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ROCKY MOUNTAIN GROUP
EMPLOYEE OWNED

SUBSURFACE SOIL INVESTIGATION

550 Sunrise Peak Rd
S-74 Site Addition to Crystal Park, Sub. No. 2
El Paso County, Colorado

PREPARED FOR:

Rob Estes
1675 Little Bear Creek Pt. Unit 303
Colorado Springs, CO 80904

JOB NO. 173916

February 25, 2020

Respectfully Submitted,
RMG – Rocky Mountain Group

Tony Munger, P.E.
Geotechnical Project Manager

Reviewed by,
RMG – Rocky Mountain Group

Kelli Zigler

Kelli Zigler
Project Geologist

Scope of Investigation

RMG – Rocky Mountain Group drilled two test borings at the above-referenced address on January 24, 2019. We understand that a single family residence with a walkout basement is to be constructed on the site. A Site Vicinity Map and Test Boring Location Plan are presented in Figures 1 and 2, respectively. Our findings, conclusions and recommendations are provided in this report.

This report presents geotechnical engineering recommendations for design and construction of residential foundations. The following is excluded from the scope of this report including but not limited to geologic, natural and environmental hazards such as landslides, unstable slopes, seismicity, snow avalanches, water flooding, corrosive soils, erosion, radon, wild fire protection, hazardous waste and natural resources.

Previous Studies and Field Investigation

One report of previous geotechnical engineering investigation specifically addressed to this site or nearby was available for our review and is listed below:

1. *Subsurface Soil Investigation, 550 Sunrise Peak Road, Lot 74, Crystal Park Subdivision,* prepared by RMG Engineers, Job No. 31905, last dated October 18, 1996.

Subsurface Materials

The subsurface materials encountered in the test borings generally consisted of granite bedrock extending to the 19-foot termination depths of the test borings. Additional descriptions and the interpreted distribution (approximate depths) of the subsurface materials are presented in the Test Boring Logs.

Groundwater was not encountered in the test borings at the time of drilling. Fluctuations in groundwater and subsurface moisture conditions may occur due to variations in rainfall and other factors not readily apparent at this time. Development of the property and adjacent properties may also affect groundwater levels.

An Explanation of the Test Boring Logs, the Test Boring Logs, and a Summary of Laboratory Test Results are presented in Figures 3 through 5. Soil Classification Data is presented in Figure 6.

Special Considerations

Soft/loose soils may be encountered at foundation bearing levels. If soft/loose soils are encountered in the excavation, they will require additional compaction to achieve the allowable bearing pressures indicated in this report. In some cases, overexcavation and recompaction to a depth of 2 feet may be required. The use of track-mounted excavation equipment or other low-ground-pressure equipment is recommended to reduce the likelihood of loss of stability during excavation.

Foundation Recommendations

It is recommended that the foundation be designed with additional rigidity to help reduce the effect of potential lateral movement of subsurface soils. This may include (but is not limited to) the use of tie

beams, counterforts, and added reinforcing to help the foundation move as a unit. This approach should reduce potential cracking and damage resulting from differential movement within the foundation system and super structure.

A spread footing foundation supported on the granite bedrock or on compacted structural fill is suitable for the proposed residential structures. We have anticipated the deepest excavation cuts for basement level construction will be approximately 6 to 8 feet below the existing ground surface.

If the bottom of the excavation consists entirely of undisturbed granite, a maximum allowable bearing pressure of 3,000 psf with no minimum dead load requirement may be used for design. However, the structure shall not be supported atop soils/bedrock of significantly different bearing capacities. If any portion of the structure is to be supported atop the on-site sand soils or on structural fill, the remaining portions of the excavation shall have the top 12 inches of exposed granite bedrock removed and replaced with structural fill.

For a structure supported atop structural fill, a maximum allowable bearing pressure of 2,000 psf with no minimum dead load requirement may be used for design. The foundation design should be prepared by a qualified Colorado Registered Professional Engineer using the recommendations presented in this report. This foundation system should be designed to span a minimum of 10 feet under the design loads. The bottoms of exterior foundations should be at least 30 inches below finished grade for frost protection.

Open Excavation Observation

During construction, foundation excavations should be observed by RMG prior to placing structural fill, forms, or concrete to verify the foundation bearing conditions for each structure. Based on the conditions observed in the foundation excavation, the recommendations made at the time of construction may vary from those contained herein. In the case of differences, the Open Excavation Observation report shall be considered to be the governing document. The recommendations presented herein are intended only as preliminary guidelines to be used for interpreting the subsurface soil conditions exposed in the excavation and determining the final recommendations for foundation construction.

Soil Test Borings

The soil/rock classifications shown on the logs are based upon the engineer's classification of samples. Lines shown on the logs represent the approximate boundary between subsurface materials, and the actual transition may be gradual and vary across the site.

Interior Floor Slabs

Vertical slab movement on the order of one to two inches is considered possible for soils/bedrock of low expansion potential. In some cases, vertical movement may exceed this range. If movement and associated damage to floors and finishes cannot be tolerated, a structural floor system should be used.

Floor slabs should be separated from structural components to allow for vertical movement. Control and construction joints should be placed in accordance with the latest guidelines and standards published by the American Concrete Institute (ACI) and applicable local Building Code requirements.

Recommendations for exterior concrete slabs, such as patios, driveways, and sidewalks, are not included in this report.

Interior Partitions

Interior non-bearing partitions and attached furnishings (e.g., cabinets, shower stalls, etc.) on concrete slabs should be constructed with a void so that they do not transmit floor slab movement to the roof or overlying floor. A void of at least 1-1/2 inches is recommended beneath non-bearing partitions. The void may require reconstruction over the life of the structure to re-establish the void due to vertical slab movement.

Lateral Earth Pressure Parameters

Foundation and basement walls should be designed to resist lateral pressures.

It has been our experience that the exterior fill on the downslope sides of basement, walkout, and foundation walls has the tendency to pull away from the walls over time, resulting in the interior backfill exerting a net outward pressure against these walls. This condition can result in the bowing, drifting, or rotation of these walls. It is recommended that downslope basement, walkout, and foundation walls be designed using an Equivalent Fluid Pressure of 55 pcf acting on the inside of the wall and assuming no backfill resistance pressure against the exterior side of the walls (passive pressure).

For the remaining foundation walls, an Equivalent Fluid Pressure (EFP) of 40 pcf applies to non-expansive backfill materials and level, drained backfill conditions. EFPs for sloping/undrained conditions should be determined on an individual basis.

Expansive soils or bedrock should not be used as backfill against foundation and basement walls.

Surface Grading and Drainage

The ground surface should be sloped from the building with a minimum gradient of 10 percent for the first 10 feet. This is equivalent to 12 inches of fall across this 10-foot zone. If a 10-foot zone is not possible on the upslope side of the structure, then a well-defined swale should be created a minimum 5 feet from the foundation and sloped parallel with the wall with a minimum slope of 2 percent to intercept the surface water and transport it around and away from the structure. Roof drains should extend across backfill zones and landscaped areas to a region that is graded to direct flow away from the structure. Owners should maintain the surface grading and drainage recommended in this report to help prevent water from being directed toward and/or ponding near the foundations.

Landscaping should be selected to reduce irrigation requirements. Plants used close to foundation walls should be limited to those with low moisture requirements; and irrigated grass should not be located within 5 feet of the foundation. To help control weed growth, geotextiles should be used below landscaped areas adjacent to foundations. Impervious plastic membranes are not recommended.

Irrigation devices should not be placed within 5 feet of the foundation. Irrigation should be limited to the amount sufficient to maintain vegetation. Application of more water will increase the likelihood of slab and foundation movements.

The recommendations listed in this report are intended to address normal surface drainage conditions, assuming the presence of groundcover (established vegetation, paved surfaces, and/or structures) throughout the regions upslope from this structure. However, groundcover may not be present due to a variety of factors (ongoing construction/development, wildfires, etc.). During periods when groundcover is not present in the "upslope" regions, higher than normal surface drainage conditions may occur, resulting in perched water tables, excess runoff, flash floods, etc. In these cases, the surface drainage recommendations presented herein (even if properly maintained) may not mitigate all groundwater problems or moisture intrusion into the structure. We recommend that the site plan be prepared with consideration of increased runoff during periods when groundcover is not present on the upslope areas.

Perimeter Drain

A subsurface perimeter drain is recommended around portions of the structure which will have habitable or storage space located below the finished ground surface. This includes crawlspace areas but not the walkout trench, if applicable. A typical drain detail is presented in Figure 7.

A subsurface perimeter drain is designed to intercept some types of subsurface moisture and not others. Therefore, the drain could operate properly and not mitigate all moisture problems relating to foundation performance or moisture intrusion into the basement area.

Concrete

Type I/II cement is recommended for concrete in contact with the subsurface materials. Calcium chloride should be used with caution for soils with high sulfate contents. The concrete should not be placed on frozen ground. If placed during periods of cold temperatures, the concrete should be kept from freezing. This may require covering the concrete with insulated blankets and heating. Concrete work should be completed in accordance with the latest applicable guidelines and standards published by ACI.

Exterior Backfill

Backfill should be placed in loose lifts not exceeding 8 to 12 inches, moisture conditioned to facilitate compaction (usually within 2 percent of the optimum moisture content) and compacted to 85 percent of the maximum dry density as determined by the Modified Proctor test, ASTM D-1557 on exterior sides of walls in landscaped areas. In areas where backfill supports pavement and concrete flatwork, the materials should be compacted to 92 percent of the maximum dry density.

Fill placed on slopes should be benched into the slope. Maximum bench heights should not exceed 4 feet, and bench widths should be wide enough to accommodate compaction equipment.

The appropriate government/utility specifications should be used for fill placed in utility trenches. If material is imported for backfill, the material should be approved by the Geotechnical Engineer prior to hauling it to the site.

The backfill should not be placed on frozen subgrade or allowed to freeze during moisture conditioning and placement. Backfill should be compacted by mechanical means, and foundation walls should be braced during backfilling and compaction.

Structural Fill

Areas to receive structural fill should have topsoil, organic material, or debris removed. The upper 6 inches of the exposed surface soils should be scarified and moisture conditioned to facilitate compaction (usually within 2 percent of the optimum moisture content) and compacted to a minimum of 95 percent of the maximum dry density as determined by the Standard Proctor test (ASTM D-698) or to a minimum of 92 percent of the maximum dry density as determined by the Modified Proctor test (ASTM D-1557) prior to placing structural fill.

Structural fill placed on slopes should be benched into the slope. Maximum bench heights should not exceed 4 feet, and bench widths should be wide enough to accommodate compaction equipment.

Structural fill shall consist of granular, non-expansive material, and it should be placed in loose lifts not exceeding 8 to 12 inches, moisture conditioned to facilitate compaction (usually within 2 percent of the optimum moisture content) and compacted to a minimum of 92 percent of the maximum dry density as determined by the Modified Proctor test, ASTM D-1557. The materials should be compacted by mechanical means.

Materials used for structural fill should be approved by RMG prior to use. Structural fill should not be placed on frozen subgrade or allowed to freeze during moisture conditioning and placement.

To verify the condition of the compacted soils, density tests should be performed during placement. The first density tests should be conducted when 24 inches of fill have been placed.

Foundation Configuration Remarks

The configuration of the foundation system is critical to its performance. The position of foundation windows, jogs, steps and the relative elevation of adjacent and opposite walls can affect foundation performance. The nature of residential foundation construction does not allow for control of these conditions by the Foundation Design Engineer. Improper placement of the above can result in differential and lateral foundation movement not anticipated by the Geotechnical Engineer. The Foundation Design Engineer should be contacted regarding the foundation configuration.

General Remarks

The recommendations provided in this report are based upon the subsurface conditions encountered in the test borings, anticipated foundation loads, and accepted engineering procedures. The recommendations are intended to reduce differential movement. *It must be recognized that the foundation will undergo some movement on all soil types*. Concrete floor slabs will likely move vertically. The recommendations for isolating floor slabs from columns, walls, partitions or other structural components should be implemented to mitigate potential damage to the structure. Subsequent owners should be provided a copy of this report. The recommendations are based on accepted local engineering practice and are intended for individuals familiar with local construction practices and standards.

RMG does not assure the existence of and/or the compliance with the above recommendations. This is the responsibility of the client referenced on the first page. RMG provided recommendations only and does not supervise, direct or control the implementation of the recommendations.

Senate Bill 13

This report may be partial fulfillment of Colorado Senate Bill 13 (1984), C.R.S. 6-6.5-101, *The Soil and Hazard Analysis of Residential Construction*, if the purchaser receives this report at least fourteen days prior to closing.

The purpose of Senate Bill 13 is to inform the purchaser of the presence of expansive soil or hazards on the site. Geologic and environmental hazards are outside the scope of services of this report. Expansive soil and bedrock may result in movement of foundation components and floor slabs. The recommendations presented in this report are intended to reduce, not eliminate, these movements.

The owner and builder should review and become familiar with Special Publications 43 issued by the Colorado Geologic Survey.

This report and the recommendations contained therein are only valid if all parts of Senate Bill 13 are satisfied.

If we can be of further assistance in discussing the contents of this report or analysis of the proposed project, from a geotechnical engineering point-of-view, please feel free to contact us.

NOT TO SCALE

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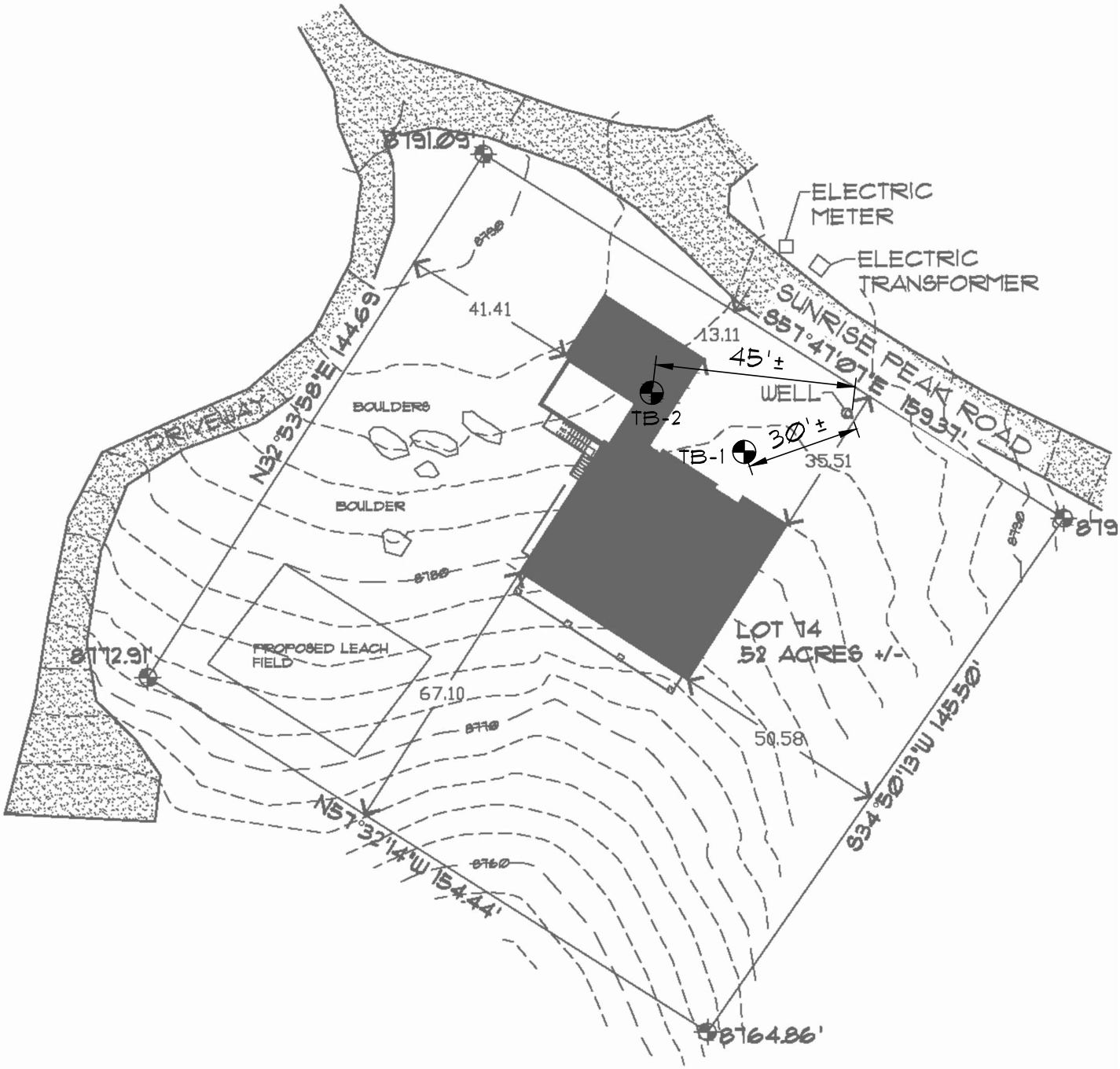
SITE VICINITY MAP

550 SUNRISE PARK RD
S-74, SITE ADDITION TO
CRYSTAL PARK, SUB. NO. 2
EL PASO COUNTY, COLORADO
ROB ESTES

JOB No. 173916

FIG No. 1

DATE 2-25-2020



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BASE MAP PROVIDED BY:
LGA STUDIOS

DENOTES APPROXIMATE LOCATION OF TEST BORINGS

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TEST BORING LOCATION PLAN

550 SUNRISE PARK RD
S-74, SITE ADDITION TO
CRYSTAL PARK, SUB. NO. 2
EL PASO COUNTY, COLORADO
ROB ESTES

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FIG No. 2

DATE 2-25-2020

SOILS DESCRIPTION

 GRANITE

UNLESS NOTED OTHERWISE, ALL LABORATORY
TESTS PRESENTED HEREIN WERE PERFORMED BY:
RMG - ROCKY MOUNTAIN GROUP
2910 AUSTIN BLUFFS PARKWAY
COLORADO SPRINGS, COLORADO

SYMBOLS AND NOTES

 XX — STANDARD PENETRATION TEST - MADE BY DRIVING A SPLIT-BARREL SAMPLER INTO THE SOIL BY DROPPING A 140 LB. HAMMER 30", IN GENERAL ACCORDANCE WITH ASTM D-1586. NUMBER INDICATES NUMBER OF HAMMER BLOWS PER FOOT (UNLESS OTHERWISE INDICATED).

 XX — UNDISTURBED CALIFORNIA SAMPLE - MADE BY DRIVING A RING-LINED SAMPLER INTO THE SOIL BY DROPPING A 140 LB. HAMMER 30", IN GENERAL ACCORDANCE WITH ASTM D-3550. NUMBER INDICATES NUMBER OF HAMMER BLOWS PER FOOT (UNLESS OTHERWISE INDICATED).

 FREE WATER TABLE

 DEPTH AT WHICH BORING CAVED

 BULK DISTURBED BULK SAMPLE

 AUG AUGER "CUTTINGS"

4.5 WATER CONTENT (%)

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EXPLANATION OF TEST BORING LOGS

JOB No. 173916

FIGURE No. 3

DATE 2/25/20

TEST BORING: **1** DATE DRILLED: 1/24/20 REMARKS: NO GROUNDWATER ON 1/24/20	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
GRANITE, reddish brown, very hard, moist	5			50/6"	5.7
	10			50/6"	3.5
	15			50/4"	3.2
					5.1

TEST BORING: **2** DATE DRILLED: 1/24/20 REMARKS: NO GROUNDWATER ON 1/24/20	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
GRANITE, reddish brown, very hard, moist	5			50/4"	4.2
	10			50/4"	3.0
	15			10/0"	4.0
					3.4

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TEST BORING LOGS

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FIGURE No. 4

DATE 2/25/20

Test Boring No.	Depth	Water Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% Retained No.4 Sieve	% Passing No. 200 Sieve	FHA Expansion Pressure (psf)	% Swell/ Collapse	USCS Classification
1	4.0	5.7		NP	NP	7.2	14.8			SM
1	9.0	3.5								
1	14.0	3.2								
1	18.0	5.1								
2	4.0	4.2								
2	9.0	3.0		NP	NP	33.4	8.9			SW-SM
2	14.0	4.0								
2	18.0	3.4								

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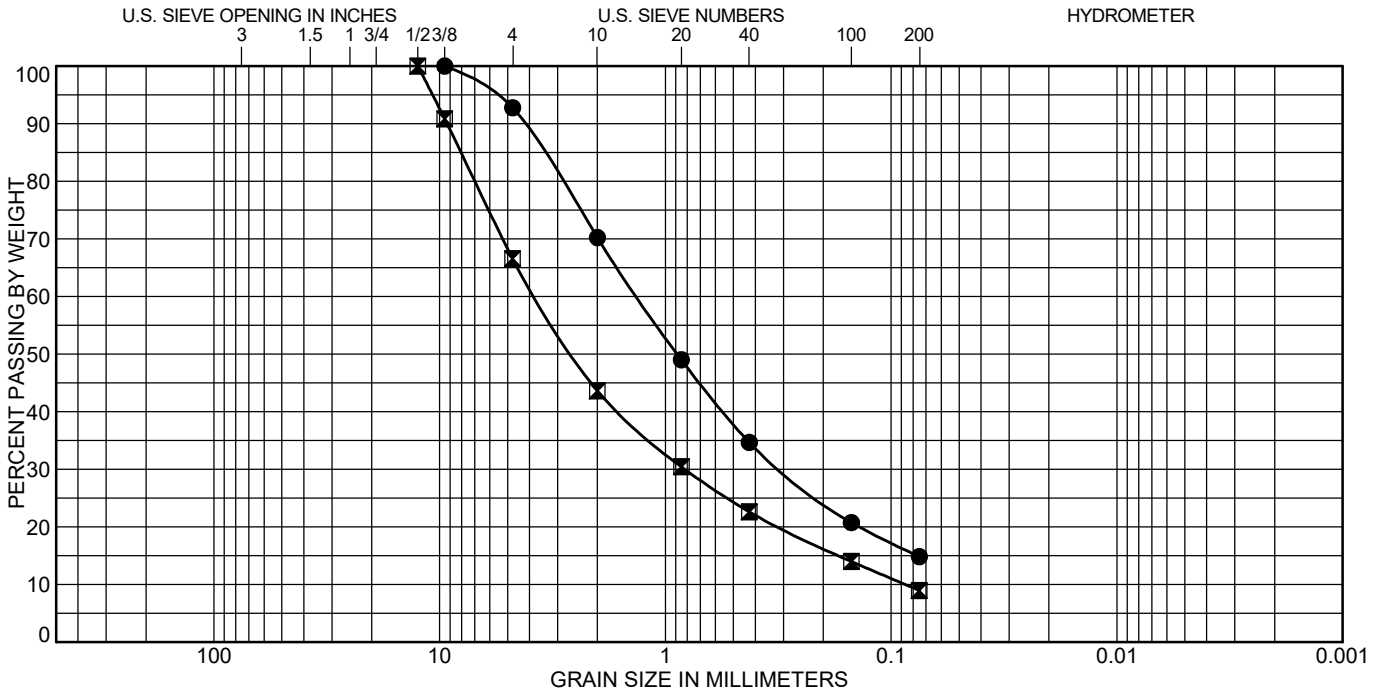
SUMMARY OF LABORATORY TEST RESULTS

JOB No. 173916
FIGURE No. 5
PAGE 1 OF 1
DATE 2/25/20



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Test Boring	Depth (ft)	Classification	LL	PL	PI
●	1	4.0	**SILTY SAND(SM)**	**NP**	**NP**	**NP**
⊠	2	9.0	**WELL-GRADED SAND with SILT and GRAVEL(SW-SM)**	**NP**	**NP**	**NP**

	Test Boring	Depth (ft)	%Gravel	%Sand	%Silt	%Clay
●	1	4.0	**7.2**	**77.9**	**14.8**	
⊠	2	9.0	**33.4**	**57.6**	**8.9**	

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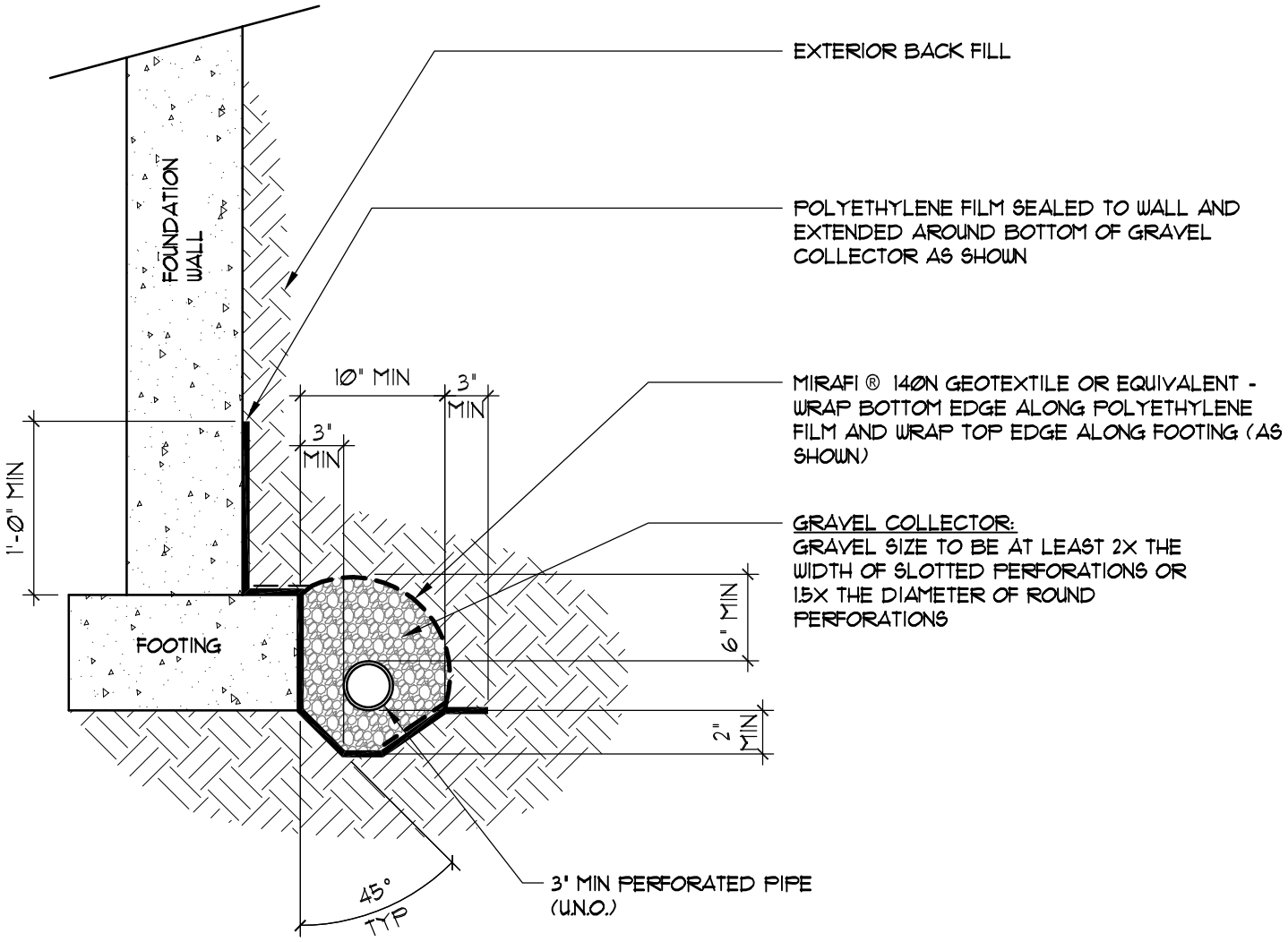
SOIL CLASSIFICATION DATA

JOB No. 173916

FIGURE No. 6

DATE 2/25/20



GENERAL NOTES:

1. BOTTOM OF DRAIN PIPE SHALL BE AT OR BELOW BOTTOM OF FOOTING AT ALL LOCATIONS
2. ALL DRAIN PIPE SHALL BE PERFORATED PLASTIC, WITH THE EXCEPTION OF THE DISCHARGE PORTION WHICH SHALL BE SOLID, NON-PERFORATED PIPE.
3. DRAIN PIPE SHALL HAVE POSITIVE FALL THROUGHOUT.
4. DRAIN PIPE SHALL BE PROVIDED WITH A FREE GRAVITY OUTFALL, IF POSSIBLE. IF A GRAVITY OUTFALL CANNOT BE ACHIEVED, THEN A SUMP PIT AND PUMP SHALL BE USED.
5. ALL DRAIN COMPONENTS SHALL BE RATED/APPROVED BY THE MANUFACTURER FOR THE INSTALLED DEPTH AND APPLICATION
6. DRAIN SYSTEM, INCLUDING THE OUTFALL OF THE DRAIN, SHALL BE OBSERVED BY QUALIFIED PERSONNEL PRIOR TO BACKFILLING TO VERIFY INSTALLATION.

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PERIMETER DRAIN

FIG No. 7