Architectural
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Materials Testing
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SOIL AND GEOLOGY STUDY

9660 Towner Avenue
Foundation Lutheran Church
Tract C, Paint Brush Hills, Filing No. 13A
Falcon, Colorado

PREPARED FOR:

Colorado Commercial Construction
12325 Oracle Blvd, Suite 120
Colorado Springs, CO 80921

JOB NO. 191726

September 26, 2023

Respectfully Submitted,

RMG – Rocky Mountain Group

Kelli Zigler

Kelli Zigler
Project Geologist

Reviewed by,

RMG – Rocky Mountain Group

COLORADO REGISTERED
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Sr. Geotechnical Project Manager

TABLE OF CONTENTS

FIGURES

1.0 GENERAL SITE AND PROJECT DESCRIPTION

1.1 Project Location

The project lies in the SW¼ of Section 25, Township 12 South, Range 65 West of the 6th Principal Meridian in El Paso County, Colorado. The site is generally located south and west of the intersection of Londonderry Drive and Towner Avenue. The approximate location of the site is shown on the Site Vicinity Map, Figure 1.

1.2 Existing and Proposed Land Use

The site currently consists of one parcel (per the El Paso County Assessor's website):

- Schedule No. 5225208001, labeled as Towners Ave, zoned CR, consists of approximately 5.97 acres, and land use is classified as religious worship;

The site is currently an undeveloped lot. The lot is to be accessed from Londonderry Drive. The lot address and zoning are to remain as is.

1.3 Project Description

It is our understanding the site is to contain a 12,000 square-foot church structure. The site is to have water and sewer provided by Paint Brush Hills Metropolitan District. An On-site Wastewater Treatment System (OWTS) is currently not proposed. The Site Plan is presented in Figure 2.

2.0 QUALIFICATIONS OF PREPARERS

This Soil and Geology Study was prepared by a professional geologist as defined by Colorado Revised Statures section 34-1-201(3) and by a qualified geotechnical engineer as defined by policy statement 15, "Engineering in Designated Natural Hazards Areas" of the Colorado State Board of Registration for Professional Engineers and Professional Land Surveyors. (Ord. 96-74; Ord. 01-42)

The principle investigators for this study are Kelli Zigler P.G., and Tony Munger, P.E. Ms. Zigler is a Professional Geologist as defined by State Statute (C.R.S 34-1-201) with over 22 years of experience in the geological and geotechnical engineering field. Ms. Kelli Zigler holds a B.S. in Geology from the University of Tulsa. Ms. Zigler has supervised and performed numerous geological and geotechnical field investigations throughout Colorado.

Tony Munger, P.E. is a licensed professional engineer with over 22 years of experience in the construction engineering (residential) field. Mr. Munger holds a B.S. in Architectural Engineering from the University of Wyoming

3.0 STUDY OVERVIEW

The purpose of this investigation is to characterize the general geotechnical, geologic site conditions and present our opinions of the potential effect of these conditions on the proposed development within the Town of Peyton, El Paso County, Colorado. As such, our services exclude evaluation of the environmental

and/or human, health related work products or recommendations previously prepared, by others, for this project.

Revisions to the conclusions presented in this report may be issued based upon submission of the Development Plan. This study has been prepared in accordance with the requirements outlined in the El Paso County Land Development Code (LDC) specifically Chapter 8, last updated August 27, 2019. Applicable sections include 8.4.8 and 8.4.9, and the El Paso County Engineering Criteria Manual (ECM), specifically Appendix C last updated July 9, 2019.

3.1 Scope and Objective

The scope of this study is to include a physical reconnaissance of the site and a review of pertinent, publically available documents including, but not limited to, previous geologic and geotechnical reports, overhead and remote sensing imagery, published geology and/or hazard maps, design documents, etc.

The objectives of our study are to:

- Identify geologic conditions present on the site
- Analyze potential negative impacts of these conditions on the proposed site development
- Analyze potential negative impacts to surrounding properties and/or public services resulting from the proposed site development as it relates to existing geologic conditions
- Provide our opinion of suitable techniques that may be utilized to mitigate any potential negative impacts identified herein

This report presents the findings of the study performed by RMG-Rocky Mountain Group relating to the geologic conditions of the above-referenced site. Revisions and modifications to this report may be issued subsequently by RMG, based upon:

- Additional observations made during grading and construction which may indicate conditions that require re-evaluation of some of the criteria presented in this report
- Review of pertinent documents (development plans, plat maps, drainage reports/plans, etc.) not available at the time of this study
- Comments received from the governing jurisdiction and/or their consultants subsequent to submission of this document

3.2 Site Evaluation Techniques

The information included in this report has been compiled from several sources, including:

- Geologic and topographic maps
- Review of selected publicly available, pertinent engineering reports
- Available aerial photographs
- Geologic research and analysis

Geophysical investigations were not considered necessary for characterization of the site geology. Monitoring programs, which typically include instrumentation and/or observations for changes in groundwater, surface water flows, slope stability, subsidence, and similar conditions, are not known to exist and were not considered applicable for the scope of this report.

3.3 Previous Studies and Field Investigation

Reports of previous geotechnical engineering/geologic investigations for the surrounding area and site were available for our review and are listed below:

1. *Subsurface Soil Investigation, Foundation Lutheran Church, TR C, Paint Brush Hills, Filing No. 13 A, Falcon, Colorado,* prepared by RMG – Rocky Mountain Group, Job No. 191726, dated April 3, 2023.
2. *Subsurface Soil Investigation, Paint Brush Hills, Filing No. 13 E, Lots 16, 19-22, 27, 28, 30-32, 42, 44-49, 53, and 56, El Paso County, Colorado,* prepared by RMG – Rocky Mountain Group, Job No. 180347, dated March 30, 2021.
3. *Subsurface Soil Investigation, District 49, North Site Elementary School, 11243 Londonderry Road, Falcon, Colorado,* prepared by RMG – Rocky Mountain Group, Job No. 155688, last dated January 20, 2017.

The findings, conclusions and recommendations contained in this reports were considered during the preparation of this report.

3.4 Additional Documents

Additional documents reviewed during the performance of this study are included in Appendix A.

4.0 SITE CONDITIONS

4.1 Existing Site Conditions

The site is currently vacant undeveloped land situated within the Paint Brush Hills area. The site is generally located south and west of the intersection of Londonderry Drive and Towner Avenue, within El Paso County, Colorado. The site is bound to the north by Londonderry Drive, to the west and south by single-family residences of the Paint Brush Hills, Filing No. 13C subdivision, and to the east by Towner Avenue.

4.2 Topography

Based on the USGS 2022 topographic map of the Falcon Quadrangle, the site generally slopes down to the center from all four sides of the property. Slopes across the property range between 1 to 20 percent. No apparent drainageways or natural waterways were observed on the property. Historically, the site appears to have had areas of ponding surface water near the southern property boundary.

4.3 Vegetation

The site vegetation primarily consists of low lying native grasses, weeds, and other prairie-type vegetation that have repopulated after the partial overlot grading operations.

4.4 Aerial Photographs and Remote-Sensing Imagery

Personnel of RMG reviewed aerial photos available through Google Earth Pro dating back to 1985, Colorado Geological Survey (CGS) surficial geologic mapping, and historical photos by

historicaerials.com dating back to 1947. Development in the Paint Brush Hills area began prior to 1999. Development of the area immediately surrounding the site occurred between 1999 and 2017. The site has remained vacant, undeveloped land.

5.0 FIELD INVESTIGATION AND LABORATORY TESTING

The subsurface conditions within the property were explored by drilling three (3) exploratory borings for the main building and three (3) exploratory borings for the parking areas on February 20, 2023 (RMG Job No. 191726, referenced above), extending to depths of approximately 20 feet below the existing ground surface. The test borings were spaced to provide soil information for the lot and the proposed parking lot. The Site Plan is presented in Figure 2.

The number of borings is in excess of the minimum one test boring per 10 acres of development up to 100 acres and one additional boring for every 25 acres of development above 100 acres as required by the ECM, Section C.3.3.

The test borings were drilled with a power-driven, continuous-flight auger drill rig. Samples were obtained during drilling of the test boring in general accordance with ASTM D-1586 and D-3550, utilizing a 2-inch O.D. Split Barrel Sampler and a 2½-inch O.D. California sampler, respectively. An Explanation of Test Boring Logs and the Test Boring Logs are presented in the referenced Subsurface Soil Investigation, included in Appendix B.

5.1 Laboratory Testing

Soil laboratory testing was performed as part of this investigation. The laboratory tests included moisture content, grain-size analyses, and Atterberg Limit tests. Due to the relatively infrequent occurrences and thin layers of sandy clay and claystone, suitable representative samples could not be obtained for swell/consolidation testing. The laboratory results are presented in Appendix B.

5.2 Groundwater

Groundwater was not encountered at the time of drilling, nor were there indications of increased moisture 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.

6.0 SOIL, GEOLOGY, AND ENGINEERING GEOLOGY

The site is located within the central portion of the Great Plains Physiographic Province. The site exists within the southern portion of a large structural feature known as the Denver Basin. In general, the on-site surficial soils consist of a combination of sand, silt, clay, and occasional gravels that overlie the Dawson Arkose sandstone. Portions of the site have had the native material disturbed.

6.1 Subsurface Soil Conditions

The subsurface materials encountered in the test borings were classified visually in the field and within the laboratory using the Unified Soil Classification System (USCS). The majority of the onsite materials were

encountered in their native state. The materials were identified and classified as clayey sand (SC) and silty sand (SM).

Additional descriptions and the interpreted distribution (approximate depths) of the subsurface materials are presented on the Test Boring Logs. The classifications shown on the logs are based upon the visual classification of the samples at the depths indicated. Stratification lines shown on the logs represent the approximate boundaries between material types and the actual transitions may be gradual and vary with location.

6.2 Bedrock Conditions

In general, the bedrock (as mapped by Colorado Geologic Survey - CGS) beneath the site is considered to be part of the Dawson Formation. Bedrock was encountered at the surface in the five borings performed by RMG. Overall, the on-site sands and sandstone can readily be excavated with standard construction equipment such as a front-end loader or excavator.

6.3 U.S. Soil Conservation Service

The USDA/NRCS soil survey identified one soil type on the property:

- 71 – Pring coarse sandy loam, 3 to 8 percent slopes. The Pring coarse sandy loam encompasses the entire property. Properties of the Pring coarse sandy loam include, well-drained soil, depth of the water table is anticipated to be more than 80 inches, runoff is anticipated to be low, frequency of flooding is none and ponding is none. Landforms include hills. The hydrologic soil group of the unit is B.

The USDA Soil Survey Map is presented in Figure 3.

6.4 General Geologic Conditions

Based on our review of relevant geologic maps, we identified the geologic conditions (listed below) affecting the development, as shown on the Engineering and Geology Map, Figure 4.

The site generally consists of alluvium and eolian deposits of the Holocene and Upper Pleistocene overlying the Dawson Formation. Three units were mapped at the site as:

- *Tka – Dawson Arkose (Paleocene to Eocene)* – white and tan thick to massive, contains beds of medium-grained fledspathic and friable sandstone that is poorly sorted and have high clay contents. Unit also contains sparse interbeds of claystone and sandstone that contains fossilized plant fragments. Thickness is estimated to be approximately 700 feet in the in the Falcon quadrangle area.
- *psw – potentially seasonally wet* – areas that have historically retained surface water runoff.
- *Af – artificial fill* – areas that have been built up around the site due to the neighboring development.

6.5 Engineering Geology

One engineering geology unit was mapped at the site and is shown on the Engineering and Geology Map, Figure 4.

- *2A* – Stable alluvium, colluvium and bedrock on gentle to moderate slopes (0-12%)

The map unit description for the above units were provided by Charles Robinson and Associates (1977).

6.6 Structural Features

Structural features such as schistocity, folds, zones of contortion or crushing, joints, shear zones or faults were not observed by RMG on the site or in the surrounding area.

6.7 Surficial (Unconsolidated) Deposits

Lake and pond sediments, swamp accumulations, sand dunes, marine terrace deposits, talus accumulations, and creep were not observed on the site. Slump and slide debris were also not observed on the site.

6.8 Features of Special Significance

Features of special significance such as accelerated erosion, (advancing gully head, badlands, or cliff reentrants) were not observed on the property. Features indicating settlement or subsidence such as fissures, scarplets, and offset reference features were not observed on the site or surrounding areas.

Features indicating creep, slump, or slide masses in bedrock and surficial deposits were not observed on the property.

6.9 Groundwater and Drainage of Surface Water

The overall topography of the site slopes down to the south and east. Groundwater was not encountered at the time of drilling. However, it should be noted that in granular soils and bedrock, some subsurface water conditions might be encountered due to the variability of the soil profile. Isolated sand and gravel layers within the soil, even those of limited thickness and width, can convey subsurface water. Subsurface water may also flow atop the interface between the upper soils and the underlying bedrock. While not indicative of a "groundwater" condition, these occurrences of subsurface water migration can (especially in times of heavy rainfall or snowmelt) result in water migration into the excavation or (once construction is complete) the building envelope. Builders and planners should be cognizant of the potential for the occurrence of subsurface water conditions during on-site construction, and be prepared to evaluate and mitigate each individual occurrence as necessary.

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.

6.10 Flooding and Surface Drainage

Based on our review of the Federal Emergency Management Agency (FEMA) Community Panel No. 08041C0551G and the online ArcGIS El Paso County Risk Map, the entire site lies outside of a 100-year floodplain.

Zone X is defined by FEMA as an area of minimal flood hazard that is determined to be outside the Special Flood Hazard Area and higher than the elevation of the 0.2-percent-annual-chance (or 500-year) flood. It's our understanding that the entire site lies within Zone X. The FEMA Map is presented in Figure 6.

Currently, the surface drainage on-site is uncontrolled. Chromatic Terrace, a cul-de-sac near the southwest corner of the property, sheetwashes water from the paved surface down onto the site. Over time, this surface water has created ponding water at the surface. Proposed drainage improvements are to include new storm inlet that is to reroute the surface water from Chromatic Terrace to an off-site drainage facility, located southeast of the property. The areas of surface water are currently indicated as potentially seasonally wet *(psw)* on the Engineering and Geology Map, Figure 4. These areas are anticipated to slowly dissipate once the proposed drainage improvements are installed.

7.0 ECONOMIC MINERAL RESOURCES

Under the provision of House Bill 1529, it was made a policy by the State of Colorado to preserve for extraction commercial mineral resources located in a populous county. Review of the *El Paso Aggregate Resource Evaluation Map, Master Plan for Mineral Extraction*, *Map 2* indicates the site is identified as Upland Deposits. The deposits are composed of sand, gravel with silt and clay. These deposits are remnants of older streams deposited on topographic highs or bench like features. The tract is underlain primarily by the Dawson Arkose, a sedimentary formation of Tertiary age related to uplift and erosion of the Front Range.

According to the *Evaluation of Mineral and Mineral Fuel Potential of El Paso County State Mineral Lands*, the site is mapped within the Denver Basin Coal Region. However, the area of the site has been mapped “Poor" for coal resources. In this part of the Denver coal region, coal resources are locally present within the lower part of the Laramie Formation of Upper Cretaceous age. The area contains strata that may contain coal. This area is not prospective for metallic mineral resources. Alluvial deposits are commonly mined in the region for sand and gravel.

8.0 IDENTIFICATION AND MITIGATION OF POTENTIAL GEOLOGIC CONDITIONS

The El Paso County Engineering Criteria Manual recognizes and delineates the difference between geologic hazards and constraints. A *geologic hazard* is one of several types of adverse geologic conditions capable of causing significant damage or loss of property and life. Geologic hazards are defined in Section C.2.2 Sub-section E.1 of the ECM. A *geologic constraint* is one of several types of adverse geologic conditions capable of limiting or restricting construction on a particular site. Geologic constraints are defined in Section C.2.2 Sub-section E.2 of the ECM (1.15 Definitions of Specific Terms and Phrases). The following geologic hazards and constraints were considered in the preparation of this report and are not anticipated to pose a significant risk to the proposed development:

- Avalanches
- Compressible Soils
- Debris Flows-Fans/Mudslides
- Ground Subsidence and Abandoned Mining Activity
- Landslides
- Rockfall

- Steeply Dipping Bedrock
- History of Landfill
- Valley Fill
- Downhill/Down-slope Creep
- Scour, Erosion, Accelerated Erosion Along Creek Banks and Drainageways

The following sections present the geologic conditions that have been identified on (or anticipated to be on) the property:

8.1 Potentially Expansive Soils and Bedrock - constraint

Based on our experience with the soils and bedrock in the vicinity, sandy clay and claystone bedrock (if encountered) generally possess low to high swell potential. The sandy clay and claystone were not encountered in the test borings performed by RMG for the subsurface soil investigation, included in Appendix B. It is anticipated if expansive clay soils or claystone bedrock are encountered at the time of the site-specific excavation observation, additional mitigations will be required at the time of the open excavation observation. These materials are readily mitigated with typical construction practices common to this region of El Paso County, Colorado.

Mitigation

Sporadic areas of expansive soils and bedrock are anticipated within the Dawson Formation. If expansive soils or bedrock are encountered beneath the foundations, mitigation will be required. Overexcavation and replacement with non-expansive (on-site or imported) soils is a suitable mitigation. "Mass" subexcavation during land development is currently not proposed. Floor slabs bearing directly on expansive material should be expected to experience movement. Overexcavation and replacement has also been successful in reducing slab movement. Overexcavation for expansive soils/bedrock is not anticipated. However, if clay or claystone seams are encountered, overexcavation depths of 3 to 4 feet may be recommended.

The final determination of mitigation alternatives and foundation design criteria is to be made in site-specific subsurface soil investigations for each lot. Provided that appropriate mitigations and/or foundation design adjustments are implemented, the presence of expansive soils or bedrock is not considered to pose a risk to the proposed structures.

8.2 Springs and Groundwater – constraint

Based on the site observations, review of USGS topographic maps dating back to 1951, and review of Google Earth images dating back to 1999, springs do not appear to originate on the subject site. Furthermore, water and areas of seasonal shallow groundwater were not encountered during our investigation.

Drilling occurred during the month of January. Generally, seasonal groundwater levels are considered lower in the winter months (November through February). The presence of groundwater was not observed in the test borings. Groundwater measurements are limited to the time of year measured and are considered snapshots only.

Fluctuations in groundwater and subsurface moisture conditions may occur due to variations in rainfall and other factors not readily apparent at this time. Groundwater information obtained at the time of the preliminary investigations performed prior to any future land development may or may not be representative of the conditions present at the time of construction. Furthermore, the development

processes (reshaping of the ground surface, installation of buried utilities, installation of an underdrain below the roadways, etc.) can significantly alter the depth and flow paths of the subsurface water. The construction of surrounding lots can also alter the amount and depth of subsurface groundwater below a given lot. The potential exists for high groundwater levels during high moisture periods and should structures encroach on these areas, the following mitigations should be followed.

Mitigation

Currently, the proposed development is for an 8,000 square-foot building for Foundation Lutheran Church, to include parking, playground, play field, and pavilion. Construction is anticipated to consist of wood-framed structure atop a slab-on-grade foundation. The shallow foundation is anticipated to have a minimum 4 to 6 feet separation from any potentially underlying seasonally fluctuating groundwater.

It is assumed underground water beneath the subject site predominates in fractured weathered consolidated sedimentary bedrock located at depth. If deeper foundations are proposed in the future or if shallower underground water conditions are encountered at the time of the open excavation observation, mitigations are to be provided at that time.

Due to the limited cut and fills proposed, groundwater is not anticipated to be encountered in the excavations or utility trenches. Foundations must have a minimum 30-inch depth for frost protection. Perimeter drains are recommended around portions of the structures which will have habitable or storage space located below the finished ground surface. This includes crawlspace areas but not the walkout trench, if applicable. Perimeter drains help reduce the risk of the intrusion of water into areas below grade.

8.3 Seasonal Surface Water – constraint

The site currently contains three low-lying areas near the southern portion of the property. In reviewing aerial photos, some depict darker shades that could indicate surface runoff is being retained in these areas. We anticipate the potential for periodically high surface moisture conditions in these areas.

Mitigation

Foundations are not proposed in the existing low-lying areas. These areas are to be reworked into new playing fields. A detention or retention pond is not proposed for the site. However, a note on the site plan indicates a 10-foot public utility and drainage easement near the southern property boundary and a 20-foot drainage easement along the eastern property boundary. The existing flows across the property are currently directed to the temporary swale that redirects the surface to an inlet near the southeast corner of the site.

Proposed drainage improvements are to include a new storm inlet that is to reroute the surface water from the west to the east. The areas of surface water are currently indicated as potentially seasonally wet *(psw)* on the Engineering and Geology Map, Figure 4.

8.4 Uncontrolled/Undocumented Fill Placement- constraint

Fill soils were encountered in one of the test borings during our investigation. Fill soils may be encountered at various depths across the site and potentially within the foundation excavation during construction of the proposed church.

Mitigation

As of the issue date of this report, no documentation has been provided to RMG indicating that the fill was placed in a controlled manner, or that it was observed or tested during placement. Until such documentation is provided, the fill soils encountered on the site are considered non-engineered and are not suitable for support of foundation components. These unsuitable fill soils may be encountered in the excavations, even on lots where none are indicated on the test boring logs. Furthermore, any fill placed atop those unsuitable fill soils will also be considered unsuitable for support of foundation components, unless the new fill soils comprise one component of a foundation bearing enhancement system. This report does not include recommendations for design or construction of such a bearing enhancement system. If such recommendations are desired, contact personnel of RMG for more information.

8.5 Corrosive Minerals - constraint

Sandstone bedrock underlies the entire site. Sandstone bedrock is generally considered to contain corrosive minerals.

Mitigation

Sulfate testing was performed on selected samples based on ASTM C1580. Test results showed 0.0% by weight, indicating the soils present Class 0 (negligible) sulfate exposure. Based on these results Type I/II cement or an equivalent mixture according to ACI 201.2R-10 is suggested for concrete in contact with the subsurface materials. Cement type shall be designed and approved by a licensed Colorado Professional Engineer and Foundation Designer. Calcium chloride should not be used for the onsite soils. 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.

The To help mitigate potential corrosion, buried ferrous metal piping, conduit, and similar construction materials should be coated, wrapped or otherwise protected to avoid or reduce contact with the on-site soils. For environments corrosive to concrete, sulfate-resistant cement and additives should be used.

8.5 Faults and Seismicity - hazard

Based on review of the Earthquake and Late Cenozoic Fault and Fold Map Server provided by CGS located at http://dnrwebmapgdev.state.co.us/CGSOnline/ and the recorded information dating back to November of 1900, Colorado Springs has not experienced a recorded earthquake with a magnitude greater than 1.6 during that period. The nearest recorded earthquakes over 1.6 occurred in December of 1995 in Manitou Springs, which experienced magnitudes ranging between 2.8 to 3.5. Additional earthquakes over 1.6 occurred between 1926 and 2001 in Woodland Park, which experienced magnitudes ranging from 2.7 to 3.3. Both of these locations are located near the Ute Pass Fault, which is greater than 10 miles from the subject site. Earthquakes felt at this site will most likely result from minor shifting of the granite mass within the Pikes Peak Batholith, which includes pull from minor movements along faults found in the

Denver basin. It is our opinion that ground motions resulting from minor earthquakes may affect structures (and the surrounding area) at this site if minor shifting were to occur.

Mitigation

In accordance with the Minimum Design Loads and Associated Criteria for Buildings and Other Structures, ASCE/SEI 7-16, seismic design parameters have been determined for this site. The seismic site class has been interpreted from the results of the soil test borings drilled within the project site. The Advanced Technology Council seismic design tool has been used to determine the seismic response acceleration parameters. The soil on this site is not considered susceptible to liquefaction.

The following recommended seismic design parameters are based upon Seismic Site Class D, and a 2-percent probability of exceedance in 50 years. The Seismic Design Category is "B".

Period (sec)	Mapped MCE Spectral Response Acceleration (g)		Site Coefficients		Adjusted MCE Spectral Response Acceleration (g)		Design Spectral Response Acceleration (g)	
0.2	S_s	0.188	F_a	1.6	S_{ms}	0.301	S_{ds}	0.201
1.0	S_1	0.055	F_v	2.4	S_{m1}	0.133	S_{d1}	0.089

Notes: MCE = Maximum Considered Earthquake
g = acceleration due to gravity

8.6 Radon – constraint

***"Radon Act 51** passed by Congress set the natural outdoor level of radon gas (0.4 pCi/L) as the target radon level for indoor radon levels".*

Northern El Paso County and the 80831 zip code in which the site is located, has an EPA assigned Radon Zone of *1*. A radon Zone of 1 predicts an average indoor radon screening level greater than 0.4 pCi/L (picocuries per liter), which is above the recommended levels assigned by the EPA. *The EPA recommends corrective measures to reduce exposure to radon gas.*

All of the State of Colorado is considered EPA Zone 1 based on the information provided at https://county-radon.info/CO/El_Paso.html. Elevated hazardous levels of radon from naturally occurring sources are not anticipated at this site.

Mitigation

Radon hazards are best mitigated at the building design and construction phases. Providing increased ventilation of basements, crawlspaces, creating slightly positive pressures within structures, and sealing of joints and cracks in the foundations and below-grade walls can help mitigate radon hazards. Passive radon mitigation systems are also available.

Passive and active mitigation procedures are commonly employed in this region to effectively reduce the buildup of radon gas. Measures that can be taken after the residence is enclosed during construction include installing a blower connected to the foundation drain and sealing the joints and cracks in concrete floors and foundation walls. If the occurrence of radon is a concern, it is recommended that the residence be tested after they are enclosed and commonly utilized techniques are in place to minimize the risk.

9.0 DETENTION STORAGE CRITERIA

It is our understanding no on-site drainage facility is currently proposed. Per the Drainage Report, referenced in Appendix A, an existing storm drain pipe located in the southwest corner of the site connects to the storm drain that runs off site.

10.0 BEARING OF GEOLOGIC CONDITIONS UPON PROPOSED DEVELOPMENT

Geologic hazards (as described in section 8 of this report) found to be present at this site include potentially faults and seismicity. Geologic conditions (as described in section 8 of this report) found to be present at this site include potentially expansive bedrock, potentially uncontrolled/undocumented fill placement, and seasonally fluctuating groundwater. It is our opinion that the existing geologic and engineering conditions can be satisfactorily mitigated through proper engineering, design, and construction practices.

11.0 CONCLUSIONS

Based upon our evaluation of the geologic conditions, it is our opinion any proposed future development is feasible. The geologic conditions identified are considered typical for the Front Range region of Colorado. Mitigation of geologic conditions is most effectively accomplished by avoidance. However, where avoidance is not a practical or acceptable alternative, geologic conditions should be mitigated by implementing appropriate planning, engineering, and suitable construction practices.

We believe the sand and sandstone will classify as Type B material as defined by OSHA. OSHA requires that temporary excavations made in Type B materials be laid back at ratios no steeper than 1:1 (horizontal to vertical), unless the excavation is shored and braced. Excavations deeper than 20 feet, or when water is present, should always be braced or the slope designed by a professional engineer.

Long term cut slopes in the upper soil should be limited to no steeper than 3:1 (horizontal to vertical). Flatter slopes will likely be necessary should groundwater conditions occur. It is recommended that long term fill slopes be no steeper than 3:1 (horizontal to vertical).

Revisions and modifications to the conclusions and recommendations presented in this report may be issued subsequently by RMG based upon additional observations made during grading and construction, which may indicate conditions that require re-evaluation of some of the criteria presented in this report.

It is important for the Owner(s) of each lot read and understand this report, and to carefully familiarize themselves with the geologic hazards associated with construction in this area. This report only addresses the geologic constraints contained within the boundaries of the site referenced above.

12.0 CLOSING

This report has been prepared for the exclusive purpose of providing geotechnical engineering information and recommendations for development described in this report. RMG should be retained to review the

final construction documents prior to construction to verify our findings, conclusions and recommendations have been appropriately implemented.

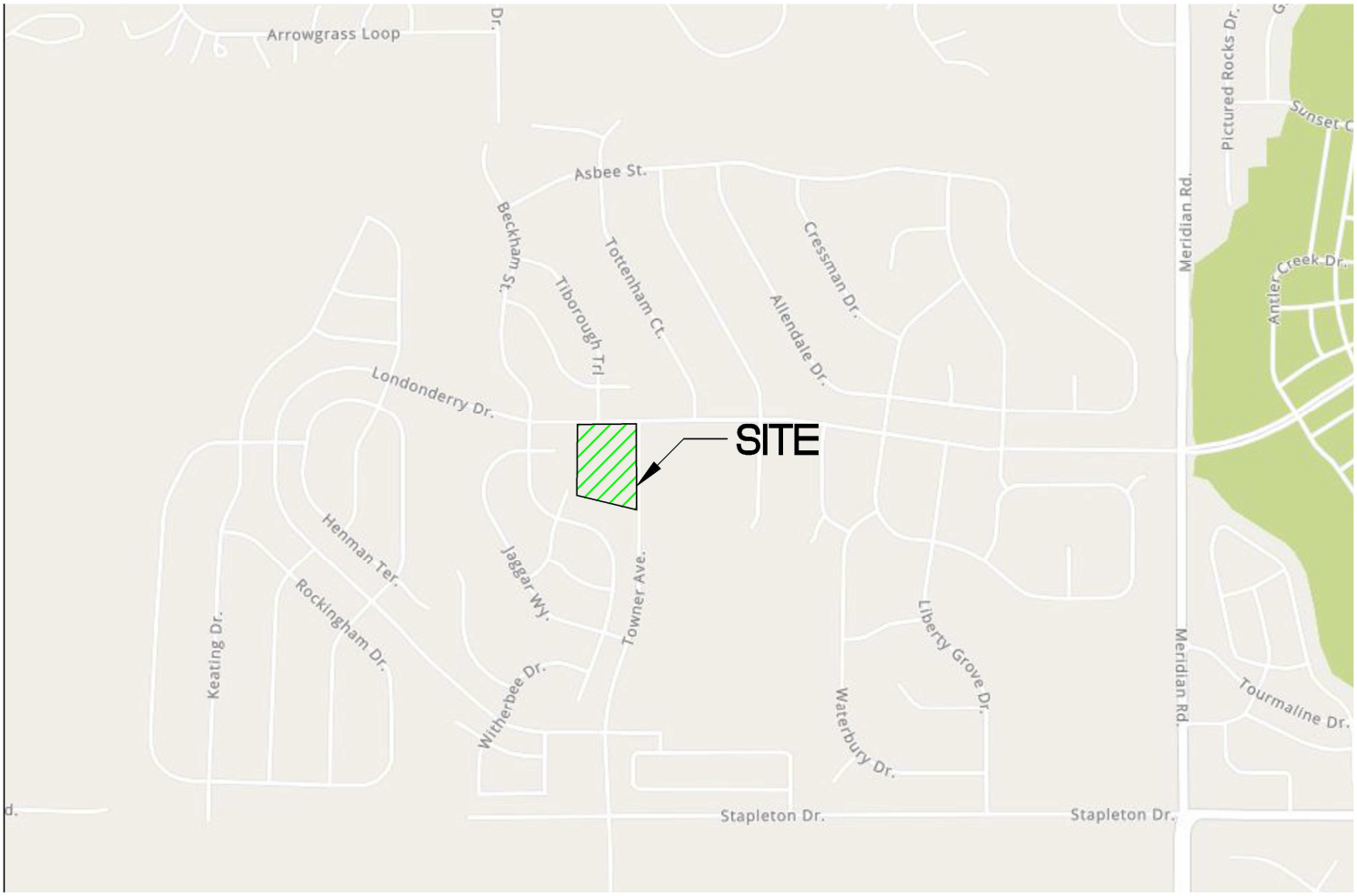
This report has been prepared for the exclusive use by **Colorado Commercial Construction** for application as an aid in the design and construction of the proposed development in accordance with generally accepted geotechnical engineering practices. The analyses and recommendations in this report are based in part upon data obtained from test borings, site observations and the information presented in referenced reports. The nature and extent of variations may not become evident until construction. If variations then become evident, RMG should be retained to review the recommendations presented in this report considering the varied condition, and either verify or modify them in writing.

Our professional services were performed using that degree of care and skill ordinarily exercised, under similar circumstances, by geotechnical engineers practicing in this or similar localities. RMG does not warrant the work of regulatory agencies or other third parties supplying information which may have been used during the preparation of this report. No warranty, express or implied is made by the preparation of this report. Third parties reviewing this report should draw their own conclusions regarding site conditions and specific construction techniques to be used on this project.

The scope of services for this project does not include, either specifically or by implication, environmental assessment of the site or identification of contaminated or hazardous materials or conditions. Development of recommendations for the mitigation of environmentally related conditions, including but not limited to biological or toxicological issues, are beyond the scope of this report. If the Client desires investigation into the potential for such contamination or conditions, other studies should be undertaken.

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

FIGURES



NOT TO SCALE

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Southern Colorado, Denver Metro, Northern Colorado

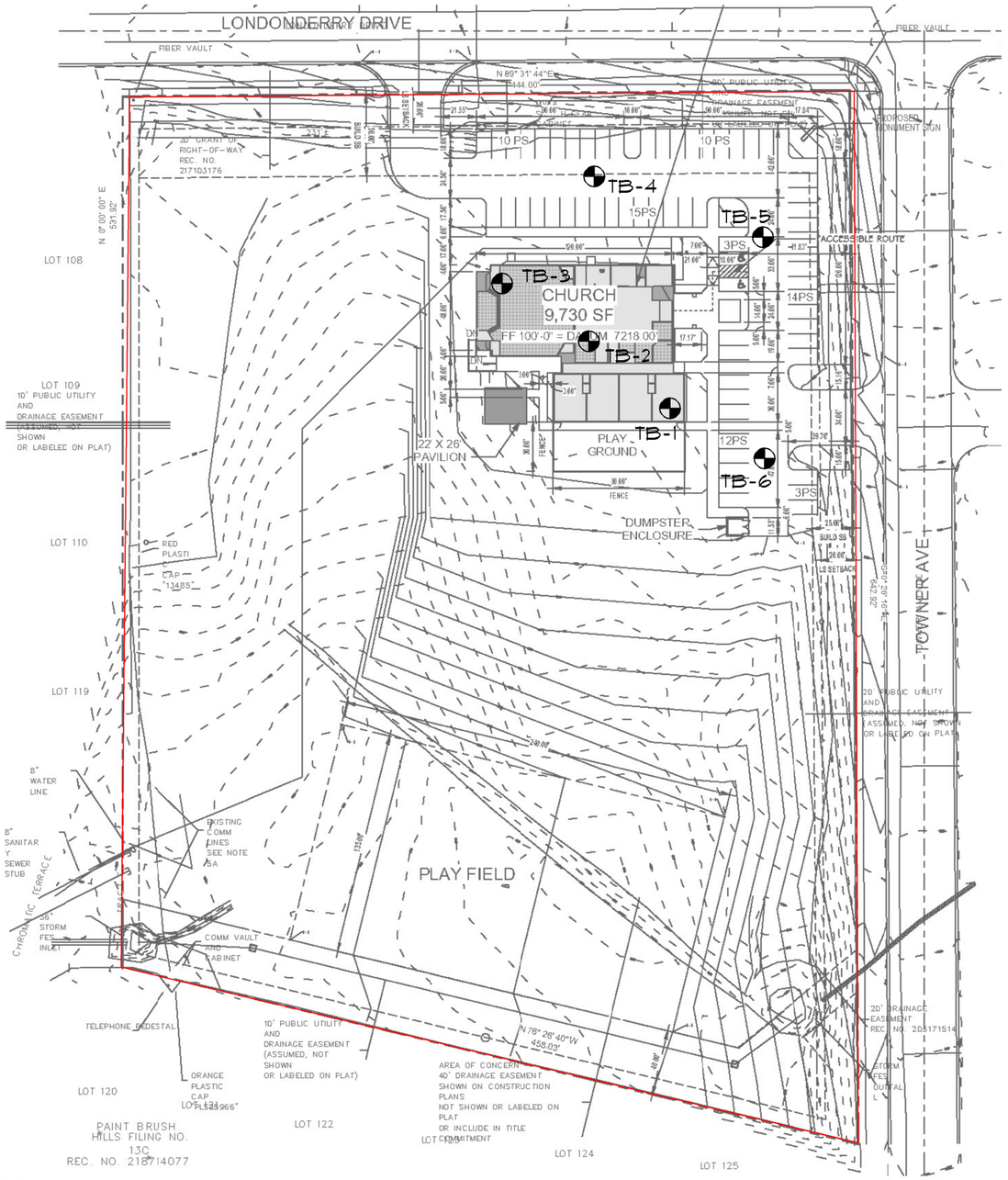
SITE VICINITY MAP

9660 TOWNER AVENUE
TRACT C, PAINT BRUSH HILLS, FILING NO. 13A
EL PASO COUNTY, COLORADO
COLORADO COMMERCIAL CONSTRUCTION

JOB No. 191726

FIG No. 1

DATE 9-26-2023



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BASE MAP PROVIDED BY: RMG - ROCKY MOUNTAIN GROUP

DENOTES APPROXIMATE LOCATION OF TEST BORINGS PERFORMED FOR THE SUBSURFACE SOIL INVESTIGATION BY RMG, DATED APRIL 3, 2023

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FILING NO. 13A
EL PASO COUNTY, COLORADO
COLORADO COMMERCIAL
CONSTRUCTION

ENGINEER:	TM
DRAWN BY:	KZ
CHECKED BY:	TM
ISSUED:	9-26-2023

SITE PLAN

SHEET No.
FIG-2

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71 - Pring coarse sandy loam, 3 to 8 percent slopes

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USDA SOIL SURVEY MAP

9660 TOWNER AVENUE
TRACT C, PAINT BRUSH HILLS, FILING NO. 13A
EL PASO COUNTY, COLORADO
COLORADO COMMERCIAL CONSTRUCTION

JOB No. 191726

FIG No. 3

DATE 9-26-2023

General Geologic Conditions

- *Tkd - Dawson Arkose Formation* - sandstone bedrock with interbedded claystone seams underlies the entire site
- *psw - potentially seasonally wet* - areas that have historically retained surface water runoff.
- *Af - Artificial fill* - areas that have been built up around the site due to the neighboring development.

Engineering Geology

- *2A* - Stable alluvium, colluvium and bedrock on gentle to moderate slopes (0-12%)

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BASE MAP PROVIDED BY: JPS Engineering

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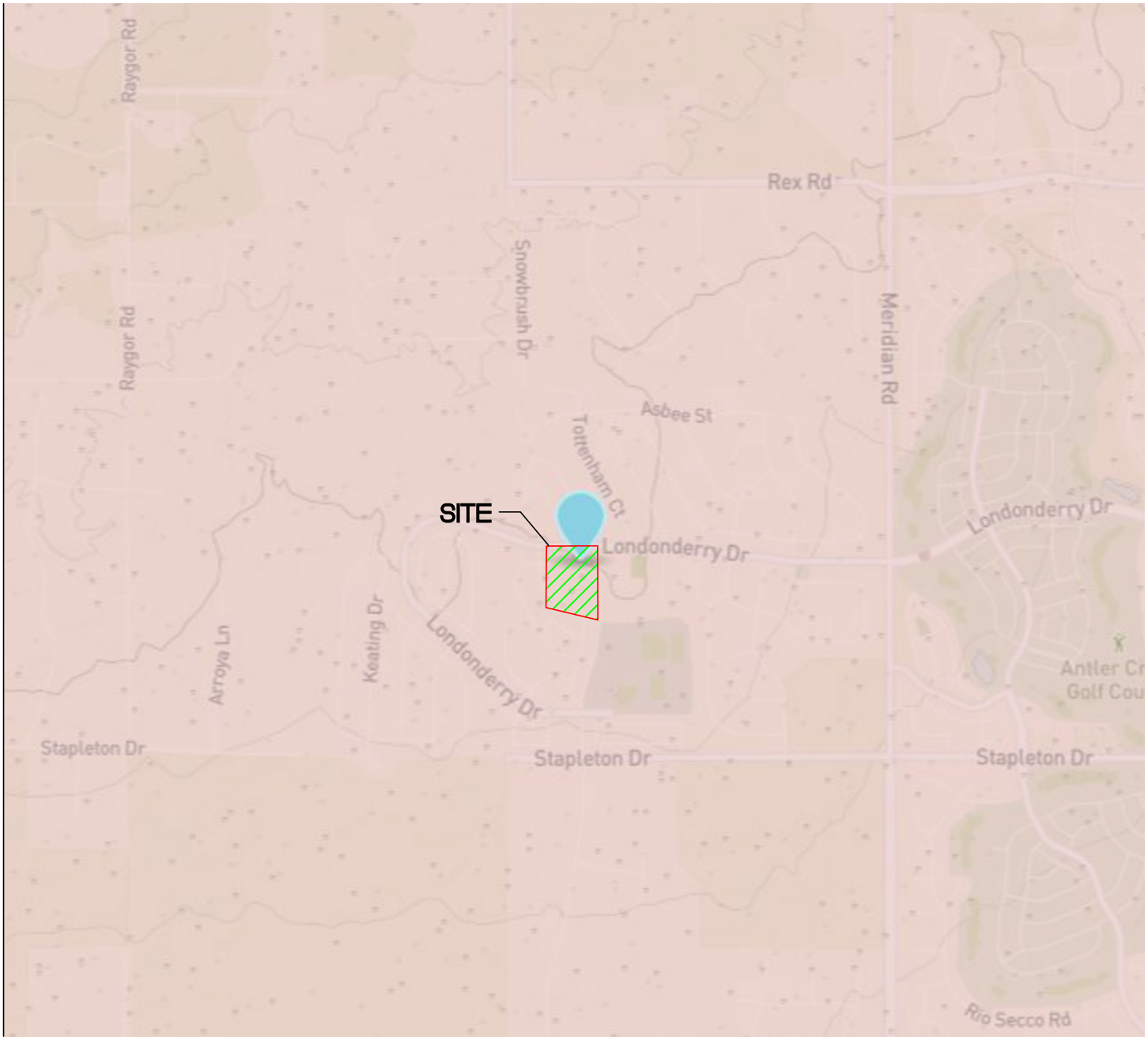
TRACT C, PAINT BRUSH HILLS
FILING NO. 13A
EL PASO COUNTY, COLORADO
COLORADO COMMERCIAL
CONSTRUCTION

ENGINEER:	TM
DRAWN BY:	KZ
CHECKED BY:	TM
ISSUED:	9-26-2023

ENGINEERING AND GEOLOGY MAP

SHEET No.
FIG-4



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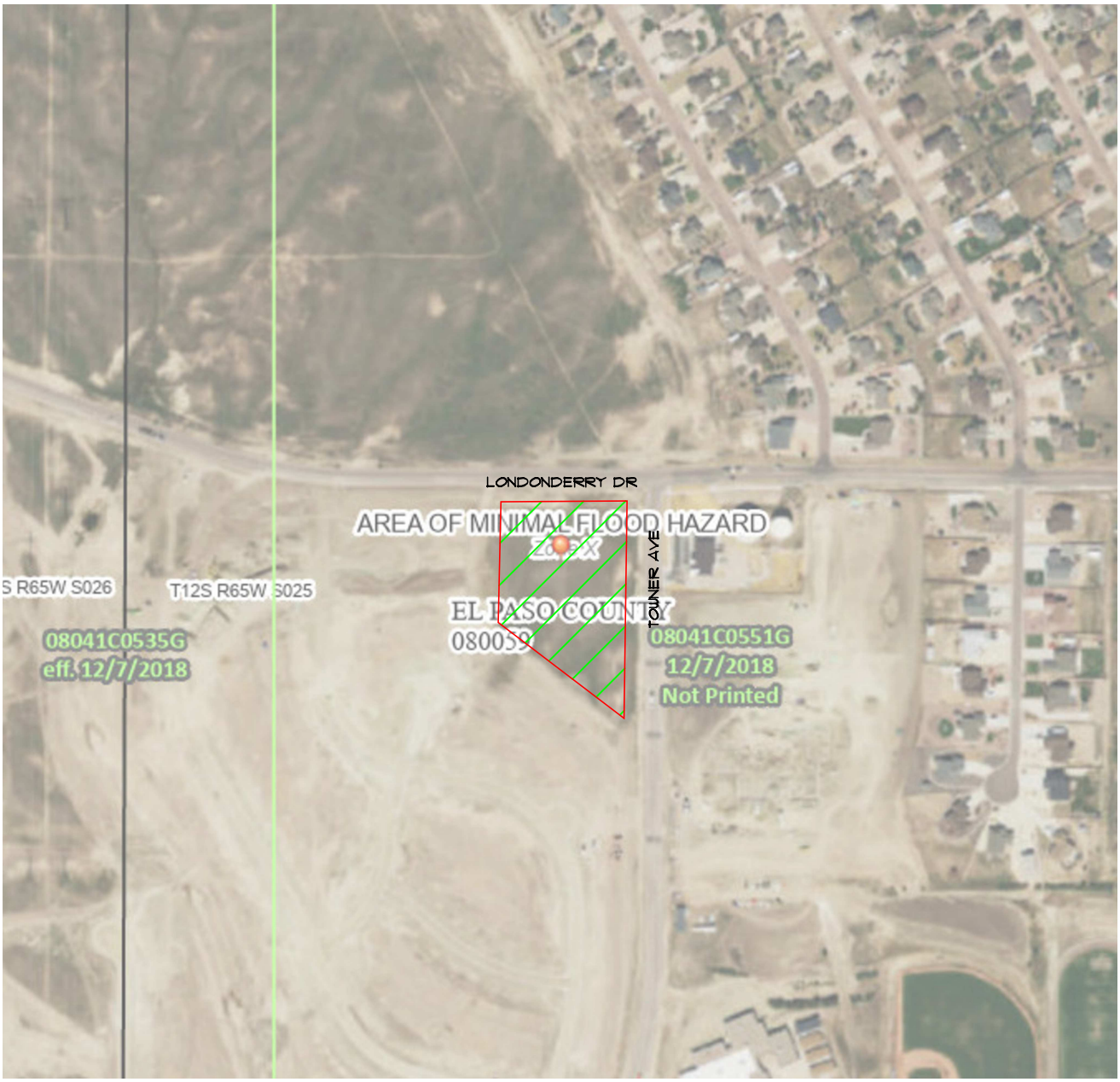
USGS TOPO MAP

9660 TOWNER AVENUE
TRACT C, PAINT BRUSH HILLS, FILING NO. 13A
EL PASO COUNTY, COLORADO
COLORADO COMMERCIAL CONSTRUCTION

JOB No. 191726

FIG No. 5

DATE 9-26-2023



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FEMA MAP

9660 TOWNER AVENUE
TRACT C, PAINT BRUSH HILLS, FILING NO. 13A
EL PASO COUNTY, COLORADO
COLORADO COMMERCIAL CONSTRUCTION

JOB No. 191726

FIG No. 6

DATE 9-26-2023

APPENDIX A
Additional Reference Documents

1. *Contours & Parcels Public Access Map,* Colorado Springs Utilities, map created September 13, 2023.
2. *Final Drainage Report, Foundation Lutheran Church, Towners Ave, Tract C, Paint Brush Hills, Filing No. 13A,* prepared by RMG – Rocky Mountain Group, Job No. 191726, dated March 28, 2023.
3. *Geotechnical Report, Equipment Storage Facility, 10028 Jagger Way, Peyton, Colorado,* RMG – Rocky Mountain Group, Job No. 179938, dated April 1, 2021.
4. *Subsurface Soil Investigation, Lots 24-25, 33-36, and 57, Paint Brush Hills, Filing No. 13, El Paso County, Colorado,* RMG – Rocky Mountain Group, Job No. 173692, dated March 24, 2020.
5. *Subsurface Soil Investigation, Lots 2-4, 11-15, 121-129, 133-144, and 149-158, Paint Brush Hills, Filing No. 13E,* RMG – Rocky Mountain Group, Job No. 173629, dated January 22, 2020.
6. *Subsurface Soil Investigation, Lots 25-120, 130-132, and 145-148, Paint Brush Hills, Filing No. 13E,* RMG – Rocky Mountain Group, Job No. 171983, dated October 3, 2019.
7. *Flood Insurance Rate Map, El Paso County, Colorado and Unincorporated Areas, Community Panel No. 08041C0551G,* Federal Emergency Management Agency (FEMA), effective December 7, 2018.
8. *Falcon Quadrangle Geologic Map, El Paso County, Colorado,* Morgan, M.L., and White, J.L. Colorado Geological Survey, Open-File Report OF-12-05, 2012.
9. *Environmental and Engineering Geologic Map for Land Use*, *Falcon Quadrangle*, compiled by Dale M. Cochran, Charles S. Robinson & Associates, Inc., Golden, Colorado, 1977.
10. *Map of Potential Geologic Hazards and Surficial Deposits, Falcon Quadrangle*, compiled by Dale M. Cochran, Charles S. Robinson & Associates, Inc., Golden, Colorado, 1977.
11. Pikes Peak Regional Building Department: https://www.pprbd.org/.
12. *El Paso County Assessor Website:* https://property.spatialest.com/co/elpaso/#/property/5225311010
13. *Colorado Geological Survey, USGS Geologic Map Viewer*: http://coloradogeologicalsurvey.org/geologic-mapping/6347-2/.
14. *Historical Aerials:* https://www.historicaerials.com/viewer, Images dated 1947, 1955, 1960, 1969, 1983, 1984, 1985, 1999, 2005, 2009, 2011, 2013, 2015, 2017, and 2019.
15. *USGS Historical Topographic Map Explorer:* http://historicalmaps.arcgis.com/usgs/ El Paso County, Falcon Quadrangle, 2022.
16. *Google Earth Pro*, Imagery dated 1999, 2003, 2004, 2005, 2006, 2011, 2013, 2015, 2017, 2019, 2020, 2021, and 2022.
17. *Coal resources of the Denver and Cheyenne basins, Colorado,* Kirkham, R.M., and Ladwig, L.R., 1979,: Colorado Geological Survey Resource Series 5, 70 p., 5 plates
18. *Mineral resource data system (MRDS*): Mason, G. T., and Arndt, R. E., 1996, U.S. Geological Survey Digital Data Series DDS-20 (CD-ROM).
19. *Evaluation of Mineral and Mineral Fuel Potential of El Paso County State Mineral Lands*
20. The *El Paso Aggregate Resource Evaluation Map, Master Plan for Mineral Extraction*, *Map 1*

APPENDIX B

Subsurface Soil Investigation, RMG – Rocky Mountain Group

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SUBSURFACE SOIL INVESTIGATION

Foundation Lutheran Church
TR C, Paint Brush Hills, Filing No. 13A
Falcon, Colorado

PREPARED FOR:

Colorado Commercial Construction
12325 Oracle Blvd, Suite 120
Colorado Springs, CO 80921

JOB NO. 191726

April 3, 2023

Respectfully Submitted,

RMG – Rocky Mountain Group

Nathan Malefyt
Staff Geologist

Reviewed by,

RMG – Rocky Mountain Group

COLORADO REGISTERED
ANTHONY P. MUNGER
4/3/23
39818
PROFESSIONAL ENGINEER

Tony Munger, P.E.
Sr. Geotechnical Project Manager

TABLE OF CONTENTS

GENERAL SITE AND PROJECT DESCRIPTION

Project Description and Scope of Work

RMG has completed a geotechnical investigation for the proposed 1-story structure on conventional construction southwest of the intersection of Towner Avenue and Londonderry Drive, in the northeastern portion of El Paso County, Colorado. The purpose of the investigation was to evaluate the subsurface soil conditions and provide geotechnical design and construction criteria for the project. These services were provided in accordance with our Proposal for RMG Job No. 191726 dated February 10, 2023.

RMG understands the proposed church is to be a 1-story structure of conventional construction, with a footprint of approximately 8,000 square feet.

Existing Site Conditions

At the time of the subsurface investigation, the site appears to have been modified from a natural state. The site appears to have been cleared and grubbed, and leveled by overlot grading. The location of the site is shown on the Site Vicinity Map, Figure 1.

FIELD INVESTIGATION AND LABORATORY TESTING

Drilling

The subsurface conditions on the site were investigated by drilling three exploratory test borings to depths of approximately 20 feet within the proposed building footprint, and three test borings to depths of approximately 5 to 10 feet within the proposed parking areas. The approximate locations of the test borings are presented in the Test Boring Location Plan, Figure 2.

The test borings were advanced with a power-driven, continuous-flight auger drill rig. Soil samples were obtained in general accordance with ASTM D-1586 utilizing a 2-inch OD split-barrel sampler or in general accordance with ASTM D-3550 utilizing a 2½-inch OD modified California sampler. Samples were returned to RMG's materials testing laboratory for testing and analysis. An Explanation of Test Boring Logs is presented in Figure 3. The Test Boring Logs are presented in Figures 4 through 6.

Laboratory Testing

The moisture content for the recovered samples was obtained in the laboratory. Grain-size analysis and Atterberg Limits tests were performed on selected samples for purposes of classification and to develop pertinent engineering properties. A Summary of Laboratory Test Results is presented in Figure 7. Soil Classification Data are presented in Figures 8 and 9.

SUBSURFACE CONDITIONS

Subsurface Materials

The test borings revealed the soil strata across the site to be fairly consistent from boring to boring. The subsurface materials encountered in the test borings consisted of silty to clayey sand fill, and silty to clayey sandstone.

Additional descriptions and the interpreted distribution (approximate depths) of the subsurface materials are presented on the Test Boring Logs. The classifications shown on the logs are based upon the engineer's classification of the samples at the depths indicated. Stratification lines shown on the logs represent the approximate boundaries between material types and the actual transitions may be gradual and vary with location.

Groundwater

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. Groundwater is not expected to be a significant factor in foundation design. Fluctuations in groundwater and subsurface moisture conditions may occur due to seasonal variations in rainfall and other factors not readily apparent at this time.

Soil Parameters

The following table presents estimated in-situ soil parameters.

Soil Description	Unit Weight (lb/ft^3)	Friction Angle (degree)	Active Earth Pressure Ka	Passive Earth Pressure Kp	At-Rest Earth Pressure Ko	Modulus of Elasticity E_s (lb/in^2)	Poisson's Ratio μ_s
Silty Sand	120	28	0.361	2.77	0.531	1,500	0.20

Seismic Design

In accordance with the Minimum Design Loads and Associated Criteria for Buildings and Other Structures, ASCE/SEI 7-16, seismic design parameters have been determined for this site. The seismic site class has been interpreted from the results of the soil test borings drilled within the project site. The Advanced Technology Council seismic design tool has been used to determine the seismic response acceleration parameters. The soil on this site is not considered susceptible to liquefaction.

The following recommended seismic design parameters are based upon Seismic Site Class D, and a 2-percent probability of exceedance in 50 years. The Seismic Design Category is "B".

Period (sec)	Mapped MCE Spectral Response Acceleration (g)		Site Coefficients		Adjusted MCE Spectral Response Acceleration (g)		Design Spectral Response Acceleration (g)	
0.2	S_s	0.188	F_a	1.6	S_{ms}	0.301	S_{ds}	0.201
1.0	S_1	0.055	F_v	2.4	S_{m1}	0.133	S_{d1}	0.089

Notes: MCE = Maximum Considered Earthquake
g = acceleration due to gravity

CONCLUSIONS AND RECOMMENDATIONS

The following discussion is based on the subsurface conditions encountered in the test borings and the project characteristics previously described. If conditions are different from those described in this report or the project characteristics change, RMG should be retained to review and revise our recommendations as necessary.

Geotechnical Considerations

Fill soils were encountered during our investigation. As of the issue date of this report, no documentation has been provided to RMG indicating that the fill was placed in a controlled manner, or that it was observed or tested during placement. Until such documentation is provided, the fill soils encountered on the site are considered non-engineered and are not suitable for support of foundation components. These unsuitable fill soils may be encountered in the excavations, even on lots where none are indicated on the test boring logs. Furthermore, any fill placed atop those unsuitable fill soils will also be considered unsuitable for support of foundation components, unless the new fill soils comprise one component of a foundation bearing enhancement system. This report does not include recommendations for design or construction of such a bearing enhancement system. If such recommendations are desired, contact personnel of RMG for more information.

Based on the subsurface soil conditions encountered in our test borings, it is our opinion that a shallow foundation system is suitable for the proposed structure. Deep foundation systems, while not anticipated to be necessary, are also a suitable alternative for the proposed structure. If a deep foundation system is desired, please contact personnel of RMG for revised recommendations.

Site Preparation

Standard Penetration Test blow counts vary across the site and with depth. Due to this variability we recommend removing (overexcavating) the foundation areas and backfilling with compacted structural fill. The on-site material is suitable as structural backfill. Site preparation should include clearing and grubbing the site of all vegetation, topsoil, and any other deleterious material within the construction area and disposing this material appropriately. Where overexcavation has not already been performed due to fill soils, the area within the foundation footprint and a 1-foot perimeter beyond should be overexcavated one (1) foot below the bottom of footing elevation. Material from the excavation may be stockpiled for

reuse as structural backfill. An Open Excavation Observation should be made at this point to verify soil conditions are as reported in the soil boring logs herein.

Upon verification, the upper 6 inches of the exposed subsurface soils should then 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 Modified Proctor test (ASTM D-1557) or 98 percent of the maximum dry density as determined by the Standard Proctor test (ASTM D-698) prior to placing structural fill.

After compaction, the native material previously removed may be used as structural backfill to bring the site to bottom-of-footing grade. The material should not be excessively wet, should be free of organic matter and construction debris, and should not contain rock fragments greater than 3-inches in any dimension. The fill material should be moisture-conditioned to facilitate compaction (usually within 2 percent of the optimum moisture content) and placed in lifts of not more than 10 inches. Each loose lift should be compacted to a minimum of 95 percent of Modified Proctor maximum dry density as determined by the Modified Proctor test (ASTM D-1557) or 98 percent of the maximum dry density as determined by the Standard Proctor test (ASTM D-698). The first density tests should be conducted when 12 inches of compacted fill have been placed.

Foundation Recommendations

A spread footing foundation supported on compacted structural fill is suitable for the proposed structure. We have anticipated the deepest excavation cuts will be approximately 3 to 4 feet below the existing ground surface, not including overexcavation.

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 Observations

As referenced above, 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 to be used to modify the site preparation recommendations as necessary.

Floor Slabs

The in-situ sand soil exhibited nil swell potential in laboratory testing and should be stable at its natural moisture content. Any fill material placed below slabs should be granular, non-expansive material to reduce the potential for slab movement.

Areas under floor slabs should be overexcavated a minimum of 1-foot and the upper 6 inches of the exposed subsurface soils should then 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 Modified Proctor test (ASTM D-1557) or 98 percent of the maximum dry density as determined by the Standard Proctor test (ASTM D-698) prior to placing structural fill. Floor slabs should bear upon a minimum of 1-foot of structural backfill compacted to a minimum of 95 percent of Modified Proctor maximum dry density as determined by the Modified Proctor test (ASTM D-1557) or 98 percent of the maximum dry density as determined by the Standard Proctor test (ASTM D-698). Non-structural slabs should be isolated from foundation members with expansion material. To reduce the possibility of capillary rise of groundwater into the floor slab, and to reduce the potential for concrete curling, a minimum 3-inch layer of ¾-inch crushed stone over 6-mil vapor retarder may be placed atop the compacted structural fill. A conventionally-reinforced or post-tensioned slab supported on stemwalls or grade beams may also be considered for strength and to reduce the potential for movement, curling, and differential settlement.

Exterior Concrete Flatwork

Reinforced concrete exterior slabs should be constructed similarly to floor slabs on compacted structural fill, with the additional caveat they be isolated from the building with expansion material and have a downturned reinforced thickened edge. Conventionally-reinforced or post-tensioned slabs supported on stemwalls or grade beams may also be considered to reduce the potential for movement, curling, and differential settlement.

Lateral Earth Pressures

Foundation walls should be designed to resist lateral pressures. For non-expansive backfill materials, we recommend an equivalent fluid pressure of 40 pcf for design. Expansive soils or bedrock should not be used as backfill against walls. The above lateral pressure applies to level, drained backfill conditions. Equivalent Fluid Pressures for sloping/undrained conditions should be determined on an individual basis.

CONSTRUCTION CONSIDERATIONS

Surface Grading and Drainage

A contributing factor to foundation settlement and floor slab heave in Colorado Front Range soils is the introduction of excess water. Improper site grading and irrigation water are respectively the most common cause and source of excess water. 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. Where a 10-foot zone cannot be achieved, a well-defined swale should be created a minimum 5 feet from the foundation and parallel with the wall, with a minimum slope of 2 percent to collect 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(s). Future maintenance operations should include activities to maintain the surface grading and drainage recommendations herein 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 excess water will increase the likelihood of slab and foundation movements.

Perimeter Drain

The site soil is generally anticipated to be well-draining, and groundwater was not encountered at depths anticipated to impact the proposed construction. 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 if applicable. Where main-level slab-on-grade foundation systems are utilized, a subsurface perimeter drain will not be required around the foundation. An underslab drain is not anticipated to be necessary.

Concrete

Sulfate testing was performed on selected samples based on ASTM C1580. Test results showed 0.02% by weight, indicating the soils present Class 0 (negligible) sulfate exposure. Based on these results Type I/II cement or an equivalent mixture according to ACI 201.2R-10 is suggested for concrete in contact with the subsurface materials. Cement type shall be designed and approved by a licensed Colorado Professional Engineer and Foundation Designer. Calcium chloride should not be used for the onsite soils. 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 around foundation stemwalls and other buried structures should be placed in loose lifts of not more than 10-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) or to 92 percent of the maximum dry density as determined by the Standard Proctor test (ASTM D-698) 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 as determined by the Modified Proctor test (ASTM D-1557) or to 95 percent of the maximum dry density as determined by the Standard Proctor test (ASTM D-698).

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 - General

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 Modified Proctor test (ASTM D-1557) or to 98 percent of the maximum dry density as determined by the Standard Proctor test (ASTM D-698) 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 should be placed in loose lifts of not more than 10-inches, 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 Modified Proctor test (ASTM D-1557) or to 98 percent of the maximum dry density as determined by the Standard Proctor test (ASTM D-698). The materials should be compacted by mechanical means.

Materials used for structural fill should be approved by the 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.

ANTICIPATED PAVEMENT RECOMMENDATIONS

The discussion presented below is based on the subsurface conditions encountered in the test borings, laboratory test results and the project characteristics previously described. If the subsurface conditions are different from those described in this report or the project characteristics change, RMG should be retained to review our recommendations and modify them, if necessary. The conclusions and recommendations presented in this report should be verified by RMG during construction.

Pavement Design

The pavement design was performed using the Colorado Asphalt Pavement Association's *A Guideline for the Design and Construction of Asphalt Parking Lots in Colorado*. Table 1 of this document shows suggested thicknesses for Hot Mix Asphalt (HMA) over aggregated base course (ABC) for various California Bearing Ratio (CBR) values and traffic levels.

Test Borings 4, 5, and 6 were performed for the purpose of pavement design. Bulk soil samples were collected from the top two feet of the soil stratum in each location and returned to RMG's soil laboratory for testing, classification and analysis. This material will form the subgrade of the pavement section, and its stability and strength are critical to pavement design. The soil consisted of well-graded and poorly-graded silty to clayey sand. The majority of the silty to clayey sand classifies as A-1 and A-2 soil in accordance with the American Association of State Highway and Transportation Officials (AASHTO) classification system. These soils are considered "excellent to good" as subgrade material.

The CBR of the bulk sample is assumed to be approximately 20 for silty to clayey sands.

Subgrade Preparation

All subgrade fill material placed below pavements should be moisture conditioned and compacted in accordance with the ***Structural Fill – General*** section of this report. Prior to placement of the pavement section, the final subgrade should be scarified to a depth of 12 inches, adjusted to within 2 percent of the optimum moisture content and recompacted. The subgrade should then be proof-rolled with a heavy, pneumatic tired vehicle. Areas which deform under wheel loads should be removed and replaced. Base course should be compacted to at least 95 percent of the maximum Modified Proctor density (ASTM D1557).

Pavement Thickness

Based on Table 1 (referenced above) and the estimated CBR of 20, the recommended pavement section for the majority of paved areas and for heavy vehicle loading areas is presented below.

Estimated Hot-Mix Asphalt Pavement Section	
Traffic Level	**HMA over ABC (inches)**
Moderate Traffic / Some Trucks	4.0 / 6.0
Heavy Vehicles with Turning Motions	5.5 / 6.0

As an alternative to the HMA section above, Rigid Concrete Pavements are recommended in areas where heavy vehicle loading is expected. These areas include drop-off/pick-up areas, loading docks, trash pick-up areas, and other locations where heavy trucks will be making frequent turning and braking movements. Rigid pavements may be constructed directly on proof-rolled non-expansive granular subgrade, the top one foot of which has been compacted to a minimum of 95% of maximum dry density as determined by ASTM D1557.

Minimum Rigid Concrete Pavement Section	
Traffic Level	**Portland Cement Concrete (in.)**
Heavy Vehicles with Turning Motions	5.0 in.

These recommendations are for preliminary planning purposes only. The CBR value is based on the materials encountered at the time of drilling and will be dependent upon the soil material used for site fill and subgrade construction. We suggest evaluating the soil conditions after site grading and pavement layout to assess our recommendations.

Pavement Materials

Pavement materials should be selected, prepared, and placed in accordance with the above referenced document, the *Pikes Peak Region Asphalt Paving Specifications*, and all other requirements set forth by the governing jurisdictions. Tests should be performed in accordance with the applicable procedures presented in those specifications.

Surface Drainage

Surface drainage is important for the satisfactory performance of pavement. Wetting of the subgrade soils or base course will cause a loss of strength which can result in pavement distress. Surface drainage should provide for efficient removal of storm-water runoff. As a general rule, parking area surfaces should have a minimum slope of 2 percent (approximately ¼ inch per foot). Water should not be allowed to pond on the pavement or at the edges of the pavement, and areas adjacent to the pavement should be designed to provide positive drainage away from the paved surface.

CLOSING

This report has been prepared for the exclusive purpose of providing geotechnical engineering information and recommendations for development described in this report. RMG should be retained to review the final construction documents prior to construction to verify our findings, conclusions and recommendations have been appropriately implemented.

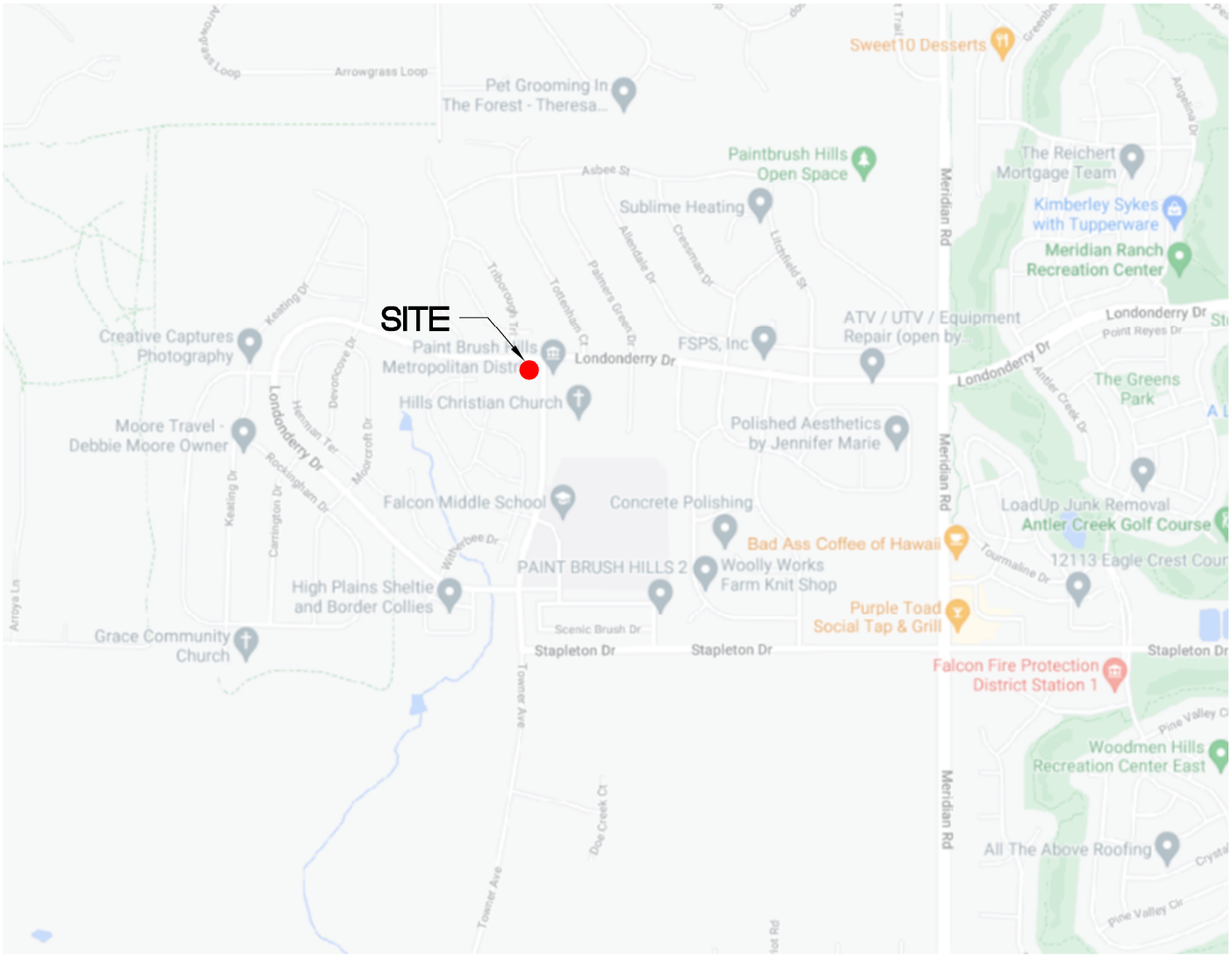
This report has been prepared for the exclusive use by **Colorado Commercial Construction** for application as an aid in the design and construction of the proposed development in accordance with generally accepted geotechnical engineering practices. The analyses and recommendations in this report are based in part upon data obtained from test borings, site observations and the information presented in referenced reports. The nature and extent of variations may not become evident until construction. If variations then become evident, RMG must be retained to review and revise the recommendations presented in this report as appropriate.

Our professional services were performed using that degree of care and skill ordinarily exercised, under similar circumstances, by geotechnical engineers practicing in this or similar localities. RMG does not warrant the work of regulatory agencies or other third parties supplying information which may have been used during the preparation of this report. No warranty, express or implied is made by the preparation of this report. Third parties reviewing this report should draw their own conclusions regarding site conditions and specific construction techniques to be used on this project.

The scope of services for this project does not include, either specifically or by implication, environmental assessment of the site or identification of contaminated or hazardous materials or conditions. Development of recommendations for the mitigation of environmentally related conditions, including but not limited to biological or toxicological issues, are beyond the scope of this report. If the Client desires investigation into the potential for such contamination or conditions, other studies should be undertaken.

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

FIGURES



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SITE VICINITY MAP

FOUNDATION LUTHERAN CHURCH
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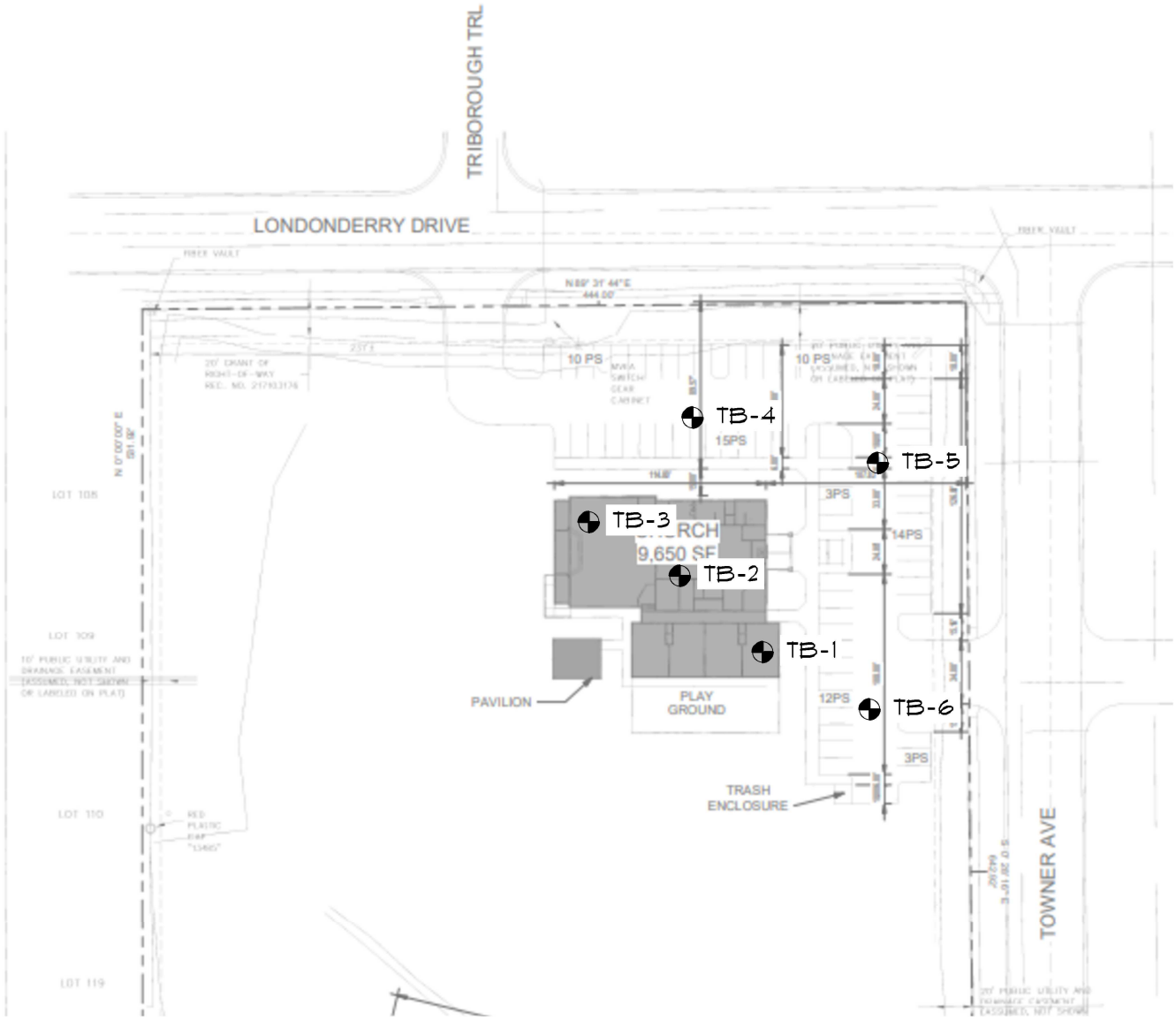
COLORADO COMMERCIAL CONSTRUCTION

JOB No. 191726

FIG No. 1

DATE 4-3-2023



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◐ DENOTES APPROXIMATE LOCATION OF TEST BORINGS

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TEST BORING LOCATION PLAN

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FIG No. 2

DATE 4-3-2023

SOILS DESCRIPTION

FILL: SAND, SILTY TO CLAYEY

SANDSTONE

UNLESS NOTED OTHERWISE, ALL LABORATORY
TESTS PRESENTED HEREIN WERE PERFORMED BY:
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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

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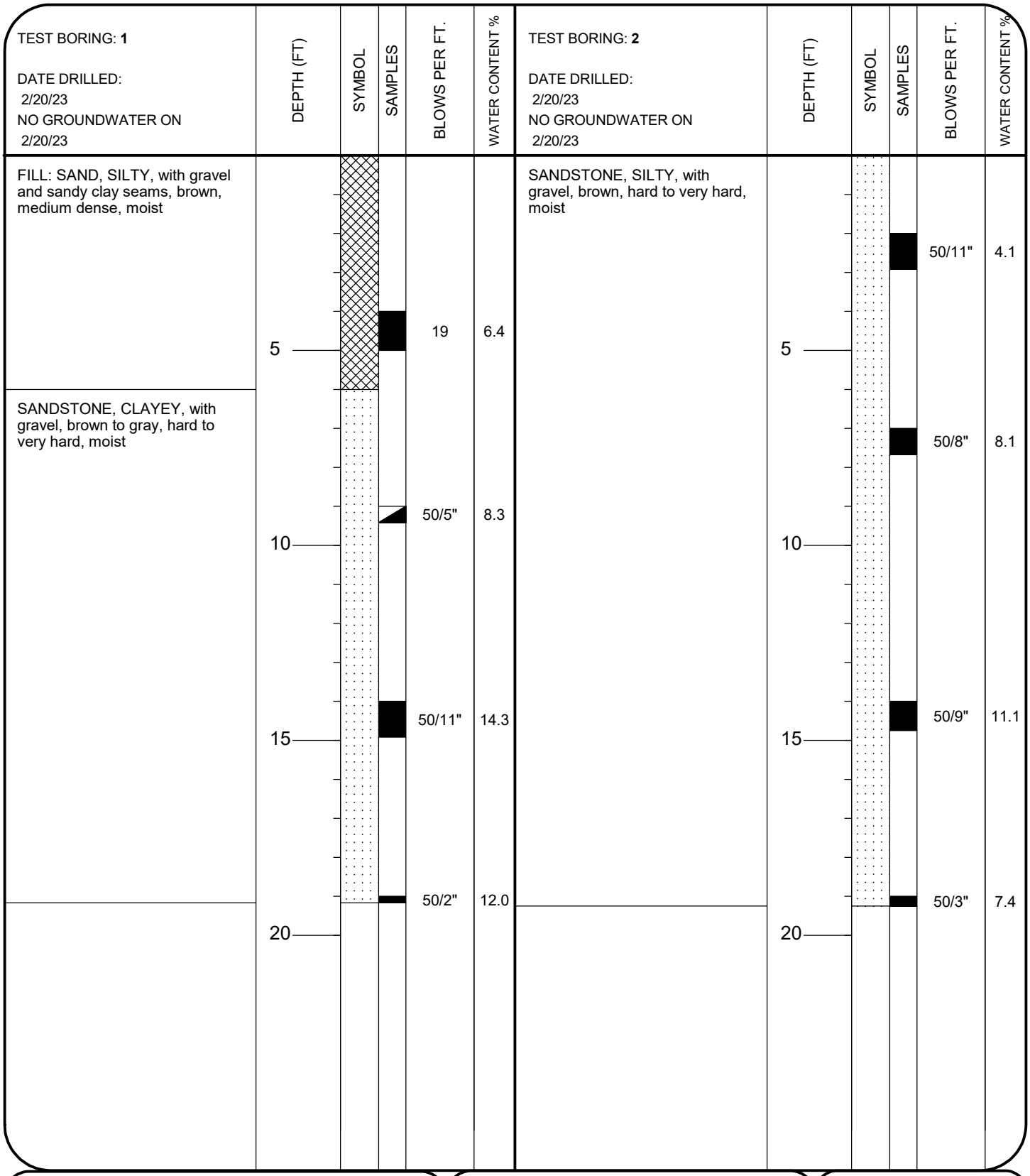
FIGURE No. 3

DATE Apr/03/2023



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TEST BORING LOG

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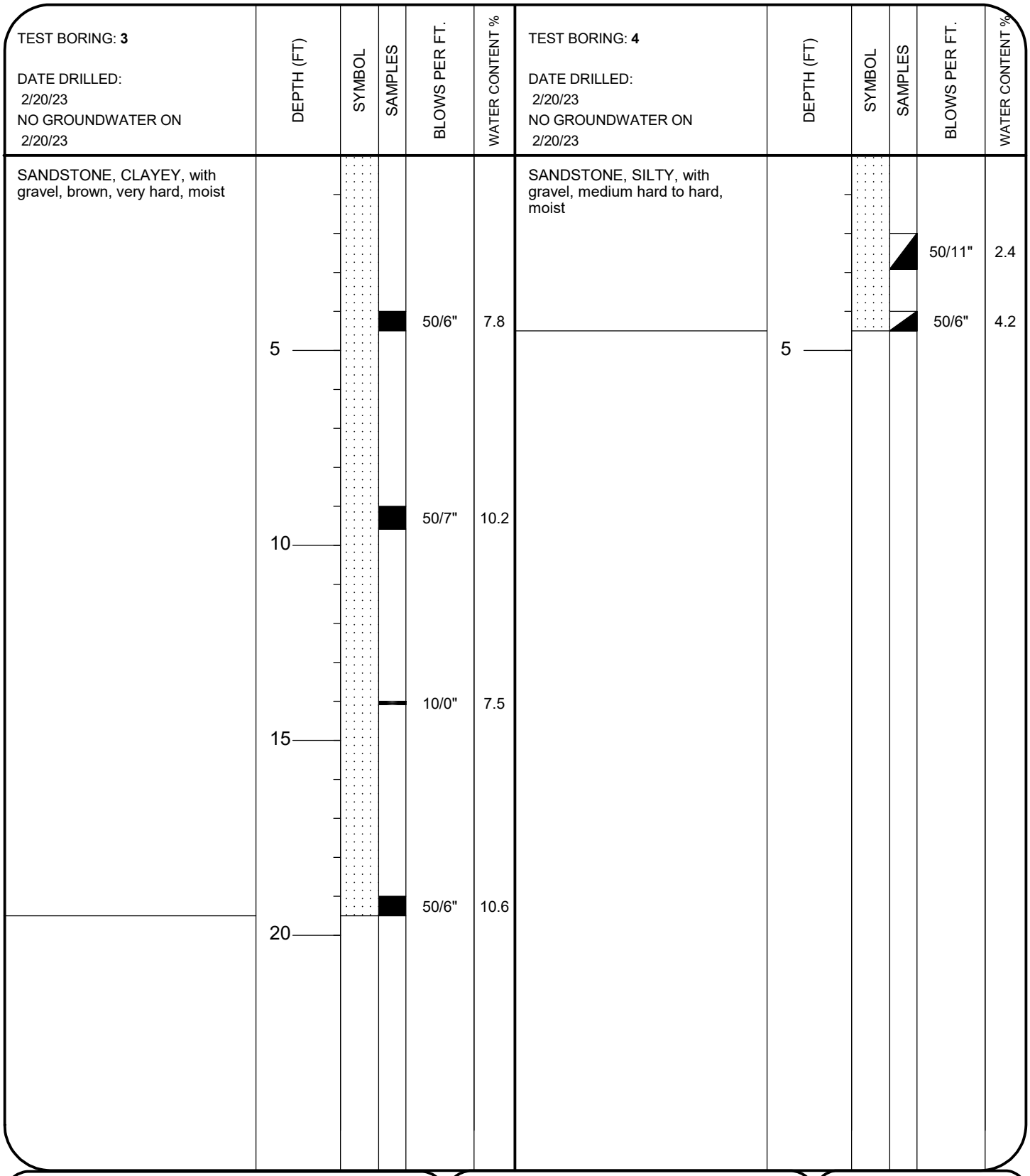
FIGURE No. 4

DATE Apr/03/2023



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TEST BORING LOG

JOB No. 191726

FIGURE No. 5

DATE Apr/03/2023

TEST BORING: **5** DATE DRILLED: 2/20/23 NO GROUNDWATER ON 2/20/23	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
SANDSTONE, CLAYEY, with gravel, brown, hard to very hard, moist					
				50/4"	4.1
				50/6"	6.0
	5				
				50/6"	9.5
	10				

TEST BORING: **6** DATE DRILLED: 2/20/23 NO GROUNDWATER ON 2/20/23	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
SANDSTONE, SILTY, with gravel, brown, hard, moist					
				50/6"	3.1
				50/6"	5.3
	5				

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TEST BORING LOG

JOB No. 191726

FIGURE No. 6

DATE Apr/03/2023

Test Boring No.	Depth	Water Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% Retained No.4 Sieve	% Passing No. 200 Sieve	Load at Saturation (psf)	% Swell/ Collapse	USCS Classification
1	4.0	6.4								
1	9.0	8.3		29	13	6.4	21.1			SC
1	14.0	14.3								
1	19.0	12.0								
2	2.0	4.1		NP	NP	15.6	12.2			SM
2	7.0	8.1								
2	14.0	11.1								
2	19.0	7.4								
3	4.0	7.8								
3	9.0	10.2								
3	14.0	7.5				4.9	18.0			
3	19.0	10.6								
4	2.0	2.4								
4	4.0	4.2				23.1	13.2			
5	2.0	4.1								
5	4.0	6.0				9.7	14.4			
5	9.0	9.5								
6	2.0	3.1				7.4	12.6			
6	4.0	5.3								

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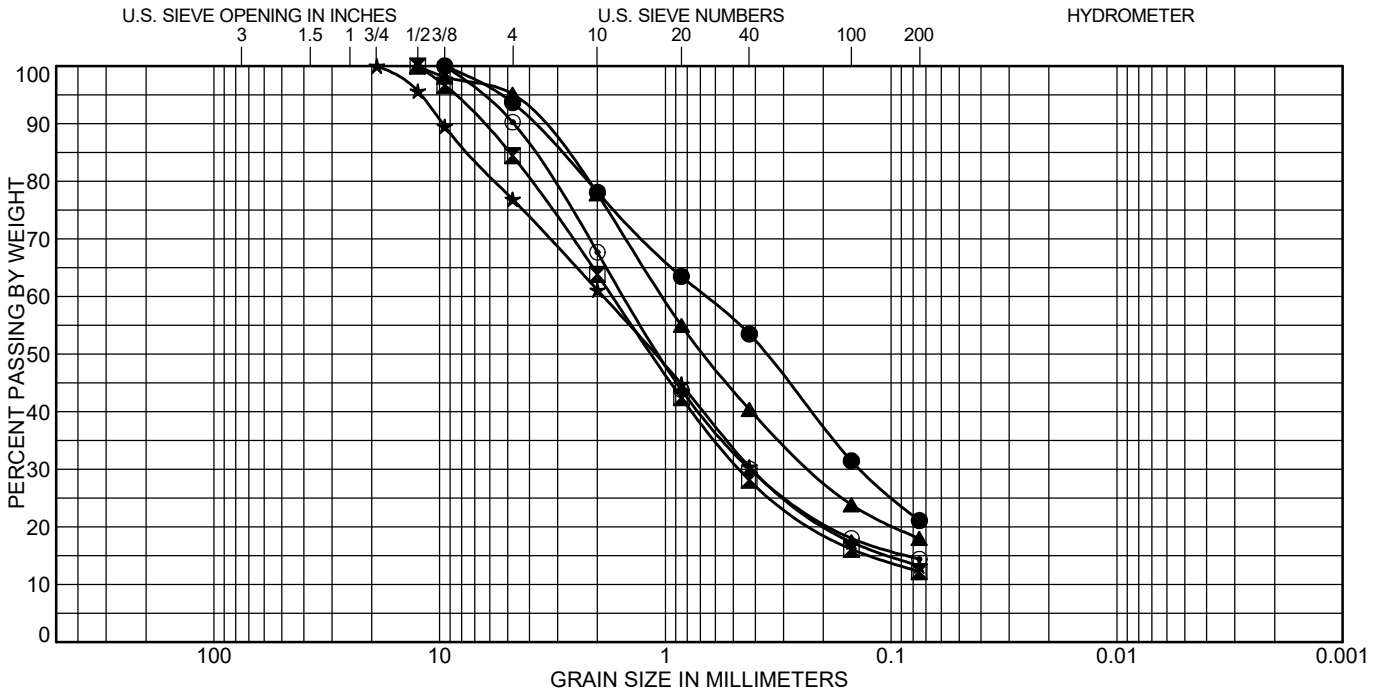
SUMMARY OF LABORATORY TEST RESULTS

JOB No. 191726
FIGURE No. 7
PAGE 1 OF 1
DATE Apr/03/2023



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Test Boring	Depth (ft)	Classification	LL	PL	PI
●	1	9.0	**CLAYEY SAND(SC)**	**29**	**16**	**13**
⧓	2	2.0	**SILTY SAND with GRAVEL(SM)**	**NP**	**NP**	**NP**
▲	3	14.0				
★	4	4.0				
⊙	5	4.0				

	Test Boring	Depth (ft)	%Gravel	%Sand	%Silt	%Clay
●	1	9.0	6.4	72.6	21.1	
⧓	2	2.0	15.6	72.2	12.2	
▲	3	14.0	4.9	77.2	18.0	
★	4	4.0	23.1	63.6	13.2	
⊙	5	4.0	9.7	75.9	14.4	

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SOIL CLASSIFICATION DATA

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FIGURE No. 8

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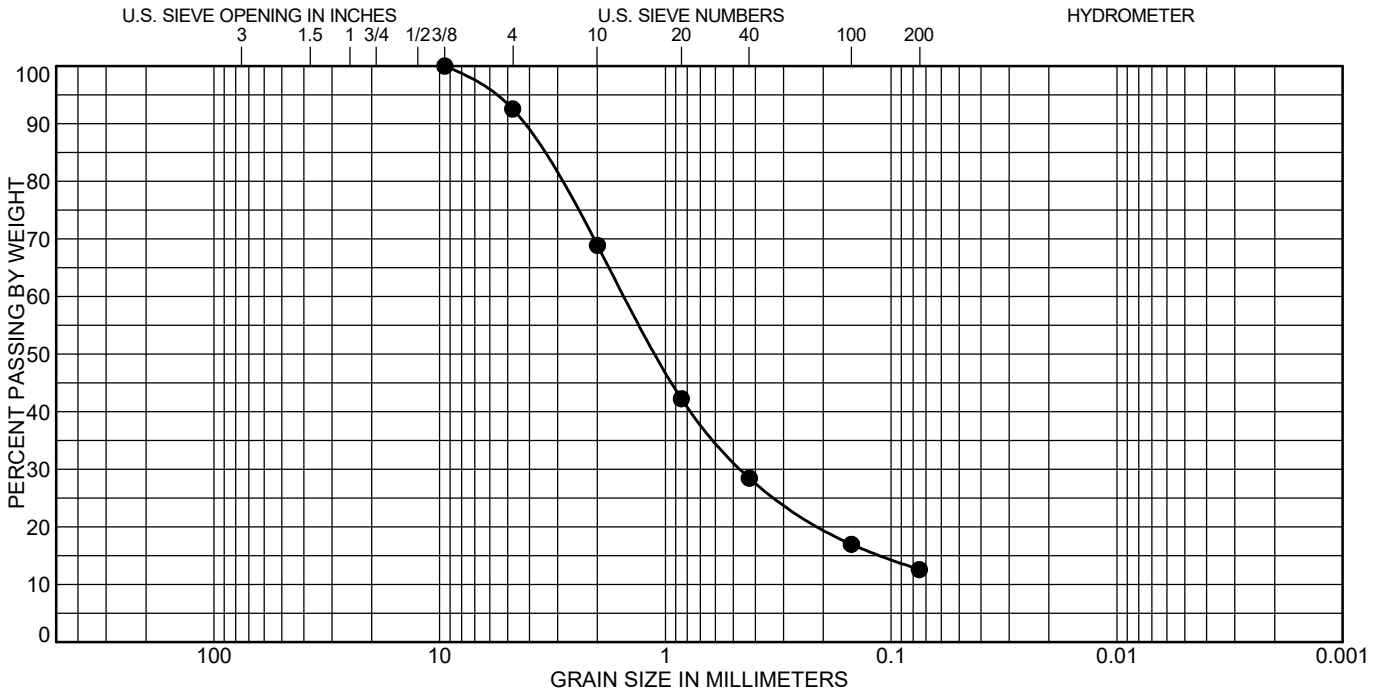

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Test Boring	Depth (ft)	Classification	LL	PL	PI
●	**6**	**2.0**				

	Test Boring	Depth (ft)	%Gravel	%Sand	%Silt	%Clay
●	**6**	**2.0**	**7.4**	**80.0**	**12.6**	

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SOIL CLASSIFICATION DATA

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FIGURE No. 9

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