Drainage Letter

for

Warner 4-Lot Subdivision

Owner/Applicant:
J. Brian Warner
Colorado Springs, CO 80908
(719) 600-7143

Prepared by:
Forsgren Associates
56 Inverness Drive East, Suite 112
Colorado Springs, CO 80923
(720) 214-5884

August, 2021

PCD File No. MS-21-004

Table of Contents

Appendices

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 preparing this report.

_______________________________ 12/14/2021

Conner Burba, P.E. #51257 Date

COLORADO LICENSED CONNER BURBA 51257 12/14/2021 PROFESSIONAL ENGINEER

Owner/Developer's Statement:

I, the owner/developer have read and will comply with all of the requirements specified in this drainage report and plan.

_______________________________ 17 DEC 2021

Brian Warner Date

17350 W Goshawk Rd

Colorado Springs, CO 80908

El Paso County:

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.

_______________________________ ___________

Jennifer Irvine, P.E. Date
County Engineer / ECM Administrator
Conditions: "

PCD File No. MS-21-004

I. BACKGROUND/PURPOSE

This letter is being presented to discuss existing and future drainage features of the proposed site at 17350 W Goshawk Rd Colorado Springs, CO 80908 and to provide a description of the proposed work. Justification will be provided showing there will be no negative impact to existing drainage features or downstream conditions.

This project is located in the southwest 1/4 of Section 23, Township 11 South, and Range 65 West of the 6th Principal Meridian. The property is located at 17350 W Goshawk Rd Colorado Springs, CO 80908. It has a tax ID number of 5123000037 and is zoned RR-5. The streets that border the project area are W Goshawk Rd. to the South and Hardy Rd. to the North. Currently, there is a single-family residential home at the south center of the property.

II. EXISTING CONDITIONS

Description of Property

The property has an area of 39.86 acres and has a single-family residential home located on the south center portion of the property. Runoff from the site flows, generally, to the northeast and eventually to a tributary of West Kiowa Creek. The soil type for the property consists of approximately 0.4% Elbeth sandy loam at slopes of 3-8%, and 99.6% Elbeth sandy loam at 8-15% slopes. All soil types on site are of the hydrologic soil group B. See Appendix for the Custom Soils Resource Report for the site obtained from the National Cooperative Soil Survey (https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm).

Major Basin Description

The site is located within the West Kiowa Creek Drainage Basin. All flows from the site flow, generally, to the south and end up, eventually, in Kettle Creek.

Floodplain Statement

The proposed improvements are not within a 100-year floodplain, FIRM #08041C0310G; dated December 7, 2018. See Appendix for FEMA FIRM Floodplain maps.

Subbasin Description

The site lies within the West Kiowa Creek Drainage Basin. Stormwater runoff flowing off site shall generally flow overland off site and follow existing drainage patterns. Runoff from basins OS-01 and A shall flow, generally, from the westerly edge of the site and flow overland off site to the northeast. Runoff from basins OS-02 and B shall flow, generally, overland to the south off site then follow existing drainage patterns to the southwest. Runoff from Basin C shall flow, generally, overland to the east. Runoff from Basin D shall flow, generally, overland to the southwest off site then follow existing drainage patterns to the south.

Four Step Process to Minimize Adverse Impacts of Urbanization

El Paso County requires the UDFCD Four Step Process be utilized for receiving waters protection. The goal of the Four Step Process is to reduce runoff volumes, treat the water quality capture volume of runoff, stabilize drainageways, and implement long-term source controls. With development projects with construction activities disturbing 1 acre or more, the Four Step Process must be implemented. Below is a description of all steps of the Four Step Process and how they were utilized in design.

Step 1: Employ Runoff Reduction Practices
In order to reduce the runoff from added impervious areas, driveways to the proposed home/homes to be constructed on-site are anticipated to meet minimum requirements and large additional impervious areas are not anticipated. The large site and surrounding soils shall act to promote infiltration and further reduce runoff volumes off-site.

Step 2: Treat and Slowly Release the WQCV
This minor subdivision is anticipated to have a maximum of 3 new single-family homes constructed on-site across 20 acres of land. The additional runoff from added impervious areas is minimal and should not warrant construction of any pond or other water treatment facility. Waters flowing off site will be treated naturally via overland flow and infiltration.

Step 3: Stabilize Stream Channels
Runoff flows overland offsite to the north, east and south. The overall existing total 100-year storm runoff of 108.4 cfs offsite (given 7% imperviousness) (since overland flow spread across property line, weighted runoff is 0.028 cfs/ft) is minimal. No streams or drainageways are present on, or adjacent to, the site so no action will be taken.

Step 4: Implement Source Controls
Sites with specific needs, such as material storage or other site operations, require specific, source control BMPs be implemented on site, post-construction. For this site, contaminants from site activities are not anticipated. In addition, no hazardous materials will be stored on site. No site specific or other source control BMPs are proposed for this site.

III. PROPOSED CONDITIONS

Proposed Conditions
No site improvements are being proposed at this time. The amount of pervious and impervious areas on site shall remain the same. The current property has a single home with an access road located at the southeast of the property. No offsite roadway improvements are required for this four-lot subdivision. When builders are selected for the various parcels to be developed, each individual homeowner shall pay all required drainage fees to the County. Each individual owner and builder shall also conduct their own due-diligence when developing each lot.

Hydrologic Calculations

Existing Conditions

Basin OS-01

Basin EX-01 has an overall area of 208,375 square feet (4.78 ac) and historically flows overland from offsite to the west of the site onto the site near the northwest corner. The 2-year maximum flow rate at a rainfall intensity of 3.20 inches per hour for this basin is 0.3 cfs, the 5-year maximum flow rate at a rainfall intensity of 4.10 inches per hour for this basin is 1.6 cfs and the 100-year maximum flow rate at a rainfall intensity of 6.80 inches per hour for this basin is 11.4 cfs (see Appendix B).

Basin OS-02

Basin EX-02 has an overall area of 87,935 square feet (2.02 ac) and historically flows overland from the offsite to the west of the site onto the site near the southwest corner. The 2-year maximum flow rate at a rainfall intensity of 3.20 inches per hour for this basin is 0.1 cfs, the 5-year maximum flow rate at a rainfall intensity of 4.10 inches per hour for this basin is 0.7 cfs and the 100-year maximum flow rate at a rainfall intensity of 6.80 inches per hour for this basin is 4.8 cfs (see Appendix B).

Basin A

Basin A has an overall area of 1,151,039 square feet (26.42 ac) and historically flows overland to the north and east and exits the site spread over the length of the property line. The 2-year maximum flow rate at a rainfall intensity of 3.20 inches per hour for this basin is 2.4 cfs, the 5-year maximum flow rate at a rainfall intensity of 4.10 inches per hour for this basin is 9.5 cfs and the 100-year maximum flow rate at a rainfall intensity of 6.80 inches per hour for this basin is 64.0 cfs (see Appendix B).

Basin B

Basin B has an overall area of 353,054 square feet (8.11 ac) and historically flows to the south and exits the site spread over the length of the property line. The 2-year maximum flow rate at a rainfall intensity of 3.20 inches per hour for this basin is 1.0 cfs, the 5-year maximum flow rate at a rainfall intensity of 4.10 inches per hour for this basin is 3.2 cfs and the 100-year maximum flow rate at a rainfall intensity of 6.80 inches per hour for this basin is 20.0 cfs (see Appendix B).

Basin C

Basin C has an overall area of 143,995 square feet (3.31 ac) and historically flows overland to the east and exits the site spread over the length of the property line. The 2-year maximum flow rate at a rainfall intensity of 3.20 inches per hour for this basin is 0.2 cfs, the 5-year maximum flow rate at a rainfall intensity of 4.10 inches per hour for this basin is 1.1 cfs and the 100-year maximum flow rate at a rainfall intensity of 6.80 inches per hour for this basin is 7.9 cfs (see Appendix B).

Basin D

Basin D has an overall area of 88,163 square feet (2.02 ac) and historically flows to the south and east and exits the site spread over the length of the property line. The 2-year maximum flow rate at a rainfall intensity of 3.20 inches per hour for this basin is 0.1 cfs, the 5-year maximum flow rate at a rainfall intensity of 4.10 inches per hour for this basin is 0.7 cfs and the 100-year maximum flow rate at a rainfall intensity of 6.80 inches per hour for this basin is 4.8 cfs (see Appendix B).

Design Point 1

Design Point 1 represents the overland flow that exits the site spread over the length of the property line within Drainage Basin A to the North and East. The area representing flows for Design Point 1 is 1,359,414 square feet (31.21 ac). The 2-year maximum flow rate at a rainfall intensity of 3.20 inches per hour for this basin is 2.7 cfs, the 5-year maximum flow rate at a rainfall intensity of 4.10 inches per hour for this basin is 11.1 cfs and the 100-year maximum flow rate at a rainfall intensity of 6.80 inches per hour for this basin is 75.4 cfs (see Appendix B).

Design Point 2

Design Point 2 represents the overland flow that exits the site spread over the length of the property line within Drainage Basin B to the South. The area representing flows for Design Point 2 is 440,989 square feet (10.12 ac). The 2-year maximum flow rate at a rainfall intensity of 3.20 inches per hour for this basin is 1.1 cfs, the 5-year maximum flow rate at a rainfall intensity of 4.10 inches per hour for this basin is 3.9 cfs and the 100-year maximum flow rate at a rainfall intensity of 6.80 inches per hour for this basin is 24.8 cfs (see Appendix B).

2-Year, 5-Year & 100-Year Storm Runoff (Existing)												
Basin		Area	Tc	2 Intensity	5 Intensity	100 Intensity	2 Comp. C	5 Comp. C	100 Comp. C	2 Q	5 Q	100 Q
		(Acres)	(Min.)	(In./hr.)	(In./hr.)	(In./hr.)				(cfs)	(cfs)	(cfs)
A	Basin A	26.42	10.00	3.20	4.10	6.80	0.03	0.09	0.36	**2.4**	**9.5**	**64.0**
B	Basin B	8.11	10.00	3.20	4.10	6.80	0.04	0.10	0.36	**1.0**	**3.2**	**20.0**
C	Basin C	3.31	10.00	3.20	4.10	6.80	0.02	0.08	0.35	**0.2**	**1.1**	**7.9**
D	Basin D	2.02	10.00	3.20	4.10	6.80	0.02	0.08	0.35	**0.1**	**0.7**	**4.8**
OS-01	Offsite Basin 01	4.78	10.00	3.20	4.10	6.80	0.02	0.08	0.35	**0.3**	**1.6**	**11.4**
OS-02	Offsite Basin 02	2.02	10.00	3.20	4.10	6.80	0.02	0.08	0.35	**0.1**	**0.7**	**4.8**
1	OS-01 + A	31.21	10.10	3.20	4.10	6.80	0.03	0.09	0.36	**2.7**	**11.1**	**75.4**
2	OS-02 + B	10.12	10.00	3.20	4.10	6.80	0.03	0.09	0.36	**1.1**	**3.9**	**24.8**

Proposed Conditions

Basin A

Basin A has an overall area of 1,151,039 square feet (26.42 ac) and historically flows overland to the north and east and exits the site spread over the length of the property line. Based on the El Paso County Engineering Criteria Manual, for sites with 5.0 acres or greater areas, the percent imperviousness is approximately 7%. Given this, the 2-year maximum flow rate at a rainfall intensity of 3.20 inches per hour for this basin is 6.8 cfs, the 5-year maximum flow rate at a rainfall intensity of 4.10 inches per hour for this basin is 14.9 cfs and the 100-year maximum flow rate at a rainfall intensity of 6.80 inches per hour for this basin is 70.6 cfs (see Appendix B).

Basin B

Basin B has an overall area of 353,054 square feet (8.11 ac) and historically flows to the south and exits the site spread over the length of the property line. Based on the El Paso County Engineering Criteria Manual, for sites with 5.0 acres or greater areas, the percent imperviousness is approximately 7%. Given this, the 2-year maximum flow rate at a rainfall intensity of 3.20 inches per hour for this basin is 2.1 cfs, the 5-year maximum flow rate at a rainfall intensity of 4.10 inches per hour for this basin is 4.6 cfs and the 100-year maximum flow rate at a rainfall intensity of 6.80 inches per hour for this basin is 21.7 cfs (see Appendix B).

Basin C

Basin C has an overall area of 143,995 square feet (3.31 ac) and historically flows overland to the east and exits the site spread over the length of the property line. Based on the El Paso County Engineering Criteria Manual, for sites with 5.0 acres or greater areas, the percent imperviousness is approximately 7%. Given this, the 2-year maximum flow rate at a rainfall intensity of 3.20 inches per hour for this basin is 0.9 cfs, the 5-year maximum flow rate at a rainfall intensity of 4.10 inches per hour for this basin is 1.9 cfs and the 100-year maximum flow rate at a rainfall intensity of 6.80 inches per hour for this basin is 8.8 cfs (see Appendix B).

Basin D

Basin D has an overall area of 88,163 square feet (2.02 ac) and historically flows to the south and east and exits the site spread over the length of the property line. Based on the El Paso County Engineering Criteria Manual, for sites with 5.0 acres or greater areas, the percent imperviousness is approximately 7%. Given this, the 2-year maximum flow rate at a rainfall intensity of 3.20 inches per hour for this basin is 0.5 cfs, the 5-year maximum flow rate at a rainfall intensity of 4.10 inches per hour for this basin is 1.1 cfs and the 100-year maximum flow rate at a rainfall intensity of 6.80 inches per hour for this basin is 5.4 cfs (see Appendix B).

Design Point 1

Design Point 1 represents the overland flow that exits the site spread over the length of the property line within Drainage Basin A to the North and East. The area representing flows for Design Point 1 is 1,359,414 square feet (31.21 ac). Based on the El Paso County Engineering Criteria Manual, for sites with 5.0 acres or greater areas, the percent imperviousness is approximately 7%. Given this, the 2-year maximum flow rate at a rainfall intensity of 3.20 inches per hour for this basin is 7.1 cfs, the 5-year maximum flow rate at a rainfall intensity of 4.10 inches per hour for this basin is 16.5 cfs and the 100-year maximum flow rate at a rainfall intensity of 6.80 inches per hour for this basin is 81.9 cfs (see Appendix B).

Design Point 2

Design Point 2 represents the overland flow that exits the site spread over the length of the property line within Drainage Basin B to the South. The area representing flows for Design Point 2 is 440,989 square feet (10.12 ac). Based on the El Paso County Engineering Criteria Manual, for sites with 5.0 acres or greater areas, the percent imperviousness is approximately 7%. Given this, the 2-year maximum flow rate at a rainfall intensity of 3.20 inches per hour for this basin is 2.2 cfs, the 5-year maximum flow rate at a rainfall intensity of 4.10 inches per hour for this basin is 5.2 cfs and the 100-year maximum flow rate at a rainfall intensity of 6.80 inches per hour for this basin is 26.5 cfs (see Appendix B).

2-Year, 5-Year & 100-Year Storm Runoff (Proposed)												
Basin		**Area**	**Tc**	**2 Intensity**	**5 Intensity**	**100 Intensity**	**2 Comp. C**	**5 Comp. C**	**100 Comp. C**	**2 Q**	**5 Q**	**100 Q**
		(Acres)	(Min.)	(In./hr.)	(In./hr.)	(In./hr.)				**(cfs)**	**(cfs)**	**(cfs)**
A	Basin A	26.42	10.00	3.20	4.10	6.80	0.08	0.14	0.39	**6.8**	**14.9**	**70.6**
B	Basin B	8.11	10.00	3.20	4.10	6.80	0.08	0.14	0.39	**2.1**	**4.6**	**21.7**
C	Basin C	3.31	10.00	3.20	4.10	6.80	0.08	0.14	0.39	**0.9**	**1.9**	**8.8**
D	Basin D	2.02	10.00	3.20	4.10	6.80	0.08	0.14	0.39	**0.5**	**1.1**	**5.4**
OS-01	Offsite Basin 01	4.78	10.00	3.20	4.10	6.80	0.02	0.08	0.35	**0.3**	**1.6**	**11.4**
OS-02	Offsite Basin 02	2.02	10.00	3.20	4.10	6.80	0.02	0.08	0.35	**0.1**	**0.7**	**4.8**
1	OS-01 + A	31.21	10.10	3.20	4.10	6.80	0.07	0.13	0.39	**7.1**	**16.5**	**81.9**
2	OS-02 + B	10.12	10.00	3.20	4.10	6.80	0.07	0.13	0.38	**2.2**	**5.2**	**26.5**

The overall increase in runoff leaving the site overland as sheet flow for the 100-year storm (given imperviousness of lots is 7%) is approximately 8.2 cfs. This represents an increase of approximately 7.5%.

Drainage Basin and Bridge Fees

Per the El Paso County Land Development Code, Section 8.5.5.C.2, drainage basin and bridge fees shall be paid prior to filing of the Final Plat. Since the proposed major subdivision is located within the West Kiowa Subbasin, per the 2020 El Paso County Drainage Basin Fees the basin and drainage fees are $0.

IV. CONCLUSION

It is the professional opinion of the engineer that the proposed improvements will not have any negative impacts on the existing site conditions or downstream conditions as extra flows from site are minimal. The additional runoff for a 100-year storm will not adversely affect the downstream and surrounding developments.

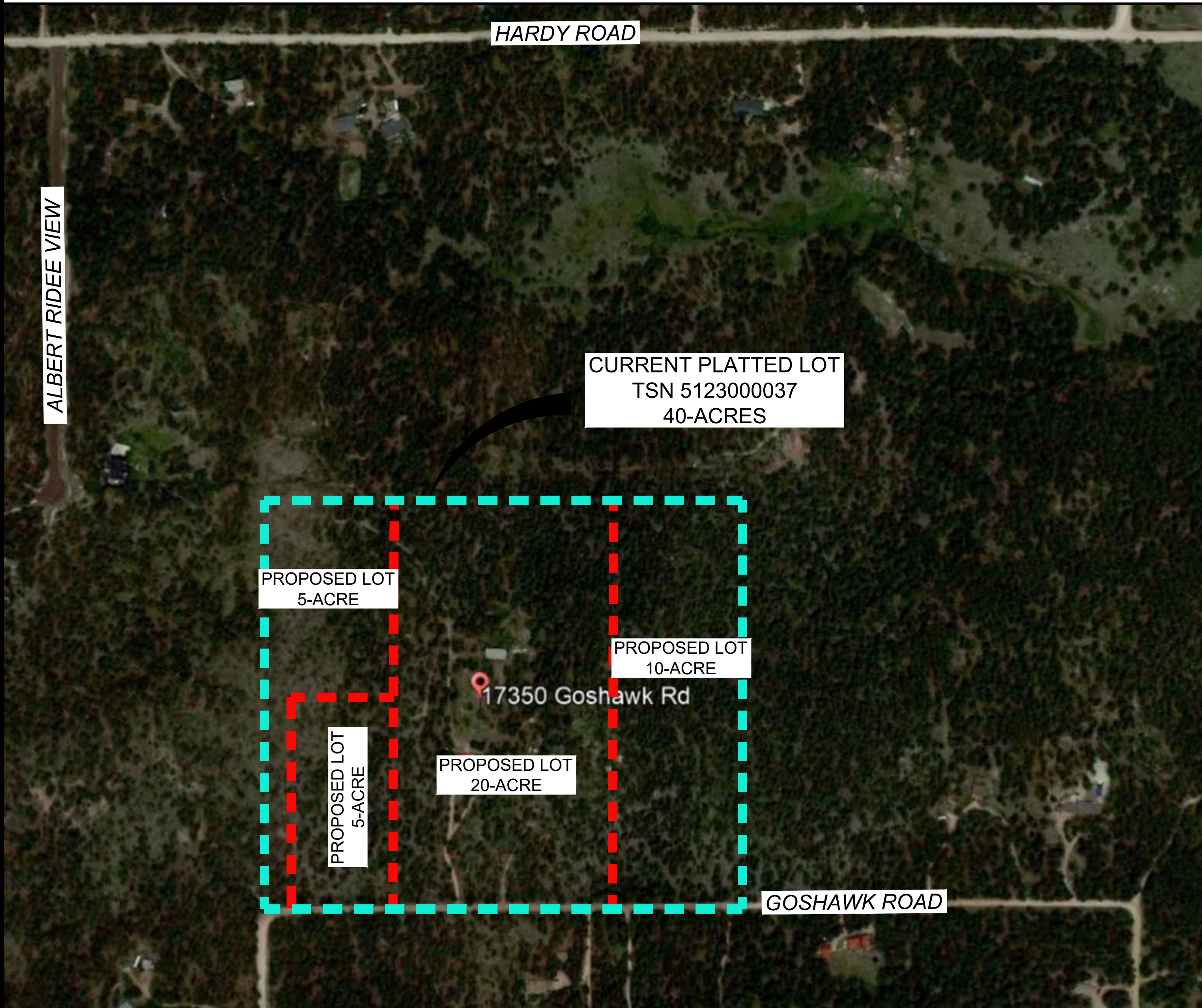
References:

Drainage Criteria Manual County of El Paso, Colorado Volume 1-2 by El Paso County, Oct 31 2018

Urban Drainage Criteria Manual, Volumes 1-3, by Urban Drainage and Flood Control District, Inc, Updated January, 2016

Appendix A - Maps

1 – Vicinity Map
2 – FEMA FIRM Floodplain Map
3 – Proposed Conditions Drainage Map



N

VICINITY MAP

SCALE: 1" = 250'

DATE: 08/05/19	WARNER 4-LOT MINOR SUBDIVISION	PROJECT NO: 04-19-XXXX
EA	PROPOSED SUBDIVISION MAP - 4 LOTS	PRELIMINARY DRAWING NOT FOR CONSTRUCTION

C:\Users\cburba\Desktop\Warner 4-Lot Subdivision\CAD\Exhibit\VicinityMap - 4 Parcels.dwg - ---- - 11/6/2020 10:27 AM

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the **North American Vertical Datum of 1988 (NAVD88)**. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242 or visit its website at http://www.ngs.noaa.gov/.

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, City of Fountain, Bureau of Land Management, National Oceanic and Atmospheric Administration, United States Geological Survey, and Anderson Consulting Engineers, Inc. These data are current as of 2006.

This map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map. The profile baselines depicted on this map represent the hydraulic modeling baselines that match the flood profiles and Floodway Data Tables if applicable, in the FIS report. As a result, the profile baselines may deviate significantly from the new base map channel representation and may appear outside of the floodplain.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

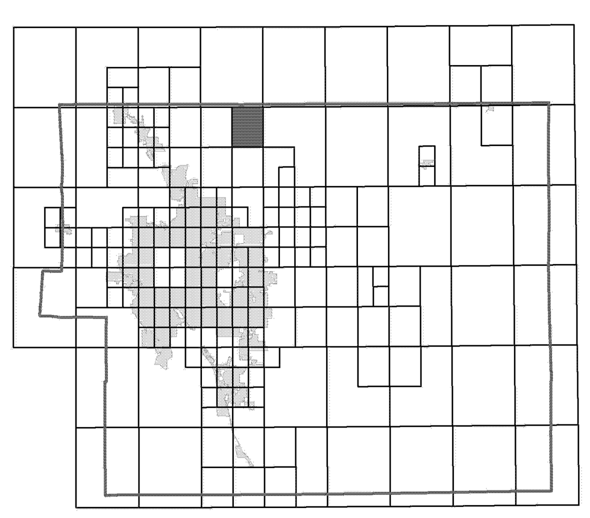
Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The MSC may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

El Paso County Vertical Datum Offset Table

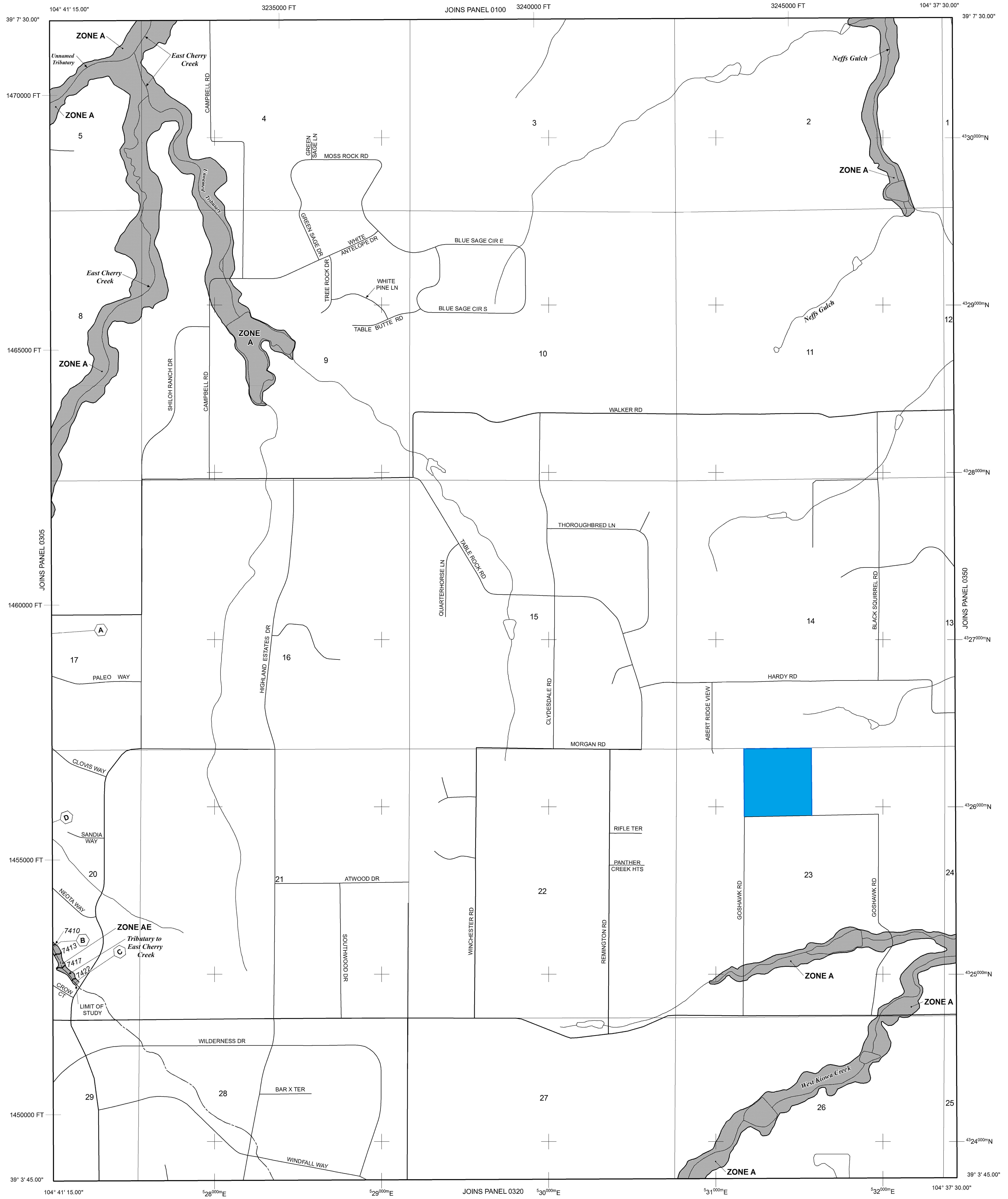
Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

Panel Location Map



This Digital Flood Insurance Rate Map (DFIRM) was produced through a Cooperating Technical Partner (CTP) agreement between the State of Colorado Water Conservation Board (CWCB) and the Federal Emergency Management Agency (FEMA).

Additional Flood Hazard information and resources are available from local communities and the Colorado Water Conservation Board.



LEGEND

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

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

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

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

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

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

- Floodplain boundary
- Floodway boundary
- Zone D Boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- ~~ 513 ~~ Base Flood Elevation line and value; elevation in feet*
- (EL 987) Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

- (A)——(A) Cross section line
- (23)--------(23) Transect line
- 97° 07' 30.00" 32° 22' 30.00" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
- 4275000mN 1000-meter Universal Transverse Mercator grid ticks, zone 13
- 6000000 FT 5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
- DX5510 × Bench mark (see explanation in Notes to Users section of this FIRM panel)
- ● M1.5 River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

For community map revision history prior to countywide mapping, refer to the Community Map History Table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

300 0 300 600 METERS

NFIP

PANEL 0310G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO
AND INCORPORATED AREAS

PANEL 310 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

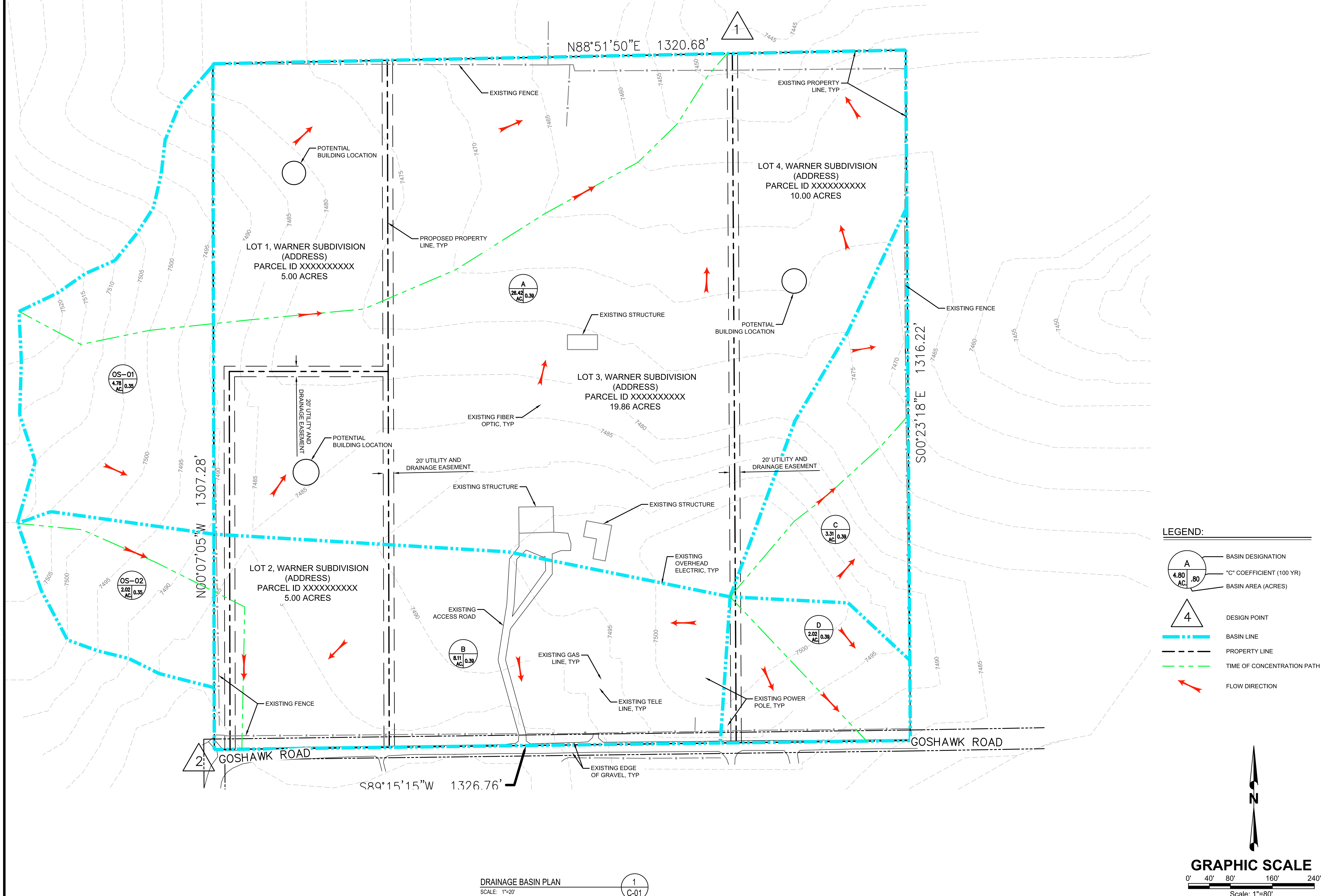
COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0310	G

Notice to User: The **Map Number** shown below should be used when placing map orders: the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08041C0310G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency



C:\Users\cburba\Desktop\Warner 4-Lot Subdivision\CAD\Exhibit\Proposed Conditions Drainage Map.dwg -- 8/24/2021 10:13 AM

NO.	REVISIONS	BY	DATE

FORSGREN Associates Inc.
56 Inverness Drive East, Suite 112, Englewood, CO 80112
PH: 720.214.5884 FAX: 720.000.0000

PROJECT NO. 04-18-0026
DRAWN C. BURBA
DESIGNED C. BURBA
APPROVED C. BURBA
QA/QC J. MOORE

OWNER
BRIAN WARNER
COLORADO SPRINGS, CO

4-LOT MINOR SUBDIVISION

PROPOSED CONDITIONS DRAINAGE MAP

SHEET NO: C-01
DATE: 08/19/2021
PAGE NO: 1 OF 1

Appendix B – Hydrologic/Hydraulic Calculations

1 – Runoff Coefficients

2 – Rational Method 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.

FORSGREN Associates Inc.

Composite "C" Values (Existing)									
Basin	**Desc.**	**Area**	**Area**	**% Imper.**	**Impervious Area**	**Pervious Area**	**2 Comp.**	**5 Comp.**	**100 Comp**
		(SF)	(Acres)	%	(Acres)	(Acres)	"C"	"C"	"C"
A	Basin A	1,151,039	26.42	1%	0.260	26.16	0.03	0.09	0.36
B	Basin B	353,054	8.11	2%	0.160	7.95	0.04	0.10	0.36
C	Basin C	143,995	3.31	0%	0.000	3.31	0.02	0.08	0.35
D	Basin D	88,163	2.02	0%	0.000	2.02	0.02	0.08	0.35
OS-01	Offsite Basin 01	208,375	4.78	0%	0.000	4.78	0.02	0.08	0.35
OS-02	Offsite Basin 02	87,935	2.02	0%	0.000	2.02	0.02	0.08	0.35
All Onsite Basins		**2,032,561**	**46.66**	**1%**	**0.42**	**46.24**	**0.03**	**0.09**	**0.36**
1	OS-01 + A	1,359,414	31.21	1%	0.260	30.95	0.03	0.09	0.36
2	OS-02 + B	440,989	10.12	2%	0.160	9.96	0.03	0.09	0.36
All Offsite Basins		**1,800,403**	**41.33**	**1%**	**0.42**	**40.91**	**0.03**	**0.09**	**0.36**

5 Impervious "C"	0.90
5 Pervious "C"	0.08
100 Impervious "C"	0.96
100 Pervious "C"	0.35
2 Impervious "C"	0.89
2 Pervious "C"	0.02

By: Conner Burba
Project: Warner 4-Lot Subdivision
Printed: 8/24/2021 10:05

Time of Concentration (Existing)

Sub-Basin Data			Initial/Overland Time (Ti)			Pavement Travel Time (Tt)				Pipe Travel Time (Tt)					Tc Check (Urbanized Basins)		Tc=Ti+Tt	Final Tc
Basin	Desc.	Area (ac)	Length (ft)	Slope (%)	*Ti (min)	Length (ft)	Slope (%)	Vel. (fps)	Tt (min)	Length (ft)	Slope (%)	Vel. (fps)	Tt (min)	Total Tt (min)	Total Length (ft)	Tc=(L/180)+10 (min)	(min)	(min)
A	Basin A	26.42	1152	3.40	9.85	0								0.00	1152	16.40	9.85	**10.00**
B	Basin B	8.11	337	4.00	5.05	0								0.00	337	11.87	5.05	**10.00**
C	Basin C	3.31	489	7.00	5.06	0								0.00	489	12.72	5.06	**10.00**
D	Basin D	2.02	378	4.00	5.35	0								0.00	378	12.10	5.35	**10.00**
OS-01	Offsite Basin 01	4.78	389	7.70	4.37	0								0.00	389	12.16	4.37	**10.00**
OS-02	Offsite Basin 02	2.02	401	4.00	5.51	0								0.00	401	12.23	5.51	**10.00**
1	OS-01 + A	31.21	1541	4.90	10.10	0								0.00	1541	18.56	10.10	**10.10**
2	OS-02 + B	10.12	739	4.00	7.48	0								0.00	739	14.11	7.48	**10.00**

C10= 0.90
C5 = 0.15
Ti=(0.395(1.1-C5)*(L)^.5)/(s)^.33
Conveyance Coefficient, Cv
Paved Areas 20
Tillage/Field 5
n (PVC) 0.012

Tc min. of 5 min.

By: Conner Burba
Project: Warner 4-Lot Subdivision
Printed: 8/24/2021 10:05

FORSGREN Associates Inc.

Basin		Area	Tc	2 Intensity	5 Intensity	100 Intensity	2 Comp. C	5 Comp. C	100 Comp. C	2 Q	5 Q	100 Q
2-Year, 5-Year & 100-Year Storm Runoff (Existing)												
		(Acres)	(Min.)	(In./hr.)	(In./hr.)	(In./hr.)				**(cfs)**	**(cfs)**	**(cfs)**
A	Basin A	26.42	10.00	3.20	4.10	6.80	0.03	0.09	0.36	**2.4**	**9.5**	**64.0**
B	Basin B	8.11	10.00	3.20	4.10	6.80	0.04	0.10	0.36	**1.0**	**3.2**	**20.0**
C	Basin C	3.31	10.00	3.20	4.10	6.80	0.02	0.08	0.35	**0.2**	**1.1**	**7.9**
D	Basin D	2.02	10.00	3.20	4.10	6.80	0.02	0.08	0.35	**0.1**	**0.7**	**4.8**
OS-01	Offsite Basin 01	4.78	10.00	3.20	4.10	6.80	0.02	0.08	0.35	**0.3**	**1.6**	**11.4**
OS-02	Offsite Basin 02	2.02	10.00	3.20	4.10	6.80	0.02	0.08	0.35	**0.1**	**0.7**	**4.8**
1	OS-01 + A	31.21	10.10	3.20	4.10	6.80	0.03	0.09	0.36	**2.7**	**11.1**	**75.4**
2	OS-02 + B	10.12	10.00	3.20	4.10	6.80	0.03	0.09	0.36	**1.1**	**3.9**	**24.8**

By: Conner Burba
Project: Warner 4-Lot Subdivision
Printed: 8/24/2021 10:05

FORSGREN Associates Inc.

Composite "C" Values (Proposed)									
Basin	**Desc.**	**Area**	**Area**	**% Imper.**	**Impervious Area**	**Pervious Area**	**2 Comp.**	**5 Comp.**	**100 Comp**
		(SF)	(Acres)	%	(Acres)	(Acres)	"C"	"C"	"C"
A	Basin A	1,151,039	26.42	7%	1.850	24.57	0.08	0.14	0.39
B	Basin B	353,054	8.11	7%	0.570	7.54	0.08	0.14	0.39
C	Basin C	143,995	3.31	7%	0.230	3.08	0.08	0.14	0.39
D	Basin D	88,163	2.02	7%	0.140	1.88	0.08	0.14	0.39
OS-01	Offsite Basin 01	208,375	4.78	0%	0.000	4.78	0.02	0.08	0.35
OS-02	Offsite Basin 02	87,935	2.02	0%	0.000	2.02	0.02	0.08	0.35
All Onsite Basins		**2,032,561**	**46.66**	**6%**	**2.65**	**44.01**	**0.07**	**0.13**	**0.38**
1	OS-01 + A	1,359,414	31.21	6%	1.850	29.36	0.07	0.13	0.39
2	OS-02 + B	440,989	10.12	6%	0.570	9.55	0.07	0.13	0.38
All Offsite Basins		**1,800,403**	**41.33**	**6%**	**2.42**	**38.91**	**0.07**	**0.13**	**0.39**

5 Impervious "C"	0.90
5 Pervious "C"	0.08
100 Impervious "C"	0.96
100 Pervious "C"	0.35
2 Impervious "C"	0.89
2 Pervious "C"	0.02

By: Conner Burba

Project: Warner 4-Lot Subdivision

Printed: 8/24/2021 10:06

FORSGREN Associates Inc.

Time of Concentration (Proposed)

Sub-Basin Data			Initial/Overland Time (Ti)			Pavement Travel Time (Tt)				Pipe Travel Time (Tt)					Tc Check (Urbanized Basins)		Tc=Ti+Tt	Final Tc
Basin	Desc.	Area (ac)	Length (ft)	Slope (%)	*Ti (min)	Length (ft)	Slope (%)	Vel. (fps)	Tt (min)	Length (ft)	Slope (%)	Vel. (fps)	Tt (min)	Total Tt (min)	Total Length (ft)	Tc=(L/180)+10 (min)	(min)	(min)
A	Basin A	26.42	1152	3.40	9.85	0								0.00	1152	16.40	9.85	**10.00**
B	Basin B	8.11	337	4.00	5.05	0								0.00	337	11.87	5.05	**10.00**
C	Basin C	3.31	489	7.00	5.06	0								0.00	489	12.72	5.06	**10.00**
D	Basin D	2.02	378	4.00	5.35	0								0.00	378	12.10	5.35	**10.00**
OS-01	Offsite Basin 01	4.78	389	7.70	4.37	0								0.00	389	12.16	4.37	**10.00**
OS-02	Offsite Basin 02	2.02	401	4.00	5.51	0								0.00	401	12.23	5.51	**10.00**
1	OS-01 + A	31.21	1541	4.90	10.10	0								0.00	1541	18.56	10.10	**10.10**
2	OS-02 + B	10.12	739	4.00	7.48	0								0.00	739	14.11	7.48	**10.00**

C10= 0.90
C5 = 0.15
Ti=(0.395(1.1-C5)*(L)^.5)/(s)^.33
Conveyance Coefficient, Cv
Paved Areas 20
Tillage/Field 5
n (PVC) 0.012

Tc min. of 5 min.

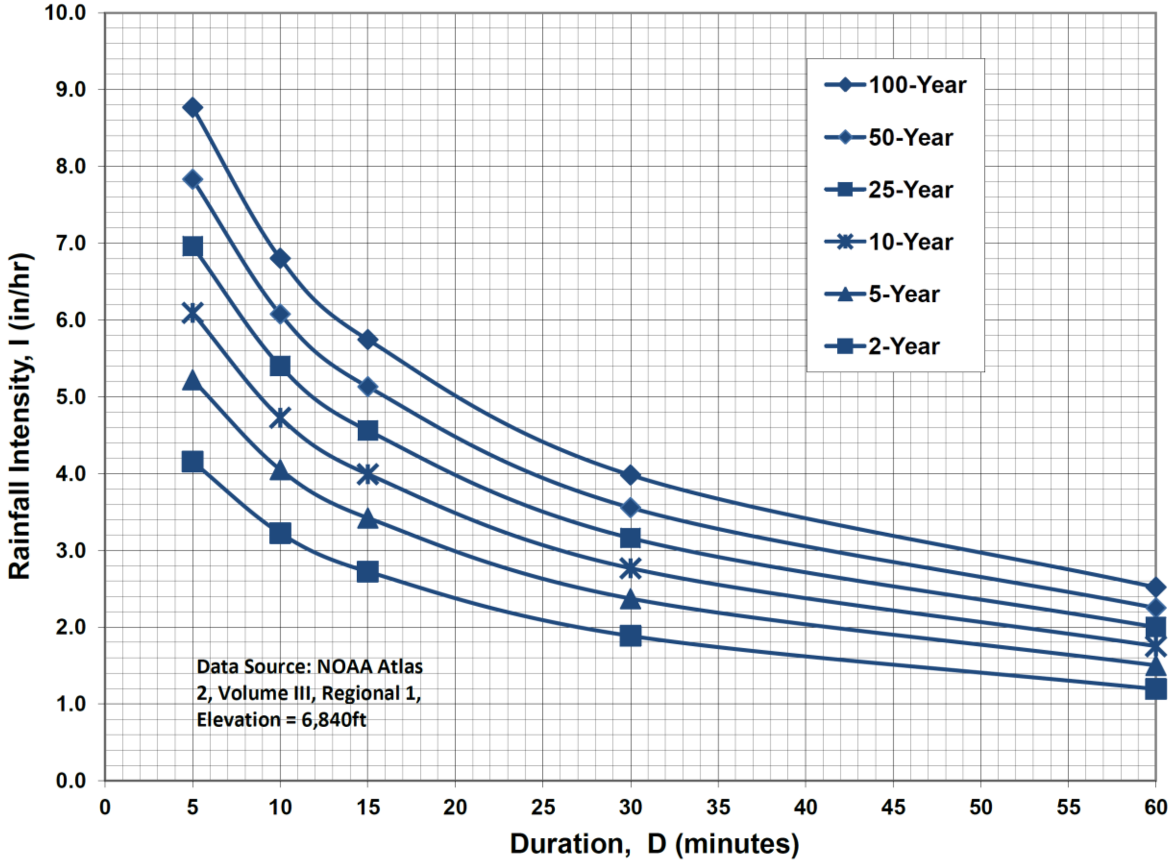
By: Conner Burba
Project: Warner 4-Lot Subdivision
Printed: 8/24/2021 10:06

FORSGREN Associates Inc.

2-Year, 5-Year & 100-Year Storm Runoff (Proposed)												
Basin		**Area**	**Tc**	**2 Intensity**	**5 Intensity**	**100 Intensity**	**2 Comp. C**	**5 Comp. C**	**100 Comp. C**	**2 Q**	**5 Q**	**100 Q**
		(Acres)	(Min.)	(In./hr.)	(In./hr.)	(In./hr.)				**(cfs)**	**(cfs)**	**(cfs)**
A	Basin A	26.42	10.00	3.20	4.10	6.80	0.08	0.14	0.39	**6.8**	**14.9**	**70.6**
B	Basin B	8.11	10.00	3.20	4.10	6.80	0.08	0.14	0.39	**2.1**	**4.6**	**21.7**
C	Basin C	3.31	10.00	3.20	4.10	6.80	0.08	0.14	0.39	**0.9**	**1.9**	**8.8**
D	Basin D	2.02	10.00	3.20	4.10	6.80	0.08	0.14	0.39	**0.5**	**1.1**	**5.4**
OS-01	Offsite Basin 01	4.78	10.00	3.20	4.10	6.80	0.02	0.08	0.35	**0.3**	**1.6**	**11.4**
OS-02	Offsite Basin 02	2.02	10.00	3.20	4.10	6.80	0.02	0.08	0.35	**0.1**	**0.7**	**4.8**
1	OS-01 + A	31.21	10.10	3.20	4.10	6.80	0.07	0.13	0.39	**7.1**	**16.5**	**81.9**
2	OS-02 + B	10.12	10.00	3.20	4.10	6.80	0.07	0.13	0.38	**2.2**	**5.2**	**26.5**

By: Conner Burba
Project: Warner 4-Lot Subdivision
Printed: 8/24/2021 10:06

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.

Appendix C - Additional Information

1 - Custom Soil Resource Report

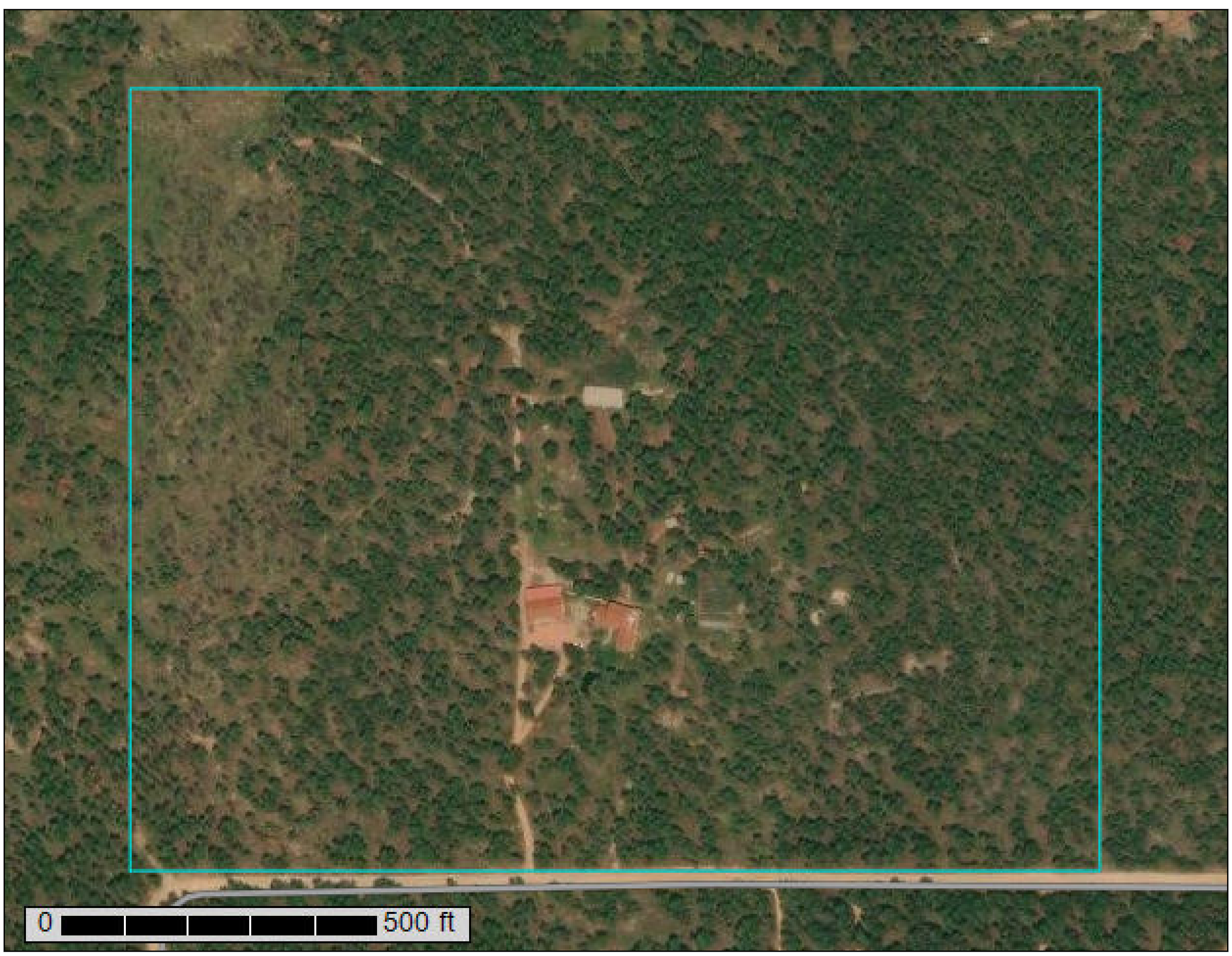
USDA United States Department of Agriculture

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



July 5, 2019

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 alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

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.

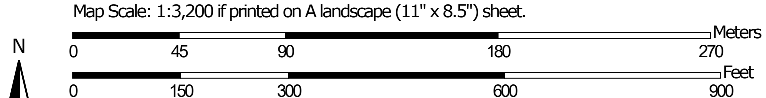
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in 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.

Soil Map

Map Scale: 1:3,200 if printed on A landscape (11" x 8.5") sheet.



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.

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

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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 16, Sep 10, 2018

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

Date(s) aerial images were photographed: Jun 7, 2016—Aug 17, 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
25	Elbeth sandy loam, 3 to 8 percent slopes	0.2	0.4%
26	Elbeth sandy loam, 8 to 15 percent slopes	43.7	99.6%
Totals for Area of Interest		**43.8**	**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

25—Elbeth sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 367x
Elevation: 7,300 to 7,600 feet
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Elbeth

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from arkose

Typical profile

A - 0 to 3 inches: sandy loam
E - 3 to 23 inches: loamy sand
Bt - 23 to 68 inches: sandy clay loam
C - 68 to 74 inches: sandy clay loam

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 (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.1 inches)

Interpretive groups

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

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

26—Elbeth sandy loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 367y
Elevation: 7,300 to 7,600 feet
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Elbeth

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from arkose

Typical profile

A - 0 to 3 inches: sandy loam
E - 3 to 23 inches: loamy sand
Bt - 23 to 68 inches: sandy clay loam
C - 68 to 74 inches: sandy clay loam

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 (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
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

Soil Information for All Uses

Soil Reports

The Soil Reports section includes various formatted tabular and narrative reports (tables) containing data for each selected soil map unit and each component of each unit. No aggregation of data has occurred as is done in reports in the Soil Properties and Qualities and Suitabilities and Limitations sections.

The reports contain soil interpretive information as well as basic soil properties and qualities. A description of each report (table) is included.

Soil Physical Properties

This folder contains a collection of tabular reports that present soil physical properties. The reports (tables) include all selected map units and components for each map unit. Soil physical properties are measured or inferred from direct observations in the field or laboratory. Examples of soil physical properties include percent clay, organic matter, saturated hydraulic conductivity, available water capacity, and bulk density.

Engineering Properties (Warner 5-Lot Subdivision)

This table gives the engineering classifications and the range of engineering properties for the layers of each soil in the survey area.

Hydrologic soil group is a group of soils having similar runoff potential under similar storm and cover conditions. The criteria for determining Hydrologic soil group is found in the National Engineering Handbook, Chapter 7 issued May 2007(http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba). Listing HSGs by soil map unit component and not by soil series is a new concept for the engineers. Past engineering references contained lists of HSGs by soil series. Soil series are continually being defined and redefined, and the list of soil series names changes so frequently as to make the task of maintaining a single national list virtually impossible. Therefore, the criteria is now used to calculate the HSG using the component soil properties and no such national series lists will be maintained. All such references are obsolete and their use should be discontinued. Soil properties that influence runoff potential are those that influence the minimum rate of infiltration for a bare soil after prolonged wetting and when not frozen. These properties are depth to a seasonal high water table, saturated hydraulic conductivity after prolonged wetting, and depth to a layer with a very slow water transmission rate. Changes in soil properties caused by land management or climate changes also cause the hydrologic soil group to change. The influence of ground cover is treated independently. There are four hydrologic soil groups, A, B, C, and D, and three dual groups, A/D, B/D, and C/D. In the dual groups, the first letter is for drained areas and the second letter is for undrained areas.

The four hydrologic soil groups are described in the following paragraphs:

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.

Depth to the upper and lower boundaries of each layer is indicated.

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is 15 percent or more, an appropriate modifier is added, for example, "gravelly."

Classification of the soils is determined according to the Unified soil classification system (ASTM, 2005) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 2004).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to particle-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of particle-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Percentage of rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

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.

Absence of an entry indicates that the data were not estimated. The asterisk '*' denotes the representative texture; other possible textures follow the dash. The criteria for determining the hydrologic soil group for individual soil components is found in the National Engineering Handbook, Chapter 7 issued May 2007(http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba). Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Engineering Properties–El Paso County Area, Colorado														
Map unit symbol and soil name	**Pct. of map unit**	**Hydrologic group**	**Depth**	**USDA texture**	**Classification**		**Pct Fragments**		**Percentage passing sieve number—**				**Liquid limit**	**Plasticity index**
					Unified	**AASHTO**	**>10 inches**	**3-10 inches**	**4**	**10**	**40**	**200**		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
25—Elbeth sandy loam, 3 to 8 percent slopes														
Elbeth	85	B	0-3	Sandy loam	SC, SC-SM	A-2-4, A-4	0- 0- 0	0- 0- 0	85-93-100	80-90-100	50-60-70	25-33-40	25-28-30	5-8 -10
			3-23	Loamy sand	SM	A-2-4, A-1	0- 0- 0	0- 0- 0	85-93-100	80-90-100	40-58-75	15-23-30	20-23-25	NP-3 -5
			23-68	Sandy clay loam	CL-ML, SC, SC-SM	A-2, A-4, A-6	0- 0- 0	0- 0- 0	85-93-100	80-90-100	65-78-90	30-43-55	25-30-35	5-10-15
			68-74	Sandy clay loam	CL, SC	A-2, A-4	0- 0- 0	0- 0- 0	85-93-100	80-90-100	50-70-90	25-40-55	25-28-30	5-8 -10
26—Elbeth sandy loam, 8 to 15 percent slopes														
Elbeth	85	B	0-3	Sandy loam	SC, SC-SM	A-4, A-2-4	0- 0- 0	0- 0- 0	85-93-100	80-90-100	50-60-70	25-33-40	25-28-30	5-8 -10
			3-23	Loamy sand	SM	A-1, A-2-4	0- 0- 0	0- 0- 0	85-93-100	80-90-100	40-58-75	15-23-30	20-23-25	NP-3 -5
			23-68	Sandy clay loam	CL-ML, SC, SC-SM	A-2, A-4, A-6	0- 0- 0	0- 0- 0	85-93-100	80-90-100	65-78-90	30-43-55	25-30-35	5-10-15
			68-74	Sandy clay loam	CL, SC	A-2, A-4	0- 0- 0	0- 0- 0	85-93-100	80-90-100	50-70-90	25-40-55	25-28-30	5-8 -10

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