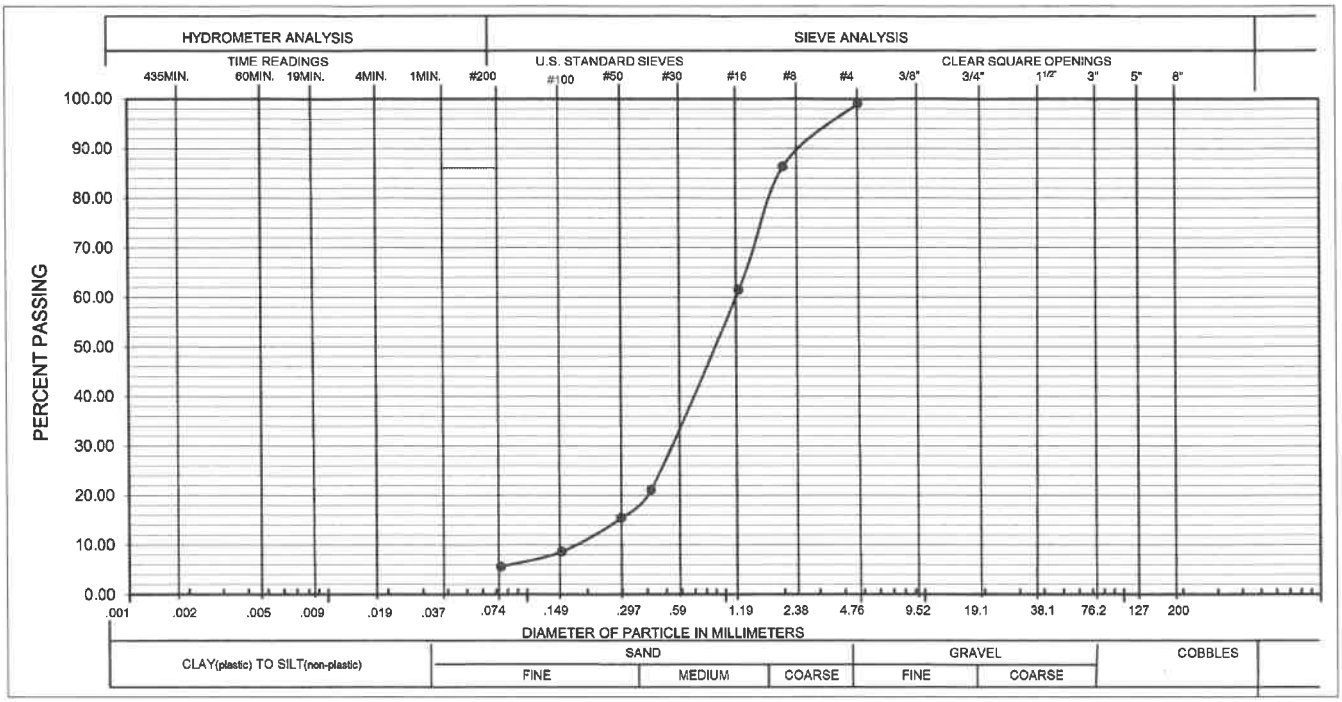


GRAVEL: 1% SAND: 87% SILT AND CLAY: 12%
LIQUID LIMIT: PLASTICITY INDEX:
SAMPLE OF: Sand (SM) silty FROM: B3 @ 4'



GRAVEL: 6% SAND: 87% SILT AND CLAY: 7%
LIQUID LIMIT: PLASTICITY INDEX:
SAMPLE OF: Sandstone FROM: B3 @ 14'

18-8-180	KUMAR & ASSOCIATES	LEARNING EXPERIENCE GRADATION ANALYSIS	FIG. 7



GRAVEL:	1%	SAND:	94%	SILT AND CLAY:	6%
LIQUID LIMIT:				PLASTICITY INDEX:	
SAMPLE OF:	Sandstone			FROM:	P1 @ 9'

18-8-180	KUMAR & ASSOCIATES	LEARNING EXPERIENCE GRADATION ANALYSIS	FIG. 8

Kumar & Associates, Inc.

TABLE I
SUMMARY OF LABORATORY TEST RESULTS

Project No.: 18-8-180

Project Name: Learning Experience Facility

SAMPLE LOCATION		NATURAL MOISTURE CONTENT (%)	NATURAL DRY DENSITY (pcf)	GRADATION		SILT & CLAY (%)	ATTERBERG LIMITS		WATER SOLUBLE SULFATES (%)	SWELL WITH 1000 PSF SURCHARGE (%)	AASHTO CLASSIFICATION (group index)	SOIL OR BEDROCK TYPE (Unified Soil Classification)
BORING	DEPTH (ft)			GRAVEL (%)	SAND (%)		LIQUID LIMIT	PLASTICITY INDEX				
B1	2	16.7	110			64	38	21	<0.01	0.9		Clay (CL) sandy
B1	4	15.2	111			46						Sand (SC) clayey
B1	9	10.7	119			34						Sand (SC) clayey
B2	2	16.3	113			58						Clay (CL) sandy
B2	4	10.8	108			33	28	13				Sand (SC) clayey
B2	9	12.8	113			38						Sand (SC) clayey
B3	2	5.4	112			16	31	16		0.4		Sand (SC) clayey
B3	4	3.1	111	1	97	12						Sand (SM) silty
B3	9	14.3	111			44						Sand (SC) clayey
B3	14	2.5	113	6	87	7						Sandstone
P1	1	17.8	113			82	55	36		3.1	A-7-6(30)	Fat Clay (CH) sandy
P1	4	6.4	113			24						Sand (SC) clayey
P1	9	2.1	108	1	94	5						Sandstone
P2	1	8.9	123			45						Sand (SC) clayey