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Horseshoe Preliminary Drainage Report

April 2021

HR Green Project No: 201135

Prepared For:

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Table of Contents

- Table of Contents 1
- General Purpose, Location and Description 2
 - a. Purpose 2
 - b. Location 2
 - c. Description of Property 2
- I. Drainage Basins and Subbasins 2
 - a. Major Basin Description 2
 - b. Existing Subbasin Description 3
 - c. Proposed Subbasin Description 3
- II. Drainage Design Criteria 4
 - a. Development Criteria Reference 4
 - b. Hydrologic Criteria 4
- III. Drainage Facility Design 4
 - a. General Concept 4
 - b. Water Quality & Detention 4
 - c. Operation and Maintenance 5
 - d. Four Step Method to Minimize Adverse Impacts of Urbanization 5
 - e. Drainage and Bridge Fees 5
- IV. Drawings 5
- V. References 6

Appendices

- A. Vicinity Map, FEMA Map, NRCS Soil Survey
- B. Hydrologic Analysis
- C. Hydraulic Analysis
- D. Water Quality and Detention
- E. Reference Material
- F. Drainage Maps

General Purpose, Location and Description

a. Purpose

The purpose of this Preliminary Drainage Report (PDR) is to describe the onsite and offsite drainage patterns, existing and proposed storm infrastructure, and the planned stormwater management for the Horseshoe development. This report will support the development plan that is currently in review the City of Colorado Springs.

b. Location

Horseshoe, referred to as ‘the site’ herein, is a parcel of land in the northwest quarter of Section 8, T13S, R65W of the P.M. in the City of Colorado Springs, EL Paso County, Colorado. The site is bound by Woodmen Road Free Baptist Church to the North, Adventure Way to the East and South, and Horseshoe Road to the West. A vicinity map is presented in Appendix A.

c. Description of Property

The site is a single parcel totaling ~3.68 acres. The existing condition of the site is sparse grasses and open space. In general, the site slopes easterly towards Adventure Way. Per a NRCS soil survey, the site is made up of Type A Blakeland loamy sand and Type B Stapleton-Bernal sandy loams. A soils map is presented in Appendix A.

There are no major drainageways or irrigation facilities that traverse the site. Two existing 18” RCP culverts discharge offsite flows from the west side of Horseshoe Road. Other onsite, existing utilities include water, communication lines, overhead and underground electric. An existing drainage map is presented in Appendix F.

I. Drainage Basins and Subbasins

a. Major Basin Description

The site is located within the Sand Creek drainage basin. The area’s drainage characteristics were previously studied in the following reports:

1. “Sand Creek Drainage Basin Planning Study Preliminary Design Report” prepared by Kiowa Engineering Corporation, revised March 1996.
2. “Master Development Drainage Plan for Woodmen Heights Master Plan” prepared by Classic Consulting Engineers & Surveyors, accepted August 2004.
3. “Preliminary/Final Drainage Report for Jayden at Woodmen Heights Lots 1 & 2” prepared by M&S Civil Consultants, Inc., November 2018.

The Master Development Drainage Plan for Woodmen Heights Master Plan recommended a regional detention facility north of Woodmen Road (Sand Creek Detention Basin #6) to provide water quality and 100-year detention for the site and surrounding areas. However, due to existing infrastructure it is not realistic to convey the site’s storm water to the regional facility. The site, located south of Woodmen Road, drains easterly towards Adventure Way, with elevations ranging from 6,925 – 6,890. The existing storm sewer in Adventure Way collects the site’s existing stormwater but does not discharge to the regional detention facility. Therefore, onsite water quality and detention will be provided while the site’s discharge to the Adventure Way storm sewer will be restricted to historic rates.

b. Existing Subbasin Description

In the site's existing condition, stormwater flows across the site easterly from Horseshoe Road towards Adventure Way. An existing inlet in Adventure Way collects and conveys the stormwater downstream. The ultimate outfall for the site is Sand Creek. An existing drainage map is presented in Appendix B. See below for existing basin descriptions:

Basin A is 3.65 acres and is comprised of onsite undeveloped area and roadway. Existing stormwater from the basin discharges into Adventure Way. Total existing flows from Basin A are $Q_5=1.1$ cfs and $Q_{100}=1.9$ cfs.

Basin B is 0.04 acres and is comprised of onsite undeveloped area. Existing stormwater from the basin discharges to Adventure Way. Total existing flows from Basin B are $Q_5=0.1$ cfs and $Q_{100}=0.1$ cfs.

Basin OS1 is 0.82 acres and is comprised of offsite paved and undeveloped area. Existing stormwater for the basin flows onsite and to Adventure Way. Total existing flows from Basin OS1 are $Q_5=1.7$ cfs and $Q_{100}=2.8$ cfs.

Basin Jayden is 3.70 acres of offsite area. The basin was derived from the *Preliminary/Final Drainage Report for Jayden at Woodmen Heights Lots 1 & 2*. Per the aforementioned report, existing flows from Basin Jayden are $Q_5=17.2$ cfs and $Q_{100}=30.5$ cfs. Basin Jayden discharges onto the site in a pair of existing 18" RCP culverts.

c. Proposed Subbasin Description

The site has been divided into 7 subbasins for analysis. All storm sewer and appurtenances will be private. See below for basin descriptions:

Basin A is 1.74 acres of townhomes, landscaping and roadway. Flow from this basin ($Q_5 = 4.0$ cfs, $Q_{100} = 6.7$ cfs) is captured in a 10' Type R sump inlet and piped to the private full spectrum detention pond.

Basin B is 0.75 acres of townhomes, landscaping and roadway. Flow from this basin ($Q_5 = 1.3$ cfs, $Q_{100} = 2.3$ cfs) is captured in a 5' Type R sump inlet and piped to the private full spectrum detention pond.

Basin C is 0.43 acres of townhomes, landscaping and roadway. Flow from this basin ($Q_5 = 0.7$ cfs, $Q_{100} = 1.2$ cfs) is captured in a Type C sump inlet and piped to the private full spectrum detention pond.

Basin D is 0.50 acres of townhomes, landscaping, roadway and the full spectrum detention pond. Flow from this basin ($Q_5 = 0.5$ cfs, $Q_{100} = 0.8$ cfs) discharges directly into the private full spectrum detention pond.

Basin E is 0.28 acres of sidewalk and landscaping area. Flow from this basin ($Q_5 = 0.1$ cfs, $Q_{100} = 0.2$ cfs) flows into Adventure Way curb and gutter and is captured in an existing 10' Type R inlet.

Basin OS1 is 0.02 acres of existing roadway. Due to the addition of curb and gutter along Horseshoe Road, flow from this basin ($Q_5 = 0.1$ cfs, $Q_{100} = 0.2$ cfs) will be captured in a curb inlet and piped into the existing storm sewer stub, constructed with the Jayden at Woodmen Heights project. Basin OS1 will not be detained in the onsite, private full spectrum water detention pond since it was planned to be tributary to Regional Detention Facility No. 6 per the approved Woodmen Heights MDDP.

Basin OS2 (Existing Basin OS1) is 0.82 acres and is comprised of offsite paved and undeveloped area. Existing stormwater for the basin will be captured in a swale along the northern property line and discharge to Adventure Way. Total flows from Basin OS2 are $Q_5=1.7$ cfs and $Q_{100}=2.8$ cfs. Basin OS2 will not be detained in the onsite, private full spectrum water detention pond.

II. Drainage Design Criteria

a. Development Criteria Reference

The drainage analysis and proposed storm sewer system follow the criteria from the “*City of Colorado Springs Drainage Criteria Manual*” Volumes 1 and 2” (CCSDCM) dated May 2014.

b. Hydrologic Criteria

Hydrologic data was obtained from the “*City of Colorado Springs Drainage Criteria Manual – Chapter 6 Hydrology*”. Onsite drainage improvements are designed for the 5-year storm (minor event) and 100-year storm (major event) using rainfall values from CCSDCM Table 6-2 below.

Return Period (yr)	5	100
1-hr Rainfall Depth (in)	1.50	2.52

Runoff was calculated per CCSDCM Section 6.3.0 - Rational Method. Preliminary pond design was completed using the latest version of Mile High Flood District’s (MHFD) UD-Detention per CCSDCM Section 13.3.2.1 – Full Spectrum Detention.

III. Drainage Facility Design

a. General Concept

Onsite stormwater will be captured via onsite roadway, curb and gutter, and Type R and C inlets. Captured stormwater will be piped to and detained in an onsite, private full spectrum detention pond. The onsite, private full spectrum detention pond will discharge at less than historic rates to the existing storm sewer in Adventure Way.

A pair existing 18” RCP culverts discharge Lot 2 Horseshoe Rancheros flow onto the site across Adventure Way. Per the approved *Preliminary/Final Drainage Report for Jayden at Woodmen Heights Lots 1 & 2* these culverts were planned to be replaced with future development. The Jayden at Woodmen Heights project constructed a storm sewer stub onto Lot 2 Horseshoe Rancheros to capture storm water previously tributary to the existing 18” culverts. To facilitate this planned connection, a 3.0’ Type C Inlet will replace the existing culverts and discharge existing stormwater into the Jayden at Woodmen Heights storm sewer stub. For reference, see DP6 on the *Preliminary/Final Drainage Report for Jayden at Woodmen Heights Lots 1 & 2* drainage map, presented in Appendix E.

Curb and gutter and a single inlet will be installed along the eastern side of Horseshoe Drive. Existing stormwater in Horseshoe drive will be collected and discharge into the existing storm sewer, located just west of Horseshoe Road that was constructed with the Jayden at Woodmen Heights project. A drainage map is presented in Appendix F.

b. Water Quality & Detention

WQCV, EURV and 100-year detention are provided in an onsite, private full spectrum detention pond located adjacent to Adventure Way. The pond is sized for 3.43 acres with an average impervious of 46%. The WQCV is 0.056 ac-ft, the EURV is 0.118 ac-ft, the 100-year detention volume is 0.121 ac-ft for a total basin volume of 0.294 ac-ft. The WQCV, EURV and 100-year volume are released in 40, 68, and 68 hours, respectively. A

forebay is located at both outfalls into the pond and a 4.0' trickle channel conveys flow towards the outlet structure. A 10.0' access and maintenance road is provided to the bottom of the pond to facilitate future maintenance of the pond facilities. A 8.0' emergency overflow spillway is provided that conveys the peak 100-yr flow rate with 1.0' of freeboard towards Adventure Way. The spillway and downstream outfall will be lined with Type L riprap.

In the site's existing condition, stormwater flows to Adventure Way and is captured by an existing 10' Type R inlet. The pond outlet structure discharges to the existing 10' Type R inlet in Adventure Way at less than historic rates. Therefore, the downstream capacity will not be exceeded due to the development of this site.

c. Inspection and Maintenance

An inspection and maintenance manual will be provided to the City during the Final Drainage Report review process. The manual will specify maintenance intervals and required actions to maintain the function of the extended detention basin and appurtenances.

d. Four Step Method to Minimize Adverse Impacts of Urbanization

Step 1 – Reducing Runoff Volumes: To reduce runoff volumes, stormwater is routed across landscaped areas whenever possible and onsite drainage swales will be grass lined. An IRF spreadsheet will be included with the FDR.

Step 2 – Treat and slowly release the WQCV: An onsite, private, full spectrum detention pond provides water quality, excess urban runoff and 100-year treatment for the site. The WQCV is released over a period of 40 hours.

Step 3 – Stabilize stream channels: There are no onsite or offsite stream channels used for stormwater conveyance within the scope of this PDR. However, the pond's outfall will be lined with riprap to reduce stormwater velocities and provide stabilization. The pond's outfall ties into existing storm sewer and discharges into an existing culvert approximately 1,000 feet downstream along Adventure Way. The culvert discharges into an existing tributary for approximately 6,000 feet prior to the ultimate outfall to Sand Creek.

Step 4 – Consider the need for source controls: No industrial or commercial uses are proposed within this development and therefore source controls will not be necessary.

e. Drainage and Bridge Fees

Drainage and bridge fees are due at time of platting. See Table below for anticipated drainage and bridge fees.

2021 Sand Creek Drainage Basin Fees		
Site Acreage	Drainage Fee/acre	Total Basin Fee
3.68	\$18,841	\$69,335

IV. Drawings

Please refer to the appendices for vicinity and drainage basin maps.

V. References

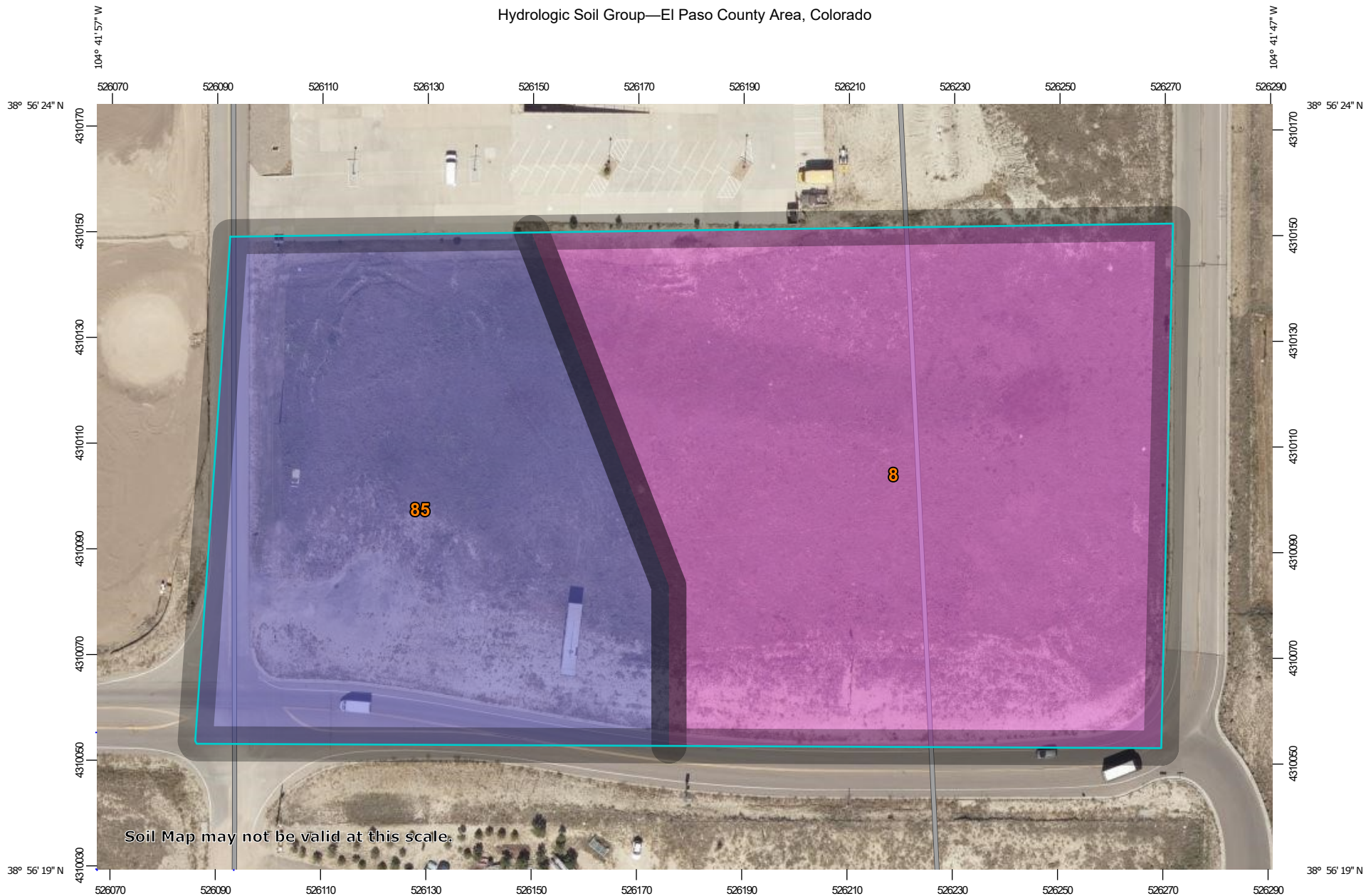
City of Colorado Springs – Drainage Criteria Manual, May 2014

Urban Storm Drainage Criteria Manual, Urban Drainage Flood Control District, January 2018



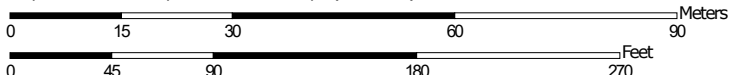
APPENDIX A – VICINITY MAP, SOIL MAP, FEMA MAP

Hydrologic Soil Group—El Paso County Area, Colorado



Soil Map may not be valid at this scale.

Map Scale: 1:1,020 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 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
8	Blakeland loamy sand, 1 to 9 percent slopes	A	2.5	57.6%
85	Stapleton-Bernal sandy loams, 3 to 20 percent slopes	B	1.9	42.4%
Totals for Area of Interest			4.4	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:

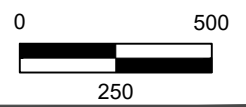
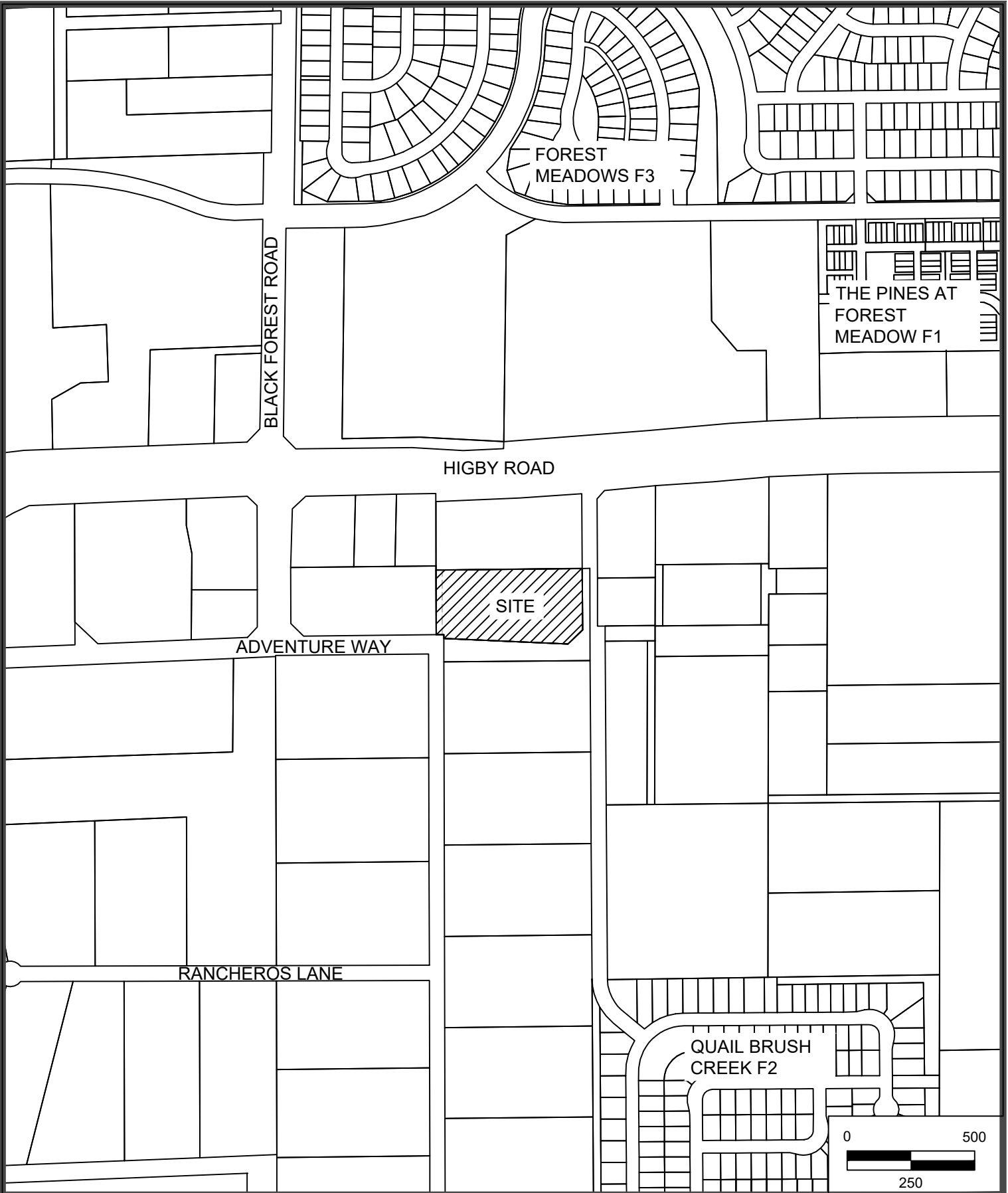
Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

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.



Xrefs: 8.5x11_Titleblock; xv-row



APPENDIX B – HYDROLOGIC CALCULATIONS



HORSESHOE	Calc'd by:	NQJ
EXISTING CONDITIONS	Checked by:	
LOCATION: COLORADO SPRINGS, COLORADO	Date:	2/5/2021

BASIN	AREA (ac)	% IMPERVIOUS	Q ₅ (cfs)	Q ₁₀₀ (cfs)
A	3.65	4	1.1	1.9
B	0.04	2	0.1	0.1
OS1	0.82	53	1.7	2.8
JAYDEN	3.70	-	17.2	30.5

DESIGN POINT	CONTRIBUTING BASINS	ΣQ ₅ (cfs)	ΣQ ₁₀₀ (cfs)
EX	JAYDEN	17.2	30.5
1	B	0.1	0.1
2	A,B,OS1 & JAYDEN	19.6	32.9



HORSESHOE

EXISTING CONDITIONS

LOCATION: COLORADO SPRINGS, COLORADO

Calc'd by:

NQJ


Checked by:

Date:

2/5/2021

COMPOSITE 'C' FACTORS

BASIN	EXISTING	WALKS & DRIVES	ROOFS	TOTAL	SOIL TYPE	LANDSCAPING			WALKS & DRIVES			ROOFS			COMPOSITE IMPERVIOUSNESS & C		
						%I	C ₅	C ₁₀₀	%I	C ₅	C ₁₀₀	%I	C ₅	C ₁₀₀	%I	C ₅	C ₁₀₀
						ACRES											
A	3.59	0.06	0.00	3.65	A/B	2	0.09	0.36	100	0.90	0.96	90	0.73	0.81	4	0.10	0.37
B	0.04	0.00	0.00	0.04	A/B	2	0.09	0.36	100	0.90	0.96	90	0.73	0.81	2	0.09	0.36
OS1	0.39	0.43	0.00	0.82	A/B	2	0.09	0.36	100	0.90	0.96	90	0.73	0.81	53	0.51	0.67
JAYDEN	-	-	-	3.70	-	-	-	-	-	-	-	-	-	-	-	0.90	0.95
Total				8.21													

	HORSESHOE	Calc'd by:	NQJ
	EXISTING CONDITIONS	Checked by:	
	LOCATION: COLORADO SPRINGS, COLORADO	Date:	2/5/2021

TIME OF CONCENTRATION											
BASIN DATA			OVERLAND TIME (T_i)			TRAVEL TIME (T_t)					TOTAL
DESIGNATION	C _s	AREA (ac)	LENGTH (ft)	SLOPE %	t _i (min)	C _v	LENGTH (ft)	SLOPE %	V (ft/s)	t _t (min)	t _c (min)
A	0.10	3.65	300	4.0	19.9	10	223	6.0	2.4	1.5	21.5
B	0.09	0.04	20	5.0	4.8	20	870	4.8	4.4	3.3	8.2
OS1	0.51	0.82	160	4.3	8.3	10	390	4.8	2.2	3.0	11.3
JAYDEN	0.90	3.70	-	-	0.6	-	-	-	-	2.2	2.8

FORMULAS:

$$t_i = \frac{0.395(1.1 - C_s)\sqrt{L}}{S^{0.33}} \quad V = C_v S_w^{0.5}$$

Table 6-7. Conveyance Coefficient, C_v

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

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



HORSESHOE

Calc'd by:

NQJ

EXISTING CONDITIONS

Checked by:

DESIGN STORM: 5-YEAR

Date:

2/5/2021

STREET	DESIGN POINT	BASIN ID	DIRECT RUNOFF						TOTAL RUNOFF				STREET			PIPE			TRAVEL TIME			REMARKS	
			AREA (ac)	C _s	t _c (min)	C _s *A (ac)	I (in./hr.)	Q (cfs)	t _c (min)	C _s *A (ac)	I (in./hr.)	Q (cfs)	Q _{street} (cfs)	C _s *A (ac)	SLOPE %	Q _{PIPE} (cfs)	C _s *A (ac)	SLOPE %	PIPE SIZE (in)	LENGTH (FT)	VEL. (FPS)		TRAVEL TIME (min)
	EX	JAYDEN	3.70	0.90	2.8	3.33	6.04	17.2															EX OFFSITE FLOWS FROM JAYDEN FDR
		A	3.65	0.10	21.5	0.38	2.98	1.1															BASIN A FLOW @ DP2
	1	B	0.04	0.09	8.2	0.00	4.43	0.1															BASIN B FLOW @ DP1, C&G FLOW TO DP2
		OS1	0.82	0.51	11.3	0.42	3.94	1.7															BASIN OS1 FLOW @ DP2
	2								21.5	0.80	2.98	19.6											TOTAL FLOW @ DP2 (EXISTING 10' TYPE R INLET)



HORSESHOE
EXISTING CONDITIONS
DESIGN STORM: 100-YEAR

Calc'd by: NQJ
Checked by:
Date: 2/5/2021

STREET	DESIGN POINT	BASIN ID	DIRECT RUNOFF						TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
			AREA (ac)	C ₁₀₀	t _c (min)	C ₁₀₀ *A (ac)	I (in./hr.)	Q (cfs)	t _c (min)	C ₁₀₀ *A (ac)	I (in./hr.)	Q (cfs)	Q _{street} (cfs)	C ₁₀₀ *A (ac)	SLOPE %	Q _{PIPE} (cfs)	C ₁₀₀ *A (ac)	SLOPE %	PIPE SIZE (ft)	LENGTH (ft)	VEL. (ft/s)	TRAVEL TIME (min)	
	EX	JAYDEN	3.70	0.90	2.8	3.33	10.14	30.5															EX OFFSITE FLOWS FROM JAYDEN FDR
		A	3.65	0.10	21.5	0.38	5.01	1.9															BASIN A FLOW @ DP2
	1	B	0.04	0.09	8.2	0.00	7.44	0.1															BASIN B FLOW @ DP1, C&G FLOW TO DP2
		OS1	0.82	0.51	11.3	0.42	6.62	2.8															BASIN OS1 FLOW @ DP2
	2								21.5	0.80	2.98	32.9											TOTAL FLOW @ DP2 (EXISTING 10' TYPE R INLET)



HORSESHOE	Calc'd by:	NQJ
PROPOSED CONDITIONS	Checked by:	
LOCATION: COLORADO SPRINGS, COLORADO	Date:	2/10/2021

BASIN	AREA (ac)	% IMPERVIOUS	Q ₅ (cfs)	Q ₁₀₀ (cfs)
A	1.74	55	4.0	6.7
B	0.75	46	1.3	2.3
C	0.39	47	0.7	1.2
D	0.50	15	0.5	0.8
E	0.28	2	0.1	0.2
OS1	0.02	100	0.1	0.2
OS2	0.82	53	1.7	2.8

DESIGN POINT	CONTRIBUTING BASINS	ΣQ ₅ (cfs)	ΣQ ₁₀₀ (cfs)
1	A	4.0	6.7
2	B	1.3	2.3
2.1	A & B	5.0	8.4
3	C	0.7	1.2
4	A, B, C & D	6.1	10.2
5	E	0.1	0.2
6	OS1	0.1	0.2
7	OS2	1.7	2.8



HORSESHOE

PROPOSED CONDITIONS

LOCATION: COLORADO SPRINGS, COLORADO

Calc'd by:

NQJ


Checked by:

Date:

2/10/2021

COMPOSITE 'C' FACTORS

BASIN	LANDSCAPING	WALKS & DRIVES	ROOFS	TOTAL	SOIL TYPE	LANDSCAPING			WALKS & DRIVES			ROOFS			COMPOSITE IMPERVIOUSNESS & C					
						ACRES			%I	C ₅	C ₁₀₀	%I	C ₅	C ₁₀₀	%I	C ₅	C ₁₀₀	%I	C ₅	C ₁₀₀
A	0.76	0.62	0.36	1.74	A/B	2	0.09	0.36	100	0.90	0.96	90	0.73	0.81	55	0.51	0.67			
B	0.40	0.22	0.13	0.75	A/B	2	0.09	0.36	100	0.90	0.96	90	0.73	0.81	46	0.44	0.61			
C	0.20	0.10	0.09	0.39	A/B	2	0.09	0.36	100	0.90	0.96	90	0.73	0.81	47	0.45	0.62			
D	0.43	0.01	0.06	0.50	A/B	2	0.09	0.36	100	0.90	0.96	90	0.73	0.81	15	0.18	0.43			
E	0.28	0.00	0.00	0.28	A/B	2	0.09	0.36	100	0.90	0.96	90	0.73	0.81	2	0.09	0.36			
OS1	0.00	0.02	0.00	0.02	A/B	2	0.09	0.36	100	0.90	0.96	90	0.73	0.81	100	0.90	0.96			
OS2	0.39	0.43	0.00	0.82	A/B	2	0.09	0.36	100	0.90	0.96	90	0.73	0.81	53	0.51	0.67			
Pond				3.38											46					
Total				4.50																

	HORSESHOE	Calc'd by:	NQJ
	PROPOSED CONDITIONS	Checked by:	
	LOCATION: COLORADO SPRINGS, COLORADO	Date:	2/10/2021

TIME OF CONCENTRATION

BASIN DATA			OVERLAND TIME (T _i)			TRAVEL TIME (T _t)					TOTAL
DESIGNATION	C _s	AREA (ac)	LENGTH (ft)	SLOPE %	t _i (min)	C _v	LENGTH (ft)	SLOPE %	V (ft/s)	t _t (min)	t _c (min)
A	0.51	1.74	57	2.0	6.5	20	280	2.6	3.2	1.4	7.9
B	0.44	0.75	85	2.0	8.9	20	162	1.0	2.0	1.4	10.2
C	0.45	0.39	63	2.0	7.6	20	188	1.0	2.0	1.6	9.1
D	0.18	0.50	24	10.0	3.8	10	295	15.0	3.9	1.3	5.1
E	0.09	0.28	56	33.0	4.3	20	460	4.0	4.0	1.9	6.2
OS1	0.90	0.02	11	2.0	0.9	20	38	0.6	1.5	0.4	5.0
OS2	0.51	0.82	160	4.3	8.3	10	390	4.8	2.2	3.0	11.3

FORMULAS:

$$t_i = \frac{0.395(1.1 - C_s)\sqrt{L}}{S^{0.33}} \quad V = C_v S_w^{0.5}$$

Table 6-7. Conveyance Coefficient, C_v

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

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



HORSESHOE		Calc'd by: NQJ
PROPOSED CONDITIONS		Checked by:
DESIGN STORM: 5-YEAR		Date: 2/10/2021

STREET	DESIGN POINT	BASIN ID	DIRECT RUNOFF						TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
			AREA (ac)	C _s	f _c (min)	C _s *A (ac)	f (in./hr.)	Q (cfs)	f _c (min)	C _s *A (ac)	f (in./hr.)	Q (cfs)	Q _{street} (cfs)	C _s *A (ac)	SLOPE %	Q _{PIPE} (cfs)	C _s *A (ac)	SLOPE %	PIPE SIZE (in)	LENGTH (FT)	VEL. (FPS)	TRAVEL TIME (min)	
	1	A	1.74	0.51	7.9	0.89	4.48	4.0							4.0	0.89	10.0	18.0	185	22.8	0.14	BASIN 1 FLOW CAPTURED IN 10' TYPE R INLET @ DP1 PIPE TO DP2.1	
	2	B	0.75	0.44	10.2	0.33	4.10	1.3						1.3	0.33	10.0	18.0	5	22.8	0.00	BASIN 2 FLOW CAPTURED IN 10' TYPE R INLET @ DP2 PIPE TO DP2.1		
	2.1								10.2	1.22	4.10	5.0		5.0	1.22	10.0	18.0	115	22.8	0.08	COMBINED DP1 & DP2 FLOW @ DP2.1, PIPE TO DP4		
	3	C	0.39	0.45	9.1	0.17	4.27	0.7						0.7	0.17	10.0	18.0	86	22.8	0.06	BASIN C FLOW CAPTURED @ DP3 IN TYPE C INLET, PIPE TO DP4		
	4	D	0.50	0.18	5.1	0.09	5.14	0.5	10.3	1.48	4.08	6.1										TOTAL FLOW ENTERING POND	
	5	E	0.28	0.09	6.2	0.03	4.84	0.1														BASIN 3 C&G FLOW IN ADVENTURE WAY TO DP5 (CAPTURED IN EXISTING 10' TYPE R INLET)	
	6	OS1	0.02	0.90	5.0	0.02	5.17	0.1														BASIN OS1 FLOW CAPTURED IN CURB INLET @ DP6, PIPED OFFSITE	
	7	OS2	0.82	0.51	11.3	0.42	3.94	1.7														BASIN OS2 FLOW, CAPTURE IN SWALE ALONG NORTH PROPERTY LINE, DISCHARGE TO ADVENTURE WAY	



HORSESHOE

PROPOSED CONDITIONS

DESIGN STORM: 100-YEAR

Calc'd by: **NQJ**

Checked by:

Date: **2/10/2021**

			DIRECT RUNOFF						TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
STREET	DESIGN POINT	BASIN ID	AREA (ac)	C ₁₀₀	f _c (min)	C ₁₀₀ *A (ac)	I (in./hr.)	Q (cfs)	f _c (min)	C ₁₀₀ *A (ac)	I (in./hr.)	Q (cfs)	Q _{street} (cfs)	C ₁₀₀ *A (ac)	SLOPE %	Q _{PIPE} (cfs)	C ₁₀₀ *A (ac)	SLOPE %	PIPE SIZE (ft)	LENGTH (ft)	VEL. (ft/s)	TRAVEL TIME (min)	
	1	A	1.74	0.51	7.9	0.89	7.52	6.7								6.7	0.89	10.0	18.0	185	22.8	0.14	BASIN 1 FLOW CAPTURED IN 10' TYPE R INLET @ DP1 PIPE TO DP2.1
	2	B	0.75	0.44	10.2	0.33	6.88	2.3								2.3	0.33	10.0	18.0	5	22.8	0.00	BASIN 2 FLOW CAPTURED IN 10' TYPE R INLET @ DP2 PIPE TO DP2.1
	2.1							10.2	1.22	6.88	8.4				8.4	1.22	10.0	18.0	115	22.8	0.08	COMBINED DP1 & DP2 FLOW @ DP2.1, PIPE TO DP4	
	3	C	0.39	0.45	9.1	0.17	7.16	1.2								1.2	0.17	10.0	18.0	86	22.8	0.06	BASIN C FLOW CAPTURED @ DP3 IN TYPE C INLET, PIPE TO DP4
	4	D	0.50	0.18	5.1	0.09	8.63	0.8	10.3	1.48	6.86	10.2											TOTAL FLOW ENTERING POND
	5	E	0.28	0.09	6.2	0.03	8.12	0.2															BASIN 3 C&G FLOW IN ADVENTURE WAY TO DP5 (CAPTURED IN EXISTING 10' TYPE R INLET)
	6	OS1	0.02	0.90	5.0	0.02	8.68	0.2															BASIN OS1 FLOW CAPTURED IN CURB INLET @ DP6, PIPED OFFSITE
	7	OS2	0.82	0.51	11.3	0.42	6.62	2.8															BASIN OS2 FLOW, CAPTURE IN SWALE ALONG NORTH PROPERTY LINE, DISCHARGE TO ADVENTURE WAY

APPENDIX C – HYDRAULIC CALCULATIONS*

***(STREET CAPACITY, INLET AND STORM SEWER HGL CALCULATIONS WILL
BE SUBMITTED WITH FINAL DRAINAGE REPORT)**

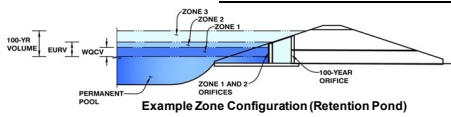


APPENDIX D – WATER QUALITY & DETENTION

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: **HORSESHOE**
Basin ID: **BASIN A-D**



Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	3.43	acres
Watershed Length =	622	ft
Watershed Length to Centroid =	70	ft
Watershed Slope =	0.060	ft/ft
Watershed Imperviousness =	46.00%	percent
Percentage Hydrologic Soil Group A =	60.0%	percent
Percentage Hydrologic Soil Group B =	40.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQC Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

After providing required inputs above including 1-hour rainfall depths, click "Run CUHP" to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

Water Quality Capture Volume (WQCV) =	0.056	acre-feet
Excess Urban Runoff Volume (EURV) =	0.174	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.126	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	0.168	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	0.216	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	0.289	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	0.345	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	0.426	acre-feet
500-yr Runoff Volume (P1 = 3.14 in.) =	0.580	acre-feet
Approximate 2-yr Detention Volume =	0.118	acre-feet
Approximate 5-yr Detention Volume =	0.159	acre-feet
Approximate 10-yr Detention Volume =	0.203	acre-feet
Approximate 25-yr Detention Volume =	0.238	acre-feet
Approximate 50-yr Detention Volume =	0.260	acre-feet
Approximate 100-yr Detention Volume =	0.294	acre-feet

Optional User Overrides

		acre-feet
		acre-feet
	1.19	inches
	1.50	inches
	1.75	inches
	2.00	inches
	2.25	inches
	2.52	inches
		inches

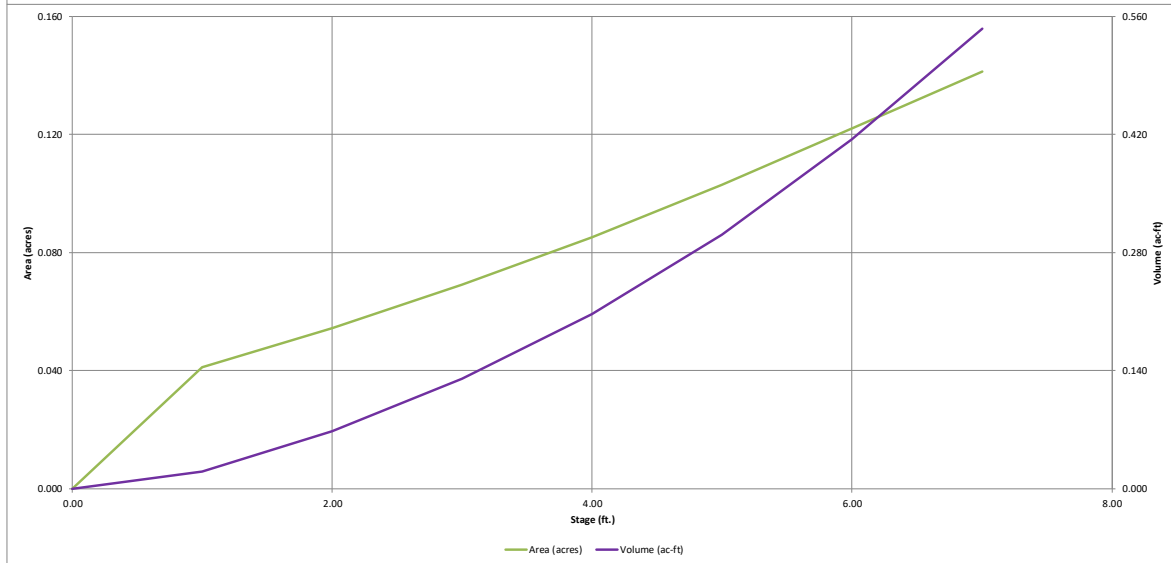
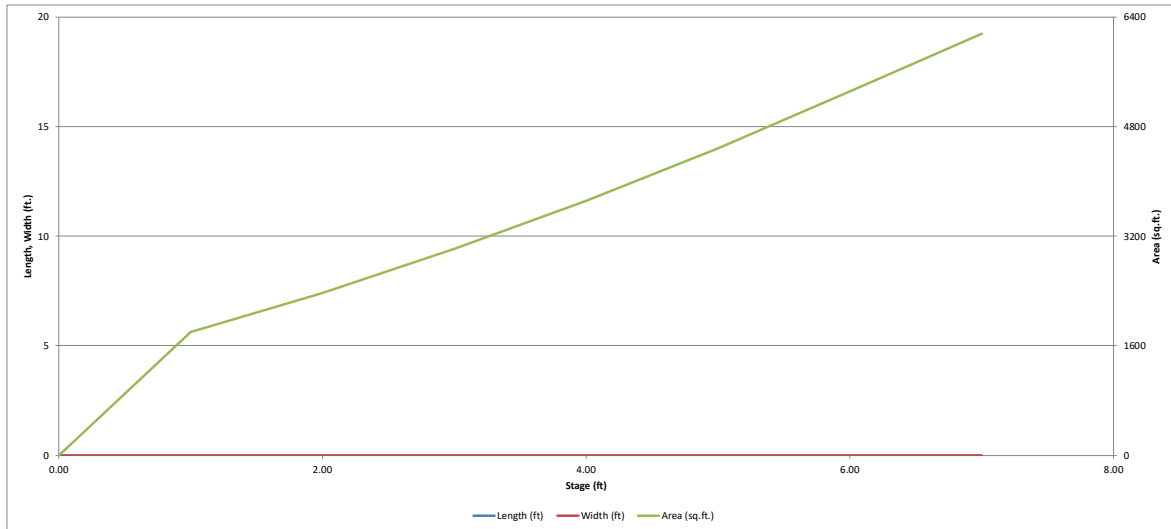
Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.056	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.118	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.121	acre-feet
Total Detention Basin Volume =	0.294	acre-feet
Initial Surcharge Volume (ISV) =	user	ft ³
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H _{total}) =	user	ft
Depth of Trickle Channel (H _{TC}) =	user	ft
Slope of Trickle Channel (S _{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S _{main}) =	user	H:V
Basin Length-to-Width Ratio (R _{L/W}) =	user	
Initial Surcharge Area (A _{ISV}) =	user	ft ²
Surcharge Volume Length (L _{ISV}) =	user	ft
Surcharge Volume Width (W _{ISV}) =	user	ft
Depth of Basin Floor (H _{FLOOR}) =	user	ft
Length of Basin Floor (L _{FLOOR}) =	user	ft
Width of Basin Floor (W _{FLOOR}) =	user	ft
Area of Basin Floor (A _{FLOOR}) =	user	ft ²
Volume of Basin Floor (V _{FLOOR}) =	user	ft ³
Depth of Main Basin (H _{MAIN}) =	user	ft
Length of Main Basin (L _{MAIN}) =	user	ft
Width of Main Basin (W _{MAIN}) =	user	ft
Area of Main Basin (A _{MAIN}) =	user	ft ²
Volume of Main Basin (V _{MAIN}) =	user	ft ³
Calculated Total Basin Volume (V _{total}) =	user	acre-feet

Depth Increment =		ft									
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft ²)	Optional Override Area (ft ²)	Area (acre)	Volume (ft ³)	Volume (ac-ft)		
6986 Top of Micropool	--	0.00	--	--	--	0	0.000				
	6987	1.00	--	--	--	1,795	0.041	897	0.021		
	6988	2.00	--	--	--	2,371	0.054	2,980	0.068		
	6989	3.00	--	--	--	3,010	0.069	5,671	0.130		
	6990	4.00	--	--	--	3,714	0.085	9,033	0.207		
	6991	5.00	--	--	--	4,481	0.103	13,130	0.301		
	6992	6.00	--	--	--	5,318	0.122	18,030	0.414		
	6993	7.00	--	--	--	6,158	0.141	23,768	0.546		

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

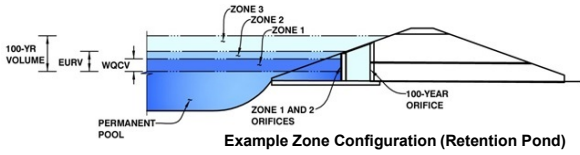
MHFD-Detention, Version 4.03 (May 2020)



DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Project: HORSESHOE
Basin ID: BASIN A-D



	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.77	0.056	Orifice Plate
Zone 2 (EURV)	3.59	0.118	Orifice Plate
Zone 3 (100-year)	4.94	0.121	Weir&Pipe (Restrict)
Total (all zones)		0.294	

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth = ft (distance below the filtration media surface)
Underdrain Orifice Diameter = inches

Calculated Parameters for Underdrain
Underdrain Orifice Area = ft²
Underdrain Orifice Centroid = feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Invert of Lowest Orifice = ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate = ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing = inches
Orifice Plate: Orifice Area per Row = sq. inches (diameter = 3/4 inch)

Calculated Parameters for Plate
WQ Orifice Area per Row = ft²
Elliptical Half-Width = feet
Elliptical Slot Centroid = feet
Elliptical Slot Area = ft²

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.20	2.39					
Orifice Area (sq. inches)	0.45	0.45	0.45					

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	inches

Calculated Parameters for Vertical Orifice
Vertical Orifice Area = ft²
Vertical Orifice Centroid = feet

User Input: Overflow Weir (Dropbox with Flat or Sloped Gate and Outlet Pipe OR Rectangular/Trapezoidal Weir (and No Outlet Pipe))

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	<input type="text" value="3.66"/>	<input type="text" value="N/A"/>	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	<input type="text" value="2.00"/>	<input type="text" value="N/A"/>	feet
Overflow Weir Gate Slope =	<input type="text" value="0.00"/>	<input type="text" value="N/A"/>	H:V
Horiz. Length of Weir Sides =	<input type="text" value="2.00"/>	<input type="text" value="N/A"/>	feet
Overflow Gate Open Area % =	<input type="text" value="70%"/>	<input type="text" value="N/A"/>	%, gate open area/total area
Debris Clogging % =	<input type="text" value="50%"/>	<input type="text" value="N/A"/>	%

Calculated Parameters for Overflow Weir
Height of Gate Upper Edge, H₁ = feet
Overflow Weir Slope Length = feet
Grate Open Area / 100-yr Orifice Area = ft²
Overflow Gate Open Area w/o Debris = ft²
Overflow Gate Open Area w/ Debris = ft²

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	<input type="text" value="2.50"/>	<input type="text" value="N/A"/>	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	<input type="text" value="18.00"/>	<input type="text" value="N/A"/>	inches
Restrictor Plate Height Above Pipe Invert =	<input type="text" value="5.40"/>	<input type="text" value="N/A"/>	inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate
Outlet Orifice Area = ft²
Outlet Orifice Centroid = feet
Half-Central Angle of Restrictor Plate on Pipe = radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage = ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length = feet
Spillway End Slopes = H:V
Freeboard above Max Water Surface = feet

Calculated Parameters for Spillway
Spillway Design Flow Depth = feet
Stage at Top of Freeboard = feet
Basin Area at Top of Freeboard = acres
Basin Volume at Top of Freeboard = acre-ft

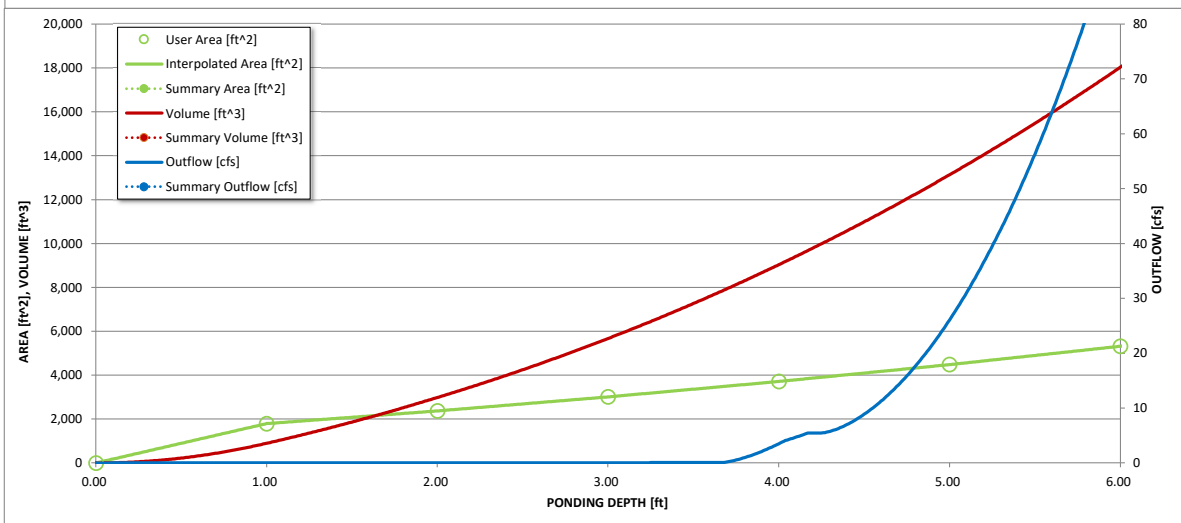
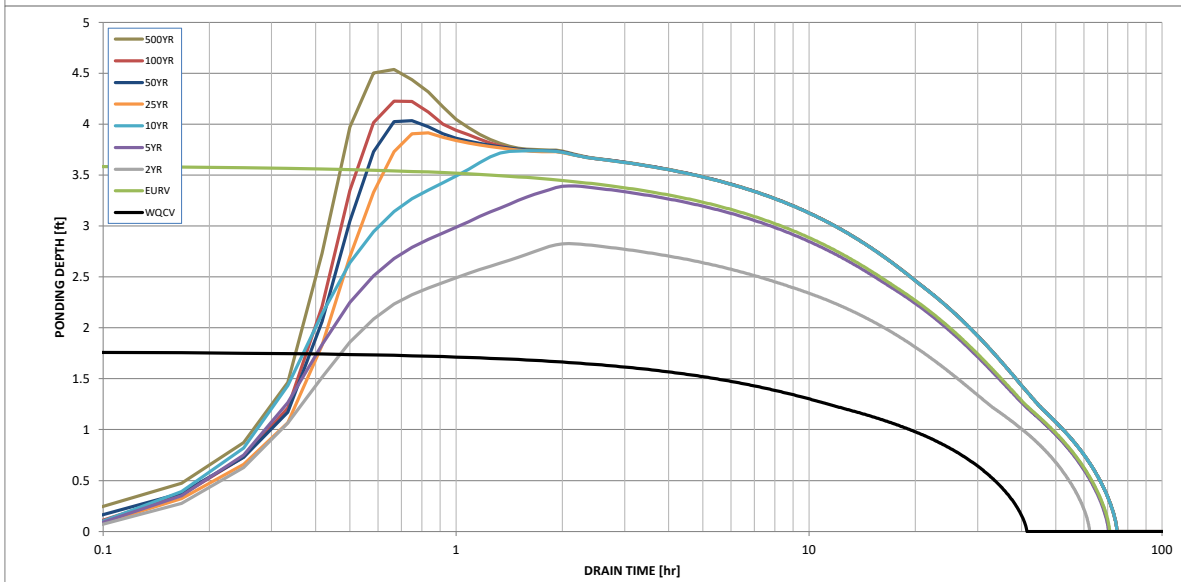
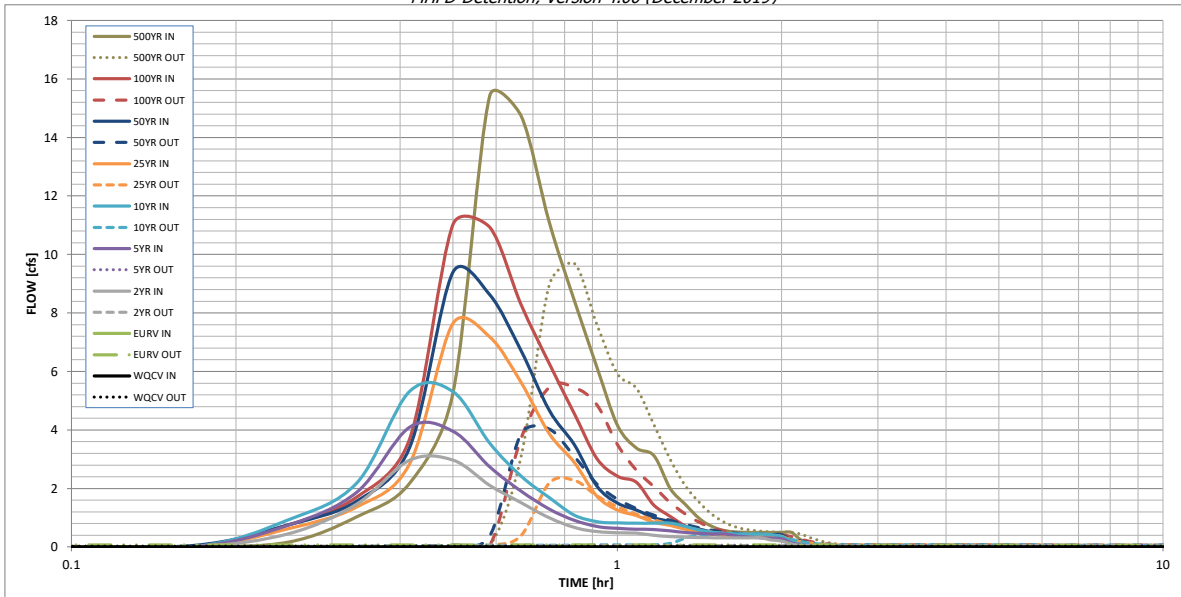
Routed Hydrograph Results

The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =									
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	0.056	0.174	0.126	0.168	0.216	0.289	0.345	0.426	0.580
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.126	0.168	0.216	0.289	0.345	0.426	0.580
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.3	1.4	3.1	4.3	6.0	9.2
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.03	0.09	0.41	0.90	1.25	1.76	2.70
Peak Inflow Q (cfs) =	N/A	N/A	3.0	4.1	5.3	7.6	9.4	11.0	15.4
Peak Outflow Q (cfs) =	0.0	0.1	0.1	0.1	0.4	2.3	4.0	5.5	9.7
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.2	0.3	0.7	0.9	0.9	1.0
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Gate 1 (fps) =	N/A	N/A	N/A	N/A	0.1	0.8	1.4	1.9	2.0
Max Velocity through Gate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	63	56	63	65	63	61	59	55
Time to Drain 99% of Inflow Volume (hours) =	40	68	60	67	70	69	69	68	66
Maximum Ponding Depth (ft) =	1.77	3.60	2.83	3.39	3.74	3.91	4.04	4.23	4.54
Area at Maximum Ponding Depth (acres) =	0.05	0.08	0.07	0.08	0.08	0.08	0.09	0.09	0.09
Maximum Volume Stored (acre-ft) =	0.056	0.175	0.118	0.158	0.185	0.200	0.210	0.227	0.255

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Depotion, Version 4.00 (December 2019)



S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

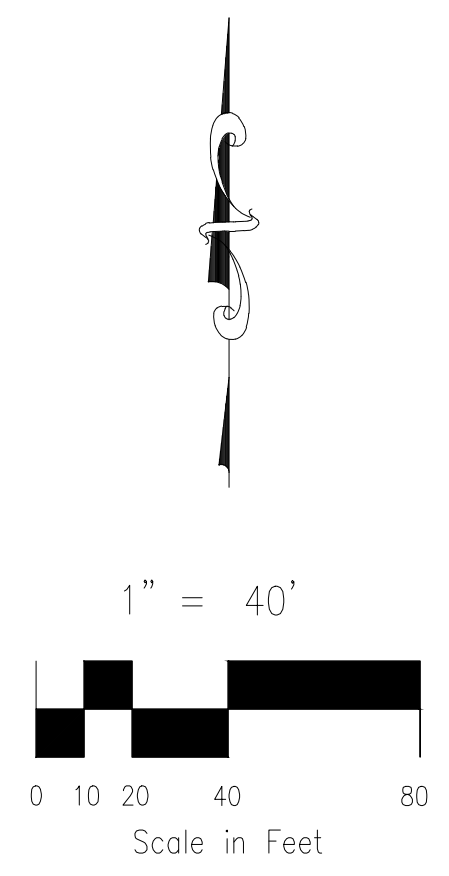
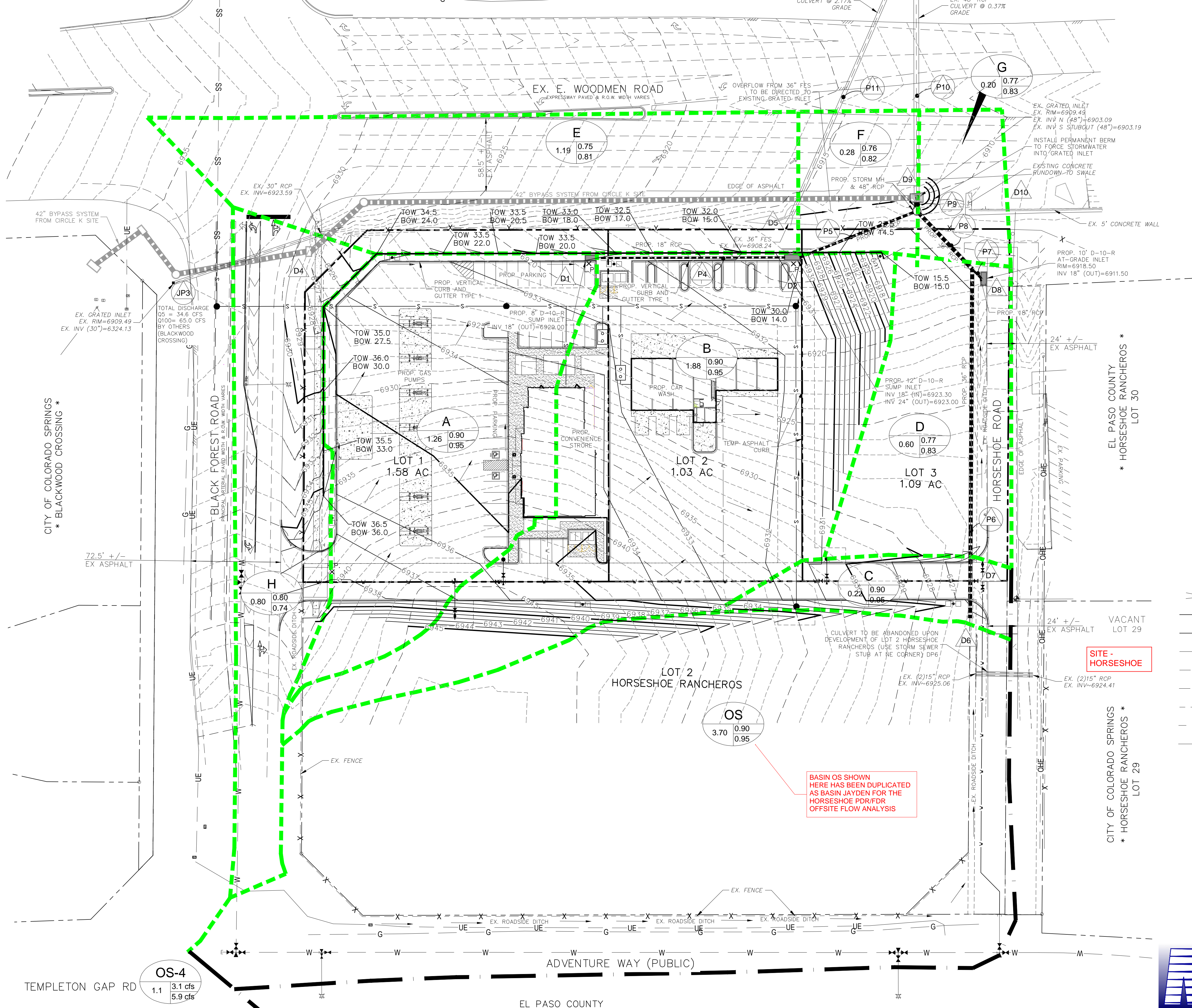
Time Interval	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.01	0.17
	0:15:00	0.00	0.00	0.46	0.75	0.93	0.62	0.76	0.76	1.03
	0:20:00	0.00	0.00	1.47	1.88	2.19	1.37	1.57	1.71	2.18
	0:25:00	0.00	0.00	2.97	4.09	5.32	2.85	3.40	3.71	5.26
	0:30:00	0.00	0.00	2.97	3.96	5.31	7.64	9.39	11.03	15.42
	0:35:00	0.00	0.00	2.11	2.74	3.55	7.19	8.62	10.93	14.74
	0:40:00	0.00	0.00	1.52	1.91	2.42	5.62	6.71	8.28	11.11
	0:45:00	0.00	0.00	1.00	1.30	1.69	3.88	4.68	6.28	8.44
	0:50:00	0.00	0.00	0.67	0.91	1.09	2.90	3.50	4.57	6.17
	0:55:00	0.00	0.00	0.53	0.70	0.86	1.75	2.09	3.03	4.17
	1:00:00	0.00	0.00	0.49	0.64	0.82	1.26	1.50	2.42	3.39
	1:05:00	0.00	0.00	0.47	0.61	0.81	1.07	1.27	2.21	3.12
	1:10:00	0.00	0.00	0.40	0.60	0.81	0.85	1.00	1.43	2.00
	1:15:00	0.00	0.00	0.36	0.55	0.82	0.74	0.87	1.05	1.45
	1:20:00	0.00	0.00	0.34	0.49	0.70	0.60	0.70	0.71	0.96
	1:25:00	0.00	0.00	0.32	0.46	0.57	0.53	0.61	0.53	0.68
	1:30:00	0.00	0.00	0.32	0.45	0.50	0.44	0.50	0.43	0.55
	1:35:00	0.00	0.00	0.32	0.44	0.46	0.40	0.45	0.41	0.51
	1:40:00	0.00	0.00	0.32	0.37	0.44	0.38	0.43	0.40	0.50
	1:45:00	0.00	0.00	0.32	0.33	0.44	0.37	0.42	0.40	0.50
	1:50:00	0.00	0.00	0.32	0.31	0.44	0.37	0.42	0.40	0.50
	1:55:00	0.00	0.00	0.24	0.30	0.42	0.37	0.42	0.40	0.50
	2:00:00	0.00	0.00	0.20	0.28	0.36	0.37	0.42	0.40	0.50
	2:05:00	0.00	0.00	0.10	0.14	0.18	0.19	0.21	0.20	0.25
	2:10:00	0.00	0.00	0.05	0.07	0.09	0.09	0.10	0.10	0.12
	2:15:00	0.00	0.00	0.02	0.03	0.04	0.04	0.05	0.05	0.06
	2:20:00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.01	0.02
	2:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

APPENDIX E – REFERENCE MATERIAL

CITY - A/AO
VACANT
LOT 1
WOODMEN FOREST
SUBDIVISION NO. 1

JAYDEN AT WOODMEN HEIGHTS DEVELOPED DRAINAGE MAP

* UNPLATTED *
SAND CREEK REGIONAL DETENTION BASIN
NO. 6 (WATER QUALITY AND DETENTION)



- LEGEND**
- A BASIN DESIGNATION
 - 0.76 0.90 0.95 C_s / C₁₀₀
 - D1 DESIGN POINT
 - P1 PIPE FLOW POINT
 - FLOW ARROW
 - BASIN DESIGNATION
 - OFF SITE BASIN DESIGNATION
 - 6932 PROPOSED CONTOUR
 - 6922 EXISTING CONTOUR
 - BYPASS SYSTEM FROM CIRCLE K SITE STORM SEWER
 - PROPOSED STORM SEWER
 - EXISTING STORM SEWER CULVERT
 - S PROPOSED SANITARY SEWER
 - W PROPOSED WATER LINE
 - UE EXISTING UNDERGROUND ELECTRICAL
 - G EXISTING GAS LINE
 - W EXISTING WATER LINE
 - X EXISTING FENCE
 - OHE EXISTING OVERHEAD ELECTRICAL
 - SS EXISTING SANITARY SEWER LINE
 - H.P. HIGH POINT
 - L.P. LOW POINT
 - TOW 33.5 BOW 28.0 TOP OF WALL/BOTTOM OF WALL

DRAINAGE BASIN SUMMARY DEVELOPED BASINS

BASIN :	MINOR FLOW (cfs) (5 YR)	MAJOR FLOW (cfs) (100 YR)
A	5.9	10.4
B	8.7	15.5
C	1.0	1.8
D	2.4	4.3
E	4.3	7.8
F	1.1	2.0
G	0.8	1.4
H	3.0	5.6
OS	17.2	30.5
OS-4	3.1	5.9

DESIGN POINTS

DESIGN POINT:	MINOR FLOW (cfs)	MAJOR FLOW (cfs)
1	5.9	10.4
2	8.7	15.5
4	3.0	5.6
5	4.3	7.8
6	17.2	30.5
7	1.0	1.8
8	3.4	6.1
9	5.3	9.6
10	4.2	7.6
11	81.5	141.1

PIPE FLOWS

PIPE RUN:	MINOR FLOW (cfs)	MAJOR FLOW (cfs)	PROP. PIPE SIZE
4	5.9	10.4	18" RCP
5	14.6	25.9	24" RCP
6	17.2	30.5	36" RCP
7	3.4	6.1	18" RCP
8	20.4	36.2	36" RCP
JP3	37.0	65.0	42" BYPASS
9	34.6	61.5	48" RCP
10	76.3	131.8	EX. 48" RCP
11	4.3	7.8	EX. 36" RCP

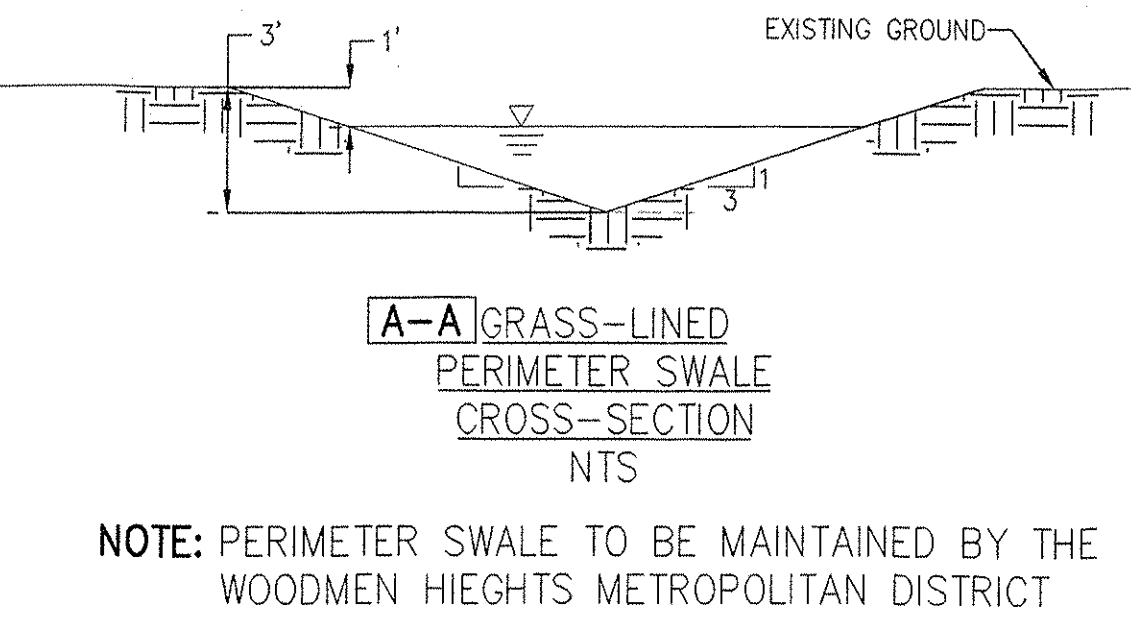
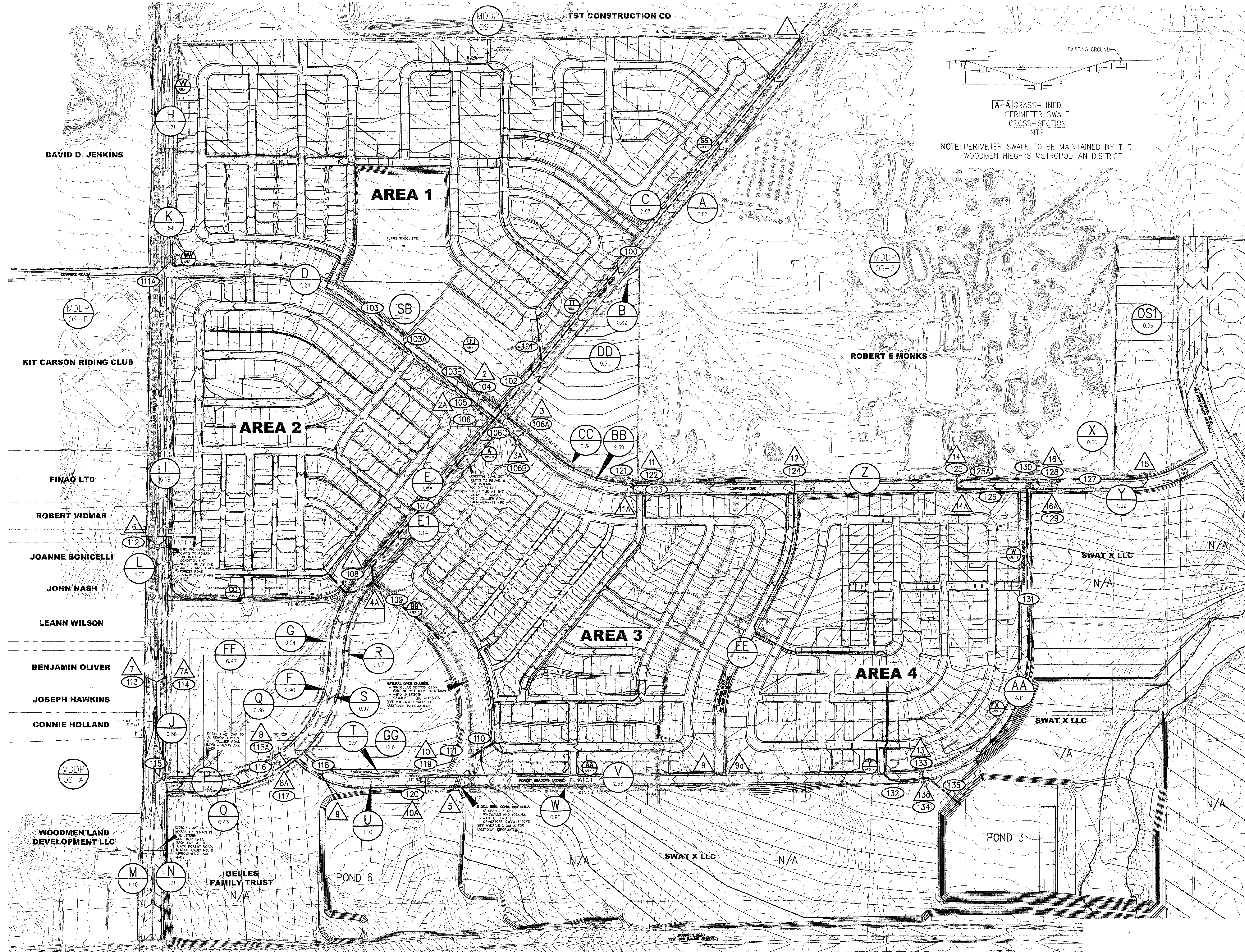
BASIN OS SHOWN
HERE HAS BEEN DUPLICATED
AS BASIN JAYDEN FOR THE
HORSESHOE PDR/PDR
OFFSITE FLOW ANALYSIS

JAYDEN AT WOODMEN HEIGHTS
DEVELOPED DRAINAGE MAP
JOB NO. 08-017
DATE PREPARED: JULY 21, 2009
DATE REVISED: NOVEMBER 27, 2018



20 BOULDER CRESCENT, SUITE 110
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5465

File: C:\80701A\Jayden\Map\Dev Plan\807017 Developed Drainage Map (Amended).dwg Plotstamp: 11/27/2018 7:33 AM



OFFSITE & ROADWAY DESIGN POINT SUMMARY

Design Point	Q ₁₀ (c.f.s.)	Q ₅₀ (c.f.s.)	STRUCTURE
1	89.6	195.5	10' D-10-R SWAMP INLET
2	12.6	35.1	10' D-10-R SWAMP INLET
2A	20.1	39.1	10' D-10-R SWAMP INLET
3	5.5	10.5	4' D-10-R SWAMP INLET
3A	5.5	10.5	4' D-10-R SWAMP INLET
4	8.3	11.9	4' D-10-R SWAMP INLET
4A	5.6	10.8	4' D-10-R SWAMP INLET
7	21.9	41.2	16' D-10-R SWAMP INLET
7A	22.8	41.1	16' D-10-R SWAMP INLET
8	18.8	33.9	8' D-10-R SWAMP INLET
8A	8.2	18.6	8' D-10-R SWAMP INLET
10	27.8	55.9	10' D-10-R SWAMP INLET
10A	8.9	15.6	10' D-10-R SWAMP INLET
11	5.4	10.4	4' D-10-R SWAMP INLET
11A	5.4	10.4	4' D-10-R SWAMP INLET
13	15.1	30.1	6' D-10-R SWAMP INLET
13A	7.9	14.7	6' D-10-R SWAMP INLET
14	3.9	7.2	4' D-10-R SWAMP INLET
14A	3.9	7.2	4' D-10-R SWAMP INLET
16	3.2	6.1	4' D-10-R SWAMP INLET
16A	3.2	6.1	4' D-10-R SWAMP INLET

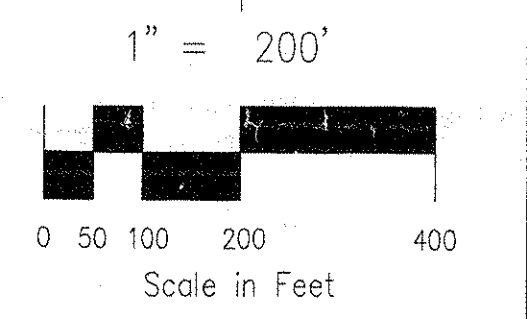
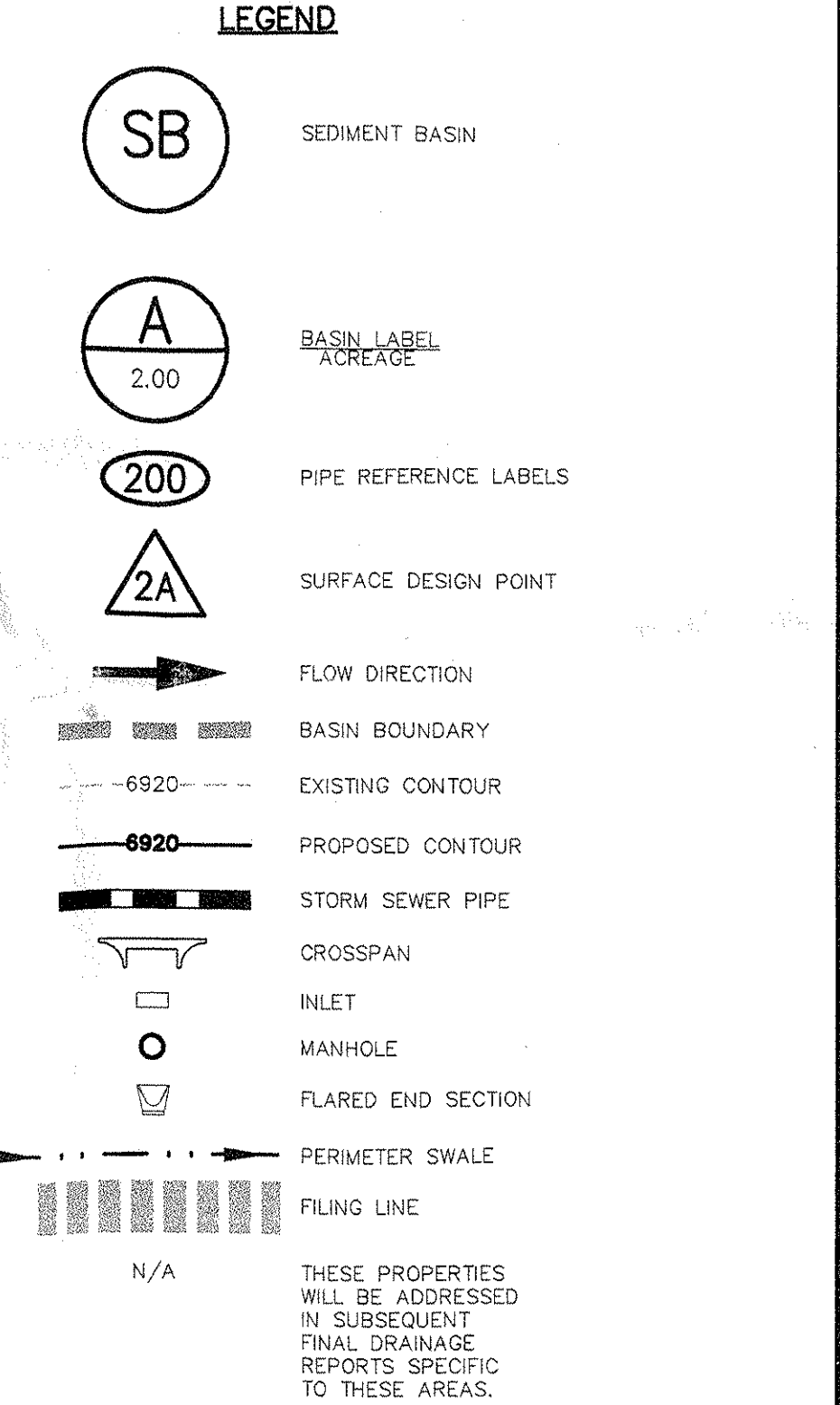
OFFSITE AND ROADWAY BASINS STORM SEWER SUMMARY

Basin	Area (Acres)	Q ₁₀ (c.f.s.)	Q ₅₀ (c.f.s.)	PIPE RUN (c.f.s.)	PIPE SIZE
100	80.6	195.5	48" RCP		
101	109.1	243.9	48" RCP		
102	190.0	439.1	60" RCP		
103	82.5	110.3	48" RCP		
103A	40.1	71.4	30" RCP		
103B	92.6	181.7	54" RCP		
104	15.0	33.8	24" RCP		
105	15.0	33.8	24" RCP		
106	122.7	249.2	66" RCP		
106A	5.5	10.5	24" RCP		
106B	5.5	10.5	24" RCP		
106C	10.9	21.0	30" RCP		
107	324.0	711.1	84" RCP		
108	140.9	304.1	84" RCP		
109	464.9	1015.1	108" RCP		
110	127.1	267.2	66" RCP		
111	30.2	62.7	36" RCP		
112	41.0	96.0	54" RCP		
113	22.0	40.4	30" RCP		
114	22.0	40.4	30" RCP		
115	44.0	80.8	42" RCP		
116	49.6	101.0	42" RCP		
117	12.6	24.1	18" RCP		
118	97.6	188.7	60" RCP		
119	15.3	29.7	18" RCP		
120	32.5	59.3	18" RCP		
121	24.2	50.3	36" RCP		
122	28.9	59.1	36" RCP		
123	33.5	68.0	36" RCP		
124	108.0	305.0	60" RCP		
125	108.0	305.0	60" RCP		
125A	111.8	312.2	60" RCP		
126	115.7	319.4	66" RCP		
127	28.3	54.8	36" RCP		
128	3.2	6.1	18" RCP		
129	3.2	6.1	18" RCP		
130	31.7	65.0	36" RCP		
131	147.3	384.5	72" RCP		
132	194.2	486.8	72" RCP		
133	11.0	21.5	30" RCP		
134	11.0	21.5	30" RCP		
135	216.1	529.7	84" RCP		

OFFSITE & ROADWAY BASIN SUMMARY

Basin	Area (Acres)	Q ₁₀ (c.f.s.)	Q ₅₀ (c.f.s.)
A	2.8	10.1	19.0
B	0.8	0.8	2.1
C	2.8	10.2	19.1
D	2.2	8.7	16.3
E	1.7	6.3	11.9
E1	1.4	4.8	9.1
F	0.9	12.8	24.0
G	0.5	0.6	1.4
H	0.9	8.7	16.3
I	0.9	17.3	32.5
J	0.6	0.6	1.5
K	1.8	7.2	13.6
L	4.1	14.5	27.2
M	1.4	6.2	11.6
N	1.3	5.8	10.8
O	0.4	0.5	1.2
P	1.2	5.6	10.5
Q	0.4	0.4	1.0
R	0.6	0.6	1.5
S	1.0	4.2	7.9
T	0.5	0.5	1.3
U	1.1	5.0	9.3
V	2.66	10.1	19.0
W	1.0	0.9	2.3
X	0.3	0.3	0.8
Y	1.3	5.6	10.5
Z	1.8	7.7	14.4
AA	4.1	15.6	29.4
BB	2.4	11.0	20.6
CC	0.3	0.4	0.9
DD	9.7	24.2	50.3
EE	2.4	9.7	18.2
FF	16.5	39.7	82.5
GG	12.6	30.2	62.7
OS1	10.7	26.3	54.6

NOTE: PROPOSED GRADING SHOWN OUTSIDE OF THE FOREST MEADOWS DEVELOPMENT AREAS (INCLUDING DETENTION PONDS 3 AND 6) IS HIGHLY CONCEPTUAL IN NATURE AND HAS BEEN SHOWN FOR INFORMATION ONLY. AS EACH INDIVIDUAL ADJACENT SITE IS DEVELOPED, A DRAINAGE REPORT AND ASSOCIATED GRADING PLAN DOCUMENT WILL BE REQUIRED PER CITY OF COLORADO SPRINGS GUIDELINES.



ENGINEERING AND SURVEYING INC.

15 NORTH NEVADA AVENUE
 COLORADO SPRINGS, CO 80903
 (719) 955-5485, FAX (719) 471-4812

FOREST MEADOWS - OFFSITE & ROADWAYS DRAINAGE MAP

PROJECT NO. 08-001 FILE: *dwg\Dev. Plan\08001 - Drainage Plan

DESIGNED BY: BES SCALE: DATE: 1/5/06

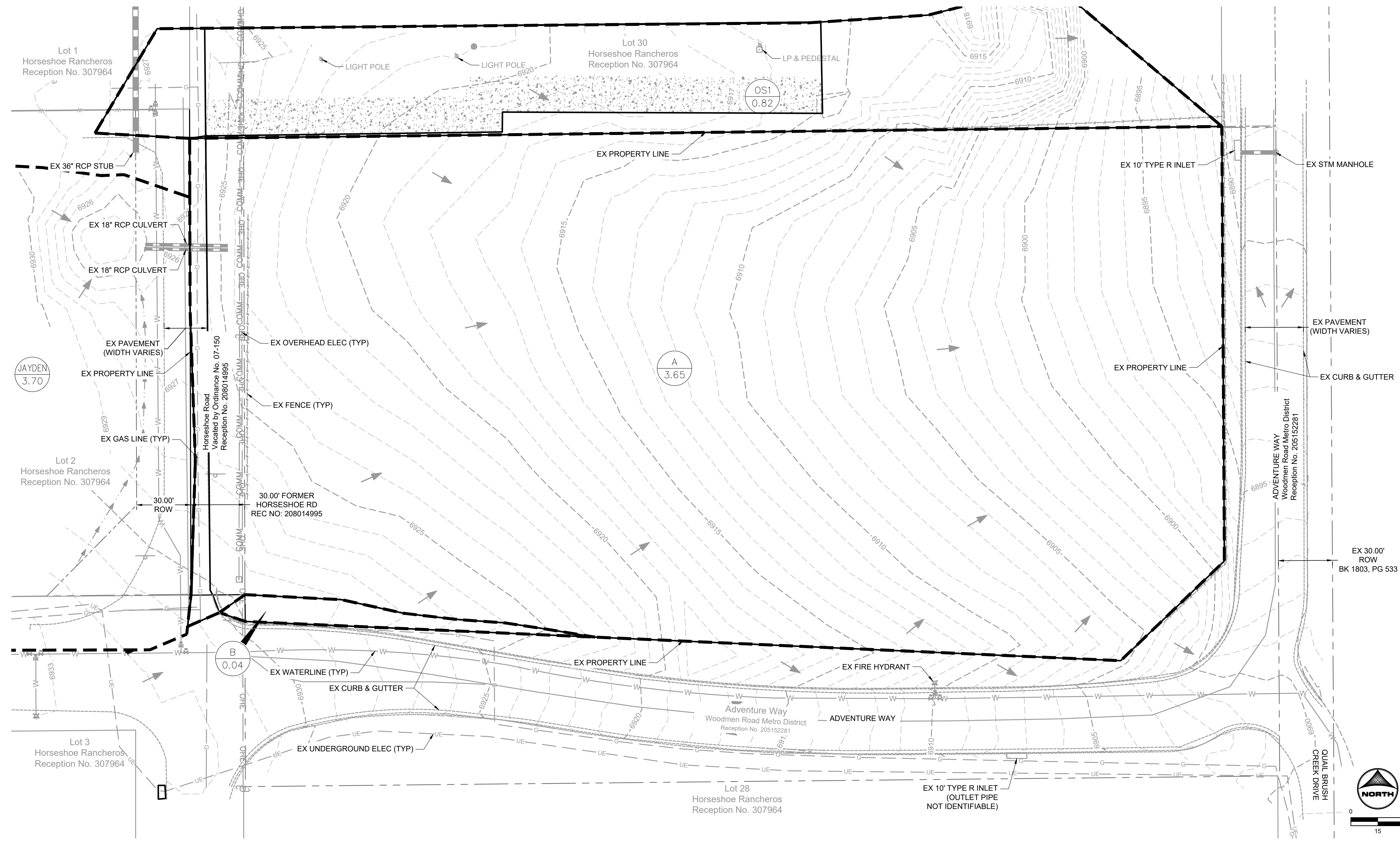
DRAWN BY: BVDP HORIZ: 1"=100'

CHECKED BY: VAS VERT: N/A

SHEET 1 OF 6 D1



APPENDIX F – DRAINAGE MAPS



LEGEND:

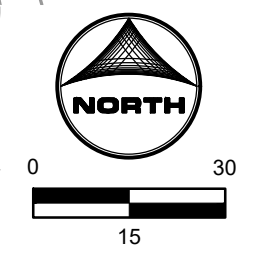
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- PROPOSED MINOR CONTOUR ———
- EXISTING MAJOR CONTOUR - - - - - 5250 - - - - -
- EXISTING MINOR CONTOUR - - - - -
- PROPOSED STORM DRAIN PIPE ———
- EXISTING STORM DRAIN PIPE - - - - -
- PROPOSED 2.0' CONCRETE PAN ———
- PROPERTY LINE ———
- PROPOSED FLOW DIRECTION ←
- EXISTING FLOW DIRECTION ←
- SUB BASIN LINE ———
- MAJOR BASIN LINE (PETERSON FIELD/SAND CREEK MAJOR BASIN SPLIT) ———
- DESIGN POINT (11) BASIN DESIGNATION
- (1.25) AREA (AC.)

SUMMARY RUNOFF TABLE

BASIN	AREA (ac)	% IMPERVIOUS	Q _s (cfs)	Q ₁₀₀ (cfs)
A	3.65	4	1.1	1.9
B	0.04	2	0.1	0.1
OS1	0.82	53	1.7	2.8
JAYDEN	3.70	-	17.2	30.5

DESIGN POINT SUMMARY TABLE

DESIGN POINT	CONTRIBUTING BASINS	ΣQ _s (cfs)	ΣQ ₁₀₀ (cfs)
EX	JAYDEN	17.2	30.5
1	B	0.1	0.1
2	A, B, OS1 & JAYDEN	19.6	32.9



HR GREEN Xref: xv-cow: xv-utl: xpr-1-d601_drainage_drain_map_legend_xv-dgn

DRAWN BY: NQJ JOB DATE: 2/5/2021
 APPROVED: KMH JOB NUMBER: 201135
 CAD DATE: 2/5/2021
 CAD FILE: J:\2020\201135\CAD\Drawings\C\Drainage\Ex_Drainage_Map

BAR IS ONE INCH ON OFFICIAL DRAWINGS.
 IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.

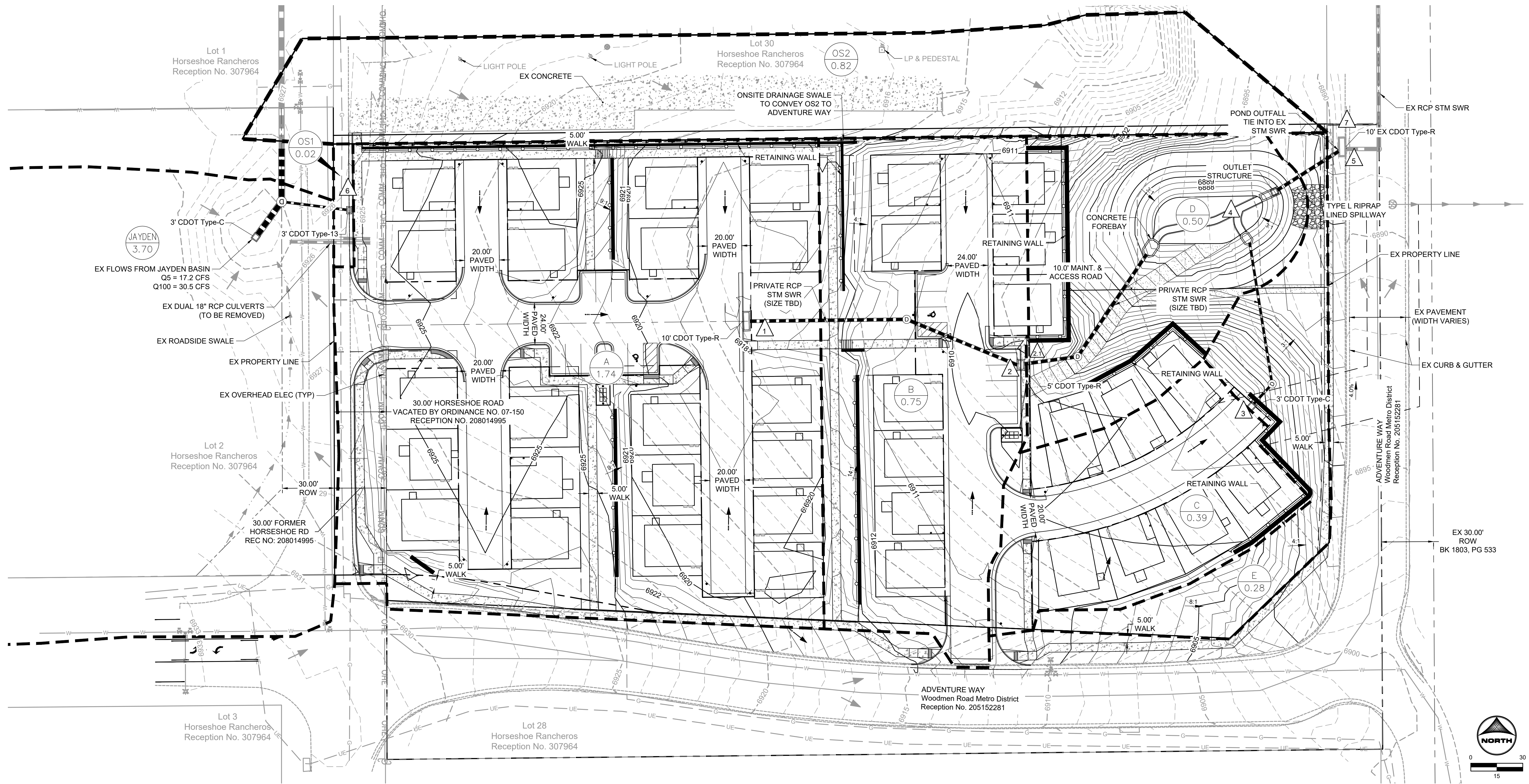
NO.	DATE	BY	REVISION DESCRIPTION

HRGreen
 HR GREEN - COLORADO SPRINGS
 722 COMMERCE CENTER DR SUITE 220
 COLORADO SPRINGS CO 80919
 PHONE: 719.622.6222 | TOLL FREE: 800.728.7805
 FAX: 844.273.1057 | HRGreen.com

CHALLENGER HOMES
 HORSESHOE CHALLENGER HOMES
 COLORADO SPRINGS, COLORADO

EXISTING DRAINAGE MAP

SHEET DR 1



SUMMARY RUNOFF TABLE				
BASIN	AREA (ac)	% IMPERVIOUS	Q _s (cfs)	Q ₁₀₀ (cfs)
A	1.74	55	4.0	6.7
B	0.75	46	1.3	2.3
C	0.39	47	0.7	1.2
D	0.50	15	0.5	0.8
E	0.28	2	0.1	0.2
OS1	0.02	100	0.1	0.2
OS2	0.82	53	1.7	2.8

DESIGN POINT SUMMARY TABLE			
DESIGN POINT	CONTRIBUTING BASINS	ΣQ _s (cfs)	ΣQ ₁₀₀ (cfs)
1	A	4.0	6.7
2	B	1.3	2.3
2.1	A & B	5.0	8.4
3	C	0.7	1.2
4	A, B, C & D	6.1	10.2
5	E	0.1	0.2
6	OS1	0.1	0.2
7	OS2	1.7	2.8

LEGEND:

- PROPOSED MAJOR CONTOUR ——— 5250 ———
- PROPOSED MINOR CONTOUR ——— 5250 ———
- EXISTING MAJOR CONTOUR - - - - - 5250 - - - - -
- EXISTING MINOR CONTOUR - - - - - 5250 - - - - -
- PROPOSED STORM DRAIN PIPE ————
- EXISTING STORM DRAIN PIPE ————
- PROPOSED 2.0' CONCRETE PAN ————
- PROPERTY LINE ————
- PROPOSED FLOW DIRECTION ←
- EXISTING FLOW DIRECTION ←
- SUB BASIN LINE - - - - -
- MAJOR BASIN LINE ————
- DESIGN POINT ▲
- PROPOSED BASIN LABEL 11
1.25 BASIN DESIGNATION
AREA (AC.)

DRAINAGE MAP NOTES:
 1. BASIN JAYDEN WAS NOT DERIVED IN THE CONTEXT OF THIS REPORT. SEE APPENDIX E - REFERENCE MATERIAL FOR ORIGINATION OF JAYDEN BASIN.

DRAWN BY: NQJ JOB DATE: 4/8/2021
 APPROVED: KMH JOB NUMBER: 201135
 CAD DATE: 4/14/2021
 CAD FILE: J:\2020\201135\CADD\Drawings\C\Drainage\Pr_Drainage_Map

BAR IS ONE INCH ON OFFICIAL DRAWINGS.
 IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.

NO.	DATE	BY	REVISION DESCRIPTION

HRGreen HR GREEN - COLORADO SPRINGS
 722 COMMERCE CENTER DR SUITE 220
 COLORADO SPRINGS CO 80919
 PHONE: 719.622.6222 | TOLL FREE: 800.728.7805
 FAX: 844.273.1057 | HRGreen.com

HORSESHOE
 CHALLENGER HOMES
 COLORADO SPRINGS, COLORADO

PROPOSED CONDITIONS DRAINAGE MAP

SHEET
 DR
 1