

Drainage Report

Village Camp Durango

La Plata County, Colorado

ROBRE 168892 | August 29th, 2025



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Contents

1	Introduction	1
1.1	Site Location.....	1
1.2	Site Description	2
2	Drainage Design Criteria.....	2
2.1	Development Criteria Reference	2
2.2	Hydrologic Criteria	2
3	Drainage Basins.....	3
3.1	Offsite Basins	3
3.2	Onsite Sub-basins	3
4	Detention Treatment Facilities	4
4.1	Detention	4
5	Conveyance Design.....	5
6	Conclusion	5

List of Tables

Table 1 – NOAA Precipitation Frequency Estimates (inches)	2
Table 2 – Proposed Basin Impervious Calculations	3
Table 3 – Basin Peak Flow Summary	4
Table 4 – Required and Provided Water Quality Volume	4

List of Figures

Figure 1 – Site Location	1
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Contents (continued)

List of Appendices

Appendix A: NRCS Soil Report

Appendix B: NOAA ATLAS 14 – Rainfall Intensity Estimates

Appendix C: Subbasin Exhibit

Appendix D: MHFD Workbook Analysis – Runoff and Detention Results

Appendix E: Culvert and Swale Analysis, Storm P-Pros, and Outlet Structure Details

Appendix F: Grading and Drainage Plan

Drainage Report

Village Camp Durango

Prepared for Roberts Resorts and Properties

1 Introduction

The purpose of this Drainage Report is to present the design methodology and results of a drainage study associated with the proposed Village Camp Development. This study describes existing conditions at the project site, compares them to the conditions of the proposed development and estimates appropriate drainage and detention features to accommodate the Water Quality Capture Volume (WQCV) per La Plata County Code 70-9.4.a.ii. This drainage study demonstrates conformity to the criteria from Chapter 70 of La Plata County Land Use Code Development Standards.

1.1 Site Location

The site is located north of Durango, in La Plata County, Colorado. The property is part of the Burnett – Trimble Lane Subdivision with a Parcel Number ID 559715100076. The project is bordered by Hermosa Sanitation District and Trimble Storage to the north, the Animas River to the south, CR 252 to the east and Dalton Ranch to the west.



Figure 1 – Site Location

1.2 Site Description

The proposed project includes the re-development of a historic gravel pit. The site will include new gravel and asphalt drives, amenity areas, and RV Sites. The site will drain via a network of grass lined swales and culverts. The site will provide water quality treatment but is not required to detain the 10- or 100-year runoff events due to its adjacency to the Animas River per La Plata County Code allowance (LUDC Section 70-9 Technical Appendix, F.4.a.i.ii). The 10-year event will be conveyed to the detention areas and then into the Animas River via site infrastructure. The detention outlets are not designed to detain the 10-year event, simply to discharge it. The 100-year event will overtop site infrastructure and surface flow into the River. In this case, on-site runoff will flow directly into the Animas River without endangering any adjacent properties or structures.

The project parcel area is approximately 34 acres. The site surface drains undetained from north to south directly into the Animas River. The watershed area tributary to the site is approximately 34 acres.

According to the Natural Resources Conservation Service Web Soil Survey (NRCS), the project site contains a mixture of hydrologic soil Group B and C with 0 to 3 percent slopes. Group B (Pescar fine sandy loam) being the most prominent with 55.4%, and Group C (Tifton loam) the least with 29.2%. The remaining 15.4% of soil was defined as River wash and water. The *NRCS Custom Soil Resource Report* can be found in Appendix A.

2 Drainage Design Criteria

2.1 Development Criteria Reference

The drainage design criteria used for this development was obtained from the 2020 Land Use Code of La Plata County, Colorado. Rainfall data was obtained from NOAA Atlas 14 while runoff calculation methodology and drainage facility design was performed in accordance with the Urban Storm Drainage Criteria Manual (USDCM) dated August 2018. References to relevant Sections of the USDCM Design Manual are made throughout the report.

2.2 Hydrologic Criteria

2.2.1 Design Rainfall

Precipitation frequency estimates for the location of the proposed project were taken from NOAA Atlas 14, Volume 8, Version 2, with a duration of 60 minutes. The frequency estimates were then used as inputs into the Mile High Flood District (MHFD) Detention Basin Workbook to analyze site drainage. The frequency estimates for the site are shown in Table 1 and the rainfall data can be found in Appendix B.

Table 1 – NOAA Precipitation Frequency Estimates (inches)

Duration	10-Year (in)	100-Year (in)
1-hour	1.08	2.09

2.2.2 Runoff Calculation Method

Runoff calculations were performed using the MHFD Peak Runoff Prediction by the Rational Method Workbook. Precipitation frequencies were taken from NOAA Atlas 14 and surface characteristics of the site. The results from the MHFD Peak Runoff Prediction by the Rational Method Workbook are included in Appendix D.

2.2.3 Detention and Storage

Detention and conveyance facilities were designed and sized according to the requirements outlined in Section 70-9 of the La Plata County Site Development Standards. Detention basins on-site were designed using the Mile High Flood District (MHFD) Detention Basin Workbook while conveyance design, sizing and analysis was performed using Hydraflow Software.

2.2.4 Water Quality

Extended Detention Basins (EDB's) were sized for each subbasin using the MHFD Detention Basin Workbook to provide the necessary water quality treatment. Each EDB will detain the WQCV and drain over a period of 40 hours per La Plata County Code 70-9.4.a.ii. Detention Worksheets and analysis are included in Appendix D.

3 Drainage Basins

3.1 Offsite Basins

Offsite drainage has been addressed by the lots adjacent to the property as part of their development requirements. Both northern lots discharge into the wetlands west of the site via engineered infrastructure and then into the Animas River.

3.2 Onsite Sub-basins

The project site was divided into seven subbasins to perform the drainage analysis as shown in Appendix C. Detention and conveyance facilities were sized to each individual subbasin per the MFHD requirements. Table 2 summarizes the imperviousness calculations for each subbasin, and Table 3 shows the post development peak flows for the site. Pre-development imperviousness and peak flows were not calculated, as detention to historic values was not a project requirement. Percent imperviousness values were obtained from UDFCD Table 6-3 and are in Table 2. Subbasin Peak flows are shown in Table 3.

Table 2 – Proposed Basin Impervious Calculations

SUB-BASIN	CONTRIBUTING AREA (ACRES)	CONCRETE AREAS 100% (ACRES)	PAVEMENT 100% (ACRES)	GRAVEL 40% (ACRES)	OPEN SPACE AREA 2% (ACRES)	ROOFS 90% (ACRES)	% IMPERVIOUS
1	6.15	0.20	1.37	1.11	3.47	0.00	34%
2	1.35	0.10	0.17	0.36	0.72	0.00	32%
3	2.34	0.10	0.38	0.85	1.01	0.00	36%
4	3.83	0.16	0.56	1.30	1.81	0.00	33%

5	5.95	0.15	0.59	1.25	3.96	0.00	22%
6	8.77	0.57	2.27	1.02	4.85	0.06	39%
7	0.64	0.07	0.19	0.00	0.33	0.06	50%

Table 3 – Basin Peak Flow Summary

SUBBASIN	DEVELOPED PEAK FLOW, Q (CFS)	
	10-YR	100-YR
1	3.34	11.38
2	1.04	3.66
3	1.56	5.14
4	2.25	7.81
5	2.30	10.04
6	5.59	17.68
7	0.73	2.02
TOTAL	16.81	57.73

4 Detention Treatment Facilities

4.1 Detention

Four Extended Detention Basins (EDB) were designed to provide water quality treatment for the site as demonstrated in Appendix C. The site will provide water quality treatment but is not required to detain the 10- or 100-year runoff events per the County Code allowance (LUDC Section 70-9 Technical Appendix, F.4.a.i.ii). The EDB's were designed to provide Water Quality Treatment by capturing the Water Quality Control Volume (WQCV). Detailed design of the EDB's and outlet structures have been provided in the plans and in Appendix E for reference.

The WQCV is detained by the EDB's and released via outlet piping over 40 hours as required by La Plata County. Table 4 shows the WQCV required and outlet structure data.

Table 4 – Required and Provided Water Quality Volume

POND	SUBBASINS RECEIVED	WQCV (AC-FT)	OUTLET STRUCTURE	DRAIN ORIFICES DIAMETER (IN)	NUMBER OF ORIFICES
1	1	0.084	CDOT TYPE C	1-3/16	3
2	2, 3, 4, 5	0.166	CDOT TYPE C	1-7/16	3
3	6	0.129	CDOT TYPE C	1-1/16	3
4	7	0.011	CDOT TYPE C	7/16	1

5 Conveyance Design

All storm water on site will be conveyed via sheet flow, swales and culverts. Appendix F shows the Grading and Drainage plan for the proposed development and Appendix E shows the outlet structure, swale and culvert design analysis. All proposed on-site drainage infrastructure was designed to have capacity for the 10-Year storm event. Table 5 summarizes the conveyance design for the site.

Table 5 – Conveyance Design Summary

SUBBASINS	10-YR RUNOFF (CFS)	STORM DRAIN ID	RECEIVING POND
1	3.34	SD1: 15" ADS PIPE	1
		SD2: 12" SDR-35 PVC PIPE	
2	1.04	SD3: 15" ADS PIPE	2
		SD4: 15" ADS PIPE	
3	1.56	SD5: 15" ADS PIPE	
		SD6: 15" ADS PIPE	
4	2.25	SD7: 15" ADS PIPE	
		SD8: 15" ADS PIPE	
5	2.30	SD9: 15" ADS PIPE	
		SD10: 15" ADS PIPE	
		SD11: 12" SDR-35 PVC PIPE	
6	5.59	SD12: 15" ADS PIPE	3
		SD13: 15" ADS PIPE	
		SD14: 15" ADS PIPE	
		SD15: 15" ADS PIPE	
		SD16: 12" SDR-35 PVC PIPE	
7	0.73	SD17: 6" SDR-35 PVC PIPE	4

The site will provide detention for WQCV and discharge higher intensity events undetained per the County Code (LUDC Section 70-9 Technical Appendix, F.4.a.i.ii). It is expected that the 100-Year storm event will overwhelm the proposed site infrastructure. However, in this case, on-site runoff will flow directly into the Animas River without endangering any adjacent properties.

6 Conclusion

The proposed project includes the re-development of a historic gravel pit for the proposed Village Camp Durango Development. The site will include new gravel and asphalt drives, amenity areas, and RV Sites. The site will largely drain via a network of grass lined swales and culverts.

Four extended detention basins were designed to provide water quality treatment for the proposed site. All conveyance via swales and culverts has been analyzed and deemed adequate to convey the 10-year event.

Appendix A

NRCS Soil Report



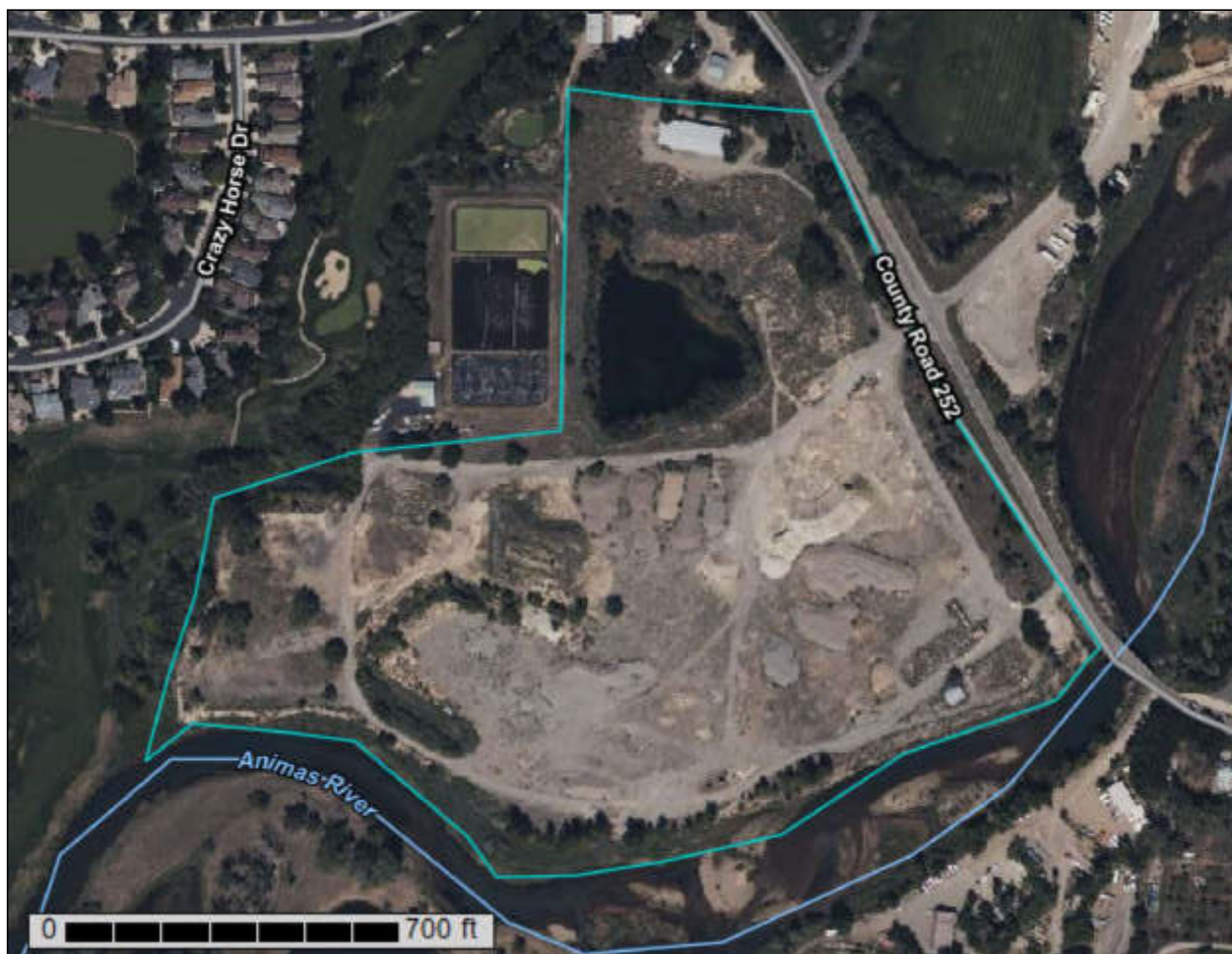
United States
Department of
Agriculture

NRCS

Natural
Resources
Conservation
Service

A product of the National
Cooperative Soil Survey,
a joint effort of the United
States Department of
Agriculture and other
Federal agencies, State
agencies including the
Agricultural Experiment
Stations, and local
participants

Custom Soil Resource Report for La Plata County Area, Colorado



Custom Soil Resource Report
Soil Map



Map Scale: 1:4,250 if printed on A landscape (11" x 8.5") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

	Area of Interest (AOI)		Spoil Area
	Area of Interest (AOI)		Stony Spot
Soils			Very Stony Spot
	Soil Map Unit Polygons		Wet Spot
	Soil Map Unit Lines		Other
	Soil Map Unit Points		Special Line Features
Special Point Features		Water Features	
	Blowout		Streams and Canals
	Borrow Pit	Transportation	
	Clay Spot		Rails
	Closed Depression		Interstate Highways
	Gravel Pit		US Routes
	Gravelly Spot		Major Roads
	Landfill		Local Roads
	Lava Flow		Aerial Photography
	Marsh or swamp	Background	
	Mine or Quarry		
	Miscellaneous Water		
	Perennial Water		
	Rock Outcrop		
	Saline Spot		
	Sandy Spot		
	Severely Eroded Spot		
	Sinkhole		
	Slide or Slip		
	Sodic Spot		

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: La Plata County Area, Colorado
Survey Area Data: Version 20, Sep 6, 2022

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

Date(s) aerial images were photographed: Sep 6, 2021—Sep 17, 2021

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.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
50	Pescar fine sandy loam	22.7	55.4%
57	Riverwash	5.1	12.3%
66	Tifton loam	12.0	29.2%
84	Water	1.3	3.1%
Totals for Area of Interest		41.1	100.0%

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The

Custom Soil Resource Report

delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

La Plata County Area, Colorado

50—Pescar fine sandy loam

Map Unit Setting

National map unit symbol: 1yp1

Elevation: 6,500 to 8,000 feet

Mean annual precipitation: 18 to 22 inches

Mean annual air temperature: 42 to 45 degrees F

Frost-free period: 90 to 110 days

Farmland classification: Not prime farmland

Map Unit Composition

Pescar and similar soils: 75 percent

Minor components: 25 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pescar

Setting

Landform: Flood plains, terraces, valleys

Landform position (three-dimensional): Tread

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Stratified, calcareous alluvium

Typical profile

H1 - 0 to 8 inches: fine sandy loam

H2 - 8 to 20 inches: stratified loam to loamy fine sand

H3 - 20 to 60 inches: very gravelly sand

Properties and qualities

Slope: 0 to 2 percent

Depth to restrictive feature: 18 to 30 inches to strongly contrasting textural stratification

Drainage class: Somewhat poorly drained

Runoff class: Very low

Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)

Depth to water table: About 18 to 30 inches

Frequency of flooding: NoneFrequent

Frequency of ponding: None

Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

Available water supply, 0 to 60 inches: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): 4w

Land capability classification (nonirrigated): 4w

Hydrologic Soil Group: B

Ecological site: R048AY241CO - Mountain Meadow

Hydric soil rating: No

Minor Components

Tifton

Percent of map unit: 15 percent

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Hydric soil rating: No

Aquents

Percent of map unit: 5 percent

Landform: Depressions

Hydric soil rating: Yes

Other soils

Percent of map unit: 5 percent

Hydric soil rating: No

57—Riverwash

Map Unit Composition

Riverwash: 100 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Riverwash

Setting

Landform: Valleys, drainageways, flood plains

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Sandy and/or cobbly or gravelly alluvium

66—Tifton loam

Map Unit Setting

National map unit symbol: 1ypl

Elevation: 6,000 to 7,500 feet

Mean annual precipitation: 16 to 19 inches

Mean annual air temperature: 45 to 53 degrees F

Frost-free period: 105 to 130 days

Farmland classification: Prime farmland if irrigated and either protected from flooding or not frequently flooded during the growing season

Map Unit Composition

Tifton and similar soils: 70 percent

Minor components: 30 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tifton

Setting

Landform: Flood plains, valley floors

Landform position (three-dimensional): Tread

Down-slope shape: Linear

Across-slope shape: Linear

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Parent material: Mixed alluvium

Typical profile

H1 - 0 to 5 inches: loam

H2 - 5 to 56 inches: stratified fine sandy loam to clay loam

H3 - 56 to 60 inches: very gravelly sand

Properties and qualities

Slope: 1 to 3 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Somewhat poorly drained

Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high
(0.20 to 2.00 in/hr)

Depth to water table: About 24 to 36 inches

Frequency of flooding: NoneRare

Frequency of ponding: None

Calcium carbonate, maximum content: 10 percent

Available water supply, 0 to 60 inches: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): 3w

Land capability classification (nonirrigated): 3w

Hydrologic Soil Group: C

Ecological site: R048AY241CO - Mountain Meadow

Hydric soil rating: No

Minor Components

Pescar

Percent of map unit: 20 percent

Hydric soil rating: No

Alamosa

Percent of map unit: 10 percent

Landform: Alluvial fans

Hydric soil rating: Yes

84—Water

Map Unit Composition

Water: 95 percent

Minor components: 5 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Minor Components

Aquolls

Percent of map unit: 5 percent

Landform: Marshes

Hydric soil rating: Yes

Appendix B

NOAA ATLAS 14 – Rainfall Intensity Estimates



NOAA Atlas 14, Volume 8, Version 2
Location name: Durango, Colorado, USA*
Latitude: 37.3857°, Longitude: -107.8397°
Elevation: m/ft**
* source: ESRI Maps
** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffrey Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aerals](#)

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches) ¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.191 (0.155-0.244)	0.245 (0.199-0.315)	0.347 (0.281-0.446)	0.443 (0.357-0.572)	0.592 (0.471-0.807)	0.721 (0.557-0.985)	0.862 (0.643-1.20)	1.02 (0.730-1.44)	1.24 (0.857-1.79)	1.42 (0.953-2.06)
10-min	0.279 (0.227-0.358)	0.359 (0.292-0.461)	0.508 (0.412-0.653)	0.649 (0.523-0.837)	0.867 (0.689-1.18)	1.06 (0.815-1.44)	1.26 (0.942-1.75)	1.49 (1.07-2.11)	1.82 (1.25-2.62)	2.08 (1.40-3.01)
15-min	0.340 (0.277-0.436)	0.438 (0.356-0.562)	0.620 (0.502-0.797)	0.791 (0.638-1.02)	1.06 (0.841-1.44)	1.29 (0.994-1.76)	1.54 (1.15-2.14)	1.82 (1.30-2.57)	2.21 (1.53-3.20)	2.54 (1.70-3.67)
30-min	0.417 (0.339-0.535)	0.532 (0.433-0.682)	0.748 (0.606-0.962)	0.954 (0.769-1.23)	1.28 (1.02-1.74)	1.56 (1.20-2.13)	1.87 (1.40-2.60)	2.21 (1.59-3.13)	2.70 (1.87-3.91)	3.11 (2.08-4.49)
60-min	0.499 (0.406-0.640)	0.623 (0.506-0.799)	0.857 (0.694-1.10)	1.08 (0.872-1.40)	1.44 (1.14-1.96)	1.75 (1.35-2.39)	2.09 (1.56-2.91)	2.47 (1.77-3.50)	3.01 (2.08-4.36)	3.47 (2.32-5.01)
2-hr	0.582 (0.480-0.735)	0.713 (0.587-0.902)	0.965 (0.792-1.22)	1.21 (0.987-1.54)	1.60 (1.29-2.15)	1.93 (1.52-2.61)	2.31 (1.75-3.16)	2.72 (1.99-3.81)	3.33 (2.34-4.74)	3.83 (2.60-5.45)
3-hr	0.664 (0.551-0.831)	0.789 (0.655-0.989)	1.03 (0.854-1.30)	1.27 (1.05-1.60)	1.65 (1.35-2.20)	1.99 (1.58-2.66)	2.37 (1.81-3.22)	2.78 (2.05-3.86)	3.40 (2.41-4.80)	3.91 (2.68-5.51)
6-hr	0.872 (0.734-1.08)	0.992 (0.834-1.23)	1.23 (1.03-1.52)	1.46 (1.22-1.81)	1.83 (1.51-2.39)	2.16 (1.73-2.83)	2.52 (1.96-3.37)	2.93 (2.19-3.99)	3.53 (2.54-4.90)	4.03 (2.81-5.59)
12-hr	1.18 (1.00-1.43)	1.31 (1.12-1.59)	1.56 (1.33-1.90)	1.80 (1.52-2.20)	2.17 (1.81-2.77)	2.49 (2.02-3.19)	2.84 (2.23-3.71)	3.22 (2.44-4.30)	3.78 (2.76-5.14)	4.23 (3.00-5.78)
24-hr	1.51 (1.30-1.80)	1.69 (1.46-2.02)	2.00 (1.73-2.40)	2.28 (1.95-2.74)	2.69 (2.25-3.34)	3.02 (2.47-3.78)	3.37 (2.68-4.30)	3.74 (2.86-4.87)	4.26 (3.15-5.67)	4.67 (3.36-6.27)
2-day	1.82 (1.60-2.15)	2.08 (1.82-2.44)	2.49 (2.17-2.94)	2.84 (2.47-3.36)	3.33 (2.81-4.04)	3.71 (3.07-4.54)	4.09 (3.29-5.11)	4.48 (3.48-5.72)	5.01 (3.76-6.53)	5.41 (3.97-7.15)
3-day	2.05 (1.81-2.39)	2.32 (2.05-2.71)	2.77 (2.44-3.24)	3.15 (2.76-3.70)	3.68 (3.14-4.43)	4.10 (3.42-4.98)	4.52 (3.67-5.59)	4.95 (3.88-6.26)	5.53 (4.19-7.14)	5.98 (4.43-7.81)
4-day	2.23 (1.98-2.59)	2.52 (2.24-2.92)	3.00 (2.65-3.48)	3.40 (3.00-3.96)	3.97 (3.41-4.74)	4.42 (3.71-5.33)	4.87 (3.98-5.99)	5.34 (4.21-6.71)	5.98 (4.56-7.67)	6.47 (4.82-8.39)
7-day	2.65 (2.38-3.03)	3.00 (2.69-3.43)	3.57 (3.19-4.09)	4.05 (3.60-4.65)	4.72 (4.10-5.56)	5.25 (4.47-6.25)	5.79 (4.79-7.02)	6.34 (5.07-7.85)	7.09 (5.48-8.96)	7.66 (5.79-9.80)
10-day	3.02 (2.73-3.42)	3.40 (3.07-3.85)	4.02 (3.63-4.57)	4.55 (4.08-5.19)	5.29 (4.62-6.17)	5.87 (5.03-6.92)	6.45 (5.38-7.75)	7.05 (5.68-8.65)	7.86 (6.13-9.85)	8.48 (6.47-10.8)
20-day	4.06 (3.73-4.53)	4.50 (4.12-5.01)	5.21 (4.76-5.82)	5.80 (5.28-6.50)	6.63 (5.88-7.60)	7.28 (6.34-8.43)	7.93 (6.72-9.36)	8.60 (7.04-10.4)	9.49 (7.53-11.7)	10.2 (7.90-12.7)
30-day	4.90 (4.53-5.41)	5.40 (4.99-5.96)	6.22 (5.73-6.88)	6.90 (6.33-7.66)	7.83 (7.00-8.88)	8.55 (7.51-9.80)	9.27 (7.93-10.8)	10.0 (8.27-11.9)	11.0 (8.79-13.3)	11.7 (9.19-14.4)
45-day	5.90 (5.51-6.45)	6.54 (6.10-7.15)	7.58 (7.05-8.31)	8.43 (7.81-9.26)	9.57 (8.62-10.7)	10.4 (9.24-11.8)	11.3 (9.72-13.0)	12.1 (10.1-14.3)	13.2 (10.7-15.9)	14.0 (11.1-17.1)
60-day	6.71 (6.30-7.28)	7.52 (7.06-8.16)	8.81 (8.25-9.59)	9.85 (9.18-10.8)	11.2 (10.2-12.5)	12.3 (10.9-13.8)	13.3 (11.5-15.1)	14.2 (11.9-16.6)	15.5 (12.6-18.4)	16.3 (13.1-19.8)
¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.										

[Back to Top](#)

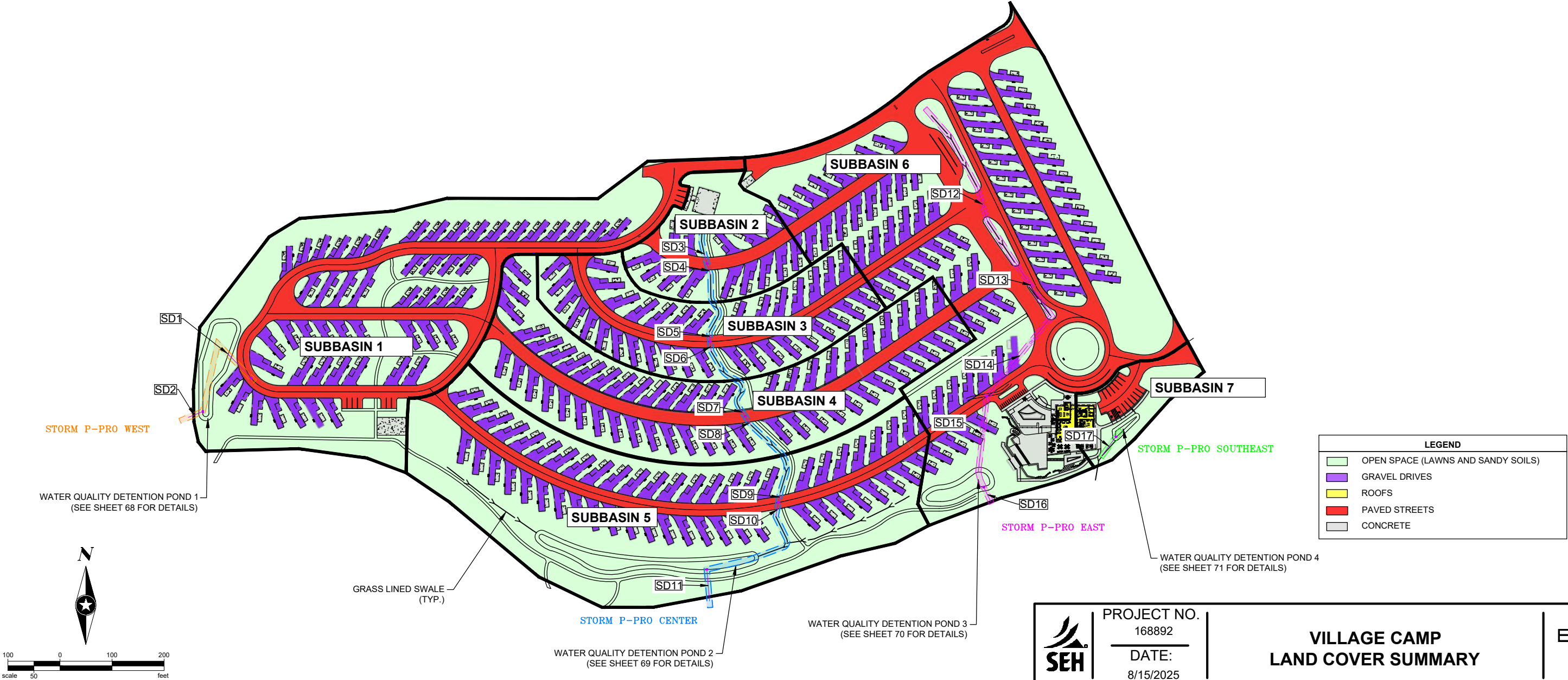
PF graphical

Appendix C

Subbasin Exhibit

Save: 8/15/2025 10:21 AM c:\moline\Plot_ 8/15/2025 10:49 AM \sehinc.com\panzura\p2\projects\PTTR\ROBRE\168892\5-final-dsgn\50-final-dsgn\50-Hydrodwg\168892_Land Cover.dwg

SUBBASIN 1					SUBBASIN 3					SUBBASIN 5					SUBBASIN 7			
LAND USE	AREA (ACRES)	% IMPERVIOUSNESS	IMPERVIOUS AREA (ACRES)		LAND USE	AREA (ACRES)	% IMPERVIOUSNESS	IMPERVIOUS AREA (ACRES)		LAND USE	AREA (ACRES)	% IMPERVIOUSNESS	IMPERVIOUS AREA (ACRES)		LAND USE	AREA (ACRES)	% IMPERVIOUSNESS	IMPERVIOUS AREA (ACRES)
LAWNS AND SANDY SOILS	3.47	2%	0.07		LAWNS AND SANDY SOILS	1.01	2%	0.02		LAWNS AND SANDY SOILS	3.96	2%	0.08		LAWNS AND SANDY SOILS	0.32	2%	0.01
GRAVEL DRIVES	1.11	40%	0.44		GRAVEL DRIVES	0.85	40%	0.34		GRAVEL DRIVES	1.25	40%	0.50		GRAVEL DRIVES	0.00	40%	0.00
ROOFS	0.00	90%	0.00		ROOFS	0.00	90%	0.00		ROOFS	0.00	90%	0.00		ROOFS	0.06	90%	0.05
PAVED STREETS	1.37	100%	1.37		PAVED STREETS	0.38	100%	0.38		PAVED STREETS	0.59	100%	0.59		PAVED STREETS	0.19	100%	0.19
CONCRETE AREAS	0.20	100%	0.20		CONCRETE AREAS	0.10	100%	0.10		CONCRETE AREAS	0.15	100%	0.15		CONCRETE AREAS	0.07	100%	0.07
TOTAL AREA	6.15		2.08		TOTAL AREA	2.34		0.84		TOTAL AREA	5.95		1.32		TOTAL AREA	0.64		0.32
WEIGHTED IMPERVIOUSNESS			34%		WEIGHTED IMPERVIOUSNESS			36%		WEIGHTED IMPERVIOUSNESS			22%		WEIGHTED IMPERVIOUSNESS			50%
SUBBASIN 2					SUBBASIN 4					SUBBASIN 6								
LAND USE	AREA (ACRES)	% IMPERVIOUSNESS	IMPERVIOUS AREA (ACRES)		LAND USE	AREA (ACRES)	% IMPERVIOUSNESS	IMPERVIOUS AREA (ACRES)		LAND USE	AREA (ACRES)	% IMPERVIOUSNESS	IMPERVIOUS AREA (ACRES)					
LAWNS AND SANDY SOILS	0.72	2%	0.01		LAWNS AND SANDY SOILS	1.81	2%	0.04		LAWNS AND SANDY SOILS	4.85	2%	0.10					
GRAVEL DRIVES	0.36	40%	0.14		GRAVEL DRIVES	1.30	40%	0.52		GRAVEL DRIVES	1.02	40%	0.41					
ROOFS	0.00	90%	0.00		ROOFS	0.00	90%	0.00		ROOFS	0.06	90%	0.05					
PAVED STREETS	0.17	100%	0.17		PAVED STREETS	0.56	100%	0.56		PAVED STREETS	2.27	100%	2.27					
CONCRETE AREAS	0.10	100%	0.10		CONCRETE AREAS	0.16	100%	0.16		CONCRETE AREAS	0.57	100%	0.57					
TOTAL AREA	1.35		0.43		TOTAL AREA	3.83		1.28		TOTAL AREA	8.77		3.40					
WEIGHTED IMPERVIOUSNESS			32%		WEIGHTED IMPERVIOUSNESS			33%		WEIGHTED IMPERVIOUSNESS			39%					





PROJECT NO.
168892
DATE:
8/15/2025

VILLAGE CAMP
LAND COVER SUMMARY

EXHIBIT
NO. 1

Appendix D

MHFD Workbook Analysis – Runoff and Detention Results

Calculation of Peak Runoff using Rational Method	
Area (A)	1000000
Runoff Coefficient (C)	0.5
Intensity (I)	100
Time of Concentration (Tc)	10
Peak Runoff (Qp)	1000000

Select UDFCD location for NOAA Atlas 14 Rainfall Depths from the pulldown list OR enter your own depths obtained from the NOAA website (click [here](#))

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1-hour rainfall depth, P1 (in) =	0.62	0.86	1.08	1.44	1.75	2.09	3.01

Rainfall Intensity Equation Coefficients =

	a	b	c
	28.50	10.00	0.786

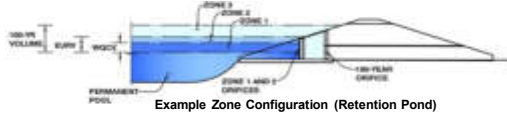
$$I(\text{in/hr}) = \frac{a + P_1}{(b + t_a)^c}$$

Q(cfs) = CIA

[illegible]

MHFD-Detention, Version 4.04 (February 2021)

Basin ID: Subbasin 1 - Pond 1



Example Zone Configuration (Retention Pond)

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

	acre-feet
	acre-feet
0.62	inches
0.86	inches
1.08	inches
1.44	inches
1.75	inches
2.09	inches
3.01	inches

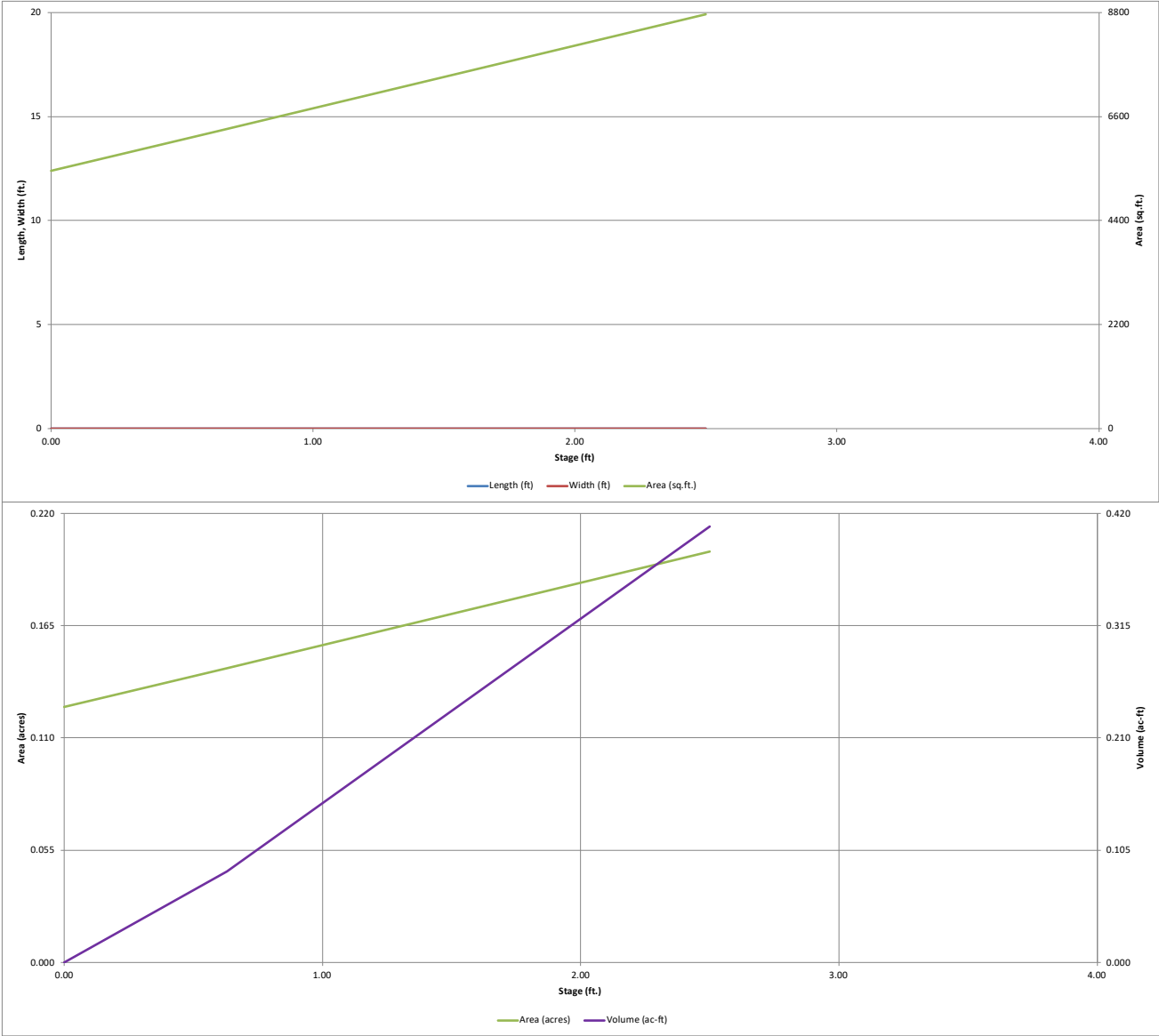
Total detention volume is less than 100-year volume.

Initial Surcharge Area (A_{SIV})	=	user	ft ²
Surcharge Volume Length (L_{SV})	=	user	ft
Surcharge Volume Width (W_{SV})	=	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

[illegible]

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

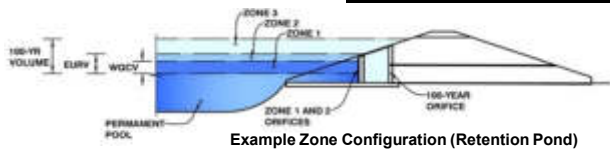


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: Village Camp

Basin ID: Subbasin 1 - Pond 1



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.63	0.084	Orifice Plate
Zone 2			Weir&Pipe (Circular)
Zone 3			
Total (all zones)		0.084	

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

Underdrain Orifice Area = ft²
Underdrain Orifice Centroid = 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 = 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 = 1-3/16 inches)

WQ Orifice Area per Row = ft²
Elliptical Half-Width = feet
Elliptical Slot Centroid = feet
Elliptical Slot Area = 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	0.13	0.27					
Orifice Area (sq. inches)	1.18	1.18	1.18					

	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)

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

Vertical Orifice Area = ft²
Vertical Orifice Centroid = feet

Calculated Parameters for Vertical Orifice

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

Overflow Weir Front Edge Height, H_o = ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length = feet
Overflow Weir Grate Slope = H:V
Horiz. Length of Weir Sides = feet
Overflow Grate Type =
Debris Clogging % = %

Height of Grate Upper Edge, H_g = feet
Overflow Weir Slope Length = feet
Grate Open Area / 100-yr Orifice Area =
Overflow Grate Open Area w/o Debris = ft²
Overflow Grate Open Area w/ Debris = ft²

Calculated Parameters for Overflow Weir

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

Depth to Invert of Outlet Pipe = ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter = inches

Outlet Orifice Area = ft²
Outlet Orifice Centroid = feet
Half-Central Angle of Restrictor Plate on Pipe = radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

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

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

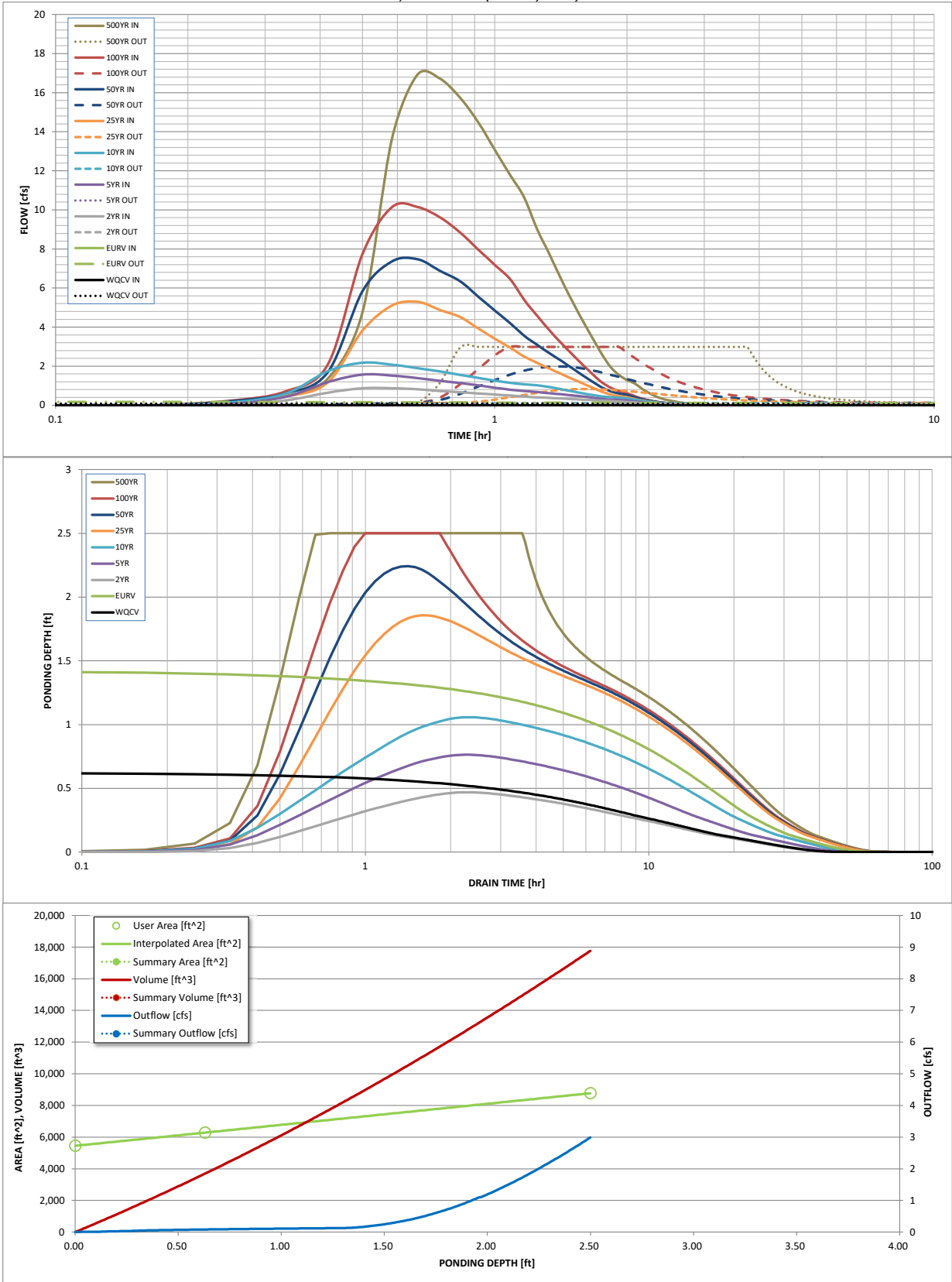
Calculated Parameters for Spillway

Routed Hydrograph Results

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	N/A	N/A	0.62	0.86	1.08	1.44	1.75	2.09	3.01
One-Hour Rainfall Depth (in) =	0.084	0.209	0.072	0.118	0.167	0.348	0.493	0.686	1.154
CUHP Runoff Volume (acre-ft) =	N/A	N/A	0.072	0.118	0.167	0.348	0.493	0.686	1.154
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.0	0.1	0.1	2.6	4.4	6.5	11.7
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	0.02	0.43	0.71	1.06	1.91
Peak Inflow Q (cfs) =	N/A	N/A	0.9	1.6	2.2	5.3	7.5	10.2	16.9
Peak Outflow Q (cfs) =	0.1	0.2	0.07	0.1	0.1	0.8	2.0	3.0	3.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.5	1.1	0.3	0.5	0.5	0.3
Structure Controlling Flow =	Plate	Overflow Weir 1	Plate	Plate	Plate	Overflow Weir	Overflow Weir	N/A	N/A
Max Velocity through Grate 1 (fps) =	N/A	0.02	N/A	N/A	N/A	0.2	0.6	1.0	1.0
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	35	43	35	39	41	42	38	35	30
Time to Drain 99% of Inflow Volume (hours) =	40	50	40	44	48	52	50	47	44
Maximum Ponding Depth (ft) =	0.63	1.43	0.47	0.76	1.06	1.86	2.24	2.50	2.50
Area at Maximum Ponding Depth (acres) =	0.14	0.17	0.14	0.15	0.16	0.18	0.19	0.20	0.20
Maximum Volume Stored (acre-ft) =	0.085	0.210	0.061	0.104	0.148	0.284	0.357	0.408	0.408

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)



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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

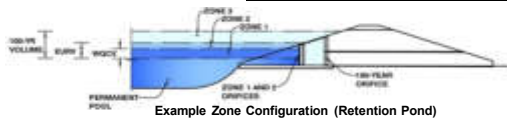
Inflow Hydrographs

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

Time Interval	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06
	0:15:00	0.00	0.00	0.00	0.07	0.14	0.12	0.21	0.23	0.47
	0:20:00	0.00	0.00	0.24	0.43	0.59	0.44	0.60	0.70	1.36
	0:25:00	0.00	0.00	0.65	1.18	1.75	1.17	1.70	2.08	4.76
	0:30:00	0.00	0.00	0.87	1.57	2.18	3.82	5.83	7.74	13.64
	0:35:00	0.00	0.00	0.87	1.52	2.08	5.10	7.36	10.14	16.92
	0:40:00	0.00	0.00	0.82	1.39	1.90	5.30	7.48	10.16	16.72
	0:45:00	0.00	0.00	0.73	1.25	1.73	4.88	6.88	9.62	15.75
	0:50:00	0.00	0.00	0.66	1.14	1.56	4.51	6.35	8.85	14.49
	0:55:00	0.00	0.00	0.61	1.02	1.40	3.93	5.56	7.97	13.08
	1:00:00	0.00	0.00	0.55	0.90	1.26	3.41	4.84	7.18	11.79
	1:05:00	0.00	0.00	0.50	0.80	1.14	2.94	4.21	6.46	10.63
	1:10:00	0.00	0.00	0.44	0.73	1.07	2.49	3.56	5.39	8.99
	1:15:00	0.00	0.00	0.41	0.67	1.02	2.17	3.09	4.57	7.71
	1:20:00	0.00	0.00	0.37	0.61	0.93	1.86	2.65	3.82	6.44
	1:25:00	0.00	0.00	0.34	0.56	0.81	1.60	2.27	3.18	5.33
	1:30:00	0.00	0.00	0.32	0.51	0.71	1.35	1.89	2.61	4.35
	1:35:00	0.00	0.00	0.29	0.45	0.61	1.12	1.54	2.09	3.46
	1:40:00	0.00	0.00	0.26	0.39	0.53	0.90	1.22	1.61	2.64
	1:45:00	0.00	0.00	0.24	0.33	0.46	0.70	0.93	1.19	1.97
	1:50:00	0.00	0.00	0.22	0.29	0.42	0.55	0.72	0.91	1.55
	1:55:00	0.00	0.00	0.19	0.27	0.39	0.46	0.60	0.73	1.29
	2:00:00	0.00	0.00	0.17	0.25	0.35	0.41	0.53	0.62	1.11
	2:05:00	0.00	0.00	0.14	0.20	0.28	0.32	0.41	0.46	0.83
	2:10:00	0.00	0.00	0.11	0.16	0.22	0.24	0.31	0.34	0.61
	2:15:00	0.00	0.00	0.09	0.13	0.18	0.19	0.24	0.24	0.44
	2:20:00	0.00	0.00	0.07	0.10	0.14	0.15	0.18	0.18	0.32
	2:25:00	0.00	0.00	0.06	0.08	0.11	0.11	0.14	0.13	0.24
	2:30:00	0.00	0.00	0.04	0.06	0.08	0.08	0.10	0.10	0.18
	2:35:00	0.00	0.00	0.03	0.05	0.06	0.06	0.08	0.08	0.14
	2:40:00	0.00	0.00	0.03	0.03	0.05	0.05	0.06	0.06	0.10
	2:45:00	0.00	0.00	0.02	0.03	0.04	0.04	0.04	0.04	0.08
	2:50:00	0.00	0.00	0.02	0.02	0.03	0.03	0.03	0.03	0.06
	2:55:00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.04
	3:00:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02
	3:05:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	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

MHFD-Detention, Version 4.04 (February 2021)

Basin ID: Subbasin 2,3,4, and 5 - Pond 2



Example Zone Configuration (Retention Pond)

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

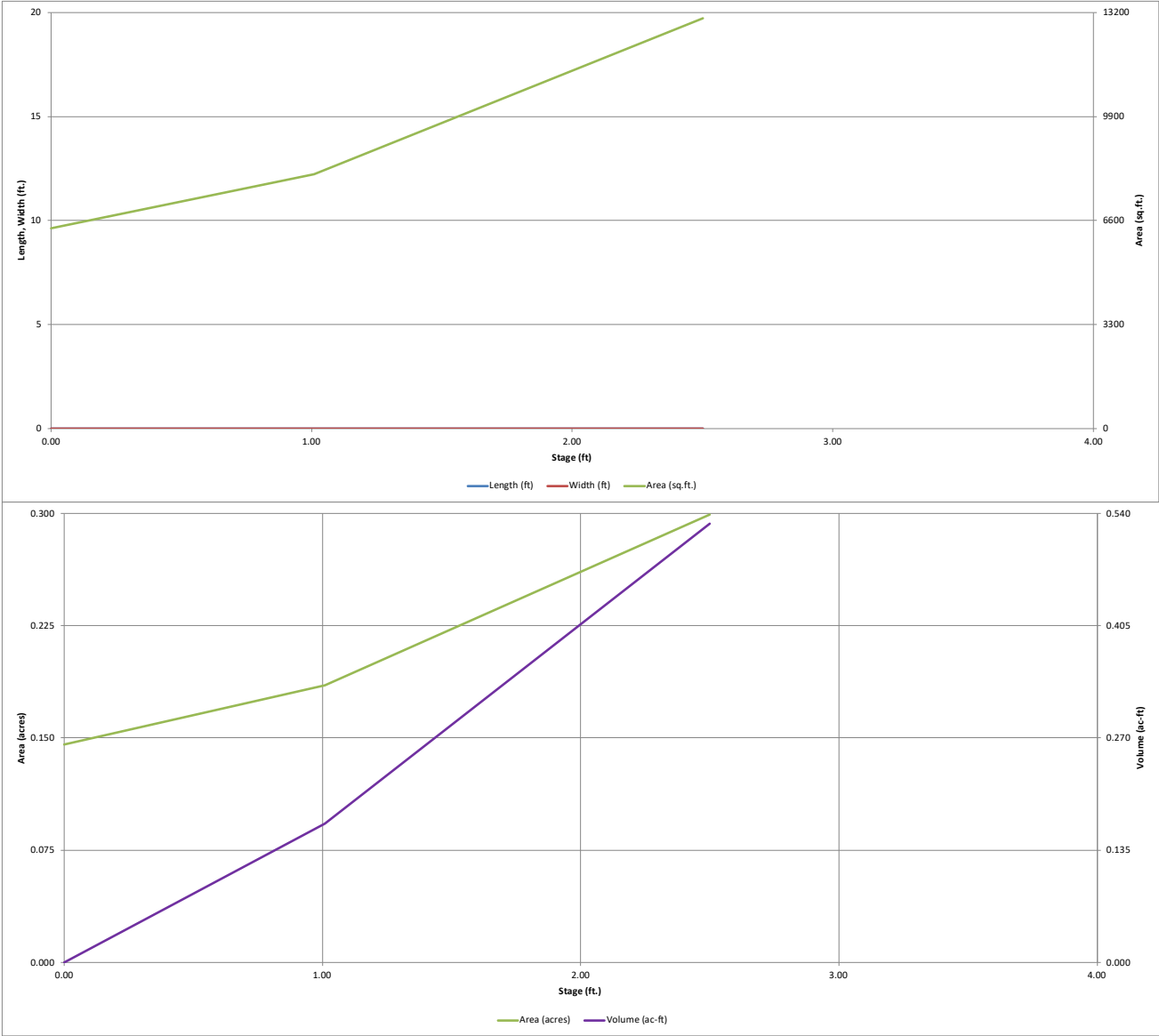
Total detention volume is less than 100-year volume.

Initial Surcharge Area (A_{SIV}) =	user	ft ²
Surcharge Volume Length (L_{SV}) =	user	ft
Surcharge Volume Width (W_{SV}) =	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

[illegible]

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

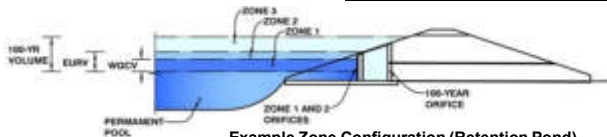


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: Village Camp

Basin ID: Subbasin 2,3,4, and 5 - Pond 2



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.01	0.166	Orifice Plate
Zone 2			Weir&Pipe (Circular)
Zone 3			
Total (all zones)		0.166	

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)

Calculated Parameters for Plate

Invert of Lowest Orifice = ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate = ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing = inches
Orifice Plate: Orifice Area per Row = sq. inches (diameter = 1-7/16 inches)

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	0.16	0.31					
Orifice Area (sq. inches)	1.65	1.65	1.65					

	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)

Calculated Parameters for Vertical Orifice

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

Vertical Orifice Area = ft²
Vertical Orifice Centroid = feet

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

Calculated Parameters for Overflow Weir

Overflow Weir Front Edge Height, H_o = ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length = feet
Overflow Weir Grate Slope = H:V
Horiz. Length of Weir Sides = feet
Overflow Grate Type =
Debris Clogging % = %

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

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

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

Depth to Invert of Outlet Pipe = ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter = inches

Zone 2 Circular =
Outlet Orifice Area = ft²
Outlet Orifice Centroid = feet
Half-Central Angle of Restrictor Plate on Pipe = radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Calculated Parameters for Spillway

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

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

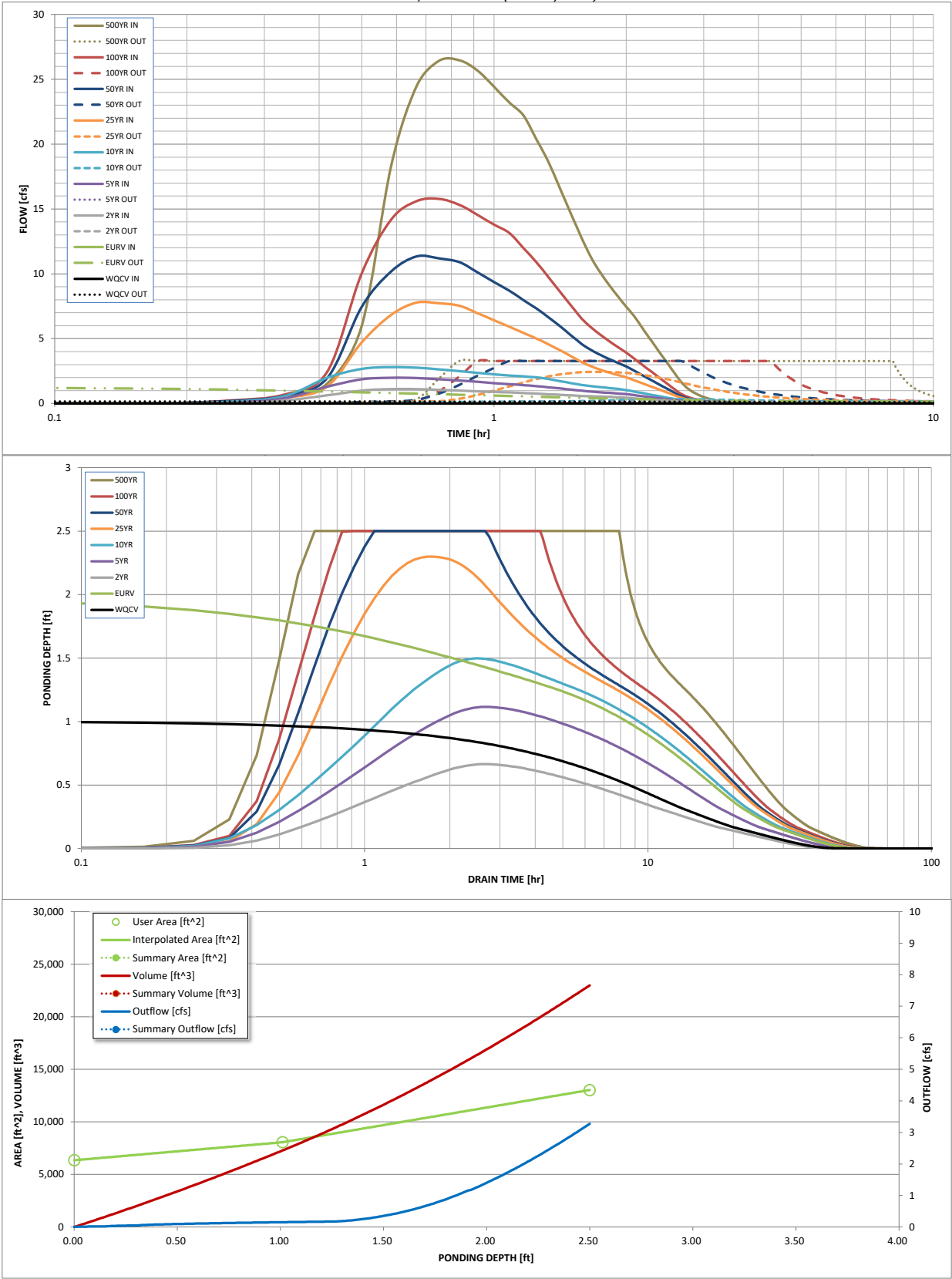
Routed Hydrograph Results

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	0.62	0.86	1.08	1.44	1.75	2.09	3.01
One-Hour Rainfall Depth (in) =	0.166	0.385	0.126	0.217	0.312	0.715	1.038	1.471	2.518
CUHP Runoff Volume (acre-ft) =	N/A	N/A	0.126	0.217	0.312	0.715	1.038	1.471	2.518
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.0	0.1	0.2	4.4	7.3	11.2	20.1
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.01	0.01	0.33	0.54	0.83	1.50
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A	0.00	0.01	0.01	0.33	0.54	0.83	1.50
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	1.1	2.0	2.8	7.8	11.3	15.8	26.5
Peak Inflow Q (cfs) =	0.2	1.3	0.1	0.2	0.3	2.4	3.3	3.3	3.3
Peak Outflow Q (cfs) =	N/A	N/A	N/A	1.6	2.1	0.6	0.4	0.3	0.2
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.6	2.1	0.6	0.4	0.3	0.2
Structure Controlling Flow =	Plate	Overflow Weir 1	Plate	Plate	Overflow Weir 1	Overflow Weir 1	N/A	N/A	N/A
Max Velocity through Grate 1 (fps) =	N/A	0.39	N/A	N/A	0.1	0.8	1.0	1.0	1.0
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	35	37	34	38	40	33	30	28	26
Time to Drain 99% of Inflow Volume (hours) =	40	45	38	44	47	44	42	40	37
Maximum Ponding Depth (ft) =	1.01	1.99	0.66	1.11	1.50	2.30	2.50	2.50	2.50
Area at Maximum Ponding Depth (acres) =	0.19	0.26	0.17	0.19	0.22	0.28	0.30	0.30	0.30
Maximum Volume Stored (acre-ft) =	0.167	0.385	0.105	0.186	0.265	0.467	0.528	0.528	0.528

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD- Detention, Version 4.04 (February 2021)



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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

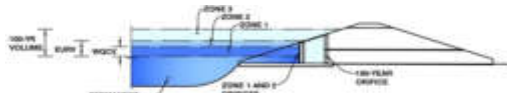
Inflow Hydrographs

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

Time Interval	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06
	0:15:00	0.00	0.00	0.00	0.06	0.13	0.11	0.20	0.22	0.45
	0:20:00	0.00	0.00	0.23	0.41	0.57	0.43	0.59	0.69	1.53
	0:25:00	0.00	0.00	0.63	1.29	1.98	1.30	1.95	2.42	6.00
	0:30:00	0.00	0.00	1.00	1.86	2.67	4.71	7.46	10.05	18.33
	0:35:00	0.00	0.00	1.10	1.98	2.81	6.84	10.19	14.19	24.47
	0:40:00	0.00	0.00	1.11	1.96	2.76	7.78	11.34	15.61	26.42
	0:45:00	0.00	0.00	1.05	1.86	2.64	7.72	11.19	15.78	26.47
	0:50:00	0.00	0.00	0.99	1.78	2.50	7.54	10.90	15.32	25.69
	0:55:00	0.00	0.00	0.94	1.67	2.37	6.97	10.12	14.55	24.43
	1:00:00	0.00	0.00	0.89	1.57	2.25	6.42	9.37	13.80	23.21
	1:05:00	0.00	0.00	0.85	1.49	2.16	5.92	8.70	13.15	22.21
	1:10:00	0.00	0.00	0.81	1.42	2.09	5.44	7.98	12.00	20.37
	1:15:00	0.00	0.00	0.76	1.34	2.01	5.01	7.32	10.89	18.57
	1:20:00	0.00	0.00	0.72	1.25	1.89	4.54	6.62	9.71	16.52
	1:25:00	0.00	0.00	0.67	1.16	1.72	4.09	5.94	8.59	14.58
	1:30:00	0.00	0.00	0.62	1.07	1.57	3.63	5.25	7.53	12.76
	1:35:00	0.00	0.00	0.58	0.99	1.43	3.20	4.59	6.56	11.21
	1:40:00	0.00	0.00	0.55	0.92	1.34	2.86	4.11	5.84	10.05
	1:45:00	0.00	0.00	0.53	0.86	1.26	2.59	3.73	5.28	9.09
	1:50:00	0.00	0.00	0.51	0.81	1.19	2.38	3.41	4.78	8.24
	1:55:00	0.00	0.00	0.48	0.77	1.12	2.19	3.12	4.34	7.47
	2:00:00	0.00	0.00	0.45	0.72	1.04	2.02	2.85	3.93	6.75
	2:05:00	0.00	0.00	0.41	0.65	0.93	1.80	2.53	3.46	5.91
	2:10:00	0.00	0.00	0.36	0.57	0.81	1.58	2.22	3.02	5.12
	2:15:00	0.00	0.00	0.32	0.50	0.71	1.38	1.91	2.61	4.38
	2:20:00	0.00	0.00	0.28	0.44	0.61	1.18	1.62	2.20	3.66
	2:25:00	0.00	0.00	0.24	0.38	0.52	0.98	1.34	1.81	2.96
	2:30:00	0.00	0.00	0.21	0.32	0.43	0.80	1.07	1.43	2.29
	2:35:00	0.00	0.00	0.17	0.26	0.35	0.62	0.81	1.06	1.67
	2:40:00	0.00	0.00	0.14	0.21	0.28	0.45	0.57	0.74	1.21
	2:45:00	0.00	0.00	0.11	0.16	0.22	0.32	0.41	0.53	0.90
	2:50:00	0.00	0.00	0.09	0.13	0.19	0.24	0.31	0.39	0.68
	2:55:00	0.00	0.00	0.08	0.11	0.15	0.18	0.23	0.29	0.50
	3:00:00	0.00	0.00	0.06	0.09	0.13	0.14	0.18	0.21	0.37
	3:05:00	0.00	0.00	0.05	0.08	0.11	0.11	0.14	0.15	0.27
	3:10:00	0.00	0.00	0.05	0.06	0.09	0.09	0.11	0.11	0.20
	3:15:00	0.00	0.00	0.04	0.05	0.07	0.07	0.09	0.08	0.16
	3:20:00	0.00	0.00	0.03	0.04	0.06	0.06	0.07	0.07	0.12
	3:25:00	0.00	0.00	0.03	0.04	0.05	0.04	0.05	0.05	0.10
	3:30:00	0.00	0.00	0.02	0.03	0.04	0.04	0.04	0.04	0.08
	3:35:00	0.00	0.00	0.02	0.02	0.03	0.03	0.03	0.03	0.06
	3:40:00	0.00	0.00	0.01	0.02	0.02	0.02	0.02	0.02	0.04
	3:45:00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.03
	3:50:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02
	3:55:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	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

MHFD-Detention, Version 4.04 (February 2021)

Basin ID: Subbasin 6 - Pond 3



Watershed Information

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

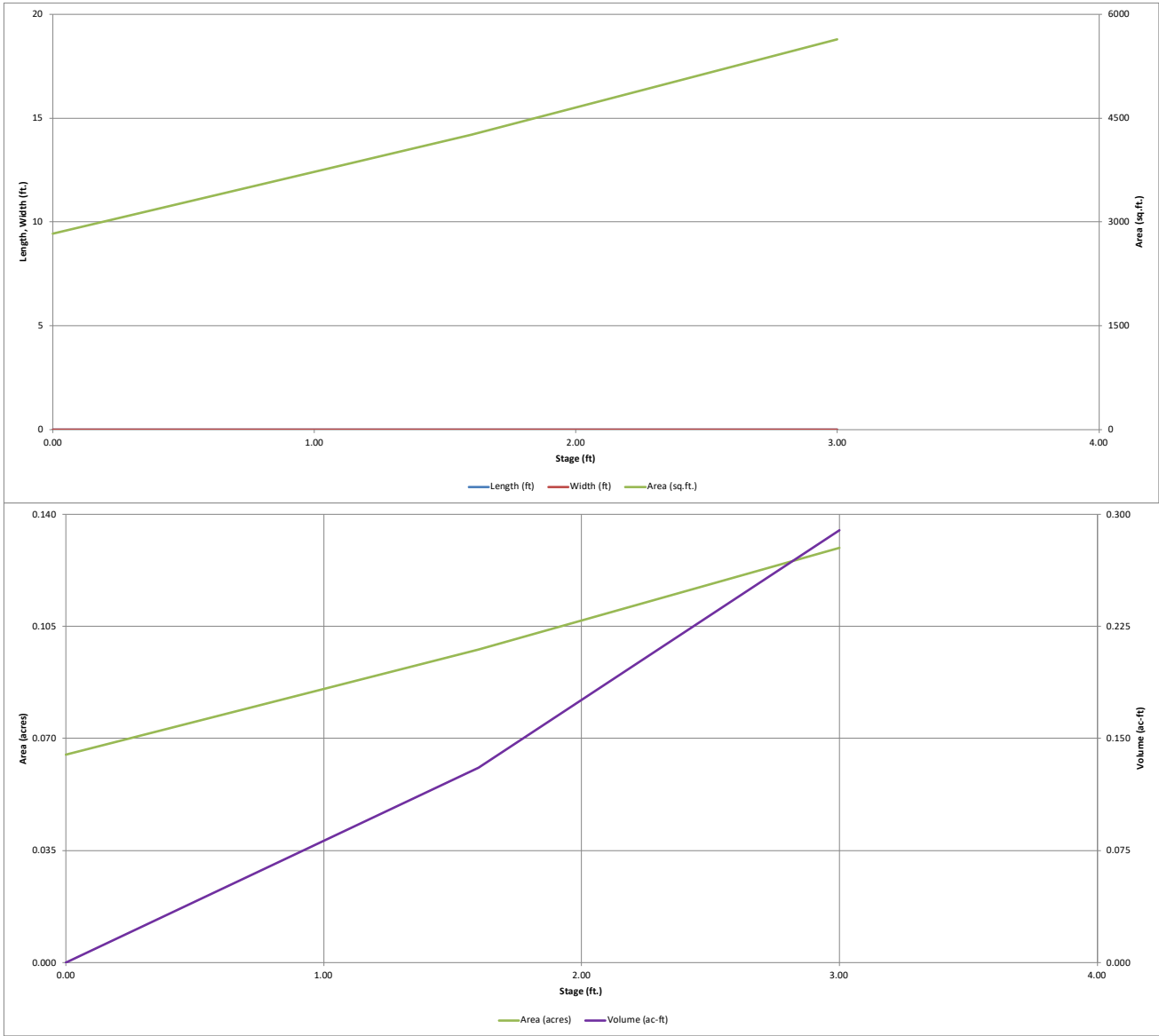
Optional User Overrides

Total detention volume is less than 100-year volume.

[illegible]

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

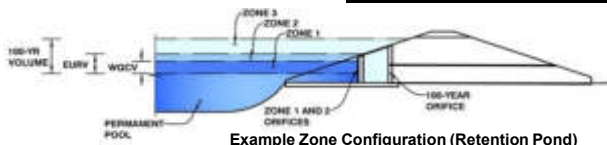


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: Village Camp

Basin ID: Subbasin 6 - Pond 3



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.60	0.129	Orifice Plate
Zone 2			Weir&Pipe (Circular)
Zone 3			
Total (all zones)		0.129	

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)

Calculated Parameters for Plate

Invert of Lowest Orifice = ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate = ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing = inches
Orifice Plate: Orifice Area per Row = sq. inches (diameter = 1-1/16 inches)

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	0.28	0.55					
Orifice Area (sq. inches)	0.89	0.89	0.89					

	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)

Calculated Parameters for Vertical Orifice

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

Vertical Orifice Area = ft²
Vertical Orifice Centroid = feet

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

Calculated Parameters for Overflow Weir

Zone 2 Weir
Overflow Weir Front Edge Height, H_o = ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length = feet
Overflow Weir Grate Slope = H:V
Horiz. Length of Weir Sides = feet
Overflow Grate Type =
Debris Clogging % = %

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

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

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

Zone 2 Circular
Depth to Invert of Outlet Pipe = ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter = inches

Outlet Orifice Area = ft²
Outlet Orifice Centroid = feet
Half-Central Angle of Restrictor Plate on Pipe = radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Calculated Parameters for Spillway

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

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

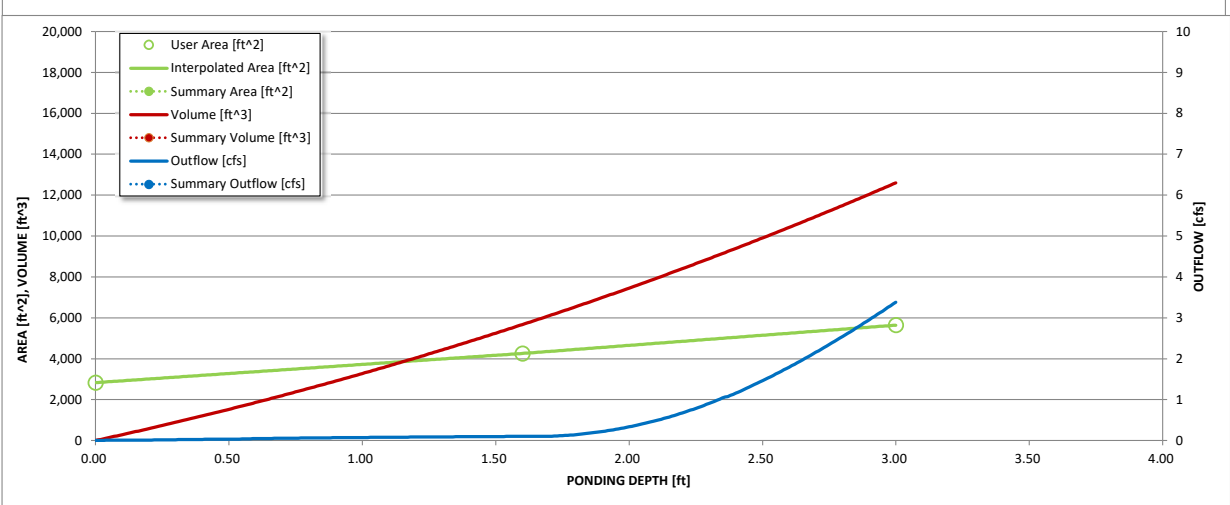
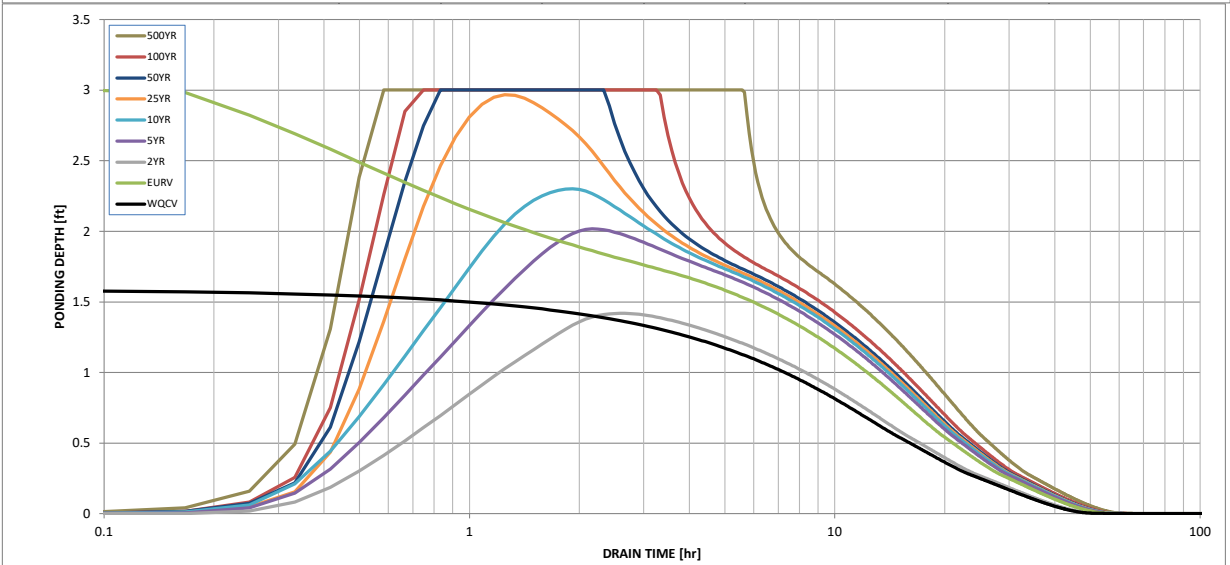
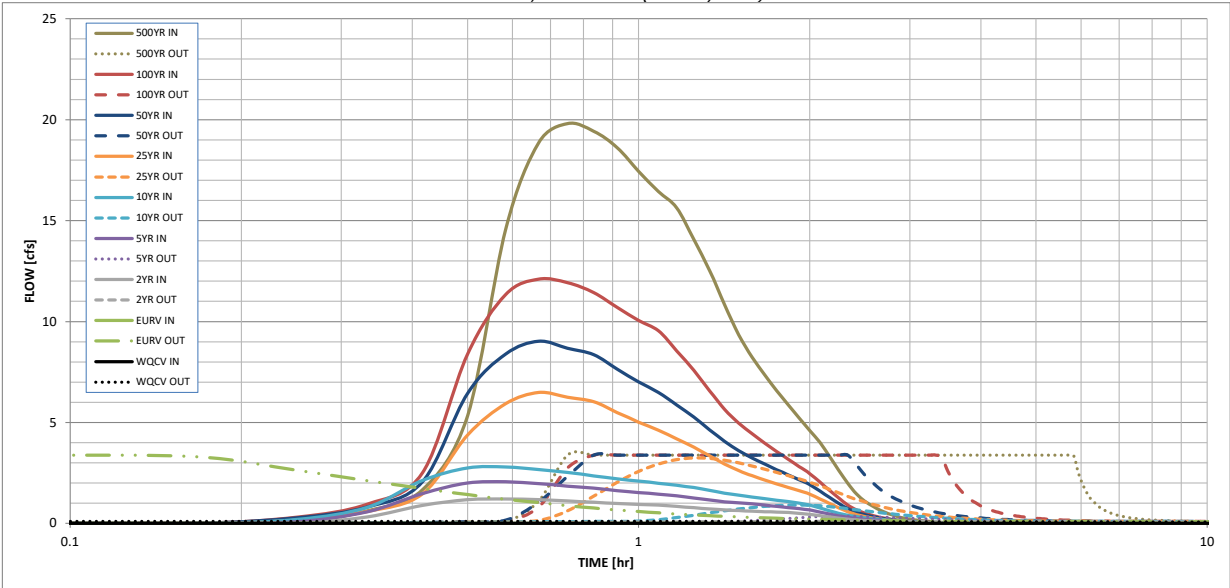
Routed Hydrograph Results

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	0.62	0.86	1.08	1.44	1.75	2.09	3.01
One-Hour Rainfall Depth (in) =	0.129	0.345	0.129	0.208	0.285	0.552	0.765	1.045	1.729
CUHP Runoff Volume (acre-ft) =	N/A	N/A	0.129	0.208	0.285	0.552	0.765	1.045	1.729
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.0	0.1	0.1	2.6	4.4	6.7	12.0
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.01	0.01	0.30	0.50	0.76	1.37
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A	0.00	0.01	0.01	0.30	0.50	0.76	1.37
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	1.2	2.1	2.8	6.5	9.0	12.1	19.8
Peak Inflow Q (cfs) =	0.1	3.4	0.1	0.4	0.9	3.2	3.4	3.4	3.4
Peak Outflow Q (cfs) =	N/A	N/A	N/A	6.1	9.4	1.2	0.8	0.5	0.3
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	6.1	9.4	1.2	0.8	0.5	0.3
Structure Controlling Flow =	Plate	N/A	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	N/A	N/A	N/A
Max Velocity through Grate 1 (fps) =	N/A	1.10	N/A	0.1	0.3	1.1	1.1	1.1	1.1
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	36	40	42	40	32	28	26	22
Time to Drain 99% of Inflow Volume (hours) =	45	45	46	49	48	44	41	39	35
Maximum Ponding Depth (ft) =	1.59	3.00	1.42	2.02	2.30	2.97	3.00	3.00	3.00
Area at Maximum Ponding Depth (acres) =	0.10	0.13	0.09	0.11	0.11	0.13	0.13	0.13	0.13
Maximum Volume Stored (acre-ft) =	0.129	0.289	0.112	0.172	0.204	0.284	0.289	0.289	0.289

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)



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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

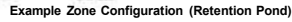
Inflow Hydrographs

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

Time Interval	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08
	0:15:00	0.00	0.00	0.00	0.09	0.19	0.16	0.28	0.31	0.62
	0:20:00	0.00	0.00	0.33	0.58	0.80	0.60	0.81	0.96	1.66
	0:25:00	0.00	0.00	0.89	1.47	2.13	1.47	2.07	2.51	5.34
	0:30:00	0.00	0.00	1.17	2.01	2.75	4.38	6.45	8.39	14.58
	0:35:00	0.00	0.00	1.21	2.06	2.79	5.93	8.39	11.34	18.85
	0:40:00	0.00	0.00	1.18	1.98	2.67	6.48	9.03	12.10	19.81
	0:45:00	0.00	0.00	1.11	1.85	2.52	6.25	8.68	11.92	19.43
	0:50:00	0.00	0.00	1.05	1.74	2.36	6.02	8.35	11.44	18.61
	0:55:00	0.00	0.00	0.99	1.63	2.21	5.49	7.64	10.70	17.44
	1:00:00	0.00	0.00	0.94	1.53	2.10	5.02	7.01	10.06	16.45
	1:05:00	0.00	0.00	0.91	1.45	1.99	4.62	6.48	9.54	15.63
	1:10:00	0.00	0.00	0.84	1.36	1.89	4.19	5.87	8.56	14.07
	1:15:00	0.00	0.00	0.78	1.26	1.78	3.78	5.27	7.59	12.53
	1:20:00	0.00	0.00	0.71	1.16	1.63	3.34	4.64	6.57	10.83
	1:25:00	0.00	0.00	0.67	1.07	1.50	2.94	4.06	5.65	9.35
	1:30:00	0.00	0.00	0.63	1.02	1.40	2.61	3.61	4.97	8.24
	1:35:00	0.00	0.00	0.61	0.97	1.31	2.36	3.25	4.44	7.35
	1:40:00	0.00	0.00	0.58	0.91	1.23	2.15	2.94	3.98	6.57
	1:45:00	0.00	0.00	0.56	0.84	1.15	1.96	2.66	3.56	5.87
	1:50:00	0.00	0.00	0.54	0.78	1.08	1.78	2.41	3.18	5.22
	1:55:00	0.00	0.00	0.49	0.73	1.00	1.62	2.16	2.81	4.60
	2:00:00	0.00	0.00	0.45	0.67	0.91	1.45	1.93	2.47	4.02
	2:05:00	0.00	0.00	0.38	0.56	0.76	1.22	1.60	2.05	3.31
	2:10:00	0.00	0.00	0.32	0.47	0.63	0.99	1.29	1.64	2.63
	2:15:00	0.00	0.00	0.26	0.37	0.50	0.77	0.99	1.25	1.99
	2:20:00	0.00	0.00	0.21	0.30	0.41	0.58	0.73	0.91	1.46
	2:25:00	0.00	0.00	0.17	0.24	0.34	0.43	0.55	0.67	1.10
	2:30:00	0.00	0.00	0.14	0.20	0.28	0.34	0.43	0.51	0.84
	2:35:00	0.00	0.00	0.12	0.17	0.23	0.27	0.34	0.39	0.64
	2:40:00	0.00	0.00	0.10	0.14	0.19	0.21	0.26	0.30	0.49
	2:45:00	0.00	0.00	0.08	0.12	0.16	0.17	0.21	0.22	0.37
	2:50:00	0.00	0.00	0.07	0.10	0.13	0.13	0.16	0.16	0.27
	2:55:00	0.00	0.00	0.06	0.08	0.10	0.11	0.13	0.12	0.21
	3:00:00	0.00	0.00	0.05	0.06	0.08	0.09	0.10	0.10	0.16
	3:05:00	0.00	0.00	0.04	0.05	0.07	0.07	0.08	0.08	0.13
	3:10:00	0.00	0.00	0.03	0.04	0.05	0.05	0.07	0.06	0.10
	3:15:00	0.00	0.00	0.02	0.03	0.04	0.04	0.05	0.05	0.08
	3:20:00	0.00	0.00	0.02	0.02	0.03	0.03	0.04	0.04	0.06
	3:25:00	0.00	0.00	0.01	0.02	0.02	0.02	0.03	0.03	0.04
	3:30:00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.03
	3:35:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02
	3:40:00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
	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

MHFD-Detention, Version 4.04 (February 2021)

Basin ID: Subbasin 7 - Pond 4



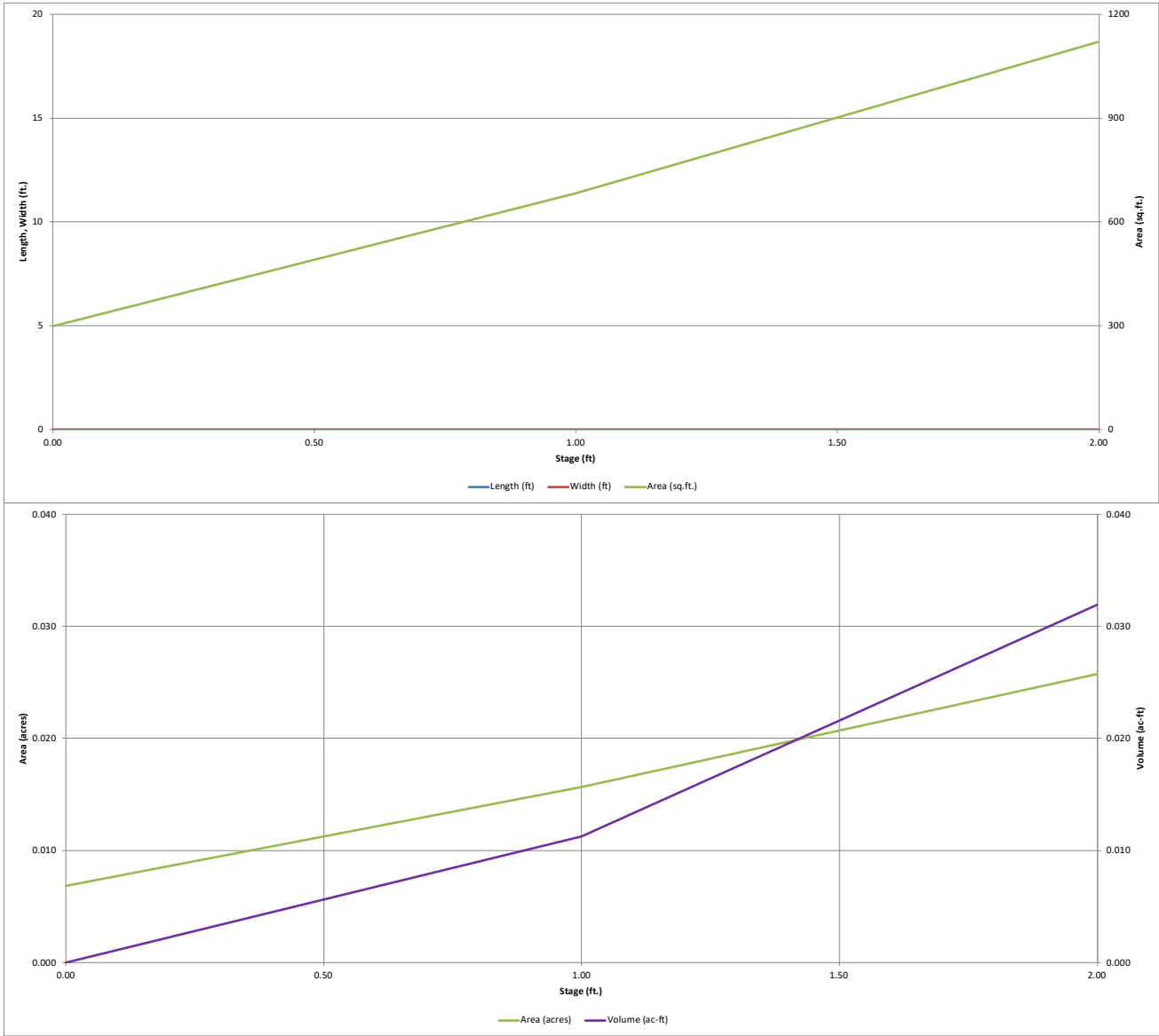
Initial Surcharge Area (A_{SIV})	=	user	ft ²
Surcharge Volume Length (L_{SV})	=	user	ft
Surcharge Volume Width (W_{SV})	=	user	ft
Depth of Basin Floor (H_{FLOOR})	=	user	ft
Length of Basin Floor (L_{FLOOR})	=	user	ft
Width of Basin Floor (W_{FLOOR})	=	user	ft
Area of Basin Floor (A_{FLOOR})	=	user	ft 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

	acre-feet
	acre-feet
0.62	inches
0.86	inches
1.08	inches
1.44	inches
1.75	inches
2.09	inches
3.01	inches

[illegible]

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

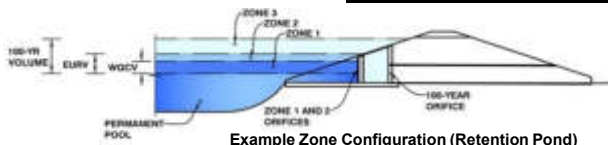


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: Village Camp

Basin ID: Subbasin 7 - Pond 4



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.99	0.011	Orifice Plate
Zone 2			Weir&Pipe (Circular)
Zone 3			
Total (all zones)		0.011	

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)

Calculated Parameters for Plate

Invert of Lowest Orifice = ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate = ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing = inches
Orifice Plate: Orifice Area per Row = sq. inches (diameter = 7/16 inch)

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							
Orifice Area (sq. inches)	0.15							

	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)

Calculated Parameters for Vertical Orifice

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

Vertical Orifice Area = ft²
Vertical Orifice Centroid = feet

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

Calculated Parameters for Overflow Weir

Overflow Weir Front Edge Height, H_o = ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length = feet
Overflow Weir Grate Slope = H:V
Horiz. Length of Weir Sides = feet
Overflow Grate Type =
Debris Clogging % = %

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

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

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

Depth to Invert of Outlet Pipe = ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter = inches

Outlet Orifice Area = ft²
Outlet Orifice Centroid = feet
Half-Central Angle of Restrictor Plate on Pipe = radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Calculated Parameters for Spillway

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

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

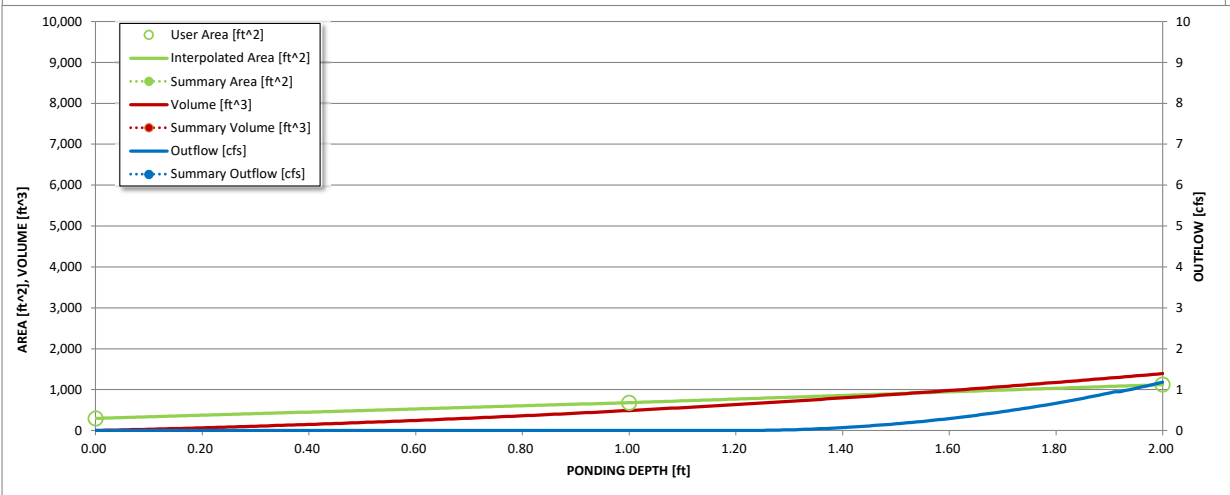
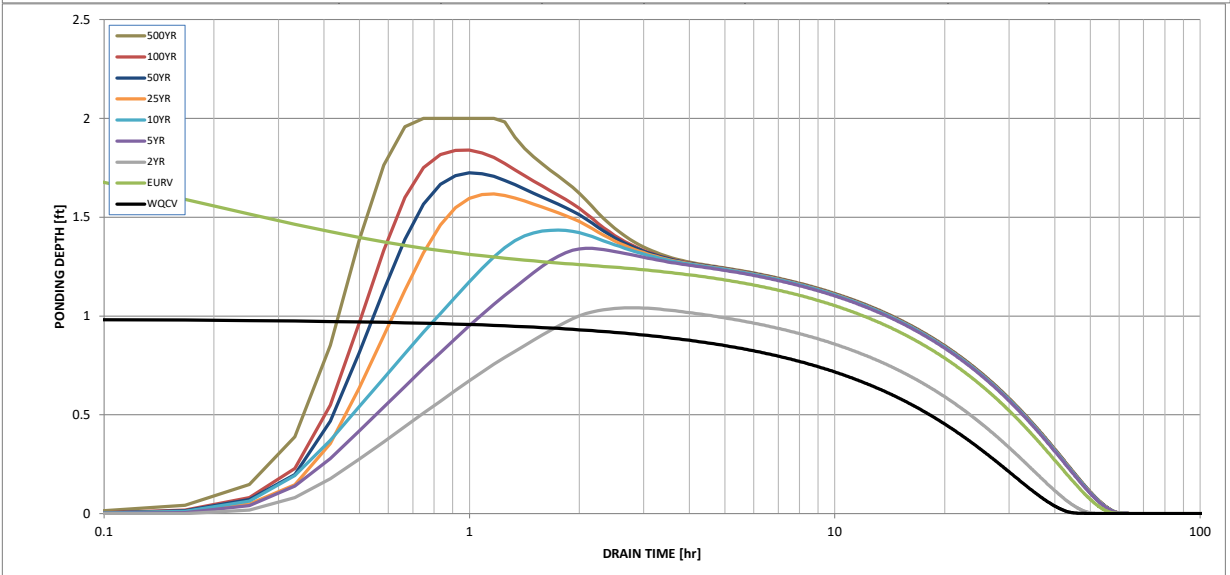
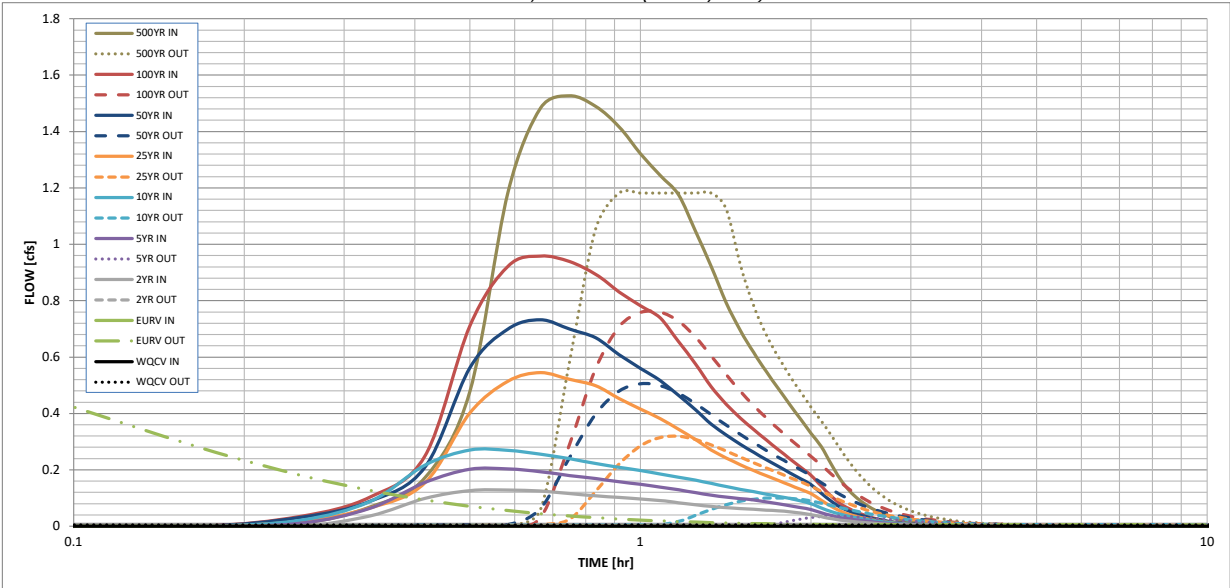
Routed Hydrograph Results

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	0.62	0.86	1.08	1.44	1.75	2.09	3.01
One-Hour Rainfall Depth (in) =	0.011	0.033	0.013	0.020	0.027	0.046	0.062	0.082	0.131
CUHP Runoff Volume (acre-ft) =	N/A	N/A	0.013	0.020	0.027	0.046	0.062	0.082	0.131
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.0	0.0	0.0	0.2	0.3	0.4	0.8
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.0	0.0	0.26	0.44	0.67	1.22
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A	0.00	0.01	0.01	0.26	0.44	0.67	1.22
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.1	0.2	0.3	0.5	0.7	1.0	1.5
Peak Inflow Q (cfs) =	N/A	N/A	0.0	0.0	0.1	0.3	0.5	0.8	1.2
Peak Outflow Q (cfs) =	N/A	N/A	0.0	0.0	0.1	0.3	0.5	0.8	1.2
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	9.6	16.1	1.9	1.8	1.8	1.5
Structure Controlling Flow =	Plate	Overflow Weir 1	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	N/A
Max Velocity through Grate 1 (fps) =	N/A	0.16	N/A	0.0	0.0	0.1	0.2	0.3	0.4
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	47	44	51	50	46	44	41	35
Time to Drain 99% of Inflow Volume (hours) =	42	52	47	55	55	53	51	50	47
Maximum Ponding Depth (ft) =	0.99	1.71	1.04	1.34	1.43	1.62	1.72	1.84	2.00
Area at Maximum Ponding Depth (acres) =	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03
Maximum Volume Stored (acre-ft) =	0.011	0.025	0.012	0.017	0.019	0.023	0.025	0.028	0.032

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)



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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

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

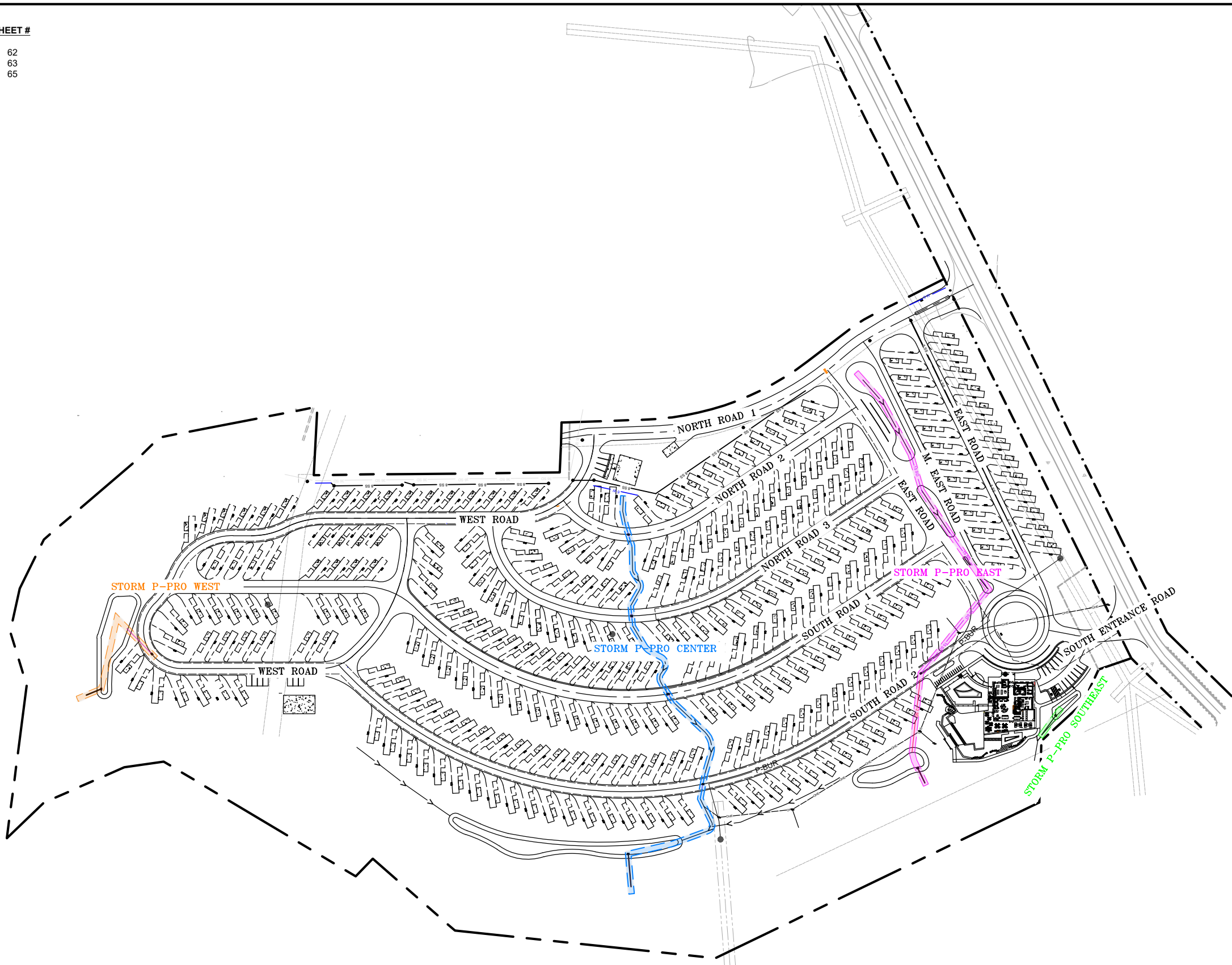
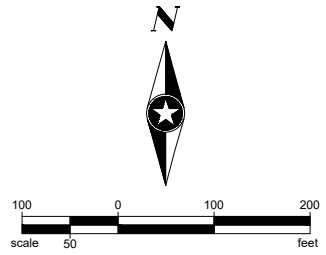
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	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	0:15:00	0.00	0.00	0.00	0.01	0.02	0.02	0.03	0.03	0.07
	0:20:00	0.00	0.00	0.04	0.06	0.09	0.07	0.09	0.10	0.17
	0:25:00	0.00	0.00	0.10	0.16	0.22	0.15	0.21	0.25	0.48
	0:30:00	0.00	0.00	0.13	0.20	0.27	0.40	0.56	0.71	1.18
	0:35:00	0.00	0.00	0.13	0.20	0.27	0.51	0.70	0.92	1.48
	0:40:00	0.00	0.00	0.12	0.19	0.26	0.54	0.73	0.96	1.53
	0:45:00	0.00	0.00	0.12	0.18	0.24	0.52	0.70	0.94	1.49
	0:50:00	0.00	0.00	0.11	0.17	0.22	0.50	0.67	0.89	1.42
	0:55:00	0.00	0.00	0.10	0.16	0.21	0.45	0.61	0.83	1.32
	1:00:00	0.00	0.00	0.10	0.15	0.20	0.42	0.56	0.78	1.24
	1:05:00	0.00	0.00	0.09	0.14	0.19	0.38	0.52	0.74	1.18
	1:10:00	0.00	0.00	0.08	0.13	0.17	0.34	0.46	0.66	1.05
	1:15:00	0.00	0.00	0.08	0.12	0.16	0.31	0.41	0.58	0.92
	1:20:00	0.00	0.00	0.07	0.11	0.15	0.27	0.36	0.49	0.79
	1:25:00	0.00	0.00	0.07	0.10	0.14	0.24	0.32	0.43	0.69
	1:30:00	0.00	0.00	0.06	0.10	0.13	0.22	0.29	0.38	0.62
	1:35:00	0.00	0.00	0.06	0.09	0.12	0.20	0.26	0.34	0.55
	1:40:00	0.00	0.00	0.06	0.09	0.11	0.18	0.24	0.31	0.49
	1:45:00	0.00	0.00	0.05	0.08	0.11	0.16	0.21	0.27	0.43
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	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
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	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Appendix E

Culvert and Swale Analysis, Storm P-Pros, and Outlet Structure Details

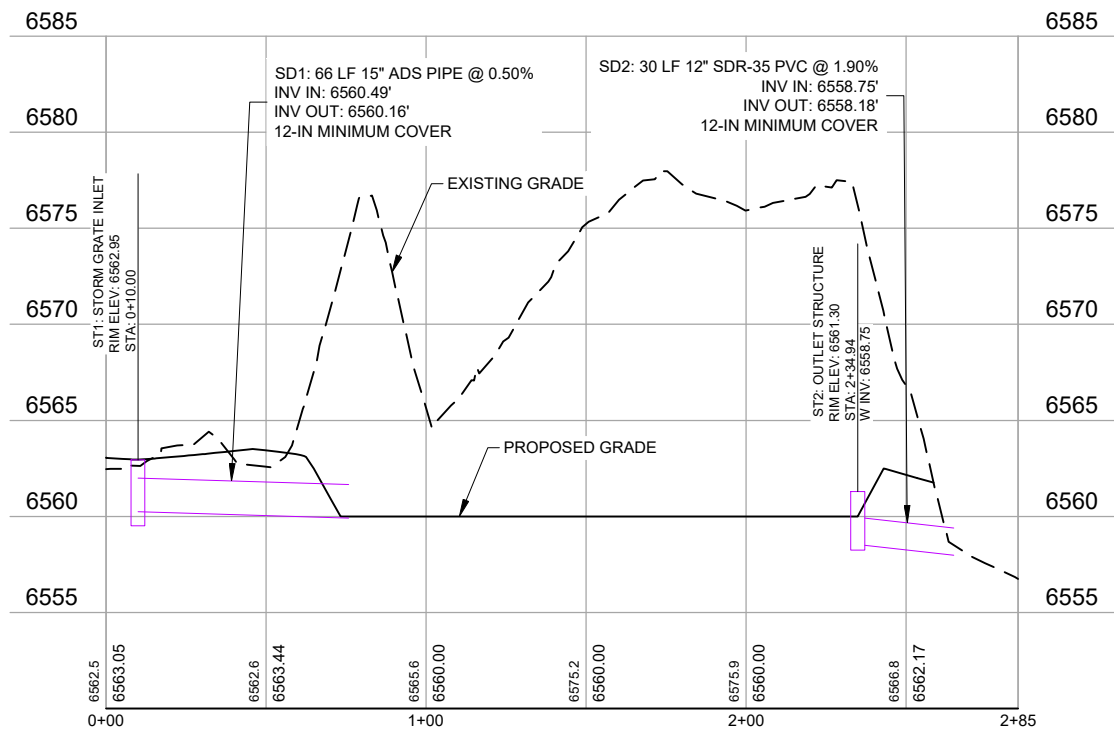
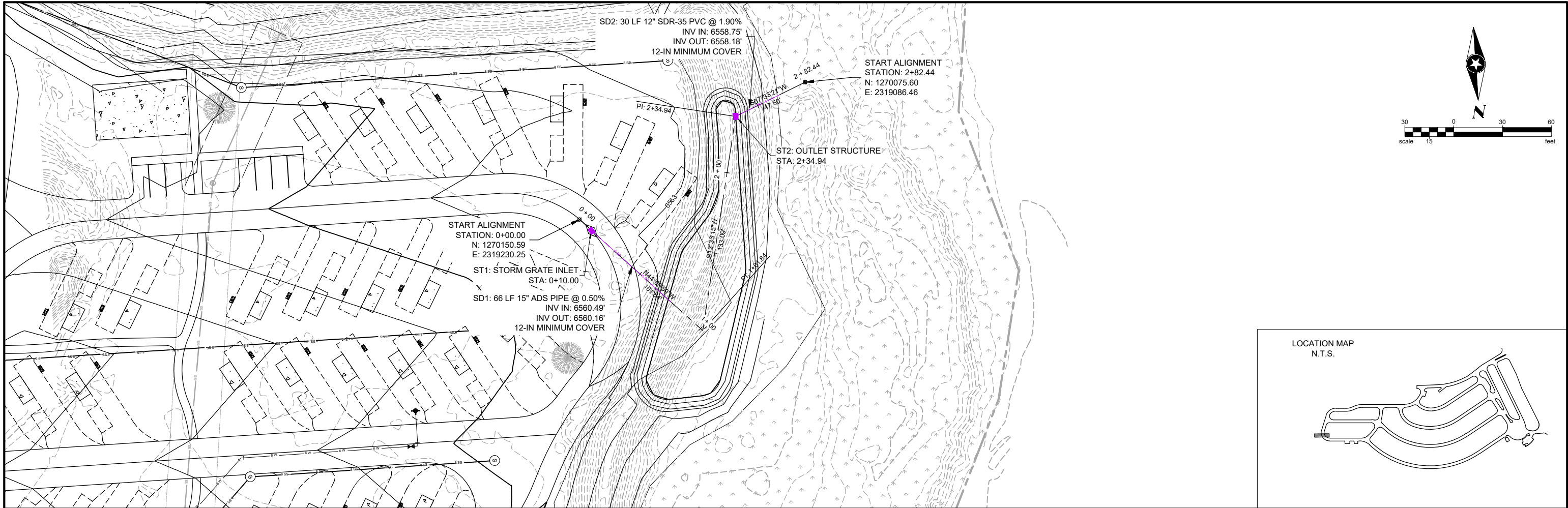
ALIGNMENT
STORM WEST 1
STORM CENTER
STORM EAST

SHEET #
62
63
65

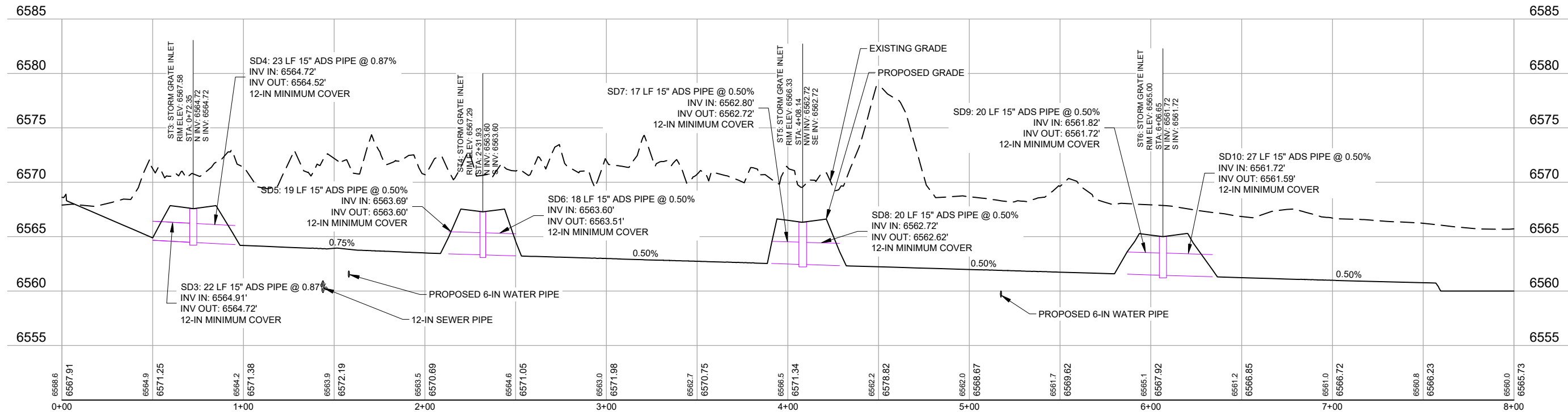
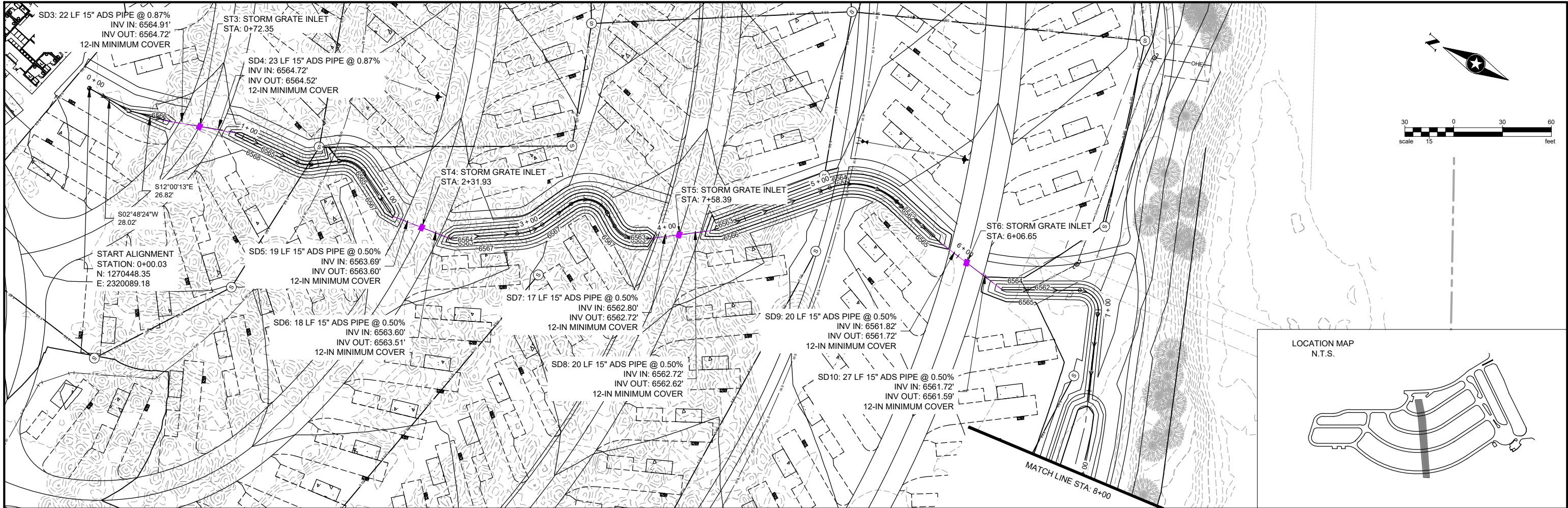


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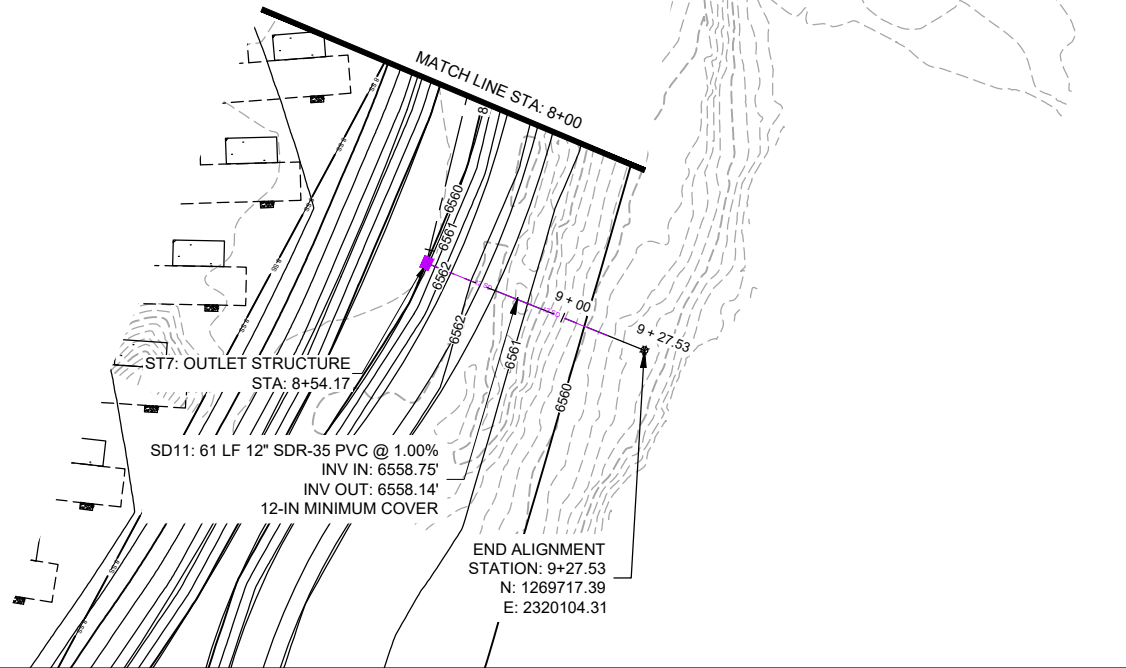
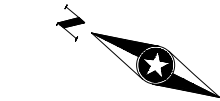
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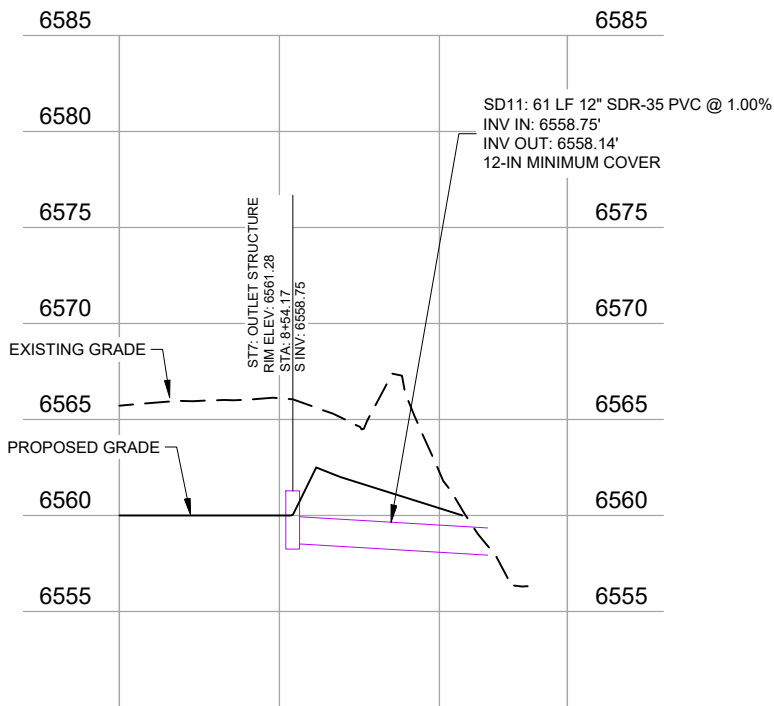
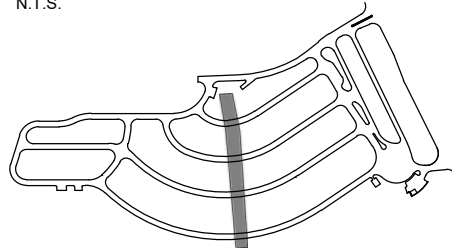
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LOCATION MAP
N.T.S.



SEH Project	168892	Rev.#	Revision Issue Description	Date	Rev.#	Revision Issue Description	Date
Drawn By	SC/CM						
Designed By	TM						
Checked By	SW						



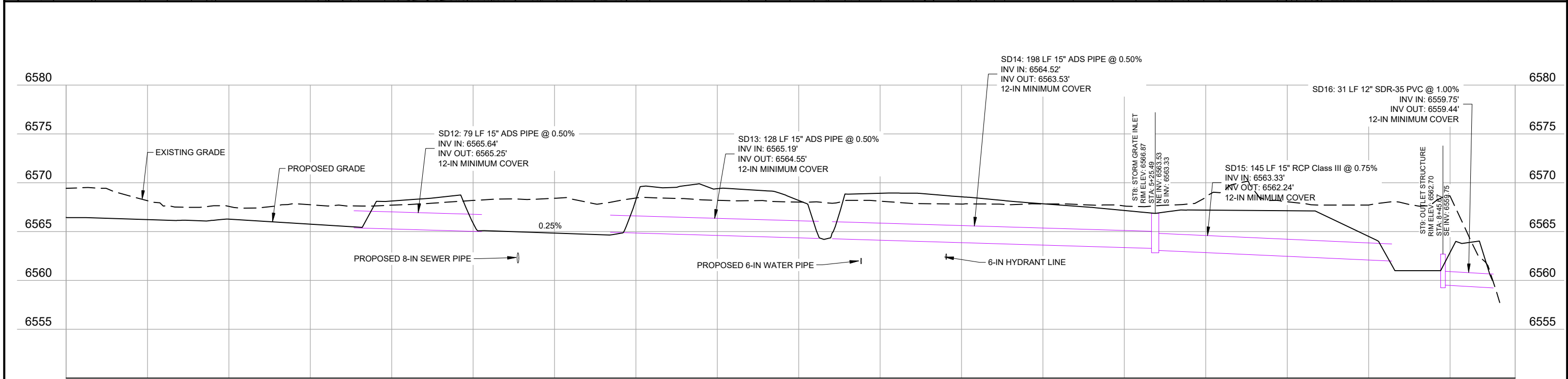
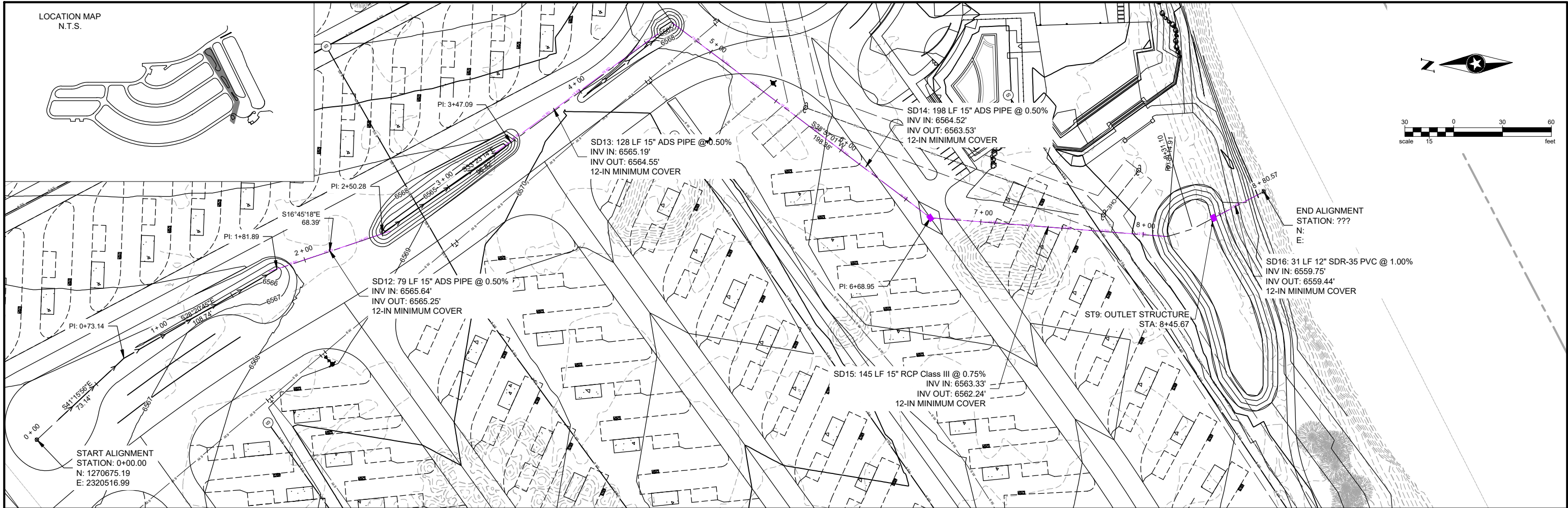
I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF CO.

TRAVIS MOONEY
DATE 01/17/2025 LICENSE NO. 0051259

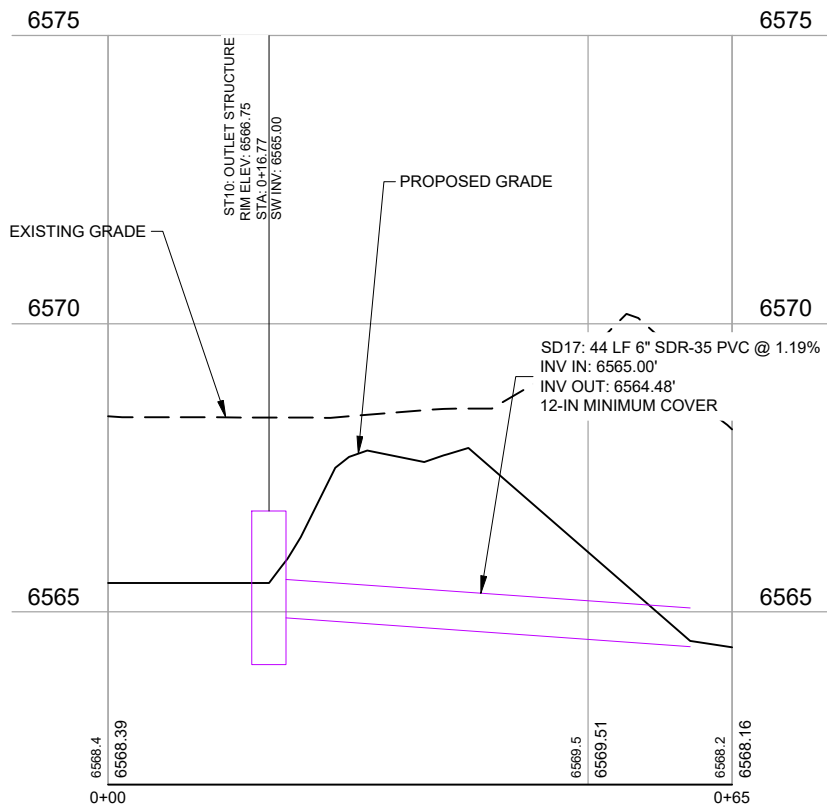
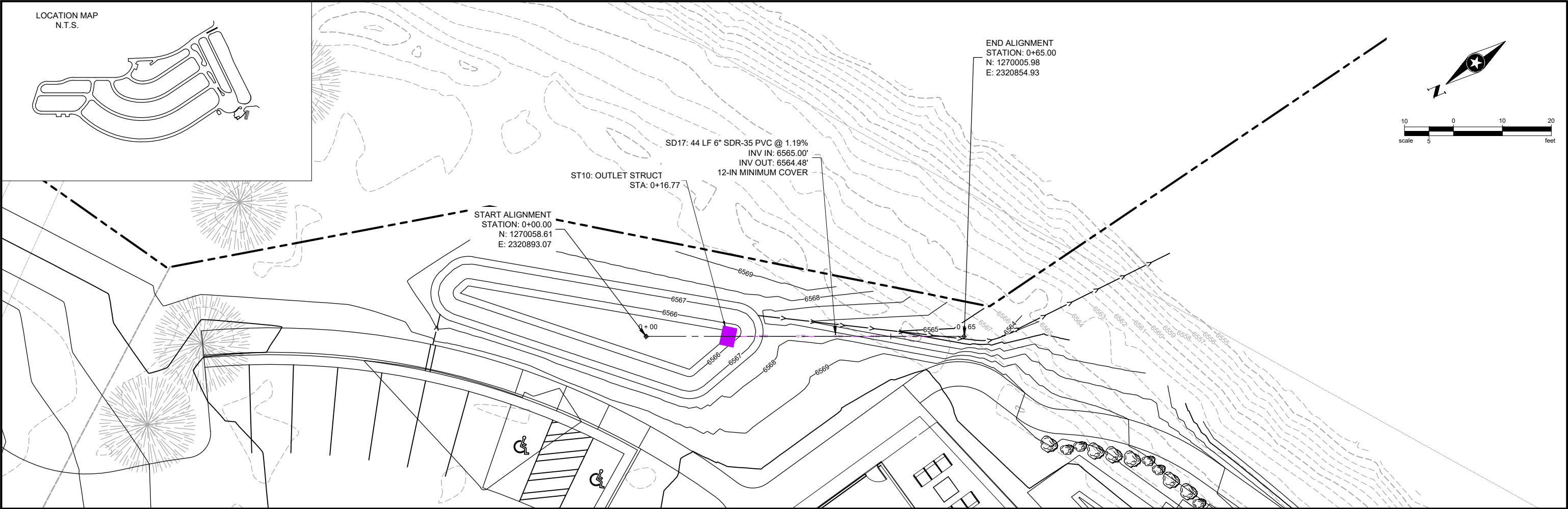
VILLAGE CAMP DURANGO
DURANGO, COLORADO

STORM P-PRO CENTER (2)

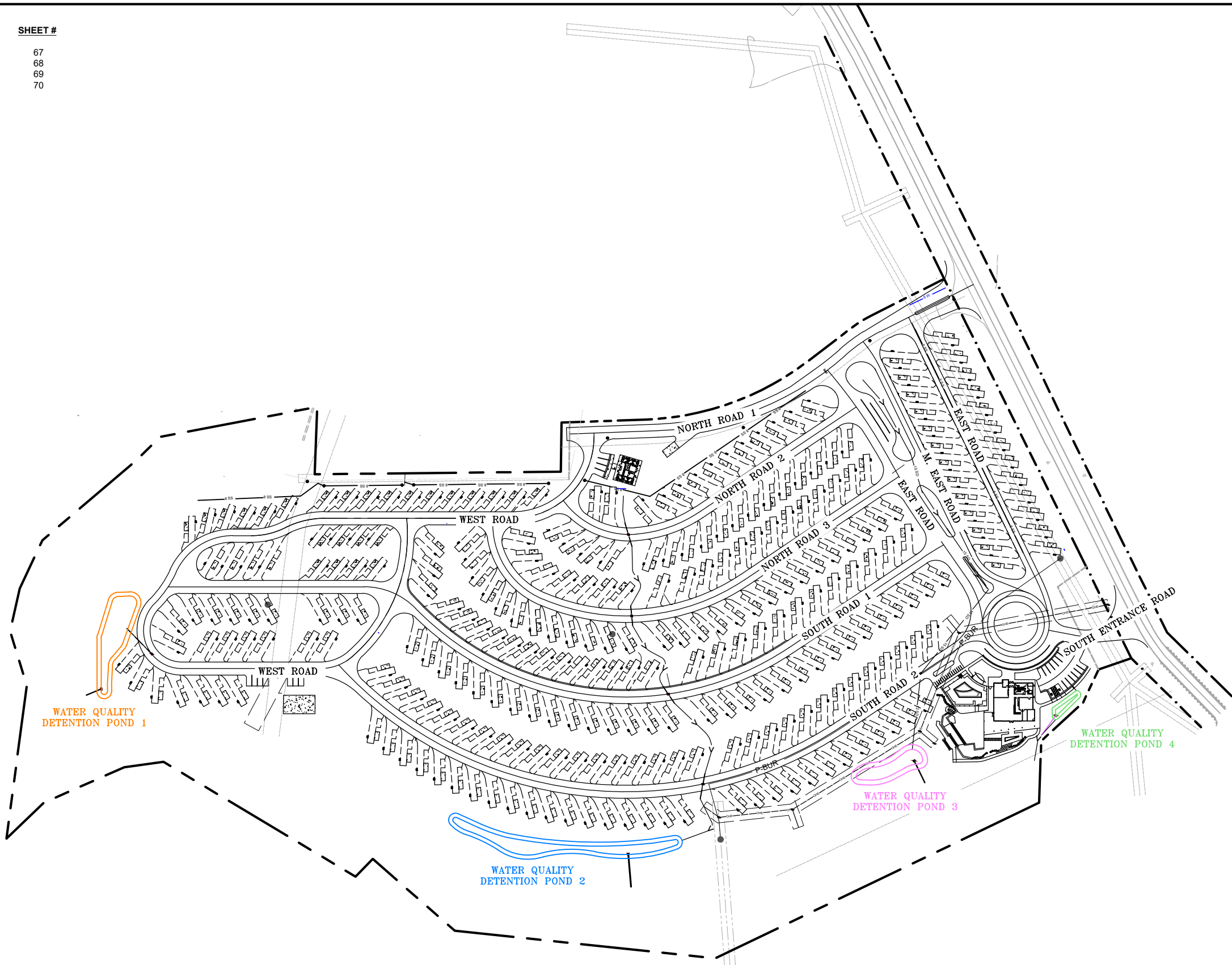
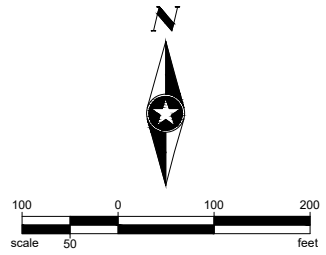
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POND	SHEET #
WATER QUALITY DETENTION POND 1	67
WATER QUALITY DETENTION POND 2	68
WATER QUALITY DETENTION POND 3	69
WATER QUALITY DETENTION POND 4	70



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