FINAL DRAINAGE REPORT
FOR
CLOVERLEAF FILING NO. 2

PCD File No. SF2123

Prepared For:

Monument Hill CM LLC
1864 Woodmoor Drive, Suite 100
Colorado Springs, CO 80920

December 14, 2021
Project No. 25158.01

Prepared By:
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J·R ENGINEERING

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CLOVERLEAF FILING NO. 2

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 El Paso County for drainage reports and said report is in conformity with the 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.

Mike Bramlett, Colorado P.E. # 32314
For and On Behalf of JR Engineering, LLC

COLORADO LICENSED
MIKE BRAMLETT
MB
32314
11/11/21
PROFESSIONAL ENGINEER

DEVELOPER'S STATEMENT:

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

Business Name: Monument Hill CM LLC

By: Joseph W. DesJardin

Title: Director of Entitlements

Address: 1864 Woodmoor Drive, Suite 100
Monument, CO 80920

El Paso County:

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

APPROVED
Engineering Department
01/31/2022 4:45:02 PM
dsdnijkamp
EPC Planning & Community Development Department

Jennifer Irvine, P.E.
County Engineer/ ECM Administrator

Conditions:

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APPENDIX

PURPOSE

This document is the Final Drainage Report for Cloverleaf Filing No. 2. The purpose of this report is to identify on-site and off-site drainage patterns, storm sewer, culvert and inlet locations, areas tributary to the site, and to safely route developed storm water to adequate outfall facilities.

GENERAL SITE DESCRIPTION

GENERAL LOCATION

The proposed Cloverleaf Filing No. 2, known as "Cloverleaf F2" from herein, is a parcel of land located in Section 23 and 24, Township 11 South, Range 67 West of the 6th Principal Meridian in El Paso County, Colorado. The subdivision will replat Tract H of Woodmoor Greens and a Portion of Tract B of Woodmoor Placer. Cloverleaf F2 is a 37.28 acre, single family-development and is comprised of 131 lots and associated infrastructure. Cloverleaf F2 will be an urban subdivision proposed for RS-5000 zoning. The site is bounded by Walters Commons Townhomes and Country Ridge Condos to the south, Bowstring Road to the west, Woodmoor Greens and Woodmoor Placer subdivision to the north and Cloverleaf Road to the east. A vicinity map of the area is presented in Appendix A.

No major drainageways or irrigation wells exist on the site.

DESCRIPTION OF PROPERTY

Cloverleaf F2 is currently unoccupied and undeveloped. The existing ground cover is sparse vegetation and open space, typical of a Colorado rolling range land condition. In general, Cloverleaf F2 slopes from northeast to southwest.

Per an NRCS web soil survey of the area, Cloverleaf F2 is made up of Type B soils. This Type B soil is Tomah-Crowfoot loamy sand. This soil type has a moderate infiltration rate when thoroughly wet. It also consists of moderately deep or deep, moderately well drained or well-drained soil. A soil survey map has been presented in Appendix A.

There are no major drainageways or known irrigation facilities located on the project site. Woodmoor Water and Sanitation District does have various easements for both sanitary and water lines run parallel to existing property lines or cross the site as shown on the drainage map in Appendix F.

FLOODPLAIN STATEMENT

Based on the FEMA Firm Map Number 08041CO278G, revised December 7, 2018, the entire development is located within Zone X, or areas area outside the Special Flood Hazard Area (SFHA)

and higher than the elevation of the 0.2-percent-annual-chance (or 500-year) flood. The FEMA map containing the site has been presented in Appendix A.

EXISTING DRAINAGE CONDITIONS

MAJOR BASIN DESCRIPTIONS

Cloverleaf F2 lies within the upper reaches of the Teachout Creek watershed basin. Although no DBPS currently exists for Teachout Creek, basin fees have been listed in the Interim Basin Section of the 2021 El Paso County Drainage Basin Fee list. Existing vegetation on the proposed site consists primarily of native grasses. The terrain is sloped generally from northeast to southwest and ranges from 3% to 15%. Drainage from the site currently discharges both west through existing culverts to Lewis Palmer High School and south under Higby Road through existing culverts.

EXISTING SUB-BASIN DRAINAGE

Existing basin drainage patterns are generally from northeast to southwest by way of sheet flow. Woodmoor Placer and Woodmoor Greens subdivisions were platted in the 1970's with half acre or larger lots served by asphalt roads with roadside ditches and culverts. Woodmoor Placer and Woodmoor Greens also had a large somewhat connected series of open space tracts that were envisioned as a golf course. Any excess drainage flows generated by Woodmoor Greens or Woodmoor Place were not detained except in natural depressions within the open space.

The upper Woodmoor drainage flows above Caribou Drive have been collected in the roadside ditches and historically discharged through the lower lots via side lot swales and into the open space where the flow dispersed as sheet flow. The open space flows drain to lower Woodmoor developments; Leggins Way, County Ridge Condos, and Walters Commons Townhomes. Leggins Way accepts the upstream flows via gentle side lot swales that drain to Leggins Way roadside swales discharge through a 28"x42" culvert under Bowstring Road and continue into the Lewis-Palmer High School drainage system. Upstream flows onto Country Ridge pass through the condos and exit into Magic Lamp Way which discharges as gutter flow at the high point of Bowstring Road with half the flows entering the high school at Leggins Way and half the flows entering the Higby Road storm sewer system. Leggins Way and Country Ridge do not provide detention. Walters Commons Townhomes was developed in the 2000's also accepts some of the Woodmoor Place and Woodmoor Greens upstream developed flows but it does provide for stormwater detention which discharges to the Higby Road storm sewer system.

A meeting was held with the school district in January 2020 and the district reported no periodic flooding or drainage concerns.

CUHP/SWMM EXISTING SUB-BASIN DRAINAGE

The Cloverleaf Filing No. 2 Site contains 3 separate areas. The main area, totaling approximately 37.24 acres will contain lots 1 – 125. The main site area has approximately 136 tributary acres upstream of it represented by Basins TX-1, TX-2 in the SWMM model. The site also has flows combining with the development's flows from the existing roadside swale along Bowstring Road. These flows are represented by Basin SX-6 with a total additional area of 49.1 acres. Due to the total analysis area being over 200 acres, the historic, existing, and proposed conditions hydrology were analyzed using CUHP/SWMM. Further discussions regarding these basins can be found below.

As seen in the "Existing Conditions CUHP/SWMM Basins & Routing Map" drainage map, the offsite and on-site areas can be broken into six sub-basins: TX-1, TX-2, SX-3, SX-4, SX-5, and SX-6.

Existing Basin TX-1 is approximately 108.7 acres and consists of prairie grasses, public streets and single family lots. Flow from this basin (Q_5=46.8 cfs, Q_{1oo} =124.8 cfs) flows through an existing side yard swale and enters the open space at Node/DP-1 (Q_5=46.8 cfs, Q_{1oo} =124.8 cfs), eventually reaching the Cloverleaf F2 site as sheet flow at Node/DP-3.

Existing Basin TX-2 is approximately 27.2 acres and consists of prairie grasses, public streets and single family lots. Flow from this basin (Q_5=10.9 cfs, Q_{1oo} =31.4 cfs) flows through an existing side yard swale and enters the open space at Node/DP-2 (Q_5=10.9 cfs, Q_{1oo} =31.4 cfs), eventually reaching the Cloverleaf F2 site as sheet flow into Basin SX-4.

Existing Basin SX-3 is approximately 27.6 acres and consists of prairie grasses. Flow from this basin (Q_5 =9.1 cfs, Q_{1oo} =33.0 cfs) combines with flows from Basins TX-1 and TX-2 at Node/DP-3 and flows ultimately to the roadside swale along the east side of Leggins Way at DP-9. The areas included in existing SWMM basin SX-3 were included in the Walters Commons FDR as portions of basins OS-5(32.05 ac) and OS-4 (5.68 ac).

Existing Basin SX-4 is approximately 5.2 acres and consists of prairie grasses and a portion of Walters Point (an existing private road access to Walters Commons. Flow from this basin (Q_5=1.7 cfs, Q_{1oo} =5.6 cfs) sheet flows south into Walters Commons at Node/DP-4. This flow continues to the southwest through the Walters Commons F1 site until it reaches the existing 1.83 ac-ft detention pond part of the Walters Commons development. This pond was sized for the offsite tributary areas that are now part of the Cloverleaf development site and included a total of 9.31 tributary acres to the existing 1.83 ac-ft detention from the Cloverleaf site in basins OS-9, OS-10, and OS-11.

The existing Walters Commons detention pond limits flows to historic rates, and ultimately discharges to the existing 2.3' diameter CMP culvert pipe those outfalls to the ditch on the south side of Higby Road.

Existing Basin SX-5 is approximately 4.3 acres and consists of prairie grasses and a portion of Walters Point. Flow from this basin (Q_5=1.7 cfs, Q_{1oo} =5.8 cfs) sheet flows to the south and enters the roadside ditch for Cloverleaf Road at Node/DP-5. Flows in the roadside ditch are collected at a Type C area inlet and enter the Walters Commons Storm Sewer System at Node/DP-11 and are then piped to the existing 1.83 ac-ft detention pond part of the Walters Commons development. This pond was sized for the offsite tributary areas that are now part of the Cloverleaf F2 development site and included a total of 9.31 tributary acres to the existing 1.83 ac-ft detention from the Cloverleaf F2 site in basins OS-9, OS-10, and OS-11.

The existing Walters Commons detention pond limits flows to historic rates, and ultimately discharges to the existing 2.3' diameter CMP culvert pipe that outfalls to the ditch on the south side of Higby Road.

Basins OS-9, OS-10, and OS-11 form the Walters Commons FDR are reasonably consistent in area, flow patterns and runoff quantities with existing basins SX-4 and SX-5 detailed in this report.

Existing Basin SX-6 is approximately 49.1 acres and consists of prairie grasses, Leggins Way, and single family lots. Flow from this basin (Q_5=22.3 cfs, Q_{1oo} =63.1 cfs) sheet flows to the roadside swales along Bowstring Road at DP-6 and continue in the roadside swale to the southeast until they reach the EX-28"X42" CMP culvert at outfall O1.

CUHP/SWMM HISTORIC SUB-BASIN DRAINAGE

Three basins were analyzed for historic flows. The first basins H1, consists of 163.4 acres of open space/fields (2% impervious). This basin roughly encompasses the same area as the proposed basins TX-1, TX-2, and S-3 from the CUHP/SWMM proposed conditions model. The intent of the historical flow analysis was to quantify pre-development flow rates for the area congruent with Pond P2's tributary area (Proposed basins TX-1, TX-2, and S-3) to determine allowable release rates for the proposed pond. This pond needed to be modeled in SWMM as it is in series with the proposed volume attenuation pond P1. Historic Basin H1 generates runoff rates of Q5 = 32.6 cfs and Q100 = 152.2 cfs.

Historic Basin H2 was provided for informational purposes only and was not used to determine allowable release rates to any pond. Basin H2 consists of 9.62 acres in the southeast corner of the proposed development site. Basin H2 generates runoff rates of Q5 = 2.8 cfs and Q100 = 12.8 cfs. Proposed Pond 3 lies within the historic basin H2, but was sized and designed using the UDFCD UD-detention workbook as its tributary is very small, and in our opinion best modeled through methods other than SWMM and CUHP.

Historic Basin H3 consists of 49.1 acres of open space/ fields (2% impervious). This basin roughly encompasses the same area as the proposed basins S-6 from the CUHP/SWMM proposed conditions

model (basin SX-6 in existing conditions model). The intent of the historical flow analysis was to quantify pre-development flow rates to add to Historic Basin H1 and better model the total outflow which can be compared to the existing and proposed conditions. Historic Basin H3 generates runoff rates of Q5 = 11.1 cfs and Q100 = 50.8 cfs and a combination flow with Historic Basin H1 of Q5 = 43.6 cfs and Q100 = 203.0 cfs.

PROPOSED DRAINAGE CONDITIONS

PROPOSED SUB-BASIN DRAINAGE (RATIONAL METHOD)

The proposed site was broken into 21 sub-basins: Basins A through O, and OS-1 through OS-5. The proposed and sub-basin delineation is shown on the drainage basin map in Appendix F. Four ponds and a sand filter are proposed as part of this development. Pond P1 is a private volume attenuation pond that receives all flow from offsite basins that are tributary to the project site, as well as Basin OS-1. Pond P2 is a private full spectrum detention extended detention basin that receives flow from Basins A through K, which make up the majority of the project site. Pond 3 is a private full spectrum detention extended detention basin that receives flow from Basin L in the southeast side of the project site. Pond 4 is a private water quality pond that receives flow from Basins M, N, and O on the western side of the project site. The proposed sand filter will be located behind lots 66-67 and will treat runoff from Sub-Basin OS-4.

The proposed Cloverleaf F2 basin delineation is described below. Refer to the basin and design point summary tables at the end of this section for basin and design point flows.

Proposed Basin A is approximately 4.39 acres in area and includes portions of twenty two proposed single family residential lots, proposed open space, and proposed roadway. Runoff from Basin A (Q_5=7.8 cfs, Q_{1oo} =17.3 cfs) sheet flows to the proposed roads and is routed via proposed El Paso County Type C curb and gutter to a proposed public 15’ Type R on-grade inlet at DP 1. Once in the inlet, the captured flow is piped via proposed public storm sewer to a DP 4.1, where it combines with the flow from Basin D.

Proposed Basin B is approximately 3.11 acres in area and includes portions of twenty one proposed single family residential lots. Runoff from Basin B (Q_5=4.2 cfs, Q_{1oo} =10.1 cfs) sheet flows to the back of the proposed lots and is routed via a proposed swale to a proposed private Type C area inlet at DP 2. The proposed swale will be within a drainage easement, which will restrict the installation of fencing, structures, or storage of materials within the easement. Once in the inlet, the captured flow is piped via proposed public storm sewer to DP 4.2, where it combines with the flow from DP 4.1. In the event that the inlet at DP 2 becomes clogged, the flow will be routed directly into the proposed private water quality pond 4 at DP 15 via a proposed swale. The proposed routing reduces the runoff to the adjacent site and instead routes the flow to the proposed pond P2, which releases flow at or below the historic rates.

Proposed Basin C is approximately 1.77 acres in area and includes portions of sixteen proposed single family residential lots and proposed roadway. Runoff from Basin C (Q_5=4.2 cfs, Q_{100} =8.7 cfs) sheet flows to the proposed road and is routed via proposed El Paso County Type C curb and gutter to a proposed public 15' Type R on-grade inlet at DP 3. The captured flow is piped via proposed private storm sewer to DP 4.3, where it combines with flow from DP 4.2.

Proposed Basin D is approximately 3.38 acres in area and includes portions of twenty proposed single family residential lots, proposed open space, and proposed roadway. Runoff from Basin D (Q_5=5.9 cfs, Q_{100} =13.0 cfs) sheet flows to the proposed road and is routed via proposed El Paso County Type C curb and gutter to a proposed public 15' Type R on-grade inlet at DP 4. Once in the inlet, the captured flow is piped via proposed public storm sewer to a proposed public manhole at DP 4.1, where it combines with the flow from Basin A.

All flow at DP 4.1 (Q_5=13.1 cfs, Q_{100} =24.6 cfs) is piped via proposed public storm sewer to DP 4.2.

All flow at DP 4.2 (Q_5=16.7 cfs, Q_{100} =33.7 cfs) is piped via proposed public storm sewer to DP 4.3.

All flow at DP 4.3 (Q_5=20.1 cfs, Q_{100} =40.4 cfs) is piped via proposed public storm sewer to DP 5.1.

Proposed Basin E is approximately 0.30 acres in area and includes portions of four proposed single family residential lots and proposed roadway. Runoff from Basin E (Q_5=1.0 cfs, Q_{100} =2.0 cfs) sheet flows to the proposed road and is routed via proposed El Paso County Type C curb and gutter to a proposed public 10' Type R on-grade inlet at DP 5. Once in the inlet, the captured flow combines with flow from DP 4.3 at DP 5.1.

All flow at DP 5.1 (Q_5=20.8 cfs, Q_{100} =41.7 cfs) is piped via proposed public storm sewer to proposed private Pond P2, where it combines with flow from Basin K and DP 10.1 at DP 11.

Proposed Basin F is approximately 1.40 acres in area and includes portions of eight proposed single family residential lots and proposed roadway. Runoff from Basin F (Q_5=3.4 cfs, Q_{100} =6.9 cfs) sheet flows to the proposed roads and is routed via proposed El Paso County Type C curb and gutter to a proposed public 10' Type R on-grade inlet at DP 6. Once in the inlet, the captured flow is piped via proposed public storm sewer to a proposed public manhole at DP 8.3, where it combines with the flow from tributary basins routed through Pond P1 (DP TB) and DP 8.2.

All flow from tributary basins is routed through Pond P1 and throttled in a proposed private outlet structure at DP TB to release into the proposed storm system at rates of Q_5=47.4 cfs, Q_{100} =84.8 cfs. This flow is routed via proposed public storm sewer to DP 8.3, where it combines with flow from Basin F and DP 8.2. In the event that the proposed private outlet structure becomes clogged, flow

will overtop the proposed pond embankment and travel down through proposed open space to the proposed public 15' Type R sump inlet at DP 8.

Proposed Basin IA is approximately 1.71 acres in area and includes portions of eighteen proposed single family residential lots and proposed roadway. Runoff from Basin IA (Q_5=3.5 cfs, Q_{1oo} =7.3 cfs) sheet flows to the proposed roads and is routed via proposed El Paso County Type C curb and gutter to a proposed public 10' Type R on-grade inlet at DP 7A. Once in the inlet, the captured flow is piped via proposed public storm sewer to a proposed public manhole at DP 8.2, where it combines with the flow from DP 8.1.

Proposed Basin G is approximately 0.90 acres in area and includes portions of four proposed single family residential lots, proposed open space, and proposed roadway. Runoff from Basin G (Q_5=2.4 cfs, Q_{1oo} =5.1 cfs) sheet flows to the proposed roads and is routed via proposed El Paso County Type C curb and gutter to a proposed public 5' Type R on-grade inlet at DP 7. Once in the inlet, the captured flow is piped via proposed public storm sewer to a proposed public manhole at DP 8.1, where it combines with the flow from Basin H.

Proposed Basin H is approximately 4.18 acres in area and includes portions of eighteen proposed single family residential lots, proposed open space, and proposed roadway. Runoff from Basin H (Q_5=6.6 cfs, Q_{1oo} =15.2 cfs) sheet flows to the proposed roads and is routed via proposed El Paso County Type C curb and gutter to a proposed public 15' Type R sump inlet at DP 8. Once in the inlet, the captured flow is piped via proposed public storm sewer to a proposed public manhole at DP 8.1, where it combines with the flow from Basin G. In the event that the proposed public sump inlet becomes clogged, flow will overtop the local depression in the road and travel in the proposed curb and gutter along the northwest side of Crimson Clover Drive in Basin J to the proposed public 10' Type R sump inlet at DP 10.

All flow at DP 8.1 (Q_5=8.2 cfs, Q_{1oo} =18.3 cfs) is piped via proposed public storm sewer to DP 8.2, where it combines with flow from DP 7A.

All flow at DP 8.2 (Q_5=11.6 cfs, Q_{1oo} =24.2 cfs) is piped via proposed public storm sewer to DP 8.3, where it combines with flow from DP TB and DP 6.

All flow at DP 8.3 (Q_5=47.5 cfs, Q_{1oo} =88.8 cfs) is piped via proposed public storm sewer to DP 9.1, where it combines with flow from DP 9.

Proposed Basin I is approximately 2.76 acres in area and includes portions of eighteen proposed single family residential lots and proposed roadway. Runoff from Basin I (Q_5=5.6 cfs, Q_{1oo} =12.0 cfs) sheet flows to the proposed roads and is routed via proposed El Paso County Type C curb and gutter to a proposed public 10' Type R sump inlet at DP 9. This inlet was sized to capture all flow in the 5 and 100-year events. Once in the inlet, the captured flow combines with flow from DP 8.3 at DP 9.1.

In the event that the proposed public sump inlet becomes clogged, flow will overtop the crown in the road and enter the proposed public 10' Type R sump inlet at DP 10.

All flow at DP 9.1 (Q_5=51.2 cfs, Q_{100} =95.6 cfs) is piped via proposed public storm sewer to DP 10.1, where it combines with flow from DP 10.

Proposed Basin J is approximately 1.39 acres in area and includes portions of 12 proposed single family residential lots and proposed roadway. Runoff from Basin J (Q_5=3.5 cfs, Q_{100} =7.2 cfs) sheet flows to the proposed roads and is routed via proposed El Paso County Type C curb and gutter to a proposed public 10' Type R sump inlet at DP 10. This inlet was sized to capture all flow in the 5 and 100-year events. Once in the inlet, the captured flow combines with flow from DP 9.1 at DP 10.1. In the event that the proposed public sump inlet becomes clogged, flow will overtop the proposed curb and travel down the proposed open space into Pond P2 at DP 11.

All flow at DP 10.1 (Q_5=53.7 cfs, Q_{100} =99.6 cfs) is piped via proposed private storm sewer to Pond P2, where it combines with flow from Basin K and DP 5.1 at DP 10.2.

Proposed Basin K is approximately 5.29 acres in area and includes portions of 20 proposed single-family residential lots, proposed private full spectrum extended detention Pond P2, and proposed open space. Runoff from Basin K (Q_5=5.3 cfs, Q_{100} =15.5 cfs) sheet flows to the back of the proposed lots and is routed via a proposed swale to the proposed Pond P2, where it combines with flow from DP 5.1 and DP 10.1. A proposed swale along the western property line ensures that all flow from Basin K is routed to Pond P2 at DP 11. The proposed swale will be within a tract, which will restrict the installation of fencing, structures, or storage of materials within the tract. The flow from DP 11 is routed via proposed private storm sewer to DP 15.2, where it combines with the flow from DP 15 (Pond 4).

Proposed Basin L is approximately 1.97 acres in area and includes portions of six proposed single family residential lots, proposed private full spectrum extended detention Pond 3, proposed open space, and existing roadway (Walters Point). Runoff from Basin L (Q_5=2.7 cfs, Q_{100} =6.9 cfs) sheet flows to the back of the proposed lots and into Pond 3 at DP 12. Proposed swales ensure that the runoff will be routed to the pond. The proposed swales will be within tracts, which will restrict the installation of fencing, structures, or storage of materials within the tracts.

Proposed Basin M is approximately 0.54 acres in area and includes portions of two proposed single family residential lots, proposed open space, and proposed roadway. Runoff from Basin M (Q_5=1.4 cfs, Q_{100} =2.9 cfs) sheet flows to the proposed road and is routed via proposed El Paso County Type C curb and gutter to a proposed public 10' Type R on-grade inlet at DP-13. This inlet was sized to capture all flow in the 5 and 100-year events. Once in the inlet, the captured flow is piped via proposed public storm sewer to a proposed public 10' Type R on-grade inlet at DP 14.1, where it combines with the flow from Basin N.

Proposed Basin N is approximately 0.53 acres in area and includes portions of eight proposed single family residential lots and proposed roadway. Runoff from Basin N (Q_5=1.4 cfs, Q_{1oo} =2.8 cfs) sheet flows to the proposed road and is routed via proposed El Paso County Type C curb and gutter to a proposed public 10' Type R on-grade inlet at DP 14. This inlet was sized to capture all flow in the 5 and 100-year events. Once in the inlet, the captured flow is piped to DP 14.1, where it combines with the flow from Basin M.

All flow at DP 14.1 (Q_5=2.7 cfs, Q_{1oo} =4.0 cfs) is piped via proposed public storm sewer to Pond 4 at DP 15, where it combines with flow from Basin O.

Proposed Basin O is approximately 0.98 acres in area and includes portions of seven proposed single family residential lots, proposed private water quality Pond 4, and proposed open space. The emergency spillway from Pond 4 will overflow to the southwest off the property and enter into an existing swale within Walters Commons Filing No. 1. The existing swale will prevent the overflow runoff from impacting the existing buildings. Runoff from Basin O (Q_5=1.5 cfs, Q_{1oo} =3.8 cfs) sheet flows to the back of the proposed lots and into the proposed swale that routes the flow to Pond 4 at DP 15 where it combines with flow from DP 14.1. The proposed swale will be within a drainage easement, which will restrict the installation of fencing, structures, or storage of materials within the easement. The flow from DP 15 is routed via proposed private storm sewer to DP 15.2, where it combines with the flow from DP 11 (Pond P2).

All flow at DP 15.2 (Q_5=64.1 cfs, Q_{1oo} =120.1 cfs) is piped via proposed public storm sewer to the outfall on the northeast corner of Bowstring Road and Leggins Way.

Proposed Basin OS-1 is approximately 0.41 acres in area and includes portions of three proposed single family residential lots and proposed open space. Runoff from Basin OS-1 (Q_5=0.8 cfs, Q_{1oo} =1.9 cfs) sheet flows to the back of the proposed lots and into Pond P1 at DP 16. The flow continues through the pond and combines with the flow from tributary basins at DP TB.

Proposed Basin OS-2 is approximately 0.79 acres in area and includes proposed open space and proposed roadway. Runoff from Basin OS-2 (Q_5=1.2 cfs, Q_{1oo} =3.6 cfs) sheet flows to the proposed road and is routed via proposed El Paso County Type C curb and gutter to DP L1, where the flow exits the site at Leggins Way and is captured by a proposed Type C inlet. Due to the low existing grade along Leggins Way, the runoff from Basin OS-2 could not be feasibly routed to a proposed pond. Basin OS-2 meets the criteria to exclude water quality capture volume for up to 20% of the applicable site, not to exceed one acre per ECM Appendix I Section I.7.1.C.1.a. A calculation is provided in Appendix D showing the roadway with grass swales section and the proposed 100-year flows.

Proposed Basin OS-3 is approximately 0.31 acres in area and includes proposed open space and existing roadway (Walters Point). Runoff from Basin OS-3 (Q_5=0.6 cfs, Q_{100} =1.6 cfs) sheet flows to the existing road and is routed via existing curb and gutter to DP-18, where the flow exits the site along Walters Point. The runoff from Basin OS-3 is received by the existing 1.83-acre foot detention pond to the southwest in the adjacent Walters Commons development, per the approved *Final Drainage Report for Walters Commons*, dated 2005. Flows tributary to the Walters Commons F1 subdivision from the proposed Cloverleaf development are consistent with the approved *Final Drainage Report for Walters Commons*; therefore, the flows from the proposed Basin OS-3 will follow the same historic path off-site onto the Walters Commons development.

The Walters Commons FDR delineates a basin (OS-9) that discharges to the same point as Basin OS-3 in this report. The runoff from Basin OS-9 (Q_5=2 cfs, Q_{100} =4 cfs) is greater than the runoff expected from the proposed Basin OS-3. Therefore, the existing adjacent Walters Commons development has accounted for the runoff from Basin OS-3 in its existing 1.83-acre foot detention pond and stormwater infrastructure. See Appendix E for applicable excerpts of the approved report.

Proposed Basin OS-4 is approximately 1.00 acres in area and includes the back portion of four proposed lots, proposed open space, and existing roadway (Walters Point). The back of the proposed lots are assumed to consist mainly of undeveloped and landscaped areas. Runoff from Basin OS-4 (Q_5=1.8 cfs, Q_{100} =4.3 cfs) is routed via proposed swales to a proposed sand filter in the back of lots 67-68. The sand filter releases stormwater via an underdrain to the roadside swale along Cloverleaf Road immediately upstream of the existing 24” RCP culvert underneath Walters Point at DP 19. From the existing culvert, the flow continues south via an existing roadside swale along Cloverleaf Road to the existing Type C inlet on the northwest corner of Higby Road and Cloverleaf Road. The flow is then routed via the existing stormwater system to the existing 1.83-acre foot detention pond in the Walters Commons development. The Walters Commons FDR delineates a basin (OS-10) that discharges to the same point as Basin OS-4 in this report. The runoff from Walters Commons F1 FDR Basin OS-10 (Q_5=2 cfs, Q_{100} =5 cfs) is reasonably consistent with the runoff expected from the proposed Basin OS-4. Therefore, the existing adjacent Walters Commons development has accounted for the runoff from Basin OS-4 in its existing 1.83-acre foot detention pond and stormwater infrastructure. However, the 1.83-acre foot existing detention pond was designed only to accommodate flood control, not water quality. The proposed sand filter will provide the water quality necessary for Basin OS-4. In the case that the sand filter becomes full, the overtopping flow will enter the adjacent ditch and flow through the existing 24” RCP culvert underneath Walters Point.

The site is anticipated to send runoff (Q_5=2.8 cfs, Q_{100} =8.8 cfs) to the existing 1.83-acre foot Walters Commons detention pond from Basin OS-3, Basin OS-4, and proposed Pond 3. Flows tributary to the Walters Commons F1 subdivision from the proposed Cloverleaf F2 development are consistent with the approved *Final Drainage Report for Walters Commons*, dated 2005. Per the approved Walters Commons FDR, the 1.83-acre foot detention pond was designed to accommodate more flow (Q_5=7

cfs, Q_{100} =17 cfs) than the proposed site is anticipated to send to the pond. See the table below for a comparison in the flows proposed in this report and the flows in the Walters Commons FDR.

Walters Commons 1.83-Acre Foot Detention Pond Flow Comparison								
	Basin OS-3 / OS-9		Basin OS-4 / OS-10		Pond 3 / Basin OS-11		Sum	
	Q5 [cfs]	Q100 [cfs]	Q5 [cfs]	Q100 [cfs]	Q5 [cfs]	Q100 [cfs]	Q5 [cfs]	Q100 [cfs]
This Report	0.6	1.6	1.8	4.3	0.4	2.9	2.8	8.8
Final Drainage Report for Walters Commons	2	4	2	5	3	8	7	17

PROPOSED SUB-BASIN DRAINAGE (CUHP/SWMM METHOD)

The areas tributary to proposed ponds P1 and P2 were analyzed for the proposed conditions utilizing CUHP/SWMM. Due to the large tributary areas to the ponds and the ponds being in series (P1 drains to P2) a CUHP/SWMM analysis was required.

Pond 3 and its tributary area (quantified as proposed rational basin L) were not included in the CUHP/SWMM proposed conditions analysis, as the ponds tributary areas is only 1.97 acres and it was analyzed and designed using the rational method and UDFCD's UD-Detention workbook. Flows from pond 3 are limited to historic rates through the full spectrum design outlet structure and outfall to Walters Commons Filing 1, along with proposed rational basins OS-3 & OS-4. The flows generated from these three basins are consistent with the Walters Commons Filing 1 FDR. See the proposed conditions rational method section above for more detail.

Proposed Pond 4's tributary area was included in proposed SWMM basin S-6 in order to quantify the total flows at the existing 28"x42" CMP pipe at the intersection of Leggins Way and Bowstring Road. However, Pond 4 is proposed to provide water quality only for its tributary area, and therefore, a controlled release was not modeled in SWMM. Pond 4 was analyzed/designed using the rational method and UDFCD's UD-Detention workbook.

Proposed Basin TX-1 is approximately 108.7 acres and consists of prairie grasses, public streets and single family lots. Flow from this basin (Node 1, Q_5=46.8 cfs, Q_{100} =124.8 cfs) flow through an existing side yard swale and enter proposed volume attenuation Pond P1 at Storage Unit/Node P1 where they combine with flows from proposed basin TX-2.

Proposed Basin TX-2 is approximately 27.2 acres and consists of prairie grasses, public streets and single family lots (2/3 acre+). Flow from this basin (Node 2, Q_5=10.9 cfs, Q_{100} =31.4 cfs) flows through an existing side yard swale and enters the proposed volume attenuation Pond P1 at Storage Unit/Node P1 where they combine with flows from proposed basin TX-1. The total flow tributary to Storage Unit/Node P1 is Q5 = 58 cfs, Q100 = 156 cfs.

Storage Unit P1 was designed to limit the release rates to Q5 = 45 cfs and Q100 = 79 cfs. Storage Unit P1 will outfall through a 42" RCP pipe (link 1) and is connected to the on-site storm sewer system which collects all onsite flows from basin S-3 and transports them directly to Pond P2, a full

spectrum extended detention basin. The DP06 run was sized based on the pond peak 100-yar release rate and used a time of concentration closer to the peak as shown in the SWMM model.

Proposed Basin S-3 consists of approximately 30.7 acres of single family residential lots, roadways and walks, and open space. Its area and composite percent imperviousness is consistent with rational basins A-K. Basin S-3 generates runoff rates of Q5 = 42 cfs and Q100 = 82 cfs. Runoff from basin S-3 is collected via the proposed Type C curb and gutter system, and proposed on-site storm sewer system and transported to the proposed full spectrum extended detention basin, Pond P2. See the proposed rational basin descriptions for on-site routing. The total flow tributary to Storage Unit P2 is Q5 = 74 cfs and Q100 = 130 cfs per the SWMM model as shown in the appendices.

Pond/Storage Unit P2 will release through a full-spectrum outlet structure into a 42" RCP outfall pipe (link 2, Q5 = 61 cfs, Q100 = 109 cfs). The proposed outfall pipe will transport flow to the existing roadside swale on the northeast corner of Leggins Way and Bowstring Road where flows will combine with proposed Basin S-6 runoff at the EX_28x42_CMP node in the SWMM model.

Proposed Basin S-6 is approximately 49.1 acres and consists of prairie grasses, Leggins Way, portions of 9 proposed residential lots (6 lots are approximately 7200 s.f.,2 lots are approximately 6000 s.f. each and one is 7500 s.f.) and existing single family lots (2/3 acre+). Flow from this basin (Q_5=25.1 cfs, Q_{1oo} =69.5 cfs) sheet flows to the roadside swales along Bowstring Road at DP 6 and continue in the roadside swale to the southeast until they reach the EX-28"X42" CMP culvert at outfall O1 where flows combine with the controlled release of Pond/Storage Unit P2, and the existing Walters Commons Flows (Q5 = 12 cfs, Q100 = 26 cfs) for a total flow of Q5 = 90 cfs & Q100 = 198 cfs.

Due to the large offsite developed areas that currently have no detention facilities that are tributary to the proposed full-spectrum extended detention basin Pond P2, it was not feasible to limit the pond's release rate to the historic flows for the entire basin. Therefore, the design goals for the site were to provide water quality for all new development part of this project, to provide detention for all new developed areas part of the project, and to provide as much additional detention for the offsite areas as practical to limit the flows downstream of the project site to as close to historic levels as possible. Flows from the three CUHP/SWMM models were compared at the existing 28"x42" CMP culvert at outfall O1. The comparison shown below is for the areas tributary to the proposed full-spectrum extended detention basin Pond P2 and water quality Pond P4. This tributary area includes Basin H1 and H3 in the historic conditions model, Basins TX-1, TX-2, SX-3, and SX-6 in the existing conditions model, and Basins TX-1, TX-2, S-3, and S-6 in the proposed conditions model.

SWMM OUTFALL COMPARISON TABLE						
Outfall	Historic		Existing		Proposed	
	Q5 (cfs)	Q100 (cfs)	Q5 (cfs)	Q100 (cfs)	Q5 (cfs)	Q100 (cfs)
Ex_28x42_CMP/O1	44	203	102	282	90	198

The historic conditions analyzed approximately 213 acres of tributary area, the existing conditions model analyzed approximately 213 acres of tributary area, and the proposed conditions model analyzed approximately 218 acres of tributary area. The analysis shows that the proposed drainage design will limit the 100-year flows to less than historic conditions at the ultimate outfall. In the historic condition, flows are not routed in roadside ditches as they are in the existing and proposed conditions. Therefore, the results of Historic Basins H1 and H3 are added and used in the comparison. The analysis also shows that the proposed drainage design will limit 5- and 100-year flows to less than existing conditions at the existing 28”x42” CMP culvert, the outfall for a majority of the developed flows.

DRAINAGE DESIGN CRITERIA

DEVELOPMENT CRITERIA REFERENCE

Storm drainage analysis and design criteria for this project were taken from the “*City of Colorado Springs/El Paso County Drainage Criteria Manual*” Volumes 1 and 2 (EPCDCM), dated October 12, 1994, the “*Urban Storm Drainage Criteria Manual*” Volumes 1 to 3 (USDCM) and Chapter 6 and Section 3.2.1 of Chapter 13 of the “*Colorado Springs Drainage Criteria Manual*” (CSDCM), dated May 2014, as adopted by El Paso County.

HYDROLOGIC CRITERIA

All hydrologic data was obtained from the “*El Paso Drainage Criteria Manual*” Volumes 1 and 2, and the “*Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual*” Volumes 1, 2, and 3. Onsite drainage improvements were designed based on the 5 year (minor) storm event and the 100-year (major) storm event. Existing Basin Runoff (offsite and on-site) were calculated with Colorado Urban Hydrograph Program (CUHP) due to basin size and Stormwater Management Model (SWMM) was used routing the flows through the offsite pond and the larger on-site pond. On-site developed condition runoff was calculated using the Rational Method, and rainfall intensities for the 5-year and the 100-year storm return frequencies were obtained from Table 6-2 of the CSDCM. One hour point rainfall data for the storm events is identified in the chart below. Runoff coefficients were determined based on proposed land use and from data in Table 6-6 from the CSDCM. Time of concentrations were developed using equations from CSDCM. All runoff calculations and applicable charts and graphs are included in the Appendices.

Table 2 - 1-hr Point Rainfall Data

Storm	Rainfall (in.)
5-year	1.50
100-year	2.52

JR was aware of the one story requirement on some lots within Cloverleaf F2 and a subsequent request for administrative relief to allow for up to 50% lot coverage. JR's drainage calculations are based upon a lot typical percent impervious percentage of 62%. Therefore, the administrative relive request does not affect JR's report analysis, calculations, construction drawings, or GEC plans.

HYDRAULIC CRITERIA

The Rational Method and USDCM's SF-2 and SF-3 forms were used to determine the runoff from the minor and major storms on the site, and the UDFCD UD-Detention v4.03 spreadsheet was utilized for evaluating proposed detention and water quality for Pond 3, Pond 4, and the proposed sand filter. The UDFCD UD-Detention v4.03 spreadsheet was also used with EPA SWMM 5.1 to model Pond P1 (peak attenuation pond) and Pond P2 (full-spectrum EDB) which are in series. The UD-Detention spreadsheet was used to input the stage storage information which was then added to the SWMM model for each pond. Then the 5-year and 100-year SWMM models were run to create inflow hydrographs for Pond P2. Those hydrographs were then transferred back to the UD-Detention spreadsheet for the 5-year and 100-year storms where they were used to design the outlet structure for Pond P2. Once the outlet structure was determined in the UD-Detention, the stage-discharge information was then transferred to SWMM models. Sump and on-grade inlets were sized using UDFCD UD-Inlet v4.06. Using Storm StormCAD V8i, a modeling program for stormwater drainage, the hydraulic grade lines and energy grade lines were determined for the storm sewer network. Manhole and pipe losses for the model were obtained from the Urban Storm Drainage Criteria Manual. Hydraulic grade lines for the Cloverleaf F2 development shall in no case be closer than one foot to the ground or street surface. Storm CAD results can be found in Appendix D.

DRAINAGE FACILITY DESIGN

FOUR STEP PROCESS TO MINIMIZE ADVERSE IMPACTS OF URBANIZATION

In accordance with the El Paso County Drainage Criteria Manual Volume 2, this site has implemented the four step process to minimize adverse impacts of urbanization. The four step process includes reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainage ways, and implementing long-term source controls.

Step 1 – Reducing Runoff Volumes: The Cloverleaf Filing No. 2 development project consists of 131 single family lots with open spaces and lawn areas interspersed within the development which helps disconnect impervious areas and reduce runoff volumes. Roof drains from the structures will discharge to lawn areas, where feasible, to allow for infiltration and runoff volume reduction. The site also uses grass lined swales to transport runoff to the proposed storm sewer system and detention ponds which allows for additional infiltration and runoff reduction above pipe conveyance systems.

Step 2 – Stabilize Drainageways: The site lies within the Teachout Creek Drainage Basin. Basin and bridge fees will be paid at time of platting. These funds will be used on future projects within the basin to stabilize drainageways. The site does not discharge directly into the open drainageway of Teachout Creek, therefore no downstream stabilization will be accomplished with this project.

Step 3 – Treat the WQCV: Water Quality treatment for this site is provided in two proposed full spectrum extended detention basins: Pond P2 and Pond 3, proposed water-quality pond 4, and a proposed sand filter. The runoff from this site will be collected within inlets and conveyed to the proposed ponds via storm sewer. Upon entrance to the ponds, flows will be captured in a forebay designed to promote settlement of suspended solids. A trickle channel is also incorporated into the ponds to minimize the amount of standing water. The outlet structure has been designed to detain the water quality capture volume (WQCV) for 40 hours, and the extended urban runoff volume (EURV) for 72 hours. The sand filter was designed to have a volume above the sand bed of the basin equal to the WQCV based on a 12-hour drain time. The sand filter does not include an impermeable liner but includes an underdrain, so some infiltration is allowed (see the description for "Partial Infiltration Section" sand filter in *Urban Storm Drainage Criteria Manual Volume 3*, page SF-4).

Step 4 – Consider Need for Industrial and Commercial BMPs: BMPs will be utilized to minimize off-site contaminants and to protect the downstream receiving waters. Site specific temporary source control BMPs that will be implemented include, but are not limited to, silt fencing placed around downstream areas of disturbance, construction vehicle tracking pads at the entrances, designated concrete truck washout basin, designated vehicle fueling areas, covered storage areas, spill containment and control, etc. The permanent erosion control BMPs include asphalt streets, storm inlets and storm pipe, two full spectrum water quality and detention ponds, and permanent vegetation.

WATER QUALITY/DETENTION

The site is split by a natural ridge, therefore; a full spectrum water quality and detention pond is provided on both sides. Basins A through K, located north of the natural ridge, will discharge to the pond at DP 10.2 (Pond P2). Basins M, N, and O, also located north of the natural ridge, will discharge to the pond at DP 15 (Pond 4). Basin L, south of the natural ridge, will discharge to the pond at DP 12 (Pond 3). Both full-spectrum ponds P2 and P3 have been designed per Section 13.3.2.1 of the City of Colorado Springs' Drainage Criteria Manual Volume 1, as revised in May 2014.

As previously discussed, two large off-site basins (TX-1 and TX-2) are tributary to the site and currently have no engineered detention or water quality features. Due to space constraints on-site, detention for the off-site basins TX-1 and TX-2 was not feasible on-site. Therefore, a volume attenuation pond, Pond P1, is proposed upstream of the site along the site's northeastern border to reduce the peak flows tributary to the site. Pond P1 is intended to provide volume attenuation only,

and is connected to proposed on-site Pond P2 (ponds in series). Both ponds were modeled using SWMM version 5.1.

As shown in the attached CUHP/SWMM models(existing & proposed), basins TX-1 and TX-2 produce a total tributary flow to proposed Pond/node P1 of Q5 = 58 cfs, & Q100 = 156 cfs. The proposed peak outflow of Pond P1 (link 1), is Q5 = 45 cfs & Q100 = 79 cfs and is piped directly to Pond P2 via proposed reinforced concrete pipe (RCP).

Pond P2 receives flows from the controlled release of Pond P1, via the storm sewer system described above, and from on-site tributary basins (rational basins A-K, and CUHP/SWMM basin S-3/Node 3). Basin S3/Node 3 produces a peak flow of Q5 = 42 cfs, & Q100 = 82 cfs which combines with the controlled release from Pond P1 (which is Q5 = 45 cfs & Q100 = 79 cfs) for a total peak flow into Pond P2 of Q5 = 74 cfs, and Q100 = 130 cfs (as shown in the SWMM model). The proposed full-spectrum outlet structure will limit Pond P2's release to a maximum of Q5 = 60 cfs, and Q100 = 109 cfs.

For comparison purposes, a Historic CUHP/SWMM model was created to quantify the pre-development flows from the entire area tributary to Pond P2. Basin H1 in the Historic Model encompasses 163.4 acres, in roughly the same area as basins TX-1, TX-2, and S-3/SX-3. This model assumed all area to be undeveloped open space with a composite percent impervious value of 2%. Basin H1 produced peak flows of Q5 = 33 cfs, and Q100 = 125 cfs. As shown above, Pond P2's maximum release rate is approximately equal to the historic peak flow for the 100 year storm, and slightly more than the historic peak flow for the 5 year storm. These flow comparisons are more fully discussed in the "Proposed Sub-Basin Drainage (CUHP/SWMM)" section above.

Pond P2's required WQCV and EURV was calculated using the UDFCD UD-Detention v4.03 spreadsheet for the on-site tributary basins A-K, totaling 30.6 acres.

- Required WQCV: 0.594 ac-ft
- Required EURV: 1.948 ac-ft

The pond was designed for a 40-hour WQCV drain time and a 72-hour EURV drain time (see appendix D for supporting calculations). As described above, Pond P2 was also sized to provide detention for both the on-site and off-site tributary areas and has a total volume of 3.34 ac-ft. The pond totally drains in less than 79 hours as shown in the SWMM model.

Both Ponds P1 and P2 will include an emergency overflow spillway sized for the undetained peak 100-year flow rate tributary to each pond. Both spillways will consist of buried soil riprap w/ a grade control concrete weir installed in the crest of the spillway. Both Pond P1 and Pond P2 will have cutoff walls to ensure proper design due to their size and peak undetained flow rate. Both spillways will provide a minimum of one foot of freeboard from the design water surface elevation to the top of embankment.

Pond P1's emergency overflow spillway will be centered on the open space tract between lots 100 and 101 where a trapezoidal channel will be graded in to direct flows westward into the proposed street. Flows will then follow the overflow routing described in the rational basins G and J description above.

Pond P2's spillway will direct water from the southwestern corner of the pond where the outlet structure is proposed to the adjacent proposed street to the south. Flows will then travel down the proposed street to the west to the existing Leggins Way, and ultimately to the existing 28"x42" CMP beneath Bowstring Road.

Pond 3 receives flows from proposed Basin L. The proposed full-spectrum outlet structure will limit Pond 3's release rate to below predevelopment peaks. The Pond 3 design includes a forebay, trickle channel, and a full spectrum detention outlet structure.

Pond 3's required WQCV and EURV was calculated using UDFCD UD-Detention workbook for the on-site tributary Basin L, totaling 1.97 acres.

- Required WQCV: 0.031 ac-ft
- Required EURV: 0.088 ac-ft

The pond was designed for a 40-hour WQCV drain time and a 72-hour EURV drain time (see appendix D for supporting calculations). Pond 3 was also sized to provide detention for the 100-yr storm and below and has a total volume of 0.164 ac-ft. The pond totally drains in 77 hours for a 100-year event.

Pond 3 will include an emergency overflow spillway sized for the undetained peak 100 year flow rate tributary to the pond. The spillway will consist of buried soil riprap. The spillway will provide a minimum of one foot of freeboard from the design water surface elevation to the top of embankment.

The overflow path for the stormwater that crests the spillway extends from the Pond 3 spillway southeast to the existing roadside swale along the west side of Cloverleaf Road. The flow will then enter the existing Type C inlet at the northwest corner of Cloverleaf Road and Higby Road. The existing offsite pond and structures are functioning as intended, has sufficient capacity, and is not in need of any maintenance.

Pond 4 receives flows from proposed Basins M, N, and O. The proposed outlet structure will limit Pond 4's water quality capture volume to release in 40 hours. The Pond 4 design includes a trickle channel and an outlet structure.

Pond 4's required WQCV was calculated using UDFCD UD-Detention workbook as well as the UD-BMP v3.07 workbook for the on-site tributary Basins M, N, and O, totaling 2.05 acres. The UD-

BMP workbook was used to reduce the percent impervious value that was used in the UD-Detention workbook.

- Required WQCV: 0.030ac-ft

The pond was designed for a 40-hour WQCV drain time (see appendix D for supporting calculations).

The Pond 4 emergency spillway will be routed to the existing swale in Walters Commons Filing 1 to the southwest of the pond's outlet structure, consistent with existing drainage patterns. The flow will travel to the existing roadside ditch along Bowstring Road, which will route the flow northwest to the existing 18" RCP culvert under Leggins Way. The proposed spillway outfall point onto Walters Commons Filing 1 is consistent with the Basin OS-4 discharge included in the approved *Final Drainage Report for Walters Commons.* The proposed peak 100-year spillway discharge from Pond 4 (6.1 cfs) is less than the anticipated flow from the aforementioned Basin OS-4 (per Walters Commons FDR) (9 cfs).

A sand filter is proposed in the back of lots 66 & 67 to provide water quality for the proposed Basin OS-4 runoff. The existing 1.83 acre-foot detention pond within Walters Commons Filing 1 receives runoff from this basin and provides detention but no water quality. The sand filter was designed to have a volume above the sand bed of the basin equal to Basin OS-4's WQCV (0.010 acre-feet) based on a 12-hour drain time. Refer to Appendix D for the sand filter sizing calculation. The sand filter does not include an impermeable liner but includes an underdrain, so some infiltration is allowed (see the description for "Partial Infiltration Section" sand filter in *Urban Storm Drainage Criteria Manual Volume 3*, page SF-4). The underdrain discharges directly into the adjacent roadside swale along Cloverleaf Road, immediately upstream of the existing 24" RCP culvert underneath Walters Point. In the event that the sand filter becomes full, the overtopping flow will enter the adjacent roadside swale and flow through the existing 24" RCP culvert underneath Walters Point and continue to the existing 1.83 acre-foot detention pond within Walters Commons Filing 1.

Three isolated lots were part of the overall Cloverleaf Preliminary plan and the drainage analysis for these lots has been completed with the *Small Subdivision Final Drainage Report for Cloverleaf Filing No. 1*, by JR Engineering, dated December 1, 2020 (PCD File No. SF2114).

EROSION CONTROL PLAN

We respectfully request that the Erosion Control Plan and Cost Estimate be submitted in conjunction with the grading and erosion control plan and construction assurances posted prior to obtaining a grading permit. The CD plan set includes a final grading plan.

OPERATION & MAINTENANCE

In order to ensure the function and effectiveness of the stormwater infrastructure, maintenance activities such as inspection, routine maintenance, restorative maintenance, rehabilitation and repair, are required. Cloverleaf Metropolitan District shall be responsible for the inspection, maintenance, rehabilitation and repair of stormwater and erosion control facilities located on the property, unless another party accepts such responsibility in writing and responsibility is properly assigned through legal documentation. Access is provided from onsite facilities and easements for proposed infrastructure located offsite. Access to Pond 3 is provided through the existing access easements centered around Walters Point.

DRAINAGE AND BRIDGE FEES

The site lies within the Teachout Creek Drainage Basin. Anticipated drainage and bridge fees are presented below and will be paid at time of platting (depending on date of plat submittal):

2021 DRAINAGE AND BRIDGE FEES – CLOVERLEAF FILING NO. 2				
Impervious Acres (ac)	Drainage Fee (Per Imp. Acre)	Bridge Fee (Per Imp. Acre)	Cloverleaf Drainage Fee	Cloverleaf Bridge Fee
22.02	$5,429	$816	$119,547	$17,968

SUMMARY

The proposed Cloverleaf Filing No. 2 development drainage improvements, including storm sewer and two full spectrum water quality and detention ponds were designed to meet or exceed the El Paso County Drainage Criteria. The proposed development will not adversely affect the offsite drainageways or surrounding development. This report is in conformance and meets the latest El Paso County Storm Drainage Criteria requirements for this site.

REFERENCES

1. El Paso County Drainage Criteria Manual Volume 1, El Paso County, CO, 1994.

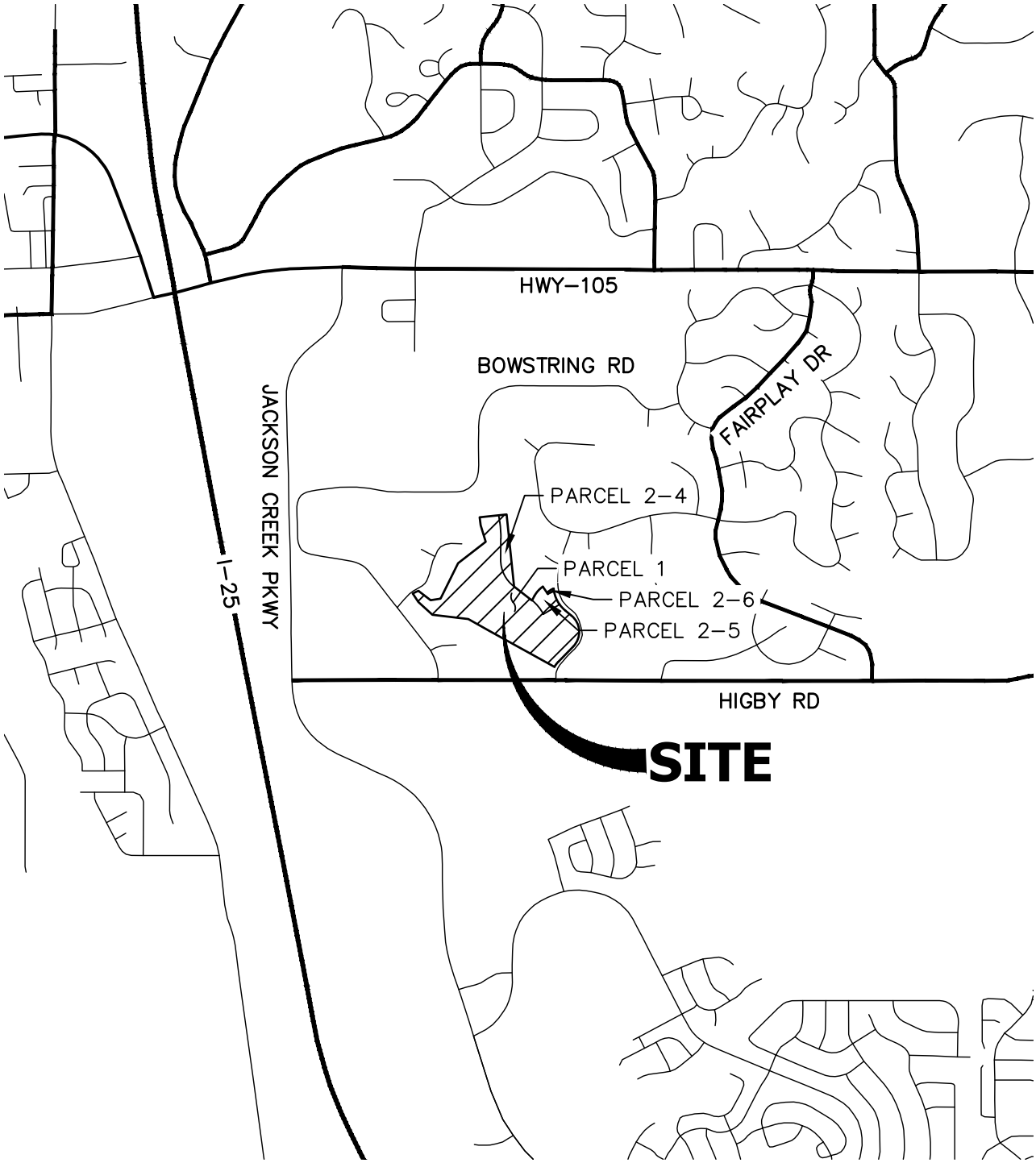
2. Urban Storm Drainage Criteria Manual (Volumes 1, 2, and 3), Urban Drainage and Flood Control District, June 2001.

3. Flood Insurance Study- El Paso County, Colorado & Incorporated Areas Vol 7 of 8, Federal Emergency Management Agency, December 7, 2018.

4. Walters Commons Final Drainage Report, prepared by JR Engineering, 2005.

5. Preliminary Drainage Report for Cloverleaf Subdivision Preliminary Plan, prepared by JR Engineering, 2020. (PCD File No. SP202)

Appendix A
Vicinity Map, Soil Descriptions, FEMA Floodplain Map



N

2000 1000 0 2000

ORIGINAL SCALE: 1" = 2000'

VICINITY MAP
CLOVERLEAF FILING NO. 2
JOB NO. 25158.01
08/19/2021
SHEET 1 OF 1

J·R ENGINEERING
A Westrian Company

Centennial 303-740-9393 • Colorado Springs 719-593-2593
Fort Collins 970-491-9888 • www.jrengineering.com

Hydrologic Soil Group—El Paso County Area, Colorado

Map Scale: 1:8,300 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 400 800 1600 2400

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

Streams and Canals

Transportation

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

Background

Aerial Photography

MAP INFORMATION

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

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 16, Sep 10, 2018

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

Date(s) aerial images were photographed: Jul 4, 2010—Oct 16, 2017

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
71	Pring coarse sandy loam, 3 to 8 percent slopes	B	0.8	0.2%
92	Tomah-Crowfoot loamy sands, 3 to 8 percent slopes	B	323.0	91.8%
93	Tomah-Crowfoot complex, 8 to 15 percent slopes	B	28.1	8.0%
Totals for Area of Interest			**352.0**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

National Flood Hazard Layer FIRMette

FEMA

Feet 1:6,000

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

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 4/4/2020 at 4:42:39 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

Appendix B
Hydrologic Calculations (Rational)

COMPOSITE % IMPERVIOUS & COMPOSITE RUNOFF COEFFICIENT CALCULATIONS

Subdivision: Cloverleaf Subdivision
Location: Colorado Springs

Project Name: Cloverleaf Subdivision - Proposed
Project No.: 2000-5158.01
Calculated By: GAG
Checked By:
Date: 11/12/21

Basin ID	Total Area (ac)	Paved Streets (100% Imp.)				Residential (6k SF min) (62% Imp.)				Parks/Open Space (7% Imp.)				Basins Total Weighted C Values		Basins Total Weighted % Imp.
		C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	
A	4.39	0.90	0.96	0.69	15.8%	0.43	0.58	3.13	44%	0.12	0.39	0.57	0.9%	0.47	0.62	61.2%
B	3.11	0.90	0.96	0.00	0.0%	0.43	0.58	2.52	51%	0.12	0.39	0.59	1.3%	0.38	0.54	51.9%
C	1.77	0.90	0.96	0.41	23.3%	0.43	0.58	1.36	48%	0.12	0.39	0.00	0.0%	0.54	0.67	71.2%
D	3.38	0.90	0.96	0.40	11.8%	0.43	0.58	2.77	51%	0.12	0.39	0.21	0.4%	0.47	0.61	63.5%
E	0.30	0.90	0.96	0.14	46.5%	0.43	0.58	0.16	33%	0.12	0.39	0.00	0.0%	0.65	0.76	79.9%
F	1.40	0.90	0.96	0.32	22.9%	0.43	0.58	1.08	48%	0.12	0.39	0.00	0.0%	0.54	0.67	71.0%
G	0.90	0.90	0.96	0.31	35.2%	0.43	0.58	0.51	36%	0.12	0.39	0.07	0.6%	0.57	0.70	71.3%
H	4.18	0.90	0.96	0.48	11.5%	0.43	0.58	2.95	44%	0.12	0.39	0.75	1.3%	0.43	0.59	56.8%
IA	1.71	0.90	0.96	0.39	22.8%	0.43	0.58	1.32	48%	0.12	0.39	0.00	0.0%	0.54	0.67	71.0%
I	2.76	0.90	0.96	0.32	11.6%	0.43	0.58	2.44	55%	0.12	0.39	0.00	0.0%	0.49	0.62	66.8%
J	1.39	0.90	0.96	0.33	23.5%	0.43	0.58	1.07	48%	0.12	0.39	0.00	0.0%	0.54	0.67	71.3%
K	5.29	0.90	0.96	0.00	0.0%	0.43	0.58	2.75	32%	0.12	0.39	2.54	3.4%	0.28	0.49	35.8%
Pond 2 Subtotal	30.6															58.5%
L	1.97	0.90	0.96	0.14	7.1%	0.43	0.58	1.02	32%	0.12	0.39	0.81	2.9%	0.34	0.53	42.3%
Pond 3 Subtotal	1.97															42.3%
M	0.54	0.90	0.96	0.12	21.8%	0.43	0.58	0.41	48%	0.12	0.39	0.01	0.1%	0.53	0.66	69.6%
N	0.53	0.90	0.96	0.15	28.5%	0.43	0.58	0.37	44%	0.12	0.39	0.01	0.1%	0.56	0.69	72.1%
O	0.98	0.90	0.96	0.00	0.0%	0.43	0.58	0.71	45%	0.12	0.39	0.27	1.9%	0.35	0.53	47.2%
Pond 4 Subtotal	2.05															59.5%
OS-1	0.41	0.90	0.96	0.00	0.0%	0.43	0.58	0.41	38%	0.12	0.39	0.00	0.0%	0.43	0.58	37.5%
OS-2	0.79	0.90	0.96	0.18	22.5%	0.43	0.58	0.00	0%	0.12	0.39	0.61	5.4%	0.30	0.52	28.0%
OS-3	0.31	0.90	0.96	0.10	32.1%	0.43	0.58	0.00	0%	0.12	0.39	0.21	4.8%	0.37	0.57	36.8%
OS-4	1.00	0.90	0.96	0.08	7.5%	0.43	0.58	0.65	19%	0.12	0.39	0.27	1.9%	0.38	0.56	28.4%
OS-5	6.12	0.90	0.96	0.32	5.2%	0.43	0.58	2.30	11%	0.12	0.39	3.50	4.0%	0.28	0.49	20.1%
TOTAL	43.2															50.8%

STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: Cloverleaf Subdivision
Location: Colorado Springs

Project Name: Cloverleaf Subdivision - Proposed
Project No.: 2000-5158.01
Calculated By: GAG
Checked By:
Date: 11/12/21

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	K	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (min)
A	4.4	B	61%	0.47	0.62	115	2.4%	9.2	688	3.2%	20.0	3.6	3.2	12.4	803.0	19.2	12.4
B	3.1	B	52%	0.38	0.54	147	8.6%	7.8	1156	3.5%	15.0	2.8	6.9	14.7	1303.0	23.5	14.7
C	1.8	B	71%	0.54	0.67	50	5.9%	3.9	1001	3.3%	20.0	3.6	4.6	8.5	1051.0	18.7	8.5
D	3.4	B	63%	0.47	0.61	162	3.4%	9.7	690	2.9%	20.0	3.4	3.4	13.0	852.0	19.0	13.0
E	0.3	B	80%	0.65	0.76	30	1.6%	3.8	300	4.4%	20.0	4.2	1.2	5.0	330.0	13.6	5.0
F	1.4	B	71%	0.54	0.67	60	3.0%	5.4	553	2.7%	20.0	3.3	2.8	8.2	613.0	16.9	8.2
G	0.9	B	71%	0.57	0.70	60	9.9%	3.5	530	2.1%	20.0	2.9	3.0	6.5	590.0	17.1	6.5
H	4.2	B	57%	0.43	0.59	100	2.7%	8.7	716	1.5%	20.0	2.4	4.9	13.6	816.0	22.1	13.6
IA	1.7	B	71%	0.54	0.67	59	2.5%	5.7	969	1.5%	20.0	2.4	6.6	12.3	1028.0	20.9	12.3
I	2.8	B	67%	0.49	0.62	215	11.0%	7.3	301	1.1%	20.0	2.1	2.4	9.7	516.0	17.2	9.7
J	1.4	B	71%	0.54	0.67	60	2.5%	5.7	405	4.3%	20.0	4.2	1.6	7.4	465.0	15.6	7.4
K	5.3	B	36%	0.28	0.49	100	6.6%	7.9	1073	3.2%	15.0	2.7	6.7	14.6	1173.0	27.0	14.6
L	2.0	B	42%	0.34	0.53	60	2.5%	7.9	652	5.0%	15.0	3.4	3.2	11.1	712.0	22.1	11.1
M	0.5	B	70%	0.53	0.66	34	2.5%	4.4	365	5.6%	20.0	4.7	1.3	5.7	399.0	15.5	5.7
N	0.5	B	72%	0.56	0.69	60	2.5%	5.6	365	5.6%	20.0	4.7	1.3	6.9	425.0	15.1	6.9
O	1.0	B	47%	0.35	0.53	97	15.0%	5.5	601	4.1%	15.0	3.0	3.3	8.8	698.0	21.2	8.8
OS-1	0.4	B	38%	0.43	0.58	100	5.4%	6.9	0	1.0%	20.0	2.0	0.0	6.9	100.0	19.6	6.9
OS-2	0.8	B	28%	0.30	0.52	13	2.0%	0.0	205	4.7%	20.0	4.3	0.8	0.8	218.0	22.5	5.0
OS-3	0.3	B	37%	0.37	0.57	48	9.1%	4.4	134	8.0%	20.0	5.7	0.4	4.8	182.0	20.3	5.0
OS-4	1.0	B	28%	0.38	0.56	90	8.1%	6.1	215	5.0%	15.0	3.4	1.1	7.2	305.0	22.4	7.2
OS-5	6.1	B	20%	0.28	0.49	300	4.1%	16.1	955	4.0%	15.0	3.0	5.3	21.4	1255.0	29.3	21.4

NOTES:

$$t_c = t_i + t_t$$ Equation 6-2

Where:

t_c = computed time of concentration (minutes)

t_i = overland (initial) flow time (minutes)

t_t = channelized flow time (minutes).

$$t_t = \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t}$$ Equation 6-4

Where:

t_t = channelized flow time (travel time, min)
L_t = waterway length (ft)
S_o = waterway slope (ft/ft)
V_t = travel time velocity (ft/sec) = $K\sqrt{S_o}$
K = NRCS conveyance factor (see Table 6-2).

Use a minimum t_c value of 5 minutes for urbanized areas and a minimum t_c value of 10 minutes for areas that are not considered urban. Use minimum values even when calculations result in a lesser time of concentration.

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_o^{0.33}}$$ Equation 6-3

Where:

t_i = overland (initial) flow time (minutes)
C_5 = runoff coefficient for 5-year frequency (from Table 6-4)
L_i = length of overland flow (ft)
S_o = average slope along the overland flow path (ft/ft).

$$t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$ Equation 6-5

Where:

t_c = minimum time of concentration for first design point when less than t_c from Equation 6-1.
L_t = length of channelized flow path (ft)
i = imperviousness (expressed as a decimal)
S_t = slope of the channelized flow path (ft/ft).

Table 6-2. NRCS Conveyance factors, K

Type of Land Surface	Conveyance Factor, K
Heavy meadow	2.5
Tillage/field	5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Cloverleaf Subdivision
Location: Colorado Springs
Design Storm: 5-Year

Project Name: Cloverleaf Subdivision - Proposed
Project No.: 2000-5158.01
Calculated By: GAG
Checked By:
Date: 11/12/21

	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			
Design Point	Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	REMARKS
1	A	4.39	0.47	12.4	2.05	3.81	7.8					0.2	0.05	2.6	7.6	2.00	2.0	24	1010 716	3.2 8.2	5.2 1.4	On-grade Inlet, Carryover flow to DP 3 Piped to DP 4.1
4	D	3.38	0.47	13.0	1.59	3.73	5.9								5.9	1.59	1.0	18	48	6.1	0.1	On-grade Inlet, Carryover flow to DP 9 Piped to DP 4.1
4.1								13.8	3.59	3.64	13.0				13.0	3.59	2.0	30	223	9.4	0.4	Sum of DP 1 & DP 4, piped to DP 4.2
2	B	3.11	0.38	14.7	1.17	3.55	4.2								4.2	1.17	2.0	24	147	7.0	0.4	Type C Inlet Piped to DP 4.2
4.2								15.0	4.76	3.52	16.7				16.7	4.76	2.0	36	223	10.0	0.4	Sum of DP 4.1 & DP 2, piped to DP 4.3
3	C	1.77	0.54	8.5	0.96	4.37	4.2	8.5	1.01	4.37	4.4				4.4	1.01	2.0	18	31	7.2	0.1	On-Grade Inlet, Sum of carryover flow from DP 1 and Sub-Basin C, Carryover flow to DP 14 Piped to DP 4.3
4.3								15.4	5.77	3.48	20.1				20.1	5.77	2.0	36	5	10.6	0.0	Sum of DP 4.2 & DP 3, piped to DP 5.1
5	E	0.30	0.65	5.0	0.19	5.17	1.0								1.0	0.19	2.0	36	0	4.2	0.0	On-grade Inlet Piped to DP 5.1
5.1								15.4	5.96	3.48	20.7				20.7	5.96	2.0	36	148	10.6	0.2	Sum of DP 4.3 & DP5, piped to DP 10.2
6	F	1.40	0.54	8.2	0.76	4.42	3.4								3.4	0.76	1.0	18	515	5.2	1.7	On-grade Inlet, Carryover flow to DP 8 Piped to DP 8.3
TB	TB	135.90	#N/A	79.0	43.96	1.03	45.2								45.2	43.96	1.0	42	182	10.1	0.3	Proposed Atenuation Pond Outlet Structure Release Piped to DP 8.3
7	G	0.90	0.57	6.5	0.51	4.77	2.4					0.3	0.07	4.3	2.1	0.44	1.0	18	470 62	4.1 4.6	1.9 0.2	On-grade Inlet, Carryover flow to DP 10 Piped to DP 8.1
8	H	4.18	0.43	13.6	1.80	3.67	6.6								6.6	1.80	1.0	24	5	6.3	0.0	Sump Inlet, sum of carryover flow from DP 6 and Sub-Basin H Piped to DP 8.1
8.1								13.6	2.24	3.67	8.2				8.2	2.24	0.7	24	37	5.8	0.1	Sum of DP 7 & DP 8, piped to DP 8.2
7A	IA	1.71	0.54	12.3	0.92	3.82	3.5								3.5	0.92	1.0	18	29	5.3	0.1	On-grade Inlet, Carryover flow to DP 9 Piped to DP 8.2
8.2								13.7	3.16	3.66	11.6				11.6	3.16	1.4	30	171	8.1	0.4	Sum of DP 8.1 & DP 7A, piped to DP 8.3
8.3								79.3	47.88	1.02	49.0				49.0	47.88	2.0	42	293	13.4	0.4	Sum of DP 8.2, DP 6, & DP TB, piped to DP 9.1
9	I	2.76	0.49	9.7	1.35	4.17	5.6								5.6	1.35	1.0	18	0	6.0	0.0	Sump Inlet, sum of carryover flow from DP 4, DP 7A, and Sub-Basin I Piped to DP 9.1
9.1								79.7	49.23	1.02	50.0				50.0	49.23	2.3	42	35	14.2	0.0	Sum of DP 8.3 & DP 9, piped to DP 10.1
10	J	1.39	0.54	7.4	0.76	4.59	3.5	8.4	0.83	4.39	3.6				3.6	0.83	2.0	42	0	6.2	0.0	Sump Inlet, sum of carryover flow from DP 7 and Sub-Basin J Piped to DP 10.1
10.1								79.7	50.06	1.02	50.8				50.8	50.06	1.6	42	140	12.5	0.2	Sum of DP 9.1 & DP 10, piped to DP 10.2
11	K	5.29	0.28	14.6	1.50	3.56	5.3					5.3	1.5	1.0								Swale Swale/Pond conveyance to DP 10.2
10.2								79.9	57.52	1.01	58.2											Sum of DP 5.1, DP 10.1, & DP 11 Pond P2 Outlet Structure
P2								90.0	71.52	0.83	59.6				59.6	71.52	2.0	42	454	14.1	0.5	Pond P2 Outlet Structure Release Piped to DP 15.2
13	M	0.54	0.53	5.7	0.28	4.97	1.4								1.4	0.28	1.0	18	34	4.1	0.1	On-Grade Inlet, sum of carryover flow from DP 5 and Sub-Basin M Piped to DP 14.1
14	N	0.53	0.56	6.9	0.30	4.70	1.4								1.4	0.30	1.0	18	0	4.0	0.0	On-Grade Inlet, sum of carryover flow from DP 3 and Sub-Basin N Piped to DP 14.1
14.1								6.9	0.58	4.70	2.7				2.7	0.58	1.0	18	31	4.9	0.1	Sum of DP 13 & DP 14 Piped to DP 15.1
15	O	0.98	0.35	8.8	0.34	4.33	1.5					1.5	0.34	0.5								Swale Swale/pond conveyance to DP 15.1

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Cloverleaf Subdivision
Location: Colorado Springs
Design Storm: 5-Year

Project Name: Cloverleaf Subdivision - Proposed
Project No.: 2000-5158.01
Calculated By: GAG
Checked By:
Date: 11/12/21

		DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			
	Design Point	Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	*I* (in/hr)	Q (cfs)	tc (min)	C*A (ac)	*I* (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	REMARKS
	15.1								8.8	0.92	4.33	4.0				4.0	0.92	0.5	18	80	4.2	0.3	Sum of DP 14.1 & DP 15 Water quality pond outlet structure
	15.2								90.5	72.44	0.82	59.7				59.7	72.44	2.5	48	116	15.2	0.1	Sum of DP P2 and DP 15.1 Piped to DP L1.1
	L1	OS-5	6.12	0.28	21.4	1.71	2.99	5.1					5.1	1.71	4.0								Type C Inlet Swale flows offsite along Leggins Way to DP L1, Piped to DP L1.0
	L1	OS-2	0.79	0.30	5.0	0.23	5.17	1.2					1.2	0.23	1.0								Type C Inlet Sheet flows offsite to DP L1, Piped to DP L1.0
	L1.0								21.4	1.94	2.99	5.8				5.8	1.94	1.2	24	51	6.4	0.1	Sum of Sub-Basin OS-2 and Sub-Basin OS-5 Piped to DP L1.1
	L1.1								90.7	74.38	0.82	61.2				61.2	74.38	1.8	48	116	13.6	0.1	Sum of DP 15.2 and DP L1.0 Piped to outfall O1
	12	L	1.97	0.34	11.1	0.67	3.97	2.7					2.7	0.67	1.0								Swale Swale/Pond conveyance to DP 12
	16	OS-1	0.41	0.43	6.9	0.18	4.69	0.8					0.8	0.18	1.0								Overland Flow Sheet flows offsite to DP 16 to the proposed attenuation pond P1
	18	OS-3	0.31	0.37	5.0	0.11	5.17	0.6					0.6	0.11	1.0								Overland Flow Sheet flows offsite to DP 18
	19	OS-4	1.00	0.38	7.2	0.38	4.62	1.8					1.8	0.38	1.0								Overland Flow Sheet flows offsite to DP 19

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Cloverleaf Subdivision
Location: Colorado Springs
Design Storm: 100-Year

Project Name: Cloverleaf Subdivision - Proposed
Project No.: 2000-5158.
Calculated By: GAG
Checked By:
Date: 11/12/21

	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			
Design Point	Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	REMARKS
1	A	4.39	0.62	12.4	2.70	6.39	17.3					3.4	0.53	2.6	13.9	2.17	2.0	24	1010 716	3.2 9.7	5.2 1.2	On-grade Inlet, Carryover flow to DP 3 Piped to DP 4.1
4	D	3.38	0.61	13.0	2.07	6.26	13.0					1.6	0.25	1.1	11.4	1.82	1.0	18	339 48	2.1 6.5	2.7 0.1	On-grade Inlet, Carryover flow to DP 9 Piped to DP 4.1
4.1								13.6	3.99	6.16	24.6				24.6	3.99	2.0	30	223	11.3	0.3	Sum of DP 1 & DP 4, piped to DP 4.2
2	B	3.11	0.54	14.7	1.69	5.97	10.1								10.1	1.69	2.0	24	147	8.9	0.3	Type C Inlet Piped to DP 4.2
4.2								14.9	5.68	5.92	33.6				33.6	5.68	2.0	36	223	12.2	0.3	Sum of DP 4.1 & DP 2, piped to DP 4.3
3	C	1.77	0.67	8.5	1.18	7.33	8.7	17.6	1.71	5.51	9.4	0.2	0.04	5.5	9.2	1.67	2.0	18	377 31	4.7 8.8	1.3 0.1	On-Grade Inlet, Sum of carryover flow from DP 1 and Sub-Basin C, Carryover flow to DP 14 Piped to DP 4.3
4.3								17.7	7.35	5.50	40.4				40.4	7.35	2.0	36	5	12.7	0.0	Sum of DP 4.2 & DP 3, piped to DP 5.1
5	E	0.30	0.76	5.0	0.23	8.68	2.0								2.0	0.23	2.0	36	0	5.2	0.0	On-grade Inlet Piped to DP 5.1
5.1								17.7	7.58	5.50	41.7				41.7	7.58	2.0	36	148	12.9	0.2	Sum of DP 4.3 & DP5, piped to DP 10.2
6	F	1.40	0.67	8.24	0.93	7.42	6.9					0.9	0.12	1.5	6.0	0.81	1.0	18	722 515	2.4 6.1	4.9 1.4	On-grade Inlet, Carryover flow to DP 8 Piped to DP 8.3
TB	TB	135.90	#N/A	106	79.88	0.98	78.5								78.5	79.88	1.0	42	182	11.5	0.3	Proposed Atenuation Pond Outlet Structure Release Piped to DP 8.3
7	G	0.90	0.70	6.5	0.63	8.02	5.1					2.1	0.26	6.5	3.0	0.37	2.0	18	470 62	5.1 6.5	1.5 0.2	On-grade Inlet, Carryover flow to DP 10 Piped to DP 8.1
8	H	4.18	0.59	13.6	2.47	6.16	15.2	13.6	2.59	6.16	16.0				16.0	2.59	1.0	24	5	7.8	0.0	Sump Inlet, sum of carryover flow from DP 6 and Sub-Basin H Piped to DP 8.1
8.1								13.6	2.97	6.16	18.3				18.3	2.97	0.7	24	37	6.9	0.1	Sum of DP 7 & DP 8, piped to DP 8.2
7A	IA	1.71	0.67	12.3	1.14	6.41	7.3					1.1	0.17	6.5	6.2	0.97	5.4	18	423 27	5.1 11.4	1.4 0.0	On-grade Inlet, Carryover flow to DP 9 Piped to DP 8.2
8.2								13.7	3.93	6.15	24.2				24.2	3.93	1.4	30	171	9.9	0.3	Sum of DP 8.1 & DP 7A, piped to DP 8.3
8.3								106.3	84.62	0.98	82.7				82.7	84.62	2.0	42	293	15.3	0.3	Sum of DP 8.2, DP 6, & DP TB, piped to DP 9.1
9	I	2.76	0.62	9.7	1.72	7.00	12.0	15.7	2.14	5.79	12.4				12.4	2.14	1.0	18	0	7.0	0.0	Sump Inlet, sum of carryover flow from DP 4, DP 7A, and Sub-Basin I Piped to DP 9.1
9.1								106.6	86.76	0.97	84.1				84.1	86.76	2.3	42	35	16.2	0.0	Sum of DP 8.3 & DP 9, piped to DP 10.1
10	J	1.39	0.67	7.4	0.93	7.70	7.2	8.0	1.19	7.48	8.9				8.9	1.19	2.0	42	0	8.1	0.0	Sump Inlet, sum of carryover flow from DP 7 and Sub-Basin J Piped to DP 10.1
10.1								106.6	87.95	0.97	85.2				85.2	87.95	1.6	42	140	14.1	0.2	Sum of DP 9.1 & DP 10, piped to DP 10.2
11	K	5.29	0.49	14.6	2.59	5.98	15.5					15.5	2.59	1.0					366	2.0	3.1	Swale Swale/Pond conveyance to DP 10.2
10.2								106.8	98.12	0.96	94.6											Sum of DP 5.1, DP 10.1, & DP 11 Pond P2 Outlet Structure
P2								75.0	58.82	1.85	109.1				109.1	58.82	2.0	42	454	16.3	0.5	Pond P2 Outlet Structure Release Piped to DP 15.2
13	M	0.54	0.66	5.7	0.35	8.34	2.9								2.9	0.35	1.0	18	34	5.1	0.1	On-Grade Inlet, sum of carryover flow from DP 5 and Sub-Basin M Piped to DP 14.1
14	N	0.53	0.69	6.9	0.36	7.88	2.8	18.9	0.40	5.32	2.1				2.1	0.40	1.0	18	0	4.6	0.0	On-Grade Inlet, sum of carryover flow from DP 3 and Sub-Basin N Piped to DP 14.1
14.1								18.9	0.75	5.32	4.0				4.0	0.75	1.0	18	31	5.5	0.1	Sum of DP 13 & DP 14 Piped to DP 15.1
15	O	0.98	0.53	8.8	0.52	7.26	3.8					3.8	0.52	0.5								Swale Swale/pond conveyance to DP 15.1

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Cloverleaf Subdivision
Location: Colorado Springs
Design Storm: 100-Year

Project Name: Cloverleaf Subdivision - Proposed
Project No.: 2000-5158.
Calculated By: GAG
Checked By:
Date: 11/12/21

		DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			
	Design Point	Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	REMARKS
	15.1								19.0	1.27	5.31	6.7				6.7	1.27	0.5	18	80	4.8	0.3	Sum of DP 14.1 & DP 15 Water quality pond outlet structure
	15.2								75.5	60.08	1.84	110.5				110.5	60.08	2.5	48	116	17.9	0.1	Sum of DP P2 and DP 15.1 Piped to DP L1.1
	L1	OS-5	6.12	0.49	21.4	3.01	5.01	15.1					15.1	3.01	1.0								Type C Inlet Swale flows offsite along Leggins Way to DP L1, Piped to DP L1.0
	L1	OS-2	0.79	0.52	5.0	0.41	8.68	3.6					3.6	0.41	1.0								Type C Inlet Sheet flows offsite to DP L1, Piped to DP L1.0
	L1.0								21.4	3.42	5.01	17.1				17.1	3.42	1.2	24	51	8.5	0.1	Sum of Sub-Basin OS-2 and Sub-Basin OS-5 Piped to DP L1.1
	L1.1								75.6	63.50	1.84	116.6				116.6	63.50	1.8	48	116	16.0	0.1	Sum of DP 15.2 and DP L1.0 Piped to outfall O1
	12	L	1.97	0.53	11.1	1.04	6.67	6.9					6.9	1.04	1.0								Swale Swale/Pond conveyance to DP 12
	16	OS-1	0.41	0.58	6.9	0.24	7.87	1.9					1.9	0.24	1.0								Overland Flow Sheet flows offsite to DP 16 to the proposed attenuation pond P1
	18	OS-3	0.31	0.57	5.0	0.18	8.68	1.6					1.6	0.18	1.0								Overland Flow Sheet flows offsite to DP 18
	19	OS-4	1.00	0.56	7.2	0.56	7.76	4.3					4.3	0.56	1.0								Overland Flow Sheet flows offsite to DP 19

Appendix C
Hydrologic Calculations (CUHP/SWMM)

Summary of CUHP Input Parameters (Version 2.0.1)
Existing Condition - 5yr

								Depression Storage		Horton's Infiltration Parameters			DCIA Level and Fractions			
Catchment Name/ID	SWMM Node/ID	Raingage Name/ID	Area (sq.mi.)	Dist. to Centroid (miles)	Length (miles)	Slope (ft./ft.)	Percent Imperv.	Pervious (inches)	Imperv. (inches)	Initial Rate (in./hr.)	Final Rate (in.hr.)	Decay Coeff. (1/sec.)	DCIA Level	Dir. Con'ct Imperv. Fraction	Receiv. Perv. Fraction	Percent Eff. Imperv.
TX-1	1	2-HOUR DESIGN STORM 5 YR	0.170	0.665	1.056	0.060	23.5	0.50	0.10	4.50	0.60	0.0018	2.00	0.12	0.38	18.41
TX-2	2	2-HOUR DESIGN STORM 5 YR	0.043	0.263	0.544	0.060	16.0	0.50	0.10	4.50	0.60	0.0018	2.00	0.08	0.34	12.08
SX-3	3	2-HOUR DESIGN STORM 5 YR	0.043	0.234	0.323	0.040	0.0	0.50	0.10	4.50	0.60	0.0018	2.00	0.00	0.00	0.00
SX-4	4	2-HOUR DESIGN STORM 5 YR	0.008	0.132	0.200	0.060	4.8	0.50	0.10	4.50	0.60	0.0018	2.00	0.00	0.14	3.41
SX-5	5	2-HOUR DESIGN STORM 5 YR	0.007	0.086	0.144	0.060	4.0	0.50	0.10	4.50	0.60	0.0018	2.00	0.00	0.12	2.84
SX-6	6	2-HOUR DESIGN STORM 5 YR	0.077	0.259	0.698	0.050	16.9	0.50	0.10	4.50	0.60	0.0018	2.00	0.08	0.34	12.82

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 2.0.1)
Existing Condition - 5yr

		Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
Catchment Name/ID	User Comment for Catchment	CT	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
TX-1		0.113	0.165	53.0	7.02	27.6	4.96	11.7	96	394,581	0.54	213,183	60.0	47	213,182	0.43
TX-2		0.122	0.092	48.3	3.70	25.1	2.62	6.2	26	98,736	0.46	45,815	56.0	11	45,815	0.40
SX-3		0.163	0.118	40.5	3.98	21.0	2.81	6.6	32	100,188	0.31	31,003	55.0	9	31,001	0.33
SX-4		0.150	0.052	46.7	2.16	24.3	1.52	3.6	5	18,876	0.35	6,696	54.0	2	6,696	0.32
SX-5		0.152	0.048	35.5	1.61	18.5	1.14	2.7	6	15,609	0.35	5,419	51.0	2	5,418	0.40
SX-6		0.121	0.119	43.1	4.23	22.4	2.99	7.1	53	178,233	0.47	84,305	55.0	22	84,302	0.45

Summary of CUHP Input Parameters (Version 2.0.1)
Existing Condition - 100yr

								Depression Storage		Horton's Infiltration Parameters			DCIA Level and Fractions			
Catchment Name/ID	SWMM Node/ID	Raingage Name/ID	Area (sq.mi.)	Dist. to Centroid (miles)	Length (miles)	Slope (ft./ft.)	Percent Imperv.	Pervious (inches)	Imperv. (inches)	Initial Rate (in./hr.)	Final Rate (in.hr.)	Decay Coeff. (1/sec.)	DCIA Level	Dir. Con'ct Imperv. Fraction	Receiv. Perv. Fraction	Percent Eff. Imperv.
TX-1	1	2-HOUR DESIGN STORM	0.170	0.665	1.056	0.060	23.5	0.50	0.10	4.50	0.60	0.0018	2.00	0.12	0.38	20.24
TX-2	2	2-HOUR DESIGN STORM	0.043	0.263	0.544	0.060	16.0	0.50	0.10	4.50	0.60	0.0018	2.00	0.08	0.34	13.47
SX-3	3	2-HOUR DESIGN STORM	0.043	0.234	0.323	0.040	0.0	0.50	0.10	4.50	0.60	0.0018	2.00	0.00	0.00	0.00
SX-4	4	2-HOUR DESIGN STORM	0.008	0.132	0.200	0.060	4.8	0.50	0.10	4.50	0.60	0.0018	2.00	0.00	0.14	3.89
SX-5	5	2-HOUR DESIGN STORM	0.007	0.086	0.144	0.060	4.0	0.50	0.10	4.50	0.60	0.0018	2.00	0.00	0.12	3.24
SX-6	6	2-HOUR DESIGN STORM	0.077	0.259	0.698	0.050	16.9	0.50	0.10	4.50	0.60	0.0018	2.00	0.08	0.34	14.27

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 2.0.1)
Existing Condition - 100yr

		Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
Catchment Name/ID	User Comment for Catchment	CT	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
TX-1		0.110	0.164	52.2	6.87	27.1	4.86	11.5	98	394,581	1.46	577,723	59.0	125	577,720	1.15
TX-2		0.120	0.091	47.9	3.64	24.9	2.57	6.1	27	98,736	1.38	136,205	55.0	31	136,206	1.15
SX-3		0.163	0.118	40.5	3.98	21.0	2.81	6.6	32	100,188	1.21	121,642	54.0	33	121,635	1.20
SX-4		0.149	0.051	46.7	2.13	24.3	1.51	3.6	5	18,876	1.26	23,820	53.0	6	23,818	1.08
SX-5		0.151	0.048	35.5	1.60	18.5	1.13	2.7	6	15,609	1.25	19,573	51.0	6	19,570	1.35
SX-6		0.119	0.118	42.7	4.16	22.2	2.94	6.9	54	178,233	1.39	247,637	54.0	63	247,623	1.28

EX-5YR REPORT
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)

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*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Flow Routing Method ...... KINWAVE
Starting Date ............ 01/01/2005 00:00:00
Ending Date .............. 01/04/2005 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Routing Time Step ........ 30.00 sec


**************************        Volume         Volume
Flow Routing Continuity        acre-feet       10^6 gal
**************************     ---------      ---------
Dry Weather Inflow .......        38.674         12.603
Wet Weather Inflow .......         0.000          0.000
Groundwater Inflow .......         0.000          0.000
RDII Inflow ..............         0.000          0.000
External Inflow ..........         8.871          2.891
External Outflow .........        47.545         15.493
Flooding Loss ............         0.000          0.000
Evaporation Loss .........         0.000          0.000
Exfiltration Loss ........         0.000          0.000
Initial Stored Volume ....         0.000          0.000
Final Stored Volume ......         0.000          0.000
Continuity Error (%) .....         0.000


*********************************
Highest Flow Instability Indexes
*********************************
All links are stable.


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :    30.00 sec
Average Time Step           :    30.00 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.00
Percent Not Converging      :     0.00
```

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
1	JUNCTION	0.00	0.00	7409.00	0 00:00	0.00
2	JUNCTION	0.00	0.00	7226.00	0 00:00	0.00
3	JUNCTION	0.00	0.00	7065.00	0 00:00	0.00
4	JUNCTION	0.00	0.00	7101.00	0 00:00	0.00
5	JUNCTION	0.00	0.00	7108.00	0 00:00	0.00
6	JUNCTION	0.00	0.00	7160.00	0 00:00	0.00
9	JUNCTION	0.00	0.00	7003.00	0 00:00	0.00
EX_28X42_CMP	JUNCTION	0.00	0.00	6992.00	0 00:00	0.00
EX_18_CMP	JUNCTION	0.00	0.00	6996.00	0 00:00	0.00
10	OUTFALL	0.00	0.00	6988.00	0 00:00	0.00
11	OUTFALL	0.00	0.00	7042.00	0 00:00	0.00

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
1	JUNCTION	46.77	46.77	0 01:00	1.59	1.59	0.000
2	JUNCTION	10.94	10.94	0 00:56	0.343	0.343	0.000
3	JUNCTION	9.13	66.47	0 00:58	0.232	2.17	0.000
4	JUNCTION	1.69	1.69	0 00:54	0.0501	0.0501	0.000
5	JUNCTION	1.74	1.74	0 00:51	0.0405	0.0405	0.000
6	JUNCTION	22.27	22.27	0 00:55	0.631	0.631	0.000
9	JUNCTION	0.00	66.47	0 00:58	0	2.17	0.000
EX_28X42_CMP	JUNCTION	0.00	96.20	0 00:57	0	15.5	0.000
EX_18_CMP	JUNCTION	6.00	7.69	0 00:54	12.6	12.7	0.000
10	OUTFALL	0.00	96.20	0 00:57	0	15.5	0.000
11	OUTFALL	0.00	1.74	0 00:51	0	0.0405	0.000

****
Node Flooding Summary
****

No nodes were flooded.

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
10	100.00	7.36	96.20	15.451
11	3.23	0.60	1.74	0.041
System	51.61	7.95	97.85	15.492

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days	hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
4	DUMMY	10.94	0	00:56			
5	DUMMY	66.47	0	00:58			
6	DUMMY	22.27	0	00:55			
7	DUMMY	1.69	0	00:54			
8	DUMMY	7.69	0	00:54			
9	DUMMY	96.20	0	00:57			
10	DUMMY	1.74	0	00:51			
13	DUMMY	66.47	0	00:58			
14	DUMMY	46.77	0	01:00			

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Thu May 13 10:36:51 2021
Analysis ended on: Thu May 13 10:36:51 2021
Total elapsed time: < 1 sec

EX-100YR REPORT
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)

****
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
****

****
Analysis Options
****
Flow Units ..... CFS
Process Models:
  Rainfall/Runoff ..... NO
  RDII ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... YES
  Ponding Allowed ..... NO
  Water Quality ..... NO
Flow Routing Method ..... KINWAVE
Starting Date 01/01/2005 00:00:00
Ending Date 01/04/2005 06:00:00
Antecedent Dry Days 0.0
Report Time Step 00:15:00
Routing Time Step ..... 30.00 sec

********** Flow Routing Continuity **********	Volume acre-feet	Volume 10^6 gal
Dry Weather Inflow	167.588	54.611
Wet Weather Inflow	0.000	0.000
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	25.862	8.427
External Outflow	193.450	63.039
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.000	0.000
Continuity Error (%)	0.000	

****
Highest Flow Instability Indexes
****
All links are stable.

****
Routing Time Step Summary
****
Minimum Time Step : 30.00 sec
Average Time Step : 30.00 sec
Maximum Time Step : 30.00 sec
Percent in Steady State : 0.00
Average Iterations per Step : 1.00
Percent Not Converging : 0.00

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
1	JUNCTION	0.00	0.00	7409.00	0 00:00	0.00
2	JUNCTION	0.00	0.00	7226.00	0 00:00	0.00
3	JUNCTION	0.00	0.00	7065.00	0 00:00	0.00
4	JUNCTION	0.00	0.00	7101.00	0 00:00	0.00
5	JUNCTION	0.00	0.00	7108.00	0 00:00	0.00
6	JUNCTION	0.00	0.00	7160.00	0 00:00	0.00
9	JUNCTION	0.00	0.00	7003.00	0 00:00	0.00
EX_28X42_CMP	JUNCTION	0.00	0.00	6992.00	0 00:00	0.00
EX_18_CMP	JUNCTION	0.00	0.00	6996.00	0 00:00	0.00
10	OUTFALL	0.00	0.00	6988.00	0 00:00	0.00
11	OUTFALL	0.00	0.00	7042.00	0 00:00	0.00

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
1	JUNCTION	124.80	124.80	0 00:59	4.32	4.32	0.000
2	JUNCTION	31.41	31.41	0 00:55	1.02	1.02	0.000
3	JUNCTION	33.04	188.19	0 00:57	0.91	6.25	0.000
4	JUNCTION	5.63	5.63	0 00:53	0.178	0.178	0.000
5	JUNCTION	5.81	5.81	0 00:51	0.146	0.146	0.000
6	JUNCTION	63.07	63.07	0 00:54	1.85	1.85	0.000
9	JUNCTION	0.00	188.19	0 00:57	0	6.25	0.000
EX_28X42_CMP	JUNCTION	0.00	282.29	0 00:56	0	62.9	0.000
EX_18_CMP	JUNCTION	26.00	31.63	0 00:53	54.6	54.8	0.000
10	OUTFALL	0.00	282.29	0 00:56	0	62.9	0.000
11	OUTFALL	0.00	5.81	0 00:51	0	0.146	0.000

****
Node Flooding Summary
****

No nodes were flooded.

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
10	100.00	29.94	282.29	62.887
11	3.50	1.99	5.81	0.146
System	51.75	31.93	287.83	63.034

****
Link Flow Summary
****

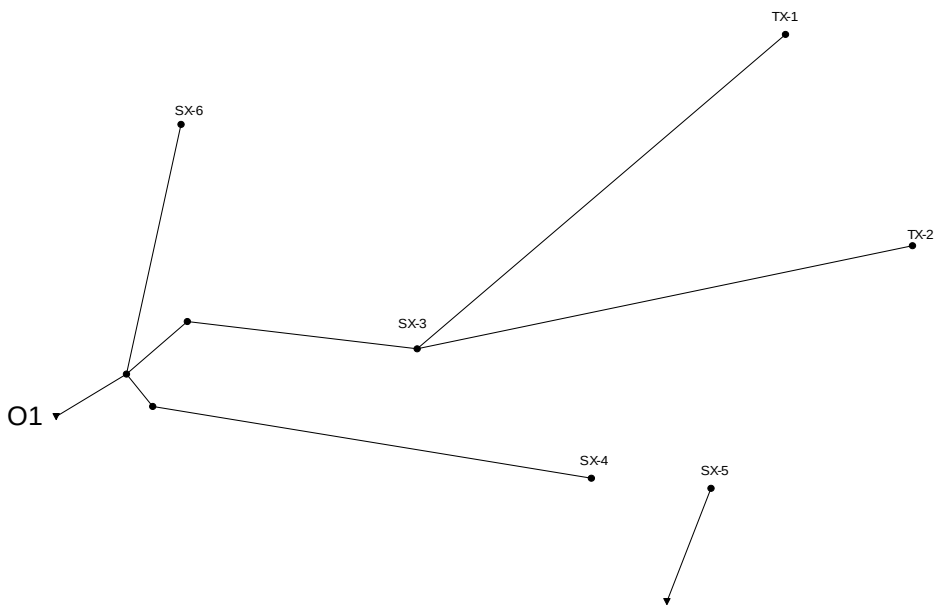
Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days	hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
4	DUMMY	31.41	0	00:55			
5	DUMMY	188.19	0	00:57			
6	DUMMY	63.07	0	00:54			
7	DUMMY	5.63	0	00:53			
8	DUMMY	31.63	0	00:53			
9	DUMMY	282.29	0	00:56			
10	DUMMY	5.81	0	00:51			
13	DUMMY	188.19	0	00:57			
14	DUMMY	124.80	0	00:59			

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Thu May 13 10:41:48 2021
Analysis ended on: Thu May 13 10:41:49 2021
Total elapsed time: 00:00:01

EXISTING CONDITIONS MODEL



Summary of CUHP Input Parameters (Version 2.0.1)
Proposed Condition - 5YR

								Depression Storage		Horton's Infiltration Parameters			DCIA Level and Fractions			
Catchment Name/ID	SWMM Node/ID	Raingage Name/ID	Area (sq.mi.)	Dist. to Centroid (miles)	Length (miles)	Slope (ft./ft.)	Percent Imperv.	Pervious (inches)	Imperv. (inches)	Initial Rate (in./hr.)	Final Rate (in.hr.)	Decay Coeff. (1/sec.)	DCIA Level	Dir. Con'ct Imperv. Fraction	Receiv. Perv. Fraction	Percent Eff. Imperv.
TX-1	1	2-HOUR DESIGN STORM 5 YR	0.170	0.665	1.056	0.060	23.5	0.50	0.10	4.50	0.60	0.0018	2.00	0.12	0.38	18.41
TX-2	2	2-HOUR DESIGN STORM 5 YR	0.043	0.263	0.544	0.060	16.0	0.50	0.10	4.50	0.60	0.0018	2.00	0.08	0.34	12.08
S-3	3	2-HOUR DESIGN STORM 5 YR	0.048	0.279	0.460	0.040	59.3	0.40	0.10	4.50	0.60	0.0018	1.00	0.69	0.42	55.33
S-6	6	2-HOUR DESIGN STORM 5 YR	0.081	0.259	0.698	0.050	18.9	0.50	0.10	4.50	0.60	0.0018	2.00	0.09	0.35	14.49

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 2.0.1)
Proposed Condition - 5YR

		Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
Catchment Name/ID	User Comment for Catchment	CT	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
TX-1		0.113	0.165	53.0	7.02	27.6	4.96	11.7	96	394,581	0.54	213,183	60.0	47	213,182	0.43
TX-2		0.122	0.092	48.3	3.70	25.1	2.62	6.2	26	98,736	0.46	45,815	56.0	11	45,815	0.40
S-3		0.086	0.145	22.5	2.80	11.7	1.98	4.7	64	110,715	1.02	112,490	47.0	42	112,483	1.37
S-6		0.118	0.120	41.6	4.15	21.6	2.93	6.9	58	188,034	0.49	92,731	55.0	25	92,727	0.48

Summary of CUHP Input Parameters (Version 2.0.1)
Proposed Condition - 100YR

								Depression Storage		Horton's Infiltration Parameters			DCIA Level and Fractions			
Catchment Name/ID	SWMM Node/ID	Raingage Name/ID	Area (sq.mi.)	Dist. to Centroid (miles)	Length (miles)	Slope (ft./ft.)	Percent Imperv.	Pervious (inches)	Imperv. (inches)	Initial Rate (in./hr.)	Final Rate (in.hr.)	Decay Coeff. (1/sec.)	DCIA Level	Dir. Con'ct Imperv. Fraction	Receiv. Perv. Fraction	Percent Eff. Imperv.
TX-1	1	2-HOUR DESIGN STORM	0.170	0.665	1.056	0.060	23.5	0.50	0.10	4.50	0.60	0.0018	2.00	0.12	0.38	20.24
TX-2	2	2-HOUR DESIGN STORM	0.043	0.263	0.544	0.060	16.0	0.50	0.10	4.50	0.60	0.0018	2.00	0.08	0.34	13.47
S-3	3	2-HOUR DESIGN STORM	0.048	0.279	0.460	0.040	58.5	0.40	0.10	4.50	0.60	0.0018	1.00	0.69	0.41	55.97
S-6	6	2-HOUR DESIGN STORM	0.081	0.259	0.698	0.050	18.9	0.50	0.10	4.50	0.60	0.0018	2.00	0.09	0.35	16.06

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 2.0.1)
Proposed Condition - 100YR

		Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
Catchment Name/ID	User Comment for Catchment	CT	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
TX-1		0.110	0.164	52.2	6.87	27.1	4.86	11.5	98	394,581	1.46	577,723	59.0	125	577,720	1.15
TX-2		0.120	0.091	47.9	3.64	24.9	2.57	6.1	27	98,736	1.38	136,205	55.0	31	136,206	1.15
S-3		0.086	0.146	22.2	2.79	11.6	1.97	4.6	64	111,078	2.00	222,496	47.0	82	222,471	2.68
S-6		0.116	0.119	41.1	4.07	21.4	2.88	6.8	59	188,034	1.41	265,448	54.0	69	265,434	1.34

Peak attenuation pond P1 input values.

Storage Unit P1

Property	Value
Name	P1
X-Coordinate	4924.166
Y-Coordinate	5420.880
Description	OFF-SITE VOLUME ATTENUATION POND
Tag	
Inflows	NO
Treatment	NO
Invert El.	7066
Max. Depth	6.08
Initial Depth	0
Surcharge Depth	0
Evap. Factor	0
Seepage Loss	NO
Storage Curve	TABULAR
Functional Curve	
Coefficient	1000
Exponent	0
Constant	0
Tabular Curve	
Curve Name	P1_VOLUME

Name of storage curve to use (after specifing a curve, you can double-click to edit it)

Storage Curve Editor

Curve Name: P1_VOLUME

Description: Per Surface Grading

	Depth (ft)	Area (ft2)
1	0	0
2	0.33	4
3	1.33	7257
4	2.33	25248
5	3.33	43939
6	4.33	60500
7	5.33	71527
8	6.33	78278
9	7.33	84848
10	8.33	92117
11		

View... Load... Save... OK Cancel Help

Pond P1 stage-storage from UD-Detention

Full-spectrum EDB pond P2 input values.

Storage Unit P2

Property	Value
Name	P2
X-Coordinate	4479.272
Y-Coordinate	5360.212
Description	ON-SITE DETENTION AND WQ POND
Tag	
Inflows	NO
Treatment	NO
Invert El.	7025
Max. Depth	8.33
Initial Depth	0
Surcharge Depth	0
Evap. Factor	0
Seepage Loss	NO
Storage Curve	TABULAR
Functional Curve	
Coefficient	1000
Exponent	0
Constant	0
Tabular Curve	
Curve Name	P2_VOLUME

User-assigned name of storage unit

Storage Curve Editor

Curve Name: P2_VOLUME

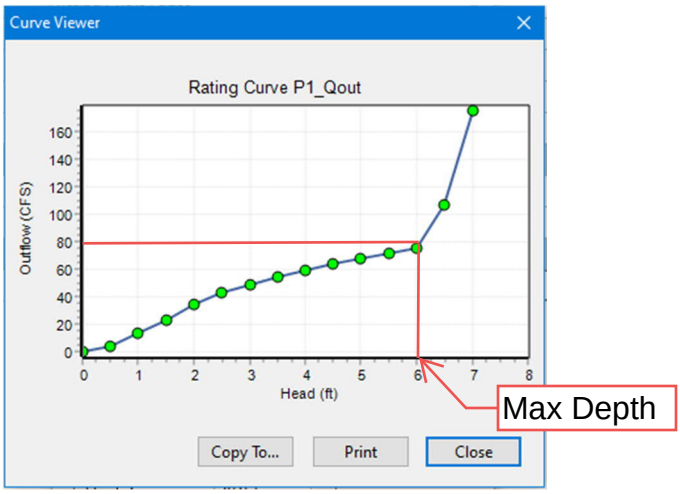
Description: STAGE STORAGE PER GRADING

	Depth (ft)	Area (ft2)
1	0	0
2	0.33	0
3	1.33	1379
4	2.33	7541
5	3.33	18733
6	4.33	35627
7	5.33	51267
8	6.33	55882
9	7.33	60677
10	8.33	65444
11		

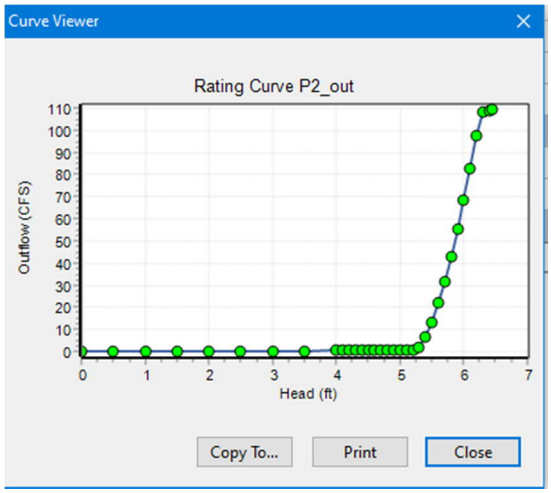
View... Load... Save... OK Cancel Help

Pond P2 stage-storage from UD-Detention

Link 1 stage-discharge from UD-Detention



Link 2 stage-discharge from UD-Detention



5-year Proposed Condition

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)

****
Element Count
****
Number of rain gages 0
Number of subcatchments ... 0
Number of nodes 10
Number of links 9
Number of pollutants 0
Number of land uses 0

****
Node Summary
****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
1	JUNCTION	7409.00	0.00	0.0	
2	JUNCTION	7226.00	0.00	0.0	
3	JUNCTION	7065.00	0.00	0.0	
6	JUNCTION	7160.00	0.00	0.0	
P2_out	JUNCTION	7003.00	0.00	0.0	
EX_28X42_CMP	JUNCTION	6992.00	0.00	0.0	
EX18CMP	JUNCTION	6993.00	0.00	0.0	Yes
O1	OUTFALL	6988.00	0.00	0.0	
P1	STORAGE	7066.00	6.08	0.0	
P2	STORAGE	7025.00	6.33	0.0	

****
Link Summary
****

Name	From Node	To Node	Type	Length	%Slope	Roughness
4	2	P1	CONDUIT	400.0	43.6436	0.0100
5	3	P2	CONDUIT	400.0	10.0504	0.0100
6	6	EX_28X42_CMP	CONDUIT	400.0	46.2798	0.0100
9	EX_28X42_CMP	O1	CONDUIT	400.0	1.0001	0.0100
13	P2_out	EX_28X42_CMP	CONDUIT	400.0	2.7510	0.0100
14	1	P1	CONDUIT	400.0	166.6719	0.0100
15	EX18CMP	EX_28X42_CMP	CONDUIT	400.0	0.2500	0.0100
1	P1	P2	OUTLET			
2	P2	P2_out	OUTLET			

```
*********************
Cross Section Summary
*********************
                 Full     Full     Hyd.     Max.    No. of     Full
Conduit Shape    Depth     Area     Rad.    Width   Barrels    Flow
----------------------------------------------------------------------
4       DUMMY    0.00     0.00     0.00     0.00        1      0.00
5       DUMMY    0.00     0.00     0.00     0.00        1      0.00
6       DUMMY    0.00     0.00     0.00     0.00        1      0.00
9       DUMMY    0.00     0.00     0.00     0.00        1      0.00
13      DUMMY    0.00     0.00     0.00     0.00        1      0.00
14      DUMMY    0.00     0.00     0.00     0.00        1      0.00
15      DUMMY    0.00     0.00     0.00     0.00        1      0.00


**********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
**********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Flow Routing Method ...... KINWAVE
Starting Date ............ 01/01/2005 00:00:00
Ending Date .............. 01/05/2005 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Routing Time Step ........ 30.00 sec


*********************
Control Actions Taken
*********************


**************************        Volume         Volume
Flow Routing Continuity        acre-feet       10^6 gal
**************************     ---------      ---------
Dry Weather Inflow .......         0.000          0.000
Wet Weather Inflow .......         0.000          0.000
Groundwater Inflow .......         0.000          0.000
RDII Inflow ..............         0.000          0.000
External Inflow ..........       111.806         36.433
```

```
  External Outflow .........       111.783        36.426
  Flooding Loss ............         0.000         0.000
  Evaporation Loss .........         0.000         0.000
  Exfiltration Loss ........         0.000         0.000
  Initial Stored Volume ....         0.000         0.000
  Final Stored Volume ......         0.000         0.000
  Continuity Error (%) .....         0.020


  ********************************
  Highest Flow Instability Indexes
  ********************************
  All links are stable.


  *************************
  Routing Time Step Summary
  *************************
  Minimum Time Step           :    30.00 sec
  Average Time Step           :    30.00 sec
  Maximum Time Step           :    30.00 sec
  Percent in Steady State     :     0.00
  Average Iterations per Step :     1.00
  Percent Not Converging      :     0.00


  ******************
  Node Depth Summary
  ******************

  ----------------------------------------------------------------------
                        Average  Maximum  Maximum  Time of Max    Reported
                         Depth    Depth      HGL   Occurrence   Max Depth
  Node         Type       Feet     Feet     Feet   days hr:min        Feet
  ----------------------------------------------------------------------
  1          JUNCTION     0.00   0.00    7409.00    0  00:00        0.00
  2          JUNCTION     0.00   0.00    7226.00    0  00:00        0.00
  3          JUNCTION     0.00   0.00    7065.00    0  00:00        0.00
  6          JUNCTION     0.00   0.00    7160.00    0  00:00        0.00
P2_out       JUNCTION     0.00   0.00    7003.00    0  00:00        0.00
EX_28X42_CMP JUNCTION     0.00   0.00    6992.00    0  00:00        0.00
 EX18CMP     JUNCTION     0.00   0.00    6993.00    0  00:00        0.00
  O1         OUTFALL      0.00   0.00    6988.00    0  00:00        0.00
  P1         STORAGE      0.05   2.69    7068.69    0  01:19        2.68
  P2         STORAGE      2.69   5.98    7030.98    0  01:22        5.96


  ******************
  Node Inflow Summary
  ******************
```

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days	hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
1	JUNCTION	46.77	46.77	0	01:00	1.59	1.59	0.000
2	JUNCTION	10.94	10.94	0	00:56	0.343	0.343	0.000
3	JUNCTION	41.63	41.63	0	00:47	0.841	0.841	0.000
6	JUNCTION	25.11	25.11	0	00:55	0.694	0.694	0.000
P2_out	JUNCTION	0.00	61.31	0	01:22	0	2.77	0.000
EX_28X42_CMP	JUNCTION	0.00	89.67	0	01:19	0	36.4	0.000
EX18CMP	JUNCTION	12.00	12.00	0	00:00	33	33	0.000
O1	OUTFALL	0.00	89.67	0	01:19	0	36.4	0.000
P1	STORAGE	0.00	57.56	0	00:59	0	1.94	0.112
P2	STORAGE	0.00	74.01	0	00:57	0	2.78	0.187

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days	hr:min	Maximum Outflow CFS
P1	0.292	0	0	0	30.252	13	0	01:19	45.23
P2	24.348	17	0	0	123.085	86	0	01:22	61.31

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
O1	100.00	13.26	89.67	36.423
System	100.00	13.26	89.67	36.423

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days	hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
4	DUMMY	10.94	0	00:56			
5	DUMMY	41.63	0	00:47			
6	DUMMY	25.11	0	00:55			
9	DUMMY	89.67	0	01:19			
13	DUMMY	61.31	0	01:22			
14	DUMMY	46.77	0	01:00			
15	DUMMY	12.00	0	00:00			
1	DUMMY	45.23	0	01:19			
2	DUMMY	61.31	0	01:22			

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Wed Oct 27 12:08:33 2021
Analysis ended on: Wed Oct 27 12:08:33 2021
Total elapsed time: < 1 sec

100-year Proposed Condition

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)

****
Element Count
****
Number of rain gages 0
Number of subcatchments ... 0
Number of nodes 10
Number of links 9
Number of pollutants 0
Number of land uses 0

****
Node Summary
****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
1	JUNCTION	7409.00	0.00	0.0	
2	JUNCTION	7226.00	0.00	0.0	
3	JUNCTION	7065.00	0.00	0.0	
6	JUNCTION	7160.00	0.00	0.0	
P2_out	JUNCTION	7003.00	0.00	0.0	
EX_28X42_CMP	JUNCTION	6992.00	0.00	0.0	
EX18CMP	JUNCTION	6993.00	0.00	0.0	Yes
O1	OUTFALL	6988.00	0.00	0.0	
P1	STORAGE	7066.00	6.08	0.0	
P2	STORAGE	7025.00	8.33	0.0	

****
Link Summary
****

Name	From Node	To Node	Type	Length	%Slope	Roughness
4	2	P1	CONDUIT	400.0	43.6436	0.0100
5	3	P2	CONDUIT	400.0	10.0504	0.0100
6	6	EX_28X42_CMP	CONDUIT	400.0	46.2798	0.0100
9	EX_28X42_CMP	O1	CONDUIT	400.0	1.0001	0.0100
13	P2_out	EX_28X42_CMP	CONDUIT	400.0	2.7510	0.0100
14	1	P1	CONDUIT	400.0	166.6719	0.0100
15	EX18CMP	EX_28X42_CMP	CONDUIT	400.0	0.2500	0.0100
1	P1	P2	OUTLET			
2	P2	P2_out	OUTLET			

****
Cross Section Summary
****

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
4	DUMMY	0.00	0.00	0.00	0.00	1	0.00
5	DUMMY	0.00	0.00	0.00	0.00	1	0.00
6	DUMMY	0.00	0.00	0.00	0.00	1	0.00
9	DUMMY	0.00	0.00	0.00	0.00	1	0.00
13	DUMMY	0.00	0.00	0.00	0.00	1	0.00
14	DUMMY	0.00	0.00	0.00	0.00	1	0.00
15	DUMMY	0.00	0.00	0.00	0.00	1	0.00

****
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
****

****
Analysis Options
****

```
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Flow Routing Method ...... KINWAVE
Starting Date ............ 01/01/2005 00:00:00
Ending Date .............. 01/05/2005 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Routing Time Step ........ 30.00 sec
```

****
Control Actions Taken
****

********** Flow Routing Continuity	Volume acre-feet	Volume 10^6 gal
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	0.000	0.000
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	246.746	80.406

```
  External Outflow .........       246.718        80.397
  Flooding Loss ............         0.000         0.000
  Evaporation Loss .........         0.000         0.000
  Exfiltration Loss ........         0.000         0.000
  Initial Stored Volume ....         0.000         0.000
  Final Stored Volume ......         0.000         0.000
  Continuity Error (%) .....         0.011


  ********************************
  Highest Flow Instability Indexes
  ********************************
  All links are stable.


  *************************
  Routing Time Step Summary
  *************************
  Minimum Time Step           :    30.00 sec
  Average Time Step           :    30.00 sec
  Maximum Time Step           :    30.00 sec
  Percent in Steady State     :     0.00
  Average Iterations per Step :     1.00
  Percent Not Converging      :     0.00


  ******************
  Node Depth Summary
  ******************

  ----------------------------------------------------------------------
                       Average  Maximum  Maximum  Time of Max    Reported
                         Depth    Depth      HGL   Occurrence   Max Depth
  Node      Type         Feet     Feet     Feet  days hr:min        Feet
  ----------------------------------------------------------------------
1          JUNCTION     0.00     0.00  7409.00     0  00:00        0.00
2          JUNCTION     0.00     0.00  7226.00     0  00:00        0.00
3          JUNCTION     0.00     0.00  7065.00     0  00:00        0.00
6          JUNCTION     0.00     0.00  7160.00     0  00:00        0.00
P2_out     JUNCTION     0.00     0.00  7003.00     0  00:00        0.00
EX_28X42_CMP JUNCTION   0.00     0.00  6992.00     0  00:00        0.00
EX18CMP    JUNCTION     0.00     0.00  6993.00     0  00:00        0.00
  O1       OUTFALL      0.00     0.00  6988.00     0  00:00        0.00
  P1       STORAGE      0.14     6.05  7072.05     0  01:46        6.05
  P2       STORAGE      2.72     6.43  7031.43     0  01:18        6.42
```

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days	hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
1	JUNCTION	124.80	124.80	0	00:59	4.32	4.32	0.000
2	JUNCTION	31.41	31.41	0	00:55	1.02	1.02	0.000
3	JUNCTION	81.88	81.88	0	00:47	1.66	1.66	0.000
6	JUNCTION	69.49	69.49	0	00:54	1.99	1.99	0.000
P2_out	JUNCTION	0.00	109.17	0	01:18	0	7	0.000
EX_28X42_CMP	JUNCTION	0.00	197.99	0	01:03	0	80.4	0.000
EX18CMP	JUNCTION	26.00	26.00	0	00:00	71.4	71.4	0.000
O1	OUTFALL	0.00	197.99	0	01:03	0	80.4	0.000
P1	STORAGE	0.00	155.84	0	00:58	0	5.34	0.010
P2	STORAGE	0.00	130.33	0	00:52	0	7	0.121

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000ft3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days	hr:min	Maximum Outflow CFS
P1	4.090	2	0	0	226.009	99	0	01:46	78.53
P2	25.457	10	0	0	147.914	56	0	01:17	109.17

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
O1	100.00	29.27	197.99	80.391
System	100.00	29.27	197.99	80.391

****
Link Flow Summary
****

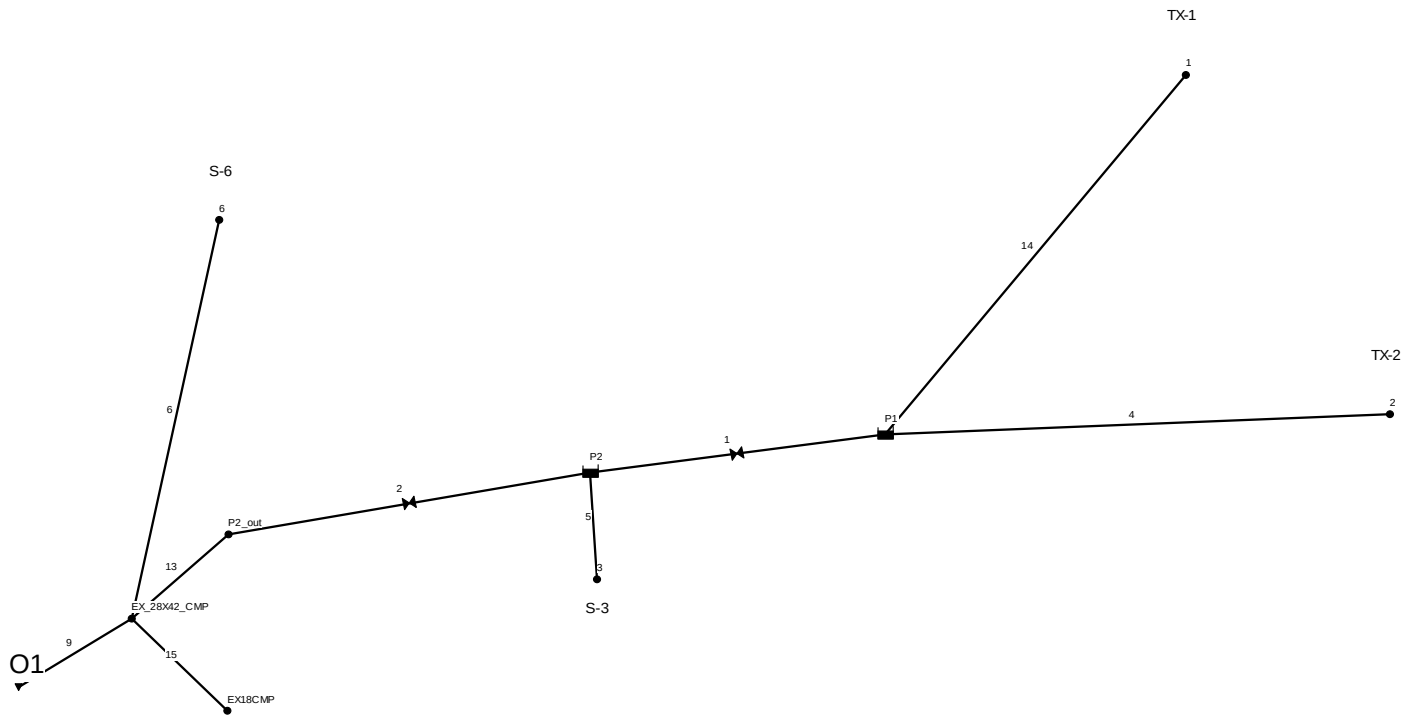
Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
4	DUMMY	31.41	0 00:55			
5	DUMMY	81.88	0 00:47			
6	DUMMY	69.49	0 00:54			
9	DUMMY	197.99	0 01:03			
13	DUMMY	109.17	0 01:18			
14	DUMMY	124.80	0 00:59			
15	DUMMY	26.00	0 00:00			
1	DUMMY	78.53	0 01:46			
2	DUMMY	109.17	0 01:18			

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Wed Oct 27 12:16:10 2021
Analysis ended on: Wed Oct 27 12:16:10 2021
Total elapsed time: < 1 sec

PROPOSED CONDITIONS MODEL



Summary of CUHP Input Parameters (Version 2.0.1)

Historic 5-Yr

								Depression Storage		Horton's Infiltration Parameters			DCIA Level and Fractions			
Catchment Name/ID	SWMM Node/ID	Raingage Name/ID	Area (sq.mi.)	Dist. to Centroid (miles)	Length (miles)	Slope (ft./ft.)	Percent Imperv.	Pervious (inches)	Imperv. (inches)	Initial Rate (in./hr.)	Final Rate (in.hr.)	Decay Coeff. (1/sec.)	DCIA Level	Dir. Con'ct Imperv. Fraction	Receiv. Perv. Fraction	Percent Eff. Imperv.
H-1	H1	2-HOUR DESIGN STORM 5 YR	0.255	0.576	1.269	0.060	2.0	0.60	0.10	4.50	0.60	0.0018	2.00	0.01	0.06	1.42
H-2	H2	2-HOUR DESIGN STORM 5 YR	0.015	0.115	0.185	0.060	2.0	0.60	0.10	4.50	0.60	0.0018	2.00	0.00	0.06	1.42
H-3	H3	2-HOUR DESIGN STORM 5 YR	0.077	0.259	0.698	0.050	2.0	0.60	0.10	4.50	0.60	0.0018	2.00	0.01	0.06	1.42

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 2.0.1)

Historic 5-Yr

		Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
Catchment Name/ID	User Comment for Catchment	CT	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
H-1		0.158	0.241	51.9	9.90	27.0	6.99	16.5	148	592,979	0.23	136,599	64.0	33	136,600	0.20
H-2		0.158	0.071	32.1	2.06	16.7	1.45	3.4	14	34,938	0.23	8,047	53.0	3	8,046	0.29
H-3		0.158	0.149	44.9	5.43	23.3	3.84	9.0	52	178,886	0.23	41,208	58.0	11	41,208	0.22

Summary of CUHP Input Parameters (Version 2.0.1)

Historic 100-YR

								Depression Storage		Horton's Infiltration Parameters			DCIA Level and Fractions			
Catchment Name/ID	SWMM Node/ID	Raingage Name/ID	Area (sq.mi.)	Dist. to Centroid (miles)	Length (miles)	Slope (ft./ft.)	Percent Imperv.	Pervious (inches)	Imperv. (inches)	Initial Rate (in./hr.)	Final Rate (in.hr.)	Decay Coeff. (1/sec.)	DCIA Level	Dir. Con'ct Imperv. Fraction	Receiv. Perv. Fraction	Percent Eff. Imperv.
H-1	H1	2-HOUR DESIGN STORM	0.255	0.576	1.269	0.060	2.0	0.60	0.10	4.50	0.60	0.0018	2.00	0.01	0.06	1.62
H-2	H2	2-HOUR DESIGN STORM	0.015	0.115	0.185	0.060	2.0	0.60	0.10	4.50	0.60	0.0018	2.00	0.00	0.06	1.62
H-3	H3	2-HOUR DESIGN STORM	0.077	0.259	0.698	0.050	2.0	0.60	0.10	4.50	0.60	0.0018	2.00	0.01	0.06	1.62

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 2.0.1)

Historic 100-YR

		Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
Catchment Name/ID	User Comment for Catchment	CT	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
H-1		0.157	0.240	51.8	9.85	27.0	6.96	16.4	148	592,979	1.14	673,696	63.0	152	673,702	0.93
H-2		0.157	0.071	32.1	2.05	16.7	1.45	3.4	14	34,938	1.14	39,691	51.0	13	39,687	1.33
H-3		0.157	0.148	44.8	5.40	23.3	3.82	9.0	52	178,886	1.14	203,237	57.0	51	203,235	1.03

```
HISTORIC-5YR REPORT
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)
  ----------------------------------------------------------------

  WARNING 08: elevation drop exceeds length for Conduit 1

  *********************************************************
  NOTE: The summary statistics displayed in this report are
  based on results found at every computational time step,
  not just on results from each reporting time step.
  *********************************************************

  ****************
  Analysis Options
  ****************
  Flow Units ............... CFS
  Process Models:
    Rainfall/Runoff ........ NO
    RDII ................... NO
    Snowmelt ............... NO
    Groundwater ............ NO
    Flow Routing ........... YES
    Ponding Allowed ........ NO
    Water Quality .......... NO
  Flow Routing Method ...... KINWAVE
  Starting Date ............ 01/01/2005 00:00:00
  Ending Date .............. 01/04/2005 06:00:00
  Antecedent Dry Days ...... 0.0
  Report Time Step ......... 00:15:00
  Routing Time Step ........ 30.00 sec


  **************************        Volume         Volume
  Flow Routing Continuity        acre-feet       10^6 gal
  **************************     ---------      ---------
  Dry Weather Inflow .......         0.000          0.000
  Wet Weather Inflow .......         0.000          0.000
  Groundwater Inflow .......         0.000          0.000
  RDII Inflow ..............         0.000          0.000
  External Inflow ..........         4.266          1.390
  External Outflow .........         4.266          1.390
  Flooding Loss ............         0.000          0.000
  Evaporation Loss .........         0.000          0.000
  Exfiltration Loss ........         0.000          0.000
  Initial Stored Volume ....         0.000          0.000
  Final Stored Volume ......         0.000          0.000
  Continuity Error (%) .....         0.000


  *********************************
  Highest Flow Instability Indexes
  *********************************
  All links are stable.
```

****
Routing Time Step Summary
****

```
Minimum Time Step           :    30.00 sec
Average Time Step           :    30.00 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.00
Percent Not Converging      :     0.00
```

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
H1	JUNCTION	0.00	0.00	7409.00	0 00:00	0.00
H2	JUNCTION	0.00	0.00	7108.00	0 00:00	0.00
H3	JUNCTION	0.00	0.00	7160.00	0 00:00	0.00
1	OUTFALL	0.00	0.00	7004.00	0 00:00	0.00
2	OUTFALL	0.00	0.00	7047.00	0 00:00	0.00
3	OUTFALL	0.00	0.00	6993.00	0 00:00	0.00

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
H1	JUNCTION	32.57	32.57	0 01:04	1.02	1.02	0.000
H2	JUNCTION	2.84	2.84	0 00:53	0.0602	0.0602	0.000
H3	JUNCTION	11.05	11.05	0 00:58	0.308	0.308	0.000
1	OUTFALL	0.00	32.57	0 01:04	0	1.02	0.000
2	OUTFALL	0.00	2.84	0 00:53	0	0.0602	0.000
3	OUTFALL	0.00	11.05	0 00:58	0	0.308	0.000

****
Node Flooding Summary
****

No nodes were flooded.

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
1	4.99	9.75	32.57	1.022
2	2.97	0.96	2.84	0.060
3	4.34	3.38	11.05	0.308
System	4.10	14.10	45.70	1.390

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
2	DUMMY	2.84	0 00:53			
1	DUMMY	32.57	0 01:04			
14	DUMMY	11.05	0 00:58			

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Fri Nov 12 06:32:32 2021
Analysis ended on: Fri Nov 12 06:32:32 2021
Total elapsed time: < 1 sec

```
HISTORIC- 100YR REPORT
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)
  --------------------------------------------------------------

  WARNING 08: elevation drop exceeds length for Conduit 1

  *********************************************************
  NOTE: The summary statistics displayed in this report are
  based on results found at every computational time step,
  not just on results from each reporting time step.
  *********************************************************

  ****************
  Analysis Options
  ****************
  Flow Units ............... CFS
  Process Models:
    Rainfall/Runoff ........ NO
    RDII ................... NO
    Snowmelt ............... NO
    Groundwater ............ NO
    Flow Routing ........... YES
    Ponding Allowed ........ NO
    Water Quality .......... NO
  Flow Routing Method ...... KINWAVE
  Starting Date ............ 01/01/2005 00:00:00
  Ending Date .............. 01/04/2005 06:00:00
  Antecedent Dry Days ...... 0.0
  Report Time Step ......... 00:15:00
  Routing Time Step ........ 30.00 sec


  **************************        Volume         Volume
  Flow Routing Continuity        acre-feet       10^6 gal
  **************************     ---------      ---------
  Dry Weather Inflow .......         0.000          0.000
  Wet Weather Inflow .......         0.000          0.000
  Groundwater Inflow .......         0.000          0.000
  RDII Inflow ..............         0.000          0.000
  External Inflow ..........        21.042          6.857
  External Outflow .........        21.042          6.857
  Flooding Loss ............         0.000          0.000
  Evaporation Loss .........         0.000          0.000
  Exfiltration Loss ........         0.000          0.000
  Initial Stored Volume ....         0.000          0.000
  Final Stored Volume ......         0.000          0.000
  Continuity Error (%) .....         0.000


  *********************************
  Highest Flow Instability Indexes
  *********************************
  All links are stable.
```

****
Routing Time Step Summary
****

```
Minimum Time Step           :    30.00 sec
Average Time Step           :    30.00 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.00
Percent Not Converging      :     0.00
```

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
H1	JUNCTION	0.00	0.00	7409.00	0 00:00	0.00
H2	JUNCTION	0.00	0.00	7108.00	0 00:00	0.00
H3	JUNCTION	0.00	0.00	7160.00	0 00:00	0.00
1	OUTFALL	0.00	0.00	7004.00	0 00:00	0.00
2	OUTFALL	0.00	0.00	7047.00	0 00:00	0.00
3	OUTFALL	0.00	0.00	6993.00	0 00:00	0.00

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
H1	JUNCTION	152.16	152.16	0 01:03	5.04	5.04	0.000
H2	JUNCTION	12.83	12.83	0 00:51	0.297	0.297	0.000
H3	JUNCTION	50.84	50.84	0 00:57	1.52	1.52	0.000
1	OUTFALL	0.00	152.16	0 01:03	0	5.04	0.000
2	OUTFALL	0.00	12.83	0 00:51	0	0.297	0.000
3	OUTFALL	0.00	50.84	0 00:57	0	1.52	0.000

****
Node Flooding Summary
****

No nodes were flooded.

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
1	5.20	46.11	152.16	5.039
2	3.24	4.37	12.83	0.297
3	4.59	15.75	50.84	1.520
System	4.34	66.23	212.73	6.856

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
2	DUMMY	12.83	0 00:51			
1	DUMMY	152.16	0 01:03			
14	DUMMY	50.84	0 00:57			

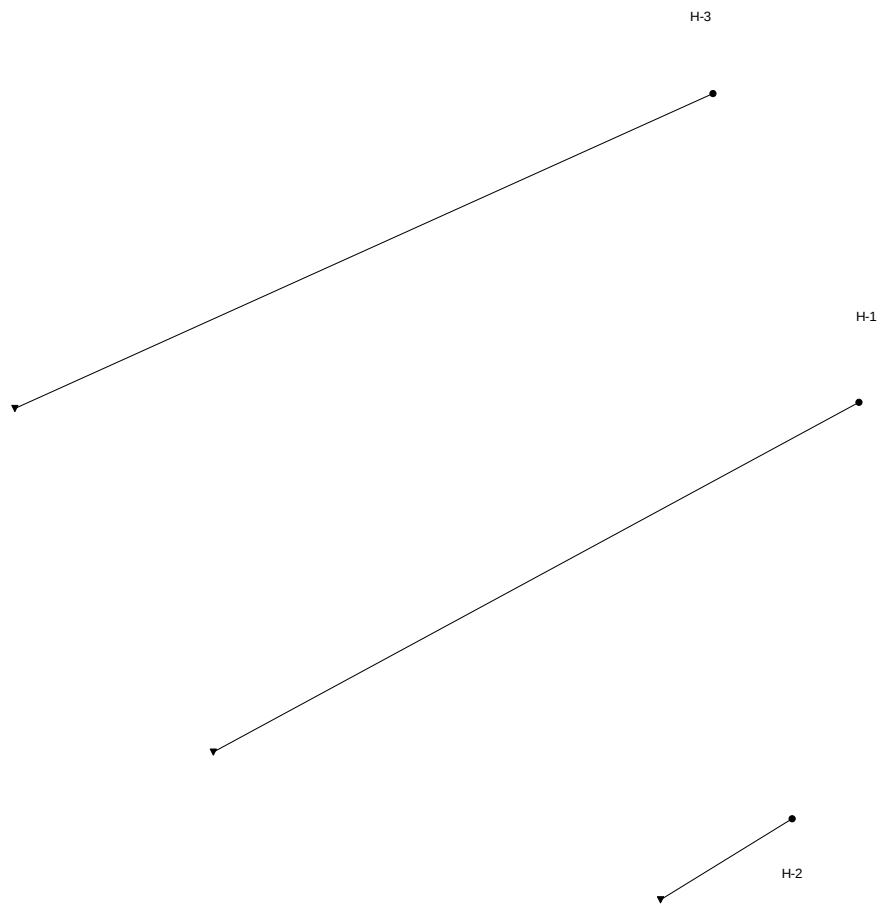
****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Fri Nov 12 06:34:53 2021
Analysis ended on: Fri Nov 12 06:34:53 2021
Total elapsed time: < 1 sec

HISTORIC CONDITIONS MODEL

01/01/2005 00:15:00



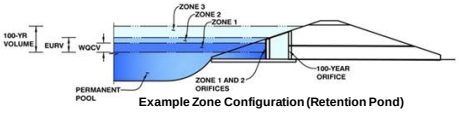
Appendix D
Hydraulic Calculations

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: **Cloverleaf Filing No. 2**

Basin ID: Attenuation Pond P1



Example Zone Configuration (Retention Pond)

Watershed Information

			Flood Control Only	
Selected BMP Type =	No BMP			
Watershed Area =	135.90	acres		
Watershed Length =	6,000	ft		
Watershed Length to Centroid =	3,000	ft		
Watershed Slope =	0.041	ft/ft		
Watershed Imperviousness =	22.00%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	100.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Target WQCV Drain Time =	N/A	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.

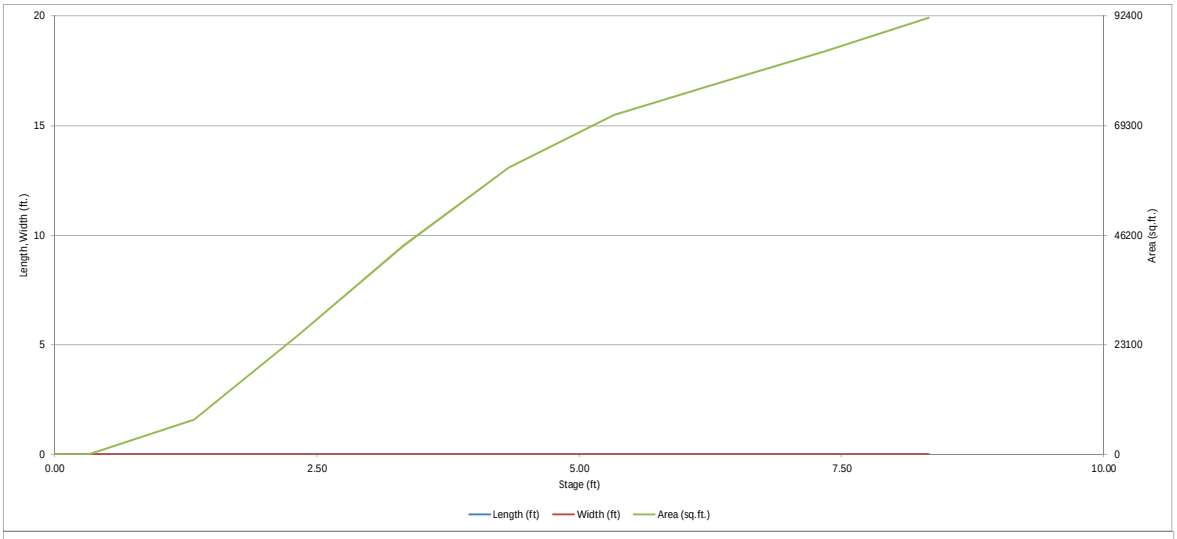
			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	1.401	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	2.993	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	3.226	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	5.717	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	8.074	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	11.847	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	14.582	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	18.346	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3 in.) =	23.804	acre-feet	3.00	inches
Approximate 2-yr Detention Volume =	2.073	acre-feet		
Approximate 5-yr Detention Volume =	3.045	acre-feet		
Approximate 10-yr Detention Volume =	4.794	acre-feet		
Approximate 25-yr Detention Volume =	5.838	acre-feet		
Approximate 50-yr Detention Volume =	6.165	acre-feet		
Approximate 100-yr Detention Volume =	7.514	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (100-year) =	7.514	acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	7.514	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	user	acre-feet

Depth Increment = 1.00 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)
Media Surface	--	0.00	--	--	--	0	0.000		
7065	--	0.33	--	--	--	4	0.000	1	0.000
7066	--	1.33	--	--	--	7,257	0.167	3,631	0.083
7067	--	2.33	--	--	--	25,248	0.580	19,883	0.456
7068	--	3.33	--	--	--	43,939	1.009	54,477	1.251
7069	--	4.33	--	--	--	60,500	1.389	106,696	2.449
7070	--	5.33	--	--	--	71,527	1.642	172,710	3.965
7071	--	6.33	--	--	--	78,278	1.797	247,612	5.684
7072	--	7.33	--	--	--	84,848	1.948	329,175	7.557
7073	--	8.33	--	--	--	92,117	2.115	417,658	9.588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15
10
5
0
Length, Width (ft.)
92400
69300
46200
23100
0
Area (sq.ft.)
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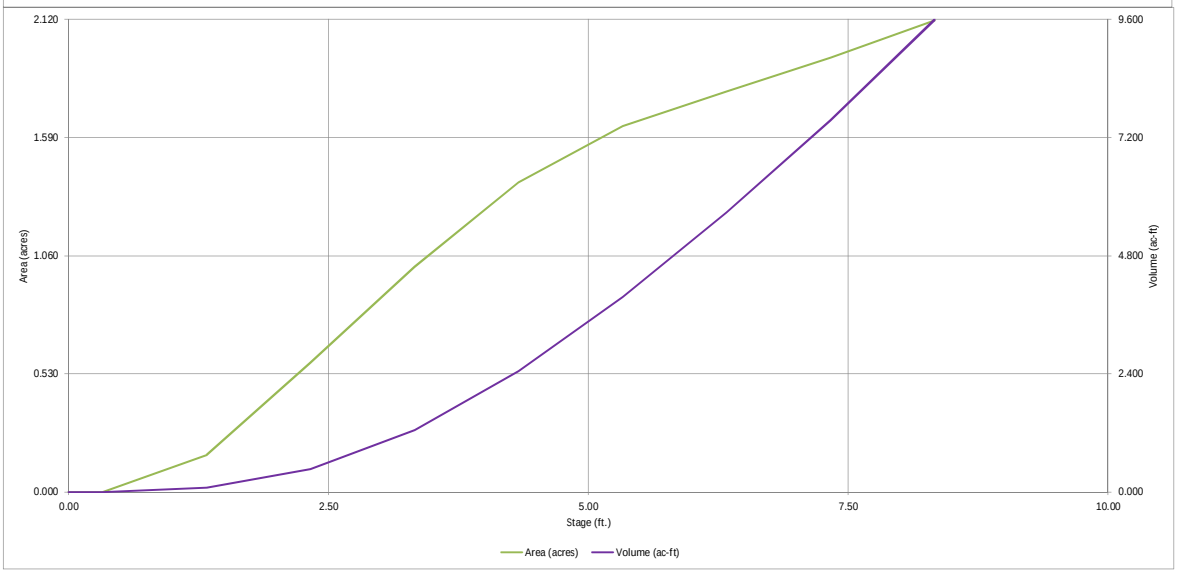
2.50
5.00
7.50
10.00
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)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1.590
1.060
0.530
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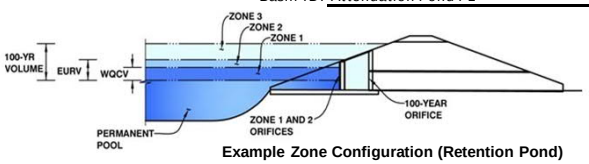
7.200
4.800
2.400
0.000
Volume (ac-ft)
0.00
2.50
5.00
7.50
10.00
Stage (ft.)
Area (acres)
Volume (ac-ft)

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Project: Cloverleaf Filing No. 1

Basin ID: Attenuation Pond P1



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (100-year)	7.31	7.514	Weir&Pipe (Restrict)
Zone 2			
Zone 3			
Total (all zones)		7.514	

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 =	N/A	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	N/A	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	N/A	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	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 (optional)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected			Not Selected	Not Selected	
Invert of Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =			ft^2
Depth at top of Zone using Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =			feet
Vertical Orifice Diameter =			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 1 Weir	Not Selected			Zone 1 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	0.00		ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	3.33		feet
Overflow Weir Front Edge Length =	6.00		feet	Overflow Weir Slope Length =	10.54		feet
Overflow Weir Grate Slope =	3.00		H:V	Grate Open Area / 100-yr Orifice Area =	6.43		
Horiz. Length of Weir Sides =	10.00		feet	Overflow Grate Open Area w/o Debris =	44.27		ft^2
Overflow Grate Open Area % =	70%		%, grate open area/total area	Overflow Grate Open Area w/ Debris =	22.14		ft^2
Debris Clogging % =	50%		%				

Calculated Parameters for Overflow Weir

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

	Zone 1 Restrictor	Not Selected			Zone 1 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.50		ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	6.88		ft^2
Outlet Pipe Diameter =	42.00		inches	Outlet Orifice Centroid =	1.32		feet
Restrictor Plate Height Above Pipe Invert =	28.25		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.92	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.08	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	1.33	feet
Spillway Crest Length =	32.00	feet	Stage at Top of Freeboard =	8.41	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	2.11	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	9.59	acre-ft

Calculated Parameters for Spillway

Routed Hydrograph Results

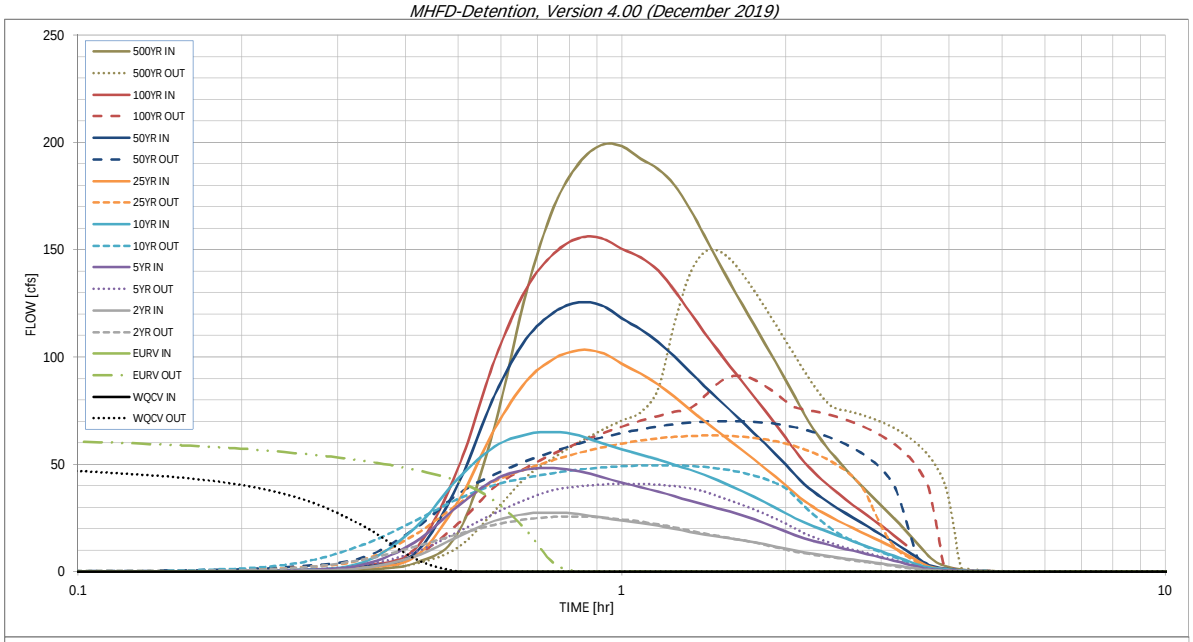
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

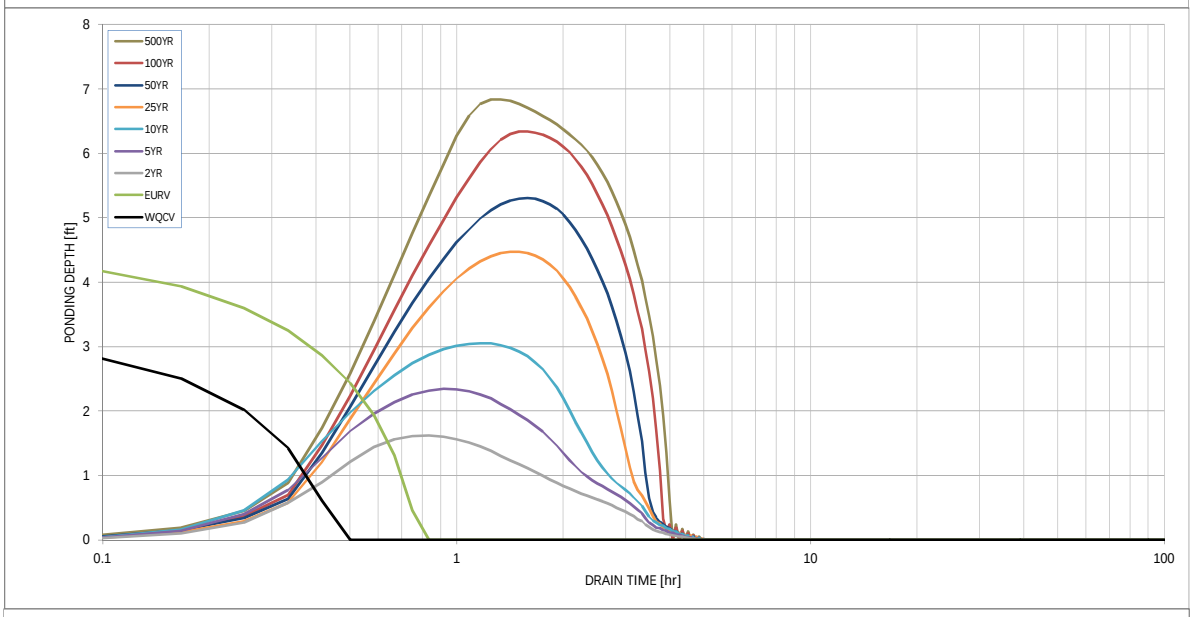
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.00
CUHP Runoff Volume (acre-ft) =	1.401	2.993	3.226	5.717	8.074	11.847	14.582	18.346	23.804
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	3.226	5.717	8.074	11.847	14.582	18.346	23.804
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	9.9	27.9	43.4	80.3	101.1	129.9	170.2
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.07	0.21	0.32	0.59	0.74	0.96	1.25
Peak Inflow Q (cfs) =	N/A	N/A	27.5	48.1	65.1	103.1	125.4	155.4	198.7
Peak Outflow Q (cfs) =	52.2	64.1	25.7	40.9	49.5	63.3	70.2	91.1	149.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.5	1.1	0.8	0.7	0.7	0.9
Structure Controlling Flow =	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Spillway	Spillway
Max Velocity through Grate 1 (fps) =	1.22	1.48	0.58	0.9	1.1	1.4	1.6	1.8	1.8
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	0	1	1	2	2	3	3	4	4
Time to Drain 99% of Inflow Volume (hours) =	0	1	2	2	3	3	3	4	4
Maximum Ponding Depth (ft) =	3.48	4.71	1.63	2.34	3.06	4.48	5.31	6.34	6.84
Area at Maximum Ponding Depth (acres) =	1.07	1.49	0.29	0.58	0.89	1.42	1.63	1.80	1.87
Maximum Volume Stored (acre-ft) =	1.406	2.995	0.149	0.462	0.985	2.646	3.916	5.702	6.602

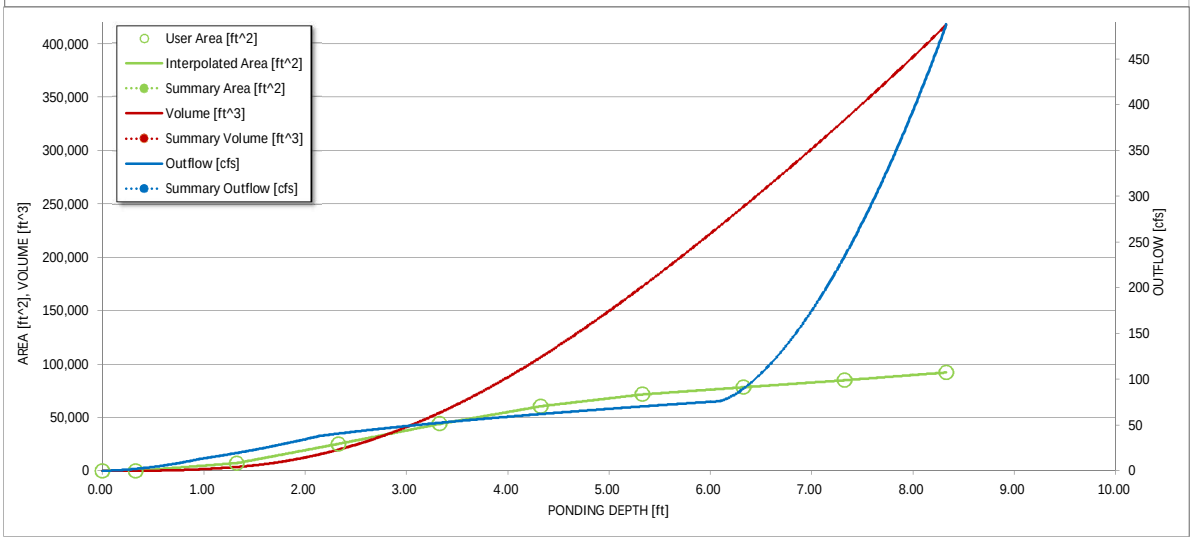
Pond Depth Per SWMM Model = 6.05'

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	0.04	0.00	0.10
	0:15:00	0.00	0.00	0.34	0.56	0.69	0.47	0.63	0.58	0.88
	0:20:00	0.00	0.00	1.61	3.09	4.17	1.75	2.24	2.60	3.98
	0:25:00	0.00	0.00	7.03	13.68	20.35	7.00	8.68	10.63	18.02
	0:30:00	0.00	0.00	16.33	30.59	43.34	32.65	40.82	48.21	67.71
	0:35:00	0.00	0.00	23.65	42.79	58.20	66.30	82.08	98.53	129.76
	0:40:00	0.00	0.00	26.87	47.50	63.86	88.51	108.37	131.60	169.95
	0:45:00	0.00	0.00	27.50	48.14	65.05	99.07	120.69	148.20	190.10
	0:50:00	0.00	0.00	26.72	46.78	63.42	103.12	125.42	155.40	198.66
	0:55:00	0.00	0.00	25.20	44.10	59.87	101.98	124.06	155.26	198.18
	1:00:00	0.00	0.00	23.72	41.44	56.86	96.85	118.04	150.33	192.34
	1:05:00	0.00	0.00	22.57	39.29	54.43	92.22	112.81	146.32	187.54
	1:10:00	0.00	0.00	21.30	37.22	52.06	87.16	106.97	140.12	180.06
	1:15:00	0.00	0.00	19.88	35.09	49.78	81.47	100.30	131.04	169.11
	1:20:00	0.00	0.00	18.52	33.01	47.52	75.46	93.11	120.99	156.78
	1:25:00	0.00	0.00	17.36	31.21	45.10	70.14	86.63	111.65	145.01
	1:30:00	0.00	0.00	16.35	29.58	42.53	65.32	80.72	103.27	134.24
	1:35:00	0.00	0.00	15.39	27.99	39.93	60.77	75.11	95.57	124.28
	1:40:00	0.00	0.00	14.47	26.26	37.35	56.45	69.77	88.51	115.08
	1:45:00	0.00	0.00	13.55	24.38	34.81	52.27	64.61	81.72	106.23
	1:50:00	0.00	0.00	12.63	22.46	32.33	48.20	59.60	75.14	97.69
	1:55:00	0.00	0.00	11.66	20.55	29.84	44.20	54.67	68.72	89.36
	2:00:00	0.00	0.00	10.65	18.68	27.27	40.28	49.86	62.51	81.31
	2:05:00	0.00	0.00	9.66	16.94	24.84	36.33	44.99	56.33	73.40
	2:10:00	0.00	0.00	8.83	15.53	22.84	32.79	40.68	50.90	66.51
	2:15:00	0.00	0.00	8.16	14.38	21.12	30.01	37.27	46.56	60.90
	2:20:00	0.00	0.00	7.56	13.32	19.52	27.66	34.35	42.84	56.02
	2:25:00	0.00	0.00	7.00	12.33	18.03	25.56	31.72	39.48	51.60
	2:30:00	0.00	0.00	6.47	11.39	16.62	23.63	29.30	36.41	47.54
	2:35:00	0.00	0.00	5.97	10.50	15.28	21.85	27.07	33.57	43.79
	2:40:00	0.00	0.00	5.49	9.64	14.00	20.14	24.93	30.91	40.28
	2:45:00	0.00	0.00	5.03	8.81	12.78	18.51	22.90	28.43	37.00
	2:50:00	0.00	0.00	4.59	8.01	11.61	16.94	20.94	26.06	33.86
	2:55:00	0.00	0.00	4.16	7.23	10.49	15.40	19.03	23.72	30.80
	3:00:00	0.00	0.00	3.74	6.48	9.42	13.89	17.16	21.41	27.77
	3:05:00	0.00	0.00	3.32	5.74	8.36	12.39	15.30	19.11	24.76
	3:10:00	0.00	0.00	2.91	5.01	7.32	10.91	13.47	16.82	21.77
	3:15:00	0.00	0.00	2.50	4.30	6.29	9.44	11.65	14.54	18.79
	3:20:00	0.00	0.00	2.10	3.59	5.27	7.98	9.83	12.27	15.83
	3:25:00	0.00	0.00	1.71	2.90	4.27	6.52	8.04	10.02	12.89
	3:30:00	0.00	0.00	1.33	2.22	3.30	5.10	6.28	7.81	10.01
	3:35:00	0.00	0.00	0.97	1.59	2.43	3.71	4.57	5.67	7.28
	3:40:00	0.00	0.00	0.70	1.17	1.89	2.49	3.12	3.88	5.11
	3:45:00	0.00	0.00	0.54	0.95	1.56	1.78	2.28	2.77	3.72
	3:50:00	0.00	0.00	0.45	0.78	1.30	1.32	1.71	2.02	2.75
	3:55:00	0.00	0.00	0.37	0.65	1.08	1.00	1.31	1.46	2.03
	4:00:00	0.00	0.00	0.31	0.54	0.89	0.76	1.00	1.05	1.48
	4:05:00	0.00	0.00	0.26	0.44	0.73	0.59	0.78	0.75	1.06
	4:10:00	0.00	0.00	0.21	0.35	0.58	0.46	0.60	0.52	0.75
	4:15:00	0.00	0.00	0.17	0.28	0.45	0.35	0.46	0.38	0.56
	4:20:00	0.00	0.00	0.14	0.22	0.35	0.28	0.36	0.31	0.44
	4:25:00	0.00	0.00	0.11	0.17	0.27	0.22	0.28	0.24	0.34
	4:30:00	0.00	0.00	0.09	0.12	0.20	0.17	0.22	0.19	0.27
	4:35:00	0.00	0.00	0.07	0.09	0.15	0.13	0.17	0.15	0.21
	4:40:00	0.00	0.00	0.05	0.06	0.11	0.10	0.12	0.11	0.16
	4:45:00	0.00	0.00	0.03	0.04	0.08	0.07	0.09	0.08	0.11
	4:50:00	0.00	0.00	0.02	0.03	0.05	0.04	0.06	0.05	0.07
	4:55:00	0.00	0.00	0.01	0.02	0.03	0.03	0.03	0.03	0.04
	5:00:00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.01	0.02
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	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

Weir Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Aug 18 2021

Pond P1 Spillway

Trapezoidal Weir

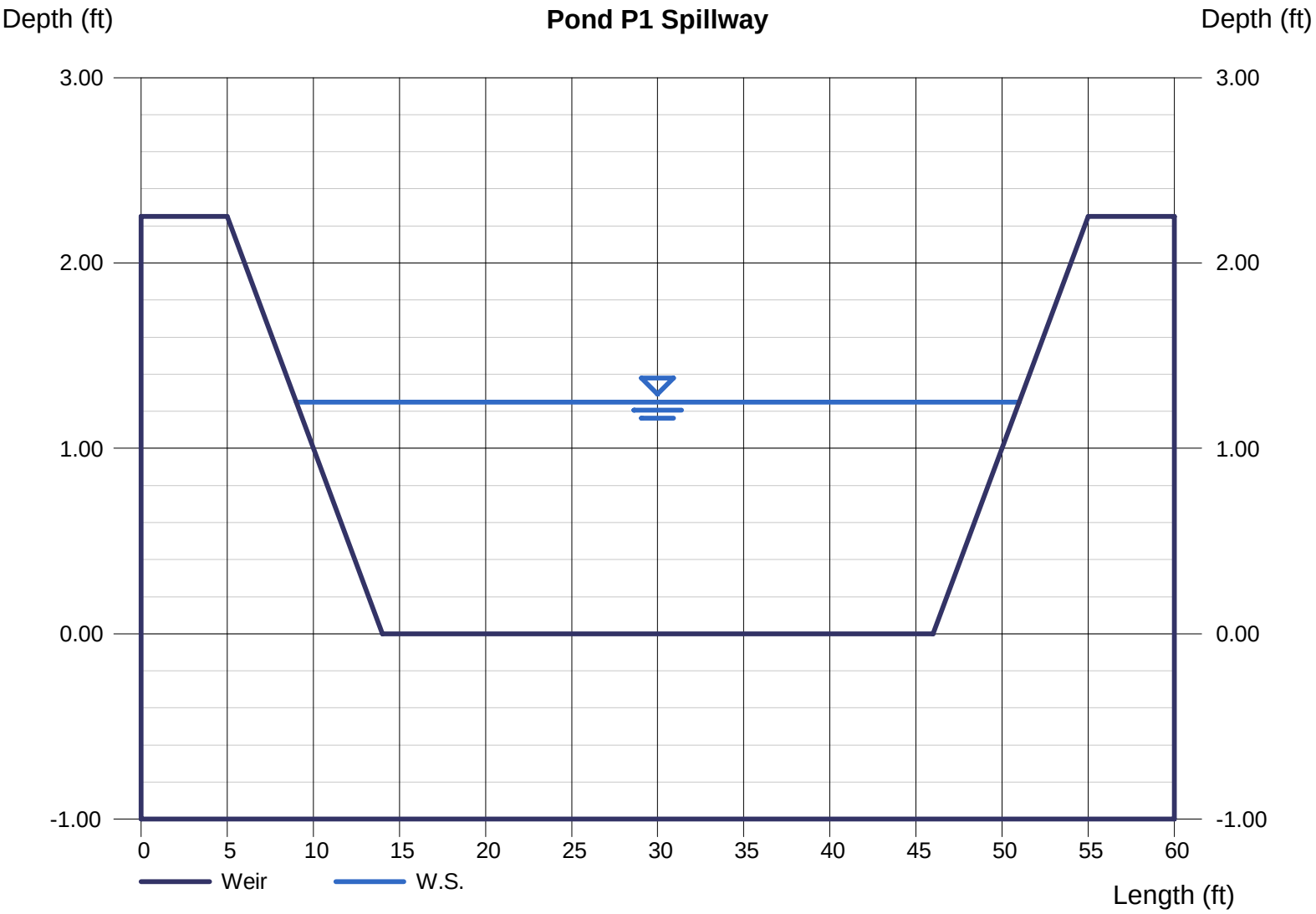
Crest	=	Sharp
Bottom Length (ft)	=	32.00
Total Depth (ft)	=	2.25
Side Slope (z:1)	=	4.00

Calculations

Weir Coeff. Cw	=	3.10
Compute by:		Known Q
Known Q (cfs)	=	155.80

Highlighted

Depth (ft)	=	1.25
Q (cfs)	=	155.80
Area (sqft)	=	46.25
Velocity (ft/s)	=	3.37
Top Width (ft)	=	42.00



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Aug 19 2021

Pond P1 Overflow Channel

Trapezoidal

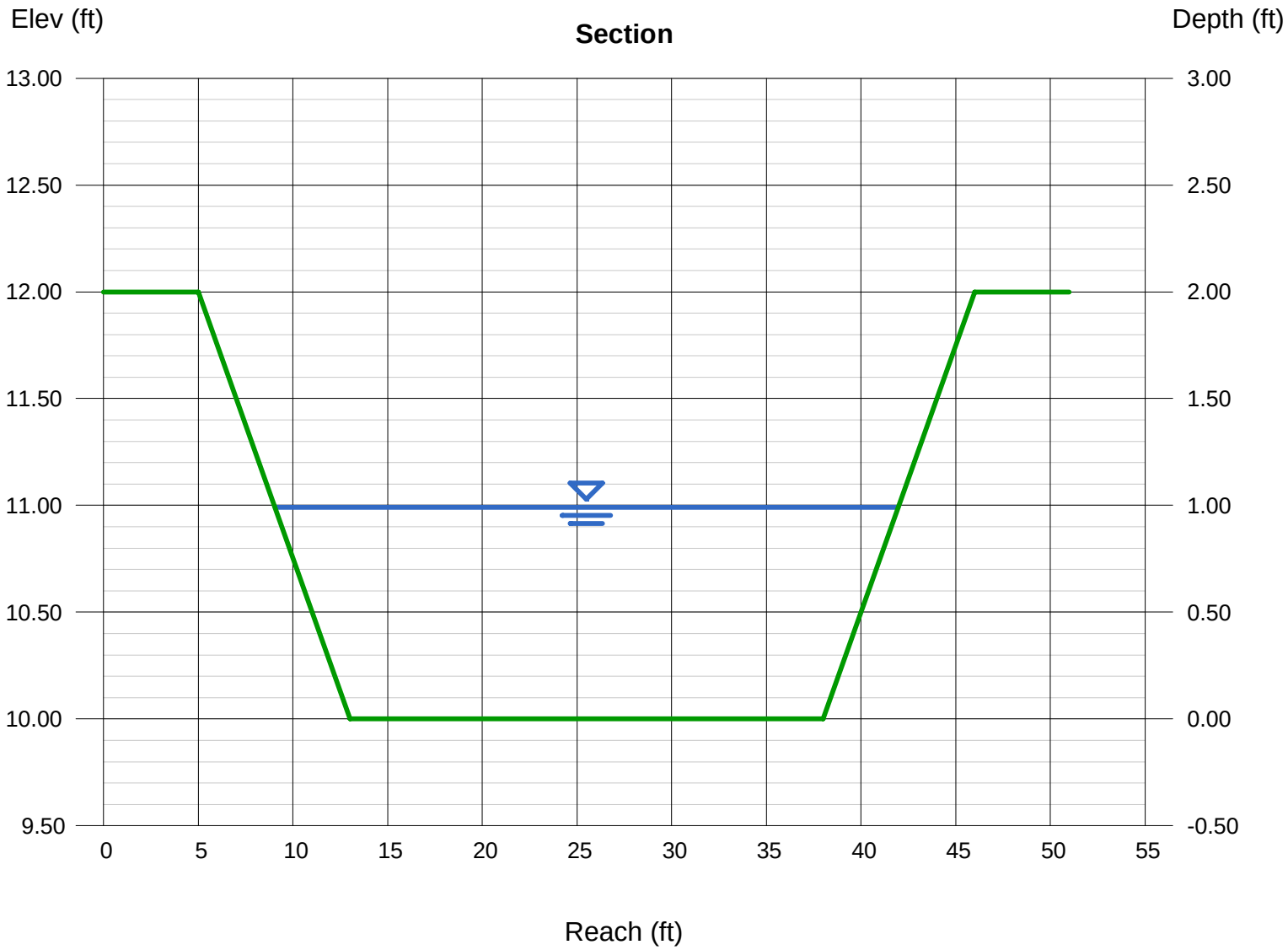
Bottom Width (ft)	=	25.00
Side Slopes (z:1)	=	4.00, 4.00
Total Depth (ft)	=	2.00
Invert Elev (ft)	=	10.00
Slope (%)	=	1.50
N-Value	=	0.030

Calculations

Compute by:		Known Q
Known Q (cfs)	=	155.80

Highlighted

Depth (ft)	=	0.99
Q (cfs)	=	155.80
Area (sqft)	=	28.67
Velocity (ft/s)	=	5.43
Wetted Perim (ft)	=	33.16
Crit Depth, Yc (ft)	=	1.01
Top Width (ft)	=	32.92
EGL (ft)	=	1.45



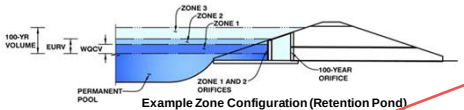
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: Cloverleaf Filing No. 2

Basin ID: Pond P2

Pond in series, for WQ/EURV Calcs, modeled in SWMM



Example Zone Configuration (Retention Pond)

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	--	--	--	0	0.000		
7022	--	0.33	--	--	--	0	0.000	0	0.000
7023	--	1.33	--	--	--	1,379	0.032	689	0.016
7024	--	2.33	--	--	--	7,541	0.173	5,149	0.118
7025	--	3.33	--	--	--	18,733	0.430	18,286	0.420
7026	--	4.33	--	--	--	35,627	0.818	45,466	1.044
7027	--	5.33	--	--	--	51,267	1.177	88,913	2.041
7028	--	6.33	--	--	--	55,882	1.283	142,487	3.271
7029	--	7.33	--	--	--	60,677	1.393	200,767	4.609
7030	--	8.33	--	--	--	65,444	1.502	263,827	6.057

Watershed Information

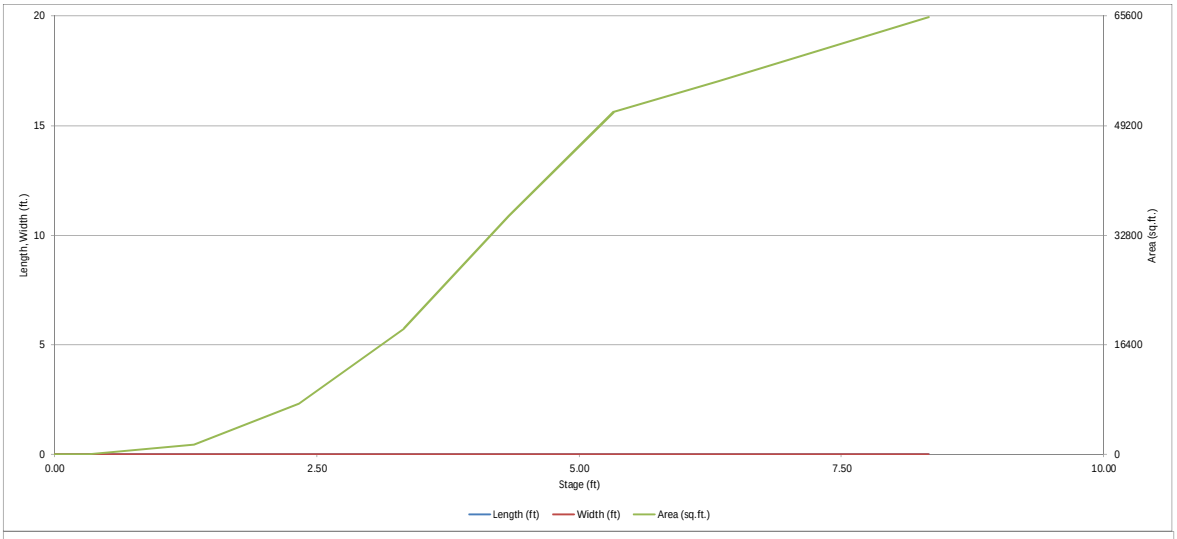
Selected BMP Type =	EDB	
Watershed Area =	30.60	acres
Watershed Length =	1,700	ft
Watershed Length to Centroid =	650	ft
Watershed Slope =	0.038	ft/ft
Watershed Imperviousness =	58.50%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

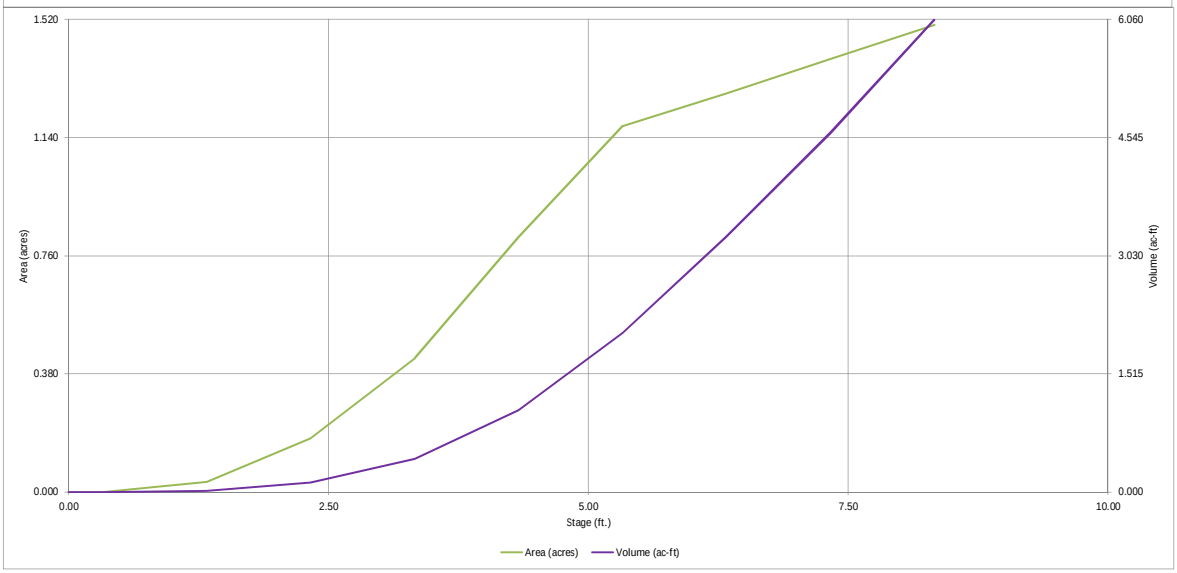
After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.590	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	1.938	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	1.760	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	2.442	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	3.030	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	3.781	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	4.411	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	5.191	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3 in.) =	6.432	acre-feet	3.00	inches
Approximate 2-yr Detention Volume =	1.486	acre-feet		
Approximate 5-yr Detention Volume =	2.011	acre-feet		
Approximate 10-yr Detention Volume =	2.601	acre-feet		
Approximate 25-yr Detention Volume =	2.816	acre-feet		
Approximate 50-yr Detention Volume =	2.937	acre-feet		
Approximate 100-yr Detention Volume =	3.216	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.590	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.348	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.279	acre-feet
Total Detention Basin Volume =	3.216	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


20
15
10
5
0
Length, Width (ft.)
65600
49200
32800
16400
0
Area (sq.ft.)
0.00
2.50
5.00
7.50
10.00
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)

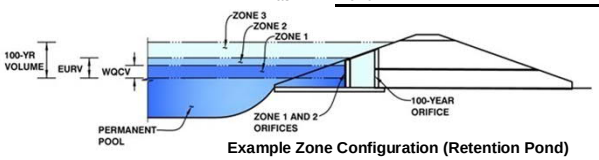

1.520
1.140
0.760
0.380
0.000
Area (acres)
6.060
4.545
3.030
1.515
0.000
Volume (ac-ft)
0.00
2.50
5.00
7.50
10.00
Stage (ft.)
Area (acres)
Volume (ac-ft)

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Project: Cloverleaf Filing No. 2

Basin ID: Pond P2



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.68	0.590	Orifice Plate
Zone 2 (EURV)	5.25	1.348	Circular Orifice
Zone 3 (100-year)	6.29	1.279	Weir&Pipe (Restrict)
Total (all zones)		3.216	

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

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

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

			Calculated Parameters for Plate		
Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	3.68	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	N/A	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	inches	Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.20	2.40					
Orifice Area (sq. inches)	1.59	1.59	1.59					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Circular	Not Selected		Calculated Parameters for Vertical Orifice	Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	3.60	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.06	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	5.25	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.14	N/A	feet
Vertical Orifice Diameter =	3.25	N/A	inches				

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

	Zone 3 Weir	Not Selected		Calculated Parameters for Overflow Weir	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	5.26	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	5.26	N/A	feet
Overflow Weir Front Edge Length =	31.06	N/A	feet	Overflow Weir Slope Length =	3.46	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	6.44	N/A	
Horiz. Length of Weir Sides =	3.46	N/A	feet	Overflow Grate Open Area w/o Debris =	53.73	N/A	ft^2
Overflow Grate Open Area % =	50%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	53.73	N/A	ft^2
Debris Clogging % =	0%	N/A	%				

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

	Zone 3 Restrictor	Not Selected		Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	8.34	N/A	ft^2
Outlet Pipe Diameter =	42.00	N/A	inches	Outlet Orifice Centroid =	1.54	N/A	feet
Restrictor Plate Height Above Pipe Invert =	34.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	2.24	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

			Calculated Parameters for Spillway		
Spillway Invert Stage=	6.45	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.79	feet
Spillway Crest Length =	45.00	feet	Stage at Top of Freeboard =	8.24	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	1.49	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	5.92	acre-ft

Routed Hydrograph Results

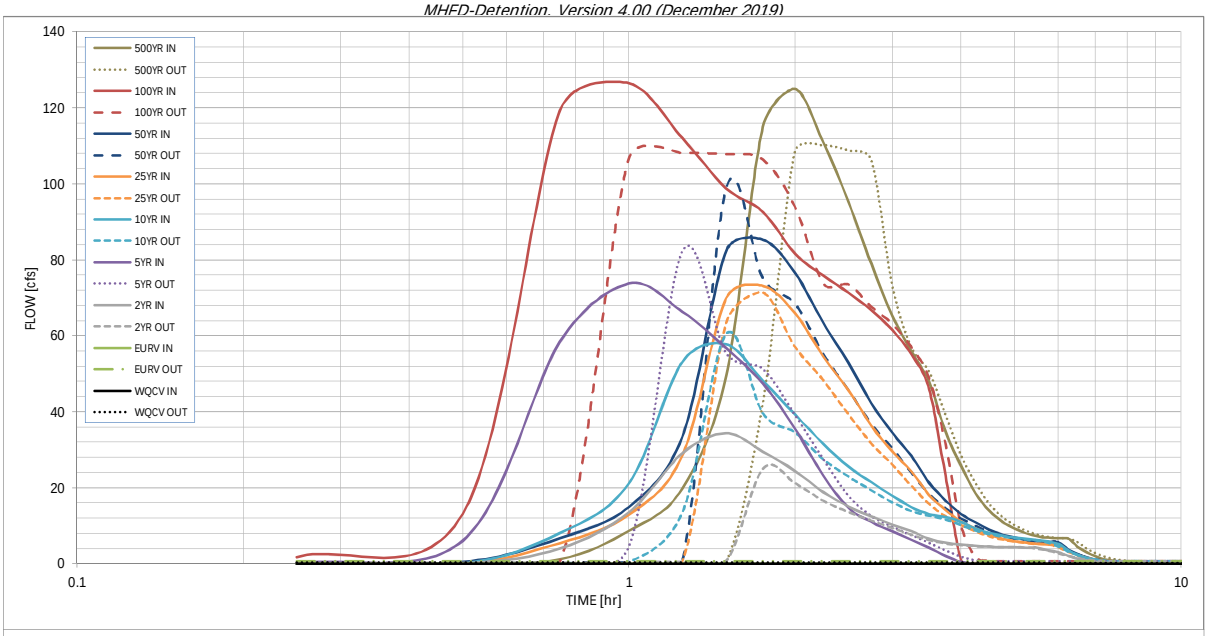
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

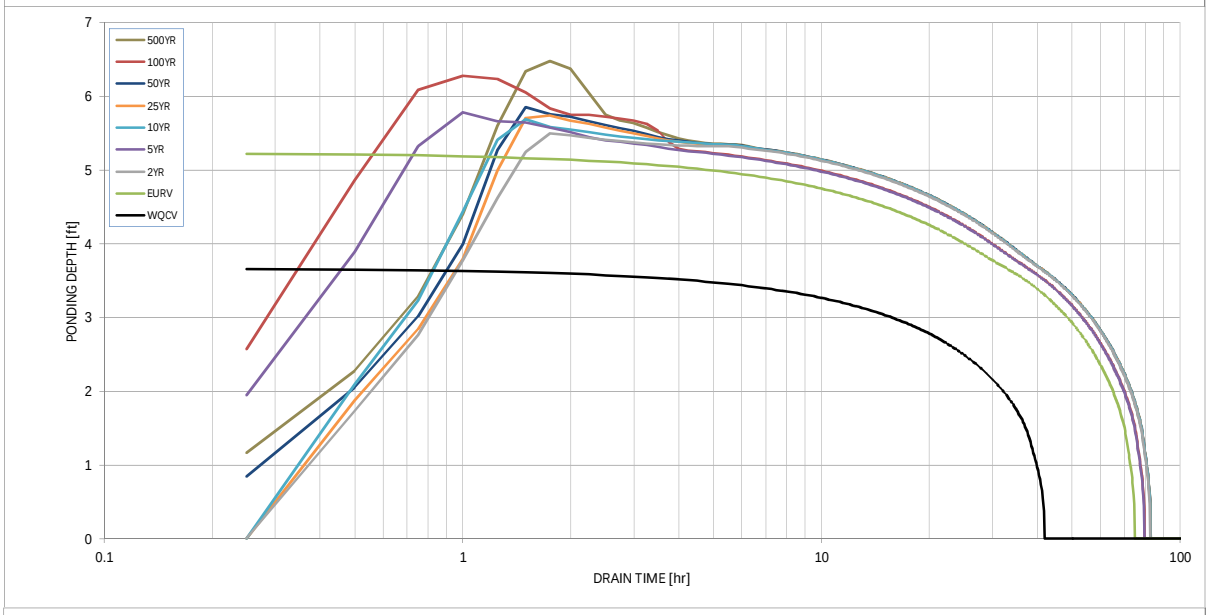
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.00
CUHP Runoff Volume (acre-ft) =	0.590	1.938	1.760	2.442	3.030	3.781	4.411	5.191	6.432
User Override Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	5.280	8.575	9.090	11.343	13.233	21.621	19.297
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	4.0	11.4	17.1	30.1	37.8	47.3	61.5
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.13	0.37	0.56	0.98	1.24	1.55	2.01
Peak Inflow Q (cfs) =	N/A	N/A	84.3	73.7	87.8	73.1	85.3	126.5	115.0
Peak Outflow Q (cfs) =	0.3	0.7	25.0	82.2	60.5	71.4	98.7	108.1	110.1
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	7.2	3.5	2.4	2.6	2.3	1.8
Structure Controlling Flow =	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	0.47	1.5	1.1	1.3	1.8	2.0	2.0
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) =	39	66	65	56	58	54	51	35	42
Time to Drain 99% of Inflow Volume (hours) =	40	71	75	68	71	69	68	58	63
Maximum Ponding Depth (ft) =	3.68	5.25	5.50	5.79	5.69	5.74	5.86	6.28	6.48
Area at Maximum Ponding Depth (acres) =	0.57	1.15	1.19	1.22	1.21	1.22	1.23	1.28	1.30
Maximum Volume Stored (acre-ft) =	0.594	1.948	2.231	2.582	2.460	2.520	2.667	3.194	3.452

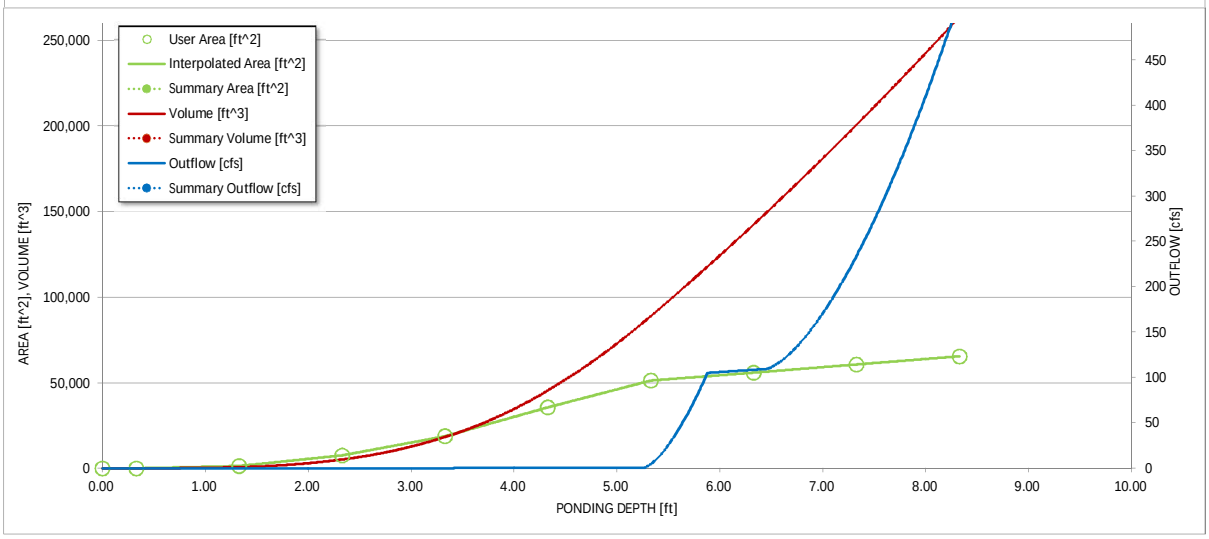
See summary table after UD-Detention results for summary of results from UD-Detention and SWMM.

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			

Values form 5-yr SWMM Model

Values form 100-yr SWMM Model

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.

User-Defined	SOURCE	CUHP	CUHP	CUHP	USER	CUHP	CUHP	CUHP	USER	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]
15.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:15:00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	1.73	0.00
	0:30:00	0.00	0.00	0.00	6.05	0.00	0.00	0.45	13.14	1.13
	0:45:00	0.00	0.00	3.99	58.42	8.07	5.42	6.68	119.28	8.64
	1:00:00	0.00	0.00	13.54	73.74	21.08	12.93	14.96	126.49	19.77
	1:15:00	0.00	0.00	29.09	66.33	53.09	28.50	33.46	112.06	49.39
	1:30:00	0.00	0.00	34.32	56.86	57.77	69.83	82.32	98.86	115.02
	1:45:00	0.00	0.00	29.47	47.39	48.16	73.15	85.31	92.61	125.01
	2:00:00	0.00	0.00	24.43	35.56	39.27	65.91	76.55	81.62	110.96
	2:15:00	0.00	0.00	18.86	23.22	31.54	54.62	63.42	75.86	95.29
	2:30:00	0.00	0.00	15.06	14.72	25.59	45.66	52.94	71.31	78.98
	2:45:00	0.00	0.00	12.49	11.00	21.44	36.35	42.30	66.75	65.47
	3:00:00	0.00	0.00	10.31	8.57	17.92	29.55	34.50	61.57	55.86
	3:15:00	0.00	0.00	8.53	6.31	14.93	24.27	28.40	55.14	47.93
	3:30:00	0.00	0.00	6.57	4.19	13.03	18.13	21.27	45.91	34.67
	3:45:00	0.00	0.00	5.49	2.03	12.32	14.10	16.64	23.07	25.75
	4:00:00	0.00	0.00	4.97	0.45	10.97	11.10	13.08	0.90	18.54
	4:15:00	0.00	0.00	4.66	0.03	9.28	9.25	10.88	0.12	13.89
	4:30:00	0.00	0.00	4.50	0.02	8.14	7.65	8.93	0.02	11.11
	4:45:00	0.00	0.00	4.38	0.01	7.36	6.60	7.62	0.02	9.22
	5:00:00	0.00	0.00	4.30	0.00	6.84	5.95	6.82	0.00	8.00
	5:15:00	0.00	0.00	4.25	0.00	6.49	5.51	6.27	0.00	7.20
	5:30:00	0.00	0.00	4.23	0.00	6.23	5.25	5.94	0.00	6.81
	5:45:00	0.00	0.00	3.56	0.00	5.85	5.10	5.76	0.00	6.66
	6:00:00	0.00	0.00	3.08	0.00	5.21	5.02	5.65	0.00	6.61
	6:15:00	0.00	0.00	2.09	0.00	3.52	3.40	3.83	0.00	4.50
	6:30:00	0.00	0.00	1.37	0.00	2.33	2.25	2.53	0.00	2.98
	6:45:00	0.00	0.00	0.89	0.00	1.52	1.48	1.66	0.00	1.96
	7:00:00	0.00	0.00	0.55	0.00	0.95	0.93	1.04	0.00	1.22
	7:15:00	0.00	0.00	0.32	0.00	0.58	0.58	0.65	0.00	0.77
	7:30:00	0.00	0.00	0.16	0.00	0.31	0.33	0.37	0.00	0.43
	7:45:00	0.00	0.00	0.07	0.00	0.13	0.15	0.17	0.00	0.19
	8:00:00	0.00	0.00	0.02	0.00	0.03	0.04	0.04	0.00	0.05
	8:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	9:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	9:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	9:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	9:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	10:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	10:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	10:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	10:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	11:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	11:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	11:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	11:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	12:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	12:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	12:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	12:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	13:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	13:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	13:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	13:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	14:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	14:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	14:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	14:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	15:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	15:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	15:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	15:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	16:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	16:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	16:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	16:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	17:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	17:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	17:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	17:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	18:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Pond 2 Summary Table: UD-Detention and SWMM Results				
	WQCV	EURV	5-Year	100-Year
Predevelopment Q (cfs)	N/A	N/A	66.5	188.2
Peak Outflow (cfs)	N/A	N/A	63.7	109.5
Ratio Peak Outflow to Predevelopment Q (cfs)	N/A	N/A	1.0	0.6
Structure Controlling Flow	Vertical Orifice	Vertical Orifice	Overflow Weir	Outlet Plate
Time to Drain (hours)	40	72	76	76
Maximum Ponding Depth (ft)	3.68	5.25	5.96	6.42
Corresponding Elevation (ft)	7025.35	7026.92	7027.63	7028.09
Maximum Volume Stored (acre-ft.)	0.594	1.948	2.807	3.391

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Aug 18 2021

Pond P2 Overflow Channel

Trapezoidal

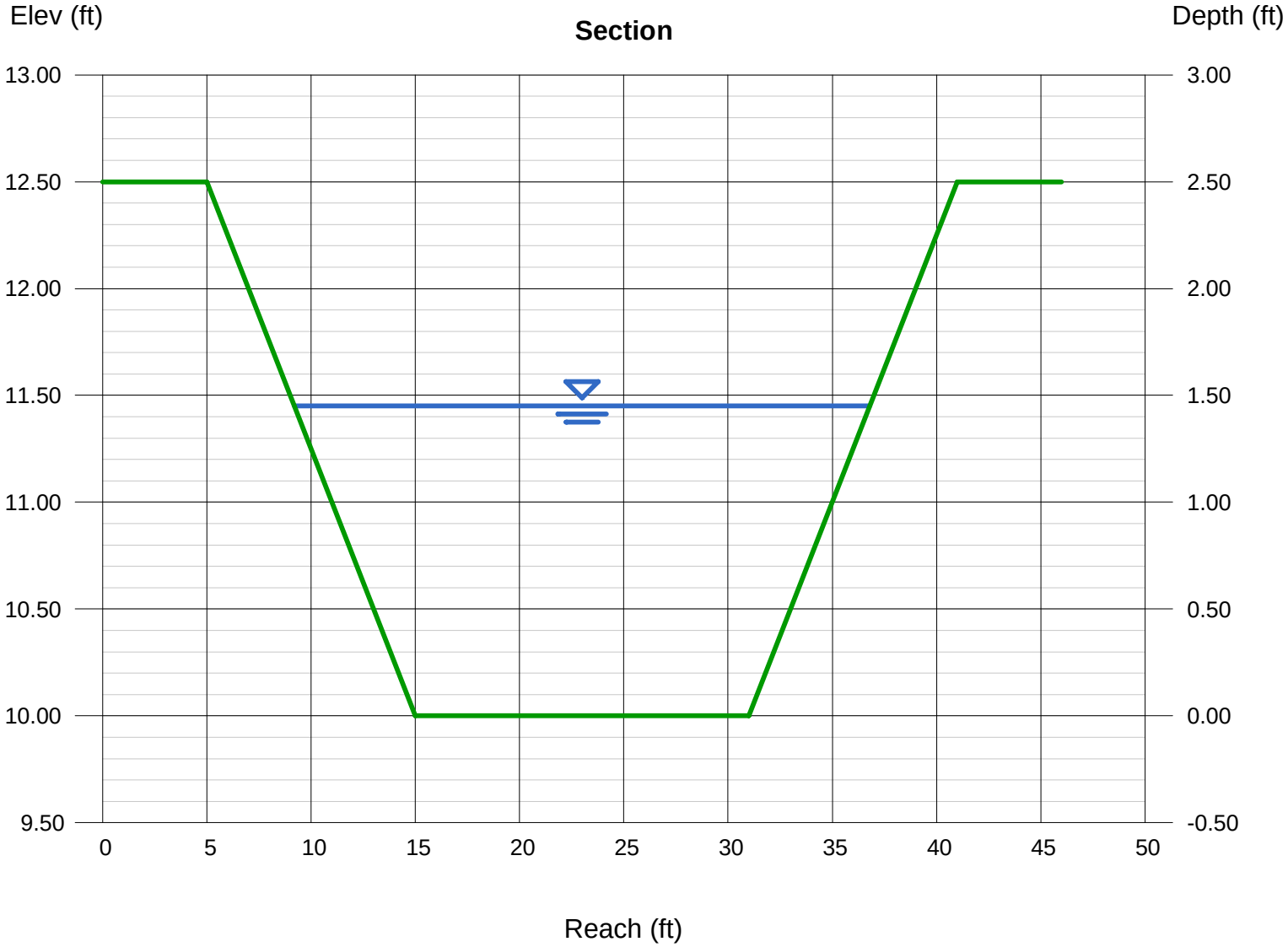
Bottom Width (ft)	=	16.00
Side Slopes (z:1)	=	4.00, 4.00
Total Depth (ft)	=	2.50
Invert Elev (ft)	=	10.00
Slope (%)	=	0.60
N-Value	=	0.030

Calculations

Compute by:		Known Q
Known Q (cfs)	=	130.30

Highlighted

Depth (ft)	=	1.45
Q (cfs)	=	130.30
Area (sqft)	=	31.61
Velocity (ft/s)	=	4.12
Wetted Perim (ft)	=	27.96
Crit Depth, Yc (ft)	=	1.16
Top Width (ft)	=	27.60
EGL (ft)	=	1.71



Controlled Release From Pond 2

SWMM Model Results -Link2

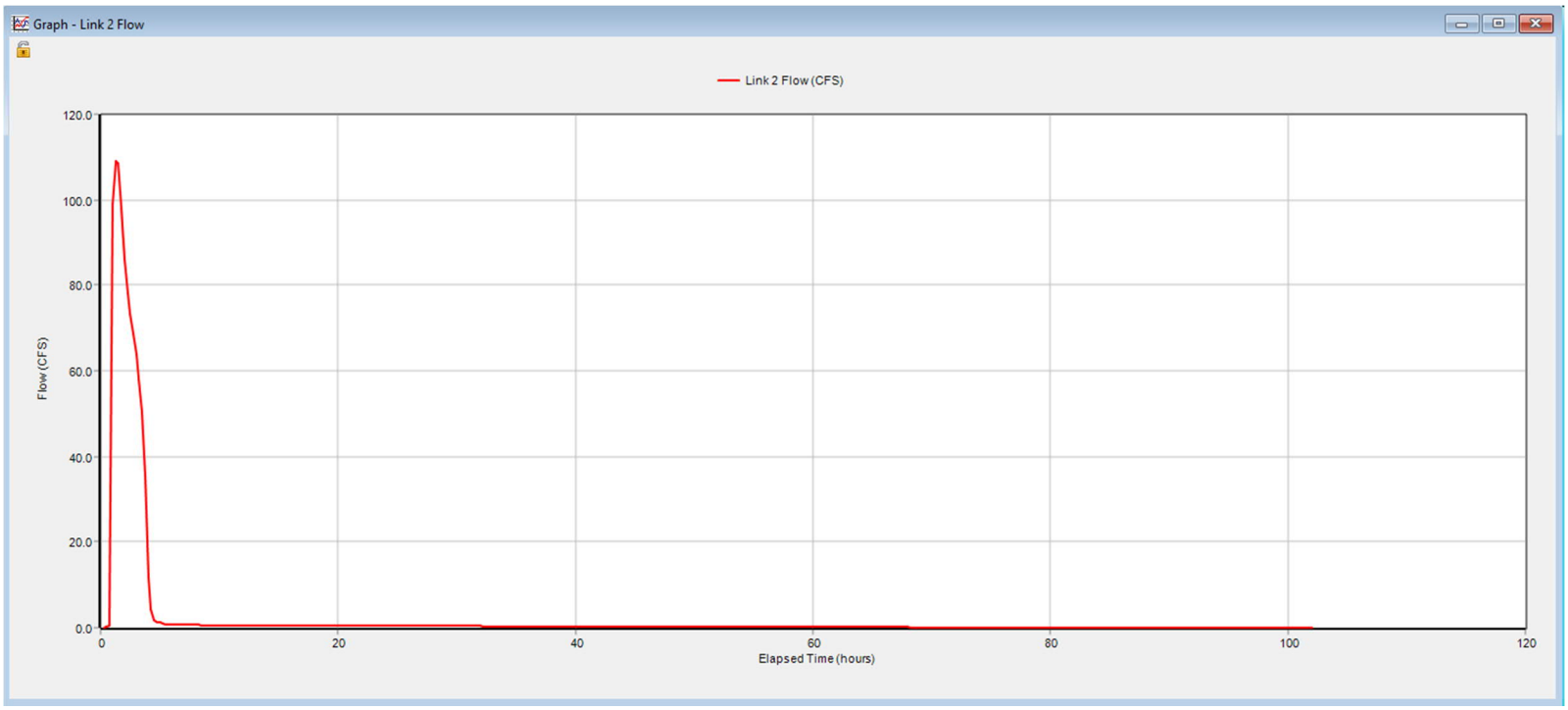
Days	Hours	Flow (CFS)	Days	Hours	Flow (CFS)	Days	Hours	Flow (CFS)
0	0:15:00	0.05	0	11:15:00	0.61	0	22:15:00	0.51
0	0:30:00	0.15	0	11:30:00	0.61	0	22:30:00	0.51
0	0:45:00	0.56	0	11:45:00	0.6	0	22:45:00	0.5
0	1:00:00	99.18	0	12:00:00	0.6	0	23:00:00	0.5
0	1:15:00	109.13	0	12:15:00	0.6	0	23:15:00	0.5
0	1:30:00	108.62	0	12:30:00	0.6	0	23:30:00	0.5
0	1:45:00	98.12	0	12:45:00	0.6	0	23:45:00	0.49
0	2:00:00	85.94	0	13:00:00	0.6	1	0:00:00	0.49
0	2:15:00	78.18	0	13:15:00	0.59	1	0:15:00	0.49
0	2:30:00	73.19	0	13:30:00	0.59	1	0:30:00	0.49
0	2:45:00	68.65	0	13:45:00	0.59	1	0:45:00	0.48
0	3:00:00	63.87	0	14:00:00	0.59	1	1:00:00	0.48
0	3:15:00	58.04	0	14:15:00	0.59	1	1:15:00	0.47
0	3:30:00	50.41	0	14:30:00	0.59	1	1:30:00	0.47
0	3:45:00	35.44	0	14:45:00	0.58	1	1:45:00	0.47
0	4:00:00	11.76	0	15:00:00	0.58	1	2:00:00	0.46
0	4:15:00	4.27	0	15:15:00	0.58	1	2:15:00	0.46
0	4:30:00	1.83	0	15:30:00	0.58	1	2:30:00	0.46
0	4:45:00	1.35	0	15:45:00	0.57	1	2:45:00	0.45
0	5:00:00	1.15	0	16:00:00	0.57	1	3:00:00	0.45
0	5:15:00	0.99	0	16:15:00	0.57	1	3:15:00	0.44
0	5:30:00	0.84	0	16:30:00	0.57	1	3:30:00	0.44
0	5:45:00	0.72	0	16:45:00	0.56	1	3:45:00	0.44
0	6:00:00	0.65	0	17:00:00	0.56	1	4:00:00	0.43
0	6:15:00	0.65	0	17:15:00	0.56	1	4:15:00	0.43
0	6:30:00	0.65	0	17:30:00	0.56	1	4:30:00	0.43
0	6:45:00	0.65	0	17:45:00	0.55	1	4:45:00	0.43
0	7:00:00	0.64	0	18:00:00	0.55	1	5:00:00	0.42
0	7:15:00	0.64	0	18:15:00	0.55	1	5:15:00	0.42
0	7:30:00	0.64	0	18:30:00	0.55	1	5:30:00	0.42
0	7:45:00	0.64	0	18:45:00	0.54	1	5:45:00	0.42
0	8:00:00	0.64	0	19:00:00	0.54	1	6:00:00	0.41
0	8:15:00	0.64	0	19:15:00	0.54	1	6:15:00	0.41
0	8:30:00	0.64	0	19:30:00	0.54	1	6:30:00	0.41
0	8:45:00	0.63	0	19:45:00	0.53	1	6:45:00	0.4
0	9:00:00	0.63	0	20:00:00	0.53	1	7:00:00	0.4
0	9:15:00	0.63	0	20:15:00	0.53	1	7:15:00	0.39
0	9:30:00	0.63	0	20:30:00	0.53	1	7:30:00	0.39
0	9:45:00	0.62	0	20:45:00	0.52	1	7:45:00	0.39
0	10:00:00	0.62	0	21:00:00	0.52	1	8:00:00	0.38
0	10:15:00	0.62	0	21:15:00	0.52	1	8:15:00	0.38
0	10:30:00	0.62	0	21:30:00	0.52	1	8:30:00	0.37
0	10:45:00	0.61	0	21:45:00	0.51	1	8:45:00	0.37
0	11:00:00	0.61	0	22:00:00	0.51	1	9:00:00	0.37

Days	Hours	Flow (CFS)	Days	Hours	Flow (CFS)	Days	Hours	Flow (CFS)
1	9:15:00	0.36	1	20:30:00	0.23	2	7:45:00	0.19
1	9:30:00	0.36	1	20:45:00	0.23	2	8:00:00	0.19
1	9:45:00	0.35	1	21:00:00	0.23	2	8:15:00	0.19
1	10:00:00	0.35	1	21:15:00	0.23	2	8:30:00	0.19
1	10:15:00	0.35	1	21:30:00	0.23	2	8:45:00	0.18
1	10:30:00	0.34	1	21:45:00	0.23	2	9:00:00	0.18
1	10:45:00	0.34	1	22:00:00	0.22	2	9:15:00	0.18
1	11:00:00	0.33	1	22:15:00	0.22	2	9:30:00	0.18
1	11:15:00	0.33	1	22:30:00	0.22	2	9:45:00	0.18
1	11:30:00	0.33	1	22:45:00	0.22	2	10:00:00	0.18
1	11:45:00	0.32	1	23:00:00	0.22	2	10:15:00	0.18
1	12:00:00	0.32	1	23:15:00	0.22	2	10:30:00	0.18
1	12:15:00	0.31	1	23:30:00	0.22	2	10:45:00	0.18
1	12:30:00	0.31	1	23:45:00	0.22	2	11:00:00	0.17
1	12:45:00	0.31	2	0:00:00	0.22	2	11:15:00	0.17
1	13:00:00	0.3	2	0:15:00	0.22	2	11:30:00	0.17
1	13:15:00	0.3	2	0:30:00	0.22	2	11:45:00	0.17
1	13:30:00	0.3	2	0:45:00	0.21	2	12:00:00	0.17
1	13:45:00	0.29	2	1:00:00	0.21	2	12:15:00	0.17
1	14:00:00	0.29	2	1:15:00	0.21	2	12:30:00	0.17
1	14:15:00	0.28	2	1:30:00	0.21	2	12:45:00	0.17
1	14:30:00	0.28	2	1:45:00	0.21	2	13:00:00	0.17
1	14:45:00	0.28	2	2:00:00	0.21	2	13:15:00	0.16
1	15:00:00	0.27	2	2:15:00	0.21	2	13:30:00	0.16
1	15:15:00	0.27	2	2:30:00	0.21	2	13:45:00	0.16
1	15:30:00	0.27	2	2:45:00	0.21	2	14:00:00	0.16
1	15:45:00	0.26	2	3:00:00	0.21	2	14:15:00	0.16
1	16:00:00	0.26	2	3:15:00	0.21	2	14:30:00	0.16
1	16:15:00	0.26	2	3:30:00	0.2	2	14:45:00	0.16
1	16:30:00	0.25	2	3:45:00	0.2	2	15:00:00	0.16
1	16:45:00	0.25	2	4:00:00	0.2	2	15:15:00	0.15
1	17:00:00	0.25	2	4:15:00	0.2	2	15:30:00	0.15
1	17:15:00	0.24	2	4:30:00	0.2	2	15:45:00	0.15
1	17:30:00	0.24	2	4:45:00	0.2	2	16:00:00	0.15
1	17:45:00	0.24	2	5:00:00	0.2	2	16:15:00	0.15
1	18:00:00	0.24	2	5:15:00	0.2	2	16:30:00	0.15
1	18:15:00	0.24	2	5:30:00	0.2	2	16:45:00	0.15
1	18:30:00	0.24	2	5:45:00	0.2	2	17:00:00	0.15
1	18:45:00	0.24	2	6:00:00	0.2	2	17:15:00	0.14
1	19:00:00	0.23	2	6:15:00	0.19	2	17:30:00	0.14
1	19:15:00	0.23	2	6:30:00	0.19	2	17:45:00	0.14
1	19:30:00	0.23	2	6:45:00	0.19	2	18:00:00	0.14
1	19:45:00	0.23	2	7:00:00	0.19	2	18:15:00	0.14
1	20:00:00	0.23	2	7:15:00	0.19	2	18:30:00	0.14
1	20:15:00	0.23	2	7:30:00	0.19	2	18:45:00	0.14

Days	Hours	Flow (CFS)
2	19:00:00	0.13
2	19:15:00	0.13
2	19:30:00	0.13
2	19:45:00	0.13
2	20:00:00	0.13
2	20:15:00	0.13
2	20:30:00	0.12
2	20:45:00	0.12
2	21:00:00	0.12
2	21:15:00	0.12
2	21:30:00	0.12
2	21:45:00	0.12
2	22:00:00	0.12
2	22:15:00	0.12
2	22:30:00	0.11
2	22:45:00	0.11
2	23:00:00	0.11
2	23:15:00	0.11
2	23:30:00	0.11
2	23:45:00	0.11
3	0:00:00	0.11
3	0:15:00	0.1
3	0:30:00	0.1
3	0:45:00	0.1
3	1:00:00	0.1
3	1:15:00	0.1
3	1:30:00	0.1
3	1:45:00	0.1
3	2:00:00	0.09
3	2:15:00	0.09
3	2:30:00	0.09
3	2:45:00	0.09
3	3:00:00	0.08
3	3:15:00	0.08
3	3:30:00	0.08
3	3:45:00	0.07
3	4:00:00	0.07
3	4:15:00	0.06
3	4:30:00	0.06
3	4:45:00	0.06
3	5:00:00	0.05
3	5:15:00	0.05
3	5:30:00	0.05
3	5:45:00	0.05
3	6:00:00	0.05

Days	Hours	Flow (CFS)
3	6:15:00	0.05
3	6:30:00	0.04
3	6:45:00	0.04
3	7:00:00	0.04
3	7:15:00	0
3	7:30:00	0

SWMM Model Results- Flow vs. Time in Link 2



Pond 2- Stage, Volume (100-yr)

SWMM Model Results Pond 2 - Node P2

Days	Hours	Depth (ft)	Volume (ft3)
0	0:15:00	0.88	207.27
0	0:30:00	2.39	5625.17
0	0:45:00	4.66	58101.26
0	1:00:00	6.21	136226.9
0	1:15:00	6.42	147703.2
0	1:30:00	6.35	143637.8
0	1:45:00	6.2	135337.7
0	2:00:00	6.12	130842.4
0	2:15:00	6.07	127975
0	2:30:00	6.03	126066.6
0	2:45:00	6	124325.3
0	3:00:00	5.97	122366.1
0	3:15:00	5.92	119970.6
0	3:30:00	5.86	116675.4
0	3:45:00	5.73	109850.3
0	4:00:00	5.48	96413.4
0	4:15:00	5.36	90255.24
0	4:30:00	5.31	87670.57
0	4:45:00	5.28	86347.05
0	5:00:00	5.26	85228.42
0	5:15:00	5.24	84266.68
0	5:30:00	5.22	83444.3
0	5:45:00	5.21	82742.81
0	6:00:00	5.2	82138.67
0	6:15:00	5.18	81554.6
0	6:30:00	5.17	80971.61
0	6:45:00	5.16	80389.69
0	7:00:00	5.15	79808.84
0	7:15:00	5.14	79229.08
0	7:30:00	5.12	78650.39
0	7:45:00	5.11	78072.79
0	8:00:00	5.1	77496.27
0	8:15:00	5.09	76921.41
0	8:30:00	5.08	76348.73
0	8:45:00	5.06	75778.23
0	9:00:00	5.05	75209.89
0	9:15:00	5.04	74643.74
0	9:30:00	5.03	74079.77
0	9:45:00	5.01	73517.97
0	10:00:00	5	72958.34
0	10:15:00	4.99	72400.91
0	10:30:00	4.98	71845.64
0	10:45:00	4.97	71292.56
0	11:00:00	4.95	70741.66
0	11:15:00	4.94	70192.94
0	11:30:00	4.93	69646.4
0	11:45:00	4.92	69102.04
0	12:00:00	4.91	68559.86
0	12:15:00	4.89	68019.73
0	12:30:00	4.88	67480.83
0	12:45:00	4.87	66943.02
0	13:00:00	4.86	66406.3
0	13:15:00	4.84	65870.69
0	13:30:00	4.83	65336.18
0	13:45:00	4.82	64802.77
0	14:00:00	4.81	64270.48
0	14:15:00	4.8	63739.35
0	14:30:00	4.78	63210.2
0	14:45:00	4.77	62683.28
0	15:00:00	4.76	62158.58
0	15:15:00	4.75	61636.11
0	15:30:00	4.73	61115.86
0	15:45:00	4.72	60597.84
0	16:00:00	4.71	60082.05
0	16:15:00	4.7	59568.5
0	16:30:00	4.68	59057.17
0	16:45:00	4.67	58548.07
0	17:00:00	4.66	58041.21
0	17:15:00	4.65	57536.57
0	17:30:00	4.63	57034.18
0	17:45:00	4.62	56534.01
0	18:00:00	4.61	56036.08
0	18:15:00	4.6	55540.39
0	18:30:00	4.59	55046.93
0	18:45:00	4.57	54555.71
0	19:00:00	4.56	54066.73
0	19:15:00	4.55	53579.98
0	19:30:00	4.54	53095.48
0	19:45:00	4.52	52613.21
0	20:00:00	4.51	52133.19
0	20:15:00	4.5	51655.41
0	20:30:00	4.49	51179.88
0	20:45:00	4.47	50706.59
0	21:00:00	4.46	50235.54
0	21:15:00	4.45	49766.74
0	21:30:00	4.44	49300.18
0	21:45:00	4.42	48835.88
0	22:00:00	4.41	48373.82

Max Volume

Drain Time: 76 hours

EURV + WQCV

Drain Time: 72 hours

Days	Hours	Depth (ft)	Volume (ft3)
0	22:15:00	4.4	47914.01
0	22:30:00	4.39	47456.45
0	22:45:00	4.37	47001.14
0	23:00:00	4.36	46548.09
0	23:15:00	4.35	46097.29
0	23:30:00	4.34	45648.74
0	23:45:00	4.32	45202.45
1	0:00:00	4.31	44758.42
1	0:15:00	4.3	44316.66
1	0:30:00	4.29	43877.88
1	0:45:00	4.27	43442.5
1	1:00:00	4.26	43010.49
1	1:15:00	4.25	42581.85
1	1:30:00	4.24	42156.59
1	1:45:00	4.22	41734.68
1	2:00:00	4.21	41316.13
1	2:15:00	4.2	40900.93
1	2:30:00	4.19	40489.08
1	2:45:00	4.17	40080.56
1	3:00:00	4.16	39675.38
1	3:15:00	4.15	39273.51
1	3:30:00	4.14	38874.97
1	3:45:00	4.12	38479.74
1	4:00:00	4.11	38087.82
1	4:15:00	4.1	37699.2
1	4:30:00	4.09	37313.31
1	4:45:00	4.08	36929.63
1	5:00:00	4.06	36548.13
1	5:15:00	4.05	36168.84
1	5:30:00	4.04	35791.76
1	5:45:00	4.03	35416.88
1	6:00:00	4.01	35044.2
1	6:15:00	4	34673.73
1	6:30:00	3.99	34306.02
1	6:45:00	3.98	33942.03
1	7:00:00	3.97	33581.78
1	7:15:00	3.95	33225.25
1	7:30:00	3.94	32872.43
1	7:45:00	3.93	32523.31
1	8:00:00	3.92	32177.87
1	8:15:00	3.9	31836.11
1	8:30:00	3.89	31498
1	8:45:00	3.88	31163.54
1	9:00:00	3.87	30832.71
1	9:15:00	3.86	30505.5

Days	Hours	Depth (ft)	Volume (ft3)
1	9:30:00	3.85	30181.89
1	9:45:00	3.83	29861.87
1	10:00:00	3.82	29545.42
1	10:15:00	3.81	29232.54
1	10:30:00	3.8	28923.21
1	10:45:00	3.79	28617.4
1	11:00:00	3.78	28315.11
1	11:15:00	3.76	28016.33
1	11:30:00	3.75	27721.03
1	11:45:00	3.74	27429.21
1	12:00:00	3.73	27140.84
1	12:15:00	3.72	26855.91
1	12:30:00	3.71	26574.4
1	12:45:00	3.7	26296.31
1	13:00:00	3.69	26021.61
1	13:15:00	3.68	25750.28
1	13:30:00	3.66	25482.32
1	13:45:00	3.65	25217.7
1	14:00:00	3.64	24956.41
1	14:15:00	3.63	24698.42
1	14:30:00	3.62	24443.73
1	14:45:00	3.61	24192.32
1	15:00:00	3.6	23944.16
1	15:15:00	3.59	23699.25
1	15:30:00	3.58	23457.56
1	15:45:00	3.57	23219.07
1	16:00:00	3.56	22983.77
1	16:15:00	3.55	22751.64
1	16:30:00	3.54	22522.66
1	16:45:00	3.53	22296.81
1	17:00:00	3.52	22074.08
1	17:15:00	3.51	21854.44
1	17:30:00	3.5	21637.75
1	17:45:00	3.49	21422.34
1	18:00:00	3.48	21207.65
1	18:15:00	3.47	20993.69
1	18:30:00	3.46	20780.46
1	18:45:00	3.45	20567.97
1	19:00:00	3.44	20356.21
1	19:15:00	3.43	20145.2
1	19:30:00	3.42	19934.93
1	19:45:00	3.4	19725.41
1	20:00:00	3.39	19516.64
1	20:15:00	3.38	19308.63
1	20:30:00	3.37	19101.38

WQCV

Drain Time: 40 hours

Days	Hours	Depth (ft)	Volume (ft3)		Days	Hours	Depth (ft)	Volume (ft3)
1	20:45:00	3.36	18894.9		2	8:00:00	2.84	10443.71
1	21:00:00	3.35	18689.19		2	8:15:00	2.83	10275.69
1	21:15:00	3.34	18484.25		2	8:30:00	2.81	10108.59
1	21:30:00	3.33	18280.09		2	8:45:00	2.8	9942.41
1	21:45:00	3.32	18076.71		2	9:00:00	2.79	9777.17
1	22:00:00	3.31	17874.12		2	9:15:00	2.78	9612.86
1	22:15:00	3.3	17672.31		2	9:30:00	2.76	9449.49
1	22:30:00	3.29	17471.3		2	9:45:00	2.75	9287.08
1	22:45:00	3.28	17271.07		2	10:00:00	2.74	9125.61
1	23:00:00	3.26	17071.64		2	10:15:00	2.72	8965.1
1	23:15:00	3.25	16873.01		2	10:30:00	2.71	8805.56
1	23:30:00	3.24	16675.18		2	10:45:00	2.7	8647
1	23:45:00	3.23	16478.14		2	11:00:00	2.68	8489.41
2	0:00:00	3.22	16281.91		2	11:15:00	2.67	8332.8
2	0:15:00	3.21	16086.49		2	11:30:00	2.65	8177.19
2	0:30:00	3.2	15891.87		2	11:45:00	2.64	8022.58
2	0:45:00	3.19	15698.07		2	12:00:00	2.63	7868.98
2	1:00:00	3.17	15505.08		2	12:15:00	2.61	7716.39
2	1:15:00	3.16	15312.9		2	12:30:00	2.6	7564.82
2	1:30:00	3.15	15121.54		2	12:45:00	2.58	7414.29
2	1:45:00	3.14	14931.01		2	13:00:00	2.57	7264.8
2	2:00:00	3.13	14741.3		2	13:15:00	2.55	7116.36
2	2:15:00	3.12	14552.41		2	13:30:00	2.54	6968.98
2	2:30:00	3.11	14364.36		2	13:45:00	2.52	6822.67
2	2:45:00	3.09	14177.14		2	14:00:00	2.51	6677.44
2	3:00:00	3.08	13990.75		2	14:15:00	2.49	6533.3
2	3:15:00	3.07	13805.2		2	14:30:00	2.48	6390.26
2	3:30:00	3.06	13620.5		2	14:45:00	2.46	6248.34
2	3:45:00	3.05	13436.64		2	15:00:00	2.45	6107.55
2	4:00:00	3.04	13253.63		2	15:15:00	2.43	5967.89
2	4:15:00	3.02	13071.46		2	15:30:00	2.42	5829.39
2	4:30:00	3.01	12890.16		2	15:45:00	2.4	5692.06
2	4:45:00	3	12709.71		2	16:00:00	2.38	5555.91
2	5:00:00	2.99	12530.13		2	16:15:00	2.37	5420.97
2	5:15:00	2.98	12351.4		2	16:30:00	2.35	5287.24
2	5:30:00	2.96	12173.55		2	16:45:00	2.33	5154.75
2	5:45:00	2.95	11996.58		2	17:00:00	2.31	5023.51
2	6:00:00	2.94	11820.47		2	17:15:00	2.3	4893.54
2	6:15:00	2.93	11645.25		2	17:30:00	2.28	4764.84
2	6:30:00	2.91	11470.92		2	17:45:00	2.26	4637.42
2	6:45:00	2.9	11297.47		2	18:00:00	2.24	4511.28
2	7:00:00	2.89	11124.91		2	18:15:00	2.22	4386.43
2	7:15:00	2.88	10953.26		2	18:30:00	2.21	4262.87
2	7:30:00	2.87	10782.5		2	18:45:00	2.19	4140.63
2	7:45:00	2.85	10612.65		2	19:00:00	2.17	4019.69

Days	Hours	Depth (ft)	Volume (ft3)
2	19:15:00	2.15	3900.08
2	19:30:00	2.13	3781.8
2	19:45:00	2.11	3664.85
2	20:00:00	2.1	3549.26
2	20:15:00	2.08	3435.02
2	20:30:00	2.06	3322.14
2	20:45:00	2.04	3210.65
2	21:00:00	2.02	3100.54
2	21:15:00	2	2991.84
2	21:30:00	1.98	2884.37
2	21:45:00	1.96	2777.97
2	22:00:00	1.94	2672.66
2	22:15:00	1.92	2568.45
2	22:30:00	1.9	2465.36
2	22:45:00	1.88	2363.41
2	23:00:00	1.86	2262.6
2	23:15:00	1.83	2162.97
2	23:30:00	1.81	2064.53
2	23:45:00	1.79	1967.31
3	0:00:00	1.77	1871.33
3	0:15:00	1.74	1776.62
3	0:30:00	1.72	1683.2
3	0:45:00	1.69	1591.12
3	1:00:00	1.67	1500.4
3	1:15:00	1.64	1411.09
3	1:30:00	1.61	1323.23
3	1:45:00	1.58	1236.88
3	2:00:00	1.55	1152.11
3	2:15:00	1.52	1068.97
3	2:30:00	1.49	987.58
3	2:45:00	1.46	908.49
3	3:00:00	1.42	832
3	3:15:00	1.38	758.34
3	3:30:00	1.33	687.8
3	3:45:00	1.28	620.77
3	4:00:00	1.23	557.33
3	4:15:00	1.18	497.47
3	4:30:00	1.13	441.18
3	4:45:00	1.08	388.44
3	5:00:00	1.03	339.26
3	5:15:00	0.98	293.47
3	5:30:00	0.93	249.2
3	5:45:00	0.88	205.89
3	6:00:00	0.82	163.59
3	6:15:00	0.75	122.41

Effective Pond Empty

Days	Hours	Depth (ft)	Volume (ft3)
3	6:30:00	0.68	82.49
3	6:45:00	0.59	44.05
3	7:00:00	0.44	8.09
3	7:15:00	0	0
3	7:30:00	0	0

Pond 2- Stage, Volume (5-yr)

SWMM Model Results Pond 2 - Node P2

Days	Hours	Depth (ft)	Volume (ft3)
0	0:15:00	0.38	1.74
0	0:30:00	1.86	2292.73
0	0:45:00	3.65	25250.49
0	1:00:00	5.31	88263.31
0	1:15:00	5.94	121373.5
0	1:30:00	5.96	122258.1
0	1:45:00	5.9	118859.6
0	2:00:00	5.81	114014.5
0	2:15:00	5.7	107942.7
0	2:30:00	5.59	102415.3
0	2:45:00	5.52	98678.73
0	3:00:00	5.48	96382.06
0	3:15:00	5.44	94424.66
0	3:30:00	5.4	92606.66
0	3:45:00	5.36	90627.93
0	4:00:00	5.32	88587.36
0	4:15:00	5.29	87079.12
0	4:30:00	5.27	85916.97
0	4:45:00	5.25	84896.91
0	5:00:00	5.23	84008.72
0	5:15:00	5.22	83238.26
0	5:30:00	5.2	82572.66
0	5:45:00	5.19	81982.06
0	6:00:00	5.18	81398.28
0	6:15:00	5.17	80815.57
0	6:30:00	5.16	80233.94
0	6:45:00	5.14	79653.38
0	7:00:00	5.13	79073.91
0	7:15:00	5.12	78495.52
0	7:30:00	5.11	77918.2
0	7:45:00	5.1	77342.02
0	8:00:00	5.08	76767.74
0	8:15:00	5.07	76195.65
0	8:30:00	5.06	75625.72
0	8:45:00	5.05	75057.98
0	9:00:00	5.04	74492.41
0	9:15:00	5.02	73929.02
0	9:30:00	5.01	73367.8
0	9:45:00	5	72808.77
0	10:00:00	4.99	72251.91
0	10:15:00	4.98	71697.23
0	10:30:00	4.96	71144.73
0	10:45:00	4.95	70594.41
0	11:00:00	4.94	70046.27
0	11:15:00	4.93	69500.32
0	11:30:00	4.91	68956.55
0	11:45:00	4.9	68414.95
0	12:00:00	4.89	67875.22
0	12:15:00	4.88	67336.61
0	12:30:00	4.87	66799.09
0	12:45:00	4.85	66262.67
0	13:00:00	4.84	65727.36
0	13:15:00	4.83	65193.14
0	13:30:00	4.82	64660.03
0	13:45:00	4.8	64128.03
0	14:00:00	4.79	63597.34
0	14:15:00	4.78	63068.79
0	14:30:00	4.77	62542.46
0	14:45:00	4.76	62018.36
0	15:00:00	4.74	61496.48
0	15:15:00	4.73	60976.84
0	15:30:00	4.72	60459.42
0	15:45:00	4.71	59944.23
0	16:00:00	4.69	59431.27
0	16:15:00	4.68	58920.54
0	16:30:00	4.67	58412.04
0	16:45:00	4.66	57905.77
0	17:00:00	4.64	57401.73
0	17:15:00	4.63	56899.93
0	17:30:00	4.62	56400.37
0	17:45:00	4.61	55903.04
0	18:00:00	4.59	55407.94
0	18:15:00	4.58	54915.08
0	18:30:00	4.57	54424.46
0	18:45:00	4.56	53936.08
0	19:00:00	4.54	53449.94
0	19:15:00	4.53	52966.03
0	19:30:00	4.52	52484.37
0	19:45:00	4.51	52004.95
0	20:00:00	4.49	51527.77
0	20:15:00	4.48	51052.84
0	20:30:00	4.47	50580.14
0	20:45:00	4.46	50109.7
0	21:00:00	4.44	49641.5
0	21:15:00	4.43	49175.55
0	21:30:00	4.42	48711.84
0	21:45:00	4.41	48250.39
0	22:00:00	4.39	47791.18
0	22:15:00	4.38	47334.23
0	22:30:00	4.37	46879.52
0	22:45:00	4.36	46427.07
0	23:00:00	4.34	45976.88
0	23:15:00	4.33	45528.93
0	23:30:00	4.32	45083.25

Max Volume

Drain Time: 76 hours

Days	Hours	Depth (ft)	Volume (ft3)
0	23:45:00	4.31	44639.82
1	0:00:00	4.29	44198.75
1	0:15:00	4.28	43760.89
1	0:30:00	4.27	43326.41
1	0:45:00	4.26	42895.3
1	1:00:00	4.24	42467.57
1	1:15:00	4.23	42043.2
1	1:30:00	4.22	41622.2
1	1:45:00	4.21	41204.55
1	2:00:00	4.19	40790.25
1	2:15:00	4.18	40379.29
1	2:30:00	4.17	39971.66
1	2:45:00	4.16	39567.37
1	3:00:00	4.15	39166.4
1	3:15:00	4.13	38768.74
1	3:30:00	4.12	38374.4
1	3:45:00	4.11	37983.36
1	4:00:00	4.1	37595.58
1	4:15:00	4.08	37210.29
1	4:30:00	4.07	36827.19
1	4:45:00	4.06	36446.29
1	5:00:00	4.05	36067.59
1	5:15:00	4.04	35691.09
1	5:30:00	4.02	35316.8
1	5:45:00	4.01	34944.71
1	6:00:00	4	34574.85
1	6:15:00	3.99	34208.12
1	6:30:00	3.97	33845.13
1	6:45:00	3.96	33485.88
1	7:00:00	3.95	33130.34
1	7:15:00	3.94	32778.52
1	7:30:00	3.93	32430.38
1	7:45:00	3.91	32085.93
1	8:00:00	3.9	31745.15
1	8:15:00	3.89	31408.02
1	8:30:00	3.88	31074.54
1	8:45:00	3.87	30744.68
1	9:00:00	3.85	30418.43
1	9:15:00	3.84	30095.79
1	9:30:00	3.83	29776.73
1	9:45:00	3.82	29461.24
1	10:00:00	3.81	29149.31
1	10:15:00	3.8	28840.92
1	10:30:00	3.78	28536.06
1	10:45:00	3.77	28234.71
1	11:00:00	3.76	27936.86
1	11:15:00	3.75	27642.49
1	11:30:00	3.74	27351.6

Days	Hours	Depth (ft)	Volume (ft3)
1	11:45:00	3.73	27064.15
1	12:00:00	3.72	26780.14
1	12:15:00	3.71	26499.55
1	12:30:00	3.69	26222.37
1	12:45:00	3.68	25948.57
1	13:00:00	3.67	25678.15
1	13:15:00	3.66	25411.08
1	13:30:00	3.65	25147.36
1	13:45:00	3.64	24886.95
1	14:00:00	3.63	24629.86
1	14:15:00	3.62	24376.04
1	14:30:00	3.61	24125.51
1	14:45:00	3.6	23878.22
1	15:00:00	3.59	23634.17
1	15:15:00	3.58	23393.34
1	15:30:00	3.57	23155.71
1	15:45:00	3.55	22921.26
1	16:00:00	3.54	22689.98
1	16:15:00	3.53	22461.84
1	16:30:00	3.52	22236.83
1	16:45:00	3.51	22014.92
1	17:00:00	3.5	21796.11
1	17:15:00	3.49	21579.96
1	17:30:00	3.48	21364.74
1	17:45:00	3.47	21150.25
1	18:00:00	3.46	20936.48
1	18:15:00	3.45	20723.45
1	18:30:00	3.44	20511.16
1	18:45:00	3.43	20299.6
1	19:00:00	3.42	20088.78
1	19:15:00	3.41	19878.71
1	19:30:00	3.4	19669.39
1	19:45:00	3.39	19460.83
1	20:00:00	3.38	19253.02
1	20:15:00	3.37	19045.98
1	20:30:00	3.36	18839.7
1	20:45:00	3.35	18634.2
1	21:00:00	3.34	18429.46
1	21:15:00	3.33	18225.51
1	21:30:00	3.32	18022.35
1	21:45:00	3.31	17819.96
1	22:00:00	3.29	17618.37
1	22:15:00	3.28	17417.57
1	22:30:00	3.27	17217.56
1	22:45:00	3.26	17018.34
1	23:00:00	3.25	16819.92
1	23:15:00	3.24	16622.3
1	23:30:00	3.23	16425.48

Days	Hours	Depth (ft)	Volume (ft3)
1	23:45:00	3.22	16229.47
2	0:00:00	3.21	16034.26
2	0:15:00	3.19	15839.86
2	0:30:00	3.18	15646.28
2	0:45:00	3.17	15453.5
2	1:00:00	3.16	15261.55
2	1:15:00	3.15	15070.41
2	1:30:00	3.14	14880.09
2	1:45:00	3.13	14690.6
2	2:00:00	3.11	14501.94
2	2:15:00	3.1	14314.11
2	2:30:00	3.09	14127.11
2	2:45:00	3.08	13940.95
2	3:00:00	3.07	13755.63
2	3:15:00	3.06	13571.15
2	3:30:00	3.04	13387.51
2	3:45:00	3.03	13204.73
2	4:00:00	3.02	13022.8
2	4:15:00	3.01	12841.72
2	4:30:00	3	12661.5
2	4:45:00	2.98	12482.15
2	5:00:00	2.97	12303.66
2	5:15:00	2.96	12126.04
2	5:30:00	2.95	11949.3
2	5:45:00	2.94	11773.44
2	6:00:00	2.92	11598.45
2	6:15:00	2.91	11424.35
2	6:30:00	2.9	11251.14
2	6:45:00	2.89	11078.83
2	7:00:00	2.87	10907.41
2	7:15:00	2.86	10736.9
2	7:30:00	2.85	10567.29
2	7:45:00	2.84	10398.6
2	8:00:00	2.82	10230.83
2	8:15:00	2.81	10063.97
2	8:30:00	2.8	9898.04
2	8:45:00	2.78	9733.05
2	9:00:00	2.77	9568.99
2	9:15:00	2.76	9405.88
2	9:30:00	2.75	9243.72
2	9:45:00	2.73	9082.51
2	10:00:00	2.72	8922.26
2	10:15:00	2.71	8762.98
2	10:30:00	2.69	8604.67
2	10:45:00	2.68	8447.35
2	11:00:00	2.66	8291.01
2	11:15:00	2.65	8135.66
2	11:30:00	2.64	7981.32

Days	Hours	Depth (ft)	Volume (ft3)
2	11:45:00	2.62	7827.99
2	12:00:00	2.61	7675.68
2	12:15:00	2.59	7524.39
2	12:30:00	2.58	7374.13
2	12:45:00	2.56	7224.92
2	13:00:00	2.55	7076.77
2	13:15:00	2.54	6929.67
2	13:30:00	2.52	6783.65
2	13:45:00	2.51	6638.71
2	14:00:00	2.49	6494.86
2	14:15:00	2.47	6352.12
2	14:30:00	2.46	6210.5
2	14:45:00	2.44	6070.01
2	15:00:00	2.43	5930.67
2	15:15:00	2.41	5792.48
2	15:30:00	2.39	5655.46
2	15:45:00	2.38	5519.63
2	16:00:00	2.36	5385.01
2	16:15:00	2.34	5251.62
2	16:30:00	2.33	5119.46
2	16:45:00	2.31	4988.56
2	17:00:00	2.29	4858.93
2	17:15:00	2.27	4730.57
2	17:30:00	2.26	4603.49
2	17:45:00	2.24	4477.7
2	18:00:00	2.22	4353.19
2	18:15:00	2.2	4229.99
2	18:30:00	2.18	4108.09
2	18:45:00	2.17	3987.51
2	19:00:00	2.15	3868.26
2	19:15:00	2.13	3750.33
2	19:30:00	2.11	3633.75
2	19:45:00	2.09	3518.51
2	20:00:00	2.07	3404.64
2	20:15:00	2.05	3292.13
2	20:30:00	2.03	3181.01
2	20:45:00	2.01	3071.28
2	21:00:00	1.99	2962.94
2	21:15:00	1.97	2855.75
2	21:30:00	1.95	2749.65
2	21:45:00	1.93	2644.63
2	22:00:00	1.91	2540.72
2	22:15:00	1.89	2437.93
2	22:30:00	1.87	2336.28
2	22:45:00	1.85	2235.79
2	23:00:00	1.83	2136.48
2	23:15:00	1.81	2038.36
2	23:30:00	1.78	1941.47

Days	Hours	Depth (ft)	Volume (ft3)
2	23:45:00	1.76	1845.83
3	0:00:00	1.74	1751.46
3	0:15:00	1.71	1658.4
3	0:30:00	1.69	1566.67
3	0:45:00	1.66	1476.33
3	1:00:00	1.63	1387.4
3	1:15:00	1.61	1299.94
3	1:30:00	1.58	1214.01
3	1:45:00	1.55	1129.66
3	2:00:00	1.51	1046.98
3	2:15:00	1.48	966.14
3	2:30:00	1.45	887.73
3	2:45:00	1.41	811.97
3	3:00:00	1.36	739.11
3	3:15:00	1.32	669.49
3	3:30:00	1.27	603.42
3	3:45:00	1.22	540.94
3	4:00:00	1.17	482.03
3	4:15:00	1.12	426.7
3	4:30:00	1.07	374.92
3	4:45:00	1.02	326.68
3	5:00:00	0.97	281.52
3	5:15:00	0.92	237.5
3	5:30:00	0.86	194.45
3	5:45:00	0.8	152.44
3	6:00:00	0.73	111.58
3	6:15:00	0.66	72.03
3	6:30:00	0.56	34.05
3	6:45:00	0.35	0.24
3	7:00:00	0	0

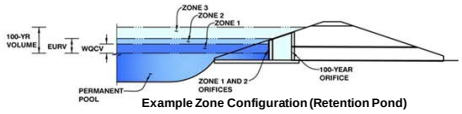
Effective Pond Empty

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: Cloverleaf Subdivision

Basin ID: P3 (Private FSD EDB for Basin L)



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	1.97	acres
Watershed Length =	431	ft
Watershed Length to Centroid =	148	ft
Watershed Slope =	0.050	ft/ft
Watershed Imperviousness =	42.30%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

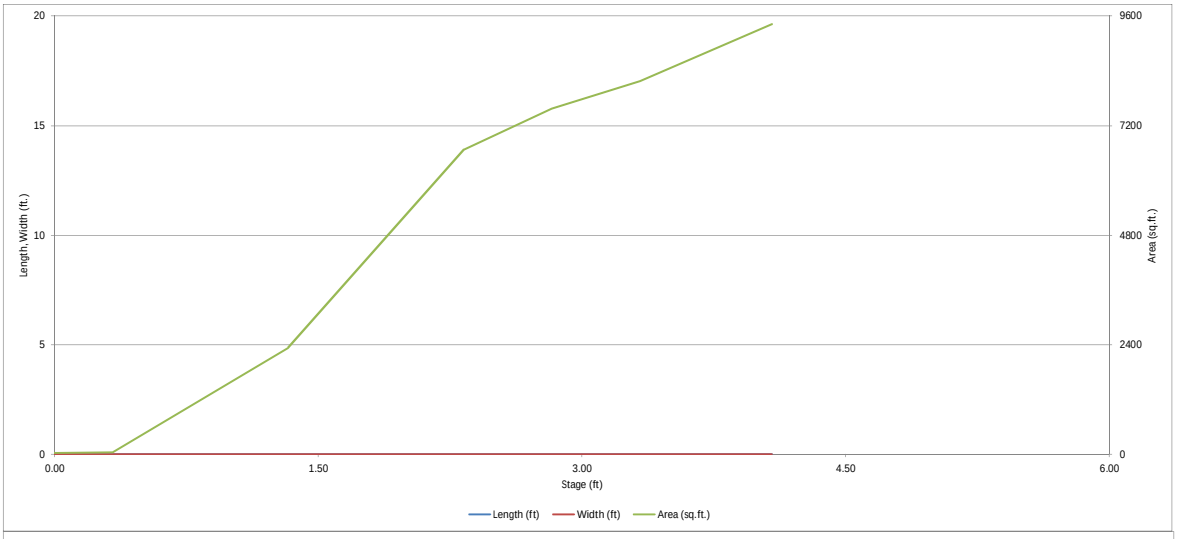
			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.031	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.088	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.080	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.118	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.153	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.201	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.239	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.288	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3 in.) =	0.364	acre-feet	3.00	inches
Approximate 2-yr Detention Volume =	0.065	acre-feet		
Approximate 5-yr Detention Volume =	0.091	acre-feet		
Approximate 10-yr Detention Volume =	0.123	acre-feet		
Approximate 25-yr Detention Volume =	0.137	acre-feet		
Approximate 50-yr Detention Volume =	0.144	acre-feet		
Approximate 100-yr Detention Volume =	0.164	acre-feet		

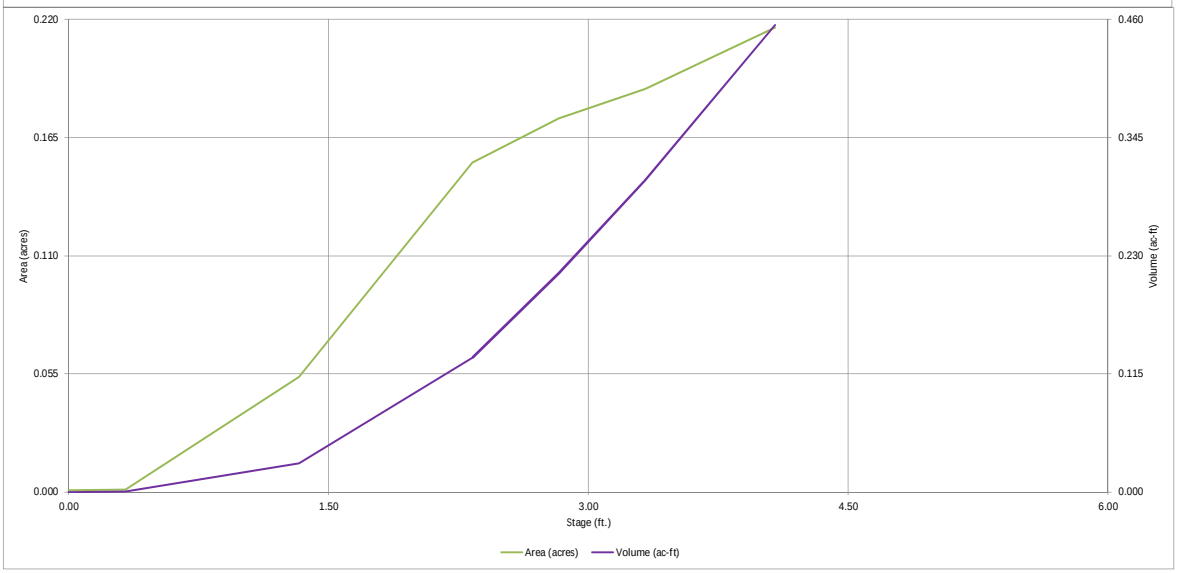
Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.031	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.057	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.076	acre-feet
Total Detention Basin Volume =	0.164	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	--	--	--	27	0.001		
EL: 7050.0	--	0.33	--	--	--	44	0.001	12	0.000
7051	--	1.33	--	--	--	2,326	0.053	1,197	0.027
7052	--	2.33	--	--	--	6,679	0.153	5,699	0.131
7052.5	--	2.83	--	--	--	7,577	0.174	9,263	0.213
7053	--	3.33	--	--	--	8,178	0.188	13,202	0.303
7053.75	--	4.08	--	--	--	9,426	0.216	19,803	0.455


20
15
10
5
0
Length, Width (ft.)
9600
7200
4800
2400
0
Area (sq.ft.)
0.00
1.50
3.00
4.50
6.00
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)

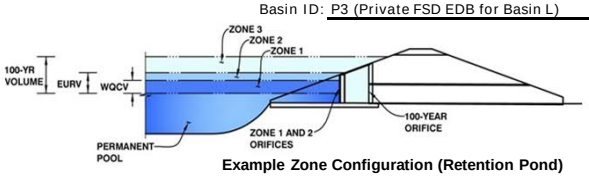

0.220
0.165
0.110
0.055
0.000
Area (acres)
0.460
0.345
0.230
0.115
0.000
Volume (ac-ft)
0.00
1.50
3.00
4.50
6.00
Stage (ft.)
Area (acres)
Volume (ac-ft)

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Project: Cloverleaf Subdivision

Basin ID: P3 (Private FSD EDB for Basin L)



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.39	0.031	Orifice Plate
Zone 2 (EURV)	2.02	0.057	Circular Orifice
Zone 3 (100-year)	2.54	0.076	Weir&Pipe (Restrict)
Total (all zones)		0.164	

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

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

Calculated Parameters for Underdrain

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	1.69	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	N/A	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	inches	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.66	1.13					
Orifice Area (sq. inches)	0.20	0.12	0.12					

	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)

	Zone 2 Circular	Not Selected			Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	1.55	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.01	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	2.02	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.05	N/A	feet
Vertical Orifice Diameter =	1.25	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 =	2.37	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	2.37	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 =	17.68	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 =	6.30	N/A	ft^2
Debris Clogging % =	0%	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 =	0.50	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.36	N/A	ft^2
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.23	N/A	feet
Restrictor Plate Height Above Pipe Invert =	4.60		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.06	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	2.83	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.25	feet
Spillway Crest Length =	14.00	feet	Stage at Top of Freeboard =	4.08	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.22	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	0.45	acre-ft

Calculated Parameters for Spillway

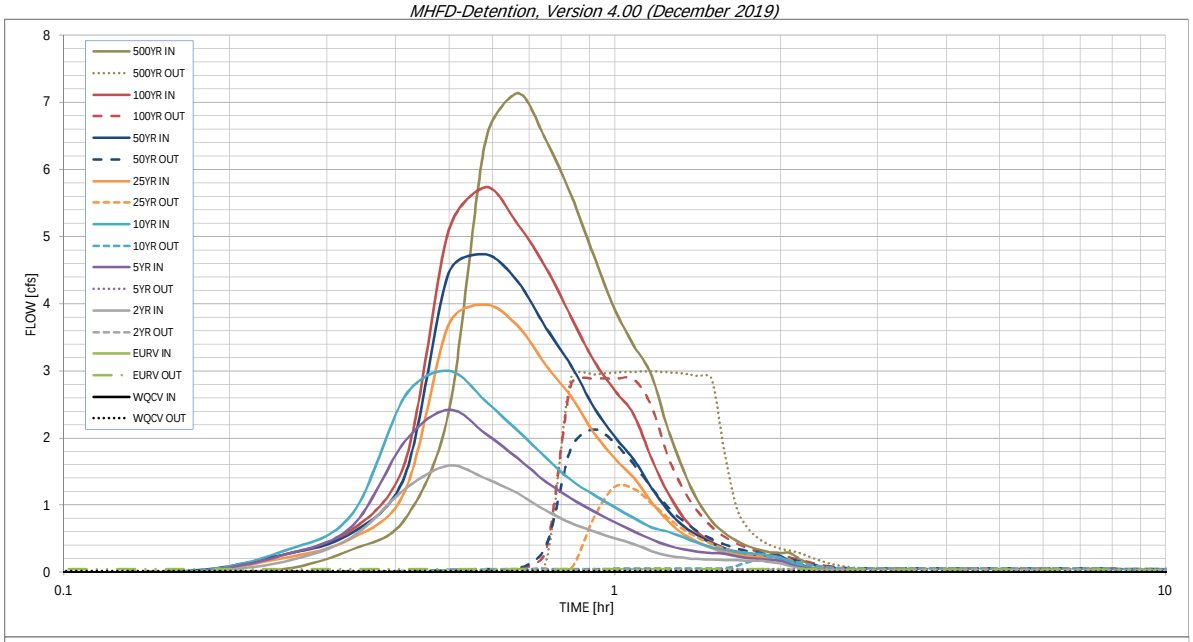
Routed Hydrograph Results

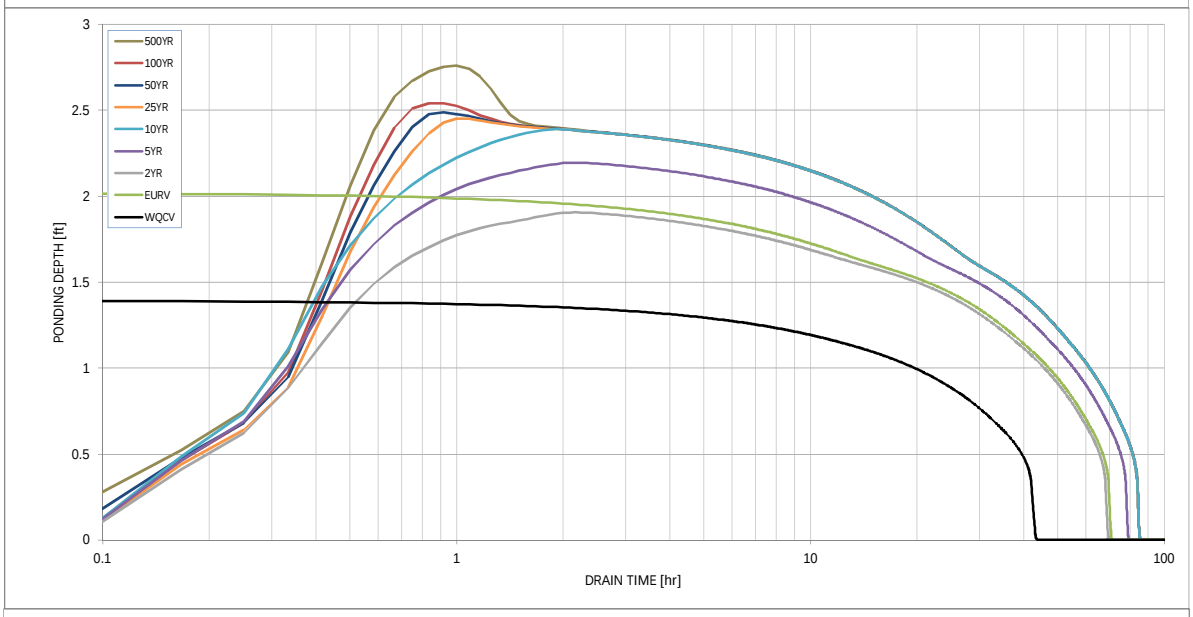
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

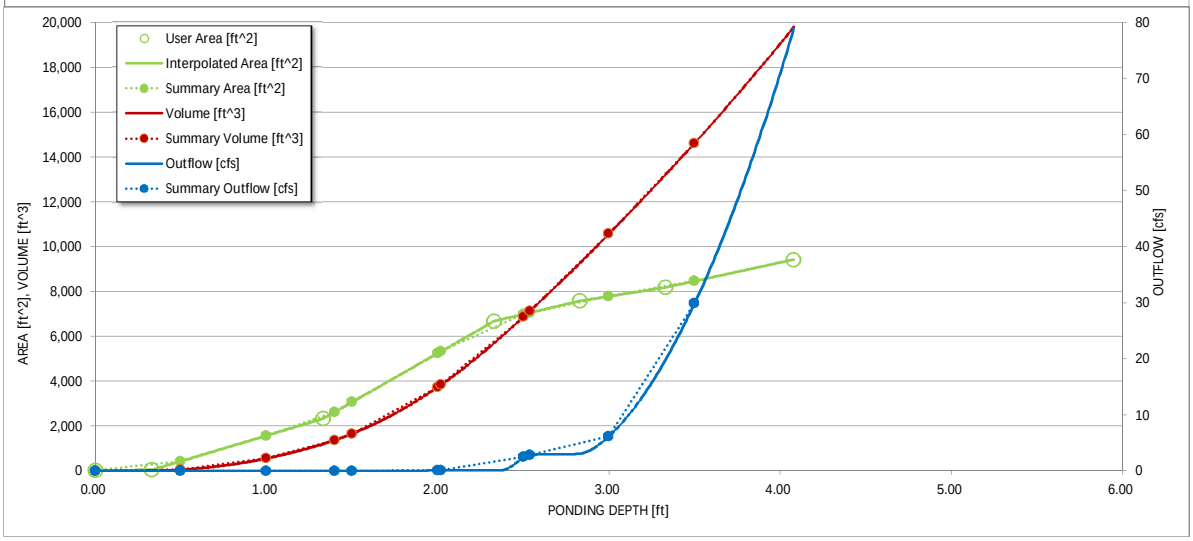
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.00
CUHP Runoff Volume (acre-ft) =	0.031	0.088	0.080	0.118	0.153	0.201	0.239	0.288	0.364
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.080	0.118	0.153	0.201	0.239	0.288	0.364
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.3	0.8	1.2	2.1	2.7	3.3	4.3
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.15	0.42	0.63	1.08	1.35	1.69	2.20
Peak Inflow Q (cfs) =	N/A	N/A	1.6	2.4	3.0	4.0	4.7	5.7	7.1
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.1	0.2	1.3	2.1	2.9	3.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.1	0.2	0.6	0.8	0.9	0.7
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	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	0.2	0.3	0.4	0.5
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) =	40	64	63	70	74	71	70	67	64
Time to Drain 99% of Inflow Volume (hours) =	42	68	67	75	81	79	79	77	76
Maximum Ponding Depth (ft) =	1.40	2.02	1.91	2.20	2.39	2.45	2.49	2.54	2.76
Area at Maximum Ponding Depth (acres) =	0.06	0.12	0.11	0.14	0.16	0.16	0.16	0.16	0.17
Maximum Volume Stored (acre-ft) =	0.031	0.088	0.074	0.110	0.140	0.150	0.154	0.164	0.201

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	0.02	0.00	0.04
	0:15:00	0.00	0.00	0.15	0.25	0.31	0.21	0.26	0.26	0.34
	0:20:00	0.00	0.00	0.52	0.68	0.86	0.50	0.58	0.63	0.80
	0:25:00	0.00	0.00	1.24	1.95	2.63	1.22	1.45	1.65	2.40
	0:30:00	0.00	0.00	1.59	2.42	3.00	3.69	4.46	5.10	6.44
	0:35:00	0.00	0.00	1.39	2.06	2.55	3.99	4.73	5.73	7.14
	0:40:00	0.00	0.00	1.17	1.70	2.11	3.67	4.33	5.19	6.44
	0:45:00	0.00	0.00	0.92	1.35	1.71	3.09	3.64	4.54	5.62
	0:50:00	0.00	0.00	0.73	1.10	1.37	2.62	3.08	3.80	4.71
	0:55:00	0.00	0.00	0.61	0.90	1.15	2.07	2.46	3.15	3.92
	1:00:00	0.00	0.00	0.51	0.75	0.97	1.70	2.02	2.71	3.38
	1:05:00	0.00	0.00	0.42	0.61	0.81	1.40	1.68	2.35	2.93
	1:10:00	0.00	0.00	0.32	0.49	0.67	1.05	1.25	1.69	2.13
	1:15:00	0.00	0.00	0.25	0.40	0.60	0.76	0.92	1.18	1.51
	1:20:00	0.00	0.00	0.21	0.34	0.52	0.57	0.69	0.81	1.05
	1:25:00	0.00	0.00	0.20	0.31	0.43	0.45	0.55	0.59	0.76
	1:30:00	0.00	0.00	0.19	0.29	0.37	0.36	0.43	0.45	0.58
	1:35:00	0.00	0.00	0.18	0.27	0.33	0.30	0.35	0.36	0.46
	1:40:00	0.00	0.00	0.18	0.24	0.31	0.26	0.31	0.29	0.39
	1:45:00	0.00	0.00	0.17	0.21	0.29	0.24	0.27	0.25	0.33
	1:50:00	0.00	0.00	0.17	0.19	0.27	0.22	0.25	0.23	0.30
	1:55:00	0.00	0.00	0.15	0.18	0.25	0.21	0.24	0.22	0.29
	2:00:00	0.00	0.00	0.13	0.17	0.22	0.21	0.24	0.22	0.28
	2:05:00	0.00	0.00	0.09	0.12	0.15	0.14	0.16	0.15	0.20
	2:10:00	0.00	0.00	0.06	0.08	0.10	0.10	0.11	0.10	0.13
	2:15:00	0.00	0.00	0.04	0.05	0.07	0.07	0.07	0.07	0.09
	2:20:00	0.00	0.00	0.03	0.03	0.05	0.04	0.05	0.05	0.06
	2:25:00	0.00	0.00	0.02	0.02	0.03	0.03	0.03	0.03	0.04
	2:30:00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.02
	2:35:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Summary Stage-Area-Volume-Discharge Relationships

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

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]
	0.00	27	0.001	0	0.000	0.00
	0.50	432	0.010	52	0.001	0.00
	1.00	1,573	0.036	553	0.013	0.01
WQCV	1.40	2,631	0.060	1,370	0.031	0.01
	1.50	3,066	0.070	1,655	0.038	0.01
	2.00	5,243	0.120	3,732	0.086	0.04
EURV	2.02	5,330	0.122	3,838	0.088	0.04
	2.50	6,984	0.160	6,861	0.157	2.49
100-YR	2.54	7,056	0.162	7,141	0.164	2.88
	3.00	7,781	0.179	10,569	0.243	6.16
	3.50	8,461	0.194	14,616	0.336	29.89

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

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

Weir Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, May 13 2021

Pond 3 Spillway

Trapezoidal Weir

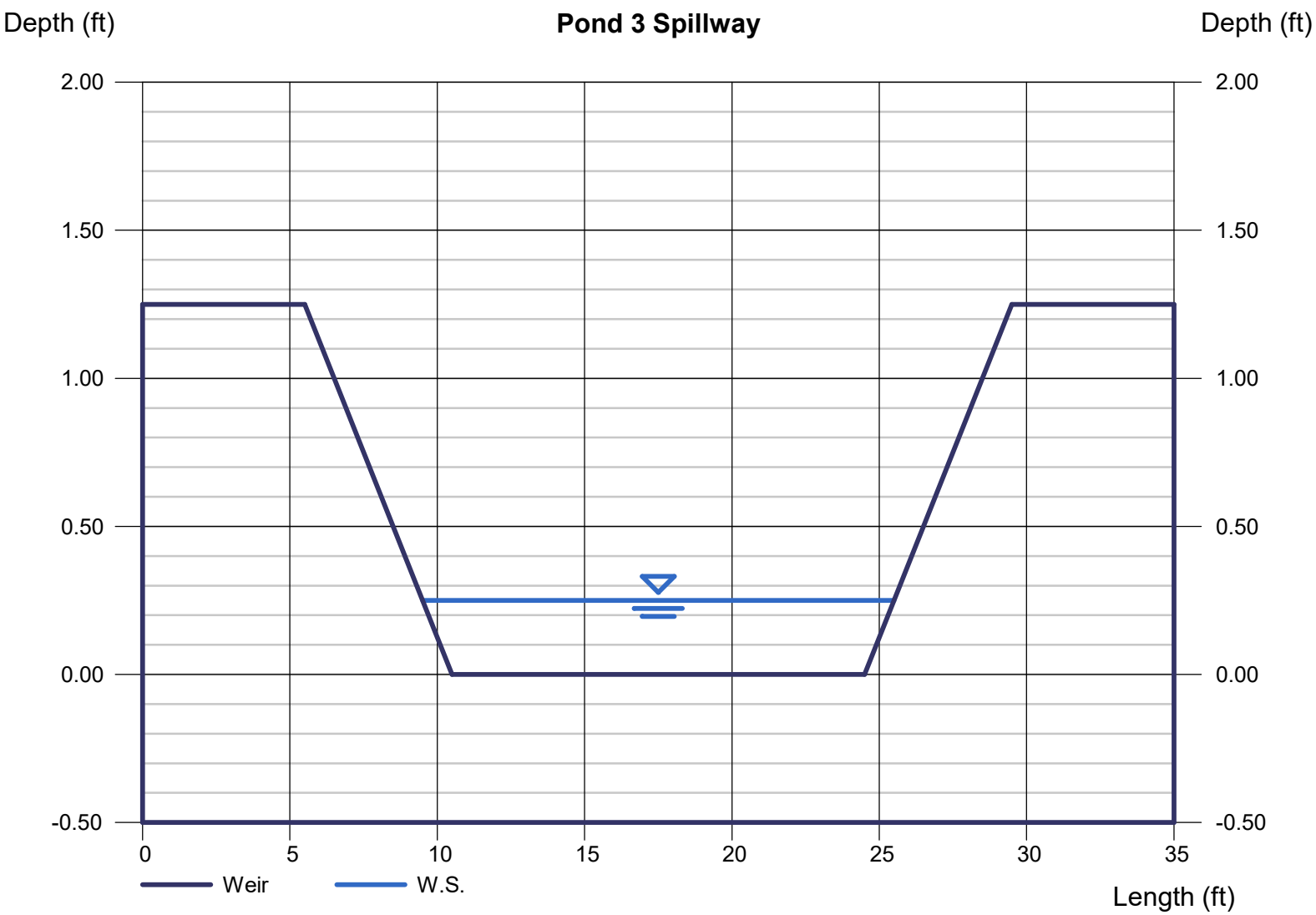
Crest	= Sharp
Bottom Length (ft)	= 14.00
Total Depth (ft)	= 1.25
Side Slope (z:1)	= 4.00

Calculations

Weir Coeff. Cw	= 3.10
Compute by:	Known Q
Known Q (cfs)	= 5.70

Highlighted

Depth (ft)	= 0.25
Q (cfs)	= 5.700
Area (sqft)	= 3.75
Velocity (ft/s)	= 1.52
Top Width (ft)	= 16.00



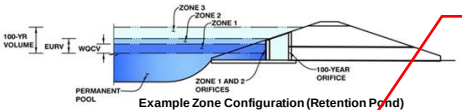
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: Cloverleaf Subdivision

Basin ID: P4 (Private Water Quality Only Pond)

From UD-BMP Spreadsheet



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	2.05	acres
Watershed Length =	586	ft
Watershed Length to Centroid =	239	ft
Watershed Slope =	0.050	ft/ft
Watershed Imperviousness =	35.80%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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) =	0.029	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.076	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.073	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.113	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.149	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.202	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.243	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.297	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3 in.) =	0.378	acre-feet	3.00	inches
Approximate 2-yr Detention Volume =	0.056	acre-feet		
Approximate 5-yr Detention Volume =	0.078	acre-feet		
Approximate 10-yr Detention Volume =	0.110	acre-feet		
Approximate 25-yr Detention Volume =	0.125	acre-feet		
Approximate 50-yr Detention Volume =	0.131	acre-feet		
Approximate 100-yr Detention Volume =	0.152	acre-feet		

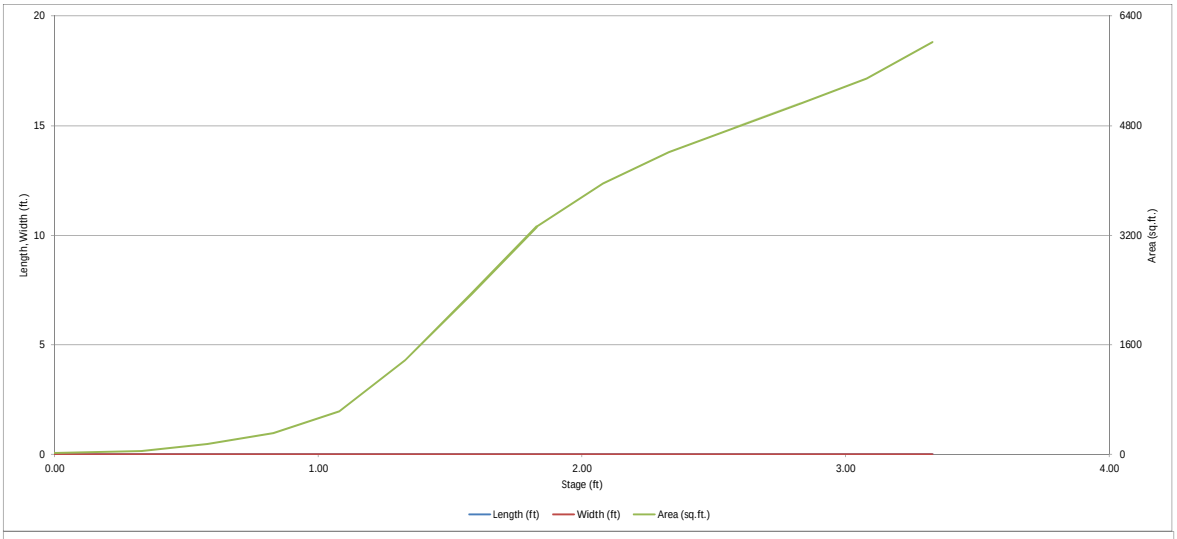
Define Zones and Basin Geometry

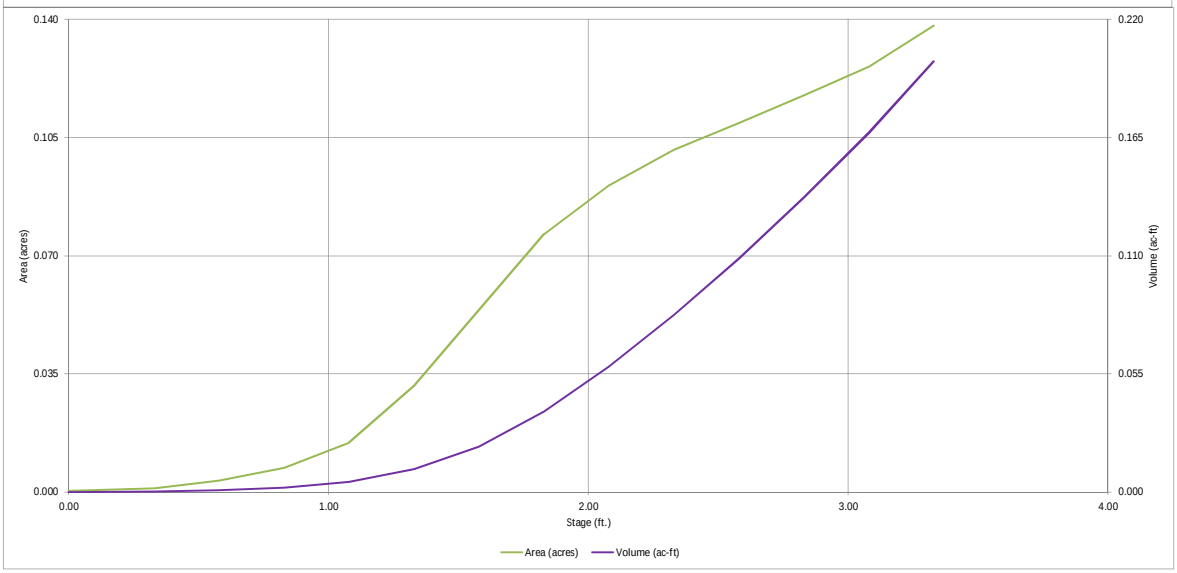
Zone 1 Volume (WQCV) =	0.029	acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.029	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention 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

Total detention volume is less than 100-year volume.

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	--	--	--	13	0.000		
EL: 7003.75	--	0.33	--	--	--	44	0.001	9	0.000
EL: 7004.00	--	0.58	--	--	--	148	0.003	33	0.001
EL: 7004.25	--	0.83	--	--	--	311	0.007	91	0.002
EL: 7004.50	--	1.08	--	--	--	629	0.014	208	0.005
EL: 7004.75	--	1.33	--	--	--	1,369	0.031	458	0.011
EL: 7005.00	--	1.58	--	--	--	2,340	0.054	922	0.021
EL: 7005.25	--	1.83	--	--	--	3,325	0.076	1,630	0.037
EL: 7005.50	--	2.08	--	--	--	3,954	0.091	2,540	0.058
EL: 7005.75	--	2.33	--	--	--	4,415	0.101	3,586	0.082
EL: 7006.00	--	2.58	--	--	--	4,764	0.109	4,733	0.109
EL: 7006.25	--	2.83	--	--	--	5,120	0.118	5,969	0.137
EL: 7006.50	--	3.08	--	--	--	5,488	0.126	7,295	0.167
EL: 7006.75	--	3.33	--	--	--	6,021	0.138	8,733	0.200


20
15
10
5
0
Length, Width (ft.)
6400
4800
3200
1600
0
Area (sq.ft.)
0.00
1.00
2.00
3.00
4.00
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)

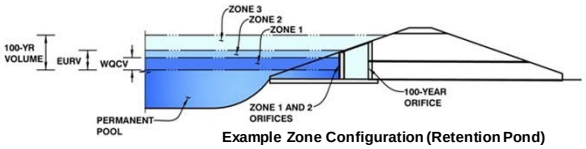

0.140
0.105
0.070
0.035
0.000
Area (acres)
0.220
0.165
0.110
0.055
0.000
Volume (ac-ft)
0.00
1.00
2.00
3.00
4.00
Stage (ft.)
Area (acres)
Volume (ac-ft)

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Project: Cloverleaf Subdivision

Basin ID: P4 (Private Water Quality Only Pond)



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.71	0.029	Orifice Plate
Zone 2			Weir&Pipe (Circular)
Zone 3			
Total (all zones)		0.029	

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

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

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

			Calculated Parameters for Plate		
Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	1.71	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	N/A	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	inches	Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.83						
Orifice Area (sq. inches)	0.13	0.18						

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

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected		Calculated Parameters for Vertical Orifice	Not Selected	Not Selected	
Invert of Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =			ft^2
Depth at top of Zone using Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =			feet
Vertical Orifice Diameter =			inches				

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

	Zone 2 Weir	Not Selected		Calculated Parameters for Overflow Weir	Zone 2 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	1.72		ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	1.72		feet
Overflow Weir Front Edge Length =	4.00		feet	Overflow Weir Slope Length =	4.00		feet
Overflow Weir Grate Slope =	0.00		H:V	Grate Open Area / 100-yr Orifice Area =	6.34		
Horiz. Length of Weir Sides =	4.00		feet	Overflow Grate Open Area w/o Debris =	11.20		ft^2
Overflow Grate Open Area % =	70%		%, grate open area/total area	Overflow Grate Open Area w/ Debris =	11.20		ft^2
Debris Clogging % =	0%		%				

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

	Zone 2 Circular	Not Selected		Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate	Zone 2 Circular	Not Selected	
Depth to Invert of Outlet Pipe =	0.50		ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	1.77		ft^2
Circular Orifice Diameter =	18.00		inches	Outlet Orifice Centroid =	0.75		feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

			Calculated Parameters for Spillway		
Spillway Invert Stage=	2.13	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.19	feet
Spillway Crest Length =	22.00	feet	Stage at Top of Freeboard =	3.32	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.14	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	0.20	acre-ft

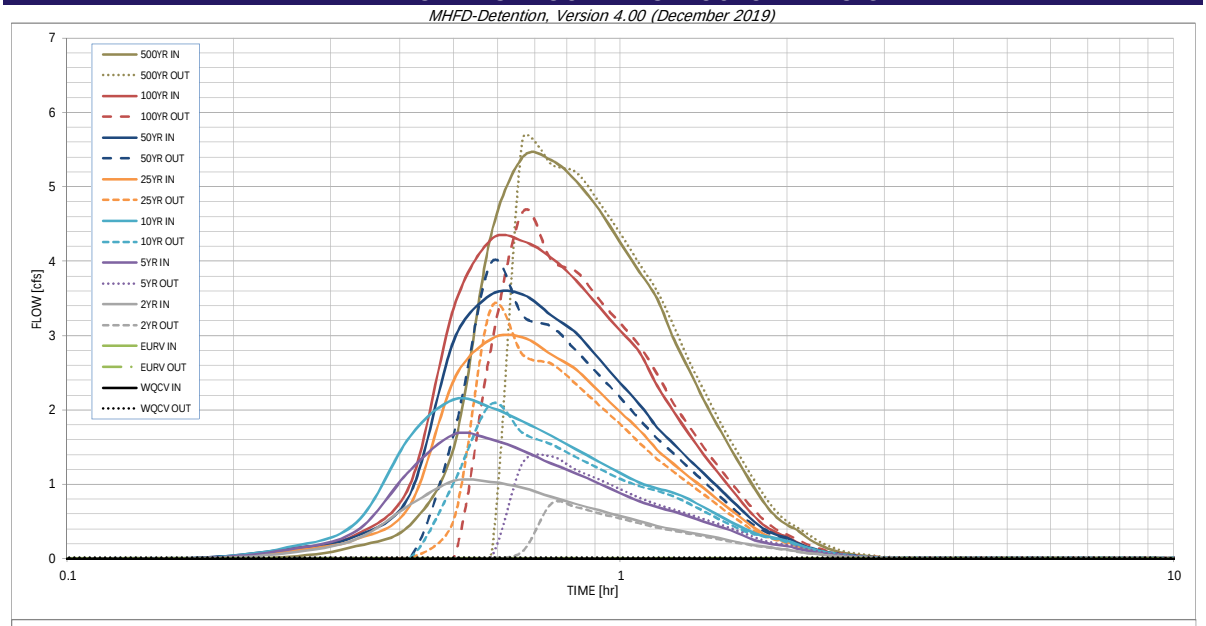
Routed Hydrograph Results

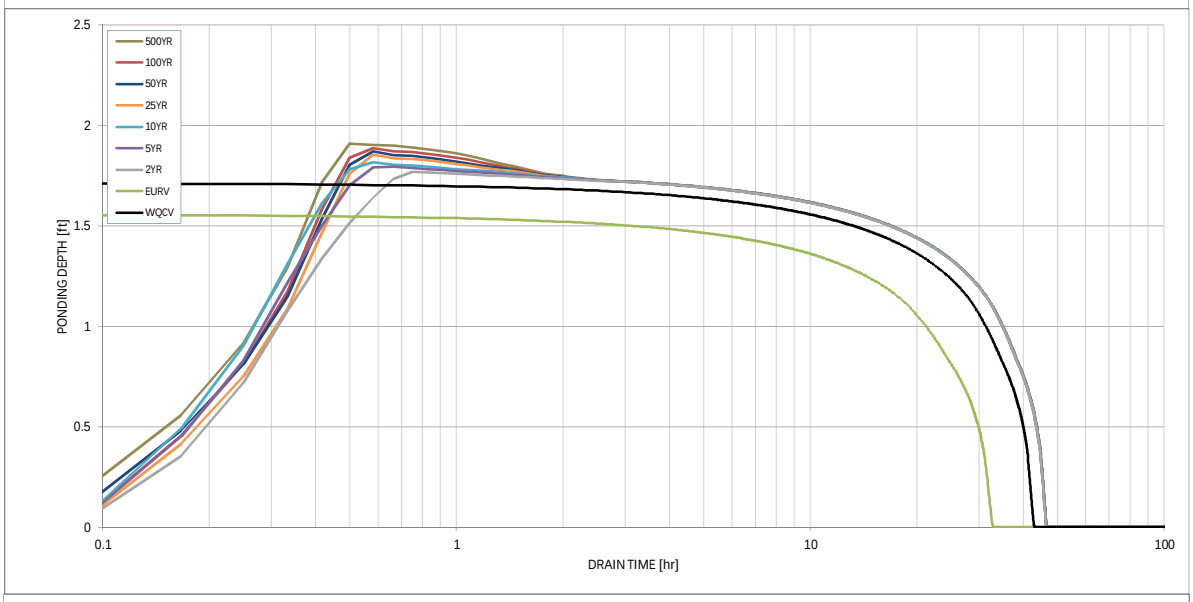
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

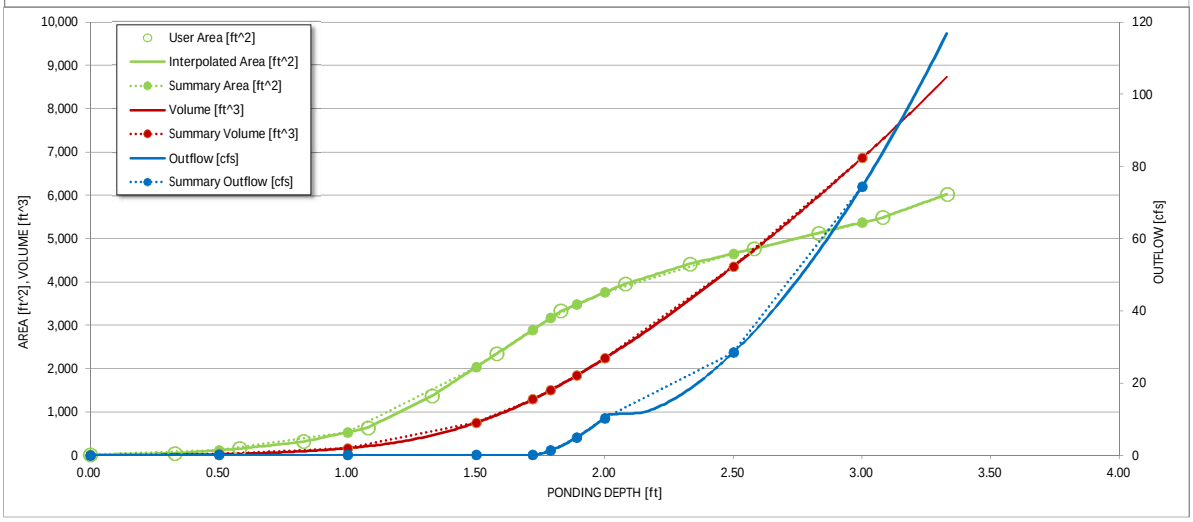
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.00
CUHP Runoff Volume (acre-ft) =	0.029	0.076	0.073	0.113	0.149	0.202	0.243	0.297	0.378
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.073	0.113	0.149	0.202	0.243	0.297	0.378
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.2	0.7	1.0	1.7	2.2	2.7	3.5
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.11	0.32	0.48	0.85	1.06	1.33	1.73
Peak Inflow Q (cfs) =	N/A	N/A	1.0	1.7	2.1	3.0	3.5	4.3	5.4
Peak Outflow Q (cfs) =	0.0	8.2	0.7	1.4	2.1	3.4	4.0	4.7	5.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	2.1	2.1	1.9	1.8	1.7	1.6
Structure Controlling Flow =	Overflow Weir 1	Spillway	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1
Max Velocity through Grate 1 (fps) =	N/A	1.08	0.07	0.1	0.2	0.3	0.4	0.4	0.5
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) =	39	27	38	36	34	31	30	27	24
Time to Drain 99% of Inflow Volume (hours) =	41	30	43	41	40	39	38	36	35
Maximum Ponding Depth (ft) =	1.72	2.27	1.77	1.79	1.82	1.85	1.87	1.89	1.91
Area at Maximum Ponding Depth (acres) =	0.07	0.10	0.07	0.07	0.07	0.08	0.08	0.08	0.08
Maximum Volume Stored (acre-ft) =	0.030	0.076	0.032	0.034	0.036	0.039	0.040	0.041	0.043

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	0.01	0.00	0.02
	0:15:00	0.00	0.00	0.07	0.12	0.15	0.10	0.13	0.12	0.17
	0:20:00	0.00	0.00	0.26	0.37	0.48	0.26	0.30	0.32	0.45
	0:25:00	0.00	0.00	0.72	1.19	1.64	0.72	0.86	0.99	1.49
	0:30:00	0.00	0.00	1.05	1.67	2.14	2.40	2.93	3.37	4.34
	0:35:00	0.00	0.00	1.03	1.61	2.03	2.95	3.54	4.28	5.40
	0:40:00	0.00	0.00	0.95	1.45	1.84	2.97	3.55	4.27	5.36
	0:45:00	0.00	0.00	0.83	1.28	1.65	2.74	3.27	4.05	5.07
	0:50:00	0.00	0.00	0.73	1.15	1.47	2.54	3.03	3.73	4.68
	0:55:00	0.00	0.00	0.65	1.01	1.30	2.24	2.68	3.38	4.25
	1:00:00	0.00	0.00	0.57	0.88	1.15	1.97	2.36	3.07	3.85
	1:05:00	0.00	0.00	0.51	0.77	1.02	1.73	2.08	2.77	3.49
	1:10:00	0.00	0.00	0.44	0.70	0.94	1.46	1.76	2.32	2.95
	1:15:00	0.00	0.00	0.39	0.63	0.89	1.27	1.54	1.98	2.53
	1:20:00	0.00	0.00	0.35	0.56	0.80	1.10	1.33	1.67	2.13
	1:25:00	0.00	0.00	0.31	0.50	0.69	0.95	1.15	1.40	1.79
	1:30:00	0.00	0.00	0.28	0.44	0.59	0.80	0.96	1.16	1.48
	1:35:00	0.00	0.00	0.24	0.38	0.50	0.66	0.79	0.94	1.20
	1:40:00	0.00	0.00	0.21	0.31	0.41	0.53	0.64	0.74	0.94
	1:45:00	0.00	0.00	0.18	0.25	0.34	0.41	0.49	0.57	0.72
	1:50:00	0.00	0.00	0.16	0.21	0.30	0.32	0.38	0.43	0.56
	1:55:00	0.00	0.00	0.14	0.19	0.27	0.26	0.32	0.35	0.46
	2:00:00	0.00	0.00	0.12	0.17	0.24	0.23	0.28	0.29	0.39
	2:05:00	0.00	0.00	0.10	0.14	0.19	0.18	0.22	0.22	0.29
	2:10:00	0.00	0.00	0.08	0.11	0.15	0.13	0.17	0.16	0.22
	2:15:00	0.00	0.00	0.06	0.09	0.12	0.10	0.13	0.12	0.16
	2:20:00	0.00	0.00	0.05	0.07	0.09	0.08	0.10	0.09	0.12
	2:25:00	0.00	0.00	0.04	0.05	0.07	0.06	0.07	0.06	0.09
	2:30:00	0.00	0.00	0.03	0.04	0.05	0.05	0.06	0.05	0.07
	2:35:00	0.00	0.00	0.02	0.03	0.04	0.03	0.04	0.04	0.05
	2:40:00	0.00	0.00	0.02	0.02	0.03	0.03	0.03	0.03	0.04
	2:45:00	0.00	0.00	0.01	0.02	0.02	0.02	0.02	0.02	0.03
	2:50:00	0.00	0.00	0.01	0.01	0.02	0.01	0.02	0.02	0.02
	2:55:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	3:00:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Summary Stage-Area-Volume-Discharge Relationships

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

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]
	0.00	13	0.000	0	0.000	0.00
	0.50	115	0.003	23	0.001	0.00
	1.00	527	0.012	162	0.004	0.01
	1.50	2,029	0.047	747	0.017	0.01
WQCV	1.72	2,892	0.066	1,288	0.030	0.01
5-YR	1.79	3,167	0.073	1,500	0.034	1.29
100-YR	1.89	3,476	0.080	1,834	0.042	4.85
	2.00	3,753	0.086	2,231	0.051	10.24
	2.50	4,652	0.107	4,356	0.100	28.42
	3.00	5,370	0.123	6,860	0.157	74.45

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

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

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	0.60	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: REB
Company: JR Engineering
Date: August 18, 2021
Project: Cloverleaf Filing No. 2
Location: El Paso County

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	O	N	M											
Receiving Pervious Area Soil Type	Sandy Loam	Sandy Loam	Sandy Loam											
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	0.980	0.530	0.540											
Directly Connected Impervious Area (DCIA, acres)	0.235	0.150	0.120											
Unconnected Impervious Area (UIA, acres)	0.319	0.160	0.200											
Receiving Pervious Area (RPA, acres)	0.426	0.220	0.220											
Separate Pervious Area (SPA, acres)	0.000	0.000	0.000											
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	V	C	C	C	C	C	C	C	C	C	C			
				MISSING INPUT	MISSING INPUT	MISSING INPUT	MISSING INPUT	MISSING INPUT	MISSING INPUT	MISSING INPUT	MISSING INPUT			

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	0.980	0.530	0.540											
Directly Connected Impervious Area (DCIA, %)	24.0%	28.3%	22.2%											
Unconnected Impervious Area (UIA, %)	32.6%	30.2%	37.0%											
Receiving Pervious Area (RPA, %)	43.5%	41.5%	40.7%											
Separate Pervious Area (SPA, %)	0.0%	0.0%	0.0%											
A_R (RPA / UIA)	1.335	1.375	1.100											
I_a Check	0.430	0.420	0.480											
f / I for WQCV Event:	1.7	1.7	1.7											
f / I for 5-Year Event:	0.5	0.5	0.5											
f / I for 100-Year Event:	0.3	0.3	0.3											
f / I for Optional User Defined Storm CUHP:														
IRF for WQCV Event:	0.00	0.62	0.65											
IRF for 5-Year Event:	0.87	0.88	0.89											
IRF for 100-Year Event:	0.92	0.92	0.93											
IRF for Optional User Defined Storm CUHP:														
Total Site Imperviousness: I_{total}	56.5%	58.5%	59.3%											
Effective Imperviousness for WQCV Event:	24.0%	47.1%	46.3%											
Effective Imperviousness for 5-Year Event:	52.3%	55.0%	55.3%											
Effective Imperviousness for 100-Year Event:	53.9%	56.1%	56.6%											
Effective Imperviousness for Optional User Defined Storm CUHP:														

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	N/A	14.2%	16.0%									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
100-Year Event CREDIT**: Reduce Detention By:	4.5%	4.0%	4.4%									N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:														

Total Site Imperviousness:	57.8%
Total Site Effective Imperviousness for WQCV Event:	35.8%
Total Site Effective Imperviousness for 5-Year Event:	53.8%
Total Site Effective Imperviousness for 100-Year Event:	55.2%
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

USACE Steep slope Method (2%-20% Channel Slope)

Emergency Overlow into Pond P2

Slope of Bed	0.09	ft/ft
Bottom width of Channel	1	ft
Channel Flow	3.8	ft^3/S
Gravity constant (g)	32.2	ft/s
Unit Discharge (q)	4.75	
d30	0.449503	
D30 INCHES	5.39404	

In cases where unit discharge is low, riprap can be used on steep slopes ranging from 2 to 20 percent. A typical application is a rock-lined chute. The stone size equation is

$$D_{30} = \frac{1.95\ S^{0.555}\ q^{2/3}}{g^{1/3}} \qquad (3\text{-}5)$$

where

S = slope of bed

q = unit discharge

Equation 3-5 is applicable to thickness = 1.5 D_{100}, angular rock, unit weight of 167 pcf, D_{85}/D_{15} from 1.7 to 2.7, slopes from 2 to 20 percent, and uniform flow on a down-slope with no tailwater. The following steps should be used in application of Equation 3-5:

(1) Estimate q = Q/b where b = bottom width of chute.

(2) Multiply q by flow concentration factor of 1.25. Use greater factor if approach flow is skewed.

(3) Compute D_{30} using Equation 3-5.

(4) Use uniform gradation having $D_{85}/D_{15} \leq 2$ such as Table 3-1.

(5) Restrict application to straight channels with side slope of 1V:2.5H or flatter.

(6) Use filter fabric beneath rock.

The guidance for steep slope riprap generally results in large riprap sizes. Grouted riprap is often used instead of loose riprap in steep slope applications. *

TABLE 3. VOID–FILLED RIPRAP PLACEMENT AND GRADATION

RIPRAP DESIGNATION	% SMALLER THAN GIVEN SIZE BY WEIGHT	INTERMEDIATE ROCK DIMENSION (INCHES)	D_{50}* (INCHES)
TYPE VL	70 – 100 50 – 70 35 – 50 2 – 10	12 9 6 2	6
TYPE L	70 – 100 50 – 70 35 – 50 2 – 10	15 12 9 3	9
TYPE M	70 – 100 50 – 70 35 – 50 2 – 10	21 18 12 4	12
TYPE H	70 – 100 50 – 70 35 – 50 2 – 10	30 24 18 6	18

*D_{50} = MEAN ROCK SIZE

NOTE: MIX ON SITE AND PRIOR TO PLACEMENT

Use Type L Riprap

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Oct 22 2021

Pond 4 Rundown

Triangular

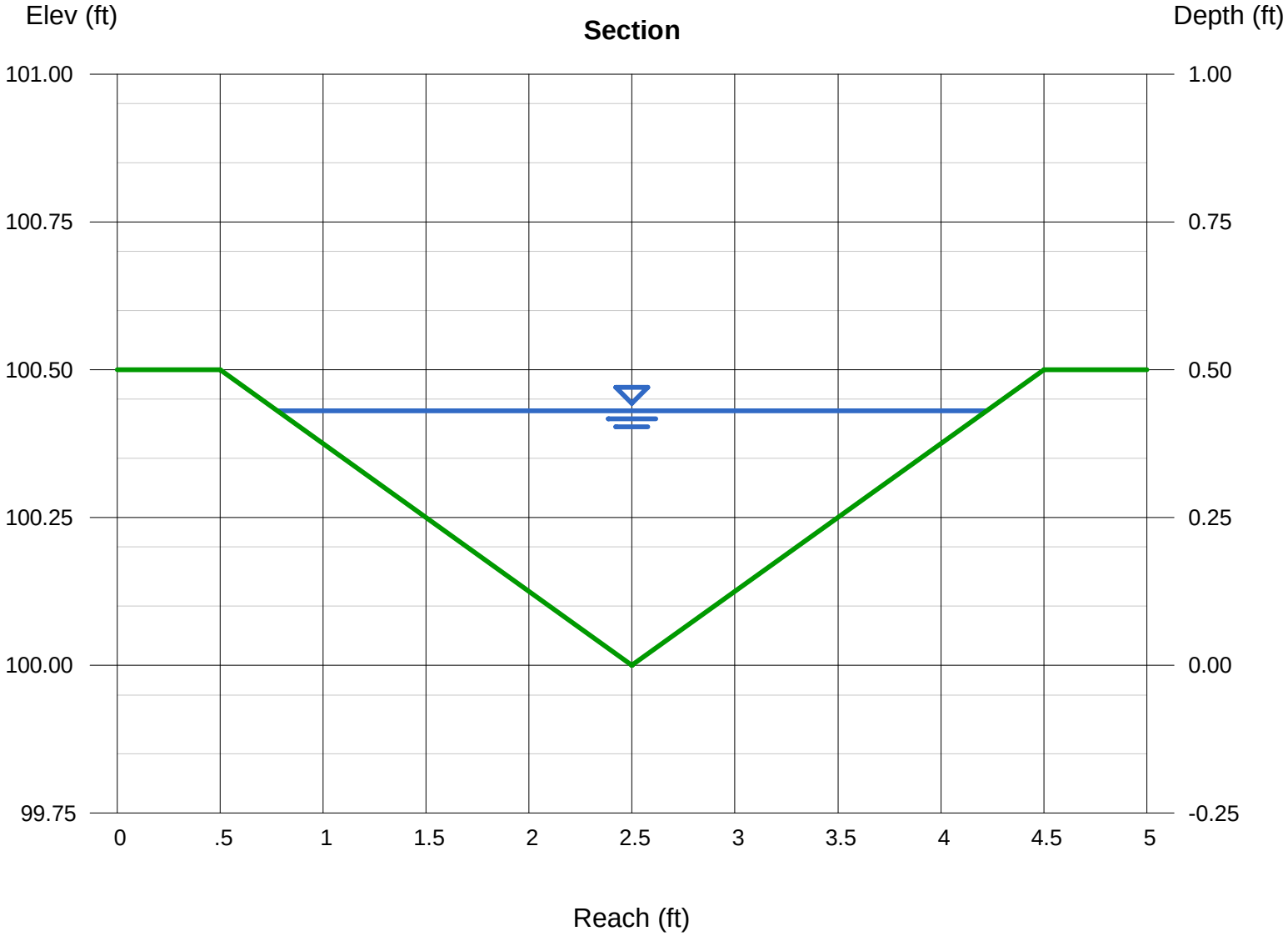
Side Slopes (z:1)	=	4.00, 4.00
Total Depth (ft)	=	0.50
Invert Elev (ft)	=	100.00
Slope (%)	=	8.77
N-Value	=	0.030

Calculations

Compute by:		Known Q
Known Q (cfs)	=	3.80

Highlighted

Depth (ft)	=	0.43
Q (cfs)	=	3.800
Area (sqft)	=	0.74
Velocity (ft/s)	=	5.14
Wetted Perim (ft)	=	3.55
Crit Depth, Yc (ft)	=	0.50
Top Width (ft)	=	3.44
EGL (ft)	=	0.84



Weir Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, May 13 2021

Pond 4 Spillway

Trapezoidal Weir

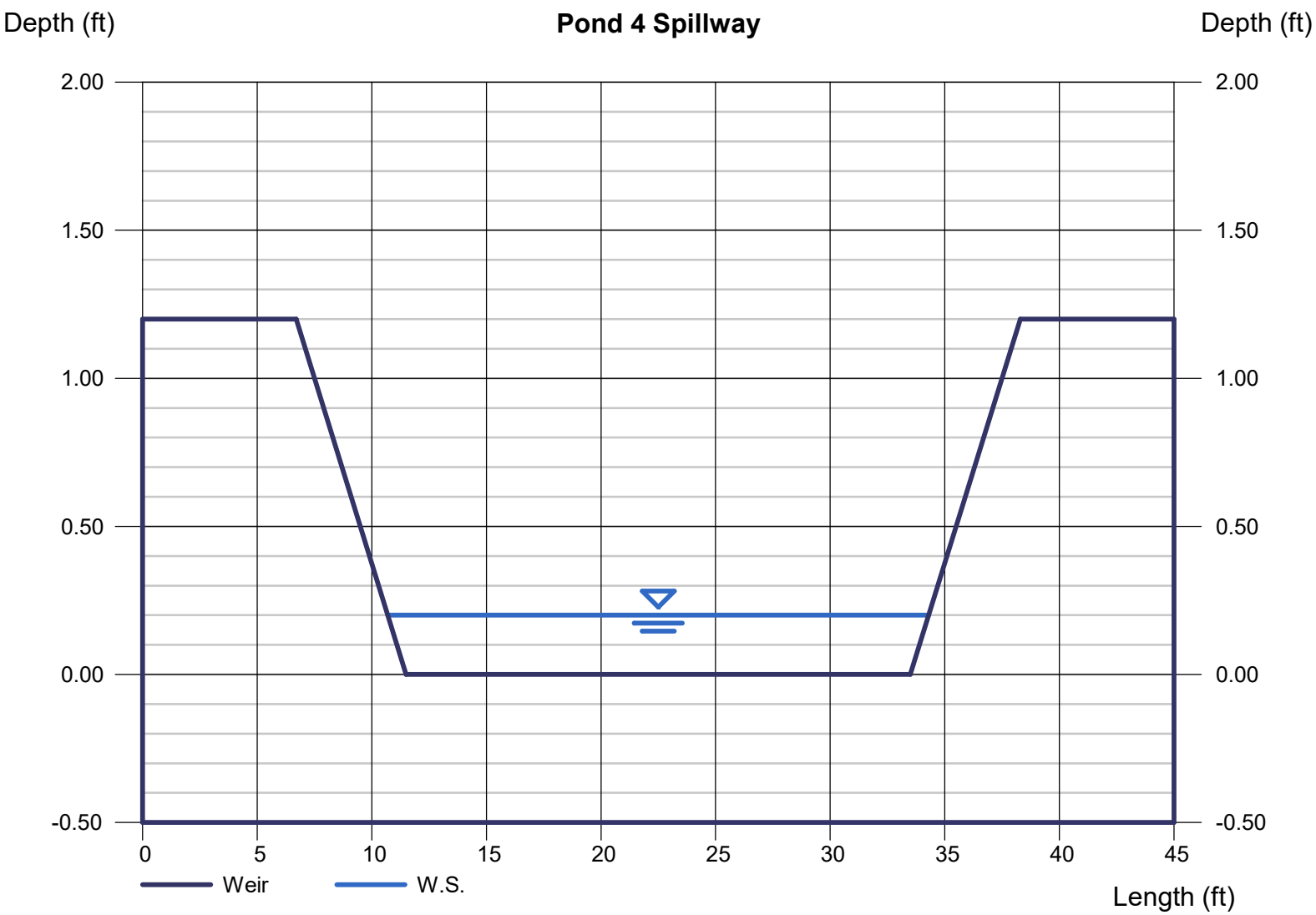
Crest	= Sharp
Bottom Length (ft)	= 22.00
Total Depth (ft)	= 1.20
Side Slope (z:1)	= 4.00

Calculations

Weir Coeff. Cw	= 3.10
Compute by:	Known Q
Known Q (cfs)	= 6.10

Highlighted

Depth (ft)	= 0.20
Q (cfs)	= 6.100
Area (sqft)	= 4.56
Velocity (ft/s)	= 1.34
Top Width (ft)	= 23.60

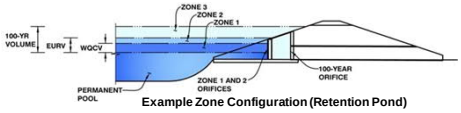


DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: Cloverleaf Subdivision

Basin ID: OS4 (Sand Filter)



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	SF	
Watershed Area =	1.00	acres
Watershed Length =	248	ft
Watershed Length to Centroid =	105	ft
Watershed Slope =	0.060	ft/ft
Watershed Imperviousness =	28.40%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	12.0	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) =	0.010	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.029	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.028	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.046	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.063	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.088	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.107	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.133	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3 in.) =	0.171	acre-feet	3.00	inches
Approximate 2-yr Detention Volume =	0.021	acre-feet		
Approximate 5-yr Detention Volume =	0.030	acre-feet		
Approximate 10-yr Detention Volume =	0.044	acre-feet		
Approximate 25-yr Detention Volume =	0.051	acre-feet		
Approximate 50-yr Detention Volume =	0.054	acre-feet		
Approximate 100-yr Detention Volume =	0.064	acre-feet		

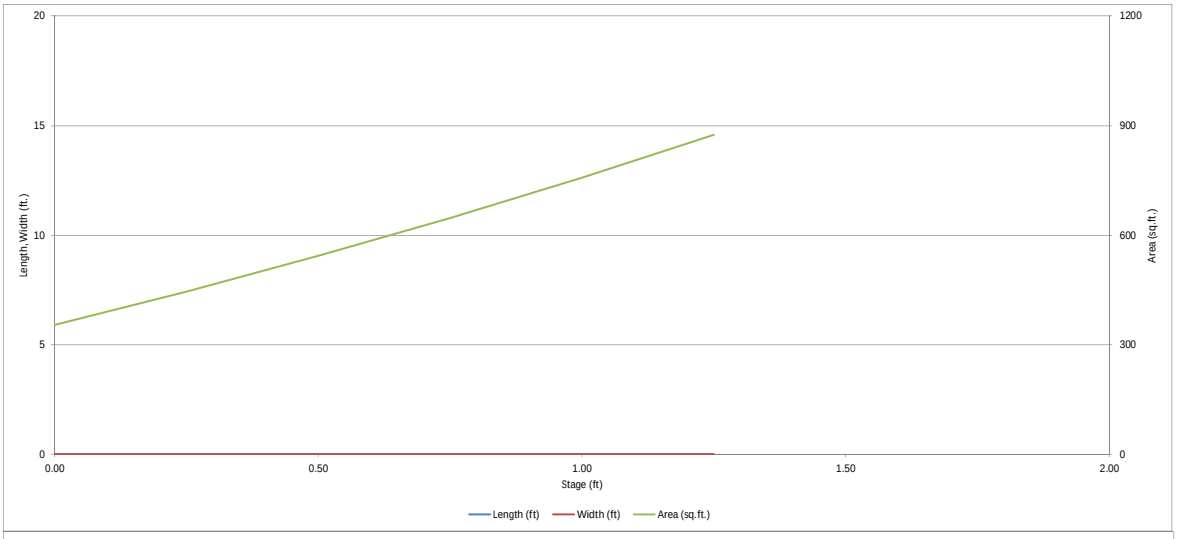
Define Zones and Basin Geometry

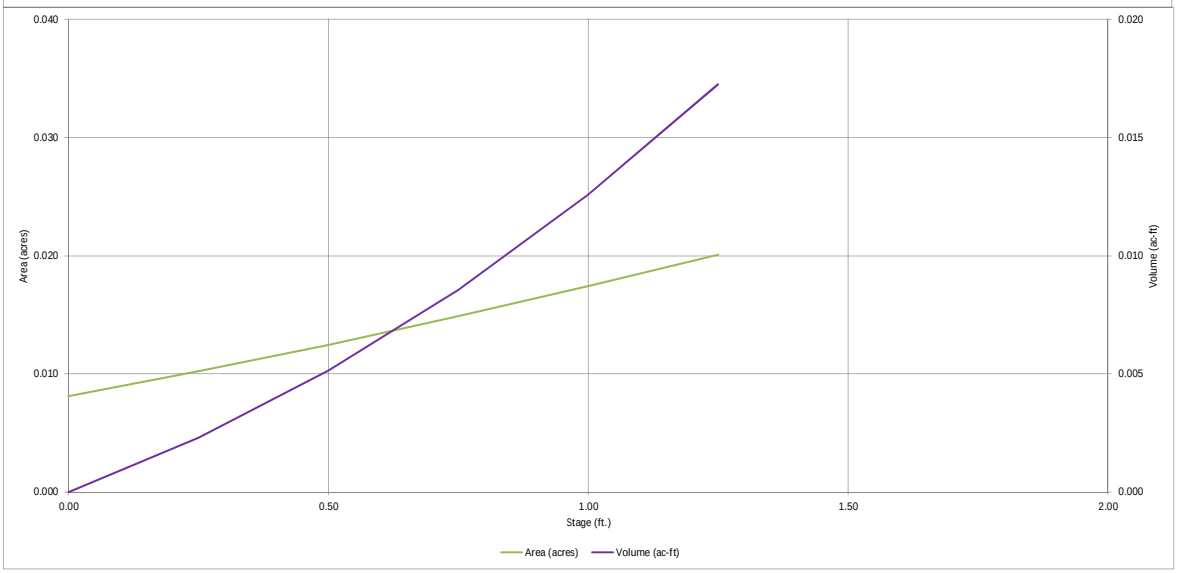
Zone 1 Volume (WQCV) =	0.010	acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.010	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	N/A	ft
Slope of Trickle Channel (S_{TC}) =	N/A	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

Total detention volume is less than 100-year volume.

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)
Media Surface	--	0.00	--	--	--	354	0.008		
EL:7064.25	--	0.25	--	--	--	445	0.010	100	0.002
EL:7064.50	--	0.50	--	--	--	543	0.012	223	0.005
EL:7064.75	--	0.75	--	--	--	647	0.015	372	0.009
EL:7065.00	--	1.00	--	--	--	758	0.017	548	0.013
EL:7065.25	--	1.25	--	--	--	875	0.020	752	0.017


20
15
10
5
0
Length, Width (ft.)
1200
900
600
300
0
Area (sq.ft.)
0.00
0.50
1.00
1.50
2.00
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)

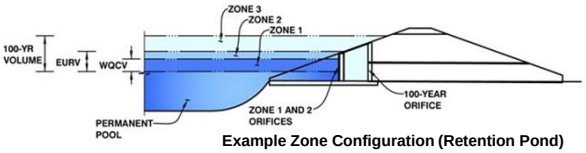

0.040
0.030
0.020
0.010
0.000
Area (acres)
0.020
0.015
0.010
0.005
0.000
Volume (ac-ft)
0.00
0.50
1.00
1.50
2.00
Stage (ft.)
Area (acres)
Volume (ac-ft)

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Project: Cloverleaf Subdivision

Basin ID: OS4 (Sand Filter)



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.83	0.010	Filtration Media
Zone 2			Weir&Pipe (Circular)
Zone 3			
Total (all zones)		0.010	

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

Underdrain Orifice Invert Depth =	2.00	ft (distance below the filtration media surface)	Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Diameter =	0.50	inches	Underdrain Orifice Centroid =	0.02	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 =	N/A	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	N/A	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	N/A	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	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 (optional)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected			Not Selected	Not Selected	
Invert of Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =			ft^2
Depth at top of Zone using Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =			feet
Vertical Orifice Diameter =			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 2 Weir	Not Selected			Zone 2 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	0.86		ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	0.86		feet
Overflow Weir Front Edge Length =	3.00		feet	Overflow Weir Slope Length =	3.00		feet
Overflow Weir Grate Slope =	0.00		H:V	Grate Open Area / 100-yr Orifice Area =	3.57		
Horiz. Length of Weir Sides =	3.00		feet	Overflow Grate Open Area w/o Debris =	6.30		ft^2
Overflow Grate Open Area % =	70%		%, grate open area/total area	Overflow Grate Open Area w/ Debris =	3.15		ft^2
Debris Clogging % =	50%		%				

Calculated Parameters for Overflow Weir

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

	Zone 2 Circular	Not Selected			Zone 2 Circular	Not Selected	
Depth to Invert of Outlet Pipe =	2.00		ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	1.77		ft^2
Circular Orifice Diameter =	18.00		inches	Outlet Orifice Centroid =	0.75		feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

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

Calculated Parameters for Spillway

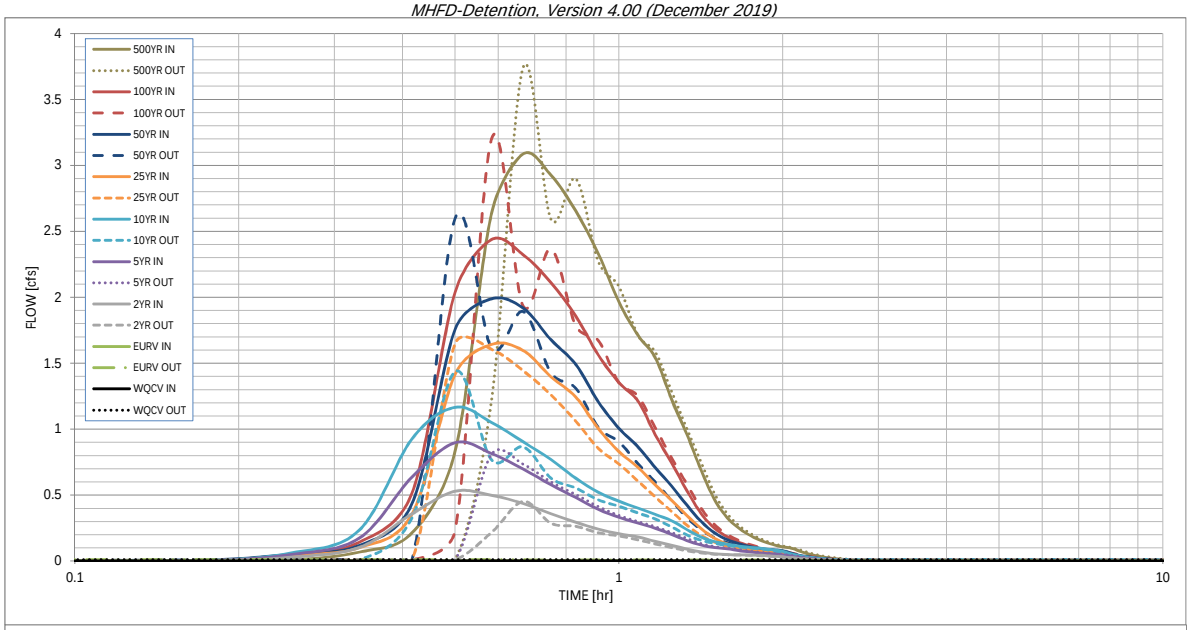
Routed Hydrograph Results

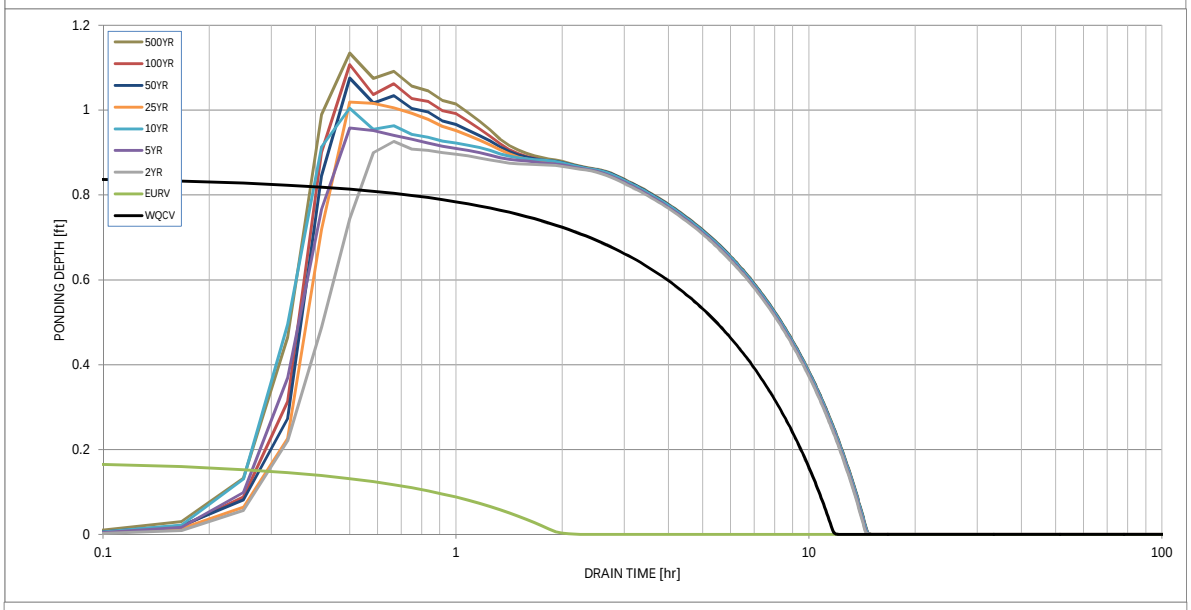
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

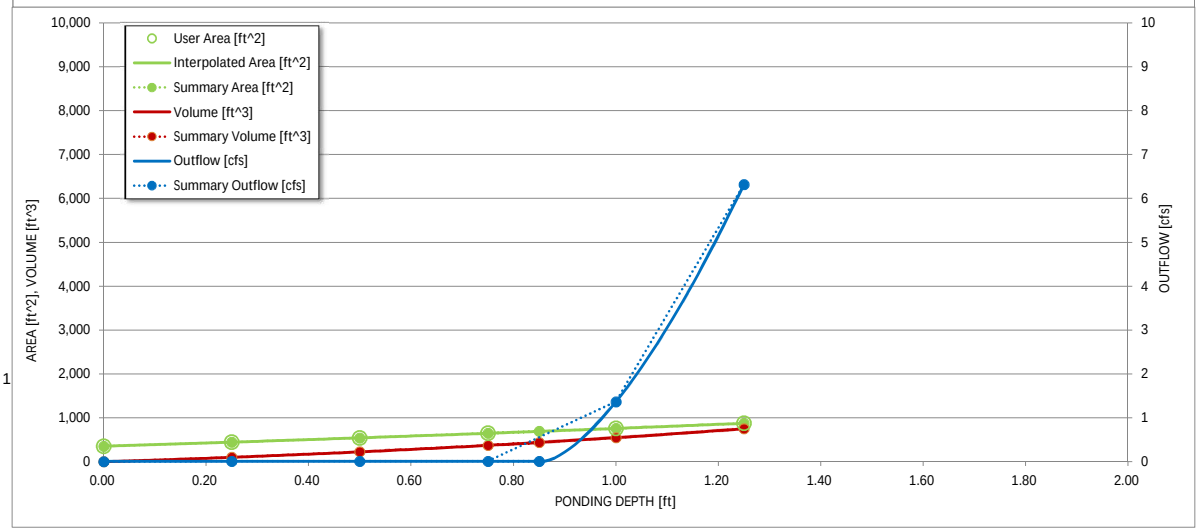
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.00
CUHP Runoff Volume (acre-ft) =	0.010	0.029	0.028	0.046	0.063	0.088	0.107	0.133	0.171
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.028	0.046	0.063	0.088	0.107	0.133	0.171
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.2	0.5	0.7	1.2	1.5	1.9	2.5
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.17	0.47	0.72	1.20	1.50	1.88	2.45
Peak Inflow Q (cfs) =	N/A	N/A	0.5	0.9	1.2	1.6	2.0	2.4	3.1
Peak Outflow Q (cfs) =	0.0	4.0	0.5	0.8	1.4	1.6	2.6	3.2	3.7
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.7	2.0	1.4	1.7	1.7	1.5
Structure Controlling Flow =	Filtration Media	Filtration Media	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir
Max Velocity through Grate 1 (fps) =	N/A	N/A	0.08	0.1	0.2	0.3	0.4	0.5	0.6
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) =	11	1	14	13	12	11	11	10	8
Time to Drain 99% of Inflow Volume (hours) =	12	2	14	14	14	14	13	13	13
Maximum Ponding Depth (ft) =	0.85	0.17	0.93	0.96	1.00	1.02	1.08	1.11	1.13
Area at Maximum Ponding Depth (acres) =	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Maximum Volume Stored (acre-ft) =	0.010	0.001	0.011	0.012	0.013	0.013	0.014	0.014	0.015

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	0.00	0.00	0.01
	0:15:00	0.00	0.00	0.03	0.05	0.06	0.04	0.05	0.05	0.07
	0:20:00	0.00	0.00	0.10	0.17	0.23	0.10	0.12	0.14	0.21
	0:25:00	0.00	0.00	0.36	0.64	0.93	0.36	0.44	0.52	0.83
	0:30:00	0.00	0.00	0.53	0.90	1.17	1.42	1.76	2.04	2.63
	0:35:00	0.00	0.00	0.50	0.82	1.05	1.64	1.99	2.44	3.09
	0:40:00	0.00	0.00	0.44	0.70	0.90	1.60	1.92	2.32	2.93
	0:45:00	0.00	0.00	0.36	0.58	0.77	1.40	1.68	2.11	2.65
	0:50:00	0.00	0.00	0.29	0.48	0.63	1.24	1.49	1.86	2.33
	0:55:00	0.00	0.00	0.24	0.39	0.52	1.00	1.21	1.56	1.97
	1:00:00	0.00	0.00	0.21	0.33	0.45	0.83	1.01	1.35	1.71
	1:05:00	0.00	0.00	0.18	0.29	0.40	0.71	0.87	1.21	1.54
	1:10:00	0.00	0.00	0.15	0.25	0.35	0.58	0.71	0.96	1.23
	1:15:00	0.00	0.00	0.12	0.20	0.31	0.46	0.57	0.74	0.96
	1:20:00	0.00	0.00	0.09	0.16	0.24	0.35	0.42	0.54	0.69
	1:25:00	0.00	0.00	0.07	0.12	0.18	0.25	0.30	0.36	0.46
	1:30:00	0.00	0.00	0.06	0.10	0.15	0.17	0.21	0.25	0.33
	1:35:00	0.00	0.00	0.05	0.09	0.13	0.13	0.16	0.18	0.25
	1:40:00	0.00	0.00	0.05	0.08	0.11	0.10	0.13	0.14	0.19
	1:45:00	0.00	0.00	0.05	0.07	0.10	0.09	0.11	0.11	0.15
	1:50:00	0.00	0.00	0.04	0.06	0.10	0.07	0.09	0.09	0.13
	1:55:00	0.00	0.00	0.04	0.05	0.09	0.07	0.09	0.08	0.11
	2:00:00	0.00	0.00	0.03	0.05	0.07	0.06	0.08	0.07	0.10
	2:05:00	0.00	0.00	0.02	0.04	0.05	0.05	0.06	0.05	0.07
	2:10:00	0.00	0.00	0.02	0.03	0.04	0.03	0.04	0.04	0.05
	2:15:00	0.00	0.00	0.01	0.02	0.03	0.02	0.03	0.03	0.04
	2:20:00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.03
	2:25:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02
	2:30:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	2:35:00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	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
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	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
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	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	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

FOREBAY VOLUME REQUIREMENTS

Equation 3-1 $WQCV = a(0.91I^3 - 1.19I^2 + 0.781I)$

a=1 (40 hour drain time)

Pond 2 Forebay 1	*I=.6137*	*WQCV=*	0.2408332
Pond 2 Forebay 2	*I= .6531*	*WQCV=*	0.2553373
Pond 4 Forebay	*I= .7084*	*WQCV=*	0.2788757

Equation 3-3 V=(WQCV/12)A

Pond 2 Forebay 1	A= 12.9 Acres	V=	0.2589
Pond 2 Forebay 2	A= 12.3 Acres	V=	0.2617
Pond 4 Forebay	A= 1.07 Acres	V=	0.0249

3% OF WQCV

FOREBAY TOTAL VOLUME= .03(V)

Volume Required For Pond P2 Forebay 1 =	0.0078	AC-FT	338	CF
Volume Required For Pond P2 Forebay 2 =	0.0079	AC-FT	342	CF
Volume Required For Pond 4 Forebay =	0.0007	AC-FT	32	CF

Volume Provided For Pond P2 Forebay 1 =	366	CF
Volume Provided For Pond P2 Forebay 2 =	404	CF
Volume Provided For Pond 4 Forebay =	74	CF

Q_{100} Discharges	2% OF Q_{100}
Q_{100} P2 Forebay 1=	.02*41.7 CFS = 0.834 CFS
Q_{100} P2 Forebay 2=	.02*99.6 CFS = 1.99 CFS
Q_{100} Pond 4 Forebay =	.02*6.1 CFS = 0.122 CFS

Weir Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Aug 18 2021

Pond P2 Forebay 1 Notch

Rectangular Weir

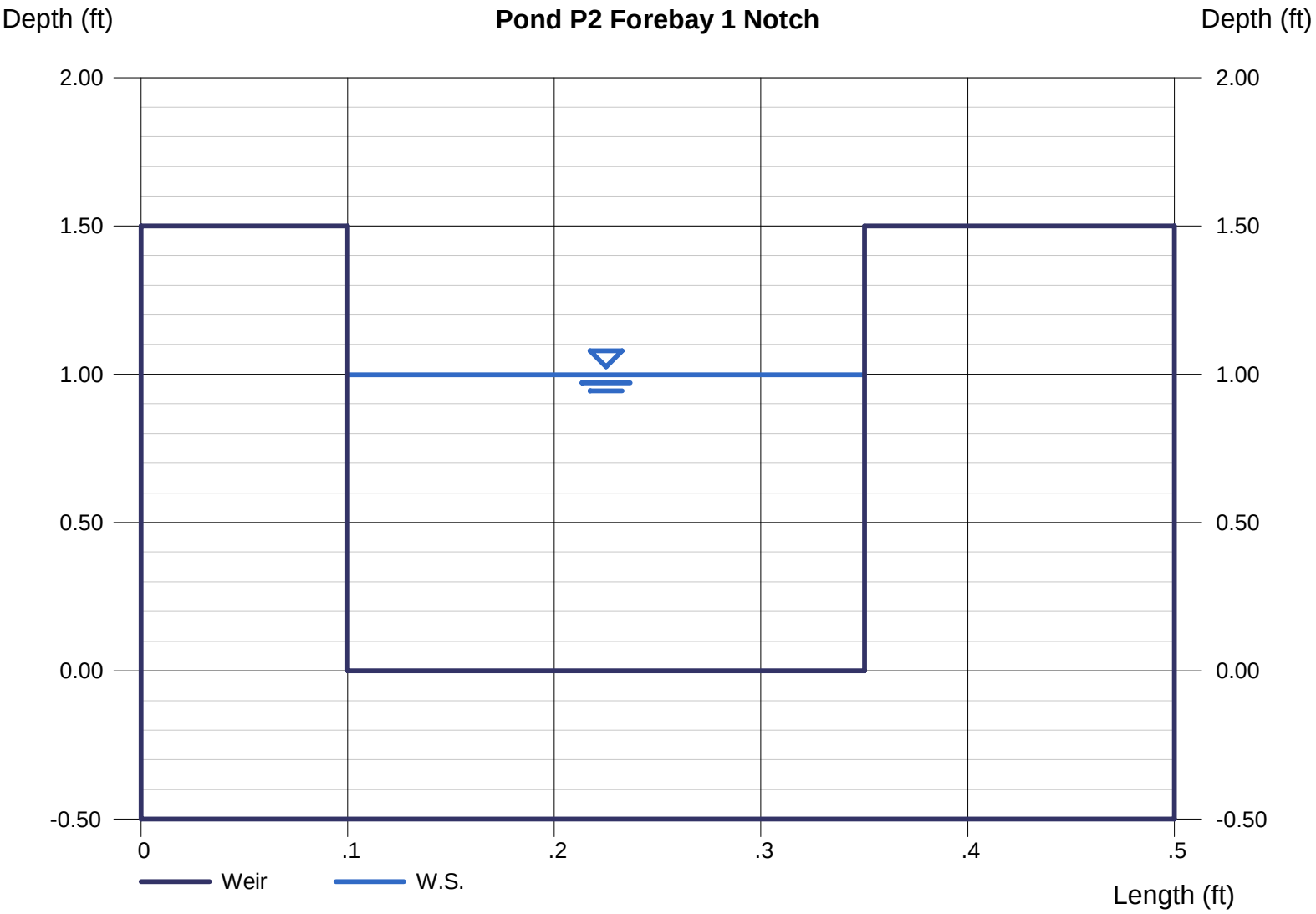
Crest	=	Sharp
Bottom Length (ft)	=	0.25
Total Depth (ft)	=	1.50

Calculations

Weir Coeff. Cw	=	3.33
Compute by:		Known Q
Known Q (cfs)	=	0.83

Highlighted

Depth (ft)	=	1.00
Q (cfs)	=	0.830
Area (sqft)	=	0.25
Velocity (ft/s)	=	3.33
Top Width (ft)	=	0.25



Weir Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, May 13 2021

Pond P2 Forebay 2 Notch

Rectangular Weir

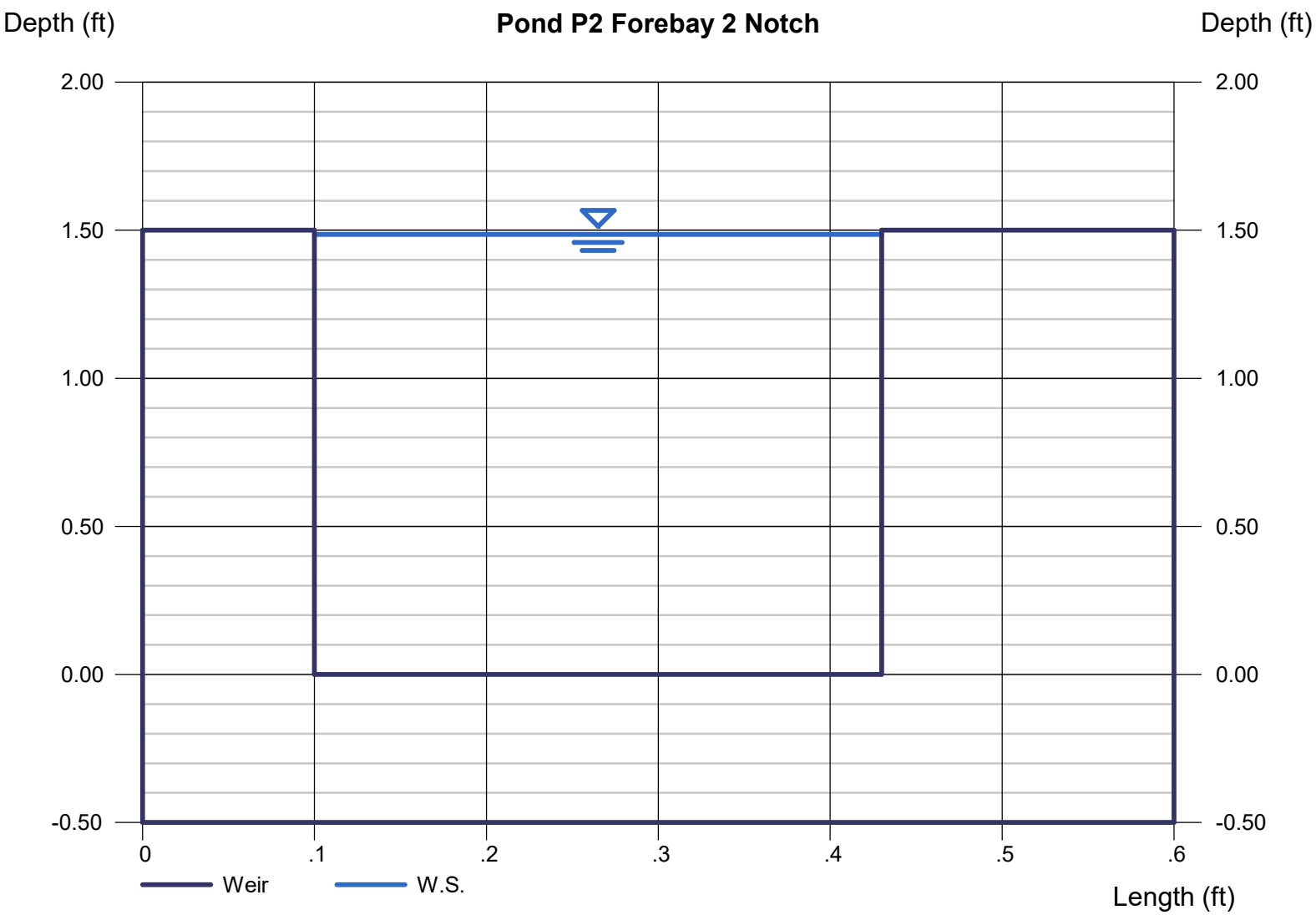
Crest	=	Sharp
Bottom Length (ft)	=	0.33
Total Depth (ft)	=	1.50

Calculations

Weir Coeff. Cw	=	3.33
Compute by:		Known Q
Known Q (cfs)	=	1.99

Highlighted

Depth (ft)	=	1.49
Q (cfs)	=	1.990
Area (sqft)	=	0.49
Velocity (ft/s)	=	4.06
Top Width (ft)	=	0.33



Weir Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Aug 18 2021

Pond 4 Forebay Notch

Rectangular Weir

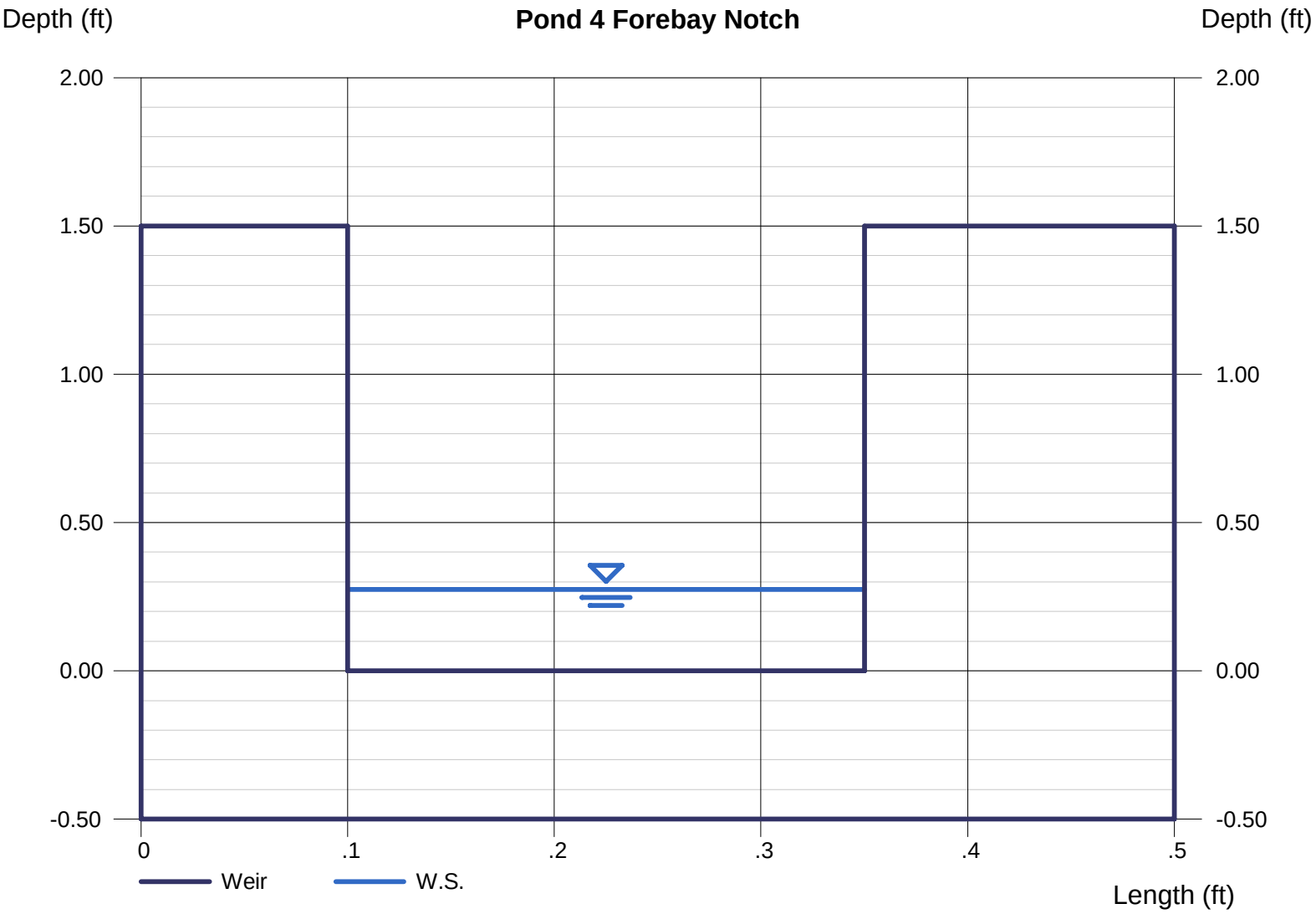
Crest	=	Sharp
Bottom Length (ft)	=	0.25
Total Depth (ft)	=	1.50

Calculations

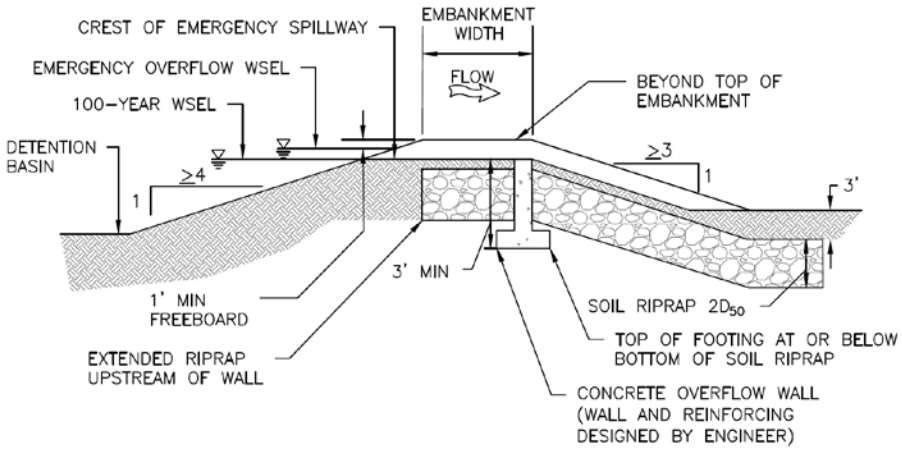
Weir Coeff. Cw	=	3.33
Compute by:		Known Q
Known Q (cfs)	=	0.12

Highlighted

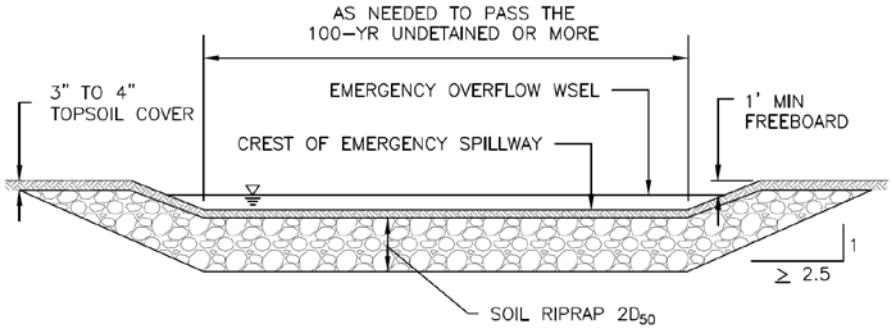
Depth (ft)	=	0.27
Q (cfs)	=	0.120
Area (sqft)	=	0.07
Velocity (ft/s)	=	1.75
Top Width (ft)	=	0.25



POND 1 SPILLWAY RIPRAP CALCULATION



EMERGENCY SPILLWAY PROFILE



EMERGENCY SPILLWAY SECTION AND SPILLWAY CHANNEL

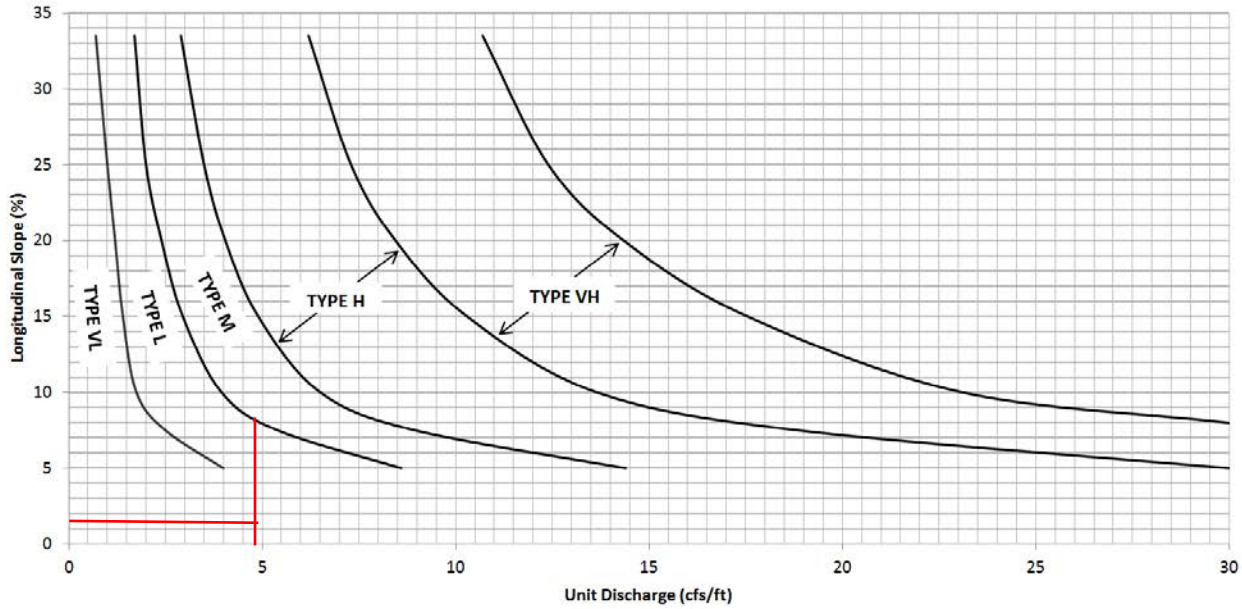
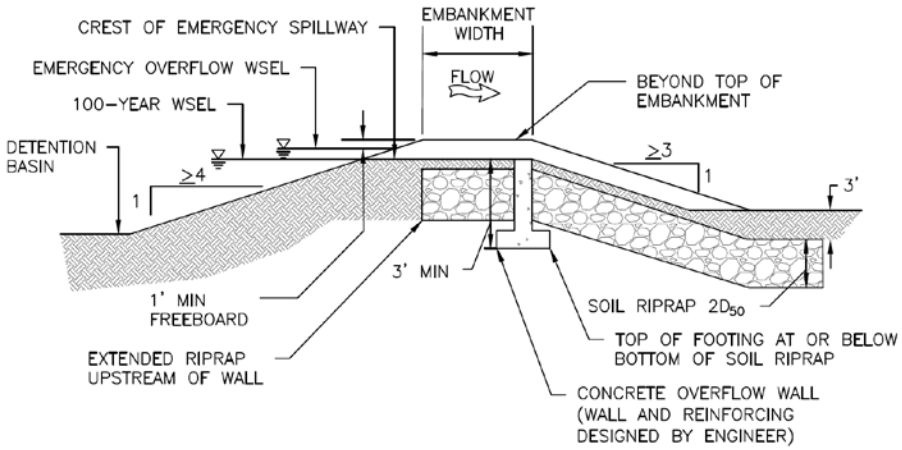
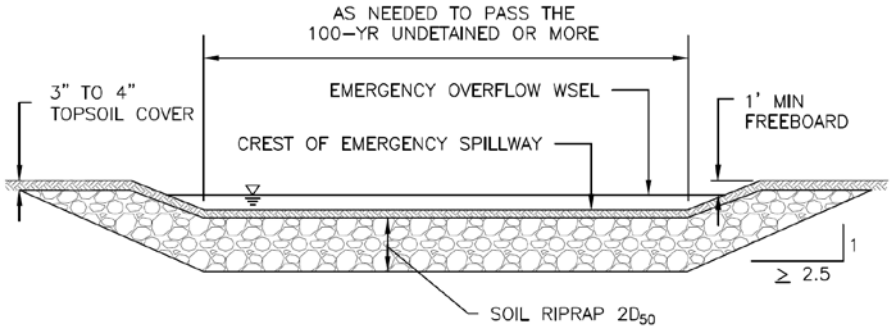


Figure 12-21. Embankment protection details and rock sizing chart (adapted from Arapahoe County)

POND 2 SPILLWAY RIPRAP CALCULATION



EMERGENCY SPILLWAY PROFILE



EMERGENCY SPILLWAY SECTION AND SPILLWAY CHANNEL

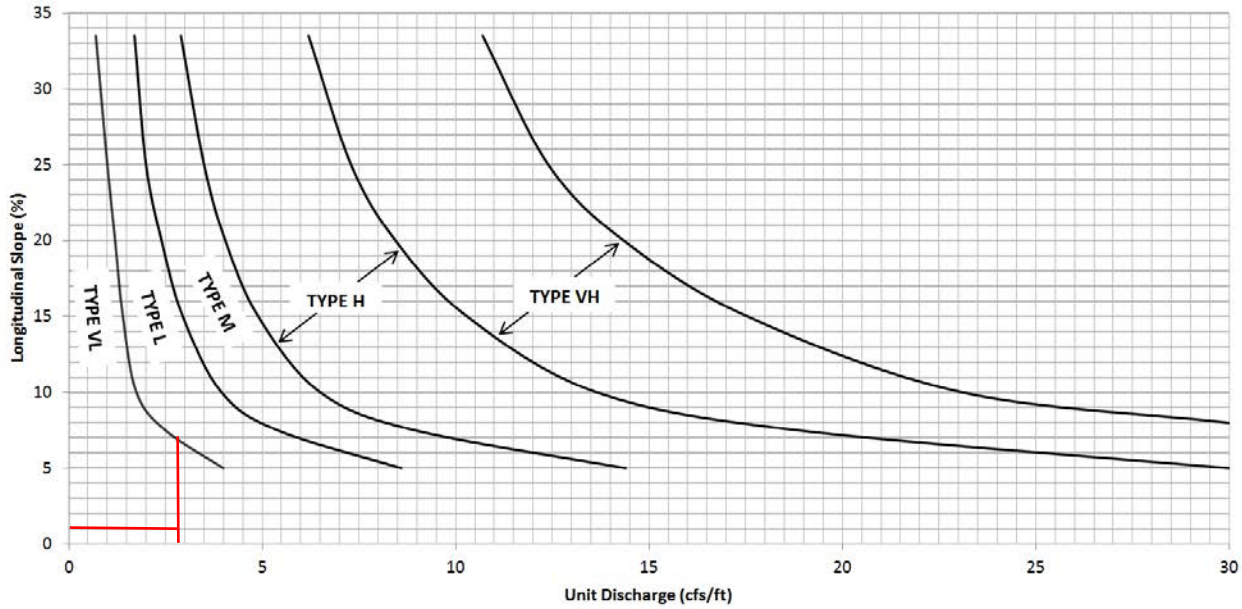
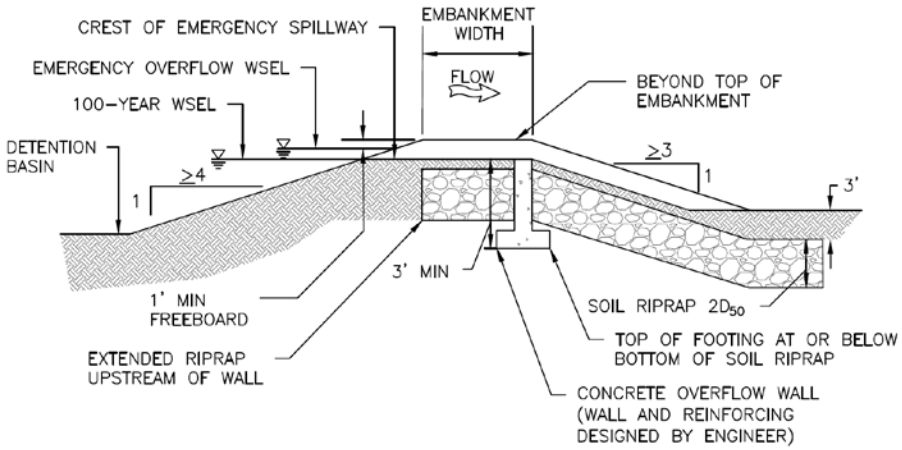
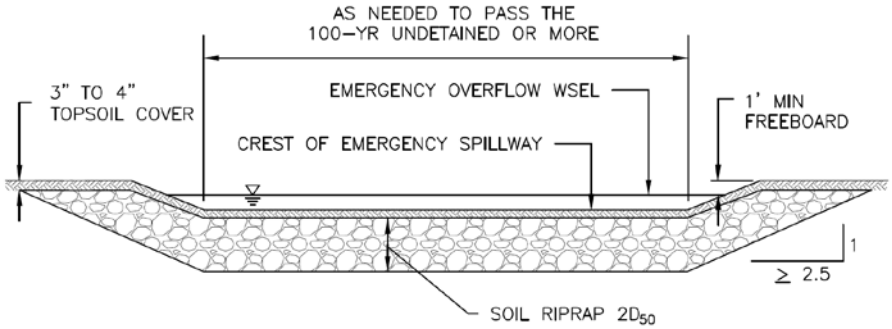


Figure 12-21. Embankment protection details and rock sizing chart (adapted from Arapahoe County)

POND 3 SPILLWAY RIPRAP CALCULATION



EMERGENCY SPILLWAY PROFILE



EMERGENCY SPILLWAY SECTION AND SPILLWAY CHANNEL

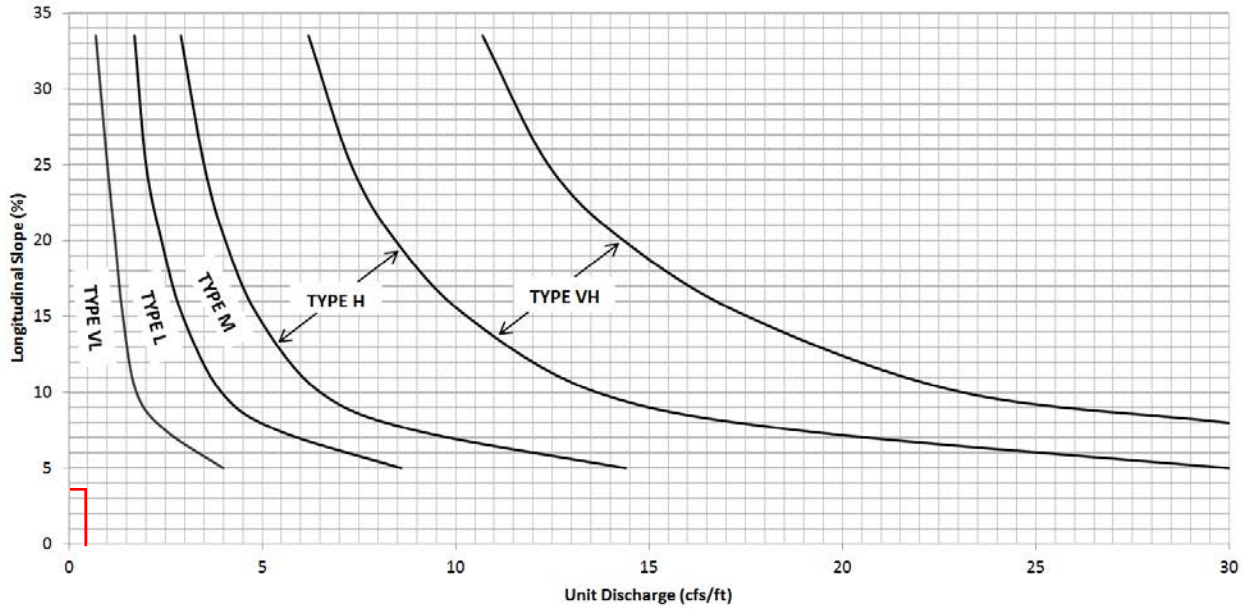
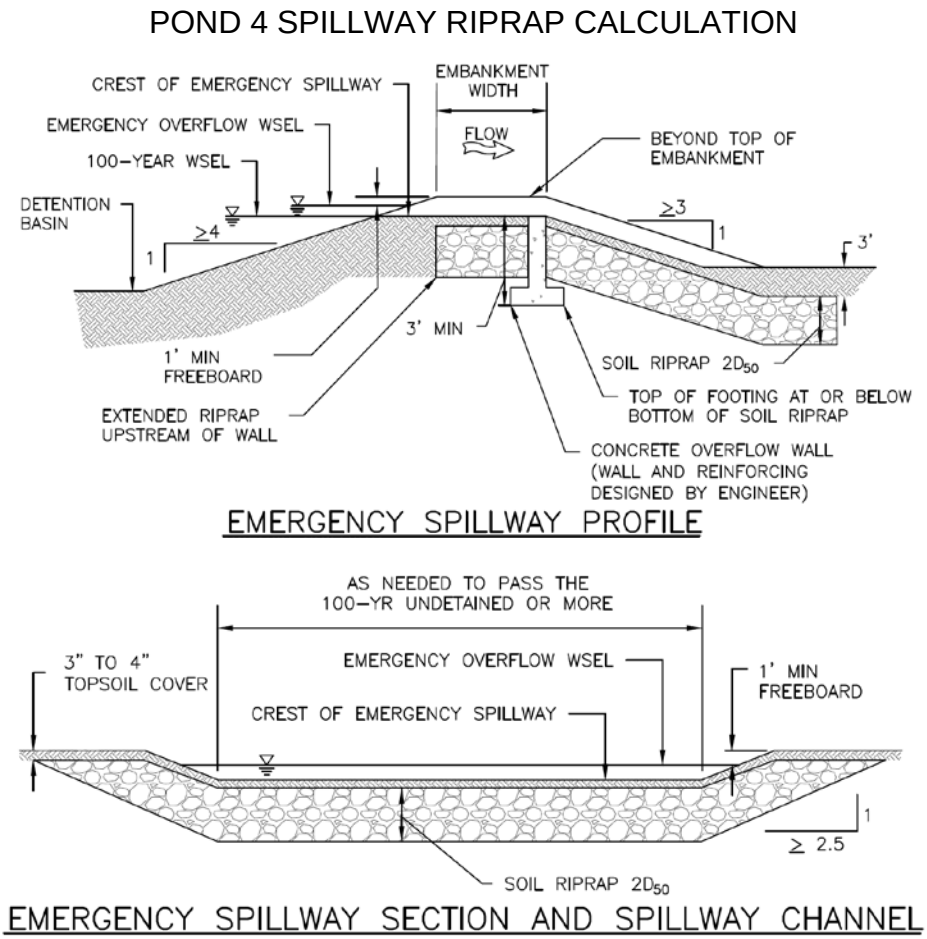


Figure 12-21. Embankment protection details and rock sizing chart (adapted from Arapahoe County)



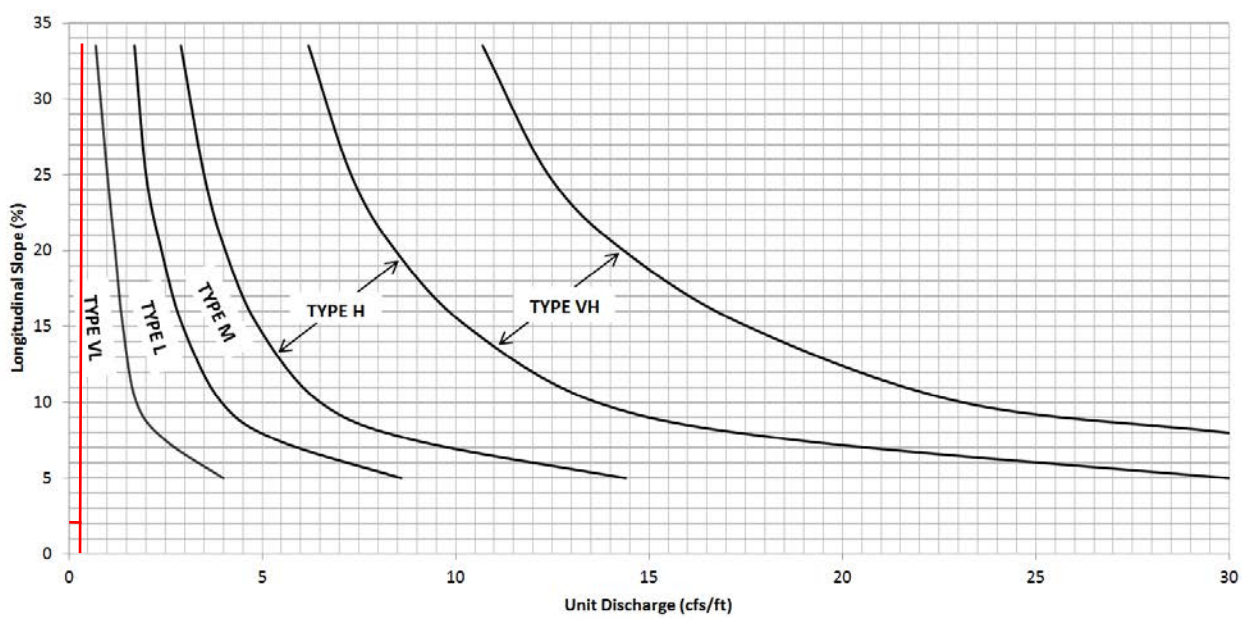


Figure 12-21. Embankment protection details and rock sizing chart (adapted from Arapahoe County)

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Apr 20 2021

Emergency Overflow - Pond P1 to Pond P2

User-defined

Invert Elev (ft)	= 0.25
Slope (%)	= 3.00
N-Value	= Composite

Calculations

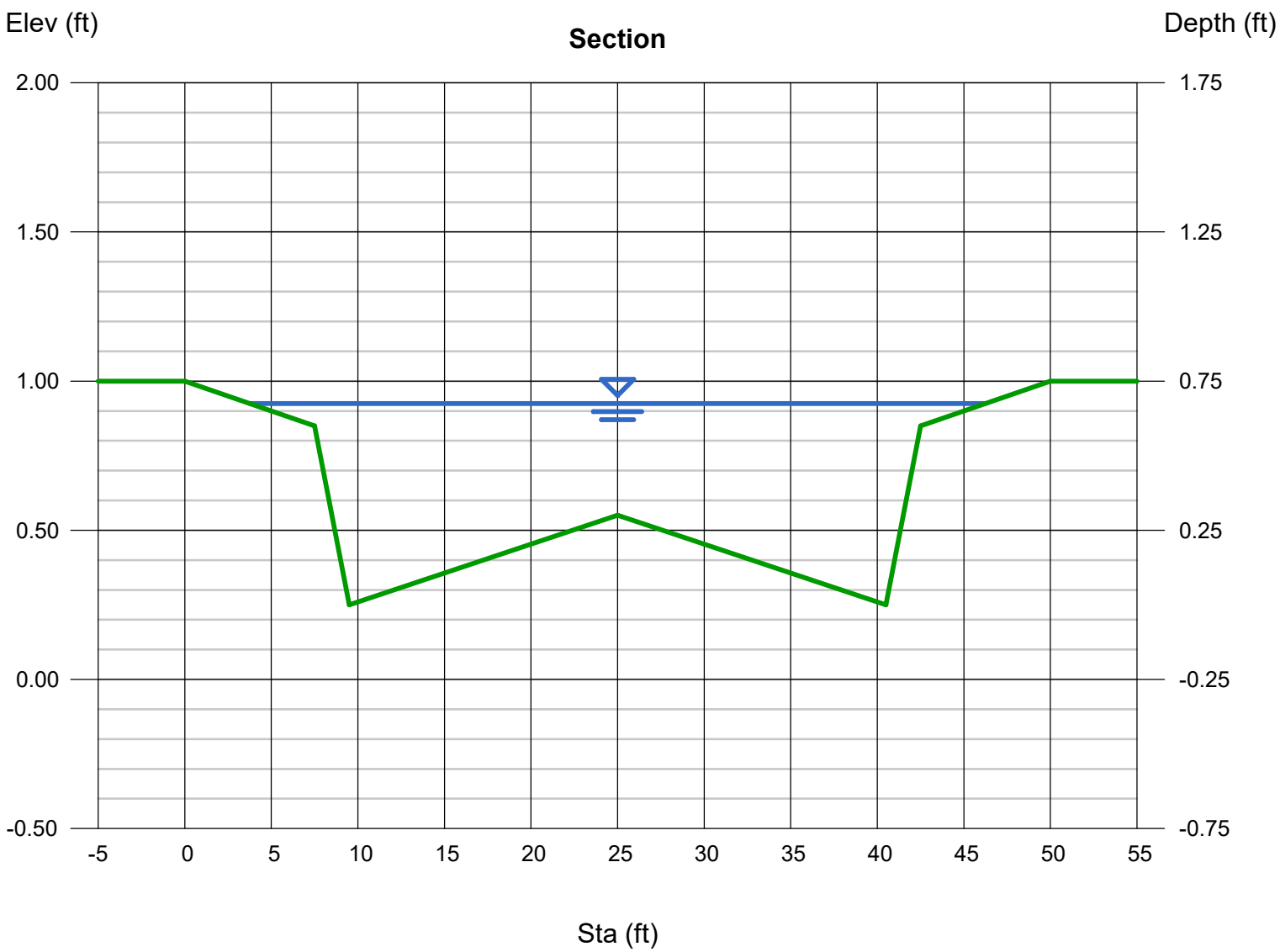
Compute by:	Q vs Depth
No. Increments	= 10

Highlighted

Depth (ft)	= 0.68
Q (cfs)	= 158.23
Area (sqft)	= 18.06
Velocity (ft/s)	= 8.76
Wetted Perim (ft)	= 42.68
Crit Depth, Yc (ft)	= 0.75
Top Width (ft)	= 42.50
EGL (ft)	= 1.87

(Sta, El, n)-(Sta, El, n)...

(0.00, 1.00)-(7.50, 0.85, 0.030)-(9.50, 0.25, 0.013)-(25.00, 0.55, 0.013)-(40.50, 0.25, 0.013)-(42.50, 0.85, 0.013)-(50.00, 1.00, 0.030)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Aug 18 2021

Emergency Overflow - Pond P2 to Leggins Way

User-defined

Invert Elev (ft)	=	7021.34
Slope (%)	=	5.42
N-Value	=	0.014

Calculations

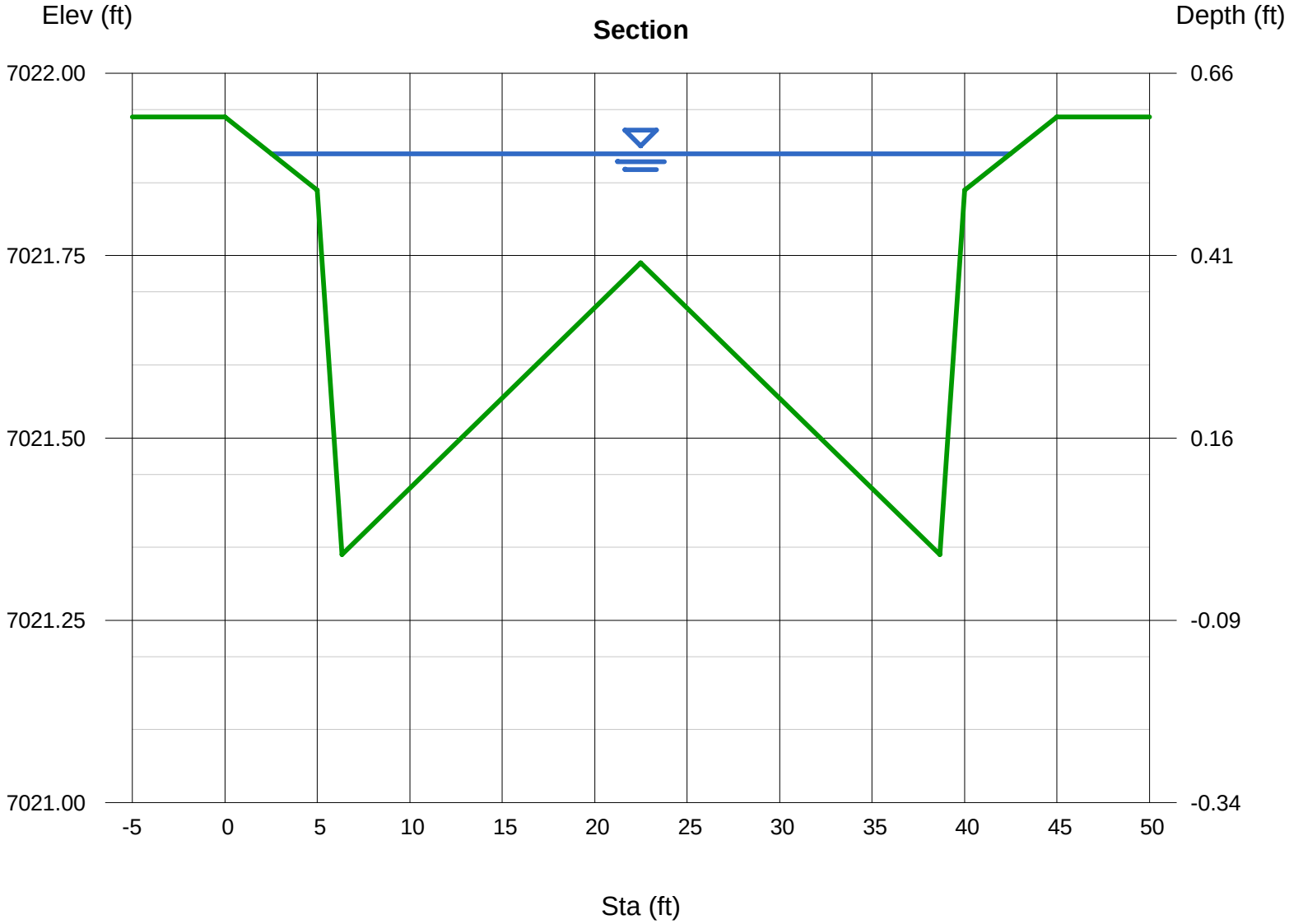
Compute by:		Known Q
Known Q (cfs)	=	130.30

Highlighted

Depth (ft)	=	0.55
Q (cfs)	=	130.30
Area (sqft)	=	12.23
Velocity (ft/s)	=	10.66
Wetted Perim (ft)	=	40.17
Crit Depth, Yc (ft)	=	0.60
Top Width (ft)	=	39.98
EGL (ft)	=	2.32

(Sta, El, n)-(Sta, El, n)...

(0.00, 7021.94) -(5.00, 7021.84, 0.013) -(6.33, 7021.34, 0.013) -(22.50, 7021.74, 0.016) -(38.67, 7021.34, 0.013) -(40.00, 7021.84, 0.013) -(45.00, 7021.94, 0.013)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Aug 18 2021

Emergency Overflow Into Pond P2

Trapezoidal

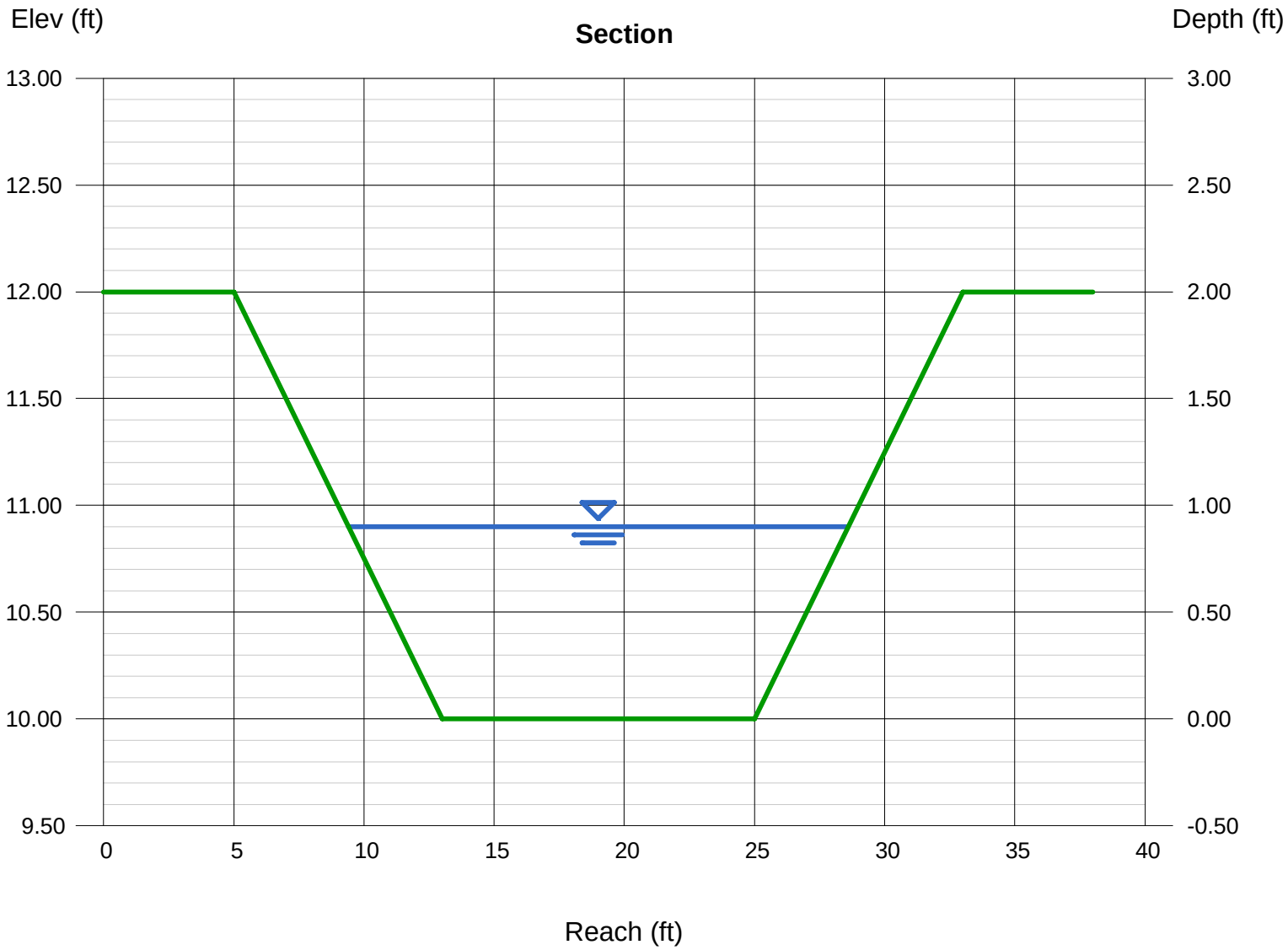
Bottom Width (ft)	=	12.00
Side Slopes (z:1)	=	4.00, 4.00
Total Depth (ft)	=	2.00
Invert Elev (ft)	=	10.00
Slope (%)	=	8.00
N-Value	=	0.030

Calculations

Compute by:		Known Q
Known Q (cfs)	=	155.80

Highlighted

Depth (ft)	=	0.90
Q (cfs)	=	155.80
Area (sqft)	=	14.04
Velocity (ft/s)	=	11.10
Wetted Perim (ft)	=	19.42
Crit Depth, Yc (ft)	=	1.47
Top Width (ft)	=	19.20
EGL (ft)	=	2.81



USACE Steep slope Method (2%-20% Channel Slope)

Emergency Overlow into Pond P2

Slope of Bed	0.08	ft/ft
Bottom width of Channel	12	ft
Channel Flow	155.8	ft^3/S
Gravity constant (g)	32.2	ft/s
Unit Discharge (q)	16.22917	
d30	0.967153	
D30 INCHES	11.60583	

In cases where unit discharge is low, riprap can be used on steep slopes ranging from 2 to 20 percent. A typical application is a rock-lined chute. The stone size equation is

$$D_{30} = \frac{1.95\ S^{0.555}\ q^{2/3}}{g^{1/3}} \qquad (3\text{-}5)$$

where

S = slope of bed

q = unit discharge

Equation 3-5 is applicable to thickness = 1.5 D_{100}, angular rock, unit weight of 167 pcf, D_{85}/D_{15} from 1.7 to 2.7, slopes from 2 to 20 percent, and uniform flow on a down-slope with no tailwater. The following steps should be used in application of Equation 3-5:

(1) Estimate q = Q/b where b = bottom width of chute.

(2) Multiply q by flow concentration factor of 1.25. Use greater factor if approach flow is skewed.

(3) Compute D_{30} using Equation 3-5.

(4) Use uniform gradation having $D_{85}/D_{15} \leq 2$ such as Table 3-1.

(5) Restrict application to straight channels with side slope of 1V:2.5H or flatter.

(6) Use filter fabric beneath rock.

The guidance for steep slope riprap generally results in large riprap sizes. Grouted riprap is often used instead of loose riprap in steep slope applications. *

TABLE 3. VOID–FILLED RIPRAP PLACEMENT AND GRADATION

RIPRAP DESIGNATION	% SMALLER THAN GIVEN SIZE BY WEIGHT	INTERMEDIATE ROCK DIMENSION (INCHES)	D_{50}* (INCHES)
TYPE VL	70 – 100 50 – 70 35 – 50 2 – 10	12 9 6 2	6
TYPE L	70 – 100 50 – 70 35 – 50 2 – 10	15 12 9 3	9
TYPE M	70 – 100 50 – 70 35 – 50 2 – 10	21 18 12 4	12
TYPE H	70 – 100 50 – 70 35 – 50 2 – 10	30 24 18 6	18

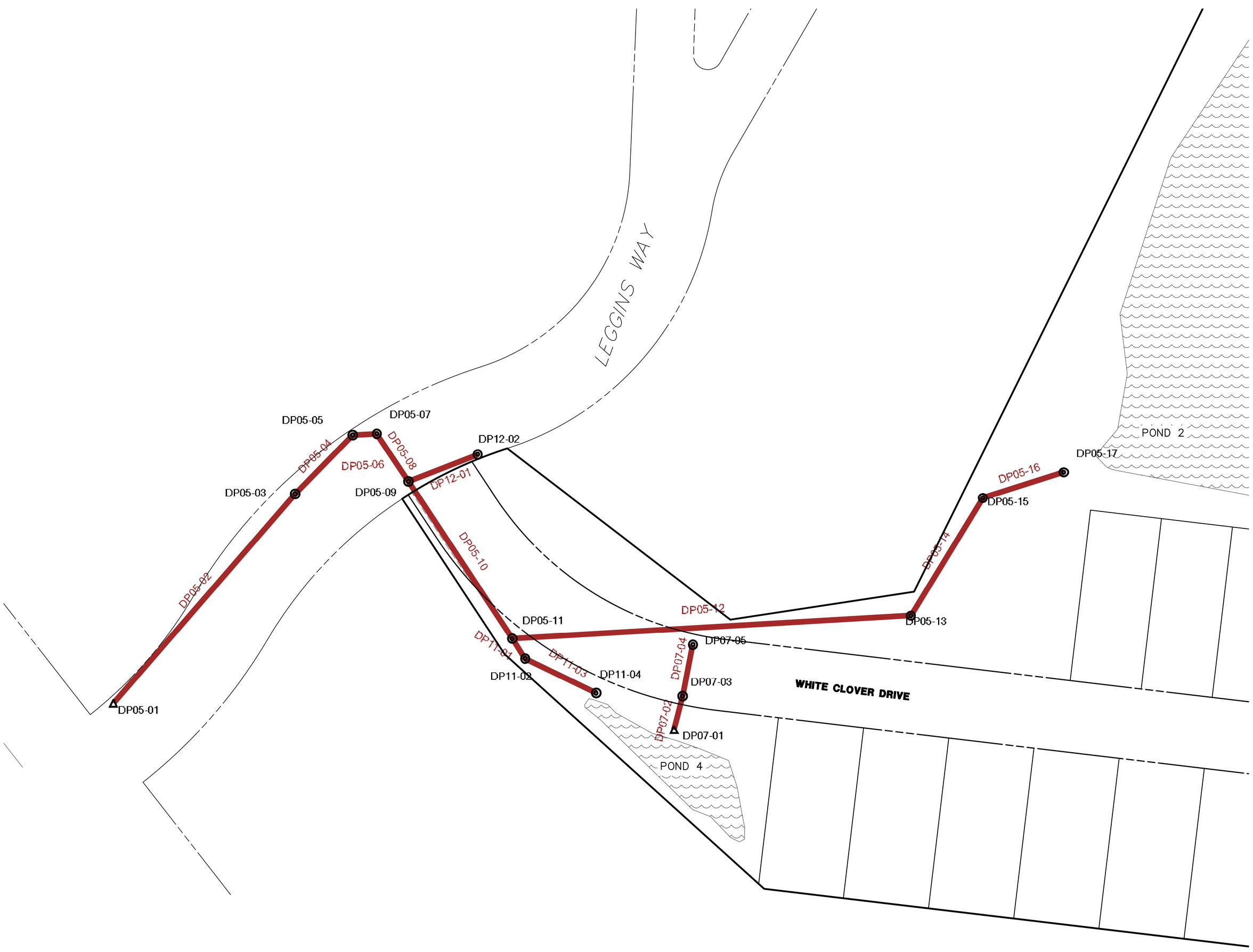
*D_{50} = MEAN ROCK SIZE

NOTE: MIX ON SITE AND PRIOR TO PLACEMENT

Use Type M Riprap

CLOVERLEAF FILING 2

STORMCAD MAP 1



40 20 0 40 80

ORIGINAL SCALE: 1" = 40'

STORMCAD MAP 1
CLOVERLEAF FILING 2
2000-5158.01
08/20/2021
SHEET 1 OF 4

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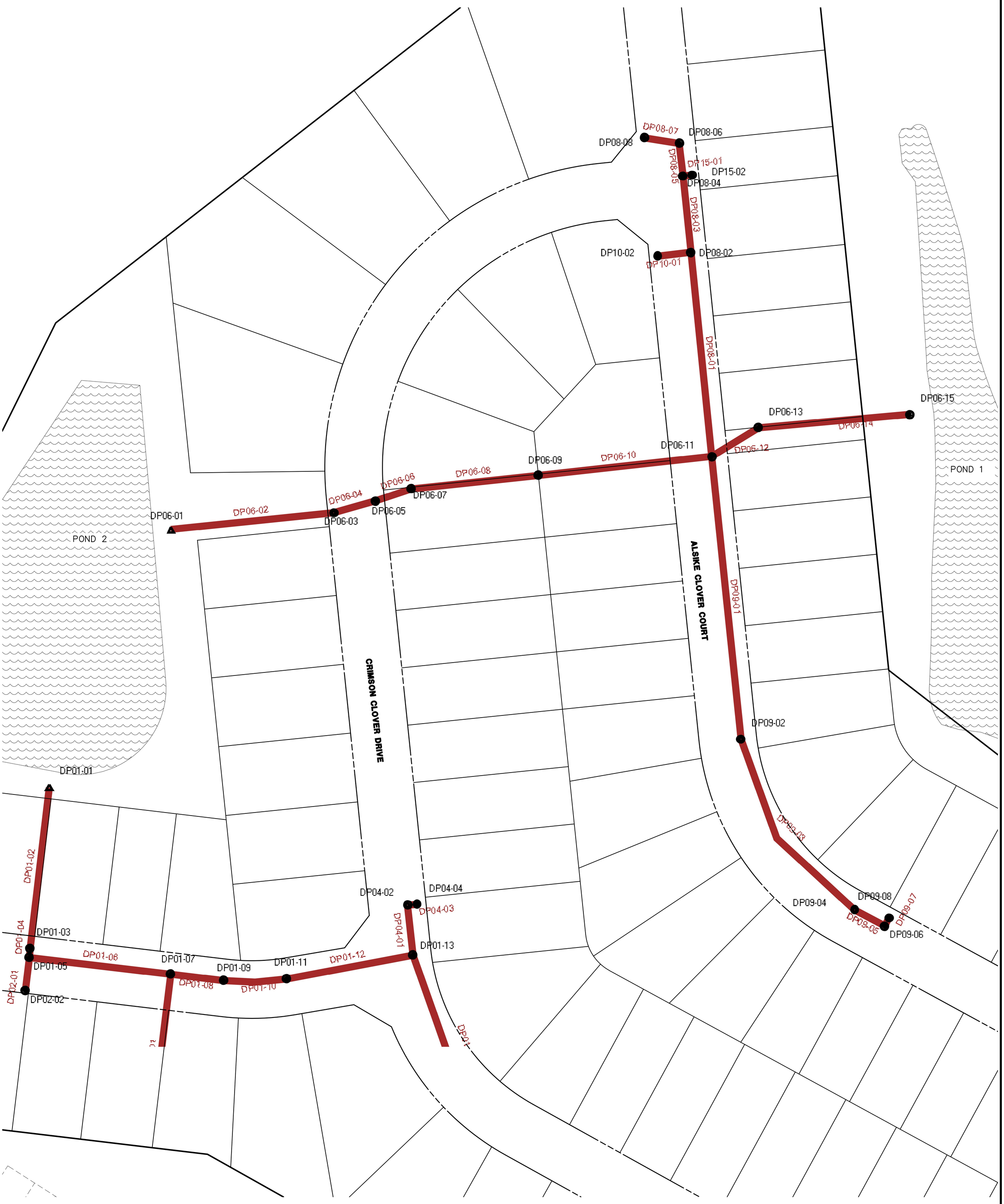
CLOVERLEAF FILING 2

STORMCAD MAP 2



STORMCAD MAP 2
CLOVERLEAF FILING 2
2000-5158.01
08/20/2021
SHEET 2 OF 4

40 20 0 40 80
ORIGINAL SCALE: 1" = 40'

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CLOVERLEAF FILING 2

STORMCAD MAP 3

60 30 0 60 120

ORIGINAL SCALE: 1" = 60'

STORMCAD MAP 3
CLOVERLEAF FILING 2
JOB NO. 2000-5158.01
08/20/2021
SHEET 3 OF 4

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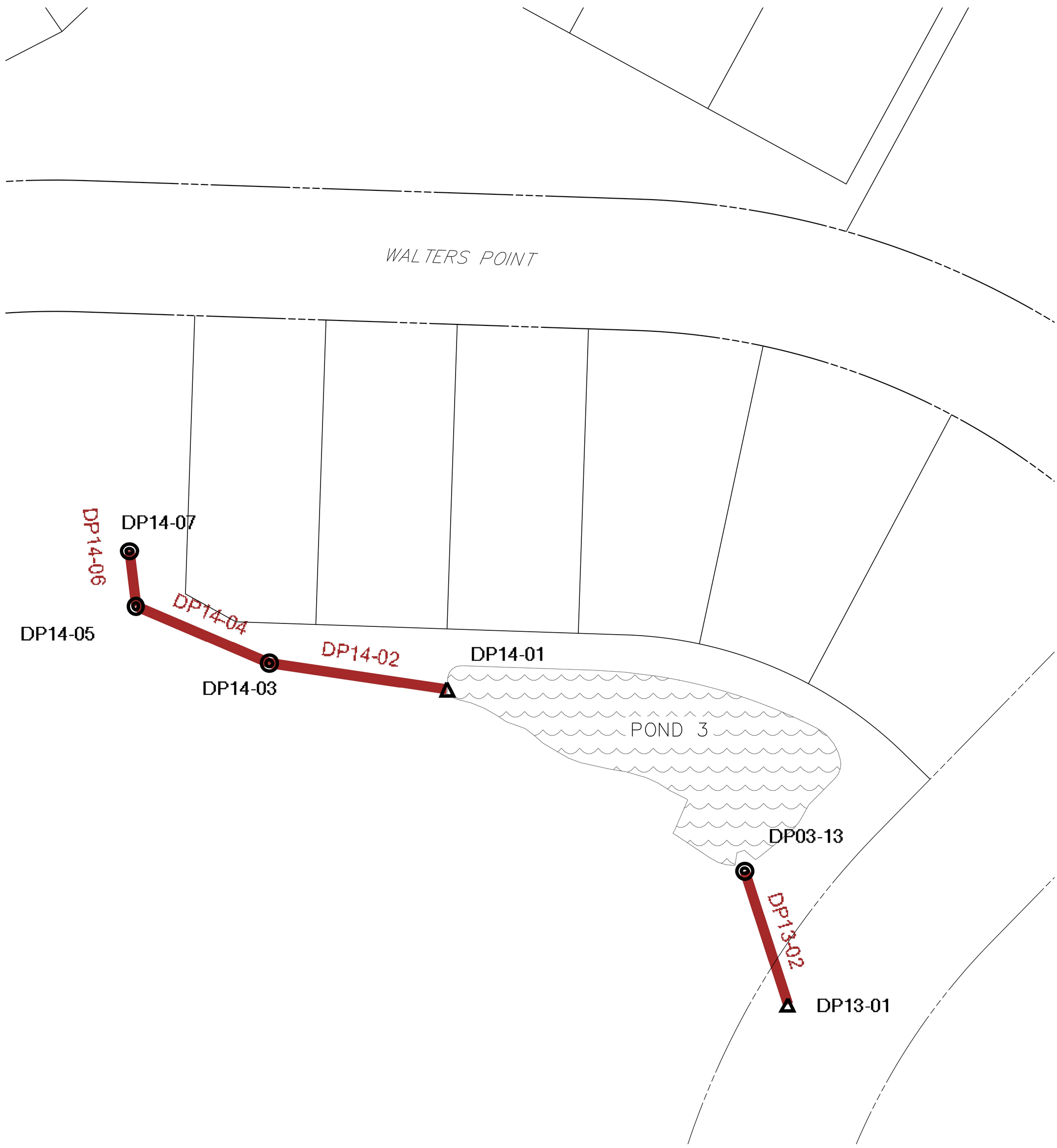
STORMCAD MAP 4



STORMCAD MAP 4
CLOVERLEAF FILING 2
JOB NO. 2000-5158.01
08/20/2021
SHEET 4 OF 4

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Scenario: 5-YR
Current Time Step: 0.000 h
Conduit FlexTable: Combined Pipe/Node Report

Upstream Structure	Label	Flow (cfs)	Capacity (Full Flow) (cfs)	Diameter (in)	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Velocity (ft/s)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Upstream Structure Headloss Coefficient	Manning's n
DP01-03	DP01-02	20.80	72.80	36.0	139.0	0.012	7,025.83	7,024.17	8.88	7,034.33	7,028.84	7,027.29	7,025.27	7,027.87	7,026.50	0.050	0.013
DP01-05	DP01-04	20.10	79.78	36.0	8.7	0.014	7,026.05	7,025.93	9.40	7,034.01	7,034.33	7,027.49	7,027.17	7,028.05	7,028.00	1.020	0.013
DP01-07	DP01-06	16.70	46.91	36.0	122.5	0.005	7,026.96	7,026.35	6.08	7,040.66	7,034.01	7,028.27	7,028.06	7,028.76	7,028.31	1.020	0.013
DP01-09	DP01-08	13.10	87.34	30.0	46.0	0.045	7,036.08	7,034.00	12.80	7,043.14	7,040.66	7,037.30	7,034.71	7,037.77	7,036.76	0.050	0.013
DP01-11	DP01-10	13.10	87.15	30.0	54.5	0.045	7,038.64	7,036.18	12.78	7,045.70	7,043.14	7,039.86	7,036.88	7,040.33	7,039.03	0.050	0.013
DP01-13	DP01-12	13.10	58.50	30.0	110.6	0.020	7,041.20	7,038.95	9.61	7,047.68	7,045.70	7,042.42	7,039.75	7,042.89	7,041.19	1.770	0.013
DP01-15	DP01-14	7.80	22.65	24.0	11.0	0.010	7,041.81	7,041.70	6.54	7,047.99	7,047.68	7,043.25	7,043.26	7,043.41	7,043.39	0.050	0.013
DP01-17	DP01-16	7.80	35.65	24.0	170.3	0.025	7,046.24	7,042.01	9.09	7,052.32	7,047.99	7,047.23	7,043.26	7,047.62	7,043.48	0.050	0.013
DP01-19	DP01-18	7.80	36.24	24.0	323.4	0.026	7,054.74	7,046.44	9.20	7,060.79	7,052.32	7,055.73	7,047.07	7,056.12	7,048.38	0.100	0.013
DP01-21	DP01-20	7.80	48.35	24.0	210.8	0.046	7,064.47	7,054.84	11.30	7,070.52	7,060.79	7,065.46	7,055.38	7,065.85	7,057.37	1.320	0.013
DP01-23	DP01-22	7.80	38.48	24.0	27.3	0.029	7,065.56	7,064.77	9.60	7,070.84	7,070.52	7,066.55	7,065.98	7,066.94	7,066.22	0.000	0.013
DP02-02	DP02-01	4.40	30.41	18.0	29.8	0.084	7,030.35	7,027.85	12.25	7,034.36	7,034.01	7,031.15	7,028.26	7,031.48	7,030.24	0.000	0.013
DP03-02	DP03-01	4.20	16.07	24.0	145.5	0.005	7,028.69	7,027.96	4.30	7,031.91	7,040.66	7,029.41	7,028.77	7,029.68	7,028.96	0.000	0.013
DP04-02	DP04-01	5.90	10.00	18.0	45.3	0.009	7,042.61	7,042.20	5.89	7,047.17	7,047.68	7,043.55	7,043.26	7,043.95	7,043.56	1.320	0.013
DP04-04	DP04-03	5.90	7.07	18.0	8.9	0.005	7,042.95	7,042.91	3.34	7,047.17	7,047.51	7,044.15	7,044.08	7,044.38	7,044.35	0.000	0.013
DP05-03	DP05-02	61.20	145.17	48.0	193.8	0.010	6,992.35	6,990.37	11.06	7,000.91	6,996.03	6,994.71	6,992.20	6,995.69	6,994.06	0.050	0.013
DP05-05	DP05-04	61.20	161.64	48.0	57.6	0.013	6,994.08	6,993.35	11.97	7,002.66	7,000.91	6,996.44	6,995.21	6,997.42	6,996.98	0.400	0.013
DP05-07	DP05-06	61.20	144.44	48.0	16.8	0.010	6,995.25	6,995.08	11.02	7,003.44	7,002.66	6,997.61	6,997.16	6,998.59	6,998.49	0.640	0.013
DP05-09	DP05-08	61.20	183.10	48.0	40.0	0.016	6,996.90	6,996.25	13.12	7,003.94	7,003.44	6,999.26	6,998.08	7,000.24	6,999.93	1.020	0.013
DP05-11	DP05-10	59.70	217.68	48.0	131.9	0.023	7,000.03	6,997.00	14.77	7,006.38	7,003.94	7,002.36	7,000.26	7,003.32	7,000.72	0.640	0.013
DP05-13	DP05-12	59.60	150.89	42.0	279.2	0.022	7,006.81	7,000.53	14.76	7,017.52	7,006.38	7,009.23	7,002.97	7,010.33	7,004.05	0.640	0.013
DP05-15	DP05-14	59.60	155.28	42.0	96.6	0.024	7,011.91	7,009.61	15.08	7,025.12	7,017.52	7,014.33	7,011.23	7,015.43	7,014.13	0.400	0.013
DP05-17	DP05-16	59.60	140.95	42.0	75.6	0.020	7,019.18	7,017.70	14.04	7,026.93	7,025.12	7,021.60	7,019.44	7,022.70	7,021.87	0.000	0.013
DP06-03	DP06-02	50.80	126.60	42.0	141.9	0.016	7,027.89	7,025.64	12.44	7,043.81	7,030.85	7,030.12	7,027.23	7,031.08	7,029.47	0.075	0.013
DP06-05	DP06-04	50.00	151.47	42.0	39.0	0.023	7,038.10	7,037.22	14.12	7,043.81	7,043.81	7,040.31	7,038.84	7,041.26	7,040.88	0.050	0.013
DP06-07	DP06-06	49.00	152.91	42.0	31.8	0.023	7,038.93	7,038.20	14.14	7,044.46	7,043.81	7,041.12	7,039.83	7,042.05	7,041.76	0.075	0.013
DP06-09	DP06-08	49.00	155.96	42.0	110.0	0.024	7,041.67	7,039.03	14.35	7,058.12	7,044.46	7,043.86	7,040.45	7,044.79	7,043.22	0.050	0.013
DP06-11	DP06-10	49.00	156.33	42.0	150.3	0.024	7,055.54	7,051.91	14.37	7,067.16	7,058.12	7,057.73	7,053.30	7,058.66	7,056.27	1.300	0.013
DP06-13	DP06-12	45.20	123.59	42.0	36.2	0.015	7,061.36	7,060.81	11.85	7,067.78	7,067.16	7,063.46	7,062.47	7,064.33	7,064.05	0.075	0.013
DP06-15	DP06-14	45.20	134.20	42.0	151.2	0.018	7,064.15	7,061.46	12.58	7,068.05	7,067.78	7,066.25	7,062.89	7,067.12	7,065.21	0.000	0.013
DP07-03	DP07-02	2.70	20.25	18.0	24.3	0.037	7,005.82	7,004.92	7.97	7,014.48	7,004.92	7,006.45	7,005.31	7,006.68	7,006.17	0.050	0.013
DP07-05	DP07-04	1.40	20.37	18.0	36.9	0.038	7,010.56	7,009.17	6.60	7,014.45	7,014.48	7,011.00	7,009.44	7,011.16	7,010.12	0.000	0.013
DP08-02	DP08-01	11.60	38.01	30.0	177.0	0.009	7,058.06	7,056.54	6.80	7,064.94	7,067.16	7,059.20	7,058.94	7,059.64	7,059.03	1.020	0.013
DP08-04	DP08-03	8.20	18.34	24.0	66.3	0.007	7,059.00	7,058.56	5.68	7,064.38	7,064.94	7,060.02	7,059.65	7,060.42	7,059.99	1.020	0.013
DP08-06	DP08-05	2.40	13.18	18.0	28.6	0.016	7,059.94	7,059.49	5.67	7,064.51	7,064.38	7,060.53	7,060.43	7,060.74	7,060.50	0.980	0.013
DP08-08	DP08-07	2.40	12.25	18.0	30.4	0.014	7,060.65	7,060.24	5.38	7,064.83	7,064.51	7,061.24	7,060.70	7,061.46	7,061.13	0.000	0.013
DP09-02	DP09-01	3.40	10.42	18.0	244.8	0.010	7,065.22	7,062.81	5.27	7,070.22	7,067.16	7,065.93	7,063.40	7,066.20	7,063.84	0.100	0.013
DP09-04	DP09-03	3.40	11.48	18.0	183.8	0.012	7,067.51	7,065.32	5.66	7,072.64	7,070.22	7,068.22	7,065.88	7,068.49	7,066.38	0.100	0.013
DP09-06	DP09-05	3.40	11.13	18.0	29.4	0.011	7,067.94	7,067.61	5.54	7,073.00	7,072.64	7,068.64	7,068.19	7,068.91	7,068.65	1.320	0.013
DP09-08	DP09-07	3.40	12.69	18.0	8.9	0.015	7,068.37	7,068.24	6.08	7,073.32	7,073.00	7,069.08	7,069.00	7,069.35	7,069.23	0.000	0.013
DP10-02	DP10-01	3.50	23.31	18.0	29.5	0.049	7,060.51	7,059.06	9.49	7,065.24	7,064.94	7,061.23	7,059.48	7,061.50	7,060.70	0.000	0.013
DP11-02	DP11-01	4.00	7.85	18.0	15.4	0.006	7,002.62	7,002.53	4.46	7,007.08	7,006.38	7,003.39	7,003.29	7,003.69	7,003.60	1.000	0.013
DP11-04	DP11-03	4.00	7.86	18.0	56.0	0.006	7,002.93	7,002.62	4.47	7,005.31	7,007.08	7,003.70	7,003.64	7,004.00	7,003.79	0.000	0.013
DP12-02	DP12-01	5.80	50.11	24.0	52.0	0.049	7,001.45	6,998.90	10.64	7,004.67	7,003.94	7,002.30	7,000.26	7,002.62	7,000.36	0.000	0.013
DP03-13	DP13-02	2.70	13.85	18.0	54.2	0.017	7,049.68	7,048.74	6.08	7,051.49	7,050.45	7,050.31	7,049.19	7,050.54	7,049.76	0.000	0.013
DP14-03	DP14-02	1.40	3.69	12.0	69.3	0.011	7,051.43	7,050.69	4.38	7,054.43	7,051.86	7,051.93	7,051.12	7,052.13	7,051.41	0.075	0.013
DP14-05	DP14-04	1.40	3.69	12.0	55.8	0.011	7,052.03	7,051.43	4.38	7,054.73	7,054.43	7,052.54	7,051.95	7,052.73	7,052.13	0.640	0.013
DP14-07	DP14-06	1.40	3.69	12.0	21.4	0.011	7,052.26	7,052.03	4.38	7,053.43	7,054.73	7,052.76	7,052.66	7,052.96	7,052.77	0.000	0.013
DP15-02	DP15-01	6.60	39.48	24.0	8.9	0.030	7,059.57	7,059.30	9.32	7,064.65	7,064.38	7,060.48	7,060.43	7,060.83	7,060.63	0.000	0.013

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Scenario: 100-YR
Current Time Step: 0.000 h
Conduit FlexTable: Combined Pipe/Node Report

Upstream Structure	Label	Flow (cfs)	Capacity (Full Flow) (cfs)	Diameter (in)	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Velocity (ft/s)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Upstream Structure Headloss Coefficient	Manning's n
DP01-03	DP01-02	41.70	72.80	36.0	139.0	0.012	7,025.83	7,024.17	10.65	7,034.33	7,028.84	7,027.93	7,025.82	7,028.90	7,027.53	0.050	0.013
DP01-05	DP01-04	40.40	79.78	36.0	8.7	0.014	7,026.05	7,025.93	11.32	7,034.01	7,034.33	7,028.12	7,027.76	7,029.06	7,029.00	1.520	0.013
DP01-07	DP01-06	33.70	46.91	36.0	122.5	0.005	7,026.96	7,026.35	7.22	7,040.66	7,034.01	7,029.85	7,029.55	7,030.21	7,029.90	1.770	0.013
DP01-09	DP01-08	24.60	87.34	30.0	46.0	0.045	7,036.08	7,034.00	15.29	7,043.14	7,040.66	7,037.77	7,035.03	7,038.53	7,037.63	0.050	0.013
DP01-11	DP01-10	24.60	87.15	30.0	54.5	0.045	7,038.64	7,036.18	15.26	7,045.70	7,043.14	7,040.33	7,037.19	7,041.09	7,039.94	0.050	0.013
DP01-13	DP01-12	24.60	58.50	30.0	110.6	0.020	7,041.20	7,038.95	11.40	7,047.68	7,045.70	7,042.89	7,040.10	7,043.64	7,042.02	1.770	0.013
DP01-15	DP01-14	17.30	22.65	24.0	11.0	0.010	7,041.81	7,041.70	5.51	7,047.99	7,047.68	7,044.29	7,044.23	7,044.76	7,044.70	0.050	0.013
DP01-17	DP01-16	17.30	35.65	24.0	170.3	0.025	7,046.24	7,042.01	11.26	7,052.32	7,047.99	7,047.74	7,044.31	7,048.47	7,044.78	0.050	0.013
DP01-19	DP01-18	17.30	36.24	24.0	323.4	0.026	7,054.74	7,046.44	11.40	7,060.79	7,052.32	7,056.24	7,047.41	7,056.97	7,049.43	0.100	0.013
DP01-21	DP01-20	17.30	48.35	24.0	210.8	0.046	7,064.47	7,054.84	14.11	7,070.52	7,060.79	7,065.97	7,055.67	7,066.70	7,058.76	1.320	0.013
DP01-23	DP01-22	17.30	38.48	24.0	27.3	0.029	7,065.56	7,064.77	11.92	7,070.84	7,070.52	7,067.06	7,066.93	7,067.79	7,067.40	0.000	0.013
DP02-02	DP02-01	9.40	30.41	18.0	29.8	0.084	7,030.35	7,027.85	15.16	7,034.36	7,034.01	7,031.54	7,029.55	7,032.15	7,029.99	0.000	0.013
DP03-02	DP03-01	10.10	16.07	24.0	145.5	0.005	7,028.69	7,027.96	3.21	7,031.91	7,040.66	7,030.78	7,030.49	7,030.94	7,030.65	0.000	0.013
DP04-02	DP04-01	13.00	10.00	18.0	45.3	0.009	7,042.61	7,042.20	7.36	7,047.17	7,047.68	7,044.92	7,044.23	7,045.76	7,045.07	1.320	0.013
DP04-04	DP04-03	13.00	7.07	18.0	8.9	0.005	7,042.95	7,042.91	7.36	7,047.17	7,047.51	7,046.17	7,046.03	7,047.01	7,046.87	0.000	0.013
DP05-03	DP05-02	116.60	145.17	48.0	193.8	0.010	6,992.35	6,990.37	12.84	7,000.91	6,996.03	6,995.61	6,993.12	6,997.37	6,995.62	0.050	0.013
DP05-05	DP05-04	116.60	161.64	48.0	57.6	0.013	6,994.08	6,993.35	14.01	7,002.66	7,000.91	6,997.34	6,996.10	6,999.10	6,998.59	0.400	0.013
DP05-07	DP05-06	116.60	144.44	48.0	16.8	0.010	6,995.25	6,995.08	12.79	7,003.44	7,002.66	6,998.51	6,998.09	7,000.27	7,000.14	0.640	0.013
DP05-09	DP05-08	116.60	183.10	48.0	40.0	0.016	6,996.90	6,996.25	15.44	7,003.94	7,003.44	7,000.16	6,999.63	7,001.92	7,001.28	1.335	0.013
DP05-11	DP05-10	110.50	217.68	48.0	131.9	0.023	7,000.03	6,997.00	17.39	7,006.38	7,003.94	7,003.21	7,002.51	7,004.86	7,003.71	0.640	0.013
DP05-13	DP05-12	109.10	150.89	42.0	279.2	0.022	7,006.81	7,000.53	17.08	7,017.52	7,006.38	7,009.98	7,004.27	7,012.19	7,006.27	0.640	0.013
DP05-15	DP05-14	109.10	155.28	42.0	96.6	0.024	7,011.91	7,009.61	17.48	7,025.12	7,017.52	7,015.07	7,011.98	7,017.28	7,015.82	0.400	0.013
DP05-17	DP05-16	109.10	140.95	42.0	75.6	0.020	7,019.18	7,017.70	16.18	7,026.93	7,025.12	7,022.35	7,020.24	7,024.56	7,023.55	0.000	0.013
DP06-03	DP06-02	85.20	126.60	42.0	141.9	0.016	7,027.89	7,025.64	14.12	7,043.81	7,030.85	7,030.77	7,027.83	7,032.34	7,030.66	0.075	0.013
DP06-05	DP06-04	84.10	151.47	42.0	39.0	0.023	7,038.10	7,037.22	16.16	7,043.81	7,043.81	7,040.96	7,039.44	7,042.52	7,042.10	0.050	0.013
DP06-07	DP06-06	82.60	152.91	42.0	31.8	0.023	7,038.93	7,038.20	16.20	7,044.46	7,043.81	7,041.77	7,041.04	7,043.29	7,042.56	0.075	0.013
DP06-09	DP06-08	82.60	155.96	42.0	110.0	0.024	7,041.67	7,039.03	16.44	7,058.12	7,044.46	7,044.51	7,041.88	7,046.03	7,043.39	0.050	0.013
DP06-11	DP06-10	82.60	156.33	42.0	150.3	0.024	7,055.54	7,051.91	16.47	7,067.16	7,058.12	7,058.38	7,053.81	7,059.90	7,057.53	1.300	0.013
DP06-13	DP06-12	78.50	123.59	42.0	36.2	0.015	7,061.36	7,060.81	13.60	7,067.78	7,067.16	7,064.13	7,063.12	7,065.57	7,065.24	0.075	0.013
DP06-15	DP06-14	78.50	134.20	42.0	151.2	0.018	7,064.15	7,061.46	14.49	7,068.05	7,067.78	7,066.92	7,064.24	7,068.36	7,065.67	0.000	0.013
DP07-03	DP07-02	4.00	20.25	18.0	24.3	0.037	7,005.82	7,004.92	8.92	7,014.48	7,004.92	7,006.59	7,005.41	7,006.89	7,006.42	0.050	0.013
DP07-05	DP07-04	2.90	20.37	18.0	36.9	0.038	7,010.56	7,009.17	8.17	7,014.45	7,014.48	7,011.21	7,009.56	7,011.45	7,010.55	0.000	0.013
DP08-02	DP08-01	24.20	38.01	30.0	177.0	0.009	7,058.06	7,056.54	4.93	7,064.94	7,067.16	7,060.97	7,060.35	7,061.35	7,060.73	1.770	0.013
DP08-04	DP08-03	18.30	18.34	24.0	66.3	0.007	7,059.00	7,058.56	5.83	7,064.38	7,064.94	7,062.07	7,061.64	7,062.60	7,062.16	1.770	0.013
DP08-06	DP08-05	5.10	13.18	18.0	28.6	0.016	7,059.94	7,059.49	2.89	7,064.51	7,064.38	7,063.07	7,063.00	7,063.20	7,063.13	0.980	0.013
DP08-08	DP08-07	5.10	12.25	18.0	30.4	0.014	7,060.65	7,060.24	2.89	7,064.83	7,064.51	7,063.27	7,063.20	7,063.40	7,063.33	0.000	0.013
DP09-02	DP09-01	6.90	10.42	18.0	244.8	0.010	7,065.22	7,062.81	6.30	7,070.22	7,067.16	7,066.24	7,063.71	7,066.70	7,064.32	0.100	0.013
DP09-04	DP09-03	6.90	11.48	18.0	183.8	0.012	7,067.51	7,065.32	6.79	7,072.64	7,070.22	7,068.53	7,066.16	7,068.99	7,066.88	0.100	0.013
DP09-06	DP09-05	6.90	11.13	18.0	29.4	0.011	7,067.94	7,067.61	6.63	7,073.00	7,072.64	7,068.96	7,068.48	7,069.41	7,069.13	1.320	0.013
DP09-08	DP09-07	6.90	12.69	18.0	8.9	0.015	7,068.37	7,068.24	7.33	7,073.32	7,073.00	7,069.52	7,069.56	7,069.87	7,069.83	0.000	0.013
DP10-02	DP10-01	7.30	23.31	18.0	29.5	0.049	7,060.51	7,059.06	11.66	7,065.24	7,064.94	7,061.61	7,061.64	7,062.04	7,061.90	0.000	0.013
DP11-02	DP11-01	6.70	7.85	18.0	15.4	0.006	7,002.62	7,002.53	3.79	7,007.08	7,006.38	7,004.33	7,004.27	7,004.55	7,004.49	0.250	0.013
DP11-04	DP11-03	6.70	7.86	18.0	56.0	0.006	7,002.93	7,002.62	3.79	7,005.31	7,007.08	7,004.61	7,004.39	7,004.84	7,004.61	0.000	0.013
DP12-02	DP12-01	17.10	50.11	24.0	52.0	0.049	7,001.45	6,998.90	14.44	7,004.67	7,003.94	7,002.94	7,002.51	7,003.66	7,002.97	0.000	0.013
DP03-13	DP13-02	6.90	13.85	18.0	54.2	0.017	7,049.68	7,048.74	7.83	7,051.49	7,050.45	7,050.70	7,049.50	7,051.16	7,050.42	0.000	0.013
DP14-03	DP14-02	3.30	3.69	12.0	69.3	0.011	7,051.43	7,050.69	5.32	7,054.43	7,051.86	7,052.21	7,051.43	7,052.61	7,051.87	0.075	0.013
DP14-05	DP14-04	3.30	3.69	12.0	55.8	0.011	7,052.03	7,051.43	5.32	7,054.73	7,054.43	7,052.81	7,052.24	7,053.21	7,052.61	0.640	0.013
DP14-07	DP14-06	3.30	3.69	12.0	21.4	0.011	7,052.26	7,052.03	5.32	7,053.43	7,054.73	7,053.24	7,053.06	7,053.52	7,053.34	0.000	0.013
DP15-02	DP15-01	16.00	39.48	24.0	8.9	0.030	7,059.57	7,059.30	5.09	7,064.65	7,064.38	7,063.05	7,063.00	7,063.45	7,063.41	0.000	0.013

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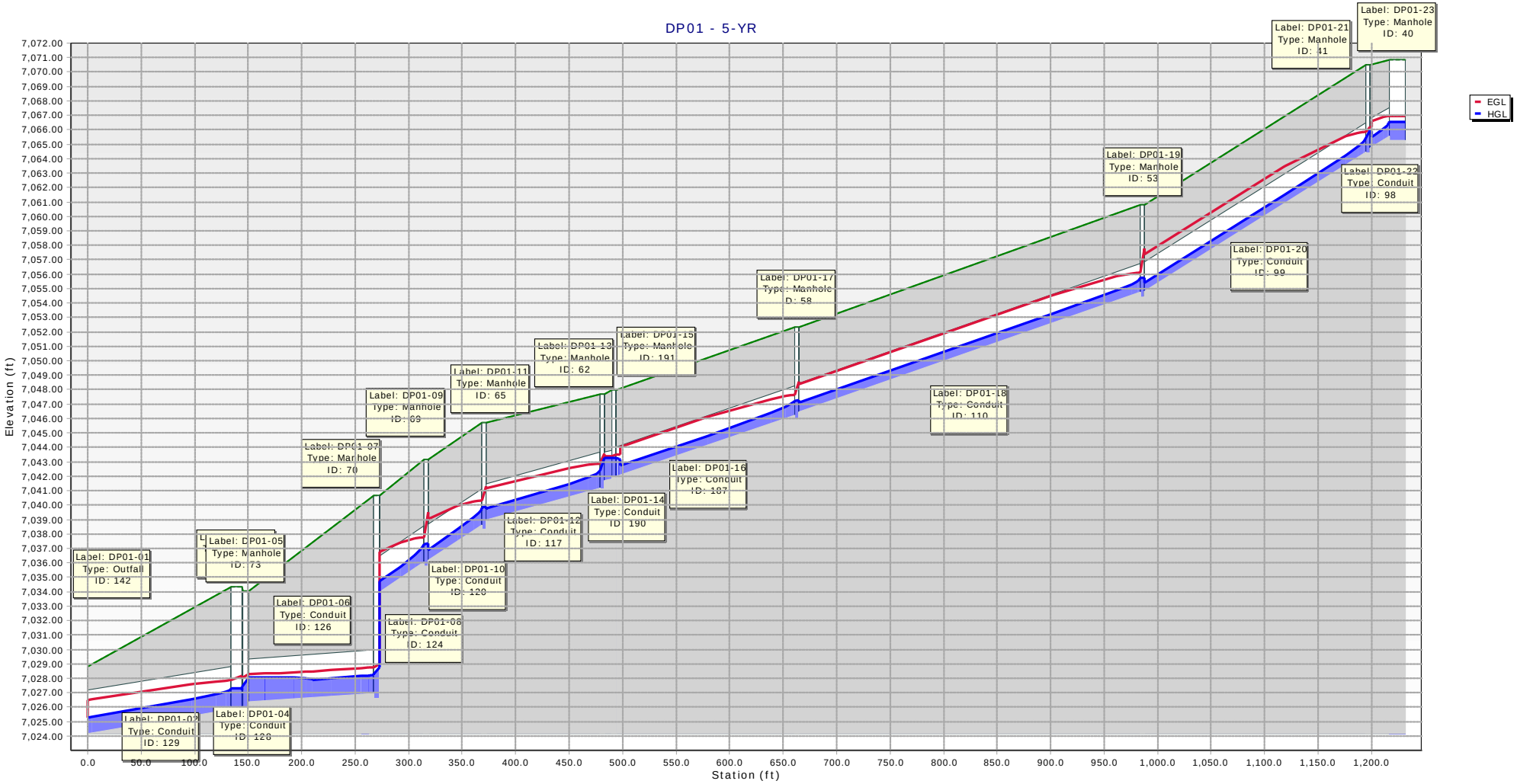
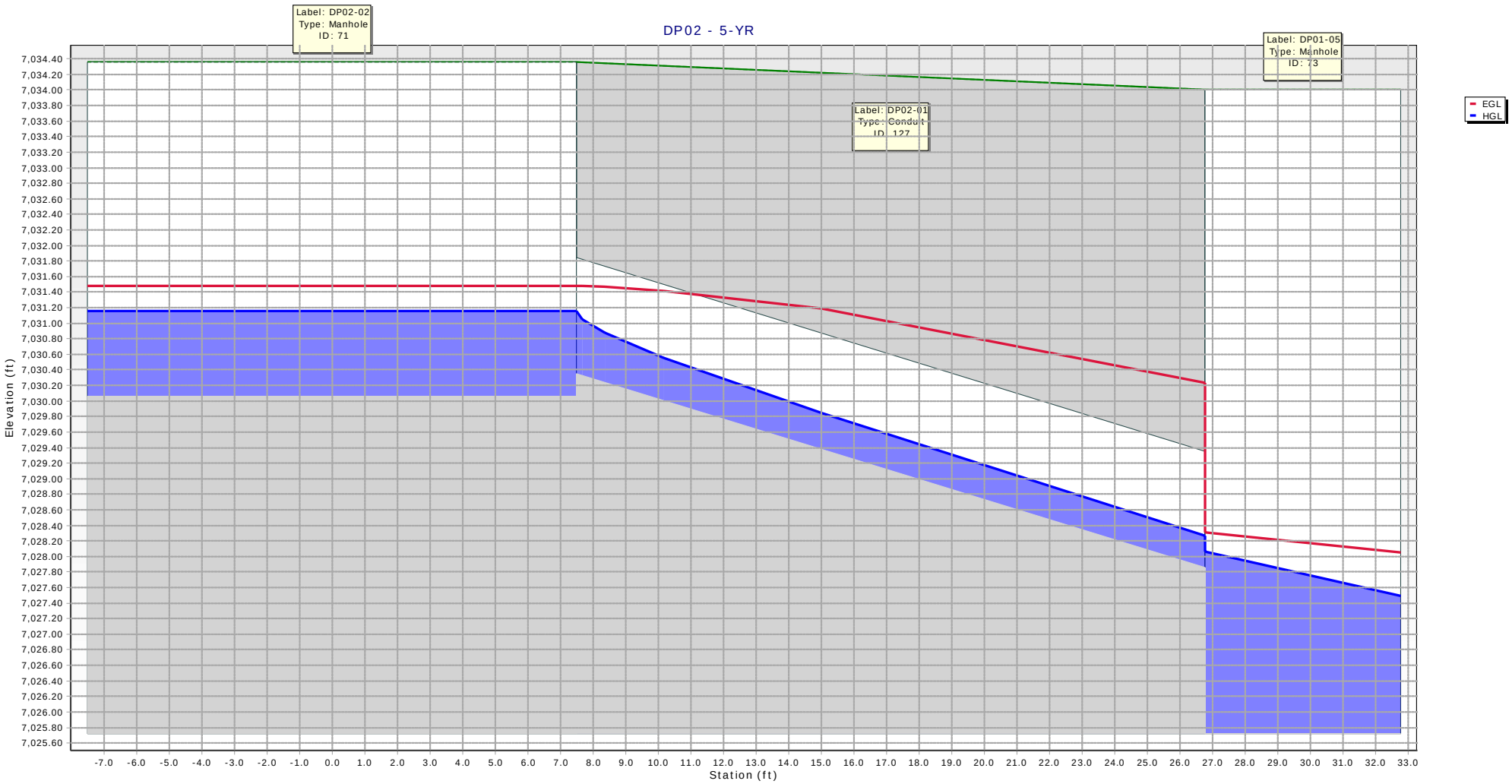
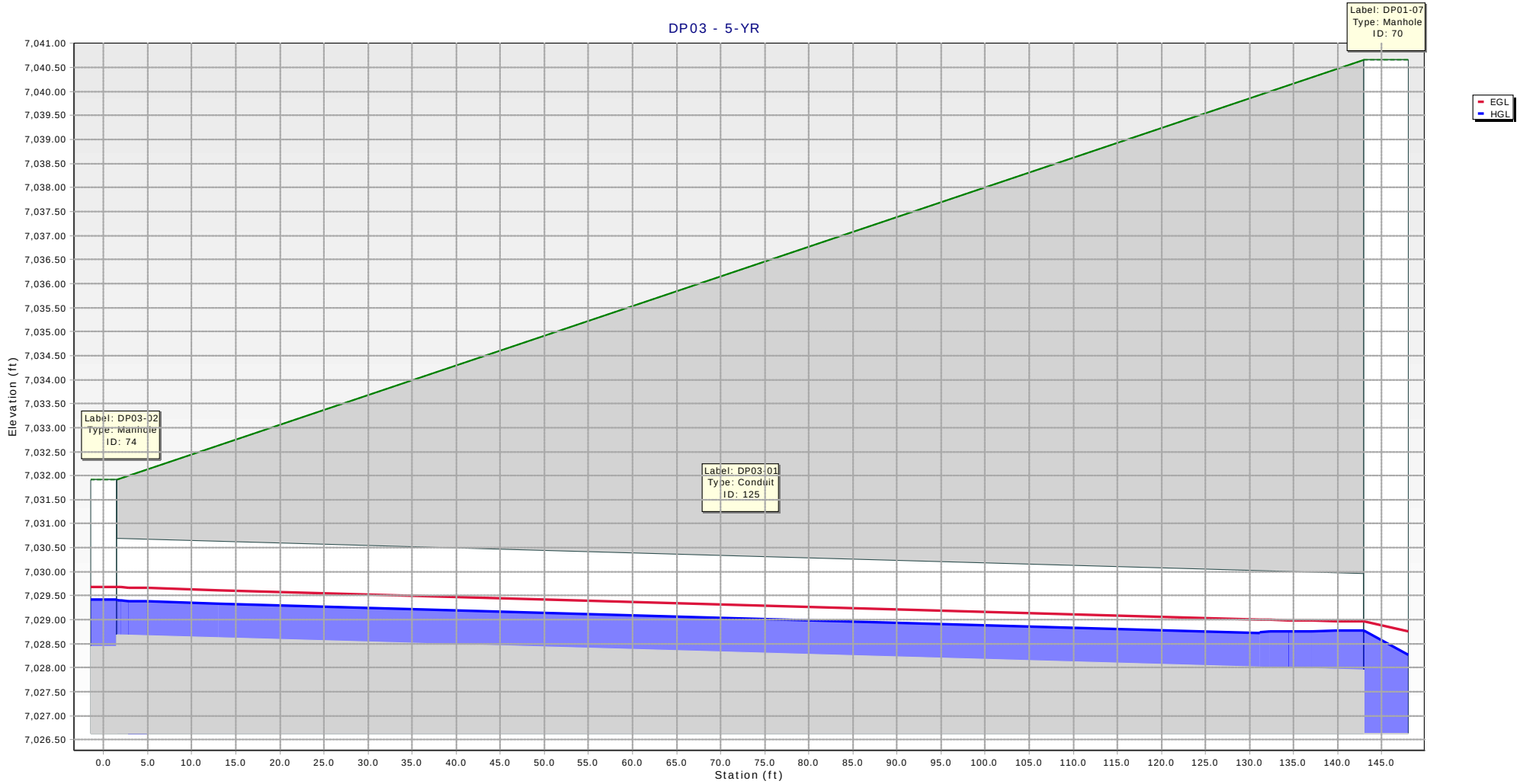

DP01 - 5-YR
Elevation (ft)
Station (ft)
EGL
HGL
Label: DP01-01
Type: Outfall
ID: 142
Label: DP01-02
Type: Conduit
ID: 129
Label: DP01-04
Type: Conduit
ID: 128
Label: DP01-05
Type: Manhole
ID: 73
Label: DP01-06
Type: Conduit
ID: 126
Label: DP01-07
Type: Manhole
ID: 70
Label: DP01-08
Type: Conduit
ID: 124
Label: DP01-09
Type: Manhole
ID: 69
Label: DP01-10
Type: Conduit
ID: 120
Label: DP01-11
Type: Manhole
ID: 65
Label: DP01-12
Type: Conduit
ID: 117
Label: DP01-13
Type: Manhole
ID: 62
Label: DP01-14
Type: Conduit
ID: 190
Label: DP01-15
Type: Manhole
ID: 191
Label: DP01-16
Type: Conduit
ID: 107
Label: DP01-17
Type: Manhole
ID: 58
Label: DP01-18
Type: Conduit
ID: 110
Label: DP01-19
Type: Manhole
ID: 53
Label: DP01-20
Type: Conduit
ID: 99
Label: DP01-21
Type: Manhole
ID: 41
Label: DP01-22
Type: Conduit
ID: 98
Label: DP01-23
Type: Manhole
ID: 40


DP02 - 5-YR
Label: DP02-02
Type: Manhole
ID: 71
Label: DP01-05
Type: Manhole
ID: 73
Label: DP02-01
Type: Conduit
ID: 127
EGL
HGL
Elevation (ft)
Station (ft)


DP03 - 5-YR
Label: DP01-07
Type: Manhole
ID: 70
Label: DP03-02
Type: Manhole
ID: 74
Label: DP03-01
Type: Conduit
ID: 125
EGL
HGL
Elevation (ft)
Station (ft)
7,041.00
7,040.50
7,040.00
7,039.50
7,039.00
7,038.50
7,038.00
7,037.50
7,037.00
7,036.50
7,036.00
7,035.50
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7,034.50
7,034.00
7,033.50
7,033.00
7,032.50
7,032.00
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7,028.50
7,028.00
7,027.50
7,027.00
7,026.50
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
55.0
60.0
65.0
70.0
75.0
80.0
85.0
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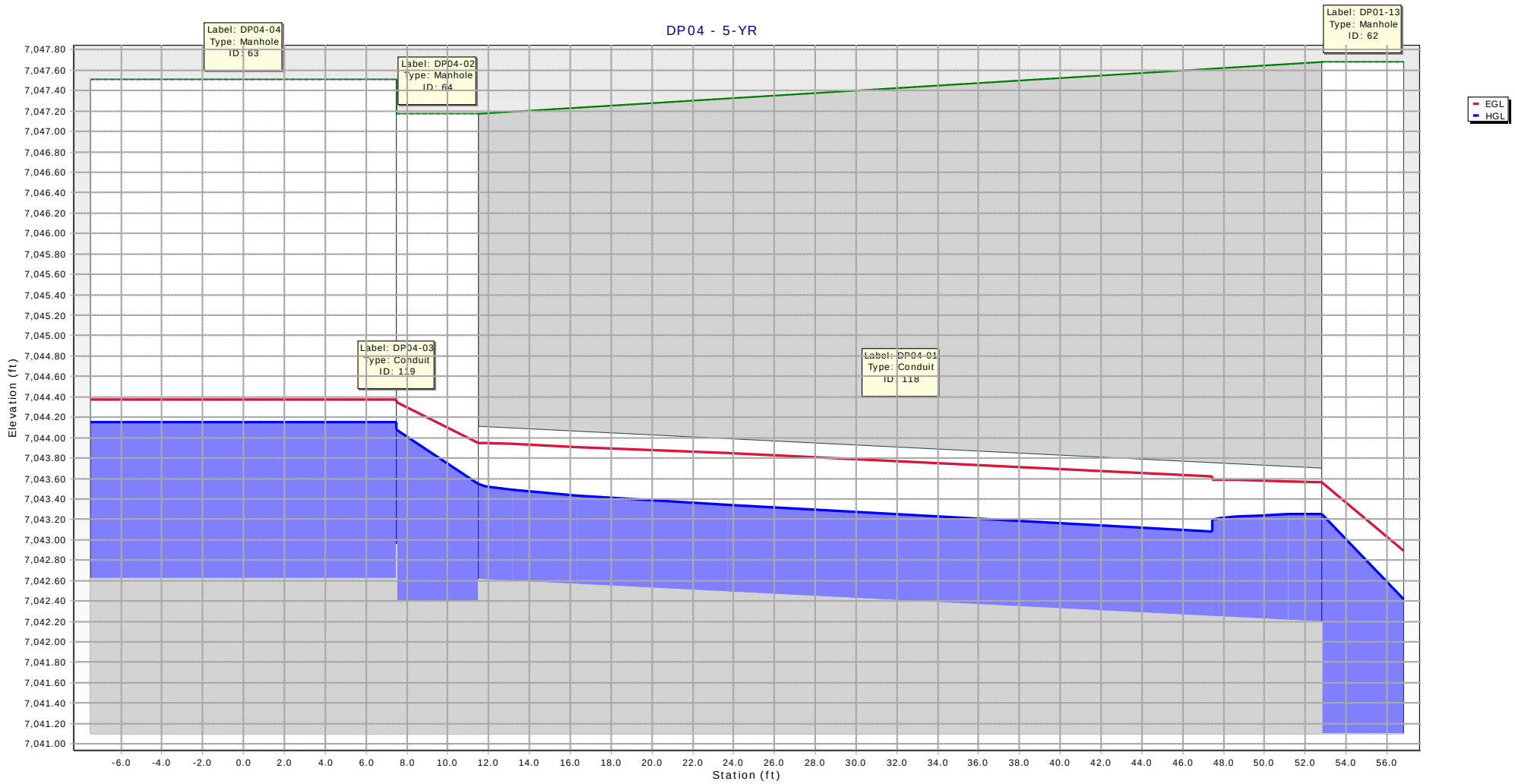
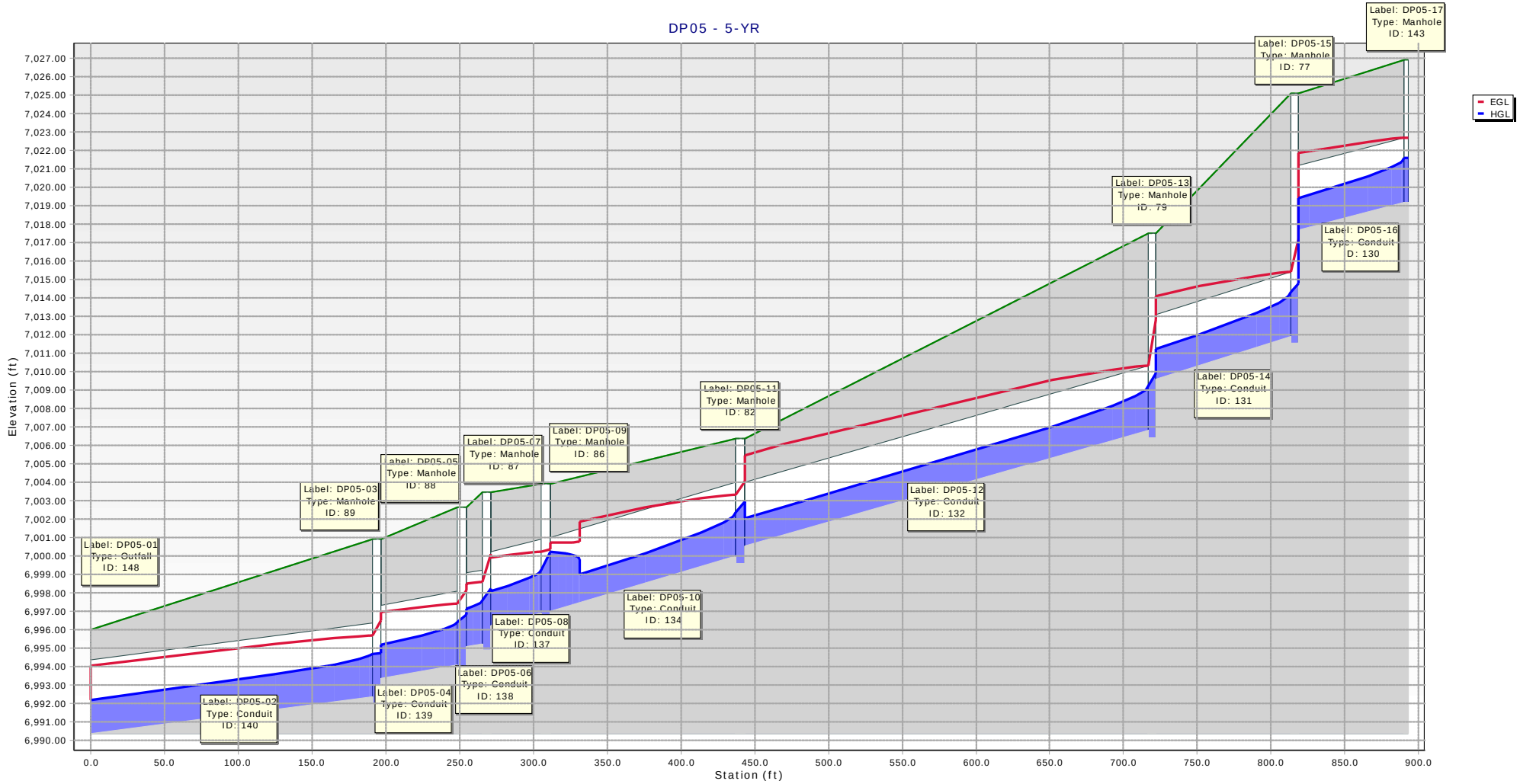
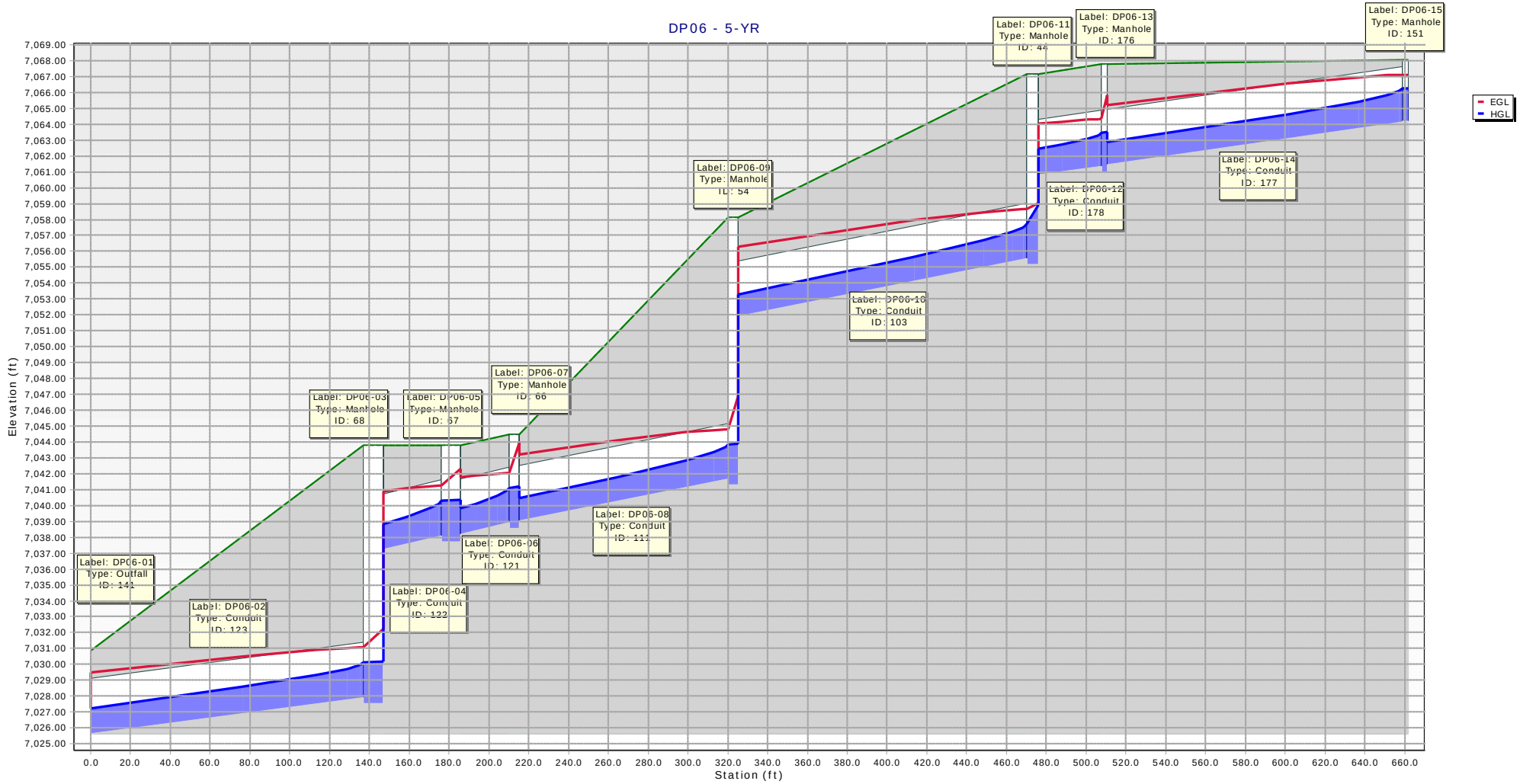
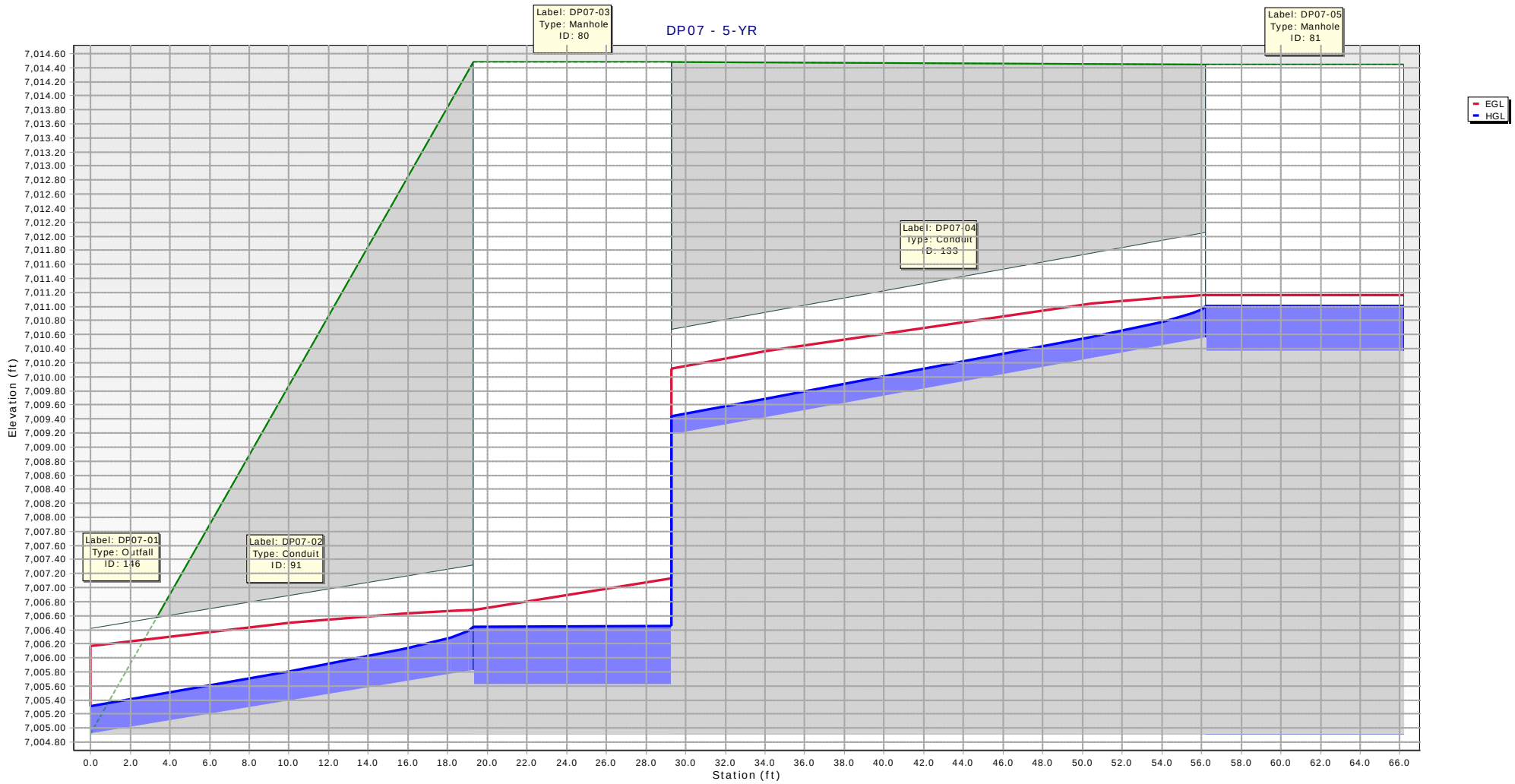
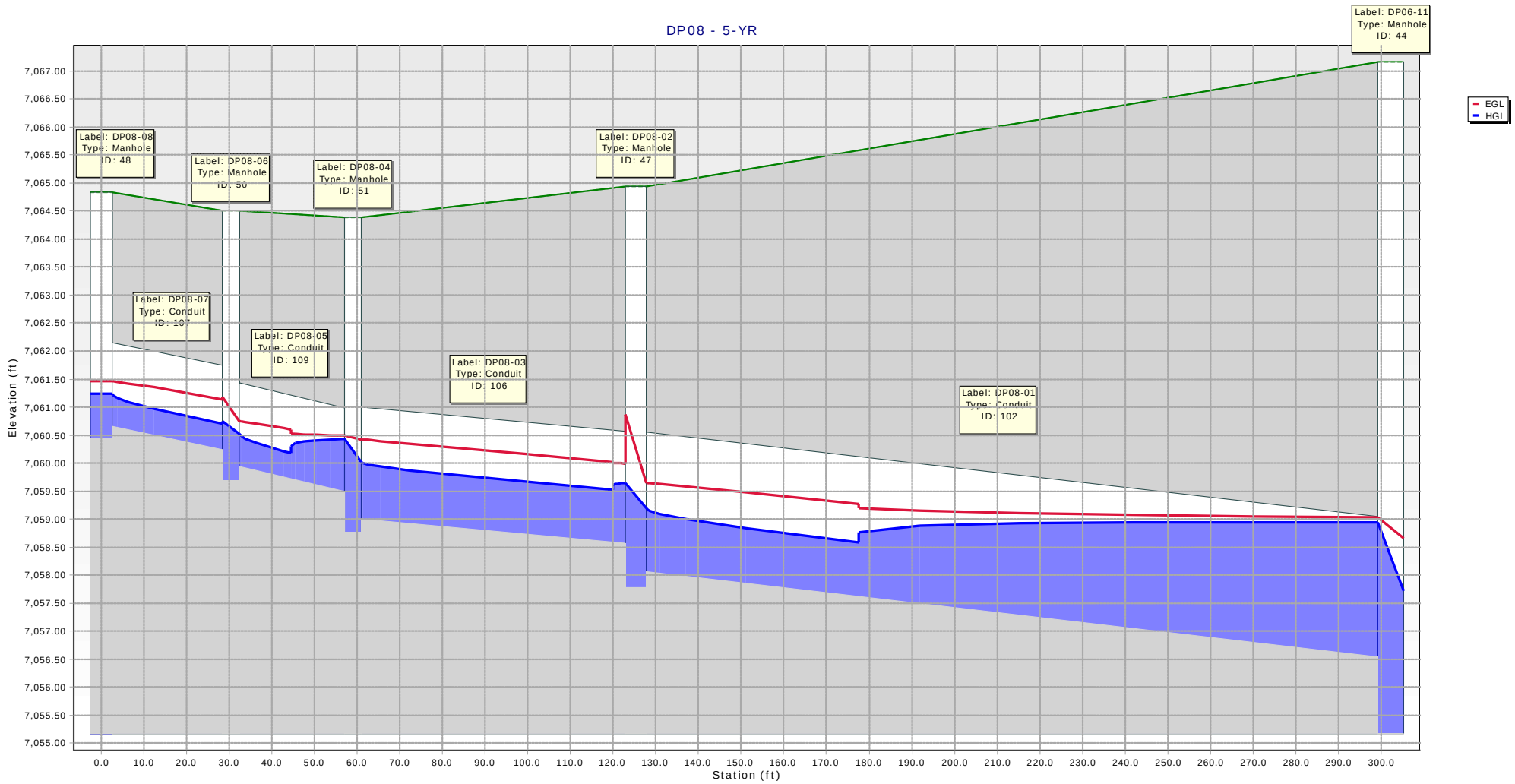
120.0
125.0
130.0
135.0
140.0
145.0

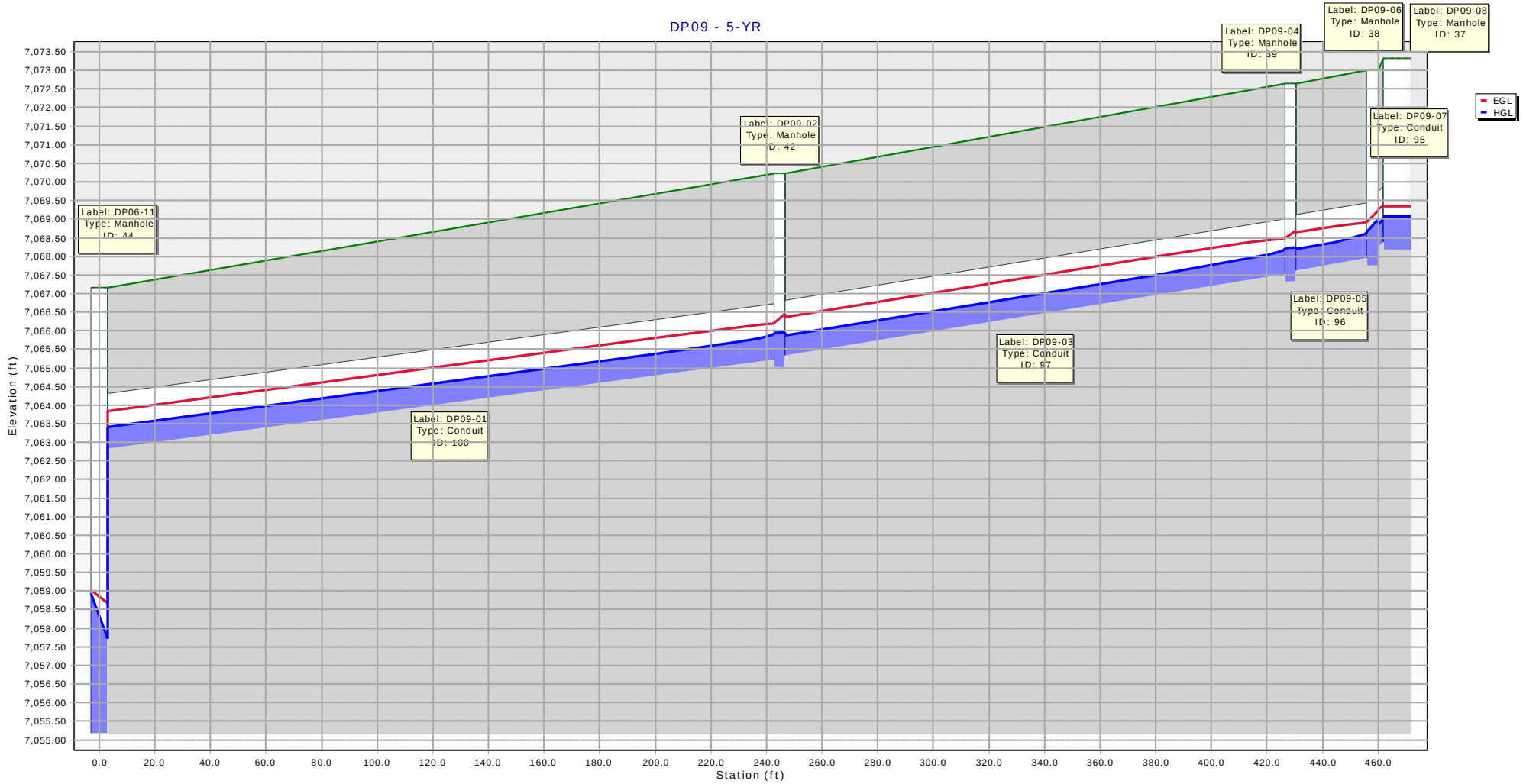

DP04 - 5-YR
Label: DP04-04
Type: Manhole
ID: 63
Label: DP04-02
Type: Manhole
ID: 64
Label: DP01-13
Type: Manhole
ID: 62
Label: DP04-03
Type: Conduit
ID: 119
Label: DP04-01
Type: Conduit
ID: 118
EGL
HGL
Elevation (ft)
Station (ft)

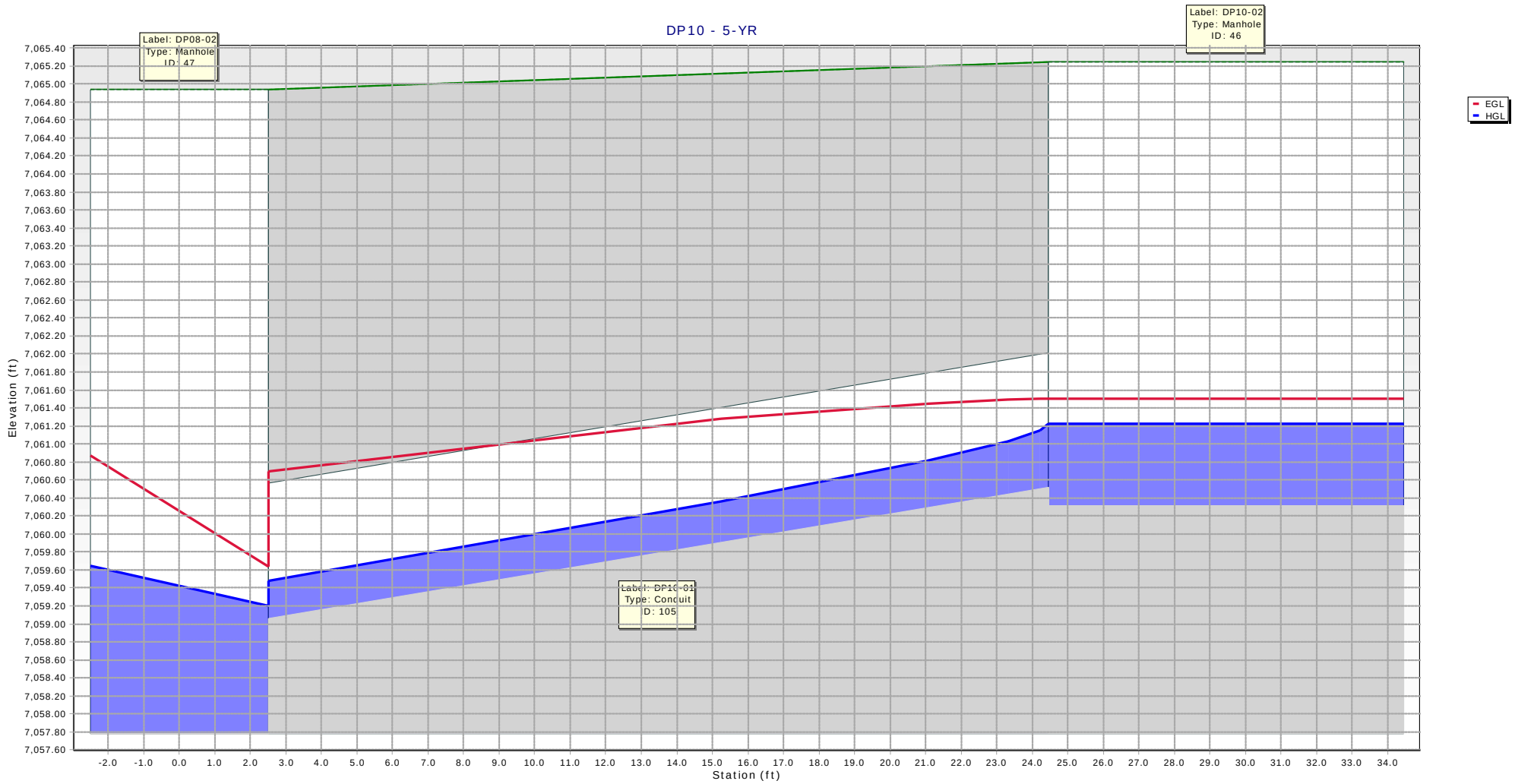

DP05 - 5-YR
Elevation (ft)
Station (ft)
EGL
HGL
Label: DP05-01
Type: Outfall
ID: 148
Label: DP05-02
Type: Conduit
ID: 140
Label: DP05-03
Type: Manhole
ID: 89
Label: DP05-04
Type: Conduit
ID: 139
Label: DP05-05
Type: Manhole
ID: 88
Label: DP05-06
Type: Conduit
ID: 138
Label: DP05-07
Type: Manhole
ID: 87
Label: DP05-08
Type: Conduit
ID: 137
Label: DP05-09
Type: Manhole
ID: 86
Label: DP05-10
Type: Conduit
ID: 134
Label: DP05-11
Type: Manhole
ID: 82
Label: DP05-12
Type: Conduit
ID: 132
Label: DP05-13
Type: Manhole
ID: 79
Label: DP05-14
Type: Conduit
ID: 131
Label: DP05-15
Type: Manhole
ID: 77
Label: DP05-16
Type: Conduit
ID: 130
Label: DP05-17
Type: Manhole
ID: 143

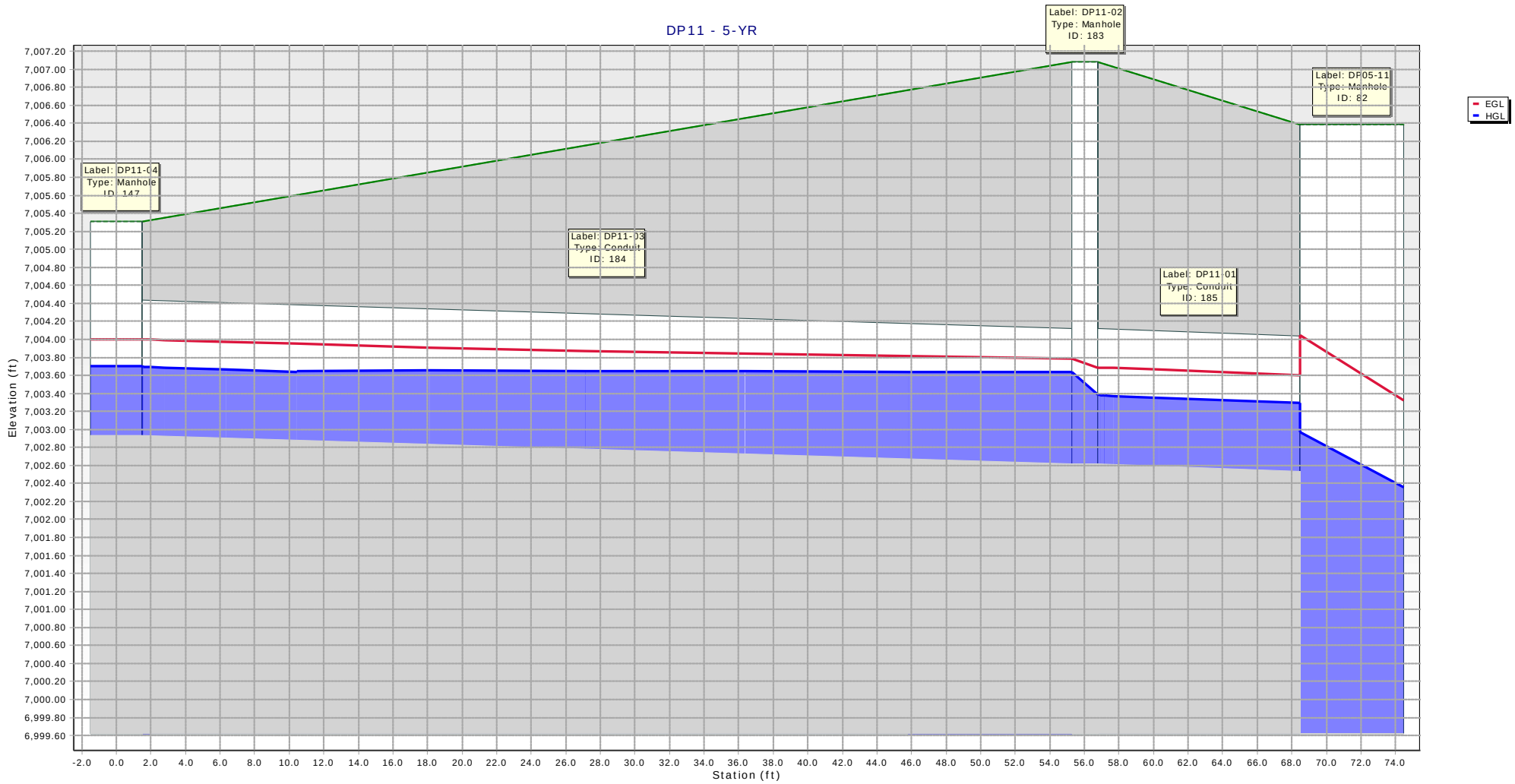

DP06 - 5-YR
Elevation (ft)
Station (ft)
EGL
HGL
Label: DP06-01
Type: Outfall
ID: 141
Label: DP06-02
Type: Conduit
ID: 123
Label: DP06-03
Type: Manhole
ID: 68
Label: DP06-04
Type: Conduit
ID: 122
Label: DP06-05
Type: Manhole
ID: 67
Label: DP06-06
Type: Conduit
ID: 121
Label: DP06-07
Type: Manhole
ID: 66
Label: DP06-08
Type: Conduit
ID: 111
Label: DP06-09
Type: Manhole
ID: 54
Label: DP06-10
Type: Conduit
ID: 103
Label: DP06-11
Type: Manhole
ID: 44
Label: DP06-12
Type: Conduit
ID: 178
Label: DP06-13
Type: Manhole
ID: 176
Label: DP06-14
Type: Conduit
ID: 177
Label: DP06-15
Type: Manhole
ID: 151

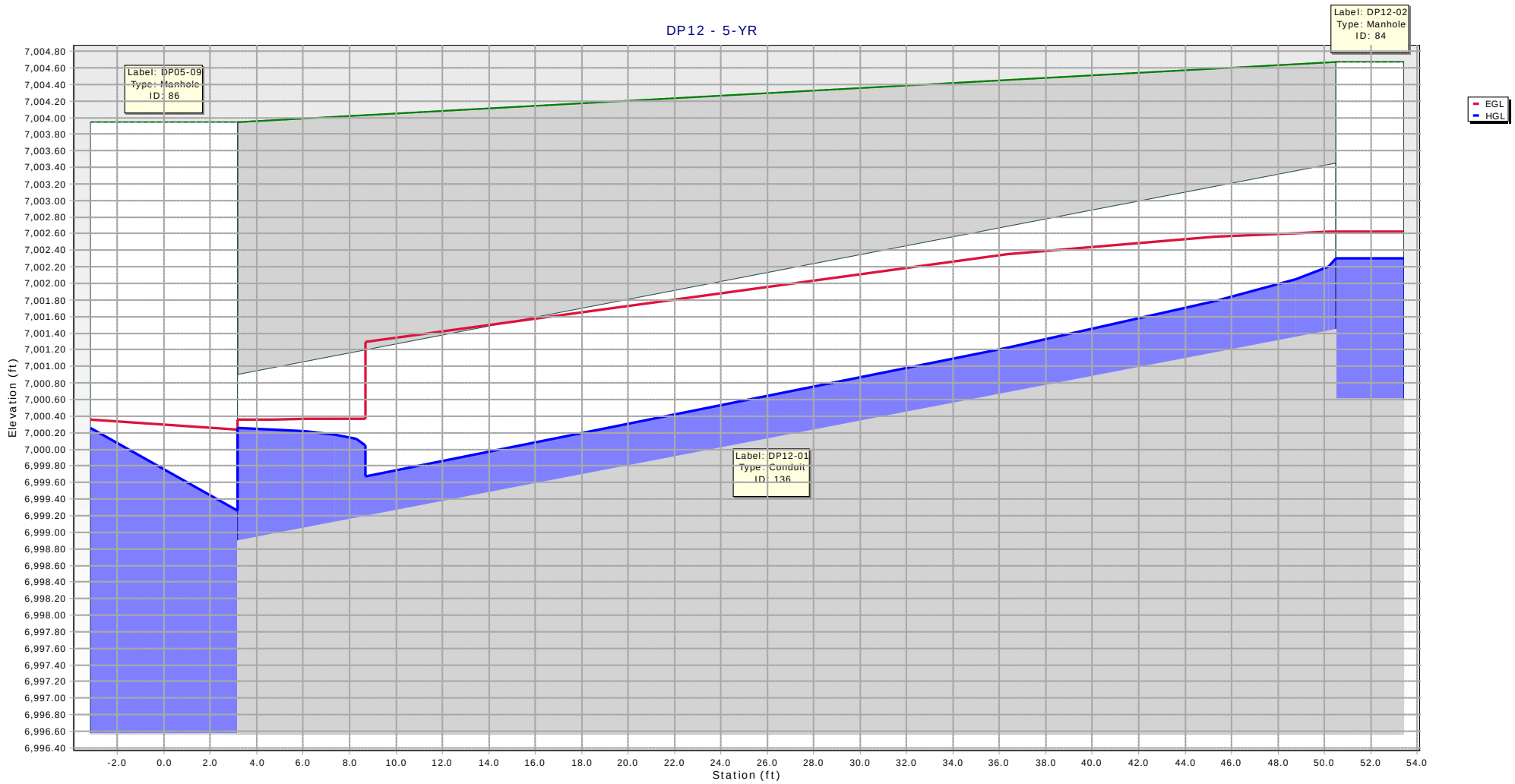

DP07 - 5-YR
Label: DP07-03
Type: Manhole
ID: 80
Label: DP07-05
Type: Manhole
ID: 81
Label: DP07-04
Type: Conduit
ID: 133
Label: DP07-01
Type: Outfall
ID: 146
Label: DP07-02
Type: Conduit
ID: 91
EGL
HGL
Elevation (ft)
Station (ft)


DP08 - 5-YR
Label: DP06-11
Type: Manhole
ID: 44
Label: DP08-08
Type: Manhole
ID: 48
Label: DP08-06
Type: Manhole
ID: 50
Label: DP08-04
Type: Manhole
ID: 51
Label: DP08-02
Type: Manhole
ID: 47
Label: DP08-07
Type: Conduit
ID: 107
Label: DP08-05
Type: Conduit
ID: 109
Label: DP08-03
Type: Conduit
ID: 106
Label: DP08-01
Type: Conduit
ID: 102
EGL
HGL
Elevation (ft)
Station (ft)


DP09 - 5-YR
Elevation (ft)
Station (ft)
EGL
HGL
Label: DP06-11
Type: Manhole
ID: 44
Label: DP09-01
Type: Conduit
ID: 100
Label: DP09-02
Type: Manhole
ID: 42
Label: DP09-03
Type: Conduit
ID: 97
Label: DP09-04
Type: Manhole
ID: 39
Label: DP09-05
Type: Conduit
ID: 96
Label: DP09-06
Type: Manhole
ID: 38
Label: DP09-07
Type: Conduit
ID: 95
Label: DP09-08
Type: Manhole
ID: 37


DP10 - 5-YR
Label: DP08-02
Type: Manhole
ID: 47
Label: DP10-02
Type: Manhole
ID: 46
Label: DP10-01
Type: Conduit
ID: 105
EGL
HGL
Elevation (ft)
Station (ft)


DP11 - 5-YR
Label: DP11-02
Type: Manhole
ID: 183
Label: DP05-11
Type: Manhole
ID: 82
Label: DP11-04
Type: Manhole
ID: 147
Label: DP11-03
Type: Conduit
ID: 184
Label: DP11-01
Type: Conduit
ID: 185
EGL
HGL
Elevation (ft)
Station (ft)


DP12 - 5-YR
Label: DP05-09
Type: Manhole
ID: 86
Label: DP12-02
Type: Manhole
ID: 84
Label: DP12-01
Type: Conduit
ID: 136
EGL
HGL
Elevation (ft)
Station (ft)
7,004.80
7,004.60
7,004.40
7,004.20
7,004.00
7,003.80
7,003.60
7,003.40
7,003.20
7,003.00
7,002.80
7,002.60
7,002.40
7,002.20
7,002.00
7,001.80
7,001.60
7,001.40
7,001.20
7,001.00
7,000.80
7,000.60
7,000.40
7,000.20
7,000.00
6,999.80
6,999.60
6,999.40
6,999.20
6,999.00
6,998.80
6,998.60
6,998.40
6,998.20
6,998.00
6,997.80
6,997.60
6,997.40
6,997.20
6,997.00
6,996.80
6,996.60
6,996.40
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
20.0
22.0
24.0
26.0
28.0
30.0
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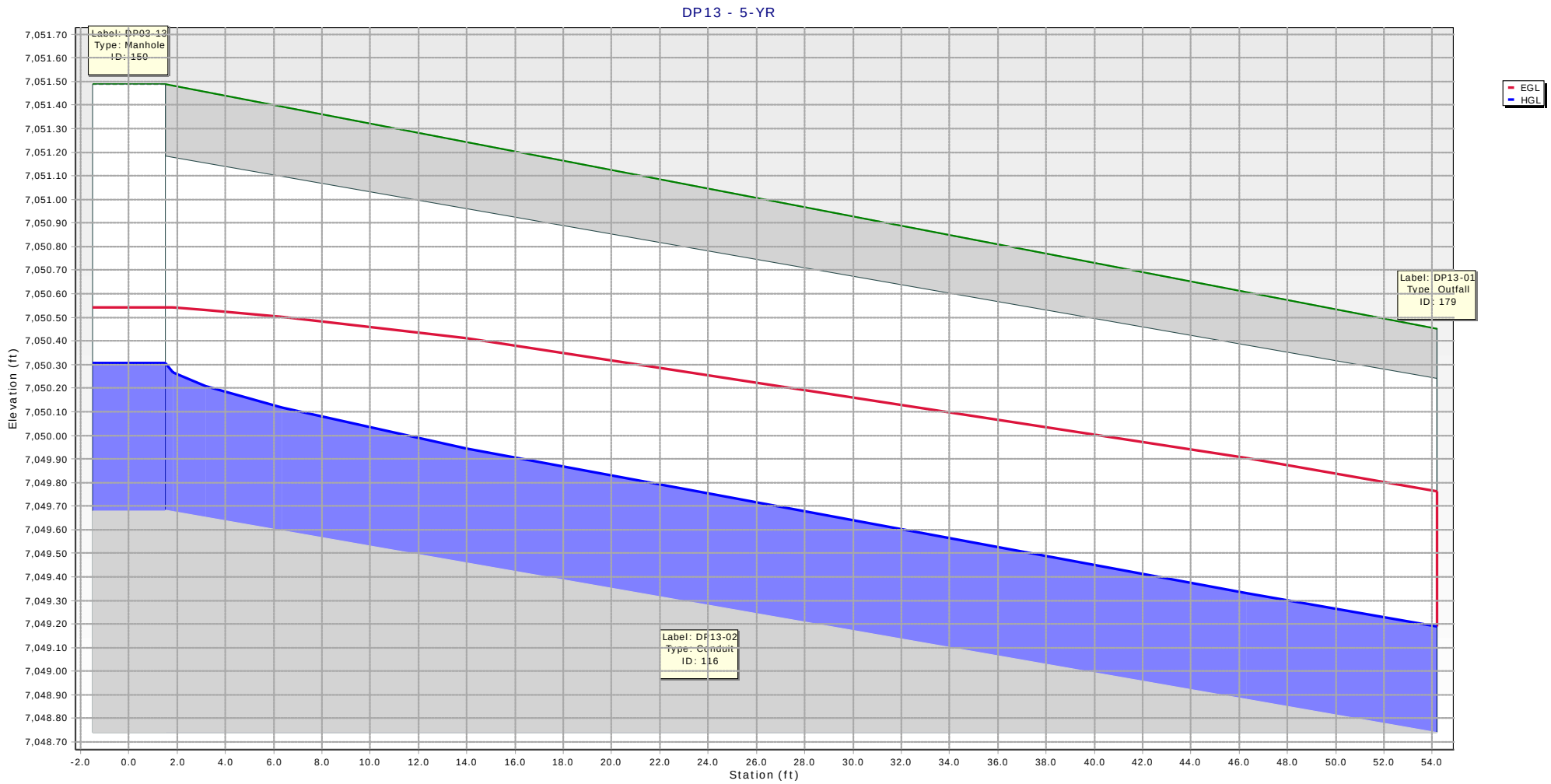
44.0
46.0
48.0
50.0
52.0
54.0


DP13 - 5-YR
Label: DP03-12
Type: Manhole
ID: 150
Label: DP13-01
Type: Outfall
ID: 179
Label: DP13-02
Type: Conduit
ID: 116
EGL
HGL
Elevation (ft)
Station (ft)
7,051.70
7,051.60
7,051.50
7,051.40
7,051.30
7,051.20
7,051.10
7,051.00
7,050.90
7,050.80
7,050.70
7,050.60
7,050.50
7,050.40
7,050.30
7,050.20
7,050.10
7,050.00
7,049.90
7,049.80
7,049.70
7,049.60
7,049.50
7,049.40
7,049.30
7,049.20
7,049.10
7,049.00
7,048.90
7,048.80
7,048.70
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
20.0
22.0
24.0
26.0
28.0
30.0
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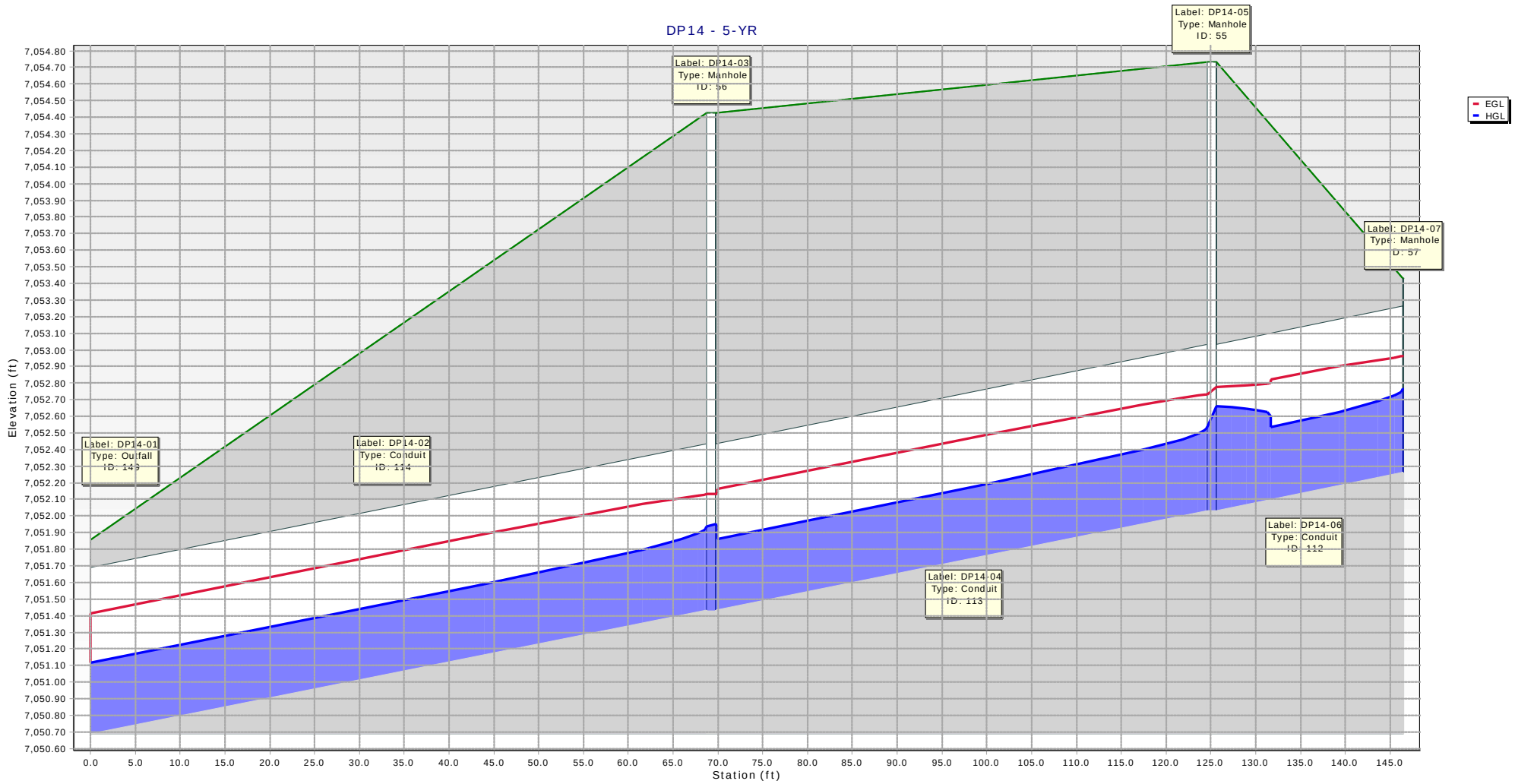
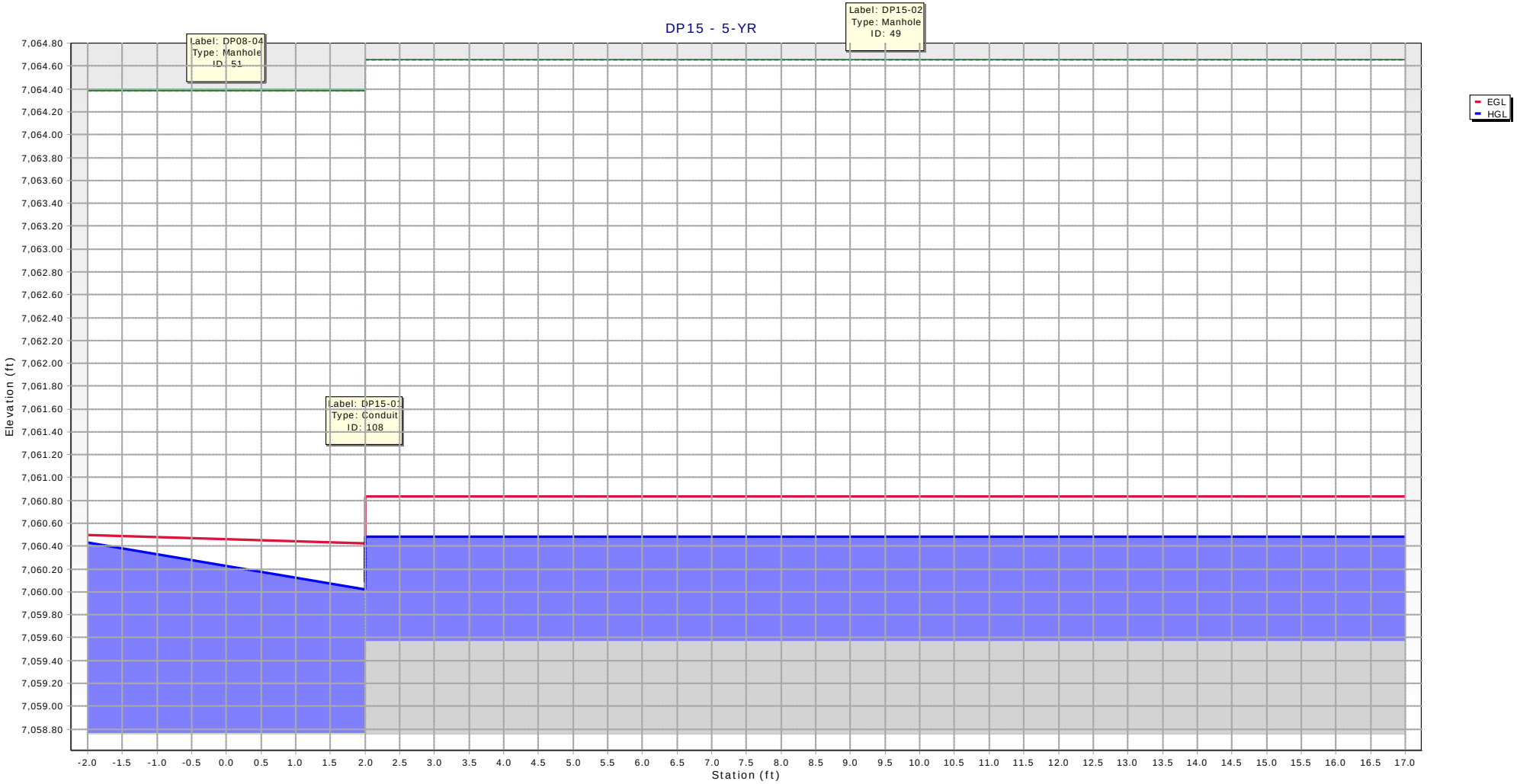
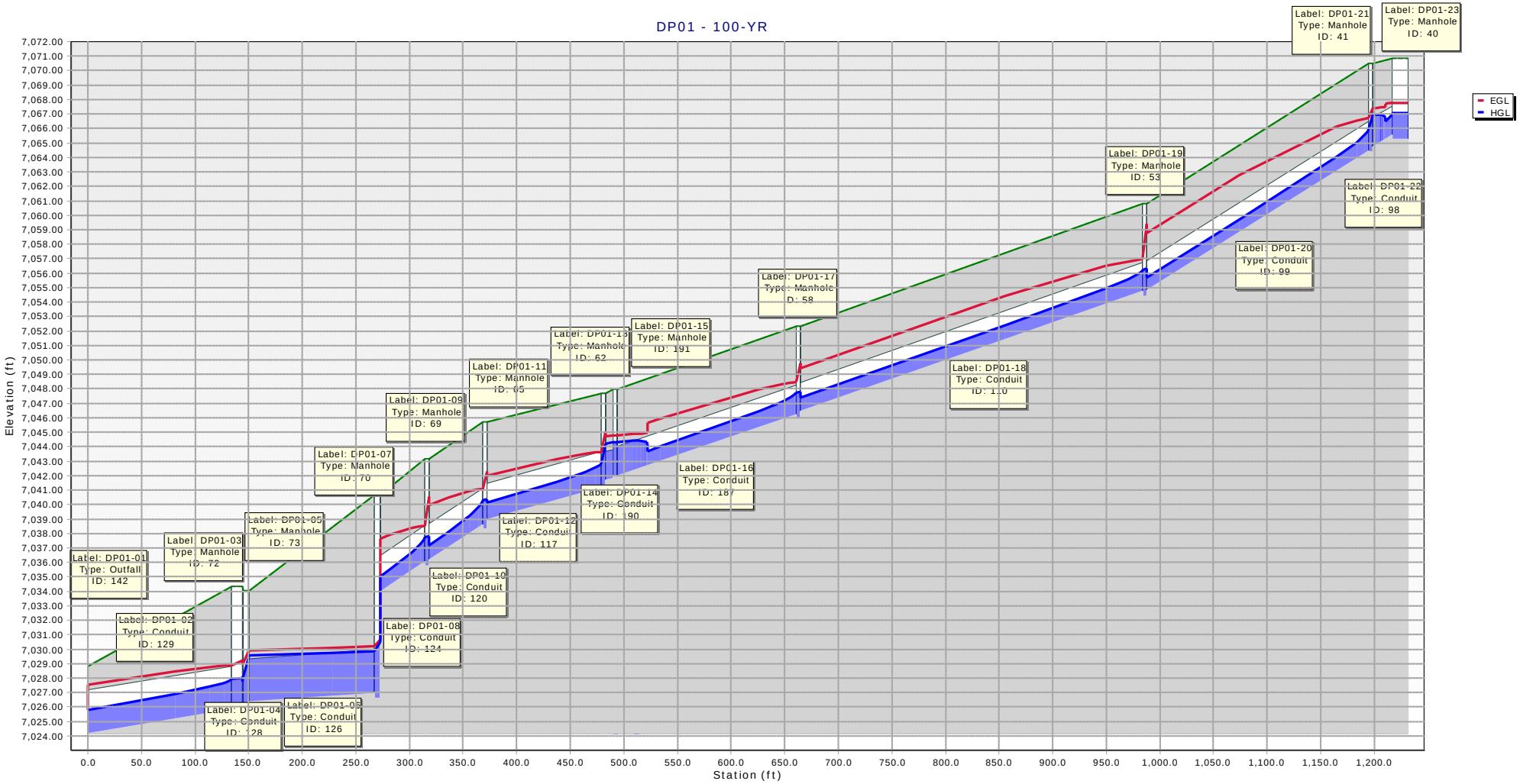
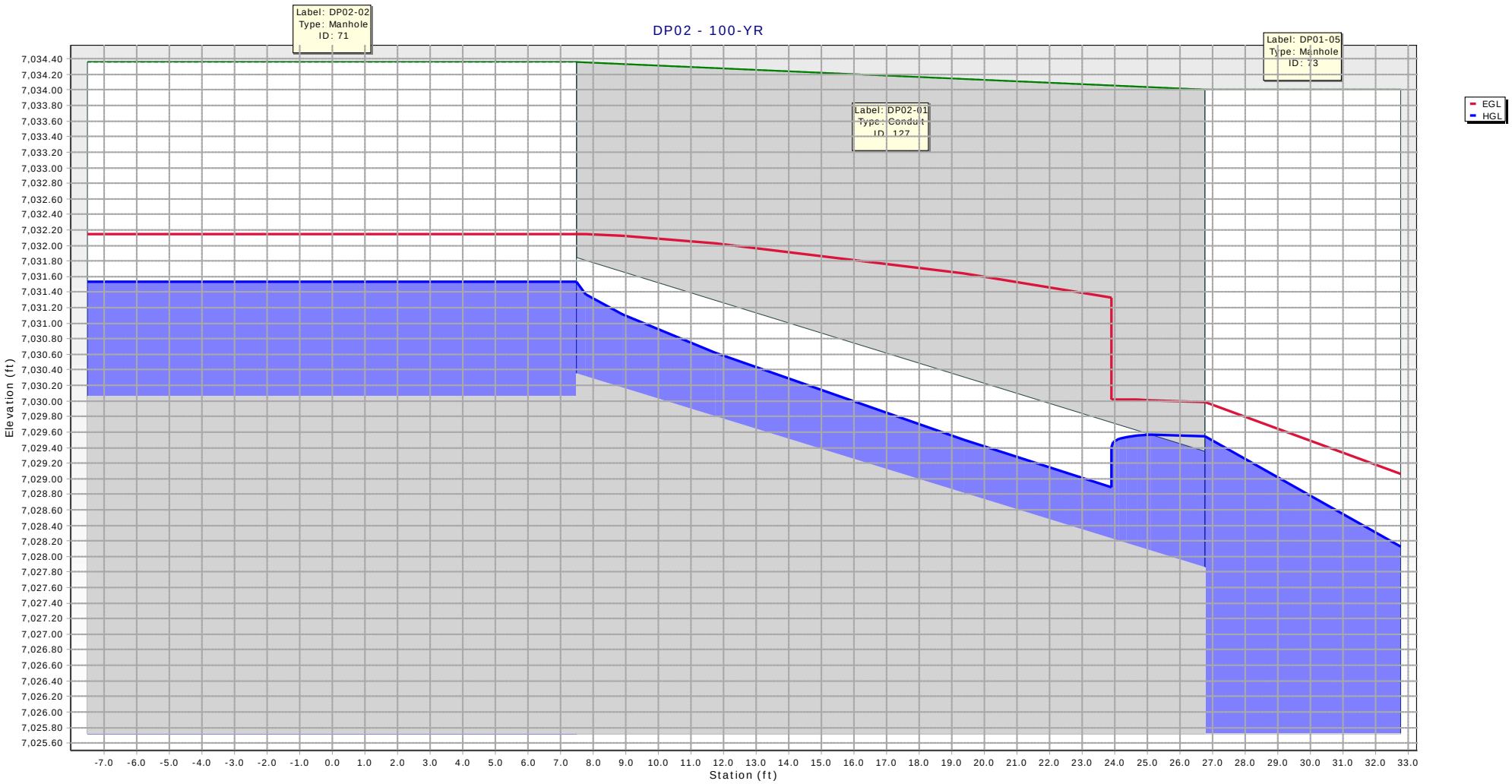
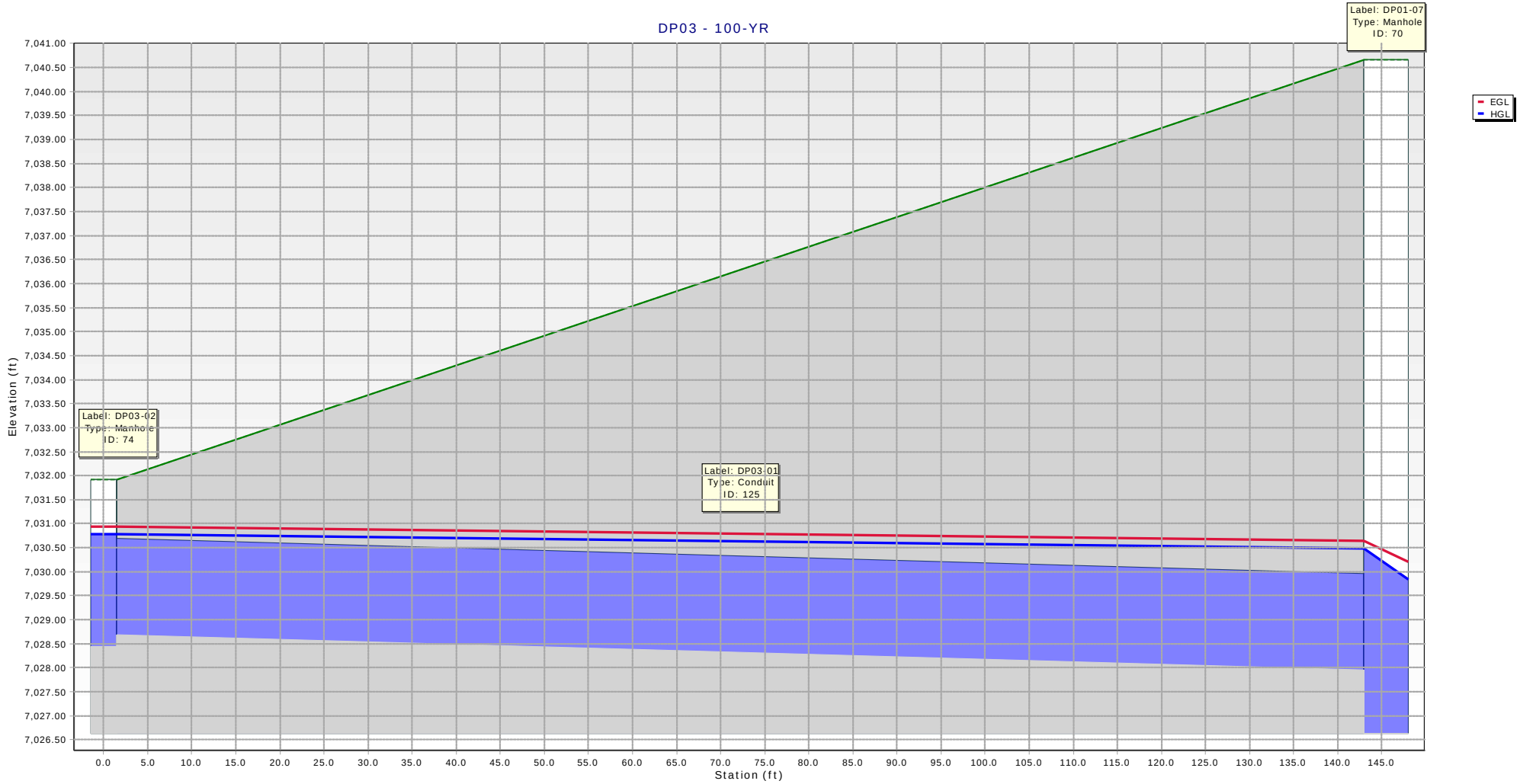
44.0
46.0
48.0
50.0
52.0
54.0

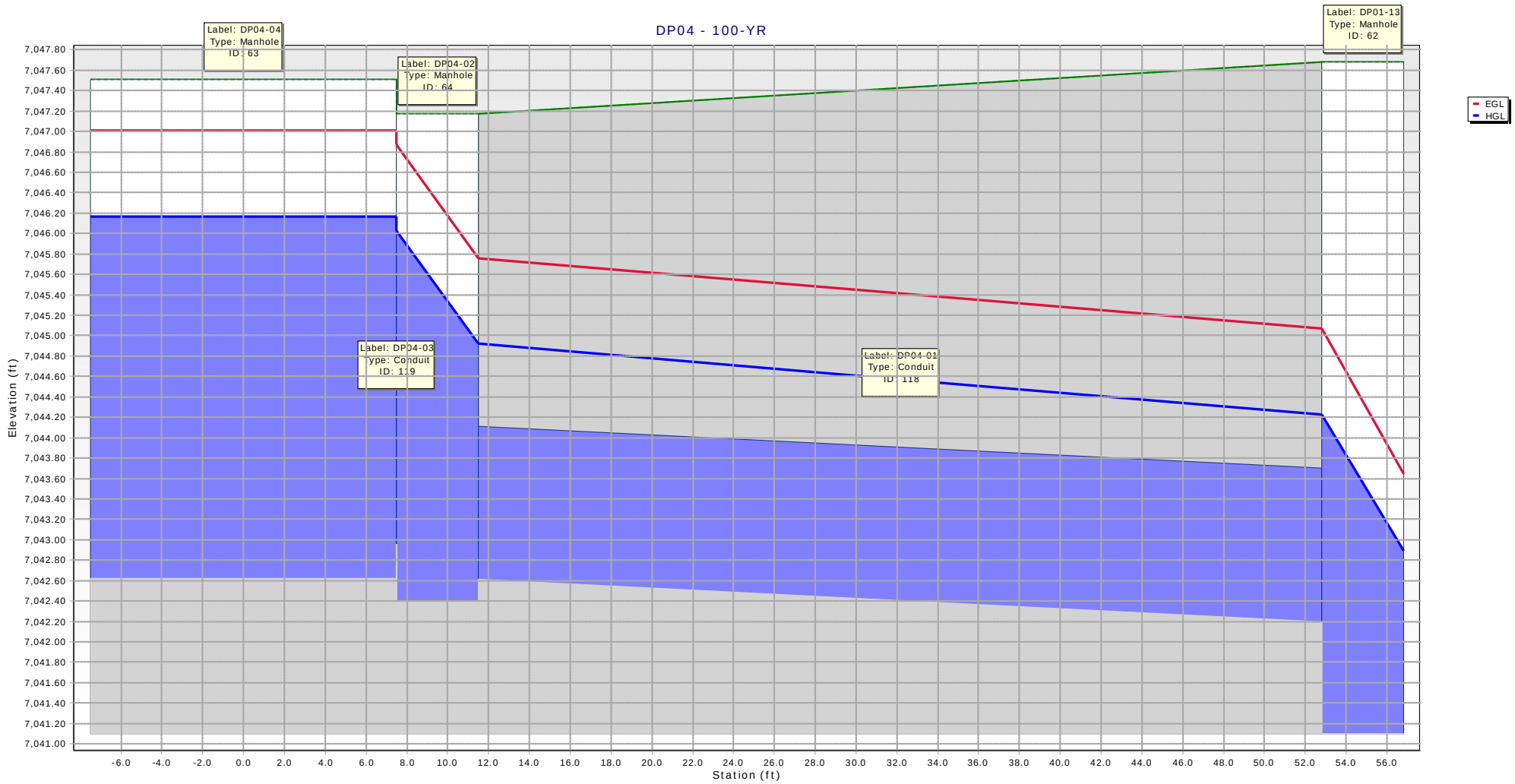

DP14 - 5-YR
Label: DP14-05
Type: Manhole
ID: 55
Label: DP14-03
Type: Manhole
ID: 56
Label: DP14-07
Type: Manhole
ID: 57
Label: DP14-01
Type: Outfall
ID: 143
Label: DP14-02
Type: Conduit
ID: 114
Label: DP14-06
Type: Conduit
ID: 112
Label: DP14-04
Type: Conduit
ID: 113
EGL
HGL
Elevation (ft)
Station (ft)

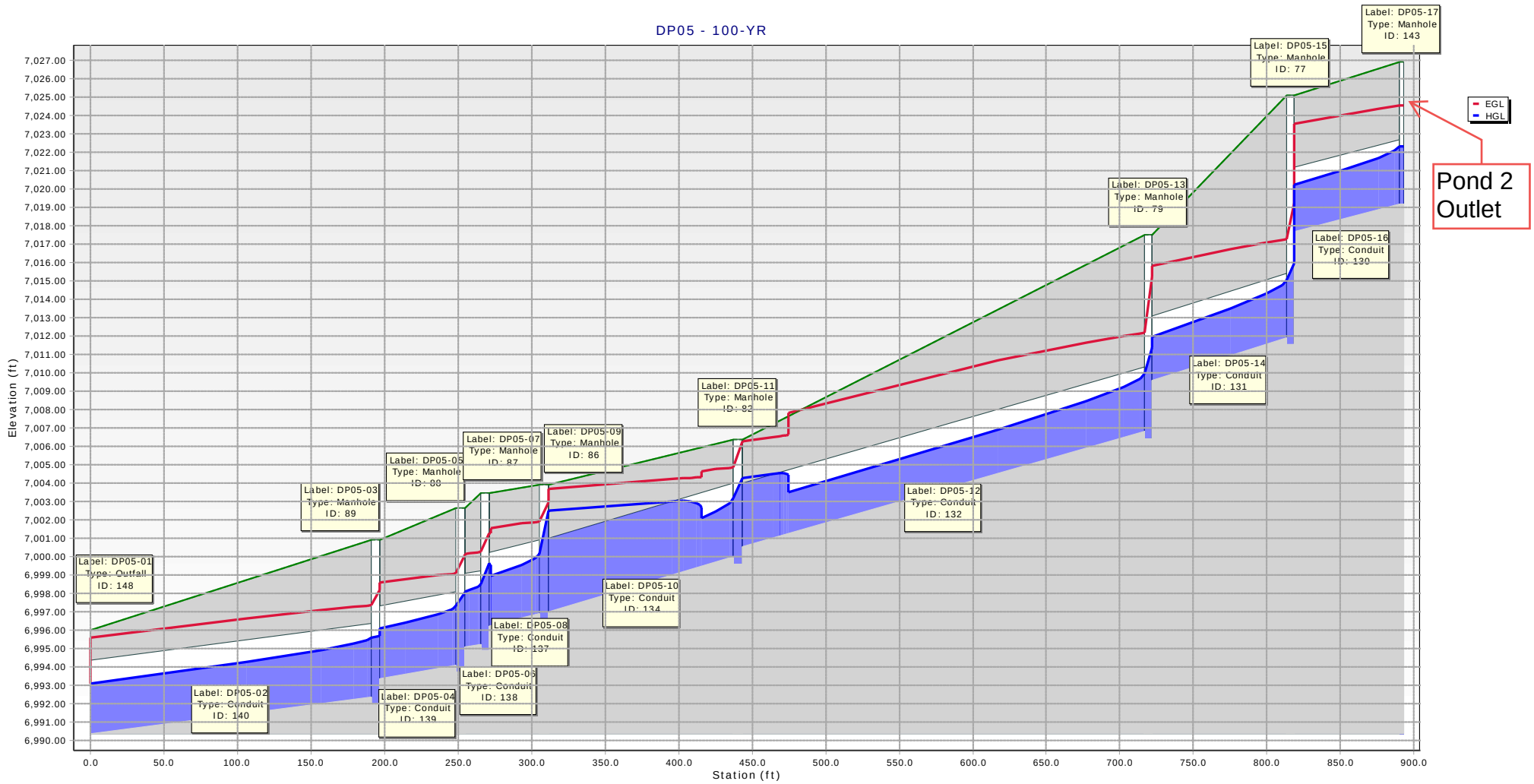

DP15 - 5-YR
Label: DP08-04
Type: Manhole
ID: 51
Label: DP15-02
Type: Manhole
ID: 49
Label: DP15-01
Type: Conduit
ID: 108
EGL
HGL
Elevation (ft)
Station (ft)
7,064.80
7,064.60
7,064.40
7,064.20
7,064.00
7,063.80
7,063.60
7,063.40
7,063.20
7,063.00
7,062.80
7,062.60
7,062.40
7,062.20
7,062.00
7,061.80
7,061.60
7,061.40
7,061.20
7,061.00
7,060.80
7,060.60
7,060.40
7,060.20
7,060.00
7,059.80
7,059.60
7,059.40
7,059.20
7,059.00
7,058.80
-2.0 -1.5 -1.0 -0.5 0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5 10.0 10.5 11.0 11.5 12.0 12.5 13.0 13.5 14.0 14.5 15.0 15.5 16.0 16.5 17.0

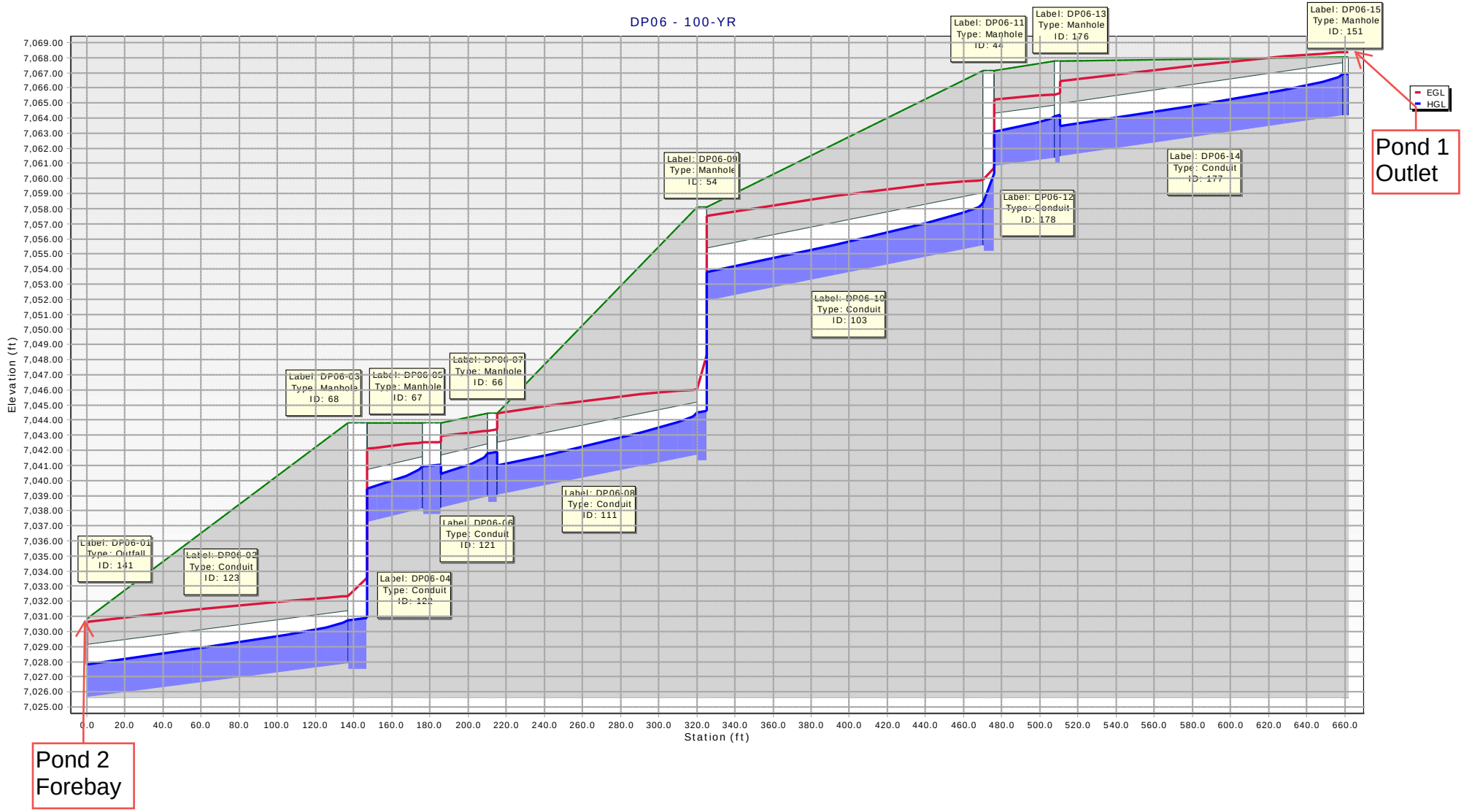

DP01 - 100-YR
Elevation (ft)
Station (ft)
EGL
HGL
Label: DP01-01
Type: Outfall
ID: 142
Label: DP01-02
Type: Conduit
ID: 129
Label: DP01-03
Type: Manhole
ID: 72
Label: DP01-04
Type: Conduit
ID: 128
Label: DP01-05
Type: Manhole
ID: 73
Label: DP01-06
Type: Conduit
ID: 126
Label: DP01-07
Type: Manhole
ID: 70
Label: DP01-08
Type: Conduit
ID: 124
Label: DP01-09
Type: Manhole
ID: 69
Label: DP01-10
Type: Conduit
ID: 120
Label: DP01-11
Type: Manhole
ID: 65
Label: DP01-12
Type: Conduit
ID: 117
Label: DP01-13
Type: Manhole
ID: 62
Label: DP01-14
Type: Conduit
ID: 190
Label: DP01-15
Type: Manhole
ID: 191
Label: DP01-16
Type: Conduit
ID: 187
Label: DP01-17
Type: Manhole
ID: 58
Label: DP01-18
Type: Conduit
ID: 110
Label: DP01-19
Type: Manhole
ID: 53
Label: DP01-20
Type: Conduit
ID: 99
Label: DP01-21
Type: Manhole
ID: 41
Label: DP01-22
Type: Conduit
ID: 98
Label: DP01-23
Type: Manhole
ID: 40

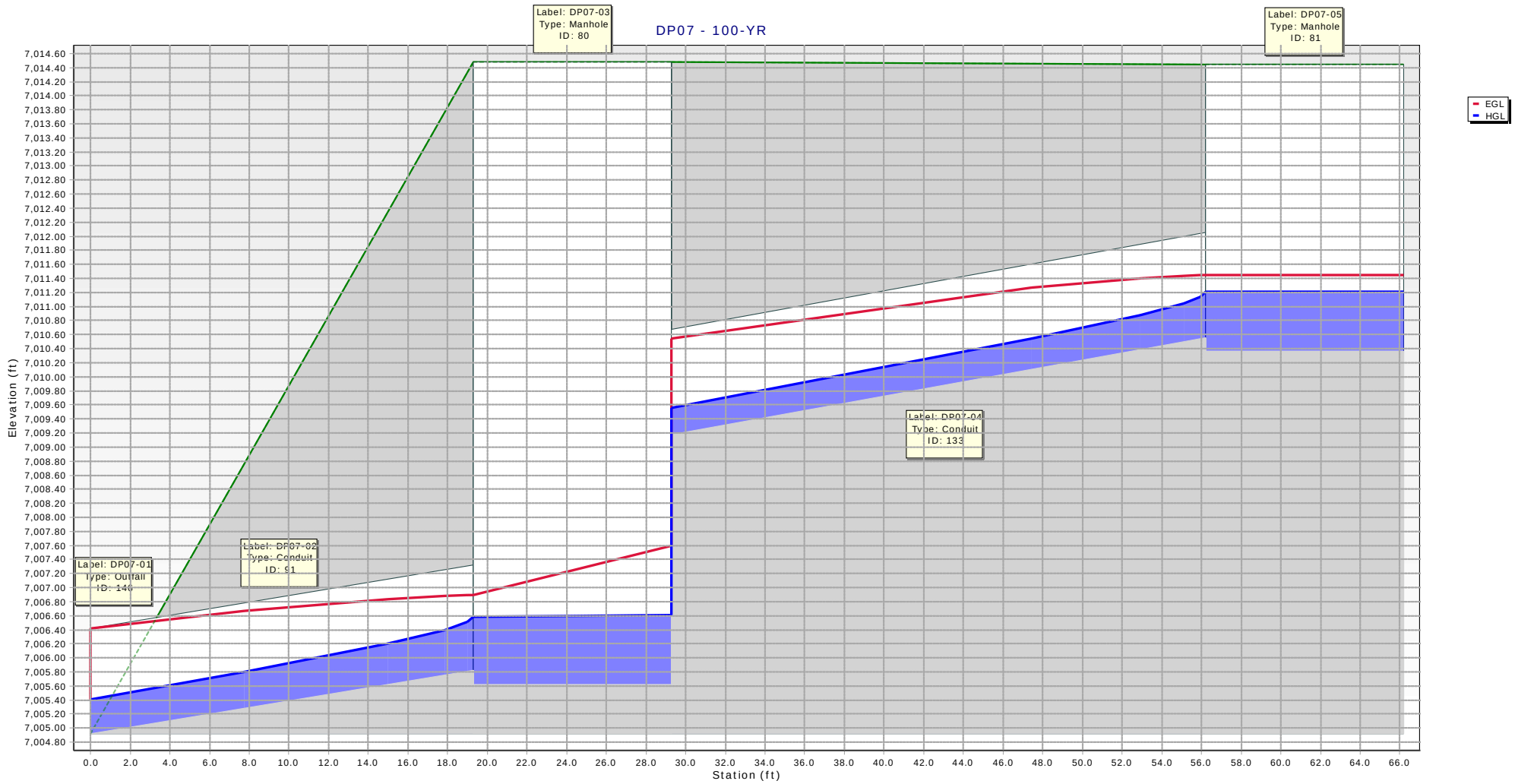

DP02 - 100-YR
Label: DP02-02
Type: Manhole
ID: 71
Label: DP01-05
Type: Manhole
ID: 73
Label: DP02-01
Type: Conduit
ID: 127
EGL
HGL
Elevation (ft)
Station (ft)

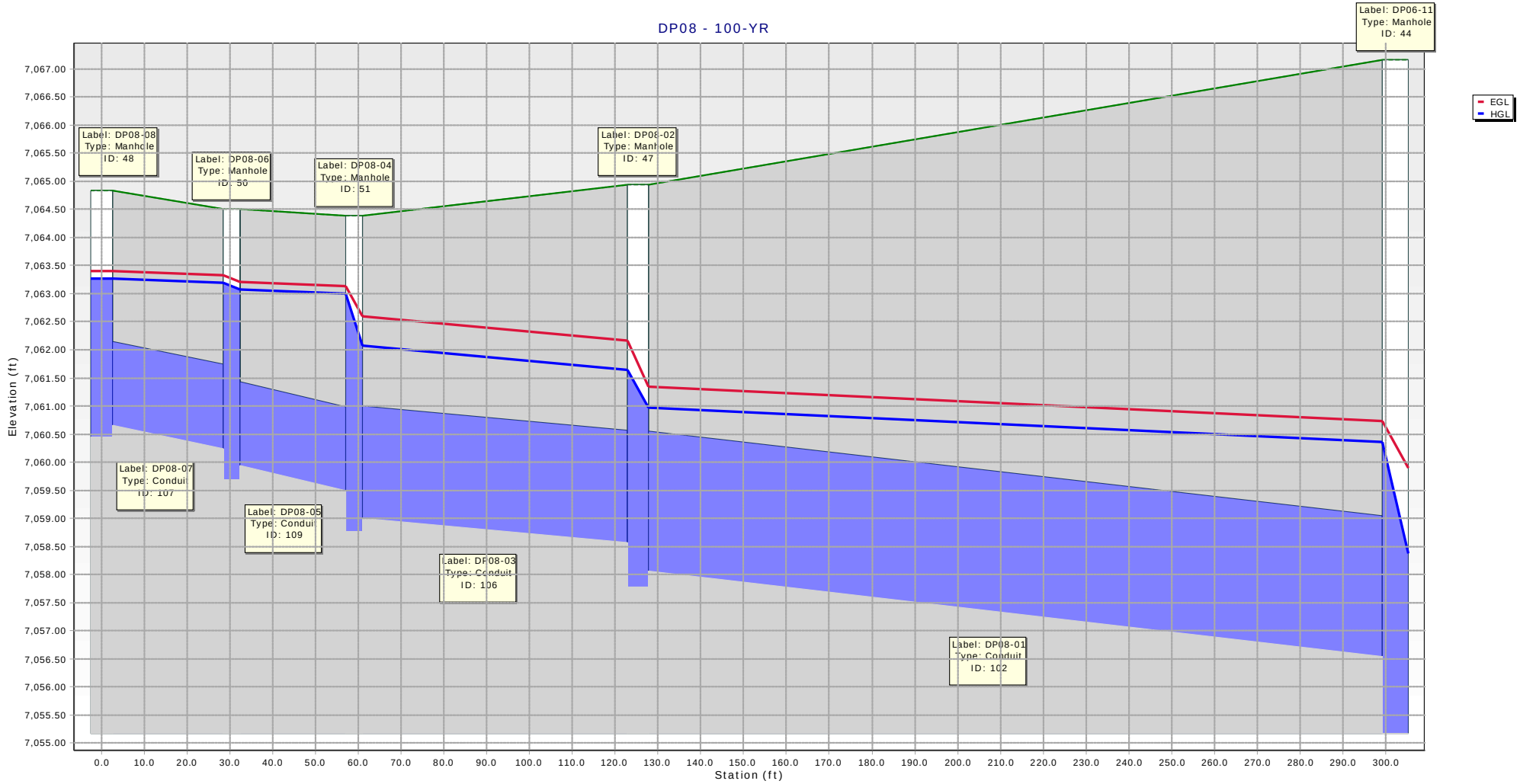

DP03 - 100-YR
Label: DP01-07
Type: Manhole
ID: 70
Label: DP03-02
Type: Manhole
ID: 74
Label: DP03-01
Type: Conduit
ID: 125
EGL
HGL
Elevation (ft)
Station (ft)
7,041.00
7,040.50
7,040.00
7,039.50
7,039.00
7,038.50
7,038.00
7,037.50
7,037.00
7,036.50
7,036.00
7,035.50
7,035.00
7,034.50
7,034.00
7,033.50
7,033.00
7,032.50
7,032.00
7,031.50
7,031.00
7,030.50
7,030.00
7,029.50
7,029.00
7,028.50
7,028.00
7,027.50
7,027.00
7,026.50
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
55.0
60.0
65.0
70.0
75.0
80.0
85.0
90.0
95.0
100.0
105.0
110.0
115.0
120.0
125.0
130.0
135.0
140.0
145.0

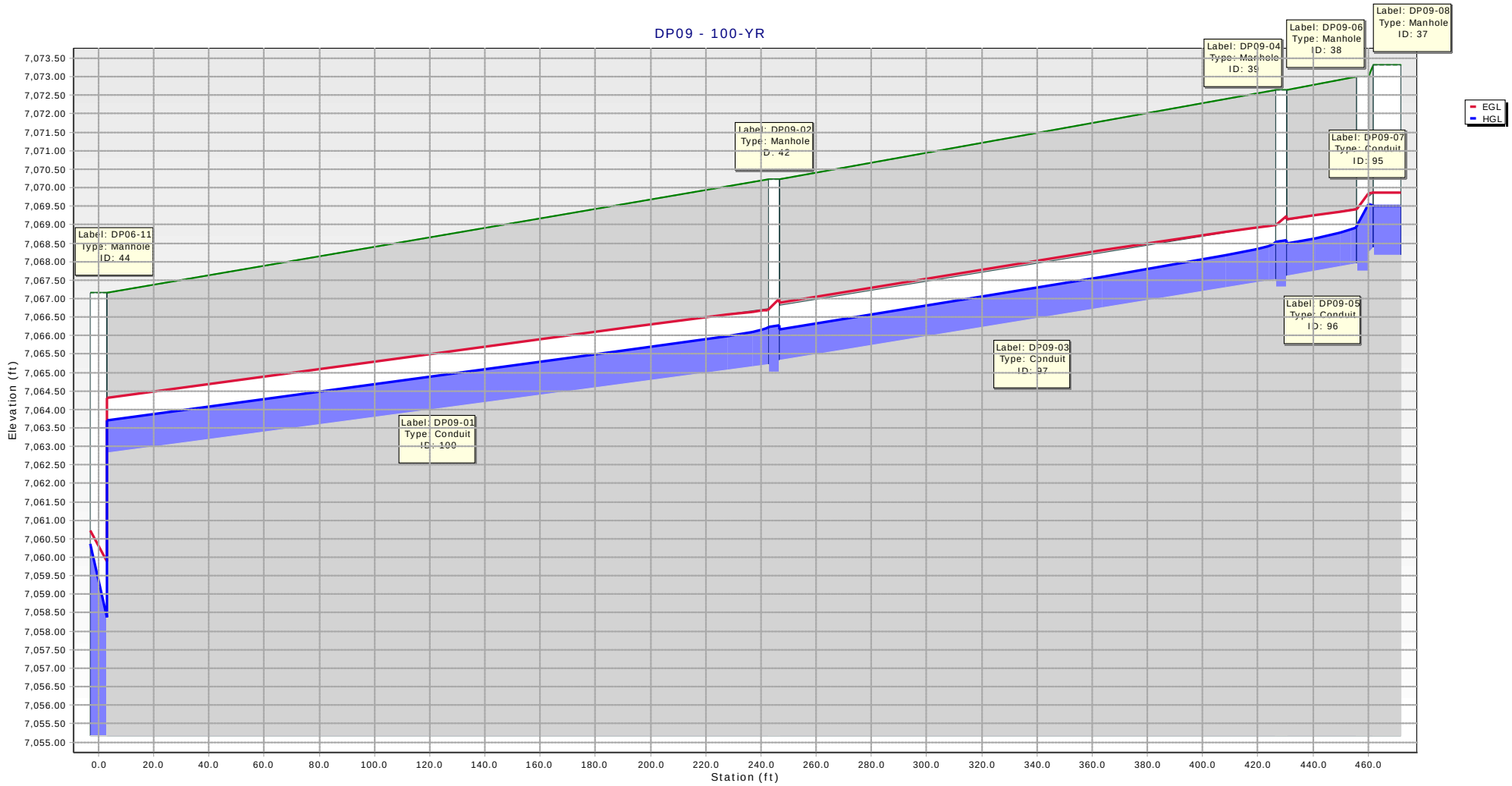

DP04 - 100-YR
Label: DP04-04
Type: Manhole
ID: 63
Label: DP04-02
Type: Manhole
ID: 64
Label: DP01-13
Type: Manhole
ID: 62
Label: DP04-03
Type: Conduit
ID: 119
Label: DP04-01
Type: Conduit
ID: 118
EGL
HGL
Elevation (ft)
Station (ft)

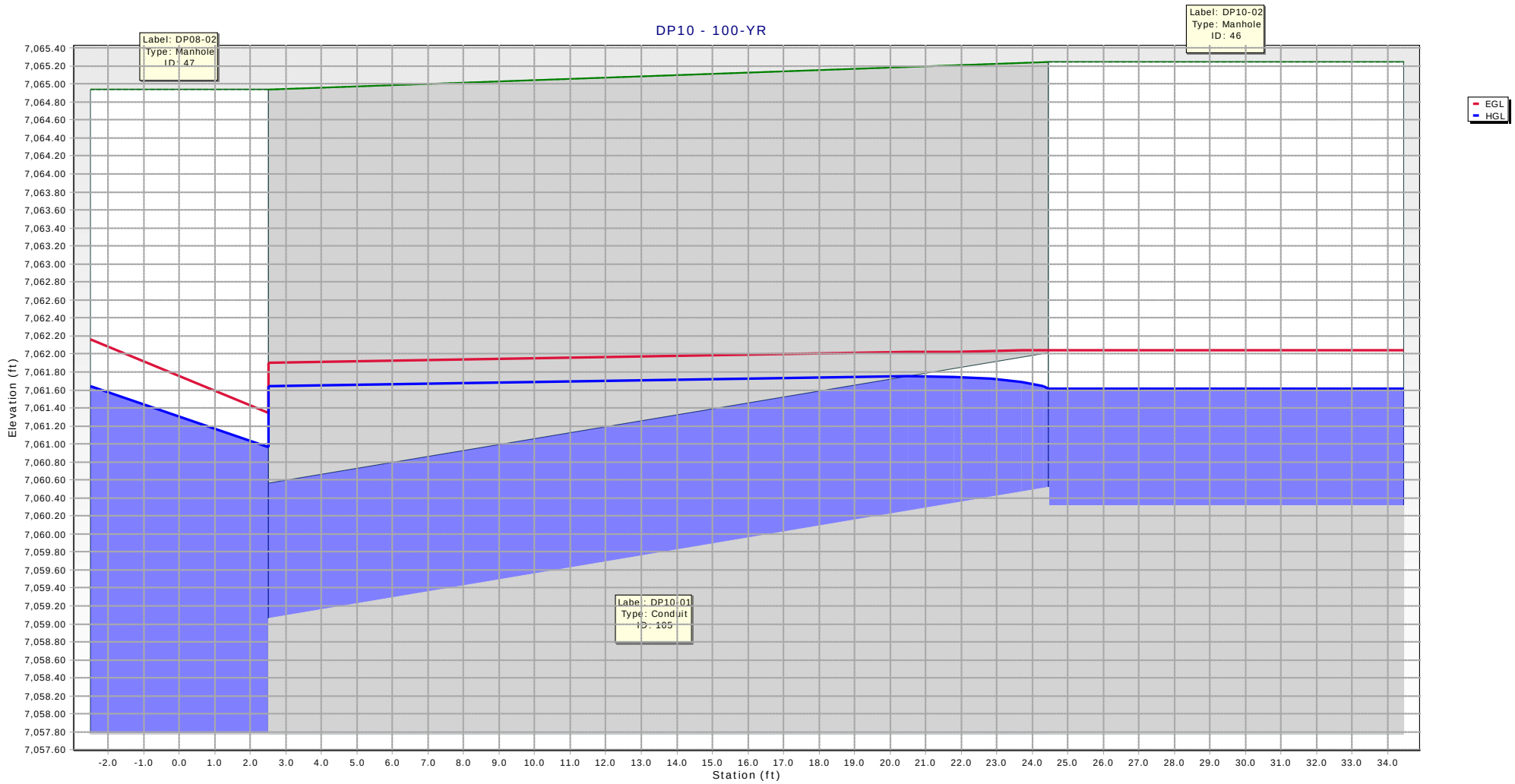

DP05 - 100-YR
Elevation (ft)
Station (ft)
EGL
HGL
Pond 2 Outlet
Label: DP05-01 Type: Outfall ID: 148
Label: DP05-02 Type: Conduit ID: 140
Label: DP05-03 Type: Manhole ID: 89
Label: DP05-04 Type: Conduit ID: 139
Label: DP05-05 Type: Manhole ID: 88
Label: DP05-06 Type: Conduit ID: 138
Label: DP05-07 Type: Manhole ID: 87
Label: DP05-08 Type: Conduit ID: 137
Label: DP05-09 Type: Manhole ID: 86
Label: DP05-10 Type: Conduit ID: 134
Label: DP05-11 Type: Manhole ID: 82
Label: DP05-12 Type: Conduit ID: 132
Label: DP05-13 Type: Manhole ID: 79
Label: DP05-14 Type: Conduit ID: 131
Label: DP05-15 Type: Manhole ID: 77
Label: DP05-16 Type: Conduit ID: 130
Label: DP05-17 Type: Manhole ID: 143

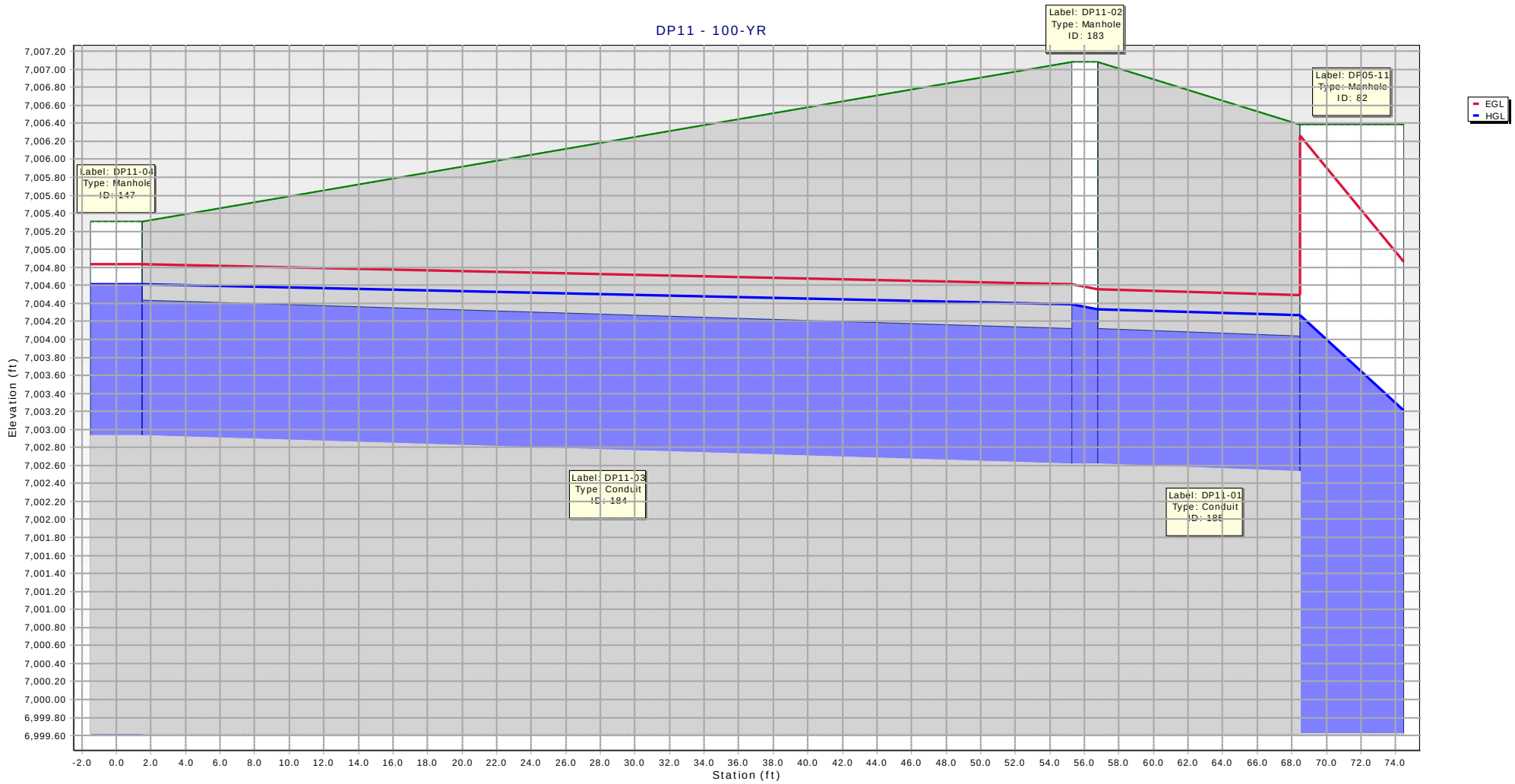

DP06 - 100-YR
Elevation (ft)
Station (ft)
EGL
HGL
Label: DP06-01
Type: Outfall
ID: 141
Label: DP06-02
Type: Conduit
ID: 123
Label: DP06-03
Type: Manhole
ID: 68
Label: DP06-04
Type: Conduit
ID: 122
Label: DP06-05
Type: Manhole
ID: 67
Label: DP06-06
Type: Conduit
ID: 121
Label: DP06-07
Type: Manhole
ID: 66
Label: DP06-08
Type: Conduit
ID: 111
Label: DP06-09
Type: Manhole
ID: 54
Label: DP06-10
Type: Conduit
ID: 103
Label: DP06-11
Type: Manhole
ID: 44
Label: DP06-12
Type: Conduit
ID: 178
Label: DP06-13
Type: Manhole
ID: 176
Label: DP06-14
Type: Conduit
ID: 177
Label: DP06-15
Type: Manhole
ID: 151
Pond 1
Outlet
Pond 2
Forebay

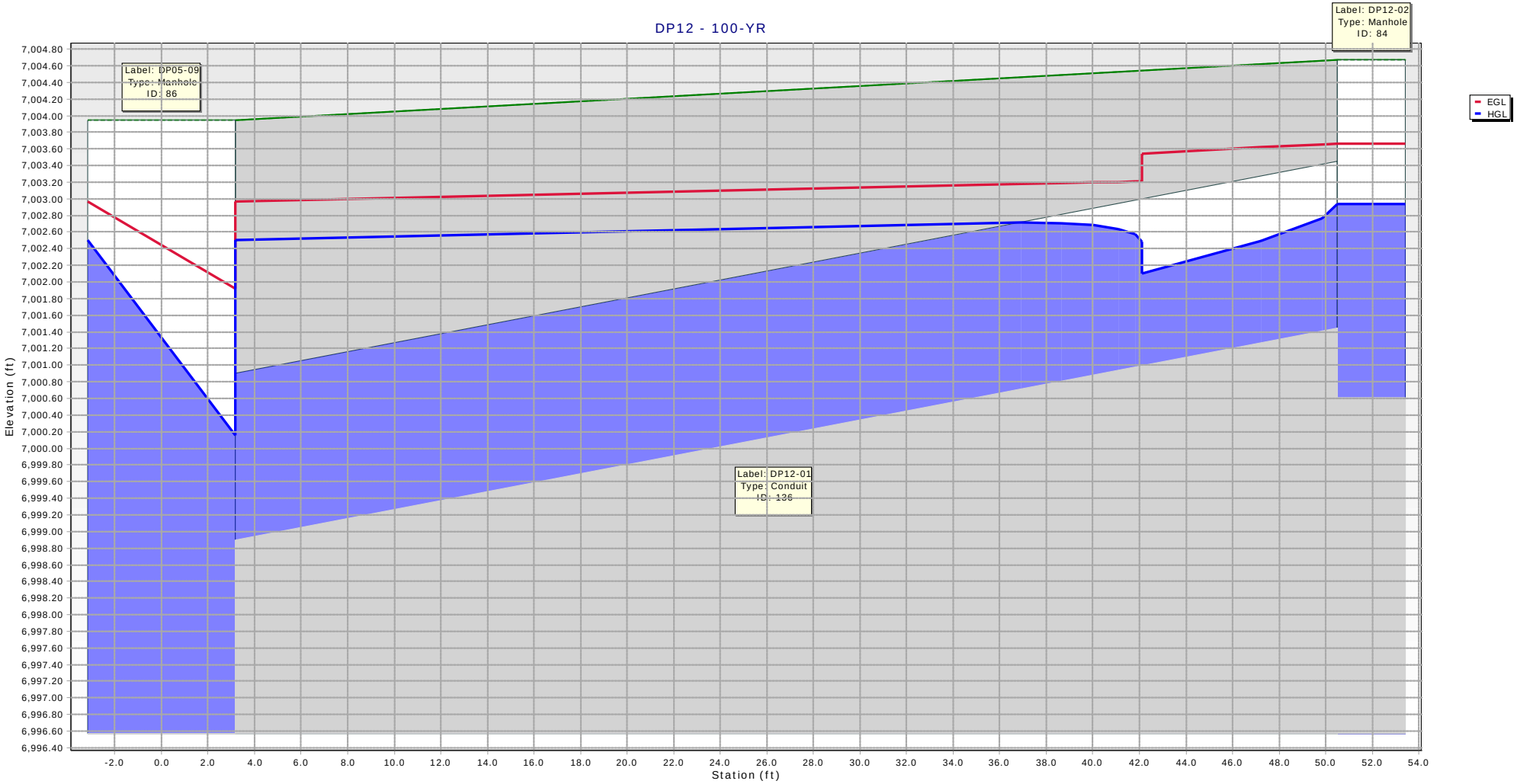

DP07 - 100-YR
Label: DP07-03
Type: Manhole
ID: 80
Label: DP07-05
Type: Manhole
ID: 81
Label: DP07-01
Type: Outfall
ID: 140
Label: DP07-02
Type: Conduit
ID: 91
Label: DP07-04
Type: Conduit
ID: 133
EGL
HGL
Elevation (ft)
Station (ft)


DP08 - 100-YR
Label: DP06-11
Type: Manhole
ID: 44
Label: DP08-08
Type: Manhole
ID: 48
Label: DP08-06
Type: Manhole
ID: 50
Label: DP08-04
Type: Manhole
ID: 51
Label: DP08-02
Type: Manhole
ID: 47
Label: DP08-07
Type: Condui
ID: 107
Label: DP08-05
Type: Condui
ID: 109
Label: DP08-03
Type: Conduit
ID: 106
Label: DP08-01
Type: Conduit
ID: 102
EGL
HGL
Elevation (ft)
Station (ft)


DP09 - 100-YR
Elevation (ft)
Station (ft)
EGL
HGL
Label: DP06-11
Type: Manhole
ID: 44
Label: DP09-01
Type: Conduit
ID: 100
Label: DP09-02
Type: Manhole
ID: 42
Label: DP09-03
Type: Conduit
ID: 97
Label: DP09-04
Type: Manhole
ID: 39
Label: DP09-05
Type: Conduit
ID: 96
Label: DP09-06
Type: Manhole
ID: 38
Label: DP09-07
Type: Conduit
ID: 95
Label: DP09-08
Type: Manhole
ID: 37


DP10 - 100-YR
Label: DP08-02
Type: Manhole
ID: 47
Label: DP10-02
Type: Manhole
ID: 46
Label: DP10-01
Type: Conduit
ID: 105
EGL
HGL
Elevation (ft)
Station (ft)


DP11 - 100-YR
Label: DP11-02
Type: Manhole
ID: 183
Label: DP05-11
Type: Manhole
ID: 82
Label: DP11-04
Type: Manhole
ID: 147
Label: DP11-03
Type: Conduit
ID: 184
Label: DP11-01
Type: Conduit
ID: 185
EGL
HGL
Elevation (ft)
Station (ft)


DP12 - 100-YR
Label: DP12-02
Type: Manhole
ID: 84
Label: DP05-09
Type: Manhole
ID: 86
Label: DP12-01
Type: Conduit
ID: 136
EGL
HGL
Elevation (ft)
Station (ft)
7,004.80
7,004.60
7,004.40
7,004.20
7,004.00
7,003.80
7,003.60
7,003.40
7,003.20
7,003.00
7,002.80
7,002.60
7,002.40
7,002.20
7,002.00
7,001.80
7,001.60
7,001.40
7,001.20
7,001.00
7,000.80
7,000.60
7,000.40
7,000.20
7,000.00
6,999.80
6,999.60
6,999.40
6,999.20
6,999.00
6,998.80
6,998.60
6,998.40
6,998.20
6,998.00
6,997.80
6,997.60
6,997.40
6,997.20
6,997.00
6,996.80
6,996.60
6,996.40
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
20.0
22.0
24.0
26.0
28.0
30.0
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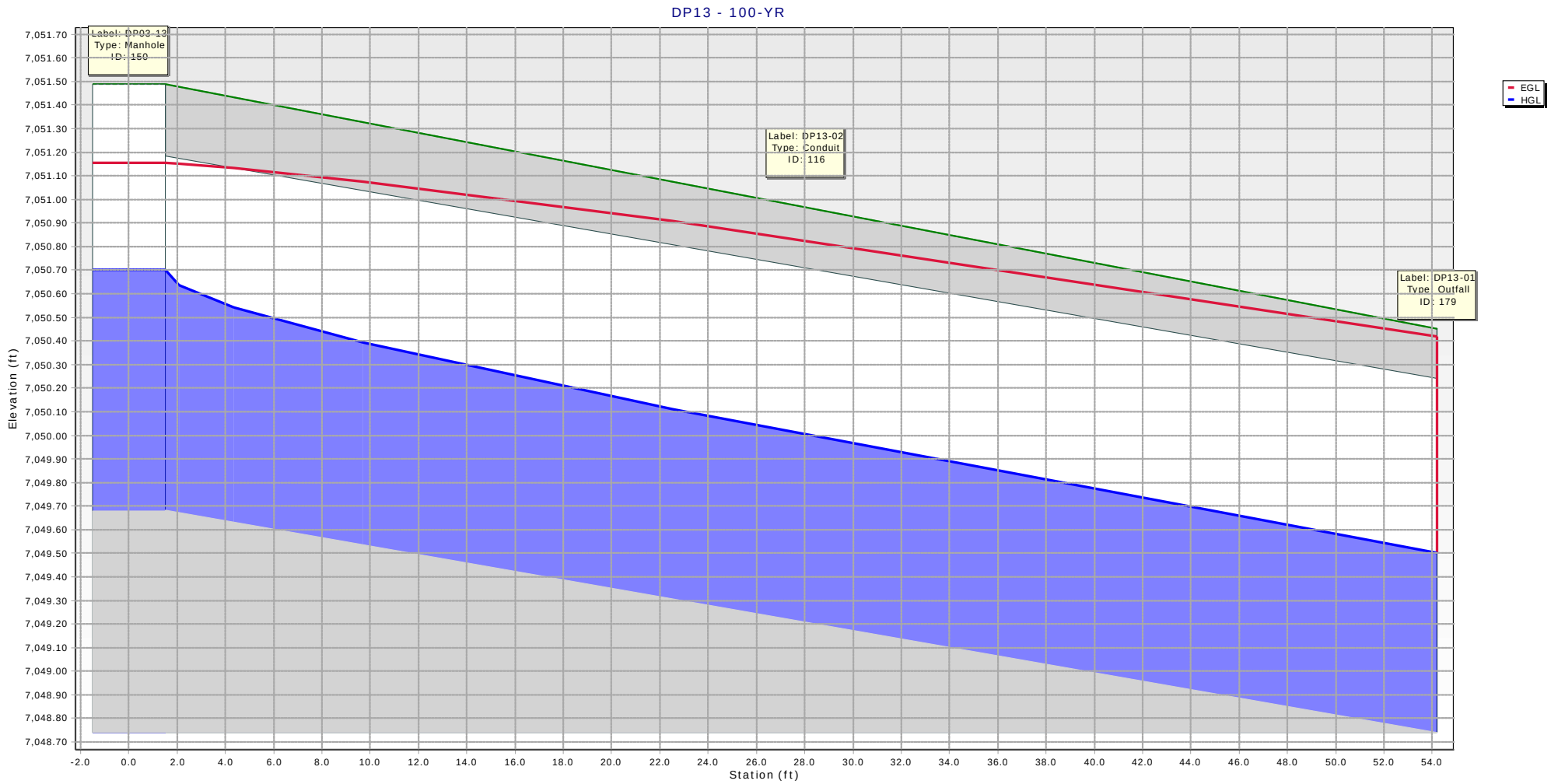
44.0
46.0
48.0
50.0
52.0
54.0


DP13 - 100-YR
Label: DP03-13
Type: Manhole
ID: 150
Label: DP13-02
Type: Conduit
ID: 116
Label: DP13-01
Type: Outfall
ID: 179
EGL
HGL
Elevation (ft)
Station (ft)
7,051.70
7,051.60
7,051.50
7,051.40
7,051.30
7,051.20
7,051.10
7,051.00
7,050.90
7,050.80
7,050.70
7,050.60
7,050.50
7,050.40
7,050.30
7,050.20
7,050.10
7,050.00
7,049.90
7,049.80
7,049.70
7,049.60
7,049.50
7,049.40
7,049.30
7,049.20
7,049.10
7,049.00
7,048.90
7,048.80
7,048.70
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
20.0
22.0
24.0
26.0
28.0
30.0
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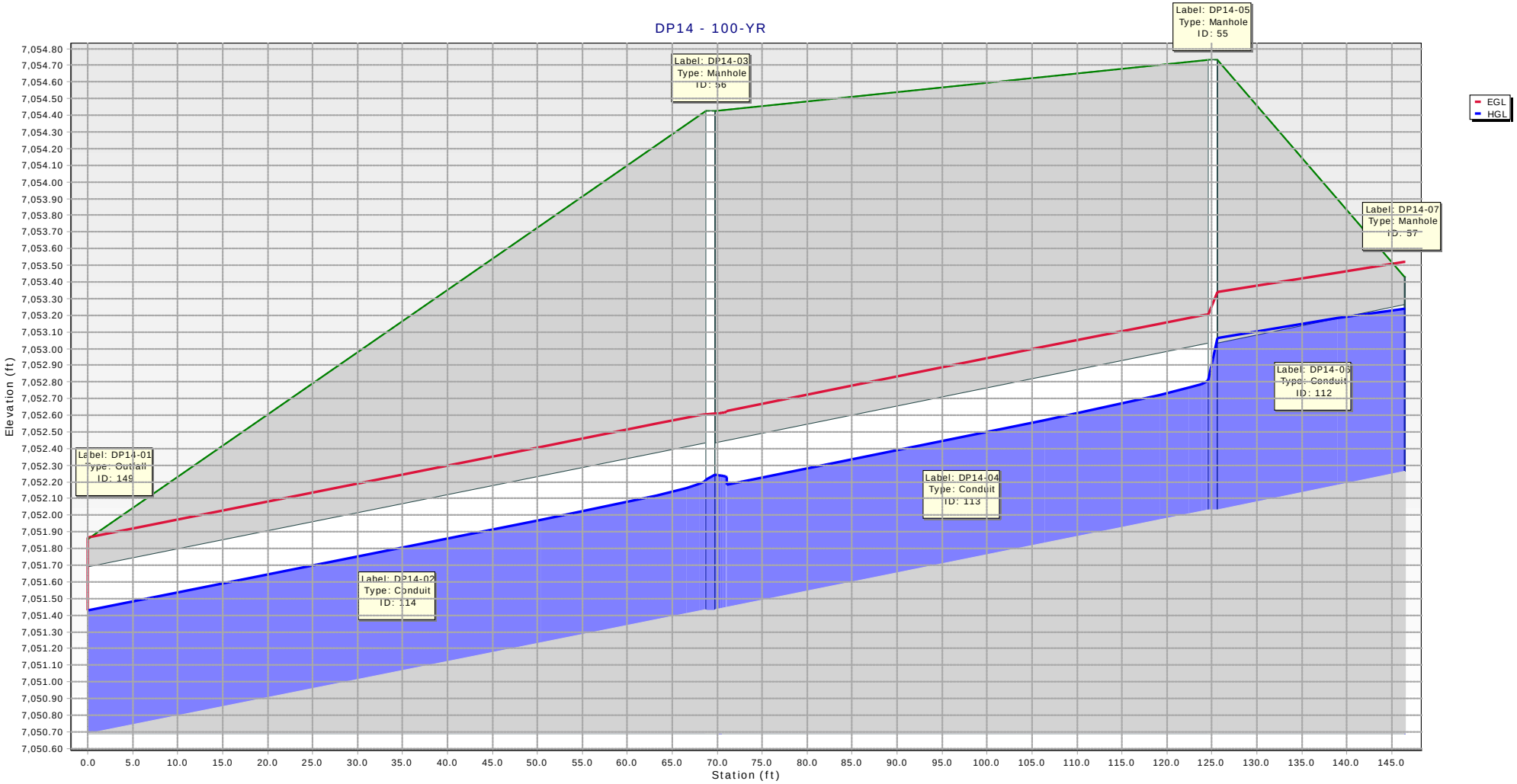
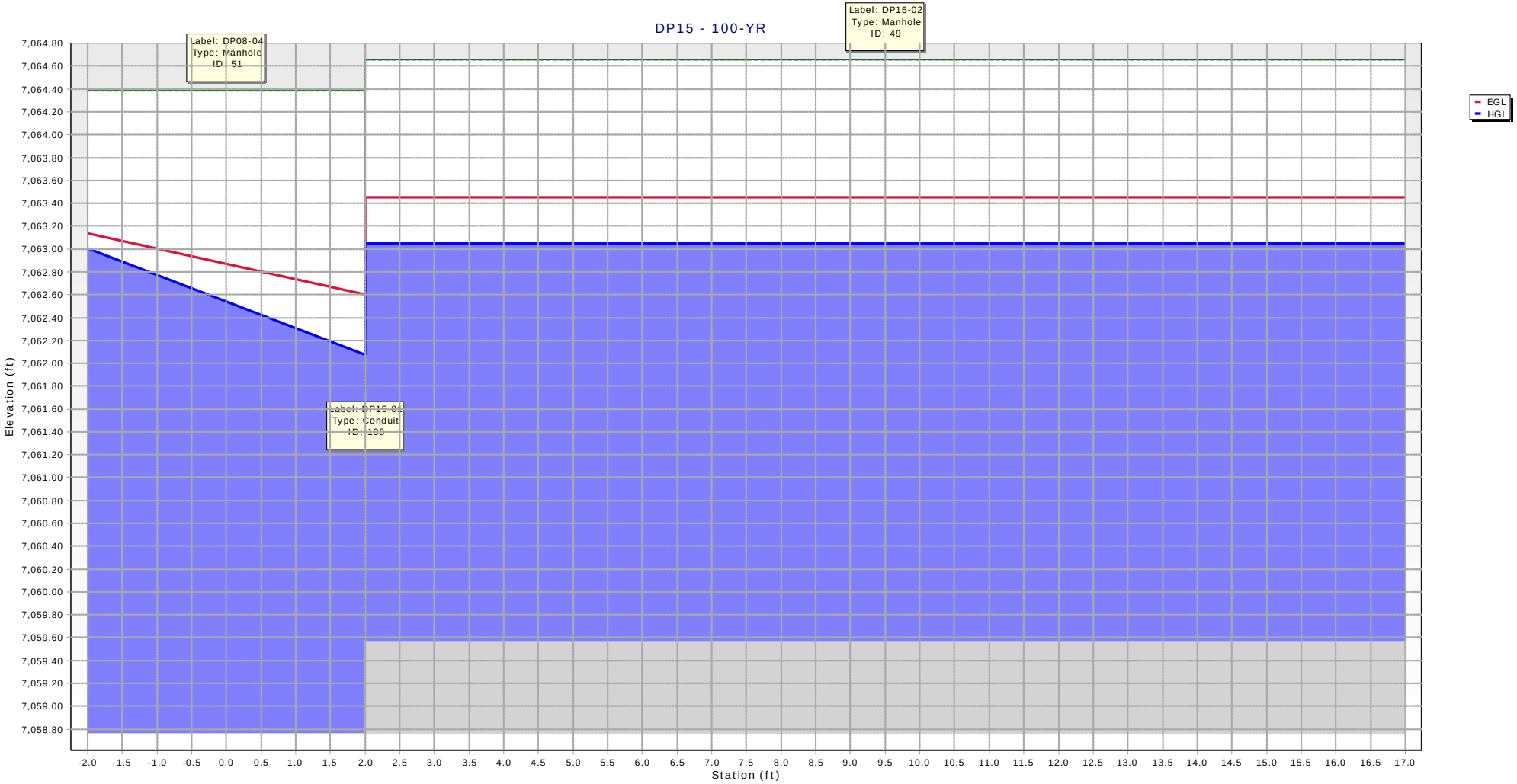
44.0
46.0
48.0
50.0
52.0
54.0


DP14 - 100-YR
Label: DP14-05
Type: Manhole
ID: 55
Label: DP14-03
Type: Manhole
ID: 56
Label: DP14-07
Type: Manhole
ID: 57
Label: DP14-06
Type: Conduit
ID: 112
Label: DP14-01
Type: Outfall
ID: 149
Label: DP14-04
Type: Conduit
ID: 113
Label: DP14-02
Type: Conduit
ID: 114
EGL
HGL
Elevation (ft)
Station (ft)


DP15 - 100-YR
Label: DP08-04
Type: Manhole
ID: 51
Label: DP15-02
Type: Manhole
ID: 49
Label: DP15-01
Type: Conduit
ID: 108
EGL
HGL
Elevation (ft)
Station (ft)

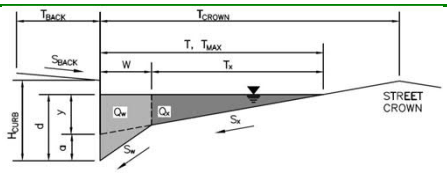
Version 4.06 Released August 2018

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Cloverleaf Subdivision**

Inlet ID: **A**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	15.0	ft
Gutter Width	W =	1.00	ft
Street Transverse Slope	S_X =	0.045	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.020	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

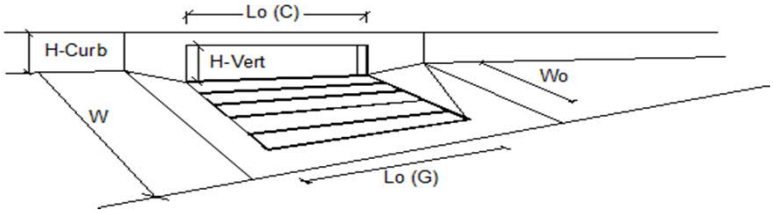
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**4.4**	**52.7**	**cfs**

WARNING: MINOR STORM max. allowable capacity is less than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	5.0	5.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	15.00	15.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: WARNING: Q > ALLOWABLE Q FOR MINOR STORM'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**7.6**	**13.9**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.2**	**3.4**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**98**	**80**	**%**

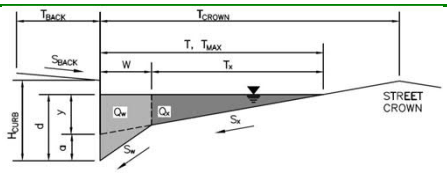
Version 4.06 Released August 2018

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Cloverleaf Subdivision**

Inlet ID: **D**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	15.0	ft
Gutter Width	W =	1.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.025	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

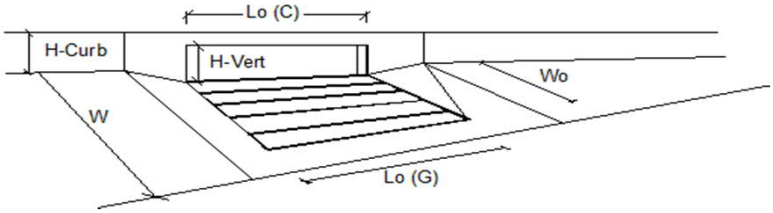
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**8.8**	**137.1**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	5.0	5.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	15.00	15.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**5.9**	**11.4**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**1.6**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**100**	**87**	**%**

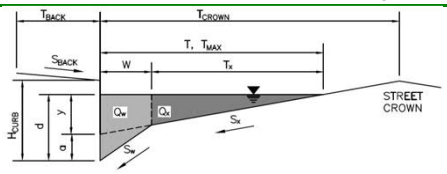
Version 4.06 Released August 2018

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Cloverleaf Subdivision**

Inlet ID: **C**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	15.0	ft
Gutter Width	W =	1.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.066	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	16.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

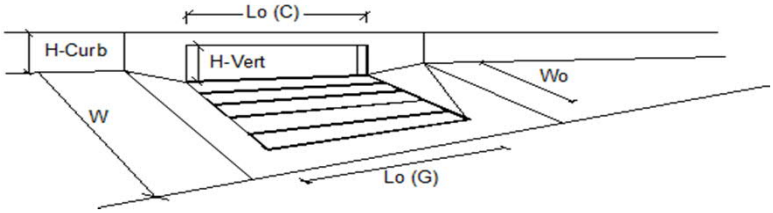
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**14.3**	**18.8**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	5.0	5.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	15.00	15.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**4.4**	**9.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**0.2**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**100**	**97**	**%**

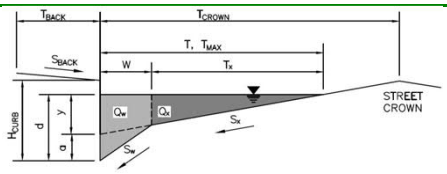
Version 4.06 Released August 2018

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Cloverleaf Subdivision**

Inlet ID: **I**



Gutter Geometry (Enter data in the blue cells)

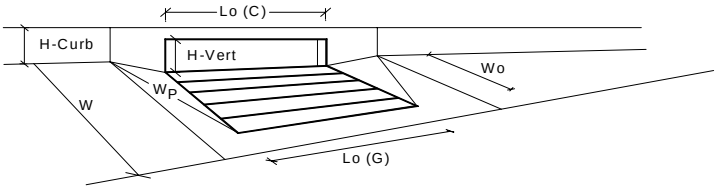
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	15.0	ft
Gutter Width	W =	1.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.0	15.0	ft
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.06 Released August 2018



Design Information (Input) CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	5.00	5.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.6	6.6	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	1.00	1.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.30	0.47	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.44	0.63	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.84	0.97	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.6**	**12.5**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	5.6	12.4	cfs

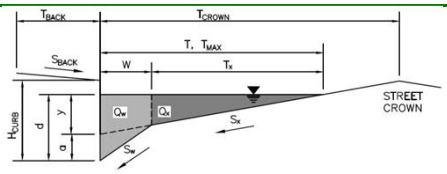
Version 4.06 Released August 2018

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Cloverleaf Subdivision**

Inlet ID: **E**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	15.0	ft
Gutter Width	W =	1.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.055	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)				check = yes

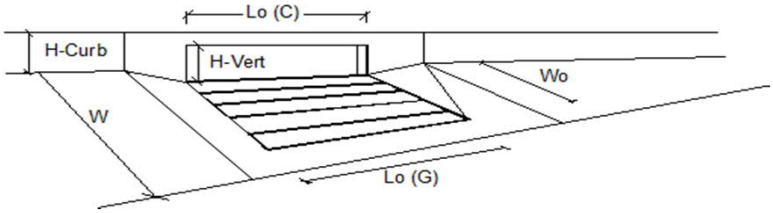
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**13.0**	**17.1**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	5.0	5.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.0**	**1.9**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.1**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**93**	**%**

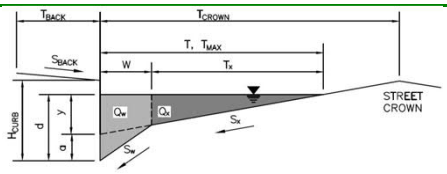
Version 4.06 Released August 2018

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Cloverleaf Subdivision**

Inlet ID: **F**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	15.0	ft
Gutter Width	W =	1.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.015	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

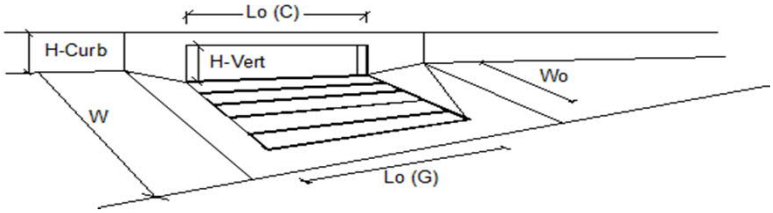
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**6.8**	**8.9**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	5.0	5.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**3.4**	**6.0**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**0.9**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**100**	**87**	**%**

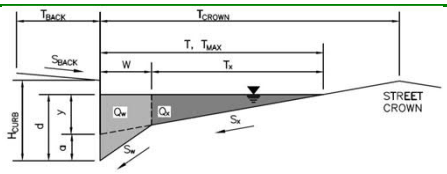
Version 4.06 Released August 2018

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Cloverleaf Subdivision**

Inlet ID: **IA**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	15.0	ft
Gutter Width	W =	1.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.015	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

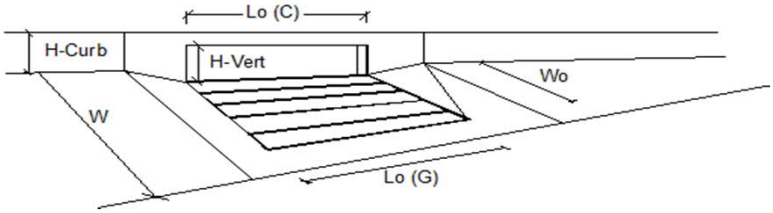
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**6.8**	**8.9**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	5.0	5.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**3.5**	**6.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**1.1**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**100**	**85**	**%**

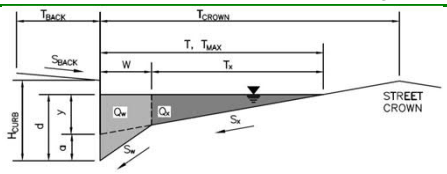
Version 4.06 Released August 2018

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Cloverleaf Subdivision**

Inlet ID: **G**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	15.0	ft
Gutter Width	W =	1.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.020	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

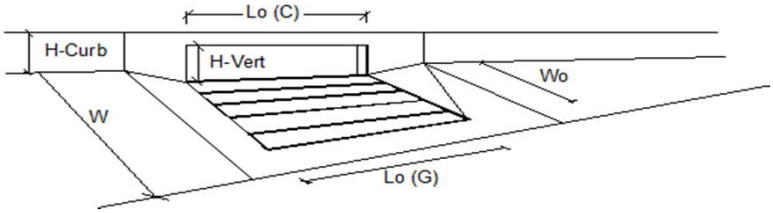
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**7.9**	**10.3**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	5.0	5.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**2.1**	**3.0**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.3**	**2.1**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**86**	**60**	**%**

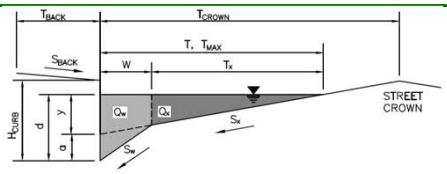
Version 4.06 Released August 2018

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Cloverleaf Subdivision**

Inlet ID: **H**



Gutter Geometry (Enter data in the blue cells)

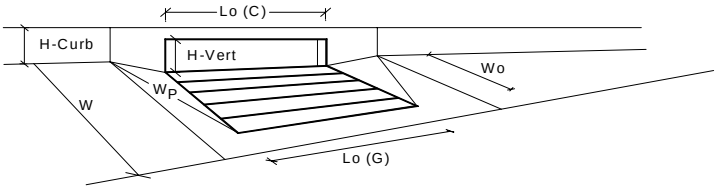
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	15.0	ft
Gutter Width	W =	1.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.0	15.0	ft
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.06 Released August 2018



Design Information (Input) CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	5.00	5.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.6	6.7	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	15.00	15.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	1.00	1.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.30	0.48	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.44	0.64	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.69	0.83	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**6.7**	**16.0**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	6.6	16.0	cfs

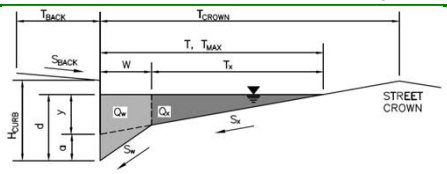
Version 4.06 Released August 2018

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Cloverleaf Subdivision**

Inlet ID: **J**



Gutter Geometry (Enter data in the blue cells)

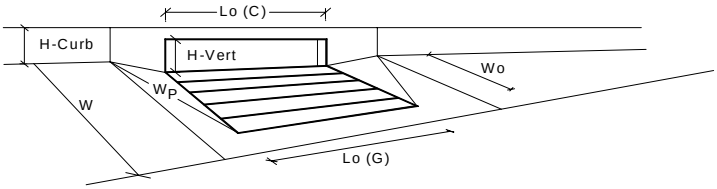
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	15.0	ft
Gutter Width	W =	1.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.0	15.0	ft
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.06 Released August 2018



Design Information (Input) CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	5.00	5.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	3.9	5.7	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	1.00	1.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.25	0.40	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.37	0.54	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.78	0.92	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**3.8**	**9.1**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	3.6	8.9	cfs

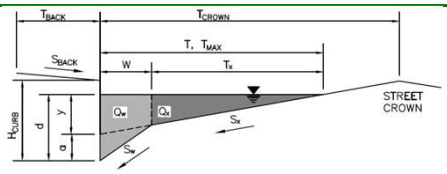
Version 4.06 Released August 2018

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Cloverleaf Subdivision**

Inlet ID: **M**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	15.0	ft
Gutter Width	W =	1.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.055	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

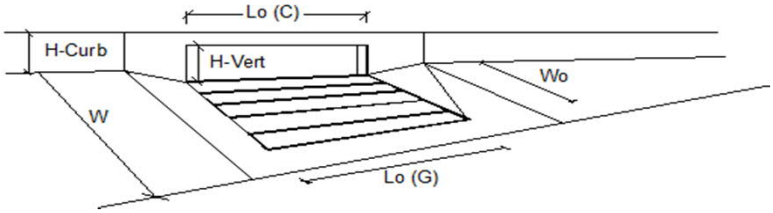
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**13.0**	**17.1**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	5.0	5.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**1.4**	**3.0**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**100**	**100**	**%**

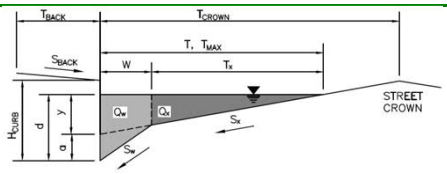
Version 4.06 Released August 2018

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Cloverleaf Subdivision**

Inlet ID: **N**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	15.0	ft
Gutter Width	W =	1.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.055	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**13.0**	**17.1**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

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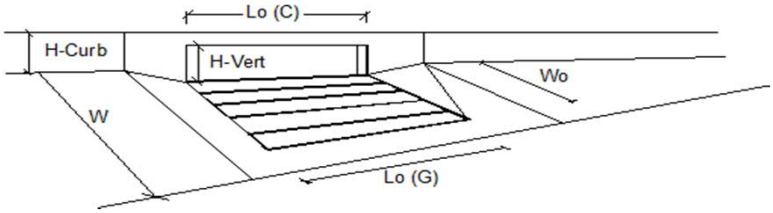
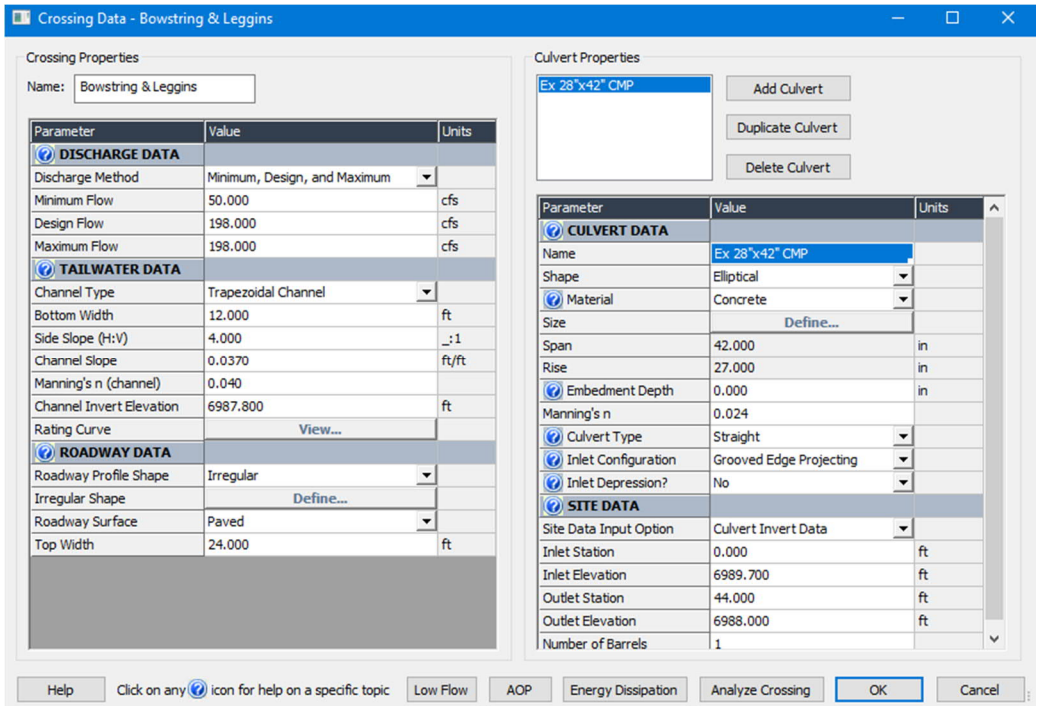
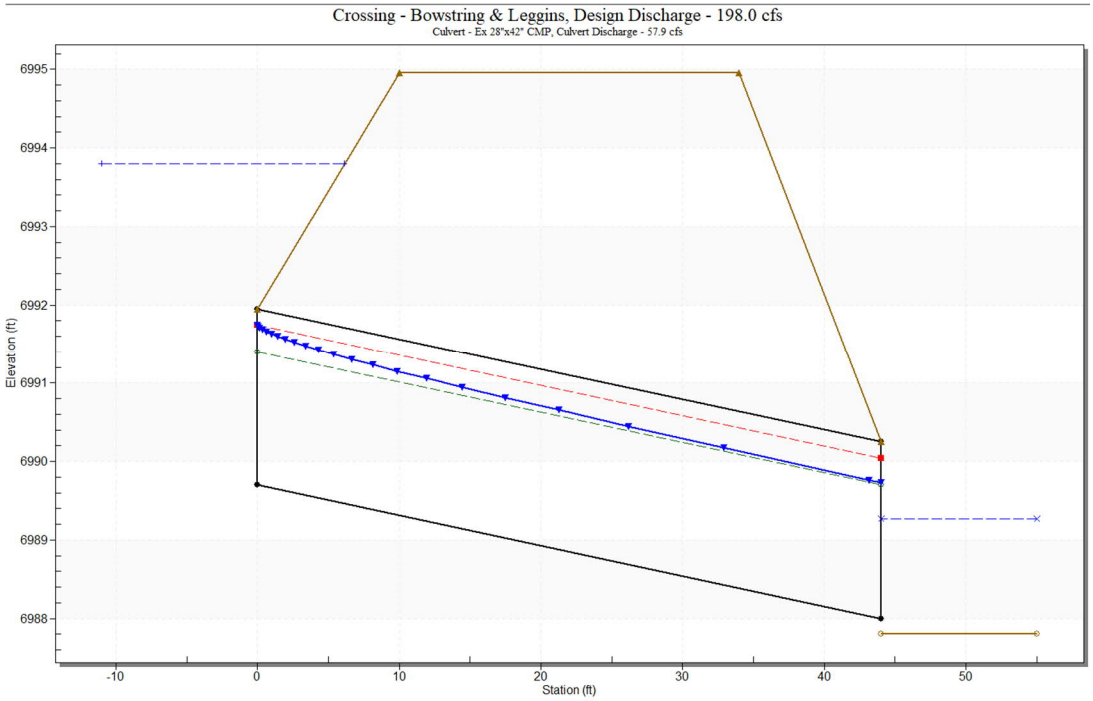


Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	5.0	5.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**1.4**	**3.9**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**100**	**100**	**%**

HY-8 Analysis Results-Bowsting & Leggins					
Conditon	Headwater Elevation (ft)	Total Discharge (cfs)	Ex 28"x42" CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5-yr Proposed	6993.41	90	53.55	36.38	4
5-yr Existing	6993.47	102	54.27	47.49	8
100-yr Proposed	6993.80	198	57.94	139.61	3
100-yr Existing	6993.97	282	59.81	222.07	3





Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, May 13 2021

Swale B (5-Year)

Triangular

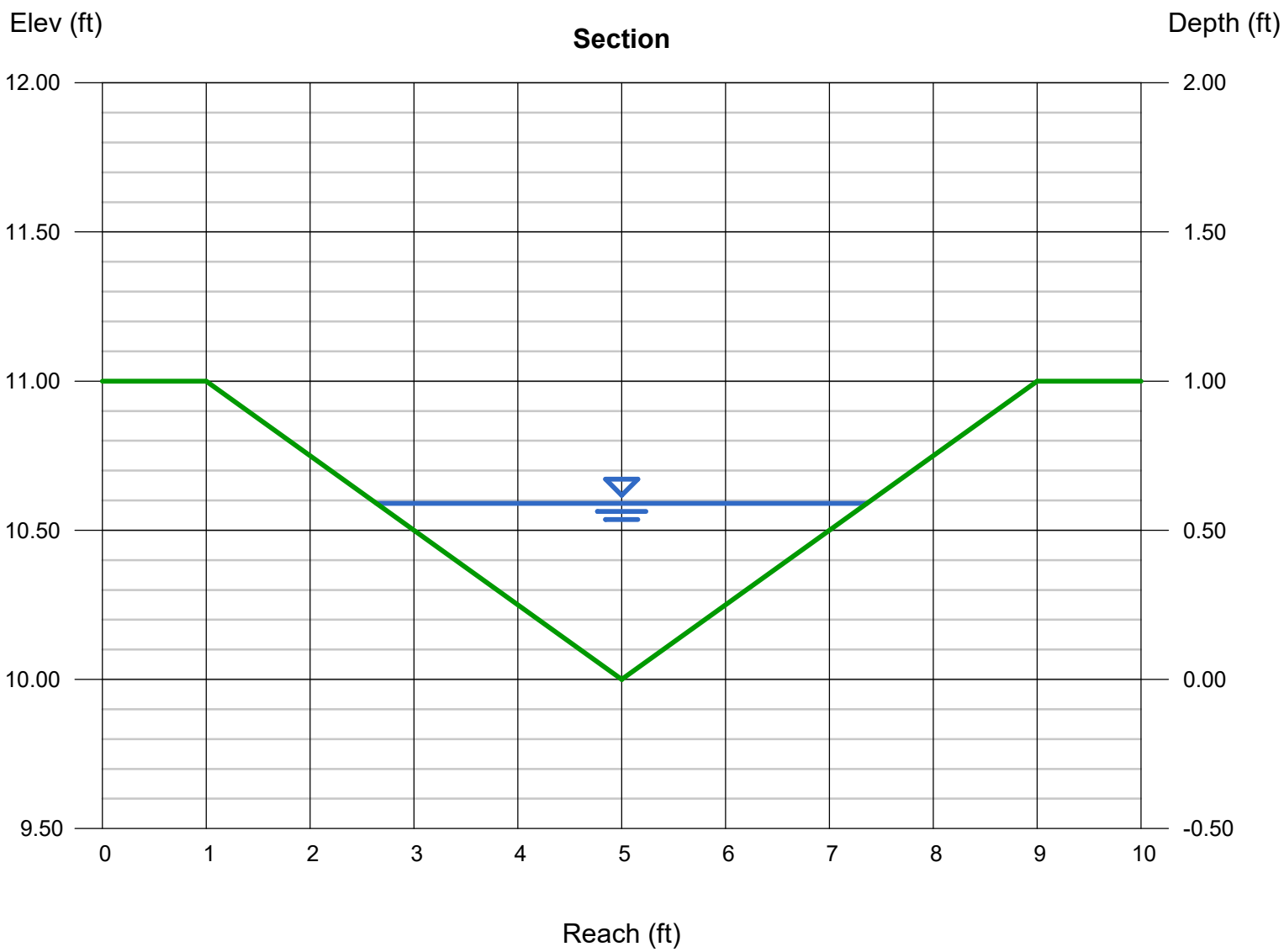
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 1.00
Invert Elev (ft)	= 10.00
Slope (%)	= 2.00
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 4.20

Highlighted

Depth (ft)	= 0.59
Q (cfs)	= 4.200
Area (sqft)	= 1.39
Velocity (ft/s)	= 3.02
Wetted Perim (ft)	= 4.87
Crit Depth, Yc (ft)	= 0.59
Top Width (ft)	= 4.72
EGL (ft)	= 0.73



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, May 13 2021

Swale B (100-Year)

Triangular

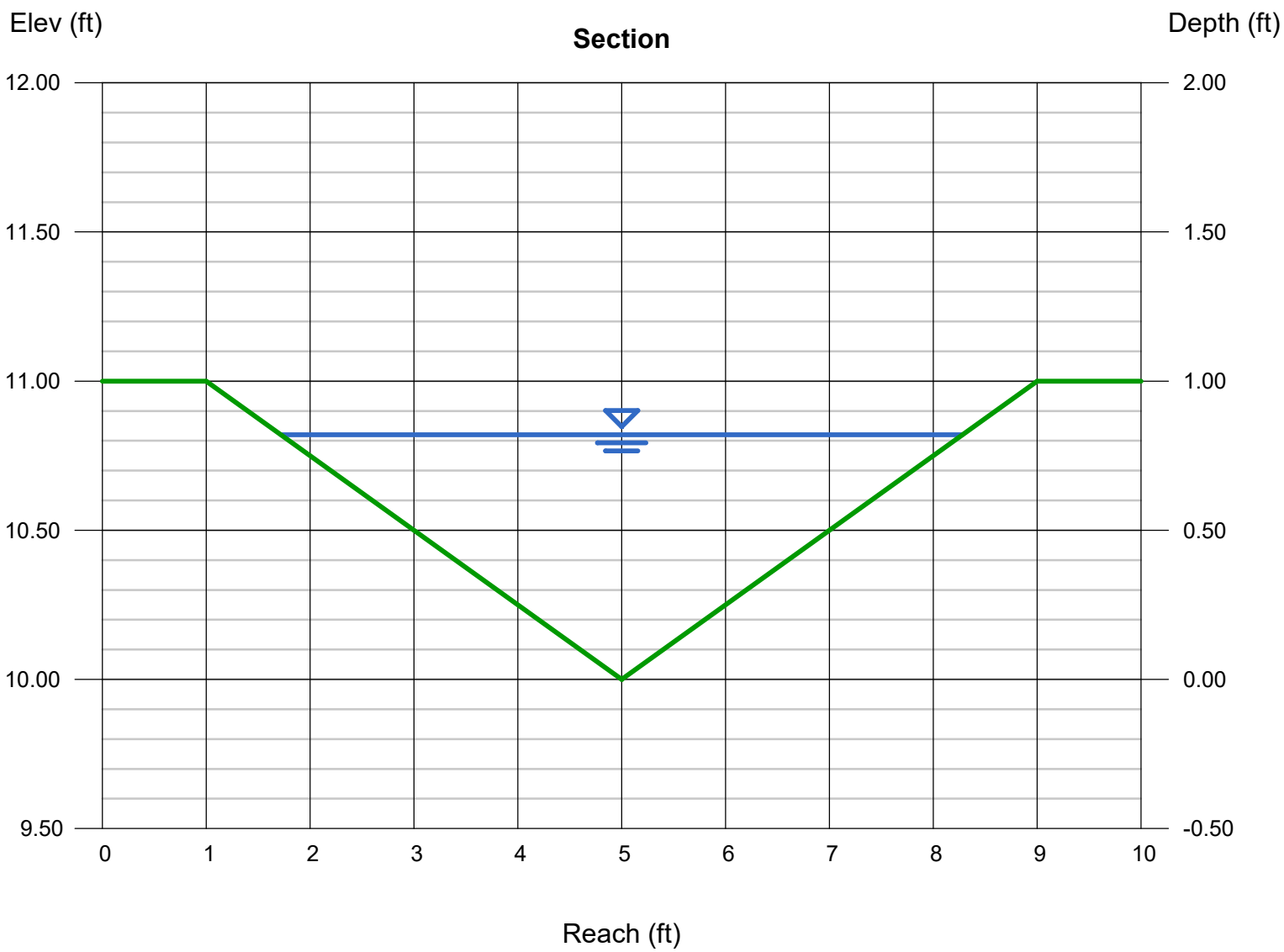
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 1.00
Invert Elev (ft)	= 10.00
Slope (%)	= 2.00
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 10.10

Highlighted

Depth (ft)	= 0.82
Q (cfs)	= 10.10
Area (sqft)	= 2.69
Velocity (ft/s)	= 3.76
Wetted Perim (ft)	= 6.76
Crit Depth, Yc (ft)	= 0.84
Top Width (ft)	= 6.56
EGL (ft)	= 1.04



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, May 13 2021

Swale K (5-Year)

Triangular

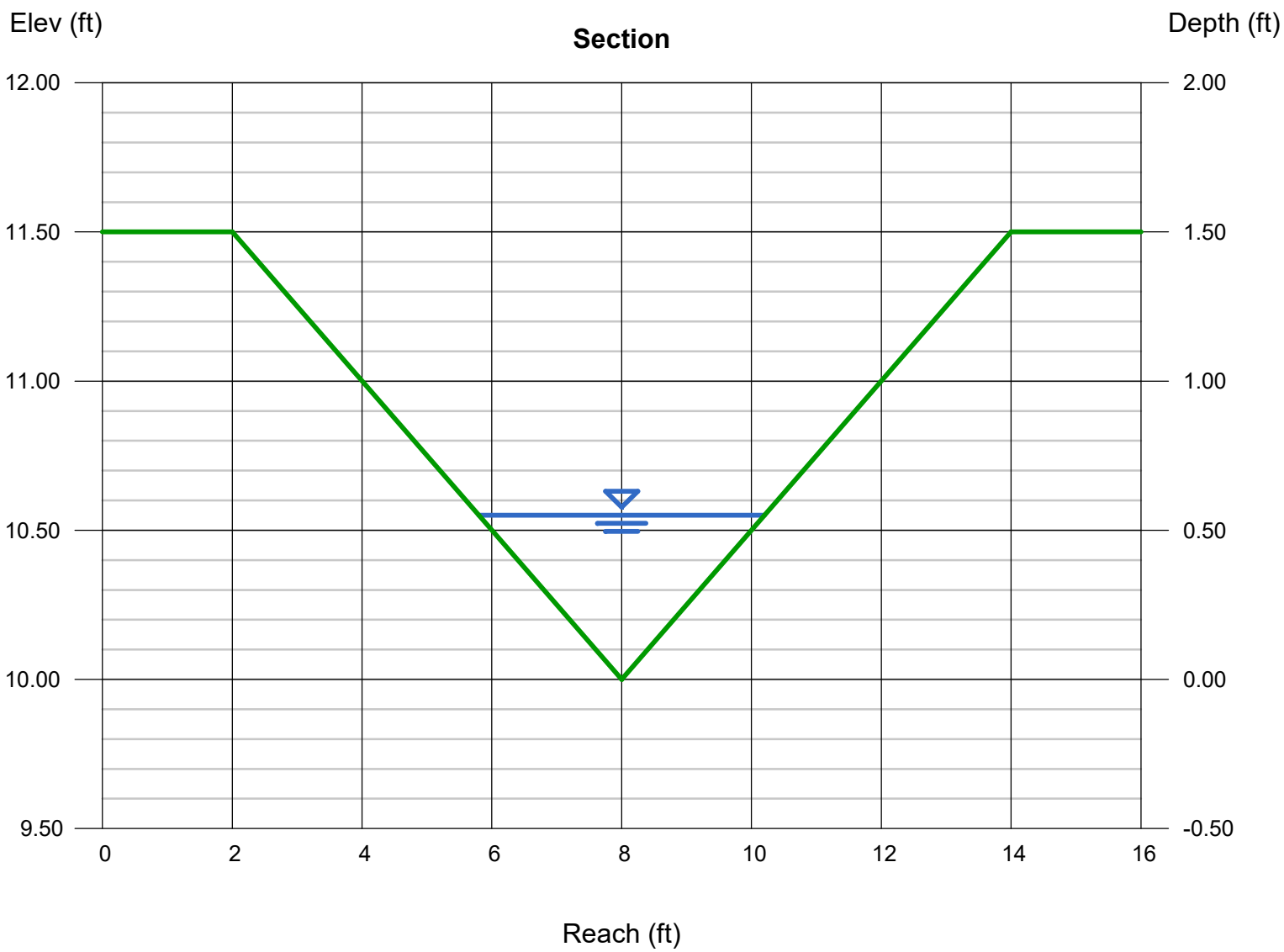
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 1.50
Invert Elev (ft)	= 10.00
Slope (%)	= 5.00
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 5.30

Highlighted

Depth (ft)	= 0.55
Q (cfs)	= 5.300
Area (sqft)	= 1.21
Velocity (ft/s)	= 4.38
Wetted Perim (ft)	= 4.54
Crit Depth, Yc (ft)	= 0.65
Top Width (ft)	= 4.40
EGL (ft)	= 0.85



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, May 13 2021

Swale K (100-Year)

Triangular

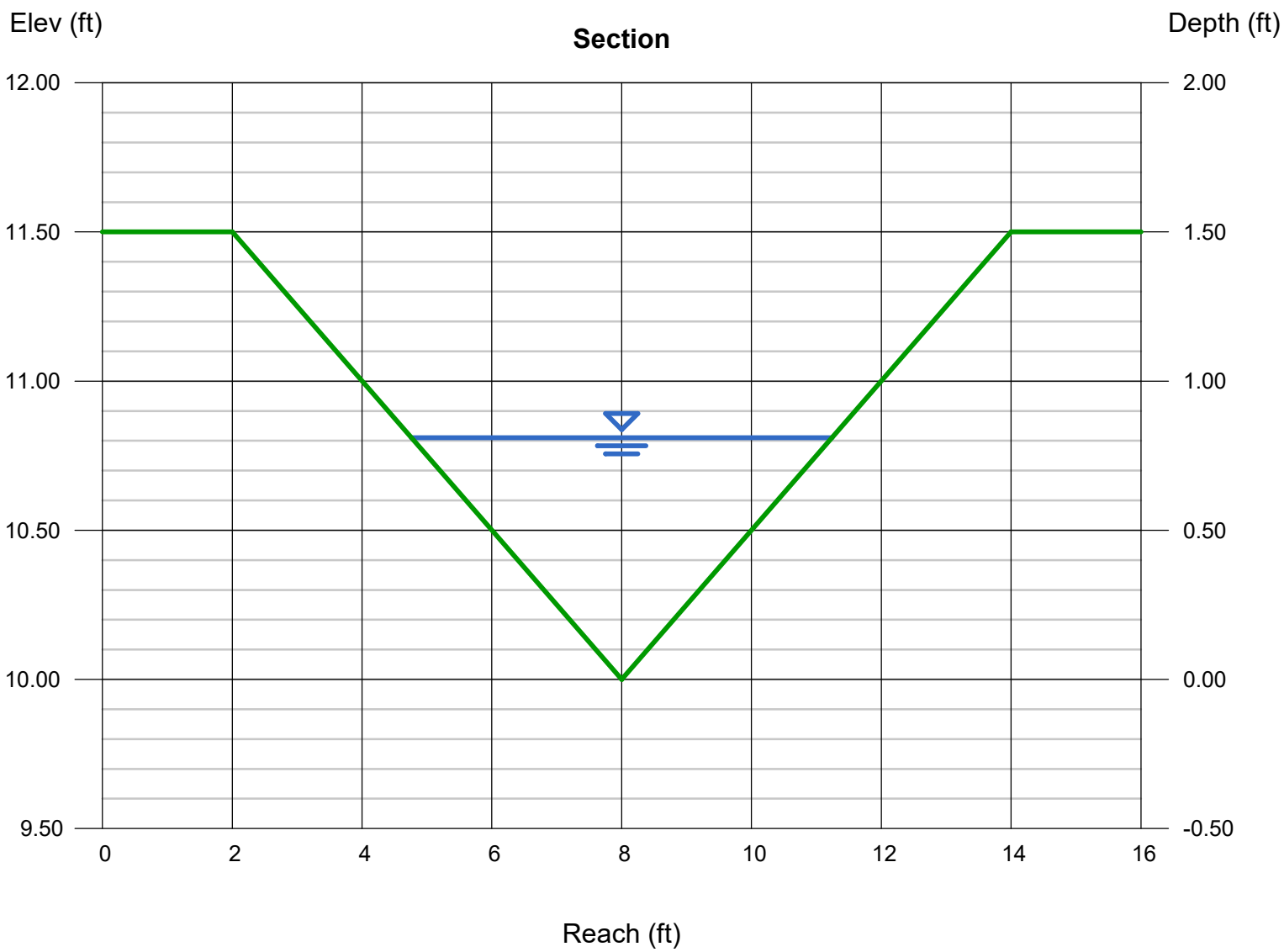
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 1.50
Invert Elev (ft)	= 10.00
Slope (%)	= 5.00
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 15.50

Highlighted

Depth (ft)	= 0.81
Q (cfs)	= 15.50
Area (sqft)	= 2.62
Velocity (ft/s)	= 5.91
Wetted Perim (ft)	= 6.68
Crit Depth, Yc (ft)	= 0.99
Top Width (ft)	= 6.48
EGL (ft)	= 1.35



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, May 13 2021

Swale L1 (5-Year)

Triangular

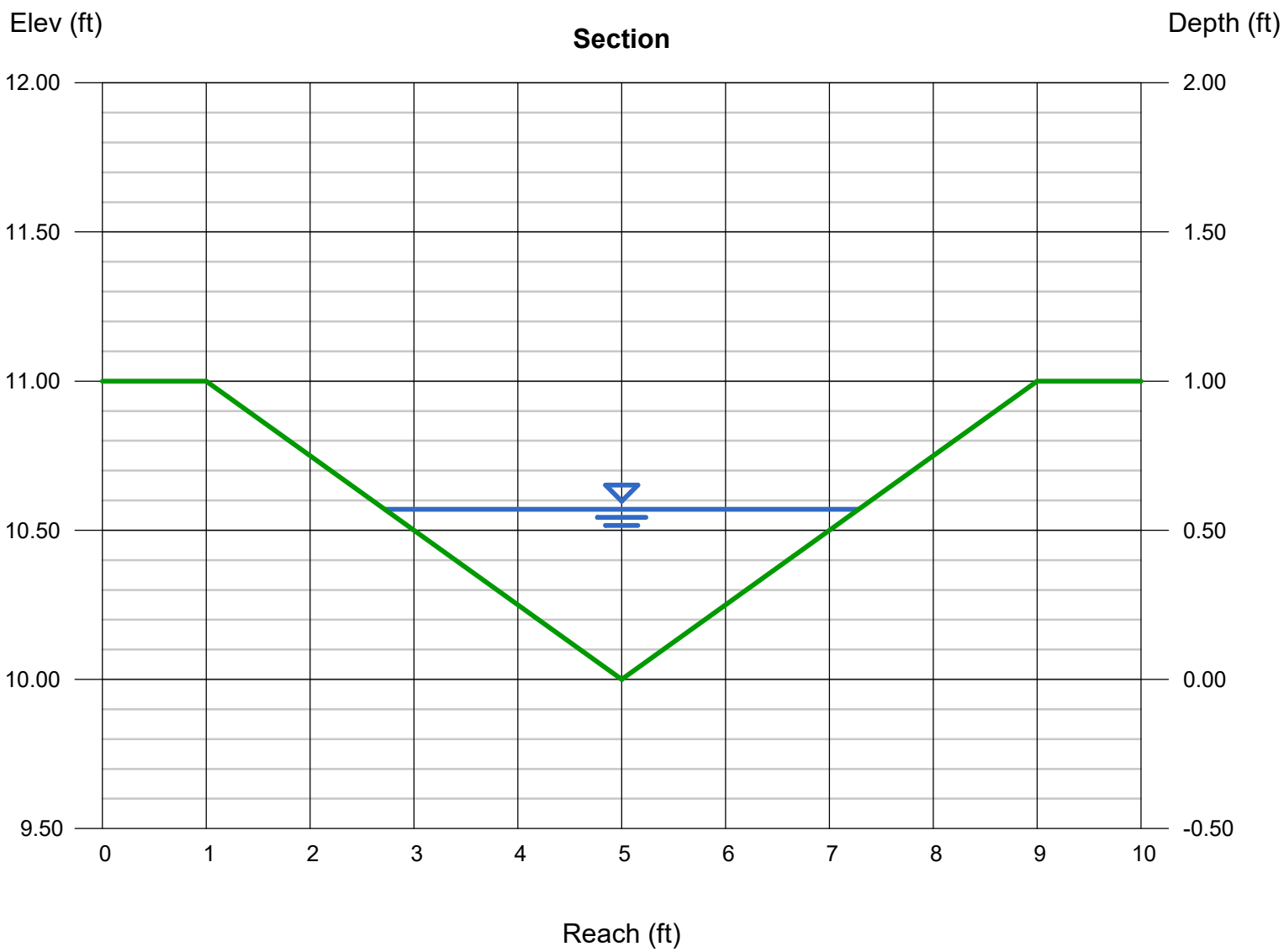
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 1.00
Invert Elev (ft)	= 10.00
Slope (%)	= 1.00
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 2.70

Highlighted

Depth (ft)	= 0.57
Q (cfs)	= 2.700
Area (sqft)	= 1.30
Velocity (ft/s)	= 2.08
Wetted Perim (ft)	= 4.70
Crit Depth, Yc (ft)	= 0.50
Top Width (ft)	= 4.56
EGL (ft)	= 0.64



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, May 13 2021

Swale L1 (100-Year)

Triangular

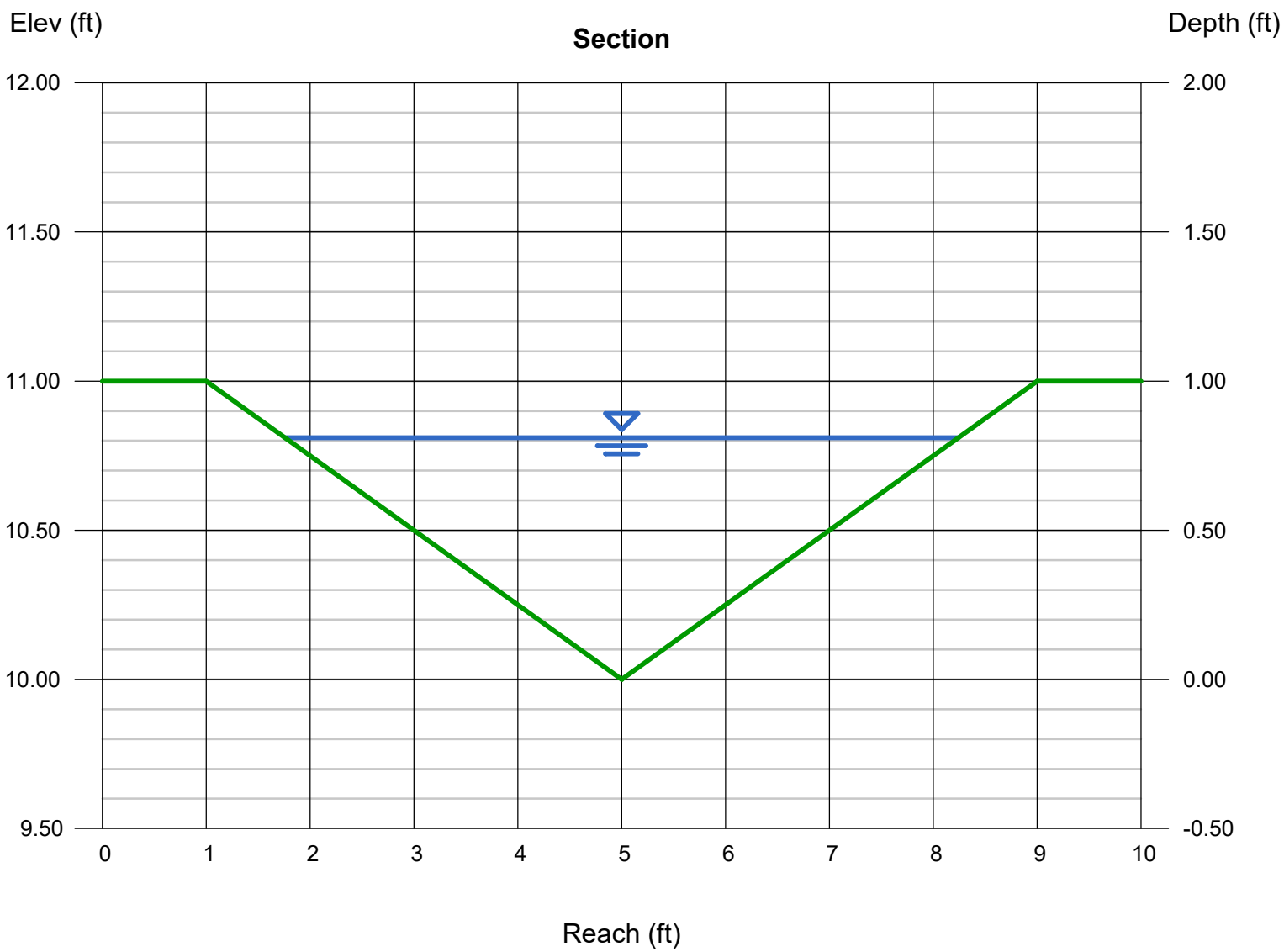
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 1.00
Invert Elev (ft)	= 10.00
Slope (%)	= 1.00
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 6.90

Highlighted

Depth (ft)	= 0.81
Q (cfs)	= 6.900
Area (sqft)	= 2.62
Velocity (ft/s)	= 2.63
Wetted Perim (ft)	= 6.68
Crit Depth, Yc (ft)	= 0.72
Top Width (ft)	= 6.48
EGL (ft)	= 0.92



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, May 13 2021

Swale L2 (5-Year)

Triangular

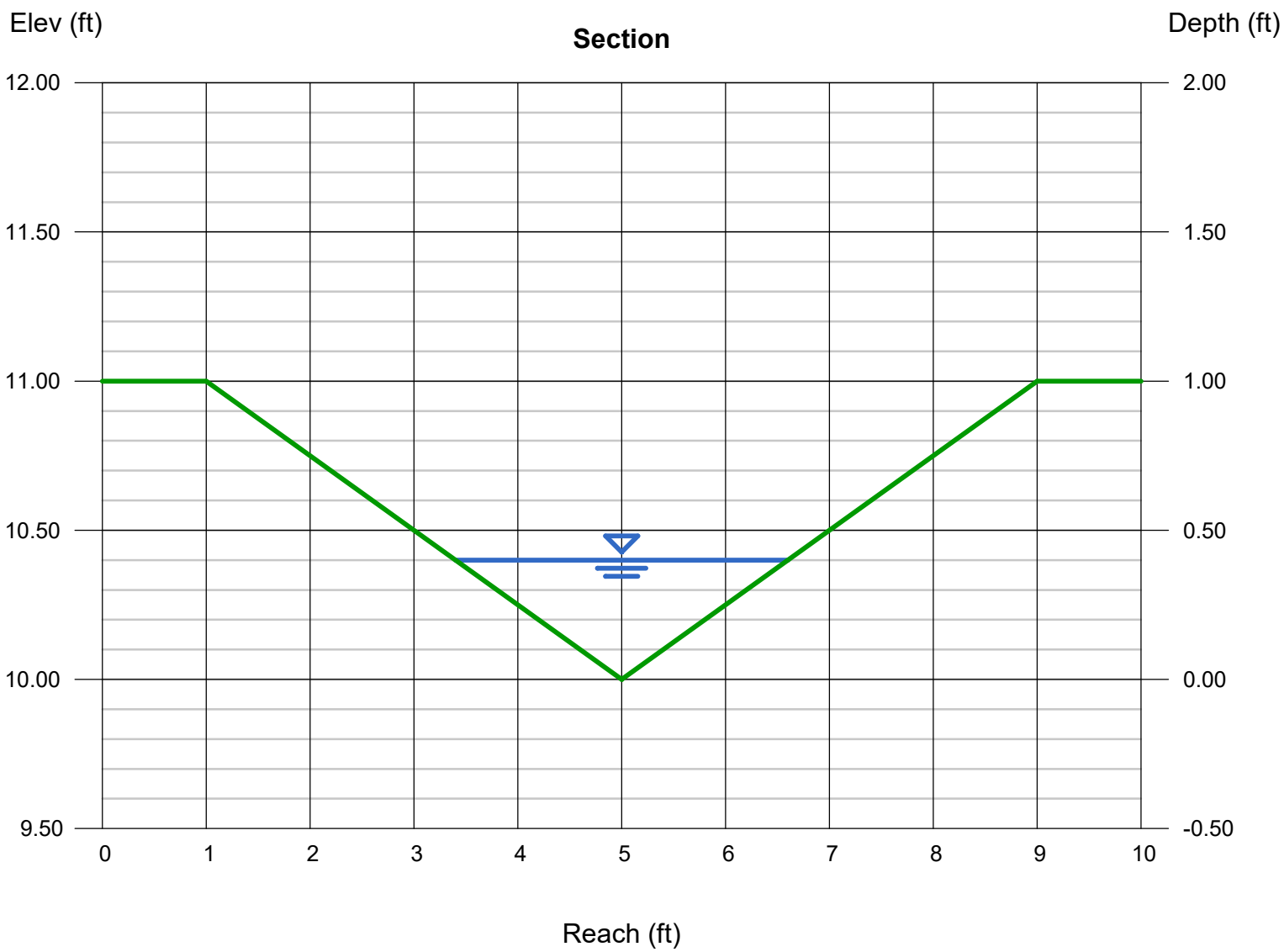
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 1.00
Invert Elev (ft)	= 10.00
Slope (%)	= 7.31
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 2.70

Highlighted

Depth (ft)	= 0.40
Q (cfs)	= 2.700
Area (sqft)	= 0.64
Velocity (ft/s)	= 4.22
Wetted Perim (ft)	= 3.30
Crit Depth, Yc (ft)	= 0.50
Top Width (ft)	= 3.20
EGL (ft)	= 0.68



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, May 13 2021

Swale L2 (100-Year)

Triangular

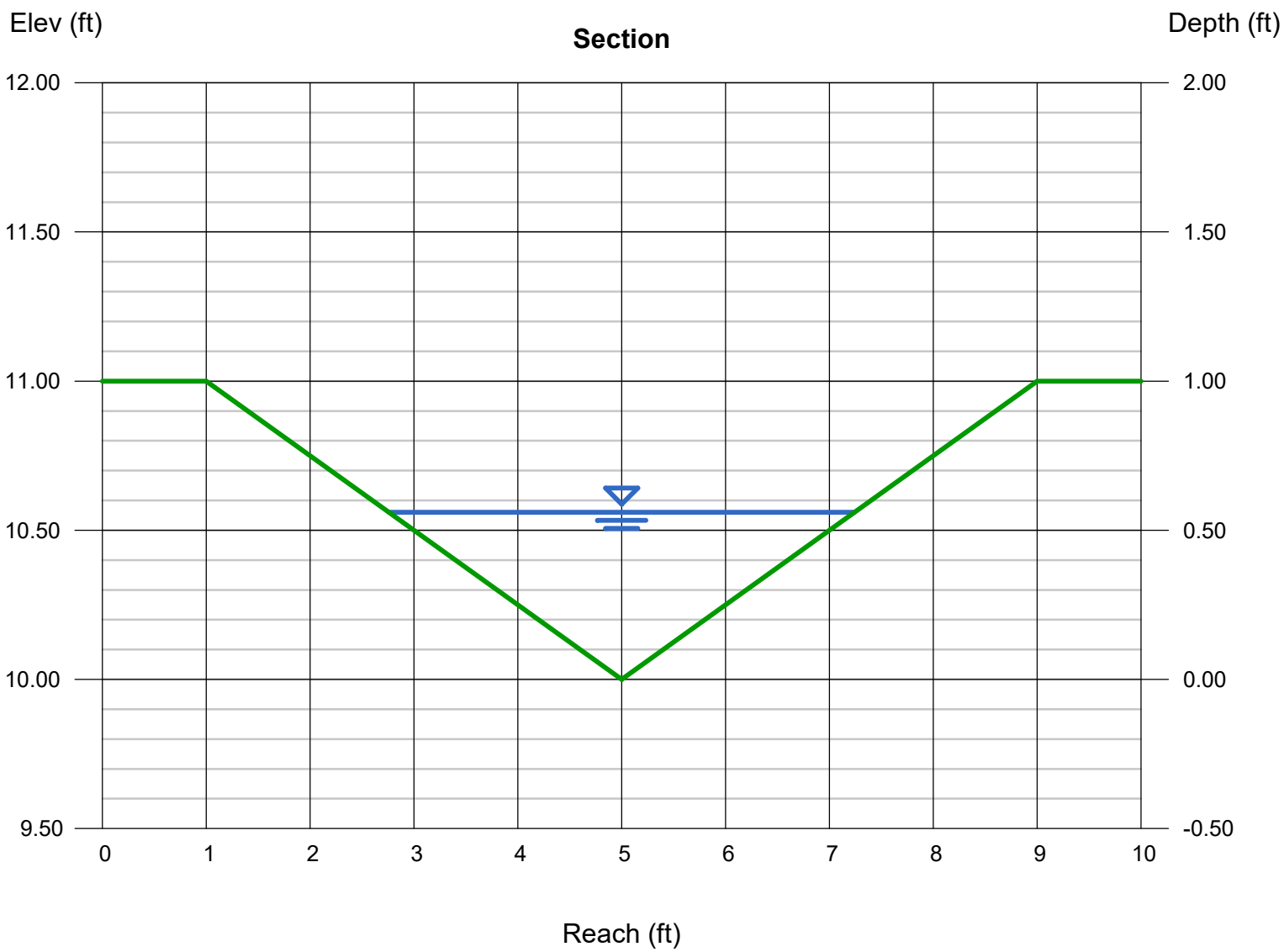
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 1.00
Invert Elev (ft)	= 10.00
Slope (%)	= 7.31
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 6.90

Highlighted

Depth (ft)	= 0.56
Q (cfs)	= 6.900
Area (sqft)	= 1.25
Velocity (ft/s)	= 5.50
Wetted Perim (ft)	= 4.62
Crit Depth, Yc (ft)	= 0.72
Top Width (ft)	= 4.48
EGL (ft)	= 1.03



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, May 13 2021

Swale OS-4 (5-Year)

Triangular

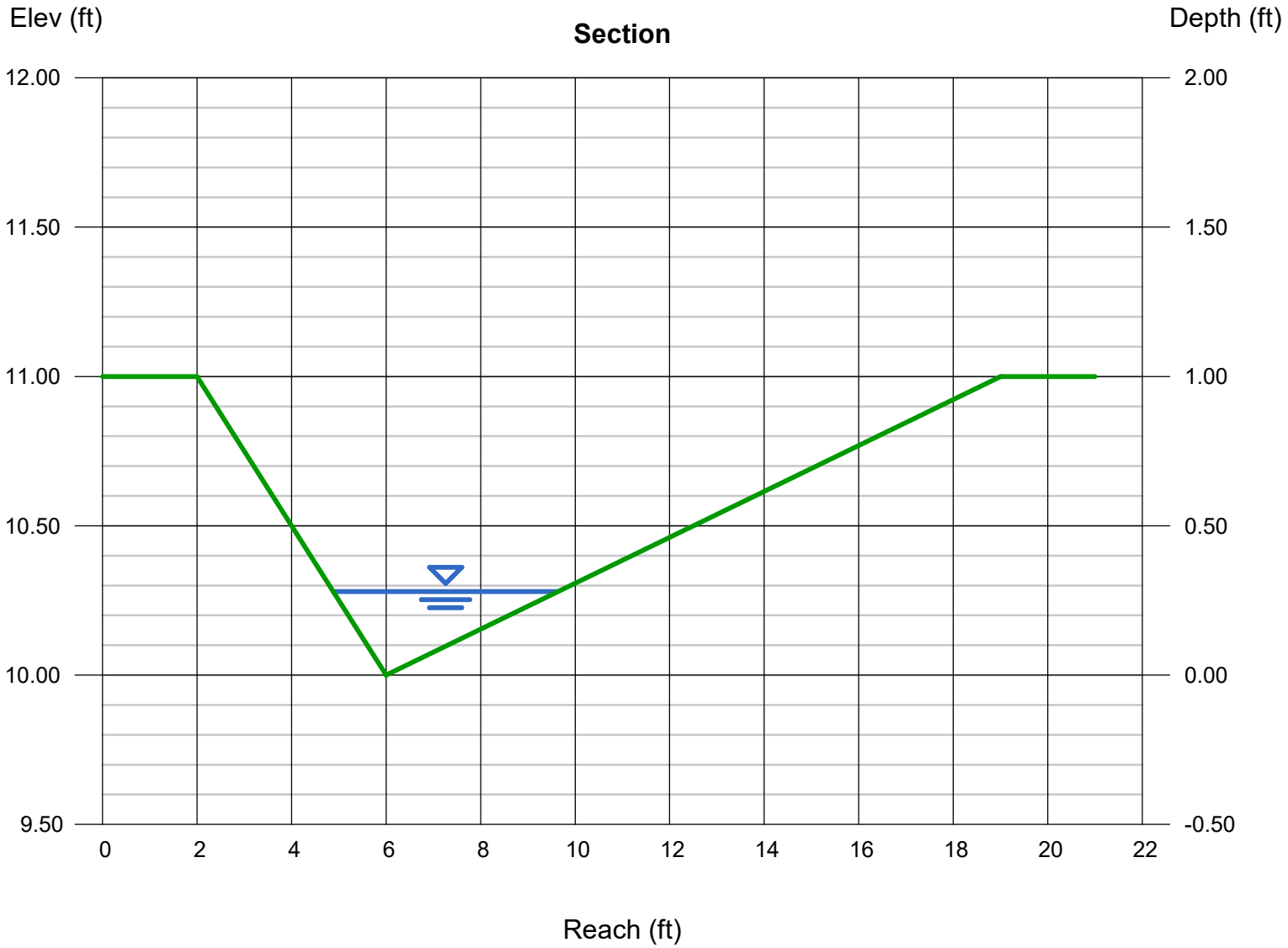
Side Slopes (z:1)	= 4.00, 13.00
Total Depth (ft)	= 1.00
Invert Elev (ft)	= 10.00
Slope (%)	= 5.00
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 1.80

Highlighted

Depth (ft)	= 0.28
Q (cfs)	= 1.800
Area (sqft)	= 0.67
Velocity (ft/s)	= 2.70
Wetted Perim (ft)	= 4.81
Crit Depth, Yc (ft)	= 0.31
Top Width (ft)	= 4.76
EGL (ft)	= 0.39



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, May 13 2021

Swale OS-4 (100-Year)

Triangular

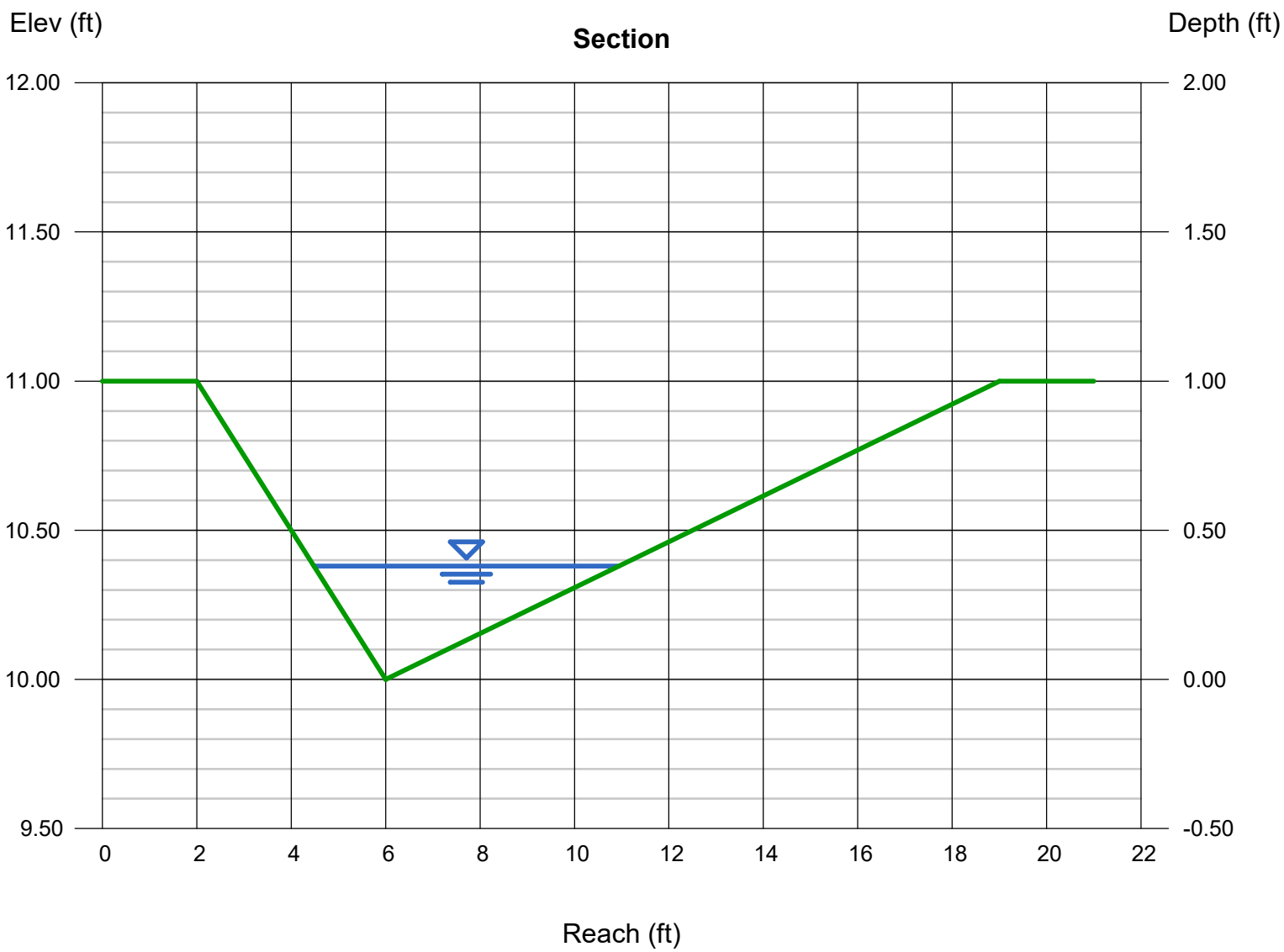
Side Slopes (z:1)	= 4.00, 13.00
Total Depth (ft)	= 1.00
Invert Elev (ft)	= 10.00
Slope (%)	= 5.00
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 4.30

Highlighted

Depth (ft)	= 0.38
Q (cfs)	= 4.300
Area (sqft)	= 1.23
Velocity (ft/s)	= 3.50
Wetted Perim (ft)	= 6.52
Crit Depth, Yc (ft)	= 0.44
Top Width (ft)	= 6.46
EGL (ft)	= 0.57



Rock Chute Design Data

(Version 4.01 - 04/23/03, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)

Project: *Cloverleaf-Pond 1 Rundown* **County:** *El Paso*
Designer: *GAG* **Checked by:**
Date: 8/18/2021 **Date:**

Input Channel Geometry

→ ***Inlet Channel***	→ ***Chute***	→ ***Outlet Channel***
Bw = *1.0* ft.	Bw = *4.0* ft.	Bw = *7.0* ft.
Side slopes = *4.0* (m:1)	Factor of safety = *1.20* (F_s)	Side slopes = *4.0* (m:1)
n-value = *0.035*	Side slopes = *4.0* (m:1) → ***2.0:1 max.***	n-value = *0.013*
Bed slope = *0.1450* ft./ft.	Bed slope (4:1) = *0.250* ft./ft. → ***2.5:1 max.***	Bed slope = *0.0050* ft./ft.
Freeboard = *1.0* ft.	Outlet apron depth, d = *1.0* ft.	Base flow = *0.0* cfs

Design Storm Data (Table 2, NHCP, NRCS Grade Stabilization Structure No. 410)

Drainage area = *27.2* acres Rainfall = ◉ 0 - 3 in. ○ 3 - 5 in. ○ 5+ in.

Apron elev. --- Inlet = *7072.4* ft. --- Outlet = *7065.8* ft. --- (H_{drop} = 5.6 ft.)

Chute capacity = Q10-year
Total capacity = Q25-year
Minimum capacity (based on a 5-year, 24-hour storm with a 0 - 3 inch rainfall)

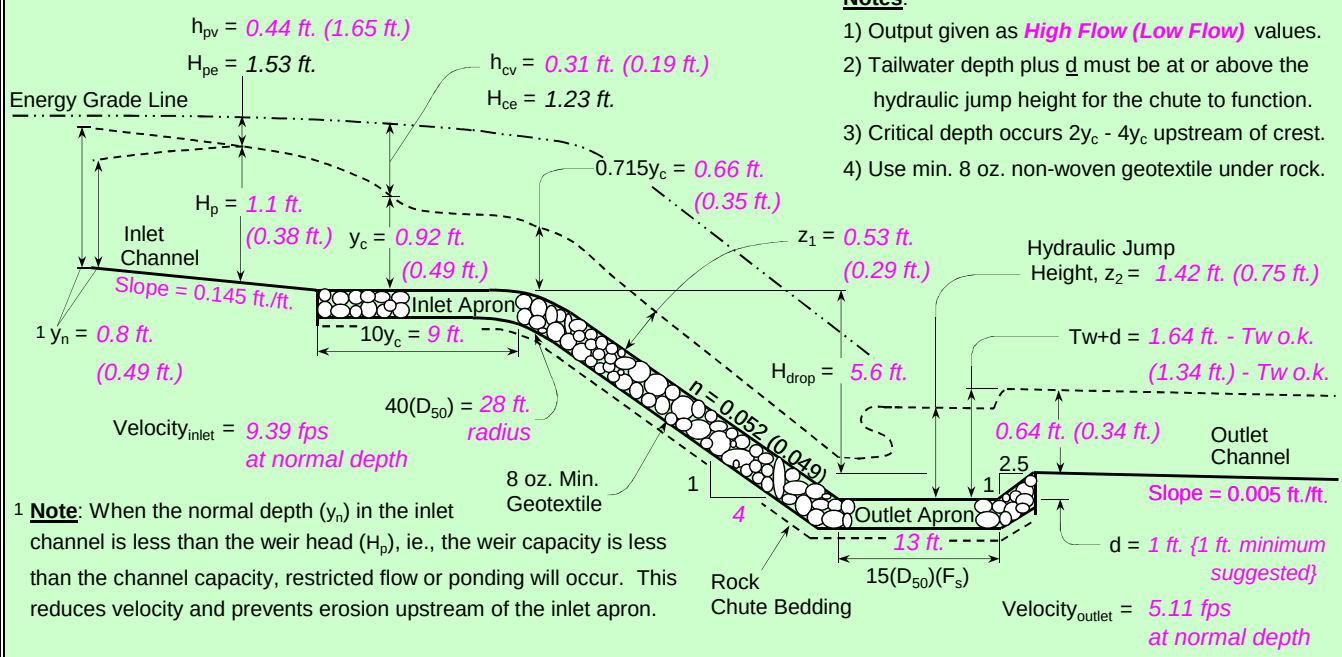
Q_{high} = *31.4* cfs High flow storm through chute → Tw (ft.) = *Program*

Q_{low} = *10.1* cfs Low flow storm through chute → Tw (ft.) = *Program*

***Note**: The total required capacity is routed through the chute (principal spillway) or in combination with an auxiliary spillway.*
***Input tailwater (Tw)**:*

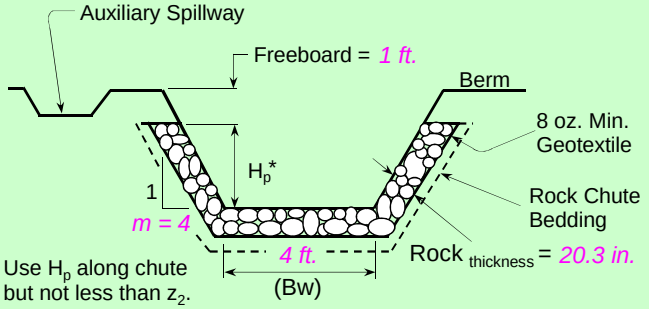
Profile and Cross Section (Output)

Notes:
1) Output given as ***High Flow (Low Flow)*** values.
2) Tailwater depth plus d must be at or above the hydraulic jump height for the chute to function.
3) Critical depth occurs $2y_c$ - $4y_c$ upstream of crest.
4) Use min. 8 oz. non-woven geotextile under rock.



1 **Note**: When the normal depth (y_n) in the inlet channel is less than the weir head (H_p), ie., the weir capacity is less than the channel capacity, restricted flow or ponding will occur. This reduces velocity and prevents erosion upstream of the inlet apron.

Profile Along Centerline of Chute

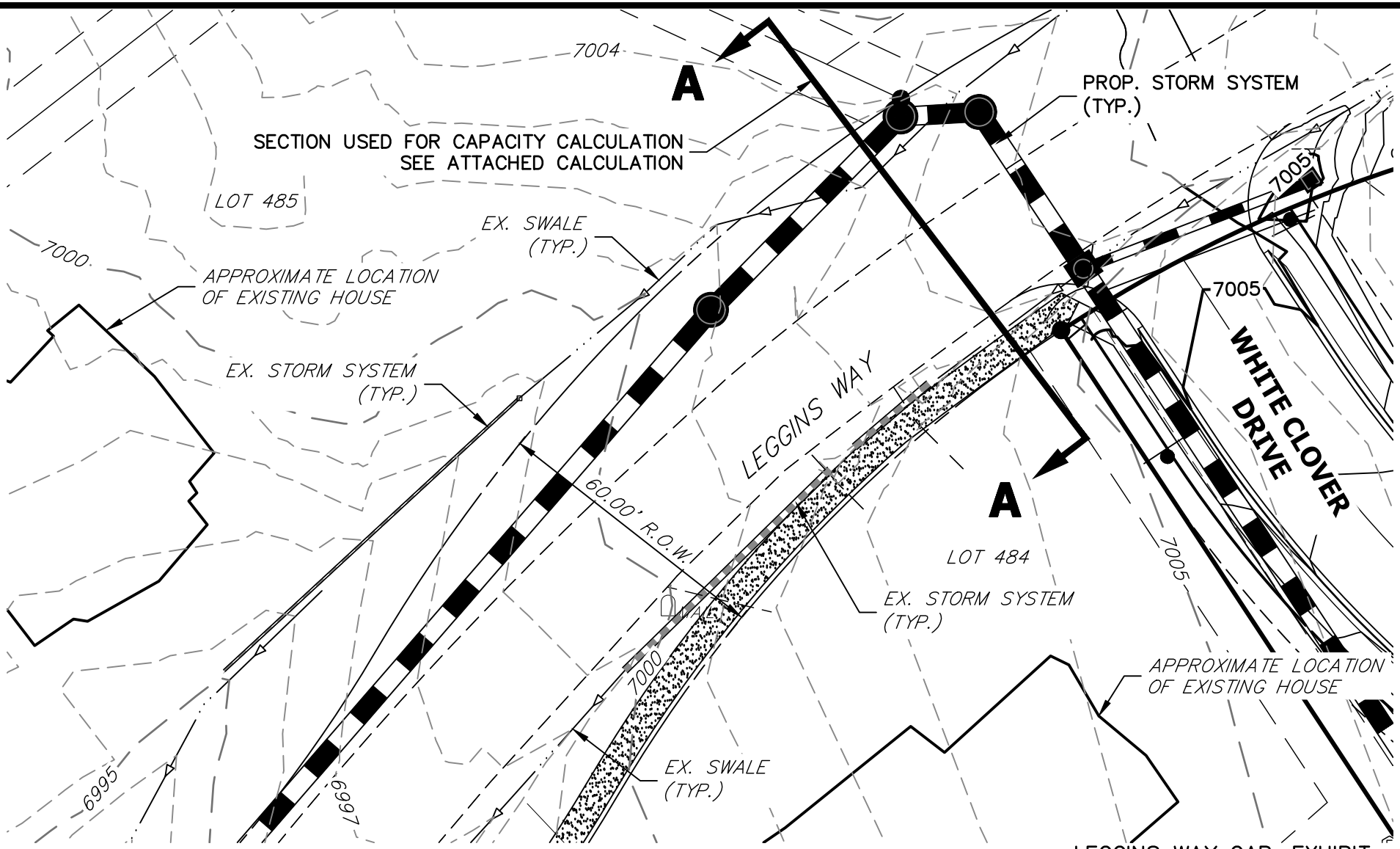


* Use H_p along chute but not less than z_2.

Typical Cross Section

q_t =	*4.98 cfs/ft.*	Equivalent unit discharge
F_S =	*1.20*	Factor of safety (multiplier)
z_1 =	*0.53 ft.*	Normal depth in chute
n-value =	*0.052*	Manning's roughness coefficient
$D_{50}(F_s)$ =	*10.2 in. (77 lbs. - 50% round / 50% angular)*	
$2(D_{50})(F_s)$ =	*20.3 in.*	Rock chute thickness
Tw + d =	*1.64 ft.*	Tailwater above outlet apron
z_2 =	*1.42 ft.*	Hydraulic jump height
****** The outlet***	***will***	***function adequately***

High Flow Storm Information



LEGGINS WAY CAP. EXHIBIT
CLOVERLEAF SUBDIVISION F2
JOB NO. 25158.01
11/3/21
SHEET 1 OF 1

J·R ENGINEERING
A Westrian Company
Centennial 303-740-9393 • Colorado Springs 719-593-2593
Fort Collins 970-491-9888 • www.jrengineering.com

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Nov 3 2021

Leggins Way Ex. Roadway and Swales

User-defined

Invert Elev (ft)	= 0.22
Slope (%)	= 4.20
N-Value	= Composite

Calculations

Compute by:	Q vs Depth
No. Increments	= 30

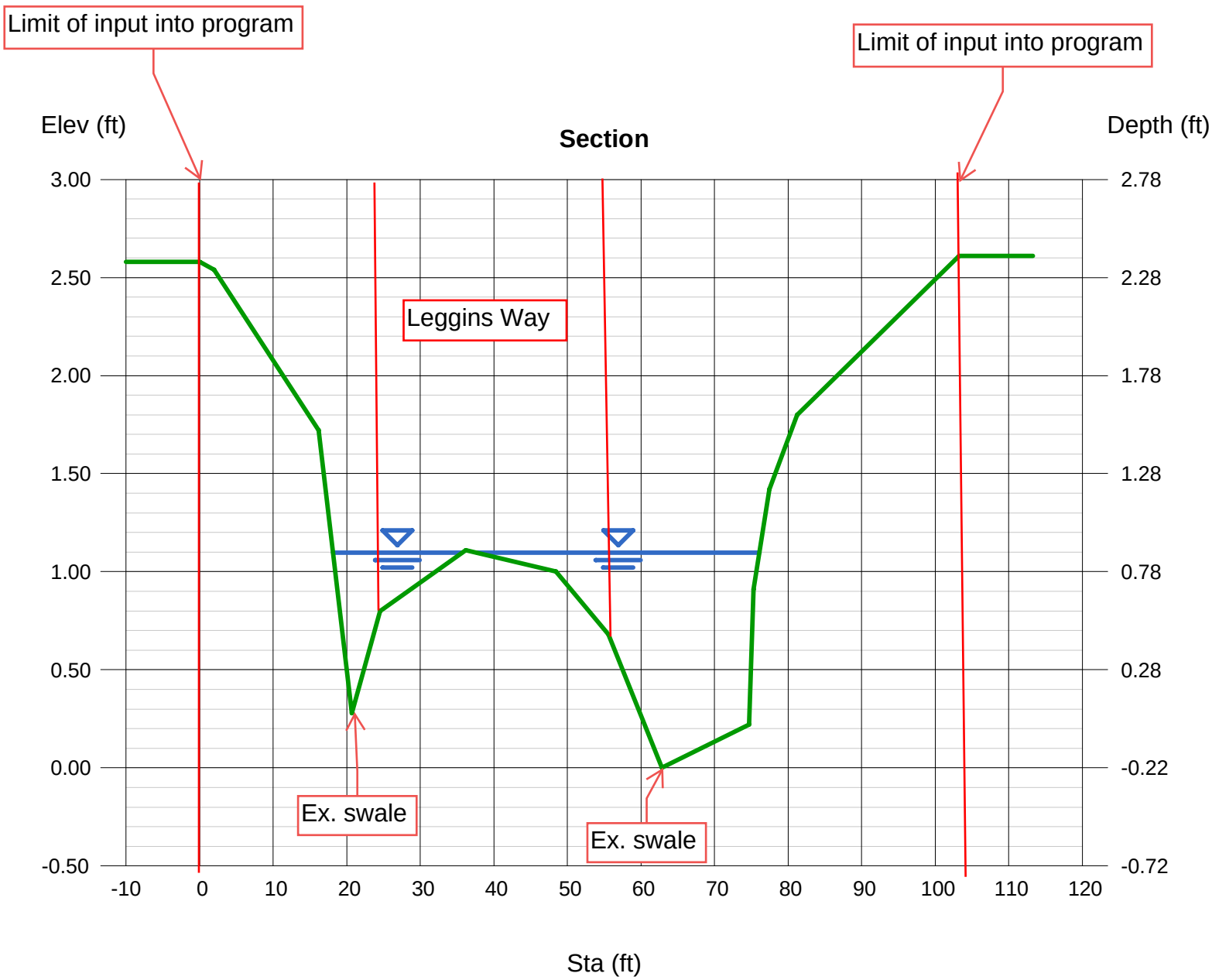
Highlighted

Depth (ft)	= 0.88
Q (cfs)	= 134.44
Area (sqft)	= 24.78
Velocity (ft/s)	= 5.43
Wetted Perim (ft)	= 56.49
Crit Depth, Yc (ft)	= 1.01
Top Width (ft)	= 55.97
EGL (ft)	= 1.33

(Sta, El, n)-(Sta, El, n)...

(0.00, 2.58) -(2.00, 2.54, 0.050) -(16.15, 1.72, 0.050) -(20.66, 0.28, 0.050) -(24.52, 0.80, 0.016) -(36.17, 1.11, 0.016) -(48.46, 1.00, 0.016) -(55.57, 0.68, 0.016) -(74.69, 0.22, 0.050) -(75.34, 0.91, 0.050) -(77.45, 1.42, 0.050) -(81.23, 1.80, 0.050) -(103.28, 2.61, 0.050)

See plan view for location of section.



PIPE OUTFALL RIPRAP SIZING CALCULATIONS

Subdivision: Cloverleaf Subdivision
Location: Colorado Springs

Project Name: Cloverleaf Subdivision - Proposed
Project No.: 2000-5158.01
Calculated By: GAG
Checked By:
Date: 10/21/21

Leggins Way
Outfall Protection

	STORM DRAIN SYSTEM			
	DESIGN POINT	DESIGN POINT	DESIGN POINT	Notes
Q_{100} (cfs):	116.6			Flows are the greater of proposed vs. future
Conduit	Pipe			
D_c, Pipe Diameter (in):	48			
W, Box Width (ft):	N/A			
H, Box Height (ft):	N/A			
Y_t, Tailwater Depth (ft):	1.60			If unknown, use Y_t/D_c (or H)=0.4
Y_t/Dc or Y_t/H	0.40			
$Q/D^{2.5}$ or $Q/(WH^{3/2})$	3.64			
Supercritical?	No			
Y_n, Normal Depth (ft) [Supercritical]:	2.75			
D_a, H_a (in) [Supercritical]:	N/A			$D_a=(D_c+Y_n)/2$
Riprap d_{50} (in) [Supercritical]:	N/A			
Riprap d_{50} (in) [Subcritical]:	12.08			
Required Riprap Size:	H			Fig. 9-38 or Fig. 9-36
d_{50} (in):	15			
Expansion Factor, $1/(2 \tan\theta)$:	4.00			Read from Fig. 9-35 or 9-36
θ:	0.12			
Erosive Soils?	No			
Area of Flow, A_t (ft^2):	16.66			$A_t=Q/V$
Length of Protection, L_p (ft):	25.6			L=(1/(2 tan θ))(At/Yt - D)
Min Length (ft)	12.0			Min L=3D or 3H
Max Length (ft)	40.0			Max L=10D or 10H
Min Bottom Width, T (ft):	10.4			$T=2*(L_p*\tan\theta)+W$
Design Length (ft)	26.0			
Design Width (ft)	10.4			
Riprap Depth (in)	30			Depth=2(d_{50})
Type II Bedding Depth (in)*	8			*Not used if Soil Riprap
Cutoff Wall	No			
Cutoff Wall Depth (ft)				Depth of Riprap and Base
Cutoff Wall Width (ft)				

Note: No Type II Base to be used if Soil Riprap is specified within the plans
* For use when the flow in the culvert is supercritical (and less than full).

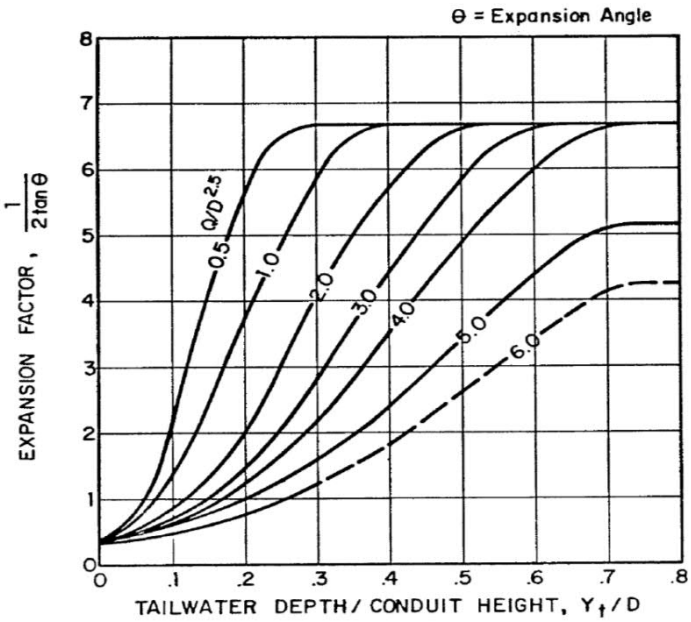


Figure 9-35. Expansion factor for circular conduits

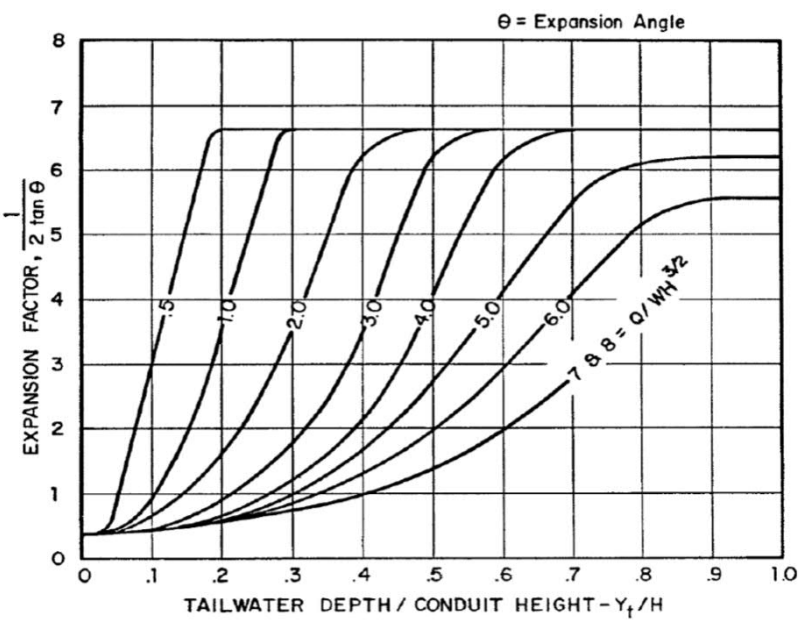


Figure 9-36. Expansion factor for rectangular conduits

Appendix E
Reference Material

RECEIVED

MAY 0 3 2005

EPC DEVELOPMENT SERVICES

J·R ENGINEERING
A Westrian Company

FINAL DRAINAGE REPORT
FOR
WALTERS COMMONS

APRIL 2005

Prepared For:

PULTE HOME CORPORATION
1975 Research Parkway
Colorado Springs, CO 80920
(719) 536-4200

Prepared By:

JR ENGINEERING
4310 ArrowsWest Drive
Colorado Springs, CO 80907
(719) 593-2593

Job No. 9170.72

FINAL DRAINAGE REPORT
FOR
WALTERS COMMONS

DRAINAGE REPORT STATEMENT

J·R ENGINEERING
A Westrian Company

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 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.

COLORADO REGISTERED PROFESSIONAL ENGINEER TROY D. KENT 35996

5/2/05

Troy D. Kent, Colorado P.E. #35996
For and On Behalf of JR Engineering

Date

DEVELOPER'S STATEMENT:
I, the developer, have read and will comply with all of the requirements specified in this drainage report and plan.

Business Name: Pulte Homes

By:

Title: Senior Project Manager

Address: 1975 Research Parkway

Colorado Springs, CO 80920

EL PASO COUNTY ONLY:
Filed in accordance with Section 51.1 of the El Paso Land Development Code, as amended.

John A. McCarty

5-4-05

John McCarty
County Engineer/Director

Date

Conditions:

4310 ArrowsWest Drive, Colorado Springs, CO 80907
719-593-2593 • Fax: 719-528-6613 • www.jrengineering.com

As indicated in the Basin Summary on the previous page, the rational method yields higher runoff amounts in all cases. This is consistent with what would be expected when applying the two methodologies to the same basin.

PROPOSED DRAINAGE CONDITIONS

Walters Commons is a proposed 291-unit townhome project on 32.3 acres. Filing 1 consists of 178 units on 18.7 acres. Proposed drainage patterns are as identified on the PROPOSED DRAINAGE MAP located in the Appendix. The general drainage concept is to collect developed runoff via a proposed R.C.P. storm sewer system and transport the runoff to two private on-site detention ponds located on the south and southwest sides of the proposed development.

The proposed private storm sewer and detention pond system will be designed to release storm water at historic rates into the Higby Road right-of-way and existing storm drain facilities under Higby Road. (See the EXISTING DRAINAGE MAP in the Appendix).

The proposed Walters Commons Development has been divided into 13 on-site sub-basins labeled A-M. Twelve off-site basins with the prefix "OS" have been identified to account for the remaining drainage from the existing sub-basins that flow through the site to four critical design points.

Proposed on-site Drainage Basin A (Q_5= 1 cfs, Q_{100}= 3 cfs), Basin B (Q_5= 3 cfs, Q_{100}= 6 cfs), Basin C (Q_5= 5 cfs, Q_{100}= 10 cfs) and Basin D (Q_5= 1 cfs, Q_{100}= 2 cfs) are comprised of a multi-family residential development and will drain to the northwest. Storm water from OS-3, Basins C and D flows through the north ditch of Magic Lamp Way to the east roadside ditch of Bowstring Road toward DP4. Proposed flows at DP4 combine with flows from Basin A in the ditch east of Bowstring and flow toward DP1. Existing flows from OS-4 will be intercepted on-site by an area inlet at DP3 and flow via an 24" storm pipe to DP2. The developed flows of Basin B are intercepted by a proposed private inlet at DP2, combine with pipe flows from DP3, and travel through a proposed private 24" R.C.P. storm sewer to DP1. The total developed flows from Basins A, B, C, D, OS-2, OS-3 and OS-4 at DP1 are Q_5= 12 cfs and Q_{100}= 27 cfs. The existing flow at DP1 is Q_5= 6 cfs, Q_{100}= 16 cfs. The flows from DP1 travel north along Bowstring Road to an existing 24" CMP

storm drain under Leggins Way and then through an existing 36" CMP storm drain under Bowstring Road and outlet into a 6' wide by 4' deep grass ditch on the Lewis Palmer High School property. These pipes and grass ditch have adequate capacity to carry the developed flows and will not need to be modified. (See Existing Facility Hydraulic Calculations in the Appendix). Existing Roadside ditches along Magic Lamp Way and Bowstring Road has 10 cfs capacity. The east ditch of Bowstring Road will be regarded from Magic Lamp Way to the north property line as part of the Bowstring Road paving improvements. This regarded ditch will direct flows from Magic Lamp Way, under Timber Run through the proposed 24" RCP culvert to the existing ditch north of the property line. The capacity of this ditch will be 13 cfs, developed flows in the 100-year condition through this ditch are 12 cfs.

Off-site Drainage Basin OS-5 (Q_5= 19 cfs, Q_{100}= 47 cfs) is comprised primarily of undeveloped area and a small portion of street. This off-site basin is part of EB1b. (See EXISTING DRAINAGE MAP in the Appendix). OS-5 flows travel through Country Ridge Estates and combine with OS-6 (Q_5= 3 cfs, Q_{100}= 7 cfs) and travel along the south ditch of Magic Lamp Way to the east ditch of Bowstring Road to DP7 in the southwest corner of the site (See Proposed Drainage Map in the Appendix).

Offsite flows from OS-7 (Q_5= 4 cfs, Q_{100}= 10 cfs) combine with on-site basin I (Q_5= 0.2 cfs, Q_{100}= 1 cfs), flow through the southern portion of the existing Country Ridge Estates and flow onto the proposed development at Basin G (Q_5= 5 cfs, Q_{100}= 10 cfs). A proposed private 20' At-Grade inlet at DP5 intercepts these flows. The intercepted flows will be routed through an 18" RCP storm sewer to the proposed sump inlet at DP6. (See Proposed Drainage Map.)

Bypass flow from the inlet at DP5 (Q_5= 2 cfs, Q_{100}= 6 cfs) continues into Basin F in the curb and gutter of Yellow Dogwood Heights and is intercepted at DP6 by a proposed 20' private sump inlet (See Inlet Sizing Calculations in the Appendix). The developed flows at DP6 sump inlet at (Q_5= 15 cfs, Q_{100}= 30 cfs). Combined flows from DP5 and DP6 will be routed to a proposed private detention pond through a proposed private 24" R.C.P. storm pipe. This 0.79 acre-foot detention facility will have an allowable outflow equal to or less than 78 cfs to ensure that peak drainage flows at Design Point 7 (DP7) are reduced to the historic rates of Q_5= 33 cfs and Q_{100}= 78 cfs. (See EXISTING

HYDROLOGIC CALCULATIONS in the Appendix). Developed Flows at DP7 include drainage from DP5, DP6, Basin E, Basin M, OS-6 and OS-5. The total developed flows in the proposed detention pond (DP6a) are $Q_5 = 17$ cfs and $Q_{100} = 36$ cfs. As mentioned above, the outfall structure will restrict 100-year flow from the proposed detention pond to ensure that DP7 flows are 78 cfs or less. Calculations for the outfall structure for this detention facility can be found in the "Storm Sewer Routing and Proposed Drainage Structures" section of this report.

Flows from Basin OS-9 (Q_5= 2 cfs, Q_{100}= 4 cfs) travel on-site to Proposed Basin H (Q_5= 10 cfs, Q_{100}= 20 cfs). A proposed curb opening and concrete swale at DP8 intercept flows from these basins. Flows from DP8 are routed through the swale to a 24" RCP storm sewer and outlet into the proposed 1.83 acre-ft detention pond on the south-central portion of the development. Bypass flows at DP8 (Q_5= 5 cfs, Q_{100}= 8 cfs) will continue along Yellow Dogwood Heights to the sump inlet at DP6. (See Proposed Drainage Map in the Appendix.)

At Design Point 9, drainage from Basin OS-11 ($Q_5 = 2$ cfs, $Q_{100} = 4$ cfs) and Basin L ($Q_5 = 1$ cfs, $Q_{100} = 2$ cfs), Basin K (Q_5= 8 cfs, $Q_{100} = 17$ cfs) combines for a resultant flow of $Q_5 = 9$ cfs and $Q_{100} = 19$ cfs. This water is intercepted by a proposed 10' private sump inlet on Burning Bush Point and routed to the proposed 1.83 acre-ft detention facility by a proposed private 24" R.C.P. storm sewer. This proposed detention facility will have an allowable outflow equal to or less than 30 cfs to ensure that peak drainage flows at DP10 are reduced to the historic rate of $Q_{100} = 30$ cfs. The outfall structure for this detention facility is detailed in the "Storm Sewer Routing and Proposed Drainage Structures" section of this report.

A 30" proposed private RCP storm sewer will transport developed flows from future Filing 2 of the Walters Commons development to the proposed 1.83 acre-feet detention pond mentioned above. Proposed flows through this storm sewer are Q_{100}= 35 cfs. The capacity of this proposed storm drain is 83 cfs. This storm drain will have a temporary plug installed in the southeast corner of Filing 1. (See Proposed Drainage Map in the Appendix.) The total developed flows to the above mentioned detention pond are Q_5= 37 cfs and Q_{100}= 77 cfs. The outfall structure from this pond is designed to limit flows at DP10 to the historic rate of Q_{100}= 30 cfs. Detention pond and outfall structure sizing will be discussed in a later portion of this report.

primarily undeveloped with the exception of a small portion of Cloverleaf Road on the east side of the basin. The calculations for the 5-year and 100-year storm flows for Basin EB2 can be found in the Appendix, EXISTING HYDROLOGIC CALCULATIONS. The existing flows at DP10 are 12 cfs for the 5-year storm and 30 cfs for the 100-year storm. Proposed Drainage Basins J,K OS-10, OS-11 and Future Filing 2 Developed Flows will result in Q_5 = 37 cfs and Q_{100} = 77 cfs at DP10 after the site is developed. The existing structure at DP10 is a 24" storm sewer that flows under Higby Road. This storm sewer has a capacity of 40 cfs at its current slope. Because development and proposed flow patterns will significantly increase flow quantities at DP10 (Q_{100} = 77 cfs), a proposed 1.83 acre-ft, on-site detention pond will be designed to maintain historical flows (Q_{100}=30 cfs) at DP10 through the existing 24" storm outfall facility. (See PROPOSED DRAINAGE MAP in the Appendix). The proposed outfall structure linking the detention pond to the existing 24" storm drain is a 30" private RCP storm sewer at 1% slope .This outfall structure is further detailed in the "Storm Sewer Routing and Proposed Drainage Structures" section of this report. Future storm drain improvements per the "Drainage Master Plan for Jackson Creek, Teachout Creek and No Name Creek Final Report" will include an extension of the existing 24" storm facility under Higby Road to the south. (See PROPOSED OFF-SITE DRAINAGE MAP in the Appendix). As this future storm drain facility may be several years from construction, the existing swale south of Higby Road will be adequate to handle the developed flows from Walters Commons. (See EXISTING FACILITY HYDRAULIC CALCULATIONS in the Appendix). The existing swale that flows from the highpoint in Cloverleaf Road and continues along the north side of Higby Road to DP10 has an existing capacity of 28 cfs. The proposed developed flows through this swale are 10 cfs in the 100-yr condition, therefore the existing swale has adequate capacity (See EXISITING FACILITY HYDRAULIC CALCULATIONS in the Appendix.)

Design Point 11

Design Point 11 will connect to the future Walters Commons Filing 2 development and transport developed flows from a proposed Filing 2 inlet to the 1.83 acre-ft detention pond in Filing 1 via a proposed 24" and 30" private RCP storm sewer. The developed flows at DP11 from future Filing 2 are Q_5 = 18 cfs and Q_{100} = 35 cfs as calculated in the approved Preliminary Drainage Report for Walters Commons. The storm drain sizing calculations can be found in the Proposed Facility Hydraulic Calculations in the Appendix of this report.

Design Point 12

Design Point 12 is located in the NW corner of the proposed Cloverleaf Road and Walters Point intersection. The existing flows at DP12 are $Q_5 = 2$ cfs and $Q_{100} = 4$ cfs. Developed flows at DP12 from Basin OS-3 and a small portion of the proposed Walters Point will be $Q_5 = 2$ cfs and $Q_{100} = 5$ cfs. Flows from DP12 are will move under Walters Point via a proposed private 24" culvert and travel to the south through Basin OS –11 in the roadside ditch west of Cloverleaf Road and continue along Higby Road to the proposed type C inlet at DP-10. Developed Flows at DP12 are 1 cfs higher than historic flows, therefore the existing swales will be adequate for increase developed flows (See EXISTING FACILITY HYDRAULIC CALCULATIONS in the Appendix). Calculations for the proposed culvert under Walters Point can be found in the Proposed Facility Hydraulic Calculations in the Appendix. The capacity of the existing swale from DP12 to DP7 is discussed above in "Design Point 10."

The two existing swales that receive developed flows from DP7 and DP10 mentioned above meet capacity for the 100-year storm event. Riprap dissipaters will reduce and disperse discharges to non-erosive velocities. The existing swales have established vegetation, therefore bank erosion and sedimentation down stream will not be significant as developed flows are only slightly higher than existing. Future improvements detailed in the Master Drainage Report include underground culverts connecting to the culverts under Higby Road and discharging to Teachout Creek.

STORM SEWER ROUTING AND PROPOSED DRAINAGE STRUCTURES

Pipe Design Point 101

The proposed storm drain facility at DP3 will collect off-site flows from basin OS-4 ($Q_5 = 4$ cfs and $Q_{100} = 8$ cfs) in a proposed area-inlet in the north portion of basin B. Flows will be diverted to DP1 via a proposed private 24" RCP storm drain. The total flow through pipe 101 is $Q_5 = 4$ cfs and $Q_{100} = 8$ cfs.

Pipe Design Point 102

Flows at DP2 are collected in a proposed 5' sump inlet and travel via a proposed 24" RCP private storm drain and combine with flows from DP3 at a WYE in the northwest corner of the site. Flows

the pond to restrict the flows consists of four parts. There will be a 4' diameter manhole structure connected to the 36" culvert exiting the pond. This manhole structure will have two orifices to accept flows: a 1.2' diameter pipe with invert 6992', and a 1.4' diameter pipe with invert 6996'. The emergency overflow weir is located at 6999.5', just above the 100-year water surface elevation. Storms greater than the 100-year storm will overtop the pond and flow into the existing elliptical CMP flowing west under Bowstring Road. Both the 1.4' diameter pipe and the 1.2' diameter pipe will have a trash rack grate. Pond calculations can be found in the Proposed Detention Pond Calculations in the Appendix.

Another pond will be built at DP 10 to maintain historic rates for flows existing the site at the existing 2.3' diameter CMP flowing under Higby Road. The historic flows at this point are 12 cfs and 30 cfs for the 5 and 100-year storms respectively. Developed flows at the point are proposed to be 37 cfs and 77 cfs. To maintain historic flows, the required storage for this pond is 1.833 acre-feet. The 5 and 100-year water surface elevations in the pond as shown on the proposed drainage map are approximately 7009.5' and 7012'.

The outlet structure that will be built in the pond to restrict the flows consists of four parts. There will be a 4' diameter manhole structure connected to the 30" culvert exiting the pond. This manhole structure will have two orifices to accept flows: a 1.1' diameter pipe with invert 7002', and a 2.0' diameter pipe with invert 7009.5'. The emergency overflow weir is located at 7012', just above the 100-year water surface elevation. Storms greater than the 100-year storm will overtop the pond and flow into the existing pipe under Higby Road. Both the 1.1' diameter pipe and the 2.0' diameter pipe will have a trash rack grate Pond calculations can be found in the Proposed Detention Pond Calculations in the Appendix.

PROPOSED BASIN PARAMETERS

WALTERS COMMONS
FINAL DRAINAGE REPORT~ FILING NO. 1
(Area Runoff Summary)

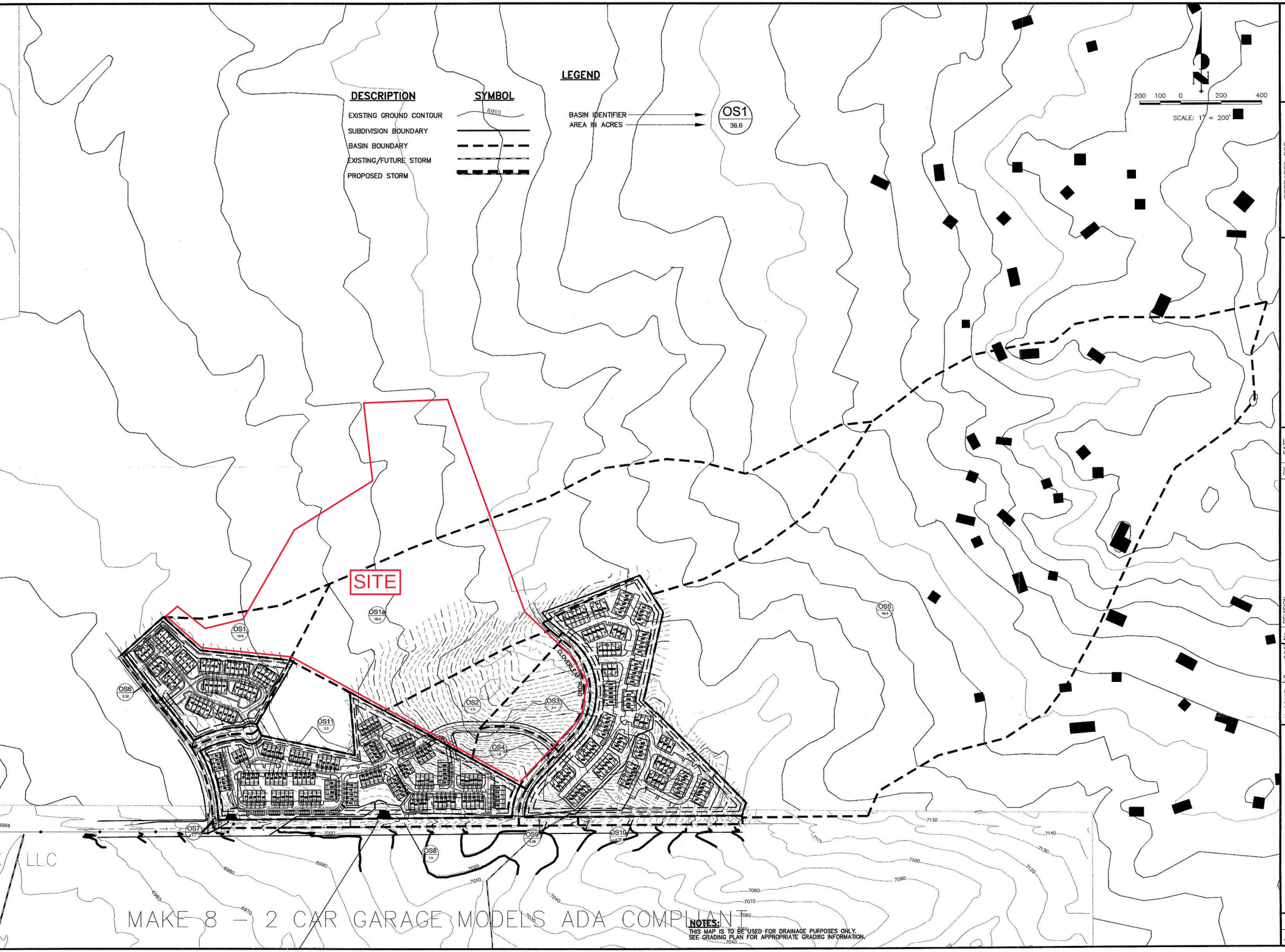
		IMPERVIOUS AREA			PERVIOUS AREA			WEIGHTED	
BASIN	TOTAL AREA (Acres)	AREA (Acres)	C(5)	C(100)	AREA (Acres)	C(5)	C(100)	C(5)	C(100)
OS - 1	0.5	0.1	0.90	0.95	0.4	0.25	0.35	0.34	0.43
OS - 2	0.2	0.2	0.90	0.95	0.0	0.25	0.35	0.90	0.95
OS - 3	0.4	0.2	0.90	0.95	0.2	0.25	0.35	0.59	0.67
OS - 4	5.7	0.0	0.90	0.95	5.7	0.25	0.35	0.25	0.35
OS - 5	32.1	0.0	0.35	0.45	32.1	0.25	0.35	0.25	0.35
OS-6	1.1	0.6	0.90	0.95	0.6	0.25	0.35	0.57	0.64
OS-7	6.8	0.0	0.90	0.95	6.8	0.25	0.35	0.25	0.35
OS-8	0.3	0.0	0.90	0.95	0.3	0.25	0.35	0.25	0.35
OS-9	2.3	0.0	0.90	0.95	2.3	0.25	0.35	0.25	0.35
OS-10	3.2	0.0	0.90	0.95	3.2	0.25	0.35	0.25	0.35
OS-11	1.7	0.0	0.90	0.95	1.7	0.25	0.35	0.25	0.35
OS-12	1.5	0.8	0.90	0.95	0.8	0.25	0.35	0.58	0.65
A	0.9	0.3	0.90	0.95	0.6	0.25	0.35	0.49	0.57
B	1.8	0.6	0.90	0.95	1.2	0.25	0.35	0.48	0.56
C	2.7	1.5	0.90	0.95	1.3	0.25	0.35	0.60	0.68
D	0.4	0.2	0.90	0.95	0.2	0.25	0.35	0.62	0.70
E	0.7	0.1	0.90	0.95	0.6	0.25	0.35	0.35	0.44
F	2.2	1.2	0.90	0.95	1.0	0.25	0.35	0.60	0.68
G	1.6	1.2	0.90	0.95	0.4	0.25	0.35	0.72	0.78
H	4.6	1.6	0.90	0.95	3.1	0.25	0.35	0.47	0.55
I	0.2	0.0	0.90	0.95	0.2	0.25	0.35	0.25	0.35
J	6.2	0.1	0.90	0.95	6.1	0.25	0.35	0.26	0.36
K	3.3	1.2	0.90	0.95	2.1	0.25	0.35	0.49	0.57
L	0.2	0.2	0.90	0.95	0.0	0.25	0.35	0.90	0.95
M	0.3	0.0	0.90	0.95	0.3	0.25	0.35	0.25	0.35

DRAINAGE MAPS

PROPOSED OFF-SITE DRAINAGE MAP

PROPOSED ON-SITE DRAINAGE MAP

EXISTING DRAINAGE MAP



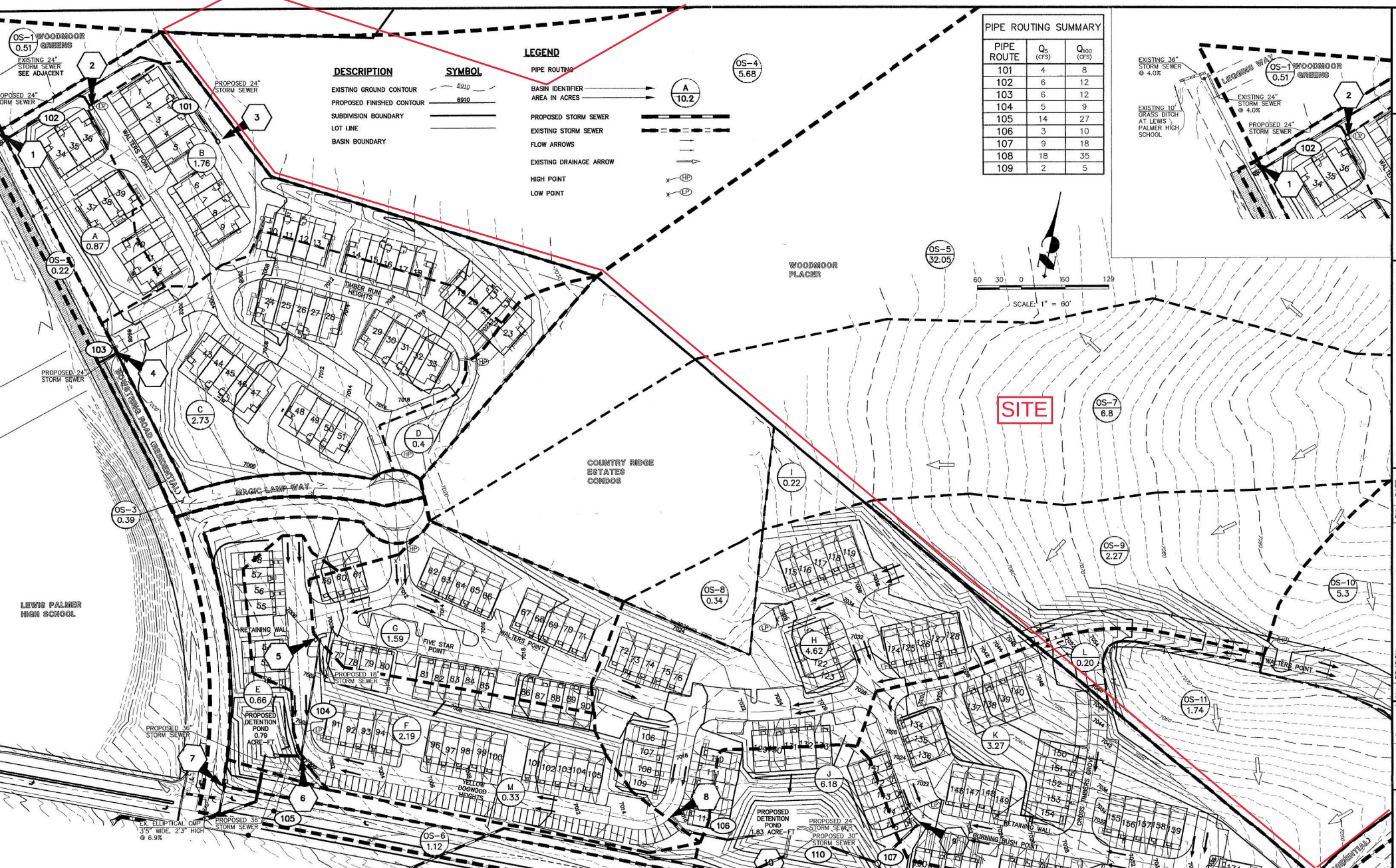
NOTES:
THIS MAP IS TO BE USED FOR DRAINAGE PURPOSES ONLY.
SEE GRADING PLAN FOR APPROPRIATE GRADING INFORMATION.

PREPARED FOR

No.	REVISION	BY	DATE

H-SCALE 1" = 200'

WALTERS COMMONS



LEGEND

DESCRIPTION	SYMBOL
EXISTING GROUND CONTOUR	6910
PROPOSED FINISHED CONTOUR	6910
SUBDIVISION BOUNDARY	
LOT LINE	
BASIN BOUNDARY	

PIPE ROUTING

BASIN IDENTIFIER → A
AREA IN ACRES → 10.2

PROPOSED STORM SEWER

EXISTING STORM SEWER

FLOW ARROWS

EXISTING DRAINAGE ARROW

HIGH POINT (HP)

LOW POINT (LP)

PIPE ROUTING SUMMARY

PIPE ROUTE	Q_5 (CFS)	Q_{100} (CFS)
101	4	8
102	6	12
103	6	12
104	5	9
105	14	27
106	3	10
107	9	18
108	18	35
109	2	5

DESIGN POINT FLOW (CFS)

1	Q_5 = 12 CFS, Q_{100} = 26 CFS	5	Q_5 = 7 CFS, Q_{100} = 16 CFS	9	Q_5 = 9 CFS, Q_{100} = 19 CFS
2	Q_5 = 3 CFS, Q_{100} = 6 CFS	6	Q_5 = 15 CFS, Q_{100} = 30 CFS	10	Q_5 = 37 CFS, Q_{100} = 77 CFS
3	Q_5 = 3 CFS, Q_{100} = 9 CFS	7	Q_5 = 37 CFS, Q_{100} = 85 CFS	11	Q_5 = 18 CFS, Q_{100} = 35 CFS
4	Q_5 = 6 CFS, Q_{100} = 12 CFS	8	Q_5 = 8 CFS, Q_{100} = 18 CFS	12	Q_5 = 2 CFS, Q_{100} = 5 CFS

BASIN SUMMARY:

BASIN	Q(5)-CFS	Q(100)-CFS	BASIN	Q(5)-CFS	Q(100)-CFS
A	1	3	OS-1	1	1
B	3	6	OS-2	1	2
C	5	10	OS-3	1	2
D	1	2	OS-4	3	9
E	1	1	OS-5	19	47
F	4	8	OS-6	3	7
G	5	10	OS-7	4	10
H	10	20	OS-8	0.5	1
I	0.5	1	OS-9	2	4
J	8	20	OS-10	2	5
K	8	17	OS-11	3	8
L	1	2	OS-12	2	6
M	0.2	1			

NOTES:

1. THIS MAP IS TO BE USED FOR DRAINAGE PURPOSES ONLY. SEE GRADING PLAN FOR APPROPRIATE GRADING INFORMATION.
2. ALL PROPOSED IMPROVEMENTS SHOWN HERON(PRIVATE DRIVES, STORM SEWER, WATERLINES/HYDRANTS, BUILDINGS, PARKING, ETC.) ARE FOR GENERAL PURPOSES ONLY. THE FINAL DESIGN SHALL BE APPROVED WITH THE FINAL PLAT AND/OR PLOT PLAN.

PREPARED FOR

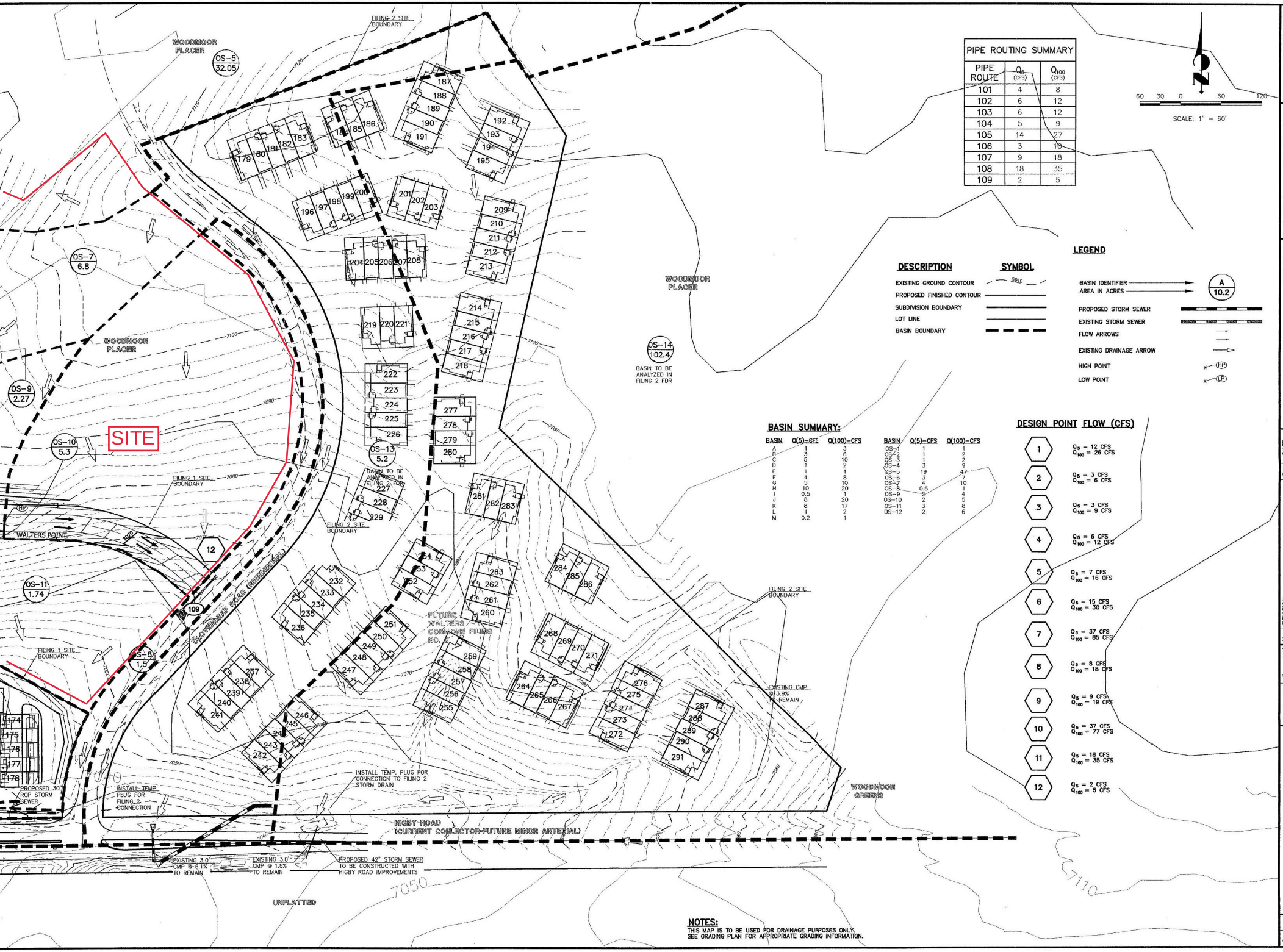
No.	REVISION	BY	DATE

H-SCALE 1" = 60'

WALTERS COMMONS

SHEET

JOB



PIPE ROUTING SUMMARY		
PIPE ROUTE	Q_5 (CFS)	Q_{100} (CFS)
101	4	8
102	6	12
103	6	12
104	5	9
105	14	27
106	3	10
107	9	18
108	18	35
109	2	5

N

60 30 0 60 120

SCALE: 1" = 60'

LEGEND

DESCRIPTION	SYMBOL
EXISTING GROUND CONTOUR	6810
PROPOSED FINISHED CONTOUR	
SUBDIVISION BOUNDARY	
LOT LINE	
BASIN BOUNDARY	

BASIN IDENTIFIER → A
AREA IN ACRES → 10.2

PROPOSED STORM SEWER
EXISTING STORM SEWER
FLOW ARROWS
EXISTING DRAINAGE ARROW
HIGH POINT (HP)
LOW POINT (LP)

BASIN SUMMARY:

BASIN	Q(5)-CFS	Q(100)-CFS	BASIN	Q(5)-CFS	Q(100)-CFS
A	1	3	OS-1	1	1
B	3	6	OS-2	1	2
C	5	10	OS-3	1	2
D	1	2	OS-4	3	9
E	1	1	OS-5	19	47
F	4	8	OS-6	3	7
G	5	10	OS-7	4	10
H	10	20	OS-8	0.5	1
I	0.5	1	OS-9	2	4
J	8	20	OS-10	2	5
K	8	17	OS-11	3	8
L	1	2	OS-12	2	6
M	0.2	1			

DESIGN POINT FLOW (CFS)

1	Q_5 = 12 CFS, Q_{100} = 26 CFS
2	Q_5 = 3 CFS, Q_{100} = 6 CFS
3	Q_5 = 3 CFS, Q_{100} = 9 CFS
4	Q_5 = 6 CFS, Q_{100} = 12 CFS
5	Q_5 = 7 CFS, Q_{100} = 16 CFS
6	Q_5 = 15 CFS, Q_{100} = 30 CFS
7	Q_5 = 37 CFS, Q_{100} = 85 CFS
8	Q_5 = 8 CFS, Q_{100} = 18 CFS
9	Q_5 = 9 CFS, Q_{100} = 19 CFS
10	Q_5 = 37 CFS, Q_{100} = 77 CFS
11	Q_5 = 18 CFS, Q_{100} = 35 CFS
12	Q_5 = 2 CFS, Q_{100} = 5 CFS

NOTES:
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H-SCALE 1" = 60'

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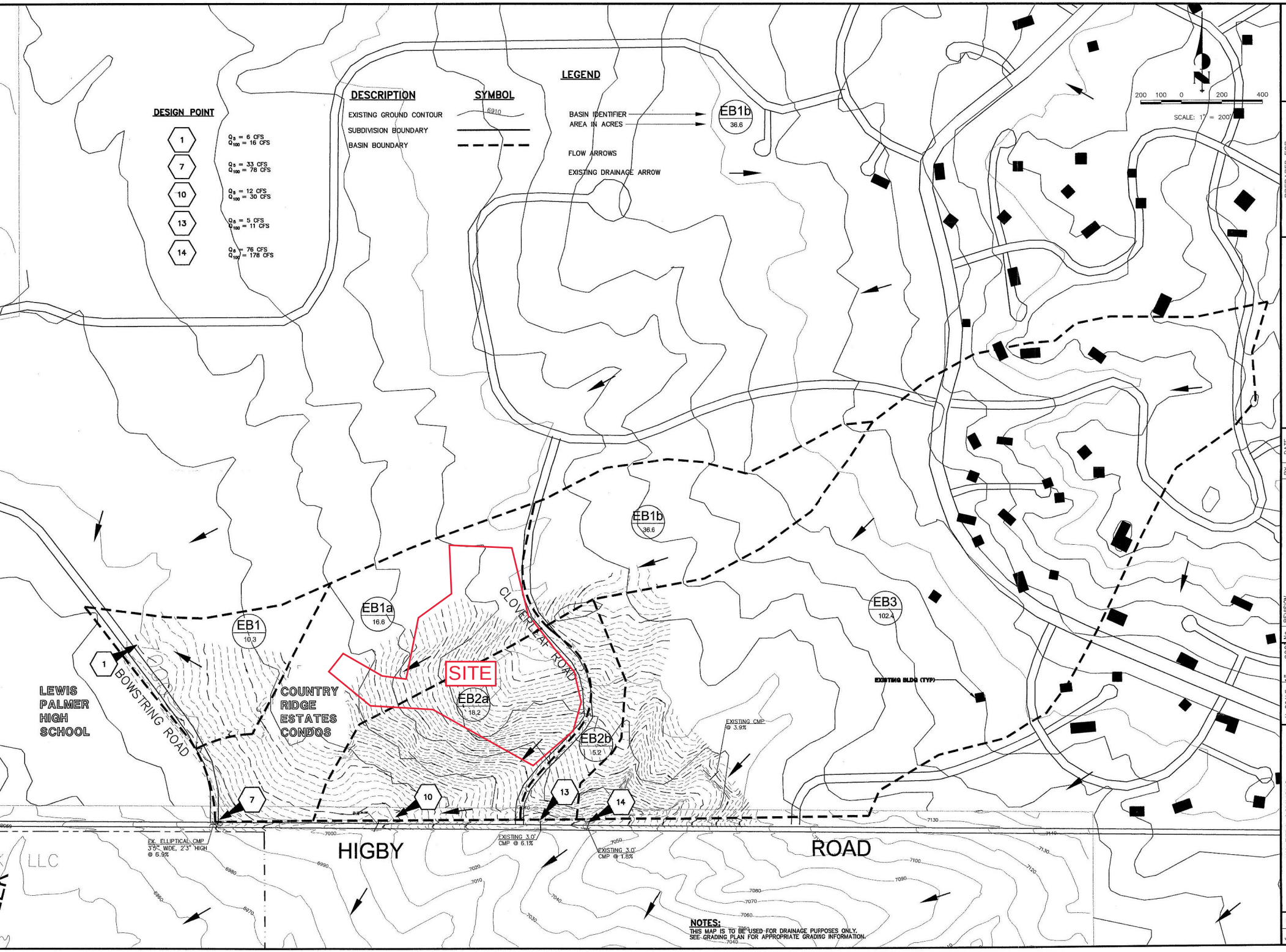
DESIGN POINT
1
7
10
13
14
Q_5 = 6 CFS
Q_{100} = 16 CFS
Q_5 = 33 CFS
Q_{100} = 78 CFS
Q_5 = 12 CFS
Q_{100} = 30 CFS
Q_5 = 5 CFS
Q_{100} = 11 CFS
Q_5 = 76 CFS
Q_{100} = 178 CFS
DESCRIPTION
SYMBOL
EXISTING GROUND CONTOUR
6910
SUBDIVISION BOUNDARY
BASIN BOUNDARY
LEGEND
BASIN IDENTIFIER
AREA IN ACRES
EB1b
36.6
FLOW ARROWS
EXISTING DRAINAGE ARROW
N
200 100 0 200 400
SCALE: 1" = 200'
EB1b
36.6
EB1a
16.6
EB1
10.3
EB2a
18.2
EB2b
15.2
EB3
102.4
SITE
CLOVERLEAF ROAD
BOWSTRING ROAD
LEWIS PALMER HIGH SCHOOL
COUNTRY RIDGE ESTATES CONDOS
EXISTING BLDG (TYP)
EXISTING CMP @ 3.9%
EX. ELLIPTICAL CMP 3'5" WIDE, 2'3" HIGH @ 6.9%
EXISTING 3.0' CMP @ 6.1%
EXISTING 3.0' CMP @ 1.8%
HIGBY
ROAD
LLC
NOTES:
THIS MAP IS TO BE USED FOR DRAINAGE PURPOSES ONLY.
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BY
DATE
No.
REVISION
H-SCALE 1" = 200'
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J·R ENGINEERING
A Westrian Company

ADDENDUM TO
FINAL DRAINAGE REPORT
FOR
WALTERS COMMONS

November 2006

Prepared For:

PULTE HOME CORPORATION
1975 Research Parkway
Colorado Springs, CO 80920
(719) 536-4200

Prepared By:

JR ENGINEERING
4310 ArrowsWest Drive
Colorado Springs, CO 80907
(719) 593-2593

Job No. 9170.72

ADDENDUM TO
FINAL DRAINAGE REPORT
FOR
WALTERS COMMONS

J·R ENGINEERING
A Westrian Company

DRAINAGE REPORT STATEMENT

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 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.

COLORADO REGISTERED PROFESSIONAL ENGINEER MIKE A. BRAMLETT

11/20/06

Mike A. Bramlett, Colorado P.E. #32314 — Date
For and On Behalf of JR Engineering

DEVELOPER'S STATEMENT:
I, the developer, have read and will comply with all of the requirements specified in this drainage report and plan.

Business Name: Pulte Homes

By:

Title: Vice President of Land

Address: 1975 Research Parkway

Colorado Springs, CO 80920

EL PASO COUNTY ONLY:
Filed in accordance with Section 51.1 of the El Paso Land Development Code, as amended.

for

11-22-06

John McCarty, P.E. — Date
County Engineer/Director

Conditions:

4310 ArrowsWest Drive, Colorado Springs, CO 80907
719-593-2593 • Fax: 719-528-6613 • www.jrengineering.com

ADDENDUM TO FINAL DRAINAGE REPORT FOR WALTERS COMMONS

PURPOSE

The purpose of this addendum is to identify changes to the approved final drainage report, as a result of construction procedures and current drainage conditions at the intersection of Cloverleaf Rd. and Higby Rd. The previously approved drainage patterns for drainage basin A-1, referred to as OS-10 and OS-8 in the approved Final Drainage Report for Walters Commons, have been revised from the original design. See attached Proposed On-Site Drainage Area Map for more information. It is the intent of this report to calculate the revised storm water runoff quantities as a result of revisions to the Walters Commons development. In addition, recommend proposed drainage facilities and calculate impacts to current storm sewer routing.

GENERAL DESCRIPTION

The general description for this project has remained the same, except that the project is now platted as Walter Commons Filing 1. For more information, see the approved Final Drainage Report for Walters Commons Filing 1.

PROPOSED DRAINAGE ADDENDUM

In the previously approved drainage report for Walters Commons Filing 1, runoff from Basin A-1 (see Proposed On-Site Drainage Map) was captured by a drainage ditch along the west side of Cloverleaf Rd. The runoff was then conveyed south paralleling the road to the intersection of Cloverleaf Rd. and Higby Rd. At this point the runoff was routed west in a drainage ditch along the north side of Higby Rd to DP-10 of the previously approved drainage report for Walters Commons Filing 1. The drainage ditch along the north side of Higby Rd. was never constructed. In it's place, a curb line was constructed and the ditch was removed to prevent relocating utilities in this area. As a result, the runoff from basin A-1 currently discharges into Higby Rd. at the intersection of Cloverleaf Rd. and Higby Rd., resulting in concentrated storm water entering Higby Rd.

This Addendum proposes that a Type-C CDOT inlet be constructed at the northwest corner of the intersection of Cloverleaf Road and Higby Road to collect the additional storm water from basin A-1 (Q_5 = 4 cfs and Q_{100} = 10 cfs). The runoff collected by the inlet will be routed south via 15' of 18" RCP to the existing 30" RCP, (Design point 11) installed with the original design. From this point the runoff is routed to the proposed 1.83 acre-ft detention pond.

The pond's current design does not accommodate basin A-1, but the effects of the increased runoff (Q_5 = 4 cfs and Q_{100} = 10 cfs) will be negligible to the function of the pond. The pond will function as previously approved except in the most extreme 100-yr event. During this storm event, the pond will over top the spillway (Q_{100} = 7cfs) and be collected by the existing 24" storm sewer pipe located at DP-10. Since DP-10 was the original collection point of basin A-1, we feel that the impacts are minimal to this system. In addition, the existing 24" storm sewer pipe has a capacity of 17.8 cfs, which is more than adequate to convey the additional runoff that will overtop the spillway. See Appendix for backup calculations.

ADDENDUM IMPACTS TO FACILITIES

Design Point 10

Design Point 10 is in the same location as in the previously approved drainage report for Walters Commons Filing 1. Only minimal flows that overtop the existing detention pond weir (Q_{100} = 7cfs) will be captured by the existing 24"storm sewer and conveyed under Higby Rd. The existing storm sewer pipe has a full flow capacity of 17.8cfs, which is more than adequate to convey the discharge. See Appendix for backup calculations.

Design Point 11

Design Point 11 is in the same location as in the previously approved drainage report for Walters Commons Filing 1, but now incorporates the additional flow captured at DP-13 as well as the existing flows at DP 14. Anticipated flows at this location will be Q_5 = 32 cfs and Q_{100} = 66 cfs.

Design Point 13

Design Point 13 is located at the northwest corner of the intersection of Cloverleaf Road and Higby

Road. A proposed Type-C CDOT inlet will be installed at this location to capture the existing flows from drainage basin A-1. The flows will be approximately $Q_5 = 4$ cfs and $Q_{100} = 10$ cfs.

Design Point 14

Design Point 14 is the same design point as design point 6 in the previously approved drainage report for Walters Commons Filing 2. The flows at this design point will be generated by the Walters Commons Filing 2 project. Flows in this existing pipe are $Q_5 = 28$ cfs and $Q_{100} = 56$ cfs.

STORM SEWER ROUTING AND PROPOSED DRAINAGE STRUCTURES

Pipe Design Point 108

Incorporates the developed flows from Walters Commons Filing 2 (DP-14) and the rerouted flows from drainage basin A-1 (DP-13). The runoff will travel to the existing 1.83 arce-ft detention pond in Filing 1 via an existing 30" RCP storm sewer. The existing facility will now convey $Q_5 = 32$ cfs and $Q_{100} = 66$ cfs. The existing pipe has adequate capacity (Full flow capacity = 66 CFS) to convey this additional runoff. See Proposed Facility Hydraulic Calculations for more information.

Pipe Design Point 200

This design point incorporates the flows at DP-13 from drainage basin A-1. The flows will be conveyed via an 18" RCP storm sewer (Full flow capacity = 70 CFS) from the proposed Type-C CDOT inlet to the existing 30" RCP storm sewer. This proposed facility will carry $Q_5 = 4$ cfs and $Q_{100} = 10$ cfs. See Proposed Facility Hydraulic Calculations for more information.

Pipe Design Point 201

This design point incorporates the flows that overtop the existing detention pond's weir in the most extreme event. Per the revised pond calculations located in the Appendix, 7cfs will overtop the spillway for roughly 35 minutes. The runoff will be conveyed under Higby Rd. by an existing 24" storm sewer (Full Flow Capacity = 17.8cfs). See Proposed Facility Hydraulic Calculations and Proposed Detention Pond Calculations for more information.

All other conditions will remain consistent with the previously approved Final Drain Report for Walters Commons.

SUMMARY

We conclude that the installation of a Type-C CDOT inlet at the intersection of Cloverleaf Rd. and Higby Rd. will be adequate to collect and convey the existing runoff from drainage basin A-1. This conclusion is based on the fact that the existing storm sewer has adequate capacity for the increased flow. In addition, the existing detention pond will face minimal impacts, except in the most extreme event, due to the increased runoff. In the event of a 100-yr storm, the pond will overtop via the emergency spillway and be conveyed under Higby Rd. through the existing 24" CMP storm sewer. Finally, the proposed improvement will eliminate the concentrated runoff that is currently entering into Higby Rd.

PREPARED BY:

JR Engineering

Kevan P. Kuhnel, E.I.
Engineer II

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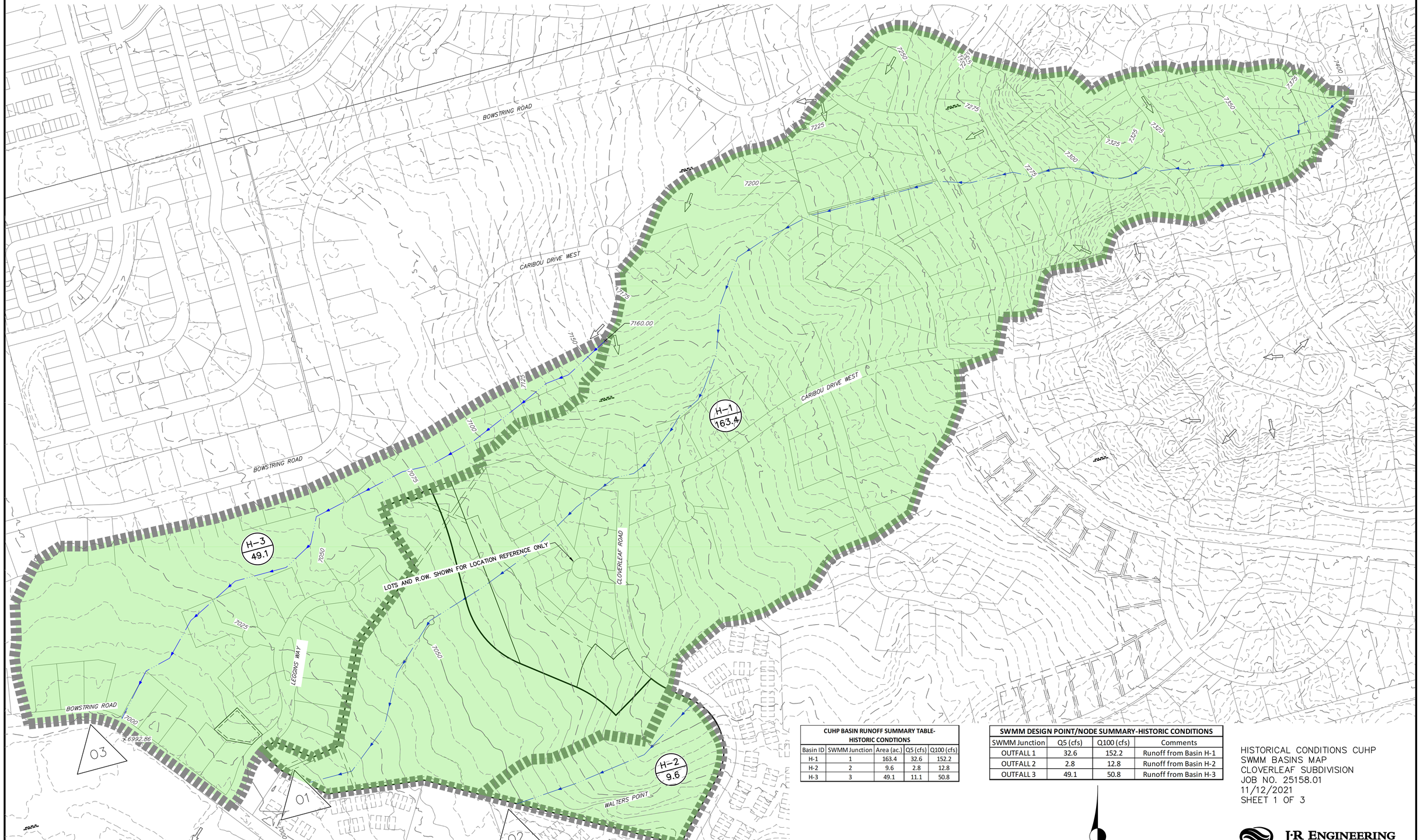
Appendix F
Drainage Maps

CLOVERLEAF SUBDIVISION

HISTORICAL CONDITIONS CUHP SWMM BASINS MAP



CUHP BASIN RUNOFF SUMMARY TABLE-HISTORIC CONDTIONS				
Basin ID	SWMM Junction	Area (ac.)	Q5 (cfs)	Q100 (cfs)
H-1	1	163.4	32.6	152.2
H-2	2	9.6	2.8	12.8
H-3	3	49.1	11.1	50.8

SWMM DESIGN POINT/NODE SUMMARY-HISTORIC CONDITIONS			
SWMM Junction	Q5 (cfs)	Q100 (cfs)	Comments
OUTFALL 1	32.6	152.2	Runoff from Basin H-1
OUTFALL 2	2.8	12.8	Runoff from Basin H-2
OUTFALL 3	49.1	50.8	Runoff from Basin H-3

200 100 0 200 400

ORIGINAL SCALE: 1" = 200'

HISTORICAL CONDITIONS CUHP
SWMM BASINS MAP
CLOVERLEAF SUBDIVISION
JOB NO. 25158.01
11/12/2021
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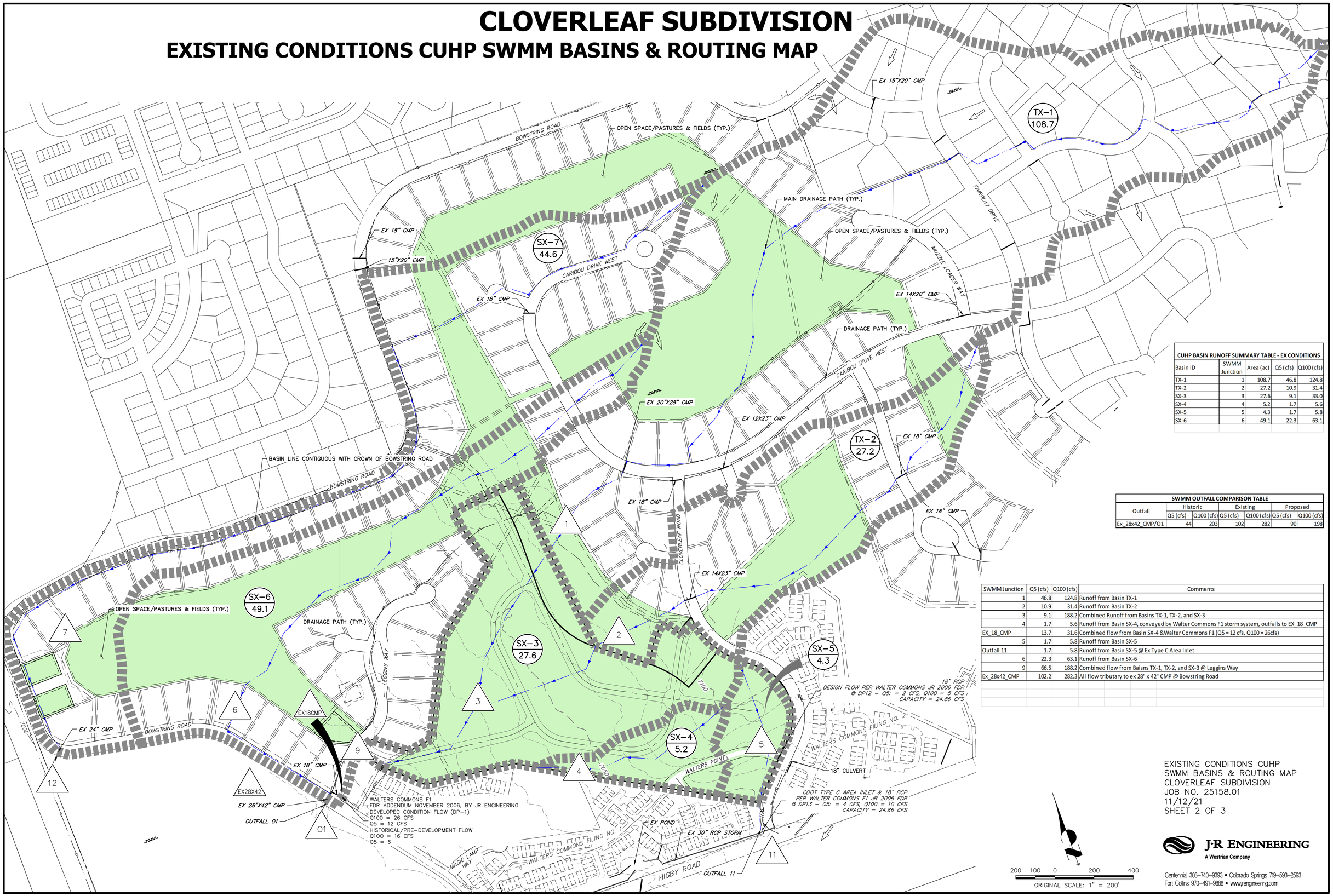
CLOVERLEAF SUBDIVISION

EXISTING CONDITIONS CUHP SWMM BASINS & ROUTING MAP



CUHP BASIN RUNOFF SUMMARY TABLE - EX CONDITIONS				
Basin ID	SWMM Junction	Area (ac)	Q5 (cfs)	Q100 (cfs)
TX-1	1	108.7	46.8	124.8
TX-2	2	27.2	10.9	31.4
SX-3	3	27.6	9.1	33.0
SX-4	4	5.2	1.7	5.6
SX-5	5	4.3	1.7	5.8
SX-6	6	49.1	22.3	63.1

SWMM OUTFALL COMPARISON TABLE						
Outfall	Historic		Existing		Proposed	
	Q5 (cfs)	Q100 (cfs)	Q5 (cfs)	Q100 (cfs)	Q5 (cfs)	Q100 (cfs)
Ex_28x42_CMP/O1	44	203	102	282	90	198

SWMM Junction	Q5 (cfs)	Q100 (cfs)	Comments
1	46.8	124.8	Runoff from Basin TX-1
2	10.9	31.4	Runoff from Basin TX-2
3	9.1	188.2	Combined Runoff from Basins TX-1, TX-2, and SX-3
4	1.7	5.6	Runoff from Basin SX-4, conveyed by Walter Commons F1 storm system, outfalls to EX_18_CMP
EX_18_CMP	13.7	31.6	Combined flow from Basin SX-4 &Walter Commons F1 (Q5 = 12 cfs, Q100 = 26cfs)
5	1.7	5.8	Runoff from Basin SX-5
Outfall 11	1.7	5.8	Runoff from Basin SX-5 @ Ex Type C Area Inlet
6	22.3	63.1	Runoff from Basin SX-6
9	66.5	188.2	Combined flow from Baisns TX-1, TX-2, and SX-3 @ Leggins Way
Ex_28x42_CMP	102.2	282.3	All flow tributary to ex 28" x 42" CMP @ Bowstring Road

EXISTING CONDITIONS CUHP
SWMM BASINS & ROUTING MAP
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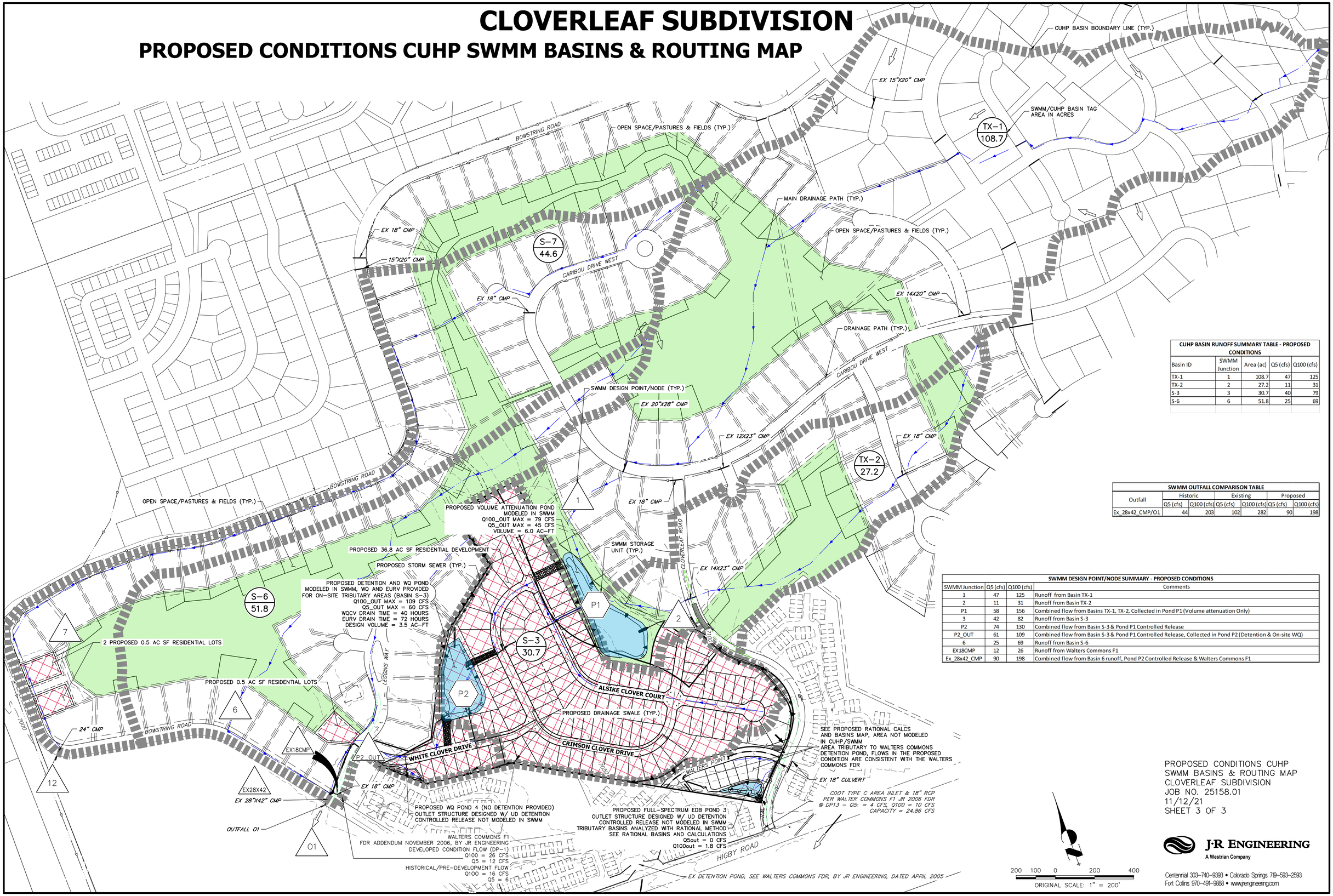
CLOVERLEAF SUBDIVISION

PROPOSED CONDITIONS CUHP SWMM BASINS & ROUTING MAP



CUHP BASIN RUNOFF SUMMARY TABLE - PROPOSED CONDITIONS

Basin ID	SWMM Junction	Area (ac)	Q5 (cfs)	Q100 (cfs)
TX-1	1	108.7	47	125
TX-2	2	27.2	11	31
S-3	3	30.7	40	79
S-6	6	51.8	25	69

SWMM OUTFALL COMPARISON TABLE

Outfall	Historic		Existing		Proposed	
	Q5 (cfs)	Q100 (cfs)	Q5 (cfs)	Q100 (cfs)	Q5 (cfs)	Q100 (cfs)
Ex_28x42_CMP/O1	44	203	102	282	90	198

SWMM DESIGN POINT/NODE SUMMARY - PROPOSED CONDITIONS

SWMM Junction	Q5 (cfs)	Q100 (cfs)	Comments
1	47	125	Runoff from Basin TX-1
2	11	31	Runoff from Basin TX-2
P1	58	156	Combined flow from Basins TX-1, TX-2, Collected in Pond P1 (Volume attenuation Only)
3	42	82	Runoff from Basin S-3
P2	74	130	Combined flow from Basin S-3 & Pond P1 Controlled Release
P2_OUT	61	109	Combined flow from Basin S-3 & Pond P1 Controlled Release, Collected in Pond P2 (Detention & On-site WQ)
6	25	69	Runoff from Basin S-6
EX18CMP	12	26	Runoff from Walters Commons F1
Ex_28x42_CMP	90	198	Combined flow from Basin 6 runoff, Pond P2 Controlled Release & Walters Commons F1

PROPOSED CONDITIONS CUHP
SWMM BASINS & ROUTING MAP
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CLOVERLEAF
DRAINAGE MAPS

DESIGN POINT SUMMARY TABLE

DP	Q5	Q100
1	7.8	17.3
2	4.2	10.1
3	4.4	9.4
4	5.9	13.0
4.1	13.0	24.6
4.2	16.7	33.6
4.3	20.1	40.4
5	1.0	2.0
5.1	20.7	41.7
6	3.4	6.9
TB	45.2	78.5
7	2.4	5.1
7A	3.5	7.3
8	6.6	16.0
8.1	8.2	18.3
8.2	11.6	24.2
8.3	49.0	82.7
9	5.6	12.4
9.1	50.0	84.1
10	3.6	8.9
10.1	50.8	85.2
10.2	58.2	94.6
11	5.3	15.5
12	2.7	6.9
13	1.4	2.9
14	1.4	2.8
14.1	2.7	4.0
15	1.5	3.8
15.1	4.0	6.7
15.2	59.7	110.5
16	0.8	1.9
18	0.6	1.6
19	1.8	4.3
L1	5.1	15.1
L1.0	5.8	17.1
L1.1	61.2	116.6
P2	59.6	109.1

BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
A	4.39	61%	0.47	0.62	12.4	7.8	17.3
B	3.11	52%	0.38	0.54	14.7	4.2	10.1
C	1.77	71%	0.54	0.67	8.5	4.2	8.7
D	3.38	63%	0.47	0.61	13.0	5.9	13.0
E	0.30	80%	0.65	0.76	5.0	1.0	2.0
F	1.40	71%	0.54	0.67	8.2	3.4	6.9
G	0.90	71%	0.57	0.70	6.5	2.4	5.1
H	4.18	57%	0.43	0.59	13.6	6.6	15.2
I	2.76	67%	0.49	0.62	9.7	5.6	12.0
IA	1.71	71%	0.54	0.67	12.3	3.5	7.3
J	1.39	71%	0.54	0.67	7.4	3.5	7.2
K	5.29	36%	0.28	0.49	14.6	5.3	15.5
L	1.97	42%	0.34	0.53	11.1	2.7	6.9
M	0.54	70%	0.53	0.66	5.7	1.4	2.9
N	0.53	72%	0.56	0.69	6.9	1.4	2.8
O	0.98	47%	0.35	0.53	8.8	1.5	3.8
OS-1	0.41	38%	0.43	0.58	6.9	0.8	1.9
OS-2	0.79	28%	0.30	0.52	5.0	1.2	3.6
OS-3	0.31	37%	0.37	0.57	5.0	0.6	1.6
OS-4	1.00	28%	0.38	0.56	7.2	1.8	4.3
OS-5	6.12	20%	0.28	0.49	21.4	5.1	15.1

LAYER LINETYPE LEGEND

EXISTING / PROPOSED

BOUNDARY LINE
PROPERTY LINE
EASEMENT LINE
RIGHT OF WAY
CENTERLINE
STORM SEWER
SWALE/WATERWAY FLOWLINE
INDEX CONTOUR (6100)
INTERMEDIATE CONTOUR
CURB & GUTTER

SUB-BASIN DRAINAGE AREA
BASIN TAG — BASIN ID: A; AREA [AC]: 4.1; C_5: 0.47; C_{100}: 0.62

DESIGN POINT DESIGNATION

FLOW DIRECTION (PROPOSED)
FLOW DIRECTION (EXISTING)

60 30 0 60 120
ORIGINAL SCALE: 1" = 60'

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JOB NO. 25158.01
11/12/21
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CLOVERLEAF
DRAINAGE MAPS

LAYER LINETYPE LEGEND

	EXISTING	PROPOSED
BOUNDARY LINE		
PROPERTY LINE		
EASEMENT LINE		
RIGHT OF WAY		
CENTERLINE		
STORM SEWER		
SWALE/WATERWAY FLOWLINE		
INDEX CONTOUR	6100	6100
INTERMEDIATE CONTOUR		
CURB & GUTTER		

SUB-BASIN DRAINAGE AREA

BASIN TAG — BASIN ID: A; AREA [AC]: 4.1; C_5: 0.47; C_{100}: 0.62

DESIGN POINT DESIGNATION: 1

FLOW DIRECTION (PROPOSED)

FLOW DIRECTION (EXISTING)

CLOVERLEAF FILING NO. 2
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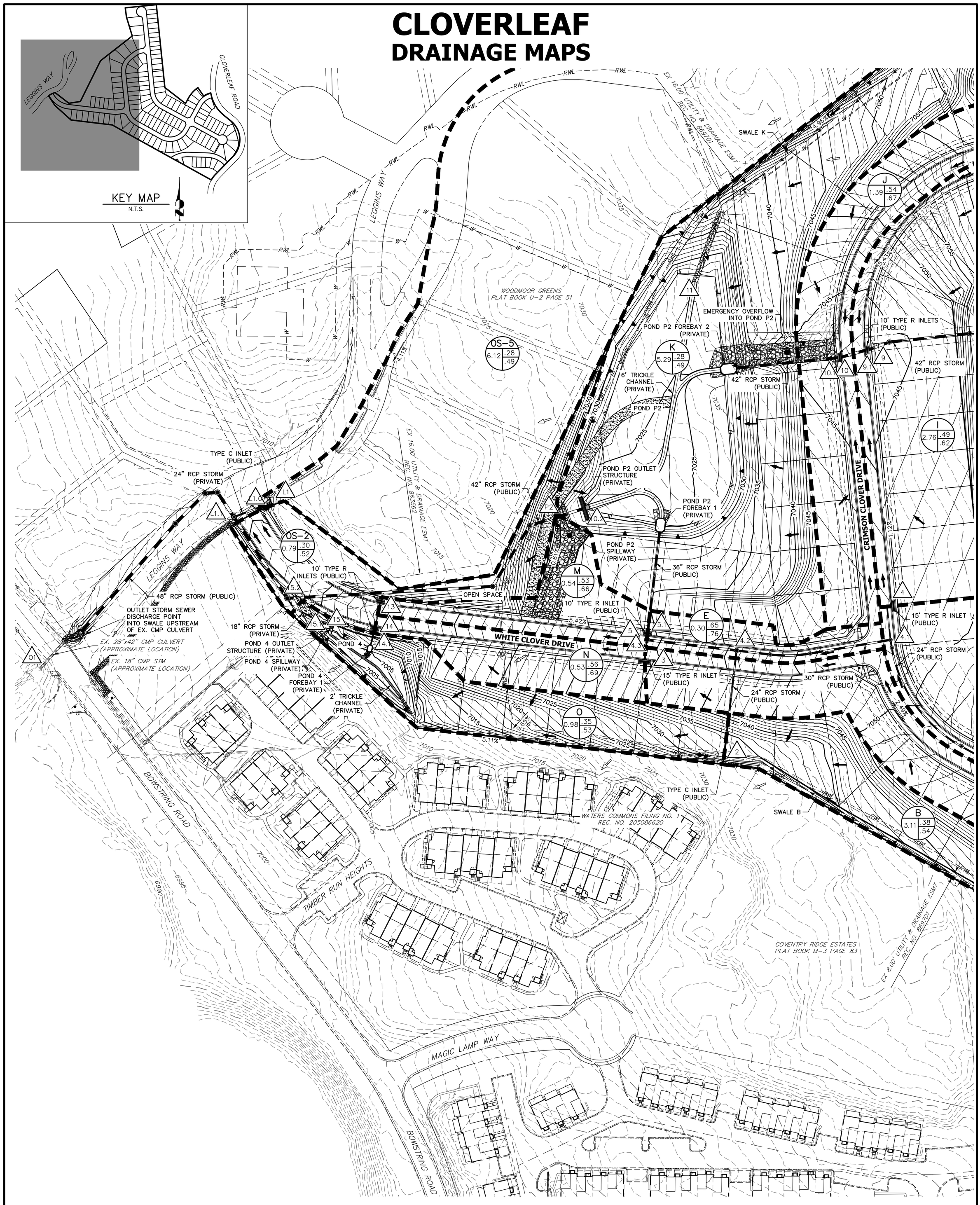
CLOVERLEAF
DRAINAGE MAPS



LAYER LINETYPE LEGEND

	EXISTING	PROPOSED
BOUNDARY LINE		
PROPERTY LINE		
EASEMENT LINE		
RIGHT OF WAY		
CENTERLINE		
STORM SEWER		
SWALE/WATERWAY FLOWLINE		
INDEX CONTOUR	6100	6100
INTERMEDIATE CONTOUR		
CURB & GUTTER		

SUB-BASIN DRAINAGE AREA

BASIN TAG — BASIN ID: A; AREA [AC]: 4.1; C_5: 0.47; C_{100}: 0.62

DESIGN POINT DESIGNATION: 1

FLOW DIRECTION (PROPOSED)

FLOW DIRECTION (EXISTING)

N

60 30 0 60 120

ORIGINAL SCALE: 1" = 60'

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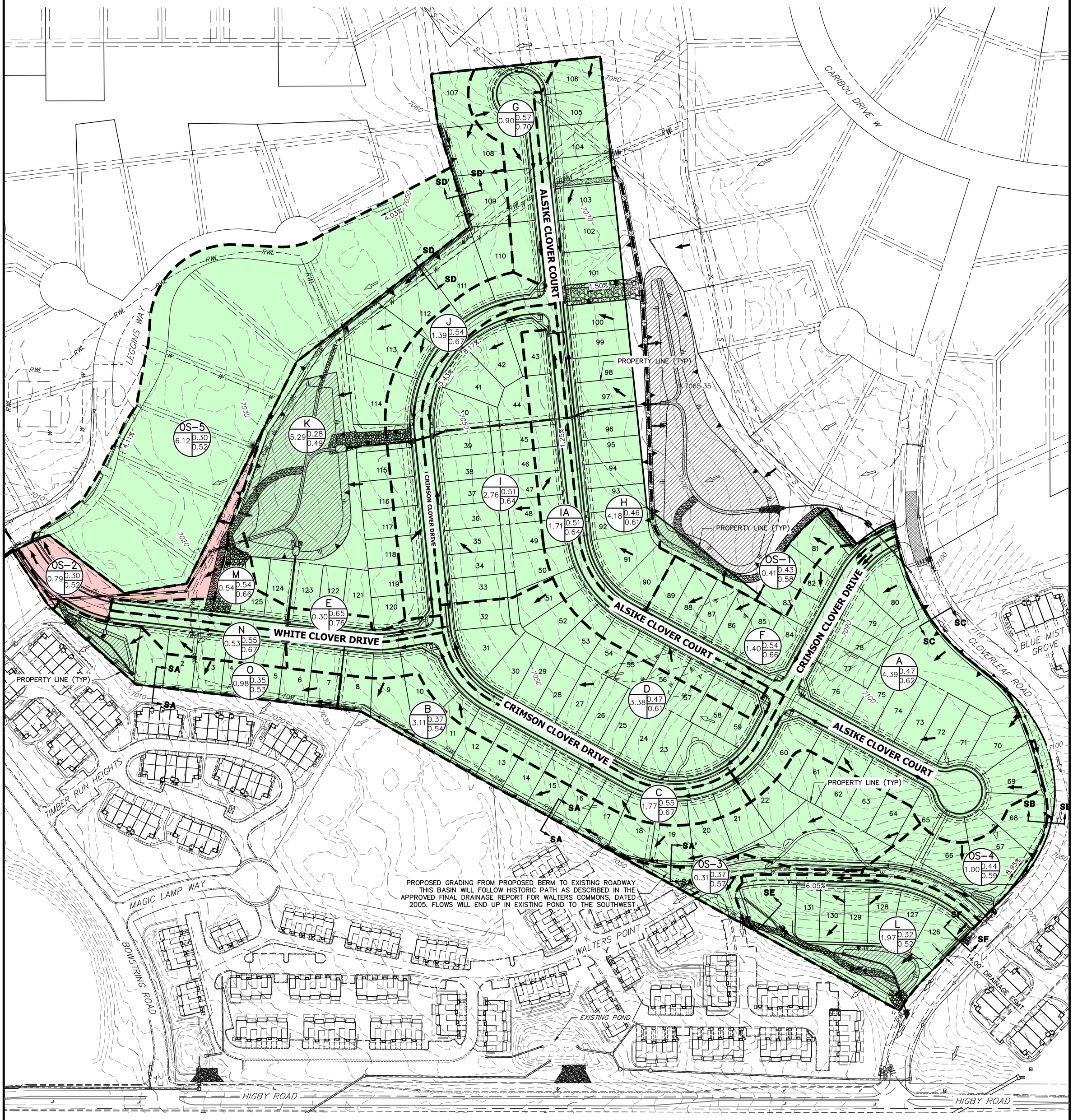
PERMANENT BMP APPLICABILITY MAP



LEGEND

I.D. / A / B / C	BASIN DESIGNATION I.D.: BASIN IDENTIFIER A: BASIN AREA B: C_5 C: C_{100}
	BASIN DELINEATION
6100	EXISTING INDEX CONTOURS
	EXISTING INTERMEDIATE CONTOURS
6100	PROPOSED INDEX CONTOURS
	PROPOSED INTERMEDIATE CONTOURS
	EXISTING FLOW DIRECTION
	PROPOSED FLOW DIRECTION
	AREA DETAINED IN PBMP
	AREA NOT DETAINED IN PBMP (20%, UP TO 1 AC, OF DEVELOPMENT SITE CAN BE EXCLUDED – DUE TO TOPOGRAPHY)
	TOP OF DETENTION POND

N

100 50 0 100

ORIGINAL SCALE: 1" = 100'

CLOVERLEAF FILING NO. 2
MS4 PERMIT EXCLUSION AREAS
JOB NO. 25158.01
11/10/2021
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