ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO 80907
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March 1, 2022

Galloway and Company
1155 Kelly Johnson Boulevard, Suite 205
Colorado Springs, CO 80920

Attn: Grant Dennis

Re: Soil, Geology and Geologic Hazard Evaluation
D+K Akers Subdivision 1, Replot Lots 1 and 2
2875 Akers Drive
El Paso County, Colorado

Dear Mr. Dennis:

As requested, personnel of Entech Engineering have investigated the above-referenced site to evaluate the conditions with respect to geology and geologic hazards that may affect the site.

GENERAL SITE CONDITIONS AND PROJECT DESCRIPTION

The site is located in a portion of the SE¼ of Section 32, Township 13 South, Range 65 West of the 6th Principal Meridian in El Paso County, Colorado. The site is located north of Constitution Drive and west of Marksheffel Road at 2875 Akers Drive in El Paso County, Colorado. The location of the site is shown on the Vicinity Map, Figure 1.

The topography of the site is relatively level with the eastern 2/3rds of the property gradually sloping to the east and the western 1/3 sloping gradually to the west. No drainages were observed on the site. The site boundaries are indicated on the USGS Map, Figure 2. Previous land uses have included rural commercial and agricultural land. The site is currently occupied with a metal building, a parking lot, a cell tower and an equipment storage yard located on the western half of the property and vacant pasture land on the east half of the property. Vegetation consists of primarily field grasses and weeds, with some scattered trees along the western edge. Site photographs, taken February 2022, are included in Appendix A.

The site consists of one 9.26-acre parcel. Proposed development will consist of subdividing the one parcel into two smaller lots (one into a 5-acre lot and the other a 4.26-acre lot) serviced by municipal water provided by Cherokee Metro District. An existing septic system is located on Lot 1 which will remain. The lots will be serviced by municipal water and private septic systems.

LAND USE AND ENGINEERING GEOLOGY

This site was found to be suitable for the proposed development, which will consist of subdividing 1 lot into 2 separate lots, with the existing structures and storage yard remaining to remain. Areas were encountered where the geologic conditions will impose some constraints on development and land use. These include areas of expansive soils, loose soils and artificial fill. A development plan was not available at the time of the investigation however it appears that these areas will have some impacts on the development. These conditions will be discussed in greater detail in the report.

In general, it is our opinion that the development can be achieved if the observed geologic conditions on site are either avoided or properly mitigated. All recommendations are subject to the limitations discussed in the report.

SCOPE OF THE REPORT

The scope of the report will include:

- A general geologic analysis utilizing published geologic data. Detailed site-specific mapping will be conducted to obtain general information in respect to major geographic and geologic features, geologic descriptions and their effects on the development of the property.

FIELD INVESTIGATION

Our field investigation consisted of the preparation of a geologic map of bedrock features and significant surficial deposits. The Natural Resource Conservation Service (NRCS), previously the Soil Conservation Service (SCS) survey was also reviewed to evaluate the site. The position of mappable units within the subject site are shown on the Geologic Map. Our mapping procedures involved both field reconnaissance and measurements, and aerial photo reconnaissance and interpretation. The same mapping procedures have also been utilized to produce the Geology/Engineering Geology Map which identified pertinent geologic conditions affecting development. The field mapping was performed by personnel of Entech Engineering, Inc. on February 28, 2022.

SOIL AND GEOLOGIC CONDITIONS

Soil Survey

The Natural Resource Conservation Service (NRCS) (Reference 2, Figure 4), previously the Soil Conservation Service (Reference 3) has mapped three soil types on the site. Complete descriptions of the soils are presented in Appendix C. In general, the soils consist of gravelly sandy loam, and very gravelly loamy sand. The soils are described as follows:

Type	Description
8	Blakeland Loamy Sand 1-9% Slopes

The soils have been described to have moderate to rapid permeabilities. The soils are described as well suited for use as homesites. Possible hazards with soils erosion are present on the site. The erosion potential can be controlled with vegetation. The soils have been described to have moderate erosion hazards (Reference 3).

Soils

Soils encountered in the test borings drilled on Lot 2 consisted of sandy clay (CL). The boring was drilled to a depth of 20 feet. Standard Penetration Testing conducted on the clay resulted in N-values of 10 to 16 bpf, indicating firm to stiff consistencies. Moisture content and grain size analysis indicated moisture contents of 6 to 13 percent, with 83.5 percent of the soil particles passing the No. 200 Sieve. An FHA swell test on a sample of sandy clay from a depth of 5 feet resulted in a swell pressure of 890 psf which indicates a low expansion potential.

Groundwater

Groundwater was not encountered in the test boring which was drilled to 20 feet bgs. Groundwater is not expected affect the construction of shallow foundations proposed for this site and deeper excavations for utilities, depending on site grading and depths of excavation. Unstable conditions should be expected where excavations approach the groundwater level. Stabilization using shot rock or geo grids may be necessary. It should be noted that fluctuation in groundwater levels could change due to seasonal variations, changes in land runoff characteristics and future development of nearby areas. Isolated sand layers within the soil profile can carry water in the subsurface. Contractors should be cognizant of the potential for the occurrence of subsurface water during construction.

Geology

Approximately 10 miles west of the site is a major structural feature known as the Rampart Range Fault. This fault marks the boundary between the Great Plains Physiographic Province and the Southern Rocky Mountain Province. The site exists within a large structural feature known as the Denver Basin. Bedrock in the area is typically gently dipping in a northernly direction. The bedrock underlying the site consists of the Dawson Formation of Cretaceous Age. The Dawson Formation typically consists of coarse-grained arkosic sandstone with interbedded layers of siltstone or claystone. Overlying the Dawson Formation are deposits of man-made fill soils and soils associated with water-deposited alluvial sands.

The geology of the site was evaluated using the *Geologic Map of the Elsmere Quadrangle, by Madole and Thorson in 2003, and Falcon NW Quadrangle,* by Madole in 2003, (References 5 and 6, Figure 5). The Geology for the site is presented in Figure 6. Two mappable units were identified on this site which, are described as follows:

Qaf **Artificial Fill of Late Holocene Age:** These are man-made fill deposits associated with the existing structures and parking lot observed on the site. Areas of fill other than those mapped may be encountered.

Qes **Wind Blown Sand of the Lower Holocene to Upper Pleistocene Age:** Fine to coarse sand with silt and clay layers derived mainly from alluvium of major streams distributed east of source area by wind.

The soils listed above were mapped from site-specific mapping, the *Geologic Map of the Elsmere Quadrangle, by Madole and Thorson in 2003, and Falcon NW Quadrangle,* by Madole in 2003, (References 5 and 6, Figure 5), and the *Geologic Map of the Pueblo 1° x 2° Quadrangle,* distributed by the US Geological Survey in 1978 (Reference 6). The test borings used in evaluating the site are included in Appendix B. The Geology Map prepared for the site is presented in Figure 6.

ENGINEERING GEOLOGIC HAZARDS/CONSTRAINTS

Mapping has been performed on this site to identify areas where various geologic conditions exist of which developers should be cognizant during the planning, design and construction

stages should new construction be proposed. The engineering geologic hazards identified on this site include artificial fill, and loose soils. Additionally, shallow groundwater may be encountered at variable depths across the site. These hazards and recommended mitigation techniques are discussed as follows:

Artificial Fill – Constraint

Fill exists associated with an existing metal building and parking lot, and cell tower on the western portion of the site. This fill is considered uncontrolled for construction purposes. Areas of fill encountered beneath foundation components or below parking lots and storage yard should be penetrated or removed on a controlled manner.

Expansive Soils – Constraint

Expansive soils were encountered in the Test Boring drilled on site. Highly expansive clay or bedrock, if encountered beneath foundations, can cause differential movement in the structure foundation.

Loose Soils – Constraint

Firm to stiff clay soils were encountered in the Test Boring and may require mitigation.

Mitigation: Should highly expansive or soft clay soils be encountered beneath any foundations proposed for the site; mitigation will be necessary and will require special foundation design. Overexcavation and replacement with non-expansive soils at a minimum of 95% of its maximum Modified Proctor Dry Density, ASTM D-1557 is a suitable mitigation, which is commonly used in the area. Overexcavation depth of 3 to 4 feet are typical. Floor slabs on expansive or soft clay soils should be expected to experience movement. Overexcavation and replacement has been successful in minimizing slab movements.

Floodplain/Drainage Areas

The site does not lie within a floodplain according to the FIRM Map, Nos. 08041CO543G and 08041CO756G (Reference 9, Figure 7). Any site grading considered should be modified to direct surface flows around the structure or roads, or carried off site to not produce any areas of ponded water. Specific drainage studies and exact floodplain locations are beyond the scope of this report.

Mitigation: Structures should not be located within the floodplain; however, structures adjacent to the floodplain may experience periods of high subsurface moisture. In these locations, foundations are subject to severe frost heave and should penetrate to a sufficient depth so as to prevent the formation of ice lenses beneath foundations. At this location and elevation, a foundation depth for frost protection of 30-inches is recommended. In areas where high subsurface moisture conditions are anticipated periodically, a subsurface perimeter drain will be necessary to help prevent the seepage of water into areas below grade. A typical perimeter drain detail is presented in Figure 8. Any grading in these areas should be done in a manner that directs surface flow around construction to avoid areas of ponded water. Areas of organic material will require removal prior to any fill placement. Unstable soil conditions should be

expected in areas of shallow groundwater. Where foundations approach the groundwater level, stabilization of the excavations utilizing shot rock may be necessary.

RELEVANCE OF GEOLOGIC CONDITIONS TO LAND USE PLANNING

The proposed development will consist of consist of 2 commercial lots, the metal building, parking lot and storage yard on Lot 1 will remain. The existing geologic and engineering geologic conditions will impose constraints on development and construction. The geologic conditions on the site include expansive and loose soils, which can be satisfactorily mitigated through avoidance or proper engineering design and construction practices.

The clay soils in the boring drilled on the site were encountered at firm to stiff consistencies. Loose or expansive soils, encountered beneath foundation or floor slabs, will require removal and recompaction. These soils will not prohibit development. Removal of 24 to 36 inches the loose sands and recompacted at a minimum of 95% of its maximum Modified Proctor Dry Density, ASTM D-1557 is a suitable mitigation, which is common in the area. Floor slabs on loose or expansive clay soils should be expected to experience movement. Recompaction has been successful in minimizing slab movement.

Areas of fill, may also be encountered. All fill within building areas should be completely removed prior to construction. Any uncontrolled fill encountered beneath new foundations and floor slabs will require removal and recompaction at a minimum of 95% of its maximum Modified Proctor Dry Density, ASTM D-1557.

Groundwater was not encountered in the test boring which was drilled to 20 feet bgs. (Reference 1, Appendix B) Groundwater may affect deeper excavations for utilities. Unstable conditions should be expected where excavations approach the groundwater level. Stabilization using shot rock or geo grids may be necessary. Specific drainage studies and exact floodplain locations are beyond the scope of this report.

In summary, recompacted onsite or imported soils will likely provide suitable support for shallow foundations. The geologic conditions encountered on site can be mitigated with proper engineering and construction practices. Specific recommendations have been made in the Subsurface Soil Investigation (Reference 1).

ECONOMIC MINERAL RESOURCES

Some of the sandy materials on-site could be considered a high-grade sand resource. According to the *El Paso County Aggregate Resource Evaluation Map* (Reference 9), the area is mapped as stream terrace deposits. According to the *Atlas of Sand, Gravel and Quarry Aggregate Resources, Colorado Front Range Counties* distributed by the Colorado Geological Survey (Reference 10), areas of the site is not mapped as with any resources. According to the *Evaluation of Mineral and Mineral Fuel Potential* (Reference 11), the area of the site has been mapped as “Good” for industrial minerals. Generally, the alluvium does not contain significant industrial mineral resources and lies within floodplain areas. The sands associated with the alluvial deposits may be considered a sand resource, however, the abundance of similar materials through the region, they would be considered to have little significance as an economic resource.

According to *the Evaluation of Mineral and Mineral Fuel Potential of El Paso County State Mineral Lands* (Reference 11), the site is not mapped within the Denver Basin Coal Region. However, the area of the site has been mapped as "Poor" for coal resources. No active or inactive mines have been mapped in the area of the site. No metallic mineral resources have been mapped on the site (Reference 11).

The site has been mapped as "Fair" for oil and gas resources (Reference 11). No oil or gas fields have been discovered in the area of the site. The sedimentary rocks in the area may lack the geologic structure for trapping oil or gas; therefore, it would not be considered a significant resource.

EROSION CONTROL

The soil types observed on the site are mildly to highly susceptible to wind erosion, and moderately to highly susceptible to water erosion. A minor wind erosion and dust problem may be created for a short time during and immediately after construction. Should the problem be considered severe enough during this time, watering of the cut areas or the use of chemical palliative may be required to control dust. However, once construction has been completed and vegetation re-established, the potential for wind erosion should be considerably reduced.

With regard to water erosion, loosely compacted soils will be the most susceptible to water erosion, residually weathered soils and weathered bedrock materials become increasingly less susceptible to water erosion. For the typical soils observed on site, allowable velocities or unvegetated and unlined earth channels would be on the order of 3 to 4 feet/second, depending upon the sediment load carried by the water. Permissible velocities may be increased through the use of vegetation to something on the order of 4 to 7 feet/second, depending upon the type of vegetation established. Should the anticipated velocities exceed these values, some form of channel lining material may be required to reduce erosion potential. These might consist of some of the synthetic channel lining materials on the market or conventional riprap. In cases where ditch-lining materials are still insufficient to control erosion, small check dams or sediment traps may be required. The check dams will serve to reduce flow velocities, as well as provide small traps for containing sediment. The determination of the amount, location and placement of ditch linings, check dams and of the special erosion control features should be performed by or in conjunction with the drainage engineer who is more familiar with the flow quantities and velocities.

Cut and fill slope areas will be subjected primarily to sheetwash and rill erosion. Unchecked rill erosion can eventually lead to concentrated flows of water and gully erosion. The best means to combat this type of erosion is, where possible, the adequate re-vegetation of cut and fill slopes. Cut and fill slopes having gradients more than three (3) horizontal to one (1) vertical become increasingly more difficult to revegetate successfully. Therefore, recommendations pertaining to the vegetation of the cut and fill slopes may require input from a qualified landscape architect and/or the Soil Conservation Service.

CLOSURE

It should be pointed out that because of the nature of data obtained by random sampling of such variable nonhomogeneous materials as soil and rock, it is important that we be informed of any differences observed between surface and subsurface conditions encountered in construction and those assumed in the body of this report. Any new construction considered on this site will require additional investigation. Construction and design personnel should be made familiar with the contents of this report. Specific construction and foundation recommendations will be provided when investigations are completed at each building site prior to new construction.

This report has been prepared for Galloway and Company for application to the proposed development in accordance with generally accepted geologic, soil and engineering practices. No other warranty expresses or implied is made.

We trust that this report has provided you with all the information that you required. Should you have any questions or require additional information, please do not hesitate to contact us.

Respectfully Submitted,

ENTECH ENGINEERING, INC.

Stuart Wood
Geologist

Reviewed by:

COLORADO REGISTERED
JOSEPH COLLIN GOODE JR.
23725
PROFESSIONAL ENGINEER
3-3-2022

Joseph C. Goode, Jr., P.E.
President

LLL/drc

Encl.

Entech Job No. 220256
AAprojects/2022/220256 sg&ghs

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FIGURES

ENTECH ENGINEERING, INC.
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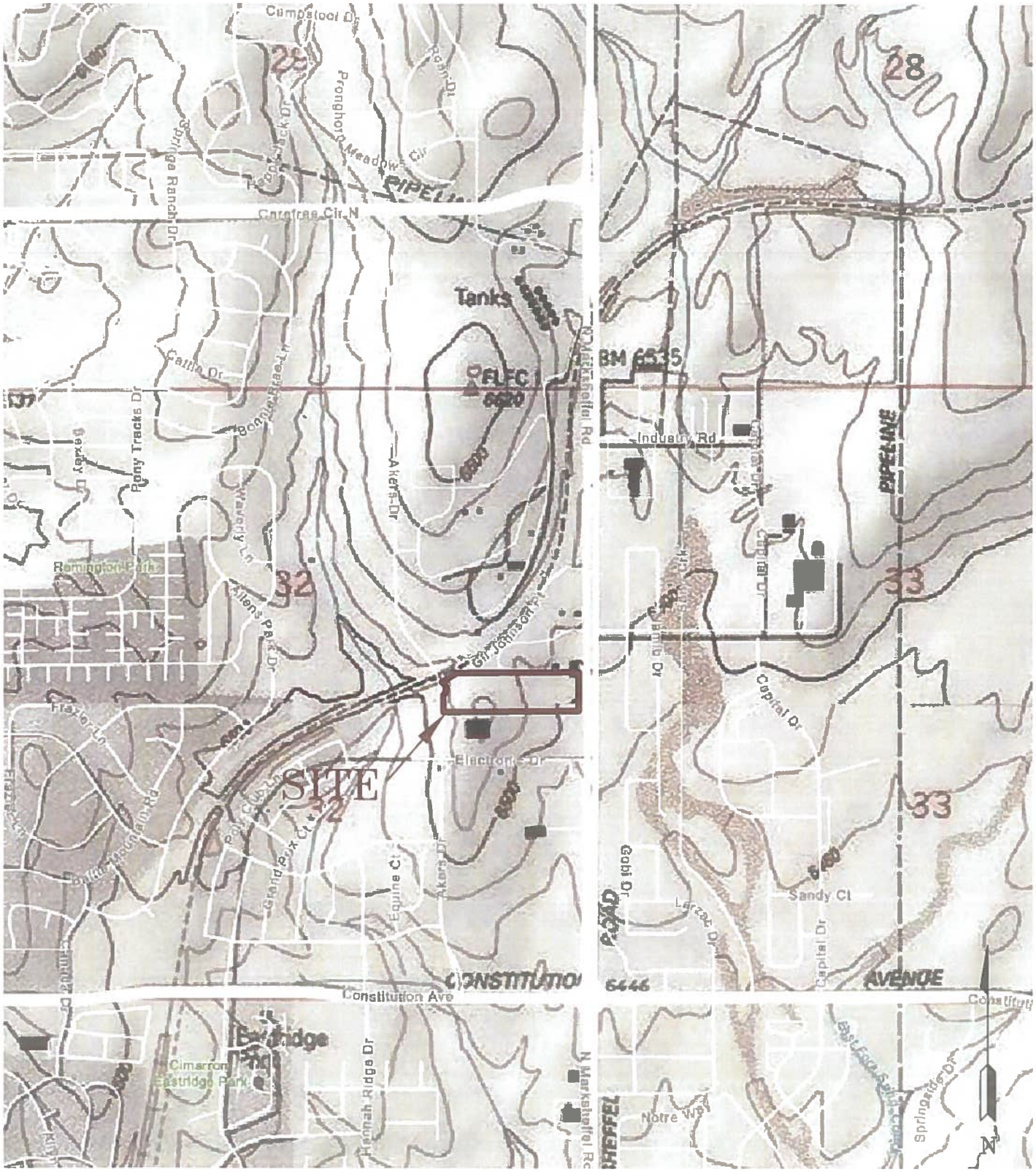
COLORADO SPRINGS, CO. 80907 (719) 531-5599

VICINITY MAP
D & K SUBDIVISION #1, LOTS 1 & 2
COLORADO SPRINGS, CO.
FOR: GALLOWAY & COMPANY INC.

DRAWN:	DATE:	CHECKED:	DATE:
JAC	3/02/22		

JOB NO.: 220256

FIG NO.: 1



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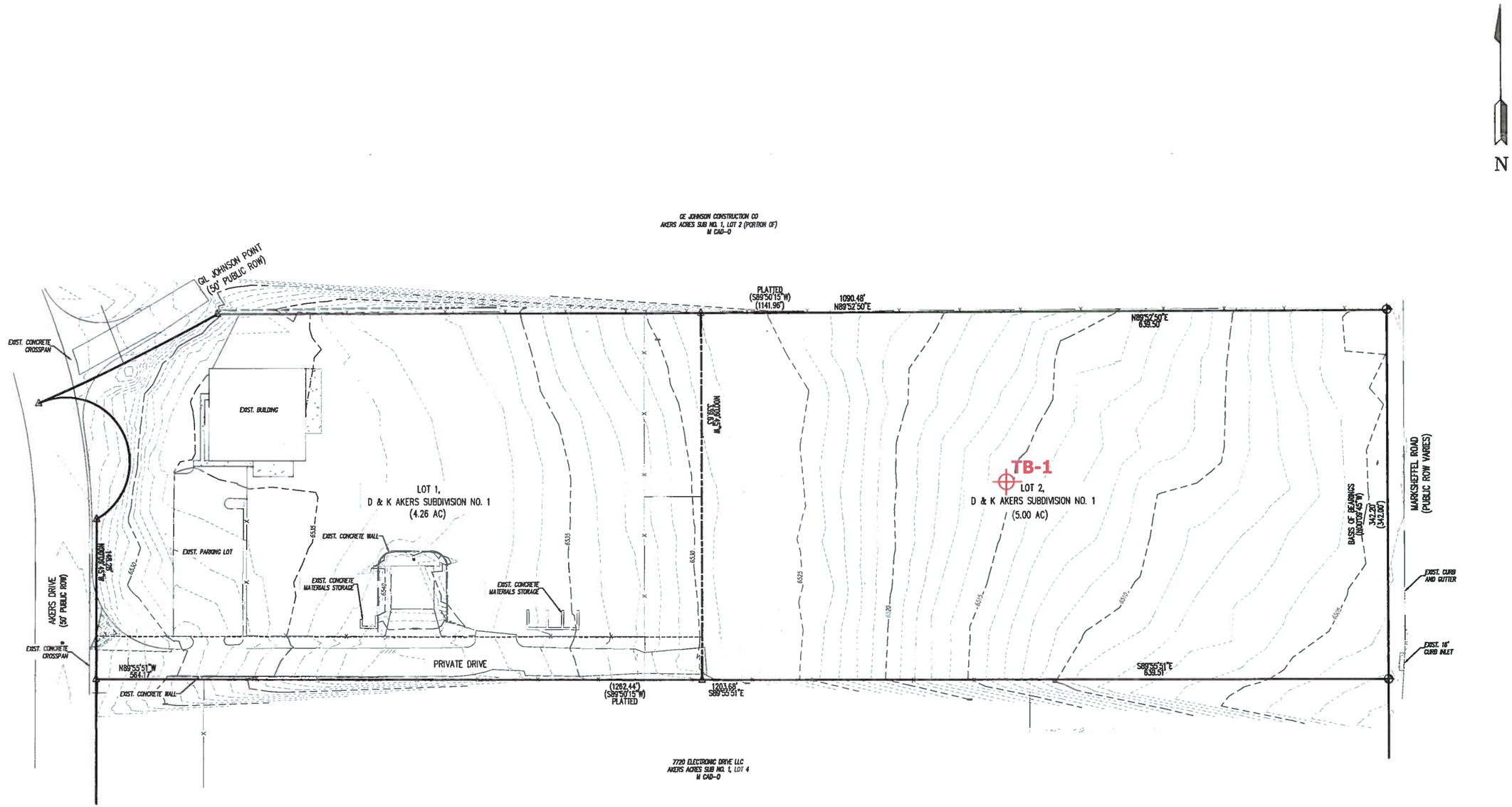
USGS TOPOGRAPHY MAP
D & K SUBDIVISION #1, LOTS 1 & 2
COLORADO SPRINGS, CO.
FOR: GALLOWAY & COMPANY INC.

DRAWN:	DATE:	CHECKED:	DATE:
JAC	3/02/22		

JOB NO.: 220256

FIG NO.: 2



LEGEND:

⊕ Approximate Test Boring Location

125 0 250 500 1000

1:500

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TEST BORING LOCATION MAP
D & K SUBDIVISION #1, LOTS 1 & 2
COLORADO SPRINGS, CO.
FOR: GALLOWAY & COMPANY INC.

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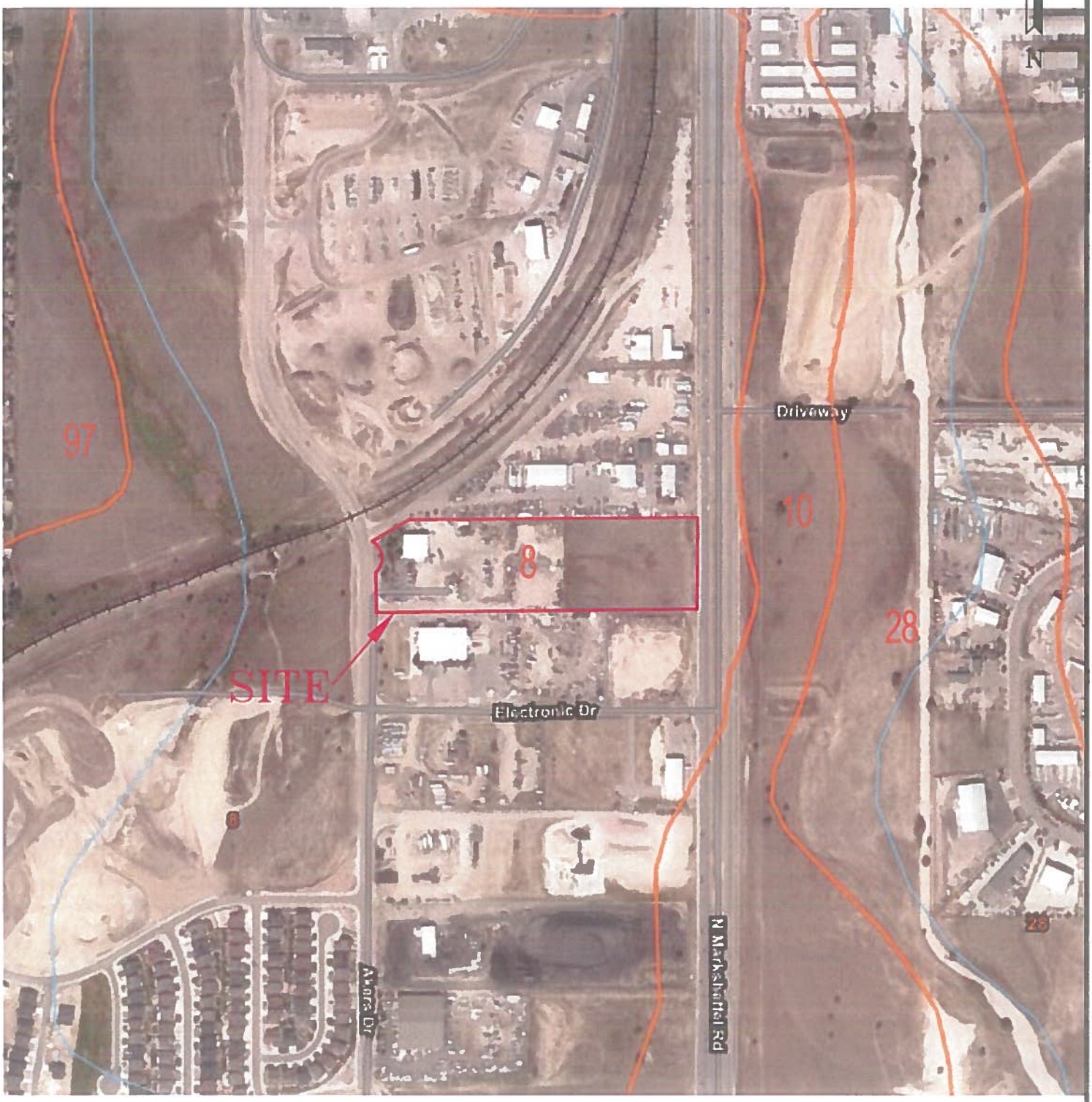
DATE	3/02/22
SCALE	AS SHOWN
JOB NO.	220256
FIGURE No.	3



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SOIL SURVEY MAP
D & K SUBDIVISION #1, LOTS 1 & 2
COLORADO SPRINGS, CO.
FOR: GALLOWAY & COMPANY INC.

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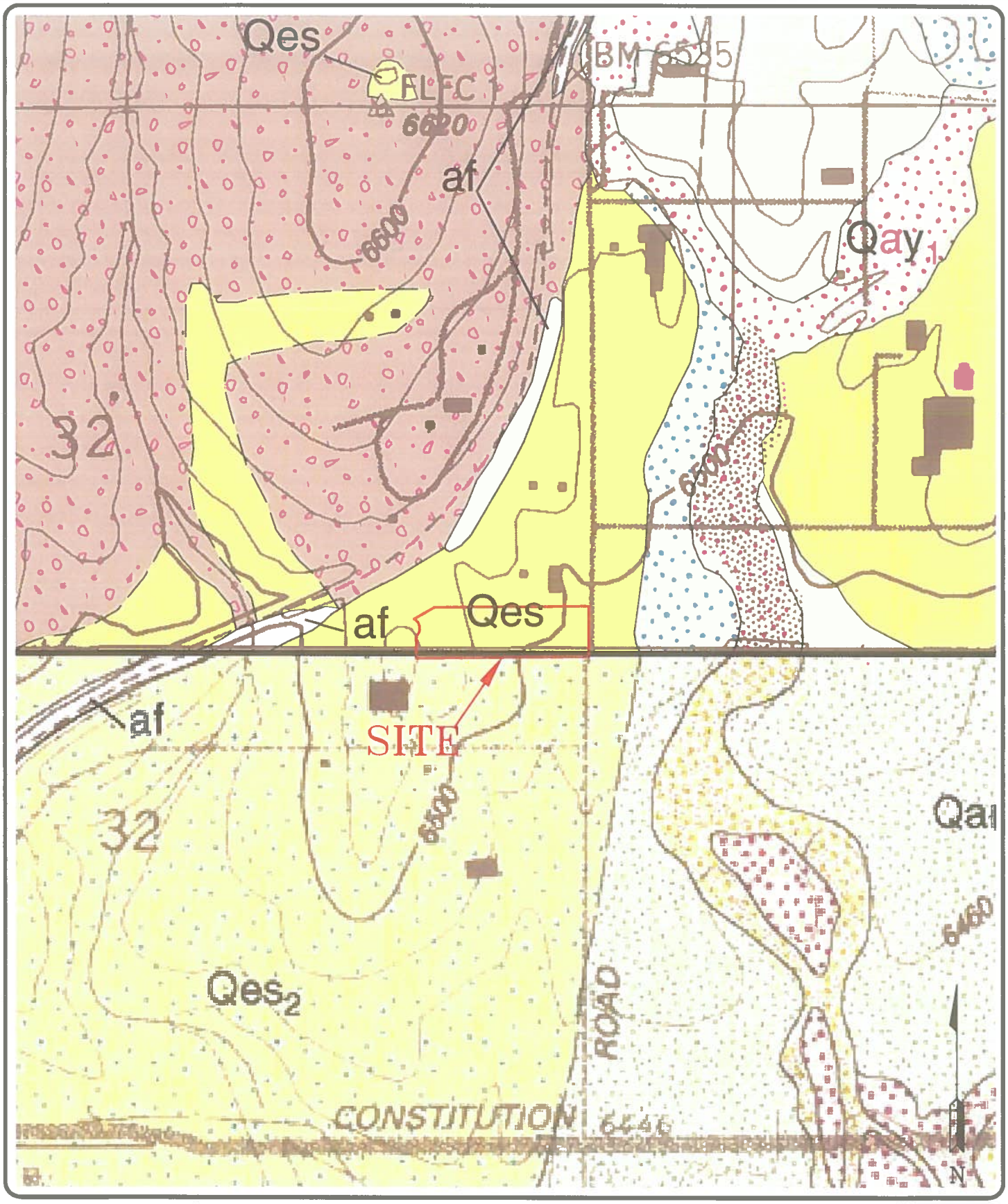
FIG NO.: 4



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ELSMERE AND FALCON NW QUADRANGLES
GEOLOGY MAP
D & K SUBDIVISION #1, LOTS 1 & 2
COLORADO SPRINGS, CO.
FOR: GALLOWAY & COMPANY INC.

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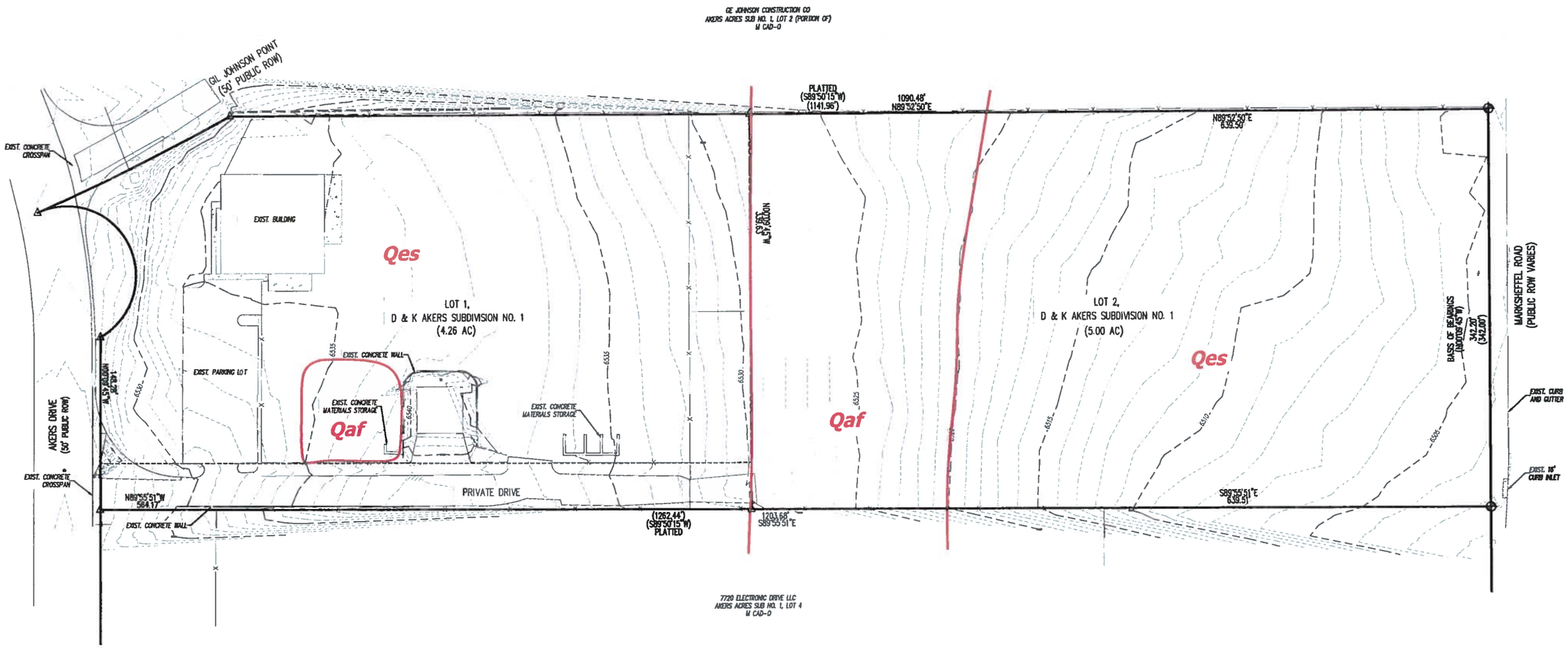
JOB NO.: 220256

FIG NO.: 5



LEGEND:

Qaf - Artificial Fill of Quaternary Age:
man-made fill deposits

Qes - Eolian Sand of Quaternary Age:
wind blown sand deposits

N

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GEOLOGY/ENGINEERING GEOLOGY MAP
D & K SUBDIVISION #1, LOTS 1 & 2
COLORADO SPRINGS, CO.
FOR: GALLOWAY & COMPANY INC.

DRAWN	JAC
CHECKED	
DATE	3/02/22
SCALE	AS SHOWN
JOB NO.	220256
FIGURE No.	6

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FLOODPLAIN MAP
D & K SUBDIVISION #1, LOTS 1 & 2
COLORADO SPRINGS, CO.
FOR: GALLOWAY & COMPANY INC.

DRAWN:	DATE:	CHECKED:	DATE:
JAC	3/02/22		

JOB NO.: 220256

FIG NO.: 7

APPENDIX A: Site Photographs

1

Looking east from the central portion of Lot 2.

February 17, 2022

2

Looking west from the central portion of Lot 2.

February 17, 2022

Job No. 220256

APPENDIX B: Test Boring Log

TEST BORING NO. 1
DATE DRILLED 2/17/2022
Job # 220256

REMARKS

DRY TO 20', 2/17/21

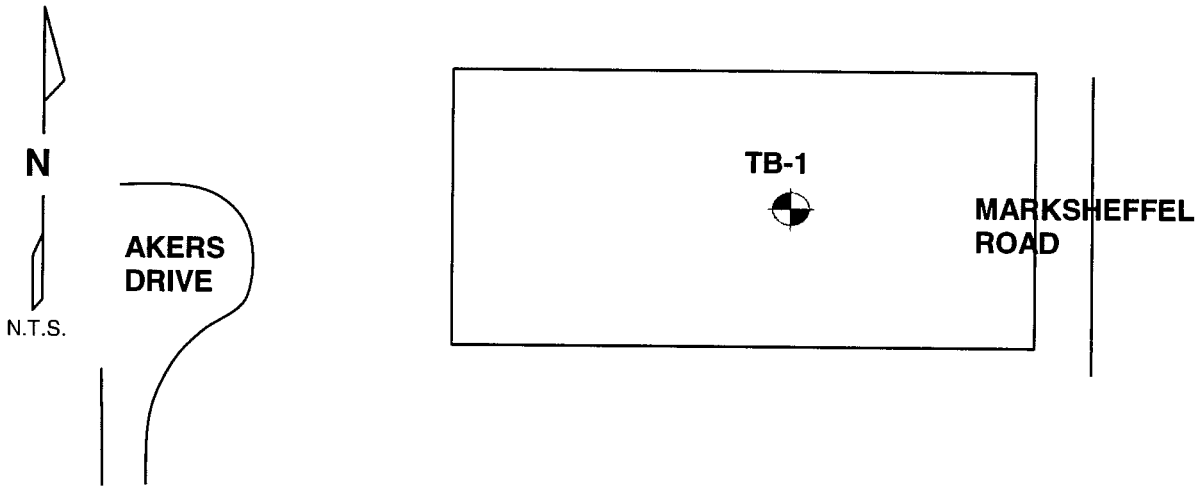
CLAY, SANDY, BROWN, FIRM TO STIFF, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			14	11.1	
5			16	12.4	
10			10	6.2	
15			14	10.9	
20			16	13.2	

TEST BORING NO.
DATE DRILLED
CLIENT GALLOWAY AND CO.
LOCATION 2875 AKERS DRIVE

REMARKS

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
5					
10					
15					
20					



LOCATIONS OF TEST BORINGS ARE APPROXIMATE

ENTECH ENGINEERING, INC.
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COLORADO SPRINGS, COLORADO 80907

TEST BORING LOG

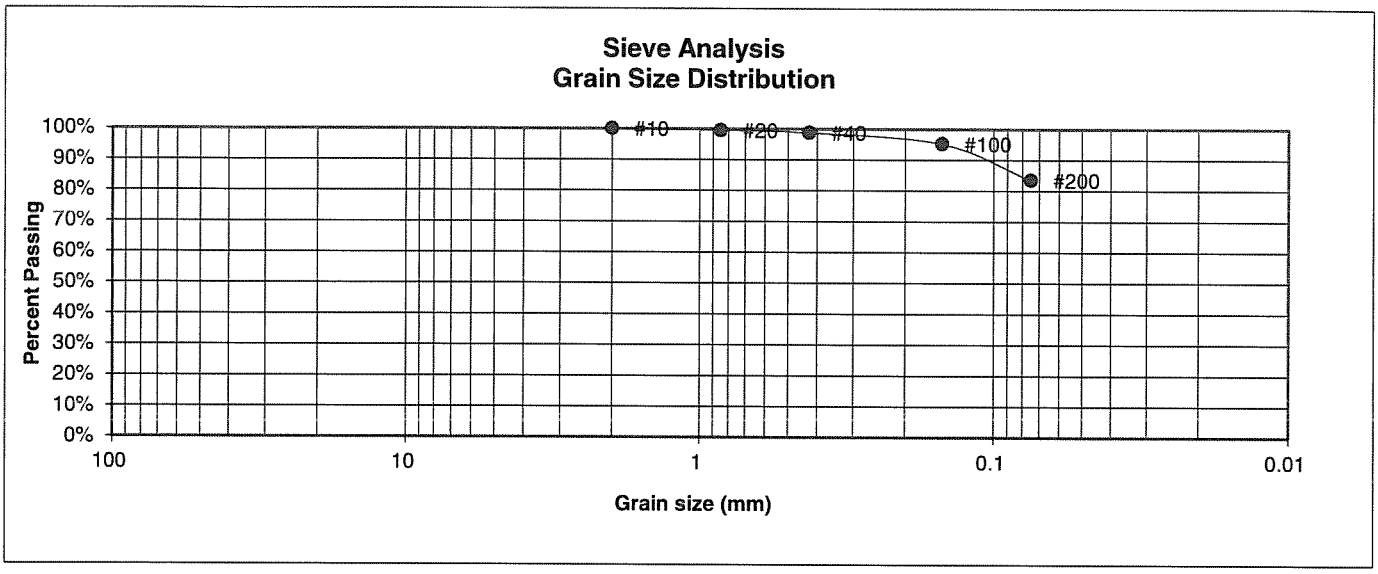
DRAWN:	DATE:	CHECKED:	DATE:
		SW	3-3-22

JOB NO.: 220256

FIG NO.: B-1

APPENDIX C: Laboratory Testing Results

BORING NO.	1	UNIFIED CLASSIFICATION	CL	TEST BY	BL
DEPTH(ft)	5	AASHTO CLASSIFICATION		JOB NO.	220256
CLIENT	GALLOWAY AND CO.				
PROJECT	2875 AKERS DRIVE				



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	
10	100.0%
20	99.5%
40	98.7%
100	95.2%
200	83.5%

Atterberg Limits	
Plastic Limit	
Liquid Limit	
Plastic Index	
Swell	
Moisture at start	17.0%
Moisture at finish	25.1%
Moisture increase	8.1%
Initial dry density (pcf)	96
Swell (psf)	890

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LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		SW	3-3-22

JOB NO.: 220256

FIG NO.: C-1

APPENDIX D: USDA Soil Survey

9—Blakeland complex, 1 to 9 percent slopes. This complex is on uplands, mostly in the Falcon area. The average annual precipitation is about 15 inches, the average annual air temperature is about 47 degrees F, and the frost-free period is about 135 days.

This complex is about 60 percent Blakeland loamy sand, about 30 percent Fluvaquentic Haplaquolls, and 10 percent other soils.

Included with these soils in mapping are areas of Columbine gravelly sandy loam, 0 to 3 percent slopes, Ellicott loamy coarse sand, 0 to 5 percent slopes, and Ustic Torrifluvents, loamy.

The Blakeland soil is in the more sloping areas. It is deep and somewhat excessively drained. It formed in sandy alluvium and eolian material derived from arkosic sedimentary rock. Typically, the surface layer is dark grayish brown loamy sand about 11 inches thick. The substratum, to a depth of 27 inches, is brown loamy sand; it grades to pale brown sand that extends to a depth of 60 inches or more.

Permeability of the Blakeland soil is rapid. The effective rooting depth is more than 60 inches. The available water capacity is moderate to low. Surface runoff is slow, and the hazard of erosion is moderate.

The Fluvaquentic Haplaquolls are in swale areas. They are deep, poorly drained soils. They formed in alluvium derived from arkosic sedimentary rock. Typically, the surface layer is brown. The texture is variable throughout. The water table is at a depth of 0 to 3 feet.

The Blakeland soil is well suited to deep-rooted grasses. Native vegetation is dominantly western wheatgrass, side-oats grama, and needleandthread. Rangeland vegetation on the Fluvaquentic Haplaquolls is dominantly tall grasses, including sand bluestem, switchgrass, prairie cordgrass, little bluestem, and sand reedgrass. Cattails and bulrushes are common in the swampy areas.

Proper range management is needed to prevent excess removal of plant cover from these soils. It is also needed to maintain the productive grasses. Interseeding improves the existing vegetation. Deferment of grazing during the growing season increases plant vigor and soil stability, and it helps to maintain and improve range condition. Proper location of livestock watering facilities helps to control grazing of animals.

Windbreaks and environmental plantings are fairly well suited to these soils. Blowing sand and low available water capacity are the main limitations to the establishment of trees and shrubs. The soils are so loose that trees need to be planted in shallow furrows and plant cover needs to be maintained between the rows. Supplemental irrigation may be needed to insure survival. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, and Siberian elm. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

The Blakeland soil is well suited to wildlife habitat. It is best suited to habitat for openland and rangeland wildlife. Rangeland wildlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, properly managing livestock grazing, and reseeding range where needed. Wetland wildlife can be attracted to the Fluvaquentic Haplaquolls and the wetland habitat can be enhanced by several means. Shallow water developments can be created by digging or by blasting potholes to create open-water areas. Fencing to control livestock grazing is beneficial, and it allows wetland plants such as cattails, reed canarygrass, and rushes to grow. Control of unplanned burning and prevention of drainage that would remove water from the wetlands are good practices. Openland wildlife use the vegetation on these soils for nesting and escape cover. These shallow marsh areas are especially important for winter cover if natural vegetation is allowed to grow.

The Blakeland soil has good potential for homesites, roads, and streets. It needs to be protected from erosion when vegetation has been removed from building sites. The Fluvaquentic Haplaquolls have poor potential for homesites. Their main limitations for this use are the high water table and the hazard of flooding. Capability subclass VIe.