

**FINAL DRAINAGE REPORT FOR  
HCD DRILLING  
2601 EAST PLATTE AVENUE  
COLORADO SPRINGS, COLORADO 80916**

January 2023

Prepared For:

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HCD DRILLING  
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# Drainage Report Statement

## **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.

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L Ducett, P.E. 32339

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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.

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HCD Properties LLC

2435 Majestic Plains Court, Colorado Springs, CO 80915

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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.

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County Engineer / ECM Administrator

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Date

Conditions:

## **Purpose**

The purpose of this Final Drainage Report is to identify and analyze the existing and proposed drainage patterns, determine proposed runoff quantities, size drainage structures to safely convey the developed runoff, and present solutions to drainage impacts on-site and off-site resulting from this development.

## **General Description**

This Final Drainage Report is an analysis of the development of “HCD DRILLING” (AKA “TRACT IN NE4NW4 SEC 18-14-65”) owned by HCD Properties, LLC. The site is located at 2601 East Platte Avenue, Colorado Springs, CO 80916 in Section 18, Township 14S, Range 65 West of the 6<sup>th</sup> Principal Meridian in El Paso County. The site is bounded on the west by a landscaping supply business, on the north by E Platte Avenue Frontage Road, on the east by an RV and boat storage business, and on the south by a vacant lot owned by the City of Colorado Springs. The site is currently unplatted.

The site is currently used primarily for the parking and storage of vehicles and heavy equipment with some areas of soil excavation and storage at the southern end.

The proposed development is the addition of a 22,479 square foot building near the centroid of the lot but this project also makes preparations for a future building to be placed near the front of the lot with all of the associated drives, utilities, grading, and stormwater features. The proposed building will be used to house a drilling company and includes a front office building with an asphalt parking lot and an attached industrial building with a surrounding gravel lot. The use of the future building will be established at a later time. The access will be from E Platte Avenue Frontage Road via two paved entrances.

The site lies within the Sand Creek Drainage Basin.

## **Soils Condition**

The soil for this project is composed completely of Blakeland Loamy Sand per the “Soils Survey of El Paso County Area, which is in Hydrologic Soil Group A.

## **Drainage Criteria**

Hydrologic and Hydraulic calculations were performed using the El Paso County Storm Drainage Design Criteria Manual Volumes 1 & 2, latest editions. The Rational Method was used to estimate storm water runoff and the design of the FSEDB was performed using UD-Detention v3.07.

## **Existing (Historic) Drainage Conditions**

No previous drainage reports or studies could be found for this site. A drainage map for the existing conditions is included in the Appendix of this report. The site lies within the Sand Creek Basin. The existing topography has a relatively consistent 3% slope from the northeast to

the southwest but drops off more steeply at the western property line. The surface cover is composed of gravel lots and areas of disturbed ground with minimal vegetation.

Drainage ways for this site are poorly defined and runoff primarily sheet flows from the east/northeast to the west/southwest and leaves the site at three locations which are designated as Design Points (DP) for analysis. At the northwest property corner (DP X-1), runoff exits into the public drainage way along E Platte Avenue Frontage Road. At the west property line, about 250 feet south of the northwest property corner (DP X-2), runoff drains into a shallow swale and onto adjacent private property. Along the south side of the proposed development (DP X-3), runoff flows onto the same adjacent private property at a location approximately 500 feet south of DP X-2. Both DP X-2 and DP X-3 eventually release drainage into an existing pond on the west side of the adjacent property. At the southeast property line (DP X-4 & DP X-5), very small areas of runoff sheet flow onto Basin EX-C. There is a ridge that exists at the property line between Basins EX-A and EX-B and the adjacent eastern property which keeps drainage from flowing between sites. Therefore, there is no runoff from the adjacent property flowing onto Basins EX-A or EX-B.

Basin EX-A contributes to DP X-1 and has an area of 1.10 acres consisting of gravel lots and areas of disturbed soil, generating runoff amounts of  $Q_5 = 1.83$  cfs and  $Q_{100} = 4.62$  cfs.

Basin EX-B contributes to DP X-2 and has an area of 2.10 acres consisting of gravel lots and areas of disturbed soil, generating runoff amounts of  $Q_5 = 2.20$  cfs and  $Q_{100} = 7.14$  cfs.

Basin EX-C contributes to DP X-3 and has an area of 3.92 acres consisting of areas of disturbed soil, generating runoff amounts of  $Q_5 = 2.02$  cfs and  $Q_{100} = 11.41$  cfs. For conservative modeling, the existing excavation pits were disregarded and it was assumed that the entire basin drains offsite to DP X-3 as was the case in the recent past.

Basin OS-1 contributes to DP X-4 and has an area of 0.05 acres consisting of undeveloped land, generating runoff amounts of  $Q_5 = 0.02$  cfs and  $Q_{100} = 0.14$  cfs.

Basin OS-2 contributes to DP X-5 and has an area of 0.10 acres consisting of undeveloped land, generating runoff amounts of  $Q_5 = 0.03$  cfs and  $Q_{100} = 0.25$  cfs.

### **Developed Drainage Conditions**

A drainage map for the proposed condition is included in the appendix of this report.

A Full Spectrum Extended Detention Basin (FSEDB) will be provided for the proposed and future development with a watershed area of 6.05 acres.

The proposed facility is comprised of asphalt parking lots, gravel lots, buildings, and landscaping. The drainage pattern for the site remains generally the same; however, the majority of the proposed developed/impervious areas are routed to the FSEDB. Only proposed Basins I & K will not be conveyed to the pond. Basins I & K total 1.12 acres. The only impervious portion is a 0.01 acre piece of the west access drive that is directed towards the drainage ditch along E Platte Avenue Frontage Road. This 0.01 acre area would qualify for an exclusion (Per ECM App I.7.1.C.1.)

Runoff continues to exit into the public drainage way along E Platte Avenue Frontage Road at the northwest corner (DP 11). The area draining to this location is significantly reduced as compared to existing conditions.

Runoff is no longer discharged at design point X2 as it had been in the existing conditions.

The outlet of the FSEDB (DP 9) is the location at which runoff from the proposed development is discharged after treatment.

Basin A contributes to DP 1 and has an area of 1.36 acres consisting primarily of proposed paved and future building area with a small portion of landscaped area, generating runoff amounts of  $Q_5 = 5.26$  cfs and  $Q_{100} = 10.67$  cfs. Minor runoff is conveyed under the entrances at E Platte Avenue Frontage Road via 2 ft wide concrete trench drains just to the north of this basin. The runoff is collected by a 8' D-10-R inlet at design point 1 and conveyed to the FSEDB via storm pipe.

Basin B contributes to DP 2 and has an area of 0.71 acres consisting mostly of paved areas and much smaller areas of lawn/landscaping, generating runoff amounts of  $Q_5 = 2.58$  cfs and  $Q_{100} = 5.35$  cfs. The runoff is collected by a type C inlet at design point 2 and conveyed to the FSEDB via storm pipe.

Basin C contributes to DP 3 and has an area of 0.54 acres consisting of paved area, building, gravel lot, and lawn/landscaping, generating runoff amounts of  $Q_5 = 1.59$  cfs and  $Q_{100} = 3.47$  cfs. The runoff sheet flows and travels by a 2' concrete pan to a type C inlet at design point 3 and then conveyed to the FSEDB via storm pipe.

Basin D contributes to DP 4 and has an area of 0.26 acres consisting of building, paved area, gravel lot, and lawn/landscaping, generating runoff amounts of  $Q_5 = 0.82$  cfs and  $Q_{100} = 1.74$  cfs. The runoff is collected by an inlet at design point 4 and conveyed to the FSEDB via storm pipe.

Basin E contributes to DP 5 and has an area of 0.35 acres consisting of building, paved area, and gravel lot, generating runoff amounts of  $Q_5 = 1.20$  cfs and  $Q_{100} = 2.48$  cfs. The runoff is collected by an inlet at design point 5 and conveyed to the FSEDB via storm pipe.

Basin F contributes to DP 6 and has an area of 0.29 acres consisting of building, paved area, and gravel lot, generating runoff amounts of  $Q_5 = 1.03$  cfs and  $Q_{100} = 2.10$  cfs. The runoff is collected by an inlet at design point 6 and conveyed to the FSEDB via storm pipe.

Basin G contributes to DP 7 and has an area of 0.35 acres consisting of building, paved area, and gravel lot, generating runoff amounts of  $Q_5 = 1.20$  cfs and  $Q_{100} = 2.48$  cfs. The runoff is collected by an inlet at design point 7 and conveyed to the FSEDB via storm pipe.

Basin H contributes to DP 8 and has an area of 0.20 acres consisting of building, paved area, and gravel lot, generating runoff amounts of  $Q_5 = 0.71$  cfs and  $Q_{100} = 1.46$  cfs. The runoff is collected by an inlet at design point 8 and conveyed to the FSEDB via storm pipe.

Basin I contributes to DP 9 and has an area of 0.96 acres consisting of grading needed for the construction of the FSEDB and other landscaped area generating runoff amounts of  $Q_5 = 0.26$  cfs and  $Q_{100} = 1.95$  cfs. No new impervious area is being added and the ground cover will be improved from gravel and disturbed soil to maintained landscaping. Basin I is excluded from permanent WQ control measures per ECM Appendix I Section I.7.1.B.7 since this area consists of land disturbance to undeveloped land that will remain undeveloped after site construction is

complete. Therefore, the area does not require treatment in the FSEDB. The runoff sheet flows onto adjacent property at design point 9 as in the existing conditions.

Basin J contributes to DP 10 and has an area of 1.82 acres consisting of the FSEDB, some paved area, gravel lot, and landscaped area, generating runoff amounts of Q5= 1.81 cfs and Q100= 5.37 cfs. The runoff sheet flows towards the FSEDB located at design point 10.

Basin K is the small area that continues to exit into the public drainage way along E Platte Avenue Frontage Road at the northwest corner (DP 11) as it had previously. The area and runoff of this basin is significantly reduced as compared to existing conditions. Basin K is excluded from permanent WQ control measures per ECM Appendix I Section I.7.1.B.7 since this area consists of land disturbance to undeveloped land that will remain undeveloped after site construction is complete. It generates runoff amounts of Q5= 0.09 cfs and Q100 = 0.45.

Basin L contributes to DP 12 and has an area of 0.06 acres consisting of building, paved area, and gravel lot, generating runoff amounts of Q5= 0.23 cfs and Q100= 0.47 cfs. The runoff is collected by an inlet at design point 12 and conveyed to the FSEDB via storm pipe.

Basin M contributes to DP 13 and has an area of 0.06 acres consisting of building, paved area, and gravel lot, generating runoff amounts of Q5= 0.19 cfs and Q100= 0.41 cfs. The runoff is collected by an inlet at design point 13 and conveyed to the FSEDB via storm pipe.

Basins OS-1 & OS-2 remain as they had previously.

## **FSEDB**

In an effort to protect receiving water and as part of the “four step process to minimize adverse impacts of urbanization” this site was analyzed in the following manner:

- Step 1: Employ Runoff Reduction Practices – The nature of the development precludes reducing runoff as most of the site is used for buildings, asphalt lots, and gravel lots.
- Step 2: Stabilize Drainageways – There are no existing streams associated with this site.
- Step 3: Provide Water Quality Capture Volume – The FSEDB is designed to capture and treat the runoff from the proposed development in the appropriate manner.
- Step 4: Consider Need for Industrial and Commercial BMPs – given that the site will be used to house a drilling company, the presence of fuel and other contaminants are likely; therefore, spill kits should be kept on site and any outdoor storage of industrial materials should include the appropriate safeguards.

The runoff from Basins A, B, C, D, E, F, G, H, J, L, M, & OS-1 of the proposed development are routed to the proposed 2.235 ac-ft private FSEDB located at the southern portion of the property at DP 10. The FSEDB treats runoff from a combined watershed area of 6.05 acres with an imperviousness of 65.3%. The elevation of the bottom of the pond is 6243.00 and the top of the berm is at 6252.00. The pond design has a WQCV storage volume of 0.129 ac-ft at a water surface elevation of 6245.20. The EURV storage volume is 0.362 ac-ft at a water surface elevation of 6246.82. The 100-year storage volume of 0.240 ac-ft corresponds to a water surface of 6247.71. The WQCV discharge is less than 0.1 cfs and will be fully released in 40 hours. The EURV discharge is 0.2 cfs and will fully released in 72 hours. The 100 year outflow is 3.5 cfs and is fully released in 73 hours.

The forebay exceeds the size requirement of 2% of the WQCV volume of 0.129 ac-ft. A Trickle channel 2 ft wide and 0.5 ft deep at 0.54% slope runs from the forebay to the micropool at the FSEDB outlet structure. The outlet structure is a 2.0 ft by 2.0 ft riser box with the inlet invert set at 6243.00 and the top of grate set at elevation 6246.82. A metal orifice plate on the front of the structure regulates the WQCV and EURV via three orifices with 0.7 square inches, 0.7 square inches, and 4 square inches spaced 1.27 ft apart. The invert of 18" outlet pipe is at elevation 6242.75 with a restrictor plate set 4.5 inches higher. The outlet pipe is 82 ft long at a slope of 1.12% with a metal end section at the outlet end with type L riprap protection (D50= 12 in).

An emergency spillway is set at elevation 6249.00. The spillway has a bottom width of 8 ft with 4:1 side slopes and is protected by type VL riprap (D50= 12 in). The 100 year HWL is 1.29 feet below the spillway. In an emergency overflow situation, the runoff will flow onto the property south of the site. Drainage from both the outlet pipe and emergency spillway will discharge from the southwest corner of the site to an existing depression in the land south of the site which is owned by the City of Colorado Springs. If this depression were to overtop, drainage would travel onto the adjacent commercial property to the west and travel over gravel and concrete channel to an existing pond on the western edge of that site in much the same way as in historical conditions.

**Floodplain Statement**

According to FEMA’s FIRM No. 08041CO754G (eff. 12/7/2018), the proposed development is within an area designated as Zone X, having minimal flood hazard.

**Construction Cost Opinion**

**Private Drainage Facilities Improvements (Non-Reimbursable)**

Description	Quantity	Unit Price	Cost
4 ft Concrete Drain Pan	735 LF	\$42	\$30,870
2 ft Conc. Trench Drain	56 LF	\$230	\$12,880
<b>Total</b>			<b>\$43,750</b>

**Private Permanent BMP (Non-Reimbursable) – 1 FSEDB**

Description	Quantity	Unit Price	Cost
Earthwork	3607 Cu Yd	\$12	\$43284
Forebays	1 EA	\$1500	\$1500
Trickle Channel	92 LF	\$32	\$2944
Outlet Structure (box riser, micropool, pipe, headwall, and riprap)	1 EA	\$5000	\$5000
Emergency Spillway	1 EA	\$1500	\$1500
Maintenance Access Rd	1 EA	\$500	\$500
Stabilization	1 EA	\$5000	\$5000
<i>Subtotal</i>			<i>\$59,728</i>
<i>10% Contingency</i>			<i>\$5973</i>



<b>Total</b>	<b>\$65,701</b>
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### **Drainage And Bridge Fees**

This currently unplatted site is in the Sand Creek Drainage Basin. The site is 7.13 acres. The combined Drainage Fees (2021) are due prior to final plat recordation.

<b>Fee Type</b>	<b>% Imp.</b>	<b>Parcel Area (acre)</b>	<b>Imp. Area (acre)</b>	<b>Fee per Imp Acre</b>	<b>Mod %</b>	<b>Fee Cost</b>
Drainage	65.3	7.13	4.66	\$20,387	100	\$95,003.42
Bridge	65.3	7.13	4.66	\$8,339	100	\$38,859.74
				<b>Total</b>		\$133,863.16

### **Maintenance**

The proposed FSEDB will be privately maintained by the lot owner and is accessible via a 12' wide aggregate base maintenance access road. The proposed entrance trench drains and proposed concrete drain pans will be privately maintained by the lot owner.

### **Summary**

This Final Drainage Report analyzed the development of HCD Drilling owned by HCD Properties, LLC, located at 2601 East Platte Avenue, Colorado Springs, CO 80916. Runoff from the development will not adversely affect the surrounding or downstream developments. Proposed flows, as detailed in this report, will follow existing drainage patterns and will be safely routed downstream. Water quality and detention are provided on-site using a FSEDB. No public storm drainage modifications or design changes are necessary as a result of the development.

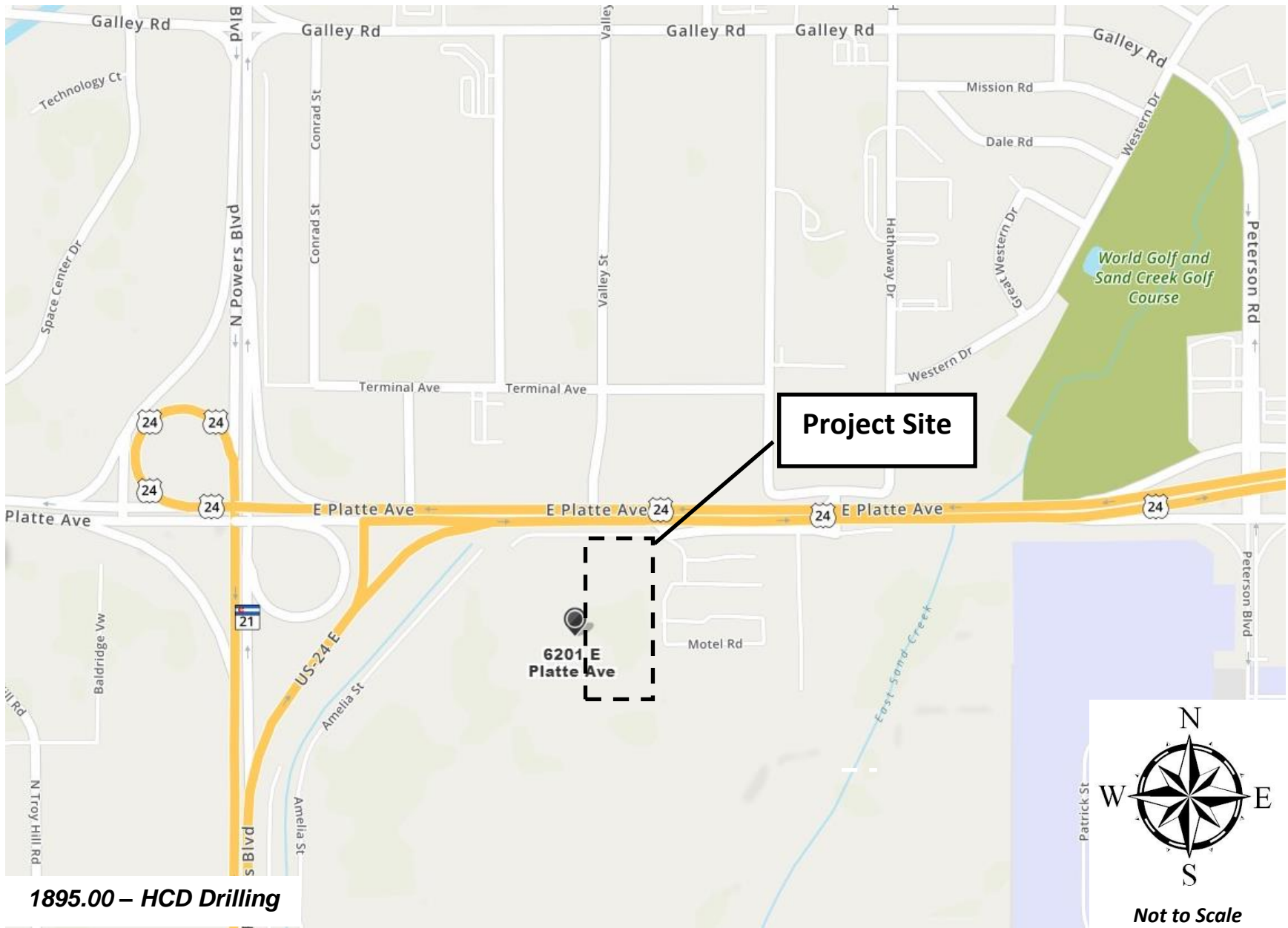
An Erosion Control Plan will be submitted separately.

### **References**

- 1) *City of Colorado Springs/County of El Paso Drainage Criteria Manual, dated May 2014.*
- 2) *Soil survey of El Paso County Area, Colorado, Prepared by United States Department of Agriculture Soil Conservation Service, dated June 1981.*
- 3) *Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map Number 08041C0754G.*

## **APPENDICES**

## **VICINITY MAP**



**1895.00 – HCD Drilling**

**Not to Scale**

## **SOILS MAP**

**Search**

**Map Unit Legend**

El Paso County Area, Colorado (C0625)

El Paso County Area, Colorado (C0625)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	7.2	100.0%
<b>Totals for Area of Interest</b>		<b>7.2</b>	<b>100.0%</b>

**HSG**  
A

1895.00 HCD Drilling

**Soil Map**

Legend

Scale (not to scale)

**Project Site**

**Not to Scale**

**FEMA FLOODPLAIN MAP**



# National Flood Hazard Layer FIRMette



38°50'29.58"N



104°43'7.17"W

USGS The National Map: Orthoimagery. Data refreshed April, 2019. 1:6,000 38°50'1.56"N

## Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard Zone D
		Channel, Culvert, or Storm Sewer
OTHER FEATURES		Levee, Dike, or Floodwall
		20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
MAP PANELS		17.5 Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature
		Digital Data Available
		No Digital Data Available
		Unmapped

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 7/24/2019 at 5:22:04 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.



104°42'29.72"W



## **HYDROLOGIC CALCULATIONS**

## 1895.00 HCD DRILLING Area Runoff Coefficient (C) Summary

HSG - A

### EXISTING

		GRAVEL LOT			DISTURBED AREA			LAWN/LANDSCAPING			WEIGHTED		WEIGHTED CA	
BASIN	TOTAL AREA	AREA	C5	C100	AREA	C5	C100	AREA	C5	C100	C5	C100	CA5	CA100
	(Acres)	(Acres)			(Acres)			(Acres)						
<i>EX-A</i>	1.1	0.7	0.59	0.70	0.4	0.15	0.50	0.0	0.08	0.35	0.43	0.63	0.47	0.69
<i>EX-B</i>	2.1	0.7	0.59	0.70	1.4	0.15	0.50	0.0	0.08	0.35	0.30	0.57	0.62	1.19
<i>EX-C</i>	3.9	0.0	0.59	0.70	3.9	0.15	0.50	0.0	0.08	0.35	0.15	0.50	0.59	1.95
<i>OS-1</i>	0.1	0.0	0.59	0.70	0.0	0.15	0.50	0.1	0.08	0.35	0.08	0.35	0.00	0.02
<i>OS-2</i>	0.1	0.0	0.59	0.70	0.0	0.15	0.50	0.1	0.08	0.35	0.08	0.35	0.01	0.04

7.3

### DEVELOPED

		GRAVEL LOT			PAVEMENT/ROOF			LAWN/LANDSCAPING			WEIGHTED		WEIGHTED CA	
BASIN	TOTAL AREA	AREA	C5	C100	AREA	C5	C100	AREA	C5	C100	C5	C100	CA5	CA100
	(Acres)	(Acres)			(Acres)			(Acres)						
<i>A</i>	1.36	0.00	0.59	0.70	1.15	0.90	0.96	0.21	0.08	0.35	0.77	0.87	1.05	1.18
<i>B</i>	0.71	0.00	0.59	0.70	0.56	0.90	0.96	0.15	0.08	0.35	0.73	0.83	0.52	0.59
<i>C</i>	0.54	0.12	0.59	0.70	0.27	0.90	0.96	0.15	0.08	0.35	0.60	0.73	0.33	0.40
<i>D</i>	0.26	0.15	0.59	0.70	0.08	0.90	0.96	0.03	0.08	0.35	0.63	0.74	0.16	0.19
<i>E</i>	0.35	0.24	0.59	0.70	0.11	0.90	0.96	0.00	0.08	0.35	0.69	0.78	0.24	0.27
<i>F</i>	0.29	0.18	0.59	0.70	0.11	0.90	0.96	0.00	0.08	0.35	0.71	0.80	0.21	0.23
<i>G</i>	0.35	0.24	0.59	0.70	0.11	0.90	0.96	0.00	0.08	0.35	0.69	0.78	0.24	0.27
<i>H</i>	0.20	0.12	0.59	0.70	0.08	0.90	0.96	0.00	0.08	0.35	0.71	0.80	0.14	0.16
<i>I</i>	0.96	0.00	0.59	0.70	0.00	0.90	0.96	0.96	0.08	0.35	0.08	0.35	0.08	0.34
<i>J</i>	1.82	0.62	0.59	0.70	0.06	0.90	0.96	1.14	0.08	0.35	0.28	0.49	0.51	0.89
<i>K</i>	0.16	0.00	0.59	0.70	0.01	0.90	0.96	0.15	0.08	0.35	0.13	0.39	0.02	0.06
<i>L</i>	0.06	0.00	0.59	0.70	0.05	0.90	0.96	0.01	0.08	0.35	0.76	0.86	0.05	0.05
<i>M</i>	0.06	0.00	0.59	0.70	0.04	0.90	0.96	0.02	0.08	0.35	0.63	0.76	0.04	0.05
<i>OS-1</i>	0.05	0.00	0.59	0.70	0.00	0.90	0.96	0.05	0.08	0.35	0.08	0.35	0.00	0.02
<i>OS-2</i>	0.10	0.00	0.59	0.70	0.00	0.90	0.96	0.10	0.08	0.35	0.08	0.35	0.01	0.04

7.3

Date: 7/20/2021 Checked by: \_\_\_\_\_

# 1895.00 HCD DRILLING Runoff Summary

## EXISTING

		WEIGHTED		OVERLAND				SHALLOW CONCENTRATED FLOW				T <sub>C</sub>	INTENSITY		TOTAL FLOWS	
BASIN	AREA TOTAL (Acres)	C <sub>5</sub>	C <sub>100</sub>	C <sub>5</sub>	Length (ft)	Slope (ft/ft)	T <sub>t</sub> (min)	Length (ft)	Slope (%)	Velocity (fps)	T <sub>t</sub> (min)	TOTAL (min)	I <sub>5</sub> (in/hr)	I <sub>100</sub> (in/hr)	Q <sub>5</sub> (c.f.s.)	Q <sub>100</sub> (c.f.s.)
		<small>* For Calcs See Runoff Summary</small>														
<b>EX-A</b>	1.10	0.43	0.63	0.43	150	0.029	10.4	180	4.4%	3.2	0.9	11.4	3.9	6.7	1.83	4.62
<b>EX-B</b>	2.10	0.30	0.57	0.30	150	0.027	12.8	276	3.6%	2.8	1.6	14.4	3.5	6.0	2.20	7.14
<b>EX-C</b>	3.92	0.15	0.50	0.15	150	0.033	14.2	176	3.5%	2.8	1.0	15.2	3.4	5.8	2.02	11.41
<b>OS-1</b>	0.05	0.08	0.35	0.08	35	0.029	7.7	0	3.5%	2.8	0.0	7.7	4.4	7.9	0.02	0.14
<b>OS-2</b>	0.10	0.08	0.35	0.08	75	0.040	10.1	0	3.5%	2.8	0.0	10.1	4.1	7.0	0.03	0.25

## DEVELOPED

		WEIGHTED		OVERLAND				SHALLOW CONCENTRATED FLOW				T <sub>C</sub>	INTENSITY		TOTAL FLOWS	
BASIN	AREA TOTAL (Acres)	C <sub>5</sub>	C <sub>100</sub>	C <sub>5</sub>	Length (ft)	Slope (ft/ft)	T <sub>t</sub> (min)	Length (ft)	Slope (%)	Velocity (fps)	T <sub>t</sub> (min)	TOTAL (min)	I <sub>5</sub> (in/hr)	I <sub>100</sub> (in/hr)	Q <sub>5</sub> (c.f.s.)	Q <sub>100</sub> (c.f.s.)
		<small>* For Calcs See Runoff Summary</small>														
<b>A</b>	1.36	0.77	0.87	0.77	55	0.02	3.4	255	3.0%	3.5	1.2	5.0	5.0	9.1	5.26	10.67
<b>B</b>	0.71	0.73	0.83	0.73	0	0.04	0.0	260	1.3%	2.2	2.0	5.0	5.0	9.1	2.58	5.35
<b>C</b>	0.54	0.60	0.73	0.60	45	0.02	4.8	95	1.0%	2.0	0.8	5.6	4.9	8.8	1.59	3.47
<b>D</b>	0.26	0.63	0.74	0.63	0	0.04	0.0	160	2.5%	3.2	0.8	5.0	5.0	9.1	0.82	1.74
<b>E</b>	0.35	0.69	0.78	0.69	0	0.33	0.0	180	4.0%	2.0	1.5	5.0	5.0	9.1	1.20	2.48
<b>F</b>	0.29	0.71	0.80	0.71	0	0.10	0.0	160	4.0%	2.0	1.3	5.0	5.0	9.1	1.03	2.10
<b>G</b>	0.35	0.69	0.78	0.69	0	0.10	0.0	180	4.0%	2.0	1.5	5.0	5.0	9.1	1.20	2.48
<b>H</b>	0.20	0.71	0.80	0.71	0	0.10	0.0	160	4.0%	2.0	1.3	5.0	5.0	9.1	0.71	1.46
<b>I</b>	0.96	0.08	0.35	0.08	100	0.03	12.8	310	4.0%	2.0	2.6	15.4	3.4	5.8	0.26	1.95
<b>J</b>	1.82	0.28	0.49	0.28	100	0.03	10.3	240	4.2%	1.0	4.0	14.3	3.5	6.0	1.81	5.37
<b>K</b>	0.16	0.13	0.39	0.13	100	0.07	9.4	0	1.0%	1.0	0.0	9.4	4.1	7.2	0.09	0.45
<b>L</b>	0.06	0.76	0.86	0.76	0	0.07	0.0	65	3.0%	1.5	0.7	5.0	5.0	9.1	0.23	0.47
<b>M</b>	0.06	0.63	0.76	0.63	0	0.07	0.0	90	3.0%	1.5	1.0	5.0	5.0	9.1	0.19	0.41
<b>OS-1</b>	0.05	0.08	0.35	0.08	50	0.02	10.4	0	1.0%	1.0	0.0	10.4	4.0	7.0	0.02	0.12
<b>OS-2</b>	0.10	0.08	0.35	0.08	90	0.03	11.8	0	1.0%	1.0	0.0	11.8	3.8	6.6	0.03	0.23

**1895.00 HCD DRILLING  
Surface Routing**

<b>EXISTING CONDITIONS</b>									
<i>Design Point(s)</i>	<i>Contributing Basins</i>	<i>Area (Acres)</i>	<i>Equivalent CA<sub>5</sub></i>	<i>Equivalent CA<sub>100</sub></i>	<i>Maximum T<sub>C</sub></i>	<i>Intensity</i>		<i>Flow</i>	
						<i>I<sub>5</sub></i>	<i>I<sub>100</sub></i>	<i>Q<sub>5</sub></i>	<i>Q<sub>100</sub></i>
X1	EX-A	1.10	0.47	0.69	11.4	3.9	6.7	1.83	4.62
X2	EX-B	2.10	0.62	1.19	14.4	3.5	6.0	2.20	7.14
X3	EX-C, OS-1, OS-2	4.07	0.59	1.95	15.2	3.4	5.8	2.07	11.80
X4	OS-1	0.05	0.00	0.02	7.7	4.4	7.9	0.02	0.14
X5	OS-2	0.10	0.01	0.04	10.1	4.1	7.0	0.03	0.25

<b>PROPOSED CONDITIONS</b>									
<i>Design Point(s)</i>	<i>Contributing Basins</i>	<i>Area (Acres)</i>	<i>Equivalent CA<sub>5</sub></i>	<i>Equivalent CA<sub>100</sub></i>	<i>Maximum T<sub>C</sub></i>	<i>Intensity</i>		<i>Flow</i>	
						<i>I<sub>5</sub></i>	<i>I<sub>100</sub></i>	<i>Q<sub>5</sub></i>	<i>Q<sub>100</sub></i>
1	A	1.36	1.05	1.18	5.0	5.0	9.1	5.26	10.67
2	B	0.71	0.52	0.59	5.0	5.0	9.1	2.58	5.35
3	C	0.54	0.33	0.40	5.6	4.9	8.8	1.59	3.47
4	D	0.26	0.16	0.19	5.0	5.0	9.1	0.82	1.74
5	E	0.35	0.24	0.27	5.0	5.0	9.1	1.20	2.48
6	F	0.29	0.21	0.23	5.0	5.0	9.1	1.03	2.10
7	G	0.35	0.24	0.27	5.0	5.0	9.1	1.20	2.48
8	H	0.20	0.14	0.16	5.0	5.0	9.1	0.71	1.46
9	I, OS-2, Pond	7.11	0.08	0.37	27.2	2.6	4.3	0.42	5.09
10	J, OS-1	1.87	0.52	0.91	24.7	2.7	4.5	1.42	4.12
11	K	0.16	0.02	0.06	9.4	4.1	7.2	0.09	0.45
12	L	0.06	0.05	0.05	5.0	5.0	9.1	0.23	0.47
13	M	0.06	0.04	0.05	5.0	5.0	9.1	0.19	0.41
14	OS-1	0.05	0.00	0.02	10.4	4.0	7.0	0.02	0.12
15	OS-2	0.10	0.01	0.04	11.8	3.8	6.6	0.03	0.23

## **HYDRAULIC CALCULATIONS**

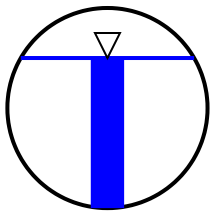
# Manning Formula Uniform Pipe Flow at Given Slope and Depth

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## Pipe Run 1

24" RCP

Inputs			Results		
Pipe diameter, $d_0$	24	in	Flow, Q (See notes)	20.6269	cfs
<a href="#">Manning roughness, <math>n</math></a>	0.013		Velocity, $v$	2.4877	m/s
Pressure slope (possibly ? equal to pipe slope), $S_0$	0.01	rise/run	Velocity head, $h_v$	0.3155	m H2O
Percent of (or ratio to) full depth (100% or 1 if flowing full)	.75	fraction	Flow area	0.2348	m <sup>2</sup>
			Wetted perimeter	1.2767	m
			Hydraulic radius	0.1839	m
			Top width, T	0.5279	m
			<a href="#">Froude number, <math>F</math></a>	1.19	
			Shear stress (tractive force), $\tau$	18.0341	N/m <sup>2</sup>



Notes:

**This is the flow and depth *inside* the pipe.**

Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or [see my 2-minute tutorial](#) for standard culvert headwater calculations using HY-8.

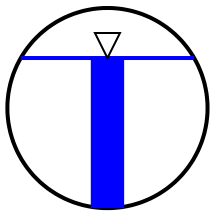
# Manning Formula Uniform Pipe Flow at Given Slope and Depth

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## Pipe Run 2

12" HDPE

Inputs			Results		
Pipe diameter, $d_0$	12	in	Flow, Q (See notes)	3.2485	cfs
<a href="#">Manning roughness, <math>n</math></a>	0.013		Velocity, $v$	1.5671	m/s
Pressure slope (possibly ? equal to pipe slope), $S_0$	0.01	rise/run	Velocity head, $h_v$	0.1252	m H2O
Percent of (or ratio to) full depth (100% or 1 if flowing full)	.75	fraction	Flow area	0.0587	m <sup>2</sup>
			Wetted perimeter	0.6384	m
			Hydraulic radius	0.0920	m
			Top width, T	0.2640	m
			<a href="#">Froude number, <math>F</math></a>	1.06	
			Shear stress (tractive force), $\tau$	9.0170	N/m <sup>2</sup>



Notes:

**This is the flow and depth *inside* the pipe.**

Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or [see my 2-minute tutorial](#) for standard culvert headwater calculations using HY-8.

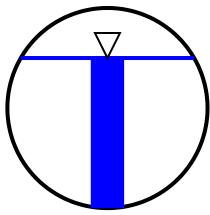
# Manning Formula Uniform Pipe Flow at Given Slope and Depth

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## Pipe Run 3

12" HDPE

Inputs			Results		
Pipe diameter, $d_0$	12	in	Flow, Q (See notes)	3.2485	cfs
<a href="#">Manning roughness, <math>n</math></a>	0.013		Velocity, $v$	1.5671	m/s
Pressure slope (possibly ? equal to pipe slope), $S_0$	0.01	rise/run	Velocity head, $h_v$	0.1252	m H2O
Percent of (or ratio to) full depth (100% or 1 if flowing full)	.75	fraction	Flow area	0.0587	m <sup>2</sup>
			Wetted perimeter	0.6384	m
			Hydraulic radius	0.0920	m
			Top width, T	0.2640	m
			<a href="#">Froude number, <math>F</math></a>	1.06	
			Shear stress (tractive force), $\tau$	9.0170	N/m <sup>2</sup>



Notes:

**This is the flow and depth *inside* the pipe.**

Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or [see my 2-minute tutorial](#) for standard culvert headwater calculations using HY-8.



# Manning Formula Uniform Pipe Flow at Given Slope and Depth

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## Pipe Run 4

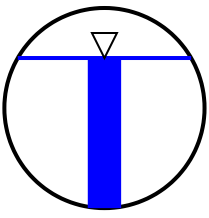
24" RCP

### Inputs

Pipe diameter, $d_0$	24	in ▾
<a href="#">Manning roughness, <math>n</math></a>	0.013	
Pressure slope (possibly ? equal to pipe slope), $S_0$	0.01	rise/run ▾
Percent of (or ratio to) full depth (100% or 1 if flowing full)	.75	fraction ▾

### Results

Flow, $Q$ (See notes)	20.6269	cfs ▾
Velocity, $v$	2.4877	m/s ▾
Velocity head, $h_v$	0.3155	m H2O ▾
Flow area	0.2348	m <sup>2</sup> ▾
Wetted perimeter	1.2767	m ▾
Hydraulic radius	0.1839	m ▾
Top width, $T$	0.5279	m ▾
<a href="#">Froude number, <math>F</math></a>	1.19	
Shear stress (tractive force), $\tau$	18.0341	N/m <sup>2</sup> ▾



Notes:

**This is the flow and depth *inside* the pipe.**

Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or [see my 2-minute tutorial](#) for standard culvert headwater calculations using HY-8.

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

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## Pipe Run 5

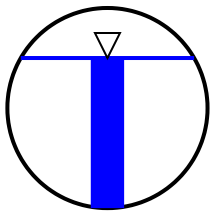
24" RCP

### Inputs

Pipe diameter, $d_0$	24	in ▾
<a href="#">Manning roughness, <math>n</math></a>	0.013	
Pressure slope (possibly ? equal to pipe slope), $S_0$	0.01	rise/run ▾
Percent of (or ratio to) full depth (100% or 1 if flowing full)	.75	fraction ▾

### Results

Flow, $Q$ (See notes)	20.6269	cfs ▾
Velocity, $v$	2.4877	m/s ▾
Velocity head, $h_v$	0.3155	m H2O ▾
Flow area	0.2348	m <sup>2</sup> ▾
Wetted perimeter	1.2767	m ▾
Hydraulic radius	0.1839	m ▾
Top width, $T$	0.5279	m ▾
<a href="#">Froude number, <math>F</math></a>	1.19	
Shear stress (tractive force), $\tau$	18.0341	N/m <sup>2</sup> ▾



Notes:

**This is the flow and depth *inside* the pipe.**

Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or [see my 2-minute tutorial](#) for standard culvert headwater calculations using HY-8.

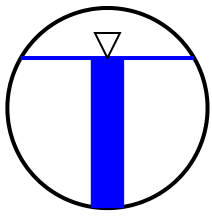
# Manning Formula Uniform Pipe Flow at Given Slope and Depth

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## Pipe Run 6

24" RCP

Inputs			Results		
Pipe diameter, $d_0$	24	in	Flow, Q (See notes)	20.6269	cfs
<a href="#">Manning roughness, <math>n</math></a>	0.013		Velocity, $v$	2.4877	m/s
Pressure slope (possibly ? equal to pipe slope), $S_0$	0.01	rise/run	Velocity head, $h_v$	0.3155	m H2O
Percent of (or ratio to) full depth (100% or 1 if flowing full)	.75	fraction	Flow area	0.2348	m <sup>2</sup>
			Wetted perimeter	1.2767	m
			Hydraulic radius	0.1839	m
			Top width, T	0.5279	m
			<a href="#">Froude number, <math>F</math></a>	1.19	
			Shear stress (tractive force), $\tau$	18.0341	N/m <sup>2</sup>



Notes:

**This is the flow and depth *inside* the pipe.**

Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or [see my 2-minute tutorial](#) for standard culvert headwater calculations using HY-8.

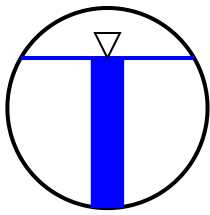
# Manning Formula Uniform Pipe Flow at Given Slope and Depth

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## Pipe Run 7

15" HDPE

Inputs			Results		
Pipe diameter, $d_0$	15	in	Flow, Q (See notes)	5.8900	cfs
<a href="#">Manning roughness, <math>n</math></a>	0.013		Velocity, $v$	1.8185	m/s
Pressure slope (possibly ? equal to pipe slope), $S_0$	0.01	rise/run	Velocity head, $h_v$	0.1686	m H2O
Percent of (or ratio to) full depth (100% or 1 if flowing full)	.75	fraction	Flow area	0.0917	m <sup>2</sup>
			Wetted perimeter	0.7980	m
			Hydraulic radius	0.1149	m
			Top width, T	0.3300	m
			<a href="#">Froude number, <math>F</math></a>	1.10	
			Shear stress (tractive force), $\tau$	11.2713	N/m <sup>2</sup>



Notes:

**This is the flow and depth *inside* the pipe.**

Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or [see my 2-minute tutorial](#) for standard culvert headwater calculations using HY-8.

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

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## Pipe Run 8

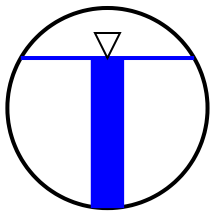
18" RCP

### Inputs

Pipe diameter, $d_0$	18	in
<a href="#">Manning roughness, <math>n</math></a>	0.013	
Pressure slope (possibly ? equal to pipe slope), $S_0$	0.01	rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	.75	fraction

### Results

Flow, $Q$ (See notes)	9.5777	cfs
Velocity, $v$	2.0535	m/s
Velocity head, $h_v$	0.2150	m H2O
Flow area	0.1321	m <sup>2</sup>
Wetted perimeter	0.9576	m
Hydraulic radius	0.1379	m
Top width, $T$	0.3959	m
<a href="#">Froude number, <math>F</math></a>	1.14	
Shear stress (tractive force), $\tau$	13.5256	N/m <sup>2</sup>



Notes:

**This is the flow and depth *inside* the pipe.**

Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or [see my 2-minute tutorial](#) for standard culvert headwater calculations using HY-8.

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

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## Pipe Run 9

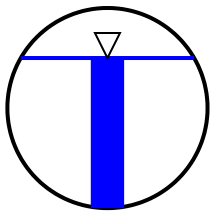
18" RCP

### Inputs

Pipe diameter, $d_0$	18	in ▾
<a href="#">Manning roughness, <math>n</math></a>	0.013	
Pressure slope (possibly ? equal to pipe slope), $S_0$	0.01	rise/run ▾
Percent of (or ratio to) full depth (100% or 1 if flowing full)	.75	fraction ▾

### Results

Flow, $Q$ (See notes)	9.5777	cfs ▾
Velocity, $v$	2.0535	m/s ▾
Velocity head, $h_v$	0.2150	m H2O ▾
Flow area	0.1321	m <sup>2</sup> ▾
Wetted perimeter	0.9576	m ▾
Hydraulic radius	0.1379	m ▾
Top width, $T$	0.3959	m ▾
<a href="#">Froude number, <math>F</math></a>	1.14	
Shear stress (tractive force), $\tau$	13.5256	N/m <sup>2</sup> ▾



Notes:

**This is the flow and depth *inside* the pipe.**

Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or [see my 2-minute tutorial](#) for standard culvert headwater calculations using HY-8.

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

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## Pipe Run 10

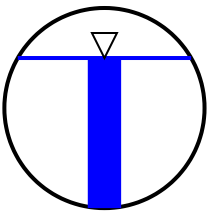
24" RCP

### Inputs

Pipe diameter, $d_0$	24	in
<a href="#">Manning roughness, <math>n</math></a>	0.013	
Pressure slope (possibly ? equal to pipe slope), $S_0$	0.01	rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	.75	fraction

### Results

Flow, $Q$ (See notes)	20.6269	cfs
Velocity, $v$	2.4877	m/s
Velocity head, $h_v$	0.3155	m H2O
Flow area	0.2348	m <sup>2</sup>
Wetted perimeter	1.2767	m
Hydraulic radius	0.1839	m
Top width, $T$	0.5279	m
<a href="#">Froude number, <math>F</math></a>	1.19	
Shear stress (tractive force), $\tau$	18.0341	N/m <sup>2</sup>



Notes:

**This is the flow and depth *inside* the pipe.**

Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or [see my 2-minute tutorial](#) for standard culvert headwater calculations using HY-8.

## **FSEDB CALCULATIONS**

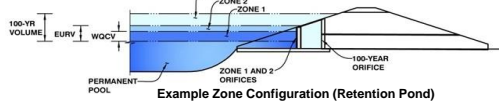


# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: \_\_\_\_\_

Basin ID: \_\_\_\_\_



**Watershed Information**

Selected BMP Type =	<b>EDB</b>
Watershed Area =	6.05 acres
Watershed Length =	800 ft
Watershed Length to Centroid =	340 ft
Watershed Slope =	0.022 ft/ft
Watershed Imperviousness =	65.30% percent
Percentage Hydrologic Soil Group A =	100.0% percent
Percentage Hydrologic Soil Group B =	0.0% percent
Percentage Hydrologic Soil Groups C/D =	0.0% percent
Target WQCV 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) =	0.129 acre-feet
Excess Urban Runoff Volume (EURV) =	0.491 acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.346 acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	0.454 acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	0.540 acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	0.653 acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	0.763 acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	0.898 acre-feet
500-yr Runoff Volume (P1 = 3 in.) =	1.123 acre-feet
Approximate 2-yr Detention Volume =	0.319 acre-feet
Approximate 5-yr Detention Volume =	0.418 acre-feet
Approximate 10-yr Detention Volume =	0.503 acre-feet
Approximate 25-yr Detention Volume =	0.605 acre-feet
Approximate 50-yr Detention Volume =	0.667 acre-feet
Approximate 100-yr Detention Volume =	0.731 acre-feet

**Optional User Overrides**

acre-feet	acre-feet
inches	inches
1.19	1.19
1.50	1.50
1.75	1.75
2.00	2.00
2.25	2.25
2.52	2.52
3.00	3.00

**Define Zones and Basin Geometry**

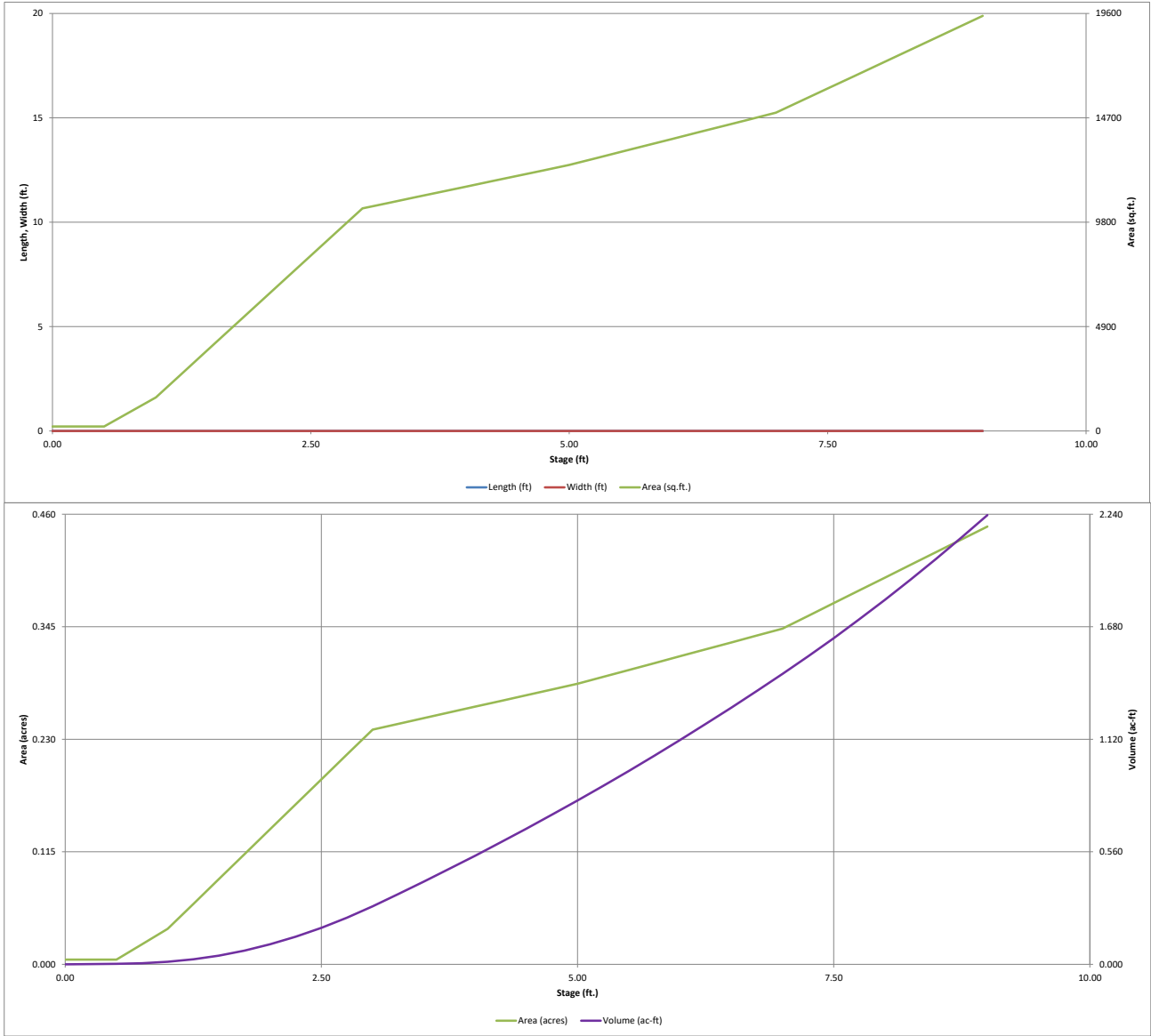
Zone 1 Volume (WQCV) =	0.129	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.362	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.240	acre-feet
Total Detention Basin Volume =	0.731	acre-feet
Initial Surcharge Volume (ISV) =	user	ft <sup>3</sup>
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H <sub>total</sub> ) =	user	ft
Depth of Trickle Channel (H <sub>TC</sub> ) =	user	ft
Slope of Trickle Channel (S <sub>TC</sub> ) =	user	ft/ft
Slopes of Main Basin Sides (S <sub>main</sub> ) =	user	H:V
Basin Length-to-Width Ratio (R <sub>LW</sub> ) =	user	
Initial Surcharge Area (A <sub>ISV</sub> ) =	user	ft <sup>2</sup>
Surcharge Volume Length (L <sub>ISV</sub> ) =	user	ft
Surcharge Volume Width (W <sub>ISV</sub> ) =	user	ft
Depth of Basin Floor (H <sub>FLOOR</sub> ) =	user	ft
Length of Basin Floor (L <sub>FLOOR</sub> ) =	user	ft
Width of Basin Floor (W <sub>FLOOR</sub> ) =	user	ft
Area of Basin Floor (A <sub>FLOOR</sub> ) =	user	ft <sup>2</sup>
Volume of Basin Floor (V <sub>FLOOR</sub> ) =	user	ft <sup>3</sup>
Depth of Main Basin (H <sub>MAIN</sub> ) =	user	ft
Length of Main Basin (L <sub>MAIN</sub> ) =	user	ft
Width of Main Basin (W <sub>MAIN</sub> ) =	user	ft
Area of Main Basin (A <sub>MAIN</sub> ) =	user	ft <sup>2</sup>
Volume of Main Basin (V <sub>MAIN</sub> ) =	user	ft <sup>3</sup>
Calculated Total Basin Volume (V <sub>total</sub> ) =	user	acre-feet

Depth Increment = \_\_\_\_\_ ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft <sup>2</sup> )	Optional Override Area (ft <sup>2</sup> )	Area (acre)	Volume (ft <sup>3</sup> )	Volume (ac-ft)
<b>Top of Micropool</b>	--	0.00	--	--	210	0.005			
<b>6243.25</b>	--	0.25	--	--	210	0.005		53	0.001
<b>6243.5</b>	--	0.50	--	--	210	0.005		105	0.002
<b>6243.75</b>	--	0.75	--	--	894	0.021		243	0.006
<b>6244</b>	--	1.00	--	--	1,578	0.036		552	0.013
	--	1.25	--	--	2,687	0.062		1,085	0.025
	--	1.50	--	--	3,796	0.087		1,895	0.044
	--	1.75	--	--	4,905	0.113		2,983	0.068
<b>6245</b>	--	2.00	--	--	6,014	0.138		4,348	0.100
	--	2.25	--	--	7,123	0.164		5,990	0.138
	--	2.50	--	--	8,232	0.189		7,909	0.182
	--	2.75	--	--	9,341	0.214		10,106	0.232
<b>6246</b>	--	3.00	--	--	10,450	0.240		12,580	0.289
	--	3.25	--	--	10,705	0.246		15,224	0.350
	--	3.50	--	--	10,960	0.252		17,932	0.412
	--	3.75	--	--	11,215	0.257		20,704	0.475
<b>6247</b>	--	4.00	--	--	11,470	0.263		23,540	0.540
	--	4.25	--	--	11,724	0.269		26,439	0.607
	--	4.50	--	--	11,979	0.275		29,402	0.675
	--	4.75	--	--	12,234	0.281		32,429	0.744
<b>6248</b>	--	5.00	--	--	12,489	0.287		35,519	0.815
	--	5.25	--	--	12,796	0.294		38,680	0.888
	--	5.50	--	--	13,102	0.301		41,917	0.962
	--	5.75	--	--	13,409	0.308		45,231	1.038
<b>6249</b>	--	6.00	--	--	13,715	0.315		48,621	1.116
	--	6.25	--	--	14,022	0.322		52,088	1.196
	--	6.50	--	--	14,328	0.329		55,632	1.277
	--	6.75	--	--	14,635	0.336		59,252	1.360
<b>6250</b>	--	7.00	--	--	14,941	0.343		62,949	1.445
	--	7.25	--	--	15,509	0.356		66,755	1.532
	--	7.50	--	--	16,078	0.369		70,704	1.623
	--	7.75	--	--	16,646	0.382		74,794	1.717
<b>6251</b>	--	8.00	--	--	17,215	0.395		79,027	1.814
	--	8.25	--	--	17,783	0.408		83,401	1.915
	--	8.50	--	--	18,351	0.421		87,918	2.018
	--	8.75	--	--	18,920	0.434		92,577	2.125
<b>6252</b>	--	9.00	--	--	19,488	0.447		97,378	2.235

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

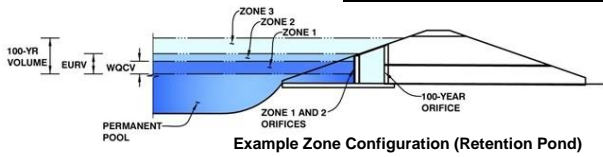
*MHFD-Detention, Version 4.04 (February 2021)*



# DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: \_\_\_\_\_  
Basin ID: \_\_\_\_\_



	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.20	0.129	Orifice Plate
Zone 2 (EURV)	3.82	0.362	Orifice Plate
Zone 3 (100-year)	4.71	0.240	Weir&Pipe (Restrict)
<b>Total (all zones)</b>		<b>0.731</b>	

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 =  ft<sup>2</sup>  
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 =  inches

Calculated Parameters for Plate  
WQ Orifice Area per Row =  ft<sup>2</sup>  
Elliptical Half-Width =  feet  
Elliptical Slot Centroid =  feet  
Elliptical Slot Area =  ft<sup>2</sup>

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	1.27	2.55					
Orifice Area (sq. inches)	0.70	0.70	4.00					
	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 =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice  
Vertical Orifice Area =  ft<sup>2</sup>  
Vertical Orifice Centroid =  feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.82	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	2.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	2.00	N/A	feet
Overflow Grate Type =	Close Mesh Grate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir  
Height of Grate Upper Edge, H<sub>u</sub> =  feet  
Overflow Weir Slope Length =  feet  
Grate Open Area / 100-yr Orifice Area =  ft<sup>2</sup>  
Overflow Grate Open Area w/o Debris =  ft<sup>2</sup>  
Overflow Grate Open Area w/ Debris =  ft<sup>2</sup>

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 =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	4.50		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate  
Outlet Orifice Area =  ft<sup>2</sup>  
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

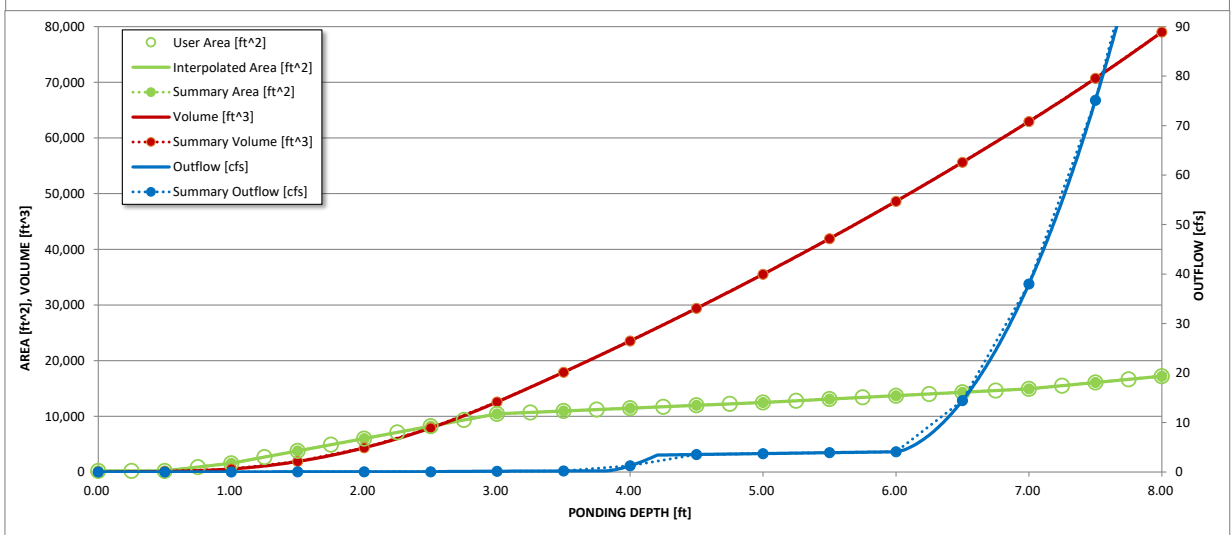
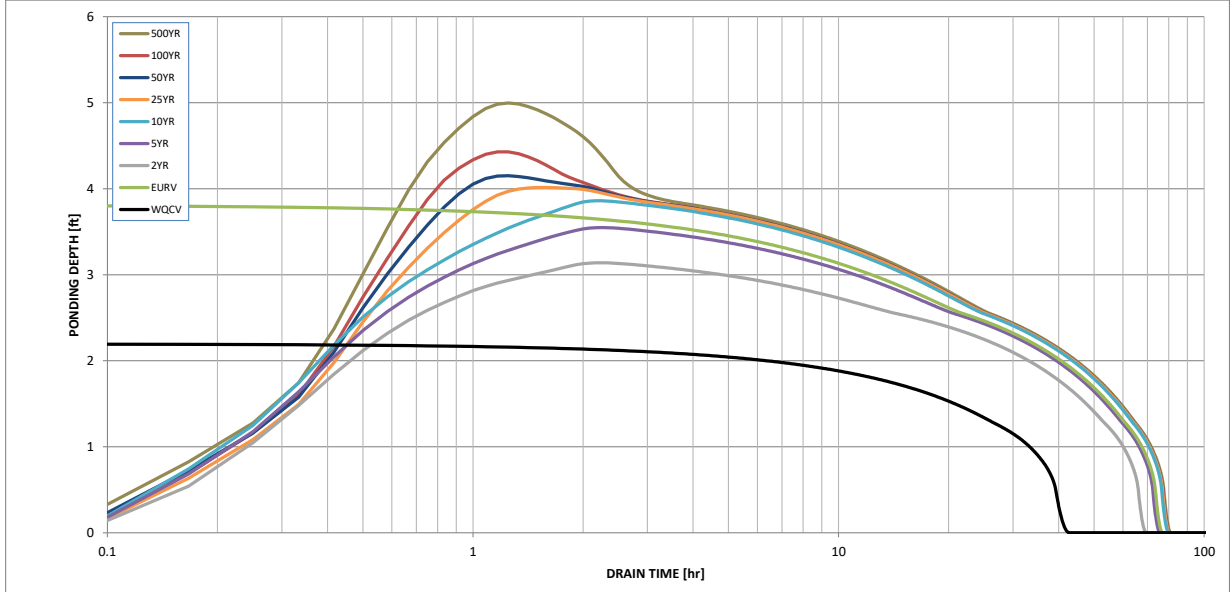
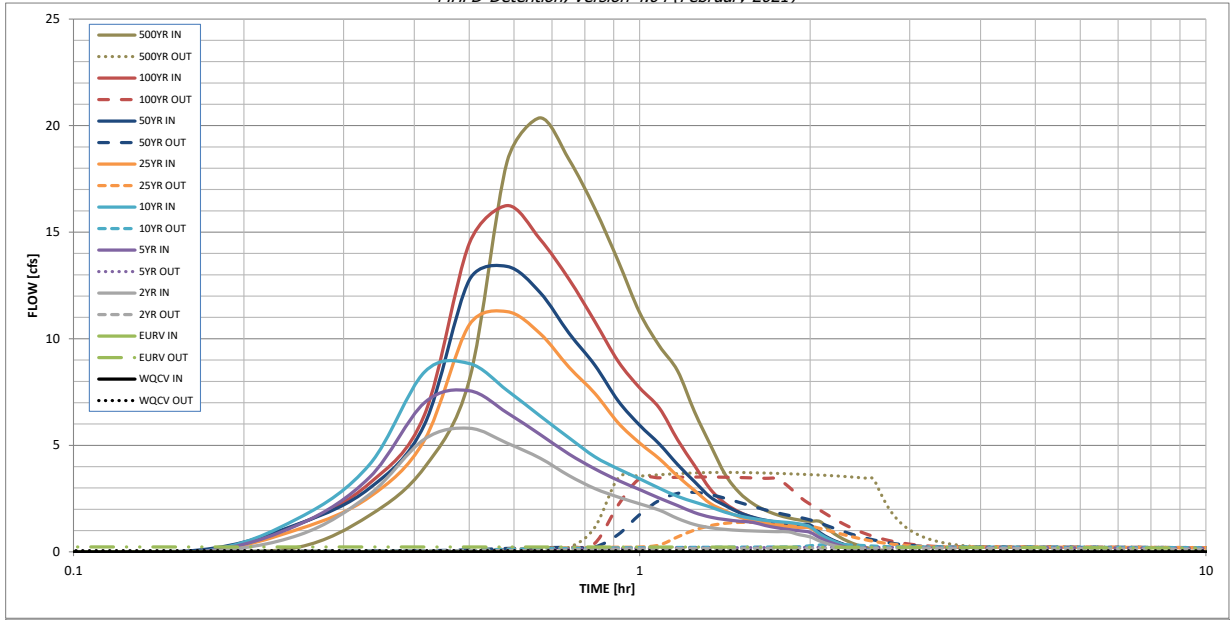
## Routed Hydrograph Results

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 =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.00
One-Hour Rainfall Depth (in) =									
CUHP Runoff Volume (acre-ft) =	0.129	0.491	0.346	0.454	0.540	0.653	0.763	0.898	1.123
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.346	0.454	0.540	0.653	0.763	0.898	1.123
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.1	0.1	1.1	2.3	3.7	6.0
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.02	0.02	0.19	0.38	0.62	0.99
Peak Inflow Q (cfs) =	N/A	N/A	5.8	7.6	8.8	11.3	13.4	16.2	20.4
Peak Outflow Q (cfs) =	0.1	0.2	0.2	0.2	0.3	1.4	2.8	3.5	3.7
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	2.3	2.7	1.2	1.2	0.9	0.6
Structure Controlling Flow =	Plate	Overflow Weir 1	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.3	0.8	1.0	1.1
Max Velocity through Grate 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	67	61	66	69	68	66	64	62
Time to Drain 99% of Inflow Volume (hours) =	40	72	65	71	75	74	74	73	72
Maximum Ponding Depth (ft) =	2.20	3.82	3.14	3.55	3.86	4.01	4.15	4.43	5.00
Area at Maximum Ponding Depth (acres) =	0.16	0.26	0.24	0.25	0.26	0.26	0.27	0.27	0.29
Maximum Volume Stored (acre-ft) =	0.129	0.493	0.320	0.422	0.501	0.543	0.580	0.653	0.813

# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.04 (February 2021)*



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	0.00	0.09	0.01	0.22
	0:15:00	0.00	0.00	0.79	1.28	1.59	1.07	1.32	1.30	1.71	1.71
	0:20:00	0.00	0.00	2.69	3.50	4.10	2.58	2.99	3.22	3.95	3.95
	0:25:00	0.00	0.00	5.29	7.00	8.43	5.24	5.96	6.42	8.05	8.05
	0:30:00	0.00	0.00	5.80	7.56	8.84	10.65	12.75	14.46	18.31	18.31
	0:35:00	0.00	0.00	5.10	6.53	7.58	11.27	13.39	16.25	20.36	20.36
	0:40:00	0.00	0.00	4.40	5.51	6.38	10.25	12.18	14.68	18.41	18.41
	0:45:00	0.00	0.00	3.58	4.59	5.35	8.67	10.26	12.80	16.11	16.11
	0:50:00	0.00	0.00	2.97	3.90	4.46	7.44	8.76	10.81	13.64	13.64
	0:55:00	0.00	0.00	2.57	3.35	3.89	6.05	7.08	8.93	11.23	11.23
	1:00:00	0.00	0.00	2.26	2.92	3.43	5.11	5.94	7.70	9.67	9.67
	1:05:00	0.00	0.00	1.96	2.52	2.99	4.37	5.06	6.75	8.49	8.49
	1:10:00	0.00	0.00	1.57	2.17	2.61	3.56	4.10	5.26	6.57	6.57
	1:15:00	0.00	0.00	1.28	1.84	2.34	2.88	3.30	4.05	5.02	5.02
	1:20:00	0.00	0.00	1.13	1.63	2.11	2.27	2.57	2.94	3.62	3.62
	1:25:00	0.00	0.00	1.06	1.52	1.86	1.92	2.17	2.27	2.78	2.78
	1:30:00	0.00	0.00	1.01	1.44	1.69	1.64	1.84	1.87	2.27	2.27
	1:35:00	0.00	0.00	0.98	1.39	1.57	1.45	1.63	1.62	1.95	1.95
	1:40:00	0.00	0.00	0.96	1.24	1.48	1.32	1.49	1.45	1.74	1.74
	1:45:00	0.00	0.00	0.95	1.13	1.42	1.24	1.40	1.33	1.59	1.59
	1:50:00	0.00	0.00	0.94	1.05	1.38	1.18	1.33	1.25	1.49	1.49
	1:55:00	0.00	0.00	0.80	0.99	1.31	1.15	1.29	1.21	1.44	1.44
	2:00:00	0.00	0.00	0.70	0.92	1.18	1.12	1.26	1.19	1.42	1.42
	2:05:00	0.00	0.00	0.50	0.65	0.83	0.80	0.89	0.85	1.01	1.01
	2:10:00	0.00	0.00	0.35	0.46	0.58	0.56	0.63	0.60	0.71	0.71
	2:15:00	0.00	0.00	0.24	0.31	0.40	0.39	0.44	0.42	0.50	0.50
	2:20:00	0.00	0.00	0.16	0.21	0.27	0.26	0.29	0.28	0.33	0.33
	2:25:00	0.00	0.00	0.10	0.13	0.18	0.17	0.19	0.19	0.22	0.22
	2:30:00	0.00	0.00	0.06	0.09	0.11	0.11	0.13	0.12	0.14	0.14
	2:35:00	0.00	0.00	0.03	0.05	0.06	0.07	0.07	0.07	0.08	0.08
	2:40:00	0.00	0.00	0.01	0.02	0.03	0.03	0.04	0.03	0.04	0.04
	2:45:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	2:50:00	0.00	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	0.00
	3:00:00	0.00	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	0.00
	3:10:00	0.00	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	0.00
	3:20:00	0.00	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	0.00
	3:30:00	0.00	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	0.00
	3:40:00	0.00	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	0.00
	3:50:00	0.00	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	0.00
	4:00:00	0.00	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	0.00
	4:10:00	0.00	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	0.00
	4:20:00	0.00	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	0.00
	4:30:00	0.00	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	0.00
	4:40:00	0.00	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	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:05:00	0.00	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	0.00	
5:15:00	0.00	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	0.00	
5:25:00	0.00	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	0.00	
5:35:00	0.00	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	0.00	
5:45:00	0.00	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	0.00	
5:55:00	0.00	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	0.00	



# FORBAY VOLUMES

## FORBAY VOLUME

<i>ELEV</i>	<i>AREA</i>	<i>AREA AVG.</i>	<i>DELTA ELEV.</i>	<i>VOLUME</i>	<i>VOLUME TOTAL</i>
6244.00	200				
		200	1.5	300	
6245.50	200				300

End Area Method: 300 C.F.  
0.007 A.F.

Required Forbay Volume = 3% of WQCV

WQCV = 0.129 ac-ft

WQCV = 5,619 cu-ft

3% of WQCV = 168.58 cu-ft

## PROPOSED MICROPOOL VOLUME

<i>ELEV</i>	<i>AREA</i>	<i>AREA AVG.</i>	<i>DELTA ELEV.</i>	<i>VOLUME</i>	<i>VOLUME TOTAL</i>
6240.50	12				
		111	3	333	
6243.50	210				333

End Area Method: 333 C.F.  
0.008 A.F.

**Design Procedure Form: Extended Detention Basin (EDB)**

**Designer:** \_\_\_\_\_  
**Company:** \_\_\_\_\_  
**Date:** January 26, 2023  
**Project:** \_\_\_\_\_  
**Location:** \_\_\_\_\_

5. Forebay

A) Minimum Forebay Volume  
 ( $V_{FMIN} = \underline{3\%}$  of the WQCV)

B) Actual Forebay Volume

C) Forebay Depth  
 ( $D_F = \underline{\hspace{2cm}}$  inch maximum)

D) Forebay Discharge

    i) Undetained 100-year Peak Discharge

    ii) Forebay Discharge Design Flow  
 ( $Q_F = 0.02 * Q_{100}$ )

E) Forebay Discharge Design

F) Discharge Pipe Size (minimum 8-inches)

G) Rectangular Notch Width

$V_{FMIN} = \underline{0.004}$  ac-ft  
 $V_F = \underline{0.007}$  ac-ft  
 $D_F = \underline{18.0}$  in  
 $Q_{100} = \underline{16.20}$  cfs  
 $Q_F = \underline{0.32}$  cfs

Choose One  
 Berm With Pipe  
 Wall with Rect. Notch  
 Wall with V-Notch Weir

Calculated  $D_p = \underline{\hspace{2cm}}$  in  
 Calculated  $W_N = \underline{4.2}$  in

6. Trickle Channel

A) Type of Trickle Channel

F) Slope of Trickle Channel

Choose One  
 Concrete  
 Soft Bottom

$S = \underline{\hspace{2cm}}$  ft / ft

7. Micropool and Outlet Structure

A) Depth of Micropool (2.5-feet minimum)

B) Surface Area of Micropool (10 ft<sup>2</sup> minimum)

C) Outlet Type

D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing  
 (Use UD-Detention)

E) Total Outlet Area

$D_M = \underline{\hspace{2cm}}$  ft  
 $A_M = \underline{\hspace{2cm}}$  sq ft

Choose One  
 Orifice Plate  
 Other (Describe):  
 \_\_\_\_\_  
 \_\_\_\_\_

$D_{orifice} = \underline{\hspace{2cm}}$  inches  
 $A_{ot} = \underline{\hspace{2cm}}$  square inches



**MANNING'S EQUATION for OPEN CHANNEL FLOW**

Project: **HCD Drilling** Location: **EDB Trickle Channels (need Q= 0.49 cfs)**  
 By: **John Fornander** Date: **7/21/2021**  
 Chk By: \_\_\_\_\_ Date: \_\_\_\_\_ version 12-2004

Mannings Formula

$$Q = (1.486/n)AR_h^{2/3}S^{1/2}$$

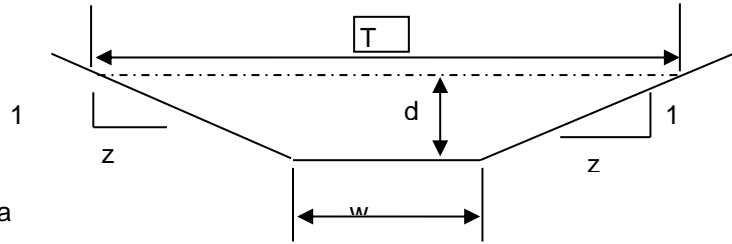
$$R = A/P$$

A = cross sectional area

P= wetted perimeter

S = slope of channel

n = Manning's roughness coefficient



$$V = (1.49/n)R_h^{2/3}S^{1/2}$$

$$Q = V \times A$$

INPUT

z (sideslope)= 0  
 z (sideslope)= 0  
 b (btm width, ft)= 1  
 d (depth, ft)= 0.5  
 S (slope, ft/ft) 0.0054  
 n<sub>low</sub> = 0.013  
 n<sub>high</sub> = 0.013

Clear Data  
Entry Cells

Depth, ft	Area, sf	Wetted Perimeter, ft	Hydraulic Radius, ft	Low N		High N		T =	Dm =
				Velocity, fps	Flow, cfs	Velocity, fps	Flow, cfs		
0.5	0.50	2.00	0.25	3.33333483	1.66667	3.333335	1.66667	1	0.500

Sc low = 0.0078 Sc high = 0.0078

s<sub>c</sub> = critical slope ft / ft

T = top width of the stream

d<sub>m</sub> = a/T = mean depth of flow

.7 Sc	1.3 Sc	.7 Sc	1.3 Sc
0.0055	0.0102	0.0055	0.0102

# 1895.00 HCD Drilling

## Riprap Protection for FSEDB Outlet Pipe<sup>1</sup>

Q100=	3.5	cfs	Q/D <sup>2.5</sup> =	1.27
D=	1.5	ft	Q/D <sup>1.5</sup> =	1.91
Yt=	0.25	ft	Yt/D =	0.4

Minimum Riprap d<sub>50</sub> Required = d<sub>50</sub> = 9 in ==> use d<sub>50</sub> = 12 in

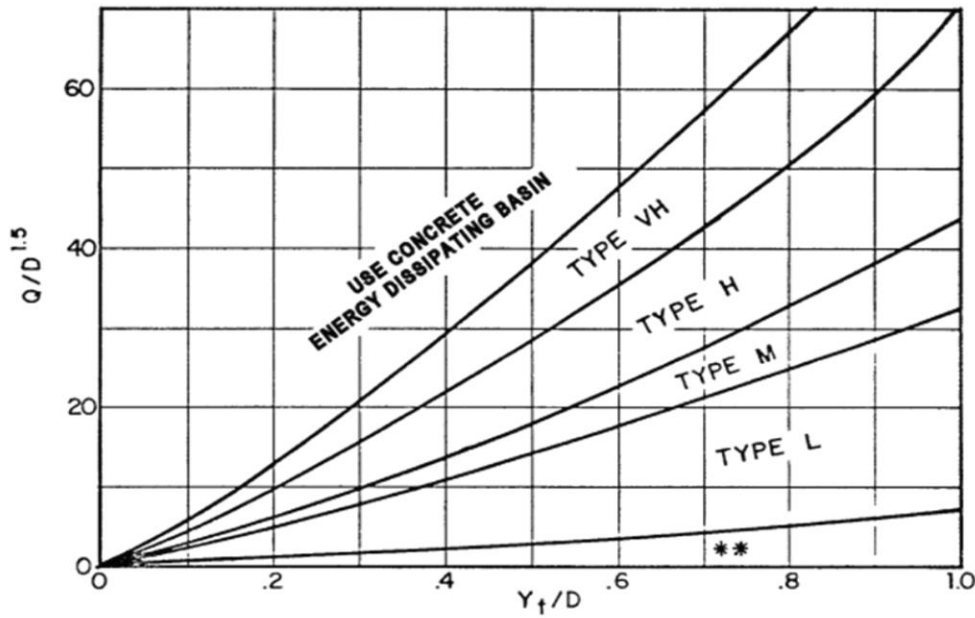


Figure 9-38. Riprap erosion protection at circular conduit outlet (valid for Q/D2.5 ≤ 6.0)

<sup>1</sup> see USDCM Chapter 9 Section Section 3.2.3

Figure 13-12c. Emergency Spillway Protection

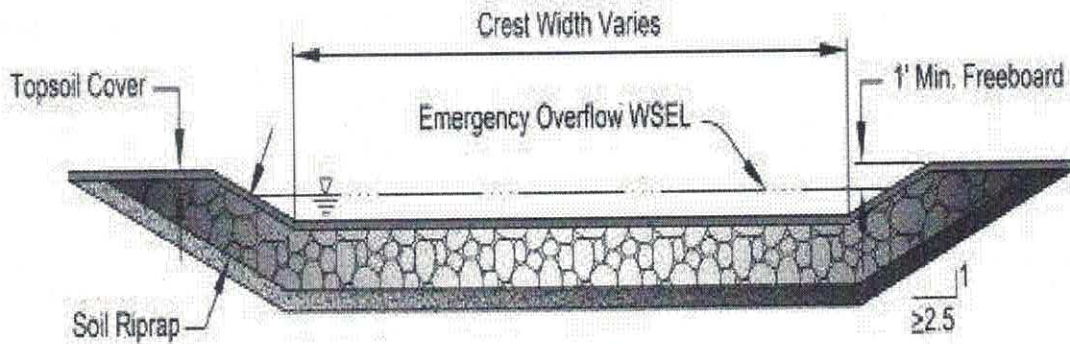
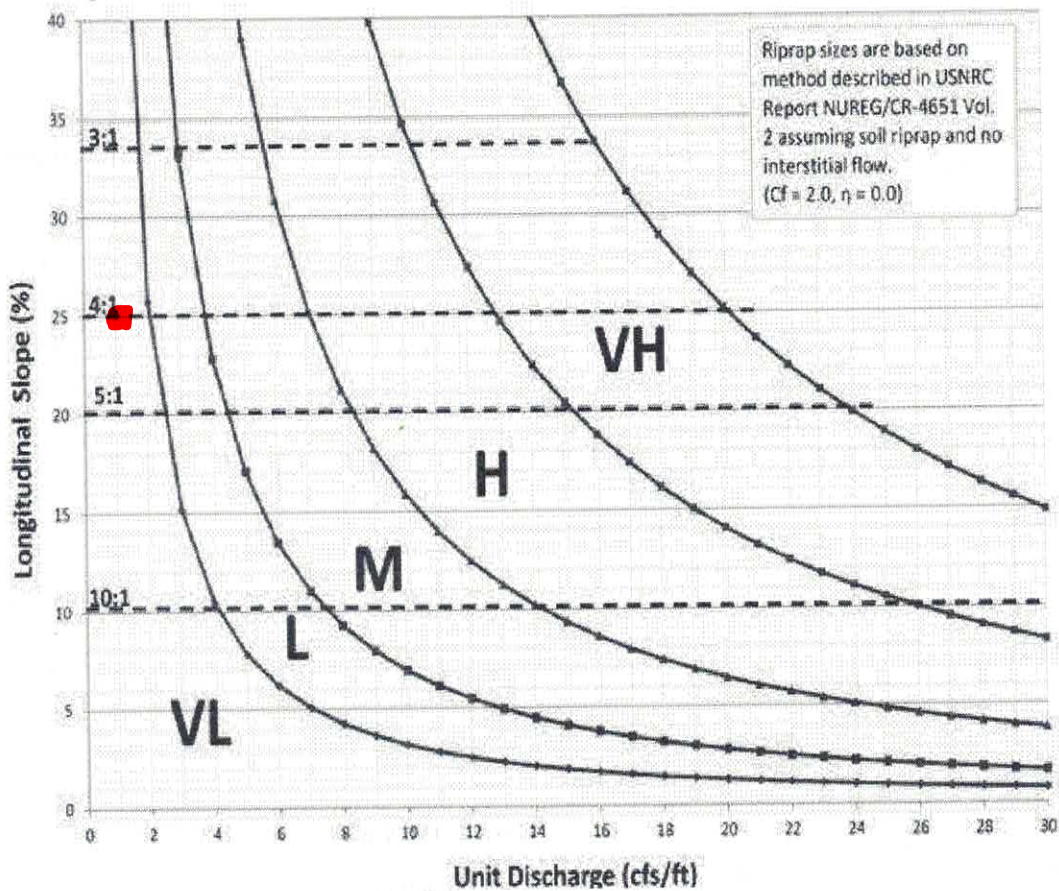


Figure 13-12d. Riprap Types for Emergency Spillway Protection



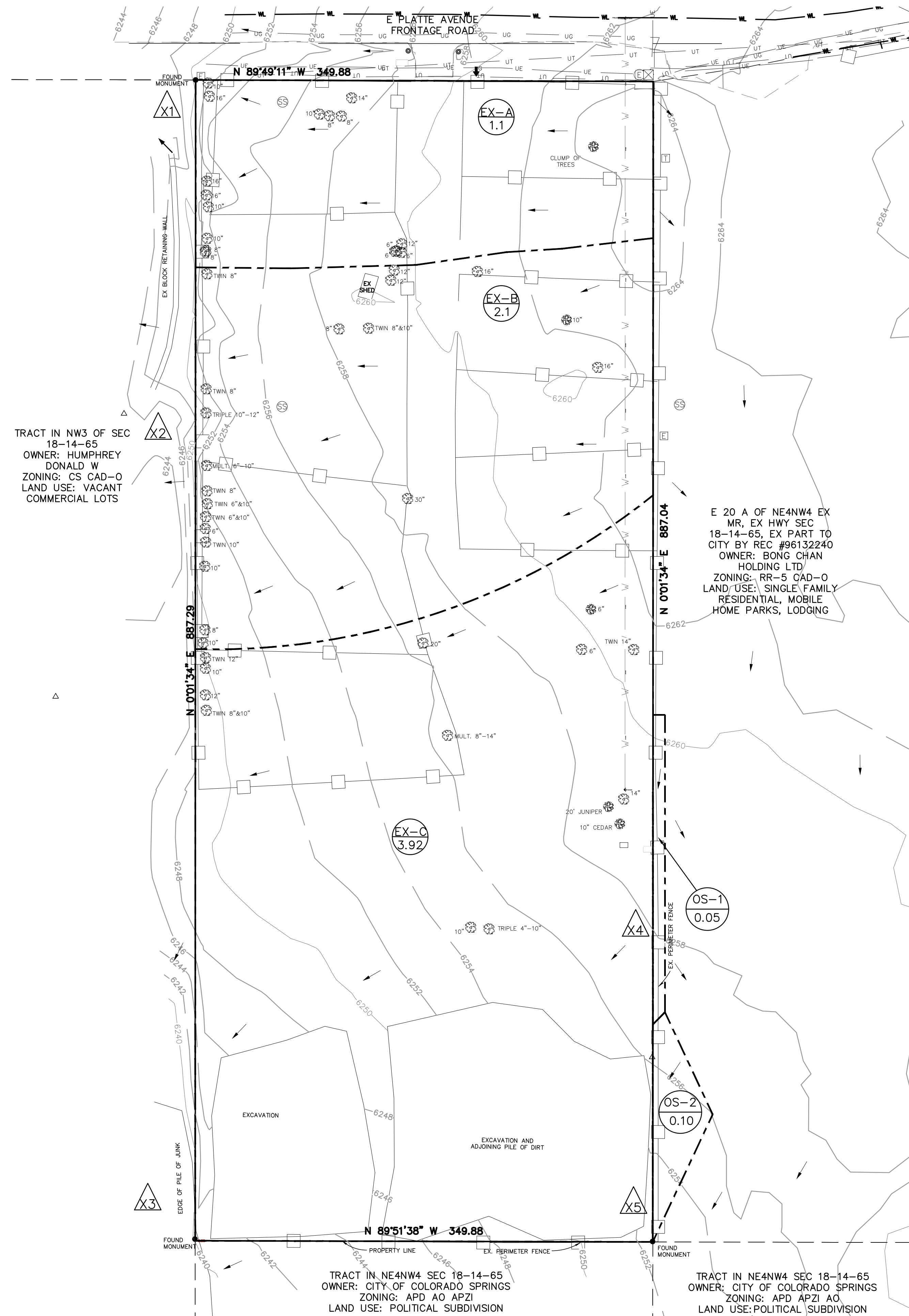
## **DRAINAGE MAPS**



# HCD DRILLING MINOR SUBDIVISION

## 6201 EAST PLATTE AVE

### EXISTING DRAINAGE MAP

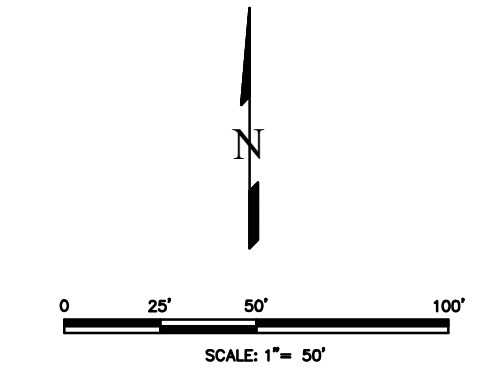


**DRAINAGE SUMMARY**

BASIN NAME	AREA (ACRES)	FLOW	
		5 YR (cfs)	100 YR (cfs)
EX-A	1.10	1.83	4.62
EX-B	2.10	2.20	7.14
EX-C	3.92	2.02	11.41
OS-1	0.05	0.02	0.14
OS-2	0.10	0.03	0.25
<b>TOTAL</b>	<b>7.27</b>		

**DESIGN POINT SUMMARY**

DP	CONTRIBUTING BASINS	AREA AC.	Q5 CFS	Q100 CFS
X1	EX-A	1.10	1.83	4.62
X2	EX-B	2.10	2.20	7.14
X3	EX-C, OS-1, OS-2	4.07	2.07	11.80
X4	OS-1	0.05	0.02	0.14
X5	OS-2	0.10	0.03	0.25



**LEGEND**

- BASIN DESIGNATION  
AREA IN BASIN (AC)
- PIPE RUN
- DESIGN POINT
- BASIN BOUNDARY
- EXISTING MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- GROUND SURFACE FLOW DIRECTION

NO.	DESCRIPTION	DATE

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COLORADO SPRINGS, CO 80915  
(719) 570-1456



721 S. 23RD ST  
COLORADO SPRINGS, CO 80904  
OFFICE: 719-635-6422  
FAX: 719-635-6426  
www.tneng.com

**HCD PROPERTIES MINOR SUBDIVISION**  
6201 E PLATTE AVE.  
EXISTING DRAINAGE MAP

DESIGNED BY JF
DRAWN BY JF
CHECKED BY LD
H-SCALE AS NOTED
V-SCALE N/A
JOB NO. 1895.00
DATE ISSUED 1/23/23
SHEET NO. 1 OF 2



# HCD DRILLING MINOR SUBDIVISION

## 6201 EAST PLATTE AVE

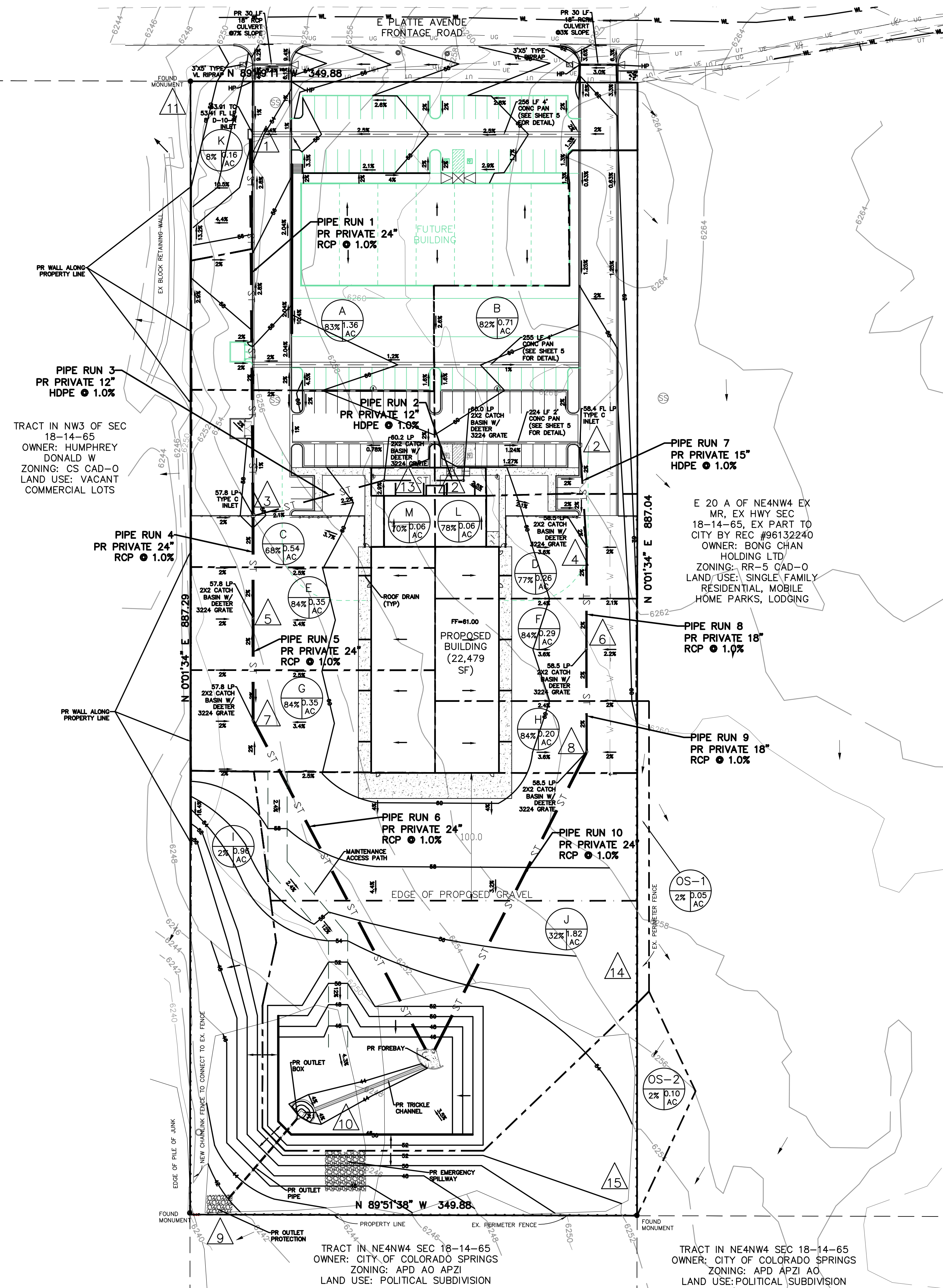
### PROPOSED DRAINAGE MAP

DRAINAGE SUMMARY

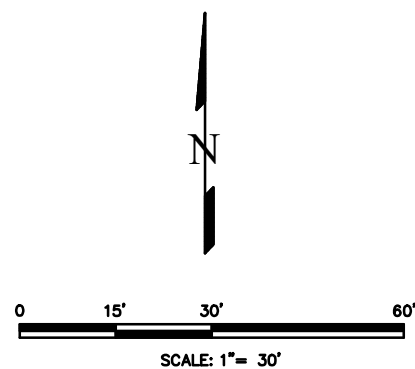
BASIN NAME	AREA (ACRES)	FLOW	
		5 YR (cfs)	100 YR (cfs)
A	1.36	5.26	10.67
B	0.71	2.58	5.35
C	0.54	1.59	3.47
D	0.26	0.82	1.74
E	0.35	1.20	2.48
F	0.29	1.03	2.10
G	0.35	1.20	2.48
H	0.20	0.71	1.46
I	0.96	0.26	1.95
J	1.82	1.81	5.37
K	0.16	0.09	0.45
L	0.06	0.23	0.47
M	0.06	0.19	0.41
OS-1	0.05	0.02	0.12
OS-2	0.10	0.03	0.23

DESIGN POINT SUMMARY

DP	CONTRIBUTING BASINS	AREA AC.	Q5 CFS	Q100 CFS
1	A	1.36	5.26	10.67
2	B	0.71	2.58	5.35
3	C	0.54	1.59	3.47
4	D	0.26	0.82	1.74
5	E	0.35	1.20	2.48
6	F	0.29	1.03	2.10
7	G	0.35	1.20	2.48
8	H	0.20	0.71	1.46
9	I, OS-2, POND	7.11	0.42	5.09
10	J, OS-1	1.87	1.42	4.12
11	K	0.16	0.09	0.45
12	L	0.06	0.23	0.47
13	M	0.06	0.19	0.41
14	OS-1	0.05	0.02	0.12
15	OS-2	0.10	0.03	0.23



NOTE: All drainage structures are PRIVATE unless otherwise labeled.



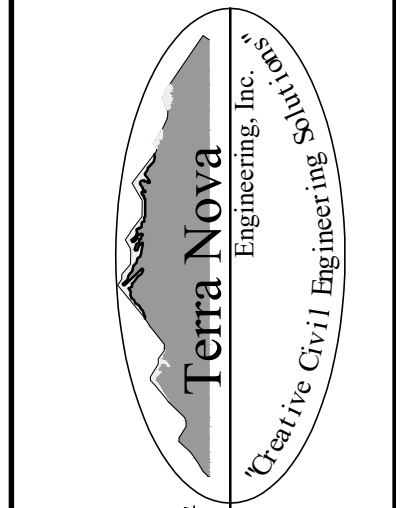
**LEGEND**

- BASIN DESIGNATION
- PERCENT IMPERVIOUSNESS
- PIPE RUN
- DESIGN POINT
- BASIN BOUNDARY
- EXISTING MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- GROUND SURFACE FLOW DIRECTION

REVISIONS NO.	DESCRIPTION	DATE

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FAX: 719-635-6426  
www.tnecinc.com

**HCD PROPERTIES MINOR SUBDIVISION**  
6201 E PLATTE AVE.  
PROPOSED DRAINAGE MAP

DESIGNED BY	JF
DRAWN BY	JF
CHECKED BY	LD
H-SCALE	AS NOTED
V-SCALE	N/A
JOB NO.	1895.00
DATE ISSUED	1/23/23
SHEET NO.	2 OF 2