

Architectural  
Structural  
Geotechnical



Materials Testing  
Forensic  
Civil/Planning

## SOILS AND GEOLOGY STUDY

**Elephant Rock Villas  
Lot 2, Rancho Iraceme Sub, Filing No. 2  
Town of Palmer Lake, El Paso County, Colorado**

### PREPARED FOR:

**Dorman Real Estate  
2760 N. Academy Blvd., Suite 209  
Colorado Springs, CO 80917**

**JOB NO. 190736**

**October 21, 2022  
Amended January 4, 2023**

Respectfully Submitted,

RMG – Rocky Mountain Group

A handwritten signature in blue ink that reads 'Kelli Zigler'.

**Kelli Zigler  
Project Geologist**

Reviewed by,

RMG – Rocky Mountain Group

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



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# 1.0 GENERAL SITE AND PROJECT DESCRIPTION

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## 1.1 Project Location

The project lies in the NE<sup>1</sup>/<sub>4</sub> of the NW<sup>1</sup>/<sub>4</sub> of Section 09, Township 11 South, Range 67 West of the 6<sup>th</sup> Principal Meridian in El Paso County, Colorado. The site is generally located north and west of the intersection of Highway 105 and Red Rock Ranch Road. 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) and is approximately 13 acres:

- Schedule No. 7109012011, current land use is classified as a vacant commercial lot

The proposed development site is a 13-acre vacant tract of land zoned PUD (Planned Unit Development) know as Lot 2 in Rancho Iracema Subdivision, Filing No. 2, in the Town of Palmer Lake, County of El Paso, State of Colorado (the "Property" or "Elephant Rock Villas"). The site is currently undeveloped.

## 1.3 Project Description

It is our understanding the property is to remain one parcel, and is to be developed with 25 multi-family structures for a total of 57 units. The structures are to be a clustered townhome community with non-owner-occupied duplexes and triplexes. Construction is to be slab-on-grade foundations with heights of eighteen feet for single-story townhomes and twenty-eight feet for two-story townhomes.

Elephant Rock Villas is to be developed, owned, managed, and maintained by Dorman Properties, LLC and Montebello 2205, LLC, who has purchased the property.

It is our understanding the site is to have access to water and sewer services from the Town of Palmer Lake and Palmer Lake Sanitation District, respectively. On-site wastewater treatment system (OWTS) are not proposed. The Proposed Building Layout Plan is presented in Figure 2.

## 1.4 Previous Investigations

Reports of previous geotechnical engineering/geologic investigations for this site were not available for our review.

# 2.0 QUALIFICATIONS OF PREPARERS

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This Soils and Geology Study was prepared by a professional geologist as defined by Colorado Revised Statutes 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 21 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 21 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

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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 Palmer Lake, 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:

- Field reconnaissance
- Geologic and topographic maps
- Review of selected publicly available, pertinent engineering reports
- Available aerial photographs
- Subsurface exploration
- 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 Additional Documents**

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

## **4.0 SITE CONDITIONS**

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### **4.1 Existing Site Conditions**

The site is currently vacant undeveloped land. The site is generally located southeast of the intersection of Highway 105 and Red Rock Road in the Town of Palmer Lake, El Paso County, Colorado and comprises approximately 13 acres. The site is bound to the northeast by the Union Pacific railroad tracks, to the north by The Recovery Village (commercial development), to the east by Highway 105, and to the south by undeveloped land.

### **4.2 Topography**

Based on our site reconnaissance on September 21, 2022 and USGS 2019 topographic map of the Palmer Lake Quadrangle, the site generally slopes down to the southeast to an existing drainage swale located along Highway 105 near the western property boundary. The site has an overall elevation change of approximately 25 to 30 feet. The majority of the elevation is along the western portion of the property; where the site is elevated approximately 23 feet above Highway 105. Minor erosional features were visible along the southern facing slope in the Highway 105 roadway cut. A natural drainage channel is visible near the northeast corner of the property and continues to run downslope to the south across the property to the east, as shown in Figure 11, Engineering Geology Map. At the time of the site reconnaissance the drainage was dry. The water level in the drainage channel is anticipated to vary, depending upon local precipitation events.

### **4.3 Vegetation**

The site vegetation primarily consists of tall native grasses, weeds, and other prairie-type vegetation. Clusters of deciduous trees and scrub oak are scattered throughout the site.

#### **4.4 Aerial Photographs and Remote-Sensing Imagery**

Personnel of RMG reviewed aerial photos available through Google Earth Pro dating back to 1999, Colorado Geological Survey (CGS) surficial geologic mapping, and historical photos by [historicaerials.com](http://historicaerials.com) dating back to 1947. Historically, the site has remained vacant, undeveloped land.

### **5.0 FIELD INVESTIGATION AND LABORATORY TESTING**

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The subsurface conditions within the property were explored by drilling four (4) exploratory borings on August 4, 2022, extending to depths of approximately 20 to 30 feet below the existing ground surface. The test borings were spaced to provide preliminary soil information across the site. The Proposed Building 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 5.

#### **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. A Summary of Laboratory Test Results is presented in Figure 6. Soils Classification Data is presented in Figures 7 and 8.

### **6.0 SOIL, GEOLOGY, AND ENGINEERING GEOLOGY**

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The site is located within the central portion of the Great Plains Physiographic Province. A major structural feature known as the Rampart Range Fault is located approximately 4 miles west of the site. The Rampart Range Fault marks the boundary between the Great Plains Physiographic Province and the Southern Rocky Mountain Province. The site exists within the southern portion of a large structural feature known as the Denver Basin. In general, the geology at the site consists of alluvium composed of sand, silt, clay, and gravel with loamy colluvium that overlies the Dawson Formation.

#### **6.1 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 silty to clayey sand 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.

## 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. The sandstone bedrock was encountered in our test borings. The Dawson sandstone is known to contain interbedded seams and/or layers of claystone. The claystone is considered expansive. The claystone or a representative sample of the claystone was not obtained for testing, however, the claystone is expected to classify as CL. Foundation stability within the Dawson sandstone generally is good and permeability is anticipated to be low. If claystone were encountered across the site, it is generally not suitable for foundations and the permeability is also considered low.

Depending on the final site grading and depth of foundations, bedrock is not anticipated in the proposed slab-on-grade foundation excavations. However, bedrock may be encountered in the utility trenches for the proposed development. Overall, the Dawson sandstone and claystone (if encountered) 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 identifies the site soils as:

- 71 – Pring coarse sandy loam, 3 to 8 percent slopes. The Pring coarse sandy loam encompasses approximately of the property 1.8 percent of the 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 Pring coarse sandy loam comprised the majority of the site.
- 93 – Tomah-Crowfoot complex, 8 to 15 percent slopes. Properties of the complex include well drained soils, depth of the water table is anticipated to be greater than 80 inches, runoff is anticipated to be medium, frequency of flooding and ponding is none, and landforms include alluvial fans and hills. The Tomah-Crowfoot complex was mapped to comprise the southwestern quadrant of the site.

The USDA Soil Survey Map is presented in Figure 10.

## 6.4 General Geologic Conditions

Based on our field observations and review of relevant geologic maps, we identified the geologic conditions (listed below) affecting the development, as shown on the Engineering Geology Map, Figure 11.

The site generally consists of alluvium and colluvium deposits of the Pleistocene overlying the Dawson Formation of the Upper Cretaceous to Eocene age. Two geologic units were mapped at the site as:

- *Qas<sub>2</sub>* – Middle alluvium-slope deposits (middle Paleocene) – This unit consists of thin beds of poorly sorted sand with fine pebbles and gravel. The unit is comprised of sheetwash and stream-deposited alluvium that spans a broad range of time and includes deposits of more than one age. Some deposits are probably correlative with terrace deposits and older gravels along the larger streams of the area, but others owe their existence to non-synchronous channel avulsions and stream piracy. Estimated thickness is approximately 5 to 40 feet. The alluvium was encountered in our test borings to depths ranging between 7 and 12 feet.

- Tkda<sub>3</sub> - Facies unit three of the Dawson Formation (Paleocene) – The middle of the Dawson unit consists of sub-equal amounts of thick and very thick-bedded, massive and cross-bedded, white, tan, and light-gray arkose and pebbly arkose. Thin to thick beds of light-green to olive-gray clay-rich material may also be encountered. The unit is up to 500 to 600 feet thick in the southeast and thins towards the northwest of the quadrangle, in which the site is located.

## 6.5 Engineering Geology

One engineering geology unit was mapped at the site as:

- 3B – Expansive and potentially expansive soil and bedrock on flat to moderate slopes (0-12%)

The map unit description for this unit was provided by Charles Robinson and Associates (1977).

## 6.6 Structural Features

Structural features such as schistosity, 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, creep, or slope wash 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 study 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 from the north, northwest to the southeast, east.

Groundwater was not encountered at the time of drilling, nor were there indications of increased moisture observed in the samples obtained by RMG. Groundwater was also not observed in follow-up groundwater checks performed on October 7, 2022, approximately two 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.

### **6.10 Flooding and Surface Drainage**

A natural drainage channel runs through the site in the northeast corner. The drainage channel was dry at the time of the site recon performed by RMG. The USGS Topo Map is presented in Figure 9.

Based on our review of the Federal Emergency Management Agency (FEMA) Community Panel No. 08041C0257G and the online ArcGIS El Paso County Risk Map, the site lies outside of a 100-year floodplain. The site is within the boundaries of Zone X. The FEMA Map is presented in Figure 12.

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.

## **7.0 ECONOMIC MINERAL RESOURCES**

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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 1* 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, the tract identifier is 41-02. 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. No oil and gas wells are drilled in the area, or within two miles of it. Alluvial deposits are commonly mined in the region for sand and gravel. There are no active or inactive gravel pits in the area, but there are several within a three-mile radius of it. Alluvial deposits containing gravel and/or sand cover approximately 112 acres of tract 41-02. Assuming a mineable thickness of 15 feet, this represents 4.1 million tons of potentially useable resource. The quality of the resource has not been determined. In the vicinity of this area, the coal-bearing beds of the Laramie Formation lie at a depth of approximately 1,500 feet (Kirkham and Ladwig, 1979). It is possible that the tract contains coal resources at this depth. The coal seams in the Laramie Formation tend to be lenticular and discontinuous in comparison to areas currently being mined in western Colorado.

## 8.0 IDENTIFICATION AND MITIGATION OF POTENTIAL GEOLOGIC CONDITIONS

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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 constraints were considered in the preparation of this report. They are not anticipated to pose a significant risk to the proposed development:

- Avalanches
- Compressible Soils
- Debris Flow-Fans/Mudslides
- Ground Subsidence and Abandoned Mining Activity
- Landslides
- Rockfall
- Flood Prone Area
- Groundwater Springs or Seeps
- Shallow Groundwater Tables
- Ponding water
- Steeply Dipping Bedrock
- Unstable or Potentially Unstable Slopes
- Scour, Erosion, Accelerated Erosion Along Creek Banks and Drainageways
- History of Landfill or Uncontrolled/Undocumented Fill Placement
- Valley Fill
- Downhill/Down-slope Creep
- Soil Slumps and Undercutting
- Corrosive Minerals

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

### 8.1 Expansive Soils

Based on our test borings and experience with similar materials in this area, the on-site soils generally possess low swell potential. However, the Dawson formation is known to have moderate to high swell potential in some locations. If these materials are encountered in the excavations for the proposed multi-family structures, they can readily be mitigated with typical construction practices common to this region of El Paso County, Colorado.

#### Mitigation

Foundation design and construction are typically adjusted for expansive soils. Mitigation of expansive soils may include overexcavation and replacement with non-expansive structural fill. Drilled piers are not anticipated. Floor slabs bearing directly on expansive soils are expected to experience movement.

Overexcavation and replacement with compacted non-expansive soils can be successful in reducing slab movement.

If expansive soils or bedrock are encountered during construction, mitigation of these expansive materials should follow the recommendations presented in a lot-specific subsurface soil investigation performed for each proposed structure.

## 8.2 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 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

The Pikes Peak Regional Building Code, 2017 Edition, indicates maximum considered earthquake spectral response accelerations of 0.213g 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.

## 8.3 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".*

Northern El Paso County and the 80133 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](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 BEARING OF GEOLOGIC CONDITIONS UPON PROPOSED DEVELOPMENT

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Geologic hazards (as described in section 8 of this report) found to be present at this site include faults and seismicity and radon. Geologic conditions (as described in section 8 of this report) found to be present at this site include compressible soils and expansive soils. It is our opinion that the existing geologic and engineering conditions can be satisfactorily mitigated through proper engineering, design, and construction practices.

## 10.0 ADDITIONAL STUDIES

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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. ***A site-specific subsurface soil investigation will be required for all proposed structures including (but not limited to) residences and any proposed retaining walls, etc.***

To develop recommendations for construction of the proposed roadways, a pavement design investigation should be performed. This investigation should consist of additional test borings, soil laboratory testing and specific recommendations for the design and construction of roadway pavement sections.

## 11.0 CONCLUSIONS

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Based upon our evaluation of the geologic conditions, it is our opinion that the proposed 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.

In addition to the previously identified mitigation alternatives, surface and subsurface drainage systems should be considered. Exterior, perimeter foundation drains should be installed around below-grade habitable or storage spaces. A typical perimeter drain detail is presented in Figure 13. Surface water should be efficiently removed from the building area to prevent ponding and infiltration into the subsurface soil.

We believe the silty to clayey sand and sandstone will classify as Type B material as defined by OSHA in 29 CFR Part 1926. 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 the property to 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

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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 **Dorman Real Estate** 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.

## FIGURES



NOT TO SCALE

Architecture  
Structural  
Geotechnical



**Engineers / Architects**

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SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

Materials Testing  
Forensics  
Civil / Planning

## SITE VICINITY MAP

ELEPHANT ROCK VILLAS  
EL PASO COUNTY, COLORADO  
DORMAN REAL ESTATE

JOB No. 190736

FIG No. 1

DATE 10-21-2022



APPROXIMATE PROPERTY BOUNDARIES

TB-4

PHASE 5  
4 UNITS

PHASE 14 UNITS  
TB-2

PHASE 4  
2 UNITS  
TB-1

PHASE 2  
11 UNITS

PHASE 3  
16 UNITS

TB-3

HIGHWAY 51CS



NOT TO SCALE  
BASE MAP PROVIDED BY NES INC.

⊕ DENOTES APPROXIMATE  
LOCATION OF TEST BORINGS  
PERFORMED FOR THIS STUDY

ELEPHANT ROCK VILLAS  
EL PASO COUNTY, COLORADO  
DORMAN REAL ESTATE

ENGINEER:	TM
DRAWN BY:	KZ
CHECKED BY:	TM
ISSUED:	10-21-2022

PROPOSED BUILDING  
LAYOUT WITH TEST  
BORING LOCATIONS

SHEET No.  
**FIG-2**

# SOILS DESCRIPTION



CLAYEY SAND



SANDSTONE



SILTY SAND



SILTY TO CLAYEY SAND

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

# SYMBOLS AND NOTES



XX

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



XX

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



FREE WATER TABLE



DEPTH AT WHICH BORING CAVED



BULK DISTURBED BULK SAMPLE



AUG AUGER "CUTTINGS"

4.5

WATER CONTENT (%)

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


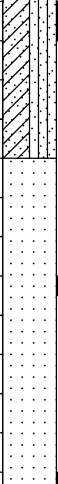



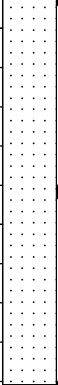








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## EXPLANATION OF TEST BORING LOGS

JOB No. 190736

FIGURE No. 3

DATE Oct/21/2022

TEST BORING: 1  DATE DRILLED: 8/4/22 NO GROUNDWATER ON 8/4/22	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %	TEST BORING: 2  DATE DRILLED: 8/4/22 NO GROUNDWATER ON 8/4/22	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
SAND, CLAYEY, with gravel, light brown, medium dense, moist	5			21	12.7	SAND, SILTY TO CLAYEY, with gravel, light brown to dark brown, loose to medium dense, moist	5			5	6.5
SANDSTONE, SILTY TO CLAYEY, with gravel, light brown, very hard, moist	10			50/6"	5.1	SANDSTONE, SILTY TO CLAYEY, with gravel, light brown, very hard, moist	10			29	10.3
	15			50/5"	6.1		15			50/6"	14.0
	20			50/4"	8.9		20			50/5"	7.8
							25			50/4"	8.4
							30			10/0"	9.1

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## TEST BORING LOG

JOB No. 190736

FIGURE No. 4

DATE Oct/21/2022

TEST BORING: 3  DATE DRILLED: 8/4/22 NO GROUNDWATER ON 8/4/22	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %	TEST BORING: 4  DATE DRILLED: 8/4/22 NO GROUNDWATER ON 8/4/22	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
SAND, SILTY TO CLAYEY, with gravel, light brown to brown, loose to medium dense, moist	5			7	4.5	SAND, SILTY, with gravel, light brown, loose to medium dense, moist	5			4	2.0
SANDSTONE, SILTY TO CLAYEY, with gravel, light brown, hard to very hard, moist	10			20	10.8	SANDSTONE, SILTY TO CLAYEY, with gravel, light brown, very hard, moist	10			12	2.1
	15			50	10.7		15			50/7"	6.2
	20			50/4"	9.5		20			50/5"	10.0
	25				6.4						
	30				8.7						

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# TEST BORING LOG

JOB No. 190736

FIGURE No. 5

DATE Oct/21/2022

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	12.7		32	15	3.7	25.2			SC
1	9.0	5.1								
1	14.0	6.1								
1	19.0	8.9								
2	2.0	6.5								
2	7.0	10.3		27	14	1.3	32.8			SC
2	14.0	14.0								
2	19.0	7.8								
2	24.0	8.4				4.8	24.1			
2	29.0	9.1								
3	4.0	4.5								
3	9.0	10.8		28	15	1.5	26.7			SC
3	14.0	10.7								
3	19.0	9.5								
3	24.0	6.4		31	21	1.3	29.7			SC
3	29.0	8.7								
4	2.0	2.0		NP	NP	5.0	6.8			SW-SM
4	7.0	2.1								
4	14.0	6.2								
4	19.0	10.0		30	14	0.0	47.8			SC

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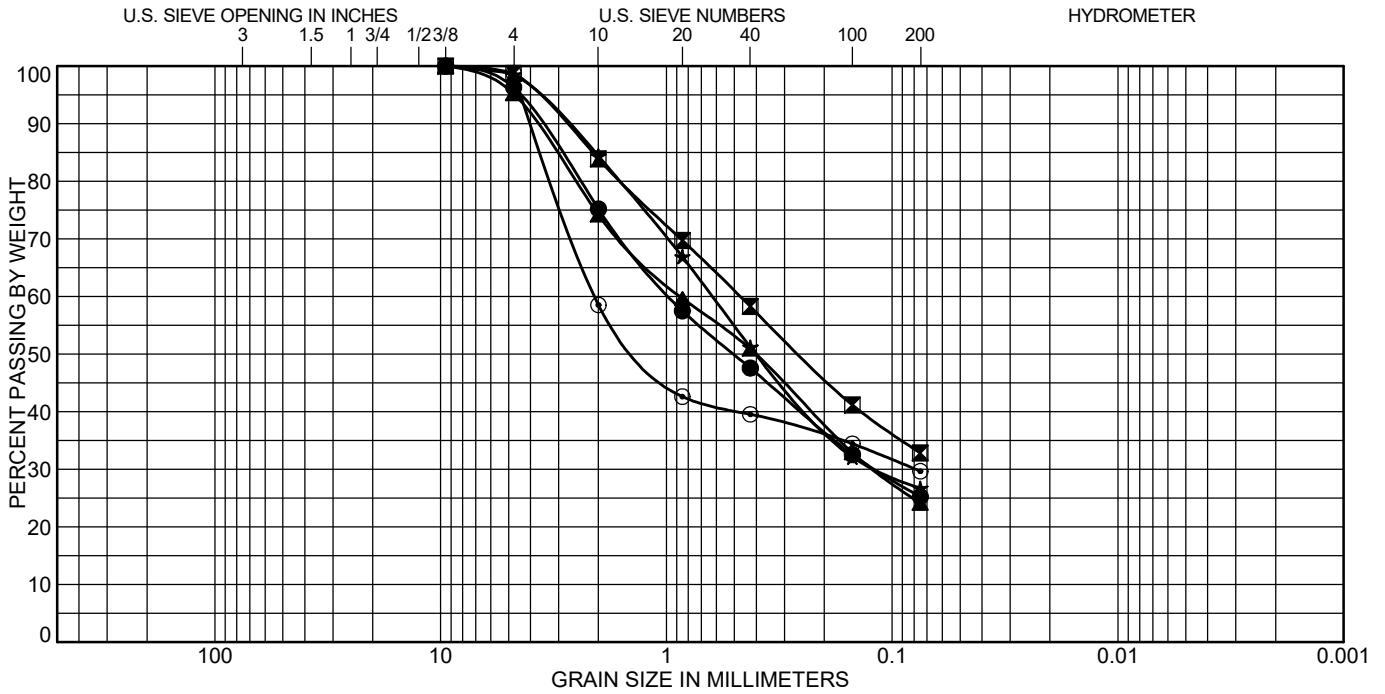
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## SUMMARY OF LABORATORY TEST RESULTS

JOB No. 190736  
 FIGURE No. 6  
 PAGE 1 OF 1  
 DATE Oct/21/2022



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	17	15
☒ 2	7.0	CLAYEY SAND(SC)	27	13	14
▲ 2	24.0				
★ 3	9.0	CLAYEY SAND(SC)	28	13	15
◎ 3	24.0	CLAYEY SAND(SC)	31	10	21

Test Boring	Depth (ft)	%Gravel	%Sand	%Silt	%Clay
● 1	4.0	3.7	71.1	25.2	
☒ 2	7.0	1.3	65.9	32.8	
▲ 2	24.0	4.8	71.1	24.1	
★ 3	9.0	1.5	71.8	26.7	
◎ 3	24.0	1.3	69.1	29.7	

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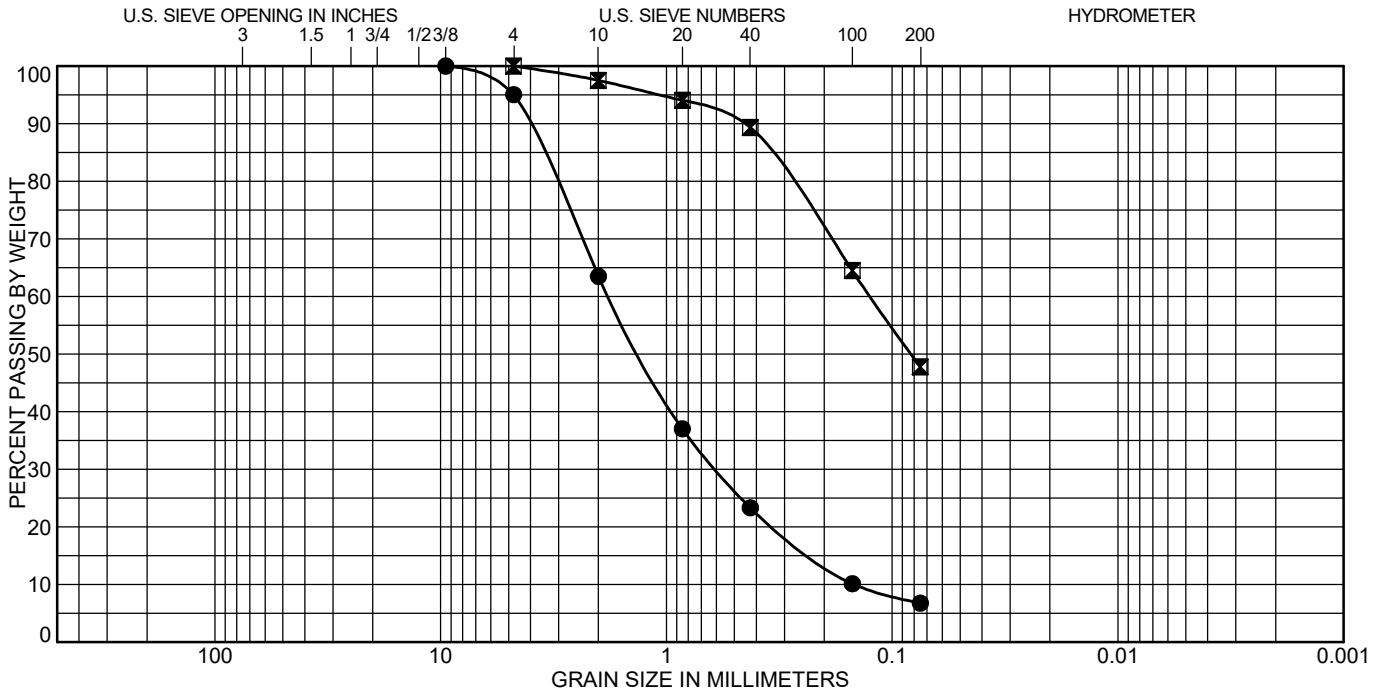
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## SOIL CLASSIFICATION DATA

JOB No. 190736

FIGURE No. 7

DATE Oct/21/2022



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Test Boring	Depth (ft)	Classification	LL	PL	PI
● 4	2.0	WELL-GRADED SAND with SILT(SW-SM)	NP	NP	NP
☒ 4	19.0	CLAYEY SAND(SC)	30	16	14

Test Boring	Depth (ft)	%Gravel	%Sand	%Silt	%Clay
● 4	2.0	5.0	88.3	6.8	
☒ 4	19.0	0.0	52.2	47.8	

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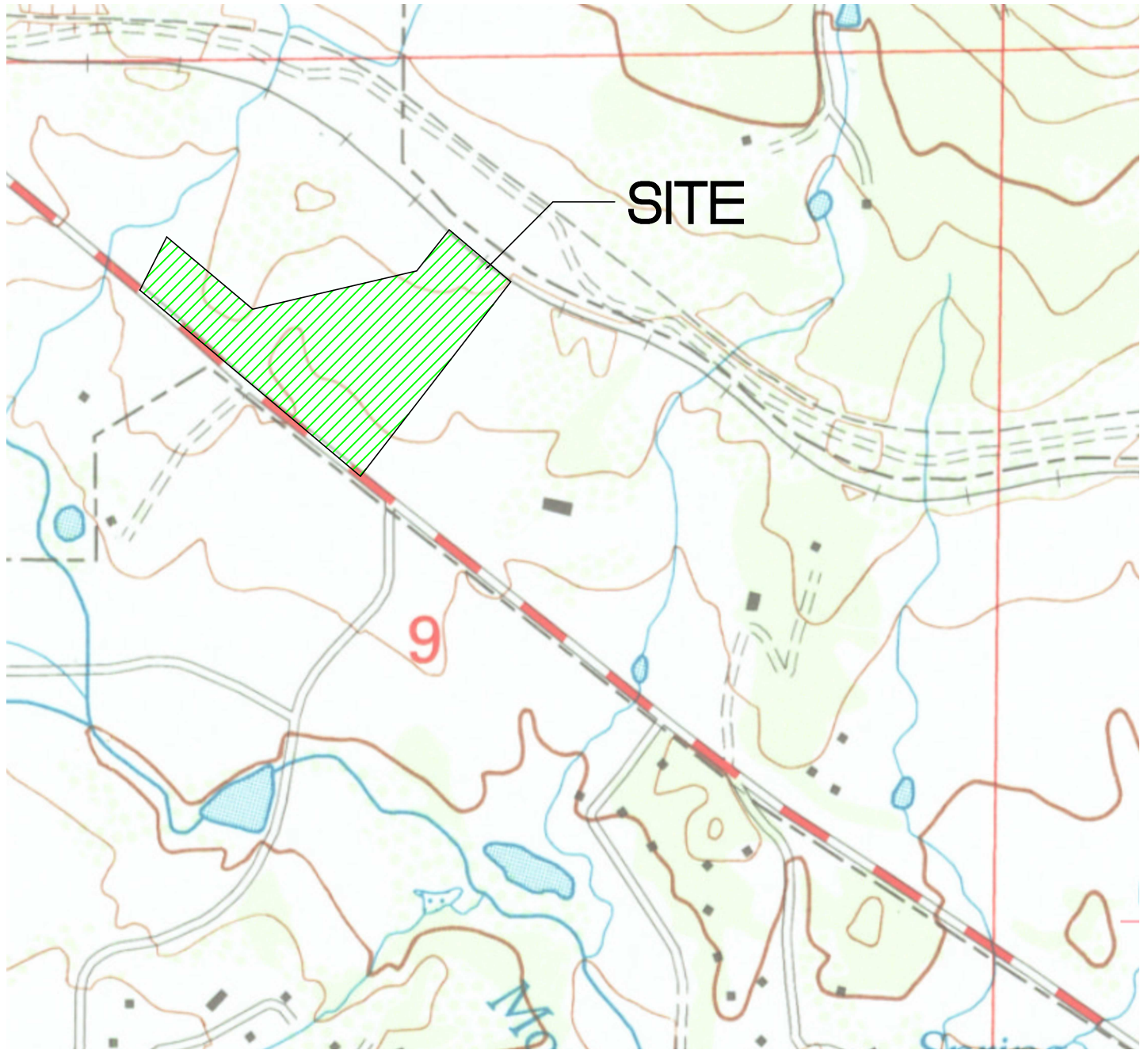
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# SOIL CLASSIFICATION DATA

JOB No. 190736

FIGURE No. 8

DATE Oct/21/2022



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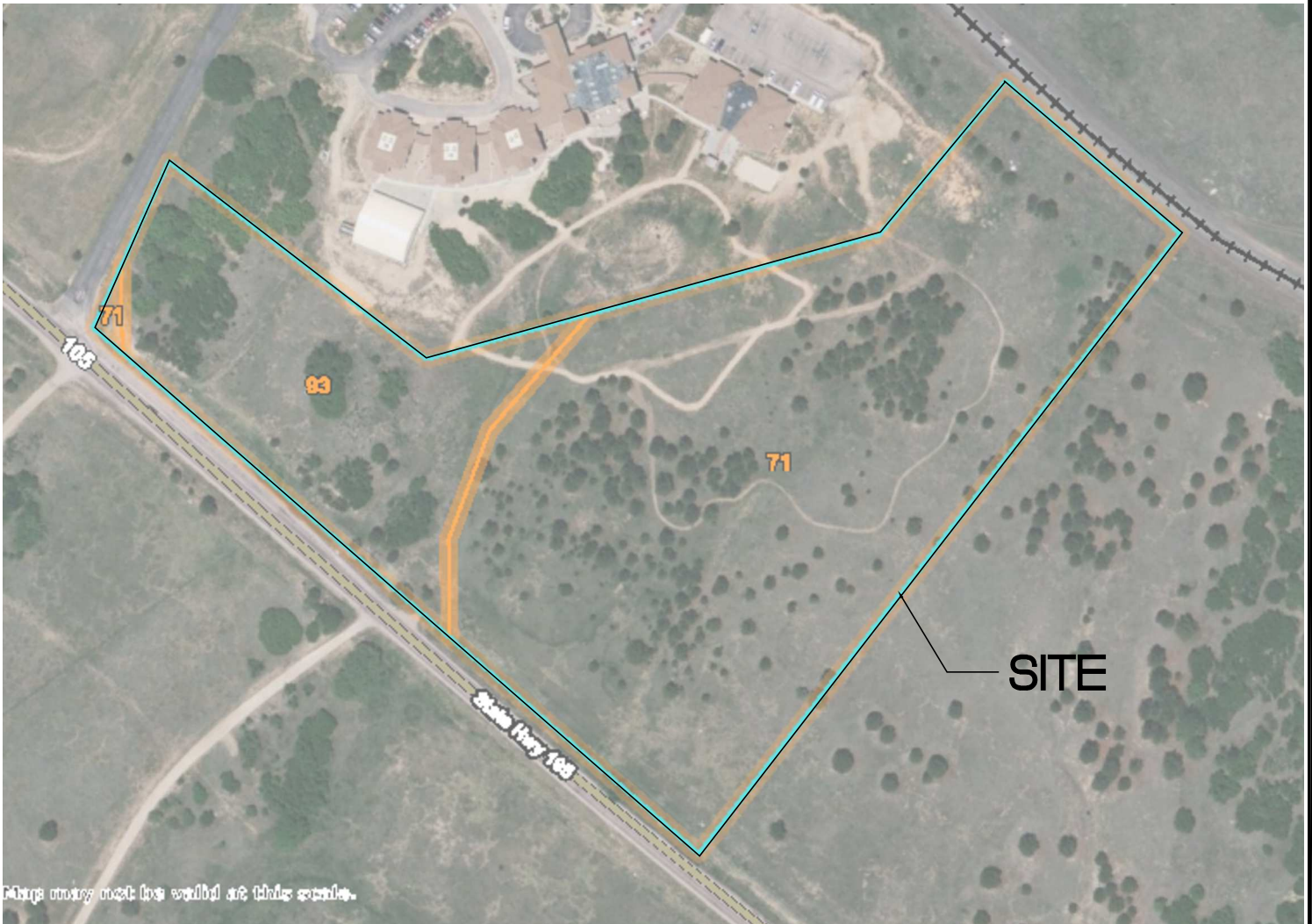
## USGS TOPO MAP

ELEPHANT ROCK VILLAS  
EL PASO COUNTY, COLORADO  
DORMAN REAL ESTATE

JOB No. 190736

FIG No. 9

DATE 10-21-2022



- 71 - Fine coarse sandy loam, 3 to 8 percent slopes
- 93 - Tomah-Crowfoot complex, 8 to 15 percent slopes



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## USDA SOIL SURVEY MAP

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FIG No. 10

DATE 10-21-2022

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**General Geology**

*Qas<sub>2</sub>* - Middle alluvium-slope deposits (middle Paleocene) - The unit is comprised of sheetwash and stream-deposited alluvium that spans a broad range of time and includes deposits of more than one age. Estimated thickness is approximately 5 to 40 feet. The alluvium was encountered in our test borings to depths ranging between 7 to 12 feet.

*Tkda<sub>3</sub>* - Facies unit three of the Dawson Formation (Paleocene) - The middle of the Dawson unit. The unit is up to 500 to 600 feet thick in the southeast and thins towards the northwest of the quadrangle, in which the site is located.

**Engineering Geology**

*3B* - Expansive and potentially expansive soil and bedrock on flat to moderate slopes (0-12%)

⊕ DENOTES APPROXIMATE LOCATION OF TEST BORINGS PERFORMED FOR THIS STUDY

NOT TO SCALE

ELEPHANT ROCK VILLAS  
EL PASO COUNTY, COLORADO  
DORMAN REAL ESTATE

ENGINEER:	TM
DRAWN BY:	KZ
CHECKED BY:	TM
ISSUED:	10-21-2022

ENGINEERING GEOLOGY MAP

SHEET No. FIG-11



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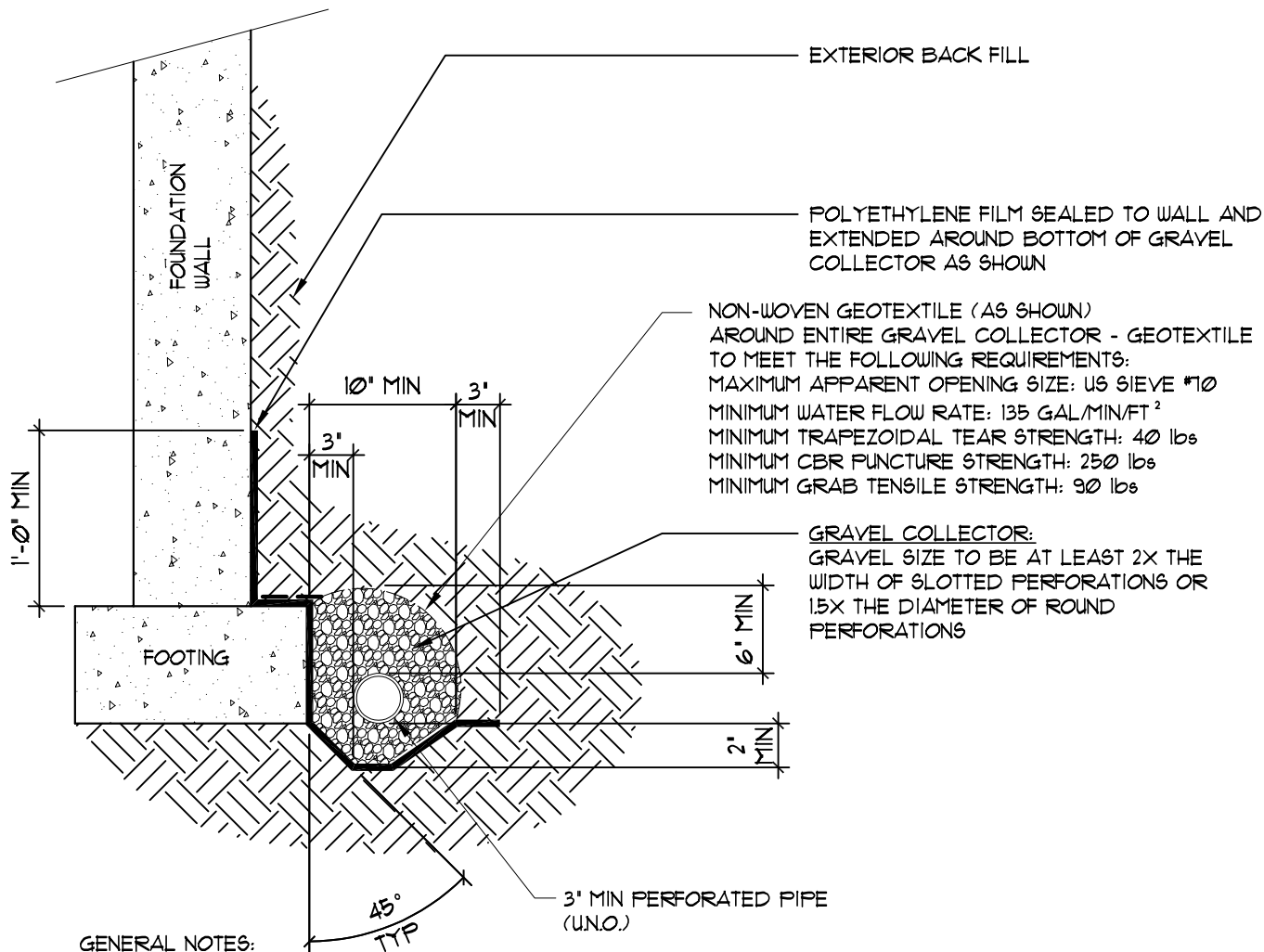
## FEMA MAP

ELEPHANT ROCK VILLAS  
EL PASO COUNTY, COLORADO  
DORMAN REAL ESTATE

JOB No. 190736

FIG No. 12

DATE 10-21-2022



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. 13**

# Appendix A

## *Additional Reviewed Documentation*

1. *Site Plan, Elephant Rock Villas*, prepared by NES, dated August 15, 2022.
  2. *Flood Insurance Rate Map, El Paso County, Colorado and Unincorporated Areas, Community Panel No. 081041C0257G*, Federal Emergency Management Agency (FEMA), effective December 7, 2018. FEMA Flood Map Service Center: <https://msc.fema.gov/portal/home>.
  3. *Geologic Map of the Larkspur, Palmer Lake & Mt. Deception Quadrangles, Colorado-El Paso County & Douglas County, Colorado*, compiled by Dale M. Cochran, 1977.
  4. *Environmental and Engineering Geologic Map for Land Use, Larkspur, Palmer Lake & Mt. Deception Quadrangles, Colorado-El Paso County & Douglas County, Colorado*, compiled by Dale M. Cochran, 1977.
  5. *Map of Potential Geologic Hazards and Surficial Deposits*, compiled by Dale M. Cochran, Charles S. Robinson & Associates, Inc., Golden, Colorado, 1977.
  6. *Geologic Map of the Palmer Lake Quadrangle, El Paso County, Colorado, Colorado Geologic Survey*, prepared by John W., Keller, Matthew L. Thorson, Jon P. Lindsey, Neil R., and Barkmann P.E., Open File Report OF-06-06, 2006.
  7. *Reconnaissance Geologic Map of Colorado Springs and Vicinity, Colorado*, Department of the Interior United State Geologic Survey, prepared by Glenn R. Scott and Reinhold A. Wobus, Miscellaneous Field Studies, Map MF-482, Sheets 1 and 2, 1973.
  8. *Colorado Springs Landslide Susceptibility, Colorado Geological Survey*:  
<https://cologeosurvey.maps.arcgis.com/apps/webappviewer/index.html?id=5e7484a637c4432e84f4f16d0af306d3>
  9. *Colorado Landslide Inventory, Colorado Geological Survey*:  
<https://cologeosurvey.maps.arcgis.com/apps/webappviewer/index.html?id=9dd73db7fbc34139abe51599396e2648>.
  10. *Pikes Peak Regional Building Department*: <https://www.pprbd.org/>.
  11. *City of Colorado Springs, Subdivision Document Viewer*:  
<http://www.springsgov.com/SubDivView/default.asp?cmdGoBack=New+Search...>
  12. *El Paso County Assessor, El Paso County, Colorado*:  
<https://property.spatalest.com/co/el Paso/#/property/7109012011>, Schedule No. 7109012011.
  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 1952, 1953, 1955, 1960, 1969, 1984, 1999, 2004, 2005, 2009, 2011, 2013, 2015, 2017, and 2019..
  15. *USGS Historical Topographic Map Explorer*: <http://historicalmaps.arcgis.com/usgs/> Images dated 1950, 1951, 1956, 1657, 1963, 1966, 1970, 1974, 1977, 1994, 2001, 2013 and 2013.
  16. *Google Earth Pro*, Imagery dated 1999, 2003, 2004, 2005, 2006, 2011, 2015, 2017, 2018, 2019, and 2020.
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