EARLY OVERLOT GRADING DRAINAGE REPORT PUD/SP 255

ANTELOPE RIDGE AT BULL HILL PHASE 1

NOVEMBER, 2025
REV. FEB, 2026

Prepared for:

Eagle Development
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Project No. 100.302

CORE
ENGINEERING GROUP

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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.

Richard L. Schindler, P.E. #33997 Date
For and on Behalf of Core Engineering Group, LLC

OWNER'S STATEMENT

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

Eagle Development Date

By
Jeff Mark

Title
Manager

Address
212 N. Wahsatch Avenue, Suite 301, Colorado Springs, CO 80903

EL PASO COUNTY

Filed in accordance with the requirements of the El Paso County Land Development Code, Drainage Criteria Manual, Volume 1 and 2, and Engineering Criteria Manual, As Amended.

Joshua J. Palmer, P.E. Date
County Engineer/ECM Administrator

Conditions: _____

1.0 LOCATION and DESCRIPTION

Antelope Ridge at Bull Hill Phase 1 is located east of the East Tributary of Jimmy Camp Creek. The site is located on approximately 164.586 acres of vacant land. This project will overlot grade this site in preparation for a future single-family residential development with several tracts of land for future development purposes. This project also incorporates excess material generated by construction of the East Tributary of JCC (CDR234) which will be constructed before this project. The land for the project is currently owned by Eagle Development Company and Murray Fountain, LLC.

The site is located in Section 12, Township 15 South and Range 65 West of the 6th Principal Meridian. The site is bounded on the west by the East Tributary of JCC, on the north by Bradley Road, on the east by Meridian Road, and the south by vacant land in Bull Hill. For reference, a vicinity map is included in Appendix A of this report.

Conformance with applicable Drainage Basin Planning Studies

The site is located in the Jimmy Camp Creek Drainage Basin. El Paso County recently adopted a DBPS for Jimmy Camp Creek prepared by Stantec dated February 13, 2025 and is referenced in this report. The only major infrastructure construction recommended by the DBPS is the reconstruction of the East Tributary of Jimmy Camp Creek (Etrib) and a bridge crossing of Bradley Road. Matrix has been working on the Etrib construction plans (CDR234) for several years and has an approved CLOMR from FEMA for the creek construction. The creek construction plans also included abandoning twin 66-inch culverts under Bradley Road that currently drain onto this site. The creek construction, new bridge crossing, and the culvert abandonment will be done prior to and/or in conjunction with the early grading of this project to incorporate the large volume of excess material generated from the creek construction into the early grading. Etrib construction within this site is in conformance with the adopted DBPS.

Antelope Ridge at Bull Hill Phase 1 is located within the ***"Jimmy Camp Creek Drainage Basin"***, which is a fee basin in El Paso County. The basin within Bull Hill was recently closed per project DR221 and the basin closure was adopted by the Drainage Board on March 11, 2025. Thus, no drainage fees apply to this project.

Conformance with Bull Hill / Rolling Meadows MDDP (SKP 233) by Core Engineering Group

Core Engineering Group has an approved MDDP for Bull Hill / Rolling Meadows, which covers this study area. This drainage report conforms to the MDDP for Bull Hill and is referenced in this report. The major infrastructure to be constructed within this site per the MDDP is on-site Detention / WQ Pond C.

2.0 DRAINAGE CRITERIA

The supporting drainage design and calculations were performed in accordance with the City of Colorado Springs and El Paso County "Drainage Criteria Manual (DCM)", dated November, 1991, the El Paso County "Engineering Criteria Manual", Chapter 6 and Section 3.2.1 Chapter 13 of the City of Colorado Springs Drainage Criteria Manual dated May 2014, and the UDFCD "Urban Storm Drainage Criteria Manual" Volumes 1, 2 and 3 for inlet sizing and full spectrum ponds. No deviations from these published criteria are requested for this site.

The Rational Method as outlined in Section 6.3.0 of the May 2014 "Drainage Criteria Manual" and in Section 3.2.8.F of the El Paso County "Engineering Criteria Manual" was used for basins less than 130 acres to determine the rainfall and runoff conditions for the proposed development of the site. The runoff rates for the 5-year initial storm and 100-year major design storm were calculated.

Current updates to the Drainage Criteria manual for El Paso County states the if detention is necessary, Full Spectrum Detention will be included in the design, based on this criteria, Full Spectrum Detention will be required for this development. Pond C will be constructed with this Early Grading project and will be used as a sediment basin.

3.0 EXISTING HYDROLOGICAL CONDITIONS

This site is currently undeveloped with native vegetation (grass with no shrubs) and moderate slopes in a westerly direction the East Tributary of Jimmy Camp Creek.

The Soil Conservation Service (SCS) classifies the soils within the Antelope Ridge at Bull Hill property as Sampson Loam and Tassel Fine Sandy Loam [2]. The loams are considered hydrologic soil group B soils with slow permeability and the Fine Sandy Loam has a moderate permeability. These soils have low to medium susceptible to erosion by wind and water and have low to moderate shrink-swell potential. (see table 3.1 below).

The Soil Conservation Service (SCS) classifies the soils within the study area per Table 3.1.

Table 3.1: SCS Soils Survey for Entire Study Area

Soil No.	Soil	Hydro. Group	Shrink/Swell Potential	Permeability	Surface Runoff Potential	Erosion Hazard
78	Sampson Loam (12.7%)	B	Moderate	Slow	Low	Slight
89	Tassel Fine Sandy Loam (20.9%)	D	Low	Moderately Rapid	Medium	Moderate to High

Excerpts from the SCS “Soil Survey of El Paso County Area, Colorado” are provided in ***Appendix A*** for further reference.

For preparing hydrologic calculations for this report, the soil of each basin are assumed to be wholly comprised of the majority soil hydrologic group.

An existing electrical easement, with existing transmission towers, is located on the east side of this site and will be set aside as open space in the future.

This site is located within the delineated 100-year floodplain of the East Tributary of Jimmy Camp Creek per the Federal Emergency Management Agency (FEMA) Flood Rate Insurance Map (FIRM) number 08041C0790G dated December 7, 2018.

Basin ET-28
This offsite-basin is located east of Meridian Road extended, approximately 1700’ south of Bradley Road. The existing electrical easement, within existing transmission towers is located on the west side. This basin contains 69.31 acres; runoff is directed westerly and southerly. The calculated historic flows are 21.2cfs and 125.7cfs for the 5-year and 100-year storm events respectively.

Basin ET-31
This offsite-basin is located east of Meridian Road extended, adjacent and south of Bradley Road, and contains 28.35 acres; runoff is directed westerly to existing basin EX-S4 and is routed to design point

S1. The calculated historic flows are 12.2cfs and 68.1cfs for the 5-year and 100-year storm events respectively.

Basin EX-S4
This basin is located in the east-central portion of the site, adjacent and south of Bradley Road and east of Meridian Road extended, contains 84.39 acres; runoff is routed westerly to design point S1 near Bradley Road. Existing condition flows from this basin are 19.4cfs and 116.6cfs for the 5-year and 100-year storm events respectively. These flows combined with the offsite basin ET-31 flows will be routed to design point S1.

Design Point S1
This existing flow design point is located south of Bradley Road and west of Meridian Road under the electric transmission lines and contains 112.74 acres. The flow is from Basin ET-31 and EX-S4 and is calculated using the Rational Method. The existing flows are 23.8cfs and 140.3cfs for the 5-year and 100-year storm events respectively.

Basin EX-S5
This basin is located in the east-center portion of the site, south of Bradley Road, contains 94.81 acres; runoff is routed westerly and southerly to design point S3 at the East Tributary of Jimmy Camp Creek. Existing condition flows from this basin are 18.0cfs and 112.5cfs for the 5-year and 100-year storm events respectively.

Design Point S3
This existing flow design point is located south of Bradley Road and west of Meridian Road and combines flow from Design Point S1 and Basin Ex-S5 and contains 207.55 acres. The flow is from Basin ET-31, EX-S4, EX-S5 and is calculated using the Rational Method. The existing flows are 39.0cfs and 235.5cfs for the 5-year and 100-year storm events respectively.

Basin EX-S6
This basin is located in the south-central portion of the site, located south of and adjacent to Bradley Road, contains 207.92 acres; runoff is routed southeasterly to the East Tributary of Jimmy Camp Creek. Existing condition flows from this basin flow directly to the East Tributary and are 21.7cfs and 153.6cfs for the 5-year and 100-year storm events respectively.

Design Point E1-T1-5
This existing flow design point is located on the north side of Bradley Road at existing twin 66" RCP culverts. The existing flows from the Stantec DBPS are 15cfs and 172cfs for the 5-year and 100-year storm events respectively. These culverts will be abandoned per the Matrix CLOMR and the flow will be routed west to the East Tributary on the north side of Bradley Road.

Design Point E2-2
This existing flow design point is located at the East Tributary of Jimmy Camp Creek crossing of Bradley Road consisting of twin 8'x12' box culverts. The existing flows from the Stantec DBPS are 33cfs and 568cfs for the 5-year and 100-year storm events respectively. These box culverts do not currently pass the 100year flow and the flow overtops Bradley Road and flow southerly. The two box culverts will be removed and replaced with a CONSPAN structure which increases capacity so the road is not overtopped per the Matrix CLOMR.

4.0 HYDROLOGICAL CONDITIONS AFTER EARLY OVERLOT GRADING

Hydrology for **Antelope Ridge at Bull Hill** drainage report was based on the City of Colorado Springs/El Paso County Drainage Criteria. The interim overlot grading developed conditions do not include construction of any impervious surfaces within the project site. The future developed conditions of the fully developed site can be found in the Preliminary Drainage report also prepared for this project.

Sub-basins that lie within this project were determined and the 5-year and 100-year peak discharges for the interim overlot grading developed conditions have been presented in this report.

Soil type B and D has been assumed for the developed hydrologic conditions which is conservative but will ensure structures are sized adequately. See Appendix A for SCS Soils Map.

The time of concentration for each basin and sub-basin was developed using an overland, ditch, and concentrated flow components. The maximum overland flow length for developed conditions was limited to 100 feet. Travel time velocities ranged from 2 to 6 feet per second. The travel time calculations are included in the back of this report.

Runoff coefficients were obtained from Table 6-6 dated May, 2014 from the updated City of Colorado Springs/El Paso County Drainage Criteria Manual for vacant land. See Appendix B.

Drainage concepts for each of the basins are briefly discussed as follows:

Basin C1.1
This basin consists of runoff from undeveloped land which will eventually be developed as a school site. Runoff will be directed south overland to Echoing Grass Way to Design Point 4 where it will be collected in the future by a flared end section and storm sewer. The undeveloped flow from this basin is 4.5cfs and 27.5cfs for the 5/100-year storm event. This low point can be drained via a swale flowing southwest if the project is abandoned by the developer. See Alternate Low Point Swale sheet in the early grading plans for location and swale layout. Future development of the school site will require an on-site WQ/Detention pond with discharge rates limited to the undeveloped runoff rates at Design Point 4. See the appendix for detailed calculations.

Basin C2.1
This basin consists of runoff from undeveloped land and open space under the electric transmission lines. Runoff will be directed west overland to Design Point 5 where it will be collected by a future CDOT Type D inlet in sump condition. This low point is less than 2' deep and can be drained via a shallow overland swale along the sideyard lot lines draining to Hoof Hallow Place if the project is abandoned by the developer. The undeveloped flow from this basin is 2.9cfs and 15.7cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin ET28a
This basin consists of runoff from undeveloped vacant land east of Meridian Road and 0.54acres of Meridian Road ROW which will not include pavement for this report. Runoff will be directed westerly overland and then southerly to Prairie Song Drive where it will be redirected westerly by a berm and continue flowing overland west in Prairie Song Drive to Design Point 6. The undeveloped flow from this basin is 0.9cfs and 5.3cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin ET31a
This basin consists of runoff from undeveloped vacant land east of Meridian Road, existing Bradley Road, and Meridian Road ROW which will not include pavement for this report. Runoff will be directed westerly overland and then southerly to Design Point 12. The undeveloped flow from this basin is 4.2cfs and 23.4cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin ET31b
This basin consists of runoff from undeveloped vacant land east of Meridian Road and Meridian Road ROW which will not include pavement for this report. Runoff will be directed westerly overland and then southerly to Design Point 12. The undeveloped flow from this basin is 4.7cfs and 26.3cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin ET31c
This basin consists of runoff from undeveloped vacant land east of Meridian Road and Meridian Road ROW which will not include pavement for this report. Runoff will be directed westerly overland and then northerly to Design Point 12. The undeveloped flow from this basin is 3.0cfs and 16.9cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin D1.1x
This basin consists of runoff from Meridian Road ROW which will not include pavement for this report. Runoff will be directed to Design Point 12. The undeveloped flow from this basin is 0.8cfs and 4.5cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin D1.2x
This basin consists of runoff from undeveloped land in Bull Hill and open space under the electric transmission line. Runoff will be directed northwesterly overland to Design Point 13 where it will be enter Swale 'D2/D3' flowing west towards the Etrib. The existing flow from this basin is 17.7cfs and 98.7cfs for the 5/100-year storm event. See Design Point 14 for swale design along Bradley Road. See the appendix for detailed calculations.

Basin D1.3x
This basin consists of runoff from existing Bradley Road, Bradly Road vacant ROW, and from Swale D2/D3. Runoff will be directed westerly via a swale to Design Point 14 where it will flow west under Rolling Meadow Parkway in two 48" culverts towards the Etrib. The existing flow from this basin is 1.8cfs and 12.0cfs for the 5/100-year storm event. See Design Point 14 for swale design. See the appendix for detailed calculations.

Basin D1.4x
This basin consists of runoff from existing Bradley Road, Bradly Road vacant ROW, and from Swale D1. Runoff will be directed to Design Point 15 which is the location of a temporary sediment basin. The existing flow from this basin is 0.5cfs and 3.2cfs for the 5/100-year storm event. See Design Point 14 for swale design. See the appendix for detailed calculations.

Basin D2.1x
This basin consists of runoff from undeveloped land which will eventually be developed as an electric substation site. Runoff will be directed east overland to a future substation on-site WQ/Detention Pond then south to Design Point 1. The future pond location will act as a temporary sediment basin per EGP253 including a pipe drain draining to Design Point 1. The undeveloped flow from this basin is 1.1cfs and 7.2cfs for the 5/100-year storm event. Future development of the substation site will require an on-site WQ/Detention pond with discharge rates limited to the undeveloped site runoff rates. See the appendix for detailed calculations.

Basin D2.2x
This basin consists of runoff from open space under an electric transmission line. Runoff will be directed west overland to Design Point 1. The existing flow from this basin is 2.0cfs and 13.3cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin D2.3x
This basin consists of runoff from the future electric substation site. This area does not include runoff from the transformer portions of the site. Runoff will be directed southeast overland to low point at Design Point 2 and will be collected in the future by a substation drainage system that flows east to the substation pond. This low point will act as a temporary sediment trap which the overflow drains east to the substation pond. The undeveloped flow from this basin is 0.3cfs and 1.9cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin D2.4
This basin consists of runoff from overlot grading and undeveloped ROW on several streets. Runoff will be directed southwesterly to Design Point 3 which is a shallow low point where future inlets will collect flows. This shallow low point will act as a temporary sediment trap and ponds to a depth less than a foot, then flows south on the east side of Rolling Meadow Parkway. The undeveloped flow from this basin is 3.9cfs and 26.3cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin D2.5
This basin consists of runoff from overlot grading for a future mulit-family area. Runoff will be directed southerly to Temp Sediment Basin #2, then in outlet pipe overland to Design Point 3. The undeveloped flow from this basin is 1.3cfs and 8.5cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin D2.6
This basin consists of runoff from overlot grading and undeveloped ROW on several streets. Runoff will be directed westerly to Design Point 7 and then to Design Point 8 where it will be collected by a rip rap rundown and storm sewer which flows to Pond C. The undeveloped flow from this basin is 15.5cfs and 86.9cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin D2.7
This basin consists of runoff from overlot grading, open space under electric transmission lines, vacant land, and undeveloped ROW of Prairie Song Drive/Hoof Hallow Pl/Meridian Rd. Runoff will be directed southwesterly gutter to Design Point 6. The undeveloped flow from this basin is 3.9cfs and 21.7cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin D2.8
This basin consists of runoff from overlot grading and undeveloped ROW on Echoing Grass Way/Sunlit Meadow Tr. Runoff will be directed southerly Design Point 9 where it will be collected by a sediment trap and a 5' Type R inlet which flows to Pond C. The undeveloped flow from this basin is 3.7cfs and 20.8cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin D2.9
This basin consists of runoff from undeveloped ROW at the future roundabout. Runoff will be directed south offsite. Treatment of runoff is not required since this is a separate pervious area and it does not drain to a different property owner. The undeveloped flow from this basin is 0.3cfs and 1.4cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin D2.10
This basin consists of runoff from a future commercial development area. Runoff will be directed southerly to Temp Sediment Basin #1, then in outlet pipe overland to Design Point 10. The undeveloped flow from this basin is 3.0cfs and 16.9cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin D2.11
This basin consists of runoff from overlot grading and undeveloped ROW on several future streets. Runoff will be directed south Design Point 11 where it will be collected by a rip rap rundown and storm sewer which flow to Pond C. The undeveloped flow from this basin is 3.8cfs and 21.0cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin D2.12

This basin consists of runoff from overlot grading and Pond C. Runoff flows directly to Pond C. The undeveloped flow from this basin is 3.5cfs and 23.5cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin D2.13
This basin consists of runoff from vacant land. Runoff will be directed southerly offsite. Treatment of runoff is not required since this is sheet flow from a separate pervious area and it does not drain to a different property owner. The undeveloped flow from this basin is 0.8cfs and 4.6cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin D2.19
This basin consists of runoff from open space areas and the Etrib of JCC. Runoff flows directly into the Etrib of JCC. The flow from this basin is 7.5cfs and 46.5cfs for the 5/100-year storm event. See the appendix for detailed calculations.

See the Early Overlot Grading Conditions Hydrology Calculations and Drainage Map (Map Pocket) for the 5-year and 100-year storm event amounts.

5.0 HYDRAULIC SUMMARY

The sizing of the hydraulic structures, swales, etc were prepared by using the *StormSewers* and *Hydrographs* computer software programs developed by Intellisolve, which conforms to the methods outlined in the "City of Colorado Springs/El Paso County Drainage Criteria Manual". Several sections of storm sewer to be constructed with this early grading project have been sized for fully developed conditions which can be found in the preliminary drainage report for this project. Pond C was taken from the Preliminary Drainage report for this project and was sized using MHFD's full spectrum xcel spreadsheets. We have elected to construct Pond C (at the Early Grading stage) to its final condition including the full spectrum outlet structure, forebays, trickle channels, outfall channel, overflow, and incoming storm sewer pipes. Pond C will treat the entire tributary drainage area for sediment removal. See Appendix D. See Appendix C for detailed hydraulic calculations and the storm sewer modeling

Design Point 1
Design Point 1 is located southeast of the electric transmission line easement at a low point. Flow is from Basin D2.2x (open space) and undeveloped runoff from the future electric substation site (Basin D2.1x, D2.3x). The undeveloped runoff is 3.3cfs/22.3cfs in the 5/100-year storm events for this design point and will be collected in the future by a storm sewer (see Des.Pt. D1, prelim drainage report, PUDSP255). This low point can be drained via a future swale (Des.Pt D1 low point swale) flowing southwest if the project is abandoned by the developer. See Low Point Swale sheet in the early grading plans and the appendix of this report for location and swale layout.

Design Point 2
Design Point 2 is located just west of the substation site at a low point. The total undeveloped flow is 0.3cfs/1.9cfs in the 5/100-year storm events for this design point. A future substation area inlet will capture runoff and a substation drain system will convey it east downstream to a future substation pond/temporary sediment basin constructed per EGP253. During early grading conditions the low point will act as a temporary sediment trap which overflows to the east.

Design Point 3

Design Point 3 is located on the east side of Rolling Meadow Parkway and Calf Creek Drive at a low point. The total undeveloped flow is 5.3cfs/35.2cfs in the 5/100-year storm events for this design point. Future type R inlets will capture runoff and convey it south downstream (see Des.Pt. D14/D15, prelim drainage report, PUDSP255). During early grading, this low point will act as a temporary sediment trap ponding to a depth less than a foot, then will overflow draining south on the east side of Rolling Meadow Parkway to Design Point 7 located at a low point just south of Echoing Grass Lane.

Design Point 4

Design Point 4 is located at a low point in Basin C1.1 which is the future school site. The total undeveloped flow is 4.5cfs/27.5cfs in the 5/100-year storm events for this design point. A future storm sewer will capture runoff and convey it south downstream to Des.Pt 7 (see Des.Pt. C5, prelim drainage report, PUDSP255). This low point can be drained via a future swale (Des.Pt D4 low point swale) flowing southwest if the project is abandoned by the developer. See Low Point Swale sheet in the early grading plans and the appendix of this report for location and swale layout.

Design Point 5

Design Point 5 is located in the electric transmission line easement on a rear lot line northeast of Hoof Hallow Place/Fox Den Way. In the future a CDOT Type D inlet will capture runoff and convey it via a future 18" storm sewer downstream. The total undeveloped flow is 2.9cfs/15.7cfs in the 5/100-year storm events for this design point. Backyard Swale 'A' will convey runoff to the future inlet and a future storm sewer will convey it south downstream to Des.Pt 7. See appendix for Swale 'A' hydraulic calculations. (see Des.Pt. C1, prelim drainage report, PUDSP255). During the early grading phase this low point is a temporary sediment trap which overflows southwest downstream to Des. Pt. 7.

Design Point 6

Design Point 6 is located at Rolling Meadow Parkway and Prairie Song Drive. The total undeveloped flow is 4.8cfs/27.0cfs in the 5/100-year storm events for this design point. Future type R inlets will capture runoff and convey it northwest downstream to a low point in Rolling Meadow Parkway. (see Des.Pt. C22/C23, prelim drainage report, PUDSP255). During early grading, runoff will be redirect northwest overland on the east side of Rolling Meadow Parkway to Design Point 7 located at a low point just south of Echoing Grass Lane.

Design Point 7

Design Point 7 is located at a low point in Rolling Meadow Parkway south of Echoing Grass Lane. The total undeveloped flow is 26.7cfs/156.3cfs in the 5/100-year storm events for this design point. Future type R inlets will capture runoff and convey it west to Pond C. (see Des.Pt. C26, prelim drainage report, PUDSP255). During early grading runoff will flow west overland to Des.Pt 8 where a rip rap rundown and a short section of 60" storm sewer will be constructed that drains to the forebay of Pond C. The storm sewer was designed for future fully developed flow (207.1cfs, Des.Pt C29, prelim drainage report, PUDSP255)

Design Point 8

Design Point 8 is located at a low point west of Rolling Meadow Parkway and south of Echoing Grass Lane. The total undeveloped flow is 26.7cfs/156.3cfs in the 5/100-year storm events for this design point. Runoff flows southwest to a rip rap rundown and then into a short section of 60" storm sewer which connects to the forebay of Pond C. The storm sewer was designed for future fully developed flow (207.1cfs, Des.Pt C29, prelim drainage report, PUDSP255).

Design Point 9

Design Point 9 is located on Echoing Grass Way at a low point west of Rolling Meadow Parkway. The total undeveloped flow is 3.7cfs/20.8cfs in the 5/100-year storm events for this design point. Future type R inlets will capture runoff and convey it downstream to Pond C (see Des.Pt. C32/C33, prelim drainage report, PUDSP255). During early grading, runoff will be collected by a 5' type R sump inlet

(no curb at inlet, 14" opening) and 30" storm sewer which connects to the forebay of Pond C. The storm sewer was designed for future fully developed flow (30.1cfs, Des.Pt C34, prelim drainage report, PUDSP255).

Design Point 10

Design Point 10 is located on Calf Creek Drive and Echoing Grass Way at a low point. The total undeveloped flow is 3.0cfs/16.9cfs in the 5/100-year storm events for this design point. Future inlets will capture runoff and convey it downstream to Pond C (see Des.Pt. D17, prelim drainage report, PUDSP255). During early grading, this low point will act as a temporary sediment trap ponding to a depth less than a foot, then will overflow draining south on the east side of Echoing Grass Lane to another low point. This second low point will act as a temporary sediment trap ponding to a depth less than a foot, then will overflow draining west to Design Point 11.

Design Point 11

Design Point 11 is located at a low point west of Echoing Grass Lane. The total undeveloped flow is 8.8cfs/49.0cfs in the 5/100-year storm events for this design point. Runoff flows southwest to a rip rap rundown then into a short section of 54" storm sewer which connects to the forebay of Pond C. The storm sewer was designed for future fully developed flow (189.3cfs, Des.Pt D32, prelim drainage report, PUDSP255).

Design Point 12

Design Point 12 is located on Meridian Road at a low point. The total undeveloped flow is 12.7cfs/71.0cfs in the 5/100-year storm events for this design point. Future inlets will capture runoff and convey it overland downstream to Design Point 13. (see Des.Pt. D21f, prelim drainage report, PUDSP255). During early grading, this low point will act as a temporary sediment trap ponding to a depth less than a foot, then will overflow draining west to Design Point 12 where a permanent rock check dam (40' long) will disperse concentrated flows at this design point. The shallow sheet flow then drains west to Design Point 13.

Design Point 13

Design Point 13 is the surface runoff entering a diversion berm redirecting runoff to Bradley Road then into a diversion swale on the south side of Bradley Road. The runoff in the diversion berm and entering Swale D2/D3 is from Basin D1.2x and Des.Pt. 12 and is 30.4cfs/169.8cfs in the 5/100-year storm events at this design point. The DP13 diversion berm will be 2' high and will flow Northwest to the south side of Bradley Road and into Swale D2/D3. Diversion Swale D2/D3 will also function as the emergency overflow for future Pond D (see MDDP) which has a design flow of 260cfs. Swale D2/D3 will be a trapezoidal swale with a 5' bottom, 3:1 side slopes, 4' of depth, and a 0.3% longitudinal slope. The sides will be blanketed with straw ECB since velocities are less than 6ft/s.

Design Point 14

Design Point 14 is the runoff entering a diversion swale on the south side of Bradley Road on the east side of Rolling Meadow Parkway. The runoff entering Swale D2/D3 is from Des.Pt. 13 and Basin D1.3x and is 32.1cfs/181.8cfs in the 5/100-year storm events at this design point. However, Swale D2/D3 will also function as the emergency overflow for future Pond D (see MDDP) which has a design flow of 260cfs. Swale D2/D3 will be designed for 260cfs. Double 48" culverts will be required to convey runoff under Rolling Meadows Parkway to the west. See appendix for rip rap design for the culverts.

Design Point 15

Design Point 15 is the runoff entering a diversion swale on the south side of Bradley Road on the west side of Rolling Meadow Parkway. The runoff entering Swale D1 is from Des.Pt. 14 and Basin D1.4x and is 32.6cfs/184.9cfs in the 5/100-year storm events at this design point. However, Swale D1 will also function as the emergency overflow for future Pond D (see MDDP) which has a design flow of 260cfs. Swale D1 will be designed for 260cfs. A future storm sewer flared end section will be located at this design point to convey a portion of the flows to Pond C and the remainder will flow to the East

Tributary of JCC (see Des.Pt D26, prelim drainage report, PUDSP255). A temporary sediment basin will be located at this design point that outlets to the East Tributary of JCC

Design Point D33 (from preliminary drainage report, PUDSP255)
Design Point D33 is the total flow into Pond C from Design Point C35, Design Point D32, and Basin D2.18 using hydraulic calculations and time of concentration in the spreadsheet. The total flow into Pond C is 170.3cfs/415.3cfs in the 5/100-year storm events in the storm sewer flowing into Pond C.

Design Point D34 (from preliminary drainage report, PUDSP255)
Design Point D34 is the total Pond C outflow into the East Tributary of Jimmy Camp Creek. The total Pond C outflow is 24.4cfs/219.7cfs in the 5/100-year storm events. This is slightly higher than the MDDP rates of 21.6cfs/172.8cfs in the 5/100-year storm events because Pond C inflow calculations have been modified in this report to include outflow from concept Pond C1 (school) and the substation pond modeled in series. See Pond C discussion in Section 6.0 of this report.

6.0 DETENTION AND WATER QUALITY PONDS (from preliminary drainage report, PUDSP255)

This section has been taken in its entirety from the preliminary drainage report from PUDSP255. Pond C will be constructed to its fully developed condition as part of the early grading process including forebays, low flow channels, outlet structures, and outlet pipes.

Detention and Storm Water Quality for Antelope Ridge at Bull Hill is required per El Paso County criteria. We have implemented the Full Spectrum approach for detention per the Denver Urban Drainage Districts specifications. Pond C will be constructed to treat/detain storm runoff for this site and to comply with the Bull Hill MDDP. The pond will treat runoff from this site and include access roads, outlet pipes, overflow structures, and low flow channels. This drainage report provides design information on the outlet structure, trickle channel, and the forebays.

Full Spectrum Pond Construction Requirements

Design calculations for all proposed full spectrum ponds are included in this report. Grading and final design details of Pond C is shown on the Early Grading plans for Antelope Ridge at Bull Hill at this time in the Preliminary Plan submittal. The final design of the full spectrum pond consists of an outlet structure, storm sewer outfall, concrete low flow channels, sediment forebays, and overflow weirs. Soil borings, embankment, slope, and compaction requirements for detention ponds can be found in the geotechnical report for the Antelope Ridge at Bull Hill prepared by RMG.

Future Pond C1 and Future MVEA substation Pond
Both of these future ponds will be constructed by others and are located upstream of Pond C. Since these two ponds drain to Pond C, we needed to provide generic pond sizing/routing so the pond outflows can be routed in series to Pond C using the full spectrum spreadsheets. The outflow hydrographs then can be added to the inflow hydrograph of Pond C to obtain a combined inflow hydrograph for Pond C. The generic pond sizes and combined hydrographs can be found in the appendix. The undetained pre-developed runoff from the vacant land prior to development is similar to the developed pond release rates for the substation and school ponds and should produce similar inflow hydrographs when routing these two ponds into Pond C.

Below are some of the pond parameters:

Substation Pond
Watershed Area: 4.5 ac
% impervious: 40% (estimated)
Soil Type A (100%)

School Pond
Watershed Area: 14.29ac
% Impervious: 80%
Soil Type A (70%), Type C/D (30%)

5yr Outflow: 0.3cfs (1.4cfs max.)	5-yr Outflow: 2.0cfs
100yr Outflow: 5.3cfs (9.7cfs max.)	100-yr Outflow: 19.2cfs

Detention Pond C

This is an on-site permanent full spectrum detention pond that includes water quality and discharges downstream directly into the reconstructed East Tributary of Jimmy Camp Creek. The outlet Structure, low flow channel, forebays, and overflow wall will be built as part of the early grading plan. Pond C is designed in the UDCF Full Spectrum spreadsheets for Water Quality and EURV volumes. The total pond inflow has been calculated using the directly tributary area CUHP Inflow hydrograph (160.9ac) and adding outflows hydrographs from future Pond C1 (school) and the MVEA substation pond (see spreadsheet in appendix). The inflow hydrograph is then inputted in the UD-Detention spreadsheet and routed through Pond C.

The 5-year and 100-year flow rates meet the Bull Hill MDDP and have been modeled in the full spectrum worksheets. The outlet structure is a standard full spectrum extended detention basin structure and the Xcel print outs are in the appendix of this report. See Design Point 34 for discussion on outflow comparisons between the Bull MDDP and this final design. See map in appendix for watershed areas.

- Watershed Area: 160.9 acres
- Watershed Imperviousness: 56%
- Hydrologic Soils Group B (76%, C/D (24%)
- Zone 1 WQCV: 3.01ac-ft, WSEL: 5778.97
- Zone 2 EURV: 9.463ac-ft, WSEL: 5780.68, Top outlet structure set at 5781.00, 30'x6' outlet structure with type C grate
- (5-yr): 10.16ac-ft, WSEL: 5780.84, 24.4cfs
- Zone 3 (100-yr): 17.956ac-ft, WSEL: 5782.36, 219.2cfs
- Pipe Outlet: 60" RCP at 0.5%
- Overflow Spillway: 55' wide bottom, elevation=5782.50
- Micropool Elevation: 5774.50

Water Quality Design

Water quality will be provided by one detention basin for the PUD area with the exception of Basin ET-28a (Meridian Road) and a small portion of the roundabout (see map in appendix). Both areas will be treated by a future pond in future developments of Bull Hill. Only 1.0acres of land in the project site is not treated and we are seeking to use the 1-ac exclusion rule (ECM Appendix I.7.1.C.1.A) for this runoff area. One additional exclusion for ground disturbance is a utility construction exclusion which does not add any impervious areas. There are several separate pervious areas that drain to Pond C and offsite which do not require WQ design which flow to Pond C and offsite. Pond C provides on-site detention and WQ for the remaining proposed areas within this development. See map in appendix for pond areas and WQ areas along with impervious percents.

7.0 DRAINAGE AND BRIDGE FEES

Antelope Ridge at Bull Hill Filing No. 1 is located within the Jimmy Camp Creek drainage basin which is currently a fee basin in El Paso County. Current El Paso County regulations require drainage and bridge fees to be paid for platting of land as part of the plat recordation process. Eagle Development Company has completed the closure of Jimmy Camp Creek drainage basin for Bull Hill and it has approved by The Pikes Peak Drainage Board and El Paso County BOCC (Resolution 24-233). Therefore, no drainage fees or bridge fees are required to be paid at this time.

Table 7.2: Bull Hill Metro District Drainage Facility Costs (non-reimbursable)

Item	Quantity	Unit	Unit Cost	Item Total

Full Spectrum Pond Outlet Structure	1	EA	$60,000	$80,000
Pond Forebay	2	EA	$30,000	$60,000
Pond Trickle Channel	1550	LF	$30	$46,500
Pond Access Road	1	EA	$20,000	$20,000
Pond Overflow Structure	1	EA	$10,000	$10,000
Soil Rip Rap	110	CY	$150	$16,500
			Subtotal	$233,000
			Eng/Cont (15%)	$34,950
			Total Est. Cost	$267,950

8.0 FOUR STEP PROCESS (from preliminary drainage report, PUDSP255)

This section has been taken in its entirety from the preliminary drainage report from PUDSP255 since Pond C will be constructed with this phase.

The site has been developed to minimize wherever possible the rate of developed runoff that will leave the site and to provide water quality management for the runoff produced by the site as proposed on the development plan. The following four step process should be considered and incorporated into the storm water collection system and storage facilities where applicable.

Step 1: Employ Runoff Reduction Practices
This project has employed several methods of reducing runoff.

- The street configuration was laid out to minimize the length of streets. Many streets are straight and perpendicular resulting in lots with less wasted space.
- There are large open space buffers under the 325' wide electric transmission easement and a "open space" area next to the East Tributary.
- Construct outlet structures for one Full Spectrum Detention Pond. The full spectrum detention mimics existing storm discharges and includes water quality.

Step 2: Stabilize Drainageways
East Tributary of Jimmy Camp Creek is a major drainageway located west of this site. The East Tributary of JCC will be reconstructed and stabilized per county criteria as part of the Bull Hill development. The design included a natural sand bottom and armored sides.

Step 3: Provide Water Quality Capture Volume
Treatment of the water quality capture volume (WQCV) is required for all new developments. This project will construct one full spectrum stormwater extended detention basin which includes Water Quality Volumes and WQ outlet structures. The majority of the disturbed land within the PUD limits drains to and will be treated by Pond C. See map in appendix for a exhibit of all WQ areas and exclusions.

The following basins do not drain to Pond C and/or are not treated by Pond C for WQ:

- Basin C1.1 – future school site drains to Pond C but will be required to provide on-site wq/detention when school is built

- Basin ET28a – the roadway portions (0.4ac) will be excluded by the 1.0-ac exclusion (ECM Appendix I.7.1.C.1.A) allowed by county criteria. The remaining areas are off-site and undeveloped and will flow to the Etrib without WQ.
- SW corner of Roundabout at Rolling Meadow Pkwy/Prairie Song Dr. – the roadway portions (0.6ac) will be excluded by the 1.0-ac exclusion (ECM Appendix I.7.1.C.1.A) allowed by county criteria. The areas will drain off-site onto land owned by Bull Hill.
- Basins ET31a,b,c – the roadway portions will drain and treat for WQ to Pond C in the interim conditions and future conditions will drain to future Pond D for WQ. The remaining areas are off-site and undeveloped and are separate pervious areas not requiring WQ.
- Basin D1.2– Undeveloped Basin – WQ not required, no development in this basin, drains to Etrib and a small portion to Pond C. Future development will require Future Pond D to be built in the NW corner of this basin
- Basin D2.1 - Electric Substation Site – drains to Pond C but will be required to provide on-site wq/detention when substation is built
- Basin D2.19 – comprised of the East Tributary and open space draining to the Etrib. WQ not required.

Step 4: Consider Need for Industrial and Commercial BMP's

There are no industrial areas within this site. The future commercial area of this site will drain to Pond C where it will be detained/treated for WQ.

9.0 CONCLUSIONS

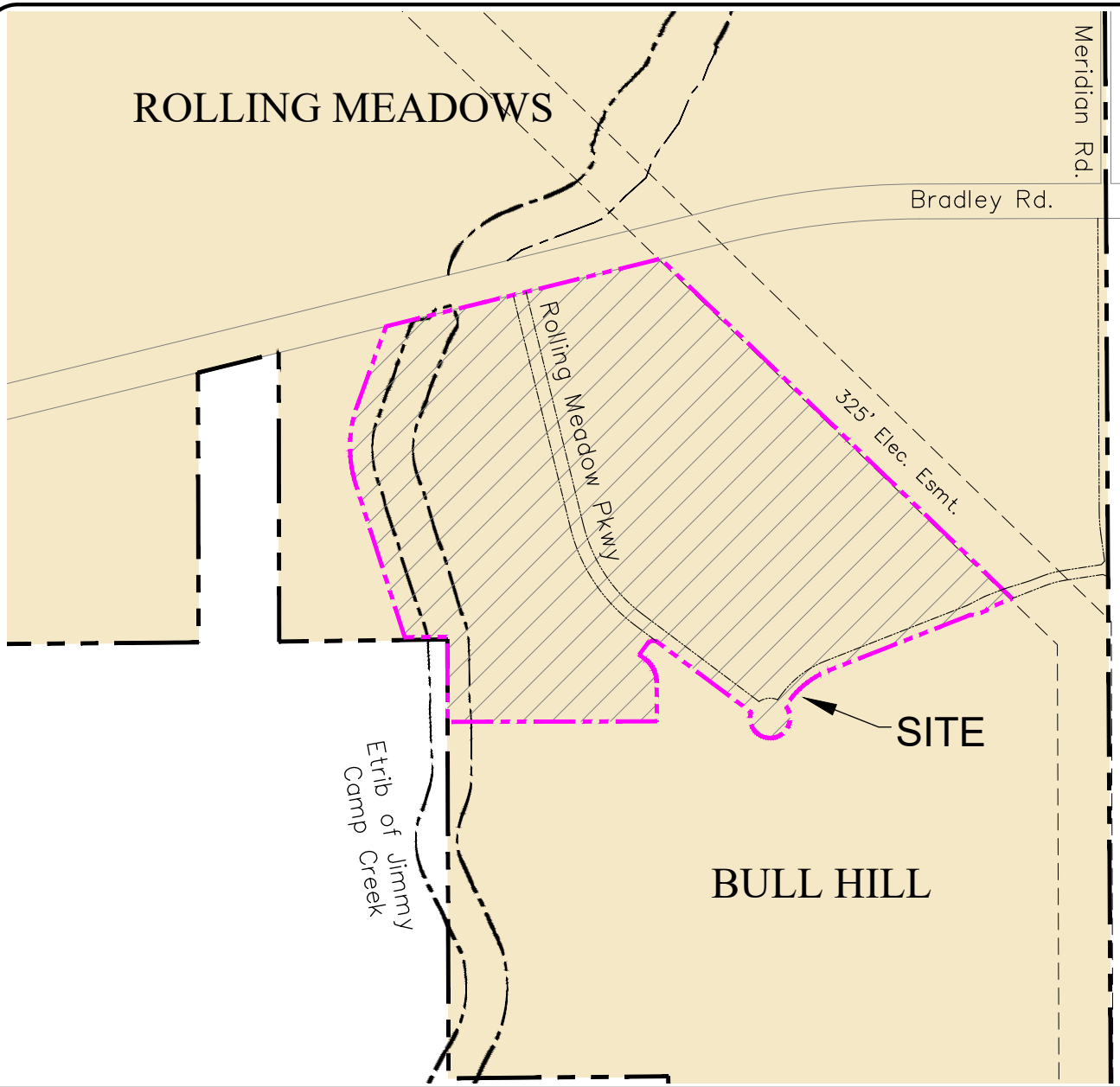
This drainage report has been prepared in accordance with the City of Colorado Springs/El Paso County Drainage Criteria Manual. The proposed development and drainage infrastructure will not cause adverse impacts to adjacent properties or properties located downstream. Several key aspects of the development discussed above are summarized as follows:

- Runoff will be conveyed via swales and storm sewer facilities
- The East Tributary of Jimmy Camp Creek will be reconstructed west of this study area (not part of this project)
- Access to this site is from Bradley Road.
- Detention and water quality for this site area will be provided in permanent ponds
- Existing runoff rates into the Jimmy Camp Creek Drainage basin have been maintained

10.0 REFERENCES

1. City of Colorado Springs/El Paso County Drainage Criteria Manual DCM, dated November, 1991
2. Soil Survey of El Paso County Area, Colorado by USDA, SCS
3. Jimmy Camp Creek Drainage Basin Planning Study, dated February 13, 2025, by Stantec
4. City of Colorado Springs “Drainage Criteria Manual, Volume 2
5. El Paso County “Engineering Criteria Manual”
6. El Paso County Resolution #15-042, El Paso County adoption of Chapter 6 and Section 3.2.1 of the City of Colorado Springs Drainage Criteria Manual dated May, 2014.
7. Bull Hill / Rolling Meadows MDDP prepared by Core Engineering Group, dated May, 2024, approved on October 17, 2024.
8. Antelope Ridge at Bull Hill Phase 1 PDR prepared by Core Engineering Group, dated Nov, 2025, submitted concurrently with the Early Grading drainage report.

APPENDIX A – VICINTIY MAP, SOILS MAP, FEMA MAP



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VICINITY MAP
SCALE: 1"=1000'

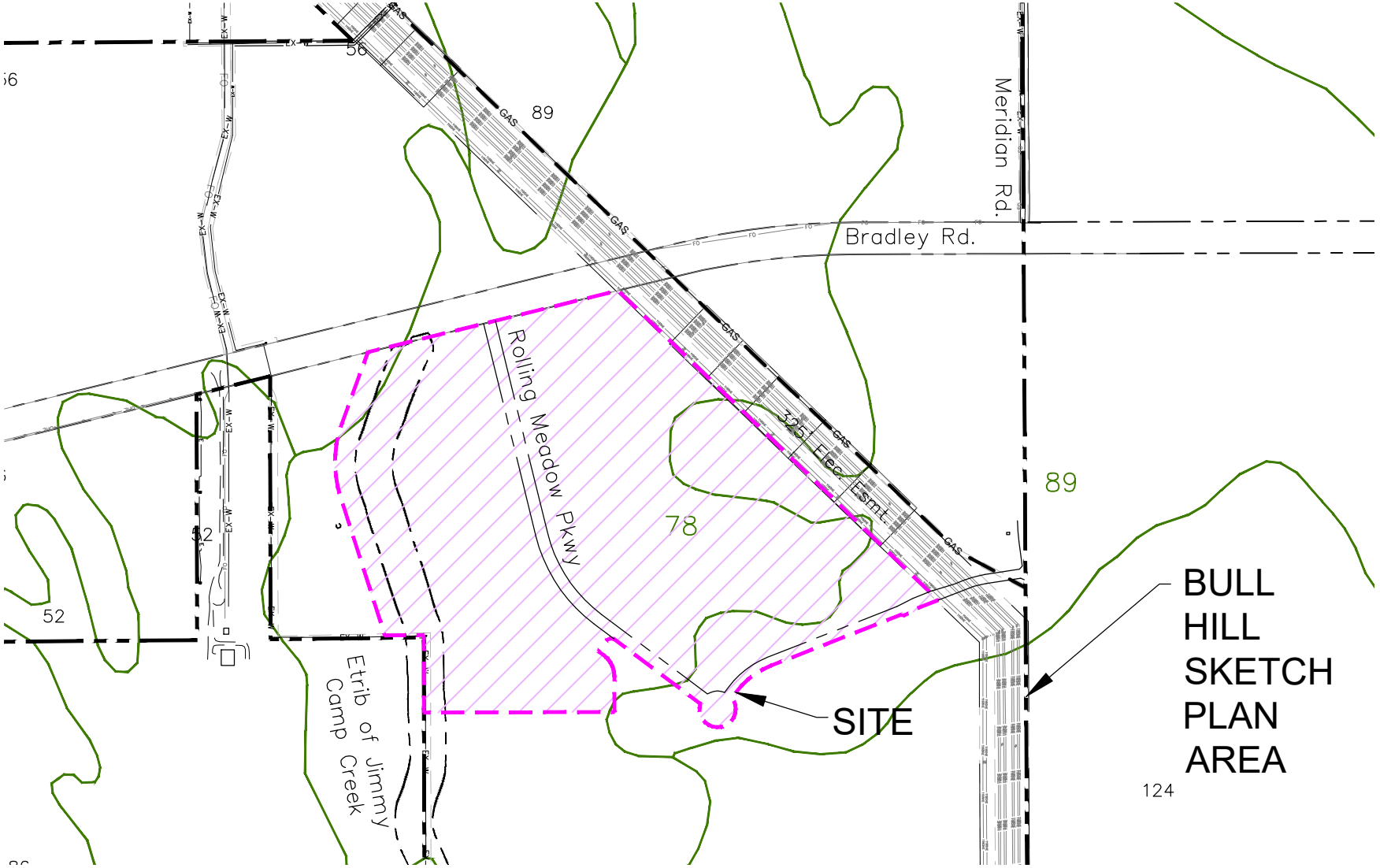
CORE
ENGINEERING GROUP

15004 1ST AVE. S.
BURNSVILLE, MN 55306
PH: 719.659-7800

CONTACT: RICHARD L. SCHINDLER, P.E.
EMAIL: Rich@ceg1.com

ANTELOPE RIDGE AT BULL HILL FIL. NO. 1
VICINITY MAP

SCALE:	DATE:	FIGURE NO.
NTS	MAY, 2025	--



VICINITY MAP
SCALE: 1"=1000'

CORE ENGINEERING GROUP
15004 1ST AVENUE S.
BURNSVILLE, MN 55306
PH: 719.570.1100
CONTACT: RICHARD L. SCHINDLER, P.E.
EMAIL: Rich@ceg1.com

ANTELOPE RIDGE AT BULL HILL FIL. NO. 1
SOILS MAP

SCALE:	DATE:	FIGURE NO.
NTS	MAY, 2025	--

El Paso County Area, Colorado

78—Sampson loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 369s
Elevation: 5,500 to 6,500 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 135 to 155 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Sampson and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sampson

Setting

Landform: Terraces, alluvial fans, depressions
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 15 inches: loam
Bt - 15 to 34 inches: clay loam
Bk - 34 to 60 inches: sandy clay loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 9.2 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: B
Ecological site: R049XB202CO - Loamy Foothill
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: 4 percent
Hydric soil rating: No

Pleasant

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 20, Sep 2, 2022

El Paso County Area, Colorado

89—Tassel fine sandy loam, 3 to 18 percent slopes

Map Unit Setting

National map unit symbol: 36b5
Elevation: 5,600 to 6,400 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 47 to 51 degrees F
Frost-free period: 135 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

Tassel and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tassel

Setting

Landform: Hills
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous slope alluvium over residuum weathered from sandstone

Typical profile

A - 0 to 4 inches: fine sandy loam
C - 4 to 10 inches: sandy loam
Cr - 10 to 14 inches: weathered bedrock

Properties and qualities

Slope: 3 to 18 percent
Depth to restrictive feature: 6 to 20 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Available water supply, 0 to 60 inches: Very low (about 1.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Ecological site: R067BY024CO - Sandy Plains
Other vegetative classification: SANDY PLAINS (069AY026CO)

Hydric soil rating: No

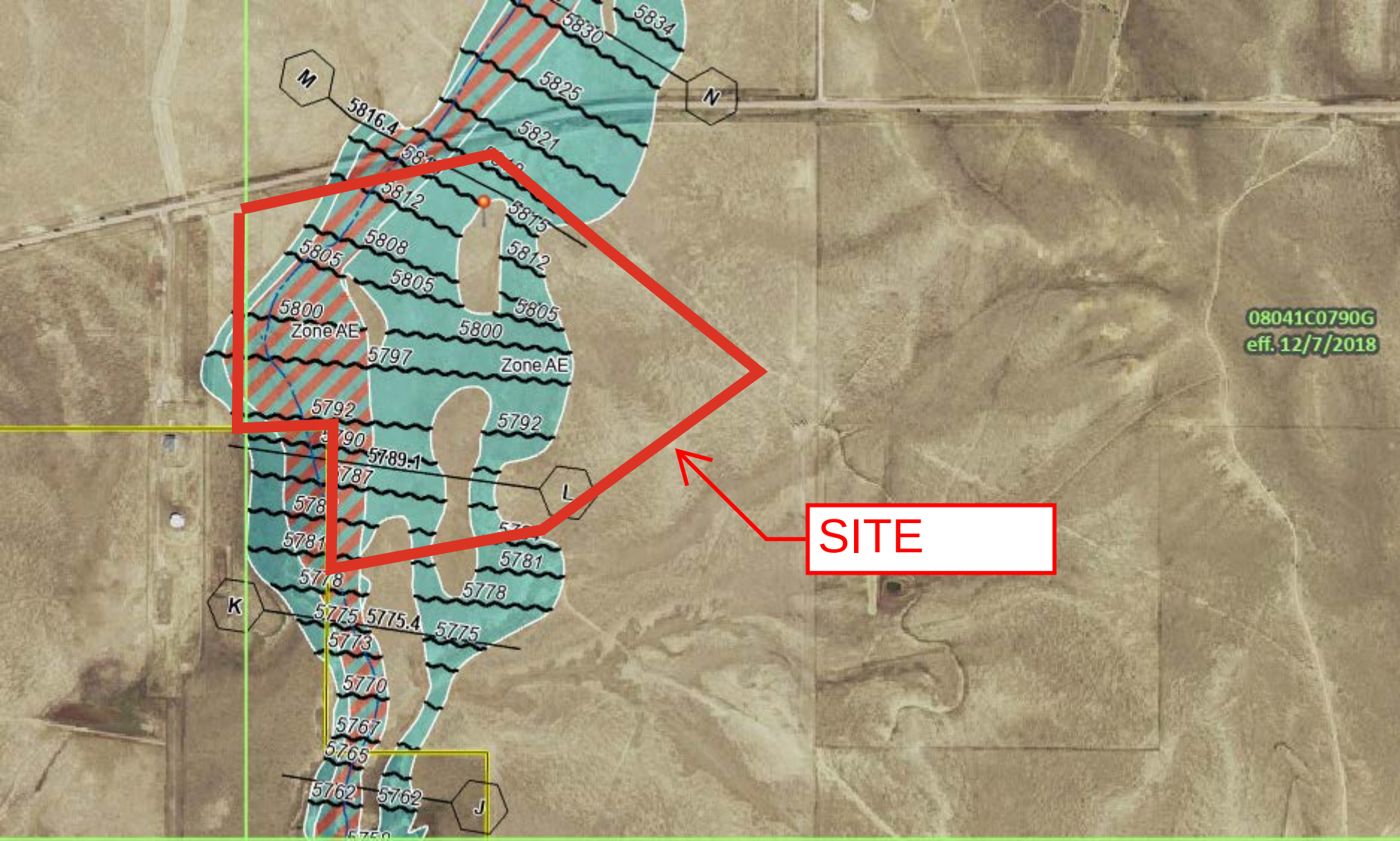
Minor Components

Other soils

Percent of map unit: 5 percent
Hydric soil rating: No

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 20, Sep 2, 2022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APPENDIX B – HYDROLOGY CALCULATIONS

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: May, 2025
Checked By: Leonard Beasley

Job No: 100.302
Project: Antelope Ridge 1
Design Storm: **5 - Year Event (Existing)**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	t_c	CA	i	Q	t_c	$\sum$ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	t_t	
		ac.			min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
ET-28			69.31	0.13	32.8	9.01	2.35	21.2													
ET-31			28.35	0.15	23.2	4.25	2.86	12.2													
EX-S4			84.39	0.12	43.8	10.13	1.91	19.4													
(ET-31 & EX-S4)	**DP-S1**	112.74							52.0	14.38	1.66	23.8									
EX-S5			94.81	0.11	49.7	10.43	1.73	18.0													
(DP-S1 & EX-S5)	**DP-S3**	207.55							55.0	24.81	1.57	39.0									
EX-S6			207.92	0.09	72.4	18.71	1.16	21.7													

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: May, 2025
Checked By: Leonard Beasley

Job No: 100.302
Project: Antelope Ridge 1
Design Storm: **100-Year Event (Existing)**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	t_c	CA	i	Q	t_c	$\sum$ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	t_t	
		ac.			min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
ET-28			69.31	0.46	32.8	31.88	3.94	125.7													
ET-31			28.35	0.50	23.2	14.18	4.81	68.1													
EX-S4			84.39	0.43	43.8	36.29	3.21	116.6													
(ET-31 & EX-S4)	**DP-S1**	112.74							52.0	50.46	2.78	140.3									
EX-S5			94.81	0.41	49.7	38.87	2.89	112.5													
(DesPt S1 & EX-S5)	**DP-S3**	207.55							55.0	89.33	2.64	235.5									
EX-S6			207.92	0.38	72.4	79.01	1.94	153.6													

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CORE ENGINEERING GROUP

15004 1st Avenue South
Burnsville, MN 55306

PROJECT NAME: *Antelope Ridge 1*
PROJECT NUMBER: *100.302*
ENGINEER: *LAB*
DATE: May, 2025

Preliminary / Final Drainage Plan
CURRENT CONDITIONS COEFFICIENT "C" CALCULATIONS

BASIN	Soil No.	Hydro Group	Area	Cover (%)	C5	Wtd. C5	C100	Wtd. C100	CN	Wtd. CN	Impervious	Type of Cover
ET-28	105	A	2.33	3.36%	0.08	0.00	0.35	0.01	49	1.65	0%	Pasture/Meadow
	108/124	B	17.04	24.59%	0.08	0.02	0.35	0.09	69	16.96	0%	Pasture/Meadow
	89	D	49.94	72.05%	0.15	0.11	0.50	0.36	84	60.52	0%	Pasture/Meadow
			69.31	100.00%		0.13		0.46		79.14		
ET-31	89	D	28.35	100.00%	0.15		0.50		84	84.00	0%	Pasture/Range
EX-S4	78	B	38.92	34.52%	0.08	0.03	0.35	0.12	69	23.82	0%	Pasture/Range
	89	D	73.82	65.48%	0.15	0.10	0.50	0.33	84	55.00	0%	Pasture/Range
			112.74	100.00%		0.13		0.45		78.82		
EX-S5	78	B	57.29	60.43%	0.08	0.05	0.35	0.21	69	41.69	0%	Pasture/Range
	89	D	37.52	39.57%	0.15	0.06	0.50	0.20	84	33.24	0%	Pasture/Range
			94.81	100.00%		0.11		0.41		74.94		
EX-S6	56/78	B	169.64	81.59%	0.08	0.07	0.35	0.29	69	56.30	0%	Pasture/Range
	52	C	38.28	18.41%	0.15	0.03	0.50	0.09	79	14.54	0%	Pasture/Range
			207.92	100.00%		0.09		0.38		70.84		

CORE ENGINEERING GROUP

Standard Form SF-1. Time of Concentration-Current

Calculated By: Leonard Beasley
Date: May, 2025
Checked By: Leonard Beasley

Job No: 100.302
Project: Antelope at Bull Hill 1

Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					Final t_c
BASIN or DESIGN	C_5	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_i minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_t minutes	Computed t_c Minutes	USDCM Recommended $t_c=t_i+t_t$ (min)
ET-28	0.13	69.31	15.0	300.00	7.00%	0.31	16.00	1633.00	6.12%	3.71	7.33		
			15.0					1806.00	4.54%	3.20	9.42	32.76	32.76
ET-31	0.15	28.35	5.0	300.00	8.33%	0.34	14.80	522.00	7.09%	1.33	6.53		
			15.0					402.00	5.47%	3.51	1.91	23.24	23.24
EX-S4	0.12	84.39	7.0	300.00	5.67%	0.29	17.34	965.00	3.83%	1.37	11.74		
			15.0					1518.00	1.32%	1.72	14.68	43.76	43.76
EX-S5	0.11	94.81	15.0	300.00	4.50%	0.26	18.91	1981.00	3.71%	2.89	11.43		
			15.0					1093.00	0.73%	1.28	14.21		
			15.0					291.00	0.40%	0.95	5.11	49.66	49.66

CORE ENGINEERING GROUP

Standard Form SF-1. Time of Concentration-Current

Calculated By: Leonard Beasley
Date: May, 2025
Checked By: Leonard Beasley

Job No: 100.302
Project: Antelope at Bull Hill 1

Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					Final t_c
BASIN or DESIGN	C_5	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_i minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_t minutes	Computed t_c Minutes	USDCM Recommended $t_c=t_i+t_t$ (min)
DP-S1	0.13	112.74	5.0	300.00	8.33%	0.33	15.11	522.00	7.09%	1.33	6.53		
(ET-31 & EX-S4)			15.0					402.00	5.47%	3.51	1.91		
			7.0					1516.00	3.83%	1.37	18.44		
			15.0					1088.00	1.47%	1.82	9.97	51.97	51.97
DP-S3	0.13	207.55	5.0	300.00	8.33%	0.33	15.11	522.00	7.09%	1.33	6.53		
(DsPT S1 & EX-S4)			15.0					402.00	5.47%	3.51	1.91		
			7.0					1516.00	3.83%	1.37	18.44		
			15.0					1088.00	1.47%	1.82	9.97		
			15.0					2500.00	73.00%	12.82	3.25	55.22	55.22
EX-S6	0.09	207.92	15.0	45.00	15.56%	0.15	4.95	1982.00	2.22%	2.23	14.78		
			15.0					3466.00	1.99%	2.12	27.30		
			15.0					1270.00	0.31%	0.84	25.34	72.38	72.38

CORE
ENGINEERING GROUP
15004 1st Avenue South
Burnsville, MN 55306

PROJECT NAME: *Antelope Ridge at Bull Hill Filing No. 1 (Early Grading)*
PROJECT NUMBER: *100.302*
ENGINEER: *LAB*
DATE: *Nov. 3, 2025*

Early Grading Drainage Plan
PROPOSED CONDITIONS COEFFICIENT "C" CALCULATIONS

BASIN	Soil No.	Hydro Group	Area	Cover (%)	C5	Wtd. C5	C100	Wtd. C100	CN	Wtd. CN	Impervious	Type of Cover
ET-31a		D	10.53	100.00%	0.15	0.15	0.50	0.50	84	84.0	0%	Undeveloped
ET-31b		D	10.66	100.00%	0.15	0.15	0.50	0.50	84	84.0	0%	Undeveloped
ET-31c		D	6.97	100.00%	0.15	0.15	0.50	0.50	84	84.0	0%	Undeveloped
D1.1 **(12)**		D	1.87	100.00%	0.15	0.15	0.50	0.50	84	84.0	0%	Undeveloped
D1.2x **(13)**		D	65.76	100.00%	0.15	0.15	0.50	0.50	84	84.0	0%	Undeveloped
D1.3x **(14)**		B	7.70	100.00%	0.09	0.09	0.36	0.36	83	84.0	0%	Undeveloped
D1.4x **(15)**		B	1.40	100.00%	0.09	0.09	0.36	0.36	83	84.0	0%	Undeveloped
D2.1x		B	4.48	100.00%	0.09	100.00%	0.36	100.00%	83	84.0	65%	Undeveloped
D2.2x **(1)**		B	7.15	100.00%	0.09	100.00%	0.36	100.00%	83	84.0	65%	Undeveloped
D2.3 **(2)**		B	1.09	100.00%	0.09	100.00%	0.36	100.00%	83	84.0	0%	Undeveloped
D2.4		B	16.90	100.00%	0.09	100.00%	0.36	100.00%	83	84.0	0%	Undeveloped
D2.5 **(3)**		B	5.49	100.00%	0.09	0.09	0.36	0.36	83	84.0	0%	Undeveloped
C1.1 **(4)**		C/D	14.29	100.00%	0.11	0.11	0.40	0.40	84	84.0	0%	Undeveloped
C2.1 **(5)**		D	7.58	100.00%	0.15	0.15	0.49	0.49	84	84.0	0%	Undeveloped
ET28a		C/D	2.21	100.00%	0.15	0.15	0.50	0.50	84	84.0	0%	Undeveloped
D2.6 **(7)**		C/D	53.56	100.00%	0.15	0.15	0.50	0.50	84	84.0	0%	Undeveloped
D2.7 **(6)**		C/D	12.24	100.00%	0.15	0.15	0.50	0.50	84	84.0	0%	Undeveloped
D2.8		B	9.24	100.00%	0.09	0.09	0.36	0.36	83	83.0	0%	Undeveloped

CORE
ENGINEERING GROUP
15004 1st Avenue South
Burnsville, MN 55306

PROJECT NAME: *Antelope Ridge at Bull Hill Filing No. 1 (Early Grading)*
PROJECT NUMBER: *100.302*
ENGINEER: *LAB*
DATE: *Nov. 3, 2025*

Early Grading Drainage Plan
PROPOSED CONDITIONS COEFFICIENT "C" CALCULATIONS

BASIN	Soil No.	Hydro Group	Area	Cover (%)	C5	Wtd. C5	C100	Wtd. C100	CN	Wtd. CN	Impervious	Type of Cover
D2.9		D	0.60	100.00%	0.15	0.15	0.50	0.50	84	84.0	0%	Undeveloped
D2.10		B	10.40	100.00%	0.09	0.09	0.36	0.36	83	83.0	0%	Undeveloped
D2.11		D	10.58	100.00%	0.15	0.15	0.50	0.50	84	84.0	0%	Undeveloped
D2.12		B	15.58	100.00%	0.09	0.09	0.36	0.36	83	83.0	0%	Undeveloped
D2.13		D	2.68	100.00%	0.15	0.15	0.50	0.50	84	84.0	0%	Undeveloped

CORE ENGINEERING GROUP

Standard Form SF-1. Time of Concentration-Proposed

Calculated By: Leonard Beasley
Date: Nov. 3, 2025
Checked By: Leonard Beasley

Job No: 100.302
Project: Antelope Ridge at Bull Hill Filing No. 1 (Early Grading)

Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					t_c Check (urbanized Basins)		Final t_c
BASIN or DESIGN	C_5	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_i minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_t minutes	Computed t_c Minutes	TOTAL LENGTH (L) feet	Regional tc tc=(L/180)+10 minutes	USDCM Recommended $t_c=t_i+t_t$ (min)
ET31a	0.15	10.53	5.0	100.00	6.00%	0.18	9.52	536.00	7.71%	1.39	6.43				
			10.0					633.00	0.93%	0.96	10.94	26.90			26.90
ET31b	0.15	10.66	5.0	100.00	6.60%	0.18	9.23	730.00	7.88%	1.40	8.67				
			10.0					412.00	2.66%	1.63	4.21	22.11			22.11
ET31c	0.15	6.97	5.0	100.00	6.50%	0.18	9.27	1064.00	6.91%	1.31	13.49	22.77			22.77
D1.1	0.15	1.87	10.0	43.00	2.00%	0.08	8.98	1115.00	1.60%	1.26	14.69	23.67			23.67
12 (D1.1-ET31c)	0.15	30.03	5.0	100.00	6.00%	0.18	9.52	536.00	7.71%	1.39	6.43				
			10.0					1053.00	1.89%	1.37	12.77	28.72			28.72
D1.2	0.15	65.76	7.0	100.00	4.50%	0.16	10.47	1321.00	3.67%	1.34	16.42				
			10.0					1000.00	0.65%	0.81	20.67	47.56			47.56
13 (D1.2-ET31c)	0.15	95.79	5.0	100.00	6.00%	0.18	9.52	536.00	7.71%	1.39	6.43				
			10.0					1053.00	1.89%	1.37	12.77				
			10.0					2770.00	2.15%	1.47	31.49	60.21			60.21
D1.3	0.09	7.70	7.0	100.00	8.20%	0.18	9.13	233.00	0.60%	0.54	7.16				
			10.0					194.00	18.18%	4.26	0.76				
			10.0					483.00	0.52%	0.72	11.16	28.21			28.21

CORE ENGINEERING GROUP

Standard Form SF-1. Time of Concentration-Proposed

Calculated By: Leonard Beasley
Date: Nov. 3, 2025
Checked By: Leonard Beasley

Job No: 100.302
Project: Antelope Ridge at Bull Hill Filing No. 1 (Early Grading)

Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					t_c Check (urbanized Basins)		Final t_c
BASIN or DESIGN	C_5	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_i minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_t minutes	Computed t_c Minutes	TOTAL LENGTH (L) feet	Regional tc tc=(L/180)+10 minutes	USDCM Recommended $t_c=t_i+t_t$ (min)
14 (ET31a-D1.3)	0.15	103.49	5.0	100.00	6.00%	0.18	9.52	536.00	7.71%	1.39	6.43				
			10.0					1053.00	1.89%	1.37	12.77				
			10.0					2770.00	2.15%	1.47	31.49				
			10.0					1395.00	0.52%	0.72	32.24	92.45			92.45
D1.4	0.09	1.40	10.0	100.00	9.10%	0.19	8.82	166.00	0.50%	0.71	3.91	12.73			12.73
15 (ET31a-D1.4)	0.15	104.89	5.0	100.00	6.00%	0.18	9.52	536.00	7.71%	1.39	6.43				
			10.0					1053.00	1.89%	1.37	12.77				
			10.0					2770.00	2.15%	1.47	31.49				
			10.0					1694.00	0.65%	0.81	35.02	95.23			95.23
D2.1x	0.09	4.48	10.0	100.00	2.00%	0.11	14.56	483.00	1.01%	1.00	8.01				
			10.0					194.00	0.60%	0.77	4.17	26.75			26.75
D2.2x	0.09	7.15	10.0	100.00	3.30%	0.14	12.34	595.00	1.55%	1.24	7.97	20.30			20.30
1 (D2.1x-D2.2x)	0.09	**11.63**	10.0	100.00	2.00%	0.11	14.56	483.00	1.01%	1.00	8.01				
			10.0					194.00	0.60%	0.77	4.17	26.75			26.75
2 (D2.3x)	0.09	1.09	7.0	100.00	1.00%	0.09	18.32	210.00	1.00%	0.70	5.00	23.32			23.32
D2.4	0.09	16.90	10.0	100.00	2.30%	0.12	13.91	1480.00	3.00%	1.73	14.24	28.15			28.15

CORE ENGINEERING GROUP

Standard Form SF-1. Time of Concentration-Proposed

Calculated By: Leonard Beasley
Date: Nov. 3, 2025
Checked By: Leonard Beasley

Job No: 100.302
Project: Antelope Ridge at Bull Hill Filing No. 1 (Early Grading)

Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					t_c Check (urbanized Basins)		Final t_c
BASIN or DESIGN	C_5	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_i minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_t minutes	Computed t_c Minutes	TOTAL LENGTH (L) feet	Regional tc tc=(L/180)+10 minutes	USDCM Recommended $t_c=t_i+t_t$ (min)
D2.5	0.09	5.49	10.0	100.00	1.90%	0.11	14.81	68.00	4.26%	2.06	0.55				
			10.0					814.00	1.11%	1.05	12.88	28.24			28.24
3 (D2.1x-D2.5)	0.09	35.11	10.0	100.00	2.00%	0.11	14.56	483.00	1.01%	1.00	8.01				
			10.0					194.00	0.60%	0.77	4.17				
			10.0					1535.00	1.04%	1.02	25.09	51.83			51.83
ET28a	0.15	2.21	5.0	100.00	5.10%	0.17	10.05	466.00	4.35%	1.04	7.45				
			10.0					670.00	3.64%	1.91	5.85	23.35			23.35
4 (C1.1)	0.15	14.29	5.0	100.00	7.20%	0.19	8.96	893.00	3.00%	0.87	17.19	26.15			26.15
5 (C2.1)	0.15	7.58	5.0	100.00	4.66%	0.16	10.35	1090.00	4.44%	1.05	17.24				
			15.0					100.00	0.50%	1.06	1.57	29.17			29.17
D2.6	0.15	53.56	5.0	75.00	6.00%	0.15	8.25	121.00	4.13%	1.02	1.98				
			10.0					2446.00	1.53%	1.24	32.96	43.19			43.19
6 (D2.7)	0.15	12.24	5.0	100.00	4.00%	0.15	10.89	617.00	4.54%	1.07	9.65				
			10.0					1712.00	2.54%	1.59	17.90	38.45			38.45

CORE ENGINEERING GROUP

Standard Form SF-1. Time of Concentration-Proposed

Calculated By: Leonard Beasley
Date: Nov. 3, 2025
Checked By: Leonard Beasley

Job No: 100.302
Project: Antelope Ridge at Bull Hill Filing No. 1 (Early Grading)

Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					t_c Check (urbanized Basins)		Final t_c
BASIN or DESIGN	C_5	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_i minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_t minutes	Computed t_c Minutes	TOTAL LENGTH (L) feet	Regional tc tc=(L/180)+10 minutes	USDCM Recommended $t_c=t_i+t_t$ (min)
8 (DP7 to pond "C")	0.15	73.38	7.0	100.00	4.90%	0.16	10.18	1188.00	4.07%	1.41	14.02				
			10.0					2196.00	1.75%	1.32	27.67	51.87			51.87
D2.8	0.09	9.24	5.0	104.00	2.00%	0.12	14.85	1268.00	3.00%	0.87	24.40	39.25			39.25
D2.9	0.09	0.60	7.0	65.00	6.15%	0.13	8.10	216.00	4.07%	1.41	2.55	10.64			10.64
D2.10	0.09	10.40	7.0	100.00	1.80%	0.11	15.08	398.00	3.67%	1.34	4.95				
			10.0					650.00	0.65%	0.81	13.44	33.46			33.46
10 (DP15&D2.10)	0.15	115.29	5.0	100.00	6.00%	0.18	9.52	536.00	7.71%	1.39	6.43				
			10.0					1053.00	1.89%	1.37	12.77				
			10.0					2770.00	2.15%	1.47	31.49				
			10.0					2746.00	1.40%	1.18	38.68	98.89			98.89
D2.11	0.15	10.59	7.0	88.00	3.07%	0.13	11.15	856.00	0.93%	0.68	21.13	32.29			32.29
11 (DP10 - pond "C")	0.15	115.29	5.0	100.00	6.00%	0.18	9.52	536.00	7.71%	1.39	6.43				
			10.0					1053.00	1.89%	1.37	12.77				
			10.0					2770.00	2.15%	1.47	31.49				
			10.0					3602.00	1.40%	1.18	50.74	110.95			110.95

CORE ENGINEERING GROUP

Standard Form SF-1. Time of Concentration-Proposed

Calculated By: Leonard Beasley
Date: Nov. 3, 2025
Checked By: Leonard Beasley

Job No: 100.302
Project: Antelope Ridge at Bull Hill Filing No. 1 (Early Grading)

Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					t_c Check (urbanized Basins)		Final t_c
BASIN or DESIGN	C_5	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_i minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_t minutes	Computed t_c Minutes	TOTAL LENGTH (L) feet	Regional tc tc=(L/180)+10 minutes	USDCM Recommended $t_c=t_i+t_t$ (min)
D2.12	0.09	15.58	7.0	100.00	1.00%	0.09	18.32	115.00	0.78%	0.62	3.10				
			10.0					82.00	10.85%	3.29	0.41				
			10.0					638.00	1.88%	1.37	7.76	29.59			29.59
11 (To Pond "C")	0.15	115.29	5.0	100.00	6.00%	0.18	9.52	536.00	7.71%	1.39	6.43				
			10.0					1053.00	1.89%	1.37	12.77				
			10.0					2770.00	2.15%	1.47	31.49				
			10.0					4240.00	1.40%	1.18	59.72	119.93			119.93
D2.13	0.15	2.68	5.0	77.00	2.86%	0.12	10.68	800.00	0.80%	0.45	29.81	40.49			40.49

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: Nov. 3, 2025
Checked By: Leonard Beasley

Job No: 100.302
Project: Antelope Ridge at Bull Hill Filing No. 1 (Early Grading)
Design Storm: **5 - Year Event (Proposed)**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	t_c	CA	i	Q	t_c	$\sum$ (CA)	i	Q	Slope	1/2 Street Cap. Flow	Flow to pipe	Slope	Pipe Size	Length	Velocity	t_t	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
ET31a			10.53	0.15	26.9	1.58	2.64	4.2													
ET31b			10.66	0.15	22.1	1.60	2.94	4.7													
ET31c			6.97	0.15	22.8	1.05	2.89	3.0													
D1.1			1.87	0.15	23.7	0.28	2.84	0.8													
ET31a - D1.1	**12**	**30.03**							Additive "Q" (ET31a-D1.1x)			12.7									
D1.2			65.76	0.15	47.6	9.86	1.79	17.7													
ET31a - D1.2x	**13**	**95.79**							Additive "Q" (ET31a-D1.2x)			30.4									
D1.3x			7.70	0.09	28.2	0.69	2.57	1.8													
ET31a - D1.3x	**14**	**103.49**							Additive "Q" (ET31a-D1.3x)			32.1									
D1.4x			1.40	0.09	12.7	0.13	3.77	0.5													
ET31a - D1.4x	**15**	**104.89**							Additive "Q" (ET31a-D1.4x)			32.6									
D2.1x			4.48	0.09	26.8	0.40	2.65	1.07													
D2.2x			7.15	0.09	20.3	0.64	3.07	1.97													
D2.1x-D2.2x	**1**	**12.72**							Additive "Q" (D2.1x+D2.2x+D2.3x			3.3									
D2.3x	**2**		1.09	0.09	23.3	0.10	2.86	0.3													
D2.4			16.90	0.09	28.2	1.52	2.58	3.9													
D2.5			5.49	0.09	28.2	0.49	2.57	1.3													
D2.1x-D2.5	**3**	**35.11**							51.8	3.16	1.66	5.3									
ET28a			2.21	0.15	23.4	0.33	2.86	0.9													

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: Nov. 3, 2025
Checked By: Leonard Beasley

Job No: 100.302
Project: Antelope Ridge at Bull Hill Filing No. 1 (Early Grading)
Design Storm: **5 - Year Event (Proposed)**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	t_c	CA	i	Q	t_c	$\sum$ (CA)	i	Q	Slope	1/2 Street Cap. Flow	Flow to pipe	Slope	Pipe Size	Length	Velocity	t_t	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
C1.1	**4**		14.29	0.11	26.2	1.57	2.69	4.5													
C2.1	**5**		7.58	0.15	29.2	1.14	2.52	2.9													
D2.6			53.56	0.15	43.2	8.03	1.93	15.5													
C2.1&D2.6		**61.14**							Additive "Q" (C2.1x+D2.6)			18.4									
D2.7			12.24	0.15	38.5	1.84	2.11	3.9													
ET28a+D2.7	**6**	**14.45**							Additive "Q" (ET28a+D2.7)			4.8									
Des.Pt3 + C1.1, C2.1, ET28a, D2.6, D2.7	**7**	**124.99**							51.8	16.07	1.66	26.7									
D2.8	**9**		9.24	0.15	26.2	1.39	2.69	3.7													
D2.9			0.60	0.15	24.2	0.09	2.80	0.3													
D2.10	**10**		10.40	0.15	43.2	1.56	1.93	3.0													
D2.11			10.58	0.15	32.3	1.59	2.37	3.8													
DP10 to Pond "C"	**11**	**30.22**							43.2	4.53	1.93	8.8									
D2.12			15.58	0.09	29.6	1.40	2.50	3.5													
D2.13			2.68	0.15	40.5	0.40	2.03	0.8													

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date:Nov. 3, 2025
Checked By: Leonard Beasley

Job No: 300.302
Project: Antelope Ridge at Bull Hill Filing No. 1 (Early Grading)
Design Storm: **100 - Year Event (Proposed)**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	t_c	CA	i	Q	t_c	Σ (CA)	i	Q	Slope	1/2 Street Cap. Flow	Design Flow	Slope	Pipe Size	Length	Velocity	t_t	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
ET31a			10.53	0.50	26.9	5.27	4.44	23.4													
ET31b			10.66	0.50	22.1	5.33	4.93	26.3													
ET31c			6.97	0.50	22.8	3.49	4.86	16.9													
D1.1x			1.87	0.50	23.7	0.94	4.76	4.5													
D1.1x, ET31a-ET31c	**12**	**30.03**							Additive "Q" (D1.1x, ET31a-ET31c)			71.0									
D1.2x			65.76	0.50	47.6	32.88	3.00	98.7													
D1.1x,D1.2x ET31a-ET31c	**13**	**95.79**							Additive "Q" (ET31a-D1.2x)			169.8									
D1.3x			7.70	0.36	28.2	2.77	4.32	12.0													
ET31a - D1.3x	**14**	**103.49**							Additive "Q" (ET31a-D1.3x)			181.8									
D1.4x			1.40	0.36	12.7	0.50	6.32	3.2													
ET31a - D1.4x	**15**	**104.89**							Additive "Q" (ET31a-D1.4x)			184.9									
D2.1x			4.48	0.36	26.8	1.61	4.45	7.18				.									
D2.2x			7.15	0.36	20.3	2.57	5.15	13.25													
D2.1x-D2.3x	**1**	**12.72**							Additive "Q" (D2.1x+D2.2x+D2.3x)			22.3									
D2.3x	**2**		1.09	0.36	23.3	0.39	4.80	1.9				.									
D2.4			16.90	0.36	28.2	6.08	4.32	26.3													
D2.5			5.49	0.36	28.2	1.98	4.32	8.5													
D2.1x-D2.5	**3**	**35.11**							51.8	12.64	2.79	35.2									
ET28a			2.21	0.50	23.4	1.11	4.80	5.3													

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date:Nov. 3, 2025
Checked By: Leonard Beasley

Job No: 300.302
Project: Antelope Ridge at Bull Hill Filing No. 1 (Early Grading)
Design Storm: **100 - Year Event (Proposed)**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	t_c	CA	i	Q	t_c	$\sum$ (CA)	i	Q	Slope	1/2 Street Cap. Flow	Design Flow	Slope	Pipe Size	Length	Velocity	t_t	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
C1.1	**4**		14.29	0.40	26.2	5.72	4.51	27.5													
C2.1	**5**		7.58	0.49	29.2	3.71	4.23	15.7													
D2.6			53.56	0.50	43.2	26.78	3.25	86.9													
D2.7			12.24	0.50	38.5	6.12	3.54	21.7													
D2.7+ET28a	**6**	**14.45**							Additive "Q" (ET28a+D2.7)			27.0									
Des.Pt3 + C1.1,C2.1, ET28a, D2.6, D2.7	**7**	**124.99**							51.8	56.07	2.79	156.3									
D2.8	**9**		9.24	0.50	26.2	4.62	4.51	20.8													
D2.9			0.60	0.50	24.2	0.30	4.71	1.4													
D2.10	**10**		10.40	0.50	43.2	5.20	3.25	16.9													
D2.11			10.58	0.50	32.3	5.29	3.98	21.0													
D2.8, D2.10, C2.11	**11**	**30.22**							43.2	15.11	3.25	49.0									
D2.12			15.58	0.36	29.6	5.61	4.20	23.5													
D2.13			2.68	0.50	40.5	1.34	3.41	4.6													

APPENDIX C – HYDRAULIC CALCULATIONS

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Nov 13 2025

east side of rolling meadow pkwy des.pt.3

Triangular

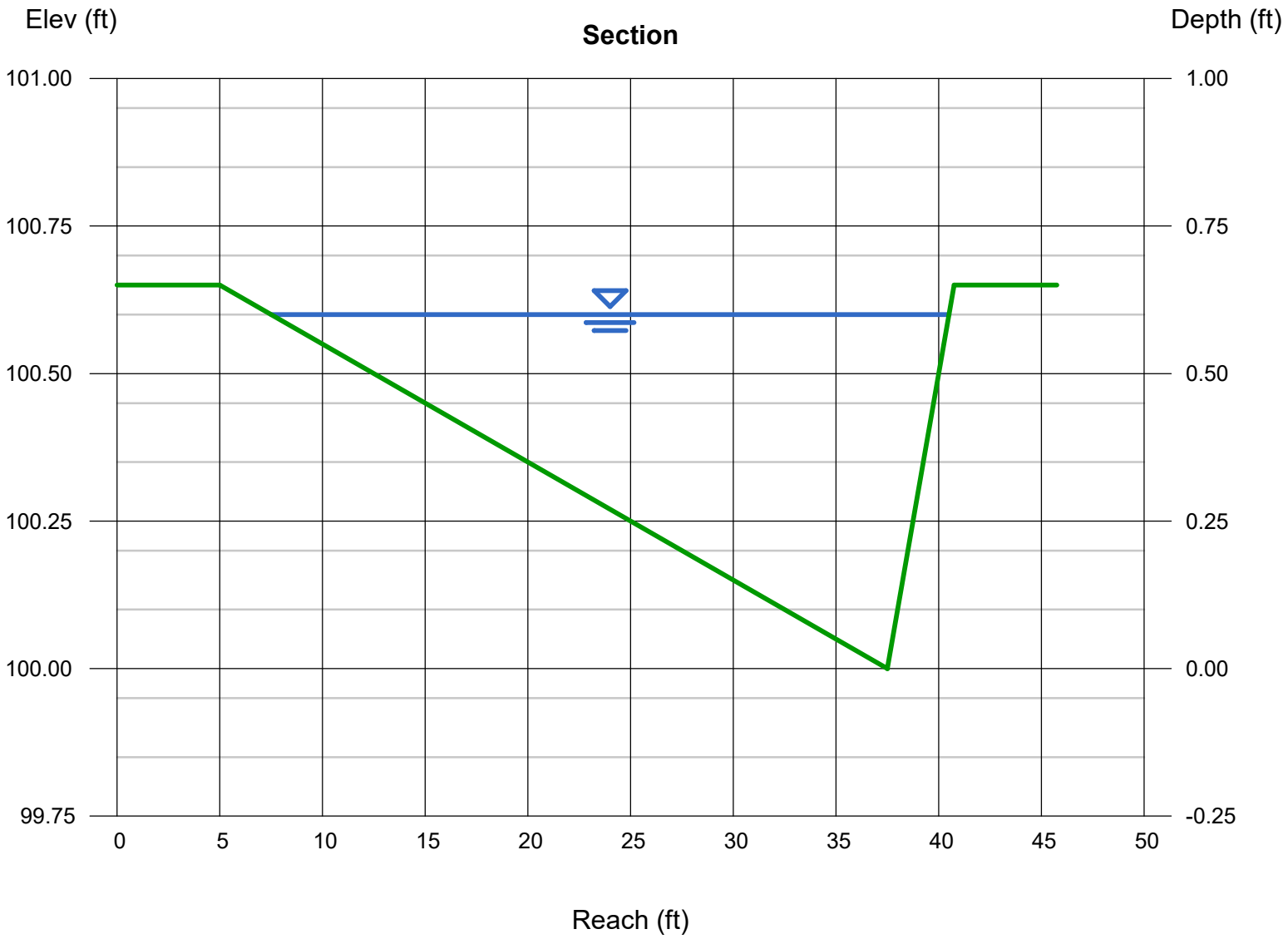
Side Slopes (z:1)	= 50.00, 5.00
Total Depth (ft)	= 0.65
Invert Elev (ft)	= 100.00
Slope (%)	= 0.70
N-Value	= 0.015

Calculations

Compute by:	Known Q
Known Q (cfs)	= 35.20

Highlighted

Depth (ft)	= 0.60
Q (cfs)	= 35.20
Area (sqft)	= 9.90
Velocity (ft/s)	= 3.56
Wetted Perim (ft)	= 33.07
Crit Depth, Yc (ft)	= 0.64
Top Width (ft)	= 33.00
EGL (ft)	= 0.80



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Apr 25 2025

see design pt. 5 for location

SWALE 'A'

Triangular

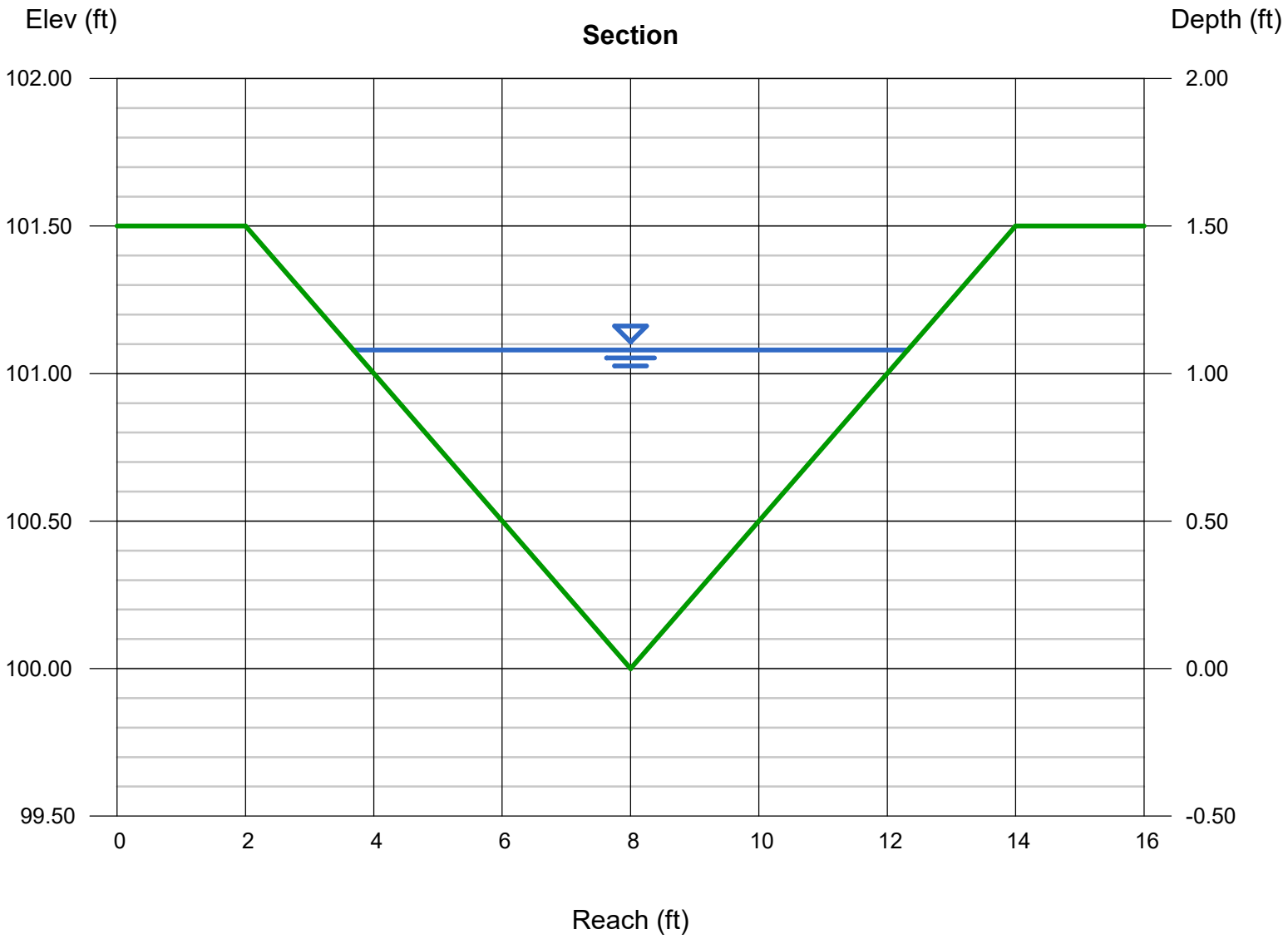
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 1.50
Invert Elev (ft)	= 100.00
Slope (%)	= 0.50
N-Value	= 0.020

Calculations

Compute by:	Known Q
Known Q (cfs)	= 15.70

Highlighted

Depth (ft)	= 1.08
Q (cfs)	= 15.70
Area (sqft)	= 4.67
Velocity (ft/s)	= 3.37
Wetted Perim (ft)	= 8.91
Crit Depth, Yc (ft)	= 1.00
Top Width (ft)	= 8.64
EGL (ft)	= 1.26



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Nov 13 2025

prairie song dr - des.pt.6

Triangular

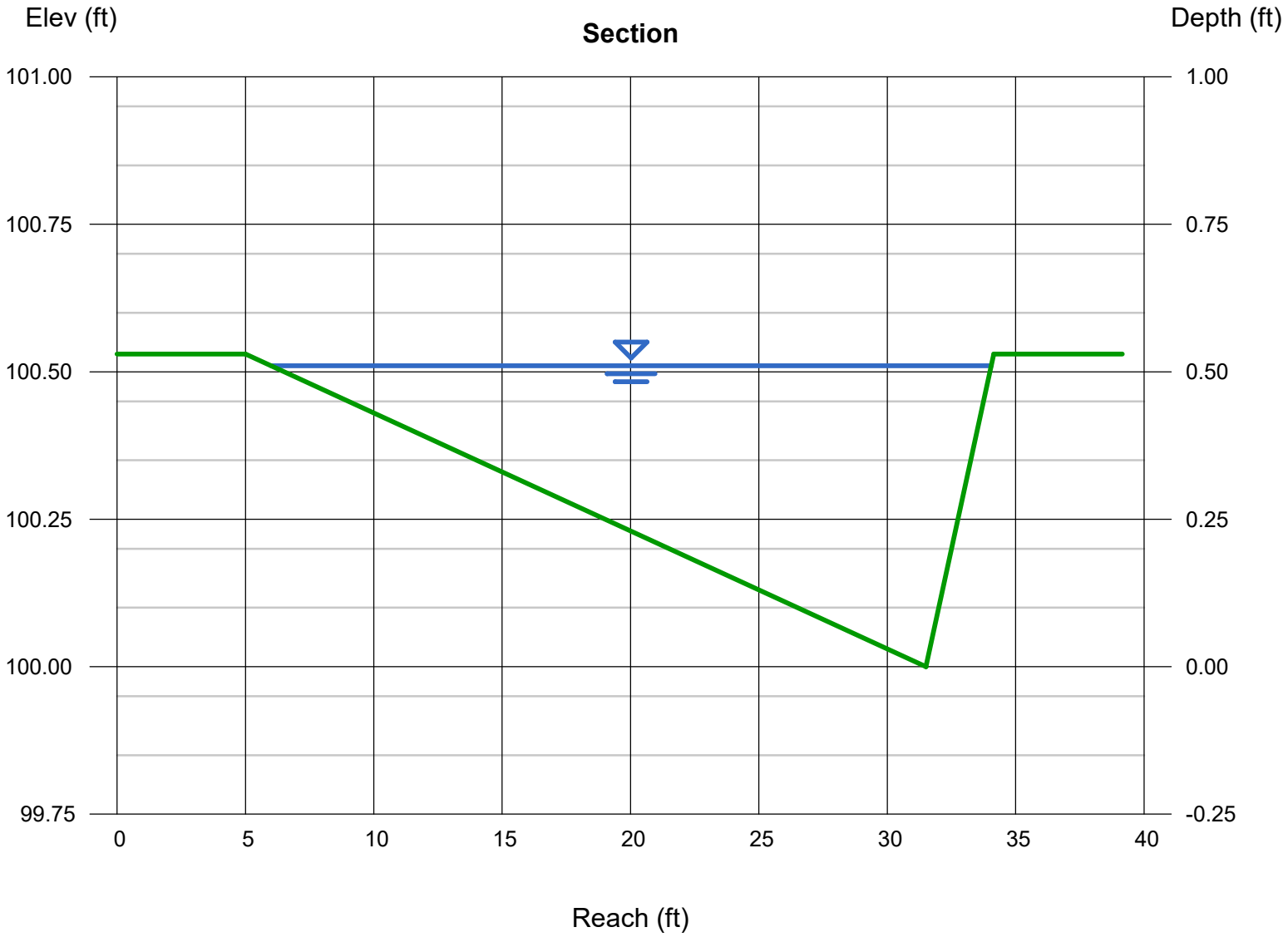
Side Slopes (z:1)	= 50.00, 5.00
Total Depth (ft)	= 0.53
Invert Elev (ft)	= 100.00
Slope (%)	= 1.00
N-Value	= 0.015

Calculations

Compute by:	Known Q
Known Q (cfs)	= 27.00

Highlighted

Depth (ft)	= 0.51
Q (cfs)	= 27.00
Area (sqft)	= 7.15
Velocity (ft/s)	= 3.77
Wetted Perim (ft)	= 28.11
Crit Depth, Yc (ft)	= 0.53
Top Width (ft)	= 28.05
EGL (ft)	= 0.73



Weir Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Nov 13 2025

des.pt9 - 5foot type R

Rectangular Weir

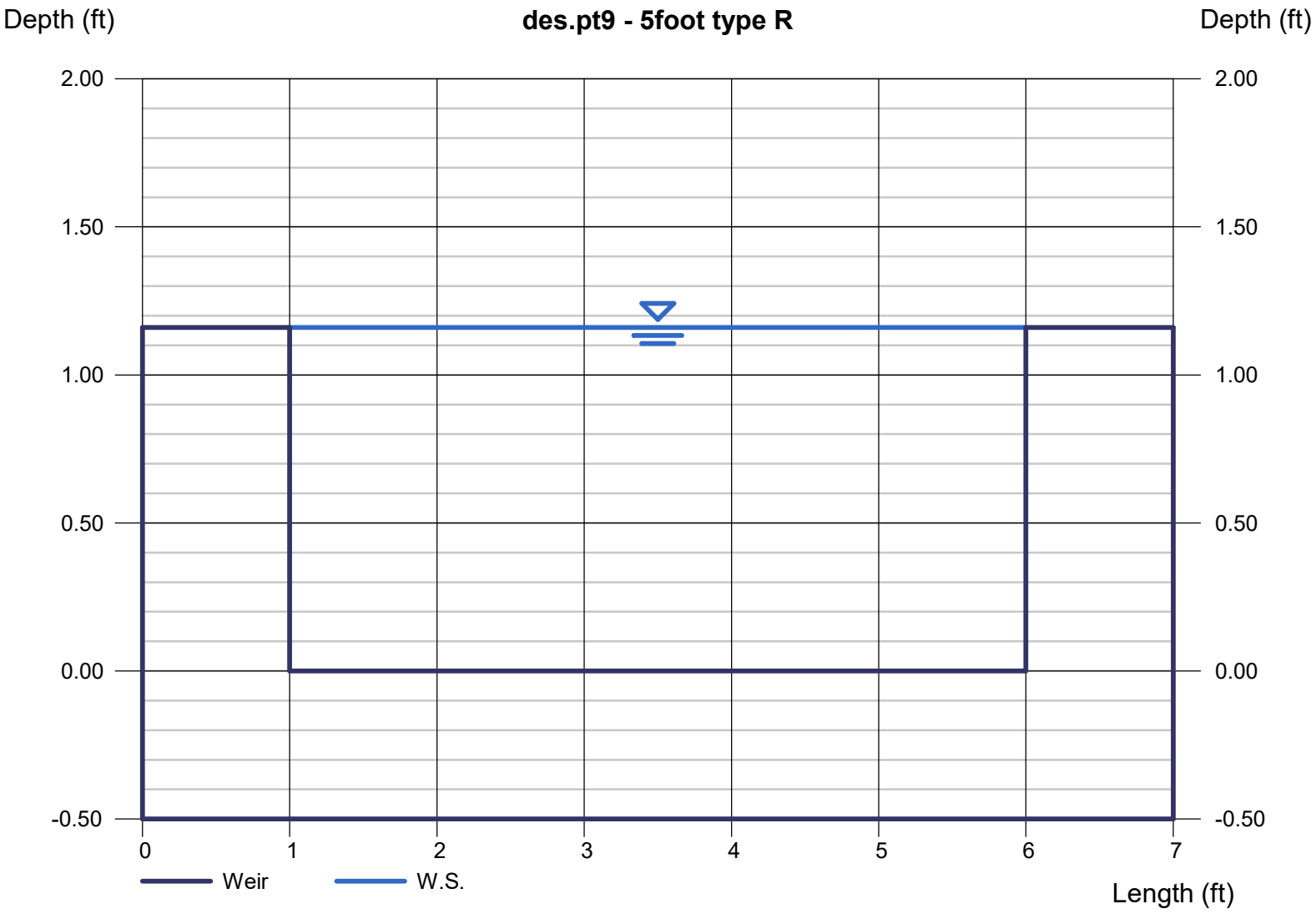
Crest	= Sharp
Bottom Length (ft)	= 5.00
Total Depth (ft)	= 1.16

Calculations

Weir Coeff. Cw	= 3.33
Compute by:	Known Depth
Known Depth (ft)	= 1.16

Highlighted

Depth (ft)	= 1.16
Q (cfs)	= 20.80
Area (sqft)	= 5.80
Velocity (ft/s)	= 3.59
Top Width (ft)	= 5.00



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Oct 24 2025

BASIN D2.5 SWALE

Triangular

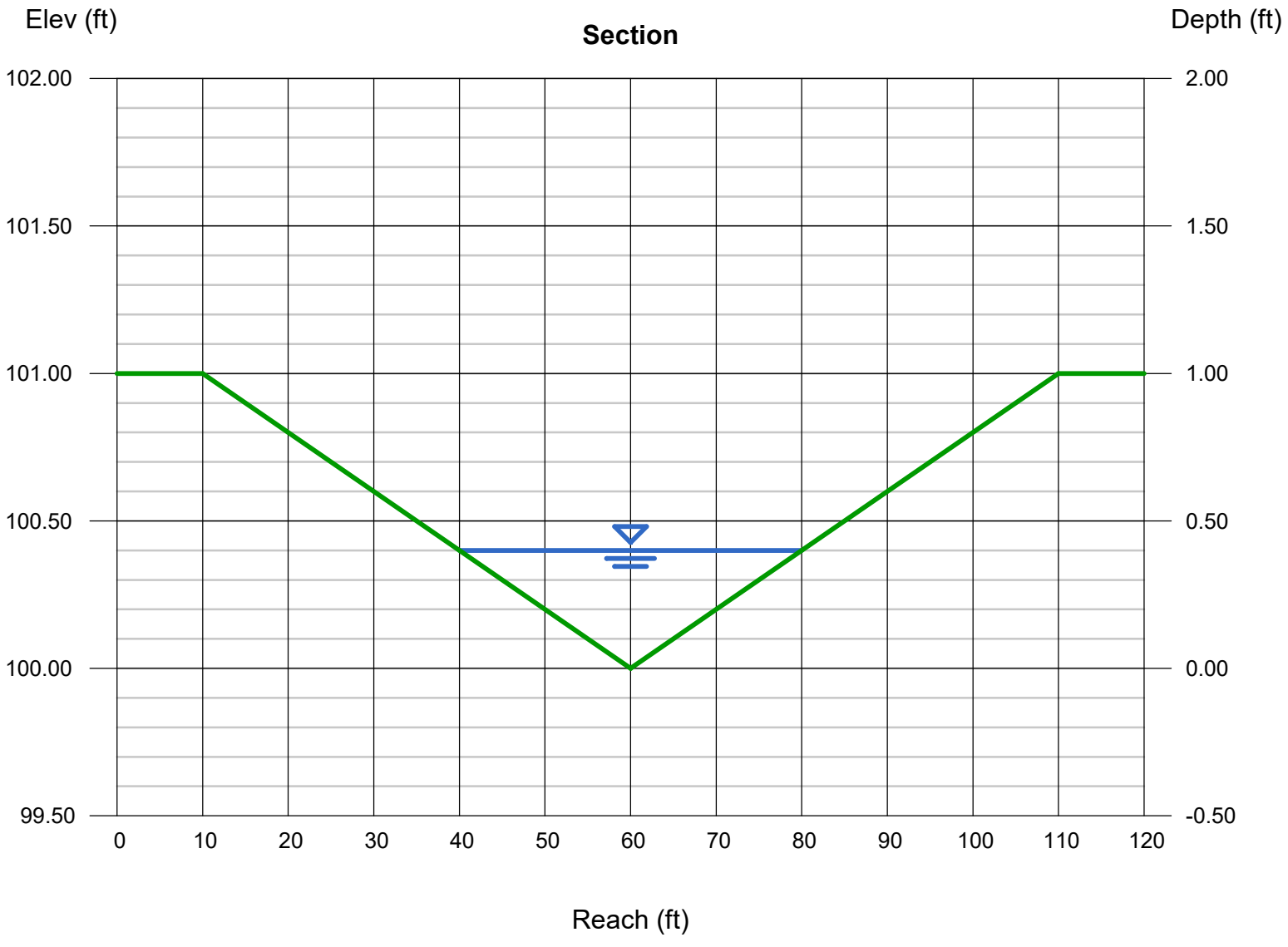
Side Slopes (z:1)	= 50.00, 50.00
Total Depth (ft)	= 1.00
Invert Elev (ft)	= 100.00
Slope (%)	= 1.20
N-Value	= 0.020

Calculations

Compute by:	Known Q
Known Q (cfs)	= 20.90

Highlighted

Depth (ft)	= 0.40
Q (cfs)	= 20.90
Area (sqft)	= 8.00
Velocity (ft/s)	= 2.61
Wetted Perim (ft)	= 40.01
Crit Depth, Yc (ft)	= 0.41
Top Width (ft)	= 40.00
EGL (ft)	= 0.51



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Nov 13 2025

Des.Pt8 stm swr

Invert Elev Dn (ft)	=	5781.20
Pipe Length (ft)	=	163.00
Slope (%)	=	0.51
Invert Elev Up (ft)	=	5782.03
Rise (in)	=	60.0
Shape	=	Circular
Span (in)	=	60.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end projecting (C)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

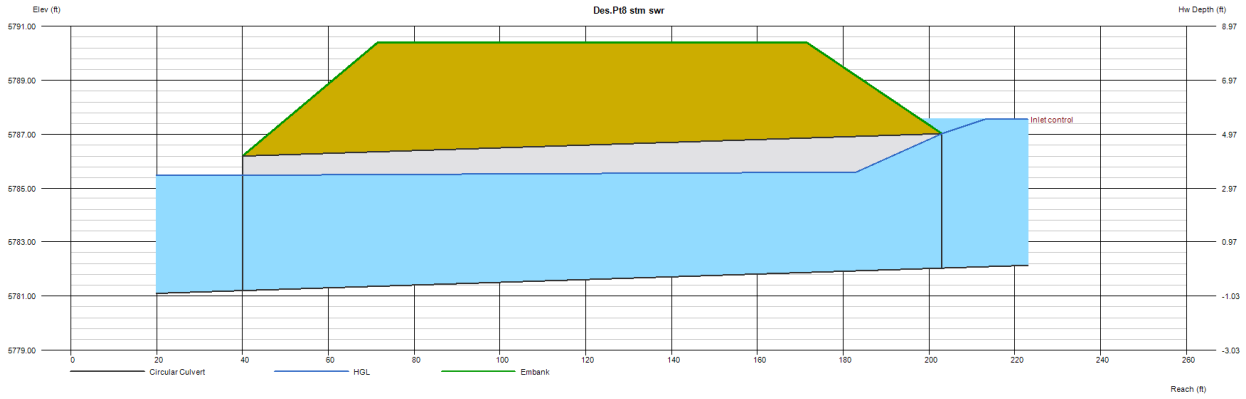
Top Elevation (ft)	=	5790.40
Top Width (ft)	=	100.00
Crest Width (ft)	=	50.00

Calculations

Qmin (cfs)	=	156.30
Qmax (cfs)	=	156.30
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	156.30
Qpipe (cfs)	=	156.30
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	8.72
Veloc Up (ft/s)	=	10.35
HGL Dn (ft)	=	5785.49
HGL Up (ft)	=	5785.62
Hw Elev (ft)	=	5787.56
Hw/D (ft)	=	1.11
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Nov 13 2025

Des.Pt11 stm swr

Invert Elev Dn (ft)	=	5778.96
Pipe Length (ft)	=	44.70
Slope (%)	=	0.81
Invert Elev Up (ft)	=	5779.32
Rise (in)	=	54.0
Shape	=	Circular
Span (in)	=	54.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end projecting (C)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

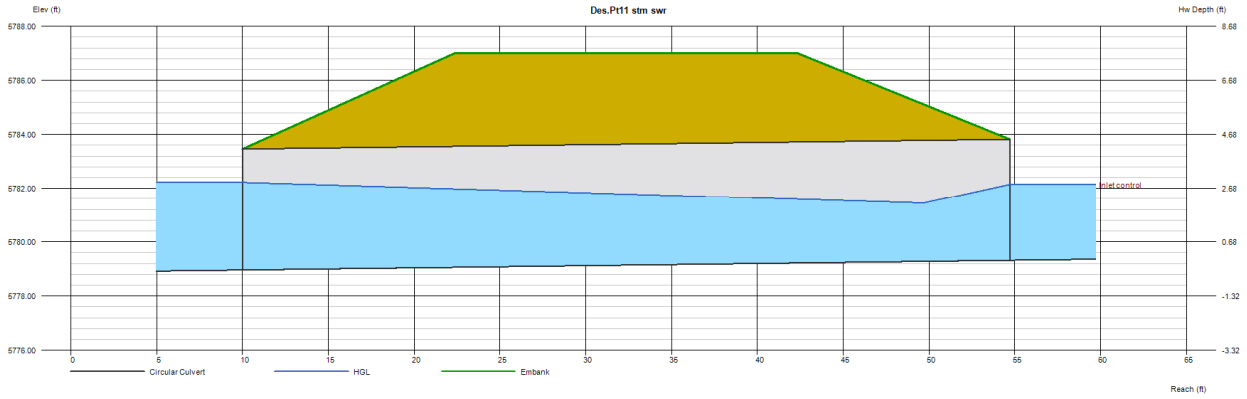
Top Elevation (ft)	=	5787.00
Top Width (ft)	=	20.00
Crest Width (ft)	=	50.00

Calculations

Qmin (cfs)	=	49.00
Qmax (cfs)	=	49.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	49.00
Qpipe (cfs)	=	49.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	3.97
Veloc Up (ft/s)	=	7.07
HGL Dn (ft)	=	5782.22
HGL Up (ft)	=	5781.34
Hw Elev (ft)	=	5782.14
Hw/D (ft)	=	0.63
Flow Regime	=	Inlet Control



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Jan 30 2026

DP13 diversion berm

Trapezoidal

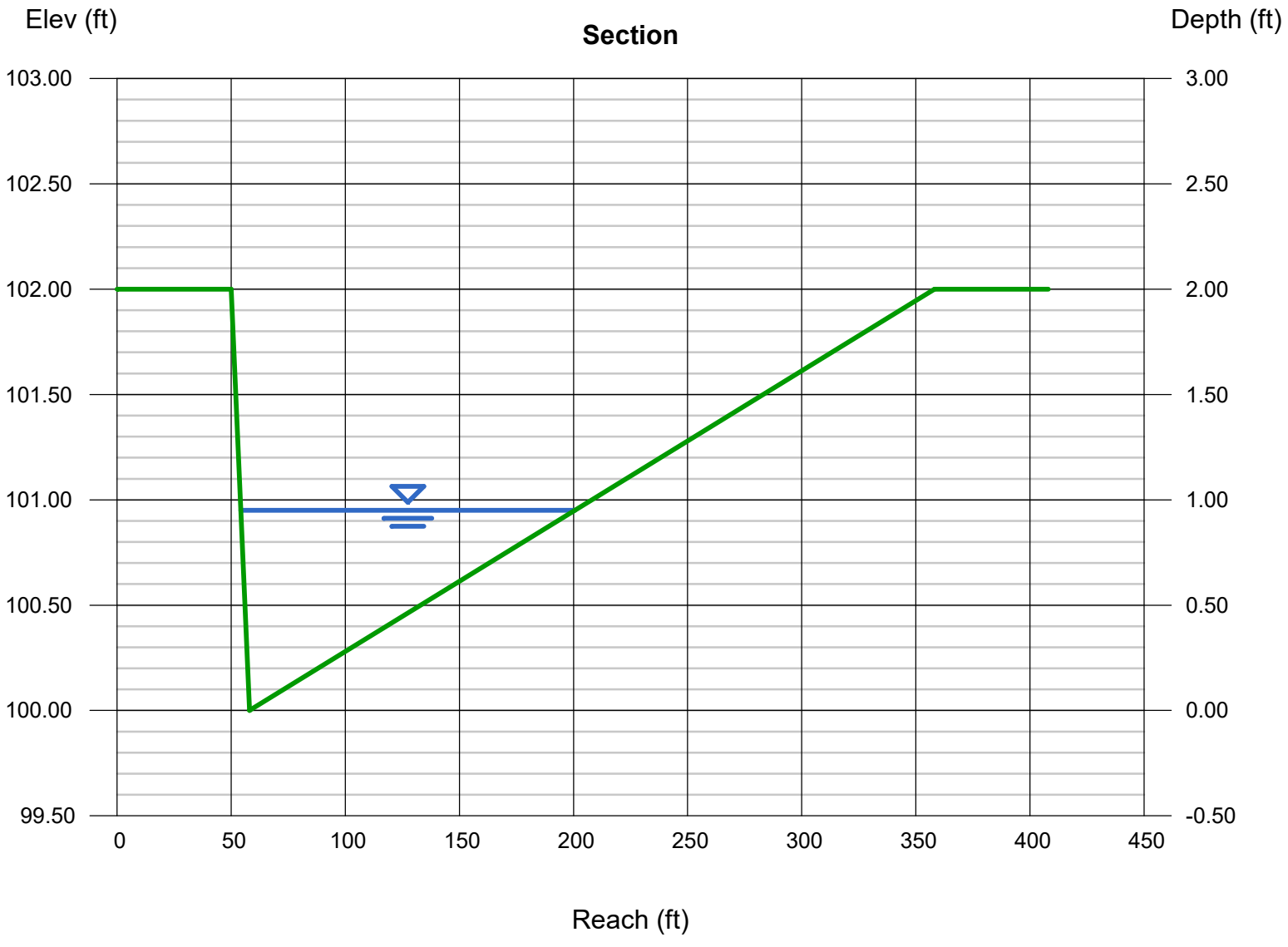
Bottom Width (ft)	= 0.10
Side Slopes (z:1)	= 4.00, 150.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 100.00
Slope (%)	= 0.30
N-Value	= 0.020

Calculations

Compute by:	Known Q
Known Q (cfs)	= 169.80

Highlighted

Depth (ft)	= 0.95
Q (cfs)	= 169.80
Area (sqft)	= 69.59
Velocity (ft/s)	= 2.44
Wetted Perim (ft)	= 146.52
Crit Depth, Yc (ft)	= 0.79
Top Width (ft)	= 146.40
EGL (ft)	= 1.04



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Apr 29 2025

Swale 'D1' at 0.5% - 260cfs

Trapezoidal

Bottom Width (ft)	= 6.00
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 4.00
Invert Elev (ft)	= 100.00
Slope (%)	= 0.50
N-Value	= 0.020

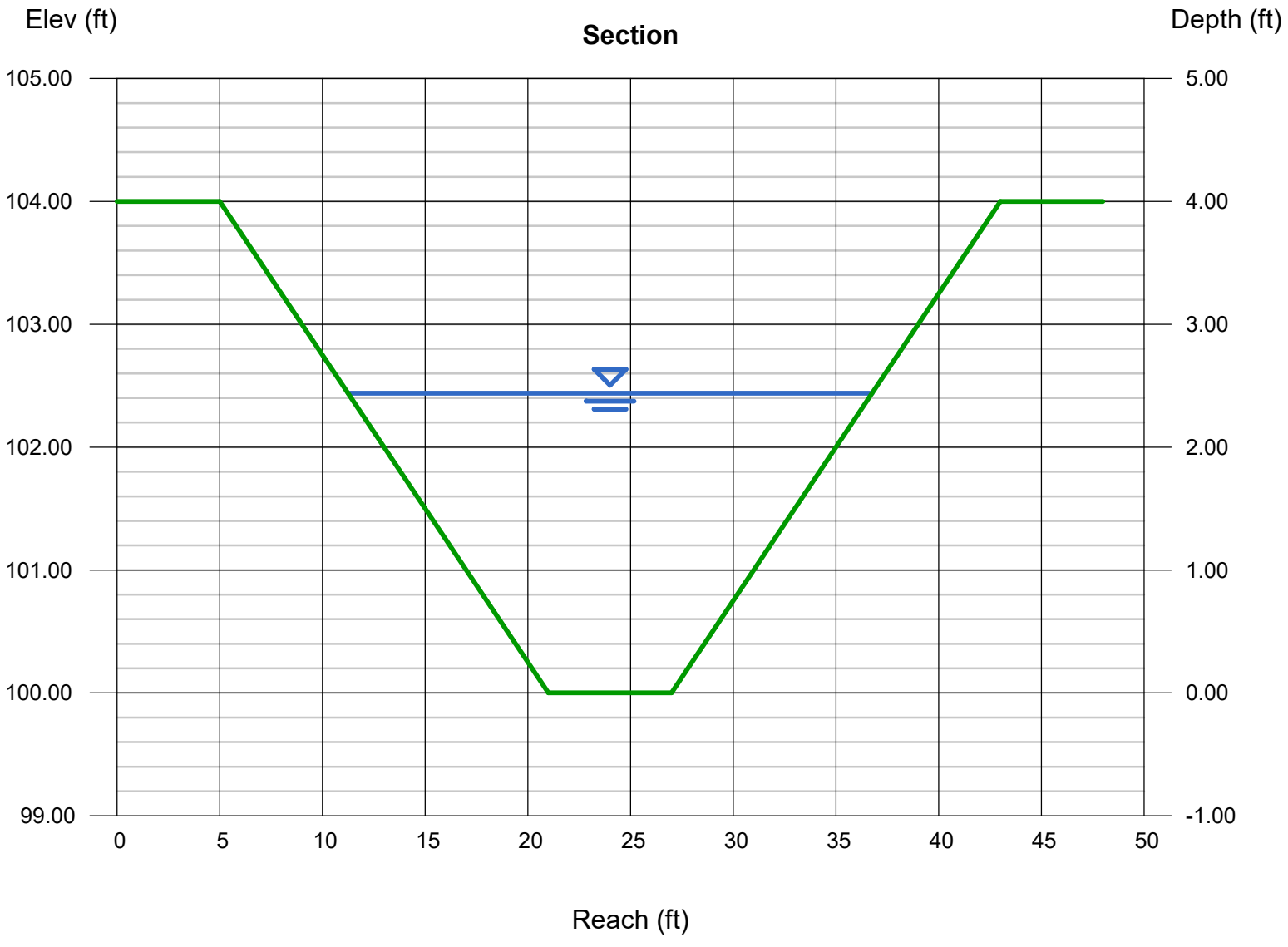
Calculations

Compute by:	Known Q
Known Q (cfs)	= 260.50

Highlighted

Depth (ft)	= 2.44
Q (cfs)	= 260.50
Area (sqft)	= 38.45
Velocity (ft/s)	= 6.77
Wetted Perim (ft)	= 26.12
Crit Depth, Yc (ft)	= 2.41
Top Width (ft)	= 25.52
EGL (ft)	= 3.15

see design pt. 15 for
design flow value explaination



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Apr 29 2025

Swale 'D2' at 0.3% - 260cfs

Trapezoidal

Bottom Width (ft)	= 6.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 4.00
Invert Elev (ft)	= 100.00
Slope (%)	= 0.30
N-Value	= 0.020

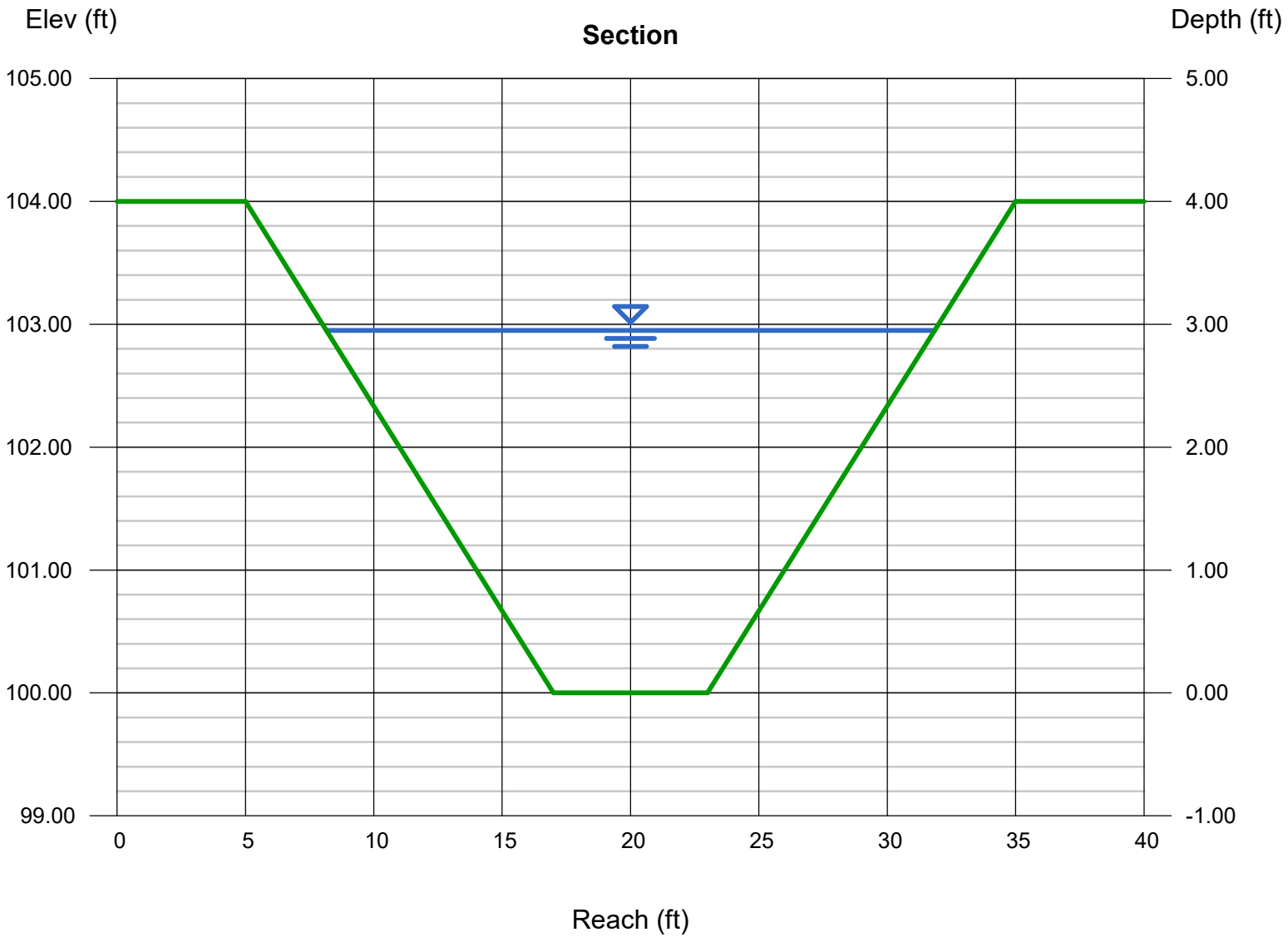
Calculations

Compute by:	Known Q
Known Q (cfs)	= 260.50

Highlighted

Depth (ft)	= 2.95
Q (cfs)	= 260.50
Area (sqft)	= 43.81
Velocity (ft/s)	= 5.95
Wetted Perim (ft)	= 24.66
Crit Depth, Yc (ft)	= 2.60
Top Width (ft)	= 23.70
EGL (ft)	= 3.50

see design pt. 15 for
design flow value explanation



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Apr 29 2025

Swale 'D2' at 2.0% - 260cfs

Trapezoidal

Bottom Width (ft)	= 6.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 4.00
Invert Elev (ft)	= 100.00
Slope (%)	= 2.00
N-Value	= 0.020

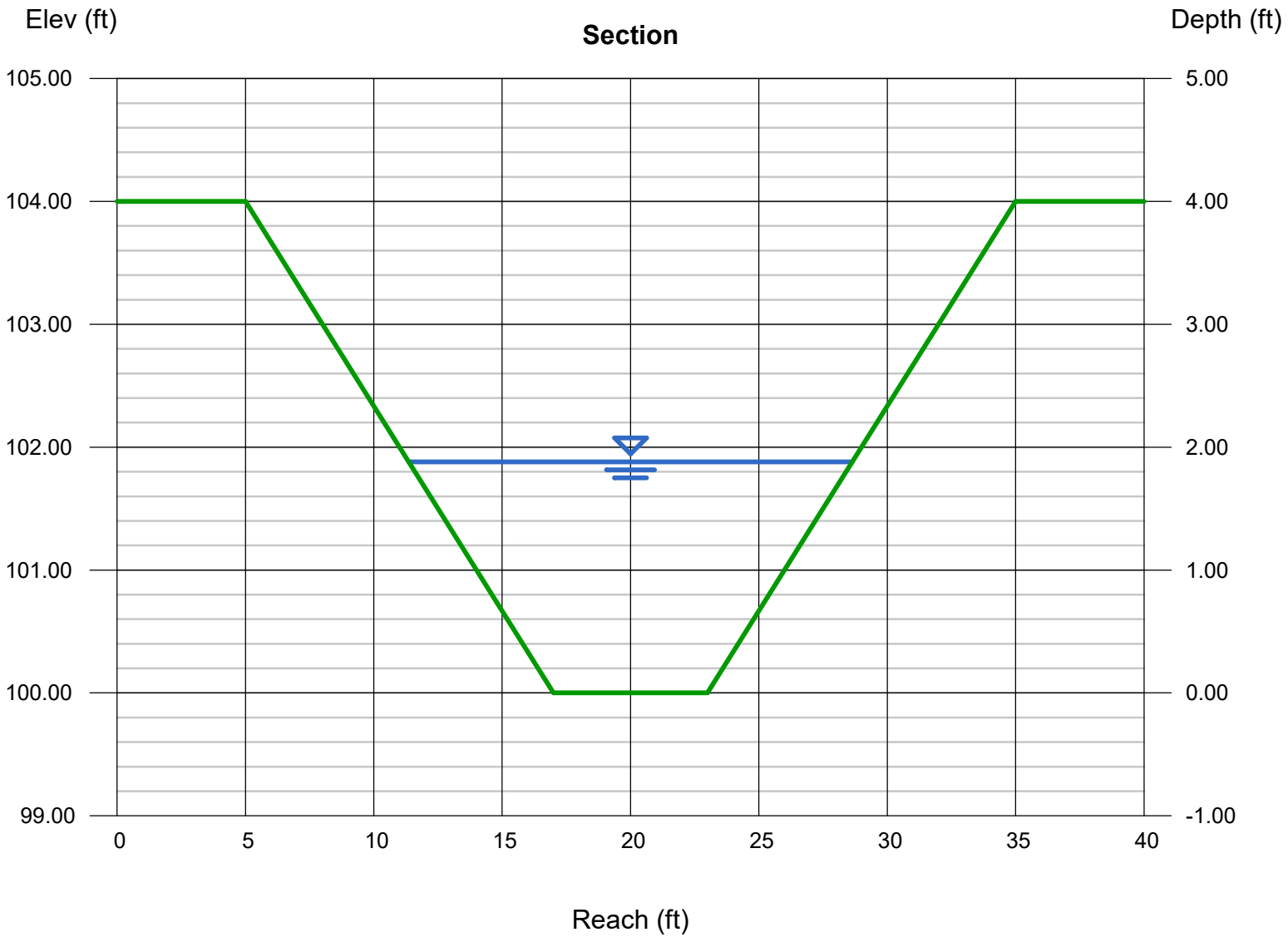
Calculations

Compute by:	Known Q
Known Q (cfs)	= 260.50

Highlighted

Depth (ft)	= 1.88
Q (cfs)	= 260.50
Area (sqft)	= 21.88
Velocity (ft/s)	= 11.90
Wetted Perim (ft)	= 17.89
Crit Depth, Yc (ft)	= 2.60
Top Width (ft)	= 17.28
EGL (ft)	= 4.08

see design pt. 14 for
design flow value explanation



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Apr 29 2025

Swale 'D3' at 0.3% - 260cfs

Trapezoidal

Bottom Width (ft)	= 6.00
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 4.00
Invert Elev (ft)	= 100.00
Slope (%)	= 0.30
N-Value	= 0.020

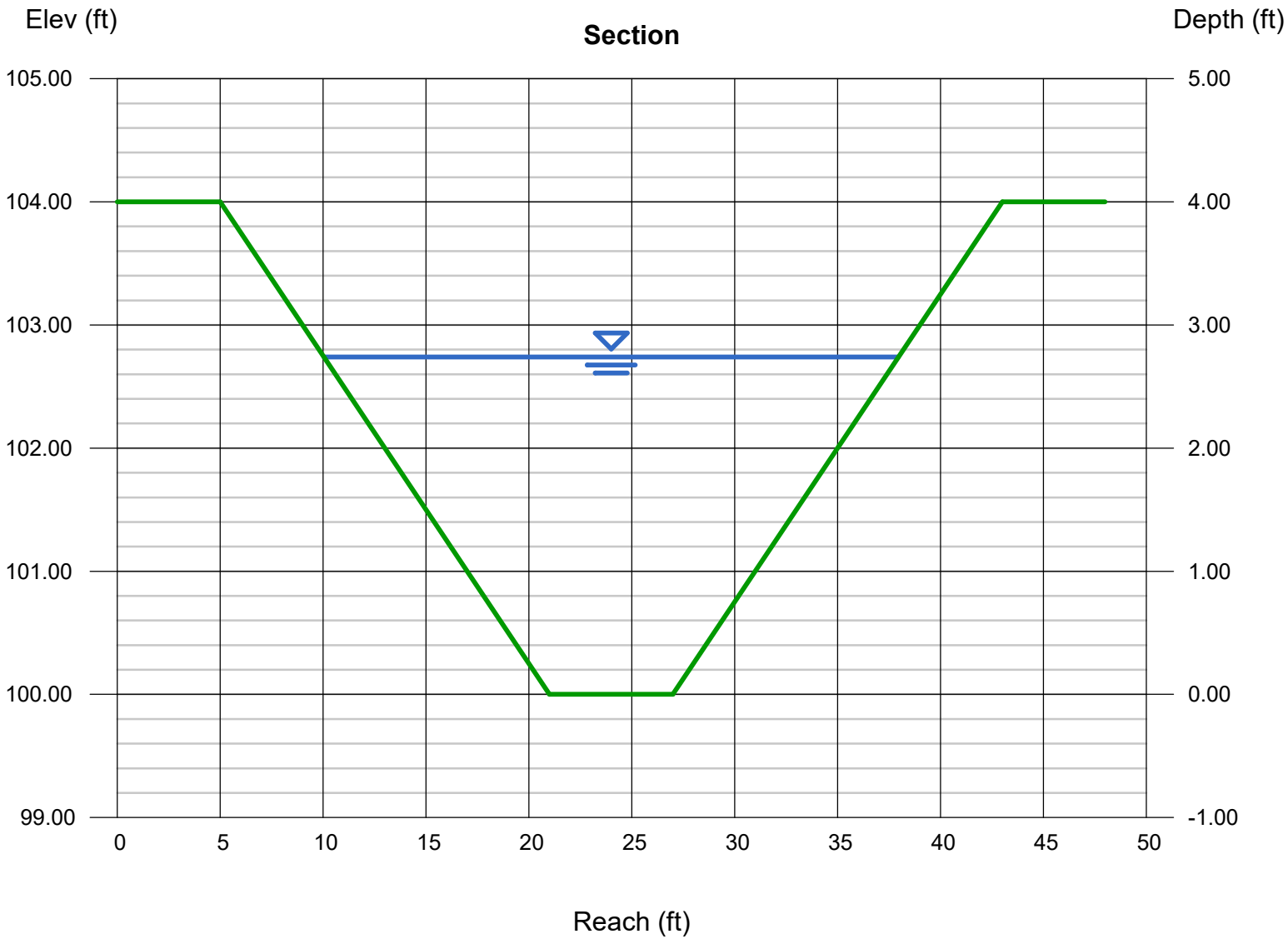
Calculations

Compute by:	Known Q
Known Q (cfs)	= 260.50

Highlighted

Depth (ft)	= 2.74
Q (cfs)	= 260.50
Area (sqft)	= 46.47
Velocity (ft/s)	= 5.61
Wetted Perim (ft)	= 28.59
Crit Depth, Yc (ft)	= 2.41
Top Width (ft)	= 27.92
EGL (ft)	= 3.23

see design pt. 14 for
design flow value explanation



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Apr 3 2025

Culverts at Des.Pt. D14 twin 48" culverts

Invert Elev Dn (ft)	=	5804.70
Pipe Length (ft)	=	92.00
Slope (%)	=	0.50
Invert Elev Up (ft)	=	5805.16
Rise (in)	=	48.0
Shape	=	Circular
Span (in)	=	48.0
No. Barrels	=	2
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

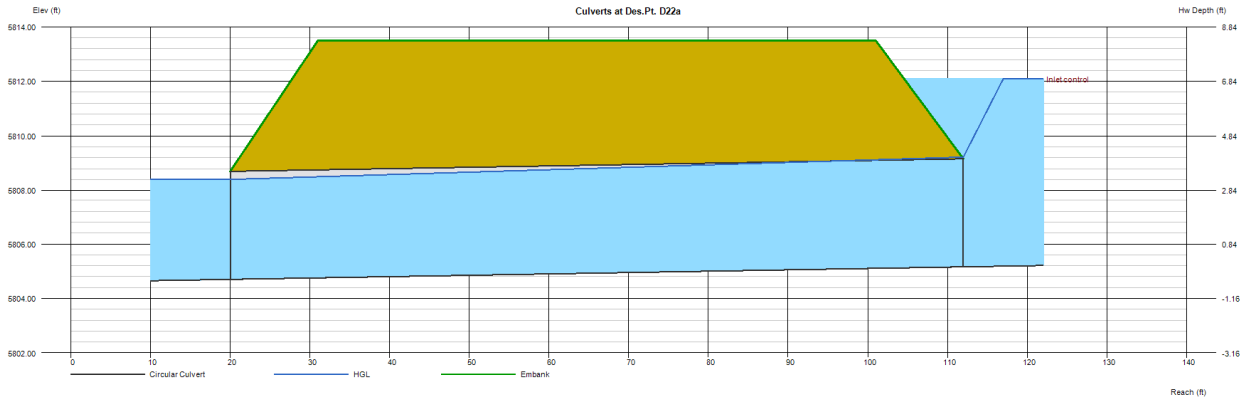
Top Elevation (ft)	=	5813.50
Top Width (ft)	=	70.00
Crest Width (ft)	=	30.00

Calculations

Qmin (cfs)	=	250.00
Qmax (cfs)	=	260.50
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	260.00
Qpipe (cfs)	=	260.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	10.70
Veloc Up (ft/s)	=	10.35
HGL Dn (ft)	=	5808.41
HGL Up (ft)	=	5809.22
Hw Elev (ft)	=	5812.09
Hw/D (ft)	=	1.73
Flow Regime	=	Inlet Control



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Jan 30 2026

DP 1 Low Point Swale

Trapezoidal

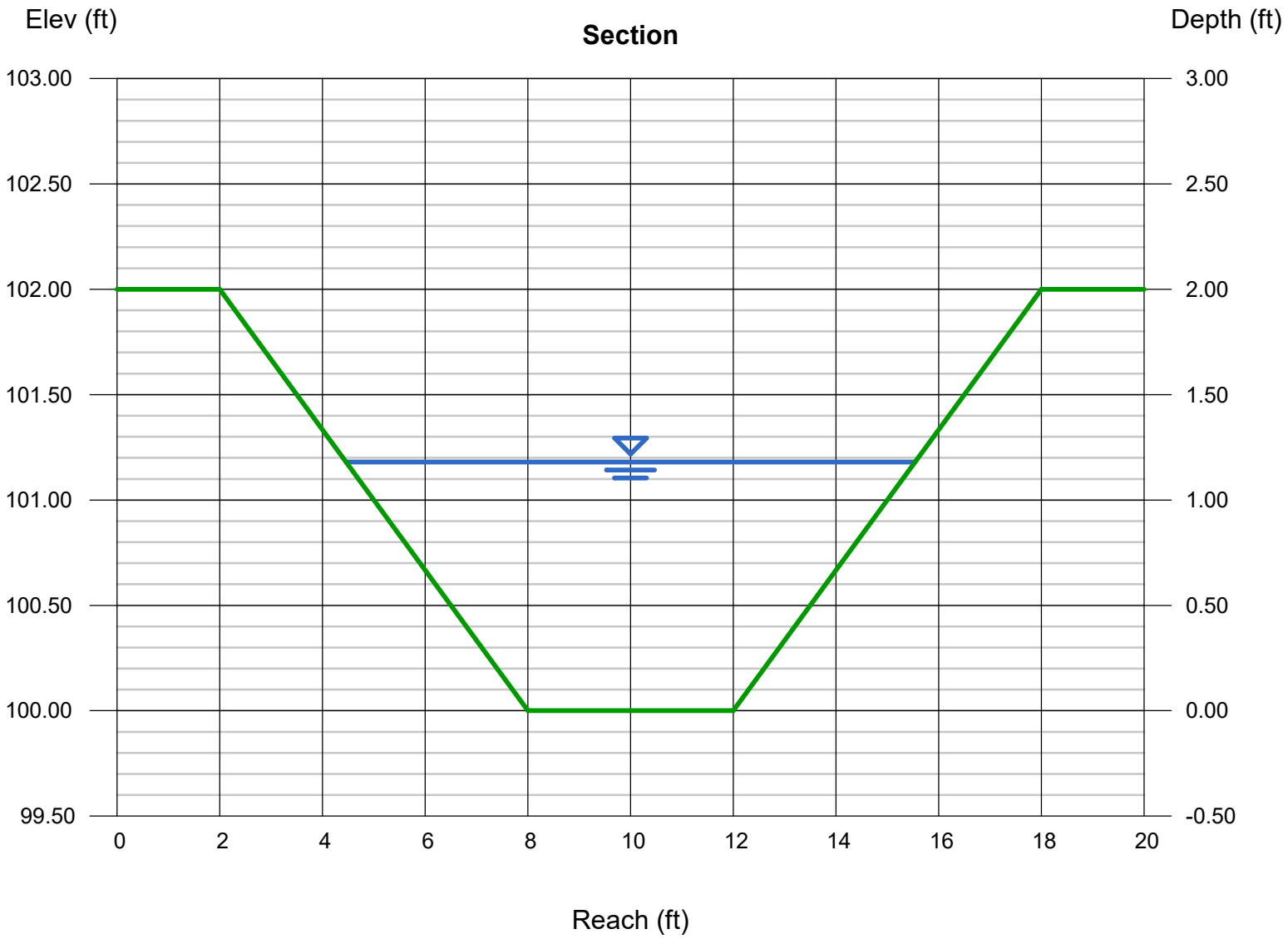
Bottom Width (ft)	= 4.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 100.00
Slope (%)	= 0.16
N-Value	= 0.020

Calculations

Compute by:	Known Q
Known Q (cfs)	= 22.30

Highlighted

Depth (ft)	= 1.18
Q (cfs)	= 22.30
Area (sqft)	= 8.90
Velocity (ft/s)	= 2.51
Wetted Perim (ft)	= 11.46
Crit Depth, Yc (ft)	= 0.81
Top Width (ft)	= 11.08
EGL (ft)	= 1.28



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Jan 29 2026

DP4 low point swale

Trapezoidal

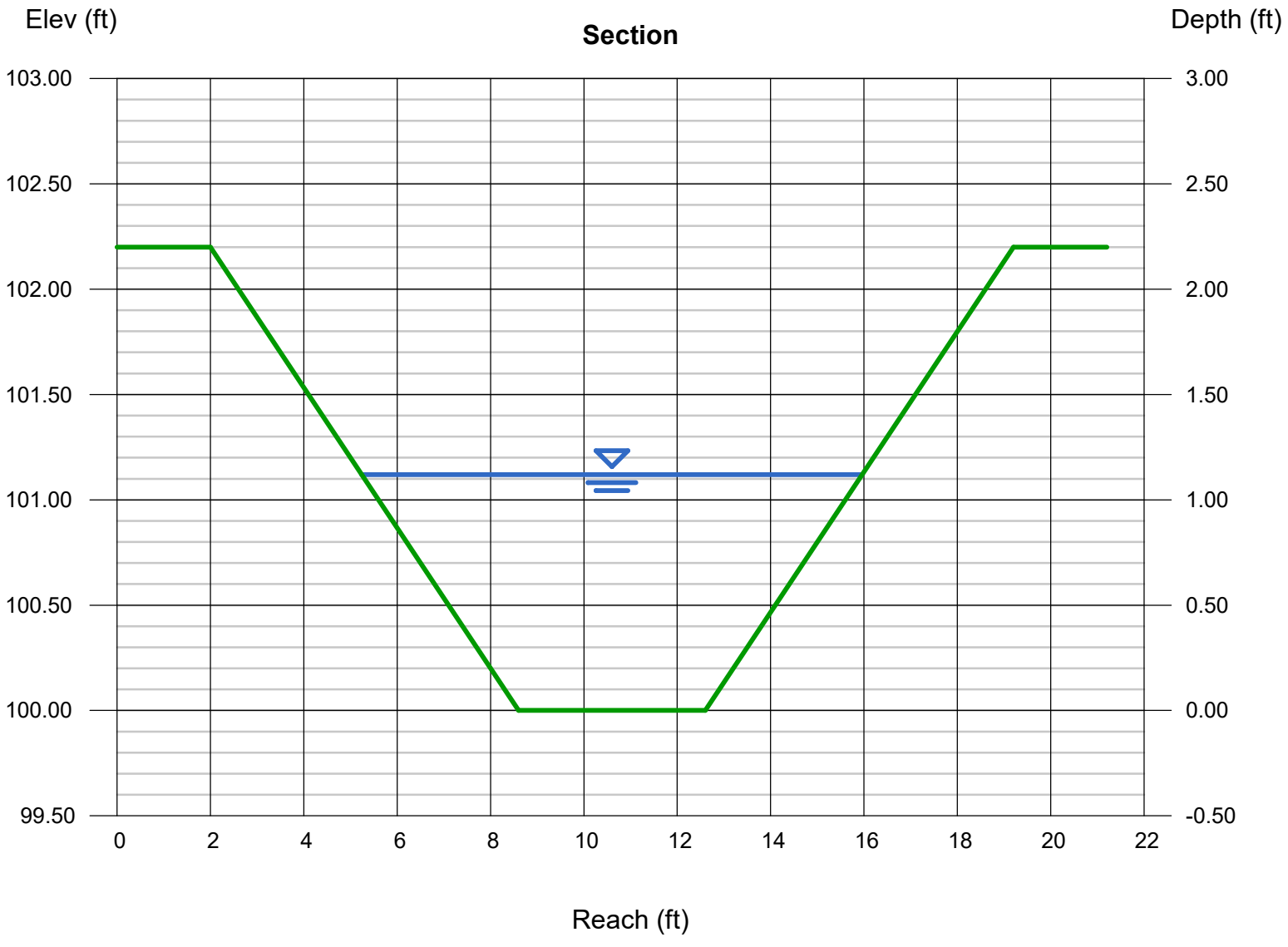
Bottom Width (ft)	= 4.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 2.20
Invert Elev (ft)	= 100.00
Slope (%)	= 0.30
N-Value	= 0.020

Calculations

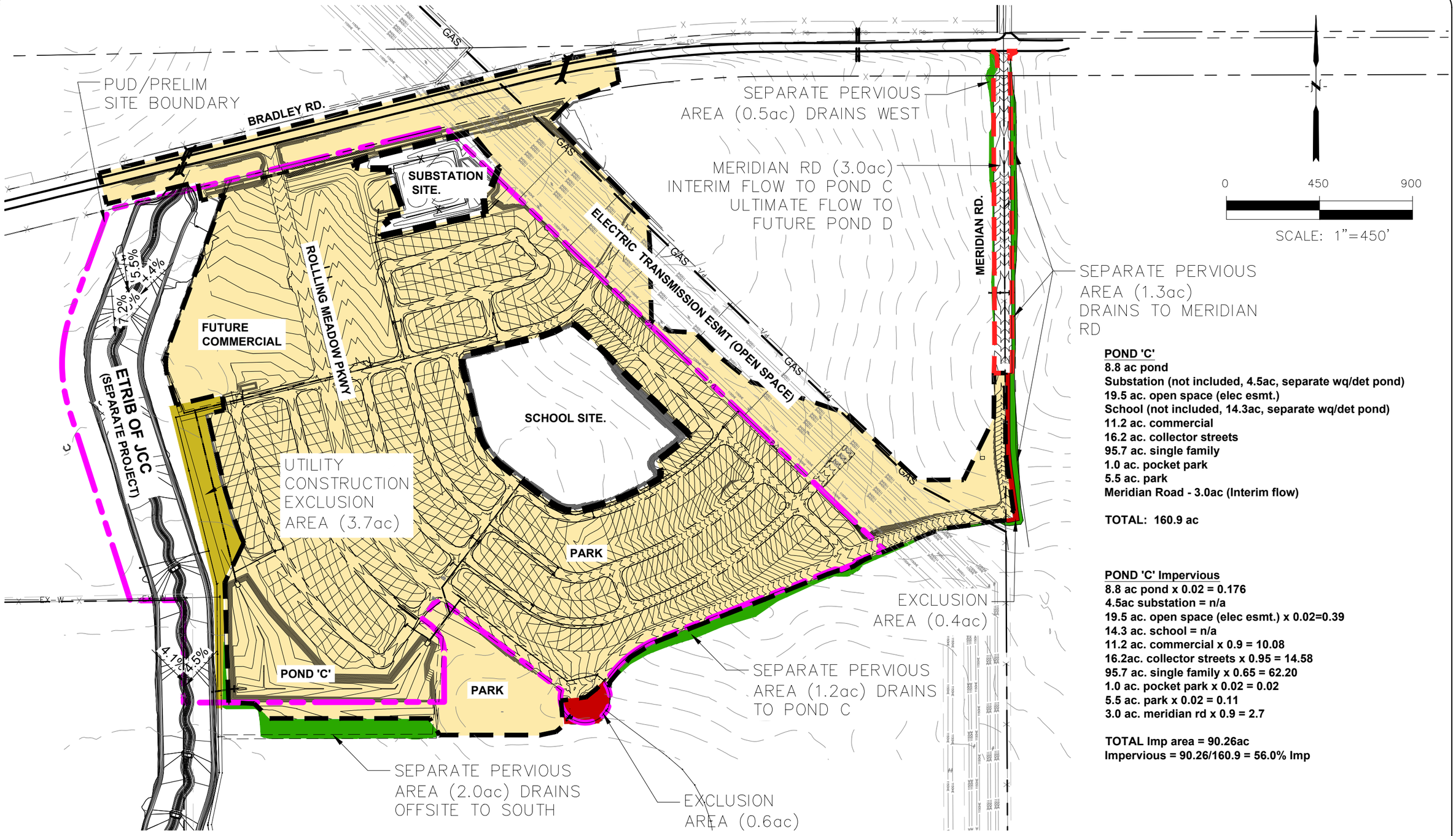
Compute by:	Known Q
Known Q (cfs)	= 27.50

Highlighted

Depth (ft)	= 1.12
Q (cfs)	= 27.50
Area (sqft)	= 8.24
Velocity (ft/s)	= 3.34
Wetted Perim (ft)	= 11.08
Crit Depth, Yc (ft)	= 0.91
Top Width (ft)	= 10.72
EGL (ft)	= 1.29



APPENDIX D – POND AND ROUTING CALCULATIONS



POND 'C'
8.8 ac pond
Substation (not included, 4.5ac, separate wq/det pond)
19.5 ac. open space (elec esmt.)
School (not included, 14.3ac, separate wq/det pond)
11.2 ac. commercial
16.2 ac. collector streets
95.7 ac. single family
1.0 ac. pocket park
5.5 ac. park
Meridian Road - 3.0ac (Interim flow)

TOTAL: 160.9 ac

POND 'C' Impervious
8.8 ac pond x 0.02 = 0.176
4.5ac substation = n/a
19.5 ac. open space (elec esmt.) x 0.02=0.39
14.3 ac. school = n/a
11.2 ac. commercial x 0.9 = 10.08
16.2ac. collector streets x 0.95 = 14.58
95.7 ac. single family x 0.65 = 62.20
1.0 ac. pocket park x 0.02 = 0.02
5.5 ac. park x 0.02 = 0.11
3.0 ac. meridian rd x 0.9 = 2.7

TOTAL Imp area = 90.26ac
Impervious = 90.26/160.9 = 56.0% Imp

CORE ENGINEERING GROUP
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POND 'C' DRAINAGE AREA AND WQ AREAS

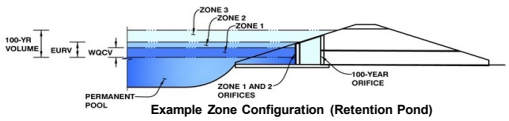
DATE: MAY, 2025
JOB NO: 100.302
SCALE: AS SHOWN N/A
FIGURE NO: 1

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Antelope Ridge at Bull Hill Filing No. 1

Basin ID: Pond C



Example Zone Configuration (Retention Pond)

micropool=5774.5

Depth Increment = 0.10 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft²)	Optional Override Area (ft²)	Area (acre)	Volume (ft³)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	30	0.001		
5775	--	0.50	--	--	--	30	0.001	15	0.000
5776	--	1.50	--	--	--	560	0.013	310	0.007
5777	--	2.50	--	--	--	16,719	0.384	8,949	0.205
5778	--	3.50	--	--	--	57,204	1.313	45,911	1.054
5779	--	4.50	--	--	--	120,334	2.762	134,679	3.092
5780	--	5.50	--	--	--	177,864	4.083	283,778	6.515
5781	--	6.50	--	--	--	210,224	4.826	477,822	10.969
5782	--	7.50	--	--	--	230,470	5.291	698,169	16.028
5783	--	8.50	--	--	--	246,275	5.654	936,542	21.500
5784	--	9.50	--	--	--	259,149	5.949	1,189,254	27.302
5785	--	10.50	--	--	--	272,091	6.246	1,454,874	33.399

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	160.90	acres
Watershed Length =	3,000	ft
Watershed Length to Centroid =	1,350	ft
Watershed Slope =	0.030	ft/ft
Watershed Imperviousness =	56.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	76.0%	percent
Percentage Hydrologic Soil Groups C/D =	24.0%	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) =	2.996	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	9.452	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	9.252	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	12.928	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	16.155	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	20.153	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	23.564	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	27.762	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3.14 in.) =	36.498	acre-feet	inches
Approximate 2-yr Detention Volume =	7.473	acre-feet	
Approximate 5-yr Detention Volume =	10.328	acre-feet	
Approximate 10-yr Detention Volume =	13.014	acre-feet	
Approximate 25-yr Detention Volume =	14.096	acre-feet	
Approximate 50-yr Detention Volume =	14.676	acre-feet	
Approximate 100-yr Detention Volume =	16.216	acre-feet	

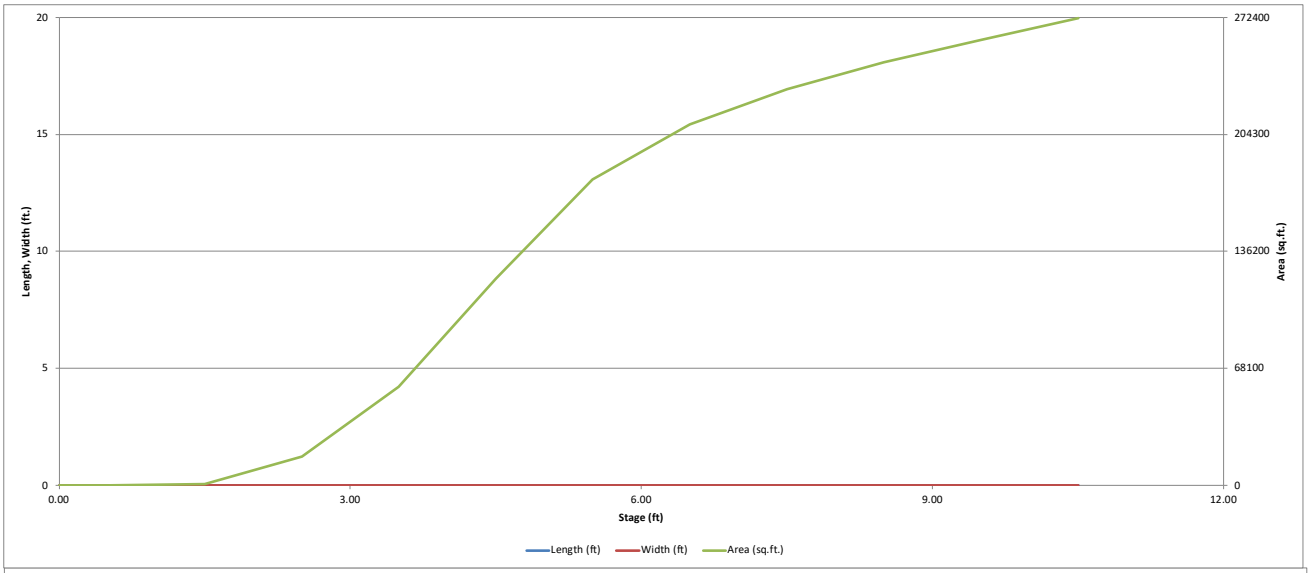
Define Zones and Basin Geometry

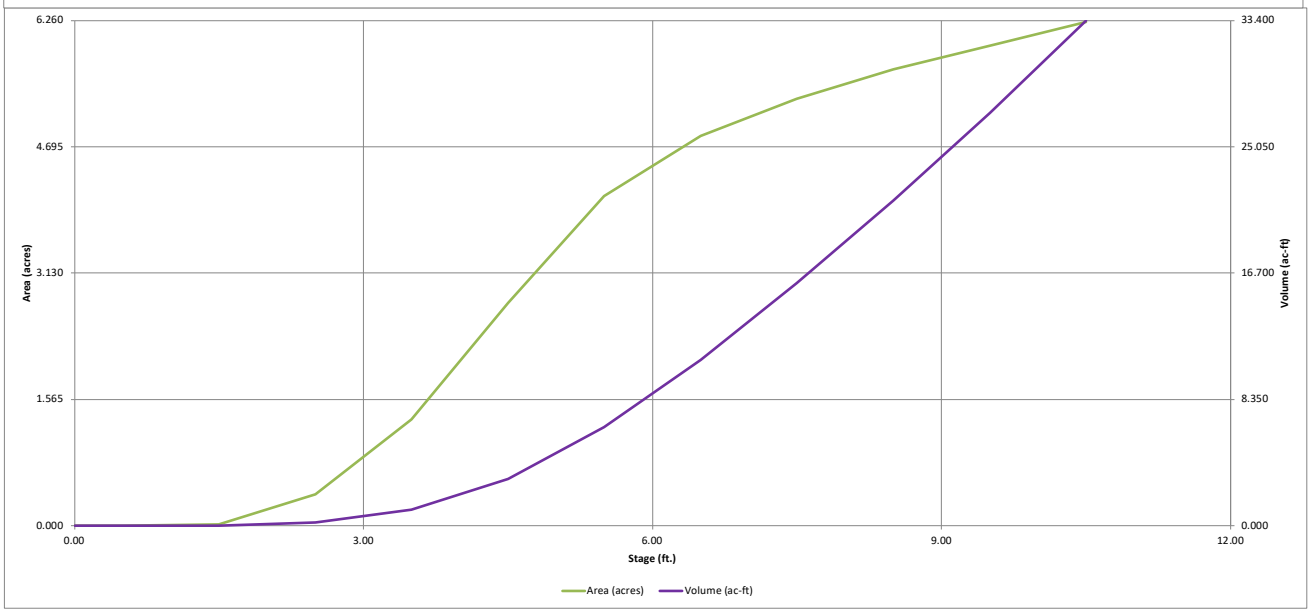
Zone 1 Volume (WQCV) =	2.996	acre-feet
Zone 2 Volume (EURV - Zone 1) =	6.456	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	8.262	acre-feet
Total Detention Basin Volume =	17.714	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention 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

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



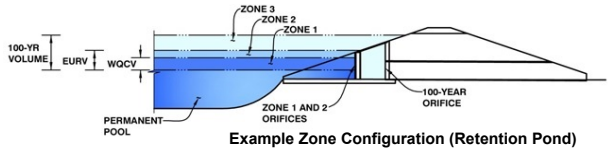


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Antelope Ridge at Bull Hill Filing No. 1

Basin ID: Pond C



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	4.47	2.996	Orifice Plate
Zone 2 (EURV)	6.18	6.456	Rectangular Orifice
Z3 (100+1/2WQCV)	7.82	8.262	Weir&Pipe (Restrict)
Total (all zones)		17.714	

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

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

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	4.771E-02	ft²
Depth at top of Zone using Orifice Plate =	4.47	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	18.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	6.87	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.50	3.00					
Orifice Area (sq. inches)	6.87	6.87	6.87					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected			Calculated Parameters for Vertical Orifi: Zone 2 Rectangular	Not Selected
Invert of Vertical Orifice =	4.47	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	4.20	N/A
Depth at top of Zone using Vertical Orifice =	6.18	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.58	N/A
Vertical Orifice Height =	14.00	N/A	inches			
Vertical Orifice Width =	43.19		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 We: Zone 3 Weir	Not Selected
Overflow Weir Front Edge Height, Ho =	6.50	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	6.50	N/A
Overflow Weir Front Edge Length =	30.00	N/A	feet	Overflow Weir Slope Length =	5.83	N/A
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	6.20	N/A
Horiz. Length of Weir Sides =	5.83	N/A	feet	Overflow Grate Open Area w/o Debris =	121.73	N/A
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	60.87	N/A
Debris Clogging % =	50%	N/A	%			

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

	Zone 3 Restrictor	Not Selected			Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla: Zone 3 Restrictor	Not Selected
Depth to Invert of Outlet Pipe =	0.33	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	19.63	N/A
Outlet Pipe Diameter =	60.00	N/A	inches	Outlet Orifice Centroid =	2.50	N/A
Restrictor Plate Height Above Pipe Invert =	60.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	8.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	1.98	feet
Spillway Crest Length =	55.00	feet	Stage at Top of Freeboard =	10.48	feet
Spillway End Slopes =	6.00	H:V	Basin Area at Top of Freeboard =	6.24	acres
Freeboard above Max Water Surface =	0.50	feet	Basin Volume at Top of Freeboard =	33.27	acre-ft

Calculated Parameters for Spillway

micropool=5774.50

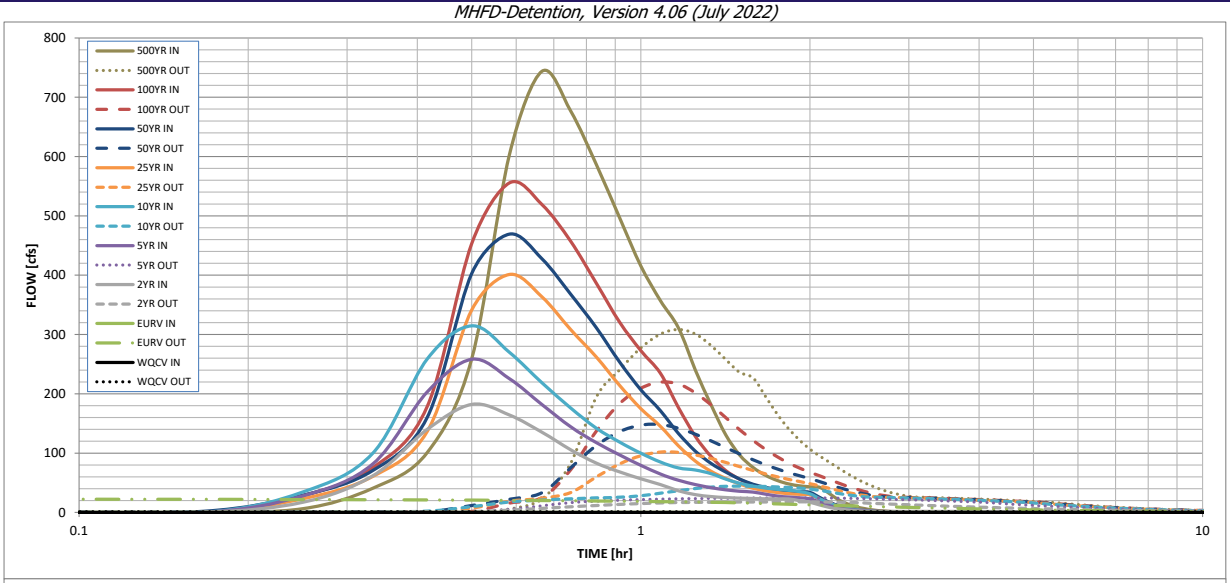
Routed Hydrograph Results

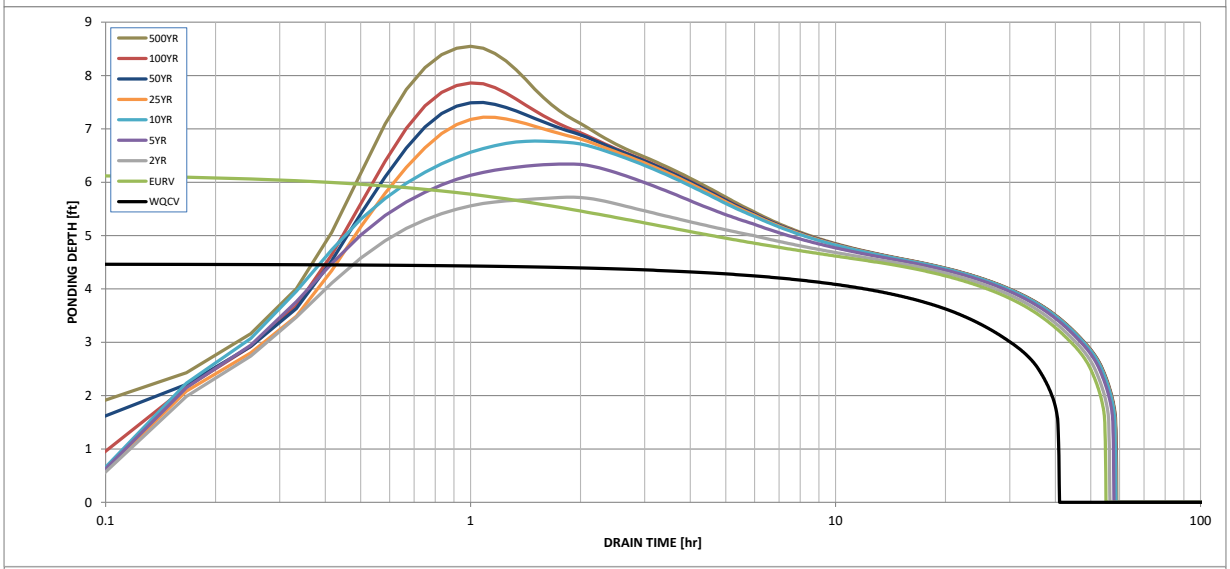
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF)

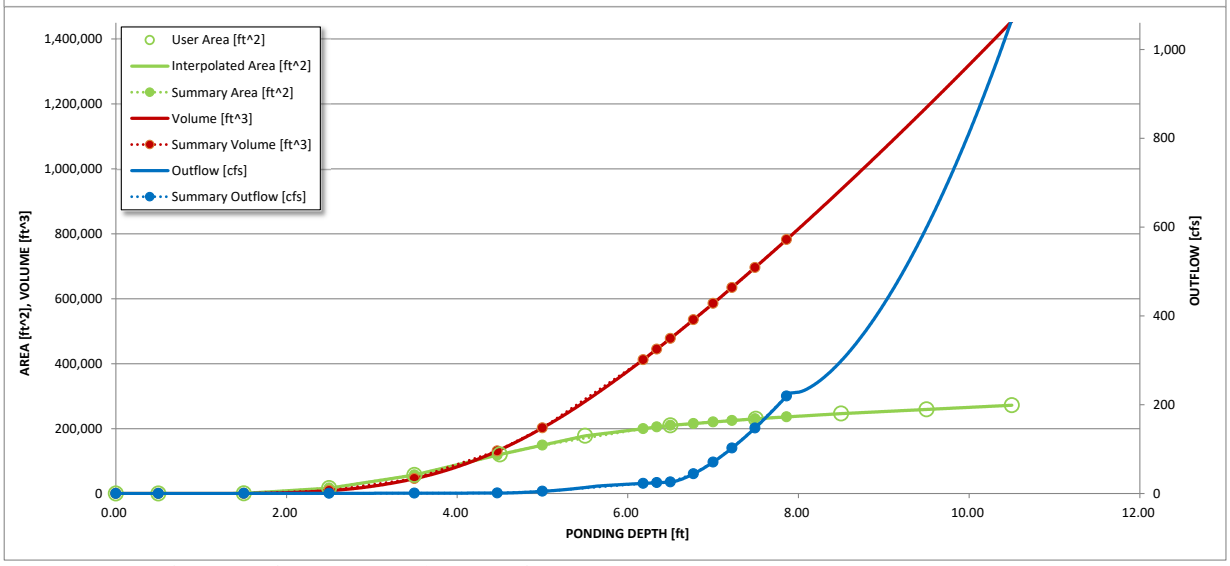
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	2.996	9.452	9.252	12.928	16.155	20.153	23.564	27.762
User Override Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	9.713	13.529	17.085	21.510	25.305	29.958
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	26.9	65.3	98.3	165.9	206.4	261.0
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.17	0.41	0.61	1.03	1.28	1.62
Peak Inflow Q (cfs) =	N/A	N/A	182.1	258.1	314.7	401.3	469.3	555.5
Peak Outflow Q (cfs) =	1.2	22.7	17.9	24.4	44.3	101.6	148.0	219.2
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.4	0.5	0.6	0.7	0.8
Structure Controlling Flow =	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.1	0.6	0.9	1.5
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	49	50	49	48	46	44	42
Time to Drain 99% of Inflow Volume (hours) =	**40**	52	54	54	54	54	53	52
Maximum Ponding Depth (ft) =	4.47	6.18	5.72	6.34	6.77	7.22	7.50	7.86
Area at Maximum Ponding Depth (acres) =	2.72	4.59	4.24	4.70	4.95	5.16	5.29	5.42
Maximum Volume Stored (acre-ft) =	3.010	9.463	7.389	10.160	12.289	14.513	15.975	17.956

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: C:\Users\Rich\OneDrive - Core Engineering Group\PROJECTS\100.302\Drainage\pc

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	USER	USER	USER	USER	USER	USER	USER
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	0.04	0.02	0.06
	0:10:00	0.00	0.00	0.07	0.08	0.09	0.08	2.00	0.27	6.25
	0:15:00	0.00	0.00	17.00	27.72	34.31	23.07	28.93	28.12	40.85
	0:20:00	0.00	0.00	61.79	81.75	99.89	60.77	70.68	75.68	100.94
	0:25:00	0.00	0.00	140.08	203.15	258.62	136.63	160.36	178.54	259.04
	0:30:00	0.00	0.00	182.08	258.14	314.68	341.27	402.80	453.17	602.36
	0:35:00	0.00	0.00	164.24	225.65	270.03	401.28	469.29	555.45	743.68
	0:40:00	0.00	0.00	135.25	181.93	218.55	363.42	427.60	519.12	676.55
	0:45:00	0.00	0.00	105.65	144.29	176.03	308.14	367.86	457.01	586.55
	0:50:00	0.00	0.00	83.03	117.72	142.08	262.06	311.38	386.30	496.40
	0:55:00	0.00	0.00	68.36	96.90	118.43	214.00	253.33	320.57	415.60
	1:00:00	0.00	0.00	56.74	79.27	99.73	174.94	206.81	272.65	357.19
	1:05:00	0.00	0.00	46.98	64.79	84.92	145.30	171.63	234.71	311.08
	1:10:00	0.00	0.00	36.57	54.14	74.91	112.26	133.00	176.73	240.53
	1:15:00	0.00	0.00	29.95	47.05	71.63	86.60	103.38	128.51	181.34
	1:20:00	0.00	0.00	26.87	41.68	65.36	69.25	82.60	94.32	130.71
	1:25:00	0.00	0.00	25.09	38.05	56.14	57.36	68.06	70.57	96.55
	1:30:00	0.00	0.00	24.17	35.75	49.12	47.79	56.28	55.99	75.94
	1:35:00	0.00	0.00	23.54	34.27	44.42	40.77	47.61	46.44	62.55
	1:40:00	0.00	0.00	23.08	30.73	41.18	36.47	42.26	40.09	53.77
	1:45:00	0.00	0.00	22.78	27.69	39.00	33.49	38.57	35.91	48.00
	1:50:00	0.00	0.00	22.66	25.83	37.40	31.63	36.25	33.58	44.75
	1:55:00	0.00	0.00	19.84	24.60	35.11	30.57	34.90	32.63	43.34
	2:00:00	0.00	0.00	17.09	23.05	31.38	29.66	33.78	31.87	42.26
	2:05:00	0.00	0.00	12.50	16.99	22.84	22.11	25.12	23.86	31.51
	2:10:00	0.00	0.00	8.48	11.39	15.41	14.89	16.87	16.11	21.15
	2:15:00	0.00	0.00	5.90	7.74	10.49	10.25	11.57	11.07	14.41
	2:20:00	0.00	0.00	4.08	5.23	7.03	6.92	7.77	7.45	9.58
	2:25:00	0.00	0.00	2.85	3.73	4.74	4.76	5.29	5.10	6.45
	2:30:00	0.00	0.00	2.02	2.71	3.19	3.30	3.61	3.50	4.29
	2:35:00	0.00	0.00	1.48	1.97	2.18	2.30	2.45	2.40	2.77
	2:40:00	0.00	0.00	1.21	1.51	1.59	1.66	1.72	1.71	1.86
	2:45:00	0.00	0.00	1.09	1.32	1.36	1.38	1.41	1.41	1.46
	2:50:00	0.00	0.00	1.09	1.32	1.35	1.36	1.38	1.38	1.42
	2:55:00	0.00	0.00	1.08	1.31	1.34	1.34	1.36	1.36	1.39
	3:00:00	0.00	0.00	1.07	1.31	1.34	1.34	1.34	1.34	1.36
	3:05:00	0.00	0.00	1.07	1.30	1.33	1.33	1.34	1.34	1.34
	3:10:00	0.00	0.00	1.06	1.30	1.33	1.33	1.33	1.33	1.33
	3:15:00	0.00	0.00	1.06	1.29	1.32	1.32	1.33	1.33	1.33
	3:20:00	0.00	0.00	1.05	1.29	1.32	1.32	1.32	1.32	1.33
	3:25:00	0.00	0.00	1.04	1.28	1.31	1.31	1.32	1.32	1.32
	3:30:00	0.00	0.00	1.04	1.28	1.31	1.31	1.31	1.31	1.32
	3:35:00	0.00	0.00	1.03	1.27	1.30	1.30	1.31	1.31	1.31
	3:40:00	0.00	0.00	1.03	1.27	1.30	1.30	1.30	1.30	1.31
	3:45:00	0.00	0.00	1.02	1.26	1.29	1.30	1.30	1.30	1.30
	3:50:00	0.00	0.00	1.02	1.26	1.29	1.29	1.29	1.29	1.30
	3:55:00	0.00	0.00	1.01	1.25	1.28	1.29	1.29	1.29	1.29
	4:00:00	0.00	0.00	1.00	1.25	1.28	1.28	1.28	1.28	1.29
	4:05:00	0.00	0.00	1.00	1.24	1.27	1.28	1.28	1.28	1.28
	4:10:00	0.00	0.00	0.99	1.24	1.27	1.27	1.27	1.27	1.28
	4:15:00	0.00	0.00	0.98	1.23	1.26	1.27	1.27	1.27	1.27
	4:20:00	0.00	0.00	0.98	1.23	1.26	1.26	1.26	1.26	1.27
	4:25:00	0.00	0.00	0.97	1.22	1.25	1.26	1.26	1.26	1.26
	4:30:00	0.00	0.00	0.97	1.22	1.25	1.25	1.25	1.25	1.26
	4:35:00	0.00	0.00	0.96	1.21	1.24	1.25	1.25	1.25	1.25
	4:40:00	0.00	0.00	0.95	1.21	1.24	1.24	1.24	1.24	1.25
	4:45:00	0.00	0.00	0.95	1.20	1.23	1.24	1.24	1.24	1.24
	4:50:00	0.00	0.00	0.94	1.20	1.23	1.23	1.23	1.23	1.24
	4:55:00	0.00	0.00	0.93	1.19	1.22	1.22	1.23	1.23	1.23
	5:00:00	0.00	0.00	0.93	1.19	1.22	1.22	1.22	1.22	1.23
	5:05:00	0.00	0.00	0.92	1.18	1.21	1.21	1.22	1.22	1.22
	5:10:00	0.00	0.00	0.92	1.18	1.21	1.21	1.21	1.21	1.22
	5:15:00	0.00	0.00	0.91	1.17	1.20	1.20	1.21	1.21	1.21
	5:20:00	0.00	0.00	0.90	1.17	1.20	1.20	1.20	1.20	1.20
	5:25:00	0.00	0.00	0.90	1.16	1.19	1.19	1.20	1.20	1.20
	5:30:00	0.00	0.00	0.89	1.15	1.19	1.19	1.19	1.19	1.19
	5:35:00	0.00	0.00	0.88	1.15	1.18	1.18	1.19	1.19	1.19
	5:40:00	0.00	0.00	0.88	1.14	1.18	1.18	1.18	1.18	1.18
	5:45:00	0.00	0.00	0.87	1.14	1.17	1.17	1.17	1.17	1.18
	5:50:00	0.00	0.00	0.86	1.13	1.17	1.17	1.17	1.17	1.17
	5:55:00	0.00	0.00	0.86	1.13	1.16	1.16	1.16	1.16	1.17
	6:00:00	0.00	0.00	0.85	1.12	1.16	1.16	1.16	1.16	1.16

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

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]
MICROPOOL	0.00	30	0.001	0	0.000	0.00
	0.50	30	0.001	15	0.000	0.16
	1.50	560	0.013	310	0.007	0.28
	2.50	16,719	0.384	8,949	0.205	0.59
	3.50	57,204	1.313	45,911	1.054	0.92
WQ ELEV	4.47	118,440	2.719	131,098	3.010	1.16
	5.00	149,099	3.423	202,038	4.638	4.97
EURV	6.18	199,869	4.588	412,207	9.463	22.94
5-YR	6.34	205,046	4.707	444,601	10.207	24.44
	6.50	210,224	4.826	477,822	10.969	25.85
10-YR	6.77	215,690	4.952	535,321	12.289	44.33
	7.00	220,347	5.058	585,465	13.440	70.82
25-YR	7.22	224,801	5.161	634,431	14.565	102.26
50-YR	7.49	230,268	5.286	695,866	15.975	147.49
100-YR	7.86	236,160	5.421	782,163	17.956	219.56

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).

Pond C User Defined Inflow Hydrograph (Pond C CUHP hydrograph + MVEA Pond Outflow hydrograph + School Pond Outflow hydrograph) for Ponds in Series

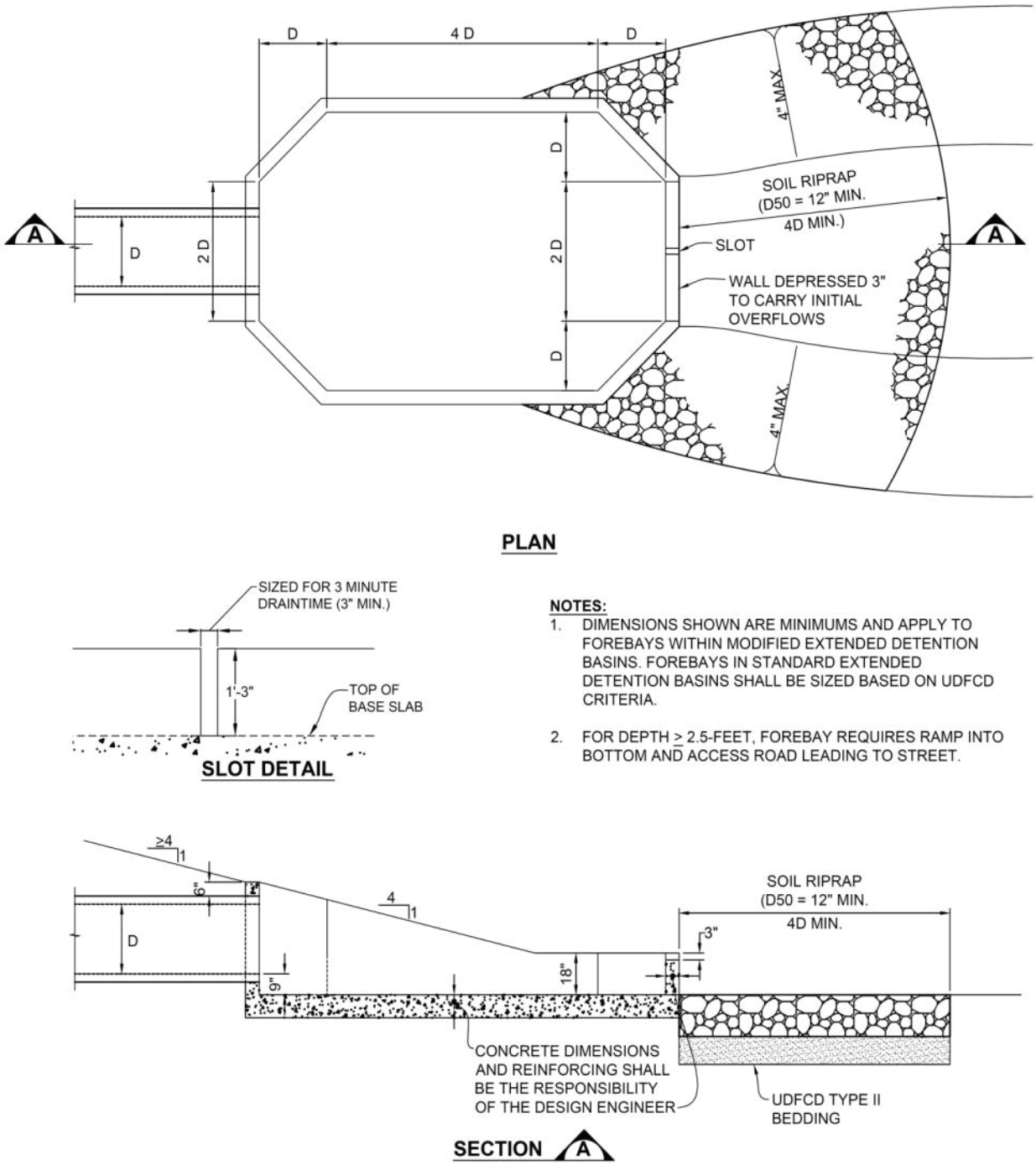
	WQCV [cfs]				EURV [cfs]				2-Year (cfs)			
SOURCE	CUHP				CUHP				CUHP			
TIME	Pond C CUHP Hydrograph	MVEA Outflow hydrograph	School Pond C1 Outflow Hydrograph	Combined WQCV Inflow (cfs)	Pond C CUHP Hydrograph	MVEA Outflow hydrograph	School Pond C1 Outflow Hydrograph	Combined EURV Inflow	Pond C CUHP Hydrograph	MVEA Outflow hydrograph	School Pond C1 Outflow Hydrograph	Combined 2-Yr Inflow (cfs)
0:00:00	0.00	0.0265937	0.18	0.20	0.00	0.2296004	1.08	1.31	0.00	0	0.00	0.00
0:05:00	0.00	0.0265769	0.18	0.20	0.00	0.2283468	1.07	1.30	0.00	0	0.00	0.00
0:10:00	0.00	0.0265601	0.18	0.20	0.00	0.2270802	1.07	1.30	0.00	0.00860037	0.07	0.07
0:15:00	0.00	0.0265432	0.18	0.20	0.00	0.2258122	1.07	1.29	16.90	0.013959554	0.09	17.00
0:20:00	0.00	0.0265264	0.18	0.20	0.00	0.2245373	1.06	1.29	61.64	0.018417961	0.13	61.79
0:25:00	0.00	0.0265096	0.18	0.20	0.00	0.2232537	1.06	1.28	139.88	0.022665892	0.17	140.08
0:30:00	0.00	0.0264928	0.18	0.20	0.00	0.2219689	1.05	1.28	181.61	0.025307388	0.45	182.08
0:35:00	0.00	0.0264761	0.18	0.20	0.00	0.2206718	1.05	1.27	163.59	0.029713354	0.61	164.24
0:40:00	0.00	0.0264592	0.18	0.20	0.00	0.2193709	1.05	1.27	134.48	0.072530896	0.70	135.25
0:45:00	0.00	0.0264422	0.18	0.20	0.00	0.2180663	1.04	1.26	104.78	0.119419964	0.75	105.65
0:50:00	0.00	0.0264251	0.18	0.20	0.00	0.2167488	1.04	1.26	82.11	0.140317224	0.78	83.03
0:55:00	0.00	0.0264081	0.18	0.20	0.00	0.2154304	1.04	1.25	67.40	0.154522338	0.80	68.36
1:00:00	0.00	0.026391	0.18	0.20	0.00	0.2141022	1.03	1.25	55.75	0.165178559	0.82	56.74
1:05:00	0.00	0.026374	0.18	0.20	0.00	0.2127667	1.03	1.24	45.96	0.173351895	0.84	46.98
1:10:00	0.00	0.026357	0.18	0.20	0.00	0.2114304	1.02	1.24	35.54	0.17944162	0.85	36.57
1:15:00	0.00	0.02634	0.17	0.20	0.00	0.2100776	1.02	1.23	28.90	0.183901103	0.87	29.95
1:20:00	0.00	0.026323	0.17	0.20	0.00	0.208724	1.02	1.23	25.81	0.187092677	0.88	26.87
1:25:00	0.00	0.0263057	0.17	0.20	0.00	0.2073624	1.01	1.22	24.01	0.189422413	0.88	25.09
1:30:00	0.00	0.0262884	0.17	0.20	0.00	0.2059909	1.01	1.22	23.08	0.191295667	0.89	24.17
1:35:00	0.00	0.0262712	0.17	0.20	0.00	0.2046191	1.01	1.21	22.45	0.192953739	0.90	23.54
1:40:00	0.00	0.0262539	0.17	0.20	0.00	0.2032309	1.00	1.20	21.97	0.194472671	0.91	23.08
1:45:00	0.00	0.0262367	0.17	0.20	0.00	0.2018407	1.00	1.20	21.67	0.19590936	0.92	22.78
1:50:00	0.00	0.0262195	0.17	0.20	0.00	0.2004433	0.99	1.19	21.53	0.197112449	0.93	22.66
1:55:00	0.00	0.0262023	0.17	0.20	0.00	0.1990342	0.99	1.19	18.72	0.197979431	0.93	19.84
2:00:00	0.00	0.026185	0.17	0.20	0.00	0.1976253	0.99	1.18	15.95	0.198427104	0.93	17.09
2:05:00	0.00	0.0261674	0.17	0.20	0.00	0.1961991	0.98	1.18	11.37	0.198409882	0.93	12.50
2:10:00	0.00	0.0261499	0.17	0.20	0.00	0.1947708	0.98	1.17	7.36	0.19803432	0.93	8.48
2:15:00	0.00	0.0261325	0.17	0.20	0.00	0.1933347	0.97	1.17	4.78	0.197379471	0.93	5.90
2:20:00	0.00	0.026115	0.17	0.20	0.00	0.1918865	0.97	1.16	2.96	0.196510867	0.92	4.08
2:25:00	0.00	0.0260975	0.17	0.20	0.00	0.1904392	0.97	1.16	1.73	0.195486245	0.92	2.85
2:30:00	0.00	0.0260801	0.17	0.20	0.00	0.1889717	0.96	1.15	0.91	0.194324424	0.91	2.02
2:35:00	0.00	0.0260626	0.17	0.20	0.00	0.187504	0.96	1.15	0.38	0.193072776	0.91	1.48
2:40:00	0.00	0.0260451	0.17	0.20	0.00	0.1860256	0.95	1.14	0.12	0.191729772	0.91	1.21
2:45:00	0.00	0.0260273	0.17	0.20	0.00	0.184537	0.95	1.13	0.00	0.190336162	0.90	1.09
2:50:00	0.00	0.0260096	0.17	0.20	0.00	0.1830476	0.95	1.13	0.00	0.188891855	0.90	1.09
2:55:00	0.00	0.0259919	0.17	0.20	0.00	0.1815373	0.94	1.12	0.00	0.187428828	0.89	1.08
3:00:00	0.00	0.0259742	0.17	0.20	0.00	0.1800295	0.94	1.12	0.00	0.185951101	0.89	1.07
3:05:00	0.00	0.0259565	0.17	0.20	0.00	0.1785042	0.93	1.11	0.00	0.184461291	0.88	1.07
3:10:00	0.00	0.0259388	0.17	0.20	0.00	0.1769744	0.93	1.11	0.00	0.182972488	0.88	1.06
3:15:00	0.00	0.0259212	0.17	0.20	0.00	0.1754368	0.93	1.10	0.00	0.181461054	0.88	1.06
3:20:00	0.00	0.0259033	0.17	0.20	0.00	0.1738842	0.92	1.09	0.00	0.179951945	0.87	1.05
3:25:00	0.00	0.0258853	0.17	0.19	0.00	0.1723339	0.92	1.09	0.00	0.17842736	0.87	1.04
3:30:00	0.00	0.0258674	0.17	0.19	0.00	0.1707581	0.91	1.08	0.00	0.176896197	0.86	1.04
3:35:00	0.00	0.0258494	0.17	0.19	0.00	0.169187	0.91	1.08	0.00	0.175359275	0.86	1.03
3:40:00	0.00	0.0258315	0.17	0.19	0.00	0.1675949	0.90	1.07	0.00	0.173805432	0.85	1.03
3:45:00	0.00	0.0258135	0.17	0.19	0.00	0.1660004	0.90	1.07	0.00	0.172255796	0.85	1.02
3:50:00	0.00	0.0257956	0.17	0.19	0.00	0.1643936	0.90	1.06	0.00	0.170678618	0.84	1.02
3:55:00	0.00	0.0257777	0.17	0.19	0.00	0.1627748	0.89	1.05	0.00	0.169106074	0.84	1.01
4:00:00	0.00	0.0257595	0.17	0.19	0.00	0.1611527	0.89	1.05	0.00	0.167514741	0.84	1.00
4:05:00	0.00	0.0257413	0.17	0.19	0.00	0.1595092	0.88	1.04	0.00	0.165918635	0.83	1.00
4:10:00	0.00	0.0257231	0.17	0.19	0.00	0.157871	0.88	1.04	0.00	0.164312627	0.83	0.99
4:15:00	0.00	0.0257049	0.17	0.19	0.00	0.156202	0.87	1.03	0.00	0.162692313	0.82	0.98
4:20:00	0.00	0.0256867	0.17	0.19	0.00	0.1545431	0.87	1.02	0.00	0.161071016	0.82	0.98
4:25:00	0.00	0.0256685	0.17	0.19	0.00	0.152852	0.87	1.02	0.00	0.159425826	0.81	0.97
4:30:00	0.00	0.0256504	0.17	0.19	0.00	0.1511681	0.86	1.01	0.00	0.157788549	0.81	0.97
4:35:00	0.00	0.0256322	0.17	0.19	0.00	0.1494574	0.86	1.01	0.00	0.156117799	0.80	0.96
4:40:00	0.00	0.0256137	0.17	0.19	0.00	0.1477482	0.85	1.00	0.00	0.154457011	0.80	0.95
4:45:00	0.00	0.0255952	0.17	0.19	0.00	0.1460167	0.85	0.99	0.00	0.152766823	0.79	0.95
4:50:00	0.00	0.0255768	0.17	0.19	0.00	0.1442817	0.84	0.99	0.00	0.151081032	0.79	0.94
4:55:00	0.00	0.0255583	0.16	0.19	0.00	0.1425279	0.84	0.98	0.00	0.149371317	0.79	0.93
5:00:00	0.00	0.0255399	0.16	0.19	0.00	0.140767	0.83	0.98	0.00	0.147660061	0.78	0.93
5:05:00	0.00	0.0255215	0.16	0.19	0.00	0.1389891	0.83	0.97	0.00	0.145929558	0.78	0.92
5:10:00	0.00	0.0255031	0.16	0.19	0.00	0.137202	0.83	0.96	0.00	0.144192443	0.77	0.92
5:15:00	0.00	0.0254845	0.16	0.19	0.00	0.1353981	0.82	0.96	0.00	0.142439684	0.77	0.91
5:20:00	0.00	0.0254658	0.16	0.19	0.00	0.1335853	0.82	0.95	0.00	0.14067642	0.76	0.90
5:25:00	0.00	0.025447	0.16	0.19	0.00	0.1317533	0.81	0.94	0.00	0.138899681	0.76	0.90
5:30:00	0.00	0.0254283	0.16	0.19	0.00	0.1299159	0.81	0.94	0.00	0.137110142	0.75	0.89
5:35:00	0.00	0.0254096	0.16	0.19	0.00	0.1280535	0.80	0.93	0.00	0.135307374	0.75	0.88
5:40:00	0.00	0.0253909	0.16	0.19	0.00	0.126193	0.80	0.92	0.00	0.13349195	0.74	0.88
5:45:00	0.00	0.0253723	0.16	0.19	0.00	0.1242965	0.79	0.92	0.00	0.131661255	0.74	0.87
5:50:00	0.00	0.0253536	0.16	0.19	0.00	0.122415	0.79	0.91	0.00	0.129821003	0.73	0.86
5:55:00	0.00	0.0253346	0.16	0.19	0.00	0.1204799	0.78	0.90	0.00	0.127959979	0.73	0.86
6:00:00	0.00	0.0253156	0.16	0.19	0.00	0.1185754	0.78	0.90	0.00	0.126096343	0.72	0.85

	5-Year				10-Year				25-Year			
SOURCE	CUHP				CUHP			Combined	CUHP			Combined
TIME	Pond C CUHP Hydrograph	MVEA Outflow hydrograph	School Pond C1 Outflow Hydrograph	Combined 5-Yr Inflow (cfs)	Pond C CUHP Hydrograph	MVEA Outflow hydrograph	School Pond C1 Outflow Hydrograph	Combined 10-Yr Inflow (cfs)	Pond C CUHP Hydrograph	MVEA Outflow hydrograph	School Pond C1 Outflow Hydrograph	Combined 25-Yr Inflow (cfs)
0:00:00	0.00	0	0.00	0.00	0.00	0	0.00	0.00	0.00	0	0.00	0.00
0:05:00	0.00	0	0.00	0.00	0.00	0	0.00	0.00	0.00	0	0.00	0.00
0:10:00	0.00	0.010846486	0.07	0.08	0.00	0.011722002	0.07	0.09	0.00	0.010089026	0.07	0.08
0:15:00	27.61	0.014604128	0.10	27.72	34.19	0.01503304	0.10	34.31	22.97	0.014153598	0.09	23.07
0:20:00	81.58	0.020679212	0.15	81.75	99.71	0.022149533	0.16	99.89	60.62	0.018555989	0.13	60.77
0:25:00	202.74	0.025076448	0.39	203.15	258.02	0.026665618	0.56	258.62	136.35	0.024548303	0.25	136.63
0:30:00	257.42	0.054139988	0.68	258.14	313.76	0.131949149	0.79	314.68	340.40	0.114426657	0.76	341.27
0:35:00	224.71	0.138848338	0.80	225.65	268.95	0.18262508	0.90	270.03	400.14	0.196032783	0.95	401.28
0:40:00	180.89	0.173467317	0.87	181.93	217.36	0.212146575	0.97	218.55	362.12	0.23853291	1.06	363.42
0:45:00	143.18	0.195327268	0.92	144.29	174.78	0.232123717	1.02	176.03	302.95	0.266636408	4.92	308.14
0:50:00	116.56	0.210535262	0.95	117.72	140.79	0.246404001	1.05	142.08	251.58	0.601166272	9.87	262.06
0:55:00	95.70	0.221720626	0.97	96.90	117.10	0.257304025	1.07	118.43	201.63	1.345467728	11.03	214.00
1:00:00	78.04	0.230494769	0.99	79.27	98.14	0.266141875	1.32	99.73	162.42	1.918254303	10.59	174.94
1:05:00	63.54	0.237587737	1.01	64.79	81.95	0.273477961	2.69	84.92	133.39	2.256725547	9.65	145.30
1:10:00	52.87	0.243211004	1.03	54.14	70.48	0.347690013	4.08	74.91	101.30	2.381717236	8.58	112.26
1:15:00	45.76	0.247437997	1.04	47.05	66.13	0.498109047	5.00	71.63	76.70	2.345079565	7.56	86.60
1:20:00	40.38	0.250489537	1.05	41.68	59.47	0.614466666	5.27	65.36	60.44	2.195351461	6.62	69.25
1:25:00	36.73	0.252761332	1.06	38.05	50.32	0.680400483	5.14	56.14	49.58	1.980023488	5.80	57.36
1:30:00	34.42	0.254621669	1.07	35.75	43.53	0.71251507	4.88	49.12	40.96	1.745711834	5.08	47.79
1:35:00	32.94	0.256162219	1.08	34.27	39.07	0.723645675	4.62	44.42	34.71	1.529227469	4.53	40.77
1:40:00	29.32	0.257386255	1.15	30.73	36.05	0.721851212	4.40	41.18	31.00	1.342205427	4.13	36.47
1:45:00	26.03	0.258380403	1.40	27.69	34.04	0.712625142	4.24	39.00	28.47	1.184665398	3.84	33.49
1:50:00	23.90	0.259199728	1.67	25.83	32.61	0.697756853	4.10	37.40	26.93	1.054566163	3.64	31.63
1:55:00	22.47	0.25986824	1.87	24.60	30.55	0.675861906	3.89	35.11	26.11	0.947664631	3.51	30.57
2:00:00	20.92	0.26024136	1.87	23.05	27.32	0.641106719	3.43	31.38	25.62	0.850598135	3.19	29.66
2:05:00	15.05	0.260229435	1.68	16.99	19.46	0.594566449	2.79	22.84	18.71	0.755548939	2.65	22.11
2:10:00	9.68	0.259923299	1.45	11.39	12.65	0.542717195	2.21	15.41	12.10	0.667282156	2.13	14.89
2:15:00	6.23	0.259396755	1.25	7.74	8.24	0.490994935	1.76	10.49	7.96	0.588309187	1.71	10.25
2:20:00	3.86	0.258702012	1.11	5.23	5.16	0.443010433	1.42	7.03	5.01	0.519316787	1.39	6.92
2:25:00	2.39	0.257872606	1.08	3.73	3.13	0.400633878	1.20	4.74	3.11	0.460131746	1.18	4.76
2:30:00	1.37	0.256952053	1.08	2.71	1.74	0.363491022	1.09	3.19	1.81	0.410202906	1.09	3.30
2:35:00	0.64	0.25595832	1.08	1.97	0.77	0.331313428	1.08	2.18	0.85	0.368428349	1.08	2.30
2:40:00	0.18	0.254913457	1.07	1.51	0.21	0.306556727	1.08	1.59	0.25	0.333465658	1.08	1.66
2:45:00	0.00	0.253818854	1.07	1.32	0.00	0.288610106	1.08	1.36	0.00	0.307584288	1.08	1.38
2:50:00	0.00	0.252694738	1.07	1.32	0.00	0.275632372	1.07	1.35	0.00	0.288808876	1.07	1.36
2:55:00	0.00	0.251550382	1.06	1.31	0.00	0.27458083	1.07	1.34	0.00	0.275632805	1.07	1.34
3:00:00	0.00	0.250393098	1.06	1.31	0.00	0.27352296	1.06	1.34	0.00	0.274576789	1.06	1.34
3:05:00	0.00	0.249234258	1.05	1.30	0.00	0.272461957	1.06	1.33	0.00	0.273518885	1.06	1.33
3:10:00	0.00	0.248067884	1.05	1.30	0.00	0.271393453	1.06	1.33	0.00	0.272457898	1.06	1.33
3:15:00	0.00	0.246896064	1.05	1.29	0.00	0.270323432	1.05	1.32	0.00	0.271389358	1.05	1.32
3:20:00	0.00	0.245722743	1.04	1.29	0.00	0.269248126	1.05	1.32	0.00	0.270319301	1.05	1.32
3:25:00	0.00	0.244538618	1.04	1.28	0.00	0.268167189	1.05	1.31	0.00	0.269244012	1.05	1.31
3:30:00	0.00	0.243351951	1.04	1.28	0.00	0.26708474	1.04	1.31	0.00	0.268163038	1.04	1.31
3:35:00	0.00	0.242161627	1.03	1.27	0.00	0.265994698	1.04	1.30	0.00	0.267080553	1.04	1.30
3:40:00	0.00	0.240961327	1.03	1.27	0.00	0.264901042	1.03	1.30	0.00	0.265990527	1.03	1.30
3:45:00	0.00	0.23975951	1.02	1.26	0.00	0.263805732	1.03	1.29	0.00	0.264896834	1.03	1.30
3:50:00	0.00	0.238550557	1.02	1.26	0.00	0.26270065	1.03	1.29	0.00	0.263801541	1.03	1.29
3:55:00	0.00	0.237334717	1.02	1.25	0.00	0.261593986	1.02	1.28	0.00	0.262696421	1.02	1.29
4:00:00	0.00	0.236117454	1.01	1.25	0.00	0.260483335	1.02	1.28	0.00	0.261589719	1.02	1.28
4:05:00	0.00	0.23488914	1.01	1.24	0.00	0.259364934	1.02	1.27	0.00	0.260479086	1.01	1.28
4:10:00	0.00	0.233657452	1.01	1.24	0.00	0.25824497	1.01	1.27	0.00	0.259360646	1.01	1.27
4:15:00	0.00	0.232422439	1.00	1.23	0.00	0.257118482	1.01	1.26	0.00	0.258240642	1.01	1.27
4:20:00	0.00	0.231176003	1.00	1.23	0.00	0.25598646	1.00	1.26	0.00	0.257114173	1.00	1.26
4:25:00	0.00	0.229928176	0.99	1.22	0.00	0.254852904	1.00	1.25	0.00	0.255982111	1.00	1.26
4:30:00	0.00	0.228672747	0.99	1.22	0.00	0.253710051	1.00	1.25	0.00	0.254848513	1.00	1.25
4:35:00	0.00	0.227409743	0.99	1.21	0.00	0.252564104	0.99	1.24	0.00	0.25370568	0.99	1.25
4:40:00	0.00	0.226145508	0.98	1.21	0.00	0.251415481	0.99	1.24	0.00	0.252559691	0.99	1.24
4:45:00	0.00	0.224868772	0.98	1.20	0.00	0.250256888	0.98	1.23	0.00	0.251411088	0.98	1.24
4:50:00	0.00	0.22358892	0.97	1.20	0.00	0.249096711	0.98	1.23	0.00	0.250252452	0.98	1.23
4:55:00	0.00	0.222304872	0.97	1.19	0.00	0.247930981	0.98	1.22	0.00	0.249092232	0.98	1.22
5:00:00	0.00	0.221009035	0.97	1.19	0.00	0.246757804	0.97	1.22	0.00	0.247926523	0.97	1.22
5:05:00	0.00	0.219712088	0.96	1.18	0.00	0.245583096	0.97	1.21	0.00	0.246753301	0.97	1.21
5:10:00	0.00	0.21840543	0.96	1.18	0.00	0.244399644	0.96	1.21	0.00	0.245578548	0.96	1.21
5:15:00	0.00	0.217092032	0.95	1.17	0.00	0.243211569	0.96	1.20	0.00	0.244395118	0.96	1.20
5:20:00	0.00	0.215777656	0.95	1.17	0.00	0.242021931	0.96	1.20	0.00	0.243206997	0.96	1.20
5:25:00	0.00	0.214447405	0.95	1.16	0.00	0.240820199	0.95	1.19	0.00	0.242017381	0.95	1.19
5:30:00	0.00	0.213116237	0.94	1.15	0.00	0.239616918	0.95	1.19	0.00	0.240815603	0.95	1.19
5:35:00	0.00	0.21177776	0.94	1.15	0.00	0.238408684	0.94	1.18	0.00	0.239612274	0.94	1.18
5:40:00	0.00	0.210429249	0.93	1.14	0.00	0.237191355	0.94	1.18	0.00	0.238404064	0.94	1.18
5:45:00	0.00	0.209080168	0.93	1.14	0.00	0.23597257	0.94	1.17	0.00	0.237186686	0.94	1.17
5:50:00	0.00	0.207716301	0.92	1.13	0.00	0.234745009	0.93	1.17	0.00	0.235967851	0.93	1.17
5:55:00	0.00	0.206349385	0.92	1.13	0.00	0.233511771	0.93	1.16	0.00	0.234740314	0.93	1.16
6:00:00	0.00	0.20497688	0.92	1.12	0.00	0.232277196	0.92	1.16	0.00	0.233507027	0.92	1.16

	50-Year				100-Year				500-Year			
SOURCE	CUHP			Combined	CUHP			Combined	CUHP			Combined
TIME	Pond C CUHP Hydrograph	MVEA Outflow hydrograph	School Pond C1 Outflow Hydrograph	Combined 50-Yr Inflow (cfs)	Pond C CUHP Hydrograph	MVEA Outflow hydrograph	School Pond C1 Outflow Hydrograph	Combined 100-Yr Inflow (cfs)	Pond C CUHP Hydrograph	MVEA Outflow hydrograph	School Pond C1 Outflow Hydrograph	Combined 500-Yr Inflow (cfs)
0:00:00	0.00	0	0.00	0.00	0.00	0	0.00	0.00	0.00	0	0.00	0.00
0:05:00	0.00	0.003198524	0.04	0.04	0.00	0.000894799	0.01	0.02	0.00	0.005536093	0.05	0.06
0:10:00	1.92	0.011459133	0.07	2.00	0.19	0.010965621	0.07	0.27	6.16	0.012926934	0.08	6.25
0:15:00	28.83	0.014530543	0.09	28.93	28.01	0.014542318	0.09	28.12	40.73	0.015296671	0.10	40.85
0:20:00	70.52	0.019629839	0.14	70.68	75.52	0.020062454	0.15	75.68	100.75	0.022390042	0.17	100.94
0:25:00	159.87	0.025647511	0.46	160.36	177.98	0.026339357	0.53	178.54	258.21	0.096408045	0.74	259.04
0:30:00	401.80	0.153699852	0.85	402.80	452.08	0.17868424	0.92	453.17	601.05	0.230634768	1.08	602.36
0:35:00	468.02	0.22404019	1.04	469.29	552.81	0.247259752	2.39	555.45	717.37	0.876176129	25.44	743.68
0:40:00	420.96	0.264504541	6.37	427.60	499.92	0.682955988	18.51	519.12	646.38	3.983970999	26.19	676.55
0:45:00	351.92	0.861114377	15.08	367.86	429.09	2.569171794	25.35	457.01	553.43	6.468314221	26.66	586.55
0:50:00	291.97	2.083991435	17.33	311.38	357.25	4.079756189	24.97	386.30	461.02	7.870259025	27.51	496.40
0:55:00	234.60	2.935474886	15.79	253.33	293.99	4.936804037	21.64	320.57	380.54	8.367693726	26.69	415.60
1:00:00	189.69	3.396765169	13.72	206.81	248.66	5.324424814	18.66	272.65	322.44	8.35010538	26.40	357.19
1:05:00	156.22	3.560053043	11.84	171.63	213.59	5.33947554	15.79	234.71	276.99	7.963040455	26.13	311.08
1:10:00	119.28	3.497923314	10.22	133.00	158.81	5.044265028	12.87	176.73	207.52	7.275490744	25.74	240.53
1:15:00	91.26	3.282052329	8.84	103.38	113.58	4.566473654	10.36	128.51	151.32	6.425754071	23.60	181.34
1:20:00	71.99	2.965995448	7.65	82.60	82.07	3.9884815	8.26	94.32	110.08	5.503606841	15.13	130.71
1:25:00	58.81	2.603015391	6.65	68.06	60.47	3.391017979	6.71	70.57	81.21	4.612237344	10.73	96.55
1:30:00	48.25	2.245380231	5.79	56.28	47.52	2.84206153	5.62	55.99	63.88	3.82269843	8.24	75.94
1:35:00	40.54	1.930901654	5.14	47.61	39.17	2.379771909	4.89	46.44	52.60	3.170307521	6.78	62.55
1:40:00	35.93	1.66713552	4.67	42.26	33.67	2.003182256	4.42	40.09	45.21	2.646632809	5.91	53.77
1:45:00	32.78	1.450658625	4.35	38.57	30.09	1.700001723	4.11	35.91	40.38	2.230114422	5.39	48.00
1:50:00	30.85	1.274653549	4.13	36.25	28.20	1.457100696	3.92	33.58	37.78	1.900024937	5.07	44.75
1:55:00	29.79	1.132284379	3.98	34.90	27.58	1.263036741	3.79	32.63	36.84	1.639156974	4.87	43.34
2:00:00	29.17	1.005317279	3.61	33.78	27.33	1.097110718	3.44	31.87	36.46	1.416541805	4.38	42.26
2:05:00	21.27	0.884053056	2.97	25.12	20.07	0.948694802	2.84	23.86	26.75	1.214965788	3.55	31.51
2:10:00	13.74	0.773146076	2.36	16.87	13.03	0.818679041	2.27	16.11	17.34	1.039158273	2.77	21.15
2:15:00	9.03	0.674883362	1.87	11.57	8.56	0.708128033	1.80	11.07	11.38	0.88871326	2.15	14.41
2:20:00	5.68	0.589715703	1.50	7.77	5.37	0.614556999	1.46	7.45	7.14	0.76220368	1.68	9.58
2:25:00	3.53	0.517133154	1.25	5.29	3.34	0.53587299	1.22	5.10	4.43	0.655754618	1.36	6.45
2:30:00	2.04	0.456255448	1.11	3.61	1.93	0.470424847	1.10	3.50	2.55	0.567436968	1.16	4.29
2:35:00	0.96	0.405638365	1.08	2.45	0.90	0.416311451	1.08	2.40	1.19	0.494717759	1.09	2.77
2:40:00	0.28	0.363767773	1.08	1.72	0.26	0.37167577	1.08	1.71	0.34	0.434467975	1.08	1.86
2:45:00	0.00	0.329352134	1.08	1.41	0.00	0.335223893	1.08	1.41	0.00	0.385329465	1.08	1.46
2:50:00	0.00	0.303210053	1.07	1.38	0.00	0.308234608	1.07	1.38	0.00	0.346229087	1.07	1.42
2:55:00	0.00	0.286269592	1.07	1.36	0.00	0.288944755	1.07	1.36	0.00	0.315736277	1.07	1.39
3:00:00	0.00	0.275430443	1.07	1.34	0.00	0.275638142	1.06	1.34	0.00	0.292885669	1.07	1.36
3:05:00	0.00	0.274375203	1.06	1.34	0.00	0.274582105	1.06	1.34	0.00	0.279112424	1.06	1.34
3:10:00	0.00	0.273315566	1.06	1.33	0.00	0.273524247	1.06	1.33	0.00	0.274874765	1.06	1.33
3:15:00	0.00	0.27225446	1.05	1.33	0.00	0.272463239	1.05	1.33	0.00	0.273819421	1.06	1.33
3:20:00	0.00	0.271185076	1.05	1.32	0.00	0.271394745	1.05	1.32	0.00	0.272757268	1.05	1.33
3:25:00	0.00	0.270113233	1.05	1.32	0.00	0.270324736	1.05	1.32	0.00	0.271691323	1.05	1.32
3:30:00	0.00	0.269038763	1.04	1.31	0.00	0.269249424	1.04	1.31	0.00	0.270623907	1.04	1.32
3:35:00	0.00	0.267955979	1.04	1.31	0.00	0.268168498	1.04	1.31	0.00	0.269547405	1.04	1.31
3:40:00	0.00	0.266871652	1.04	1.30	0.00	0.267086062	1.03	1.30	0.00	0.268469108	1.04	1.31
3:45:00	0.00	0.265782479	1.03	1.30	0.00	0.265996014	1.03	1.30	0.00	0.267387456	1.03	1.30
3:50:00	0.00	0.264686917	1.03	1.29	0.00	0.26490237	1.03	1.29	0.00	0.266298068	1.03	1.30
3:55:00	0.00	0.263589821	1.02	1.29	0.00	0.263807054	1.02	1.29	0.00	0.265207137	1.03	1.29
4:00:00	0.00	0.262485489	1.02	1.28	0.00	0.262701984	1.02	1.28	0.00	0.264110561	1.02	1.29
4:05:00	0.00	0.261376856	1.02	1.28	0.00	0.261595332	1.02	1.28	0.00	0.263008242	1.02	1.28
4:10:00	0.00	0.260266708	1.01	1.27	0.00	0.260484676	1.01	1.27	0.00	0.261904392	1.01	1.28
4:15:00	0.00	0.259146731	1.01	1.27	0.00	0.259366287	1.01	1.27	0.00	0.260792423	1.01	1.27
4:20:00	0.00	0.258024733	1.00	1.26	0.00	0.258246336	1.00	1.26	0.00	0.259676877	1.01	1.27
4:25:00	0.00	0.256899205	1.00	1.26	0.00	0.257119842	1.00	1.26	0.00	0.258559438	1.00	1.26
4:30:00	0.00	0.255765118	1.00	1.25	0.00	0.255987833	1.00	1.25	0.00	0.257431963	1.00	1.26
4:35:00	0.00	0.254629457	0.99	1.25	0.00	0.25485429	0.99	1.25	0.00	0.256302893	0.99	1.25
4:40:00	0.00	0.253487606	0.99	1.24	0.00	0.253711431	0.99	1.24	0.00	0.255169403	0.99	1.25
4:45:00	0.00	0.252339521	0.99	1.24	0.00	0.252565497	0.98	1.24	0.00	0.254028075	0.99	1.24
4:50:00	0.00	0.251189899	0.98	1.23	0.00	0.251416868	0.98	1.23	0.00	0.252885184	0.98	1.24
4:55:00	0.00	0.250031165	0.98	1.22	0.00	0.250258288	0.98	1.23	0.00	0.2517351	0.98	1.23
5:00:00	0.00	0.248868774	0.97	1.22	0.00	0.249098125	0.97	1.22	0.00	0.25057961	0.98	1.23
5:05:00	0.00	0.247704111	0.97	1.21	0.00	0.247932389	0.97	1.22	0.00	0.2494226	0.97	1.22
5:10:00	0.00	0.246528683	0.97	1.21	0.00	0.246759225	0.96	1.21	0.00	0.248255345	0.97	1.22
5:15:00	0.00	0.245351679	0.96	1.20	0.00	0.245584532	0.96	1.21	0.00	0.247085384	0.96	1.21
5:20:00	0.00	0.244169342	0.96	1.20	0.00	0.244401073	0.96	1.20	0.00	0.245912109	0.96	1.20
5:25:00	0.00	0.242978931	0.95	1.19	0.00	0.243213012	0.95	1.20	0.00	0.244728923	0.96	1.20
5:30:00	0.00	0.241787012	0.95	1.19	0.00	0.242023366	0.95	1.19	0.00	0.243544186	0.95	1.19
5:35:00	0.00	0.240586343	0.94	1.18	0.00	0.24082165	0.94	1.19	0.00	0.242352921	0.95	1.19
5:40:00	0.00	0.239380637	0.94	1.18	0.00	0.239618384	0.94	1.18	0.00	0.241154583	0.94	1.18
5:45:00	0.00	0.238173508	0.94	1.17	0.00	0.238410142	0.94	1.17	0.00	0.23995477	0.94	1.18
5:50:00	0.00	0.236953798	0.93	1.17	0.00	0.237192829	0.93	1.17	0.00	0.238744832	0.93	1.17
5:55:00	0.00	0.235732489	0.93	1.16	0.00	0.235974059	0.93	1.16	0.00	0.237531031	0.93	1.17
6:00:00	0.00	0.234506177	0.92	1.16	0.00	0.23474649	0.92	1.16	0.00	0.236314612	0.93	1.16

CUHP hydrograph for Pond C for drainage area

Figure 13-9. Concept for Integral Forebay at Pipe Outfall



Weir Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Apr 14 2025

RECTANGULAR SLOT IN FOREBAY (1100cf), 4.68 in wide

Rectangular Weir

Crest	= Sharp
Bottom Length (ft)	= 0.39
Total Depth (ft)	= 2.00

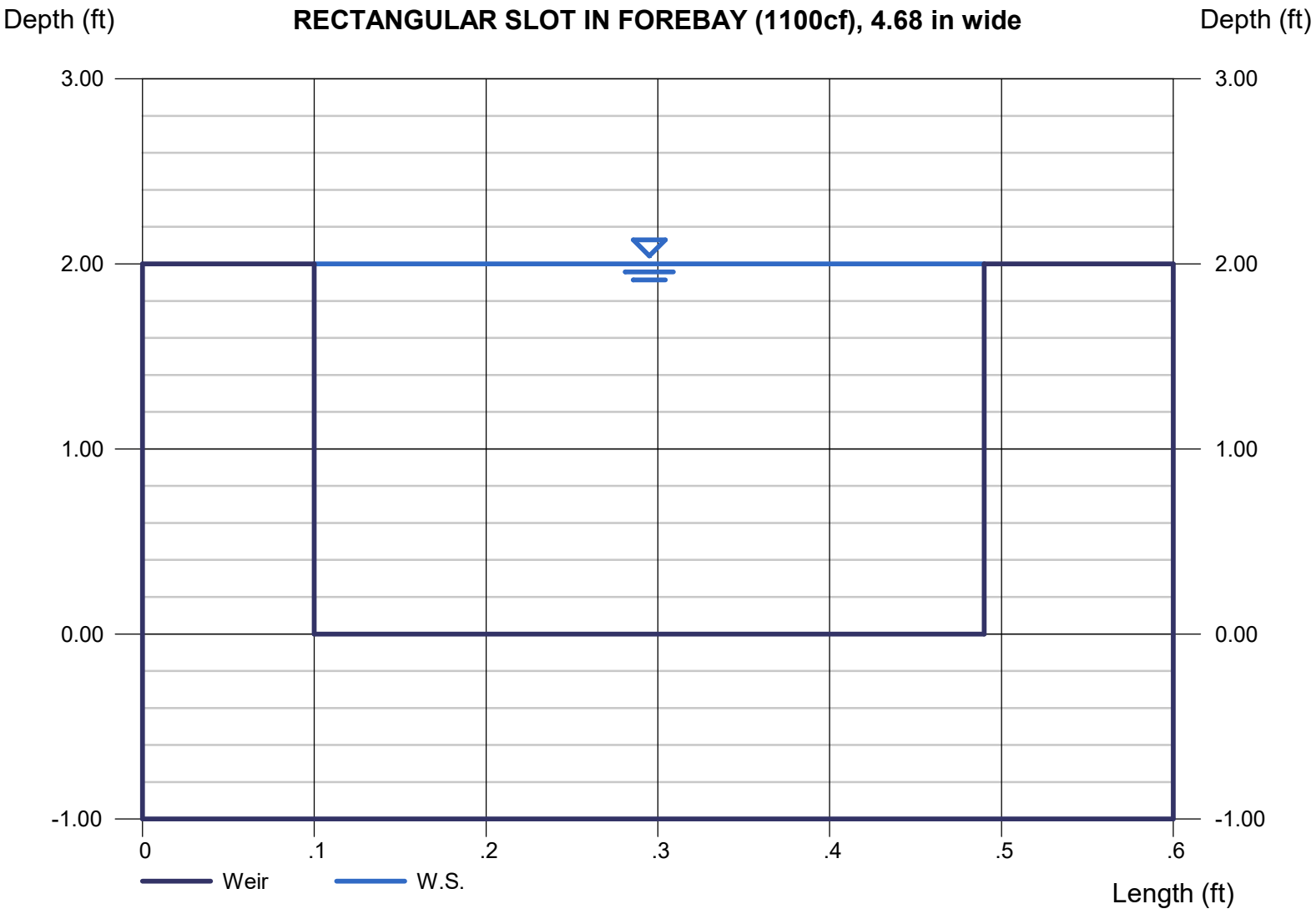
Calculations

Weir Coeff. Cw	= 3.33
Compute by:	Q vs Depth
No. Increments	= 10

Highlighted

Depth (ft)	= 2.00
Q (cfs)	= 3.673
Area (sqft)	= 0.78
Velocity (ft/s)	= 4.71
Top Width (ft)	= 0.39

Required Time = 3-5 minutes
Calculated Drain Time = 1100cf/3.673 = 299seconds = 4.99minutes



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Apr 14 2025

LOW FLOW CHANNEL (2xforebay discharge)

Rectangular

Bottom Width (ft)	= 4.00
Total Depth (ft)	= 0.50
Invert Elev (ft)	= 100.00
Slope (%)	= 0.50
N-Value	= 0.013

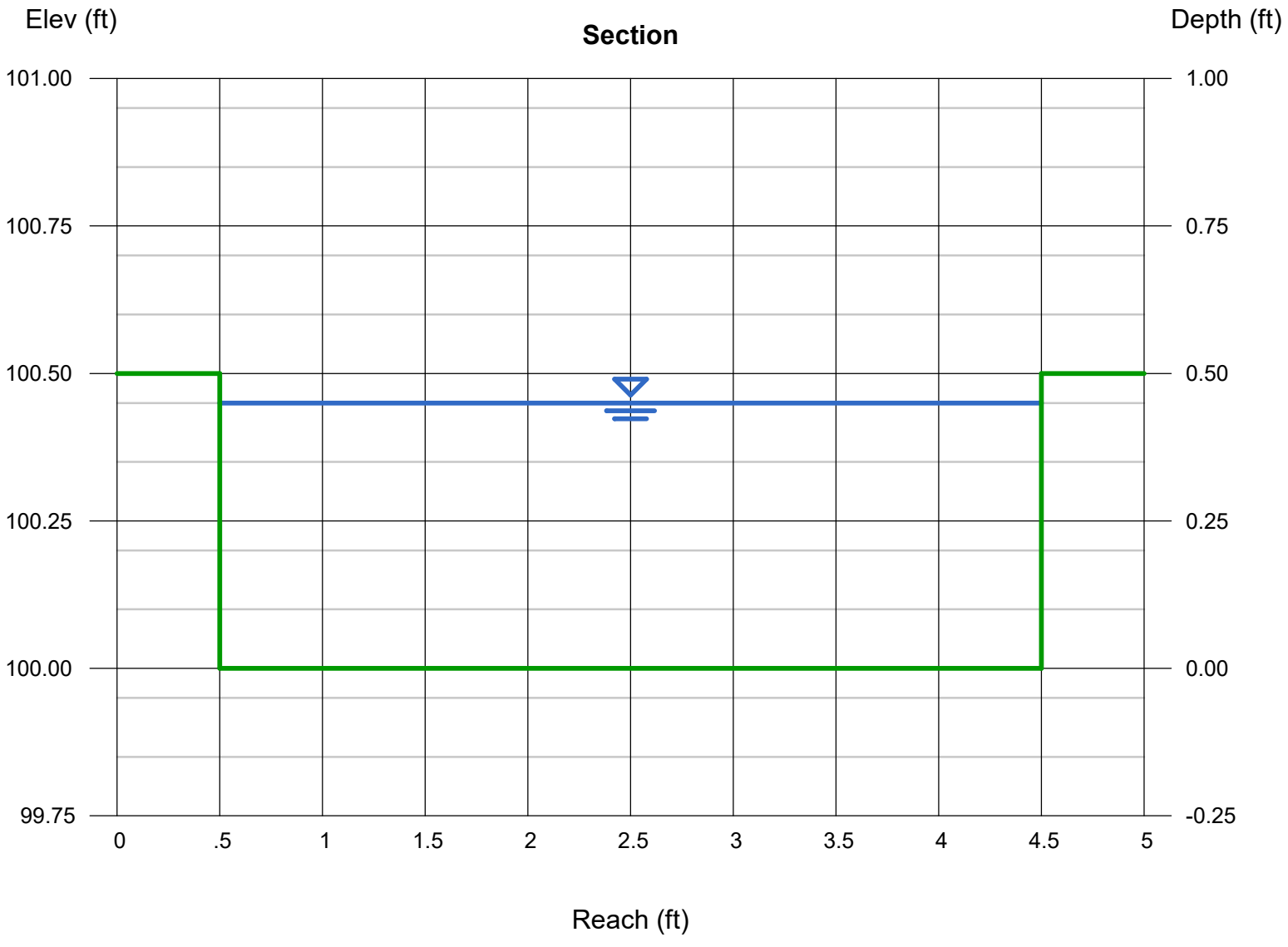
Calculations

Compute by:	Q vs Depth
No. Increments	= 10

Highlighted

Depth (ft)	= 0.45
Q (cfs)	= 7.460
Area (sqft)	= 1.80
Velocity (ft/s)	= 4.14
Wetted Perim (ft)	= 4.90
Crit Depth, Yc (ft)	= 0.48
Top Width (ft)	= 4.00
EGL (ft)	= 0.72

Required Discharge (for one forebay) = 2 x 3.673 = 7.346cfs



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Apr 14 2025

LOW FLOW CHANNEL (2 x forebay discharge)

Rectangular

Bottom Width (ft)	= 7.00
Total Depth (ft)	= 0.50
Invert Elev (ft)	= 100.00
Slope (%)	= 0.50
N-Value	= 0.013

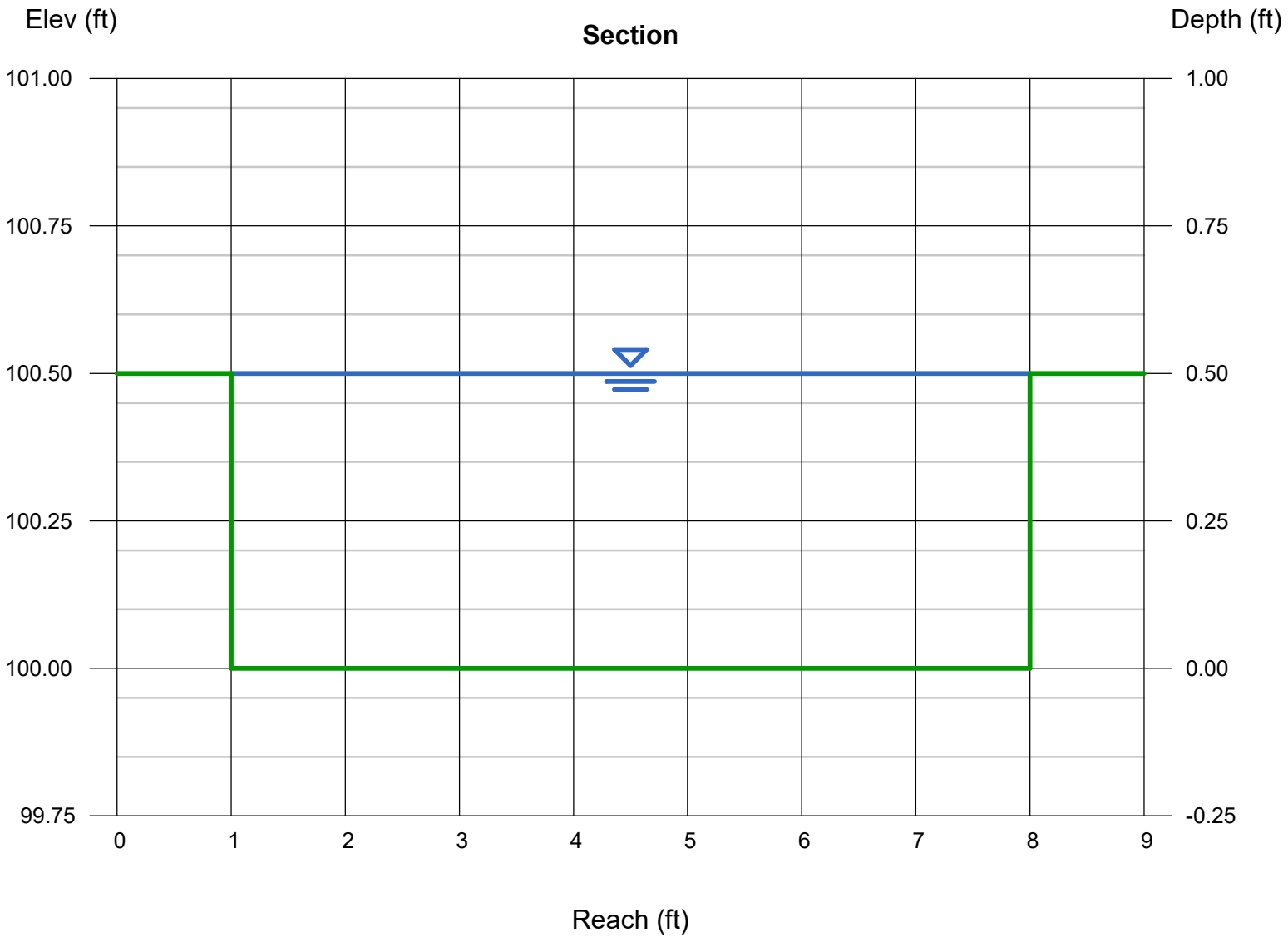
Calculations

Compute by:	Q vs Depth
No. Increments	= 10

Highlighted

Depth (ft)	= 0.50
Q (cfs)	= 16.30
Area (sqft)	= 3.50
Velocity (ft/s)	= 4.66
Wetted Perim (ft)	= 8.00
Crit Depth, Yc (ft)	= 0.50
Top Width (ft)	= 7.00
EGL (ft)	= 0.84

Required Discharge = 3.673 x 2 x 2 forebays
= 14.69cfs



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Oct 23 2025

Outfall Channel In Etrib

Trapezoidal

Bottom Width (ft)	= 12.00
Side Slopes (z:1)	= 6.00, 6.00
Total Depth (ft)	= 1.80
Invert Elev (ft)	= 100.00
Slope (%)	= 0.60
N-Value	= 0.020

Calculations

Compute by:	Known Q
Known Q (cfs)	= 219.70

Highlighted

Depth (ft)	= 1.63
Q (cfs)	= 219.70
Area (sqft)	= 35.50
Velocity (ft/s)	= 6.19
Wetted Perim (ft)	= 31.83
Crit Depth, Yc (ft)	= 1.66
Top Width (ft)	= 31.56
EGL (ft)	= 2.23

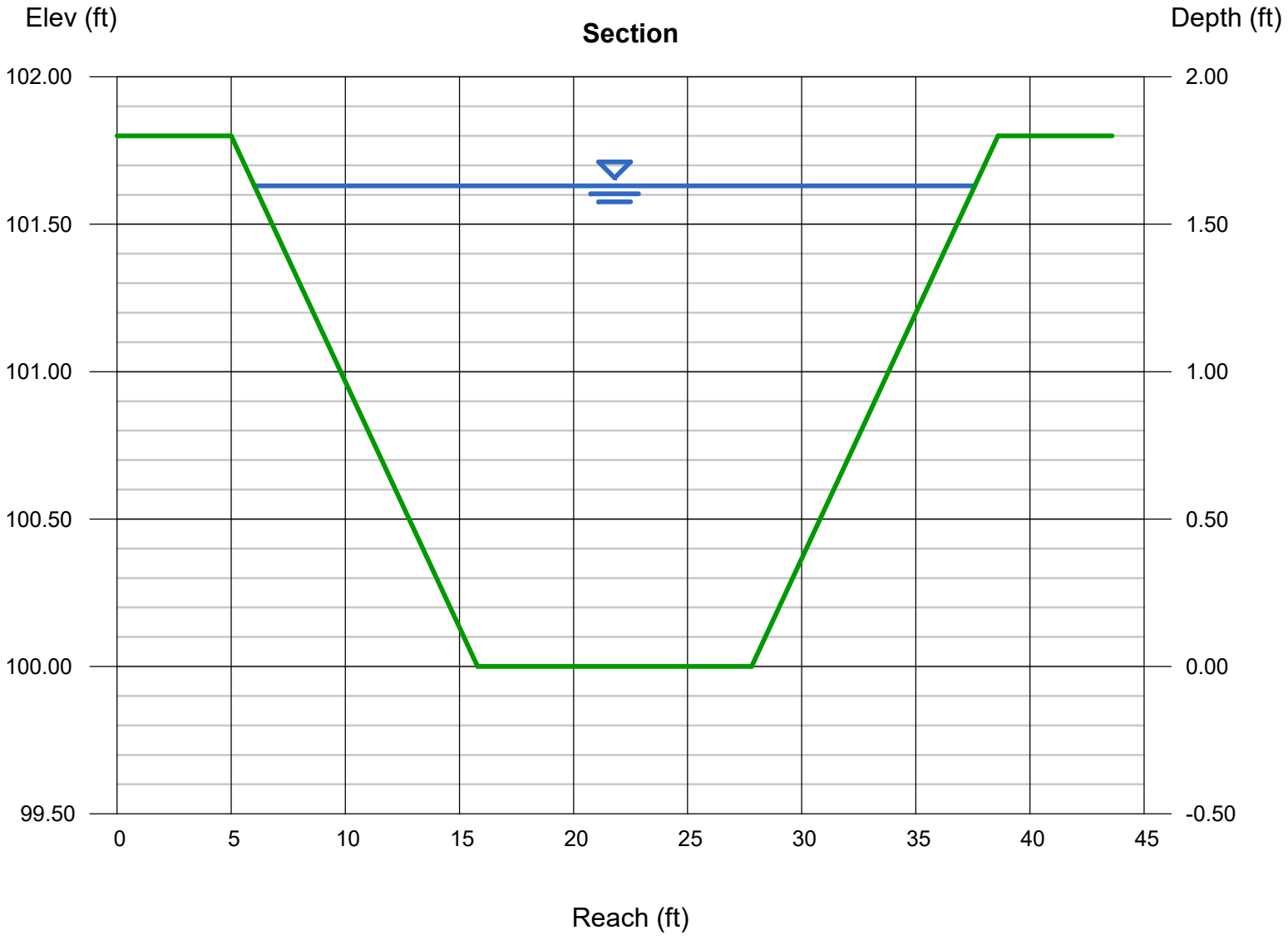


Figure 13-12c. Emergency Spillway Protection

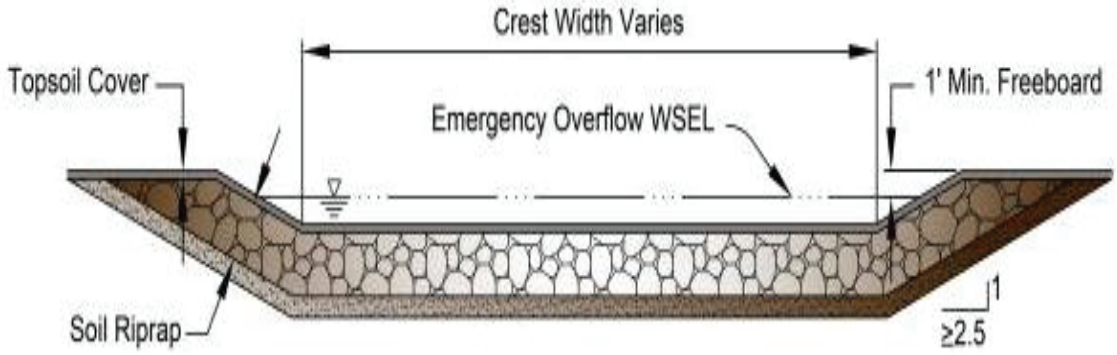
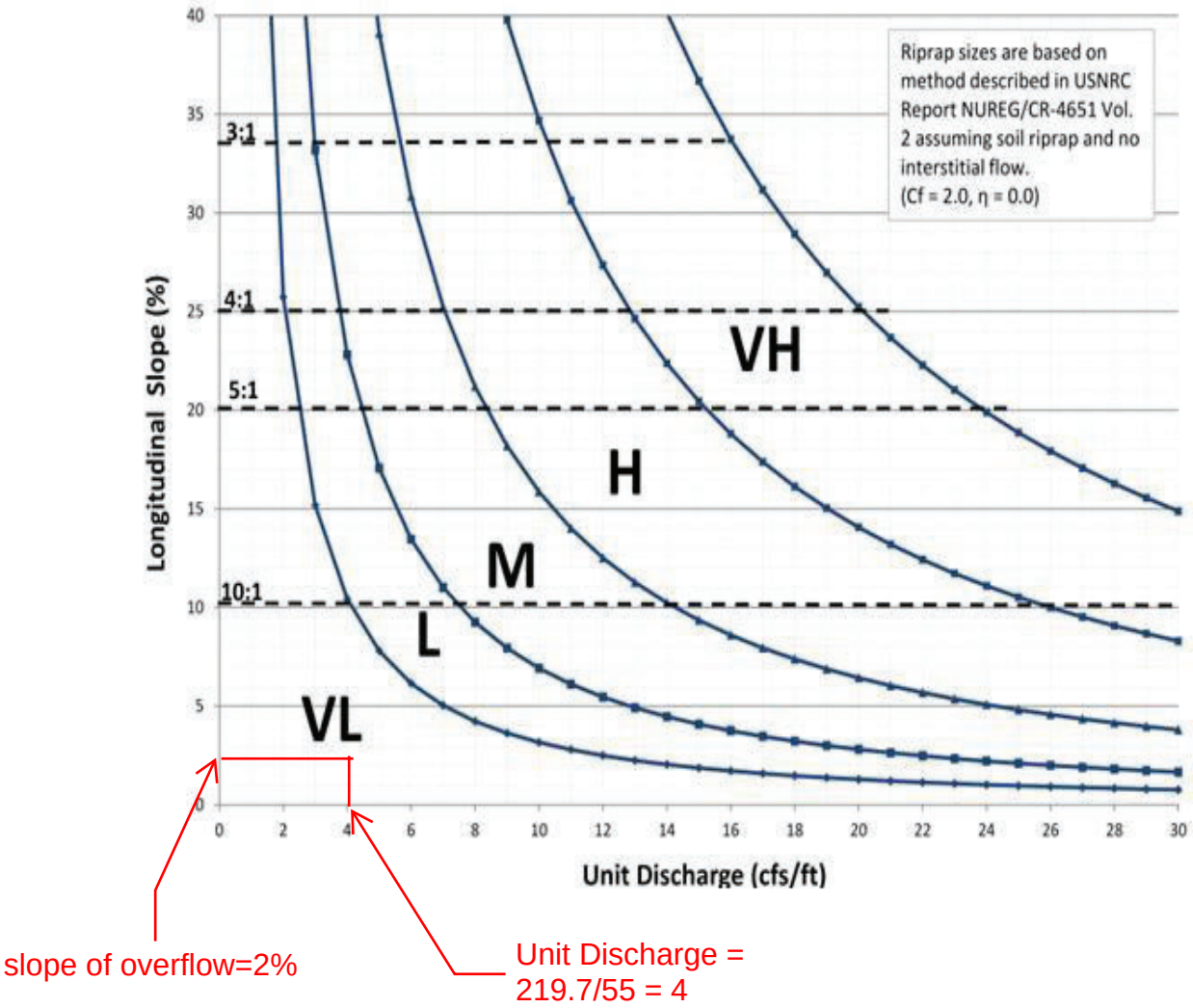


Figure 13-12d. Riprap Types for Emergency Spillway Protection



2. ASTM International (ASTM): D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft^3 (600 kN-m/m^3)).

1.04 SUBMITTALS

A. CONTRACTOR shall cooperate with ENGINEER in obtaining and providing samples of all specified materials.

B. CONTRACTOR shall submit certified laboratory test certificates for all items required in this section.

PART 2 PRODUCTS

2.01 MATERIALS

A. RIPRAP

1. Riprap used shall be the type designated on the DRAWINGS and shall conform to Table 1.

Table 1: Riprap 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
Type VH	70 - 100 50 - 70 35 - 50 2 - 10	41 33 24 9	24

*d_{50} = Mean Particle Size

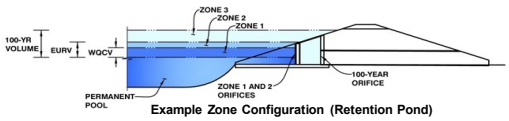
**Mix VL, L and M riprap with 35% topsoil (by volume) and bury it with 4 to 6 inches of topsoil, all vibration compacted, and revegetate.

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: MVEA Substation Concept Pond

Basin ID:



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	4.50	acres
Watershed Length =	520	ft
Watershed Length to Centroid =	250	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	40.00%	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 =	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) =	0.067	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.189	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.179	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.267	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.346	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.461	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.549	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.665	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	0.895	acre-feet		inches
Approximate 2-yr Detention Volume =	0.139	acre-feet		
Approximate 5-yr Detention Volume =	0.195	acre-feet		
Approximate 10-yr Detention Volume =	0.268	acre-feet		
Approximate 25-yr Detention Volume =	0.299	acre-feet		
Approximate 50-yr Detention Volume =	0.314	acre-feet		
Approximate 100-yr Detention Volume =	0.360	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.067	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.122	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	0.205	acre-feet
Total Detention Basin Volume =	0.394	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

micropool - 5803.20

1.8 ac gravel

2.7ac landscaping

Depth Increment = 0.20 ft

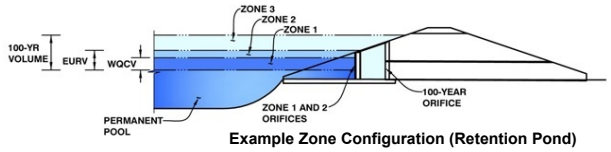
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	30	0.001		
5803.53	--	0.33	--	--	--	30	0.001	10	0.000
5804	--	0.80	--	--	--	300	0.007	87	0.002
5805	--	1.88	--	--	--	8,190	0.188	4,672	0.107
5806	--	2.88	--	--	--	16,000	0.367	16,767	0.385
5807	--	3.88	--	--	--	18,100	0.416	33,817	0.776
5808	--	4.88	--	--	--	20,200	0.464	52,967	1.216

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: MVEA Substation Concept Pond

Basin ID:



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.65	0.067	Orifice Plate
Zone 2 (EURV)	2.25	0.122	Rectangular Orifice
Z3 (100+1/2WQCV)	2.91	0.205	Weir&Pipe (Restrict)
Total (all zones)		0.394	

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

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

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	1.806E-03	ft²
Depth at top of Zone using Orifice Plate =	1.65	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	6.60	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	0.26	sq. inches (diameter = 9/16 inch)	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.55	1.10					
Orifice Area (sq. inches)	0.26	0.26	0.26					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected			
Invert of Vertical Orifice =	1.65	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.06	N/A
Depth at top of Zone using Vertical Orifice =	2.25	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.08	N/A
Vertical Orifice Height =	2.00	N/A	inches			
Vertical Orifice Width =	4.09		inches			

Calculated Parameters for Vertical Orifi

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

	Zone 3 Weir	Not Selected				
Overflow Weir Front Edge Height, Ho =	2.50	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	2.50	N/A
Overflow Weir Front Edge Length =	3.00	N/A	feet	Overflow Weir Slope Length =	3.00	N/A
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	3.54	N/A
Horiz. Length of Weir Sides =	3.00	N/A	feet	Overflow Grate Open Area w/o Debris =	6.26	N/A
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	3.13	N/A
Debris Clogging % =	50%	N/A	%			

Calculated Parameters for Overflow We

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

	Zone 3 Restrictor	Not Selected				
Depth to Invert of Outlet Pipe =	0.33	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	1.77	N/A
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.75	N/A
Restrictor Plate Height Above Pipe Invert =	18.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	3.50	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.66	feet
Spillway Crest Length =	5.00	feet	Stage at Top of Freeboard =	4.66	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.45	acres
Freeboard above Max Water Surface =	0.50	feet	Basin Volume at Top of Freeboard =	1.12	acre-ft

Calculated Parameters for Spillway

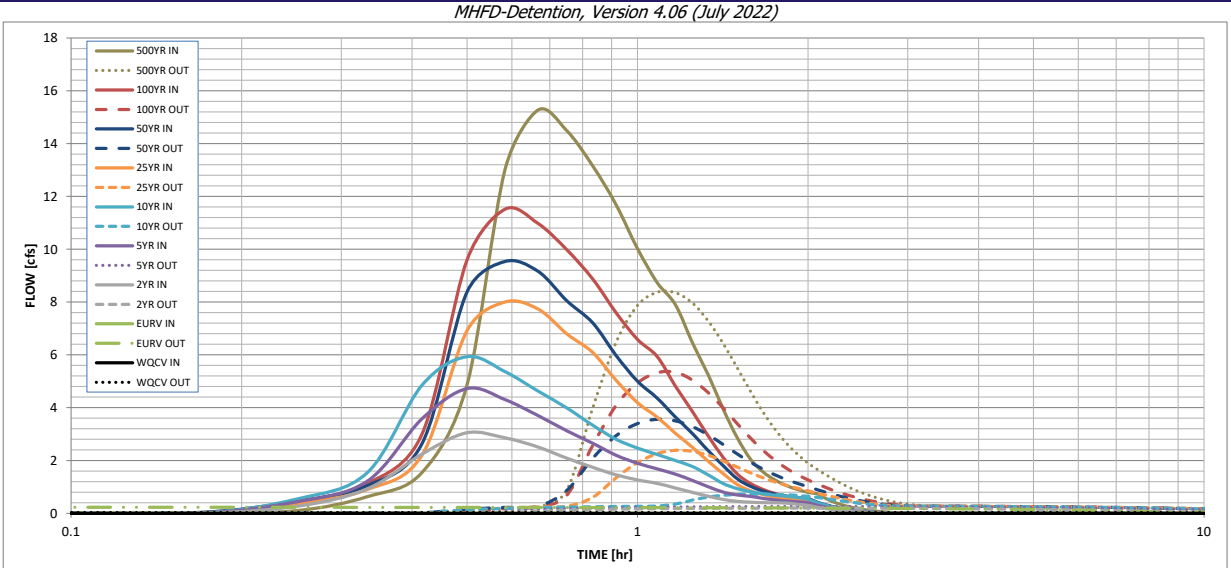
Routed Hydrograph Results

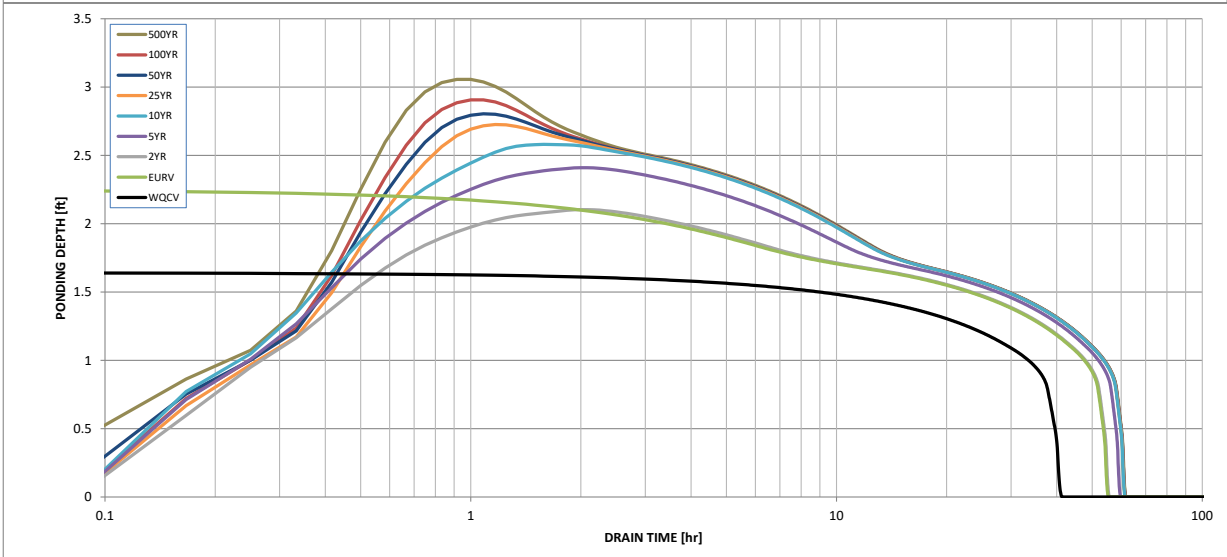
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF)

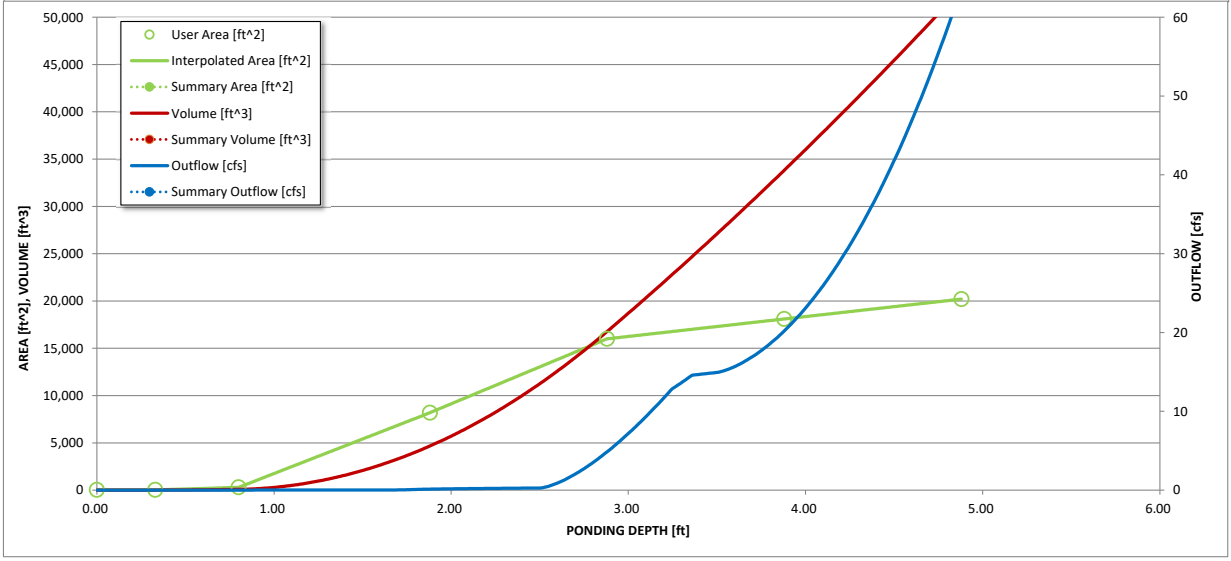
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	0.067	0.189	0.179	0.267	0.346	0.461	0.549	0.665
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.179	0.267	0.346	0.461	0.549	0.665
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.6	1.6	2.5	4.4	5.5	6.8
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	0.55	0.97	1.21	1.52
Peak Inflow Q (cfs) =	N/A	N/A	3.0	4.7	5.9	8.0	9.5	11.5
Peak Outflow Q (cfs) =	0.0	0.2	0.2	0.3	0.7	2.4	3.6	5.3
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.2	0.3	0.5	0.7	0.8
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.1	0.3	0.5	0.8
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	49	49	51	51	48	47	45
Time to Drain 99% of Inflow Volume (hours) =	**39**	52	52	56	57	56	55	54
Maximum Ponding Depth (ft) =	1.65	2.25	2.10	2.41	2.58	2.73	2.80	2.91
Area at Maximum Ponding Depth (acres) =	0.15	0.25	0.23	0.28	0.31	0.34	0.35	0.37
Maximum Volume Stored (acre-ft) =	0.068	0.189	0.153	0.229	0.280	0.328	0.356	0.392

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: *mvea pond outflow*

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.10
	0:15:00	0.00	0.00	0.26	0.43	0.54	0.36	0.45	0.44	0.63
	0:20:00	0.00	0.00	0.92	1.21	1.54	0.90	1.04	1.12	1.55
	0:25:00	0.00	0.00	2.25	3.58	4.85	2.21	2.64	3.01	4.87
	0:30:00	0.00	0.00	3.05	4.72	5.93	6.92	8.38	9.59	13.01
	0:35:00	0.00	0.00	2.85	4.31	5.36	8.00	9.54	11.51	15.26
	0:40:00	0.00	0.00	2.51	3.71	4.63	7.74	9.17	10.98	14.49
	0:45:00	0.00	0.00	2.09	3.12	3.99	6.80	8.05	9.98	13.16
	0:50:00	0.00	0.00	1.74	2.65	3.33	6.09	7.21	8.87	11.69
	0:55:00	0.00	0.00	1.46	2.20	2.80	5.04	5.98	7.60	10.02
	1:00:00	0.00	0.00	1.27	1.90	2.47	4.19	5.00	6.58	8.73
	1:05:00	0.00	0.00	1.13	1.68	2.23	3.64	4.36	5.94	7.90
	1:10:00	0.00	0.00	0.96	1.48	2.00	3.03	3.64	4.82	6.46
	1:15:00	0.00	0.00	0.79	1.25	1.77	2.50	3.02	3.86	5.23
	1:20:00	0.00	0.00	0.65	1.00	1.45	1.96	2.37	2.92	3.94
	1:25:00	0.00	0.00	0.52	0.80	1.12	1.50	1.80	2.11	2.86
	1:30:00	0.00	0.00	0.45	0.69	0.93	1.09	1.30	1.49	2.04
	1:35:00	0.00	0.00	0.42	0.64	0.82	0.85	1.02	1.12	1.56
	1:40:00	0.00	0.00	0.40	0.56	0.74	0.71	0.84	0.90	1.26
	1:45:00	0.00	0.00	0.39	0.51	0.68	0.61	0.72	0.75	1.04
	1:50:00	0.00	0.00	0.39	0.46	0.65	0.55	0.64	0.64	0.90
	1:55:00	0.00	0.00	0.34	0.43	0.60	0.51	0.59	0.56	0.79
	2:00:00	0.00	0.00	0.30	0.40	0.53	0.48	0.56	0.51	0.72
	2:05:00	0.00	0.00	0.22	0.30	0.39	0.36	0.41	0.37	0.52
	2:10:00	0.00	0.00	0.17	0.22	0.29	0.26	0.30	0.27	0.38
	2:15:00	0.00	0.00	0.12	0.16	0.21	0.19	0.22	0.20	0.28
	2:20:00	0.00	0.00	0.09	0.12	0.15	0.14	0.16	0.15	0.20
	2:25:00	0.00	0.00	0.06	0.08	0.11	0.10	0.11	0.10	0.14
	2:30:00	0.00	0.00	0.04	0.06	0.07	0.07	0.08	0.07	0.10
	2:35:00	0.00	0.00	0.03	0.04	0.05	0.05	0.06	0.05	0.07
	2:40:00	0.00	0.00	0.02	0.03	0.03	0.03	0.04	0.03	0.05
	2:45:00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.03
	2:50:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	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
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	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
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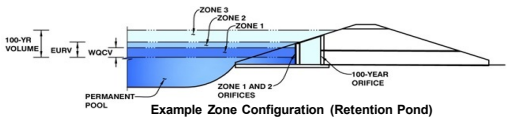
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Bull Hill/Rolling Meadows MDDP

Basin ID: Pond C1 - school (CONCEPT)



Example Zone Configuration (Retention Pond)

micropool=5790.00

Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft²)	Optional Override Area (ft²)	Area (acre)	Volume (ft³)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	30	0.001		
5790.33	--	0.30	--	--	--	30	0.001	9	0.000
5791	--	1.00	--	--	--	100	0.002	54	0.001
5792	--	2.00	--	--	--	7,997	0.184	4,103	0.094
5793	--	3.00	--	--	--	9,873	0.227	13,038	0.299
5794	--	4.00	--	--	--	11,932	0.274	23,940	0.550
5795	--	5.00	--	--	--	14,176	0.325	36,994	0.849
5796	--	6.00	--	--	--	16,604	0.381	52,384	1.203
5797	--	7.00	--	--	--	19,216	0.441	70,294	1.614
5798	--	8.00	--	--	--	22,013	0.505	90,909	2.087
5799	--	9.00	--	--	--	25,000	0.574	114,415	2.627

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	14.29	acres
Watershed Length =	800	ft
Watershed Length to Centroid =	375	ft
Watershed Slope =	0.025	ft/ft
Watershed Imperviousness =	80.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	70.0%	percent
Percentage Hydrologic Soil Groups C/D =	30.0%	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) =	0.391	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	1.225	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	1.081	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.430	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.720	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	2.034	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	2.332	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	2.670	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3.14 in.) =	3.416	acre-feet	inches
Approximate 2-yr Detention Volume =	1.009	acre-feet	
Approximate 5-yr Detention Volume =	1.343	acre-feet	
Approximate 10-yr Detention Volume =	1.630	acre-feet	
Approximate 25-yr Detention Volume =	1.741	acre-feet	
Approximate 50-yr Detention Volume =	1.801	acre-feet	
Approximate 100-yr Detention Volume =	1.899	acre-feet	

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.391	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.834	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	0.870	acre-feet
Total Detention Basin Volume =	2.095	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	

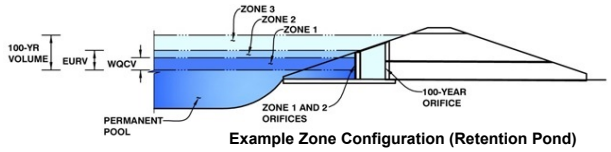
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user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

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Bull Hill/Rolling Meadows MDDP

Basin ID: Pond C1 - school (CONCEPT)



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.39	0.391	Orifice Plate
Zone 2 (EURV)	6.06	0.834	Rectangular Orifice
Z3 (100+1/2WQCV)	8.02	0.870	Weir&Pipe (Restrict)
Total (all zones)		2.095	

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

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

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	7.153E-03	ft²
Depth at top of Zone using Orifice Plate =	3.39	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	11.20	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	1.03	sq. inches (diameter = 1-1/8 inches)	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.13	2.26					
Orifice Area (sq. inches)	1.03	1.03	1.03					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected				
Invert of Vertical Orifice =	3.39	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.11	N/A
Depth at top of Zone using Vertical Orifice =	6.06	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.17	N/A
Vertical Orifice Height =	4.00	N/A	inches			
Vertical Orifice Width =	3.83		inches			

Calculated Parameters for Vertical Orifi

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

	Zone 3 Weir	Not Selected				
Overflow Weir Front Edge Height, Ho =	6.06	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	6.06	N/A
Overflow Weir Front Edge Length =	4.00	N/A	feet	Overflow Weir Slope Length =	4.00	N/A
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	7.25	N/A
Horiz. Length of Weir Sides =	4.00	N/A	feet	Overflow Grate Open Area w/o Debris =	11.14	N/A
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	5.57	N/A
Debris Clogging % =	50%	N/A	%			

Calculated Parameters for Overflow We

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

	Zone 3 Restrictor	Not Selected				
Depth to Invert of Outlet Pipe =	0.33	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	1.54	N/A
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.66	N/A
Restrictor Plate Height Above Pipe Invert =	14.60		inches	Half-Central Angle of Restrictor Plate on Pipe =	2.24	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.50	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.89	feet
Spillway Crest Length =	16.00	feet	Stage at Top of Freeboard =	8.89	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.57	acres
Freeboard above Max Water Surface =	0.50	feet	Basin Volume at Top of Freeboard =	2.56	acre-ft

Calculated Parameters for Spillway

micropool=5775.00

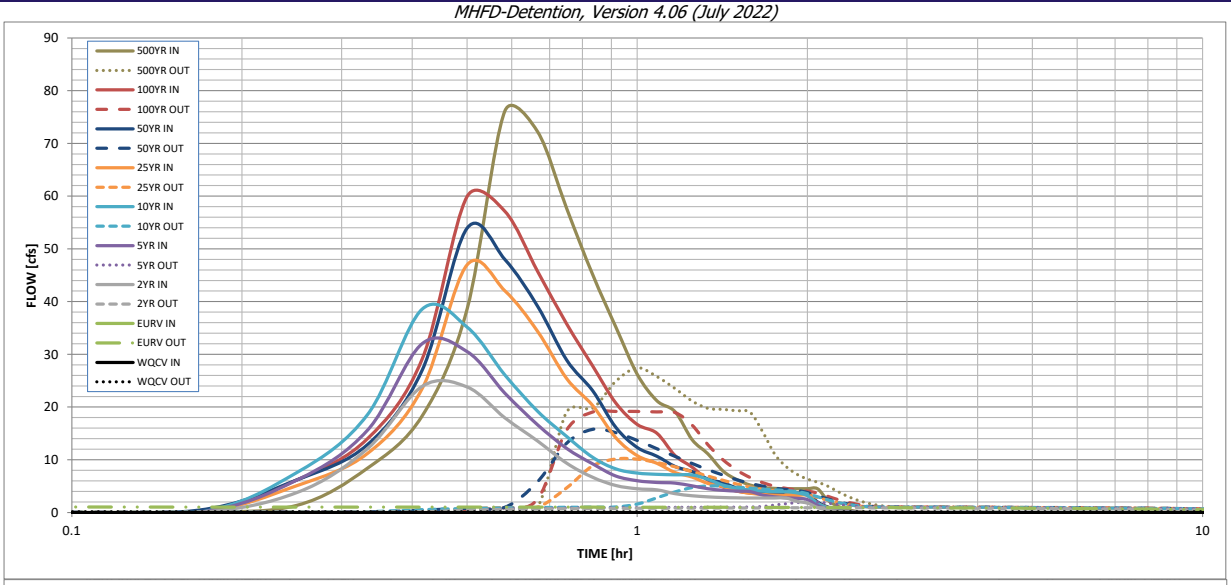
Routed Hydrograph Results

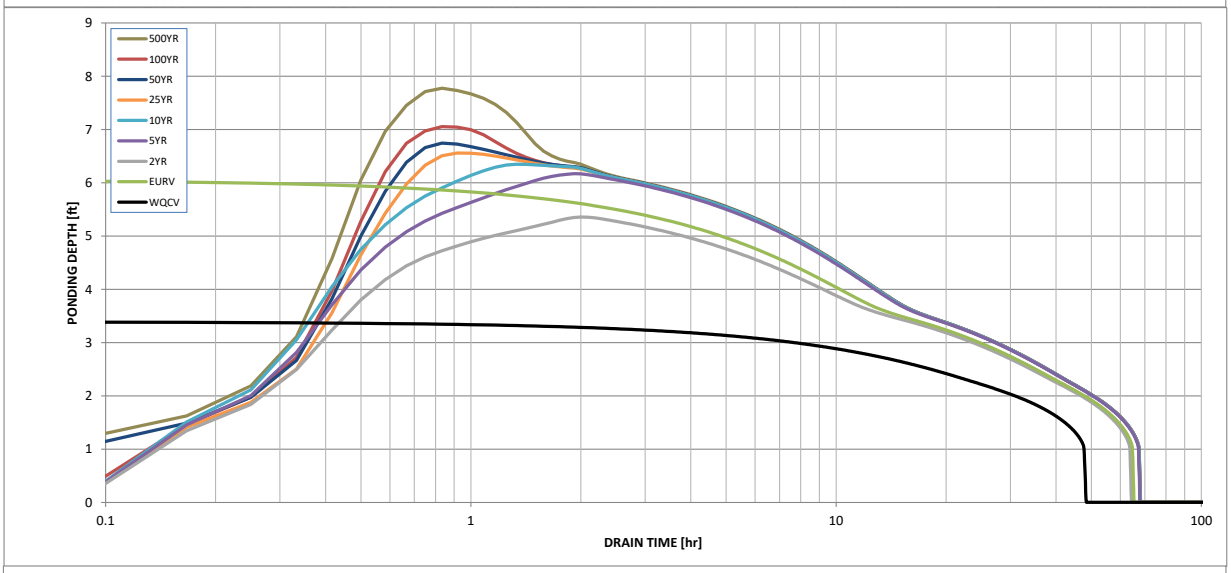
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF)

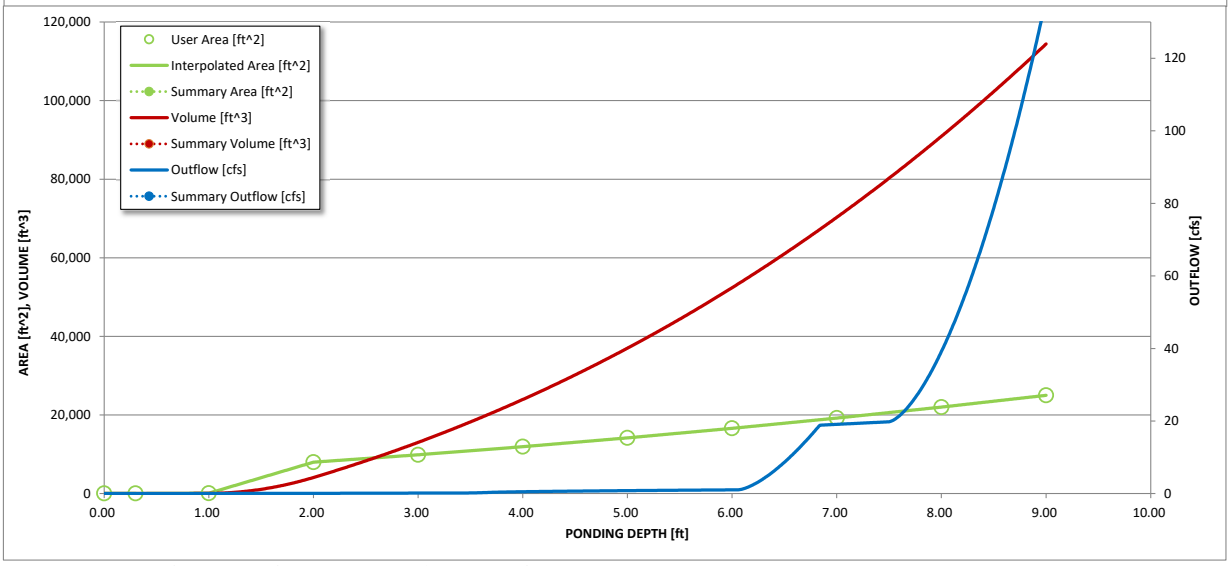
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	0.391	1.225	1.081	1.430	1.720	2.034	2.332	2.670
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	1.081	1.430	1.720	2.034	2.332	2.670
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	2.8	6.6	9.8	16.3	20.2	25.2
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.20	0.47	0.68	1.14	1.42	1.76
Peak Inflow Q (cfs) =	N/A	N/A	23.9	32.0	38.6	47.0	53.9	59.9
Peak Outflow Q (cfs) =	0.2	1.0	0.9	2.0	5.0	10.1	15.8	19.2
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.3	0.5	0.6	0.8	0.8
Structure Controlling Flow =	Vertical Orifice 1	Overflow Weir 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.1	0.4	0.8	1.3	1.6
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	45	57	57	59	57	56	54	53
Time to Drain 99% of Inflow Volume (hours) =	**47**	62	61	64	64	63	62	62
Maximum Ponding Depth (ft) =	3.39	6.06	5.36	6.17	6.35	6.56	6.74	7.05
Area at Maximum Ponding Depth (acres) =	0.25	0.38	0.34	0.39	0.40	0.41	0.43	0.44
Maximum Volume Stored (acre-ft) =	0.391	1.226	0.967	1.268	1.336	1.421	1.501	1.636

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: *Pond C1 outflow*

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	0.42	0.04	1.36
	0:15:00	0.00	0.00	3.77	6.14	7.58	5.08	6.19	6.17	8.39
	0:20:00	0.00	0.00	12.08	15.57	18.53	11.19	12.86	13.98	18.33
	0:25:00	0.00	0.00	23.94	32.04	38.58	23.52	27.03	29.15	38.57
	0:30:00	0.00	0.00	23.80	30.52	35.16	46.97	53.92	59.90	76.12
	0:35:00	0.00	0.00	17.93	22.63	26.09	42.04	47.98	57.13	72.21
	0:40:00	0.00	0.00	13.56	16.62	19.18	34.34	39.11	45.72	57.69
	0:45:00	0.00	0.00	9.35	12.16	14.44	25.41	28.93	35.80	45.19
	0:50:00	0.00	0.00	6.68	9.23	10.48	20.32	23.14	27.85	35.15
	0:55:00	0.00	0.00	5.10	6.92	8.26	14.14	16.12	20.75	26.23
	1:00:00	0.00	0.00	4.50	6.03	7.48	10.79	12.33	16.70	21.19
	1:05:00	0.00	0.00	4.30	5.70	7.24	9.32	10.68	15.03	19.11
	1:10:00	0.00	0.00	3.55	5.57	7.15	7.58	8.72	10.79	13.82
	1:15:00	0.00	0.00	3.19	5.05	7.12	6.71	7.74	8.61	11.11
	1:20:00	0.00	0.00	2.96	4.51	6.30	5.52	6.34	6.14	7.91
	1:25:00	0.00	0.00	2.84	4.21	5.21	4.92	5.64	4.84	6.22
	1:30:00	0.00	0.00	2.77	4.04	4.60	4.08	4.67	4.05	5.21
	1:35:00	0.00	0.00	2.74	3.95	4.25	3.64	4.17	3.70	4.75
	1:40:00	0.00	0.00	2.74	3.30	4.04	3.41	3.90	3.57	4.57
	1:45:00	0.00	0.00	2.74	2.97	3.95	3.29	3.77	3.52	4.51
	1:50:00	0.00	0.00	2.74	2.78	3.92	3.24	3.71	3.52	4.51
	1:55:00	0.00	0.00	2.11	2.68	3.71	3.22	3.69	3.52	4.51
	2:00:00	0.00	0.00	1.78	2.45	3.21	3.22	3.69	3.52	4.51
	2:05:00	0.00	0.00	0.94	1.32	1.73	1.74	1.99	1.90	2.43
	2:10:00	0.00	0.00	0.50	0.71	0.93	0.95	1.08	1.03	1.32
	2:15:00	0.00	0.00	0.23	0.35	0.45	0.47	0.54	0.52	0.66
	2:20:00	0.00	0.00	0.09	0.16	0.19	0.21	0.24	0.23	0.30
	2:25:00	0.00	0.00	0.02	0.04	0.04	0.05	0.06	0.06	0.07
	2:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

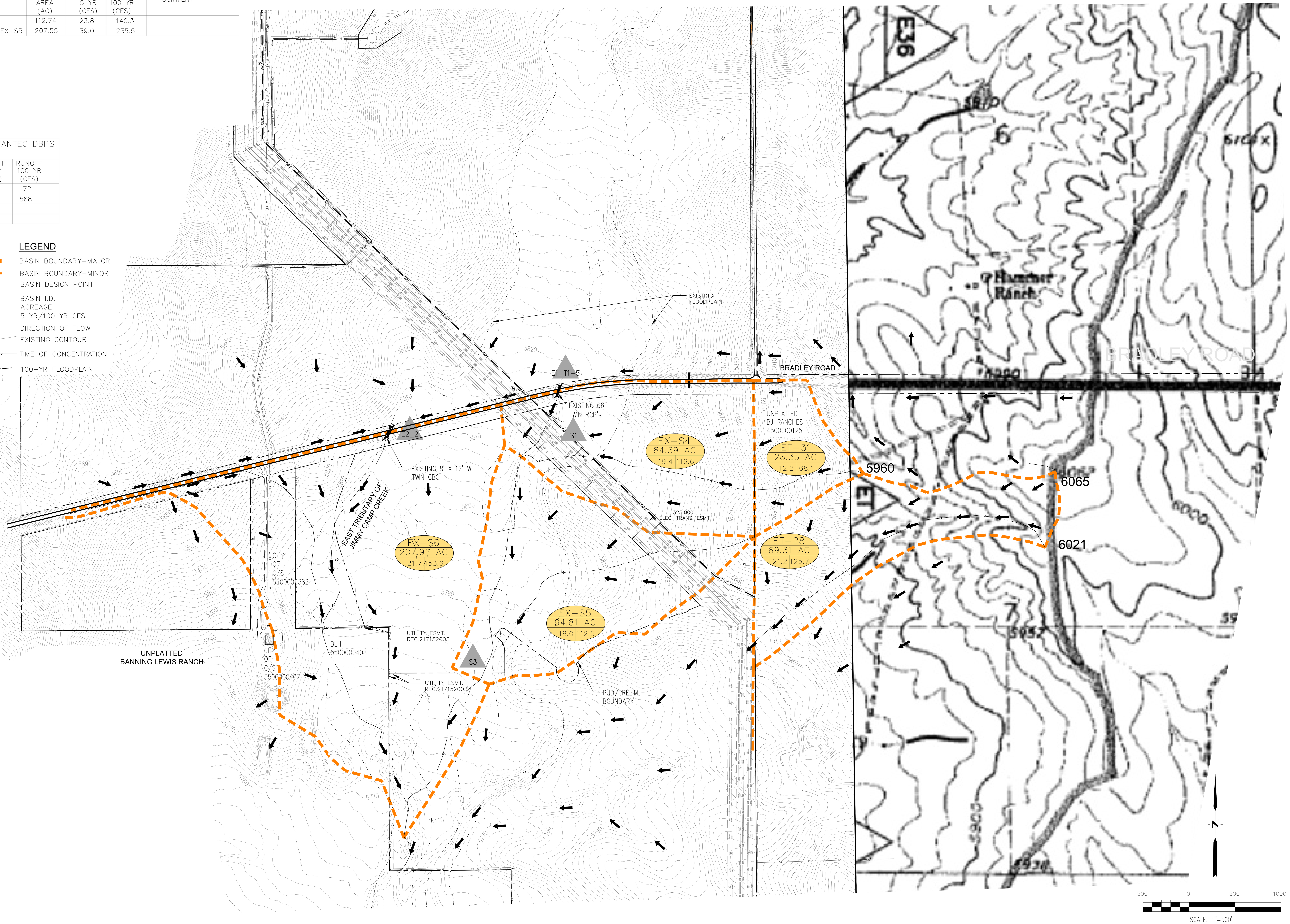
MAP POCKET

DESIGN POINT SUMMARY TABLE					
DESIGN POINT	TRIBUTARY BASINS	DRAINAGE AREA (AC)	RUNOFF 5 YR (CFS)	RUNOFF 100 YR (CFS)	COMMENT
S1	ET–31, EX–S4	112.74	23.8	140.3	
S3	ET–31, EX–S4, EX–S5	207.55	39.0	235.5	

EAST TRIBUTARY STANTEC DBPS FLOW DATA		
DESIGN POINT	RUNOFF 5 YR (CFS)	RUNOFF 100 YR (CFS)
E1_T1_5	15	172
E2_2	33	568

LEGEND

- BASIN BOUNDARY–MAJOR
- BASIN BOUNDARY–MINOR
- BASIN DESIGN POINT
- BASIN I.D. / ACREAGE / 5 YR/100 YR CFS (BASIN XXAC x.x x.x)
- DIRECTION OF FLOW
- EXISTING CONTOUR (6690)
- TIME OF CONCENTRATION
- 100–YR FLOODPLAIN



SCALE: 1"=500'

CORE ENGINEERING GROUP
15004 1ST AVENUE S.
BURNSVILLE, MN 55306
PH: 719.570.1100
CONTACT: RICHARD L. SCHINDLER, P.E.
EMAIL: Rich@ceg1.com

NO.	DESCRIPTION	DATE

PREPARED FOR:
EAGLE DEVELOPMENT CO.
212 NORTH WAHSATCH AVE, SUITE 301
COLORADO SPRINGS, COLORADO 80903 (719) 635–3200
CONTACT: JEFF MARK

PROJECT:
ANTELOPE RIDGE AT BULL HILL FIL. 1
BRADLEY RD/MERIDIAN RD.
EL PASO COUNTY, COLORADO

DRAWN: LAB
DESIGNED: LAB
CHECKED: RLS

EXISTING CONDITIONS
ANTELOPE RIDGE AT BULL HILL 1

DATE: OCT, 2025

PROJECT NO. 100.302

SHEET NUMBER 1

TOTAL SHEETS: 1

LEGEND

- PUD BOUNDARY
- BASIN BOUNDARY
- BASIN DESIGN POINT (X)
- BASIN I.D. / ACREAGE / 5 YR/100 YR CFS (BASIN XX AC | X.X | X.X)
- DIRECTION OF FLOW
- EXISTING CONTOUR (6690)
- PROPOSED CONTOUR (6670)
- ROW
- EXISTING STORM SEWER
- PROPOSED STORM SEWER
- TIME OF CONCENTRATION
- HP HIGH POINT
- LP LOW POINT

NOTES:

1. ALL PROPOSED STORM SEWER IS RCP ROUND PIPE AND IS A PUBLIC STORM SEWER SYSTEM UNLESS NOTED OTHERWISE.

DESIGN POINT SUMMARY

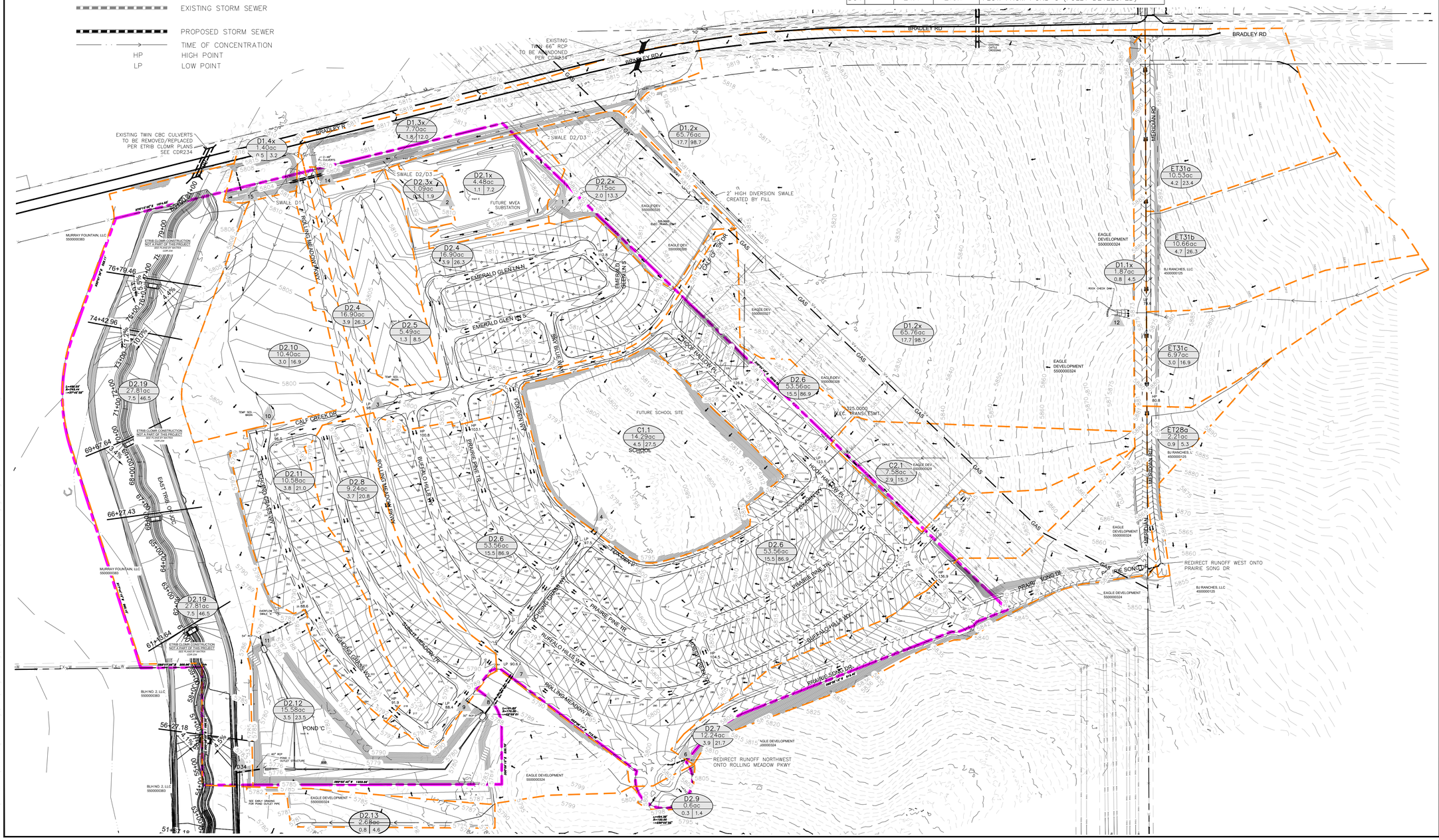
D.P.		5 YEAR cfs	100 YEAR cfs	NOTES
1		3.3	22.3	
2		0.3	1.9	
3		5.3	35.2	
4		4.5	27.5	
5		2.9	15.7	
6		4.8	27.0	
7		26.7	156.3	
8		26.7	156.3	FLOW INTO 60" STM

DESIGN POINT SUMMARY

D.P.		5 YEAR cfs	100 YEAR cfs	NOTES
9		3.7	20.8	FLOW INTO 5' TYPE R INLET
10		3.0	16.9	
11		8.8	49.0	FLOW INTO 54" STM
12		12.7	71.0	
13		30.4	169.8	SWALE FLOW, SWALE DESIGN FOR 260cfs
14		32.1	181.8	SWALE FLOW, SWALE DESIGN FOR 260cfs
15		32.6	184.9	SWALE FLOW, SWALE DESIGN FOR 260cfs
D33		170.3	415.3	FLOW INTO POND C (FULLY DEVELOPED)
D34		24.4	219.7	FLOW FROM POND C (FULLY DEVELOPED)

200 100 0 200 400

SCALE: 1"=200'



CORE ENGINEERING GROUP
15004 1ST AVENUE S.
BURNSVILLE, MN 55306
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CONTACT: RICHARD L. SCHINDLER, P.E.
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PREPARED FOR:
EAGLE DEVELOPMENT CO.
212 NORTH WAHSATCH AVE. SUITE 301
COLORADO SPRINGS, COLORADO 80903
(719) 635-3200
CONTACT: JEFF MARK

NO.	DESCRIPTION

PROJECT:
ANTELOPE RIDGE AT BULL HILL FIL. NO. 1
BRADLEY RD / ROLLING MEADOW DR.
EL PASO COUNTY, COLORADO

DRAWN: RLS
DESIGNED: LAB
CHECKED: RLS

OVERALL DRAINAGE MAP
EARLY OVERLOT GRADING CONDITIONS
ANTELOPE RIDGE AT BULL HILL PHASE 1

DATE: NOV, 2025

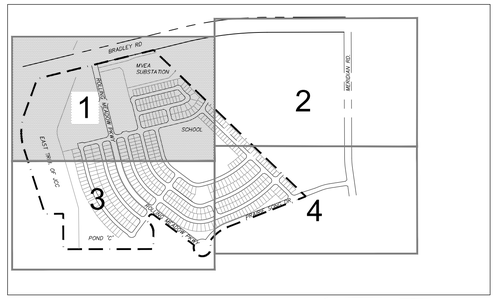
PROJECT NO. 100.302

SHEET NUMBER 1

TOTAL SHEETS: 1

LEGEND

- PUD BOUNDARY
- BASIN BOUNDARY
- BASIN DESIGN POINT
- BASIN I.D. (X) / BASIN XX AC / X.X | X.X — ACREAGE, 5 YR/100 YR CFS
- DIRECTION OF FLOW
- 6690 — EXISTING CONTOUR
- 6670 — PROPOSED CONTOUR
- ROW
- EXISTING STORM SEWER
- PROPOSED STORM SEWER
- TIME OF CONCENTRATION
- HP — HIGH POINT
- LP — LOW POINT



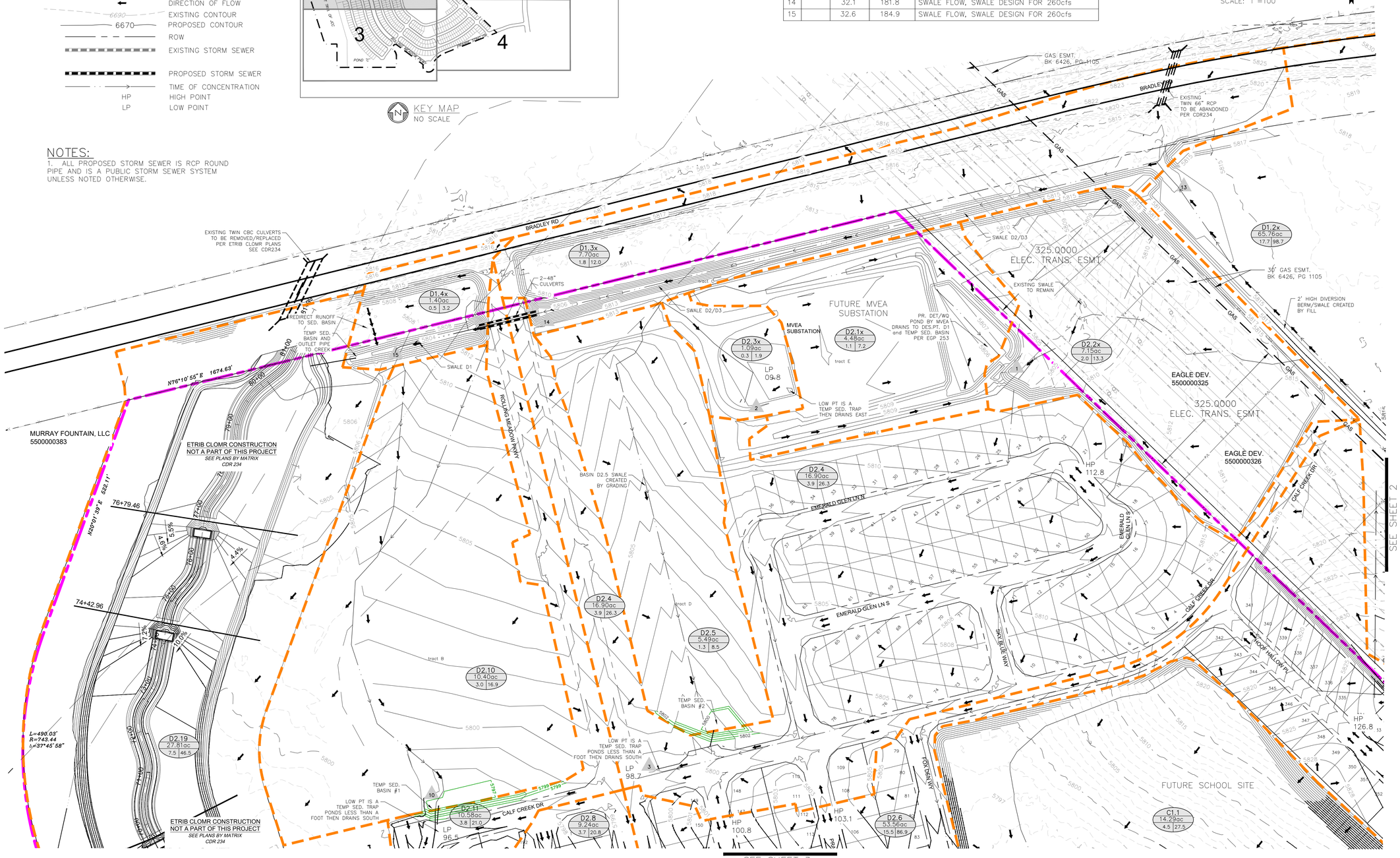
KEY MAP
NO SCALE

DESIGN POINT SUMMARY				
D.P.		5 YEAR cfs	100 YEAR cfs	NOTES
1		3.3	22.3	
2		0.3	1.9	
3		5.3	35.2	
10		3.0	16.9	
13		30.4	169.8	SWALE FLOW, SWALE DESIGN FOR 260cfs
14		32.1	181.8	SWALE FLOW, SWALE DESIGN FOR 260cfs
15		32.6	184.9	SWALE FLOW, SWALE DESIGN FOR 260cfs

SCALE: 1"=100'

NOTES:

1. ALL PROPOSED STORM SEWER IS RCP ROUND PIPE AND IS A PUBLIC STORM SEWER SYSTEM UNLESS NOTED OTHERWISE.



CORE ENGINEERING GROUP
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BURNSVILLE, MN 55306
PHONE: (612) 703-1000
CONTACT: RICHARD L. SCHINDLER, P.E.
EMAIL: Rich@ceg1.com

NO.	DESCRIPTION

PREPARED FOR:
EAGLE DEVELOPMENT CO.
212 NORTH WAHSATCH AVE. SUITE 301
COLORADO SPRINGS, COLORADO 80903
(719) 635-3200
CONTACT: JEFF MARK

PROJECT:
ANTELOPE RIDGE AT BULL HILL FIL. NO. 1
BRADLEY RD / ROLLING MEADOW DR.
EL PASO COUNTY, COLORADO

DRAWN: RLS
DESIGNED: LAB
CHECKED: RLS

EARLY OVERLOT GRADING CONDITIONS DRAINAGE REPORT ANTELOPE RIDGE AT BULL HILL PHASE 1

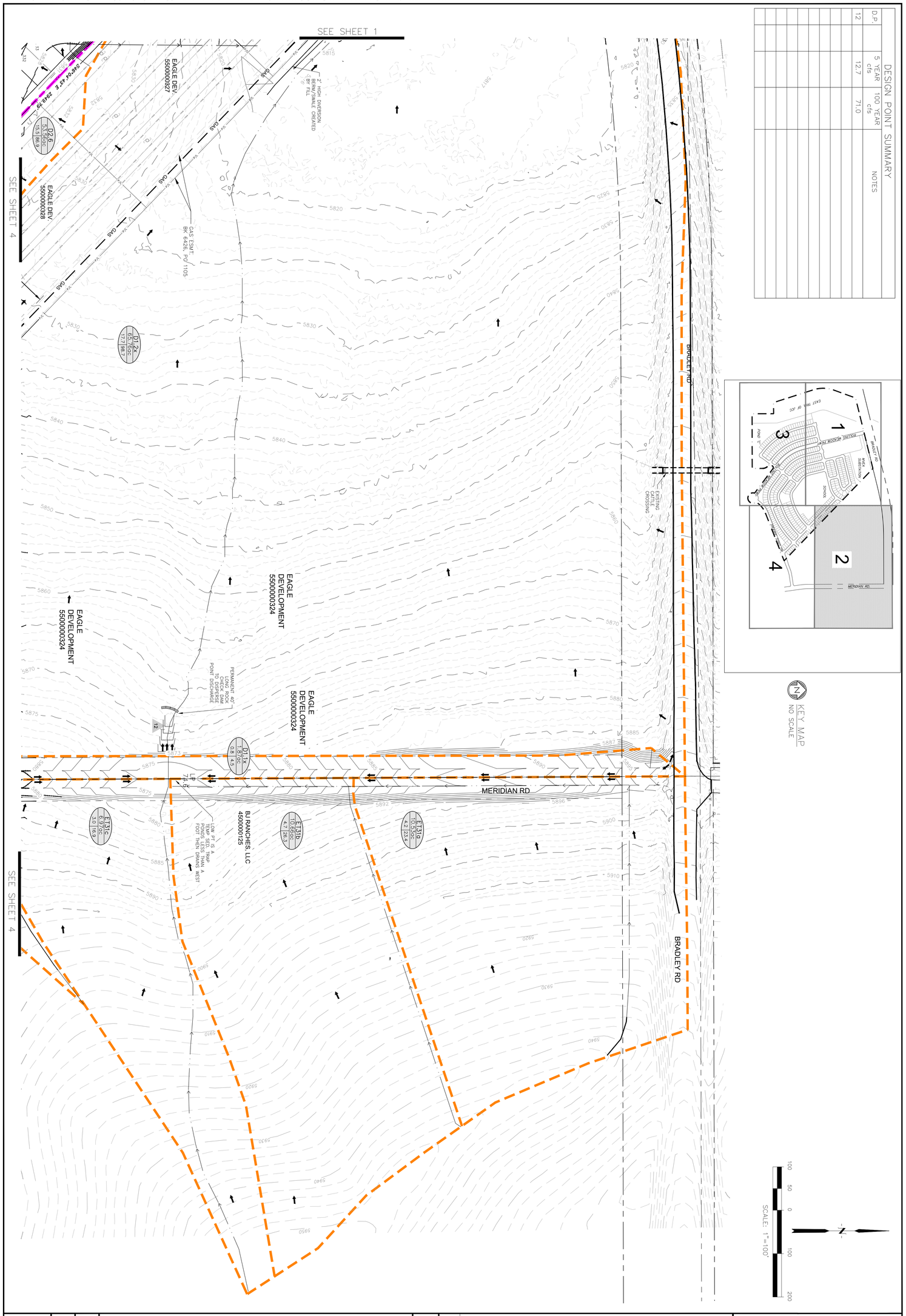
DATE: FEB, 2026

PROJECT NO. 100.302

SHEET NUMBER 1

TOTAL SHEETS: 4

T:\PROJECTS\100.302\preliminary plan\Early Grading\EARLY GRADING DRAINAGE REPORT\100.302early grading dev conditions.dwg Feb 12, 2026 - 7:56am



TOTAL SHEETS:	2
SHEET NUMBER	4
PROJECT NO.	100.302
DATE:	FEB. 2026

EARLY OVERLOT GRADING CONDITIONS DRAINAGE REPORT ANTELOPE RIDGE AT BULL HILL PHASE 1

DRAWN: RLS
DESIGNED: RLS
CHECKED: RLS

NO.	DESCRIPTION

PROJECT:
ANTELOPE RIDGE AT BULL HILL FIL. NO. 1
BRADLEY RD / ROLLING MEADOW DR.
EL PASO COUNTY, COLORADO

PREPARED FOR:
EAGLE DEVELOPMENT CO.
212 NORTH WAHSATCH AVE, SUITE 301
COLORADO SPRINGS, COLORADO 80903
(719) 635-3200
CONTACT: JEFF MARK

CORE ENGINEERING GROUP
15004 1ST AVENUE S.
BURNSVILLE, MN 55306
PH: 719.570.1100
CONTACT: RICHARD L. SCHINDLER, P.E.
EMAIL: Rich@ceg1.com

DESIGN POINT SUMMARY

D.P.		5 YEAR cfs	100 YEAR cfs	NOTES
4		4.5	27.5	
6		4.8	27.0	
7		26.7	156.3	
8		26.7	156.3	FLOW INTO 60" STM
9		3.7	20.8	FLOW INTO 5' TYPE R INLET
11		8.8	49.0	FLOW INTO 54" STM
D33		170.3	415.3	FLOW INTO POND C (FULLY DEVELOPED)
D34		24.4	219.7	FLOW FROM POND C (FULLY DEVELOPED)

KEY MAP
NO SCALE

N

100 50 0 100 200
SCALE: 1"=100'

SEE SHEET 1

SEE SHEET 1

SEE SHEET 4

69+67.64
3.4%
64+00
60+00
EAST TRIB OF JCC
66+27.43
62+00
64+00
MURRAY FOUNTAIN, LLC
5500000383
N17°41'15"W 995.15'
D2.19
27.81ac
7.5 46.5
2:1 RIP RAP SLOPE TO INVERT OF STM SWR. SEE EARLY GRADING PLANS
54" RCP
ETRIB CLOMR CONSTRUCTION NOT A PART OF THIS PROJECT
SEE PLANS BY MATRIX
COR 234
61+14.64
S89°17'26"W 256.96'
UTILITY ESMT. REC. 217152003
BLH NO. 2, LLC
5500000383
60+00
56+27.76
4.1%
4.5%
S00°09'15"E 996.98'
BLH NO. 2, LLC
5500000383
SEE EARLY GRADING FOR POND OUTLET PIPE
UTILITY ESMT. REC. 217152003
D34
POND 'C'
tract N
60" RCP
POND C OUTLET STRUCTURE
D33
S89°50'45"W 1259.66'
EAGLE DEVELOPMENT
5500000324
D2.13
2.68ac
0.8 4.6
D2.12
15.58ac
3.5 23.5
D2.11
10.58ac
3.8 21.0
LP
88.6
OVERFLOW SWALE 'A'
LOW PT IS A TEMP. SED. TRAP PONDS LESS THAN A FOOT THEN DRAINS WEST
ECHOING GRASS WY
SUNLIT MEADOW TR
ROLLING MEADOW PKWY
BUFFALO HILLS WY
PRAIRIE PINE TR
HP
91.9
LP
88.4
D2.8
9.24ac
3.7 20.8
INLET 033
5' TYPE R SUMP
60" RCP
L=161.83'
R=175.00'
Δ=52°59'01"
30" RCP
LOW PT IS A TEMP. SED. TRAP PONDS LESS THAN A FOOT THEN DRAINS SOUTH
LOW PT IS A TEMP. SED. TRAP PONDS LESS THAN A FOOT THEN DRAINS OVERLAND SOUTHWEST
LP
97.5
LP
90.6
2:1 RIP RAP SLOPE TO INVERT OF STM SWR. SEE EARLY GRADING PLANS
N53°08'17"W 713.58'
S00°09'15"E 235.78'
SCHOOL
tract K
FUTURE SCHOOL SITE
C1.1
14.29ac
4.5 27.5
D2.6
53.56ac
15.5 86.9
FOXTAIL WAY
tract J
MOSSY CREEK TR
D2.7
12.24ac
3.9 21.7
REDIRECT RUNOFF NORTH ONTO ROLLING MEADOW P
D2.9
0.6ac
0.3 1.4
L=494.38'
R=120.00
Δ=236°03'05"

CORE ENGINEERING GROUP
15004 1ST AVENUE S.
BURNSVILLE, MN 55306
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EMAIL: Rich@ceg1.com

NO. | DESCRIPTION

PREPARED FOR:
EAGLE DEVELOPMENT CO.
212 NORTH WAHSATCH AVE. SUITE 301
COLORADO SPRINGS, COLORADO 80903
(719) 635-3200
CONTACT: JEFF MARK

PROJECT:
ANTELOPE RIDGE AT
BULL HILL FIL. NO. 1
BRADLEY RD / ROLLING MEADOW DR.
EL PASO COUNTY, COLORADO

DRAWN: RLS
DESIGNED: LAB
CHECKED: RLS

EARLY OVERLOT GRADING CONDITIONS
DRAINAGE REPORT
ANTELOPE RIDGE AT BULL HILL PHASE 1

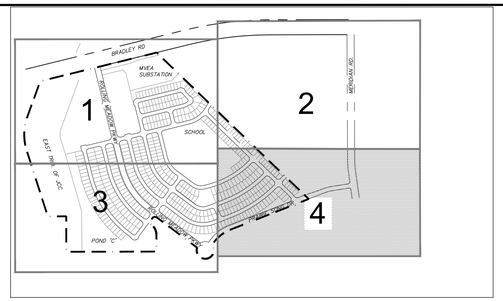
DATE: FEB, 2026

PROJECT NO. 100.302

SHEET NUMBER 3

TOTAL SHEETS: 4

DESIGN POINT SUMMARY				
D.P.		5 YEAR cfs	100 YEAR cfs	NOTES
5		2.9	15.7	

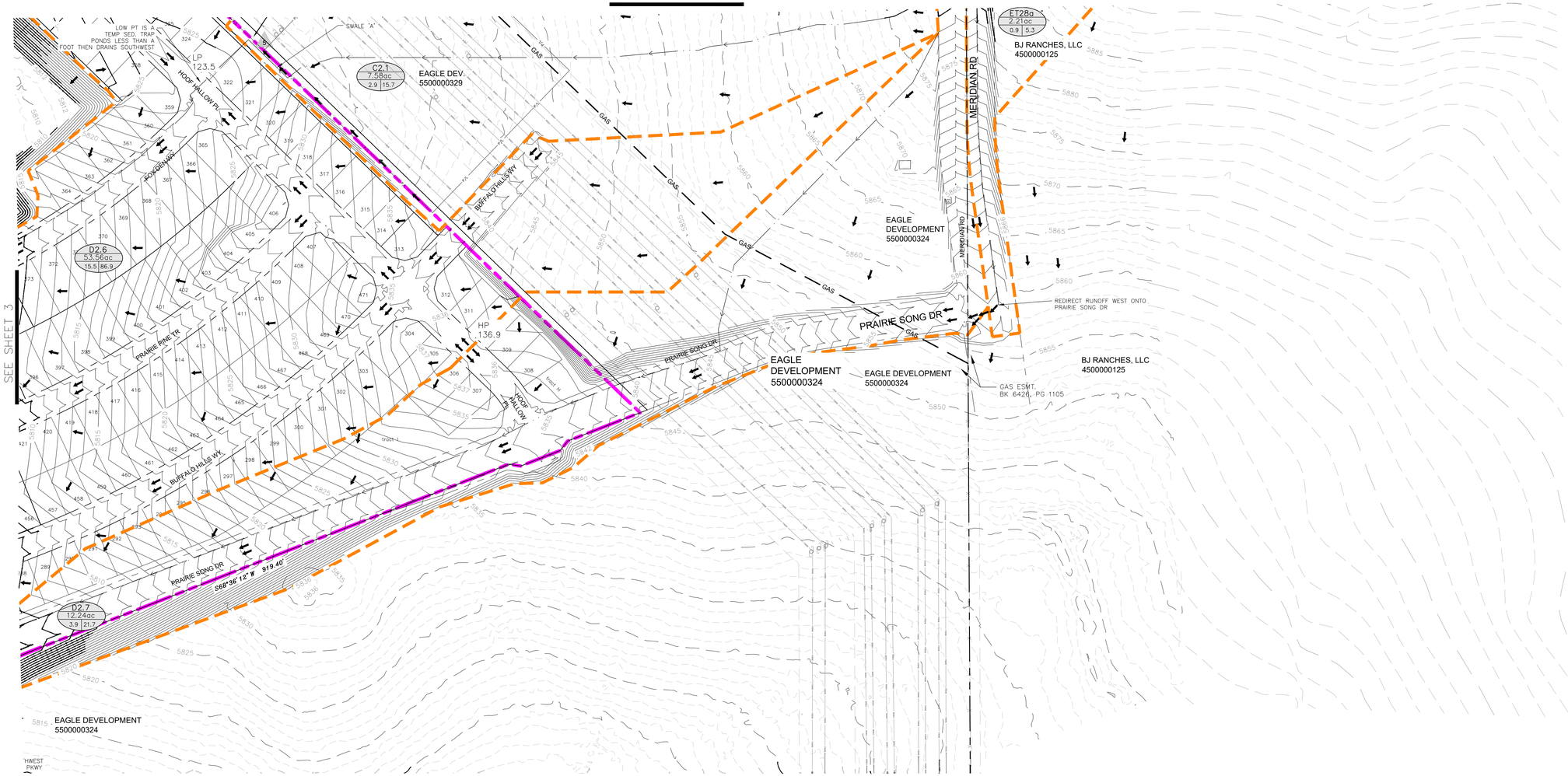


KEY MAP
NO SCALE

N

0 80 160
SCALE: 1"=80'

SEE SHEET 2



CORE ENGINEERING GROUP
15004 1ST AVENUE S.
BURNSVILLE, MN 55306
PHONE: (763) 479-4700
CONTACT: RICHARD L. SCHINDLER, P.E.
EMAIL: Rich@ceg1.com

NO. DESCRIPTION

PREPARED FOR:
EAGLE DEVELOPMENT CO.
212 NORTH WAHSATCH AVE. SUITE 301
COLORADO SPRINGS, COLORADO 80903
(719) 635-3200
CONTACT: JEFF MARK

PROJECT:
ANTELOPE RIDGE AT BULL HILL FIL. NO. 1
BRADLEY RD / ROLLING MEADOW DR.
EL PASO COUNTY, COLORADO

DRAWN: RLS
DESIGNED: LAB
CHECKED: RLS

EARLY OVERLOT GRADING CONDITIONS DRAINAGE REPORT ANTELOPE RIDGE AT BULL HILL PHASE 1

DATE: FEB, 2026

PROJECT NO. 100.302

SHEET NUMBER 4

TOTAL SHEETS: 4

LEGEND

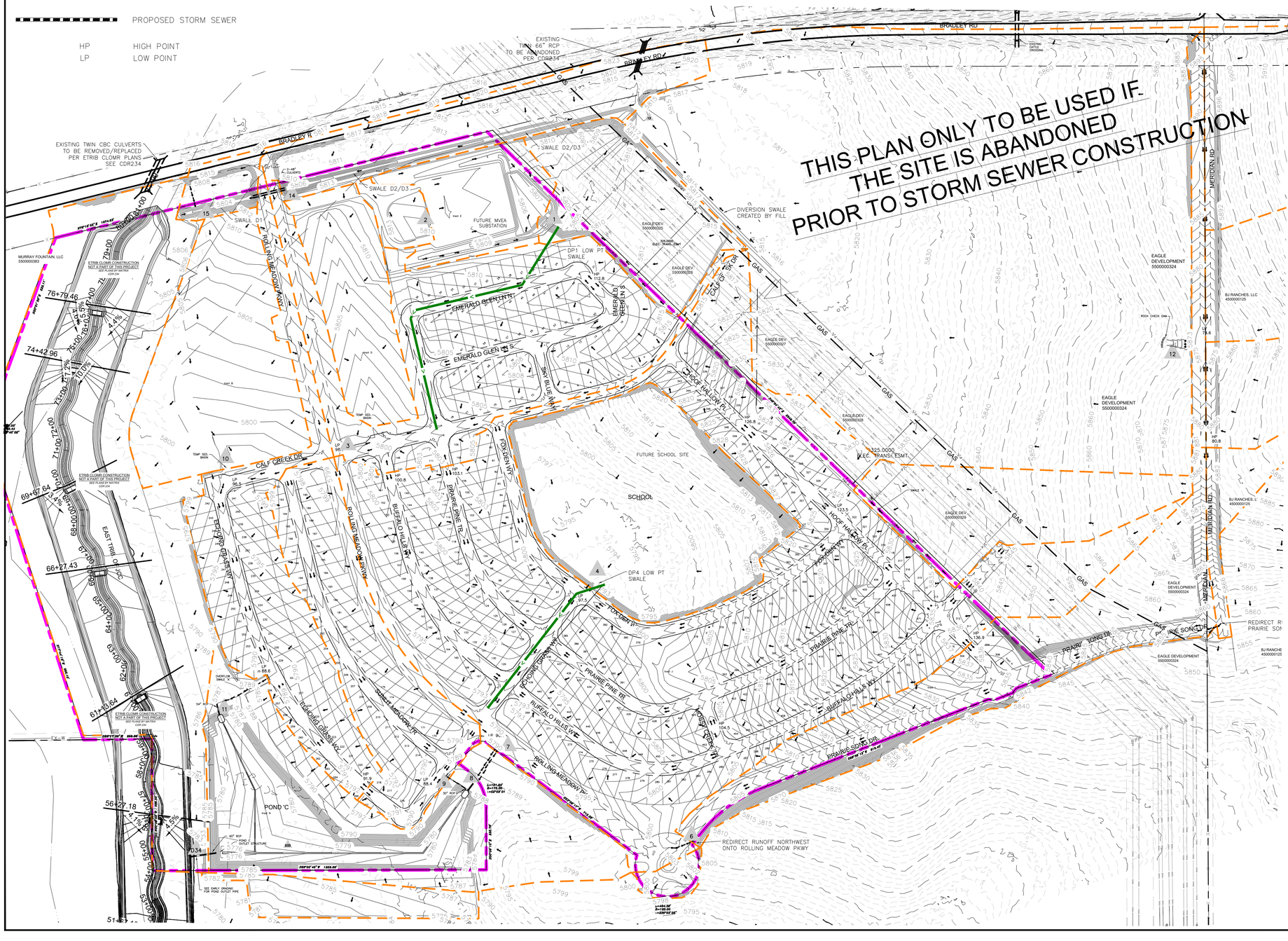
- PUD BOUNDARY
- BASIN BOUNDARY
- BASIN DESIGN POINT (X)
- LOW POINT DRAINAGE SWALE
- DIRECTION OF FLOW
- 6690 EXISTING CONTOUR
- 6670 PROPOSED CONTOUR
- ROW
- EXISTING STORM SEWER
- PROPOSED STORM SEWER
- HP HIGH POINT
- LP LOW POINT

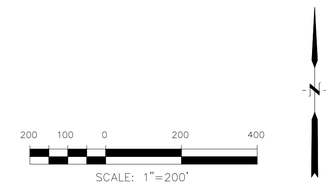
NOTES:

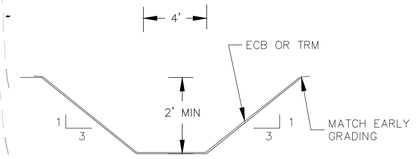
1. LOW POINT SWALES ON THIS PLAN ARE ONLY TO BE USED IN THE EVENT THE SITE IS ABANDONED PRIOR TO STORM SEWER CONSTRUCTION BY THE DEVELOPER AND LOW POINTS NEED TO HAVE POSITIVE DRAINAGE TO ELIMINATE PONDING OF WATER

DESIGN POINT SUMMARY				
D.P.		5 YEAR cfs	100 YEAR cfs	NOTES
1		3.3	22.3	
2		0.3	1.9	
3		5.3	35.2	
4		4.5	27.5	
5		2.9	15.7	
6		4.8	27.0	
7		26.7	156.3	
8		26.7	156.3	FLOW INTO 60" STM

DESIGN POINT SUMMARY				
D.P.		5 YEAR cfs	100 YEAR cfs	NOTES
9		3.7	20.8	FLOW INTO 5' TYPE R INLET
10		3.0	16.9	
11		8.8	49.0	FLOW INTO 54" STM
12		12.7	71.0	
13		30.4	169.8	SWALE FLOW, SWALE DESIGN FOR 260cfs
14		32.1	181.8	SWALE FLOW, SWALE DESIGN FOR 260cfs
15		32.6	184.9	SWALE FLOW, SWALE DESIGN FOR 260cfs
D33		170.3	415.3	FLOW INTO POND C (FULLY DEVELOPED)
D34		24.4	219.7	FLOW FROM POND C (FULLY DEVELOPED)

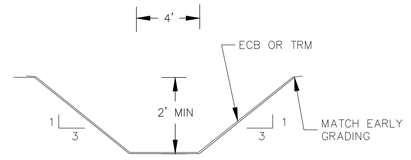






DP1 LOW POINT SWALE

0.16% SLOPE, Q100=22.3cfs, FLOW DEPTH=1.18'
VEL=2.51fps
UPSTREAM INV=5803.80, DOWNSTREAM INV=5802.00
LENGTH=1140'



DP4 LOW POINT SWALE

0.3% SLOPE, Q100=27.5cfs, FLOW DEPTH=1.12'
VEL=3.34fps
UPSTREAM INV=5792.80, DOWNSTREAM INV=5791.00
LENGTH=600'

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EMAIL: Rich@ceg1.com

PREPARED FOR:
EAGLE DEVELOPMENT
212 N. WAHSATCH AVE, SUITE 301
COLORADO SPRINGS, COLORADO 80903
(719) 635-3200
CONTACT: JEFF MARK

NO.	DESCRIPTION	DATE
###	###	###

PROJECT:
ANTELOPE RIDGE AT BULL HILL PHASE 1
FONTAINE BLVD/MARKSHEFFEL RD
COLORADO SPRINGS, CO

DRAWN: BRN:
DESIGNED: RLS
CHECKED: RLS:

LOW POINT DRAINAGE SWALES GRADING AND EROSION CONTROL PLAN

PRELIMINARY

DATE: FEB., 2026
PROJECT NO. 100.302
SHEET NUMBER C4.11
TOTAL SHEETS: 25