PRELIMINARY DRAINAGE REPORT
WOLF BUSINESS PARK FILING NO. 2
and
FINAL DRAINAGE REPORT
LOT 7, WOLF BUSINESS PARK FILING NO. 2

Prepared for:

Hammers Construction, Inc.
1411 Woolsey Heights
Colorado Springs, CO 80915

April 7, 2017

Prepared by:

JPS ENGINEERING
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(719)-477-9429
www.jpsengr.com

JPS Project No. 051601

WOLF BUSINESS PARK FILING NO. 2
DRAINAGE REPORT STATEMENTS

1. 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 City/County for drainage reports and said report is in conformity with the master plan for the drainage basin. I accept responsibility for liability caused by negligent acts, errors or omissions on my part in preparing this report:

_____

John P. Schwab Colorado P.E. No. 29891

2. Town Of Monument:

Filed in accordance with the Code of the Town of Monument.

_____ _____

Director of Development Services Date

Conditions:

I. INTRODUCTION

Wolf Business Park is a platted commercial subdivision in the Town of Monument, Colorado. The original subdivision plat consisted of four lots comprising approximately 10 acres on the east side of Beacon Lite Road. The subdivision included platting of Wolf Court as a public road extending east from Beacon Lite Road to a cul-de-sac. Preliminary site development activities included partial construction of the Wolf Court roadway and utilities, construction of a stormwater detention pond on the unplatted property southwest of the site, and construction of a 48-inch storm sewer along the west boundary of the subdivision, but no further development has occurred.

Wolf Business Park Filing No. 2 is a proposed replat which reconfigures the originally platted lot lines, and includes an additional area of approximately 5 acres adjoining the south boundary of the original subdivision. The replat will create a total of 7 commercial lots, along with a tract to encompass the existing stormwater detention pond at the southwest corner of the subdivision. No changes to the Wolf Court right-of-way are proposed with the replat.

Tri-Lakes Collision is planning to construct a new commercial auto service building on the proposed Lot 7, Wolf Business Park Filing No. 2. The site is a part of a currently unplatted 4.0-acre parcel (El Paso County Assessor's No.71113-00-015). The replat of Wolf Business Park Filing No. 2 includes the subject parcel as Lots 6 and 7.

The proposed site development plan for Lot 7 consists of a new 10,000 square-foot auto service building with asphalt parking areas, landscaping, and related site improvements. Access to the new commercial lot will be provided by a proposed access drive connection to Beacon Lite Road at the northwest corner of the site. The private access drive along the north side of Lot 7 will also provide access for future development of Lot 6 adjoining the east boundary of this site.

The Lot 7 site is surrounded by vacant properties to the north, east, and west. The south boundary of the site adjoins the existing stormwater detention pond, and the existing Monument Meadows Mobile Home Park is located southeast of the site.

This report is intended to meet the Town of Monument requirements for a Preliminary Drainage Report in support of the Wolf Business Park Filing No. 2 replat and a Final Drainage Report in support of the proposed Development Plan for Tri-Lakes Collision on Lot 7.

II. EXISTING DRAINAGE CONDITIONS

The existing site generally slopes downward to the southwest, with average grades in the range of 3-8 percent. According to the NRCS Soil Survey for this area (see Appendix A), on-site soils are identified as Tomah-Crowfoot loamy sands, which are well-drained soils classified as hydrologic soils group B (moderate infiltration rate).

The site is impacted by off-site upstream drainage from tributary areas of the Crystal Creek Drainage Basin north and east of the property. This site and the upstream drainage areas are located within Basins CC165 and CC167 as delineated in the "Dirty Woman Creek and Crystal Creek Drainage Basin Planning Study" by Kiowa Engineering Corporate dated June, 1993. The DBPS identifies calculated developed flows at the crossing of Beacon Lite Road (DBPS Design Point #CC167) as $Q_{10} = 49$ cfs and $Q_{100} = 116$ cfs.

Drainage planning for this subdivision was previously studied in the "Master Drainage Report for the 15-acre Wolf Business Park Development" by Colorado Engineering & Geotechnical Group, Inc. dated August 27, 2004. The subdivision drainage report identifies calculated developed peak flows at the crossing of Beacon Lite Road as $Q_5 = 65.9$ cfs and $Q_{100} = 146.7$ cfs.

The subdivision drainage report states that the stormwater detention pond at the south end of the property will mitigate developed flow impacts from the Wolf Business Park development, and further states that "should the vacant lot to the north of the site ever be developed, any flows leaving that site should be restricted to historical rates so as not to overburden any system located within this project."

As shown on the enclosed Historic Drainage Plans (Sh. EX1 and EX2, Appendix D), the existing site has been delineated as Basin A, which sheet flows southwesterly to the existing detention pond on the east side of Beacon Lite Road. For consistency with the DBPS, the upstream area east of this site has been delineated as Basin CC165, and the upstream basin area north of this site has been delineated as Basin CC167. A small unplatted area at the southeast corner of the subdivision has been delineated as Basin OA1.

Off-site flows from the east (Basin CC165 and OA1) enter the east boundary of the property through an existing 30-inch RCP storm sewer crossing I-25. These flows drain southwesterly across Basin OA1 and flow through an existing open channel along the south boundary of the site, ultimately reaching the existing detention pond at Beacon Lite Road. Off-site flows from the north (Basin CC167) drain through an existing 48-inch RCP storm sewer which flows southerly along the full extent of the west boundary of the subdivision, ultimately reaching the existing detention pond.

Drainage from Basins CC165, CC167, OA1, and A combines at Design Point #1, with historic peak flows calculated as $Q_5 = 18.2$ cfs and $Q_{100} = 133.8$ cfs (see hydrologic calculations in Appendix B). The existing detention pond at Design Point #1 has an outlet structure and an existing 48-inch CMP discharge pipe which crosses Beacon Lite Road and flows southwesterly to an existing downstream drainage swale.

III. PROPOSED DRAINAGE CONDITIONS

As shown on the enclosed Developed Drainage Plan (Sheets D1 and D1.1, Appendix D), the developed site has been delineated as Basins A1-A4, flowing towards Design Point #1 at the southwest corner of the property. The existing detention pond has been delineated as Basin A5. Off-site flow from Basin CC167 will continue to drain south in the existing 48" storm sewer along the west side of Basins A1, A2, and A4, ultimately flowing into the detention pond.

Future development of Basins A1 and A2 is anticipated to include private storm sewer laterals extending easterly to collect surface drainage from the developed sites.

Lot 7 has been delineated as a single on-site drainage basin (Basin A4) flowing towards Design Point #A4 at the southwest corner of the property. The northern part of Basin A4 will drain to proposed 5' Type R Inlets northeast and northwest of the new building, and the southern part of Basin A4 will drain to a proposed 5' Type R Inlet in the southwest corner of the parking lot. A private 18-inch storm sewer system will collect flow from the private storm inlets and convey developed drainage into the existing 48" storm sewer along the west side of the site and the existing stormwater detention pond immediately south of the property. Developed peak flows at Design Point #A4 are calculated as $Q_5 = 5.4$ cfs and $Q_{100} = 10.7$ cfs.

Developed drainage from Basins CC167, A1, A2, and A4 combines at Design Point #A4.1, with peak flows calculated as $Q_5 = 27.9$ cfs and $Q_{100} = 94.6$ cfs. The existing 48" RCP storm sewer system along the west side of the subdivision has a minimum slope of 1.7 percent and a corresponding minimum capacity of 187.3 cfs (per hydraulic calculations in Appendix C), which is more than adequate to convey the calculated 100-year flows.

Off-site flows from the east (Basin CC165 and OA1) will continue to drain southwesterly across Basin OA1 and flow west through the existing open channel along the south boundary of Basin A3, ultimately reaching the detention pond.

Developed drainage from Basins CC165, CC167, OA1, and A1-A5 will combine at Design Point #1, with peak flows calculated as $Q_5 = 76.0$ cfs and $Q_{100} = 218.9$ cfs (see Appendix B).

There are no public roadway or drainage infrastructure improvements required for the proposed site development. The existing stormwater detention pond adjoining the south boundary of this site provides an adequate outfall for developed drainage from this site. As such, the proposed project is not anticipated to have any significant drainage impact on downstream drainage facilities or adjacent properties.

The enclosed drainage plan includes the following general grading and drainage recommendations:

- Builders and property owners shall provide positive drainage away from structures and account for potential cross-lot drainage impacts within each lot.
- Builders and property owners shall implement and maintain proper best management practices for drainage and erosion control for protection of downstream properties.

IV. DETENTION POND EVALUATION

The developed drainage plan has been designed to convey on-site developed drainage into the existing stormwater detention pond located at the southwest corner of the subdivision. Based on review of the previous subdivision drainage report and the proposed replat, the existing pond has sufficient capacity to accept developed flows from the full extents of the replatted subdivision.

As shown on the enclosed Drainage Plan, the existing detention pond has a capacity of approximately 4.4 acre-feet.

Pond sizing calculations have been performed using the Denver Urban Drainage "UD-Detention_v3.07" software. According to the pond calculations in Appendix C, based on the total impervious area of the Wolf Business Park draining into the existing pond, the total required water quality capture volume and 100-year detention storage volume is 1.8 acre-feet, which is significantly less than the existing pond capacity. As such, the existing pond has sufficient capacity to accept developed flows from the replatted subdivision, and the existing pond is the optimal outfall location for developed drainage from the site.

V. FLOODPLAIN IMPACTS

This site is located beyond the limits of any delineated 100-year floodplain as shown in the FEMA floodplain map for this area, FIRM Panel No. 08041C0276F, dated March 17, 1997.

VI. SUMMARY

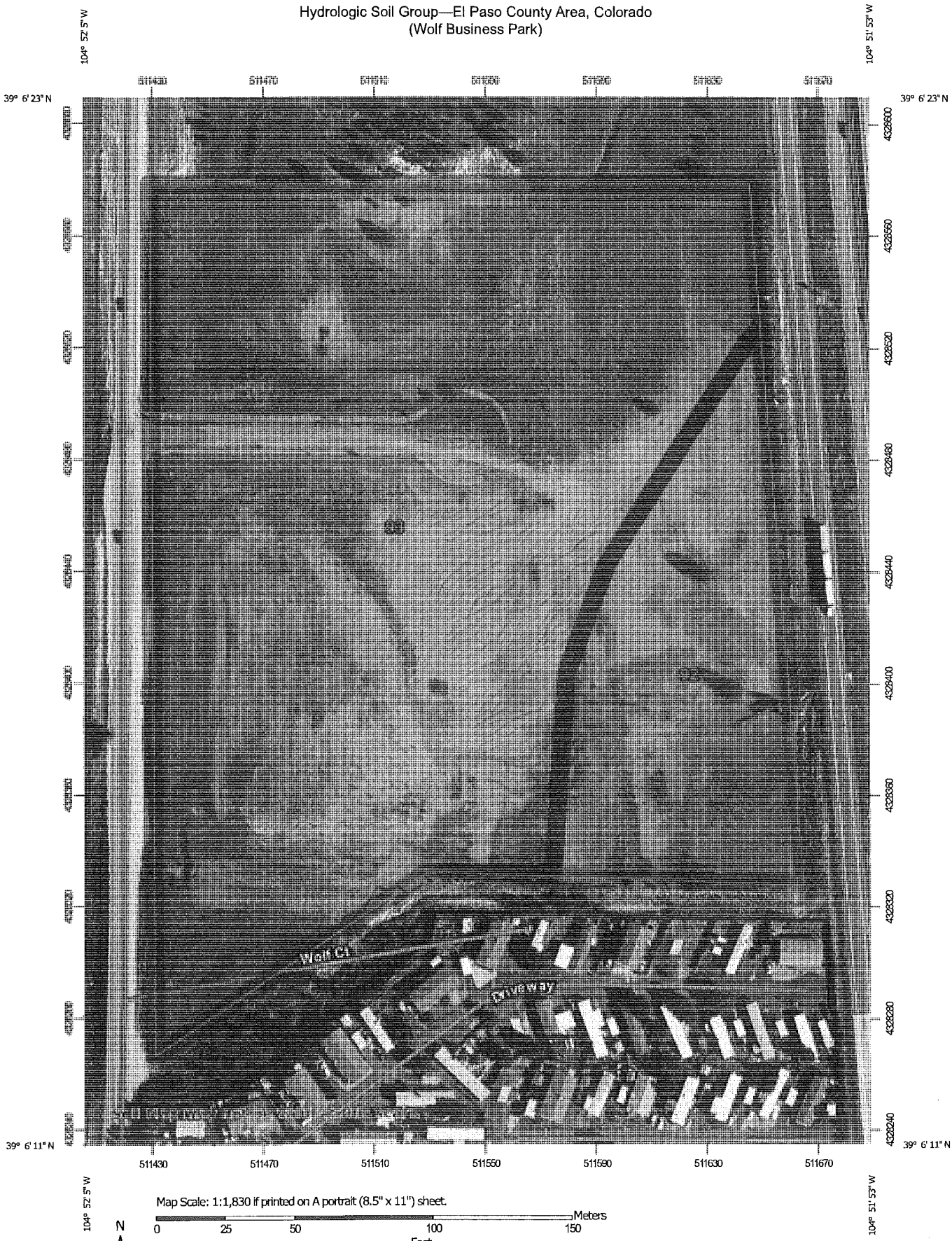
The proposed drainage patterns associated with the Wolf Business Park Filing No. 2 replat and the new Tri-Lakes Collision site development will remain consistent with historic conditions and the overall drainage plan for the Wolf Business Park. The proposed drainage plan will convey developed drainage to the existing subdivision stormwater detention pond on the south side of the property, and the existing pond has adequate capacity to accept developed flows from the full extents of the replatted subdivision.

Recommended site drainage construction practices include establishment and maintenance of adequate protective slopes draining away from buildings, positive drainage through the site, and proper erosion control practices. Construction and maintenance of the proposed site drainage improvements, in conjunction with proper erosion control measures, will ensure that the developed site has no significant adverse drainage impact on adjacent properties or downstream facilities.

APPENDIX A

SOILS INFORMATION

Hydrologic Soil Group—El Paso County Area, Colorado
(Wolf Business Park)



MAP LEGEND

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

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

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.

Warning: Soil Map may not be valid at this scale.

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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)

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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 14, Sep 23, 2016

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

Date(s) aerial images were photographed: Apr 15, 2011—Sep 22, 2011

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Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — El Paso County Area, Colorado (CO625)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
92	Tomah-Crowfoot loamy sands, 3 to 8 percent slopes	B	2.9	20.0%
93	Tomah-Crowfoot complex, 8 to 15 percent slopes	B	11.7	80.0%
Totals for Area of Interest			**14.6**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

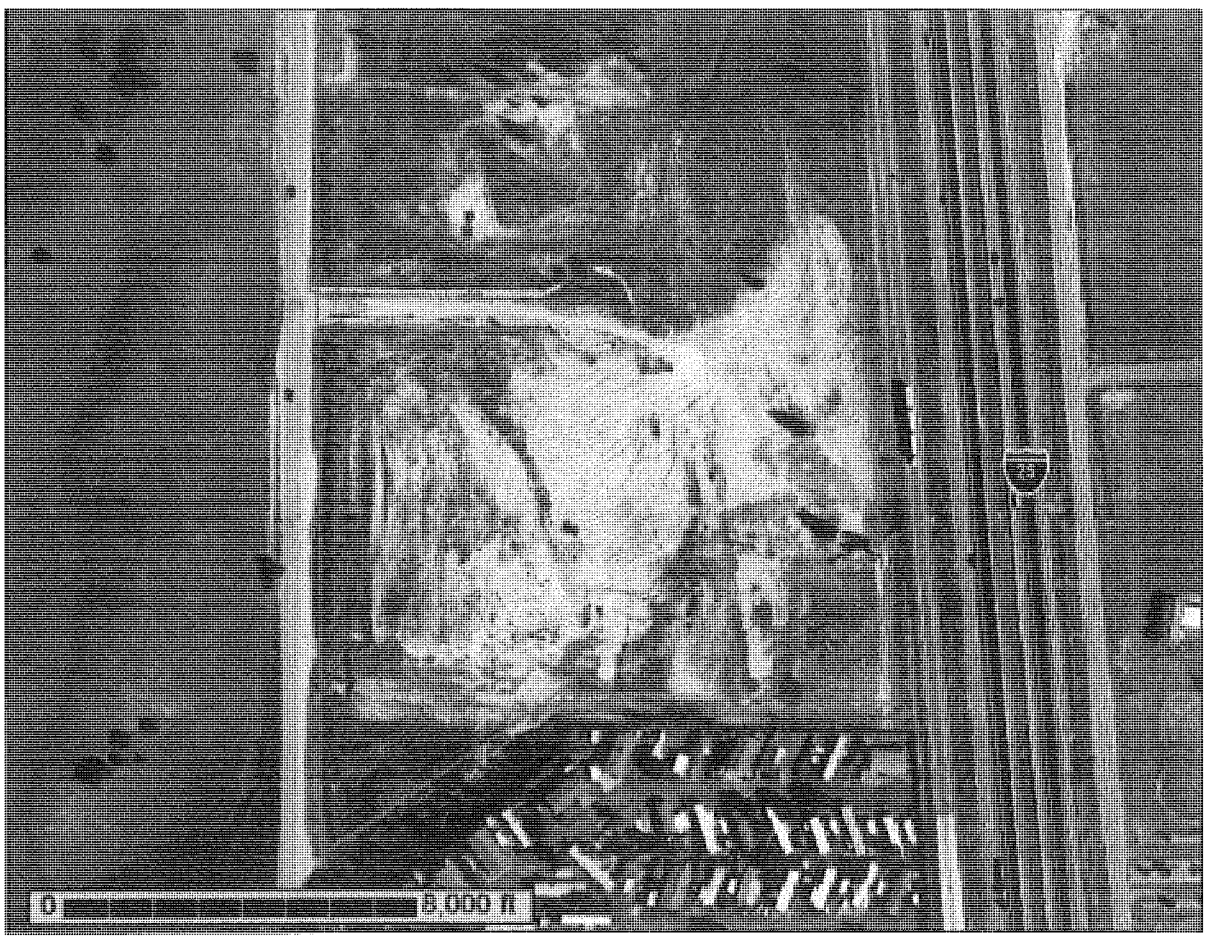
United States Department of Agriculture

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



April 6, 2017

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.

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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.

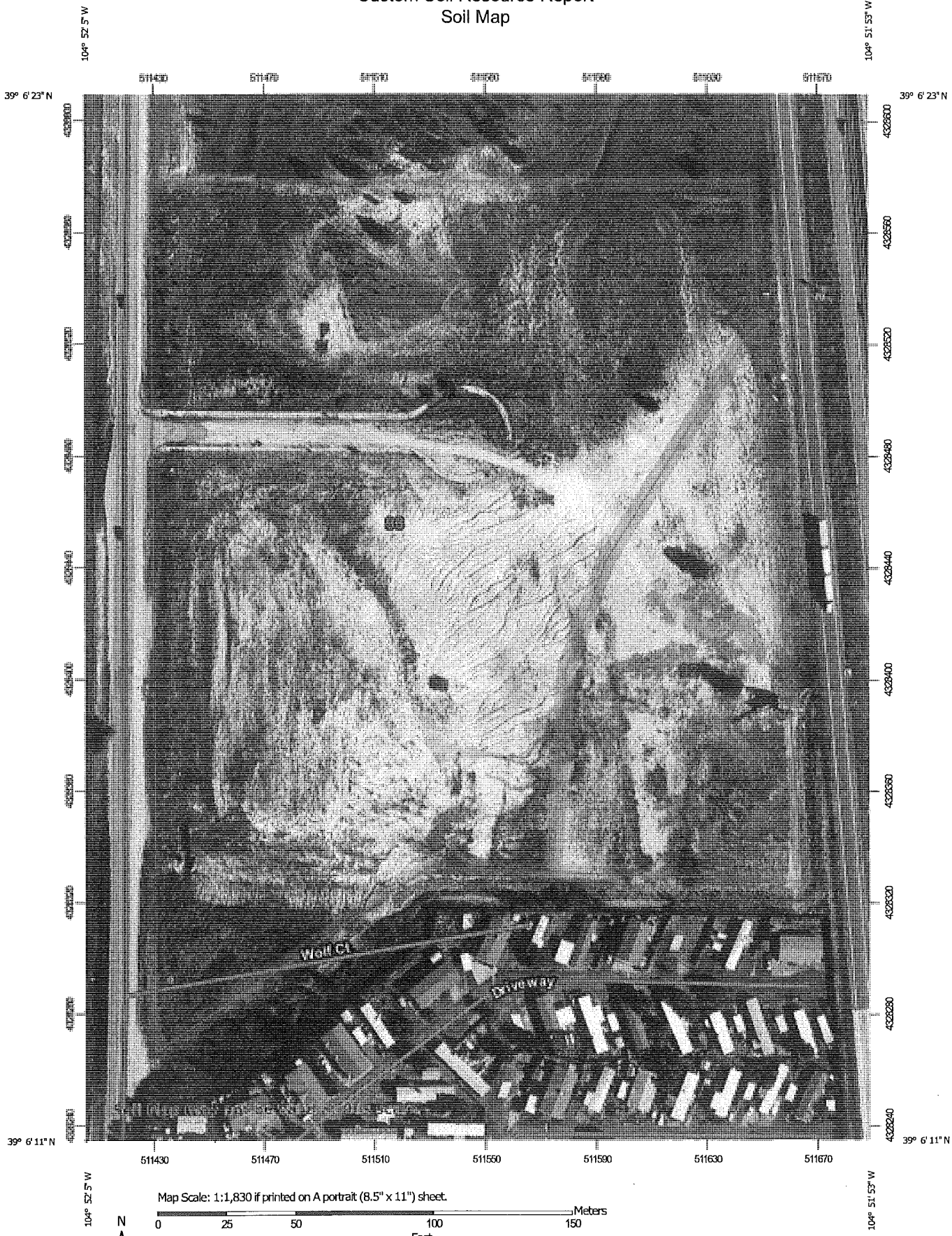
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree 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.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104° 51' 53" W
39° 6' 23" N
39° 6' 11" N
511430
511470
511510
511550
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4328440
4328400
4328360
4328320
4328280
4328240
Well Ct
Driveway
Map Scale: 1:1,830 if printed on A portrait (8.5" x 11") sheet.
Meters
0 25 50 100 150
Feet
0 50 100 200 300
N
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

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- Aerial Photography

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Map Unit Legend

El Paso County Area, Colorado (CO625)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
92	Tomah-Crowfoot loamy sands, 3 to 8 percent slopes	2.9	20.0%
93	Tomah-Crowfoot complex, 8 to 15 percent slopes	11.7	80.0%
Totals for Area of Interest		**14.6**	**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

92—Tomah-Crowfoot loamy sands, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 36b9
Elevation: 7,300 to 7,600 feet
Farmland classification: Not prime farmland

Map Unit Composition

Tomah and similar soils: 50 percent
Crowfoot and similar soils: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tomah

Setting

Landform: Alluvial fans, hills
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from arkose and/or residuum weathered from arkose

Typical profile

A - 0 to 10 inches: loamy sand
E - 10 to 22 inches: coarse sand
C - 48 to 60 inches: coarse sand

Properties and qualities

Slope: 3 to 8 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 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: Sandy Divide (R049BY216CO)
Hydric soil rating: No

Description of Crowfoot

Setting

Landform: Alluvial fans, hills
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 12 inches: loamy sand
E - 12 to 23 inches: sand
Bt - 23 to 36 inches: sandy clay loam
C - 36 to 60 inches: coarse sand

Properties and qualities

Slope: 3 to 8 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 2.00 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 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: Sandy Divide (R049BY216CO)
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

93—Tomah-Crowfoot complex, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 36bb
Elevation: 7,300 to 7,600 feet
Farmland classification: Not prime farmland

Map Unit Composition

Tomah and similar soils: 50 percent
Crowfoot and similar soils: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tomah

Setting

Landform: Alluvial fans, hills
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from arkose and/or residuum weathered from arkose

Typical profile

A - 0 to 10 inches: loamy sand
E - 10 to 22 inches: coarse sand
C - 48 to 60 inches: coarse sand

Properties and qualities

Slope: 8 to 15 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 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: Sandy Divide (R049BY216CO)
Hydric soil rating: No

Description of Crowfoot

Setting

Landform: Alluvial fans, hills
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 12 inches: loamy sand
E - 12 to 23 inches: sand
Bt - 23 to 36 inches: sandy clay loam
C - 36 to 60 inches: coarse sand

Properties and qualities

Slope: 8 to 15 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 2.00 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 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: Sandy Divide (R049BY216CO)
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

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

APPENDIX B

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.

$$t_c = t_i + t_t \quad \text{(Eq. 6-7)}$$

Where:

t_c = time of concentration (min)

t_i = overland (initial) flow time (min)

t_t = travel time in the ditch, channel, gutter, storm sewer, etc. (min)

3.2.1 Overland (Initial) Flow Time

The overland flow time, t_i, may be calculated using Equation 6-8.

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \quad \text{(Eq. 6-8)}$$

Where:

t_i = overland (initial) flow time (min)
C_5 = runoff coefficient for 5-year frequency (see Table 6-6)
L = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
S = average basin slope (ft/ft)

Note that in some urban watersheds, the overland flow time may be very small because flows quickly concentrate and channelize.

3.2.2 Travel Time

For catchments with overland and channelized flow, the time of concentration needs to be considered in combination with the travel time, t_t, which is calculated using the hydraulic properties of the swale, ditch, or channel. For preliminary work, the overland travel time, t_t, can be estimated with the help of Figure 6-25 or Equation 6-9 (Guo 1999).

$$V = C_v S_w^{0.5} \quad \text{(Eq. 6-9)}$$

Where:

V = velocity (ft/s)

C_v = conveyance coefficient (from Table 6-7)

S_w = watercourse slope (ft/ft)

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)*	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

* For buried riprap, select C_v value based on type of vegetative cover.

The travel time is calculated by dividing the flow distance (in feet) by the velocity calculated using Equation 6-9 and converting units to minutes.

The time of concentration (t_c) is then the sum of the overland flow time (t_i) and the travel time (t_t) per Equation 6-7.

3.2.3 First Design Point Time of Concentration in Urban Catchments

Using this procedure, the time of concentration at the first design point (typically the first inlet in the system) in an urbanized catchment should not exceed the time of concentration calculated using Equation 6-10. The first design point is defined as the point where runoff first enters the storm sewer system.

$$t_c = \frac{L}{180} + 10 \qquad \text{(Eq. 6-10)}$$

Where:

t_c = maximum time of concentration at the first design point in an urban watershed (min)

L = waterway length (ft)

Equation 6-10 was developed using the rainfall-runoff data collected in the Denver region and, in essence, represents regional "calibration" of the Rational Method. Normally, Equation 6-10 will result in a lesser time of concentration at the first design point and will govern in an urbanized watershed. For subsequent design points, the time of concentration is calculated by accumulating the travel times in downstream drainageway reaches.

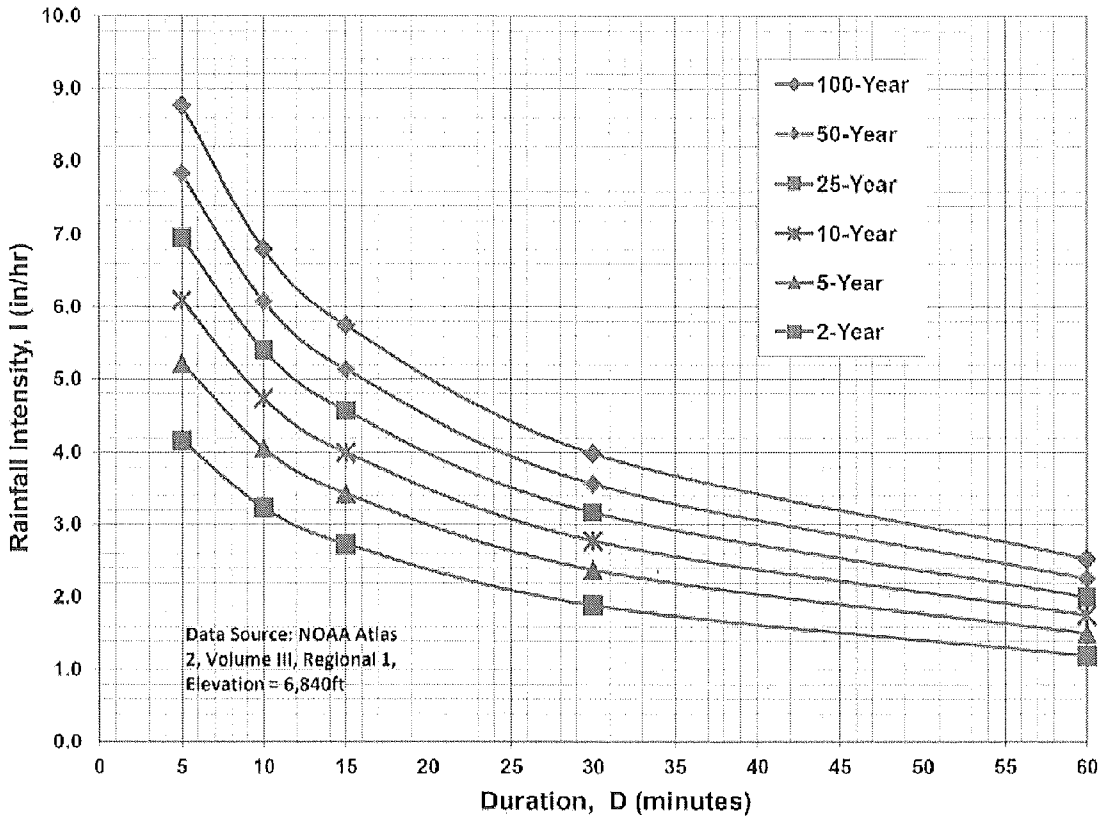
3.2.4 Minimum Time of Concentration

If the calculations result in a t_c of less than 10 minutes for undeveloped conditions, it is recommended that a minimum value of 10 minutes be used. The minimum t_c for urbanized areas is 5 minutes.

3.2.5 Post-Development Time of Concentration

As Equation 6-8 indicates, the time of concentration is a function of the 5-year runoff coefficient for a drainage basin. Typically, higher levels of imperviousness (higher 5-year runoff coefficients) correspond to shorter times of concentration, and lower levels of imperviousness correspond to longer times of

Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

$I_{100} = -2.52 \ln(D) + 12.735$

$I_{50} = -2.25 \ln(D) + 11.375$

$I_{25} = -2.00 \ln(D) + 10.111$

$I_{10} = -1.75 \ln(D) + 8.847$

$I_{5} = -1.50 \ln(D) + 7.583$

$I_{2} = -1.19 \ln(D) + 6.035$

Note: Values calculated by equations may not precisely duplicate values read from figure.

WOLF BUSINESS PARK
RATIONAL METHOD

HISTORIC FLOWS

BASIN	DESIGN POINT	AREA (AC)	C		Overland Flow			Channel flow					TOTAL Tc [4] (MIN)	TOTAL Tc [4] (MIN)	INTENSITY [5]		PEAK FLOW	
			5-YEAR [7]	100-YEAR [7]	LENGTH (FT)	SLOPE (FT/FT)	Tco [1] (MIN)	CHANNEL LENGTH (FT)	CONVEYANCE COEFFICIENT C	SLOPE (FT/FT)	SCS [2] VELOCITY (FT/S)	Tt [3] (MIN)			5-YR (IN/HR)	100-YR (IN/HR)	Q5 [6] (CFS)	Q100 [6] (CFS)
CC165	CC165	43.20	0.080	0.350									12.0	12.0	3.86	6.47	13.33	97.87
CC167(N)	CC167	30.70	0.080	0.350									16.8	16.8	3.35	5.63	8.23	60.44
OA1	OA1	0.98	0.080	0.350	300	0.037	20.9	1100	15.00	0.072	4.02	4.6	25.5	25.5	2.73	4.58	0.21	1.57
A	A	14.17	0.080	0.350	100	0.100	8.7	1200	15.00	0.0383	2.94	6.8	15.5	15.5	3.47	5.83	3.94	28.92
Tt through A							0.0	640	15.00	0.0547	3.51	3.0	3.0					
CC165-167,OA1,A	1	89.05	0.080	0.350									28.5	28.5	2.56	4.29	18.22	133.77

1) OVERLAND FLOW Tco = (0.395*(1.1-RUNOFF COEFFICIENT)*(OVERLAND FLOW LENGTH^(0.5)/(SLOPE^(0.333))
2) SCS VELOCITY = C * ((SLOPE(FT/FT)^0.5)
C = 2.5 FOR HEAVY MEADOW
C = 5 FOR TILLAGE/FIELD
C = 7 FOR SHORT PASTURE AND LAWNS
C = 10 FOR NEARLY BARE GROUND
C = 15 FOR GRASSED WATERWAY
C = 20 FOR PAVED AREAS AND SHALLOW PAVED SWALES

3) MANNING'S CHANNEL TRAVEL TIME = L/V (WHEN CHANNEL VELOCITY IS KNOWN)
4) Tc = Tco + Tt
*** IF TOTAL TIME OF CONCENTRATION IS LESS THAN 5 MINUTES, THEN 5 MINUTES IS USED
5) INTENSITY BASED ON I-D-F EQUATIONS IN CITY OF COLORADO SPRINGS DRAINAGE CRITERIA MANUAL
$I_5 = -1.5 * \ln(Tc) + 7.583$
$I_{100} = -2.52 * \ln(Tc) + 12.735$
6) Q = CiA

WOLF BUSINESS PARK
COMPOSITE RUNOFF COEFFICIENTS

DEVELOPED CONDITIONS

5-YEAR C VALUES

BASIN	TOTAL AREA (AC)	(AC)	SUB-AREA 1 DEVELOPMENT/ COVER	C	AREA (AC)	SUB-AREA 2 DEVELOPMENT/ COVER	C	(AC)	SUB-AREA 3 DEVELOPMENT/ COVER	C	WEIGHTED C VALUE
CC167	30.70	30.70	UNDEVELOPED	0.09							0.090
A1	4.54	4.54	COMMERCIAL / INDUSTRIAL	0.59							0.590
CC167,A1	35.24										0.154
A2	4.53	4.53	COMMERCIAL / INDUSTRIAL	0.59							0.590
CC167,A1,A2	39.77										0.204
A4	2.00	2.00	COMMERCIAL / INDUSTRIAL	0.59							0.590
CC167,A1,A2,A4	41.77										0.223
CC165	43.20	21.60	COMMERCIAL	0.59	21.60	LANDSCAPED	0.08				0.335
OA1	0.98	0.98	COMMERCIAL / INDUSTRIAL	0.59							0.590
CC165,OA1	44.18										0.341
A3	2.02	2.02	COMMERCIAL / INDUSTRIAL	0.59							0.590
CC165,OA1,A3	46.20										0.352
A5	1.08	1.08	DETENTION POND	0.08							0.080
CC165-167,OA1,A1-A5	89.05										0.288

100-YEAR C VALUES

BASIN	TOTAL AREA (AC)	(AC)	SUB-AREA 1 DEVELOPMENT/ COVER	C	AREA (AC)	SUB-AREA 2 DEVELOPMENT/ COVER	C	(AC)	SUB-AREA 3 DEVELOPMENT/ COVER	C	WEIGHTED C VALUE
CC167	30.70	30.70	UNDEVELOPED	0.36							0.360
A1	4.54	4.54	COMMERCIAL / INDUSTRIAL	0.7							0.700
CC167,A1	35.24										0.404
A2	4.53	4.53	COMMERCIAL / INDUSTRIAL	0.7							0.700
CC167,A1,A2	39.77										0.438
A4	2.00	2.00	COMMERCIAL / INDUSTRIAL	0.7							0.700
CC167,A1,A2,A4	41.77										0.450
CC165	43.20	21.60	COMMERCIAL	0.7	21.60	LANDSCAPED	0.35				0.525
OA1	0.98	0.98	COMMERCIAL / INDUSTRIAL	0.7							0.700
CC165,OA1	44.18										0.529
A3	2.02	2.02	COMMERCIAL / INDUSTRIAL	0.7							0.700
CC165,OA1,A3	46.20										0.536
A5	1.08	1.08	DETENTION POND	0.35							0.350
CC165-167,OA1,A1-A5	89.05										0.494

WOLF BUSINESS PARK
RATIONAL METHOD

DEVELOPED FLOWS

BASIN	DESIGN POINT	AREA (AC)	C 5-YEAR[7]	C 100-YEAR[7]	Overland Flow LENGTH (FT)	Overland Flow SLOPE (FT/FT)	Overland Flow Tco[1] (MIN)	Channel flow CHANNEL LENGTH (FT)	Channel flow CONVEYANCE COEFFICIENT C	Channel flow SLOPE (FT/FT)	Channel flow SCS[2] VELOCITY (FT/S)	Tt[3] (MIN)	TOTAL Tc[4] (MIN)	TOTAL Tc[4] (MIN)	INTENSITY[5] 5-YR (IN/HR)	INTENSITY[5] 100-YR (IN/HR)	PEAK FLOW Q5[6] (CFS)	PEAK FLOW Q100[6] (CFS)
CC167(N)	CC167	30.7	0.090	0.360									16.8	16.8	3.35	5.63	9.26	62.17
A1	A1	4.54	0.590	0.700	100	0.100	4.3	680	20.00	0.0309	3.52	3.2	7.6	7.6	4.55	7.64	12.18	24.27
Tt-Pipe A1								300	20.00	0.04	4.00	1.3						
CC167,A1	A1.1	35.24	0.154	0.404									18.1	18.1	3.24	5.44	17.60	77.51
A2	A2	4.53	0.590	0.700	100	0.050	5.5	730	20.00	0.0384	3.92	3.1	8.6	8.6	4.36	7.32	11.66	23.22
Tt-Pipe A2								340	20.00	0.0147	2.42	2.3						
CC167,A1,A2	A2.1	39.77	0.204	0.438									20.4	20.4	3.06	5.14	24.83	89.49
A4	A4	2.00	0.590	0.700	80	0.033	5.6	380	20.00	0.027	3.31	1.9	7.6	7.6	4.55	7.64	5.37	10.70
Tt-Pipe-A4								260	20.00	0.0615	4.96	0.9						
CC167,A1,A2,A4	A4.1	41.77	0.223	0.450									21.3	21.3	3.00	5.03	27.92	94.58
CC165	CC165	43.2	0.335	0.525									12.0	12.0	3.86	6.47	55.80	146.81
OA1	OA1	0.98	0.590	0.700			0.0	280	20.00	0.036	3.78	1.2	1.2	5.0	5.17	8.68	2.99	5.95
A3	A3	2.02	0.590	0.700	100	0.070	4.9	320	20.00	0.078	5.59	1.0	5.8	5.8	4.94	8.29	5.88	11.72
Tt-Channel-A3								340	15.00	0.0735	4.07	1.4						
CC165,OA1,A3	A3.1	46.2	0.352	0.536									14.6	14.6	3.56	5.97	57.87	147.93
A1-A4		13.09	0.590	0.700														
CC165-167,OA1,A1-A4		87.97	0.590	0.700														
A5		1.1	0.080	0.350			0.0	90	15.00	0.044	3.15	0.5	0.5					
CC165-167,OA1,A1-A5	1	89.05	0.288	0.494									21.7	21.7	2.96	4.98	76.03	218.89

1) OVERLAND FLOW Tco = (0.395*(1.1-RUNOFF COEFFICIENT)*(OVERLAND FLOW LENGTH^(0.5)/(SLOPE^(0.333))
2) SCS VELOCITY = C * ((SLOPE(FT/FT)^0.5)
C = 2.5 FOR HEAVY MEADOW
C = 5 FOR TILLAGE/FIELD
C = 7 FOR SHORT PASTURE AND LAWNS
C = 10 FOR NEARLY BARE GROUND
C = 15 FOR GRASSED WATERWAY
C = 20 FOR PAVED AREAS AND SHALLOW PAVED SWALES

3) MANNING'S CHANNEL TRAVEL TIME = L/V (WHEN CHANNEL VELOCITY IS KNOWN)
4) Tc = Tco + Tt
*** IF TOTAL TIME OF CONCENTRATION IS LESS THAN 5 MINUTES, THEN 5 MINUTES IS USED
5) INTENSITY BASED ON I-D-F EQUATIONS IN CITY OF COLORADO SPRINGS DRAINAGE CRITERIA MANUAL
$I_5 = -1.5 * \ln(Tc) + 7.583$
$I_{100} = -2.52 * \ln(Tc) + 12.735$
6) Q = CiA

7) WEIGHTED AVERAGE C VALUES FOR COMBINED BASINS

APPENDIX C

HYDRAULIC CALCULATIONS

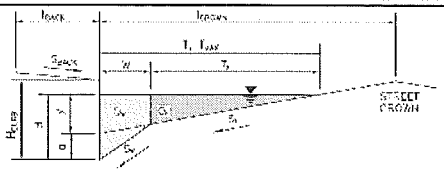
Version 4.04 Released November 2016

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Wolf Business Park - Lot 7 - Basin A4.1-A4.2 (Q = 25% * DPA4)

Inlet ID: Inlet A4.1-A4.2



Gutter Geometry (Enter data in the blue cells)

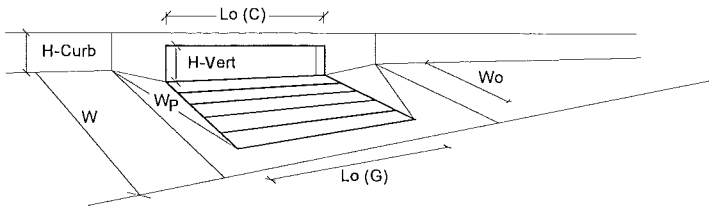
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	10.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	20.0	20.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

Version 4.04 Released November 2016



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening	
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')		a_{local} =	3.00	3.00 inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	6.3 inches
Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A feet
Width of a Unit Grate		W_o =	N/A	N/A feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00 feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00 inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00 inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40 degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00 feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.33	0.36 ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.77	0.81
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	1.00	1.00
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**5.4**	**6.0** **cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	1.3	2.7 cfs

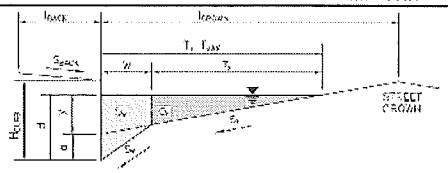
Version 4.04 Released November 2016

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Wolf Business Park - Lot 7 - Basin A4.3 (Q = 50% * DPA4)

Inlet ID: Inlet A4.3



Gutter Geometry (Enter data in the blue cells)

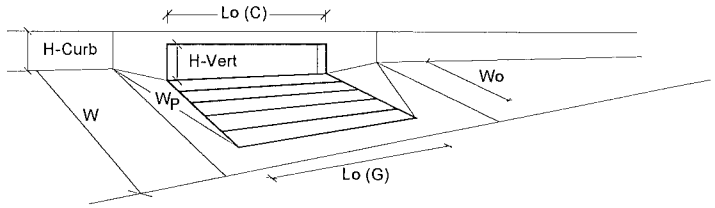
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	50.0	ft
Gutter Width	W =	1.00	ft
Street Transverse Slope	S_X =	0.050	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	50.0	50.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)				check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

Version 4.04 Released November 2016



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	12.0	inches
Grate Information			MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	1.00	1.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.42	0.92	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.77	1.00	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**5.9**	**12.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	2.7	5.4	cfs

Hydraulic Analysis Report

Project Data

Project Title: Wolf Business Park
Designer: JPS
Project Date: Friday, April 07, 2017
Project Units: U.S. Customary Units
Notes:

Channel Analysis: New-SD-Pipe-A4.1-4.3

Notes:

Input Parameters

Channel Type: Circular
Pipe Diameter: 1.5000 ft
Longitudinal Slope: 0.0100 ft/ft
Manning's n: 0.0130
Flow: 5.3500 cfs

Result Parameters

Depth: 0.7582 ft
Area of Flow: 0.8959 ft^2
Wetted Perimeter: 2.3726 ft
Hydraulic Radius: 0.3776 ft
Average Velocity: 5.9718 ft/s
Top Width: 1.4999 ft
Froude Number: 1.3617
Critical Depth: 0.8914 ft
Critical Velocity: 4.8888 ft/s
Critical Slope: 0.0059 ft/ft
Critical Top Width: 1.47 ft
Calculated Max Shear Stress: 0.4731 lb/ft^2
Calculated Avg Shear Stress: 0.2356 lb/ft^2

Channel Analysis: Exst-SD-Pipe-A4

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 4.0000 ft

Longitudinal Slope: 0.0170 ft/ft

Manning's n: 0.0130

Depth: 4.0000 ft

Result Parameters

Flow: 187.2879 cfs

Area of Flow: 12.5664 ft^2

Wetted Perimeter: 12.5664 ft

Hydraulic Radius: 1.0000 ft

Average Velocity: 14.9039 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 3.8047 ft

Critical Velocity: 15.1778 ft/s

Critical Slope: 0.0147 ft/ft

Critical Top Width: 1.72 ft

Calculated Max Shear Stress: 4.2432 lb/ft^2

Calculated Avg Shear Stress: 1.0608 lb/ft^2

WOLF BUSINESS PARK
COMPOSITE IMPERVIOUS AREAS

IMPERVIOUS AREAS

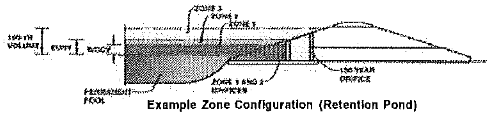
BASIN	TOTAL AREA (AC)	(AC)	SUB-AREA 1 DEVELOPMENT/ COVER	PERCENT IMPERVIOUS	AREA (AC)	SUB-AREA 2 DEVELOPMENT/ COVER	PERCENT IMPERVIOUS	(AC)	SUB-AREA 3 DEVELOPMENT/ COVER	PERCENT IMPERVIOUS	WEIGHTED % IMP
CC167	30.70	30.70	UNDEVELOPED	2							2.000
A1	4.54	4.54	COMMERCIAL / INDUSTRIAL	80							80.000
CC167,A1	35.24										12.049
A2	4.53	4.53	COMMERCIAL / INDUSTRIAL	80							80.000
CC167,A1,A2	39.77										19.789
A4	2.00	2.00	COMMERCIAL / INDUSTRIAL	80							80.000
CC167,A1,A2,A4	41.77										22.672
CC165	43.20	21.60	COMMERCIAL	80	21.60	LANDSCAPED	0				40.000
OA1	0.98	0.98	COMMERCIAL / INDUSTRIAL	80							80.000
CC165,OA1	44.18										40.887
A3	2.02	2.02	COMMERCIAL / INDUSTRIAL	80							80.000
CC165,OA1,A3	46.20										42.597
A5	1.08	1.08	DETENTION POND	0							0.000
CC165-167,OA1,A1-A5	89.05										32.734

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Wolf Business Park

Basin ID: A1-A5



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB			
Watershed Area =	13.10	acres		
Watershed Length =	1,470	ft		
Watershed Slope =	0.038	ft/ft		
Watershed Imperviousness =	80.00%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	100.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Desired WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			
Water Quality Capture Volume (WQCV) =	0.358	acre-feet	Optional User Override 1-hr Precipitation	
Excess Urban Runoff Volume (EURV) =	1.163	acre-feet		
2-yr Runoff Volume (P1 = 1.19 in.) =	0.983	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.292	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.600	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	1.849	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	2.217	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	2.568	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet		inches
Approximate 2-yr Detention Volume =	0.922	acre-feet		
Approximate 5-yr Detention Volume =	1.214	acre-feet		
Approximate 10-yr Detention Volume =	1.508	acre-feet		
Approximate 25-yr Detention Volume =	1.616	acre-feet		
Approximate 50-yr Detention Volume =	1.679	acre-feet		
Approximate 100-yr Detention Volume =	1.769	acre-feet		

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.358	acre-feet
Zone 2 Volume (100-year - Zone 1) =	1.410	acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	1.769	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	user	acre-feet

Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	704	0.016		
	--	1.00	--	--	--	3,709	0.085	2,170	0.050
	--	2.00	--	--	--	15,256	0.350	11,537	0.265
	--	3.00	--	--	--	22,092	0.507	30,363	0.697
	--	4.00	--	--	--	27,404	0.629	55,111	1.265
	--	5.00	--	--	--	31,414	0.721	84,520	1.940
	--	6.00	--	--	--	34,121	0.783	117,287	2.693
	--	7.00	--	--	--	37,365	0.858	153,030	3.513
100-YR WSL	--	8.00	--	--	--	40,529	0.930	191,977	4.407
	--	9.00	--	--	--	46,500	1.067	235,492	5.406
TOP	--	10.00	--	--	--	50,000	1.148	283,742	6.514
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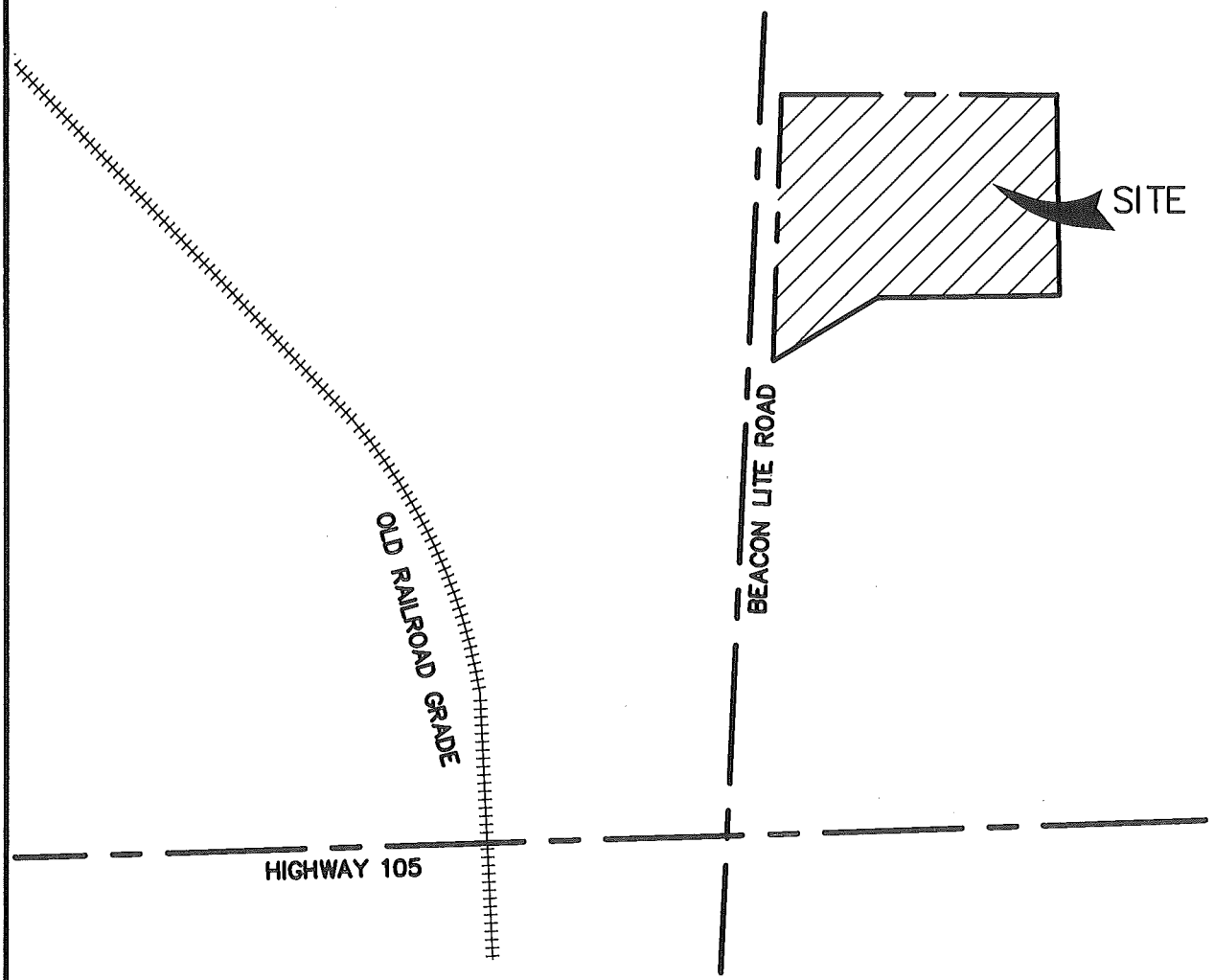
APPENDIX D

FIGURES



VICINITY MAP

JPS ENGINEERING

WOLF BUSINESS PARK

FIGURE A1

JPS PROJ NO. 051601

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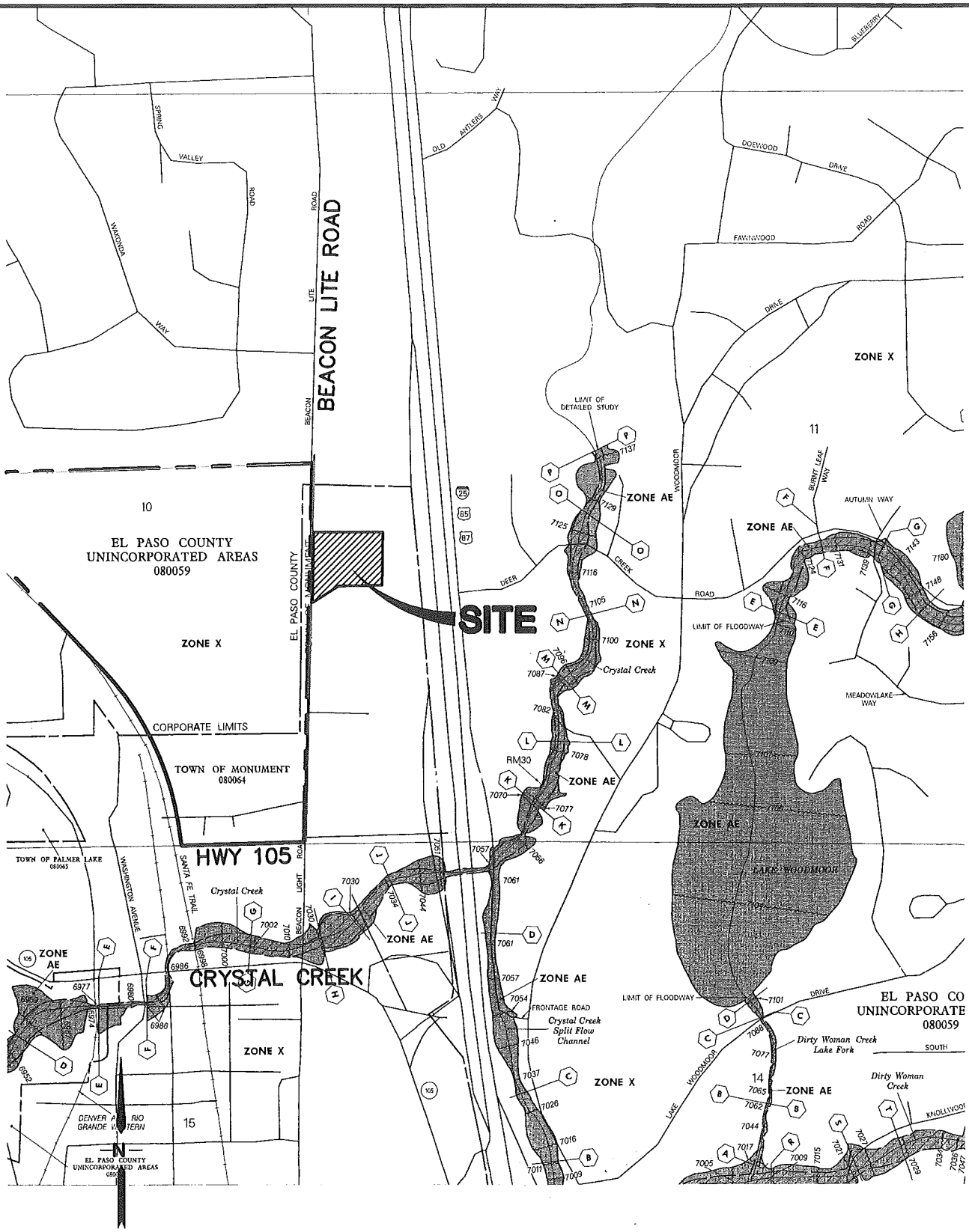

SCALE: 1"=1000'

(EL PASO COUNTY FIRM 08041C0276F, DATED MAR 17, 1997)

WOLF BUSINESS PARK

JPS ENGINEERING

FLOODPLAIN MAP

FIGURE A2

JPS PROJ NO. 051601

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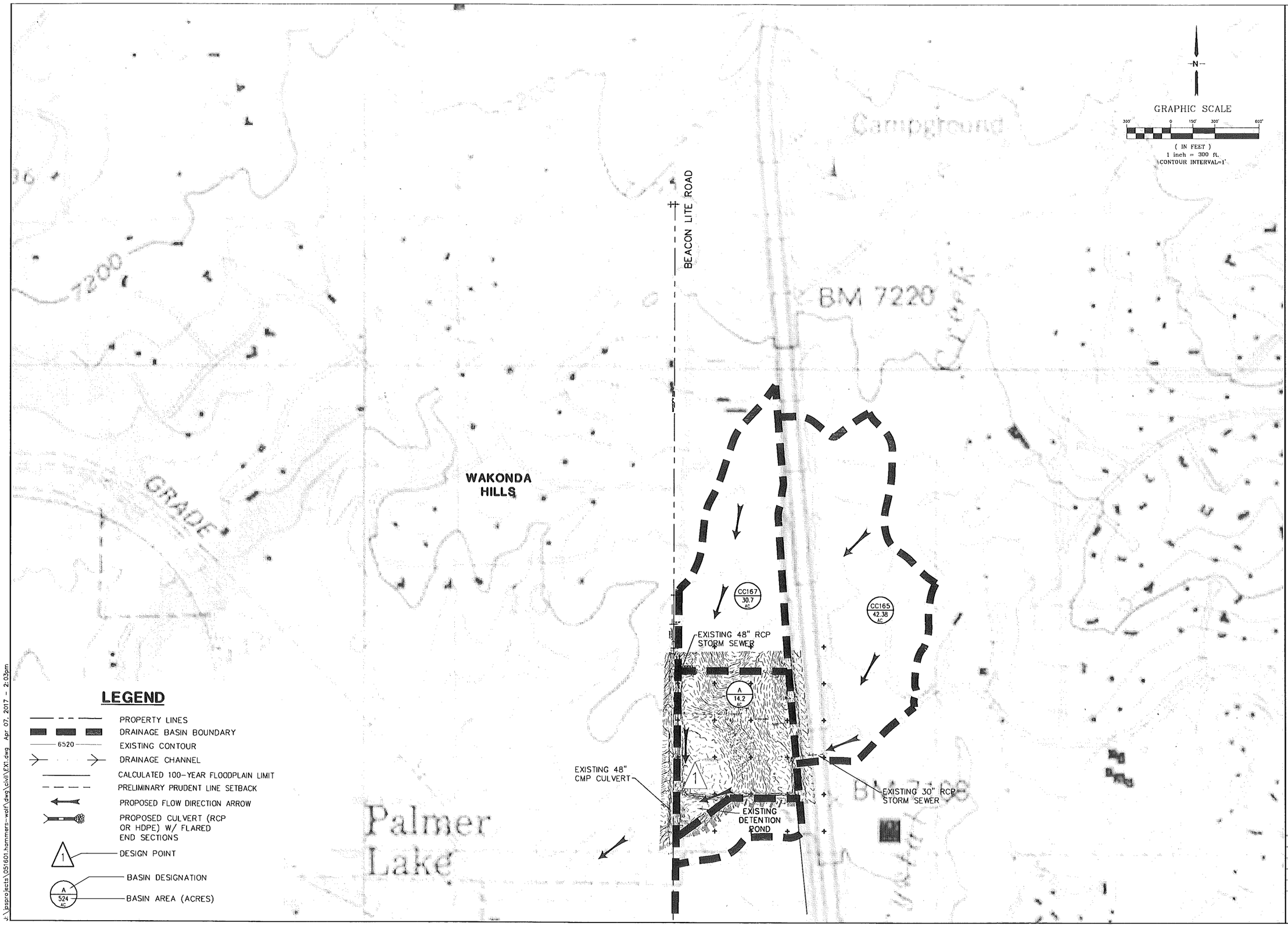

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WOLF BUSINESS PARK - FILING NO. 2
BEACON LITE RD, MONUMENT, CO 80132

MAJOR BASIN HISTORIC DRAINAGE PLAN

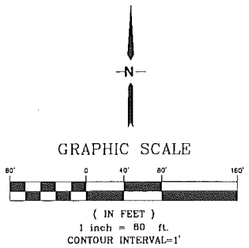
JPS ENGINEERING
19 E. Willamette Ave.
Colorado Springs, CO 80903
PH: 719-477-9429
FAX: 719-471-0766
www.jpsengr.com

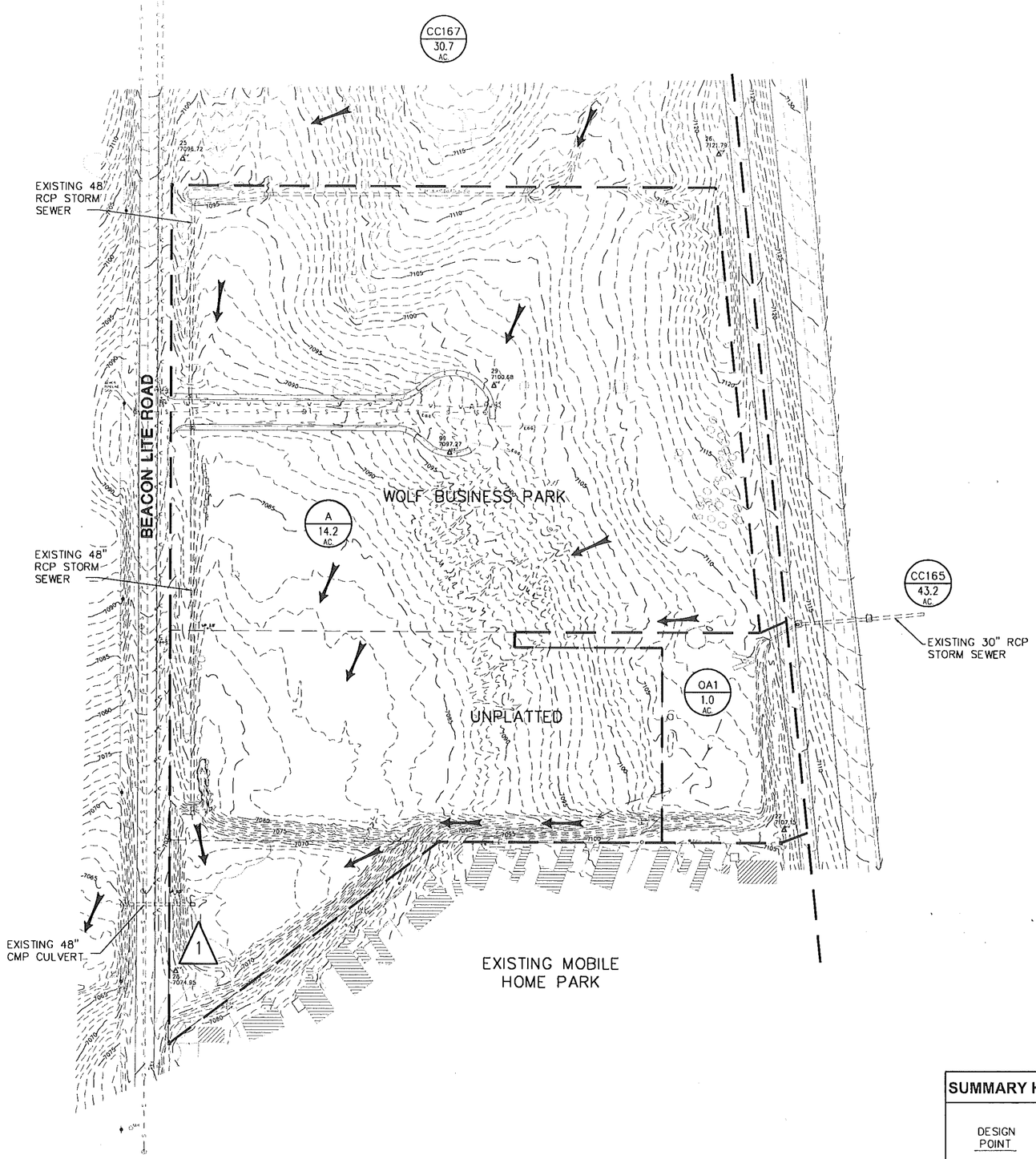
CALL UTILITY NOTIFICATION CENTER OF COLORADO
1-800-922-1987
CALL 2-BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

No.	REVISION	BY	DATE

HORZ. SCALE:	1"=300'	DRAWN:	BJJ
VERT. SCALE:	N/A	DESIGNED:	JPS
SURVEYED:	RAMPART	CHECKED:	JPS
CREATED:	3/30/17	LAST MODIFIED:	4/07/17
PROJECT NO:	051601	MODIFIED BY:	BJJ

SHEET: EX1





LEGEND

- PROPERTY LINES
- DRAINAGE BASIN BOUNDARY
- 6520 EXISTING CONTOUR
- DRAINAGE CHANNEL
- CALCULATED 100-YEAR FLOODPLAIN LIMIT
- PRELIMINARY PRUDENT LINE SETBACK
- PROPOSED FLOW DIRECTION ARROW
- PROPOSED CULVERT (RCP OR HDPE) W/ FLARED END SECTIONS
- 1 DESIGN POINT
- A / 524 / AC BASIN DESIGNATION
- BASIN AREA (ACRES)

SUMMARY HYDROLOGY TABLE		
	DEVELOPED	
DESIGN POINT	Q5 (CFS)	Q100 (CFS)
1	18.2	133.8

WOLF BUSINESS PARK
BEACON LITE RD, MONUMENT, CO 80132

HISTORIC DRAINAGE PLAN

No.	REVISION	BY	DATE

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Colorado Springs, CO
80903
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1-800-922-1987
CALL 2-BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

HORZ. SCALE: 1"=80'	DRAWN: BJJ
VERT. SCALE: N/A	DESIGNED: JPS
SURVEYED: RAMPART	CHECKED: JPS
CREATED: 5/09/16	LAST MODIFIED: 4/07/17
PROJECT NO: 051601	MODIFIED BY: BJJ

SHEET: EX2

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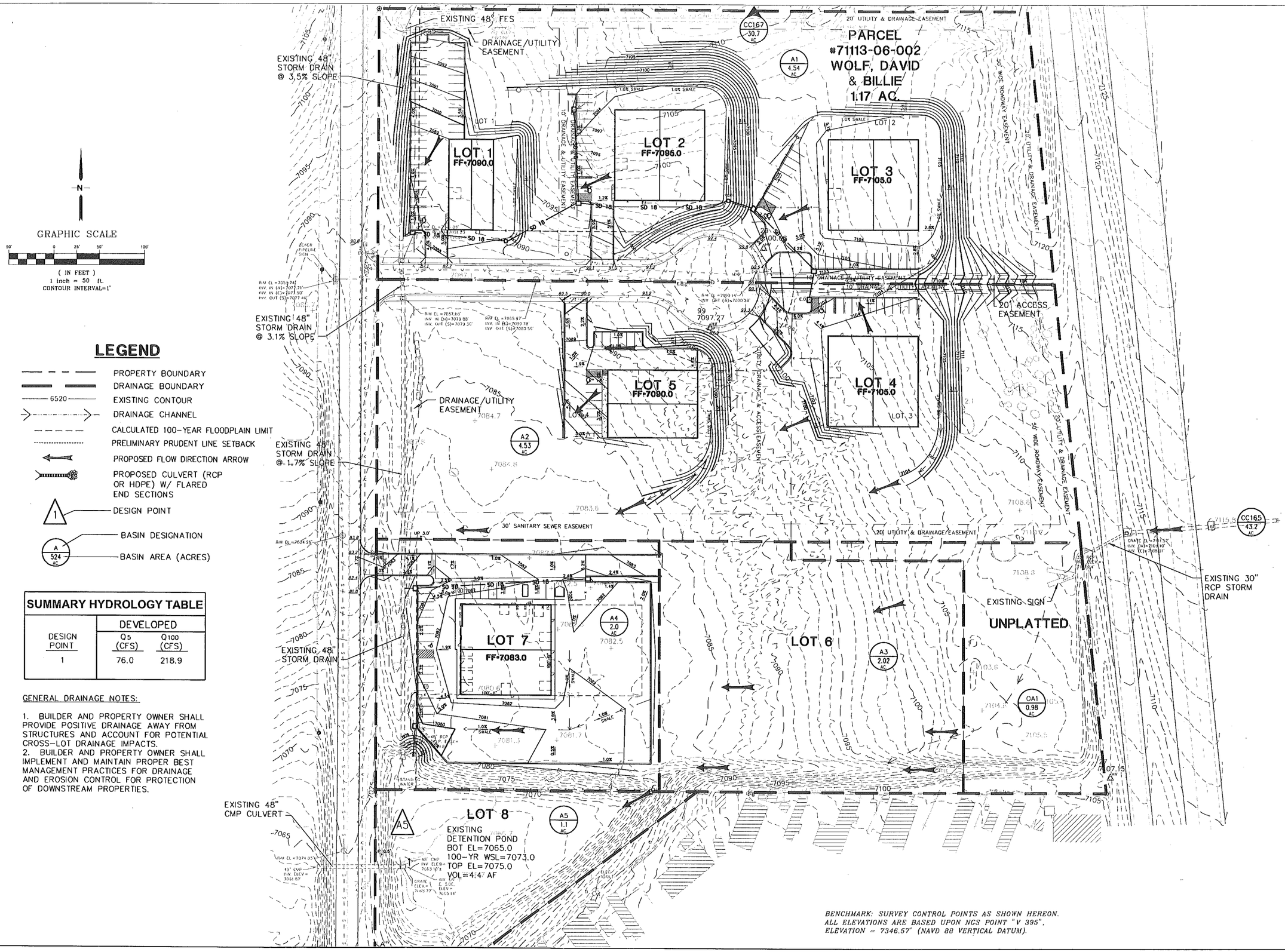

GRAPHIC SCALE

50' 0 25' 50' 100'

(IN FEET)
1 inch = 50 ft.
CONTOUR INTERVAL=1'

LEGEND

- PROPERTY BOUNDARY
- DRAINAGE BOUNDARY
- 6520 — EXISTING CONTOUR
- DRAINAGE CHANNEL
- CALCULATED 100-YEAR FLOODPLAIN LIMIT
- PRELIMINARY PRUDENT LINE SETBACK
- PROPOSED FLOW DIRECTION ARROW
- PROPOSED CULVERT (RCP OR HDPE) W/ FLARED END SECTIONS
- 1 — DESIGN POINT
- A / 524 AC — BASIN DESIGNATION / BASIN AREA (ACRES)

SUMMARY HYDROLOGY TABLE		
	DEVELOPED	
DESIGN POINT	Q5 (CFS)	Q100 (CFS)
1	76.0	218.9

GENERAL DRAINAGE NOTES:

1. BUILDER AND PROPERTY OWNER SHALL PROVIDE POSITIVE DRAINAGE AWAY FROM STRUCTURES AND ACCOUNT FOR POTENTIAL CROSS-LOT DRAINAGE IMPACTS.
2. BUILDER AND PROPERTY OWNER SHALL IMPLEMENT AND MAINTAIN PROPER BEST MANAGEMENT PRACTICES FOR DRAINAGE AND EROSION CONTROL FOR PROTECTION OF DOWNSTREAM PROPERTIES.

BENCHMARK: SURVEY CONTROL POINTS AS SHOWN HEREON. ALL ELEVATIONS ARE BASED UPON NGS POINT "V 395", ELEVATION = 7346.57' (NAVD 88 VERTICAL DATUM).

WOLF BUSINESS PARK - FILING NO. 2
BEACON LITE RD, MONUMENT, CO 80132

DEVELOPED DRAINAGE PLAN

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NO.	REVISION	BY	DATE

HORZ. SCALE: 1"=50'	DRAWN: BJJ
VERT. SCALE: N/A	DESIGNED: JPS
SURVEYED: RAMPART	CHECKED: JPS
CREATED: 5/09/16	LAST MODIFIED: 4/07/17
PROJECT NO: 051601	MODIFIED BY: BJJ
SHEET: D1	

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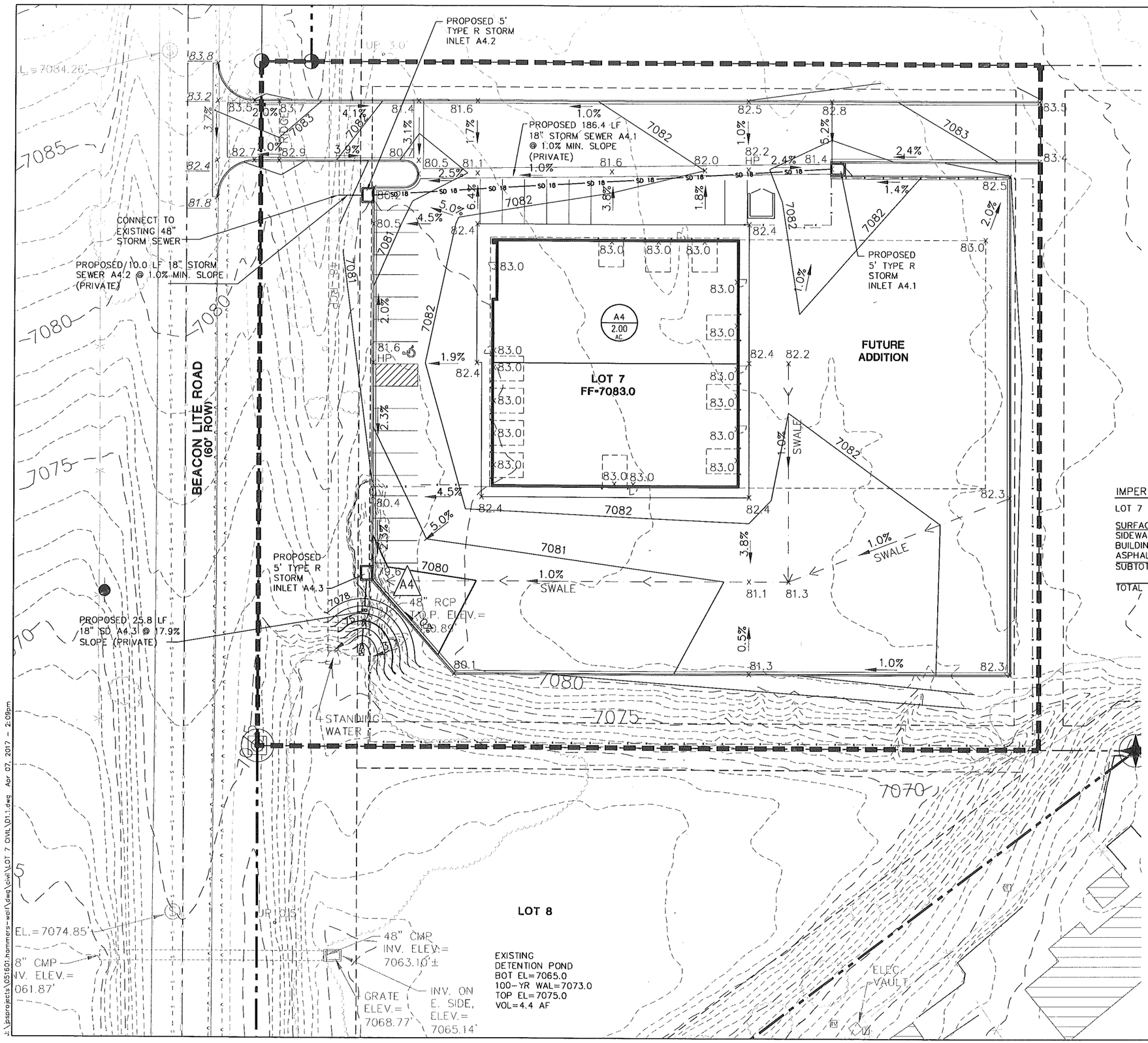

LEGEND

- FEMA 100-YEAR FLOODWAY
- FEMA 100-YR FLOODPLAIN
- FILING LIMITS
- MAJOR BASIN BOUNDARY
- 6520 EXISTING CONTOUR
- FLOWLINE
- PROPOSED FLOW DIRECTION ARROW
- DESIGN POINT (1)
- BASIN DESIGNATION (A) / BASIN AREA (ACRES) (0.86 AC.)
- SILT FENCE (SF)
- RIPRAP (RR)
- VEHICLE TRACKING PAD (VTC)
- INLET PROTECTION (IP)

IMPERVIOUS AREA CALCULATIONS:

LOT 7 AREA = 2.0 AC.

SURFACE TYPE	AREA
SIDEWALK	2,027 SF
BUILDING	9,964 SF
ASPHALT PARKING	48,714 SF
SUBTOTAL	60,705 SF = 1.39 AC (100% IMPERVIOUS)

TOTAL IMPERVIOUS AREA = **69.7%** IMPERVIOUS

SUMMARY HYDROLOGY TABLE

DESIGN POINT	Q_5 (CFS)	Q_{100} (CFS)
A4	5.4	10.7

N

20' 0 20' 40'

ORIGINAL SCALE: 1"=20' (24"x36" SHEET)
CONTOUR INTERVAL: 1'

LOT 7, WOLF BUSINESS PARK - FILING NO. 2
BEACON LITE RD, MONUMENT, CO 80132

DEVELOPED DRAINAGE PLAN

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HORZ. SCALE: 1"=20'	DRAWN: BJJ
VERT. SCALE: N/A	DESIGNED: JPS
SURVEYED: RAMPART	CHECKED: JPS
CREATED: 2/17/17	LAST MODIFIED: 4/07/17
PROJECT NO: 051601	MODIFIED BY: BJJ
SHEET: D1.1	

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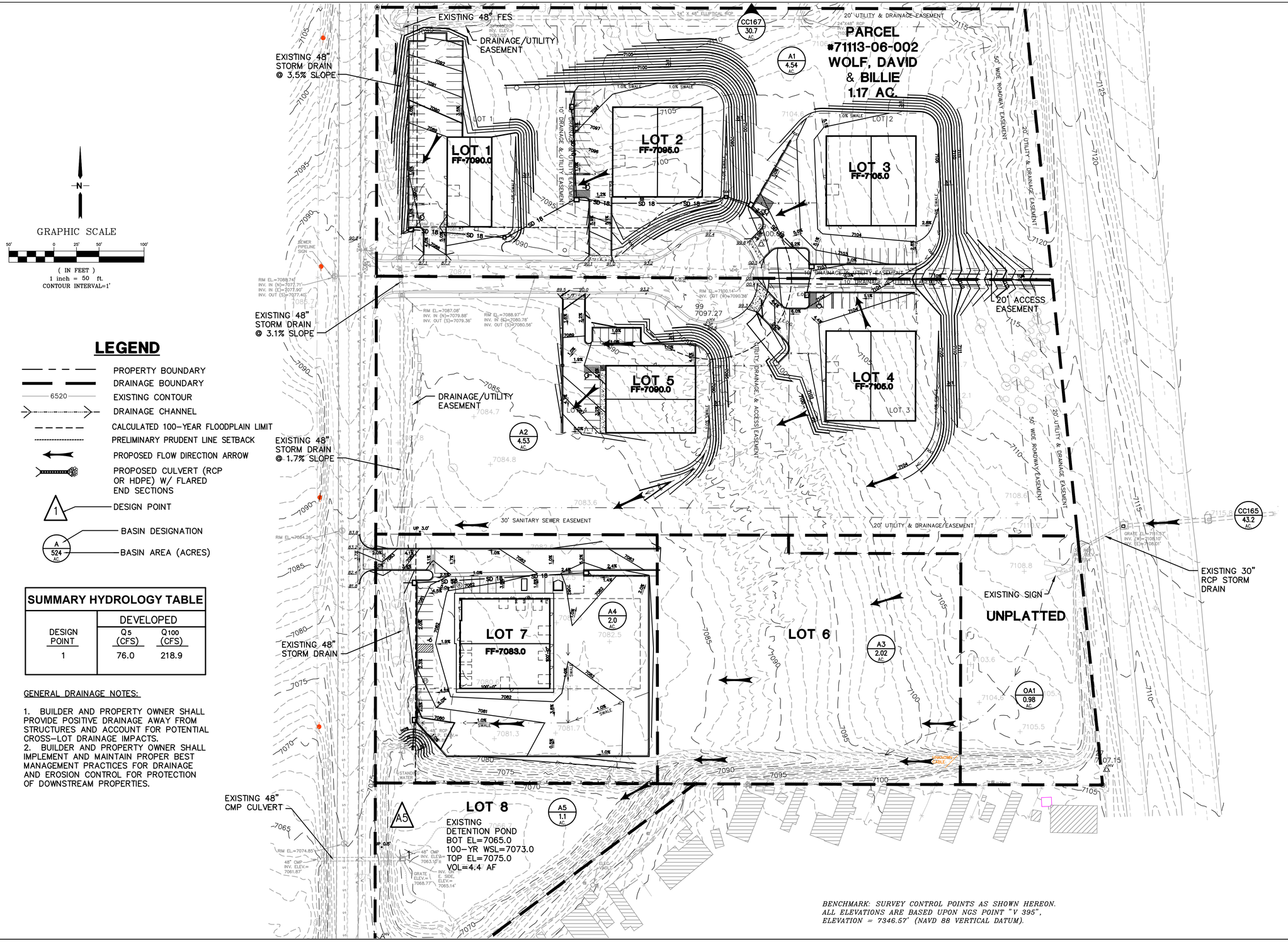

LEGEND

- PROPERTY BOUNDARY
- DRAINAGE BOUNDARY
- 6520 — EXISTING CONTOUR
- DRAINAGE CHANNEL
- CALCULATED 100-YEAR FLOODPLAIN LIMIT
- PRELIMINARY PRUDENT LINE SETBACK
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	DEVELOPED	
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PROJECT NO: 051601	MODIFIED BY: BJJ
SHEET: D1	

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PROPOSED 5' TYPE R STORM INLET A4.2

PROPOSED 186.4 LF 18" STORM SEWER A4.1 @ 1.0% MIN. SLOPE (PRIVATE)

CONNECT TO EXISTING 48" STORM SEWER

PROPOSED/10.0 LF 18" STORM SEWER A4.2 @ 1.0% MIN. SLOPE (PRIVATE)

PROPOSED 5' TYPE R STORM INLET A4.1

PROPOSED 5' TYPE R STORM INLET A4.3

PROPOSED 25.8 LF 18" SD A4.3 @ 17.9% SLOPE (PRIVATE)

BEACON LITE ROAD (60' ROW)

LOT 7
FF-7083.0

FUTURE ADDITION

LOT 8

EXISTING DETENTION POND
BOT EL=7065.0
100-YR WAL=7073.0
TOP EL=7075.0
VOL=4.4 AF

LEGEND

- FEMA 100-YEAR FLOODWAY
- FEMA 100-YR FLOODPLAIN
- FILING LIMITS
- MAJOR BASIN BOUNDARY
- 6520 EXISTING CONTOUR
- FLOWLINE
- PROPOSED FLOW DIRECTION ARROW
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DEVELOPED DRAINAGE PLAN

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PROJECT NO:	051601	MODIFIED BY:	BJJ

SHEET: D1.1

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