Structural
Geotechnical

Materials Testing
Forensic

SOILS AND GEOLOGY STUDY

Falcon Reserve
EPC Schedule No. 5225400001
El Paso County, Colorado

PREPARED FOR:

Landhuis Company
212 N. Wahsatch Ave. Ste 301
Colorado Springs, CO

JOB NO. 188276

July 14, 2022
Amended May 20, 2026

Respectfully Submitted,

RMG – Rocky Mountain Group

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Project Geologist

Reviewed by,

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1.0 GENERAL SITE AND PROJECT DESCRIPTION

1.1 Project Location

The project lies in the SE ¼ of the SE ¼ of Section 25, Township 12 South, Range 65 West of the 6th Principal Meridian in El Paso County, Colorado. The approximate location of the site is shown on the Site Vicinity Map, Figure 1.

1.2 Existing Land Use

The site currently consists of one parcel totaling approximately 40 acres as denoted on the El Paso County Assessors website. The parcel included is:

- **Schedule No. 5225400001:** consists of 40 acres, currently not addressed but labeled as N. Meridian Road. The site is undeveloped.

The current zoning is "CR – Commercial Regional" and it is our understanding the proposed zoning is to be "PUD - Planned Unit Development".

1.3 Project Description

The proposed site development is to consist of single-family residential construction on a total of 149 lots, with the option for 11 additional lots along the southern portion of the site in the future. Entrance into the subdivision is to be provided from the existing Liberty Grove Drive. Additional proposed land usage includes landscaped easements, one pocket-park (+/-1.5 acres), utility easements, and four drainage ponds. One pond is to be located at each corner of the property. The Proposed Lot Layout is presented in Figure 2.

The streets within the subdivision are to be public Residential Urban Local (Public) with a 50' R.O.W and constructed to El Paso County standards. The proposed interior roadways were not named on the Concept Plan dated 2022. The streets are to be maintained by El Paso County Department of Transportation.

The development is to utilize sewer and water services provided by Falcon Water and Sanitation District. Neither individual wells nor on-site wastewater treatment systems are proposed.

2.0 QUALIFICATIONS OF PREPARERS

This Soils 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 25 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 is a licensed professional engineer with over 25 years of experience in the construction engineering (residential) field. Mr. Munger and holds a Bachelor of Science in Architectural Engineering from the University of Wyoming.

3.0 STUDY OVERVIEW

The purpose of this investigation is to characterize the general geotechnical and geologic site conditions, and present our opinions of the potential effect of these conditions on the proposed development of single-family residences within the referenced site. 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 Engineering Criteria Manual (ECM), specifically Appendix C last updated July 9, 2019.

This report presents the findings of the study performed by RMG relating to the geotechnical and geologic conditions of the above-referenced site. 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.

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. Our services exclude the evaluation of the environmental and/or human, health-related work products or recommendations previously prepared, by others, for this project.

The objectives of our study are to:

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

This report presents the findings of the study performed by RMG 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:

- Field reconnaissance
- Geologic and topographic maps
- Review of selected publicly available, pertinent engineering reports
- Available aerial photographs
- Exploratory soil test borings by RMG
- Laboratory testing of representative site soil and rock samples by RMG
- 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 this site or adjacent sites were not available for our review.

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 undeveloped and vacant. The site is bound to the north by an existing single family residential property identified as Paint Brush, Filing No. 4, to the west by Liberty Grove Drive, to the south by existing Stapleton Road, and to the east by existing Meridian. Two roadside ditches are located along the east and south boundaries of the property, along Meridian Road and Stapleton Road, respectively. Two existing detention areas are located near the northeast and southwest corner of the property. An offsite detention pond (Paint Brush Hills Pond No. 4) is located just to the northwest corner of the site.

4.2 Topography

The site topography is generally flat and slopes from the northwest to southeast at approximately 3 percent. The elevation varies approximately 35 to 40 feet across the entire site.

4.3 Vegetation

The majority of the site consists of low-lying native grasses and weeds. The grasses are taller within the drainage areas. Few deciduous trees exist the drainage areas and the remainder of the site is devoid of trees.

4.4 Aerial photographs and remote-sensing imagery

Personnel of RMG reviewed aerial photos available through Google Earth Pro dating back to 1999, CGS surficial geologic mapping, and historical photos by historicaerials.com dating back to 1947. Prior to 1983, the majority of the area surrounding the site was open grazing land. Falcon Middle School was constructed just prior to 1983. After 1999, development of the surrounding area exploded. All four-detention areas have been present since 1999 and have been depicted as relatively dry with no apparent standing water.

5.0 FIELD INVESTIGATION AND LABORATORY TESTING

The subsurface conditions within the property were explored by drilling five (5) exploratory borings on February 16, 2022, extending to depths of approximately 20 feet below the existing ground surface. The test borings were spaced to provide soil information for the lots and the proposed ponds. The Proposed Lot Layout with Test Boring Locations 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 Figures 3 through 6.

5.1 Laboratory Testing

Soil laboratory testing was performed as part of this investigation. The laboratory tests included moisture content, dry density, grain-size analyses, and Atterberg Limit tests. A Summary of Laboratory Test Results is presented in Figure 7. Soils Classification Data is presented in Figure 8.

6.0 SOIL, GEOLOGY, AND ENGINEERING GEOLOGY

6.1 Geologic Conditions

The site is located within the western portion of the Colorado Piedmont section of the Great Plains physiographic province. The Colorado Piedmont, formed during Late Tertiary and Early Quaternary time (approximately 2,000,000 years ago), is a broad, erosional trench which separates the Southern Rocky Mountains from the High Plains. During the Late Mesozoic and Early Cenozoic Periods (approximately 70,000,000 years ago), intense tectonic activity occurred, causing the uplifting of the Front Range and associated downwarping of the Denver Basin to the east. Relatively flat uplands and broad valleys characterize the present-day topography of the Colorado Piedmont in this region.

6.2 Subsurface Soil Conditions

The subsurface materials encountered in the test borings performed for this study were classified within the laboratory using the Unified Soil Classification System (USCS). The materials were visually identified and classified in the laboratory as well-graded sand with silt (SW-SM), clayey sand (SC), sandstone (SC), and claystone (CL).

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.

6.3 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. Seams of claystone bedrock were encountered in test borings TB-3, TB-4 and TB-5 at depths of approximately 9 feet and 19 feet below the existing surface. The sandstone bedrock also classified as SC. The claystone bedrock was thinly interbedded within the sandstone and a good representative sample was not obtained for testing, however, the claystone is expected to classify as CL.

The bedrock is anticipated to be encountered in basement foundation excavations and the utility trenches for the proposed development. Overall, the Dawson sandstone and claystone bedrock can readily be excavated with standard construction equipment such as a front-end loader or excavator, but seams of very hard sandstone may be encountered at deeper depths.

6.4 U.S. Soil Conservation Service

The U.S. Soil Conservation Service along with United States Department of Agriculture (USDA) has identified the soils on the property as:

- **83 – Stapleton sandy loam**, 3 to 8 percent slopes. The Stapleton sandy loam was mapped by the USDA to encompass the entire property. Properties of the sandy loam include, well-drained soils, depth of the water table is anticipated to be greater than 80 inches, runoff is anticipated to be low, frequency of flooding and/or ponding is none, and landforms include hills.

The USDA Soil Survey Map is presented in Figure 9.

6.5 General Geologic Conditions

Based on our field observations, the USDA map and the Geologic Map of the Falcon quadrangle, an interpreted geologic map of significant surficial deposits and features was mapped for the site. The identified geologic conditions affecting the development are presented in the Engineering Geology Map, Figure 10.

The site generally consists of silty to clayey sand overlying sandstone bedrock with interbedded claystone seams. One geologic unit was mapped at the site as:

- ***Tda* – Dawson Arkose** *(Paleocene to Eocene)* – Predominately sandstone with thinly bedded layers of gray claystone. Thickness may reach 700 feet in the Falcon quadrangle. The unit is prone to swelling when wet. Sandstone and interbedded claystone were encountered in all five test borings performed for this investigation.

6.6 Structural Features

Structural features such as schistocity, folds, zones of contortion or crushing, joints, shear zones or faults were not observed on the site, in the surrounding area, or in the soil samples collected for laboratory testing.

6.7 Surficial (Unconsolidated) Deposits

Lake and pond sediments, swamp accumulations, sand dunes, marine terrace deposits, talus accumulations, creep, or slope wash were not observed on the site. Slump and slide debris were also not observed on the site. The alluvial deposits moderately consolidated, poorly to moderately stratified silt, sand, gravel, and cobbly gravel. The maximum thickness is anticipated to be approximately 20 feet.

6.8 Engineering Geology

Charles Robinson and Associates (1977) have mapped one environmental engineering unit and RMG has mapped two additional units at the site as:

- **3B** – Expansive and potentially expansive soil and bedrock on flat to moderate slopes (0 to 12%).
- **rs** – existing roadside ditches
- **dp** – existing detention ponds

The engineering geology is presented in the Engineering Geology Map, Figure 10.

6.9 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 property or surrounding areas.

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

6.10 Drainage of Water and Groundwater

The overall topography of the site slopes down from the north to the south, east and west, towards the existing drainage areas.

Groundwater was not encountered at the time of drilling, nor where their indications of increased moisture observed in the samples obtained by RMG. Groundwater was also not observed in follow up groundwater checks performed on July 15, 2022, approximately five months from the original drill date.

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.

Based on our knowledge of the area and engineering design and construction techniques commonly employed in the El Paso County area at this time, it is our opinion that there is insufficient reason to preclude full-depth basements on any of the lots in this subdivision at this time. Shallow groundwater conditions are not anticipated to be found at the time of the site-specific subsurface soil investigations.

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.

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 valley fill comprised of sand and gravel with silt and clay deposited by water in one or a series of stream valley. Extraction of the sand and gravel resources are not considered to be economical compared to materials available elsewhere within the county.

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, no active or inactive mines have been mapped in the area of the site. No metallic mineral resources have been mapped on the site.

The site has also been mapped as “Poor” for oil and gas resources per the Atlas of Sand, Gravel, and Quarry Aggregate Resources. No oil or gas fields have been discovered in the area of the site. The sedimentary rocks in the area lack the geologic structure for trapping oil or gas, therefore, it is not considered a significant resource.

8.0 IDENTIFICATION AND MITIGATION OF POTENTIAL GEOLOGIC CONDITIONS

The El Paso County Engineering Criteria Manual recognizes and delineates the difference between 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 list of geologic conditions were considered in the preparation of this report and were not identified on the property. These constraints are not anticipated to pose a significant risk to the proposed development:

- Avalanches
- Debris Flow-Fans/Mudslides
- Ground Subsidence
- Landslides
- Rockfall
- Ponding water
- Steeply Dipping Bedrock
- Unstable or Potentially Unstable Slopes
- Scour, Erosion, accelerated erosion along creek banks and drainageways
- Springs and High Groundwater
- Corrosive Minerals

The following sections present the geologic conditions that have been identified on the property:

8.1 Expansive Soils and Bedrock

Based on the test borings performed by RMG for this investigation, sandy clay and claystone bedrock encountered at this site generally possess low to high swell potential. It is anticipated if expansive clay soils or claystone bedrock are encountered at the time of the site-specific subsurface soil investigation, additional mitigations will be provided 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. If expansive soils or bedrock are encountered beneath the foundations, mitigation will be required. "Mass" subexcavation during land development is currently not proposed, nor do we recommend it at this time. Overexcavation and replacement with non-expansive soils at a minimum of 95 percent of its maximum Modified Proctor Dry Density (ASTM D-1557) is a suitable mitigation. Floor slabs bearing directly on expansive material should be expected to experience movement. Overexcavation and replacement has been successful in reducing slab movement. Overexcavation is not anticipated for the majority of the lots. However, if clay or claystone seams are encountered, overexcavation depths of 3 to 4 feet are anticipated. Moisture-conditioning and recompacting the on-site clays (if encountered) may also be considered for mitigation of expansive materials.

The final determination of mitigation alternatives and foundation design criteria are to be determined 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 Compressible Soils

Based on the test borings performed by RMG for this investigation, the silty to clayey sands will be encountered within some of the building excavations. In some cases, loose sands may be encountered in the excavations. Overexcavation and recompaction is a suitable mitigation.

Mitigation
If loose soils are encountered beneath the foundations, mitigation will be required. “Mass” subexcavation during land development is currently not proposed, nor do we recommend it at this time.

If loose soils are encountered during the Open Excavation Observation, they may require additional compaction to achieve the allowable bearing pressure indicated in this report. Fluctuations in material density may occur. In some cases, removal and recompaction of up to 2 feet of soil may be required. The removal and recompaction shall extend a minimum of the same distance beyond the building perimeter, and at least that same distance beyond the perimeter of counterfort and "T" wall footings. The use of track-mounted excavation equipment, or other low ground pressure equipment, is recommended on loose soils to reduce the likelihood of loss of stability during excavation.

8.3 Seasonal Surface Water

The site currently contains four low-lying areas, one at each corner 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. The site is not mapped within floodplain zones according to the FEMA Map No. 08041C0535G.

Mitigation
Foundations are not proposed in the existing low-lying areas. These areas are also to be reworked into new drainage ponds. It is uncertain at this time if the ponds are to be retention or detention. The ponds shall be designed to handle the calculated flows required for the subdivision. With the addition of four new ponds, the seasonally shallow surface water is not is not considered to pose a risk to the proposed structures.

Additionally, foundations that are subjected to constant moisture variations are subject to frost heave. The foundations for this site’s elevation should penetrate to the recommended frost depth of 30 inches to limit the formation of ice lenses beneath foundation components. A subsurface perimeter drain will be necessary to help prevent the instruction of water into areas located below grade; this includes crawlspace areas but not the walkout trench.

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. A typical perimeter drain detail is presented in Figure 12.

8.4 Faults and Seismicity

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 time 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 in the vicinity of 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

The Pikes Peak Regional Building Code, 2017 Edition, indicates maximum considered earthquake spectral response accelerations of 0.185g for a short period (S_s) and 0.059g for a 1-second period (S_1). Based on the results of our experience with similar subsurface conditions, we recommend the site be classified as Site Class B, with average shear wave velocities ranging from 2,500 to 5,000 feet per second for the materials in the upper 100 feet.

8.5 Radon

***"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. The US EPA has set an action level of 4 pCi/L. At or above this level of radon, the EPA recommends you take corrective measures to reduce your exposure to radon gas".*

Most of Colorado is generally considered to have the potential for high indoor levels of radon gas, based on the geology, soils, construction type and aerial radiation measurements that have been gathered from indoor testing by the Colorado Department of Public Health and Environment (CDPHE), Radon Outreach Program and Colorado Environmental Public Health Tracking the information provided at: https://www.elpasocountyhealth.org/sites/default/files/CDPHERadonMap.pdf

There is not believed to be unusually hazardous levels of radioactivity from naturally occurring sources at this site. However, the granular materials found in the area are often associated with the production of radon gas and concentrations may exceed those currently accepted by the EPA.

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.

8.6 Proposed Grading, Cuts and Masses of Fill, and Erosion Control

Fill soils were not encountered at the time of drilling. If fill soils are encountered, they may be considered unsuitable for a variety of reasons. These include (but are not limited to) non-engineered fills, fill soils containing trash or debris, fill soils that appear to have been improperly placed and/or compacted, etc.

Mitigation

If unsuitable fill soils are encountered during the site-specific subsurface soil investigation and/or the open excavation observation, they will require removal (overexcavation) and replacement with newly-placed and compacted structural fill.

The silty to clayey sand soils can generally be used as site-grading fill, though use of claystone within the fill (if encountered) should be avoided where the fill will be located below the proposed foundations. If unsuitable fill soils are encountered at the time of construction for the single-family residences, they should be removed (overexcavated) and replaced with compacted structural fill. The zone of overexcavation shall extend to the bottom of the unsuitable fill zone and shall extend at least that same distance beyond the building perimeter (or lateral extent of any fill, if encountered first). Provided that this recommendation is implemented, the presence of this fill is not considered to pose a risk to proposed structures.

Prior to placement of overlot fill or removal and recompaction of the existing materials, topsoil, low-density native soil, fill and organic matter should be removed from the fill area. The subgrade should be scarified, moisture conditioned to within 2% of the optimum moisture content, and recompacted to the same degree as the overlying fill to be placed. The placement and compaction of fill should be periodically observed and tested by a representative of RMG during construction.

We believe the surficial silty to clayey soils will classify as Type B as defined by OSHA in 29CFR Part 1926, date January 2, 1990. OSHA requires temporary slopes made in Type B materials be laid back at ratios no steeper than 1:1 (horizontal to vertical) unless the excavation is shored or braced. 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).

Erosion generally refers to lowering the ground surface over a wide area. The on-site soils are mildly to moderately susceptible to wind and water erosion. Temporary problems may arise due to minor wind erosion and dust during and immediately after construction. Watering of the cut areas or the use of chemical palliatives may be needed to control dust. However, once construction has been completed and vegetation reestablished, the potential for wind erosion and dust will be considerably reduced.

Loose soils are the most susceptible to water erosion. The residually weathered sands on site were encountered at medium densities and overlaid medium hard to very hard sandstone bedrock which is increasingly less susceptible to water erosion.

Cut and fill areas may be subjected to sheetwash (surface) erosion. Unchecked erosion could eventually lead to concentrated flows of water. Generally, the most effective means to control erosion is to re-vegetate the cut and fill slopes with native vegetation.

Guideline Site Grading Specifications are included in the Appendix B.

9.0 BEARING OF GEOLOGIC CONDITIONS UPON PROPOSED DEVELOPMENT

Geologic hazards (as described in Section 8.0 of this report) were not found to be present at this site. Geologic constraints (also as described in section 8.0 of this report) such as expansive soils and bedrock, compressible soils, faults, seismicity, and radon were found on the site. Where avoidance is not feasible, it is our opinion that the existing geologic and engineering conditions can be satisfactorily mitigated through proper engineering, design, and construction practices.

10.0 BURIED UTILITIES

Based upon the conditions encountered in the test borings, we anticipate that the soils encountered in individual utility trench excavations will consist of native silty to clayey sand and sandstone with interbedded sandy clay and claystone. It is anticipated the sands will be medium dense conditions, the sandy clay (if encountered) at stiff to very stiff conditions, and the claystone at medium hard to hard conditions. Bedrock may be encountered within some of the utility trenches.

We believe the sand (if encountered) will classify as Type C materials and the clay as Type B materials, as defined by OSHA in 29 CFR Part 1926. OSHA requires that temporary excavations made in Type B and C materials be laid back at ratios no steeper than 1:1 (horizontal to vertical) and 1½:1 (horizontal to vertical), respectively, unless the excavation is shored and braced. Excavations deeper than 20 feet, or when water is present, should always be braced or have the slope designed by a professional engineer.

11.0 PRELIMINARY PAVEMENTS

The proposed roadways with in this development will require a new pavement design prepared in accordance with the El Paso County regulations.

The Concept Plan provided by Matrix did not have the interior roadways classified but it is anticipated the roadways are to be Residential Urban Local. ***The actual pavement section design for individual streets is to be performed following completion of utility installation within the roadways.***

The developer, Landhuis Company, has generally preferred to construct the roadways with a composite roadway section consisting of Hot Mix Asphalt (HMA) over Cement-Treated Subgrade (CTS). For purposes of this report, we anticipate the subgrade soils will primarily have American Association of State Highway and Transportation Officials (AASHTO) Soil Classifications of A-6(3-7), A-2-6 (0-1), and A-1-b(0) with an estimated design subgrade CBR on the order of approximately 5 to 15.

The above values are for preliminary planning purposes only, and may vary upon final design depending on the soil materials used for subgrade construction within the proposed roadways. Pavement materials should be selected, prepared, and placed in accordance with the El Paso County specification and the Pikes Peak Region Asphalt Paving Specifications. Tests should be performed in accordance with the applicable procedures presented in the final design.

12.0 ANTICIPATED FOUNDATION SYSTEMS

Based on the information presented previously, conventional shallow foundation systems consisting of standard spread footings/stemwalls are anticipated to be suitable for the proposed residential structures. It is our understanding that crawlspace and/or basement excavations are proposed. The anticipated excavation cuts are approximately 3 to 4 feet below the final ground surface for crawlspaces and 6 to 8 feet for basements, not including overexcavation, if needed.

Sporadic lenses of expansive sandy clay and claystone were encountered in the test borings performed for this study. Expansive soils are anticipated to be encountered near foundation and/or floor slab bearing levels. Overexcavation and replacement or subexcavation with nonexpansive structural fill will be required. Overexcavation depths of 3 to 4 feet are typical for the soil conditions encountered. Overexcavation depths for each lot are to be determined in site-specific subsurface soil investigations, and confirmed at the time of the open excavation observations for each lot.

If undocumented fill is encountered during construction of the structures, it will be assumed that this fill was not moisture conditioned and compacted in a manner consistent with the **Structural Fill** recommendations contained within this report, unless appropriate documentation can be provided. If such fill is encountered, it is not considered suitable for support of shallow foundations. This unsuitable fill will require removal (overexcavation) and replacement with non-expansive, granular structural fill below foundation components and floor slabs. The structural fill should be observed and tested during placement as indicated under the **Structural Fill** section of this report, to ensure proper compaction.

The foundation system for each single family residences should be designed and constructed based upon recommendations developed in a site-specific subsurface soil investigation. The recommendations presented in the *Subsurface Soil Investigation* report for each lot should be verified following the excavations of each structure and evaluation of the building loads.

12.1 Foundation Drains

A subsurface perimeter drain is 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.

Shallow groundwater conditions were not encountered in the test boring performed for this study. Shallow groundwater conditions are not anticipated, however depending on the conditions encountered during the site-specific subsurface soil investigations and the conditions observed at the time of construction, additional subsurface drainage systems may be recommended.

It must be understood that the drain systems are designed to intercept some types of subsurface moisture and not others. Therefore, the drains could operate properly and not mitigate all moisture problems relating to foundation performance or moisture intrusion into the basement area.

13.0 EARTHWORK

13.1 Granular Structural Fill

Areas to receive granular (non-expansive) 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. 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.

14.0 ADDITIONAL STUDIES

The findings, conclusions and recommendations presented in this report were provided to evaluate the suitability of the site for future development. Unless indicated otherwise, the test borings, laboratory test results, conclusions and recommendations presented in this report are not intended for use for design and construction. **We recommend that a *lot-specific* Subsurface Soil Investigation be performed for the proposed structures.** The extent of any fill soils encountered during the lot-specific investigation(s) should be evaluated for suitability to support the proposed structures prior to construction. Additionally, the groundwater conditions (if encountered) in the lot-specific investigation should be evaluated to determine the feasibility of basement construction on that lot.

The lot-specific subsurface soil investigation should consider the proposed structure type, anticipated foundation loading conditions, location within the property, and local construction methods. Recommendations resulting from the investigations should be used for design and confirmed by on-site observation and testing during development and construction.

15.0 CONCLUSIONS

Based upon our evaluation of the geologic conditions, it is our opinion that the proposed development is feasible. The geologic conditions identified (expansive soils, compressive soils, faults, seismicity, and radon) are not considered unusual 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 local construction practices.

In addition to the previously identified mitigation alternatives, surface and subsurface drainage systems should be implemented. Exterior, perimeter foundation drains should be installed around below-grade habitable or storage spaces. Surface water should be efficiently removed from the building area to prevent ponding and infiltration into the subsurface soil.

The foundation system for each single family residences should be designed and constructed based upon recommendations developed in a site-specific subsurface soil investigation.

The foundation and floor slabs of each structure should be designed using the recommendations provided in the lot-specific subsurface soil investigation performed for each lot. In addition, appropriate surface drainage should be established during construction and maintained by the homeowner.

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.

Additionally, 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.

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.

We believe the surficial sand soils will classify as Type C as defined by OSHA in 29CFR Part 1926, date January 2, 1990. OSHA requires temporary slopes made in Type B materials be laid back at ratios no steeper than 1:1 (horizontal to vertical) unless the excavation is shored or braced.

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 these properties read and understand this report, as well as the previous reports referenced above, and too carefully familiarize themselves with the geologic constraints associated with construction in this area. This report only addresses the geologic constraints contained within the boundaries of the site referenced above.

16.0 CLOSING

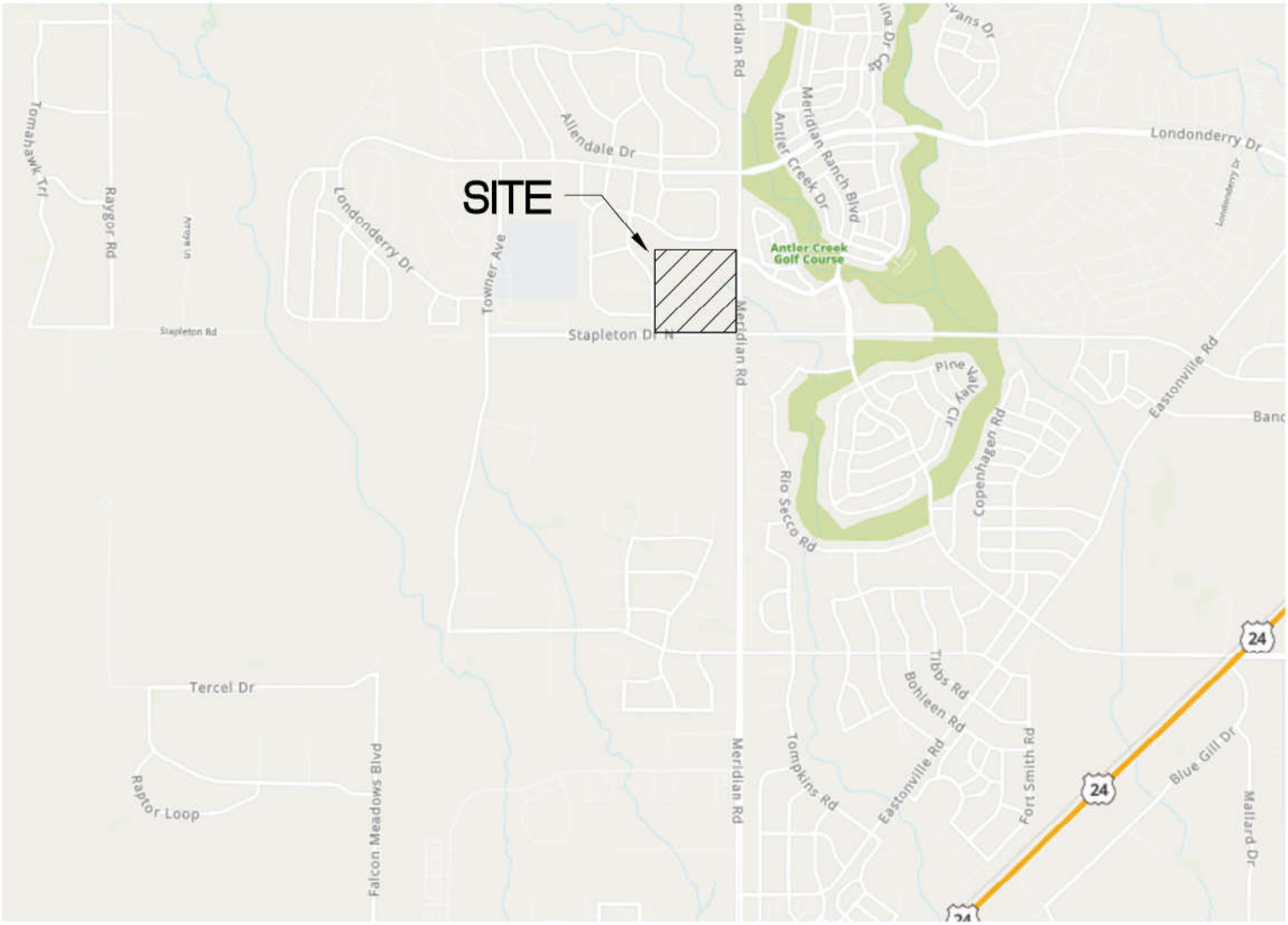
This report is for the exclusive purpose of providing geologic hazards information and preliminary geotechnical engineering recommendations. The scope of services did not include, either specifically or by implication, evaluation of wild fire hazards, environmental assessment of the site, or identification 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 owner is concerned about the potential for such contamination or conditions, other studies should be undertaken.

This report has been prepared for **Landhuis Company** in accordance with generally accepted geotechnical engineering and engineering geology practices. The conclusions and recommendations in this report are based in part upon data obtained from review of available topographic and geologic maps, review of available reports of previous studies conducted in the site vicinity, a site reconnaissance, and research of available published information, soil test borings, soil laboratory testing, and engineering analyses. The nature and extent of variations may not become evident until construction activities begin. If variations then become evident, RMG should be retained to re-evaluate the recommendations of this report, if necessary.

Our professional services were performed using that degree of care and skill ordinarily exercised, under similar circumstances, by geotechnical engineers and engineering geologists 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.

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

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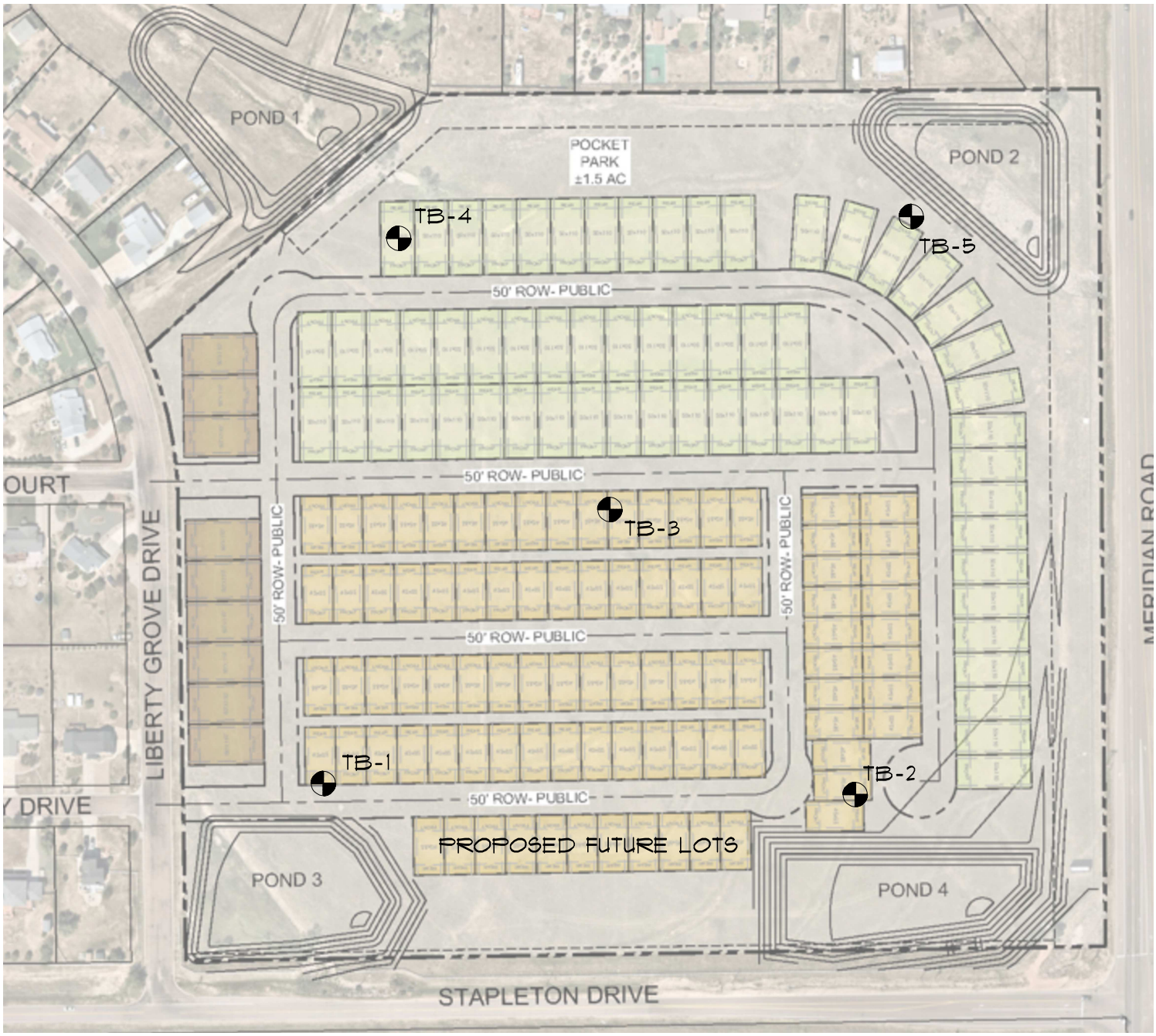
FIG No. 1

DATE 7/15/2022



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⊕ DENOTES APPROXIMATE LOCATION OF TEST BORINGS

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PROPOSED LOT LAYOUT WITH TEST BORING LOCATIONS

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FIG No. 2

DATE 7/15/2022
AMENDED 5/20/26

SOILS DESCRIPTION


CLAYSTONE


SANDSTONE


SILTY SAND


SILTY TO CLAYEY SAND

UNLESS NOTED OTHERWISE, ALL LABORATORY
TESTS PRESENTED HEREIN WERE PERFORMED BY:
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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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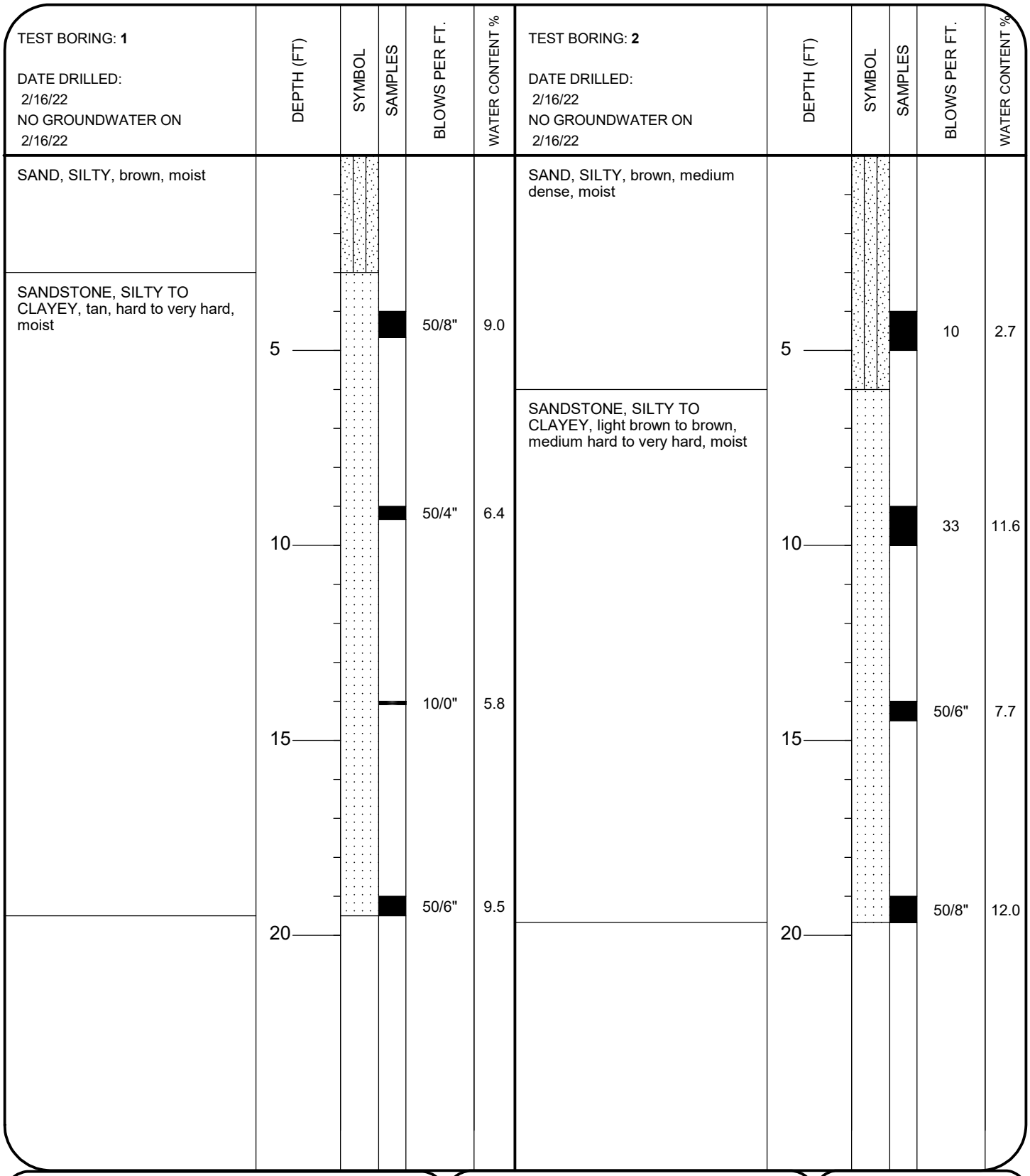
FIGURE No. 3

DATE Jul/14/2022



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TEST BORING LOG

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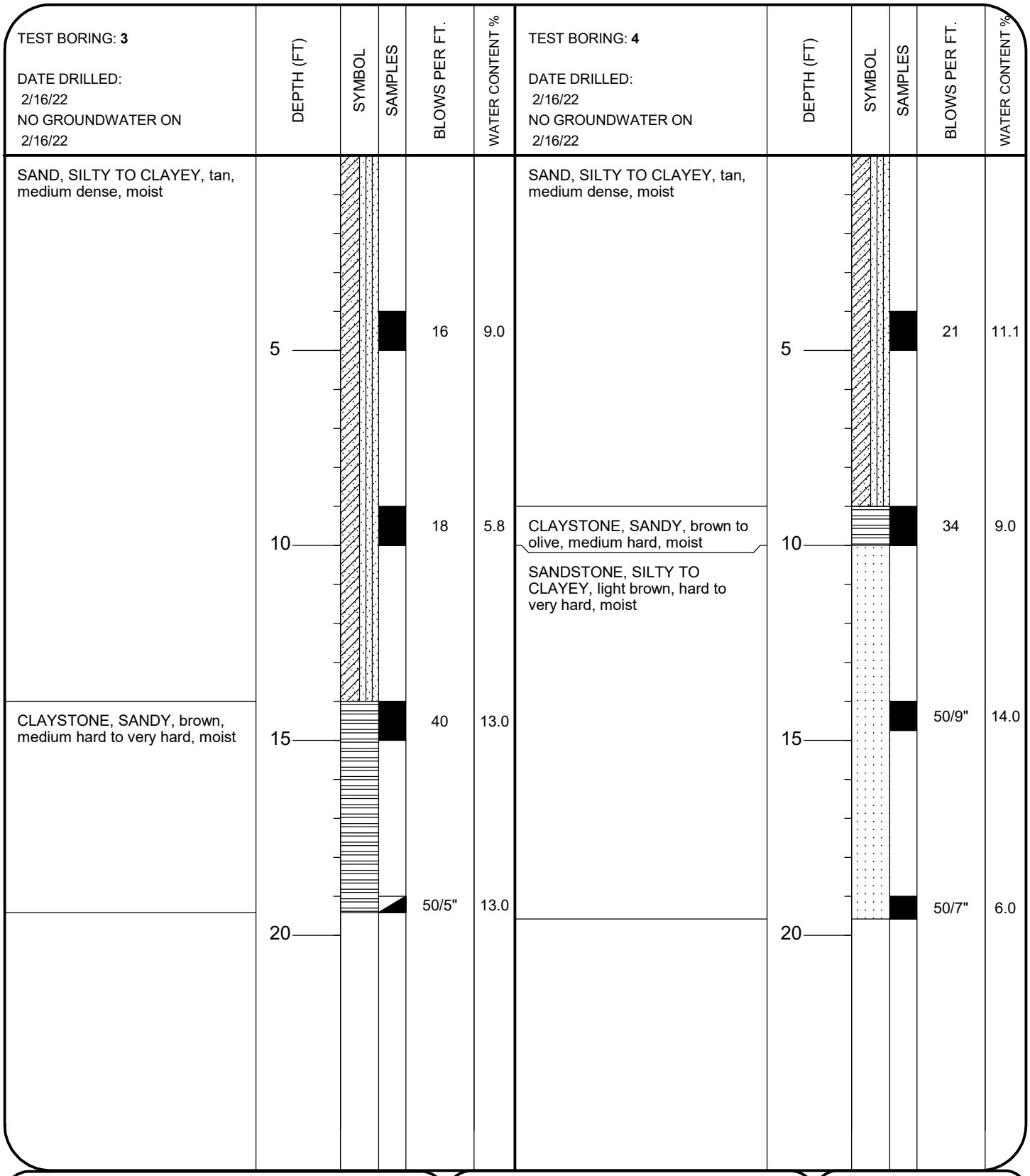
FIGURE No. 4

DATE Jul/14/2022



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TEST BORING LOG

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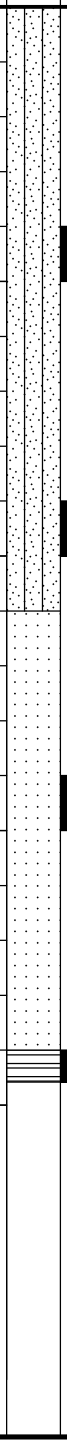
FIGURE No. 5

DATE Jul/14/2022

TEST BORING: **5**

DATE DRILLED:
2/16/22
NO GROUNDWATER ON
2/16/22



DEPTH (FT)	SAMPLES	BLOWS PER FT.	WATER CONTENT %
5		17	2.7
10		16	5.2
15		35	10.8
20		50/7"	13.9

SAND, SILTY, with gravel, tan to brown, medium dense, moist

SANDSTONE, CLAYEY, brown, medium hard, moist

CLAYSTONE, SANDY, brown, with rust staining, very hard, moist

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TEST BORING LOG

JOB No. 188276

FIGURE No. 6

DATE Jul/14/2022

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	9.0		32	19	3.5	40.5			SC
1	9.0	6.4								
1	14.0	5.8								
1	19.0	9.5								
2	4.0	2.7								
2	9.0	11.6		34	19	9.0	21.1			SC
2	14.0	7.7								
2	19.0	12.0								
3	4.0	9.0								
3	9.0	5.8								
3	14.0	13.0		35	19	0.5	56.1			CL
3	19.0	13.0								
4	4.0	11.1		36	21	5.1	14.2			SC
4	9.0	9.0								
4	14.0	14.0								
4	19.0	6.0								
5	4.0	2.7								
5	9.0	5.2		NP	NP	3.1	10.3			SW-SM
5	14.0	10.8								
5	19.0	13.9								

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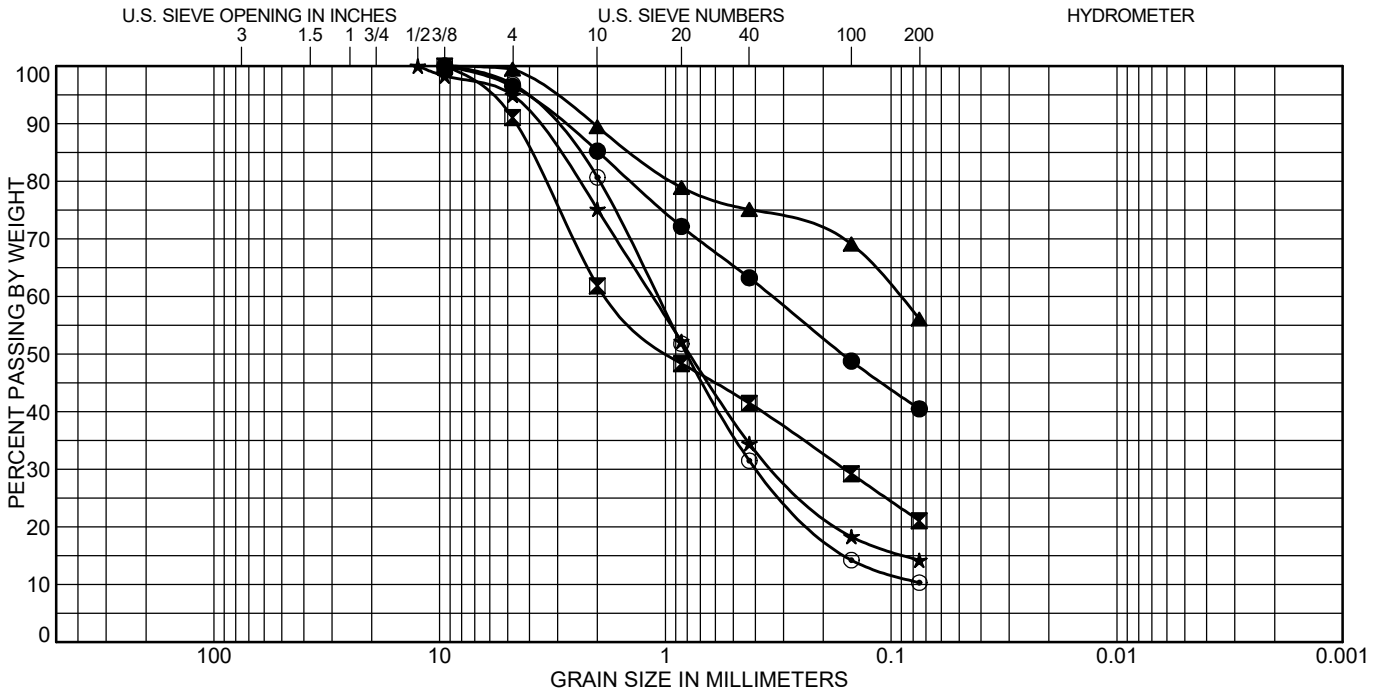
SUMMARY OF LABORATORY TEST RESULTS

JOB No. 188276
FIGURE No. 7
PAGE 1 OF 1
DATE Jul/14/2022



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Test Boring	Depth (ft)	Classification	LL	PL	PI
●	1	4.0	CLAYEY SAND(SC)	32	13	19
⊠	2	9.0	CLAYEY SAND(SC)	34	15	19
▲	3	14.0	SANDY LEAN CLAY(CL)	35	16	19
★	4	4.0	CLAYEY SAND(SC)	36	15	21
⊙	5	9.0	WELL-GRADED SAND with SILT(SW-SM)	NP	NP	NP

	Test Boring	Depth (ft)	%Gravel	%Sand	%Silt	%Clay
●	1	4.0	3.5	56.0	40.5	
⊠	2	9.0	9.0	70.0	21.1	
▲	3	14.0	0.5	43.4	56.1	
★	4	4.0	5.1	80.7	14.2	
⊙	5	9.0	3.1	86.5	10.3	

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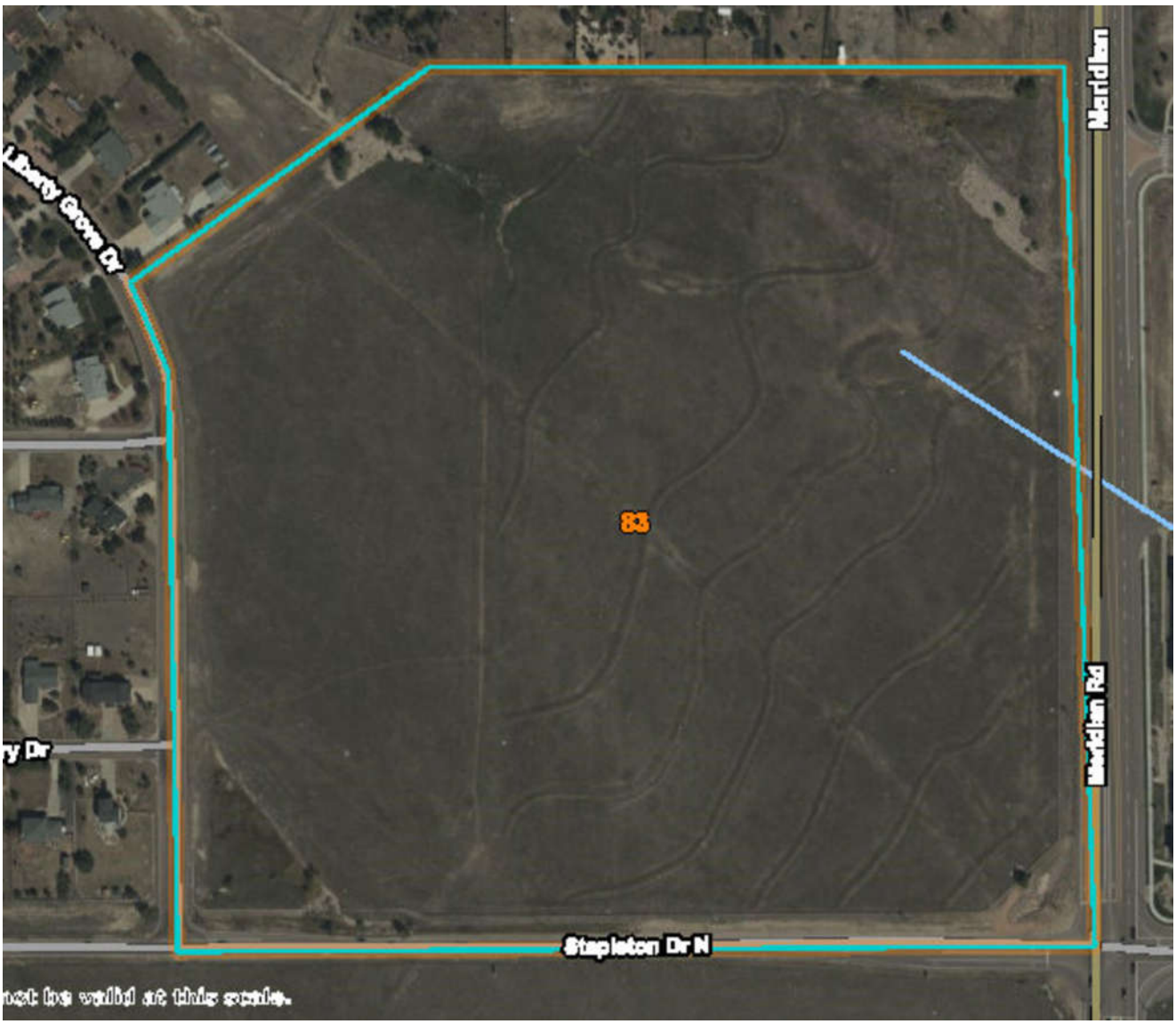
SOIL CLASSIFICATION DATA

JOB No. 188276

FIGURE No. 8

DATE Jul/14/2022



83 - STAPLETON SANDY LOAM, 3 TO 8% SLOPES

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USDA SOILS SURVEY MAP

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FIG No. 9

DATE 7/15/2022

Geologic

Tda - Dawson Arkose

Engineering

3B - Stable alluvium, colluvium and bedrock on flat to moderate slopes (0% to 12%)

rs - existing roadside ditches

dp - existing detention ponds

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ENGINEERING AND GEOLOGY MAP

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FIG No. 10

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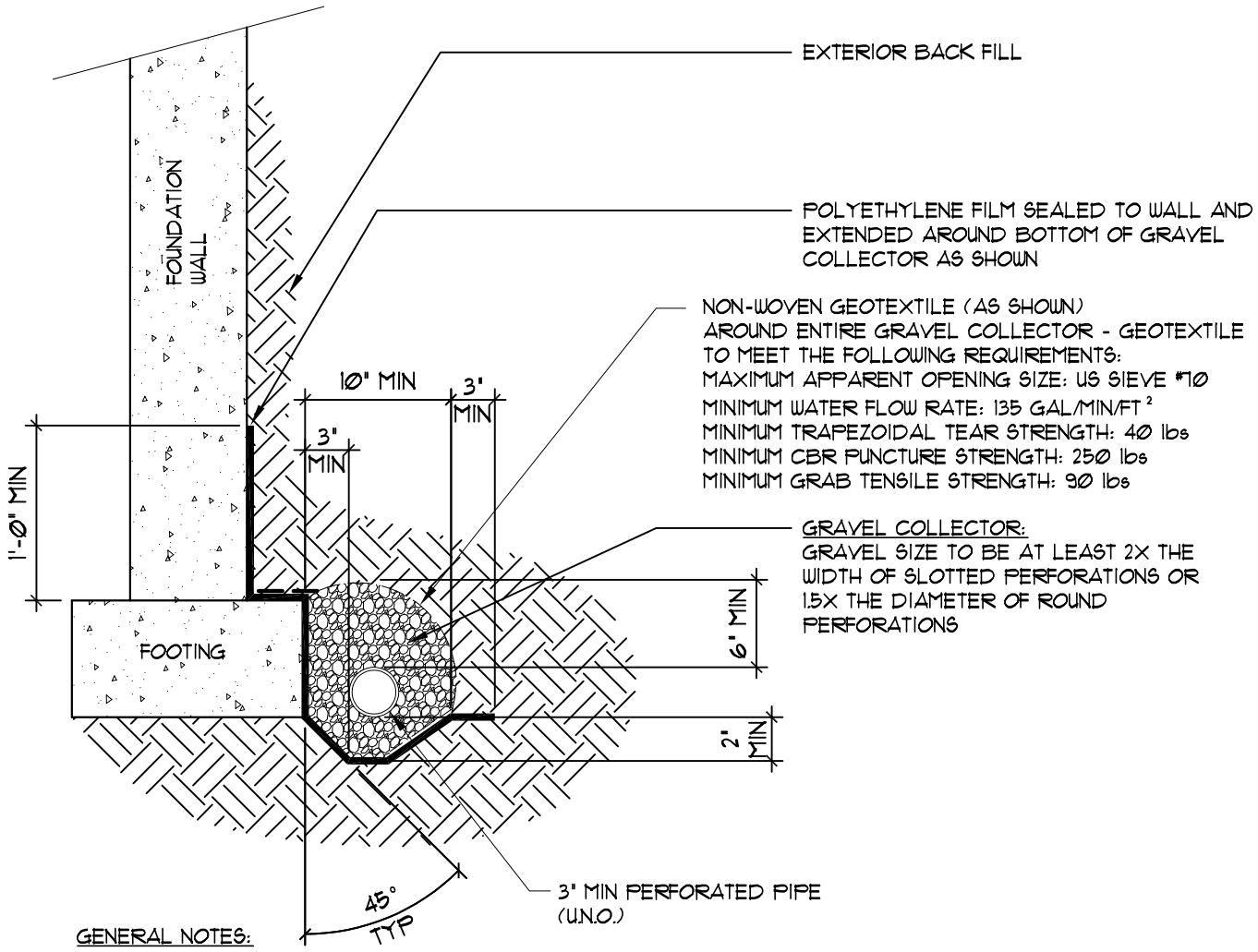

GENERAL NOTES:

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. THE OUTFALL SHOULD EXTEND PAST BACKFILL ZONES AND DISCHARGE TO A LOCATION THAT IS GRADED TO DIRECT WATER OFF-SITE.
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.
7. A VERTICAL SEGMENT OF PERFORATED DRAIN PIPE, CAPPED AT THE TOP, SHALL EXTEND TO FINISH GRADE WITHIN ALL WINDOW WELLS.

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PERIMETER DRAIN

FIG No. 11

APPENDIX A
Additional Reference Documents

1. *Flood Insurance Rate Map, El Paso County, Colorado and Unincorporated Areas, Community Panel No. 08041C0535G,* Federal Emergency Management Agency (FEMA), effective December 7, 2018.
2. *Geologic Map of Colorado, Ogden, 1979, U.S. Geological Survey*
3. *Falcon Quadrangle Geologic Map, El Paso County*, Colorado, Colorado Geological Survey, Open File Report OF-12-05, Morgan, M.L. and White J.L. 2012.
4. *Notes on the Denver Basin Geologic Maps: Bedrock Geology, Structure, and Isopach Maps of the Upper Cretaceous to Paleogene Strata between Greely and Colorado Springs, Colorado, Colorado Geological Survey.* Compiled by Dechesne, Raynolds, Barkmann and Johnson, 2011.
5. *Environmental and Engineering Geologic Map for Land Use*, compiled by Dale M. Cochran, Charles S. Robinson & Associates, Inc., Golden, Colorado, 1977.
6. *Pikes Peak Regional Building Department:* https://www.pprbd.org/.
7. El Paso County Assessor Website: https://property.spatialest.com/co/elpaso/#/property/5225400001; Schedule No. 5225400001
8. *Colorado Geological Survey, USGS Geologic Map Viewer*: http://coloradogeologicalsurvey.org/geologic-mapping/6347-2/.
9. *Historical Aerials:* https://www.historicaerials.com/viewer, Images dated 1952, 1955, 1983, 1984, 1999, 2005, 2009, 2011, 2013, 2015, and 2017.
10. *USGS Historical Topographic Map Explorer:* http://historicalmaps.arcgis.com/usgs/ El Paso County, Falcon Quadrangle, 2019.
11. *Google Earth Pro*, Imagery dated 1999, 2004, 2005, 2006, 2011, 2013, 2015, 2017, 2019 and 2020.
12. *Coal resources of the Denver and Cheyenne basins*, Colorado: Colorado Geological Survey Resource Series 5, 70 p., 5 plates, Kirkham, R.M., and Ladwig, L.R., 1979
13. *Historic coal mines of Colorado*: Colorado Geological Survey Information Series 64, CD ROM, Carroll, C.J., and Bauer, M.A., 2002.
14. *Digital inventory of industrial mineral mines and mine permit locations in* Colorado: Colorado Geological Survey Information Series IS-62, CD ROM, Keller, J.W., Phillips, R.C., and Morgan, Karen, 2002.
15. *Mineral resource data system (MRDS):* U.S. Geological Survey Digital Data Series DDS-20 (CD-ROM), Mason, G. T., and Arndt, R. E., 1996, Scott, Glenn R., Taylor, R.B., Epis, R.C., and Wobus, R.A., 1978.
16. *Geologic map of the Pueblo 1 x 2 quadrangle, south-central Colorado:* U.S. Geological Survey Miscellaneous Investigation Series, Map I-1022, scale 1:250,000.
17. The *El Paso Aggregate Resource Evaluation Map, Master Plan for Mineral Extraction*, *Map 1*
18. *Atlas of Sand, Gravel, and Quarry Aggregate Resources*, Colorado Front Range Counties, Colorado Geological Survey, Special Publication 5-B, Keller, John W.; TerBest, Harry and Garrison, Rachel E. 2003.

APPENDIX B
Guideline Site Grading Specifications

Description: Unless specified otherwise by local or state regulatory agencies, these guideline specifications are for the excavation, placement and compaction of material from locations indicated on the plans, or staked by the Engineer, as necessary to achieve the required elevations. These specifications shall also apply to compaction of materials that may be placed outside of the project.

General: The Geotechnical Engineer shall approve fill materials, method of placement, moisture contents and percent compactions, and shall give written approval of the compacted fill.

Clearing Site: The Contractor shall remove trees, brush, rubbish, vegetation, topsoil and existing structures before excavation or fill placement is commenced. The Contractor shall dispose of the cleared material to provide the Owner with a clean job site. Cleared material shall not be placed in areas to receive fill or where the material will support structures. Clearing shall also include removal of existing fills that do not meet the requirements of this specification and existing structures.

Preparation of Slopes or Drainage Areas to Receive Fill: Natural slopes or slopes of drainage gullies where grades are 20 percent (5:1, horizontal to vertical) or steeper shall be benched prior to fill placement. Benches shall be at least 10 feet wide. Benches may require additional width to accommodate excavation or compaction equipment. At least one bench shall be provided for each 5 feet or less of vertical elevation difference. The bench surface shall be essentially horizontal perpendicular to the slope or at a slight incline into the slope.

Scarifying: Topsoil and vegetation shall be removed from the ground surface in areas to receive fill. The surface shall be plowed or scarified a minimum of 12 inches until the surface is free from ruts, hummocks or other uneven features which would prevent uniform compaction by the equipment to be used.

Compacting Area to Receive Fill: After the area to receive fill has been cleared and scarified, it shall be disked or bladed until it is free from large clods, moisture conditioned to a proper moisture content and compacted to the maximum density as specified for the overlying fill. Areas to receive fill shall be worked, stabilized, or removed and replaced, if necessary, in accordance with the Geotechnical Engineer's recommendations in preparation for fill.

Fill Materials: Fill material shall be free from organic material or other deleterious substances, and shall not contain rocks or lumps having a diameter greater than six inches. Fill materials shall be obtained from cut areas shown on the plans or staked in the field by the Engineer or imported to the site and shall be approved by the Geotechnical Engineer prior to placement. It is recommended that the fill materials have nil to low expansion potential, i.e., consist of silty to slightly clayey sand.

The moisture-conditioned materials should be placed in maximum 6" compacted lifts. These materials should be compacted to a minimum of 92 percent of the maximum

- Modified Proctor dry density or 95 percent of the maximum Standard Proctor dry density. Material not meeting the above requirements shall be reprocessed.

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

Moisture Content: Fill materials shall be moisture conditioned to within limits of optimum moisture content specified. Sufficient laboratory compaction tests shall be made to determine the optimum moisture content for the various soils encountered in borrow areas or imported to the site.

The contractor may be required to add moisture to the excavation materials in the borrow area if, in the opinion of the Geotechnical Engineer, it is not possible to obtain uniform moisture content by adding water to the fill material during placement. The Contractor may be required to rake or disk the fill soils to provide uniform moisture content through the soils.

The application of water to embankment materials shall be made with watering equipment, approved by the Geotechnical Engineer, which will give the desired results. Water jets from the spreader shall not be directed at the embankment with such force that fill materials are eroded.

Should too much water be added to the fill, such that the material is too wet to permit the desired compaction to be obtained, compacting and work on that section of the fill shall be delayed until the material has been allowed to dry to the required moisture content. The Contractor will be permitted to rework the wet material in an approved manner to hasten its drying.

Compaction of Fill Areas: Selected fill material shall be placed and mixed in evenly spread layers. After each fill layer has been placed, it shall be uniformly compacted to not less than the specified percentage of maximum density. Fill materials shall be placed such that the thickness of loose material does not exceed 10 inches and the compacted lift thickness does not exceed 6 inches.

Compaction, as specified above, shall be obtained by the use of sheepsfoot rollers, multiple-wheel pneumatic-tired rollers, or other equipment approved by the Geotechnical Engineer. Granular fill shall be compacted using vibratory equipment or other equipment approved by the Geotechnical Engineer. Compaction shall be accomplished while the fill material is at the specified moisture content. Compaction of each layer shall be continuous over the entire area.

Moisture Content and Density Criteria:

A. Fill placed in roadways and utility trenches should be moisture conditioned and compacted in accordance with El Paso County Specifications.
B. Fill placed outside of roadways and utility trenches should be compacted to at least 92% of the maximum Modified Proctor density (ASTM D-1557) or at least 95% of the maximum Standard Proctor density (ASTM D-698) at a moisture content within 2% of optimum.

Compaction of Slopes: Fill slopes shall be compacted by means of sheepsfoot rollers or other suitable equipment. Compaction operations shall be continued until slopes are stable, but not too dense for planting, and such that there is no appreciable amount of loose soil on the slopes. Compaction of slopes may be done progressively in increments of three to five feet in height or after the fill is brought to its total height. Permanent fill slopes shall not exceed 3:1 (horizontal to vertical).

Density Testing: Field density testing shall be performed by the Geotechnical Engineer at locations and depths of his choosing. Where sheepsfoot rollers are used, the soil may be disturbed to a depth of several inches. Density tests shall be taken in compacted material below the disturbed surface. When density tests indicate the density or moisture content of any layer of fill or portion thereof is below that required, the particular layer or portion shall be reworked until the required density or moisture content has been achieved.

Observation and Testing of Fill: Observation by the Geotechnical Engineer shall be sufficient during the placement of fill and compaction operations so that he can declare the fill was placed in general conformance with Specifications. All observations necessary to test the placement of fill and observe compaction operations will be at the expense of the Owner.

Seasonal Limits: No fill material shall be placed, spread or rolled while it is frozen, thawing, or during unfavorable weather conditions. When work is interrupted by heavy precipitation, fill operations shall not be resumed until the Geotechnical Engineer indicates the moisture content and density of previously placed materials are as specified.

Reporting of Field Density Tests: Density tests made by the Geotechnical Engineer shall be submitted progressively to the Owner. Dry density, moisture content, percent compaction, and approximate location shall be reported for each test taken.