

TRI-STATE GENERATION & TRANSMISSION, INC.

FOX RUN SUBSTATION FINAL DRAINAGE REPORT

PCD FILE # PPR-22-044

March 21, 2023

Prepared by:



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TRI-STATE GENERATION & TRANSMISSION, INC.



FOX RUN SUBSTATION FINAL DRAINAGE REPORT

Design Engineer's Statement:

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

David Schieldt

3/21/2023

David Schieldt
Registered Professional Engineer
State of Colorado No. 47195

Date

Owner/Developer's Statement:

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

Karl W. Myers

3/21/23

~~XXXXXX~~ Karl W. Myers
Tri-State Generation and Transmission Association
1100 W. 116th Ave
Westminster, CO 80234

Date

El Paso County:

Filed in accordance with the requirements of the Drainage Criteria Manual, Volumes 1 and 2, El Paso County Engineering Criteria Manual and Land Development Code as amended.

County Engineer / ECM Administrator

Date



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1.0 General Location and Description

Tri-State Generation and Transmission (TSGT) in coordination with Del-Mont Consultants, Inc. (DMC) is in the process of designing a new substation yard. The scope of work includes the construction of the substation yard & retaining walls, driveway, detention pond and swales, installation of new perimeter fence, and the addition of high voltage electrical equipment and facilities. The purpose of this report is to present the findings from the hydrologic and hydraulic analyses that were performed on the existing property as well as present the results from a detailed analysis performed on the proposed improvements to the property.

1.1 Site Location

The proposed substation yard is located on a 14.92-acre parcel owned by TSGT, situated in the NW ¼ of Section 21, Township 11 South, Range 66 West, 6th Principal Meridian in El Paso County, Colorado. The substation site is accessed from Shahara Road.

1.2 Site Description

The site naturally drains to the northeast and is currently covered in various grasses. There are currently no features on the site to provide water quality or quantity treatment for discharge from the site. Site layout details will be discussed in more detail in **Section 2**.

There are developments on the properties to the south and the west of the site. MVEA Substation located on the neighboring property to the south, and Jackson Ranch Subdivision to the west. No wetlands are present on the site and the site is not located within a floodplain. Provide the FIRM # and map

To the knowledge of Del-Mont Consultants, no prior drainage studies have been conducted on this property.

2.0 Drainage Basins and Sub-Basins

The property functions overall as one large basin, flowing to the northeast into a drainage on the east edge of the property, ultimately flowing into West Cherry Creek. Proposed conditions produce several smaller sub-basins and will be discussed in detail in the following sections.

2.1 Existing Drainage Sub-Basins

The existing site was analyzed as one basin. A small portion of the existing site was unanalyzed as it did not affect the majority of the site. A map illustrating the delineation of the existing property can be found in **Appendix C**. There are developments on the properties to the south and the west of the site. MVEA Substation located on the neighboring property to the south, and Jackson Ranch Subdivision to the west. **Table 2-1** presents the existing basin and its corresponding acreage. The existing member substation was not analyzed as a part of this project.

Table 2-1: Existing Basin Acreages

Sub-Basin	Total Area (Acres)
Existing	14.38
Unanalyzed	0.54

2.2 Proposed Drainage Sub-Basins

The proposed conditions will produce several different sub-basins. The proposed site is divided into three different sub-basins; Yard Area, Proposed North, and Proposed South. A map illustrating the delineation of the sub-basins can be found in **Appendix C**. The Yard Area contains the entirety of the yard and the detention pond, which make up greater than 90% of the impervious or improved areas. The remainder of the impervious area consists of the access driveway, which creates negligible runoff and will continue to follow historic flow paths. The Proposed North and Proposed South areas contain swales that will route any run-on around the substation site, returning to historical discharge patterns. The run-on flows are minimal and will have negligible effects on the site. The majority of the North and South basins will not be disturbed during construction and will not require water quality treatment. The disturbed areas of the North and South basins will be reseeded, and total less the 1 acre. An offsite basin has been analyzed to verify culvert sizing for the access road. **Table 2-2** presents the proposed sub-basins and their corresponding acreages.

Table 2-2: Proposed Sub-Basin Acreages

Sub-Basin	Total Area (Acres)
Yard Area	5.23
Proposed North	6.70
Proposed South	2.44
Offsite	4.5

3.0 Drainage Design Criteria

3.1 Methodology

The hydrologic/hydraulic analysis of the site was performed using the Autodesk Storm and Sanitary analysis utilizing the Rational Method model for a 5-year and a 100-year rainfall event. Runoff Coefficients were obtained from El Paso County Drainage Criteria Manual Volume 1 Update, Chapter 6, Section 3.1, Table 6-6. Rainfall Intensity was obtained from EPC DCM Volume 1 Update, Figure 6-5. Modeling results are presented in **Appendix B**.

The Mile High Flood District *Detention Basin Design Workbook* was utilized to determine the required water quality capture volume (WQCV) and detention and to aid in the design the outlet structure. The spreadsheets/worksheets can be found in **Appendix A** and are discussed in more detail in **Section 4.0**.

Soil data was obtained from a Geotechnical Study provided by Yeh and Associates and gives a hydrologic soil group B for the site.

The described methods/tools used in the analysis, are in accordance with common engineering practices and guidelines.

3.2 Land Cover Hydrologic Properties

Runoff Coefficients and Percent Impervious numbers, for hydrologic soil group B, were assigned to the various land cover types found on the project, both existing and proposed, and are presented in **Table 3-1**.

Table 3-1: Land Cover Hydrologic Properties

Land Cover Type	Percent Impervious	Runoff Coefficient 5 Year	Runoff Coefficient 100 Year
Gravel	80	0.59	0.70
Historical Flow Analysis	2	0.09	0.36
Pond	100	0.85	0.89

3.3 Weighted Design Values

Utilizing the land cover hydrologic properties presented above, a weighted Runoff Coefficient and Percent Impervious value was calculated for each of the sub-basins, presented in **Section 2.0** to be used for analysis. **Table 3-2** presents the weighted design values for existing conditions and **Table 3-3** presents the weighted design values for proposed conditions. Detailed calculations can be found in **Appendix A**.

Table 3-2: Existing Sub-Basin Weighted Design Values

Sub-Basin	Total Area (Acres)	Weighted Percent Impervious	Weighted Runoff Coefficient 5 year	Weighted Runoff Coefficient 100 year
Existing	14.38	2%	0.09	0.36
Offsite	4.5	2%	0.09	0.36

Table 3-3: Proposed Sub-Basin Weighted Design Values

Sub-Basin	Total Area (Acres)	Weighted Percent Impervious	Weighted Runoff Coefficient 5 year	Weighted Runoff Coefficient 100 year
Yard Area	5.23	71%	0.55	0.68
Proposed North	6.70	5%	0.12	0.38
Proposed South	2.44	9%	0.14	0.40

4.0 Drainage Facility Design

4.1 Historical Drainage

Per common practice, the 100-year historical discharge value for the site shall be used to determine the allowable discharge from the site for the proposed conditions. Values presented in **Table 3-2** were used in the model to calculate a historical discharge rate for the existing property. **Table 4-1** presents the discharge rate for the existing property for both the 5-year and 100-year 1-hour storm events although the design is based on the 100-year discharge values.

Table 4-1: Existing Property Discharge Values

Sub-Basin	5-Year Discharge (CFS)	100-Year Discharge (CFS)
Existing	7.20	48.26
Offsite	2.36	15.81

4.2 Proposed Drainage

Values presented in **Table 3-3** were utilized in the model to calculate the runoff for the proposed conditions. The Mile High Flood District *Detention Basin Design Workbook* was utilized to determine the WQCV in conjunction with the model to size the detention pond. Once the pond was sized, the Mile High Flood District *Detention Basin Design Workbook* was utilized to estimate required orifice sizes in the outlet structure to provide water quality treatment. The model was then used to verify all design elements of the pond and the outlet structure to ensure the pond not only retained the correct WQCV but to also discharge at or less than the required 100-year historic discharge rate presented in **Table 4-1** as well as drain the pond in less than the allowable time per State Requirements. The spreadsheet showing the detailed calculations can be found in **Appendix A**. The design of the outlet structure is detailed in the grading drawings.

The west drainage swales that will receive run-on flows were not analyzed as the contributing areas are extremely small. These swales are designed as a V-bottom swale with 4:1 side slopes, a minimum depth of 1 foot, and a flow line slope of 0.5%. The swale has a max flow capacity 20cfs, which will easily convey the negligible run-on flows.

The proposed detention pond was designed to provide water quality treatment as well as detain the 100-year storm event while maintaining the required 1-foot of freeboard. The proposed detention pond stage-storage curve is presented in **Table 4-2**. The emergency spillway has been designed to convey the 100 year storm event, however the calculated 100 year water surface elevation is 1.5 feet below the emergency spillway.

Table 4-2: Detention Pond Stage-Storage Table

Elevation	Surface Area (Sq. Ft.)
7442.25	0
7443	1,640
7444	5,811
7445	11,212
7446	17,263
7447	23,884
7448	28,485

elevations do not match figures

The model of the proposed site conditions was utilized to calculate discharge flow rates from the outlet structure in order to size the pond discharge culvert. **Table 4-3** presents the hydraulic capacity of the culvert and the required capacity to discharge flow from the outlet structure for the 100-year event. Hydraulic calculations for the remainder of the piping systems and corresponding capacities are found in **Appendix B**.

Table 4-3: Outlet Pipe Hydraulic Capacity (100-year event)

Drainage Feature	Pipe Diameter (in)	Total Capacity (cfs)	Required Flow Capacity (cfs)	Remaining Capacity (cfs)
Pond Outlet	18	18.59	2.53	16.08

100-year event discharge is 12.7cfs (see UD-Detention Spreadsheet)

Table 4-4 presents the discharge rates for the proposed sub-basins for both the 5-year and 100-year 1-hour storm events prior to detention. This discharge value represents the flow rate that the pond is receiving. The discharge from the pond and other basins (total discharge from site) is summarized in **Table 5-1**.

Table 4-4: Proposed Sub-Basin Discharge Values (Pre-Detention)

Sub-Basin	5-Year Discharge (CFS)	100-Year Discharge (CFS)
Yard Area	12.13	25.16
Proposed North	4.15	22.03
Proposed South	2.03	9.73

Utilizing the flow rates presented above, the model was utilized to analyze the flow path of water through the piping and pond system. With the installation of the outlet structure, the pond was designed to pass both the 5-year and 100-year events, treat the required WQCV, and slowly release the water in the required length of time after the end of an event set forth by the State. The entire substation drains to the pond and the discharge rate leaving the pond is presented in **Table 5-1**.

5.0 Conclusions

5.1 Drainage Concept

The drainage design has been prepared using sound engineering judgement and practices and will provide an effective means of controlling runoff on the project site as well as protect the site from damage. The design has been completed according to common engineering practices and will result in no downstream impacts to any people or structures. Historic flow paths, discharge rates, and water quality have been maintained or improved.

5.2 Compliance with Common Practices

Per common practices, the historical discharge rate from the 100-year storm shall be utilized to determine the allowable discharge rate for the proposed improvements. To demonstrate compliance with this requirement, both the existing and proposed conditions were combined into one overall sub-basin. **Table 5-1** presents the overall discharge rates for the overall basin as well as the individual basins.

does not match UD-Detention calculations

Table 5-1: Overall Sub-Basin Discharge Values (Post Detention)

Basin	5-Year Discharge (CFS)		100-Year Discharge (CFS)	
	Existing	Proposed	Existing	Proposed
Yard Area (Pond Outlet)	7.2	0.09	48.26	2.53
North		4.15		22.03
South		2.03		9.73
Total	7.2	6.27	48.26	34.29

The pond outlet structure was sized according to common practices so that the proposed condition 100-year discharge rate is less than the required discharge rate from the 100-year storm event, resulting in compliance with common practices.

The detention pond was also sized according to UDFCD requirements to treat the WQCV, detain the 100-year event, maintain 1 foot of freeboard, and maintain historical discharge patterns resulting in no downstream impacts.

Inspections of the pond and outlet structure will be conducted by the owner on an annual basis as well as after large storm events. If deficiencies are identified or if maintenance is required, maintenance of the outlet structure will be performed by the owner of the property in an effort to return the structure to its original level of functionality. Maintenance may involve cleaning of sediment and debris from the facility, maintaining vegetation growth around the structure, and performing any additional maintenance required.

5.3 Four Step Process

The “Four Step Process” as recommended by the Urban Drainage Flood Control District has been addressed as follows:

Step 1 - Runoff Reduction

this section should discuss swales and pervious areas to remain pervious to promote runoff reduction. the pond is discussed in Step 3.

Runoff on the site has been reduced through the implementation of an Extended Detention Basin. More than 90% of the impervious and improved areas of the site are routed through the detention pond and outlet structure which has been sized to discharge at rates less than historic runoff.

Step 2 – Stabilized Drainageways

All swales proposed on the site will be stabilized with grass cover and the use of Rip-Rap armoring will be implemented in areas of higher concentration and/or velocity.

Step 3 – Provide Water Quality Capture Volume

The detention pond and outlet structure on site have been designed to achieve WQCV. The Mile High Flood District *Detention Basin Design Workbook* was utilized to determine the required water quality capture volume (WQCV) and to aid in the design of the outlet structure. The spreadsheets/worksheets can be found in **Appendix A** and are discussed in more detail in **Section 4.0**. The design was then analyzed with Autodesk Storm and Sanitary analysis utilizing the Rational Method model for a 5-year and a 100-year rainfall event. Modeling results are presented in **Appendix B**.

Step 4 – Consider Need for Industrial and Commercial BMPs

The site has low potential for industrial pollution upon the completion of construction. The improved areas of the site that could see vehicular traffic are all routed through the detention pond system where it receives water quality treatment. The electrical equipment found inside of the yard also utilizes local containment basins to prevent the spilling of contaminants within the yard.

Please address the comment on Drainage map concerning the pond outlet flow

Unresolved - dotschoenheit
03/23/2023 4:56:11 PM

Provide sw pipe calculations, drainage ditch calculations, culvert calculations, spillway riprap calculations, and riprap outlet protection calculations unresolved.

6.0 References

United States Department of Agriculture Natural Resources Conservation Service. Web Soil Survey

Mile High Flood District and Flood Control District. *Detention Basin Design Workbook*, Version 4.04, February 2021.

Urban Drainage and Flood Control District. *Urban Storm Drainage Criteria Manual*, Volume 1-3, June 2001.

El Paso County, Colorado, *Drainage Criteria Manual*, Volume 1-2, October 31, 2018

El Paso County, Colorado, *Engineering Criteria Manual*, December 13, 2016

Yeh and Associates, Inc. *Geotechnical Engineering Study, Fox Run Substation. Yeh Project Number 221-290*. November 11, 2021

Appendix A

Site Specific Physical Design Properties

Fox Run Drainage Design
Existing Conditions-5 Year

Area Name	Total Area		Flow Length	Slope (%)	TOC (min)
	(sf)	(acres)			
Existing	626336.766	14.38	1000	6%	4.70
Offsite	196020	4.50	700	4%	4.18

Land Cover Type	Percent Impervious	Runoff Coefficient
Historical Flow Analysis	2%	0.09
Gravel	80%	0.59
Pond	100%	0.85

Roughness Coefficient and Curve Number Analysis

Existing						
	<u>Description</u>	<u>Total Area (ac)</u>	<u>Runoff Coefficient</u>	<u>A*C</u>	<u>Percent Impervious</u>	<u>A*%</u>
Existing Site		14.38	0.09	1.29	2%	29%
			sum	1.29		29%
Total Area (ac)		14.379	Weighted	0.09		2%
Weighted Runoff Coefficient		0.09				
Weighted Percent Impervious		2%				

Offsite						
	<u>Description</u>	<u>Total Area (ac)</u>	<u>Runoff Coefficient</u>	<u>A*C</u>	<u>Percent Impervious</u>	<u>A*%</u>
Existing Site		4.50	0.09	0.41	2%	9%
			sum	0.41		9%
Total Area (ac)		4.500	Weighted	0.09		2%
Weighted Runoff Coefficient		0.09				
Weighted Percent Impervious		2%				

Fox Run Drainage Design

Proposed Conditions-5 Year

Area Name	Total Area		Flow Length	Slope (%)	TOC (min)
	(sf)	(acres)			
Yard	228010.3171	5.23	1000	1.00%	9.38
North Proposed	292051.9481	6.70	1000	5.00%	5.05
South Proposed	106271.1511	2.44	800	6.00%	3.96

Land Cover Type	Percent Impervious	Runoff Coefficient
Historical Flow Analysis	2%	0.09
Gravel	80%	0.59
Pond	100%	0.85

Roughness Coefficient and Curve Number Analysis

Yard					
Description	Total Area (ac)	Runoff Coefficient	A*C	Percent Impervious	A*%
Substation Yard	3.83	0.59	2.26	80%	306.2%
Native	0.75	0.09	0.07	2%	1.5%
Pond	0.66	0.85	0.56	100%	65.6%
		sum	2.88		373.4%
Total Area (ac)	5.23	Weighted	0.55		71%
Weighted Runoff Coefficient	0.55				
Weighted Percent Impervious	71%				

North Proposed					
Description	Total Area (ac)	Runoff Coefficient	A*C	Percent Impervious	A*%
Native	6.47	0.09	0.58	2%	12.9%
Swale	0.23	0.85	0.20	100%	23.2%
		sum	0.78		36.1%
Total Area (ac)	6.70	Weighted	0.12		5%
Weighted Runoff Coefficient	0.12				
Weighted Percent Impervious	5%				

South Proposed					
Description	Total Area (ac)	Runoff Coefficient	A*C	Percent Impervious	A*%
Native	2.24	0.09	0.20	2%	4.5%
Gravel	0.08	0.59	0.05	80%	6.2%
Swale	0.12	0.85	0.10	100%	12.0%
		sum	0.35		22.7%
Total Area (ac)	2.44	Weighted	0.14		9%
Weighted Runoff Coefficient	0.14				
Weighted Percent Impervious	9%				

Fox Run Drainage Design
Existing Conditions-100 Year

Area Name	Total Area		Flow Length	Slope (%)	TOC (min)
	(sf)	(acres)			
Existing	626336.766	14.38	1000	6%	4.70
Offsite	196020	4.50	700	4%	4.18

Land Cover Type	Percent Impervious	Runoff Coefficient
Historical Flow Analysis	2%	0.36
Gravel	80%	0.7
Pond	100%	0.89

Roughness Coefficient and Curve Number Analysis

Existing						
	<u>Description</u>	<u>Total Area (ac)</u>	<u>Runoff Coefficient</u>	<u>A*C</u>	<u>Percent Impervious</u>	<u>A*%</u>
Existing Site		14.38	0.36	5.18	2%	29%
			sum	5.18		29%
Total Area (ac)		14.379	Weighted	0.36		2%
Weighted Runoff Coefficient		0.36				
Weighted Percent Impervious		2%				

Offsite						
	<u>Description</u>	<u>Total Area (ac)</u>	<u>Runoff Coefficient</u>	<u>A*C</u>	<u>Percent Impervious</u>	<u>A*%</u>
Existing Site		4.50	0.36	1.62	2%	9%
			sum	1.62		9%
Total Area (ac)		4.500	Weighted	0.36		2%
Weighted Runoff Coefficient		0.36				
Weighted Percent Impervious		2%				

Fox Run Drainage Design

Proposed Conditions-100 Year

Area Name	Total Area		Flow Length	Slope (%)	TOC (min)
	(sf)	(acres)			
Yard	228010.3171	5.23	1000	1.00%	9.38
North Proposed	292051.9481	6.70	1000	5.00%	5.05
South Proposed	106271.1511	2.44	800	6.00%	3.96

Land Cover Type	Percent Impervious	Runoff Coefficient
Historical Flow Analysis	2%	0.36
Gravel	80%	0.7
Pond	100%	0.89

Roughness Coefficient and Curve Number Analysis

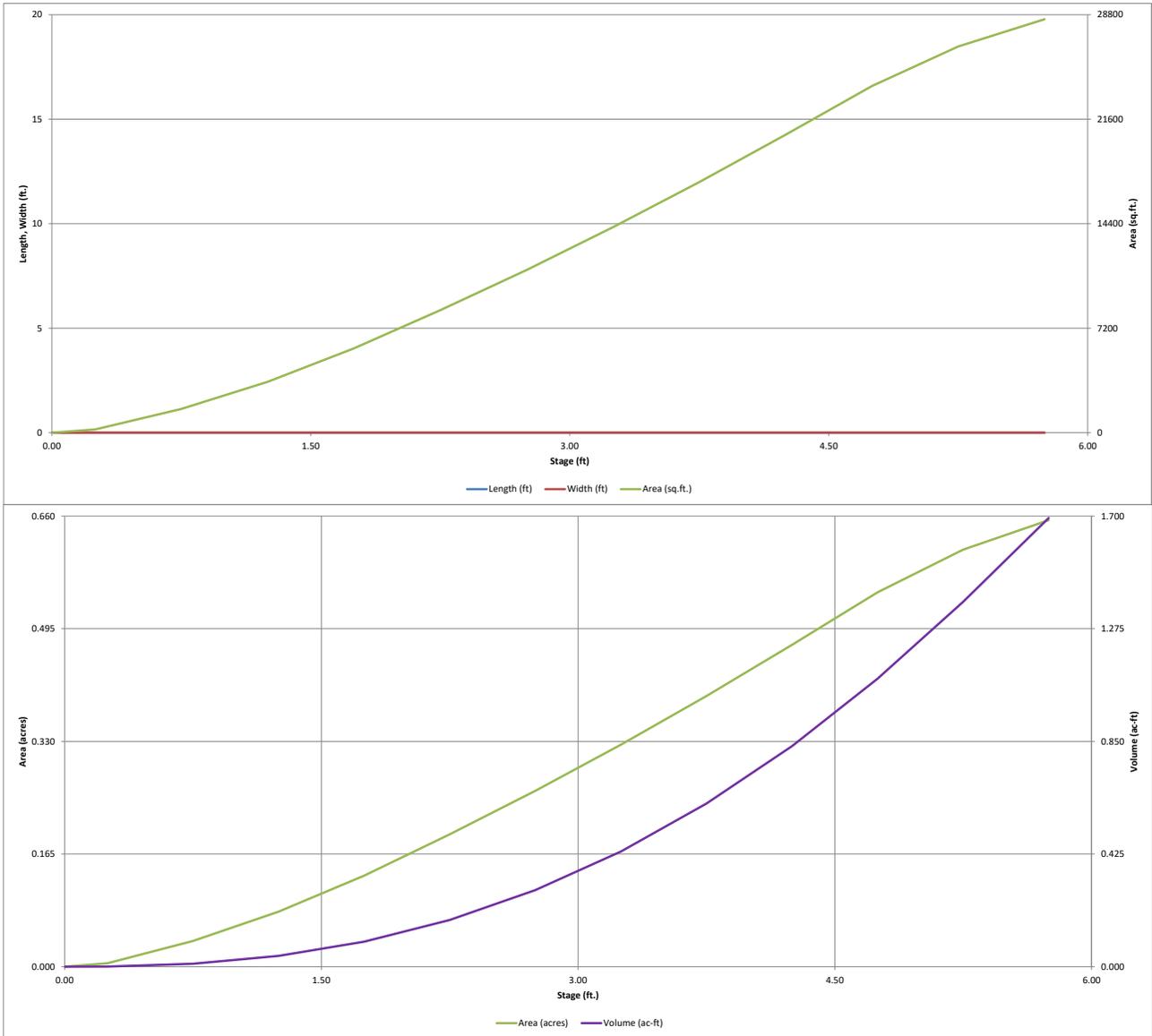
Yard					
Description	Total Area (ac)	Runoff Coefficient	A*C	Percent Impervious	A*%
Substation Yard	3.83	0.7	2.68	80%	306.2%
Native	0.75	0.36	0.27	2%	1.5%
Pond	0.66	0.89	0.58	100%	65.6%
		sum	3.53		373.4%
Total Area (ac)	5.23	Weighted	0.68		71%
Weighted Runoff Coefficient	0.68				
Weighted Percent Impervious	71%				

North Proposed					
Description	Total Area (ac)	Runoff Coefficient	A*C	Percent Impervious	A*%
Native	6.47	0.36	2.33	2%	12.9%
Swale	0.23	0.89	0.21	100%	23.2%
		sum	2.54		36.1%
Total Area (ac)	6.70	Weighted	0.38		5%
Weighted Runoff Coefficient	0.38				
Weighted Percent Impervious	5%				

South Proposed					
Description	Total Area (ac)	Runoff Coefficient	A*C	Percent Impervious	A*%
Native	2.24	0.36	0.81	2%	4.5%
Gravel	0.08	0.7	0.05	80%	6.2%
Swale	0.12	0.89	0.11	100%	12.0%
		sum	0.97		22.7%
Total Area (ac)	2.44	Weighted	0.40		9%
Weighted Runoff Coefficient	0.40				
Weighted Percent Impervious	9%				

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

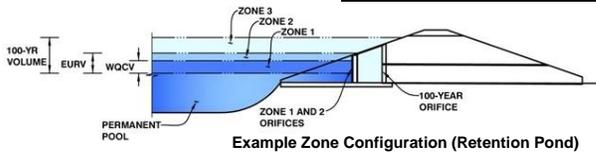
MHFD-Detention, Version 4.06 (July 2022)



DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Fox Run Substation
Basin ID: Detention Pond



	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.94	0.122	Orifice Plate
Zone 2 (EURV)	3.17	0.286	Orifice Plate
Zone 3 (100-year)	3.82	0.232	Weir&Pipe (Restrict)
Total (all zones)		0.640	

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

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

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

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

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

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

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.50	1.00	1.50	2.00			
Orifice Area (sq. inches)	0.44	0.44	0.44	0.44	0.44			

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

User Input: Vertical Orifice (Circular or Rectangular)

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

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

2.83?

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	<input type="text" value="2.50"/>	<input type="text" value="N/A"/>	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	<input type="text" value="4.00"/>	<input type="text" value="N/A"/>	feet
Overflow Weir Gate Slope =	<input type="text" value="0.00"/>	<input type="text" value="N/A"/>	H:V
Horiz. Length of Weir Sides =	<input type="text" value="2.50"/>	<input type="text" value="N/A"/>	feet
Overflow Gate Type =	<input type="text" value="Type C Gate"/>	<input type="text" value="N/A"/>	
Debris Clogging % =	<input type="text" value="0%"/>	<input type="text" value="N/A"/>	%

assume 50% (in accordance with MHFD Chapter 12)

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

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

0.25 shown on GEC

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	<input type="text" value="0.25"/>	<input type="text" value="N/A"/>	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	<input type="text" value="18.00"/>	<input type="text" value="N/A"/>	inches
Restrictor Plate Height Above Pipe Invert =	<input type="text" value="18.00"/>	<input type="text" value="N/A"/>	inches

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

User Input: Emergency Spillway (Rectangular or Trapezoidal)

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

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

Routed Hydrograph Results

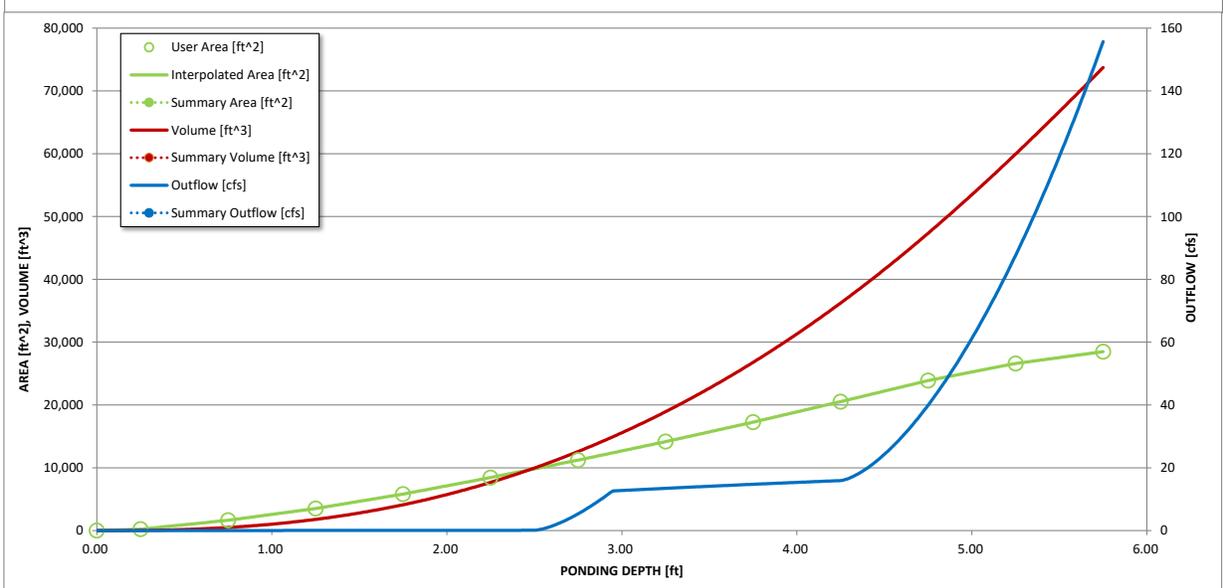
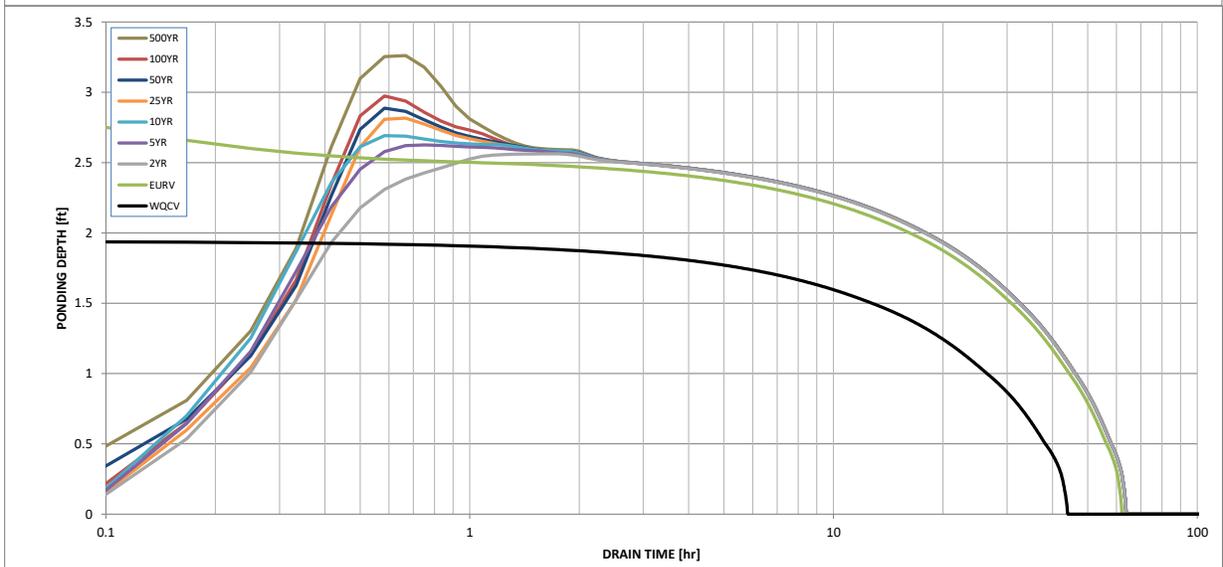
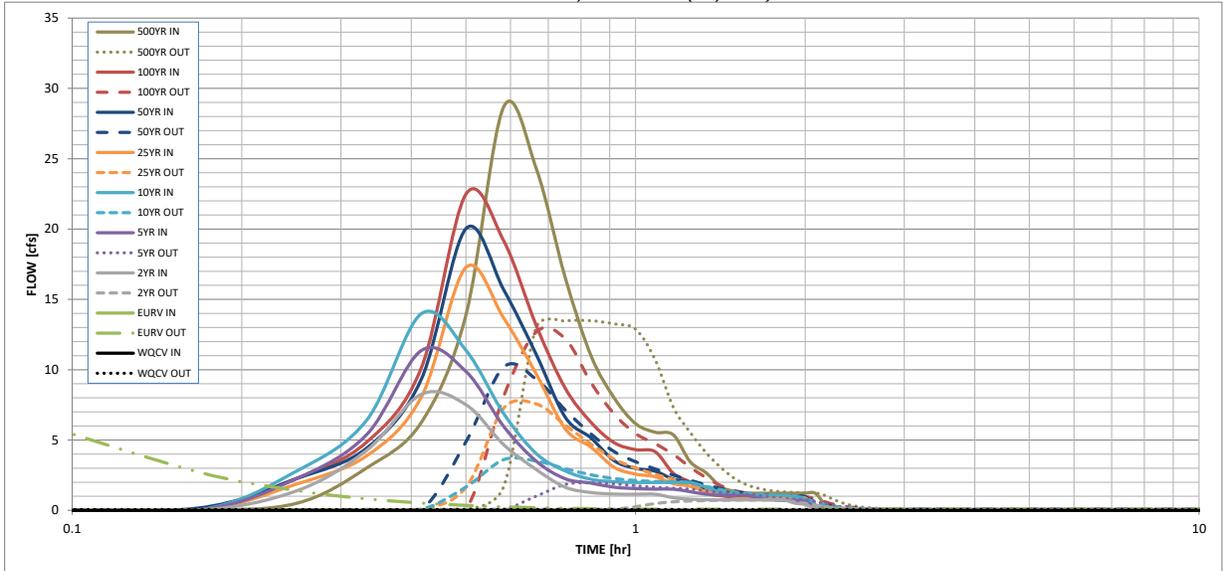
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
One-Hour Rainfall Depth (in)	0.122	0.408	0.299	0.402	0.489	0.590	0.681	0.788	1.017
CUHP Runoff Volume (acre-ft)	N/A	N/A	0.299	0.402	0.489	0.590	0.681	0.788	1.017
Inflow Hydrograph Volume (acre-ft)	N/A	N/A	1.1	3.3	4.8	7.7	9.7	12.4	17.1
CUHP Predevelopment Peak Q (cfs)	N/A	N/A							
OPTIONAL Override Predevelopment Peak Q (cfs)	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre)	N/A	N/A	0.22	0.62	0.92	1.48	1.86	2.37	3.27
Peak Inflow Q (cfs)	N/A	N/A	8.3	11.4	14.0	17.3	20.0	22.5	28.7
Peak Outflow Q (cfs)	0.1	12.8	0.7	2.0	3.6	7.6	10.2	12.7	13.5
Ratio Peak Outflow to Predevelopment Q	N/A	N/A	N/A	0.6	0.8	1.0	1.0	1.0	0.8
Structure Controlling Flow	Plate	Outlet Plate 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1				
Max Velocity through Gate 1 (fps)	N/A	1.89	0.09	0.3	0.5	1.1	1.5	1.8	1.9
Max Velocity through Gate 2 (fps)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours)	39	51	54	52	51	49	48	46	43
Time to Drain 99% of Inflow Volume (hours)	42	57	59	58	57	56	56	55	53
Maximum Ponding Depth (ft)	1.95	3.17	2.56	2.63	2.69	2.82	2.89	2.97	3.26
Area at Maximum Ponding Depth (acres)	0.16	0.31	0.23	0.24	0.25	0.27	0.27	0.29	0.33
Maximum Volume Stored (acre-ft)	0.123	0.409	0.242	0.257	0.274	0.305	0.324	0.349	0.438

these should be weir/pipe

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)



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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

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

Time Interval	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.02	0.50
	0:15:00	0.00	0.00	1.39	2.25	2.79	1.87	2.25	2.26	3.02
	0:20:00	0.00	0.00	4.27	5.39	6.42	3.88	4.43	4.85	6.25
	0:25:00	0.00	0.00	8.25	11.36	13.98	8.06	9.33	10.14	13.89
	0:30:00	0.00	0.00	7.51	9.88	11.38	17.27	20.03	22.48	28.68
	0:35:00	0.00	0.00	4.67	5.97	6.88	13.67	15.69	19.17	24.28
	0:40:00	0.00	0.00	2.90	3.49	4.03	9.68	11.07	13.12	16.56
	0:45:00	0.00	0.00	1.65	2.25	2.81	5.81	6.63	8.69	11.01
	0:50:00	0.00	0.00	1.27	1.94	2.21	4.50	5.15	6.27	7.98
	0:55:00	0.00	0.00	1.16	1.65	2.04	3.06	3.53	4.81	6.17
	1:00:00	0.00	0.00	1.15	1.55	1.98	2.58	2.99	4.32	5.56
	1:05:00	0.00	0.00	1.15	1.51	1.98	2.39	2.78	4.17	5.37
	1:10:00	0.00	0.00	0.90	1.51	1.99	1.90	2.22	2.64	3.46
	1:15:00	0.00	0.00	0.80	1.33	1.99	1.71	2.00	2.01	2.68
	1:20:00	0.00	0.00	0.75	1.15	1.66	1.35	1.56	1.27	1.67
	1:25:00	0.00	0.00	0.75	1.07	1.27	1.22	1.40	1.04	1.36
	1:30:00	0.00	0.00	0.75	1.05	1.11	0.99	1.13	0.96	1.24
	1:35:00	0.00	0.00	0.75	1.05	1.06	0.91	1.03	0.95	1.22
	1:40:00	0.00	0.00	0.75	0.84	1.06	0.88	0.99	0.95	1.22
	1:45:00	0.00	0.00	0.75	0.75	1.06	0.88	0.99	0.95	1.22
	1:50:00	0.00	0.00	0.75	0.71	1.06	0.88	0.99	0.95	1.22
	1:55:00	0.00	0.00	0.52	0.71	0.98	0.88	0.99	0.95	1.22
	2:00:00	0.00	0.00	0.42	0.65	0.81	0.88	0.99	0.95	1.22
	2:05:00	0.00	0.00	0.15	0.24	0.30	0.33	0.37	0.36	0.46
	2:10:00	0.00	0.00	0.05	0.08	0.09	0.11	0.12	0.12	0.15
	2:15:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02
	2:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 3

Designer: Thayne Clement
Company: Del-Mont Consultants
Date: March 21, 2023
Project: Fox Run Substation
Location: Monument, CO

1. Basin Storage Volume

A) Effective Imperviousness of Tributary Area, I_a

B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)

C) Contributing Watershed Area

D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm

E) Design Concept
(Select EURV when also designing for flood control)

F) Design Volume (WQCV) Based on 40-hour Drain Time
($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area)$)

G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume
($V_{WQCV\ OTHER} = (d_6 * V_{DESIGN} / 0.43)$)

H) User Input of Water Quality Capture Volume (WQCV) Design Volume
(Only if a different WQCV Design Volume is desired)

I) NRCS Hydrologic Soil Groups of Tributary Watershed
 i) Percentage of Watershed consisting of Type A Soils
 ii) Percentage of Watershed consisting of Type B Soils
 iii) Percentage of Watershed consisting of Type C/D Soils

J) Excess Urban Runoff Volume (EURV) Design Volume
 For HSG A: $EURV_A = 1.68 * i^{1.28}$
 For HSG B: $EURV_B = 1.36 * i^{1.08}$
 For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$

K) User Input of Excess Urban Runoff Volume (EURV) Design Volume
(Only if a different EURV Design Volume is desired)

$I_a =$ %
 $i =$
 Area = ac
 $d_6 =$ in

Choose One
 Water Quality Capture Volume (WQCV)
 Excess Urban Runoff Volume (EURV)

$V_{DESIGN} =$ ac-ft
 $V_{DESIGN\ OTHER} =$ ac-ft
 $V_{DESIGN\ USER} =$ ac-ft

$HSG_A =$ %
 $HSG_B =$ %
 $HSG_{C/D} =$ %

$EURV_{DESIGN} =$ ac-ft
 $EURV_{DESIGN\ USER} =$ ac-ft

2. Basin Shape: Length to Width Ratio
(A basin length to width ratio of at least 2:1 will improve TSS reduction.)

$L : W =$: 1 INCREASE FLOW PATH FOR 2:1 RATIO

3. Basin Side Slopes

A) Basin Maximum Side Slopes
(Horizontal distance per unit vertical, 4:1 or flatter preferred)

$Z =$ ft / ft

4. Inlet

A) Describe means of providing energy dissipation at concentrated inflow locations:

5. Forebay

A) Minimum Forebay Volume
($V_{MIN} =$ of the WQCV)

B) Actual Forebay Volume

C) Forebay Depth
($D_F =$ inch maximum)

D) Forebay Discharge
 i) Undetained 100-year Peak Discharge
 ii) Forebay Discharge Design Flow
($Q_F = 0.02 * Q_{100}$)

E) Forebay Discharge Design

F) Discharge Pipe Size (minimum 8-inches)

G) Rectangular Notch Width

$V_{MIN} =$ ac-ft
 $V_F =$ ac-ft
 $D_F =$ in ← 15"

$Q_{100} =$ cfs
 $Q_F =$ cfs

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

Calculated $D_P =$ in

Calculated $W_N =$ in

Flow too small for berm w/ pipe

forebay should be 87cf.
current design is only 45

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Thayne Clement
Company: Del-Mont Consultants
Date: March 21, 2023
Project: Fox Run Substation
Location: Monument, CO

<p>6. Trickle Channel</p> <p>A) Type of Trickle Channel</p> <p>F) Slope of Trickle Channel</p>	<div style="border: 1px solid black; padding: 2px; margin-bottom: 10px;"> Choose One <input checked="" type="radio"/> Concrete <input type="radio"/> Soft Bottom </div> <p>S = <input type="text" value="0.0050"/> ft / ft</p>
<p>7. Micropool and Outlet Structure</p> <p>A) Depth of Micropool (2.5-foot minimum)</p> <p>B) Surface Area of Micropool (10 ft² minimum)</p> <p>C) Outlet Type</p> <p>D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)</p> <p>E) Total Outlet Area</p>	<p>D_M = <input type="text" value="2.5"/> ft</p> <p>A_M = <input type="text" value="11"/> sq ft</p> <div style="border: 1px solid black; padding: 2px; margin-bottom: 10px;"> Choose One <input checked="" type="radio"/> Orifice Plate <input type="radio"/> Other (Describe): </div> <hr/> <hr/> <p>D_{orifice} = <input type="text" value="0.75"/> inches</p> <p>A_{orifice} = <input type="text" value="2.20"/> square inches</p>
<p>8. Initial Surcharge Volume</p> <p>A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)</p> <p>B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV)</p> <p>C) Initial Surcharge Provided Above Micropool</p>	<p>D_{IS} = <input type="text" value="4"/> in</p> <p>V_{IS} = <input type="text"/> cu ft</p> <p>V_s = <input type="text" value="3.7"/> cu ft</p>
<p>9. Trash Rack</p> <p>A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5 * (e^{-0.095D})$</p> <p>B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open are to the total screen are for the material specified.)</p> <p style="margin-left: 40px;">Other (Y/N): <input type="text" value="N"/></p> <p>C) Ratio of Total Open Area to Total Area (only for type 'Other')</p> <p>D) Total Water Quality Screen Area (based on screen type)</p> <p>E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)</p> <p>F) Height of Water Quality Screen (H_{TR})</p> <p>G) Width of Water Quality Screen Opening (W_{opening}) (Minimum of 12 inches is recommended)</p>	<p>A_t = <input type="text" value="79"/> square inches</p> <div style="border: 1px solid black; padding: 2px; margin-bottom: 10px; width: fit-content;"> S.S. Well Screen with 60% Open Area </div> <hr/> <hr/> <p>User Ratio = <input type="text"/></p> <p>A_{total} = <input type="text" value="131"/> sq. in.</p> <p>H = <input type="text" value="3.17"/> feet</p> <p>H_{TR} = <input type="text" value="66.04"/> inches</p> <p>W_{opening} = <input type="text" value="12.0"/> inches VALUE LESS THAN RECOMMENDED MIN. WIDTH. WIDTH HAS BEEN SET TO 12 INCHES.</p>

Design Procedure Form: Extended Detention Basin (EDB)

Sheet 3 of 3

Designer: Thayne Clement
Company: Del-Mont Consultants
Date: March 21, 2023
Project: Fox Run Substation
Location: Monument, CO

<p>10. Overflow Embankment</p> <p>A) Describe embankment protection for 100-year and greater overtopping:</p> <p>B) Slope of Overflow Embankment (Horizontal distance per unit vertical, 4:1 or flatter preferred)</p>	<p>_____</p> <p>_____</p> <p>_____</p> <p>Ze = <input type="text" value="4.00"/> ft / ft</p>
---	--

<p>11. Vegetation</p>	<p>Choose One</p> <p><input type="radio"/> Irrigated</p> <p><input checked="" type="radio"/> Not Irrigated</p>
-----------------------	--

<p>12. Access</p> <p>A) Describe Sediment Removal Procedures</p>	<p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>
--	--

Notes: _____

Appendix B

Rational Method Modeling Results

Project Description

File Name 21036-Fox Run Drainage - RM5.SPF

Project Options

Flow Units CFS
Elevation Type Elevation
Hydrology Method Rational
Time of Concentration (TOC) Method Kirpich
Link Routing Method Kinematic Wave
Enable Overflow Ponding at Nodes YES
Skip Steady State Analysis Time Periods NO

Analysis Options

Start Analysis On 00:00:00 0:00:00
End Analysis On 00:00:00 0:00:00
Start Reporting On 00:00:00 0:00:00
Antecedent Dry Days 0 days
Runoff (Dry Weather) Time Step 0 01:00:00 days hh:mm:ss
Runoff (Wet Weather) Time Step 0 00:05:00 days hh:mm:ss
Reporting Time Step 0 00:05:00 days hh:mm:ss
Routing Time Step 30 seconds

Number of Elements

	Qty
Rain Gages	0
Subbasins	5
Nodes.....	8
<i>Junctions</i>	4
<i>Outfalls</i>	3
<i>Flow Diversions</i>	0
<i>Inlets</i>	0
<i>Storage Nodes</i>	1
Links.....	11
<i>Channels</i>	1
<i>Pipes</i>	3
<i>Pumps</i>	0
<i>Orifices</i>	5
<i>Weirs</i>	2
<i>Outlets</i>	0
Pollutants	0
Land Uses	0

Rainfall Details

Return Period..... 5 year(s)

Subbasin Summary

SN Subbasin ID	Area (ac)	Weighted Runoff Coefficient	Average Slope (%)	Flow Length (ft)	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1 Existing	14.38	0.0900	6.0000	1000.00	0.43	0.04	0.56	7.20	0 00:04:42
2 Offsite	4.50	0.0900	4.0000	700.00	0.40	0.04	0.16	2.36	0 00:04:10
3 Proposed-North	6.70	0.1200	5.0000	1000.00	0.43	0.05	0.35	4.14	0 00:05:03
4 Proposed-South	2.44	0.1400	6.0000	800.00	0.40	0.06	0.14	2.03	0 00:03:57
5 Yard	5.23	0.5500	1.0000	1000.00	0.66	0.36	1.89	12.13	0 00:09:22

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft ²)	Peak Inflow (cfs)	Max HGL Elevation (ft)	Max Surcharge Depth (ft)	Min Freeboard (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Culvert-In	Junction	7462.72	7464.00	0.00	0.00	0.00	2.36	7463.02	0.00	1.70	0 00:00	0.00	0.00
2	Culvert-Out	Junction	7460.63	7462.00	0.00	0.00	0.00	2.34	7460.93	0.00	1.70	0 00:00	0.00	0.00
3	Pipe-Out	Junction	7440.60	7442.00	0.00	7446.00	0.00	0.09	7440.68	0.00	1.42	0 00:00	0.00	0.00
4	Pond-Out	Junction	7441.67	7447.00	0.00	7447.00	0.00	0.09	7441.75	0.00	5.67	0 00:00	0.00	0.00
5	Existing-Out	Outfall	7435.00					7.20	7435.00					
6	Out-North	Outfall	7435.00					4.16	7435.04					
7	Out-South	Outfall	7435.00					4.27	7435.00					
8	Pond	Storage Node	7442.25	7448.00	0.00		0.00	12.13	7444.38				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
1	Access-Culvert	Pipe	Culvert-In	Culvert-Out	52.25	7462.72	7460.63	4.0000	24.000	0.0120	2.34	49.02	0.05	9.37	0.30	0.15	0.00	Calculated
2	Link-04	Pipe	Culvert-Out	Out-South	414.64	0.00	7435.00	-1793.1200	0.000	0.0150	2.34	0.00	0.05	0.00	0.30	0.15	0.00	Calculated
3	Out-Pipe	Pipe	Pond-Out	Pipe-Out	60.00	7441.67	7440.60	1.7800	18.000	0.0120	0.09	15.20	0.01	2.30	0.08	0.05	0.00	Calculated
4	Out-Swale	Channel	Pipe-Out	Out-North	150.00	7440.60	7435.00	3.7300	12.000	0.0270	0.09	44.66	0.00	1.11	0.04	0.04	0.00	
5	Orifice-01	Orifice	Pond	Pond-Out		7442.25	7441.67		0.750		0.02							
6	Orifice-02	Orifice	Pond	Pond-Out		7442.25	7441.67		0.750		0.02							
7	Orifice-03	Orifice	Pond	Pond-Out		7442.25	7441.67		0.750		0.02							
8	Orifice-04	Orifice	Pond	Pond-Out		7442.25	7441.67		0.750		0.01							
9	Orifice-05	Orifice	Pond	Pond-Out		7442.25	7441.67		0.750		0.01							
10	Spillway	Weir	Pond	Pond-Out		7442.25	7441.67				0.00							
11	Weir	Weir	Pond	Pond-Out		7442.25	7441.67				0.00							

Subbasin Hydrology

Subbasin : Existing

Input Data

Area (ac) 14.38
 Weighted Runoff Coefficient 0.09
 Average Slope (%) 6
 Flow Length (ft) 1000

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	14.38	-	0.09
Composite Area & Weighted Runoff Coeff.	14.38		0.09

Time of Concentration

TOC Method : Kirpich

Sheet Flow Equation :

$$T_c = (0.0078 * ((L_f^{0.77}) * (S_f^{-0.385})))$$

Where :

Tc = Time of Concentration (min)

Lf = Flow Length (ft)

Sf = Slope (ft/ft)

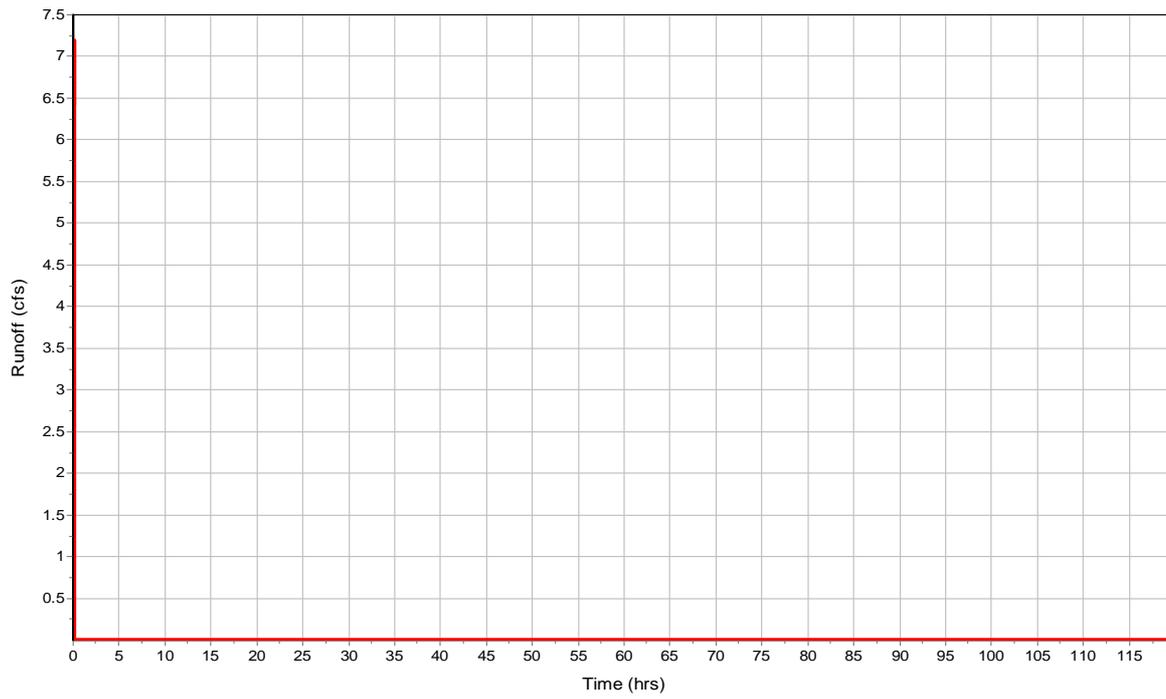
Flow Length (ft) 1000
 Slope (%) 6
 Computed TOC (min) 4.7

Subbasin Runoff Results

Total Rainfall (in) 0.43
 Total Runoff (in) 0.04
 Peak Runoff (cfs) 7.2
 Rainfall Intensity 5.562
 Weighted Runoff Coefficient 0.09
 Time of Concentration (days hh:mm:ss) 0 00:04:42

Subbasin : Existing

Runoff Hydrograph



Subbasin : Offsite

Input Data

Area (ac) 4.5
Weighted Runoff Coefficient 0.09
Average Slope (%) 4
Flow Length (ft) 700

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	4.5	-	0.09
Composite Area & Weighted Runoff Coeff.	4.5		0.09

Time of Concentration

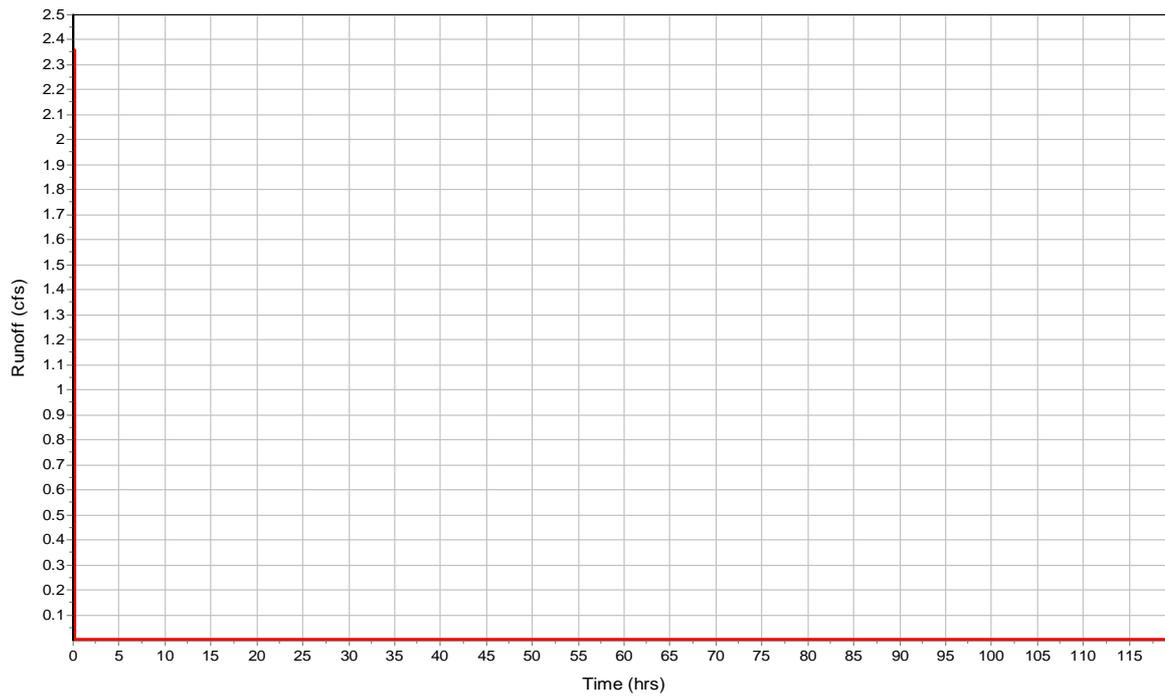
Flow Length (ft) 700
Slope (%) 4
Computed TOC (min) 4.18

Subbasin Runoff Results

Total Rainfall (in) 0.4
Total Runoff (in) 0.04
Peak Runoff (cfs) 2.36
Rainfall Intensity 5.825
Weighted Runoff Coefficient 0.09
Time of Concentration (days hh:mm:ss) 0 00:04:11

Subbasin : Offsite

Runoff Hydrograph



Subbasin : Proposed-North

Input Data

Area (ac) 6.7
 Weighted Runoff Coefficient 0.12
 Average Slope (%) 5
 Flow Length (ft) 1000

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	6.7	-	0.12
Composite Area & Weighted Runoff Coeff.	6.7		0.12

Time of Concentration

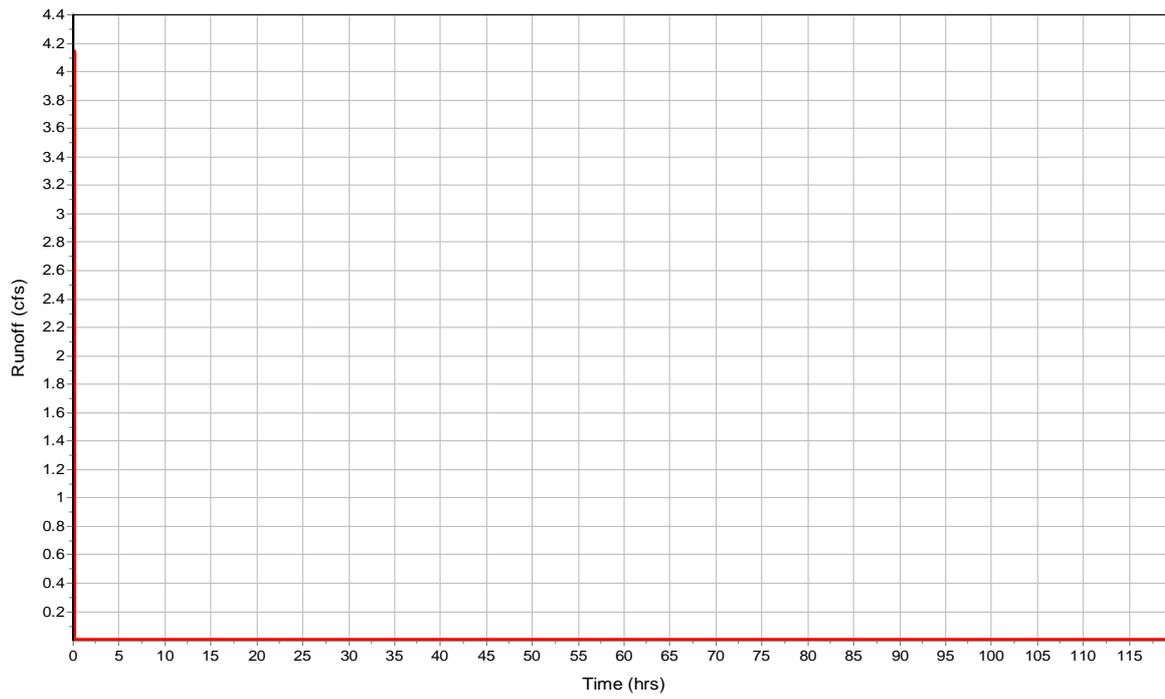
Flow Length (ft) 1000
 Slope (%) 5
 Computed TOC (min) 5.05

Subbasin Runoff Results

Total Rainfall (in) 0.43
 Total Runoff (in) 0.05
 Peak Runoff (cfs) 4.14
 Rainfall Intensity 5.153
 Weighted Runoff Coefficient 0.12
 Time of Concentration (days hh:mm:ss) 0 00:05:03

Subbasin : Proposed-North

Runoff Hydrograph



Subbasin : Proposed-South

Input Data

Area (ac) 2.44
Weighted Runoff Coefficient 0.14
Average Slope (%) 6
Flow Length (ft) 800

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	2.44	-	0.14
Composite Area & Weighted Runoff Coeff.	2.44		0.14

Time of Concentration

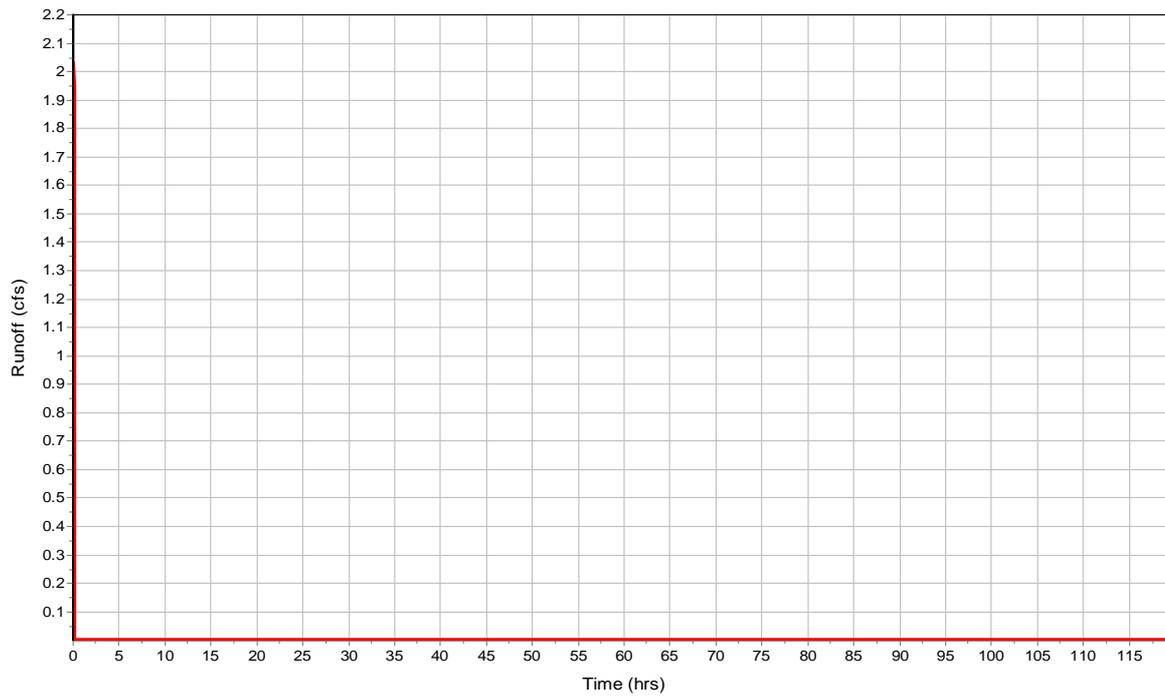
Flow Length (ft) 800
Slope (%) 6
Computed TOC (min) 3.96

Subbasin Runoff Results

Total Rainfall (in) 0.4
Total Runoff (in) 0.06
Peak Runoff (cfs) 2.03
Rainfall Intensity 5.95
Weighted Runoff Coefficient 0.14
Time of Concentration (days hh:mm:ss) 0 00:03:58

Subbasin : Proposed-South

Runoff Hydrograph



Subbasin : Yard

Input Data

Area (ac) 5.23
Weighted Runoff Coefficient 0.55
Average Slope (%) 1
Flow Length (ft) 1000

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	5.23	-	0.55
Composite Area & Weighted Runoff Coeff.	5.23		0.55

Time of Concentration

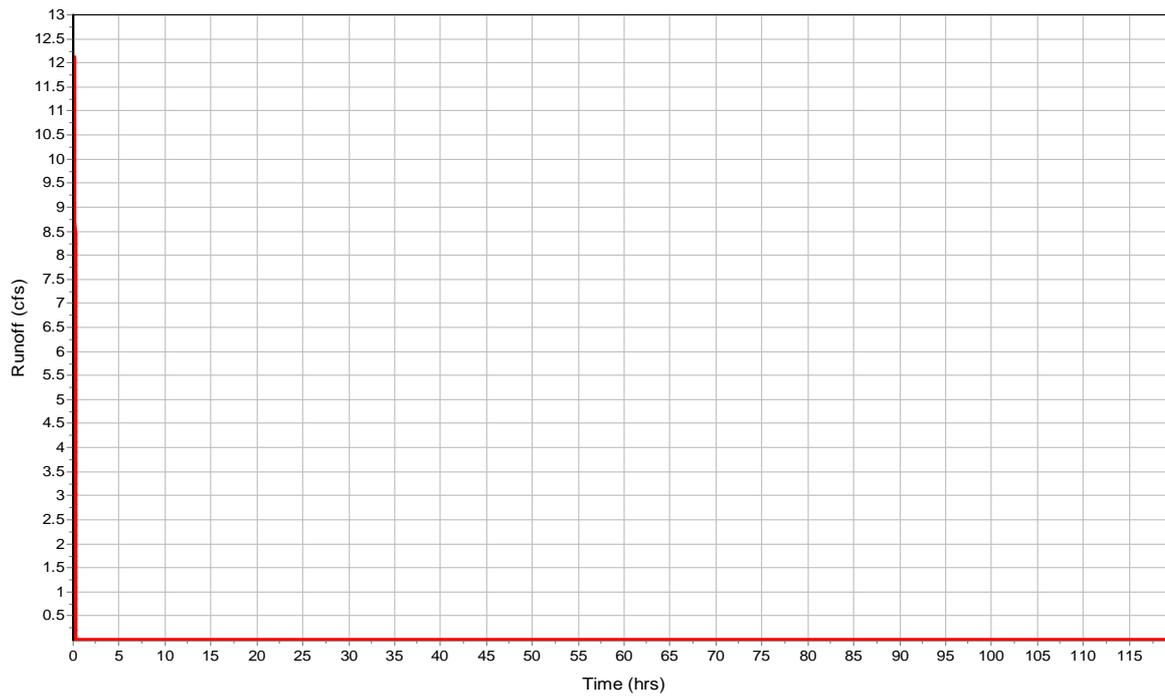
Flow Length (ft) 1000
Slope (%) 1
Computed TOC (min) 9.38

Subbasin Runoff Results

Total Rainfall (in) 0.66
Total Runoff (in) 0.36
Peak Runoff (cfs) 12.13
Rainfall Intensity 4.217
Weighted Runoff Coefficient 0.55
Time of Concentration (days hh:mm:ss) 0 00:09:23

Subbasin : Yard

Runoff Hydrograph



Junction Input

SN Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft²)	Minimum Pipe Cover (in)
1 Culvert-In	7462.72	7464.00	1.28	0.00	-7462.72	0.00	-7464.00	0.00	0.00
2 Culvert-Out	7460.63	7462.00	1.37	0.00	-7460.63	0.00	-7462.00	0.00	0.00
3 Pipe-Out	7440.60	7442.00	1.40	0.00	-7440.60	7446.00	4.00	0.00	0.00
4 Pond-Out	7441.67	7447.00	5.33	0.00	-7441.67	7447.00	0.00	0.00	0.00

Junction Results

SN Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation (ft)	Max HGL Depth (ft)	Max Surcharge Depth (ft)	Min Freeboard (ft)	Average HGL Elevation (ft)	Average HGL Depth (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1 Culvert-In	2.36	2.36	7463.02	0.30	0.00	1.70	7462.72	0.00	0 00:04	0 00:00	0.00	0.00
2 Culvert-Out	2.34	0.00	7460.93	0.30	0.00	1.70	7460.63	0.00	0 00:04	0 00:00	0.00	0.00
3 Pipe-Out	0.09	0.00	7440.68	0.08	0.00	1.42	7440.62	0.02	0 00:19	0 00:00	0.00	0.00
4 Pond-Out	0.09	0.00	7441.75	0.08	0.00	5.67	7441.69	0.02	0 00:18	0 00:00	0.00	0.00

Channel Input

SN Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Shape	Height (ft)	Width (ft)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
1 Out-Swale	150.00	7440.60	0.00	7435.00	0.00	5.60	3.7300	Trapezoidal	1.000	10.000	0.0270	0.5000	0.5000	0.0000	0.00	No

Channel Results

SN Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1 Out-Swale	0.09	0 00:21	44.66	0.00	1.11	2.25	0.04	0.04	0.00		

Pipe Input

SN Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Pipe Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
1 Access-Culvert	52.25	7462.72	0.00	7460.63	0.00	2.09	4.0000	CIRCULAR	24.000	24.000	0.0120	0.5000	0.5000	0.0000	0.00	No
2 Link-04	414.64	0.00	-7460.63	7435.00	0.00	-7435.00	-1793.1200	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No
3 Out-Pipe	60.00	7441.67	0.00	7440.60	0.00	1.07	1.7800	CIRCULAR	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No

21036 Fox Run Substation
5 Year Storm Event

No. of
Barrels

1
1
1

Pipe Results

SN Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1 Access-Culvert	2.34	0 00:04	49.02	0.05	9.37	0.09	0.30	0.15	0.00		Calculated
2 Link-04	2.34	0 00:04	0.00	0.05	0.00		0.30	0.15	0.00		Calculated
3 Out-Pipe	0.09	0 00:19	15.20	0.01	2.30	0.43	0.08	0.05	0.00		Calculated

Storage Nodes

Storage Node : Pond

Input Data

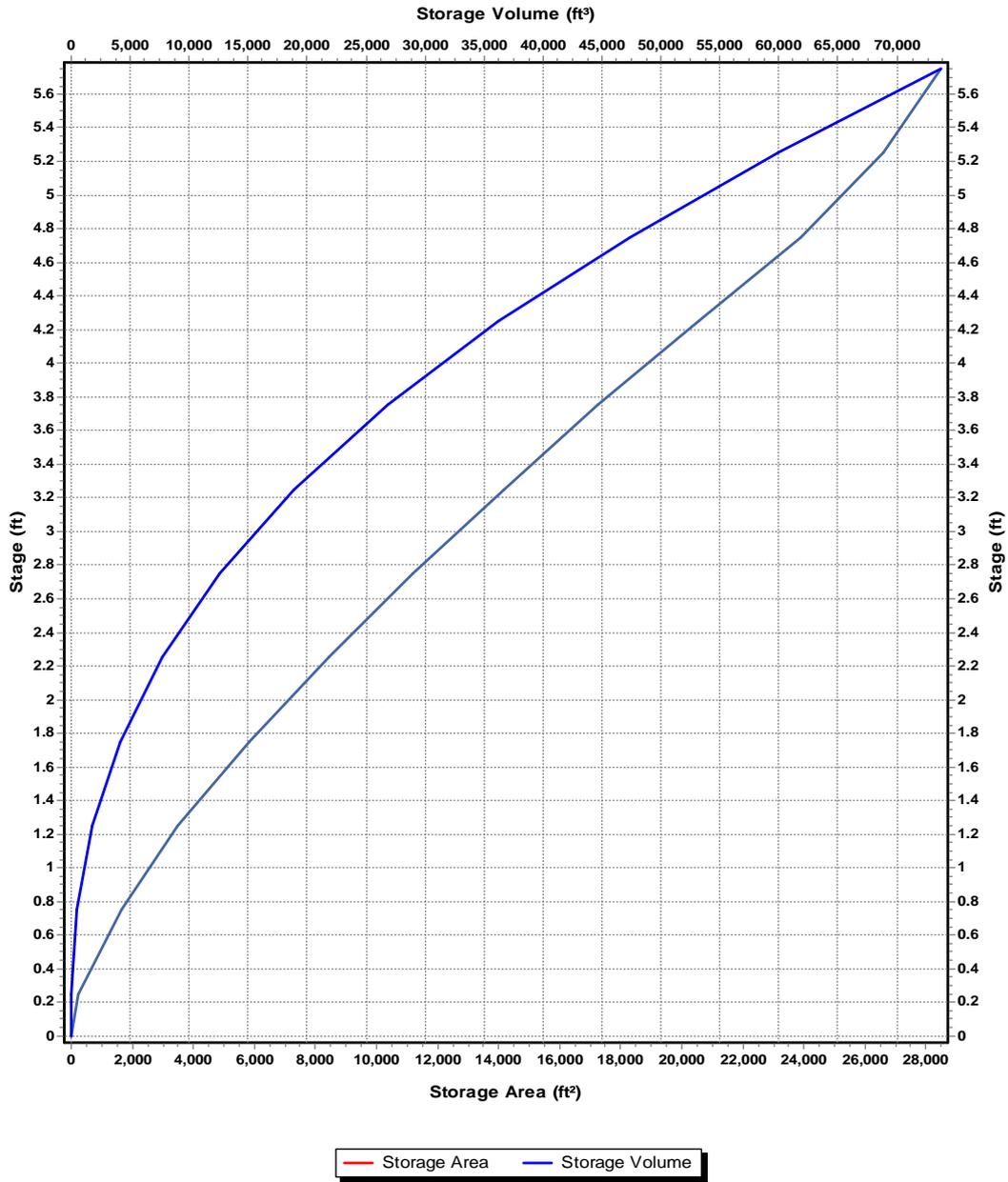
Invert Elevation (ft) 7442.25
Max (Rim) Elevation (ft) 7448
Max (Rim) Offset (ft) 5.75
Initial Water Elevation (ft) 0
Initial Water Depth (ft) -7442.25
Ponded Area (ft²) 0
Evaporation Loss 0

Storage Area Volume Curves

Storage Curve : Detention-Pond

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	0	0
0.25	222	27.75
0.75	1640	493.25
1.25	3509	1780.5
1.75	5810	4110.25
2.25	8441	7673
2.75	11212	12586.25
3.25	14161	18929.5
3.75	17263	26785.5
4.25	20531	36234
4.75	23884	47337.75
5.25	26606	59960.25
5.75	28486	73733.25

Storage Area Volume Curves



Storage Node : Pond (continued)

Outflow Weirs

SN Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1 Spillway	Trapezoidal	No	7447.00	4.75	10.00	1.00	3.37
2 Weir	Rectangular	No	7444.75	2.50	4.00	1.00	3.33

Outflow Orifices

SN Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1 Orifice-01	Side	CIRCULAR	No	0.75			7441.92	0.61
2 Orifice-02	Side	CIRCULAR	No	0.75			7442.42	0.61
3 Orifice-03	Side	CIRCULAR	No	0.75			7442.92	0.61
4 Orifice-04	Side	CIRCULAR	No	0.75			7443.42	0.61
5 Orifice-05	Side	CIRCULAR	No	0.75			7443.92	0.61

Output Summary Results

Peak Inflow (cfs)	12.13
Peak Lateral Inflow (cfs)	12.13
Peak Outflow (cfs)	0.09
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	7444.38
Max HGL Depth Attained (ft)	2.13
Average HGL Elevation Attained (ft)	7442.66
Average HGL Depth Attained (ft)	0.41
Time of Max HGL Occurrence (days hh:mm)	0 00:18
Total Exfiltration Volume (1000-ft³)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Project Description

File Name 21036-Fox Run Drainage - RM100.SPF

Project Options

Flow Units CFS
Elevation Type Elevation
Hydrology Method Rational
Time of Concentration (TOC) Method Kirpich
Link Routing Method Kinematic Wave
Enable Overflow Ponding at Nodes YES
Skip Steady State Analysis Time Periods NO

Analysis Options

Start Analysis On 00:00:00 0:00:00
End Analysis On 00:00:00 0:00:00
Start Reporting On 00:00:00 0:00:00
Antecedent Dry Days 0 days
Runoff (Dry Weather) Time Step 0 01:00:00 days hh:mm:ss
Runoff (Wet Weather) Time Step 0 00:05:00 days hh:mm:ss
Reporting Time Step 0 00:05:00 days hh:mm:ss
Routing Time Step 30 seconds

Number of Elements

	Qty
Rain Gages	0
Subbasins	5
Nodes.....	8
<i>Junctions</i>	4
<i>Outfalls</i>	3
<i>Flow Diversions</i>	0
<i>Inlets</i>	0
<i>Storage Nodes</i>	1
Links.....	11
<i>Channels</i>	1
<i>Pipes</i>	3
<i>Pumps</i>	0
<i>Orifices</i>	5
<i>Weirs</i>	2
<i>Outlets</i>	0
Pollutants	0
Land Uses	0

Rainfall Details

Return Period..... 100 year(s)

Subbasin Summary

SN Subbasin ID	Area (ac)	Weighted Runoff Coefficient	Average Slope (%)	Flow Length (ft)	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1 Existing	14.38	0.3600	6.0000	1000.00	0.73	0.26	3.75	48.26	0 00:04:42
2 Offsite	4.50	0.3600	4.0000	700.00	0.68	0.24	1.10	15.81	0 00:04:10
3 Proposed-North	6.70	0.3800	5.0000	1000.00	0.72	0.27	1.84	22.03	0 00:05:03
4 Proposed-South	2.44	0.4000	6.0000	800.00	0.67	0.27	0.65	9.73	0 00:03:57
5 Yard	5.23	0.6800	1.0000	1000.00	1.10	0.75	3.91	25.16	0 00:09:22

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft ²)	Peak Inflow (cfs)	Max HGL Elevation (ft)	Max Surcharge Depth (ft)	Min Freeboard (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Culvert-In	Junction	7462.72	7464.00	0.00	0.00	0.00	15.81	7463.50	0.00	1.22	0 00:00	0.00	0.00
2	Culvert-Out	Junction	7460.63	7462.00	0.00	0.00	0.00	15.74	7461.41	0.00	1.22	0 00:00	0.00	0.00
3	Pipe-Out	Junction	7440.60	7442.10	0.00	7446.00	0.00	2.53	7440.97	0.00	1.13	0 00:00	0.00	0.00
4	Pond-Out	Junction	7441.67	7447.00	0.00	7447.00	0.00	2.53	7442.04	0.00	5.38	0 00:00	0.00	0.00
5	Existing-Out	Outfall	7435.00					48.26	7435.00					
6	Out-North	Outfall	7435.00					22.05	7435.25					
7	Out-South	Outfall	7435.00					25.02	7435.00					
8	Pond	Storage Node	7442.25	7448.00	0.00		0.00	25.16	7445.07				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Reported (min)	Surcharged Condition
1	Access-Culvert	Pipe	Culvert-In	Culvert-Out	52.25	7462.72	7460.63	4.0000	24.000	0.0120	15.74	49.02	0.32	14.33	0.78	0.39	0.00	Calculated
2	Link-04	Pipe	Culvert-Out	Out-South	414.64	0.00	7435.00	-1793.1200	0.000	0.0150	15.74	0.00	0.32	0.00	0.78	0.39	0.00	Calculated
3	Out-Pipe	Pipe	Pond-Out	Pipe-Out	40.00	7441.67	7440.60	2.6700	18.000	0.0120	2.53	18.61	0.14	7.37	0.37	0.25	0.00	Calculated
4	Out-Swale	Channel	Pipe-Out	Out-North	150.00	7440.60	7435.00	3.7300	12.000	0.0270	2.53	44.66	0.06	3.44	0.25	0.25	0.00	
5	Orifice-01	Orifice	Pond	Pond-Out		7442.25	7441.67		0.750		0.03							
6	Orifice-02	Orifice	Pond	Pond-Out		7442.25	7441.67		0.750		0.02							
7	Orifice-03	Orifice	Pond	Pond-Out		7442.25	7441.67		0.750		0.02							
8	Orifice-04	Orifice	Pond	Pond-Out		7442.25	7441.67		0.750		0.02							
9	Orifice-05	Orifice	Pond	Pond-Out		7442.25	7441.67		0.750		0.02							
10	Spillway	Weir	Pond	Pond-Out		7442.25	7441.67				0.00							
11	Weir	Weir	Pond	Pond-Out		7442.25	7441.67				2.42							

Subbasin Hydrology

Subbasin : Existing

Input Data

Area (ac) 14.38
 Weighted Runoff Coefficient 0.36
 Average Slope (%) 6
 Flow Length (ft) 1000

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	14.38	-	0.36
Composite Area & Weighted Runoff Coeff.	14.38		0.36

Time of Concentration

TOC Method : Kirpich

Sheet Flow Equation :

$$T_c = (0.0078 * ((L_f^{0.77}) * (S_f^{-0.385})))$$

Where :

Tc = Time of Concentration (min)
 Lf = Flow Length (ft)
 Sf = Slope (ft/ft)

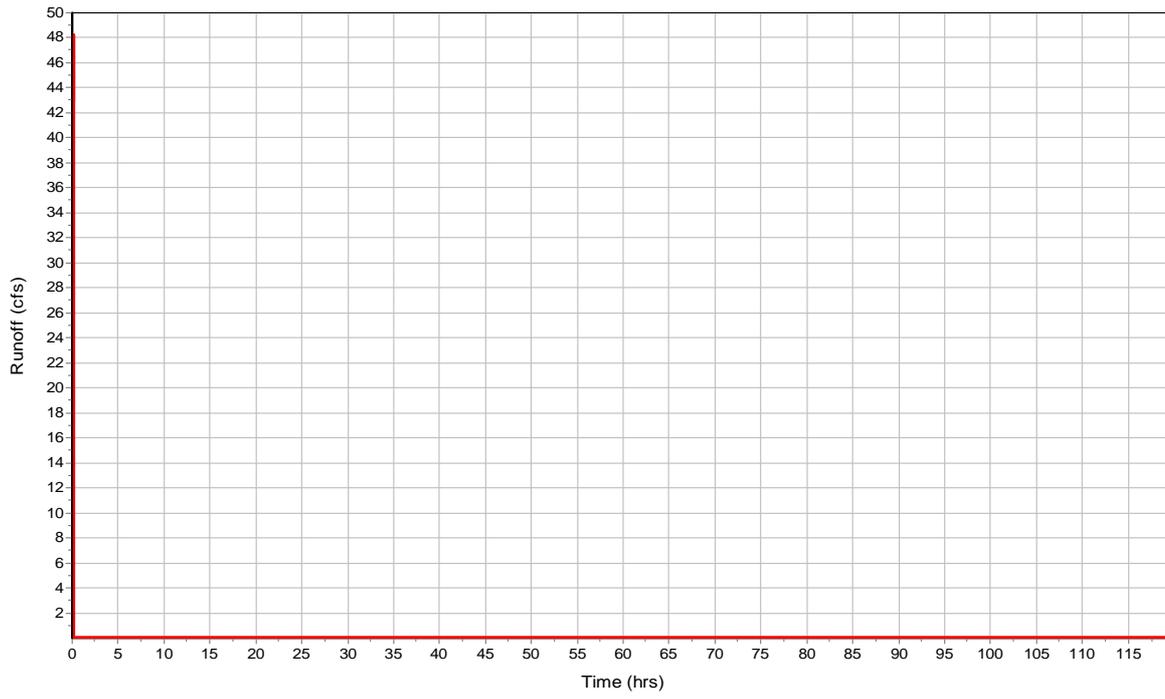
Flow Length (ft) 1000
 Slope (%) 6
 Computed TOC (min) 4.7

Subbasin Runoff Results

Total Rainfall (in) 0.73
 Total Runoff (in) 0.26
 Peak Runoff (cfs) 48.26
 Rainfall Intensity 9.322
 Weighted Runoff Coefficient 0.36
 Time of Concentration (days hh:mm:ss) 0 00:04:42

Subbasin : Existing

Runoff Hydrograph



Subbasin : Offsite

Input Data

Area (ac) 4.5
Weighted Runoff Coefficient 0.36
Average Slope (%) 4
Flow Length (ft) 700

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	4.5	-	0.36
Composite Area & Weighted Runoff Coeff.	4.5		0.36

Time of Concentration

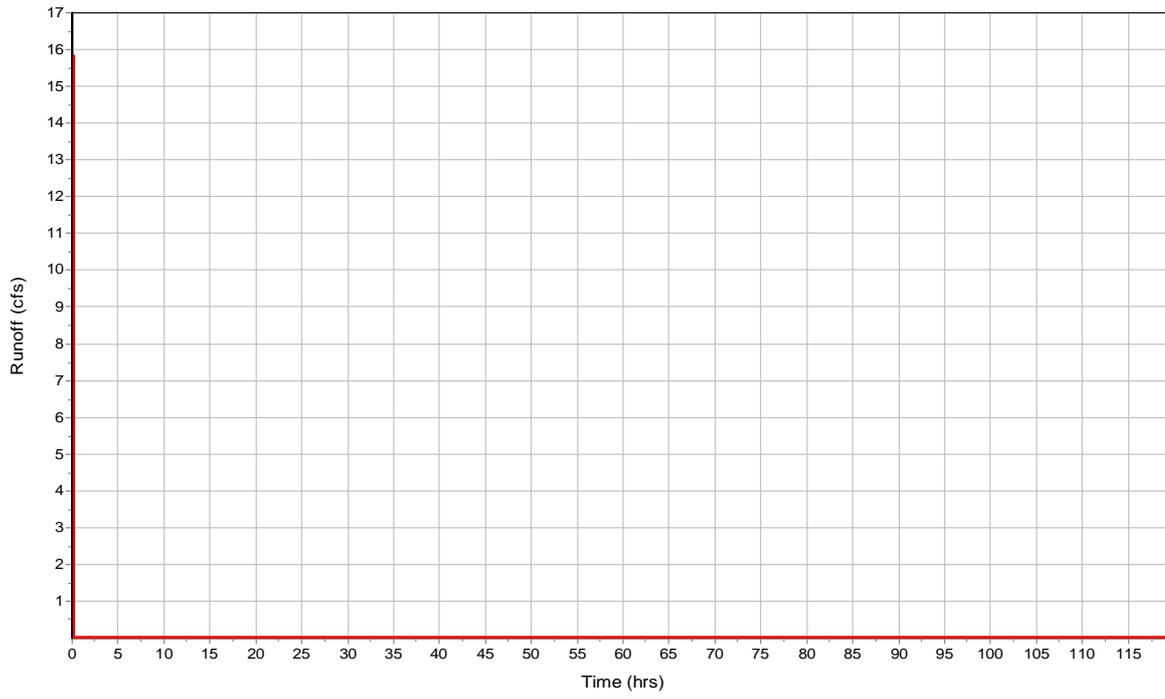
Flow Length (ft) 700
Slope (%) 4
Computed TOC (min) 4.18

Subbasin Runoff Results

Total Rainfall (in) 0.68
Total Runoff (in) 0.24
Peak Runoff (cfs) 15.81
Rainfall Intensity 9.761
Weighted Runoff Coefficient 0.36
Time of Concentration (days hh:mm:ss) 0 00:04:11

Subbasin : Offsite

Runoff Hydrograph



Subbasin : Proposed-North

Input Data

Area (ac) 6.7
Weighted Runoff Coefficient 0.38
Average Slope (%) 5
Flow Length (ft) 1000

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	6.7	-	0.38
Composite Area & Weighted Runoff Coeff.	6.7		0.38

Time of Concentration

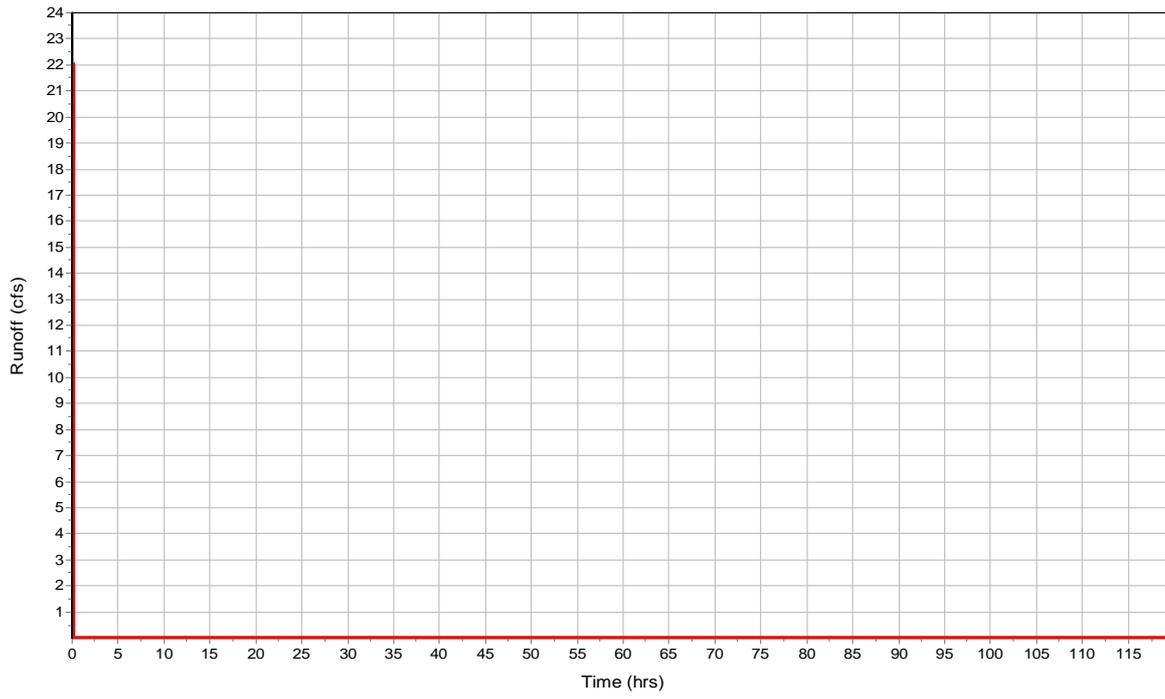
Flow Length (ft) 1000
Slope (%) 5
Computed TOC (min) 5.05

Subbasin Runoff Results

Total Rainfall (in) 0.72
Total Runoff (in) 0.27
Peak Runoff (cfs) 22.03
Rainfall Intensity 8.652
Weighted Runoff Coefficient 0.38
Time of Concentration (days hh:mm:ss) 0 00:05:03

Subbasin : Proposed-North

Runoff Hydrograph



Subbasin : Proposed-South

Input Data

Area (ac) 2.44
Weighted Runoff Coefficient 0.4
Average Slope (%) 6
Flow Length (ft) 800

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	2.44	-	0.4
Composite Area & Weighted Runoff Coeff.	2.44		0.4

Time of Concentration

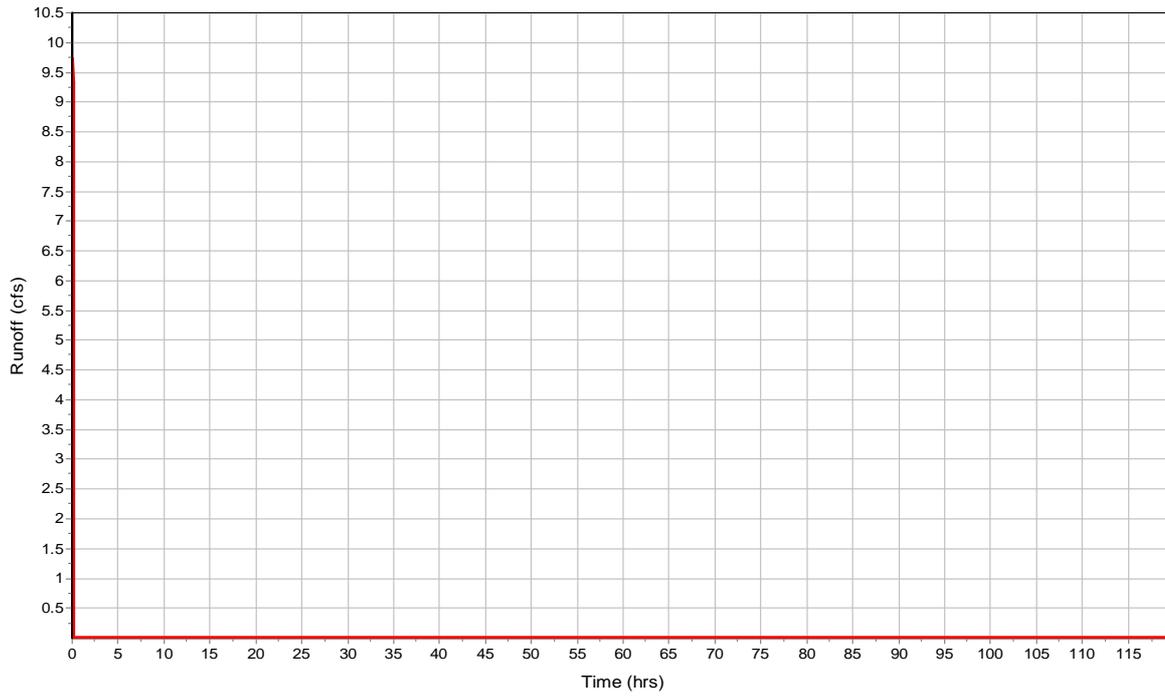
Flow Length (ft) 800
Slope (%) 6
Computed TOC (min) 3.96

Subbasin Runoff Results

Total Rainfall (in) 0.67
Total Runoff (in) 0.27
Peak Runoff (cfs) 9.73
Rainfall Intensity 9.97
Weighted Runoff Coefficient 0.4
Time of Concentration (days hh:mm:ss) 0 00:03:58

Subbasin : Proposed-South

Runoff Hydrograph



Subbasin : Yard

Input Data

Area (ac) 5.23
Weighted Runoff Coefficient 0.68
Average Slope (%) 1
Flow Length (ft) 1000

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	5.23	-	0.68
Composite Area & Weighted Runoff Coeff.	5.23		0.68

Time of Concentration

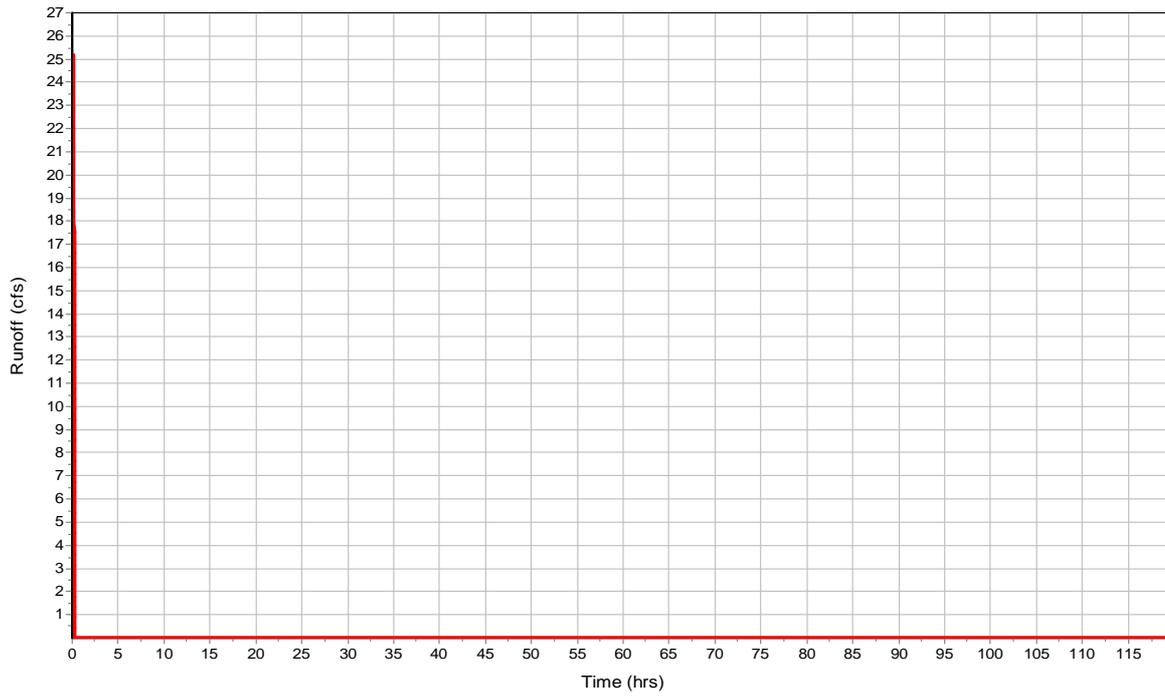
Flow Length (ft) 1000
Slope (%) 1
Computed TOC (min) 9.38

Subbasin Runoff Results

Total Rainfall (in) 1.1
Total Runoff (in) 0.75
Peak Runoff (cfs) 25.16
Rainfall Intensity 7.076
Weighted Runoff Coefficient 0.68
Time of Concentration (days hh:mm:ss) 0 00:09:23

Subbasin : Yard

Runoff Hydrograph



Junction Input

SN Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft²)	Minimum Pipe Cover (in)
1 Culvert-In	7462.72	7464.00	1.28	0.00	-7462.72	0.00	-7464.00	0.00	0.00
2 Culvert-Out	7460.63	7462.00	1.37	0.00	-7460.63	0.00	-7462.00	0.00	0.00
3 Pipe-Out	7440.60	7442.10	1.50	0.00	-7440.60	7446.00	3.90	0.00	0.00
4 Pond-Out	7441.67	7447.00	5.33	0.00	-7441.67	7447.00	0.00	0.00	0.00

Junction Results

SN Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1 Culvert-In	15.81	15.81	7463.50	0.78	0.00	1.22	7462.72	0.00	0 00:04	0 00:00	0.00	0.00
2 Culvert-Out	15.74	0.00	7461.41	0.78	0.00	1.22	7460.63	0.00	0 00:04	0 00:00	0.00	0.00
3 Pipe-Out	2.53	0.00	7440.97	0.37	0.00	1.13	7440.63	0.03	0 00:17	0 00:00	0.00	0.00
4 Pond-Out	2.53	0.00	7442.04	0.37	0.00	5.38	7441.70	0.03	0 00:17	0 00:00	0.00	0.00

Channel Input

SN Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Shape	Height (ft)	Width (ft)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
1 Out-Swale	150.00	7440.60	0.00	7435.00	0.00	5.60	3.7300	Trapezoidal	1.000	10.000	0.0270	0.5000	0.5000	0.0000	0.00	No

Channel Results

SN Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
	(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
1 Out-Swale	2.53	0 00:18	44.66	0.06	3.44	0.73	0.25	0.25	0.00		

Pipe Input

SN Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Pipe Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
1 Access-Culvert	52.25	7462.72	0.00	7460.63	0.00	2.09	4.0000	CIRCULAR	24.000	24.000	0.0120	0.5000	0.5000	0.0000	0.00	No
2 Link-04	414.64	0.00	-7460.63	7435.00	0.00	-7435.00	-1793.1200	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No
3 Out-Pipe	40.00	7441.67	0.00	7440.60	0.00	1.07	2.6700	CIRCULAR	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No

21036 Fox Run Substation
100 Year Storm Event

No. of
Barrels

1
1
1

Pipe Results

SN Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
	(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
1 Access-Culvert	15.74	0 00:04	49.02	0.32	14.33	0.06	0.78	0.39	0.00		Calculated
2 Link-04	15.74	0 00:04	0.00	0.32	0.00		0.78	0.39	0.00		Calculated
3 Out-Pipe	2.53	0 00:17	18.61	0.14	7.37	0.09	0.37	0.25	0.00		Calculated

Storage Nodes

Storage Node : Pond

Input Data

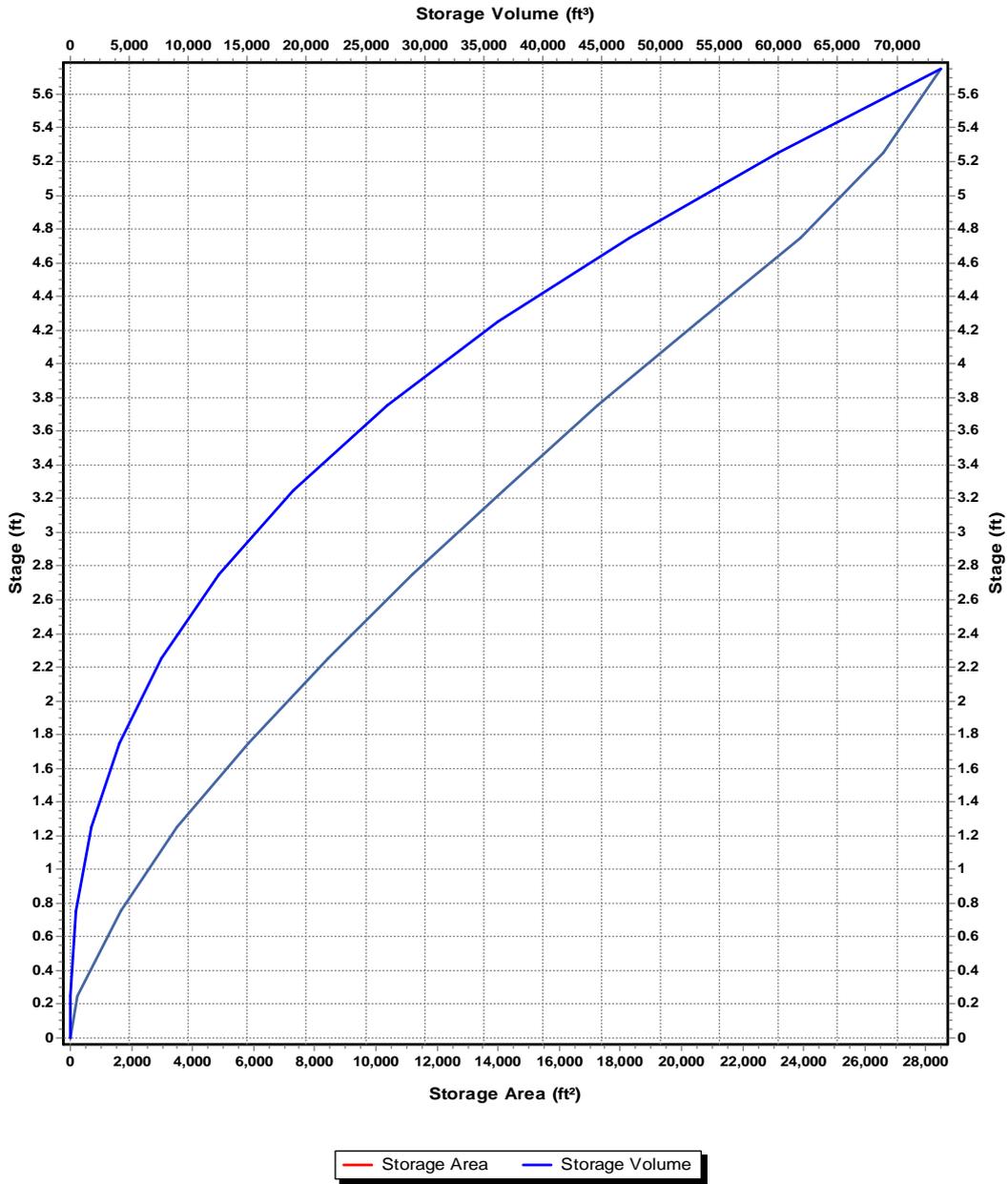
Invert Elevation (ft) 7442.25
Max (Rim) Elevation (ft) 7448
Max (Rim) Offset (ft) 5.75
Initial Water Elevation (ft) 0
Initial Water Depth (ft) -7442.25
Ponded Area (ft²) 0
Evaporation Loss 0

Storage Area Volume Curves

Storage Curve : Detention-Pond

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	0	0
0.25	222	27.75
0.75	1640	493.25
1.25	3509	1780.5
1.75	5810	4110.25
2.25	8441	7673
2.75	11212	12586.25
3.25	14161	18929.5
3.75	17263	26785.5
4.25	20531	36234
4.75	23884	47337.75
5.25	26606	59960.25
5.75	28486	73733.25

Storage Area Volume Curves



Storage Node : Pond (continued)

Outflow Weirs

SN Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1 Spillway	Trapezoidal	No	7447.00	4.75	10.00	1.00	3.37
2 Weir	Rectangular	No	7444.75	2.50	4.00	1.00	3.33

Outflow Orifices

SN Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1 Orifice-01	Side	CIRCULAR	No	0.75			7441.92	0.61
2 Orifice-02	Side	CIRCULAR	No	0.75			7442.42	0.61
3 Orifice-03	Side	CIRCULAR	No	0.75			7442.92	0.61
4 Orifice-04	Side	CIRCULAR	No	0.75			7443.42	0.61
5 Orifice-05	Side	CIRCULAR	No	0.75			7443.92	0.61

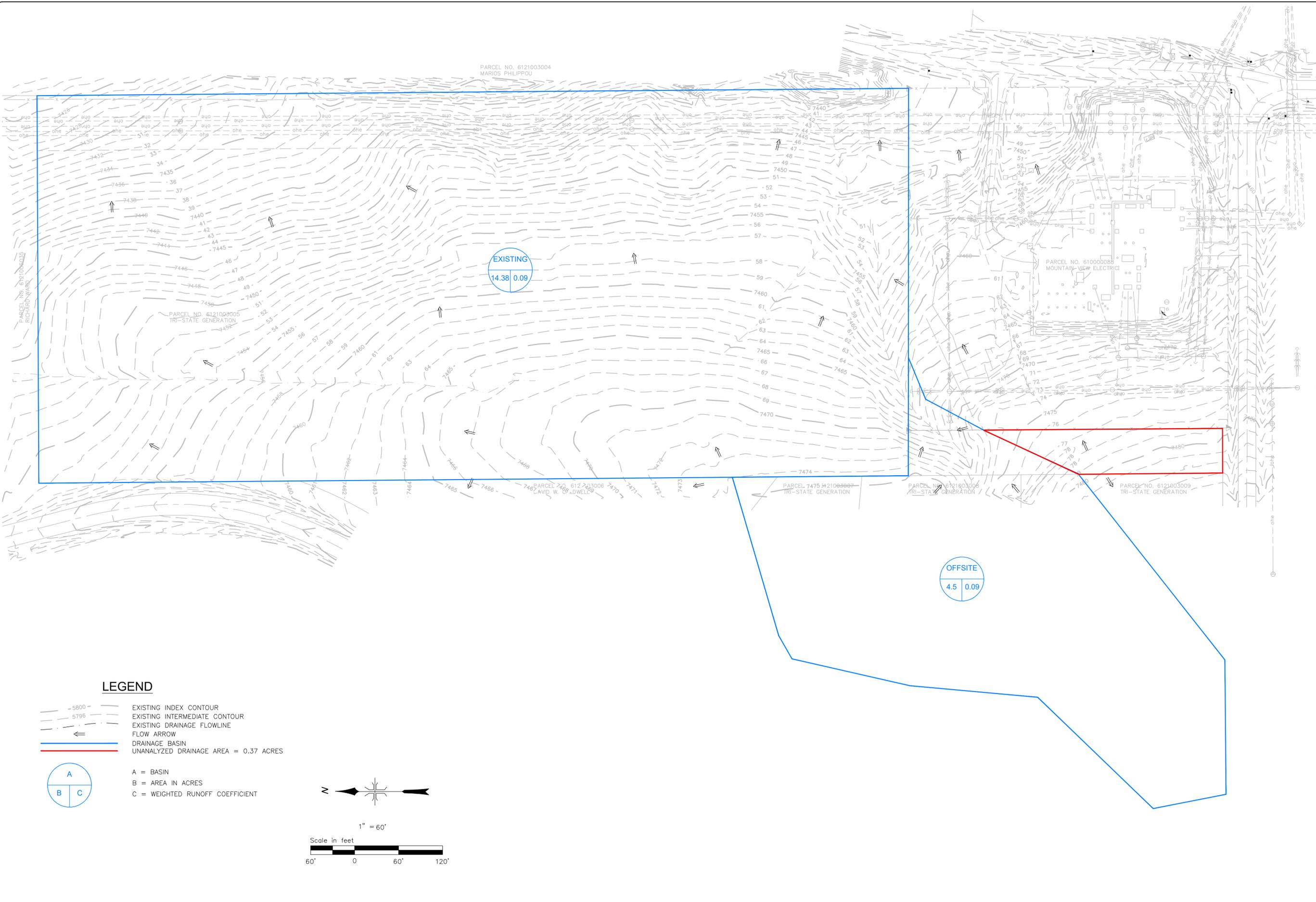
Output Summary Results

Peak Inflow (cfs)	25.16
Peak Lateral Inflow (cfs)	25.16
Peak Outflow (cfs)	2.53
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	7445.07
Max HGL Depth Attained (ft)	2.82
Average HGL Elevation Attained (ft)	7442.89
Average HGL Depth Attained (ft)	0.64
Time of Max HGL Occurrence (days hh:mm)	0 00:17
Total Exfiltration Volume (1000-ft³)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Appendix C

Site Maps & Design Drawings

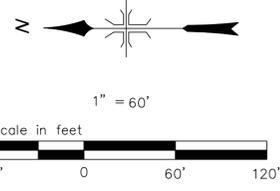
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LEGEND

- 5800 - EXISTING INDEX CONTOUR
- 5796 - EXISTING INTERMEDIATE CONTOUR
- EXISTING DRAINAGE FLOWLINE
- FLOW ARROW
- DRAINAGE BASIN
- UNANALYZED DRAINAGE AREA = 0.37 ACRES

- A = BASIN
- B = AREA IN ACRES
- C = WEIGHTED RUNOFF COEFFICIENT



NO	DATE	REVISIONS	BY

DMC DEL-MONT CONSULTANTS, INC.
ENGINEERING & SURVEYING
122 Colorado Ave., Aurora, CO 80012
TEL: (303) 249-2522 FAX: (303) 249-2523
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SCALE: _____ AS NOTED
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TRI-STATE GENERATION & TRANSMISSION
FOX RUN SUBSTATION
MONUMENT, CO

DMC JOB NO: 21036
SHEET NO: C-1

The manner of flow has changed from sheet flow to concentrated flow. Analyze the conveyance path up to the suitable outfall as defined in ECM 3.2.4. The conveyance path must be hydraulically adequate/stable.

Unresolved. Add a paragraph or section in the Drainage Facility design summarizing the results.
 - Identify the velocity along the highlighted section and state whether it's within the permissible non-erosive velocity for the given soil, ground cover, and slope. Mitigation will be required if the concentrated pond discharge is likely to erode the existing ground downstream of the proposed swale. Contact the review engineer to discuss if additional clarification is required.

Unresolved - dotschoenheit
 03/23/2023 4:50:44 PM

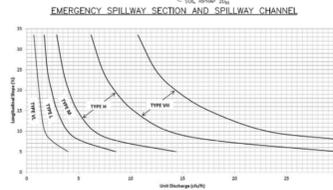
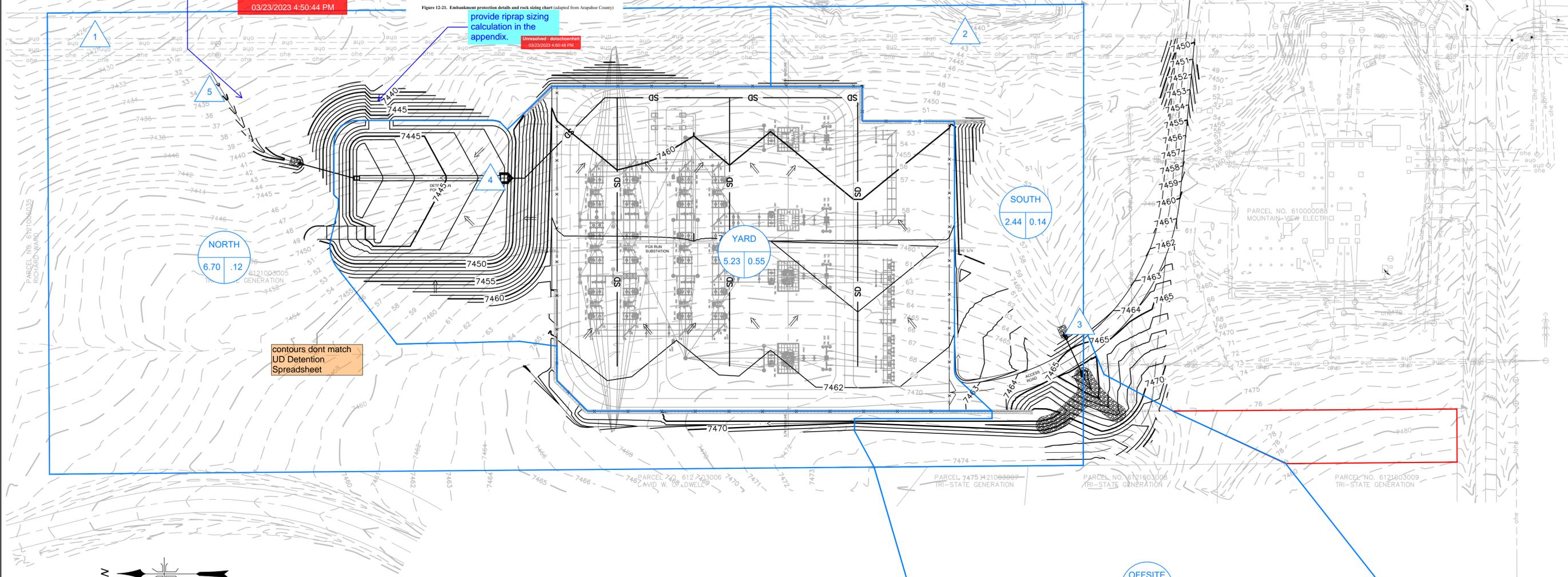


Figure 13-21. Embankment protection details and rock sizing chart (adapted from Arupacoe County)

provide riprap sizing calculation in the appendix.

Unresolved - dotschoenheit
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contours dont match UD Detention Spreadsheet

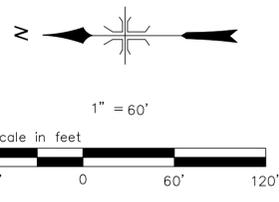


NORTH
 6.70 .12

YARD
 5.23 0.55

SOUTH
 2.44 0.14

OFFSITE
 4.5 0.09



LEGEND

- 5800 - EXISTING INDEX CONTOUR
 - 5796 - EXISTING INTERMEDIATE CONTOUR
 - 5800 — PROPOSED INDEX CONTOUR
 - 5796 — PROPOSED INTERMEDIATE CONTOUR
 - PROPOSED DRAINAGE FLOWLINE
 - ← FLOW ARROW
 - PROPOSED DRAINAGE BASIN
 - UNANALYZED DRAINAGE AREA = 0.37 ACRES
- A = BASIN
 B = AREA IN ACRES
 C = WEIGHTED RUNOFF COEFFICIENT
- D = DESIGN POINT DESIGNATION

Summary Runoff Tables			
Existing			
Design Point	Contributing Area	Runoff Peak 5-year Event	Runoff Peak 100-year Event
	(acres)	(cfs)	(cfs)
1	14.38	7.20	48.26
Proposed			
Design Point	Contributing Area	Runoff Peak 5-year Event	Runoff Peak 100-year Event
	(acres)	(cfs)	(cfs)
1	6.7	4.15	22.03
2	2.44	2.03	9.73
3	4.5	2.36	15.81
4	5.23	12.13	25.16
5	5.23	0.09	2.53

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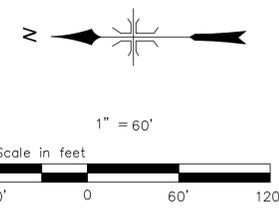
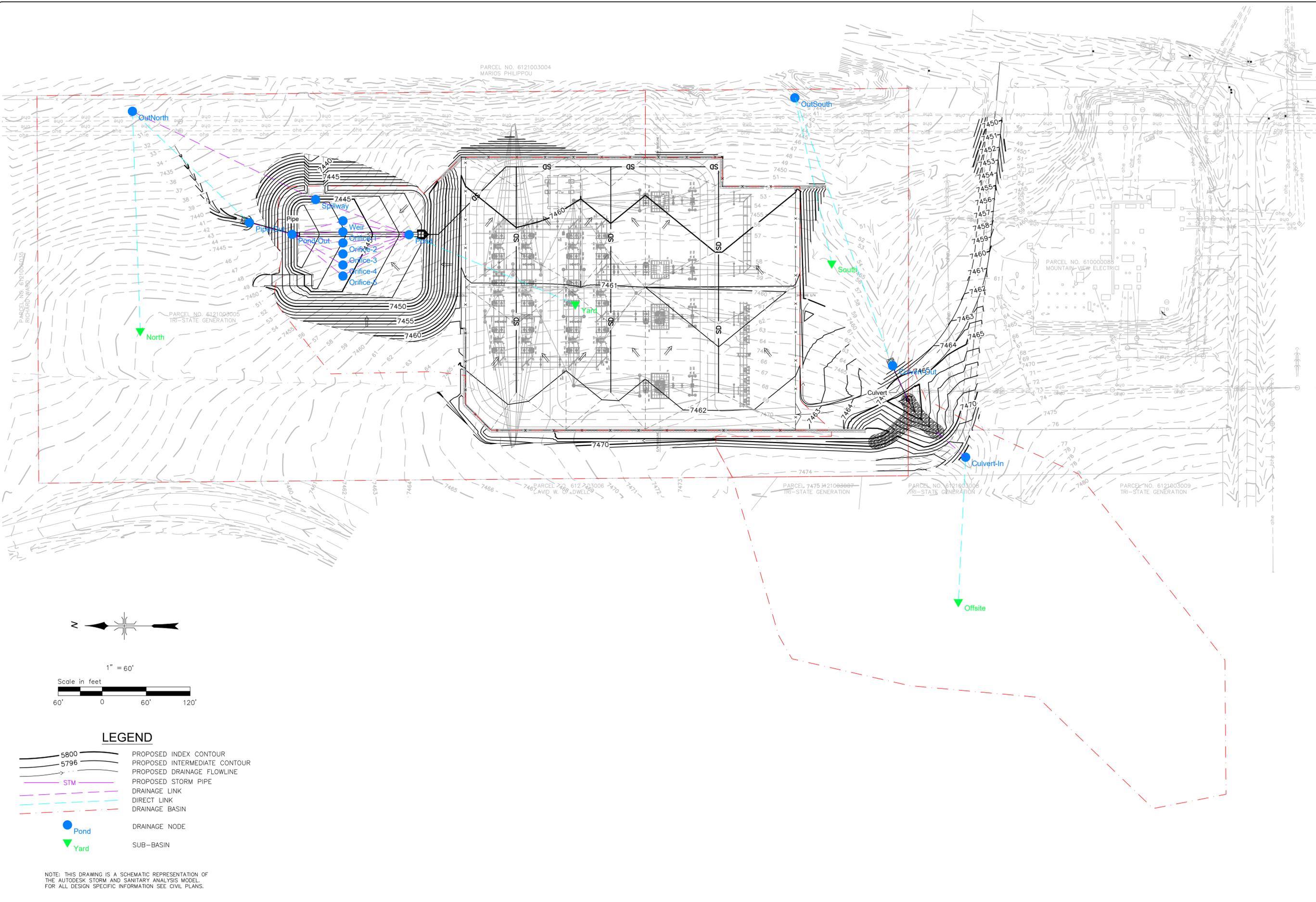
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DRAINAGE BASIN DELINEATION

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LEGEND

- 5800 PROPOSED INDEX CONTOUR
- 5796 PROPOSED INTERMEDIATE CONTOUR
- PROPOSED DRAINAGE FLOWLINE
- STM PROPOSED STORM PIPE
- DRAINAGE LINK
- DIRECT LINK
- DRAINAGE BASIN
- Pond DRAINAGE NODE
- Yard SUB-BASIN

NOTE: THIS DRAWING IS A SCHEMATIC REPRESENTATION OF THE AUTODESK STORM AND SANITARY ANALYSIS MODEL. FOR ALL DESIGN SPECIFIC INFORMATION SEE CIVIL PLANS.

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