Preliminary Drainage Report

Palmer Solar Facility
El Paso County, Colorado

Prepared for:
JSI Construction Group LLC.
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Project #: 096495003

Prepared: June 27, 2018

WSEO-18-001

Kimley»Horn

CERTIFICATION

DESIGN ENGINEER'S STATEMENT

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the applicable master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparation of this report.

SIGNATURE (Affix Seal): _____

Colorado P.E. No. 49487 Date

OWNER/DEVELOPER'S STATEMENT

I, the developer, have read and will comply with all of the requirements specified in this Drainage Report and Plan.

_____
Name of Developer

_____
Authorized Signature Date

_____
Printed Name

_____
Title

_____
Address:

EL PASO COUNTY STATEMENT

Filed in accordance with the requirements of the Drainage Criteria Manual, Volumes 1 and 2, El Paso County Engineering Criteria Manual and Land Development Code as amended.

_____ _____
For County Engineer Date

Conditions:

Jennifer Irvine, P.E.
County Engineer / ECM Administrator

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PURPOSE AND SCOPE OF STUDY

The purpose of this preliminary drainage report is to provide the hydrologic and hydraulic calculations and to document the drainage design methodology in support of the proposed Palmer Solar Facility ("the Project") for JSI Construction Group LLC. The Project is located within the jurisdictional limits of El Paso county, therefore Volumes 1 and 2 of the El Paso County Drainage Criteria Manual were used as the guidelines for the hydrologic and hydraulic design components.

The proper criteria is listed at the bottom of this page.

GENERAL PROJECT DESCRIPTION

The Project is located on approximately 523 acres of land approximately 3.5 miles southeast of Fountain, Colorado within El Paso County (the "Site"). More specifically, the Site is located north of Birdsall Road, approximately 1 mile east of Old Pueblo Road. The Site is split into two primary array areas, the first being Array Area 1 located along the west boundary of the Site and the second being Array Area 2 located along the east boundary of the Site. A vicinity map has been provided in the Appendix of this report. The Site is currently owned by the Woodmoor Water and Sanitation District (the "District") and will be leased to JSI Construction Group LLC to develop the Project.

Improvements will consist of clearing and grubbing, weed control, native seeding, gravel access road construction, overlot grading, solar array installation, roadside ditches, drainage swales and two proposed permanent sediment basins.

ALTA and topographic field survey was completed for the Project by Clark Land Surveying Inc. dated April 23rd, 2018 and is the basis for design for the drainage improvements.

SOILS CONDITIONS

NRCS soil data is available for this Site and it has been noted that soils onsite are generally USCS Type C and D. There are no major drainage ways or irrigation facilities within the Site. The Site does not currently provide water quality or detention for the Project area. The existing land use is undeveloped vacant land. The proposed land use is a solar facility with native ground cover. Additional information on specific soil types and other geotechnical information, reference the Geotechnical Engineering Report for CO404 Palmer Solar Facility prepared by Terracon Consultants, Inc. dated May 21, 2018.

DRAINAGE CRITERIA

REGULATIONS

The proposed storm facilities are designed to be in compliance with the El Paso County Drainage Criteria Manual Volume 1 and 2 (the "CRITERIA") and the Urban Storm Drainage Criteria Manual (the "MANUAL"). Site drainage is not significantly impacted by such constraints as utilities or existing development.

City of Colorado Springs and El Paso County "Drainage Criteria Manual (DCM)", dated November, 1991, the El Paso County "Engineering Criteria Manual", Chapter 6 and Section 3.2.1 Chapter 13 of the City of Colorado Springs Drainage Criteria Manual dated May 2014,

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DRAINAGE STUDIES, MASTER PLANS, AND SITE CONSTRAINTS

There are no previous drainage studies, master plans or site constraints for this Site.

HYDROLOGY

The 5-year 10-year and 100-year design storm events were used in determining rainfall and runoff for the proposed drainage analysis per the CRITERIA. Table 6-2 of the CRITERIA is the source for rainfall data for the 5-year, 10-year and 100-year design storm events. Design runoff was calculated using the Rational Method for developed conditions as established in the CRITERIA and MANUAL. The Rational Method was used as all existing and proposed sub-basins are less than 100 acres. Runoff coefficients for the proposed development were determined using Table 6-6 of the MANUAL by calculating weighted impervious values for each specific Site basin. There are no additional provisions selected or deviations from the CRITERIA.

HYDRAULICS

Hydraulic calculations for the proposed culverts and drainage swales will be provided with the Final Drainage Report.

EXISTING DRAINAGE CONDITIONS

The existing Site consists of vacant land with native vegetation and is classified as “Pasture and Meadow” per Table 6-6 of the CRITERIA. The existing site imperviousness value for the Site is 0%.

Is in El Paso County's Calhan Reservoir basin

The west side of the Site, or Array Area 1, has been divided into 6 drainage sub-basins (W1-W6) and consists of slopes ranging from 2% to 4:1. Existing drainage patterns are split by a ridge that runs north-south and generally divides the drainage areas in half. Drainage along the west side flows west overland to existing agricultural land which ultimately drains to Fountain Creek (sub-basins W1 and W3). Fountain Creek is a part of the Arkansas River Basin. Drainage along the east side flows east overland to an existing unnamed drainage ditch which flows south ultimately to Fountain Creek (sub-basins W2, W4, W5 and W6).

Is in El Paso County's Lower Williams Creek basin

The east side of the Site, or Array Area 2, has been divided into 4 drainage sub-basins (E1-E4) and consists of slopes ranging from 2% to 4:1. Existing drainage patterns are split by a ridge that runs east-west along the southern 1/3 of the area. Drainage along the north side of flows south overland to existing unnamed drainage ditches, eastward and ultimately southward to Fountain Creek (sub-basins E1-E3). Drainage along the southern 1/3 of the areas flows south overland to existing unnamed drainage ditches, and ultimately southward to Fountain Creek (sub-basin E4).

An Existing Drainage Conditions Map and hydrologic calculations are included in the Appendix of this report for reference.

PROPOSED DRAINAGE CONDITIONS

The proposed drainage patterns will match the existing drainage conditions and historic patterns discussed in the previous section of this report. Overlot grading of specific areas within the Site will be required to facilitate the construction of the solar arrays on adequate slopes. The overlot grading will follow the existing topography and will not alter the historic drainage patterns. Areas

that are overlot graded will be revegetated with native seeding. Native seeding and vegetation will be established beneath the solar arrays such that the overall impervious area of the Site will not increase except for the addition of gravel access roads throughout and therefore will not require water quality or detention. Additionally, the solar arrays provide a level of shade to the underlying vegetation to facilitate growth. Mowing operations are included as part of the operations and maintenance plan for the facility.

PROPOSED SEDIMENT BASINS

A public meeting was held prior to completion of this report. The public meeting was hosted by JSI Construction Group LLC and the neighboring public was invited to attend to comment on the Project. During that meeting, existing home owners along the west side of the Site raised concerns about EXISTING drainage issues relative to the hillside that drains westward, towards their property. These areas are shown on the Existing Drainage Conditions Map. Based upon this public comment, proposed sediment basins and associated ditches are proposed along the west side of Array Area 1 as shown on the proposed drainage maps. The sediment basins are proposed to be a non-draining sediment basin that will drain through evaporation and percolation into the soil. Additionally, the water temporarily stored within the basin will be used by the District for use throughout the property. Additionally, a third sediment basin is proposed along the east side of Array Area 2 to reduce the amount of sediment laden water during the revegetation phase of the overlot grading. All sediment basins are sized based on Urban Drainage and Flood Control District (UDFCD) criteria per Sediment Basin Detail SC-7. Sizes and details are included on the Proposed Drainage Map.

WATER QUALITY AND DETENTION

Permanent water quality measures and detention facilities will not be necessary for the Project as previously discussed in the report. Temporary water quality and erosion control measures will be provided during construction to prevent sediment laden water from discharging from the Site. Two proposed sediment basins are proposed with the Project.

EROSION CONTROL PLAN

A Grading, Erosion and Sediment Control Plan will be submitted as a standalone construction drawing and report to the County.

FLOODPLAIN STATEMENT

No portion of the Project is located within the 100-year floodplain as determined by the Flood Insurance Rate Map (FIRM) numbers 08041C0970F and 08041C1160F effective date, March 17, 1997 (see Appendix).

Name the drainage basins.

SUMMARY

The proposed drainage concept is to maintain the historic drainage patterns, the overall imperviousness and release rates for the Site. Runoff from the Site will flow overland to existing unnamed drainage ditches which ultimately discharge to Fountain Creek. The drainage design presented within this report conforms to the the CRITERIA and the MANUAL.

Additionally, the Site runoff and storm drain facilities will not adversely affect the downstream and surrounding developments, including Fountain Creek.

Add a statement that a Final Drainage Report will be provided with the Site Development Plan.

REFERENCES

1. City of Colorado Springs Drainage Criteria Manual, May 2014.

2. Urban Drainage and Flood Control District Drainage Criteria Manual (UDFCDCM), Vol. 1, prepared by Wright-McLaughlin Engineers, June 2001, with latest revisions.

3. Flood Insurance Rate Map, El Paso County, Colorado and Incorporated Areas, Map Number 08041C0970F and 08041C1160F, Effective Date March 17, 1997, prepared by the Federal Emergency Management Agency (FEMA).

City of Colorado Springs and El Paso County “Drainage Criteria Manual (DCM)”, dated November, 1991, the El Paso County “Engineering Criteria Manual”, Chapter 6 and Section 3.2.1 Chapter 13 of the City of Colorado Springs Drainage Criteria Manual dated May 2014,

APPENDIX

VICINITY MAP

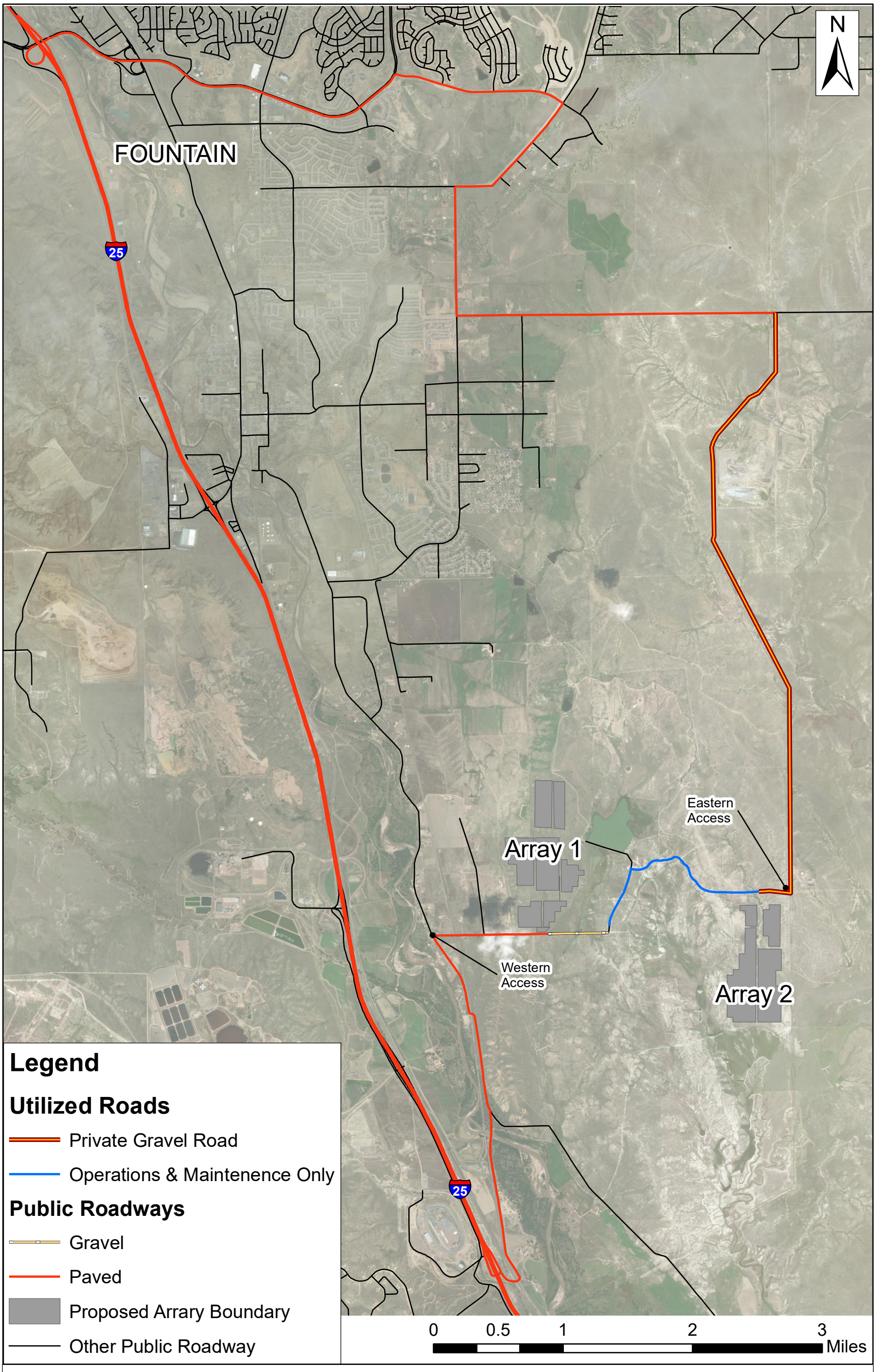


Figure 1

Vicinity Map

El Paso County, Colorado

Kimley»Horn

SOILS MAP

United States Department of Agriculture

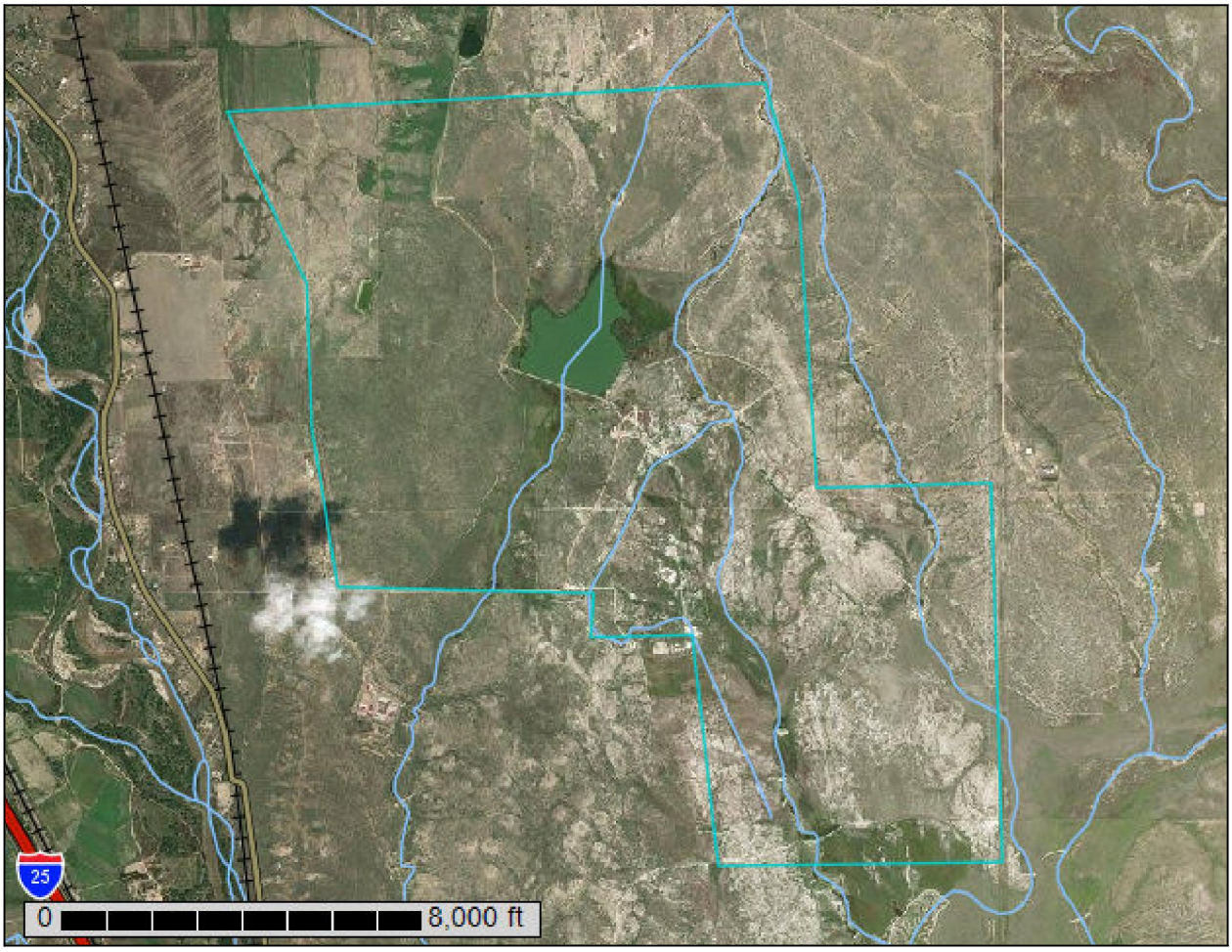
NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for El Paso County Area, Colorado

Palmer Solar



June 13, 2018

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

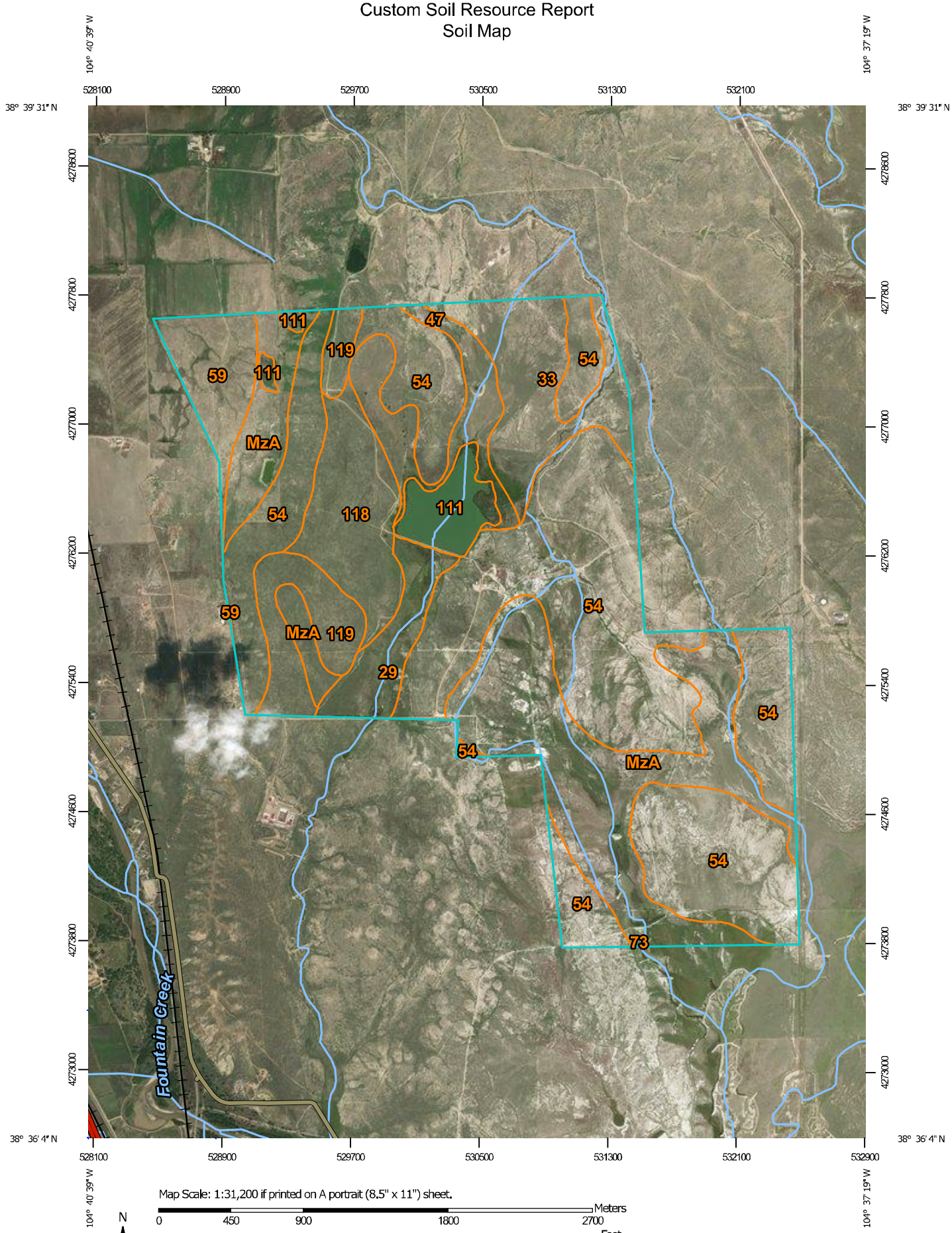
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



Map Scale: 1:31,200 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 450 900 1800 2700

Feet: 0 1500 3000 6000 9000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 15, Oct 10, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Nov 7, 2015—Mar 9, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
29	Fluvaquentic Haplaquolls, nearly level	82.3	3.5%
33	Heldt clay loam, 0 to 3 percent slopes	177.2	7.5%
47	Limon clay, 0 to 3 percent slopes	111.5	4.7%
54	Midway clay loam, 3 to 25 percent slopes	1,040.4	44.2%
59	Nunn clay loam, 0 to 3 percent slopes	93.3	4.0%
73	Razor clay loam, 3 to 9 percent slopes	1.2	0.1%
111	Water	72.2	3.1%
118	Fort loam, 1 to 5 percent slopes, cool	154.8	6.6%
119	Fort sandy loam, 1 to 8 percent slopes, cool	121.6	5.2%
MzA	Manzanola silty clay loam, saline, 0 to 2 percent slopes	497.1	21.1%
Totals for Area of Interest		**2,351.5**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different

management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

El Paso County Area, Colorado

29—Fluvaquentic Haplaquolls, nearly level

Map Unit Setting

National map unit symbol: 3681
Elevation: 5,000 to 7,800 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 110 to 165 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Fluvaquentic Haplaquolls

Setting

Landform: Flood plains, marshes, swales
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 6.00 in/hr)
Depth to water table: About 0 to 24 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: D
Ecological site: Sandy Meadow (R067BY029CO)
Hydric soil rating: Yes

Minor Components

Haplaquolls

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

Other soils

Percent of map unit:
Hydric soil rating: No

33—Heldt clay loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 3686
Elevation: 5,200 to 6,500 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 155 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

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

Description of Heldt

Setting

Landform: Alluvial fans, stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Clayey alluvium derived from shale

Typical profile

Ap - 0 to 8 inches: clay loam
Bw - 8 to 41 inches: silty clay
Bk - 41 to 60 inches: silty clay loam

Properties and qualities

Slope: 0 to 3 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): Moderately low to moderately high (0.06 to 0.20 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
Gypsum, maximum in profile: 4 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 10.0
Available water storage in profile: High (about 10.4 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: C
Ecological site: Alkaline Plains LRU's A & B (R069XY047CO)
Other vegetative classification: ALKALINE PLAINS (069BY047CO)

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

47—Limon clay, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 368p
Elevation: 5,200 to 6,200 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Limon, Occasionally Flooded

Setting

Landform: Alluvial fans, flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Clayey alluvium derived from shale

Typical profile

A - 0 to 4 inches: clay
AC - 4 to 12 inches: silty clay
C - 12 to 60 inches: silty clay loam

Properties and qualities

Slope: 0 to 3 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): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent

Gypsum, maximum in profile: 2 percent
Salinity, maximum in profile: Very slightly saline to moderately saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 10.0
Available water storage in profile: High (about 9.9 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: Salt Flat LRU's A & B (R069XY033CO)
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

54—Midway clay loam, 3 to 25 percent slopes

Map Unit Setting

National map unit symbol: 368y
Elevation: 5,200 to 6,200 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Midway

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Slope alluvium over residuum weathered from shale

Typical profile

A - 0 to 4 inches: clay loam
C - 4 to 13 inches: clay
Cr - 13 to 17 inches: weathered bedrock

Properties and qualities

Slope: 3 to 25 percent
Depth to restrictive feature: 6 to 20 inches to paralithic bedrock
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Gypsum, maximum in profile: 15 percent
Salinity, maximum in profile: Very slightly saline to moderately saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 15.0
Available water storage in profile: Very low (about 2.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Ecological site: Shaly Plains LRU's A & B (R069XY046CO)
Other vegetative classification: SHALY PLAINS (069AY046CO)
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

59—Nunn clay loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 3693
Elevation: 5,400 to 6,500 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 135 to 155 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

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

Description of Nunn

Setting

Landform: Terraces, fans
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium

Typical profile

A - 0 to 12 inches: clay loam
Bt - 12 to 26 inches: clay loam
BC - 26 to 30 inches: clay loam
Bk - 30 to 58 inches: sandy clay loam
C - 58 to 72 inches: clay

Properties and qualities

Slope: 0 to 3 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): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Gypsum, maximum in profile: 2 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 9.8 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: C
Ecological site: Clayey Plains LRU's A & B (R069XY042CO)
Other vegetative classification: CLAYEY PLAINS (069AY042CO)
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

73—Razor clay loam, 3 to 9 percent slopes

Map Unit Setting

National map unit symbol: 369m
Elevation: 5,300 to 6,100 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Razor

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Clayey slope alluvium over residuum weathered from shale

Typical profile

A - 0 to 3 inches: clay loam
Bw - 3 to 9 inches: clay loam
Bk - 9 to 31 inches: clay
Cr - 31 to 35 inches: weathered bedrock

Properties and qualities

Slope: 3 to 9 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Gypsum, maximum in profile: 5 percent
Salinity, maximum in profile: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 15.0
Available water storage in profile: Low (about 5.5 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D

Ecological site: Alkaline Plains LRU's A & B (R069XY047CO)
Other vegetative classification: ALKALINE PLAINS (069AY047CO)
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

111—Water

Map Unit Composition
Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

118—Fort loam, 1 to 5 percent slopes, cool

Map Unit Setting
National map unit symbol: 2rgqs
Elevation: 5,500 to 6,500 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 48 to 54 degrees F
Frost-free period: 125 to 160 days
Farmland classification: Prime farmland if irrigated

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

Description of Fort

Setting
Landform: Interfluves, fans
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Loamy alluvium and/or eolian deposits

Typical profile
A - 0 to 4 inches: loam
Bt - 4 to 12 inches: clay loam

Btk - 12 to 33 inches: clay loam
Bk1 - 33 to 47 inches: loam
Bk2 - 47 to 79 inches: sandy loam

Properties and qualities

Slope: 1 to 5 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): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 25 percent
Gypsum, maximum in profile: 2 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.5 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 3.0
Available water storage in profile: Moderate (about 8.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: C
Ecological site: Loamy Plains, LRU's A & B 10-14 Inches, P.Z. (R069XY006CO)
Forage suitability group: Loamy (G069XW017CO)
Other vegetative classification: Loamy Plains #6 (069XY006CO_2)
Hydric soil rating: No

Minor Components

Wilid

Percent of map unit: 10 percent
Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Loamy Plains, LRU's A & B 10-14 Inches, P.Z. (R069XY006CO)
Other vegetative classification: Loamy Plains #6 (069XY006CO_2)
Hydric soil rating: No

Oterodry

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: Sandy Plains LRU's A & B (R069XY026CO)
Hydric soil rating: No

119—Fort sandy loam, 1 to 8 percent slopes, cool

Map Unit Setting

National map unit symbol: 2t50n
Elevation: 4,500 to 6,000 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 48 to 54 degrees F
Frost-free period: 125 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Fort, Cool

Setting

Landform: Hills, interfluves
Landform position (two-dimensional): Footslope, backslope
Landform position (three-dimensional): Side slope, head slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium and/or eolian deposits

Typical profile

A - 0 to 5 inches: sandy loam
Bt - 5 to 13 inches: clay loam
Btk - 13 to 28 inches: clay loam
Bk1 - 28 to 36 inches: loam
Bk2 - 36 to 79 inches: sandy loam

Properties and qualities

Slope: 1 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 25 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.1 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 2.0
Available water storage in profile: Moderate (about 8.2 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e

Hydrologic Soil Group: B
Ecological site: Sandy Plains LRU's A & B (R069XY026CO)
Forage suitability group: Loamy (G069XW017CO)
Other vegetative classification: Sandy Plains #26 (069XY026CO_2)
Hydric soil rating: No

Minor Components

Wilid

Percent of map unit: 5 percent
Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Loamy Plains, LRU's A & B 10-14 Inches, P.Z. (R069XY006CO)
Other vegetative classification: Loamy Plains #6 (069XY006CO_2)
Hydric soil rating: No

Vonid

Percent of map unit: 5 percent
Landform: Ridges, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Ecological site: Sandy Plains LRU's A & B (R069XY026CO)
Hydric soil rating: No

Kimera

Percent of map unit: 5 percent
Landform: Interfluves, fan remnants
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Interfluve, side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear
Ecological site: Loamy Plains, LRU's A & B 10-14 Inches, P.Z. (R069XY006CO)
Hydric soil rating: No

MzA—Manzanola silty clay loam, saline, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2rgrg
Elevation: 3,900 to 6,000 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 48 to 54 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

Manzanola and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Manzanola

Setting

Landform: Fan remnants, interfluves, terraces, drainageways
Landform position (two-dimensional): Footslope, summit
Landform position (three-dimensional): Side slope, tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from shale

Typical profile

A - 0 to 4 inches: silty clay loam
Bt1 - 4 to 11 inches: silty clay loam
Bt2 - 11 to 26 inches: silty clay loam
Bk1 - 26 to 38 inches: silty clay loam
Bk2 - 38 to 79 inches: silty clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 14 percent
Gypsum, maximum in profile: 3 percent
Salinity, maximum in profile: Moderately saline (8.0 to 15.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: Very high (about 12.1 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: C
Ecological site: Saline Overflow LRU's A & B (R069XY037CO)
Other vegetative classification: Saline Overflow (069XY037CO_1)
Hydric soil rating: No

Minor Components

Aguilar

Percent of map unit: 5 percent
Landform: Fan remnants
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Salt Flat LRU's A & B (R069XY033CO)
Other vegetative classification: Salt Flat #33 (069AY033CO_2)

Hydric soil rating: No

Haversid

Percent of map unit: 5 percent
Landform: Terraces, drainageways
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Saline Overflow LRU's A & B (R069XY037CO)
Hydric soil rating: No

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

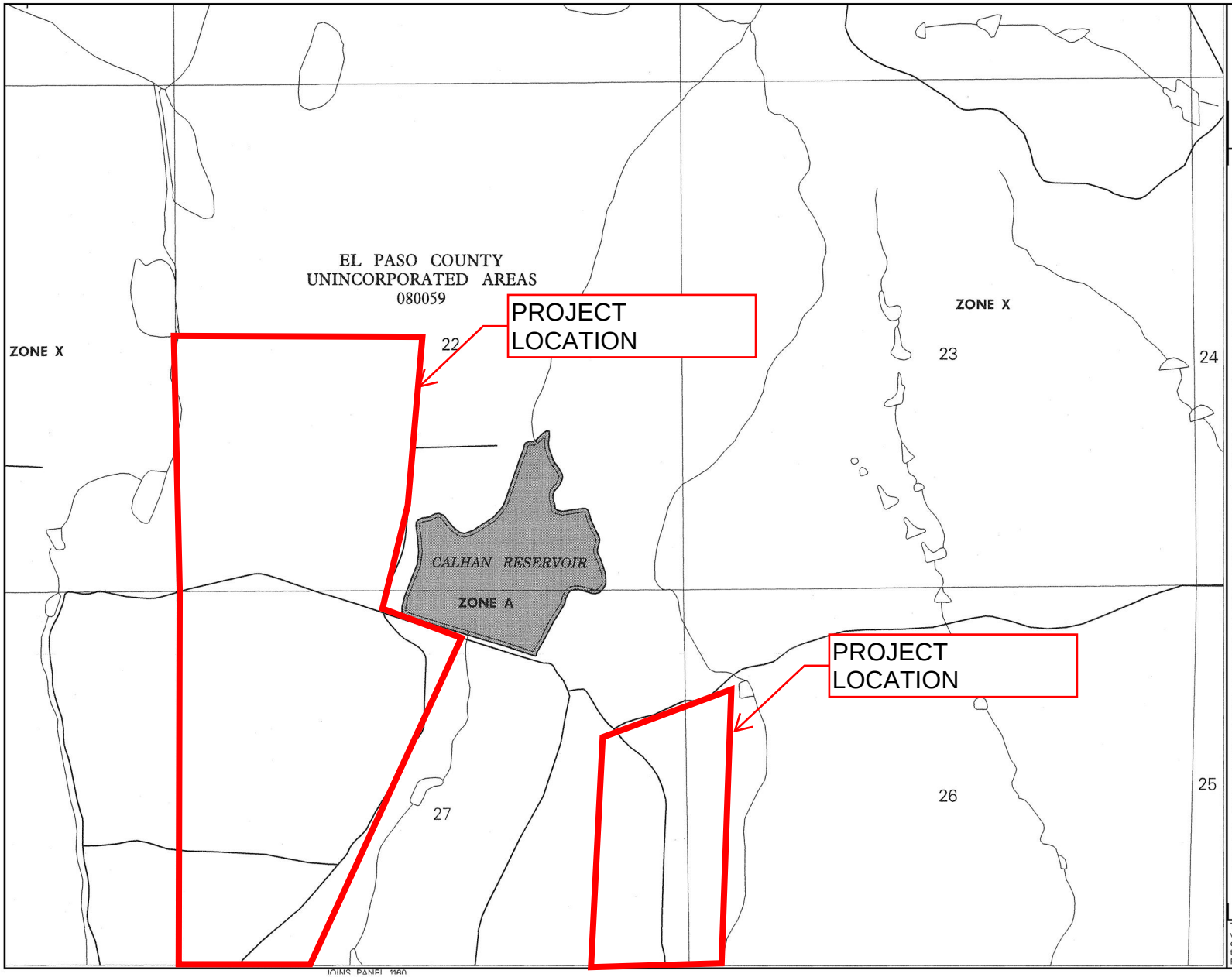
United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

FEMA FLOODPLAIN MAP



APPROXIMATE SCALE IN FEET
1000 0 1000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

EL PASO COUNTY,
COLORADO AND
INCORPORATED AREAS

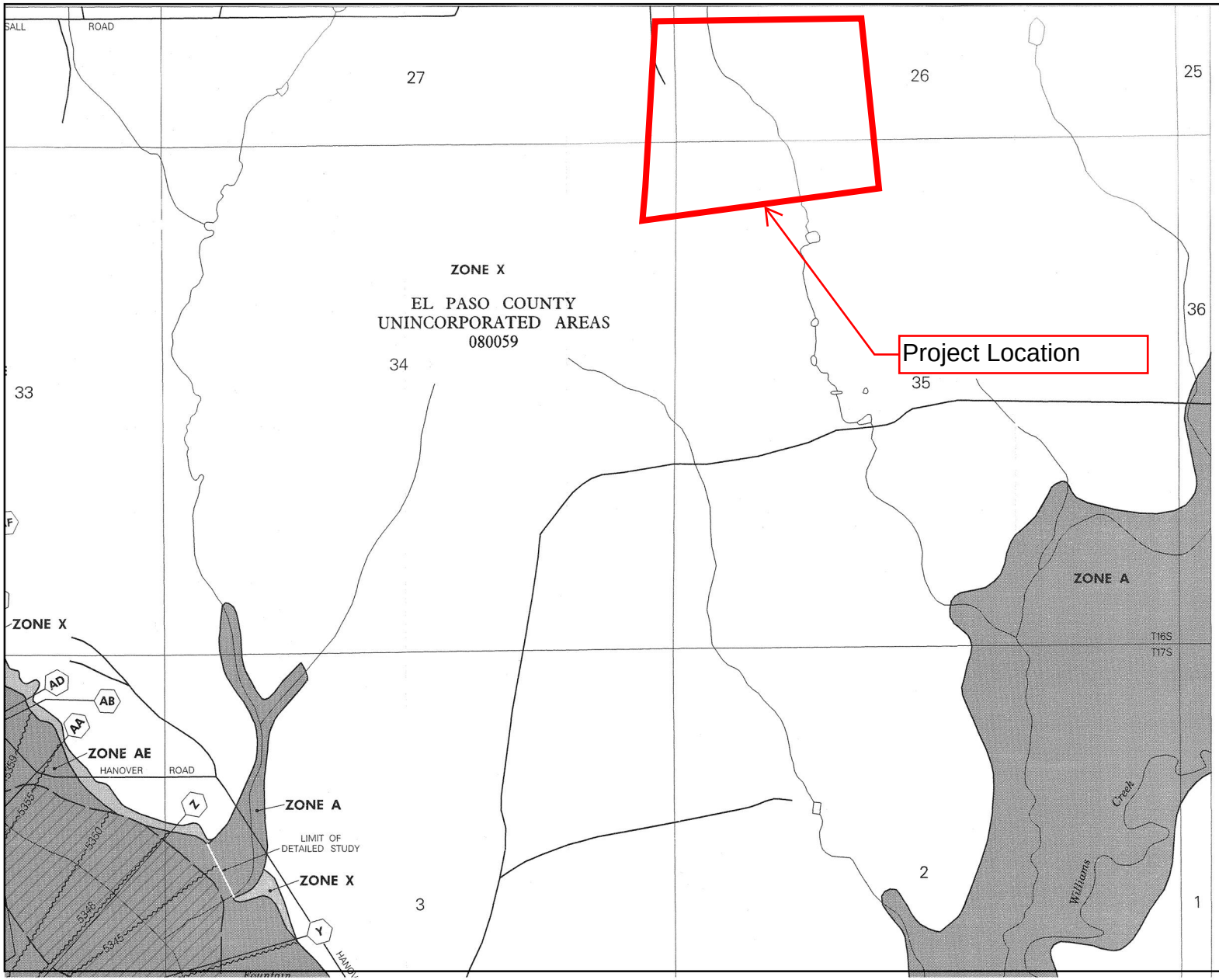
PANEL 970 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS: COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY, UNINCORPORATED AREAS	080059	0970	F

MAP NUMBER
08041C0970 F

EFFECTIVE DATE:
MARCH 17, 1997

Federal Emergency Management Agency



APPROXIMATE SCALE IN FEET
1000 0 1000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

EL PASO COUNTY,
COLORADO AND
INCORPORATED AREAS

PANEL 1160 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS: COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY, UNINCORPORATED AREAS	080059	1160	F
FOUNTAIN, CITY OF	080081	1160	F

MAP NUMBER
08041C1160 F

EFFECTIVE DATE:
MARCH 17, 1997

Federal Emergency Management Agency

HYDROLOGIC CALCULATIONS

Table 6-6. Runoff Coefficients for Rational Method
(Source: UDFCD 2001)

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
1/8 Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
1/4 Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
1/3 Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
1/2 Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
Undeveloped Areas													
Historic Flow Analysis-- Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

3.2 Time of Concentration

One of the basic assumptions underlying the Rational Method is that runoff is a function of the average rainfall rate during the time required for water to flow from the hydraulically most remote part of the drainage area under consideration to the design point. However, in practice, the time of concentration can be an empirical value that results in reasonable and acceptable peak flow calculations.

For urban areas, the time of concentration (t_c) consists of an initial time or overland flow time (t_i) plus the travel time (t_t) in the storm sewer, paved gutter, roadside drainage ditch, or drainage channel. For non-urban areas, the time of concentration consists of an overland flow time (t_i) plus the time of travel in a concentrated form, such as a swale or drainageway. The travel portion (t_t) of the time of concentration can be estimated from the hydraulic properties of the storm sewer, gutter, swale, ditch, or drainageway. Initial time, on the other hand, will vary with surface slope, depression storage, surface cover, antecedent rainfall, and infiltration capacity of the soil, as well as distance of surface flow. The time of concentration is represented by Equation 6-7 for both urban and non-urban areas.

$$I = \frac{28.5\ P_1}{(10+T_D)^{0.786}}$$

Where:

I = rainfall intensity (inches per hour)

P_1 = one-hour rainfall depth (inches) from Table 6-2 One-hour Point Rainfall D City of Colorado Springs Drainage Design

T_C = storm duration (minutes)

	2-yr	5-yr	10-yr	100-yr
P_1 =	1.19	1.50	1.75	2.52

Time Intensity Frequency Tabulation

TIME	2 YR	5 YR	10 YR	100 YR
5	4.04	5.09	5.94	8.55
10	3.22	4.06	4.73	6.82
15	2.70	3.41	3.97	5.72
30	1.87	2.35	2.75	3.95
60	1.20	1.52	1.77	2.55
120	0.74	0.93	1.09	1.57

Weighted Imperviousness Calculations-Existing Conditions

SUB-BASIN	AREA (SF)	AREA (Acres)	ROOF AREA	ROOF IMPERVIOUSNESS	ROOF C2	ROOF C5	ROOF C10	ROOF C100	LANDSCAPE AREA	LANDSCAPE IMPERVIOUSNESS*	LANDSCAPE C2	LANDSCAPE C5	LANDSCAPE C10	LANDSCAPE C100	PAVEMENT AREA	PAVEMENT IMPERVIOUSNESS	PAVEMENT C2	PAVEMENT C5	PAVEMENT C10	PAVEMENT C100	WEIGHTED IMPERVIOUSNESS	WEIGHTED COEFFICIENTS C2	WEIGHTED COEFFICIENTS C5	WEIGHTED COEFFICIENTS C10	WEIGHTED COEFFICIENTS C100
W1	4,066,927	93.36	0	90%	0.71	0.73	0.75	0.82	4,066,927	0%	0.04	0.15	0.25	0.50	0	100%	0.89	0.90	0.92	0.96	0.0%	0.04	0.15	0.25	0.50
W2	2,020,218	46.38	0	90%	0.71	0.73	0.75	0.82	2,020,218	0%	0.04	0.15	0.25	0.50	0	100%	0.89	0.90	0.92	0.96	0.0%	0.04	0.15	0.25	0.50
W3	3,907,936	89.71	0	90%	0.71	0.73	0.75	0.82	3,907,936	0%	0.04	0.15	0.25	0.50	0	100%	0.89	0.90	0.92	0.96	0.0%	0.04	0.15	0.25	0.50
W4	2,654,321	60.93	0	90%	0.71	0.73	0.75	0.82	2,654,321	0%	0.04	0.15	0.25	0.50	0	100%	0.89	0.90	0.92	0.96	0.0%	0.04	0.15	0.25	0.50
W5	2,761,394	63.39	0	90%	0.71	0.73	0.75	0.82	2,761,394	0%	0.04	0.15	0.25	0.50	0	100%	0.89	0.90	0.92	0.96	0.0%	0.04	0.15	0.25	0.50
W6	4,026,580	92.44	0	90%	0.71	0.73	0.75	0.82	4,026,580	0%	0.04	0.15	0.25	0.50	0	100%	0.89	0.90	0.92	0.96	0.0%	0.04	0.15	0.25	0.50
E1	3,115,271	71.52	0	90%	0.71	0.73	0.75	0.82	3,115,271	0%	0.04	0.15	0.25	0.50	0	100%	0.89	0.90	0.92	0.96	0.0%	0.04	0.15	0.25	0.50
E2	3,556,254	81.64	0	90%	0.71	0.73	0.75	0.82	3,556,254	0%	0.04	0.15	0.25	0.50	0	100%	0.89	0.90	0.92	0.96	0.0%	0.04	0.15	0.25	0.50
E3	4,217,688	96.82	0	90%	0.71	0.73	0.75	0.82	4,217,688	0%	0.04	0.15	0.25	0.50	0	100%	0.89	0.90	0.92	0.96	0.0%	0.04	0.15	0.25	0.50
E4	4,010,275	92.06	0	90%	0.71	0.73	0.75	0.82	4,010,275	0%	0.04	0.15	0.25	0.50	0	100%	0.89	0.90	0.92	0.96	0.0%	0.04	0.15	0.25	0.50
TOTAL	34,336,864	788.27	0	90%	0.71	0.73	0.75	0.82	34,336,864	0%	0.04	0.15	0.25	0.50	0	100%	0.89	0.90	0.92	0.96	0.0%	0.04	0.15	0.25	0.50

*C values and imperviousness are based on Pasture and Meadow from Table 6-6 of the Colorado Springs DCM

Palmer Solar
Existing Runoff Calculations
Time of Concentration

Watercourse Coefficient

					Forest & Meadow	2.50		Short Grass Pasture & Lawns	7.00					Grassed Waterway		15.00
					Fallow or Cultivation	5.00		Nearly Bare Ground	10.00					Paved Area & Shallow Gutter		20.00
	SUB-BASIN DATA				INITIAL / OVERLAND TIME			TRAVEL TIME T(t)					T(c) CHECK* (URBANIZED BASINS)			FINAL T(c)
DESIGN POINT	DRAIN BASIN	AREA sq. ft.	AREA ac.	C(5)	Length ft.	Slope %	T(i) min	Length ft.	Slope %	Coeff.	Velocity fps	T(t) min.	COMP. T(c)	TOTAL LENGTH	L/180+10	min.
W1	W1	4,066,927	93.36	0.15	300	4.2%	18.8	0	0.0%	7.00	0.0	0.0	18.8	300	11.7	11.7
W2	W2	2,020,218	46.38	0.15	300	4.9%	17.7	0	0.0%	7.00	0.0	0.0	17.7	300	11.7	11.7
W3	W3	3,907,936	89.71	0.15	300	4.8%	17.9	0	0.0%	7.00	0.0	0.0	17.9	300	11.7	11.7
W4	W4	2,654,321	60.93	0.15	300	4.2%	18.8	0	0.0%	7.00	0.0	0.0	18.8	300	11.7	11.7
W5	W5	2,761,394	63.39	0.15	300	4.2%	18.7	0	0.0%	7.00	0.0	0.0	18.7	300	11.7	11.7
W6	W6	4,026,580	92.44	0.15	300	4.2%	18.7	0	0.0%	7.00	0.0	0.0	18.7	300	11.7	11.7
E1	E1	3,115,271	71.52	0.15	300	1.9%	24.3	0	0.0%	7.00	0.0	0.0	24.3	300	11.7	11.7
E2	E2	3,556,254	81.64	0.15	300	3.3%	20.2	0	0.0%	7.00	0.0	0.0	20.2	300	11.7	11.7
E3	E3	4,217,688	96.82	0.15	300	1.0%	30.1	0	0.0%	7.00	0.0	0.0	30.1	300	11.7	11.7
E4	E4	4,010,275	92.06	0.15	300	2.5%	22.2	0	0.0%	7.00	0.0	0.0	22.2	300	11.7	11.7

Palmer Solar
Existing Runoff Calculations
(Rational Method Procedure)

Design Storm 5 Year

BASIN INFORMATION				DIRECT RUNOFF				CUMMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
W1	W1	93.36	0.15	18.8	14.00	3.05	42.67					
W2	W2	46.38	0.15	17.7	6.96	3.14	21.85					
W3	W3	89.71	0.15	17.9	13.46	3.12	42.04					
W4	W4	60.93	0.15	18.8	9.14	3.05	27.85					
W5	W5	63.39	0.15	18.7	9.51	3.06	29.05					
W6	W6	92.44	0.15	18.7	13.87	3.06	42.36					
E1	E1	71.52	0.15	24.3	10.73	2.66	28.49					
E2	E2	81.64	0.15	20.2	12.25	2.94	35.95					
E3	E3	96.82	0.15	30.1	14.52	2.35	34.11					
E4	E4	92.06	0.15	22.2	13.81	2.79	38.54					

Palmer Solar
Existing Runoff Calculations *Design Storm* *10 Year*
(Rational Method Procedure)

BASIN INFORMATION				DIRECT RUNOFF				CUMMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
W1	W1	93.36	0.25	18.8	23.34	3.55	82.97					0.00
W2	W2	46.38	0.25	17.7	11.59	3.67	42.50					0.00
W3	W3	89.71	0.25	17.9	22.43	3.64	81.74					0.00
W4	W4	60.93	0.25	18.8	15.23	3.55	54.15					0.00
W5	W5	63.39	0.25	18.7	15.85	3.56	56.49					0.00
W6	W6	92.44	0.25	18.7	23.11	3.56	82.37					0.00
E1	E1	71.52	0.25	24.3	17.88	3.10	55.40					0.00
E2	E2	81.64	0.25	20.2	20.41	3.42	69.89					0.00
E3	E3	96.82	0.25	30.1	24.21	2.74	66.33					0.00
E4	E4	92.06	0.25	22.2	23.02	3.26	74.94					0.00

Palmer Solar
Existing Runoff Calculations
(Rational Method Procedure)

Design Storm 100 Year

BASIN INFORMATION				DIRECT RUNOFF				CUMMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
W1	W1	93.36	0.50	18.8	46.68	5.12	238.95					0.00
W2	W2	46.38	0.50	17.7	23.19	5.28	122.39					0.00
W3	W3	89.71	0.50	17.9	44.86	5.25	235.41					0.00
W4	W4	60.93	0.50	18.8	30.47	5.12	155.95					0.00
W5	W5	63.39	0.50	18.7	31.70	5.13	162.69					0.00
W6	W6	92.44	0.50	18.7	46.22	5.13	237.23					0.00
E1	E1	71.52	0.50	24.3	35.76	4.46	159.54					0.00
E2	E2	81.64	0.50	20.2	40.82	4.93	201.30					0.00
E3	E3	96.82	0.50	30.1	48.41	3.95	191.04					0.00
E4	E4	92.06	0.50	22.2	46.03	4.69	215.84					0.00

SUMMARY - PROPOSED RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)
1	W1	93.36	42.67	238.95
2	W2	46.38	21.85	122.39
3	W3	89.71	42.04	235.41
4	W4	60.93	27.85	155.95
5	W5	63.39	29.05	162.69
6	W6	92.44	42.36	237.23
7	E1	71.52	28.49	159.54
8	E2	81.64	35.95	201.30
9	E3	96.82	34.11	191.04
10	E4	92.06	38.54	215.84

$$I = \frac{28.5\ P_1}{(10+T_D)^{0.786}}$$

Where:

I = rainfall intensity (inches per hour)

P_1 = one-hour rainfall depth (inches) from Table 6-2 One-hour Point Rainfall D City of Colorado Springs Drainage Design

T_C = storm duration (minutes)

	2-yr	5-yr	10-yr	100-yr
P_1 =	1.19	1.50	1.75	2.52

Time Intensity Frequency Tabulation

TIME	2 YR	5 YR	10 YR	100 YR
5	4.04	5.09	5.94	8.55
10	3.22	4.06	4.73	6.82
15	2.70	3.41	3.97	5.72
30	1.87	2.35	2.75	3.95
60	1.20	1.52	1.77	2.55
120	0.74	0.93	1.09	1.57

Weighted Imperviousness Calculations-Existing Conditions

SUB-BASIN	AREA (SF)	AREA (Acres)	ROOF AREA	ROOF IMPERVIOUSNESS	ROOF C2	ROOF C5	ROOF C10	ROOF C100	LANDSCAPE AREA	LANDSCAPE IMPERVIOUSNESS*	LANDSCAPE C2	LANDSCAPE C5	LANDSCAPE C10	LANDSCAPE C100	GRAVEL AREA	PAVEMENT IMPERVIOUSNESS	PAVEMENT C2	PAVEMENT C5	PAVEMENT C10	PAVEMENT C100	WEIGHTED IMPERVIOUSNESS	WEIGHTED COEFFICIENTS C2	WEIGHTED COEFFICIENTS C5	WEIGHTED COEFFICIENTS C10	WEIGHTED COEFFICIENTS C100
W1	4,066,927	93.36	0	90%	0.71	0.73	0.75	0.82	3,999,450	0%	0.04	0.15	0.25	0.50	67,477	80%	0.60	0.63	0.66	0.74	1.3%	0.05	0.16	0.26	0.50
W2	2,020,218	46.38	0	90%	0.71	0.73	0.75	0.82	2,004,140	0%	0.04	0.15	0.25	0.50	16,078	80%	0.60	0.63	0.66	0.74	0.6%	0.04	0.15	0.25	0.50
W3	3,907,936	89.71	0	90%	0.71	0.73	0.75	0.82	3,893,127	0%	0.04	0.15	0.25	0.50	14,809	80%	0.60	0.63	0.66	0.74	0.3%	0.04	0.15	0.25	0.50
W4	2,654,321	60.93	0	90%	0.71	0.73	0.75	0.82	2,639,367	0%	0.04	0.15	0.25	0.50	14,954	80%	0.60	0.63	0.66	0.74	0.5%	0.04	0.15	0.25	0.50
W5	2,761,394	63.39	0	90%	0.71	0.73	0.75	0.82	2,714,029	0%	0.04	0.15	0.25	0.50	47,365	80%	0.60	0.63	0.66	0.74	1.4%	0.05	0.16	0.26	0.50
W6	4,026,580	92.44	0	90%	0.71	0.73	0.75	0.82	3,949,349	0%	0.04	0.15	0.25	0.50	77,231	80%	0.60	0.63	0.66	0.74	1.5%	0.05	0.16	0.26	0.50
E1	3,115,271	71.52	0	90%	0.71	0.73	0.75	0.82	3,025,328	0%	0.04	0.15	0.25	0.50	89,943	80%	0.60	0.63	0.66	0.74	2.3%	0.06	0.16	0.26	0.51
E2	3,556,254	81.64	0	90%	0.71	0.73	0.75	0.82	3,546,510	0%	0.04	0.15	0.25	0.50	9,744	80%	0.60	0.63	0.66	0.74	0.2%	0.04	0.15	0.25	0.50
E3	4,217,688	96.82	0	90%	0.71	0.73	0.75	0.82	4,190,139	0%	0.04	0.15	0.25	0.50	27,549	80%	0.60	0.63	0.66	0.74	0.5%	0.04	0.15	0.25	0.50
E4	4,010,275	92.06	0	90%	0.71	0.73	0.75	0.82	3,969,847	0%	0.04	0.15	0.25	0.50	40,428	80%	0.60	0.63	0.66	0.74	0.8%	0.05	0.15	0.25	0.50
TOTAL	34,336,864	788.27	0	90%	0.71	0.73	0.75	0.82	33,931,286	0%	0.04	0.15	0.25	0.50	405,578	80%	0.60	0.63	0.66	0.74	0.9%	0.05	0.16	0.25	0.50

*C values and imperviousness are based on Pasture and Meadow and Gravel Road from Table 6-6 of the Colorado Springs DCM

Palmer Solar
Existing Runoff Calculations
Time of Concentration

Watercourse Coefficient

					Forest & Meadow	2.50		Short Grass Pasture & Lawns	7.00				Grassed Waterway	15.00		
					Fallow or Cultivation	5.00		Nearly Bare Ground	10.00				Paved Area & Shallow Gutter	20.00		
	SUB-BASIN DATA				INITIAL / OVERLAND TIME			TRAVEL TIME T(t)					T(c) CHECK* (URBANIZED BASINS)			FINAL T(c)
DESIGN POINT	DRAIN BASIN	AREA sq. ft.	AREA ac.	C(5)	Length ft.	Slope %	T(i) min	Length ft.	Slope %	Coeff.	Velocity fps	T(t) min.	COMP. T(c)	TOTAL LENGTH	L/180+10	min.
W1	W1	4,066,927	93.36	0.16	300	4.2%	18.6	0	0.0%	7.00	0.0	0.0	18.6			18.6
W2	W2	2,020,218	46.38	0.15	300	4.9%	17.7	0	0.0%	7.00	0.0	0.0	17.7			17.7
W3	W3	3,907,936	89.71	0.15	300	4.8%	17.8	0	0.0%	7.00	0.0	0.0	17.8			17.8
W4	W4	2,654,321	60.93	0.15	300	4.2%	18.7	0	0.0%	7.00	0.0	0.0	18.7			18.7
W5	W5	2,761,394	63.39	0.16	300	4.2%	18.5	0	0.0%	7.00	0.0	0.0	18.5			18.5
W6	W6	4,026,580	92.44	0.16	300	4.2%	18.5	0	0.0%	7.00	0.0	0.0	18.5			18.5
E1	E1	3,115,271	71.52	0.16	300	1.9%	24.0	0	0.0%	7.00	0.0	0.0	24.0			24.0
E2	E2	3,556,254	81.64	0.15	300	3.3%	20.2	0	0.0%	7.00	0.0	0.0	20.2			20.2
E3	E3	4,217,688	96.82	0.15	300	1.0%	30.0	0	0.0%	7.00	0.0	0.0	30.0			30.0
E4	E4	4,010,275	92.06	0.15	300	2.5%	22.1	0	0.0%	7.00	0.0	0.0	22.1			22.1

Palmer Solar
Existing Runoff Calculations
(Rational Method Procedure)

Design Storm 5 Year

BASIN INFORMATION				DIRECT RUNOFF				CUMMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
W1	W1	93.36	0.16	18.6	14.75	3.06	45.18					
W2	W2	46.38	0.15	17.7	7.13	3.14	22.41					
W3	W3	89.71	0.15	17.8	13.62	3.13	42.67					
W4	W4	60.93	0.15	18.7	9.31	3.06	28.43					
W5	W5	63.39	0.16	18.5	10.03	3.07	30.82					
W6	W6	92.44	0.16	18.5	14.72	3.07	45.21					
E1	E1	71.52	0.16	24.0	11.72	2.67	31.34					
E2	E2	81.64	0.15	20.2	12.35	2.94	36.26					
E3	E3	96.82	0.15	30.0	14.83	2.35	34.90					
E4	E4	92.06	0.15	22.1	14.25	2.80	39.88					

Palmer Solar
Existing Runoff Calculations *Design Storm* *10 Year*
(Rational Method Procedure)

BASIN INFORMATION				DIRECT RUNOFF				CUMMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
W1	W1	93.36	0.26	18.6	23.98	3.57	85.70					0.00
W2	W2	46.38	0.25	17.7	11.75	3.67	43.05					0.00
W3	W3	89.71	0.25	17.8	22.57	3.65	82.48					0.00
W4	W4	60.93	0.25	18.7	15.37	3.56	54.80					0.00
W5	W5	63.39	0.26	18.5	16.29	3.58	58.40					0.00
W6	W6	92.44	0.26	18.5	23.84	3.58	85.43					0.00
E1	E1	71.52	0.26	24.0	18.73	3.12	58.42					0.00
E2	E2	81.64	0.25	20.2	20.50	3.42	70.21					0.00
E3	E3	96.82	0.25	30.0	24.47	2.75	67.18					0.00
E4	E4	92.06	0.25	22.1	23.40	3.26	76.37					0.00

Palmer Solar
Existing Runoff Calculations
(Rational Method Procedure)

Design Storm 100 Year

BASIN INFORMATION				DIRECT RUNOFF				CUMMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
W1	W1	93.36	0.50	18.6	47.05	5.15	242.18					0.00
W2	W2	46.38	0.50	17.7	23.28	5.28	122.85					0.00
W3	W3	89.71	0.50	17.8	44.94	5.26	236.51					0.00
W4	W4	60.93	0.50	18.7	30.55	5.13	156.80					0.00
W5	W5	63.39	0.50	18.5	31.96	5.16	164.93					0.00
W6	W6	92.44	0.50	18.5	46.64	5.16	240.73					0.00
E1	E1	71.52	0.51	24.0	36.25	4.49	162.88					0.00
E2	E2	81.64	0.50	20.2	40.87	4.93	201.56					0.00
E3	E3	96.82	0.50	30.0	48.56	3.95	192.02					0.00
E4	E4	92.06	0.50	22.1	46.25	4.70	217.41					0.00

SUMMARY - PROPOSED RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)
1	W1	93.36	45.18	242.18
2	W2	46.38	22.41	122.85
3	W3	89.71	42.67	236.51
4	W4	60.93	28.43	156.80
5	W5	63.39	30.82	164.93
6	W6	92.44	45.21	240.73
7	E1	71.52	31.34	162.88
8	E2	81.64	36.26	201.56
9	E3	96.82	34.90	192.02
10	E4	92.06	39.88	217.41

DRAINAGE MAPS

LEGEND

A = BASIN DESIGNATION
B = AREA (ACRES)
C = BASIN IMPERVIOUSNESS
D = 100YR DESIGN STORM RUNOFF (CFS)

= DESIGN POINT

FLOW DIRECTION

DRAINAGE BASIN BOUNDARY

XXXX EXISTING MAJOR CONTOUR (25 FT)

XXXX EXISTING MINOR CONTOUR (5 FT)

SUMMARY - PROPOSED RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)
1	W1	93.36	42.67	238.95
2	W2	46.38	21.85	122.39
3	W3	89.71	42.04	235.41
4	W4	60.93	27.85	155.95
5	W5	63.39	29.05	162.69
6	W6	92.44	42.36	237.23
7	E1	71.52	28.49	159.54
8	E2	81.64	35.95	201.30
9	E3	96.82	34.11	191.04
10	E4	92.06	38.54	215.84

WOODMOOR WATER AND SANITATION DISTRICT SCHEDULE NUMBER 5600000122

W1
93.36 | 0% | 238.95

EXISTING POND

1

W2
46.38 | 0% | 122.39

2

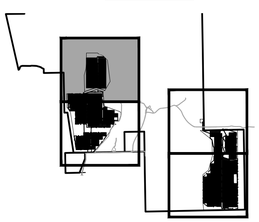
WOODMOOR WATER AND SANITATION DISTRICT SCHEDULE NUMBER 5600000122

CALHAN RESERVOIR

W3
89.71 | 0% | 235.41

W4
60.93 | 0% | 155.96

KEYMAP



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PALMER SOLAR-EXISTING DRAINAGE MAP

LEGEND

A = BASIN DESIGNATION
B = AREA (ACRES)
C = BASIN IMPERVIOUSNESS
D = 100YR DESIGN STORM RUNOFF (CFS)

= DESIGN POINT

FLOW DIRECTION

DRAINAGE BASIN BOUNDARY

XXXX EXISTING MAJOR CONTOUR (25 FT)

XXXX EXISTING MINOR CONTOUR (5 FT)

SUMMARY - PROPOSED RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)
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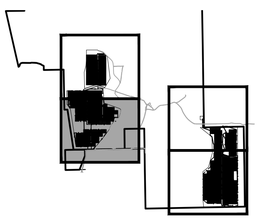
7	E1	71.52	28.49	159.54
8	E2	81.64	35.95	201.30
9	E3	96.82	34.11	191.04
10	E4	92.06	38.54	215.84

KEYMAP



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PALMER SOLAR-EXISTING DRAINAGE MAP

LEGEND

A = BASIN DESIGNATION
B = AREA (ACRES)
C = BASIN IMPERVIOUSNESS
D = 100YR DESIGN STORM RUNOFF (CFS)

= DESIGN POINT

FLOW DIRECTION

DRAINAGE BASIN BOUNDARY

EXISTING MAJOR CONTOUR (25 FT)

EXISTING MINOR CONTOUR (5 FT)

SUMMARY - PROPOSED RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)
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6	W6	92.44	42.36	237.23
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8	E2	81.64	35.95	201.30
9	E3	96.82	34.11	191.04
10	E4	92.06	38.54	215.84

WOODMOOR WATER AND SANITATION DISTRICT SCHEDULE NUMBER 5600000122

CITY OF COLORADO SPRINGS SCHEDULE NUMBER 5600000123

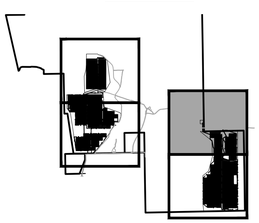
PROPERTY LINE

CSU SUBSTATION

E1
71.52 | 0% | 159.54

E2
81.64 | 0% | 201.30

KEYMAP



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PALMER SOLAR-EXISTING DRAINAGE MAP

LEGEND

A = BASIN DESIGNATION
B = AREA (ACRES)
C = BASIN IMPERVIOUSNESS
D = 100YR DESIGN STORM RUNOFF (CFS)

= DESIGN POINT

FLOW DIRECTION

DRAINAGE BASIN BOUNDARY

XXXX EXISTING MAJOR CONTOUR (25 FT)

XXXX EXISTING MINOR CONTOUR (5 FT)

SUMMARY - PROPOSED RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)
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6	W6	92.44	42.36	237.23
7	E1	71.52	28.49	159.54
8	E2	81.64	35.95	201.30
9	E3	96.82	34.11	191.04
10	E4	92.06	38.54	215.84

WOODMOOR WATER AND SANITATION DISTRICT SCHEDULE NUMBER 5600000122

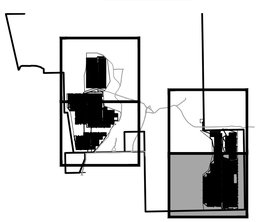
E2 — 81.64 — 0% — 201.30

E3 — 96.82 — 0% — 191.04

E4 — 92.06 — 0% — 215.84

PROPERTY LINE

KEYMAP



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PALMER SOLAR-EXISTING DRAINAGE MAP

LEGEND

A = BASIN DESIGNATION
B = AREA (ACRES)
C = BASIN IMPERVIOUSNESS
D = 100YR DESIGN STORM RUNOFF (CFS)

= DESIGN POINT

FLOW DIRECTION

DRAINAGE BASIN BOUNDARY

EMERGENCY OVERFLOW PATH

XXXX PROPOSED MAJOR CONTOUR

XXXX PROPOSED MINOR CONTOUR

XXXX EXISTING MAJOR CONTOUR

XXXX EXISTING MINOR CONTOUR

ROADSIDE SWALE/DITCH

PROPOSED CULVERT

SUMMARY - PROPOSED RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)
1	W1	93.36	45.18	242.18
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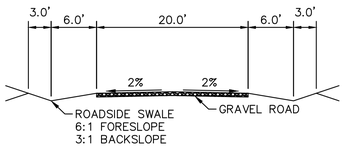
5	W5	63.39	30.82	164.93
6	W6	92.44	45.21	240.73
7	E1	71.52	31.34	162.88
8	E2	81.64	36.26	201.56
9	E3	96.82	34.90	192.02
10	E4	92.06	39.88	217.41

TYPICAL STREET SECTION



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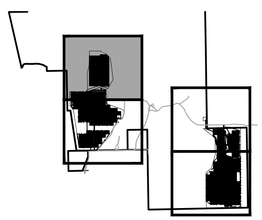

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PALMER SOLAR-PROPOSED DRAINAGE MAP

WOODMOOR WATER AND SANITATION DISTRICT SCHEDULE NUMBER 5600000122

PROPOSED CULVERT

W1
93.36 | 1.3% | 242.18

PROPOSED CULVERT

EXISTING POND

1

ROADSIDE SWALE (TYP.)

W2
46.38 | 0.6% | 122.85

PROPOSED SEDIMENT BASIN B
CATCHMENT AREA: 18.1 AC
REQUIRED STORAGE (PER UDFCD): 1.49 AC-FT
PROVIDED STORAGE: 1.50 AC-FT
DIMENSIONS: 230'L X 50'W
TOP OF POND: 5445
BOTTOM OF POND: 5441

2

WOODMOOR WATER AND SANITATION DISTRICT SCHEDULE NUMBER 5600000122

CALHAN RESERVOIR

3

PROPOSED CULVERT

W3
89.71 | 0.3% | 236.51

PROPOSED CULVERT

W4
60.93 | 0.5% | 156.80

LEGEND

A = BASIN DESIGNATION
B = AREA (ACRES)
C = BASIN IMPERVIOUSNESS
D = 100YR DESIGN STORM RUNOFF (CFS)

= DESIGN POINT

FLOW DIRECTION

DRAINAGE BASIN BOUNDARY

EMERGENCY OVERFLOW PATH

XXXX — PROPOSED MAJOR CONTOUR

XXXX — PROPOSED MINOR CONTOUR

XXXX — EXISTING MAJOR CONTOUR

XXXX — EXISTING MINOR CONTOUR

ROADSIDE SWALE/DITCH

PROPOSED CULVERT

SUMMARY - PROPOSED RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)
1	W1	93.36	45.18	242.18
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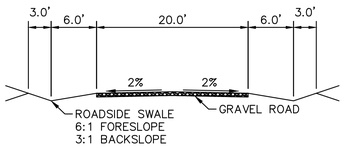
6	W6	92.44	45.21	240.73
7	E1	71.52	31.34	162.88
8	E2	81.64	36.26	201.56
9	E3	96.82	34.90	192.02
10	E4	92.06	39.88	217.41

TYPICAL STREET SECTION



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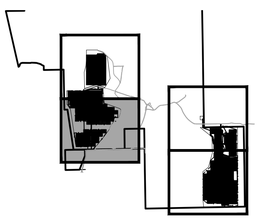

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0 100 200 400

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PALMER SOLAR-PROPOSED DRAINAGE MAP

PROPOSED SWALE (TYP.)

PROPOSED SEDIMENT BASIN A
CATCHMENT AREA: 32.6 AC
REQUIRED STORAGE (PER UDFCD): 2.69 AC-FT
PROVIDED STORAGE: 2.92 AC-FT
DIMENSIONS: 200'L X 100'W
BOTTOM OF POND: 5455
TOP OF POND: 5450

ROADSIDE SWALE (TYP.)

HAROLD SNOWDEN
SYLVIA BYSON
13425 MOONSHADOW LANE

PROPOSED CULVERT

DANIEL MCCARTAN
8790 BIRDSALL RD

PROPERTY LINE

EXISTING POND

BIRDSALL ROAD

LEGEND

A = BASIN DESIGNATION
B = AREA (ACRES)
C = BASIN IMPERVIOUSNESS
D = 100YR DESIGN STORM RUNOFF (CFS)

= DESIGN POINT

FLOW DIRECTION

DRAINAGE BASIN BOUNDARY

EMERGENCY OVERFLOW PATH

XXXX PROPOSED MAJOR CONTOUR

XXXX PROPOSED MINOR CONTOUR

XXXX EXISTING MAJOR CONTOUR

XXXX EXISTING MINOR CONTOUR

ROADSIDE SWALE/DITCH

PROPOSED CULVERT

SUMMARY - PROPOSED RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)
1	W1	93.36	45.18	242.18
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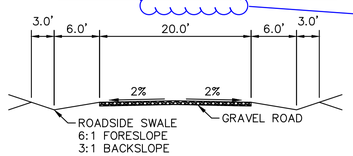
7	E1	71.52	31.34	162.88
8	E2	81.64	36.26	201.56
9	E3	96.82	34.90	192.02
10	E4	92.06	39.88	217.41

TYPICAL STREET SECTION

Access road?



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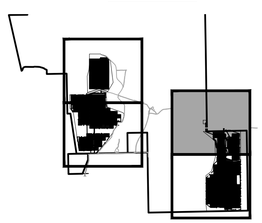

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PALMER SOLAR-PROPOSED DRAINAGE MAP

See redlined GEC plan regarding questions on sediment basin locations (in regard to concentrated flow locations).

WOODMOOR WATER AND SANITATION DISTRICT SCHEDULE NUMBER 5600000122

CITY OF COLORADO SPRINGS SCHEDULE NUMBER 5600000123

PROPERTY LINE

PROPOSED CULVERT

ROADSIDE SWALE (TYP.)

PROPOSED CULVERT

PROPOSED CULVERT

PROPOSED DITCH

PROPOSED CULVERT

PROPOSED CULVERT

E1
71.52 | 2.3% | 162.88

PROPOSED DITCH

ROADSIDE SWALE (TYP.)

PROPOSED CULVERT

PROPOSED CULVERT

ROADSIDE SWALE (TYP.)

E2
81.64 | 0.2% | 201.56

PROPOSED CULVERT

PROPOSED CULVERT

PROPOSED SWALE (TYP.)

K:\COS_Civil\096495003_Palmer Solar\CADD\Exhibits\Proposed Drainage Map.dwg 6/25/2018 3:19 PM

LEGEND

A = BASIN DESIGNATION
B = AREA (ACRES)
C = BASIN IMPERVIOUSNESS
D = 100YR DESIGN STORM RUNOFF (CFS)

= DESIGN POINT

FLOW DIRECTION

DRAINAGE BASIN BOUNDARY

EMERGENCY OVERFLOW PATH

XXXX PROPOSED MAJOR CONTOUR

XXXX PROPOSED MINOR CONTOUR

XXXX EXISTING MAJOR CONTOUR

XXXX EXISTING MINOR CONTOUR

ROADSIDE SWALE/DITCH

PROPOSED CULVERT

SUMMARY - PROPOSED RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)
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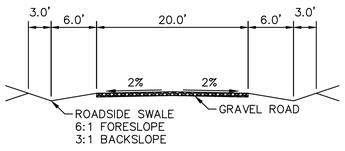
TYPICAL STREET SECTION



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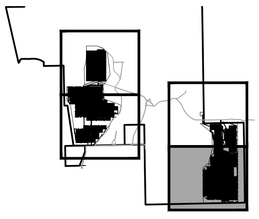

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WOODMOOR WATER AND SANITATION DISTRICT SCHEDULE NUMBER 5600000122

ROADSIDE SWALE (TYP.)
PROPOSED SWALE (TYP.)
PROPOSED CULVERT
PROPOSED SEDIMENT BASIN C
CATCHMENT AREA: 65.0 AC
REQUIRED STORAGE (PER UDFCD): 5.37 AC-FT
PROVIDED STORAGE: 5.40 AC-FT
DIMENSIONS: 520'L X 140'W
BOTTOM OF POND: 5473
TOP OF POND: 5476
PROPERTY LINE

E2 81.64 0.2% 201.56
E3 96.82 0.5% 192.02
E4 92.06 0.8% 217.41

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PALMER SOLAR-PROPOSED DRAINAGE MAP

Markup Summary

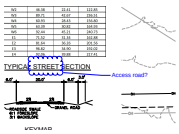
dsdrice (3)

Subject: Text Box
Page Label: 7
Author: dsdrice
Date: 9/19/2018 10:37:35 AM
Color:

Add a statement that a Final Drainage Report will be provided with the Site Development Plan.

Subject: Text Box
Page Label: 65
Author: dsdrice
Date: 9/19/2018 10:39:40 AM
Color:

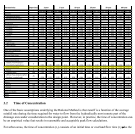
See redlined GEC plan regarding questions on sediment basin locations (in regard to concentrated flow locations).



Subject: Cloud+
Page Label: 65
Author: dsdrice
Date: 9/19/2018 10:40:02 AM
Color:

Access road?

kevin.kofford (8)



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Page Label: 43
Author: kevin.kofford
Date: 6/14/2018 11:20:15 AM
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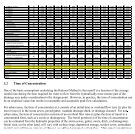

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Page Label: 43
Author: kevin.kofford
Date: 6/14/2018 11:20:23 AM
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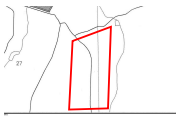

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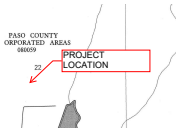
Page Label: 40
Author: kevin.kofford
Date: 6/14/2018 11:44:33 AM
Color:

Subject: Polygon
Page Label: 40
Author: kevin.kofford
Date: 6/14/2018 11:44:47 AM
Color:

Subject: Callout
Page Label: 40
Author: kevin.kofford
Date: 6/14/2018 11:45:14 AM
Color:

PROJECT LOCATION



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Author: kevin.kofford
Date: 6/14/2018 11:45:17 AM
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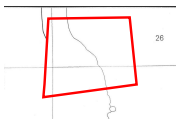

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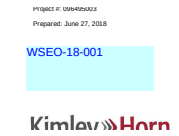
Page Label: 41
Author: kevin.kofford
Date: 6/14/2018 2:05:05 PM
Color:

Subject: Callout
Page Label: 41
Author: kevin.kofford
Date: 6/14/2018 2:05:22 PM
Color:

Project Location

Steve Kuehster (14)



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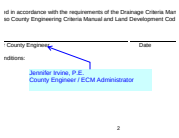

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Author: Steve Kuehster
Date: 9/18/2018 10:51:37 AM
Color:

Jennifer Irvine, P.E.
County Engineer / ECM Administrator

Subject: text box
Page Label: 4
Author: Steve Kuehster
Date: 9/18/2018 10:57:14 AM
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City of Colorado Springs and El Paso County “Drainage Criteria Manual (DCM)”, dated November, 1991, the
El Paso County “Engineering Criteria Manual”, Chapter 6 and Section 3.2.1 Chapter 13 of the City of
Colorado Springs Drainage Criteria Manual dated May 2014,

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Author: Steve Kuehster
Date: 9/18/2018 10:57:58 AM
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Volumes 1 and 2 of the El Paso County Drainage Criteria Manua

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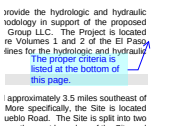

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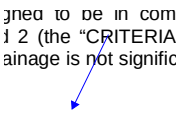

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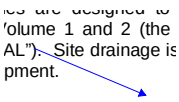

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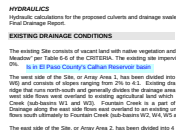

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Author: Steve Kuehster
Date: 9/18/2018 11:30:06 AM
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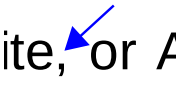
Is in El Paso County's Calhan Reservoir basin



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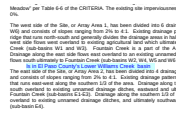

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Author: Steve Kuehster
Date: 9/18/2018 11:31:43 AM
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Is in El Paso County's Lower Williams Creek basin

Subject: Arrow
Page Label: 5
Author: Steve Kuehster
Date: 9/18/2018 11:32:17 AM
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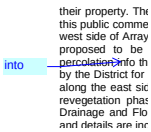
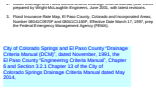


Subject: arrow & box
Page Label: 6
Author: Steve Kuehster
Date: 9/18/2018 12:00:30 PM
Color:

into



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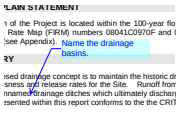
City of Colorado Springs and El Paso County “Drainage Criteria Manual (DCM)”, dated November, 1991, the
El Paso County “Engineering Criteria Manual”, Chapter 6 and Section 3.2.1 Chapter 13 of the City of
Colorado Springs Drainage Criteria Manual dated May 2014,



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Author: Steve Kuehster
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Name the drainage basins.
