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SOIL, GEOLOGY, AND GEOLOGIC HAZARD
SPRINGS AT WATERVIEW
GRINNELL BOULEVARD AND BRADLEY ROAD
EL PASO COUNTY, COLORADO

Prepared for

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Attn: Charles K. Cothern

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Respectfully Submitted,

ENTECH ENGINEERING, INC.

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LLL/rm

Encl.

Entech Job No. 170008
AAprojects/2017/170008 countysoil/geo

Reviewed by:

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TABLE OF CONTENTS

1.0 SUMMARY

Project Location

The project lies in a portion of the NW¼ of Section 7, Township 15 South, Range 65 West of the 6th Principal Meridian in El Paso County, Colorado. The site is located approximately ½ mile east of Security-Widefield, Colorado.

Project Description

Total acreage involved in the project is approximately 15 acres. The proposed site development consists of eighty-five single-family residential lots. The development will utilize municipal sewer and water.

Scope of Report

This report presents the results of our geologic evaluation and treatment of engineering geologic hazard study.

Land Use and Engineering Geology

This site was found to be suitable for the proposed development. Areas were encountered where the geologic conditions will impose some constraints on development and land use. These include areas of seasonal shallow groundwater and drainage areas. Based on the proposed development plan, it appears that these areas will have some impact 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.

2.0 GENERAL SITE CONDITIONS AND PROJECT DESCRIPTION

The site is located in a portion of the NW¼ of Section 7, Township 15 South, Range 65 West of the 6th Principal Meridian in El Paso County, Colorado. The site is located approximately ½ mile east of Security-Widefield, Colorado, at the northeast corner of Grinnell Boulevard and Bradley Road. The location of the site is as shown on the Vicinity Map, Figure 1.

The topography of the site is generally gradually sloping to the west-southwest, with a moderate slope along the eastern portion of the site. The drainages on site flow in southerly and westerly direction through the central portion of the site. A stormwater outlet from the adjacent development exists on the eastern side of the site and a stormwater inlet exists on the western side of the site that discharges off of the site to a tributary of Sand Creek. Water was not observed in the drainages at the time of this investigation. The site boundaries are indicated on the USGS Map, Figure 2. Previous land uses have included grazing and pasture land. The site contains primarily field grasses and weeds with areas of scattered trees along the drainages. Site photographs, taken February 10, 2017, are included in Appendix A.

Total acreage involved in the proposed development is approximately 15 acres. Eighty-five single-family residential lots are proposed. The proposed lots vary in size from approximately 5,000 to 10,600 square feet. The area will be serviced municipal sewer and water. The proposed Development Plan is presented in Figure 3.

3.0 SCOPE OF THE REPORT

The scope of the report will include the following:

- 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.

4.0 FIELD INVESTIGATION

Our field investigation consisted of the preparation of a geologic map of any 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 property are shown on the Geologic Map. Our mapping procedures involved both field reconnaissance and measurements and air photo reconnaissance and interpretation. The same mapping procedures have also been utilized to produce the Engineering Geology Map which identified pertinent geologic conditions affecting development. The field mapping was performed by personnel of Entech Engineering, Inc. on February 10, 2017.

Four (4) Test Borings were performed on the site to determine general soil and bedrock characteristics. The locations of the test borings are indicated on the Development Plan/Test Boring Location Map, Figure 3. The Test Boring Logs are presented in Appendix B. Results of this testing will be discussed later in this report.

Laboratory testing was also performed on some of the soils to classify and determine the soils engineering characteristics. Laboratory tests included grain-size analysis, ASTM D-422, and Atterberg Limits, ASTM D-4318. Sulfate testing was performed on selected samples to evaluate potential for below grade concrete degradation due to sulfate attack. Results of the laboratory testing are included in Appendix C. A Summary of Laboratory Test Results is presented in Table 1.

5.0 SOIL, GEOLOGY AND ENGINEERING GEOLOGY

5.1 General Geology

Physiographically, the site lies in the western portion of the Great Plains Physiographic Province. Approximately 7 miles to the west is a major structural feature known as the Ute Pass Fault. This fault marks the boundary between the Great Plains Physiographic Province and the Southern Rocky Mountain Province. The site exists within the southeastern edge of a large structural feature known as the Denver Basin. Bedrock in the area tends to be very gently

dipping in a northeasterly direction (Reference 1). The rocks in the area of the site are sedimentary in nature and typically Upper Cretaceous in age. The bedrock underlying the site consists of the Pierre Shale Formation. Overlying this formation are unconsolidated deposits of man-made, and alluvial soils of Quaternary Age. The alluvial soils were deposited by water on site and as stream terraces along an abandoned paleovalley. Man-made soils exist as fill piles located in the southern portion of the site. The site's stratigraphy will be discussed in more detail in Section 5.3.

5.2 Soil Conservation Survey

The Natural Resource Conservation Service (Reference 2), previously the Soil Conservation Service (Reference 3) has mapped three soil types on the site (Figure 4). In general, the soils classify as sandy loam to loamy sand. The soils are described as follows:

Type	Description
3	Ascalon Sandy Loam, 3 to 9% slopes
8	Blakeland Loamy Sand, 0 to 3% slopes
97	Truckton Sandy Loam, 3 to 9% slopes

Complete descriptions of each soil type are presented in Appendix D. The soils have generally been described to have moderate to moderately rapid permeabilities. Possible hazards with soil erosion are present on the site. The erosion potential can be controlled with vegetation. The majority of the soils have been described to have slight to moderate erosion hazards.

5.3 Site Stratigraphy

The Elsmere Quadrangle Geology Map showing the site is presented in Figure 5 (Reference 4). The Geology Map prepared for the site is presented in Figure 6. Four mappable units were identified on this site which are described as follows:

Qaf **Artificial Fill of Holocene Age:** These are recent deposits of man-made fill. They are associated with fill piles located in the southern portion of the site.

Qal **Recent Alluvium of Holocene Age:** These are recent deposits that have been deposited along the drainages on-site.

Qav **Valley-Side Alluvium of Holocene to Late Pleistocene Age:** These materials are water deposited alluvium, typically classified as pale-brown to strong brown fine to very coarse sand, silty and clayey sand, and gravel.

Qao_1 **Old Alluvium One of Middle Pleistocene Age:** These materials are water deposited alluvium, typically classified as brown to light-yellowish-brown extremely poorly sorted sand, silty and clayey sand and minor amounts of gravel. The unit exists primarily on valley-side slopes and alluvial fans and consists of sheetwash and reworked wind deposited sediment.

The soils listed above were mapped from site-specific mapping, the *Geologic Map of the Elsmere Quadrangle* distributed by the Colorado Geological Survey in 2002 (Reference 4), the *Geologic Map of the Colorado Springs-Castle Rock Area*, distributed by the US Geological Survey in 1979 (Reference 5), and the *Geologic Map of the Denver 1^0 x 2^0 Quadrangle*, distributed by the US Geological Survey in 1981 (Reference 6). The Test Borings and Profile Holes were also used in evaluating the site and are included in Appendix B. The Geology Map prepared for the site is presented in Figure 6.

5.4 Soil Conditions

The soils encountered in the Profile Holes can be grouped into two general soil types. The soils were classified using the Unified Soil Classification System (USCS).

Soil Type 1 is clayey to very clayey sand, silty-clayey sand, and silty sand (SC, SM-SC, SM), encountered in all of Test Borings at the existing ground surface and extending to depths ranging from 17 feet bgs to the termination of the borings (20 to 25 feet). These soils were encountered at loose to dense states and at moist conditions. The majority of the soils were encountered and medium dense states. Samples tested had 37 to 48 percent passing the No. 200 Sieve. Atterberg Limits Testing resulted in liquid limits of 26 to 28 and plastic indexes of 9 to 10. Sulfate testing resulted in 0.02 percent sulfate by weight indicating the sand exhibits negligible potential for below grade concrete degradation.

Soil Type 2 is sandy claystone (CL), encountered in Test Boring No. 1 at 17 feet bgs and extending to the termination of the test boring (20 feet). The claystone was encountered at hard consistencies and at moist conditions. The sample tested had 76 percent passing the No. 200 Sieve. Atterberg Limits Testing resulted in a liquid limit of 30 and a plastic index of 10. The claystone is typically highly expansive.

The Test Boring Logs are presented in Appendix B. Laboratory Test Results are presented in Appendix C. A Summary of Laboratory Test Results is presented in Table 1.

5.5 Groundwater

Groundwater was not encountered in the test borings which were drilled to depths ranging from 20 to 25 feet. Areas of seasonal shallow groundwater water have been mapped along the drainages on-site. These areas are discussed in the following section. Fluctuation in groundwater conditions may occur due to variations in rainfall and other factors not readily apparent at this time.

It should be noted that in the sandy materials on site, some groundwater conditions might be encountered due to the variability in the soil profile. Isolated sand and gravel layers within the soils, sometimes only a few feet in thickness and width, can carry water in the subsurface. Groundwater may also flow on top of the underlying bedrock. Builders and planners should be cognizant of the potential for the occurrence of such subsurface water features during construction on-site and deal with each individual problem as necessary at the time of construction.

6.0 ENGINEERING GEOLOGY – IDENTIFICATION AND MITIGATION OF GEOLOGIC HAZARDS

As mentioned previously, detailed mapping has been performed on this site to produce an Engineering Geology Map (Figure 6). This map shows the location of various geologic conditions of which the developers should be cognizant during the planning, design and construction stages of the project. These hazards and the recommended mitigation techniques are as follows:

Artificial Fill

These are recent man-made fill deposits associated with fill piles located in the southern portion of the site.

Mitigation This area will likely be mitigated by site grading. All uncontrolled fill encountered beneath foundation members will require removal and recompaction at 95% of Modified Proctor Dry Density, ASTM D-1557.

Collapsible Soils

The majority of the soils encountered on-site do not exhibit collapsible characteristics, however, areas of loose soils were encountered in the test borings drilled on site. Should loose or collapsible soils be encountered beneath foundations, recompaction and moisture conditioning of the upper 2 feet of soil at 95% of its maximum Modified Proctor Dry Density ASTM D-1557 will be required. Exterior flatwork and parking areas may also experience movement. Proofrolling and recompaction of soft areas should be performed during site work.

Expansive Soils

Expansive soils are common in the area. These occurrences are typically sporadic; therefore, none have been indicated on the maps. These clays, if encountered beneath foundations, can cause differential movement in the structure foundation. These occurrences should be identified and dealt with on an individual basis.

Mitigation Should expansive soils be encountered beneath the foundation, mitigation will be necessary. Mitigation of expansive soils 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 common in the area. Floor slabs on expansive soils should be expected to experience movement. Overexcavation and replacement has been successful in minimizing slab movements. The use of structural floors should be considered for basement construction on highly expansive clays. Final recommendations should be determined after additional investigation of each building site.

Groundwater and Floodplain Areas

Areas within the drainages on-site have been identified as areas of seasonally high groundwater areas. Water was not flowing in the any of the drainages at the time of this investigation. The site is not mapped within floodplain zones according to the FEMA Map No. 08041CO764F, Figure 9 (Reference 7). These areas are discussed as follows:

Potentially Seasonal High Groundwater

In these areas, we would anticipate the potential for periodically high subsurface moisture conditions and possible frost heave potential, depending on the soil conditions.

Mitigation In these locations, foundations in areas subject to severe frost heave potential should penetrate sufficient depth so as to discourage the formation of ice lenses beneath foundations. At this location and elevation, a foundation depth for frost protection of 2.5 feet is recommended. In areas where high subsurface moisture conditions are anticipated periodically, a subsurface perimeter drain will be necessary to help prevent the intrusion of water into areas located below grade. A typical perimeter drain detail is presented in Figure 16. Additionally, swales should be created to intercept surface runoff and carry it safely around and away from structures. It is anticipated that the site grading will likely mitigate the drainages on site.

6.1 Relevance of Geologic Conditions to Land Use Planning

As mentioned earlier in this report, we understand that the development will be single family residential. It is our opinion that the existing geologic and engineering geologic conditions will impose some constraints on the proposed development and construction. The most significant problems affecting development will be those associated with the drainage on site that can be properly mitigated. Other hazards on site may be satisfactorily mitigated through proper engineering design and construction practices.

The upper materials are typically at loose to medium dense states. Loose soils if encountered at foundation depth will require mitigation. Foundations anticipated for the site are standard spread footings on existing soils or in conjunction with overexcavation in areas of expansive soils or loose soils. Excavation is anticipated to be moderate with rubber-tired equipment. Expansive layers may also be encountered in the soil on this site. Areas of expansive soils encountered on site are sporadic; therefore, none have been indicated on the maps. Expansive soils, if encountered, will require special foundation design and/or overexcavation. These soils will not prohibit development.

An area of seasonal shallow groundwater was noticed in the central portion of the site. These areas will likely be mitigated with site grading and proper stormwater planning. A stormwater outlet exist on the eastern side of the site and a stormwater inlet exist on the western side of the site and discharges off of the site to a tributary of Sand Creek.

In summary, development of the site can be achieved if the items mentioned above are mitigated. These items can be mitigated through proper design and construction or through avoidance. Additional subsurface soil investigation is recommended prior to construction.

7.0 ECONOMIC MINERAL RESOURCES

Some of the sandy materials on-site could be considered a low-grade sand resource. According to the *El Paso County Aggregate Resource Evaluation Map* (Reference 8), the area is not mapped with any aggregate deposits. According to the *Atlas of Sand, Gravel and Quarry Aggregate Resources, Colorado Front Range Counties* distributed by the Colorado Geological Survey (Reference 9), areas of the site are not mapped with any resources. According to the *Evaluation of Mineral and Mineral Fuel Potential* (Reference 10), the area of the site has been mapped as "Fair" for industrial minerals. However, considering the silty nature of much of these materials and abundance of similar materials through the region and the close proximity to developed land, 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 10), the site is 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-site (Reference 10).

The site has been mapped as "Fair" for oil and gas resources (Reference 10). 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 may not be considered a significant resource. Hydraulic fracturing is a new method that is being used to extract oil and gas from rocks. It utilizes pressurized fluid to extract oil and gas from rocks that would not normally be productive. The area of the site has not been explored to determine if the rocks underlying the site would be commercially viable utilizing hydraulic fracturing. The practice of hydraulic fracturing has come under review due to concerns about environmental impacts, health and safety.

8.0 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 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.

9.0 CLOSURE

It is our opinion that the existing geologic engineering and geologic conditions will impose some constraints on development and construction of the site. The majority of these conditions can be mitigated through proper engineering design and construction practices. The proposed development and use is consistent with anticipated geologic and engineering geologic conditions.

It should be pointed out that because of the nature of data obtained by random sampling of such variable and non-homogeneous 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. Individual investigations for building sites will be required prior to construction. Construction and design personnel should be made familiar with the contents of this report. Reporting such discrepancies to Entech Engineering, Inc. soon after they are discovered would be greatly appreciated and could possibly help avoid construction and development problems.

This report has been prepared for Dakota Springs, Engineering, Inc. for application to the proposed project in accordance with generally accepted geologic soil and engineering practices. No other warranty expressed or implied is made.

We trust that this report has provided you with all the information that you required. Should you require additional information, please do not hesitate to contact Entech Engineering, Inc.

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TABLES

TABLE 1

SUMMARY OF LABORATORY TEST RESULTS

CLIENT DAKOTA SPRINGS ENGINEERING
PROJECT SPRINGS AT WATERVIEW
JOB NO. 170008

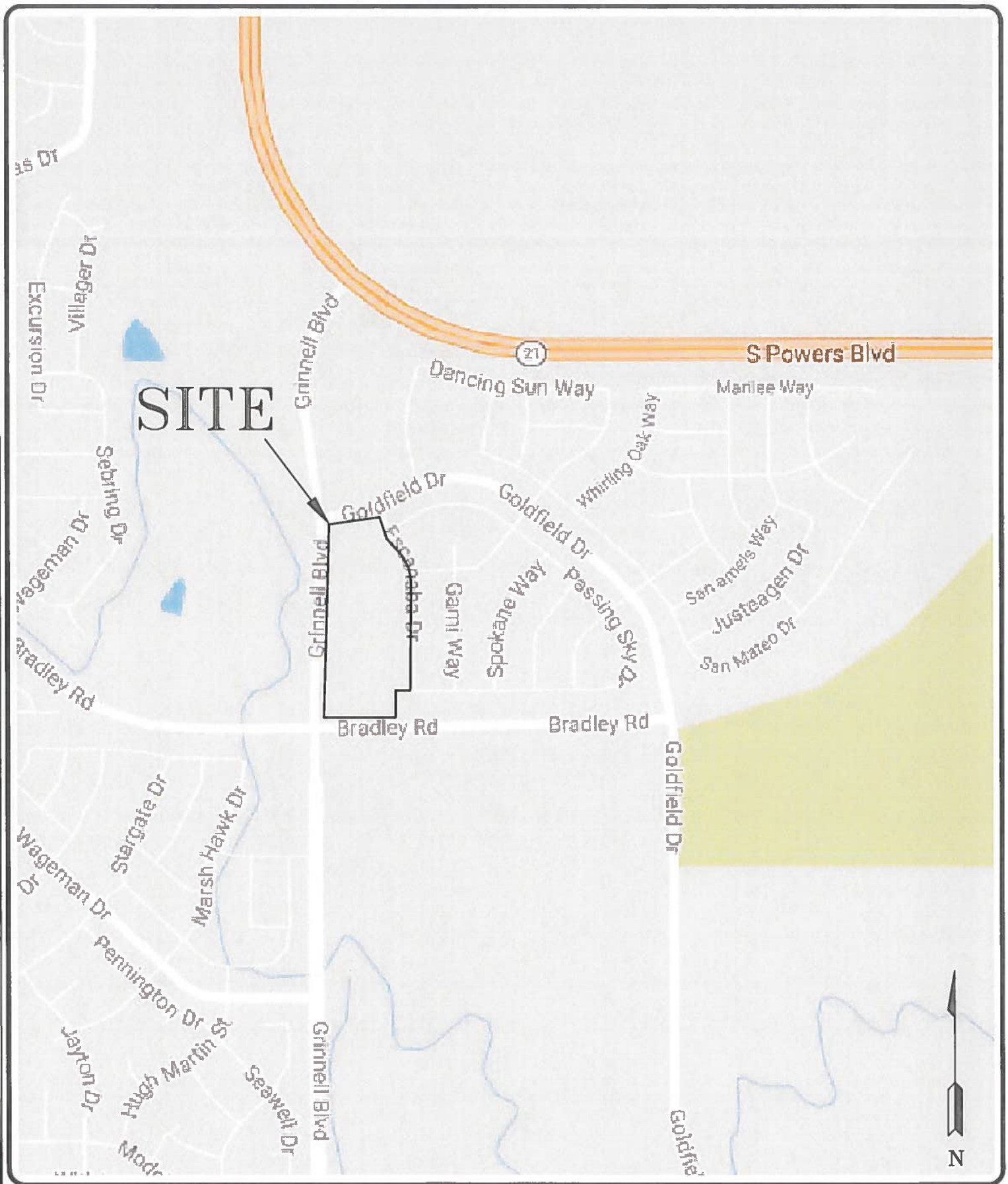
SOIL TYPE	TEST BORING NO.	DEPTH (FT)	WATER (%)	DRY DENSITY (PCF)	PASSING NO. 200 SIEVE (%)	LIQUID LIMIT (%)	PLASTIC INDEX (%)	SULFATE (WT %)	FHA SWELL (PSF)	SWELL/ CONSOL (%)	UNIFIED CLASSIFICATION	SOIL DESCRIPTION
1	2	15			36.9	26	9				SC	SAND, CLAYEY
1	3	10			47.9	28	10				SC	SAND, VERY CLAYEY
1	4	2-3			37.5			0.02			SC	SAND, CLAYEY
2	1	20			75.9	30	10	<0.01			CL	CLAYSTONE, SANDY

TABLE 2

Summary of Depth to Bedrock, Groundwater

Test Boring No.	Depth to Bedrock (ft)	Depth to Groundwater (ft)
1	17	Dry
2	N/A	Dry
3	N/A	Dry
4	N/A	Dry

FIGURES



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VICINITY MAP
SPRINGS AT WATERVIEW
GRINNELL BOULEVARD AND BRADLEY ROAD
EL PASO COUNTY, CO.
FOR: DAKOTA SPRINGS ENGINEERING, INC.

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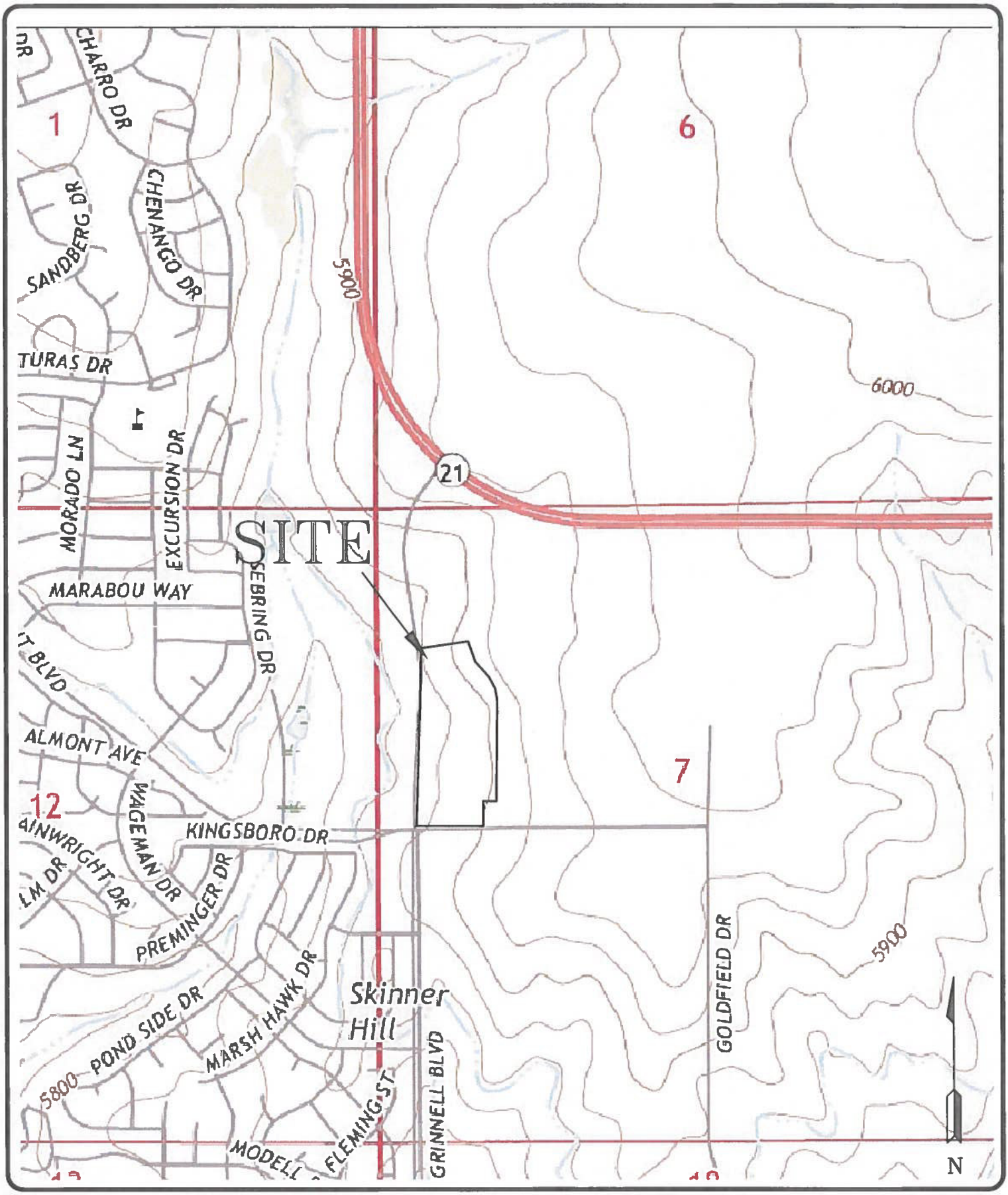
LLL	3/10/17		

JOB NO.: 170008

FIG NO.: 1



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USGS MAP
SPRINGS AT WATERVIEW
GRINNELL BOULEVARD AND BRADLEY ROAD
EL PASO COUNTY, CO.
FOR: DAKOTA SPRINGS ENGINEERING, INC.

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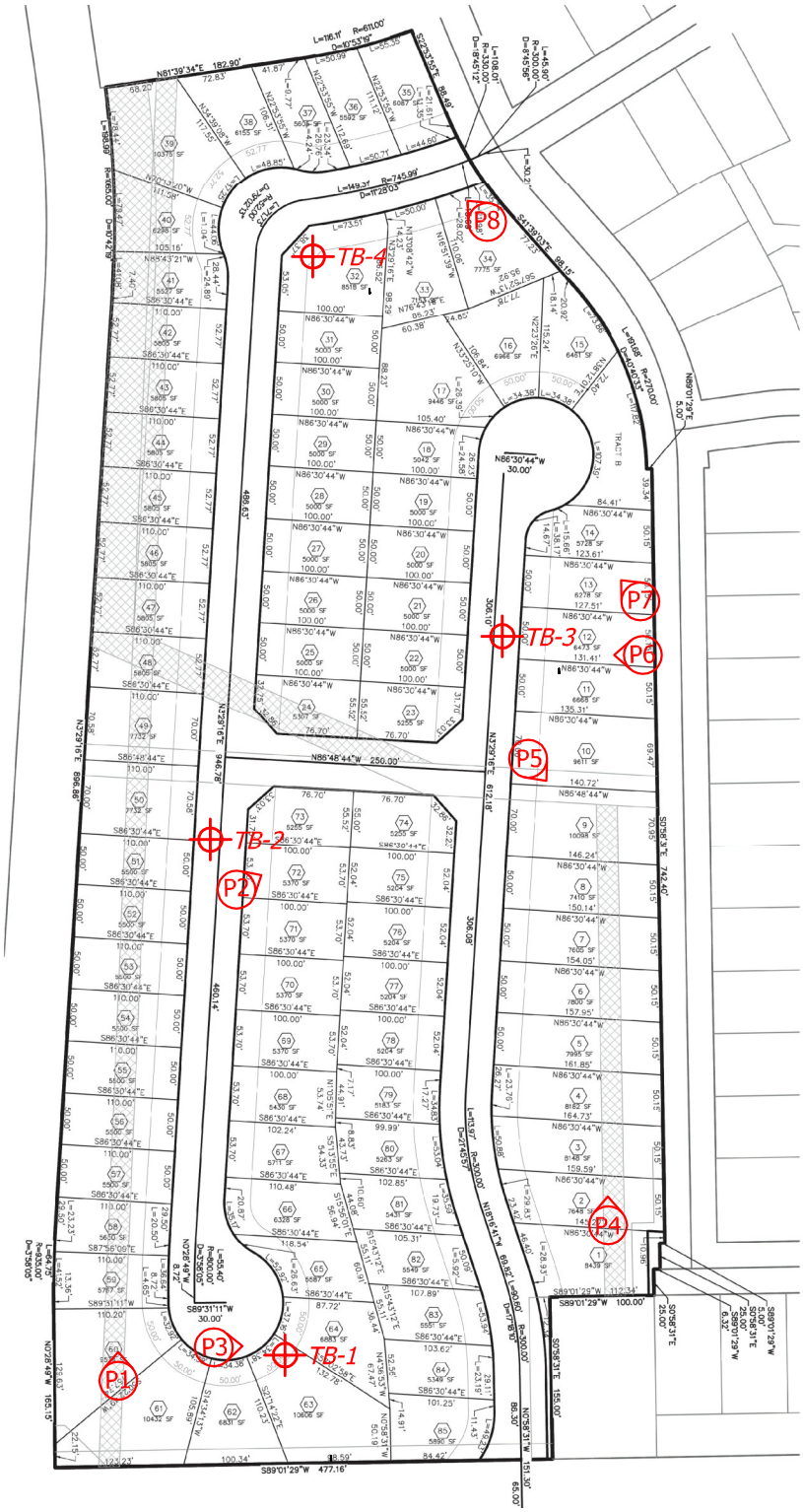
LLL	3/10/17		

JOB NO.: 170008

FIG NO.: 2



TB - APPROXIMATE TEST BORING LOCATION AND NUMBER

P1 - APPROXIMATE PHOTOGRAPH LOCATION AND NUMBER

N

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SITE PLAN/TEST BORING LOCATION MAP
SPRINGS AT WATERVIEW
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FIG NO.: 3

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SOIL SURVERY MAP
SPRINGS AT WATERVIEW
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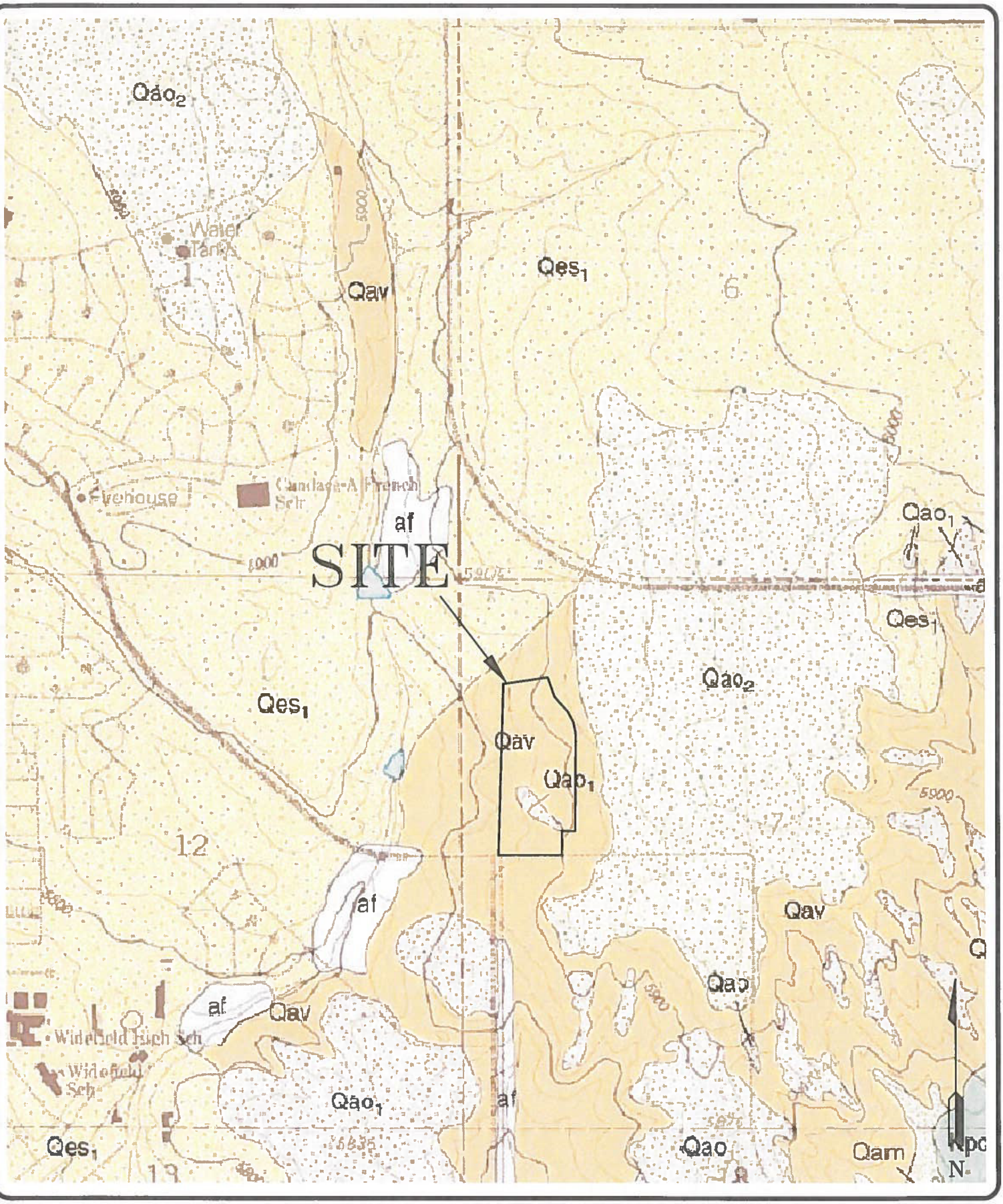
FIG NO.: 4



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ELSMERE QUADRANGLE GEOLOGY MAP
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FIG NO.: 5

Legend:

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

Qal - Recent Alluvium of Quaternary Age:
water deposited materials along the drainages

Qav - Valley-Side Alluvium of Quaternary Age:
water deposited alluviumassociated with nearby abandonded paleovalley

Qao1 - Old Alluvium One of Quaternary Age:
water deposited alluvium associated with nearby abandonded paleovalley

psw - potentially season

af - artificial fill

N

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GEOLOGY MAP/ ENGINEERING GEOLOGY MAP
SPRINGS AT WATER VIEW
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EL PASO COUNTY, CO.
FOR: DAKOTA SPRINGS ENGINEERING

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JOB NO.: 170008

FIG NO.: 6

LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	1% annual chance floodplain boundary
	0.2% annual chance floodplain boundary
	Floodway boundary
	Zone D boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the National Geodetic Vertical Datum of 1929

A — A	Cross section line
23 — 23	Transect line
97°07'30", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
4276000 M	1000-meter Universal Transverse Mercator grid tick values, zone 4
600000 FT	5000-foot grid tick values: Hawaii State Plane coordinate system, zone 3 (FIPSZONE 5103), Transverse Mercator projection
DX5510 X	Bench mark (see explanation in Notes to Users section of this FIRM panel)
M 2	Coastal Mile marker

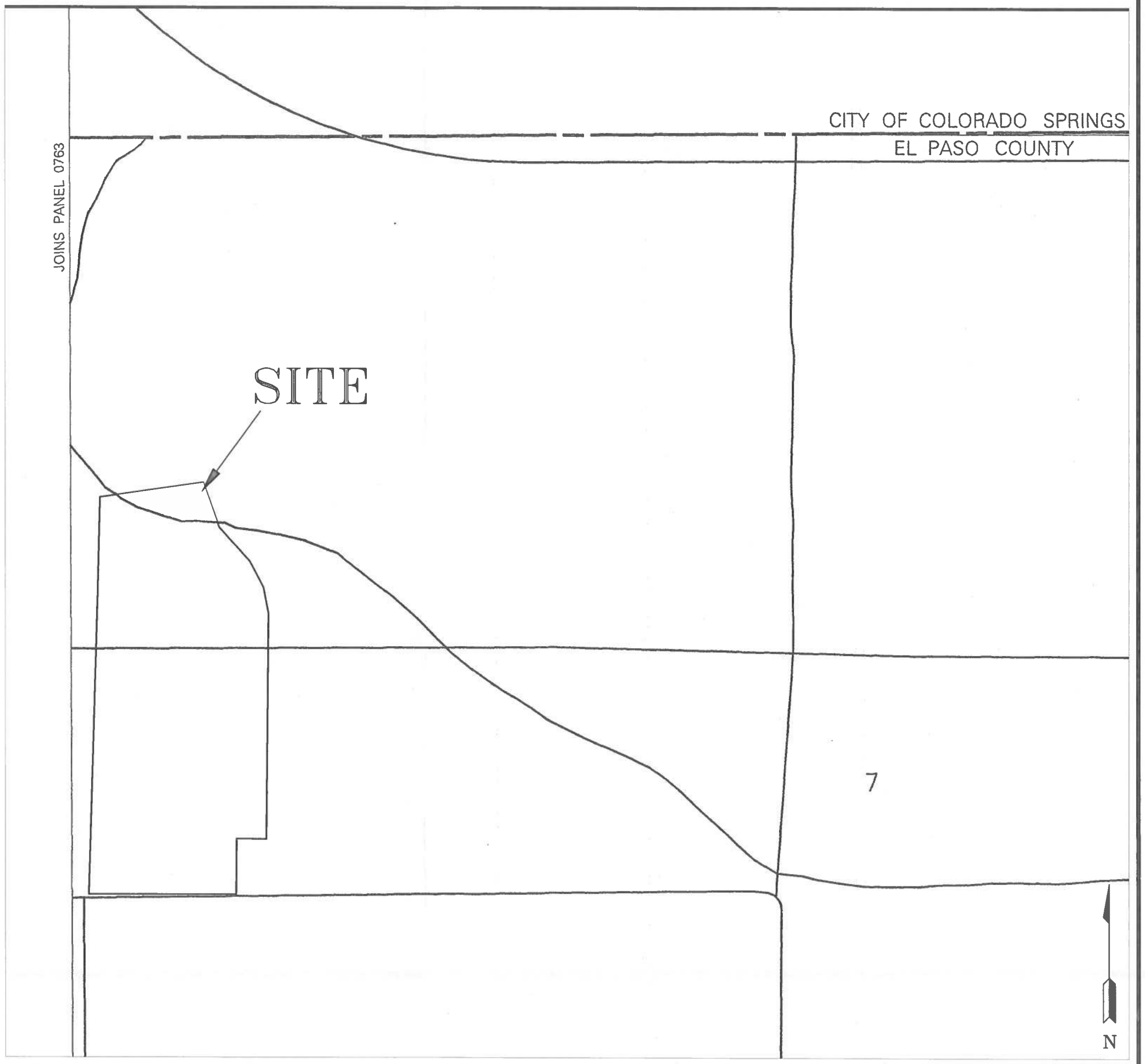
MAP REPOSITORY

Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
November 20, 2000

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

September 30, 2004 – to change Special Flood Hazard Areas, to update map format, to reflect revised shoreline and to incorporate previously issued Letters of Map Revision.

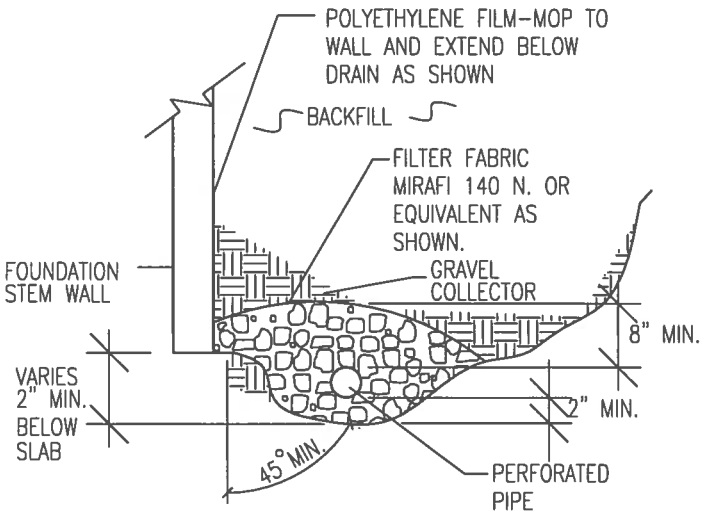


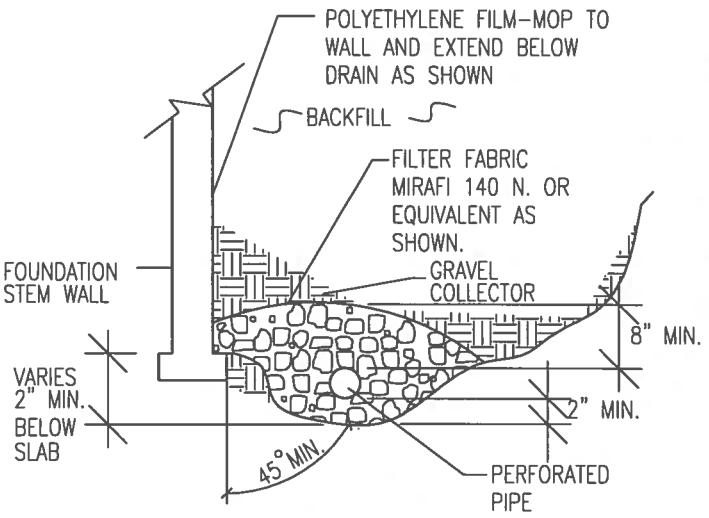
REVISION	BY

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

FLOODPLAIN MAP
SPRINGS AT WATERVIEW
GRINNELL BOULEVARD AND BRADLEY ROAD
EL PASO COUNTY, CO.
FOR: DAKOTA SPRINGS ENGINEERING, INC.

DRAWN	LLL
CHECKED	
DATE	3/10/17
SCALE	AS SHOWN
JOB NO.	170008
FIGURE No.	7





NOTES:

–GRAVEL SIZE IS RELATED TO DIAMETER OF PIPE PERFORATIONS–85% GRAVEL GREATER THAN 2x PERFORATION DIAMETER.

–PIPE DIAMETER DEPENDS UPON EXPECTED SEEPAGE. 4–INCH DIAMETER IS MOST OFTEN USED.

–ALL PIPE SHALL BE PERFORATED PLASTIC. THE DISCHARGE PORTION OF THE PIPE SHOULD BE NON–PERFORATED PIPE.

–FLEXIBLE PIPE MAY BE USED UP TO 8 FEET IN DEPTH, IF SUCH PIPE IS DESIGNED TO WITHSTAND THE PRESSURES. RIGID PLASTIC PIPE WOULD OTHERWISE BE REQUIRED.

–MINIMUM GRADE FOR DRAIN PIPE TO BE 1% OR 3 INCHES OF FALL IN 25 FEET.

–DRAIN TO BE PROVIDED WITH A FREE GRAVITY OUTFALL, IF POSSIBLE. A SUMP AND PUMP MAY BE USED IF GRAVITY OUT FALL IS NOT AVAILABLE.

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

PERIMETER DRAIN DETAIL

DRAWN:	DATE:	DESIGNED:	CHECKED:
		DS	LLL

JOB NO.: 170008

FIG NO.: 8

APPENDIX A: Site Photographs

1

Looking north from the southwestern portion of the site.

February 10, 2017

2

Looking northeast from the western portion of the site.

February 10, 2017

Job No. 170008

3

Looking east from the southern portion of the site towards fill piles.

February 10, 2017

4

Looking north from the eastern portion of the site along Escanaba Drive.

February 10, 2017

Job No. 170008

5

48" stormwater outlet in the eastern side of the site.

February 10, 2017

6

Looking west from the eastern portion of the site.

February 10, 2017

Job No. 170008

7

Looking southeast at slope along Muirfield Drive.

February 10, 2017

8

Looking northwest from the northeastern portion of the site.

February 10, 2017

Job No. 170008

APPENDIX B: Test Boring Logs

APPENDIX C: Laboratory Test Results

APPENDIX D: Soil Survey Descriptions

TEST BORING NO. 1
DATE DRILLED 1/20/2017
Job # 170008

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 20', 1/20/17						
SAND, CLAYEY, FINE TO COARSE GRAINED, BROWN, MEDIUM DENSE TO LOOSE, MOIST				12	6.2	1
	5			9	9.6	1
	10			12	8.3	1
	15			14	10.7	1
CLAYSTONE, SANDY, BROWN, HARD, MOIST	20			50/11"	17.0	2

TEST BORING NO. 2
DATE DRILLED 1/20/2017
CLIENT DAKOTA SPRINGS ENGINEERING
LOCATION SPRINGS AT WATERVIEW

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 20', 1/20/17						
SAND, CLAYEY, FINE TO COARSE GRAINED, BROWN, MEDIUM DENSE, MOIST				17	4.6	1
	5			10	7.9	1
	10			10	9.2	1
	15			17	12.5	1
	20			21	4.5	1

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TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	2/27/17

JOB NO.: 170008
FIG NO.: B- 1

TEST BORING NO. 3
DATE DRILLED 1/20/2017
Job # 170008

REMARKS

DRY TO 20', 1/20/17

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
	SAND, CLAYEY TO VERY CLAYEY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE, MOIST		13	16.9	1
5			17	9.1	1
10			13	9.6	1
15			19	13.9	1
20			21	6.8	1

TEST BORING NO. 4
DATE DRILLED 1/20/2017
CLIENT DAKOTA SPRINGS ENGINEERING
LOCATION SPRINGS AT WATERVIEW

REMARKS

DRY TO 25', 1/20/17

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
	SAND, CLAYEY TO VERY CLAYEY, FINE TO COARSE GRAINED, TAN, LOOSE TO DENSE, MOIST		22	6.1	1
5			9	8.8	1
10			4	5.2	1
15			4	8.2	1
20			9	7.9	1
25			30	2.9	1

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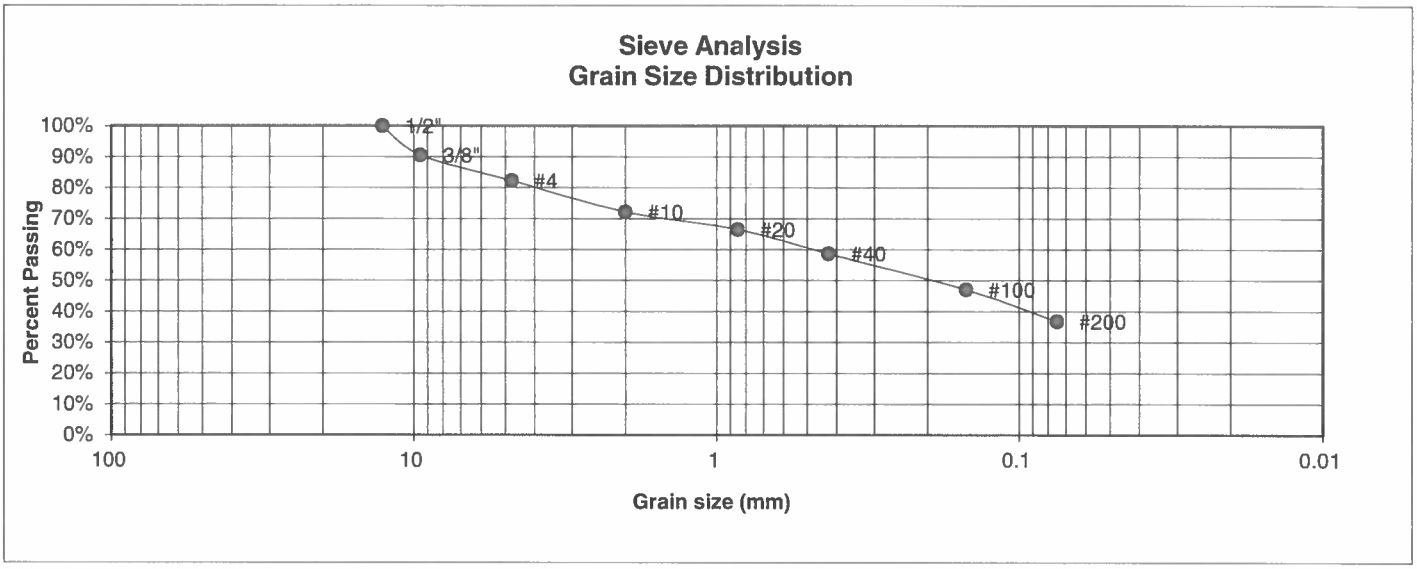
TEST BORING LOG

DRAWN:	DATE:	CHECKED: LLL	DATE: 2/27/17

JOB NO.: 170008
FIG NO.: B- 2

APPENDIX C: Laboratory Test Results

UNIFIED CLASSIFICATION	SC	CLIENT	DAKOTA SPRINGS ENGINEERING
SOIL TYPE #	1	PROJECT	SPRINGS AT WATERVIEW
TEST BORING #	2	JOB NO.	170008
DEPTH (FT)	15	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	90.6%
4	82.2%
10	72.2%
20	66.5%
40	58.7%
100	47.1%
200	36.9%

Atterberg Limits	
Plastic Limit	17
Liquid Limit	26
Plastic Index	9

Swell	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	

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COLORADO SPRINGS, COLORADO 80907

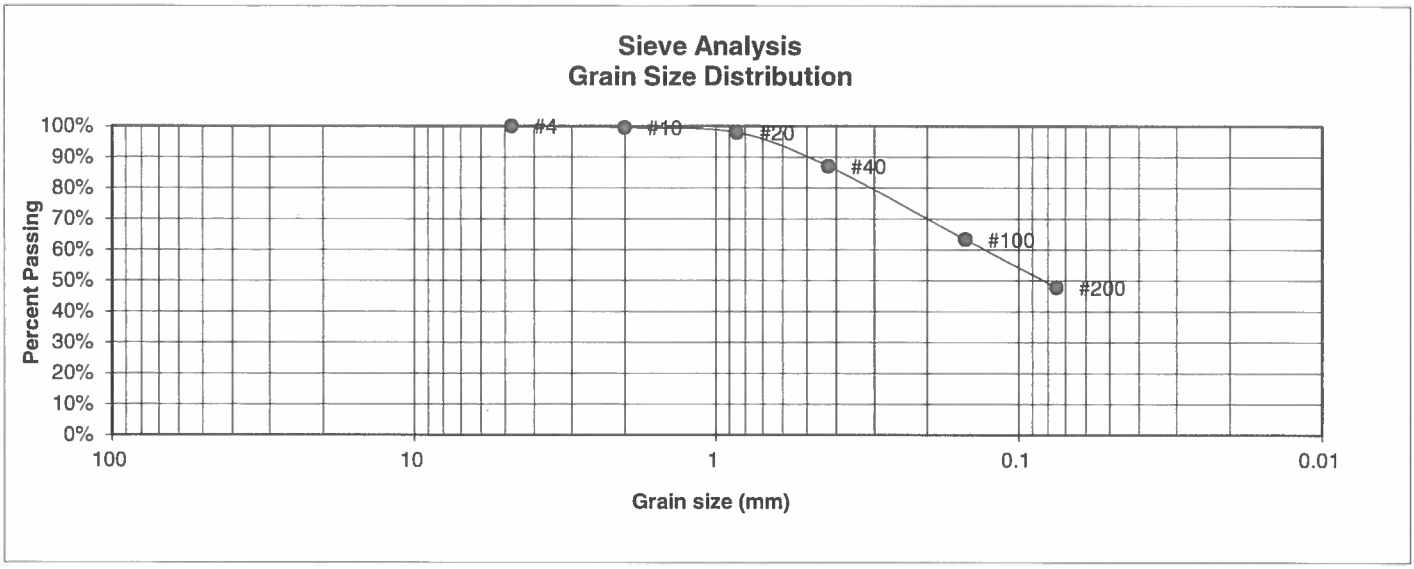
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
			2/3/17

JOB NO.: 170008

FIG NO.: C-1

UNIFIED CLASSIFICATION	SC	CLIENT	DAKOTA SPRINGS ENGINEERING
SOIL TYPE #	1	PROJECT	SPRINGS AT WATERVIEW
TEST BORING #	3	JOB NO.	170008
DEPTH (FT)	10	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	100.0%
10	99.6%
20	97.9%
40	87.0%
100	63.3%
200	47.9%

Atterberg Limits	
Plastic Limit	18
Liquid Limit	28
Plastic Index	10

Swell	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	

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COLORADO SPRINGS, COLORADO 80907

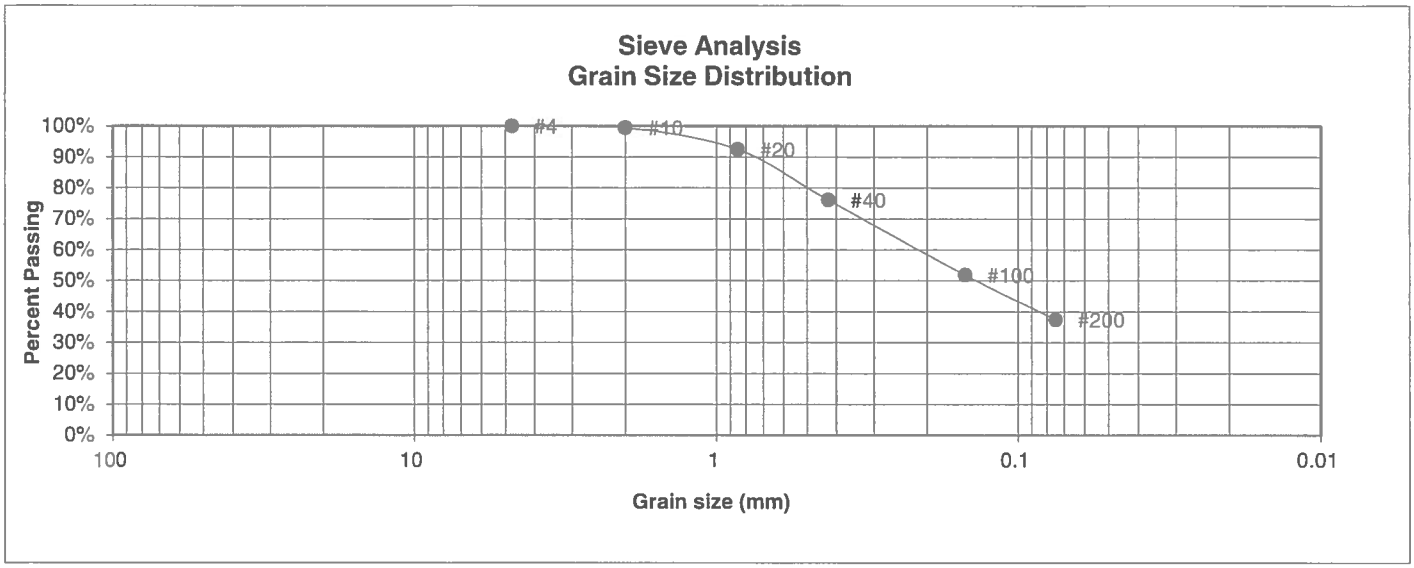
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
			2/3/17

JOB NO.: 170008

FIG NO.: C-2

UNIFIED CLASSIFICATION	SC	CLIENT	DAKOTA SPRINGS ENGINEERING
SOIL TYPE #	1	PROJECT	SPRINGS AT WATERVIEW
TEST BORING #	4	JOB NO.	170008
DEPTH (FT)	2-3	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	100.0%
10	99.5%
20	92.4%
40	76.1%
100	51.8%
200	37.5%

Atterberg Limits
Plastic Limit
Liquid Limit
Plastic Index

Swell
Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)

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505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

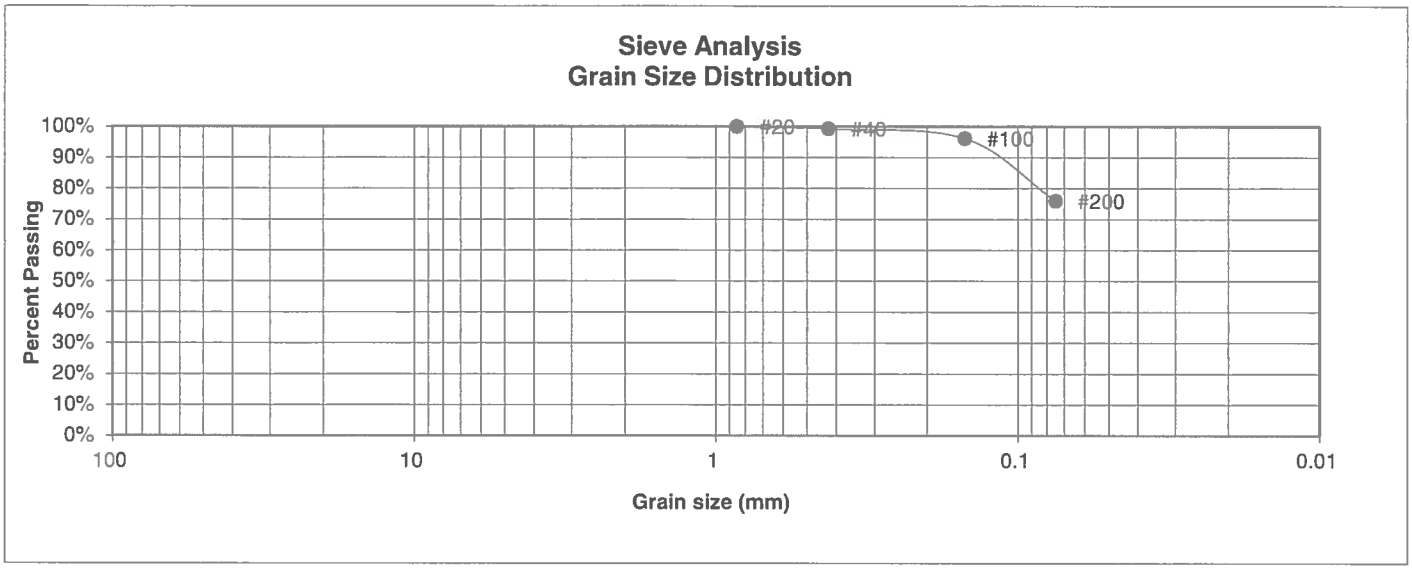
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
			2/3/17

JOB NO.: 170008

FIG NO.: C-3

UNIFIED CLASSIFICATION	CL	CLIENT	DAKOTA SPRINGS ENGINEERING
SOIL TYPE #	2	PROJECT	SPRINGS AT WATERVIEW
TEST BORING #	1	JOB NO.	170008
DEPTH (FT)	20	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	
10	
20	100.0%
40	99.3%
100	96.2%
200	75.9%

Atterberg Limits	
Plastic Limit	20
Liquid Limit	30
Plastic Index	10

Swell	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	

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505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
			2/3/17

JOB NO.: 170008

FIG NO.: C-4

CLIENT	DAKOTA SPRINGS ENGINEERING	JOB NO.	170008
PROJECT	SPRINGS AT WATERVIEW	DATE	1/31/2017
LOCATION	SPRINGS AT WATERVIEW	TEST BY	BL

BORING NUMBER	DEPTH, (ft)	SOIL TYPE NUMBER	UNIFIED CLASSIFICATION	WATER SOLUBLE SULFATE, (wt%)
TB-1	20	2	CL	<0.01
TB-4	2-3	1	SC	0.02

QC BLANK PASS

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505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

LABORATORY TEST
SULFATE RESULTS

DRAWN:	DATE:	CHECKED:	DATE: 2/3/17

JOB NO.: 170008

FIG NO.: C-5

APPENDIX D: Soil Survey Descriptions

El Paso County Area, Colorado

3—Ascalon sandy loam, 3 to 9 percent slopes

Map Unit Setting

National map unit symbol: 2tlny
Elevation: 3,870 to 5,960 feet
Mean annual precipitation: 13 to 18 inches
Mean annual air temperature: 46 to 54 degrees F
Frost-free period: 95 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

Ascalon and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ascalon

Setting

Landform: Interfluves
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Wind-reworked alluvium and/or calcareous sandy eolian deposits

Typical profile

Ap - 0 to 6 inches: sandy loam
Bt1 - 6 to 12 inches: sandy clay loam
Bt2 - 12 to 19 inches: sandy clay loam
Bk1 - 19 to 35 inches: fine sandy loam
Bk2 - 35 to 80 inches: fine sandy loam

Properties and qualities

Slope: 3 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 5.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline (0.1 to 1.9 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 1.0
Available water storage in profile: Moderate (about 7.1 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: Sandy Plains (R067BY024CO)
Hydric soil rating: No

Minor Components

Olnest

Percent of map unit: 10 percent
Landform: Interfluves
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Sandy Plains (R067BY024CO)
Hydric soil rating: No

Vona

Percent of map unit: 5 percent
Landform: Interfluves
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Sandy Plains (R067BY024CO)
Hydric soil rating: No

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 14, Sep 23, 2016

El Paso County Area, Colorado

8—Blakeland loamy sand, 1 to 9 percent slopes

Map Unit Setting

National map unit symbol: 369v
Elevation: 4,600 to 5,800 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Blakeland and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Blakeland

Setting

Landform: Flats, hills
Landform position (three-dimensional): Side slope, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock and/or eolian deposits derived from sedimentary rock

Typical profile

A - 0 to 11 inches: loamy sand
AC - 11 to 27 inches: loamy sand
C - 27 to 60 inches: sand

Properties and qualities

Slope: 1 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Available water storage in profile: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: Sandy Foothill (R049BY210CO)
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

Pleasant

Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 14, Sep 23, 2016

El Paso County Area, Colorado

97—Truckton sandy loam, 3 to 9 percent slopes

Map Unit Setting

National map unit symbol: 36bg
Elevation: 6,000 to 7,000 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Truckton and similar soils: 80 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Truckton

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Arkosic alluvium derived from sedimentary rock and/or arkosic residuum weathered from sedimentary rock

Typical profile

A - 0 to 8 inches: sandy loam
Bt - 8 to 24 inches: sandy loam
C - 24 to 60 inches: coarse sandy loam

Properties and qualities

Slope: 3 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: Sandy Foothill (R049BY210CO)
Hydric soil rating: No

Minor Components

Pleasant

Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

Haplaquolls

Percent of map unit:
Landform: Marshes
Hydric soil rating: Yes

Other soils

Percent of map unit:
Hydric soil rating: No

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 14, Sep 23, 2016