# MASTER DEVELOPMENT DRAINAGE PLAN AND PRELIMINARY DRAINAGE REPORT FOR WATERBURY FILINGS NO. 1 & 2 EL PASO COUNTY, COLORADO

**PCD FILE NO:**
**PUDSP-21-005**

**SEPTEMBER 2021**

Prepared For:

Prepared for:
4-WAY RANCH JOINT VENTURE
P.O. BOX 50223
COLORADO SPRINGS, CO 80949
Contact: Peter Martz

Prepared By:

**TERRA NOVA ENGINEERING, INC.**
721 S. 23rd ST.
Colorado Springs, CO 80904

Job No. 1715.00

# MASTER DEVELOPMENT DRAINAGE PLAN AND PRELIMINARY DRAINAGE REPORT FOR WATERBURY FILINGS NO. 1 & 2 EL PASO COUNTY, COLORADO

## TABLE OF CONTENTS


| | |
|---|---|
| ENGINEER'S STATEMENT | PAGE 3 |
| INTRODUCTION | PAGE 4 |
| PROJECT CHARACTERISTICS | PAGE 5 |
| FLOODPLAINS STATEMENT | PAGE 6 |
| HYDROLOGIC ANALYSIS FOR MDDP | PAGE 6 |
| Existing Condition Analysis for MDDP | PAGE 7 |
| Early Grading Analysis for MDDP | PAGE 9 |
| Proposed Condition Analysis for MDDP | PAGE 11 |
| HYDRAULIC ANALYSIS FOR MDDP | PAGE 23 |
| HYDROLOGIC ANALYSIS FOR FILING 1 FDR | PAGE 24 |
| DRAINAGE FEES | PAGE 28 |
| SUMMARY | PAGE 28 |
| BIBLIOGRAPHY | PAGE 29 |


**REQUIRED MAPS AND DRAWINGS**


VICINITY MAP

S.C.S. SOILS MAP

FEMA FIRM MAP

HYDROLOGIC CALCULATIONS

HYDRUALIC CALCULATIONS

FULL SPECTRUM & WATER QUALITY CALCULATIONS

HEC-RAS ANALYSIS

DRAINAGE MAPS

# MASTER DEVELOPMENT DRAINAGE PLAN AND PRELIMINARY DRAINAGE REPORT FOR WATERBURY FILINGS NO. 1 & 2 EL PASO COUNTY, COLORADO

## DESIGN ENGINEER'S STATEMENT:

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

_____ _____

Quentin Armijo, P.E. 37170 Date
On behalf of Terra Nova Engineering, Inc.

## OWNER/DEVELOPER'S STATEMENT:

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

_____ _____

Authorized Signature Date

_____

Printed Name, Title

_____

Business Name

_____

Address

---

## EL PASO COUNTY:

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

_____ _____

Jennifer Irvine, P.E. Date
County Engineer / ECM Administrator
Conditions:

# MASTER DEVELOPMENT DRAINAGE PLAN AND PRELIMINARY DRAINAGE REPORT FOR WATERBURY FILINGS NO. 1 & 2 EL PASO COUNTY, COLORADO

## INTRODUCTION

### *PURPOSE*

The purpose of this Master Development Drainage Plan is to identify and analyze the proposed drainage patterns, determine proposed runoff quantities, size drainage structures for conveyance of developed runoff based upon the overall development of single-family homes along with all the supporting infrastructure, while following the guidelines of the 4-step process.

This site was previously submitted as Waterbury Phase 1 Preliminary Plan with 3 separate filings by Classic Consulting Engineers & Surveyors, LLC. The Final Drainage Report for Filing 1 along with the construction drawings were approved in September of 2016 by EL Paso County Development Services and the Final Drainage Report for Filing 2 along with the construction drawings were submitted for review in September of 2017 and comments given back in September of 2017. Filing 3 had been preliminary designed but nothing submitted to EL Paso County. Since this time the owner has revised the lot layout and removed the alleys shown in Filings 1 & 2. All the public roadways have remained the same with the exception of the ROW for Saybrook Road from Stapleton to Bayshore Way, where the it changed from 65' to 89'. With these changes El Paso County Development Services has requested that we submit a new Preliminary Plan and the associated MDDP for these revisions. The site will now be developed in 2 Filings, Filing 1 & Filing 2. A Final Drainage Report will be submitted with the Final Plat and Construction drawings. With the Preliminary Plan submittal an Early Grading Permit is also being submitted. The overall proposed drainage patterns do not differ much and follow the previous studies closely.

### *DBPS*

The Waterbury site lies within the Geick Ranch and the Haegler Drainage Basins, storm runoff drains southerly via 2 existing natural waterways, one bordering the site on the west (Haegler Drainage Basin) and one on the east (Geick Ranch Drainage Basin). The "Haegler Drainage Basin Planning Study" was prepared by URS and approved in June of 2009. Drexel Barrel & Co prepared the "Geick Ranch Drainage Basin Planning Study" submitted for approval February 2008 but it has yet to be

approved by El Paso County, and therefore there are no drainage fees in this basin. In the Haelger DBPS it is noted that "a portion of the Haelger Ranch as delineated by the County map was found to part of the Geick ranch Drainage Basin at judge Orr Road, due toa the lack of a roadway culvert at the crossing. This is excluded from the Haegler Ranch DBPS and is included as part of the Geick ranch DBPS, per the County." These 2 channels eventually drain to Black Squirrel Creek and ultimately the Arkansas River.

***PROJECT CHARACTERISTICS***

Waterbury Filings 1 & 2 consists of 61.93 acres and is part of a larger development of 322.0 acres to be developed over time and in multiple filings. A PUD Development Plan, Zoning and Conceptual plans have all been previously processed and approved with El Paso County. Filing 1 is 29.44 acres with 108 single family units, while Filing 2 is 32.44 acres 93 single family lots.

The site is in the SE 1/4 of Sections 28, SE ¼ 29 & NW 1/4 33, Township 12 South, Range 64 West of the 6$^{th}$ Principal Meridian within El Paso County, Colorado. The site is bounded to the west by natural channel and 4-Way Ranch Filing No. 1. To the south by Stapleton Drive. To the north by unplatted land consisting of future Waterbury Filings, and to the west by a natural channel unplatted land consisting of future Waterbury Filings (See vicinity map, Appendix A).

The site consists of 100% Columbine Gravelly (19) per the USDA, NRCS web soil survey. The hydrologic soil group "A" was used to represent the soil types and determine the onsite basin overland flow. (See map in appendix)

The study area consists of undeveloped land that has existing vegetation consisting of established native grasses. A ridge running north to south splits the site with the west 1/3 draining southwest with average slopes of 0% to 3% and the remaining 2/3 drains southwest with average slopes of 0% to 3%. There are no existing on-site improvements.

The site has been analyzed in several approved studies including the following "Revision to the MDDP for Meridian Ranch, EL Paso County, Colorado", approved October 2005, and prepared by

PBS&J. "Final Drainage Report for 4-Way Ranch Phase 1" by JR Engineering Dated March 2006. The "Geick Ranch Drainage Basin Planning Study" dated February 2008, and prepared by Drexel Barrel & Co. The "Preliminary/Final Drainage Report for Meridian Ranch filing No. 3" by Tech Contractors, November 2011. The "Master Development Drainage Plan, 4-Way Ranch – Phase 1" by Advanced Design Professionals, Inc. dated January 2012. The "Preliminary Drainage Report for Waterbury (Phase 1 Preliminary Plan) dated June 2013 by Classic Consulting analyzes this area in more detail and then Classic followed up with the "Final Drainage Report for Waterbury Filing No. 1" dated September 2016 which studied a portion of the area now being developed.

As-built field survey data is the basis for the design of the drainage basins.

**FLOODPLAIN STATEMENT**

A portion of this site along the western edge is within a designated F.E.M.A. floodplain, as determined by Flood Insurance Rate Map No. 08041C0552G December 7, 2018 (see appendix). The floodplain is shown on the proposed Drainage Map in the appendix along with the FEMA Firmette. Lots from Filings 1 & 2 abut the channel with rear lots lines, but are set to be outside of the floodplain. As mentioned in the previously approved "Final Drainage Report for Waterbury Filing 1" dated September 2016 prepared by Classic Consulting Engineering & Surveying the floodplain was determined by Kiowa Engineering in a 2004 LOMR (04-08-0012) using a HEC-RAS analysis modeling developed flows along the channel from the 3-42" culverts under Eastonville Road south to the existing stock pond (Design Point 13) south of Stapleton Drive with proposed and existing improvements such as the proposed 42" dual culverts located at the Gilbert Road crossing and existing dual 4' x 8' box culverts at Stapleton Drive (see appendix for HEC-RAS model). At the time of Final Platting the Floodplain elevations are required to be shown on the Final Plat.

## HYDROLOGIC ANALYSIS FOR MDDP

***MAJOR DRAINAGE BASIN***

The Waterbury Filing 1 & 2 site lies within the within the Geick Ranch and Haegler Drainage Basin, storm runoff drains southerly to Black Squirrel Creek via a public piped system and then into Fountain Creek. "Geick Ranch Drainage Basin Planning Study" dated February 2008, and preprepared by Drexel Barrel & Co. has been drafted but not yet approved. The Haelger Ranch DBPS the Drainage

Basin Planning Study on file for this basin was prepared by URS and approved in June of 2009.

***METHODOLOGY***

The El Paso County Drainage Criteria Manual (EPCDCM), dated May 1994 was the resource used in this analysis with the exception for calculating the 5-year and 100-year design storm events. Chapter 6 of the City of Colorado Springs Drainage Criteria Manual (CSDCM) was referenced in determining rainfall and runoff for the proposed drainage system per the EPC DCM1 Update resolution. Runoff was calculated using the Rational Method for developed conditions (see appendix). Runoff coefficients were calculated using weighted impervious values for each specific basin base upon Table 6.6 of the CSDCM. Table 6.5 was used for calculating intensity (see appendix).

***EXISTING MAJOR SUBBASIN DESCRIPTION (FOR MDDP)***

In the existing condition runoff from Filing 2 sheet flows south onto Filing 1 and from here the runoff is directed southwest and southeast overland to the existing channels on the west and eastside of the site. Below is a description of the existing condition's Design Points, Basins and site runoff.

There are 3 offsite basins that drain existing runoff onto the site from the north under Eastonville Road through culverts. There is also unplatted open space just north of the proposed Waterbury Filing No. 1 & 2.

At Design Point 10A 3-42" RCP that routes runoff from a temporary sediment pond south onto the property (Basin OS-5). The "Preliminary/Final Drainage Report for Meridian Ranch Filing No. 3" and shows flows of $Q_5$ = 28 cfs, $Q_{100}$ = 153 cfs while the Meridian Ranch MDDP shows a 100-year flow of 185 cfs. This larger flow is used in the HEC-RAS model for downstream channel analysis and culvert design. As mentioned above in the Floodplain Statement section the natural channel along the west side of the site is a recognized FEMA floodplain. This channel in the Haegler Creek Basin drains south to Stapleton Drive where dual 4' x 8' concrete box culverts route the water south in its natural path.

Design Point EX1 consist of onsite Basin EXA's 9.62 acres and offsite Basin OS-5's 6.74 acres,

which both consist of undeveloped open space prairie and the FEMA flood channel and the runoff form Design Point EX10A mentioned above travel in the channel south to the southern boundary of our site. the combined flow from these upstream basins and our onsite basins that contribute to the flow is $Q_5$ = 38 cfs, $Q_{100}$ = 198 cfs. This report does not analyze the flow coming from the adjacent Subdivision as the culverts were previously sized and installed in the approved Classic Consulting "Final Drainage Report for Waterbury Filing No. 1" dated September 2016.

Design Point EX2 is a point at the southern boundary of Filing 1 where runoff ($Q_5$ = 1 cfs, $Q_{100}$ = 9 cfs) from Basin EXB's 4.09 acres of undeveloped prairie flow into Stapleton Road.

Design Point EX3 consists of a shallow swale that leave the site at the south east boundary. Runoff ($Q_5$ = 0 cfs, $Q_{100}$ = 1 cfs) from Basin OS-4's 0.29 acres is directed south onto Basin EXC. The runoff ($Q_5$ = 7 cfs, $Q_{100}$ = 45 cfs) form Basin EXC's 24.80 acres is combined with the Basin's OS-4. The combined runoff ($Q_5$ = 7 cfs, $Q_{100}$ = 45 cfs) is directed offsite and shortly later in the existing channel in the Geick Ranch Basin.

Design Point EX4 is a point at the southern boundary of Filing 1 where runoff ($Q_5$ = 0 cfs, $Q_{100}$ = 1 cfs) from Basin OS-3's 1.11 acres of undeveloped prairie flows south onto Basin EXD's 15.87 acres ($Q_5$ = 5 cfs, $Q_{100}$ = 31 cfs). The combined flow ($Q_5$ = 5 cfs, $Q_{100}$ = 33 cfs) travels south and drains into the existing channel along the eastern boundary.

At Design Point EX10 a 36" RCP culvert that drains from north to south under Eastonville Road (Basin OS-8) onto the undeveloped open space north (Basin OS-2) of the proposed Filing 2 layout. The Meridian Ranch MDDP states the runoff is $Q_5$ = 5 cfs, $Q_{100}$ = 11 cfs.

Design Point EX5 consists of a swale that leave the site at the south east boundary. Runoff ($Q_5$ = 3 cfs, $Q_{100}$ = 22 cfs) from Basin OS-2's 11.40 acres and Design Point EX10 is directed south onto Basin EXE. The runoff ($Q_5$ = 2 cfs, $Q_{100}$ = 14 cfs) form Basin EXE's 5.83 acres is combined with the Basin's OS-4. The combined runoff ($Q_5$ = 5 cfs, $Q_{100}$ = 33 cfs) of the 3 basins is directed offsite and into the existing channel in the Geick Ranch Basin.

At Design Point EX10 a 36" RCP culvert that drains from north to south under Eastonville Road (Basin OS-8) onto the undeveloped open space north of the proposed Filing 2 layout. The Meridian Ranch MDDP states the runoff is $Q_5$ = 5 cfs, $Q_{100}$ = 11 cfs.

At Design Point EX9 (Basin OS-9) is another 36" RCP that routes the runoff ($Q_5$ = 8 cfs, $Q_{100}$ = 19 cfs) under Eastonville Road and onto the open space in Basin OS-1. The runoff ($Q_5$ = 13 cfs, $Q_{100}$ = 85 cfs) from Basin OS-1's 45.02 acres is routed south via the existing channel located in the Geick Ranch Basin. An analysis found that this drainage channel is a jurisdictional waters of the U.S. with associated jurisdictional wetland habitat. Basin EXF's 1.62 acres is a small area consisting of open space prairies located at the north east corner of the site. Runoff $Q_5$ = 1 cfs, $Q_{100}$ = 4 cfs) from Basin EXF is directed onto Basin OS-1 along the eastern boundary at Design Point EX6.

Design Point EX7 is a point in the channel that corresponds to the proposed Design Point 30. The combined flow of Basin OS-1, Design Points EX5, EX 7, & EX9 at DP EX7 is $Q_5$ = 21 cfs, $Q_{100}$ = 107 cfs).

***EARLY GRADING PERMIT SUBBASIN DESCRIPTION***

The developer/owner is applying for an Early Grading Permit with the PUD and Final Plat submittal. Per El Paso County Standards, the site must be analyzed for this step in the process. All the flow will be treated via temporary BMP's. These BMP's include silt fence for areas along the site boundary that cannot be routed to a Temporary Sediment Basin (TSB). The larger open areas being graded will be routed via natural and temporary diversion swales to a TSB. All the diversion swales are trapezoidal swales 2' deep, 4' bottom with 4:1 side slopes (see appendix for clacs) and will have Sediment Control Logs to help control sediment runoff. All TSBs will allow sediment to settle out and runoff will be routed via 6" PVC pipe wrapped in rock or in the bigger storm via the riprap armored weir. Below is a description of the site for the Initial Grading Phase.

Basin PRE-A's 4.61 acres consists of small open space prairie along the western boundary that cannot be routed to a Temporary Sediment Basin, and the existing channel floodplain. Runoff ($Q_5$ = 1 cfs,

$Q_{100}$ = 10 cfs) will sheet flow to Silt Fence BMPs prior to draining into the channel.

Design Point PRE1 is Temporary Sediment Basin 1 (TSB1) located at the southwestern corner of the site and will become a permanent Full Spectrum Detention Basin (FSD 1) when construction starts. Offsite Basin OS-4's 0.56 acres will sheet flow ($Q_5$ = 0 cfs, $Q_{100}$ = 1 cfs) onto Basin PRE-B. Runoff ($Q_5$ = 4 cfs, $Q_{100}$ = 24 cfs) from Basin PRE-B's 12.35 acres will combine with the upstream offsite Basin OS-4. The combined flow ($Q_5$ = 4 cfs, $Q_{100}$ = 25 cfs) will be routed overland and via temporary diversion swale to TSB where the water will be treated prior to leaving the site.

Design Point PRE2 is Temporary Sediment Basin 2 (TSB2) located at the southeastern corner of the site. Runoff ($Q_5$ = 6 cfs, $Q_{100}$ = 38 cfs) from Basin PRE-C's 19.08 acres will be routed overland and via 2 temporary diversion swales to the TSB where the water will be treated prior to leaving the site.

Design Point PRE3 is Temporary Sediment Basin 3 (TSB3) located on the eastern boundary of the site. Offsite Basin OS-3's 1.11 acres will sheet flow ($Q_5$ = 0 cfs, $Q_{100}$ = 3 cfs) onto Basin PRE-D. Runoff ($Q_5$ = 5 cfs, $Q_{100}$ = 30 cfs) from Basin PRE-D's 15.52 acres will combine with the upstream offsite Basin OS-3. The combined flow ($Q_5$ = 5 cfs, $Q_{100}$ = 33 cfs) will be routed overland and via a temporary diversion swale that is located along the Boundary between Filing 1 & 2, to the TSB where the water will be treated prior to leaving the site.

Design Point PRE4 is Temporary Sediment Basin 4 (TSB4) located on the eastern boundary of the site just north of TSB3. Offsite Basin OS-1's 2.74 acres will sheet flow ($Q_5$ = 1 cfs, $Q_{100}$ = 7 cfs) onto Basin PRE-E. Runoff ($Q_5$ = 2 cfs, $Q_{100}$ = 16 cfs) from Basin PRE-E's 6.33 acres will combine with the upstream offsite Basin OS-2. The combined flow ($Q_5$ = 3 cfs, $Q_{100}$ = 23 cfs) will be routed overland and via a temporary diversion swale to the TSB where the water will be treated prior to leaving the site.

Design Point PRE5 is an existing stock pond located just north of Filing 2 boundary in a future Waterbury Phase and will be upgraded to function as a Temporary Sediment Basin 5 (TSB5). Offsite Basin OS-8's 2.56 acres flow ($Q_5$ = 5 cfs, $Q_{100}$ = 11 cfs) under Eastonville Road via a 36" culvert onto Basin OS-2. Runoff ($Q_5$ = 2 cfs, $Q_{100}$ = 16 cfs) from Basin PRE-E's 9.15 acres will combine

with the upstream offsite Basin OS-2. The combined flow ($Q_5$ = 8 cfs, $Q_{100}$ = 32 cfs) will be routed overland and a small existing channel to the TSB 5 where the water will be treated prior to leaving the site. This TSB will remain in effect until this area is developed in the future.

Design Point PRE6 is a point located at the southern boundary of the site in Stapleton Road. Basin PRE-F's 0.62 acres consists of small open space prairie that cannot be routed to a Temporary Sediment Basin. Runoff ($Q_5$ = 0 cfs, $Q_{100}$ = 2 cfs) will sheet flow to Silt Fence BMPs prior to draining offsite in it' historic path.

Design Point PRE7 is a point located at the eastern boundary of the site in the existing channel in the Geick Ranch Basin. Basin PRE-G's 2.00 acres consists of small open space prairie next to the channel and wetlands in Filing 1 that cannot be routed to a Temporary Sediment Basin. Runoff ($Q_5$ = 0 cfs, $Q_{100}$ = 2 cfs) will sheet flow to Silt Fence BMPs prior to draining offsite in it' historic path. Basin PRE-H's 2.00 acres consists of small open space prairie next to the channel and wetlands in Filing 2 that cannot be routed to a Temporary Sediment Basin. Runoff ($Q_5$ = 1 cfs, $Q_{100}$ = 4 cfs) will sheet flow to Silt Fence BMPs prior to draining offsite in it' historic path. Along with these 2 Basins, runoff discharged from TSB 2, TSB3 & TSB 4 for a combined runoff of $Q_5$ = 26 cfs, $Q_{100}$ = 152 cfs that is routed to the existing channel.

***PROPOSED MAJOR SUBBASIN DESCRIPTION (FOR MDDP)***

The overall site will be developed in several Filings with each filing requiring its own final drainage report. The Proposed Major Basin Descriptions below is for Waterbury Filings 1 & 2 development and the preliminary layout of the future filings to the north tributary to the storm drain system and detention ponds in Filings 1 & 2. This future area is shown as fully developed to analyze the ultimate storm drain capacity and pond volumes. In the section below labeled Hydrologic Analysis for Filing 1 FDR the interim condition will be discussed and how runoff is captured and routed safely to the proposed private EDB for Filings 1 & 2 construction. See the Proposed MDDP Drainage Map in the appendix for a visual representation of the below Basin descriptions.

Design Point 1 is a proposed public 6' D10-R sump inlet located in the west flowline of Saybrook drive just north of the roundabout. Basin A's 3.39 acres consists of roadway and single-family development. Runoff ($Q_5$ = 5 cfs, $Q_{100}$ = 12 cfs) sheet flows into street sections and then is routed

south via c&g where the inlet captures the flow.

Design Point 2 is a proposed public 4' D10-R sump inlet located in the west flowline of Saybrook drive opposite of DP 1. Basin C's 0.86 acres is comprised of roadway and single-family development. Runoff ($Q_5$ = 2 cfs, $Q_{100}$ = 4 cfs) drains overland to the street and then to the inlet. Pipe run 1 an 18" RCP routes the flow to a junction at DP 1. Pipe Run 2 a public 24" RCP routes the combined flow ($Q_5$ = 7 cfs, $Q_{100}$ = 15 cfs) of DP 1 & 2 down Saybrook Road and then down Bayshore Drive over to manhole junction in Sandy Neck Way.

Design Point 3 is a proposed public 4' D10-R sump inlet located in the east flowline of Sandy Neck Way. Basin B1's 2.30 acres consists of roadway and single-family development. Runoff ($Q_5$ = 4 cfs, $Q_{100}$ = 8 cfs) is directed south to Design Point 3. The 4' D10-R sump inlet captures the entire flow. Pipe run 3 an 18" public RCP storm sewer routes the flow west to a manhole junction with Pipe run 4.

Design Point 4 is a proposed public 4' D10-R sump inlet located in the west flowline of Sandy Neck Way opposite of DP 3. Basin B2's 2.69 acres consists of roadway and single-family development. Runoff ($Q_5$ = 4 cfs, $Q_{100}$ = 9 cfs) is routed to Design Point 4. The 4' D10-R sump inlet captures the entire flow. Pipe run 4 an 18" public RCP storm sewer routes the flow west to a manhole junction with Pipe run 3. Pipe run 5 a 24" RCP routes the combined ($Q_5$ = 8 cfs, $Q_{100}$ = 17 cfs) flow of Pipe runs 3 & 4 south down Sandy Neck Way to the manhole junction with Pipe run 2. Pipe run 6 a public 30" RCP then routes the combined ($Q_5$ = 15 cfs, $Q_{100}$ = 32 cfs) flow of Pipe runs 2 & 5 south down Sandy Neck Way to a junction at Design Point 5.

Design Point 5 is a proposed public 6' D10-R sump inlet located in the west flowline of Sandy Neck Way. Runoff ($Q_5$ = 4 cfs, $Q_{100}$ = 9 cfs) from Basin F's 2.18 acres consisting of single-family development is directed to the east flow line of Sandy Neck Way and then south to the cul-de-sac bulb low point. Runoff ($Q_5$ = 2 cfs, $Q_{100}$ = 5 cfs) from Basin H's 1.13 acres consisting of single-family development is directed to the west flow line of Sandy Neck Way and then south to the cul-de-sac bulb low point. The combined flow ($Q_5$ = 6 cfs, $Q_{100}$ = 14 cfs) at DP 5 is captured in the 6' D10-R sump inlet and then is routed to the pond along with the flow from Pipe Run 6 via a proposed 36"

public RCP storm sewer (Pipe run 7) to Design Point a junction with Pipe run 3. If this inlet were blocked, runoff would overtop the curb and flow sown the storm drain tract and into the proposed FSD Pond 1 (Design Point 8).

Design Point 6 is a proposed public 4' D10-R sump inlet located in the west flowline of Saybrook Road. Runoff ($Q_5$ = 4 cfs, $Q_{100}$ = 8 cfs) from Basin D's 2.11 acres consisting of single-family development is directed to the low point in Saybrook Road. It is then routed via a proposed 18" public RCP storm sewer (Pipe run 8) to a manhole junction with Pipe run 9.

Design Point 7 is a proposed public 4' D10-R sump inlet located opposite of DP 6 in Saybrook Road. Runoff ($Q_5$ = 4 cfs, $Q_{100}$ = 8 cfs) from Basin E's 2.18 acres consisting of roadway and single-family lots is directed via side lot line swales and C&G to the proposed inlet. The 4' inlet captures all of the flow and Pipe run 9 a public 18" diameter RCP storm sewer routes the flow to a manhole junction at with Pipe run 8. The combined flows ($Q_5$ = 7 cfs, $Q_{100}$ = 15 cfs) of Pipe runs 8 & 9 are routed south down Saybrook Road to the proposed FSD Pond 1 Design (Design Point 8).

Design Point 8 is a proposed private Full Spectrum Detention Basin called FSD Pond 1. Design Points 1-7 are routed to the pond and treated for Water Quality and Detention along with Basin K's 3.06 acres consisting mainly of the EDB area and rear yards. Runoff ($Q_5$ = 3 cfs, $Q_{100}$ = 11 cfs) sheet flows into the EDB. The basins tributary to Design Point 21 are Basins A, B1, B2, C, D, E, F, H & K with a total area of 19.91 acres. The 100-year effective impervious area of 55.9% was calculated using UD-BMP Version 3.07 IRF spreadsheet. This information was entered into the UD-Detention_v4.03 spreadsheet and the calculation yielded a required a WQCV of 0.324 ac-ft, a EURV of 0.703 ac-ft and a 100-year detention volume of 1.016 ac-ft. This gave a total required volume of 2.043 ac-ft. The top of pond is set at 6930.00, with a bottom of pond at 6923.50. The pipes and swales to the pond discharge into 2 concrete forebays (3% WQCV see calcs in appendix) with 18" high walls and a 3" notch to release minor flows into 2' wide concrete tickle channel. The trickle channel directs runoff to the proposed concrete micro-pool at the surcharge elevation of 6923.83. The bottom of the micro-pool is set at 6921.00 and the top set at 6923.50. A proposed 4' x 4' outlet box with the grate set at 6926.54, an outlet plate on the front to meet the 3-orifice requirement and an 18" outlet pipe with a restrictor plate set 7.5" above the invert will route all runoff from the pond. The metal plate will have

1 column containing 3 rows of 1-13/16" diameter orifice holes spaced 12.2" apart starting at 6923.50. The WQCV release is 0.20 cfs with a ponding elevation of 6925.14 and takes 40 hours to release. The EURV release is 0.4 cfs, with an elevation of 6926.54 and takes 70 hours to release. The 100-year detention release is 8.3 cfs, with an elevation of 6927.70 and takes 71 hours to release. A 30' long riprap emergency spillway set at 6928.00 will allow the 100-year developed peak in flow ($Q_{100}$= 35.9 cfs) with a depth of 0.46' (top of water = 6928.46) to be routed west into the natural channel. 1.00' freeboard is provided (see appendix). The spillway and downhill slope will be armored with d50= VH 24" riprap. Pipe Run 10A a private 18" RCP will route the pond release into the existing natural channel. (See Pond Calculations in appendix).

Design Point 9 is an existing 36" RCP culvert under Eastonville Road where Offsite Basin OS-9 discharges onto offsite Basin OS-2. Runoff ($Q_5$ = 8 cfs, $Q_{100}$ = 19 cfs) from Basin OS-9's 11.80 acres consists of historic flow based upon upstream detention. Further breakdown of this flow will be discussed with analysis of Design Point 29 and the discussion for Tributary flow to the FSD Pond 3.

Design Point 10 is an existing 36" RCP culvert under Eastonville Road south of the existing High School Pond where Offsite Basin OS-8 discharges onto a future Waterbury Filing. Runoff ($Q_5$ = 5 cfs, $Q_{100}$ = 11 cfs) from Basin OS-10's 3.41 acres consists of historic flow based upon upstream detention. In the ultimate buildout this flow will be piped west to the existing natural channel along the westside of Waterbury and to Offsite Basin OS-5. Until the future filings are built this flow will follow its natural channel south to the existing channel located along the eastern boundary of Filings 1 & 2. This will be discussed again in the Preliminary Drainage Report section below.

Design Point 10A is another crossing under Eastonville Road where existing 3-42" RCP culverts route the flow ($Q_5$ = 28 cfs, $Q_{100}$ = 135 cfs) from the temporary Meridian Ranch pond per the Meridian Ranch MDDP. The pipes discharge onto Offsite Basin OS-5. Offsite Basin OS-5's 5.64 acres consists of future Waterbury rear lots, open space and the natural channel. Runoff ($Q_5$ = 10 cfs, $Q_{100}$ = 23 cfs) from OS-5 sheet flows to the channel. The flow is then routed south to Design Point 11

Design Point 11 is a proposed crossing under the proposed continuation of Gilbert Drive with dual

42" RCP culverts. Basin I's 5.66 acres consists of rear lots and the natural channel. Runoff ($Q_5$ = 5 cfs, $Q_{100}$ = 19 cfs) sheet flows to the channel and is directed south Design Points 11. As mentioned above Kiowas Engineering did a HEC-RAS analysis modeling developed flows along the channel. There have been no design or layout changes to affect this model therefore this report will reference the original output data computed by this model. The combined flow of Design Points 10 & 10A along with Basins OS-5 and I is $Q_5$ = 53 cfs, $Q_{100}$ = 212 cfs. This flow is routed south under Gilbert drive and onto Basin J. Basin I's runoff was intended to be treated downstream in the existing EDB at Design Point 13. This online EDB is no longer considered a viable solution to treating for WQCV due to new regulations. Therefore, the UD-BMP Version 3.07 Runoff Reduction was used to show that this area has 100% WQCV reduction.

Design Point 12 is a proposed 18" RCP culvert under Gilbert Drive that routes the runoff ($Q_5$ = 2 cfs, $Q_{100}$ = 4 cfs) from offsite Basin OS-6's 1.06 acres that is comprised of the eastern half of Thatcher Court located int 4-Way Ranch Filing 1 to the existing natural channel.

Basin J's 1.99 acres is comprised of rear lots and the existing channel along the west boundary. Runoff ($Q_5$ = 4 cfs, $Q_{100}$ = 8 cfs) sheet flows into the channel and then is routed south to Design Point 13, an on-line existing stock pond that is being converted to an EDB to provide water quality for part of 4-Way Ranch Filing No. 1 and Waterbury Basins I, J & N. As mentioned above this online EDB is no longer considered a viable solution to treating for WQCV. Therefore, the UD-BMP Version 3.07 Runoff Reduction was used to show that this area has 100% WQCV reduction.

Basin N's 0.22 acres is comprised of the proposed extension of Gilbert road form 4-Way Ranch into Waterbury. Runoff ($Q_5$ = 1 cfs, $Q_{100}$ = 1 cfs) sheet flows into the channel and then is routed south to Design Point 13, an on-line existing stock pond that is being converted to an EDB to provide water quality for part of 4-Way Ranch Filing No. 1 and Waterbury Basins I, J & N. Once again, this online EDB is no longer considered a viable solution to treating for WQCV. Therefore, the UD-BMP Version 3.07 Runoff Reduction was used to show that this area has 100% WQCV reduction.

In the previously approved "Final Drainage Report for Waterbury Filing No. 1" by Classic Consulting it was stated that there were 3 Stormwater Quality Ponds that needed to be provided for the adjacent

4-Way Ranch per conditions set forth by the Board of County Commissioners at approval of the Waterbury PUD Development Plan. Because there have been no changes to the tributary areas to these 3 Ponds and they have already been designed and constructed. This report will reference the original work done by Classic Consulting. Below is a brief description of the 3 Stormwater Quality Ponds. The original approved calculations and results can be found in the appendix of the original report by Classic Consulting along with the Basin Exhibit Map.

Stormwater Quality Pond 1 (SWQ Pond 1) treats 56.8 acres of 4-Way Ranch Filing No. 1 from their Basins H, I, J, S, R & 60% of L. An EDB was designed between the existing Lots 15 and 35 using a 4' x 4' outlet set at 6924.00 with an orifice plate with 1 column of 10-15/16" diameter holes spaced 4" apart. The forebay top is set at 6920.5 with the bottom at 6918.00. The required volume was calculated to be 0.52 ac-ft and the design volume shown is 0.66 ac-ft. The release out of the pond was calculated to be $Q_5$ = 13 cfs, $Q_{100}$ = 131 cfs (See Classic Consulting Drainage Map in Appendix).

Stormwater Quality Pond 2 (SWQ Pond 2) treats 37.2 acres of 4-Way Ranch Filing No. 1 from their Basins F, G, K, & M. An EDB was designed along the south edge of existing Lot 15 using a 4' x 4' outlet set at 6918.00 with an orifice plate with 1 column of 9-13/16" diameter holes spaced 4" apart. The forebay top is set at 6915.00 with the bottom at 6914.75. The required volume was calculated to be 0.34 ac-ft and the design volume shown is 0.60 ac-ft. The release out of the pond was calculated to be $Q_5$ = 0.4 cfs, $Q_{100}$ = 51 cfs (See Classic Consulting Drainage Map in Appendix).

Design Point 13 is existing Stormwater Quality Pond 3 (SWQ Pond 3), an existing stock pond south of Stapleton Drive that was be converted to a EDB and treat 40.4 acres of 4-Way Ranch Filing No. 1 from their Basins OS-5, Os-6, D, E, N 40% of L, 50% of O, Q & basins I, J & N of Waterbury Filing No. 1. The EDB was designed using a 4' x 4' outlet set at 6907.50 with an orifice plate with 1 column of 8-1/8" diameter holes spaced 4" apart. The forebay top is set at 6915.00 with the bottom at 6914.75. The required volume was calculated to be 0.66 ac-ft and the design volume shown is 1.20 ac-ft. The release out of the pond was calculated to be $Q_5$ = 69 cfs, $Q_{100}$ = 396 cfs (See Classic Consulting Drainage Map in Appendix).

Basin M1's 2.90 acres is comprised of the rear yards & open space tract along Stapleton Drive along

with a portion of Saybrook Drive. Runoff ($Q_5$ = 5 cfs, $Q_{100}$ = 12 cfs) sheet flows over the back yard and open space tract onto Stapleton Drive the channel and then is routed south overland. The area consists roof area and pervious rear yards that sheet flow over pervious area. The UD-BMP Version 3.07 Runoff Reduction was used to show that this area has 100% WQCV reduction based upon the Unconnected Impervious Area being routed over the Receiving Pervious Area.

Basin M2's 0.47 acres is comprised of the rear yards adjacent to undeveloped land east of the site. Runoff ($Q_5$ = 1 cfs, $Q_{100}$ = 2 cfs) sheet flows from the back yard onto the undeveloped. This area is not treated for water quality but is pervious area. The UD-BMP Version 3.07 Runoff Reduction was used to show that this area has 100% WQCV reduction based upon the Unconnected Impervious Area being routed over the Receiving Pervious Area.

Basin P's 1.18 acres is comprised of the rear yards adjacent to undeveloped land east of the site. Runoff ($Q_5$ = 2 cfs, $Q_{100}$ = 5 cfs) sheet flows from the back yard onto the undeveloped. This area is not treated for water quality but is pervious area. The UD-BMP Version 3.07 Runoff Reduction was used to show that this area has 100% WQCV reduction based upon the Unconnected Impervious Area being routed over the Receiving Pervious Area.

Design Point 14 is a low point in the knuckle of Beech Creek Drive with a proposed public 10' D10-R sump inlet. Runoff ($Q_5$ = 8 cfs, $Q_{100}$ = 18 cfs) from Basin L1's 5.27 acres consisting of roadway and single-family lots is directed via side lot line swales and C&G to the proposed inlet. The 10' inlet captures all of the flow and Pipe run 11 a public 24" diameter RCP storm sewer routes the flow to a manhole junction with Pipe run 12.

Design Point 15 is a proposed public 4' D10-R sump inlet opposite of DP 14 in Beech Creek Drive Runoff ($Q_5$ = 8 cfs, $Q_{100}$ = 18 cfs) from Basin L1's 5.27 acres consisting of roadway and single-family lots is directed via side lot line swales and C&G to the proposed inlet. The 4' inlet captures all of the flow and Pipe run 12 a public 18" diameter RCP storm sewer routes the flow to a manhole junction with Pipe run 11. Pipe run 13 a 30" RCP routes the combined flow ($Q_5$ = 11 cfs, $Q_{100}$ = 24 cfs) of Pipe Runs 11 & 12 north in Beech Creek Drive to a manhole junction with Pipe run 14.

Design Point 16 is a proposed public 6' D10-R sump inlet located in the proposed western half of the private street of Beech Creek Drive. Runoff ($Q_5$ = 5 cfs, $Q_{100}$ = 11 cfs) from Basin O1's 1.27 acres consisting of roadway and single-family lots is directed via side lot line swales and C&G to the proposed inlet. The 6' inlet captures all of the flow and Pipe run 14 a public 24" diameter RCP storm sewer routes the flow to a manhole junction with Pipe run 13. Pipe run 15 a 36" RCP routes the combined flow ($Q_5$ = 15 cfs, $Q_{100}$ = 34 cfs) of Pipe Runs 13 & 14 west to a manhole junction with Pipe run 16.

Design Point 17 is a proposed public 4' D10-R sump inlet located opposite of DP 14 in Beech Creek Drive. Runoff ($Q_5$ = 1 cfs, $Q_{100}$ = 3 cfs) from Basin O2's 0.94 acres consisting of roadway, parking, roof and landscape area sheet flows to the east flowline of Beech Creek Drive and to the proposed inlet. After being captured by the inlet Pipe run 16. Pipe run 17 routes the combined flows ($Q_5$ = 17 cfs, $Q_{100}$ = 37 cfs) of Pipe runs 15 and 16 are routed west offsite via a private 36" diameter RCP to Design Point 18 a proposed private temporary EDB. This is the FSD Pond 2.

Design Point 18 is a proposed temporary private Full Spectrum Detention Basin called FSD Pond 2. This pond will be replaced and resized when future filings to the east are final designed. There are no set time frames at this time to when the final design of the permanent pond will happen. Design Points 14-17 are routed to the pond and treated for Water Quality and Detention along with the Basin OS-4's 10.90 acres consisting of the EDB area and undeveloped upstream tributary area. Runoff ($Q_5$ = 2 cfs, $Q_{100}$ = 16 cfs) from Basin OS-4 sheet flows into the EDB. The basins tributary to Design Point are L1, L2, O1, O2 and OS-4 with a total area of 21.93 acres. The 100-year effective impervious area of 30.0% was calculated using UD-BMP Version 3.07 IRF spreadsheet. This information was entered into the UD-Detention_v4.03 spreadsheet and the calculation yielded a required a WQCV of 0.243 ac-ft, a EURV of 0.264 ac-ft and a 100-year detention volume of 0.720ac-ft. This gave a total required volume of 1.227 ac-ft. The top of pond is set at 6906.00, with a bottom of pond at 6899.00. The pipes and swales to the pond discharge into a concrete forebay (3% WQCV see calcs in appendix) with 18" high walls and a 3" notch to release minor flows into 2' wide concrete tickle channel. The trickle channel directs runoff to the proposed concrete micro-pool at the surcharge elevation of 6899.33. The bottom of the micro-pool is set at 6896.50 and the top set at 6899.00. A proposed 4' x 4' outlet box with the grate set at 6902.06, an outlet plate on the front to meet the 3-orifice requirement

and an 18" outlet pipe with a restrictor plate set 12.0" above the invert will route all runoff from the pond. The metal plate will have 1 column containing 3 rows of 1-5/16" diameter orifice holes spaced 12.2" apart starting at 6899.00. The WQCV release is 0.10 cfs with a ponding elevation of 6901.22 and takes 40 hours to release. The EURV release is 0.2 cfs, with an elevation of 6902.06 and takes 58 hours to release. The 100-year detention release is 10.6 cfs, with an elevation of 6902.66 and takes 58 hours to release. A 20' long riprap emergency spillway set at 6904.00 will allow the 100-year developed peak in flow ($Q_{100}$= 20.7 cfs) with a depth of 0.47' (top of water = 6904.47) to be routed west into the natural channel. 1.00' freeboard is provided (see appendix). The spillway and downhill slope will be armored with d50= VH 24" riprap. Pipe Run 17A a private 18" RCP will route the pond release into the existing natural channel. (See Pond Calculations in appendix). When future filings are developed this temporary Pond 2 will be replaced with a permanent Pond as shown in the "Conceptual Drainage Report for Waterbury PUD Plan" prepared by Classic Consulting and dated November 2012.

For Design Points 19-25 this MDDP assumes the offsite basins upstream are fully developed with future Waterbury Filings.

Design Point 19 is a proposed 8' D10-R sump inlet located in the south curb of Muddy Pond Street. Runoff ($Q_5$ = 6 cfs, $Q_{100}$ = 12 cfs) from Basin OS-Q1's 4.31 acres consists of future single-family development and will be directed via lot line swales and c&g onto Basin Q1. Runoff ($Q_5$ = 2 cfs, $Q_{100}$ = 4 cfs) from Basin Q1's 1.04 acres is directed to the 8' inlet. The combined flow ($Q_5$ = 7 cfs, $Q_{100}$ = 15 cfs) is captured in the inlet and Pipe run 18 a 24" RCP diameter storm routes the flows to a manhole junction with Pipe run 19.

Design Point 20 is a proposed 4' D10-R sump inlet located opposite of DP 19. Runoff ($Q_5$ = 2 cfs, $Q_{100}$ = 4 cfs) from Basin OS-Q2's 0.94 acres consists of future single-family development and will be directed via lot line swales and c&g onto Basin Q2. Runoff ($Q_5$ = 2 cfs, $Q_{100}$ = 5 cfs) from Basin Q2's 1.10 acres is directed to the 4' inlet. The combined flow ($Q_5$ = 3 cfs, $Q_{100}$ = 8 cfs) is captured in the inlet and Pipe run 19 an 18" RCP diameter storm routes the flows to a manhole junction with Pipe run 18. Pipe Run 20 a 24" RCP storm routes the combined flow ($Q_5$ = 10 cfs, $Q_{100}$ = 21 cfs) of Pipe runs 19 & 20 east down Muddy Pond Street east down Muddy Pond Street to a manhole junction with

Pipe run 21.

Design Point 21 is a proposed 12' D10-R at-grade inlet located in the north curb of Muddy Pond Street just east of Masonboro Way intersection. Runoff ($Q_5$ = 11 cfs, $Q_{100}$ = 24 cfs) from Basin OS-R's 6.05 acres consists of future single-family development and will be directed via lot line swales and c&g onto Basin R. Runoff ($Q_5$ = 0 cfs, $Q_{100}$ = 1 cfs) from Basin R's 0.13 acres is directed to the 12' inlet. The combined flow ($Q_5$ = 11 cfs, $Q_{100}$ = 24 cfs) is routed to the inlet and $Q_5$ = 5 cfs, $Q_{100}$ = 9 cfs is captured. Pipe run 21 an 18" RCP diameter storm routes the captured flow to a manhole junction with Pipe run 20. Pipe run 22 routes the combined flow ($Q_5$ = 14 cfs, $Q_{100}$ = 27 cfs) of Pipe runs 20 & 21 east down Muddy Pond Street to a manhole junction with Pipe run 25. The bypass flow ($Q_5$ = 5 cfs, $Q_{100}$ = 16 cfs) at DP 21 travels in the north flow line of Muddy Pond Street to Design Point 22.

Design Point 22 is a proposed 10' D10-R sump inlet located in the west curb of Megansett Wat. Runoff ($Q_5$ = 8 cfs, $Q_{100}$ = 18 cfs) from Basin OS-S1's 5.59 acres consists of future single-family development and will be directed via lot line swales and c&g onto Basin S1. Runoff ($Q_5$ = 3 cfs, $Q_{100}$ = 7 cfs) from Basin S1's 1.55 acres is directed to the 4' inlet. The combined flow ($Q_5$ = 15 cfs, $Q_{100}$ = 37 cfs) of Basins OS-S1, S1 & the bypass flow from DP 21 is routed to the low point.

Design Point 23 is a proposed 10' D10-R sump inlet located opposite of DP 22. Runoff ($Q_5$ = 0 cfs, $Q_{100}$ = 1 cfs) from Basin OS-S2's 0.17 acres consists of future single-family development and will be directed via lot line swales and c&g onto Basin S2. Runoff ($Q_5$ = 0 cfs, $Q_{100}$ = 1 cfs) from Basin S2's 0.13 acres is directed to the 10' inlet. The combined flow at DP 23 is $Q_5$ = 1 cfs, $Q_{100}$ = 1 cfs. It is presumed that the combined flow ($Q_5$ = 16 cfs, $Q_{100}$ = 38 cfs) at DP 22 & 23 is evenly split between the 2-10' D10-R sump inlets. Pipe run 23 a 24" RCP diameter storm routes the flow ($Q_5$ = 8 cfs, $Q_{100}$ = 19 cfs) from the inlet at DP 22 to a manhole junction with Pipe run 24. Pipe Run 24 a 24" RCP storm routes the flow ($Q_5$ = 8 cfs, $Q_{100}$ = 19 cfs) to the manhole junction with Pipe run 23. Pipe Run 25 a 30" RCP routes the combined flow ($Q_5$ = 16 cfs, $Q_{100}$ = 38 cfs) of Pipe runs 23 & 24 south to a manhole junction with Pipe run 22 in Muddy Pond Street. Pipe run 26 a 36" RCP then routes the combined flow ($Q_5$ = 27 cfs, $Q_{100}$ = 59 cfs) of Pipe runs 22 & 25 east in Muddy Pond to a manhole junction with Pipe runs 27 & 28.

Design Point 24 is a proposed 4' D10-R sump inlet located in the south curb of Muddy Pond Street. Runoff ($Q_5$ = 3 cfs, $Q_{100}$ = 6 cfs) from Basin T1's 1.42 acres consists of single-family development and will be directed via lot line swales and c&g to the 4' inlet. Pipe run 27 an 18" RCP diameter storm routes the flow from the inlet to a manhole junction with Pipe runs 26 & 28.

Design Point 25 is a proposed 4' D10-R sump inlet located opposite of DP 24. Runoff ($Q_5$ = 1 cfs, $Q_{100}$ = 3 cfs) from Basin OS-T2's 0.76 acres consists of future single-family development and will be directed via lot line swales and c&g onto Basin T2. Runoff ($Q_5$ = 0 cfs, $Q_{100}$ = 1 cfs) from Basin T2's 1.23 acres is directed to the 4' inlet. The combined flow at DP 25 is $Q_5$ = 3 cfs, $Q_{100}$ = 7 cfs. Pipe run 28 an 18" RCP diameter storm routes the flow from the inlet to a manhole junction with Pipe runs 27 & 28. Pipe run 29 a 36" RCP then routes the combined flow ($Q_5$ = 32 cfs, $Q_{100}$ = 69 cfs) of Pipe runs 26, 27 & 28 east in Muddy Pond Street and then south down Fish Camp Circle to a manhole junction with Pipe run 30.

Design Point 26 is a proposed 10' D10-R sump inlet located in the west curb of Fish Camp Circle near the Knuckle. Runoff ($Q_5$ = 7 cfs, $Q_{100}$ = 16 cfs) from Basin U1's 4.38 acres consists of single-family development and will be directed via lot line swales and c&g to the 10' inlet. Pipe run 30 a 24" RCP diameter storm routes the flow from the inlet to a manhole junction with Pipe run 29. Pipe run 31 a 42" RCP transports the combined flow ($Q_5$ = 37 cfs, $Q_{100}$ = 81 cfs) of Pipe runs 29 & 30.

Design Point 27 is a proposed 6' D10-R sump inlet located opposite of DP 26. Runoff ($Q_5$ = 3 cfs, $Q_{100}$ = 7 cfs) from Basin U2's 1.89 acres consists of future single-family development and will be directed via lot line swales to the 6' inlet. Pipe run 32 an 18" RCP diameter storm routes the flow from the inlet to a manhole junction with Pipe runs 31. Pipe run 33 a 42" RCP then routes the combined flow ($Q_5$ = 40 cfs, $Q_{100}$ = 87 cfs) of Pipe runs 31 & 32 east through a Drainage Tract to FSD Pond 3.

Design Point 28 is a proposed 10' D10-R sump inlet located in the future north curb of Sunken Meadow Road. This inlet is offsite in a future phase and will be built within a proposed drainage easement. The offsite curb and gutter in this area will also need to be built along with some temporary

asphalt to direct runoff to the 10' inlet. Runoff ($Q_5$ = 8 cfs, $Q_{100}$ = 18 cfs) from Basin W's 5.20 acres is captured in the inlet and routed to Pond 3 via Pipe run 24" RCP.

The following Basin are for future Waterbury Filings to the north and east that will be tributary to FSD Pond 3. All the basin descriptions are the same, they are comprised of future single-family development and will be directed via lot line swales and c&g to future storm drain systems the future drain systems will be routed to FSD Pond 3. The exact routes and design have not been finalized at this time but will be with a future Final Drainage Report at the time of development. Below is the summary of the flow and acreage.

Basin OS-1: 11.81 acres, Runoff ($Q_5$ = 18 cfs, $Q_{100}$ = 41 cfs)
Basin OS-2: 15.90 acres Runoff ($Q_5$ = 22 cfs, $Q_{100}$ = 49 cfs)
Basin OS-3A: 0.79 acres Runoff ($Q_5$ = 1 cfs, $Q_{100}$ = 3 cfs)
Basin OS-3B: 5.66 acres Runoff ($Q_5$ = 9 cfs, $Q_{100}$ = 20 cfs)

As mentioned above Design Point 9 is an existing 36" RCP culvert under Eastonville Road where Offsite Basin OS-9 discharges onto Offsite Basin OS-2. Runoff ($Q_5$ = 8 cfs, $Q_{100}$ = 19 cfs) from Basin OS-9's 11.80 acres consists of historic flow based upon upstream detention. Runoff will be directed through the future Waterbury filings and into FSD Pond 3.

Design Point 29 is a proposed private Full Spectrum Detention Basin called FSD Pond 3. Design Points 19-28 and Offsite Basins OS-1, 2, 3A, 3B, 7, & 9 with a total area of 84.64 acres are routed to the pond and treated for Water Quality and Detention. The 100-year effective impervious area of 47.5% was calculated using UD-BMP Version 3.07 IRF spreadsheet. This information was entered into the UD-Detention_v4.03 spreadsheet and the calculation yielded a required a WQCV of 1.200 ac-ft, a EURV of 2.000 ac-ft and a 100-year detention volume of 4.165 ac-ft. This gave a total required volume of 7.365 ac-ft. The top of pond is set at 6930.00, with a bottom of pond at 6922.00. The pipes and swales to the pond discharge into a concrete forebay (3% WQCV see calcs in appendix) with 18" high walls and a 3" notch to release minor flows into 2' wide concrete tickle channel. The trickle channel directs runoff to the proposed concrete micro-pool at the surcharge elevation of 6922.33. The bottom of the micro-pool is set at 6899.50 and the top set at 6922.00. A proposed 6' x 6' outlet box

with the grate set at 6926.59, an outlet plate on the front to meet the 3-orifice requirement and a 36" outlet pipe with a restrictor plate set 28.0" above the invert will route all runoff from the pond. The metal plate will have 1 column containing 3 rows of 2" x 3" orifice holes spaced 18.3" apart starting at 6922.00. The WQCV release is 0.60 cfs with a ponding elevation of 6924.99 and takes 40 hours to release. The EURV release is 1.0 cfs, with an elevation of 6926.59 and takes 67 hours to release. The 100-year detention release is 60.7 cfs, with an elevation of 6927.75 and takes 67 hours to release. A 60' long riprap emergency spillway set at 6928.00 will allow the 100-year developed peak in flow ($Q_{100}$= 155.2 cfs) with a depth of 0.88' (top of water = 6928.88) to be routed west into the natural channel. 1.12' freeboard is provided (see appendix). The spillway and downhill slope will be armored with d50= VH 24" riprap. Pipe Run 35 a private 36" RCP will route the pond release into the existing natural channel. (See Pond Calculations in appendix).

Design Point 30 is a triple 36" RCP culvert crossing under Sunken Meadow Road. Offsite Basin OS-10's 3.41 acres consists of open space containing the natural channel. Runoff ($Q_5$ = 1 cfs, $Q_{100}$ = 8 cfs) is directed south through the wetlands to the culverts. Basin V's 1.32 acres is comprised of the rear yards adjacent to the existing natural channel along the west side of the site. Runoff ($Q_5$ = 1 cfs, $Q_{100}$ = 2 cfs) sheet flows from the back yard onto the undeveloped area. This area is not treated for water quality but per the UD-BMP Version 3.07 Runoff Reduction spreadsheet shows that this area has 100% WQCV reduction based upon the Unconnected Impervious Area being routed over the Receiving Pervious Area. The combined flow ($Q_5$ = 3 cfs, $Q_{100}$ = 10 cfs) at DP 30 does not warrant the triple 36" RCP culverts alone but in case of failure in the "Pond 3 outlet runoff from the emergency spillway ($Q_{100}$ = 155.2 cfs) will be safely routed through the triple 36" RCP culverts (See appendix).

## HYDRAULIC ANALYSIS

### *MAJOR DRAINAGEWAYS*

As mentioned above here are 2 major drainage ways on the east and west side of the site. In the previously approved "Final Drainage Report for Waterbury Filing 1" dated September 2016 prepared by Classic Consulting Engineering & Surveying the floodplain along the west side of the site was determined by Kiowa Engineering in a 2004 LOMR (04-08-0012) using a HEC-RAS analysis modeling developed flows along the channel from the 3-42" culverts under Eastonville Road south to the existing stock pond (Design Point 13) south of Stapleton Drive with proposed and existing

improvements such as the proposed 42" dual culverts located at the Gilbert Road crossing and existing dual 4' x 8' box culverts at Stapleton Drive (see appendix for HEC-RAS model). As part of the revised Preliminary Plan submittal for the site revisions an analysis of the eastern channel by ECO Systems found that this drainage channel is a jurisdictional waters of the U.S. with associated jurisdictional wetland habitat. Therefore, to comply with Section 404 of the Clean Water Act, we must meet the 404(b)(1) project review criteria, which include impact avoidance and minimization. The option the client plan to take is to minimize Project-wide impacts to 0.5-acre or less such that the pre-approved Nationwide Permits (NWP) may be used. No channel grading or redesign is proposed for the 2 channels; therefore, no analysis was done on our part. The existing 2004 LOMR was the last analysis done on the western channel located in the Haegler Drainage Basin any channel information can be found in that report.

## HYDROLOGIC ANALYSIS FOR FILING 1 & 2 PDR

### *PROPSOED BASIN DESCRIPTION (FOR PDR)*

The development of the overall Waterbury site will occur in several platting phases. With the design of Waterbury Filings 1 & 2 the site will have an interim condition where the area to the north will be unplatted natural open space with drainage patterns differing from the future full build out analysis in the MDDP section until such time that it is developed. Below is a description of the Design Points and the overall proposed drainage characteristics for the development of only Waterbury Filing 1 & 2. Design Points 1-18 do not have any changes to them from the description above in the MDDP section therefore these basins will not be described below. The following is a description of the Design Points 19-30 altered by the interim state of undeveloped land upstream. In all cases the design flow is less than the ultimate build-out and therefore the inlets and pipes can capture and route the flow safely

Design Point 19 is a proposed 8' D10-R sump inlet located in the south curb of Muddy Pond Street. Runoff ($Q_5$ = 0 cfs, $Q_{100}$ = 1 cfs) from Basin OS-Q1's 0.33 acres consists of undeveloped land and will sheet flow onto Basin Q1. Runoff ($Q_5$ = 2 cfs, $Q_{100}$ = 4 cfs) from Basin Q1's 1.04 acres is directed to the 8' inlet. The combined flow ($Q_5$ = 2 cfs, $Q_{100}$ = 5 cfs) is captured in the inlet and Pipe run 18 a 24" RCP diameter storm routes the flows to a manhole junction with Pipe run 19.

Design Point 20 is a proposed 4' D10-R sump inlet located opposite of DP 19. Runoff ($Q_5$ = 0 cfs, $Q_{100}$ = 1 cfs) from Basin OS-Q2's 0.22 acres consists of undeveloped land and will sheet flow onto Basin Q2. Runoff ($Q_5$ = 2 cfs, $Q_{100}$ = 5 cfs) from Basin Q2's 1.10 acres is directed to the 4' inlet. The combined flow ($Q_5$ = 2 cfs, $Q_{100}$ = 5 cfs) is captured in the inlet and Pipe run 19 an 18" RCP diameter storm routes the flows to a manhole junction with Pipe run 18. Pipe Run 20 a 24" RCP storm routes the combined flow ($Q_5$ = 4 cfs, $Q_{100}$ = 9 cfs) of Pipe runs 19 & 20 east down Muddy Pond Street east down Muddy Pond Street to a manhole junction with Pipe run 21.

Design Point 21 is a proposed 12' D10-R at-grade inlet located in the north curb of Muddy Pond Street just east of Masonboro Way intersection. Runoff ($Q_5$ = 0 cfs, $Q_{100}$ = 2 cfs) from Basin OS-R's 1.04 acres consists of undeveloped land and will sheet flow onto Basin R. Runoff ($Q_5$ = 0 cfs, $Q_{100}$ = 1 cfs) from Basin R's 0.13 acres is directed to the 12' inlet. The combined flow ($Q_5$ = 1 cfs, $Q_{100}$ = 3 cfs) is routed to the inlet and $Q_5$ = 1 cfs, $Q_{100}$ = 2 cfs is captured. Pipe run 21 an 18" RCP diameter storm routes the captured flow to a manhole junction with Pipe run 20. Pipe run 22 routes the combined flow ($Q_5$ = 4 cfs, $Q_{100}$ = 11 cfs) of Pipe runs 20 & 21 east down Muddy Pond Street to a manhole junction with Pipe run 25. The bypass flow ($Q_5$ = 0 cfs, $Q_{100}$ = 1 cfs) at DP 21 travels in the north flow line of Muddy Pond Street to Design Point 22.

Design Point 22 is a proposed 10' D10-R sump inlet located in the west curb of Megansett Way. Runoff ($Q_5$ = 0 cfs, $Q_{100}$ = 1 cfs) from Basin OS-S1's 0.31 acres consists of undeveloped land and will sheet flow onto Basin S1. Runoff ($Q_5$ = 3 cfs, $Q_{100}$ = 7 cfs) from Basin S1's 1.55 acres is directed to the 4' inlet. The combined flow ($Q_5$ = 3 cfs, $Q_{100}$ = 7 cfs) of Basins OS-S1, S1 & the bypass flow from DP 21 is routed to the low point via Pipe run 23.

Design Point 23 is a proposed 10' D10-R sump inlet located opposite of DP 22. Runoff ($Q_5$ = 0 cfs, $Q_{100}$ = 0 cfs) from Basin OS-S2's 0.13 acres consists of future single-family development and will be directed via lot line swales and c&g onto Basin S2. Runoff ($Q_5$ = 0 cfs, $Q_{100}$ = 1 cfs) from Basin S2's 0.13 acres is directed to the 10' inlet. The combined flow at DP 23 is $Q_5$ = 0 cfs, $Q_{100}$ = 1 cfs. Pipe run 23 a 24" RCP diameter storm routes the flow ($Q_5$ = 3 cfs, $Q_{100}$ = 7 cfs) from the inlet at DP 22 to a manhole junction with Pipe run 24. Pipe Run 24 a 24" RCP storm routes the flow ($Q_5$ = 0 cfs, $Q_{100}$ = 1 cfs) to the manhole junction with Pipe run 23. Pipe Run 25 a 30" RCP routes the combined flow

($Q_5$ = 3 cfs, $Q_{100}$ = 8 cfs) of Pipe runs 23 & 24 south to a manhole junction with Pipe run 22 in Muddy Pond Street. Pipe run 26 a 36" RCP then routes the combined flow ($Q_5$ = 7 cfs, $Q_{100}$ = 19 cfs) of Pipe runs 22 & 25 east in Muddy Pond to a manhole junction with Pipe runs 27 & 28.

Design Point 24 is a proposed 4' D10-R sump inlet located in the south curb of Muddy Pond Street. Runoff ($Q_5$ = 3 cfs, $Q_{100}$ = 6 cfs) from Basin T1's 1.42 acres consists of single-family development and will be directed via lot line swales and c&g to the 4' inlet. Pipe run 27 an 18" RCP diameter storm routes the flow from the inlet to a manhole junction with Pipe runs 26 & 28.

Design Point 25 is a proposed 4' D10-R sump inlet located opposite of DP 24. Runoff ($Q_5$ = 0 cfs, $Q_{100}$ = 1 cfs) from Basin OS-T2's 0.30 acres consists of future single-family development and will be directed via lot line swales and c&g onto Basin T2. Runoff ($Q_5$ = 2 cfs, $Q_{100}$ = 5 cfs) from Basin T2's 1.23 acres is directed to the 4' inlet. The combined flow at DP 25 is $Q_5$ = 2 cfs, $Q_{100}$ = 5 cfs. Pipe run 28 an 18" RCP diameter storm routes the flow from the inlet to a manhole junction with Pipe runs 27 & 28. Pipe run 29 a 36" RCP then routes the combined flow ($Q_5$ = 12 cfs, $Q_{100}$ = 29 cfs) of Pipe runs 26, 27 & 28 east in Muddy Pond Street and then south down Fish Camp Circle to a manhole junction with Pipe run 30.

Design Point 26 is a proposed 10' D10-R sump inlet located in the west curb of Fish Camp Circle near the Knuckle. Runoff ($Q_5$ = 7 cfs, $Q_{100}$ = 16 cfs) from Basin U1's 4.38 acres consists of single-family development and will be directed via lot line swales and c&g to the 10' inlet. Pipe run 30 a 24" RCP diameter storm routes the flow from the inlet to a manhole junction with Pipe run 29. Pipe run 31 a 42" RCP transports the combined flow ($Q_5$ = 18 cfs, $Q_{100}$ = 44 cfs) of Pipe runs 29 & 30.

Design Point 27 is a proposed 6' D10-R sump inlet located opposite of DP 26. Runoff ($Q_5$ = 3 cfs, $Q_{100}$ = 7 cfs) from Basin U2's 1.89 acres consists of future single-family development and will be directed via lot line swales to the 6' inlet. Pipe run 32 an 18" RCP diameter storm routes the flow from the inlet to a manhole junction with Pipe runs 31. Pipe run 33 a 42" RCP then routes the combined flow ($Q_5$ = 21 cfs, $Q_{100}$ = 51 cfs) of Pipe runs 31 & 32 east through a Drainage Tract to FSD Pond 3.

Design Point 30 is a triple 36" RCP culvert crossing under Sunken Meadow Road. Offsite Basin OS-9 discharges onto Offsite Basin OS-1. Runoff ($Q_5$ = 3 cfs, $Q_{100}$ = 18 cfs) from Basin OS-9's 11.80 acres consists of historic flow based upon upstream detention. Offsite Basin OS-8' runoff of $Q_5$ = 5 cfs, $Q_{100}$ = 11 cfs is discharged onto the undeveloped Basin OS-1. Offsite Basin OS-1's 51.92 acres consists of undeveloped land and open space containing the natural channel. Runoff ($Q_5$ = 14 cfs, $Q_{100}$ = 92 cfs) is directed south through the wetlands to the culverts. Basin V's 1.32 acres is comprised of the rear yards adjacent to the existing natural channel along the west side of the site. Runoff ($Q_5$ = 3 cfs, $Q_{100}$ = 3 cfs) sheet flows from the back yard onto the undeveloped. This area is not treated for water quality but is accounted for using Runoff Reduction as mentioned in the MDDP discussion mentioned above. The combined flow ($Q_5$ = 24 cfs, $Q_{100}$ = 115 cfs) at DP 30 will be safely routed through the triple 36" RCP culverts (See appendix).

The above Design point and Basin description shows that in the interim condition all runoff can be safely routed through the proposed storms drain system.

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

1. Reduce Runoff- The proposed impervious areas on the site are surrounded by landscaping and green space areas. Additionally, the new improvements and impervious areas on the site will be routed to a proposed private Extended Detention Basin. These items will reduce the volume of runoff using ponding and infiltration.
2. Stabilize Drainageways- There are 2 existing drainageways onsite. The westerly channel has been studied in HEC-RAS model and based upon calculations velocities are within the range for stabilized flow. The easterly channel has wetlands that allow the channel to stay stabilized.
3. Provide Water Quality Capture Volume (WQCV)- The 6 Extended Detention Basin have been sized and designed to sufficiently capture the required WQCV and slowly release it though the three-hole outlet, thereby allowing solids and contaminants to settle out.
4. Consider Need for Industrial and Commercial BMPs- The proposed development is single family site; therefore, no Industrial and Commercial BMPs have been proposed.

**DRAINAGE FEES**

This site lies within the Haegler Ranch Drainage Basin and Geick Ranch Basin. There is no approved Drainage Basin Planning study on file for with fees for this basin. At the time of the Final Drainage Report Basin fee calculations will be done for the portion in the Haegler Ranch Basin.

**SUMMARY**

Site runoff and storm drain and appurtenances associated with the development of the Waterbury Filing No. 1 & 2 site will not adversely affect the surrounding and downstream developments. Runoff will be routed to the existing and proposed detention basins and reduce the runoff to be at or below historic rates mentioned above in the report via Full Spectrum Detention while slowly treating the water quality capture volume and in turn helping to stabilize the downstream channel banks. Terra Nova Engineering requests that this report satisfy the submittal requirements for the drainage analysis for Waterbury. This report and findings are in general conformance with all previously approved reports for this site.

PREPARED BY:
**TERRA NOVA ENGINEERING, INC.**

Quentin N. Armijo, P.E.
Vice President
Jobs/1717.00/drainage/1715.00 MMDP-FDR 1-2

# APPENDIX

# VICINTY MAP

VICINITY MAP
N.T.S

# NRCS SOILS MAP

104° 36' 6"
104° 32' 1"
38° 59' 42"
38° 59' 41"
38° 57' 34"
38° 57' 33"
534600
535200
535800
536400
537000
537600
538200
538800
539400
540000
4315800
4315200
4314600
4314000
4313400
4312800
SITE
Phase 1
24
State Hwy 217
83
19
111
8
104° 36' 7"
104° 32' 2"
N
Map Scale: 1:28,200 if printed on A size (8.5" x 11") sheet.
Meters
0
350
700
1,400
2,100
Feet
0
1,500
3,000
6,000
9,000

## 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: 1:28,200 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

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: El Paso County Area, Colorado
Survey Area Data: Version 8, Apr 6, 2011

Date(s) aerial images were photographed: 7/29/2005; 8/17/2005; 7/2/2005

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 — El Paso County Area, Colorado (CO625) | | | | |
|---|---|---|---|---|
| **Map unit symbol** | **Map unit name** | **Rating** | **Acres in AOI** | **Percent of AOI** |
| 8 | Blakeland loamy sand, 1 to 9 percent slopes | A | 155.7 | 3.9% |
| 19 | Columbine gravelly sandy loam, 0 to 3 percent slopes | A | 2,095.1 | 52.1% |
| 83 | Stapleton sandy loam, 3 to 8 percent slopes | B | 1,768.2 | 44.0% |
| 111 | Water | | 3.8 | 0.1% |
| **Totals for Area of Interest** | | | **4,022.9** | **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.

# FEMA FIRM MAP

# National Flood Hazard Layer FIRMette

FEMA

104°34'31"W 38°58'31"N

104°33'53"W 38°58'3"N

Feet 1:6,000

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

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

## Legend

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

**SPECIAL FLOOD HAZARD AREAS**

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

**OTHER AREAS OF FLOOD HAZARD**

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

**OTHER AREAS**

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

**GENERAL STRUCTURES**

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

**OTHER FEATURES**

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

**MAP PANELS**

- Digital Data Available
- No Digital Data Available
- Unmapped

N

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 8/27/2021 at 4:44 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

# Federal Emergency Management Agency

Washington, D.C. 20472

**FEB 19 2004**

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

The Honorable Chuck Brown
Chairman, El Paso County
Board of Commissioners
27 East Vermijo Avenue
Colorado Springs, CO 80903-2208

IN REPLY REFER TO:
Case No.: 04-08-0012P
Community Name: El Paso County, CO
Community No.: 080059
Effective Date of This Revision: **MAR 19 2004**

Dear Mr. Brown:

The Flood Insurance Rate Map for your community has been revised by this Letter of Map Revision (LOMR). Please use the enclosed annotated map panel(s) revised by this LOMR for floodplain management purposes and for all flood insurance policies and renewals issued in your community.

Additional documents are enclosed which provide information regarding this LOMR. Please see the List of Enclosures below to determine which documents are included. Other attachments specific to this request may be included as referenced in the Determination Document. If you have any questions regarding floodplain management regulations for your community or the National Flood Insurance Program (NFIP) in general, please contact the Consultation Coordination Officer for your community. If you have any technical questions regarding this LOMR, please contact the Director, Federal Insurance and Mitigation Division of the Department of Homeland Security's Federal Emergency Management Agency (FEMA) in Denver, Colorado, at (303) 235-4830, or the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP). Additional information about the NFIP is available on our website at http://www.fema.gov/nfip.

Sincerely,

Kevin C. Long

Kevin C. Long, CFM, Project Engineer
Hazard Identification Section
Mitigation Division
Emergency Preparedness
and Response Directorate

For: Doug Bellomo, P.E., CFM, Acting Chief
Hazard Identification Section
Mitigation Division
Emergency Preparedness
and Response Directorate

List of Enclosures:
- Letter of Map Revision Determination Document
- Annotated Flood Insurance Rate Map

cc: Mr. Kevin Stilson, P.E., CFM
Floodplain Administrator
Pikes Peak Regional Building Department

Mr. Richard N. Wray, P.E.
Principal
Kiowa Engineering Corporation

 | Issue Date: FEB 19 2004 | Effective Date: MAR 19 2004 | Case No.: 04-08-0012P | LOMR-APP

# Federal Emergency Management Agency

Washington, D.C. 20472

# LETTER OF MAP REVISION DETERMINATION DOCUMENT

| COMMUNITY AND REVISION INFORMATION | | PROJECT DESCRIPTION | BASIS OF REQUEST |
|---|---|---|---|
| COMMUNITY | El Paso County<br>Colorado<br>(Unincorporated Areas) | NO PROJECT | HYDROLOGIC ANALYSIS<br>HYDRAULIC ANALYSIS<br>NEW TOPOGRAPHIC DATA |
| | COMMUNITY NO.: 080059 | | |
| IDENTIFIER | Fourway Ranch Letter of Map Revision | APPROXIMATE LATITUDE & LONGITUDE: 39.974, -104.566<br>SOURCE: USGS QUADRANGLE DATUM: NAD 83 | |
| FLOODING SOURCE(S) & REVISED REACH(ES) | **Haegler Ranch Tributary 1** – from approximately 1,200 feet upstream of the Cadillac and Lake City Railroad to just upstream of Eastonville Road<br>**Haegler Ranch Tributary 1A** – from the confluence with Haegler Ranch Tributary 1 to just upstream of Eastonville Road<br>**Haegler Ranch Tributary 2** – from the confluence with Haegler Ranch Tributary 1 to just upstream of Eastonville Road<br>**Geick Ranch Tributary 1** – from approximately 600 feet upstream to approximately 4,000 feet upstream of the Cadillac and Lake City Railroad<br>**Geick Ranch Tributary 2** – from approximately 600 feet upstream to approximately 2,600 feet upstream of the Cadillac and Lake City Railroad | | |

**SUMMARY OF REVISIONS**

Effective Flooding: Zone A
Revised Flooding: Zone A
Increases: YES
Decreases: YES

* BFEs – Base Flood Elevations

| ANNOTATED MAPPING ENCLOSURES | ANNOTATED STUDY ENCLOSURES |
|---|---|
| TYPE: FIRM* NO.: 08041C0575 F Date: March 17, 1997 | NO REVISION TO THE FLOOD INSURANCE STUDY REPORT |

* FIRM – Flood Insurance Rate Map; ** FBFM – Flood Boundary and Floodway Map; *** FHBM – Flood Hazard Boundary Map

## DETERMINATION

This document provides the determination from the Department of Homeland Security's Federal Emergency Management Agency (FEMA) regarding a request for a Letter of Map Revision (LOMR) for the area described above. Using the information submitted, we have determined that a revision to the flood hazards depicted in the Flood Insurance Study (FIS) report and/or National Flood Insurance Program (NFIP) map is warranted. This document revises the effective NFIP map, as indicated in the attached documentation. Please use the enclosed annotated map panels revised by this LOMR for floodplain management purposes and for all flood insurance policies and renewals in your community.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2677 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional information about the NFIP is available on our website at http://www.fema.gov/nfip.

Doug Bellomo, P.E., CFM, Acting Chief
Hazard Identification Section
Mitigation Division
Emergency Preparedness and Response Directorate

102061 D.A04080012 102IC

Federal Emergency Management Agency
Washington, D.C. 20472

# LETTER OF MAP REVISION DETERMINATION DOCUMENT (CONTINUED)

## COMMUNITY INFORMATION

### APPLICABLE NFIP REGULATIONS/COMMUNITY OBLIGATION

We have made this determination pursuant to Section 206 of the Flood Disaster Protection Act of 1973 (P.L. 93-234) and in accordance with the National Flood Insurance Act of 1968, as amended (Title XIII of the Housing and Urban Development Act of 1968, P.L. 90-448), 42 U.S.C. 4001-4128, and 44 CFR Part 65. Pursuant to Section 1361 of the National Flood Insurance Act of 1968, as amended, communities participating in the NFIP are required to adopt and enforce floodplain management regulations that meet or exceed NFIP criteria. These criteria, including adoption of the FIS report and FIRM, and the modifications made by this LOMR, are the minimum requirements for continued NFIP participation and do not supersede more stringent State/Commonwealth or local requirements to which the regulations apply.

### COMMUNITY REMINDERS

We based this determination on the 1-percent-annual-chance discharges computed in the submitted hydrologic model. Future development of projects upstream could cause increased discharges, which could cause increased flood hazards. A comprehensive restudy of your community's flood hazards would consider the cumulative effects of development on discharges and could, therefore, indicate that greater flood hazards exist in this area.

Your community must regulate all proposed floodplain development and ensure that permits required by Federal and/or State/Commonwealth law have been obtained. State/Commonwealth or community officials, based on knowledge of local conditions and in the interest of safety, may set higher standards for construction or may limit development in floodplain areas. If your State/Commonwealth or community has adopted more restrictive or comprehensive floodplain management criteria, those criteria take precedence over the minimum NFIP requirements.

We will not print and distribute this LOMR to primary users, such as local insurance agents or mortgage lenders; instead, the community will serve as a repository for the new data. We encourage you to disseminate the information in this LOMR by preparing a news release for publication in your community's newspaper that describes the revision and explains how your community will provide the data and help interpret the NFIP maps. In that way, interested persons, such as property owners, insurance agents, and mortgage lenders, can benefit from the information.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2677 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional information about the NFIP is available on our website at http://www.fema.gov/nfip.

Doug Bellomo, P.E., CFM, Acting Chief
Hazard Identification Section
Mitigation Division
Emergency Preparedness and Response Directorate

102061 D.A04080012 102IC

Federal Emergency Management Agency
Washington, D.C. 20472

# LETTER OF MAP REVISION DETERMINATION DOCUMENT (CONTINUED)

## COMMUNITY INFORMATION (CONTINUED)

We have designated a Consultation Coordination Officer (CCO) to assist your community. The CCO will be the primary liaison between your community and FEMA. For information regarding your CCO, please contact:

Mr. Steve L. Olsen
Director, Federal Insurance and Mitigation Division
Federal Emergency Management Agency, Region VIII
Denver Federal Center, Building 710
P.O. Box 25267
Denver, CO 80225-0267
(303) 235-4830

**STATUS OF THE COMMUNITY NFIP MAPS**

We will not physically revise and republish the FIRM and FIS report for your community to reflect the modifications made by this LOMR at this time. When changes to the previously cited FIRM panel and FIS report warrant physical revision and republication in the future, we will incorporate the modifications made by this LOMR at that time.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2677 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional information about the NFIP is available on our website at http://www.fema.gov/nfip.

Doug Bellomo, P.E., CFM, Acting Chief
Hazard Identification Section
Mitigation Division
Emergency Preparedness and Response Directorate

102061 D.A04080012 102IC

Federal Emergency Management Agency
Washington, D.C. 20472

# LETTER OF MAP REVISION DETERMINATION DOCUMENT (CONTINUED)

## PUBLIC NOTIFICATION OF REVISION

This revision will become effective 30 days from the date of this letter. Any requests to review or alter this determination should be made within 30 days and must be based on scientific or technical data.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2677 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional information about the NFIP is available on our website at http://www.fema.gov/nfip.

Doug Bellomo, P.E., CFM, Acting Chief
Hazard Identification Section
Mitigation Division
Emergency Preparedness and Response Directorate 102061 D.A04080012 102IC

# HYDROLOGIC CALCULATIONS

# EXISTING CONDITIONS

JOB NAME: *WATERBURY MDDP*
JOB NUMBER: *1715.00*
DATE: *09/21/21*
CALCULATED BY: *QNA*

## MDDP DRAINAGE REPORT ~ EXISTING BASIN RUNOFF COEFFICIENT SUMMARY

| BASIN | TOTAL AREA (AC) | IMPERVIOUS / DEVELOPED AREA | | | NONIMPERVIOUS / UNDEVELOPED AREA | | | WEIGHTED | | **WEIGHTED CA** | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | AREA (AC) | C(5) | C(100) | AREA (AC) | C(5) | C(100) | C(5) | C(100) | **CA(5)** | **CA(100)** |
| EXA | 9.62 | 0.00 | 0.45 | 0.59 | 9.62 | 0.09 | 0.36 | 0.09 | 0.36 | **0.87** | **3.46** |
| EXB | 4.09 | 0.00 | 0.45 | 0.59 | 4.09 | 0.09 | 0.36 | 0.09 | 0.36 | **0.37** | **1.47** |
| EXC | 24.80 | 0.00 | 0.45 | 0.59 | 24.80 | 0.09 | 0.36 | 0.09 | 0.36 | **2.23** | **8.93** |
| EXD | 15.87 | 0.00 | 0.45 | 0.59 | 15.87 | 0.09 | 0.36 | 0.09 | 0.36 | **1.43** | **5.71** |
| EXE | 5.83 | 0.00 | 0.45 | 0.59 | 5.83 | 0.09 | 0.36 | 0.09 | 0.36 | **0.52** | **2.10** |
| EXF | 1.62 | 0.00 | 0.45 | 0.59 | 1.62 | 0.09 | 0.36 | 0.09 | 0.36 | **0.15** | **0.58** |
| OS-1 | 45.02 | 0.00 | 0.45 | 0.59 | 45.02 | 0.09 | 0.36 | 0.09 | 0.36 | **4.05** | **16.21** |
| OS-2 | 11.40 | 0.00 | 0.45 | 0.59 | 11.40 | 0.09 | 0.36 | 0.09 | 0.36 | **1.03** | **4.11** |
| OS-3 | 1.11 | 0.00 | 0.45 | 0.59 | 1.11 | 0.09 | 0.36 | 0.09 | 0.36 | **0.10** | **0.40** |
| OS-4 | 0.29 | 0.00 | 0.45 | 0.59 | 0.29 | 0.09 | 0.36 | 0.09 | 0.36 | **0.03** | **0.11** |
| OS-5 | 6.74 | 0.00 | 0.45 | 0.59 | 6.74 | 0.09 | 0.36 | 0.09 | 0.36 | **0.61** | **2.43** |
| OS-8 | 2.56 | FLOW TAKEN FROM MERIDAIN RANCH MDDP | | | | | | | | | |
| OS-9 | 11.80 | FLOW TAKEN FROM MERIDAIN RANCH MDDP | | | | | | | | | |

JOB NAME: *WATERBURY MDDP*
JOB NUMBER: *1715.00*
DATE: *09/21/21*
CALC'D BY: *QNA*

# MDDP ~ EXISTING BASIN RUNOFF SUMMARY

| BASIN | WEIGHTED CA(5) | WEIGHTED CA(100) | OVERLAND C(5) | OVERLAND Length (ft) | OVERLAND Height (ft) | OVERLAND Tc (min) | STREET / CHANNEL FLOW Length (ft) | STREET / CHANNEL FLOW Slope (%) | STREET / CHANNEL FLOW Velocity (fps) | STREET / CHANNEL FLOW Tc (min) | Tc TOTAL (min) | INTENSITY I(5) (in/hr) | INTENSITY I(100) (in/hr) | TOTAL FLOWS Q(5) (cfs) | TOTAL FLOWS Q(100) (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EXA | 0.87 | 3.46 | 0.25 | 100 | 3 | 11.1 | 1193 | 1.7% | 4.5 | 4.4 | 15.4 | 3.43 | 5.81 | 3 | 20 |
| EXB | 0.37 | 1.47 | 0.25 | 100 | 2 | 12.6 | 623 | 2.2% | 5.2 | 2.0 | 14.6 | 3.51 | 5.96 | 1 | 9 |
| EXC | 2.23 | 8.93 | 0.25 | 100 | 2.5 | 11.7 | 2420 | 1.7% | 4.6 | 8.9 | 20.6 | 3.01 | 5.01 | 7 | 45 |
| EXD | 1.43 | 5.71 | 0.25 | 100 | 2 | 12.6 | 1615 | 2.6% | 5.6 | 4.8 | 17.4 | 3.25 | 5.47 | 5 | 31 |
| EXE | 0.52 | 2.10 | 0.25 | 100 | 8 | 8.0 | 1063 | 2.1% | 5.0 | 3.5 | 11.5 | 3.86 | 6.66 | 2 | 14 |
| EXF | 0.15 | 0.58 | 0.25 | 100 | 6 | 8.8 | 400 | 2.5% | 5.5 | 1.2 | 10.0 | 4.06 | 7.07 | 1 | 4 |
| OS-1 | 4.05 | 16.21 | 0.25 | 100 | 6 | 8.8 | 3219 | 2.3% | 5.3 | 10.1 | 18.9 | 3.13 | 5.24 | 13 | 85 |
| OS-2 | 1.03 | 4.11 | 0.25 | 100 | 2 | 12.6 | 1203 | 1.0% | 3.5 | 5.7 | 18.4 | 3.17 | 5.32 | 3 | 22 |
| OS-3 | 0.10 | 0.40 | 0.25 | 100 | 2 | 12.6 | 330 | 2.6% | 5.6 | 1.0 | 13.6 | 3.61 | 6.17 | 0 | 2 |
| OS-4 | 0.03 | 0.11 | 0.25 | 100 | 2 | 12.6 | 230 | 2.6% | 5.7 | 0.7 | 13.3 | 3.64 | 6.23 | 0 | 1 |
| OS-5 | 0.61 | 2.43 | 0.25 | 80 | 5 | 7.8 | 1000 | 2.5% | 5.5 | 3.0 | 10.8 | 3.96 | 6.85 | 2 | 17 |
| OS-8 | FLOW TAKEN FROM MERIDAIN RANCH MDDP | | | | | | | | | | | | | 5 | 11 |
| OS-9 | FLOW TAKEN FROM MERIDAIN RANCH MDDP | | | | | | | | | | | | | 8 | 19 |

JOB NAME: *WATERBURY MDDP*
JOB NUMBER: *1715.00*
DATE: *09/21/21*
CALCULATED BY: *QNA*

## MDDP ~ EXISTING SURFACE ROUTING SUMMARY

| Design Point(s) | Contributing Basins | Area (AC) | Equivalent CA(5) | Equivalent CA(100) | Maximum Tc | Intensity | | Flow | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | I(5) | I(100) | Q(5) | Q(100) | Facility Size |
| EX1 | EXA, OS-5, DP-10A & DP-10 | 18.92 | 1.47 | 5.89 | 15.4 | 3.43 | 5.81 | 38 | 180 | 3-42" CULVERTS |
| EX2 | EXB | 4.09 | 0.37 | 1.47 | 14.6 | 3.51 | 5.96 | 1 | 9 | STAPLETON ROAD |
| EX3 | EXC & OS-4 | 25.10 | 2.26 | 9.03 | 20.6 | 3.01 | 5.01 | 7 | 45 | EAST BOUNDARY |
| EX4 | EXD & OS-3 | 16.98 | 1.53 | 6.11 | 17.4 | 3.25 | 5.47 | 5 | 33 | EAST BOUNDARY |
| EX5 | EXE, OS-2 & OS-8 | 17.23 | 1.55 | 6.20 | 18.4 | 3.17 | 5.32 | 5 | 33 | EAST BOUNDARY |
| EX6 | EXF | 1.62 | 0.15 | 0.58 | 11.4 | 3.87 | 6.69 | 1 | 4 | EAST BOUNDARY |
| EX7 | EXF, OS-1 & OS-9 | 58.45 | 4.20 | 16.79 | 18.9 | 3.13 | 5.24 | 21 | 107 | DP 30 PROP CONDITION |

# EARLY GRADING CONDITIONS

JOB NAME: *WATERBURY MDDP*
JOB NUMBER: *1715.00*
DATE: *09/21/21*
CALCULATED BY: *QNA*

## MDDP DRAINAGE REPORT ~ EARLY GRADING BASIN RUNOFF COEFFICIENT SUMMARY

| BASIN | TOTAL AREA (AC) | IMPERVIOUS / DEVELOPED AREA | | | NONIMPERVIOUS / UNDEVELOPED AREA | | | WEIGHTED | | **WEIGHTED CA** | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | AREA (AC) | C(5) | C(100) | AREA (AC) | C(5) | C(100) | C(5) | C(100) | **CA(5)** | **CA(100)** |
| PRE-A | 4.61 | 0.00 | 0.45 | 0.59 | 4.61 | 0.09 | 0.36 | 0.09 | 0.36 | **0.41** | **1.66** |
| PRE-B | 12.35 | 0.00 | 0.45 | 0.59 | 12.35 | 0.09 | 0.36 | 0.09 | 0.36 | **1.11** | **4.45** |
| PRE-C | 19.08 | 0.00 | 0.45 | 0.59 | 19.08 | 0.09 | 0.36 | 0.09 | 0.36 | **1.72** | **6.87** |
| PRE-D | 15.52 | 0.00 | 0.45 | 0.59 | 15.52 | 0.09 | 0.36 | 0.09 | 0.36 | **1.40** | **5.59** |
| PRE-E | 6.33 | 0.00 | 0.45 | 0.59 | 6.33 | 0.09 | 0.36 | 0.09 | 0.36 | **0.57** | **2.28** |
| PRE-F | 0.62 | 0.00 | 0.45 | 0.59 | 0.62 | 0.09 | 0.36 | 0.09 | 0.36 | **0.06** | **0.22** |
| PRE-G | 2.00 | 0.00 | 0.45 | 0.59 | 2.00 | 0.09 | 0.36 | 0.09 | 0.36 | **0.18** | **0.72** |
| PRE-H | 1.33 | 0.00 | 0.45 | 0.59 | 1.33 | 0.09 | 0.36 | 0.09 | 0.36 | **0.12** | **0.48** |
| OS-1 | 0.75 | 0.00 | 0.45 | 0.59 | 0.75 | 0.09 | 0.36 | 0.09 | 0.36 | **0.07** | **0.27** |
| OS-2 | 11.15 | 0.00 | 0.45 | 0.59 | 11.15 | 0.09 | 0.36 | 0.09 | 0.36 | **1.00** | **4.01** |
| OS-3 | 1.11 | 0.00 | 0.45 | 0.59 | 1.11 | 0.09 | 0.36 | 0.09 | 0.36 | **0.10** | **0.40** |
| OS-4 | 0.56 | 0.00 | 0.45 | 0.59 | 0.56 | 0.09 | 0.36 | 0.09 | 0.36 | **0.05** | **0.20** |
| OS-8 | 2.56 | FLOW TAKEN FROM MERIDAIN RANCH MDDP | | | | | | | | | |

JOB NAME: *WATERBURY MDDP*
JOB NUMBER: *1715.00*
DATE: *09/21/21*
CALC'D BY: *QNA*

# MDDP ~ EARLY GRADING BASIN RUNOFF SUMMARY

| BASIN | WEIGHTED CA(5) | WEIGHTED CA(100) | OVERLAND C(5) | OVERLAND Length (ft) | OVERLAND Height (ft) | OVERLAND Tc (min) | STREET / CHANNEL FLOW Length (ft) | STREET / CHANNEL FLOW Slope (%) | STREET / CHANNEL FLOW Velocity (fps) | STREET / CHANNEL FLOW Tc (min) | Tc TOTAL (min) | INTENSITY I(5) (in/hr) | INTENSITY I(100) (in/hr) | TOTAL FLOWS Q(5) (cfs) | TOTAL FLOWS Q(100) (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PRE-A | 0.41 | 1.66 | 0.25 | 100 | 2.5 | 11.7 | 909 | 1.4% | 4.2 | 3.6 | 15.4 | 3.43 | 5.82 | 1 | 10 |
| PRE-B | 1.11 | 4.45 | 0.25 | 100 | 2.5 | 11.7 | 1612 | 1.3% | 4.0 | 6.7 | 18.5 | 3.16 | 5.31 | 4 | 24 |
| PRE-C | 1.72 | 6.87 | 0.25 | 100 | 2.5 | 11.7 | 1308 | 1.3% | 4.0 | 5.5 | 17.2 | 3.27 | 5.50 | 6 | 38 |
| PRE-D | 1.40 | 5.59 | 0.25 | 100 | 2 | 12.6 | 1297 | 1.6% | 4.5 | 4.9 | 17.5 | 3.24 | 5.46 | 5 | 30 |
| PRE-E | 0.57 | 2.28 | 0.25 | 100 | 8 | 8.0 | 752 | 2.1% | 5.1 | 2.5 | 10.5 | 4.00 | 6.94 | 2 | 16 |
| PRE-F | 0.06 | 0.22 | 0.25 | 64 | 2 | 8.7 | | | | | 8.7 | 4.26 | 7.47 | 0 | 2 |
| PRE-G | 0.18 | 0.72 | 0.25 | 161 | 5 | 13.9 | | | | | 13.9 | 3.58 | 6.12 | 1 | 4 |
| PRE-H | 0.12 | 0.48 | 0.25 | 67 | 2 | 9.1 | | | | | 9.1 | 4.21 | 7.36 | 1 | 4 |
| OS-1 | 0.07 | 0.27 | 0.25 | 85 | 2 | 11.0 | 75 | 1.3% | 4.0 | 0.3 | 11.4 | 3.88 | 6.70 | 0 | 2 |
| OS-2 | 1.00 | 4.01 | 0.25 | 76 | 2 | 10.1 | 1427 | 2.1% | 5.1 | 4.7 | 14.8 | 3.49 | 5.94 | 4 | 24 |
| OS-3 | 0.10 | 0.40 | 0.25 | 100 | 9 | 7.7 | 329 | 2.5% | 5.5 | 1.0 | 8.7 | 4.27 | 7.49 | 0 | 3 |
| OS-4 | 0.05 | 0.20 | 0.25 | 100 | 2 | 12.6 | 127 | 2.4% | 5.4 | 0.4 | 13.0 | 3.68 | 6.30 | 0 | 1 |
| OS-8 | FLOW TAKEN FROM MERIDAIN RANCH MDDP | | | | | | | | | | | | | 5 | 11 |

| | |
|---|---|
| JOB NAME: | *WATERBURY MDDP* |
| JOB NUMBER: | *1715.00* |
| DATE: | *09/21/21* |
| CALCULATED BY: | *QNA* |

## MDDP ~ EARLY GRADING SURFACE ROUTING SUMMARY

| Design Point(s) | Contributing Basins | Area (AC) | Equivalent CA(5) | Equivalent CA(100) | Maximum Tc | Intensity | | Flow | | Facility Size |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | I(5) | I(100) | Q(5) | Q(100) | |
| PRE1 | PRE-B & OS-4 | 4.65 | 1.16 | 4.65 | 18.5 | 3.16 | 5.31 | 4 | 25 | TSB 1 |
| PRE2 | PRE-C | 19.08 | 1.72 | 6.87 | 17.2 | 3.27 | 5.50 | 6 | 38 | TSB 2 |
| PRE3 | PRE-D & OS-3 | 16.63 | 1.50 | 5.99 | 17.5 | 3.24 | 5.46 | 5 | 33 | TSB 3 |
| PRE4 | PRE-E & OS-1 | 7.07 | 0.64 | 2.55 | 10.5 | 4.00 | 6.94 | 3 | 18 | TSB 4 |
| PRE5 | OS-8 & OS-2 | 13.71 | 1.34 | 4.76 | 8.7 | 4.26 | 7.47 | 6 | 36 | EX STOCK POND |
| PRE6 | PRE-F | 0.62 | 0.06 | 0.22 | 8.7 | 4.26 | 7.47 | 0 | 2 | STAPLETON ROAD |
| PRE7 | PRE-G, PRE-H & DP PRE2-PRE5 | 59.82 | 5.31 | 21.25 | 17.5 | 3.24 | 5.46 | 23 | 152 | EX GEICK RANCH CHANNEL |

# MDDP CALCULATIONS

JOB NAME: *WATERBURY MDDP*
JOB NUMBER: *1715.00*
DATE: *09/21/21*
CALCULATED BY: *QNA*

# MDDP DRAINAGE REPORT ~ PROPOSED BASIN RUNOFF COEFFICIENT SUMMARY

| BASIN | TOTAL AREA (AC) | IMPERVIOUS / DEVELOPED AREA | | | NONIMPERVIOUS / UNDEVELOPED AREA | | | WEIGHTED | | **WEIGHTED CA** | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | AREA (AC) | C(5) | C(100) | AREA (AC) | C(5) | C(100) | C(5) | C(100) | **CA(5)** | **CA(100)** |
| A | 3.39 | 3.39 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **1.52** | **2.00** |
| B1 | 2.30 | 2.30 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **1.03** | **1.36** |
| B2 | 2.69 | 2.69 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **1.21** | **1.59** |
| C | 0.86 | 0.86 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.39** | **0.51** |
| D | 2.11 | 2.11 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.95** | **1.24** |
| E | 2.18 | 2.18 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.98** | **1.29** |
| F | 2.18 | 2.18 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.98** | **1.29** |
| G | NOT USED | | | | | | | | | | |
| H | 1.13 | 1.13 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.51** | **0.67** |
| I | 5.66 | 2.14 | 0.45 | 0.59 | 3.53 | 0.09 | 0.36 | 0.23 | 0.45 | **1.28** | **2.53** |
| J | 1.99 | 1.99 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.90** | **1.17** |
| K | 3.06 | 1.14 | 0.45 | 0.59 | 1.92 | 0.09 | 0.36 | 0.22 | 0.45 | **0.69** | **1.37** |
| L1 | 5.27 | 5.27 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **2.37** | **3.11** |
| L2 | 2.00 | 2.00 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.90** | **1.18** |
| M1 | 2.90 | 2.90 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **1.31** | **1.71** |
| M2 | 0.47 | 0.47 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.21** | **0.28** |
| N | 0.22 | 0.22 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.10** | **0.13** |
| O1 | 2.82 | 2.82 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **1.27** | **1.66** |
| O2 | 0.94 | 0.94 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.42** | **0.56** |
| P | 1.18 | 1.18 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.53** | **0.70** |
| Q1 | 1.04 | 1.04 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.47** | **0.61** |
| Q2 | 1.10 | 1.10 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.49** | **0.65** |
| R | 0.13 | 0.13 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.06** | **0.08** |
| S1 | 1.55 | 1.55 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.70** | **0.91** |
| S2 | 0.13 | 0.13 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.06** | **0.08** |
| T1 | 1.42 | 1.42 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.64** | **0.84** |

JOB NAME: *WATERBURY MDDP*
JOB NUMBER: *1715.00*
DATE: *09/21/21*
CALC'D BY: *QNA*

# MDDP ~ PROPOSED BASIN RUNOFF SUMMARY

| BASIN | WEIGHTED CA(5) | WEIGHTED CA(100) | OVERLAND C(5) | OVERLAND Length (ft) | OVERLAND Height (ft) | OVERLAND Tc (min) | STREET / CHANNEL FLOW Length (ft) | STREET / CHANNEL FLOW Slope (%) | STREET / CHANNEL FLOW Velocity (fps) | STREET / CHANNEL FLOW Tc (min) | Tc TOTAL (min) | INTENSITY I(5) (in/hr) | INTENSITY I(100) (in/hr) | TOTAL FLOWS Q(5) (cfs) | TOTAL FLOWS Q(100) (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 1.52 | 2.00 | 0.25 | 100 | 2 | 12.6 | 420 | 1.5% | 4.3 | 1.6 | 14.3 | 3.54 | 6.03 | 5 | 12 |
| B1 | 1.03 | 1.36 | 0.25 | 100 | 2 | 12.6 | 400 | 1.5% | 4.3 | 1.6 | 14.2 | 3.55 | 6.05 | 4 | 8 |
| B2 | 1.21 | 1.59 | 0.25 | 100 | 2 | 12.6 | 550 | 1.5% | 4.3 | 2.1 | 14.8 | 3.49 | 5.93 | 4 | 9 |
| C | 0.39 | 0.51 | 0.25 | 20 | 0.5 | 5.3 | 500 | 2.0% | 4.9 | 1.7 | 6.9 | 4.58 | 8.14 | 2 | 4 |
| D | 0.95 | 1.24 | 0.25 | 80 | 2 | 10.5 | 300 | 2.5% | 5.5 | 0.9 | 11.4 | 3.87 | 6.69 | 4 | 8 |
| E | 0.98 | 1.29 | 0.25 | 100 | 2 | 12.6 | 400 | 2.5% | 5.5 | 1.2 | 13.8 | 3.59 | 6.12 | 4 | 8 |
| F | 0.98 | 1.29 | 0.25 | 50 | 2 | 7.1 | 620 | 1.5% | 4.3 | 2.4 | 9.5 | 4.14 | 7.22 | 4 | 9 |
| G | NOT USED | | | | | | | | | | | | | | |
| H | 0.51 | 0.67 | 0.25 | 50 | 2 | 7.1 | 525 | 1.5% | 4.3 | 2.0 | 9.2 | 4.19 | 7.33 | 2 | 5 |
| I | 1.28 | 2.53 | 0.25 | 80 | 4 | 8.4 | 250 | 2.0% | 4.9 | 0.8 | 9.2 | 4.18 | 7.32 | 5 | 19 |
| J | 0.90 | 1.17 | 0.25 | 90 | 6 | 8.1 | 850 | 2.0% | 4.9 | 2.9 | 10.9 | 3.94 | 6.81 | 4 | 8 |
| K | 0.69 | 1.37 | 0.25 | 100 | 18 | 6.1 | 80 | 1.0% | 3.5 | 0.4 | 6.5 | 4.67 | 8.33 | 3 | 11 |
| L1 | 2.37 | 3.11 | 0.25 | 100 | 2 | 12.6 | 860 | 1.4% | 4.1 | 3.5 | 16.1 | 3.36 | 5.69 | 8 | 18 |
| L2 | 0.90 | 1.18 | 0.25 | 55 | 1.1 | 9.4 | 860 | 1.4% | 4.1 | 3.5 | 12.8 | 3.70 | 6.34 | 3 | 7 |
| M1 | 1.31 | 1.71 | 0.25 | 70 | 1.5 | 10.3 | 200 | 2.0% | 4.9 | 0.7 | 11.0 | 3.92 | 6.79 | 5 | 12 |
| M2 | 0.21 | 0.28 | 0.25 | 65 | 3 | 7.7 | 0 | 0.0% | 0.0 | 0.0 | 7.7 | 4.43 | 7.83 | 1 | 2 |
| N | 0.10 | 0.13 | 0.25 | | | | | | | | 5.0 | 5.00 | 9.06 | 1 | 1 |
| O1 | 1.27 | 1.66 | 0.25 | 100 | 3 | 11.1 | 460 | 1.5% | 4.3 | 1.8 | 12.8 | 3.70 | 6.34 | 5 | 11 |
| O2 | 0.42 | 0.56 | 0.25 | 100 | 2 | 12.6 | 850 | 2.0% | 4.9 | 2.9 | 15.5 | 3.42 | 5.80 | 1 | 3 |
| P | 0.53 | 0.70 | 0.25 | 65 | 3 | 7.7 | 0 | 0.0% | 0.0 | 0.0 | 7.7 | 4.43 | 7.83 | 2 | 5 |
| Q1 | 0.47 | 0.61 | 0.25 | 55 | 1.3 | 8.9 | 445 | 2.0% | 5.0 | 1.5 | 10.4 | 4.01 | 6.97 | 2 | 4 |
| Q2 | 0.49 | 0.65 | 0.25 | 55 | 1.3 | 8.9 | 445 | 2.0% | 5.0 | 1.5 | 10.4 | 4.01 | 6.97 | 2 | 5 |
| R | 0.06 | 0.08 | 0.25 | 100 | 4 | 10.1 | 700 | 2.0% | 4.9 | 2.4 | 12.4 | 3.75 | 6.44 | 0 | 1 |
| S1 | 0.70 | 0.91 | 0.25 | 100 | 6 | 8.8 | 175 | 2.0% | 4.9 | 0.6 | 9.4 | 4.16 | 7.26 | 3 | 7 |

JOB NAME: *WATERBURY MDDP*
JOB NUMBER: *1715.00*
DATE: *09/21/21*
CALC'D BY: *QNA*

# MDDP ~ PROPOSED BASIN RUNOFF SUMMARY

| BASIN | WEIGHTED CA(5) | WEIGHTED CA(100) | OVERLAND C(5) | OVERLAND Length (ft) | OVERLAND Height (ft) | OVERLAND Tc (min) | STREET / CHANNEL FLOW Length (ft) | STREET / CHANNEL FLOW Slope (%) | STREET / CHANNEL FLOW Velocity (fps) | STREET / CHANNEL FLOW Tc (min) | Tc TOTAL (min) | INTENSITY I(5) (in/hr) | INTENSITY I(100) (in/hr) | TOTAL FLOWS Q(5) (cfs) | TOTAL FLOWS Q(100) (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S2 | 0.06 | 0.08 | 0.25 | | | | | | | | 5.0 | 5.00 | 9.06 | 0 | 1 |
| T1 | 0.64 | 0.84 | 0.25 | 55 | 1.1 | 9.4 | 390 | 2.0% | 4.9 | 1.3 | 10.7 | 3.97 | 6.88 | 3 | 6 |
| T2 | 0.55 | 0.73 | 0.25 | 100 | 2 | 12.6 | 245 | 2.0% | 5.0 | 0.8 | 13.5 | 3.63 | 6.20 | 2 | 5 |
| U1 | 1.97 | 2.58 | 0.25 | 100 | 2 | 12.6 | 520 | 2.3% | 5.3 | 1.6 | 14.3 | 3.54 | 6.03 | 7 | 16 |
| U2 | 0.85 | 1.11 | 0.25 | 100 | 2 | 12.6 | 385 | 2.3% | 5.4 | 1.2 | 13.8 | 3.59 | 6.12 | 3 | 7 |
| W | 2.34 | 3.07 | 0.25 | 100 | 2 | 12.6 | 630 | 1.6% | 4.4 | 2.4 | 15.0 | 3.47 | 5.89 | 8 | 18 |
| V | 0.59 | 0.78 | 0.25 | 95 | 6 | 8.4 | | | | | 8.4 | 4.31 | 7.58 | 3 | 6 |
| OS-1 | 5.31 | 6.97 | 0.25 | 100 | 2 | 12.6 | 690 | 2.0% | 5.0 | 2.3 | 15.0 | 3.47 | 5.90 | 18 | 41 |
| OS-2 | 7.15 | 9.38 | 0.25 | 100 | 2 | 12.6 | 1700 | 1.8% | 4.6 | 6.1 | 18.7 | 3.14 | 5.27 | 22 | 49 |
| 0S-3A | 0.35 | 0.47 | 0.25 | 55 | 1.1 | 9.4 | 480 | 1.3% | 3.9 | 2.0 | 11.4 | 3.87 | 6.68 | 1 | 3 |
| 0S-3B | 2.55 | 3.34 | 0.25 | 100 | 2 | 12.6 | 480 | 1.3% | 3.9 | 2.0 | 14.7 | 3.50 | 5.95 | 9 | 20 |
| OS-4 | 0.98 | 3.92 | 0.25 | 800 | 26 | 30.5 | | | | | 30.5 | 2.46 | 4.01 | 2 | 16 |
| OS-5 | 2.54 | 3.33 | 0.25 | 80 | 5 | 7.8 | 1000 | 2.5% | 5.5 | 3.0 | 10.8 | 3.96 | 6.85 | 10 | 23 |
| OS-6 | 0.48 | 0.63 | 0.25 | 30 | 0.6 | 6.9 | 900 | 1.8% | 4.7 | 3.2 | 10.1 | 4.05 | 7.04 | 2 | 4 |
| OS-7 | 0.25 | 1.01 | | | | | | | | | 5.0 | 5.00 | 9.06 | 1 | 9 |
| OS-8 | FLOW TAKEN FROM MERIDAIN RANCH MDDP | | | | | | | | | | | | | 5 | 11 |
| OS-9 | FLOW TAKEN FROM MERIDAIN RANCH MDDP | | | | | | | | | | | | | 8 | 19 |
| OS-10 | 0.31 | 1.23 | 0.25 | 100 | 2 | 12.6 | 300 | 2.7% | 5.7 | 0.9 | 13.5 | 3.62 | 6.19 | 1 | 8 |
| OS-Q1 | 1.94 | 2.54 | 0.25 | 200 | 5 | 16.6 | 1500 | 1.5% | 4.3 | 5.8 | 22.4 | 2.88 | 4.78 | 6 | 12 |
| OS-Q2 | 0.42 | 0.55 | 0.25 | 50 | 1 | 8.9 | 900 | 1.5% | 4.3 | 3.5 | 12.4 | 3.75 | 6.43 | 2 | 4 |
| OS-R | 2.72 | 3.57 | 0.25 | 50 | 1 | 8.9 | 850 | 2.7% | 5.8 | 2.5 | 11.4 | 3.87 | 6.69 | 11 | 24 |
| OS-S1 | 2.51 | 3.30 | 0.25 | 100 | 2 | 12.6 | 920 | 1.2% | 3.8 | 4.0 | 16.7 | 3.32 | 5.60 | 8 | 18 |
| OS-S2 | 0.08 | 0.10 | 0.25 | 100 | 2 | 12.6 | | | | | 12.6 | 3.72 | 6.39 | 0 | 1 |
| OS-T2 | 0.34 | 0.45 | 0.25 | 100 | 2 | 12.6 | | | | | 12.6 | 3.72 | 6.39 | 1 | 3 |

JOB NAME: *WATERBURY MDDP*
JOB NUMBER: *1715.00*
DATE: *09/21/21*
CALCULATED BY: *QNA*

## MDDP ~ PROPOSED SURFACE ROUTING SUMMARY

| Design Point(s) | Contributing Basins | Area (AC) | Equivalent CA(5) | Equivalent CA(100) | Maximum Tc | Intensity | | Flow | | Facility Size |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | I(5) | I(100) | Q(5) | Q(100) | |
| 1 | A | 3.39 | 1.52 | 2.00 | 14.3 | 3.54 | 6.03 | 5 | 12 | 6' Type R Sump Inlet |
| 2 | C | 0.86 | 0.39 | 0.51 | 6.9 | 4.58 | 8.14 | 2 | 4 | 4' Type R Sump Inlet |
| 3 | B1 | 2.30 | 1.03 | 1.36 | 14.2 | 3.55 | 6.05 | 4 | 8 | 4' Type R Sump Inlet |
| 4 | B2 | 2.69 | 1.21 | 1.59 | 14.8 | 3.49 | 5.93 | 4 | 9 | 4' Type R Sump Inlet |
| 5 | F & H | 3.31 | 1.49 | 1.95 | 9.5 | 4.14 | 7.22 | 6 | 14 | 6' Type R Sump Inlet |
| 6 | D | 2.11 | 0.95 | 1.24 | 11.4 | 3.87 | 6.69 | 4 | 8 | 4' Type R Sump Inlets |
| 7 | E | 2.18 | 0.98 | 1.29 | 13.8 | 3.59 | 6.12 | 4 | 8 | 4' Type R Sump Inlets |
| 8 | DESIGN POINTS 1-7 | 16.84 | 7.58 | 9.94 | 14.8 | 3.49 | 5.93 | 26 | 59 | FSD Pond 1 |
| 9 | OS-9 | 11.80 | | | | | | 5 | 11 | EX 36" CMP Culvert |
| 10 | OS-8 | 2.56 | | | | | | 8 | 19 | EX 36" CMP Culvert |
| 10A | MERIDIAN POND E RELEASE | | | | | | | 28 | 135 | EX 3-42" RCP Culverts |
| 11 | OS-5, I, OS-& MERIDIAN POND E RELEASE | SCS MODEL | | | | | | 53 | 212 | PR 2-42" RCP Culverts |
| 12 | OS-6 | 1.06 | 0.48 | 0.63 | 10.1 | 4.05 | 7.04 | 2 | 4 | 18"' RCP Culvert |
| 13 | TOTAL OFFISITE EX. STOCK POND INFLOW | SCS MODEL | | | | | | 69 | 396 | EX STOCK POND |
| 14 | L1 | 5.27 | 2.37 | 3.11 | 16.1 | 3.36 | 5.69 | 8 | 18 | 10' Type R Sump Inlet |
| 15 | L2 | 2.00 | 0.90 | 1.18 | 12.8 | 3.70 | 6.34 | 3 | 7 | 4' Type R Sump Inlet |

JOB NAME: *WATERBURY MDDP*
JOB NUMBER: *1715.00*
DATE: *09/21/21*
CALCULATED BY: *QNA*

## MDDP ~ PROPOSED SURFACE ROUTING SUMMARY

| Design Point(s) | Contributing Basins | Area (AC) | Equivalent CA(5) | Equivalent CA(100) | Maximum Tc | Intensity | | Flow | | Facility Size |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | I(5) | I(100) | Q(5) | Q(100) | |
| 16 | O1 | 2.82 | 1.27 | 1.66 | 12.8 | 3.70 | 6.34 | 5 | 11 | 6' Type R Sump Inlet |
| 17 | O2 | 0.94 | 0.42 | 0.56 | 15.5 | 3.42 | 5.80 | 1 | 3 | 4' Type R Sump Inlet |
| 18 | DESIGN POINTS 7-10 & BASIN 0S-4 | 21.93 | 5.95 | 6.51 | 16.1 | 3.36 | 5.69 | 20 | 37 | Interim FSD Pond 2 |
| 19 | Q1 & OS-Q1 | 5.34 | 2.40 | 3.15 | 22.4 | 2.88 | 4.78 | 7 | 15 | 8' Type R Sump Inlet |
| 20 | Q2 & OS-Q2 | 2.03 | 0.91 | 1.20 | 12.4 | 3.75 | 6.43 | 3 | 8 | 4' Type R Sump Inlet |
| 21 | R & OS-R | 6.18 | 2.78 | 3.65 | 11.4 | 3.87 | 6.69 | 11 | 24 | 12' Type R At-grade Inlet |
| 22 | S1 & OS-S1 & DP 21 FLOW BY | 7.14 | 4.61 | 6.55 | 16.7 | 3.32 | 5.60 | 15 | 37 | 10' Type R Sump Inlet |
| 23 | S2 & OS-S2 | 0.31 | 0.14 | 0.18 | 12.6 | 3.72 | 6.39 | 1 | 1 | 10' Type R Sump Inlet |
| 22 & 23 SPLIT | S1, OS-S1, S2, OS-S2, & DP 21 FLOW BY | 7.44 | 4.75 | 6.73 | 16.7 | 3.32 | 5.60 | 16 | 38 | 2-10' Type R Sump Inlets |
| 24 | T1 | 1.42 | 0.64 | 0.84 | 10.7 | 3.97 | 6.88 | 3 | 6 | 4' Type R Sump Inlets |
| 25 | T2 & OS-T2 | 1.99 | 0.90 | 1.18 | 13.5 | 3.63 | 6.20 | 3 | 7 | 4' Type R Sump Inlets |
| 26 | U1 | 4.38 | 1.97 | 2.58 | 14.3 | 3.54 | 6.03 | 7 | 16 | 10' Type R Sump Inlets |
| 27 | U2 | 1.89 | 0.85 | 1.11 | 13.8 | 3.59 | 6.12 | 3 | 7 | 6' Type R Sump Inlets |
| 28 | W | 5.20 | 2.34 | 3.07 | 15.0 | 3.47 | 5.89 | 8 | 18 | 10' Type R Sump Inlets |
| 29 | DESIGN POINTS 19-28, OFFSITE BASINS OS-1, 2, 3A, 3B, 7, & 9 | 84.64 | 37.91 | 51.40 | 22.4 | 2.88 | 4.78 | 117 | 265 | FSD POND |

JOB NAME: *WATERBURY MDDP*
JOB NUMBER: *1715.00*
DATE: *09/21/21*
CALCULATED BY: *QNA*

* PIPES ARE LISTED AT MAXIMUM SIZE REQUIRED TO ACCOMMODATE Q100 FLOWS AT MINIMUM GRADE.
REFER TO INDIVIDUAL PIPE SHEETS FOR HYDRAULIC INFORMATION.

## MDDP ~ PIPE ROUTING SUMMARY

| Pipe Run | Contributing Design Points/Basins | Equivalent CA(5) | Equivalent CA(100) | Maximum Tc | Intensity | | Flow | | Pipe Size* |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | I(5) | I(100) | Q(5) | Q(100) | |
| 1 | DP 2 | 0.39 | 0.51 | 6.9 | 4.58 | 8.14 | 2 | 4 | 18" RCP |
| 2 | DP 1 & 2 | 1.91 | 2.51 | 14.3 | 3.54 | 6.03 | 7 | 15 | 24" RCP |
| 3 | DP 3 | 1.03 | 1.36 | 14.2 | 3.55 | 6.05 | 4 | 8 | 18" RCP |
| 4 | DP-4 | 1.21 | 1.59 | 14.8 | 3.49 | 5.93 | 4 | 9 | 18" RCP |
| 5 | DP 3 & 4 | 2.25 | 2.94 | 14.8 | 3.49 | 5.93 | 8 | 17 | 24" RCP |
| 6 | DP 1-4 | 4.16 | 5.45 | 14.8 | 3.49 | 5.93 | 15 | 32 | 30" RCP |
| 7 | DP-1-5 | 5.65 | 7.41 | 14.8 | 3.49 | 5.93 | 20 | 44 | 36" RCP |
| 8 | DP-6 | 0.95 | 1.24 | 11.4 | 3.87 | 6.69 | 4 | 8 | 18" RCP |
| 9 | DP-7 | 0.98 | 1.29 | 13.8 | 3.59 | 6.12 | 4 | 8 | 18" RCP |
| 10 | DP-6 & 7 | 1.97 | 2.58 | 13.8 | 3.59 | 6.12 | 7 | 16 | 18" RCP |
| 10A | POND 1 RELEASE | 2.95 | 3.87 | 13.8 | 3.59 | 6.12 | 2.2 | 8.0 | 18" RCP |
| 11 | DP-14 | 2.37 | 3.11 | 16.1 | 3.36 | 5.69 | 8 | 18 | 24" RCP |
| 12 | DP-15 | 0.90 | 1.18 | 12.8 | 3.70 | 6.34 | 3 | 7 | 18" RCP |
| 13 | DP 14 & 15 | 3.27 | 4.29 | 16.1 | 3.36 | 5.69 | 11 | 24 | 30" RCP |
| 14 | DP 16 | 1.27 | 1.66 | 12.8 | 3.70 | 6.34 | 5 | 11 | 24" RCP |
| 15 | DP 14, 15 & 16 | 4.54 | 5.95 | 16.1 | 3.36 | 5.69 | 15 | 34 | 36" RCP |
| 16 | DP 17 | 0.42 | 0.56 | 15.5 | 3.42 | 5.80 | 1 | 3 | 18" RCP |
| 17 | DP 14, 15, 16, & 17 | 4.97 | 6.51 | 16.1 | 3.36 | 5.69 | 17 | 37 | 36" RCP |

JOB NAME: *WATERBURY MDDP*
JOB NUMBER: *1715.00*
DATE: *09/21/21*
CALCULATED BY: *QNA*

* PIPES ARE LISTED AT MAXIMUM SIZE REQUIRED TO ACCOMMODATE Q100 FLOWS AT MINIMUM GRADE.
REFER TO INDIVIDUAL PIPE SHEETS FOR HYDRAULIC INFORMATION.

## MDDP ~ PIPE ROUTING SUMMARY

| Pipe Run | Contributing Design Points/Basins | Equivalent CA(5) | Equivalent CA(100) | Maximum Tc | Intensity | | Flow | | Pipe Size* |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | I(5) | I(100) | Q(5) | Q(100) | |
| 17A | POND 2 RELEASE | | | | | | 0.2 | 10.6 | 18" RCP |
| 18 | DP 19 | 2.40 | 3.15 | 22.4 | 2.88 | 4.78 | 7 | 15 | 24" RCP |
| 19 | DP 20 | 0.91 | 1.20 | 12.4 | 3.75 | 6.43 | 3 | 8 | 18" RCP |
| 20 | DP 19 & 20 | 3.32 | 4.35 | 22.4 | 2.88 | 4.78 | 10 | 21 | 24" RCP |
| 21 | DP 21 PICK UP | 1.38 | 1.31 | 11.4 | 3.87 | 6.69 | 5 | 9 | 18" RCP |
| 22 | DP 19, 20 & 21 | 4.70 | 5.66 | 22.4 | 2.88 | 4.78 | 14 | 27 | 24" RCP |
| 23 | DP 22 | 2.37 | 3.36 | 16.7 | 3.32 | 5.60 | 8 | 19 | 24" RCP |
| 24 | DP 23 | 2.37 | 3.36 | 16.7 | 3.32 | 5.60 | 8 | 19 | 24" RCP |
| 25 | DP 22 & 23 | 4.75 | 6.73 | 16.7 | 3.32 | 5.60 | 16 | 38 | 30" RCP |
| 26 | DP 19 -23 | 9.45 | 12.39 | 22.4 | 2.88 | 4.78 | 27 | 59 | 36" RCP |
| 27 | DP 24 | 0.64 | 0.84 | 10.7 | 3.97 | 6.88 | 3 | 6 | 18" RCP |
| 28 | DP 25 | 0.90 | 1.18 | 13.5 | 3.63 | 6.20 | 3 | 7 | 18" RCP |
| 29 | DP 19-25 | 10.99 | 14.40 | 22.4 | 2.88 | 4.78 | 32 | 69 | 36" RCP |
| 30 | DP 26 | 1.97 | 2.58 | 14.3 | 3.54 | 6.03 | 7 | 16 | 24" RCP |
| 31 | DP 19-26 | 12.96 | 16.99 | 22.4 | 2.89 | 4.79 | 37 | 81 | 42" RCP |
| 32 | DP 27 | 0.85 | 1.11 | 13.8 | 3.59 | 6.12 | 3 | 7 | 18" RCP |
| 33 | DP 19-27 | 13.80 | 18.10 | 22.4 | 2.88 | 4.78 | 40 | 87 | 36" RCP |
| 34 | 28 | 2.34 | 3.07 | 15.0 | 3.47 | 5.89 | 8 | 18 | 24" RCP |
| 35 | Pond 3 Release | 0.90 | 2.00 | 13.5 | 3.62 | 6.19 | 1.0 | 60.7 | 36" RCP |

# PDR CALCULATIONS

JOB NAME: *WATERBURY FDR*
JOB NUMBER: *1715.00*
DATE: *09/21/21*
CALCULATED BY: *QNA*

# PRELIMINARY DRAINAGE REPORT ~ BASIN RUNOFF COEFFICIENT SUMMARY

| BASIN | TOTAL AREA (AC) | IMPERVIOUS / DEVELOPED AREA | | | NONIMPERVIOUS / UNDEVELOPED AREA | | | WEIGHTED | | **WEIGHTED CA** | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | AREA (AC) | C(5) | C(100) | AREA (AC) | C(5) | C(100) | C(5) | C(100) | **CA(5)** | **CA(100)** |
| A | 3.39 | 3.39 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **1.52** | **2.00** |
| B1 | 2.30 | 2.30 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **1.03** | **1.36** |
| B2 | 2.69 | 2.69 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **1.21** | **1.59** |
| C | 0.86 | 0.86 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.39** | **0.51** |
| D | 2.11 | 2.11 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.95** | **1.24** |
| E | 2.18 | 2.18 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.98** | **1.29** |
| F | 2.18 | 2.18 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.98** | **1.29** |
| G | 0.66 | 0.66 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.30** | **0.39** |
| H | 1.13 | 1.13 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.51** | **0.67** |
| I | 5.66 | 2.14 | 0.45 | 0.59 | 3.53 | 0.09 | 0.36 | 0.23 | 0.45 | **1.28** | **2.53** |
| J | 1.99 | 1.99 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.90** | **1.17** |
| K | 3.06 | 1.14 | 0.45 | 0.59 | 1.92 | 0.09 | 0.36 | 0.22 | 0.45 | **0.69** | **1.37** |
| L1 | 5.27 | 5.27 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **2.37** | **3.11** |
| L2 | 2.00 | 2.00 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.90** | **1.18** |
| M1 | 2.90 | 2.90 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **1.31** | **1.71** |
| M2 | 0.47 | 0.47 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.21** | **0.28** |
| N | 0.22 | 0.22 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.10** | **0.13** |
| O1 | 2.82 | 2.82 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **1.27** | **1.66** |
| O2 | 0.94 | 0.94 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.42** | **0.56** |
| P | 1.18 | 1.18 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.53** | **0.70** |
| Q1 | 1.04 | 1.04 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.47** | **0.61** |
| Q2 | 1.10 | 1.10 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.49** | **0.65** |
| R | 0.13 | 0.13 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.06** | **0.08** |
| S1 | 1.55 | 1.55 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.70** | **0.91** |
| S2 | 0.13 | 0.13 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.06** | **0.08** |
| T1 | 1.42 | 1.42 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.64** | **0.84** |

JOB NAME: *WATERBURY FDR*
JOB NUMBER: *1715.00*
DATE: *09/21/21*
CALCULATED BY: *QNA*

## PRELIMINARY DRAINAGE REPORT ~ BASIN RUNOFF COEFFICIENT SUMMARY

| BASIN | TOTAL AREA (AC) | IMPERVIOUS / DEVELOPED AREA | | | NONIMPERVIOUS / UNDEVELOPED AREA | | | WEIGHTED | | **WEIGHTED CA** | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | AREA (AC) | C(5) | C(100) | AREA (AC) | C(5) | C(100) | C(5) | C(100) | **CA(5)** | **CA(100)** |
| T2 | 1.23 | 1.23 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.55** | **0.73** |
| U1 | 4.38 | 4.38 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **1.97** | **2.58** |
| U2 | 1.89 | 1.89 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.85** | **1.11** |
| W | 5.20 | 5.20 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **2.34** | **3.07** |
| V | 1.32 | 1.32 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.59** | **0.78** |
| **OS-1** | **51.92** | **0.00** | **0.45** | **0.59** | **51.92** | **0.09** | **0.36** | **0.09** | **0.36** | **4.67** | **18.69** |
| OS-4 | 10.90 | 0.00 | 0.45 | 0.59 | 10.90 | 0.09 | 0.36 | 0.09 | 0.36 | **0.98** | **3.92** |
| OS-5 | 5.64 | 5.64 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **2.54** | **3.33** |
| OS-6 | 1.06 | 1.06 | 0.45 | 0.59 | 0.00 | 0.09 | 0.36 | 0.45 | 0.59 | **0.48** | **0.63** |
| **OS-7** | **3.64** | **0.00** | **0.45** | **0.59** | **3.64** | **0.09** | **0.36** | **0.09** | **0.36** | **0.33** | **1.31** |
| OS-8 | 2.56 | FLOW TAKEN FROM MERIDAIN RANCH MDDP | | | | | | | | | |
| OS-9 | 11.80 | FLOW TAKEN FROM MERIDAIN RANCH MDDP | | | | | | | | | |
| **OS-Q1** | **0.33** | **0.00** | **0.45** | **0.59** | **0.33** | **0.09** | **0.36** | **0.09** | **0.36** | **0.03** | **0.12** |
| **OS-Q2** | **0.22** | **0.00** | **0.45** | **0.59** | **0.22** | **0.09** | **0.36** | **0.09** | **0.36** | **0.02** | **0.08** |
| **OS-R** | **1.04** | **0.00** | **0.45** | **0.59** | **1.04** | **0.09** | **0.36** | **0.09** | **0.36** | **0.09** | **0.38** |
| **OS-S1** | **0.31** | **0.00** | **0.45** | **0.59** | **0.31** | **0.09** | **0.36** | **0.09** | **0.36** | **0.03** | **0.11** |
| **OS-S2** | **0.13** | **0.00** | **0.45** | **0.59** | **0.13** | **0.09** | **0.36** | **0.09** | **0.36** | **0.01** | **0.05** |
| **OS-T2** | **0.30** | **0.00** | **0.45** | **0.59** | **0.30** | **0.09** | **0.36** | **0.09** | **0.36** | **0.03** | **0.11** |

JOB NAME: ***WATERBURY FDR***
JOB NUMBER: ***1715.00***
DATE: ***09/21/21***
CALC'D BY: ***QNA***

PRELIMINARY DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY

| | WEIGHTED | | OVERLAND | | | | STREET / CHANNEL FLOW | | | | Tc | INTENSITY | | TOTAL FLOWS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BASIN | CA(5) | CA(100) | C(5) | Length (ft) | Height (ft) | Tc (min) | Length (ft) | Slope (%) | Velocity (fps) | Tc (min) | TOTAL (min) | I(5) (in/hr) | I(100) (in/hr) | Q(5) (cfs) | Q(100) (cfs) |
| A | 1.52 | 2.00 | 0.25 | 100 | 2 | 12.6 | 420 | 1.5% | 4.3 | 1.6 | 14.3 | 3.54 | 6.03 | **5** | **12** |
| B1 | 1.03 | 1.36 | 0.25 | 100 | 2 | 12.6 | 400 | 1.5% | 4.3 | 1.6 | 14.2 | 3.55 | 6.05 | **4** | **8** |
| B2 | 1.21 | 1.59 | 0.25 | 100 | 2 | 12.6 | 550 | 1.5% | 4.3 | 2.1 | 14.8 | 3.49 | 5.93 | **4** | **9** |
| C | 0.39 | 0.51 | 0.25 | 20 | 0.5 | 5.3 | 500 | 2.0% | 4.9 | 1.7 | 6.9 | 4.58 | 8.14 | **2** | **4** |
| D | 0.95 | 1.24 | 0.25 | 80 | 2 | 10.5 | 300 | 2.5% | 5.5 | 0.9 | 11.4 | 3.87 | 6.69 | **4** | **8** |
| E | 0.98 | 1.29 | 0.25 | 100 | 2 | 12.6 | 400 | 2.5% | 5.5 | 1.2 | 13.8 | 3.59 | 6.12 | **4** | **8** |
| F | 0.98 | 1.29 | 0.25 | 50 | 2 | 7.1 | 620 | 1.5% | 4.3 | 2.4 | 9.5 | 4.14 | 7.22 | **4** | **9** |
| G | 0.30 | 0.39 | 0.25 | 25 | 2 | 4.0 | 620 | 1.0% | 3.4 | 3.0 | 7.0 | 4.57 | 8.12 | **1** | **3** |
| H | 0.51 | 0.67 | 0.25 | 50 | 2 | 7.1 | 525 | 1.5% | 4.3 | 2.0 | 9.2 | 4.19 | 7.33 | **2** | **5** |
| I | 1.28 | 2.53 | 0.25 | 80 | 4 | 8.4 | 250 | 2.0% | 4.9 | 0.8 | 9.2 | 4.18 | 7.32 | **5** | **19** |
| J | 0.90 | 1.17 | 0.25 | 90 | 6 | 8.1 | 850 | 2.0% | 4.9 | 2.9 | 10.9 | 3.94 | 6.81 | **4** | **8** |
| K | 0.69 | 1.37 | 0.25 | 100 | 18 | 6.1 | 80 | 1.0% | 3.5 | 0.4 | 6.5 | 4.67 | 8.33 | **3** | **11** |
| L1 | 2.37 | 3.11 | 0.25 | 100 | 2 | 12.6 | 860 | 1.4% | 4.1 | 3.5 | 16.1 | 3.36 | 5.69 | **8** | **18** |
| L2 | 0.90 | 1.18 | 0.25 | 55 | 1.1 | 9.4 | 860 | 1.4% | 4.1 | 3.5 | 12.8 | 3.70 | 6.34 | **3** | **7** |
| M1 | 1.31 | 1.71 | 0.25 | 70 | 1.5 | 10.3 | 200 | 2.0% | 4.9 | 0.7 | 11.0 | 3.92 | 6.79 | **5** | **12** |
| M2 | 0.21 | 0.28 | 0.25 | 65 | 3 | 7.7 | 0 | 0.0% | 0.0 | 0.0 | 7.7 | 4.43 | 7.83 | **1** | **2** |
| N | 0.10 | 0.13 | 0.25 | | | | | | | | 5.0 | 5.00 | 9.06 | **1** | **1** |
| O1 | 1.27 | 1.66 | 0.25 | 100 | 3 | 11.1 | 460 | 1.5% | 4.3 | 1.8 | 12.8 | 3.70 | 6.34 | **5** | **11** |
| O2 | 0.42 | 0.56 | 0.25 | 100 | 2 | 12.6 | 850 | 2.0% | 4.9 | 2.9 | 15.5 | 3.42 | 5.80 | **1** | **3** |
| P | 0.53 | 0.70 | 0.25 | 65 | 3 | 7.7 | 0 | 0.0% | 0.0 | 0.0 | 7.7 | 4.43 | 7.83 | **2** | **5** |
| Q1 | 0.47 | 0.61 | 0.25 | 55 | 1.3 | 8.9 | 445 | 2.0% | 5.0 | 1.5 | 10.4 | 4.01 | 6.97 | **2** | **4** |
| Q2 | 0.49 | 0.65 | 0.25 | 55 | 1.3 | 8.9 | 445 | 2.0% | 5.0 | 1.5 | 10.4 | 4.01 | 6.97 | **2** | **5** |
| R | 0.06 | 0.08 | 0.25 | 100 | 4 | 10.1 | 700 | 2.0% | 4.9 | 2.4 | 12.4 | 3.75 | 6.44 | **0** | **1** |
| S1 | 0.70 | 0.91 | 0.25 | 100 | 6 | 8.8 | 175 | 2.0% | 4.9 | 0.6 | 9.4 | 4.16 | 7.26 | **3** | **7** |

JOB NAME: *WATERBURY FDR*
JOB NUMBER: *1715.00*
DATE: *09/21/21*
CALC'D BY: *QNA*

PRELIMINARY DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY

| BASIN | WEIGHTED CA(5) | CA(100) | OVERLAND C(5) | Length (ft) | Height (ft) | Tc (min) | STREET / CHANNEL FLOW Length (ft) | Slope (%) | Velocity (fps) | Tc (min) | Tc TOTAL (min) | INTENSITY I(5) (in/hr) | I(100) (in/hr) | TOTAL FLOWS Q(5) (cfs) | Q(100) (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S2 | 0.06 | 0.08 | 0.25 | | | | | | | | 5.0 | 5.00 | 9.06 | 0 | 1 |
| T1 | 0.64 | 0.84 | 0.25 | 55 | 1.1 | 9.4 | 390 | 2.0% | 4.9 | 1.3 | 10.7 | 3.97 | 6.88 | 3 | 6 |
| T2 | 0.55 | 0.73 | 0.25 | 100 | 2 | 12.6 | 245 | 2.0% | 5.0 | 0.8 | 13.5 | 3.63 | 6.20 | 2 | 5 |
| U1 | 1.97 | 2.58 | 0.25 | 100 | 2 | 12.6 | 520 | 2.3% | 5.3 | 1.6 | 14.3 | 3.54 | 6.03 | 7 | 16 |
| U2 | 0.85 | 1.11 | 0.25 | 100 | 2 | 12.6 | 385 | 2.3% | 5.4 | 1.2 | 13.8 | 3.59 | 6.12 | 3 | 7 |
| W | 2.34 | 3.07 | 0.25 | 100 | 2 | 12.6 | 630 | 1.6% | 4.4 | 2.4 | 15.0 | 3.47 | 5.89 | 8 | 18 |
| V | 0.59 | 0.78 | 0.25 | 95 | 6 | 8.4 | | | | | 8.4 | 4.31 | 7.58 | 3 | 6 |
| **OS-1** | **4.67** | **18.69** | **0.25** | **100** | **2** | **12.6** | **2700** | **2.3%** | **5.3** | **8.5** | **21.1** | **2.97** | **4.94** | **14** | **92** |
| OS-4 | 0.98 | 3.92 | 0.25 | 800 | 26 | 30.5 | | | | | 30.5 | 2.46 | 4.01 | 2 | 16 |
| OS-5 | 2.54 | 3.33 | 0.25 | 600 | 18 | 27.1 | | | | | 27.1 | 2.62 | 4.30 | 7 | 14 |
| OS-6 | 0.48 | 0.63 | 0.25 | 30 | 0.6 | 6.9 | 900 | 1.8% | 4.7 | 3.2 | 10.1 | 4.05 | 7.04 | 2 | 4 |
| **OS-7** | **0.33** | **1.31** | **0.25** | | | | | | | | **5.0** | **5.00** | **9.06** | **2** | **12** |
| OS-8 | FLOW TAKEN FROM MERIDAIN RANCH MDDP | | | | | | | | | | | | | 5 | 11 |
| OS-9 | FLOW TAKEN FROM MERIDAIN RANCH MDDP | | | | | | | | | | | | | 8 | 19 |
| **OS-Q1** | **0.03** | **0.12** | **0.25** | **100** | **2** | **12.6** | **135** | **1.5%** | **4.3** | **0.5** | **13.2** | **3.66** | **6.27** | **0** | **1** |
| **OS-Q2** | **0.02** | **0.08** | **0.25** | **50** | **1** | **8.9** | **135** | **1.5%** | **4.3** | **0.5** | **9.5** | **4.14** | **7.24** | **0** | **1** |
| **OS-R** | **0.09** | **0.38** | **0.25** | **100** | **2** | **12.6** | **50** | **2.7%** | **5.8** | **0.1** | **12.8** | **3.70** | **6.35** | **0** | **2** |
| **OS-S1** | **0.03** | **0.11** | | | | | | | | | **5.0** | **5.00** | **9.06** | **0** | **1** |
| **OS-S2** | **0.01** | **0.05** | | | | | | | | | **5.0** | **5.00** | **9.06** | **0** | **0** |
| **OS-T2** | **0.03** | **0.11** | | | | | | | | | **5.0** | **5.00** | **9.06** | **0** | **1** |

JOB NAME: *WATERBURY FDR*
JOB NUMBER: *1715.00*
DATE: *09/22/21*
CALCULATED BY: *QNA*

## PELIMNARY DRAINAGE REPORT ~ SURFACE ROUTING SUMMARY

| Design Point(s) | Contributing Basins | Area (AC) | Equivalent CA(5) | Equivalent CA(100) | Maximum Tc | Intensity | | Flow | | Facility Size |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | I(5) | I(100) | Q(5) | Q(100) | |
| 1 | A | 3.39 | 1.52 | 2.00 | 14.3 | 3.54 | 6.03 | 5 | 12 | 6' Type R Sump Inlet |
| 2 | C | 0.86 | 0.39 | 0.51 | 6.9 | 4.58 | 8.14 | 2 | 4 | 4' Type R Sump Inlet |
| 3 | B1 | 2.30 | 1.03 | 1.36 | 14.2 | 3.55 | 6.05 | 4 | 8 | 4' Type R Sump Inlet |
| 4 | B2 | 2.69 | 1.21 | 1.59 | 14.8 | 3.49 | 5.93 | 4 | 9 | 4' Type R Sump Inlet |
| 5 | F & H | 3.31 | 1.49 | 1.95 | 9.5 | 4.14 | 7.22 | 6 | 14 | 6' Type R Sump Inlet |
| 6 | D | 2.11 | 0.95 | 1.24 | 11.4 | 3.87 | 6.69 | 4 | 8 | 4' Type R Sump Inlets |
| 7 | E | 2.18 | 0.98 | 1.29 | 13.8 | 3.59 | 6.12 | 4 | 8 | 4' Type R Sump Inlets |
| 8 | DESIGN POINTS 1-7 | 16.84 | 7.58 | 9.94 | 14.8 | 3.49 | 5.93 | 26 | 59 | FSD Pond 1 |
| 9 | OS-9 | 0.31 | 0.03 | 0.11 | 5.0 | 5.00 | 9.06 | 0 | 1 | EX 36" CMP Culvert |
| 10 | OS-8 | 1.04 | 0.09 | 0.38 | 12.8 | 3.70 | 6.35 | 0 | 2 | EX 36" CMP Culvert |
| 10A | MERIDIAN POND E RELEASE | | | | | | | 28 | 135 | EX 3-42" RCP Culverts |
| 11 | OS-5, I, OS-& MERIDIAN POND E RELEASE | SCS MODEL | | | | | | 53 | 212 | PR 2-42" RCP Culverts |
| 12 | OS-6 | 0.33 | 0.48 | 0.63 | 10.1 | 4.05 | 7.04 | 2 | 4 | 18"' RCP Culvert |
| 13 | TOTAL OFFISITE EX. STOCK POND INFLOW | SCS MODEL | | | | | | 69 | 396 | EX STOCK POND |
| 14 | L1 | 5.27 | 2.37 | 3.11 | 16.1 | 3.36 | 5.69 | 8 | 18 | 10' Type R Sump Inlet |
| 15 | L2 | 2.00 | 0.90 | 1.18 | 12.8 | 3.70 | 6.34 | 3 | 7 | 4' Type R Sump Inlet |

JOB NAME: *WATERBURY FDR*
JOB NUMBER: *1715.00*
DATE: *09/22/21*
CALCULATED BY: *QNA*

## PELIMNARY DRAINAGE REPORT ~ SURFACE ROUTING SUMMARY

| Design Point(s) | Contributing Basins | Area (AC) | Equivalent CA(5) | Equivalent CA(100) | Maximum Tc | Intensity | | Flow | | Facility Size |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | I(5) | I(100) | Q(5) | Q(100) | |
| 16 | O1 | 2.82 | 1.27 | 1.66 | 12.8 | 3.70 | 6.34 | 5 | 11 | 6' Type R Sump Inlet |
| 17 | O2 | 0.94 | 0.42 | 0.56 | 15.5 | 3.42 | 5.80 | 1 | 3 | 4' Type R Sump Inlet |
| 18 | DESIGN POINTS 7-10 & BASIN 0S-4 | 21.93 | 4.97 | 6.51 | 16.1 | 3.36 | 5.69 | 17 | 37 | Interim FSD Pond 2 |
| **19*** | **Q1 & OS-Q1** | **1.36** | **0.50** | **0.73** | **13.2** | **3.66** | **6.27** | **2** | **5** | **8' Type R Sump Inlet** |
| **20*** | **Q2 & OS-Q2** | **1.32** | **0.51** | **0.73** | **9.5** | **4.14** | **7.24** | **2** | **5** | **4' Type R Sump Inlet** |
| **21*** | **R & OS-R** | **1.18** | **0.15** | **0.45** | **12.4** | **3.75** | **6.44** | **1** | **3** | **12' Type R At-grade Inlet** |
| **22*** | **S1 & OS-S1 & DP 21 FLOW BY** | **1.86** | **0.74** | **1.16** | **12.4** | **3.75** | **6.44** | **3** | **7** | **10' Type R Sump Inlet** |
| **23*** | **S2 & OS-S2** | **0.27** | **0.07** | **0.13** | **5.0** | **5.00** | **9.06** | **0** | **1** | **10' Type R Sump Inlet** |
| **24*** | **T1** | **1.42** | **0.64** | **0.84** | **10.7** | **3.97** | **6.88** | **3** | **6** | **4' Type R Sump Inlets** |
| **25*** | **T2 & OS-T2** | **1.54** | **0.58** | **0.84** | **13.5** | **3.63** | **6.20** | **2** | **5** | **4' Type R Sump Inlets** |
| **26*** | **U1** | **4.38** | **1.97** | **2.58** | **14.3** | **3.54** | **6.03** | **7** | **16** | **10' Type R Sump Inlets** |
| **27*** | **U2** | **1.89** | **0.85** | **1.11** | **13.8** | **3.59** | **6.12** | **3** | **7** | **6' Type R Sump Inlets** |
| **28*** | **W** | **5.20** | **2.34** | **3.07** | **15.0** | **3.47** | **5.89** | **8** | **18** | **10' Type R Sump Inlets** |
| **29*** | **DESIGN POINTS 19-28 & OS-7** | **21.72** | **8.94** | **12.42** | **15.0** | **3.47** | **5.89** | **31** | **73** | **FSD POND** |
| **30*** | **V, OS-1, OS-8 & OS-9** | **67.60** | **5.27** | **19.47** | **21.1** | **2.97** | **4.94** | **24** | **115** | **Triple 36" RCP Culverts** |

**DESIGN POINT* = DESIGN POINT REVISED FROM MDDP IN PRELIMINARY CONDITION DUE TO UNDEVELOPED UPSTREAM**

JOB NAME: *WATERBURY FDR*
JOB NUMBER: *1715.00*
DATE: *09/22/21*
CALCULATED BY: *QNA*

* PIPES ARE LISTED AT MAXIMUM SIZE REQUIRED TO ACCOMMODATE Q100 FLOWS AT MINIMUM GRADE.
REFER TO INDIVIDUAL PIPE SHEETS FOR HYDRAULIC INFORMATION.

## PELIMNARY DRAINAGE REPORT ~ PIPE ROUTING SUMMARY

| | | | | | Intensity | | Flow | | |
|---|---|---|---|---|---|---|---|---|---|
| Pipe Run | Contributing Design Points/Basins | Equivalent CA(5) | Equivalent CA(100) | Maximum Tc | I(5) | I(100) | Q(5) | Q(100) | Pipe Size* |
| 1 | DP 2 | 0.39 | 0.51 | 6.9 | 4.58 | 8.14 | 2 | 4 | 18" RCP |
| 2 | DP 1 & 2 | 1.91 | 2.51 | 14.3 | 3.54 | 6.03 | 7 | 15 | 24" RCP |
| 3 | DP 3 | 1.03 | 1.36 | 14.2 | 3.55 | 6.05 | 4 | 8 | 18" RCP |
| 4 | DP-4 | 1.21 | 1.59 | 14.8 | 3.49 | 5.93 | 4 | 9 | 18" RCP |
| 5 | DP 3 & 4 | 2.25 | 2.94 | 14.8 | 3.49 | 5.93 | 8 | 17 | 24" RCP |
| 6 | DP 1-4 | 4.16 | 5.45 | 14.8 | 3.49 | 5.93 | 15 | 32 | 30" RCP |
| 7 | DP-1-5 | 5.65 | 7.41 | 14.8 | 3.49 | 5.93 | 20 | 44 | 36" RCP |
| 8 | DP-6 | 0.95 | 1.24 | 11.4 | 3.87 | 6.69 | 4 | 8 | 18" RCP |
| 9 | DP-7 | 0.98 | 1.29 | 13.8 | 3.59 | 6.12 | 4 | 8 | 18" RCP |
| 10 | DP-6 & 7 | 1.93 | 2.53 | 13.8 | 3.59 | 6.12 | 7 | 15 | 18" RCP |
| 10A | Pond 1 Release | | | | | | 2.2 | 8.0 | 18" RCP |
| 11 | DP-14 | 2.37 | 3.11 | 16.1 | 3.36 | 5.69 | 8 | 18 | 24" RCP |
| 12 | DP-15 | 0.90 | 1.18 | 12.8 | 3.70 | 6.34 | 3 | 7 | 18" RCP |
| 13 | DP 14 & 15 | 3.27 | 4.29 | 16.1 | 3.36 | 5.69 | 11 | 24 | 30" RCP |
| 14 | DP 16 | 1.27 | 1.66 | 12.8 | 3.70 | 6.34 | 5 | 11 | 24" RCP |
| 15 | DP 14, 15 & 16 | 4.54 | 5.95 | 16.1 | 3.36 | 5.69 | 15 | 34 | 36" RCP |
| 16 | DP 17 | 0.42 | 0.56 | 15.5 | 3.42 | 5.80 | 1 | 3 | 18" RCP |

JOB NAME: *WATERBURY FDR*
JOB NUMBER: *1715.00*
DATE: *09/22/21*
CALCULATED BY: *QNA*

* PIPES ARE LISTED AT MAXIMUM SIZE REQUIRED TO ACCOMMODATE Q100 FLOWS AT MINIMUM GRADE.
REFER TO INDIVIDUAL PIPE SHEETS FOR HYDRAULIC INFORMATION.

## PELIMNARY DRAINAGE REPORT ~ PIPE ROUTING SUMMARY

| | | | | | Intensity | | Flow | | |
|---|---|---|---|---|---|---|---|---|---|
| Pipe Run | Contributing Design Points/Basins | Equivalent CA(5) | Equivalent CA(100) | Maximum Tc | I(5) | I(100) | Q(5) | Q(100) | Pipe Size* |
| 17 | DP 14, 15, 16, & 17 | 4.97 | 6.51 | 16.1 | 3.36 | 5.69 | 17 | 37 | 36" RCP |
| 17A | Pond 2 Release | | | | | | 0.2 | 10.6 | 18" RCP |
| **18*** | **DP 19** | **0.50** | **0.73** | **13.2** | **3.66** | **6.27** | **2** | **5** | **24" RCP** |
| **19*** | **DP 20** | **0.51** | **0.73** | **9.5** | **4.14** | **7.24** | **2** | **5** | **18" RCP** |
| **20*** | **DP 19 & 20** | **1.01** | **1.46** | **13.2** | **3.66** | **6.27** | **4** | **9** | **24" RCP** |
| **21*** | **DP 21 PICK UP** | **0.14** | **0.32** | **12.4** | **3.75** | **6.44** | **1** | **2** | **18" RCP** |
| **22*** | **DP 19, 20 & 21** | **1.15** | **1.77** | **13.2** | **3.66** | **6.27** | **4** | **11** | **30" RCP** |
| **23*** | **DP 22** | **0.74** | **1.16** | **12.4** | **3.75** | **6.44** | **3** | **7** | **24" RCP** |
| **24*** | **DP 23** | **0.07** | **0.13** | **5.0** | **5.00** | **9.06** | **0** | **1** | **24" RCP** |
| **25*** | **DP 22 & 23** | **0.81** | **1.29** | **12.4** | **3.75** | **6.44** | **3** | **8** | **24" RCP** |
| **26*** | **DP 19 -23** | **1.96** | **3.06** | **13.2** | **3.66** | **6.27** | **7** | **19** | **36" RCP** |
| **27*** | **DP 24** | **0.64** | **0.84** | **10.7** | **3.97** | **6.88** | **3** | **6** | **18" RCP** |
| **28*** | **DP 25** | **0.58** | **0.84** | **13.5** | **3.63** | **6.20** | **2** | **5** | **18" RCP** |
| **29*** | **DP 19-25** | **3.18** | **4.74** | **13.5** | **3.63** | **6.20** | **12** | **29** | **36" RCP** |
| **30*** | **DP 26** | **1.97** | **2.58** | **14.3** | **3.54** | **6.03** | **7** | **16** | **24" RCP** |
| **31*** | **DP 19-26** | **5.15** | **7.32** | **14.3** | **3.54** | **6.03** | **18** | **44** | **42" RCP** |
| **32*** | **27** | **0.85** | **1.11** | **13.8** | **3.59** | **6.12** | **3** | **7** | **18" RCP** |
| **33*** | **DP 19-27** | **6.00** | **8.43** | **14.3** | **3.54** | **6.03** | **21** | **51** | **42" RCP** |
| 34 | DP 28 | 2.34 | 3.07 | 21.1 | 2.97 | 4.94 | 7 | 15 | 24" RCP |
| **35*** | **Pond 3 Release** | **0.00** | **0.00** | **0.0** | **7.12** | **14.19** | **1.0** | **60.7** | **TRIPLE 36" RCP** |

**PIPE RUN* = PIPE RUN REVISED FROM MDDP IN PRELIMINARY CONDITION DUE TO UNDEVELOPED UPSTREAM**

# HYDRAULIC CALCULATIONS

# MDDP
# INLET CALCULATIONS

| | |
|---|---|
| JOB NAME: | *WATERBURY MDDP* |
| JOB NUMBER: | *1715.00* |
| DATE: | *12/17/20* |
| CALCULATED BY: | *QNA* |

**DESIGN POINT 1**

***Total Flow:***

| | | | |
|---|---|---|---|
| $Q_5$ | = | **5** | cfs |
| $Q_{100}$ | = | **12** | cfs |

***Max. allowable ponding depth:***
***(Residential street, ramp curb)***

| | | | |
|---|---|---|---|
| $D_5$ | = | 0.50 | ft. |
| $D_{100}$ | = | 0.75 | ft. |

***Std. Type R curb inlet detail:***

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

***Curb inlet sizing:***

***5-Year Event:*** **4** foot inlet required

***100-Year Event:*** **6** foot inlet required

| | |
|---|---|
| JOB NAME: | *WATERBURY MDDP* |
| JOB NUMBER: | *1715.00* |
| DATE: | *12/17/20* |
| CALCULATED BY: | *QNA* |

**DESIGN POINT 2**

***Total Flow:***

| | | | |
|---|---|---|---|
| $Q_5$ | = | **2** | cfs |
| $Q_{100}$ | = | **4** | cfs |

***Max. allowable ponding depth:***
***(Residential street, ramp curb)***

| | | | |
|---|---|---|---|
| $D_5$ | = | 0.50 | ft. |
| $D_{100}$ | = | 0.75 | ft. |

***Std. Type R curb inlet detail:***

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

***Curb inlet sizing:***

***5-Year Event:*** **4** foot inlet required

***100-Year Event:*** **4** foot inlet required

| | |
|---|---|
| JOB NAME: | ***WATERBURY MDDP*** |
| JOB NUMBER: | ***1715.00*** |
| DATE: | ***12/17/20*** |
| CALCULATED BY: | ***QNA*** |

**DESIGN POINT 3**

***Total Flow:***

| | | | |
|---|---|---|---|
| $Q_5$ | = | **4** | cfs |
| $Q_{100}$ | = | **8** | cfs |

***Max. allowable ponding depth:***
***(Residential street, ramp curb)***

| | | | |
|---|---|---|---|
| $D_5$ | = | 0.50 | ft. |
| $D_{100}$ | = | 0.75 | ft. |

***Std. Type R curb inlet detail:***

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

***Curb inlet sizing:***

***5-Year Event:*** **4** foot inlet required

***100-Year Event:*** **4** foot inlet required

| | |
|---|---|
| JOB NAME: | ***WATERBURY MDDP*** |
| JOB NUMBER: | ***1715.00*** |
| DATE: | ***12/17/20*** |
| CALCULATED BY: | ***QNA*** |

**DESIGN POINT 4**

***Total Flow:***

| | | | |
|---|---|---|---|
| $Q_5$ | = | **4** | cfs |
| $Q_{100}$ | = | **9** | cfs |

***Max. allowable ponding depth:***
***(Residential street, ramp curb)***

| | | | |
|---|---|---|---|
| $D_5$ | = | 0.50 | ft. |
| $D_{100}$ | = | 0.75 | ft. |

***Std. Type R curb inlet detail:***

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

***Curb inlet sizing:***

***5-Year Event:*** **4** foot inlet required

***100-Year Event:*** **4** foot inlet required

| | |
|---|---|
| JOB NAME: | *WATERBURY MDDP* |
| JOB NUMBER: | *1715.00* |
| DATE: | *12/17/20* |
| CALCULATED BY: | *QNA* |

**DESIGN POINT 5**

***Total Flow:***

$Q_5$ = **6** cfs

$Q_{100}$ = **14** cfs

***Max. allowable ponding depth:***
***(Residential street, ramp curb)***

$D_5$ = 0.50 ft.

$D_{100}$ = 0.75 ft.

***Std. Type R curb inlet detail:***

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

***Curb inlet sizing:***

***5-Year Event:*** **4** foot inlet required

***100-Year Event:*** **6** foot inlet required

| | |
|---|---|
| JOB NAME: | *WATERBURY MDDP* |
| JOB NUMBER: | *1715.00* |
| DATE: | *12/17/20* |
| CALCULATED BY: | *QNA* |

**DESIGN POINT 6**

***Total Flow:***

| | | | |
|---|---|---|---|
| $Q_5$ | = | **4** | cfs |
| $Q_{100}$ | = | **8** | cfs |

***Max. allowable ponding depth:***
***(Residential street, ramp curb)***

| | | | |
|---|---|---|---|
| $D_5$ | = | 0.50 | ft. |
| $D_{100}$ | = | 0.75 | ft. |

***Std. Type R curb inlet detail:***

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

***Curb inlet sizing:***

***5-Year Event:*** **4** foot inlet required

***100-Year Event:*** **4** foot inlet required

| | |
|---|---|
| JOB NAME: | *WATERBURY MDDP* |
| JOB NUMBER: | *1715.00* |
| DATE: | *12/17/20* |
| CALCULATED BY: | *QNA* |

**DESIGN POINT 7**

***Total Flow:***

| | | | |
|---|---|---|---|
| $Q_5$ | = | **4** | cfs |
| $Q_{100}$ | = | **8** | cfs |

***Max. allowable ponding depth:***
***(Residential street, ramp curb)***

| | | | |
|---|---|---|---|
| $D_5$ | = | 0.50 | ft. |
| $D_{100}$ | = | 0.75 | ft. |

***Std. Type R curb inlet detail:***

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

***Curb inlet sizing:***

***5-Year Event:*** **4** foot inlet required

***100-Year Event:*** **4** foot inlet required

| | |
|---|---|
| JOB NAME: | *WATERBURY MDDP* |
| JOB NUMBER: | *1715.00* |
| DATE: | *12/17/20* |
| CALCULATED BY: | *QNA* |

**DESIGN POINT 14**

***Total Flow:***

$Q_5$ = **8** cfs

$Q_{100}$ = **18** cfs

***Max. allowable ponding depth:***
***(Residential street, ramp curb)***

$D_5$ = 0.50 ft.

$D_{100}$ = 0.75 ft.

***Std. Type R curb inlet detail:***

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

***Curb inlet sizing:***

***5-Year Event:*** **6** foot inlet required

***100-Year Event:*** **10** foot inlet required

| | |
|---|---|
| JOB NAME: | *WATERBURY MDDP* |
| JOB NUMBER: | *1715.00* |
| DATE: | *12/17/20* |
| CALCULATED BY: | *QNA* |

**DESIGN POINT 15**

***Total Flow:***

| | | | |
|---|---|---|---|
| $Q_5$ | = | **3** | cfs |
| $Q_{100}$ | = | **7** | cfs |

***Max. allowable ponding depth:***
***(Residential street, ramp curb)***

| | | | |
|---|---|---|---|
| $D_5$ | = | 0.50 | ft. |
| $D_{100}$ | = | 0.75 | ft. |

***Std. Type R curb inlet detail:***

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

***Curb inlet sizing:***

***5-Year Event:*** **4** foot inlet required

***100-Year Event:*** **4** foot inlet required

| | |
|---|---|
| JOB NAME: | *WATERBURY MDDP* |
| JOB NUMBER: | *1715.00* |
| DATE: | *12/17/20* |
| CALCULATED BY: | *QNA* |

**DESIGN POINT 16**

***Total Flow:***

| | | | |
|---|---|---|---|
| $Q_5$ | = | **5** | cfs |
| $Q_{100}$ | = | **11** | cfs |

***Max. allowable ponding depth:***
***(Residential street, ramp curb)***

| | | | |
|---|---|---|---|
| $D_5$ | = | 0.50 | ft. |
| $D_{100}$ | = | 0.75 | ft. |

***Std. Type R curb inlet detail:***

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

***Curb inlet sizing:***

***5-Year Event:*** **4** foot inlet required

***100-Year Event:*** **4** foot inlet required

| | |
|---|---|
| JOB NAME: | *WATERBURY MDDP* |
| JOB NUMBER: | *1715.00* |
| DATE: | *12/17/20* |
| CALCULATED BY: | *QNA* |

**DESIGN POINT 17**

***Total Flow:***

| | | | |
|---|---|---|---|
| $Q_5$ | = | **1** | cfs |
| $Q_{100}$ | = | **3** | cfs |

***Max. allowable ponding depth:***
***(Residential street, ramp curb)***

| | | | |
|---|---|---|---|
| $D_5$ | = | 0.50 | ft. |
| $D_{100}$ | = | 0.75 | ft. |

***Std. Type R curb inlet detail:***

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

***Curb inlet sizing:***

***5-Year Event:*** **4** foot inlet required

***100-Year Event:*** **4** foot inlet required

| | |
|---|---|
| JOB NAME: | *WATERBURY MDDP* |
| JOB NUMBER: | *1715.00* |
| DATE: | *12/17/20* |
| CALCULATED BY: | *QNA* |

**DESIGN POINT 19**

***Total Flow:***

$Q_5$ = **7** cfs

$Q_{100}$ = **15** cfs

***Max. allowable ponding depth:***
***(Residential street, ramp curb)***

$D_5$ = 0.50 ft.

$D_{100}$ = 0.75 ft.

***Std. Type R curb inlet detail:***

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

***Curb inlet sizing:***

***5-Year Event:*** **6** foot inlet required

***100-Year Event:*** **8** foot inlet required

| | |
|---|---|
| JOB NAME: | *WATERBURY MDDP* |
| JOB NUMBER: | *1715.00* |
| DATE: | *12/17/20* |
| CALCULATED BY: | *QNA* |

**DESIGN POINT 20**

***Total Flow:***

| | | | |
|---|---|---|---|
| $Q_5$ | = | **3** | cfs |
| $Q_{100}$ | = | **8** | cfs |

***Max. allowable ponding depth:***
***(Residential street, ramp curb)***

| | | | |
|---|---|---|---|
| $D_5$ | = | 0.50 | ft. |
| $D_{100}$ | = | 0.75 | ft. |

***Std. Type R curb inlet detail:***

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

***Curb inlet sizing:***

***5-Year Event:*** **4** foot inlet required

***100-Year Event:*** **4** foot inlet required

# *DESIGN POINT 21*

## *5-YR FLOW*

| | | | | | |
|---|---|---|---|---|---|
| Q(5) | 11 | I(5) | 3.9 | | |
| DEPTH | 0.37 | Fr | 1.78 | Inlet size ? L(i) = | **12** |
| SPREAD | 17.6 | L(1) | 24.1 | If Li < L(2) then Qi = | 5 |
| CROSS SLOPE | 2.0% | L(2) | 14.5 | If Li > L(2) then Qi = | 6 |
| STREET SLOPE | 1.8% | L(3) | 51.7 | FB = | 5 |
| | | | | CA(eqv.)= | 1.40 |

## *100-YR FLOW*

| | | | | | |
|---|---|---|---|---|---|
| Q(100) | 24 | I(100) | 6.7 | | |
| DEPTH | 0.49 | Fr | 1.88 | Inlet size ? L(i) = | **12** |
| SPREAD | 23.1 | L(1) | 33.4 | If Li < L(2) then Qi = | 9 |
| CROSS SLOPE | 2.0% | L(2) | 20.1 | If Li > L(2) then Qi = | 12 |
| STREET SLOPE | 1.8% | L(3) | 71.6 | FB = | 16 |
| | | | | CA(eqv.)= | 2.34 |

| | |
|---|---|
| JOB NAME: | *WATERBURY MDDP* |
| JOB NUMBER: | *1715.00* |
| DATE: | *12/17/20* |
| CALCULATED BY: | *QNA* |

**DESIGN POINT 22 & 23 SPLIT**

***Total Flow:*** $Q_5$ = **8** cfs

$Q_{100}$ = **19** cfs

***(Assume even split of flows at lowpoint for prelim. inlet sizing)***

***Max. allowable ponding depth:***
***(Residential street, ramp curb)***

$D_5$ = 0.50 ft.

$D_{100}$ = 0.75 ft.

***Std. Type R curb inlet detail:***

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

***Curb inlet sizing:***

***5-Year Event:*** **6** foot inlet required

***100-Year Event:*** **10** foot inlet required

| | |
|---|---|
| JOB NAME: | *WATERBURY MDDP* |
| JOB NUMBER: | *1715.00* |
| DATE: | *12/17/20* |
| CALCULATED BY: | *QNA* |

**DESIGN POINT 22 & 23 SPLIT**

***Total Flow:*** $Q_5$ = **8** cfs

$Q_{100}$ = **19** cfs

***(Assume even split of flows at lowpoint inlet sizing)***

***Max. allowable ponding depth:***
***(Residential street, ramp curb)***

$D_5$ = 0.50 ft.

$D_{100}$ = 0.75 ft.

***Std. Type R curb inlet detail:***

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

***Curb inlet sizing:***

***5-Year Event:*** **6** foot inlet required

***100-Year Event:*** **10** foot inlet required

| | |
|---|---|
| JOB NAME: | *WATERBURY MDDP* |
| JOB NUMBER: | *1715.00* |
| DATE: | *12/17/20* |
| CALCULATED BY: | *QNA* |

**DESIGN POINT 24**

***Total Flow:***

| | | | |
|---|---|---|---|
| $Q_5$ | = | **3** | cfs |
| $Q_{100}$ | = | **6** | cfs |

***Max. allowable ponding depth:***
***(Residential street, ramp curb)***

| | | | |
|---|---|---|---|
| $D_5$ | = | 0.50 | ft. |
| $D_{100}$ | = | 0.75 | ft. |

***Std. Type R curb inlet detail:***

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

***Curb inlet sizing:***

***5-Year Event:*** **4** foot inlet required

***100-Year Event:*** **4** foot inlet required

| | |
|---|---|
| JOB NAME: | *WATERBURY MDDP* |
| JOB NUMBER: | *1715.00* |
| DATE: | *12/17/20* |
| CALCULATED BY: | *QNA* |

**DESIGN POINT 25**

***Total Flow:***

| | | | |
|---|---|---|---|
| $Q_5$ | = | **3** | cfs |
| $Q_{100}$ | = | **7** | cfs |

***Max. allowable ponding depth:***
***(Residential street, ramp curb)***

| | | | |
|---|---|---|---|
| $D_5$ | = | 0.50 | ft. |
| $D_{100}$ | = | 0.75 | ft. |

***Std. Type R curb inlet detail:***

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

***Curb inlet sizing:***

***5-Year Event:*** **4** foot inlet required

***100-Year Event:*** **4** foot inlet required

| | |
|---|---|
| JOB NAME: | *WATERBURY MDDP* |
| JOB NUMBER: | *1715.00* |
| DATE: | *12/17/20* |
| CALCULATED BY: | *QNA* |

**DESIGN POINT 26**

***Total Flow:***

| | | | |
|---|---|---|---|
| $Q_5$ | = | **7** | cfs |
| $Q_{100}$ | = | **16** | cfs |

***Max. allowable ponding depth:***
***(Residential street, ramp curb)***

| | | | |
|---|---|---|---|
| $D_5$ | = | 0.50 | ft. |
| $D_{100}$ | = | 0.75 | ft. |

***Std. Type R curb inlet detail:***

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

***Curb inlet sizing:***

***5-Year Event:*** **6** foot inlet required

***100-Year Event:*** **8** foot inlet required

| | |
|---|---|
| JOB NAME: | *WATERBURY MDDP* |
| JOB NUMBER: | *1715.00* |
| DATE: | *12/17/20* |
| CALCULATED BY: | *QNA* |

**DESIGN POINT 27**

***Total Flow:*** $Q_5$ = **3** cfs

$Q_{100}$ = **7** cfs

***(Assume even split of flows at lowpoint for prelim. inlet sizing)***

***Max. allowable ponding depth:***
***(Residential street, ramp curb)***

$D_5$ = 0.50 ft.

$D_{100}$ = 0.75 ft.

***Std. Type R curb inlet detail:***

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

***Curb inlet sizing:***

***5-Year Event:*** **4** foot inlet required

***100-Year Event:*** **4** foot inlet required

| | |
|---|---|
| JOB NAME: | *WATERBURY MDDP* |
| JOB NUMBER: | *1715.00* |
| DATE: | *12/17/20* |
| CALCULATED BY: | *QNA* |

**DESIGN POINT 28**

***Total Flow:***

| | | | |
|---|---|---|---|
| $Q_5$ | = | **8** | cfs |
| $Q_{100}$ | = | **18** | cfs |

***Max. allowable ponding depth:***
***(Residential street, ramp curb)***

| | | | |
|---|---|---|---|
| $D_5$ | = | 0.50 | ft. |
| $D_{100}$ | = | 0.75 | ft. |

***Std. Type R curb inlet detail:***

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

***Curb inlet sizing:***

***5-Year Event:*** **6** foot inlet required

***100-Year Event:*** **10** foot inlet required

# MDDP
# PIPE CALCULATIONS

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## Pipe run 1

18" RCP @ 1.00%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 18 | in |
| Manning roughness, n | .013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 1 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 43 | % |

Results

| | | |
|---|---|---|
| Flow, Q | 4.0349 | cfs |
| Velocity, v | 5.5533 | ft/sec |
| Velocity head, $h_v$ | 0.4793 | ft H2O |
| Flow area | 0.7266 | ft^2 |
| Wetted perimeter | 2.1455 | ft |
| Hydraulic radius | 0.3387 | ft |
| Top width, T | 1.4852 | ft |
| Froude number, F | 1.40 | |
| Shear stress (tractive force), tau | 0.2114 | psf |

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

Pipe run 2

24" RCP @ 0.60%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 24 | in |
| Manning roughness, n | .013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | .6 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 71.3 | % |

Results

| | | |
|---|---|---|
| Flow, Q | 15.0220 | cfs |
| Velocity, v | 6.2691 | ft/sec |
| Velocity head, $h_v$ | 0.6108 | ft H2O |
| Flow area | 2.3963 | ft^2 |
| Wetted perimeter | 4.0217 | ft |
| Hydraulic radius | 0.5958 | ft |
| Top width, T | 1.8094 | ft |
| Froude number, F | 0.96 | |
| Shear stress (tractive force), tau | 0.2232 | psf |

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## Pipe run 3

### 18" RCP @ 2.00%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 18 | in |
| Manning roughness, n | .013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 2 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 52.3 | % |

Results

| | | |
|---|---|---|
| Flow, Q | 8.0101 | cfs |
| Velocity, v | 8.5644 | ft/sec |
| Velocity head, $h_v$ | 1.1400 | ft H2O |
| Flow area | 0.9353 | ft^2 |
| Wetted perimeter | 2.4252 | ft |
| Hydraulic radius | 0.3857 | ft |
| Top width, T | 1.4984 | ft |
| Froude number, F | 1.91 | |
| Shear stress (tractive force), tau | 0.4815 | psf |

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## Pipe run 4

### 18" RCP @ 2.00%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 18 | in |
| Manning roughness, n | .013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 2 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 56.2 | % |

Results

| | | |
|---|---|---|
| Flow, Q | 9.0077 | cfs |
| Velocity, v | 8.8079 | ft/sec |
| Velocity head, $h_v$ | 1.2057 | ft H2O |
| Flow area | 1.0227 | ft^2 |
| Wetted perimeter | 2.5426 | ft |
| Hydraulic radius | 0.4022 | ft |
| Top width, T | 1.4884 | ft |
| Froude number, F | 1.87 | |
| Shear stress (tractive force), tau | 0.5022 | psf |

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## Pipe run 5

### 24" RCP @ 1.5%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 24 | in |
| Manning roughness, n | .013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 1.5 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 56.7 | % |

Results

| | | |
|---|---|---|
| Flow, Q | 17.0392 | cfs |
| Velocity, v | 9.2708 | ft/sec |
| Velocity head, $h_v$ | 1.3358 | ft H2O |
| Flow area | 1.8380 | ft^2 |
| Wetted perimeter | 3.4104 | ft |
| Hydraulic radius | 0.5389 | ft |
| Top width, T | 1.9819 | ft |
| Froude number, F | 1.70 | |
| Shear stress (tractive force), tau | 0.5047 | psf |

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## Pipe run 6

## 30" RCP @ 0.7%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 30 | in |
| Manning roughness, n | .013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 1.5 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 58 | % |

Results

| | | |
|---|---|---|
| Flow, Q | 32.0201 | cfs |
| Velocity, v | 10.8464 | ft/sec |
| Velocity head, $h_v$ | 1.8284 | ft H2O |
| Flow area | 2.9523 | ft^2 |
| Wetted perimeter | 4.3287 | ft |
| Hydraulic radius | 0.6820 | ft |
| Top width, T | 2.4678 | ft |
| Froude number, F | 1.75 | |
| Shear stress (tractive force), tau | 0.6387 | psf |

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

Pipe run 7

36" RCP @ 0.74%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 36 | in |
| Manning roughness, n | .013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | .74 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 65.7 | % |

Results

| | | |
|---|---|---|
| Flow, Q | 44.0607 | cfs |
| Velocity, v | 8.9490 | ft/sec |
| Velocity head, $h_v$ | 1.2446 | ft H2O |
| Flow area | 4.9238 | ft^2 |
| Wetted perimeter | 5.6705 | ft |
| Hydraulic radius | 0.8683 | ft |
| Top width, T | 2.8482 | ft |
| Froude number, F | 1.20 | |
| Shear stress (tractive force), tau | 0.4011 | psf |

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## Pipe run 8

### 18" RCP @ 1.00%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 18 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 1 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 65.4 | % |

Results

| | | |
|---|---|---|
| Flow, Q | 8.0145 | cfs |
| Velocity, v | 6.5452 | ft/sec |
| Velocity head, $h_v$ | 0.6658 | ft H2O |
| Flow area | 1.2245 | ft^2 |
| Wetted perimeter | 2.8258 | ft |
| Hydraulic radius | 0.4333 | ft |
| Top width, T | 1.4271 | ft |
| Froude number, F | 1.25 | |
| Shear stress (tractive force), tau | 0.2705 | psf |

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## Pipe run 9

### 18" RCP @ 1.00%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 18 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 1 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 65.4 | % |

Results

| | | |
|---|---|---|
| Flow, Q | 8.0145 | cfs |
| Velocity, v | 6.5452 | ft/sec |
| Velocity head, $h_v$ | 0.6658 | ft H2O |
| Flow area | 1.2245 | ft^2 |
| Wetted perimeter | 2.8258 | ft |
| Hydraulic radius | 0.4333 | ft |
| Top width, T | 1.4271 | ft |
| Froude number, F | 1.25 | |
| Shear stress (tractive force), tau | 0.2705 | psf |

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## Pipe run 10

### 18" RCP @ 3.00%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 18 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 3 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 69.3 | % |

Results

| | | |
|---|---|---|
| Flow, Q | 15.0311 | cfs |
| Velocity, v | 11.5027 | ft/sec |
| Velocity head, $h_v$ | 2.0564 | ft H2O |
| Flow area | 1.3068 | ft^2 |
| Wetted perimeter | 2.9506 | ft |
| Hydraulic radius | 0.4429 | ft |
| Top width, T | 1.3837 | ft |
| Froude number, F | 2.09 | |
| Shear stress (tractive force), tau | 0.8295 | psf |

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## Pipe run 10A

### 18' RCP @ 1%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 18 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 1 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 61.4 | % |

Results

| | | |
|---|---|---|
| Flow, Q | 7.3079 | cfs |
| Velocity, v | 6.4228 | ft/sec |
| Velocity head, $h_v$ | 0.6411 | ft H2O |
| Flow area | 1.1378 | ft^2 |
| Wetted perimeter | 2.7012 | ft |
| Hydraulic radius | 0.4212 | ft |
| Top width, T | 1.4605 | ft |
| Froude number, F | 1.28 | |
| Shear stress (tractive force), tau | 0.2630 | psf |

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## Pipe run 11

## 24" RCP @ 1.00%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 24 | in |
| Manning roughness, n | .013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 1 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 59.5 | % |

Results

| | | |
|---|---|---|
| Flow, Q | 15.0032 | cfs |
| Velocity, v | 7.7001 | ft/sec |
| Velocity head, $h_v$ | 0.9215 | ft H2O |
| Flow area | 1.9485 | ft^2 |
| Wetted perimeter | 3.5239 | ft |
| Hydraulic radius | 0.5529 | ft |
| Top width, T | 1.9635 | ft |
| Froude number, F | 1.36 | |
| Shear stress (tractive force), tau | 0.3452 | psf |

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## Pipe run 12

### 18" RCP @ 1.00%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 18 | in |
| Manning roughness, n | .013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 1 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 59.7 | % |

Results

| | | |
|---|---|---|
| Flow, Q | 7.0025 | cfs |
| Velocity, v | 6.3635 | ft/sec |
| Velocity head, $h_v$ | 0.6294 | ft H2O |
| Flow area | 1.1005 | ft^2 |
| Wetted perimeter | 2.6490 | ft |
| Hydraulic radius | 0.4154 | ft |
| Top width, T | 1.4715 | ft |
| Froude number, F | 1.30 | |
| Shear stress (tractive force), tau | 0.2593 | psf |

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## Pipe run 13

### 30" RCP @ 1.00%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 30 | in |
| Manning roughness, n | .013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 1 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 63.6 | % |

Results

| | | |
|---|---|---|
| Flow, Q | 30.0630 | cfs |
| Velocity, v | 9.1275 | ft/sec |
| Velocity head, $h_v$ | 1.2948 | ft H2O |
| Flow area | 3.2938 | ft^2 |
| Wetted perimeter | 4.6156 | ft |
| Hydraulic radius | 0.7136 | ft |
| Top width, T | 2.4057 | ft |
| Froude number, F | 1.38 | |
| Shear stress (tractive force), tau | 0.4455 | psf |

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## Pipe run 14

## 24" RCP @ 1.00%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 24 | in |
| Manning roughness, n | .013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 1 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 51.9 | % |

Results

| | | |
|---|---|---|
| Flow, Q | 12.0430 | cfs |
| Velocity, v | 7.3133 | ft/sec |
| Velocity head, $h_v$ | 0.8312 | ft H2O |
| Flow area | 1.6468 | ft^2 |
| Wetted perimeter | 3.2176 | ft |
| Hydraulic radius | 0.5118 | ft |
| Top width, T | 1.9985 | ft |
| Froude number, F | 1.42 | |
| Shear stress (tractive force), tau | 0.3195 | psf |

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## Pipe run 15

### 36" RCP @ 1.00%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 36 | in |
| Manning roughness, n | .013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 1 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 48.9 | % |

Results

| | | |
|---|---|---|
| Flow, Q | 32.1044 | cfs |
| Velocity, v | 9.3457 | ft/sec |
| Velocity head, $h_v$ | 1.3575 | ft H2O |
| Flow area | 3.4353 | ft^2 |
| Wetted perimeter | 4.6463 | ft |
| Hydraulic radius | 0.7393 | ft |
| Top width, T | 2.9992 | ft |
| Froude number, F | 1.54 | |
| Shear stress (tractive force), tau | 0.4616 | psf |

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## Pipe run 16

18" RCP @ 17.80%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 18 | in |
| Manning roughness, n | .013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 17.8 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 14.7 | % |

Results

| | | |
|---|---|---|
| Flow, Q | 2.0660 | cfs |
| Velocity, v | 12.7995 | ft/sec |
| Velocity head, $h_v$ | 2.5462 | ft H2O |
| Flow area | 0.1614 | ft^2 |
| Wetted perimeter | 1.1804 | ft |
| Hydraulic radius | 0.1367 | ft |
| Top width, T | 1.0623 | ft |
| Froude number, F | 5.83 | |
| Shear stress (tractive force), tau | 1.5195 | psf |

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## Pipe run 17

## 36" RCP @ 0.70%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 36 | in |
| Manning roughness, n | .013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 0.7 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 58.5 | % |

Results

| | | |
|---|---|---|
| Flow, Q | 36.0498 | cfs |
| Velocity, v | 8.3925 | ft/sec |
| Velocity head, $h_v$ | 1.0947 | ft H2O |
| Flow area | 4.2956 | ft^2 |
| Wetted perimeter | 5.2248 | ft |
| Hydraulic radius | 0.8221 | ft |
| Top width, T | 2.9563 | ft |
| Froude number, F | 1.23 | |
| Shear stress (tractive force), tau | 0.3593 | psf |

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## Pipe Run 17A

### 18" RCP @ 2.00%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 18 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 2 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 62.5 | % |

Results

| | | |
|---|---|---|
| Flow, Q | 10.6124 | cfs |
| Velocity, v | 9.1342 | ft/sec |
| Velocity head, $h_v$ | 1.2967 | ft H2O |
| Flow area | 1.1619 | ft^2 |
| Wetted perimeter | 2.7352 | ft |
| Hydraulic radius | 0.4248 | ft |
| Top width, T | 1.4524 | ft |
| Froude number, F | 1.80 | |
| Shear stress (tractive force), tau | 0.5304 | psf |

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## Pipe run 18

## 24" RCP @ 2.00%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 24 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 2 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 48.3 | % |

Results

| | | |
|---|---|---|
| Flow, Q | 15.0762 | cfs |
| Velocity, v | 10.0323 | ft/sec |
| Velocity head, $h_v$ | 1.5642 | ft H2O |
| Flow area | 1.5028 | ft^2 |
| Wetted perimeter | 3.0735 | ft |
| Hydraulic radius | 0.4889 | ft |
| Top width, T | 1.9988 | ft |
| Froude number, F | 2.04 | |
| Shear stress (tractive force), tau | 0.6105 | psf |

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## Pipe run 19

### 18" RCP @ 2.00%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 18 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 2 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 52.5 | % |

Results

| | | |
|---|---|---|
| Flow, Q | 8.0610 | cfs |
| Velocity, v | 8.5777 | ft/sec |
| Velocity head, $h_v$ | 1.1435 | ft H2O |
| Flow area | 0.9398 | ft^2 |
| Wetted perimeter | 2.4312 | ft |
| Hydraulic radius | 0.3865 | ft |
| Top width, T | 1.4981 | ft |
| Froude number, F | 1.91 | |
| Shear stress (tractive force), tau | 0.4826 | psf |

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## Pipe run 20

24" RCP @ 1.75%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 24 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 1.75 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 61.8 | % |

Results

| | | |
|---|---|---|
| Flow, Q | 21.0236 | cfs |
| Velocity, v | 10.3142 | ft/sec |
| Velocity head, $h_v$ | 1.6534 | ft H2O |
| Flow area | 2.0384 | ft^2 |
| Wetted perimeter | 3.6181 | ft |
| Hydraulic radius | 0.5634 | ft |
| Top width, T | 1.9435 | ft |
| Froude number, F | 1.78 | |
| Shear stress (tractive force), tau | 0.6155 | psf |

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## Pipe run 21

### 18" RCP @ 2.0%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 18 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 2 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 52.5 | % |

Results

| | | |
|---|---|---|
| Flow, Q | 8.0610 | cfs |
| Velocity, v | 8.5777 | ft/sec |
| Velocity head, $h_v$ | 1.1435 | ft H2O |
| Flow area | 0.9398 | ft^2 |
| Wetted perimeter | 2.4312 | ft |
| Hydraulic radius | 0.3865 | ft |
| Top width, T | 1.4981 | ft |
| Froude number, F | 1.91 | |
| Shear stress (tractive force), tau | 0.4826 | psf |

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## Pipe run 22

### 24" RCP @ 1.75%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 24 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 1.75 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 74.4 | % |

Results

| | | |
|---|---|---|
| Flow, Q | 27.0312 | cfs |
| Velocity, v | 10.7846 | ft/sec |
| Velocity head, $h_v$ | 1.8076 | ft H2O |
| Flow area | 2.5066 | ft^2 |
| Wetted perimeter | 4.1611 | ft |
| Hydraulic radius | 0.6024 | ft |
| Top width, T | 1.7457 | ft |
| Froude number, F | 1.59 | |
| Shear stress (tractive force), tau | 0.6581 | psf |

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## Pipe run 23

### 24" RCP @ 1.00%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 24 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 1.00 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 70.2 | % |

Results

| | | |
|---|---|---|
| Flow, Q | 19.0091 | cfs |
| Velocity, v | 8.0678 | ft/sec |
| Velocity head, $h_v$ | 1.0116 | ft H2O |
| Flow area | 2.3563 | ft^2 |
| Wetted perimeter | 3.9733 | ft |
| Hydraulic radius | 0.5930 | ft |
| Top width, T | 1.8295 | ft |
| Froude number, F | 1.25 | |
| Shear stress (tractive force), tau | 0.3702 | psf |

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## Pipe run 24

24" RCP @ 1.00%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 24 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 1 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 70.3 | % |

Results

| | | |
|---|---|---|
| Flow, Q | 19.0443 | cfs |
| Velocity, v | 8.0702 | ft/sec |
| Velocity head, $h_v$ | 1.0122 | ft H2O |
| Flow area | 2.3599 | ft^2 |
| Wetted perimeter | 3.9777 | ft |
| Hydraulic radius | 0.5933 | ft |
| Top width, T | 1.8277 | ft |
| Froude number, F | 1.25 | |
| Shear stress (tractive force), tau | 0.3704 | psf |

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## Pipe run 24

24" RCP @ 1.00%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 24 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 1 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 70.3 | % |

Results

| | | |
|---|---|---|
| Flow, Q | 19.0443 | cfs |
| Velocity, v | 8.0702 | ft/sec |
| Velocity head, $h_v$ | 1.0122 | ft H2O |
| Flow area | 2.3599 | ft^2 |
| Wetted perimeter | 3.9777 | ft |
| Hydraulic radius | 0.5933 | ft |
| Top width, T | 1.8277 | ft |
| Froude number, F | 1.25 | |
| Shear stress (tractive force), tau | 0.3704 | psf |

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## Pipe run 25

### 30" RCP @ 1.00%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 30 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 1 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 72.8 | % |

Results

| | | |
|---|---|---|
| Flow, Q | 36.0904 | cfs |
| Velocity, v | 9.4275 | ft/sec |
| Velocity head, $h_v$ | 1.3813 | ft H2O |
| Flow area | 3.8284 | ft^2 |
| Wetted perimeter | 5.1107 | ft |
| Hydraulic radius | 0.7491 | ft |
| Top width, T | 2.2249 | ft |
| Froude number, F | 1.27 | |
| Shear stress (tractive force), tau | 0.4676 | psf |

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## Pipe run 26

### 36" RCP @ 1.75%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 36 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 1.75 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 59.9 | % |

Results

| | | |
|---|---|---|
| Flow, Q | 59.1220 | cfs |
| Velocity, v | 13.3781 | ft/sec |
| Velocity head, $h_v$ | 2.7816 | ft H2O |
| Flow area | 4.4195 | ft^2 |
| Wetted perimeter | 5.3103 | ft |
| Hydraulic radius | 0.8322 | ft |
| Top width, T | 2.9406 | ft |
| Froude number, F | 1.92 | |
| Shear stress (tractive force), tau | 0.9092 | psf |

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## Pipe run 27

### 18" RCP @ 2.00%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 18 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 2 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 44.5 | % |

Results

| | | |
|---|---|---|
| Flow, Q | 6.0659 | cfs |
| Velocity, v | 7.9810 | ft/sec |
| Velocity head, $h_v$ | 0.9899 | ft H2O |
| Flow area | 0.7601 | ft^2 |
| Wetted perimeter | 2.1908 | ft |
| Hydraulic radius | 0.3469 | ft |
| Top width, T | 1.4909 | ft |
| Froude number, F | 1.97 | |
| Shear stress (tractive force), tau | 0.4332 | psf |

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## Pipe run 28

### 18" RCP @ 2.00%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 18 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 2 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 48.5 | % |

Results

| | | |
|---|---|---|
| Flow, Q | 7.0503 | cfs |
| Velocity, v | 8.2965 | ft/sec |
| Velocity head, $h_v$ | 1.0698 | ft H2O |
| Flow area | 0.8498 | ft^2 |
| Wetted perimeter | 2.3112 | ft |
| Hydraulic radius | 0.3677 | ft |
| Top width, T | 1.4993 | ft |
| Froude number, F | 1.94 | |
| Shear stress (tractive force), tau | 0.4591 | psf |

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## Pipe run 29

### 36" RCP @ 1.75%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 36 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 1.75 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 66.6 | % |

Results

| | | |
|---|---|---|
| Flow, Q | 69.0619 | cfs |
| Velocity, v | 13.8118 | ft/sec |
| Velocity head, $h_v$ | 2.9648 | ft H2O |
| Flow area | 5.0004 | ft^2 |
| Wetted perimeter | 5.7276 | ft |
| Hydraulic radius | 0.8730 | ft |
| Top width, T | 2.8298 | ft |
| Froude number, F | 1.83 | |
| Shear stress (tractive force), tau | 0.9538 | psf |

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## Pipe run 30

### 24" RCP @ 2%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 24 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 2 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 50.1 | % |

Results

| | | |
|---|---|---|
| Flow, Q | 16.0492 | cfs |
| Velocity, v | 10.1916 | ft/sec |
| Velocity head, $h_v$ | 1.6143 | ft H2O |
| Flow area | 1.5748 | ft^2 |
| Wetted perimeter | 3.1456 | ft |
| Hydraulic radius | 0.5006 | ft |
| Top width, T | 2.0000 | ft |
| Froude number, F | 2.03 | |
| Shear stress (tractive force), tau | 0.6251 | psf |

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## PIPE RUN 31

### 42" RCP @ 1.00%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 42 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 1.00 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 68 | % |

Results

| | | |
|---|---|---|
| Flow, Q (See notes) | 81.0338 | cfs |
| Velocity, v | 11.6315 | ft/sec |
| Velocity head, $h_v$ | 2.1027 | ft H2O |
| Flow area | 6.9670 | ft^2 |
| Wetted perimeter | 6.7867 | ft |
| Hydraulic radius | 1.0265 | ft |
| Top width, T | 3.2653 | ft |
| Froude number, F | 1.40 | |
| Shear stress (tractive force), tau | 0.6409 | psf |

Notes:

**This is the flow and depth *inside* the pipe.**
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## Pipe run 32

### 18" RCP @ 2%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 18 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 2 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 48.5 | % |

Results

| | | |
|---|---|---|
| Flow, Q | 7.0503 | cfs |
| Velocity, v | 8.2965 | ft/sec |
| Velocity head, $h_v$ | 1.0698 | ft H2O |
| Flow area | 0.8498 | ft^2 |
| Wetted perimeter | 2.3112 | ft |
| Hydraulic radius | 0.3677 | ft |
| Top width, T | 1.4993 | ft |
| Froude number, F | 1.94 | |
| Shear stress (tractive force), tau | 0.4591 | psf |

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## PIPE RUN 33

## 42" RCP @ 1.00%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 42 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 1.00 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 71.8 | % |

Results

| | | |
|---|---|---|
| Flow, Q (See notes) | 87.0150 | cfs |
| Velocity, v | 11.7689 | ft/sec |
| Velocity head, $h_v$ | 2.1526 | ft H2O |
| Flow area | 7.3940 | ft^2 |
| Wetted perimeter | 7.0767 | ft |
| Hydraulic radius | 1.0448 | ft |
| Top width, T | 3.1498 | ft |
| Froude number, F | 1.35 | |
| Shear stress (tractive force), tau | 0.6523 | psf |

Notes:

**This is the flow and depth *inside* the pipe.**
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## Pipe run 34

## 24" RCP @ 2.00%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 24 | in |
| Manning roughness, n | .013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 2 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 53.7 | % |

Results

| | | |
|---|---|---|
| Flow, Q | 18.0202 | cfs |
| Velocity, v | 10.4853 | ft/sec |
| Velocity head, $h_v$ | 1.7087 | ft H2O |
| Flow area | 1.7187 | ft^2 |
| Wetted perimeter | 3.2897 | ft |
| Hydraulic radius | 0.5224 | ft |
| Top width, T | 1.9945 | ft |
| Froude number, F | 1.99 | |
| Shear stress (tractive force), tau | 0.6523 | psf |

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## PIPE RUN 35

## 36" RCP @ 1.34%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 36 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 1.34 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 66.82 | % |

Results

| | | |
|---|---|---|
| Flow, Q (See notes) | 60.7101 | cfs |
| Velocity, v | 12.0963 | ft/sec |
| Velocity head, $h_v$ | 2.2741 | ft H2O |
| Flow area | 5.0191 | ft^2 |
| Wetted perimeter | 5.7416 | ft |
| Hydraulic radius | 0.8741 | ft |
| Top width, T | 2.8251 | ft |
| Froude number, F | 1.60 | |
| Shear stress (tractive force), tau | 0.7313 | psf |

Notes:

**This is the flow and depth *inside* the pipe.**
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

# CULVERT STAGE-DISCHARGE SIZING (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

**Project:** WATERBURY FILING 1
**Basin ID:** Design Point 11- Dual 42" RCP Culverts
**Status:**

## Design Information (Input):

| | | | | |
|---|---|---|---|---|
| **Circular Culvert:** | Barrel Diameter in Inches | D = | 42 | inches |
| | Inlet Edge Type (choose from pull-down list) | | Grooved End Projection | |
| **OR:** | | | | |
| **Box Culvert:** | Barrel Height (Rise) in Feet | Height (Rise) = | | ft. |
| | Barrel Width (Span) in Feet | Width (Span) = | | ft. |
| | Inlet Edge Type (choose from pull-down list) | | Square Edge w/ 90-15 Deg. Headwall | |
| | Number of Barrels | No = | 2 | |
| | Inlet Elevation at Culvert Invert | Inlet Elev = | 7270.37 | ft. elev. |
| | Outlet Elevation at Culvert Invert **OR** Slope of Culvert (ft v./ft h.) | Outlet Elev = | 7269.7 | ft. elev. |
| | Culvert Length in Feet | L = | 80 | ft. |
| | Manning's Roughness | n = | 0.013 | |
| | Bend Loss Coefficient | $K_b$ = | 0 | |
| | Exit Loss Coefficient | $K_x$ = | 1 | |

## Design Information (calculated):

| | | |
|---|---|---|
| Entrance Loss Coefficient | $K_e$ = | 0.20 |
| Friction Loss Coefficient | $K_f$ = | 0.47 |
| Sum of All Loss Coefficients | $K_s$ = | 1.67 |
| Orifice Inlet Condition Coefficient | $C_d$ = | 0.95 |
| Minimum Energy Condition Coefficient | $KE_{low}$ = | -0.0198 |

## Calculations of Culvert Capacity (output):

| Water Surface Elevation (ft., linked) | Tailwater Surface Elevation ft | Culvert Inlet-Control Flowrate cfs | Culvert Outlet-Control Flowrate cfs | Controlling Culvert Flowrate cfs (output) | Inlet Equation Used: | Flow Control Used |
|---|---|---|---|---|---|---|
| 7272.00 | | 31.20 | 66.11 | **31.20** | Min. Energy. Eqn. | INLET |
| 7272.10 | | 34.80 | 66.85 | **34.80** | Min. Energy. Eqn. | INLET |
| 7272.20 | | 38.00 | 67.67 | **38.00** | Regression Eqn. | INLET |
| 7272.30 | | 41.60 | 68.69 | **41.60** | Regression Eqn. | INLET |
| 7272.40 | | 45.20 | 69.70 | **45.20** | Regression Eqn. | INLET |
| 7272.50 | | 49.00 | 70.99 | **49.00** | Regression Eqn. | INLET |
| 7272.60 | | 53.00 | 72.37 | **53.00** | Regression Eqn. | INLET |
| 7272.70 | | 57.20 | 73.93 | **57.20** | Regression Eqn. | INLET |
| 7272.80 | | 61.40 | 75.59 | **61.40** | Regression Eqn. | INLET |
| 7272.90 | | 66.00 | 77.43 | **66.00** | Regression Eqn. | INLET |
| 7273.00 | | 70.60 | 79.55 | **70.60** | Regression Eqn. | INLET |
| 7273.10 | | 75.40 | 81.76 | **75.40** | Regression Eqn. | INLET |
| 7273.20 | | 80.20 | 84.25 | **80.20** | Regression Eqn. | INLET |
| 7273.30 | | 85.20 | 86.73 | **85.20** | Regression Eqn. | INLET |
| 7273.40 | | 90.20 | 89.31 | **89.31** | Regression Eqn. | OUTLET |
| 7273.50 | | 95.20 | 92.17 | **92.17** | Regression Eqn. | OUTLET |
| 7273.60 | | 100.20 | 94.93 | **94.93** | Regression Eqn. | OUTLET |
| 7273.70 | | 105.20 | 97.87 | **97.87** | Regression Eqn. | OUTLET |
| 7273.80 | | 110.00 | 100.64 | **100.64** | Regression Eqn. | OUTLET |
| 7273.90 | | 115.00 | 104.50 | **104.50** | Regression Eqn. | OUTLET |
| 7274.00 | | 119.80 | 110.30 | **110.30** | Regression Eqn. | OUTLET |
| 7274.10 | | 124.40 | 116.01 | **116.01** | Regression Eqn. | OUTLET |
| 7274.20 | | 129.00 | 121.54 | **121.54** | Regression Eqn. | OUTLET |
| 7274.30 | | 133.40 | 127.06 | **127.06** | Regression Eqn. | OUTLET |
| 7274.40 | | 137.80 | 132.22 | **132.22** | Regression Eqn. | OUTLET |
| 7274.50 | | 142.00 | 137.37 | **137.37** | Regression Eqn. | OUTLET |
| 7274.60 | | 146.20 | 142.35 | **142.35** | Regression Eqn. | OUTLET |
| 7274.70 | | 150.20 | 147.22 | **147.22** | Regression Eqn. | OUTLET |
| 7274.80 | | 154.00 | 151.83 | **151.83** | Regression Eqn. | OUTLET |
| 7274.90 | | 157.80 | 156.52 | **156.52** | Regression Eqn. | OUTLET |

Processing Time: 00.90 Seconds

## CULVERT STAGE-DISCHARGE SIZING (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

**Project:** WATERBURY FILING 1
**Basin ID:** Design Point 11- Dual 42" RCP Culverts

# CULVERT STAGE-DISCHARGE SIZING (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

**Project:** WATERBURY FILING 1
**Basin ID:** Design Point 12- 18" RCP Culvert
**Status:**

## Design Information (Input):

| | | | | |
|---|---|---|---|---|
| **Circular Culvert:** | Barrel Diameter in Inches | D = | 42 | inches |
| | Inlet Edge Type (choose from pull-down list) | | Grooved End Projection | |
| **OR:** | | | | |
| **Box Culvert:** | Barrel Height (Rise) in Feet | Height (Rise) = | | ft. |
| | Barrel Width (Span) in Feet | Width (Span) = | | ft. |
| | Inlet Edge Type (choose from pull-down list) | | Square Edge w/ 90-15 Deg. Headwall | |
| | Number of Barrels | No = | 2 | |
| | Inlet Elevation at Culvert Invert | Inlet Elev = | 7270.37 | ft. elev. |
| | Outlet Elevation at Culvert Invert **OR** Slope of Culvert (ft v./ft h.) | Outlet Elev = | 7269.7 | ft. elev. |
| | Culvert Length in Feet | L = | 80 | ft. |
| | Manning's Roughness | n = | 0.013 | |
| | Bend Loss Coefficient | $K_b$ = | 0 | |
| | Exit Loss Coefficient | $K_x$ = | 1 | |

## Design Information (calculated):

| | | |
|---|---|---|
| Entrance Loss Coefficient | $K_e$ = | 0.20 |
| Friction Loss Coefficient | $K_f$ = | 0.47 |
| Sum of All Loss Coefficients | $K_s$ = | 1.67 |
| Orifice Inlet Condition Coefficient | $C_d$ = | 0.95 |
| Minimum Energy Condition Coefficient | $KE_{low}$ = | -0.0198 |

## Calculations of Culvert Capacity (output):

| Water Surface Elevation (ft., linked) | Tailwater Surface Elevation ft | Culvert Inlet-Control Flowrate cfs | Culvert Outlet-Control Flowrate cfs | Controlling Culvert Flowrate cfs (output) | Inlet Equation Used: | Flow Control Used |
|---|---|---|---|---|---|---|
| 7272.00 | | 31.20 | 66.11 | **31.20** | Min. Energy. Eqn. | INLET |
| 7272.10 | | 34.80 | 66.85 | **34.80** | Min. Energy. Eqn. | INLET |
| 7272.20 | | 38.00 | 67.67 | **38.00** | Regression Eqn. | INLET |
| 7272.30 | | 41.60 | 68.69 | **41.60** | Regression Eqn. | INLET |
| 7272.40 | | 45.20 | 69.70 | **45.20** | Regression Eqn. | INLET |
| 7272.50 | | 49.00 | 70.99 | **49.00** | Regression Eqn. | INLET |
| 7272.60 | | 53.00 | 72.37 | **53.00** | Regression Eqn. | INLET |
| 7272.70 | | 57.20 | 73.93 | **57.20** | Regression Eqn. | INLET |
| 7272.80 | | 61.40 | 75.59 | **61.40** | Regression Eqn. | INLET |
| 7272.90 | | 66.00 | 77.43 | **66.00** | Regression Eqn. | INLET |
| 7273.00 | | 70.60 | 79.55 | **70.60** | Regression Eqn. | INLET |
| 7273.10 | | 75.40 | 81.76 | **75.40** | Regression Eqn. | INLET |
| 7273.20 | | 80.20 | 84.25 | **80.20** | Regression Eqn. | INLET |
| 7273.30 | | 85.20 | 86.73 | **85.20** | Regression Eqn. | INLET |
| 7273.40 | | 90.20 | 89.31 | **89.31** | Regression Eqn. | OUTLET |
| 7273.50 | | 95.20 | 92.17 | **92.17** | Regression Eqn. | OUTLET |
| 7273.60 | | 100.20 | 94.93 | **94.93** | Regression Eqn. | OUTLET |
| 7273.70 | | 105.20 | 97.87 | **97.87** | Regression Eqn. | OUTLET |
| 7273.80 | | 110.00 | 100.64 | **100.64** | Regression Eqn. | OUTLET |
| 7273.90 | | 115.00 | 104.50 | **104.50** | Regression Eqn. | OUTLET |
| 7274.00 | | 119.80 | 110.30 | **110.30** | Regression Eqn. | OUTLET |
| 7274.10 | | 124.40 | 116.01 | **116.01** | Regression Eqn. | OUTLET |
| 7274.20 | | 129.00 | 121.54 | **121.54** | Regression Eqn. | OUTLET |
| 7274.30 | | 133.40 | 127.06 | **127.06** | Regression Eqn. | OUTLET |
| 7274.40 | | 137.80 | 132.22 | **132.22** | Regression Eqn. | OUTLET |
| 7274.50 | | 142.00 | 137.37 | **137.37** | Regression Eqn. | OUTLET |
| 7274.60 | | 146.20 | 142.35 | **142.35** | Regression Eqn. | OUTLET |
| 7274.70 | | 150.20 | 147.22 | **147.22** | Regression Eqn. | OUTLET |
| 7274.80 | | 154.00 | 151.83 | **151.83** | Regression Eqn. | OUTLET |
| 7274.90 | | 157.80 | 156.52 | **156.52** | Regression Eqn. | OUTLET |

Processing Time: 00.90 Seconds

## CULVERT STAGE-DISCHARGE SIZING (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

**Project:** WATERBURY FILING 1
**Basin ID:** Design Point 12- 18" RCP Culvert

# CULVERT STAGE-DISCHARGE SIZING (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

**Project:** WATERBURY FILING 1
**Basin ID:** Design Point 30- Triple 36" RCP Culverts
**Status:**

## Design Information (Input):

| | | | | |
|---|---|---|---|---|
| **Circular Culvert:** | Barrel Diameter in Inches | D = | 36 | inches |
| | Inlet Edge Type (choose from pull-down list) | | Grooved End Projection | |
| **OR:** | | | | |
| **Box Culvert:** | Barrel Height (Rise) in Feet | Height (Rise) = | | ft. |
| | Barrel Width (Span) in Feet | Width (Span) = | | ft. |
| | Inlet Edge Type (choose from pull-down list) | | Square Edge w/ 90-15 Deg. Headwall | |
| | Number of Barrels | No = | 3 | |
| | Inlet Elevation at Culvert Invert | Inlet Elev = | 6920 | ft. elev. |
| | Outlet Elevation at Culvert Invert **OR** Slope of Culvert (ft v./ft h.) | Outlet Elev = | 6919 | ft. elev. |
| | Culvert Length in Feet | L = | 130 | ft. |
| | Manning's Roughness | n = | 0.013 | |
| | Bend Loss Coefficient | $K_b$ = | 0 | |
| | Exit Loss Coefficient | $K_x$ = | 1 | |

## Design Information (calculated):

| | | |
|---|---|---|
| Entrance Loss Coefficient | $K_e$ = | 0.20 |
| Friction Loss Coefficient | $K_f$ = | 0.93 |
| Sum of All Loss Coefficients | $K_s$ = | 2.13 |
| Orifice Inlet Condition Coefficient | $C_d$ = | 0.95 |
| Minimum Energy Condition Coefficient | $KE_{low}$ = | -0.0132 |

## Calculations of Culvert Capacity (output):

| Water Surface Elevation (ft., linked) | Tailwater Surface Elevation ft | Culvert Inlet-Control Flowrate cfs | Culvert Outlet-Control Flowrate cfs | Controlling Culvert Flowrate cfs (output) | Inlet Equation Used: | Flow Control Used |
|---|---|---|---|---|---|---|
| 6920.00 | | 0.00 | 0.00 | **0.00** | No Flow (WS < inlet) | N/A |
| 6920.25 | | 0.90 | 65.46 | **0.90** | Min. Energy. Eqn. | INLET |
| 6920.50 | | 3.60 | 66.25 | **3.60** | Min. Energy. Eqn. | INLET |
| 6920.75 | | 9.90 | 67.92 | **9.90** | Min. Energy. Eqn. | INLET |
| 6921.00 | | 16.80 | 70.46 | **16.80** | Min. Energy. Eqn. | INLET |
| 6921.25 | | 25.80 | 74.06 | **25.80** | Min. Energy. Eqn. | INLET |
| 6921.50 | | 36.00 | 78.71 | **36.00** | Min. Energy. Eqn. | INLET |
| 6921.75 | | 46.50 | 84.33 | **46.50** | Regression Eqn. | INLET |
| 6922.00 | | 58.50 | 90.82 | **58.50** | Regression Eqn. | INLET |
| 6922.25 | | 71.70 | 97.66 | **71.70** | Regression Eqn. | INLET |
| 6922.50 | | 86.10 | 104.77 | **86.10** | Regression Eqn. | INLET |
| 6922.75 | | 101.10 | 111.79 | **101.10** | Regression Eqn. | INLET |
| 6923.00 | | 115.80 | 118.55 | **115.80** | Regression Eqn. | INLET |
| 6923.25 | | 129.90 | 131.45 | **129.90** | Regression Eqn. | INLET |
| 6923.50 | | 142.80 | 143.38 | **142.80** | Regression Eqn. | INLET |
| 6923.75 | | 155.10 | 154.08 | **154.08** | Regression Eqn. | OUTLET |
| 6924.00 | | 166.20 | 164.79 | **164.79** | Regression Eqn. | OUTLET |
| 6924.25 | | 176.70 | 174.79 | **174.79** | Regression Eqn. | OUTLET |
| 6924.50 | | 186.60 | 184.18 | **184.18** | Regression Eqn. | OUTLET |
| 6924.75 | | 195.90 | 193.22 | **193.22** | Regression Eqn. | OUTLET |
| 6925.00 | | 204.90 | 201.82 | **201.82** | Regression Eqn. | OUTLET |
| 6925.25 | | 213.30 | 209.98 | **209.98** | Regression Eqn. | OUTLET |
| 6925.50 | | 221.40 | 217.97 | **217.97** | Regression Eqn. | OUTLET |
| 6925.75 | | 229.20 | 225.60 | **225.60** | Regression Eqn. | OUTLET |
| 6926.00 | | 236.70 | 232.97 | **232.97** | Regression Eqn. | OUTLET |
| 6926.25 | | 243.90 | 240.17 | **240.17** | Regression Eqn. | OUTLET |
| 6926.50 | | 250.80 | 247.10 | **247.10** | Regression Eqn. | OUTLET |
| 6926.75 | | 257.70 | 253.85 | **253.85** | Regression Eqn. | OUTLET |
| 6927.00 | | 264.30 | 260.52 | **260.52** | Regression Eqn. | OUTLET |
| 6927.25 | | 270.90 | 266.93 | **266.93** | Regression Eqn. | OUTLET |

Processing Time: 00.91 Seconds

## CULVERT STAGE-DISCHARGE SIZING (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

**Project:** WATERBURY FILING 1
**Basin ID:** Design Point 30- Triple 36" RCP Culverts

# PDR
# INLET CALCULATIONS

| | |
|---|---|
| JOB NAME: | *WATERBURY FDR* |
| JOB NUMBER: | *1715.00* |
| DATE: | *09/22/21* |
| CALCULATED BY: | *QNA* |

**DESIGN POINT 19**

***Total Flow:***

| | | | |
|---|---|---|---|
| $Q_5$ | = | **2** | cfs |
| $Q_{100}$ | = | **5** | cfs |

***Max. allowable ponding depth:***
***(Residential street, ramp curb)***

| | | | |
|---|---|---|---|
| $D_5$ | = | 0.50 | ft. |
| $D_{100}$ | = | 0.75 | ft. |

***Std. Type R curb inlet detail:***

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

***Curb inlet sizing:***

***5-Year Event:*** **4** foot inlet required

***100-Year Event:*** **4** foot inlet required

| | |
|---|---|
| JOB NAME: | *WATERBURY FDR* |
| JOB NUMBER: | *1715.00* |
| DATE: | *09/22/21* |
| CALCULATED BY: | *QNA* |

**DESIGN POINT 20**

***Total Flow:***

| | | | |
|---|---|---|---|
| $Q_5$ | = | **2** | cfs |
| $Q_{100}$ | = | **5** | cfs |

***Max. allowable ponding depth:***
***(Residential street, ramp curb)***

| | | | |
|---|---|---|---|
| $D_5$ | = | 0.50 | ft. |
| $D_{100}$ | = | 0.75 | ft. |

***Std. Type R curb inlet detail:***

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

***Curb inlet sizing:***

***5-Year Event:*** **4** foot inlet required

***100-Year Event:*** **4** foot inlet required

$$Q = 0.56\ (Z/n)\ d^{(8/3)}\ S^{(1/2)}$$

| | | | |
|---|---|---|---|
| **ENTER:** | Manning's "$n_b$" for road surface= | 0.016 | |
| **ENTER:** | Manning's "$n_a$" for curb surface= | 0.013 | |
| **ENTER:** | Cross Slope ($S_x$) = | 0.02 | ft/ft |
| **ENTER:** | Street Slope (S) = | 0.04 | ft/ft |
| **ENTER:** | Gutter Slope ($S_g$) = | 0.0833 | ft/ft |
| **ENTER:** | Gutter Width = | 2 | ft |
| **ENTER:** | Distance from Flow Line to Crown = | 15 | ft |
| | Total Depth at A = | 0.0625 | ft |
| | Za = $1/S_x$ = | 50 | ft/ft |
| | Zb = $1/S_g$ = | 12 | ft/ft |

As of May 2001, Colorado Springs City Standard Curb and Gutters have the following characteristics:

| Type | Gutter Width (feet) | Vertical Change (inches) | Slope |
|---|---|---|---|
| Type I | 2 | 1.5 | 0.0625 |
| Type III | 1 | 0.5 | 0.0417 |
| Type V | 0.833 | 0.5 | 0.0500 |
| | 2 | 2 | 0.0833 |

| | |
|---|---|
| JOB NAME: | *WATERBURY FDR* |
| JOB NUMBER: | *1715.00* |
| DATE: | *09/22/21* |
| CALCULATED BY: | *QNA* |

**DESIGN POINT 22**

***Total Flow:***

| | | | |
|---|---|---|---|
| $Q_5$ | = | **3** | cfs |
| $Q_{100}$ | = | **7** | cfs |

***Max. allowable ponding depth:***
***(Residential street, ramp curb)***

| | | | |
|---|---|---|---|
| $D_5$ | = | 0.50 | ft. |
| $D_{100}$ | = | 0.75 | ft. |

***Std. Type R curb inlet detail:***

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

***Curb inlet sizing:***

***5-Year Event:*** **4** foot inlet required

***100-Year Event:*** **4** foot inlet required

***Using 12' D10 Sump Inlet***

| | |
|---|---|
| JOB NAME: | *WATERBURY FDR* |
| JOB NUMBER: | *1715.00* |
| DATE: | *09/22/21* |
| CALCULATED BY: | *QNA* |

**DESIGN POINT 23**

***Total Flow:***

| | | | |
|---|---|---|---|
| $Q_5$ | = | **0** | cfs |
| $Q_{100}$ | = | **1** | cfs |

***Max. allowable ponding depth:***
***(Residential street, ramp curb)***

| | | | |
|---|---|---|---|
| $D_5$ | = | 0.50 | ft. |
| $D_{100}$ | = | 0.75 | ft. |

***Std. Type R curb inlet detail:***

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

***Curb inlet sizing:***

***5-Year Event:*** **4** foot inlet required

***100-Year Event:*** **4** foot inlet required

***Using 12' D10 Sump Inlet***

| | |
|---|---|
| JOB NAME: | ***WATERBURY FDR*** |
| JOB NUMBER: | ***1715.00*** |
| DATE: | ***09/22/21*** |
| CALCULATED BY: | ***QNA*** |

**DESIGN POINT 24**

***Total Flow:***

$Q_5$ = **3** cfs

$Q_{100}$ = **6** cfs

***Max. allowable ponding depth:***
***(Residential street, ramp curb)***

$D_5$ = 0.50 ft.

$D_{100}$ = 0.75 ft.

***Std. Type R curb inlet detail:***

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

***Curb inlet sizing:***

***5-Year Event:*** **4** foot inlet required

***100-Year Event:*** **4** foot inlet required

| | |
|---|---|
| JOB NAME: | ***WATERBURY FDR*** |
| JOB NUMBER: | ***1715.00*** |
| DATE: | ***09/22/21*** |
| CALCULATED BY: | ***QNA*** |

**DESIGN POINT 25**

***Total Flow:***

| | | | |
|---|---|---|---|
| $Q_5$ | = | **2** | cfs |
| $Q_{100}$ | = | **5** | cfs |

***Max. allowable ponding depth:***
***(Residential street, ramp curb)***

| | | | |
|---|---|---|---|
| $D_5$ | = | 0.50 | ft. |
| $D_{100}$ | = | 0.75 | ft. |

***Std. Type R curb inlet detail:***

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

***Curb inlet sizing:***

***5-Year Event:*** **4** foot inlet required

***100-Year Event:*** **4** foot inlet required

| | |
|---|---|
| JOB NAME: | *WATERBURY FDR* |
| JOB NUMBER: | *1715.00* |
| DATE: | *09/22/21* |
| CALCULATED BY: | *QNA* |

**DESIGN POINT 26**

***Total Flow:***

| | | | |
|---|---|---|---|
| $Q_5$ | = | **7** | cfs |
| $Q_{100}$ | = | **16** | cfs |

***Max. allowable ponding depth:***
***(Residential street, ramp curb)***

| | | | |
|---|---|---|---|
| $D_5$ | = | 0.50 | ft. |
| $D_{100}$ | = | 0.75 | ft. |

***Std. Type R curb inlet detail:***

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

***Curb inlet sizing:***

***5-Year Event:*** **6** foot inlet required

***100-Year Event:*** **8** foot inlet required

| | |
|---|---|
| JOB NAME: | *WATERBURY FDR* |
| JOB NUMBER: | *1715.00* |
| DATE: | *09/22/21* |
| CALCULATED BY: | *QNA* |

**DESIGN POINT 27**

***Total Flow:***

| | | | |
|---|---|---|---|
| $Q_5$ | = | **3** | cfs |
| $Q_{100}$ | = | **7** | cfs |

***Max. allowable ponding depth:***
***(Residential street, ramp curb)***

| | | | |
|---|---|---|---|
| $D_5$ | = | 0.50 | ft. |
| $D_{100}$ | = | 0.75 | ft. |

***Std. Type R curb inlet detail:***

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

***Curb inlet sizing:***

***5-Year Event:*** **4** foot inlet required

***100-Year Event:*** **4** foot inlet required

| | |
|---|---|
| JOB NAME: | ***WATERBURY FDR*** |
| JOB NUMBER: | ***1715.00*** |
| DATE: | ***09/22/21*** |
| CALCULATED BY: | ***QNA*** |

**DESIGN POINT 28**

***Total Flow:***

| | | | |
|---|---|---|---|
| $Q_5$ | = | **8** | cfs |
| $Q_{100}$ | = | **18** | cfs |

***Max. allowable ponding depth:***
***(Residential street, ramp curb)***

| | | | |
|---|---|---|---|
| $D_5$ | = | 0.50 | ft. |
| $D_{100}$ | = | 0.75 | ft. |

***Std. Type R curb inlet detail:***

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

***Curb inlet sizing:***

***5-Year Event:*** **6** foot inlet required

***100-Year Event:*** **10** foot inlet required

# PDR
# PIPE CALCULATIONS

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## PIPE RUN 19

### 18" RCP @ 2.00%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 18 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 2 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 40 | % |

Results

| | | |
|---|---|---|
| Flow, Q (See notes) | 5.0056 | cfs |
| Velocity, v | 7.5835 | ft/sec |
| Velocity head, $h_v$ | 0.8938 | ft H2O |
| Flow area | 0.6601 | ft^2 |
| Wetted perimeter | 2.0541 | ft |
| Hydraulic radius | 0.3213 | ft |
| Top width, T | 1.4697 | ft |
| Froude number, F | 2.00 | |
| Shear stress (tractive force), tau | 0.4012 | psf |

Notes:

**This is the flow and depth *inside* the pipe.**
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## PIPE RUN 20

### 24" RCP @ 1.75%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 24 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 1.75 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 37.7 | % |

Results

| | | |
|---|---|---|
| Flow, Q (See notes) | 9.0416 | cfs |
| Velocity, v | 8.3427 | ft/sec |
| Velocity head, $h_v$ | 1.0817 | ft H2O |
| Flow area | 1.0838 | ft^2 |
| Wetted perimeter | 2.6445 | ft |
| Hydraulic radius | 0.4098 | ft |
| Top width, T | 1.9385 | ft |
| Froude number, F | 1.97 | |
| Shear stress (tractive force), tau | 0.4477 | psf |

Notes:

**This is the flow and depth *inside* the pipe.**
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## PIPE RUN 21

### 18" RCP @ 2.00%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 18 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 2.00 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 25 | % |

Results

| | | |
|---|---|---|
| Flow, Q (See notes) | 2.0347 | cfs |
| Velocity, v | 5.8897 | ft/sec |
| Velocity head, $h_v$ | 0.5391 | ft H2O |
| Flow area | 0.3455 | ft^2 |
| Wetted perimeter | 1.5708 | ft |
| Hydraulic radius | 0.2199 | ft |
| Top width, T | 1.2990 | ft |
| Froude number, F | 2.01 | |
| Shear stress (tractive force), tau | 0.2746 | psf |

Notes:

**This is the flow and depth *inside* the pipe.**
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## PIPE RUN 22

## 24" RCP @ 1.75%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 24 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 1.75 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 42 | % |

Results

| | | |
|---|---|---|
| Flow, Q (See notes) | 11.0188 | cfs |
| Velocity, v | 8.8001 | ft/sec |
| Velocity head, $h_v$ | 1.2036 | ft H2O |
| Flow area | 1.2522 | ft^2 |
| Wetted perimeter | 2.8202 | ft |
| Hydraulic radius | 0.4440 | ft |
| Top width, T | 1.9742 | ft |
| Froude number, F | 1.95 | |
| Shear stress (tractive force), tau | 0.4851 | psf |

Notes:

**This is the flow and depth *inside* the pipe.**
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## PIPE RUN 23

### 24" RCP @ 1.00%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 24 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 1.00 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 38.5 | % |

Results

| | | |
|---|---|---|
| Flow, Q (See notes) | 7.1057 | cfs |
| Velocity, v | 6.3736 | ft/sec |
| Velocity head, $h_v$ | 0.6314 | ft H2O |
| Flow area | 1.1149 | ft^2 |
| Wetted perimeter | 2.6774 | ft |
| Hydraulic radius | 0.4164 | ft |
| Top width, T | 1.9464 | ft |
| Froude number, F | 1.48 | |
| Shear stress (tractive force), tau | 0.2600 | psf |

Notes:

**This is the flow and depth *inside* the pipe.**
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## PIPE RUN 24

### 24" RCP @ 1.00%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 24 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 1.00 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 15 | % |

Results

| | | |
|---|---|---|
| Flow, Q (See notes) | 1.0996 | cfs |
| Velocity, v | 3.7211 | ft/sec |
| Velocity head, $h_v$ | 0.2152 | ft H2O |
| Flow area | 0.2955 | ft^2 |
| Wetted perimeter | 1.5908 | ft |
| Hydraulic radius | 0.1858 | ft |
| Top width, T | 1.4283 | ft |
| Froude number, F | 1.44 | |
| Shear stress (tractive force), tau | 0.1160 | psf |

Notes:

**This is the flow and depth *inside* the pipe.**
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## PIPE RUN 25

### 30" RCP @ 1.00%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 30 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 1.00 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 30 | % |

Results

| | | |
|---|---|---|
| Flow, Q (See notes) | 8.0317 | cfs |
| Velocity, v | 6.4849 | ft/sec |
| Velocity head, $h_v$ | 0.6536 | ft H2O |
| Flow area | 1.2386 | ft^2 |
| Wetted perimeter | 2.8982 | ft |
| Hydraulic radius | 0.4273 | ft |
| Top width, T | 2.2913 | ft |
| Froude number, F | 1.56 | |
| Shear stress (tractive force), tau | 0.2668 | psf |

Notes:

**This is the flow and depth *inside* the pipe.**
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## PIPE RUN 26

## 36" RCP @ 1.75%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 36 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 1.75 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 31.6 | % |

Results

| | | |
|---|---|---|
| Flow, Q (See notes) | 19.0979 | cfs |
| Velocity, v | 9.9655 | ft/sec |
| Velocity head, $h_v$ | 1.5435 | ft H2O |
| Flow area | 1.9165 | ft^2 |
| Wetted perimeter | 3.5818 | ft |
| Hydraulic radius | 0.5350 | ft |
| Top width, T | 2.7894 | ft |
| Froude number, F | 2.12 | |
| Shear stress (tractive force), tau | 0.5846 | psf |

Notes:

**This is the flow and depth *inside* the pipe.**
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## PIPE RUN 27

### 18" RCP @ 2.00%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 18 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 2.0 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 44.5 | % |

Results

| | | |
|---|---|---|
| Flow, Q (See notes) | 6.0659 | cfs |
| Velocity, v | 7.9810 | ft/sec |
| Velocity head, $h_v$ | 0.9899 | ft H2O |
| Flow area | 0.7601 | ft^2 |
| Wetted perimeter | 2.1908 | ft |
| Hydraulic radius | 0.3469 | ft |
| Top width, T | 1.4909 | ft |
| Froude number, F | 1.97 | |
| Shear stress (tractive force), tau | 0.4332 | psf |

Notes:

**This is the flow and depth *inside* the pipe.**
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## PIPE RUN 28

### 18" RCP @ 2.00%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 18 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 2.0 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 40 | % |

Results

| | | |
|---|---|---|
| Flow, Q (See notes) | 5.0056 | cfs |
| Velocity, v | 7.5835 | ft/sec |
| Velocity head, $h_v$ | 0.8938 | ft H2O |
| Flow area | 0.6601 | ft^2 |
| Wetted perimeter | 2.0541 | ft |
| Hydraulic radius | 0.3213 | ft |
| Top width, T | 1.4697 | ft |
| Froude number, F | 2.00 | |
| Shear stress (tractive force), tau | 0.4012 | psf |

Notes:

**This is the flow and depth *inside* the pipe.**
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## PIPE RUN 29

## 36" RCP @ 1.75%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 36 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 1.75 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 39.5 | % |

Results

| | | |
|---|---|---|
| Flow, Q (See notes) | 29.0535 | cfs |
| Velocity, v | 11.1908 | ft/sec |
| Velocity head, $h_v$ | 1.9463 | ft H2O |
| Flow area | 2.5963 | ft^2 |
| Wetted perimeter | 4.0776 | ft |
| Hydraulic radius | 0.6367 | ft |
| Top width, T | 2.9331 | ft |
| Froude number, F | 2.10 | |
| Shear stress (tractive force), tau | 0.6956 | psf |

Notes:

**This is the flow and depth *inside* the pipe.**
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## PIPE RUN 30

## 24" RCP @ 2.00%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 24 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 2.00 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 50.1 | % |

Results

| | | |
|---|---|---|
| Flow, Q (See notes) | 16.0492 | cfs |
| Velocity, v | 10.1916 | ft/sec |
| Velocity head, $h_v$ | 1.6143 | ft H2O |
| Flow area | 1.5748 | ft^2 |
| Wetted perimeter | 3.1456 | ft |
| Hydraulic radius | 0.5006 | ft |
| Top width, T | 2.0000 | ft |
| Froude number, F | 2.03 | |
| Shear stress (tractive force), tau | 0.6251 | psf |

Notes:

**This is the flow and depth *inside* the pipe.**
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## PIPE RUN 31

## 42" RCP @ 1.00%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 42 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 1.00 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 46.3 | % |

Results

| | | |
|---|---|---|
| Flow, Q (See notes) | 44.0548 | cfs |
| Velocity, v | 10.1099 | ft/sec |
| Velocity head, $h_v$ | 1.5885 | ft H2O |
| Flow area | 4.3578 | ft^2 |
| Wetted perimeter | 5.2385 | ft |
| Hydraulic radius | 0.8318 | ft |
| Top width, T | 3.4904 | ft |
| Froude number, F | 1.60 | |
| Shear stress (tractive force), tau | 0.5193 | psf |

Notes:

**This is the flow and depth *inside* the pipe.**
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## PIPE RUN 32

### 18" RCP @ 2.00%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 18 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 2.00 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 48.3 | % |

Results

| | | |
|---|---|---|
| Flow, Q (See notes) | 7.0004 | cfs |
| Velocity, v | 8.2815 | ft/sec |
| Velocity head, $h_v$ | 1.0659 | ft H2O |
| Flow area | 0.8453 | ft^2 |
| Wetted perimeter | 2.3052 | ft |
| Hydraulic radius | 0.3667 | ft |
| Top width, T | 1.4991 | ft |
| Froude number, F | 1.94 | |
| Shear stress (tractive force), tau | 0.4579 | psf |

Notes:

**This is the flow and depth *inside* the pipe.**
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

# Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

## PIPE RUN 33

## 42" RCP @ 1.00%

Inputs

| | | |
|---|---|---|
| Pipe diameter, $d_0$ | 42 | in |
| Manning roughness, n | 0.013 | |
| Pressure slope (possibly ? equal to pipe slope), $S_0$ | 1.00 | % rise/run |
| Percent of (or ratio to) full depth (100% or 1 if flowing full) | 50.5 | % |

Results

| | | |
|---|---|---|
| Flow, Q (See notes) | 51.1550 | cfs |
| Velocity, v | 10.5005 | ft/sec |
| Velocity head, $h_v$ | 1.7136 | ft H2O |
| Flow area | 4.8719 | ft^2 |
| Wetted perimeter | 5.5327 | ft |
| Hydraulic radius | 0.8805 | ft |
| Top width, T | 3.4998 | ft |
| Froude number, F | 1.57 | |
| Shear stress (tractive force), tau | 0.5497 | psf |

Notes:

**This is the flow and depth *inside* the pipe.**
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

# MDDP
# FULL SPECTRUM DETENTION & WATER QUALITY CALCULATIONS

# POND TRIBUTARY AREA

| | | | | |
|---|---|---|---|---|
| POND 1 TRIB AREA (DP 8) | **19.91** AC | BASINS A, B1, B2, C, D ,E, F, H, & K | DCIA | 4.68 |
| | | | UIA | 6.57 |
| | | | RPA | 0.71 |
| | | | SPA | 7.94 |
| | | | **Total** | **19.91** |
| POND 2 TRIB AREA (DP 18) | **21.93** AC | BASINS L1, L2, O1, O2, & OS-4 | DCIA | 2.58 |
| | | | UIA | 4.13 |
| | | | RPA | 0.68 |
| | | | SPA | 14.55 |
| | | | **Total** | **21.93** |
| POND 3 TRIB AREA (DP 29) | **84.64** AC | BASINS Q1, Q2, R, S1, S2, T1, T2, U1, U2, W, OS-1, OS-2, OS-3A, 0S-3B, OS-Q1, OS-Q2, OS-4, OS-S1, OS-S2, OS-T2, OS-7, & OS-9 | DCIA | 19.50 |
| | | | UIA | 22.09 |
| | | | RPA | 11.31 |
| | | | SPA | 31.74 |
| | | | **Total** | **84.64** |

Worksheet Protected

# Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

## LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

| | | | |
|---|---|---|---|
| ***Design Storm: 1-Hour Rain Depth | WQCV Event | 0.43 | inches |
| ***Minor Storm: 1-Hour Rain Depth | 5-Year Event | 1.50 | inches |
| ***Major Storm: 1-Hour Rain Depth | 100-Year Event | 2.52 | inches |
| Optional User Defined Storm | CUHP | | |
| (CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm | 100-Year Event | | |
| Max Intensity for Optional User Defined Storm | 0 | | |

| | |
|---|---|
| **Designer:** | **QNA** |
| **Company:** | **Terra Nova Engineering** |
| **Date:** | **September 20, 2021** |
| **Project:** | **WATERBURY FILING 1 POND 1** |
| **Location:** | **POND 1 Design Point 8 Full Spectrum Detention 19.91 Acres** |

**SITE INFORMATION (USER-INPUT)**

| **Sub-basin Identifier** | **DP 9 FSD** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Receiving Pervious Area Soil Type | Loamy Sand | | | | | | | | | | | | | |
| Total Area (ac., Sum of DCIA, UIA, RPA, & SPA) | 19.91 | | | | | | | | | | | | | |
| Directly Connected Impervious Area (DCIA, acres) | 4.68 | | | | | | | | | | | | | |
| Unconnected Impervious Area (UIA, acres) | 6.57 | | | | | | | | | | | | | |
| Receiving Pervious Area (RPA, acres) | 0.71 | | | | | | | | | | | | | |
| Separate Pervious Area (SPA, acres) | 7.94 | | | | | | | | | | | | | |
| RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP) | C | | | | | | | | | | | | | |

**CALCULATED RESULTS (OUTPUT)**

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Calculated Area (ac, check against input) | 19.905 | | | | | | | | | | | | | |
| Directly Connected Impervious Area (DCIA, %) | 23.5% | | | | | | | | | | | | | |
| Unconnected Impervious Area (UIA, %) | 33.0% | | | | | | | | | | | | | |
| Receiving Pervious Area (RPA, %) | 3.5% | | | | | | | | | | | | | |
| Separate Pervious Area (SPA, %) | 39.9% | | | | | | | | | | | | | |
| $A_R$ (RPA / UIA) | 0.107 | | | | | | | | | | | | | |
| $I_a$ Check | 0.900 | | | | | | | | | | | | | |
| f / I for WQCV Event: | 4.5 | | | | | | | | | | | | | |
| f / I for 5-Year Event: | 0.5 | | | | | | | | | | | | | |
| f / I for 100-Year Event: | 0.4 | | | | | | | | | | | | | |
| f / I for Optional User Defined Storm CUHP: | | | | | | | | | | | | | | |
| IRF for WQCV Event: | 0.89 | | | | | | | | | | | | | |
| IRF for 5-Year Event: | 0.97 | | | | | | | | | | | | | |
| IRF for 100-Year Event: | 0.98 | | | | | | | | | | | | | |
| IRF for Optional User Defined Storm CUHP: | | | | | | | | | | | | | | |
| Total Site Imperviousness: $I_{total}$ | 56.6% | | | | | | | | | | | | | |
| Effective Imperviousness for WQCV Event: | 52.8% | | | | | | | | | | | | | |
| Effective Imperviousness for 5-Year Event: | 55.6% | | | | | | | | | | | | | |
| Effective Imperviousness for 100-Year Event: | 55.9% | | | | | | | | | | | | | |
| Effective Imperviousness for Optional User Defined Storm CUHP: | | | | | | | | | | | | | | |

**LID / EFFECTIVE IMPERVIOUSNESS CREDITS**

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WQCV Event CREDIT: Reduce Detention By: | 4.9% | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| This line only for 10-Year Event | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| 100-Year Event CREDIT**: Reduce Detention By: | 1.2% | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| User Defined CUHP CREDIT: Reduce Detention By: | | | | | | | | | | | | | | |

| | |
|---|---|
| **Total Site Imperviousness:** | **56.6%** |
| **Total Site Effective Imperviousness for WQCV Event:** | **52.8%** |
| **Total Site Effective Imperviousness for 5-Year Event:** | **55.6%** |
| **Total Site Effective Imperviousness for 100-Year Event:** | **55.9%** |
| **Total Site Effective Imperviousness for Optional User Defined Storm CUHP:** | |

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.

** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.

*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

# Stormwater Detention and Infiltration Design Data Sheet

Workbook Protected  Worksheet Protected

**Stormwater Facility Name:** **Waterbury Filing No. 1 & 2 EDB Pond 1 D8 8**

**Facility Location & Jurisdiction:** **Stapleton Dr. & Bandernero Dr Intersection**

**User Input: Watershed Characteristics**

| | | |
|---|---|---|
| Watershed Slope = | 0.012 | ft/ft |
| Watershed Length = | 1935 | ft |
| Watershed Area = | 19.91 | acres |
| Watershed Imperviousness = | 55.9% | percent |
| Percentage Hydrologic Soil Group A = | 100.0% | percent |
| Percentage Hydrologic Soil Group B = | 0.0% | percent |
| Percentage Hydrologic Soil Groups C/D = | 0.0% | percent |

Location for 1-hr Rainfall Depths (use dropdown):

User Input

WQCV Treatment Method = Extended Detention

| User Defined Stage [ft] | User Defined Area [ft^2] | User Defined Stage [ft] | User Defined Discharge [cfs] |
|---|---|---|---|
| 0.00 | 100 | 0.00 | 0.00 |
| 0.25 | 3,176 | 0.25 | 0.04 |
| 0.50 | 6,253 | 0.50 | 0.06 |
| 0.75 | 8,372 | 0.75 | 0.07 |
| 1.00 | 10,492 | 1.00 | 0.09 |
| 1.25 | 12,612 | 1.25 | 0.14 |
| 1.50 | 14,732 | 1.50 | 0.17 |
| 1.75 | 16,852 | 1.75 | 0.19 |
| 2.00 | 18,972 | 2.00 | 0.21 |
| 2.25 | 21,092 | 2.25 | 0.27 |
| 2.50 | 23,212 | 2.50 | 0.30 |
| 2.75 | 25,435 | 2.75 | 0.33 |
| 3.00 | 27,658 | 3.00 | 0.36 |
| 3.25 | 29,881 | 3.25 | 3.70 |
| 3.50 | 32,105 | 3.50 | 7.91 |
| 3.75 | 34,328 | 3.75 | 8.21 |
| 4.00 | 36,551 | 4.00 | 8.50 |
| 4.25 | 38,744 | 4.25 | 8.78 |
| 4.50 | 40,997 | 4.50 | 9.06 |
| 4.75 | 43,176 | 4.75 | 20.80 |
| 5.00 | 45,355 | 5.00 | 42.67 |
| 5.25 | 47,534 | 5.25 | 71.79 |
| 5.50 | 49,712 | 5.50 | 107.27 |
| 5.75 | 51,891 | 5.75 | 148.67 |
| 6.00 | 54,070 | 6.00 | 195.73 |
| 6.25 | 56,249 | 6.25 | 248.30 |
| 6.50 | 58,428 | 6.50 | 306.29 |

**After completing and printing this worksheet to a pdf, go to:**
**https://maperture.digitaldataservices.com/gvh/?viewer=cswdif**
**create a new stormwater facility, and**
**attach the pdf of this worksheet to that record.**

**Routed Hydrograph Results**

| Design Storm Return Period = | WQCV | 2 Year | 5 Year | 10 Year | 50 Year | 100 Year | |
|---|---|---|---|---|---|---|---|
| One-Hour Rainfall Depth = | 0.53 | 1.19 | 1.50 | 1.75 | 2.25 | 2.52 | in |
| Calculated Runoff Volume = | 0.370 | 0.905 | 1.187 | 1.454 | 2.191 | 2.659 | acre-ft |
| OPTIONAL Override Runoff Volume = | | | | | | | acre-ft |
| Inflow Hydrograph Volume = | 0.370 | 0.905 | 1.186 | 1.454 | 2.191 | 2.659 | acre-ft |
| Time to Drain 97% of Inflow Volume = | 42.2 | 62.8 | **67.2** | 65.8 | 62.0 | 60.0 | hours |
| Time to Drain 99% of Inflow Volume = | 45.0 | 67.5 | 72.8 | 72.4 | 70.9 | **70.2** | hours |
| Maximum Ponding Depth = | 1.67 | 2.73 | 3.08 | 3.25 | 3.67 | 4.04 | ft |
| Maximum Ponded Area = | 0.37 | 0.58 | 0.65 | 0.69 | 0.77 | **0.85** | acres |
| Maximum Volume Stored = | 0.334 | 0.842 | 1.050 | 1.168 | 1.471 | 1.771 | acre-ft |

# Stormwater Detention and Infiltration Design Data Sheet

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

*MHFD-Detention, Version 4.03 (May 2020)*

**Project:** **WATERBURY**

**Basin ID:** **POND 1 DP 8**

**Example Zone Configuration (Retention Pond)**

Watershed Information

| | | |
|---|---|---|
| Selected BMP Type = | **EDB** | |
| Watershed Area = | 19.91 | acres |
| Watershed Length = | 1,935 | ft |
| Watershed Length to Centroid = | 800 | ft |
| Watershed Slope = | 0.012 | ft/ft |
| Watershed Imperviousness = | 55.86% | percent |
| Percentage Hydrologic Soil Group A = | 100.0% | percent |
| Percentage Hydrologic Soil Group B = | 0.0% | percent |
| Percentage Hydrologic Soil Groups C/D = | 0.0% | percent |
| Target WQCV Drain Time = | 40.0 | hours |
| Location for 1-hr Rainfall Depths = | User Input | |

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

| | | | Optional User Overrides | |
|---|---|---|---|---|
| Water Quality Capture Volume (WQCV) = | 0.324 | acre-feet | 0.324 | acre-feet |
| Excess Urban Runoff Volume (EURV) = | 1.027 | acre-feet | 1.027 | acre-feet |
| 2-yr Runoff Volume (P1 = 1.19 in.) = | 0.990 | acre-feet | 1.19 | inches |
| 5-yr Runoff Volume (P1 = 1.5 in.) = | 1.308 | acre-feet | 1.50 | inches |
| 10-yr Runoff Volume (P1 = 1.75 in.) = | 1.564 | acre-feet | 1.75 | inches |
| 25-yr Runoff Volume (P1 = 2 in.) = | 1.933 | acre-feet | 2.00 | inches |
| 50-yr Runoff Volume (P1 = 2.25 in.) = | 2.296 | acre-feet | 2.25 | inches |
| 100-yr Runoff Volume (P1 = 2.52 in.) = | 2.748 | acre-feet | 2.52 | inches |
| 500-yr Runoff Volume (P1 = 3 in.) = | 3.502 | acre-feet | 3.00 | inches |
| Approximate 2-yr Detention Volume = | 0.855 | acre-feet | | |
| Approximate 5-yr Detention Volume = | 1.122 | acre-feet | | |
| Approximate 10-yr Detention Volume = | 1.362 | acre-feet | | |
| Approximate 25-yr Detention Volume = | 1.654 | acre-feet | | |
| Approximate 50-yr Detention Volume = | 1.836 | acre-feet | | |
| Approximate 100-yr Detention Volume = | 2.043 | acre-feet | | |

Define Zones and Basin Geometry

| | | |
|---|---|---|
| Zone 1 Volume (WQCV) = | 0.324 | acre-feet |
| Zone 2 Volume (EURV - Zone 1) = | 0.703 | acre-feet |
| Zone 3 Volume (100-year - Zones 1 & 2) = | 1.016 | acre-feet |
| Total Detention Basin Volume = | 2.043 | acre-feet |
| Initial Surcharge Volume (ISV) = | user | $ft^3$ |
| Initial Surcharge Depth (ISD) = | user | ft |
| Total Available Detention Depth ($H_{total}$) = | user | ft |
| Depth of Trickle Channel ($H_{TC}$) = | user | ft |
| Slope of Trickle Channel ($S_{TC}$) = | user | ft/ft |
| Slopes of Main Basin Sides ($S_{main}$) = | user | H:V |
| Basin Length-to-Width Ratio ($R_{L/W}$) = | user | |
| Initial Surcharge Area ($A_{ISV}$) = | user | $ft^2$ |
| Surcharge Volume Length ($L_{ISV}$) = | user | ft |
| Surcharge Volume Width ($W_{ISV}$) = | user | ft |
| Depth of Basin Floor ($H_{FLOOR}$) = | user | ft |
| Length of Basin Floor ($L_{FLOOR}$) = | user | ft |
| Width of Basin Floor ($W_{FLOOR}$) = | user | ft |
| Area of Basin Floor ($A_{FLOOR}$) = | user | $ft^2$ |
| Volume of Basin Floor ($V_{FLOOR}$) = | user | $ft^3$ |
| Depth of Main Basin ($H_{MAIN}$) = | user | ft |
| Length of Main Basin ($L_{MAIN}$) = | user | ft |
| Width of Main Basin ($W_{MAIN}$) = | user | ft |
| Area of Main Basin ($A_{MAIN}$) = | user | $ft^2$ |
| Volume of Main Basin ($V_{MAIN}$) = | user | $ft^3$ |
| Calculated Total Basin Volume ($V_{total}$) = | **user** | acre-feet |

Depth Increment = ft

| Stage - Storage Description | Stage (ft) | Optional Override Stage (ft) | Length (ft) | Width (ft) | Area ($ft^2$) | Optional Override Area ($ft^2$) | Area (acre) | Volume ($ft^3$) | Volume (ac-ft) |
|---|---|---|---|---|---|---|---|---|---|
| **Top of Micropool** | -- | 0.00 | -- | -- | -- | 100 | 0.002 | | |
| **6923.75** | -- | 0.25 | -- | -- | -- | 3,176 | 0.073 | 409 | 0.009 |
| **6924.00** | -- | 0.50 | -- | -- | -- | 6,253 | 0.144 | 1,588 | 0.036 |
| **6924.25** | -- | 0.75 | -- | -- | -- | 8,372 | 0.192 | 3,416 | 0.078 |
| **6924.50** | -- | 1.00 | -- | -- | -- | 10,492 | 0.241 | 5,774 | 0.133 |
| **6924.75** | -- | 1.25 | -- | -- | -- | 12,612 | 0.290 | 8,662 | 0.199 |
| **6925.00** | -- | 1.50 | -- | -- | -- | 14,732 | 0.338 | 12,080 | 0.277 |
| **6925.25** | -- | 1.75 | -- | -- | -- | 16,852 | 0.387 | 16,028 | 0.368 |
| **6925.50** | -- | 2.00 | -- | -- | -- | 18,972 | 0.436 | 20,506 | 0.471 |
| **6925.75** | -- | 2.25 | -- | -- | -- | 21,092 | 0.484 | 25,514 | 0.586 |
| **6926.00** | -- | 2.50 | -- | -- | -- | 23,212 | 0.533 | 31,052 | 0.713 |
| **6926.25** | -- | 2.75 | -- | -- | -- | 25,435 | 0.584 | 37,133 | 0.852 |
| **6926.50** | -- | 3.00 | -- | -- | -- | 27,658 | 0.635 | 43,769 | 1.005 |
| **6926.75** | -- | 3.25 | -- | -- | -- | 29,881 | 0.686 | 50,962 | 1.170 |
| **6927.00** | -- | 3.50 | -- | -- | -- | 32,105 | 0.737 | 58,710 | 1.348 |
| **6927.25** | -- | 3.75 | -- | -- | -- | 34,328 | 0.788 | 67,014 | 1.538 |
| **6927.50** | -- | 4.00 | -- | -- | -- | 36,551 | 0.839 | 75,874 | 1.742 |
| **6927.75** | -- | 4.25 | -- | -- | -- | 38,744 | 0.889 | 85,286 | 1.958 |
| **6928.00** | -- | 4.50 | -- | -- | -- | 40,997 | 0.941 | 95,254 | 2.187 |
| **6928.25** | -- | 4.75 | -- | -- | -- | 43,176 | 0.991 | 105,775 | 2.428 |
| **6928.50** | -- | 5.00 | -- | -- | -- | 45,355 | 1.041 | 116,842 | 2.682 |
| **6928.75** | -- | 5.25 | -- | -- | -- | 47,534 | 1.091 | 128,453 | 2.949 |
| **6929.00** | -- | 5.50 | -- | -- | -- | 49,712 | 1.141 | 140,608 | 3.228 |
| **6929.25** | -- | 5.75 | -- | -- | -- | 51,891 | 1.191 | 153,309 | 3.519 |
| **6929.50** | -- | 6.00 | -- | -- | -- | 54,070 | 1.241 | 166,554 | 3.824 |
| **6929.75** | -- | 6.25 | -- | -- | -- | 56,249 | 1.291 | 180,344 | 4.140 |
| **6930.00** | -- | 6.50 | -- | -- | -- | 58,428 | 1.341 | 194,678 | 4.469 |

20
15
10
5
0
58800
44100
29400
14700
0
0.00
2.00
4.00
6.00
8.00
Length, Width (ft.)
Area (sq.ft.)
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)

1.360
1.020
0.680
0.340
0.000
4.480
3.360
2.240
1.120
0.000
0.00
2.00
4.00
6.00
8.00
Area (acres)
Volume (ac-ft)
Stage (ft.)
Area (acres)
Volume (ac-ft)

# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.03 (May 2020)*

**Project:** **WATERBURY**

**Basin ID:** **POND 1 DP 8**

**Example Zone Configuration (Retention Pond)**

| | Estimated Stage (ft) | Estimated Volume (ac-ft) | Outlet Type |
|---|---|---|---|
| Zone 1 (WQCV) | 1.64 | 0.324 | Orifice Plate |
| Zone 2 (EURV) | 3.04 | 0.703 | Orifice Plate |
| Zone 3 (100-year) | 4.35 | 1.016 | Weir&Pipe (Restrict) |
| Total (all zones) | | 2.043 | |

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 Area = | | $ft^2$ |
| Underdrain Orifice Diameter = | | inches | Underdrain Orifice Centroid = | | feet |

Calculated Parameters for Underdrain

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

| | | | | | |
|---|---|---|---|---|---|
| Invert of Lowest Orifice = | 0.00 | ft (relative to basin bottom at Stage = 0 ft) | WQ Orifice Area per Row = | 1.792E-02 | $ft^2$ |
| Depth at top of Zone using Orifice Plate = | 3.04 | ft (relative to basin bottom at Stage = 0 ft) | Elliptical Half-Width = | N/A | feet |
| Orifice Plate: Orifice Vertical Spacing = | 12.20 | inches | Elliptical Slot Centroid = | N/A | feet |
| Orifice Plate: Orifice Area per Row = | 2.58 | sq. inches (diameter = 1-13/16 inches) | Elliptical Slot Area = | N/A | $ft^2$ |

Calculated Parameters for Plate

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

| | Row 1 (required) | Row 2 (optional) | Row 3 (optional) | Row 4 (optional) | Row 5 (optional) | Row 6 (optional) | Row 7 (optional) | Row 8 (optional) |
|---|---|---|---|---|---|---|---|---|
| Stage of Orifice Centroid (ft) | 0.00 | 1.01 | 2.03 | | | | | |
| Orifice Area (sq. inches) | 2.58 | 2.58 | 2.58 | | | | | |

| | 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 | | | Not Selected | Not Selected | |
|---|---|---|---|---|---|---|---|
| Invert of Vertical Orifice = | N/A | N/A | ft (relative to basin bottom at Stage = 0 ft) | Vertical Orifice Area = | N/A | N/A | $ft^2$ |
| Depth at top of Zone using Vertical Orifice = | N/A | N/A | ft (relative to basin bottom at Stage = 0 ft) | Vertical Orifice Centroid = | N/A | N/A | feet |
| Vertical Orifice Diameter = | N/A | N/A | inches | | | | |

Calculated Parameters for Vertical Orifice

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

| | Zone 3 Weir | Not Selected | | | Zone 3 Weir | Not Selected | |
|---|---|---|---|---|---|---|---|
| Overflow Weir Front Edge Height, Ho = | 3.04 | N/A | ft (relative to basin bottom at Stage = 0 ft) | Height of Grate Upper Edge, $H_t$ = | 3.04 | N/A | feet |
| Overflow Weir Front Edge Length = | 3.00 | N/A | feet | Overflow Weir Slope Length = | 3.00 | N/A | feet |
| Overflow Weir Grate Slope = | 0.00 | N/A | H:V | Grate Open Area / 100-yr Orifice Area = | 7.51 | N/A | |
| Horiz. Length of Weir Sides = | 3.00 | N/A | feet | Overflow Grate Open Area w/o Debris = | 6.30 | N/A | $ft^2$ |
| Overflow Grate Open Area % = | 70% | N/A | %, grate open area/total area | Overflow Grate Open Area w/ Debris = | 3.15 | N/A | $ft^2$ |
| Debris Clogging % = | 50% | N/A | % | | | | |

Calculated Parameters for Overflow Weir

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

| | Zone 3 Restrictor | Not Selected | | | Zone 3 Restrictor | Not Selected | |
|---|---|---|---|---|---|---|---|
| Depth to Invert of Outlet Pipe = | 0.10 | N/A | ft (distance below basin bottom at Stage = 0 ft) | Outlet Orifice Area = | 0.84 | N/A | $ft^2$ |
| Outlet Pipe Diameter = | 24.00 | N/A | inches | Outlet Orifice Centroid = | 0.37 | N/A | feet |
| Restrictor Plate Height Above Pipe Invert = | 7.50 | | inches | Half-Central Angle of Restrictor Plate on Pipe = | 1.19 | N/A | radians |

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

| | | | | | |
|---|---|---|---|---|---|
| Spillway Invert Stage= | 4.50 | ft (relative to basin bottom at Stage = 0 ft) | Spillway Design Flow Depth= | 0.46 | feet |
| Spillway Crest Length = | 30.00 | feet | Stage at Top of Freeboard = | 5.96 | feet |
| Spillway End Slopes = | 3.00 | H:V | Basin Area at Top of Freeboard = | 1.23 | acres |
| Freeboard above Max Water Surface = | 1.00 | feet | Basin Volume at Top of Freeboard = | 3.77 | acre-ft |

Calculated Parameters for Spillway

Routed Hydrograph Results

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

| Design Storm Return Period = | WQCV | EURV | 2 Year | 5 Year | 10 Year | 25 Year | 50 Year | 100 Year | 500 Year |
|---|---|---|---|---|---|---|---|---|---|
| One-Hour Rainfall Depth (in) = | N/A | N/A | 1.19 | 1.50 | 1.75 | 2.00 | 2.25 | 2.52 | 3.00 |
| CUHP Runoff Volume (acre-ft) = | 0.324 | 1.027 | 0.990 | 1.308 | 1.564 | 1.933 | 2.296 | 2.748 | 3.502 |
| Inflow Hydrograph Volume (acre-ft) = | N/A | N/A | 0.990 | 1.308 | 1.564 | 1.933 | 2.296 | 2.748 | 3.502 |
| CUHP Predevelopment Peak Q (cfs) = | N/A | N/A | 0.1 | 0.2 | 0.3 | 2.5 | 5.0 | 8.4 | 13.8 |
| OPTIONAL Override Predevelopment Peak Q (cfs) = | N/A | N/A | | | | | | | |
| Predevelopment Unit Peak Flow, q (cfs/acre) = | N/A | N/A | 0.01 | 0.01 | 0.01 | 0.13 | 0.25 | 0.42 | 0.69 |
| Peak Inflow Q (cfs) = | N/A | N/A | 11.5 | 15.2 | 18.1 | 24.2 | 29.4 | 35.9 | 46.0 |
| Peak Outflow Q (cfs) = | 0.2 | 0.4 | 0.3 | 2.2 | 4.4 | 7.3 | 7.6 | 8.0 | 14.8 |
| Ratio Peak Outflow to Predevelopment Q = | N/A | N/A | N/A | 11.3 | 16.1 | 2.9 | 1.5 | 0.9 | 1.1 |
| Structure Controlling Flow = | Plate | Overflow Weir 1 | Plate | Overflow Weir 1 | Overflow Weir 1 | Outlet Plate 1 | Outlet Plate 1 | Outlet Plate 1 | Spillway |
| Max Velocity through Grate 1 (fps) = | N/A | N/A | N/A | 0.3 | 0.6 | 1.1 | 1.1 | 1.2 | 1.3 |
| Max Velocity through Grate 2 (fps) = | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Time to Drain 97% of Inflow Volume (hours) = | 38 | 65 | 65 | 68 | 66 | 64 | 63 | 61 | 58 |
| Time to Drain 99% of Inflow Volume (hours) = | **40** | 70 | 69 | 73 | 73 | 72 | 71 | 71 | 70 |
| Maximum Ponding Depth (ft) = | 1.64 | 3.04 | 2.88 | 3.21 | 3.33 | 3.50 | 3.78 | 4.20 | 4.67 |
| Area at Maximum Ponding Depth (acres) = | 0.37 | 0.64 | 0.61 | 0.68 | 0.70 | 0.74 | 0.79 | 0.88 | 0.97 |
| Maximum Volume Stored (acre-ft) = | 0.327 | 1.030 | 0.924 | 1.143 | 1.225 | 1.348 | 1.554 | 1.905 | 2.340 |

# 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.

| | SOURCE | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP |
|---|---|---|---|---|---|---|---|---|---|---|
| Time Interval | 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 | 0.13 | 0.01 | 0.34 |
| | 0:15:00 | 0.00 | 0.00 | 1.18 | 1.92 | 2.38 | 1.60 | 2.02 | 1.96 | 2.67 |
| | 0:20:00 | 0.00 | 0.00 | 4.35 | 5.75 | 6.79 | 4.31 | 5.05 | 5.38 | 6.71 |
| | 0:25:00 | 0.00 | 0.00 | 9.15 | 12.29 | 14.94 | 9.11 | 10.47 | 11.32 | 14.37 |
| | 0:30:00 | 0.00 | 0.00 | 11.47 | 15.24 | 18.11 | 19.50 | 23.75 | 27.13 | 35.08 |
| | 0:35:00 | 0.00 | 0.00 | 11.37 | 14.88 | 17.52 | 23.99 | 29.14 | 35.34 | 45.28 |
| | 0:40:00 | 0.00 | 0.00 | 10.66 | 13.72 | 16.09 | 24.25 | 29.45 | 35.91 | 45.98 |
| | 0:45:00 | 0.00 | 0.00 | 9.64 | 12.51 | 14.71 | 22.45 | 27.17 | 33.89 | 43.51 |
| | 0:50:00 | 0.00 | 0.00 | 8.77 | 11.53 | 13.44 | 20.76 | 25.00 | 31.09 | 40.05 |
| | 0:55:00 | 0.00 | 0.00 | 8.05 | 10.57 | 12.36 | 18.70 | 22.42 | 28.18 | 36.22 |
| | 1:00:00 | 0.00 | 0.00 | 7.37 | 9.64 | 11.32 | 16.88 | 20.14 | 25.72 | 33.04 |
| | 1:05:00 | 0.00 | 0.00 | 6.74 | 8.78 | 10.37 | 15.25 | 18.13 | 23.56 | 30.30 |
| | 1:10:00 | 0.00 | 0.00 | 6.03 | 8.08 | 9.59 | 13.51 | 15.98 | 20.52 | 26.29 |
| | 1:15:00 | 0.00 | 0.00 | 5.50 | 7.51 | 9.13 | 12.00 | 14.12 | 17.76 | 22.66 |
| | 1:20:00 | 0.00 | 0.00 | 5.10 | 6.99 | 8.59 | 10.76 | 12.63 | 15.43 | 19.63 |
| | 1:25:00 | 0.00 | 0.00 | 4.74 | 6.50 | 7.87 | 9.73 | 11.39 | 13.53 | 17.15 |
| | 1:30:00 | 0.00 | 0.00 | 4.41 | 6.05 | 7.17 | 8.71 | 10.16 | 11.90 | 15.01 |
| | 1:35:00 | 0.00 | 0.00 | 4.08 | 5.61 | 6.52 | 7.74 | 9.00 | 10.42 | 13.09 |
| | 1:40:00 | 0.00 | 0.00 | 3.76 | 5.00 | 5.90 | 6.84 | 7.92 | 9.03 | 11.29 |
| | 1:45:00 | 0.00 | 0.00 | 3.44 | 4.39 | 5.31 | 5.99 | 6.89 | 7.73 | 9.60 |
| | 1:50:00 | 0.00 | 0.00 | 3.15 | 3.86 | 4.79 | 5.20 | 5.95 | 6.53 | 8.05 |
| | 1:55:00 | 0.00 | 0.00 | 2.74 | 3.45 | 4.34 | 4.52 | 5.13 | 5.49 | 6.71 |
| | 2:00:00 | 0.00 | 0.00 | 2.42 | 3.15 | 3.96 | 3.99 | 4.51 | 4.70 | 5.71 |
| | 2:05:00 | 0.00 | 0.00 | 2.00 | 2.62 | 3.30 | 3.23 | 3.64 | 3.73 | 4.52 |
| | 2:10:00 | 0.00 | 0.00 | 1.63 | 2.13 | 2.69 | 2.58 | 2.90 | 2.93 | 3.53 |
| | 2:15:00 | 0.00 | 0.00 | 1.32 | 1.72 | 2.18 | 2.06 | 2.31 | 2.29 | 2.75 |
| | 2:20:00 | 0.00 | 0.00 | 1.06 | 1.39 | 1.76 | 1.64 | 1.84 | 1.79 | 2.14 |
| | 2:25:00 | 0.00 | 0.00 | 0.85 | 1.12 | 1.41 | 1.31 | 1.46 | 1.40 | 1.66 |
| | 2:30:00 | 0.00 | 0.00 | 0.68 | 0.89 | 1.11 | 1.03 | 1.15 | 1.08 | 1.28 |
| | 2:35:00 | 0.00 | 0.00 | 0.53 | 0.70 | 0.87 | 0.80 | 0.90 | 0.83 | 0.99 |
| | 2:40:00 | 0.00 | 0.00 | 0.42 | 0.54 | 0.67 | 0.62 | 0.69 | 0.65 | 0.77 |
| | 2:45:00 | 0.00 | 0.00 | 0.33 | 0.42 | 0.52 | 0.48 | 0.54 | 0.51 | 0.60 |
| | 2:50:00 | 0.00 | 0.00 | 0.26 | 0.32 | 0.41 | 0.38 | 0.42 | 0.40 | 0.47 |
| | 2:55:00 | 0.00 | 0.00 | 0.19 | 0.24 | 0.31 | 0.29 | 0.32 | 0.31 | 0.36 |
| | 3:00:00 | 0.00 | 0.00 | 0.14 | 0.18 | 0.23 | 0.22 | 0.24 | 0.23 | 0.27 |
| | 3:05:00 | 0.00 | 0.00 | 0.09 | 0.12 | 0.16 | 0.15 | 0.17 | 0.16 | 0.19 |
| | 3:10:00 | 0.00 | 0.00 | 0.06 | 0.08 | 0.10 | 0.10 | 0.11 | 0.10 | 0.12 |
| | 3:15:00 | 0.00 | 0.00 | 0.03 | 0.05 | 0.06 | 0.06 | 0.06 | 0.06 | 0.07 |
| | 3:20:00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| | 3:25:00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| | 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 |

Worksheet Protected

# Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

## LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

| | | | |
|---|---|---|---|
| ***Design Storm: 1-Hour Rain Depth | WQCV Event | 0.43 | inches |
| ***Minor Storm: 1-Hour Rain Depth | 5-Year Event | 1.50 | inches |
| ***Major Storm: 1-Hour Rain Depth | 100-Year Event | 2.52 | inches |
| Optional User Defined Storm | CUHP | | |
| (CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm | 100-Year Event | | |
| Max Intensity for Optional User Defined Storm | 0 | | |

| | |
|---|---|
| **Designer:** | **QNA** |
| **Company:** | **Terra Nova Engineering** |
| **Date:** | **September 20, 2021** |
| **Project:** | **WATERBURY FILING 1 POND 2** |
| **Location:** | **POND 2 Design Point 18 Full Spectrum Detention 19.91 Acres** |

**SITE INFORMATION (USER-INPUT)**

| **Sub-basin Identifier** | **DP 9 FSD** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Receiving Pervious Area Soil Type | Loamy Sand | | | | | | | | | | | | | |
| Total Area (ac., Sum of DCIA, UIA, RPA, & SPA) | 21.93 | | | | | | | | | | | | | |
| Directly Connected Impervious Area (DCIA, acres) | 2.58 | | | | | | | | | | | | | |
| Unconnected Impervious Area (UIA, acres) | 4.13 | | | | | | | | | | | | | |
| Receiving Pervious Area (RPA, acres) | 0.68 | | | | | | | | | | | | | |
| Separate Pervious Area (SPA, acres) | 14.55 | | | | | | | | | | | | | |
| RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP) | C | | | | | | | | | | | | | |

**CALCULATED RESULTS (OUTPUT)**

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Calculated Area (ac, check against input) | 21.935 | | | | | | | | | | | | | |
| Directly Connected Impervious Area (DCIA, %) | 11.8% | | | | | | | | | | | | | |
| Unconnected Impervious Area (UIA, %) | 18.8% | | | | | | | | | | | | | |
| Receiving Pervious Area (RPA, %) | 3.1% | | | | | | | | | | | | | |
| Separate Pervious Area (SPA, %) | 66.3% | | | | | | | | | | | | | |
| $A_R$ (RPA / UIA) | 0.164 | | | | | | | | | | | | | |
| $I_a$ Check | 0.860 | | | | | | | | | | | | | |
| f / I for WQCV Event: | 4.5 | | | | | | | | | | | | | |
| f / I for 5-Year Event: | 0.5 | | | | | | | | | | | | | |
| f / I for 100-Year Event: | 0.4 | | | | | | | | | | | | | |
| f / I for Optional User Defined Storm CUHP: | | | | | | | | | | | | | | |
| IRF for WQCV Event: | 0.84 | | | | | | | | | | | | | |
| IRF for 5-Year Event: | 0.96 | | | | | | | | | | | | | |
| IRF for 100-Year Event: | 0.97 | | | | | | | | | | | | | |
| IRF for Optional User Defined Storm CUHP: | | | | | | | | | | | | | | |
| Total Site Imperviousness: $I_{total}$ | 30.6% | | | | | | | | | | | | | |
| Effective Imperviousness for WQCV Event: | 27.6% | | | | | | | | | | | | | |
| Effective Imperviousness for 5-Year Event: | 29.8% | | | | | | | | | | | | | |
| Effective Imperviousness for 100-Year Event: | 30.0% | | | | | | | | | | | | | |
| Effective Imperviousness for Optional User Defined Storm CUHP: | | | | | | | | | | | | | | |

**LID / EFFECTIVE IMPERVIOUSNESS CREDITS**

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WQCV Event CREDIT: Reduce Detention By: | 6.2% | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| This line only for 10-Year Event | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| 100-Year Event CREDIT**: Reduce Detention By: | 1.9% | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| User Defined CUHP CREDIT: Reduce Detention By: | | | | | | | | | | | | | | |

| | |
|---|---|
| **Total Site Imperviousness:** | **30.6%** |
| **Total Site Effective Imperviousness for WQCV Event:** | **27.6%** |
| **Total Site Effective Imperviousness for 5-Year Event:** | **29.8%** |
| **Total Site Effective Imperviousness for 100-Year Event:** | **30.0%** |
| **Total Site Effective Imperviousness for Optional User Defined Storm CUHP:** | |

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.

** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.

*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

# Stormwater Detention and Infiltration Design Data Sheet

Workbook Protected  Worksheet Protected

**Stormwater Facility Name:** **Waterbury Filing No. 1 & 2 EDB Pond 3 DP 29**

**Facility Location & Jurisdiction:** **Stapleton Dr. & Bandernero Dr Intersection**

**User Input: Watershed Characteristics**

| | | |
|---|---|---|
| Watershed Slope = | 0.022 | ft/ft |
| Watershed Length = | 2265 | ft |
| Watershed Area = | 84.64 | acres |
| Watershed Imperviousness = | 47.5% | percent |
| Percentage Hydrologic Soil Group A = | 100.0% | percent |
| Percentage Hydrologic Soil Group B = | 0.0% | percent |
| Percentage Hydrologic Soil Groups C/D = | 0.0% | percent |

Location for 1-hr Rainfall Depths (use dropdown):

User Input

WQCV Treatment Method = Extended Detention

| User Defined Stage [ft] | User Defined Area [ft^2] | User Defined Stage [ft] | User Defined Discharge [cfs] |
|---|---|---|---|
| 0.00 | 100 | 0.00 | 0.00 |
| 0.25 | 2,785 | 0.25 | 0.10 |
| 0.50 | 5,470 | 0.50 | 0.14 |
| 0.75 | 8,155 | 0.75 | 0.18 |
| 1.00 | 10,840 | 1.00 | 0.20 |
| 1.25 | 13,525 | 1.25 | 0.23 |
| 1.50 | 16,210 | 1.50 | 0.25 |
| 1.75 | 18,895 | 1.75 | 0.37 |
| 2.00 | 21,580 | 2.00 | 0.43 |
| 2.25 | 26,334 | 2.25 | 0.48 |
| 2.50 | 31,088 | 2.50 | 0.53 |
| 2.75 | 35,842 | 2.75 | 0.57 |
| 3.00 | 40,596 | 3.00 | 0.60 |
| 3.25 | 45,530 | 3.25 | 0.73 |
| 3.50 | 50,105 | 3.50 | 0.81 |
| 3.75 | 54,895 | 3.75 | 0.87 |
| 4.00 | 59,613 | 4.00 | 0.93 |
| 4.25 | 62,301 | 4.25 | 0.98 |
| 4.50 | 64,989 | 4.50 | 1.03 |
| 4.75 | 67,677 | 4.75 | 4.39 |
| 5.00 | 70,365 | 5.00 | 14.71 |
| 5.25 | 73,504 | 5.25 | 28.91 |
| 5.50 | 75,742 | 5.50 | 46.13 |
| 5.75 | 78,430 | 5.75 | 60.71 |
| 6.00 | 81,118 | 6.00 | 62.35 |
| 6.25 | 82,113 | 6.25 | 74.47 |
| 6.50 | 83,503 | 6.50 | 111.77 |
| 6.75 | 84,696 | 6.75 | 163.81 |
| 7.00 | 85,888 | 7.00 | 227.74 |
| 7.25 | 87,081 | 7.25 | 302.17 |
| 7.50 | 88,274 | 7.50 | 386.27 |
| 7.75 | 89,466 | 7.75 | 479.48 |
| 8.00 | 90,659 | 8.00 | 581.41 |
| | | | |

**After completing and printing this worksheet to a pdf, go to:**
**https://maperture.digitaldataservices.com/gvh/?viewer=cswdif**
**create a new stormwater facility, and**
**attach the pdf of this worksheet to that record.**

**Routed Hydrograph Results**

| Design Storm Return Period = | WQCV | 2 Year | 5 Year | 10 Year | 50 Year | 100 Year | |
|---|---|---|---|---|---|---|---|
| One-Hour Rainfall Depth = | 0.53 | 1.19 | 1.50 | 1.75 | 2.25 | 2.52 | in |
| Calculated Runoff Volume = | 1.407 | 3.112 | 4.098 | 5.057 | 7.980 | 9.934 | acre-ft |
| OPTIONAL Override Runoff Volume = | | | | | | | acre-ft |
| Inflow Hydrograph Volume = | 1.407 | 3.112 | 4.097 | 5.051 | 7.979 | 9.930 | acre-ft |
| Time to Drain 97% of Inflow Volume = | 41.9 | 61.4 | **62.8** | 61.3 | 56.9 | 54.2 | hours |
| Time to Drain 99% of Inflow Volume = | 44.5 | 65.9 | 68.3 | 67.8 | 65.9 | **64.8** | hours |
| Maximum Ponding Depth = | 3.12 | 4.43 | 4.85 | 5.11 | 5.71 | 6.19 | ft |
| Maximum Ponded Area = | 0.98 | 1.47 | 1.58 | 1.65 | 1.79 | **1.88** | acres |
| Maximum Volume Stored = | 1.316 | 2.969 | 3.604 | 4.033 | 5.054 | 5.934 | acre-ft |

# Stormwater Detention and Infiltration Design Data Sheet

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

*MHFD-Detention, Version 4.03 (May 2020)*

**Project:** **WATERBURY**

**Basin ID:** **TEMPORARY POND 2 DP 18**

**Example Zone Configuration (Retention Pond)**

Watershed Information

| | | |
|---|---|---|
| Selected BMP Type = | **EDB** | |
| Watershed Area = | 21.93 | acres |
| Watershed Length = | 1,425 | ft |
| Watershed Length to Centroid = | 650 | ft |
| Watershed Slope = | 0.014 | ft/ft |
| Watershed Imperviousness = | 30.02% | percent |
| Percentage Hydrologic Soil Group A = | 100.0% | percent |
| Percentage Hydrologic Soil Group B = | 0.0% | percent |
| Percentage Hydrologic Soil Groups C/D = | 0.0% | percent |
| Target WQCV Drain Time = | 40.0 | hours |
| Location for 1-hr Rainfall Depths = | User Input | |

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

| | | | Optional User Overrides | |
|---|---|---|---|---|
| Water Quality Capture Volume (WQCV) = | 0.243 | acre-feet | 0.243 | acre-feet |
| Excess Urban Runoff Volume (EURV) = | 0.507 | acre-feet | 0.507 | acre-feet |
| 2-yr Runoff Volume (P1 = 1.19 in.) = | 0.337 | acre-feet | 1.19 | inches |
| 5-yr Runoff Volume (P1 = 1.5 in.) = | 0.474 | acre-feet | 1.50 | inches |
| 10-yr Runoff Volume (P1 = 1.75 in.) = | 0.597 | acre-feet | 1.75 | inches |
| 25-yr Runoff Volume (P1 = 2 in.) = | 0.949 | acre-feet | 2.00 | inches |
| 50-yr Runoff Volume (P1 = 2.25 in.) = | 1.281 | acre-feet | 2.25 | inches |
| 100-yr Runoff Volume (P1 = 2.52 in.) = | 1.730 | acre-feet | 2.52 | inches |
| 500-yr Runoff Volume (P1 = 3 in.) = | 2.464 | acre-feet | 3.00 | inches |
| Approximate 2-yr Detention Volume = | 0.414 | acre-feet | | |
| Approximate 5-yr Detention Volume = | 0.552 | acre-feet | | |
| Approximate 10-yr Detention Volume = | 0.690 | acre-feet | | |
| Approximate 25-yr Detention Volume = | 0.872 | acre-feet | | |
| Approximate 50-yr Detention Volume = | 1.008 | acre-feet | | |
| Approximate 100-yr Detention Volume = | 1.227 | acre-feet | | |

Define Zones and Basin Geometry

| | | |
|---|---|---|
| Zone 1 Volume (WQCV) = | 0.243 | acre-feet |
| Zone 2 Volume (EURV - Zone 1) = | 0.264 | acre-feet |
| Zone 3 Volume (100-year - Zones 1 & 2) = | 0.720 | acre-feet |
| Total Detention Basin Volume = | 1.227 | acre-feet |
| Initial Surcharge Volume (ISV) = | user | $ft^3$ |
| Initial Surcharge Depth (ISD) = | user | ft |
| Total Available Detention Depth ($H_{total}$) = | user | ft |
| Depth of Trickle Channel ($H_{TC}$) = | user | ft |
| Slope of Trickle Channel ($S_{TC}$) = | user | ft/ft |
| Slopes of Main Basin Sides ($S_{main}$) = | user | H:V |
| Basin Length-to-Width Ratio ($R_{L/W}$) = | user | |
| Initial Surcharge Area ($A_{ISV}$) = | user | $ft^2$ |
| Surcharge Volume Length ($L_{ISV}$) = | user | ft |
| Surcharge Volume Width ($W_{ISV}$) = | user | ft |
| Depth of Basin Floor ($H_{FLOOR}$) = | user | ft |
| Length of Basin Floor ($L_{FLOOR}$) = | user | ft |
| Width of Basin Floor ($W_{FLOOR}$) = | user | ft |
| Area of Basin Floor ($A_{FLOOR}$) = | user | $ft^2$ |
| Volume of Basin Floor ($V_{FLOOR}$) = | user | $ft^3$ |
| Depth of Main Basin ($H_{MAIN}$) = | user | ft |
| Length of Main Basin ($L_{MAIN}$) = | user | ft |
| Width of Main Basin ($W_{MAIN}$) = | user | ft |
| Area of Main Basin ($A_{MAIN}$) = | user | $ft^2$ |
| Volume of Main Basin ($V_{MAIN}$) = | user | $ft^3$ |
| Calculated Total Basin Volume ($V_{total}$) = | **user** | acre-feet |

Depth Increment = ft

| Stage - Storage Description | Stage (ft) | Optional Override Stage (ft) | Length (ft) | Width (ft) | Area ($ft^2$) | Optional Override Area ($ft^2$) | Area (acre) | Volume ($ft^3$) | Volume (ac-ft) |
|---|---|---|---|---|---|---|---|---|---|
| **Top of Micropool** | -- | 0.00 | -- | -- | -- | 100 | 0.002 | | |
| **6899.25** | -- | 0.25 | -- | -- | -- | 942 | 0.022 | 130 | 0.003 |
| **6899.50** | -- | 0.50 | -- | -- | -- | 1,784 | 0.041 | 471 | 0.011 |
| **6899.75** | -- | 0.75 | -- | -- | -- | 2,626 | 0.060 | 1,022 | 0.023 |
| **6900.00** | -- | 1.00 | -- | -- | -- | 3,468 | 0.080 | 1,784 | 0.041 |
| **6900.25** | -- | 1.25 | -- | -- | -- | 5,034 | 0.116 | 2,847 | 0.065 |
| **6900.50** | -- | 1.50 | -- | -- | -- | 6,600 | 0.152 | 4,301 | 0.099 |
| **6900.75** | -- | 1.75 | -- | -- | -- | 8,166 | 0.187 | 6,147 | 0.141 |
| **6901.00** | -- | 2.00 | -- | -- | -- | 9,732 | 0.223 | 8,384 | 0.192 |
| **6901.25** | -- | 2.25 | -- | -- | -- | 11,297 | 0.259 | 11,013 | 0.253 |
| **6901.50** | -- | 2.50 | -- | -- | -- | 12,863 | 0.295 | 14,033 | 0.322 |
| **6901.75** | -- | 2.75 | -- | -- | -- | 14,429 | 0.331 | 17,444 | 0.400 |
| **6902.00** | -- | 3.00 | -- | -- | -- | 15,995 | 0.367 | 21,247 | 0.488 |
| **6902.25** | -- | 3.25 | -- | -- | -- | 19,602 | 0.450 | 25,697 | 0.590 |
| **6902.50** | -- | 3.50 | -- | -- | -- | 23,209 | 0.533 | 31,048 | 0.713 |
| **6902.75** | -- | 3.75 | -- | -- | -- | 26,815 | 0.616 | 37,301 | 0.856 |
| **6903.00** | -- | 4.00 | -- | -- | -- | 30,422 | 0.698 | 44,456 | 1.021 |
| **6903.25** | -- | 4.25 | -- | -- | -- | 34,029 | 0.781 | 52,512 | 1.206 |
| **6903.50** | -- | 4.50 | -- | -- | -- | 37,636 | 0.864 | 61,470 | 1.411 |
| **6903.75** | -- | 4.75 | -- | -- | -- | 41,243 | 0.947 | 71,330 | 1.638 |
| **6904.00** | -- | 5.00 | -- | -- | -- | 44,850 | 1.030 | 82,092 | 1.885 |
| **6904.25** | -- | 5.25 | -- | -- | -- | 48,650 | 1.117 | 93,779 | 2.153 |
| **6904.50** | -- | 5.50 | -- | -- | -- | 52,450 | 1.204 | 106,417 | 2.443 |
| **6904.75** | -- | 5.75 | -- | -- | -- | 56,251 | 1.291 | 120,004 | 2.755 |
| **6905.00** | -- | 6.00 | -- | -- | -- | 60,051 | 1.379 | 134,542 | 3.089 |
| **6905.25** | -- | 6.25 | -- | -- | -- | 63,851 | 1.466 | 150,030 | 3.444 |
| **6905.50** | -- | 6.50 | -- | -- | -- | 67,652 | 1.553 | 166,468 | 3.822 |
| **6905.75** | -- | 6.75 | -- | -- | -- | 71,452 | 1.640 | 183,856 | 4.221 |
| **6906.00** | -- | 7.00 | -- | -- | -- | 75,252 | 1.728 | 202,194 | 4.642 |

20
15
10
5
0
Length, Width (ft.)
75600
56700
37800
18900
0
Area (sq.ft.)
0.00
2.00
4.00
6.00
8.00
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)

1.740
1.305
0.870
0.435
0.000
Area (acres)
4.660
3.495
2.330
1.165
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 4.03 (May 2020)*

**Project:** **WATERBURY**

**Basin ID:** **TEMPORARY POND 2 DP 18**

**Example Zone Configuration (Retention Pond)**

| | Estimated Stage (ft) | Estimated Volume (ac-ft) | Outlet Type |
|---|---|---|---|
| Zone 1 (WQCV) | 2.22 | 0.243 | Orifice Plate |
| Zone 2 (EURV) | 3.06 | 0.264 | Orifice Plate |
| Zone 3 (100-year) | 4.28 | 0.720 | Weir&Pipe (Restrict) |
| Total (all zones) | | 1.227 | |

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

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

Calculated Parameters for Underdrain

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

| | | | | | |
|---|---|---|---|---|---|
| Invert of Lowest Orifice = | 0.00 | ft (relative to basin bottom at Stage = 0 ft) | WQ Orifice Area per Row = | 9.306E-03 | $ft^2$ |
| Depth at top of Zone using Orifice Plate = | 3.06 | ft (relative to basin bottom at Stage = 0 ft) | Elliptical Half-Width = | N/A | feet |
| Orifice Plate: Orifice Vertical Spacing = | 12.20 | inches | Elliptical Slot Centroid = | N/A | feet |
| Orifice Plate: Orifice Area per Row = | 1.34 | sq. inches (diameter = 1-5/16 inches) | Elliptical Slot Area = | N/A | $ft^2$ |

Calculated Parameters for Plate

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

| | Row 1 (required) | Row 2 (optional) | Row 3 (optional) | Row 4 (optional) | Row 5 (optional) | Row 6 (optional) | Row 7 (optional) | Row 8 (optional) |
|---|---|---|---|---|---|---|---|---|
| Stage of Orifice Centroid (ft) | 0.00 | 1.02 | 2.04 | | | | | |
| Orifice Area (sq. inches) | 1.34 | 1.34 | 1.34 | | | | | |

| | 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 = | 3.06 | N/A | ft (relative to basin bottom at Stage = 0 ft) |
| Overflow Weir Front Edge Length = | 4.00 | N/A | feet |
| Overflow Weir Grate Slope = | 0.00 | N/A | H:V |
| Horiz. Length of Weir Sides = | 4.00 | N/A | feet |
| Overflow Grate Open Area % = | 70% | N/A | %, grate open area/total area |
| Debris Clogging % = | 50% | N/A | % |

Calculated Parameters for Overflow Weir

| | Zone 3 Weir | Not Selected | |
|---|---|---|---|
| Height of Grate Upper Edge, $H_t$ = | 3.06 | N/A | feet |
| Overflow Weir Slope Length = | 4.00 | N/A | feet |
| Grate Open Area / 100-yr Orifice Area = | 8.95 | N/A | |
| Overflow Grate Open Area w/o Debris = | 11.20 | N/A | $ft^2$ |
| Overflow Grate Open Area w/ Debris = | 5.60 | 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 = | 18.00 | N/A | inches |
| Restrictor Plate Height Above Pipe Invert = | 12.00 | | inches |

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

| | Zone 3 Restrictor | Not Selected | |
|---|---|---|---|
| Outlet Orifice Area = | 1.25 | N/A | $ft^2$ |
| Outlet Orifice Centroid = | 0.56 | N/A | feet |
| Half-Central Angle of Restrictor Plate on Pipe = | 1.91 | N/A | radians |

User Input: Emergency Spillway (Rectangular or Trapezoidal)

| | | | | | |
|---|---|---|---|---|---|
| Spillway Invert Stage= | 5.00 | ft (relative to basin bottom at Stage = 0 ft) | Spillway Design Flow Depth= | 0.47 | feet |
| Spillway Crest Length = | 20.00 | feet | Stage at Top of Freeboard = | 6.47 | feet |
| Spillway End Slopes = | 3.00 | H:V | Basin Area at Top of Freeboard = | 1.54 | acres |
| Freeboard above Max Water Surface = | 1.00 | feet | Basin Volume at Top of Freeboard = | 3.78 | acre-ft |

Calculated Parameters for Spillway

Routed Hydrograph Results

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

| Design Storm Return Period = | WQCV | EURV | 2 Year | 5 Year | 10 Year | 25 Year | 50 Year | 100 Year | 500 Year |
|---|---|---|---|---|---|---|---|---|---|
| One-Hour Rainfall Depth (in) = | N/A | N/A | 1.19 | 1.50 | 1.75 | 2.00 | 2.25 | 2.52 | 3.00 |
| CUHP Runoff Volume (acre-ft) = | 0.243 | 0.507 | 0.337 | 0.474 | 0.597 | 0.949 | 1.281 | 1.730 | 2.464 |
| Inflow Hydrograph Volume (acre-ft) = | N/A | N/A | 0.337 | 0.474 | 0.597 | 0.949 | 1.281 | 1.730 | 2.464 |
| CUHP Predevelopment Peak Q (cfs) = | N/A | N/A | 0.1 | 0.3 | 0.4 | 3.8 | 7.5 | 12.3 | 19.8 |
| OPTIONAL Override Predevelopment Peak Q (cfs) = | N/A | N/A | | | | | | | |
| Predevelopment Unit Peak Flow, q (cfs/acre) = | N/A | N/A | 0.01 | 0.01 | 0.02 | 0.17 | 0.34 | 0.56 | 0.90 |
| Peak Inflow Q (cfs) = | N/A | N/A | 3.5 | 5.0 | 6.2 | 11.0 | 15.3 | 20.7 | 29.1 |
| Peak Outflow Q (cfs) = | 0.1 | 0.2 | 0.2 | 0.2 | 0.7 | 4.4 | 8.0 | 10.6 | 11.6 |
| Ratio Peak Outflow to Predevelopment Q = | N/A | N/A | N/A | 0.6 | 1.8 | 1.2 | 1.1 | 0.9 | 0.6 |
| Structure Controlling Flow = | Plate | Overflow Weir 1 | Plate | Plate | Overflow Weir 1 | Overflow Weir 1 | Overflow Weir 1 | Outlet Plate 1 | Outlet Plate 1 |
| Max Velocity through Grate 1 (fps) = | N/A | N/A | N/A | N/A | 0.0 | 0.4 | 0.7 | 0.9 | 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 | 54 | 45 | 53 | 57 | 54 | 51 | 48 | 44 |
| Time to Drain 99% of Inflow Volume (hours) = | **40** | 58 | 48 | 57 | 62 | 60 | 59 | 58 | 55 |
| Maximum Ponding Depth (ft) = | 2.22 | 3.06 | 2.45 | 2.86 | 3.12 | 3.30 | 3.43 | 3.66 | 4.26 |
| Area at Maximum Ponding Depth (acres) = | 0.26 | 0.39 | 0.29 | 0.35 | 0.41 | 0.47 | 0.51 | 0.59 | 0.78 |
| Maximum Volume Stored (acre-ft) = | 0.245 | 0.510 | 0.305 | 0.434 | 0.534 | 0.613 | 0.676 | 0.802 | 1.213 |

# 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.

| | SOURCE | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP |
|---|---|---|---|---|---|---|---|---|---|---|
| Time Interval | 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 | 0.03 | 0.00 | 0.07 |
| | 0:15:00 | 0.00 | 0.00 | 0.23 | 0.37 | 0.46 | 0.31 | 0.39 | 0.38 | 0.52 |
| | 0:20:00 | 0.00 | 0.00 | 0.84 | 1.11 | 1.31 | 0.83 | 0.98 | 1.04 | 1.30 |
| | 0:25:00 | 0.00 | 0.00 | 2.40 | 3.66 | 4.73 | 2.23 | 2.87 | 3.24 | 4.42 |
| | 0:30:00 | 0.00 | 0.00 | 3.39 | 4.92 | 6.15 | 7.31 | 10.40 | 12.97 | 18.83 |
| | 0:35:00 | 0.00 | 0.00 | 3.46 | 4.97 | 6.23 | 10.35 | 14.30 | 19.22 | 27.01 |
| | 0:40:00 | 0.00 | 0.00 | 3.31 | 4.69 | 5.84 | 11.03 | 15.31 | 20.70 | 29.14 |
| | 0:45:00 | 0.00 | 0.00 | 3.05 | 4.32 | 5.38 | 10.53 | 14.52 | 20.17 | 28.62 |
| | 0:50:00 | 0.00 | 0.00 | 2.82 | 4.01 | 4.95 | 9.91 | 13.57 | 18.77 | 26.95 |
| | 0:55:00 | 0.00 | 0.00 | 2.62 | 3.70 | 4.57 | 9.06 | 12.37 | 17.27 | 24.77 |
| | 1:00:00 | 0.00 | 0.00 | 2.45 | 3.44 | 4.25 | 8.28 | 11.27 | 15.90 | 22.81 |
| | 1:05:00 | 0.00 | 0.00 | 2.31 | 3.23 | 4.02 | 7.63 | 10.36 | 14.75 | 21.31 |
| | 1:10:00 | 0.00 | 0.00 | 2.15 | 3.04 | 3.82 | 6.98 | 9.46 | 13.37 | 19.34 |
| | 1:15:00 | 0.00 | 0.00 | 1.98 | 2.82 | 3.63 | 6.37 | 8.64 | 12.07 | 17.47 |
| | 1:20:00 | 0.00 | 0.00 | 1.82 | 2.58 | 3.34 | 5.74 | 7.76 | 10.73 | 15.50 |
| | 1:25:00 | 0.00 | 0.00 | 1.66 | 2.35 | 3.01 | 5.14 | 6.90 | 9.45 | 13.61 |
| | 1:30:00 | 0.00 | 0.00 | 1.52 | 2.14 | 2.72 | 4.53 | 6.05 | 8.23 | 11.81 |
| | 1:35:00 | 0.00 | 0.00 | 1.42 | 2.02 | 2.53 | 3.99 | 5.30 | 7.16 | 10.27 |
| | 1:40:00 | 0.00 | 0.00 | 1.36 | 1.89 | 2.38 | 3.62 | 4.79 | 6.40 | 9.17 |
| | 1:45:00 | 0.00 | 0.00 | 1.30 | 1.77 | 2.25 | 3.33 | 4.39 | 5.82 | 8.29 |
| | 1:50:00 | 0.00 | 0.00 | 1.25 | 1.66 | 2.12 | 3.08 | 4.04 | 5.31 | 7.52 |
| | 1:55:00 | 0.00 | 0.00 | 1.15 | 1.55 | 1.99 | 2.84 | 3.71 | 4.83 | 6.81 |
| | 2:00:00 | 0.00 | 0.00 | 1.06 | 1.44 | 1.83 | 2.61 | 3.39 | 4.38 | 6.14 |
| | 2:05:00 | 0.00 | 0.00 | 0.93 | 1.26 | 1.60 | 2.30 | 2.98 | 3.84 | 5.37 |
| | 2:10:00 | 0.00 | 0.00 | 0.80 | 1.09 | 1.38 | 2.00 | 2.57 | 3.31 | 4.63 |
| | 2:15:00 | 0.00 | 0.00 | 0.68 | 0.92 | 1.16 | 1.70 | 2.18 | 2.81 | 3.91 |
| | 2:20:00 | 0.00 | 0.00 | 0.57 | 0.76 | 0.96 | 1.41 | 1.80 | 2.31 | 3.21 |
| | 2:25:00 | 0.00 | 0.00 | 0.46 | 0.62 | 0.78 | 1.14 | 1.44 | 1.84 | 2.54 |
| | 2:30:00 | 0.00 | 0.00 | 0.36 | 0.48 | 0.61 | 0.88 | 1.09 | 1.37 | 1.88 |
| | 2:35:00 | 0.00 | 0.00 | 0.28 | 0.37 | 0.48 | 0.64 | 0.77 | 0.94 | 1.27 |
| | 2:40:00 | 0.00 | 0.00 | 0.23 | 0.30 | 0.39 | 0.45 | 0.54 | 0.64 | 0.86 |
| | 2:45:00 | 0.00 | 0.00 | 0.19 | 0.26 | 0.33 | 0.34 | 0.40 | 0.46 | 0.62 |
| | 2:50:00 | 0.00 | 0.00 | 0.16 | 0.21 | 0.28 | 0.27 | 0.32 | 0.35 | 0.46 |
| | 2:55:00 | 0.00 | 0.00 | 0.14 | 0.18 | 0.23 | 0.22 | 0.25 | 0.26 | 0.34 |
| | 3:00:00 | 0.00 | 0.00 | 0.11 | 0.15 | 0.19 | 0.17 | 0.20 | 0.20 | 0.26 |
| | 3:05:00 | 0.00 | 0.00 | 0.10 | 0.12 | 0.16 | 0.14 | 0.16 | 0.16 | 0.19 |
| | 3:10:00 | 0.00 | 0.00 | 0.08 | 0.10 | 0.13 | 0.12 | 0.13 | 0.12 | 0.15 |
| | 3:15:00 | 0.00 | 0.00 | 0.07 | 0.08 | 0.11 | 0.09 | 0.11 | 0.10 | 0.12 |
| | 3:20:00 | 0.00 | 0.00 | 0.05 | 0.07 | 0.08 | 0.08 | 0.09 | 0.08 | 0.09 |
| | 3:25:00 | 0.00 | 0.00 | 0.04 | 0.05 | 0.07 | 0.06 | 0.07 | 0.06 | 0.07 |
| | 3:30:00 | 0.00 | 0.00 | 0.03 | 0.04 | 0.05 | 0.05 | 0.05 | 0.05 | 0.06 |
| | 3:35:00 | 0.00 | 0.00 | 0.02 | 0.03 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| | 3:40:00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| | 3:45:00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| | 3:50:00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| | 3:55:00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| | 4:00:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 4:05:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 4:10:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 4:15:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 4:20:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 4:25:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 4:30:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 4:35:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 4:40:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 4:45:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 4:50:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 4:55:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 5:00:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 5:05:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 5:10:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 5:15:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 5:20:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 5:25:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 5:30:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 5:35:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 5:40:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 5:45:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 5:50:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 5:55:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 6:00:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

Worksheet Protected

# Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

## LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

| | | | |
|---|---|---|---|
| ***Design Storm: 1-Hour Rain Depth | WQCV Event | 0.43 | inches |
| ***Minor Storm: 1-Hour Rain Depth | 5-Year Event | 1.50 | inches |
| ***Major Storm: 1-Hour Rain Depth | 100-Year Event | 2.52 | inches |
| Optional User Defined Storm | CUHP | | |
| (CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm | 100-Year Event | | |
| Max Intensity for Optional User Defined Storm | 0 | | |

| | |
|---|---|
| **Designer:** | **QNA** |
| **Company:** | **Terra Nova Engineering** |
| **Date:** | **September 20, 2021** |
| **Project:** | **WATERBURY FILING 1 POND 2** |
| **Location:** | **POND 3 Design Point 29 Full Spectrum Detention 76.61 Acres** |

**SITE INFORMATION (USER-INPUT)**

| **Sub-basin Identifier** | **DP 9 FSD** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Receiving Pervious Area Soil Type | Loamy Sand | | | | | | | | | | | | | |
| Total Area (ac., Sum of DCIA, UIA, RPA, & SPA) | 84.64 | | | | | | | | | | | | | |
| Directly Connected Impervious Area (DCIA, acres) | 19.50 | | | | | | | | | | | | | |
| Unconnected Impervious Area (UIA, acres) | 22.09 | | | | | | | | | | | | | |
| Receiving Pervious Area (RPA, acres) | 11.31 | | | | | | | | | | | | | |
| Separate Pervious Area (SPA, acres) | 31.74 | | | | | | | | | | | | | |
| RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP) | C | | | | | | | | | | | | | |

**CALCULATED RESULTS (OUTPUT)**

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Calculated Area (ac, check against input) | 84.645 | | | | | | | | | | | | | |
| Directly Connected Impervious Area (DCIA, %) | 23.0% | | | | | | | | | | | | | |
| Unconnected Impervious Area (UIA, %) | 26.1% | | | | | | | | | | | | | |
| Receiving Pervious Area (RPA, %) | 13.4% | | | | | | | | | | | | | |
| Separate Pervious Area (SPA, %) | 37.5% | | | | | | | | | | | | | |
| $A_R$ (RPA / UIA) | 0.512 | | | | | | | | | | | | | |
| $I_a$ Check | 0.660 | | | | | | | | | | | | | |
| f / I for WQCV Event: | 4.5 | | | | | | | | | | | | | |
| f / I for 5-Year Event: | 0.5 | | | | | | | | | | | | | |
| f / I for 100-Year Event: | 0.4 | | | | | | | | | | | | | |
| f / I for Optional User Defined Storm CUHP: | | | | | | | | | | | | | | |
| IRF for WQCV Event: | 0.70 | | | | | | | | | | | | | |
| IRF for 5-Year Event: | 0.92 | | | | | | | | | | | | | |
| IRF for 100-Year Event: | 0.94 | | | | | | | | | | | | | |
| IRF for Optional User Defined Storm CUHP: | | | | | | | | | | | | | | |
| Total Site Imperviousness: $I_{total}$ | 49.1% | | | | | | | | | | | | | |
| Effective Imperviousness for WQCV Event: | 41.2% | | | | | | | | | | | | | |
| Effective Imperviousness for 5-Year Event: | 47.0% | | | | | | | | | | | | | |
| Effective Imperviousness for 100-Year Event: | 47.5% | | | | | | | | | | | | | |
| Effective Imperviousness for Optional User Defined Storm CUHP: | | | | | | | | | | | | | | |

**LID / EFFECTIVE IMPERVIOUSNESS CREDITS**

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WQCV Event CREDIT: Reduce Detention By: | 10.2% | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| This line only for 10-Year Event | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| 100-Year Event CREDIT**: Reduce Detention By: | 3.3% | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| User Defined CUHP CREDIT: Reduce Detention By: | | | | | | | | | | | | | | |

| | |
|---|---|
| **Total Site Imperviousness:** | **49.1%** |
| **Total Site Effective Imperviousness for WQCV Event:** | **41.2%** |
| **Total Site Effective Imperviousness for 5-Year Event:** | **47.0%** |
| **Total Site Effective Imperviousness for 100-Year Event:** | **47.5%** |
| **Total Site Effective Imperviousness for Optional User Defined Storm CUHP:** | |

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.

** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.

*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

# Stormwater Detention and Infiltration Design Data Sheet

Workbook Protected Worksheet Protected

**Stormwater Facility Name:** **Waterbury Filing No. 1 & 2 EDB Pond 2 DP 18**

**Facility Location & Jurisdiction:** **Stapleton Dr. & Bandernero Dr Intersection**

**User Input: Watershed Characteristics**

| | | |
|---|---|---|
| Watershed Slope = | 0.014 | ft/ft |
| Watershed Length = | 1425 | ft |
| Watershed Area = | 21.93 | acres |
| Watershed Imperviousness = | 30.0% | percent |
| Percentage Hydrologic Soil Group A = | 100.0% | percent |
| Percentage Hydrologic Soil Group B = | 0.0% | percent |
| Percentage Hydrologic Soil Groups C/D = | 0.0% | percent |

Location for 1-hr Rainfall Depths (use dropdown):

User Input

WQCV Treatment Method = Extended Detention

| User Defined Stage [ft] | User Defined Area [ft^2] | User Defined Stage [ft] | User Defined Discharge [cfs] |
|---|---|---|---|
| 0.00 | 100 | 0.00 | 0.00 |
| 0.25 | 942 | 0.25 | 0.02 |
| 0.50 | 1,784 | 0.50 | 0.03 |
| 0.75 | 2,626 | 0.75 | 0.04 |
| 1.00 | 3,468 | 1.00 | 0.04 |
| 1.25 | 5,034 | 1.25 | 0.07 |
| 1.50 | 6,600 | 1.50 | 0.09 |
| 1.75 | 8,166 | 1.75 | 0.10 |
| 2.00 | 9,732 | 2.00 | 0.11 |
| 2.25 | 11,297 | 2.25 | 0.14 |
| 2.50 | 12,863 | 2.50 | 0.16 |
| 2.75 | 14,429 | 2.75 | 0.17 |
| 3.00 | 15,995 | 3.00 | 0.18 |
| 3.25 | 19,602 | 3.25 | 3.05 |
| 3.50 | 23,209 | 3.50 | 10.28 |
| 3.75 | 26,815 | 3.75 | 10.76 |
| 4.00 | 30,422 | 4.00 | 11.17 |
| 4.25 | 34,029 | 4.25 | 11.57 |
| 4.50 | 37,636 | 4.50 | 11.96 |
| 4.75 | 41,243 | 4.75 | 12.33 |
| 5.00 | 44,850 | 5.00 | 12.70 |
| 5.25 | 48,650 | 5.25 | 20.77 |
| 5.50 | 52,450 | 5.50 | 35.88 |
| 5.75 | 56,251 | 5.75 | 56.20 |
| 6.00 | 60,051 | 6.00 | 81.25 |
| 6.25 | 63,851 | 6.25 | 110.80 |
| 6.50 | 67,652 | 6.50 | 144.75 |
| 6.75 | 71,452 | 6.75 | 183.06 |
| 7.00 | 75,252 | 7.00 | 225.73 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

**After completing and printing this worksheet to a pdf, go to:**
**https://maperture.digitaldataservices.com/gvh/?viewer=cswdif**
**create a new stormwater facility, and**
**attach the pdf of this worksheet to that record.**

**Routed Hydrograph Results**

| Design Storm Return Period = | WQCV | 2 Year | 5 Year | 10 Year | 50 Year | 100 Year | |
|---|---|---|---|---|---|---|---|
| One-Hour Rainfall Depth = | 0.53 | 1.19 | 1.50 | 1.75 | 2.25 | 2.52 | in |
| Calculated Runoff Volume = | 0.277 | 0.442 | 0.589 | 0.741 | 1.343 | 1.830 | acre-ft |
| OPTIONAL Override Runoff Volume = | | | | | | | acre-ft |
| Inflow Hydrograph Volume = | 0.276 | 0.442 | 0.588 | 0.741 | 1.343 | 1.829 | acre-ft |
| Time to Drain 97% of Inflow Volume = | 41.1 | 51.3 | **55.1** | 53.9 | 48.7 | 45.2 | hours |
| Time to Drain 99% of Inflow Volume = | 43.9 | 55.1 | 59.9 | 59.3 | 57.1 | **55.5** | hours |
| Maximum Ponding Depth = | 2.26 | 2.79 | 3.08 | 3.23 | 3.53 | 3.94 | ft |
| Maximum Ponded Area = | 0.26 | 0.34 | 0.39 | 0.44 | 0.54 | **0.68** | acres |
| Maximum Volume Stored = | 0.254 | 0.413 | 0.516 | 0.580 | 0.727 | 0.975 | acre-ft |

# Stormwater Detention and Infiltration Design Data Sheet

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

*MHFD-Detention, Version 4.03 (May 2020)*

**Project:** **WATERBURY**

**Basin ID:** **POND 3 DP 29**

**Example Zone Configuration (Retention Pond)**

Watershed Information

| | | |
|---|---|---|
| Selected BMP Type = | **EDB** | |
| Watershed Area = | 84.64 | acres |
| Watershed Length = | 2,265 | ft |
| Watershed Length to Centroid = | 850 | ft |
| Watershed Slope = | 0.022 | ft/ft |
| Watershed Imperviousness = | 47.50% | percent |
| Percentage Hydrologic Soil Group A = | 100.0% | percent |
| Percentage Hydrologic Soil Group B = | 0.0% | percent |
| Percentage Hydrologic Soil Groups C/D = | 0.0% | percent |
| Target WQCV Drain Time = | 40.0 | hours |
| Location for 1-hr Rainfall Depths = | User Input | |

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

| | | | Optional User Overrides | |
|---|---|---|---|---|
| Water Quality Capture Volume (WQCV) = | 1.200 | acre-feet | 1.200 | acre-feet |
| Excess Urban Runoff Volume (EURV) = | 3.200 | acre-feet | 3.200 | acre-feet |
| 2-yr Runoff Volume (P1 = 1.19 in.) = | 2.401 | acre-feet | 1.19 | inches |
| 5-yr Runoff Volume (P1 = 1.5 in.) = | 3.253 | acre-feet | 1.50 | inches |
| 10-yr Runoff Volume (P1 = 1.75 in.) = | 3.937 | acre-feet | 1.75 | inches |
| 25-yr Runoff Volume (P1 = 2 in.) = | 5.380 | acre-feet | 2.00 | inches |
| 50-yr Runoff Volume (P1 = 2.25 in.) = | 6.757 | acre-feet | 2.25 | inches |
| 100-yr Runoff Volume (P1 = 2.52 in.) = | 8.573 | acre-feet | 2.52 | inches |
| 500-yr Runoff Volume (P1 = 3 in.) = | 11.534 | acre-feet | 3.00 | inches |
| Approximate 2-yr Detention Volume = | 2.932 | acre-feet | | |
| Approximate 5-yr Detention Volume = | 3.865 | acre-feet | | |
| Approximate 10-yr Detention Volume = | 4.728 | acre-feet | | |
| Approximate 25-yr Detention Volume = | 5.803 | acre-feet | | |
| Approximate 50-yr Detention Volume = | 6.495 | acre-feet | | |
| Approximate 100-yr Detention Volume = | 7.365 | acre-feet | | |

Define Zones and Basin Geometry

| | | |
|---|---|---|
| Zone 1 Volume (WQCV) = | 1.200 | acre-feet |
| Zone 2 Volume (EURV - Zone 1) = | 2.000 | acre-feet |
| Zone 3 Volume (100-year - Zones 1 & 2) = | 4.165 | acre-feet |
| Total Detention Basin Volume = | 7.365 | acre-feet |
| Initial Surcharge Volume (ISV) = | user | $ft^3$ |
| Initial Surcharge Depth (ISD) = | user | ft |
| Total Available Detention Depth ($H_{total}$) = | user | ft |
| Depth of Trickle Channel ($H_{TC}$) = | user | ft |
| Slope of Trickle Channel ($S_{TC}$) = | user | ft/ft |
| Slopes of Main Basin Sides ($S_{main}$) = | user | H:V |
| Basin Length-to-Width Ratio ($R_{L/W}$) = | user | |
| Initial Surcharge Area ($A_{ISV}$) = | user | $ft^2$ |
| Surcharge Volume Length ($L_{ISV}$) = | user | ft |
| Surcharge Volume Width ($W_{ISV}$) = | user | ft |
| Depth of Basin Floor ($H_{FLOOR}$) = | user | ft |
| Length of Basin Floor ($L_{FLOOR}$) = | user | ft |
| Width of Basin Floor ($W_{FLOOR}$) = | user | ft |
| Area of Basin Floor ($A_{FLOOR}$) = | user | $ft^2$ |
| Volume of Basin Floor ($V_{FLOOR}$) = | user | $ft^3$ |
| Depth of Main Basin ($H_{MAIN}$) = | user | ft |
| Length of Main Basin ($L_{MAIN}$) = | user | ft |
| Width of Main Basin ($W_{MAIN}$) = | user | ft |
| Area of Main Basin ($A_{MAIN}$) = | user | $ft^2$ |
| Volume of Main Basin ($V_{MAIN}$) = | user | $ft^3$ |
| Calculated Total Basin Volume ($V_{total}$) = | **user** | acre-feet |

Depth Increment = ft

| Stage - Storage Description | Stage (ft) | Optional Override Stage (ft) | Length (ft) | Width (ft) | Area ($ft^2$) | Optional Override Area ($ft^2$) | Area (acre) | Volume ($ft^3$) | Volume (ac-ft) |
|---|---|---|---|---|---|---|---|---|---|
| **Top of Micropool** | -- | 0.00 | -- | -- | -- | 100 | 0.002 | | |
| **6922.25** | -- | 0.25 | -- | -- | -- | 2,785 | 0.064 | 360 | 0.008 |
| **6922.50** | -- | 0.50 | -- | -- | -- | 5,470 | 0.126 | 1,392 | 0.032 |
| **6922.75** | -- | 0.75 | -- | -- | -- | 8,155 | 0.187 | 3,095 | 0.071 |
| **6923.00** | -- | 1.00 | -- | -- | -- | 10,840 | 0.249 | 5,470 | 0.126 |
| **6923.25** | -- | 1.25 | -- | -- | -- | 13,525 | 0.310 | 8,515 | 0.195 |
| **6923.50** | -- | 1.50 | -- | -- | -- | 16,210 | 0.372 | 12,232 | 0.281 |
| **6923.75** | -- | 1.75 | -- | -- | -- | 18,895 | 0.434 | 16,620 | 0.382 |
| **6924.00** | -- | 2.00 | -- | -- | -- | 21,580 | 0.495 | 21,680 | 0.498 |
| **6924.25** | -- | 2.25 | -- | -- | -- | 26,334 | 0.605 | 27,669 | 0.635 |
| **6924.50** | -- | 2.50 | -- | -- | -- | 31,088 | 0.714 | 34,847 | 0.800 |
| **6924.75** | -- | 2.75 | -- | -- | -- | 35,842 | 0.823 | 43,213 | 0.992 |
| **6925.00** | -- | 3.00 | -- | -- | -- | 40,596 | 0.932 | 52,768 | 1.211 |
| **6925.25** | -- | 3.25 | -- | -- | -- | 45,530 | 1.045 | 63,533 | 1.459 |
| **6925.50** | -- | 3.50 | -- | -- | -- | 50,105 | 1.150 | 75,488 | 1.733 |
| **6925.75** | -- | 3.75 | -- | -- | -- | 54,895 | 1.260 | 88,613 | 2.034 |
| **6926.00** | -- | 4.00 | -- | -- | -- | 59,613 | 1.369 | 102,926 | 2.363 |
| **6926.25** | -- | 4.25 | -- | -- | -- | 62,301 | 1.430 | 118,166 | 2.713 |
| **6926.50** | -- | 4.50 | -- | -- | -- | 64,989 | 1.492 | 134,077 | 3.078 |
| **6926.75** | -- | 4.75 | -- | -- | -- | 67,677 | 1.554 | 150,660 | 3.459 |
| **6927.00** | -- | 5.00 | -- | -- | -- | 70,365 | 1.615 | 167,915 | 3.855 |
| **6927.25** | -- | 5.25 | -- | -- | -- | 73,504 | 1.687 | 185,899 | 4.268 |
| **6927.50** | -- | 5.50 | -- | -- | -- | 75,742 | 1.739 | 204,555 | 4.696 |
| **6927.75** | -- | 5.75 | -- | -- | -- | 78,430 | 1.801 | 223,826 | 5.138 |
| **6928.00** | -- | 6.00 | -- | -- | -- | 81,118 | 1.862 | 243,770 | 5.596 |
| **6928.25** | -- | 6.25 | -- | -- | -- | 82,113 | 1.885 | 264,174 | 6.065 |
| **6928.50** | -- | 6.50 | -- | -- | -- | 83,503 | 1.917 | 284,876 | 6.540 |
| **6928.75** | -- | 6.75 | -- | -- | -- | 84,696 | 1.944 | 305,900 | 7.023 |
| **6929.00** | -- | 7.00 | -- | -- | -- | 85,888 | 1.972 | 327,223 | 7.512 |
| **6929.25** | -- | 7.25 | -- | -- | -- | 87,081 | 1.999 | 348,845 | 8.008 |
| **6929.50** | -- | 7.50 | -- | -- | -- | 88,274 | 2.026 | 370,764 | 8.512 |
| **6929.75** | -- | 7.75 | -- | -- | -- | 89,466 | 2.054 | 392,981 | 9.022 |
| **6930.00** | -- | 8.00 | -- | -- | -- | 90,659 | 2.081 | 415,497 | 9.538 |

20
15
10
5
0
Length, Width (ft.)
90800
68100
45400
22700
0
Area (sq.ft.)
0.00
2.00
4.00
6.00
8.00
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)

2.100
1.575
1.050
0.525
0.000
Area (acres)
9.540
7.155
4.770
2.385
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 4.03 (May 2020)*

**Project:** **WATERBURY**

**Basin ID:** **POND 3 DP 29**

**Example Zone Configuration (Retention Pond)**

| | Estimated Stage (ft) | Estimated Volume (ac-ft) | Outlet Type |
|---|---|---|---|
| Zone 1 (WQCV) | 2.99 | 1.200 | Orifice Plate |
| Zone 2 (EURV) | 4.59 | 2.000 | Orifice Plate |
| Zone 3 (100-year) | 6.93 | 4.165 | Weir&Pipe (Restrict) |
| Total (all zones) | | 7.365 | |

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 Area = | | $ft^2$ |
| Underdrain Orifice Diameter = | | inches | Underdrain Orifice Centroid = | | feet |

Calculated Parameters for Underdrain

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

| | | | | | |
|---|---|---|---|---|---|
| Invert of Lowest Orifice = | 0.00 | ft (relative to basin bottom at Stage = 0 ft) | WQ Orifice Area per Row = | 4.250E-02 | $ft^2$ |
| Depth at top of Zone using Orifice Plate = | 4.59 | ft (relative to basin bottom at Stage = 0 ft) | Elliptical Half-Width = | N/A | feet |
| Orifice Plate: Orifice Vertical Spacing = | 18.40 | inches | Elliptical Slot Centroid = | N/A | feet |
| Orifice Plate: Orifice Area per Row = | 6.12 | sq. inches (use rectangular openings) | Elliptical Slot Area = | N/A | $ft^2$ |

Calculated Parameters for Plate

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

| | Row 1 (required) | Row 2 (optional) | Row 3 (optional) | Row 4 (optional) | Row 5 (optional) | Row 6 (optional) | Row 7 (optional) | Row 8 (optional) |
|---|---|---|---|---|---|---|---|---|
| Stage of Orifice Centroid (ft) | 0.00 | 1.53 | 3.06 | | | | | |
| Orifice Area (sq. inches) | 6.12 | 6.12 | 6.12 | | | | | |

| | 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 = | 4.59 | N/A | ft (relative to basin bottom at Stage = 0 ft) |
| Overflow Weir Front Edge Length = | 6.00 | N/A | feet |
| Overflow Weir Grate Slope = | 0.00 | N/A | H:V |
| Horiz. Length of Weir Sides = | 6.00 | N/A | feet |
| Overflow Grate Open Area % = | 70% | N/A | %, grate open area/total area |
| Debris Clogging % = | 50% | N/A | % |

Calculated Parameters for Overflow Weir

| | Zone 3 Weir | Not Selected | |
|---|---|---|---|
| Height of Grate Upper Edge, $H_t$ = | 4.59 | N/A | feet |
| Overflow Weir Slope Length = | 6.00 | N/A | feet |
| Grate Open Area / 100-yr Orifice Area = | 4.27 | N/A | |
| Overflow Grate Open Area w/o Debris = | 25.20 | N/A | $ft^2$ |
| Overflow Grate Open Area w/ Debris = | 12.60 | 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 = | 0.10 | 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 = | 28.00 | | inches |

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

| | Zone 3 Restrictor | Not Selected | |
|---|---|---|---|
| Outlet Orifice Area = | 5.90 | N/A | $ft^2$ |
| Outlet Orifice Centroid = | 1.28 | N/A | feet |
| Half-Central Angle of Restrictor Plate on Pipe = | 2.16 | N/A | radians |

User Input: Emergency Spillway (Rectangular or Trapezoidal)

| | | |
|---|---|---|
| Spillway Invert Stage= | 6.00 | ft (relative to basin bottom at Stage = 0 ft) |
| Spillway Crest Length = | 60.00 | feet |
| Spillway End Slopes = | 3.00 | H:V |
| Freeboard above Max Water Surface = | 1.00 | feet |

Calculated Parameters for Spillway

| | | |
|---|---|---|
| Spillway Design Flow Depth= | 0.88 | feet |
| Stage at Top of Freeboard = | 7.88 | feet |
| Basin Area at Top of Freeboard = | 2.07 | acres |
| Basin Volume at Top of Freeboard = | 9.29 | 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 | 1.19 | 1.50 | 1.75 | 2.00 | 2.25 | 2.52 | 3.00 |
| CUHP Runoff Volume (acre-ft) = | 1.200 | 3.200 | 2.401 | 3.253 | 3.937 | 5.380 | 6.757 | 8.573 | 11.534 |
| Inflow Hydrograph Volume (acre-ft) = | N/A | N/A | 2.401 | 3.253 | 3.937 | 5.380 | 6.757 | 8.573 | 11.534 |
| CUHP Predevelopment Peak Q (cfs) = | N/A | N/A | 0.8 | 1.6 | 2.2 | 20.4 | 40.4 | 66.1 | 105.3 |
| OPTIONAL Override Predevelopment Peak Q (cfs) = | N/A | N/A | | | | | | | |
| Predevelopment Unit Peak Flow, q (cfs/acre) = | N/A | N/A | 0.01 | 0.02 | 0.03 | 0.24 | 0.48 | 0.78 | 1.24 |
| Peak Inflow Q (cfs) = | N/A | N/A | 36.6 | 51.0 | 62.3 | 92.6 | 120.1 | 155.2 | 209.7 |
| Peak Outflow Q (cfs) = | 0.6 | 1.0 | 0.9 | 1.0 | 5.9 | 21.2 | 38.0 | 60.7 | 99.9 |
| Ratio Peak Outflow to Predevelopment Q = | N/A | N/A | N/A | 0.7 | 2.7 | 1.0 | 0.9 | 0.9 | 0.9 |
| Structure Controlling Flow = | Plate | Overflow Weir 1 | Plate | Plate | Overflow Weir 1 | Overflow Weir 1 | Overflow Weir 1 | Outlet Plate 1 | Spillway |
| Max Velocity through Grate 1 (fps) = | N/A | N/A | N/A | N/A | 0.2 | 0.8 | 1.5 | 2.4 | 2.5 |
| Max Velocity through Grate 2 (fps) = | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Time to Drain 97% of Inflow Volume (hours) = | 38 | 62 | 54 | 63 | 64 | 62 | 60 | 57 | 54 |
| Time to Drain 99% of Inflow Volume (hours) = | **40** | 66 | 58 | 67 | 70 | 69 | 68 | 67 | 65 |
| Maximum Ponding Depth (ft) = | 2.99 | 4.59 | 3.92 | 4.50 | 4.79 | 5.12 | 5.39 | 5.75 | 6.34 |
| Area at Maximum Ponding Depth (acres) = | 0.93 | 1.51 | 1.33 | 1.49 | 1.56 | 1.65 | 1.71 | 1.80 | 1.90 |
| Maximum Volume Stored (acre-ft) = | 1.202 | 3.213 | 2.241 | 3.078 | 3.521 | 4.051 | 4.489 | 5.120 | 6.216 |

# 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.

| | SOURCE | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP |
|---|---|---|---|---|---|---|---|---|---|---|
| Time Interval | 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 | 0.41 | 0.04 | 1.05 |
| | 0:15:00 | 0.00 | 0.00 | 3.55 | 5.78 | 7.24 | 4.91 | 6.22 | 6.07 | 8.29 |
| | 0:20:00 | 0.00 | 0.00 | 13.09 | 17.30 | 20.59 | 13.13 | 15.43 | 16.55 | 20.61 |
| | 0:25:00 | 0.00 | 0.00 | 28.60 | 41.05 | 51.54 | 27.53 | 34.09 | 37.77 | 49.74 |
| | 0:30:00 | 0.00 | 0.00 | 36.64 | 50.97 | 62.26 | 72.28 | 95.24 | 114.31 | 157.81 |
| | 0:35:00 | 0.00 | 0.00 | 34.27 | 46.36 | 55.81 | 92.55 | 120.15 | 155.21 | 209.73 |
| | 0:40:00 | 0.00 | 0.00 | 30.17 | 39.93 | 47.69 | 88.19 | 114.23 | 148.90 | 200.50 |
| | 0:45:00 | 0.00 | 0.00 | 25.93 | 34.54 | 41.27 | 75.85 | 97.57 | 130.35 | 176.81 |
| | 0:50:00 | 0.00 | 0.00 | 22.24 | 30.07 | 35.44 | 66.27 | 84.49 | 112.23 | 153.86 |
| | 0:55:00 | 0.00 | 0.00 | 19.19 | 25.79 | 30.31 | 55.81 | 70.55 | 94.82 | 129.19 |
| | 1:00:00 | 0.00 | 0.00 | 16.92 | 22.52 | 26.70 | 46.18 | 57.98 | 79.53 | 107.82 |
| | 1:05:00 | 0.00 | 0.00 | 15.39 | 20.38 | 24.34 | 39.43 | 49.42 | 69.13 | 94.59 |
| | 1:10:00 | 0.00 | 0.00 | 13.57 | 18.64 | 22.31 | 33.84 | 42.05 | 57.65 | 78.55 |
| | 1:15:00 | 0.00 | 0.00 | 11.79 | 16.56 | 20.30 | 29.04 | 35.64 | 47.27 | 63.76 |
| | 1:20:00 | 0.00 | 0.00 | 10.14 | 14.22 | 17.65 | 24.11 | 29.23 | 37.40 | 49.89 |
| | 1:25:00 | 0.00 | 0.00 | 8.65 | 12.12 | 14.65 | 19.63 | 23.40 | 28.58 | 37.60 |
| | 1:30:00 | 0.00 | 0.00 | 7.48 | 10.46 | 12.26 | 15.30 | 17.82 | 20.87 | 26.87 |
| | 1:35:00 | 0.00 | 0.00 | 6.84 | 9.63 | 11.03 | 11.93 | 13.70 | 15.36 | 19.61 |
| | 1:40:00 | 0.00 | 0.00 | 6.57 | 8.73 | 10.33 | 10.10 | 11.52 | 12.39 | 15.70 |
| | 1:45:00 | 0.00 | 0.00 | 6.41 | 7.95 | 9.82 | 9.08 | 10.31 | 10.71 | 13.33 |
| | 1:50:00 | 0.00 | 0.00 | 6.31 | 7.39 | 9.46 | 8.44 | 9.54 | 9.62 | 11.79 |
| | 1:55:00 | 0.00 | 0.00 | 5.64 | 6.96 | 9.02 | 8.00 | 9.02 | 8.88 | 10.76 |
| | 2:00:00 | 0.00 | 0.00 | 4.98 | 6.48 | 8.28 | 7.72 | 8.69 | 8.35 | 10.02 |
| | 2:05:00 | 0.00 | 0.00 | 3.90 | 5.10 | 6.48 | 6.08 | 6.81 | 6.43 | 7.64 |
| | 2:10:00 | 0.00 | 0.00 | 2.93 | 3.81 | 4.82 | 4.49 | 5.01 | 4.69 | 5.55 |
| | 2:15:00 | 0.00 | 0.00 | 2.20 | 2.85 | 3.58 | 3.33 | 3.72 | 3.47 | 4.09 |
| | 2:20:00 | 0.00 | 0.00 | 1.64 | 2.12 | 2.64 | 2.47 | 2.75 | 2.58 | 3.04 |
| | 2:25:00 | 0.00 | 0.00 | 1.21 | 1.55 | 1.93 | 1.80 | 2.00 | 1.88 | 2.20 |
| | 2:30:00 | 0.00 | 0.00 | 0.87 | 1.10 | 1.39 | 1.29 | 1.42 | 1.35 | 1.57 |
| | 2:35:00 | 0.00 | 0.00 | 0.62 | 0.78 | 1.00 | 0.93 | 1.03 | 0.97 | 1.13 |
| | 2:40:00 | 0.00 | 0.00 | 0.42 | 0.54 | 0.69 | 0.65 | 0.72 | 0.67 | 0.78 |
| | 2:45:00 | 0.00 | 0.00 | 0.26 | 0.36 | 0.44 | 0.43 | 0.46 | 0.43 | 0.49 |
| | 2:50:00 | 0.00 | 0.00 | 0.14 | 0.21 | 0.25 | 0.25 | 0.26 | 0.24 | 0.27 |
| | 2:55:00 | 0.00 | 0.00 | 0.06 | 0.10 | 0.11 | 0.12 | 0.12 | 0.11 | 0.11 |
| | 3:00:00 | 0.00 | 0.00 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.02 |
| | 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 |

# RUNOFF REDUCTION

# AREA NOT TRIBUTARY TO WQ PONDS FOR RUNOFF REDUCTION

| | | | | | | AREA > 80,000 |
|---|---|---|---|---|---|---|
| BASIN I | **5.66** AC | BASIN I | DCIA | 0.00 | 0.00 |
| | 246748.53 SQ FT | | UIA | 38987.12 | 9746.78 |
| | | | RPA | 10413.58 | 2603.40 |
| | | | SPA | 197347.83 | 49336.96 |
| | | | **Total** | **246748.53** | 61687.13 |
| BASIN J | **1.99** AC | BASIN J | DCIA | 0.00 | 0.00 |
| | 86638.12 SQ FT | | UIA | 19060.56 | 9530.28 |
| | | | RPA | 5039.06 | 2519.53 |
| | | | SPA | 62538.50 | 31269.25 |
| | | | **Total** | **86638.12** | 43319.06 |
| BASIN N | **0.22** AC | BASIN N | DCIA | 0.00 | |
| | 9795.98 SQ FT | | UIA | 5504.67 | |
| | | | RPA | 2173.63 | |
| | | | SPA | 2117.68 | |
| | | | **Total** | **9795.98** | |
| BASIN M1 | **2.90** AC | BASIN N | DCIA | 0.00 | 0.00 |
| | 126442.54 SQ FT | | UIA | 47732.98 | 23866.49 |
| | | | RPA | 12939.55 | 6469.78 |
| | | | SPA | 65770.01 | 32885.01 |
| | | | **Total** | **126442.54** | 63221.27 |
| BASIN M2 | **0.47** AC | BASIN N | DCIA | 0.00 | |
| | 20667.55 SQ FT | | UIA | 8546.78 | |
| | | | RPA | 2867.91 | |
| | | | SPA | 9252.86 | |
| | | | **Total** | **20667.55** | |
| BASIN P | **1.18** AC | BASIN N | DCIA | 0.00 | 0.00 |
| | 51440.65 SQ FT | | UIA | 15769.44 | 15769.44 |
| | | | RPA | 6561.79 | 35671.21 |
| | | | SPA | 29109.42 | 0.00 |
| | | | **Total** | **51440.65** | **51440.65** |
| BASIN V | **1.32** AC | BASIN N | DCIA | 0.00 | 0.00 |
| | 57387.62 SQ FT | | UIA | 32204.59 | 32204.59 |
| | | | RPA | 7784.50 | 25183.03 |
| | | | SPA | 17398.53 | 0.00 |
| | | | **Total** | **57387.62** | **57387.62** |

## Design Procedure Form: Runoff Reduction

UD-BMP (Version 3.07, March 2018)



| | |
|---|---|
| **Designer:** | **Quentin Armijo** |
| **Company:** | **Terra Nova Engineering, Inc.** |
| **Date:** | **September 21, 2021** |
| **Project:** | **Waterbury Filings 1 & 2** |
| **Location:** | **BASIN I, J & N WESTERN CHANNEL DIRECT RELEASE BROKE DOWN TO MEET 80,000 SQ FT** |

### SITE INFORMATION (User Input in Blue Cells)

WQCV Rainfall Depth: 0.60 inches

Depth of Average Runoff Producing Storm, $d_6$ = 0.43 inches (for Watersheds Outside of the Denver Region, Figure 3-1 in USDCM Vol. 3)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Area Type | UIA:RPA | UIA:RPA | UIA:RPA | UIA:RPA | UIA:RPA | UIA:RPA | UIA:RPA | | | | | |
| Area ID | IA | IB | IC | ID | JA | JB | N | | | | | |
| Downstream Design Point ID | WEST CH | WEST CH | WEST CH | WEST CH | WEST CH | WEST CH | WEST CH | | | | | |
| Downstream BMP Type | None | None | None | None | None | None | None | | | | | |
| DCIA ($ft^2$) | -- | -- | -- | -- | -- | -- | -- | | | | | |
| UIA ($ft^2$) | 9,747 | 9,747 | 9,747 | 9,747 | 9,530 | 9,530 | 5,505 | | | | | |
| RPA ($ft^2$) | 2,603 | 2,603 | 2,603 | 2,603 | 2,520 | 2,520 | 2,174 | | | | | |
| SPA ($ft^2$) | -- | -- | -- | -- | -- | -- | -- | | | | | |
| HSG A (%) | 100% | 100% | 100% | 100% | 100% | 100% | 100% | | | | | |
| HSG B (%) | 0% | 0% | 0% | 0% | 0% | 0% | 0% | | | | | |
| HSG C/D (%) | 0% | 0% | 0% | 0% | 0% | 0% | 0% | | | | | |
| Average Slope of RPA (ft/ft) | 0.020 | 0.020 | 0.020 | 0.020 | 0.020 | 0.020 | 0.020 | | | | | |
| UIA:RPA Interface Width (ft) | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 100.00 | | | | | |

### CALCULATED RUNOFF RESULTS

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Area ID | IA | IB | IC | ID | JA | JB | N | | | | | |
| UIA:RPA Area ($ft^2$) | 12,350 | 12,350 | 12,350 | 12,350 | 12,050 | 12,050 | 7,678 | | | | | |
| L / W Ratio | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 0.77 | | | | | |
| UIA / Area | 0.7892 | 0.7892 | 0.7892 | 0.7892 | 0.7909 | 0.7909 | 0.7169 | | | | | |
| Runoff (in) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | | | | |
| Runoff ($ft^3$) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| Runoff Reduction ($ft^3$) | 406 | 406 | 406 | 406 | 397 | 397 | 229 | | | | | |

### CALCULATED WQCV RESULTS

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Area ID | IA | IB | IC | ID | JA | JB | N | | | | | |
| WQCV ($ft^3$) | 406 | 406 | 406 | 406 | 397 | 397 | 229 | | | | | |
| WQCV Reduction ($ft^3$) | 406 | 406 | 406 | 406 | 397 | 397 | 229 | | | | | |
| WQCV Reduction (%) | 100% | 100% | 100% | 100% | 100% | 100% | 100% | | | | | |
| Untreated WQCV ($ft^3$) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |

### CALCULATED DESIGN POINT RESULTS (sums results from all columns with the same Downstream Design Point ID)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Downstream Design Point ID | WEST CH | | | | | | | | | | | |
| DCIA ($ft^2$) | 0 | | | | | | | | | | | |
| UIA ($ft^2$) | 63,552 | | | | | | | | | | | |
| RPA ($ft^2$) | 17,626 | | | | | | | | | | | |
| SPA ($ft^2$) | 0 | | | | | | | | | | | |
| Total Area ($ft^2$) | 81,179 | | | | | | | | | | | |
| Total Impervious Area ($ft^2$) | 63,552 | | | | | | | | | | | |
| WQCV ($ft^3$) | 2,648 | | | | | | | | | | | |
| WQCV Reduction ($ft^3$) | 2,648 | | | | | | | | | | | |
| WQCV Reduction (%) | 100% | | | | | | | | | | | |
| Untreated WQCV ($ft^3$) | 0 | | | | | | | | | | | |

### CALCULATED SITE RESULTS (sums results from all columns in worksheet)

| | |
|---|---|
| Total Area ($ft^2$) | 81,179 |
| Total Impervious Area ($ft^2$) | 63,552 |
| WQCV ($ft^3$) | 2,648 |
| WQCV Reduction ($ft^3$) | 2,648 |
| WQCV Reduction (%) | 100% |
| Untreated WQCV ($ft^3$) | 0 |

## Design Procedure Form: Runoff Reduction

UD-BMP (Version 3.07, March 2018)



| | |
|---|---|
| **Designer:** | **QUENTIN ARMIJO** |
| **Company:** | **TERRA NOVA ENGINEERING, INC.** |
| **Date:** | **September 21, 2021** |
| **Project:** | **WATERBURY FILING 1 & 2** |
| **Location:** | **BASIN M1 STAPELTON DRIVE DIRECT RELEASE** |

### SITE INFORMATION (User Input in Blue Cells)

| | | |
|---|---|---|
| WQCV Rainfall Depth | 0.60 | inches |
| Depth of Average Runoff Producing Storm, $d_6$ = | 0.43 | inches (for Watersheds Outside of the Denver Region, Figure 3-1 in USDCM Vol. 3) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Area Type | UIA:RPA | UIA:RPA | | | | | | | | | | |
| Area ID | M1A | M1B | | | | | | | | | | |
| Downstream Design Point ID | M1 | M1 | | | | | | | | | | |
| Downstream BMP Type | None | None | | | | | | | | | | |
| DCIA ($ft^2$) | -- | -- | | | | | | | | | | |
| UIA ($ft^2$) | 23,866 | 23,866 | | | | | | | | | | |
| RPA ($ft^2$) | 6,470 | 6,470 | | | | | | | | | | |
| SPA ($ft^2$) | -- | -- | | | | | | | | | | |
| HSG A (%) | 100% | 100% | | | | | | | | | | |
| HSG B (%) | 0% | 0% | | | | | | | | | | |
| HSG C/D (%) | 0% | 0% | | | | | | | | | | |
| Average Slope of RPA (ft/ft) | 0.040 | 0.020 | | | | | | | | | | |
| UIA:RPA Interface Width (ft) | 10.00 | 10.00 | | | | | | | | | | |

### CALCULATED RUNOFF RESULTS

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Area ID | M1A | M1B | | | | | | | | | | |
| UIA:RPA Area ($ft^2$) | 30,336 | 30,336 | | | | | | | | | | |
| L / W Ratio | 16.00 | 16.00 | | | | | | | | | | |
| UIA / Area | 0.7867 | 0.7867 | | | | | | | | | | |
| Runoff (in) | 0.00 | 0.00 | | | | | | | | | | |
| Runoff ($ft^3$) | 0 | 0 | | | | | | | | | | |
| Runoff Reduction ($ft^3$) | 994 | 994 | | | | | | | | | | |

### CALCULATED WQCV RESULTS

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Area ID | M1A | M1B | | | | | | | | | | |
| WQCV ($ft^3$) | 994 | 994 | | | | | | | | | | |
| WQCV Reduction ($ft^3$) | 994 | 994 | | | | | | | | | | |
| WQCV Reduction (%) | 100% | 100% | | | | | | | | | | |
| Untreated WQCV ($ft^3$) | 0 | 0 | | | | | | | | | | |

### CALCULATED DESIGN POINT RESULTS (sums results from all columns with the same Downstream Design Point ID)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Downstream Design Point ID | M1 | M1 | | | | | | | | | | |
| DCIA ($ft^2$) | 0 | 0 | | | | | | | | | | |
| UIA ($ft^2$) | 23,866 | 23,866 | | | | | | | | | | |
| RPA ($ft^2$) | 6,470 | 6,470 | | | | | | | | | | |
| SPA ($ft^2$) | 0 | 0 | | | | | | | | | | |
| Total Area ($ft^2$) | 30,336 | 30,336 | | | | | | | | | | |
| Total Impervious Area ($ft^2$) | 23,866 | 23,866 | | | | | | | | | | |
| WQCV ($ft^3$) | 994 | 994 | | | | | | | | | | |
| WQCV Reduction ($ft^3$) | 994 | 994 | | | | | | | | | | |
| WQCV Reduction (%) | 100% | 100% | | | | | | | | | | |
| Untreated WQCV ($ft^3$) | 0 | 0 | | | | | | | | | | |

### CALCULATED SITE RESULTS (sums results from all columns in worksheet)

| | |
|---|---|
| Total Area ($ft^2$) | 60,673 |
| Total Impervious Area ($ft^2$) | 47,733 |
| WQCV ($ft^3$) | 1,989 |
| WQCV Reduction ($ft^3$) | 1,989 |
| WQCV Reduction (%) | 100% |
| Untreated WQCV ($ft^3$) | 0 |

## Design Procedure Form: Runoff Reduction

UD-BMP (Version 3.07, March 2018)



| | |
|---|---|
| **Designer:** | **QUENTIN ARMIJO** |
| **Company:** | **TERRA NOVA ENGINEERING, INC.** |
| **Date:** | **September 21, 2021** |
| **Project:** | **WATERBURY FILING 1 & 2** |
| **Location:** | **BASINS M2, P & V EASTERN CHANNEL DIRECT RELEASE** |

### SITE INFORMATION (User Input in Blue Cells)

WQCV Rainfall Depth: 0.60 inches

Depth of Average Runoff Producing Storm, $d_6$ = 0.43 inches (for Watersheds Outside of the Denver Region, Figure 3-1 in USDCM Vol. 3)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Area Type | UIA:RPA | UIA:RPA | UIA:RPA | | | | | | | | | |
| Area ID | M2 | P | V | | | | | | | | | |
| Downstream Design Point ID | EAST CH | EAST CH | EAST CH | | | | | | | | | |
| Downstream BMP Type | None | None | None | | | | | | | | | |
| DCIA ($ft^2$) | -- | -- | -- | | | | | | | | | |
| UIA ($ft^2$) | 8,547 | 15,769 | 32,205 | | | | | | | | | |
| RPA ($ft^2$) | 2,868 | 6,562 | 7,785 | | | | | | | | | |
| SPA ($ft^2$) | -- | -- | -- | | | | | | | | | |
| HSG A (%) | 100% | 100% | 100% | | | | | | | | | |
| HSG B (%) | 0% | 0% | 0% | | | | | | | | | |
| HSG C/D (%) | 0% | 0% | 0% | | | | | | | | | |
| Average Slope of RPA (ft/ft) | 0.020 | 0.020 | 0.020 | | | | | | | | | |
| UIA:RPA Interface Width (ft) | 10.00 | 10.00 | 10.00 | | | | | | | | | |

### CALCULATED RUNOFF RESULTS

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Area ID | M2 | P | V | | | | | | | | | |
| UIA:RPA Area ($ft^2$) | 11,415 | 22,331 | 39,989 | | | | | | | | | |
| L / W Ratio | 16.00 | 16.00 | 16.00 | | | | | | | | | |
| UIA / Area | 0.7488 | 0.7062 | 0.8053 | | | | | | | | | |
| Runoff (in) | 0.00 | 0.00 | 0.00 | | | | | | | | | |
| Runoff ($ft^3$) | 0 | 0 | 0 | | | | | | | | | |
| Runoff Reduction ($ft^3$) | 356 | 657 | 1342 | | | | | | | | | |

### CALCULATED WQCV RESULTS

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Area ID | M2 | P | V | | | | | | | | | |
| WQCV ($ft^3$) | 356 | 657 | 1342 | | | | | | | | | |
| WQCV Reduction ($ft^3$) | 356 | 657 | 1342 | | | | | | | | | |
| WQCV Reduction (%) | 100% | 100% | 100% | | | | | | | | | |
| Untreated WQCV ($ft^3$) | 0 | 0 | 0 | | | | | | | | | |

### CALCULATED DESIGN POINT RESULTS (sums results from all columns with the same Downstream Design Point ID)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Downstream Design Point ID | EAST CH | | | | | | | | | | | |
| DCIA ($ft^2$) | 0 | | | | | | | | | | | |
| UIA ($ft^2$) | 56,521 | | | | | | | | | | | |
| RPA ($ft^2$) | 17,214 | | | | | | | | | | | |
| SPA ($ft^2$) | 0 | | | | | | | | | | | |
| Total Area ($ft^2$) | 73,735 | | | | | | | | | | | |
| Total Impervious Area ($ft^2$) | 56,521 | | | | | | | | | | | |
| WQCV ($ft^3$) | 2,355 | | | | | | | | | | | |
| WQCV Reduction ($ft^3$) | 2,355 | | | | | | | | | | | |
| WQCV Reduction (%) | 100% | | | | | | | | | | | |
| Untreated WQCV ($ft^3$) | 0 | | | | | | | | | | | |

### CALCULATED SITE RESULTS (sums results from all columns in worksheet)

| | |
|---|---|
| Total Area ($ft^2$) | 73,735 |
| Total Impervious Area ($ft^2$) | 56,521 |
| WQCV ($ft^3$) | 2,355 |
| WQCV Reduction ($ft^3$) | 2,355 |
| WQCV Reduction (%) | 100% |
| Untreated WQCV ($ft^3$) | 0 |

# HEC-RAS ANALYSIS

| Project Summary | |
|---|---|
| Title | Waterbury Phase 1 - Drainage Report |
| Engineer | MAW |
| Company | CCES |
| Date | 7/6/2016 |

| | |
|---|---|
| Notes | 2 year SCS Model |

# Table of Contents


| | | |
|---|---|---|
| | Master Network Summary | 2 |
| C Springs | Time-Depth Curve, 2 years | 5 |
| EXIST. STOCK POND | | |
| | Elevation-Area Volume Curve, 2 years | 6 |
| SWQ POND 1 | | |
| | Elevation-Area Volume Curve, 2 years | 7 |
| SWQ POND 2 | | |
| | Elevation-Area Volume Curve, 2 years | 8 |
| Waterbury Pond A | | |
| | Elevation-Area Volume Curve, 2 years | 9 |
| Exist. Stock Pond | | |
| | Outlet Input Data, 2 years | 10 |
| POND A OUTLET | | |
| | Outlet Input Data, 2 years | 14 |
| SWQ Pond 1 | | |
| | Outlet Input Data, 2 years | 18 |
| SWQ Pond 2 | | |
| | Outlet Input Data, 2 years | 22 |
| EXIST. STOCK POND | | |
| | Elevation-Volume-Flow Table (Pond), 2 years | 26 |
| SWQ POND 1 | | |
| | Elevation-Volume-Flow Table (Pond), 2 years | 27 |
| SWQ POND 2 | | |
| | Elevation-Volume-Flow Table (Pond), 2 years | 28 |
| Waterbury Pond A | | |
| | Elevation-Volume-Flow Table (Pond), 2 years | 29 |

Subsection: Master Network Summary

## Catchments Summary

| Label | Scenario | Return Event (years) | Hydrograph Volume (ac-ft) | Time to Peak (hours) | Peak Flow ($ft^3/s$) |
|---|---|---|---|---|---|
| 4 WAY BASINS D, E, N, Q, (50%)O | Post-Development 2 YEAR | 2 | 0.630 | 6.150 | 5.45 |
| 4-WAY BASINS F, G, K, M | Post-Development 2 YEAR | 2 | 0.363 | 6.150 | 1.91 |
| 4-WAY BASINS H, I, J, L, R, S | Post-Development 2 YEAR | 2 | 0.555 | 6.100 | 3.57 |
| A BASINS | Post-Development 2 YEAR | 2 | 0.711 | 6.100 | 9.78 |
| BASIN OS5, I, N | Post-Development 2 YEAR | 2 | 0.293 | 6.150 | 2.51 |
| Basin J OS-6 | Post-Development 2 YEAR | 2 | 0.064 | 6.050 | 0.89 |
| FG08 | Post-Development 2 YEAR | 2 | 3.709 | 6.150 | 39.20 |
| FG09 | Post-Development 2 YEAR | 2 | 0.967 | 6.100 | 13.67 |
| FG10 | Post-Development 2 YEAR | 2 | 0.895 | 6.100 | 12.21 |
| FG11 | Post-Development 2 YEAR | 2 | 1.613 | 6.050 | 26.19 |
| FG12 | Post-Development 2 YEAR | 2 | 1.123 | 6.050 | 16.95 |
| FG13 | Post-Development 2 YEAR | 2 | 1.031 | 6.200 | 9.50 |
| FG14 | Post-Development 2 YEAR | 2 | 1.182 | 6.150 | 12.59 |
| FG25 | Post-Development 2 YEAR | 2 | 1.296 | 6.150 | 15.65 |
| FG26 | Post-Development 2 YEAR | 2 | 1.709 | 6.150 | 18.55 |
| FG27 | Post-Development 2 YEAR | 2 | 1.975 | 6.050 | 30.23 |
| FG28 | Post-Development 2 YEAR | 2 | 2.698 | 6.150 | 32.37 |
| FG32 | Post-Development 2 YEAR | 2 | 3.308 | 6.100 | 43.12 |
| FG33 | Post-Development 2 YEAR | 2 | 4.279 | 6.050 | 74.56 |

## Node Summary

| Label | Scenario | Return Event (years) | Hydrograph Volume (ac-ft) | Time to Peak (hours) | Peak Flow ($ft^3/s$) |
|---|---|---|---|---|---|
| 4 WAY RELEASE | Post-Development 2 YEAR | 2 | 17.203 | 8.150 | 19.20 |
| G17 | Post-Development 2 YEAR | 2 | 7.278 | 6.150 | 17.25 |

Subsection: Master Network Summary

## Node Summary

| Label | Scenario | Return Event (years) | Hydrograph Volume (ac-ft) | Time to Peak (hours) | Peak Flow ($ft^3/s$) |
|---|---|---|---|---|---|
| G18 | Post-Development 2 YEAR | 2 | 10.962 | 6.100 | 63.23 |

## Pond Summary

| Label | Scenario | Return Event (years) | Hydrograph Volume (ac-ft) | Time to Peak (hours) | Peak Flow ($ft^3/s$) | Maximum Water Surface Elevation (ft) | Maximum Pond Storage (ac-ft) |
|---|---|---|---|---|---|---|---|
| EXIST. STOCK POND (IN) | Post-Development 2 YEAR | 2 | 18.392 | 8.100 | 19.22 | (N/A) | (N/A) |
| EXIST. STOCK POND (OUT) | Post-Development 2 YEAR | 2 | 17.203 | 8.150 | 19.20 | 6,907.13 | 1.237 |
| INLINE POND 1 (IN) | Post-Development 2 YEAR | 2 | 16.493 | 8.100 | 17.68 | (N/A) | (N/A) |
| INLINE POND 1 (OUT) | Post-Development 2 YEAR | 2 | 16.493 | 8.150 | 17.67 | 6,937.09 | 0.025 |
| POND D (IN) | Post-Development 2 YEAR | 2 | 10.520 | 6.100 | 124.02 | (N/A) | (N/A) |
| POND D (OUT) | Post-Development 2 YEAR | 2 | 5.982 | 10.200 | 5.11 | 7,053.21 | 5.538 |
| POND E (IN) | Post-Development 2 YEAR | 2 | 21.187 | 6.050 | 174.97 | (N/A) | (N/A) |
| POND E (OUT) | Post-Development 2 YEAR | 2 | 16.480 | 8.150 | 18.35 | 6,966.63 | 7.059 |
| POND HS (IN) | Post-Development 2 YEAR | 2 | 2.698 | 6.150 | 32.37 | (N/A) | (N/A) |
| POND HS (OUT) | Post-Development 2 YEAR | 2 | 2.639 | 6.500 | 10.49 | 6,969.04 | 0.869 |
| SWQ POND 1 (IN) | Post-Development 2 YEAR | 2 | 0.836 | 6.100 | 3.57 | (N/A) | (N/A) |
| SWQ POND 1 (OUT) | Post-Development 2 YEAR | 2 | 0.496 | 15.100 | 0.36 | 6,923.38 | 0.402 |
| SWQ POND 2 (IN) | Post-Development 2 YEAR | 2 | 0.363 | 6.150 | 1.91 | (N/A) | (N/A) |

Subsection: Master Network Summary

## Pond Summary

| Label | Scenario | Return Event (years) | Hydrograph Volume (ac-ft) | Time to Peak (hours) | Peak Flow ($ft^3/s$) | Maximum Water Surface Elevation (ft) | Maximum Pond Storage (ac-ft) |
|---|---|---|---|---|---|---|---|
| SWQ POND 2 (OUT) | Post-Development 2 YEAR | 2 | 0.191 | 20.200 | 0.14 | 6,916.51 | 0.184 |
| Waterbury Pond A (IN) | Post-Development 2 YEAR | 2 | 0.711 | 6.100 | 9.78 | (N/A) | (N/A) |
| Waterbury Pond A (OUT) | Post-Development 2 YEAR | 2 | 0.530 | 8.350 | 0.39 | 6,926.84 | 0.378 |

Subsection: Time-Depth Curve
Label: C Springs

Return Event: 2 years
Storm Event: TYPEIIA 24HR (2.0 in)

| Time-Depth Curve: TYPEIIA 24HR (2.0 in) | |
|---|---|
| Label | TYPEIIA 24HR (2.0 in) |
| Start Time | 0.000 hours |
| Increment | 0.250 hours |
| End Time | 24.000 hours |
| Return Event | 2 years |

**CUMULATIVE RAINFALL (in)**
**Output Time Increment = 0.250 hours**
**Time on left represents time for first value in each row.**

| Time (hours) | Depth (in) | Depth (in) | Depth (in) | Depth (in) | Depth (in) |
|---|---|---|---|---|---|
| 0.000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1.250 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2.500 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 |
| 3.750 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 5.000 | 0.1 | 0.2 | 0.2 | 0.8 | 1.4 |
| 6.250 | 1.5 | 1.5 | 1.5 | 1.6 | 1.6 |
| 7.500 | 1.6 | 1.6 | 1.6 | 1.7 | 1.7 |
| 8.750 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 |
| 10.000 | 1.7 | 1.7 | 1.7 | 1.7 | 1.8 |
| 11.250 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 |
| 12.500 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 |
| 13.750 | 1.8 | 1.8 | 1.8 | 1.8 | 1.9 |
| 15.000 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 |
| 16.250 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 |
| 17.500 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 |
| 18.750 | 1.9 | 1.9 | 1.9 | 2.0 | 2.0 |
| 20.000 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| 21.250 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| 22.500 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| 23.750 | 2.0 | 2.0 | (N/A) | (N/A) | (N/A) |

Subsection: Elevation-Area Volume Curve
Label: EXIST. STOCK POND

Return Event: 2 years
Storm Event: TYPEIIA 24HR (2.0 in)

| Elevation (ft) | Planimeter ($ft^2$) | Area (acres) | A1+A2+sqr (A1*A2) (acres) | Volume (ac-ft) | Volume (Total) (ac-ft) |
|---|---|---|---|---|---|
| 6,904.00 | 0.0000 | 0.23 | 0.00 | 0.000 | 0.000 |
| 6,906.00 | 0.0000 | 0.43 | 0.97 | 0.650 | 0.650 |
| 6,908.00 | 0.0000 | 0.79 | 1.80 | 1.202 | 1.852 |
| 6,910.00 | 0.0000 | 1.29 | 3.09 | 2.060 | 3.911 |

Subsection: Elevation-Area Volume Curve
Label: SWQ POND 1

Return Event: 2 years
Storm Event: TYPEIIA 24HR (2.0 in)

| Elevation (ft) | Planimeter ($ft^2$) | Area (acres) | A1+A2+sqr (A1*A2) (acres) | Volume (ac-ft) | Volume (Total) (ac-ft) |
|---|---|---|---|---|---|
| 6,920.50 | 0.0000 | 0.00 | 0.00 | 0.000 | 0.000 |
| 6,921.00 | 0.0000 | 0.01 | 0.01 | 0.002 | 0.002 |
| 6,922.00 | 0.0000 | 0.11 | 0.11 | 0.055 | 0.055 |
| 6,923.00 | 0.0000 | 0.33 | 0.63 | 0.210 | 0.265 |
| 6,924.00 | 0.0000 | 0.47 | 1.19 | 0.398 | 0.663 |
| 6,925.00 | 0.0000 | 0.55 | 1.53 | 0.509 | 1.173 |

Subsection: Elevation-Area Volume Curve
Label: SWQ POND 2

Return Event: 2 years
Storm Event: TYPEIIA 24HR (2.0 in)

| Elevation (ft) | Planimeter ($ft^2$) | Area (acres) | A1+A2+sqr (A1*A2) (acres) | Volume (ac-ft) | Volume (Total) (ac-ft) |
|---|---|---|---|---|---|
| 6,914.75 | 0.0000 | 0.00 | 0.00 | 0.000 | 0.000 |
| 6,915.25 | 0.0000 | 0.03 | 0.03 | 0.005 | 0.005 |
| 6,916.00 | 0.0000 | 0.19 | 0.19 | 0.079 | 0.079 |
| 6,918.00 | 0.0000 | 0.34 | 0.78 | 0.523 | 0.602 |
| 6,919.00 | 0.0000 | 0.40 | 1.11 | 0.370 | 0.972 |

Subsection: Elevation-Area Volume Curve
Label: Waterbury Pond A

Return Event: 2 years
Storm Event: TYPEIIA 24HR (2.0 in)

| Elevation (ft) | Planimeter ($ft^2$) | Area (acres) | A1+A2+sqr (A1*A2) (acres) | Volume (ac-ft) | Volume (Total) (ac-ft) |
|---|---|---|---|---|---|
| 6,921.00 | 0.0000 | 0.00 | 0.00 | 0.000 | 0.000 |
| 6,922.00 | 0.0000 | 0.00 | 0.01 | 0.002 | 0.002 |
| 6,924.00 | 0.0000 | 0.00 | 0.01 | 0.005 | 0.007 |
| 6,926.00 | 0.0000 | 0.22 | 0.24 | 0.160 | 0.167 |
| 6,928.00 | 0.0000 | 0.41 | 0.92 | 0.612 | 0.779 |
| 6,930.00 | 0.0000 | 0.54 | 1.42 | 0.946 | 1.725 |
| 6,931.00 | 0.0000 | 0.61 | 1.73 | 0.578 | 2.303 |

Subsection: Outlet Input Data
Label: Exist. Stock Pond

Return Event: 2 years
Storm Event: TYPEIIA 24HR (2.0 in)

| Requested Pond Water Surface Elevations | |
|---|---|
| Minimum (Headwater) | 6,904.00 ft |
| Increment (Headwater) | 0.50 ft |
| Maximum (Headwater) | 6,910.00 ft |

## Spot Elevations

| SpotElevation (ft) |
|---|
| 6,908.13 |

## Outlet Connectivity

| Structure Type | Outlet ID | Direction | Outfall | E1 (ft) | E2 (ft) |
|---|---|---|---|---|---|
| Inlet Box | Riser - 1 | Forward | Culvert - 1 | 6,907.50 | 6,910.00 |
| Orifice-Area | Orifice - 1 | Forward | Culvert - 1 | 6,904.75 | 6,910.00 |
| Culvert-Circular | Culvert - 1 | Forward | TW | 6,904.50 | 6,910.00 |
| Irregular Weir | Weir - 1 | Forward | TW | 6,907.00 | 6,910.00 |
| Tailwater Settings | Tailwater | | | (N/A) | (N/A) |

**Structure ID: Weir - 1**
**Structure Type: Irregular Weir**

| Station (ft) | Elevation (ft) |
|---|---|
| 100.00 | 0.00 |
| 109.00 | -3.00 |
| 170.00 | -3.00 |
| 220.00 | -2.00 |
| 320.00 | 0.00 |

| | |
|---|---|
| Lowest Elevation | 6,907.00 ft |
| Weir Coefficient | 3.00 (ft^0.5)/s |

Structure ID: Riser - 1
Structure Type: Inlet Box

| | |
|---|---|
| Number of Openings | 1 |
| Elevation | 6,907.50 ft |
| Orifice Area | 10.4000 ft² |
| Orifice Coefficient | 0.600 |
| Weir Length | 4.00 ft |
| Weir Coefficient | 3.00 (ft^0.5)/s |
| K Reverse | 1.000 |
| Manning's n | 0.000 |
| Kev, Charged Riser | 0.000 |
| Weir Submergence | False |
| Orifice H to crest | False |

Structure ID: Orifice - 1
Structure Type: Orifice-Area

| | |
|---|---|
| Number of Openings | 8 |
| Elevation | 6,904.75 ft |
| Orifice Area | 0.0069 ft² |
| Top Elevation | 6,907.50 ft |
| Datum Elevation | 6,904.75 ft |
| Orifice Coefficient | 0.600 |

Structure ID: Culvert - 1
Structure Type: Culvert-Circular

| | |
|---|---|
| Number of Barrels | 1 |
| Diameter | 24.0 in |
| Length | 77.00 ft |
| Length (Computed Barrel) | 77.00 ft |
| Slope (Computed) | 0.006 ft/ft |

Outlet Control Data

| | |
|---|---|
| Manning's n | 0.013 |
| Ke | 0.200 |
| Kb | 0.012 |
| Kr | 0.000 |
| Convergence Tolerance | 0.00 ft |

| Inlet Control Data | |
|---|---|
| Equation Form | Form 1 |
| K | 0.0045 |
| M | 2.0000 |
| C | 0.0317 |
| Y | 0.6900 |
| T1 ratio (HW/D) | 1.092 |
| T2 ratio (HW/D) | 1.194 |
| Slope Correction Factor | -0.500 |

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

| | | | |
|---|---|---|---|
| T1 Elevation | 6,906.68 ft | T1 Flow | 15.55 $ft^3/s$ |
| T2 Elevation | 6,906.89 ft | T2 Flow | 17.77 $ft^3/s$ |

Structure ID: TW
Structure Type: TW Setup, DS Channel

| Tailwater Type | Free Outfall |
|---|---|

| Convergence Tolerances | |
|---|---|
| Maximum Iterations | 30 |
| Tailwater Tolerance (Minimum) | 0.01 ft |
| Tailwater Tolerance (Maximum) | 0.50 ft |
| Headwater Tolerance (Minimum) | 0.01 ft |
| Headwater Tolerance (Maximum) | 0.50 ft |
| Flow Tolerance (Minimum) | 0.001 $ft^3/s$ |
| Flow Tolerance (Maximum) | 10.000 $ft^3/s$ |

Subsection: Outlet Input Data
Label: POND A OUTLET

Return Event: 2 years
Storm Event: TYPEIIA 24HR (2.0 in)

| Requested Pond Water Surface Elevations | |
|---|---|
| Minimum (Headwater) | 6,921.00 ft |
| Increment (Headwater) | 0.50 ft |
| Maximum (Headwater) | 6,931.00 ft |

## Outlet Connectivity

| Structure Type | Outlet ID | Direction | Outfall | E1 (ft) | E2 (ft) |
|---|---|---|---|---|---|
| Inlet Box | Riser - 1 | Forward | Culvert - 1 | 6,928.50 | 6,931.00 |
| Orifice-Area | Orifice - 1 | Forward | Culvert - 1 | 6,923.50 | 6,931.00 |
| Culvert-Circular | Culvert - 1 | Forward | TW | 6,920.80 | 6,931.00 |
| Tailwater Settings | Tailwater | | | (N/A) | (N/A) |

| Structure ID: Orifice - 1<br>Structure Type: Orifice-Area | |
|---|---|
| Number of Openings | 15 |
| Elevation | 6,923.50 ft |
| Orifice Area | 0.0036 ft² |
| Top Elevation | 6,928.50 ft |
| Datum Elevation | 6,923.50 ft |
| Orifice Coefficient | 0.600 |

| Structure ID: Riser - 1<br>Structure Type: Inlet Box | |
|---|---|
| Number of Openings | 1 |
| Elevation | 6,928.50 ft |
| Orifice Area | 12.8000 ft² |
| Orifice Coefficient | 0.600 |
| Weir Length | 4.00 ft |
| Weir Coefficient | 3.00 (ft^0.5)/s |
| K Reverse | 1.000 |
| Manning's n | 0.000 |
| Kev, Charged Riser | 0.000 |
| Weir Submergence | False |
| Orifice H to crest | False |

| Structure ID: Culvert - 1<br>Structure Type: Culvert-Circular | |
|---|---|
| Number of Barrels | 1 |
| Diameter | 24.0 in |
| Length | 75.00 ft |
| Length (Computed Barrel) | 75.00 ft |
| Slope (Computed) | 0.011 ft/ft |

| Outlet Control Data | |
|---|---|
| Manning's n | 0.013 |
| Ke | 0.200 |
| Kb | 0.012 |
| Kr | 0.000 |
| Convergence Tolerance | 0.00 ft |

| Inlet Control Data | |
|---|---|
| Equation Form | Form 1 |
| K | 0.0045 |
| M | 2.0000 |
| C | 0.0317 |

Subsection: Outlet Input Data
Label: POND A OUTLET

Return Event: 2 years
Storm Event: TYPEIIA 24HR (2.0 in)

| Inlet Control Data | |
|---|---|
| Y | 0.6900 |
| T1 ratio (HW/D) | 1.090 |
| T2 ratio (HW/D) | 1.192 |
| Slope Correction Factor | -0.500 |

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

| | | | |
|---|---|---|---|
| T1 Elevation | 6,922.98 ft | T1 Flow | 15.55 $ft^3/s$ |
| T2 Elevation | 6,923.18 ft | T2 Flow | 17.77 $ft^3/s$ |

Structure ID: TW
Structure Type: TW Setup, DS Channel

| Tailwater Type | Free Outfall |
|---|---|

| Convergence Tolerances | |
|---|---|
| Maximum Iterations | 30 |
| Tailwater Tolerance (Minimum) | 0.01 ft |
| Tailwater Tolerance (Maximum) | 0.50 ft |
| Headwater Tolerance (Minimum) | 0.01 ft |
| Headwater Tolerance (Maximum) | 0.50 ft |
| Flow Tolerance (Minimum) | 0.001 $ft^3/s$ |
| Flow Tolerance (Maximum) | 10.000 $ft^3/s$ |

Subsection: Outlet Input Data
Label: SWQ Pond 1

Return Event: 2 years
Storm Event: TYPEIIA 24HR (2.0 in)

| Requested Pond Water Surface Elevations | |
|---|---|
| Minimum (Headwater) | 6,920.50 ft |
| Increment (Headwater) | 0.50 ft |
| Maximum (Headwater) | 6,925.00 ft |

## Outlet Connectivity

| Structure Type | Outlet ID | Direction | Outfall | E1 (ft) | E2 (ft) |
|---|---|---|---|---|---|
| Inlet Box | Riser - 1 | Forward | Culvert - 1 | 6,924.00 | 6,925.00 |
| Orifice-Area | Orifice - 1 | Forward | Culvert - 1 | 6,920.50 | 6,925.00 |
| Culvert-Circular | Culvert - 1 | Forward | TW | 6,920.00 | 6,925.00 |
| Irregular Weir | Weir - 1 | Forward | TW | 6,924.00 | 6,925.00 |
| Tailwater Settings | Tailwater | | | (N/A) | (N/A) |

| Structure ID: Riser - 1<br>Structure Type: Inlet Box | |
|---|---|
| Number of Openings | 1 |
| Elevation | 6,924.00 ft |
| Orifice Area | 12.8000 ft² |
| Orifice Coefficient | 0.600 |
| Weir Length | 4.00 ft |
| Weir Coefficient | 3.00 (ft^0.5)/s |
| K Reverse | 1.000 |
| Manning's n | 0.000 |
| Kev, Charged Riser | 0.000 |
| Weir Submergence | False |
| Orifice H to crest | False |

| Structure ID: Orifice - 1<br>Structure Type: Orifice-Area | |
|---|---|
| Number of Openings | 10 |
| Elevation | 6,920.50 ft |
| Orifice Area | 0.0048 ft² |
| Top Elevation | 6,924.00 ft |
| Datum Elevation | 6,920.50 ft |
| Orifice Coefficient | 0.600 |

Subsection: Outlet Input Data
Label: SWQ Pond 1

Return Event: 2 years
Storm Event: TYPEIIA 24HR (2.0 in)

| Structure ID: Culvert - 1<br>Structure Type: Culvert-Circular | |
|---|---|
| Number of Barrels | 1 |
| Diameter | 24.0 in |
| Length | 26.07 ft |
| Length (Computed Barrel) | 26.07 ft |
| Slope (Computed) | 0.019 ft/ft |

| Outlet Control Data | |
|---|---|
| Manning's n | 0.013 |
| Ke | 0.200 |
| Kb | 0.012 |
| Kr | 0.000 |
| Convergence Tolerance | 0.00 ft |

| Inlet Control Data | |
|---|---|
| Equation Form | Form 1 |
| K | 0.0045 |
| M | 2.0000 |
| C | 0.0317 |
| Y | 0.6900 |
| T1 ratio (HW/D) | 1.086 |
| T2 ratio (HW/D) | 1.188 |
| Slope Correction Factor | -0.500 |

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

| | | | |
|---|---|---|---|
| T1 Elevation | 6,922.17 ft | T1 Flow | 15.55 $ft^3/s$ |
| T2 Elevation | 6,922.38 ft | T2 Flow | 17.77 $ft^3/s$ |

**Structure ID: Weir - 1**
**Structure Type: Irregular Weir**

| Station (ft) | Elevation (ft) |
|---|---|
| 100.00 | 0.00 |
| 104.00 | -1.00 |
| 156.00 | -1.00 |
| 160.00 | 0.00 |

| | |
|---|---|
| Lowest Elevation | 6,924.00 ft |
| Weir Coefficient | 3.00 (ft^0.5)/s |

Structure ID: TW
Structure Type: TW Setup, DS Channel

| | |
|---|---|
| Tailwater Type | Free Outfall |

| Convergence Tolerances | |
|---|---|
| Maximum Iterations | 30 |
| Tailwater Tolerance (Minimum) | 0.01 ft |
| Tailwater Tolerance (Maximum) | 0.50 ft |
| Headwater Tolerance (Minimum) | 0.01 ft |
| Headwater Tolerance (Maximum) | 0.50 ft |
| Flow Tolerance (Minimum) | 0.001 $ft^3/s$ |
| Flow Tolerance (Maximum) | 10.000 $ft^3/s$ |

Subsection: Outlet Input Data
Label: SWQ Pond 2

Return Event: 2 years
Storm Event: TYPEIIA 24HR (2.0 in)

| Requested Pond Water Surface Elevations | |
|---|---|
| Minimum (Headwater) | 6,914.00 ft |
| Increment (Headwater) | 0.50 ft |
| Maximum (Headwater) | 6,919.00 ft |

## Outlet Connectivity

| Structure Type | Outlet ID | Direction | Outfall | E1 (ft) | E2 (ft) |
|---|---|---|---|---|---|
| Inlet Box | Riser - 1 | Forward | Culvert - 1 | 6,918.00 | 6,919.00 |
| Orifice-Area | Orifice - 1 | Forward | Culvert - 1 | 6,914.75 | 6,919.00 |
| Culvert-Circular | Culvert - 1 | Forward | TW | 6,914.75 | 6,919.00 |
| Irregular Weir | Weir - 1 | Forward | TW | 6,918.00 | 6,919.00 |
| Tailwater Settings | Tailwater | | | (N/A) | (N/A) |

| Structure ID: Riser - 1<br>Structure Type: Inlet Box | |
|---|---|
| Number of Openings | 1 |
| Elevation | 6,918.00 ft |
| Orifice Area | 12.8000 ft² |
| Orifice Coefficient | 0.600 |
| Weir Length | 4.00 ft |
| Weir Coefficient | 3.00 (ft^0.5)/s |
| K Reverse | 1.000 |
| Manning's n | 0.000 |
| Kev, Charged Riser | 0.000 |
| Weir Submergence | False |
| Orifice H to crest | False |

| Structure ID: Orifice - 1<br>Structure Type: Orifice-Area | |
|---|---|
| Number of Openings | 9 |
| Elevation | 6,914.75 ft |
| Orifice Area | 0.0036 ft² |
| Top Elevation | 6,918.00 ft |
| Datum Elevation | 6,914.75 ft |
| Orifice Coefficient | 0.600 |

Subsection: Outlet Input Data
Label: SWQ Pond 2

Return Event: 2 years
Storm Event: TYPEIIA 24HR (2.0 in)

| Structure ID: Culvert - 1<br>Structure Type: Culvert-Circular | |
|---|---|
| Number of Barrels | 1 |
| Diameter | 24.0 in |
| Length | 23.00 ft |
| Length (Computed Barrel) | 23.00 ft |
| Slope (Computed) | 0.011 ft/ft |

| Outlet Control Data | |
|---|---|
| Manning's n | 0.013 |
| Ke | 0.200 |
| Kb | 0.012 |
| Kr | 0.000 |
| Convergence Tolerance | 0.00 ft |

| Inlet Control Data | |
|---|---|
| Equation Form | Form 1 |
| K | 0.0045 |
| M | 2.0000 |
| C | 0.0317 |
| Y | 0.6900 |
| T1 ratio (HW/D) | 1.090 |
| T2 ratio (HW/D) | 1.192 |
| Slope Correction Factor | -0.500 |

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

| | | | |
|---|---|---|---|
| T1 Elevation | 6,916.93 ft | T1 Flow | 15.55 $ft^3/s$ |
| T2 Elevation | 6,917.13 ft | T2 Flow | 17.77 $ft^3/s$ |

**Structure ID: Weir - 1**
**Structure Type: Irregular Weir**

| Station (ft) | Elevation (ft) |
|---|---|
| 100.00 | 0.00 |
| 106.00 | -1.00 |
| 156.00 | -1.00 |
| 162.00 | 0.00 |

| | |
|---|---|
| Lowest Elevation | 6,918.00 ft |
| Weir Coefficient | 3.00 (ft^0.5)/s |

Structure ID: TW
Structure Type: TW Setup, DS Channel

| | |
|---|---|
| Tailwater Type | Free Outfall |

| Convergence Tolerances | |
|---|---|
| Maximum Iterations | 30 |
| Tailwater Tolerance (Minimum) | 0.01 ft |
| Tailwater Tolerance (Maximum) | 0.50 ft |
| Headwater Tolerance (Minimum) | 0.01 ft |
| Headwater Tolerance (Maximum) | 0.50 ft |
| Flow Tolerance (Minimum) | 0.001 $ft^3/s$ |
| Flow Tolerance (Maximum) | 10.000 $ft^3/s$ |

Subsection: Elevation-Volume-Flow Table (Pond)
Label: EXIST. STOCK POND

Return Event: 2 years
Storm Event: TYPEIIA 24HR (2.0 in)

| Infiltration | |
|---|---|
| Infiltration Method (Computed) | No Infiltration |

| Initial Conditions | |
|---|---|
| Elevation (Water Surface, Initial) | 6,904.00 ft |
| Volume (Initial) | 0.000 ac-ft |
| Flow (Initial Outlet) | 0.00 ft³/s |
| Flow (Initial Infiltration) | 0.00 ft³/s |
| Flow (Initial, Total) | 0.00 ft³/s |
| Time Increment | 0.050 hours |

| Elevation (ft) | Outflow (ft³/s) | Storage (ac-ft) | Area (acres) | Infiltration (ft³/s) | Flow (Total) (ft³/s) | 2S/t + O (ft³/s) |
|---|---|---|---|---|---|---|
| 6,904.00 | 0.00 | 0.000 | 0.23 | 0.00 | 0.00 | 0.00 |
| 6,904.50 | 0.00 | 0.126 | 0.27 | 0.00 | 0.00 | 60.93 |
| 6,904.75 | 0.00 | 0.197 | 0.30 | 0.00 | 0.00 | 95.52 |
| 6,905.00 | 0.04 | 0.275 | 0.32 | 0.00 | 0.04 | 133.06 |
| 6,905.50 | 0.12 | 0.449 | 0.37 | 0.00 | 0.12 | 217.33 |
| 6,906.00 | 0.20 | 0.650 | 0.43 | 0.00 | 0.20 | 314.63 |
| 6,906.50 | 0.29 | 0.884 | 0.51 | 0.00 | 0.29 | 428.30 |
| 6,907.00 | 0.36 | 1.161 | 0.60 | 0.00 | 0.36 | 562.09 |
| 6,907.50 | 75.07 | 1.482 | 0.69 | 0.00 | 75.07 | 792.30 |
| 6,908.00 | 243.87 | 1.852 | 0.79 | 0.00 | 243.87 | 1,140.02 |
| 6,908.13 | 305.87 | 1.956 | 0.82 | 0.00 | 305.87 | 1,252.63 |
| 6,908.50 | 516.71 | 2.275 | 0.90 | 0.00 | 516.71 | 1,617.63 |
| 6,909.00 | 886.56 | 2.756 | 1.02 | 0.00 | 886.56 | 2,220.65 |
| 6,909.50 | 1,357.52 | 3.301 | 1.15 | 0.00 | 1,357.52 | 2,955.03 |
| 6,910.00 | 1,927.84 | 3.911 | 1.29 | 0.00 | 1,927.84 | 3,820.87 |

Subsection: Elevation-Volume-Flow Table (Pond)
Label: SWQ POND 1

Return Event: 2 years
Storm Event: TYPEIIA 24HR (2.0 in)

| Infiltration | |
|---|---|
| Infiltration Method (Computed) | No Infiltration |

| Initial Conditions | |
|---|---|
| Elevation (Water Surface, Initial) | 6,920.50 ft |
| Volume (Initial) | 0.000 ac-ft |
| Flow (Initial Outlet) | 0.00 ft³/s |
| Flow (Initial Infiltration) | 0.00 ft³/s |
| Flow (Initial, Total) | 0.00 ft³/s |
| Time Increment | 0.050 hours |

| Elevation (ft) | Outflow (ft³/s) | Storage (ac-ft) | Area (acres) | Infiltration (ft³/s) | Flow (Total) (ft³/s) | 2S/t + O (ft³/s) |
|---|---|---|---|---|---|---|
| 6,920.50 | 0.00 | 0.000 | 0.00 | 0.00 | 0.00 | 0.00 |
| 6,921.00 | 0.06 | 0.002 | 0.01 | 0.00 | 0.06 | 1.05 |
| 6,921.50 | 0.12 | 0.016 | 0.05 | 0.00 | 0.12 | 8.01 |
| 6,922.00 | 0.18 | 0.055 | 0.11 | 0.00 | 0.18 | 26.80 |
| 6,922.50 | 0.25 | 0.133 | 0.21 | 0.00 | 0.25 | 64.42 |
| 6,923.00 | 0.31 | 0.265 | 0.33 | 0.00 | 0.31 | 128.65 |
| 6,923.50 | 0.37 | 0.447 | 0.40 | 0.00 | 0.37 | 216.55 |
| 6,924.00 | 0.43 | 0.663 | 0.47 | 0.00 | 0.43 | 321.38 |
| 6,924.50 | 61.32 | 0.908 | 0.51 | 0.00 | 61.32 | 500.73 |
| 6,925.00 | 176.90 | 1.173 | 0.55 | 0.00 | 176.90 | 744.43 |

Subsection: Elevation-Volume-Flow Table (Pond)
Label: SWQ POND 2

Return Event: 2 years
Storm Event: TYPEIIA 24HR (2.0 in)

| Infiltration | |
|---|---|
| Infiltration Method (Computed) | No Infiltration |

| Initial Conditions | |
|---|---|
| Elevation (Water Surface, Initial) | 6,914.75 ft |
| Volume (Initial) | 0.000 ac-ft |
| Flow (Initial Outlet) | 0.00 ft³/s |
| Flow (Initial Infiltration) | 0.00 ft³/s |
| Flow (Initial, Total) | 0.00 ft³/s |
| Time Increment | 0.050 hours |

| Elevation (ft) | Outflow (ft³/s) | Storage (ac-ft) | Area (acres) | Infiltration (ft³/s) | Flow (Total) (ft³/s) | 2S/t + O (ft³/s) |
|---|---|---|---|---|---|---|
| 6,914.75 | 0.00 | 0.000 | 0.00 | 0.00 | 0.00 | 0.00 |
| 6,915.25 | 0.04 | 0.005 | 0.03 | 0.00 | 0.04 | 2.49 |
| 6,915.75 | 0.08 | 0.041 | 0.12 | 0.00 | 0.08 | 19.69 |
| 6,916.25 | 0.12 | 0.129 | 0.21 | 0.00 | 0.12 | 62.41 |
| 6,916.75 | 0.16 | 0.240 | 0.24 | 0.00 | 0.16 | 116.55 |
| 6,917.25 | 0.20 | 0.370 | 0.28 | 0.00 | 0.20 | 179.44 |
| 6,917.75 | 0.26 | 0.520 | 0.32 | 0.00 | 0.26 | 251.74 |
| 6,918.00 | 0.27 | 0.602 | 0.34 | 0.00 | 0.27 | 291.61 |
| 6,918.25 | 20.91 | 0.689 | 0.35 | 0.00 | 20.91 | 354.27 |
| 6,918.75 | 111.66 | 0.873 | 0.38 | 0.00 | 111.66 | 534.43 |
| 6,919.00 | 174.96 | 0.972 | 0.40 | 0.00 | 174.96 | 645.19 |

Subsection: Elevation-Volume-Flow Table (Pond)
Label: Waterbury Pond A

Return Event: 2 years
Storm Event: TYPEIIA 24HR (2.0 in)

| Infiltration | |
|---|---|
| Infiltration Method (Computed) | No Infiltration |

| Initial Conditions | |
|---|---|
| Elevation (Water Surface, Initial) | 6,921.00 ft |
| Volume (Initial) | 0.000 ac-ft |
| Flow (Initial Outlet) | 0.00 ft³/s |
| Flow (Initial Infiltration) | 0.00 ft³/s |
| Flow (Initial, Total) | 0.00 ft³/s |
| Time Increment | 0.050 hours |

| Elevation (ft) | Outflow (ft³/s) | Storage (ac-ft) | Area (acres) | Infiltration (ft³/s) | Flow (Total) (ft³/s) | 2S/t + O (ft³/s) |
|---|---|---|---|---|---|---|
| 6,921.00 | 0.00 | 0.000 | 0.00 | 0.00 | 0.00 | 0.00 |
| 6,921.50 | 0.00 | 0.001 | 0.00 | 0.00 | 0.00 | 0.56 |
| 6,922.00 | 0.00 | 0.002 | 0.00 | 0.00 | 0.00 | 1.11 |
| 6,922.50 | 0.00 | 0.003 | 0.00 | 0.00 | 0.00 | 1.67 |
| 6,923.00 | 0.00 | 0.005 | 0.00 | 0.00 | 0.00 | 2.22 |
| 6,923.50 | 0.00 | 0.006 | 0.00 | 0.00 | 0.00 | 2.78 |
| 6,924.00 | 0.06 | 0.007 | 0.00 | 0.00 | 0.06 | 3.39 |
| 6,924.50 | 0.12 | 0.012 | 0.02 | 0.00 | 0.12 | 6.09 |
| 6,925.00 | 0.17 | 0.034 | 0.07 | 0.00 | 0.17 | 16.46 |
| 6,925.50 | 0.23 | 0.082 | 0.13 | 0.00 | 0.23 | 39.76 |
| 6,926.00 | 0.29 | 0.167 | 0.22 | 0.00 | 0.29 | 81.25 |
| 6,926.50 | 0.35 | 0.286 | 0.26 | 0.00 | 0.35 | 138.57 |
| 6,927.00 | 0.41 | 0.426 | 0.30 | 0.00 | 0.41 | 206.50 |
| 6,927.50 | 0.47 | 0.590 | 0.35 | 0.00 | 0.47 | 285.92 |
| 6,928.00 | 0.52 | 0.779 | 0.41 | 0.00 | 0.52 | 377.73 |
| 6,928.50 | 0.58 | 0.990 | 0.44 | 0.00 | 0.58 | 479.94 |
| 6,929.00 | 4.85 | 1.218 | 0.47 | 0.00 | 4.85 | 594.34 |
| 6,929.50 | 12.64 | 1.463 | 0.51 | 0.00 | 12.64 | 720.55 |
| 6,930.00 | 22.67 | 1.725 | 0.54 | 0.00 | 22.67 | 857.59 |
| 6,930.50 | 34.46 | 2.005 | 0.58 | 0.00 | 34.46 | 1,005.00 |
| 6,931.00 | 47.73 | 2.303 | 0.61 | 0.00 | 47.73 | 1,162.46 |

# Index

C

C Springs (Time-Depth Curve, 2 years)...5

E

EXIST. STOCK POND (Elevation-Area Volume Curve, 2 years)...6

EXIST. STOCK POND (Elevation-Volume-Flow Table (Pond), 2 years)...26

Exist. Stock Pond (Outlet Input Data, 2 years)...10, 11, 12, 13

M

Master Network Summary...2, 3, 4

P

POND A OUTLET (Outlet Input Data, 2 years)...14, 15, 16, 17

S

SWQ POND 1 (Elevation-Area Volume Curve, 2 years)...7

SWQ POND 1 (Elevation-Volume-Flow Table (Pond), 2 years)...27

SWQ Pond 1 (Outlet Input Data, 2 years)...18, 19, 20, 21

SWQ POND 2 (Elevation-Area Volume Curve, 2 years)...8

SWQ POND 2 (Elevation-Volume-Flow Table (Pond), 2 years)...28

SWQ Pond 2 (Outlet Input Data, 2 years)...22, 23, 24, 25

W

Waterbury Pond A (Elevation-Area Volume Curve, 2 years)...9

Waterbury Pond A (Elevation-Volume-Flow Table (Pond), 2 years)...29

| Project Summary | |
|---|---|
| Title | Waterbury Phase 1 - Drainage Report |
| Engineer | MAW |
| Company | CCES |
| Date | 7/6/2016 |

| | |
|---|---|
| Notes | 5 year SCS Model |

# Table of Contents


| | | |
|---|---|---|
| | Master Network Summary | 2 |
| C Springs | Time-Depth Curve, 5 years | 5 |
| EXIST. STOCK POND | | |
| | Elevation-Area Volume Curve, 5 years | 6 |
| SWQ POND 1 | | |
| | Elevation-Area Volume Curve, 5 years | 7 |
| SWQ POND 2 | | |
| | Elevation-Area Volume Curve, 5 years | 8 |
| Waterbury Pond A | | |
| | Elevation-Area Volume Curve, 5 years | 9 |
| Exist. Stock Pond | | |
| | Outlet Input Data, 5 years | 10 |
| POND A OUTLET | | |
| | Outlet Input Data, 5 years | 14 |
| SWQ Pond 1 | | |
| | Outlet Input Data, 5 years | 18 |
| SWQ Pond 2 | | |
| | Outlet Input Data, 5 years | 22 |
| EXIST. STOCK POND | | |
| | Elevation-Volume-Flow Table (Pond), 5 years | 26 |
| SWQ POND 1 | | |
| | Elevation-Volume-Flow Table (Pond), 5 years | 27 |
| SWQ POND 2 | | |
| | Elevation-Volume-Flow Table (Pond), 5 years | 28 |
| Waterbury Pond A | | |
| | Elevation-Volume-Flow Table (Pond), 5 years | 29 |

Subsection: Master Network Summary

## Catchments Summary

| Label | Scenario | Return Event (years) | Hydrograph Volume (ac-ft) | Time to Peak (hours) | Peak Flow ($ft^3/s$) |
|---|---|---|---|---|---|
| 4 WAY BASINS D, E, N, Q, (50%)O | Post-Development 5 YEAR | 5 | 1.358 | 6.150 | 15.36 |
| 4-WAY BASINS F, J, K, M | Post-Development 5 YEAR | 5 | 0.946 | 6.150 | 9.57 |
| 4-WAY BASINS H, I, J, L, R, S | Post-Development 5 YEAR | 5 | 1.446 | 6.100 | 17.68 |
| A BASINS | Post-Development 5 YEAR | 5 | 1.212 | 6.100 | 17.48 |
| BASIN OS5, I, N | Post-Development 5 YEAR | 5 | 0.633 | 6.150 | 7.14 |
| Basin J OS-6 | Post-Development 5 YEAR | 5 | 0.139 | 6.050 | 2.32 |
| FG08 | Post-Development 5 YEAR | 5 | 7.119 | 6.150 | 86.00 |
| FG09 | Post-Development 5 YEAR | 5 | 1.794 | 6.050 | 27.48 |
| FG10 | Post-Development 5 YEAR | 5 | 1.678 | 6.100 | 24.73 |
| FG11 | Post-Development 5 YEAR | 5 | 2.772 | 6.050 | 46.50 |
| FG12 | Post-Development 5 YEAR | 5 | 1.914 | 6.050 | 30.28 |
| FG13 | Post-Development 5 YEAR | 5 | 2.048 | 6.150 | 22.45 |
| FG14 | Post-Development 5 YEAR | 5 | 2.393 | 6.100 | 30.96 |
| FG25 | Post-Development 5 YEAR | 5 | 2.333 | 6.100 | 30.76 |
| FG26 | Post-Development 5 YEAR | 5 | 3.294 | 6.150 | 40.61 |
| FG27 | Post-Development 5 YEAR | 5 | 3.609 | 6.050 | 59.22 |
| FG28 | Post-Development 5 YEAR | 5 | 4.600 | 6.150 | 58.43 |
| FG32 | Post-Development 5 YEAR | 5 | 6.000 | 6.100 | 84.87 |
| FG33 | Post-Development 5 YEAR | 5 | 6.899 | 6.050 | 119.74 |

## Node Summary

| Label | Scenario | Return Event (years) | Hydrograph Volume (ac-ft) | Time to Peak (hours) | Peak Flow ($ft^3/s$) |
|---|---|---|---|---|---|
| 4 WAY RELEASE | Post-Development 5 YEAR | 5 | 38.688 | 7.150 | 69.33 |
| G17 | Post-Development 5 YEAR | 5 | 16.990 | 6.250 | 35.13 |

Subsection: Master Network Summary

## Node Summary

| Label | Scenario | Return Event (years) | Hydrograph Volume (ac-ft) | Time to Peak (hours) | Peak Flow ($ft^3/s$) |
|---|---|---|---|---|---|
| G18 | Post-Development 5 YEAR | 5 | 23.894 | 6.100 | 128.10 |

## Pond Summary

| Label | Scenario | Return Event (years) | Hydrograph Volume (ac-ft) | Time to Peak (hours) | Peak Flow ($ft^3/s$) | Maximum Water Surface Elevation (ft) | Maximum Pond Storage (ac-ft) |
|---|---|---|---|---|---|---|---|
| EXIST. STOCK POND (IN) | Post-Development 5 YEAR | 5 | 39.892 | 7.100 | 69.42 | (N/A) | (N/A) |
| EXIST. STOCK POND (OUT) | Post-Development 5 YEAR | 5 | 38.688 | 7.150 | 69.33 | 6,907.46 | 1.456 |
| INLINE POND 1 (IN) | Post-Development 5 YEAR | 5 | 32.982 | 7.150 | 53.46 | (N/A) | (N/A) |
| INLINE POND 1 (OUT) | Post-Development 5 YEAR | 5 | 32.982 | 7.200 | 53.45 | 6,938.15 | 0.109 |
| POND D (IN) | Post-Development 5 YEAR | 5 | 19.718 | 6.100 | 258.91 | (N/A) | (N/A) |
| POND D (OUT) | Post-Development 5 YEAR | 5 | 14.656 | 6.950 | 28.13 | 7,054.04 | 8.700 |
| POND E (IN) | Post-Development 5 YEAR | 5 | 41.303 | 6.050 | 331.70 | (N/A) | (N/A) |
| POND E (OUT) | Post-Development 5 YEAR | 5 | 35.890 | 7.200 | 63.87 | 6,967.46 | 12.015 |
| POND HS (IN) | Post-Development 5 YEAR | 5 | 4.600 | 6.150 | 58.43 | (N/A) | (N/A) |
| POND HS (OUT) | Post-Development 5 YEAR | 5 | 4.510 | 6.450 | 22.94 | 6,969.68 | 1.493 |
| SWQ POND 1 (IN) | Post-Development 5 YEAR | 5 | 4.988 | 6.100 | 17.77 | (N/A) | (N/A) |
| SWQ POND 1 (OUT) | Post-Development 5 YEAR | 5 | 4.351 | 7.100 | 13.34 | 6,924.11 | 0.713 |
| SWQ POND 2 (IN) | Post-Development 5 YEAR | 5 | 0.946 | 6.150 | 9.57 | (N/A) | (N/A) |

Subsection: Master Network Summary

## Pond Summary

| Label | Scenario | Return Event (years) | Hydrograph Volume (ac-ft) | Time to Peak (hours) | Peak Flow ($ft^3/s$) | Maximum Water Surface Elevation (ft) | Maximum Pond Storage (ac-ft) |
|---|---|---|---|---|---|---|---|
| SWQ POND 2 (OUT) | Post-Development 5 YEAR | 5 | 0.360 | 20.000 | 0.35 | 6,918.00 | 0.602 |
| Waterbury Pond A (IN) | Post-Development 5 YEAR | 5 | 1.212 | 6.100 | 17.48 | (N/A) | (N/A) |
| Waterbury Pond A (OUT) | Post-Development 5 YEAR | 5 | 0.720 | 10.100 | 0.51 | 6,927.86 | 0.722 |

Subsection: Time-Depth Curve
Label: C Springs

Return Event: 5 years
Storm Event: TYPEIIA 24HR (2.6 in)

| Time-Depth Curve: TYPEIIA 24HR (2.6 in) | |
|---|---|
| Label | TYPEIIA 24HR (2.6 in) |
| Start Time | 0.000 hours |
| Increment | 0.250 hours |
| End Time | 24.000 hours |
| Return Event | 5 years |

**CUMULATIVE RAINFALL (in)**
**Output Time Increment = 0.250 hours**
**Time on left represents time for first value in each row.**

| Time (hours) | Depth (in) | Depth (in) | Depth (in) | Depth (in) | Depth (in) |
|---|---|---|---|---|---|
| 0.000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1.250 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2.500 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 |
| 3.750 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 5.000 | 0.2 | 0.2 | 0.3 | 1.0 | 1.8 |
| 6.250 | 1.9 | 2.0 | 2.0 | 2.0 | 2.1 |
| 7.500 | 2.1 | 2.1 | 2.1 | 2.1 | 2.2 |
| 8.750 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 |
| 10.000 | 2.2 | 2.2 | 2.3 | 2.3 | 2.3 |
| 11.250 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 |
| 12.500 | 2.3 | 2.3 | 2.4 | 2.4 | 2.4 |
| 13.750 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 |
| 15.000 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 |
| 16.250 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| 17.500 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| 18.750 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| 20.000 | 2.5 | 2.6 | 2.6 | 2.6 | 2.6 |
| 21.250 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 |
| 22.500 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 |
| 23.750 | 2.6 | 2.6 | (N/A) | (N/A) | (N/A) |

Subsection: Elevation-Area Volume Curve
Label: EXIST. STOCK POND

Return Event: 5 years
Storm Event: TYPEIIA 24HR (2.6 in)

| Elevation (ft) | Planimeter ($ft^2$) | Area (acres) | A1+A2+sqr (A1*A2) (acres) | Volume (ac-ft) | Volume (Total) (ac-ft) |
|---|---|---|---|---|---|
| 6,904.00 | 0.0000 | 0.23 | 0.00 | 0.000 | 0.000 |
| 6,906.00 | 0.0000 | 0.43 | 0.97 | 0.650 | 0.650 |
| 6,908.00 | 0.0000 | 0.79 | 1.80 | 1.202 | 1.852 |
| 6,910.00 | 0.0000 | 1.29 | 3.09 | 2.060 | 3.911 |

Subsection: Elevation-Area Volume Curve
Label: SWQ POND 1

Return Event: 5 years
Storm Event: TYPEIIA 24HR (2.6 in)

| Elevation (ft) | Planimeter ($ft^2$) | Area (acres) | A1+A2+sqr (A1*A2) (acres) | Volume (ac-ft) | Volume (Total) (ac-ft) |
|---|---|---|---|---|---|
| 6,920.50 | 0.0000 | 0.00 | 0.00 | 0.000 | 0.000 |
| 6,921.00 | 0.0000 | 0.01 | 0.01 | 0.002 | 0.002 |
| 6,922.00 | 0.0000 | 0.11 | 0.11 | 0.055 | 0.055 |
| 6,923.00 | 0.0000 | 0.33 | 0.63 | 0.210 | 0.265 |
| 6,924.00 | 0.0000 | 0.47 | 1.19 | 0.398 | 0.663 |
| 6,925.00 | 0.0000 | 0.55 | 1.53 | 0.509 | 1.173 |

Subsection: Elevation-Area Volume Curve
Label: SWQ POND 2

Return Event: 5 years
Storm Event: TYPEIIA 24HR (2.6 in)

| Elevation (ft) | Planimeter ($ft^2$) | Area (acres) | A1+A2+sqr (A1*A2) (acres) | Volume (ac-ft) | Volume (Total) (ac-ft) |
|---|---|---|---|---|---|
| 6,914.75 | 0.0000 | 0.00 | 0.00 | 0.000 | 0.000 |
| 6,915.25 | 0.0000 | 0.03 | 0.03 | 0.005 | 0.005 |
| 6,916.00 | 0.0000 | 0.19 | 0.19 | 0.079 | 0.079 |
| 6,918.00 | 0.0000 | 0.34 | 0.78 | 0.523 | 0.602 |
| 6,919.00 | 0.0000 | 0.40 | 1.11 | 0.370 | 0.972 |

Subsection: Elevation-Area Volume Curve
Label: Waterbury Pond A

Return Event: 5 years
Storm Event: TYPEIIA 24HR (2.6 in)

| Elevation (ft) | Planimeter ($ft^2$) | Area (acres) | A1+A2+sqr (A1*A2) (acres) | Volume (ac-ft) | Volume (Total) (ac-ft) |
|---|---|---|---|---|---|
| 6,921.00 | 0.0000 | 0.00 | 0.00 | 0.000 | 0.000 |
| 6,922.00 | 0.0000 | 0.00 | 0.01 | 0.002 | 0.002 |
| 6,924.00 | 0.0000 | 0.00 | 0.01 | 0.005 | 0.007 |
| 6,926.00 | 0.0000 | 0.22 | 0.24 | 0.160 | 0.167 |
| 6,928.00 | 0.0000 | 0.41 | 0.92 | 0.612 | 0.779 |
| 6,930.00 | 0.0000 | 0.54 | 1.42 | 0.946 | 1.725 |
| 6,931.00 | 0.0000 | 0.61 | 1.73 | 0.578 | 2.303 |

Subsection: Outlet Input Data
Label: Exist. Stock Pond

Return Event: 5 years
Storm Event: TYPEIIA 24HR (2.6 in)

| Requested Pond Water Surface Elevations | |
|---|---|
| Minimum (Headwater) | 6,904.00 ft |
| Increment (Headwater) | 0.50 ft |
| Maximum (Headwater) | 6,910.00 ft |

## Spot Elevations

| SpotElevation (ft) |
|---|
| 6,908.13 |

## Outlet Connectivity

| Structure Type | Outlet ID | Direction | Outfall | E1 (ft) | E2 (ft) |
|---|---|---|---|---|---|
| Inlet Box | Riser - 1 | Forward | Culvert - 1 | 6,907.50 | 6,910.00 |
| Orifice-Area | Orifice - 1 | Forward | Culvert - 1 | 6,904.75 | 6,910.00 |
| Culvert-Circular | Culvert - 1 | Forward | TW | 6,904.50 | 6,910.00 |
| Irregular Weir | Weir - 1 | Forward | TW | 6,907.00 | 6,910.00 |
| Tailwater Settings | Tailwater | | | (N/A) | (N/A) |

**Structure ID: Weir - 1**
**Structure Type: Irregular Weir**

| Station (ft) | Elevation (ft) |
|---|---|
| 100.00 | 0.00 |
| 109.00 | -3.00 |
| 170.00 | -3.00 |
| 220.00 | -2.00 |
| 320.00 | 0.00 |

| | |
|---|---|
| Lowest Elevation | 6,907.00 ft |
| Weir Coefficient | 3.00 (ft^0.5)/s |

Structure ID: Riser - 1
Structure Type: Inlet Box

| | |
|---|---|
| Number of Openings | 1 |
| Elevation | 6,907.50 ft |
| Orifice Area | 10.4000 ft² |
| Orifice Coefficient | 0.600 |
| Weir Length | 4.00 ft |
| Weir Coefficient | 3.00 (ft^0.5)/s |
| K Reverse | 1.000 |
| Manning's n | 0.000 |
| Kev, Charged Riser | 0.000 |
| Weir Submergence | False |
| Orifice H to crest | False |

Structure ID: Orifice - 1
Structure Type: Orifice-Area

| | |
|---|---|
| Number of Openings | 8 |
| Elevation | 6,904.75 ft |
| Orifice Area | 0.0069 ft² |
| Top Elevation | 6,907.50 ft |
| Datum Elevation | 6,904.75 ft |
| Orifice Coefficient | 0.600 |

Structure ID: Culvert - 1
Structure Type: Culvert-Circular

| | |
|---|---|
| Number of Barrels | 1 |
| Diameter | 24.0 in |
| Length | 77.00 ft |
| Length (Computed Barrel) | 77.00 ft |
| Slope (Computed) | 0.006 ft/ft |

Outlet Control Data

| | |
|---|---|
| Manning's n | 0.013 |
| Ke | 0.200 |
| Kb | 0.012 |
| Kr | 0.000 |
| Convergence Tolerance | 0.00 ft |

| Inlet Control Data | |
|---|---|
| Equation Form | Form 1 |
| K | 0.0045 |
| M | 2.0000 |
| C | 0.0317 |
| Y | 0.6900 |
| T1 ratio (HW/D) | 1.092 |
| T2 ratio (HW/D) | 1.194 |
| Slope Correction Factor | -0.500 |

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

| | | | |
|---|---|---|---|
| T1 Elevation | 6,906.68 ft | T1 Flow | 15.55 $ft^3/s$ |
| T2 Elevation | 6,906.89 ft | T2 Flow | 17.77 $ft^3/s$ |

Structure ID: TW
Structure Type: TW Setup, DS Channel

| Tailwater Type | Free Outfall |
|---|---|

| Convergence Tolerances | |
|---|---|
| Maximum Iterations | 30 |
| Tailwater Tolerance (Minimum) | 0.01 ft |
| Tailwater Tolerance (Maximum) | 0.50 ft |
| Headwater Tolerance (Minimum) | 0.01 ft |
| Headwater Tolerance (Maximum) | 0.50 ft |
| Flow Tolerance (Minimum) | 0.001 $ft^3/s$ |
| Flow Tolerance (Maximum) | 10.000 $ft^3/s$ |

Subsection: Outlet Input Data
Label: POND A OUTLET

Return Event: 5 years
Storm Event: TYPEIIA 24HR (2.6 in)

| Requested Pond Water Surface Elevations | |
|---|---|
| Minimum (Headwater) | 6,921.00 ft |
| Increment (Headwater) | 0.50 ft |
| Maximum (Headwater) | 6,931.00 ft |

## Outlet Connectivity

| Structure Type | Outlet ID | Direction | Outfall | E1 (ft) | E2 (ft) |
|---|---|---|---|---|---|
| Inlet Box | Riser - 1 | Forward | Culvert - 1 | 6,928.50 | 6,931.00 |
| Orifice-Area | Orifice - 1 | Forward | Culvert - 1 | 6,923.50 | 6,931.00 |
| Culvert-Circular | Culvert - 1 | Forward | TW | 6,920.80 | 6,931.00 |
| Tailwater Settings | Tailwater | | | (N/A) | (N/A) |

| Structure ID: Orifice - 1<br>Structure Type: Orifice-Area | |
|---|---|
| Number of Openings | 15 |
| Elevation | 6,923.50 ft |
| Orifice Area | 0.0036 ft² |
| Top Elevation | 6,928.50 ft |
| Datum Elevation | 6,923.50 ft |
| Orifice Coefficient | 0.600 |

| Structure ID: Riser - 1<br>Structure Type: Inlet Box | |
|---|---|
| Number of Openings | 1 |
| Elevation | 6,928.50 ft |
| Orifice Area | 12.8000 ft² |
| Orifice Coefficient | 0.600 |
| Weir Length | 4.00 ft |
| Weir Coefficient | 3.00 (ft^0.5)/s |
| K Reverse | 1.000 |
| Manning's n | 0.000 |
| Kev, Charged Riser | 0.000 |
| Weir Submergence | False |
| Orifice H to crest | False |

| Structure ID: Culvert - 1<br>Structure Type: Culvert-Circular | |
|---|---|
| Number of Barrels | 1 |
| Diameter | 24.0 in |
| Length | 75.00 ft |
| Length (Computed Barrel) | 75.00 ft |
| Slope (Computed) | 0.011 ft/ft |

| Outlet Control Data | |
|---|---|
| Manning's n | 0.013 |
| Ke | 0.200 |
| Kb | 0.012 |
| Kr | 0.000 |
| Convergence Tolerance | 0.00 ft |

| Inlet Control Data | |
|---|---|
| Equation Form | Form 1 |
| K | 0.0045 |
| M | 2.0000 |
| C | 0.0317 |

Subsection: Outlet Input Data
Label: POND A OUTLET

Return Event: 5 years
Storm Event: TYPEIIA 24HR (2.6 in)

| Inlet Control Data | |
|---|---|
| Y | 0.6900 |
| T1 ratio (HW/D) | 1.090 |
| T2 ratio (HW/D) | 1.192 |
| Slope Correction Factor | -0.500 |

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

| | | | |
|---|---|---|---|
| T1 Elevation | 6,922.98 ft | T1 Flow | 15.55 $ft^3/s$ |
| T2 Elevation | 6,923.18 ft | T2 Flow | 17.77 $ft^3/s$ |

Structure ID: TW
Structure Type: TW Setup, DS Channel

| Tailwater Type | Free Outfall |
|---|---|

| Convergence Tolerances | |
|---|---|
| Maximum Iterations | 30 |
| Tailwater Tolerance (Minimum) | 0.01 ft |
| Tailwater Tolerance (Maximum) | 0.50 ft |
| Headwater Tolerance (Minimum) | 0.01 ft |
| Headwater Tolerance (Maximum) | 0.50 ft |
| Flow Tolerance (Minimum) | 0.001 $ft^3/s$ |
| Flow Tolerance (Maximum) | 10.000 $ft^3/s$ |

Subsection: Outlet Input Data
Label: SWQ Pond 1

Return Event: 5 years
Storm Event: TYPEIIA 24HR (2.6 in)

| Requested Pond Water Surface Elevations | |
|---|---|
| Minimum (Headwater) | 6,920.50 ft |
| Increment (Headwater) | 0.50 ft |
| Maximum (Headwater) | 6,925.00 ft |

## Outlet Connectivity

| Structure Type | Outlet ID | Direction | Outfall | E1 (ft) | E2 (ft) |
|---|---|---|---|---|---|
| Inlet Box | Riser - 1 | Forward | Culvert - 1 | 6,924.00 | 6,925.00 |
| Orifice-Area | Orifice - 1 | Forward | Culvert - 1 | 6,920.50 | 6,925.00 |
| Culvert-Circular | Culvert - 1 | Forward | TW | 6,920.00 | 6,925.00 |
| Irregular Weir | Weir - 1 | Forward | TW | 6,924.00 | 6,925.00 |
| Tailwater Settings | Tailwater | | | (N/A) | (N/A) |

| Structure ID: Riser - 1<br>Structure Type: Inlet Box | |
|---|---|
| Number of Openings | 1 |
| Elevation | 6,924.00 ft |
| Orifice Area | 12.8000 ft² |
| Orifice Coefficient | 0.600 |
| Weir Length | 4.00 ft |
| Weir Coefficient | 3.00 (ft^0.5)/s |
| K Reverse | 1.000 |
| Manning's n | 0.000 |
| Kev, Charged Riser | 0.000 |
| Weir Submergence | False |
| Orifice H to crest | False |

| Structure ID: Orifice - 1<br>Structure Type: Orifice-Area | |
|---|---|
| Number of Openings | 10 |
| Elevation | 6,920.50 ft |
| Orifice Area | 0.0048 ft² |
| Top Elevation | 6,924.00 ft |
| Datum Elevation | 6,920.50 ft |
| Orifice Coefficient | 0.600 |

| Structure ID: Culvert - 1<br>Structure Type: Culvert-Circular | |
|---|---|
| Number of Barrels | 1 |
| Diameter | 24.0 in |
| Length | 26.07 ft |
| Length (Computed Barrel) | 26.07 ft |
| Slope (Computed) | 0.019 ft/ft |

| Outlet Control Data | |
|---|---|
| Manning's n | 0.013 |
| Ke | 0.200 |
| Kb | 0.012 |
| Kr | 0.000 |
| Convergence Tolerance | 0.00 ft |

| Inlet Control Data | |
|---|---|
| Equation Form | Form 1 |
| K | 0.0045 |
| M | 2.0000 |
| C | 0.0317 |
| Y | 0.6900 |
| T1 ratio (HW/D) | 1.086 |
| T2 ratio (HW/D) | 1.188 |
| Slope Correction Factor | -0.500 |

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

| | | | |
|---|---|---|---|
| T1 Elevation | 6,922.17 ft | T1 Flow | 15.55 $ft^3/s$ |
| T2 Elevation | 6,922.38 ft | T2 Flow | 17.77 $ft^3/s$ |

**Structure ID: Weir - 1**
**Structure Type: Irregular Weir**

| Station (ft) | Elevation (ft) |
|---|---|
| 100.00 | 0.00 |
| 104.00 | -1.00 |
| 156.00 | -1.00 |
| 160.00 | 0.00 |

| | |
|---|---|
| Lowest Elevation | 6,924.00 ft |
| Weir Coefficient | 3.00 (ft^0.5)/s |

Structure ID: TW
Structure Type: TW Setup, DS Channel

| | |
|---|---|
| Tailwater Type | Free Outfall |

| Convergence Tolerances | |
|---|---|
| Maximum Iterations | 30 |
| Tailwater Tolerance (Minimum) | 0.01 ft |
| Tailwater Tolerance (Maximum) | 0.50 ft |
| Headwater Tolerance (Minimum) | 0.01 ft |
| Headwater Tolerance (Maximum) | 0.50 ft |
| Flow Tolerance (Minimum) | 0.001 $ft^3/s$ |
| Flow Tolerance (Maximum) | 10.000 $ft^3/s$ |

Subsection: Outlet Input Data
Label: SWQ Pond 2

Return Event: 5 years
Storm Event: TYPEIIA 24HR (2.6 in)

| Requested Pond Water Surface Elevations | |
|---|---|
| Minimum (Headwater) | 6,914.00 ft |
| Increment (Headwater) | 0.50 ft |
| Maximum (Headwater) | 6,919.00 ft |

## Outlet Connectivity

| Structure Type | Outlet ID | Direction | Outfall | E1 (ft) | E2 (ft) |
|---|---|---|---|---|---|
| Inlet Box | Riser - 1 | Forward | Culvert - 1 | 6,918.00 | 6,919.00 |
| Orifice-Area | Orifice - 1 | Forward | Culvert - 1 | 6,914.75 | 6,919.00 |
| Culvert-Circular | Culvert - 1 | Forward | TW | 6,914.75 | 6,919.00 |
| Irregular Weir | Weir - 1 | Forward | TW | 6,918.00 | 6,919.00 |
| Tailwater Settings | Tailwater | | | (N/A) | (N/A) |

| Structure ID: Riser - 1<br>Structure Type: Inlet Box | |
|---|---|
| Number of Openings | 1 |
| Elevation | 6,918.00 ft |
| Orifice Area | 12.8000 ft² |
| Orifice Coefficient | 0.600 |
| Weir Length | 4.00 ft |
| Weir Coefficient | 3.00 (ft^0.5)/s |
| K Reverse | 1.000 |
| Manning's n | 0.000 |
| Kev, Charged Riser | 0.000 |
| Weir Submergence | False |
| Orifice H to crest | False |

| Structure ID: Orifice - 1<br>Structure Type: Orifice-Area | |
|---|---|
| Number of Openings | 9 |
| Elevation | 6,914.75 ft |
| Orifice Area | 0.0036 ft² |
| Top Elevation | 6,918.00 ft |
| Datum Elevation | 6,914.75 ft |
| Orifice Coefficient | 0.600 |

Subsection: Outlet Input Data
Label: SWQ Pond 2

Return Event: 5 years
Storm Event: TYPEIIA 24HR (2.6 in)

| Structure ID: Culvert - 1<br>Structure Type: Culvert-Circular | |
|---|---|
| Number of Barrels | 1 |
| Diameter | 24.0 in |
| Length | 23.00 ft |
| Length (Computed Barrel) | 23.01 ft |
| Slope (Computed) | -0.033 ft/ft |

| Outlet Control Data | |
|---|---|
| Manning's n | 0.013 |
| Ke | 0.200 |
| Kb | 0.012 |
| Kr | 0.000 |
| Convergence Tolerance | 0.00 ft |

| Inlet Control Data | |
|---|---|
| Equation Form | Form 1 |
| K | 0.0045 |
| M | 2.0000 |
| C | 0.0317 |
| Y | 0.6900 |
| T1 ratio (HW/D) | 1.112 |
| T2 ratio (HW/D) | 1.214 |
| Slope Correction Factor | -0.500 |

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

| | | | |
|---|---|---|---|
| T1 Elevation | 6,916.97 ft | T1 Flow | 15.55 $ft^3/s$ |
| T2 Elevation | 6,917.18 ft | T2 Flow | 17.77 $ft^3/s$ |

**Structure ID: Weir - 1**
**Structure Type: Irregular Weir**

| Station (ft) | Elevation (ft) |
|---|---|
| 100.00 | 0.00 |
| 106.00 | -1.00 |
| 156.00 | -1.00 |
| 162.00 | 0.00 |

| | |
|---|---|
| Lowest Elevation | 6,918.00 ft |
| Weir Coefficient | 3.00 (ft^0.5)/s |

Structure ID: TW
Structure Type: TW Setup, DS Channel

| | |
|---|---|
| Tailwater Type | Free Outfall |

| Convergence Tolerances | |
|---|---|
| Maximum Iterations | 30 |
| Tailwater Tolerance (Minimum) | 0.01 ft |
| Tailwater Tolerance (Maximum) | 0.50 ft |
| Headwater Tolerance (Minimum) | 0.01 ft |
| Headwater Tolerance (Maximum) | 0.50 ft |
| Flow Tolerance (Minimum) | 0.001 $ft^3/s$ |
| Flow Tolerance (Maximum) | 10.000 $ft^3/s$ |

Subsection: Elevation-Volume-Flow Table (Pond)
Label: EXIST. STOCK POND

Return Event: 5 years
Storm Event: TYPEIIA 24HR (2.6 in)

| Infiltration | |
|---|---|
| Infiltration Method (Computed) | No Infiltration |

| Initial Conditions | |
|---|---|
| Elevation (Water Surface, Initial) | 6,904.00 ft |
| Volume (Initial) | 0.000 ac-ft |
| Flow (Initial Outlet) | 0.00 ft³/s |
| Flow (Initial Infiltration) | 0.00 ft³/s |
| Flow (Initial, Total) | 0.00 ft³/s |
| Time Increment | 0.050 hours |

| Elevation (ft) | Outflow (ft³/s) | Storage (ac-ft) | Area (acres) | Infiltration (ft³/s) | Flow (Total) (ft³/s) | 2S/t + O (ft³/s) |
|---|---|---|---|---|---|---|
| 6,904.00 | 0.00 | 0.000 | 0.23 | 0.00 | 0.00 | 0.00 |
| 6,904.50 | 0.00 | 0.126 | 0.27 | 0.00 | 0.00 | 60.93 |
| 6,904.75 | 0.00 | 0.197 | 0.30 | 0.00 | 0.00 | 95.52 |
| 6,905.00 | 0.04 | 0.275 | 0.32 | 0.00 | 0.04 | 133.06 |
| 6,905.50 | 0.12 | 0.449 | 0.37 | 0.00 | 0.12 | 217.33 |
| 6,906.00 | 0.20 | 0.650 | 0.43 | 0.00 | 0.20 | 314.63 |
| 6,906.50 | 0.29 | 0.884 | 0.51 | 0.00 | 0.29 | 428.30 |
| 6,907.00 | 0.36 | 1.161 | 0.60 | 0.00 | 0.36 | 562.09 |
| 6,907.50 | 75.07 | 1.482 | 0.69 | 0.00 | 75.07 | 792.30 |
| 6,908.00 | 243.87 | 1.852 | 0.79 | 0.00 | 243.87 | 1,140.02 |
| 6,908.13 | 305.87 | 1.956 | 0.82 | 0.00 | 305.87 | 1,252.63 |
| 6,908.50 | 516.71 | 2.275 | 0.90 | 0.00 | 516.71 | 1,617.63 |
| 6,909.00 | 886.56 | 2.756 | 1.02 | 0.00 | 886.56 | 2,220.65 |
| 6,909.50 | 1,357.52 | 3.301 | 1.15 | 0.00 | 1,357.52 | 2,955.03 |
| 6,910.00 | 1,927.84 | 3.911 | 1.29 | 0.00 | 1,927.84 | 3,820.87 |

Subsection: Elevation-Volume-Flow Table (Pond)
Label: SWQ POND 1

Return Event: 5 years
Storm Event: TYPEIIA 24HR (2.6 in)

| Infiltration | |
|---|---|
| Infiltration Method (Computed) | No Infiltration |

| Initial Conditions | |
|---|---|
| Elevation (Water Surface, Initial) | 6,920.50 ft |
| Volume (Initial) | 0.000 ac-ft |
| Flow (Initial Outlet) | 0.00 ft³/s |
| Flow (Initial Infiltration) | 0.00 ft³/s |
| Flow (Initial, Total) | 0.00 ft³/s |
| Time Increment | 0.050 hours |

| Elevation (ft) | Outflow (ft³/s) | Storage (ac-ft) | Area (acres) | Infiltration (ft³/s) | Flow (Total) (ft³/s) | 2S/t + O (ft³/s) |
|---|---|---|---|---|---|---|
| 6,920.50 | 0.00 | 0.000 | 0.00 | 0.00 | 0.00 | 0.00 |
| 6,921.00 | 0.06 | 0.002 | 0.01 | 0.00 | 0.06 | 1.05 |
| 6,921.50 | 0.12 | 0.016 | 0.05 | 0.00 | 0.12 | 8.01 |
| 6,922.00 | 0.18 | 0.055 | 0.11 | 0.00 | 0.18 | 26.80 |
| 6,922.50 | 0.25 | 0.133 | 0.21 | 0.00 | 0.25 | 64.42 |
| 6,923.00 | 0.31 | 0.265 | 0.33 | 0.00 | 0.31 | 128.65 |
| 6,923.50 | 0.37 | 0.447 | 0.40 | 0.00 | 0.37 | 216.55 |
| 6,924.00 | 0.43 | 0.663 | 0.47 | 0.00 | 0.43 | 321.38 |
| 6,924.50 | 61.32 | 0.908 | 0.51 | 0.00 | 61.32 | 500.73 |
| 6,925.00 | 176.90 | 1.173 | 0.55 | 0.00 | 176.90 | 744.43 |

Subsection: Elevation-Volume-Flow Table (Pond)
Label: SWQ POND 2

Return Event: 5 years
Storm Event: TYPEIIA 24HR (2.6 in)

| Infiltration | |
|---|---|
| Infiltration Method (Computed) | No Infiltration |

| Initial Conditions | |
|---|---|
| Elevation (Water Surface, Initial) | 6,914.75 ft |
| Volume (Initial) | 0.000 ac-ft |
| Flow (Initial Outlet) | 0.00 ft³/s |
| Flow (Initial Infiltration) | 0.00 ft³/s |
| Flow (Initial, Total) | 0.00 ft³/s |
| Time Increment | 0.050 hours |

| Elevation (ft) | Outflow (ft³/s) | Storage (ac-ft) | Area (acres) | Infiltration (ft³/s) | Flow (Total) (ft³/s) | 2S/t + O (ft³/s) |
|---|---|---|---|---|---|---|
| 6,914.75 | 0.00 | 0.000 | 0.00 | 0.00 | 0.00 | 0.00 |
| 6,915.25 | 0.00 | 0.005 | 0.03 | 0.00 | 0.00 | 2.45 |
| 6,915.75 | 0.02 | 0.041 | 0.12 | 0.00 | 0.02 | 19.64 |
| 6,916.25 | 0.07 | 0.129 | 0.21 | 0.00 | 0.07 | 62.36 |
| 6,916.75 | 0.11 | 0.240 | 0.24 | 0.00 | 0.11 | 116.50 |
| 6,917.25 | 0.17 | 0.370 | 0.28 | 0.00 | 0.17 | 179.40 |
| 6,917.75 | 0.22 | 0.520 | 0.32 | 0.00 | 0.22 | 251.70 |
| 6,918.00 | 0.24 | 0.602 | 0.34 | 0.00 | 0.24 | 291.58 |
| 6,918.25 | 20.87 | 0.689 | 0.35 | 0.00 | 20.87 | 354.23 |
| 6,918.75 | 111.63 | 0.873 | 0.38 | 0.00 | 111.63 | 534.39 |
| 6,919.00 | 174.91 | 0.972 | 0.40 | 0.00 | 174.91 | 645.14 |

Subsection: Elevation-Volume-Flow Table (Pond)
Label: Waterbury Pond A

Return Event: 5 years
Storm Event: TYPEIIA 24HR (2.6 in)

| Infiltration | |
|---|---|
| Infiltration Method (Computed) | No Infiltration |

| Initial Conditions | |
|---|---|
| Elevation (Water Surface, Initial) | 6,921.00 ft |
| Volume (Initial) | 0.000 ac-ft |
| Flow (Initial Outlet) | 0.00 ft³/s |
| Flow (Initial Infiltration) | 0.00 ft³/s |
| Flow (Initial, Total) | 0.00 ft³/s |
| Time Increment | 0.050 hours |

| Elevation (ft) | Outflow (ft³/s) | Storage (ac-ft) | Area (acres) | Infiltration (ft³/s) | Flow (Total) (ft³/s) | 2S/t + O (ft³/s) |
|---|---|---|---|---|---|---|
| 6,921.00 | 0.00 | 0.000 | 0.00 | 0.00 | 0.00 | 0.00 |
| 6,921.50 | 0.00 | 0.001 | 0.00 | 0.00 | 0.00 | 0.56 |
| 6,922.00 | 0.00 | 0.002 | 0.00 | 0.00 | 0.00 | 1.11 |
| 6,922.50 | 0.00 | 0.003 | 0.00 | 0.00 | 0.00 | 1.67 |
| 6,923.00 | 0.00 | 0.005 | 0.00 | 0.00 | 0.00 | 2.22 |
| 6,923.50 | 0.00 | 0.006 | 0.00 | 0.00 | 0.00 | 2.78 |
| 6,924.00 | 0.06 | 0.007 | 0.00 | 0.00 | 0.06 | 3.39 |
| 6,924.50 | 0.12 | 0.012 | 0.02 | 0.00 | 0.12 | 6.09 |
| 6,925.00 | 0.17 | 0.034 | 0.07 | 0.00 | 0.17 | 16.46 |
| 6,925.50 | 0.23 | 0.082 | 0.13 | 0.00 | 0.23 | 39.76 |
| 6,926.00 | 0.29 | 0.167 | 0.22 | 0.00 | 0.29 | 81.25 |
| 6,926.50 | 0.35 | 0.286 | 0.26 | 0.00 | 0.35 | 138.57 |
| 6,927.00 | 0.41 | 0.426 | 0.30 | 0.00 | 0.41 | 206.50 |
| 6,927.50 | 0.47 | 0.590 | 0.35 | 0.00 | 0.47 | 285.92 |
| 6,928.00 | 0.52 | 0.779 | 0.41 | 0.00 | 0.52 | 377.73 |
| 6,928.50 | 0.58 | 0.990 | 0.44 | 0.00 | 0.58 | 479.94 |
| 6,929.00 | 4.85 | 1.218 | 0.47 | 0.00 | 4.85 | 594.34 |
| 6,929.50 | 12.64 | 1.463 | 0.51 | 0.00 | 12.64 | 720.55 |
| 6,930.00 | 22.67 | 1.725 | 0.54 | 0.00 | 22.67 | 857.59 |
| 6,930.50 | 34.46 | 2.005 | 0.58 | 0.00 | 34.46 | 1,005.00 |
| 6,931.00 | 47.73 | 2.303 | 0.61 | 0.00 | 47.73 | 1,162.46 |

# Index

C

C Springs (Time-Depth Curve, 5 years)...5

E

EXIST. STOCK POND (Elevation-Area Volume Curve, 5 years)...6

EXIST. STOCK POND (Elevation-Volume-Flow Table (Pond), 5 years)...26

Exist. Stock Pond (Outlet Input Data, 5 years)...10, 11, 12, 13

M

Master Network Summary...2, 3, 4

P

POND A OUTLET (Outlet Input Data, 5 years)...14, 15, 16, 17

S

SWQ POND 1 (Elevation-Area Volume Curve, 5 years)...7

SWQ POND 1 (Elevation-Volume-Flow Table (Pond), 5 years)...27

SWQ Pond 1 (Outlet Input Data, 5 years)...18, 19, 20, 21

SWQ POND 2 (Elevation-Area Volume Curve, 5 years)...8

SWQ POND 2 (Elevation-Volume-Flow Table (Pond), 5 years)...28

SWQ Pond 2 (Outlet Input Data, 5 years)...22, 23, 24, 25

W

Waterbury Pond A (Elevation-Area Volume Curve, 5 years)...9

Waterbury Pond A (Elevation-Volume-Flow Table (Pond), 5 years)...29

| Project Summary | |
|---|---|
| Title | Waterbury Phase 1 - Drainage Report |
| Engineer | MAW |
| Company | CCES |
| Date | 7/6/2016 |

| | |
|---|---|
| Notes | 100 year SCS Model |

# Table of Contents


| | | |
|---|---|---|
| | Master Network Summary | 2 |
| C Springs | Time-Depth Curve, 100 years | 5 |
| EXIST. STOCK POND | | |
| | Elevation-Area Volume Curve, 100 years | 6 |
| SWQ POND 1 | | |
| | Elevation-Area Volume Curve, 100 years | 7 |
| SWQ POND 2 | | |
| | Elevation-Area Volume Curve, 100 years | 8 |
| Waterbury Pond A | | |
| | Elevation-Area Volume Curve, 100 years | 9 |
| Exist. Stock Pond | | |
| | Outlet Input Data, 100 years | 10 |
| POND A OUTLET | | |
| | Outlet Input Data, 100 years | 14 |
| SWQ Pond 1 | | |
| | Outlet Input Data, 100 years | 18 |
| SWQ Pond 2 | | |
| | Outlet Input Data, 100 years | 22 |
| EXIST. STOCK POND | | |
| | Elevation-Volume-Flow Table (Pond), 100 years | 26 |
| SWQ POND 1 | | |
| | Elevation-Volume-Flow Table (Pond), 100 years | 27 |
| SWQ POND 2 | | |
| | Elevation-Volume-Flow Table (Pond), 100 years | 28 |
| Waterbury Pond A | | |
| | Elevation-Volume-Flow Table (Pond), 100 years | 29 |

Subsection: Master Network Summary

## Catchments Summary

| Label | Scenario | Return Event (years) | Hydrograph Volume (ac-ft) | Time to Peak (hours) | Peak Flow ($ft^3/s$) |
|---|---|---|---|---|---|
| 4 WAY BASINS D, E, N, Q (50%)O | Post-Development 100 YEAR | 100 | 4.459 | 6.100 | 60.75 |
| 4-WAY BASINS F, G, K, M | Post-Development 100 YEAR | 100 | 3.726 | 6.100 | 52.94 |
| 4-WAY BASINS H, I, J, L, R, S | Post-Development 100 YEAR | 100 | 5.693 | 6.050 | 91.21 |
| A BASINS | Post-Development 100 YEAR | 100 | 3.004 | 6.050 | 44.87 |
| BASIN OS5, I, N | Post-Development 100 YEAR | 100 | 2.079 | 6.100 | 28.25 |
| Basin J, OS-6 | Post-Development 100 YEAR | 100 | 0.456 | 6.050 | 8.14 |
| FG08 | Post-Development 100 YEAR | 100 | 20.511 | 6.100 | 278.75 |
| FG09 | Post-Development 100 YEAR | 100 | 4.964 | 6.050 | 80.98 |
| FG10 | Post-Development 100 YEAR | 100 | 4.700 | 6.050 | 75.10 |
| FG11 | Post-Development 100 YEAR | 100 | 6.949 | 6.050 | 117.19 |
| FG12 | Post-Development 100 YEAR | 100 | 4.746 | 6.050 | 77.10 |
| FG13 | Post-Development 100 YEAR | 100 | 6.138 | 6.150 | 77.95 |
| FG14 | Post-Development 100 YEAR | 100 | 7.336 | 6.100 | 107.44 |
| FG25 | Post-Development 100 YEAR | 100 | 6.214 | 6.100 | 88.74 |
| FG26 | Post-Development 100 YEAR | 100 | 9.539 | 6.100 | 132.96 |
| FG27 | Post-Development 100 YEAR | 100 | 9.794 | 6.050 | 165.74 |
| FG28 | Post-Development 100 YEAR | 100 | 11.406 | 6.100 | 154.75 |
| FG32 | Post-Development 100 YEAR | 100 | 16.129 | 6.050 | 240.72 |
| FG33 | Post-Development 100 YEAR | 100 | 15.853 | 6.000 | 271.41 |

## Node Summary

| Label | Scenario | Return Event (years) | Hydrograph Volume (ac-ft) | Time to Peak (hours) | Peak Flow ($ft^3/s$) |
|---|---|---|---|---|---|
| 4 WAY RELEASE | Post-Development 100 YEAR | 100 | 127.556 | 6.200 | 396.12 |
| G17 | Post-Development 100 YEAR | 100 | 55.751 | 6.200 | 179.81 |

Subsection: Master Network Summary

## Node Summary

| Label | Scenario | Return Event (years) | Hydrograph Volume (ac-ft) | Time to Peak (hours) | Peak Flow ($ft^3/s$) |
|---|---|---|---|---|---|
| G18 | Post-Development 100 YEAR | 100 | 75.084 | 6.100 | 443.03 |

## Pond Summary

| Label | Scenario | Return Event (years) | Hydrograph Volume (ac-ft) | Time to Peak (hours) | Peak Flow ($ft^3/s$) | Maximum Water Surface Elevation (ft) | Maximum Pond Storage (ac-ft) |
|---|---|---|---|---|---|---|---|
| EXIST. STOCK POND (IN) | Post-Development 100 YEAR | 100 | 128.794 | 6.200 | 395.44 | (N/A) | (N/A) |
| EXIST. STOCK POND (OUT) | Post-Development 100 YEAR | 100 | 127.556 | 6.200 | 396.12 | 6,908.29 | 2.089 |
| INLINE POND 1 (IN) | Post-Development 100 YEAR | 100 | 87.165 | 6.500 | 212.23 | (N/A) | (N/A) |
| INLINE POND 1 (OUT) | Post-Development 100 YEAR | 100 | 87.165 | 6.750 | 207.73 | 6,941.92 | 1.212 |
| POND D (IN) | Post-Development 100 YEAR | 100 | 55.344 | 6.050 | 787.29 | (N/A) | (N/A) |
| POND D (OUT) | Post-Development 100 YEAR | 100 | 49.537 | 6.550 | 137.40 | 7,056.69 | 25.125 |
| POND E (IN) | Post-Development 100 YEAR | 100 | 118.291 | 6.050 | 971.63 | (N/A) | (N/A) |
| POND E (OUT) | Post-Development 100 YEAR | 100 | 111.575 | 6.600 | 316.33 | 6,969.72 | 29.584 |
| POND HS (IN) | Post-Development 100 YEAR | 100 | 11.406 | 6.100 | 154.75 | (N/A) | (N/A) |
| POND HS (OUT) | Post-Development 100 YEAR | 100 | 11.224 | 6.350 | 77.69 | 6,971.51 | 3.793 |
| SWQ POND 1 (IN) | Post-Development 100 YEAR | 100 | 32.183 | 6.100 | 132.55 | (N/A) | (N/A) |
| SWQ POND 1 (OUT) | Post-Development 100 YEAR | 100 | 31.516 | 6.150 | 131.35 | 6,924.80 | 1.066 |
| SWQ POND 2 (IN) | Post-Development 100 YEAR | 100 | 3.726 | 6.100 | 52.94 | (N/A) | (N/A) |

Subsection: Master Network Summary

## Pond Summary

| Label | Scenario | Return Event (years) | Hydrograph Volume (ac-ft) | Time to Peak (hours) | Peak Flow ($ft^3/s$) | Maximum Water Surface Elevation (ft) | Maximum Pond Storage (ac-ft) |
|---|---|---|---|---|---|---|---|
| SWQ POND 2 (OUT) | Post-Development 100 YEAR | 100 | 3.123 | 6.150 | 50.71 | 6,918.41 | 0.748 |
| Waterbury Pond A (IN) | Post-Development 100 YEAR | 100 | 3.004 | 6.050 | 44.87 | (N/A) | (N/A) |
| Waterbury Pond A (OUT) | Post-Development 100 YEAR | 100 | 2.107 | 6.400 | 11.93 | 6,929.45 | 1.440 |

Subsection: Time-Depth Curve
Label: C Springs

Return Event: 100 years
Storm Event: TYPEIIA 24HR (4.4 in)

| Time-Depth Curve: TYPEIIA 24HR (4.4 in) | |
|---|---|
| Label | TYPEIIA 24HR (4.4 in) |
| Start Time | 0.000 hours |
| Increment | 0.250 hours |
| End Time | 24.000 hours |
| Return Event | 100 years |

**CUMULATIVE RAINFALL (in)**
**Output Time Increment = 0.250 hours**
**Time on left represents time for first value in each row.**

| Time (hours) | Depth (in) | Depth (in) | Depth (in) | Depth (in) | Depth (in) |
|---|---|---|---|---|---|
| 0.000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1.250 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 |
| 2.500 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 3.750 | 0.1 | 0.1 | 0.2 | 0.2 | 0.2 |
| 5.000 | 0.3 | 0.3 | 0.4 | 1.8 | 3.1 |
| 6.250 | 3.2 | 3.3 | 3.4 | 3.4 | 3.5 |
| 7.500 | 3.5 | 3.6 | 3.6 | 3.6 | 3.7 |
| 8.750 | 3.7 | 3.7 | 3.7 | 3.7 | 3.8 |
| 10.000 | 3.8 | 3.8 | 3.8 | 3.8 | 3.9 |
| 11.250 | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 |
| 12.500 | 3.9 | 4.0 | 4.0 | 4.0 | 4.0 |
| 13.750 | 4.0 | 4.0 | 4.1 | 4.1 | 4.1 |
| 15.000 | 4.1 | 4.1 | 4.1 | 4.1 | 4.1 |
| 16.250 | 4.1 | 4.2 | 4.2 | 4.2 | 4.2 |
| 17.500 | 4.2 | 4.2 | 4.2 | 4.2 | 4.2 |
| 18.750 | 4.3 | 4.3 | 4.3 | 4.3 | 4.3 |
| 20.000 | 4.3 | 4.3 | 4.3 | 4.3 | 4.3 |
| 21.250 | 4.3 | 4.3 | 4.4 | 4.4 | 4.4 |
| 22.500 | 4.4 | 4.4 | 4.4 | 4.4 | 4.4 |
| 23.750 | 4.4 | 4.4 | (N/A) | (N/A) | (N/A) |

Subsection: Elevation-Area Volume Curve
Label: EXIST. STOCK POND

Return Event: 100 years
Storm Event: TYPEIIA 24HR (4.4 in)

| Elevation (ft) | Planimeter ($ft^2$) | Area (acres) | A1+A2+sqr (A1*A2) (acres) | Volume (ac-ft) | Volume (Total) (ac-ft) |
|---|---|---|---|---|---|
| 6,904.00 | 0.0000 | 0.23 | 0.00 | 0.000 | 0.000 |
| 6,906.00 | 0.0000 | 0.43 | 0.97 | 0.650 | 0.650 |
| 6,908.00 | 0.0000 | 0.79 | 1.80 | 1.202 | 1.852 |
| 6,910.00 | 0.0000 | 1.29 | 3.09 | 2.060 | 3.911 |

Subsection: Elevation-Area Volume Curve
Label: SWQ POND 1

Return Event: 100 years
Storm Event: TYPEIIA 24HR (4.4 in)

| Elevation (ft) | Planimeter ($ft^2$) | Area (acres) | A1+A2+sqr (A1*A2) (acres) | Volume (ac-ft) | Volume (Total) (ac-ft) |
|---|---|---|---|---|---|
| 6,920.50 | 0.0000 | 0.00 | 0.00 | 0.000 | 0.000 |
| 6,921.00 | 0.0000 | 0.01 | 0.01 | 0.002 | 0.002 |
| 6,922.00 | 0.0000 | 0.11 | 0.11 | 0.055 | 0.055 |
| 6,923.00 | 0.0000 | 0.33 | 0.63 | 0.210 | 0.265 |
| 6,924.00 | 0.0000 | 0.47 | 1.19 | 0.398 | 0.663 |
| 6,925.00 | 0.0000 | 0.55 | 1.53 | 0.509 | 1.173 |

Subsection: Elevation-Area Volume Curve
Label: SWQ POND 2

Return Event: 100 years
Storm Event: TYPEIIA 24HR (4.4 in)

| Elevation (ft) | Planimeter ($ft^2$) | Area (acres) | A1+A2+sqr (A1*A2) (acres) | Volume (ac-ft) | Volume (Total) (ac-ft) |
|---|---|---|---|---|---|
| 6,914.75 | 0.0000 | 0.00 | 0.00 | 0.000 | 0.000 |
| 6,915.25 | 0.0000 | 0.03 | 0.03 | 0.005 | 0.005 |
| 6,916.00 | 0.0000 | 0.19 | 0.19 | 0.079 | 0.079 |
| 6,918.00 | 0.0000 | 0.34 | 0.78 | 0.523 | 0.602 |
| 6,919.00 | 0.0000 | 0.40 | 1.11 | 0.370 | 0.972 |

Subsection: Elevation-Area Volume Curve
Label: Waterbury Pond A

Return Event: 100 years
Storm Event: TYPEIIA 24HR (4.4 in)

| Elevation (ft) | Planimeter ($ft^2$) | Area (acres) | A1+A2+sqr (A1*A2) (acres) | Volume (ac-ft) | Volume (Total) (ac-ft) |
|---|---|---|---|---|---|
| 6,921.00 | 0.0000 | 0.00 | 0.00 | 0.000 | 0.000 |
| 6,922.00 | 0.0000 | 0.00 | 0.01 | 0.002 | 0.002 |
| 6,924.00 | 0.0000 | 0.00 | 0.01 | 0.005 | 0.007 |
| 6,926.00 | 0.0000 | 0.22 | 0.24 | 0.160 | 0.167 |
| 6,928.00 | 0.0000 | 0.41 | 0.92 | 0.612 | 0.779 |
| 6,930.00 | 0.0000 | 0.54 | 1.42 | 0.946 | 1.725 |
| 6,931.00 | 0.0000 | 0.61 | 1.73 | 0.578 | 2.303 |

| Requested Pond Water Surface Elevations | |
|---|---|
| Minimum (Headwater) | 6,904.00 ft |
| Increment (Headwater) | 0.50 ft |
| Maximum (Headwater) | 6,910.00 ft |

## Spot Elevations

| SpotElevation (ft) |
|---|
| 6,908.13 |

## Outlet Connectivity

| Structure Type | Outlet ID | Direction | Outfall | E1 (ft) | E2 (ft) |
|---|---|---|---|---|---|
| Inlet Box | Riser - 1 | Forward | Culvert - 1 | 6,907.50 | 6,910.00 |
| Orifice-Area | Orifice - 1 | Forward | Culvert - 1 | 6,904.75 | 6,910.00 |
| Culvert-Circular | Culvert - 1 | Forward | TW | 6,904.50 | 6,910.00 |
| Irregular Weir | Weir - 1 | Forward | TW | 6,907.00 | 6,910.00 |
| Tailwater Settings | Tailwater | | | (N/A) | (N/A) |

**Structure ID: Weir - 1**
**Structure Type: Irregular Weir**

| Station (ft) | Elevation (ft) |
|---|---|
| 100.00 | 0.00 |
| 109.00 | -3.00 |
| 170.00 | -3.00 |
| 220.00 | -2.00 |
| 320.00 | 0.00 |

| | |
|---|---|
| Lowest Elevation | 6,907.00 ft |
| Weir Coefficient | 3.00 (ft^0.5)/s |

Structure ID: Riser - 1
Structure Type: Inlet Box

| | |
|---|---|
| Number of Openings | 1 |
| Elevation | 6,907.50 ft |
| Orifice Area | 10.4000 ft² |
| Orifice Coefficient | 0.600 |
| Weir Length | 4.00 ft |
| Weir Coefficient | 3.00 (ft^0.5)/s |
| K Reverse | 1.000 |
| Manning's n | 0.000 |
| Kev, Charged Riser | 0.000 |
| Weir Submergence | False |
| Orifice H to crest | False |

Subsection: Outlet Input Data
Label: Exist. Stock Pond

Return Event: 100 years
Storm Event: TYPEIIA 24HR (4.4 in)

| Structure ID: Culvert - 1<br>Structure Type: Culvert-Circular | |
|---|---|
| Number of Barrels | 1 |
| Diameter | 24.0 in |
| Length | 77.00 ft |
| Length (Computed Barrel) | 77.00 ft |
| Slope (Computed) | 0.006 ft/ft |

| Outlet Control Data | |
|---|---|
| Manning's n | 0.013 |
| Ke | 0.200 |
| Kb | 0.012 |
| Kr | 0.000 |
| Convergence Tolerance | 0.00 ft |

| Inlet Control Data | |
|---|---|
| Equation Form | Form 1 |
| K | 0.0045 |
| M | 2.0000 |
| C | 0.0317 |
| Y | 0.6900 |
| T1 ratio (HW/D) | 1.092 |
| T2 ratio (HW/D) | 1.194 |
| Slope Correction Factor | -0.500 |

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

| | | | |
|---|---|---|---|
| T1 Elevation | 6,906.68 ft | T1 Flow | 15.55 $ft^3/s$ |
| T2 Elevation | 6,906.89 ft | T2 Flow | 17.77 $ft^3/s$ |

| Structure ID: Orifice - 1<br>Structure Type: Orifice-Area | |
|---|---|
| Number of Openings | 8 |
| Elevation | 6,904.75 ft |
| Orifice Area | 0.0069 $ft^2$ |
| Top Elevation | 6,907.50 ft |
| Datum Elevation | 6,904.75 ft |
| Orifice Coefficient | 0.600 |

| Structure ID: TW<br>Structure Type: TW Setup, DS Channel | |
|---|---|
| Tailwater Type | Free Outfall |

| Convergence Tolerances | |
|---|---|
| Maximum Iterations | 30 |
| Tailwater Tolerance (Minimum) | 0.01 ft |
| Tailwater Tolerance (Maximum) | 0.50 ft |
| Headwater Tolerance (Minimum) | 0.01 ft |
| Headwater Tolerance (Maximum) | 0.50 ft |
| Flow Tolerance (Minimum) | 0.001 $ft^3/s$ |
| Flow Tolerance (Maximum) | 10.000 $ft^3/s$ |

Subsection: Outlet Input Data
Label: POND A OUTLET

Return Event: 100 years
Storm Event: TYPEIIA 24HR (4.4 in)

| Requested Pond Water Surface Elevations | |
|---|---|
| Minimum (Headwater) | 6,921.00 ft |
| Increment (Headwater) | 0.50 ft |
| Maximum (Headwater) | 6,931.00 ft |

## Outlet Connectivity

| Structure Type | Outlet ID | Direction | Outfall | E1 (ft) | E2 (ft) |
|---|---|---|---|---|---|
| Inlet Box | Riser - 1 | Forward | Culvert - 1 | 6,928.50 | 6,931.00 |
| Orifice-Area | Orifice - 1 | Forward | Culvert - 1 | 6,923.50 | 6,931.00 |
| Culvert-Circular | Culvert - 1 | Forward | TW | 6,920.80 | 6,931.00 |
| Tailwater Settings | Tailwater | | | (N/A) | (N/A) |

| Structure ID: Orifice - 1<br>Structure Type: Orifice-Area | |
|---|---|
| Number of Openings | 15 |
| Elevation | 6,923.50 ft |
| Orifice Area | 0.0036 ft² |
| Top Elevation | 6,928.50 ft |
| Datum Elevation | 6,923.50 ft |
| Orifice Coefficient | 0.600 |

| Structure ID: Riser - 1<br>Structure Type: Inlet Box | |
|---|---|
| Number of Openings | 1 |
| Elevation | 6,928.50 ft |
| Orifice Area | 12.8000 ft² |
| Orifice Coefficient | 0.600 |
| Weir Length | 4.00 ft |
| Weir Coefficient | 3.00 (ft^0.5)/s |
| K Reverse | 1.000 |
| Manning's n | 0.000 |
| Kev, Charged Riser | 0.000 |
| Weir Submergence | False |
| Orifice H to crest | False |

| Structure ID: Culvert - 1<br>Structure Type: Culvert-Circular | |
|---|---|
| Number of Barrels | 1 |
| Diameter | 24.0 in |
| Length | 75.00 ft |
| Length (Computed Barrel) | 75.00 ft |
| Slope (Computed) | 0.011 ft/ft |

| Outlet Control Data | |
|---|---|
| Manning's n | 0.013 |
| Ke | 0.200 |
| Kb | 0.012 |
| Kr | 0.000 |
| Convergence Tolerance | 0.00 ft |

| Inlet Control Data | |
|---|---|
| Equation Form | Form 1 |
| K | 0.0045 |
| M | 2.0000 |
| C | 0.0317 |

Subsection: Outlet Input Data
Label: POND A OUTLET

Return Event: 100 years
Storm Event: TYPEIIA 24HR (4.4 in)

| Inlet Control Data | |
|---|---|
| Y | 0.6900 |
| T1 ratio (HW/D) | 1.090 |
| T2 ratio (HW/D) | 1.192 |
| Slope Correction Factor | -0.500 |

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

| | | | |
|---|---|---|---|
| T1 Elevation | 6,922.98 ft | T1 Flow | 15.55 $ft^3/s$ |
| T2 Elevation | 6,923.18 ft | T2 Flow | 17.77 $ft^3/s$ |

Structure ID: TW
Structure Type: TW Setup, DS Channel

| Tailwater Type | Free Outfall |
|---|---|

| Convergence Tolerances | |
|---|---|
| Maximum Iterations | 30 |
| Tailwater Tolerance (Minimum) | 0.01 ft |
| Tailwater Tolerance (Maximum) | 0.50 ft |
| Headwater Tolerance (Minimum) | 0.01 ft |
| Headwater Tolerance (Maximum) | 0.50 ft |
| Flow Tolerance (Minimum) | 0.001 $ft^3/s$ |
| Flow Tolerance (Maximum) | 10.000 $ft^3/s$ |

Subsection: Outlet Input Data
Label: SWQ Pond 1

Return Event: 100 years
Storm Event: TYPEIIA 24HR (4.4 in)

| Requested Pond Water Surface Elevations | |
|---|---|
| Minimum (Headwater) | 6,920.50 ft |
| Increment (Headwater) | 0.50 ft |
| Maximum (Headwater) | 6,925.00 ft |

## Outlet Connectivity

| Structure Type | Outlet ID | Direction | Outfall | E1 (ft) | E2 (ft) |
|---|---|---|---|---|---|
| Inlet Box | Riser - 1 | Forward | Culvert - 1 | 6,924.00 | 6,925.00 |
| Orifice-Area | Orifice - 1 | Forward | Culvert - 1 | 6,920.50 | 6,925.00 |
| Culvert-Circular | Culvert - 1 | Forward | TW | 6,920.00 | 6,925.00 |
| Irregular Weir | Weir - 1 | Forward | TW | 6,924.00 | 6,925.00 |
| Tailwater Settings | Tailwater | | | (N/A) | (N/A) |

| Structure ID: Riser - 1<br>Structure Type: Inlet Box | |
|---|---|
| Number of Openings | 1 |
| Elevation | 6,924.00 ft |
| Orifice Area | 12.8000 ft² |
| Orifice Coefficient | 0.600 |
| Weir Length | 4.00 ft |
| Weir Coefficient | 3.00 (ft^0.5)/s |
| K Reverse | 1.000 |
| Manning's n | 0.000 |
| Kev, Charged Riser | 0.000 |
| Weir Submergence | False |
| Orifice H to crest | False |

| Structure ID: Orifice - 1<br>Structure Type: Orifice-Area | |
|---|---|
| Number of Openings | 10 |
| Elevation | 6,920.50 ft |
| Orifice Area | 0.0048 ft² |
| Top Elevation | 6,924.00 ft |
| Datum Elevation | 6,920.50 ft |
| Orifice Coefficient | 0.600 |

Subsection: Outlet Input Data
Label: SWQ Pond 1

Return Event: 100 years
Storm Event: TYPEIIA 24HR (4.4 in)

| Structure ID: Culvert - 1<br>Structure Type: Culvert-Circular | |
|---|---|
| Number of Barrels | 1 |
| Diameter | 24.0 in |
| Length | 26.07 ft |
| Length (Computed Barrel) | 26.07 ft |
| Slope (Computed) | 0.019 ft/ft |

| Outlet Control Data | |
|---|---|
| Manning's n | 0.013 |
| Ke | 0.200 |
| Kb | 0.012 |
| Kr | 0.000 |
| Convergence Tolerance | 0.00 ft |

| Inlet Control Data | |
|---|---|
| Equation Form | Form 1 |
| K | 0.0045 |
| M | 2.0000 |
| C | 0.0317 |
| Y | 0.6900 |
| T1 ratio (HW/D) | 1.086 |
| T2 ratio (HW/D) | 1.188 |
| Slope Correction Factor | -0.500 |

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

| | | | |
|---|---|---|---|
| T1 Elevation | 6,922.17 ft | T1 Flow | 15.55 $ft^3/s$ |
| T2 Elevation | 6,922.38 ft | T2 Flow | 17.77 $ft^3/s$ |

**Structure ID: Weir - 1**
**Structure Type: Irregular Weir**

| Station (ft) | Elevation (ft) |
|---|---|
| 100.00 | 0.00 |
| 104.00 | -1.00 |
| 156.00 | -1.00 |
| 160.00 | 0.00 |

| | |
|---|---|
| Lowest Elevation | 6,924.00 ft |
| Weir Coefficient | 3.00 (ft^0.5)/s |

Structure ID: TW
Structure Type: TW Setup, DS Channel

| Tailwater Type | Free Outfall |
|---|---|

| Convergence Tolerances | |
|---|---|
| Maximum Iterations | 30 |
| Tailwater Tolerance (Minimum) | 0.01 ft |
| Tailwater Tolerance (Maximum) | 0.50 ft |
| Headwater Tolerance (Minimum) | 0.01 ft |
| Headwater Tolerance (Maximum) | 0.50 ft |
| Flow Tolerance (Minimum) | 0.001 $ft^3/s$ |
| Flow Tolerance (Maximum) | 10.000 $ft^3/s$ |

| Requested Pond Water Surface Elevations | |
|---|---|
| Minimum (Headwater) | 6,914.00 ft |
| Increment (Headwater) | 0.50 ft |
| Maximum (Headwater) | 6,919.00 ft |

## Outlet Connectivity

| Structure Type | Outlet ID | Direction | Outfall | E1 (ft) | E2 (ft) |
|---|---|---|---|---|---|
| Inlet Box | Riser - 1 | Forward | Culvert - 1 | 6,918.00 | 6,919.00 |
| Orifice-Area | Orifice - 1 | Forward | Culvert - 1 | 6,914.75 | 6,919.00 |
| Culvert-Circular | Culvert - 1 | Forward | TW | 6,914.75 | 6,919.00 |
| Irregular Weir | Weir - 1 | Forward | TW | 6,918.00 | 6,919.00 |
| Tailwater Settings | Tailwater | | | (N/A) | (N/A) |

| Structure ID: Riser - 1<br>Structure Type: Inlet Box | |
|---|---|
| Number of Openings | 1 |
| Elevation | 6,918.00 ft |
| Orifice Area | 12.8000 ft² |
| Orifice Coefficient | 0.600 |
| Weir Length | 4.00 ft |
| Weir Coefficient | 3.00 (ft^0.5)/s |
| K Reverse | 1.000 |
| Manning's n | 0.000 |
| Kev, Charged Riser | 0.000 |
| Weir Submergence | False |
| Orifice H to crest | False |

| Structure ID: Orifice - 1<br>Structure Type: Orifice-Area | |
|---|---|
| Number of Openings | 9 |
| Elevation | 6,914.75 ft |
| Orifice Area | 0.0036 ft² |
| Top Elevation | 6,918.00 ft |
| Datum Elevation | 6,914.75 ft |
| Orifice Coefficient | 0.600 |

Subsection: Outlet Input Data
Label: SWQ Pond 2

Return Event: 100 years
Storm Event: TYPEIIA 24HR (4.4 in)

| Structure ID: Culvert - 1<br>Structure Type: Culvert-Circular | |
|---|---|
| Number of Barrels | 1 |
| Diameter | 24.0 in |
| Length | 23.00 ft |
| Length (Computed Barrel) | 23.00 ft |
| Slope (Computed) | 0.011 ft/ft |

| Outlet Control Data | |
|---|---|
| Manning's n | 0.013 |
| Ke | 0.200 |
| Kb | 0.012 |
| Kr | 0.000 |
| Convergence Tolerance | 0.00 ft |

| Inlet Control Data | |
|---|---|
| Equation Form | Form 1 |
| K | 0.0045 |
| M | 2.0000 |
| C | 0.0317 |
| Y | 0.6900 |
| T1 ratio (HW/D) | 0.000 |
| T2 ratio (HW/D) | 1.192 |
| Slope Correction Factor | -0.500 |

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

| | | | |
|---|---|---|---|
| T1 Elevation | 6,914.75 ft | T1 Flow | 15.55 $ft^3/s$ |
| T2 Elevation | 6,917.13 ft | T2 Flow | 17.77 $ft^3/s$ |

**Structure ID: Weir - 1**
**Structure Type: Irregular Weir**

| Station (ft) | Elevation (ft) |
|---|---|
| 100.00 | 0.00 |
| 106.00 | -1.00 |
| 156.00 | -1.00 |
| 162.00 | 0.00 |

| | |
|---|---|
| Lowest Elevation | 6,918.00 ft |
| Weir Coefficient | 3.00 (ft^0.5)/s |

Structure ID: TW
Structure Type: TW Setup, DS Channel

| | |
|---|---|
| Tailwater Type | Free Outfall |

| Convergence Tolerances | |
|---|---|
| Maximum Iterations | 30 |
| Tailwater Tolerance (Minimum) | 0.01 ft |
| Tailwater Tolerance (Maximum) | 0.50 ft |
| Headwater Tolerance (Minimum) | 0.01 ft |
| Headwater Tolerance (Maximum) | 0.50 ft |
| Flow Tolerance (Minimum) | 0.001 $ft^3/s$ |
| Flow Tolerance (Maximum) | 10.000 $ft^3/s$ |

Subsection: Elevation-Volume-Flow Table (Pond)
Label: EXIST. STOCK POND

Return Event: 100 years
Storm Event: TYPEIIA 24HR (4.4 in)

| Infiltration | |
|---|---|
| Infiltration Method (Computed) | No Infiltration |

| Initial Conditions | |
|---|---|
| Elevation (Water Surface, Initial) | 6,904.00 ft |
| Volume (Initial) | 0.000 ac-ft |
| Flow (Initial Outlet) | 0.00 ft³/s |
| Flow (Initial Infiltration) | 0.00 ft³/s |
| Flow (Initial, Total) | 0.00 ft³/s |
| Time Increment | 0.050 hours |

| Elevation (ft) | Outflow (ft³/s) | Storage (ac-ft) | Area (acres) | Infiltration (ft³/s) | Flow (Total) (ft³/s) | 2S/t + O (ft³/s) |
|---|---|---|---|---|---|---|
| 6,904.00 | 0.00 | 0.000 | 0.23 | 0.00 | 0.00 | 0.00 |
| 6,904.50 | 0.00 | 0.126 | 0.27 | 0.00 | 0.00 | 60.93 |
| 6,904.75 | 0.00 | 0.197 | 0.30 | 0.00 | 0.00 | 95.52 |
| 6,905.00 | 0.04 | 0.275 | 0.32 | 0.00 | 0.04 | 133.06 |
| 6,905.50 | 0.12 | 0.449 | 0.37 | 0.00 | 0.12 | 217.33 |
| 6,906.00 | 0.20 | 0.650 | 0.43 | 0.00 | 0.20 | 314.63 |
| 6,906.50 | 0.29 | 0.884 | 0.51 | 0.00 | 0.29 | 428.30 |
| 6,907.00 | 0.36 | 1.161 | 0.60 | 0.00 | 0.36 | 562.09 |
| 6,907.50 | 75.07 | 1.482 | 0.69 | 0.00 | 75.07 | 792.30 |
| 6,908.00 | 243.87 | 1.852 | 0.79 | 0.00 | 243.87 | 1,140.02 |
| 6,908.13 | 305.87 | 1.956 | 0.82 | 0.00 | 305.87 | 1,252.63 |
| 6,908.50 | 516.71 | 2.275 | 0.90 | 0.00 | 516.71 | 1,617.63 |
| 6,909.00 | 886.56 | 2.756 | 1.02 | 0.00 | 886.56 | 2,220.65 |
| 6,909.50 | 1,357.52 | 3.301 | 1.15 | 0.00 | 1,357.52 | 2,955.03 |
| 6,910.00 | 1,927.84 | 3.911 | 1.29 | 0.00 | 1,927.84 | 3,820.87 |

Subsection: Elevation-Volume-Flow Table (Pond)
Label: SWQ POND 1

Return Event: 100 years
Storm Event: TYPEIIA 24HR (4.4 in)

| Infiltration | |
|---|---|
| Infiltration Method (Computed) | No Infiltration |

| Initial Conditions | |
|---|---|
| Elevation (Water Surface, Initial) | 6,920.50 ft |
| Volume (Initial) | 0.000 ac-ft |
| Flow (Initial Outlet) | 0.00 ft³/s |
| Flow (Initial Infiltration) | 0.00 ft³/s |
| Flow (Initial, Total) | 0.00 ft³/s |
| Time Increment | 0.050 hours |

| Elevation (ft) | Outflow (ft³/s) | Storage (ac-ft) | Area (acres) | Infiltration (ft³/s) | Flow (Total) (ft³/s) | 2S/t + O (ft³/s) |
|---|---|---|---|---|---|---|
| 6,920.50 | 0.00 | 0.000 | 0.00 | 0.00 | 0.00 | 0.00 |
| 6,921.00 | 0.06 | 0.002 | 0.01 | 0.00 | 0.06 | 1.05 |
| 6,921.50 | 0.12 | 0.016 | 0.05 | 0.00 | 0.12 | 8.01 |
| 6,922.00 | 0.18 | 0.055 | 0.11 | 0.00 | 0.18 | 26.80 |
| 6,922.50 | 0.25 | 0.133 | 0.21 | 0.00 | 0.25 | 64.42 |
| 6,923.00 | 0.31 | 0.265 | 0.33 | 0.00 | 0.31 | 128.65 |
| 6,923.50 | 0.37 | 0.447 | 0.40 | 0.00 | 0.37 | 216.55 |
| 6,924.00 | 0.43 | 0.663 | 0.47 | 0.00 | 0.43 | 321.38 |
| 6,924.50 | 61.32 | 0.908 | 0.51 | 0.00 | 61.32 | 500.73 |
| 6,925.00 | 176.90 | 1.173 | 0.55 | 0.00 | 176.90 | 744.43 |

Subsection: Elevation-Volume-Flow Table (Pond)
Label: SWQ POND 2

Return Event: 100 years
Storm Event: TYPEIIA 24HR (4.4 in)

| Infiltration | |
|---|---|
| Infiltration Method (Computed) | No Infiltration |

| Initial Conditions | |
|---|---|
| Elevation (Water Surface, Initial) | 6,914.75 ft |
| Volume (Initial) | 0.000 ac-ft |
| Flow (Initial Outlet) | 0.00 ft³/s |
| Flow (Initial Infiltration) | 0.00 ft³/s |
| Flow (Initial, Total) | 0.00 ft³/s |
| Time Increment | 0.050 hours |

| Elevation (ft) | Outflow (ft³/s) | Storage (ac-ft) | Area (acres) | Infiltration (ft³/s) | Flow (Total) (ft³/s) | 2S/t + O (ft³/s) |
|---|---|---|---|---|---|---|
| 6,914.75 | 0.00 | 0.000 | 0.00 | 0.00 | 0.00 | 0.00 |
| 6,915.25 | 0.04 | 0.005 | 0.03 | 0.00 | 0.04 | 2.49 |
| 6,915.75 | 0.08 | 0.041 | 0.12 | 0.00 | 0.08 | 19.69 |
| 6,916.25 | 0.12 | 0.129 | 0.21 | 0.00 | 0.12 | 62.41 |
| 6,916.75 | 0.16 | 0.240 | 0.24 | 0.00 | 0.16 | 116.55 |
| 6,917.25 | 0.20 | 0.370 | 0.28 | 0.00 | 0.20 | 179.44 |
| 6,917.75 | 0.26 | 0.520 | 0.32 | 0.00 | 0.26 | 251.74 |
| 6,918.00 | 0.27 | 0.602 | 0.34 | 0.00 | 0.27 | 291.61 |
| 6,918.25 | 20.91 | 0.689 | 0.35 | 0.00 | 20.91 | 354.27 |
| 6,918.75 | 111.66 | 0.873 | 0.38 | 0.00 | 111.66 | 534.43 |
| 6,919.00 | 174.96 | 0.972 | 0.40 | 0.00 | 174.96 | 645.19 |

Subsection: Elevation-Volume-Flow Table (Pond)
Label: Waterbury Pond A

Return Event: 100 years
Storm Event: TYPEIIA 24HR (4.4 in)

| Infiltration | |
|---|---|
| Infiltration Method (Computed) | No Infiltration |

| Initial Conditions | |
|---|---|
| Elevation (Water Surface, Initial) | 6,921.00 ft |
| Volume (Initial) | 0.000 ac-ft |
| Flow (Initial Outlet) | 0.00 ft³/s |
| Flow (Initial Infiltration) | 0.00 ft³/s |
| Flow (Initial, Total) | 0.00 ft³/s |
| Time Increment | 0.050 hours |

| Elevation (ft) | Outflow (ft³/s) | Storage (ac-ft) | Area (acres) | Infiltration (ft³/s) | Flow (Total) (ft³/s) | 2S/t + O (ft³/s) |
|---|---|---|---|---|---|---|
| 6,921.00 | 0.00 | 0.000 | 0.00 | 0.00 | 0.00 | 0.00 |
| 6,921.50 | 0.00 | 0.001 | 0.00 | 0.00 | 0.00 | 0.56 |
| 6,922.00 | 0.00 | 0.002 | 0.00 | 0.00 | 0.00 | 1.11 |
| 6,922.50 | 0.00 | 0.003 | 0.00 | 0.00 | 0.00 | 1.67 |
| 6,923.00 | 0.00 | 0.005 | 0.00 | 0.00 | 0.00 | 2.22 |
| 6,923.50 | 0.00 | 0.006 | 0.00 | 0.00 | 0.00 | 2.78 |
| 6,924.00 | 0.06 | 0.007 | 0.00 | 0.00 | 0.06 | 3.39 |
| 6,924.50 | 0.12 | 0.012 | 0.02 | 0.00 | 0.12 | 6.09 |
| 6,925.00 | 0.17 | 0.034 | 0.07 | 0.00 | 0.17 | 16.46 |
| 6,925.50 | 0.23 | 0.082 | 0.13 | 0.00 | 0.23 | 39.76 |
| 6,926.00 | 0.29 | 0.167 | 0.22 | 0.00 | 0.29 | 81.25 |
| 6,926.50 | 0.35 | 0.286 | 0.26 | 0.00 | 0.35 | 138.57 |
| 6,927.00 | 0.41 | 0.426 | 0.30 | 0.00 | 0.41 | 206.50 |
| 6,927.50 | 0.47 | 0.590 | 0.35 | 0.00 | 0.47 | 285.92 |
| 6,928.00 | 0.52 | 0.779 | 0.41 | 0.00 | 0.52 | 377.73 |
| 6,928.50 | 0.58 | 0.990 | 0.44 | 0.00 | 0.58 | 479.94 |
| 6,929.00 | 4.85 | 1.218 | 0.47 | 0.00 | 4.85 | 594.34 |
| 6,929.50 | 12.64 | 1.463 | 0.51 | 0.00 | 12.64 | 720.55 |
| 6,930.00 | 22.67 | 1.725 | 0.54 | 0.00 | 22.67 | 857.59 |
| 6,930.50 | 34.46 | 2.005 | 0.58 | 0.00 | 34.46 | 1,005.00 |
| 6,931.00 | 47.73 | 2.303 | 0.61 | 0.00 | 47.73 | 1,162.46 |

# Index

C

C Springs (Time-Depth Curve, 100 years)...5

E

EXIST. STOCK POND (Elevation-Area Volume Curve, 100 years)...6

EXIST. STOCK POND (Elevation-Volume-Flow Table (Pond), 100 years)...26

Exist. Stock Pond (Outlet Input Data, 100 years)...10, 11, 12, 13

M

Master Network Summary...2, 3, 4

P

POND A OUTLET (Outlet Input Data, 100 years)...14, 15, 16, 17

S

SWQ POND 1 (Elevation-Area Volume Curve, 100 years)...7

SWQ POND 1 (Elevation-Volume-Flow Table (Pond), 100 years)...27

SWQ Pond 1 (Outlet Input Data, 100 years)...18, 19, 20, 21

SWQ POND 2 (Elevation-Area Volume Curve, 100 years)...8

SWQ POND 2 (Elevation-Volume-Flow Table (Pond), 100 years)...28

SWQ Pond 2 (Outlet Input Data, 100 years)...22, 23, 24, 25

W

Waterbury Pond A (Elevation-Area Volume Curve, 100 years)...9

Waterbury Pond A (Elevation-Volume-Flow Table (Pond), 100 years)...29

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 3600
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
6973
6972
6971
6970
6969
6968
0
50
100
150
200
250
300
350
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 3500
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6971
6970
6969
6968
6967
6966
0
50
100
150
200
250
300
350
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 3400
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6968.0
6967.5
6967.0
6966.5
6966.0
6965.5
6965.0
6964.5
0
50
100
150
200
250
300
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 3300
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6965.5
6965.0
6964.5
6964.0
6963.5
6963.0
6962.5
0
50
100
150
200
250
300
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 3200
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6963.0
6962.5
6962.0
6961.5
6961.0
6960.5
6960.0
0
50
100
150
200
250
300
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 3100
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6961.5
6961.0
6960.5
6960.0
6959.5
6959.0
6958.5
6958.0
6957.5
0
50
100
150
200
250
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 3000
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
6958.0
6957.5
6957.0
6956.5
6956.0
6955.5
Elevation (ft)
0
20
40
60
80
100
120
140
160
180
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 2900
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
6958.0
6957.5
6957.0
6956.5
6956.0
6955.5
6955.0
6954.5
6954.0
6953.5
0
50
100
150
200
250
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 2800
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6957
6956
6955
6954
6953
6952
0
20
40
60
80
100
120
140
160
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 2700
.035
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
6954
6953
6952
6951
6950
6949
6948
6947
0
50
100
150
200
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 2600
.035
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6953
6952
6951
6950
6949
6948
6947
0
50
100
150
200
250
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 2500
.035
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
6951
6950
6949
6948
6947
6946
6945
0
50
100
150
200
250
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 2400
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6951
6950
6949
6948
6947
6946
6945
0
50
100
150
200
250
300
350
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 2300
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6951
6950
6949
6948
6947
6946
6945
6944
6943
50
100
150
200
250
300
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 2200
.035
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
6947
6946
6945
6944
6943
6942
6941
6940
0
50
100
150
200
250
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 2100
.035
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
6946
6945
6944
6943
6942
6941
6940
6939
6938
6937
0
50
100
150
200
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 2050
.035
0
3
5
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
6946
6944
6942
6940
6938
6936
20
40
60
80
100
120
140
160
180
200
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 2030.81
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6948
6946
6944
6942
6940
6938
6936
40
60
80
100
120
140
160
180
200
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 2028.90 Culv
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6948
6946
6944
6942
6940
6938
6936
6934
40
60
80
100
120
140
160
180
200
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 2028.90 Culv
.035
Legend
Crit PF 1
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
6946
6944
6942
6940
6938
6936
6934
0
50
100
150
200
250
300
350
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 1868.07
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6944
6942
6940
6938
6936
6934
0
50
100
150
200
250
300
350
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 1850
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
6942
6941
6940
6939
6938
6937
6936
6935
6934
6933
0
20
40
60
80
100
120
140
160
180
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 1800
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
6941
6940
6939
6938
6937
6936
6935
6934
6933
0
50
100
150
200
250
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 1700
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
6938
6937
6936
6935
6934
6933
0
50
100
150
200
250
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 1600
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6936.5
6936.0
6935.5
6935.0
6934.5
6934.0
6933.5
6933.0
6932.5
6932.0
0
50
100
150
200
250
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 1500
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6934.5
6934.0
6933.5
6933.0
6932.5
6932.0
6931.5
6931.0
6930.5
50
100
150
200
250
300
350
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 1400
.035
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6931.0
6930.5
6930.0
6929.5
6929.0
6928.5
6928.0
6927.5
0
50
100
150
200
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 1300
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6929
6928
6927
6926
6925
6924
0
20
40
60
80
100
120
140
160
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 1200
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6928
6927
6926
6925
6924
6923
6922
6921
0
20
40
60
80
100
120
140
160
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 975
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6926
6924
6922
6920
6918
6916
0
50
100
150
200
250
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 933.63
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6922
6921
6920
6919
6918
6917
6916
0
50
100
150
200
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 950
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
6921
6920
6919
6918
6917
6916
Elevation (ft)
0
20
40
60
80
100
120
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 917.62 Culv
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6922
6921
6920
6919
6918
6917
6916
6915
6914
0
50
100
150
200
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 917.62 Culv
.035
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
6924
6922
6920
6918
6916
6914
6912
0
50
100
150
200
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 737.79
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
6922
6920
6918
6916
6914
6912
0
50
100
150
200
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 700
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
6920
6919
6918
6917
6916
6915
6914
6913
0
20
40
60
80
100
120
140
160
180
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 675
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
6921
6920
6919
6918
6917
6916
6915
6914
6913
0
50
100
150
200
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 650
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6921
6920
6919
6918
6917
6916
6915
6914
6913
0
50
100
150
200
250
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 600
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6922
6920
6918
6916
6914
6912
0
50
100
150
200
250
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 500
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6917
6916
6915
6914
6913
6912
6911
6910
0
50
100
150
200
250
300
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 404.23
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6918
6916
6914
6912
6910
6908
6906
0
50
100
150
200
250
300
350
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 300
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6914
6913
6912
6911
6910
6909
6908
6907
6906
0
50
100
150
200
250
300
350
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 200
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6914
6912
6910
6908
6906
6904
0
100
200
300
400
500
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = FLOODPLAIN ALIGN Reach = FLOODPLAIN ALIGN RS = 100
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6911
6910
6909
6908
6907
6906
6905
6904
0
100
200
300
400
500
600
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = RCP OUTFALL FROM Reach = RCP OUTFALL FROM RS = 313.36
.035
Legend
WS PF 1
EG PF 1
Ground
Bank Sta
Elevation (ft)
6926
6924
6922
6920
6918
6916
0
20
40
60
80
100
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = RCP OUTFALL FROM Reach = RCP OUTFALL FROM RS = 300
.035
Legend
WS PF 1
EG PF 1
Ground
Bank Sta
Elevation (ft)
6926
6924
6922
6920
6918
6916
0
20
40
60
80
100
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = RCP OUTFALL FROM Reach = RCP OUTFALL FROM RS = 282.59
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6928
6926
6924
6922
6920
6918
6916
0
20
40
60
80
100
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = RCP OUTFALL FROM Reach = RCP OUTFALL FROM RS = 141.96 Culv
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6928
6926
6924
6922
6920
6918
6916
0
20
40
60
80
100
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = RCP OUTFALL FROM Reach = RCP OUTFALL FROM RS = 141.96 Culv
.035
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
6920
6919
6918
6917
6916
6915
6914
0
2
4
6
8
10
12
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = RCP OUTFALL FROM Reach = RCP OUTFALL FROM RS = 125
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6916.0
6915.8
6915.6
6915.4
6915.2
6915.0
6914.8
6914.6
6914.4
6914.2
0
2
4
6
8
10
12
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = WEST TRIBUTARY A Reach = WEST TRIBUTARY A RS = 300
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6929
6928
6927
6926
6925
6924
6923
6922
6921
0
50
100
150
200
250
300
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = WEST TRIBUTARY A Reach = WEST TRIBUTARY A RS = 200
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6926
6925
6924
6923
6922
6921
6920
6919
0
20
40
60
80
100
120
140
160
180
Station (ft)

WATERBURY REV 5 -- 10-10-13
River = WEST TRIBUTARY A Reach = WEST TRIBUTARY A RS = 151.62
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6922
6921
6920
6919
6918
6917
0
50
100
150
200
Station (ft)

# DRAINAGE MAPS

## MDDP DRAINAGE REPORT ~ EXISTING BASIN RUNOFF COEFFICIENT SUMMARY

| BASIN | TOTAL AREA (AC) | IMPERVIOUS / DEVELOPED AREA | | | NONIMPERVIOUS / UNDEVELOPED AREA | | | WEIGHTED | | WEIGHTED CA | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | AREA (AC) | C(5) | C(100) | AREA (AC) | C(5) | C(100) | C(5) | C(100) | CA(5) | CA(100) |
| EXA | 9.62 | 0.00 | 0.45 | 0.59 | 9.62 | 0.09 | 0.36 | 0.09 | 0.36 | **0.87** | **3.46** |
| EXB | 4.09 | 0.00 | 0.45 | 0.59 | 4.09 | 0.09 | 0.36 | 0.09 | 0.36 | **0.37** | **1.47** |
| EXC | 24.80 | 0.00 | 0.45 | 0.59 | 24.80 | 0.09 | 0.36 | 0.09 | 0.36 | **2.23** | **8.93** |
| EXD | 15.87 | 0.00 | 0.45 | 0.59 | 15.87 | 0.09 | 0.36 | 0.09 | 0.36 | **1.43** | **5.71** |
| EXE | 5.83 | 0.00 | 0.45 | 0.59 | 5.83 | 0.09 | 0.36 | 0.09 | 0.36 | **0.52** | **2.10** |
| EXF | 1.62 | 0.00 | 0.45 | 0.59 | 1.62 | 0.09 | 0.36 | 0.09 | 0.36 | **0.15** | **0.58** |
| OS-1 | 45.02 | 0.00 | 0.45 | 0.59 | 45.02 | 0.09 | 0.36 | 0.09 | 0.36 | **4.05** | **16.21** |
| OS-2 | 11.40 | 0.00 | 0.45 | 0.59 | 11.40 | 0.09 | 0.36 | 0.09 | 0.36 | **1.03** | **4.11** |
| OS-3 | 1.11 | 0.00 | 0.45 | 0.59 | 1.11 | 0.09 | 0.36 | 0.09 | 0.36 | **0.10** | **0.40** |
| OS-4 | 0.29 | 0.00 | 0.45 | 0.59 | 0.29 | 0.09 | 0.36 | 0.09 | 0.36 | **0.03** | **0.11** |
| OS-5 | 6.74 | 0.00 | 0.45 | 0.59 | 6.74 | 0.09 | 0.36 | 0.09 | 0.36 | **0.61** | **2.43** |
| OS-8 | 2.56 | FLOW TAKEN FROM MERIDAIN RANCH MDDP | | | | | | | | | |
| OS-9 | 11.80 | FLOW TAKEN FROM MERIDAIN RANCH MDDP | | | | | | | | | |
| OS-10A | 12.80 | FLOW TAKEN FROM MERIDAIN RANCH MDDP | | | | | | | | | |

## MDDP ~ EXISTING BASIN RUNOFF SUMMARY

| BASIN | WEIGHTED | | OVERLAND | | | | STREET / CHANNEL FLOW | | | | Tc | INTENSITY | | TOTAL FLOWS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CA(5) | CA(100) | C(5) | Length (ft) | Height (ft) | Tc (min) | Length (ft) | Slope (%) | Velocity (fps) | Tc (min) | TOTAL (min) | I(5) (in/hr) | I(100) (in/hr) | Q(5) (cfs) | Q(100) (cfs) |
| EXA | 0.87 | 3.46 | 0.25 | 100 | 3 | 11.1 | 1193 | 1.7% | 4.5 | 4.4 | 15.4 | 3.43 | 5.81 | **3** | **20** |
| EXB | 0.37 | 1.47 | 0.25 | 100 | 2 | 12.6 | 623 | 2.2% | 5.2 | 2.0 | 14.6 | 3.51 | 5.96 | **1** | **9** |
| EXC | 2.23 | 8.93 | 0.25 | 100 | 2.5 | 11.7 | 2420 | 1.7% | 4.6 | 8.9 | 20.6 | 3.01 | 5.01 | **7** | **45** |
| EXD | 1.43 | 5.71 | 0.25 | 100 | 2 | 12.6 | 1615 | 2.6% | 5.6 | 4.8 | 17.4 | 3.25 | 5.47 | **5** | **31** |
| EXE | 0.52 | 2.10 | 0.25 | 100 | 8 | 8.0 | 1063 | 2.1% | 5.0 | 3.5 | 11.5 | 3.86 | 6.66 | **2** | **14** |
| EXF | 0.15 | 0.58 | 0.25 | 100 | 6 | 8.8 | 400 | 2.5% | 5.5 | 1.2 | 10.0 | 4.06 | 7.07 | **1** | **4** |
| OS-1 | 4.05 | 16.21 | 0.25 | 100 | 6 | 8.8 | 3219 | 2.3% | 5.3 | 10.1 | 18.9 | 3.13 | 5.24 | **13** | **85** |
| OS-2 | 1.03 | 4.11 | 0.25 | 100 | 2 | 12.6 | 1203 | 1.0% | 3.5 | 5.7 | 18.4 | 3.17 | 5.32 | **3** | **22** |
| OS-3 | 0.10 | 0.40 | 0.25 | 100 | 2 | 12.6 | 330 | 2.6% | 5.6 | 1.0 | 13.6 | 3.61 | 6.17 | **0** | **2** |
| OS-4 | 0.03 | 0.11 | 0.25 | 100 | 2 | 12.6 | 230 | 2.6% | 5.7 | 0.7 | 13.3 | 3.64 | 6.23 | **0** | **1** |
| OS-5 | 0.61 | 2.43 | 0.25 | 80 | 5 | 7.8 | 1000 | 2.5% | 5.5 | 3.0 | 10.8 | 3.96 | 6.85 | **2** | **17** |
| OS-8 | FLOW TAKEN FROM MERIDAIN RANCH MDDP | | | | | | | | | | | | | **5** | **11** |
| OS-9 | FLOW TAKEN FROM MERIDAIN RANCH MDDP | | | | | | | | | | | | | **8** | **19** |

## MDDP ~ EXISTING SURFACE ROUTING SUMMARY

| Design Point(s) | Contributing Basins | Area (AC) | Equivalent CA(5) | Equivalent CA(100) | Maximum Tc | Intensity | | Flow | | Facility Size |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | I(5) | I(100) | Q(5) | Q(100) | |
| EX1 | EXA, OS-5, DP-10A & DP-10 | 18.92 | 1.47 | 5.89 | 15.4 | 3.43 | 5.81 | 38 | 180 | 3-42" CULVERTS |
| EX2 | EXB | 4.09 | 0.37 | 1.47 | 14.6 | 3.51 | 5.96 | 1 | 9 | STAPLeTON ROAD |
| EX3 | EXC & OS-4 | 25.10 | 2.26 | 9.03 | 20.6 | 3.01 | 5.01 | 7 | 45 | EAST BOUNDARY |
| EX4 | EXD & OS-3 | 16.98 | 1.53 | 6.11 | 17.4 | 3.25 | 5.47 | 5 | 33 | EAST BOUNDARY |
| EX5 | EXE, OS-2 & OS-8 | 17.23 | 1.55 | 6.20 | 18.4 | 3.17 | 5.32 | 5 | 33 | EAST BOUNDARY |
| EX6 | EXF | 1.62 | 0.15 | 0.58 | 11.4 | 3.87 | 6.69 | 1 | 4 | EAST BOUNDARY |
| EX7 | EXF, OS-1 & OS-9 | 58.45 | 4.20 | 16.79 | 18.9 | 3.13 | 5.24 | 21 | 107 | DP 30 PROP CONDITION |
| EX9 | EXF, OS-1 & OS-11 | 2.56 | | | | | | 5 | 11 | DP 30 PROP CONDITION |
| EX10 | EXF, OS-1 & OS-12 | 11.80 | | | | | | 8 | 19 | DP 30 PROP CONDITION |
| EX10A | MERIDIAN POND E RELEASE | | | | | | | 28 | 135 | EX 3-42" RCP Culverts |

REVISIONS

| NO. | DESCRIPTION | DATE |
|---|---|---|
| | | |

UNTIL SUCH TIME AS THESE DRAWINGS ARE APPROVED BY THE APPROPRIATE REVIEWING AGENCIES, TERRA NOVA ENGINEERING AND SURVEYING, INC. APPROVES THEIR USE ONLY FOR THE PURPOSES DESIGNATED BY WRITTEN AUTHORIZATION.

PREPARED FOR:
4-WAY RANCH JOINT VENTURES
ATTN: PETER MARTZ
PO BOX 50223
COLORADO SPRINGS, CO 80949
719-471-3150


Terra Nova Engineering, Inc.
Creative Civil Engineering Solutions
721 S. 23RD STREET
COLORADO SPRINGS, CO 80904
OFFICE: 719-635-6422
FAX: 719-635-6426
www.tneainc.com


# WATERBURY FILING 1 & 2

EXISTING MDDP DRAINAGE MAP 1
OFFSITE MAP

| | |
|---|---|
| DESIGNED BY | QNA |
| DRAWN BY | QNA |
| CHECKED BY | |
| H-SCALE | 1"=100' |
| V-SCALE | |
| JOB NO. | 1715.00 |
| DATE ISSUED | 9/22/21 |
| SHEET NO. | 1 OF 2 |

REVISIONS

| NO. | DESCRIPTION | DATE |
|---|---|---|
| | | |

UNTIL SUCH TIME AS THESE DRAWINGS ARE APPROVED BY ALL APPROPRIATE REVIEWING AGENCIES, TERRA NOVA ENGINEERING AND SURVEYING, INC. APPROVES THEIR USE ONLY FOR THE PURPOSES DESIGNATED BY WRITTEN AUTHORIZATION.

PREPARED FOR:
4-WAY RANCH JOINT VENTURES
ATTN: PETER MARTZ
PO BOX 50223
COLORADO SPRINGS, CO 80949
719-471-3150


Terra Nova Engineering, Inc.
Creative Civil Engineering Solutions
721 S. 23RD STREET
COLORADO SPRINGS, CO 80904
OFFICE: 719-635-6422
FAX: 719-635-6426
www.tneainc.com


# WATERBURY FILING 1 & 2

EXISITING MDDP DRAINAGE MAP 2
ONSITE MAP

DESIGNED BY QNA
DRAWN BY QNA
CHECKED BY
H-SCALE 1"=100'
V-SCALE
JOB NO. 1715.00
DATE ISSUED 9/22/21
SHEET NO. 2 OF 2

REVISIONS

| NO. | DESCRIPTION | DATE |
|---|---|---|
| | | |

UNTIL SUCH TIME AS THESE DRAWINGS ARE APPROVED BY ALL APPROPRIATE REVIEWING AGENCIES, TERRA NOVA ENGINEERING AND SURVEYING, INC. APPROVES THEIR USE ONLY FOR THE PURPOSES DESIGNATED BY WRITTEN AUTHORIZATION.

PREPARED FOR:
4-WAY RANCH JOINT VENTURES
ATTN: PETER MARTZ
PO BOX 50223
COLORADO SPRINGS, CO 80949
719-471-3150

Terra Nova Engineering, Inc.
Creative Civil Engineering Solutions
721 S. 23RD STREET
COLORADO SPRINGS, CO 80904
OFFICE: 719-635-6422
FAX: 719-635-6426
www.tnesinc.com

# WATERBURY FILING 1 & 2

## EARLY GRADING DRAINAGE MAP 2
## ONSITE MAP

DESIGNED BY QNA
DRAWN BY QNA
CHECKED BY
H-SCALE 1"=100'
V-SCALE
JOB NO. 1715.00
DATE ISSUED 9/22/21
SHEET NO. 2 OF 2

## MDDP DRAINAGE REPORT ~ EXISTING BASIN RUNOFF COEFFICIENT SUMMARY

| BASIN | TOTAL AREA (AC) | IMPERVIOUS / DEVELOPED AREA | | | NONIMPERVIOUS / UNDEVELOPED AREA | | | WEIGHTED | | WEIGHTED CA | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | AREA (AC) | C(5) | C(100) | AREA (AC) | C(5) | C(100) | C(5) | C(100) | CA(5) | CA(100) |
| EXA | 9.62 | 0.00 | 0.45 | 0.59 | 9.62 | 0.09 | 0.36 | 0.09 | 0.36 | **0.87** | **3.46** |
| EXB | 4.09 | 0.00 | 0.45 | 0.59 | 4.09 | 0.09 | 0.36 | 0.09 | 0.36 | **0.37** | **1.47** |
| EXC | 24.80 | 0.00 | 0.45 | 0.59 | 24.80 | 0.09 | 0.36 | 0.09 | 0.36 | **2.23** | **8.93** |
| EXD | 15.87 | 0.00 | 0.45 | 0.59 | 15.87 | 0.09 | 0.36 | 0.09 | 0.36 | **1.43** | **5.71** |
| EXE | 5.83 | 0.00 | 0.45 | 0.59 | 5.83 | 0.09 | 0.36 | 0.09 | 0.36 | **0.52** | **2.10** |
| EXF | 1.62 | 0.00 | 0.45 | 0.59 | 1.62 | 0.09 | 0.36 | 0.09 | 0.36 | **0.15** | **0.58** |
| OS-1 | 45.02 | 0.00 | 0.45 | 0.59 | 45.02 | 0.09 | 0.36 | 0.09 | 0.36 | **4.05** | **16.21** |
| OS-2 | 11.40 | 0.00 | 0.45 | 0.59 | 11.40 | 0.09 | 0.36 | 0.09 | 0.36 | **1.03** | **4.11** |
| OS-3 | 1.11 | 0.00 | 0.45 | 0.59 | 1.11 | 0.09 | 0.36 | 0.09 | 0.36 | **0.10** | **0.40** |
| OS-4 | 0.29 | 0.00 | 0.45 | 0.59 | 0.29 | 0.09 | 0.36 | 0.09 | 0.36 | **0.03** | **0.11** |
| OS-5 | 6.74 | 0.00 | 0.45 | 0.59 | 6.74 | 0.09 | 0.36 | 0.09 | 0.36 | **0.61** | **2.43** |
| OS-8 | 2.56 | FLOW TAKEN FROM MERIDAIN RANCH MDDP | | | | | | | | | |
| OS-9 | 11.80 | FLOW TAKEN FROM MERIDAIN RANCH MDDP | | | | | | | | | |
| OS-10A | 12.80 | FLOW TAKEN FROM MERIDAIN RANCH MDDP | | | | | | | | | |

## MDDP ~ EXISTING BASIN RUNOFF SUMMARY

| BASIN | WEIGHTED CA(5) | CA(100) | OVERLAND C(5) | OVERLAND Length (ft) | OVERLAND Height (ft) | OVERLAND Tc (min) | STREET / CHANNEL FLOW Length (ft) | STREET / CHANNEL FLOW Slope (%) | STREET / CHANNEL FLOW Velocity (fps) | STREET / CHANNEL FLOW Tc (min) | Tc TOTAL (min) | INTENSITY I(5) (in/hr) | INTENSITY I(100) (in/hr) | TOTAL FLOWS Q(5) (cfs) | TOTAL FLOWS Q(100) (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EXA | 0.87 | 3.46 | 0.25 | 100 | 3 | 11.1 | 1193 | 1.7% | 4.5 | 4.4 | 15.4 | 3.43 | 5.81 | **3** | **20** |
| EXB | 0.37 | 1.47 | 0.25 | 100 | 2 | 12.6 | 623 | 2.2% | 5.2 | 2.0 | 14.6 | 3.51 | 5.96 | **1** | **9** |
| EXC | 2.23 | 8.93 | 0.25 | 100 | 2.5 | 11.7 | 2420 | 1.7% | 4.6 | 8.9 | 20.6 | 3.01 | 5.01 | **7** | **45** |
| EXD | 1.43 | 5.71 | 0.25 | 100 | 2 | 12.6 | 1615 | 2.6% | 5.6 | 4.8 | 17.4 | 3.25 | 5.47 | **5** | **31** |
| EXE | 0.52 | 2.10 | 0.25 | 100 | 8 | 8.0 | 1063 | 2.1% | 5.0 | 3.5 | 11.5 | 3.86 | 6.66 | **2** | **14** |
| EXF | 0.15 | 0.58 | 0.25 | 100 | 6 | 8.8 | 400 | 2.5% | 5.5 | 1.2 | 10.0 | 4.06 | 7.07 | **1** | **4** |
| OS-1 | 4.05 | 16.21 | 0.25 | 100 | 6 | 8.8 | 3219 | 2.3% | 5.3 | 10.1 | 18.9 | 3.13 | 5.24 | **13** | **85** |
| OS-2 | 1.03 | 4.11 | 0.25 | 100 | 2 | 12.6 | 1203 | 1.0% | 3.5 | 5.7 | 18.4 | 3.17 | 5.32 | **3** | **22** |
| OS-3 | 0.10 | 0.40 | 0.25 | 100 | 2 | 12.6 | 330 | 2.6% | 5.6 | 1.0 | 13.6 | 3.61 | 6.17 | **0** | **2** |
| OS-4 | 0.03 | 0.11 | 0.25 | 100 | 2 | 12.6 | 230 | 2.6% | 5.7 | 0.7 | 13.3 | 3.64 | 6.23 | **0** | **1** |
| OS-5 | 0.61 | 2.43 | 0.25 | 80 | 5 | 7.8 | 1000 | 2.5% | 5.5 | 3.0 | 10.8 | 3.96 | 6.85 | **2** | **17** |
| OS-8 | FLOW TAKEN FROM MERIDAIN RANCH MDDP | | | | | | | | | | | | | **5** | **11** |
| OS-9 | FLOW TAKEN FROM MERIDAIN RANCH MDDP | | | | | | | | | | | | | **8** | **19** |

## MDDP ~ EXISTING SURFACE ROUTING SUMMARY

| Design Point(s) | Contributing Basins | Area (AC) | Equivalent CA(5) | Equivalent CA(100) | Maximum Tc | Intensity I(5) | Intensity I(100) | Flow Q(5) | Flow Q(100) | Facility Size |
|---|---|---|---|---|---|---|---|---|---|---|
| EX1 | EXA, OS-5, DP-10A & DP-10 | 18.92 | 1.47 | 5.89 | 15.4 | 3.43 | 5.81 | 38 | 180 | 3-42" CULVERTS |
| EX2 | EXB | 4.09 | 0.37 | 1.47 | 14.6 | 3.51 | 5.96 | 1 | 9 | STAPLeTON ROAD |
| EX3 | EXC & OS-4 | 25.10 | 2.26 | 9.03 | 20.6 | 3.01 | 5.01 | 7 | 45 | EAST BOUNDARY |
| EX4 | EXD & OS-3 | 16.98 | 1.53 | 6.11 | 17.4 | 3.25 | 5.47 | 5 | 33 | EAST BOUNDARY |
| EX5 | EXE, OS-2 & OS-8 | 17.23 | 1.55 | 6.20 | 18.4 | 3.17 | 5.32 | 5 | 33 | EAST BOUNDARY |
| EX6 | EXF | 1.62 | 0.15 | 0.58 | 11.4 | 3.87 | 6.69 | 1 | 4 | EAST BOUNDARY |
| EX7 | EXF, OS-1 & OS-9 | 58.45 | 4.20 | 16.79 | 18.9 | 3.13 | 5.24 | 21 | 107 | DP 30 PROP CONDITION |
| EX9 | EXF, OS-1 & OS-11 | 2.56 | | | | | | 5 | 11 | DP 30 PROP CONDITION |
| EX10 | EXF, OS-1 & OS-12 | 11.80 | | | | | | 8 | 19 | DP 30 PROP CONDITION |
| EX10A | MERIDIAN POND E RELEASE | | | | | | | 28 | 135 | EX 3-42" RCP Culverts |

REVISIONS

| NO. | DESCRIPTION | DATE |
|---|---|---|
| | | |

UNTIL SUCH TIME AS THESE DRAWINGS ARE APPROVED BY ALL APPLICABLE REVIEWING AGENCIES, TERRA NOVA ENGINEERING AND ASSOCIATES, INC. APPROVES THEIR USE ONLY FOR REVIEW PURPOSES AS DESIGNATED BY WRITTEN AUTHORIZATION.

PREPARED FOR:
4-WAY RANCH JOINT VENTURES
ATTN: PETER MARTZ
PO BOX 50223
COLORADO SPRINGS, CO 80949
719-471-3150


Terra Nova Engineering, Inc.
Creative Civil Engineering Solutions
721 S. 23RD STREET
COLORADO SPRINGS, CO 80904
OFFICE: 719-635-6422
FAX: 719-635-6426
www.tneainc.com


# WATERBURY FILING 1 & 2

EARLY GRADING DRAINAGE MAP 2
OFFSITE MAP

DESIGNED BY QNA
DRAWN BY QNA
CHECKED BY
H-SCALE 1"=100'
V-SCALE
JOB NO. 1715.00
DATE ISSUED 9/22/21
SHEET NO. 1 OF 2

## MDDP ~ PROPOSED BASIN RUNOFF SUMMARY

| BASIN | WEIGHTED CA(5) | WEIGHTED CA(100) | OVERLAND C(5) | OVERLAND Length (ft) | OVERLAND Height (ft) | OVERLAND Tc (min) | STREET / CHANNEL FLOW Length (ft) | STREET / CHANNEL FLOW Slope (%) | STREET / CHANNEL FLOW Velocity (fps) | STREET / CHANNEL FLOW Tc (min) | Tc TOTAL (min) | INTENSITY I(5) (in/hr) | INTENSITY I(100) (in/hr) | TOTAL FLOWS Q(5) (cfs) | TOTAL FLOWS Q(100) (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 1.52 | 2.00 | 0.25 | 100 | 2 | 12.6 | 420 | 1.5% | 4.3 | 1.6 | 14.3 | 3.54 | 6.03 | **5** | **12** |
| B1 | 1.03 | 1.36 | 0.25 | 100 | 2 | 12.6 | 400 | 1.5% | 4.3 | 1.6 | 14.2 | 3.55 | 6.05 | **4** | **8** |
| B2 | 1.21 | 1.59 | 0.25 | 100 | 2 | 12.6 | 550 | 1.5% | 4.3 | 2.1 | 14.8 | 3.49 | 5.93 | **4** | **9** |
| C | 0.39 | 0.51 | 0.25 | 20 | 0.5 | 5.3 | 500 | 2.0% | 4.9 | 1.7 | 6.9 | 4.58 | 8.14 | **2** | **4** |
| D | 0.95 | 1.24 | 0.25 | 80 | 2 | 10.5 | 300 | 2.5% | 5.5 | 0.9 | 11.4 | 3.87 | 6.69 | **4** | **8** |
| E | 0.98 | 1.29 | 0.25 | 100 | 2 | 12.6 | 400 | 2.5% | 5.5 | 1.2 | 13.8 | 3.59 | 6.12 | **4** | **8** |
| F | 0.98 | 1.29 | 0.25 | 50 | 2 | 7.1 | 620 | 1.5% | 4.3 | 2.4 | 9.5 | 4.14 | 7.22 | **4** | **9** |
| G | NOT USED | | | | | | | | | | | | | | |
| H | 0.51 | 0.67 | 0.25 | 50 | 2 | 7.1 | 525 | 1.5% | 4.3 | 2.0 | 9.2 | 4.19 | 7.33 | **2** | **5** |
| I | 1.28 | 2.53 | 0.25 | 80 | 4 | 8.4 | 250 | 2.0% | 4.9 | 0.8 | 9.2 | 4.18 | 7.32 | **5** | **19** |
| J | 0.90 | 1.17 | 0.25 | 90 | 6 | 8.1 | 850 | 2.0% | 4.9 | 2.9 | 10.9 | 3.94 | 6.81 | **4** | **8** |
| K | 0.69 | 1.37 | 0.25 | 100 | 18 | 6.1 | 80 | 1.0% | 3.5 | 0.4 | 6.5 | 4.67 | 8.33 | **3** | **11** |
| L1 | 2.37 | 3.11 | 0.25 | 100 | 2 | 12.6 | 860 | 1.4% | 4.1 | 3.5 | 16.1 | 3.36 | 5.69 | **8** | **18** |
| L2 | 0.90 | 1.18 | 0.25 | 55 | 1.1 | 9.4 | 860 | 1.4% | 4.1 | 3.5 | 12.8 | 3.70 | 6.34 | **3** | **7** |
| M1 | 1.31 | 1.71 | 0.25 | 70 | 1.5 | 10.3 | 200 | 2.0% | 4.9 | 0.7 | 11.0 | 3.92 | 6.79 | **5** | **12** |
| M2 | 0.21 | 0.28 | 0.25 | 65 | 3 | 7.7 | 0 | 0.0% | 0.0 | 0.0 | 7.7 | 4.43 | 7.83 | **1** | **2** |
| N | 0.10 | 0.13 | 0.25 | | | | | | | | 5.0 | 5.00 | 9.06 | **1** | **1** |
| O1 | 1.27 | 1.66 | 0.25 | 100 | 3 | 11.1 | 460 | 1.5% | 4.3 | 1.8 | 12.8 | 3.70 | 6.34 | **5** | **11** |
| O2 | 0.42 | 0.56 | 0.25 | 100 | 2 | 12.6 | 850 | 2.0% | 4.9 | 2.9 | 15.5 | 3.42 | 5.80 | **1** | **3** |
| P | 0.53 | 0.70 | 0.25 | 65 | 3 | 7.7 | 0 | 0.0% | 0.0 | 0.0 | 7.7 | 4.43 | 7.83 | **2** | **5** |
| Q1 | 0.47 | 0.61 | 0.25 | 55 | 1.3 | 8.9 | 445 | 2.0% | 5.0 | 1.5 | 10.4 | 4.01 | 6.97 | **2** | **4** |
| Q2 | 0.49 | 0.65 | 0.25 | 55 | 1.3 | 8.9 | 445 | 2.0% | 5.0 | 1.5 | 10.4 | 4.01 | 6.97 | **2** | **5** |
| R | 0.06 | 0.08 | 0.25 | 100 | 4 | 10.1 | 700 | 2.0% | 4.9 | 2.4 | 12.4 | 3.75 | 6.44 | **0** | **1** |
| S1 | 0.70 | 0.91 | 0.25 | 100 | 6 | 8.8 | 175 | 2.0% | 4.9 | 0.6 | 9.4 | 4.16 | 7.26 | **3** | **7** |
| S2 | 0.06 | 0.08 | 0.25 | | | | | | | | 5.0 | 5.00 | 9.06 | **0** | **1** |
| T1 | 0.64 | 0.84 | 0.25 | 55 | 1.1 | 9.4 | 390 | 2.0% | 4.9 | 1.3 | 10.7 | 3.97 | 6.88 | **3** | **6** |
| T2 | 0.55 | 0.73 | 0.25 | 100 | 2 | 12.6 | 245 | 2.0% | 5.0 | 0.8 | 13.5 | 3.63 | 6.20 | **2** | **5** |
| U1 | 1.97 | 2.58 | 0.25 | 100 | 2 | 12.6 | 520 | 2.3% | 5.3 | 1.6 | 14.3 | 3.54 | 6.03 | **7** | **16** |
| U2 | 0.85 | 1.11 | 0.25 | 100 | 2 | 12.6 | 385 | 2.3% | 5.4 | 1.2 | 13.8 | 3.59 | 6.12 | **3** | **7** |
| W | 2.34 | 3.07 | 0.25 | 100 | 2 | 12.6 | 630 | 1.6% | 4.4 | 2.4 | 15.0 | 3.47 | 5.89 | **8** | **18** |
| V | 0.59 | 0.78 | 0.25 | 95 | 6 | 8.4 | | | | | 8.4 | 4.31 | 7.58 | **3** | **6** |
| OS-1 | 5.31 | 6.97 | 0.25 | 100 | 2 | 12.6 | 690 | 2.0% | 5.0 | 2.3 | 15.0 | 3.47 | 5.90 | **18** | **41** |
| OS-2 | 7.15 | 9.38 | 0.25 | 100 | 2 | 12.6 | 1700 | 1.8% | 4.6 | 6.1 | 18.7 | 3.14 | 5.27 | **22** | **49** |
| OS-3A | 0.35 | 0.47 | 0.25 | 55 | 1.1 | 9.4 | 480 | 1.3% | 3.9 | 2.0 | 11.4 | 3.87 | 6.68 | **1** | **3** |
| OS-3B | 2.55 | 3.34 | 0.25 | 100 | 2 | 12.6 | 480 | 1.3% | 3.9 | 2.0 | 14.7 | 3.50 | 5.95 | **9** | **20** |
| OS-4 | 0.98 | 3.92 | 0.25 | 800 | 26 | 30.5 | | | | | 30.5 | 2.46 | 4.01 | **2** | **16** |
| OS-5 | 2.54 | 3.33 | 0.25 | 80 | 5 | 7.8 | 1000 | 2.5% | 5.5 | 3.0 | 10.8 | 3.96 | 6.85 | **10** | **23** |
| OS-6 | 0.48 | 0.63 | 0.25 | 30 | 0.6 | 6.9 | 900 | 1.8% | 4.7 | 3.2 | 10.1 | 4.05 | 7.04 | **2** | **4** |
| OS-7 | 0.25 | 1.01 | | | | | | | | | 5.0 | 5.00 | 9.06 | **1** | **9** |
| OS-8 | FLOW TAKEN FROM MERIDIAN RANCH MDDP | | | | | | | | | | | | | **5** | **11** |
| OS-9 | FLOW TAKEN FROM MERIDIAN RANCH MDDP | | | | | | | | | | | | | **8** | **19** |
| OS-10 | 0.31 | 1.23 | 0.25 | 100 | 2 | 12.6 | 300 | 2.7% | 5.7 | 0.9 | 13.5 | 3.62 | 6.19 | **1** | **8** |
| OS-Q1 | 1.94 | 2.54 | 0.25 | 200 | 5 | 16.6 | 1500 | 1.5% | 4.3 | 5.8 | 22.4 | 2.88 | 4.78 | **6** | **12** |
| OS-Q2 | 0.42 | 0.55 | 0.25 | 50 | 1 | 8.9 | 900 | 1.5% | 4.3 | 3.5 | 12.4 | 3.75 | 6.43 | **2** | **4** |
| OS-R | 2.72 | 3.57 | 0.25 | 50 | 1 | 8.9 | 850 | 2.7% | 5.8 | 2.5 | 11.4 | 3.87 | 6.69 | **11** | **24** |
| OS-S1 | 2.51 | 3.30 | 0.25 | 100 | 2 | 12.6 | 920 | 1.2% | 3.8 | 4.0 | 16.7 | 3.32 | 5.60 | **8** | **18** |
| OS-S2 | 0.08 | 0.10 | 0.25 | 100 | 2 | 12.6 | | | | | 12.6 | 3.72 | 6.39 | **0** | **1** |
| OS-T2 | 0.34 | 0.45 | 0.25 | 100 | 2 | 12.6 | | | | | 12.6 | 3.72 | 6.39 | **1** | **3** |

## MDDP ~ PIPE ROUTING SUMMARY

| Pipe Run | Contributing Design Points/Basins | Equivalent CA(5) | Equivalent CA(100) | Maximum Tc | Intensity I(5) | Intensity I(100) | Flow Q(5) | Flow Q(100) | Pipe Size* |
|---|---|---|---|---|---|---|---|---|---|
| 1 | DP 2 | 0.39 | 0.51 | 6.9 | 4.58 | 8.14 | 2 | 4 | 18" RCP |
| 2 | DP 1 & 2 | 1.91 | 2.51 | 14.3 | 3.54 | 6.03 | 7 | 15 | 24" RCP |
| 3 | DP 3 | 1.03 | 1.36 | 14.2 | 3.55 | 6.05 | 4 | 8 | 18" RCP |
| 4 | DP-4 | 1.21 | 1.59 | 14.8 | 3.49 | 5.93 | 4 | 9 | 18" RCP |
| 5 | DP 3 & 4 | 2.25 | 2.94 | 14.8 | 3.49 | 5.93 | 8 | 17 | 24" RCP |
| 6 | DP 1-4 | 4.16 | 5.45 | 14.8 | 3.49 | 5.93 | 15 | 32 | 30" RCP |
| 7 | DP-1-5 | 5.65 | 7.41 | 14.8 | 3.49 | 5.93 | 20 | 44 | 36" RCP |
| 8 | DP-6 | 0.95 | 1.24 | 11.4 | 3.87 | 6.69 | 4 | 8 | 18" RCP |
| 9 | DP-7 | 0.98 | 1.29 | 13.8 | 3.59 | 6.12 | 4 | 8 | 18" RCP |
| 10 | DP-6 & 7 | 1.97 | 2.58 | 13.8 | 3.59 | 6.12 | 7 | 16 | 18" RCP |
| 10A | POND 1 RELEASE | 2.95 | 3.87 | 13.8 | 3.59 | 6.12 | 2.2 | 8.0 | 18" RCP |
| 11 | DP-14 | 2.37 | 3.11 | 16.1 | 3.36 | 5.69 | 8 | 18 | 24" RCP |
| 12 | DP-15 | 0.90 | 1.18 | 12.8 | 3.70 | 6.34 | 3 | 7 | 18" RCP |
| 13 | DP 14 & 15 | 3.27 | 4.29 | 16.1 | 3.36 | 5.69 | 11 | 24 | 30" RCP |
| 14 | DP 16 | 1.27 | 1.66 | 12.8 | 3.70 | 6.34 | 5 | 11 | 24" RCP |
| 15 | DP 14, 15 & 16 | 4.54 | 5.95 | 16.1 | 3.36 | 5.69 | 15 | 34 | 36" RCP |
| 16 | DP 17 | 0.42 | 0.56 | 15.5 | 3.42 | 5.80 | 1 | 3 | 18" RCP |
| 17 | DP 14, 15, 16, & 17 | 4.97 | 6.51 | 16.1 | 3.36 | 5.69 | 17 | 37 | 36" RCP |
| 17A | POND 2 RELEASE | | | | | | 0.2 | 10.6 | 18" RCP |
| 18 | DP 19 | 2.40 | 3.15 | 22.4 | 2.88 | 4.78 | 7 | 15 | 24" RCP |
| 19 | DP 20 | 0.91 | 1.20 | 12.4 | 3.75 | 6.43 | 3 | 8 | 18" RCP |
| 20 | DP 19 & 20 | 3.32 | 4.35 | 22.4 | 2.88 | 4.78 | 10 | 21 | 24" RCP |
| 21 | DP 21 PICK UP | 1.38 | 1.31 | 11.4 | 3.87 | 6.69 | 5 | 9 | 18" RCP |
| 22 | DP 19, 20 & 21 | 4.70 | 5.66 | 22.4 | 2.88 | 4.78 | 14 | 27 | 24" RCP |
| 23 | DP 22 | 2.37 | 3.36 | 16.7 | 3.32 | 5.60 | 8 | 19 | 24" RCP |
| 24 | DP 23 | 2.37 | 3.36 | 16.7 | 3.32 | 5.60 | 8 | 19 | 24" RCP |
| 25 | DP 22 & 23 | 4.75 | 6.73 | 16.7 | 3.32 | 5.60 | 16 | 38 | 30" RCP |
| 26 | DP 19 -23 | 9.45 | 12.39 | 22.4 | 2.88 | 4.78 | 27 | 59 | 36" RCP |
| 27 | DP 24 | 0.64 | 0.84 | 10.7 | 3.97 | 6.88 | 3 | 6 | 18" RCP |
| 28 | DP 25 | 0.90 | 1.18 | 13.5 | 3.63 | 6.20 | 3 | 7 | 18" RCP |
| 29 | DP 19-25 | 10.99 | 14.40 | 22.4 | 2.88 | 4.78 | 32 | 69 | 36" RCP |
| 30 | DP 26 | 1.97 | 2.58 | 14.3 | 3.54 | 6.03 | 7 | 16 | 24" RCP |
| 31 | DP 19-26 | 12.96 | 16.99 | 22.4 | 2.89 | 4.79 | 37 | 81 | 42" RCP |
| 32 | DP 27 | 0.85 | 1.11 | 13.8 | 3.59 | 6.12 | 3 | 7 | 18" RCP |
| 33 | DP 19-27 | 13.80 | 18.10 | 22.4 | 2.88 | 4.78 | 40 | 87 | 42" RCP |
| 34 | 28 | 2.34 | 3.07 | 15.0 | 3.47 | 5.89 | 8 | 18 | 24" RCP |
| 35 | Pond 3 Release | 0.90 | 2.00 | 13.5 | 3.62 | 6.19 | 1.0 | 60.7 | 42" RCP |
| 36 | DP 30 | | | | | | | 155.2 | TRIPLE 36" RCP |

## MDDP ~ PROPOSED SURFACE ROUTING SUMMARY

| Design Point(s) | Contributing Basins | Area (AC) | Equivalent CA(5) | Equivalent CA(100) | Maximum Tc | Intensity I(5) | Intensity I(100) | Flow Q(5) | Flow Q(100) | Facility Size |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | A | 3.39 | 1.52 | 2.00 | 14.3 | 3.54 | 6.03 | 5 | 12 | 6' Type R Sump Inlet |
| 2 | C | 0.86 | 0.39 | 0.51 | 6.9 | 4.58 | 8.14 | 2 | 4 | 4' Type R Sump Inlet |
| 3 | B1 | 2.30 | 1.03 | 1.36 | 14.2 | 3.55 | 6.05 | 4 | 8 | 4' Type R Sump Inlet |
| 4 | B2 | 2.69 | 1.21 | 1.59 | 14.8 | 3.49 | 5.93 | 4 | 9 | 4' Type R Sump Inlet |
| 5 | F & H | 3.31 | 1.49 | 1.95 | 9.5 | 4.14 | 7.22 | 6 | 14 | 6' Type R Sump Inlet |
| 6 | D | 2.11 | 0.95 | 1.24 | 11.4 | 3.87 | 6.69 | 4 | 8 | 4' Type R Sump Inlets |
| 7 | E | 2.18 | 0.98 | 1.29 | 13.8 | 3.59 | 6.12 | 4 | 8 | 4' Type R Sump Inlets |
| 8 | DESIGN POINTS 1-7 | 16.84 | 7.58 | 9.94 | 14.8 | 3.49 | 5.93 | 26 | 59 | FSD Pond 1 |
| 9 | OS-9 | 11.80 | | | | | | 5 | 11 | EX 36" CMP Culvert |
| 10 | OS-8 | 2.56 | | | | | | 8 | 19 | EX 36" CMP Culvert |
| 10A | MERIDIAN POND E RELEASE | | | | | | | 28 | 135 | EX 3-42" RCP Culverts |
| 11 | OS-5, I, OS-& MERIDIAN POND E RELEASE | SCS MODEL | | | | | | 53 | 212 | PR 2-42" RCP Culverts |
| 12 | OS-6 | 1.06 | 0.48 | 0.63 | 10.1 | 4.05 | 7.04 | 2 | 4 | 18" RCP Culvert |
| 13 | TOTAL OFFSITE EX. STOCK POND INFLOW | SCS MODEL | | | | | | 69 | 396 | EX STOCK POND |
| 14 | L1 | 5.27 | 2.37 | 3.11 | 16.1 | 3.36 | 5.69 | 8 | 18 | 10' Type R Sump Inlet |
| 15 | L2 | 2.00 | 0.90 | 1.18 | 12.8 | 3.70 | 6.34 | 3 | 7 | 4' Type R Sump Inlet |
| 16 | O1 | 2.82 | 1.27 | 1.66 | 12.8 | 3.70 | 6.34 | 5 | 11 | 6' Type R Sump Inlet |
| 17 | O2 | 0.94 | 0.42 | 0.56 | 15.5 | 3.42 | 5.80 | 1 | 3 | 4' Type R Sump Inlet |
| 18 | DESIGN POINTS 7-10 & BASIN OS-4 | 21.93 | 5.95 | 6.51 | 16.1 | 3.36 | 5.69 | 20 | 37 | Interim FSD Pond 2 |
| 19 | Q1 & OS-Q1 | 5.34 | 2.40 | 3.15 | 22.4 | 2.88 | 4.78 | 7 | 15 | 8' Type R Sump Inlet |
| 20 | Q2 & OS-Q2 | 2.03 | 0.91 | 1.20 | 12.4 | 3.75 | 6.43 | 3 | 8 | 4' Type R Sump Inlet |
| 21 | R & OS-R | 6.18 | 2.78 | 3.65 | 11.4 | 3.87 | 6.69 | 11 | 24 | 12' Type R At-grade Inlet |
| 22 | S1 & OS-S1 & DP 21 FLOW BY | 7.14 | 4.61 | 6.55 | 16.7 | 3.32 | 5.60 | 15 | 37 | 10' Type R Sump Inlet |
| 23 | S2 & OS-S2 | 0.31 | 0.14 | 0.18 | 12.6 | 3.72 | 6.39 | 1 | 1 | 10' Type R Sump Inlet |
| 22 & 23 SPLIT | S1, OS-S1, S2, OS-S2, & DP 21 FLOW BY | 7.44 | 4.75 | 6.73 | 16.7 | 3.32 | 5.60 | 16 | 38 | 2-10' Type R Sump Inlets |
| 24 | T1 | 1.42 | 0.64 | 0.84 | 10.7 | 3.97 | 6.88 | 3 | 6 | 4' Type R Sump Inlets |
| 25 | T2 & OS-T2 | 1.99 | 0.90 | 1.18 | 13.5 | 3.63 | 6.20 | 3 | 7 | 4' Type R Sump Inlets |
| 26 | U1 | 4.38 | 1.97 | 2.58 | 14.3 | 3.54 | 6.03 | 7 | 16 | 10' Type R Sump Inlets |
| 27 | U2 | 1.89 | 0.85 | 1.11 | 13.8 | 3.59 | 6.12 | 3 | 7 | 6' Type R Sump Inlets |
| 28 | W | 5.20 | 2.34 | 3.07 | 15.0 | 3.47 | 5.89 | 8 | 18 | 10' Type R Sump Inlets |
| 29 | DESIGN POINTS 19-28, OFFSITE BASINS OS-1, 2, 3A, 3B, 7, & 9 | 84.64 | 37.91 | 51.40 | 22.4 | 2.88 | 4.78 | 117 | 265 | FSD POND |
| 30 | V & OS-10 | 4.72 | 0.90 | 2.00 | 13.5 | 3.62 | 6.19 | 3 | 12 | Triple 36" RCP Culverts |

REVISIONS

| NO. | DESCRIPTION | DATE |
|---|---|---|
| | | |

UNTIL SUCH TIME AS THESE DRAWINGS ARE APPROVED BY ALL APPROPRIATE REVIEWING AGENCIES, ATTORNEYS, ENGINEERING AND SURVEYING FIRMS, OWNER APPROVES THEIR USE ONLY FOR THE PURPOSES DESIGNATED BY WRITTEN AUTHORIZATION.

PREPARED FOR:
4-WAY RANCH JOINT VENTURES
ATTN: PETER MARTZ
PO BOX 50223
COLORADO SPRINGS, CO 80949
719-471-3150


Terra Nova Engineering, Inc.
Practice Civil Engineering Solutions
721 S. 23RD STREET
COLORADO SPRINGS, CO 80904
OFFICE: 719-635-6422
FAX: 719-635-6426
www.tnesinc.com


# WATERBURY FILING 1 & 2

MDDP
PROPOSED MDDP DRAINAGE MAP 1
OFFSITE MAP

| | |
|---|---|
| DESIGNED BY | QNA |
| DRAWN BY | QNA |
| CHECKED BY | |
| H-SCALE | 1"=100' |
| V-SCALE | |
| JOB NO. | 1715.00 |
| DATE ISSUED | 9/22/21 |
| SHEET NO. | 1 OF 2 |

REVISIONS

| NO. | DESCRIPTION | DATE |
|---|---|---|
| | | |

UNTIL SUCH TIME AS THESE DRAWINGS ARE APPROVED BY ALL APPROPRIATE REVIEWING AGENCIES, TERRA NOVA ENGINEERING AND SURVEYING, INC. APPROVES THEIR USE ONLY FOR REVIEW PURPOSES, AS DESIGNATED BY WRITTEN AUTHORIZATION.

PREPARED FOR:
4-WAY RANCH JOINT VENTURES
ATTN: PETER MARTZ
P.O. BOX 50223
COLORADO SPRINGS, CO 80949
719-471-3150


Terra Nova Engineering, Inc.
Creative Civil Engineering & Surveying
721 S. 23RD STREET
COLORADO SPRINGS, CO 80904
OFFICE: 719-635-6422
FAX: 719-635-6426
www.tneinc.com


# WATERBURY FILING 1 & 2

MDDP
PROPOSED MDDP DRAINAGE MAP 2
ONSITE MAP

DESIGNED BY QNA
DRAWN BY QNA
CHECKED BY
H-SCALE 1"=100'
V-SCALE
JOB NO. 1715.00
DATE ISSUED 9/22/21
SHEET NO. 2 OF 2

## PELIMNARY DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY

| BASIN | WEIGHTED CA(5) | WEIGHTED CA(100) | OVERLAND C(5) | OVERLAND Length (ft) | OVERLAND Height (ft) | OVERLAND Tc (min) | STREET / CHANNEL FLOW Length (ft) | STREET / CHANNEL FLOW Slope (%) | STREET / CHANNEL FLOW Velocity (fps) | STREET / CHANNEL FLOW Tc (min) | Tc TOTAL (min) | INTENSITY I(5) (in/hr) | INTENSITY I(100) (in/hr) | TOTAL FLOWS Q(5) (cfs) | TOTAL FLOWS Q(100) (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 1.52 | 2.00 | 0.25 | 100 | 2 | 12.6 | 420 | 1.5% | 4.3 | 1.6 | 14.3 | 3.54 | 6.03 | **5** | **12** |
| B1 | 1.03 | 1.36 | 0.25 | 100 | 2 | 12.6 | 400 | 1.5% | 4.3 | 1.6 | 14.2 | 3.55 | 6.05 | **4** | **8** |
| B2 | 1.21 | 1.59 | 0.25 | 100 | 2 | 12.6 | 550 | 1.5% | 4.3 | 2.1 | 14.8 | 3.49 | 5.93 | **4** | **9** |
| C | 0.39 | 0.51 | 0.25 | 20 | 0.5 | 5.3 | 500 | 2.0% | 4.9 | 1.7 | 6.9 | 4.58 | 8.14 | **2** | **4** |
| D | 0.95 | 1.24 | 0.25 | 80 | 2 | 10.5 | 300 | 2.5% | 5.5 | 0.9 | 11.4 | 3.87 | 6.69 | **4** | **8** |
| E | 0.98 | 1.29 | 0.25 | 100 | 2 | 12.6 | 400 | 2.5% | 5.5 | 1.2 | 13.8 | 3.59 | 6.12 | **4** | **8** |
| F | 0.98 | 1.29 | 0.25 | 50 | 2 | 7.1 | 620 | 1.5% | 4.3 | 2.4 | 9.5 | 4.14 | 7.22 | **4** | **9** |
| G | 0.30 | 0.39 | 0.25 | 25 | 2 | 4.0 | 620 | 1.0% | 3.4 | 3.0 | 7.0 | 4.57 | 8.12 | **1** | **3** |
| H | 0.51 | 0.67 | 0.25 | 50 | 2 | 7.1 | 525 | 1.5% | 4.3 | 2.0 | 9.2 | 4.19 | 7.33 | **2** | **5** |
| I | 1.28 | 2.53 | 0.25 | 80 | 4 | 8.4 | 250 | 2.0% | 4.9 | 0.8 | 9.2 | 4.18 | 7.32 | **5** | **19** |
| J | 0.90 | 1.17 | 0.25 | 90 | 6 | 8.1 | 850 | 2.0% | 4.9 | 2.9 | 10.9 | 3.94 | 6.81 | **4** | **8** |
| K | 0.69 | 1.37 | 0.25 | 100 | 18 | 6.1 | 80 | 1.0% | 3.5 | 0.4 | 6.5 | 4.67 | 8.33 | **3** | **11** |
| L1 | 2.37 | 3.11 | 0.25 | 100 | 2 | 12.6 | 860 | 1.4% | 4.1 | 3.5 | 16.1 | 3.36 | 5.69 | **8** | **18** |
| L2 | 0.90 | 1.18 | 0.25 | 55 | 1.1 | 9.4 | 860 | 1.4% | 4.1 | 3.5 | 12.8 | 3.70 | 6.34 | **3** | **7** |
| M1 | 1.31 | 1.71 | 0.25 | 70 | 1.5 | 10.3 | 200 | 2.0% | 4.9 | 0.7 | 11.0 | 3.92 | 6.79 | **5** | **12** |
| M2 | 0.21 | 0.28 | 0.25 | 65 | 3 | 7.7 | 0 | 0.0% | 0.0 | 0.0 | 7.7 | 4.43 | 7.83 | **1** | **2** |
| N | 0.10 | 0.13 | 0.25 | | | | | | | | 5.0 | 5.00 | 9.06 | **1** | **1** |
| O1 | 1.27 | 1.66 | 0.25 | 100 | 3 | 11.1 | 460 | 1.5% | 4.3 | 1.8 | 12.8 | 3.70 | 6.34 | **5** | **11** |
| O2 | 0.42 | 0.56 | 0.25 | 100 | 2 | 12.6 | 850 | 2.0% | 4.9 | 2.9 | 15.5 | 3.42 | 5.80 | **1** | **3** |
| P | 0.53 | 0.70 | 0.25 | 65 | 3 | 7.7 | 0 | 0.0% | 0.0 | 0.0 | 7.7 | 4.43 | 7.83 | **2** | **5** |
| Q1 | 0.47 | 0.61 | 0.25 | 55 | 1.3 | 8.9 | 445 | 2.0% | 5.0 | 1.5 | 10.4 | 4.01 | 6.97 | **2** | **4** |
| Q2 | 0.49 | 0.65 | 0.25 | 55 | 1.3 | 8.9 | 445 | 2.0% | 5.0 | 1.5 | 10.4 | 4.01 | 6.97 | **2** | **5** |
| R | 0.06 | 0.08 | 0.25 | 100 | 4 | 10.1 | 700 | 2.0% | 4.9 | 2.4 | 12.4 | 3.75 | 6.44 | **0** | **1** |
| S1 | 0.70 | 0.91 | 0.25 | 100 | 6 | 8.8 | 175 | 2.0% | 4.9 | 0.6 | 9.4 | 4.16 | 7.26 | **3** | **7** |
| S2 | 0.06 | 0.08 | 0.25 | | | | | | | | 5.0 | 5.00 | 9.06 | **0.3** | **1** |
| T1 | 0.64 | 0.84 | 0.25 | 55 | 1.1 | 9.4 | 390 | 2.0% | 4.9 | 1.3 | 10.7 | 3.97 | 6.88 | **3** | **6** |
| T2 | 0.55 | 0.73 | 0.25 | 100 | 2 | 12.6 | 245 | 2.0% | 5.0 | 0.8 | 13.5 | 3.63 | 6.20 | **2** | **5** |
| U1 | 1.97 | 2.58 | 0.25 | 100 | 2 | 12.6 | 520 | 2.3% | 5.3 | 1.6 | 14.3 | 3.54 | 6.03 | **7** | **16** |
| U2 | 0.85 | 1.11 | 0.25 | 100 | 2 | 12.6 | 385 | 2.3% | 5.4 | 1.2 | 13.8 | 3.59 | 6.12 | **3** | **7** |
| W | 2.34 | 3.07 | 0.25 | 100 | 2 | 12.6 | 630 | 1.6% | 4.4 | 2.4 | 15.0 | 3.47 | 5.89 | **8** | **18** |
| V | 0.59 | 0.78 | 0.25 | 95 | 6 | 8.4 | | | | | 8.4 | 4.31 | 7.58 | **3** | **6** |
| **OS-1*** | **4.67** | **18.69** | **0.25** | **100** | **2** | **12.6** | **2700** | **2.3%** | **5.3** | **8.5** | **21.1** | **2.97** | **4.94** | **14** | **92** |
| OS-4 | 0.98 | 3.92 | 0.25 | 800 | 26 | 30.5 | | | | | 30.5 | 2.46 | 4.01 | **2** | **16** |
| OS-5 | 2.54 | 3.33 | 0.25 | 600 | 18 | 27.1 | | | | | 27.1 | 2.62 | 4.30 | **7** | **14** |
| OS-6 | 0.48 | 0.63 | 0.25 | 30 | 0.6 | 6.9 | 900 | 1.8% | 4.7 | 3.2 | 10.1 | 4.05 | 7.04 | **2** | **4** |
| **OS-7*** | **0.33** | **1.31** | **0.25** | | | | | | | | **5.0** | **5.00** | **9.06** | **2** | **12** |
| OS-8 | FLOW TAKEN FROM MERIDAN RANCH MDDP | | | | | | | | | | | | | **5** | **11** |
| OS-9 | FLOW TAKEN FROM MERIDAN RANCH MDDP | | | | | | | | | | | | | **8** | **19** |

**BASIN* = BASIN AREA REVISED FROM MDDP IN PRELIMINARY CONDITION DUE TO UNDEVELOPED UPSTREAM**

## PELIMNARY DRAINAGE REPORT ~ PIPE ROUTING SUMMARY

| Pipe Run | Contributing Design Points/Basins | Equivalent CA(5) | Equivalent CA(100) | Maximum Tc | Intensity I(5) | Intensity I(100) | Flow Q(5) | Flow Q(100) | Pipe Size* |
|---|---|---|---|---|---|---|---|---|---|
| 1 | DP 2 | 0.39 | 0.51 | 6.9 | 4.58 | 8.14 | 2 | 4 | 18" RCP |
| 2 | DP 1 & 2 | 1.91 | 2.51 | 14.3 | 3.54 | 6.03 | 7 | 15 | 24" RCP |
| 3 | DP 3 | 1.03 | 1.36 | 14.2 | 3.55 | 6.05 | 4 | 8 | 18" RCP |
| 4 | DP-4 | 1.21 | 1.59 | 14.8 | 3.49 | 5.93 | 4 | 9 | 18" RCP |
| 5 | DP 3 & 4 | 2.25 | 2.94 | 14.8 | 3.49 | 5.93 | 8 | 17 | 24" RCP |
| 6 | DP 1-4 | 4.16 | 5.45 | 14.8 | 3.49 | 5.93 | 15 | 32 | 30" RCP |
| 7 | DP-1-5 | 5.65 | 7.41 | 14.8 | 3.49 | 5.93 | 20 | 44 | 36" RCP |
| 8 | DP-6 | 0.95 | 1.24 | 11.4 | 3.87 | 6.69 | 4 | 8 | 18" RCP |
| 9 | DP-7 | 0.98 | 1.29 | 13.8 | 3.59 | 6.12 | 4 | 8 | 18" RCP |
| 10 | DP-6 & 7 | 1.93 | 2.53 | 13.8 | 3.59 | 6.12 | 7 | 15 | 18" RCP |
| 10A | Pond 1 Release | | | | | | 2.2 | 8.0 | 18" RCP |
| 11 | DP-14 | 2.37 | 3.11 | 16.1 | 3.36 | 5.69 | 8 | 18 | 24" RCP |
| 12 | DP-15 | 0.90 | 1.18 | 12.8 | 3.70 | 6.34 | 3 | 7 | 18" RCP |
| 13 | DP 14 & 15 | 3.27 | 4.29 | 16.1 | 3.36 | 5.69 | 11 | 24 | 30" RCP |
| 14 | DP 16 | 1.27 | 1.66 | 12.8 | 3.70 | 6.34 | 5 | 11 | 24" RCP |
| 15 | DP 14, 15 & 16 | 4.54 | 5.95 | 16.1 | 3.36 | 5.69 | 15 | 34 | 36" RCP |
| 16 | DP 17 | 0.42 | 0.56 | 15.5 | 3.42 | 5.80 | 1 | 3 | 18" RCP |
| 17 | DP 14, 15, 16, & 17 | 4.97 | 6.51 | 16.1 | 3.36 | 5.69 | 17 | 37 | 36" RCP |
| 17A | Pond 2 Release | | | | | | 0.2 | 10.6 | 18" RCP |
| **18*** | **DP 19** | **0.50** | **0.73** | **0.0** | **7.12** | **14.19** | **4** | **10** | **24" RCP** |
| **19*** | **DP 20** | **0.51** | **0.73** | **0.0** | **7.12** | **14.19** | **4** | **10** | **18" RCP** |
| **20*** | **DP 19 & 20** | **1.01** | **1.46** | **0.0** | **7.12** | **14.19** | **7** | **21** | **24" RCP** |
| **21*** | **DP 21 PICK UP** | **0.07** | **0.08** | **12.4** | **3.75** | **6.44** | **0** | **0** | **18" RCP** |
| **22*** | **DP 19, 20 & 21** | **1.08** | **1.53** | **0.0** | **7.12** | **14.19** | **8** | **22** | **30" RCP** |
| **23*** | **DP 22** | **0.69** | **0.92** | **12.4** | **3.75** | **6.44** | **3** | **6** | **24" RCP** |
| **24*** | **DP 23** | **0.06** | **0.08** | **5.0** | **5.00** | **9.06** | **0** | **1** | **24" RCP** |
| **25*** | **DP 22 & 23** | **0.75** | **0.99** | **12.4** | **3.75** | **6.44** | **3** | **6** | **24" RCP** |
| **26*** | **DP 19 -23** | **1.83** | **2.53** | **0.0** | **7.12** | **14.19** | **13** | **36** | **36" RCP** |
| **27*** | **DP 24** | **0.64** | **0.84** | **10.7** | **3.97** | **6.88** | **3** | **6** | **18" RCP** |
| **28*** | **DP 25** | **0.58** | **0.84** | **13.5** | **3.63** | **6.20** | **2** | **5** | **18" RCP** |
| **29*** | **DP 19-25** | **3.05** | **4.20** | **13.5** | **3.63** | **6.20** | **11** | **26** | **36" RCP** |
| **30*** | **DP 26** | **1.97** | **2.58** | **14.3** | **3.54** | **6.03** | **7** | **16** | **24" RCP** |
| **31*** | **DP 19-26** | **5.02** | **6.78** | **14.3** | **3.54** | **6.03** | **18** | **41** | **42" RCP** |
| **32*** | **27** | **0.85** | **1.11** | **13.8** | **3.59** | **6.12** | **3** | **7** | **18" RCP** |
| **33*** | **DP 19-27** | **5.87** | **7.90** | **14.3** | **3.54** | **6.03** | **21** | **48** | **42" RCP** |
| 34 | DP 28 | 2.34 | 3.07 | 21.1 | 2.97 | 4.94 | 7 | 15 | 24" RCP |
| **35*** | **Pond 3 Release** | **0.00** | **0.00** | **0.0** | **7.12** | **14.19** | **1.0** | **60.7** | **TRIPLE 36" RCP** |

**PIPE RUN* = PIPE RUN REVISED FROM MDDP IN PRELIMINARY CONDITION DUE TO UNDEVELOPED UPSTREAM**

## PELIMNARY DRAINAGE REPORT ~ SURFACE ROUTING SUMMARY

| Design Point(s) | Contributing Basins | Area (AC) | Equivalent CA(5) | Equivalent CA(100) | Maximum Tc | Intensity I(5) | Intensity I(100) | Flow Q(5) | Flow Q(100) | Facility Size |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | A | 3.39 | 1.52 | 2.00 | 14.3 | 3.54 | 6.03 | 5 | 12 | 6' Type R Sump Inlet |
| 2 | C | 0.86 | 0.39 | 0.51 | 6.9 | 4.58 | 8.14 | 2 | 4 | 4' Type R Sump Inlet |
| 3 | B1 | 2.30 | 1.03 | 1.36 | 14.2 | 3.55 | 6.05 | 4 | 8 | 4' Type R Sump Inlet |
| 4 | B2 | 2.69 | 1.21 | 1.59 | 14.8 | 3.49 | 5.93 | 4 | 9 | 4' Type R Sump Inlet |
| 5 | F & H | 3.31 | 1.49 | 1.95 | 9.5 | 4.14 | 7.22 | 6 | 14 | 6' Type R Sump Inlet |
| 6 | D | 2.11 | 0.95 | 1.24 | 11.4 | 3.87 | 6.69 | 4 | 8 | 4' Type R Sump Inlets |
| 7 | E | 2.18 | 0.98 | 1.29 | 13.8 | 3.59 | 6.12 | 4 | 8 | 4' Type R Sump Inlets |
| 8 | DESIGN POINTS 1-7 | 16.84 | 7.58 | 9.94 | 14.8 | 3.49 | 5.93 | 26 | 59 | FSD Pond 1 |
| 9 | OS-9 | 0.31 | 0.03 | 0.11 | 0.0 | 7.12 | 14.19 | 0 | 2 | EX 36" CMP Culvert |
| 10 | OS-8 | 1.04 | 0.09 | 0.38 | 0.0 | 7.12 | 14.19 | 1 | 5 | EX 36" CMP Culvert |
| 10A | MERIDIAN POND E RELEASE | | | | | | | 28 | 135 | EX 3-42" RCP Culverts |
| 11 | OS-5, I, OS-& MERIDIAN POND E RELEASE | SCS MODEL | | | | | | 53 | 212 | PR 2-42" RCP Culverts |
| 12 | OS-6 | 0.33 | 0.48 | 0.63 | 10.1 | 4.05 | 7.04 | 2 | 4 | 18" RCP Culvert |
| 13 | TOTAL OFFISITE EX. STOCK POND INFLOW | SCS MODEL | | | | | | 69 | 396 | EX STOCK POND |
| 14 | L1 | 5.27 | 2.37 | 3.11 | 16.1 | 3.36 | 5.69 | 8 | 18 | 10' Type R Sump Inlet |
| 15 | L2 | 2.00 | 0.90 | 1.18 | 12.8 | 3.70 | 6.34 | 3 | 7 | 4' Type R Sump Inlet |
| 16 | O1 | 2.82 | 1.27 | 1.66 | 12.8 | 3.70 | 6.34 | 5 | 11 | 6' Type R Sump Inlet |
| 17 | O2 | 0.94 | 0.42 | 0.56 | 15.5 | 3.42 | 5.80 | 1 | 3 | 4' Type R Sump Inlet |
| 18 | DESIGN POINTS 7-10 & BASIN OS-4 | 21.93 | 4.97 | 6.51 | 16.1 | 3.36 | 5.69 | 17 | 37 | Interim FSD Pond 2 |
| **19*** | **Q1 & OS-Q1** | **1.36** | **0.50** | **0.73** | **0.0** | **7.12** | **14.19** | **4** | **10** | **8' Type R Sump Inlet** |
| **20*** | **Q2 & OS-Q2** | **1.32** | **0.51** | **0.73** | **0.0** | **7.12** | **14.19** | **4** | **10** | **4' Type R Sump Inlet** |
| **21*** | **R & OS-R** | **1.18** | **0.06** | **0.08** | **12.4** | **3.75** | **6.44** | **0** | **1** | **12' Type R At-grade Inlet** |
| **22*** | **S1 & OS-S1 & DP 21 FLOW BY** | **1.86** | **0.69** | **0.92** | **12.4** | **3.75** | **6.44** | **3** | **6** | **10' Type R Sump Inlet** |
| **23*** | **S2 & OS-S2** | **0.27** | **0.06** | **0.08** | **5.0** | **5.00** | **9.06** | **0** | **1** | **10' Type R Sump Inlet** |
| **24*** | **T1** | **1.42** | **0.64** | **0.84** | **10.7** | **3.97** | **6.88** | **3** | **6** | **4' Type R Sump Inlets** |
| **25*** | **T2 & OS-T2** | **1.54** | **0.58** | **0.84** | **13.5** | **3.63** | **6.20** | **2** | **5** | **4' Type R Sump Inlets** |
| **26*** | **U1** | **4.38** | **1.97** | **2.58** | **14.3** | **3.54** | **6.03** | **7** | **16** | **10' Type R Sump Inlets** |
| **27*** | **U2** | **1.89** | **0.85** | **1.11** | **13.8** | **3.59** | **6.12** | **3** | **7** | **6' Type R Sump Inlets** |
| **28*** | **W** | **5.20** | **2.34** | **3.07** | **15.0** | **3.47** | **5.89** | **8** | **18** | **10' Type R Sump Inlets** |
| **29*** | **DESIGN POINTS 19-28 & OS-7** | **21.72** | **8.79** | **11.74** | **15.0** | **3.47** | **5.89** | **30** | **69** | **FSD POND** |
| **30*** | **V, OS-1, OS-8 & OS-9** | **67.60** | **5.27** | **19.47** | **21.1** | **2.97** | **4.94** | **24** | **115** | **Triple 36" RCP Culverts** |

**DESIGN POINT* = DESIGN POINT REVISED FROM MDDP IN PRELIMINARY CONDITION DUE TO UNDEVELOPED UPSTREAM**

REVISIONS

| NO. | DESCRIPTION | DATE |
|---|---|---|
| | | |

UNTIL SUCH TIME AS THESE DRAWINGS ARE APPROVED BY ALL APPROPRIATE REVIEWING AGENCIES, THE ENGINEER OR SURVEYOR ACTING AS AGENT THEREOF APPROVES THEIR USE ONLY FOR REVIEW PURPOSES, OR DESIGNATED BY WRITTEN AUTHORIZATION.

PREPARED FOR:
4-WAY RANCH JOINT VENTURE
ATTN: PETER MARTZ
P.O. BOX 50223
COLORADO SPRINGS, CO 80949
719-471-3150

Terra Nova Engineering, Inc.
Creative Civil Engineering Solutions
721 S. 23RD STREET
COLORADO SPRINGS, CO 80904
OFFICE: 719-635-6422
FAX: 719-635-6426
www.tneinc.com

WATERBURY FILING NO. 1

PRELIMINARY
PROPOSED FINAL DRAINAGE MAP
OFF-SITE

DESIGNED BY QNA
DRAWN BY QNA
CHECKED BY
H-SCALE 1"=100
V-SCALE NA
JOB NO. 1715.00
DATE ISSUED 12/23/20
SHEET NO. 1 OF 2

MATCHLINE SEE SHEET 1

REVISIONS

| NO. | DESCRIPTION | DATE |
|---|---|---|
| | | |

UNTIL SUCH TIME AS THESE DRAWINGS ARE APPROVED BY ALL APPROPRIATE REVIEWING AGENCIES, TERRA NOVA ENGINEERING INC. DOES NOT ASSUME OR APPROVE THEIR USE ONLY FOR REVIEW PURPOSES AS DESIGNATED BY WRITTEN AUTHORIZATION.

PREPARED FOR:
4-WAY RANCH JOINT VENTURE
ATTN: PETER MARTZ
PO BOX 50223
COLORADO SPRINGS, CO 80949
719-471-3150


Terra Nova Engineering, Inc.
"Total Civil Engineering"
721 S. 23RD STREET
COLORADO SPRINGS, CO 80904
OFFICE: 719-635-6422
FAX: 719-635-6426
www.tnesinc.com


# WATERBURY FILING NO. 1

PRELIMINARY
PROPOSED DRAINAGE MAP
ON-SITE

| | |
|---|---|
| DESIGNED BY | QNA |
| DRAWN BY | QNA |
| CHECKED BY | |
| H-SCALE | 1"=100 |
| V-SCALE | NA |
| JOB NO. | 1715.00 |
| DATE ISSUED | 9/22/20 |
| SHEET NO. | 2 OF 2 |