AURORA WATER AT SEAM MASTER DRAINAGE

MASTER DRAINAGE REPORT 2020 UPDATE

JUNE 2020

For:
Aurora Water
15151 E. Alameda Parkway
Aurora, CO 80012

Prepared By:
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APPROVED FOR ONE YEAR FROM THIS DATE	
City Engineer	Date
Aurora Water Department	Date

ENGINEER'S STATEMENT:

I hereby certify that this report and plan for the master drainage design of Aurora Water at SEAM Master Drainage, was prepared by me (or under my direction supervision) in accordance with the provisions of the City of Aurora Drainage Criteria Manual for the owners thereof.

Brian K. Moss, P.E. Date
State of Colorado No. 37702
For and on behalf of Calibre Engineering, Inc.

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APPENDICES

SCOPE

This master drainage report update builds upon the 2012 Master Drainage report prepared by PEAK Civil and discusses the historic and proposed design for the Aurora Water at SEAM Master Drainage improvements. The intent of this report is to update the concepts for the drainage facilities discussed in the *Master Drainage Report for Southeast Aurora Maintenance Facility (Pronghorn Natural Area and Open Space #01), prepared by Peak Civil Consultants dated April 2012,* COA Approval Number 212034*.* This report will be referred to as *2012 Master Drainage Report* in this report. This Aurora Water at SEAM Master Drainage report update includes hydrologic and hydraulic calculations, tables, graphs and exhibits showing drainage basins, routing, and proposed storm improvements. Our report generally agrees with the conclusions found in the 2012 Master Drainage Report but updates them per the developed site design that is currently being performed by Eidos/Calibre Engineering team.

A. INTRODUCTION

1. Location

- The proposed Aurora Water at SEAM Facility is bounded on the north and east side by Open space, to the south by East Quincy Avenue, and to the west by the City and County of Denver DADS site.
- The site is located in the City of Aurora, Adams County and State of Colorado. The site is located in the Southwest Quarter of Section 1, Township 6 South, Range 66 West of the 6th Principal Meridian.
- See Vicinity Map located in Appendix A.

2. Proposed Development

- The overall site is approximately 86 acres in size with the disturbed area for the current project being approximately 45 acres.
- The site is currently undeveloped agricultural range land.
- Site Soil Mapping Units consist of FdC (Fondis silt loam, Hydrologic Soil Group C), RhD (Renohill-Buick loams, Hydrologic Soil Group D), and RtE (Renohill-Litle-Thedalund complex, Hydrologic Soil Group D).
- The site is covered with native grasses. The dominant native grass species being western wheatgrass. The upper areas of the site have a more natural blend of native prairie grasses. The general topography slopes south (Quincy Road) to the north with a ridgeline on the site splitting flows east and west, average slopes range between 2% and 3%. There is an existing drainageway that crosses the site running diagonally southwest to northeast across the northern limits of the Filing boundary. This drainageway was identified as Baldwin Creek tributary to Senac Creek within the *2012 Master Drainage Report*. Baldwin Creek was further analyzed with the *Senac Creek Major Drainageway Plan, dated December 2014*.
- Existing land use for the site is undeveloped with associated imperviousness estimated to be between 5% to 7%.

- Land uses for the Aurora Water SEAM facility will include 5 new municipal buildings, along with access roads, internal drive aisles, parking/landscape areas and other associated infrastructure.
- Two future commercial outparcels are south of the proposed Aurora Water at SEAM but are not proposed to be developed at this time. Scenarios to provide stormwater management for these areas will be discussed later in this report.
- The proposed site will increase the overall percent imperviousness to:
  - Basin A – 90.6% on 11. 7 acres,
  - Basin B – 65.8 % on 17.8 acres,
  - Basin C1 - COMM 1 (15.1 ac.) will remain undeveloped at this time
  - Basin C2 – COMM 2 (21.3 ac.) will remain undeveloped at this time
- Portions of future developed commercial areas will remain undeveloped and surface drainage will be intercepted by proposed access roadside swales. A portion of this area, approximately 13.5 acres currently drains directly offsite into the Baldwin Creek drainage basin. In the future this sub-basin will reduce to approximately 7.0 acres (OS -4 sub-basin).

B. HISTORIC DRAINAGE

1. Overall Basin Description

- Aurora Water at SEAM Master Drainage is located within the Upper Sand Creek watershed and is identified within the Senac Creek Basin and the Coal Creek Basin. A ridgeline divides the site in generally a south to north direction creating this split. The runoff for this area will split into flows going east and west discharging ultimately into the Senac Creek drainageway and all being a part of the Coal Creek Drainage Basin.
- The development is within FEMA Flood Insurance Rate Map (FIRM) panel 08005C0219L, dated April 18, 2020. All of the proposed development is located in Zone X and no mapped 100-year floodplains exist on the proposed site.
- The site is contained within historic drainage Basins A-G as identified in the previous *2012 Master Drainage Report* by Peak Civil Consulting. An updated rational analysis for these historic basins in the undeveloped condition can be found in the Appendix B.

2. Drainage Patterns Through Property

- In addition to the major historic basins noted above, there is runoff historically tributary to the site from the south and west. This is noted as Basin O1 in the *2012 Master Drainage Report and is the upstream drainage basin for Baldwin Creek*. This historic basin was re-delineated as a part of the *2014 Senac Creek Major Drainageway Plan* report into basins 228A, 228B, and 229A to reflect the ridge south of the Arapahoe County racetrack as well as the roadway crossing at East Quincy Avenue. East Quincy Avenue currently unintentionally acts to detain upstream flows (released by existing 48” CMP culvert under Quincy Ave.) and creates passive detention until upstream flows equalize. Baldwin Creek

will remain as an open channel through the Seam site with a culvert crossing added to provide access to the northwest corner of the site. Some re-channelization will occur to provide an alignment that minimizes disruption to the existing channel and assists in balancing the planned site plan improvements. This channel analysis is included within Appendix C.

- The existing drainageway, Baldwin Creek, flows diagonally across the northern portion of the site through the site to Senac Creek. The previous *2012 Master Drainage Report* discussed providing a trapezoidal swale to re-align a portion of this drainageway and provide more usable space on site. The current development plan shows this open channel being slightly modified to allow access to the northwest corner.
- A 6' x 8' box culvert has been preliminarily designed to convey Baldwin Creek upstream flows through the site. From discussions between City of Aurora staff and MHFD staff, the channel conveyance and culvert conveyance design will be based upon the *2014 Senac Creek Major Drainageway Plan* Baldwin Creek existing condition flows tributary to this culvert, including onsite basins. The fully developed condition 100-year peak flow in excess of the maximum headwater elevation and capacity of the proposed 6' x 8' culvert will be conveyed via overtopping of the proposed local access roadway. HY-8 was used for the culvert analysis and a preliminary analysis is included in Appendix C. The full design analysis shall be provided later as a part of the final drainage design.
- There are no existing major irrigation facilities on the Aurora Water at SEAM Master Drainage property.

3. Outfalls Downstream of Property

- Aurora Water at SEAM Master Drainage is mainly tributary to Senac Creek with lesser flows split by the ridgeline into Baldwin Creek. Baldwin Creek confluences with Senac Creek just north of Aurora Water at SEAM site. Both drainageways eventually drain into Upper Sand Creek via Coal Creek.

C. DESIGN CRITERIA

4. References

- Existing drainage reports for the property used for this analysis include:
  - *Master Drainage Report for Southeast Aurora Maintenance Facility (Pronghorn Natural Area and Open Space #01), prepared by Peak Civil Consultants dated April 2012,* COA Approval Number 212034.
- The main guide used in the development of this Master Drainage Report Update is the *City of Aurora Storm Drainage Design and Technical Criteria* (Criteria).
- The Mile High Flood District's (MHFD) *Urban Storm Drainage Criteria Manual* (USDCM) was also used as a reference and guide for criteria.
- The site is included within the *Baseline Hydrology Report, Sand Creek, Colfax to Yale, Major Drainageway Plan* by Matrix Design Group, dated November 2011

- The site is also included within the *Upper Sand Creek Basin, Outfall Planning Study, Preliminary Design* by Kiowa Engineering Corporation dated August 1990.
- The site is also included within the *Senac Creek Major Drainageway Plan* by Matrix Design Group dated December 2014.

5. Hydrologic Criteria

- Peak storm runoff was determined using the Rational Formula: Q=CIA. This method is considered appropriate for basin areas up to 90 acres. Total property area with this project is approximately 86 acres, therefore the Rational Method is acceptable
- Parameters for use with the Rational Method were determined as follows:
  - Recommended percent impervious values are taken from MHFD Table 6-3 of their USDCM.
  - Runoff Coefficient “C” factors taken from Table 1 of COA Storm Drainage Criteria.
  - The 2-year storm was analyzed as the minor event, with a 1-hour point rainfall value of 0.84 in taken from MHFD Figure 5-1 of their USDCM. This value is different than previously used in the *2012 Master Drainage Report* which used a 2-year storm rainfall value of 1.00 in.
  - The 100-year storm was analyzed as the major event, with a 1-hour point rainfall value of 2.42 in taken from MHFD Figure 5-6 of their USDCM. This value is different than previously used in the *2012 Master Drainage Report* which used a 100-year storm rainfall value of 2.65 in.
  - Senac Creek Major Drainageway Plan existing condition flows will be utilized to size the Baldwin Creek proposed improvements. These include the 6’ x 8’ box culvert and the channel realignment cross section. Geomorphic analysis has not been completed for this reach of the channel and may be required to complete the final design analysis for the channel. The concept design presented herein is based upon design criteria presented within Volume 1 of MHFD UDSCM manual.

6. Hydraulic Criteria

- Swale, culverts and channel capacities are evaluated with either Bentley Flow Master V8i or HY-8 software as appropriate and in accordance with current MHFD Criteria. Flow velocities for unprotected swales/channels are limited to less than erosive velocities or will be protected with erosion control materials.

D. DRAINAGE PLAN

1. General Concept

- The onsite drainage will, in general, be captured by roadside ditches, parking area curb and gutter and storm sewer. Where possible grassed swales or other low impact development techniques have been employed to pre-treat water before entering the storm system. The proposed drainage patterns have been developed to efficiently move stormwater to and through the development site to the proposed detention/WQ ponds.

- Aurora Water at SEAM was previously analyzed in the *2012 Master Drainage Report* which discussed the necessary drainage improvement to develop the site. The proposed land use (commercial) is consistent with the land use assumed in the *2012 Master Drainage Report*.
- Future Commercial development areas will contribute unimproved drainage flows to proposed roadside ditches and routed to and through proposed detention/WQ pond B.
- Future development of these areas will require provisions for separate detention/WQ facilities to handle these future commercial areas which is discussed in greater detail below. Future storm sewer outfalls will also need to be considered at that time.

2. Specific Details

- The site has been split into four key basins that have been delineated to establish 2 year and 100 year runoff quantities for the various developed areas, partial undeveloped areas impacted by access roads and direct flow areas that direct surface offsite in a nearly historic manner.
- Basin A consists of approximately 13.8 acres that comprises the northern one-third of the proposed improved site area. This basin has been broken into 10 sub-basins to analyze runoff captured from building areas, parking areas, driveways and landscape areas. These proposed sub-basins were used to establish inlet capture points, size proposed storm sewer and route intercepted drainage flows to proposed detention pond A. Detention pond A has been sized to provide detention storage to attenuate peak runoff flows and release into Baldwin Creek at or near a historic runoff rate. Water quality capture volume has been provided within detention pond A to treat site stormwater intercepted by the pond and release stormwater at a rate that equates to a 40 hour drain time.
- Basin B consists of approximately 18.0 acres that comprises the bulk of the remaining improved site area. Basin B has been broken into 11 sub-basins to analyze runoff captured from building areas, parking areas, driveways and landscape areas. These proposed sub-basins, similar to Basin A, were used to establish inlet capture points, preliminary size proposed storm sewer and route intercepted drainage flows to proposed detention pond B. Detention pond B has been sized to provide detention storage to attenuate peak runoff flows and release into Senac Creek at or near a historic runoff rate. Water quality capture volume has been provided within detention pond B to treat site stormwater intercepted by the pond and release stormwater at a rate that equates to a 40 hour drain time.
- Pond B has been designed to capture developed drainage from Basin B and has also been initially designed to capture undeveloped offsite flows from Basins CM 1 and 2, the basin comprises 36.4 acres. Basins CM 1 and CM 2 represent the future development area for proposed commercial. On an interim basis these basin flows are captured as ditch flows and need to be routed to and through detention pond B. Sub-basins CM 1 and CM 2 surface flows will be captured by the proposed maintenance access and main access roadway ditches. These roadside ditches lead into the site near the proposed

fueling station and will be intercepted by proposed onsite storm sewer and will be conveyed onto the detention pond by either storm sewer or via onsite roadside ditches during major storm events. These offsite flows are considered Interim and will be required to be captured via improved drainage facilities provided with the development of the Future Commercial areas planned within sub-basins CM 1 and CM 2. Sub-basin FD4 comprises a portion of the Future Commercial development area and portions of this sub-basin by virtual of site grades will continue to have surface drainage that will need to be captured by onsite planned drainage facilities. Sub-basin FD7 will remain as open space and contain bioswales along the east side of the entry roadway. Surface flows from this sub-basin will directly discharge into detention pond B now and in the future.

3. Pond A

- Pond A has been designed as a dry extended detention/water quality pond to treat stormwater runoff for Basin A and Basin C. The pond tributary area includes all of basin A1 through A10 and basins C1 and C2. UD Detention pond design worksheets are included within Appendix B.

4. Pond B

- Pond B has been preliminarily designed as a dry extended detention/water quality pond to treat stormwater runoff for Basin B and portions of future developed Basin FD. The pond tributary area includes all of basin B1 through B11 and undeveloped flows from basins FD1 Through FD7. Pond B has been sized to handle and pass these undeveloped flows through the proposed outlet facilities and outfall storm sewer. Future development of the remaining Commercial sites will require providing additional detention and water quality ponding on their respective sites. UD Detention pond design worksheets are included within Appendix B.

5. Site Conformance

In order to make an accurate comparison of the overall basins of this report to the *2012 Master Drainage Report*, percent imperviousness values for Aurora Water at SEAM Master Drainage have been estimated with the Watershed Imperviousness charts from 2018 MHFD criteria.

6. Future Commercial Sites

- The two commercial sites referred to in this report as basins C1 and C2 are roughly 15.1 acres and 21.3 acres respectively and are accounted for in the current design as passthrough flows that are captured in roadside swales and routed through Pond B as discussed in the previous paragraphs.

- As part of this master plan however, our office has investigated three (3) scenarios in which detention and water quality requirements could be met for the future development once constructed.

- The first scenario requires construction of two (2) additional ponds, one on each of the future commercial parcels. This could provide stormwater management with water quality volume provided in each individual pond for its respective basin.

- The ponds each with their own water quality volume would need to meet the following criteria at a minimum:

Pond	WQ Volume (ac-ft)	EURV Volume (ac-ft)	100 YR Volume (ac-ft)	Total Pond Volume (ac-ft)
B	0.744	0.997	2.331	4.072
C1	0.552	0.920	1.034	2.507
C2	0.713	1.188	1.335	3.236

- The second scenario requires construction of one (1) additional pond which would be sized to handle the entirety of the two (2) commercial area's runoff. This could be accomplished with water quality volume provided in both the new commercial pond and pond B or only handling stormwater management in the new pond and oversizing pond B to provide water quality for both of the commercial parcels and onsite basin B.
  - The ponds each with their own water quality volume would need to meet the following criteria at a minimum:

Pond	WQ Volume (ac-ft)	EURV Volume (ac-ft)	100 YR Volume (ac-ft)	Total Pond Volume (ac-ft)
B	0.744	.997	2.331	4.072
C1	0.589	0.811	1.532	2.932

  - The new commercial pond only providing detention and providing water quality volume in an oversized Pond B would need to meet the following criteria at a minimum:

Pond	WQ Volume (ac-ft)	EURV Volume (ac-ft)	100 YR Volume (ac-ft)	Total Pond Volume (ac-ft)
B	1.333	0.408	2.626	4.366
C1	-	0.811	2.121	2.932

E. BEST MANAGEMENT PRACTICES (BMPS)

1. Temporary BMPs

- Please see the separate Stormwater Management Plan for details regarding temporary (construction) BMPs.

2. Permanent BMPs

- Permanent BMPs for the Aurora Water at SEAM Master Drainage site include Local Detention Ponds A and Pond B, and numerous roadside swales throughout the proposed site.

F. LOW IMPACT DEVELOPMENT

1. 2012 Master Drainage Report Update

- The *2012 Master Drainage Report* suggested additional water quality measures be included within the overall project framework such as porous pavement, engineered grass swales, and localized landscape detention. The report further suggested that the site may qualify for Level 1 or Level 2 Lower Impact Development (LID) Status based upon these improvements. A functional description of each status as provided in the *2012 Master Drainage Report* is provided below along with a response to how the proposed development will apply this guidance.
    - Level 1:The intent of Level 1 is to direct runoff from impervious surfaces to flow over grass covered areas and/or permeable pavement, and to provide a sufficient travel time to facilitate the removal of suspended solids before runoff leaves the site, enters a curb and gutter system, or enter another stormwater collection system.
    - Level 1 Response: Grass-lined ditches and roadside grass buffer strip shoulders are being planned for the key entrance roadways however, the roadway grades are consistently within the 3 to 4% grade range and are not suitable to mitigate channel velocities. Permeable paving is not considered a desirable option due the highly expansive soils present on the site.
    - Level 2: The intent of Level 2 LID is to provide an enhancement to Level 1 by replacing solid street curb and gutter systems with no curb or slotted curbing, low velocity grass-lined swales and pervious street shoulders, including pervious rock lined swales.
    - Level 2 Response: Solid curb and gutter will only be used onsite within parking areas. Local access drives will utilize pervious grass covered street shoulders to serve as ‘buffer strips’ adjacent to receiving roadside ditches. Roadside ditches will require erosion protection, utilizing to the extent possible rock lining or other suitable erosion protective alternatives. Drainage within roadside ditches will be intercepted by area drains and conveyed by storm sewer to planned detention/water quality ponds.

G. CONCLUSIONS

1. Compliance with Standards

- This report generally agrees with and builds upon the recommendations of the *2012 Master Drainage Report* prepared by PEAK Civil.
- This report is in general accordance with the *City of Aurora Storm Drainage Design and Technical Criteria*.
- This report is in general accordance, where applicable and not superseded by other criteria, to the USDCM.
- This report is in general accordance with FEMA, there are no mapped 100-year floodplains shown on the FIRM for the site.

2. Summary of Changes from 2012 Master Drainage Report

- Update of rainfall values to current standards. The *2012 Peak Civil Report* used rainfall values of 1.00 in and 2.65 in; the rainfall values for the aurora reservoir used in our report are 0.84 in and 2.42 in.
- It's unclear how PEAK Civil routed or delineated the area for the offsite flow to the Baldwin Creek Diversion. Our office performed a site visit and has downloaded regional topography to generate the existing on-site basin delineation and update it per the proposed grading for the site.
- Baldwin Creek routing through the site: The *2012 Master Drainage Report* considered an improved open channel section through the northeast corner of the site. The current plan also proposes an open channel with two 3-ft drops and a 6' x 8' culvert crossing to re-align a portion of this drainageway and provide more usable space on site. Further design and analysis of this channel will be covered with the *Aurora Seam Final Drainage Report (In Progress)*. The culvert was designed for existing flow peak discharges from the *2014 Senac Creek MDP*. Please see the summary table below for a summary of the culvert analysis. A more detailed summary can be found in the Appendix C.

HY-8 Analysis Results Seam Site 8' X 6' RCBC Exisiting Condition			
Discharge Name	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)
2 year	32.00	32.00	5751.44
5 year	121.00	121.00	5753.00
10 year	178.00	178.00	5753.90
25 year	330.00	330.00	5756.07
50 year	438.00	438.00	5757.49
100 year	556.00	556.00	5759.27

3. Summary of Concept

- Runoff from the site will be conveyed through inlets and a storm sewer system to the planned Onsite Local Detention Ponds A and B.
- Inlets have been located to ensure street capacity is not exceeded in the minor or major storm events. Local high-points have been designed to safely convey runoff to the detention pond in an emergency flow routing condition.
- Baldwin Creek, which is adjacent to the site and crosses the northwest corner of the site will be impacted by the development of Aurora Water at SEAM Master Drainage. Open channel grading with two 3-ft drop structures, and the culvert (8'x6' RCBC) are currently the only drainageway improvements proposed at this time. The downstream reach will include some transition grading to tie into the existing channel alignment and erosion

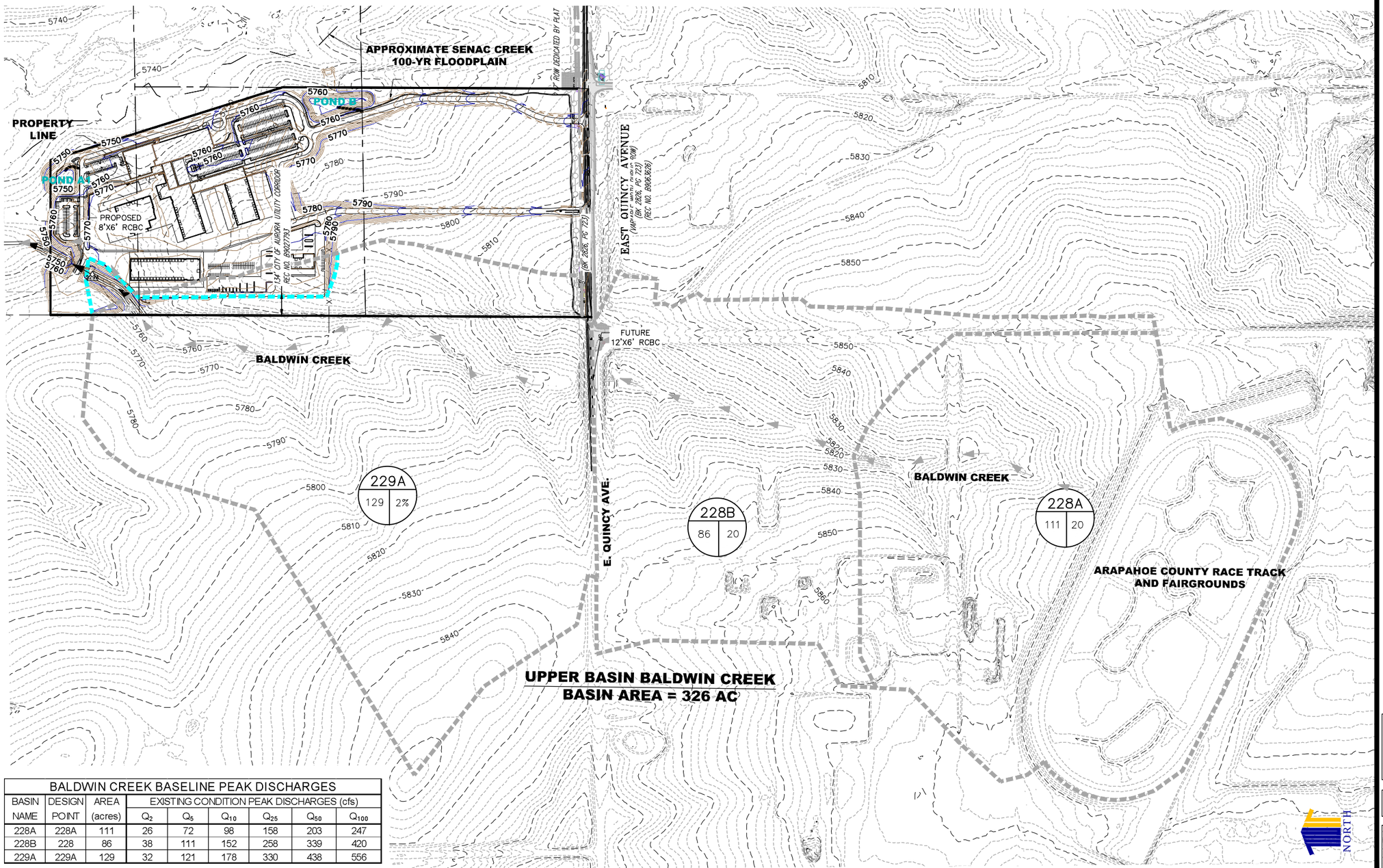
protection added at the exit point of the culvert. Please see the Aurora Seam Final Drainage Report for the design and analysis of the open channel. Analysis of the culvert is included in this report and can be found in the Appendix C.

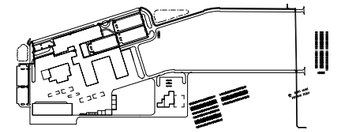
- Downstream properties should not be affected by the development of the proposed site. The onsite local Detention/WQ Ponds A and B will provide the appropriate detention to control the stormwater release and provide water quality capture volume to assist with water quality from the Aurora Water at SEAM project development as these detention facilities release to downstream properties to the north (Baldwin Creek) and east (Senac Creek).
- Development of the future commercial areas will need to consider additional water quality and detention to meet the goals of this report, the City of Aurora, the Mile High Flood District, and the State of Colorado.
- None of the proposed detention and water quality control features meet the criteria to be considered regional detention facilities and will not be maintenance eligible.

H. LIST OF REFERENCES

1. *City of Aurora Storm Drainage Design and Technical Criteria*, revised January 2010.
2. *Urban Storm Drainage Criteria Manual, Volumes 1, & 2 & 3*, Mile High Flood District, Updated January 2016.
3. *Urban Storm Drainage Criteria Manual, Volume 3, Best Management Practices,* Updated November 2010
4. *Master Drainage Report for Southeast Aurora Maintenance Facility (Pronghorn Natural Area and Open Space #01*), Prepared by Peak Civil Consultants, Inc., April 2012, COA No. 212034mdi 20073025.
5. *Upper Sand creek Basin OSP*, Kiowa Engineering Corporation, August 1990.
6. *Aurora Reservoir Parks and Water Master Plan*, December 2011.
7. *Sand Creek (Colfax to Yale) Major Drainage Plan and FHAD Baseline Hydrology*, Matrix Design Group, November 2011.
8. *Senac Creek Major Drainageway Plan*, Matrix Design Group, December 2014.

APPENDIX A:
MAPS AND EXHIBITS





LEGEND

- EXISTING MAJOR CONTOUR (10') — 5250
- EXISTING MINOR CONTOUR (2')
- PROPOSED MAJOR CONTOUR (10') — 5250
- PROPOSED MINOR CONTOUR (2')
- BALDWIN CREEK ALIGNMENT
- BALDWIN CREEK PROPOSED ALIGNMENT
- PROPERTY LINE
- 100-YR FLOODPLAIN
- 2014 MDP HISTORIC BASIN LINE
- MDP ADDENDUM 1 BASIN LINE

MDP BASIN LABEL: XX (BASIN DESIGNATION); AREA (AC.) XX | XX PERCENT IMPERVIOUS

BALDWIN CREEK BASELINE PEAK DISCHARGES

BASIN NAME	DESIGN POINT	AREA (acres)	EXISTING CONDITION PEAK DISCHARGES (cfs) Q_2	Q_5	Q_{10}	Q_{25}	Q_{50}	Q_{100}
228A	228A	111	26	72	98	158	203	247
228B	228	86	38	111	152	258	339	420
229A	229A	129	32	121	178	330	438	556

NOTE: THE FLOWS SUMMARIZED HEREIN ARE BASED UPON EXISTING CONDITION FLOWS PUBLISHED IN THE SENACK CREEK MDP (2014)

CITY OF AURORA PLAN REVIEW IS ONLY FOR GENERAL CONFORMANCE WITH CITY OF AURORA DESIGN CRITERIA AND THE CITY CODE. THE CITY IS NOT RESPONSIBLE FOR THE ACCURACY AND ADEQUACY OF THE DESIGN, DIMENSIONS, AND ELEVATIONS WHICH SHALL BE CONFIRMED AND CORRELATED AT THE JOB SITE. THE CITY OF AURORA, THROUGH THE APPROVAL OF THIS DOCUMENT, ASSUMES NO RESPONSIBILITY FOR THE COMPLETENESS AND/OR ACCURACY OF THIS DOCUMENT.

ENSURE THAT THE PROVISIONS OF CRS 37-92-602, AS AMMENDED BY SENATE BILL 15-212, REGARDING NOTIFICATION OF DOWNSTREAM WATER RIGHTS HOLDERS ARE UPHELD

CITY OF AURORA BENCHMARK #5S6507SW003 (AZTEC #155). RECOVERED A 3"BRASS CAP @ THE N.E. CORNER OF A CURB OPENING INLET STRUCTURE BEING ON THE SOUTH SIDE OF E. BELLEVIEW AVE. AND BEING THE FIRST INLET EAST OF THE COVERED BRIDGE.

Elevation = 5876.73 (NAVD 88).

DATE	REVISION DESCRIPTION

Drawing Name: DR1.dwg
Job Number: EIDOS COA SEAM
Prepared For: EIDOS
Designer: DES | Drafter: DFT | Checked: CKD
0 150 300 600
1 inch = 300 ft. Horizontal

Calibre
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Construction Management Civil Engineering Surveying

AURORA SEAM FACILITY
CIVIL PLANS
BALDWIN CREEK DRAINAGE EXHIBIT

Sheet: DR1 — 1 of 1
Date: MAY 8, 2020

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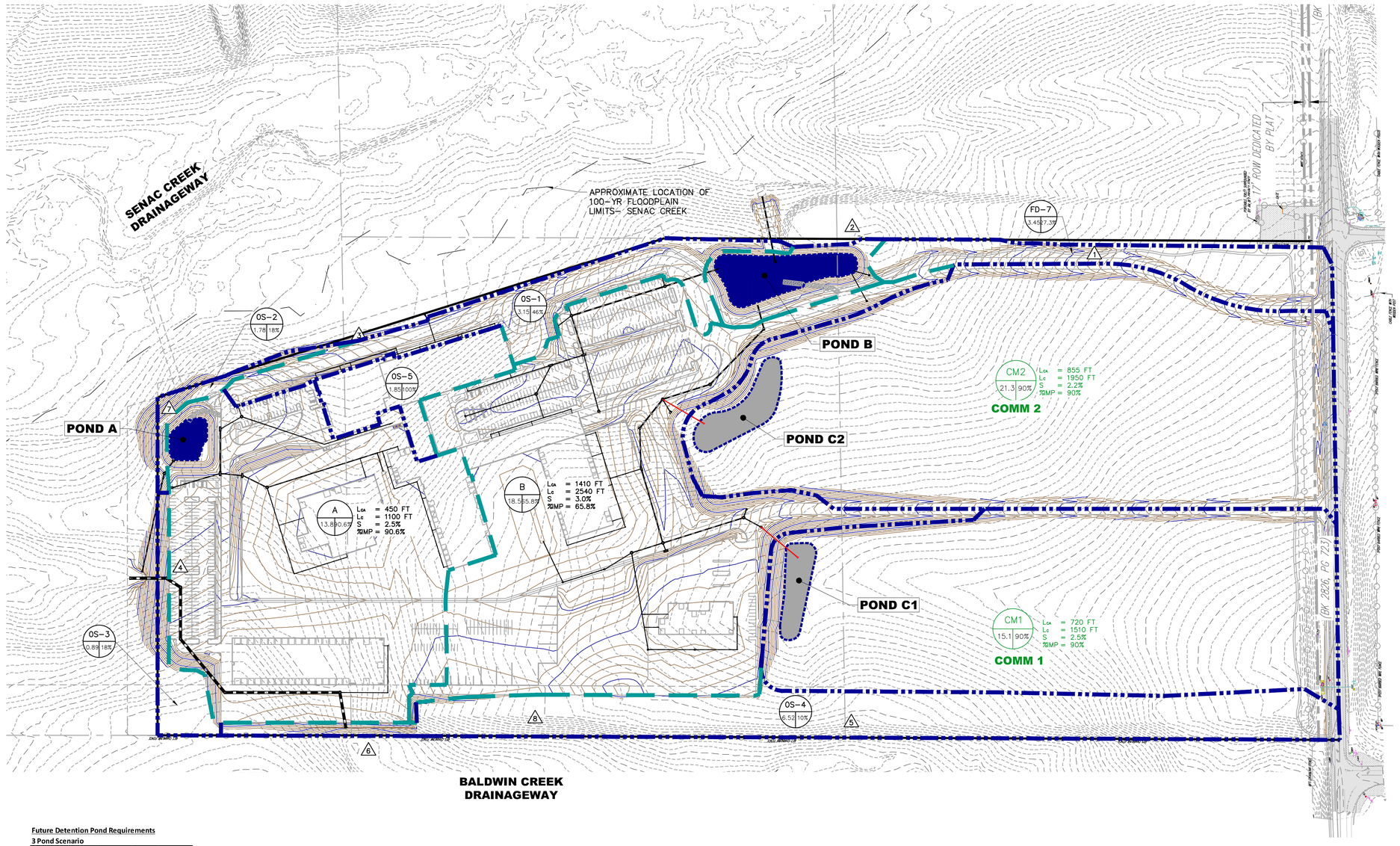


Future Detention Pond Requirements

3 Pond Scenario

Pond	WQ Volume (ac-ft)	EURV Volume (ac-ft)	100 YR Volume (ac-ft)	Total Pond Volume (ac-ft)
B	0.744	0.997	2.331	4.072
C1	0.552	0.92	1.034	2.507
C2	0.713	1.188	1.335	3.236

2 Pond Scenario

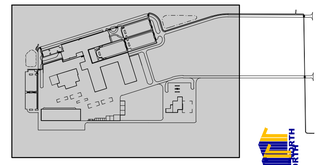
Pond	WQ Volume (ac-ft)	EURV Volume (ac-ft)	100 YR Volume (ac-ft)	Total Pond Volume (ac-ft)
B	0.744	0.997	2.331	4.072
C1	0.589	0.811	1.532	2.932

2 Pond Scenario - All WQ in Pond B

Pond	WQ Volume (ac-ft)	EURV Volume (ac-ft)	100 YR Volume (ac-ft)	Total Pond Volume (ac-ft)
B	1.333	0.408	2.626	4.366
C1	-	0.811	2.121	2.932

NOTE:

1. THIS MASTER DRAINAGE PLAN HAS BEEN REVISED AND UPDATED FROM THE ORIGINAL MASTER DRAINAGE PLAN PREPARED BY PEAK CIVIL CONSULTANTS, DATED APRIL 12, 2012.



KEYMAP

DRAINAGE LEGEND

PROPOSED MAJOR CONTOUR (5') 5250
PROPOSED MINOR CONTOUR (1')
EXISTING MAJOR CONTOUR (5') 5250
EXISTING MINOR CONTOUR (1')
PROPOSED STORM DRAIN PIPE
EXISTING STORM DRAIN PIPE
PROPOSED SWALE
PROPERTY LINE
DIRECTIONAL FLOW ARROW
EMERGENCY OVERFLOW ARROW
PROPOSED 100-YR FLOODPLAIN
OFFSITE BASIN LINE
PROPOSED BASIN LINE
DESIGN POINT
PROPOSED BASIN LABEL (B / 18.5 / 10%) — BASIN DESIGNATION; AREA (AC.); % IMPERVIOUS
DITCH CROSS-SECTION MARKER

SITE NOTES:

1. ALL STORM ON-SITE IS PUBLIC AND SIZED FOR THE 2-YEAR EVENT UNLESS OTHERWISE NOTED. OVERFLOW PATHS ARE PROVIDED TO CONVEY THE 100-YR STORM WITH LESS THAN 1.5' OF PONDING UNLESS OTHERWISE NOTED.
2. ALL DRAINAGE SWALES ARE PUBLIC AND SIZED FOR THE 100-YEAR EVENT UNLESS OTHERWISE NOTED.

NORTH

CITY OF AURORA PLAN REVIEW IS ONLY FOR GENERAL CONFORMANCE WITH CITY OF AURORA DESIGN CRITERIA AND THE CITY CODE. THE CITY IS NOT RESPONSIBLE FOR THE ACCURACY AND ADEQUACY OF THE DESIGN, DIMENSIONS, AND ELEVATIONS WHICH SHALL BE CONFIRMED AND CORRELATED AT THE JOB SITE. THE CITY OF AURORA, THROUGH THE APPROVAL OF THIS DOCUMENT, ASSUMES NO RESPONSIBILITY FOR THE COMPLETENESS AND/OR ACCURACY OF THIS DOCUMENT.

ENSURE THAT THE PROVISIONS OF CRS 37-92-602, AS AMMENDED BY SENATE BILL 15-212, REGARDING NOTIFICATION OF DOWNSTREAM WATER RIGHTS HOLDERS ARE UPHELD

CITY OF AURORA BENCHMARK #5S6507SW003 (AZTEC #155). RECOVERED A 3"BRASS CAP @ THE N.E. CORNER OF A CURB OPENING INLET STRUCTURE BEING ON THE SOUTH SIDE OF E. BELLEVIEW AVE. AND BEING THE FIRST INLET EAST OF THE COVERED BRIDGE.

Elevation = 5876.73 (NAVD 88).

APPROVED FOR ONE YEAR FROM THIS DATE

CITY ENGINEER _____ DATE _____

WATER DEPARTMENT _____ DATE _____

DATE	REVISION DESCRIPTION

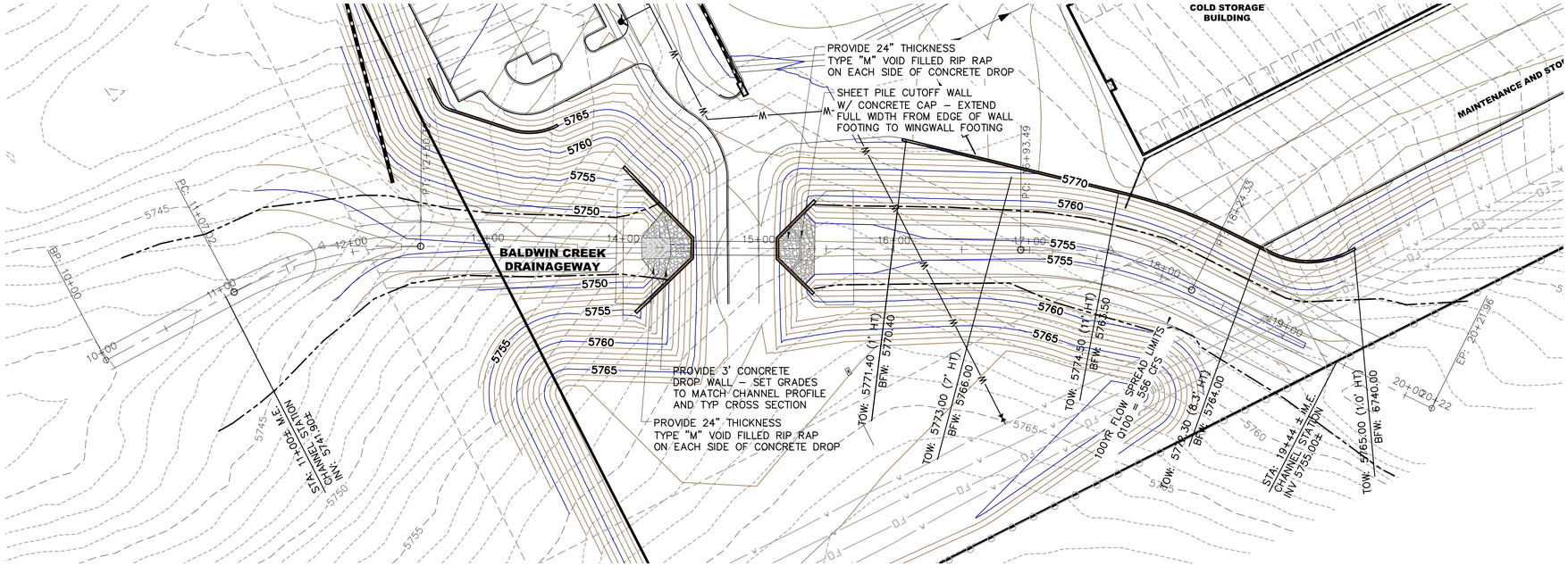
Drawing Name: DR-4_Future.dwg
Job Number: EIDOS COA SEAM
Prepared For: EIDOS
0 75 150 300 — 1 inch = 150 ft. Horizontal
Designer: DES | Drafter: DFT | Checked: CKD

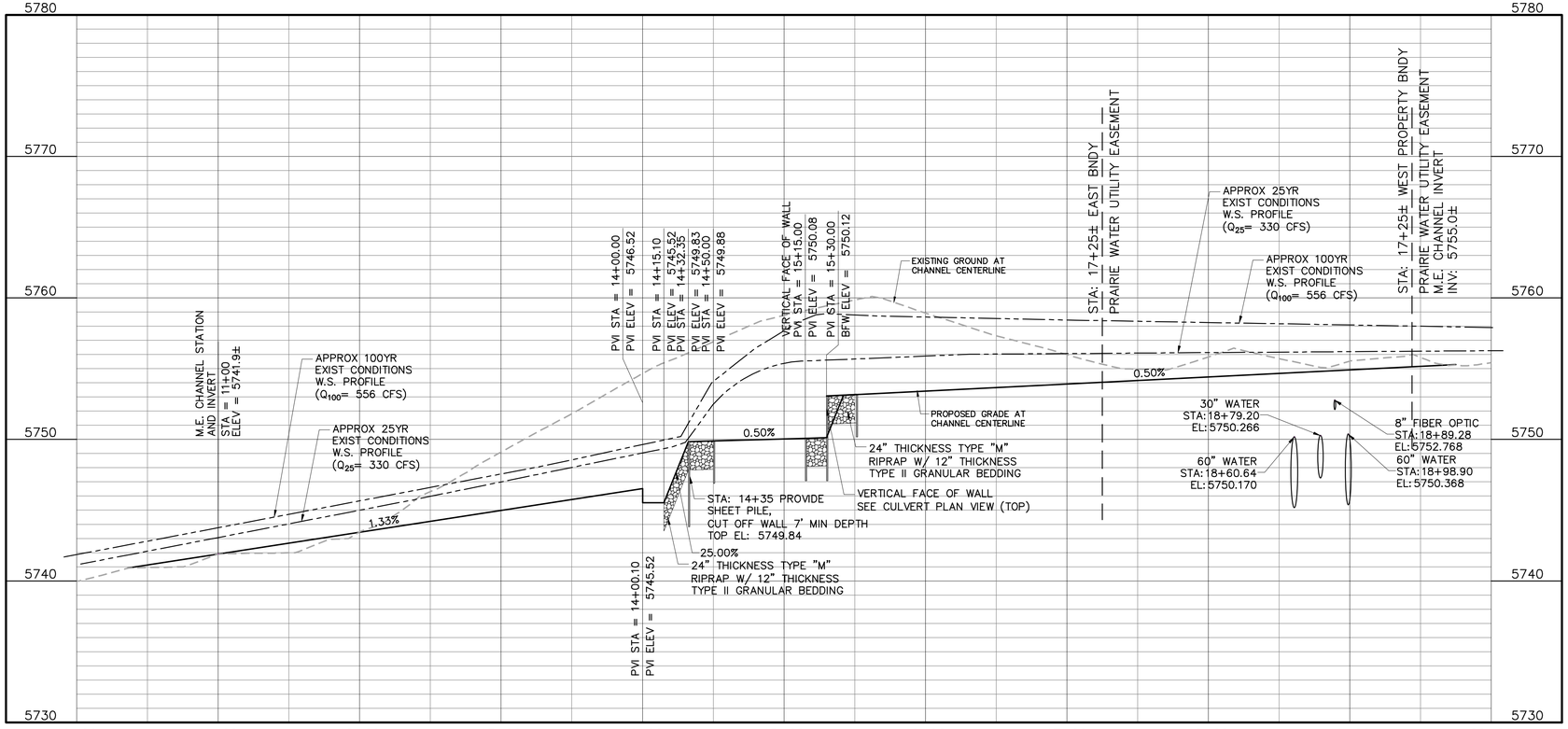
Calibre
Calibre Engineering, Inc.
9090 South Ridgeline Boulevard, Suite 105
Highlands Ranch, CO 80129 (303) 730-0434
www.calibre-engineering.com
Construction Management Civil Engineering Surveying

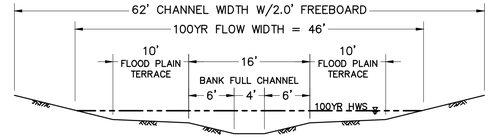
AURORA SEAM FACILITY
CIVIL PLANS
AMENDED MASTER DRAINAGE EXHIBIT

Sheet DR2 — 1 of 1
Date: MAY 11, 2020

PATH: P:\AURORA SEAM\CADD\DRAINAGE\DR-4_FUTURE.DWG
PLOTTED BY: CALEB NELSON PLOT DATE: 5/12/2020 4:28 PM
XREFS:







TYP. TRAPEZOIDAL CHANNEL SECTION

1' = 10'-0"

CITY OF AURORA PLAN REVIEW IS ONLY FOR GENERAL CONFORMANCE WITH CITY OF AURORA DESIGN CRITERIA AND THE CITY CODE. THE CITY IS NOT RESPONSIBLE FOR THE ACCURACY AND ADEQUACY OF THE DESIGN, DIMENSIONS, AND ELEVATIONS WHICH SHALL BE CONFIRMED AND CORRELATED AT THE JOB SITE. THE CITY OF AURORA, THROUGH THE APPROVAL OF THIS DOCUMENT, ASSUMES NO RESPONSIBILITY FOR THE COMPLETENESS AND/OR ACCURACY OF THIS DOCUMENT.

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CITY OF AURORA BENCHMARK #5S6507SW003 (AZTEC #155). RECOVERED A 3"BRASS CAP @ THE N.E. CORNER OF A CURB OPENING INLET STRUCTURE BEING ON THE SOUTH SIDE OF E. BELLEVIEW AVE. AND BEING THE FIRST INLET EAST OF THE COVERED BRIDGE.

Elevation = 5876.73 (NAVD 88).

DATE	REVISION DESCRIPTION

Drawing Name: DR-3-Profile.dwg
Job Number: EIDOS COA SEAM
Prepared For: EIDOS
Designer: ETG | Drafter: ETG | Checked: RLB
0 25 50 100
1 inch = 50 ft. Horizontal

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Highlands Ranch, CO 80129 (303) 730-0434
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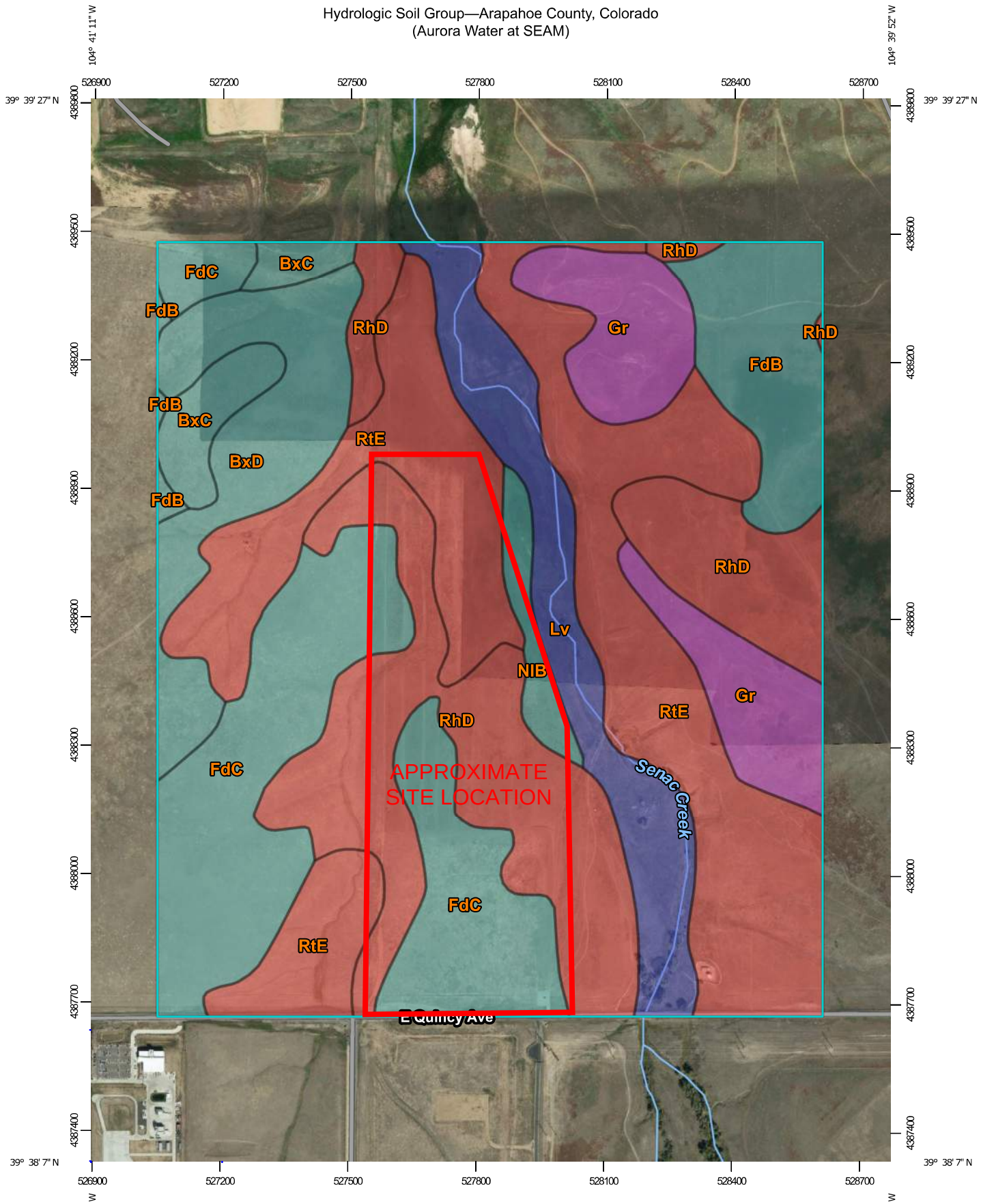
AURORA SEAM FACILITY
CIVIL PLANS
BALDWIN CREEK DRAINAGE P & P

Sheet: DR3 | 3 of 3
Date: MAY 8, 2020

PATH: P:\AURORA SEAM\CADD\DRAINAGE\MDP A1\DR-3-PROFILE.DWG
PLOTTED BY: ERIC GALLEGOS PLOT DATE: 7/2/2020 5:02 PM
XREFS:

Hydrologic Soil Group—Arapahoe County, Colorado
(Aurora Water at SEAM)



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

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: Arapahoe County, Colorado
Survey Area Data: Version 15, Sep 12, 2019

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

Date(s) aerial images were photographed: Jul 24, 2018—Dec 4, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BxC	Buick loam, 3 to 5 percent slopes	C	18.7	2.7%
BxD	Buick loam, 5 to 9 percent slopes	C	54.1	7.7%
FdB	Fondis silt loam, 1 to 3 percent slopes	C	41.9	6.0%
FdC	Fondis silt loam, 3 to 5 percent slopes	C	125.7	17.9%
Gr	Gravelly land	A	54.6	7.8%
Lv	Loamy alluvial land	B	59.3	8.5%
NlB	Nunn loam, 1 to 3 percent slopes	C	11.0	1.6%
RhD	Renohill-Buick loams, 3 to 9 percent slopes	D	141.7	20.2%
RtE	Renohill-Litle-Thedalund complex, 9 to 30 percent slopes	D	193.4	27.6%
Totals for Area of Interest			**700.3**	**100.0%**

Description

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

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

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

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

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

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

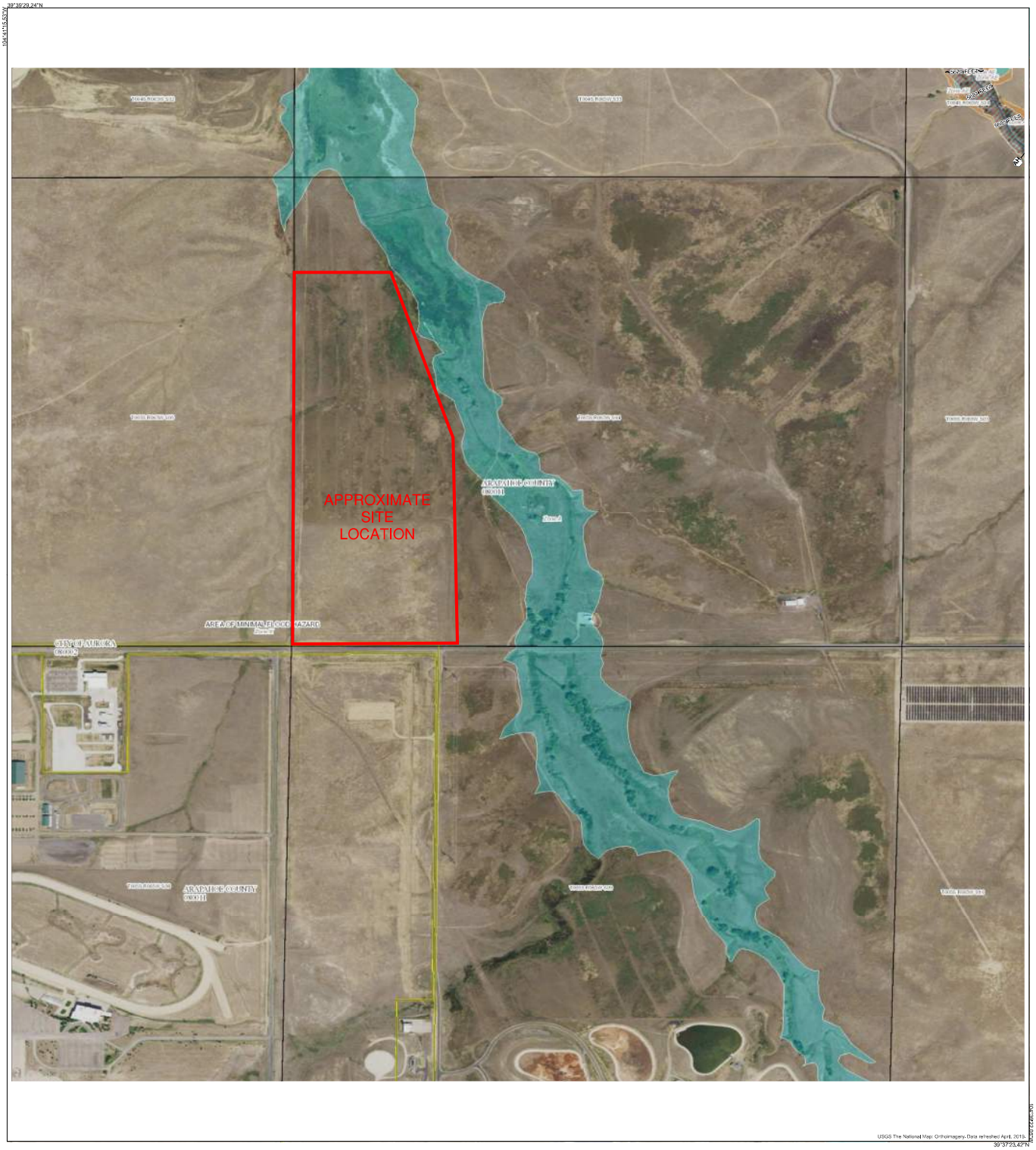
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher



FLOOD HAZARD INFORMATION

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

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) Zone A, V, A99
- With BFE or Depth Zone AE, AO, AH, VE, AR
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
- Future Conditions 1% Annual Chance Flood Hazard Zone X
- Area with Reduced Flood Risk due to Levee See Notes. Zone X
- Area with Flood Risk due to Levee Zone D

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard Zone X
- Effective LOMRs
- Area of Undetermined Flood Hazard Zone D

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

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

NOTES TO USERS

For information and questions about this Flood Insurance Rate Map (FIRM), available products associated with this FIRM, including historic versions, the current map date for each FIRM panel, how to order products, or the National Flood Insurance Program (NFIP) in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Flood Map Service Center website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Flood Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study Report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Basemap information shown on this FIRM was provided in digital format by USDA, Farm Service Agency (FSA). This information was derived from NAIP, dated April 11, 2018.

This map was exported from FEMA's National Flood Hazard Layer (NFHL) on 4/21/2020 4:55:47 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Upcates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

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

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date.

SCALE

N

Map Projection:
GCS: Geodetic Reference System 1980;
Vertical Datum: NAVD88
For information about the specific vertical datum for elevation features, datum conversions, or vertical monuments used to create this map please see the Flood Insurance Study(FIS) Report for your community at https://msc.fema.gov

1 inch = 500 feet 1:6,000

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

0 50 100 200 300 400 Meters

FEMA

National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

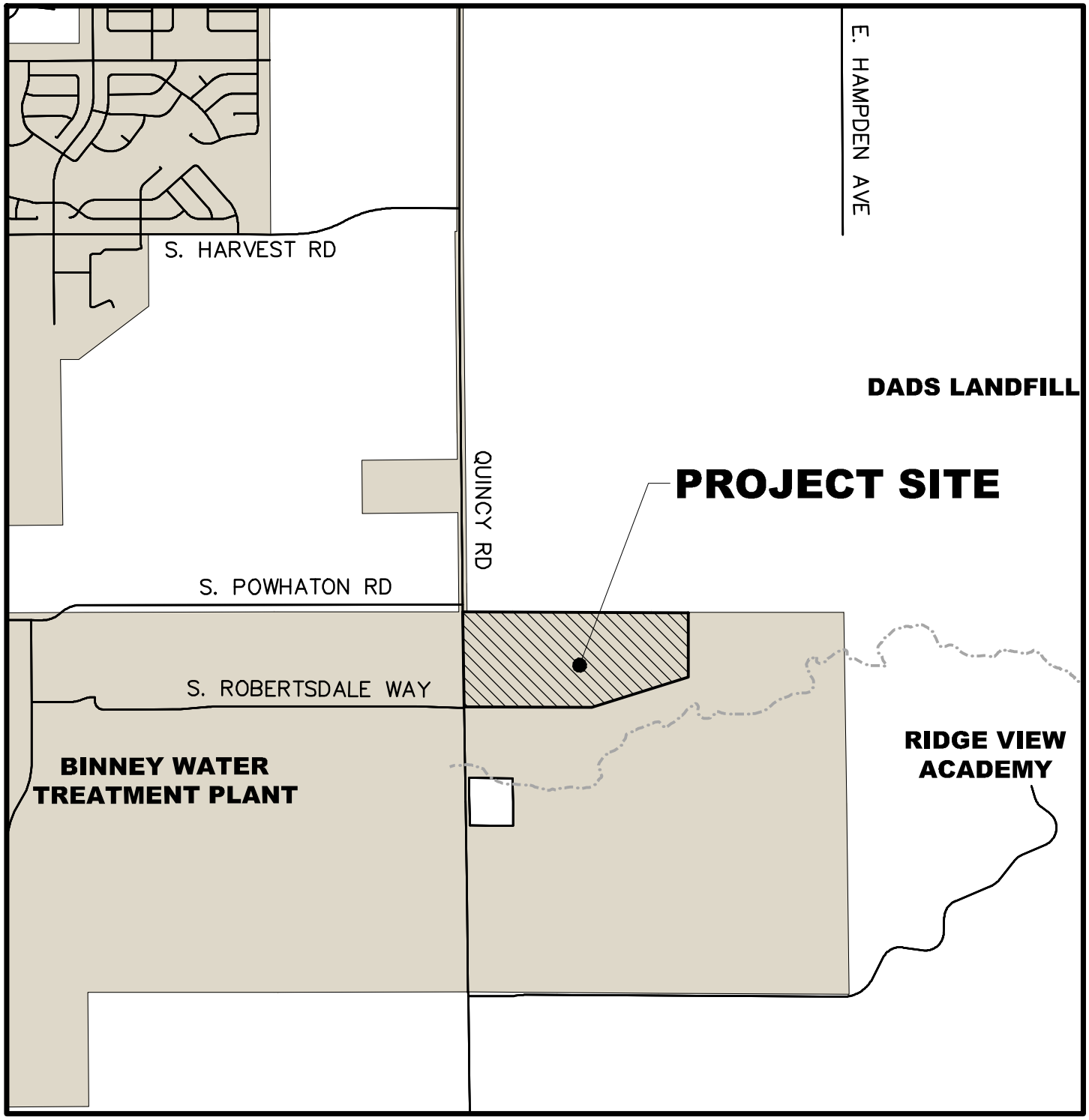
ARAPAHOE COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 218 OF 675

Panel Contains:

COMMUNITY	NUMBER	PANEL
CITY OF AURORA COLORADO	080002	0218
ARAPAHOE COUNTY COLORADO	080011	0218

MAP NUMBER
08005C0218L
EFFECTIVE DATE
04/18/2018



VICINITY MAP
SCALE: 1" = 2000'

NORTH

P:\AURORA SEAM\CADD\EXHIBITS\ X-Vinity Map.dwg

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Construction Management Civil Engineering Surveying

GREEN VALLEY RANCH EAST
VICINITY MAP

Sheet
VM
Scale 1" = 2000'
Date
APRIL 20, 2017

APPENDIX B:
HYDROLOGIC COMPUTATIONS

Senac Creek

Major Drainageway Plan

December 2014

Prepared by:
Matrix Design Group, Inc.
1601 Blake Street
Suite 200
Denver, CO 80202
303.572.0200

Prepared for:
Urban Drainage & Flood Control District
Southeast Metro Stormwater Authority
City of Aurora

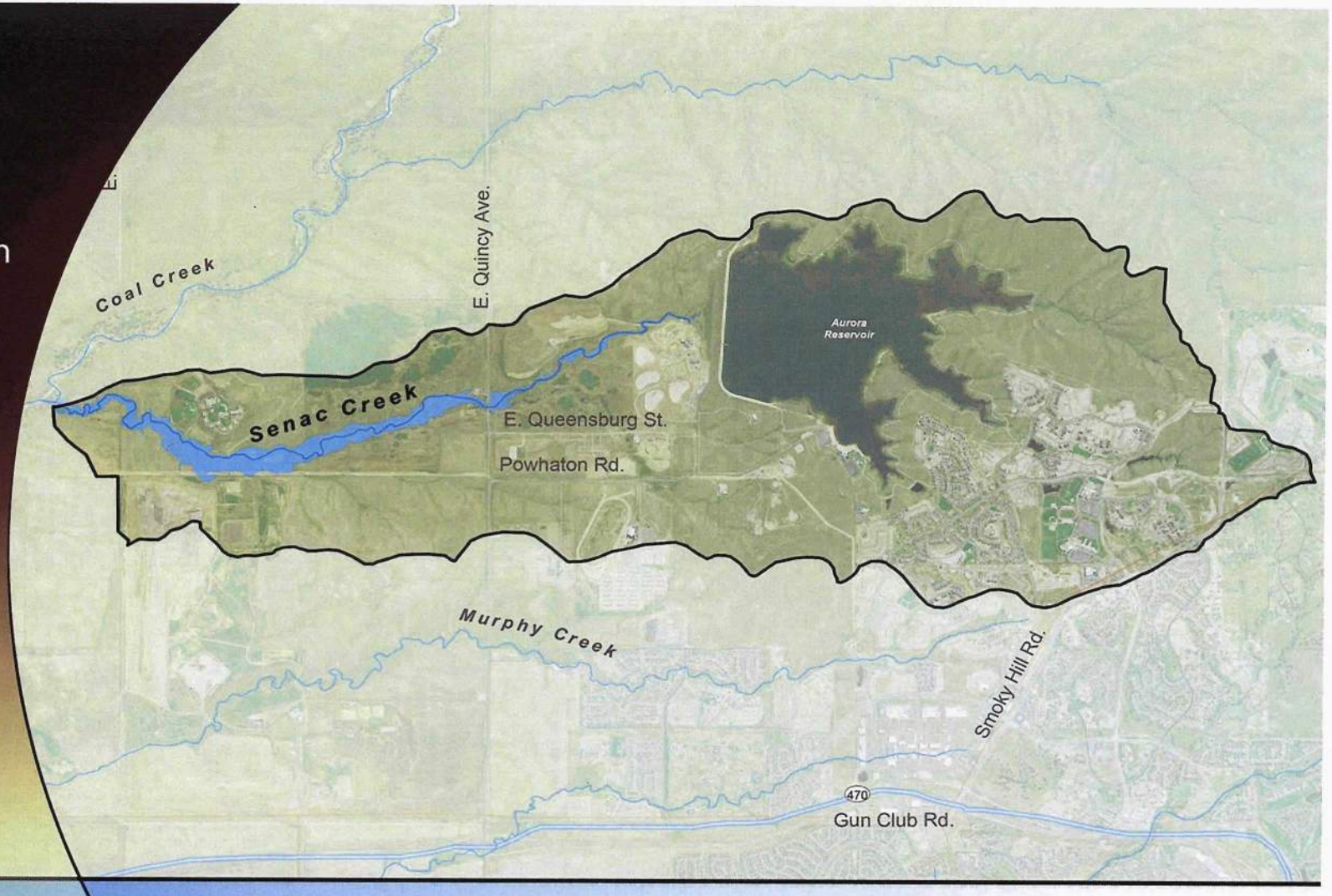


Table B-2 CUHP Input Parameters

Catchment Name	Area	Area	Distance to Centroid	Length	Slope	Existing Percent Imperviousness	Future Percent Imperviousness	Existing Depression Storage on Pervious	Future Depression Storage on Pervious	Existing Depression Storage on Impervious	Future Depression Storage on Impervious	Initial Infiltration Rate	Horton's Decay Coefficient	Final Infiltration Rate
	acres	mi2	mi	mi	ft/ft	%	%	in	in	in	in	in/hr	1/seconds	in/hr
201	406	0.6338	0.7477	1.6793	0.0271	30	45	0.35	0.35	0.1	0.1	3.37	0.00180	0.52
203	106	0.1659	0.1972	0.5052	0.0375	46	46	0.35	0.35	0.1	0.1	3.87	0.00180	0.56
204	269	0.4197	0.3981	0.9186	0.0371	49	49	0.35	0.35	0.1	0.1	3.17	0.00180	0.51
207	108	0.1688	0.3123	0.6977	0.0420	2	50	0.35	0.35	0.1	0.1	3.18	0.00180	0.51
208	149	0.2335	0.3189	0.7817	0.0420	2	46	0.35	0.35	0.1	0.1	3.13	0.00180	0.51
209	201	0.3143	0.3658	0.8858	0.0363	8	42	0.35	0.35	0.1	0.1	3.09	0.00172	0.49
210	90	0.1411	0.3467	0.6587	0.0440	7	40	0.35	0.35	0.1	0.1	2.87	0.00172	0.48
211	81	0.1259	0.1456	0.6139	0.0339	36	46	0.35	0.35	0.1	0.1	2.11	0.00126	0.35
212	86	0.1342	0.3316	0.6053	0.0344	22	46	0.35	0.35	0.1	0.1	2.48	0.00149	0.41
215	228	0.3569	0.6330	1.4086	0.0309	45	46	0.35	0.35	0.1	0.1	3.12	0.00178	0.51
217	155	0.2420	0.4397	0.9560	0.0357	44	44	0.35	0.35	0.1	0.1	2.98	0.00179	0.50
218	1307	2.0428	0.6384	2.4029	0.0131	63	65	0.35	0.35	0.1	0.1	1.49	0.00088	0.25
223	85	0.1327	0.2211	0.5128	0.0392	6	6	0.4	0.35	0.1	0.1	3.03	0.00180	0.50
222A	86	0.1345	0.0977	0.6515	0.0413	29	52	0.35	0.35	0.1	0.1	3.30	0.00180	0.52
222B	130	0.2027	0.5153	0.9058	0.0284	16	46	0.35	0.35	0.1	0.1	3.38	0.00180	0.53
222C	50	0.0787	0.1887	0.5080	0.0283	78	83	0.35	0.35	0.1	0.1	3.24	0.00180	0.52
222D	90	0.1403	0.2584	0.7298	0.0301	14	21	0.35	0.35	0.1	0.1	3.10	0.00180	0.51
222E	115	0.1793	0.3478	0.7512	0.0272	2	3	0.35	0.35	0.1	0.1	3.00	0.00180	0.50
224A	119	0.1866	0.3188	0.7529	0.0367	2	2	0.4	0.35	0.1	0.1	3.00	0.00180	0.50
224B	30	0.0466	0.1405	0.3287	0.0553	2	2	0.4	0.35	0.1	0.1	3.00	0.00180	0.50
224C	110	0.1713	0.1980	0.6584	0.0167	16	39	0.4	0.35	0.1	0.1	3.00	0.00180	0.50
224D	111	0.1732	0.2187	0.6957	0.0316	55	68	0.4	0.35	0.1	0.1	3.00	0.00180	0.50
225A	30	0.0461	0.1292	0.2448	0.0600	2	2	0.4	0.35	0.1	0.1	3.00	0.00180	0.50
225B	77	0.1204	0.3164	0.7089	0.0310	2	2	0.4	0.35	0.1	0.1	3.00	0.00180	0.50
225C	54	0.0848	0.1583	0.4424	0.0342	2	2	0.4	0.35	0.1	0.1	3.00	0.00180	0.50
225D	73	0.1141	0.2453	0.5424	0.0307	78	83	0.4	0.35	0.1	0.1	3.00	0.00180	0.50
226A	79	0.1230	0.2542	0.4991	0.0114	5	6	0.4	0.35	0.1	0.1	3.00	0.00180	0.50
226B	91	0.1424	0.3125	0.6938	0.0360	24	39	0.4	0.35	0.1	0.1	3.00	0.00180	0.50
227A	52	0.0811	0.2837	0.6497	0.0292	41	71	0.4	0.35	0.1	0.1	3.00	0.00180	0.50
227B	42	0.0650	0.2901	0.5900	0.0398	2	13	0.4	0.35	0.1	0.1	3.11	0.00180	0.51
227C	56	0.0882	0.1773	0.5025	0.0400	2	27	0.4	0.35	0.1	0.1	3.27	0.00180	0.52
227D	49	0.0758	0.3894	0.6381	0.0226	2	58	0.4	0.35	0.1	0.1	3.01	0.00180	0.50
227E	73	0.1143	0.2867	0.6008	0.0347	2	8	0.4	0.35	0.1	0.1	3.83	0.00148	0.66
227F	98	0.1531	0.2559	0.6504	0.0215	2	15	0.4	0.35	0.1	0.1	3.56	0.00160	0.60
227G	119	0.1855	0.4612	0.9341	0.0247	2	2	0.4	0.35	0.1	0.1	3.60	0.00159	0.61
228A	111	0.1735	0.2803	0.6142	0.0290	20	49	0.35	0.35	0.1	0.1	3.00	0.00180	0.50
228B	86	0.1346	0.1936	0.5629	0.0262	20	84	0.35	0.35	0.1	0.1	3.00	0.00180	0.50
229A	129	0.2014	0.3515	0.7555	0.0201	2	49	0.4	0.35	0.1	0.1	3.00	0.00180	0.50
229B	64	0.1000	0.1973	0.5723	0.0311	2	40	0.4	0.35	0.1	0.1	3.00	0.00180	0.50
229C	97	0.1513	0.1924	0.5629	0.0202	2	31	0.4	0.35	0.1	0.1	3.00	0.00180	0.50
229D	94	0.1474	0.2735	0.5528	0.0322	6	37	0.4	0.35	0.1	0.1	3.00	0.00180	0.50
230A	111	0.1732	0.2483	0.5475	0.0436	39	40	0.35	0.35	0.1	0.1	3.00	0.00180	0.50
230B	72	0.1128	0.2527	0.5513	0.0316	3	3	0.35	0.35	0.1	0.1	3.73	0.00171	0.58
230C	43	0.0672	0.1784	0.4712	0.0314	2	2	0.35	0.35	0.1	0.1	3.09	0.00175	0.52
230D	117	0.1821	0.2322	0.6858	0.0342	24	24	0.35	0.35	0.1	0.1	3.32	0.00180	0.52
230E	103	0.1604	0.3676	0.6850	0.0387	39	44	0.35	0.35	0.1	0.1	3.04	0.00180	0.50
230F	116	0.1818	0.3214	0.7587	0.0315	19	19	0.35	0.35	0.1	0.1	3.20	0.00178	0.52
230G	106	0.1650	0.3218	1.0881	0.0164	2	56	0.35	0.35	0.1	0.1	3.26	0.00179	0.52

Table B-4 - Senac Creek Baseline Peak Discharges

Design Point	Drainage Area	Existing Conditions Peak Discharges (cfs)							Future Conditions Peak Discharges (cfs)						
	(acres)	Q_2	Q_5	Q_{10}	Q_{25}	Q_{50}	Q_{100}	Q_{100}/Acre	Q_2	Q_5	Q_{10}	Q_{25}	Q_{50}	Q_{100}	Q_{100}/Acre
203	106	92	172	221	316	394	473	4.45	92	172	221	316	394	473	4.45
204	780	324	649	839	1255	1592	1930	2.47	429	811	1037	1532	1914	2305	2.95
207	108	5	40	60	109	144	180	1.67	94	173	221	312	387	452	4.19
208	257	8	84	133	254	340	431	1.67	183	359	456	664	826	992	3.85
210	549	27	137	224	449	617	804	1.46	232	487	639	1035	1339	1645	3.00
212	715	71	186	294	572	782	1032	1.44	258	566	746	1238	1603	1985	2.77
217	383	224	430	545	790	985	1172	3.06	229	437	553	800	997	1186	3.09
218	3186	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00
218A	3186	1714	3033	3787	5501	6829	8113	2.55	2043	3620	4531	6593	8204	9767	3.07
223	***85***	5	35	52	95	128	159	1.87	9	41	59	101	133	164	1.93
225	***689***	220	361	453	636	867	1114	1.62	289	472	585	802	1024	1254	1.82
226	***1329***	231	533	742	1301	1723	2190	1.65	408	810	1049	1663	2159	2664	2.00
228	***197***	38	111	152	258	339	420	2.13	172	286	354	503	621	741	3.76
229D	***581***	30	159	258	501	684	893	1.54	262	504	652	1016	1291	1580	2.72
230	***2960***	193	662	1048	1986	2771	3652	1.23	464	1058	1500	2522	3370	4272	1.44
230T	***3066***	187	654	1048	1988	2782	3683	1.20	464	1058	1504	2513	3370	4274	1.39
224A	***204***	5	62	100	194	265	337	1.65	11	74	112	207	276	347	1.70
224B	***30***	1	11	18	33	45	56	1.87	2	14	20	35	47	58	1.94
224T	***234***	5	71	114	223	305	387	1.65	13	84	128	237	318	400	1.71
224C	***344***	16	106	168	329	447	571	1.66	66	141	207	376	501	633	1.84
224D	***455***	112	196	255	418	567	728	1.60	170	304	379	550	698	851	1.87
225A	***30***	1	13	20	38	51	64	2.15	2	16	23	40	53	66	2.22
225B	***161***	2	48	78	153	207	262	1.63	7	58	88	162	214	270	1.68
225C	***54***	1	20	31	58	79	99	1.82	4	24	35	62	82	102	1.88
225AT	***30***	0	12	20	37	50	63	2.12	2	15	22	39	52	64	2.18
225D	***234***	109	164	198	259	319	399	1.71	118	176	209	269	331	410	1.75
226A	***767***	145	270	362	669	911	1168	1.52	207	375	482	780	1028	1293	1.68
226B	***858***	151	299	411	748	1012	1305	1.52	221	417	543	874	1146	1447	1.69
222A	***86***	32	76	102	154	197	236	2.75	82	149	184	253	312	373	4.33
222B	***266***	104	226	297	459	584	709	2.66	235	422	535	762	951	1105	4.15
222C	***50***	75	114	136	175	210	244	4.85	81	120	142	180	215	249	4.95
222D	***356***	105	245	332	530	684	836	2.35	238	447	560	809	1018	1207	3.39
222E	***471***	91	245	337	571	750	933	1.98	196	408	527	815	1048	1275	2.71
227B	***1423***	244	567	788	1378	1831	2327	1.64	432	855	1112	1773	2295	2831	1.99
228A	***111***	26	72	98	158	203	247	2.23	97	180	230	323	400	468	4.22
229A	***326***	32	121	178	330	438	556	1.70	206	364	460	687	864	1037	3.18
229B	***64***	1	21	32	61	83	104	1.63	40	82	106	154	193	229	3.58
229C	***487***	30	144	228	438	597	771	1.58	244	456	585	910	1154	1401	2.88
227C	***1479***	236	569	800	1408	1883	2402	1.62	424	857	1129	1815	2342	2901	1.96
227E	***1601***	227	572	814	1456	1956	2510	1.57	427	872	1147	1880	2429	3027	1.89
227F	***1699***	206	554	805	1473	1987	2571	1.51	404	844	1143	1876	2462	3093	1.82

Areas in ***Bold Italic*** show only tributary area downstream of Aurora Reservoir because of no release from Aurora Reservoir.

Table B-5 - Senac Creek Baseline Peak Volume

Design Point	Drainage Area	Existing Conditions Runoff Volumes (ac-ft)							Future Conditions Runoff Volumes (ac-ft)						
	(acres)	V_2	V_5	V_{10}	V_{25}	V_{50}	V_{100}	V_{100}/Acre	V_2	V_5	V_{10}	V_{25}	V_{50}	V_{100}	V_{100}/Acre
203	106	4	7	9	12	15	18	0.17	4	7	9	12	15	18	0.17
204	780	25	46	62	88	111	135	0.17	30	53	68	94	118	141	0.18
207	108	0	3	5	8	11	15	0.14	4	8	10	13	17	20	0.18
208	257	1	7	11	20	27	36	0.14	10	18	23	31	39	46	0.18
210	549	3	16	27	46	61	79	0.14	21	37	48	66	83	99	0.18
212	715	8	26	40	65	86	108	0.15	28	50	64	88	109	130	0.18
217	383	14	25	33	46	57	68	0.18	14	25	33	46	57	69	0.18
218	3186	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00
218A	3186	119	217	284	389	487	581	0.18	146	249	317	421	519	611	0.19
223	***85***	0	2	4	7	9	12	0.14	1	3	4	7	9	12	0.14
225	***689***	11	28	41	64	84	105	0.15	16	34	47	70	90	111	0.16
226	***1329***	23	56	81	125	164	205	0.15	35	71	96	140	179	219	0.17
228	***197***	3	9	12	19	25	31	0.16	10	16	20	26	32	38	0.19
229D	***581***	4	18	29	49	66	84	0.14	24	41	53	71	89	106	0.18
230	***2960***	42	111	164	266	352	443	0.15	80	158	215	314	401	489	0.17
230T	***3066***	42	113	169	274	363	458	0.15	85	166	225	328	418	509	0.17
224A	***204***	1	5	9	16	22	28	0.14	1	6	10	17	22	29	0.14
224B	***30***	0	1	1	2	3	4	0.13	0	1	1	2	3	4	0.14
224T	***234***	1	6	10	18	25	32	0.14	1	7	11	19	26	33	0.14
224C	***344***	2	10	16	28	38	48	0.14	5	13	20	31	42	52	0.15
224D	***455***	7	18	26	41	55	68	0.15	11	23	31	46	60	73	0.16
225A	***30***	0	1	1	2	3	4	0.13	0	1	1	2	3	4	0.14
225B	***161***	0	4	7	12	17	22	0.14	1	4	7	13	17	22	0.14
225C	***54***	0	1	2	4	6	7	0.14	0	1	2	4	6	8	0.14
225AT	***30***	0	1	1	2	3	4	0.14	0	1	1	2	3	4	0.14
225D	***234***	5	10	15	23	29	36	0.16	5	11	16	24	30	37	0.16
226A	***767***	13	31	46	71	93	117	0.15	18	38	52	78	100	123	0.16
226B	***858***	14	35	51	80	105	131	0.15	21	43	60	88	113	139	0.16
222A	***86***	2	4	6	9	11	14	0.16	4	6	8	11	13	16	0.18
222B	***266***	7	14	19	28	35	43	0.16	12	20	25	34	42	49	0.18
222C	***50***	3	5	6	7	9	10	0.20	3	5	6	8	9	10	0.21
222D	***356***	8	17	24	36	46	57	0.16	13	24	31	42	53	63	0.18
222E	***471***	8	20	29	45	59	73	0.16	14	27	36	52	66	80	0.17
227B	***1423***	24	60	87	134	176	220	0.15	39	77	105	152	193	236	0.17
228A	***111***	2	5	7	11	14	17	0.16	4	8	10	14	17	20	0.18
229A	***326***	4	12	18	29	39	49	0.15	16	26	33	43	53	62	0.19
229B	***64***	0	1	3	5	7	9	0.13	2	4	5	7	9	11	0.18
229C	***487***	4	16	25	42	56	71	0.15	21	35	45	61	75	90	0.18
227C	***1479***	25	61	89	138	182	227	0.15	40	80	108	157	201	245	0.17
227E	***1601***	25	63	92	146	193	242	0.15	43	85	116	169	216	264	0.16
227F	***1699***	25	64	95	153	202	254	0.15	44	88	120	177	227	278	0.16

Areas in ***Bold Italic*** show only tributary area downstream of Aurora Reservoir because of no release from Aurora Reservoir.

APPENDIX C:
HYDRAULIC COMPUTATIONS

APPENDIX C:
HYDRAULIC COMPUTATIONS
BALDWIN CREEK REALIGNMENT DESIGN
- **CHANNEL DESIGN**

Baldwin Creek Channel Realignment Design:

Senac Creek Major Drainageway Plan existing condition flows will be utilized to size the Baldwin Creek proposed improvements. These include the 4' x 8' box culvert and the channel realignment cross section. Geomorphic analysis has not been completed for this reach of the channel and may be required to complete the final design analysis for the channel. The concept design presented herein is based upon design criteria presented within Chapter 8, Volume 1 of MHFD UDSCM manual. The 100year peak utilized is 556cfs and the 25year peak flow is 330cfs. The bankflow design flow was determined using 10% of the Q100 peak or 56cfs. Please refer to attached computations and channel flow section analysis.

The existing vegetation is well established and can be contributed to the land application of treated wastewater sludge. Natural vegetation is native grasses with western wheatgrass being the dominant species. Existing topsoil stripped from the SEAM site will be utilized for replacement topsoil within the disturbed corridor of the channel. Recommended topsoil thickness should be on the order of 6 to 12inches.

The proposed 4' x 8 box culvert will have a 3 feet vertical drop entrance structure to reduce headwater depth and adjust for existing channel profile drop. A sloping void filled cobble rip rap lining is proposed for the downstream exit from the culvert and final channel drop can be adjusted to match final channel profile grades.

Calibre

Project	Date	Page
SEAM MDP	7-1-20	
Subject	Job No.	Initials
BALDWIN CREEK		RLB

BALDWIN CREEK
NATURALIZED CHANNEL DESIGN

HYDROLOGIC CONDITIONS:

SENAC CREEK MDP, 2014
EXISTING CONDITION PEAK DISCHARGES
@ D.P. 229A (ENTERY TO SEAM SITE)

Q_2 = 32 C.F.S.
Q_5 = 121 C.F.S.
Q_{100} = 556 C.F.S.

Q_{100}/Ac = 1.71 C.F.S.

FUTURE CONDITIONS PEAK DISCHARGES
@ D.P. 229A.

Q_2 = 206 C.F.S.
Q_5 = 364 C.F.S.
Q_{100} = 1037 C.F.S.

BASIN AREA = 326 Ac.
Q_{100}/Ac = 3.18 C.F.S./Ac.

CHANNEL HYDRAULIC DESIGN:

BANK FULL DESIGN. - USE EXISTING CONDITION PEAK FLOWS FROM TABLE 8-2 MHFD VOL. 1 USDCM

CHANNEL DEPTH = ±1.5 FT., MIN. BANKFULL WIDTH = 16 FT.
MIN FLOODPLAIN TERRACE WIDTH = 12 FT EACH SIDE.
DESIGN DISCHARGE = 70% 2-YR. FUTURE CONDITION FLOW
OR 10% 100YR FUT. COND. $\approx$ 0.70 X 32.0 = 22.4 C.F.S
0.10 X 556 = 55.6 C.F.S.

USE: 56 C.F.S. BANK FULL FLOW

RE: ATTACHED FLOWMASTER DESIGN SHEETS & SECTION.

FROM EQN. 8-2 DETERMINE BANK FULL WIDTH.

$W = aQ^{0.5}$ a = 2.1 (AVE. BANK FULL WIDTH.
W = 15.72 FT. Q = 56 C.F.S.

PROPOSED CHANNEL SECTION:

DETERMINE FLOODPLAIN TERRACE

ENTRENCHMENT RATIO = $\frac{\text{FLOOD PRONE CHANEL WIDTH}}{\text{BANKFULL CHANNEL WIDTH}} \geq 3.0$

EQN 8-4

FLOOD PRONE CHANNEL WIDTH = 3.0 X BANKFULL CHANNEL WIDTH

F.P. CHANNEL WIDTH = 3.0 X 16.0 = 48.0 FT MIN.

FLOOD PRONE CHANNEL DEPTH = 2 X MAXIMUM BANKFULL DEPH.

MAX. BANK FULL DEPTH = 1.5 FT

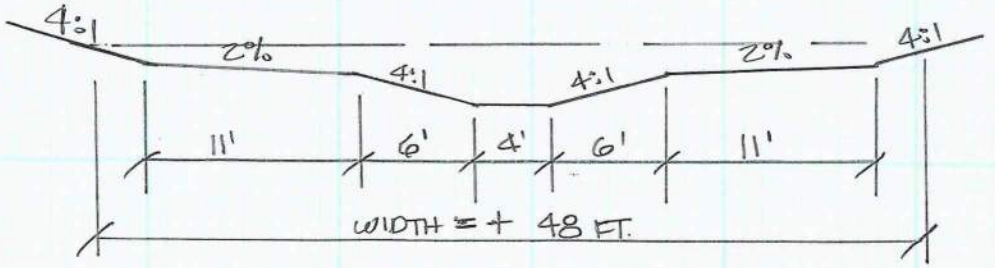
∴ FLOOD PRONE CHANNEL DEPTH = 2 X 1.5 = 3.0 FT.

FLOODPLAIN TERRACE WIDTH

SIDESLOPE = 4:1 1.5 FT X 4 = 6.0 ≃ 12' TOTAL FOR BOTH SIDES.

FP TERRACE WIDTH = $\frac{48.0 - 12' - 16}{2}$ = 11 FT.

TYPICAL SECTION



Worksheet for Sta 1100 Ex Op7 100yr Flow Channel

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01540	ft/ft
Discharge	556.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	5745.00
0+29	5744.00
0+50	5743.00
0+60	5742.00
0+82	5741.40
0+93	5742.00
1+37	5744.00
1+53	5745.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 5745.00)	(0+60, 5742.00)	0.035
(0+60, 5742.00)	(0+93, 5742.00)	0.030
(0+93, 5742.00)	(1+53, 5745.00)	0.035

Options

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

Results

Normal Depth	2.06	ft
Elevation Range	5741.40 to 5745.00 ft	
Flow Area	93.72	ft²

Worksheet for Sta 1100 Ex Op7 100yr Flow Channel

Results

Wetted Perimeter		85.08	ft
Hydraulic Radius		1.10	ft
Top Width		84.97	ft
Normal Depth		2.06	ft
Critical Depth		2.06	ft
Critical Slope		0.01553	ft/ft
Velocity		5.93	ft/s
Velocity Head		0.55	ft
Specific Energy		2.61	ft
Froude Number		1.00	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth		0.00	ft
Length		0.00	ft
Number Of Steps		0	

GVF Output Data

Upstream Depth		0.00	ft
Profile Description			
Profile Headloss		0.00	ft
Downstream Velocity		Infinity	ft/s
Upstream Velocity		Infinity	ft/s
Normal Depth		2.06	ft
Critical Depth		2.06	ft
Channel Slope		0.01540	ft/ft
Critical Slope		0.01553	ft/ft

Cross Section for Sta 1100 Ex Op7 100yr Flow Channel

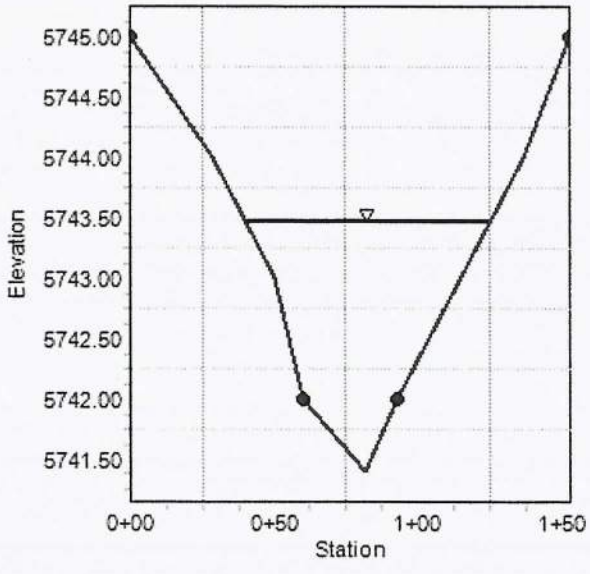
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01540	ft/ft
Normal Depth	2.06	ft
Discharge	556.00	ft³/s

Cross Section Image



Rating Curve for Sta 1100 Ex Op7 100yr Flow Channel

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01540	ft/ft
Discharge	556.00	ft^3/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	5745.00
0+29	5744.00
0+50	5743.00
0+60	5742.00
0+82	5741.40
0+93	5742.00
1+37	5744.00
1+53	5745.00

Roughness Segment Definitions

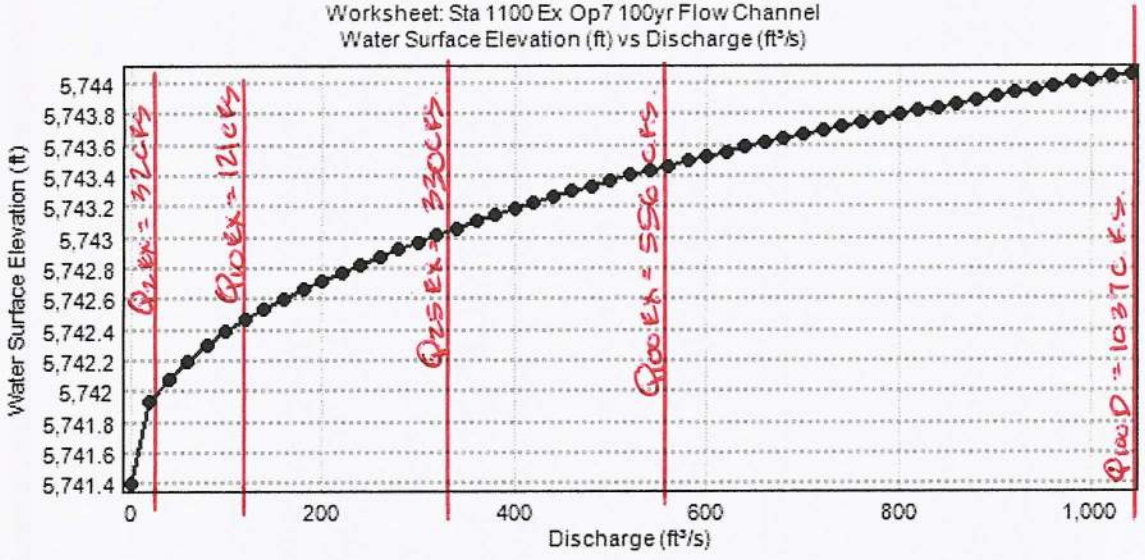
Start Station	Ending Station	Roughness Coefficient
(0+00, 5745.00)	(0+60, 5742.00)	0.035

Rating Curve for Sta 1100 Ex Op7 100yr Flow Channel

Input Data

Start Station	Ending Station	Roughness Coefficient
(0+60, 5742.00)	(0+93, 5742.00)	0.030
(0+93, 5742.00)	(1+53, 5745.00)	0.035

Rating Curve Plot



Rating Curve for Sta 1100 Ex Op7 100yr Flow Channel

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01540	ft/ft
Discharge	556.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	5745.00
0+29	5744.00
0+50	5743.00
0+60	5742.00
0+82	5741.40
0+93	5742.00
1+37	5744.00
1+53	5745.00

Roughness Segment Definitions

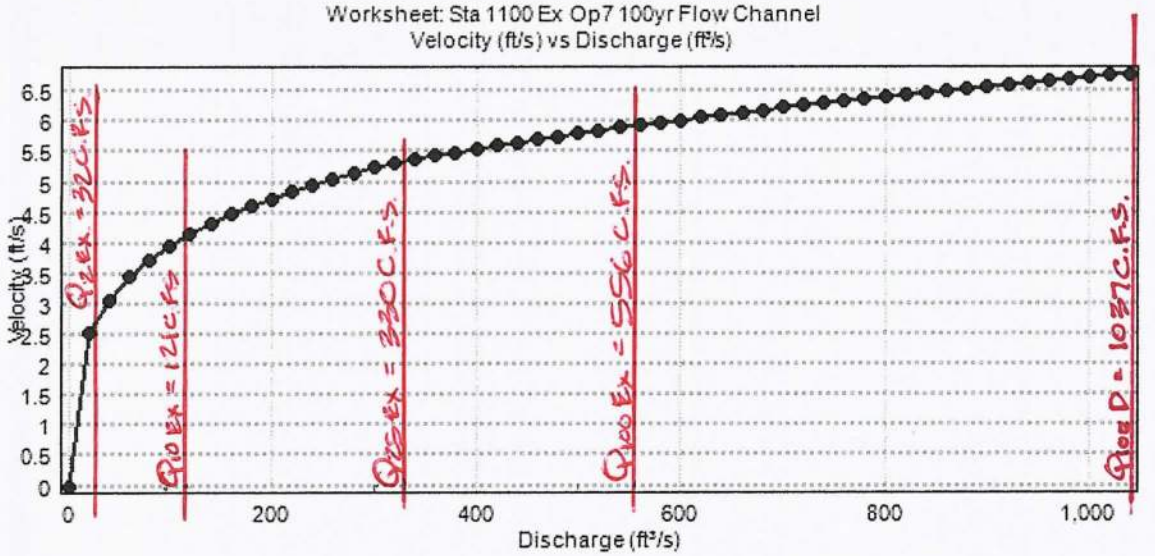
Start Station	Ending Station	Roughness Coefficient
(0+00, 5745.00)	(0+60, 5742.00)	0.035

Rating Curve for Sta 1100 Ex Op7 100yr Flow Channel

Input Data

Start Station	Ending Station	Roughness Coefficient
(0+60, 5742.00)	(0+93, 5742.00)	0.030
(0+93, 5742.00)	(1+53, 5745.00)	0.035

Rating Curve Plot



Worksheet for Sta 1300 Irr. Section - Bankful Op7

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01330	ft/ft
Discharge	56.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	5746.25
0+06	5745.00
0+10	5745.00
0+16	5746.25

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 5746.25)	(0+16, 5746.25)	0.030

Options

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

Results

Normal Depth	1.21	ft
Elevation Range	5745.00 to 5746.25 ft	
Flow Area	11.89	ft²
Wetted Perimeter	15.88	ft
Hydraulic Radius	0.75	ft
Top Width	15.63	ft
Normal Depth	1.21	ft
Critical Depth	1.18	ft
Critical Slope	0.01477	ft/ft

Worksheet for Sta 1300 Irr. Section - Bankful Op7

Results

Velocity		4.71	ft/s
Velocity Head		0.34	ft
Specific Energy		1.56	ft
Froude Number		0.95	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.21	ft
Critical Depth	1.18	ft
Channel Slope	0.01330	ft/ft
Critical Slope	0.01477	ft/ft

Cross Section for Sta 1300 Irr. Section - Bankful Op7

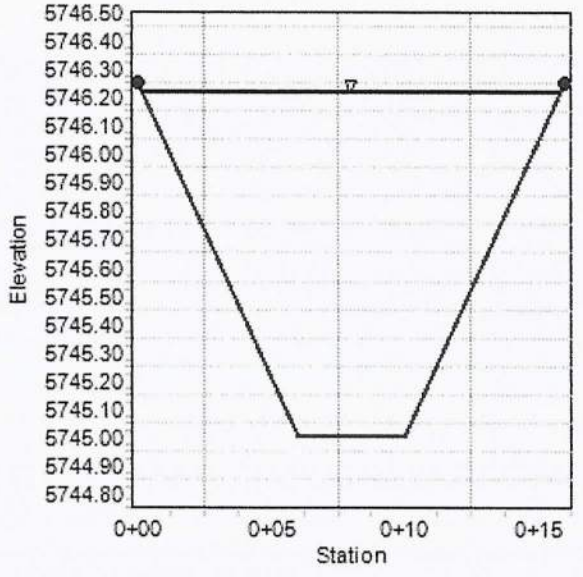
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01330	ft/ft
Normal Depth	1.21	ft
Discharge	56.00	ft³/s

Cross Section Image



Worksheet for Sta 1300 Irr. Full Section - Op7

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01330	ft/ft
Discharge	556.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	5750.00
0+14	5746.50
0+24	5746.25
0+30	5745.00
0+34	5745.00
0+40	5746.25
0+50	5746.50
0+64	5750.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 5750.00)	(0+24, 5746.25)	0.035
(0+24, 5746.25)	(0+40, 5746.25)	0.030
(0+40, 5746.25)	(0+64, 5750.00)	0.035

Options

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

Results

Normal Depth	2.92	ft
Elevation Range	5745.00 to 5750.00 ft	
Flow Area	78.22	ft²

Worksheet for Sta 1300 Irr. Full Section - Op7

Results

Wetted Perimeter		47.98	ft
Hydraulic Radius		1.63	ft
Top Width		47.37	ft
Normal Depth		2.92	ft
Critical Depth		2.89	ft
Critical Slope		0.01404	ft/ft
Velocity		7.11	ft/s
Velocity Head		0.79	ft
Specific Energy		3.71	ft
Froude Number		0.98	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.92	ft
Critical Depth	2.89	ft
Channel Slope	0.01330	ft/ft
Critical Slope	0.01404	ft/ft

Cross Section for Sta 1300 Irr. Full Section - Op7

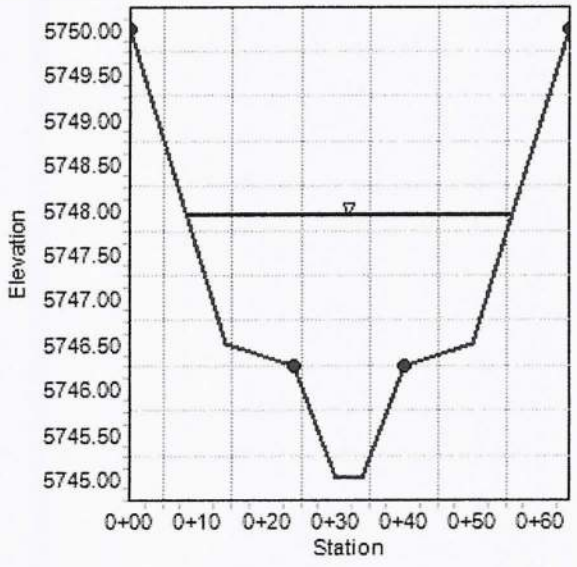
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01330	ft/ft
Normal Depth	2.92	ft
Discharge	556.00	ft³/s

Cross Section Image



Rating Curve for Sta 1300 Irr. Full Section - Op7

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01330	ft/ft
Discharge	556.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	5750.00
0+14	5746.50
0+24	5746.25
0+30	5745.00
0+34	5745.00
0+40	5746.25
0+50	5746.50
0+64	5750.00

Roughness Segment Definitions

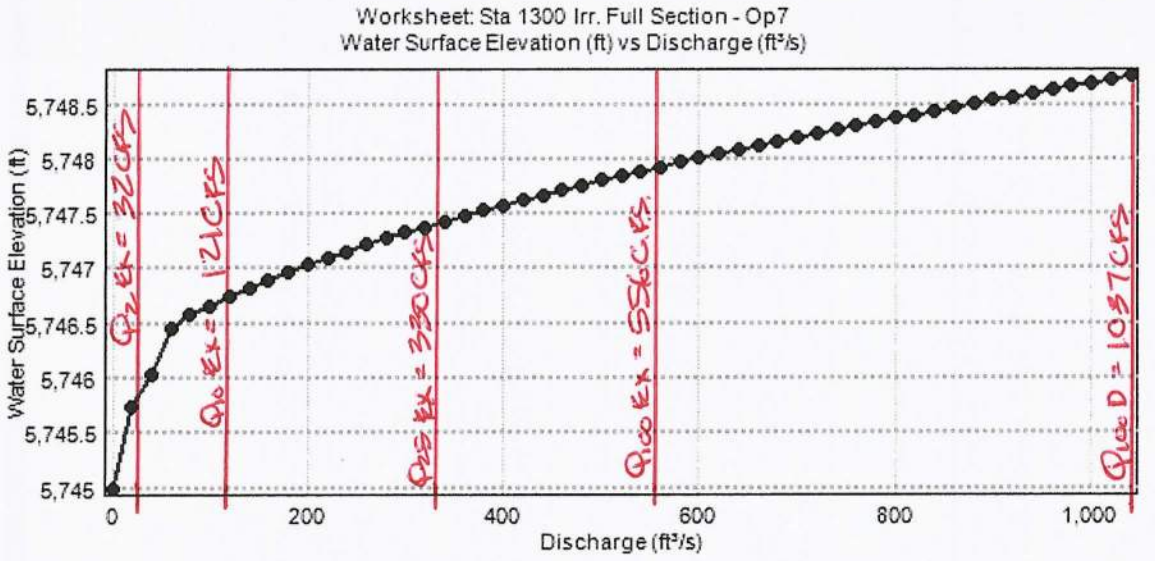
Start Station	Ending Station	Roughness Coefficient
(0+00, 5750.00)	(0+24, 5746.25)	0.035

Rating Curve for Sta 1300 Irr. Full Section - Op7

Input Data

Start Station	Ending Station	Roughness Coefficient
(0+24, 5746.25)	(0+40, 5746.25)	0.030
(0+40, 5746.25)	(0+64, 5750.00)	0.035

Rating Curve Plot



Rating Curve for Sta 1300 Irr. Full Section - Op7

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01330	ft/ft
Discharge	556.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	5750.00
0+14	5746.50
0+24	5746.25
0+30	5745.00
0+34	5745.00
0+40	5746.25
0+50	5746.50
0+64	5750.00

Roughness Segment Definitions

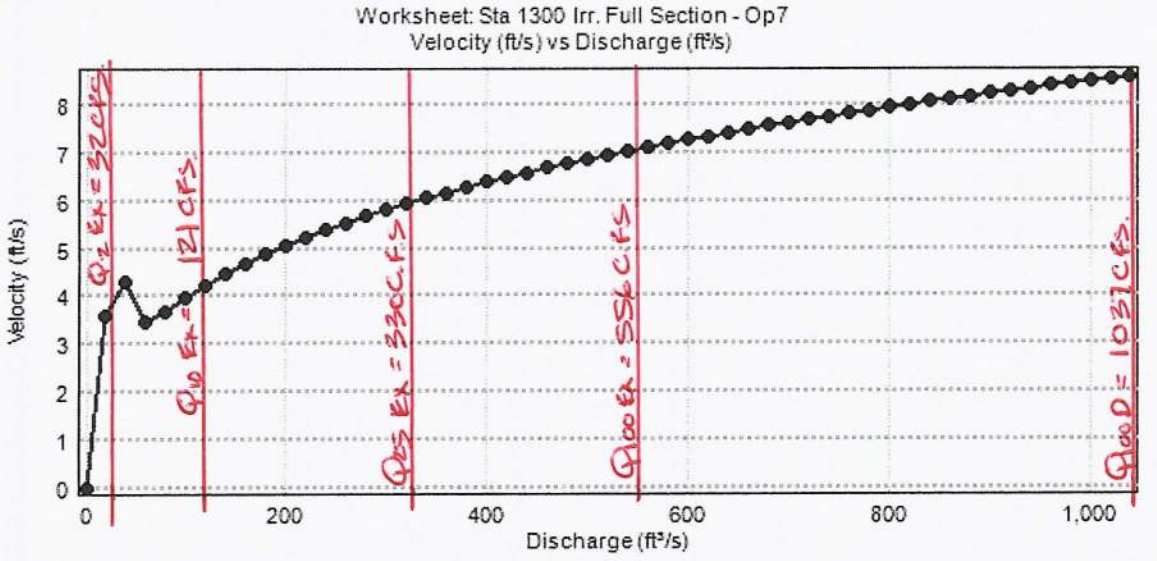
Start Station	Ending Station	Roughness Coefficient
(0+00, 5750.00)	(0+24, 5746.25)	0.035

Rating Curve for Sta 1300 Irr. Full Section - Op7

Input Data

Start Station	Ending Station	Roughness Coefficient
(0+24, 5746.25)	(0+40, 5746.25)	0.030
(0+40, 5746.25)	(0+64, 5750.00)	0.035

Rating Curve Plot



Worksheet for Sta 1700 Irr. Section - Bankful Op7

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00500	ft/ft
Discharge	56.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	5755.50
0+06	5754.00
0+10	5754.00
0+16	5755.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 5755.50)	(0+16, 5755.50)	0.030

Options

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

Results

Normal Depth	1.57	ft
Elevation Range	5754.00 to 5755.50 ft	
Flow Area	16.20	ft²
Wetted Perimeter	16.52	ft
Hydraulic Radius	0.98	ft
Top Width	16.00	ft
Normal Depth	1.57	ft
Critical Depth	1.24	ft
Critical Slope	0.01456	ft/ft

Worksheet for Sta 1700 Irr. Section - Bankful Op7

Results

Velocity		3.46	ft/s
Velocity Head		0.19	ft
Specific Energy		1.76	ft
Froude Number		0.61	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.57	ft
Critical Depth	1.24	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.01456	ft/ft

Cross Section for Sta 1700 Irr. Section - Bankful Op7

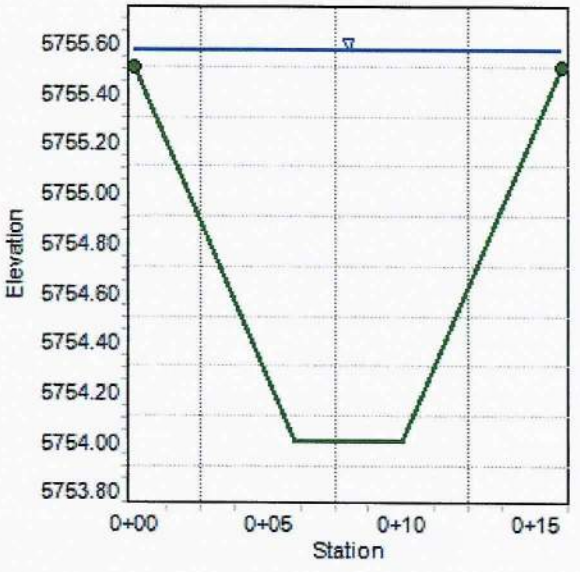
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00500	ft/ft
Normal Depth	1.57	ft
Discharge	56.00	ft³/s

Cross Section Image



Worksheet for Sta 1700 Irr. Full Section - Op7

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00500	ft/ft
Discharge	556.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	5757.80
0+14	5755.75
0+24	5755.50
0+30	5754.00
0+34	5754.00
0+40	5755.50
0+50	5755.75
0+64	5759.25

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 5757.80)	(0+24, 5755.50)	0.035
(0+24, 5755.50)	(0+40, 5755.50)	0.030
(0+40, 5755.50)	(0+64, 5759.25)	0.035

Options

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

Results

Normal Depth	3.73	ft
Elevation Range	5754.00 to 5759.25 ft	
Flow Area	113.86	ft²

Worksheet for Sta 1700 Irr. Full Section - Op7

Results

Wetted Perimeter		58.18	ft
Hydraulic Radius		1.96	ft
Top Width		57.41	ft
Normal Depth		3.73	ft
Critical Depth		3.07	ft
Critical Slope		0.01448	ft/ft
Velocity		4.88	ft/s
Velocity Head		0.37	ft
Specific Energy		4.10	ft
Froude Number		0.61	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.73	ft
Critical Depth	3.07	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.01448	ft/ft

Cross Section for Sta 1700 Irr. Full Section - Op7

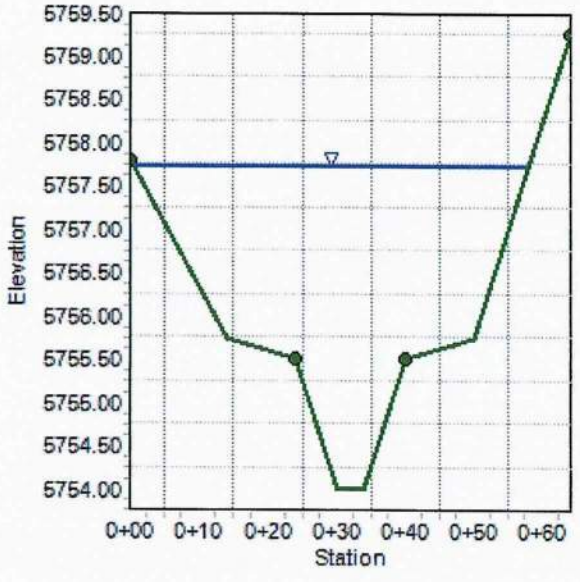
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00500	ft/ft
Normal Depth	3.73	ft
Discharge	556.00	ft³/s

Cross Section Image



Rating Curve for Sta 1700 Irr. Full Section - Op7

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00500	ft/ft
Discharge	556.00	ft^3/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	5757.80
0+14	5755.75
0+24	5755.50
0+30	5754.00
0+34	5754.00
0+40	5755.50
0+50	5755.75
0+64	5759.25

Roughness Segment Definitions

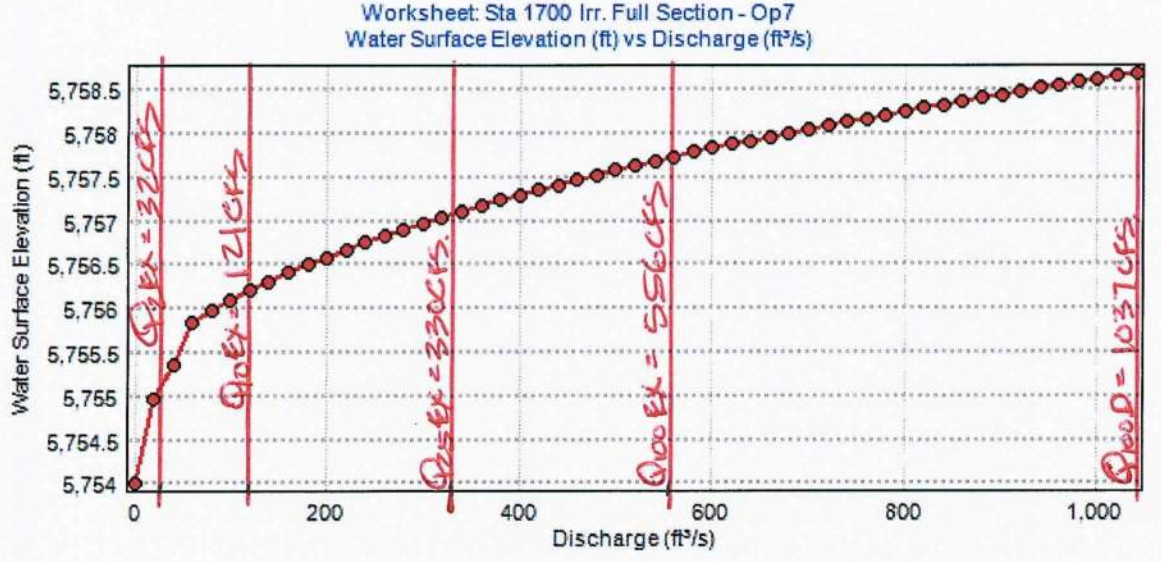
Start Station	Ending Station	Roughness Coefficient
(0+00, 5757.80)	(0+24, 5755.50)	0.035

Rating Curve for Sta 1700 Irr. Full Section - Op7

Input Data

Start Station	Ending Station	Roughness Coefficient
(0+24, 5755.50)	(0+40, 5755.50)	0.030
(0+40, 5755.50)	(0+64, 5759.25)	0.035

Rating Curve Plot



Rating Curve for Sta 1700 Irr. Full Section - Op7

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00500	ft/ft
Discharge	556.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	5757.80
0+14	5755.75
0+24	5755.50
0+30	5754.00
0+34	5754.00
0+40	5755.50
0+50	5755.75
0+64	5759.25

Roughness Segment Definitions

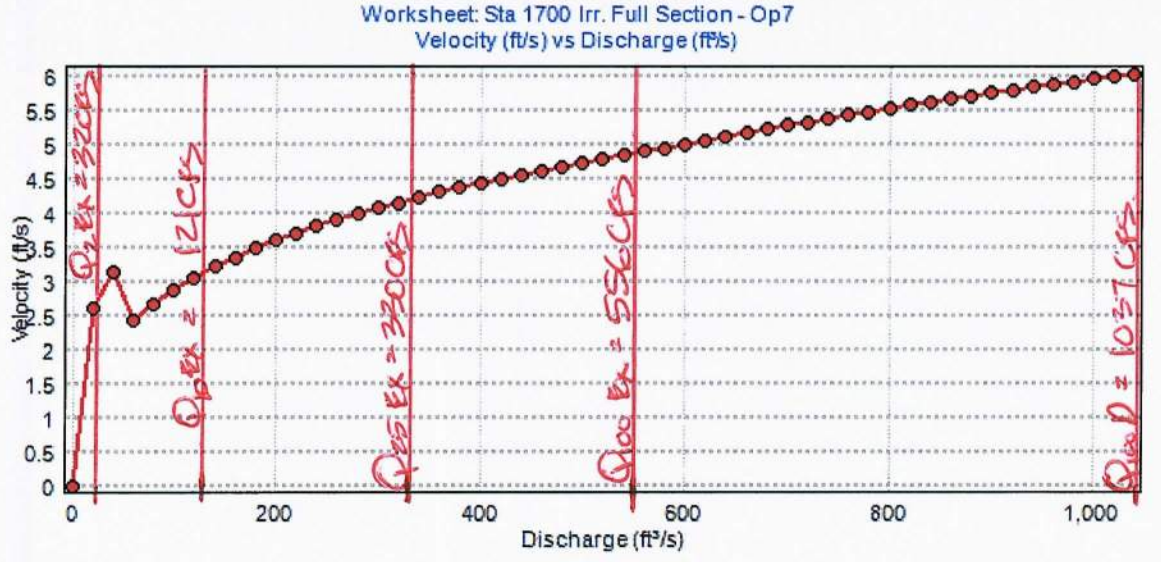
Start Station	Ending Station	Roughness Coefficient
(0+00, 5757.80)	(0+24, 5755.50)	0.035

Rating Curve for Sta 1700 Irr. Full Section - Op7

Input Data

Start Station	Ending Station	Roughness Coefficient
(0+24, 5755.50)	(0+40, 5755.50)	0.030
(0+40, 5755.50)	(0+64, 5759.25)	0.035

Rating Curve Plot



Worksheet for Sta 1900 Ex Op7 100yr Flow Channel

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00500	ft/ft
Discharge	556.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	5760.00
0+56	5756.00
0+77	5755.70
0+96	5755.70
1+00	5756.00
1+60	5760.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 5760.00)	(0+56, 5756.00)	0.035
(0+56, 5756.00)	(1+00, 5756.00)	0.030
(1+00, 5756.00)	(1+60, 5760.00)	0.035

Options

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

Results

Normal Depth	2.12	ft
Elevation Range	5755.70 to 5760.00 ft	
Flow Area	137.56	ft²
Wetted Perimeter	96.92	ft
Hydraulic Radius	1.42	ft

Worksheet for Sta 1900 Ex Op7 100yr Flow Channel

Results

Top Width		96.78	ft
Normal Depth		2.12	ft
Critical Depth		1.62	ft
Critical Slope		0.01512	ft/ft
Velocity		4.04	ft/s
Velocity Head		0.25	ft
Specific Energy		2.37	ft
Froude Number		0.60	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.12	ft
Critical Depth	1.62	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.01512	ft/ft

Rating Curve for Sta 1900 Ex Op7 100yr Flow Channel

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00500	ft/ft
Discharge	556.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	5760.00
0+56	5756.00
0+77	5755.70
0+96	5755.70
1+00	5756.00
1+60	5760.00

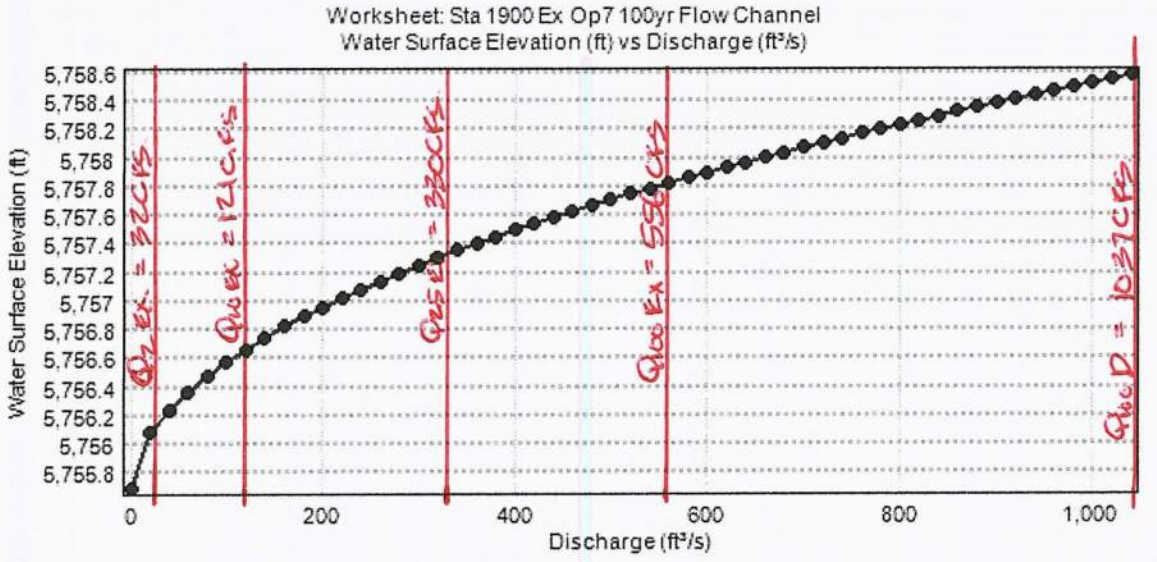
Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 5760.00)	(0+56, 5756.00)	0.035
(0+56, 5756.00)	(1+00, 5756.00)	0.030
(1+00, 5756.00)	(1+60, 5760.00)	0.035

Rating Curve for Sta 1900 Ex Op7 100yr Flow Channel

Input Data

Rating Curve Plot



Rating Curve for Sta 1900 Ex Op7 100yr Flow Channel

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00500	ft/ft
Discharge	556.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	5760.00
0+56	5756.00
0+77	5755.70
0+96	5755.70
1+00	5756.00
1+60	5760.00

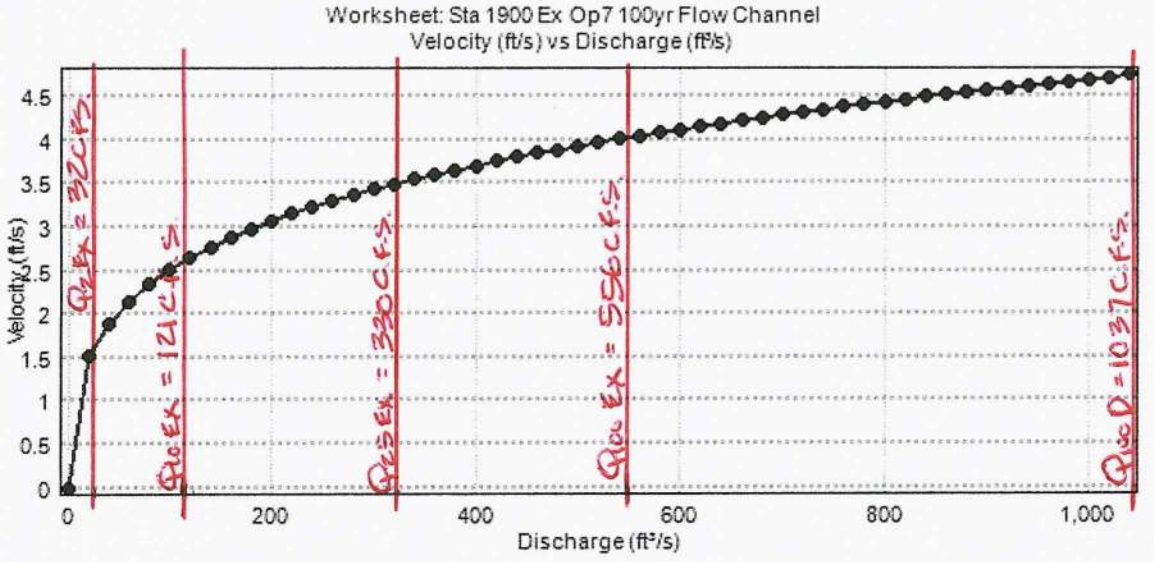
Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 5760.00)	(0+56, 5756.00)	0.035
(0+56, 5756.00)	(1+00, 5756.00)	0.030
(1+00, 5756.00)	(1+60, 5760.00)	0.035

Rating Curve for Sta 1900 Ex Op7 100yr Flow Channel

Input Data

Rating Curve Plot

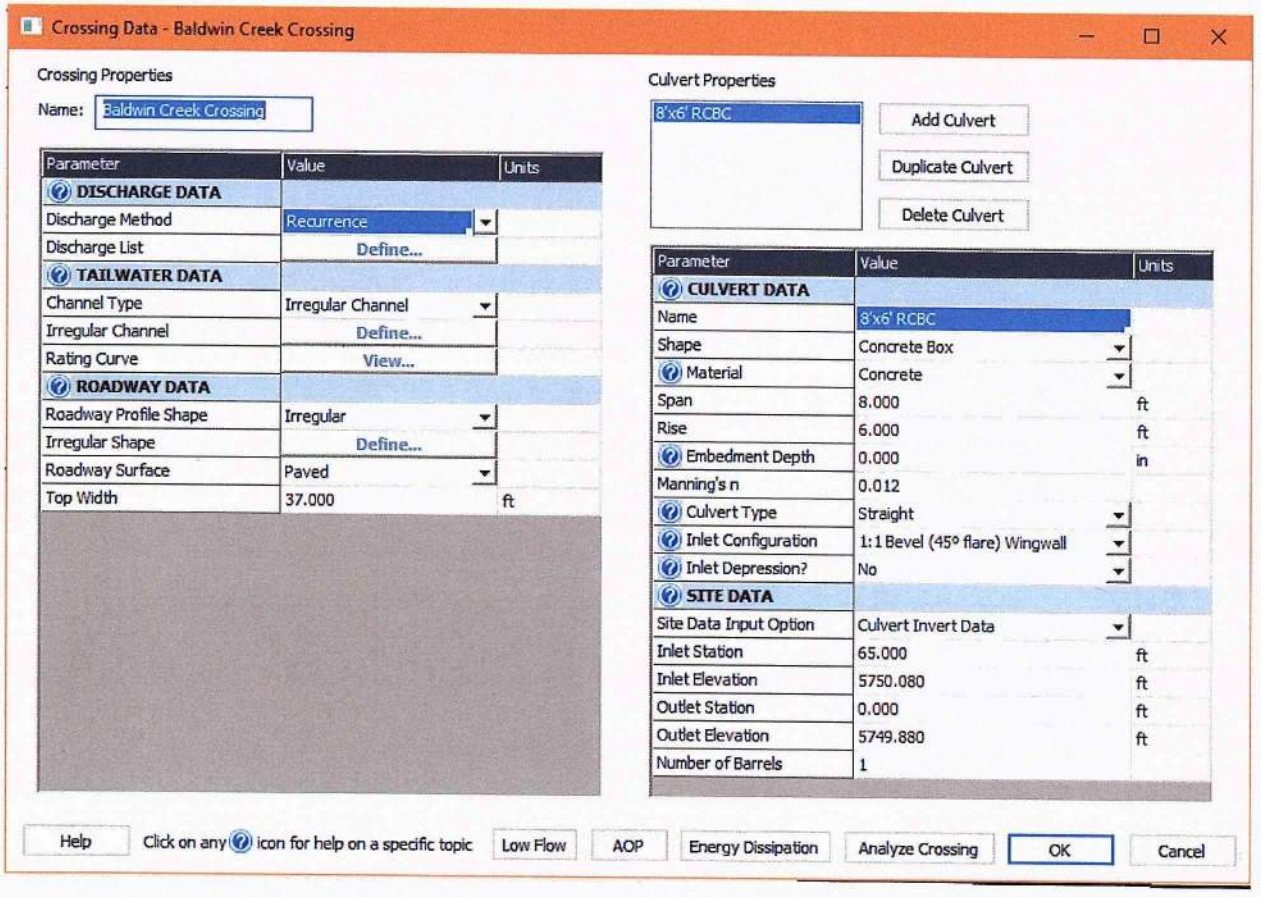


APPENDIX C:
HYDRAULIC COMPUTATIONS
BALDWIN CREEK REALIGNMENT DESIGN
- **BOX CULVERT DESIGN**

Baldwin Creek Culvert Design:

Senac Creek Major Drainageway Plan existing condition flows will be utilized to size the Baldwin Creek crossing at the Aurora Seam site. A 65-ft long, 6' x 8' box culvert is proposed and will be designed to convey the 25-year and 100-year events underneath the proposed roadway for the Aurora Seam facility. The 100-year peak discharge is 556 cfs and the 25-year peak discharge is 330 cfs. A 3-ft drop structure discussed in the channel design section was incorporated into the analysis for energy dissipation. The fully developed condition 100-year peak flow in excess of the maximum headwater elevation and capacity of the proposed 6' x 8' culvert will be conveyed via overtopping of the proposed local access roadway. Please refer to attached HY-8 computations and culvert analysis.

The proposed 6' x 8' box culvert will also have a 3 feet vertical drop entrance structure to reduce headwater depth and adjust for existing channel profile drop. A sloping void filled cobble rip rap lining is proposed for the downstream exit from the culvert and final channel drop can be adjusted to match final channel profile grades. The downstream reach will include some transition grading to tie into the existing channel alignment

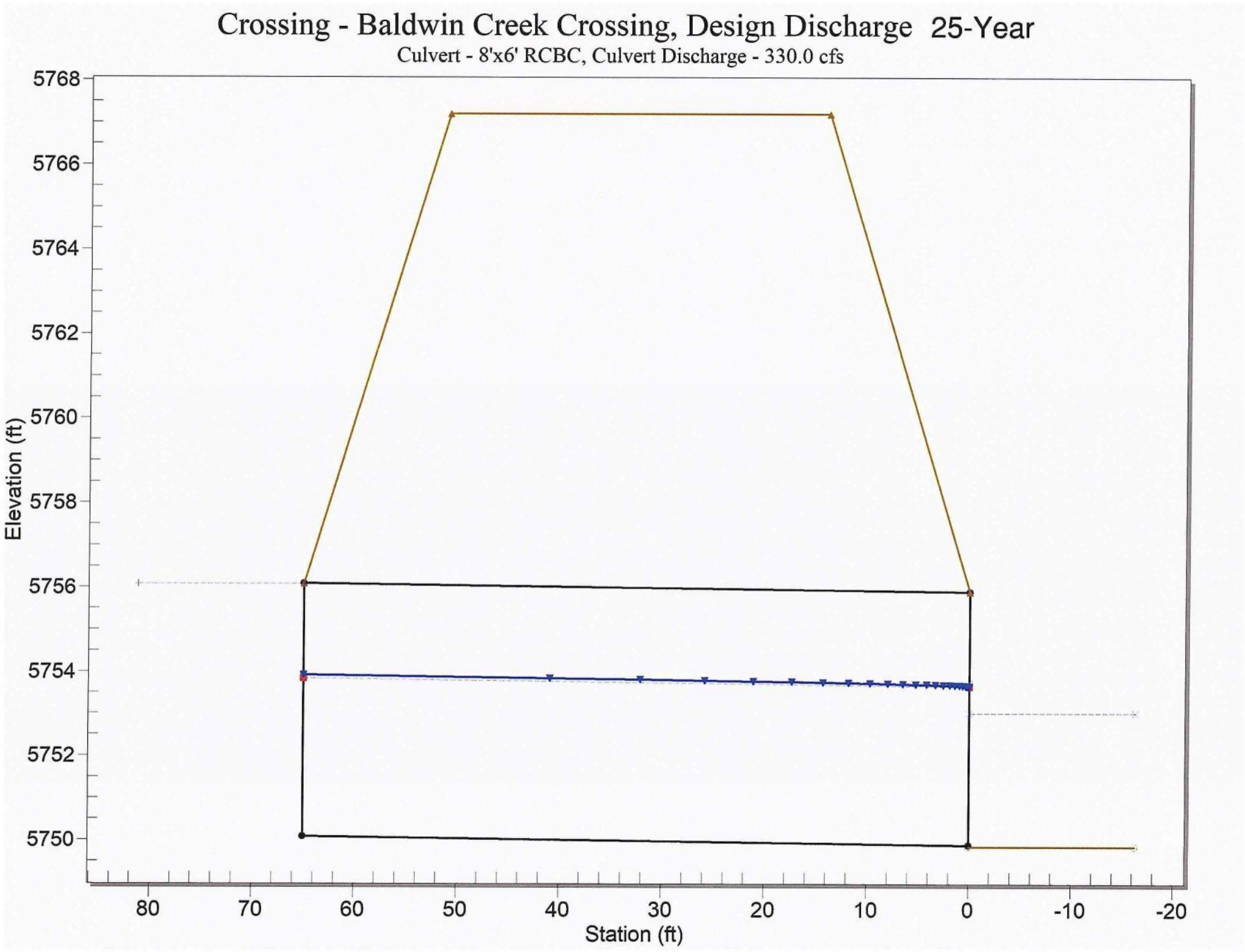

Crossing Data - Baldwin Creek Crossing
Crossing Properties
Name: Baldwin Creek Crossing
Parameter
Value
Units
DISCHARGE DATA
Discharge Method
Recurrence
Discharge List
Define...
TAILWATER DATA
Channel Type
Irregular Channel
Irregular Channel
Define...
Rating Curve
View...
ROADWAY DATA
Roadway Profile Shape
Irregular
Irregular Shape
Define...
Roadway Surface
Paved
Top Width
37.000
ft
Culvert Properties
8'x6' RCBC
Add Culvert
Duplicate Culvert
Delete Culvert
Parameter
Value
Units
CULVERT DATA
Name
8'x6' RCBC
Shape
Concrete Box
Material
Concrete
Span
8.000
ft
Rise
6.000
ft
Embedment Depth
0.000
in
Manning's n
0.012
Culvert Type
Straight
Inlet Configuration
1:1 Bevel (45° flare) Wingwall
Inlet Depression?
No
SITE DATA
Site Data Input Option
Culvert Invert Data
Inlet Station
65.000
ft
Inlet Elevation
5750.080
ft
Outlet Station
0.000
ft
Outlet Elevation
5749.880
ft
Number of Barrels
1
Help
Click on any icon for help on a specific topic
Low Flow
AOP
Energy Dissipation
Analyze Crossing
OK
Cancel

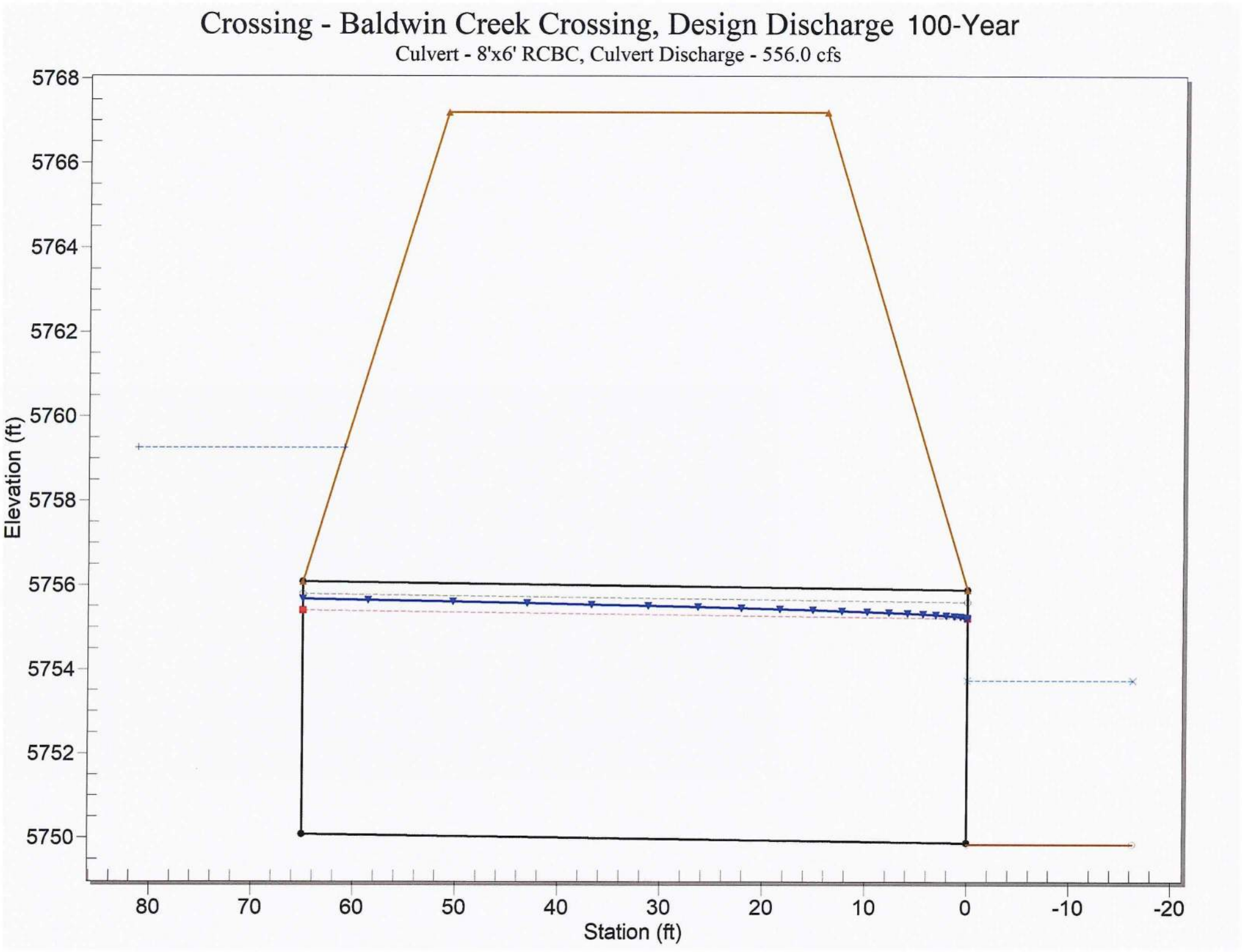
HY-8 Analysis Results

Culvert Summary Table - Seam Site 8' X 6' RCBC (Exisiting Condition)

Culvert Crossing @ Seam Site

Discharge Name	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
2 year	32.00	32.00	5751.44	1.20	1.36	1-S1t	0.77	0.79	1.33	1.37	3.00	2.43
5 year	121.00	121.00	5753.00	2.92	2.12	1-JS1t	1.87	1.92	2.19	2.23	6.91	2.93
10 year	178.00	178.00	5753.90	3.82	2.57	1-S2n	2.45	2.49	2.45	2.53	9.08	3.31
25 year	330.00	330.00	5756.07	5.93	5.99	2-M2c	3.83	3.75	3.75	3.16	10.99	4.13
50 year	438.00	438.00	5757.49	7.41~	7.23	7-M2c	4.75	4.53	4.53	3.53	12.08	4.59
100 year	556.00	556.00	5759.27	9.19~	8.47	7-M2c	5.71	5.31	5.31	3.89	13.08	5.02


Crossing - Baldwin Creek Crossing, Design Discharge 25-Year
Culvert - 8'x6' RCBC, Culvert Discharge - 330.0 cfs
Elevation (ft)
5768
5766
5764
5762
5760
5758
5756
5754
5752
5750
80
70
60
50
40
30
20
10
0
-10
-20
Station (ft)


Crossing - Baldwin Creek Crossing, Design Discharge 100-Year
Culvert - 8'x6' RCBC, Culvert Discharge - 556.0 cfs
Elevation (ft)
5768
5766
5764
5762
5760
5758
5756
5754
5752
5750
80
70
60
50
40
30
20
10
0
-10
-20
Station (ft)

HY-8 Energy Dissipation Report

External Energy Dissipator

Parameter	Value	Units
Select Culvert and Flow		
Crossing	Baldwin Creek Crossing	
Culvert	8'x6' RCBC	
Flow	556.00	cfs
Culvert Data		
Culvert Width (including multiple barrels)	8.0	ft
Culvert Height	6.0	ft
Outlet Depth	5.31	ft
Outlet Velocity	13.08	ft/s
Froude Number	1.00	
Tailwater Depth	3.89	ft
Tailwater Velocity	5.02	ft/s
Tailwater Slope (SO)	0.0031	
External Dissipator Data		
External Dissipator Category	Drop Structures	
External Dissipator Type	Straight Drop-structure	
Restrictions		
TailWater	REQUIRED	
Special Limitations	FROUDE < 1	
Input Data		
Estimate for the Vertical Drop Height	3.000	ft
New Channel Slope to be used with Drop Structures	0.0154	ft/ft
Enter all required input before computation will occur		

APPENDIX C:
HYDRAULIC COMPUTATIONS
SEAM SITE DETENTION PONDING DESIGN

SEAM Site Detention Pond Design Options:

1. Pond A

- Pond A has been designed as a dry extended detention/water quality pond to treat stormwater runoff for Basin A and Basin C. The pond tributary area includes all of basin A1 through A10 and basins C1 and C2. UD Detention pond design worksheets are included within Appendix B.

2. Pond B

- Pond B has been preliminarily designed as a dry extended detention/water quality pond to treat stormwater runoff for Basin B and portions of future developed Basin FD. The pond tributary area includes all of basin B1 through B11 and undeveloped flows from basins FD1 Through FD7. Pond B has been sized to handle and pass these undeveloped flows through the proposed outlet facilities and outfall storm sewer. Future development of the remaining Commercial sites will require providing additional detention and water quality ponding on their respective sites. UD Detention pond design worksheets are included within Appendix B.

3. Future Commercial Sites

- The two commercial sites referred to in this report as basins C1 and C2 are roughly 15.1 acres and 21.3 acres respectively and are accounted for in the current design as passthrough flows that are captured in roadside swales and routed through Pond B as discussed in the previous paragraphs.
- As part of this master plan however, our office has investigated three (3) scenarios in which detention and water quality requirements could be met for the future development once constructed.
- The first scenario requires construction of two (2) additional ponds, one on each of the future commercial parcels. This could provide stormwater management with water quality volume provided in each individual pond for its respective basin.
    - The ponds each with their own water quality volume would need to meet the following criteria at a minimum:

Pond	WQ Volume (ac-ft)	EURV Volume (ac-ft)	100 YR Volume (ac-ft)	Total Pond Volume (ac-ft)
B	0.744	0.997	2.331	4.072
C1	0.552	0.920	1.034	2.507
C2	0.713	1.188	1.335	3.236

- The second scenario requires construction of one (1) additional pond which would be sized to handle the entirety of the two (2) commercial areas runoff. This could be accomplished with water quality volume provided in both the new commercial pond and

pond B or only handling stormwater management in the new pond and oversizing pond B to provide water quality for both of the commercial parcels and onsite basin B.

- The ponds each with their own water quality volume would need to meet the following criteria at a minimum:

Pond	WQ Volume (ac-ft)	EURV Volume (ac-ft)	100 YR Volume (ac-ft)	Total Pond Volume (ac-ft)
B	0.744	.997	2.331	4.072
C1	0.589	0.811	1.532	2.932

- The new commercial pond only providing detention and providing water quality volume in an oversized Pond B would need to meet the following criteria at a minimum:

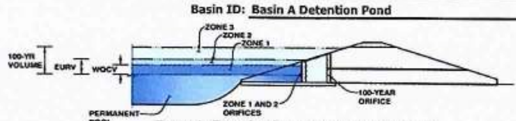
Pond	WQ Volume (ac-ft)	EURV Volume (ac-ft)	100 YR Volume (ac-ft)	Total Pond Volume (ac-ft)
B	1.333	0.408	2.626	4.366
C1	-	0.811	2.121	2.932

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)

Project: Aurora Seam

Basin ID: Basin A Detention Pond



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	13.69	acres
Watershed Length =	1,100	ft
Watershed Length to Centroid =	450	ft
Watershed Slope =	0.025	ft/ft
Watershed Imperviousness =	90.60%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	100.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Aurora Reservoir	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.464	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	1.231	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.84 in.) =	0.804	acre-feet		inches
5-yr Runoff Volume (P1 = 1.13 in.) =	1.128	acre-feet		inches
10-yr Runoff Volume (P1 = 1.39 in.) =	1.429	acre-feet		inches
25-yr Runoff Volume (P1 = 1.77 in.) =	1.882	acre-feet		inches
50-yr Runoff Volume (P1 = 2.08 in.) =	2.248	acre-feet		inches
100-yr Runoff Volume (P1 = 2.42 in.) =	2.656	acre-feet		inches
500-yr Runoff Volume (P1 = 3.3 in.) =	3.697	acre-feet		inches
Approximate 2-yr Detention Volume =	0.795	acre-feet		
Approximate 5-yr Detention Volume =	1.125	acre-feet		
Approximate 10-yr Detention Volume =	1.376	acre-feet		
Approximate 25-yr Detention Volume =	1.621	acre-feet		
Approximate 50-yr Detention Volume =	1.729	acre-feet		
Approximate 100-yr Detention Volume =	1.861	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.464	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.767	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	0.862	acre-feet
Total Detention Basin Volume =	2.093	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

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

Depth Increment = 0.10 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	25	0.001		
	--	1.00	--	--	--	3,589	0.082	1,807	0.041
	--	2.00	--	--	--	9,317	0.214	8,260	0.190
	--	3.00	--	--	--	11,632	0.267	18,734	0.430
	--	4.00	--	--	--	13,444	0.309	31,272	0.718
	--	5.00	--	--	--	15,389	0.353	45,689	1.049
	--	6.00	--	--	--	17,498	0.402	62,132	1.426
	--	7.00	--	--	--	19,651	0.451	80,707	1.853
	--	8.00	--	--	--	22,041	0.506	101,553	2.331
	--	9.00	--	--	--	25,123	0.577	125,135	2.873
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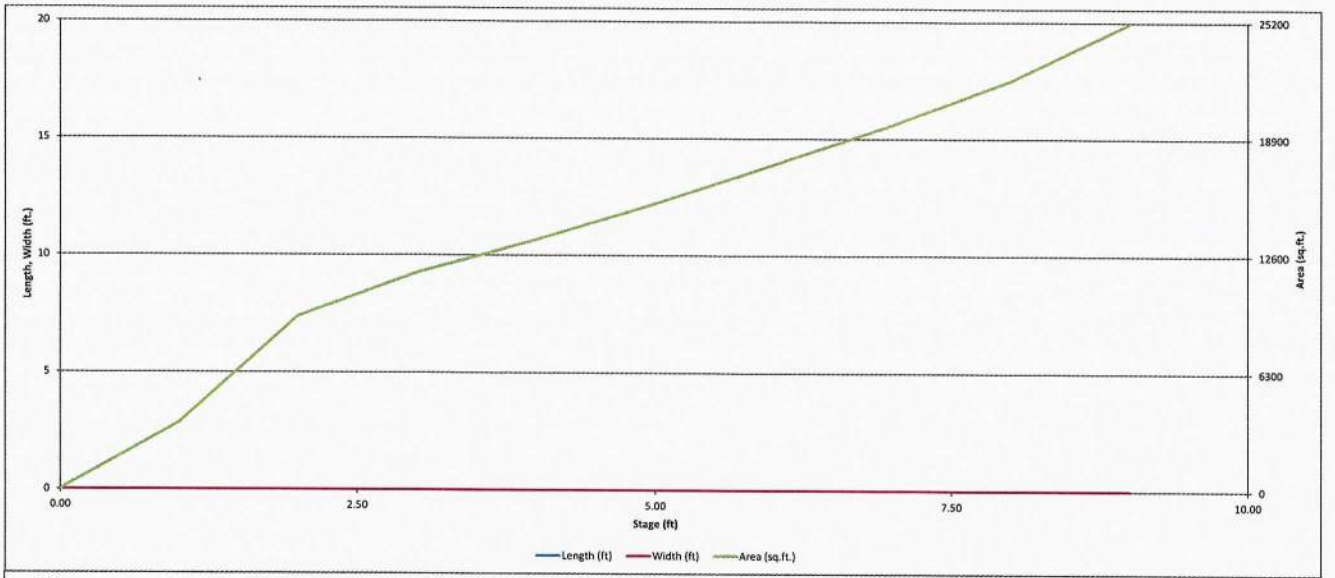
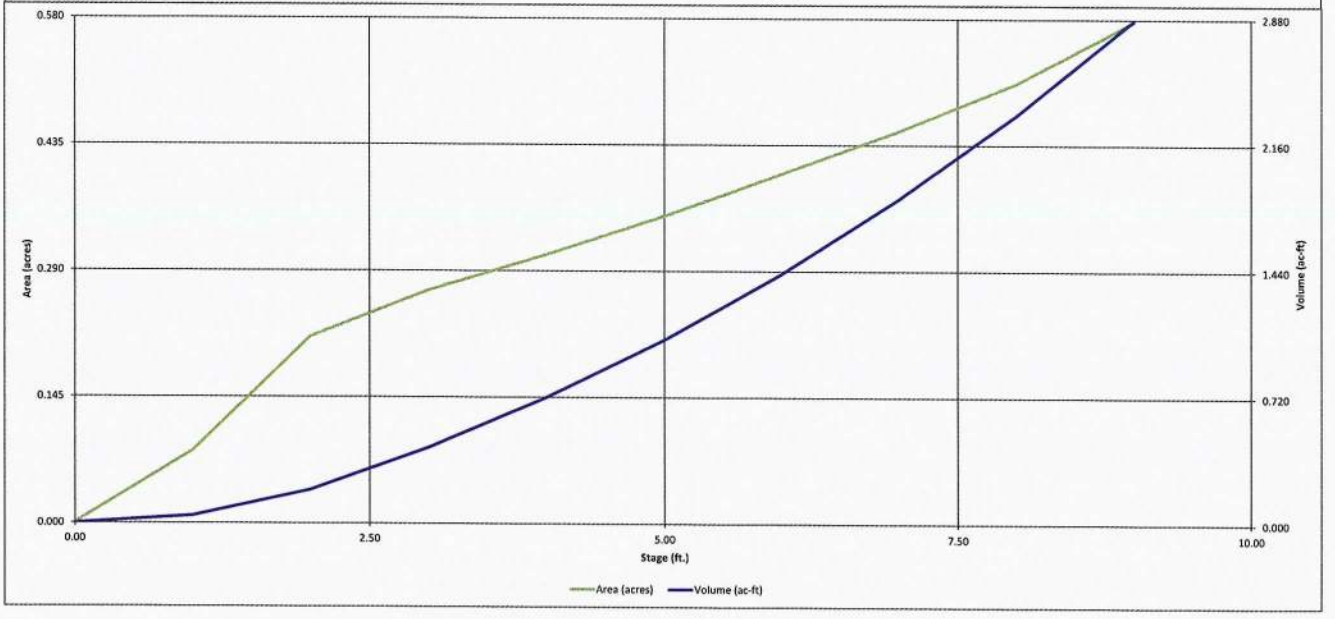
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)



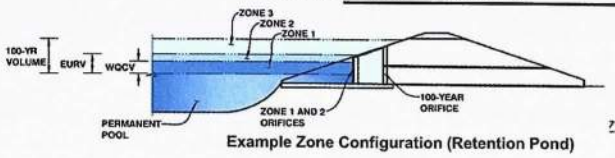


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.02 (February 2020)

Project: Aurora Seam

Basin ID: Basin A Detention Pond



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.13	0.464	Orifice Plate
Zone 2 (EURV)	5.50	0.767	Orifice Plate
Z3 (100+1/2WQCV)	7.52	0.862	Weir&Pipe (Restrict)
Total (all zones)		2.093	

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

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

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	5.50	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	11.00	inches
Orifice Plate: Orifice Area per Row =	1.70	sq. inches (diameter = 1-7/16 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row =	1.181E-02	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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	0.90	1.80	2.70	3.60	4.50	5.40	
Orifice Area (sq. inches)	1.70	1.70	1.70	1.70	1.70	1.70	1.70	

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

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	5.60	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	5.67	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	2.92	N/A	feet
Overflow Grate Open Area % =	75%	N/A	%, grate open area/total area
Debris Clogging % =	0%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	5.60	N/A	feet
Overflow Weir Slope Length =	2.92	N/A	feet
Grate Open Area / 100-yr Orifice Area =	11.54	N/A	
Overflow Grate Open Area w/o Debris =	12.42	N/A	ft^2
Overflow Grate Open Area w/ Debris =	12.42	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	24.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	9.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	1.08	N/A	ft^2
Outlet Orifice Centroid =	0.44	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.32	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.80	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	32.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.63	feet
Stage at Top of Freeboard =	8.43	feet
Basin Area at Top of Freeboard =	0.54	acres
Basin Volume at Top of Freeboard =	2.56	acre-ft

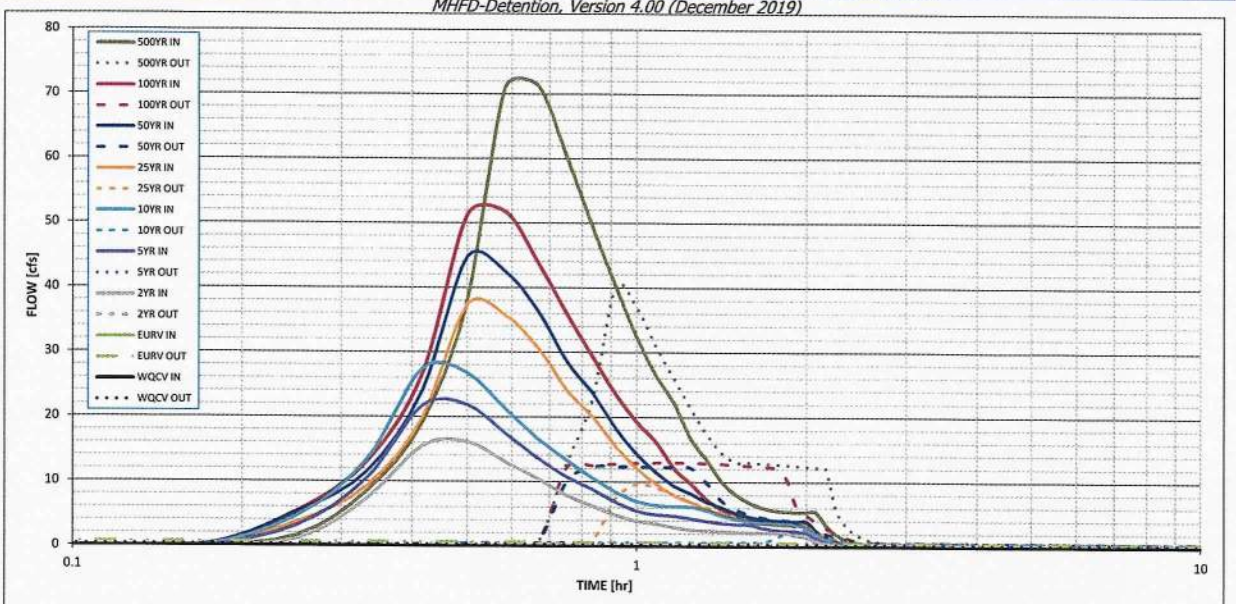
Routed Hydrograph Results

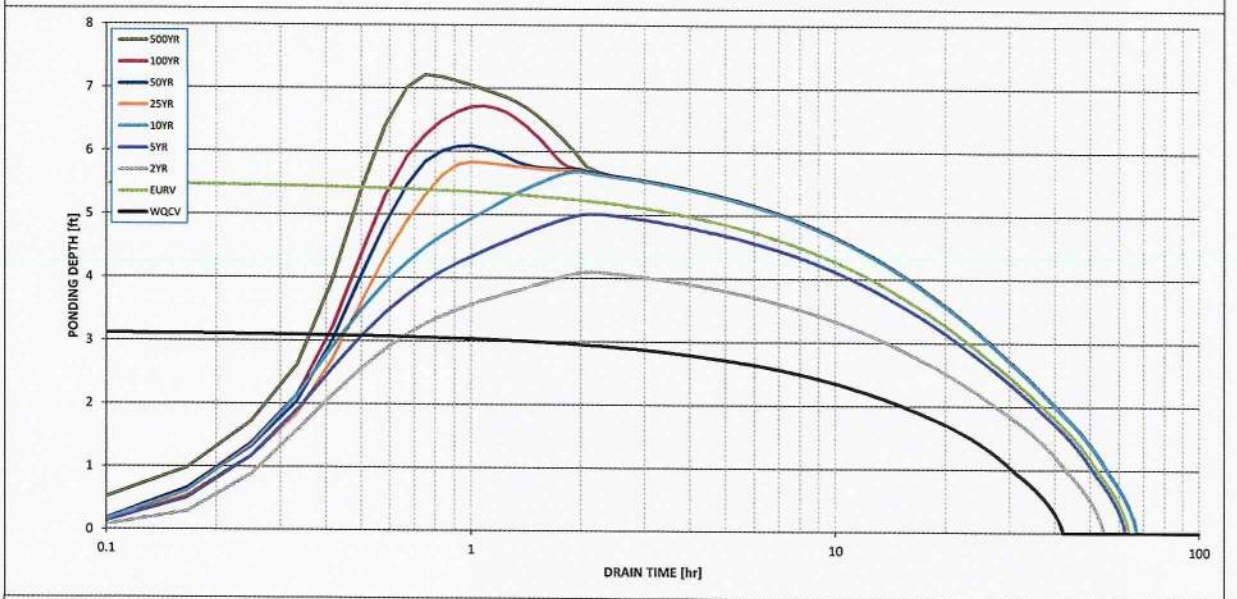
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

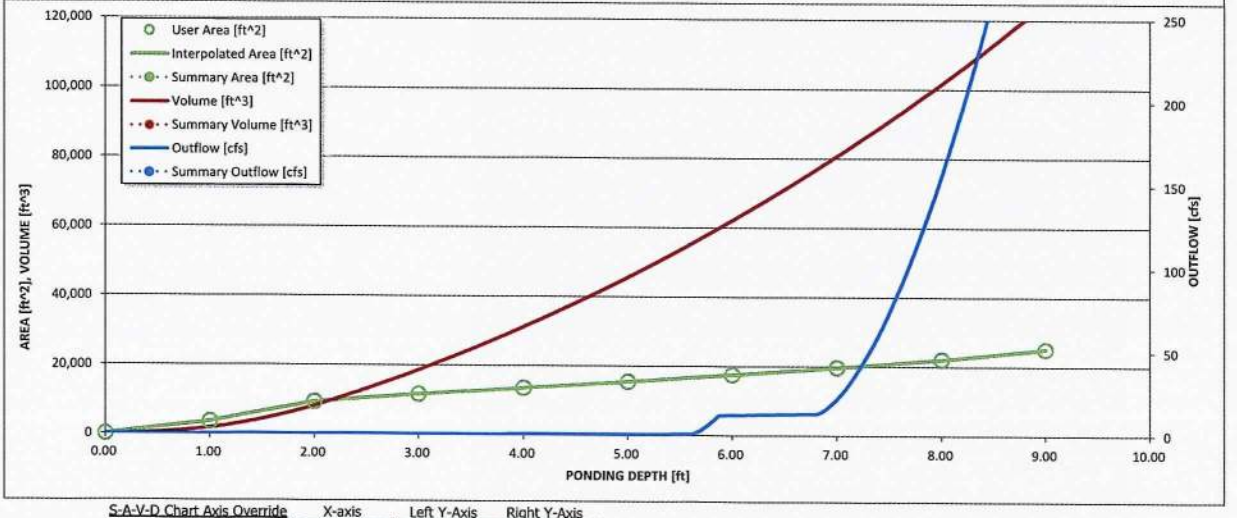
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.84	1.13	1.39	1.77	2.08	2.42	3.30
CUHP Runoff Volume (acre-ft) =	0.464	1.231	0.804	1.128	1.429	1.882	2.248	2.656	3.697
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.804	1.128	1.429	1.882	2.248	2.656	3.697
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.2	1.9	4.7	11.2	15.3	20.2	31.7
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.14	0.35	0.82	1.12	1.47	2.32
Peak Inflow Q (cfs) =	N/A	N/A	16.1	21.8	27.4	37.4	44.7	51.8	71.4
Peak Outflow Q (cfs) =	0.3	0.6	0.4	0.5	2.6	9.7	12.3	13.0	40.1
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.3	0.5	0.9	0.8	0.6	1.3
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.1	0.7	0.9	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) =	37	53	47	52	55	53	52	51	47
Time to Drain 99% of Inflow Volume (hours) =	**40**	59	51	58	62	61	60	59	56
Maximum Ponding Depth (ft) =	3.13	5.50	4.10	5.02	5.68	5.83	6.09	6.72	7.21
Area at Maximum Ponding Depth (acres) =	0.27	0.38	0.31	0.35	0.39	0.39	0.41	0.44	0.46
Maximum Volume Stored (acre-ft) =	0.465	1.232	0.746	1.052	1.300	1.359	1.459	1.728	1.949

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

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

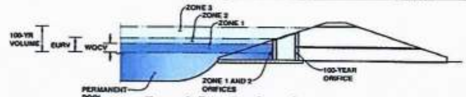
Time Interval	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.59
	0:15:00	0.00	0.00	1.06	3.11	4.62	3.65	5.15	5.37	8.55
	0:20:00	0.00	0.00	7.35	10.55	13.45	9.34	11.53	13.15	19.14
	0:25:00	0.00	0.00	15.50	21.68	27.41	19.90	24.00	26.69	37.94
	0:30:00	0.00	0.00	16.13	21.83	26.71	37.40	44.71	51.30	71.07
	0:35:00	0.00	0.00	13.04	17.42	21.24	35.71	42.50	51.79	71.43
	0:40:00	0.00	0.00	10.42	13.61	16.59	30.67	36.43	43.92	60.47
	0:45:00	0.00	0.00	7.91	10.74	13.31	24.15	28.65	36.04	49.54
	0:50:00	0.00	0.00	6.23	8.78	10.56	20.05	23.75	29.37	40.37
	0:55:00	0.00	0.00	4.86	6.83	8.42	15.41	18.27	23.55	32.37
	1:00:00	0.00	0.00	3.91	5.46	6.89	12.03	14.26	19.22	26.43
	1:05:00	0.00	0.00	3.51	4.88	6.33	9.64	11.44	16.11	22.19
	1:10:00	0.00	0.00	2.95	4.69	6.16	7.83	9.32	12.00	16.59
	1:15:00	0.00	0.00	2.63	4.30	6.09	6.86	8.17	9.71	13.46
	1:20:00	0.00	0.00	2.45	3.89	5.53	5.76	6.85	7.26	10.07
	1:25:00	0.00	0.00	2.34	3.63	4.75	5.09	6.05	5.82	8.07
	1:30:00	0.00	0.00	2.27	3.48	4.24	4.34	5.16	4.93	6.83
	1:35:00	0.00	0.00	2.22	3.38	3.93	3.87	4.60	4.36	6.04
	1:40:00	0.00	0.00	2.20	2.92	3.73	3.58	4.25	4.04	5.60
	1:45:00	0.00	0.00	2.20	2.62	3.59	3.42	4.06	3.92	5.43
	1:50:00	0.00	0.00	2.20	2.44	3.52	3.33	3.95	3.86	5.35
	1:55:00	0.00	0.00	1.78	2.34	3.34	3.28	3.90	3.86	5.35
	2:00:00	0.00	0.00	1.51	2.16	2.97	3.26	3.87	3.86	5.35
	2:05:00	0.00	0.00	0.92	1.32	1.83	2.02	2.40	2.39	3.31
	2:10:00	0.00	0.00	0.55	0.79	1.10	1.23	1.46	1.46	2.02
	2:15:00	0.00	0.00	0.31	0.46	0.64	0.72	0.85	0.85	1.17
	2:20:00	0.00	0.00	0.16	0.26	0.35	0.41	0.48	0.48	0.66
	2:25:00	0.00	0.00	0.07	0.13	0.16	0.20	0.24	0.24	0.33
	2:30:00	0.00	0.00	0.02	0.04	0.05	0.07	0.08	0.08	0.11
	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

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)

Project: Aurora Seam

Basin ID: Basin B-1 Det. Pond - Interim 53.3Ac.



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	53.27	acres
Watershed Length =	2,540	ft
Watershed Length to Centroid =	1,410	ft
Watershed Slope =	0.030	ft/ft
Watershed Imperviousness =	35.50%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	100.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Aurora Reservoir	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.744	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	1.741	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.84 in.) =	1.139	acre-feet		inches
5-yr Runoff Volume (P1 = 1.13 in.) =	1.950	acre-feet		inches
10-yr Runoff Volume (P1 = 1.39 in.) =	2.945	acre-feet		inches
25-yr Runoff Volume (P1 = 1.77 in.) =	4.841	acre-feet		inches
50-yr Runoff Volume (P1 = 2.08 in.) =	6.239	acre-feet		inches
100-yr Runoff Volume (P1 = 2.42 in.) =	7.996	acre-feet		inches
500-yr Runoff Volume (P1 = 3.3 in.) =	12.083	acre-feet		inches
Approximate 2-yr Detention Volume =	1.068	acre-feet		
Approximate 5-yr Detention Volume =	1.824	acre-feet		
Approximate 10-yr Detention Volume =	2.211	acre-feet		
Approximate 25-yr Detention Volume =	2.732	acre-feet		
Approximate 50-yr Detention Volume =	2.977	acre-feet		
Approximate 100-yr Detention Volume =	3.700	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.744	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.997	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	2.331	acre-feet
Total Detention Basin Volume =	4.072	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

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

Depth Increment = 0.10 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	80	0.002		
	--	1.00	--	--	--	1,365	0.031	722	0.017
	--	2.00	--	--	--	11,180	0.257	6,995	0.161
	--	3.00	--	--	--	17,901	0.411	21,535	0.494
	--	4.00	--	--	--	22,839	0.524	41,905	0.962
	--	5.00	--	--	--	26,693	0.613	66,671	1.531
	--	6.00	--	--	--	30,225	0.694	95,130	2.184
	--	7.00	--	--	--	33,862	0.777	127,174	2.920
	--	8.00	--	--	--	37,605	0.863	162,907	3.740
	--	9.00	--	--	--	41,453	0.952	202,436	4.647
	--	10.00	--	--	--	45,471	1.044	245,898	5.645
	--	11.00	--	--	--	50,500	1.159	293,884	6.747
	--	12.00	--	--	--	55,000	1.263	346,634	7.958
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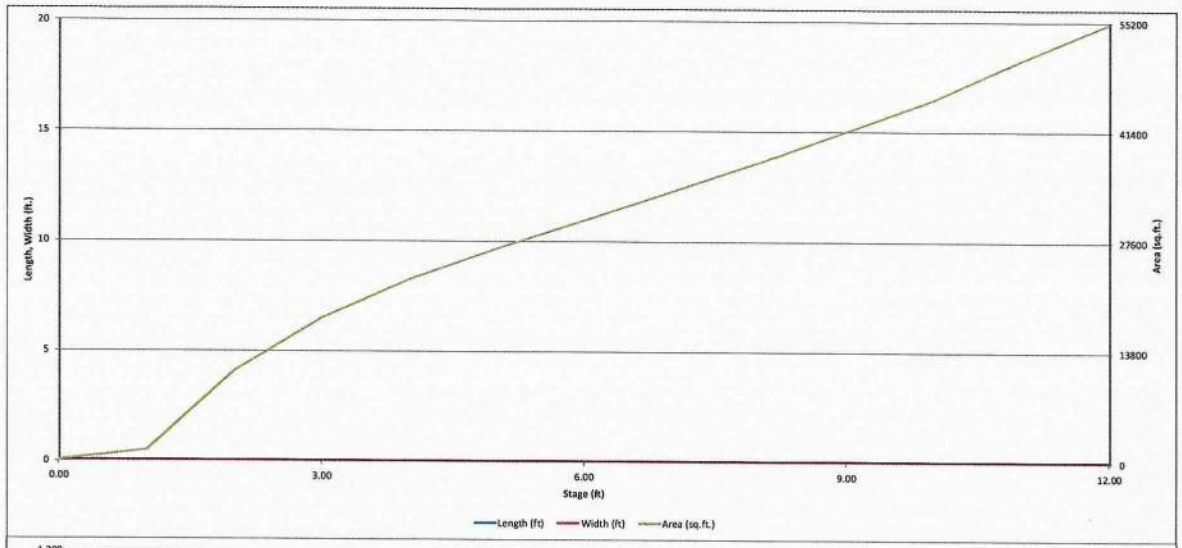
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10
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13800
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3.00
6.00
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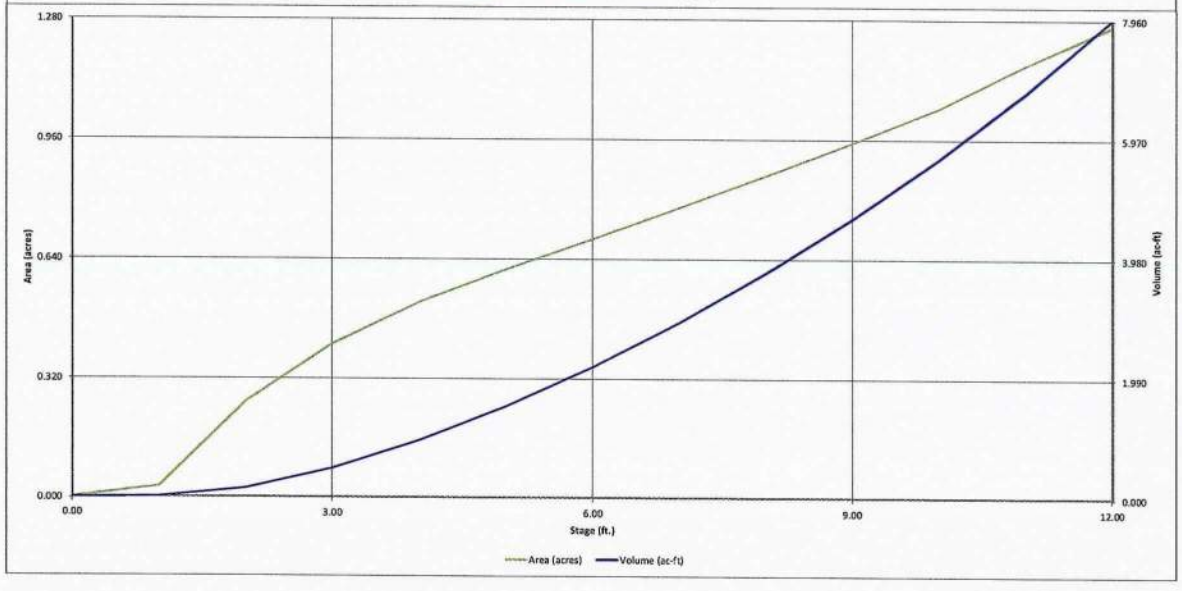
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)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0.000
Volume (ac-ft)
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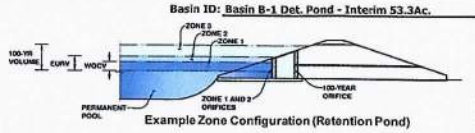
9.00
12.00
Stage (ft.)
Area (acres)
Volume (ac-ft)

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)

Project: Aurora Seam

Basin ID: Basin B-1 Det. Pond - Interim 53.3Ac.



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	53.27	acres
Watershed Length =	2,540	ft
Watershed Length to Centroid =	1,410	ft
Watershed Slope =	0.030	ft/ft
Watershed Imperviousness =	35.50%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	100.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Aurora Reservoir	

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

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	0.744	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	1.741	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 0.84 in.) =	1.139	acre-feet	inches
5-yr Runoff Volume (P1 = 1.13 in.) =	1.950	acre-feet	inches
10-yr Runoff Volume (P1 = 1.39 in.) =	2.945	acre-feet	inches
25-yr Runoff Volume (P1 = 1.77 in.) =	4.841	acre-feet	inches
50-yr Runoff Volume (P1 = 2.08 in.) =	6.239	acre-feet	inches
100-yr Runoff Volume (P1 = 2.42 in.) =	7.996	acre-feet	inches
500-yr Runoff Volume (P1 = 3.3 in.) =	12.083	acre-feet	inches
Approximate 2-yr Detention Volume =	1.068	acre-feet	
Approximate 5-yr Detention Volume =	1.824	acre-feet	
Approximate 10-yr Detention Volume =	2.211	acre-feet	
Approximate 25-yr Detention Volume =	2.732	acre-feet	
Approximate 50-yr Detention Volume =	2.977	acre-feet	
Approximate 100-yr Detention Volume =	3.700	acre-feet	

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.744	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.997	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	2.331	acre-feet
Total Detention Basin Volume =	4.072	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

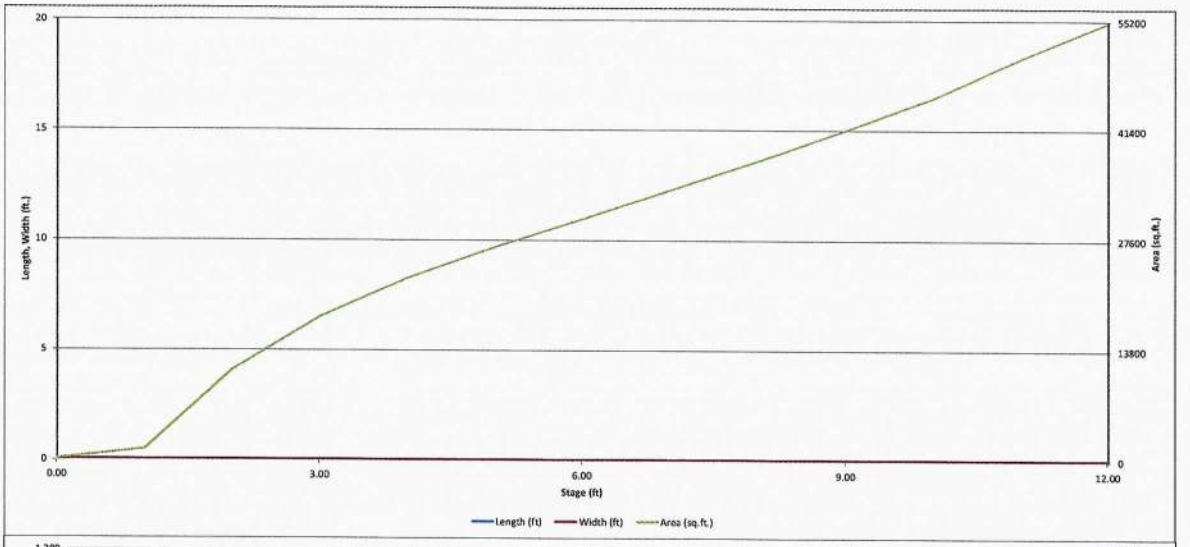
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user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

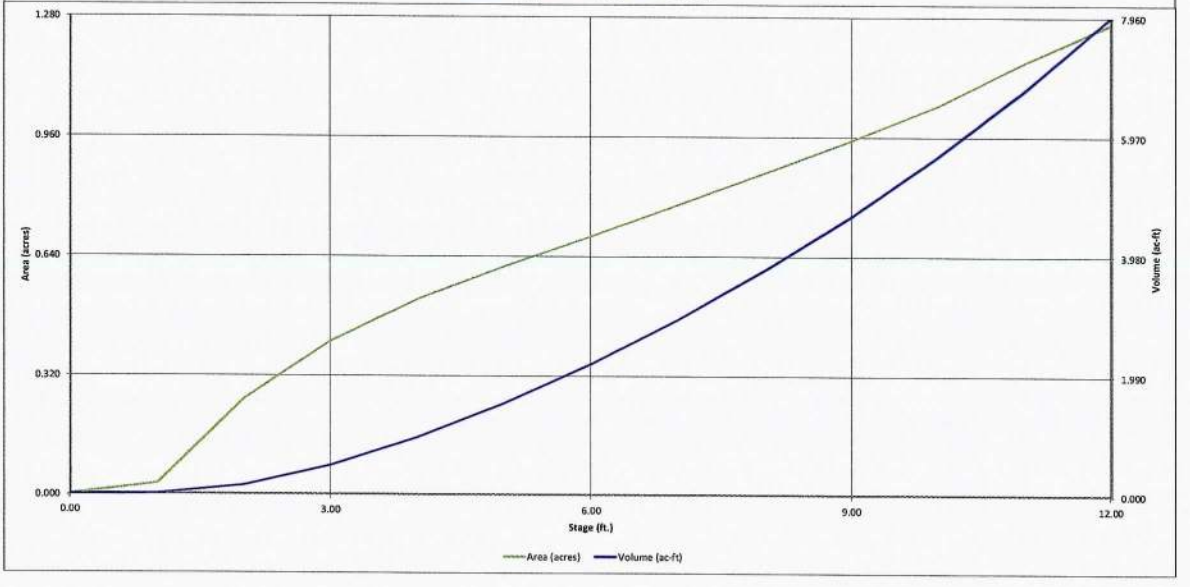
Depth Increment = 0.10 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	80	0.002		
	--	1.00	--	--	--	1,365	0.031	722	0.017
	--	2.00	--	--	--	11,180	0.257	6,995	0.161
	--	3.00	--	--	--	17,901	0.411	21,535	0.494
	--	4.00	--	--	--	22,839	0.524	41,905	0.962
	--	5.00	--	--	--	26,693	0.613	66,671	1.531
	--	6.00	--	--	--	30,225	0.694	95,130	2.184
	--	7.00	--	--	--	33,862	0.777	127,174	2.920
	--	8.00	--	--	--	37,605	0.863	162,907	3.740
	--	9.00	--	--	--	41,453	0.952	202,436	4.647
	--	10.00	--	--	--	45,471	1.044	245,898	5.645
	--	11.00	--	--	--	50,500	1.159	293,884	6.747
	--	12.00	--	--	--	55,000	1.263	346,634	7.958

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)



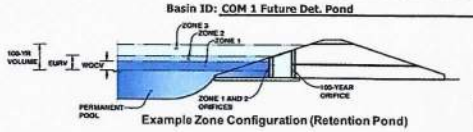


DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)

Project: SEAM Master Drainage

Basin ID: COM 1 Future Det. Pond



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	16.50	acres
Watershed Length =	1,520	ft
Watershed Length to Centroid =	720	ft
Watershed Slope =	0.023	ft/ft
Watershed Imperviousness =	90.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	100.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Aurora Reservoir	

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

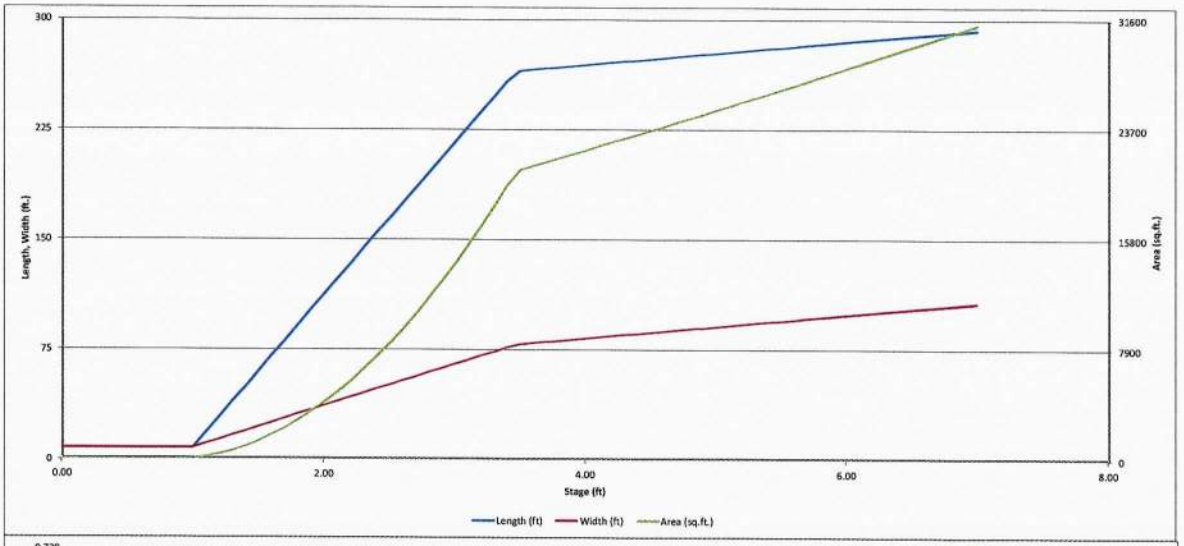
			Optional User Overrides
Water Quality Capture Volume (WQCV) =	0.552	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	1.473	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 0.84 in.) =	0.984	acre-feet	inches
5-yr Runoff Volume (P1 = 1.13 in.) =	1.381	acre-feet	inches
10-yr Runoff Volume (P1 = 1.39 in.) =	1.752	acre-feet	inches
25-yr Runoff Volume (P1 = 1.77 in.) =	2.310	acre-feet	inches
50-yr Runoff Volume (P1 = 2.08 in.) =	2.761	acre-feet	inches
100-yr Runoff Volume (P1 = 2.42 in.) =	3.264	acre-feet	inches
500-yr Runoff Volume (P1 = 3.3 in.) =	4.548	acre-feet	inches
Approximate 2-yr Detention Volume =	0.950	acre-feet	
Approximate 5-yr Detention Volume =	1.348	acre-feet	
Approximate 10-yr Detention Volume =	1.647	acre-feet	
Approximate 25-yr Detention Volume =	1.941	acre-feet	
Approximate 50-yr Detention Volume =	2.070	acre-feet	
Approximate 100-yr Detention Volume =	2.231	acre-feet	

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.552	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.920	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	1.034	acre-feet
Total Detention Basin Volume =	2.507	acre-feet
Initial Surcharge Volume (ISV) =	30	ft^3
Initial Surcharge Depth (ISD) =	0.50	ft
Total Available Detention Depth (H_{total}) =	7.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.010	ft/ft
Slopes of Main Basin Sides (S_{main}) =	4	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	3.5	
Initial Surcharge Area (A_{ISV}) =	60	ft^2
Surcharge Volume Length (L_{ISV}) =	7.7	ft
Surcharge Volume Width (W_{ISV}) =	7.7	ft
Depth of Basin Floor (H_{FLOOR}) =	2.47	ft
Length of Basin Floor (L_{FLOOR}) =	264.6	ft
Width of Basin Floor (W_{FLOOR}) =	78.3	ft
Area of Basin Floor (A_{FLOOR}) =	20,725	ft^2
Volume of Basin Floor (V_{FLOOR}) =	18,031	ft^3
Depth of Main Basin (H_{MAIN}) =	3.53	ft
Length of Main Basin (L_{MAIN}) =	292.9	ft
Width of Main Basin (W_{MAIN}) =	106.6	ft
Area of Main Basin (A_{MAIN}) =	31,207	ft^2
Volume of Main Basin (V_{MAIN}) =	91,031	ft^3
Calculated Total Basin Volume (V_{total}) =	**2.505**	acre-feet

Depth Increment = 0.10 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	0.00		7.7	7.7	60		0.001		
ISV	0.50		7.7	7.7	60		0.001	30	0.001
	0.60		7.7	7.7	60		0.001	36	0.001
	0.70		7.7	7.7	60		0.001	42	0.001
	0.80		7.7	7.7	60		0.001	48	0.001
	0.90		7.7	7.7	60		0.001	54	0.001
	1.00		7.7	7.7	60		0.001	60	0.001
	1.10		18.1	10.6	192		0.004	72	0.002
	1.20		28.5	13.5	384		0.009	100	0.002
	1.30		38.9	16.3	635		0.015	151	0.003
	1.40		49.3	19.2	946		0.022	230	0.005
	1.50		59.7	22.0	1,316		0.030	342	0.008
	1.60		70.1	24.9	1,746		0.040	495	0.011
	1.70		80.5	27.7	2,235		0.051	693	0.016
	1.80		90.9	30.6	2,783		0.064	944	0.022
	1.90		101.3	33.5	3,391		0.078	1,252	0.029
	2.00		111.7	36.3	4,058		0.093	1,624	0.037
	2.10		122.1	39.2	4,785		0.110	2,066	0.047
	2.20		132.5	42.0	5,571		0.128	2,583	0.059
	2.30		142.9	44.9	6,417		0.147	3,182	0.073
	2.40		153.3	47.7	7,322		0.168	3,868	0.089
	2.50		163.7	50.6	8,286		0.190	4,648	0.107
	2.60		174.1	53.5	9,310		0.214	5,527	0.127
	2.70		184.5	56.3	10,393		0.239	6,512	0.149
	2.80		194.9	59.2	11,536		0.265	7,608	0.175
	2.90		205.3	62.0	12,738		0.292	8,821	0.203
	3.00		215.7	64.9	14,000		0.321	10,158	0.233
	3.10		226.1	67.7	15,320		0.352	11,623	0.267
	3.20		236.5	70.6	16,701		0.383	13,224	0.304
	3.30		246.9	73.5	18,141		0.416	14,965	0.344
	3.40		257.3	76.3	19,640		0.451	16,854	0.387
	3.50		264.9	78.6	20,807		0.478	18,889	0.434
	3.60		265.7	79.4	21,083		0.484	20,984	0.482
	3.70		266.5	80.2	21,359		0.490	23,106	0.530
Zone 1 (WQCV)	3.73		266.7	80.4	21,442		0.492	23,748	0.545
	3.80		267.3	81.0	21,637		0.497	25,256	0.580
	3.90		268.1	81.8	21,916		0.503	27,433	0.630
	4.00		268.9	82.6	22,197		0.510	29,639	0.680
	4.10		269.7	83.4	22,479		0.516	31,873	0.732
	4.20		270.5	84.2	22,762		0.523	34,135	0.784
	4.30		271.3	85.0	23,046		0.529	36,425	0.836
	4.40		272.1	85.8	23,332		0.536	38,744	0.889
	4.50		272.9	86.6	23,619		0.542	41,092	0.943
	4.60		273.7	87.4	23,907		0.549	43,468	0.998
	4.70		274.5	88.2	24,196		0.555	45,873	1.053
	4.80		275.3	89.0	24,487		0.562	48,307	1.109
Zone 2 (EURV)	4.85		275.7	89.4	24,633		0.565	49,535	1.137
	4.90		276.1	89.8	24,779		0.569	50,770	1.166
	5.00		276.9	90.6	25,072		0.576	53,263	1.223
	5.10		277.7	91.4	25,367		0.582	55,785	1.281
	5.20		278.5	92.2	25,663		0.589	58,336	1.339
	5.30		279.3	93.0	25,960		0.596	60,917	1.398
	5.40		280.1	93.8	26,258		0.603	63,528	1.458
	5.50		280.9	94.6	26,558		0.610	66,169	1.519
	5.60		281.7	95.4	26,859		0.617	68,840	1.580
	5.70		282.5	96.2	27,161		0.624	71,541	1.642
	5.80		283.3	97.0	27,465		0.631	74,272	1.705
	5.90		284.1	97.8	27,770		0.638	77,034	1.768
	6.00		284.9	98.6	28,076		0.645	79,826	1.833
	6.10		285.7	99.4	28,383		0.652	82,649	1.897
	6.20		286.5	100.2	28,692		0.659	85,503	1.963
	6.30		287.3	101.0	29,002		0.666	88,388	2.029
	6.40		288.1	101.8	29,313		0.673	91,303	2.096
	6.50		288.9	102.6	29,625		0.680	94,250	2.164
	6.60		289.7	103.4	29,939		0.687	97,228	2.232
	6.70		290.5	104.2	30,254		0.695	100,238	2.301
	6.80		291.3	105.0	30,571		0.702	103,279	2.371
	6.90		292.1	105.8	30,888		0.709	106,352	2.442
Floor	7.00		292.9	106.6	31,207		0.716	109,457	2.513
	5.63		281.9	95.6	26,949		0.619	69,647	1.599
	5.73		282.7	96.4	27,252		0.626	72,357	1.661
	5.83		283.5	97.2	27,556		0.633	75,098	1.724
	5.93		284.3	98.0	27,861		0.640	77,868	1.788
	6.03		285.1	98.8	28,168		0.647	80,670	1.852
	6.13		285.9	99.6	28,475		0.654	83,502	1.917
	6.23		286.7	100.4	28,785		0.661	86,365	1.983
	6.33		287.5	101.2	29,095		0.668	89,259	2.049
	6.43		288.3	102.0	29,406		0.675	92,184	2.116
	6.53		289.1	102.8	29,719		0.682	95,140	2.184
	6.63		289.9	103.6	30,034		0.689	98,128	2.253
	6.73		290.7	104.4	30,349		0.697	101,147	2.322
	6.83		291.5	105.2	30,666		0.704	104,198	2.392
	6.93		292.3	106.0	30,984		0.711	107,280	2.463
Floor	7.00		292.9	106.6	31,207		0.716	109,457	2.513
	5.63		281.9	95.6	26,949		0.619	69,647	1.599
	5.73		282.7	96.4	27,252		0.626	72,357	1.661
	5.83		283.5	97.2	27,556		0.633	75,098	1.724
	5.93		284.3	98.0	27,861		0.640	77,868	1.788
	6.03		285.1	98.8	28,168		0.647	80,670	1.852
	6.13		285.9	99.6	28,475		0.654	83,502	1.917
	6.23		286.7	100.4	28,785		0.661	86,365	1.983
	6.33		287.5	101.2	29,095		0.668	89,259	2.049
	6.43		288.3	102.0	29,406		0.675	92,184	2.116
	6.53		289.1	102.8	29,719		0.682	95,140	2.184
	6.63		289.9	103.6	30,034		0.689	98,128	2.253
	6.73		290.7	104.4	30,349		0.697	101,147	2.322
	6.83		291.5	105.2	30,666		0.704	104,198	2.392
	6.93		292.3	106.0	30,984		0.711	107,280	2.463
Floor	7.00		292.9	106.6	31,207		0.716	109,457	2.513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Length, Width (ft.)
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23700
15800
7900
0
Area (sq.ft.)
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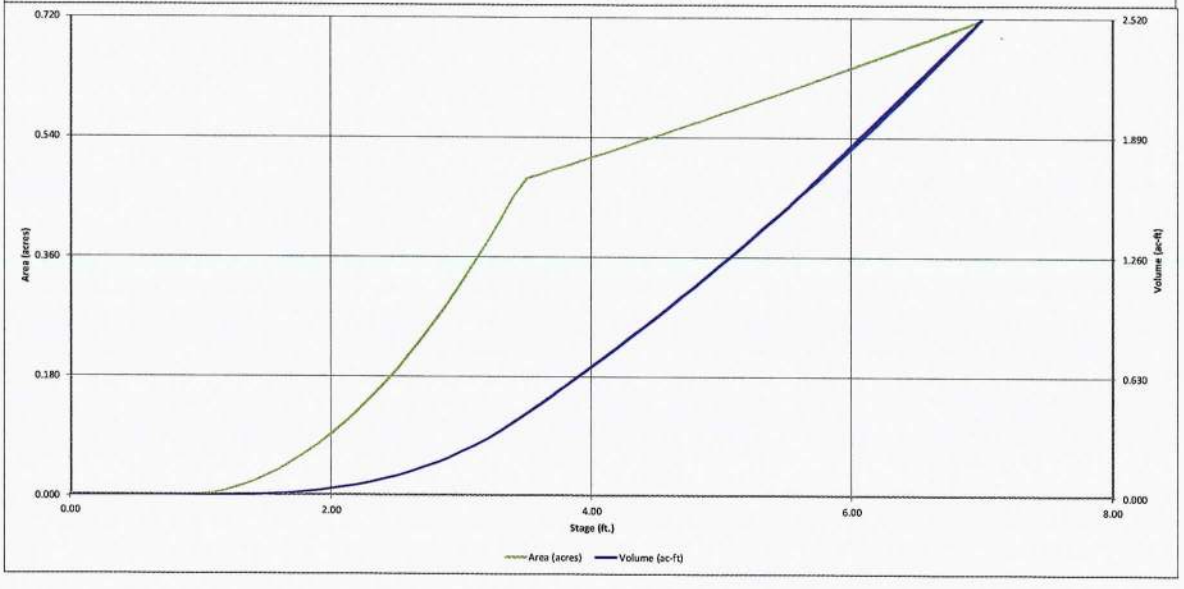
2.00
4.00
6.00
8.00
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)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0.540
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0.180
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Area (acres)
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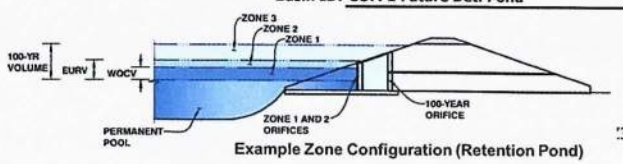
1.890
1.260
0.630
0.000
Volume (ac-ft)
0.00
2.00
4.00
6.00
8.00
Stage (ft.)
Area (acres)
Volume (ac-ft)

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.02 (February 2020)

Project: SEAM Master Drainage

Basin ID: COM 1 Future Det. Pond



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.75	0.552	Orifice Plate
Zone 2 (EURV)	5.43	0.920	Rectangular Orifice
Zone 3 (100+1/2WQCV)	7.00	1.034	Weir&Pipe (Restrict)
Total (all zones)		2.507	

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

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

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 =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	9.861E-03	ft^2
Depth at top of Zone using Orifice Plate =	3.75	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	15.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	1.42	sq. inches (diameter = 1-5/16 inches)	Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.25	2.50					
Orifice Area (sq. inches)	1.42	1.42	1.42					

	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)

	Zone 2 Rectangular	Not Selected		Calculated Parameters for Vertical Orif	Zone 2 Rectangular	Not Selected
Invert of Vertical Orifice =	3.75	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.02	N/A
Depth at top of Zone using Vertical Orifice =	5.43	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.08	N/A
Vertical Orifice Height =	2.00	N/A	inches			
Vertical Orifice Width =	1.56		inches			

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

	Zone 3 Weir	Not Selected		Calculated Parameters for Overflow W	Zone 3 Weir	Not Selected
Overflow Weir Front Edge Height, Ho =	5.43	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	5.43	N/A
Overflow Weir Front Edge Length =	4.00	N/A	feet	Overflow Weir Slope Length =	4.00	N/A
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	8.87	N/A
Horiz. Length of Weir Sides =	4.00	N/A	feet	Overflow Grate Open Area w/o Debris =	11.20	N/A
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	11.20	N/A
Debris Clogging % =	0%	N/A	%			

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

	Zone 3 Restrictor	Not Selected		Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla	Zone 3 Restrictor	Not Selected
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	1.26	N/A
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.57	N/A
Restrictor Plate Height Above Pipe Invert =	12.10		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.92	N/A

User Input: Emergency Spillway (Rectangular or Trapezoidal)

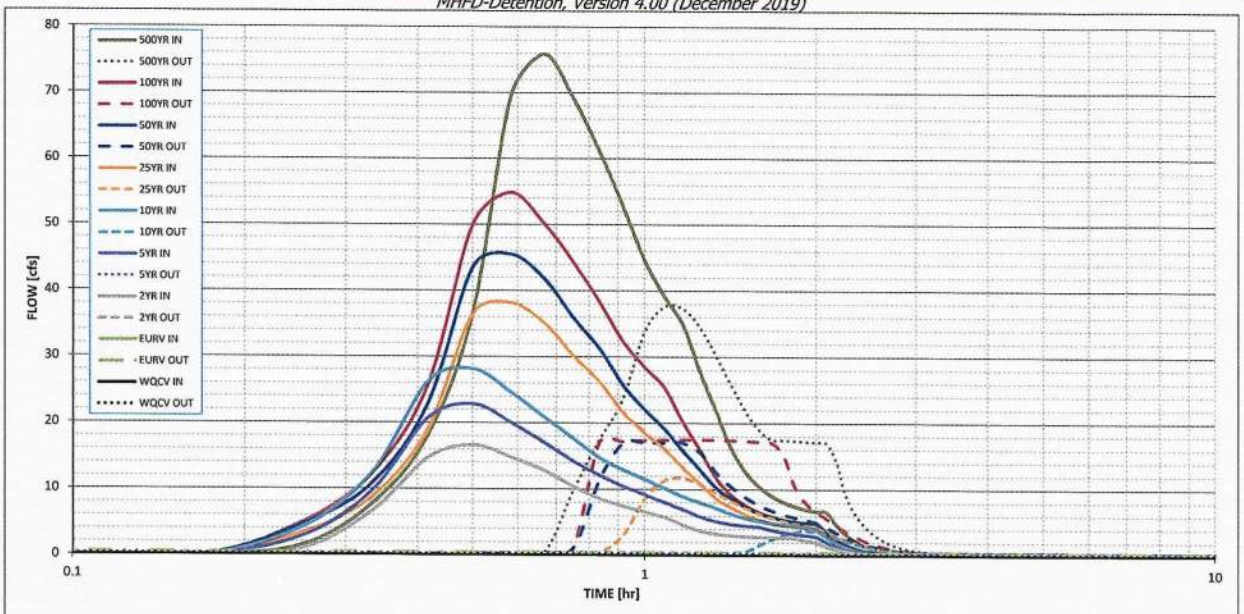
			Calculated Parameters for Spillway		
Spillway Invert Stage=	6.40	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.91	feet
Spillway Crest Length =	18.00	feet	Stage at Top of Freeboard =	8.31	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.82	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	3.52	acre-ft

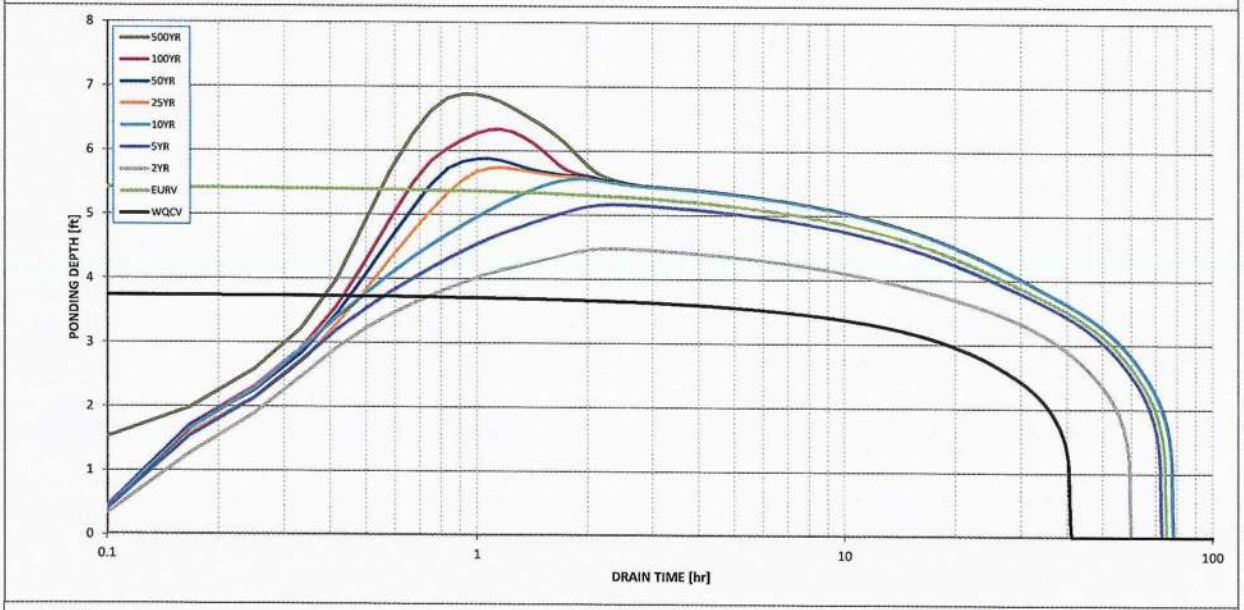
Routed Hydrograph Results — *The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through A*

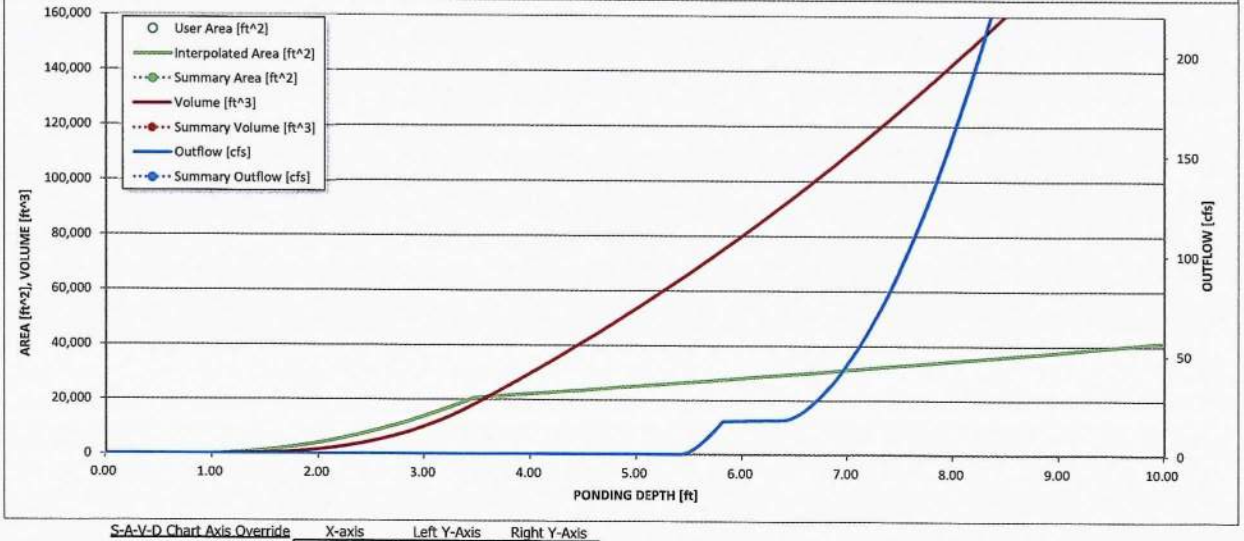
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.84	1.13	1.39	1.77	2.08	2.42
CUHP Runoff Volume (acre-ft) =	0.552	1.473	0.984	1.381	1.752	2.310	2.761	3.264
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.984	1.381	1.752	2.310	2.761	3.264
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.2	1.7	4.4	10.6	14.4	19.4
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.11	0.27	0.64	0.87	1.18
Peak Inflow Q (cfs) =	N/A	N/A	16.6	22.8	28.1	38.1	45.5	54.8
Peak Outflow Q (cfs) =	0.2	0.4	0.3	0.4	3.8	11.6	17.0	17.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.2	0.9	1.1	1.2	0.9
Structure Controlling Flow =	Plate	Overflow Weir 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.3	1.0	1.5	1.5
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	69	55	67	71	69	68	66
Time to Drain 99% of Inflow Volume (hours) =	**40**	72	58	70	75	74	74	73
Maximum Ponding Depth (ft) =	3.75	5.43	4.48	5.16	5.56	5.73	5.87	6.33
Area at Maximum Ponding Depth (acres) =	0.49	0.60	0.54	0.59	0.61	0.62	0.64	0.67
Maximum Volume Stored (acre-ft) =	0.555	1.477	0.927	1.316	1.556	1.655	1.749	2.042

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

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

Time Interval	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.40
	0:15:00	0.00	0.00	0.93	2.74	4.07	3.21	4.54	4.73	7.74
	0:20:00	0.00	0.00	6.61	9.69	12.44	8.70	10.82	12.28	18.06
	0:25:00	0.00	0.00	14.67	20.65	26.19	18.94	22.92	25.54	36.58
	0:30:00	0.00	0.00	16.64	22.78	28.10	36.37	43.61	49.91	69.49
	0:35:00	0.00	0.00	14.81	19.99	24.53	38.12	45.49	54.84	75.87
	0:40:00	0.00	0.00	12.83	16.99	20.82	35.11	41.78	50.17	69.33
	0:45:00	0.00	0.00	10.44	14.19	17.59	30.17	35.90	44.39	61.28
	0:50:00	0.00	0.00	8.62	12.06	14.69	26.24	31.19	38.36	52.91
	0:55:00	0.00	0.00	7.47	10.42	12.87	21.62	25.69	32.40	44.68
	1:00:00	0.00	0.00	6.61	9.16	11.46	18.51	21.99	28.45	39.20
	1:05:00	0.00	0.00	5.80	7.99	10.10	16.04	19.05	25.35	34.93
	1:10:00	0.00	0.00	4.66	6.92	8.87	13.23	15.72	20.19	27.85
	1:15:00	0.00	0.00	3.77	5.84	7.95	10.83	12.88	15.92	21.99
	1:20:00	0.00	0.00	3.30	5.14	7.13	8.57	10.19	11.78	16.30
	1:25:00	0.00	0.00	3.06	4.75	6.26	7.27	8.64	9.19	12.74
	1:30:00	0.00	0.00	2.91	4.49	5.64	6.14	7.30	7.59	10.52
	1:35:00	0.00	0.00	2.83	4.32	5.20	5.41	6.43	6.56	9.10
	1:40:00	0.00	0.00	2.78	3.84	4.90	4.89	5.81	5.85	8.11
	1:45:00	0.00	0.00	2.73	3.49	4.69	4.57	5.43	5.38	7.46
	1:50:00	0.00	0.00	2.70	3.24	4.54	4.33	5.15	5.04	6.99
	1:55:00	0.00	0.00	2.32	3.05	4.29	4.18	4.97	4.83	6.71
	2:00:00	0.00	0.00	2.03	2.82	3.85	4.09	4.86	4.76	6.60
	2:05:00	0.00	0.00	1.46	2.02	2.74	2.93	3.48	3.43	4.75
	2:10:00	0.00	0.00	1.01	1.41	1.91	2.05	2.44	2.41	3.35
	2:15:00	0.00	0.00	0.70	0.97	1.33	1.43	1.69	1.69	2.34
	2:20:00	0.00	0.00	0.47	0.64	0.90	0.97	1.15	1.15	1.59
	2:25:00	0.00	0.00	0.30	0.41	0.59	0.64	0.76	0.76	1.05
	2:30:00	0.00	0.00	0.19	0.27	0.38	0.43	0.51	0.50	0.70
	2:35:00	0.00	0.00	0.10	0.16	0.22	0.26	0.30	0.30	0.42
	2:40:00	0.00	0.00	0.04	0.08	0.10	0.13	0.15	0.15	0.21
	2:45:00	0.00	0.00	0.02	0.03	0.03	0.04	0.05	0.05	0.07
	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

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.02 (February 2020)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.
The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft²]	Area [acres]	Volume [ft³]	Volume [ac-ft]	Total Outflow [cfs]

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

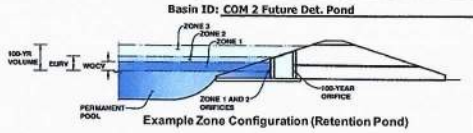
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)

Project: SEAM Master Drainage

Basin ID: COM 2 Future Det. Pond



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	21.30	acres
Watershed Length =	1,950	ft
Watershed Length to Centroid =	855	ft
Watershed Slope =	0.022	ft/ft
Watershed Imperviousness =	90.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	100.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Aurora Reservoir	

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

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	0.713	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	1.901	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 0.84 in.) =	1.293	acre-feet	inches
5-yr Runoff Volume (P1 = 1.13 in.) =	1.815	acre-feet	inches
10-yr Runoff Volume (P1 = 1.39 in.) =	2.303	acre-feet	inches
25-yr Runoff Volume (P1 = 1.77 in.) =	3.036	acre-feet	inches
50-yr Runoff Volume (P1 = 2.08 in.) =	3.629	acre-feet	inches
100-yr Runoff Volume (P1 = 2.42 in.) =	4.290	acre-feet	inches
500-yr Runoff Volume (P1 = 3.3 in.) =	5.977	acre-feet	inches
Approximate 2-yr Detention Volume =	1.227	acre-feet	
Approximate 5-yr Detention Volume =	1.740	acre-feet	
Approximate 10-yr Detention Volume =	2.127	acre-feet	
Approximate 25-yr Detention Volume =	2.506	acre-feet	
Approximate 50-yr Detention Volume =	2.673	acre-feet	
Approximate 100-yr Detention Volume =	2.880	acre-feet	

Define Zones and Basin Geometry

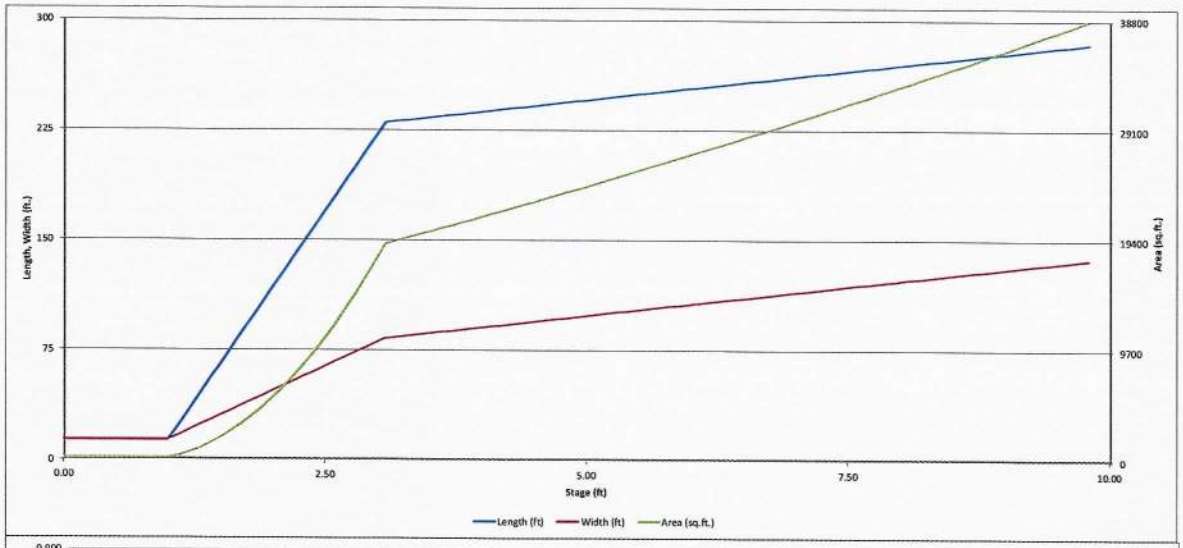
Zone 1 Volume (WQCV) =	0.713	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.188	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	1.335	acre-feet
Total Detention Basin Volume =	3.236	acre-feet
Initial Surcharge Volume (ISV) =	93	ft^3
Initial Surcharge Depth (ISD) =	0.50	ft
Total Available Detention Depth (H_{total}) =	8.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.010	ft/ft
Slopes of Main Basin Sides (S_{main}) =	4	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	3	
Initial Surcharge Area (A_{ISV}) =	186	ft^2
Surcharge Volume Length (L_{ISV}) =	13.6	ft
Surcharge Volume Width (W_{ISV}) =	13.6	ft
Depth of Basin Floor (H_{FLOOR}) =	2.08	ft
Length of Basin Floor (L_{FLOOR}) =	230.0	ft
Width of Basin Floor (W_{FLOOR}) =	83.0	ft
Area of Basin Floor (A_{FLOOR}) =	19,083	ft^2
Volume of Basin Floor (V_{FLOOR}) =	14,667	ft^3
Depth of Main Basin (H_{MAIN}) =	4.92	ft
Length of Main Basin (L_{MAIN}) =	269.3	ft
Width of Main Basin (W_{MAIN}) =	122.3	ft
Area of Main Basin (A_{MAIN}) =	32,950	ft^2
Volume of Main Basin (V_{MAIN}) =	126,457	ft^3
Calculated Total Basin Volume (V_{total}) =	**3.244**	acre-feet

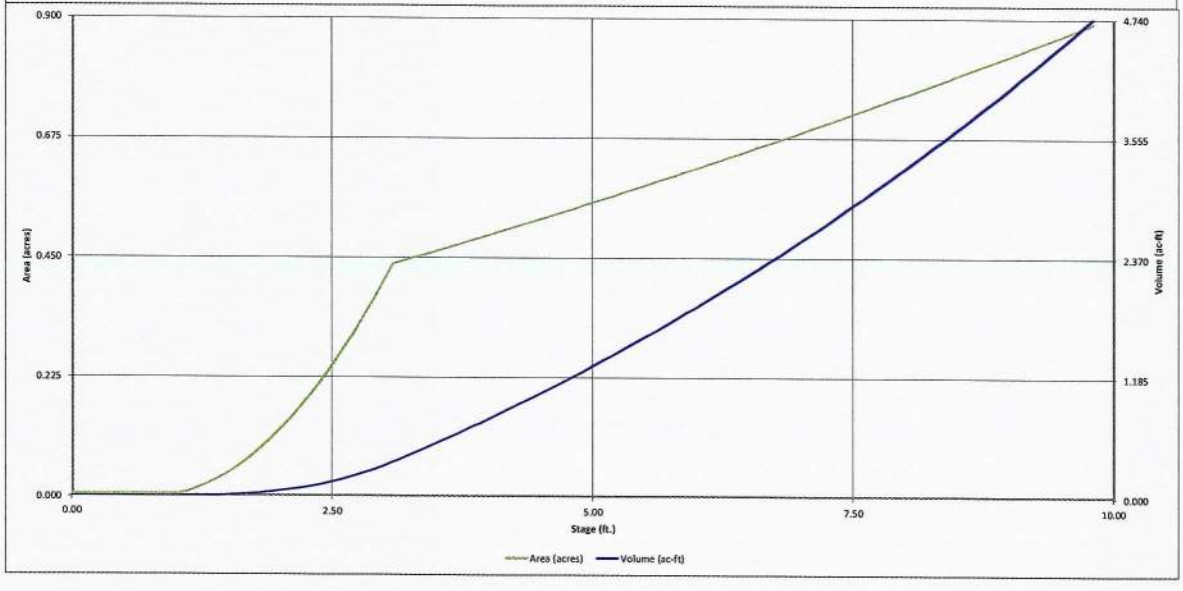
Depth Increment = 0.10 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	0.00		13.6	13.6	186		0.004		
ISV	0.50		13.6	13.6	186		0.004	93	0.002
	0.60		13.6	13.6	186		0.004	112	0.003
	0.70		13.6	13.6	186		0.004	130	0.003
	0.80		13.6	13.6	186		0.004	149	0.003
	0.90		13.6	13.6	186		0.004	168	0.004
	1.00		13.6	13.6	186		0.004	186	0.004
	1.10		24.0	17.0	408		0.009	215	0.005
	1.20		34.4	20.3	700		0.016	270	0.006
	1.30		44.8	23.6	1,061		0.024	358	0.008
	1.40		55.2	27.0	1,491		0.034	485	0.011
	1.50		65.6	30.3	1,990		0.046	658	0.015
	1.60		76.0	33.6	2,559		0.059	885	0.020
	1.70		86.4	37.0	3,197		0.073	1,172	0.027
	1.80		96.8	40.3	3,904		0.090	1,527	0.035
	1.90		107.2	43.6	4,681		0.107	1,955	0.045
	2.00		117.6	47.0	5,527		0.127	2,465	0.057
	2.10		128.0	50.3	6,443		0.148	3,063	0.070
	2.20		138.4	53.6	7,427		0.171	3,756	0.086
	2.30		148.8	57.0	8,481		0.195	4,551	0.104
	2.40		159.2	60.3	9,605		0.220	5,455	0.125
	2.50		169.6	63.6	10,798		0.248	6,474	0.149
	2.60		180.0	67.0	12,060		0.277	7,616	0.175
	2.70		190.4	70.3	13,391		0.307	8,888	0.204
	2.80		200.8	73.6	14,792		0.340	10,297	0.236
	2.90		211.2	77.0	16,262		0.373	11,849	0.272
	3.00		221.6	80.3	17,801		0.409	13,552	0.311
Floor	3.08		230.0	83.0	19,083		0.438	15,027	0.345
	3.10		230.1	83.1	19,133		0.439	15,409	0.354
	3.20		230.9	83.9	19,384		0.445	17,335	0.398
	3.30		231.7	84.7	19,637		0.451	19,286	0.443
	3.40		232.5	85.5	19,891		0.457	21,262	0.488
	3.50		233.3	86.3	20,146		0.462	23,264	0.534
	3.60		234.1	87.1	20,402		0.468	25,291	0.581
	3.70		234.9	87.9	20,660		0.474	27,345	0.628
	3.80		235.7	88.7	20,919		0.480	29,423	0.675
Zone 1 (WQCV)	3.88		236.4	89.4	21,127		0.485	31,105	0.714
	3.90		236.5	89.5	21,179		0.486	31,528	0.724
	4.00		237.3	90.3	21,440		0.492	33,659	0.773
	4.10		238.1	91.1	21,703		0.498	35,816	0.822
	4.20		238.9	91.9	21,967		0.504	38,000	0.872
	4.30		239.7	92.7	22,233		0.510	40,210	0.923
	4.40		240.5	93.5	22,499		0.517	42,446	0.974
	4.50		241.3	94.3	22,767		0.523	44,710	1.026
	4.60		242.1	95.1	23,036		0.529	47,000	1.079
	4.70		242.9	95.9	23,307		0.535	49,317	1.132
	4.80		243.7	96.7	23,578		0.541	51,661	1.186
	4.90		244.5	97.5	23,851		0.548	54,033	1.240
	5.00		245.3	98.3	24,126		0.554	56,432	1.295
	5.10		246.1	99.1	24,401		0.560	58,858	1.351
	5.20		246.9	99.9	24,678		0.567	61,312	1.408
	5.30		247.7	100.7	24,956		0.573	63,794	1.465
	5.40		248.5	101.5	25,236		0.579	66,303	1.522
	5.50		249.3	102.3	25,516		0.586	68,841	1.580
	5.60		250.1	103.1	25,798		0.592	71,407	1.639
	5.70		250.9	103.9	26,082		0.599	74,001	1.699
	5.80		251.7	104.7	26,366		0.605	76,623	1.759
	5.90		252.5	105.5	26,652		0.612	79,274	1.820
	6.00		253.3	106.3	26,939		0.618	81,953	1.881
Zone 2 (EURV)	6.04		253.6	106.7	27,054		0.621	83,033	1.906
	6.10		254.1	107.1	27,227		0.625	84,662	1.944
	6.20		254.9	107.9	27,517		0.632	87,399	2.006
	6.30		255.7	108.7	27,808		0.638	90,165	2.070
	6.40		256.5	109.5	28,100		0.645	92,961	2.134
	6.50		257.3	110.3	28,394		0.652	95,785	2.199
	6.60		258.1	111.1	28,689		0.659	98,639	2.264
	6.70		258.9	111.9	28,985		0.665	101,523	2.331
	6.80		259.7	112.7	29,282		0.672	104,436	2.398
	6.90		260.5	113.5	29,581		0.679	107,379	2.465
	7.00		261.3	114.3	29,880		0.686	110,353	2.533
	7.10		262.1	115.1	30,182		0.693	113,356	2.602
	7.20		262.9	115.9	30,484		0.700	116,389	2.672
	7.30		263.7	116.7	30,788		0.707	119,452	2.742
	7.40		264.5	117.5	31,093		0.714	122,546	2.813
	7.50		265.3	118.3	31,399		0.721	125,671	2.885
	7.60		266.1	119.1	31,707		0.728	128,826	2.957
	7.70		266.9	119.9	32,016		0.735	132,012	3.031
	7.80		267.7	120.7	32,326		0.742	135,229	3.104
	7.90		268.5	121.5	32,637		0.749	138,478	3.179
Z3 (100+1/2WQCV	7.98		269.2	122.2	32,887		0.755	141,099	3.239
	8.00		269.3	122.3	32,950		0.756	141,757	3.254
	8.10		270.1	123.1	33,264		0.764	145,068	3.330
	8.20		270.9	123.9	33,579		0.771	148,410	3.407
	8.30		271.7	124.7	33,896		0.778	151,783	3.484
	8.40		272.5	125.5	34,213		0.785	155,189	3.563
	8.50		273.3	126.3	34,532		0.793	158,626	3.642
	8.60		274.1	127.1	34,853		0.800	162,095	3.721
	8.70		274.9	127.9	35,174		0.807	165,597	3.802
	8.80		275.7	128.7	35,497		0.815	169,130	3.883
	8.90		276.5	129.5	35,822		0.822	172,696	3.965
	9.00		277.3	130.3	36,147		0.830	176,295	4.047
	9.10		278.1	131.1	36,474		0.837	179,926	4.131
	9.20		278.9	131.9	36,802		0.845	183,590	4.215
	9.30		279.7	132.7	37,131		0.852	187,286	4.300
	9.40		280.5	133.5	37,462		0.860	191,016	4.385
	9.50		281.3	134.3	37,794		0.868	194,779	4.472
	9.60		282.1	135.1	38,127		0.875	198,575	4.559
	9.70		282.9	135.9	38,461		0.883	202,404	4.647
	9.80		283.7	136.7	38,797		0.891	206,267	4.735

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)



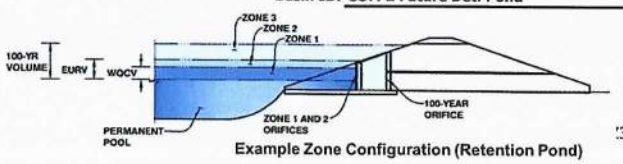


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.02 (February 2020)

Project: SEAM Master Drainage

Basin ID: COM 2 Future Det. Pond



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.88	0.713	Orifice Plate
Zone 2 (EURV)	6.04	1.188	Rectangular Orifice
Zone 3 (100+1/2WQCV)	7.98	1.335	Weir&Pipe (Restrict)
Total (all zones)		3.236	

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

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

Calculated Parameters for Underdrain

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	1.313E-02 ft²
Depth at top of Zone using Orifice Plate =	3.88	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A feet
Orifice Plate: Orifice Vertical Spacing =	15.50	inches	Elliptical Slot Centroid =	N/A feet
Orifice Plate: Orifice Area per Row =	1.89	sq. inches (diameter = 1-9/16 inches)	Elliptical Slot Area =	N/A ft²

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.29	2.59					
Orifice Area (sq. inches)	1.89	1.89	1.89					

	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)

	Zone 2 Rectangular	Not Selected			Calculated Parameters for Vertical Orif: Zone 2 Rectangular	Not Selected
Invert of Vertical Orifice =	3.88	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.02	N/A
Depth at top of Zone using Vertical Orifice =	6.04	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.08	N/A
Vertical Orifice Height =	2.00	N/A	inches			
Vertical Orifice Width =	1.25		inches			

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

	Zone 3 Weir	Not Selected			Calculated Parameters for Overflow W: Zone 3 Weir	Not Selected
Overflow Weir Front Edge Height, Ho =	6.04	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	6.04	N/A
Overflow Weir Front Edge Length =	4.00	N/A	feet	Overflow Weir Slope Length =	4.00	N/A
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	7.70	N/A
Horiz. Length of Weir Sides =	4.00	N/A	feet	Overflow Grate Open Area w/o Debris =	11.20	N/A
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	11.20	N/A
Debris Clogging % =	0%	N/A	%			

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

	Zone 3 Restrictor	Not Selected			Calculated Parameters for Outlet Pipe w/ Flow Restriction Pl: Zone 3 Restrictor	Not Selected
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	1.45	N/A
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.63	N/A
Restrictor Plate Height Above Pipe Invert =	13.80		inches	Half-Central Angle of Restrictor Plate on Pipe =	2.13	N/A

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.30	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.72 feet
Spillway Crest Length =	35.00	feet	Stage at Top of Freeboard =	9.02 feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.83 acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	4.06 acre-ft

Calculated Parameters for Spillway

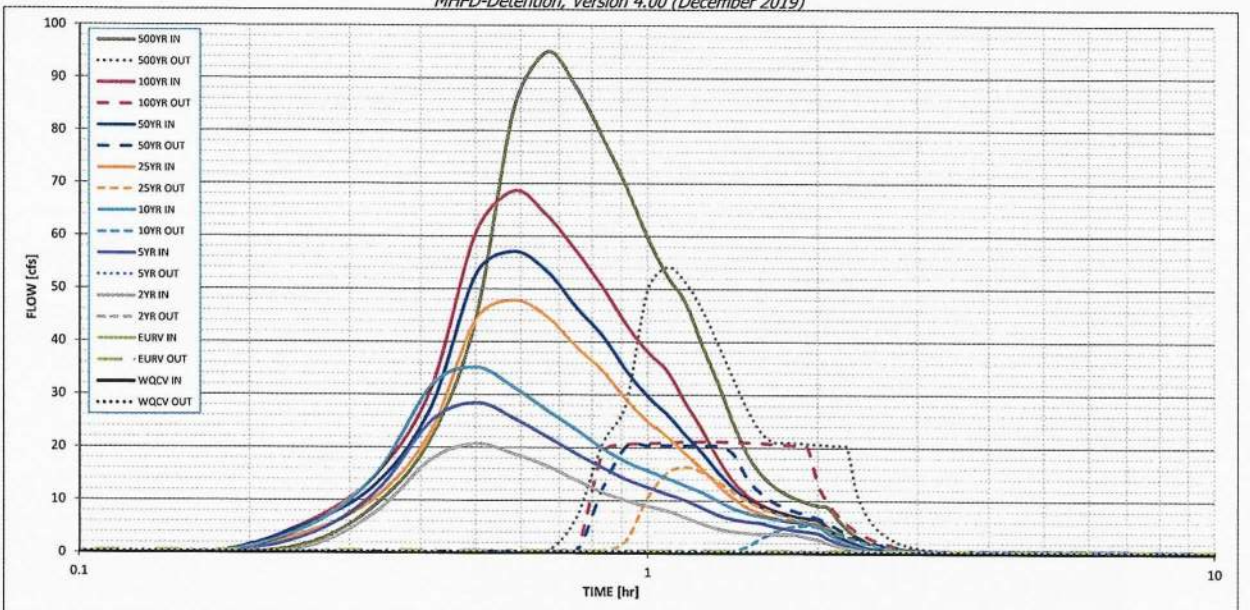
Routed Hydrograph Results

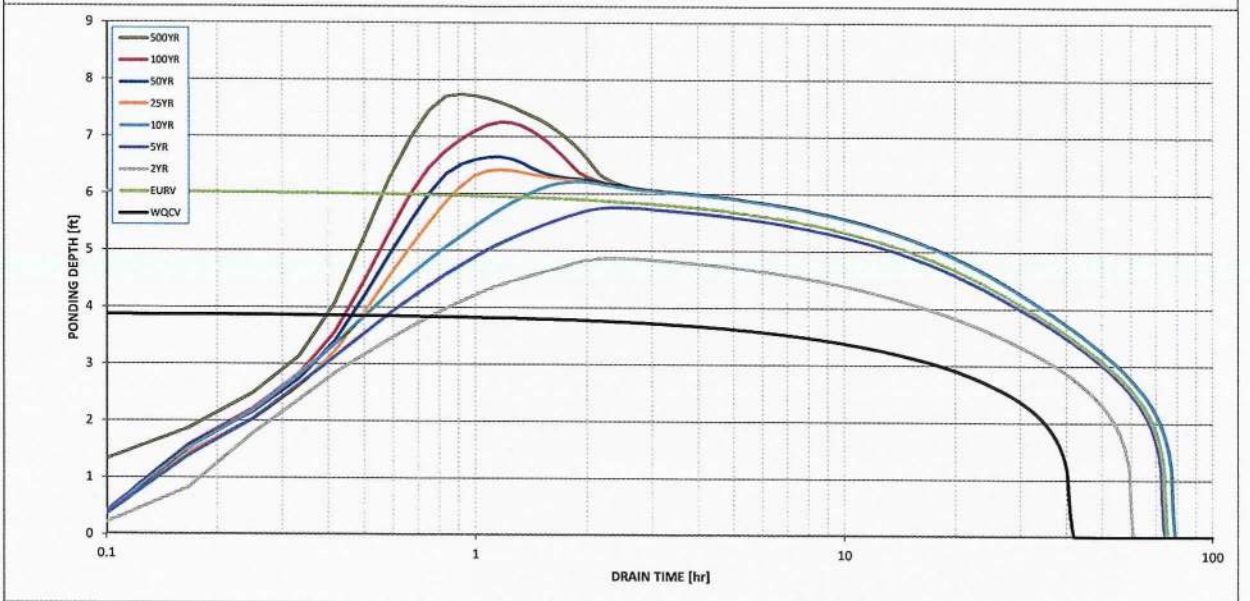
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through A

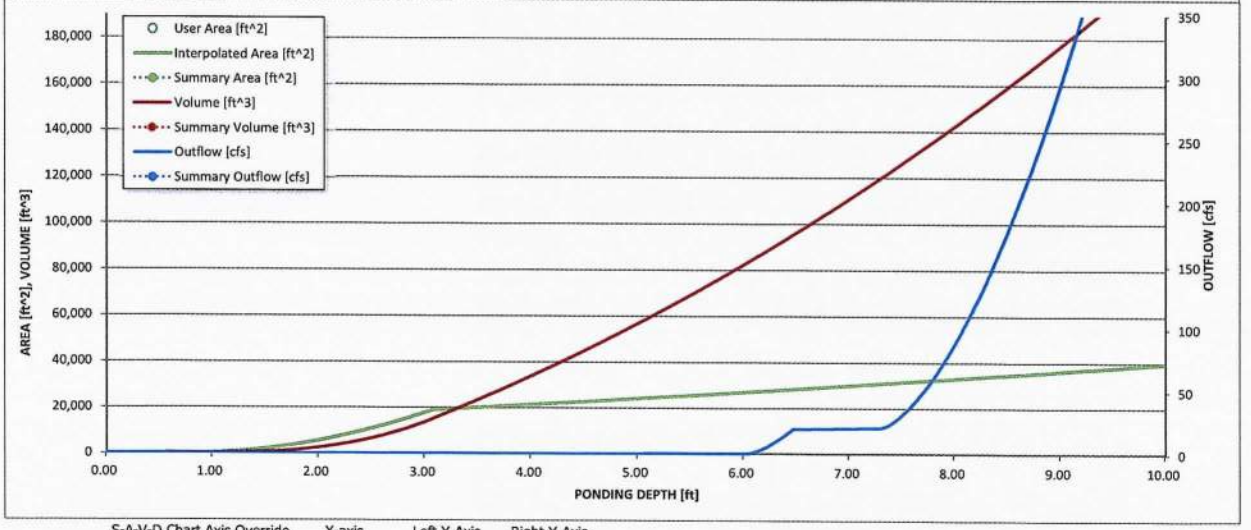
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.84	1.13	1.39	1.77	2.08	2.42
CUHP Runoff Volume (acre-ft) =	0.713	1.901	1.293	1.815	2.303	3.036	3.629	4.290
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	1.293	1.815	2.303	3.036	3.629	4.290
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.2	2.1	5.2	12.8	17.4	23.5
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.10	0.24	0.60	0.82	1.10
Peak Inflow Q (cfs) =	N/A	N/A	20.7	28.4	35.1	47.8	57.1	68.6
Peak Outflow Q (cfs) =	0.3	0.5	0.4	0.5	5.3	16.3	20.4	21.1
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.2	1.0	1.3	1.2	0.9
Structure Controlling Flow =	Plate	Overflow Weir 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.4	1.4	1.8	1.8
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	68	56	67	71	69	68	66
Time to Drain 99% of Inflow Volume (hours) =	**40**	72	58	71	75	74	74	73
Maximum Ponding Depth (ft) =	3.88	6.04	4.87	5.75	6.21	6.41	6.64	7.25
Area at Maximum Ponding Depth (acres) =	0.49	0.62	0.55	0.60	0.63	0.65	0.66	0.70
Maximum Volume Stored (acre-ft) =	0.714	1.906	1.219	1.729	2.006	2.141	2.291	2.700

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

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

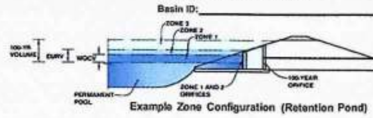
Time Interval	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.63
	0:15:00	0.00	0.00	1.08	3.18	4.73	3.73	5.28	5.50	9.12
	0:20:00	0.00	0.00	7.77	11.51	14.84	10.41	13.00	14.71	21.72
	0:25:00	0.00	0.00	17.66	24.90	31.60	22.82	27.65	30.83	44.21
	0:30:00	0.00	0.00	20.71	28.42	35.12	44.05	52.84	60.41	84.25
	0:35:00	0.00	0.00	18.81	25.46	31.27	47.82	57.10	68.57	94.98
	0:40:00	0.00	0.00	16.52	21.96	26.94	44.69	53.22	63.91	88.35
	0:45:00	0.00	0.00	13.84	18.79	23.27	39.03	46.44	57.20	79.03
	0:50:00	0.00	0.00	11.61	16.20	19.79	34.56	41.10	50.44	69.64
	0:55:00	0.00	0.00	10.04	14.00	17.27	29.09	34.59	43.40	59.90
	1:00:00	0.00	0.00	8.99	12.48	15.60	24.96	29.68	38.15	52.65
	1:05:00	0.00	0.00	8.12	11.22	14.18	22.06	26.22	34.52	47.59
	1:10:00	0.00	0.00	6.85	10.02	12.77	18.80	22.34	28.59	39.44
	1:15:00	0.00	0.00	5.66	8.58	11.47	15.90	18.91	23.35	32.24
	1:20:00	0.00	0.00	4.74	7.24	9.90	12.88	15.30	17.99	24.84
	1:25:00	0.00	0.00	4.21	6.46	8.52	10.50	12.46	13.72	18.96
	1:30:00	0.00	0.00	3.94	6.05	7.63	8.70	10.33	11.01	15.24
	1:35:00	0.00	0.00	3.78	5.78	7.03	7.52	8.94	9.35	12.96
	1:40:00	0.00	0.00	3.70	5.19	6.60	6.76	8.04	8.25	11.44
	1:45:00	0.00	0.00	3.63	4.71	6.30	6.23	7.41	7.49	10.39
	1:50:00	0.00	0.00	3.58	4.37	6.08	5.88	6.99	6.97	9.66
	1:55:00	0.00	0.00	3.12	4.12	5.76	5.64	6.70	6.59	9.14
	2:00:00	0.00	0.00	2.74	3.81	5.21	5.47	6.49	6.35	8.81
	2:05:00	0.00	0.00	2.04	2.83	3.85	4.09	4.85	4.75	6.59
	2:10:00	0.00	0.00	1.47	2.03	2.75	2.92	3.47	3.41	4.72
	2:15:00	0.00	0.00	1.05	1.45	1.97	2.10	2.49	2.46	3.42
	2:20:00	0.00	0.00	0.75	1.02	1.40	1.49	1.77	1.76	2.44
	2:25:00	0.00	0.00	0.51	0.69	0.97	1.03	1.23	1.22	1.70
	2:30:00	0.00	0.00	0.34	0.47	0.66	0.71	0.85	0.85	1.17
	2:35:00	0.00	0.00	0.22	0.31	0.44	0.48	0.57	0.57	0.79
	2:40:00	0.00	0.00	0.12	0.19	0.26	0.30	0.35	0.35	0.48
	2:45:00	0.00	0.00	0.06	0.10	0.13	0.15	0.18	0.18	0.25
	2:50:00	0.00	0.00	0.02	0.03	0.04	0.06	0.07	0.07	0.09
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
	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

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: 1 Pond for Commercial

Basin ID:



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	41.35	acres
Watershed Length =	1,676	ft
Watershed Slope =	0.026	ft/ft
Watershed Imperviousness =	36.70%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	100.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Aurora Reservoir	
Water Quality Capture Volume (WQCV) =	0.589	acre-feet
Excess Urban Runoff Volume (EURV) =	1.401	acre-feet
2-yr Runoff Volume (P1 = 0.84 in.) =	0.919	acre-feet
5-yr Runoff Volume (P1 = 1.13 in.) =	1.546	acre-feet
10-yr Runoff Volume (P1 = 1.39 in.) =	2.230	acre-feet
25-yr Runoff Volume (P1 = 1.77 in.) =	3.700	acre-feet
50-yr Runoff Volume (P1 = 2.08 in.) =	4.783	acre-feet
100-yr Runoff Volume (P1 = 2.42 in.) =	6.172	acre-feet
500-yr Runoff Volume (P1 = 3.3 in.) =	9.330	acre-feet
Approximate 2-yr Detention Volume =	0.861	acre-feet
Approximate 5-yr Detention Volume =	1.450	acre-feet
Approximate 10-yr Detention Volume =	1.766	acre-feet
Approximate 25-yr Detention Volume =	2.177	acre-feet
Approximate 50-yr Detention Volume =	2.371	acre-feet
Approximate 100-yr Detention Volume =	2.932	acre-feet

Optional User Override 1-hr Precipitation

	inches
	inches
	inches
	inches
	inches
	inches
	inches

Stage-Storage Calculation

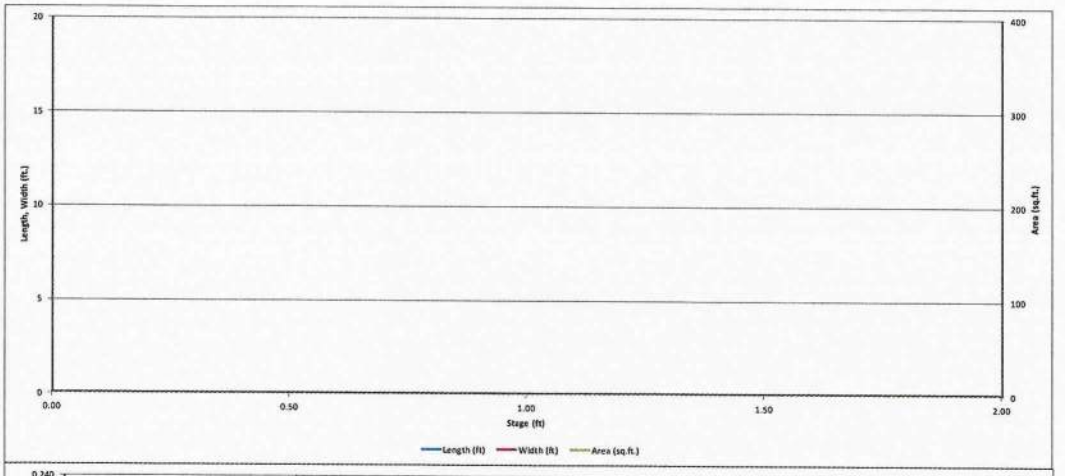
Zone 1 Volume (WQCV) =	0.589	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.811	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.532	acre-feet
Total Detention Basin Volume =	2.932	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	user	acre-feet

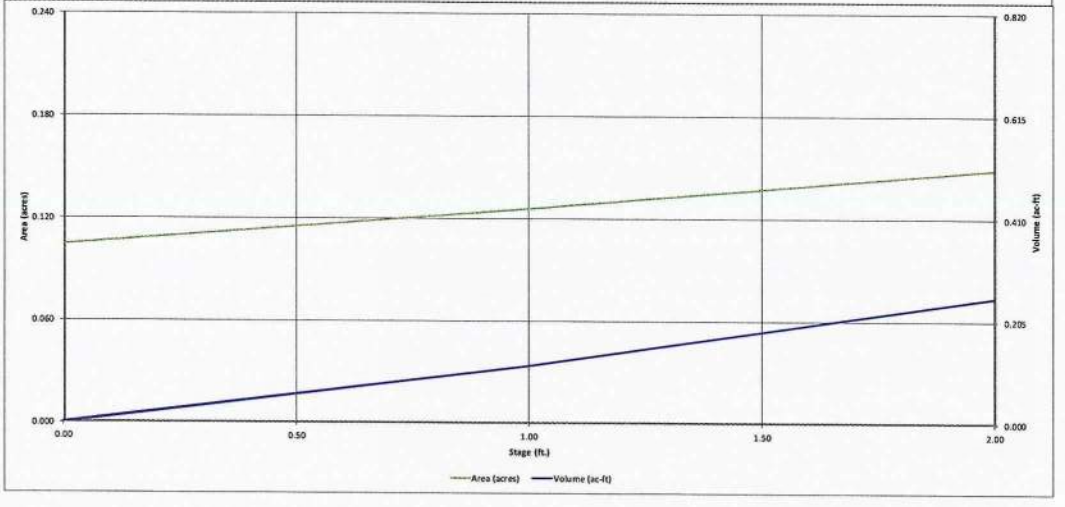
Depth Increment = 1 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	4,549	0.104		
	--	1.00	--	--	--	5,467	0.126	4,953	0.114
	--	2.00	--	--	--	6,478	0.149	10,916	0.251
	--	3.00	--	--	--	7,591	0.174	18,015	0.414
	--	4.00	--	--	--	8,764	0.201	26,192	0.601
	--	5.00	--	--	--	9,934	0.228	35,541	0.816

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



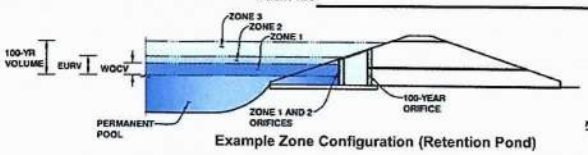


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: _____

Basin ID: _____



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.94	0.589	
Zone 2 (EURV)		0.811	
Zone 3 (100-year)		1.532	
		2.932	Total

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

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

Underdrain Orifice Diameter = _____ inches

Calculated Parameters for Underdrain

Underdrain Orifice Area = _____ ft^2

Underdrain Orifice Centroid = _____ feet

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

Invert of Lowest Orifice = _____ ft (relative to basin bottom at Stage = 0 ft)

Depth at top of Zone using Orifice Plate = _____ ft (relative to basin bottom at Stage = 0 ft)

Orifice Plate: Orifice Vertical Spacing = _____ inches

Orifice Plate: Orifice Area per Row = _____ inches

Calculated Parameters for Plate

WQ Orifice Area per Row = N/A ft^2

Elliptical Half-Width = N/A feet

Elliptical Slot Centroid = N/A feet

Elliptical Slot Area = N/A ft^2

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

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

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

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =			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

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =			ft^2
Vertical Orifice Centroid =			feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =			ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =			feet
Overflow Weir Slope =			H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =			feet
Overflow Grate Open Area % =			%, grate open area/total area
Debris Clogging % =			%

Calculated Parameters for Overflow Weir

	Not Selected	Not Selected	
Height of Grate Upper Edge, H_t =			feet
Over Flow Weir Slope Length =			feet
Grate Open Area / 100-yr Orifice Area =			should be ≥ 4
Overflow Grate Open Area w/o Debris =			ft^2
Overflow Grate Open Area w/ Debris =			ft^2

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

	Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =			ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter =			inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Not Selected	Not Selected	
Outlet Orifice Area =			ft^2
Outlet Orifice Centroid =			feet
Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	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

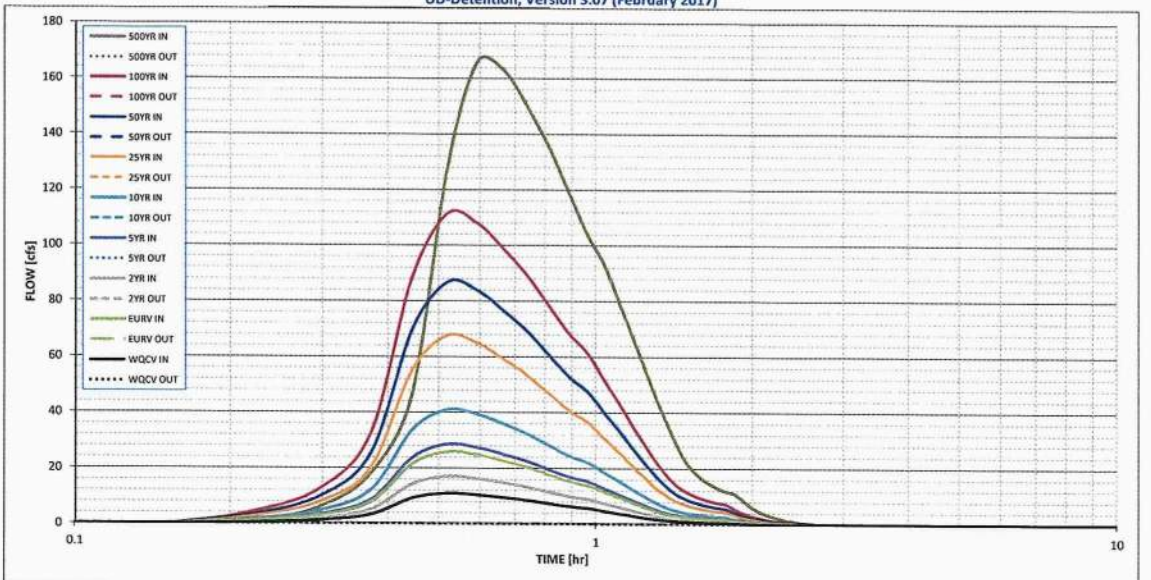
Basin Area at Top of Freeboard = _____ acres

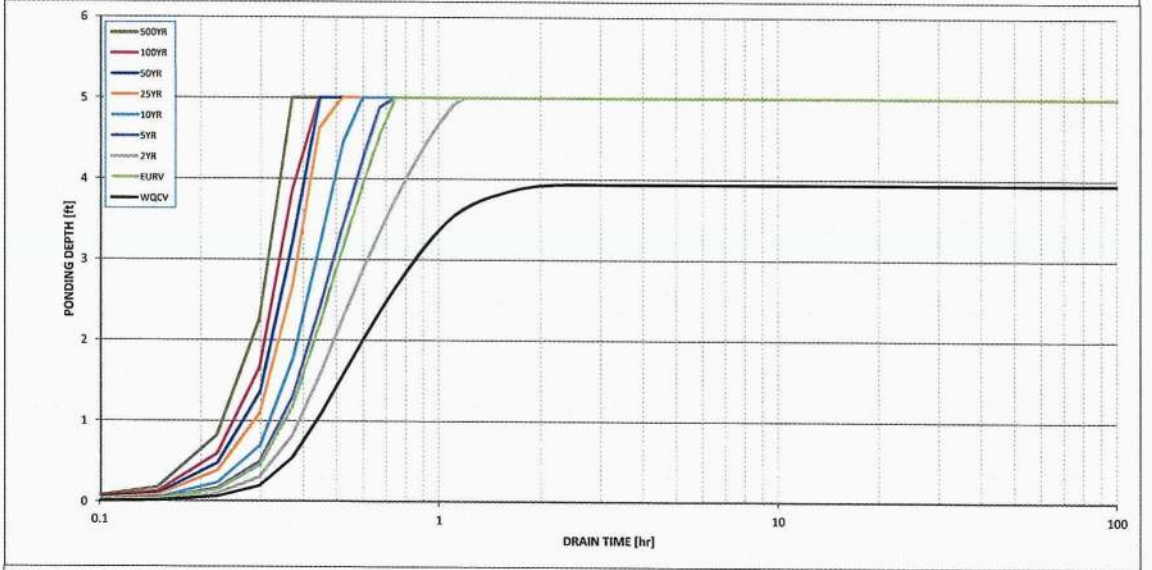
Routed Hydrograph Results

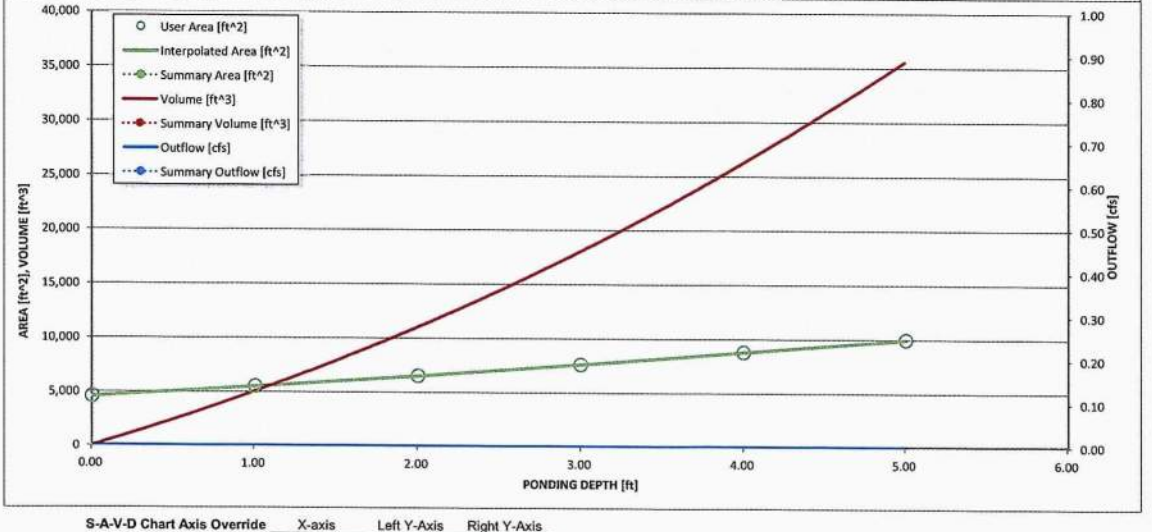
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	0.84	1.13	1.39	1.77	2.08	2.42	3.30
Calculated Runoff Volume (acre-ft) =	0.589	1.401	0.919	1.546	2.230	3.700	4.783	6.172	9.330
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.588	1.399	0.918	1.545	2.227	3.697	4.779	6.167	9.316
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.11	0.31	0.80	1.10	1.48	2.34
Predevelopment Peak Q (cfs) =	0.0	0.0	0.5	4.5	12.9	33.0	45.4	61.2	96.8
Peak Inflow Q (cfs) =	11.0	25.9	17.1	28.5	40.9	67.5	86.7	111.3	166.2
Peak Outflow Q (cfs) =									
Ratio Peak Outflow to Predevelopment Q =									
Structure Controlling Flow =									
Max Velocity through Grate 1 (fps) =									
Max Velocity through Grate 2 (fps) =									
Time to Drain 97% of Inflow Volume (hours) =									
Time to Drain 99% of Inflow Volume (hours) =									
Maximum Ponding Depth (ft) =									
Area at Maximum Ponding Depth (acres) =									
Maximum Volume Stored (acre-ft) =									

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







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: _____

Storm Inflow Hydrographs **UD-Detention, Version 3.07 (February 2017)**

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

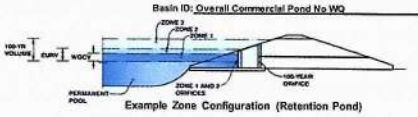
Time Interval	SOURCE									
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
4.45 min	0:00:00									
	0:04:27									
Hydrograph Constant	0:08:54									
	0:13:21									
1.123	0:17:48									
	0:22:15									
	0:26:42									
	0:31:09									
	0:35:36									
	0:40:03									
	0:44:30									
	0:48:57									
	0:53:24									
	0:57:51									
	1:02:18									
	1:06:45									
	1:11:12									
	1:15:39									
	1:20:06									
	1:24:33									
	1:29:00									
	1:33:27									
	1:37:54									
	1:42:21									
	1:46:48									
	1:51:15									
	1:55:42									
	2:00:09									
	2:04:36									
	2:09:03									
	2:13:30									
	2:17:57									
	2:22:24									
	2:26:51									
	2:31:18									
	2:35:45									
	2:40:12									
	2:44:39									
	2:49:06									
	2:53:33									
	2:58:00									
	3:02:27									
	3:06:54									
	3:11:21									
	3:15:48									
	3:20:15									
	3:24:42									
	3:29:09									
	3:33:36									
	3:38:03									
	3:42:30									
	3:46:57									
	3:51:24									
	3:55:51									
	4:00:18									
	4:04:45									
	4:09:12									
	4:13:39									
	4:18:06									
	4:22:33									
	4:27:00									
	4:31:27									
	4:35:54									
	4:40:21									
	4:44:48									
	4:49:15									
	4:53:42									
	4:58:09									
	5:02:36									
	5:07:03									
	5:11:30									
	5:15:57									
	5:20:24									

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: _____

Basin ID: Overall Commercial Pond No WQ



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	41.35	acres
Watershed Length =	1,676	ft
Watershed Slope =	0.026	ft/ft
Watershed Imperviousness =	36.70%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	100.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Aurora Reservoir	
Water Quality Capture Volume (WQCV) =	0.589	acre-feet
Excess Urban Runoff Volume (EURV) =	1.401	acre-feet
2-yr Runoff Volume (P1 = 0.84 in.) =	0.919	acre-feet
5-yr Runoff Volume (P1 = 1.13 in.) =	1.546	acre-feet
10-yr Runoff Volume (P1 = 1.39 in.) =	2.230	acre-feet
25-yr Runoff Volume (P1 = 1.77 in.) =	3.700	acre-feet
50-yr Runoff Volume (P1 = 2.08 in.) =	4.783	acre-feet
100-yr Runoff Volume (P1 = 2.42 in.) =	6.172	acre-feet
500-yr Runoff Volume (P1 = 3.3 in.) =	9.330	acre-feet
Approximate 2-yr Detention Volume =	0.861	acre-feet
Approximate 5-yr Detention Volume =	1.459	acre-feet
Approximate 10-yr Detention Volume =	1.766	acre-feet
Approximate 25-yr Detention Volume =	2.177	acre-feet
Approximate 50-yr Detention Volume =	2.371	acre-feet
Approximate 100-yr Detention Volume =	2.932	acre-feet

Optional User Override 1-hr Precipitation

	inches
	inches
	inches
	inches
	inches
	inches

Stage-Storage Calculation

Zone 1 Volume (EURV-WQCV) =	0.811	acre-feet
Zone 2 Volume (100-year - Zone 1) =	2.121	acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	2.932	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

WQCV not provided!

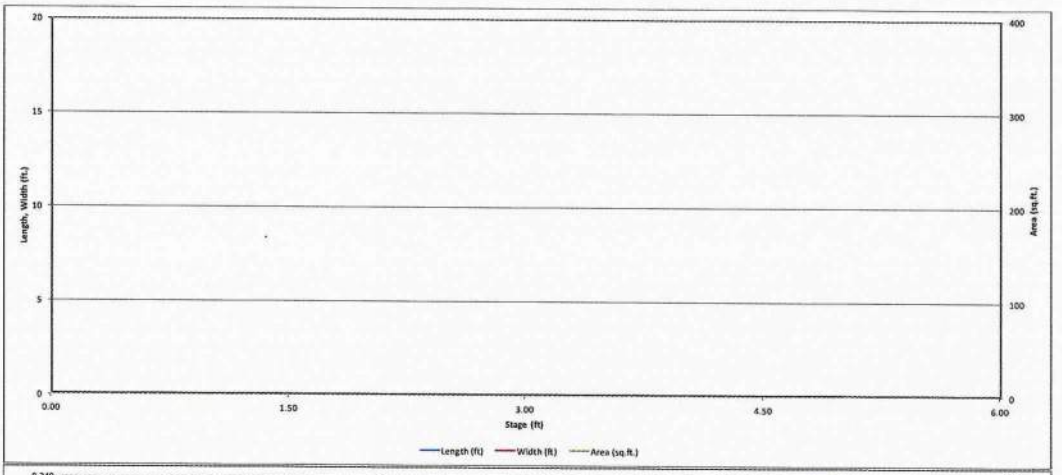
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user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

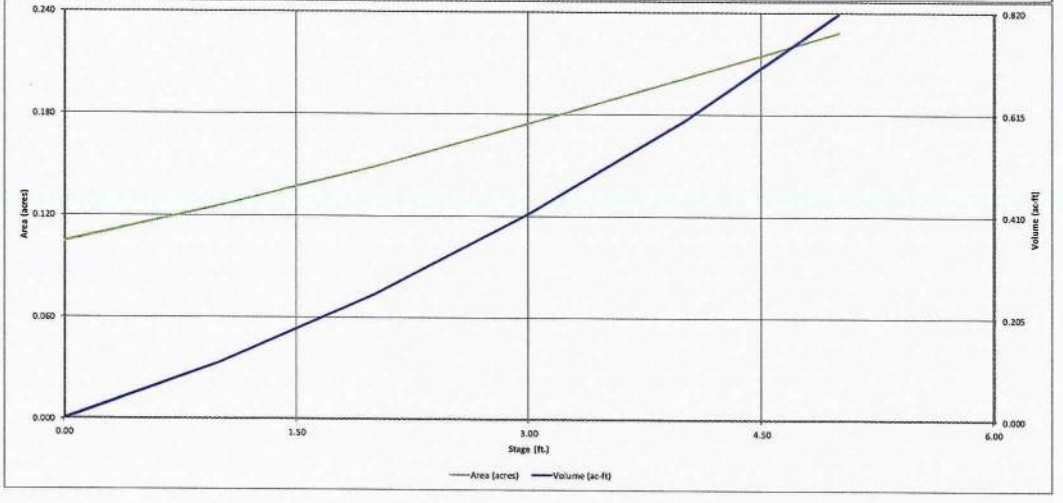
Depth Increment = 1 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acres)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	4,549	0.104		
	--	1.00	--	--	--	5,467	0.126	4,953	0.114
	--	2.00	--	--	--	6,478	0.149	10,916	0.251
	--	3.00	--	--	--	7,591	0.174	18,015	0.414
	--	4.00	--	--	--	8,764	0.201	26,192	0.601
	--	5.00	--	--	--	9,934	0.228	35,541	0.816

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



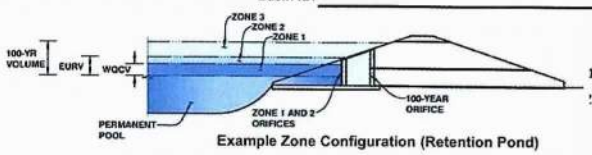


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: _____

Basin ID: _____



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
1 (EURV - WQCV)	4.99	0.811	
one 2 (100-year)		2.121	
Zone 3			
		2.932	Total

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

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

Underdrain Orifice Diameter = _____ inches

Calculated Parameters for Underdrain

Underdrain Orifice Area = _____ ft^2

Underdrain Orifice Centroid = _____ feet

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

Invert of Lowest Orifice = _____ ft (relative to basin bottom at Stage = 0 ft)

Depth at top of Zone using Orifice Plate = _____ ft (relative to basin bottom at Stage = 0 ft)

Orifice Plate: Orifice Vertical Spacing = _____ inches

Orifice Plate: Orifice Area per Row = _____ inches

Calculated Parameters for Plate

WQ Orifice Area per Row =	N/A	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

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

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

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =			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

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =			ft^2
Vertical Orifice Centroid =			feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =			ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =			feet
Overflow Weir Slope =			H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =			feet
Overflow Grate Open Area % =			%, grate open area/total area
Debris Clogging % =			%

Calculated Parameters for Overflow Weir

	Not Selected	Not Selected	
Height of Grate Upper Edge, H_t =			feet
Over Flow Weir Slope Length =			feet
Grate Open Area / 100-yr Orifice Area =			should be ≥ 4
Overflow Grate Open Area w/o Debris =			ft^2
Overflow Grate Open Area w/ Debris =			ft^2

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

	Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =			ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter =			inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Not Selected	Not Selected	
Outlet Orifice Area =			ft^2
Outlet Orifice Centroid =			feet
Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	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

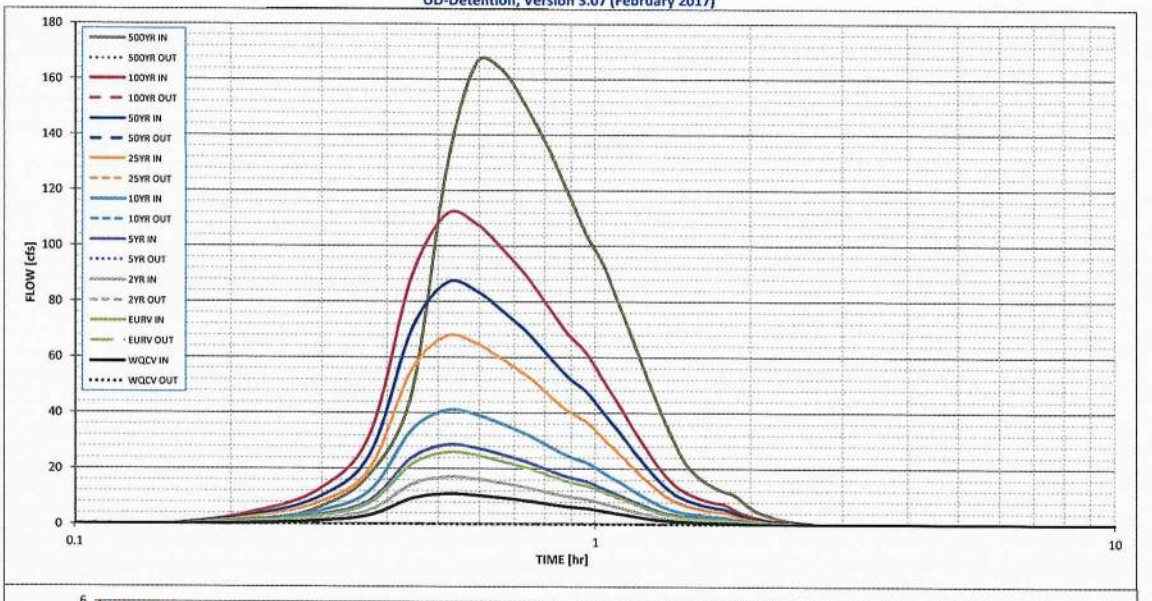
Basin Area at Top of Freeboard = _____ acres

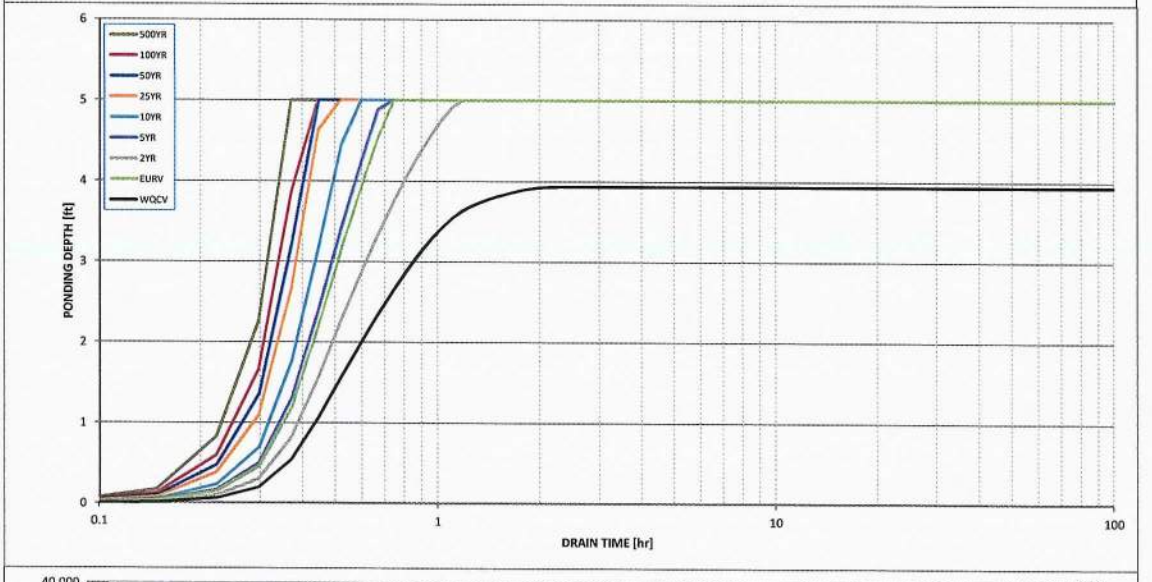
Routed Hydrograph Results

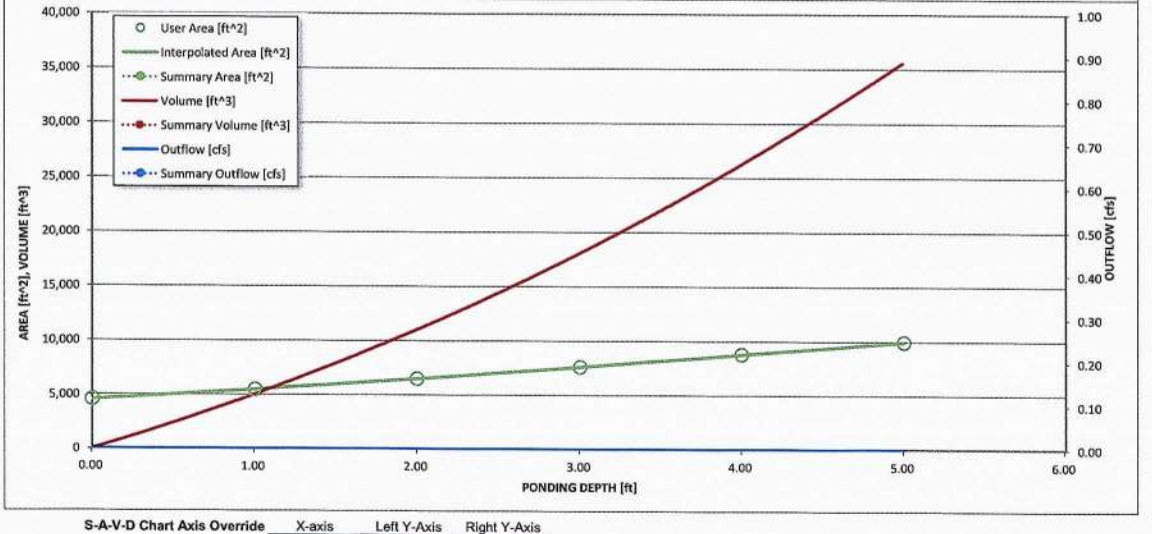
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	0.84	1.13	1.39	1.77	2.08	2.42	3.30
Calculated Runoff Volume (acre-ft) =	0.589	1.401	0.919	1.546	2.230	3.700	4.783	6.172	9.330
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.588	1.399	0.918	1.545	2.227	3.697	4.779	6.167	9.316
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.11	0.31	0.80	1.10	1.48	2.34
Predevelopment Peak Q (cfs) =	0.0	0.0	0.5	4.5	12.9	33.0	45.4	61.2	96.8
Peak Inflow Q (cfs) =	11.0	25.9	17.1	28.5	40.9	67.5	86.7	111.3	166.2
Peak Outflow Q (cfs) =									
Ratio Peak Outflow to Predevelopment Q =									
Structure Controlling Flow =									
Max Velocity through Grate 1 (fps) =									
Max Velocity through Grate 2 (fps) =									
Time to Drain 97% of Inflow Volume (hours) =									
Time to Drain 99% of Inflow Volume (hours) =									
Maximum Ponding Depth (ft) =									
Area at Maximum Ponding Depth (acres) =									
Maximum Volume Stored (acre-ft) =									

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







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: _____

Storm Inflow Hydrographs **UD-Detention, Version 3.07 (February 2017)**

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

Time Interval	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
	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]
4.45 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:04:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph Constant	0:08:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:13:21	0.49	1.12	0.75	1.24	1.75	2.82	3.55	4.43	6.19
1.123	0:17:48	1.31	3.05	2.03	3.36	4.80	7.82	9.94	12.55	18.12
	0:22:15	3.37	7.85	5.21	8.64	12.32	20.07	25.51	32.23	46.55
	0:26:42	9.27	21.54	14.30	23.72	33.82	55.03	69.93	88.27	127.27
	0:31:09	10.99	25.87	17.06	28.53	40.94	67.45	86.75	111.29	166.20
	0:35:36	10.49	24.74	16.30	27.30	39.22	64.80	83.66	107.88	163.00
	0:40:03	9.55	22.52	14.84	24.85	35.69	58.97	76.27	98.58	149.58
	0:44:30	8.52	20.19	13.28	22.29	32.07	53.11	68.73	88.87	134.97
	0:48:57	7.35	17.51	11.49	19.34	27.91	46.43	60.18	77.97	118.79
	0:53:24	6.41	15.22	10.00	16.81	24.27	40.51	52.57	68.18	104.01
	0:57:51	5.81	13.81	9.06	15.24	21.99	36.59	47.41	61.36	93.25
	1:02:18	4.79	11.48	7.50	12.68	18.35	30.64	39.80	51.67	79.05
	1:06:45	3.91	9.44	6.15	10.44	15.14	25.37	33.00	42.91	65.75
	1:11:12	3.00	7.36	4.76	8.15	11.89	20.07	26.21	34.21	52.76
	1:15:39	2.23	5.57	3.57	6.18	9.08	15.47	20.28	26.56	41.17
	1:20:06	1.62	4.06	2.58	4.52	6.70	11.53	15.19	19.98	31.16
	1:24:33	1.26	3.10	1.99	3.45	5.07	8.66	11.36	14.88	23.05
	1:29:00	1.03	2.54	1.63	2.81	4.12	6.98	9.12	11.89	18.30
	1:33:27	0.88	2.15	1.38	2.38	3.48	5.88	7.67	9.99	15.34
	1:37:54	0.77	1.88	1.21	2.08	3.04	5.12	6.67	8.67	13.27
	1:42:21	0.69	1.69	1.09	1.87	2.72	4.58	5.96	7.74	11.82
	1:46:48	0.64	1.55	1.01	1.72	2.50	4.19	5.45	7.08	10.79
	1:51:15	0.47	1.14	0.74	1.26	1.85	3.12	4.08	5.34	8.27
	1:55:42	0.34	0.83	0.54	0.92	1.34	2.26	2.95	3.85	5.96
	2:00:09	0.25	0.61	0.40	0.68	0.99	1.67	2.18	2.86	4.42
	2:04:36	0.19	0.45	0.29	0.50	0.73	1.24	1.62	2.12	3.28
	2:09:03	0.13	0.33	0.21	0.36	0.53	0.91	1.19	1.56	2.43
	2:13:30	0.09	0.23	0.15	0.26	0.38	0.65	0.86	1.13	1.75
	2:17:57	0.07	0.17	0.11	0.19	0.28	0.47	0.62	0.82	1.27
	2:22:24	0.04	0.11	0.07	0.13	0.19	0.33	0.44	0.57	0.90
	2:26:51	0.03	0.07	0.04	0.08	0.12	0.21	0.28	0.38	0.60
	2:31:18	0.01	0.04	0.02	0.04	0.07	0.12	0.16	0.22	0.36
	2:35:45	0.00	0.01	0.01	0.02	0.03	0.05	0.08	0.10	0.17
	2:40:12	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.06
	2:44:39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:49:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:53:33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:58:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:02:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:06:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:11:21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:24:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:29:09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:33:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:38:03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:42:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:46:57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:51:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:04:45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:09:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:13:39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:18:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:22:33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:27:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:31:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:44:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:49:15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:53:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:58:09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:02:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:07:03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:11:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

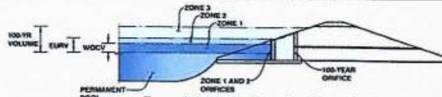
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)

Project: Aurora Seam

Basin ID: Pond B with WQ for Comm Parcels



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	53.27	acres
Watershed Length =	2,540	ft
Watershed Length to Centroid =	1,410	ft
Watershed Slope =	0.030	ft/ft
Watershed Imperviousness =	35.50%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	100.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Aurora Reservoir	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	1.333	acre-feet	1.333	acre-feet
Excess Urban Runoff Volume (EURV) =	1.741	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.84 in.) =	1.139	acre-feet		inches
5-yr Runoff Volume (P1 = 1.13 in.) =	1.950	acre-feet		inches
10-yr Runoff Volume (P1 = 1.39 in.) =	2.945	acre-feet		inches
25-yr Runoff Volume (P1 = 1.77 in.) =	4.841	acre-feet		inches
50-yr Runoff Volume (P1 = 2.08 in.) =	6.239	acre-feet		inches
100-yr Runoff Volume (P1 = 2.42 in.) =	7.996	acre-feet		inches
500-yr Runoff Volume (P1 = 3.3 in.) =	12.083	acre-feet		inches
Approximate 2-yr Detention Volume =	1.068	acre-feet		
Approximate 5-yr Detention Volume =	1.824	acre-feet		
Approximate 10-yr Detention Volume =	2.211	acre-feet		
Approximate 25-yr Detention Volume =	2.732	acre-feet		
Approximate 50-yr Detention Volume =	2.977	acre-feet		
Approximate 100-yr Detention Volume =	3.700	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	1.333	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.408	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	2.626	acre-feet
Total Detention Basin Volume =	4.366	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

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

Depth Increment = 0.10 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	80	0.002		
	--	1.00	--	--	--	1,365	0.031	722	0.017
	--	2.00	--	--	--	11,180	0.257	6,995	0.161
	--	3.00	--	--	--	17,901	0.411	21,535	0.494
	--	4.00	--	--	--	22,839	0.524	41,905	0.962
	--	5.00	--	--	--	26,693	0.613	66,671	1.531
	--	6.00	--	--	--	30,225	0.694	95,130	2.184
	--	7.00	--	--	--	33,862	0.777	127,174	2.920
	--	8.00	--	--	--	37,605	0.863	162,907	3.740
	--	9.00	--	--	--	41,453	0.952	202,436	4.647
	--	10.00	--	--	--	45,471	1.044	245,898	5.645
	--	11.00	--	--	--	50,500	1.159	293,884	6.747
	--	12.00	--	--	--	55,000	1.263	346,634	7.958
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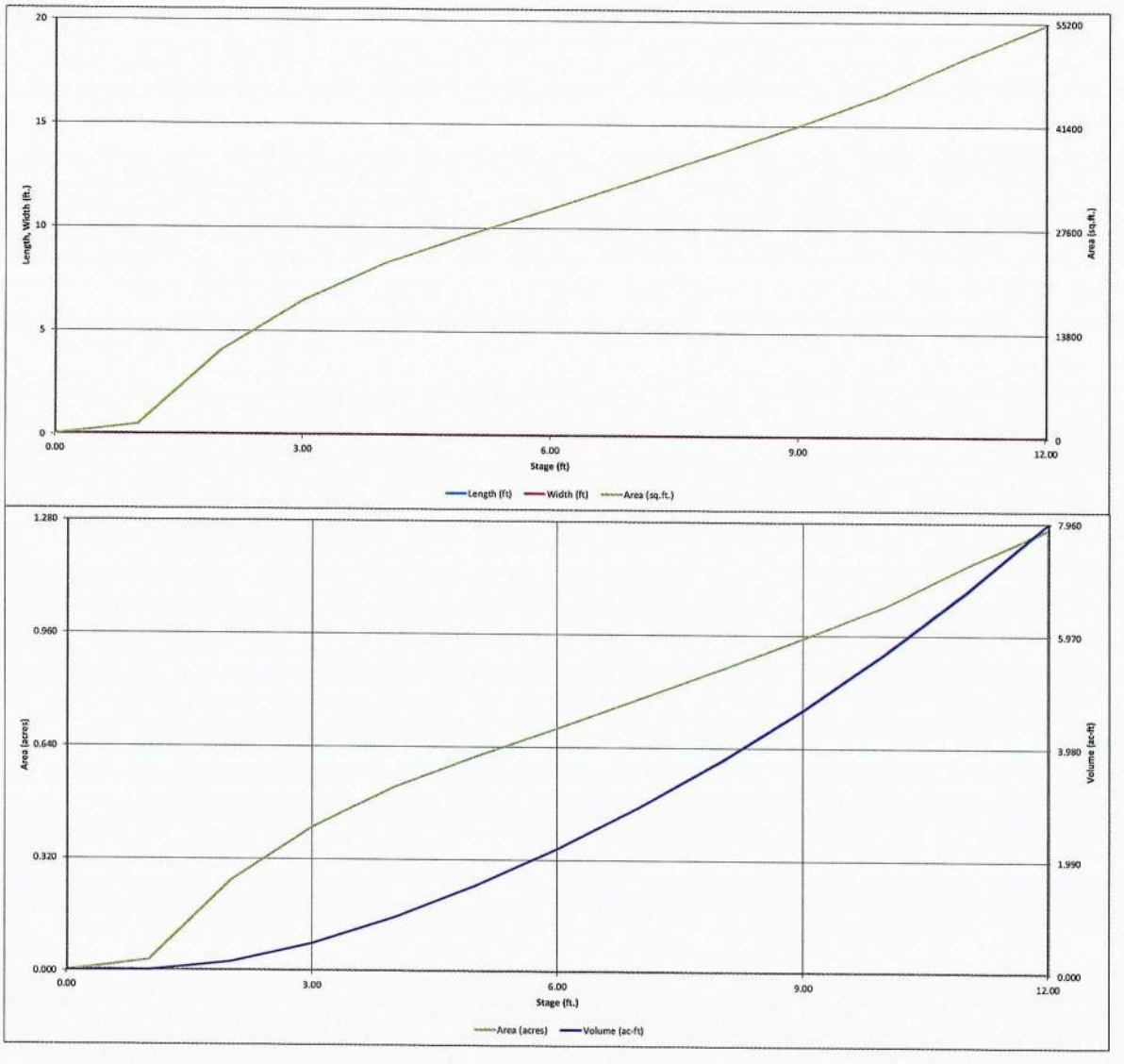
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)

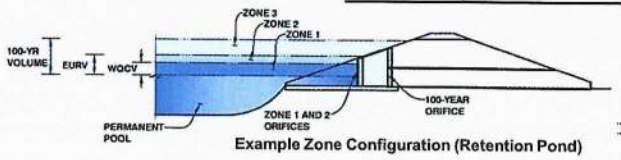


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.02 (February 2020)

Project: Aurora Seam

Basin ID: Pond B with WQ for Comm Parcels



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	4.67	1.333	Orifice Plate
Zone 2 (EURV)	5.34	0.408	Orifice Plate
Zone 3 (100+1/2WQCV)	8.71	2.626	Weir&Pipe (Restrict)
Total (all zones)		4.366	

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

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

Calculated Parameters for Underdrain

Underdrain Orifice Area =		ft^2
Underdrain Orifice Centroid =		feet

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	5.34	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	21.40	inches
Orifice Plate: Orifice Area per Row =	3.06	sq. inches (diameter = 1-15/16 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row =	2.125E-02	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.78	3.56					
Orifice Area (sq. inches)	3.06	3.06	3.06					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orif

	Not Selected	Not Selected
Vertical Orifice Area =	N/A	N/A
Vertical Orifice Centroid =	N/A	N/A

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	5.50	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	8.67	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	3.00	N/A	feet
Overflow Grate Open Area % =	75%	N/A	%, grate open area/total area
Debris Clogging % =	0%	N/A	%

Calculated Parameters for Overflow W

	Zone 3 Weir	Not Selected
Height of Grate Upper Edge, H_t =	5.50	N/A
Overflow Weir Slope Length =	3.00	N/A
Grate Open Area / 100-yr Orifice Area =	9.46	N/A
Overflow Grate Open Area w/o Debris =	19.51	N/A
Overflow Grate Open Area w/ Debris =	19.51	N/A

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.25	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	36.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	12.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

	Zone 3 Restrictor	Not Selected
Outlet Orifice Area =	2.06	N/A
Outlet Orifice Centroid =	0.59	N/A
Half-Central Angle of Restrictor Plate on Pipe =	1.23	N/A

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	9.25	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	34.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.94	feet
Stage at Top of Freeboard =	11.19	feet
Basin Area at Top of Freeboard =	1.18	acres
Basin Volume at Top of Freeboard =	6.97	acre-ft

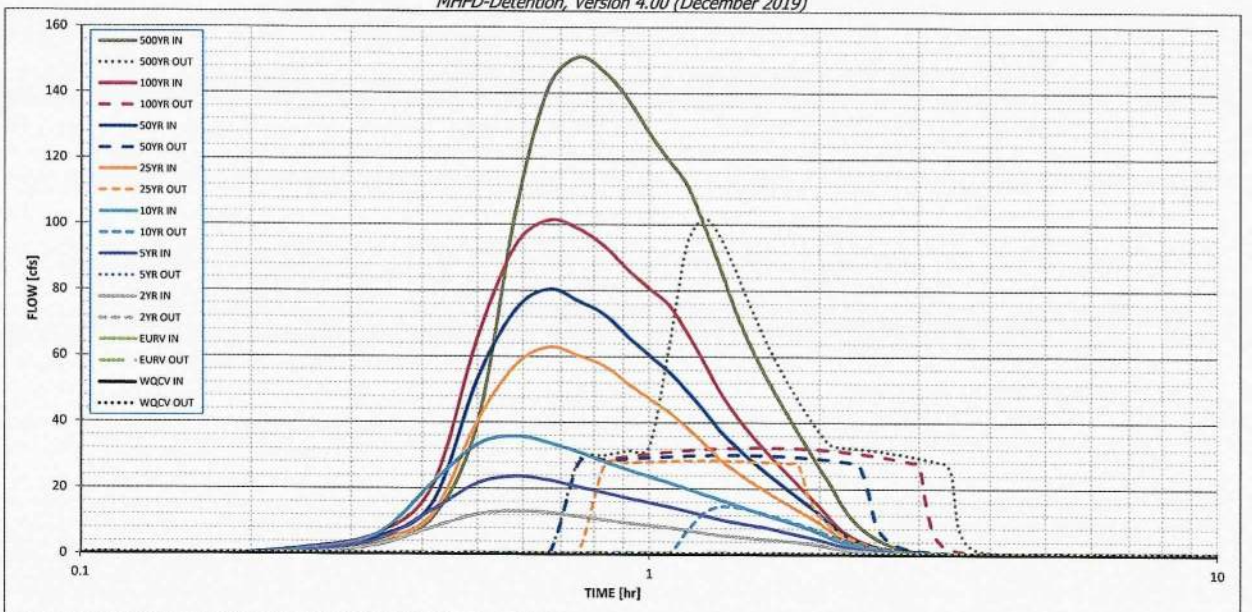
Routed Hydrograph Results

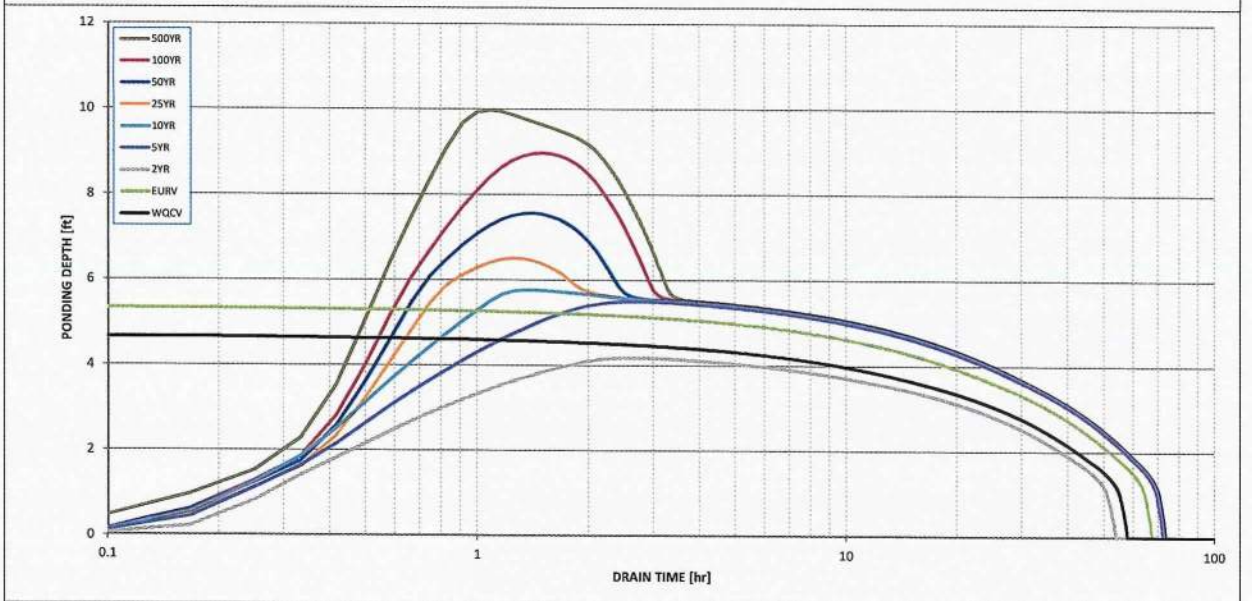
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through A

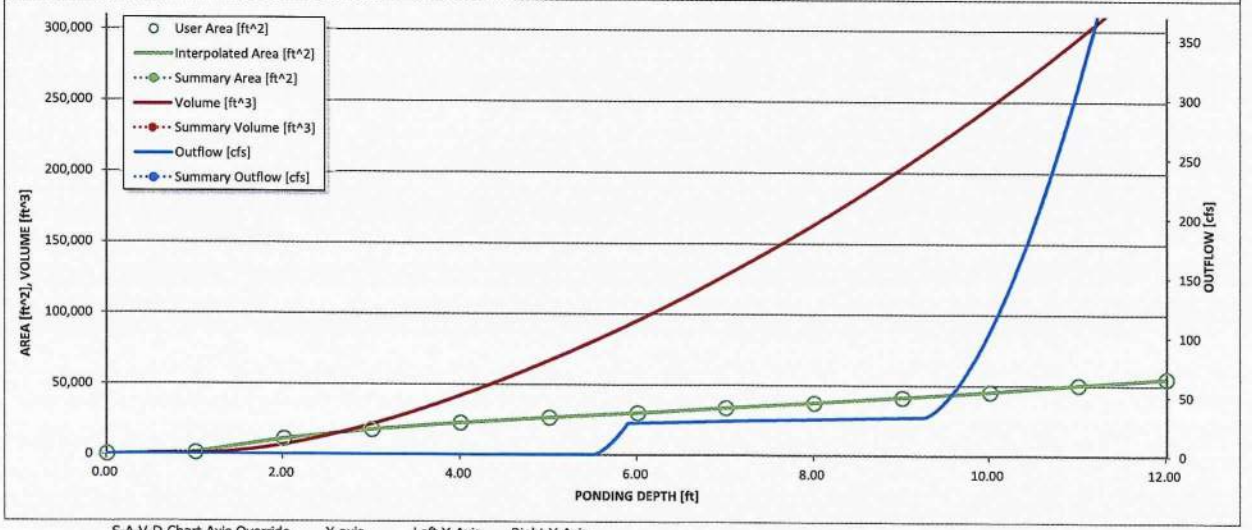
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.84	1.13	1.39	1.77	2.08	2.42
CUHP Runoff Volume (acre-ft) =	1.333	1.741	1.139	1.950	2.945	4.841	6.239	7.996
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	1.139	1.950	2.945	4.841	6.239	7.996
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.5	5.8	14.6	35.3	48.0	64.8
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.11	0.27	0.66	0.90	1.22
Peak Inflow Q (cfs) =	N/A	N/A	13.2	23.6	35.8	62.8	80.4	101.3
Peak Outflow Q (cfs) =	0.5	0.6	0.4	0.6	14.6	28.4	30.2	32.4
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.1	1.0	0.8	0.6	0.5
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.7	1.4	1.5	1.6
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	53	61	49	65	63	58	56	53
Time to Drain 99% of Inflow Volume (hours) =	**56**	64	52	69	69	67	65	64
Maximum Ponding Depth (ft) =	4.67	5.34	4.18	5.49	5.76	6.50	7.56	8.97
Area at Maximum Ponding Depth (acres) =	0.58	0.64	0.54	0.65	0.67	0.73	0.82	0.95
Maximum Volume Stored (acre-ft) =	1.333	1.744	1.052	1.834	2.013	2.534	3.360	4.609

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

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

Time Interval	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60
	0:15:00	0.00	0.00	0.38	1.13	1.70	1.35	1.93	2.02	3.56
	0:20:00	0.00	0.00	2.83	4.44	6.21	4.19	5.34	6.23	11.11
	0:25:00	0.00	0.00	8.19	13.50	21.77	12.18	15.81	20.62	40.00
	0:30:00	0.00	0.00	12.26	21.59	33.41	40.59	53.68	65.69	104.10
	0:35:00	0.00	0.00	13.19	23.60	35.76	57.35	74.39	93.74	142.00
	0:40:00	0.00	0.00	12.76	22.46	33.74	62.76	80.42	101.30	151.01
	0:45:00	0.00	0.00	11.64	20.49	31.05	60.23	76.80	98.79	146.66
	0:50:00	0.00	0.00	10.56	18.74	28.08	57.12	72.70	93.56	138.55
	0:55:00	0.00	0.00	9.67	17.11	25.62	51.81	66.01	86.46	128.29
	1:00:00	0.00	0.00	8.96	15.73	23.60	47.19	60.34	80.67	119.83
	1:05:00	0.00	0.00	8.29	14.43	21.71	43.08	55.25	75.67	112.38
	1:10:00	0.00	0.00	7.46	13.17	19.86	38.33	49.38	67.22	100.15
	1:15:00	0.00	0.00	6.63	11.82	18.15	33.52	43.42	58.23	87.34
	1:20:00	0.00	0.00	5.99	10.63	16.58	28.79	37.38	49.33	74.49
	1:25:00	0.00	0.00	5.53	9.75	15.05	25.37	32.96	42.60	64.43
	1:30:00	0.00	0.00	5.16	9.02	13.61	22.38	29.06	37.14	56.14
	1:35:00	0.00	0.00	4.84	8.36	12.32	19.81	25.69	32.55	49.13
	1:40:00	0.00	0.00	4.53	7.56	11.14	17.46	22.61	28.40	42.77
	1:45:00	0.00	0.00	4.22	6.75	10.01	15.34	19.83	24.59	36.94
	1:50:00	0.00	0.00	3.91	5.97	8.93	13.30	17.16	20.99	31.44
	1:55:00	0.00	0.00	3.46	5.22	7.77	11.36	14.62	17.63	26.30
	2:00:00	0.00	0.00	2.98	4.48	6.55	9.52	12.23	14.52	21.56
	2:05:00	0.00	0.00	2.40	3.56	5.12	7.32	9.37	11.00	16.35
	2:10:00	0.00	0.00	1.90	2.79	4.05	5.34	6.91	8.05	12.19
	2:15:00	0.00	0.00	1.52	2.24	3.28	4.02	5.25	6.02	9.22
	2:20:00	0.00	0.00	1.25	1.82	2.68	3.09	4.06	4.56	7.03
	2:25:00	0.00	0.00	1.02	1.48	2.18	2.40	3.16	3.43	5.32
	2:30:00	0.00	0.00	0.84	1.21	1.76	1.86	2.45	2.57	4.01
	2:35:00	0.00	0.00	0.68	0.97	1.41	1.45	1.90	1.90	2.97
	2:40:00	0.00	0.00	0.55	0.77	1.11	1.11	1.45	1.39	2.17
	2:45:00	0.00	0.00	0.44	0.61	0.86	0.85	1.11	1.04	1.63
	2:50:00	0.00	0.00	0.36	0.48	0.67	0.66	0.85	0.81	1.26
	2:55:00	0.00	0.00	0.29	0.38	0.52	0.52	0.67	0.65	1.00
	3:00:00	0.00	0.00	0.23	0.29	0.41	0.41	0.52	0.51	0.79
	3:05:00	0.00	0.00	0.18	0.22	0.31	0.31	0.40	0.39	0.60
	3:10:00	0.00	0.00	0.13	0.16	0.23	0.23	0.30	0.29	0.44
	3:15:00	0.00	0.00	0.09	0.11	0.16	0.16	0.21	0.20	0.30
	3:20:00	0.00	0.00	0.06	0.07	0.10	0.11	0.13	0.13	0.19
	3:25:00	0.00	0.00	0.04	0.05	0.06	0.06	0.08	0.07	0.11
	3:30:00	0.00	0.00	0.02	0.02	0.03	0.03	0.04	0.03	0.05
	3:35:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	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

APPENDIX D:
COPIES OF GRAPHS, TABLES, AND CHARTS USED

TABLE 1
RUNOFF COEFFICIENTS AND PERCENTS IMPERVIOUS

LAND USE OR SURFACE CHARACTERISTICS	PERCENT IMPERVIOUS	FREQUENCY			
		2	5	10	100
Business:					
Commercial Areas	95	.87	.87	.88	.89
Neighborhood Areas	85	.60	.65	.70	.80
Residential:					
Single-Family (**)	(*)	.40	.45	.50	.60
Multi-Unit (detached)	60	.45	.50	.60	.70
Multi-Unit (attached)	75	.60	.65	.70	.80
1/2 Acre Lot or Larger	(*)	.30	.35	.40	.60
Apartments	80	.65	.70	.70	.80
Industrial:					
Light Areas	80	.71	.72	.76	.82
Heavy Areas	90	.80	.80	.85	.90
Parks, Cemeteries	5	.10	.10	.35	.60
Playgrounds	10	.15	.25	.35	.65
Schools	50	.45	.50	.60	.70
Railroad Yard Areas	15	.40	.45	.50	.60
Undeveloped Areas:					
Historic Flow Analysis, Greenbelts, Agricultural	2	(See "Lawns")			
Off-Site Flow Analysis (when land use not defined)	45	.43	.47	.55	.65

TABLE 1 (continued)

RUNOFF COEFFICIENTS AND PERCENTS IMPERVIOUS

LAND USE OR SURFACE CHARACTERISTICS	PERCENT IMPERVIOUS	FREQUENCY			
		2	5	10	100
Streets:					
Paved	100	.87	.88	.90	.93
Gravel	40	.15	.25	.35	.65
Concrete Drive and Walks	96	.87	.87	.88	.89
Roofs	90	.80	.85	.90	.90
Lawns, Sandy Soil (A and B Soils):	2				
2% Slope		.05	.06	.08	.10
2-7% Slope		.10	.11	.13	.15
>7% Slope		.15	.16	.18	.20
Lawns, Clay Soil (C and D Soils):	5				
2% Slope		.13	.14	.15	.17
2-7% Slope		.18	.19	.20	.22
>7% Slope		.25	.27	.30	.35

NOTE: These Rational Formula coefficients may not be valid for large basins

(*)See Figures *RO-3 through RO-5* of USDCM Volume 1 for percent impervious.

(**)Up to 5 units per acre. Single-family with more than 5 units per acre, use values for multi-unit/detached

.

Table 6-3. Recommended percentage imperviousness values

Land Use or Surface Characteristics	Percentage Imperviousness (%)
Business:	
Downtown Areas	95
Suburban Areas	75
Residential:	
Single-family	
2.5 acres or larger	12
0.75 – 2.5 acres	20
0.25 – 0.75 acres	30
0.25 acres or less	45
Apartments	75
Industrial:	
Light areas	80
Heavy areas	90
Parks, cemeteries	10
Playgrounds	25
Schools	55
Railroad yard areas	50
Undeveloped Areas:	
Historic flow analysis	2
Greenbelts, agricultural	2
Off-site flow analysis (when land use not defined)	45
Streets:	
Paved	100
Gravel (packed)	40
Drive and walks	90
Roofs	90
Lawns, sandy soil	2
Lawns, clayey soil	2

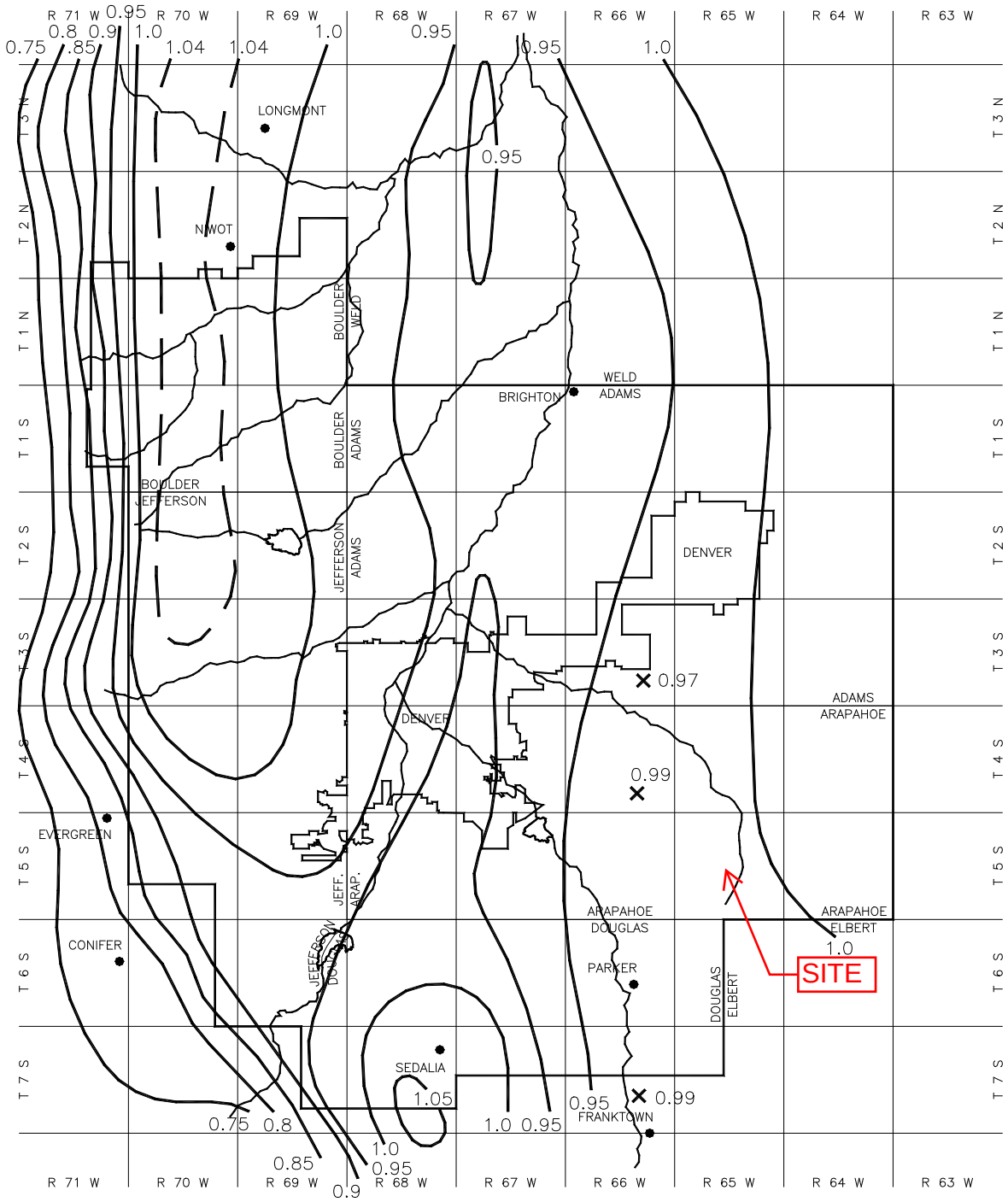


Figure 5-1. Rainfall depth-duration-frequency: 2-year, 1-hour rainfall

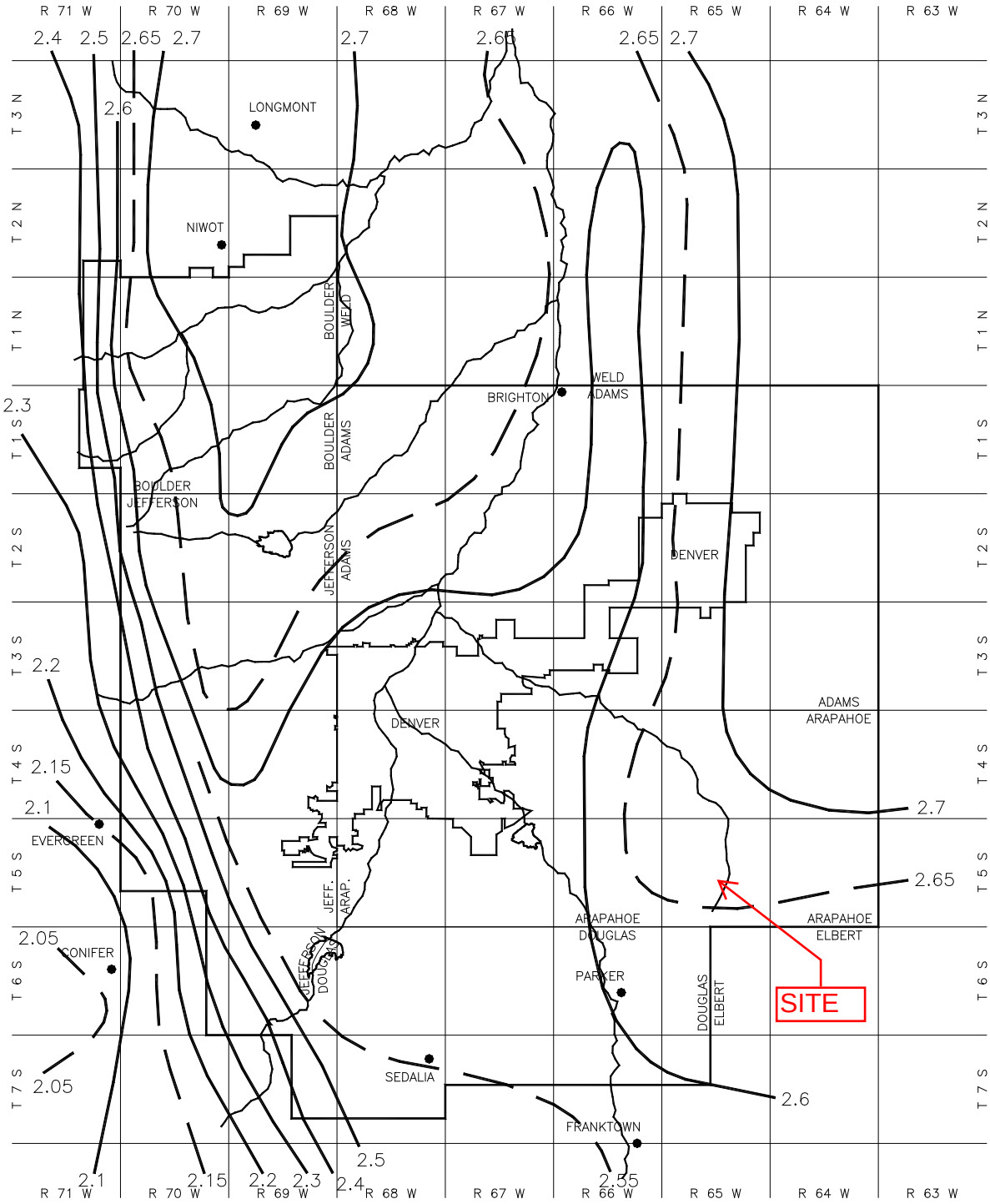


Figure 5-6. Rainfall depth-duration-frequency: 100-year, 1-hour rainfall

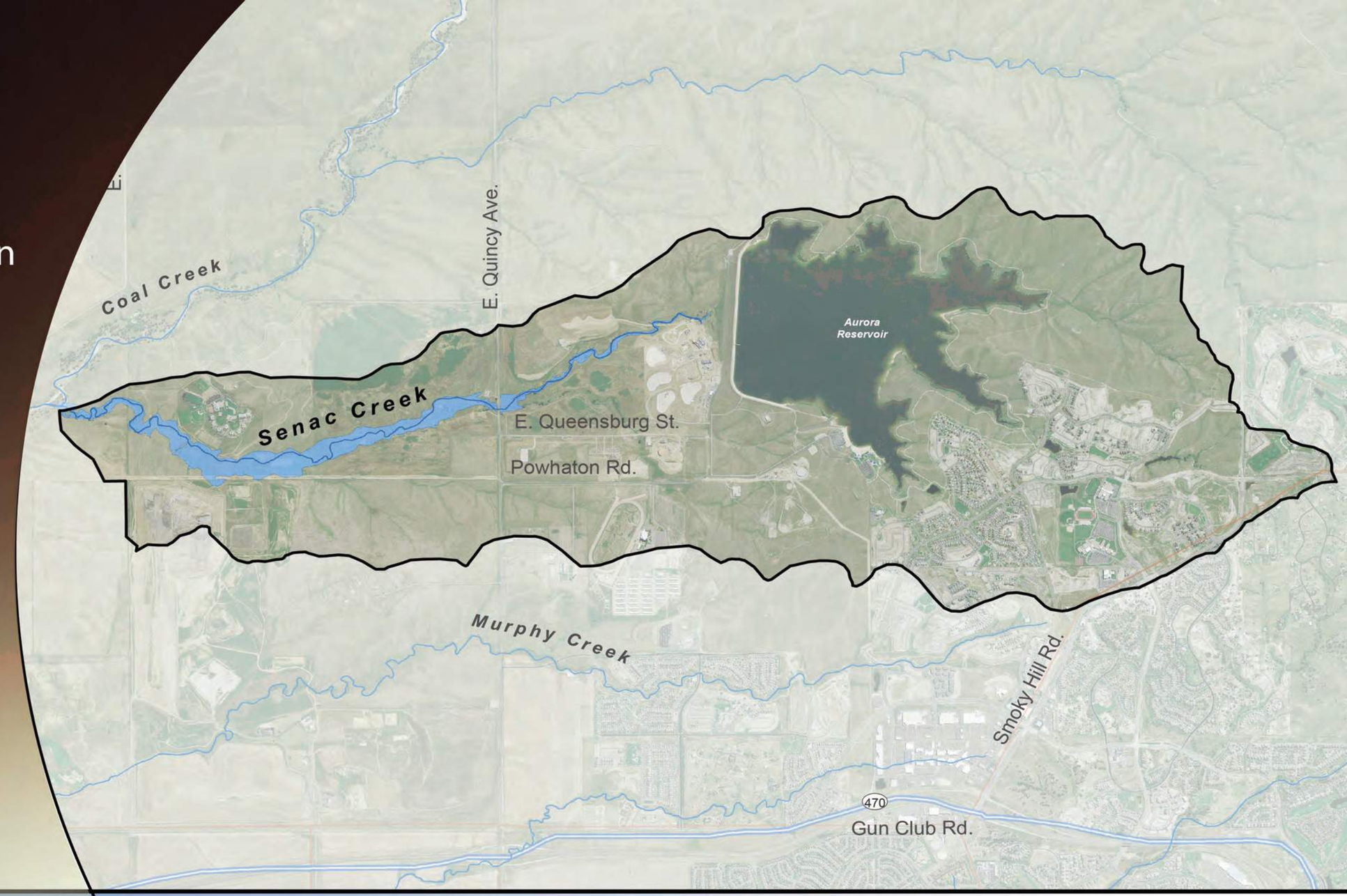
APPENDIX E:
REFERENCED REPORTS

Senac Creek
Major Drainageway Plan

December 2014

Prepared by:
Matrix Design Group, Inc.
1601 Blake Street
Suite 200
Denver, CO 80202
303.572.0200

Prepared for:
Urban Drainage & Flood Control District
Southeast Metro Stormwater Authority
City of Aurora



1601 Blake Street, Suite 200
Denver, Colorado 80202
(303) 572-0200
fax (303) 572-0202

December 18, 2014

Shea Thomas, PE
Senior Master Planning Engineer
Urban Drainage & Flood Control District
2480 W. 26th Ave., Suite 156-B
Denver, Colorado 80211

RE: Senac Creek (Aurora Reservoir Dam to Coal Creek)
Major Drainageway Plan Report
Agreement No. 11-03.03D

Dear Mrs. Thomas:

Matrix Design Group, Inc. is pleased to submit the *Senac Creek (Aurora Reservoir Dam to Coal Creek) Major Drainageway Plan Report*. This report provides Project Sponsors (City of Aurora, Southeast Metropolitan Stormwater Authority and the Urban Drainage & Flood Control District) with information and recommendations for better management of the Senac Creek drainageway and watershed. The report format and submittal is intended to follow the requirements of the Urban Drainage & Flood Control District guidelines.

The Senac Creek watershed includes Aurora Reservoir. The upper watershed tributary to Aurora Reservoir is master planned by development; therefore, this study focuses on the main stem of Senac Creek downstream from Aurora Reservoir for the purposes of defining hydrology, hydraulics and recommended channel improvements that fit into the context of the adjacent open space land use.

This study provides a description of the 9.77 square mile Senac Creek watershed, existing and future conditions hydrology, hydraulic analysis of the 4.89 mile main stem channel, proposed channel improvements and associated costs for budgeting purposes. It is anticipated that the Senac Creek drainageway will remain relatively undeveloped and there are currently no insurable structures in the floodplain. Therefore, the Major Drainageway Plan emphasizes floodplain preservation, enhancement of the natural habitat, protection of water quality, and use of natural stream stabilization measures.

We appreciate the opportunity to provide this study with recommendations to protect and manage our community's waterways.

Sincerely,
Matrix Design Group, Inc.

Robert Krehbiel, PE
Project Manager

HungTeng Ho, PE
Project Engineer

APPENDIX B

HYDROLOGIC ANALYSIS

Legend

- City of Aurora Boundary
- Stream/River
- Sanderson Gulch Watershed
- Subbasin
- Basin ID Area, %Imp
- Planned Development
- DADS
- Park/Open Space

SWMM Routing Elements

- Detention
- Outfall
- Design Point

Hydrologic Soil Group

- A
- B
- C
- D
- Water

Future Land Use, % Impervious

- Open Space/Agricultural, 2%
- Athletic Complex, 30%
- Residential - 1 DU/AC, 30%
- Extraction/Disposal Utilities, 40%
- State Land Board (LR), 40%
- Residential - 2 DU/AC, 45%
- Residential - 3 DU/AC, 50%
- Residential - 4 DU/AC, 60%
- School, 50%
- Light Industrial, 80%
- Industrial, 85%
- Heavy Industrial, 90%
- Office, 85%
- Roadway, 100%
- Water, 100%

Existing Land Use, % Impervious

- Open Space, 2%
- Residential - 1 DU/AC, 30%
- Athletic Complex, 30%
- Extraction/Disposal Utilities, 40%
- Residential - 2 DU/AC, 45%
- Medium Density Residential, 50%
- School, 50%
- Light Industrial, 80%
- Industrial, 85%
- Water, 100%

Layer Control Instructions

The Map Controls above set the visibility of the layers automatically for the selected map. Additional layer control is available through the "Layers" Navigation Panel which can be accessed from the View Menu under Navigation Panels. In the Panel, the visibility of layers and layer groups can be changed by clicking the square left of the layer/group. An eye in the square indicates that the layer is on. An empty square indicates that the layer is off. Layer groups can be expanded and reduced by clicking the +/- symbol left of the layer/group.

Cottonwood Creek
E. Yale Ave.
Coal Creek
Arapahoe County
City of Aurora
Section 4 Athletic Field Complex
Pronghorn Natural Area
Aurora Reservoir
Arapahoe County
City of Aurora
E. Smoky Hill Rd.
E. County Line Rd.
Eastern Hills South
Senac Creek
E. Queensburg St.
Future City Maintenance Facility
S. Powhaton Rd.
Southshore
High Plains
The Parklands
USACE
Reservoir Community Park
Beacon Point
Cherry Creek High School
Serenity Ridge
Denver Arapahoe Disposal Site (DADS)
Arapahoe County Fairgrounds and Regional Park
Cherry Creek School District
E. Quincy Ave.
Wheatlands
Villages at Murphy Creek
Murphy Creek
City of Aurora
Arapahoe County
Arapahoe County
City of Aurora
0 500 1,000 2,000
Feet

Interactive Figures (Select from Below)

- Study Area Map
- Soils Map
- Existing Land Use Map
- Future Land Use Map
- Planned Development Map
- Subwatershed Boundaries Map
- Baseline Hydrology SWMM Routing Map

FILE: G:\gis_projects\UDFCD_Sand_Creek\activeMaps\Senac Creek\Hydrology_Report\Fig_B-1_UDFCD_Senac Creek_Hydrology_Map.mxd, 4/2/2014, wilson_wheeler

Figure B-1
Hydrology Map
Senac Creek Major Drainageway Plan

E. Yale Ave.

Coal Creek

E. Quincy Ave.

Senac Creek

E. Queensburg St.

S. Powhaton Rd

Aurora Reservoir

E. Smoky Hill Rd.

Murphy Creek

Smoky Hill Rd.

470

Gun Club Rd.

230G 2%
230F 19%
230C 2%
230D 24%
230B 3%
230E 39%
230A 39%
227G 2%
227F 2%
227E 2%
227C 2%
227B 2%
227D 2%
227A 41%
229D 6%
229C 2%
229A 2%
229B 2%
228B 20%
228A 20%
222E 2%
222D 14%
222B 16%
222A 29%
222C 78%
226A 5%
226B 24%
224D 55%
225D 78%
225C 2%
225B 2%
225A 2%
224B 2%
224C 16%
224A 2%
223 6%
218 63%
212 22%
211 36%
210 7%
209 8%
208 2%
207 2%
201 30%
217 44%
215 45%
204 49%
203 46%

Legend

- Hydrology Study Area
- Subbasin

% Impervious - Existing Conditions

- 2 - 10
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 60
- 60 - 70
- 70 - 80
- 80 - 90
- 90 - 100

0 0.25 0.5 1
Miles

No.	DATE	DESCRIPTION	APPR.

Matrix DESIGN GROUP

designed by: _____
drawn by: WW
checked by: RK
project no.: 11.155.019
date: 10/2/2013

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT, CITY OF AURORA, SEMSWA

MAJOR DRAINAGEWAY PLAN
SENAC CREEK

PERCENT IMPERVIOUS
EXISTING CONDITIONS

FIGURE
B-2

FILE: G:\gis_projects\UDFCD_Sand_Creek\activeapps\Senac_Creek\Hydrology_Report\Fig_B-2_Impervious_Existing.mxd, 4/2/2014, wilson_wheeler

E. Yale Ave.

Coal Creek

E. Quincy Ave.

Senac Creek

E. Queensburg St.

S. Powhaton Rd.

Aurora Reservoir

E. Smoky Hill Rd.

Murphy Creek

Smoky Hill Rd.

470

Gun Club Rd.

222B 46%
222D 21%
222A 52%
222E 3%
222C 83%
218 65%
212 46%
211 46%
210 40%
209 42%
208 46%
207 50%
201 45%
227E 8%
227C 27%
227B 13%
226A 6%
226B 39%
225D 83%
225C 2%
225B 2%
225A 2%
224D 68%
224B 2%
224A 2%
223 6%
224C 39%
228A 49%
227D 58%
227A 71%
228B 84%
229A 49%
229B 40%
229C 31%
229D 37%
230C 2%
230F 19%
230G 56%
230D 24%
230B 3%
227G 2%
227F 15%
230E 44%
230A 40%
215 46%
217 44%
204 49%
203 46%

Legend

- Hydrology Study Area
- Subbasin

% Impervious - Future Conditions

- 2 - 10
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 60
- 60 - 70
- 70 - 80
- 80 - 90
- 90 - 100

0 0.25 0.5 1
Miles

No.	DATE	DESCRIPTION	APPR.

Matrix DESIGN GROUP

designed by: _____
drawn by: WW
checked by: RK
project no.: 11.155.019
date: 10/2/2013

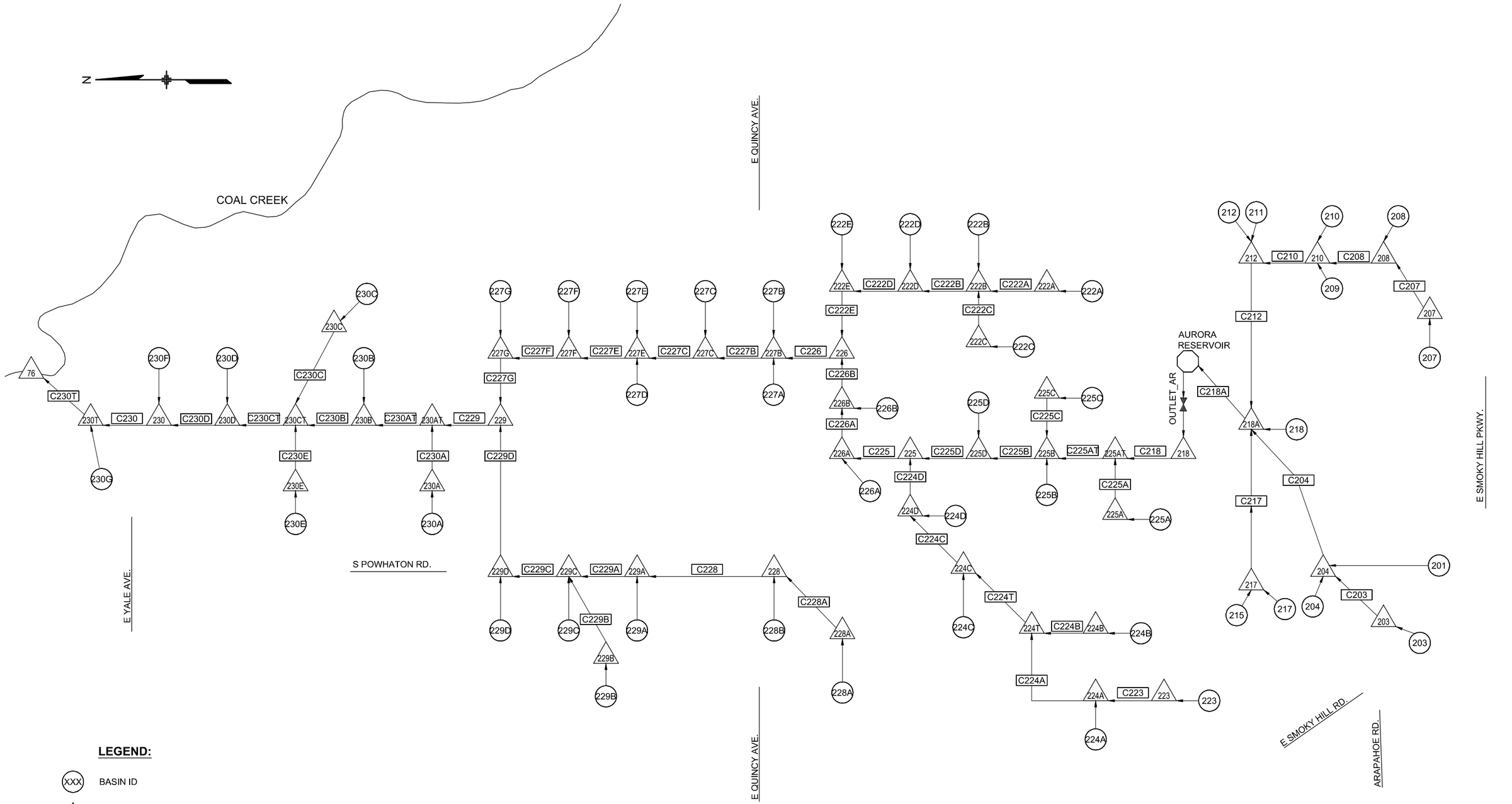
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT, CITY OF AURORA, SEMSWA

MAJOR DRAINAGEWAY PLAN
SENAC CREEK

PERCENT IMPERVIOUS
FUTURE CONDITIONS

FIGURE
B-3

FILE: G:\gis_projects\UDFCD_Sand_Creek\activeapps\Senac_Creek\Hydrology_Report\Fig_B-3_Impervious_Future.mxd, 4/2/2014, wilson_wheeler



No.	DATE	DESCRIPTION	APPR.

Matrix DESIGN GROUP

Designed by: HTH
Drawn by: HTH
Checked by: RK
Project no.: 11.155.019
Date: 2/4/2014

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT, CITY OF AURORA, SEMSWA

SENAC CREEK
MAJOR DRAINAGEWAY PLAN

EPA SWMM 5.0 ROUTING SCHEMATIC

FIGURE
B - 6

Table B-2 CUHP Input Parameters

Catchment Name	Area	Area	Distance to Centroid	Length	Slope	Existing Percent Imperviousness	Future Percent Imperviousness	Existing Depression Storage on Pervious	Future Depression Storage on Pervious	Existing Depression Storage on Impervious	Future Depression Storage on Impervious	Initial Infiltration Rate	Horton's Decay Coefficient	Final Infiltration Rate
	acres	mi2	mi	mi	ft/ft	%	%	in	in	in	in	in/hr	1/seconds	in/hr
201	406	0.6338	0.7477	1.6793	0.0271	30	45	0.35	0.35	0.1	0.1	3.37	0.00180	0.52
203	106	0.1659	0.1972	0.5052	0.0375	46	46	0.35	0.35	0.1	0.1	3.87	0.00180	0.56
204	269	0.4197	0.3981	0.9186	0.0371	49	49	0.35	0.35	0.1	0.1	3.17	0.00180	0.51
207	108	0.1688	0.3123	0.6977	0.0420	2	50	0.35	0.35	0.1	0.1	3.18	0.00180	0.51
208	149	0.2335	0.3189	0.7817	0.0420	2	46	0.35	0.35	0.1	0.1	3.13	0.00180	0.51
209	201	0.3143	0.3658	0.8858	0.0363	8	42	0.35	0.35	0.1	0.1	3.09	0.00172	0.49
210	90	0.1411	0.3467	0.6587	0.0440	7	40	0.35	0.35	0.1	0.1	2.87	0.00172	0.48
211	81	0.1259	0.1456	0.6139	0.0339	36	46	0.35	0.35	0.1	0.1	2.11	0.00126	0.35
212	86	0.1342	0.3316	0.6053	0.0344	22	46	0.35	0.35	0.1	0.1	2.48	0.00149	0.41
215	228	0.3569	0.6330	1.4086	0.0309	45	46	0.35	0.35	0.1	0.1	3.12	0.00178	0.51
217	155	0.2420	0.4397	0.9560	0.0357	44	44	0.35	0.35	0.1	0.1	2.98	0.00179	0.50
218	1307	2.0428	0.6384	2.4029	0.0131	63	65	0.35	0.35	0.1	0.1	1.49	0.00088	0.25
223	85	0.1327	0.2211	0.5128	0.0392	6	6	0.4	0.35	0.1	0.1	3.03	0.00180	0.50
222A	86	0.1345	0.0977	0.6515	0.0413	29	52	0.35	0.35	0.1	0.1	3.30	0.00180	0.52
222B	130	0.2027	0.5153	0.9058	0.0284	16	46	0.35	0.35	0.1	0.1	3.38	0.00180	0.53
222C	50	0.0787	0.1887	0.5080	0.0283	78	83	0.35	0.35	0.1	0.1	3.24	0.00180	0.52
222D	90	0.1403	0.2584	0.7298	0.0301	14	21	0.35	0.35	0.1	0.1	3.10	0.00180	0.51
222E	115	0.1793	0.3478	0.7512	0.0272	2	3	0.35	0.35	0.1	0.1	3.00	0.00180	0.50
224A	119	0.1866	0.3188	0.7529	0.0367	2	2	0.4	0.35	0.1	0.1	3.00	0.00180	0.50
224B	30	0.0466	0.1405	0.3287	0.0553	2	2	0.4	0.35	0.1	0.1	3.00	0.00180	0.50
224C	110	0.1713	0.1980	0.6584	0.0167	16	39	0.4	0.35	0.1	0.1	3.00	0.00180	0.50
224D	111	0.1732	0.2187	0.6957	0.0316	55	68	0.4	0.35	0.1	0.1	3.00	0.00180	0.50
225A	30	0.0461	0.1292	0.2448	0.0600	2	2	0.4	0.35	0.1	0.1	3.00	0.00180	0.50
225B	77	0.1204	0.3164	0.7089	0.0310	2	2	0.4	0.35	0.1	0.1	3.00	0.00180	0.50
225C	54	0.0848	0.1583	0.4424	0.0342	2	2	0.4	0.35	0.1	0.1	3.00	0.00180	0.50
225D	73	0.1141	0.2453	0.5424	0.0307	78	83	0.4	0.35	0.1	0.1	3.00	0.00180	0.50
226A	79	0.1230	0.2542	0.4991	0.0114	5	6	0.4	0.35	0.1	0.1	3.00	0.00180	0.50
226B	91	0.1424	0.3125	0.6938	0.0360	24	39	0.4	0.35	0.1	0.1	3.00	0.00180	0.50
227A	52	0.0811	0.2837	0.6497	0.0292	41	71	0.4	0.35	0.1	0.1	3.00	0.00180	0.50
227B	42	0.0650	0.2901	0.5900	0.0398	2	13	0.4	0.35	0.1	0.1	3.11	0.00180	0.51
227C	56	0.0882	0.1773	0.5025	0.0400	2	27	0.4	0.35	0.1	0.1	3.27	0.00180	0.52
227D	49	0.0758	0.3894	0.6381	0.0226	2	58	0.4	0.35	0.1	0.1	3.01	0.00180	0.50
227E	73	0.1143	0.2867	0.6008	0.0347	2	8	0.4	0.35	0.1	0.1	3.83	0.00148	0.66
227F	98	0.1531	0.2559	0.6504	0.0215	2	15	0.4	0.35	0.1	0.1	3.56	0.00160	0.60
227G	119	0.1855	0.4612	0.9341	0.0247	2	2	0.4	0.35	0.1	0.1	3.60	0.00159	0.61
228A	111	0.1735	0.2803	0.6142	0.0290	20	49	0.35	0.35	0.1	0.1	3.00	0.00180	0.50
228B	86	0.1346	0.1936	0.5629	0.0262	20	84	0.35	0.35	0.1	0.1	3.00	0.00180	0.50
229A	129	0.2014	0.3515	0.7555	0.0201	2	49	0.4	0.35	0.1	0.1	3.00	0.00180	0.50
229B	64	0.1000	0.1973	0.5723	0.0311	2	40	0.4	0.35	0.1	0.1	3.00	0.00180	0.50
229C	97	0.1513	0.1924	0.5629	0.0202	2	31	0.4	0.35	0.1	0.1	3.00	0.00180	0.50
229D	94	0.1474	0.2735	0.5528	0.0322	6	37	0.4	0.35	0.1	0.1	3.00	0.00180	0.50
230A	111	0.1732	0.2483	0.5475	0.0436	39	40	0.35	0.35	0.1	0.1	3.00	0.00180	0.50
230B	72	0.1128	0.2527	0.5513	0.0316	3	3	0.35	0.35	0.1	0.1	3.73	0.00171	0.58
230C	43	0.0672	0.1784	0.4712	0.0314	2	2	0.35	0.35	0.1	0.1	3.09	0.00175	0.52
230D	117	0.1821	0.2322	0.6858	0.0342	24	24	0.35	0.35	0.1	0.1	3.32	0.00180	0.52
230E	103	0.1604	0.3676	0.6850	0.0387	39	44	0.35	0.35	0.1	0.1	3.04	0.00180	0.50
230F	116	0.1818	0.3214	0.7587	0.0315	19	19	0.35	0.35	0.1	0.1	3.20	0.00178	0.52
230G	106	0.1650	0.3218	1.0881	0.0164	2	56	0.35	0.35	0.1	0.1	3.26	0.00179	0.52

EPA SWMM 5.0 100-YEAR, FUTURE CONDITIONS OUTPUT

Table B-4 - Senac Creek Baseline Peak Discharges

Design Point	Drainage Area	Existing Conditions Peak Discharges (cfs)							Future Conditions Peak Discharges (cfs)						
	(acres)	Q_2	Q_5	Q_{10}	Q_{25}	Q_{50}	Q_{100}	Q_{100}/Acre	Q_2	Q_5	Q_{10}	Q_{25}	Q_{50}	Q_{100}	Q_{100}/Acre
203	106	92	172	221	316	394	473	4.45	92	172	221	316	394	473	4.45
204	780	324	649	839	1255	1592	1930	2.47	429	811	1037	1532	1914	2305	2.95
207	108	5	40	60	109	144	180	1.67	94	173	221	312	387	452	4.19
208	257	8	84	133	254	340	431	1.67	183	359	456	664	826	992	3.85
210	549	27	137	224	449	617	804	1.46	232	487	639	1035	1339	1645	3.00
212	715	71	186	294	572	782	1032	1.44	258	566	746	1238	1603	1985	2.77
217	383	224	430	545	790	985	1172	3.06	229	437	553	800	997	1186	3.09
218	3186	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00
218A	3186	1714	3033	3787	5501	6829	8113	2.55	2043	3620	4531	6593	8204	9767	3.07
223	***85***	5	35	52	95	128	159	1.87	9	41	59	101	133	164	1.93
225	***689***	220	361	453	636	867	1114	1.62	289	472	585	802	1024	1254	1.82
226	***1329***	231	533	742	1301	1723	2190	1.65	408	810	1049	1663	2159	2664	2.00
228	***197***	38	111	152	258	339	420	2.13	172	286	354	503	621	741	3.76
229D	***581***	30	159	258	501	684	893	1.54	262	504	652	1016	1291	1580	2.72
230	***2960***	193	662	1048	1986	2771	3652	1.23	464	1058	1500	2522	3370	4272	1.44
230T	***3066***	187	654	1048	1988	2782	3683	1.20	464	1058	1504	2513	3370	4274	1.39
224A	***204***	5	62	100	194	265	337	1.65	11	74	112	207	276	347	1.70
224B	***30***	1	11	18	33	45	56	1.87	2	14	20	35	47	58	1.94
224T	***234***	5	71	114	223	305	387	1.65	13	84	128	237	318	400	1.71
224C	***344***	16	106	168	329	447	571	1.66	66	141	207	376	501	633	1.84
224D	***455***	112	196	255	418	567	728	1.60	170	304	379	550	698	851	1.87
225A	***30***	1	13	20	38	51	64	2.15	2	16	23	40	53	66	2.22
225B	***161***	2	48	78	153	207	262	1.63	7	58	88	162	214	270	1.68
225C	***54***	1	20	31	58	79	99	1.82	4	24	35	62	82	102	1.88
225AT	***30***	0	12	20	37	50	63	2.12	2	15	22	39	52	64	2.18
225D	***234***	109	164	198	259	319	399	1.71	118	176	209	269	331	410	1.75
226A	***767***	145	270	362	669	911	1168	1.52	207	375	482	780	1028	1293	1.68
226B	***858***	151	299	411	748	1012	1305	1.52	221	417	543	874	1146	1447	1.69
222A	***86***	32	76	102	154	197	236	2.75	82	149	184	253	312	373	4.33
222B	***266***	104	226	297	459	584	709	2.66	235	422	535	762	951	1105	4.15
222C	***50***	75	114	136	175	210	244	4.85	81	120	142	180	215	249	4.95
222D	***356***	105	245	332	530	684	836	2.35	238	447	560	809	1018	1207	3.39
222E	***471***	91	245	337	571	750	933	1.98	196	408	527	815	1048	1275	2.71
227B	***1423***	244	567	788	1378	1831	2327	1.64	432	855	1112	1773	2295	2831	1.99
228A	***111***	26	72	98	158	203	247	2.23	97	180	230	323	400	468	4.22
229A	***326***	32	121	178	330	438	556	1.70	206	364	460	687	864	1037	3.18
229B	***64***	1	21	32	61	83	104	1.63	40	82	106	154	193	229	3.58
229C	***487***	30	144	228	438	597	771	1.58	244	456	585	910	1154	1401	2.88
227C	***1479***	236	569	800	1408	1883	2402	1.62	424	857	1129	1815	2342	2901	1.96
227E	***1601***	227	572	814	1456	1956	2510	1.57	427	872	1147	1880	2429	3027	1.89
227F	***1699***	206	554	805	1473	1987	2571	1.51	404	844	1143	1876	2462	3093	1.82

Areas in ***Bold Italic*** show only tributary area downstream of Aurora Reservoir because of no release from Aurora Reservoir.

Table B-5 - Senac Creek Baseline Peak Volume

Design Point	Drainage Area	Existing Conditions Runoff Volumes (ac-ft)							Future Conditions Runoff Volumes (ac-ft)						
	(acres)	V_2	V_5	V_{10}	V_{25}	V_{50}	V_{100}	V_{100}/Acre	V_2	V_5	V_{10}	V_{25}	V_{50}	V_{100}	V_{100}/Acre
203	106	4	7	9	12	15	18	0.17	4	7	9	12	15	18	0.17
204	780	25	46	62	88	111	135	0.17	30	53	68	94	118	141	0.18
207	108	0	3	5	8	11	15	0.14	4	8	10	13	17	20	0.18
208	257	1	7	11	20	27	36	0.14	10	18	23	31	39	46	0.18
210	549	3	16	27	46	61	79	0.14	21	37	48	66	83	99	0.18
212	715	8	26	40	65	86	108	0.15	28	50	64	88	109	130	0.18
217	383	14	25	33	46	57	68	0.18	14	25	33	46	57	69	0.18
218	3186	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00
218A	3186	119	217	284	389	487	581	0.18	146	249	317	421	519	611	0.19
223	***85***	0	2	4	7	9	12	0.14	1	3	4	7	9	12	0.14
225	***689***	11	28	41	64	84	105	0.15	16	34	47	70	90	111	0.16
226	***1329***	23	56	81	125	164	205	0.15	35	71	96	140	179	219	0.17
228	***197***	3	9	12	19	25	31	0.16	10	16	20	26	32	38	0.19
229D	***581***	4	18	29	49	66	84	0.14	24	41	53	71	89	106	0.18
230	***2960***	42	111	164	266	352	443	0.15	80	158	215	314	401	489	0.17
230T	***3066***	42	113	169	274	363	458	0.15	85	166	225	328	418	509	0.17
224A	***204***	1	5	9	16	22	28	0.14	1	6	10	17	22	29	0.14
224B	***30***	0	1	1	2	3	4	0.13	0	1	1	2	3	4	0.14
224T	***234***	1	6	10	18	25	32	0.14	1	7	11	19	26	33	0.14
224C	***344***	2	10	16	28	38	48	0.14	5	13	20	31	42	52	0.15
224D	***455***	7	18	26	41	55	68	0.15	11	23	31	46	60	73	0.16
225A	***30***	0	1	1	2	3	4	0.13	0	1	1	2	3	4	0.14
225B	***161***	0	4	7	12	17	22	0.14	1	4	7	13	17	22	0.14
225C	***54***	0	1	2	4	6	7	0.14	0	1	2	4	6	8	0.14
225AT	***30***	0	1	1	2	3	4	0.14	0	1	1	2	3	4	0.14
225D	***234***	5	10	15	23	29	36	0.16	5	11	16	24	30	37	0.16
226A	***767***	13	31	46	71	93	117	0.15	18	38	52	78	100	123	0.16
226B	***858***	14	35	51	80	105	131	0.15	21	43	60	88	113	139	0.16
222A	***86***	2	4	6	9	11	14	0.16	4	6	8	11	13	16	0.18
222B	***266***	7	14	19	28	35	43	0.16	12	20	25	34	42	49	0.18
222C	***50***	3	5	6	7	9	10	0.20	3	5	6	8	9	10	0.21
222D	***356***	8	17	24	36	46	57	0.16	13	24	31	42	53	63	0.18
222E	***471***	8	20	29	45	59	73	0.16	14	27	36	52	66	80	0.17
227B	***1423***	24	60	87	134	176	220	0.15	39	77	105	152	193	236	0.17
228A	***111***	2	5	7	11	14	17	0.16	4	8	10	14	17	20	0.18
229A	***326***	4	12	18	29	39	49	0.15	16	26	33	43	53	62	0.19
229B	***64***	0	1	3	5	7	9	0.13	2	4	5	7	9	11	0.18
229C	***487***	4	16	25	42	56	71	0.15	21	35	45	61	75	90	0.18
227C	***1479***	25	61	89	138	182	227	0.15	40	80	108	157	201	245	0.17
227E	***1601***	25	63	92	146	193	242	0.15	43	85	116	169	216	264	0.16
227F	***1699***	25	64	95	153	202	254	0.15	44	88	120	177	227	278	0.16

Areas in ***Bold Italic*** show only tributary area downstream of Aurora Reservoir because of no release from Aurora Reservoir.

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Master Drainage Report
for
Southeast Aurora Maintenance Facility
(Pronghorn Natural Area and Open Space #01)

City of Aurora, Colorado

Owner:
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Public Works Department
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Project Number 10.58
April 2012

APPROVED FOR ONE YEAR FROM THIS DATE 05.30.12

RL 5/14/12 Kevin Wegener 5-15-12
City Engineer Date

5/23/12
Aurora Water Date

3rd

Master Drainage Report for
Southeast Aurora Maintenance Facility

Table of Contents

I. Introduction

The purpose of this report is to provide master and conceptual design of drainage facilities for the Southeast Aurora Maintenance Facility. The proposed site is located in a portion of the West 1/2 of the Southwest 1/4 of Section 4, Township 5 South, Range 65 West of the 6th Principle Meridian, City of Aurora, Arapahoe County, Colorado. The total site consists of approximately 88 acres. The site is located northeast of the E. Quincy Ave./S. Powhaton Road intersection. The site represents a proposed merger of two parcels, both of which are owned by the City of Aurora. The first is an unplatted 38.07 acres that fronts E. Quincy Ave and the second is 50 acres due north of the first parcel. The second parcel is currently a part of Lot 1, Block 1, Pronghorn Natural Area and Open Space Subdivision Filing No. 1. Since this project is currently in the FDP phase, no platting of these two parcels is anticipated at this time. The site is bounded on the west by the Denver Arapahoe Landfill. A vicinity map is included within Appendix A of this report.

The site is currently an open field covered with native type grasses. The existing site has a ridge running from the southwest corner of the site to the north east corner. Areas east of the ridge are part of the Senac Creek drainage basin. Areas west of the ridge are part of the Baldwin Creek Basin which is conveyed by open channel through the northern portion of the site. The Baldwin Creek is tributary to Senac Creek, with the confluence being approximately 3,200 LF north of the subject site. Both Baldwin Creek and Senac Creek drain to the north and are tributary to Coal Creek and Sand Creek prior to discharging into the Platte River.

Generally, on-site soils are classified in the Fondis group (FdC) and the Renohill group (RhD, RtE), which are within the SCS Type C hydrologic classification (Reference 10). The site is within flood zone "X", which are areas outside the 500-year flood, according to FIRM Panel 08005C0218K dated December 17, 2010.

The proposed site will be multi-use with a mixture of office buildings, shop warehouses, storage areas, a café, and an on-site fueling station. The drainage for this site has not been analyzed previously; however, Baldwin Creek and Senac Creek have been analyzed as part of the Upper Sand Creek Basin Outfall Planning Study (Ref. 3), which has recommended improvements for each channel. A more recent study, Sand Creek (Colfax to Yale) Major Drainageway Plan and FHAD Baseline Hydrology (Ref. 6), has also included this site within its study area; however, it does not specifically address Baldwin Creek as Reference 3 does. Excerpts from both studies have been included in Appendix A for reference.

Concepts, drainage patterns, and offsite facilities presented within this report shall be confirmed in the subsequent Preliminary and Final Drainage Reports for this site.

No variances from the City of Aurora Drainage Criteria are requested within this report.

II. Historic Drainage

The site lies within the Senac Creek Basin and the Coal Creek Basin. Locally, a ridgeline divides the site in a north-south direction. Areas west of the ridgeline are tributary to Baldwin Creek and drain to the north towards the confluence with Senac Creek and are identified as Basins C and D on the Historic Drainage Map. Basins A, B, E, and F are tributary to Senac Creek to the east of the site and eventually Coal Creek to the north of the proposed site.

The land to the southwest of the project site, noted as Basin 01 on the Master Drainage Plan and Historic Drainage Map, is area that is tributary to Baldwin Creek and is conveyed through the proposed site at Design Point 6 on the Historic Drainage Map. Proposed improvements to Baldwin Creek have been identified in the Upper Sand Creek Basin Outfall Planning Study (Ref. 3) based on anticipated upstream development. The OSP anticipates a peak 100-year runoff within Baldwin Creek of 1,400 cfs. This runoff includes area for the entire Baldwin Creek basin, Basins 228 & 229 (Ref 3). The basin map and the proposed plan and profiles sheets from the OSP have been included in the appendix for reference.

The Sand Creek (Colfax to Yale) Major Drainageway Plan and FHAD Baseline Hydrology (Ref. 6), approved in November 2011, includes the Southeast Aurora Maintenance Facility Site within its study area. It does not, however, specifically address Baldwin Creek, with the closest design point approximately 500' south of Quincy Avenue, and therefore has not been incorporated into this study.

Areas east of the ridgeline are tributary to Senac Creek and drain northeast and east towards the confluence with Baldwin Creek and then Coal Creek. Developed runoff from the proposed site has been accounted for in Reference 3.

Runoff from Quincy Avenue is currently conveyed by a roadside ditch to the low point at the Senac Creek crossing east of the subject site. No other off-site flows from the south are conveyed on-site.

III. Design Criteria

This study has been prepared based on the City of Aurora Storm Drainage Design and Technical Criteria Manual (Reference 1) and the Urban Drainage Criteria Manual (Reference 2). This report is also in compliance with the Upper Sand Creek Basin Outfall Planning Study (Ref 3).

Preliminary Runoff calculations for both historic and developed flows have been included with this report. Subsequent Preliminary and Final Drainage Reports for this project will refine design parameters and update calculations as necessary. The Rational Method will be used to develop peak discharges corresponding to the 2-year and 100-year events. Rainfall intensities will be taken from the City of Aurora Storm Drainage Design and Technical Criteria. These are presented in the Appendix of this report on the rational calculation forms per Equation 5.5 of Reference 1.

Historic and Developed runoff coefficients for the 2-year and 100-year storms are presented in the Appendix of this report. Conceptual storm sewer has been shown on the drainage plan. Final storm sewer and inlet design and locations will be determined in subsequent drainage reports. Rainfall rates are in conformance with USDCM Volume 1 and 2. The 2-year and 100-year P1 equals 1.00 inches and 2.65 inches, respectively.

Per Section 3.61 of Reference 1, on-site detention is required for all developments. Three water quality/detention ponds are being proposed to serve Basins A, B, E, and D2. All ponds will be designed utilizing the Urban Drainage Full Spectrum Detention Method including ½ of the Excess Urban Runoff Volume within the 100-year detention volume per section 6.31 of Reference 1.

Channel improvements to Baldwin Creek will follow Urban Drainage Volume 1 (Ref 2) criteria for horizontal and vertical alignment, lining, freeboard, and erosion protection measures. For Master Planning purposes, Upper Sand Creek Outfall Planning Study (Ref 3) flow rates have been utilized by this study. Future studies for this site will include additional runoff analysis in order to finalize the open channel design.

IV. Conceptual Drainage Plan

This study presents the general concept plan for stormwater management for the overall site. Final drainage patterns and improvements will be determined in subsequent drainage

studies. However, in general, runoff from the site will be directed in the proposed streets and parking areas to the proposed culvert/storm sewer locations. The street flow will be conveyed by a combination of curb and gutter and roadside ditches. Vertical conditions may require the use of drop structure in roadside ditches to provide a velocity control measure. Culvert sizes shown on the Master Drainage Plan are preliminary in nature. Final culvert and storm sewer pipe sizes will be provided in subsequent studies.

Runoff from the on-site developed areas will be conveyed into proposed detention/water quality ponds prior to being released into the drainageway. Refer to the Master Drainage Plan in the back pocket of this report for conceptual drainage patterns. A conceptual site layout for the entire campus is shown on the Master Drainage Plan. This layout is for information only and to determine conceptual developed drainage patterns. The final layout may be subject to change during the Contextual Site Plan (CSP) process. This project is intended to be constructed in phases. Subsequent drainage studies for the individual phases will address the final drainage details.

The off-site Basin O1 runoff (Baldwin Creek) flows onto the site near the northwest corner of the site and into Basin D. Currently, the plan for Baldwin Creek is to realign the segment crossing the site in order to create more useable land for the Maintenance Facility. Proposed improvements for the Creek will conform to recommendations made in the Upper Sand Creek Outfall Planning Study including a 102' right-of-way which includes a trapezoidal channel with a 42' bottom width, 5' depth, 4:1 side slopes, two 10' benches on either side of the channel, and two 4' vertical drop structures to provide a sustainable channel slope through the site (Ref 3). In order to conform with the City of Aurora standard 2' freeboard, the typical section for this channel has been adjusted to include 110' right-of-way.

After reviewing the Upper Sand Creek Basin OSP, it has been determined that the 1,400 cfs anticipated by the study for Baldwin Creek is conservative in nature. The runoff calculated by the OSP includes approximately 250 acres downstream of the SE Aurora Maintenance Facility site in the determination of the channel section proposed for Baldwin Creek. In order to provide an alternative channel design, Peak Civil has performed a preliminary CUHP analysis for Basin O1 utilizing existing topography provided by the City of Aurora. Assuming 45% imperviousness for upstream tributary areas, the 100-year peak flow at Design Point 6, shown on the Historic Basin map, is 752 cfs. Based on this flow rate, the proposed Baldwin Creek cross section through the site would consist of a trapezoidal channel w/ a 20' bottom width, 4:1 side slopes, and 5.5' depth including 2' of freeboard.

This analysis provides an optional channel cross section, should the client prefer to maximize the useable on-site space. Output files have been included in the appendix for reference.

Basin C lies on the west side of the site and are tributary to Baldwin Creek. Basin C will be entirely landscape area/pervious area and will discharge undetained into Baldwin Creek.

Basin D, which has been subdivided into two basins D1 and D2, lies in the northwest corner of the site and is also tributary to Baldwin Creek. This basin consists of landscape area and roadway/hard surface storage area. For the purposes of this report, the hard surface storage areas have been assumed to be asphalt pavement; however, this assumption may change with subsequent studies for this site. Runoff from Basin D2 will be routed to Detention/Water Quality Pond 3. Runoff from Basin D1, which will consist of entirely landscape and/or native vegetation, will discharge undetained off-site and into Baldwin Creek. Calculations have been included in the appendix for Pond 3.

Basins A, B, E, and F lay on the eastern side of the site and are tributary to Senac Creek. Basins A, B, and E land uses consist of landscape, multiple building types, and parking/roadway areas. Runoff from these basins will be conveyed via storm sewer and/or open channels into Detention/Water Quality Ponds located on the east side of the site. Pond 1 will serve Basins A and B and Pond 2 will serve Basin E. Discharge from Ponds 1 and 2 will be into Senac Creek. Basin F is predominantly landscape area. Runoff from this basin will discharge undetained into Senac Creek.

V. Water Quality

The overall water quality concept for the SE Aurora Maintenance Facility is to conserve and protect the Coal Creek watershed. This will be accomplished through several control measures including the following:

- Construction site stormwater discharge
- Post-Construction/Permanent stormwater management
- Pollution prevention/good housekeeping

A construction site stormwater management plan will be submitted at the time of final construction documents. Construction Best Management Practices (BMPs) to be implemented will be determined at the same time. Refer to the City of Aurora Rules and

Regulations Regarding Stormwater Discharges Associated with Construction Activities (Reference 5) for typical construction BMP measures.

Post-Construction/Permanent BMPs may include a combination of extended detention basins, engineered grass swales, porous pavement, and bioretention rain gardens. Currently, two extended detention/water quality ponds are proposed with development of the SE Aurora Maintenance Facility with an optional third pond depending on final site layout. The ponds have been preliminarily sized according to City of Aurora Criteria (Reference 1) and Urban Storm Drainage Criteria Manual, Volume 3 (Reference 2). Preliminary pond calculations utilizing the Full Spectrum Method (Reference 2) have been included in the appendix of this report. The outlet structure for the detention/water quality ponds will effectively provide a two-stage release for the Excess Urban Runoff Volume and the 100-year storm events. The EURV release rate is based on a 72-hour drain time. Release rates for the 100-year storm event are determined by the soil types and have been determined to be 1.0 cfs/acre, per City of Aurora criteria. The historic release rate for the entire site is equal to 1 cfs/acre, so the Full Spectrum pond design method will be adequate for this site. Please reference the chart below. Additional details of the detention/water quality pond facilities will be presented in subsequent drainage reports.

100-Year Release Rate Comparison

Basin	Area (AC)	Historic Runoff (cfs)	Runoff (cfs)/AC
A	7.5	7.4	1.0
B	24.0	22.6	0.9
C	10.8	10.5	1.0
D	15.6	13.5	0.9
E	24.7	25.0	1.0
F	1.5	2.3	1.5
G	5.2	5.1	1.0
Total	**89.2**	**86.4**	**1.0**

Additional water quality measures may be included within the overall project framework including, but not limited to, porous pavement, engineered grass swales, and localized porous landscape detention. Depending on which BMPs are used, the site may qualify for Level 1 or Level 2 Lower Impact Development (LID) status. The functional description of each level of Lower Impact Development is described as follows, per Reference 2:

- Level 1 – the intent of Level 1 LID is to direct runoff from impervious surfaces to flow over grass covered areas and/or permeable pavement, and to provide a sufficient travel time to facilitate the removal of suspended solids before runoff leaves the site, enters a curb and gutter system, or enter another stormwater collection system.
- Level 2 – the intent of Level 2 LID is to provide an enhancement to Level 1 by replacing solid street curb and gutter systems with no curb or slotted curbing, low velocity grass-lined swales and pervious street shoulders, including pervious rock-lined swales.

Level 1 and Level 2 LID qualification will result in approximately 10% or 20% reduction in water quality capture volume required, respectively. Final water quality details will be presented in subsequent drainage reports and will be in compliance with the framework established in the Aurora Reservoir Parks and Water Master Plan (Ref 4). Please refer to Volume 3 of Reference 2 for additional information regarding post-construction/permanent BMPs.

VI. Conclusions

This study is in compliance with the City of Aurora Storm Drainage Design and Technical Criteria Manual and the Urban Storm Drainage Criteria Manual (References 1 and 2). This study is also in compliance with the Upper Sand Creek Basin Outfall Planning Study (Ref 3). This study is a conceptualized analysis of the drainage patterns and requirements for the SE Aurora Maintenance Facility site based upon preliminary FDP level planning. Subsequent drainage studies will include conveyance and water quality details required for each project phase. The proposed development and proposed drainage facilities will result in no adverse impacts created by the quantity or quality of storm water generated by this project. Maintenance of all on-site BMPs and storm drainage facilities shall be by the City of Aurora.

VII. References

1. Storm Drainage Design and Technical Criteria Manual; City of Aurora; Latest Edition.

2. Urban Storm Drainage Criteria Manual; Denver Regional Council of Governments; Latest Edition.

3. Upper Sand Creek Basin OSP; Kiowa Engineering Corporation; August 1990.

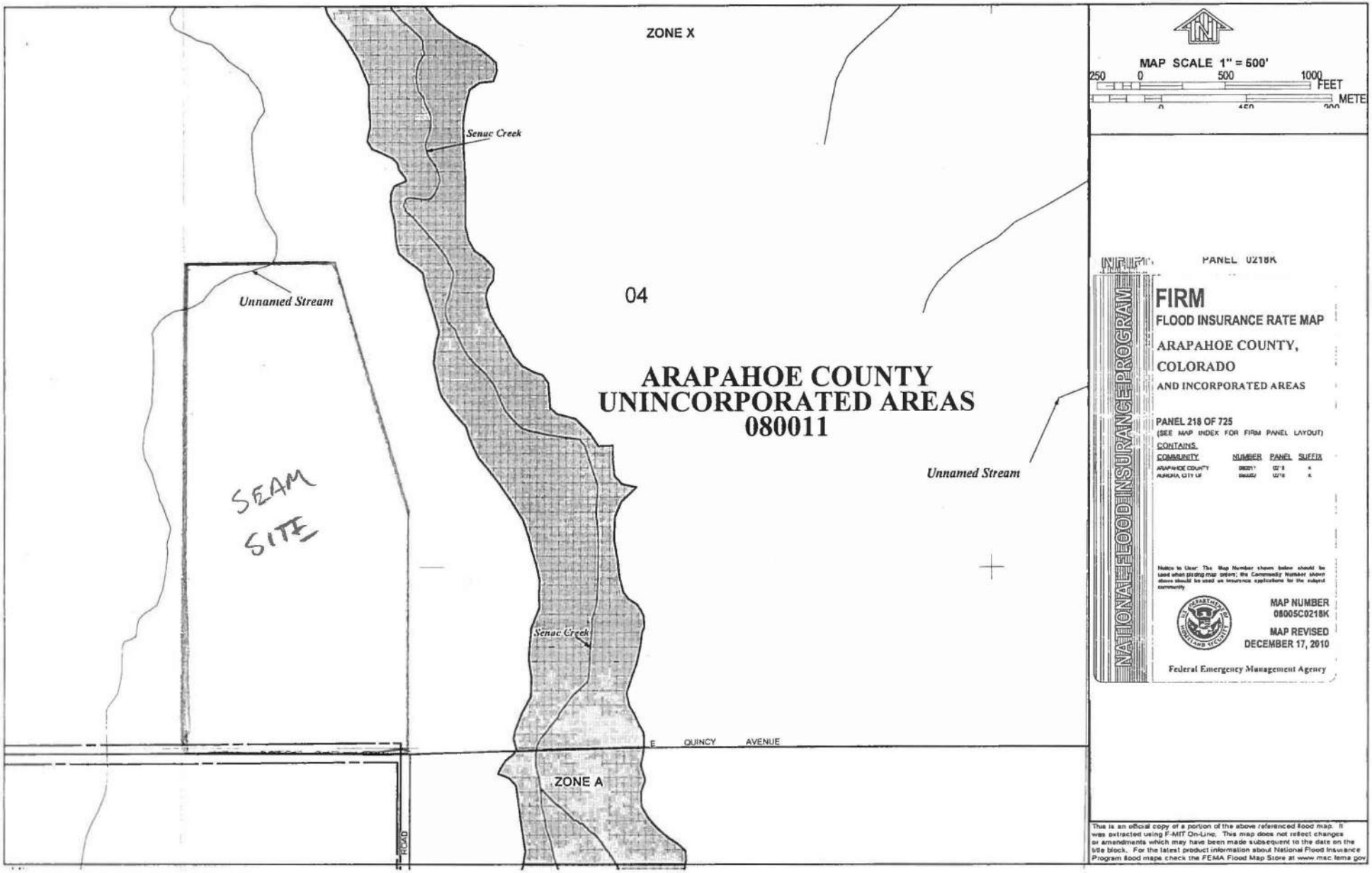
4. Aurora Reservoir Parks and Water Master Plan, December 2011

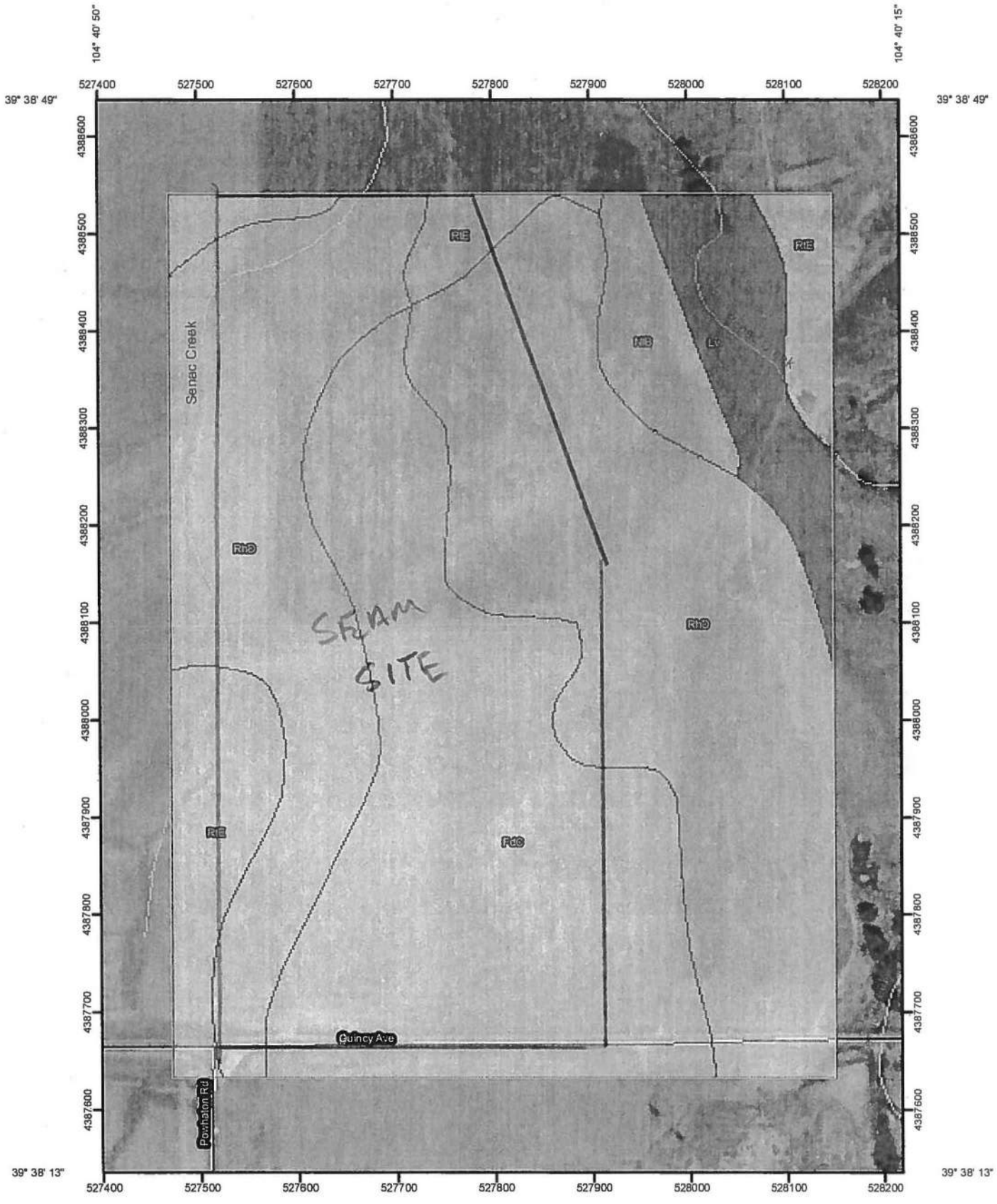
5. Rules and Regulations Regarding Stormwater Discharges Associated with Construction Activities; City of Aurora; 2010

6. Sand Creek (Colfax to Yale) Major Drainageway Plan and FHAD Baseline Hydrology; Matrix Design Group; November 2011

VICINITY/OFF-SITE BASIN MAP

SCALE 1"=3000'


ZONE X
Senac Creek
Unnamed Stream
04
ARAPAHOE COUNTY
UNINCORPORATED AREAS
080011
Unnamed Stream
SEAM
SITE
Senac Creek
E QUINCY AVENUE
ZONE A
ROAD
MAP SCALE 1" = 500'
250 0 500 1000 FEET
METE
PANEL 0218K
NATIONAL FLOOD INSURANCE PROGRAM
FIRM
FLOOD INSURANCE RATE MAP
ARAPAHOE COUNTY,
COLORADO
AND INCORPORATED AREAS
PANEL 218 OF 725
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)
CONTAINS:
COMMUNITY NUMBER PANEL SUFFIX
ARAPAHOE COUNTY 080011 0218 K
AURORA, CITY OF 080002 0218 K
Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.
MAP NUMBER
08005C0218K
MAP REVISED
DECEMBER 17, 2010
Federal Emergency Management Agency
This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov


104° 40' 50"
104° 40' 15"
39° 38' 49"
39° 38' 13"
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4388600
4388500
4388400
4388300
4388200
4388100
4388000
4387900
4387800
4387700
4387600
Senac Creek
RtE
NaB
RhD
FdD
STEAM SITE
Quincy Ave
Powhaton Rd
Map Scale: 1:5,260 if printed on A size (8.5" x 11") sheet.
N
Meters
0 50 100 200 300
Feet
0 200 400 800 1,200

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features

- Cities

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:5,260 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

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 accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Arapahoe County, Colorado
Survey Area Data: Version 8, May 1, 2009

Date(s) aerial images were photographed: 8/6/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Arapahoe County, Colorado (CO005)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
FdC	Fondis silt loam, 3 to 5 percent slopes	C	48.5	31.8%
Lv	Loamy alluvial land	B	8.9	5.8%
NlB	Nunn loam, 0 to 3 percent slopes	C	5.3	3.4%
RhD	Renohill-Buick loams, 3 to 9 percent slopes	C	76.3	50.1%
RtE	Renohill-Litle-Thedalund complex, 9 to 30 percent slopes	C	13.4	8.8%
Totals for Area of Interest			**152.4**	**100.0%**

Description

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

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

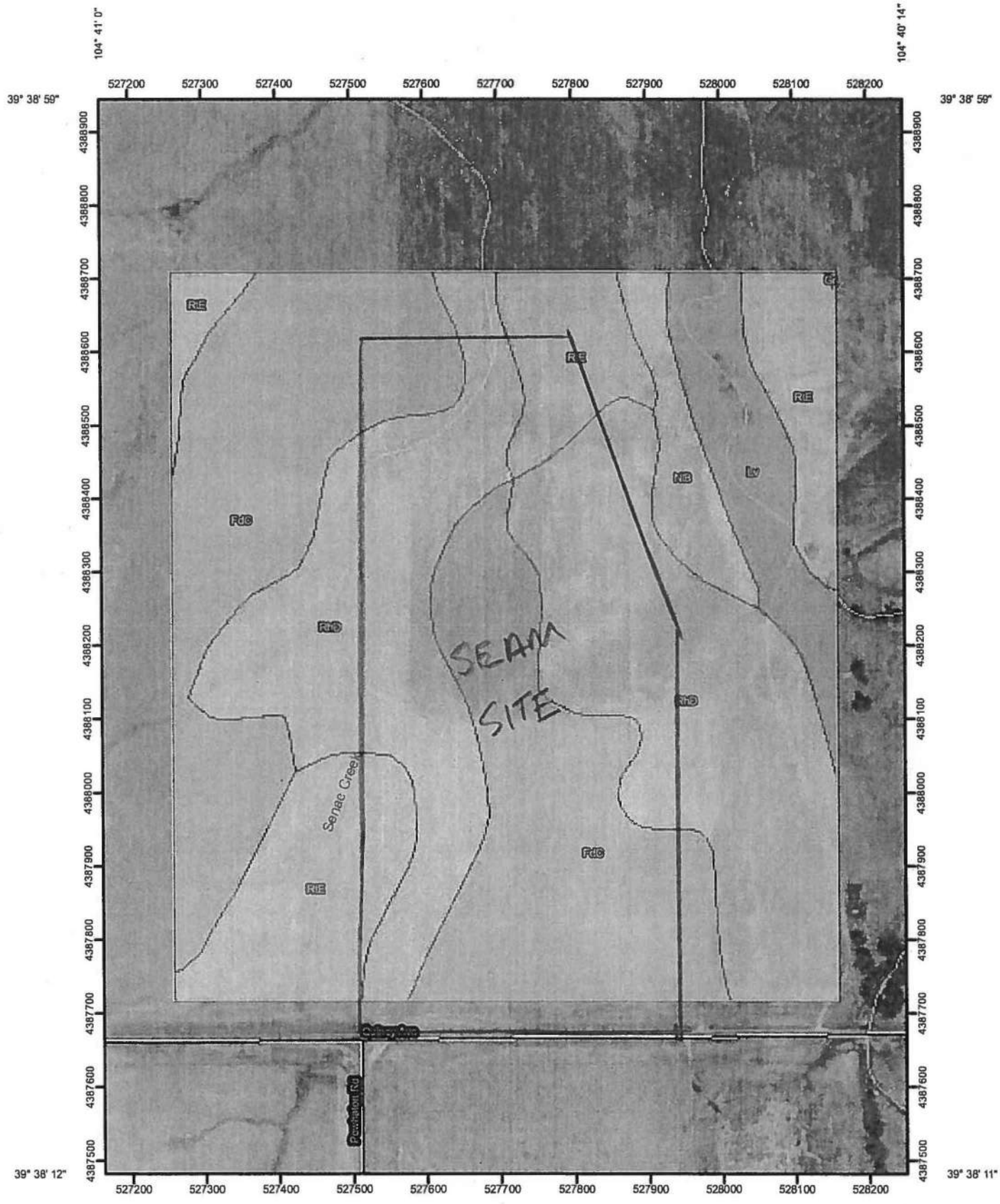
Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

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

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

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

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.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4388000
4387900
4387800
4387700
4387600
4387500
RtE
RhD
FdC
NtB
Lv
G
SEAM SITE
Senac Creek
Peoria Rd
Map Scale: 1:6,980 if printed on A size (8.5" x 11") sheet.
N
Meters
0 50 100 200 300
Feet
0 250 500 1,000 1,500

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- .02
- .05
- .10
- .15
- .17
- .20
- .24
- .28
- .32
- .37
- .43
- .49
- .55
- .64
- Not rated or not available

Political Features
- Cities

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:6,980 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

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 accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Arapahoe County, Colorado
Survey Area Data: Version 8, May 1, 2009

Date(s) aerial images were photographed: 8/6/2005

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.

K Factor, Whole Soil

K Factor, Whole Soil— Summary by Map Unit — Arapahoe County, Colorado (CO005)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
FdC	Fondis silt loam, 3 to 5 percent slopes	.32	76.8	34.7%
Gr	Gravelly land	.10	0.1	0.0%
Lv	Loamy alluvial land	.37	13.8	6.2%
NlB	Nunn loam, 0 to 3 percent slopes	.24	7.3	3.3%
RhD	Renohill-Buick loams, 3 to 9 percent slopes	.28	85.1	38.5%
RtE	Renohill-Litle-Thedalund complex, 9 to 30 percent slopes	.28	38.1	17.2%
Totals for Area of Interest			**221.2**	**100.0%**

Description

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

"Erosion factor Kw (whole soil)" indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Rating Options

Aggregation Method: Dominant Condition

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "Dominant Condition" first groups like attribute values for the components in a map unit. For each group, percent composition is set to the sum of the percent composition of all components participating in that group. These groups now represent "conditions" rather than components. The attribute value associated with the group with the highest cumulative percent composition is returned. If more than one group shares the highest cumulative percent composition, the corresponding "tie-break" rule determines which value should be returned. The "tie-break" rule indicates whether the lower or higher group value should be returned in the case of a percent composition tie.

The result returned by this aggregation method represents the dominant condition throughout the map unit only when no tie has occurred.

Component Percent Cutoff: *None Specified*

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Layer Options: Surface Layer

For an attribute of a soil horizon, a depth qualification must be specified. In most cases it is probably most appropriate to specify a fixed depth range, either in centimeters or inches. The Bottom Depth must be greater than the Top Depth, and the Top Depth can be greater than zero. The choice of "inches" or "centimeters" only applies to the depth of soil to be evaluated. It has no influence on the units of measure the data are presented in.

When "Surface Layer" is specified as the depth qualifier, only the surface layer or horizon is considered when deriving a value for a component, but keep in mind that the thickness of the surface layer varies from component to component.

When "All Layers" is specified as the depth qualifier, all layers recorded for a component are considered when deriving the value for that component.

Whenever more than one layer or horizon is considered when deriving a value for a component, and the attribute being aggregated is a numeric attribute, a weighted average value is returned, where the weighting factor is the layer or horizon thickness.

TABLE 1
RUNOFF COEFFICIENTS AND PERCENTS IMPERVIOUS

LAND USE OR SURFACE CHARACTERISTICS	PERCENT IMPERVIOUS	FREQUENCY			
		2	5	10	100
Business:					
Commercial Areas	95	.87	.87	.88	.89
Neighborhood Areas	85	.60	.65	.70	.80
Residential:					
Single-Family (**)	(*)	.40	.45	.50	.60
Multi-Unit (detached)	60	.45	.50	.60	.70
Multi-Unit (attached)	75	.60	.65	.70	.80
1/2 Acre Lot or Larger	(*)	.30	.35	.40	.60
Apartments	80	.65	.70	.70	.80
Industrial:					
Light Areas	80	.71	.72	.76	.82
Heavy Areas	90	.80	.80	.85	.90
Parks, Cemeteries	5	.10	.10	.35	.60
Playgrounds	10	.15	.25	.35	.65
Schools	50	.45	.50	.60	.70
Railroad Yard Areas	15	.40	.45	.50	.60
Undeveloped Areas:					
Historic Flow Analysis, Greenbelts, Agricultural	2	(See "Lawns")			
Off-Site Flow Analysis (when land use not defined)	45	.43	.47	.55	.65

TABLE 1 (continued)

RUNOFF COEFFICIENTS AND PERCENTS IMPERVIOUS

LAND USE OR SURFACE CHARACTERISTICS	PERCENT IMPERVIOUS	FREQUENCY			
		2	5	10	100
Streets:					
Paved	100	.87	.88	.90	.93
Gravel	40	.15	.25	.35	.65
Concrete Drive and Walks	96	.87	.87	.88	.89
Roofs	90	.80	.85	.90	.90
Lawns, Sandy Soil (A and B Soils):	2				
2% Slope		.05	.06	.08	.10
2-7% Slope		.10	.11	.13	.15
>7% Slope		.15	.16	.18	.20
Lawns, Clay Soil (C and D Soils):	5				
2% Slope		.13	.14	.15	.17
2-7% Slope		.18	.19	.20	.22
>7% Slope		.25	.27	.30	.35

NOTE: These Rational Formula coefficients may not be valid for large basins

(*)See Figures *RO-3 through RO-5* of USDCM Volume 1 for percent impervious.

(**)Up to 5 units per acre. Single-family with more than 5 units per acre, use values for multi-unit/detached

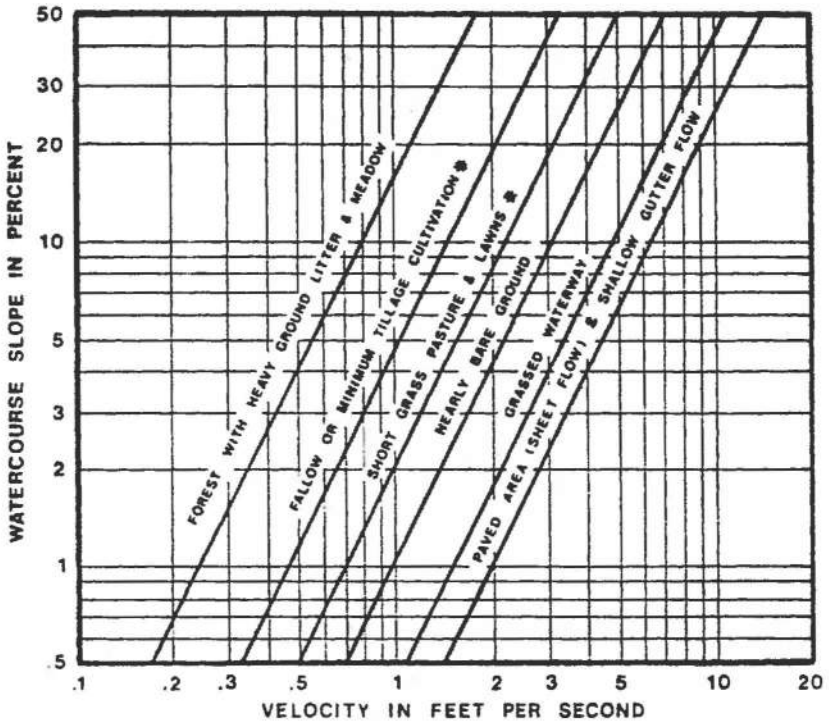


Figure RO-1—Estimate of Average Overland Flow Velocity for Use With the Rational Formula

FIGURE 1

2/16/2012

LEGEND

- PROPERTY BOUNDARY
- EXISTING RIGHT OF WAY
- 01 / 298.0 / 22 / 40 — BASIN DESIGNATION; 2-YR RUNOFF COEFF.; 100-YR RUNOFF COEFF.; BASIN AREA (AC)
- 5 — DESIGN POINT
- MAJOR DRAINAGE BASIN BOUNDARY
- 6500 — EXISTING CONTOUR
- FLOW DIRECTION

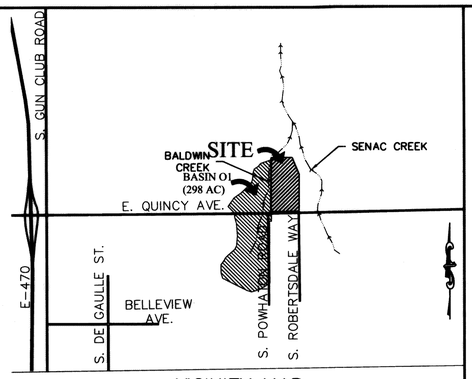
NOTES:

1) OFF-SITE BASIN 01 HAS BEEN EVALUATED AS PART OF REF. 3, REF. 6, AND INDEPENDENTLY AS PART OF THIS STUDY. FOR CONSERVATIVE MASTER PLANNING PURPOSES, FLOW RATES FROM REF. 3 HAVE BEEN UTILIZED BY THIS STUDY. FUTURE STUDIES OF THIS SITE WILL INCLUDE ADDITIONAL RUNOFF ANALYSIS IN ORDER TO FINALIZE THE OPEN CHANNEL DESIGN.

RUNOFF SUMMARY TABLE

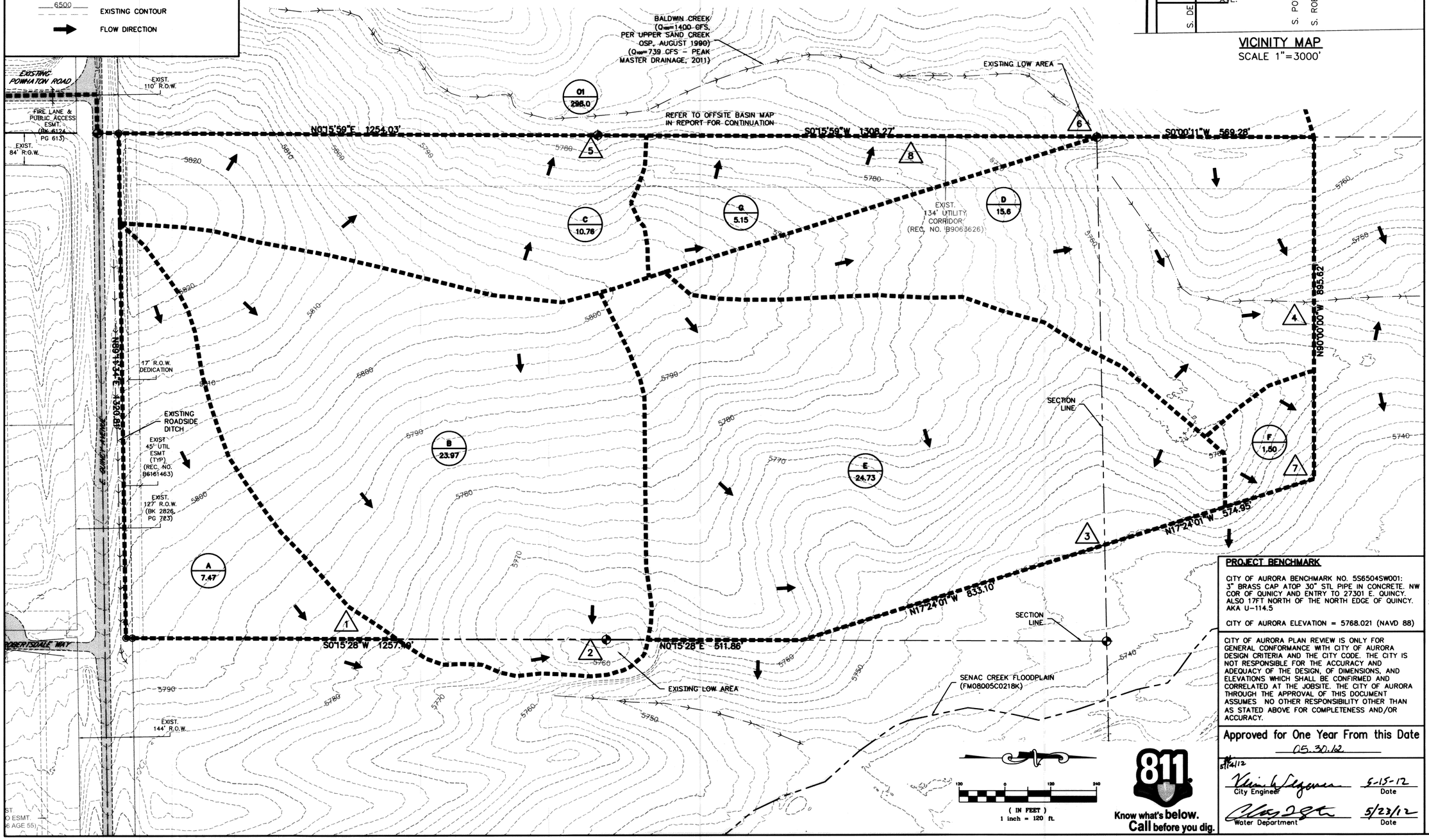
DESIGN POINT	BASINS	AREA (AC)	Q_5(CFS)	Q_{100}(CFS)
1	A	7.47	2.4	7.4
2	B	23.97	7.4	22.6
5	C	10.76	3.4	10.5
3	E	24.73	8.1	25.0
7	F	1.5	0.7	2.3
6	01	298		1400*
8	G	5.15	1.7	5.1
4	D	15.6	4.4	13.5
4	01+D+C+G	329.51		1400*

* PER UPPER SAND CREEK OSP, AUGUST 1990 (REF. 3)



VICINITY MAP
SCALE 1"=3000'

NO.	REVISION	DATE	BY
1	PER CITY COMMENTS	4/9/12	BR
2	PER CITY COMMENTS	4/25/12	BR



PROJECT BENCHMARK

CITY OF AURORA BENCHMARK NO. 5S6504SW001: 3" BRASS CAP ATOP 30" STL PIPE IN CONCRETE. NW COR OF QUINICY AND ENTRY TO 27301 E. QUINCY. ALSO 17FT NORTH OF THE NORTH EDGE OF QUINCY. AKA U-114.5

CITY OF AURORA ELEVATION = 5768.021 (NAVD 88)

CITY OF AURORA PLAN REVIEW IS ONLY FOR GENERAL CONFORMANCE WITH CITY OF AURORA DESIGN CRITERIA AND THE CITY CODE. THE CITY IS NOT RESPONSIBLE FOR THE ACCURACY AND ADEQUACY OF THE DESIGN, OF DIMENSIONS, AND ELEVATIONS WHICH SHALL BE CONFIRMED AND CORRELATED AT THE JOBSITE. THE CITY OF AURORA THROUGH THE APPROVAL OF THIS DOCUMENT ASSUMES NO OTHER RESPONSIBILITY OTHER THAN AS STATED ABOVE FOR COMPLETENESS AND/OR ACCURACY.

Approved for One Year From this Date
05.30.12

5/24/12
City Engineer — 5-15-12 Date

Water Department — 5/23/12 Date

811 Know what's below. Call before you dig.

SOUTHEAST AURORA MAINTENANCE FACILITY

HISTORIC DRAINAGE PLAN

Peak Civil Consultants
200 W. HAMPDEN AVE., SUITE 200
ENGLEWOOD, COLORADO 80110
PH: 720.855.3859
FAX: 720.855.3860
CONTACT: JEFF FRENCH

REGISTERED PROFESSIONAL ENGINEER 32615 4.30.12

DATE: 11/22/11
JOB NO: 10.58
DRAWN BY: ---
APPROVED:
CADD FILE: 10.58_HISTORIC DRAINAGE

1

2/1034

LEGEND

- PROPERTY BOUNDARY
- PROPOSED RIGHT OF WAY
- EXISTING RIGHT OF WAY
- O1 / 298.0 / .22 / .40 — BASIN DESIGNATION, 2-YR RUNOFF COEFF., 100-YR RUNOFF COEFF., BASIN AREA (AC)
- PROPOSED SWALE
- DESIGN POINT
- MAJOR DRAINAGE BASIN BOUNDARY
- CONCEPTUAL STORM SEWER
- 6500 — EXISTING CONTOUR
- FLOW DIRECTION

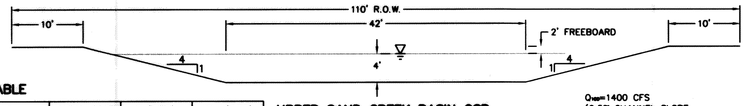
NOTES:

1. PONDS SHOWN HEREON ARE SCHEMATIC ONLY. ACTUAL SIZE, SHAPE, AND LOCATION WILL BE REFINED AS SITE DESIGN PROGRESSES.
2. THE LOCAL STREET ALIGNMENT SHOWN HEREON IS NOT APPROVED BY THIS PLAN.
3. LAYOUT SHOWN ON THIS PLAN IS CONCEPTUAL AND FOR INFORMATION ONLY. LAYOUT MAY BE SUBJECT TO CHANGE.
4. THIS MASTER DRAINAGE PLAN HAS BEEN PREPARED BASED UPON THE BEST INFORMATION AVAILABLE AT THE TIME. CONCEPTS, DRAINAGE PATTERNS, AND OFFSITE FACILITIES PRESENTED ON THIS PLAN SHALL BE CONFIRMED IN THE SUBSEQUENT PRELIMINARY AND FINAL DRAINAGE PLANS FOR THIS PROPERTY.
5. ALL DRAINAGE FACILITIES ON SITE INCLUDING STORM SEWERS AND SWALES, ARE DESIGNED FOR THE 100-YEAR STORM EVENT.
6. OFF-SITE BASIN O1 HAS BEEN EVALUATED AS PART OF REF. 3, REF. 6, AND INDEPENDENTLY AS PART OF THIS STUDY. FOR CONSERVATIVE MASTER PLANNING PURPOSES, FLOW RATES FROM REF. 3 HAVE BEEN UTILIZED BY THIS STUDY. FUTURE STUDIES OF THIS SITE WILL INCLUDE ADDITIONAL RUNOFF ANALYSIS IN ORDER TO FINALIZE THE OPEN CHANNEL DESIGN.

RUNOFF SUMMARY TABLE

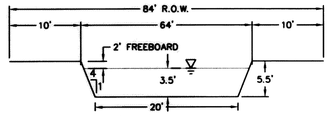
DESIGN POINT	BASINS	AREA (AC)	Q_{100}(CFS)	Q_{max}(CFS)
1	A	7.56	10.3	30.1
8	B1	4.63	9.0	27.4
2	B2	39.98	56.9	164.4
2	A+B1+B2	52.17	68.6	199.6
3	E	16.12	21.3	62.3
5	C	4.45	2.1	6.9
6	O1	298.0		1400*
9	D2	8.78	21.6	61.2
4	D1	5.98	2.5	8.0
4	O1+D1+D2+C	317.21		1400*
7	F	1.50	1.0	3.1

* PER UPPER SAND CREEK OSP, AUGUST 1990 (REF. 3)



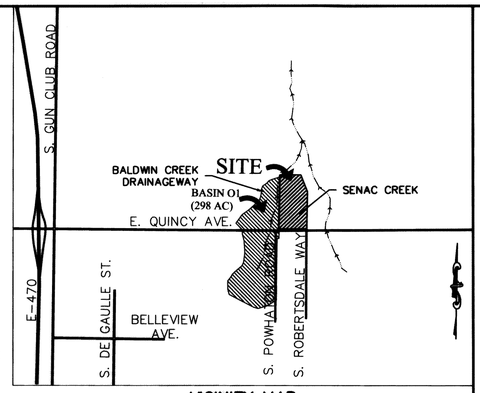
UPPER SAND CREEK BASIN OSP TYPICAL CROSS SECTION FOR BALDWIN CREEK
1" = 10'

Q_{max}=1400 CFS
(0.5% CHANNEL SLOPE W/2 - 4' DROPS)



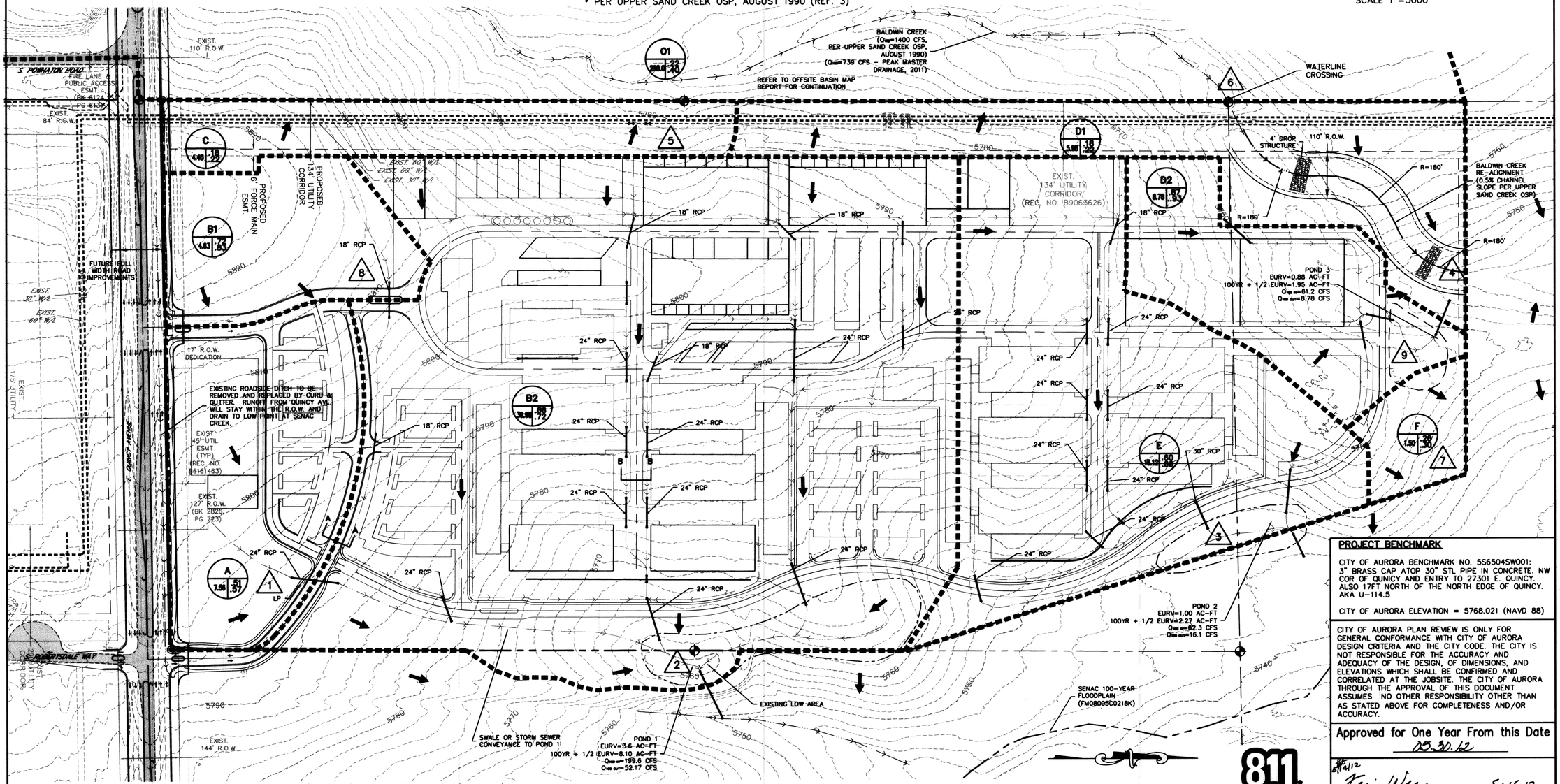
ALTERNATE BALDWIN CREEK CROSS SECTION
1" = 10'

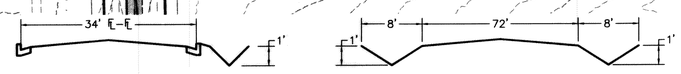
Q_{max}=739 CFS
(0.5% CHANNEL SLOPE W/2 - 4' DROPS)



VICINITY MAP
SCALE 1"=3000'

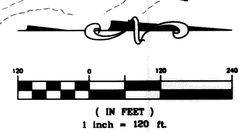
NO.	REVISION	DATE	BY
1	PER CITY COMMENTS	4/9/12	BR
2	PER CITY COMMENTS	4/25/12	BR





SECTION A-A
N.T.S.

SECTION B-B
N.T.S.



(IN FEET)
1 inch = 120 ft.

811 Know what's below. Call before you dig.

PROJECT BENCHMARK

CITY OF AURORA BENCHMARK NO. 5S6504SW001: 3" BRASS CAP ATOP 30" STL PIPE IN CONCRETE. NW COR OF QUNICY AND ENTRY TO 27301 E. QUINCY. ALSO 17FT NORTH OF THE NORTH EDGE OF QUINCY. AKA U-114.5

CITY OF AURORA ELEVATION = 5768.021 (NAVD 88)

CITY OF AURORA PLAN REVIEW IS ONLY FOR GENERAL CONFORMANCE WITH CITY OF AURORA DESIGN CRITERIA AND THE CITY CODE. THE CITY IS NOT RESPONSIBLE FOR THE ACCURACY AND ADEQUACY OF THE DESIGN, OF DIMENSIONS, AND ELEVATIONS WHICH SHALL BE CONFIRMED AND CORRELATED AT THE JOBSITE. THE CITY OF AURORA THROUGH THE APPROVAL OF THIS DOCUMENT ASSUMES NO OTHER RESPONSIBILITY OTHER THAN AS STATED ABOVE FOR COMPLETENESS AND/OR ACCURACY.

Approved for One Year From this Date
05.30.12

5/14/12
City Engineer — 5-15-12 Date

Water Department — 5/23/12 Date

SOUTHEAST AURORA MAINTENANCE FACILITY

MASTER DRAINAGE PLAN
PROPOSED CONDITIONS

Peak Civil Consultants
200 W. HAMPDEN AVE., SUITE 200
ENGLEWOOD, COLORADO 80110
PH: 720.855.3859
FAX: 720.855.3860
CONTACT: JEFF FRENCH

COLORADO REGISTERED 32815 PROFESSIONAL ENGINEER 4/30/12

DATE: 10/25/11
JOB NO: 10.58
DRAWN BY: ---
APPROVED:
CADD FILE: 10.58_MASTER DRAINAGE

2

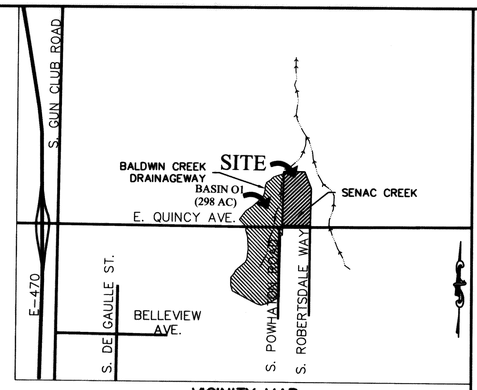
2/10/34 3

LEGEND

- PROPERTY BOUNDARY
- PROPOSED RIGHT OF WAY
- EXISTING RIGHT OF WAY
- BASIN DESIGNATION (01; 298.0 AC; .22 2-YR RUNOFF COEFF.; .40 100-YR RUNOFF COEFF.)
- BASIN AREA (AC)
- PROPOSED SWALE
- DESIGN POINT (5)
- MAJOR DRAINAGE BASIN BOUNDARY
- CONCEPTUAL STORM SEWER
- 6500 EXISTING CONTOUR
- FLOW DIRECTION
- POROUS PAVEMENT.
- POROUS LANDSCAPING DETENTION
- WATER QUALITY GRASS SWALES

NOTES:

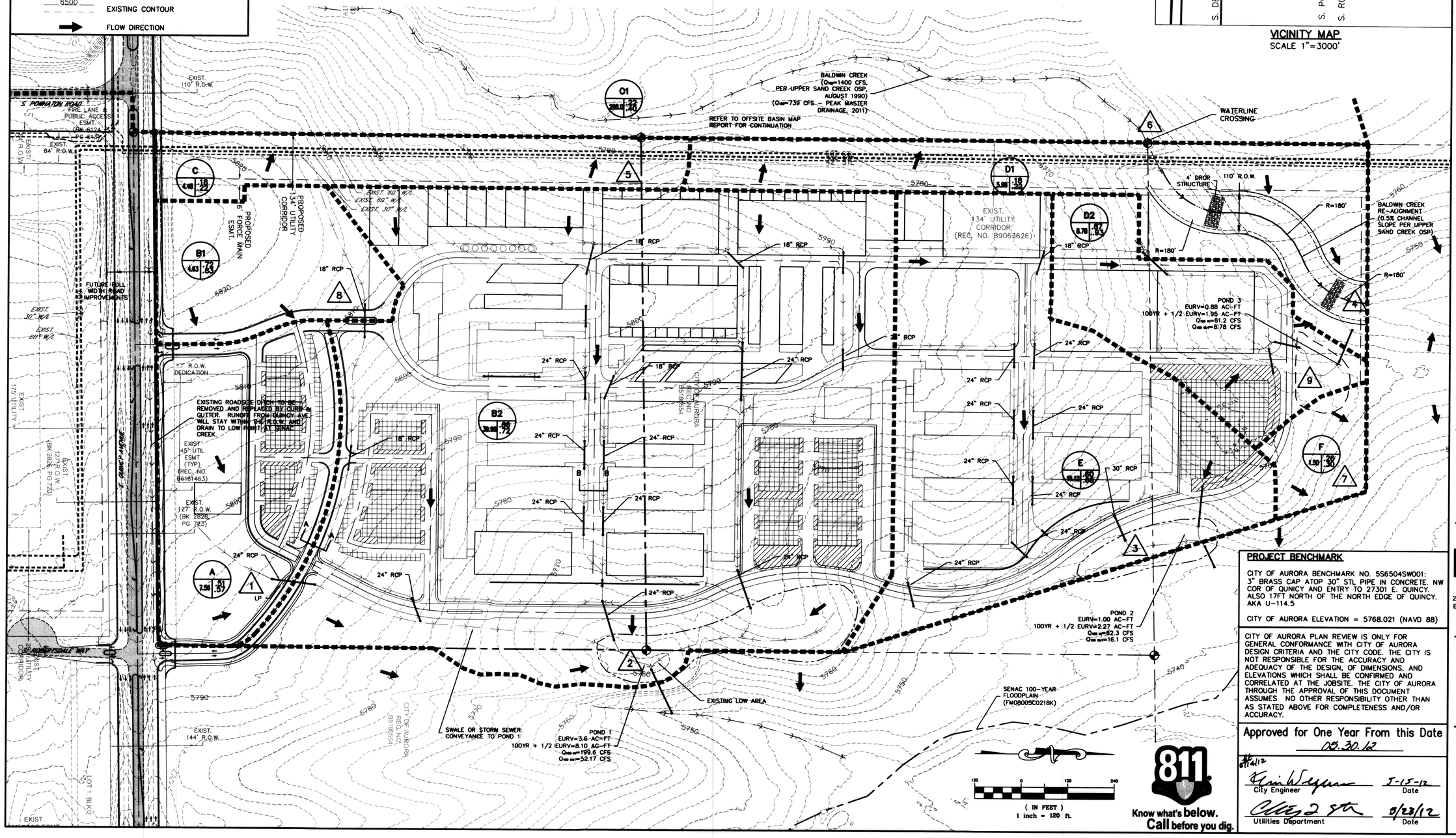
1. WATER QUALITY FACILITIES IDENTIFIED ON THIS EXHIBIT ARE CONCEPTUAL IN NATURE AND WILL NEED TO BE REFINED DURING FINAL DESIGN PHASE.



VICINITY MAP
SCALE 1"=3000'

NO.	REVISION	DATE	BY
1	PER CITY COMMENTS	4/9/12	BR
2	PER CITY COMMENTS	4/25/12	BR

SOUTHEAST AURORA MAINTENANCE FACILITY
WATER QUALITY EXHIBIT



(IN FEET)
1 inch = 120 ft.

Know what's below. Call before you dig.

PROJECT BENCHMARK

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Approved for One Year From this Date
05.30.12

5/11/12
City Engineer — 5-15-12 Date

Utilities Department — 5/23/12 Date

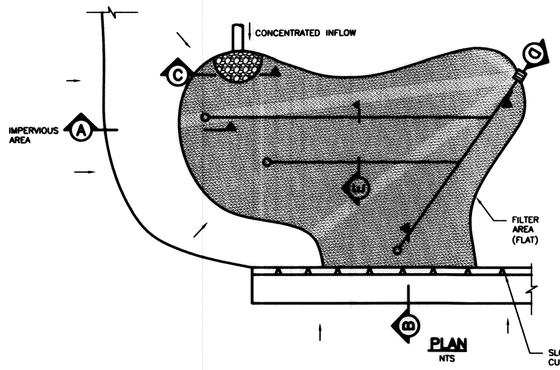
Peak Civil Consultants
200 W. HAMPDEN AVE., SUITE 200
ENGLEWOOD, COLORADO 80110
PH: 720.855.3859
FAX: 720.855.3860
CONTACT: JEFF FRENCH

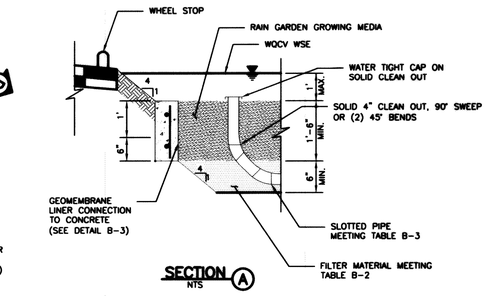
COLORADO REGISTERED PROFESSIONAL ENGINEER — 32815 — 4.30.12 — PROFESSIONAL ENGINEER

DATE: 11/22/11
JOB NO: 10.58
DRAWN BY: ---
APPROVED:
CADD FILE: 10.58_MASTER DRAINAGE

3

2/2024





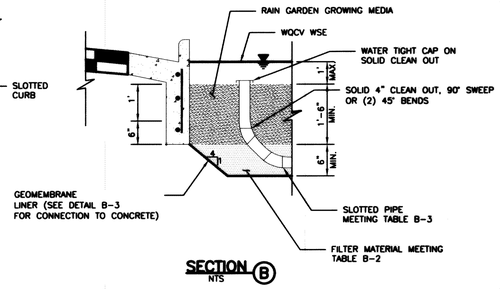
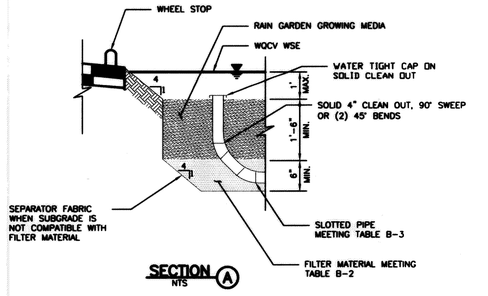
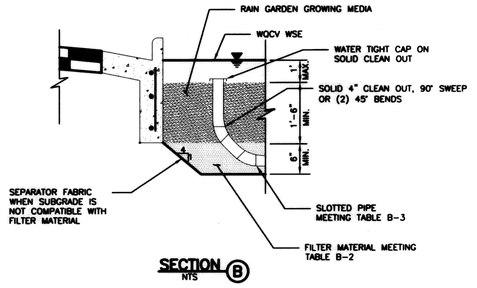


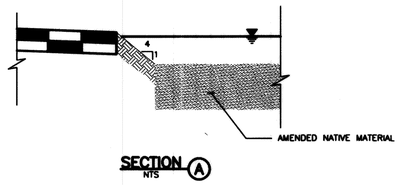
FIGURE B-1
RAIN GARDEN
PLAN AND PROFILE

NO-INFILTRATION SECTIONS
TYPICAL RAIN GARDEN SECTIONS

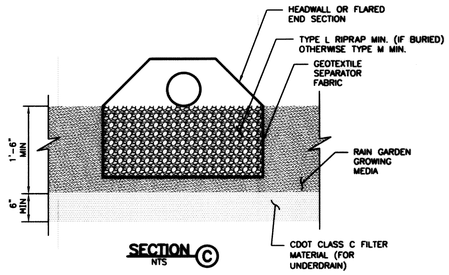


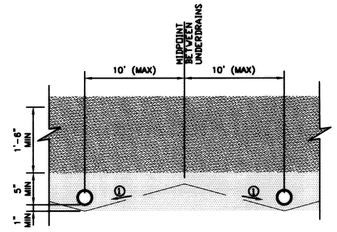


PARTIAL INFILTRATION SECTIONS



FULL INFILTRATION SECTION





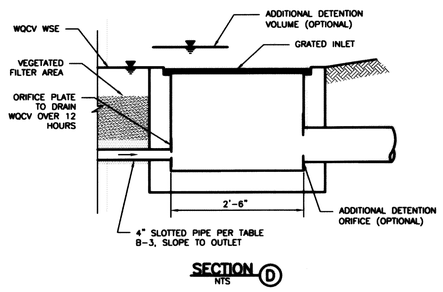
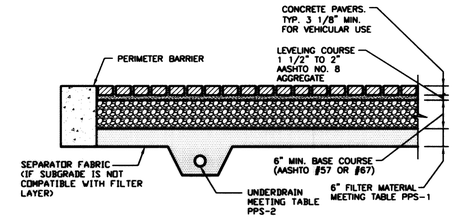


FIGURE B-1 SECTION C AND D

FIGURE B-1 SECTION E

POROUS LANDSCAPE DETENTION/RAIN GARDEN

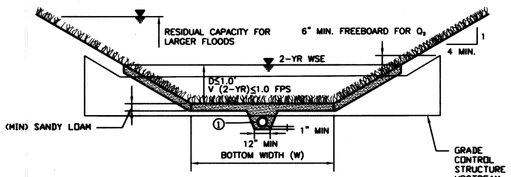


NOTES:

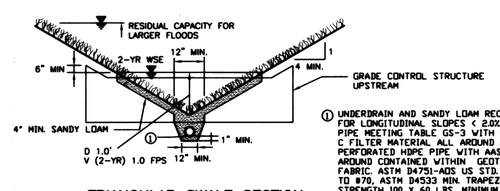
1. THIS SECTION IS DESIGNED FOR PARTIAL INFILTRATION AS DESCRIBED IN BMP FACT SHEET T-10. SEE FIGURE PPS-1 FOR MODIFICATIONS FOR USE WITH NO INFILTRATION OR FULL INFILTRATION SECTIONS.
2. A PAVEMENT DESIGN SHOULD BE PERFORMED IN AREAS OF VEHICULAR USE.

FIGURE PICP-1 PICP PAVEMENT SECTION
NTS

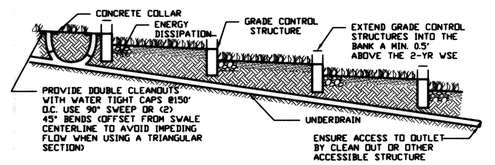
POROUS PAVEMENT



TRAPEZOIDAL SWALE SECTION
NTS



TRIANGULAR SWALE SECTION
NTS



SWALE PROFILE
NTS

FIGURE GS-1

WATER QUALITY GRASS SWALE

FOR INFORMATION ONLY

NO.	REVISION	DATE	BY
1	PER CITY COMMENTS	4/9/12	BR
2	PER CITY COMMENTS	4/25/12	BR

SOUTHEAST AURORA MAINTENANCE FACILITY

WATER QUALITY EXHIBIT
DETAILS

Peak Civil Consultants
200 W. HAMPDEN AVE., SUITE 200
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PH: 720.855.3859
FAX: 720.855.3860
CONTACT: JEFF FRENCH

JEFFREY A. FRENCH 32615 4-25-12 PROFESSIONAL ENGINEER

DATE: 11/22/11
JOB NO: 10.58
DRAWN BY: ---
APPROVED:
CADD FILE: 10.58_MASTER DRAWINGS