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GEOTECHNICAL ENGINEERING STUDY
PROPOSED MAYBERRY DEVELOPMENT ROADWAYS
FILINGS 2 THRU 4, AND BALANCE OF FILING 1
EL PASO COUNTY, COLORADO

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Attn: Mr. Al Watson

Project No. 22-2-131

May 9, 2022

TABLE OF CONTENTS

SUMMARY

1. In general, the soils encountered consisted of granular fill overlying native granular soils extending to the maximum explored depth of 10 feet. The fill extended to the maximum 5-foot depth explored in 18 borings, and to depths between 3 and 7 feet in six of the borings. Due to visual similarities between the fill and native soils, the actual transition between fill and native materials may differ from what is described or shown on the boring logs. The fill included silty sand (SM), clayey sand (SC), and poorly to well-graded sand with silt (SP-SM, SW-SM), and appeared to consist of reworked native soils. The underlying native soils were of a similar composition to the fill material.

2. Groundwater was not encountered at the time of drilling. The depth to groundwater is anticipated to fluctuate over time but groundwater is unlikely to be a construction consideration for this project.

3. We understand the roadways included within this study will classify as Urban Local and Urban Residential Collector as shown on Fig 1. Referencing the default ESAL's for these classifications presented in the El Paso County Pavement Design Criteria Manual (ECM), design-life ESAL's of 292,000 and 821,000 were used, respectively. If it is determined that actual traffic volume or roadway designation is significantly different from the estimated values, we should be contacted to reevaluate the pavement thickness design presented in this report.

4. Based on the assumed traffic volumes, we recommend the following pavement sections for the various road classifications.

Pavement Section Recommendations	
Road Classification	Composite Asphalt over Aggregate Base Course (in.)
Urban Residential Collector	4 over 8
Urban Local	4 over 8

PURPOSE AND SCOPE OF STUDY

This report presents the results of a geotechnical engineering study for proposed new roadways that will be constructed as part of the Mayberry development in El Paso County, Colorado. The overall project site is shown on Fig. 1. The study was conducted in general accordance with the scope of work in our Proposal No. C22-132, dated February 8, 2022 for the purpose of providing pavement section thickness recommendations.

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

We understand the proposed construction will consist of approximately 15,000 LF of new roadway as shown on Fig. 1. The new roadway will include segments with Urban Residential Collector and Urban Local traffic loading in accordance with a traffic study prepared by LSC Transportation Consultants Inc, dated January 3, 2022. Site grading in the areas of new pavement is anticipated to 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 located in eastern El Paso County, just south of State Highway 94, west of Ellicott, Colorado. The proposed development is located approximately one mile to a quarter mile west of Log Road. The site is bound by State Highway 94 to the north, with vacant land adjacent to the highway. The areas west, south, and east of the development are vacant land with the exception of a rural residence located to the east. An existing 500,000-gallon water tank and booster pump station, operated by Cherokee Metro Water District, are located on the north-center of the development. A hangar-style building and a handful of previously demolished building foundations were located just east of the existing water tank and pump station, but have since been removed in preparation for this development. The site is currently undergoing roadway and utility installation, progressing eastward at the time this report was prepared. The topography of the subject site generally slopes down to the east/southeast. The site grading is known to contain a mixture of cut and fill, with much of the fill consisting of reworked native soil. Vegetation within the property has been stripped and the site consisted of roughly graded roadways, with some

sections of curb and gutter in place in addition to various utility excavations within the roadways during the time of our site visits.

FIELD EXPLORATION AND SUBSURFACE CONDITIONS

The exploratory borings were drilled at the approximate locations shown on Fig. 1 using a 4-inch diameter continuous-flight solid stem auger powered by a truck mounted drill rig. In general, the soils encountered consisted of fill overlying native soils extending to the maximum explored depth of 10 feet.

Existing Fill: The fill extended to the maximum 5-foot depth explored in 18 borings, and to depths between 3 and 7 feet in six of the borings. Due to visual similarities between the fill and native soils, the actual transition between fill and native materials may differ from the depths described or depicted on the attached boring logs. Our study did not determine the exact lateral or vertical extent of the fill. The fill consisted of silty sand (SM), clayey sand (SC), and poorly to well-graded sand with silt (SP-SM, SW-SM), and appeared to consist of reworked native soils. The fill appeared dry to moist, and was tan in color. Swell-consolidation test results presented on Figs. 4 and 5 indicate the tested samples of silty sand fill ranged from having a negligible amount of swell (+0.2%) to a low amount of consolidation (-0.1 to -1.0%), and the tested sample of clayey sand fill had a low swell potential (+1.3%), after wetting the samples under a 150 psf surcharge. Soil moisture density relationship test results (modified Proctors) presented on Figs. 14 and 15 indicate the tested samples of silty sand fill had optimum moisture contents of 7.3% to 9.5%, and a maximum dry density of 129.9 pcf to 131.2 pcf.

Native Granular Soils: The underlying native soils were of a similar composition to the fill material. The native soils were loose to very dense, dry to slightly moist, and tan, brown and reddish-brown in color.

Groundwater: Groundwater was not encountered at the time of drilling. The depth to groundwater is anticipated to fluctuate over time but groundwater is unlikely to be a construction consideration for this project.

LABORATORY TESTING

Laboratory testing performed on selected samples obtained from the borings included the natural moisture content and dry density, gradation analysis, liquid and plastic limits, swell-consolidation, soil moisture-density relationships (Proctors), Hveem's stability testing (R-value), and water-

soluble sulfate concentrations. The laboratory test results are shown adjacent to the boring logs on Figs. 2 and 3, plotted graphically on Figs. 4 through 17, and summarized in Table I.

GEOTECHNICAL CONSIDERATIONS

The existing fill encountered appears to be associated with the utility installations and roadway preparations that were occurring at the time of our field investigation. Kumar & Associates is currently contracted separately by the owner to provide construction observation and materials testing services during the roadway preparations and utility installations. It is anticipated that once the field construction activities have been completed, our firm would provide a summary letter for this effort. Based on this, it is our opinion the existing fill will not require overexcavation or other means of stabilization. The subgrade preparations should follow the requirements of the El Paso County Engineering Criteria Manual and the recommendations presented in this report.

PAVEMENT DESIGN

Subgrade Materials: Based on the American Association of State Highway Transportation Officials (AASHTO) classification system the soils tested near the proposed subgrade elevation were generally A-1-a, A-1-b, and A-2-4 soils with a group index of 0. In general, these soil types are considered good for use as subgrade materials.

The Hveem's stabilometer test results (R-value) presented on Figs. 16 and 17 indicate R-values of 66 and 68 for the tested samples of A-2-4 soil. Based on our experience with similar soil types, and the anticipated variability throughout the project area, an R-value of 50 was selected for design of flexible pavements. Based on the AASHTO 1993 design method presented in the El Paso County Pavement Design Criteria Manual (ECM), this value corresponds to a resilient modulus of 13,168 psi. If imported fill is used, tests should be performed to confirm it meets or exceeds the design R-value.

Design Traffic: Based on a traffic study prepared by LSC Transportation Consultants Inc dated January 3, 2022, we understand the roadways included within this study will classify as Urban Local and Urban Residential Collector as shown on Fig 1. Referencing the default ESAL's for these classifications presented in the El Paso County Pavement Design Criteria Manual (ECM), design-life ESAL's of 292,000, and 821,000 were used, respectively. If it is determined that actual traffic volume or roadway designation is significantly different from the estimated values, we should be contacted to reevaluate the pavement thickness design presented in this report.

Pavement Sections: The recommended sections were determined using the AASHTO 1993 design method as outlined in the ECM. The design parameters used for the analysis is included in the Appendix. Based on the assumed traffic volumes, we recommend the following pavement sections for the various road classifications.

Pavement Section Recommendation	
Road Classification	Composite Asphalt over Aggregate Base Course (in.)
Urban Residential Collector	4 over 8
Urban Local	4 over 8

The calculated pavement section required for Urban Local roadways was determined to be 3 inches of asphalt over 8 inches of aggregate base course, which meets the minimum section requirement described in the ECM; however, we recommend 4 inches of asphalt be considered at a minimum, to accommodate the anticipated occasional truck traffic that may not be adequately accounted for in the default ESAL value that was assumed.

Pavement Materials: The asphalt pavement should consist of a bituminous material which meets the requirements of the Pikes Peak Region Asphalt Paving Specifications. Aggregate base course should meet the requirements of a CDOT Class 6 and those requirements presented in the ECM. Based on the anticipated traffic volume, a Superpave SX mix with a design gyration N value of 75, and a binder performance grade of 58-28 should be used. A PG 64-28 binder may also be considered if rutting is a concern. A minimum lift thickness of 2-inches is recommended. Lift thickness should not exceed 3 inches unless pneumatic or vibratory rollers are used.

Subgrade Preparation: As specified in the “Site Grading and Earthwork” section, ground surfaces should be scarified to a depth of 12 inches, moisture conditioned, and compacted prior to placement of new fill. After compaction, a proof roll should be conducted to identify unstable areas, which should be repaired according to the recommendations presented in the “Subgrade Stabilization” subsection presented below. New fill should then be moisture conditioned and recompacted in accordance with the “Site Grading and Earthwork” section of this report.

To develop a properly compacted, stable surface with sufficient moisture content, we recommend that immediately prior to paving, the pavement subgrade be thoroughly scarified and well-mixed to a minimum depth of 12 inches and adjusted to the moisture and compaction criteria presented in the “Site Grading and Earthwork” section of the report. This should occur no more than 48 hours before the placement of pavement materials.

Proof Roll: Before paving, the subgrade should be proof rolled with a heavily loaded, pneumatic-tired vehicle. The vehicle should have a gross weight of at least 50,000 pounds, with a single loaded axle weight of 18,000 pounds, and a tire pressure of 100 psi. Areas that 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.

Maintenance: The periodic maintenance of paved areas is critical to achieve the desired pavement life. Preventative measures such as crack sealing, the application of chip seals, fog seals, or slurry seals, patching and structural overlays should be applied when necessary.

Subgrade Stabilization: It is possible that some unstable subgrade areas may be encountered during construction. We anticipate stabilization of these areas may be achieved by methods such as scarification of the subgrade to accelerate partial drying of the materials; excavation and replacement of unstable soils with drier materials; or stabilization using geogrid reinforcement (Type 2 Geogrid or similar) in combination with 1 to 2 feet of aggregate base course. Specific stabilization requirements should be evaluated at the time of construction. Given the amount of subsurface information collected, we cannot 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.

Drainage: Providing proper surface drainage, both during construction and after the construction has been completed, is very important for acceptable performance of this project. Drainage considerations should ensure that excessive wetting or drying of the pavement subgrades is avoided during construction. Additionally, drainage design should provide for the removal of water from paved areas and prevent the wetting of the subgrade soils.

SITE GRADING AND EARTHWORK

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

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

1. *Fill Below Pavements*: The on-site soils, minus any deleterious materials, will be generally be suitable for reuse. Import soils if used, should consist of a non-expansive soil, consisting of a minus 2-inch material that has a maximum 35% passing the No. 200 sieve, a maximum plasticity index of 10, and an R-value of at least 50.

2. *Material Suitability*: All fill material should be free of vegetation, brush, sod and other deleterious substances. The geotechnical engineer should evaluate the suitability of all proposed fill materials prior to placement.

3. *Subgrade Preparation*: The ground surface shall be stripped of vegetation/organics, loose soils, or any other unsuitable materials 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. As noted within this report, the compacted surface should be proof rolled prior to the placement of additional fill.

4. *Compaction Requirements*: 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 1557)
Aggregate Base Course (ABC)	95%
Pavement Subgrade	95%
Exterior Flatwork	95%
Landscape and Other Misc. Overlot Fill Areas	90%
Compaction of fill materials should be achieved at a moisture content within 2 percent of optimum for granular soils, and within +0 to +3 percent for cohesive materials.	

New fill should be placed in horizontal layers not to exceed 8 inches in loose lift thickness. Each layer should be compacted prior to the placement of subsequent layers. Spreading equipment should be used to obtain uniform thickness prior to compaction. As the compaction progresses, continuous mixing, leveling, and manipulating shall be done to assure uniform moisture and density.

EXCAVATION CONSIDERATIONS

In our opinion, excavation of the overburden soils should be possible with conventional excavation equipment. All excavations should be in accordance with OSHA, state and local requirements. The contractor should follow appropriate safety precautions. In accordance with OSHA guidelines, the on-site soils will likely classify as a Type C material. A contractor's competent person should make decisions regarding soil types encountered during excavation.

Per OSHA criteria, unless excavations are shored, temporary unretained excavations in Type C

materials should have slopes no steeper than 1½:1 (H:V). Flatter slopes will be required where ground-water is encountered. Surface draining should be diverted away from all temporary cut slopes in order to reduce the potential for slope erosion and instability. OSHA regulations require that excavations greater than 20 feet in depth be designed by a professional engineer.

Although not anticipated, if groundwater is encountered in excavations, we believe the dewatering can be accomplished by pumping from sumps installed within the excavation. The pits should be constructed well below the base of the excavation to avoid loss of supporting capacity of the soils. The dewatering system should be properly designed, installed and maintained. 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. Overly moist soils may also contribute to unstable subgrade conditions when preparing roadway embankment.

WATER SOLUBLE SULFATES

The measured concentration of water soluble sulfates in representative samples obtained from the exploratory borings was approximately 0.01 percent. This concentration of water soluble sulfates 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 this information, we believe special sulfate resistant cement will not be required for concrete exposed to the on-site soils.

DESIGN AND CONSTRUCTION SUPPORT SERVICES

Kumar & Associates, Inc. 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.

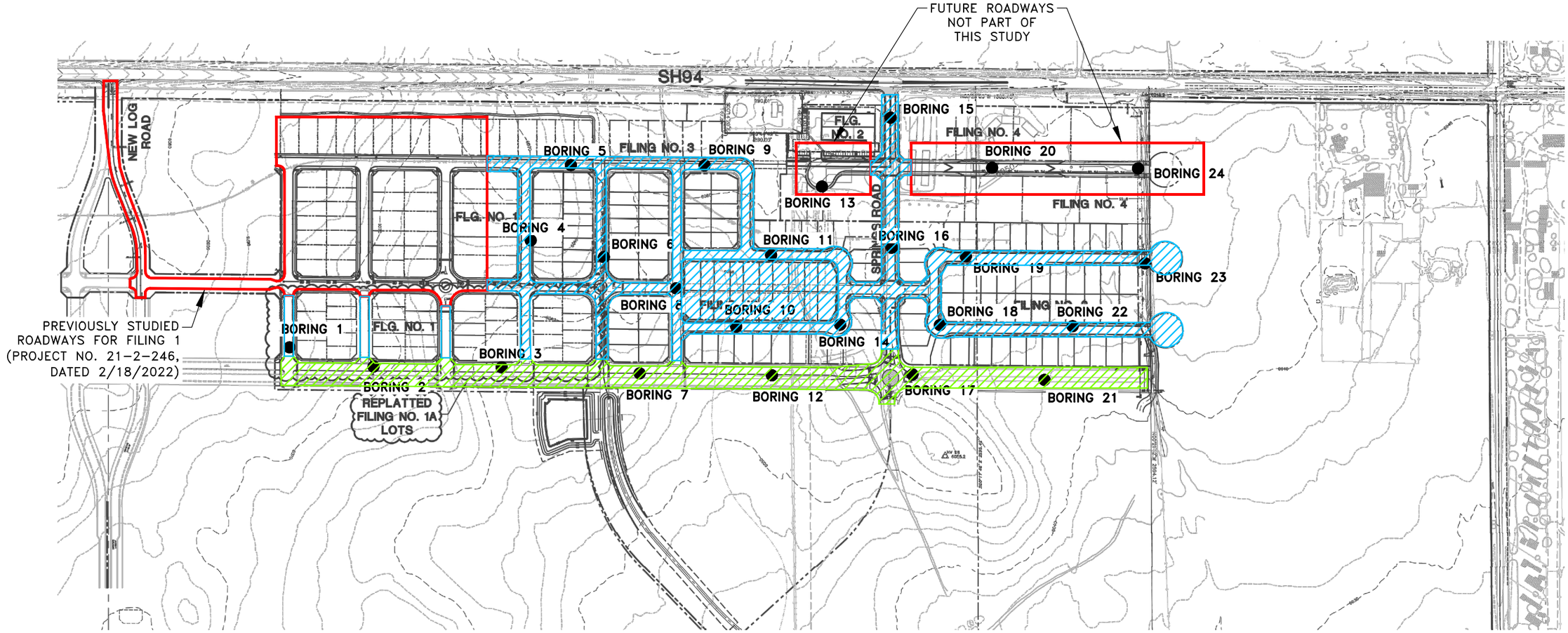
We recommend that Kumar & Associates, Inc. be retained to provide observation and testing services to document that the intent of this report and the requirements of the plans and specifications are being followed during construction, and to identify possible variations in subsurface conditions from those encountered in this study so that we can re-evaluate our recommendations, if needed.

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 between the exploratory borings, 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.

DPC/th



22-2-131	Kumar & Associates		LOCATION OF EXPLORATORY BORINGS	Fig. 1

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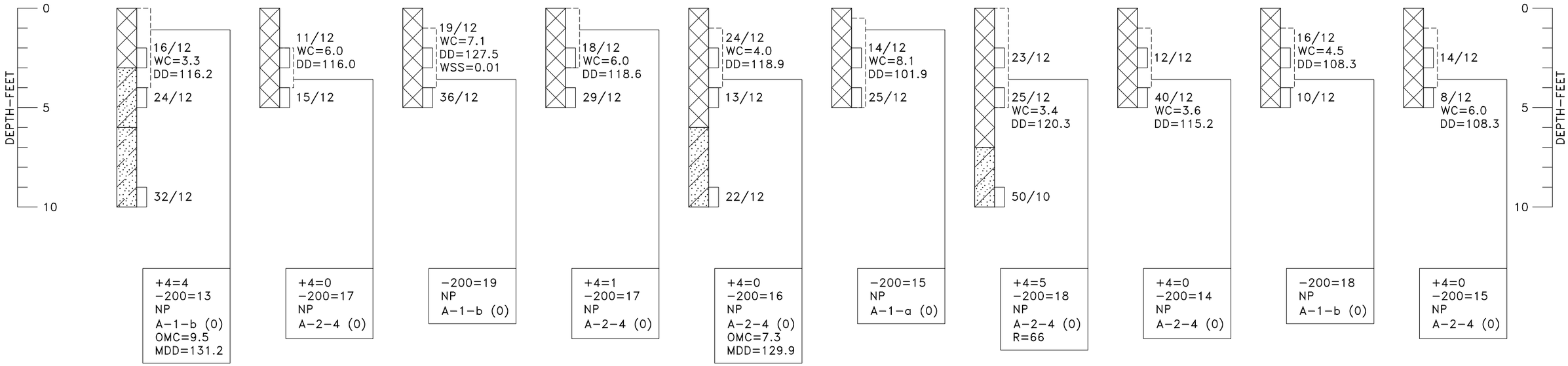
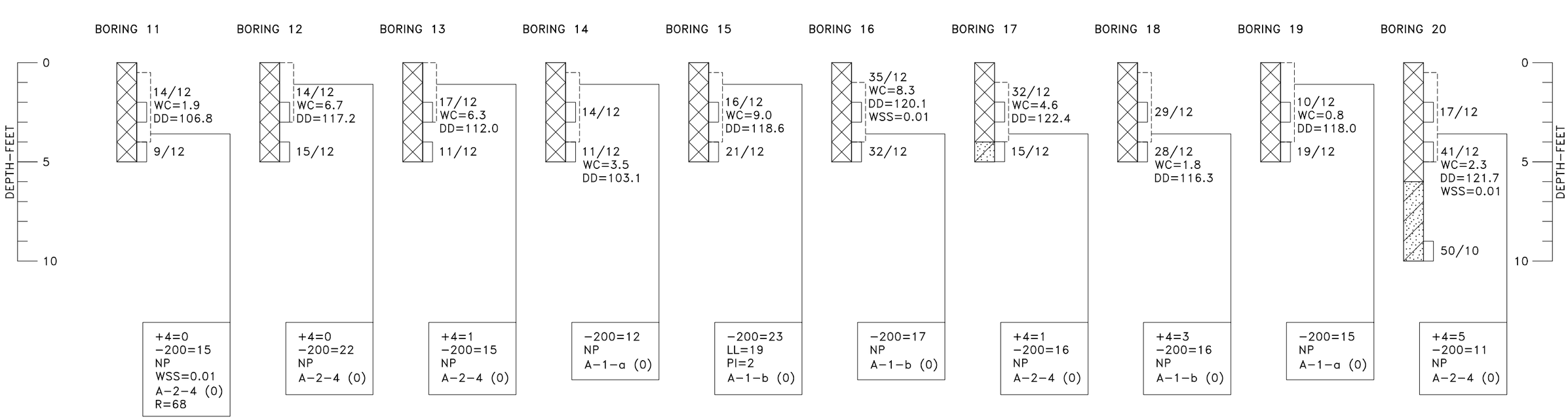
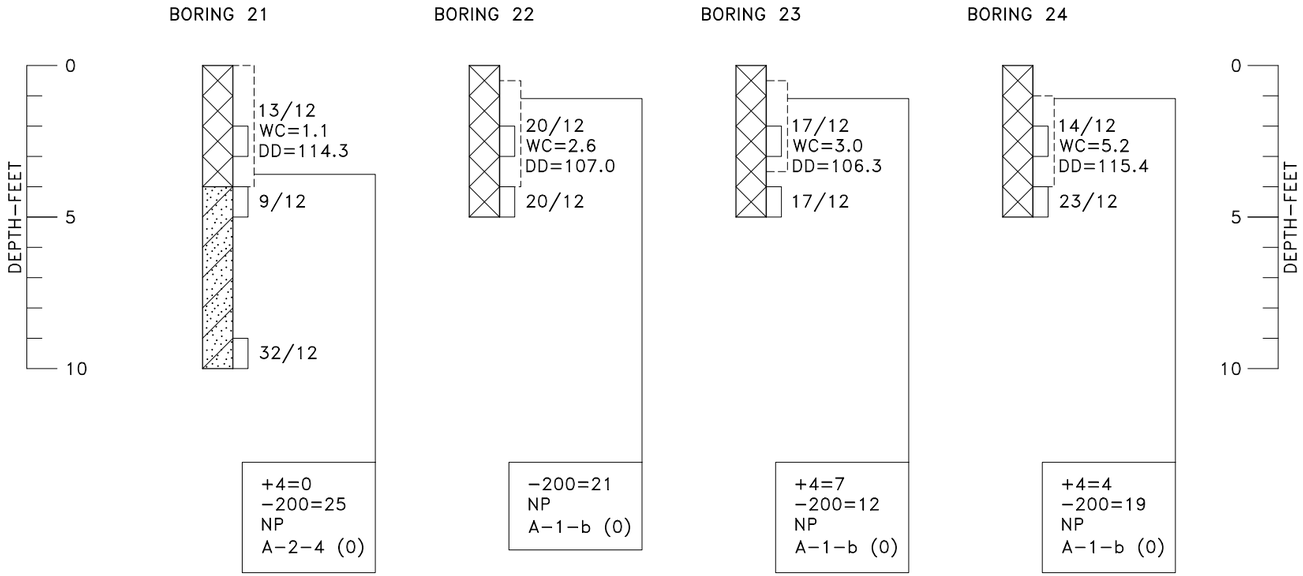




22-2-131	Kumar & Associates		LOGS OF EXPLORATORY BORINGS

Fig. 2



LEGEND

FILL: SILTY SAND (SM), CLAYEY SAND (SC), AND POORLY TO WELL GRADED SAND WITH SILT (SP-SM, SW-SM), WITH OCCASIONAL GRAVEL, DRY TO MOIST, TAN.

SILTY SAND (SM), AND POORLY GRADED SAND WITH SILT (SP-SM), WITH OCCASIONAL GRAVEL, LOOSE TO VERY DENSE, DRY TO SLIGHTLY MOIST, TAN, BROWN, REDDISH-BROWN.

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

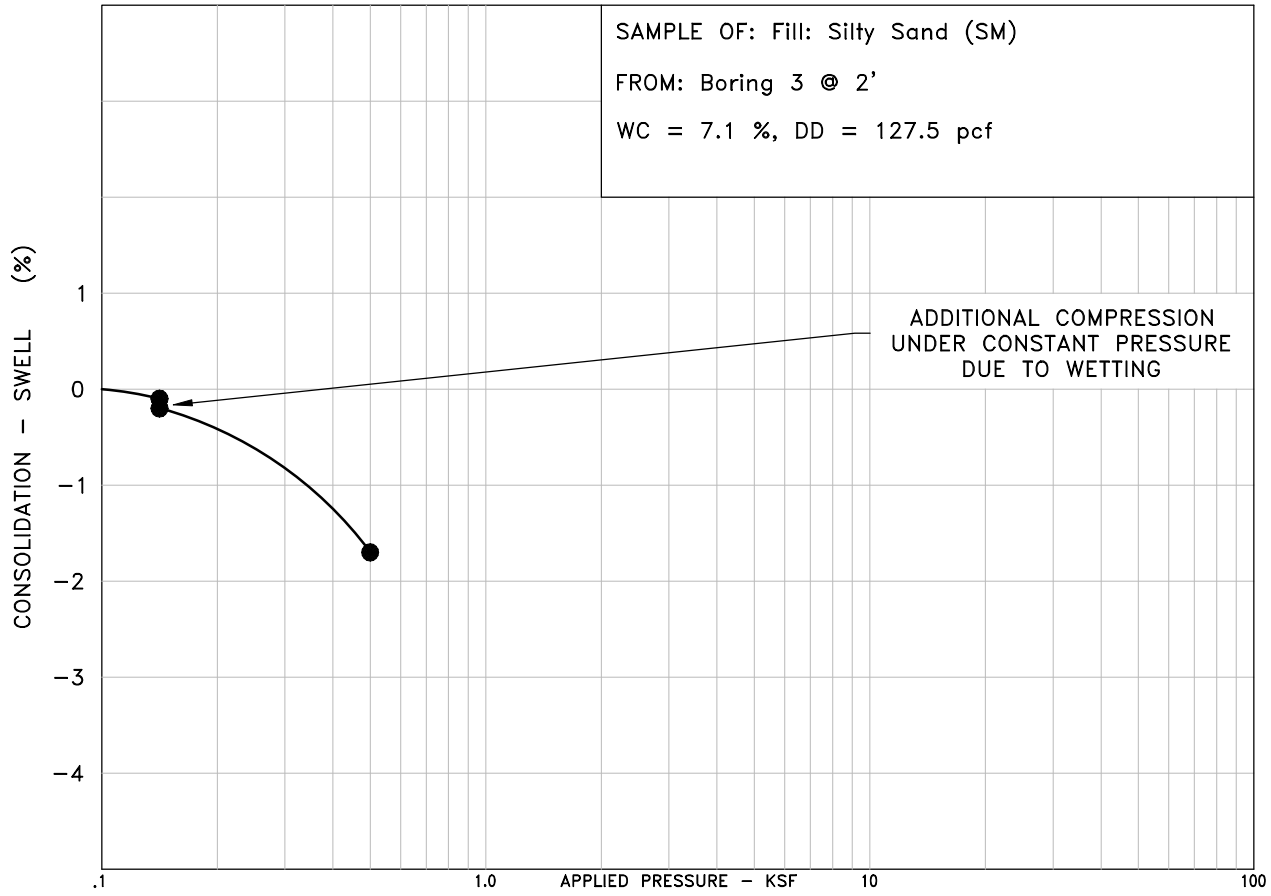
DRIVE SAMPLE, 2-INCH I.D. CALIFORNIA LINER SAMPLE.

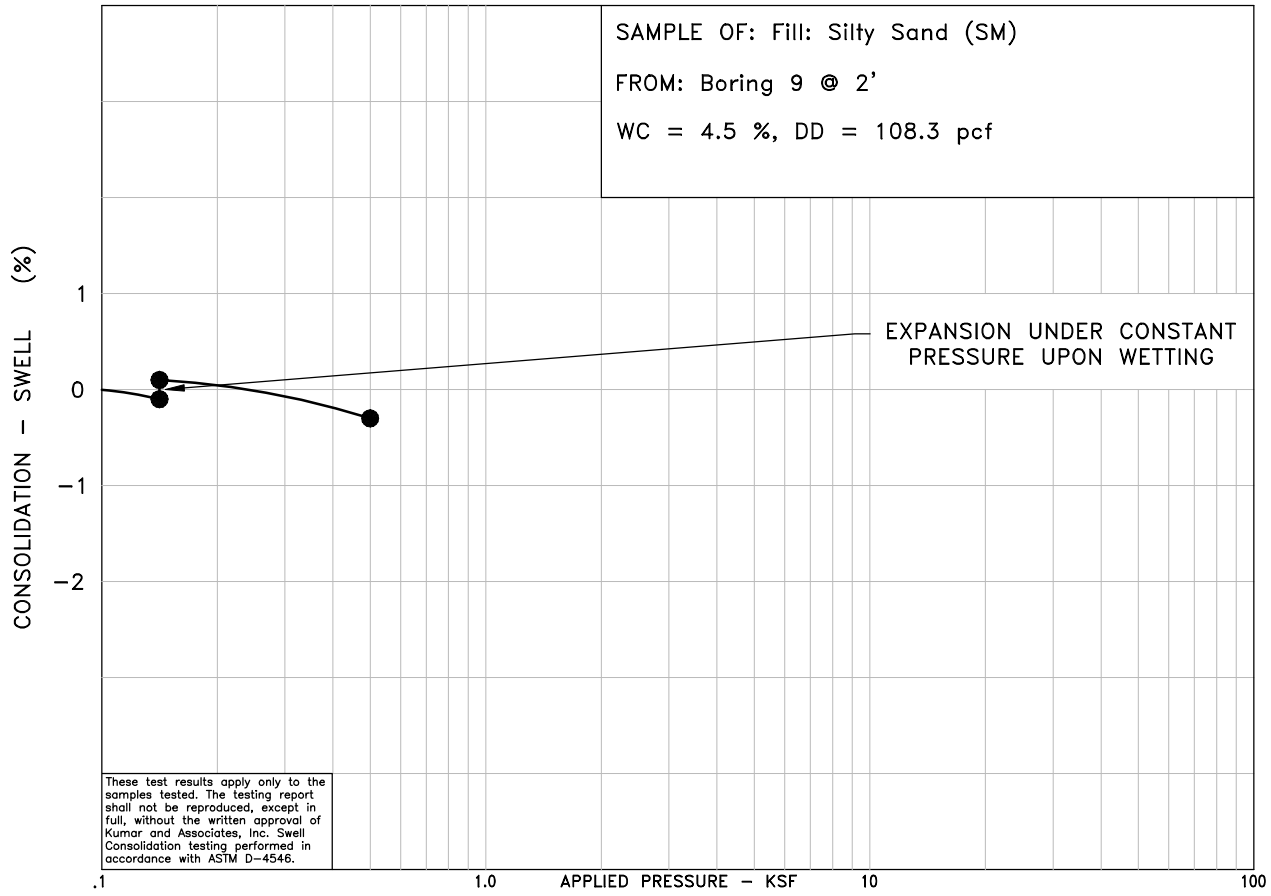
DISTURBED BULK SAMPLE.

16/12 DRIVE SAMPLE BLOW COUNT. INDICATES THAT 16 BLOWS OF A 140-POUND HAMMER FALLING 30 INCHES WERE REQUIRED TO DRIVE THE SAMPLER 12 INCHES.

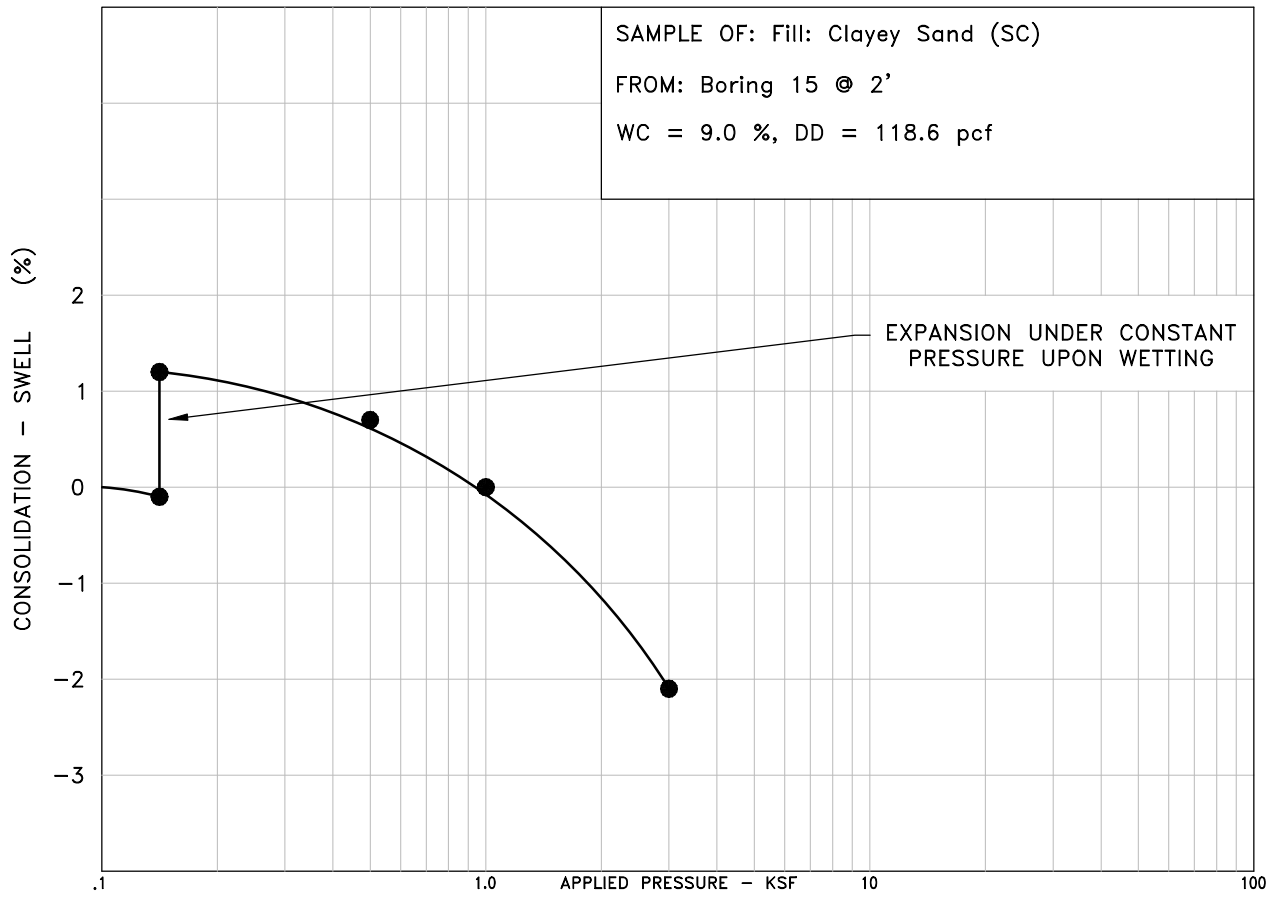
NOTES

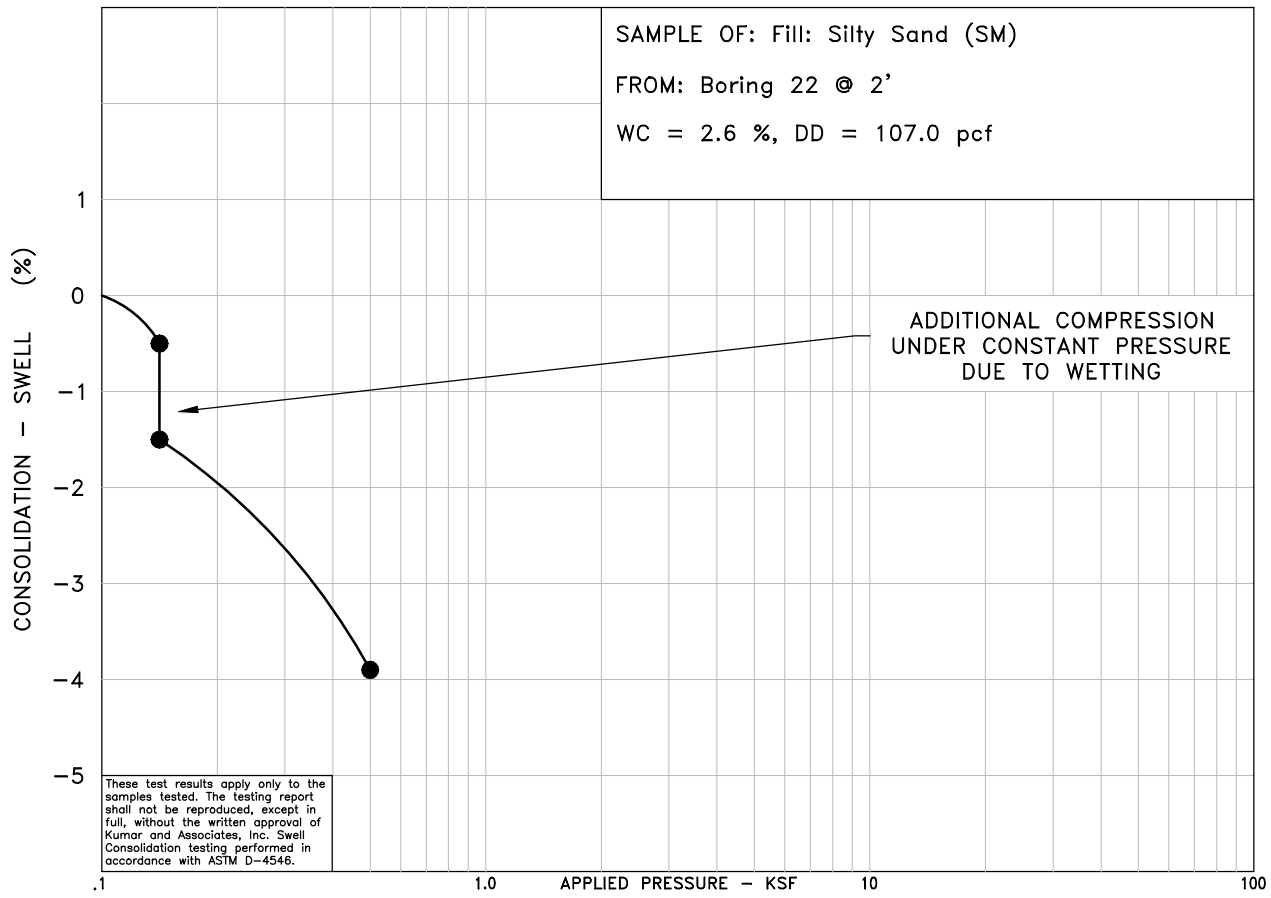
1. THE EXPLORATORY BORINGS WERE DRILLED ON APRIL 7 & 8, 2022 WITH A 4-INCH-DIAMETER CONTINUOUS-FLIGHT POWER AUGER.
2. THE LOCATIONS OF THE EXPLORATORY BORINGS WERE MEASURED APPROXIMATELY BY PACING FROM FEATURES SHOWN ON THE SITE PLAN PROVIDED AND SHOULD BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED 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 WAS NOT ENCOUNTERED IN THE BORINGS AT THE TIME OF DRILLING. 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);
   WSS = WATER SOLUBLE SULFATES (%) (CP-L 2103);
   A-1-b (0) = AASHTO CLASSIFICATION (GROUP INDEX) (AASHTO M 145);
   R = HVEEM R-VALUE (AT 300 psi) (ASTM D2844);
   OMC = OPTIMUM MOISTURE CONTENT (%) (ASTM D1557);
   MDD = MAXIMUM DRY DENSITY (pcf) (ASTM D1557).



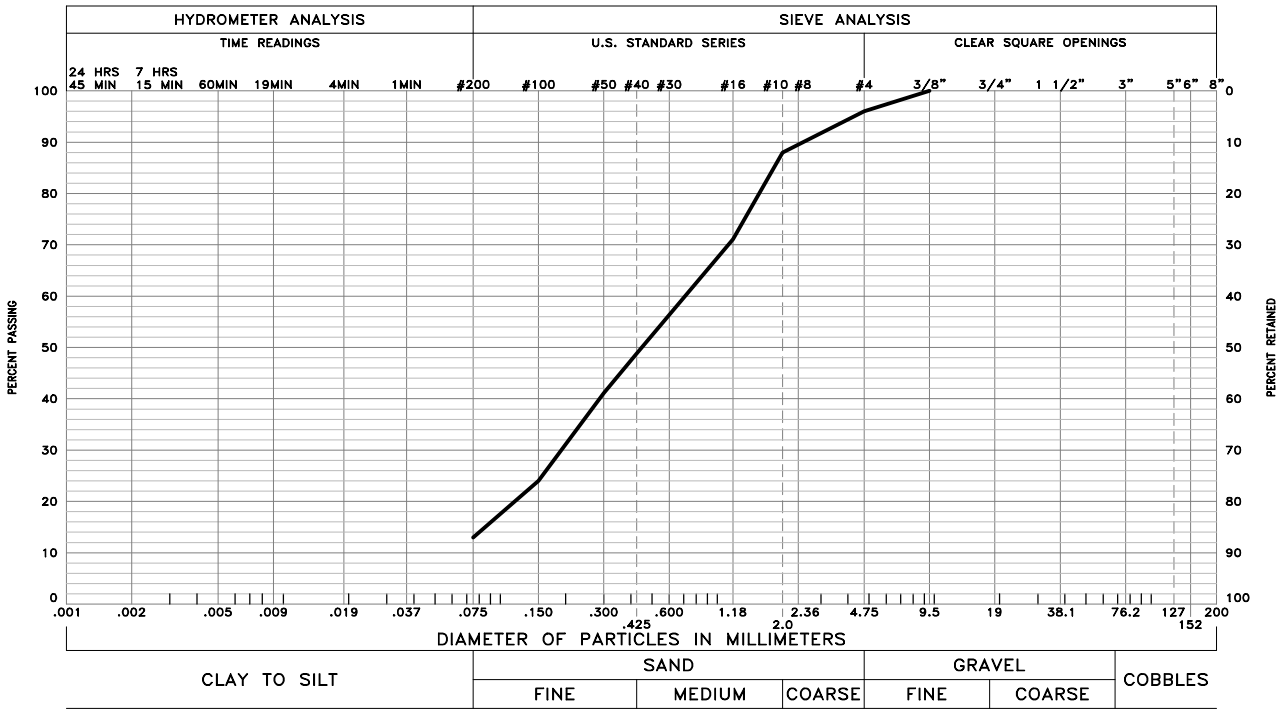


22-2-131	Kumar & Associates	SWELL-CONSOLIDATION TEST RESULTS	Fig. 4





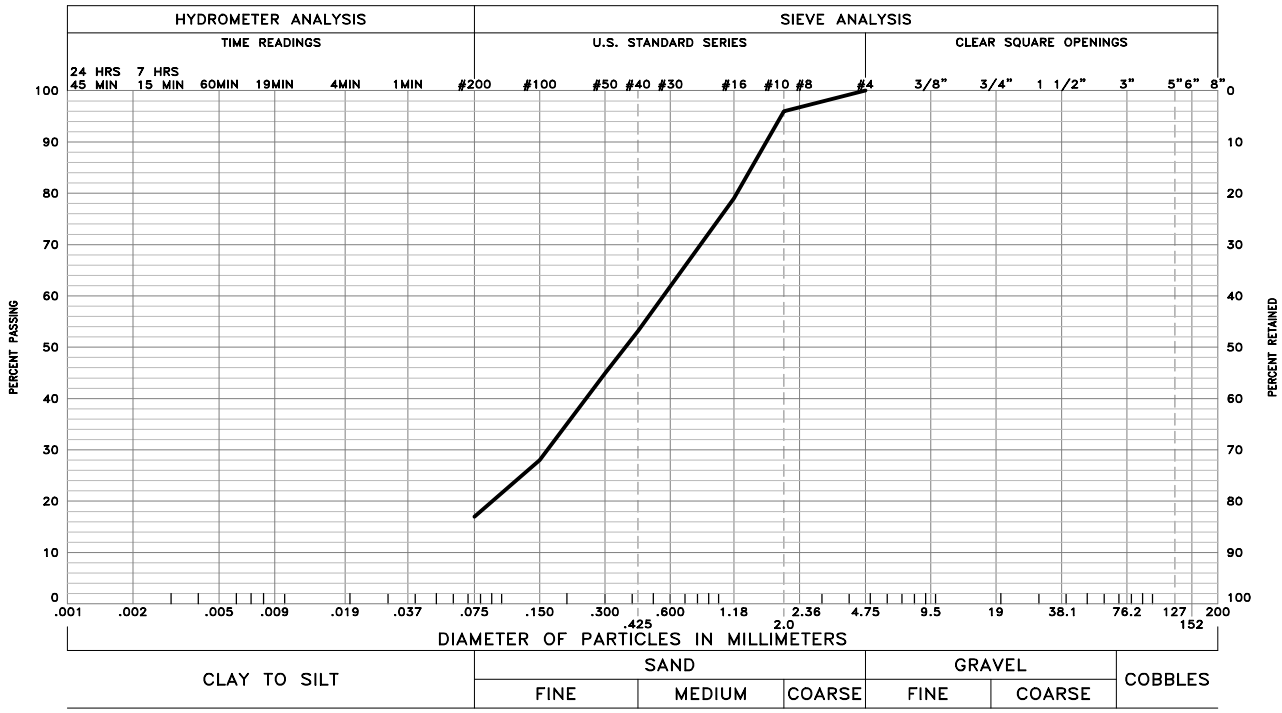
22-2-131	Kumar & Associates	SWELL-CONSOLIDATION TEST RESULTS	Fig. 5



GRAVEL 4 % SAND 83 % SILT AND CLAY 13 %

LIQUID LIMIT PLASTICITY INDEX NP

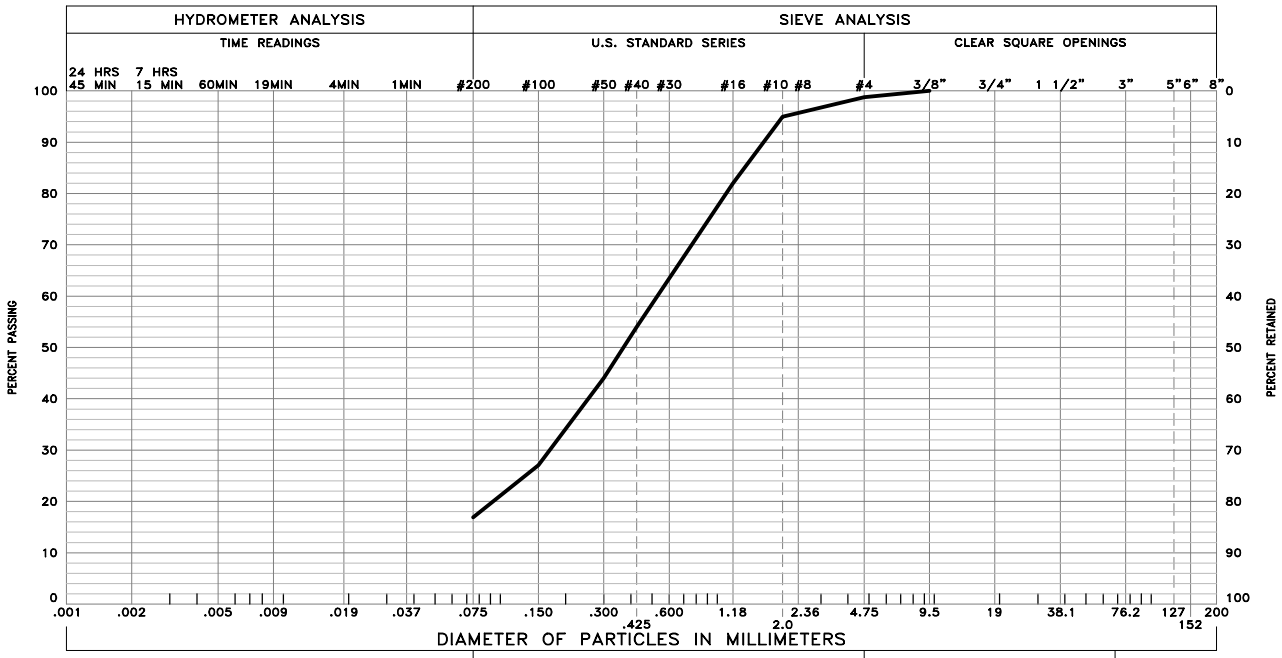
SAMPLE OF: Fill: Silty Sand (SM) FROM: Boring 1 @ 0–4'



GRAVEL 0 % SAND 83 % SILT AND CLAY 17 %

LIQUID LIMIT PLASTICITY INDEX NP

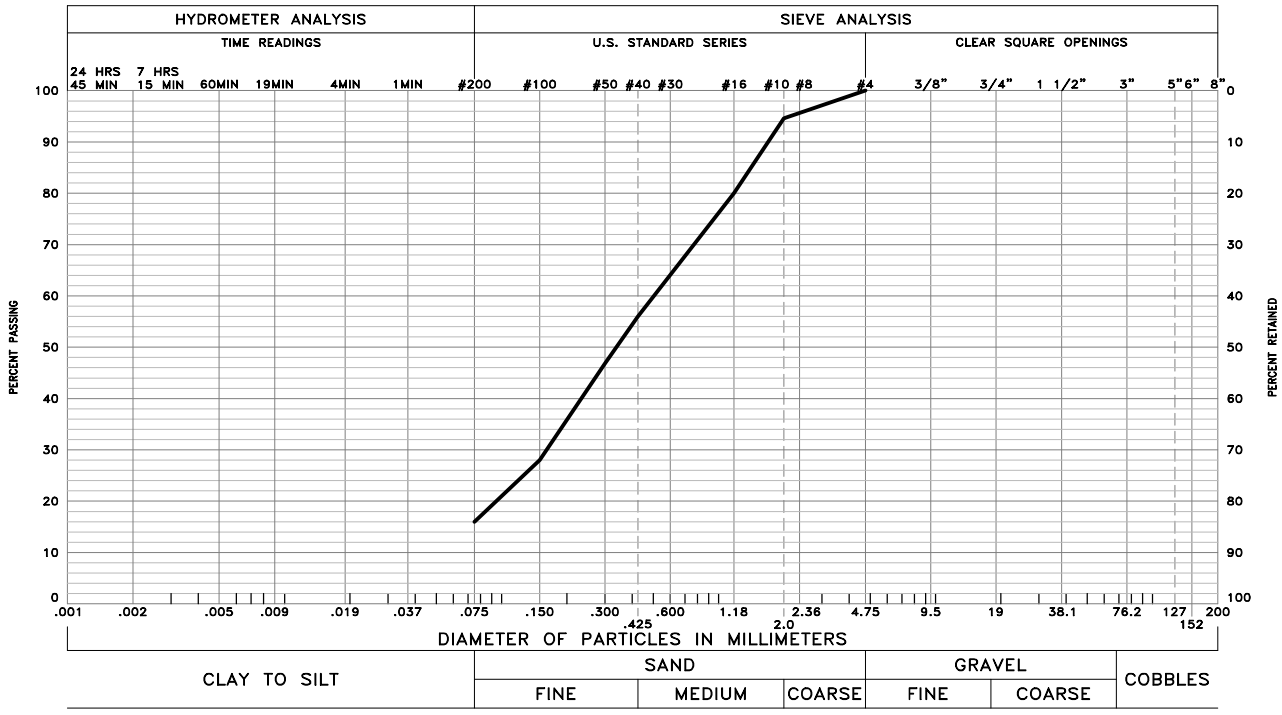
SAMPLE OF: Fill: Silty Sand (SM) FROM: Boring 2 @ 2'–4'



GRAVEL 1 % SAND 82 % SILT AND CLAY 17 %

LIQUID LIMIT PLASTICITY INDEX NP

SAMPLE OF: Fill: Silty Sand (SM) FROM: Boring 4 @ 0–3'

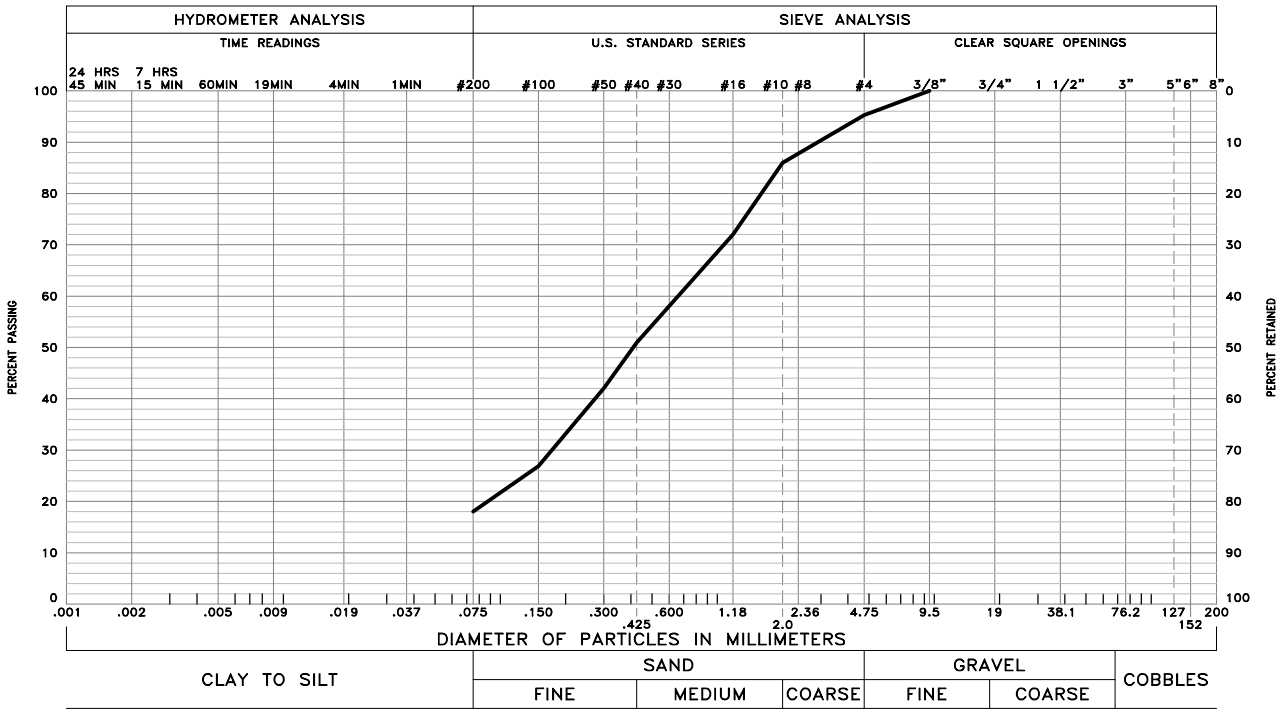


GRAVEL 0 % SAND 84 % SILT AND CLAY 16 %

LIQUID LIMIT PLASTICITY INDEX NP

SAMPLE OF: Fill: Silty Sand (SM) FROM: Boring 5 @ 1'–4'

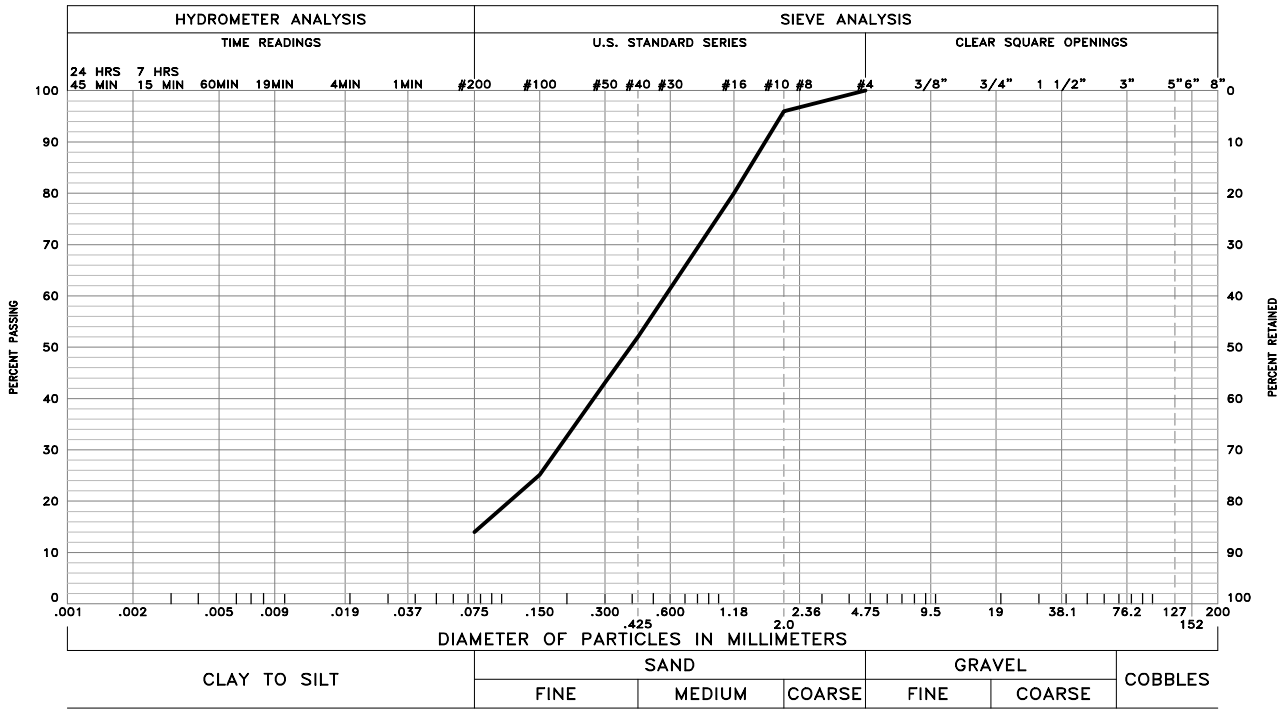
22–2–131	Kumar & Associates	GRADATION TEST RESULTS	Fig. 7



GRAVEL 5 % SAND 77 % SILT AND CLAY 18 %

LIQUID LIMIT PLASTICITY INDEX NP

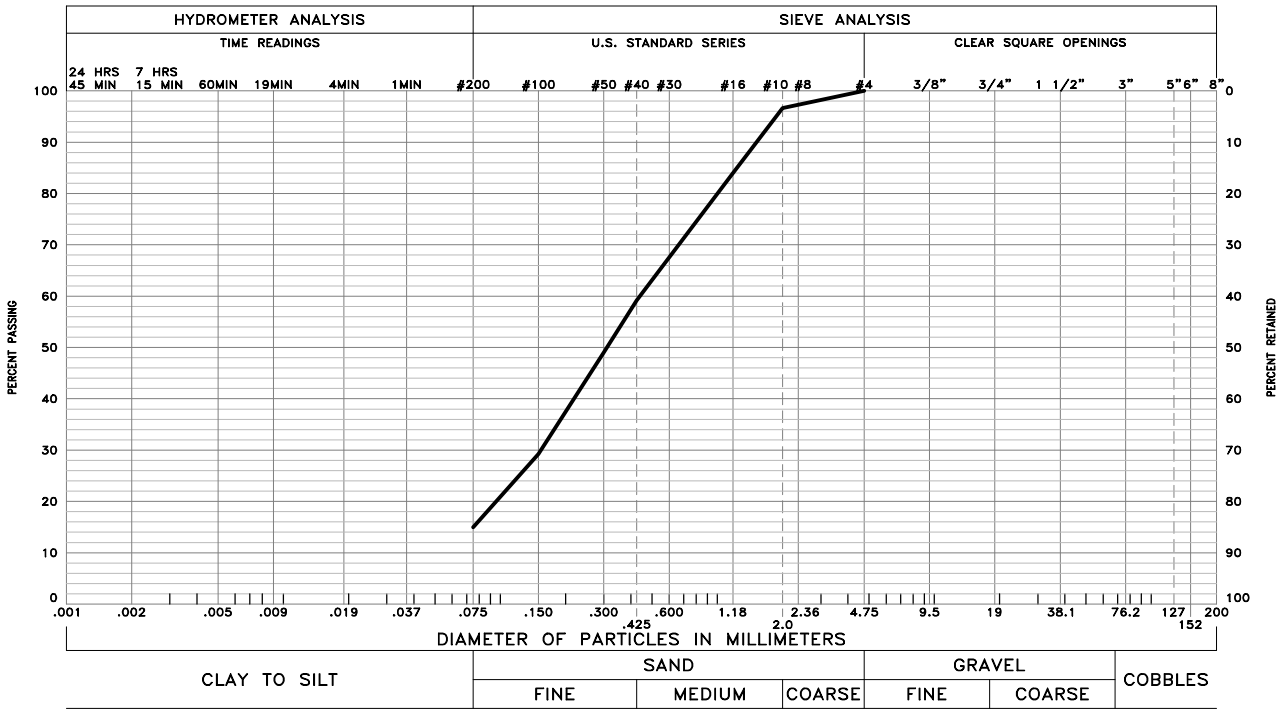
SAMPLE OF: Fill: Silty Sand (SM) FROM: Boring 7 @ 0–5'



GRAVEL 0 % SAND 86 % SILT AND CLAY 14 %

LIQUID LIMIT PLASTICITY INDEX NP

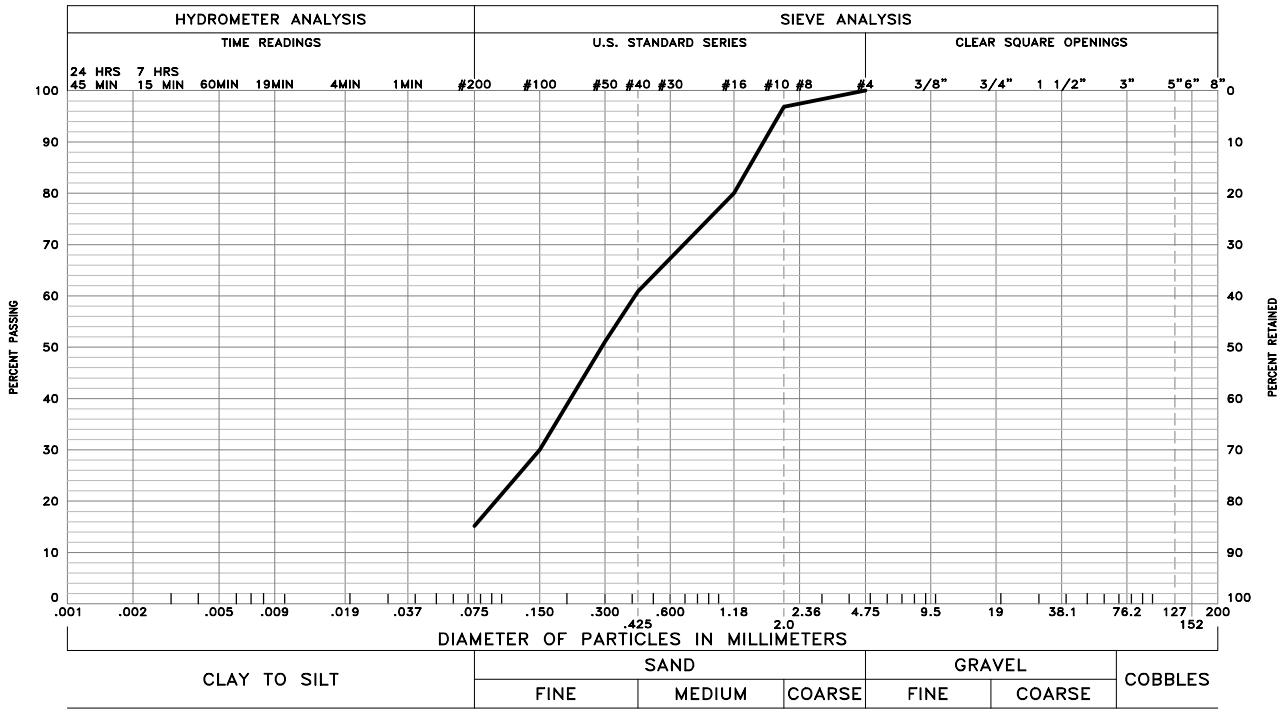
SAMPLE OF: Fill: Silty Sand (SM) FROM: Boring 8 @ 1'–4'



GRAVEL 0 % SAND 85 % SILT AND CLAY 15 %

LIQUID LIMIT PLASTICITY INDEX NP

SAMPLE OF: Fill: Silty Sand (SM) FROM: Boring 10 @ 1'–4'

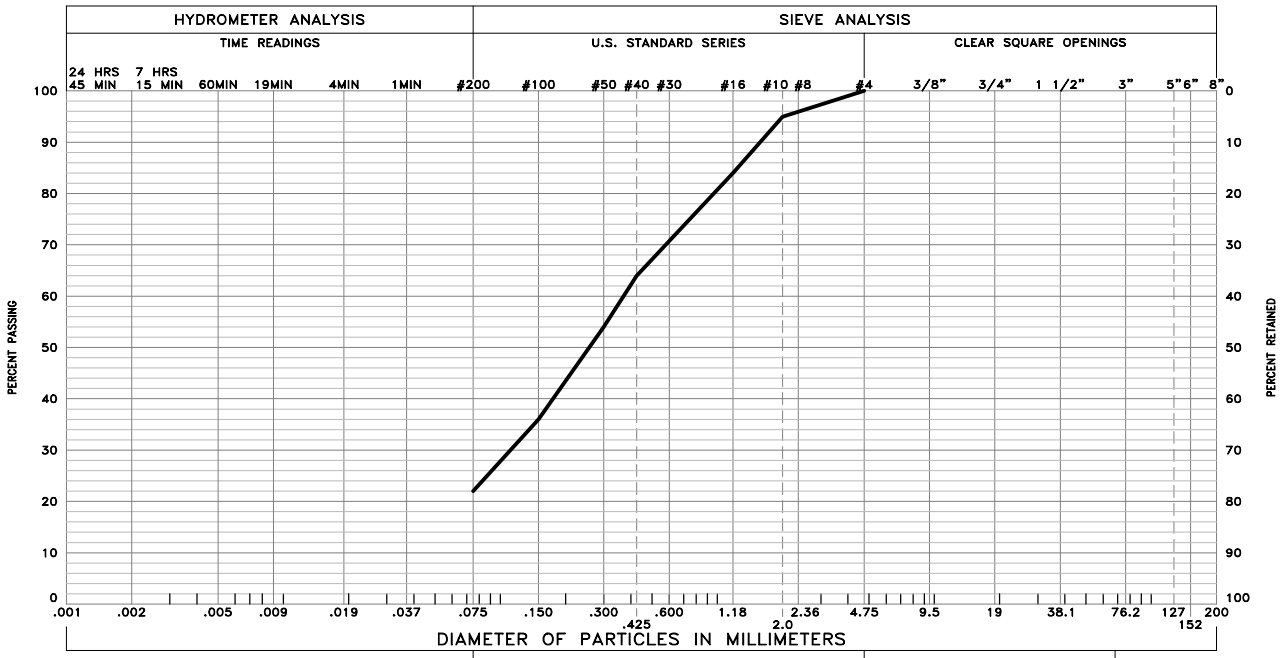


GRAVEL 0 % SAND 85 % SILT AND CLAY 15 %

LIQUID LIMIT PLASTICITY INDEX NP

SAMPLE OF: Fill: Silty Sand (SM) FROM: Boring 11 @ .5'–4'

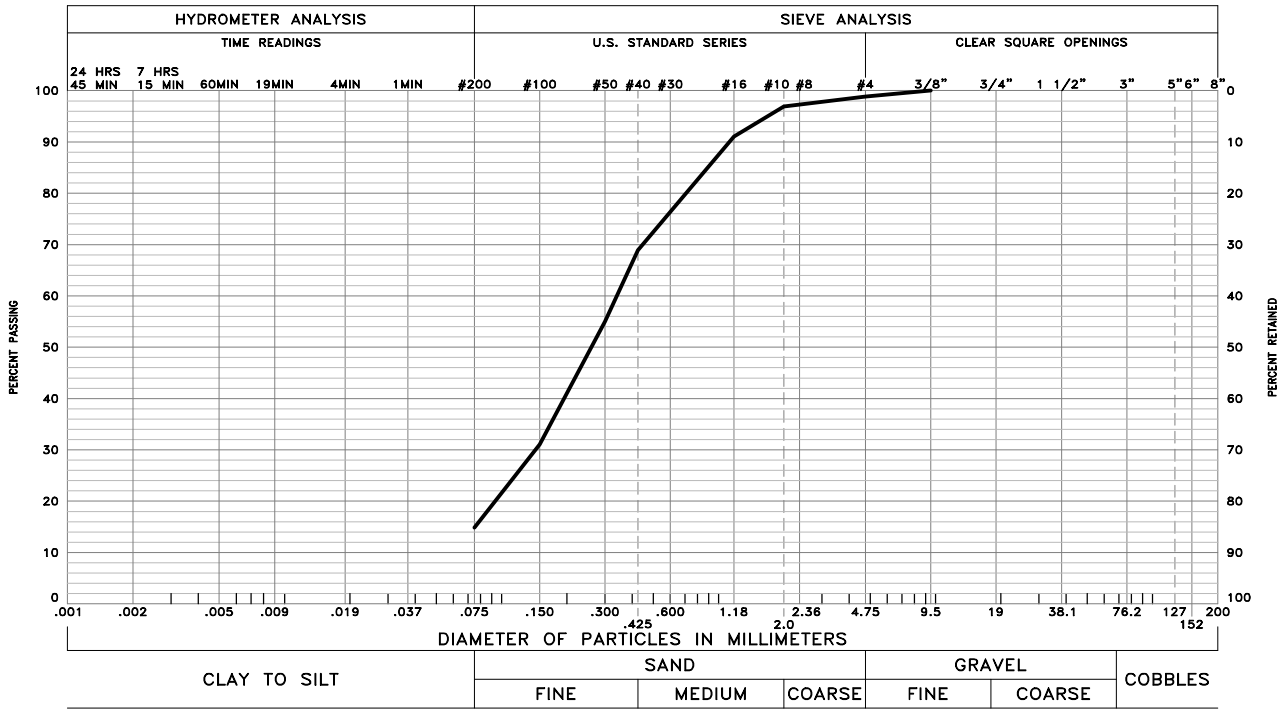
22–2–131	Kumar & Associates	GRADATION TEST RESULTS	Fig. 9



GRAVEL 0 % SAND 78 % SILT AND CLAY 22 %

LIQUID LIMIT PLASTICITY INDEX NP

SAMPLE OF: Fill: Silty Sand (SM) FROM: Boring 12 @ 0–3'

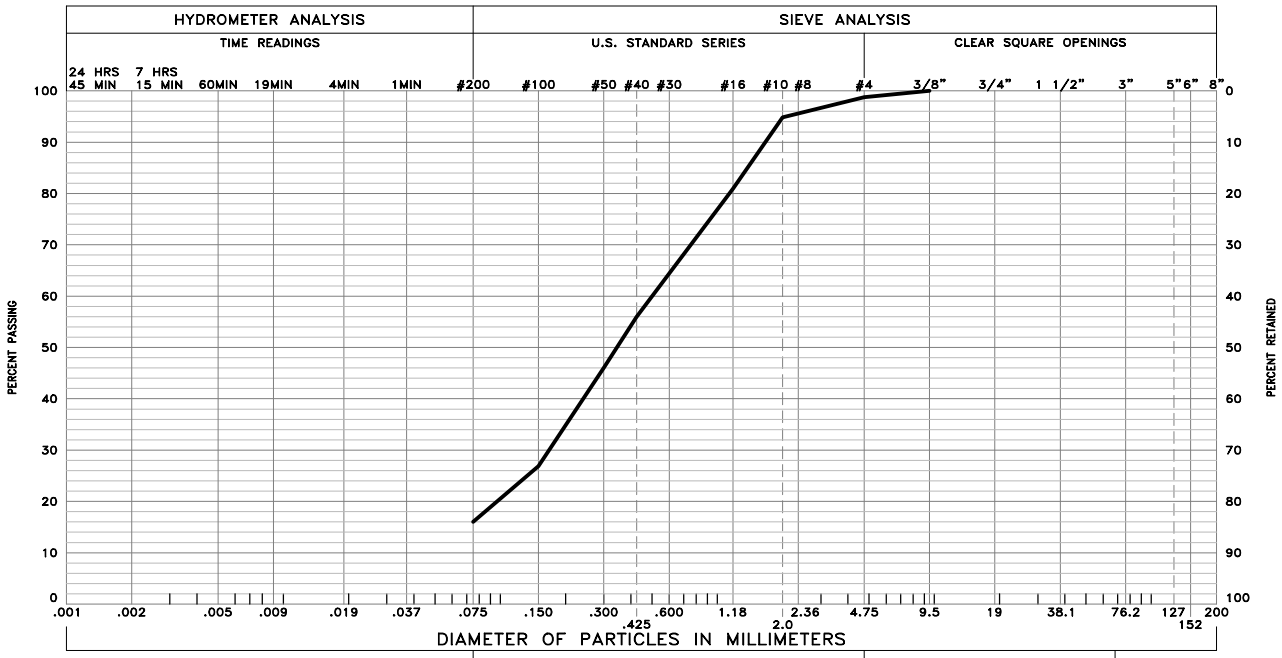


GRAVEL 1 % SAND 84 % SILT AND CLAY 15 %

LIQUID LIMIT PLASTICITY INDEX NP

SAMPLE OF: Fill: Silty Sand (SM) FROM: Boring 13 @ 0–3'

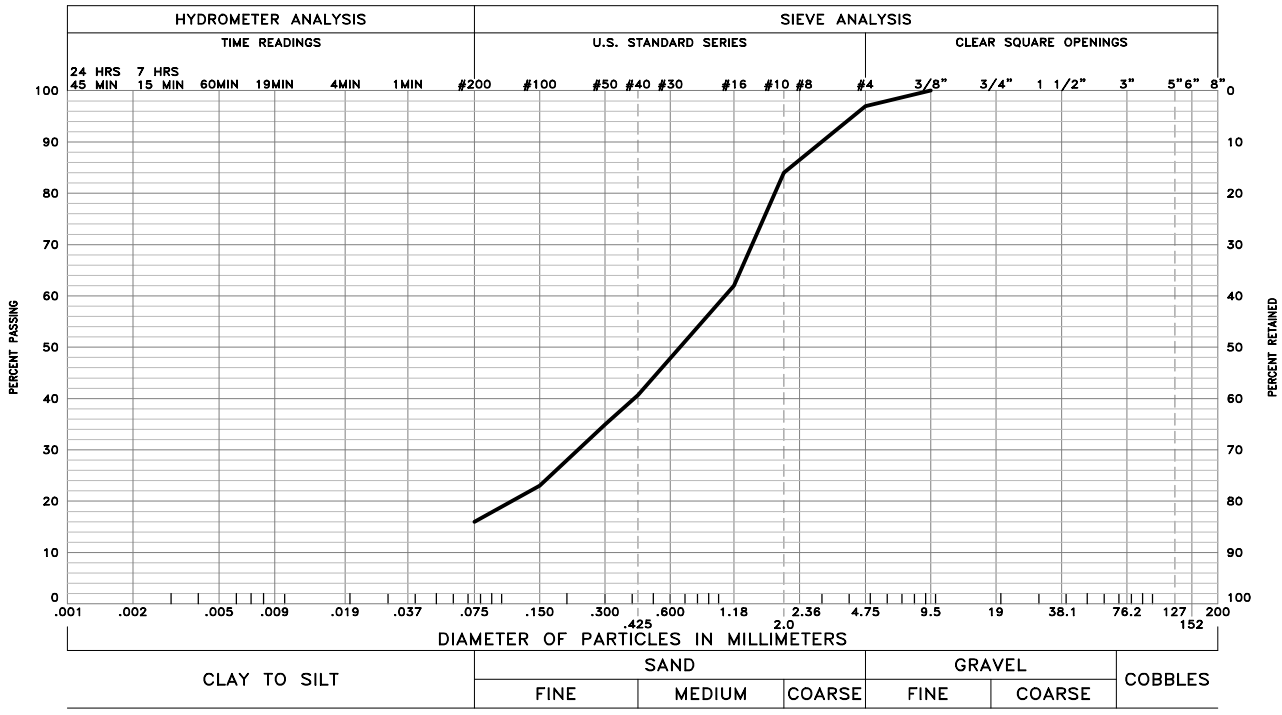
22–2–131	Kumar & Associates	GRADATION TEST RESULTS	Fig. 10



GRAVEL 1 % SAND 83 % SILT AND CLAY 16 %

LIQUID LIMIT PLASTICITY INDEX NP

SAMPLE OF: Fill: Silty Sand (SM) FROM: Boring 17 @ 1'–4'

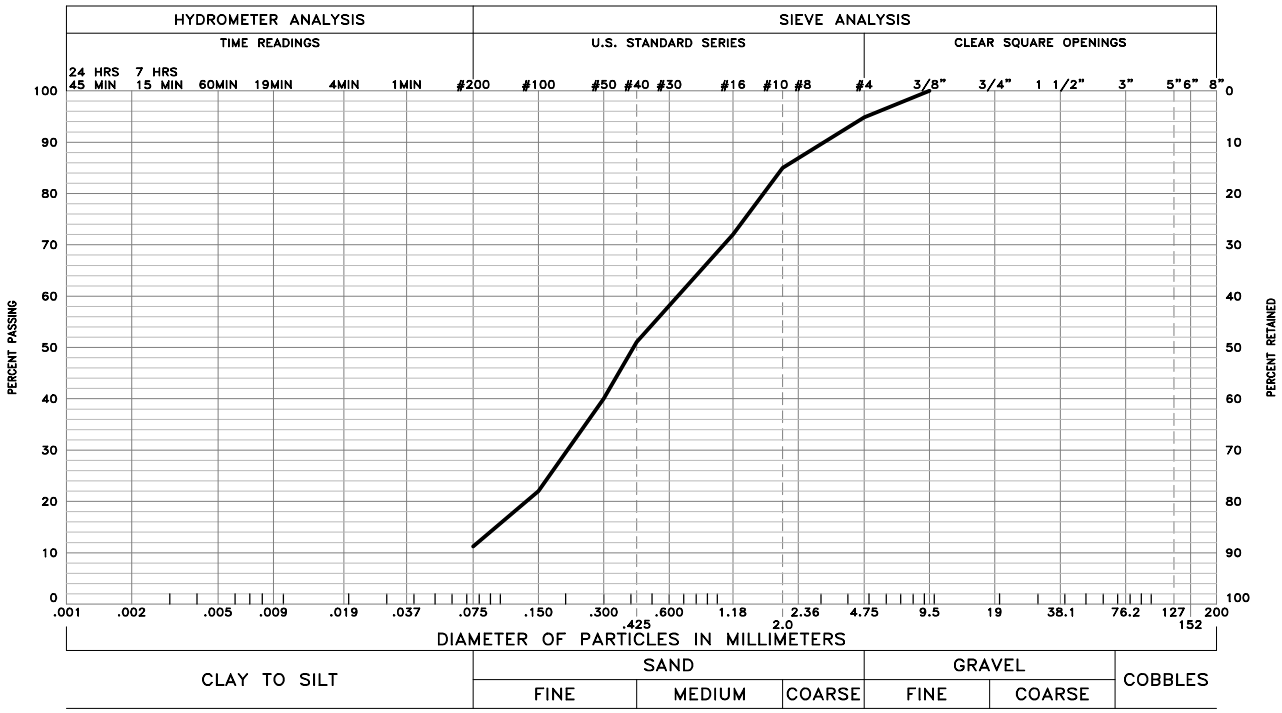


GRAVEL 3 % SAND 81 % SILT AND CLAY 16 %

LIQUID LIMIT PLASTICITY INDEX NP

SAMPLE OF: Fill: Silty Sand (SM) FROM: Boring 18 @ .5'–4'

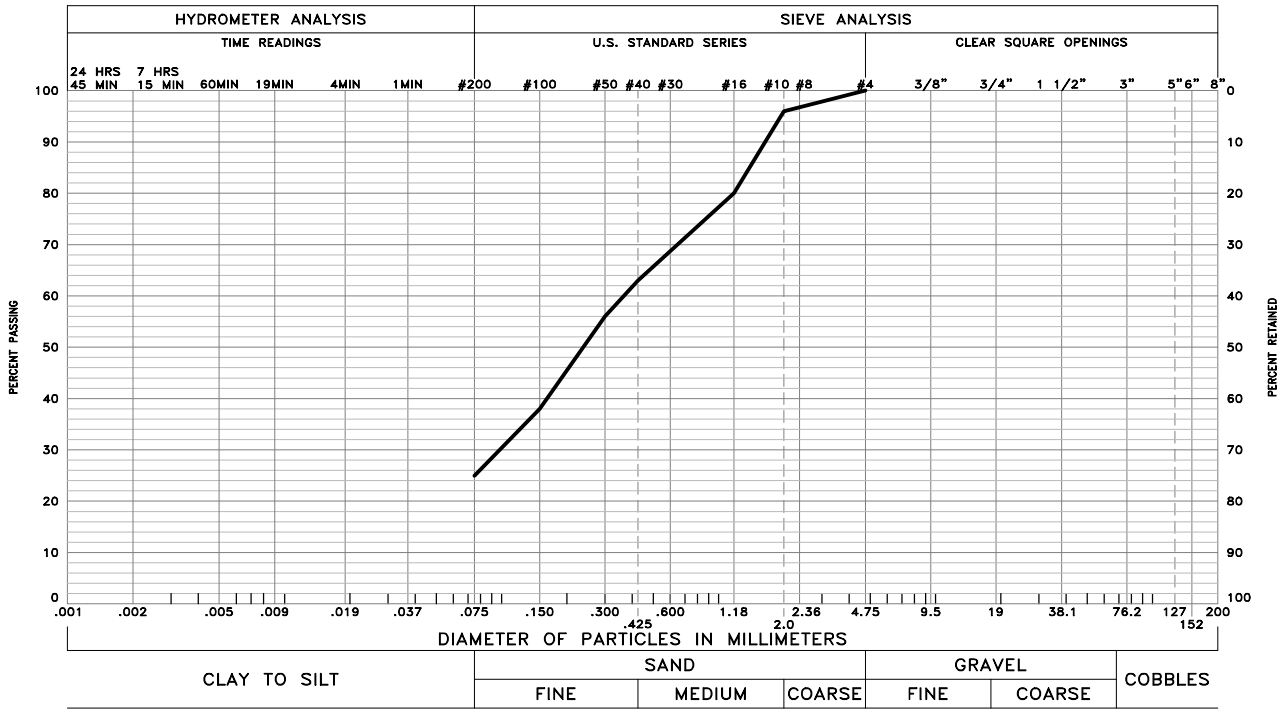
22–2–131	Kumar & Associates	GRADATION TEST RESULTS	Fig. 11



GRAVEL 5 % SAND 84 % SILT AND CLAY 11 %

LIQUID LIMIT PLASTICITY INDEX NP

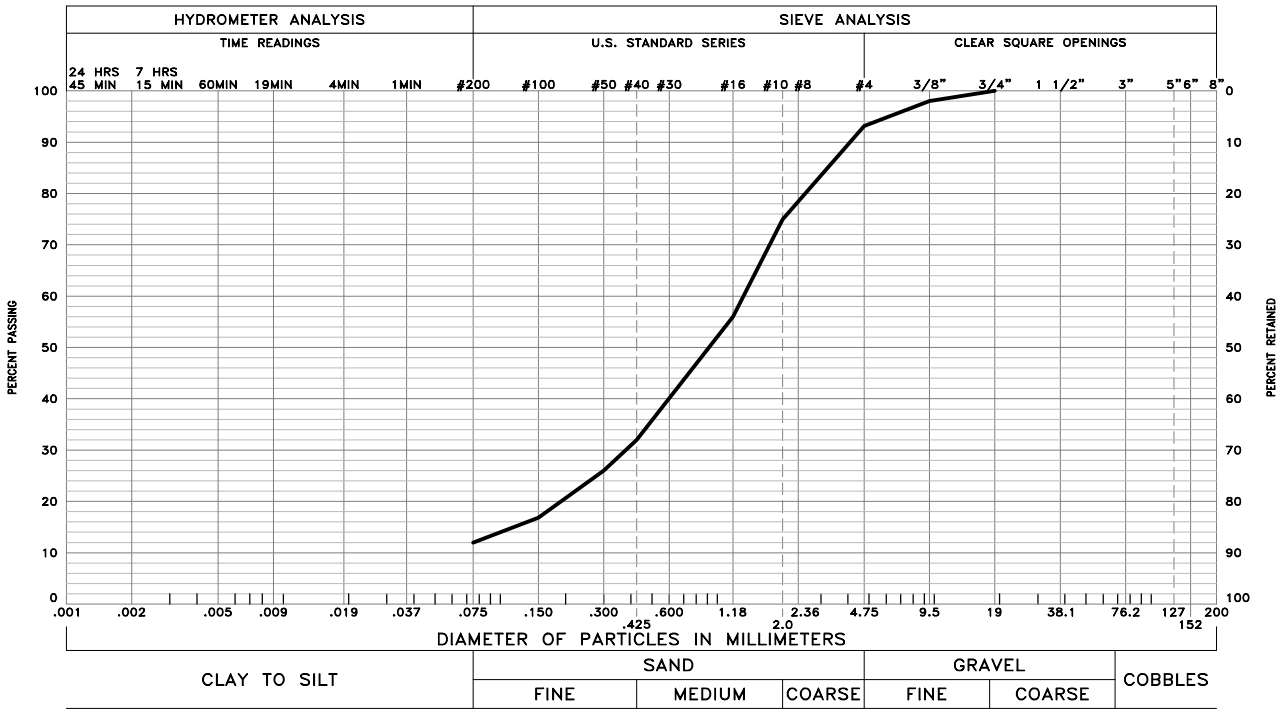
SAMPLE OF: Fill: Poorly Graded Sand with Silt (SP-SM) FROM: Boring 20 @ .5'-5'



GRAVEL 0 % SAND 75 % SILT AND CLAY 25 %

LIQUID LIMIT PLASTICITY INDEX NP

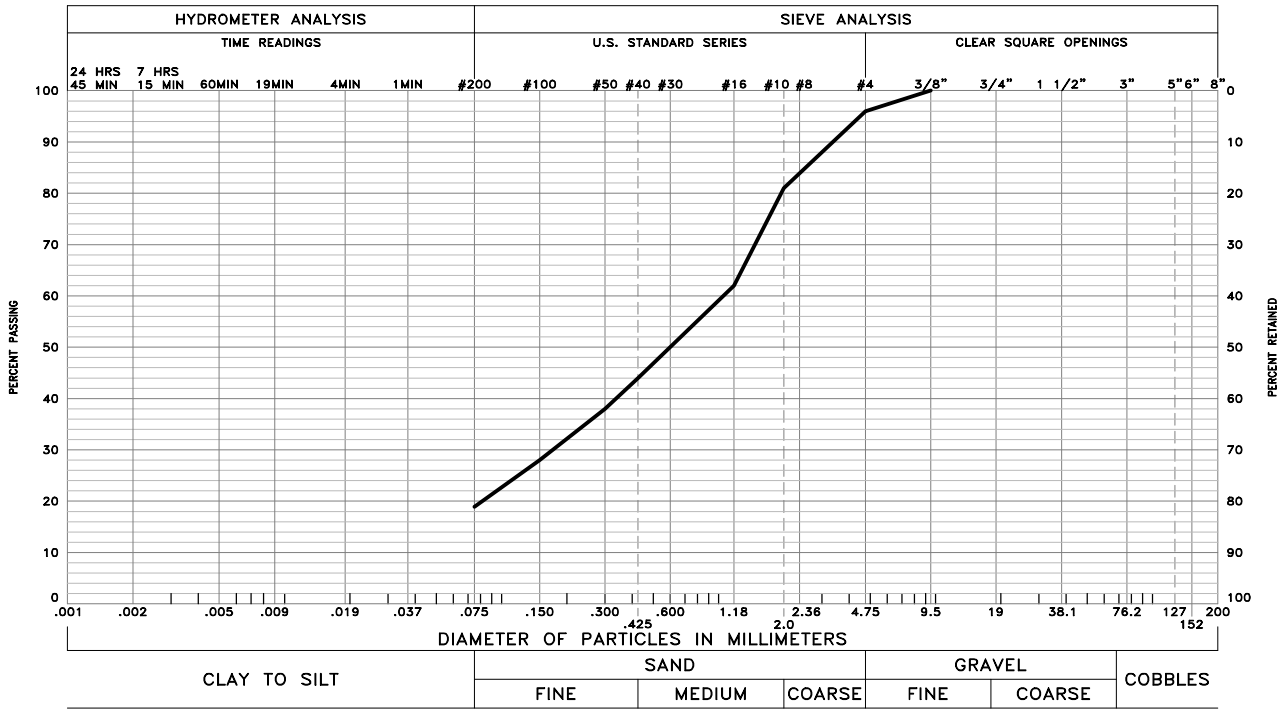
SAMPLE OF: Fill: Silty Sand (SM) FROM: Boring 21 @ 0-4'



GRAVEL 7 % SAND 81 % SILT AND CLAY 12 %

LIQUID LIMIT PLASTICITY INDEX NP

SAMPLE OF: Fill: Well Graded Sand with Silt (SW-SM) FROM: Boring 23 @ .5'-3.5'

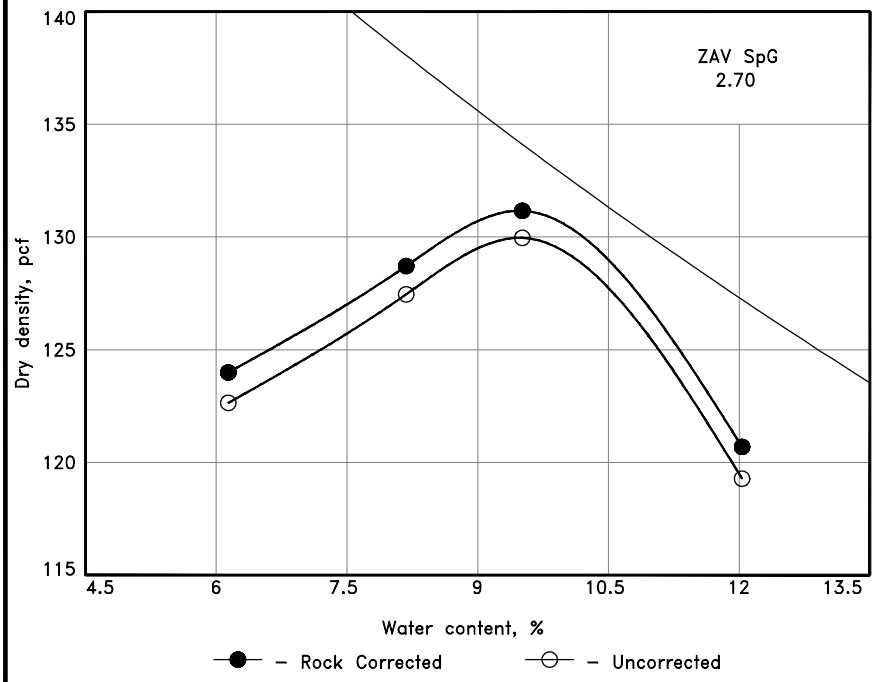


GRAVEL 4 % SAND 77 % SILT AND CLAY 19 %

LIQUID LIMIT PLASTICITY INDEX NP

SAMPLE OF: Fill: Silty Sand (SM) FROM: Boring 24 @ 1'-4'

COMPACTION TEST REPORT



Preparation Method	ASTM D 1557A
Rammer: Wt.	10 lb. Drop 18 in.
Type	
Layers: No.	five Blows per 25
Mold Size	0.03333 cu. ft.
Test Performed on Material Passing	#4 Sieve
%>#4	4 %<No.200 13
Atterberg (D 4318): LL	NV PI NP
NM (D 2216)	Sp.G. (D 854) 2.7
USCS (D 2487)	SM
AASHTO (M 145)	A-1-b
Date: Sampled	4/25/22
Received	
Tested	
Tested By	JEE

COMPACTION TESTING DATA
ASTM D 1557-12 Method A Modified
ASTM D4718-15 Oversize Corr. Applied to Each Test Point

	1	2	3	4	5	6
WM + WS	6306.7	6423.3	6490.5	6359.0		
WM	4338.8	4338.8	4338.8	4338.8		
WW + T #1	830.2	805.4	652.4	701.4		
WD + T #1	794.9	761.1	612.3	649.3		
TARE #1	219.9	219.5	190.7	216.3		
WW + T #2						
WD + T #2						
TARE #2						
MOIST.	6.1	8.2	9.5	12.0		
DRY DENS.	124.0	128.7	131.2	120.7		

SIEVE TEST RESULTS

Opening Size	% Passing	Specs.
3/8"	100	
#4	96	
#10	88	
#16	71	
#40	50	
#50	41	
#100	24	
#200	13	

ROCK CORRECTED TEST RESULTS	UNCORRECTED
Maximum dry density = 131.2 pcf	130.0 pcf
Optimum moisture = 9.5 %	9.5 %

Material Description

Fil: Silty Sand (SM)

Project No. 222-131 Client: Mayberry Community Authority c/o Development

Project: Mayberry Roadways – Balance Filing 1, 2 & 4

○ Location: Borings 1, 0-4' Sample Number: 1

Remarks:

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 and Associates, Inc. Moisture/density relationships performed in accordance with ASTM D698, D1557. Atterberg limits performed in accordance with ASTM D4318 sieve analysis performed in accordance with ASTM D422, D1140.

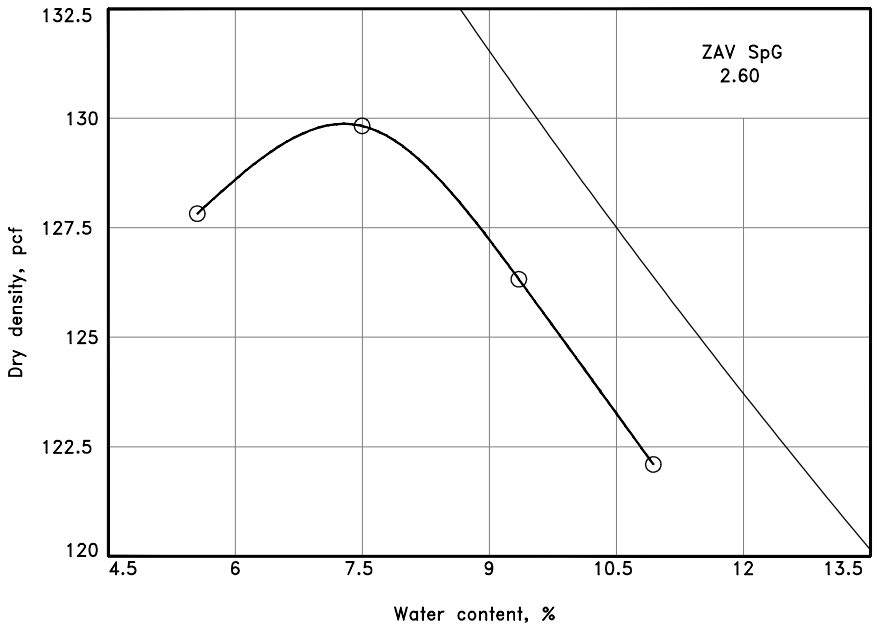
Checked by: DPC

Title: Project Manager

22-2-131	Kumar & Associates	MOISTURE-DENSITY RELATIONSHIPS	Fig. 14

May 09, 2022 - 02:50pm
V:\Projects\2022\22-2-131 Mayberry Roadways - Balance of Filing\Drafting\222131-14 to 15.dwg

COMPACTION TEST REPORT



Preparation Method	ASTM D 1557A
Rammer: Wt.	10 lb. Drop 18 in.
Type	
Layers: No.	five Blows per 25
Mold Size	0.03333 cu. ft.
Test Performed on Material Passing	#4 Sieve
%>#4	0 %<No.200 16
Atterberg (D 4318): LL	NV PI NP
NM (D 2216)	Sp.G. (D 854) 2.6
USCS (D 2487)	SM
AASHTO (M 145)	A-2-4(0)
Date: Sampled	4/27/22
Received	
Tested	
Tested By	JEE

COMPACTION TESTING DATA
ASTM D 1557-12 Method A Modified

	1	2	3	4	5	6
WM + WS	6379.1	6449.3	6427.7	6387.1		
WM	4339.4	4339.4	4339.4	4339.4		
WW + T #1	927.3	1253.8	761.9	777.5		
WD + T #1	888.5	1181.8	715.7	719.5		
TARE #1	189.4	221.3	221.4	189.1		
WW + T #2						
WD + T #2						
TARE #2						
MOIST.	5.5	7.5	9.3	10.9		
DRY DENS.	127.8	129.8	126.3	122.1		

SIEVE TEST RESULTS

Opening Size	% Passing	Specs.
3/8"	100	
#4	100	
#10	95	
#16	80	
#40	56	
#50	47	
#100	28	
#200	16	

TEST RESULTS

Maximum dry density = 129.9 pcf

Optimum moisture = 7.3 %

Material Description

Fill: Silty Sand (SM)

Project No. 222-131 Client: Mayberry Community Authority c/o Development

Project: Mayberry Roadways - Balance Filing 1, 2 & 4

○ Location: Borings 5, 1-4' Sample Number: 2

Remarks:

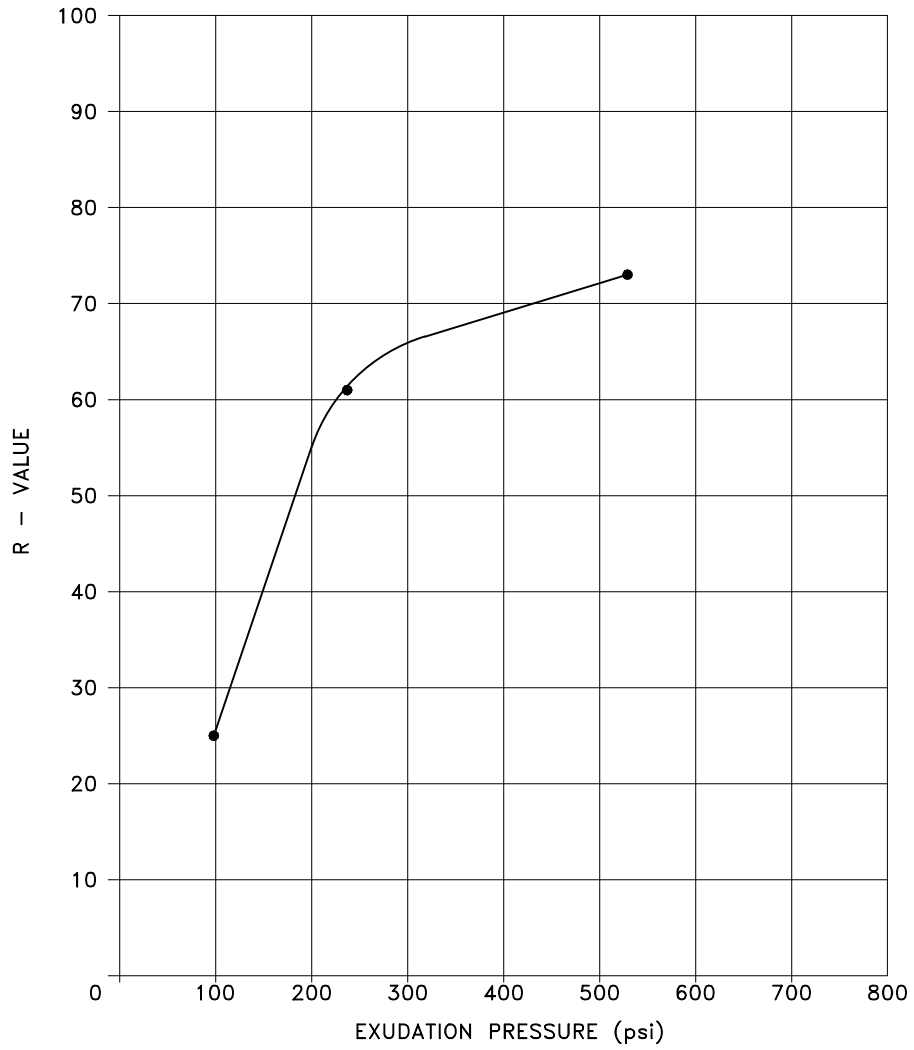
These test results apply only to the samples which were tested. the testing report shall not be reproduced, except in full, without the written approval of Kumar and Associates, Inc. Moisture/density relationships performed in accordance with ASTM D698, D1557. Atterberg limits performed in accordance with ASTM D4318 sieve analysis performed in accordance with ASTM D422, D1140.

Checked by: DPC

Title: Project Manager

22-2-131	Kumar & Associates	MOISTURE-DENSITY RELATIONSHIPS	Fig. 15

TEST SPECIMEN	1	2	3	4	R –VALUE (300 psi)
MOISTURE CONTENT (%)	10.3	9.5	8.6		
DENSITY (pcf)	125.8	130.7	131.8		
EXPANSION PRESSURE (psi)	0.000	0.000	0.000		
EXUDATION PRESSURE (psi)	98	237	529		
R VALUE	25	61	73		66



SOIL TYPE: Fill: Silty Sand (SM), A–2–4 (0)

LOCATION: Boring 7 @ 0–5'

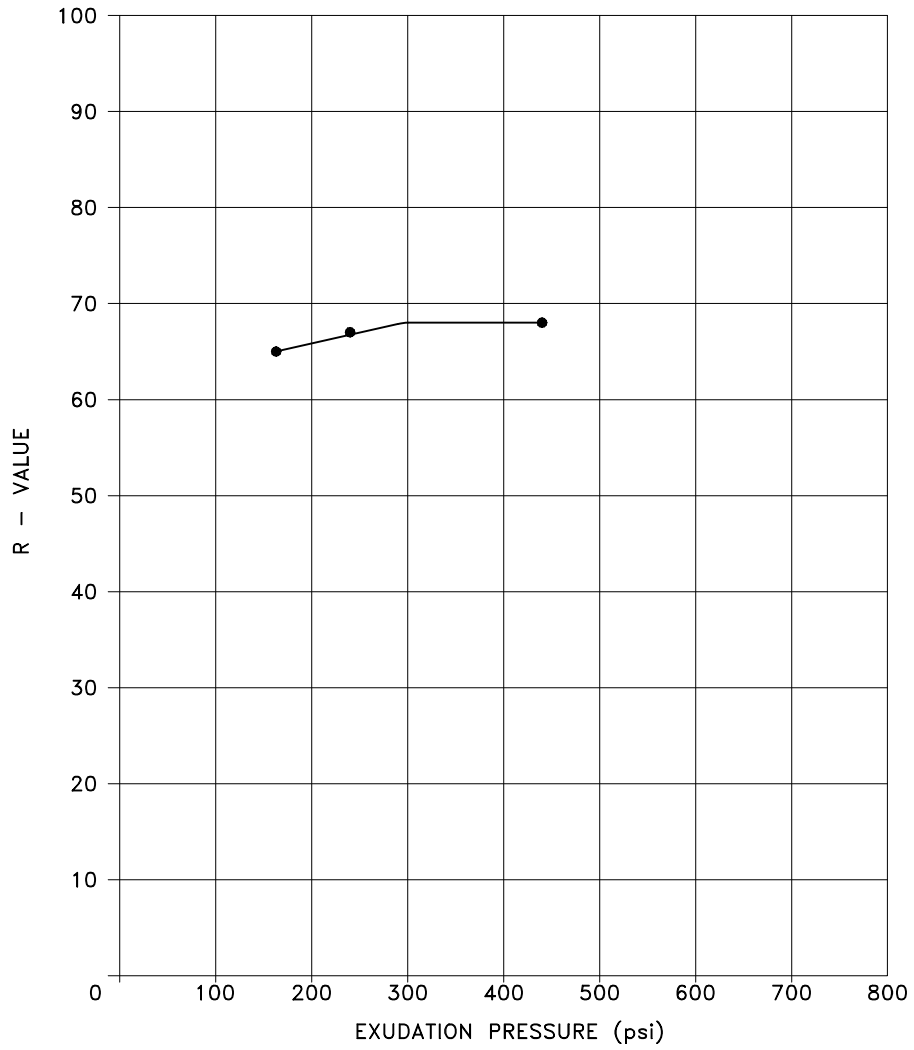
DATE SAMPLED: 04–07–22 DATE RECEIVED: 04–25–22 DATE TESTED: 04–29–22

GRAVEL: 5 % SAND: 77 % SILT AND CLAY: 18 %

LIQUID LIMIT: _____ PLASTICITY INDEX: NP

22–2–131	Kumar & Associates	HVEEM STABILOMETER TEST RESULTS	Fig. 16

TEST SPECIMEN	1	2	3	4	R -VALUE (300 psi)
MOISTURE CONTENT (%)	10.8	10.0	9.1		
DENSITY (pcf)	121.3	121.4	121.9		
EXPANSION PRESSURE (psi)	0.000	0.000	0.000		
EXUDATION PRESSURE (psi)	163	240	440		
R VALUE	65	67	68		68



SOIL TYPE: Fill: Silty Sand (SM), A-2-4 (0)

LOCATION: Boring 1 @ 0.5'-4'

DATE SAMPLED: 04-07-22 DATE RECEIVED: 04-25-22 DATE TESTED: 05-02-2022

GRAVEL: 0 % SAND: 85 % SILT AND CLAY: 15 %

LIQUID LIMIT: _____ PLASTICITY INDEX: NP

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. R-value performed in accordance with ASTM D2844. Atterberg limits performed in accordance with ASTM D4318. Sieve analyses performed in accordance with ASTM D422, D1140.

22-2-131	Kumar & Associates	HVEEM STABILOMETER TEST RESULTS	Fig. 17

Kumar and Associates, Inc.

TABLE I

SUMMARY OF LABORATORY TEST RESULTS

Project No.: 222-131
Project Name: Mayberry
Date Sampled: 4/7/22 & 4/8/22
Date Received: 4/11/22

SAMPLE LOCATION		DATE TESTED	NATURAL MOISTURE CONTENT (%)	NATURAL DRY DENSITY (pcf)	GRADATION		PERCENT PASSING NO. 200 SIEVE	ATTERBERG LIMITS		WATER SOLUBLE SULFATES (%)	R-VALUE	MODIFIED PROCTOR (ASTM D 1557)		AASHTO CLASSIFICATION (Group Index)	SOIL OR BEDROCK TYPE (Unified Soil Classification)
BORING	DEPTH (ft)				GRAVEL (%)	SAND (%)		LIQUID LIMIT	PLASTICITY INDEX			MAX DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)		
1	0-4	4/22/22			4	83	13		NP			131.2	9.5	A-1-b (0)	Fill: Silty Sand (SM)
1	2	4/22/22	3.3	116.2											Fill: Silty Sand (SM)
2	2-4	4/22/22			0	83	17		NP					A-2-4 (0)	Fill: Silty Sand (SM)
2	2	4/22/22	6.0	116.0											Fill: Silty Sand (SM)
3	1-4	4/22/22					19		NP					A-1-b (0)	Fill: Silty Sand (SM)
3	2	4/22/22	7.1	127.5						0.01					Fill: Silty Sand (SM)
4	0-3	4/22/22			1	82	17		NP					A-2-4 (0)	Fill: Silty Sand (SM)
4	2	4/22/22	6.0	118.6											Fill: Silty Sand (SM)
5	1-4	4/22/22			0	84	16		NP			129.9	7.3	A-2-4 (0)	Fill: Silty Sand (SM)
5	2	4/22/22	4.0	118.9											Fill: Silty Sand (SM)
6	0.5-5						15		NP					A-1-a (0)	Fill: Silty Sand (SM)
6	2	4/22/22	8.1	101.9											Fill: Silty Sand (SM)
7	0-5	4/22/22			5	77	18		NP		66			A-2-4 (0)	Fill: Silty Sand (SM)
7	4	4/22/22	3.4	120.3											Fill: Silty Sand (SM)
8	1-4	4/22/22			0	86	14		NP					A-2-4 (0)	Fill: Silty Sand (SM)
8	4	4/22/22	3.6	115.2											Fill: Silty Sand (SM)
9	1-4	4/22/22					18		NP					A-1-b (0)	Fill: Silty Sand (SM)
9	2	4/22/22	4.5	108.3											Fill: Silty Sand (SM)

Kumar and Associates, Inc.

TABLE I

SUMMARY OF LABORATORY TEST RESULTS

Project No.: 222-131
Project Name: Mayberry
Date Sampled: 4/7/22 & 4/8/22
Date Received: 4/11/22

SAMPLE LOCATION		DATE TESTED	NATURAL MOISTURE CONTENT (%)	NATURAL DRY DENSITY (pcf)	GRADATION		PERCENT PASSING NO. 200 SIEVE	ATTERBERG LIMITS		WATER SOLUBLE SULFATES (%)	R-VALUE	MODIFIED PROCTOR (ASTM D 1557)		AASHTO CLASSIFICATION (Group Index)	SOIL OR BEDROCK TYPE (Unified Soil Classification)
BORING	DEPTH (ft)				GRAVEL (%)	SAND (%)		LIQUID LIMIT	PLASTICITY INDEX			MAX DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)		
10	1-4	4/22/22			0	85	15		NP					A-2-4 (0)	Fill: Silty Sand (SM)
10	4	4/22/22	6.0	108.3											Fill: Silty Sand (SM)
11	0.5-4	4/22/22			0	85	15		NP	0.01	68			A-2-4 (0)	Fill: Silty Sand (SM)
11	2	4/22/22	1.9	106.8											Fill: Silty Sand (SM)
12	0-3	4/22/22			0	78	22		NP					A-2-4 (0)	Fill: Silty Sand (SM)
12	2	4/22/22	6.7	117.2											Fill: Silty Sand (SM)
13	0-3	4/22/22			1	84	15		NP					A-2-4 (0)	Fill: Silty Sand (SM)
13	2	4/22/22	6.3	112.0											Fill: Silty Sand (SM)
14	0.5-4	4/22/22					12		NP					A-1-a (0)	Fill: Poorly Graded Sand with Silt (SP-SM)
14	4	4/22/22	3.5	103.1											Fill: Poorly Graded Sand with Silt (SP-SM)
15	0.5-4	4/22/22					23	19	2					A-1-b (0)	Fill: Silty Sand (SM)
15	2	4/22/22	9.0	118.6											Fill: Clayey Sand (SC)
16	1-4	4/22/22					17		NP					A-1-b (0)	Fill: Silty Sand (SM)
16	2	4/22/22	8.3	120.1						0.01					Fill: Silty Sand (SM)
17	1-4	4/22/22			1	83	16		NP					A-2-4 (0)	Fill: Silty Sand (SM)
17	2	4/22/22	4.6	122.4											Fill: Silty Sand (SM)
18	0.5-4	4/22/22			3	81	16		NP					A-1-b (0)	Fill: Silty Sand (SM)

Kumar and Associates, Inc.

TABLE I

SUMMARY OF LABORATORY TEST RESULTS

Project No.: 222-131
Project Name: Mayberry
Date Sampled: 4/7/22 & 4/8/22
Date Received: 4/11/22

SAMPLE LOCATION		DATE TESTED	NATURAL MOISTURE CONTENT (%)	NATURAL DRY DENSITY (pcf)	GRADATION		PERCENT PASSING NO. 200 SIEVE	ATTERBERG LIMITS		WATER SOLUBLE SULFATES (%)	R-VALUE	MODIFIED PROCTOR (ASTM D 1557)		AASHTO CLASSIFICATION (Group Index)	SOIL OR BEDROCK TYPE (Unified Soil Classification)
BORING	DEPTH (ft)				GRAVEL (%)	SAND (%)		LIQUID LIMIT	PLASTICITY INDEX			MAX DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)		
18	4	4/22/22	1.8	116.3											Fill: Silty Sand (SM)
19	0-4	4/22/22					15		NP					A-1-a (0)	Fill: Silty Sand (SM)
19	2	4/22/22	0.8	118.0											Fill: Silty Sand (SM)
20	0.5-5	4/22/22			5	84	11		NP					A-2-4 (0)	Fill: Poorly Graded Sand with Silt (SP-SM)
20	4	4/22/22	2.3	121.7						0.01					Fill: Poorly Graded Sand with Silt (SP-SM)
21	0-4	4/22/22			0	75	25		NP					A-2-4 (0)	Fill: Silty Sand (SM)
21	2	4/22/22	1.1	114.3											Fill: Silty Sand (SM)
22	0.5-4	4/22/22					21		NP					A-1-b (0)	Fill: Silty Sand (SM)
22	2	4/22/22	2.6	107.0											Fill: Silty Sand (SM)
23	0.5-3.5	4/22/22			7	81	12		NP					A-1-b (0)	Fill: Well Graded Sand with Silt (SW-SM)
23	2	4/22/22	3.0	106.3											Fill: Well Graded Sand with Silt (SW-SM)
24	1-4	4/22/22			4	77	19		NP					A-1-b (0)	Fill: Silty Sand (SM)
24	2	4/22/22	5.2	115.4											Fill: Silty Sand (SM)

APPENDIX

(Pavement Design Calculations)

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare Computer Software Product

Kumar & Associates
6735 Kumar Heights
Colorado Springs, CO 80918
USA

Flexible Structural Design Module

22-2-131
Urban Local
Composite HMA/ABC

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	292,000
Initial Serviceability	4.5
Terminal Serviceability	2
Reliability Level	80 %
Overall Standard Deviation	0.45
Roadbed Soil Resilient Modulus	13,168 psi
Stage Construction	1
Calculated Design Structural Number	2.07 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	HMA	0.44	1	3	-	1.32
2	ABC	0.12	1	8	-	0.96
Total	-	-	-	11.00	-	2.28

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare Computer Software Product

Kumar & Associates
6735 Kumar Heights
Colorado Springs, CO 80918
USA

Flexible Structural Design Module

22-2-131
Urban Residential Collector
Composite HMA/ABC

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	821,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	85 %
Overall Standard Deviation	0.45
Roadbed Soil Resilient Modulus	13,168 psi
Stage Construction	1
Calculated Design Structural Number	2.56 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	HMA	0.44	1	4	-	1.76
2	ABC	0.12	1	8	-	0.96
Total	-	-	-	12.00	-	2.72