Architecture
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ROCKY MOUNTAIN GROUP

GEOLOGY AND SOILS REPORT
with Wastewater Study

Lot 10, Lot K, Lot L, Springs Crest Subdivison
El Paso County, Colorado

PREPARED FOR:

Hunsinger Development Corporation
4406 College Park Court
Colorado Springs, CO 80918

JOB NO. 162650

May 18, 2018

Respectfully Submitted,

RMG – Rocky Mountain Group

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Project Geologist

Reviewed by,

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see comments on OWTS Report

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1.0 GENERAL SITE AND PROJECT DESCRIPTION

1.1 Project Location

The project lies in the northeast portion of Section 28, Township 12 South, Range 66 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 three parcels included in this investigation are partially developed land and are currently owned by one owner. An existing two-story single family residence reportedly constructed in 1914 resides near the southwestern corner of the western parcel. A barn, cattle shed and miscellaneous structures are located to the east and north of the residence. A well and septic service the residence. Two vacant parcels are located to the northeast and east of the residence and each parcel has a well. An existing overhead electric line and utility easement transverses the property from north to south. Two low lying areas (man-made) that may have previously been used as ponds are located on the property. One pond is located near the northwest corner of the property and the other pond is near the southeastern portion of the site. Both ponds were dry and overgrown with vegetation.

1.3 Project Description

The proposed development currently consists of three parcels. It is proposed the combined 14.959 acres be subdivided into five 2.5 to 3.3 acre parcels. Each parcel is to contain one new single-family residence with a well and septic based on preliminary plan provided by Clark Land Surveying, Inc. dated April 5, 2016. It is our understanding the single-family residence, barn, cattle shed and miscellaneous structures will remain on Lot 1 of the subdivision. The well and septic are to remain on Lot 1 and the well on Lot 4 is to remain. The existing wells on Lots 2 and 5 are to be abandoned. No detention ponds are proposed. It is anticipated the home builders are to construct their own driveways for Lots 2 and 3.

2.0 QUALIFICATIONS OF PREPARERS

This Geology and Soils report 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 Geoff G. Webster, P.E. Ms. Zigler is a Professional Geologist as defined by State Statute (C.R.S 34-1-201) with over 16 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 in Colorado.

Geoff Webster, P.E. is a licensed Professional Engineer with over 33 years of experience in the structural and geotechnical engineering fields. Mr. Webster is a professional engineer and holds a Master's degree from the University of Central Florida. Mr. Webster has supervised and performed numerous geological and geotechnical field investigation programs in Colorado and other states.

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 01/06/2015 applicable sections include 8.4.9. and the Engineering Criteria Manual (ECM), specifically Appendix C last updated July 29, 2015.

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

This report presents the findings of our Geology and Soils Investigation for the proposed single family development located in northern El Paso County, Colorado.

The purpose of our report is to adhere to the guidelines outlined in Appendix C of the ECM and Chapter 8.4.9 of the LDC. The occurrences of potential geologic hazards were evaluated and our opinions of the observed conditions on the proposed development with the respect to the intended usage are outlined in this report.

This report presents the findings of the study performed by RMG-Rocky Mountain Group (RMG) relating to the geology and soil conditions of the above-referenced site.

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 reports
- Available aerial photographs
- Exploratory borings
- Laboratory testing of representative site soil and rock samples
- Geologic research and analysis
- Site development plans prepared by others

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 were not available for our review.

4.0 SITE CONDITIONS

4.1 Proposed Land Use and Zoning

The site is generally located south and west of the intersection of Otero Avenue and Old Ranch Road, Colorado Springs, El Paso County. The site includes three parcels and has a combined total acreage of approximately 14.959 acres, on which there are multiple existing structures. It is proposed the combined existing 14.959 acres be subdivided into five 2.5 to 3.3 acre parcels. Figure 1 presents the general boundaries of our investigation.

The parcels included are:

1. Schedule No. 6228004012, addressed as 10140 Otero Avenue, 8.61 acres,
2. Schedule No. 6228004010, addressed as 10240 Otero Avenue, 3.71 acres,
3. Schedule No. 6228004011, addressed as 10150 Otero Avenue, 3.95 acres.

Based upon our review of the Public Record Real Estate Property Search provided by El Paso County Assessors web-site, the parcels of land are zoned "RR-2.5 – Residential Rural". The surrounding properties are county zoned as "RR-2.5 – Residential Rural to RR-5 – Residential Rural".

4.2 Topography

In general, the site slopes down from the north to the south with slopes of 8 to 20 percent. The overall elevation difference from the northeast corner to the southwest corner of the property is approximately 60 to 65 feet.

4.3 Vegetation

The majority of the site consists of tall grasses and weeds. Deciduous trees and vegetation are denser near the southwestern corner of the property.

5.0 FIELD INVESTIGATION

5.1 Drilling

The subsurface conditions within the property were explored by drilling three exploratory borings on March 4, 2018 extending to depths of approximately 20 to 35 feet below the existing ground surface. The test borings were performed to explore the subsurface soils underlying the proposed site. 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 borings in general accordance with ASTM D-1586 utilizing a 2-inch O.D. Split Barrel sampler or in general accordance with ASTM D-3550 utilizing a 2½-inch OD modified California sampler. Results of the penetration tests are shown on the drilling logs. The Test Boring and Test Pit Logs are presented in Figures 6 through 8.

In conjunction with the test borings, two 8-foot deep test pits were excavated to obtain preliminary soils information for the proposed Onsite Wastewater Treatment Systems (OWTS).

5.2 Laboratory Testing

Soil laboratory testing was performed as part of this investigation. The laboratory tests included moisture content, dry density, grain-size analyses, Atterberg Limits and Swell/Consolidation tests. A Summary of Laboratory Test Results is presented in Figure 9. Soils Classification Data is presented in Figure 10. Swell/Consolidation tests are presented in Figure 11.

6.0 GEOLOGIC AND SUBSURFACE CONDITIONS

6.1 Geologic Conditions

Based upon review of the *Geologic Map of the Pikeview Quadrangle, El Paso County, Colorado* the site reconnaissance and exploratory drilling, the site is underlain by the Dawson Formation.

The geology at the site and surrounding area generally consists of a silty to clayey sand (alluvium) overlying the Dawson Formation. A General Geology and Engineering Geology Map is presented in Figure 14.

6.2 General Geology

Our field investigation included a site reconnaissance with consideration given to geologic features and significant surficial deposits.

In general, the geology at the site consists of alluvium soils overlying the Dawson formation. Three geologic units were mapped at the site as:

- Qes - Eolian sand, (Holocene to late Pleistocene) – fine to coarse grain sands deposited by wind.
- Qt1 - Terrace alluvium one (Holocene and late Pleistocene) – the unit is poorly to moderately sorted, consists of unconsolidated material capped with a 1 to 2 feet this humic soil. Comprised of light to dark clay, silt, sand and gravel.
- Tkda2 - Dawson Formation facies unit two – middle part of the Dawson Formation is dominated by fine grained arkosic sandstone with interbedded thin beds of green claystone.

The General Geology and Engineering Geology Map is presented if Figure 13.

6.3 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:

- 19 – Columbine gravelly sandy loam, 0 to 3 percent slopes. Properties of the gravelly sandy loam include, well-drained soils, depth of the water table is anticipated to be greater than 6.5 feet, run-off is anticipated to be very low, frequency of flooding and/or ponding is none, and landforms include fan terraces, fans and flood plains.

- 85 – Stapleton-Bernal sandy loams 3 to 20% slopes. Properties of the sandy loam include, well drained soils, depth of the water table is anticipated to be greater than 6.5 feet, run-off 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 12.

6.4 Subsurface Materials

The subsurface materials encountered in the test borings were classified using the Unified Soils Classification System (USCS) and the materials were grouped into the general categories of clayey sand (SC). Poorly to well graded sand (SP, SW) and sandy clay (CH), overlying sandstone and claystone bedrock.

Additional descriptions and the interpreted distribution (approximate depths) of the subsurface materials are presented on the Test Boring and Test Pit Logs presented in Figures 6 through 8. 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.

6.5 Bedrock Conditions

Bedrock was encountered in all three of the test borings for this investigation. The bedrock beneath the site is considered to be part of the Dawson Formation – facies unit two which consists of silty sandstone. The Dawson formation is thick-bedded to massive, generally light colored arkose, pebbly, and pebble conglomerate. The sandstones are poorly sorted with high clay contents. The sandstone is generally permeable, well drained, and has good foundation characteristics.

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, surrounding the site or in the soil samples collected for laboratory testing.

6.7 Surficial (Unconsolidated) Deposits

Various lake and pond sediments, swamp accumulations, sand dunes, marine and non-marine terrace deposits, talus accumulations, creep or slope wash were not observed on the site. Slump and slide debris were not observed on the site.

6.8 Drainage of Water and Groundwater

The overall topography of the site slopes down from the north to the south towards Kettle Creek. Groundwater was encountered at a depth of approximately 28 feet in TB-1 at the time of drilling and at approximately 17 feet when checked nine days subsequent to drilling.

Kettle Creek is currently a defined drainage way that crosses the southwest corner of the property and resides south of Otero Avenue approximately 150 to 300 feet south of the southern property line on Lot 1. The remainder of the lots lie outside of the Kettle Creek drainage way. It is not anticipated that the drainage of Kettle Creek will adversely impact new construction on the new lots.

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 also not observed on the property.

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

6.10 Engineering Geology

The Engineering Geology is presented below. Charles Robinson and Associates (1977) have mapped two environmental engineering units the site as:

- 1A – Stable alluvium, colluvium and bedrock on flat to gentle slopes (0 to 5%).
- 3B – Expansive and potentially expansive soil and bedrock on flat to moderate slopes (0-12%).

The Engineering Geology is presented in the General Geology and Engineering Geology Map in Figure 13.

6.11 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 *Master Plan for Mineral Extraction*, *Map 2* indicates the site is not identified as an aggregate resource. Extraction of the sand and sandstone resources are not considered to be economical compared to materials available elsewhere within the county.

6.12 Permeability

The permeability of a soil measures how well air and water can flow within the soil. Soil permeability varies according to the type of soil and other factors.

The infiltration rate of a soil refers to how much water a type of soil can absorb over a specific time period. Infiltration rates are determined by soil permeability and surface conditions, and usually are measured in inches per hour.

The soils encountered in the test borings, at the time of drilling were silty to clayey sand and sandy clay overlying claystone and sandstone bedrock. The permeability of the sand and sandstone is anticipated to be moderate to high. The permeability of the clay and claystone is anticipated to be low.

7.0 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. The following sections discuss potential geologic conditions that commonly exist within El Paso County, Colorado.

7.1 Landslides

Landslides are a form of mass wasting slope failure that consists of relatively rapid downward sliding, falling, or flowing of a mass of soil, rock, or a mixture of the two. Landslides typically have one or more distinct failure surfaces. They typically occur on slope sides where the shear strength of a material is exceeded by the driving mass or weight of the material and may be induced by the presence of groundwater, heavy precipitation, and seismic events.

The entire area appears to lie out the mapped areas of previous landslide and/or unstable slopes in the electronic (online) version of the Colorado Landside Inventory map prepared by the Colorado Geological Survey (CGS) located at:

https://cologeosurvey.maps.arcgis.com/apps/webappviewer/index.html?id=5e7484a637c4432e84f4f16d0af306d3

Neither unstable slopes nor apparent signs of ongoing slope movement were observed on the property.

7.2 Rockfall

Rockfall is the falling of a newly detached mass of rock from a cliff or down a very steep slope, and is considered to be a type of landslide with a very rapid rate of down-slope movement. It usually occurs on mountainsides or other steep slopes during periods of abundant moisture and frequent freeze-thaw cycles, and is caused by the loss of support from underneath or detachment from a larger rock mass. Ice wedging, root growth, or ground shaking, erosion or chemical weathering may start the fall. The rocks may freefall, bounce, tumble, roll, or slide down slope and can vary considerably in size.

The subject site does not have steep slopes with large boulders above or around it to generate rockfall. The subject property is not considered to be prone to rockfall.

7.3 Debris Flow and Debris Fans

Debris flows consist of water with a high sediment load of sand, cobbles and boulders flowing down a stream, ravine, canyon, arroyo or gully, and are typically activated by heavy or long-term rains or snowmelts which cause rapid erosion and transport of surficial materials down slope of drainages. Debris fans are created when debris flows reach a valley with a much lower gradient. As the energy level drops, the sediment load is deposited creating the fan shape.

The potential for the development of significant debris flows was not observed on the surface of the property.

7.4 Faults and Seismicity

Review of the *Geologic Map of the Colorado Springs Quadrangle* and *Map of Areas Susceptible to Differential Heave in Expansive, Steeply Dipping Bedrock, City of Colorado Springs, Colorado* indicates the Ute Pass Fault lies approximately 10 miles to the west of the proposed residential development. According to the CGS, these faults are not considered to be recently active. However, they have been active during geologic times and could affect the site if they did rupture.

Information presented by the CGS indicates that several recent earthquakes have occurred in the vicinity of the Ute Pass Fault near Colorado Springs and Woodland Park. The earthquakes, with magnitudes in the range of 3.0 to 3.9, occurred approximately from 1962 to 2007.

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. Ground motions resulting from small earthquakes are more likely to affect structures at this site and will likely only affect slopes stability to a minimal degree.

In accordance with the International Building Code, 2012/2015, seismic design parameters have been determined for this site. The Seismic Site Class has been interpreted from the results of the soil test boring drilled within the project site. The USGS seismic design tool has been used to determine the seismic response acceleration parameters. USGS output is presented in Appendix B. The soil on this site is not considered susceptible to liquefaction. The following recommended Seismic Design Parameters are based upon Seismic Site Class B, and a 2 percent probability of exceedance in 50 years. The Seismic Design Category is "B".

Period (se	Mapped MCE Sp Response Accele (g)		Site Coefficien		Adjusted Spectral Res Acceleration (g		Design Sp Response Accele (g)	
0.2	S_s	0.182	F_a	1.2	S_{ms}	0.218	S_{ds}	0.145
1.0	S_1	0.060	F_v	1.7	S_{m1}	0.102	S_{d1}	0.068

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

The USGS Seismic Output is presented in Appendix A.

7.5 Steeply Dipping Bedrock

Steeply dipping bedrock is a geological hazard common along the Rocky Mountain Front Range piedmont where uplifted sedimentary formations containing thin layers of moderately to highly expansive shale are encountered near the ground surface e.g., Noe and Dodson 1995; Noe 1997. Problematic formations in the region, most notably the Pierre Shale, are characterized by relatively thin vertically oriented beds that can exhibit dissimilar swelling characteristics from one particular bed to the next.

The site is lies outside of the mapped zone of areas susceptible to differential heave in expansive steeply dipping bedrock. Bedrock was encountered in all nine of the test borings drilled for this investigation. Indications of dipping bedrock were not observed in the soil samples collected. The site is generally not considered to be prone to steeply dipping bedrock.

7.6 Unstable or Potentially Unstable Slopes

Slope stability is the potential of soil covered slopes to withstand and undergo movement. The stability of a slope is determined by the balance of shear stress and shear strength. Previously stable slopes may initially be affected by preparatory factors, making the slope conditionally unstable. Factors that may trigger a slope failure may be climatic events that can make a slope actively unstable, leading to mass movements. Mass movements can be caused by an increase in shear stress, such as loading, lateral pressure, and transient forces. Alternatively, shear strength may be decreased by weathering, changes in pore water pressure, and organic material.

According to the LDC, Chapter 8.4.2 Section B.3 Unsuitable Building Areas, areas that are identified as having certain characteristics "*… shall be deemed unsuitable for building and shall be identified as no build areas on the plat."* One such characteristic is *"Areas where slopes are greater than 30%."* These areas have typically been designated as "No Build" areas in the recent past.

Unstable slopes greater than 30 percent or apparent signs of ongoing slope movement were not observed around or on the property. The subject site is also not in an area identified as containing unstable slopes in the Colorado Landslide Inventory map referenced in section 7.1 of this report.

Mitigation

Long term fill slopes should be limited to areas supported by foundation walls or other engineered components, unless adequately benched into the bedrock. Long term cut slopes in the upper soil should be limited to no steeper than 3:1 (horizontal:vertical).

We believe the surficial soils will classify as Type C materials as defined by OSHA in 29CFR Part 1926, date January 2, 1990. OSHA requires temporary slopes made in Type C materials be laid back at ratios no steeper than 1.5:1 (horizontal to vertical) unless the excavation is shored or braced. Flatter slopes will likely be necessary should groundwater conditions occur.

7.7 Ground Subsidence

Subsidence is the motion of the ground surface as it shifts downward relative to a datum such as sea-level.

Common causes of land subsidence from human activity are pumping water, oil, and gas from underground reservoirs; dissolution of limestone aquifers (sinkholes); collapse of underground mines; drainage of organic soils; and initial wetting of dry soils (hydrocompaction).

The presence of sinkholes and collapse were not observed on the site. The site lies outside of the Colorado Springs Subsidence Investigation report (Dames and Moore, 1985). Evidence of underground mining in the presence of coal was not encountered in the test boring samples. The site is generally not considered to be prone to ground subsidence.

7.8 Hydrocompactive and Potentially Expansive Soils (Moisture Sensitive Soils)

The subsurface materials at the site generally consist of silty to clayey sand and sandy clay overlying the Dawson Formation. Based on the test borings performed on site, the silty to clayey sand and sandstone generally possess low swell potential. The sandy clay and claystone are generally possess low to moderate swell potential. It is anticipated that if these materials are encountered can readily be mitigated with typical construction practices common to this region of El Paso County, Colorado.

<u>Mitigation</u>
Shallow foundations are anticipated for structures within this development. Foundation design and construction are typically adjusted for expansive soils. Mitigation of expansive soils and bedrock are typically accomplished by overexcavation and replacement with structural fill, subexcavation and replacement with on-site moisture-conditioned soils, and/or the installation of deep foundation systems. If loose sands are encountered, mitigation of hydrocompactive soils can be accomplished by overexcavation and replacement with structural fill, subexcavation and replacement with on-site moisture-conditioned soils, and/or the use of a geogrid reinforced fill.

7.9 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, CO and the 80820 zip code located in El Paso County, has an EPA assigned Radon Zone of 1. A radon zone of 1 predicts an average indoor radon screening level greater than 4 pCi/L, which is above the recommended levels assigned by the EPA. Black Forest is located in a high risk area of the country. *The EPA recommends you take corrective measures to reduce your exposure to radon gas.*

Most of Colorado is generally considered to have the potential of high levels of radon gas, based on the information provided at: <u>http://county-radon.info/CO/El_Paso.html</u>. There is not believed to be unusually hazardous levels of radon from naturally occurring sources at this site.

<u>Mitigation</u>
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.

7.10 Flooding and Surface Drainage

Based on our review of the Federal Emergency Management Agency (FEMA) Community Panel No. 08041C0506F and the online ArcGIS El Paso County Risk Map, the southwest corner of Lot 1 does lie within the 100 or 500-year floodplain of Kettle Creek. No new structures are proposed on Lot 1 and the presence of the floodplain is not anticipated to preclude the proposed construction on Lots 2 through 5.

7.11 Springs and High Groundwater

Based on the site observations, review of the Pikeview Quadrangle and Google Earth images dating back to September 1999, springs do not appear to originate on the subject site. Groundwater was encountered in TB-1 at a depth of 28 feet at the time of drilling. When checked nine days subsequent to drilling groundwater was encountered at 17 feet.

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.

Mitigation:
If shallow groundwater conditions are encountered during the Site Specific Soils Investigations and Open Excavation Observations, mitigations can include a combination of surface and subsurface drainage systems, vertical drainboard, etc.

In general, if groundwater was encountered within 4 to 6 feet of the proposed basement slab elevation, an underslab drain should be anticipated in conjunction with the perimeter drain. Perimeter drains are anticipated for each individual lot to prevent the infiltration of water and to help control wetting of potentially expansive and hydrocompactive soils in the immediate vicinity of foundation elements. It must be understood that the 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.

7.12 Erosion and Corrosion

The upper sands encountered at the site are susceptible to erosion by wind and flowing water. The sandstone at this site typically has low resistivity values (less than 2,000 ohm-cm) and is likely to be potentially corrosive to buried, ferrous metal piping and other structures.

Mitigation:
Due to the nature of the soils on the site it is anticipated that the majority of the surficial soils (silty to clayey sand) is subject to erosion by water. During construction disturbance of the site most likely will occur around the building site and may require regrading and revegetation. Further recommendations for Erosion Control are discussed in section 7.15

7.13 Surface Grading and Drainage

The ground surface should be sloped from the buildings 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. Homeowners should maintain the surface grading and drainage recommended in this report to help prevent water from being directed toward and/or ponding near the foundations.

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

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

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

7.14 Fill Soils

Fill soils were not encountered at the time of drilling. However, 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. If unsuitable soils are encountered during the Site Specific Soils Investigation and/or the Open Excavation Observation, they may require removal (overexcavation) and replacement with compacted structural fill.

<u>Mitigation</u>
Existing fill soils maybe encountered in the locations of the previous structures. If fill is encountered, it is considered unsuitable for support of foundations. If unsuitable fill soils are encountered during construction, 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.

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

Preliminary grading plans were not provided and reviewed at the time the report was issued. It is assumed based on the test borings for this investigation that the excavations will encounter silty to clayey sands near the surface overlying sandstone bedrock. The on-site sand soils can be used as site grading fill.

The on-site soils are mildly susceptible to win and water erosion. Minor wind erosion and dust may be an issue for a short time during and immediately after construction. Should the problem be considered severe during construction, watering of the cut areas may be required. Once construction is complete, vegetation should be re-established.

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.

7.16 Onsite Wastewater Treatment Systems

It is our understanding that On-site Wastewater Treatment Systems (OWTS) are proposed. Induvial well and septic systems are proposed for each individual residence. The site was evaluated in general accordance with the El Paso Land Development Code. Two test pits were performed across the site to obtain a general understanding of the soil and bedrock conditions. The Test Pits Logs are presented in Figures 7 and 8.

The United States Department of Agriculture (USDA) as discussed in section 6.3 consisted of loamy sand, silty clay loam and clay loam overlying. Limiting layers were not encountered in the test pits. The long term acceptance rates (LTAR) associated with the soils observed in the test pits range from 0.30 for the sandy clay/sandy clay loam (Soil Type 3 to 3A) to 0.80 for the silty to clayey sand/sandy loam (Soil Type 1) gallons per day per square foot. Signs of seasonal groundwater were not observed in the test pits.

Treatment areas must be 4 feet above groundwater or bedrock. Contamination of surface and subsurface water resources should not occur provided the OWTS sites are evaluated and installed according to the El Paso County Guidelines and property maintained. Treatment areas must be located a minimum 100 feet from any well, including those located on adjacent properties. It is our opinion that the site is suitable for individual treatment systems.

An OWTS Investigation will need to be performed to provide recommendations for each individual treatment area. During the reconnaissance, a total of two 8-foot deep test pits will need to be excavated in the vicinity of the proposed treatment area for each site.

8.0 BEARING OF GEOLOGIC CONDITIONS UPON PROPOSED DEVELOPMENT

Geologic hazards (as described in section 7.0 of this report) and geologic constraints (also as described in section 7.0 of this report) were not found to be present at this site.

The proposed development is to consist of the construction of a residential development to include well and septic and associated site improvements. Shallow foundations are anticipated for the structures on site. It is our opinion that the existing geologic and engineering conditions will not constraints on the proposed development.

Anticipated hazards anticipated to affect this site are Seismicity, Radioactivity/Radon Gas and potentially expansive soils and bedrock. These hazards can be satisfactorily mitigated through proper engineering and design contraction practices and avoidance when deemed necessary.

Undocumented fill soils are anticipated in the vicinity of the previous structures. However, new construction is not proposed for Lot 1. The existing fill from the ponds may be processed in the grading activities that may take place, however dependent on the individual home sites; the existing fill may not be encountered. All fill placed during these operations should be periodically observed and tested for compaction during placement. The frequency of the testing required should be determined by a preliminary subsurface soil investigation or a soils and geology report by a registered Colorado engineer. Following completion of the overlot grading activities, it is recommended that a site specific subsurface soil investigation be performed for all proposed structures to verify the conditions of the fill.

9.0 BURIED UTILITIES

Based upon the conditions encountered in the exploratory test borings, we anticipate that the soils encountered in the individual utility trench excavations will consist of native silty to clayey sand and sandstone. It is anticipated that the sands will be encountered at loose to medium dense relative densities, the sandy clay at stiff to very stiff densities and the sandstone and claystone at medium hard to hard relative densities.

We believe the sand 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 the slope designed by a professional engineer.

Each lot is to have an individual well and septic and utility mains such as water and sanitary sewer lines are not anticipated to be placed beneath paved roadways.

10.0 PAVEMENTS

Otero Avenue is currently paved and not anticipated to require a new pavement design. Four new driveway accesses are proposed off of Otero Avenue. It is not anticipated that a pavement section design for the driveway accesses will be required. No new roads are proposed within the subdivision.

11.0 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 assumed that the deepest basement excavation cuts will be approximately 6 to 8 feet below the final ground surface not including overexcavation or subexcavation which may be required.

Expansive clay and claystone were encountered in the test borings. If expansive soils are encountered near foundation or floor slab bearing levels, overexcavation and replacement with nonexpansive structural fill will be required. Overexcavation depths of about 3 to 4 feet should be anticipated. However, depending on the soil conditions encountered in the site specific subsurface soil investigations, overexcavation to deeper depths may be required.

If loose sands are encountered, composed of either native or overlot fill soils, they may require additional compaction to achieve the allowable bearing pressure indicated in this report. In some cases, removal and recompaction may be required for loose soils. Similarly, if shallow groundwater conditions are encountered and result in unstable soils unsuitable for bearing of residential foundations, these soils may require stabilization prior to construction of foundation components.

The foundation system for each lot should be designed and constructed based upon recommendations developed in a detailed Subsurface Soil Investigation completed after site development activities are complete. The recommendations presented in the Subsurface Soil Investigation should be verified following the excavation on each lot and evaluation of the building loads.

11.1 Subexcavation and Moisture-Conditioned Fill

Based upon the field exploration and laboratory testing, subexcavation and replacement is not anticipated. However, prior to performing excavation and/or filling operations, vegetation, organic and deleterious material shall be cleared and disposed of in accordance with applicable requirements. The excavation should extend to a minimum depth below and laterally beyond the bottom of foundations as determined based on final grading plans.

11.2 Uncontrolled Fill

If man-placed (uncontrolled) fill is encountered during construction, 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.

Following completion of the overexcavation and moisture conditioning process, it is imperative that the "as-compacted" moisture content be maintained prior to construction and establishment of landscape irrigation.

11.3 Foundation Stabilization

Groundwater was encountered at 17 feet nine days subsequent to drilling in TB-1. It is anticipated the groundwater will have adequate separation from the bottom of basement foundation components and floor slabs. However, if moisture conditions encountered at the time of the foundation excavation result in water flow into the excavation and/or destabilization of the foundation bearing soils, stabilization techniques should be implemented. Various stabilization methods can be employed, and can be discussed at the time of construction. However, a method that affords potentially a reduced amount of overexcavation (versus other methods) and provides increased performance under moderately to severely unstable conditions is the use of a layered geogrid and structural fill system.

Additionally, dependent upon the rate of groundwater flow into the excavation, a geosynthetic vertical drain and an overexcavation perimeter drain may be required around the lower portions of the excavation to allow for installation of the layered geogrid and structural fill system.

11.4 Foundations Drains

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

Shallow groundwater conditions were not encountered in the test borings at the time of field exploration. Depending on the conditions encountered during the lot specific Subsurface Soil Investigation and the conditions observed at the time of the Open Excavation Observation, additional subsurface drainage systems may be recommended.

One such system is an underslab drainage layer to help intercept groundwater before it enters the slab area should the groundwater levels rise. In general, if groundwater was encountered within 4 to 6 feet of the proposed basement slab elevation, an underslab drain should be anticipated. Another such system would consist of a subsurface drain and/or vertical drain board placed around the perimeter of the overexcavation to help intercept groundwater and allow for proper placement and compaction of the replacement structural fill. Careful attention should be paid to grade and discharge of the drain pipes of these systems.

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.

11.5 Structural Fill

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

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

Structural fill shall consist of granular, non-expansive material. 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.

11.6 Design Parameters

The allowable bearing pressure of the surface sands should be determined by a detailed site specific Subsurface Soil Investigation. Bearing directly on the clay and/or hydrocompactive sands is not recommended.

12.0 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. ***A site specific Subsurface Soil Investigation will be required for all proposed structures including (but not limited to) residences, retaining walls and pumphouses, 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.

13.0 CONCLUSIONS

Based upon our evaluation of the geologic conditions, it is our opinion that the proposed development is feasible. Except for the potential of expansive soils and bedrock the geologic hazards identified are not considered unusual for the Front Range region of Colorado. Mitigation of geologic hazards is most effectively accomplished by avoidance. However, where avoidance is not a practical or acceptable alternative, geologic hazards should be mitigated by implementing appropriate planning, engineering, and local construction practices.

Foundation selection and design should consider the potential for subsurface expansive soil-related movements. Mitigation techniques commonly used in the Colorado Springs area include drilled piers, micropiles with structural floors and/or overexcavation and replacement with structural fill as indicated in a site specific Subsurface Soil Investigations.

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.

14.0 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 **Hunsigner Development Corporation** 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 and/or geologic hazards point-of-view, please feel free to contact us.

15.0 REFERENCES

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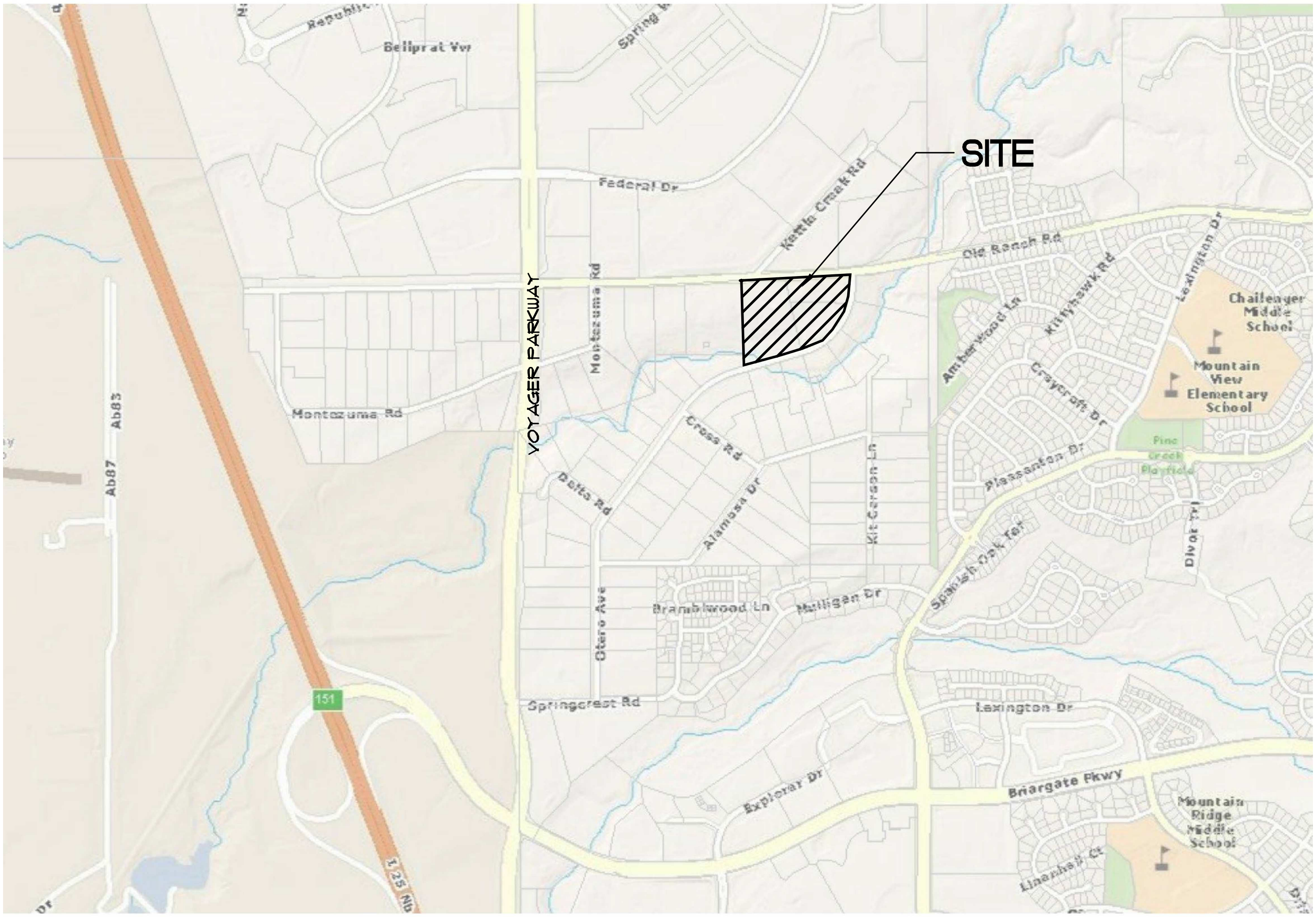
FIGURES



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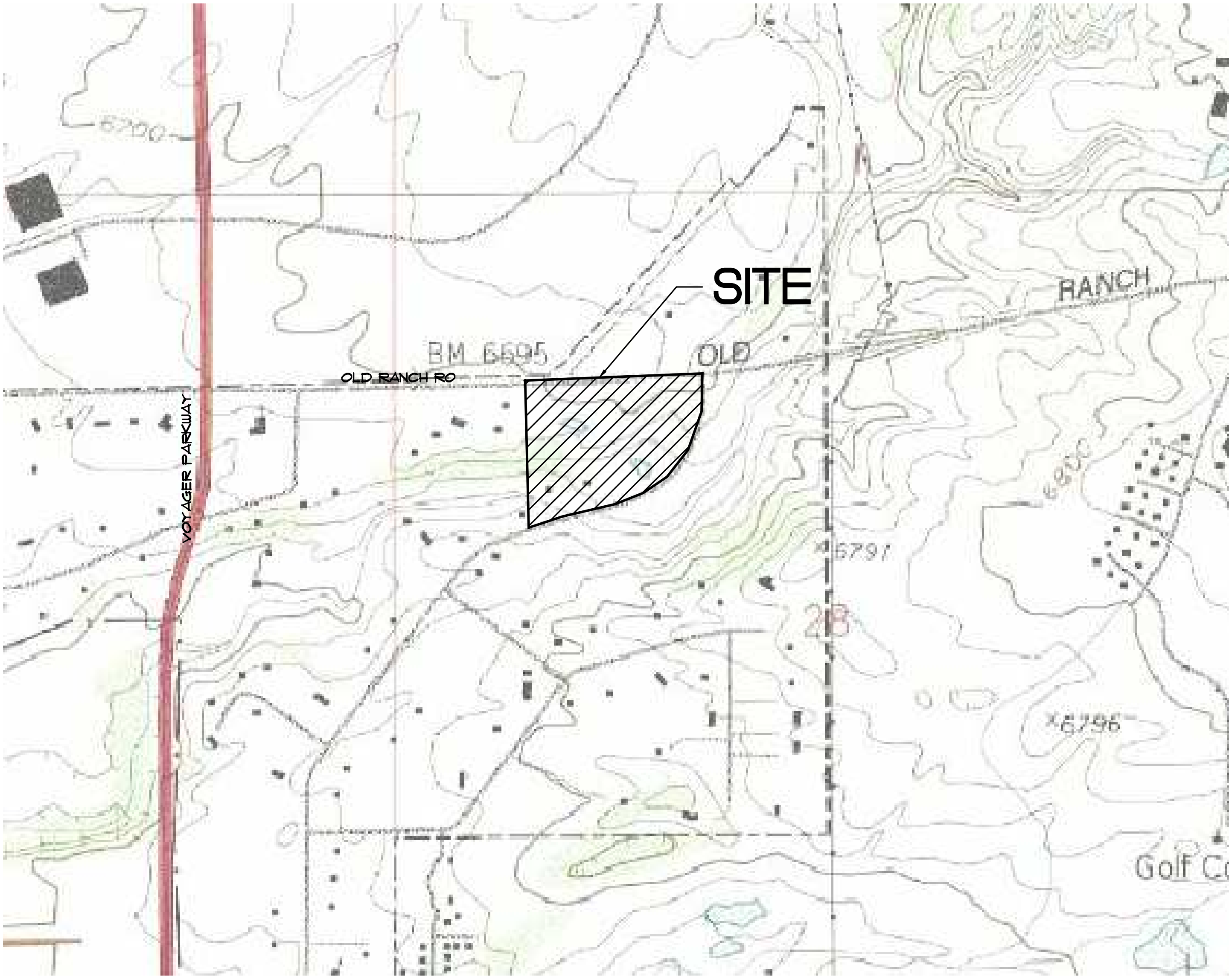
SITE VICINITY MAP

OLD RANCH ROAD
EL PASO COUNTY, CO
HUNSINGER DEVELOPMENT CORP.

JOB No. 162650

FIG No. 1

DATE 5-18-2018



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BASE MAP PROVIDED BY USGS

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USGS TOPO MAP

OLD RANCH ROAD
EL PASO COUNTY, CO
HUNSINGER DEVELOPMENT CORP.

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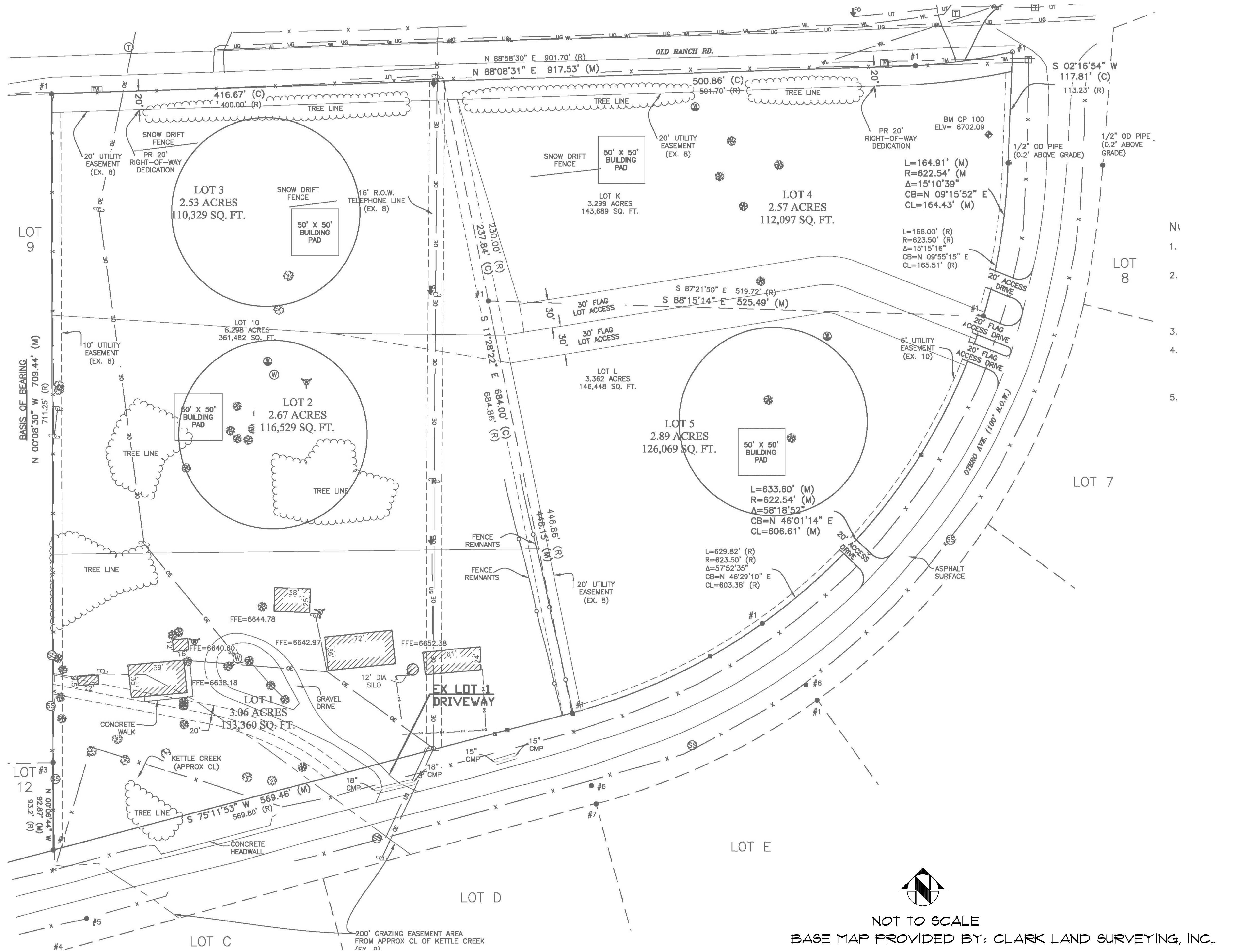
FIG No. 2

DATE 5-18-2018



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BASE MAP PROVIDED BY: CLARK LAND SURVEYING, INC.

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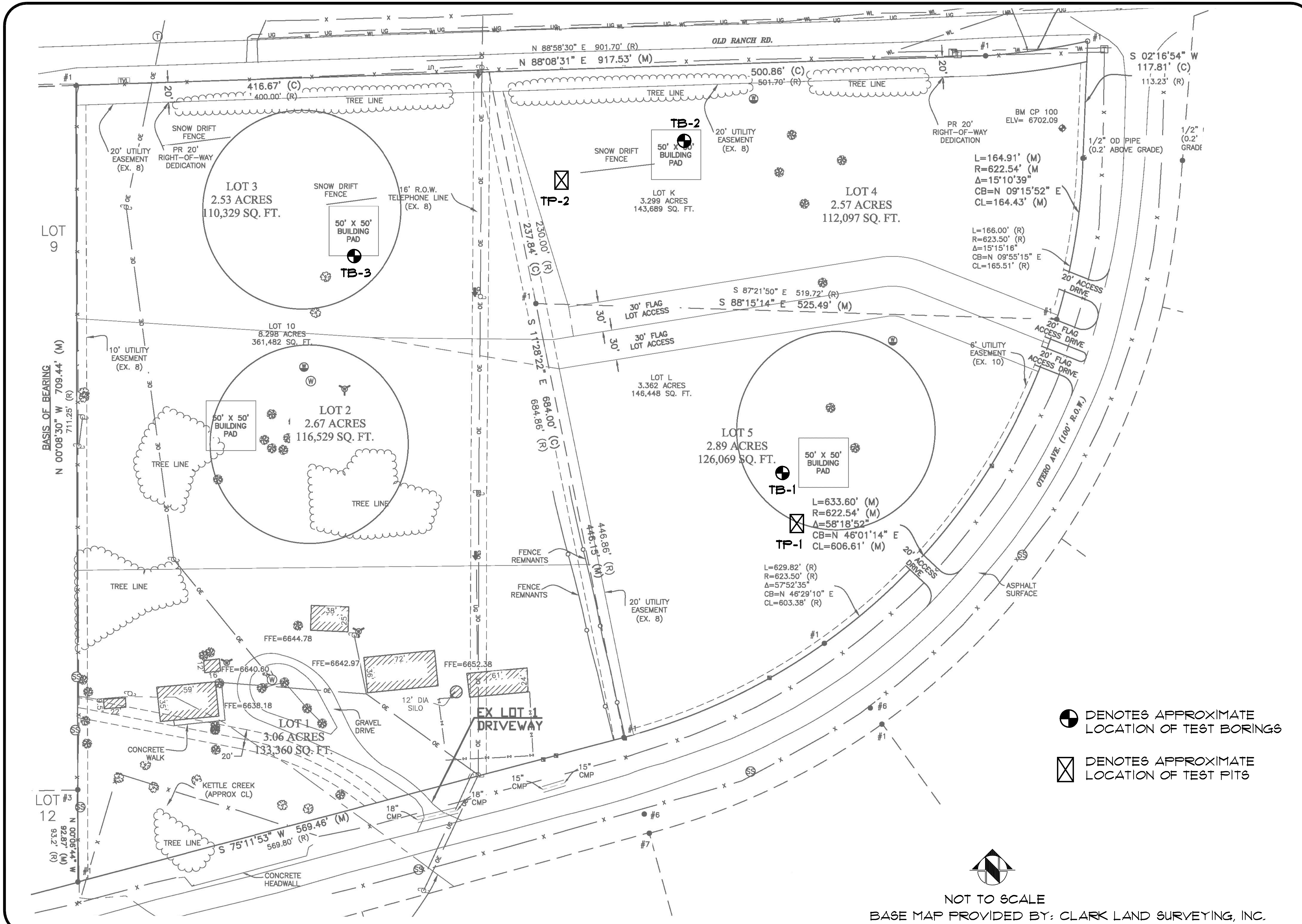
OLD RANCH ROAD
EL PASO COUNTY, CO
HUNSINGER DEVELOPMENT CORP

ENGINEER:	GW
DRAWN BY:	KZ
CHECKED BY:	KZ
ISSUED:	5-18-18
REVISION:	DATE: JOB #:
REVISION:	
REVISION:	

PRELIMINARY CONCEPT PLAN

SHEET No.
FIG-3



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EL PASO COUNTY, CO
HUNSINGER DEVELOPMENT CORP

ENGINEER:	GW
DRAWN BY:	KZ
CHECKED BY:	KZ
ISSUED:	5-18-18
REVISION:	DATE: JOB #:
REVISION:	
REVISION:	

PRELIMINARY CONCEPT PLAN WITH TEST BORING AND TEST PIT LOCATION PLAN

SHEET No.
FIG-4

SOILS DESCRIPTION

- CLAY LOAM
- SANDSTONE
- SANDY CLAY
- SHALE/CLAYSTONE
- SILT CLAY LOAM
- SILTY TO CLAYEY SAND
- LOAMY SAND

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).
▽	FREE WATER TABLE
BULK	DISTURBED BULK SAMPLE
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).
1	RMG SOIL TYPE - SEE REPORT TEXT FOR DESCRIPTION
4.5	WATER CONTENT (%)

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EXPLANATION OF TEST BORING LOGS

JOB No. 162650

FIGURE No. 5

DATE 5/18/18

TEST BORING: **1**

DATE DRILLED:
4/4/18
REMARKS:
GROUNDWATER @ 28.0 '
4/4/18

Soil description	Depth (ft)
SAND, SILTY TO CLAYEY, brown to dark brown, moist	0 – 2
CLAY, SANDY, brown to dark brown, stiff to very stiff, moist	2 – 18
SANDSTONE, SILTY TO CLAYEY, gray to blue, hard, moist to wet	18 – 30
CLAYSTONE, SANDY, gray to blue, hard, moist to wet	30 – 35

DEPTH (FT)	BLOWS PER FT.	WATER CONTENT %	SOIL TYPE
5	32	20.7	
10	23	12.3	
15	13	18.2	
25	50/8"	10.6	
35	50/9"	13.9	

TEST BORING: **2**

DATE DRILLED:
4/4/18
REMARKS:
NO GROUNDWATER ON
4/4/18

Soil description	Depth (ft)
SAND, SILTY TO CLAYEY, tan to brown, medium dense, moist	0 – 7
CLAY, SANDY, tan with rust staining, very stiff, moist	7 – 19
CLAYSTONE, SANDY, gray, hard, moist	19 – 20

DEPTH (FT)	BLOWS PER FT.	WATER CONTENT %	SOIL TYPE
5	27	20.9	
10	32	30.6	
15	28	35.2	
20	50/12"	21.1	

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TEST BORING/ TEST PIT LOGS

JOB No. 162650

FIGURE No. 6

DATE 5/18/18

TEST BORING: **3** DATE DRILLED: 4/4/18 REMARKS: NO GROUNDWATER ON 4/4/18	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %	SOIL TYPE
SAND, SILTY, with gravel, tan, loose, moist						
WEATHERED SANDSTONE TO SANDSTONE, SILTY TO CLAYEY, brown to dark brown, hard, moist	5			9	2.6	
	10			34	16.7	
	15			50/8"	13.9	
CLAYSTONE, SANDY, brown to olive, moist						
SANDSTONE, SILTY, gray to blue, hard, moist	20			50/9"	16.9	

TEST BORING: **TP-1** DATE DRILLED: 4/13/18 REMARKS: NO GROUNDWATER ON 4/13/18	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %	SOIL TYPE
LOAMY SAND, granular, no structure, light brown, moist LTAR 0.80						
SILT CLAY LOAM, blocky, moderate (2), dark brown, moist LTAR 0.35						
LOAMY SAND, granular, no structure, light brown, moist LTAR 0.80	5					
SILT CLAY LOAM, blocky, moderate (2), dark brown, moist LTAR 0.35						

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TEST BORING/ TEST PIT LOGS

JOB No. 162650

FIGURE No. 7

DATE 5/18/18

TEST BORING: **TP-2**
DATE DRILLED:
4/13/18
REMARKS:
NO GROUNDWATER ON
4/13/18

Description	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %	SOIL TYPE
LOAMY SAND, granular, no structure, light brown, moist LTAR 0.80						
CLAY LOAM, blocky, moderate (2) - weak (1), brown, moist LTAR 0.30	5					
CLAY LOAM, massive, weak (1), brown, moist LTAR 0.30						

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TEST BORING/ TEST PIT LOGS

JOB No. 162650

FIGURE No. 8

DATE 5/18/18

Test Boring No.	Depth	Water Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% Retained No.4 Sieve	% Passing No. 200 Sieve	FHA Expansion Pressure (psf)	% Swell @ 1000 psf	USCS Classification
1	4.0	20.7	94.3	72	46	1.3	68.0			CH
1	9.0	12.3								
1	14.0	18.2		47	30	0.0	33.2			SC
1	24.0	10.6								
1	34.0	13.9								
2	4.0	20.9								
2	9.0	30.6	91.4	68	37	0.0	0.2			SP
2	14.0	35.2								
2	19.0	21.1								
3	4.0	2.6		NP	NP	14.1	0.0			SW
3	9.0	16.7								
3	14.0	13.9		NP	NP	3.5	0.3			SP
3	19.0	16.9								

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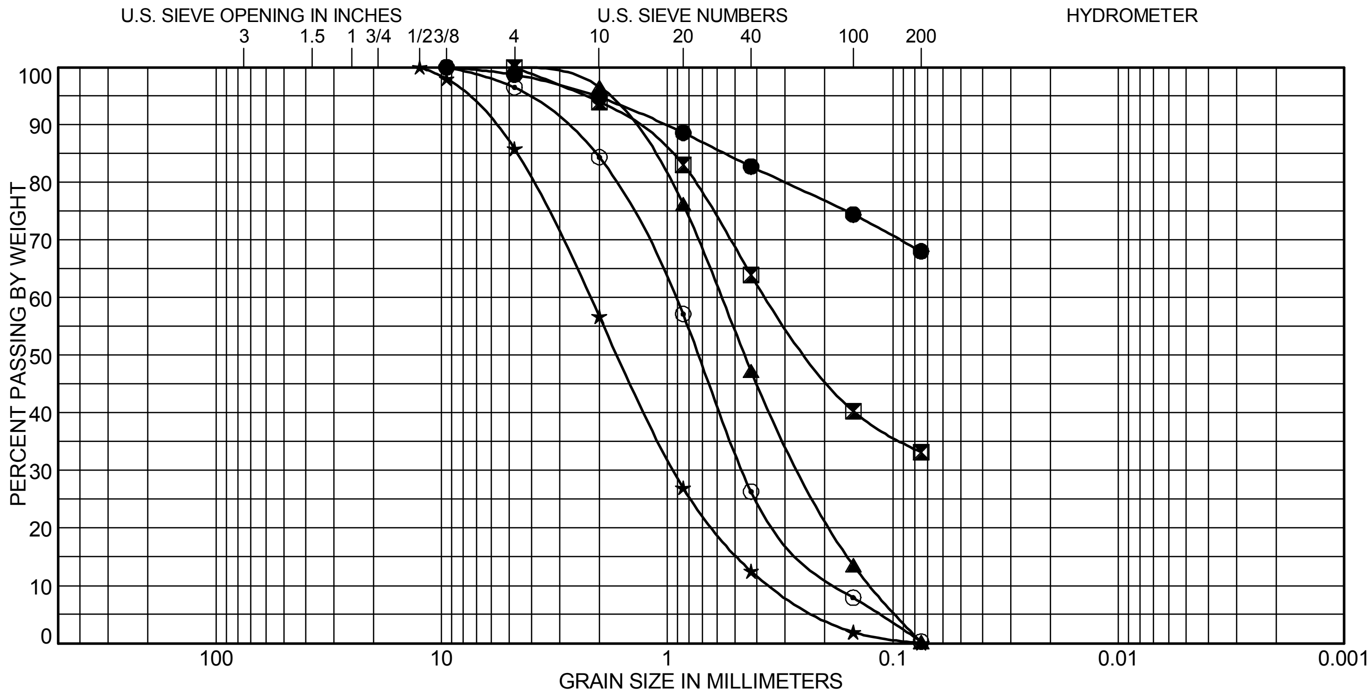
SUMMARY OF LABORATORY TEST RESULTS

JOB No. 162650
FIGURE No. 9
PAGE 1 OF 1
DATE 5/17/18



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<tr><td rowspan="2">COBBLES</td><td colspan="2">GRAVEL</td><td colspan="3">SAND</td><td rowspan="2">SILT OR CLAY</td></tr>
<tr><td>coarse</td><td>fine</td><td>coarse</td><td>medium</td><td>fine</td></tr>
</table>

Test Boring		Depth (ft)	Classification	LL	PL	PI	Cc	Cu
●	1	4.0	**SANDY FAT CLAY(CH)**	72	26	46		
⊠	1	14.0	**CLAYEY SAND(SC)**	47	17	30		
▲	2	9.0	**POORLY GRADED SAND(SP)**	68	31	37	0.9	4.6
★	3	4.0	**WELL-GRADED SAND(SW)**	NP	NP	NP	1.2	6.6
⊙	3	14.0	**POORLY GRADED SAND(SP)**	NP	NP	NP	1.4	5.5

Test Boring		Depth (ft)	%Gravel	%Sand	%Silt	%Clay
●	1	4.0	1.3	30.7	68.0	
⊠	1	14.0	0.0	66.8	33.2	
▲	2	9.0	0.0	99.8	0.2	
★	3	4.0	14.1	85.9	0.0	
⊙	3	14.0	3.5	96.2	0.3	

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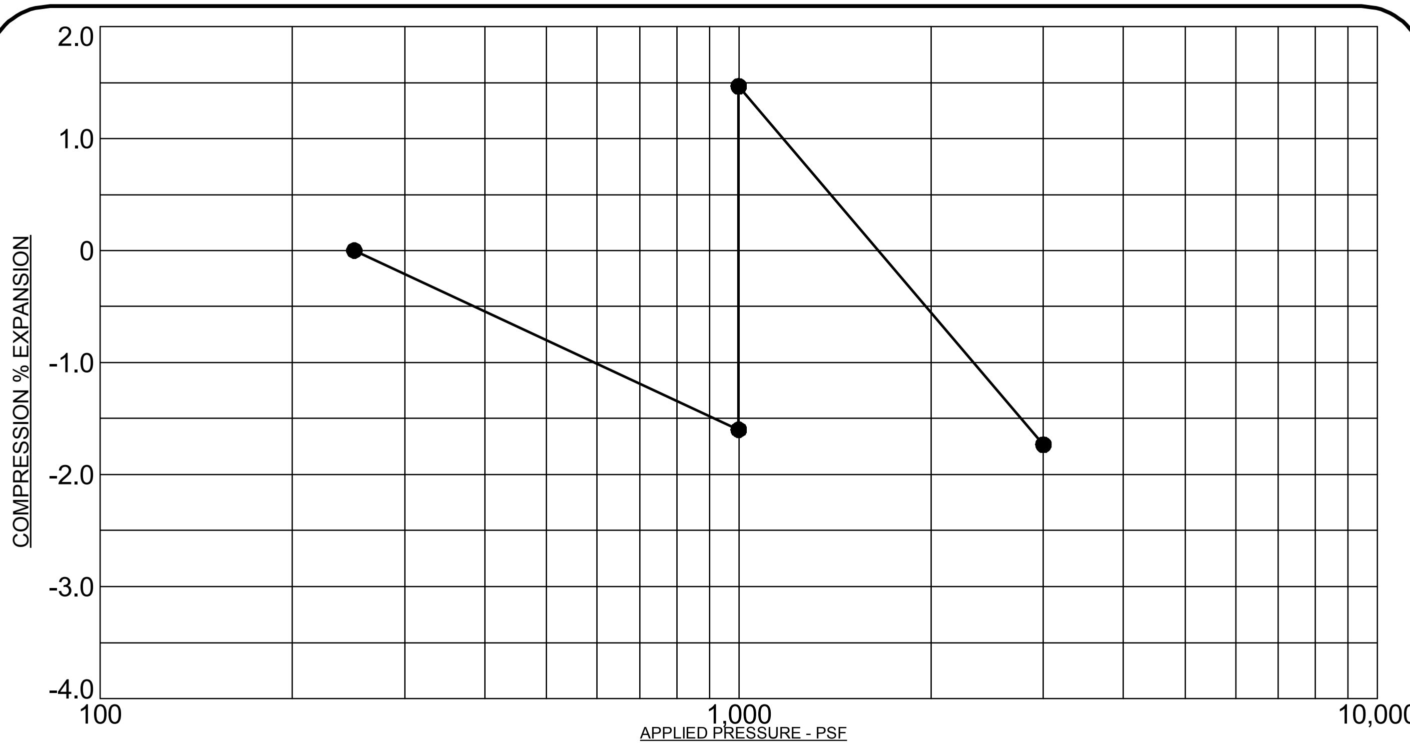
SOIL CLASSIFICATION DATA

JOB No. 162650

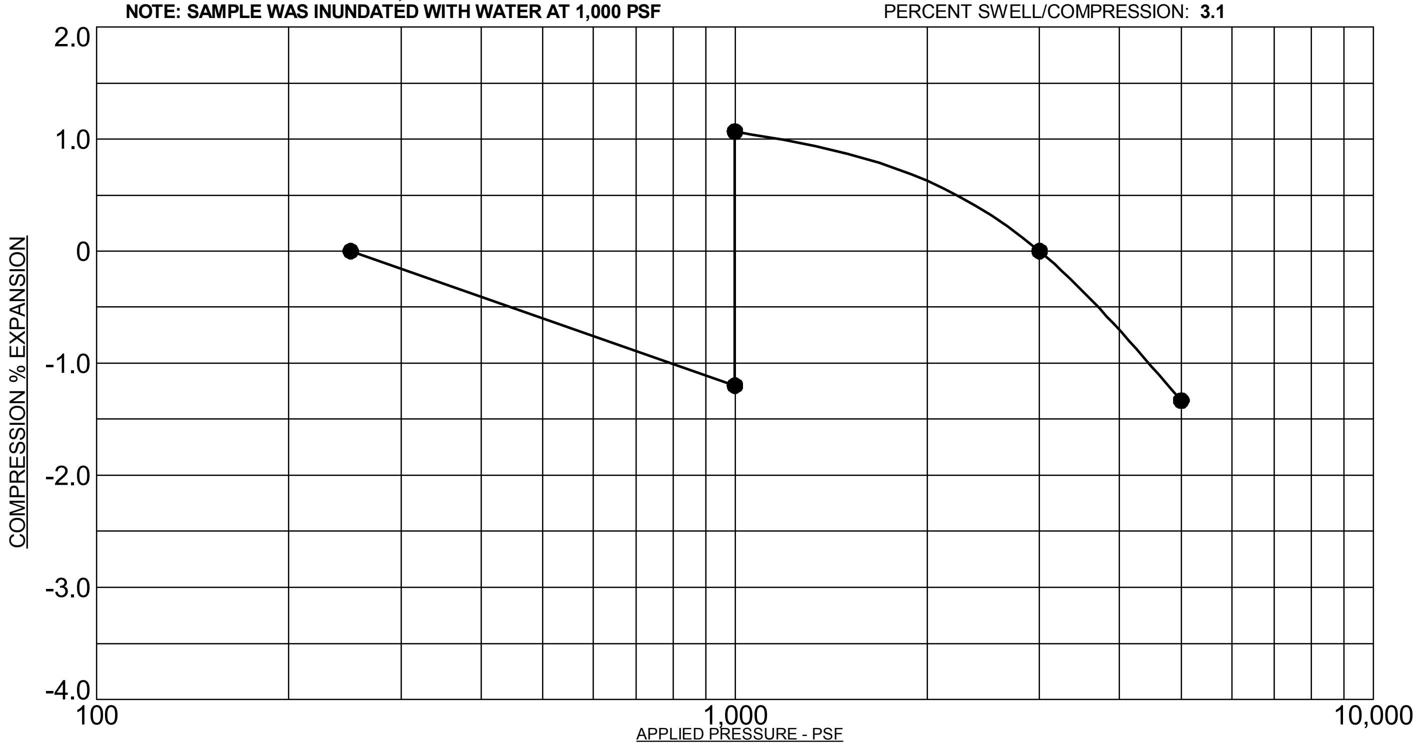
FIGURE No. 10

DATE 5/17/18



PROJECT: **Old Ranch Road, Colorado Springs, Colorado**
RMG SOIL TYPE:
SAMPLE DESCRIPTION: **CLAY, SANDY**
NOTE: SAMPLE WAS INUNDATED WITH WATER AT 1,000 PSF

SAMPLE LOCATION: **1 @ 4 FT**
NATURAL DRY UNIT WEIGHT: **94.3 PCF**
NATURAL MOISTURE CONTENT: **20.7%**
PERCENT SWELL/COMPRESSION: **3.1**



PROJECT: **Old Ranch Road, Colorado Springs, Colorado**
RMG SOIL TYPE:
SAMPLE DESCRIPTION: **CLAY, SANDY**
NOTE: SAMPLE WAS INUNDATED WITH WATER AT 1,000 PSF

SAMPLE LOCATION: **2 @ 9 FT**
NATURAL DRY UNIT WEIGHT: **91.4 PCF**
NATURAL MOISTURE CONTENT: **30.6%**
PERCENT SWELL/COMPRESSION: **2.3**

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2910 Austin Bluffs Parkway
Colorado Spings, CO 80918
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RMG
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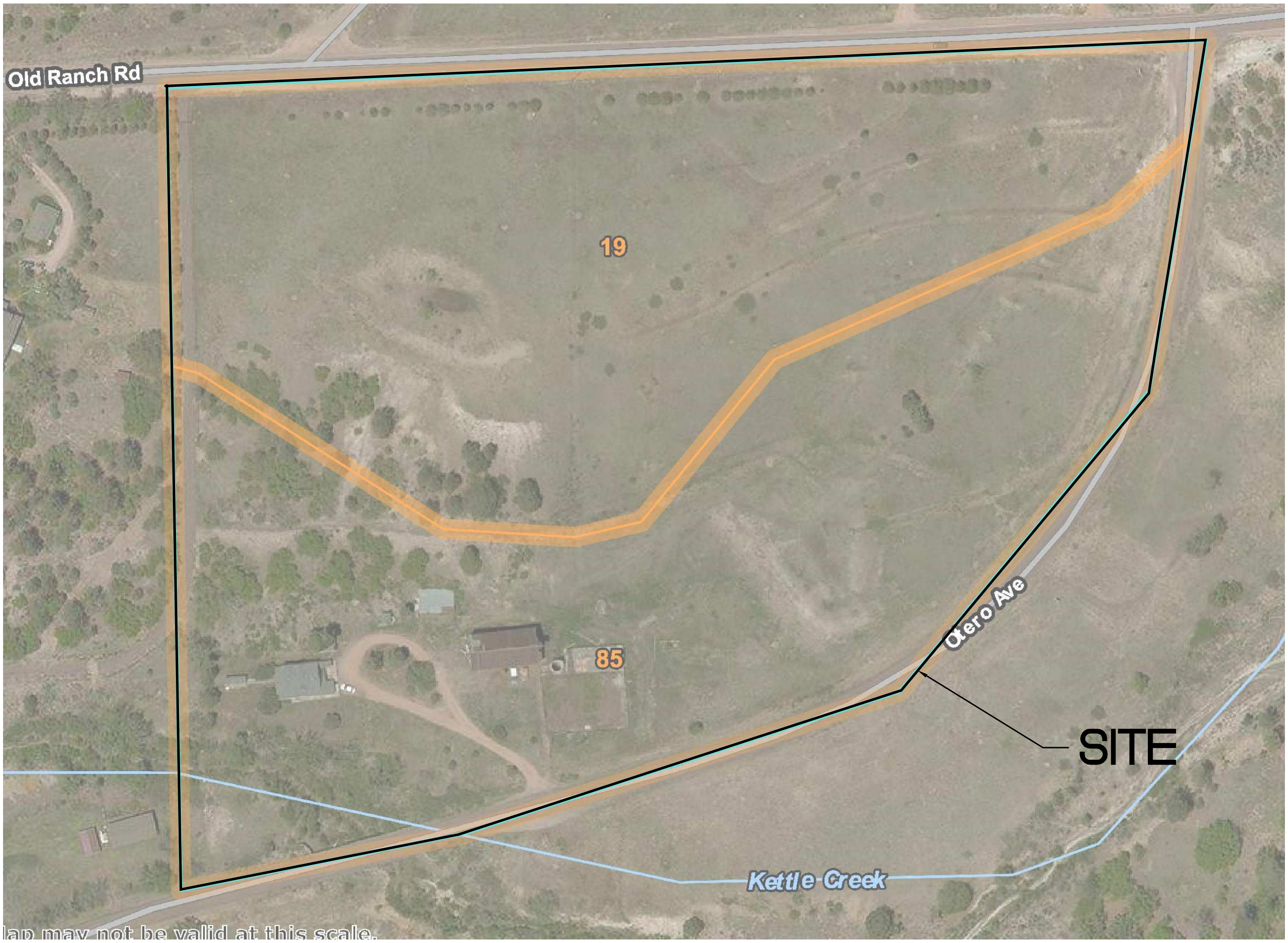
SWELL/CONSOLIDATION TEST RESULTS

JOB No. 162650

FIGURE No. 11

DATE 5/17/18



19 - Coumbine gravelly sandy loam

85 - Stapletone-Bernal sandy loams

REFERENCE
NOT TO SCALE

ARCHITECTS RMG ENGINEERS

ROCKY MOUNTAIN GROUP

Southern Office
Colorado Springs,CO
80918
(719) 548-0600
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Englewood, CO 80112
(303) 688-9475
Northern Office:
Greeley / Evans, CO 80620
(970) 330-1071

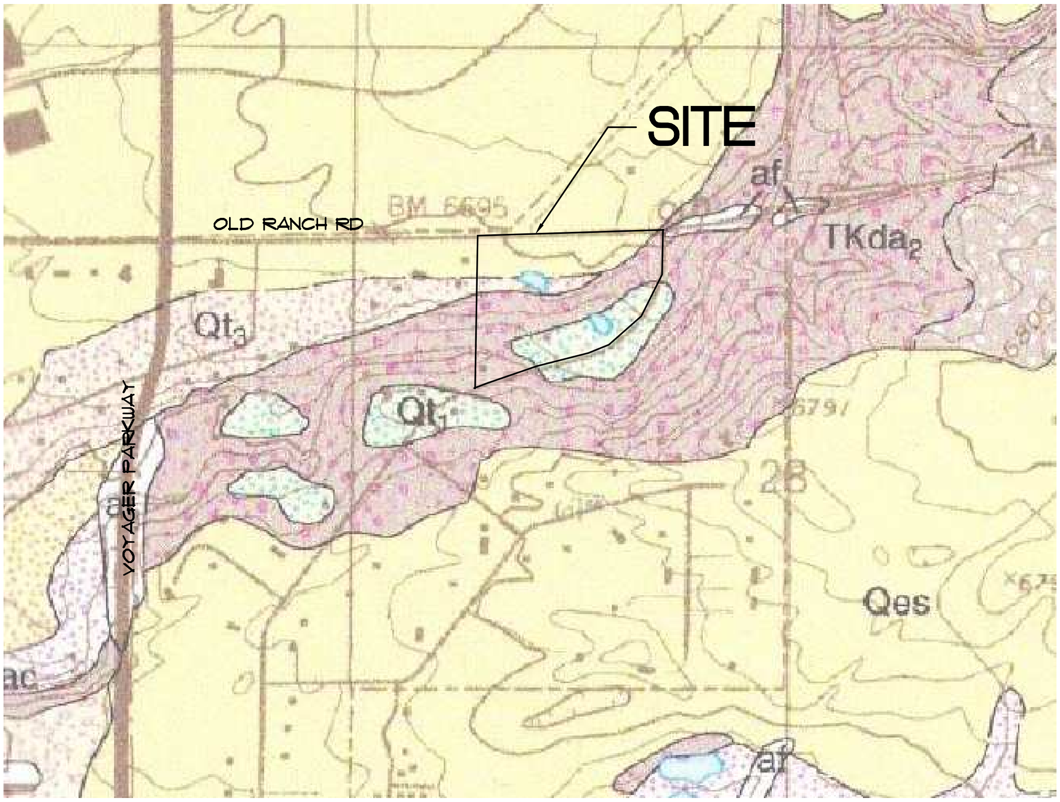
USDA SOIL SURVEY MAP

OLD RANCH ROAD
EL PASO COUNTY, CO
HUNSINGER DEVELOPMENT CORP.

JOB No. 162650

FIG No. 12

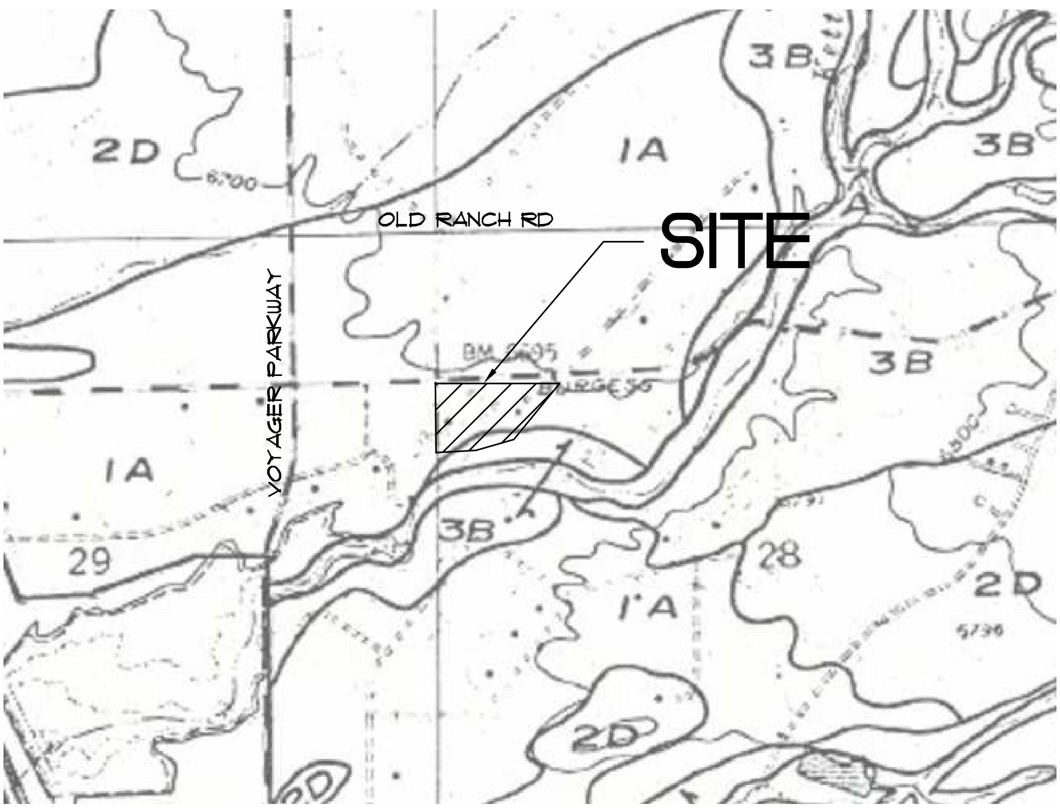
DATE 5-18-2018



GEOLOGY MAP

Qes - Eolian Sand
Qt1 - Terrace alluvium one
TKda2 - Dawson Formation

REFERENCE
NOT TO SCALE



ENGINEERING
GEOLOGY MAP

1A - Stable alluvium colluvium and bedrock

3B - Expansive and potentially expansive soil

REFERENCE
NOT TO SCALE

ARCHITECTS
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ENGINEERS
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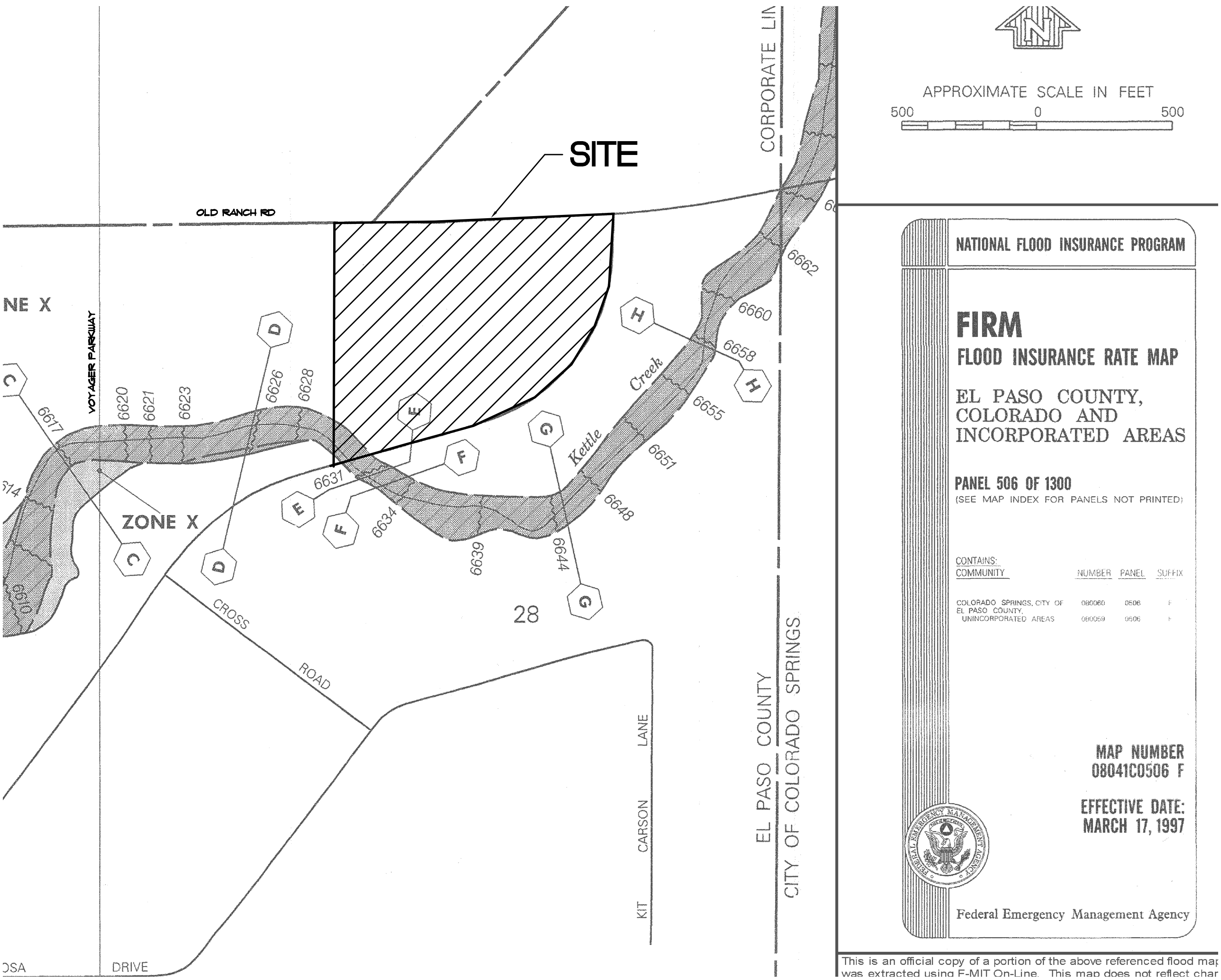
GEOLOGY and ENGINEERING GEOLOGY MAP

OLD RANCH ROAD
EL PASO COUNTY, CO
HUNSINGER DEVELOPMENT CORP.

JOB No. 162650

FIG No. 13

DATE 5-18-2018



REFERENCE
NOT TO SCALE

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FEMA MAP

OLD RANCH ROAD
EL PASO COUNTY, CO
HUNSINGER DEVELOPMENT CORP.

JOB No. 162650

FIG No. 14

DATE 5-18-2018

APPENDIX A
USGS Seismic Output

USGS Design Maps Summary Report

User–Specified Input

Report Title Hunsinger Development
Thu May 17, 2018 19:32:04 UTC

Building Code Reference Document 2012/2015 International Building Code
(which utilizes USGS hazard data available in 2008)

Site Coordinates 38.97846°N, 104.7894°W

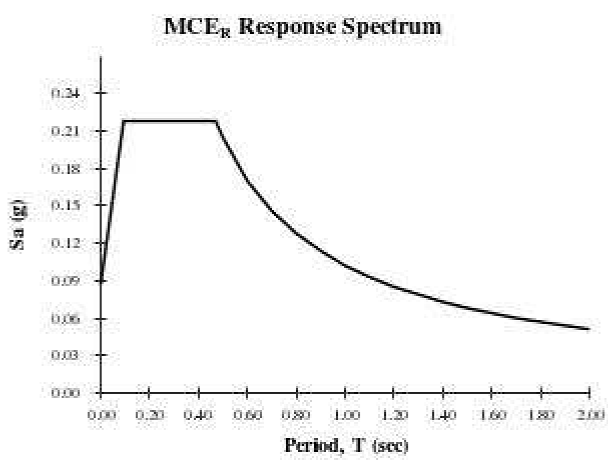
Site Soil Classification Site Class C – “Very Dense Soil and Soft Rock”

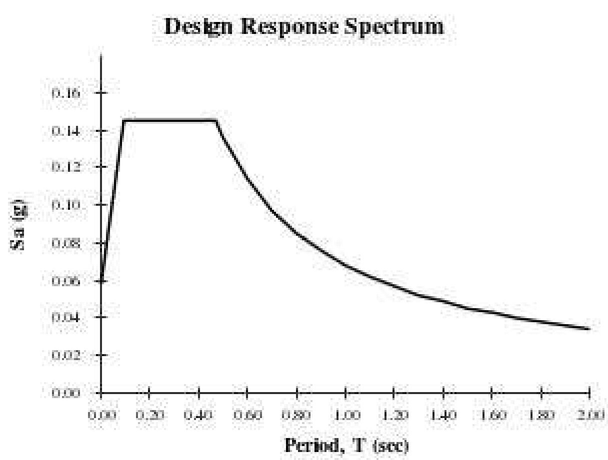
Risk Category I/II/III

USGS–Provided Output

S_S =	0.182 g	S_{MS} =	0.218 g	S_{DS} =	0.145 g
S_1 =	0.060 g	S_{M1} =	0.102 g	S_{D1} =	0.068 g

For information on how the SS and S1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the “2009 NEHRP” building code reference document.





USGS Design Maps Detailed Report

2012/2015 International Building Code (38.97846°N, 104.7894°W)

Site Class C – “Very Dense Soil and Soft Rock”, Risk Category I/II/III

Section 1613.3.1 — Mapped acceleration parameters

Note: Ground motion values provided below are for the direction of maximum horizontal spectral response acceleration. They have been converted from corresponding geometric mean ground motions computed by the USGS by applying factors of 1.1 (to obtain S_S) and 1.3 (to obtain S_1). Maps in the 2012/2015 International Building Code are provided for Site Class B. Adjustments for other Site Classes are made, as needed, in Section 1613.3.3.

From Figure 1613.3.1(1) [1] $S_S = 0.182$ g

From Figure 1613.3.1(2) [2] $S_1 = 0.060$ g

Section 1613.3.2 — Site class definitions

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site as Site Class C, based on the site soil properties in accordance with Section 1613.

2010 ASCE-7 Standard – Table 20.3-1
SITE CLASS DEFINITIONS

Site Class	$\bar{v}_s$	$\bar{N}$ or $\bar{N}_{ch}$	$\bar{s}_u$
A. Hard Rock	>5,000 ft/s	N/A	N/A
B. Rock	2,500 to 5,000 ft/s	N/A	N/A
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff Soil	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
E. Soft clay soil	<600 ft/s	<15	<1,000 psf
	Any profile with more than 10 ft of soil having the characteristics: • Plasticity index *PI* > 20, • Moisture content *w* ≥ 40%, and • Undrained shear strength $\bar{s}_u$ < 500 psf		
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.3.1		

For SI: 1ft/s = 0.3048 m/s 1lb/ft² = 0.0479 kN/m²

Section 1613.3.3 — Site coefficients and adjusted maximum considered earthquake spectral response acceleration parameters

TABLE 1613.3.3(1)
VALUES OF SITE COEFFICIENT F_a

Site Class	Mapped Spectral Response Acceleration at Short Period				
	$S_S \le 0.25$	$S_S = 0.50$	$S_S = 0.75$	$S_S = 1.00$	$S_S \ge 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_S

For Site Class = C and S_s = 0.182 g, F_a = 1.200

TABLE 1613.3.3(2)
VALUES OF SITE COEFFICIENT F_v

Site Class	Mapped Spectral Response Acceleration at 1–s Period				
	$S_1 \le 0.10$	$S_1 = 0.20$	$S_1 = 0.30$	$S_1 = 0.40$	$S_1 \ge 0.50$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_1

For Site Class = C and S_1 = 0.060 g, F_v = 1.700

Equation (16-37): $S_{MS} = F_aS_S = 1.200 \times 0.182 = 0.218$ g

Equation (16-38): $S_{M1} = F_vS_1 = 1.700 \times 0.060 = 0.102$ g

Section 1613.3.4 — Design spectral response acceleration parameters

Equation (16-39): $S_{DS} = ⅔ S_{MS} = ⅔ \times 0.218 = 0.145$ g

Equation (16-40): $S_{D1} = ⅔ S_{M1} = ⅔ \times 0.102 = 0.068$ g

Section 1613.3.5 — Determination of seismic design category

TABLE 1613.3.5(1)
SEISMIC DESIGN CATEGORY BASED ON SHORT-PERIOD (0.2 second) RESPONSE ACCELERATION

VALUE OF S_{DS}	RISK CATEGORY		
	I or II	III	IV
$S_{DS} < 0.167g$	A	A	A
$0.167g \le S_{DS} < 0.33g$	B	B	C
$0.33g \le S_{DS} < 0.50g$	C	C	D
$0.50g \le S_{DS}$	D	D	D

For Risk Category = I and S_{DS} = 0.145 g, Seismic Design Category = A

TABLE 1613.3.5(2)
SEISMIC DESIGN CATEGORY BASED ON 1-SECOND PERIOD RESPONSE ACCELERATION

VALUE OF S_{D1}	RISK CATEGORY		
	I or II	III	IV
$S_{D1} < 0.067g$	A	A	A
$0.067g \le S_{D1} < 0.133g$	B	B	C
$0.133g \le S_{D1} < 0.20g$	C	C	D
$0.20g \le S_{D1}$	D	D	D

For Risk Category = I and S_{D1} = 0.068 g, Seismic Design Category = B

Note: When S_1 is greater than or equal to 0.75g, the Seismic Design Category is **E** for buildings in Risk Categories I, II, and III, and **F** for those in Risk Category IV, irrespective of the above.

Seismic Design Category ≡ "the more severe design category in accordance with Table 1613.3.5(1) or 1613.3.5(2)" = B

Note: See Section 1613.3.5.1 for alternative approaches to calculating Seismic Design Category.

References

1. *Figure 1613.3.1(1)*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/IBC-2012-Fig1613p3p1(1).pdf
2. *Figure 1613.3.1(2)*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/IBC-2012-Fig1613p3p1(2).pdf

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