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*APPROVED
Engineering Department
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dsdnijkamp
EPC Planning & Community
Development Department

*Approval does not include Village Main Street between New Log and Indian Grass (or any location where the new CD's may impact.

GEOTECHNICAL ENGINEERING STUDY
PROPOSED MAYBERRY FILING 1A ROADWAYS
EL PASO COUNTY, COLORADO

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EPC file no SF1825

Project No. 21-2-246

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SUMMARY

1. In general, the soils encountered consisted of about 1 to 2 feet of fill overlying native soils extending to the maximum explored depth of 10 feet. The fill consisted of silty sand and poorly to well-graded sand with silt and occasional gravel, and appeared to consist of reworked native soils. The underlying native soils were of a similar composition to the fill material but also included clayey sand with occasional clay lenses which were encountered beginning at depths of 4 to 7 feet.

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 Phase 1A roadways will classify as Urban Minor Arterial (New Log Road), Urban Non-Residential Collection (Village Main Street - west of Marketplace Drive), and Urban Local (Village Main Street – east of Marketplace Drive, Cattlemen Run, Marketplace Drive, Indian Grass Street, and Garden Park Drive). Referencing the default ESAL's for these classifications presented in the El Paso County Pavement Design Criteria Manual (ECM), design-life ESAL's of 1,971,000, 821,000 and 292,000 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 Minor Arterial	5 over 8
Urban Non-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 Filing 1A 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. C21-370, dated October 11, 2021, 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 4,000 LF of new roadway as shown on Fig. 1. The new roadway will include segments with Urban Minor Arterial, Urban Non-residential Collector and Urban Local traffic loading in accordance with a traffic study prepared by LSC Transportation Consultants Inc, dated October 22, 2021. 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 three quarters of a mile west of Log Road. The site itself was previously vacant and is presently being constructed as a new development, with roadway and utility installation occurring. 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 subject site are vacant with the exception of a 500,000-gallon water tank to the northwest/west of the site, and a 500,000-gallon water tank and booster pump station to the northeast/east of the site, both operated by Cherokee Metro Water District. The topography of the subject site generally slopes down to the east, with an approximate elevation difference of 20 feet across the site. 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 subject site 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 about 1 to 2 feet of fill overlying native soils extending to the maximum explored depth of 10 feet. The fill consisted of silty sand and poorly to well-graded sand with silt and occasional gravel, and appeared to consist of reworked native soils. The fill appeared dry to slightly moist, and was tan in color. The underlying native soils were of a similar composition to the fill material but also included clayey sand with occasional clay lenses which were encountered beginning at a depth between 4 and 7 feet. The native soils were loose to dense, dry to moist, and tan, brown and reddish-brown in color.

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 performed on selected samples obtained from the borings included the natural moisture content and dry density, gradation analysis, liquid and plastic limits, Hveem's stability testing (R-value), and water-soluble sulfate concentrations. The laboratory test results are shown adjacent to the boring logs on Fig. 2, plotted graphically on Figs. 4 through 9, 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 has been 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, a summary letter would be generated 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-b, A-2-4 and A-3 soils with a group index of 0 or 1. In general, these soil types are considered good for use as subgrade materials.

The Hveem's stabilometer test results (R-value) presented on Figs. 9 and 10 indicate R-values of 71 and 72 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 ensure it meets or exceeds the design R-value.

Design Traffic: Based on a traffic study prepared by LSC Transportation Consultants Inc dated October 22, 2021, we understand the Phase 1A roadways will classify as Urban Minor Arterial (New Log Road), Urban Non-Residential Collection (Village Main Street - west of Marketplace Drive), and Urban Local (Village Main Street – east of Marketplace Drive, Cattlemen Run, Marketplace Drive, Indian Grass Street, and Garden Park Drive). Referencing the default ESAL's for these classifications presented in the El Paso County Pavement Design Criteria Manual (ECM), design-life ESAL's of 1,971,000, 821,000 and 292,000 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.

Approval does not include Village Main Street between New Log and Indian Grass.

Pavement Section Recommendation	
Road Classification	Composite Asphalt over Aggregate Base Course (in.)
Urban Minor Arterial	5 over 8
Urban Non-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 accurately represented 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 concentrations of water soluble sulfates measured in representative samples obtained from the exploratory borings were less than 0.01 percent. These concentrations of water soluble sulfates represent 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

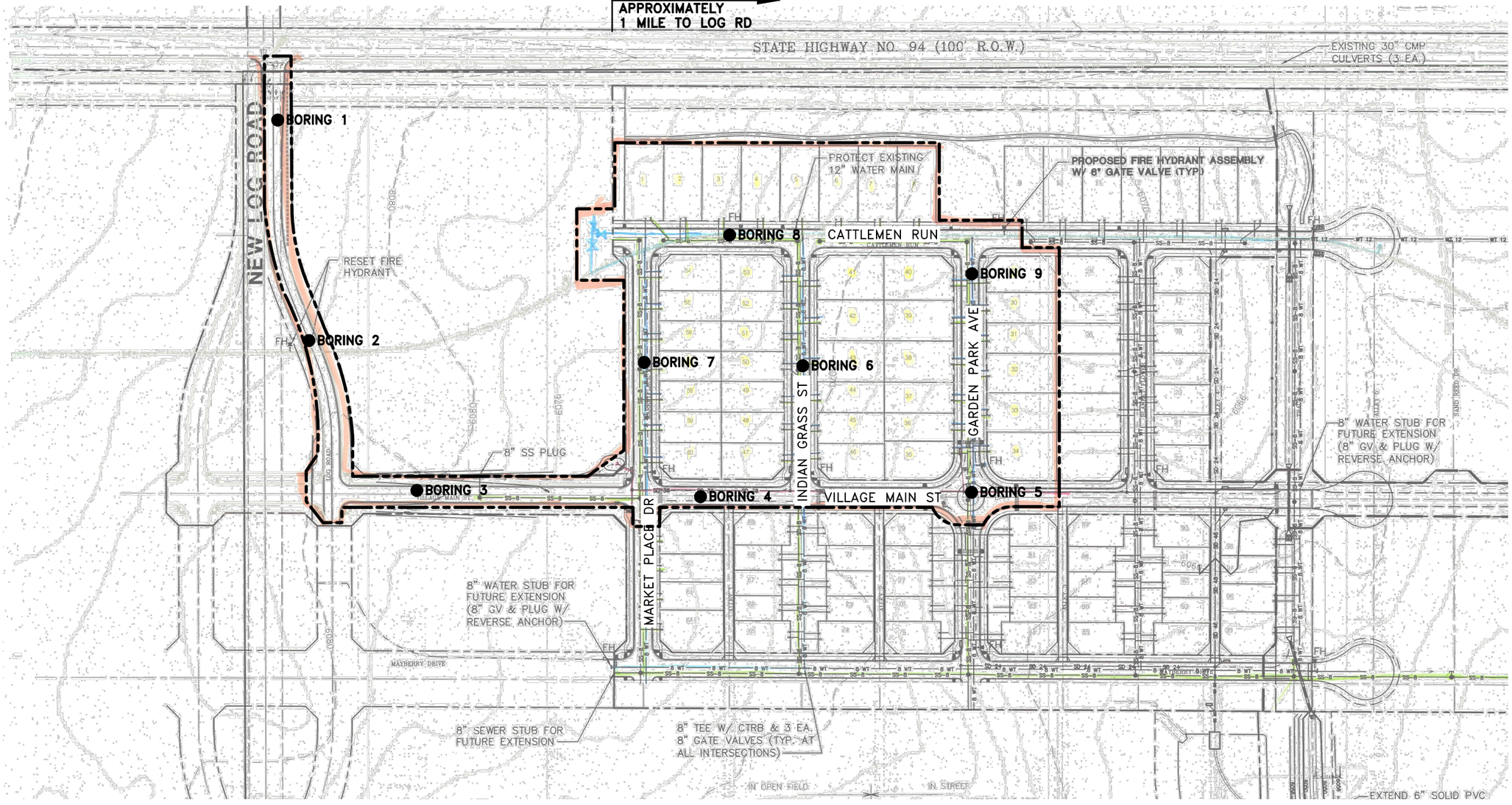
Kumar & Associates, Inc. should be retained to review the project plans and specifications for conformance with the recommendations provided in our report. We are also available to assist the design team in preparing specifications for geotechnical aspects of the project, and performing additional studies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

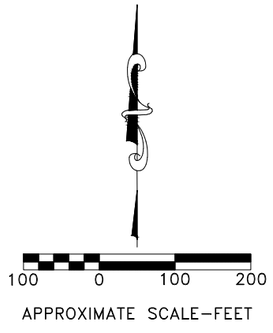
We recommend that Kumar & Associates, Inc. be retained to provide observation and testing services to document that the intent of this report and the requirements of the plans and specifications are being followed during construction, and to identify possible variations in subsurface conditions from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





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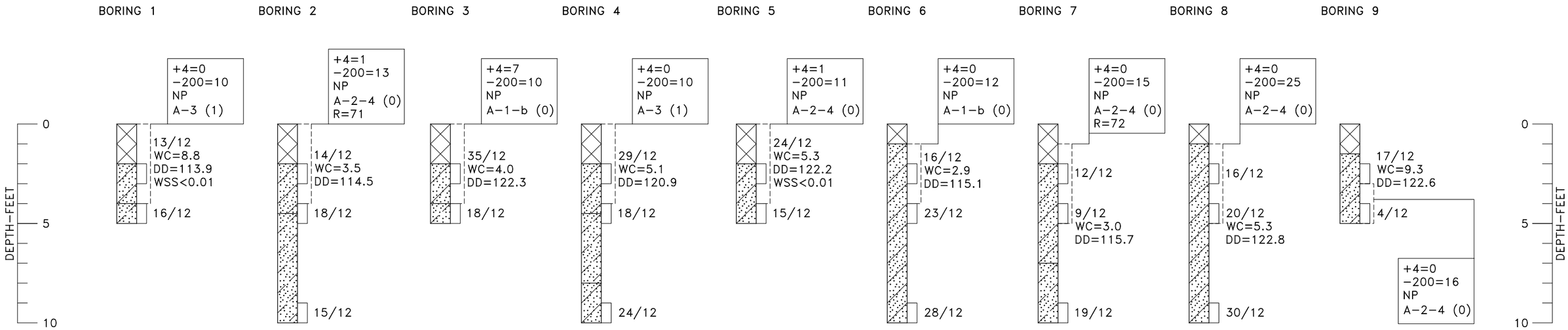
21–2–246	Kumar & Associates	MAYBERRY – FILING 1A ROADWAYS	LOCATION OF EXPLORATORY BORINGS	Fig. 1



21−2−246	Kumar & Associates	MAYBERRY − FILING 1A ROADWAYS	LOGS OF EXPLORATORY BORINGS	Fig. 2

LEGEND

FILL: SILTY SAND (SM), AND POORLY GRADED SAND WITH SILT (SP–SM), WITH OCCASIONAL GRAVEL, DRY TO SLIGHTLY MOIST, TAN.

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

CLAYEY SAND (SC), WITH OCCASIONAL CLAY LENSES, MEDIUM DENSE, MOIST, TAN AND BROWN.

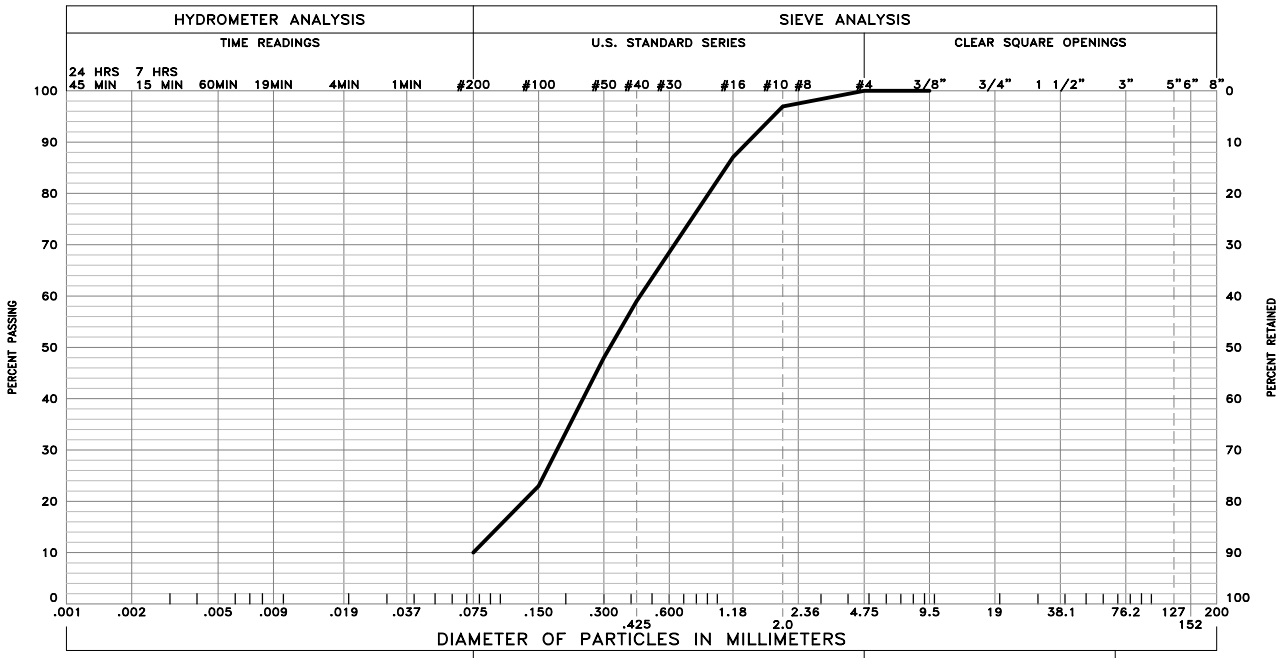
DRIVE SAMPLE, 2–INCH I.D. CALIFORNIA LINER SAMPLE.

DISTURBED BULK SAMPLE.

13/12 DRIVE SAMPLE BLOW COUNT. INDICATES THAT 13 BLOWS OF A 140–POUND HAMMER FALLING 30 INCHES WERE REQUIRED TO DRIVE THE SAMPLER 12 INCHES.

NOTES

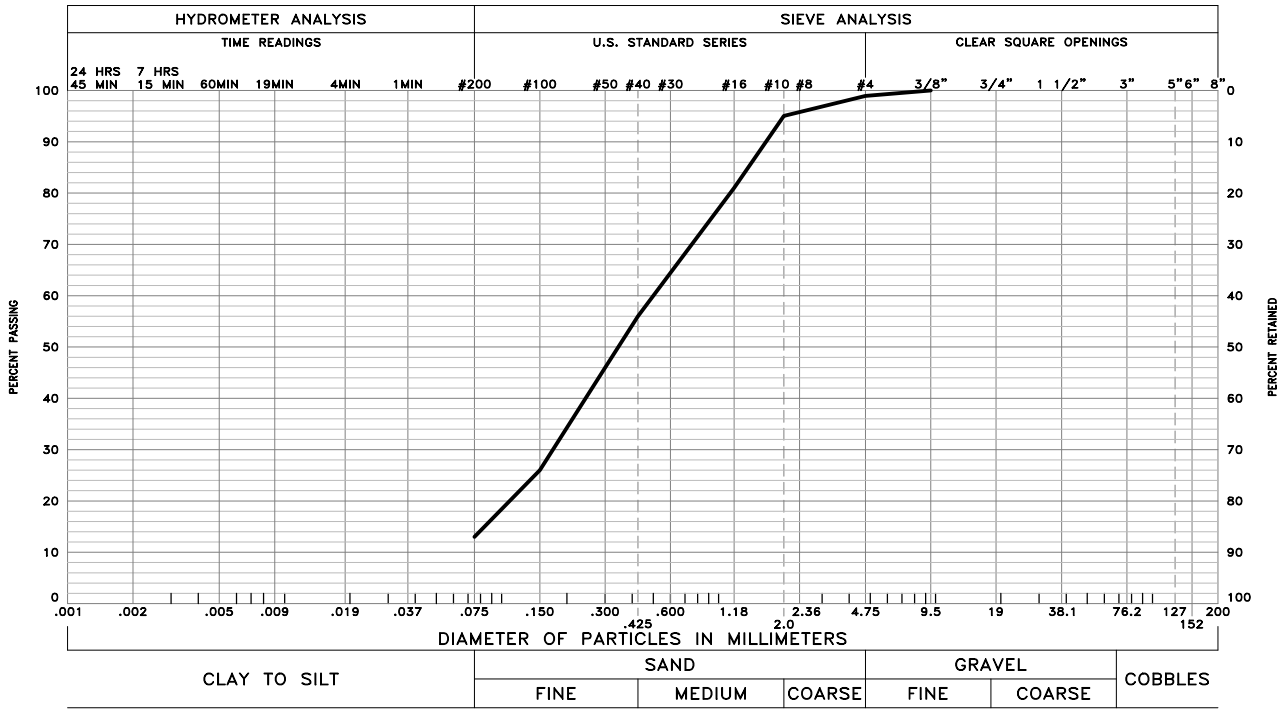
1. THE EXPLORATORY BORINGS WERE DRILLED ON NOVEMBER 18, 2021 WITH A 4–INCH–DIAMETER CONTINUOUS–FLIGHT POWER AUGER.
2. THE LOCATIONS OF THE EXPLORATORY BORINGS WERE MEASURED APPROXIMATELY BY PACING FROM FEATURES SHOWN ON THE SITE PLAN PROVIDED AND SHOULD BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED 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.
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 D 4318);
   WSS = WATER SOLUBLE SULFATES (%) (CP–L 2103);
   R = HVEEM R–VALUE (AT 300 psi) (ASTM D2844);
   A-3 (1) = AASHTO CLASSIFICATION (GROUP INDEX) (AASHTO M145).



GRAVEL 0 % SAND 90 % SILT AND CLAY 10 %

LIQUID LIMIT – PLASTICITY INDEX NP

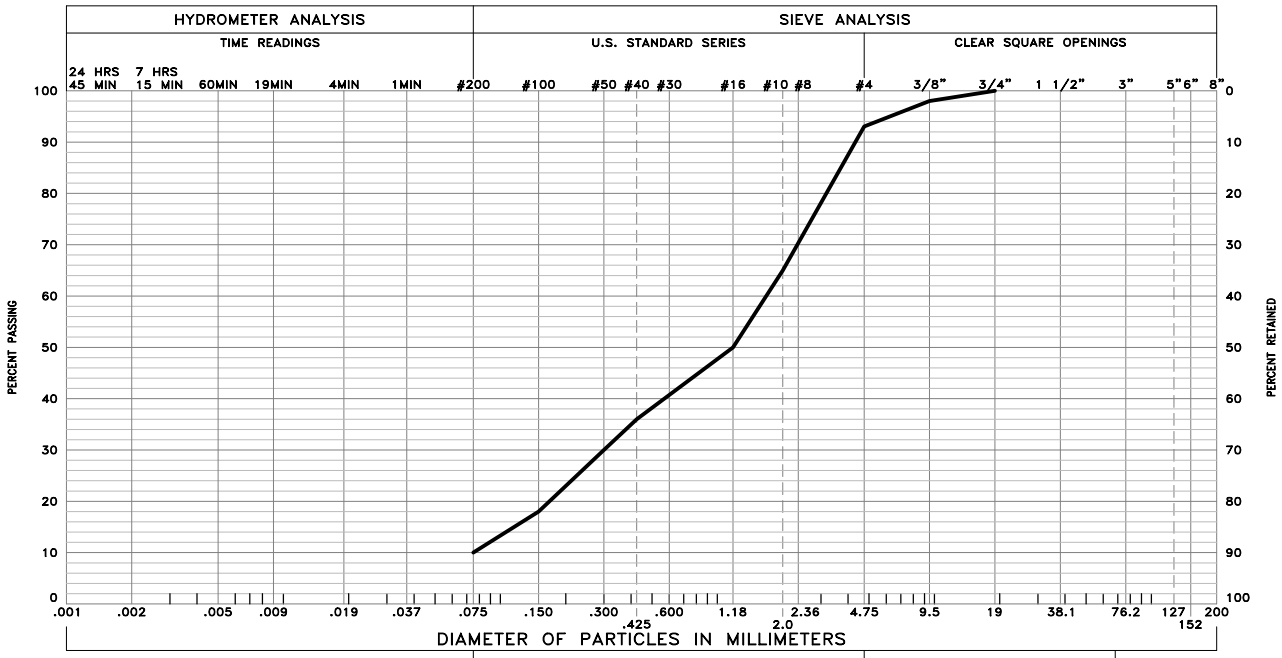
SAMPLE OF: Fill: Poorly Graded Sand with Silt (SP-SM) FROM: Boring 1 @ 0-4'



GRAVEL 1 % SAND 86 % SILT AND CLAY 13 %

LIQUID LIMIT – PLASTICITY INDEX NP

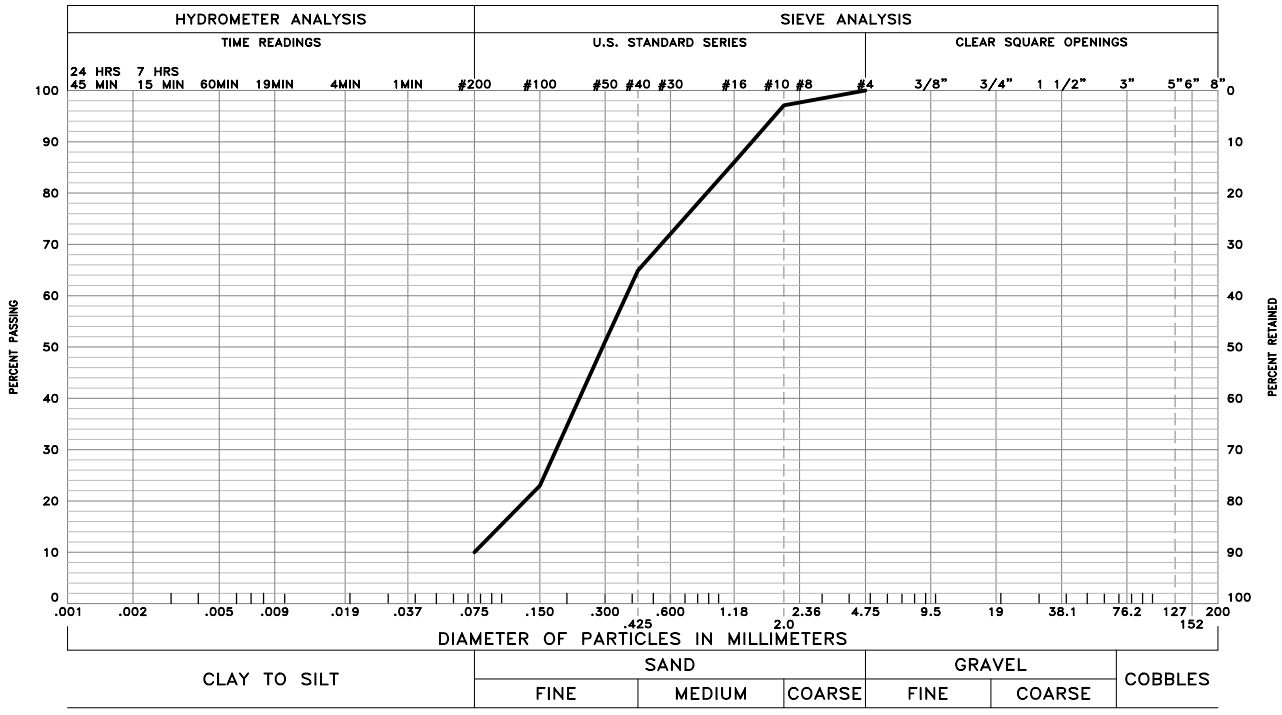
SAMPLE OF: Fill: Silty Sand (SM) FROM: Boring 2 @ 0-4'



GRAVEL 7 % SAND 83 % SILT AND CLAY 10 %

LIQUID LIMIT – PLASTICITY INDEX NP

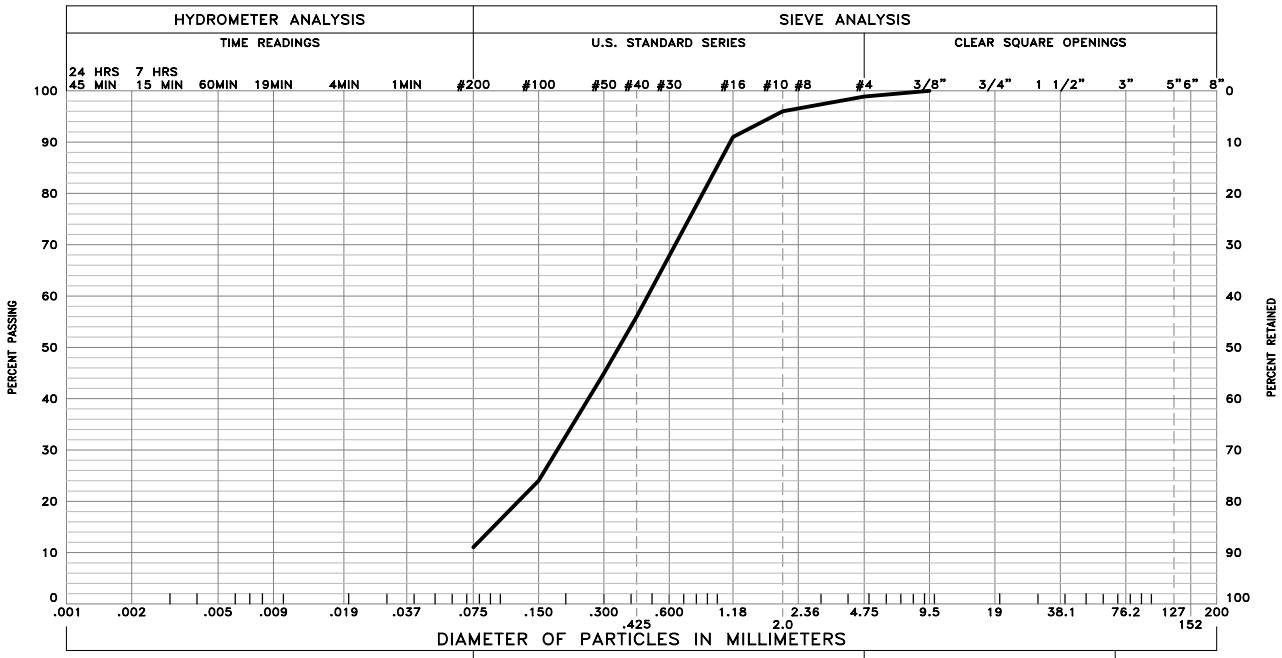
SAMPLE OF: Fill: Poorly Graded Sand with Silt (SP–SM) FROM: Boring 3 @ 0–4'



GRAVEL 0 % SAND 90 % SILT AND CLAY 10 %

LIQUID LIMIT – PLASTICITY INDEX NP

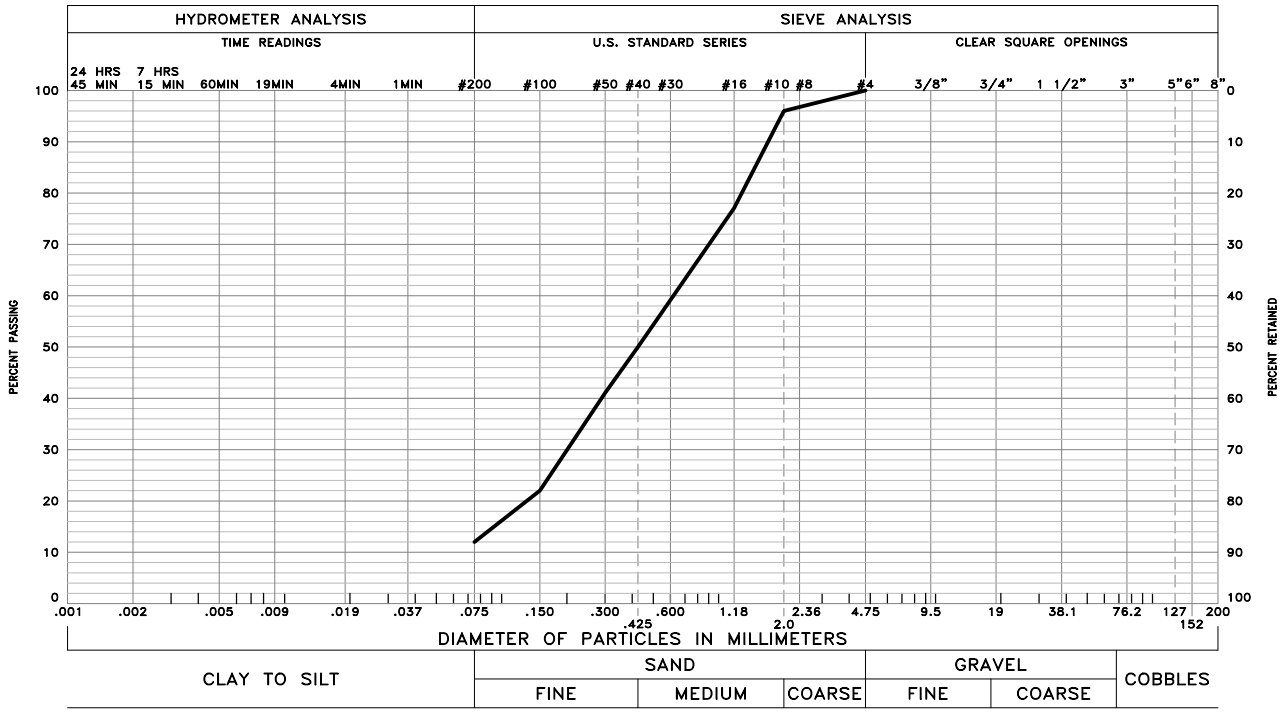
SAMPLE OF: Fill: Poorly Graded Sand with Silt (SP–SM) FROM: Boring 4 @ 0–4'



GRAVEL 1 % SAND 88 % SILT AND CLAY 11 %

LIQUID LIMIT – PLASTICITY INDEX NP

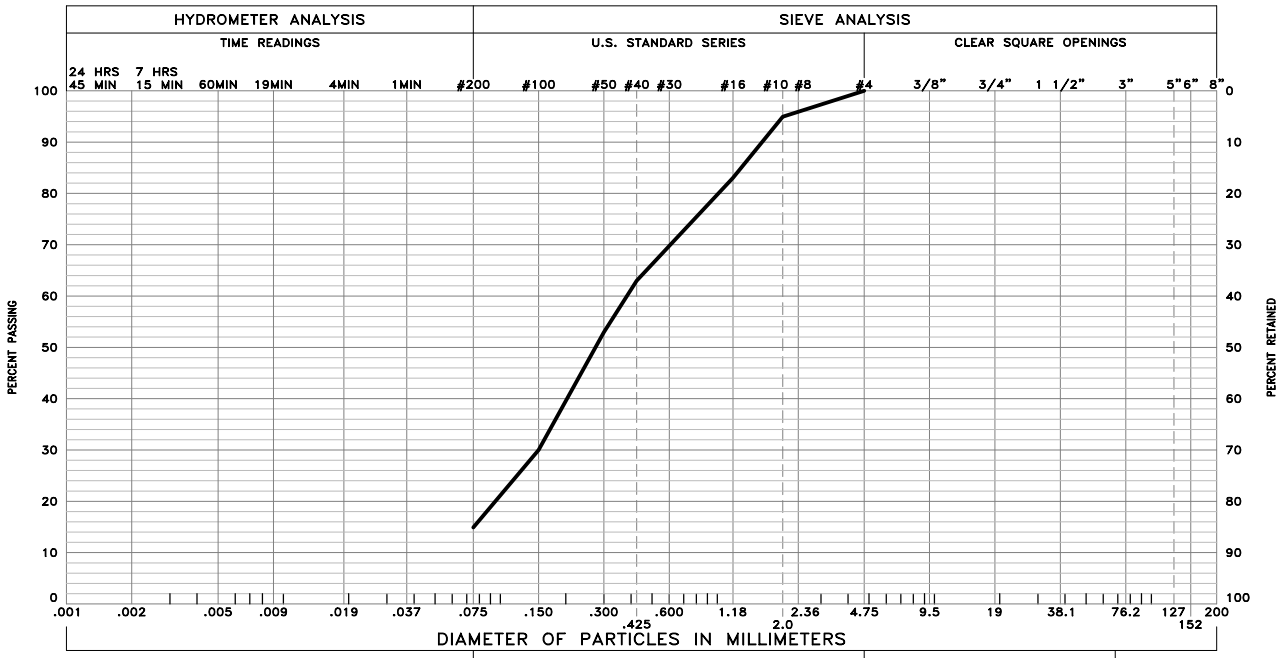
SAMPLE OF: Fill: Poorly Graded Sand with Silt (SP–SM) FROM: Boring 5 @ 0–4'



GRAVEL 0 % SAND 88 % SILT AND CLAY 12 %

LIQUID LIMIT – PLASTICITY INDEX NP

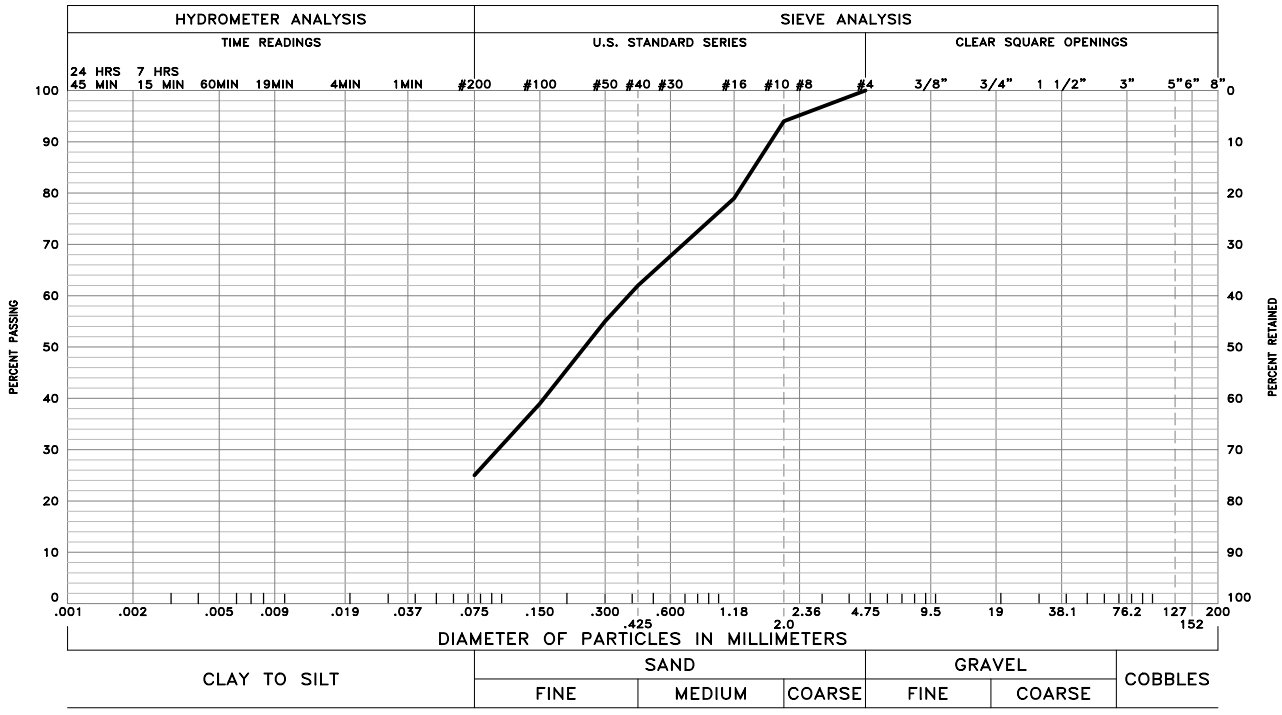
SAMPLE OF: Poorly Graded Sand with Silt (SP–SM) FROM: Boring 6 @ 1–4'



GRAVEL 0 % SAND 85 % SILT AND CLAY 15 %

LIQUID LIMIT – PLASTICITY INDEX NP

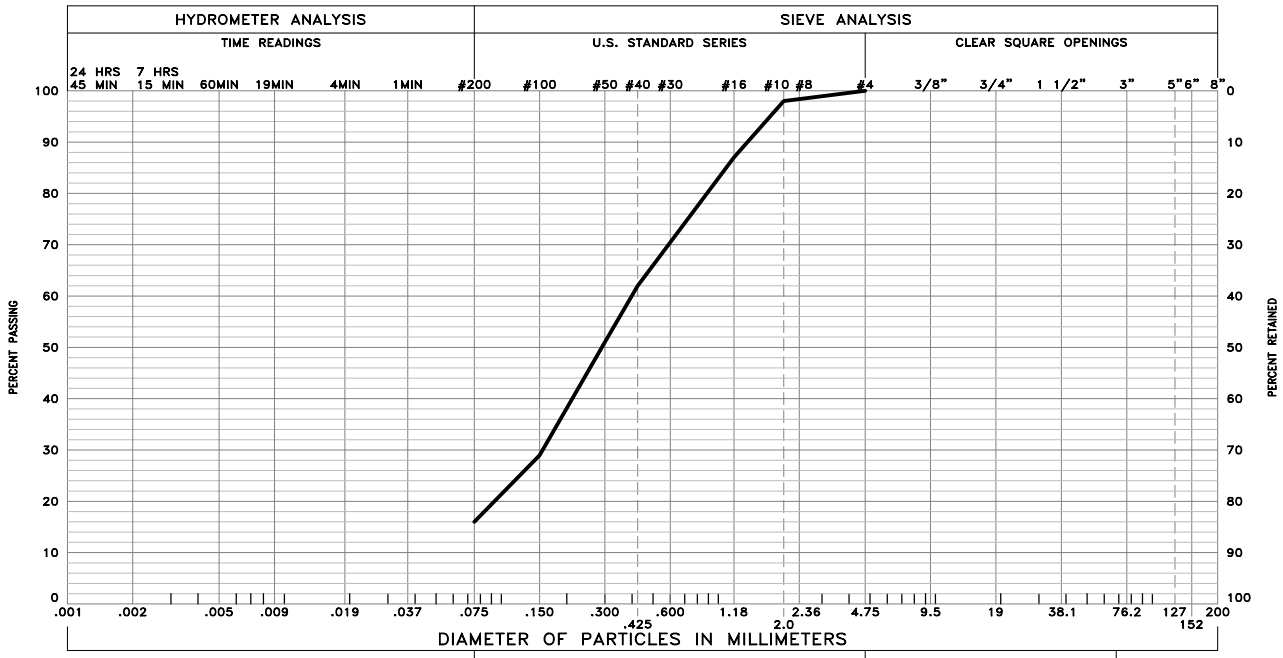
SAMPLE OF: Fill: Silty Sand (SM) FROM: Boring 7 @ 1–5'



GRAVEL 0 % SAND 75 % SILT AND CLAY 25 %

LIQUID LIMIT – PLASTICITY INDEX NP

SAMPLE OF: Silty Sand (SM) FROM: Boring 8 @ 1–5'



GRAVEL 0 % SAND 84 % SILT AND CLAY 16 %

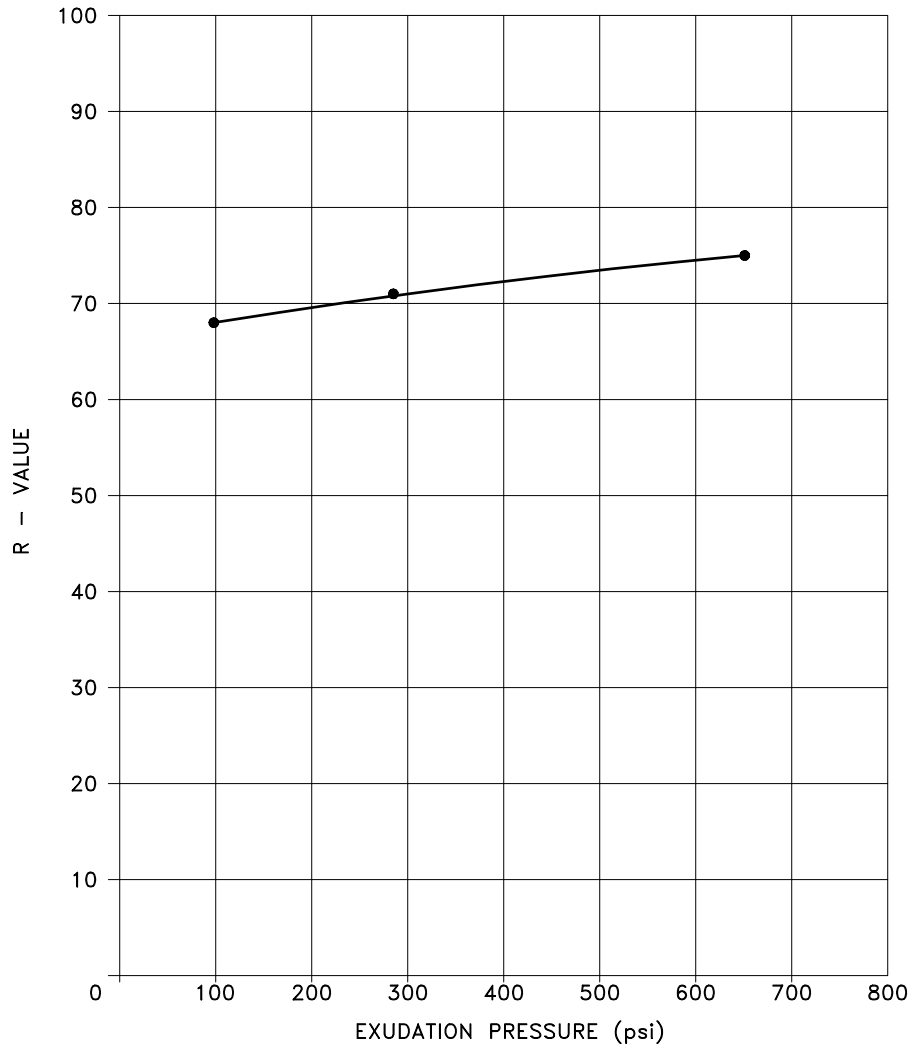
LIQUID LIMIT – PLASTICITY INDEX NP

SAMPLE OF: Silty Sand (SM) FROM: Boring 9 @ 3–5'

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.

21–2–246	Kumar & Associates	GRADATION TEST RESULTS	Fig. 8

TEST SPECIMEN	1	2	3	4	R –VALUE (300 psi)
MOISTURE CONTENT (%)	8.6	9.0	10.2		
DENSITY (pcf)	128.3	129.0	131.0		
EXPANSION PRESSURE (psi)	0.000	0.000	0.000		
EXUDATION PRESSURE (psi)	651	285	98		
R VALUE	75	71	68		71



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

LOCATION: Boring 2 @ 0–4'

DATE SAMPLED: 11/18/2021 DATE RECEIVED: 11/30/2021 DATE TESTED: 12/9/2021

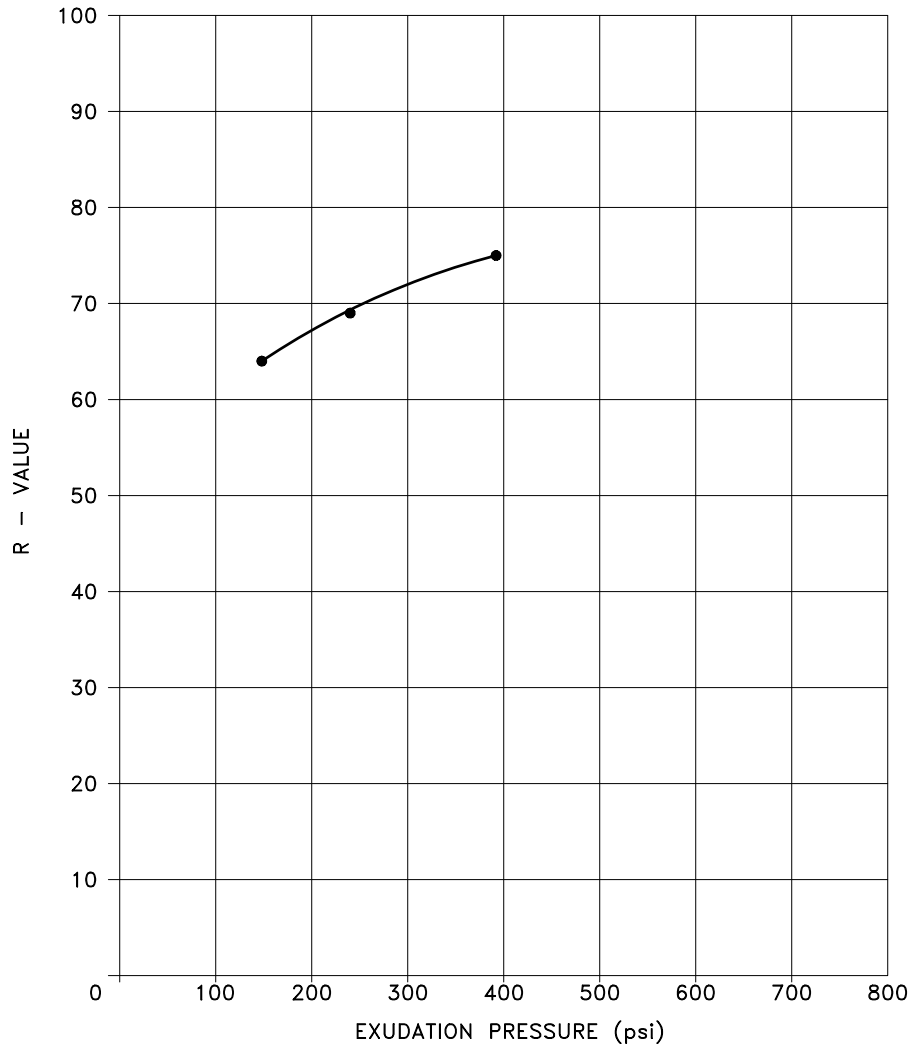
GRAVEL: 1 % SAND: 86 % SILT AND CLAY: 13 %

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.

21–2–246	Kumar & Associates	HVEEM STABILOMETER TEST RESULTS	Fig. 9

TEST SPECIMEN	1	2	3	4	R –VALUE (300 psi)
MOISTURE CONTENT (%)	9.6	9.2	8.8		
DENSITY (pcf)	130.0	124.6	124.3		
EXPANSION PRESSURE (psi)	0.000	0.000	0.000		
EXUDATION PRESSURE (psi)	148	240	392		
R VALUE	64	69	75		72



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

LOCATION: Boring 7 @ 1'–5'

DATE SAMPLED: 11/18/2021 DATE RECEIVED: 11/30/2021 DATE TESTED: 12/7/2021

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

LIQUID LIMIT: _____ PLASTICITY INDEX: NP

21–2–246	Kumar & Associates	HVEEM STABILOMETER TEST RESULTS	Fig. 10

Kumar and Associates, Inc.

TABLE I

SUMMARY OF LABORATORY TEST RESULTS

Project No.: 21-2-246
Project Name: Mayberry Filing 1A Roadways
Date Sampled: 11/18/2021
Date Received: 11/18/2021

SAMPLE LOCATION		DATE TESTED	NATURAL MOISTURE CONTENT (%)	NATURAL DRY DENSITY (pcf)	GRADATION		PERCENT PASSING NO. 200 SIEVE	ATTERBERG LIMITS		WATER SOLUBLE SULFATES (%)	R-Value	AASHTO CLASSIFICATION (Group Index)	SOIL OR BEDROCK TYPE (Unified Soil Classification)
BORING	DEPTH (ft)				GRAVEL (%)	SAND (%)		LIQUID LIMIT	PLASTICITY INDEX				
1	0-4	11/30/21			0	90	10		NP			A-3 (1)	Fill: Poorly Graded Sand with Silt (SP-SM)
1	2	11/30/21	8.8	113.9						<0.01			Fill: Poorly Graded Sand with Silt (SP-SM)
2	0-4	11/30/21			1	86	13		NP		71	A-2-4 (0)	Fill: Silty Sand (SM)
2	2	11/30/21	3.5	114.5									Fill: Silty Sand (SM)
3	0-4	11/30/21			7	83	10		NP			A-1-b (0)	Fill: Poorly Graded Sand with Silt (SP-SM)
3	2	11/30/21	4.0	122.3									Fill: Poorly Graded Sand with Silt (SP-SM)
4	0-4	11/30/21			0	90	10		NP			A-3 (1)	Fill: Poorly Graded Sand with Silt (SP-SM)
4	2	11/30/21	5.1	120.9									Fill: Poorly Graded Sand with Silt (SP-SM)
5	0-4	11/30/21			1	88	11		NP			A-2-4 (0)	Fill: Poorly Graded Sand with Silt (SP-SM)
5	2	11/30/21	5.3	122.2						<0.01			Fill: Poorly Graded Sand with Silt (SP-SM)
6	1-4	11/30/21			0	88	12		NP			A-1-b (0)	Poorly Graded Sand with Silt (SP-SM)
6	2	11/30/21	2.9	115.1									Poorly Graded Sand with Silt (SP-SM)

Kumar and Associates, Inc.

TABLE I

SUMMARY OF LABORATORY TEST RESULTS

Project No.: 21-2-246
Project Name: Mayberry Filing 1A Roadways
Date Sampled: 11/18/2021
Date Received: 11/18/2021

SAMPLE LOCATION		DATE TESTED	NATURAL MOISTURE CONTENT (%)	NATURAL DRY DENSITY (pcf)	GRADATION		PERCENT PASSING NO. 200 SIEVE	ATTERBERG LIMITS		WATER SOLUBLE SULFATES (%)	R-Value	AASHTO CLASSIFICATION (Group Index)	SOIL OR BEDROCK TYPE (Unified Soil Classification)
BORING	DEPTH (ft)				GRAVEL (%)	SAND (%)		LIQUID LIMIT	PLASTICITY INDEX				
7	1-5	11/30/21			0	85	15		NP		72	A-2-4 (0)	Fill: Silty Sand (SM)
7	4	11/30/21	3.0	115.7									Fill: Silty Sand (SM)
8	1-5	11/30/21			0	75	25		NP			A-2-4 (0)	Silty Sand (SM)
8	4	11/30/21	5.3	122.8									Silty Sand (SM)
9	3-5	11/30/21			0	84	16		NP			A-2-4 (0)	Silty Sand (SM)
9	2	11/30/21	9.3	122.6									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

21-2-246
Urban Minor Arterial
Composite HMA/ABC

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	1,971,000
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	2.94 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	5	-	2.20
2	ABC	0.12	1	8	-	0.96
Total	-	-	-	13.00	-	3.16

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

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Computer Software Product

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

Flexible Structural Design Module

21-2-246
Urban Non-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

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

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Computer Software Product

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6735 Kumar Heights
Colorado Springs, CO 80918
USA

Flexible Structural Design Module

21-2-246
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