MASTER DEVELOPMENT DRAINAGE PLAN

Villages at Waterview North
Colorado Springs, CO

Prepared for:

CPR Entitlements, LLC
31 N. Tejon Street, Suite 500
Colorado Springs, CO 80903
Contact: P. A. Koscielski, Manager
719-377-0244

Prepared by:

Kimley-Horn and Associates, Inc.
2 North Nevada Avenue, Suite 900
Colorado Springs, Colorado 80903
(719) 453-0180
Contact: Jessica McCallum, P.E.

Project #: 096955000

Submitted: August 15, 2022
Resubmitted: September 29, 2022
Resubmitted: November 1, 2022
Resubmitted: December 23, 2022
Resubmitted: January 12, 2023

Kimley»Horn

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CERTIFICATION

ENGINEERS STATEMENT

"This report and plan for the drainage design of the Villages at Waterview North project was prepared by me (or under my direct supervision) and is correct to the best of my knowledge and belief. Said report and plan has been prepared in accordance with the provisions of the City of Colorado Springs Drainage Criteria Manual and is in conformity with the master plan of the drainage basin. I understand that City of Colorado Springs does not and will not assume liability for drainage facilities designed by others. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report."

SIGNATURE: _____ 01/12/2023

Jessica J. McCallum, P.E. Colorado P.E. No. 59054 Date

Kimley»Horn

DEVELOPER'S STATEMENT

CPR Entitlements, LLC. hereby certifies that the drainage facilities for the Villages at Waterview North development shall be constructed according to the design presented in this report. I understand that the City of Colorado Springs does not and will not assume liability for the drainage facilities designed and/or certified by my engineer and that are submitted to the City of Colorado Springs pursuant to section 7.7.906 of the City Code; and cannot, on behalf of the Villages at Waterview North development guarantee that final drainage design review will absolve CPR Entitlements, LLC. and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the final plat does not imply approval of my engineer's drainage design.

CPR ENTITLEMENTS, LLC
Name of Developer

1/12/23
Authorized Signature Date

P.J. KOSCIELSKI, MANAGER
Printed Name

Title

31 N. TEJON ST #500
Address: CO. SPR., CO. 80903

CITY OF COLORADO SPRINGS STATEMENT

Filed in accordance with Section 7.7.906 of the Code of the City of Colorado Springs, 2001, as amended.

2023/01/19
For City Engineer Date

Conditions:

INTRODUCTION

PURPOSE AND SCOPE OF STUDY

The purpose of this report is to outline the Master Development Drainage Plan (the "MDDP") associated with the Villages at Waterview North Concept Plan (the "Concept Plan") and annexation/ zone change into the City of Colorado Springs (the "City"). The Project is located on three parcels at the northeast corner of S. Powers Blvd and Bradley Rd (the "Site"), City of Colorado Springs, Colorado.

This MDDP identifies on-site and offsite drainage patterns, areas tributary to the site and proposes to safely route developed storm water to adequate outfalls at or less than historic flow rates. A Final Drainage Report for the master development roadways and infrastructure and for each individual lot and use containing detailed proposed site stormwater infrastructure design will be submitted at a later date and prior to construction of the individual lots and roadways. The Project will be processed through the City of Colorado Springs and is currently going through the annexation process with the City. Additional outside agency review or processing is not anticipated as part of the Project.

DBPS INVESTIGATIONS

This Site is located within West Fork Jimmy Camp Creek and Jimmy Camp Creek Drainage Basins per the "West Fork Jimmy Camp Creek Drainage Basin Planning Study" prepared by Kiowa Engineering Corporation, dated October 2003, and "Jimmy Camp Creek Drainage Basin Planning Study" prepared by Wilson & Company, dated 1987. The Site is also located in the Big Johnson Drainage Basin per the "Big Johnson Reservoir/Crews Gulch Drainage Basin Planning Study" prepared by Kiowa Engineering Corporation, dated September 1991. These reports serve as the current, approved DBPS for these basins. The proposed development will comply with the standards and required improvements set by the DBPS's.

GENERAL PROJECT DESCRIPTION

The Project is located on three parcels at the northeast corner of S. Powers Blvd and Bradley Rd within a portion of Section 8 and Section 9, both in Township 15 South, Range 65 West of the 6th P.M. El Paso County, Colorado. The Site is located within the Jimmy Camp Creek and Big Johnson Drainage Basins which are mostly vacant land. The Site is surrounded by:

North: Peak Innovation Parkway, Lot 7 Colorado Springs Airport Filing No. 1D

South: Bradley Road

East: Colorado Centre Metro District, Lot 4 Colorado Centre Foreign Trade Zone & Business Park Filing No. 1

West: S. Powers Boulevard

DESCRIPTION OF PROPERTY

The proposed improvements consist of community commercial, regional commercial, and medium and high to very high residential uses within the Site. The Project will also include construction of internal roadways and utility infrastructure which will be detailed in the infrastructure Final Drainage Report submitted at a later date.

The total Site is approximately 116.5 acres and consists of vacant land with native vegetation

within the Jimmy Camp Creek Basin and Big Johnson Basin. There is a ridge located in the western portion of the Site that splits the site into the two basins. The Jimmy Camp Creek Basin portion of the Site drains approximately west to east at grades that vary from 3% to 9%. The Big Johnson Basin portion of the Site drains approximately northeast to southwest at grades that vary from 3% to 10%.

There are no major irrigation facilities within the Site. The Site does not currently provide on-site water quality or detention for the Project area. There is no regional detention pond for the Project Site.

There is an existing gas main that runs along the east side of the property.

PROJECT CHARACTERISTICS

The Project Site is 116.5 acres and the proposed improvements consist of community commercial, regional commercial, and medium and high to very high residential uses within the Site.

The proposed project will route stormwater to the private temporary sediment basins ("TSB's") via the proposed temporary drainage swales. It is intended that the temporary sediment basins in the northwest corner, southwest corner, and southeast corner of the Site will be upgraded to full spectrum detention basins. The Full Spectrum Detention Basins will be designed and further discussed in the infrastructure Final Drainage Report.

There are no major irrigation facilities within the Site. The Site does not currently provide on-site water quality or detention for the Project area. There is no regional detention pond for the Project Site. The existing land use is vacant land.

DBPS COMPLIANCE

The proposed development will comply with the requirements, recommendations, and design intent set forth by West Fork Jimmy Camp Creek, Jimmy Camp Creek, and Big Johnson Reservoir DBPS's. The Project is not adjacent to any major drainage ways located within West Fork Jimmy Camp Creek, Jimmy Camp Creek or Big Johnson Reservoir.

SOIL CONDITIONS

NRCS soil data is available for this Site and it has been noted that soils onsite are generally USCS Type A and B. The NRSC Soils map is provided in **Appendix A**.

MAJOR DRAINAGEWAYS & STRUCTURES

Jimmy Camp Creek is located approximately 3,000 feet east of the Site. The Big Johnson Reservoir is located approximately 3,700 feet southwest of the Site.

EXISTING AND PROPOSED LAND USES

The existing use of the Site is vacant land. The proposed uses will consist of community commercial, regional commercial, and medium and high to very high residential uses within the Site.

HYDROLOGIC ANALYSIS

REGULATIONS

Water quality and detention are required for this Project per the City of Colorado Springs Drainage Criteria Manual (the "DCM"), dated May 2014, and revised January 2021. The Site proposes private temporary sediment basins to accompany the initial erosion control measures, concept plan, zone change, and annexation into the City of Colorado Springs. The infrastructure Drainage Report will provided detailed information and design for the permanent full spectrum detention ponds proposed on Site.

DESIGN CRITERIA REFERENCE AND CONSTRAINTS

The Project follows the City of Colorado Springs Storm Drainage Criteria Manual, Volumes 1 and 2 (the "DCM") and the MHFD Urban Storm Drainage Criteria Manual Volumes 1, 2, and 3 (the "MANUAL"). Project area drainage is not significantly impacted by such constraints as utilities or existing development. Further detail regarding on-site drainage patterns is provided in the Proposed Drainage Conditions Section.

HYDROLOGIC CRITERIA

The 5-year and 100-year design storm events were used in determining rainfall and runoff for the proposed drainage system per Section 6 of the DCM. Table 6-2 of the DCM is the source for rainfall data for the 5-year and 100-year design storm events. Design runoff was calculated using the Rational Method for developed conditions as established in the DCM and the USDCM. Runoff coefficients for the proposed development were determined using Table 6-6 of the DCM by calculating weighted impervious values for each specific site basin.

Temporary sediment basins were provided for the Site for the overlot grading construction associated with the initial erosion control permit. Temporary sediment basins were sized per the MANUAL fact sheet on sediment basins which is provided in **Appendix C**.

EXISTING DRAINAGE BASIN

The Project Site is a part of the *Amendment to the Master Drainage Development Plan for Waterview, Waterview North* prepared by Dakota Springs Engineering, dated February 2021 (the "MDDP Amendment"). The MDDP Amendment defines 9 basins on the Pre-Development Basin Map provided in **Appendix F.** The Site consists of the MDDP Amendment existing basins BJD-12c, BJDEX14, JCDEX3.1, JCDEX3.2, and JCDEX3.3.

MAJOR DRAINAGE BASIN DESCRIPTION

The Site is located in the Jimmy Camp Creek and Big Johnson Drainage Basins. Currently, the site consists of natural vegetation. The existing runoff from the Site is captured by existing storm sewer within S. Powers Boulevard and Bradley Road. The runoff eventually outfalls to either Jimmy Camp Creek or the Big Johnson Reservoir. The Pre-Development Basin Map from the MDDP Amendment with respective runoffs and calculations is provided in **Appendix F**.

The Project Site is split between the Big Johnson Drainage Basin and the Jimmy Camp Creek Drainage Basin. The release rate from the future full spectrum detention ponds will release flows

at or below the historic runoff values for each major drainage basin. The platted lots will pay fees to the respective drainage basins. A Major Basin Exhibit with calculations was provided in **Appendix G.**

PROPOSED BASIN DESCRIPTIONS

The proposed Site was divided into eleven sub-basins. Each of these sub-basins sheet flows to a temporary sediment basin in the overlot graded condition. Hydrologic calculations are provided in **Appendix B**. A Drainage Exhibit is provided in **Appendix F.**

SPECIFIC DETAILS

Sub-Basin 1

Sub-basin 1 is 19.06 acres and is anticipated to be developed primarily into a regional commercial use with a portion to be community commercial use per the Villages at Waterview North Master Plan. The runoff within this sub-basin will be captured by the basin 1 temporary swale and routed to the private temporary sediment basin 1. The 5-year and 100-year storm event runoffs are 66.15 cfs and 120.65 cfs, respectively. The runoff developed within this sub-basin ultimately discharges into the Big Johnson Drainage Basin.

Sub-Basin 2

Sub-basin 2 is 20.77 acres and is anticipated to be developed into a community commercial use per the Villages at Waterview North Master Plan. The runoff within this sub-basin will be captured by the basin 2 east and 2 south temporary swales and routed to the private temporary sediment basin 2. The 5-year and 100-year storm event runoffs are 72.34 cfs and 131.96 cfs, respectively. The runoff within this sub-basin is split with ultimate outfalls to Big Johnson and Jimmy Camp Creek.

Sub-Basin 3

Sub-basin 3 is 8.16 acres and is anticipated to be developed into a regional commercial use and residential high and very high use. The runoff within this sub-basin will be captured by the basin 3 temporary swale and routed to the private temporary sediment basin 3A. The 5-year and 100-year storm event runoffs are 33.27 cfs and 60.69 cfs, respectively. The runoff developed within this sub-basin ultimately discharges into the Jimmy Camp Creek Drainage Basin.

Sub-Basin 4

Sub-basin 3 is 7.86 acres and is anticipated to be developed into a regional commercial use and residential high and very high use. The runoff within this sub-basin will be captured by the basin 4 temporary swale and routed to the private temporary sediment basin 4A. The 5-year and 100-year storm event runoffs are 16.46 cfs and 34.97 cfs, respectively. The runoff developed within this sub-basin ultimately discharges into the Jimmy Camp Creek Drainage Basin.

Sub-Basin 5

Sub-basin 5 is 9.73 acres and is anticipated to be developed into a residential high and very high use. The runoff within this sub-basin will be captured by the basin 5 temporary swale and routed to the private temporary sediment basin 5. The 5-year and 100-year storm event runoffs are 21.15 cfs and 44.93 cfs, respectively. The runoff developed within this sub-basin ultimately discharges into the Jimmy Camp Creek Drainage Basin.

Sub-Basin 6

Sub-basin 6 is 26.44 acres and is anticipated to be developed into a residential high and very high use. The runoff within this sub-basin will be captured by the basin 6 north, 6 south, and 6 east temporary swales and routed to the private temporary sediment basin 6. The 5-year and 100-year storm event runoffs are 49.21 cfs and 104.53 cfs, respectively. The runoff developed within this sub-basin ultimately discharges into the Jimmy Camp Creek Drainage Basin.

Sub-Basin 7

Sub-basin 7 is 22.41 acres and is anticipated to be developed into a residential medium use. The runoff within this sub-basin will be captured by the basin 7 temporary swale and routed to the private temporary sediment basin 6. The 5-year and 100-year storm event runoffs are 41.88 cfs and 88.96 cfs, respectively. The runoff developed within this sub-basin ultimately discharges into the Jimmy Camp Creek Drainage Basin.

Sub-Basin RW-1 through RW-5

Sub-Basins RW-1 through RW-5 consist of the main shared access roads that connect each phase of the development. The roads traverse from Bradley Road to the north adjacent parcel and east to tie back into Bradley Road. Sub-Basins RW-1 through RW-5 are 1.61 acres, 1.33 acres, 0.60 acres, 0.65 acres, and 0.47 acres respectively. The 5-year storm event runoffs are 6.02 cfs, 5.72 cfs, 2.69 cfs, 2.79 cfs, and 2.16 cfs respectively. The 100-year storm event runoffs are 10.77 cfs, 10.25 cfs, 4.83 cfs, 5.01 cfs, and 3.87 cfs respectively.

HYDRAULIC ANALYSIS

The proposed private temporary sediment basins are designed in accordance with the MANUAL and the fact sheet provided in **Appendix C**.

The proposed temporary sediment basins are designed to capture and slow runoff during construction to allow time for the settling of sediment prior to discharge downstream. The temporary sediment basins were sized with at least 3,600 cubic feet per acre of drainage area upstream of the basin. The orifice plate or riser pipes were designed to accommodate an emptying time of approximately 72 hours. Temporary sediment basins 1, 2, and 6 have orifice plates and spillways sized utilizing the MHFCD UD Detention spreadsheet due to the drainage area going to these basins exceeding 15 acres. Temporary sediment basins 3A, 3B, 4A, 4B, and 5 are sized utilizing Table SB-1 for the Temporary Sediment Basin detail in the City of Colorado Springs Stormwater Construction Manual.

Hydraulic calculations for the temporary drainage swales were computed using Flowmaster. Hydraulic calculations are included in **Appendix D**.

The inlet, storm sewer sizing, and full spectrum detention designs will be complete with the infrastructure Drainage Report.

OUTLET REQUIREMENTS

The water quality standards established by the CRITERIA will be met by the proposed full spectrum extended detention basins designed by the infrastructure Final Drainage Report. The orifice plates will allow the WQCV to be drained from the structure in at least 40 hours and the EURV in 68-72 hours.

FEMA INFORMATION

The Federal Emergency Management Agency (FEMA), Flood Insurance Rate Map (FIRM) No. 80841C0768G, effective date December 7, 2018, indicated the Site is located in Zone X (Areas determined outside the 500-year floodplain).

ENVIRONMENTAL EVALUATIONS

FOUR-STEP PROCESS

The four-step process per the MANUAL provides guidance and requirements for the selection of siting of structural Best Management Practices (BMPs) for new development and significant redevelopment.

Step 1: Employ Runoff Reduction Practices
Temporary drainage swales and temporary sediment basins are provided to help reduce runoff and promote infiltration. The Colorado Springs Green Infrastructure Guidance Manual, dated March 2022, will be implemented with individual lot Final Drainage Reports.

Step 2: Implement BMPs That Provide a Water Quality Capture Volume with Slow Release
This MDDP is associated with the initial erosion control permit, Concept Plan, Master Plan, zone change, and annexation process which does not require the capture and treatment of the water quality capture volume at this time. Erosion control techniques are implemented throughout the development in the form of temporary drainage swales and temporary sediment basins. The temporary sediment basins provide risers pipes that provide an emptying time of approximately 72 hours. Permanent extended detention basins will be designed and constructed with the infrastructure Final Drainage Report for the infrastructure improvements for the development.

Step 3: Stabilize Drainageways
The Project Site is located more than 500’ away from any major drainageways and there are no open channels located on or adjacent to the Site. The Project outfall is ultimately to Jimmy Camp Creek and Big Johnson.

All new and re-development projects are required to construct or participate in the funding of channel stabilization measures. Drainage basin fees paid, at the time of platting, go toward channel stabilization within the drainage basin.

Step 4: Implement Site Specific and Other Source Control BMPs
The Site does not require “Covering of Storage/Handling Areas” or “Spill Containment and Control” (specialized BMPs) in the final constructed condition. There is no proposed material storage or other site operations that would introduce contaminants to the County’s MS4 that would require site specific control or source control BMP for the proposed project.

All flows leaving the Site will be released at the historic rates and are not anticipated to cause adverse impact to downstream facilities and additional off-site improvements are not required by this Project at this time.

OUTLET REQUIREMENTS

The water quality standards established by the CRITERIA will be met by the proposed full spectrum extended detention basins. The water quality outlet structures will be designed per the specifications in the CRITERIA. The outlet structure for the extended detention basin will meet the micro-pool requirement that it be integrated into the design of the structure with an additional surcharge volume. The orifice plates of the structures will be designed based on the CRITERIA. The orifice plates will allow the WQCV to be drained from the structure in at least 40 hours and the EURC in 72 hours.

GRADING AND EROSION CONTROL PLAN

Erosion Control Plans will be submitted separately as a standalone construction document.

OFFSITE DRAINAGE ANALYSIS

Per the MDDP Amendment, sub-basins BJD-12a, BJD-12b, JCD OS-1.A, and JCD OS-1.B on the offsite northern property surface flow south towards the Project Site. In the Final Drainage Report a 20’ wide berm with a height of 2’ will be designed spanning the portion of the northern property where the offsite drainage sheet flows south to the Project Site. This berm will then direct flow east following historical drainage patterns. If the north adjacent parcel is in construction for their proposed project, the berm will not be required as it is the responsibility of the north adjacent owner to capture and treat their on-site storm runoff.

Temporary sediment basin 3 discharges east to the east property line and eventually discharges to an existing drainage channel along Bradley Road. A proposed riprap pad was provided at the outfall of this discharge pipe. The riprap sizing will be re-evaluated during final design of the extended detention basin and these calculations will be provided in that Final Drainage Report.

DEVELOPMENT FEES

DRAINAGE AND BRIDGE FEES

The Project Site is located in the Big Johnson, West Fork Jimmy Camp Creek, and Jimmy Camp Creek Basins. Fees are not applicable with the Concept Plan. Fees will be calculated with each subsequent subdivision plat’s final drainage report and the drainage fees will be paid at the time of final plat recordation.

CONSTRUCTION COST OPINION

An opinion of probable construction cost for the construction of the private and public drainage facilities for the Project will be included in the infrastructure Final Drainage Report. Each individual lot will provide their own construction cost opinion in the Final Drainage Report for their specific development.

SUMMARY

COMPLIANCE WITH STANDARDS

The drainage design presented within this report for Villages at Waterview North conforms to the CRITERIA and MANUAL. Site runoff and storm drain facilities are not anticipated to adversely affect the downstream and surrounding developments.

This report and findings are in general conformance with all previously approved reports and/or studies which include this Site. The proposed Project does not adversely impact the peak flows downstream within Jimmy Camp Creek or Big Johnson.

REFERENCES

1. City of Colorado Springs Drainage Criteria Manual, January 2021.

2. Mile High Flood District Drainage Criteria Manual Vol. 1, prepared by Wright-McLaughlin Engineers, June 2001, with latest revisions.

3. Flood Insurance Rate Map, El Paso County, Colorado and Incorporated Areas, Map Number 08041C0768G, Effective Date December 7, 2018, prepared by the Federal Emergency Management Agency (FEMA).

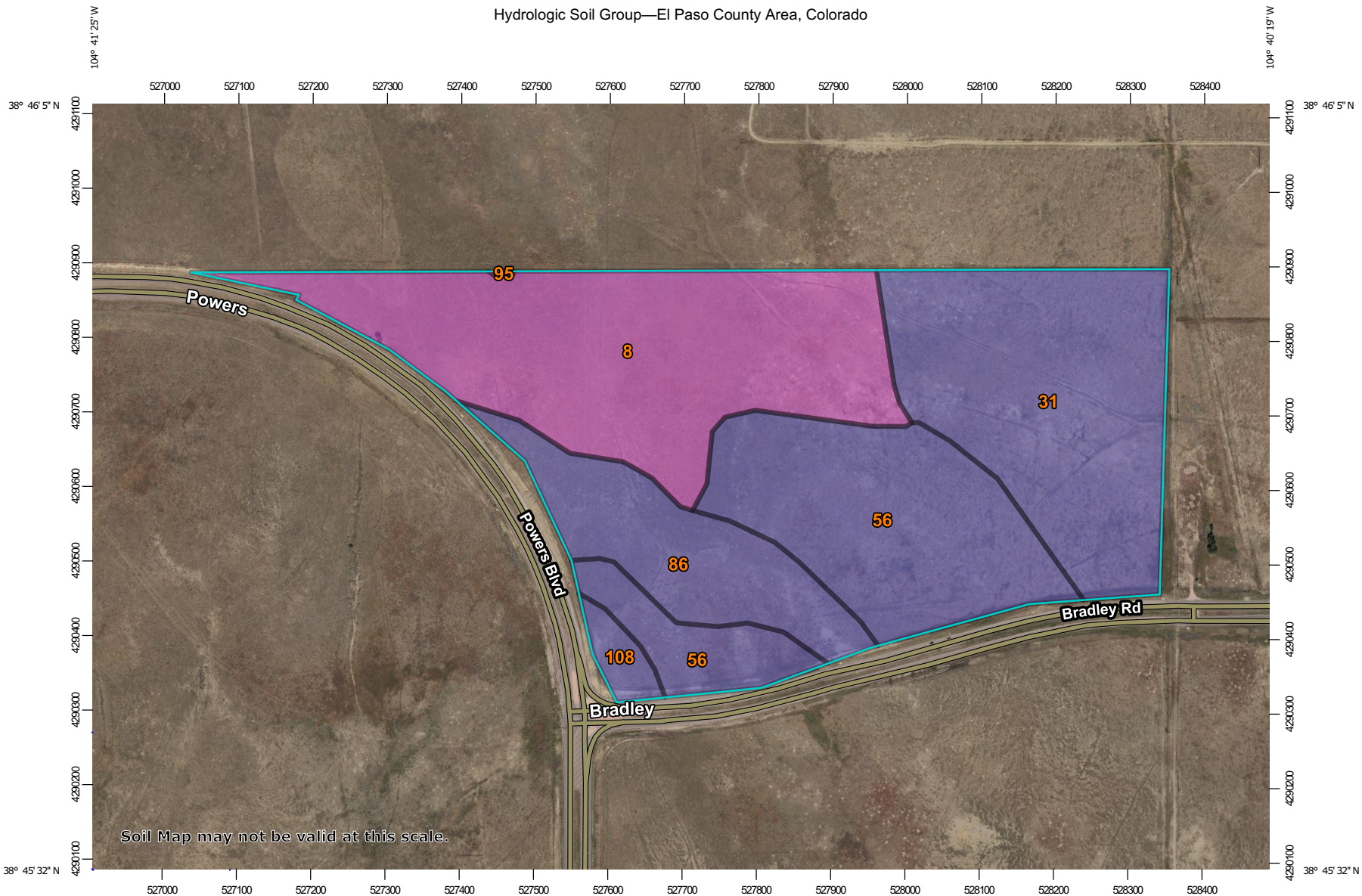
4. Amendment to Master Drainage Development Plan for Waterview, Waterview North, prepared by Dakota Springs Engineering, February 2021.

5. Big Johnson Reservoir/Crews Gulch Drainage Basin Planning Study, prepared by Kiowa Engineering Corporation, September 1991.

6. Jimmy Camp Creek Drainage Basin Planning Study, prepared by Kiowa Engineering Corporation, dated March 9, 2015.

APPENDIX A – SOILS MAP AND FEMA FIRM PANEL

Hydrologic Soil Group—El Paso County Area, Colorado



Map Scale: 1:7,240 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 350 700 1400 2100

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	38.3	33.1%
31	Fort Collins loam, 3 to 8 percent slopes	B	30.6	26.5%
56	Nelson-Tassel fine sandy loams, 3 to 18 percent slopes	B	30.0	26.0%
86	Stoneham sandy loam, 3 to 8 percent slopes	B	14.6	12.6%
95	Truckton loamy sand, 1 to 9 percent slopes	A	0.0	0.0%
108	Wiley silt loam, 3 to 9 percent slopes	B	2.0	1.7%
Totals for Area of Interest			**115.6**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

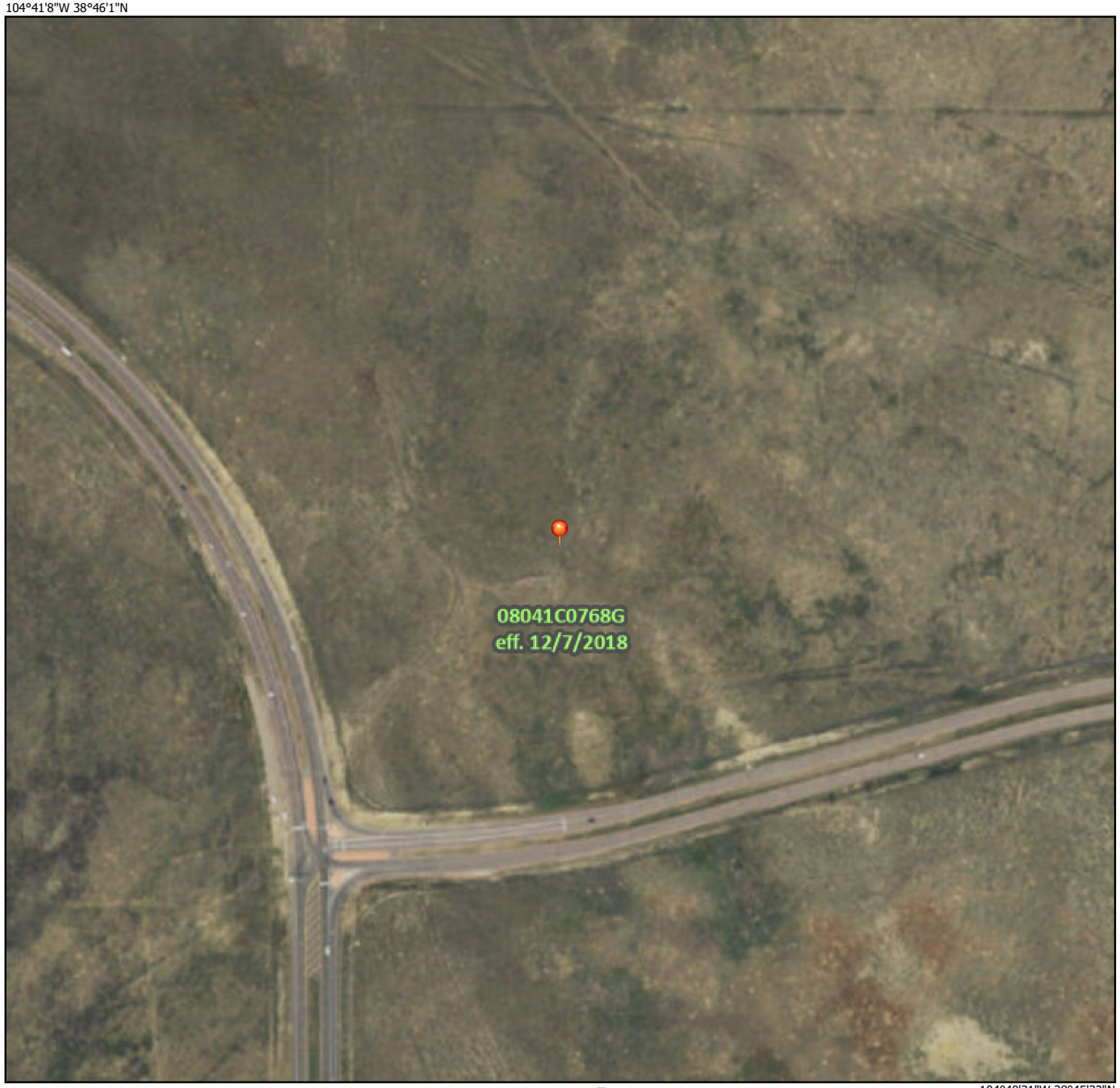
Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

National Flood Hazard Layer FIRMette

104°41'8"W 38°46'1"N



104°40'31"W 38°45'33"N

Feet 1:6,000

0 250 500 1,000 1,500 2,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

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
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

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 7/7/2021 at 3:45 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.

APPENDIX B – HYDROLOGIC CALCULATIONS

IDF Equations:

I_{100} = -2.52ln(D) + 12.735
I_{50} = -2.25ln(D) + 11.375
I_{25} -2.00ln(D) + 10.111
I_{10} -1.75ln(D) + 8.847
I_{5} -1.50ln(D) + 7.583
I_{2} -1.19ln(D) + 6.035

Where:
I = Rainfall Intensity (in/hr)
D= Duration (minutes)

	2-yr	5-yr	10-yr	100-yr
P_1 =	1.19	1.5	1.75	2.52

*The Design Point Rainfall Values and Time Intensity Frequency Tabulation are found in Table 6-2 and Figure 6-5, respectively of the Colorado Springs Drainage Criteria Manual, Volume1

Weighted Imperviousness Calculations

SUB-BASIN	AREA (SF)	AREA (Acres)	BASIN DESIGNATION	SOIL GROUP DESIGNATION	WEIGHTED IMPERVIOUSNESS	WEIGHTED COEFFICIENTS			
						C2	C5	C10	C100
1	830,188	19.06	COMMERCIAL	A	95.0%	0.79	0.81	0.83	0.88
2	904,811	20.77	COMMERCIAL	B	95.0%	0.79	0.81	0.83	0.88
3	355,415	8.16	COMMERCIAL	A	95.0%	0.79	0.81	0.83	0.88
4	342,309	7.86	RESIDENTIAL	A	70.0%	0.45	0.49	0.53	0.62
5	423,625	9.73	RESIDENTIAL	A	70.0%	0.45	0.49	0.53	0.62
6	1,151,520	26.44	RESIDENTIAL	B	70.0%	0.45	0.49	0.53	0.62
7	976,336	22.41	RESIDENTIAL	B	70.0%	0.45	0.49	0.53	0.62
TOTAL	4,984,204	114.42							

ROADWAYS

SUB-BASIN	AREA (SF)	AREA (Acres)	BASIN DESIGNATION	WEIGHTED IMPERVIOUSNESS	WEIGHTED COEFFICIENTS			
					C2	C5	C10	C100
RW-1	70025	1.60755	ROADWAY	100.0%	0.89	0.9	0.92	0.96
RW-2	57797	1.32684	ROADWAY	100.0%	0.89	0.9	0.92	0.96
RW-3	26088	0.5989	ROADWAY	100.0%	0.89	0.9	0.92	0.96
RW-4	28224	0.64793	ROADWAY	100.0%	0.89	0.9	0.92	0.96
RW-5	20293	0.46586	ROADWAY	100.0%	0.89	0.9	0.92	0.96
TOTAL	202,427	4.65			0.89	0.9	0.92	0.96

Waterview North - Drainage Report
Proposed Runoff Calculations
Time of Concentration

Watercourse Coefficient

Forest & Meadow	2.50	Short Grass Pasture & Lawns	7.00	Grassed Waterway	15.00
Fallow or Cultivation	5.00	Nearly Bare Ground	10.00	Paved Area & Shallow Gutter	20.00

	SUB-BASIN DATA				INITIAL / OVERLAND TIME			TRAVEL TIME T(t)					T(c) CHECK (URBANIZED BASINS)			FINAL T(c)
DESIGN POINT	DRAIN BASIN	AREA sq. ft.	AREA ac.	C(5)	Length ft.	Slope %	T(i) min	Length ft.	Slope %	Coeff.	Velocity fps	T(t) min.	COMP. T(c)	TOTAL LENGTH	L/180+10	min.
1	1	830,188	19.06	0.81	100	2.0%	4.2	817	2.0%	20.00	2.8	4.8	9.0	917	15.1	9.0
2	2	904,811	20.77	0.81	100	4.0%	3.3	1350	4.0%	20.00	4.0	5.6	8.9	1450	18.1	8.9
3	3	355,415	8.16	0.81	100	6.0%	2.9	690	5.0%	20.00	4.5	2.6	5.5	790	14.4	5.5
4	4	342,309	7.86	0.49	100	5.0%	6.5	690	5.0%	20.00	4.5	2.6	9.1	790	14.4	9.1
5	5	423,625	9.73	0.49	100	5.0%	6.5	440	5.0%	20.00	4.5	1.6	8.1	540	13.0	8.1
6	6	1,151,520	26.44	0.49	100	5.0%	6.5	1600	5.0%	20.00	4.5	6.0	12.5	1700	19.4	12.5
7	7	976,336	22.41	0.49	100	3.9%	7.1	1700	7.3%	20.00	5.4	5.2	12.3	1800	20.0	12.3
RW-1	RW-1	70,025	1.61	0.90	50	1.0%	2.6	1368	2.5%	20.00	3.2	7.2	9.8	1418	17.9	9.8
RW-2	RW-2	57,797	1.33	0.90	50	1.0%	2.6	920	4.0%	20.00	4.0	3.8	6.4	970	15.4	6.4
RW-3	RW-3	26,088	0.60	0.90	50	1.0%	2.6	720	4.0%	20.00	4.0	3.0	5.6	770	14.3	5.6
RW-4	RW-4	28,224	0.65	0.90	50	1.0%	2.6	795	3.0%	20.00	3.5	3.8	6.4	845	14.7	6.4
RW-5	RW-5	20,293	0.47	0.90	50	1.0%	2.6	550	3.5%	20.00	3.7	2.4	5.0	600	13.3	5.0

Waterview North - Drainage Report
Proposed Runoff Calculations ***Design Storm 5 Year***
(Rational Method Procedure)

BASIN INFORMATION				DIRECT RUNOFF				CUMMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
1	1	19.06	0.81	9.0	15.44	4.28	66.15					
2	2	20.77	0.81	8.9	16.82	4.30	72.34					
3	3	8.16	0.81	5.5	6.61	5.03	33.27					
4	4	7.86	0.49	9.1	3.85	4.28	16.46					
5	5	9.73	0.49	8.1	4.77	4.44	21.15					
6	6	26.44	0.49	12.5	12.95	3.80	49.21					
7	7	22.41	0.49	12.3	10.98	3.81	41.88					
RW-1	RW-1	1.61	0.90	9.8	1.45	4.16	6.02					
RW-2	RW-2	1.33	0.90	6.4	1.19	4.79	5.72					
RW-3	RW-3	0.60	0.90	5.6	0.54	5.00	2.69					
RW-4	RW-4	0.65	0.90	6.4	0.58	4.79	2.79					
RW-5	RW-5	0.47	0.90	5.0	0.42	5.15	2.16					

Waterview North - Drainage Report
Proposed Runoff Calculations ***Design Storm*** ***100 Year***
(Rational Method Procedure)

BASIN INFORMATION				DIRECT RUNOFF				CUMMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
1	1	19.06	0.88	9.0	16.77	7.19	120.65					
2	2	20.77	0.88	8.9	18.28	7.22	131.96					
3	3	8.16	0.88	5.5	7.18	8.45	60.69					
4	4	7.86	0.62	9.1	4.87	7.18	34.97					
5	5	9.73	0.62	8.1	6.03	7.45	44.93					
6	6	26.44	0.62	12.5	16.39	6.38	104.53					
7	7	22.41	0.62	12.3	13.90	6.40	88.96					
RW-1	RW-1	1.61	0.96	9.8	1.54	6.98	10.77					
RW-2	RW-2	1.33	0.96	6.4	1.27	8.04	10.25					
RW-3	RW-3	0.60	0.96	5.6	0.57	8.39	4.83					
RW-4	RW-4	0.65	0.96	6.4	0.62	8.05	5.01					
RW-5	RW-5	0.47	0.96	5.0	0.45	8.65	3.87					

SUMMARY - PROPOSED RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)	IMPERVIOUSNESS (%)
1	1	19.06	66.15	120.65	0.95
2	2	20.77	72.34	131.96	0.95
3	3	8.16	33.27	60.69	0.95
4	4	7.86	16.46	34.97	0.70
5	5	9.73	21.15	44.93	0.70
6	6	26.44	49.21	104.53	0.70
7	7	22.41	41.88	88.96	0.70
RW-1	RW-1	1.61	6.02	10.77	100.00
RW-2	RW-2	1.33	5.72	10.25	100.00
RW-3	RW-3	0.60	2.69	4.83	100.00
RW-4	RW-4	0.65	2.79	5.01	100.00
RW-5	RW-5	0.47	2.16	3.87	100.00

APPENDIX C – SEDIMENT BASIN FACT SHEET

Sediment Basin (SB) SC-7

Description

A sediment basin is a temporary pond built on a construction site to capture eroded or disturbed soil transported in storm runoff prior to discharge from the site. Sediment basins are designed to capture site runoff and slowly release it to allow time for settling of sediment prior to discharge. Sediment basins are often constructed in locations that will later be modified to serve as post-construction stormwater basins.

Photograph SB-1. Sediment basin at the toe of a slope. Photo courtesy of WWE.

Appropriate Uses

Most large construction sites (typically greater than 2 acres) will require one or more sediment basins for effective management of construction site runoff. On linear construction projects, sediment basins may be impractical; instead, sediment traps or other combinations of BMPs may be more appropriate.

Sediment basins should not be used as stand-alone sediment controls. Erosion and other sediment controls should also be implemented upstream.

When feasible, the sediment basin should be installed in the same location where a permanent post-construction detention pond will be located.

Design and Installation

The design procedure for a sediment basin includes these steps:

- **Basin Storage Volume**: Provide a storage volume of at least 3,600 cubic feet per acre of drainage area. To the extent practical, undisturbed and/or off-site areas should be diverted around sediment basins to prevent "clean" runoff from mixing with runoff from disturbed areas. For undisturbed areas (both on-site and off-site) that cannot be diverted around the sediment basin, provide a minimum of 500 ft^3/acre of storage for undeveloped (but stable) off-site areas in addition to the 3,600 ft^3/acre for disturbed areas. For stable, developed areas that cannot be diverted around the sediment basin, storage volume requirements are summarized in Table SB-1.

- **Basin Geometry:** Design basin with a minimum length-to-width ratio of 2:1 (L:W). If this cannot be achieved because of site space constraints, baffling may be required to extend the effective distance between the inflow point(s) and the outlet to minimize short-circuiting.

- **Dam Embankment**: It is recommended that embankment slopes be 4:1 (H:V) or flatter and no steeper than 3:1 (H:V) in any location.

Sediment Basins	
Functions	
Erosion Control	No
Sediment Control	Yes
Site/Material Management	No

- **Inflow Structure**: For concentrated flow entering the basin, provide energy dissipation at the point of inflow.

Table SB-1. Additional Volume Requirements for Undisturbed and Developed Tributary Areas Draining through Sediment Basins

Imperviousness (%)	Additional Storage Volume (ft^3) Per Acre of Tributary Area
Undeveloped	500
10	800
20	1230
30	1600
40	2030
50	2470
60	2980
70	3560
80	4360
90	5300
100	6460

- **Outlet Works**: The outlet pipe shall extend through the embankment at a minimum slope of 0.5 percent. Outlet works can be designed using one of the following approaches:

  - **Riser Pipe (Simplified Detail):** Detail SB-1 provides a simplified design for basins treating no more than 15 acres.

  - **Orifice Plate or Riser Pipe**: Follow the design criteria for Full Spectrum Detention outlets in the EDB Fact Sheet provided in Chapter 4 of this manual for sizing of outlet perforations with an emptying time of approximately 72 hours. In lieu of the trash rack, pack uniformly sized 1½ - to 2-inch gravel in front of the plate or surrounding the riser pipe. This gravel will need to be cleaned out frequently during the construction period as sediment accumulates within it. The gravel pack will need to be removed and disposed of following construction to reclaim the basin for use as a permanent detention facility. If the basin will be used as a permanent extended detention basin for the site, a trash rack will need to be installed once contributing drainage areas have been stabilized and the gravel pack and accumulated sediment have been removed.

  - **Floating Skimmer**: If a floating skimmer is used, install it using manufacturer's recommendations. Illustration SB-1 provides an illustration of a Faircloth Skimmer Floating Outlet™, one of the more commonly used floating skimmer outlets. A skimmer should be designed to release the design volume in no less than 48 hours. The use of a floating skimmer outlet can increase the sediment capture efficiency of a basin significantly. A floating outlet continually decants cleanest water off the surface of the pond and releases cleaner water than would discharge from a perforated riser pipe or plate.

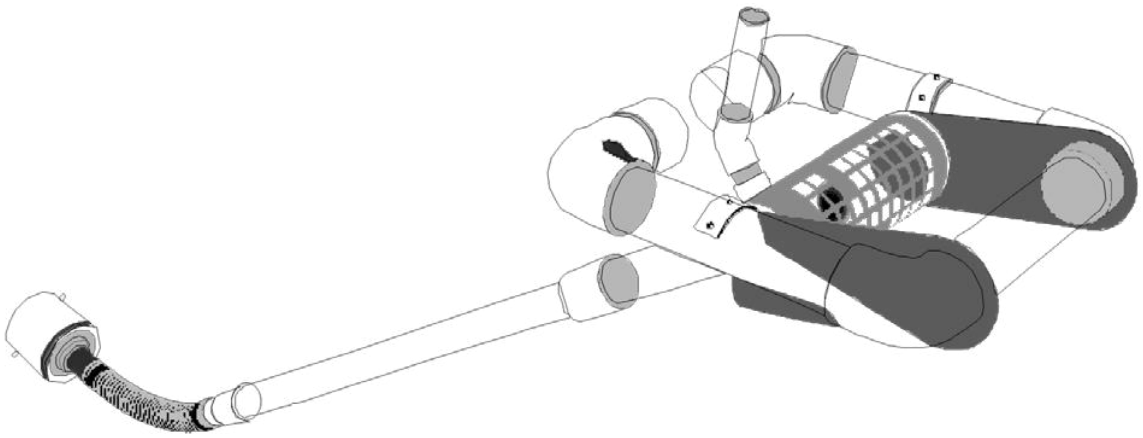


Illustration SB-1. Outlet structure for a temporary sediment basin - Faircloth Skimmer Floating Outlet. Illustration courtesy of J. W. Faircloth & Sons, Inc., FairclothSkimmer.com.

- **Outlet Protection and Spillway:** Consider all flow paths for runoff leaving the basin, including protection at the typical point of discharge as well as overtopping.
  - **Outlet Protection:** Outlet protection should be provided where the velocity of flow will exceed the maximum permissible velocity of the material of the waterway into which discharge occurs. This may require the use of a riprap apron at the outlet location and/or other measures to keep the waterway from eroding.
  - **Emergency Spillway:** Provide a stabilized emergency overflow spillway for rainstorms that exceed the capacity of the sediment basin volume and its outlet. Protect basin embankments from erosion and overtopping. If the sediment basin will be converted to a permanent detention basin, design and construct the emergency spillway(s) as required for the permanent facility. If the sediment basin will not become a permanent detention basin, it may be possible to substitute a heavy polyvinyl membrane or properly bedded rock cover to line the spillway and downstream embankment, depending on the height, slope, and width of the embankments.

Maintenance and Removal

Maintenance activities include the following:

- Dredge sediment from the basin, as needed to maintain BMP effectiveness, typically when the design storage volume is no more than one-third filled with sediment.
- Inspect the sediment basin embankments for stability and seepage.
- Inspect the inlet and outlet of the basin, repair damage, and remove debris. Remove, clean and replace the gravel around the outlet on a regular basis to remove the accumulated sediment within it and keep the outlet functioning.
- Be aware that removal of a sediment basin may require dewatering and associated permit requirements.
- Do not remove a sediment basin until the upstream area has been stabilized with vegetation.

Final disposition of the sediment basin depends on whether the basin will be converted to a permanent post-construction stormwater basin or whether the basin area will be returned to grade. For basins being converted to permanent detention basins, remove accumulated sediment and reconfigure the basin and outlet to meet the requirements of the final design for the detention facility. If the sediment basin is not to be used as a permanent detention facility, fill the excavated area with soil and stabilize with vegetation.

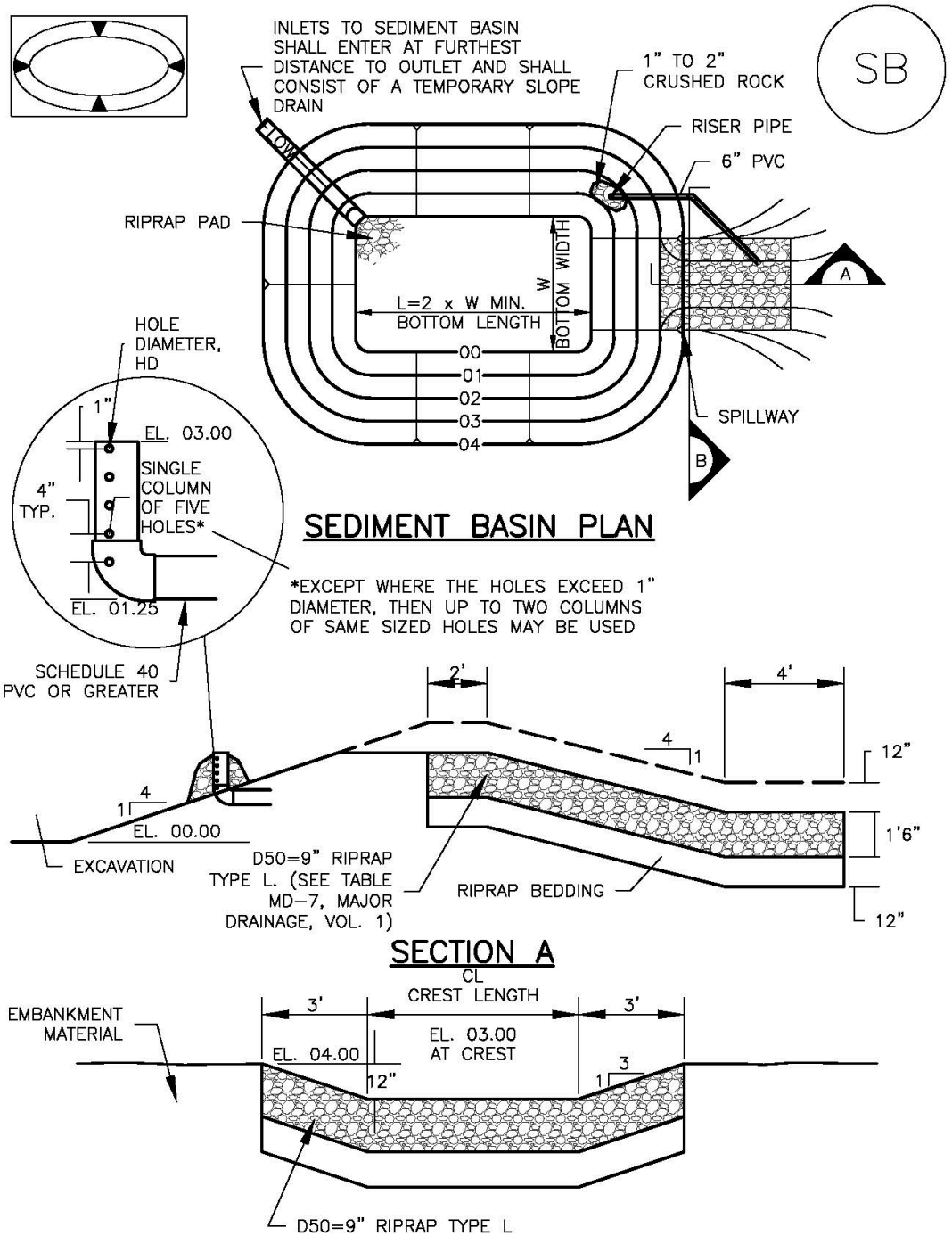

INLETS TO SEDIMENT BASIN SHALL ENTER AT FURTHEST DISTANCE TO OUTLET AND SHALL CONSIST OF A TEMPORARY SLOPE DRAIN
FLOW
1" TO 2" CRUSHED ROCK
SB
RISER PIPE
6" PVC
RIPRAP PAD
W BOTTOM WIDTH
L=2 x W MIN. BOTTOM LENGTH
00
01
02
03
04
A
B
SPILLWAY
HOLE DIAMETER, HD
1"
EL. 03.00
4" TYP.
SINGLE COLUMN OF FIVE HOLES*
EL. 01.25
SEDIMENT BASIN PLAN
*EXCEPT WHERE THE HOLES EXCEED 1" DIAMETER, THEN UP TO TWO COLUMNS OF SAME SIZED HOLES MAY BE USED
SCHEDULE 40 PVC OR GREATER
2'
4'
4
1
12"
4
1
EL. 00.00
1'6"
EXCAVATION
D50=9" RIPRAP TYPE L. (SEE TABLE MD-7, MAJOR DRAINAGE, VOL. 1)
RIPRAP BEDDING
12"
SECTION A
CL
CREST LENGTH
3'
3'
EMBANKMENT MATERIAL
EL. 04.00
EL. 03.00 AT CREST
12"
3
1
D50=9" RIPRAP TYPE L

TABLE SB–1. SIZING INFORMATION FOR STANDARD SEDIMENT BASIN			
Upstream Drainage Area (rounded to nearest acre), (ac)	Basin Bottom Width (W), (ft)	Spillway Crest Length (CL), (ft)	Hole Diameter (HD), (in)
1	12 ½	2	9/32
2	21	3	13/16
3	28	5	½
4	33 ½	6	9/16
5	38 ½	8	21/32
6	43	9	21/32
7	47 ¼	11	25/32
8	51	12	27/32
9	55	13	⅞
10	58 ¼	15	15/16
11	61	16	31/32
12	64	18	1
13	67 ½	19	1 1/16
14	70 ½	21	1 ⅛
15	73 ¼	22	1 3/16

SEDIMENT BASIN INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
   - –LOCATION OF SEDIMENT BASIN.
   - –TYPE OF BASIN (STANDARD BASIN OR NONSTANDARD BASIN).
   - –FOR STANDARD BASIN, BOTTOM WIDTH W, CREST LENGTH CL, AND HOLE DIAMETER, HD.
   - –FOR NONSTANDARD BASIN, SEE CONSTRUCTION DRAWINGS FOR DESIGN OF BASIN INCLUDING RISER HEIGHT H, NUMBER OF COLUMNS N, HOLE DIAMETER HD AND PIPE DIAMETER D.

2. FOR STANDARD BASIN, BOTTOM DIMENSION MAY BE MODIFIED AS LONG AS BOTTOM AREA IS NOT REDUCED.

3. SEDIMENT BASINS SHALL BE INSTALLED PRIOR TO ANY OTHER LAND–DISTURBING ACTIVITY THAT RELIES ON ON BASINS AS AS A STORMWATER CONTROL.

4. EMBANKMENT MATERIAL SHALL CONSIST OF SOIL FREE OF DEBRIS, ORGANIC MATERIAL, AND ROCKS OR CONCRETE GREATER THAN 3 INCHES AND SHALL HAVE A MINIMUM OF 15 PERCENT BY WEIGHT PASSING THE NO. 200 SIEVE.

5. EMBANKMENT MATERIAL SHALL BE COMPACTED TO AT LEAST 95 PERCENT OF MAXIMUM DENSITY IN ACCORDANCE WITH ASTM D698.

6. PIPE SCH 40 OR GREATER SHALL BE USED.

7. THE DETAILS SHOWN ON THESE SHEETS PERTAIN TO STANDARD SEDIMENT BASIN(S) FOR DRAINAGE AREAS LESS THAN 15 ACRES. SEE CONSTRUCTION DRAWINGS FOR EMBANKMENT, STORAGE VOLUME, SPILLWAY, OUTLET, AND OUTLET PROTECTION DETAILS FOR ANY SEDIMENT BASIN(S) THAT HAVE BEEN INDIVIDUALLY DESIGNED FOR DRAINAGE AREAS LARGER THAN 15 ACRES.

SEDIMENT BASIN MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

4. SEDIMENT ACCUMULATED IN BASIN SHALL BE REMOVED AS NEEDED TO MAINTAIN BMP EFFECTIVENESS, TYPICALLY WHEN SEDIMENT DEPTH REACHES ONE FOOT (I.E., TWO FEET BELOW THE SPILLWAY CREST).

5. SEDIMENT BASINS ARE TO REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS STABILIZED AND GRASS COVER IS ACCEPTED BY THE LOCAL JURISDICTION.

6. WHEN SEDIMENT BASINS ARE REMOVED, ALL DISTURBED AREAS SHALL BE COVERED WITH TOPSOIL, SEEDED AND MULCHED OR OTHERWISE STABILIZED AS APPROVED BY LOCAL JURISDICTION.

(DETAILS ADAPTED FROM DOUGLAS COUNTY, COLORADO)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

TEMPORARY SEDIMENT BASIN

TSB

1.0 DESCRIPTION

- Temporary sediment basins are small impoundments of water with a small outlet structure built on a construction site.

2.0 PURPOSE

- Used to capture and slowly release runoff prior to discharge from a construction site to allow sediment to settle out.

3.0 IMPLEMENTATION

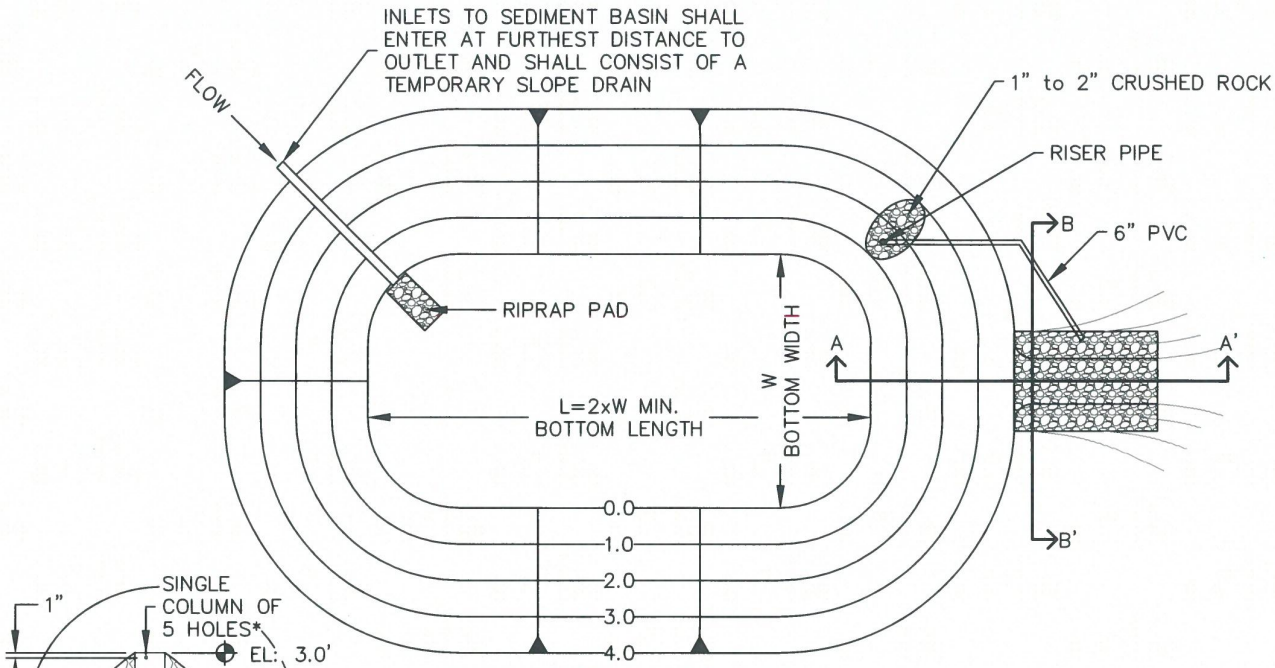
- Temporary sediment basins for drainage areas larger than 15 acres must be individually designed by engineer.
- Erosion and other sediment controls should be implemented upstream of temporary sediment basins.

4.0 TIMING

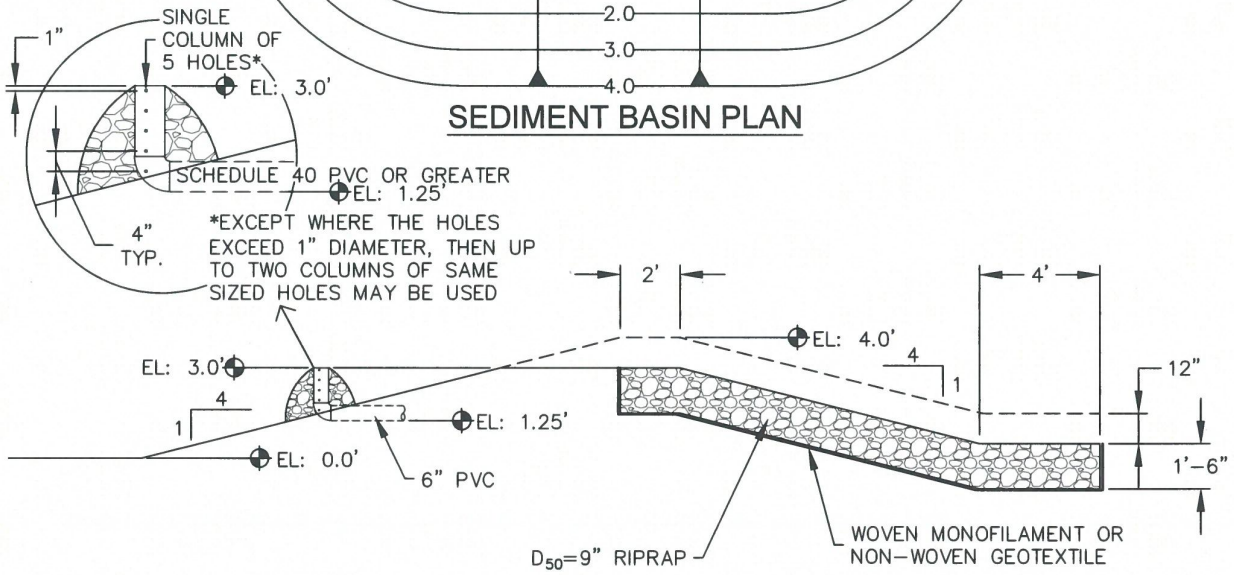
- Install prior to upstream land disturbance.
- Remove temporary sediment basin after upstream area has been stabilized. Permanently stabilize area after basin has been removed.

5.0 MAINTENANCE

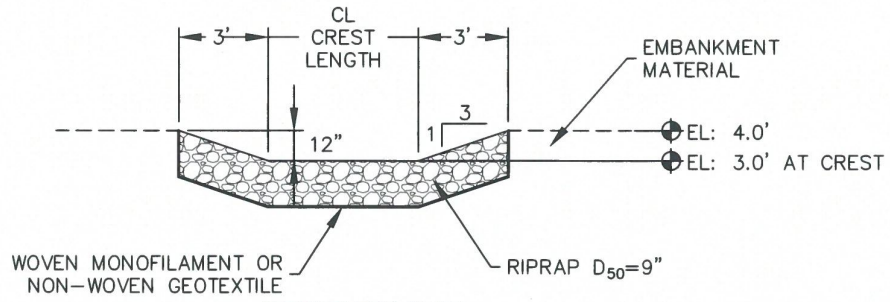
- Remove sediment from basin as needed to maintain the effectiveness of the temporary sediment basin. This is typically when sediment depth reaches one foot.
- Inspect sediment basin embankments for stability and seepage.
- Inspect the inlet and outlet of the basin, repair damage, and remove debris.



SEDIMENT BASIN PLAN



SECTION A-A'



SECTION B-B'

TSB

STORMWATER ENTERPRISE

TEMPORARY SEDIMENT BASIN

APPROVED:

SWENT MANAGER

ISSUED:	REVISED:	DRAWING NO.
10/7/19	8/19/2020	900-TSB-1

TABLE SB–1, SIZING INFORMATION FOR STANDARD SEDIMENT BASIN

UPSTREAM DRAINAGE AREA (ROUNDED TO NEAREST ACRE), (AC)	BASIN BOTTOM WIDTH (W), (FT)	SPILLWAY CREST LENGTH (CL), (FT)	HOLE DIAMETER (HD), (IN)
1	12½"	2	9/32
2	21	3	13/16
3	28	5	½
4	33½	6	9/16
5	38½	8	21/32
6	43	9	21/32
7	47¼	11	25/32
8	51	12	27/32
9	55	13	⅞
10	58¼	15	15/16
11	61	16	31/32
12	64	18	1
13	67½	19	1 1/16
14	70½	21	1⅛
15	73¼	22	1 3/16

INSTALLATION NOTES

1. FOR STANDARD BASIN, BOTTOM DIMENSION MAY BE MODIFIED AS LONG AS BOTTOM AREA IS NOT REDUCED.
2. EMBANKMENT MATERIAL SHALL CONSIST OF SOIL FREE OF DEBRIS, ORGANIC MATERIAL, AND ROCKS OR CONCRETE GREATER THAN 3 INCHES, AND SHALL HAVE A MINIMUM OF 15 PERCENT BY WEIGHT PASSING THE No. 200 SIEVE
3. EMBANKMENT MATERIAL SHALL BE COMPACTED TO AT LEAST 95 PERCENT OF MAXIMUM DENSITY IN ACCORDANCE WITH ASTM D–698.
4. PIPE SCHEDULE 40 OR GREATER SHALL BE USED.
5. THE DETAILS SHOWN ON THESE SHEETS PERTAIN TO STANDARD SEDIMENT BASIN(S) FOR DRAINAGE AREAS LESS THAN 15 ACRES. SEE CONSTRUCTION DRAWINGS FOR EMBANKMENT, STORAGE VOLUME, SPILLWAY, OUTLET, AND OUTLET PROTECTION DETAILS FOR ANY SEDIMENT BASIN(S) THAT HAVE BEEN INDIVIDUALLY DESIGNED FOR DRAINAGE AREAS LARGER THAN 15 ACRES. DESIGN CALCULATIONS MUST BE APPROVED PRIOR TO IMPLEMENTATION.

MAINTENANCE NOTES

1. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN CONTROL MEASURES IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.
2. SEDIMENT ACCUMULATED IN BASIN SHALL BE REMOVED AS NEEDED TO MAINTAIN CONTROL MEASURE EFFECTIVENESS, TYPICALLY WHEN SEDIMENT DEPTH REACHES ONE FOOT (I.E. TWO FEET BELOW SPILLWAY CREST).
3. SEDIMENT BASINS ARE TO REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS PERMANENTLY STABILIZED.
4. PERMANENTLY STABILIZE AREA AFTER SEDIMENT BASIN REMOVAL.

TSB

STORMWATER ENTERPRISE

TEMPORARY SEDIMENT BASIN

APPROVED:

SWENT MANAGER

ISSUED:	REVISED:	DRAWING NO.
10/7/19	8/19/2020	900–TSB–2

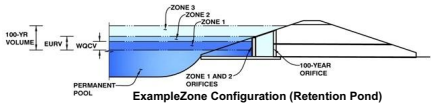
APPENDIX D – SEDIMENT BASIN SIZING

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Temporary Sediment Basin 1

Basin ID: 1



ExampleZone Configuration (Retention Pond)

DRAIN TIME MATCHES MHFCD TEMP SEDIMENT BASIN REQUIREMENTS

CALCULATED PER MHFCD REQUIREMENTS OF 3,600 CF PER DRAINAGE AREA (19.06*3,600 = 68,616 CF = 1.575 ACRE-FEET)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	19.06	acres
Watershed Length =	1,750	ft
Watershed Length to Centroid =	840	ft
Watershed Slope =	0.010	ft/ft
Watershed Imperviousness =	2.00%	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 =	72.0	hours
Location for 1-hr Rainfall Depths =	User Input	

Drain Time Too Long

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

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	0.024	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	0.018	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.010	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.019	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.027	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	0.240	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.482	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.814	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3.14 in.) =	1.593	acre-feet	inches
Approximate 2-yr Detention Volume =	0.010	acre-feet	
Approximate 5-yr Detention Volume =	0.014	acre-feet	
Approximate 10-yr Detention Volume =	0.020	acre-feet	
Approximate 25-yr Detention Volume =	0.030	acre-feet	
Approximate 50-yr Detention Volume =	0.075	acre-feet	
Approximate 100-yr Detention Volume =	0.206	acre-feet	

Define Zones and Basin Geometry

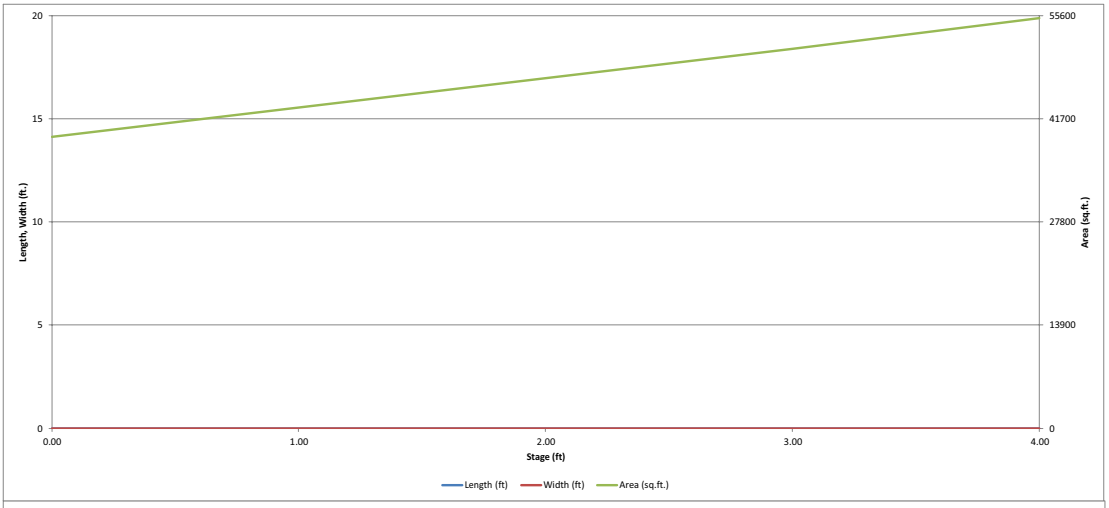
Zone 1 Volume (User Defined) =	1.575	acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	1.575	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

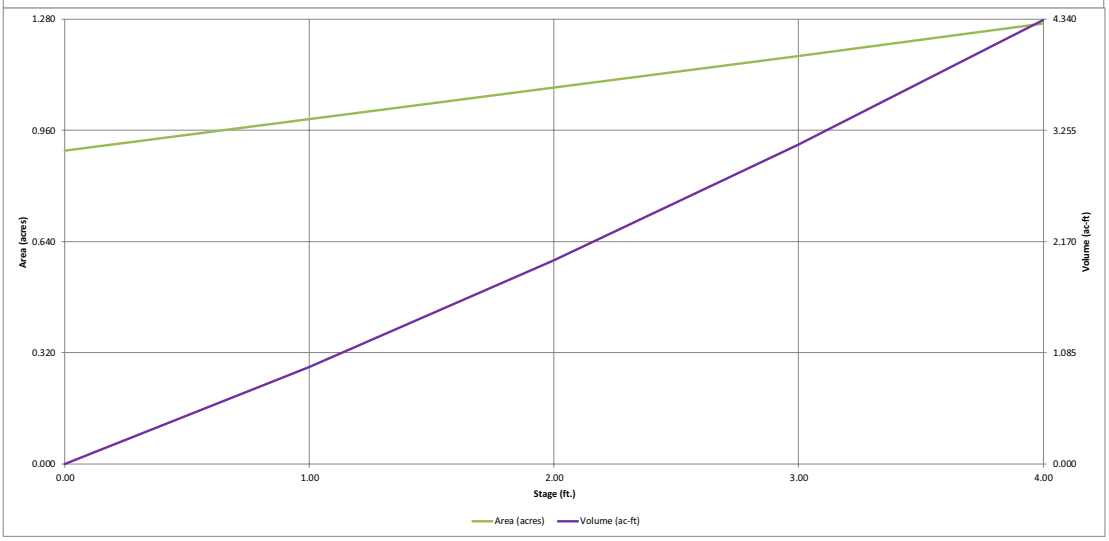
Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	39,339	0.903		
	--	1.00	--	--	--	43,170	0.991	41,254	0.947
	--	2.00	--	--	--	47,171	1.083	86,425	1.984
	--	3.00	--	--	--	51,161	1.174	135,590	3.113
	--	4.00	--	--	--	55,268	1.269	188,805	4.334

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



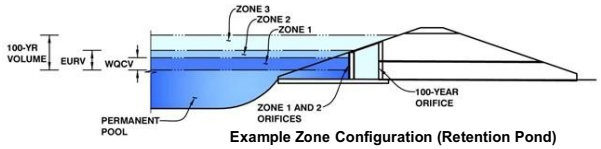


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Temporary Sediment Basin 1**

Basin ID: **1**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (User)	1.62	1.575	Orifice Plate
Zone 2			
Zone 3			
Total (all zones)		1.575	

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft²
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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)

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	1.542E-02	ft²
Depth at top of Zone using Orifice Plate =	1.62	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	6.50	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	2.22	sq. inches (diameter = 1-11/16 inches)	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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	0.54	1.08					
Orifice Area (sq. inches)	2.22	2.22	2.22					

	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 =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	
Depth at top of Zone using Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	
Vertical Orifice Diameter =			inches		

Calculated Parameters for Vertical Orific

Not Selected	Not Selected

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

	Not Selected	Not Selected			
Overflow Weir Front Edge Height, Ho =			ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	
Overflow Weir Front Edge Length =			feet	Overflow Weir Slope Length =	
Overflow Weir Grate Slope =			H:V	Grate Open Area / 100-yr Orifice Area =	
Horiz. Length of Weir Sides =			feet	Overflow Grate Open Area w/o Debris =	
Overflow Grate Type =				Overflow Grate Open Area w/ Debris =	
Debris Clogging % =			%		

Calculated Parameters for Overflow Wei

Not Selected	Not Selected

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

	Not Selected	Not Selected			
Depth to Invert of Outlet Pipe =			ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	
Circular Orifice Diameter =			inches	Outlet Orifice Centroid =	
				Half-Central Angle of Restrictor Plate on Pipe =	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plat

Not Selected	Not Selected
N/A	N/A

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=		ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	feet
Spillway Crest Length =		feet	Stage at Top of Freeboard =	feet
Spillway End Slopes =		H:V	Basin Area at Top of Freeboard =	acres
Freeboard above Max Water Surface =		feet	Basin Volume at Top of Freeboard =	acre-ft

Calculated Parameters for Spillway

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).

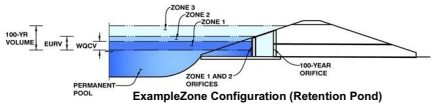
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	0.024	0.018	0.010	0.019	0.027	0.240	0.482	0.814
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.010	0.019	0.027	0.240	0.482	0.814
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.2	0.3	2.3	4.6	7.8
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.00	0.01	0.01	0.12	0.24	0.41
Peak Inflow Q (cfs) =	N/A	N/A	0.1	0.2	0.3	2.3	4.6	7.8
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.1	0.0	0.0	0.0	0.0
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	56	54	53	55	58	>120	>120	>120
Time to Drain 99% of Inflow Volume (hours) =	**72**	70	69	71	74	>120	>120	>120
Maximum Ponding Depth (ft) =	0.03	0.02	0.01	0.02	0.03	0.25	0.51	0.84
Area at Maximum Ponding Depth (acres) =	0.91	0.90	0.90	0.90	0.90	0.93	0.95	0.98
Maximum Volume Stored (acre-ft) =	0.027	0.018	0.000	0.009	0.018	0.229	0.463	0.790

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Waterview North Pond 1 Spillway Calcs

Basin ID: 1



ExampleZone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	19.06	acres
Watershed Length =	1,750	ft
Watershed Length to Centroid =	840	ft
Watershed Slope =	0.010	ft/ft
Watershed Imperviousness =	95.00%	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	

Assumed imperviousness for Basin 1 development

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

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	0.710	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	2.499	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	1.789	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	2.298	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	2.709	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	3.136	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	3.559	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	4.025	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3.14 in.) =	5.083	acre-feet	inches
Approximate 2-yr Detention Volume =	1.653	acre-feet	
Approximate 5-yr Detention Volume =	2.140	acre-feet	
Approximate 10-yr Detention Volume =	2.534	acre-feet	
Approximate 25-yr Detention Volume =	2.977	acre-feet	
Approximate 50-yr Detention Volume =	3.233	acre-feet	
Approximate 100-yr Detention Volume =	3.449	acre-feet	

Define Zones and Basin Geometry

Select Zone 1 Storage Volume (Required) =	0.710	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.788	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.951	acre-feet
Total Detention Basin Volume =	3.449	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

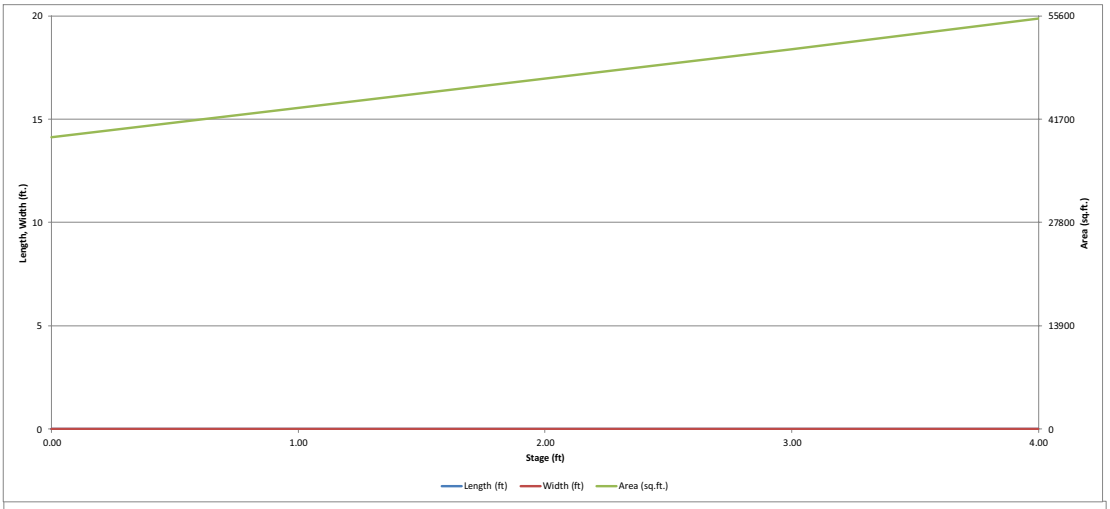
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

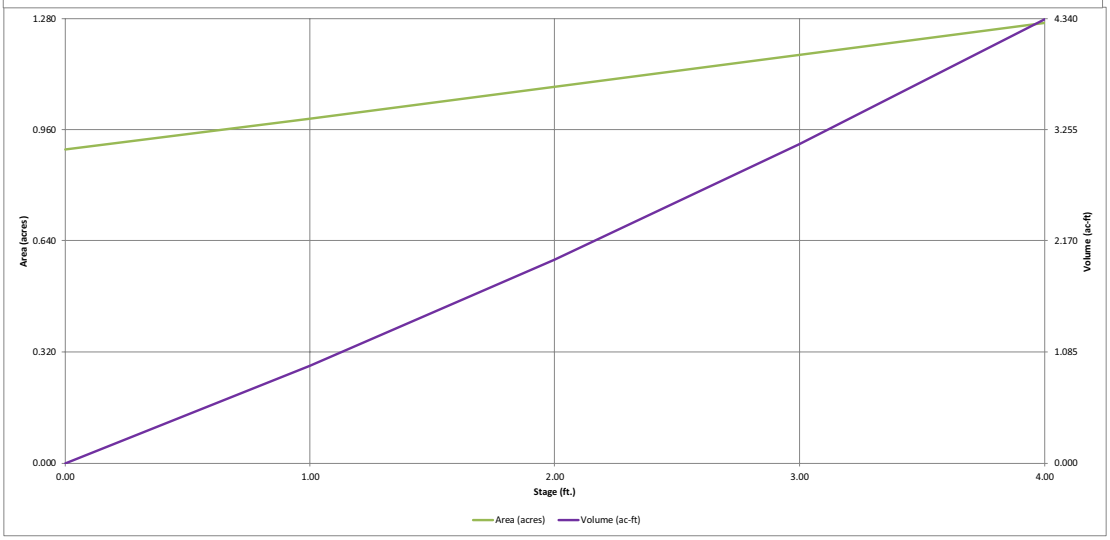
Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	39,339	0.903		
	--	1.00	--	--	--	43,170	0.991	41,254	0.947
	--	2.00	--	--	--	47,171	1.083	86,425	1.984
	--	3.00	--	--	--	51,161	1.174	135,590	3.113
	--	4.00	--	--	--	55,268	1.269	188,805	4.334

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)



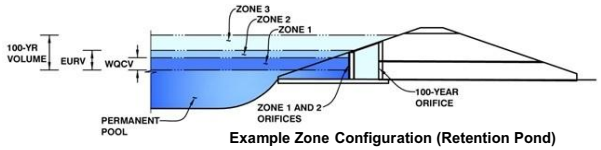


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: **Waterview North Pond 1 Spillway Calcs**

Basin ID: **1**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1	0.76	0.710	Orifice Plate
Zone 2 (EURV)	2.47	1.788	Orifice Plate
Zone 3 (100-year)	3.29	0.951	
Total (all zones)		3.449	

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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 =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	2.47	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	9.90	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =		sq. inches	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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	0.82	1.65					
Orifice Area (sq. inches)	0.00	0.00	0.00					

	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 =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	
Depth at top of Zone using Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	
Vertical Orifice Diameter =			inches		

Calculated Parameters for Vertical Orific

Not Selected	Not Selected

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

	Not Selected	Not Selected			
Overflow Weir Front Edge Height, Ho =			ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	
Overflow Weir Front Edge Length =			feet	Overflow Weir Slope Length =	
Overflow Weir Grate Slope =			H:V	Grate Open Area / 100-yr Orifice Area =	
Horiz. Length of Weir Sides =			feet	Overflow Grate Open Area w/o Debris =	
Overflow Grate Type =				Overflow Grate Open Area w/ Debris =	
Debris Clogging % =			%		

Calculated Parameters for Overflow Wei

Not Selected	Not Selected

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

	Not Selected	Not Selected			
Depth to Invert of Outlet Pipe =			ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	
Circular Orifice Diameter =			inches	Outlet Orifice Centroid =	
				Half-Central Angle of Restrictor Plate on Pipe =	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plat

Not Selected	Not Selected
N/A	N/A

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	3.30	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.39	feet
Spillway Crest Length =	75.00	feet	Stage at Top of Freeboard =	4.69	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	1.27	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	4.33	acre-ft

Calculated Parameters for Spillway

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).

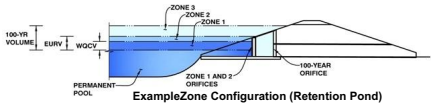
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	0.710	2.499	1.789	2.298	2.709	3.136	3.559	4.025
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	1.789	2.298	2.709	3.136	3.559	4.025
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.2	0.3	2.3	4.6	7.8
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.00	0.01	0.01	0.12	0.24	0.41
Peak Inflow Q (cfs) =	N/A	N/A	25.7	32.2	37.0	44.3	50.3	57.8
Peak Outflow Q (cfs) =							1.4	8.0
Ratio Peak Outflow to Predevelopment Q =							0.3	1.0
Structure Controlling Flow =							Spillway	Spillway
Max Velocity through Grate 1 (fps) =							N/A	N/A
Max Velocity through Grate 2 (fps) =							N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =							>120	>120
Time to Drain 99% of Inflow Volume (hours) =							>120	>120
Maximum Ponding Depth (ft) =							3.33	3.41
Area at Maximum Ponding Depth (acres) =							1.21	1.21
Maximum Volume Stored (acre-ft) =							3.505	3.590

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Temporary Sediment Basin 2

Basin ID: 2



ExampleZone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	20.77	acres
Watershed Length =	1,800	ft
Watershed Length to Centroid =	900	ft
Watershed Slope =	0.040	ft/ft
Watershed Imperviousness =	2.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	72.0	hours
Location for 1-hr Rainfall Depths =	Denver - Capitol Building	

Drain Time Too Long

DRAIN TIME MATCHES MHFCD TEMP SEDIMENT BASIN REQUIREMENTS

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

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	0.026	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	0.034	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.158	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.455	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.769	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	1.386	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	1.780	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	2.374	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3.14 in.) =	3.421	acre-feet	inches
Approximate 2-yr Detention Volume =	0.019	acre-feet	
Approximate 5-yr Detention Volume =	0.033	acre-feet	
Approximate 10-yr Detention Volume =	0.191	acre-feet	
Approximate 25-yr Detention Volume =	0.295	acre-feet	
Approximate 50-yr Detention Volume =	0.283	acre-feet	
Approximate 100-yr Detention Volume =	0.388	acre-feet	

CALCULATED PER MHFCD REQUIREMENTS OF 3,600 CF PER DRAINAGE AREA (20.77*3,600 = 74,772 CF = 1.717 ACRE-FEET)

Define Zones and Basin Geometry

Zone 1 Volume (User Defined) =	1.717	acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	1.717	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

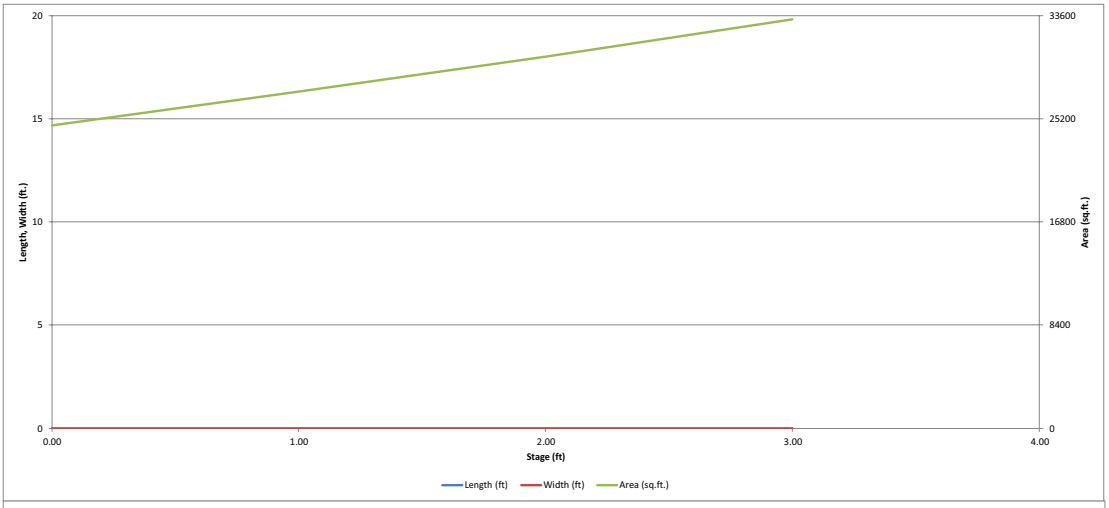
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

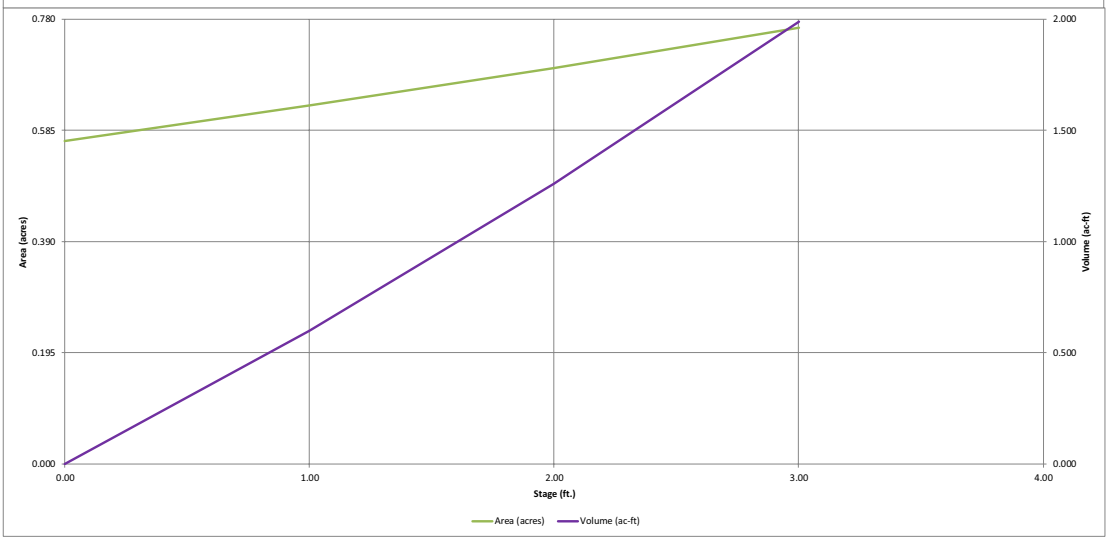
Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	24,667	0.566		
	--	1.00	--	--	--	27,384	0.629	26,025	0.597
	--	2.00	--	--	--	30,245	0.694	54,840	1.259
	--	3.00	--	--	--	33,339	0.765	86,632	1.989

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



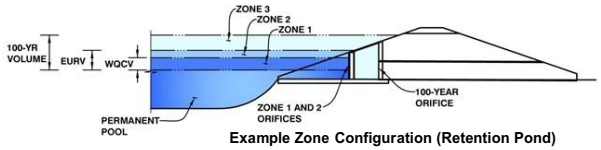


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Temporary Sediment Basin 2**

Basin ID: **2**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (User)	2.64	1.717	Orifice Plate
Zone 2			
Zone 3			
Total (all zones)		1.717	

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft²
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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)

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	1.063E-02	ft²
Depth at top of Zone using Orifice Plate =	2.64	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	10.60	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	1.53	sq. inches (diameter = 1-3/8 inches)	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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	0.88	1.76					
Orifice Area (sq. inches)	1.53	1.53	1.53					

	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				Calculated Parameters for Vertical Orific	Not Selected	Not Selected
Invert of Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =				
Depth at top of Zone using Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =				
Vertical Orifice Diameter =			inches					

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

	Not Selected	Not Selected				Calculated Parameters for Overflow Wei	Not Selected	Not Selected
Overflow Weir Front Edge Height, Ho =			ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =				
Overflow Weir Front Edge Length =			feet	Overflow Weir Slope Length =				
Overflow Weir Grate Slope =			H:V	Grate Open Area / 100-yr Orifice Area =				
Horiz. Length of Weir Sides =			feet	Overflow Grate Open Area w/o Debris =				
Overflow Grate Type =				Overflow Grate Open Area w/ Debris =				
Debris Clogging % =			%					

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

	Not Selected	Not Selected				Calculated Parameters for Outlet Pipe w/ Flow Restriction Plat	Not Selected	Not Selected
Depth to Invert of Outlet Pipe =			ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =				
Circular Orifice Diameter =			inches	Outlet Orifice Centroid =				
				Half-Central Angle of Restrictor Plate on Pipe =			N/A	N/A

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=		ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=		feet
Spillway Crest Length =		feet	Stage at Top of Freeboard =		feet
Spillway End Slopes =		H:V	Basin Area at Top of Freeboard =		acres
Freeboard above Max Water Surface =		feet	Basin Volume at Top of Freeboard =		acre-ft

Calculated Parameters for Spillway

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).

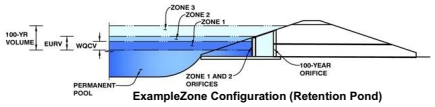
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	0.026	0.034	0.158	0.455	0.769	1.386	1.780	2.374
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.158	0.455	0.769	1.386	1.780	2.374
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	2.0	5.7	8.6	15.5	19.5	24.9
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.10	0.27	0.42	0.75	0.94	1.20
Peak Inflow Q (cfs) =	N/A	N/A	2.0	5.7	8.6	15.5	19.5	24.9
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.2
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.0	0.0	0.0	0.0	0.0
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Plate	Plate	N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	57	62	118	>120	>120	>120	>120	>120
Time to Drain 99% of Inflow Volume (hours) =	**72**	77	>120	>120	>120	>120	>120	>120
Maximum Ponding Depth (ft) =	0.05	0.06	0.27	0.76	1.24	2.14	2.68	3.00
Area at Maximum Ponding Depth (acres) =	0.57	0.57	0.58	0.61	0.64	0.70	0.74	0.77
Maximum Volume Stored (acre-ft) =	0.028	0.034	0.149	0.442	0.750	1.357	1.740	1.989

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Waterview North Pond 2 Spillway Calcs

Basin ID: 2



ExampleZone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	20.77	acres
Watershed Length =	1,800	ft
Watershed Length to Centroid =	900	ft
Watershed Slope =	0.040	ft/ft
Watershed Imperviousness =	95.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

Assumed imperviousness for Basin 1 development

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

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	0.774	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	2.221	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	1.930	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	2.491	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	2.946	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	3.409	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	3.867	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	4.368	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3.14 in.) =	5.507	acre-feet	inches
Approximate 2-yr Detention Volume =	1.791	acre-feet	
Approximate 5-yr Detention Volume =	2.326	acre-feet	
Approximate 10-yr Detention Volume =	2.832	acre-feet	
Approximate 25-yr Detention Volume =	3.037	acre-feet	
Approximate 50-yr Detention Volume =	3.151	acre-feet	
Approximate 100-yr Detention Volume =	3.251	acre-feet	

Define Zones and Basin Geometry

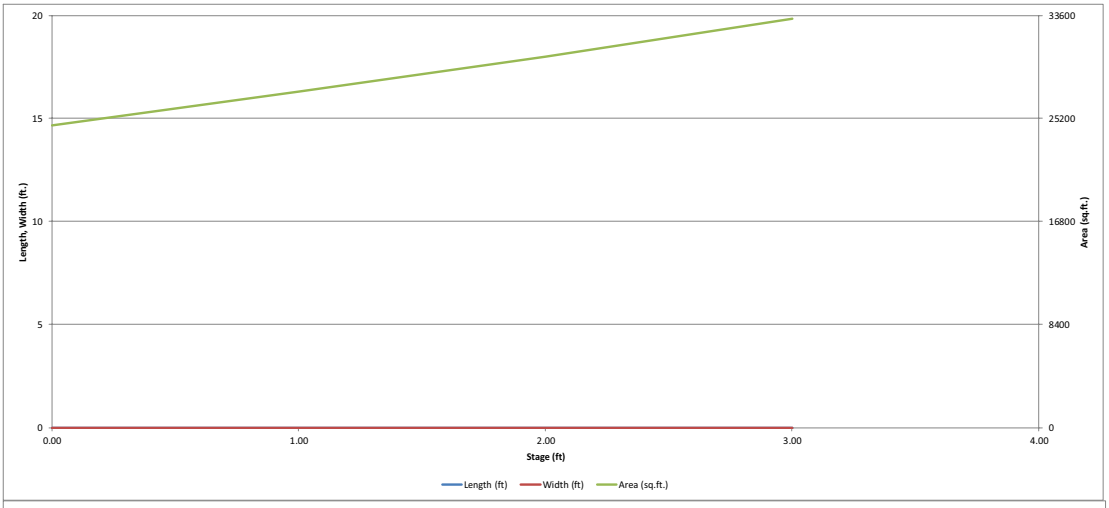
Select Zone 1 Storage Volume (Required) =		acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Zone 3 Volume (User Defined - Zones 1 & 2) =	1.988	acre-feet
Total Detention Basin Volume =		acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

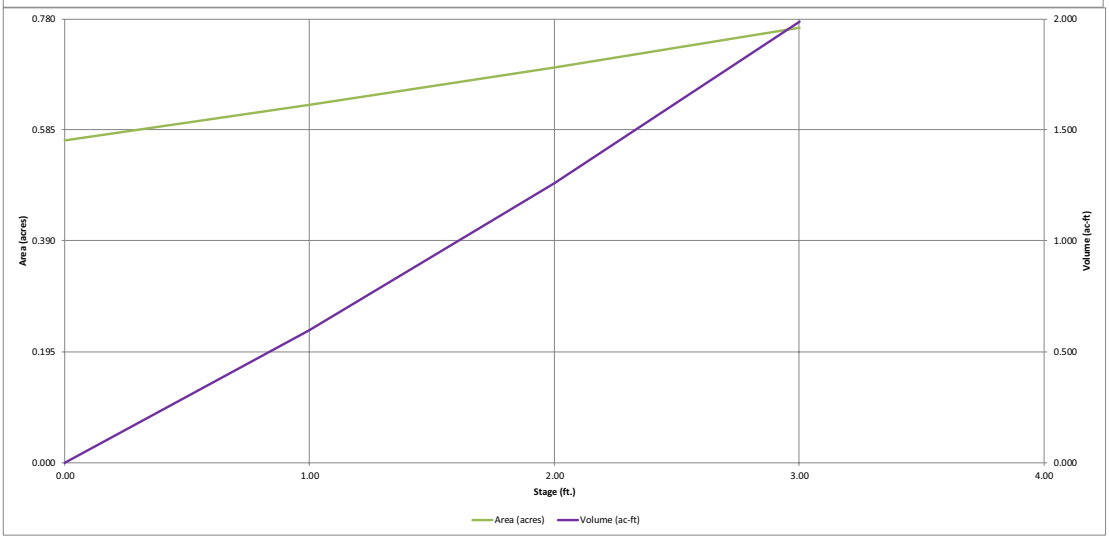
Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	24,667	0.566		
	--	1.00	--	--	--	27,384	0.629	26,025	0.597
	--	2.00	--	--	--	30,245	0.694	54,840	1.259
	--	3.00	--	--	--	33,339	0.765	86,632	1.989

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)



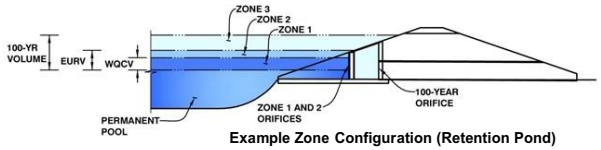


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: **Waterview North Pond 2 Spillway Calcs**

Basin ID: **2**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1	#N/A		Orifice Plate
Zone 2			Weir&Pipe (Rect.)
Zone 3 (User)	3.00	1.988	Weir (No Pipe)
Total (all zones)			

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft²
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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 =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft²
Depth at top of Zone using Orifice Plate =		ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =		inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =		sq. inches	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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)								
Orifice Area (sq. inches)								

	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)	Vertical Orifice Area =	N/A	N/A
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A
Vertical Orifice Diameter =	N/A	N/A	inches			

Calculated Parameters for Vertical Orific

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

	Zone 2 Weir	Zone 3 Weir			Zone 2 Weir	Zone 3 Weir
Overflow Weir Front Edge Height, Ho =		0.00	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =		N/A
Weir Front Edge Length OR Weir Bottom Length			feet	Overflow Weir Slope Length =		N/A
Weir Grate Slope OR Weir Side Slopes			H:V	Grate Open Area / 100-yr Orifice Area =		N/A
Horiz. Length of Weir Sides =		N/A	feet	Overflow Grate Open Area w/o Debris =		N/A
Overflow Grate Type =		N/A		Overflow Grate Open Area w/ Debris =		N/A
Debris Clogging % =		N/A	%			

Calculated Parameters for Overflow Wei

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

	Zone 2 Rectangular	Not Selected			Zone 2 Rectangular	Not Selected
Depth to Invert of Outlet Pipe =		N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =		N/A
Rectangular Orifice Width =		N/A	inches	Outlet Orifice Centroid =		N/A
Rectangular Orifice Height =			inches	Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plat

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	2.60	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.83	feet
Spillway Crest Length =	30.00	feet	Stage at Top of Freeboard =	4.43	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.77	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	1.99	acre-ft

Calculated Parameters for Spillway

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).

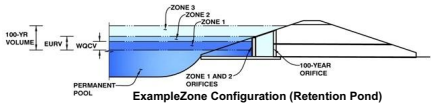
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	0.774	2.221	1.930	2.491	2.946	3.409	3.867	4.368
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	1.930	2.491	2.946	3.409	3.867	4.368
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	2.0	5.7	8.6	15.5	19.5	24.9
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.10	0.27	0.42	0.75	0.94	1.20
Peak Inflow Q (cfs) =	N/A	N/A	33.7	42.2	48.3	57.2	64.8	75.0
Peak Outflow Q (cfs) =		23.7	3.9	9.2	14.8	23.7	23.7	23.7
Ratio Peak Outflow to Predevelopment Q =		N/A	N/A	1.6	1.7	1.5	1.2	1.0
Structure Controlling Flow =		Spillway	Spillway	Spillway	Spillway	N/A	N/A	N/A
Max Velocity through Grate 1 (fps) =		N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =		N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =		>120	>120	>120	>120	>120	>120	>120
Time to Drain 99% of Inflow Volume (hours) =		>120	>120	>120	>120	>120	>120	>120
Maximum Ponding Depth (ft) =		2.99	2.72	2.82	2.89	3.00	3.00	3.00
Area at Maximum Ponding Depth (acres) =		0.76	0.75	0.75	0.76	0.77	0.77	0.77
Maximum Volume Stored (acre-ft) =		1.974	1.777	1.845	1.905	1.989	1.989	1.989

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Temporary Sediment Basin 6

Basin ID: 6 and 7



ExampleZone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	48.85	acres
Watershed Length =	2,300	ft
Watershed Length to Centroid =	1,150	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	2.00%	percent
Percentage Hydrologic Soil Group A =	35.0%	percent
Percentage Hydrologic Soil Group B =	65.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	72.0	hours
Location for 1-hr Rainfall Depths =	User Input	

Drain Time Too Long

DRAIN TIME MATCHES MHFCD TEMP SEDIMENT BASIN REQUIREMENTS

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

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	0.062	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	0.068	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.059	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.535	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.049	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	2.422	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	3.311	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	4.741	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3.14 in.) =	7.085	acre-feet	inches
Approximate 2-yr Detention Volume =	0.037	acre-feet	
Approximate 5-yr Detention Volume =	0.064	acre-feet	
Approximate 10-yr Detention Volume =	0.310	acre-feet	
Approximate 25-yr Detention Volume =	0.479	acre-feet	
Approximate 50-yr Detention Volume =	0.500	acre-feet	
Approximate 100-yr Detention Volume =	0.779	acre-feet	

CALCULATED PER MHFCD REQUIREMENTS OF 3,600 CF PER DRAINAGE AREA (48.85*3,600 = 175,860 CF = 4.037 ACRE-FEET)

Define Zones and Basin Geometry

Zone 1 Volume (User Defined) =	4.037	acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	4.037	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

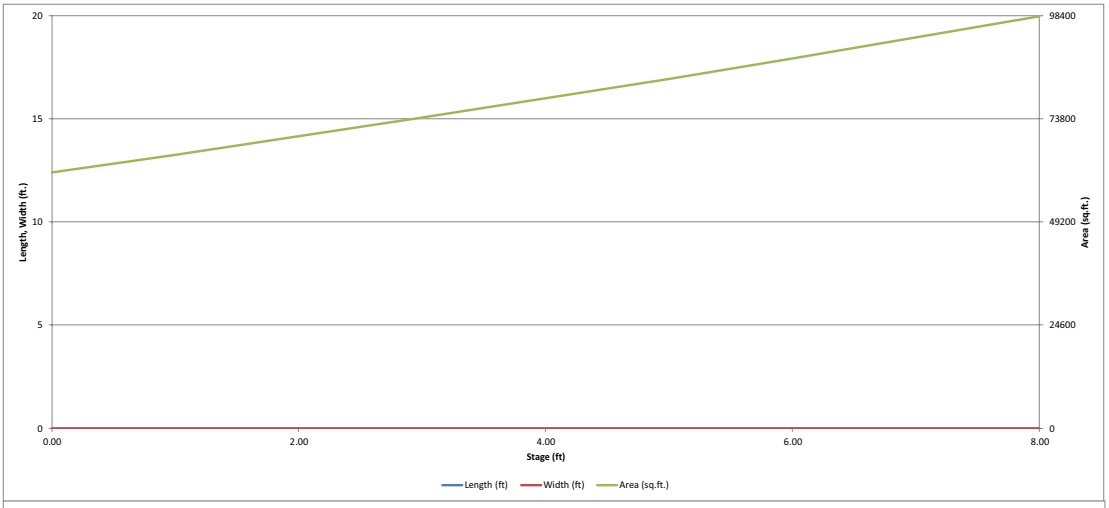
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

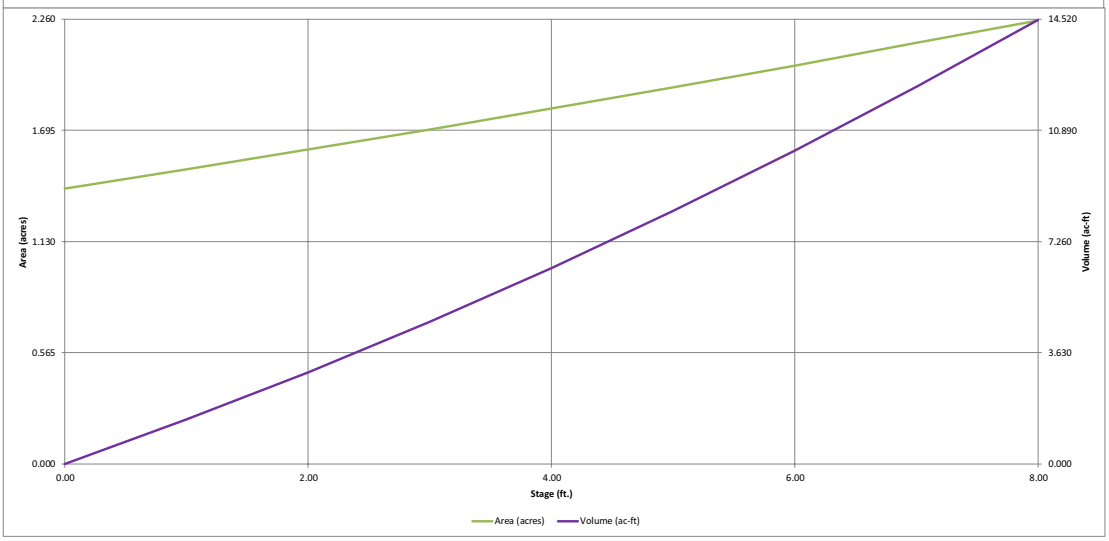
Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	61,013	1.401		
	--	1.00	--	--	--	65,222	1.497	63,117	1.449
	--	2.00	--	--	--	69,563	1.597	130,510	2.996
	--	3.00	--	--	--	74,028	1.699	202,305	4.644
	--	4.00	--	--	--	78,621	1.805	278,630	6.396
	--	5.00	--	--	--	83,340	1.913	359,610	8.256
	--	6.00	--	--	--	88,189	2.025	445,375	10.224
	--	7.00	--	--	--	93,164	2.139	536,051	12.306
	--	8.00	--	--	--	98,266	2.256	631,766	14.503

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



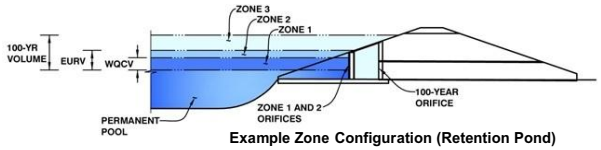


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Temporary Sediment Basin 6**

Basin ID: **6 and 7**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (User)	2.64	4.037	Orifice Plate
Zone 2			
Zone 3			
Total (all zones)		4.037	

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft²
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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)

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	2.604E-02	ft²
Depth at top of Zone using Orifice Plate =	2.64	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	10.60	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	3.75	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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	0.88	1.76					
Orifice Area (sq. inches)	3.75	3.75	3.75					

	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				Calculated Parameters for Vertical Orific	Not Selected	Not Selected
Invert of Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)		Vertical Orifice Area =			
Depth at top of Zone using Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)		Vertical Orifice Centroid =			
Vertical Orifice Diameter =			inches					

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

	Not Selected	Not Selected			Calculated Parameters for Overflow Wei	Not Selected	Not Selected
Overflow Weir Front Edge Height, Ho =			ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =			
Overflow Weir Front Edge Length =			feet	Overflow Weir Slope Length =			
Overflow Weir Grate Slope =			H:V	Grate Open Area / 100-yr Orifice Area =			
Horiz. Length of Weir Sides =			feet	Overflow Grate Open Area w/o Debris =			
Overflow Grate Type =				Overflow Grate Open Area w/ Debris =			
Debris Clogging % =			%				

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

	Not Selected	Not Selected		Calculated Parameters for Outlet Pipe w/ Flow Restriction Plat	Not Selected	Not Selected
Depth to Invert of Outlet Pipe =			ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =		
Circular Orifice Diameter =			inches	Outlet Orifice Centroid =		
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=		ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=		feet
Spillway Crest Length =		feet	Stage at Top of Freeboard =		feet
Spillway End Slopes =		H:V	Basin Area at Top of Freeboard =		acres
Freeboard above Max Water Surface =		feet	Basin Volume at Top of Freeboard =		acre-ft

Calculated Parameters for Spillway

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).

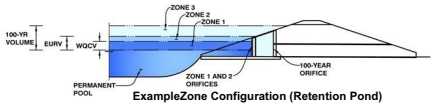
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	0.062	0.068	0.059	0.535	1.049	2.422	3.311	4.741
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.059	0.535	1.049	2.422	3.311	4.741
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.7	6.9	13.4	28.8	38.1	50.7
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.14	0.27	0.59	0.78	1.04
Peak Inflow Q (cfs) =	N/A	N/A	0.7	6.9	13.4	28.8	38.1	50.7
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.1	0.1	0.3	0.4	0.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.0	0.0	0.0	0.0	0.0
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	57	59	57	>120	>120	>120	>120	>120
Time to Drain 99% of Inflow Volume (hours) =	**72**	74	72	>120	>120	>120	>120	>120
Maximum Ponding Depth (ft) =	0.05	0.05	0.04	0.37	0.72	1.61	2.16	3.00
Area at Maximum Ponding Depth (acres) =	1.41	1.41	1.40	1.44	1.47	1.56	1.61	1.70
Maximum Volume Stored (acre-ft) =	0.070	0.070	0.042	0.511	1.019	2.365	3.237	4.644

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Waterview North Pond 3 (Temp. Sediment Basin 6)

Basin ID: 6 and 7



ExampleZone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	48.85	acres
Watershed Length =	2,300	ft
Watershed Length to Centroid =	1,150	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	70.00%	percent
Percentage Hydrologic Soil Group A =	35.0%	percent
Percentage Hydrologic Soil Group B =	65.0%	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	

Assumed imperviousness for Basin 1 development

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

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	1.120	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	3.957	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	3.315	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	4.424	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	5.378	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	6.568	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	7.606	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	8.881	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3.14 in.) =	11.508	acre-feet	inches
Approximate 2-yr Detention Volume =	2.897	acre-feet	
Approximate 5-yr Detention Volume =	3.833	acre-feet	
Approximate 10-yr Detention Volume =	4.759	acre-feet	
Approximate 25-yr Detention Volume =	5.305	acre-feet	
Approximate 50-yr Detention Volume =	5.627	acre-feet	
Approximate 100-yr Detention Volume =	6.064	acre-feet	

Define Zones and Basin Geometry

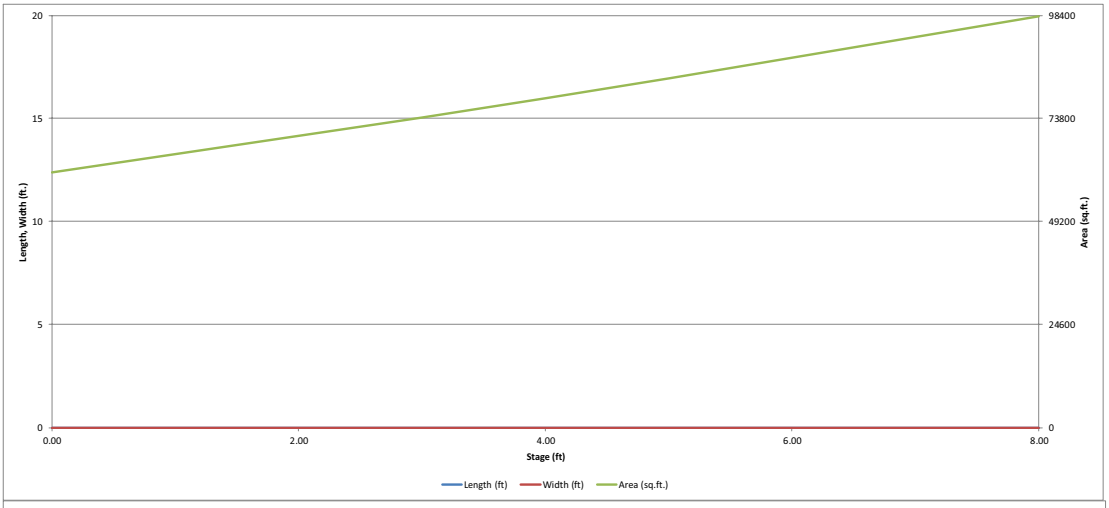
Zone 1 Volume (WQCV) =	1.120	acre-feet
Zone 2 Volume (EURV - Zone 1) =	2.838	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	2.107	acre-feet
Total Detention Basin Volume =	6.064	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

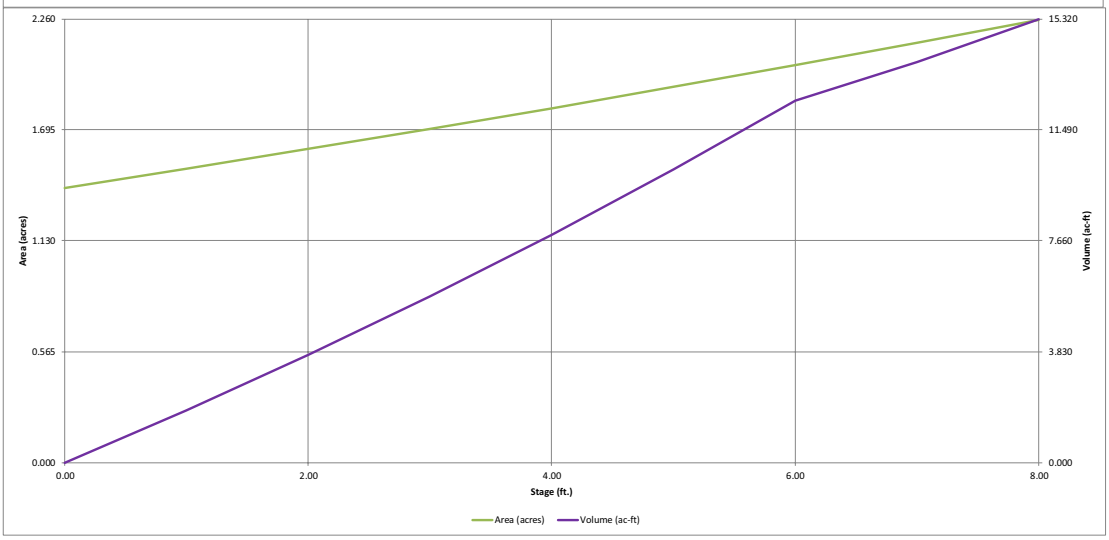
Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	61,013	1.401		
	--	1.00	--	--	--	65,222	1.497	78,370	1.799
	--	2.00	--	--	--	69,563	1.597	161,482	3.707
	--	3.00	--	--	--	74,028	1.699	249,463	5.727
	--	4.00	--	--	--	78,621	1.805	342,445	7.861
	--	5.00	--	--	--	83,340	1.913	440,556	10.114
	--	6.00	--	--	--	88,189	2.025	543,922	12.487
	--	7.00	--	--	--	93,164	2.139	602,647	13.835
	--	8.00	--	--	--	98,266	2.256	666,837	15.308

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)



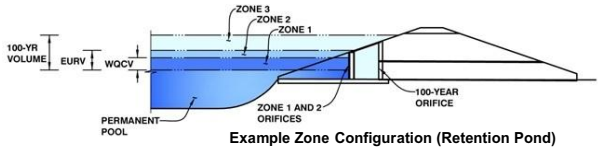


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: **Waterview North Pond 3 (Temp. Sediment Basin 6)**

Basin ID: **6 and 7**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.63	1.120	Orifice Plate
Zone 2 (EURV)	2.13	2.838	Orifice Plate
Zone 3 (100-year)	3.17	2.107	Weir (No Pipe)
Total (all zones)		6.064	

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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 =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	2.13	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	8.50	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =		sq. inches	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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	0.71	1.42					
Orifice Area (sq. inches)	0.00	0.00	0.00					

	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)	Vertical Orifice Area =	N/A	N/A
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A
Vertical Orifice Diameter =	N/A	N/A	inches			

Calculated Parameters for Vertical Orific

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			Zone 3 Weir	Not Selected
Overflow Weir Front Edge Height, Ho =	2.13	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	N/A	N/A
Overflow Weir Bottom Length =		N/A	feet	Overflow Weir Slope Length =	N/A	N/A
Overflow Weir Side Slopes =		N/A	H:V	Grate Open Area / 100-yr Orifice Area =	N/A	N/A
Horiz. Length of Weir Sides =	N/A	N/A	feet	Overflow Grate Open Area w/o Debris =	N/A	N/A
Overflow Grate Type =	N/A	N/A		Overflow Grate Open Area w/ Debris =	N/A	N/A
Debris Clogging % =	N/A	N/A	%			

Calculated Parameters for Overflow Wei

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

	Not Selected	Not Selected			Not Selected	Not Selected
Depth to Invert of Outlet Pipe =	N/A	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	N/A	N/A
Circular Orifice Diameter =	N/A	N/A	inches	Outlet Orifice Centroid =	N/A	N/A
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plat

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	3.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.74	feet
Spillway Crest Length =	75.00	feet	Stage at Top of Freeboard =	4.74	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	2.28	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	9.52	acre-ft
Spillway position relative to Overflow Weir =	Offset				

Calculated Parameters for Spillway

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).

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	1.120	3.957	3.315	4.424	5.378	6.568	7.606	8.881
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	3.315	4.424	5.378	6.568	7.606	8.881
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.7	6.9	13.4	28.8	38.1	50.7
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.14	0.27	0.59	0.78	1.04
Peak Inflow Q (cfs) =	N/A	N/A	54.2	72.5	87.0	109.2	126.8	149.0
Peak Outflow Q (cfs) =						10.6	25.7	53.0
Ratio Peak Outflow to Predevelopment Q =						0.4	0.7	1.0
Structure Controlling Flow =						Spillway	Spillway	Spillway
Max Velocity through Grate 1 (fps) =						N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =						N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =						>120	>120	>120
Time to Drain 99% of Inflow Volume (hours) =						>120	>120	>120
Maximum Ponding Depth (ft) =						3.13	3.23	3.38
Area at Maximum Ponding Depth (acres) =						2.09	2.10	2.12
Maximum Volume Stored (acre-ft) =						5.977	6.208	6.503

Worksheet for Outfall 6" PVC Riser Pipe for Southeast temporary sediment basin

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Roughness Coefficient	0.010
Channel Slope	0.020 ft/ft
Normal Depth	5.8 in
Diameter	6.0 in

Results	
Discharge	1.11 cfs
Flow Area	0.2 ft²
Wetted Perimeter	1.4 ft
Hydraulic Radius	1.7 in
Top Width	0.20 ft
Critical Depth	5.8 in
Percent Full	95.8 %
Critical Slope	0.020 ft/ft
Velocity	5.71 ft/s
Velocity Head	0.51 ft
Specific Energy	0.99 ft
Froude Number	1.023
Maximum Discharge	1.11 cfs
Discharge Full	1.03 cfs
Slope Full	0.023 ft/ft
Flow Type	Supercritical

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	96.7 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	5.8 in
Critical Depth	5.8 in
Channel Slope	0.020 ft/ft
Critical Slope	0.020 ft/ft

Rip-Rap Calculation

TEMPORARY SEDIMENT BASIN 6

.

Applicable Equations:

$L_p = (1/2\tan\Theta)(A_t/Y_t-D)$	Equation 9-11 per USCDM
$A_t = Q/V$	Equation 9-12 per USDCM
$\Theta = \tan^{-1}(1/(2*\text{ExpansionFactor}))$	Equation 9-13 per USDCM
$W = 2(L_p\tan\Theta)+D$	Equation 9-14 per USDCM
$T = 2D_{50}$	Equation 9-15 per USDCM

Assumptions

Maximum Major Event Velocity is 5fps for FES outletting into grass channel

Input parameters:

Description		Variable	Input	Unit
Width of the conduit (use diameter for circular conduits),		D:	0.50	ft
HGL Elevation			0.48	ft
Invert Elevation			0.00	ft
Tailwater depth (ft),		Y_t:	0.48	ft
Expansion angle of the culvert flow		Θ:	0.12	radians
Design discharge (cfs)*		Q:	1.11	cfs
Froude Number		F_r	1.43	Supercritical
Unitless Variables for Tables:				
	For Figure 9-35	$Q/D^{2.5}$	6.28	
	For Figure 9-35	Y_t/D	0.97	
	For Figure 9-38	$Q/D^{1.5}$	3.14	
	For Figure 9-38	Y_t/D	0.97	
Allowable non-eroding velocity in the downstream channel (ft/sec)		V:	5	ft/sec
Expansion Factor (Figure 9-35), 1/(2tan(θ))			4.2	

Solve for:

Description	Variable	Output	Unit
1. Required area of flow at allowable velocity (ft^2)	A_t:	0.22	ft^2
2. Length of Protection	L_p:	-0.17	ft
	L_p < 3D?	Yes	
	L_{pmin}:	1.50	ft
3. Width of downstream riprap protection	W:	1.00	ft
4. Rip Rap Type (Figure 9-38)	-	VL	
5. Rip Rap Size (Figure 8-34)	D_{50}:	6	inches

Rip Rap Summary

Length	L_p	2.00	ft
Width	W	1.00	ft
Size	D_{50}	6	inches
Type	-	VL	-
Thickness	T	12	inches

APPENDIX E – TEMPORARY SWALE SIZING

Earth Dikes and Drainage Swales (ED/DS) EC-10

Description

Earth dikes and drainage swales are temporary storm conveyance channels constructed either to divert runoff around slopes or to convey runoff to additional sediment control BMPs prior to discharge of runoff from a site. Drainage swales may be lined or unlined, but if an unlined swale is used, it must be well compacted and capable of resisting erosive velocities.

Photograph ED/DS-1. Example of an earth dike used to divert flows at a construction site. Photo courtesy of CDOT.

Appropriate Uses

Earth dikes and drainage swales are typically used to control the flow path of runoff at a construction site by diverting runoff around areas prone to erosion, such as steep slopes. Earth dikes and drainage swales may also be constructed as temporary conveyance features. This will direct runoff to additional sediment control treatment BMPs, such as sediment traps or basins.

Design and Installation

When earth dikes are used to divert water for slope protection, the earth dike typically consists of a horizontal ridge of soil placed perpendicular to the slope and angled slightly to provide drainage along the contour. The dike is used in conjunction with a swale or a small channel upslope of the berm to convey the diverted water. Temporary diversion dikes can be constructed by excavation of a V-shaped trench or ditch and placement of the fill on the downslope side of the cut. There are two types of placement for temporary slope diversion dikes:

- A dike located at the top of a slope to divert upland runoff away from the disturbed area and convey it in a temporary or permanent channel.
- A diversion dike located at the base or mid-slope of a disturbed area to intercept runoff and reduce the effective slope length.

Depending on the project, either an earth dike or drainage swale may be more appropriate. If there is a need for cut on the project, then an excavated drainage swale may be better suited. When the project is primarily fill, then a conveyance constructed using a berm may be the better option.

All dikes or swales receiving runoff from a disturbed area should direct stormwater to a sediment control BMP such as a sediment trap or basin.

Earth Dikes and Drainage Swales	
Functions	
Erosion Control	Yes
Sediment Control	Moderate
Site/Material Management	No

EC-10 Earth Dikes and Drainage Swales (ED/DS)

Unlined dikes or swales should only be used for intercepting sheet flow runoff and are not intended for diversion of concentrated flows.

Details with notes are provided for several design variations, including:

ED-1. Unlined Earth Dike formed by Berm

DS-1. Unlined Excavated Swale

DS-2. Unlined Swale Formed by Cut and Fill

DS-3. ECB-lined Swale

DS-4. Synthetic-lined Swale

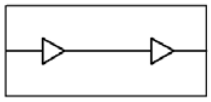
DS-5. Riprap-lined Swale

The details also include guidance on permissible velocities for cohesive channels if unlined approaches will be used.

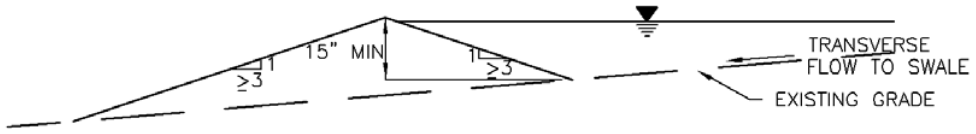
Maintenance and Removal

Inspect earth dikes for stability, compaction, and signs of erosion and repair. Inspect side slopes for erosion and damage to erosion control fabric. Stabilize slopes and repair fabric as necessary. If there is reoccurring extensive damage, consider installing rock check dams or lining the channel with riprap.

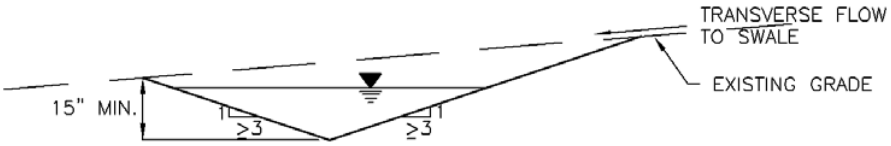
If drainage swales are not permanent, remove dikes and fill channels when the upstream area is stabilized. Stabilize the fill or disturbed area immediately following removal by revegetation or other permanent stabilization method approved by the local jurisdiction.



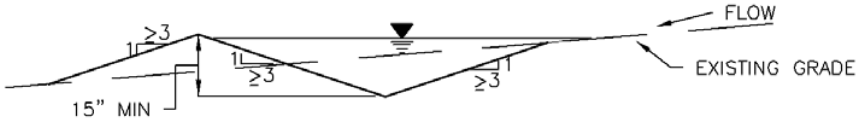
ED/DS



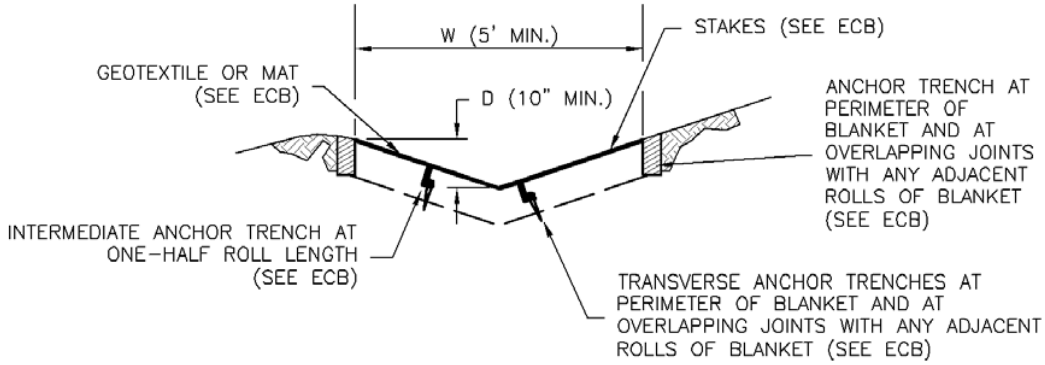
ED–1. COMPACTED UNLINED EARTH DIKE FORMED BY BERM



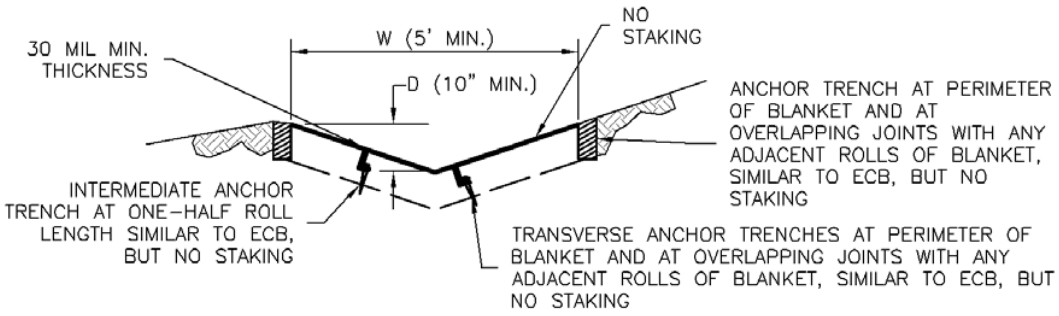
DS–1. COMPACTED UNLINED EXCAVATED SWALE



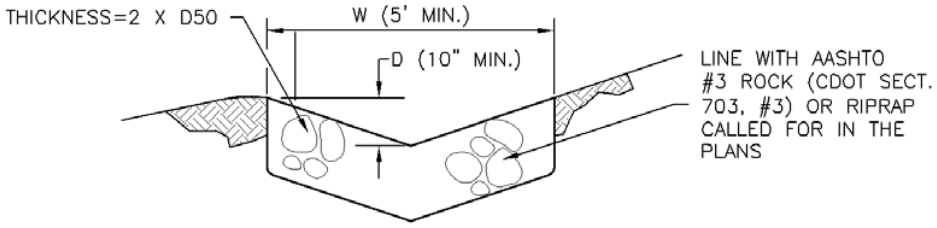
DS–2. COMPACTED UNLINED SWALE FORMED BY CUT AND FILL



DS–3. ECB LINED SWALE (CUT AND FILL OR BERM)



DS-4. SYNTHETIC LINED SWALE



DS-5. RIPRAP LINED SWALE

EARTH DIKE AND DRAINAGE SWALE INSTALLATION NOTES

1. SEE SITE PLAN FOR:
   - LOCATION OF DIVERSION SWALE
   - TYPE OF SWALE (UNLINED, COMPACTED AND/OR LINED).
   - LENGTH OF EACH SWALE.
   - DEPTH, D, AND WIDTH, W DIMENSIONS.
   - FOR ECB/TRM LINED DITCH, SEE ECB DETAIL.
   - FOR RIPRAP LINED DITCH, SIZE OF RIPRAP, D50.

2. SEE DRAINAGE PLANS FOR DETAILS OF PERMANENT CONVEYANCE FACILITIES AND/OR DIVERSION SWALES EXCEEDING 2-YEAR FLOW RATE OR 10 CFS.

3. EARTH DIKES AND SWALES INDICATED ON SWMP PLAN SHALL BE INSTALLED PRIOR TO LAND-DISTURBING ACTIVITIES IN PROXIMITY.

4. EMBANKMENT IS TO BE COMPACTED TO 90% OF MAXIMUM DENSITY AND WITHIN 2% OF OPTIMUM MOISTURE CONTENT ACCORDING TO ASTM D698.

5. SWALES ARE TO DRAIN TO A SEDIMENT CONTROL BMP.

6. FOR LINED DITCHES, INSTALLATION OF ECB/TRM SHALL CONFORM TO THE REQUIREMENTS OF THE ECB DETAIL.

7. WHEN CONSTRUCTION TRAFFIC MUST CROSS A DIVERSION SWALE, INSTALL A TEMPORARY CULVERT WITH A MINIMUM DIAMETER OF 12 INCHES.

EARTH DIKE AND DRAINAGE SWALE MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

4. SWALES SHALL REMAIN IN PLACE UNTIL THE END OF CONSTRUCTION; IF APPROVED BY LOCAL JURISDICTION, SWALES MAY BE LEFT IN PLACE.

5. WHEN A SWALE IS REMOVED, THE DISTURBED AREA SHALL BE COVERED WITH TOPSOIL, SEEDED AND MULCHED OR OTHERWISE STABILIZED IN A MANNER APPROVED BY LOCAL JURISDICTION.

(DETAIL ADAPTED FROM DOUGLAS COUNTY, COLORADO AND THE CITY OF COLORADO SPRINGS, COLORADO, NOT AVAILABLE IN AUTOCAD)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

Worksheet for Basin 1 Temp Drainage Swale

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Roughness Coefficient	0.030
Channel Slope	0.020 ft/ft
Normal Depth	28.0 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V

Results	
Discharge	122.42 cfs
Flow Area	16.3 ft²
Wetted Perimeter	14.8 ft
Hydraulic Radius	13.3 in
Top Width	14.00 ft
Critical Depth	30.4 in
Critical Slope	0.013 ft/ft
Velocity	7.49 ft/s
Velocity Head	0.87 ft
Specific Energy	3.21 ft
Froude Number	1.223
Flow Type	Supercritical

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	28.0 in
Critical Depth	30.4 in
Channel Slope	0.020 ft/ft
Critical Slope	0.013 ft/ft

Worksheet for Basin 2 Temp Drainage Swale

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Roughness Coefficient	0.030
Channel Slope	0.030 ft/ft
Normal Depth	27.0 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V

Results	
Discharge	136.07 cfs
Flow Area	15.2 ft²
Wetted Perimeter	14.2 ft
Hydraulic Radius	12.8 in
Top Width	13.50 ft
Critical Depth	31.7 in
Critical Slope	0.013 ft/ft
Velocity	8.96 ft/s
Velocity Head	1.25 ft
Specific Energy	3.50 ft
Froude Number	1.489
Flow Type	Supercritical

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	27.0 in
Critical Depth	31.7 in
Channel Slope	0.030 ft/ft
Critical Slope	0.013 ft/ft

Worksheet for Basin 3 Temp Drainage Swale

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Roughness Coefficient	0.030
Channel Slope	0.020 ft/ft
Normal Depth	22.0 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V

Results	
Discharge	64.35 cfs
Flow Area	10.1 ft²
Wetted Perimeter	11.6 ft
Hydraulic Radius	10.4 in
Top Width	11.00 ft
Critical Depth	23.5 in
Critical Slope	0.014 ft/ft
Velocity	6.38 ft/s
Velocity Head	0.63 ft
Specific Energy	2.47 ft
Froude Number	1.175
Flow Type	Supercritical

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	22.0 in
Critical Depth	23.5 in
Channel Slope	0.020 ft/ft
Critical Slope	0.014 ft/ft

Worksheet for Basin 4 Temp Drainage Swale

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Roughness Coefficient	0.030
Channel Slope	0.020 ft/ft
Normal Depth	18.0 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V

Results	
Discharge	37.68 cfs
Flow Area	6.8 ft²
Wetted Perimeter	9.5 ft
Hydraulic Radius	8.5 in
Top Width	9.00 ft
Critical Depth	18.9 in
Critical Slope	0.015 ft/ft
Velocity	5.58 ft/s
Velocity Head	0.48 ft
Specific Energy	1.98 ft
Froude Number	1.136
Flow Type	Supercritical

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	18.0 in
Critical Depth	18.9 in
Channel Slope	0.020 ft/ft
Critical Slope	0.015 ft/ft

Worksheet for Basin 5 Temp Drainage Swale

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Roughness Coefficient	0.030
Channel Slope	0.008 ft/ft
Normal Depth	24.0 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V

Results	
Discharge	49.70 cfs
Flow Area	12.0 ft²
Wetted Perimeter	12.6 ft
Hydraulic Radius	11.4 in
Top Width	12.00 ft
Critical Depth	21.2 in
Critical Slope	0.015 ft/ft
Velocity	4.14 ft/s
Velocity Head	0.27 ft
Specific Energy	2.27 ft
Froude Number	0.730
Flow Type	Subcritical

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	24.0 in
Critical Depth	21.2 in
Channel Slope	0.008 ft/ft
Critical Slope	0.015 ft/ft

Worksheet for Basin 6 North Temp Drainage Swale

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Roughness Coefficient	0.030
Channel Slope	0.020 ft/ft
Normal Depth	27.0 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V

Results	
Discharge	111.10 cfs
Flow Area	15.2 ft²
Wetted Perimeter	14.2 ft
Hydraulic Radius	12.8 in
Top Width	13.50 ft
Critical Depth	29.2 in
Critical Slope	0.013 ft/ft
Velocity	7.32 ft/s
Velocity Head	0.83 ft
Specific Energy	3.08 ft
Froude Number	1.216
Flow Type	Supercritical

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	27.0 in
Critical Depth	29.2 in
Channel Slope	0.020 ft/ft
Critical Slope	0.013 ft/ft

Worksheet for Basin 7 Temp Drainage Swale

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Roughness Coefficient	0.030
Channel Slope	0.035 ft/ft
Normal Depth	23.0 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V

Results	
Discharge	95.84 cfs
Flow Area	11.0 ft²
Wetted Perimeter	12.1 ft
Hydraulic Radius	10.9 in
Top Width	11.50 ft
Critical Depth	27.5 in
Critical Slope	0.013 ft/ft
Velocity	8.70 ft/s
Velocity Head	1.18 ft
Specific Energy	3.09 ft
Froude Number	1.566
Flow Type	Supercritical

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	23.0 in
Critical Depth	27.5 in
Channel Slope	0.035 ft/ft
Critical Slope	0.013 ft/ft

Worksheet for Basin 6 East Temp Drainage Swale

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Roughness Coefficient	0.030
Channel Slope	0.013 ft/ft
Normal Depth	29.0 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V

Results	
Discharge	108.38 cfs
Flow Area	17.5 ft²
Wetted Perimeter	15.3 ft
Hydraulic Radius	13.8 in
Top Width	14.50 ft
Critical Depth	28.9 in
Critical Slope	0.013 ft/ft
Velocity	6.19 ft/s
Velocity Head	0.59 ft
Specific Energy	3.01 ft
Froude Number	0.992
Flow Type	Subcritical

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	29.0 in
Critical Depth	28.9 in
Channel Slope	0.013 ft/ft
Critical Slope	0.013 ft/ft

Worksheet for Basin 6 South Temp Drainage Swale

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Roughness Coefficient	0.030
Channel Slope	0.013 ft/ft
Normal Depth	29.0 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V

Results	
Discharge	108.38 cfs
Flow Area	17.5 ft²
Wetted Perimeter	15.3 ft
Hydraulic Radius	13.8 in
Top Width	14.50 ft
Critical Depth	28.9 in
Critical Slope	0.013 ft/ft
Velocity	6.19 ft/s
Velocity Head	0.59 ft
Specific Energy	3.01 ft
Froude Number	0.992
Flow Type	Subcritical

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	29.0 in
Critical Depth	28.9 in
Channel Slope	0.013 ft/ft
Critical Slope	0.013 ft/ft

APPENDIX F – OFFSITE DRAINAGE ANALYSIS

Worksheet for North Offsite Drainage Berm

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Channel Slope	0.019 ft/ft
Normal Depth	12.0 in

Section Definitions

Station (ft)	Elevation (ft)
-0+85	1.00
0+00	0.00
0+20	0.00
0+26	2.00
0+46	2.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(-0+85, 1.00)	(0+46, 2.00)	0.030

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Discharge	306.33 cfs
Roughness Coefficient	0.030
Elevation Range	0.0 to 2.0 ft
Flow Area	64.0 ft²
Wetted Perimeter	108.2 ft
Hydraulic Radius	7.1 in
Top Width	108.00 ft
Normal Depth	12.0 in
Critical Depth	12.5 in
Critical Slope	0.015 ft/ft
Velocity	4.79 ft/s
Velocity Head	0.36 ft
Specific Energy	1.36 ft
Froude Number	1.096
Flow Type	Supercritical

GVF Input Data

Worksheet for North Offsite Drainage Berm

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	12.0 in
Critical Depth	12.5 in
Channel Slope	0.019 ft/ft
Critical Slope	0.015 ft/ft

Worksheet for North Offsite Drainage Berm

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Channel Slope	0.019 ft/ft
Normal Depth	12.0 in

Section Definitions

Station (ft)	Elevation (ft)
-0+85	1.00
0+00	0.00
0+20	0.00
0+26	2.00
0+46	2.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(-0+85, 1.00)	(0+46, 2.00)	0.030

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Discharge	306.33 cfs
Roughness Coefficient	0.030
Elevation Range	0.0 to 2.0 ft
Flow Area	64.0 ft²
Wetted Perimeter	108.2 ft
Hydraulic Radius	7.1 in
Top Width	108.00 ft
Normal Depth	12.0 in
Critical Depth	12.5 in
Critical Slope	0.015 ft/ft
Velocity	4.79 ft/s
Velocity Head	0.36 ft
Specific Energy	1.36 ft
Froude Number	1.096
Flow Type	Supercritical

GVF Input Data

Worksheet for North Offsite Drainage Berm

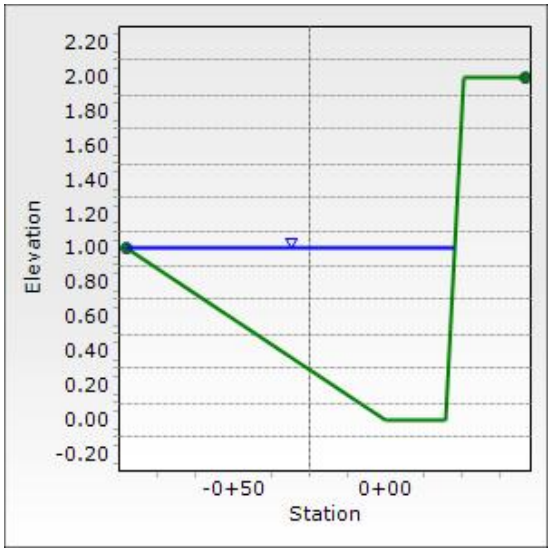
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	12.0 in
Critical Depth	12.5 in
Channel Slope	0.019 ft/ft
Critical Slope	0.015 ft/ft

Cross Section for North Offsite Drainage Berm

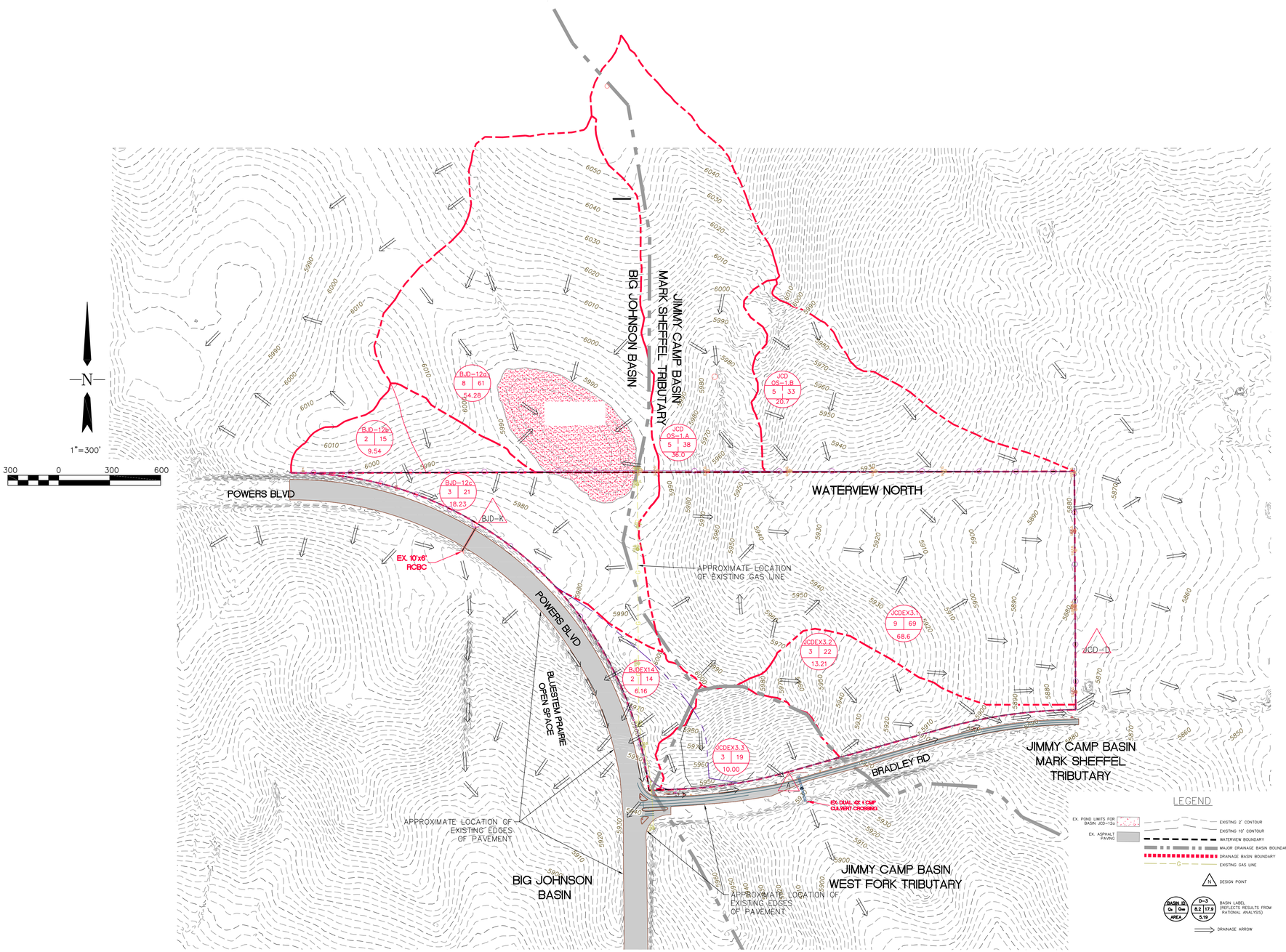
Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Channel Slope	0.019 ft/ft
Normal Depth	12.0 in
Discharge	306.33 cfs



APPENDIX G – DRAINAGE EXHIBITS

PRE-DEVELOPMENT BASIN MAP



BASIN ID	BASIN AREA (Ac.)	DESIGN POINT	RATIONAL ANALYSIS RESULTS	
			Q_5 (CFS)	Q_{100} (CFS)
BJD-12a	54.28		8	61
BJD-12b	9.54		2	15
BJD-12c	18.23		3	21
		BJD-K	4	31
JCD OS-1A	36.0		5	38
JCD OS-1B	20.7		5	33
JCDEX-3.1	68.6		9	69
JCDEX-3.2	13.21		3	22
		JCD-D	12	84
JCDEX-3.3	10.0		3	19
BJDEX14	6.16		2	14
		A	3	19
		A*	5	25

A* – MODELLED AS BASIN OS-1 IN THE FINAL DRAINAGE REPORT FOR FILING 1 OF TRAILS AT ASPEN RIDGE, APP'D ON FEBRUARY 13, 2020.

REVISIONS:

NO.	DESCRIPTION	DATE

ENGINEER:
DESIGNED BY: CEB DATE: 11-05-20
DRAWN BY: CEB DATE: 11-05-20
CHECKED BY: CKC DATE: 11-05-20

48 HOURS BEFORE YOU DIG, CALL UTILITY LOCATORS
1-800-922-1987
CITY OF COLORADO SPRINGS DEPT. OF UTILITIES GAS, ELECTRIC, WATER AND WASTEWATER

DSE Dakota Springs Engineering
31 N. TEJON, SUITE 518
COLORADO SPRINGS, CO 80903
P: (719) 227-7388
F: (719) 227-7392

PROJECT WATERVIEW NORTH
SHEET TITLE PRE-DEVELOPMENT BASIN MAP
FROM n/a TO n/a
JOB NO. 02-19-05 SHEET 2 OF 3

Z:\2001 Dakota Springs\06 Waterview Partners\19-05 Waterview North Site\CAD\Plan\sheet\ASDP\Pre Basin Exhibit.dwg, PRE-DEV BASIN MAP, 11/5/2020 12:24:41 PM, ARCH full bleed D (36.00 x 24.00 Inches)

PROPOSED PRIVATE TEMPORARY SEDIMENT BASIN 1
BASIN BOTTOM WIDTH AVERAGE: 120'
BASIN BOTTOM LENGTH: 325'
DEPTH 4'
SPILLWAY CREST LENGTH: 75'
SPILLWAY CREST HEIGHT: 3.30'
RISER PIPE HOLE DIAMETER: (3) 1 11/16"
RISER PIPE HEIGHT: 1.62'
RISER PIPE HOLE SEPARATIONS: 6.50"
REQUIRED VOLUME: 68,616 CF
PROPOSED VOLUME: 188,805 CF
(BASIN TO BE CONVERTED TO A FULL SPECTRUM DETENTION BASIN AT FINAL DESIGN AND DEVELOPMENT)

BJD-12a
54.28 | 80.0 | 61

BJD-12b
9.54 | 80.0 | 15

PROPOSED PRIVATE TEMPORARY SEDIMENT BASIN 3A
BASIN BOTTOM WIDTH: 60'
BASIN BOTTOM LENGTH: 355'
DEPTH 2'
SPILLWAY CREST LENGTH: 12'
RISER PIPE HOLE DIAMETER: 27/32"
REQUIRED VOLUME: 29,373 CF
PROPOSED VOLUME: 45,333 CF

BASIN 3 TEMP SWALE
PROPOSED UDFCD DS-1 COMPACTED EXCAVATED UNLINED TEMPORARY DRAINAGE SWALE 4
TOP WIDTH: 11.0'
3:1 SIDE SLOPES

PROPOSED PRIVATE TEMPORARY SEDIMENT BASIN 3B
BASIN BOTTOM WIDTH: 50'
BASIN BOTTOM LENGTH: 345'
DEPTH 2'
SPILLWAY CREST LENGTH: 12'
RISER PIPE HOLE DIAMETER: 27/32"
REQUIRED VOLUME: 2,075 CF
PROPOSED VOLUME: 45,000 CF

JCD OS-1.A
36 | 80.0 | 38

OUTLET/STANDPIPE AND 12' SPILLWAY

OUTLET/STANDPIPE AND 12' SPILLWAY

PROPOSED PRIVATE TEMPORARY SEDIMENT BASIN 5
BASIN BOTTOM WIDTH: 73'
BASIN BOTTOM LENGTH: 99'
DEPTH 5.0"
SPILLWAY CREST LENGTH: 15'
RISER PIPE HOLE DIAMETER: 15/16"
REQUIRED VOLUME: 35,028 CF
PROPOSED VOLUME: 49,834 CF

JCD OS-1.B
20.7 | 80.0 | 33

BASIN 5 TEMP SWALE
PROPOSED UDFCD DS-2 COMPACTED UNLINED TEMPORARY DRAINAGE SWALE 5 FORMED BY CUT AND FILL
TOP WIDTH: 12'
3:1 SIDE SLOPES

OUTLET/STANDPIPE TO DISCHARGE TO SWALE AND 15' SPILLWAY

PROPERTY LINE

BASIN 6 NORTH TEMP SWALE
PROPOSED UDFCD DS-2 COMPACTED UNLINED TEMPORARY DRAINAGE SWALE 6 FORMED BY CUT AND FILL
TOP WIDTH: 15'
3:1 SIDE SLOPES

RW-1
1.61 | 100 | 10.77

1 | 19.06 | 95.0 | 120.65

3 | 8.16 | 95.0 | 60.69

4 | 7.86 | 70.0 | 34.97

5 | 9.73 | 70.0 | 44.93

6 | 26.44 | 70.0 | 104.53

RW-3
0.60 | 100 | 4.83

RW-4
0.65 | 100 | 5.01

JIMMY CAMP CREEK BASIN

S. POWERS BLVD.

75.0' SPILLWAY

OUTLET/STANDPIPE

EX. PUBLIC 10'X6' REINFORCED CONCRETE BOX CULVERT

BASIN 1 TEMP SWALE
PROPOSED UDFCD DS-2 COMPACTED UNLINED TEMPORARY DRAINAGE SWALE 1 FORMED BY CUT AND FILL
TOP WIDTH: 14'
V-SWALE

PROPOSED PRIVATE TEMPORARY SEDIMENT BASIN 4B
BASIN BOTTOM WIDTH: 50'
BASIN BOTTOM LENGTH: 345'
DEPTH 2'
SPILLWAY CREST LENGTH: 12'
RISER PIPE HOLE DIAMETER: 27/32"
REQUIRED VOLUME: 28,296 CF
PROPOSED VOLUME: 45,000 CF

PROPOSED PRIVATE TEMPORARY SEDIMENT BASIN 4A
BASIN BOTTOM WIDTH: 60'
BASIN BOTTOM LENGTH: 355'
DEPTH: 2'
SPILLWAY CREST LENGTH: 12'
RISER PIPE DIAMETER: 27/32"
REQUIRED VOLUME: 28,296
PROPOSED VOLUME: 45,333

PROPERTY LINE

BASIN 4 TEMP SWALE
PROPOSED UDFCD DS-1 COMPACTED EXCAVATED UNLINED TEMPORARY DRAINAGE SWALE
TOP WIDTH: 9.0'
3:1 SIDE SLOPES

BASIN 2 EAST TEMP SWALE
PROPOSED UDFCD DS-2 COMPACTED UNLINED TEMPORARY DRAINAGE SWALE 2 FORMED BY CUT AND FILL
TOP WIDTH: 13.5'
V-SWALE

BIG JOHNSON BASIN

2 | 20.77 | 95.0 | 131.96

RW-2
1.32 | 100 | 10.25

7 | 22.41 | 70.0 | 88.9

RW-5
0.47 | 100 | 3.87

30.0' SPILLWAY

BRADLEY ROAD

OUTLET/STANDPIPE AND 12' SPILLWAY

OUTLET/STANDPIPE AND 12' SPILLWAY

OUTLET/STANDPIPE TO DISCHARGE TO EXISTING CULVERT

BASIN 2 SOUTH TEMP SWALE
PROPOSED UDFCD DS-2 COMPACTED UNLINED TEMPORARY DRAINAGE SWALE 2 FORMED BY CUT AND FILL
TOP WIDTH: 13.5'
V-SWALE

PROPOSED PRIVATE TEMPORARY SEDIMENT BASIN 2
BASIN BOTTOM WIDTH: 113'
BASIN BOTTOM LENGTH: 227'
DEPTH 3'
SPILLWAY CREST LENGTH: 30'
SPILLWAY CREST HEIGHT: 2.60'
RISER PIPE HOLE DIAMETER: (3) 1 3/8"
RISER PIPE HEIGHT: 2.64'
RISER PIPE HOLE SEPARATIONS: 10.60"
REQUIRED VOLUME: 74,772 CF
PROPOSED VOLUME: 86,632 CF
(BASIN TO BE CONVERTED TO A FULL SPECTRUM DETENTION BASIN AT FINAL DESIGN AND DEVELOPMENT)

BASIN 7 TEMP SWALE
PROPOSED UDFCD DS-1 COMPACTED UNLINED EXCAVATED TEMPORARY DRAINAGE SWALE 7
TOP WIDTH: 11.5'
3:1 SIDE SLOPES

PROPERTY LINE

EX. PUBLIC 24" RCP SLEEVED THROUGH 42" CMP CULVERT TO REMAIN

BASIN 6 EAST TEMP SWALE
PROPOSED UDFCD DS-2 COMPACTED UNLINED TEMPORARY DRAINAGE SWALE 6 FORMED BY CUT AND FILL
TOP WIDTH: 16'
3:1 SIDE SLOPES

BASIN 6 SOUTH TEMP SWALE
PROPOSED UDFCD DS-2 COMPACTED UNLINED TEMPORARY DRAINAGE SWALE FORMED BY CUT AND FILL
TOP WIDTH: 14.5'
3:1 SIDE SLOPES

PROPOSED PRIVATE TEMPORARY SEDIMENT BASIN 6
BASIN BOTTOM WIDTH: 210'
BASIN BOTTOM LENGTH: 400'
DEPTH 8'
SPILLWAY CREST LENGTH: 75'
SPILLWAY CREST HEIGHT: 3'
RISER PIPE HOLE SIZE: (3) 1"X 3 3/4" RECTANGULAR HOLES
RISER PIPE HEIGHT: 2.64'
RISER PIPE HOLE SEPARATIONS: 10.60"
REQUIRED VOLUME: 175,860 CF
PROPOSED VOLUME: 666,837 CF
(BASIN TO BE CONVERTED TO A FULL SPECTRUM DETENTION BASIN AT FINAL DESIGN AND DEVELOPMENT)

75.0' SPILLWAY

PROPERTY LINE

OUTLET/STANDPIPE

20' LONG X 10' WIDE TYPE VL (6-IN DIAMETER), 12-IN THICK RIPRAP

LEGEND

A = BASIN DESIGNATION
B = AREA (ACRES)
C = BASIN IMPERVIOUSNESS
D = 100YR DESIGN STORM RUNOFF (CFS)

= DESIGN POINT

FLOW DIRECTION

PROPERTY BOUNDARY
MAJOR FEE BASIN DELINEATION
EASEMENT
EXISTING STORM SEWER
DRAINAGE BASIN BOUNDARY
TEMPORARY DRAINAGE SWALE
PROPOSED MAJOR CONTOUR
PROPOSED MINOR CONTOUR
EXISTING MAJOR CONTOUR
EXISTING MINOR CONTOUR
PROPOSED STORM SEWER
PROPOSED STORM INLET
RIPRAP
SPILLWAY

SUMMARY - PROPOSED RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)	IMPERVIOUSNESS (%)
1	1	19.06	66.15	120.65	0.95
2	2	20.77	72.34	131.96	0.95
3	3	8.16	33.27	60.69	0.95
4	4	7.86	16.46	34.97	0.70
5	5	9.73	21.15	44.93	0.70
6	6	26.44	49.21	104.53	0.70
7	7	22.41	41.88	88.96	0.70
RW-1	RW-1	1.61	6.02	10.77	100.00
RW-2	RW-2	1.33	5.72	10.25	100.00
RW-3	RW-3	0.60	2.69	4.83	100.00
RW-4	RW-4	0.65	2.79	5.01	100.00
RW-5	RW-5	0.47	2.16	3.87	100.00

NORTH

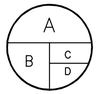
GRAPHIC SCALE IN FEET
0 100 200 400

DRAINAGE EXHIBIT – WATERVIEW NORTH COLORADO SPRINGS, CO

Kimley»Horn

APPENDIX H –MASTER DRAINAGE BASIN EXHIBIT AND CALCULATIONS

LEGEND



A = BASIN DESIGNATION
B = AREA (ACRES)
C = BASIN IMPERVIOUSNESS
D = 100YR DESIGN STORM RUNOFF (CFS)

PROPERTY BOUNDARY

BASIN DELINEATION

EXISTING MAJOR CONTOUR

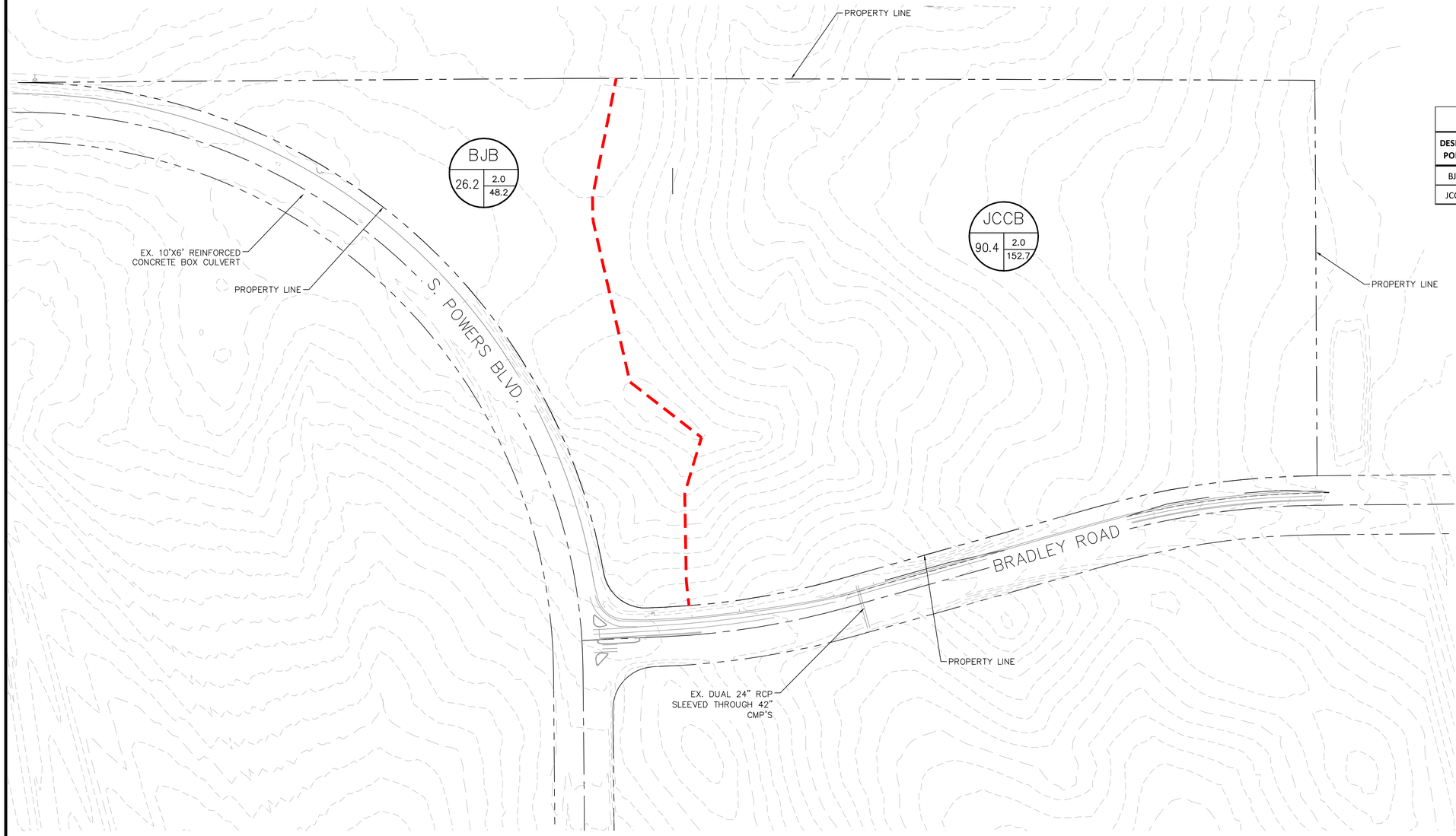
EXISTING MINOR CONTOUR

SUMMARY - PROPOSED RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)	IMPERVIOUSNESS (%)
BJB	BJB	26.20	7.18	48.21	0.02
JCCB	JCCB	90.34	22.74	152.69	0.02

BJB BIG JOHNSON BASIN

JCCB JIMMY CAMP CREEK BASIN



NORTH

GRAPHIC SCALE IN FEET
0 100 200 400

MAJOR BASIN EXHIBIT – WATERVIEW NORTH COLORADO SPRINGS, CO

Kimley»Horn

IDF Equations:

I_{100} = -2.52ln(D) + 12.735
I_{50} = -2.25ln(D) + 11.375
I_{25} -2.00ln(D) + 10.111
I_{10} -1.75ln(D) + 8.847
I_{5} -1.50ln(D) + 7.583
I_{2} -1.19ln(D) + 6.035

Where:
I = Rainfall Intensity (in/hr)
D= Duration (minutes)

	2-yr	5-yr	10-yr	100-yr
P_1 =	1.19	1.5	1.75	2.52

*The Design Point Rainfall Values and Time Intensity Frequency Tabulation are found in Table 6-2 and Figure 6-5, respectively of the Colorado Springs Drainage Criteria Manual, Volume1

Weighted Imperviousness Calculations

SUB-BASIN	AREA (SF)	AREA (Acres)	SOIL GROUP DESIGNATION	WEIGHTED IMPERVIOUSNESS	WEIGHTED COEFFICIENTS			
					C2	C5	C10	C100
BJB	1,141,190	26.20	A/B	2.0%	0.03	0.09	0.17	0.36
JCCB	3,935,162	90.34	A/B	2.0%	0.03	0.09	0.17	0.36
TOTAL	5,076,352	116.54						

Waterview North - Drainage Report
Proposed Runoff Calculations
Time of Concentration

Watercourse Coefficient

Forest & Meadow	2.50	Short Grass Pasture & Lawns	7.00			Grassed Waterway	15.00
Fallow or Cultivation	5.00	Nearly Bare Ground	10.00			Paved Area & Shallow Gutter	20.00

	SUB-BASIN DATA				INITIAL / OVERLAND TIME			TRAVEL TIME T(t)					T(c) CHECK (URBANIZED BASINS)			FINAL T(c)
DESIGN POINT	DRAIN BASIN	AREA sq. ft.	AREA ac.	C(5)	Length ft.	Slope %	T(i) min	Length ft.	Slope %	Coeff.	Velocity fps	T(t) min.	COMP. T(c)	TOTAL LENGTH	L/180+10	min.
BJB	BJB	1,141,190	26.20	0.09	100	3.0%	12.8	1811	10.0%	2.50	0.8	38.2	51.0	1911	20.6	20.6
JCCB	JCCB	3,935,162	90.34	0.09	100	5.0%	10.8	2466	9.5%	2.50	0.8	53.3	64.1	2566	24.3	24.3

Waterview North - Drainage Report
Proposed Runoff Calculations ***Design Storm 5 Year***
(Rational Method Procedure)

BASIN INFORMATION				DIRECT RUNOFF				CUMMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
BJB	BJB	26.20	0.09	20.6	2.36	3.05	7.18					
JCCB	JCCB	90.34	0.09	24.3	8.13	2.80	22.74					

Waterview North - Drainage Report
Proposed Runoff Calculations ***Design Storm*** ***100 Year***
(Rational Method Procedure)

BASIN INFORMATION				DIRECT RUNOFF				CUMMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
BJB	BJB	26.20	0.36	20.6	9.43	5.11	48.21					
JCCB	JCCB	90.34	0.36	24.3	32.52	4.69	152.69					

SUMMARY - PROPOSED RUNOFF TABLE					
DESIGN POINT	**BASIN DESIGNATION**	**BASIN AREA (ACRES)**	**DIRECT 5-YR RUNOFF (CFS)**	**DIRECT 100-YR RUNOFF (CFS)**	**IMPERVIOUSNESS (%)**
BJB	BJB	26.20	7.18	48.21	0.02
JCCB	JCCB	90.34	22.74	152.69	0.02