CENTRAL WATER TREATMENT PLANT IMPROVEMENTS

FINAL DRAINAGE REPORT

AT

SW ¼ SECTION 11, TOWNSHIP 11 SOUTH, RANGE 67 WEST OF THE 6TH P.M.

COUNTY OF EL PASO, COLORADO

FOR

WOODMOOR WATER AND SANITATION DISTRICT NO. 1

1845 WOODMOOR DRIVE

MONUMENT, CO 80132

JVA, Inc.
Consulting Engineers
1319 Spruce Street
Boulder, CO 80302
(303) 444-1951

EPC project : COM 20-066

JVA Inc. Project No. 1051.1c

December 11, 2020

JVA, Incorporated
1319 Spruce Street
Boulder, CO 80302
303.444.1951
info@jvajva.com

www.jvajva.com

Nov. 23, 2020

EPC PCD
County Engineer/ECM Administrator
El Paso County Planning & Community Development
Colorado Springs, CO 80910

RE: Final Drainage Report
WWSD Treatment Plant Improvements
JVA No. 1051.5e

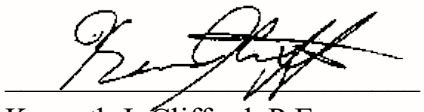
Dear EPC PCD,

The following *Final Drainage Report* and attached drainage maps have been prepared for the above referenced project. The stormwater report and drainage maps have been produced in accordance with "The City of Colorado Springs/El Paso County Drainage Criteria Manual" recommendations.

It is our understanding that the information provided herein meets all requirements of the County of El Paso.

Please contact us if you have any questions regarding this submission.

Sincerely,
JVA, Inc.



Kenneth J. Clifford, P.E.
Professional Engineer

CONSULTING ENGINEERS

Design Engineer's Statement:

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

Charles R. Hager, P.E. # 37146

COLORADO REGISTERED CHARLES R. HAGER, IV 37146 PROFESSIONAL ENGINEER

12/11/2020
Date

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.

Jessie Shaffer, District Manager
Woodmoor Water Sanitation District No. 1
1845 Woodmoor Dr, Monument, CO 80132

12-22-20
Date

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.
County Engineer / ECM Administrator

Conditions:

APPROVED
Engineering Department
01/04/2021 11:50:39 AM
dsdnijkamp
EPC Planning & Community Development Department

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FINAL DRAINAGE REPORT
CENTRAL WATER TREATMENT PLANT
IMPROVEMENTS

GENERAL LOCATION AND DESCRIPTION

LOCATION

Woodmoor Water and Sanitation District No. 1 (WWSD) proposes to develop a new water pre-treatment plant facility, the Central Water Treatment Plant, in unincorporated El Paso County, Colorado. The facility is located on Lot 2, Patriot Place Subdivision - A in the Southwest ¼ Section 11 of Township 11 North, Range 67 West of the 6th Principal Meridian in Unincorporated El Paso County, State of Colorado. The project site is located west of the intersection of Deer Creek Road and Woodmoor Drive and northwest of the Lewis-Palmer Middle School. A vicinity map is included in Appendix A.

The site currently drains in a southwest direction to Crystal Creek. Historic runoff also flows south off the property to the riprap drainage ditch owned by Lewis-Palmer School District No. 38. The riprap ditch collects runoff which is eventually conveyed to Crystal Creek. The property is bound by Deer Creek Road to the northeast, Palen LLC owns the property to the north, Monument Hill Self Storage LLC to the west, Lewis-Palmer School District No. 38 to the south and southeast, and the Redner Family Trust to the northeast across Deer Creek Road.

DESCRIPTION OF PROPERTY

The WWSD property is currently 2.08 acres that houses the Central Water Treatment Plant. The WWSD property line will be adjusted to include 0.24 acres that Lewis-Palmer School Distric No. 38 is annexing. The total acreage of the proposed property will then be 2.32 acres. Although the property will increase in acreage only 0.36 acres of the property will be disturbed for the proposed building addition and improvements. In addition to the existing Water Treatment Plant building, the property includes a gravel access road to the structure with the remnant of the property being undisturbed open space with various trees and shrubs. The majority of the property has slopes steeper than 10 percent with an exception of the gravel lot adjacent to the structure and the open space near the Deer Creek Road.

The U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) mapping of the area indicates that the soils are predominately Pring coarse sand loam, 3 to 8 percent slopes. These soils within the site area are classified as hydrological soil group B. Soils in this group have a moderate infiltration rate when thoroughly wet and therefore have moderate runoff potential. A Soils Map is provided in Appendix A.

There are no irrigation facilities on site. Water utilities are found within the property including pipes, hydrant, and water valve.

DRAINAGE BASINS AND SUB-BASINS

MAJOR DRAINAGE BASIN DESCRIPTION

The property will drain to Crystal Creek which is then conveyed to Monument Creek. This is part of the Fountain Creek Watershed which drains to the Arkansas River.

The Property is located within Zone X as defined by the Federal Emergency Management Agency (FEMA). Zone X is defined as: *Area of Minimal Flood Hazard.* The site is located within FEMA Flood Insurance Rate Map (FIRM) number 08041C0276G, revised December, 7, 2018. A portion of the FEMA FIRM is included in Appendix A for reference.

The floodplain as part of Crystal Creek is shown in the FEMA Flood Insurance Rate Map (FIRM). The increased imperviousness will produce an additional 1.01 cfs in the developed condition. This runoff will be conveyed in the proposed swale which will mimic the historic, natural swale pattern. It is not anticipated that the development will have any impact on the Crystal Creek floodplain because of the small increase in runoff and it follows the historic flow pattern.

SUB-BASIN DESCRIPTION

The historic major basin H is made up of 3 sub-basins, H1, H2, and H3. The imperviousness of basin H is 14.7% in the existing condition. These historic sub-basins include off-site and on-site runoff that drain to one design point and therefore are part of the same sub-basin.

Sub-basin H1 is 0.38 acres and is made up of landscape and gravel from the access road and lot surrounding the building. Runoff from the basin sheetflows to the southwest and then stays to the west of the building before entering Crystal Creek. Sub-basin H1 produces 1.28 cfs in the 100-year storm.

Sub-basin H2 is 1.26 acres and is made up of the existing Central Water Treatment Plant. In addition to the building, the basin also includes an asphalt from the public ROW, steep grades of landscape and the majority of the gravel access road servicing the existing treatment plant. Sub-basin H2 includes an existing swale that conveys flows to Crystal Creek. Runoff from the sub-basin will drain toward the existing building, combine within the swale, and then wrap around the east side of the existing building before flowing to Crystal Creek. Sub-basin H2 produces 3.86 cfs in the 100-year storm.

Sub-basin H3 is 0.47 acres and includes asphalt paving and landscape. Runoff sheetflows south to the riprap drainage ditch which then is conveyed to drainage structure. Flows will then continue to the southwest and terminate in Crystal Creek. Sub-basin H3 produces 1.12 cfs in the 100-year storm.

DRAINAGE DESIGN CRITERIA

DEVELOPMENT CRITERIA REFERENCE

The proposed storm drainage facilities for the project are designed to comply with the "The City of Colorado Springs/El Paso County Drainage Criteria Manual, as revised in November 1991 and October 1994 with County adopted Chapter 6 and Section 3.2.1 of Chapter 13 of the City of Colorado Springs/El Paso County Drainage Criteria Manual as revised in May 2014.

HYDROLOGIC METHOD AND DESIGN STORM FREQUENCIES

Design storm recurrence intervals for this project are consistent with The City of Colorado Springs/El Paso County Drainage Criteria Manual: the minor storm will be the 5-year event and the major storm will be the 100-year event.

The Rational Method (Q=CIA) was used to determine the storm runoff (Q) from the site, with composite runoff coefficients (C) and contributing areas (A) given for design points in sub-basins. Intensities (I) were determined using NOAA Time-Intensity-Frequency Tables for the site located in Unincorporated El Paso County, Colorado and a calculated Time of Concentration (t_c). Runoff coefficients were calculated based on Table 6-3 of the UDFCD Runoff chapter. Post-development Time of Concentration calculations for each sub-basin, corresponding rainfall intensities, and composite runoff coefficients for each sub-basin are provided in Appendix B.

The runoff calculations were based on NOAA Point Precipitation Frequency Estimates Tables set in the location of the site in unincorporated El Paso County and are listed in Table 1 below.

Return Period	One Hour Depth (in).
5-year	1.20
100-year	2.52

The proposed development will not disrupt historic drainage patterns and will not be disturbing more than an acre (.36 acres) for the new addition. Because of these considerations, there will not be any detention or water quality facilities proposed.

DRAINAGE FACILITY DESIGN

GENERAL CONCEPT

The boundary and drainage pattern for the proposed basin will remain unchanged from the historic major basin, H. Offsite flows that are not within the WWSD property will continue to flow in historic patterns, entering and exiting the property until ending at Crystal Creek. There will be one developed swale to mimic the existing natural swale that conveys runoff to Crystal Creek. See "Developed Drainage Map" in Figure 2.

SPECIFIC DETAILS

The drainage facilities for the development of the WWSD pre-treatment plant will include a proposed swale to convey flows in their historic pattern. The proposed major basin boundary will include five sub-basins, A1, A2, A3, A4, and S1. The following is a description of the sub-basins:

A1 is 0.38 acres and includes existing and proposed asphalt paving, a portion of the gravel access road, and landscaping. There will be a change in imperviousness from 21.0% to 22.2%. Runoff

from the basin continues to sheetflow to the southwest and then stay west of the building before entering Crystal Creek. Sub-basin A1 will produce 1.29 cfs in the 100-year storm.

A2 is 0.24 acres and includes the existing WWSD water treatment plant and adjacent landscaping. There will be no proposed development within the sub-basin and no change in imperviousness and will have 1.18 cfs in runoff in the 100-year storm.

A3 is 0.37 acres and includes asphalt paving from existing public ROW, landscaping, and asphalt paving from the proposed parking lot for the pre-treatment plant. There will be a change in imperviousness from 10.3% to 10.8% in the developed condition. Runoff will continue to sheetflow south to the riprap drainage ditch which will then be conveyed to the drainage structure. Flows will then continue to the southwest and terminate in Crystal Creek. Sub-basin A3 produces 1.13 cfs in the 100-year storm.

A4 is 0.32 acres and includes existing landscaping that will not be disturbed. Flows will continue to flow to Crystal Creek. There will be no change in imperviousness. The basin will generate 0.97 cfs in runoff.

S1 is 0.70 acres of which 0.36 acres will be disturbed. The sub-basin will include the proposed pre-treatment plant building, sidewalk, asphalt parking lot, landscaping and a portion of the existing asphalt and gravel roads. The sub-basin will have an imperviousness of 18.6%. Runoff will sheetflow into the proposed swale where it will then be conveyed to the southwest and then terminate at Crystal Creek.

Sub-basins A2, A4, and S1 are a conglomerate of the historic sub-basin H2. The change in impervious from existing to proposed will be 14.2% to 21.1%. Overall, the entire major basin will have a change in imperviousness of 14.7% to 19.4% and a change in runoff from 6.26 cfs to 7.27 cfs from the historic to proposed condition, respectively.

The swale has also been analyzed to assure that the runoff does not overtop. The maximum depth during the 100-year storm with 2.7 cfs of runoff in the swale with 2:1 slopes is approximately 6.7 inches. The velocity of the runoff is expected to be 4.3 ft/s. This will not top the swale which has a total depth close to 2 feet. Riprap will be provided at the end of the swale to prevent erosion to the existing channel. See swale calculations in Appendix B.

The proposed WWSD pre-treatment plant has been designed in accordance with The City of Colorado Springs/El Paso County Drainage Criteria Manual. The area of disturbance will be less than one acre with 0.36 acres being disturbed. The total increase in impervious area on the parcel is 5,785 square feet. Historic drainage patterns will be maintained and will have minimal increase in runoff from historic to proposed, 6.26 cfs to 7.27 cfs, respectively. It is determined that the drainage impact from the development of the WWSD property will not adversely affect downstream properties.

REFERENCES

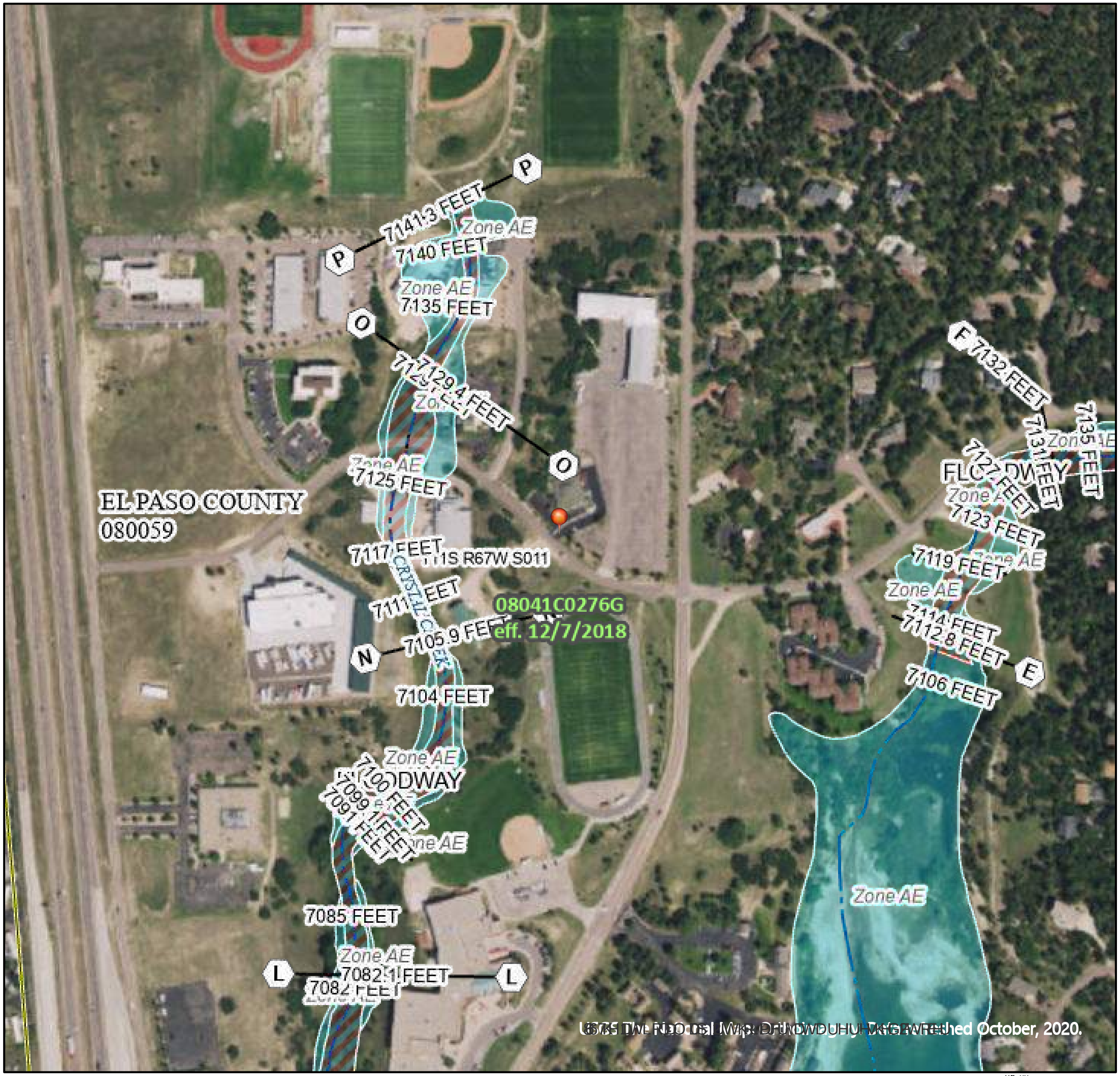
1. City of Colorado Springs/County of El Paso Drainage Criteria Manual, October 1991.
2. "Urban Storm Drainage Criteria Manual," Urban Drainage and Flood Control District, updated March 2017.
3. Web Soil Survey, Natural Resources Conservation Service, United State Department of Agriculture, Online at http://websoilsurvey.nrcs.usda.gov, accessed May 15, 2020.

APPENDIX A – MAPPING AND FLOODPLAIN INFORMATION


Base Camp Rd
Emigrant Trail E
Woodmoor Dr
Deer Creek Rd
87
Proposed Site
Google Earth
© 2020 Google

1DWLRQDO)ORRG +D]DUG /D\HU)5,50HWWH

FEMA



/HJHQG

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6,*1,),&$17 +$=$5'
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- :LWKRXW %DVH)ORRG (OHYDWLRQ %)(Zone A, V, A99
- :LWK %)(RU 'HSWK Zone AE, AO, AH, VE, AR
- 5HJXODWRU\ )ORRGZD\

27+(5 $5($6 2)
)/22' +$=$5'

- $QQXDO &KDQFH)ORRG +D]DUG $UHDV RI DQQXDO FKDQFH IORRG ZLWK DYHUDJH GHSWK OHVV WKDQ RQH IRRW RU ZLWK GUDLQDJH DUHDV RI OHVV WKDQ RQH VTXDUH PLOH Zone X
-)XWXUH &RQGLWLRQV $QQXDO &KDQFH)ORRG +D]DUG Zone X
- $UHD ZLWK 5HGXFHG)ORRG 5LVN GXH WR /HYHH 6HH 1RWHV Zone X
- $UHD ZLWK)ORRG 5LVN GXH WR /HYHH Zone D

27+(5 $5($6

- 12 6&5((1 $UHD RI 0LQLPDO)ORRG +D]DUG Zone X
- (IIHFWLYH /20 5V
- $UHD RI 8QGHWHUPLQHG)ORRG +D]DUG Zone D

*(1(5$/ 6758&785(6

- &KDQQHO &XOYHUW RU 6WRUP 6HZHU
- /HYHH 'LNH RU)ORRGZDOO

27+(5)($785(6

- &URVV 6HFWLRQV ZLWK $QQXDO &KDQFH :DWHU 6XUIDFH (OHYDWLRQ
- &RDVWDO 7UDQVHFW
- %DVH)ORRG (OHYDWLRQ /LQH %)(
- /LPLW RI 6WXG\
- -XULVGLFWLRQ %RXQGDU\
- &RDVWDO 7UDQVHFW %DVHOLQH
- 3URILOH %DVHOLQH
- +\GURJUDSKLF)HDWXUH

0$3 3$1(/6

- 'LJLWDO 'DWD $YDLODEOH
- 1R 'LJLWDO 'DWD $YDLODEOH
- 8QPDSSHG

7KH SLQ GLVSOD\HG RQ WKH PDS LV DQ DSSUR[LPDWH SRLQW VHOHFWHG E\ WKH XVHU DQG GRHV QRW UHSUHVHQW DQ DXWKRULWDWLYH SURSHUW\ ORFDWLRQ

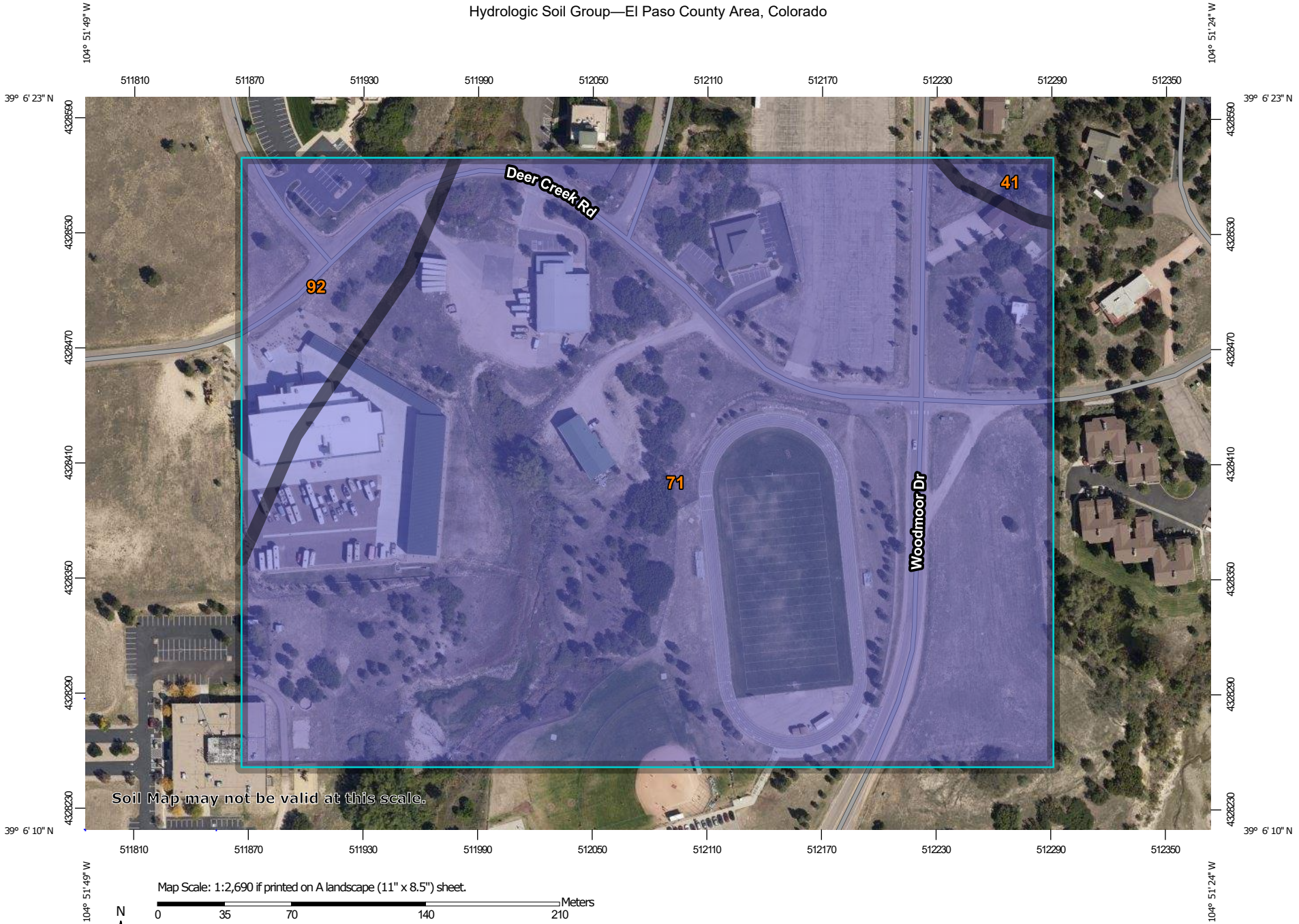
7KLV PDS FRPSOLHV ZLWK)(0\$V VWDQGDUGV IRU WKH XVH RI GLJLWDO IORRG PDSV LI LW LV QRW YRLG DV GHVFULEHG EHORZ 7KH EDVHPDS VKRZQ FRPSOLHV ZLWK)(0\$V EDVHPDS DFFXUDF\ VWDQGDUGV

7KH IORRG KD]DUG LQIRUPDWLRQ LV GHULYHG GLUHFWO\ IURP WKH DXWKRULWDWLYH 1)+/ ZHE VHUYLFHV SURYLGHG E\ )(0\$ 7KLV PDS ZDV H[SRUWHG RQ DW 30 DQG GRHV QRW UHIOHFW FKDQJHV RU DPHQGPHQWV VXEVHTXHQW WR WKLV GDWH DQG WLPH 7KH 1)+/ DQG HIIHFWLYH LQIRUPDWLRQ PD\ FKDQJH RU EHFRPH VXSHUVHGHG E\ QHZ GDWD RYHU WLPH

7KLV PDS LPDJH LV YRLG LI WKH RQH RU PRUH RI WKH IROORZLQJ PDS HOHPHQWV GR QRW DSSHDU EDVHPDS LPDJHU\ IORRG]RQH ODEHOV OHJHQG VFDOH EDU PDS FUHDWLRQ GDWH FRPPXQLW\ LGHQWLILHUV)(0\$ SDQHO QXPEHU DQG),50 HIIHFWLYH GDWH 0DS LPDJHV IRU XQPDSSHG DQG XQPRGHUQL]HG DUHDV FDQQRW EH XVHG IRU UHJXODWRU\ SXUSRVHV

USGS The National Map: Orthoimagery. Data refreshed October, 2020.

)HHW



Map Scale: 1:2,690 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 35 70 140 210

Feet
0 100 200 400 600

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 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.

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 18, Jun 5, 2020

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

Date(s) aerial images were photographed: Aug 19, 2018—Sep 23, 2018

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.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
41	Kettle gravelly loamy sand, 8 to 40 percent slopes	B	0.3	0.9%
71	Pring coarse sandy loam, 3 to 8 percent slopes	B	30.3	90.3%
92	Tomah-Crowfoot loamy sands, 3 to 8 percent slopes	B	2.9	8.7%
Totals for Area of Interest			**33.5**	**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

APPENDIX B – CALCULATIONS

JVA Incorporated
1319 Spruce Street
Boulder, CO 80302
Ph: (303) 444 1951

JVA Office:
Boulder

Version 2020_XT: 9/8/2020

Project Information:

Job Name:	Woodmoor
Job Number:	1051.5c
Date:	12/10/2020
Designed by:	SAH
Municipality :	UDFCD
Soil Type:	B

Runoff Calculations:

Minor Design Storm:	5	year
Major Design Storm:	100	year

Detention Calculations:

Minor Storm Detention:	N/A	year	plus	0	% WQCV
Major Storm Detention:	N/A	year	plus	0	% WQCV
Detention Volume by:	N/A		Enter WQCV :	0	cf

(GB, PP, PLD, SFB, EDB,etc.)

Allowable Release Rates (if applicable):

Max release rate 1 cfs / acre? No Site Area: 0.00 acres

Enter Offsite flows to bypass site (these will be added to the allowable release rates)

Qminor =	0.00	cfs (bypass flows)	**Qminor allow =**	**ENTER VALUE**	**cfs**
Q100 =	0.00	cfs (bypass flows)	**Qmajor allow =**	**ENTER VALUE**	**cfs**

Rainfall Data Information:

Enter City, Town, or County:

Frequency of Design Event	One Hour Point Rainfall P1	
2 yr	0.90	in
5 yr	1.20	in
10 yr	1.46	in
100 yr	2.52	in

Do you need to Calc P1? No

Runoff Coefficient Calculations:

Use MHFD Equations? Yes

Intensity Duration Values:

I-D-F Calculate

JVA Incorporated
1319 Spruce Street
Boulder, CO 80302
Ph: (303) 444 1951

Job Name: Woodmoor
Job Number: 1051.5c
Date: 12/10/20
By: SAH

Woodmoor

Historic Runoff Coefficient & Time of Concentration Calculations

Location: 0
Minor Design Storm: 5
Major Design Storm: 100
Soil Type: B

Basin Design Data

	I (%) =	100%	90%	90%	40%	25%	25%	2%	2%			I (%)	Runoff Coeff's				Initial Overland Time (t_i)			Travel Time (t_t) t_t=Length/(Velocity x 60)						t_c Comp	tc Urbanized Check ON		t_c Final
Basin Name	Design Point	$A_{paved\ streets}$ (sf)	$A_{drives/conc}$ (sf)	A_{roof} (sf)	A_{gravel} (sf)	A_{plygnd} (sf)	$A_{art.\ turf}$ (sf)	$A_{lscape\ (B\ soil)}$ (sf)	$A_{lscape\ (C/D\ soil)}$ (sf)	A_{Total} (sf)	A_{Total} (ac)	Imp (%)	C2	C5	C10	C100	Upper most Length (ft)	Slope (%)	t_i (min)	Length (ft)	Slope (%)	Type of Land Surface	K	Velocity (fps)	t_t (min)	Time of Conc $t_i + t_t = t_c$	Total Length (ft)	t_c=(L/180)+ 10 (min.)	Min t_c
H1	1	228			7,655			8,560		16,443	0.38	21.0%	0.14	0.16	0.23	0.52	173	9.3%	10.8	230	8.8%	Paved areas & shallow paved swales	20	5.9	0.6	11.5	403	12.2	11.5
H2	2	390		4,677	5,731			44,054		54,853	1.26	14.2%	0.09	0.10	0.17	0.49	220	10.8%	12.3	233	6.8%	Short Pasture and lawns	7	1.8	2.1	14.4	453	12.5	12.5
H3	3	1,353							14,683	16,037	0.37	10.3%	0.06	0.07	0.14	0.47	137	6.9%	11.6	137	7.6%	Short Pasture and lawns	7	1.9	1.2	12.8	274	11.5	11.5
										0	0.00											Paved areas & shallow paved swales	20				0	10.0	
										0	0.00											Paved areas & shallow paved swales	20				0	10.0	
TOTAL SITE		1,971	0	4,677	13,386	0	0	52,615	14,683	87,332	2.00	14.7%	0.09	0.11	0.18	0.50													

I = (28.5 P1) / ((10 + TC) 0.786)

			Runoff Coeff's				Rainfall Intensities (in/hr)				Area		Flow Rates (cfs)			
Basin Name	Design Point	Time of Conc (tc)	C2	C5	C10	C100	2	5	10	100	A_{Total} (sf)	A_{Total} (ac)	Q2	Q5	Q10	Q100
H1	1	11.5	0.14	0.16	0.23	0.52	2.30	3.07	3.73	6.44	16,443	0.38	0.12	0.18	0.32	1.28
H2	2	12.5	0.09	0.10	0.17	0.49	2.22	2.96	3.60	6.21	54,853	1.26	0.24	0.38	0.78	3.86
H3	3	11.5	0.06	0.07	0.14	0.47	2.30	3.07	3.73	6.44	16,037	0.37	0.05	0.08	0.19	1.12
0	0										0	0.00				
0	0										0	0.00				
										TOTAL SITE	87,332	2.00	0.41	0.65	1.29	6.26

JVA Incorporated
1319 Spruce Street
Boulder, CO 80302
Ph: (303) 444 1951

Job Name: Woodmoor
Job Number: 1051.5c
Date: 12/10/20
By: SAH

Woodmoor

Composite Runoff Coefficient Calculations

Location: 0
Minor Design Storm: 5
Major Design Storm: 100
Soil Type: B

CA 100yr = 0.78i + 0.11
CB 100yr = 0.47i + 0.426
CC/D 100yr = 0.41i + 0.484)

Basin Design Data

	I (%) =	100%	90%	90%	40%	25%	25%	2%	2%			I (%)	Runoff Coeff's			
Basin Name	Design Point	A_{paved} streets (sf)	$A_{drives/conc}$ (sf)	A_{roof} (sf)	A_{gravel} (sf)	A_{plygnd} (sf)	$A_{art. turf}$ (sf)	$A_{lscape (B soil)}$ (sf)	$A_{lscape (C/D soil)}$ (sf)	A_{Total} (sf)	A_{Total} (ac)	Imp (%)	C2	C5	C10	C100
A1	1	557			7,325			8,560		16,443	0.38	22.2%	0.14	0.17	0.24	0.53
A2	2			4,677	3,520			2,414		10,611	0.24	53.4%	0.40	0.43	0.49	0.68
A3	3	1,434						14,602		16,037	0.37	10.8%	0.06	0.08	0.14	0.48
A4	4							13,875		13,875	0.32	2.0%	0.01	0.01	0.07	0.44
S1	5	3,233	509	868	1,724			24,032		30,366	0.70	18.6%	0.12	0.14	0.21	0.51
TOTAL SITE		5,225	509	5,545	12,569	0	0	63,484	0	87,332	2.00	19.4%	0.12	0.14	0.21	0.52
To Swale	6	3,233	509	5,545	5,244	0	0	40,321	0	54,852	1.26	21.1%				

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Boulder, CO 80302
Ph: (303) 444 1951

Job Name: Woodmoor
Job Number: 1051.5c
Date: 12/10/20
By: SAH

Woodmoor

Time of Concentration Calculations

Location: 0
Minor Design Storm: 5
Major Design Storm: 100
Soil Type: B

Sub-Basin Data				Initial Overland Time (t_i)			Travel Time (t_t) t_t=Length/(Velocity x 60)						t_c Comp	tc Urbanized Check ON		t_c Final
Basin Name	Design Point	A_{Total} (ac)	C5	Upper most Length (ft)	Slope (%)	t_i (min)	Length (ft)	Slope (%)	Type of Land Surface	C_v	Velocity (fps)	t_t (min)	Time of Conc $t_i + t_t = t_c$	Total Length (ft)	t_c=(L/180) +10 (min)	Min t_c
A1	1	0.38	0.17	173	9.3%	10.7	230	8.8%	Paved areas & shallow paved swales	20	5.9	0.6	11.4	403	12.2	11.4
A2	2	0.24	0.43	106	3.2%	8.5	90	13.6%	Grassed waterway	15	5.5	0.3	8.8	196	11.1	8.8
A3	3	0.37	0.08	137	6.9%	11.5	137	7.6%	Short Pasture and lawns	7	1.9	1.2	12.7	274	11.5	11.5
A4	4	0.32	0.01	106	13.1%	8.7	128	9.9%	Nearly bare ground	10	3.1	0.7	9.4	234	11.3	9.4
S1	5	0.70	0.14	55	8.1%	6.5	393	9.1%	Paved areas & shallow paved swales	20	6.0	1.1	7.6	448	12.5	7.6

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Woodmoor

Developed Storm Runoff Calculations

Design Storm : **100 Year**

Point Hour Rainfall (P_1) : **2.52**

I = (28.5 P1) / ((10 + TC)^0.786)

	Direct Runoff							Total Runoff				Inlets				Pipe					Pipe/Swale Travel Time				
Basin Name	Design Point	Area (ac)	Runoff Coeff	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Total tc (min)	ΣC*A (ac)	I (in/hr)	Q (cfs)	Inlet Type	Q Intercepted	Q carryover	Q bypass	Pipe Size (in) or equivalent	Pipe Material	Slope (%)	Pipe Flow (cfs)	Max Pipe Capacity (cfs)	Length (ft)	Velocity (fps)	tt (min)	Total Time (min)	Notes
A1	1	0.38	0.53	11.40	0.20	6.46	1.29	11.40	0.20	6.46	1.29														
A2	2	0.24	0.68	8.80	0.16	7.15	1.18	8.80	0.16	7.16	1.18														
A3	3	0.37	0.48	11.50	0.18	6.44	1.13	11.50	0.18	6.44	1.13														
A4	4	0.32	0.44	9.40	0.14	6.98	0.97	9.40	0.14	6.98	0.97														
S1	5	0.70	0.51	7.60	0.36	7.53	2.69	7.60	0.36	7.54	2.70														

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Job Name: Woodmoor
Job Number: 1051.5c
Date: 12/10/20
By: SAH

Woodmoor

Developed Storm Runoff Calculations

Design Storm : **5 Year**

Point Hour Rainfall (P_1) : **1.20**

I = (28.5 P1) / ((10 + TC)^0.786)

	Direct Runoff							Total Runoff				Inlets				Pipe					Pipe/Swale Travel Time				
Basin Name	Design Point	Area (ac)	Runoff Coeff	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Total tc (min)	ΣC*A (ac)	I (in/hr)	Q (cfs)	Inlet Type	Q Intercepted	Q carryover	Q bypass	Pipe Size (in) or equivalent	Pipe Material	Slope (%)	Pipe Flow (cfs)	Max Pipe Capacity (cfs)	Length (ft)	Velocity (fps)	tt (min)	Total Time (min)	Notes
A1	1	0.38	0.17	11.40	0.06	3.07	0.19	11.40	0.06	3.08	0.19														
A2	2	0.24	0.43	8.80	0.11	3.40	0.36	8.80	0.11	3.41	0.36														
A3	3	0.37	0.08	11.50	0.03	3.06	0.09	11.50	0.03	3.07	0.09														
A4	4	0.32	0.01	9.40	0.00	3.32	0.01	9.40	0.00	3.33	0.01														
S1	5	0.70	0.14	7.60	0.10	3.58	0.34	7.60	0.10	3.59	0.34														

Triangular Swale

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.050
Channel Slope	0.136 ft/ft
Left Side Slope	2.000 H:V
Right Side Slope	2.000 H:V
Discharge	2.70 cfs

Results	
Normal Depth	6.7 in
Flow Area	0.6 ft²
Wetted Perimeter	2.5 ft
Hydraulic Radius	3.0 in
Top Width	2.23 ft
Critical Depth	7.8 in
Critical Slope	0.062 ft/ft
Velocity	4.34 ft/s
Velocity Head	0.29 ft
Specific Energy	0.85 ft
Froude Number	1.449
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	6.7 in
Critical Depth	7.8 in
Channel Slope	0.136 ft/ft
Critical Slope	0.062 ft/ft

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Dec 10 2020

Triangular Swale

Triangular

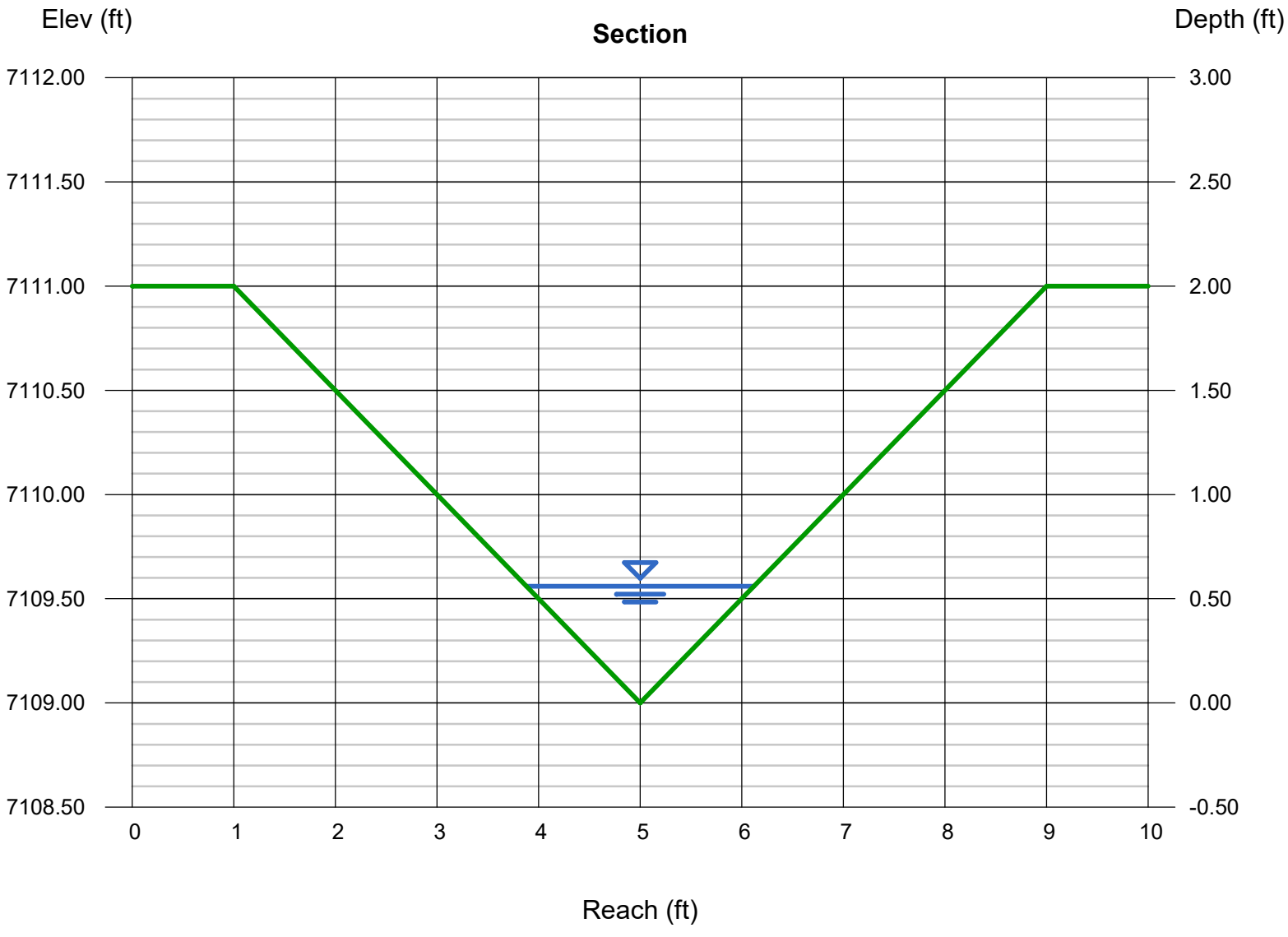
Side Slopes (z:1)	= 2.00, 2.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 7109.00
Slope (%)	= 13.60
N-Value	= 0.050

Calculations

Compute by:	Known Q
Known Q (cfs)	= 2.70

Highlighted

Depth (ft)	= 0.56
Q (cfs)	= 2.700
Area (sqft)	= 0.63
Velocity (ft/s)	= 4.30
Wetted Perim (ft)	= 2.50
Crit Depth, Yc (ft)	= 0.65
Top Width (ft)	= 2.24
EGL (ft)	= 0.85



DRAINAGE MAP LEGEND

- EXISTING INDEX CONTOUR
- EXISTING INTERMEDIATE CONTOUR
- PROPOSED INDEX CONTOUR
- PROPOSED INTERMEDIATE CONTOUR
- EXISTING SPOT ELEVATION
- PROPOSED SPOT ELEVATION
- HISTORIC DRAINAGE BASIN BOUNDARY (MAJOR BASIN)
- HISTORIC DRAINAGE BASIN BOUNDARY (SUB BASIN)
- DEVELOPED DRAINAGE BASIN BOUNDARY (MAJOR BASIN)
- DEVELOPED DRAINAGE BASIN BOUNDARY (SUB BASIN)
- DIRECTION OF FLOW (HISTORIC)
- DIRECTION OF FLOW (DEVELOPED)
- BASIN DESIGN POINT
- DRAINAGE BASIN IDENTIFICATION BUBBLE

A = DEVELOPED BASIN DESIGNATION
.50 = 100-YR RUNOFF COEFFICIENT
1.0 = AREA ACRES

SUMMARY PROPOSED UNDEVELOPED RUNOFF

BASIN	DESIGN POINT	AREA (AC)	RUNOFF COEFF. (5-YR)	RUNOFF COEFF. (100-YR)	DIRECT 5 YR RUNOFF (CFS)	DIRECT 100 YR PEAK (CFS)
H1	1	0.38	0.16	0.52	0.18	1.28
H2	2	1.26	0.10	0.49	0.38	3.86
H3	3	0.37	0.07	0.47	0.08	1.12
TOTAL		2.00	0.11	0.50	0.65	6.26

20 0 20 40
SCALE IN FEET

JVA, Inc. 1512 Larimer Street, Suite 710
Denver, CO 80202 303.444.1951
www.jvajva.com
Boulder • Fort Collins • Winter Park
Glenwood Springs • Denver

NO.	DATE	DES'D	DWN	REVISION DESCRIPTION

DESIGNED BY:	PMH
DRAWN BY:	JGJ/MHT
CHECKED BY:	RAH/JJM
JOB #:	1051.5e
DATE:	DEC 2020

WOODMOOR WSD NO.1
CENTRAL WTP IMPROVEMENTS
EL PASO COUNTY, COLORADO

HISTORIC DRAINAGE MAP

SHEET NO.
FIG1

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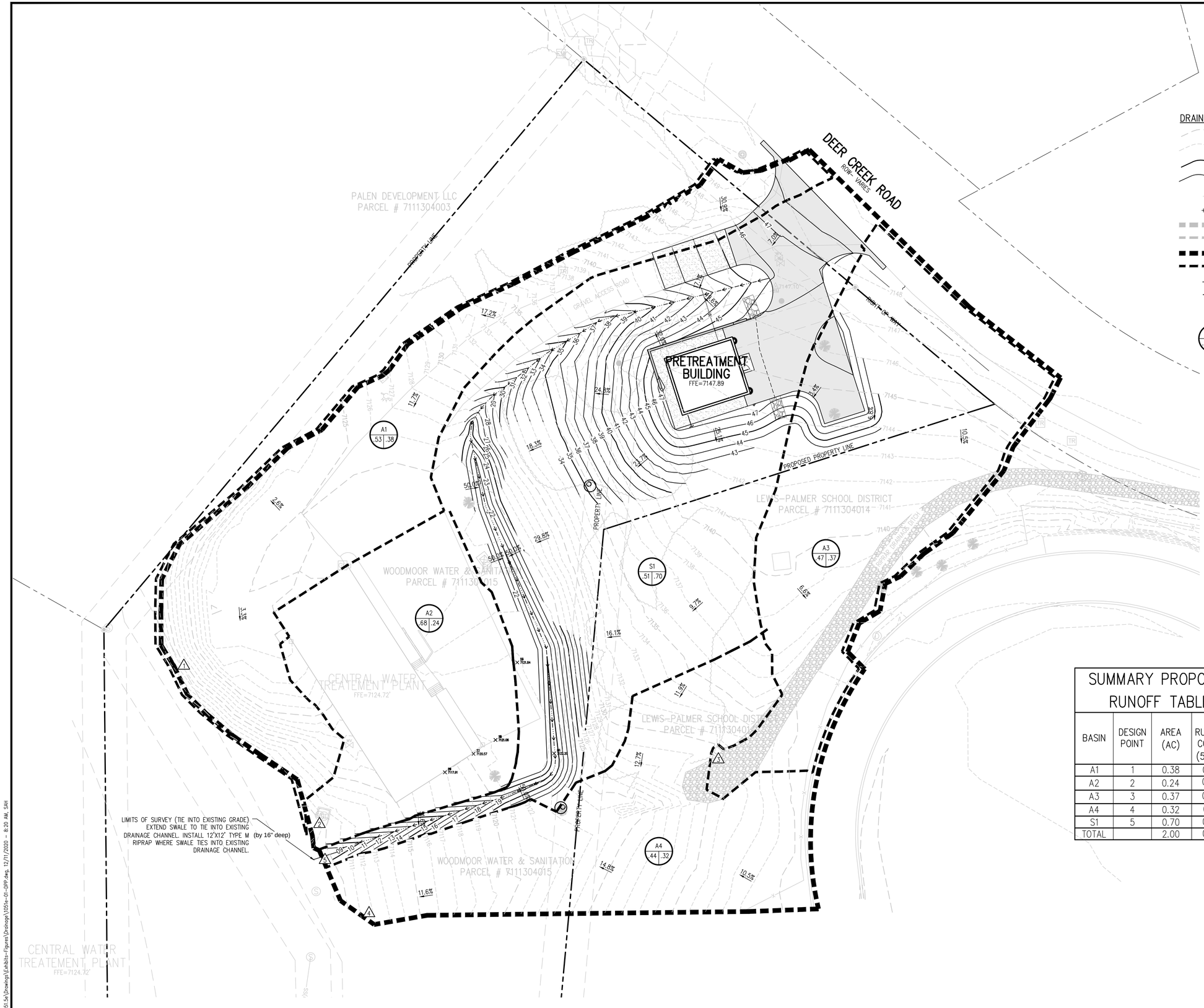

DRAINAGE MAP LEGEND

- EXISTING INDEX CONTOUR
- EXISTING INTERMEDIATE CONTOUR
- PROPOSED INDEX CONTOUR
- PROPOSED INTERMEDIATE CONTOUR
- EXISTING SPOT ELEVATION
- PROPOSED SPOT ELEVATION
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- DIRECTION OF FLOW (DEVELOPED)
- BASIN DESIGN POINT
- DRAINAGE BASIN IDENTIFICATION BUBBLE

A = DEVELOPED BASIN DESIGNATION
.50 = 100-YR RUNOFF COEFFICIENT
1.0 = AREA ACRES

SUMMARY PROPOSED RUNOFF TABLE

BASIN	DESIGN POINT	AREA (AC)	RUNOFF COEFF. (5-YR)	RUNOFF COEFF. (100-YR)	DIRECT 5 YR RUNOFF (CFS)	DIRECT 100 YR PEAK (CFS)
A1	1	0.38	0.17	0.53	0.19	1.29
A2	2	0.24	0.43	0.68	0.36	1.18
A3	3	0.37	0.08	0.48	0.09	1.13
A4	4	0.32	0.01	0.44	0.01	0.97
S1	5	0.70	0.14	0.51	0.34	2.70
TOTAL		2.00	0.14	0.52	1.00	7.27

20 0 20 40
SCALE IN FEET

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NO.	DATE	DES'D	DWN	REVISION DESCRIPTION

DESIGNED BY:	PMH
DRAWN BY:	JGJ/MHT
CHECKED BY:	RAH/JJM
JOB #:	1051.5e
DATE:	DEC 2020

WOODMOOR WSD NO.1
CENTRAL WTP IMPROVEMENTS
EL PASO COUNTY, COLORADO

DEVELOPED DRAINAGE MAP

SHEET NO.
FIG2

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