

**FINAL DRAINAGE REPORT
FOR
LAZY Y AND ROCKING J SUBDIVISION**

November 2024

Prepared For:

Scott Smith

1172 Greenland Forest Drive
Monument, CO 80106
(719) 499-7764

Prepared By:

JR Engineering, LLC

5475 Tech Center Drive, Suite 235
Colorado Springs, CO 80919
719-593-2593

Project No. 25228.00

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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 letter 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.

Bryan T. Law, Colorado P.E. # 25043
For and On Behalf of JR Engineering, LLC

Date

DEVELOPER'S STATEMENT:

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

Business Name: Scott Smith

By: _____

Title: _____

Address: 1172 Greenland Forest Drive
Monument, CO 80106

El Paso County:

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

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

Date

Conditions: 

Table of Contents

Purpose.....	1
General Site Description.....	1
General Location	1
Description of Property	1
Floodplain Statement.....	1
Existing Drainage Conditions	2
Major Basin Descriptions	2
Existing Sub-basin Drainage	2
Proposed Drainage Conditions	3
Proposed Drainage Conveyance.....	3
Proposed Sub-basin Drainage.....	4
Comparison of Flows	6
Drainage Design Criteria	7
Development Criteria Reference	7
Hydrologic Criteria.....	7
Hydraulic Criteria.....	8
Drainage Facility Design	8
General Concept	8
Specific Details.....	8
<i>Four Step Process to Minimize Adverse Impacts of Urbanization</i>	8
<i>Water Quality</i>	9
<i>Erosion Control Plan</i>	11
<i>Operation & Maintenance</i>	11
<i>Drainage and Bridge Fees</i>	11
<i>Construction Cost Opinion</i>	12
Summary.....	12
References.....	13

APPENDICES

- Appendix A – Vicinity Map, Soil Descriptions, FEMA Floodplain Map
- Appendix B – Hydrologic Calculations
- Appendix C – Hydraulic Calculations
- Appendix D – Reference Material
- Appendix E – Drainage Maps



PURPOSE

This document is the Final Drainage Report for Lazy Y and Rocking J Subdivision. The purpose of this report is to identify on-site and off-site drainage patterns, culverts, areas tributary to the site, and to safely route developed storm water to adequate outfall facilities.

GENERAL SITE DESCRIPTION

GENERAL LOCATION

Lazy Y and Rocking J Subdivision (hereby referred to as the “site”) is a proposed development with a total area of approximately 34 acres. The site presently is used as a commercial equipment building. The site is located in the south half of Section 7, Township 12 South, Range 63 West of the Sixth Principal Meridian in El Paso County, State of Colorado. The site is bounded by Peyton Highway to the east, Longhorn Acres Subdivision to the south, and unplatted land to the west and north. Refer to the vicinity map in Appendix A for additional information.

DESCRIPTION OF PROPERTY

The site has a split drainage pattern with a ridge running across the site. The site generally slope(s) as follows: to the north at 1 to 9% off-site to unplatted land, to the northeast at 1 to 15% to the existing roadside ditch along Peyton Highway, and to the south at 1 to 9% off-site to Longhorn Acres Subdivision. The site is currently comprised of gravel roads, a building, a shed, concrete pads, a cell tower, dry utilities, trees and vegetation. A wire fence wraps around the perimeter of the site along the west, north, and east sides.

The proposed site development proposes asphalt and gravel drive aisles, asphalt and gravel parking spaces, tent sites, buildings, concrete sidewalks, two full-spectrum Extended Detention Basins (EDBs) and associated utility infrastructure.

Soils located on the project site are Stapleton sandy loam. These soils are classified as Hydrologic Soil Group B. Group B soils exhibit moderate infiltration rates when thoroughly wet, and consist mainly of moderately deep, moderately well drained to well drained soils. Refer to the soil survey map in Appendix A for additional information.

There are no known irrigation facilities located on the project site.

FLOODPLAIN STATEMENT

Based on the FEMA FIRM Map number 08041C0375G, dated December 7, 2018, the entire site lies within Zone X. Zone X is defined as area outside the Special Flood Hazard Area (SFHA) and higher than the elevation of the 0.2-percent-annual-chance (or 500-year) flood. Refer to the FIRM Map in Appendix A for additional information.



EXISTING DRAINAGE CONDITIONS

MAJOR BASIN DESCRIPTIONS

Based on the map of the Drainage Basins for El Paso County, the site lies within both the Upper Brackett Creek and the La Vega Ranch Drainage Basins. Neither of these basins have been studied, and therefore no Drainage Basin Planning Studies are available. The site generally drains towards the north, northeast, and south from the middle of the site. Brackett Creek is located to the north and east of the site and runs from northwest to southeast. An unnamed tributary of Brackett Creek is located to the south of the site and runs from northwest to southeast. The Upper Brackett Creek Basin is tributary to the La Vega Ranch Basin. The La Vega Ranch drainageway flows south about 10 miles where the Hook and Line Ranch Basin, La Vega Ranch Basin, and Baggett Basin combine just north of State Highway 94.

EXISTING SUB-BASIN DRAINAGE

The existing condition of the site was broken into three on-site sub-basins. The basin delineation is shown on the existing drainage map in Appendix E and is described as follows:

Basin EXA is 4.25 acres with a 2% percent impervious and is located on the northwestern portion of the site. This basin is comprised of existing vegetation and undeveloped area. Runoff from this basin ($Q_5=1.1$ cfs, $Q_{100}=7.2$ cfs) sheet flows overland northeast onto the unplatted adjacent property at design point (DP) 1. Runoff then follows historic drainage patterns off-site and eventually outfalls to Brackett Creek.

Basin EXB is 3.59 acres with a 2% percent impervious and is located on the northwestern portion of the site. This basin is comprised of existing vegetation and undeveloped area. Runoff from this basin ($Q_5=0.8$ cfs, $Q_{100}=5.6$ cfs) sheet flows overland northeast onto the unplatted adjacent property at DP2. Runoff then follows historic drainage patterns off-site and eventually outfalls to Brackett Creek.

Basin EXC is 7.40 acres with a 2% percent impervious and is located on the northern portion of the site. This basin is comprised of existing vegetation and undeveloped area. Runoff from this basin ($Q_5=2.0$ cfs, $Q_{100}=13.5$ cfs) sheet flows overland northeast to DP3 and along the existing Peyton Hwy roadside swale combining at DP3.1.

Basin OS1 is approximately 0.57 acres with a 42% percent impervious and is comprised of existing west half of Peyton Hwy roadway and swale. Runoff generated by this basin ($Q_5=1.1$ cfs, $Q_{100}=2.5$ cfs) flows within the existing swale to DPO1. Flows then combine within the existing Peyton Hwy swale at DP3.1 ($Q_5=2.8$ cfs, $Q_{100}=15.2$ cfs). Runoff then follows historic drainage patterns off-site and eventually outfalls to Brackett Creek.

Basin EXD is 6.29 acres with a 7.3% percent impervious and is located on the central portion of the site. This basin is comprised of existing vegetation and an existing gravel road. Runoff from this basin ($Q_5=1.9$ cfs, $Q_{100}=9.9$ cfs) sheet flows overland southeast to DP4 and along the existing Peyton Hwy Road.

Basin EXE is 5.31 acres with a 8.6% percent impervious and is located on the northeastern portion of the site. This basin is comprised of part of gravel roads, building, a cell tower, concrete pads, dry utilities, existing vegetation, and undeveloped area. Runoff from this basin ($Q_5=1.8$ cfs, $Q_{100}=8.7$ cfs) sheet flows overland south to onto the adjacent Longhorn Acres Subdivision property at DP5. Runoff then follows historic drainage patterns off-site and eventually outfalls to the unnamed tributary of Brackett Creek.

Basin EXF is 7.08 acres with a 2% percent impervious and is located on the southwestern portion of the site. This basin is comprised of existing vegetation and undeveloped area. Runoff from this basin ($Q_5=1.8$ cfs, $Q_{100}=12.3$ cfs) sheet flows overland south onto the adjacent Longhorn Acres Subdivision property at DP5. Runoff then follows historic drainage patterns off-site and eventually outfalls to the unnamed tributary of Brackett Creek.

PROPOSED DRAINAGE CONDITIONS

PROPOSED DRAINAGE CONVEYANCE

In general, developed flows are collected in proposed swales, which convey water to the proposed water quality and detention areas, Pond A and Pond B. Proposed swale sections were designed to ensure they are stable and have required capacity to satisfy criteria. A swale is considered stable with a velocity of 5 ft/s or less. Erosion protection shall be provided where velocities exceed 5 ft/s. Where velocities exceed 5 ft/s, swales will be reinforced with the specified SC250 VMax TRM (turf reinforcement mat) product (or approved equivalent) shown in Appendix C. The roadway swale slopes in general follow the roadway slopes and specific locations where the TRM reinforcing is required in swale sections are shown in the Grading and Erosion Control Construction Documents. To ensure capacity, swales will have a minimum of 1 ft. of freeboard over the water surface for flows anticipated in a 100-year storm event. In addition to the swales, a proposed culvert also conveys flows under the access roadway. The culvert was sized to not overtop the roadways with flows from a 100-year storm event. Detailed swale calculations, sections, and culvert calculations are located in Appendix C.

PROPOSED SUB-BASIN DRAINAGE

The proposed basin delineation for the site as shown on the map within Appendix E is as follows:

Basin A is approximately 1.51 acres with a 21% percent impervious and is comprised of proposed gravel roadways, gravel parking areas, concrete sidewalks and RV parking spots. Runoff generated by this basin ($Q_5=1.3$ cfs, $Q_{100}=4.3$ cfs) sheet flows overland to the proposed swale at DP1. Flows enter Basin B and combine at DP2.1.

Basin B is approximately 3.10 acres with a 16.5% percent impervious and is comprised of proposed asphalt roadways, gravel parking areas, concrete sidewalk and RV hookup sites. Runoff generated by this basin ($Q_5=2.0$ cfs, $Q_{100}=7.5$ cfs) sheet flows overland to the proposed swale at DP2. Flows then combine with DP1 at DP2.1 ($Q_5=3.1$ cfs, $Q_{100}=11.4$ cfs) and enter into the proposed culvert. DP2.1 flows continue within a proposed swale to the combination at DP3.1.

Basin C is approximately 4.27 acres with a 17.6% percent impervious and is comprised of proposed gravel parking areas, concrete sidewalks and RV hookup sites. Runoff generated by this basin ($Q_5=3.1$ cfs, $Q_{100}=11.3$ cfs) sheet flows overland to the proposed swale at DP3. Flows then combine with DP2.1 at DP3.1 ($Q_5=5.7$ cfs, $Q_{100}=20.8$ cfs) and are captured by the proposed culvert at DP4.2.

Basin D is approximately 2.57 acres with a 15% percent impervious and is comprised of proposed asphalt roadways, concrete sidewalk and RV hookup sites. Runoff generated by this basin ($Q_5=1.5$ cfs, $Q_{100}=5.8$ cfs) sheet flows overland to the proposed swale at DP4. Flows then combine at DP4.1 ($Q_5=4.8$ cfs, $Q_{100}=17.9$ cfs) and are captured by the proposed culvert. DP4.1 flows then combine with DP3.1 at DP4.2 ($Q_5=5.8$ cfs, $Q_{100}=21.6$ cfs) and are captured by the proposed inflow culvert. Flows then are combined within the proposed full-spectrum EDB (Pond A) at DP5.1.

Basin E is approximately 0.83 acres with a 16.6% percent impervious and is comprised of proposed Pond A and associated infrastructure. Runoff generated by this basin ($Q_5=0.6$ cfs, $Q_{100}=2.3$ cfs) sheet flows to Pond A at DP5. Flow at DP5.1 ($Q_5=6.1$ cfs, $Q_{100}=22.9$ cfs) combines the flow of DP4.2 and DP5, representing the total inflow into Pond A. Flows will be released through the outlet structure at DP5.2 ($Q_5=0.1$ cfs, $Q_{100}=8.2$ cfs). Flows will then enter Basin H and follow the drainage patterns of the basin as described below, combining at DP7.1.

Basin OS1 is approximately 0.39 acres with a 42.2% percent impervious and is comprised of existing west half of Peyton Hwy roadway and swale. Runoff generated by this basin ($Q_5=0.8$ cfs, $Q_{100}=1.9$ cfs) flows within the existing swale to DPO1. Flows combine at the proposed DP7.1 culvert.

Basin F is approximately 1.52 acres with a 2% percent impervious and is comprised of existing undeveloped land to remain undeveloped. Runoff generated by this basin ($Q_5=0.5$ cfs, $Q_{100}=3.4$ cfs) sheet flows overland to the proposed swale at DP6. Flows combine at the proposed DP7.1 culvert.

DP6.1 flows ($Q_5=1.1$ cfs, $Q_{100}=4.9$ cfs) enter the culvert and continue within the existing Peyton Hwy swale combining at DP7.1.

Basin OS2 is approximately 0.18 acres with a 56% percent impervious and is comprised of existing west half of Peyton Hwy roadway and swale. Runoff generated by this basin ($Q_5=0.5$ cfs, $Q_{100}=1.0$ cfs) flows within the existing swale to DPO2. Flows combine at the existing Peyton Hwy swale at DP8.1.

Basin G is approximately 0.75 acres with a 25.5% percent impervious and is comprised of proposed riprap, part of the access roadway and undeveloped land. Runoff generated by this basin ($Q_5=0.9$ cfs, $Q_{100}=2.6$ cfs) sheet flows overland to the existing Peyton Hwy swale at DP7. DP5.2, DP6.1, DPO2 and DP7 flows combine at the existing Peyton Hwy swale at DP7.1 ($Q_5=2.3$ cfs, $Q_{100}=15.8$ cfs). Flows continue flowing north off-site per the historic conditions and eventually outfall to Brackett Creek.

Basin I-A is approximately 0.24 acres with a 2% percent impervious and is comprised of existing undeveloped land to remain undeveloped. Runoff generated by this basin ($Q_5=0.1$ cfs, $Q_{100}=0.6$ cfs) sheet flows overland north to DP8A. From there flows follow the historic drainage patterns off-site and eventually outfalls to Brackett Creek.

Basin I-B is approximately 0.76 acres with a 2% percent impervious and is comprised of existing undeveloped land to remain undeveloped. Runoff generated by this basin ($Q_5=0.3$ cfs, $Q_{100}=1.7$ cfs) sheet flows overland north DP8B. From there flows follow the historic drainage patterns off-site and eventually outfalls to Brackett Creek.

Basin J is approximately 2.53 acres with a 20.6% percent impervious and is comprised of proposed gravel roadways, gravel parking areas, building and RV hookup sites. Runoff generated by this basin ($Q_5=2.0$ cfs, $Q_{100}=6.9$ cfs) sheet flows overland to the proposed swale at DP9. Flows then enter into the proposed culvert and combine at DP10.1.

Basin K is approximately 0.82 acres with a 15.8% percent impervious and is comprised of proposed gravel roadway and concrete sidewalks. Runoff generated by this basin ($Q_5=0.5$ cfs, $Q_{100}=2.0$ cfs) sheet flows overland to the proposed swale at DP10. Flows then enter into the proposed culvert and combine at DP11.1.

Basin L is approximately 8.46 acres with a 30.4% percent impervious and is comprised of proposed gravel roadway and concrete sidewalks. Runoff generated by this basin ($Q_5=8.5$ cfs, $Q_{100}=23.8$ cfs) sheet flows overland to the proposed swale at DP11 and are captured by the proposed sump inlet. In the case where this inlet becomes clogged, the emergency overflow path would overtop the maintenance trail and flow into Pond B. DP11.1 ($Q_5=10.7$ cfs, $Q_{100}=31.6$ cfs) flows then combine within proposed Pond B at DP12.1.

Basin M is approximately 1.24 acres with a 16.3% percent impervious and is comprised of proposed gravel roadways, concrete sidewalk, RV hookup sites, Pond B and associated infrastructure. Runoff generated by this basin ($Q_5=0.8$ cfs, $Q_{100}=3$ cfs) sheet flows to Pond B at DP12. Flow at DP12.1 ($Q_5=11.4$ cfs, $Q_{100}=34.5$ cfs) combines the flow of DP11.1 and DP12, representing the total inflow into Pond B. Flows will be released through the outlet structure at DP12.2 ($Q_5=0.2$ cfs, $Q_{100}=5.6$ cfs). Flows will then enter Basin O and then flow off-site along the driveway combining at DP13.1 at the flow spreader sending flows off-site to the south.

Basin N is approximately 0.28 acres with a 16% percent impervious located within Lot 2 and is comprised of a private gravel driveway. Runoff generated by this basin ($Q_5=0.2$ cfs, $Q_{100}=0.8$ cfs) flows over the driveway to DP13 and DP12.2 flows combine at DP13.1 ($Q_5=0.4$ cfs, $Q_{100}=6.4$ cfs) at the proposed property boundary. Flows then continue off-site to the south following historic drainage patterns off-site and eventually outfalls to the unnamed tributary of Brackett Creek.

Basin O is approximately 1.01 acres with a 13% percent impervious located within Lot 2 and is comprised of a private gravel driveway and undeveloped land. Runoff generated by this basin ($Q_5=0.2$ cfs, $Q_{100}=0.9$ cfs) sheet flows overland to the basin boundary at DP14. Flows continue off-site to the south following historic drainage patterns off-site and eventually outfalls to the unnamed tributary of Brackett Creek.

Basin P is approximately 4.32 acres with a 5.6% percent impervious located within Lot 2 and is comprised of a single-family residence and private gravel driveway. Runoff generated by this basin ($Q_5=1.7$ cfs, $Q_{100}=9.5$ cfs) sheet flows overland to the basin boundary at DP15. Flows then continue off-site to the south following historic drainage patterns off-site and eventually outfalls to the unnamed tributary of Brackett Creek.

COMPARISON OF FLOWS

There are several locations where the existing and proposed flows leave the site:

- Flows leave the northwestern part of the site at existing DP1 and proposed DP8A. Existing DP1 flows ($Q_5=1.1$ cfs, $Q_{100}=7.2$ cfs) are greater than the proposed DP8A flows ($Q_5=0.1$ cfs, $Q_{100}=0.6$ cfs).
- Flows leave the northern part of the site at existing DP2 and proposed DP8B. Existing DP2 flows ($Q_5=0.8$ cfs, $Q_{100}=5.6$ cfs) are greater than the proposed DP8B flows ($Q_5=0.3$ cfs, $Q_{100}=1.7$ cfs).
- Flows leave the northeastern part of the site at existing DP3.1 and proposed DP7.1. Existing DP3.1 flows ($Q_5=2.8$ cfs, $Q_{100}=15.2$ cfs) are approximately equal to the proposed DP7.1 flows ($Q_5=2.3$ cfs, $Q_{100}=15.8$ cfs).
- Flows leave the southeastern part of the site at existing DP4 and proposed DP12.2 Existing DP4 flows ($Q_5=1.9$ cfs, $Q_{100}=9.9$ cfs) are greater than the proposed DP12.2 flows ($Q_5=0.2$ cfs, $Q_{100}=5.6$ cfs).

- Flows leave the southern part of the site at existing DP5 and proposed DP13.1. Existing DP5 flows ($Q_5=1.8$ cfs, $Q_{100}=8.7$ cfs) are greater than the proposed DP13.1 flows ($Q_5=0.4$ cfs, $Q_{100}=6.4$ cfs).
- Flows leave the southern part of the site at existing DP6 and proposed DP15. Existing DP6 flows ($Q_5=1.8$ cfs, $Q_{100}=12.3$ cfs) are greater than the proposed DP15 flows ($Q_5=1.7$ cfs, $Q_{100}=9.5$ cfs).

Overall the proposed flows in both the minor and major storms leave the site at less than or equal to the historic flow rates. Therefore, there is no negative impact anticipated to downstream properties.

DRAINAGE DESIGN CRITERIA

DEVELOPMENT CRITERIA REFERENCE

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

HYDROLOGIC CRITERIA

All hydrologic data was obtained from the “*El Paso Drainage Criteria Manual*” Volumes 1 and 2, and the “*Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual*” Volumes 1, 2, and 3. On-site drainage improvements were designed based on the 5-year (minor) storm event and the 100-year (major) storm event. Runoff was calculated using the Rational Method, and rainfall intensities for the 5-year and the 100-year storm return frequencies were obtained from the CSDCM. One-hour point rainfall data for the storm events is identified in the chart below from NOAA Point Precipitation Data for the site, see Appendix A for the full NOAA data. Runoff coefficients were determined based on proposed land use and from data in Table 6-6 from the CSDCM. Time of concentrations were developed using equations from CSDCM. All runoff calculations and applicable charts and graphs are included in the Appendices.

Table 2 – 1-hr Point Rainfall Data

Storm	Rainfall (in.)
5-year	1.22
100-year	2.50



HYDRAULIC CRITERIA

The Rational Method and USDCM's SF-2 and SF-3 forms were used to determine the runoff from the minor and major storms on the site. Autodesk Inc.'s Hydraflow Express Extension (Volume 10.5) was used to size the roadside ditches and drainage swales per criteria. Per Section 6.4.1 of the EPCDCM, culverts were sized as to not overtop the road in the 100-year storm. The MHFD-Detention_v4.06 spreadsheet was utilized for evaluating proposed detention and water quality for the five ponds. Required detention volumes and allowable release rates were designed per USDCM and CCS/EPCDCM. See Appendix C for hydraulic calculations. The hydraulic design will be finalized with the Final Drainage Report.

DRAINAGE FACILITY DESIGN

GENERAL CONCEPT

The proposed stormwater conveyance system was designed to convey the developed site flows to one of two full-spectrum EDBs via swales, culverts, inlets and storm sewer infrastructure. The proposed full-spectrum EDBs will be designed to release flows at less than historic to minimize adverse impacts downstream. Due to this, there are no drainage problems anticipated downstream of the site.

SPECIFIC DETAILS

All full-spectrum EDBs will have proposed forebays at inflow points, concrete trickle channels, and outlet structures. The proposed pond forebays and weir contain the required percentage of the Water Quality Capture Volume (WQCV). The forebays weir will release 2% of the undetained peak 100-year inflow (depending on impervious acres per EDB-4) into the full-spectrum EDB to the proposed concrete trickle channel. The trickle channel will direct flows into the proposed full-spectrum EDB outlet structure, which will detain water per times specified by criteria. The WQCV will be released within 40 hours and the EURV will be released within 72 hours.

Four Step Process to Minimize Adverse Impacts of Urbanization

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

Step 1: Reducing Runoff Volumes - The site development consists of gravel drive aisles and parking spaces with lawn areas interspersed within the development. This layout will allow for increased infiltration and reduce runoff volume.

Step 2: Treat the WQCV - Runoff from this development is treated through capture and slow release of the WQCV in the on-site permanent full-spectrum EDBs that are designed per current El Paso



County drainage criteria. The 2.5-acre (minimum) residential house on Lot 2 will be limited to a maximum of 10% imperviousness to meet the requirements of Section I.7.1.B.5 of the ECM Stormwater Quality Policy and Procedure for water quality through a plat note. Should Lot 2 exceed 10% imperviousness, a lot specific drainage report addressing the increased imperviousness must be submitted.

Step 3: Stabilize Drainageways - The site lies within the Upper Bracket Creek Drainage Basin and the La Vega Ranch Drainage Basin. Both these basins are not studied and therefore no basin and bridge fees are due. The site does not discharge directly into the open drainageway of Brackett Creek, and developed flows leaving the site are limited to below existing rates, therefore no downstream stabilization will be required with this project.

Step 4: Implementing Long Term Source Controls - A site specific stormwater quality and erosion control plan and narrative shall be prepared in conjunction with the final drainage report. Site specific temporary source control BMPs as well as permanent BMP's will be detailed in that plan and narrative to protect receiving waters.

Water Quality

In accordance with Section 13.3.2.1 of the CCS/EPCDCM, full-spectrum water quality and detention will be provided for all of the development site not meeting exclusions present in the ECM - Stormwater Quality Policy and Procedures Section I.7.1.B. As previously stated, the applicable exclusions for Basin O and R located within Lot 2 fall under Section I.7.1.B.5 of the ECM Stormwater Quality Policy and Procedure for areas with large single-family lots (2.5-acre min.). In addition, Basins G, H, I-A and I-B fall under the Section I.7.1.B.7 of the ECM Stormwater Quality Policy and Procedure for sites with land disturbance to undeveloped land that will remain undeveloped. A portion of Basin H is comprised of a portion of the asphalt roadway which are not able to be undetained or treated. This area is under the maximum allowable of 1.0 total acres. The remaining basins will be treated within the proposed full-spectrum EDBs (Pond A and Pond B). Outlet structure release rates will be limited to less than historic rates to minimize adverse impacts to downstream stormwater facilities.

See Table 3 below for the water quality treatment summary table indicating which basins are treated and which are excluded.



Table 3 - Water quality treatment summary table.

PBMP Summary Table		
Basins	Tributary Area (acres)	PBMP
A-E	12.28	POND A
F, G, I-A & I-B	3.27	EXCLUDED*
Part of G	0.75	EXCLUDED***
J-M	13.05	POND B
N,O	1.29	EXCLUDED**
*EXCLUDED BASED ON LAND DISTURBANCE TO UNDEVELOPED LAND THAT WILL REMAIN UNDEVELOPED PER ECM APP. I.7.B.7 **EXCLUDED BASED ON LARGE LOT SINGLE FAMILY SITES PER ECM APP. I.7.B.5 ***UNTREATED/UNDETAINED AREA (< 1 TOTAL ACRE)		

Proposed Full-Spectrum EDBs

Water quality is provided for the site by two private full-spectrum detention and water quality EDBs. Table 4 below shows the basin parameters for the two ponds. Refer to Appendix C for the MHFD- Detention design sheets that include the tributary basin parameters as well as the stage-storage table and outlet structure design. The outlet structure includes an orifice plate, overflow grate, and restrictor plate to release stormwater at the appropriate rates. The WQCV will be released within 40 hours, the EURV will be released within 72 hours, and the minor and major flows will be released at or below the pre-development flow rate. Table 5 below gives the designed results for Pond A and 2.

Table 4 - Watershed design parameters for both EDBs.

Name	Watershed Area	Percent Impervious	Watershed Slope
Pond A	12.28 ac	17.20%	0.030 ft/ft
Pond B	13.05 ac	26.5%	0.030 ft/ft

Table 5- Full-spectrum EDB design for both EDBs.

Name	Required Volume (ac-ft)	Provided Volume (ac-ft)	WQCV (ac-ft)	EURV (ac-ft)	5-year Release (cfs)	100-year Release (cfs)
Pond A	0.587	1.091	0.106	0.206	0.1	3.36
Pond B	0.792	0.980	0.151	0.347	0.1	9.59

Calculations and pond design parameters are presented in Appendix C.

- For Pond A, a broad-crested weir lined with buried soil riprap is provided as an emergency spillway along the eastern embankment of the pond. Pond A emergency flows are conveyed



overland to the existing Peyton Hwy roadside ditch before going off-site to the north, following the historic drainage patterns. Flows released off-site to the existing Peyton Hwy ditch are less than the existing concentrated flows and therefore will have no negative impact to downstream properties, meaning that the outfall is suitable.

- For Pond B, a broad-crested weir lined with concrete is provided as an emergency spillway along the southern embankment of the pond. There is a proposed concrete sidewalk through this location, which is why concrete is used as the spillway crest. Pond B emergency flows and released flows are directed to a proposed MHFD low tailwater basin to dissipate flows and ensure they are not concentrated before going off-site to the south, following the historic drainage patterns. Flows released off-site to the south are less than the existing flows and therefore will have no negative impact to downstream properties, meaning that the outfall is suitable.

Erosion Control Plan

We respectfully request that the Final Erosion Control Plan and associated Cost Estimate to be submitted in conjunction with the construction drawings and plat prior to obtaining a grading permit.

Operation & Maintenance

In order to ensure the function and effectiveness of the stormwater infrastructure, maintenance activities such as inspection, routine maintenance, restorative maintenance, rehabilitation and repair, are required. All proposed drainage structures within easements or tracts (full-spectrum water quality ponds, local road culverts and drainageway improvements) will be owned and maintained by the property owner unless another party accepts such responsibility in writing and responsibility is properly assigned through legal documentation. Inspection access for El Paso County will be provided through a maintenance easement.

Drainage and Bridge Fees

The site lies within the Upper Bracket Creek Drainage Basin and the La Vega Ranch Drainage Basin. Both these basins are not studied and therefore no basin and bridge fees are due.



Construction Cost Opinion

Lazy Y and Rocking J Subdivision					
Cost Opinion					
Subdivision Name:		Lazy Y and Rocking J			
Project No.:		25228.00			
Pond 1					
Item No.	Item	Unit	Installation Unit Cost	Quantity	Cost
1	18" RCP	LF	\$82.00	41	\$3,362
2	Maintenance Trail ABC (6" Depth)	CY	\$66.00	57	\$3,762
3	Type VL Riprap	CY	\$60.00	2	\$120
4	Emergency Spillway-Type VL Riprap	CY	\$60.00	100	\$6,000
5	Concrete Pavement (6") Trickle Channel	CY	\$94.00	157	\$14,758
6	Concrete Forebay	LS	\$3,000.00	1	\$3,000
7	Outlet Structure	LS	\$10,000.00	1	\$10,000
Pond 1 Total					\$41,002.00
Pond 2					
Item No.	Item	Unit	Installation Unit Cost	Quantity	Cost
1	18" RCP	LF	\$82.00	27	\$2,214
2	Maintenance Trail ABC (6" Depth)	CY	\$66.00	63	\$4,158
3	Type VL Riprap	CY	\$60.00	1	\$60
5	Concrete Pavement (6") Trickle Channel	CY	\$94.00	103	\$9,682
6	Concrete Forebay	LS	\$3,000.00	2	\$6,000
7	Outlet Structure	LS	\$10,000.00	1	\$10,000
Pond 2 Total					\$32,114.00
JR Engineering					
5475 Tech Center Drive, Suite 235					
Colorado Springs, CO 80919					
(719) 593-2593					
JR Engineering cannot and does not guarantee that the construction cost will not vary from these opinions of probable construction costs. These opinions represent our best judgment as design professionals familiar with the construction industry and this development.					

SUMMARY

The proposed Lazy Y and Rocking J Subdivision drainage improvements were designed to meet or exceed the El Paso County Drainage Criteria. The proposed development will not adversely affect the off-site drainageways or surrounding development. This report is in conformance and meets the latest El Paso County Storm Drainage Criteria requirements for this site.

REFERENCES

1. Engineering Criteria Manual, El Paso County, October 14, 2020.
 2. City of Colorado Springs Drainage Criteria Manual Volume 1, City of Colorado Springs, CO, May 2014.
 3. Urban Storm Drainage Criteria Manual, Urban Drainage and Flood Control District, Latest Revision.
 4. Drainage Basins: El Paso County Colorado, El Paso County, 2005.
-

Appendix A
Vicinity Map, Soil Descriptions, FEMA Floodplain Map



SITE



2000 1000 0 2000

ORIGINAL SCALE: 1" = 2000'

VICINITY MAP
 LONGHORN ACRES RV PARK
 JOB NO. 25228.00
 09/01/2023
 SHEET 1 OF 1

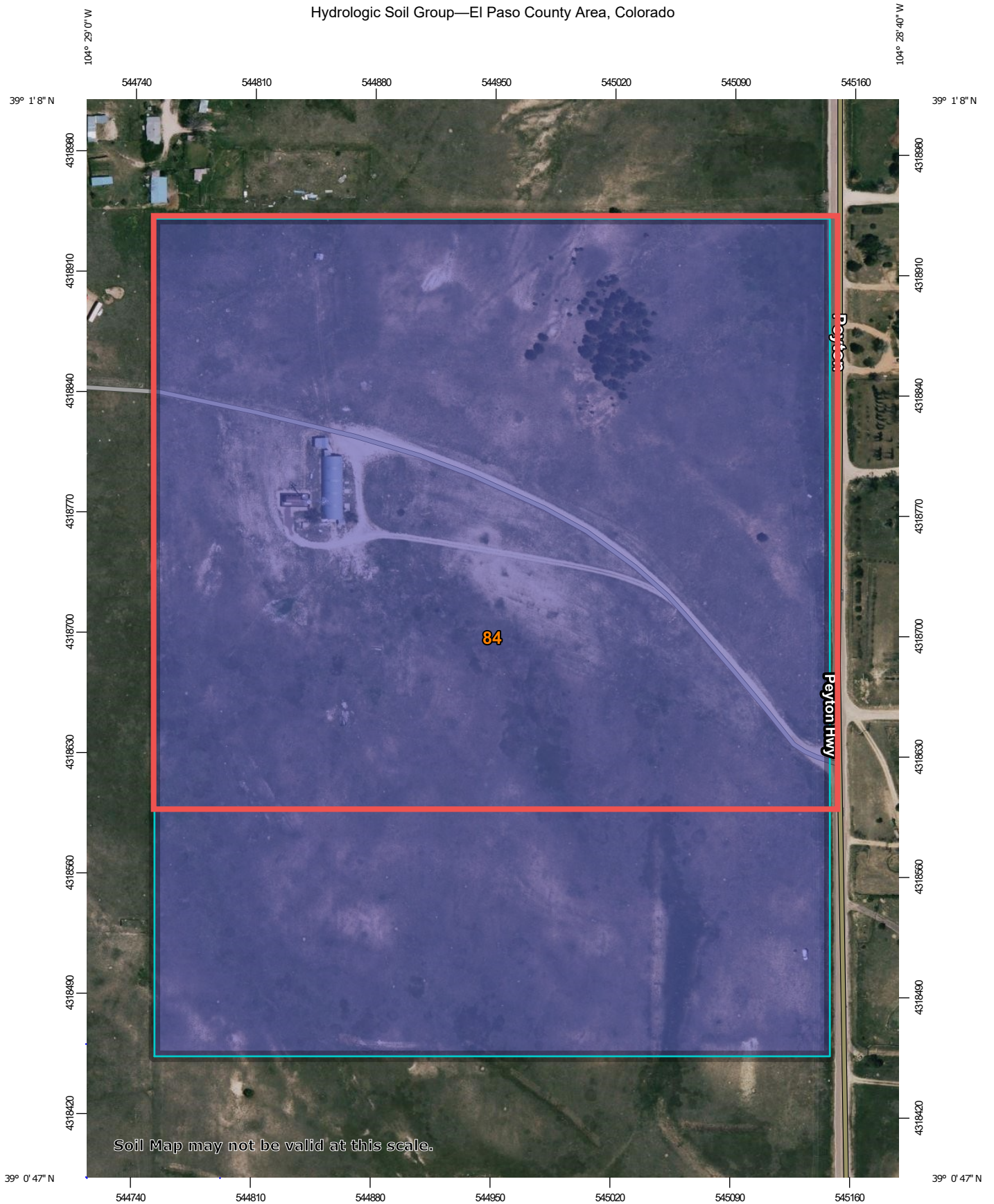


J-R ENGINEERING

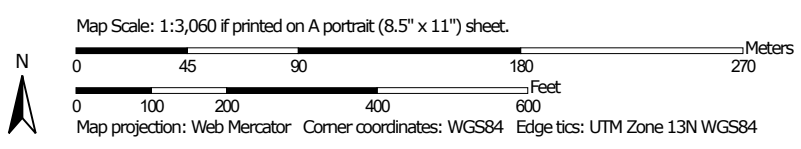
A Westrian Company

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

Hydrologic Soil Group—El Paso County Area, Colorado




Soil Map may not be valid at this scale.



MAP LEGEND

Area of Interest (AOI)









 Area of Interest (AOI)

Soils

Soil Rating Polygons





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

Soil Rating Lines

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

Soil Rating Points






-  A
-  A/D
-  B
-  B/D

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


Water Features

 Streams and Canals

Transportation

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

Background

 Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

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

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

Date(s) aerial images were photographed: Jun 9, 2021—Jun 12, 2021

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
84	Stapleton sandy loam, 8 to 15 percent slopes	B	47.7	100.0%
Totals for Area of Interest			47.7	100.0%

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

NOTES TO USERS

This map is for use in accordance with the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The community map repository should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where Base Flood Elevations (BFEs) and/or floodways have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRMs. Users are also encouraged to consult the Flood Insurance Study (FIS) report for more detailed information. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRMs for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only inland of 0.0' North American Vertical Datum of 1988 (NAVD88). Users of this FIRMs should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations and Floodway Data tables. The Summary of Stillwater Elevations and/or floodplain management purposes when they are higher than the elevations shown on this FIRMs.

Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by flood control structures. Refer to section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The projection used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The horizontal datum was NAD83, GRS80 spheroid. Differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRMs.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988 (NAVD88). These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at <http://www.ngs.noaa.gov> or contact the National Geodetic Survey at the following address:

NGS Information Services
 National Geodetic Survey
 SSMC-3 #6202
 1315 East-West Highway
 Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for bench marks shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242 or visit its website at <http://www.ngs.noaa.gov/>.

Base Map information shown on this FIRMs was provided in digital format by El Paso County, Colorado Springs Utilities, City of Fountain, Bureau of Land Management, National Oceanic and Atmospheric Administration, United States Geological Survey, and Anderson Consulting Engineers, Inc. These data are current as of 2006.

This map reflects more detailed and up-to-date stream channel configurations and floodplain delineations than those shown on the previous FIRMs for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRMs may differ from those shown on this map. The floodplains and floodways shown on this map result from the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report which contains authoritative hydraulic data that reflect stream channel dimensions that differ from what is shown on this map. The profile baselines depicted on this map represent the hydraulic modeling baselines that match the flood profiles and floodway data shown on this map. These BFEs and floodway data are based on the baselines that may deviate significantly from the new base map channel representation and may appear outside of the floodplain.

Copyrights limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed Map Index for an overview map of the county showing the layout of map panels; community map repository addresses; and a listing of communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact FEMA Map Service Center (MSC) via the FEMA Map Information eXchange (FIRM) 1-877-336-2627 for information on available products associated with this FIRMs. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, or a Flood Insurance Study Report. For more information, also be reached by Fax at 1-800-358-9620 and its website at <http://www.msc.fema.gov/>.

If you have questions about this map or questions concerning the National Flood Insurance Program in general, please call 1-877-FEMA MAP (1-877-336-2627) or visit the FEMA website at <http://www.fema.gov/business/inf>.

El Paso County Vertical Datum Offset Table

Flooding Source	Vertical Datum Offset (ft)
REVEREND STREET, EL PASO COUNTY, COLORADO	0.00
ROCKY MOUNTAIN STREAM, EL PASO COUNTY, COLORADO	0.00
ROCKY MOUNTAIN STREAM, EL PASO COUNTY, COLORADO	0.00

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAS) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, AP, AV, and VE. The Base Flood Elevation is the water surface elevation of the 1% annual chance flood.

ZONE A
 No Base Flood Elevations determined.

ZONE AE
 Base Flood Elevations determined.

ZONE AH
 Flood depths of 1 to 3 feet (usually result from on sloping terrain); average elevations determined. For areas of alluvial fan flooding, velocities also determined.

ZONE AO
 Flood depths of 1 to 3 feet (usually result from on sloping terrain); average elevations determined.

ZONE AR
 Special Flood Hazard Area Formerly protected from the 1% annual chance flood by a flood control system that was subsequently identified. Zone boundaries are shown with a dashed line. Flood elevations are provided to provide protection from the 1% annual chance or greater flood.

ZONE AV
 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.

ZONE V
 Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

ZONE VE
 Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE
 The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X
 Areas of 0.2% annual chance flood (500-year flood) with a base flood elevation of 1 foot or less above the ground surface. Areas of 0.1% annual chance flood (1000-year flood) with a base flood elevation of 1 foot or less above the ground surface and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE D
 Areas determined to be outside the 0.2% annual chance floodplain.

ZONE E
 Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS
 Areas of 0.2% annual chance flood (500-year flood) with a base flood elevation of 1 foot or less above the ground surface and areas protected by levees from 1% annual chance flood.

OTHERWISE PROTECTED AREAS (OPAs)
 CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

— Floodplain boundary
 — Zone D boundary
 — Zone E boundary
 — CBRS and OPA boundary

Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, including Special Flood Hazard Areas of different Base Flood Elevations that are older, elevation in feet above elevation in feet where elevation within zone; elevation in feet

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

— Cross section line
 — Traverset line

Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
 1000-meter Universal Transverse Mercator grid ticks, zone 13

5000-foot grid ticks: Colorado State Plane coordinate system, North American Datum of 1983 (NAD 83)
 1000-foot grid ticks: Colorado State Plane coordinate system, North American Datum of 1983 (NAD 83)

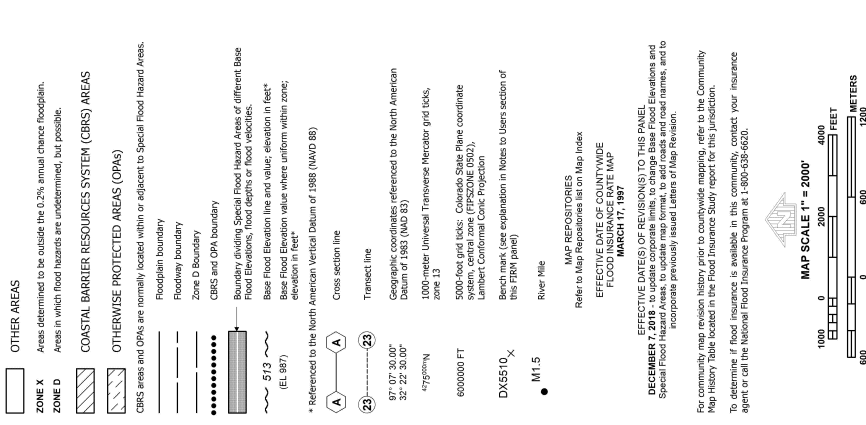
Bench marks (see explanation in Notes to Users section of this FIRMs panel)
 River Mile
 Map Depositories
 Refer to Map Repository list on Map Index

EFFECTIVE DATE OF COUNTY-WIDE FLOOD INSURANCE RATE MAP
 MARCH 17, 1997

EFFECTIVE DATES OF REVISIONS TO THIS PANEL
 Special Flood Hazard Areas to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

For community map revision history prior to copyright markings, refer to the Community Map History Table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-338-6620.



INFLIP

PANEL 0375G

FIRM FLOOD INSURANCE RATE MAP EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 375 OF 1300
 (SEE MAP INDEX FOR FIRM PANEL LAYOUT)

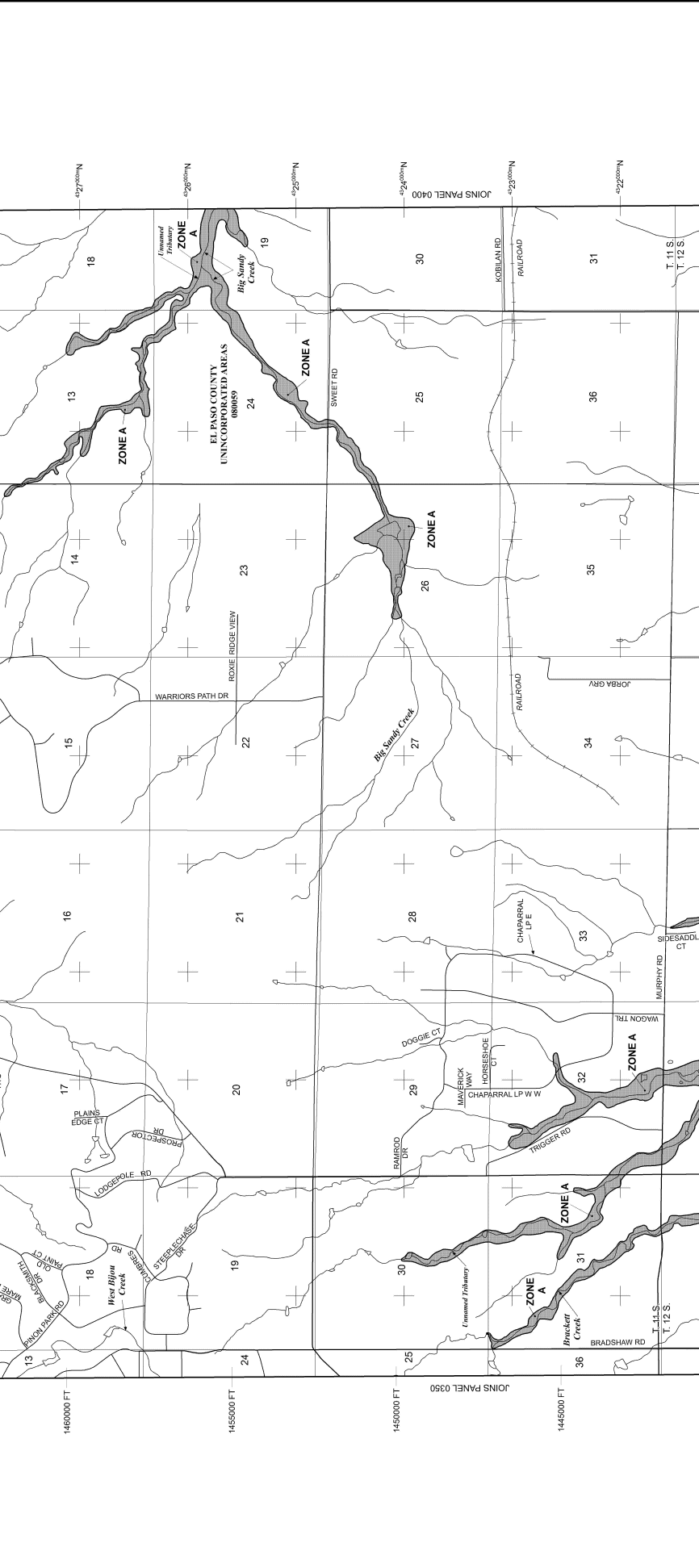
CONTAINS:
 COMMUNITY NUMBER 08089
 PANEL NUMBER 0375
 SHEET 0

MAP NUMBER 08041C0375G
MAP REVISED DECEMBER 7, 2018

NATIONAL FLOOD INSURANCE PROGRAM

Notes to User: The Map Number shown below should be used when obtaining the Flood Insurance Study Report for the subject community.

Federal Emergency Management Agency



Panel Location Map

Vertical Datum Offset Table

REVEREND STREET, EL PASO COUNTY, COLORADO
 ROCKY MOUNTAIN STREAM, EL PASO COUNTY, COLORADO
 ROCKY MOUNTAIN STREAM, EL PASO COUNTY, COLORADO

This Digital Flood Insurance Rate Map (DFIRM) was produced through a Cooperating Technical Partner (CTP) agreement between the State of Colorado Water Conservation Board (CWCB) and the Federal Emergency Management Agency (FEMA).

Additional Flood Hazard information and resources are available from local communities and the Colorado Water Conservation Board.



POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

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

PF tabular

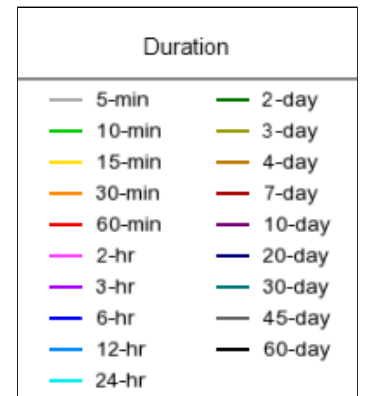
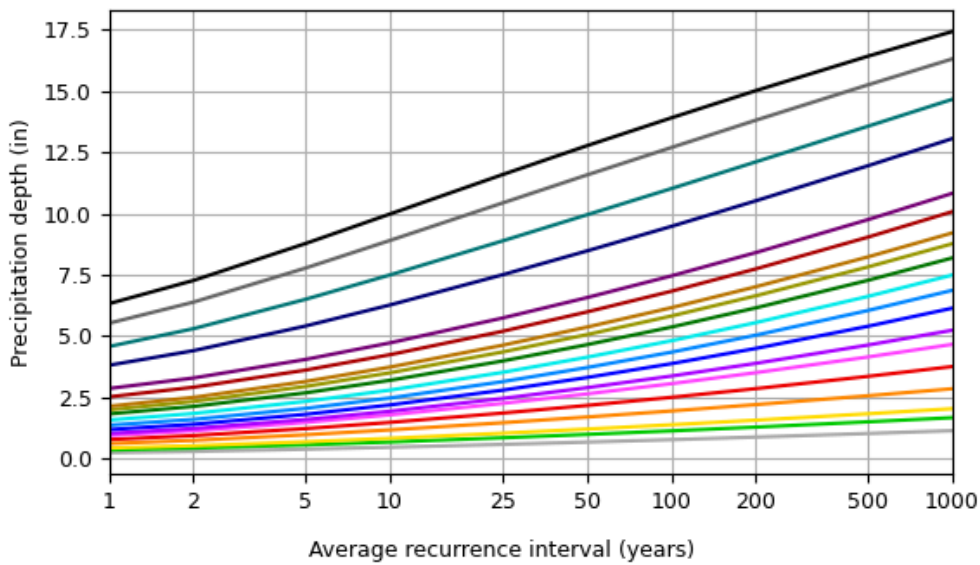
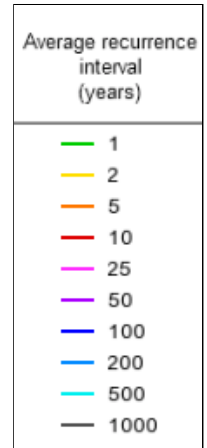
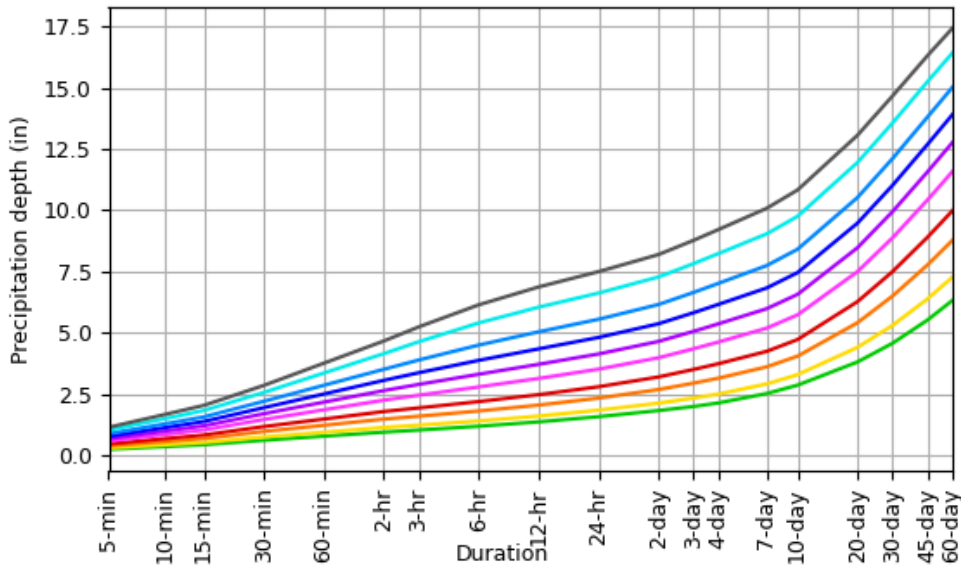
PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.241 (0.189-0.309)	0.294 (0.230-0.376)	0.384 (0.300-0.493)	0.463 (0.360-0.598)	0.579 (0.439-0.778)	0.674 (0.498-0.915)	0.773 (0.552-1.07)	0.879 (0.603-1.25)	1.02 (0.677-1.50)	1.14 (0.734-1.68)
10-min	0.353 (0.277-0.452)	0.430 (0.337-0.551)	0.562 (0.439-0.722)	0.679 (0.527-0.875)	0.849 (0.642-1.14)	0.987 (0.729-1.34)	1.13 (0.809-1.57)	1.29 (0.883-1.83)	1.50 (0.992-2.19)	1.67 (1.07-2.46)
15-min	0.430 (0.338-0.551)	0.524 (0.411-0.672)	0.686 (0.536-0.881)	0.828 (0.643-1.07)	1.04 (0.783-1.39)	1.20 (0.889-1.63)	1.38 (0.986-1.92)	1.57 (1.08-2.23)	1.83 (1.21-2.67)	2.04 (1.31-3.00)
30-min	0.613 (0.481-0.784)	0.745 (0.584-0.955)	0.973 (0.760-1.25)	1.17 (0.911-1.51)	1.46 (1.11-1.96)	1.70 (1.25-2.30)	1.94 (1.39-2.70)	2.20 (1.51-3.13)	2.57 (1.70-3.74)	2.85 (1.83-4.20)
60-min	0.778 (0.610-0.996)	0.940 (0.737-1.20)	1.22 (0.956-1.57)	1.48 (1.15-1.91)	1.86 (1.41-2.50)	2.17 (1.60-2.95)	2.50 (1.79-3.48)	2.86 (1.96-4.07)	3.36 (2.22-4.90)	3.76 (2.42-5.54)
2-hr	0.943 (0.746-1.20)	1.13 (0.896-1.44)	1.48 (1.16-1.88)	1.78 (1.40-2.28)	2.25 (1.72-3.02)	2.64 (1.97-3.57)	3.06 (2.21-4.23)	3.51 (2.44-4.97)	4.15 (2.77-6.03)	4.66 (3.03-6.82)
3-hr	1.03 (0.817-1.30)	1.23 (0.975-1.55)	1.60 (1.26-2.02)	1.93 (1.52-2.46)	2.45 (1.89-3.28)	2.89 (2.17-3.90)	3.37 (2.45-4.65)	3.89 (2.72-5.50)	4.64 (3.12-6.72)	5.24 (3.42-7.64)
6-hr	1.18 (0.947-1.48)	1.40 (1.12-1.75)	1.81 (1.44-2.27)	2.19 (1.74-2.76)	2.79 (2.18-3.72)	3.31 (2.51-4.44)	3.88 (2.84-5.32)	4.50 (3.17-6.33)	5.40 (3.67-7.79)	6.14 (4.04-8.90)
12-hr	1.36 (1.10-1.69)	1.60 (1.29-1.99)	2.05 (1.64-2.55)	2.47 (1.98-3.09)	3.14 (2.47-4.15)	3.71 (2.84-4.95)	4.34 (3.21-5.92)	5.04 (3.59-7.04)	6.05 (4.14-8.66)	6.87 (4.56-9.89)
24-hr	1.58 (1.28-1.94)	1.84 (1.49-2.26)	2.33 (1.89-2.88)	2.80 (2.25-3.46)	3.52 (2.78-4.60)	4.14 (3.19-5.45)	4.81 (3.59-6.50)	5.55 (3.98-7.69)	6.62 (4.58-9.42)	7.50 (5.03-10.7)
2-day	1.82 (1.49-2.22)	2.13 (1.74-2.60)	2.68 (2.19-3.28)	3.20 (2.59-3.92)	3.98 (3.17-5.14)	4.65 (3.60-6.06)	5.37 (4.03-7.18)	6.16 (4.45-8.45)	7.28 (5.07-10.3)	8.20 (5.54-11.6)
3-day	1.99 (1.64-2.41)	2.33 (1.92-2.83)	2.94 (2.41-3.58)	3.50 (2.85-4.28)	4.35 (3.47-5.58)	5.06 (3.94-6.56)	5.82 (4.39-7.73)	6.65 (4.83-9.08)	7.82 (5.48-11.0)	8.78 (5.97-12.4)
4-day	2.14 (1.76-2.58)	2.50 (2.06-3.02)	3.15 (2.58-3.81)	3.74 (3.05-4.55)	4.62 (3.70-5.90)	5.37 (4.19-6.92)	6.16 (4.66-8.15)	7.02 (5.11-9.54)	8.23 (5.78-11.5)	9.22 (6.30-13.0)
7-day	2.52 (2.09-3.02)	2.91 (2.41-3.49)	3.61 (2.98-4.34)	4.24 (3.49-5.12)	5.19 (4.18-6.57)	5.98 (4.70-7.66)	6.83 (5.20-8.98)	7.75 (5.68-10.5)	9.04 (6.40-12.6)	10.1 (6.94-14.1)
10-day	2.86 (2.38-3.41)	3.29 (2.74-3.92)	4.05 (3.36-4.84)	4.72 (3.90-5.68)	5.73 (4.63-7.21)	6.57 (5.18-8.36)	7.46 (5.70-9.74)	8.41 (6.20-11.3)	9.76 (6.94-13.5)	10.8 (7.49-15.1)
20-day	3.81 (3.20-4.50)	4.41 (3.70-5.21)	5.41 (4.52-6.41)	6.27 (5.22-7.47)	7.50 (6.07-9.27)	8.48 (6.72-10.6)	9.48 (7.29-12.2)	10.5 (7.80-14.0)	12.0 (8.56-16.3)	13.1 (9.13-18.1)
30-day	4.57 (3.86-5.37)	5.30 (4.47-6.23)	6.50 (5.46-7.66)	7.50 (6.27-8.88)	8.88 (7.20-10.9)	9.95 (7.91-12.4)	11.0 (8.50-14.1)	12.1 (9.01-16.0)	13.6 (9.75-18.4)	14.7 (10.3-20.3)
45-day	5.52 (4.68-6.45)	6.39 (5.41-7.46)	7.78 (6.56-9.11)	8.91 (7.48-10.5)	10.4 (8.48-12.6)	11.6 (9.23-14.3)	12.7 (9.83-16.1)	13.8 (10.3-18.1)	15.3 (11.0-20.6)	16.3 (11.5-22.5)
60-day	6.32 (5.38-7.35)	7.27 (6.18-8.46)	8.78 (7.43-10.2)	9.99 (8.42-11.7)	11.6 (9.44-14.0)	12.8 (10.2-15.7)	13.9 (10.8-17.5)	15.0 (11.2-19.5)	16.4 (11.9-22.1)	17.4 (12.4-24.0)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

[Back to Top](#)

PF graphical

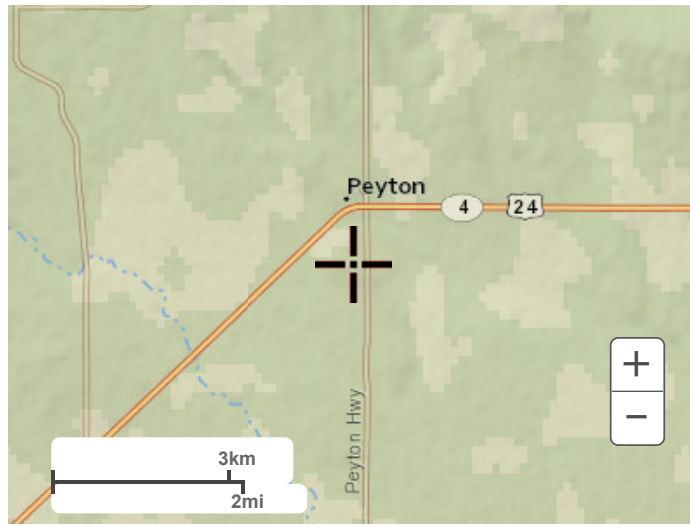
PDS-based depth-duration-frequency (DDF) curves
 Latitude: 39.0174°, Longitude: -104.4808°



[Back to Top](#)

Maps & aerials

Small scale terrain



Large scale terrain



Large scale map



Large scale aerial

Appendix B

Hydrologic Calculations

COMPOSITE % IMPERVIOUS & COMPOSITE PRE-DEVELOPMENT RUNOFF COEFFICIENT CALCULATIONS

Subdivision: _____
 Location: El Paso County

Project Name: Lazy Y and Rocking J Subdivision
 Project No.: 25228.00
 Calculated By: GAG
 Checked By: _____
 Date: 10/22/24

Basin ID	Total Area (ac)	Drives and Walks (100% Impervious)				Roofs (90% Impervious)				Streets-Gravel (80% Impervious)				Historical Analysis (2% Impervious)				Basins Total Weighted C Values		Basins Total Weighted % Imp.
		C ₅	C ₁₀₀	Area (ac)	Weighted % Imp.	C ₅	C ₁₀₀	Area (ac)	Weighted % Imp.	C ₅	C ₁₀₀	Area (ac)	Weighted % Imp.	C ₅	C ₁₀₀	Area (ac)	Weighted % Imp.	C ₅	C ₁₀₀	
EXA	4.25	0.90	0.96	0.00	0.0%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.09	0.36	4.25	2.0%	0.09	0.36	2.0%
EXB	3.59	0.90	0.96	0.00	0.0%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.09	0.36	3.59	2.0%	0.09	0.36	2.0%
EXC	7.40	0.90	0.96	0.00	0.0%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.09	0.36	7.40	2.0%	0.09	0.36	2.0%
EXD	6.29	0.90	0.96	0.00	0.0%	0.73	0.81	0.00	0.0%	0.59	0.70	0.43	5.5%	0.09	0.36	5.86	1.9%	0.12	0.38	7.3%
EXE	5.31	0.90	0.96	0.01	0.2%	0.73	0.81	0.15	2.5%	0.59	0.70	0.27	4.1%	0.09	0.36	4.88	1.8%	0.14	0.39	8.6%
EXF	7.08	0.90	0.96	0.00	0.0%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.09	0.36	7.08	2.0%	0.09	0.36	2.0%
OS1	0.57	0.90	0.96	0.23	40.4%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.09	0.36	0.34	1.2%	0.42	0.60	41.5%
TOTAL ON-SITE	33.92																			4.0%

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients																				
		2-year		5-year		10-year		25-year		50-year		100-year										
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D									
Business																						
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89									
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68									
Residential																						
1/8 Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65									
1/4 Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58									
1/3 Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57									
1/2 Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56									
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55									
Industrial																						
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74									
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83									
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52									
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54									
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58									
Undeveloped Areas																						
Historic Flow Analysis-- Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51									
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50									
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50									
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96									
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59									
Streets																						
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96									
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74									
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96									
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83									
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50									

**PRE-DEVELOPMENT
STANDARD FORM SF-2
TIME OF CONCENTRATION**

Subdivision: _____
Location: El Paso County

Project Name: Lazy Y and Rocking J Subdivision
Project No.: 25228.00
Calculated By: GAG
Checked By: _____
Date: 10/22/24

SUB-BASIN						INITIAL/OVERLAND			TRAVEL TIME					t _c CHECK			FINAL
DATA						(T _i)			(T _t)					(URBANIZED BASINS)			
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C _s	C ₁₀₀	L (ft)	S _o (%)	t _i (min)	L _t (ft)	S _t (%)	K	VEL. (ft/s)	t _t (min)	COMP. t _c (min)	TOTAL LENGTH (ft)	Urbanized t _c (min)	t _c (min)
EXA	4.25	B	2%	0.09	0.36	300	3.0%	22.0	210	6.4%	7.0	1.8	2.0	24.0	510.0	27.2	24.0
EXB	3.59	B	2%	0.09	0.36	300	1.0%	31.6	335	6.8%	7.0	1.8	3.1	34.6	635.0	28.0	28.0
EXC	7.40	B	2%	0.09	0.36	300	6.4%	17.1	375	5.6%	7.0	1.7	3.8	20.9	675.0	28.5	20.9
EXD	6.29	B	7%	0.12	0.38	300	1.0%	30.5	650	3.4%	10.0	1.8	5.9	36.4	950.0	30.6	30.6
EXE	5.31	B	9%	0.14	0.39	300	2.1%	23.6	640	3.0%	10.0	1.7	6.2	29.8	940.0	30.6	29.8
EXF	7.08	B	2%	0.09	0.36	300	4.5%	19.2	400	6.0%	7.0	1.7	3.9	23.1	700.0	28.6	23.1
OS1	0.57	B	42%	0.42	0.60	25	8.0%	3.1	885	3.5%	15.0	2.8	5.3	8.4	910.0	24.3	8.4

NOTES:

$$t_c = t_i + t_t$$

Equation 6-2

$$t_i = \frac{0.395(1.1 - C_s)\sqrt{L_i}}{S_o^{0.33}}$$

Equation 6-3

Where:

t_c = computed time of concentration (minutes)

t_i = overland (initial) flow time (minutes)

t_t = channelized flow time (minutes).

Where:

t_i = overland (initial) flow time (minutes)

C_s = runoff coefficient for 5-year frequency (from Table 6-4)

L_i = length of overland flow (ft)

S_o = average slope along the overland flow path (ft/ft).

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

$$t_t = \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t}$$

Equation 6-4 $t_t = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_o}}$

Equation 6-5

Where:

t_t = channelized flow time (travel time, min)

L_t = waterway length (ft)

S_o = waterway slope (ft/ft)

V_t = travel time velocity (ft/sec) = K√S_o

K = NRCS conveyance factor (see Table 6-2).

Where:

t_c = minimum time of concentration for first design point when less than t_c from Equation 6-1.

L_t = length of channelized flow path (ft)

i = imperviousness (expressed as a decimal)

S_o = slope of the channelized flow path (ft/ft).

Table 6-2. NRCS Conveyance factors, K

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

STANDARD FORM SF-3 - PRE-DEVELOPMENT
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: _____
Location: El Paso County
Design Storm: 5-Year

Project Name: Lazy Y and Rocking J Subdivision
Project No.: 25228.00
Calculated By: GAG
Checked By: _____
Date: 10/22/24

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	$Q_{street/swale}$ (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	1	EXA	4.25	0.09	24.0	0.38	2.82	1.1															Sheet flows overland to DP1 Flows off-site to the north
	2	EXB	3.59	0.09	28.0	0.32	2.59	0.8															Sheet flows overland to DP2 Flows off-site to the north
	3	EXC	7.40	0.09	20.9	0.67	3.02	2.0															Sheet flows overland to DP3 Combines at swale at DP3.1
	O1	OS1	0.57	0.42	8.4	0.24	4.40	1.1															Flows in ex. roadside swale Combines at swale at DP3.1
	3.1								20.9	0.91	3.02	2.8											Combines DP3 and DPO1 Flows off-site to the north in swale
	4	EXD	6.29	0.12	30.6	0.78	2.45	1.9															Sheet flows overland to DP4 Flows off-site to the south in swale
	5	EXE	5.31	0.14	29.8	0.72	2.49	1.8															Sheet flows overland to DP5 Flows off-site to the south
	6	EXF	7.08	0.09	23.1	0.64	2.87	1.8															Sheet flows overland to DP6 Flows off-site to the south

Notes:
Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.

STANDARD FORM SF-3 - PRE-DEVELOPMENT

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: _____
 Location: El Paso County
 Design Storm: 100-Year

Project Name: Lazy Y and Rocking J Subdivision
 Project No.: 25228.00
 Calculated By: GAG
 Checked By: _____
 Date: 10/22/24

Description	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	$Q_{street/swale}$ (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	1	EXA	4.25	0.36	24.0	1.53	4.73	7.2															Sheet flows overland to DP1 Flows off-site to the north
	2	EXB	3.59	0.36	28.0	1.29	4.34	5.6															Sheet flows overland to DP2 Flows off-site to the north
	3	EXC	7.40	0.36	20.9	2.66	5.08	13.5															Sheet flows overland to DP3 Combines at swale at DP3.1
	O1	OS1	0.57	0.60	8.4	0.34	7.38	2.5															Flows in ex. roadside swale Combines at swale at DP3.1
	3.1								20.9	3.00	5.08	15.2											Combines DP3 and DPO1 Flows off-site to the north in swale
	4	EXD	6.29	0.38	30.6	2.41	4.11	9.9															Sheet flows overland to DP4 Flows off-site to the south in swale
	5	EXE	5.31	0.39	29.8	2.08	4.18	8.7															Sheet flows overland to DP5 Flows off-site to the south
	6	EXF	7.08	0.36	23.1	2.55	4.82	12.3															Sheet flows overland to DP6 Flows off-site to the south

Notes:
 Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.

COMPOSITE % IMPERVIOUS & COMPOSITE PROPOSED RUNOFF COEFFICIENT CALCULATIONS

Subdivision: Lazy Y and Rocking J Subdivision
 Location: El Paso County

Project Name: Lazy Y and Rocking J Subdivision
 Project No.: 25228.00
 Calculated By: GAG
 Checked By: _____
 Date: 11/7/24

Basin ID	Total Area (ac)	Streets-Paved/ Sidewalks/ Water Surface (100% Impervious)				Roofs (90% Impervious)				Streets-Gravel (80% Impervious)				Historical Analysis/Lawn (2% Impervious)				Basins Total Weighted C Values		Basins Total Weighted % Imp.
		C ₅	C ₁₀₀	Area (ac)	Weighted % Imp.	C ₅	C ₁₀₀	Area (ac)	Weighted % Imp.	C ₅	C ₁₀₀	Area (ac)	Weighted % Imp.	C ₅	C ₁₀₀	Area (ac)	Weighted % Imp.	C ₅	C ₁₀₀	
		A	1.51	0.90	0.96	0.07	4.6%	0.73	0.81	0.00	0.0%	0.59	0.70	0.28	14.8%	0.09	0.36	1.16	1.5%	
B	3.10	0.90	0.96	0.14	4.5%	0.73	0.81	0.00	0.0%	0.59	0.70	0.40	10.3%	0.09	0.36	2.56	1.7%	0.19	0.43	16.5%
C	4.27	0.90	0.96	0.40	9.4%	0.73	0.81	0.00	0.0%	0.59	0.70	0.35	6.6%	0.09	0.36	3.52	1.6%	0.21	0.44	17.6%
D	2.57	0.90	0.96	0.11	4.3%	0.73	0.81	0.00	0.0%	0.59	0.70	0.29	9.0%	0.09	0.36	2.17	1.7%	0.18	0.42	15.0%
E	0.83	0.90	0.96	0.06	7.2%	0.73	0.81	0.00	0.0%	0.59	0.70	0.08	7.7%	0.09	0.36	0.69	1.7%	0.20	0.44	16.6%
F	1.52	0.90	0.96	0.00	0.0%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.09	0.36	1.52	2.0%	0.09	0.36	2.0%
G	0.75	0.90	0.96	0.14	18.7%	0.73	0.81	0.00	0.0%	0.59	0.70	0.05	5.3%	0.09	0.36	0.56	1.5%	0.27	0.49	25.5%
I-A	0.24	0.90	0.96	0.00	0.0%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.09	0.36	0.24	2.0%	0.09	0.36	2.0%
I-B	0.76	0.90	0.96	0.00	0.0%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.09	0.36	0.76	2.0%	0.09	0.36	2.0%
J	2.53	0.90	0.96	0.00	0.0%	0.73	0.81	0.11	3.9%	0.59	0.70	0.48	15.2%	0.09	0.36	1.94	1.5%	0.21	0.44	20.6%
K	0.82	0.90	0.96	0.04	4.9%	0.73	0.81	0.00	0.0%	0.59	0.70	0.10	9.3%	0.09	0.36	0.69	1.7%	0.19	0.43	15.8%
L	8.46	0.90	0.96	2.01	23.8%	0.73	0.81	0.01	0.1%	0.59	0.70	0.54	5.1%	0.09	0.36	5.90	1.4%	0.32	0.52	30.4%
M	1.24	0.90	0.96	0.03	2.4%	0.73	0.81	0.00	0.0%	0.59	0.70	0.19	12.3%	0.09	0.36	1.02	1.6%	0.19	0.43	16.3%
N	0.28	0.90	0.96	0.00	0.0%	0.73	0.81	0.00	0.0%	0.59	0.70	0.05	14.3%	0.09	0.36	0.23	1.6%	0.18	0.42	15.9%
O	1.01	0.90	0.96	0.00	0.0%	0.73	0.81	0.00	0.0%	0.59	0.70	0.14	11.1%	0.09	0.36	0.87	1.7%	0.16	0.41	12.8%
P	4.32	0.90	0.96	0.00	0.0%	0.73	0.81	0.09	1.9%	0.59	0.70	0.10	1.9%	0.09	0.36	4.13	1.9%	0.11	0.38	5.6%
OS1	0.39	0.90	0.96	0.16	41.0%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.09	0.36	0.23	1.2%	0.42	0.61	42.2%
OS2	0.18	0.90	0.96	0.10	55.6%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.09	0.36	0.08	0.9%	0.54	0.69	56.4%
TOTAL (POND A)	12.28																			17.1%
TOTAL (POND B)	13.05																			26.2%

Basin ID	Total Area (ac)	Streets-Paved/ Sidewalks/ Water Surface (100% Impervious)				Roofs (90% Impervious)				Streets-Gravel (80% Impervious)				Historical Analysis/Lawn (2% Impervious)				Basins Total Weighted C Values		Basins Total Weighted % Imp.
		C ₅	C ₁₀₀	Area (ac)	Weighted % Imp.	C ₅	C ₁₀₀	Area (ac)	Weighted % Imp.	C ₅	C ₁₀₀	Area (ac)	Weighted % Imp.	C ₅	C ₁₀₀	Area (ac)	Weighted % Imp.	C ₅	C ₁₀₀	
																		C ₅	C ₁₀₀	

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
1/8 Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
1/4 Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
1/3 Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
1/2 Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries													
Playgrounds	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Railroad Yard Areas	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Undeveloped Areas													
Historic Flow Analysis-- Greenbelts, Agriculture	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
Pasture/Meadow	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks													
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs													
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns													
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

PROPOSED
STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: Lazy Y and Rocking J Subdivision
Location: El Paso County

Project Name: Lazy Y and Rocking J Subdivision
Project No.: 25228.00
Calculated By: GAG
Checked By: _____
Date: 11/7/24

SUB-BASIN						INITIAL/OVERLAND			TRAVEL TIME					t _c CHECK			FINAL
DATA						(T _i)			(T _t)					(URBANIZED BASINS)			
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C ₅	C ₁₀₀	L (ft)	S _o (%)	t _i (min)	L _t (ft)	S _t (%)	K	VEL. (ft/s)	t _t (min)	COMP. t _c (min)	TOTAL LENGTH (ft)	Urbanized t _c (min)	
A	1.51	A	21%	0.22	0.45	100	3.5%	10.5	310	3.0%	15.0	2.6	2.0	12.5	410.0	24.9	12.5
B	3.10	A	16%	0.19	0.43	100	2.0%	13.1	680	4.0%	15.0	3.0	3.8	16.8	780.0	28.2	16.8
C	4.27	A	18%	0.21	0.44	100	3.5%	10.7	685	3.3%	15.0	2.7	4.2	14.9	785.0	28.5	14.9
D	2.57	A	15%	0.18	0.42	100	1.5%	14.5	575	2.0%	15.0	2.1	4.5	19.0	675.0	29.6	19.0
E	0.83	A	17%	0.20	0.44	100	3.0%	11.3	50	1.5%	15.0	1.8	0.5	11.8	150.0	23.8	11.8
F	1.52	A	2%	0.09	0.36	100	15.0%	7.5	515	0.5%	20.0	1.4	6.1	13.5	615.0	38.7	13.5
G	0.75	A	25%	0.27	0.49	100	14.0%	6.2	340	3.0%	10.0	1.7	3.3	9.5	440.0	24.3	9.5
I-A	0.24	A	2%	0.09	0.36	110	3.6%	12.5	0	0.0%	7.0	0.0	0.0	12.5	110.0	25.7	12.5
I-B	0.76	A	2%	0.09	0.36	175	7.0%	12.7	0	0.0%	7.0	0.0	0.0	12.7	175.0	25.7	12.7
J	2.53	A	21%	0.21	0.44	100	3.0%	11.1	280	2.0%	15.0	2.1	2.2	13.3	380.0	25.3	13.3
K	0.82	A	16%	0.19	0.43	100	2.0%	13.1	302	1.0%	15.0	1.5	3.4	16.5	402.0	27.8	16.5
L	8.46	A	30%	0.32	0.52	100	1.5%	12.4	805	2.0%	15.0	2.1	6.3	18.7	905.0	28.0	18.7
M	1.24	A	16%	0.19	0.43	100	1.0%	16.5	50	1.2%	15.0	1.6	0.5	17.0	150.0	23.9	17.0
N	0.28	A	16%	0.18	0.42	75	3.0%	10.0	0	1.5%	15.0	1.8	0.0	10.0	75.0	23.3	10.0
O	1.01	A	13%	0.16	0.41	100	12.7%	7.3	55	0.0%	15.0	0.0	61.1	68.5	155.0	108.7	68.5
P	4.32	A	6%	0.11	0.38	100	2.4%	13.3	375	4.0%	15.0	3.0	2.1	15.4	475.0	28.2	15.4
OS1	0.39	A	42%	0.42	0.61	25	8.0%	3.1	610	3.5%	15.0	2.8	3.6	6.7	635.0	22.5	6.7
OS2	0.18	A	56%	0.54	0.69	25	4.0%	3.2	270	3.5%	15.0	2.8	1.6	4.8	295.0	17.8	5.0

PROPOSED STANDARD FORM SF-2 TIME OF CONCENTRATION

Subdivision: Lazy Y and Rocking J Subdivision
 Location: El Paso County

Project Name: Lazy Y and Rocking J Subdivision
 Project No.: 25228.00
 Calculated By: GAG
 Checked By: _____
 Date: 11/7/24

SUB-BASIN						INITIAL/OVERLAND			TRAVEL TIME					t _c CHECK			FINAL
DATA						(T _i)			(T _t)					(URBANIZED BASINS)			
BASIN	D.A.	Hydrologic	Impervious	C ₅	C ₁₀₀	L	S _o	t _i	L _t	S _t	K	VEL.	t _t	COMP. t _c	TOTAL	Urbanized t _c	t _c

NOTES:

$$t_c = t_i + t_t$$

Equation 6-2

Where:

t_c = computed time of concentration (minutes)

t_i = overland (initial) flow time (minutes)

t_t = channelized flow time (minutes).

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

Equation 6-3

Where:

t_i = overland (initial) flow time (minutes)

C₅ = runoff coefficient for 5-year frequency (from Table 6-4)

L_i = length of overland flow (ft)

S_o = average slope along the overland flow path (ft/ft).

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

$$t_t = \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t}$$

Equation 6-4 $t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$

Equation 6-5

Where:

t_t = channelized flow time (travel time, min)

L_t = waterway length (ft)

S_o = waterway slope (ft/ft)

V_t = travel time velocity (ft/sec) = K√S_o

K = NRCS conveyance factor (see Table 6-2).

Where:

t_c = minimum time of concentration for first design point when less than t_c from Equation 6-1

L_t = length of channelized flow path (ft)

i = imperviousness (expressed as a decimal)

S_t = slope of the channelized flow path (ft/ft).

Table 6-2. NRCS Conveyance factors, K

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

STANDARD FORM SF-3 - PROPOSED
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Lazy Y and Rocking J Subdivision
 Location: El Paso County
 Design Storm: 5-Year

Project Name: Lazy Y and Rocking J Subdivision
 Project No.: 25228.00
 Calculated By: GAG
 Checked By: _____
 Date: 11/7/24

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t _c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	t _c (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q _{street/swale} (cfs)	C*A (ac)	Slope (%)	Q _{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t _t (min)	
	1	A	1.51	0.22	12.5	0.33	3.80	1.3					1.3	0.33	2.0					275	2.8	1.6	Sheet flows overland to DP1 swale Combines flow within swale at DP2.1
	2	B	3.10	0.19	16.8	0.59	3.35	2.0															Sheet flows overland to DP2 swale Combines flow within swale at DP2.1
	2.1								16.8	0.92	3.35	3.1	3.1	0.92	2.5					410	3.2	2.2	Combines flow of DP1 and DP2 at DP2.1 culvert Flows along in swale to DP3.1
	3	C	4.27	0.21	14.9	0.88	3.54	3.1															Sheet flows overland to DP3 at swale Combines flow within swale at DP3.1
	3.1								19.0	1.80	3.17	5.7											Combines flow of DP2.1 and DP3 Combines flow at DP4.2 inlet
	4	D	2.57	0.18	19.0	0.47	3.16	1.5															Sheet flows overland to DP4 swale Combines flow within swale at DP4.1
	4.1								38.0	2.27	2.13	4.8	4.8	2.27	10.0					150	6.3	0.4	Combines flow of DP4 at culvert Flows along in swale to D4.2
	4.2								38.4	2.74	2.11	5.8											Combines flow of DP3.1 and DP4.1 at DP4.2 culvert Flows into Pond A forebay and combines at DP5.1
	5	E	0.83	0.20	11.8	0.16	3.88	0.6															Sheet flows overland to Pond A at DP5 Combines flow at Pond A outlet structure at DP5.1
	5.1								38.4	2.90	2.11	6.1											Combines flow of DP4.2 and DP5 Released through Pond A outlet pipe at DP5.2
	5.2								-	-	-	0.1											Controlled released through Pond A outlet pipe Combines in existing roadside swale at DP6.1
	01	OS1	0.39	0.42	6.7	0.16	4.73	0.8															Flows along Peyton Hwy ditch to DPO1 Combines flow at DP6.1 culvert
	6	F	1.52	0.09	13.5	0.14	3.68	0.5															Sheet flows to Peyton Hwy ditch and then to DP6 Combines flow at DP6.1 culvert
	6.1								13.5	0.30	3.68	1.1	1.1	0.30	1.5					190	2.4	1.3	Combines flow of DPO1 and DP6 at culvert Continues along Peyton Hwy ditch to DP7.1
	02	OS2	0.18	0.54	5.0	0.10	5.17	0.5															Flows along Peyton Hwy ditch to DPO2 Combines flow at DP7.1 ditch
	7	G	0.75	0.27	9.5	0.21	4.20	0.9															Sheet flows to Peyton Hwy ditch and then to DP7 Combines flow at DP7.1 ditch
	7.1								14.8	0.61	3.54	2.3											Combines flow of DP5.2, DP6.1, DPO2 and DP7 Continues along Peyton Hwy ditch off-site north

STANDARD FORM SF-3 - PROPOSED
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Lazy Y and Rocking J Subdivision
 Location: El Paso County
 Design Storm: 5-Year

Project Name: Lazy Y and Rocking J Subdivision
 Project No.: 25228.00
 Calculated By: GAG
 Checked By: _____
 Date: 11/7/24

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t _c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	t _c (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q _{street/swale} (cfs)	C*A (ac)	Slope (%)	Q _{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t _t (min)	
	8A	I-A	0.24	0.09	12.5	0.02	3.79	0.1															Sheet flows off-site to DP8A Follows historic path off-site
	8B	I-B	0.76	0.09	12.7	0.07	3.77	0.3															Sheet flows off-site to DP8B Follows historic path off-site
	9	J	2.53	0.21	13.3	0.54	3.70	2.0					2.0	0.54	1.0					40	2.0	0.3	Sheet flows overland to DP9 culvert Combines flow at DP10.1 culvert
	10	K	0.82	0.19	16.5	0.15	3.38	0.5															Sheet flows overland to DP9 culvert Combines flow at DP10.1 culvert
	10.1								16.5	0.69	3.38	2.3	2.3	0.69	2.0					190	2.8	1.1	Combines flow of DP9 and DP10 at culvert Flows along in swale to D11.1 inlet
	11	L	8.46	0.32	18.7	2.67	3.19	8.5															Sheet flows to swale at DP11 Combines flow at DP11.1 inlet
	11.1								18.7	3.36	3.19	10.7											Combines flow of DP10.1 and DP11 at inlet Flows into Pond B forebay and combines at DP12.1
	12	M	1.24	0.19	17.0	0.23	3.33	0.8															Sheet flows to swale at DP12 Flows into Pond B forebay and combines at DP12.1
	12.1								18.7	3.59	3.19	11.4											Combines flow of DP11.1 and DP13 Released through Pond B outlet pipe at DP12.2
	12.2								-	-	-	0.2											Controlled released through Pond B outlet pipe Flows to low tailwater basin to DP13.1
	13	N	0.28	0.18	10.0	0.05	4.13	0.2															Flows to DP13 Combines off-site at DP13.1
	13.1								10.0	0.05	4.13	0.4											Combines flow of DP12.2 and DP14 Flows off-site per historic patterns

STANDARD FORM SF-3 - PROPOSED
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Lazy Y and Rocking J Subdivision
 Location: El Paso County
 Design Storm: 5-Year

Project Name: Lazy Y and Rocking J Subdivision
 Project No.: 25228.00
 Calculated By: GAG
 Checked By: _____
 Date: 11/7/24

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t _c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	t _c (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q _{street/swale} (cfs)	C*A (ac)	Slope (%)	Q _{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t _t (min)	
	14	O	1.01	0.16	68.5	0.16	1.24	0.2															Sheet flows off-site south to DP14 Flows off-site to the southeast
	15	P	4.32	0.11	15.4	0.50	3.48	1.7															Sheet flows off-site south to DP15 Flows off-site to the southwest

Notes:
 Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.

STANDARD FORM SF-3 - PROPOSED
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Lazy Y and Rocking J Subdivision
 Location: El Paso County
 Design Storm: 100-Year

Project Name: Lazy Y and Rocking J Subdivision
 Project No.: 25228.00
 Calculated By: GAG
 Checked By: _____
 Date: 11/7/24

Description	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t _c (min)	C*A (ac)	I (in/hr)	Q (cfs)	t _c (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q _{street/swale} (cfs)	C*A (ac)	Slope (%)	Q _{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t _t (min)	
	1	A	1.51	0.45	12.5	0.68	6.37	4.3					4.3	0.68	2.0					275	2.8	1.6	Sheet flows overland to DP1 swale Combines flow within swale at DP2.1
	2	B	3.10	0.43	16.8	1.34	5.62	7.5															Sheet flows overland to DP2 swale Combines flow within swale at DP2.1
	2.1								16.8	2.02	5.62	11.4	11.4	2.02	2.5					410	3.2	2.2	Combines flow of DP1 and DP2 at DP2.1 culvert Flows along in swale to DP3.1
	3	C	4.27	0.44	14.9	1.90	5.94	11.3															Sheet flows overland to DP3 at swale Combines flow within swale at DP3.1
	3.1								19.0	3.92	5.32	20.8											Combines flow of DP2.1 and DP3 Combines flow at DP4.2 inlet
	4	D	2.57	0.42	19.0	1.09	5.31	5.8															Sheet flows overland to DP4 swale Combines flow within swale at DP4.1
	4.1								38.0	5.01	3.57	17.9	17.9	5.01	10.0					150	6.3	0.4	Combines flow of DP3 and DP4 at culvert Flows along in swale to D4.2
	4.2								38.4	6.10	3.54	21.6											Combines flow of DP2.1 and DP4.1 at DP4.2 culvert Flows into Pond A forebay and combines at DP5.1
	5	E	0.83	0.44	11.8	0.36	6.51	2.3															Sheet flows overland to Pond A at DP5 Combines flow at Pond A outlet structure at DP5.1
	5.1								38.4	6.46	3.54	22.9											Combines flow of DP4.2 and DP5 Released through Pond A outlet pipe at DP5.2
	5.2								-	-	-	8.2											Controlled released through Pond A outlet pipe Combines in existing roadside swale at DP7.1
	O1	OS1	0.39	0.61	6.7	0.24	7.94	1.9															Flows along Peyton Hwy ditch to DPO1 Combines flow at DP6.1 culvert
	6	F	1.52	0.36	13.5	0.55	6.17	3.4															Sheet flows to Peyton Hwy ditch and then to DP6 Combines flow at DP6.1 culvert
	6.1								13.5	0.79	6.17	4.9	4.9	0.79	1.5					190	2.4	1.3	Combines flow of DPO1 and DP6 at culvert Continues along Peyton Hwy ditch to DP6.1
	O2	OS2	0.18	0.69	5.0	0.12	8.68	1.0															Flows along Peyton Hwy ditch to DPO2 Combines flow at DP6.1 ditch
	7	G	0.75	0.49	9.5	0.37	7.06	2.6															Sheet flows to Peyton Hwy ditch and then to DP7 Combines flow at DP7.1 ditch
	7.1								14.8	1.28	5.94	15.8											Combines flow of DP5.2, DP6.1, DPO2 and DP7 Continues along Peyton Hwy ditch off-site north

STANDARD FORM SF-3 - PROPOSED
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Lazy Y and Rocking J Subdivision
 Location: El Paso County
 Design Storm: 100-Year

Project Name: Lazy Y and Rocking J Subdivision
 Project No.: 25228.00
 Calculated By: GAG
 Checked By: _____
 Date: 11/7/24

Description	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t _c (min)	C*A (ac)	I (in/hr)	Q (cfs)	t _c (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q _{street/swale} (cfs)	C*A (ac)	Slope (%)	Q _{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t _t (min)	
	8A	I-A	0.24	0.36	12.5	0.09	6.36	0.6															Sheet flows off-site to DP8A Follows historic path off-site
	8B	I-B	0.76	0.36	12.7	0.27	6.33	1.7															Sheet flows off-site to DP8B Follows historic path off-site
	9	J	2.53	0.44	13.3	1.12	6.20	6.9				6.9	1.12	1.0						40	2.0	0.3	Sheet flows overland to DP9 culvert Combines flow at DP10.1 culvert
	10	K	0.82	0.43	16.5	0.35	5.68	2.0															Sheet flows overland to DP9 culvert Combines flow at DP10.1 culvert
	10.1								16.5	1.47	5.68	8.3	1.47	2.0						190	2.8	1.1	Combines flow of DP9 and DP10 at culvert Flows along in swale to D11.1 inlet
	11	L	8.46	0.52	18.7	4.44	5.35	23.8															Sheet flows to swale at DP11 Combines flow at DP11.1 inlet
	11.1								18.7	5.91	5.35	31.6											Combines flow of DP10.1 and DP11 at inlet Flows into Pond B forebay and combines at DP13.1
	12	M	1.24	0.43	17.0	0.53	5.59	3.0															Sheet flows to swale at DP12 Flows into Pond B forebay and combines at DP12.1
	12.1								18.7	6.44	5.35	34.5											Combines flow of DP11.1 and DP13 Released through Pond B outlet pipe at DP12.2
	12.2								-	-	-	5.6											Controlled released through Pond B outlet pipe Flows to low tailwater basin to DP13.1
	13	N	0.28	0.42	10.0	0.12	6.93	0.8															Flows to DP13 Combines off-site at DP13.1
	13.1								10.0	0.12	6.93	6.4											Combines flow of DP12.2 and DP14 Flows off-site per historic patterns

STANDARD FORM SF-3 - PROPOSED
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Lazy Y and Rocking J Subdivision
 Location: El Paso County
 Design Storm: 100-Year

Project Name: Lazy Y and Rocking J Subdivision
 Project No.: 25228.00
 Calculated By: GAG
 Checked By: _____
 Date: 11/7/24

Description	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t _c (min)	C*A (ac)	I (in/hr)	Q (cfs)	t _c (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q _{street/swale} (cfs)	C*A (ac)	Slope (%)	Q _{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t _t (min)	
	14	O	1.01	0.41	68.5	0.41	2.09	0.9															Sheet flows off-site south to DP14 Flows off-site to the southeast
	15	P	4.32	0.38	15.4	1.63	5.84	9.5															Sheet flows off-site south to DP15 Flows off-site to the southwest

Notes:
 Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.

Appendix C

Hydraulic Calculations

Channel Report

Ex. DP2.1-Existing Roadside Swale

User-defined

Invert Elev (ft) = 6798.54
Slope (%) = 3.30
N-Value = 0.030

Highlighted

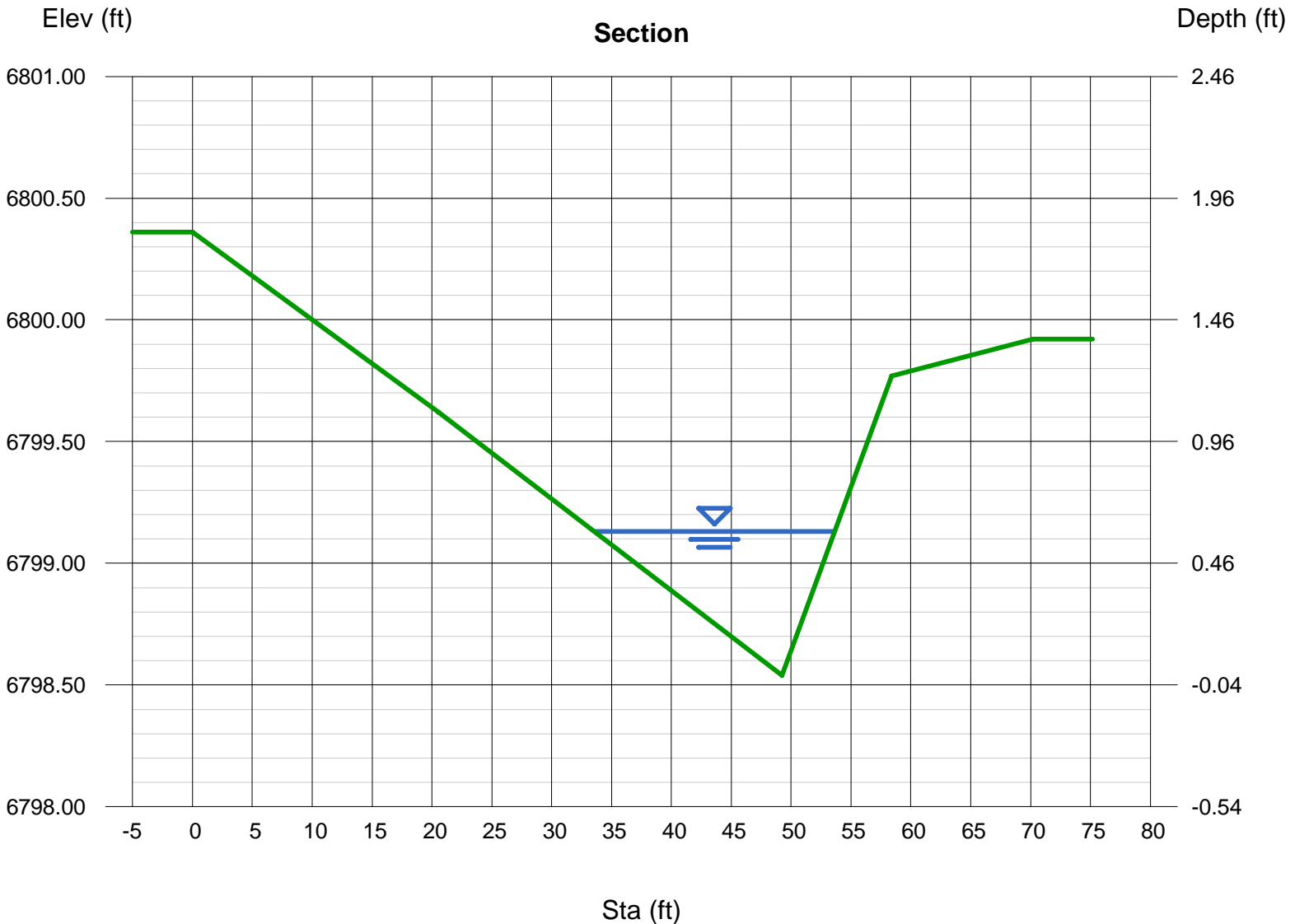
Depth (ft) = 0.59
Q (cfs) = 23.00
Area (sqft) = 5.91
Velocity (ft/s) = 3.89
Wetted Perim (ft) = 20.08
Crit Depth, Yc (ft) = 0.65
Top Width (ft) = 20.03
EGL (ft) = 0.83

Calculations

Compute by: Known Q
Known Q (cfs) = 23.00

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

(0.00, 6800.36) -(20.58, 6799.62, 0.030) -(49.23, 6798.54, 0.030) -(58.38, 6799.77, 0.030) -(70.18, 6799.92, 0.030)



Channel Report

DP1 Swale

Triangular

Side Slopes (z:1) = 4.00, 4.00
Total Depth (ft) = 1.75

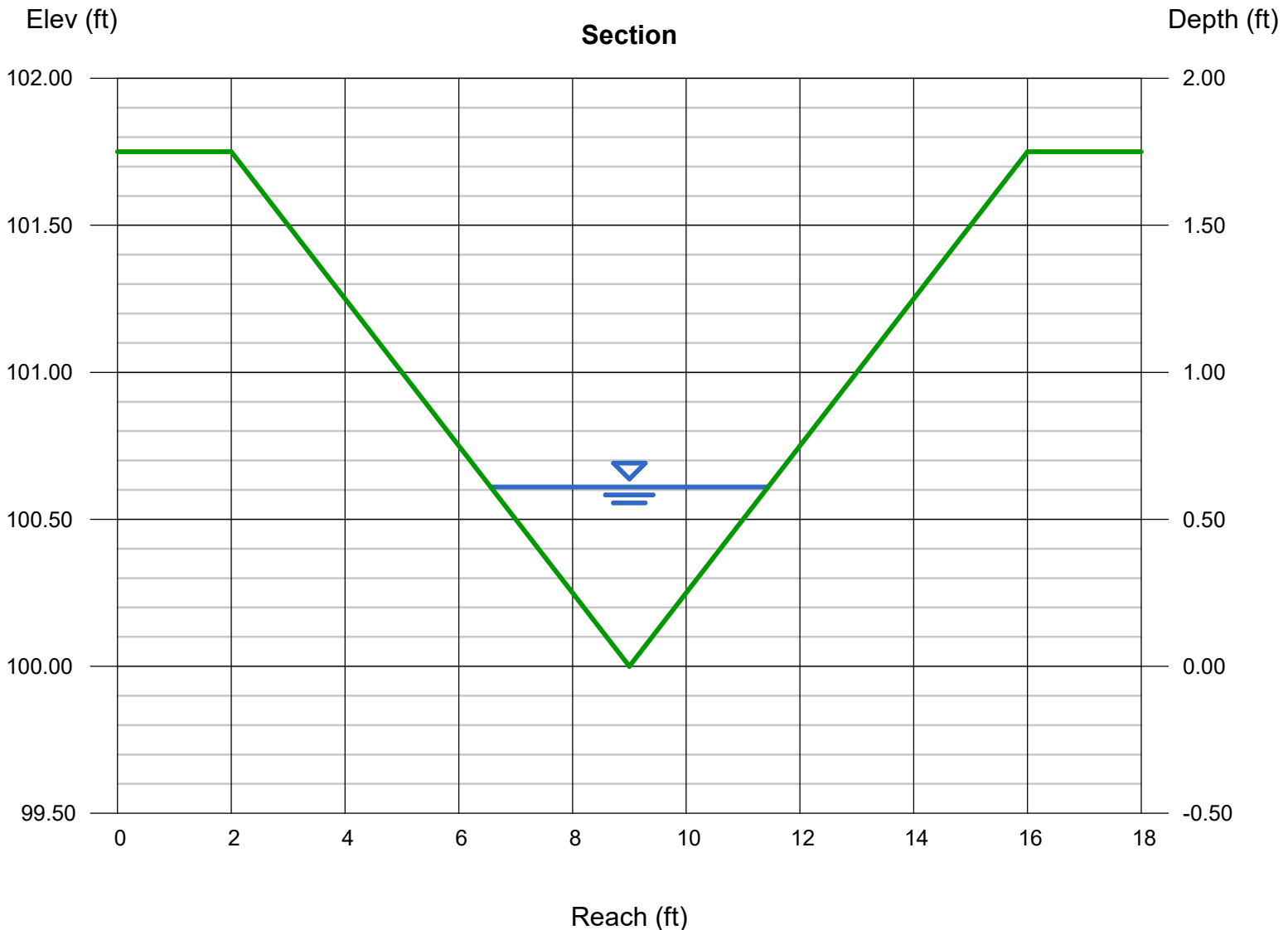
Invert Elev (ft) = 100.00
Slope (%) = 2.00
N-Value = 0.030

Calculations

Compute by: Known Q
Known Q (cfs) = 4.50

Highlighted

Depth (ft) = 0.61
Q (cfs) = 4.500
Area (sqft) = 1.49
Velocity (ft/s) = 3.02
Wetted Perim (ft) = 5.03
Crit Depth, Yc (ft) = 0.61
Top Width (ft) = 4.88
EGL (ft) = 0.75



Channel Report

DP2.1 Swale

Triangular

Side Slopes (z:1) = 4.00, 4.00
Total Depth (ft) = 2.00

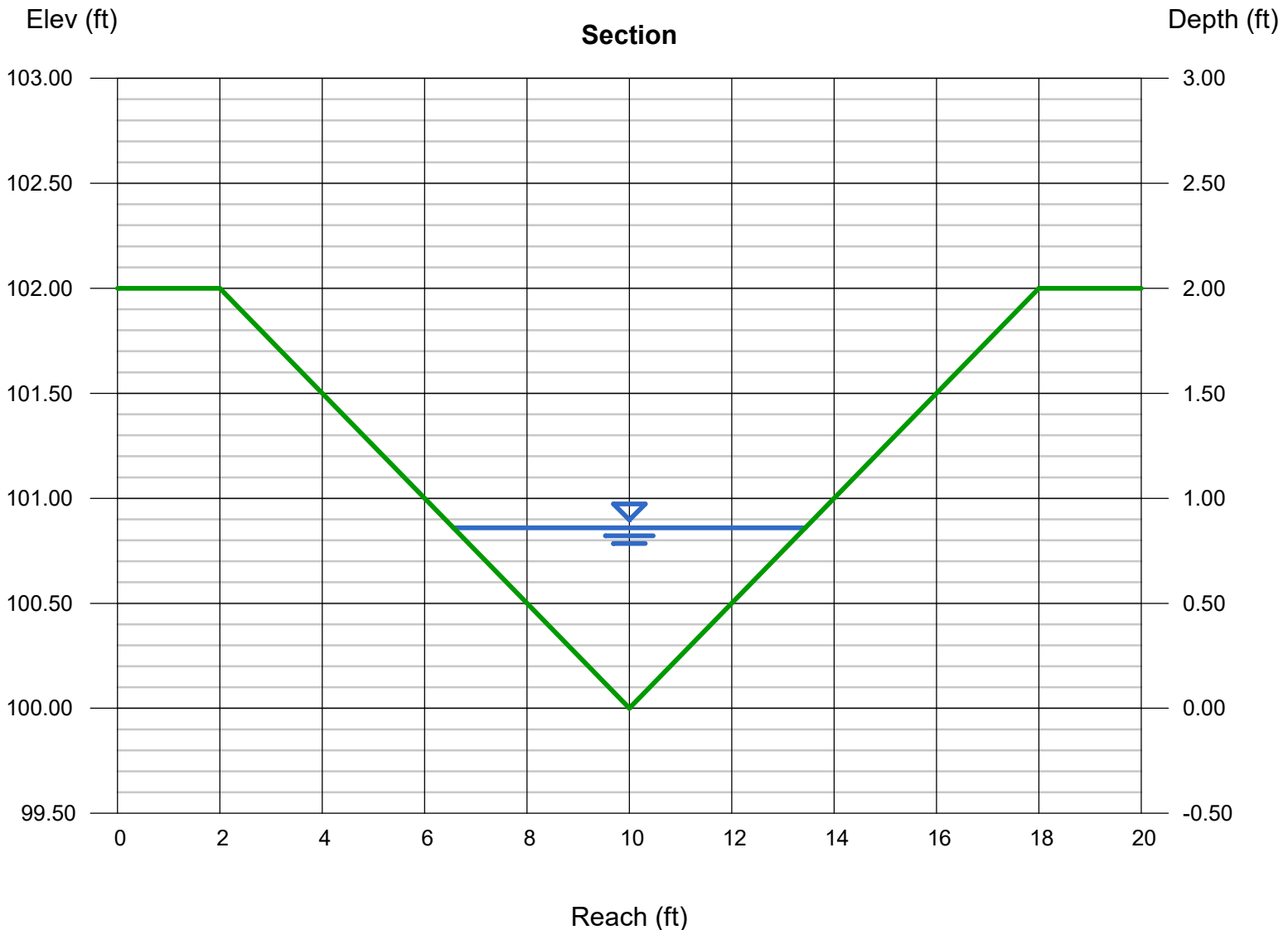
Invert Elev (ft) = 100.00
Slope (%) = 2.00
N-Value = 0.030

Calculations

Compute by: Known Q
Known Q (cfs) = 11.50

Highlighted

Depth (ft) = 0.86
Q (cfs) = 11.50
Area (sqft) = 2.96
Velocity (ft/s) = 3.89
Wetted Perim (ft) = 7.09
Crit Depth, Yc (ft) = 0.88
Top Width (ft) = 6.88
EGL (ft) = 1.09



Culvert Report

DP2.1 Culvert

Invert Elev Dn (ft)	= 6824.49
Pipe Length (ft)	= 23.01
Slope (%)	= 1.48
Invert Elev Up (ft)	= 6824.83
Rise (in)	= 24.0
Shape	= Circular
Span (in)	= 24.0
No. Barrels	= 1
n-Value	= 0.013
Culvert Type	= Circular Corrugate Metal Pipe
Culvert Entrance	= Headwall
Coeff. K,M,c,Y,k	= 0.0078, 2, 0.0379, 0.69, 0.5

Calculations

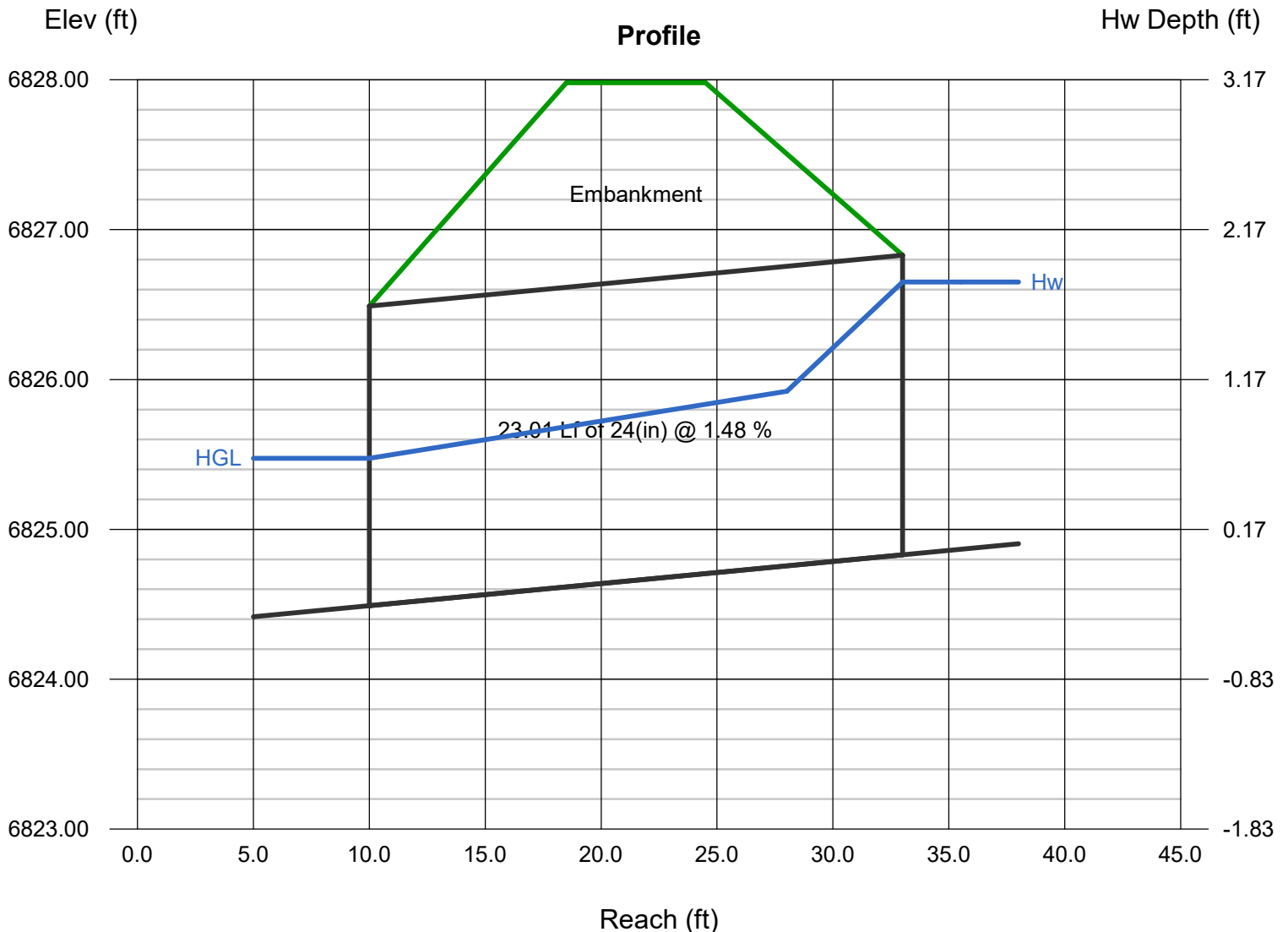
Qmin (cfs)	= 11.50
Qmax (cfs)	= 11.50
Tailwater Elev (ft)	= Normal

Highlighted

Qtotal (cfs)	= 11.50
Qpipe (cfs)	= 11.50
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 7.47
Veloc Up (ft/s)	= 5.75
HGL Dn (ft)	= 6825.48
HGL Up (ft)	= 6826.05
Hw Elev (ft)	= 6826.65
Hw/D (ft)	= 0.91
Flow Regime	= Inlet Control

Embankment

Top Elevation (ft)	= 6827.98
Top Width (ft)	= 6.00
Crest Width (ft)	= 100.00



Channel Report

DP3.1 Swale

Triangular

Side Slopes (z:1) = 4.00, 4.00
Total Depth (ft) = 2.10

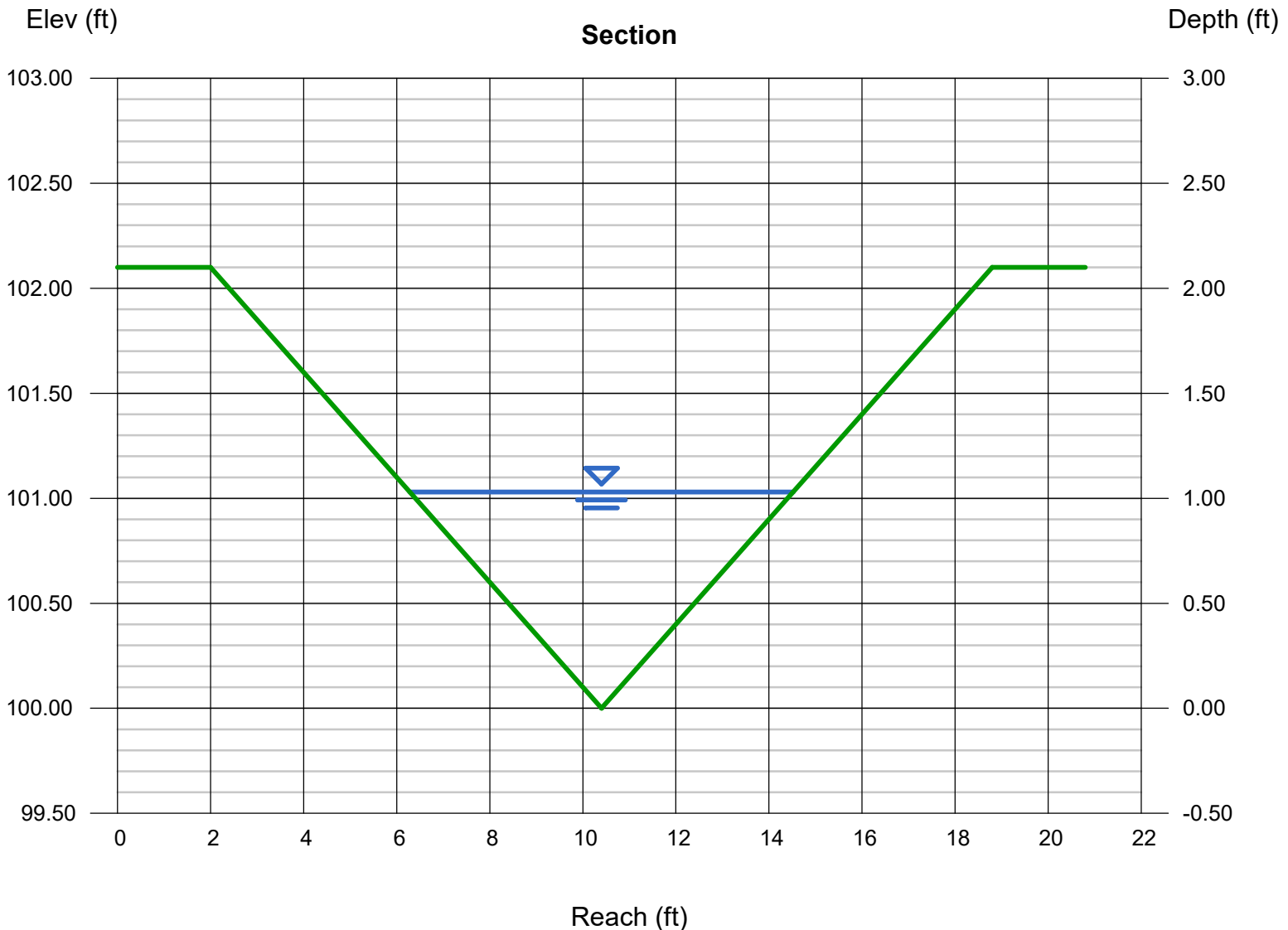
Invert Elev (ft) = 100.00
Slope (%) = 2.65
N-Value = 0.030

Calculations

Compute by: Known Q
Known Q (cfs) = 21.00

Highlighted

Depth (ft) = 1.03
Q (cfs) = 21.00
Area (sqft) = 4.24
Velocity (ft/s) = 4.95
Wetted Perim (ft) = 8.49
Crit Depth, Yc (ft) = 1.12
Top Width (ft) = 8.24
EGL (ft) = 1.41



Channel Report

DP4.1 Swale

Triangular

Side Slopes (z:1) = 4.00, 4.00
Total Depth (ft) = 2.15

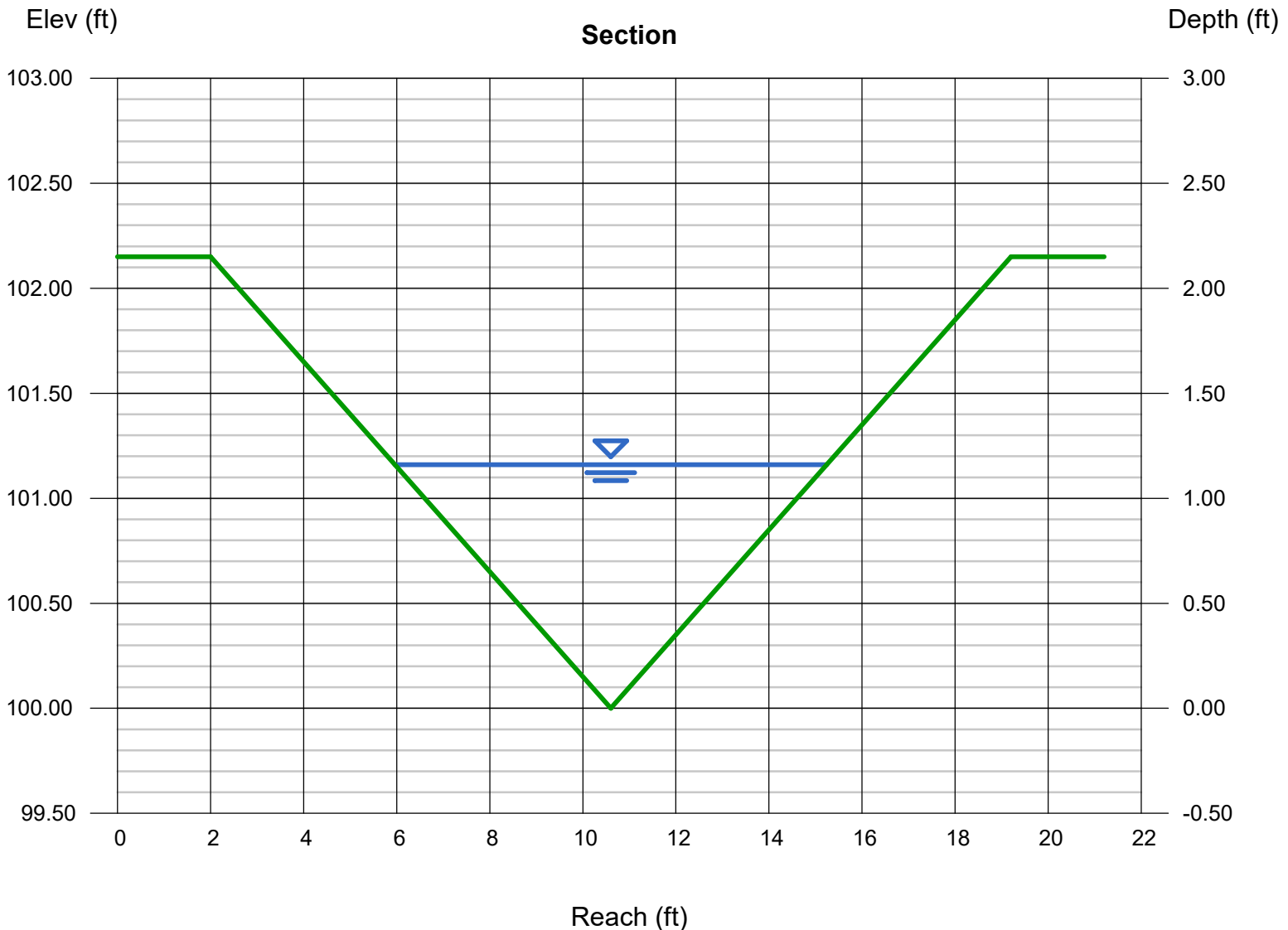
Invert Elev (ft) = 100.00
Slope (%) = 1.00
N-Value = 0.030

Calculations

Compute by: Known Q
Known Q (cfs) = 18.00

Highlighted

Depth (ft) = 1.16
Q (cfs) = 18.00
Area (sqft) = 5.38
Velocity (ft/s) = 3.34
Wetted Perim (ft) = 9.57
Crit Depth, Yc (ft) = 1.05
Top Width (ft) = 9.28
EGL (ft) = 1.33



Culvert Report

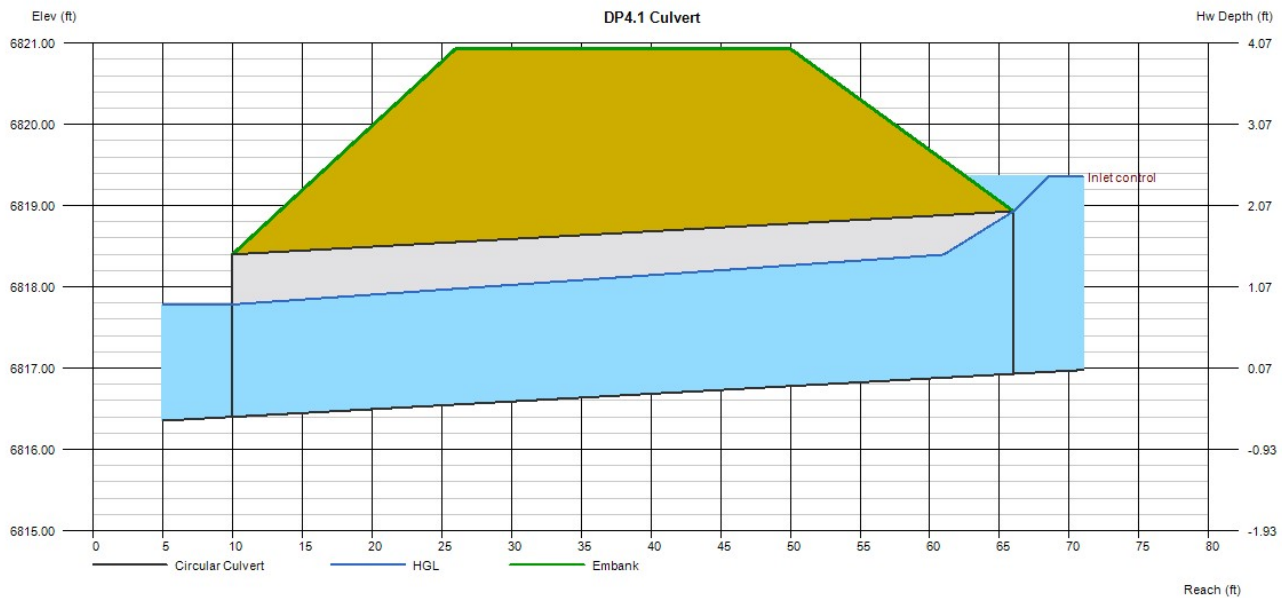
DP4.1 Culvert

Invert Elev Dn (ft)	= 6816.40
Pipe Length (ft)	= 56.00
Slope (%)	= 0.95
Invert Elev Up (ft)	= 6816.93
Rise (in)	= 24.0
Shape	= Circular
Span (in)	= 24.0
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)	= 6820.93
Top Width (ft)	= 24.00
Crest Width (ft)	= 100.00

Calculations	
Qmin (cfs)	= 18.00
Qmax (cfs)	= 18.00
Tailwater Elev (ft)	= Normal

Highlighted	
Qtotal (cfs)	= 18.00
Qpipe (cfs)	= 18.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 7.76
Veloc Up (ft/s)	= 6.99
HGL Dn (ft)	= 6817.78
HGL Up (ft)	= 6818.46
Hw Elev (ft)	= 6819.36
Hw/D (ft)	= 1.21
Flow Regime	= Inlet Control



Culvert Report

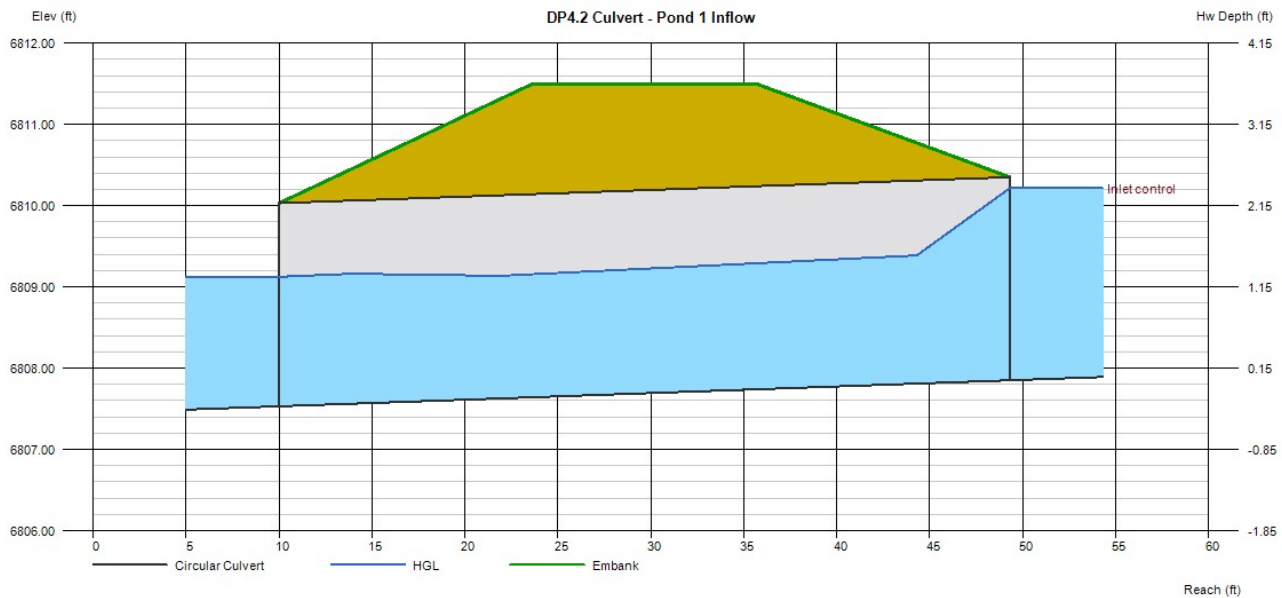
DP4.2 Culvert - Pond A Inflow

Invert Elev Dn (ft)	= 6807.53
Pipe Length (ft)	= 39.30
Slope (%)	= 0.82
Invert Elev Up (ft)	= 6807.85
Rise (in)	= 30.0
Shape	= Circular
Span (in)	= 30.0
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)	= 6811.50
Top Width (ft)	= 12.00
Crest Width (ft)	= 100.00

Calculations	
Qmin (cfs)	= 22.00
Qmax (cfs)	= 22.00
Tailwater Elev (ft)	= 6808.99

Highlighted	
Qtotal (cfs)	= 22.00
Qpipe (cfs)	= 22.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 6.66
Veloc Up (ft/s)	= 6.66
HGL Dn (ft)	= 6809.12
HGL Up (ft)	= 6809.44
Hw Elev (ft)	= 6810.21
Hw/D (ft)	= 0.95
Flow Regime	= Inlet Control



Channel Report

DP5.2 Swale (Pond Outfall)

Triangular

Side Slopes (z:1) = 4.00, 4.00
Total Depth (ft) = 1.75

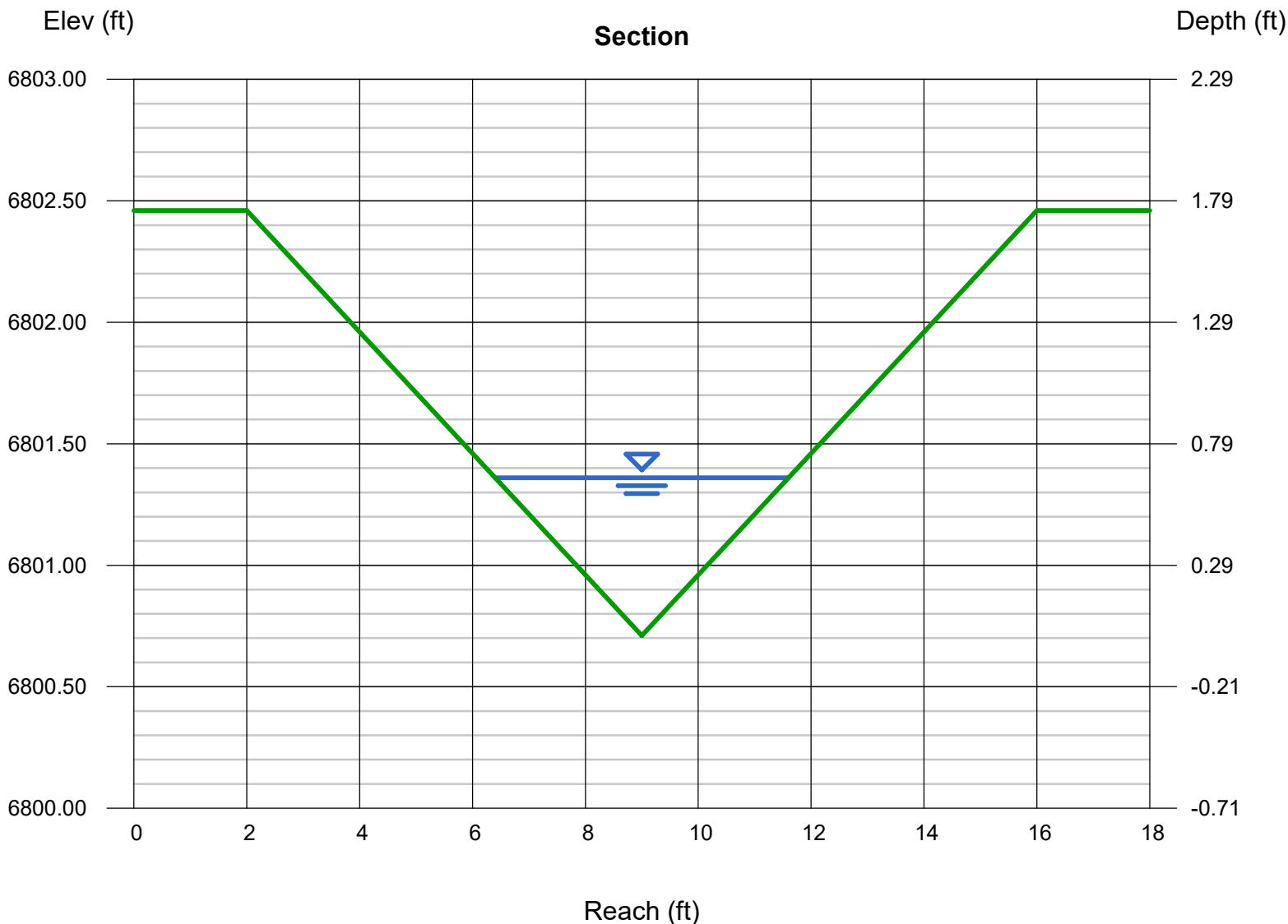
Invert Elev (ft) = 6800.71
Slope (%) = 5.00
N-Value = 0.030

Calculations

Compute by: Known Q
Known Q (cfs) = 8.50

Highlighted

Depth (ft) = 0.65
Q (cfs) = 8.500
Area (sqft) = 1.69
Velocity (ft/s) = 5.03
Wetted Perim (ft) = 5.36
Crit Depth, Yc (ft) = 0.78
Top Width (ft) = 5.20
EGL (ft) = 1.04



Culvert Report

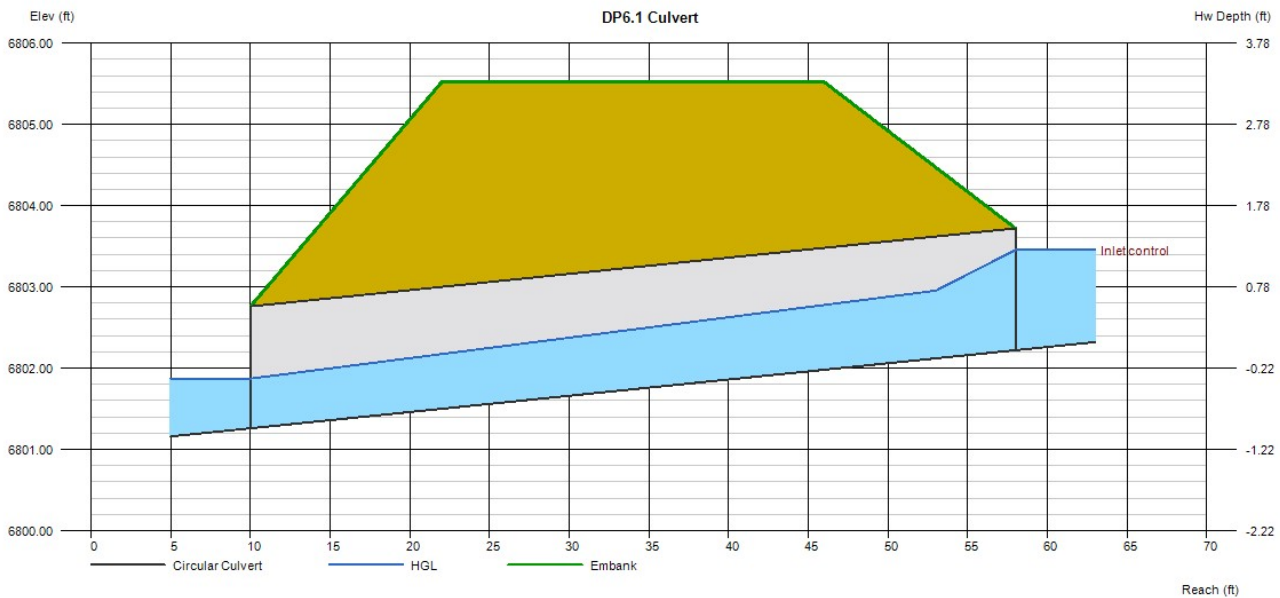
DP6.1 Culvert

Invert Elev Dn (ft)	= 6801.26
Pipe Length (ft)	= 48.00
Slope (%)	= 2.00
Invert Elev Up (ft)	= 6802.22
Rise (in)	= 18.0
Shape	= Circular
Span (in)	= 18.0
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)	= 6805.52
Top Width (ft)	= 24.00
Crest Width (ft)	= 100.00

Calculations	
Qmin (cfs)	= 5.00
Qmax (cfs)	= 5.00
Tailwater Elev (ft)	= Normal

Highlighted	
Qtotal (cfs)	= 5.00
Qpipe (cfs)	= 5.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 7.39
Veloc Up (ft/s)	= 4.77
HGL Dn (ft)	= 6801.87
HGL Up (ft)	= 6803.08
Hw Elev (ft)	= 6803.46
Hw/D (ft)	= 0.82
Flow Regime	= Inlet Control



Channel Report

DP7.1-Existing Roadside Swale

User-defined

Invert Elev (ft) = 6798.54
Slope (%) = 3.30
N-Value = 0.030

Highlighted

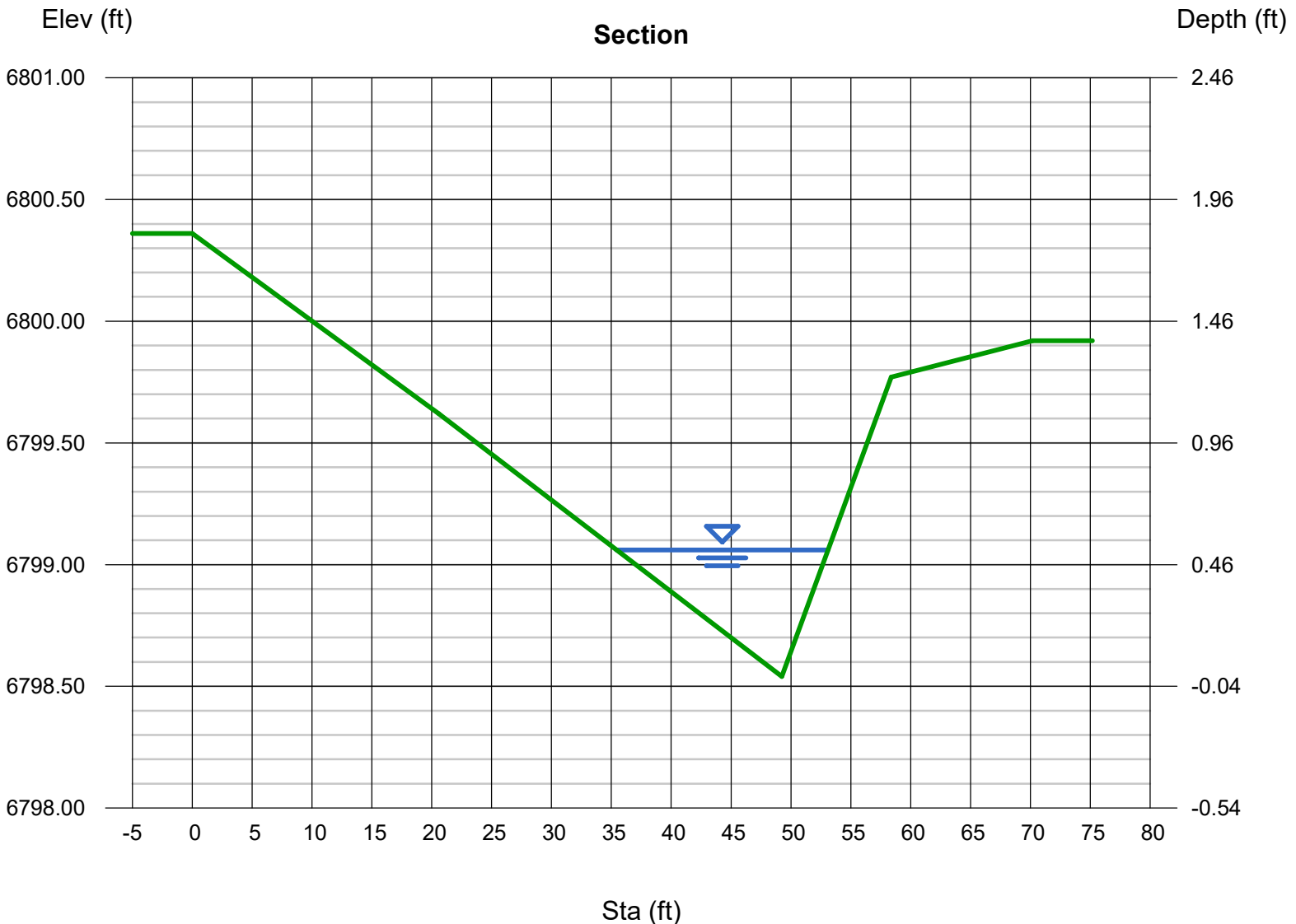
Depth (ft) = 0.52
Q (cfs) = 16.00
Area (sqft) = 4.59
Velocity (ft/s) = 3.48
Wetted Perim (ft) = 17.71
Crit Depth, Yc (ft) = 0.57
Top Width (ft) = 17.66
EGL (ft) = 0.71

Calculations

Compute by: Known Q
Known Q (cfs) = 16.00

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

(0.00, 6800.36)-(20.58, 6799.62, 0.030)-(49.23, 6798.54, 0.030)-(58.38, 6799.77, 0.030)-(70.18, 6799.92, 0.030)



Channel Report

DP8.1-Existing Roadside Swale

User-defined

Invert Elev (ft) = 6798.54
Slope (%) = 3.30
N-Value = 0.030

Highlighted

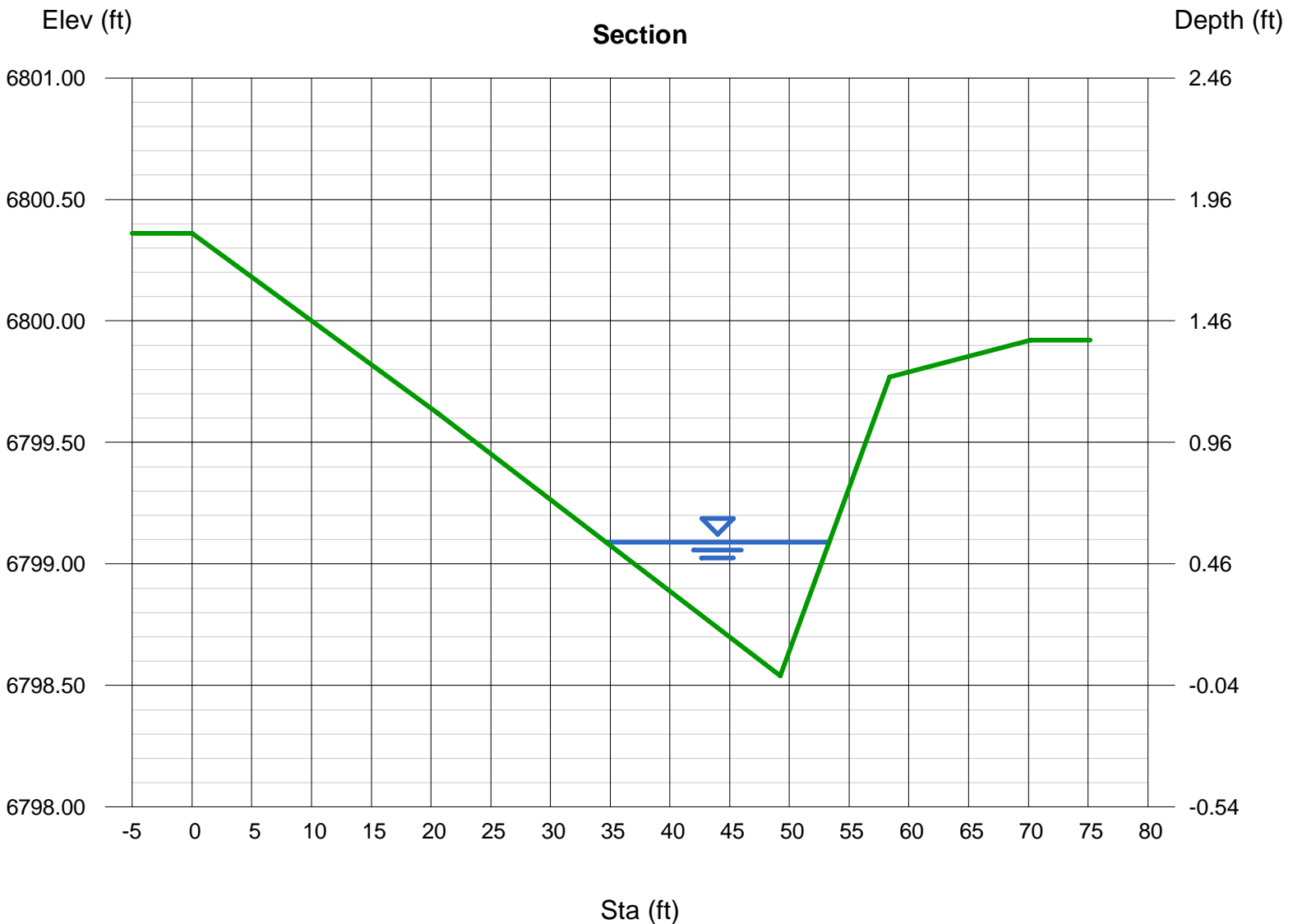
Depth (ft) = 0.55
Q (cfs) = 19.00
Area (sqft) = 5.13
Velocity (ft/s) = 3.70
Wetted Perim (ft) = 18.72
Crit Depth, Yc (ft) = 0.61
Top Width (ft) = 18.67
EGL (ft) = 0.76

Calculations

Compute by: Known Q
Known Q (cfs) = 19.00

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

(0.00, 6800.36) -(20.58, 6799.62, 0.030) -(49.23, 6798.54, 0.030) -(58.38, 6799.77, 0.030) -(70.18, 6799.92, 0.030)



Channel Report

DP9 (Half-Flows) Swale

Triangular

Side Slopes (z:1) = 4.00, 4.00
Total Depth (ft) = 1.50

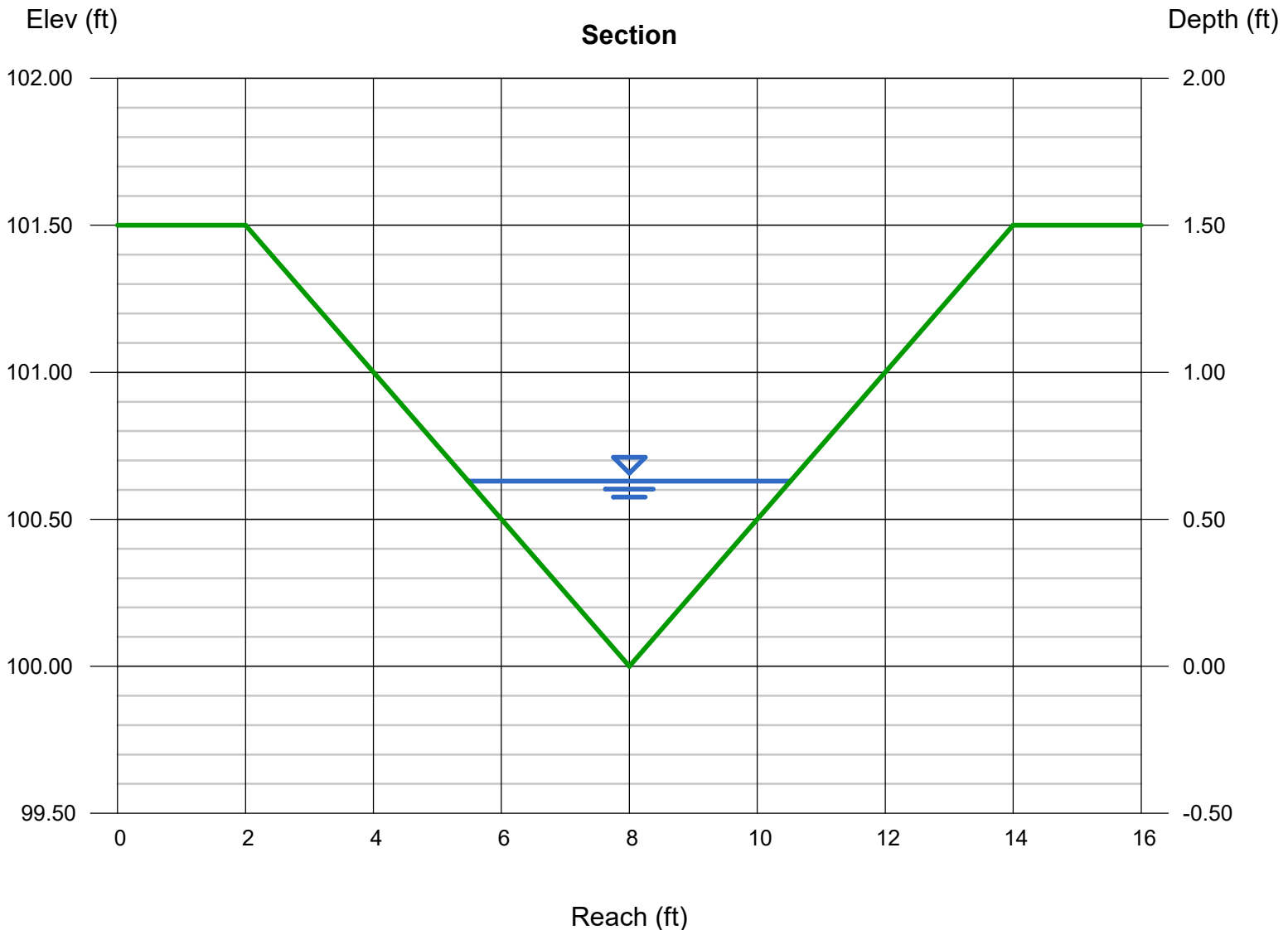
Invert Elev (ft) = 100.00
Slope (%) = 1.00
N-Value = 0.030

Calculations

Compute by: Known Q
Known Q (cfs) = 3.50

Highlighted

Depth (ft) = 0.63
Q (cfs) = 3.500
Area (sqft) = 1.59
Velocity (ft/s) = 2.20
Wetted Perim (ft) = 5.20
Crit Depth, Yc (ft) = 0.55
Top Width (ft) = 5.04
EGL (ft) = 0.71



Culvert Report

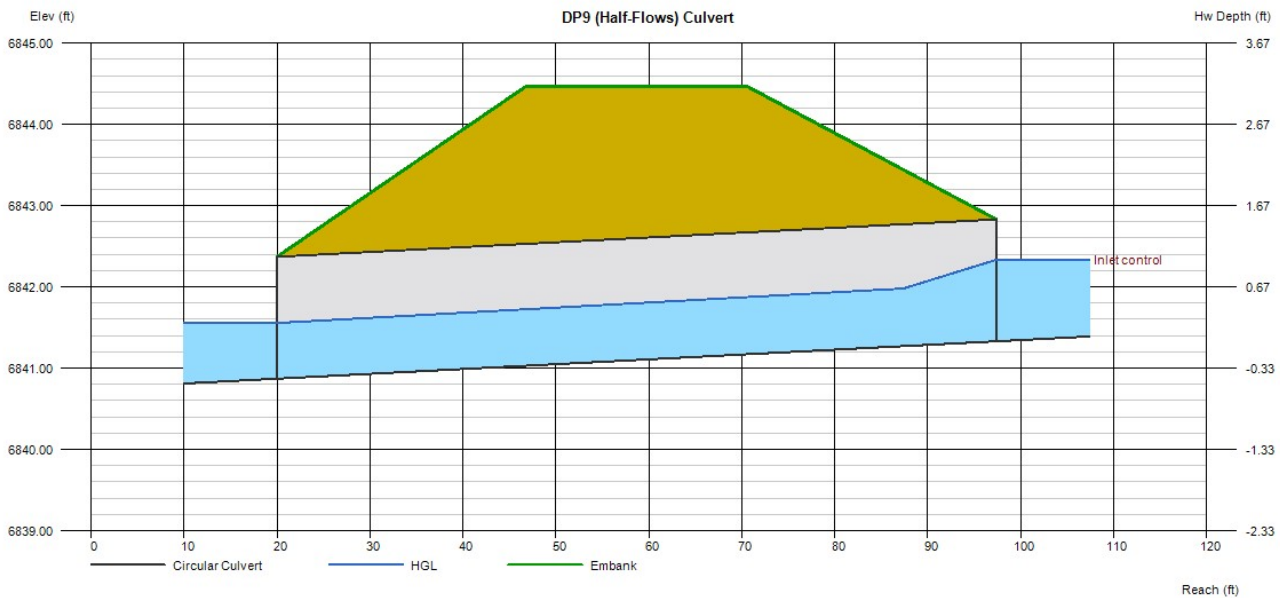
DP9 (Half-Flows) Culvert

Invert Elev Dn (ft)	= 6840.87
Pipe Length (ft)	= 77.37
Slope (%)	= 0.59
Invert Elev Up (ft)	= 6841.33
Rise (in)	= 18.0
Shape	= Circular
Span (in)	= 18.0
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)	= 6844.46
Top Width (ft)	= 24.00
Crest Width (ft)	= 100.00

Calculations	
Qmin (cfs)	= 3.50
Qmax (cfs)	= 3.50
Tailwater Elev (ft)	= Normal

Highlighted	
Qtotal (cfs)	= 3.50
Qpipe (cfs)	= 3.50
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 4.45
Veloc Up (ft/s)	= 4.23
HGL Dn (ft)	= 6841.56
HGL Up (ft)	= 6842.04
Hw Elev (ft)	= 6842.33
Hw/D (ft)	= 0.67
Flow Regime	= Inlet Control



Channel Report

DP9 Swale

Triangular

Side Slopes (z:1) = 4.00, 4.00

Total Depth (ft) = 2.00

Invert Elev (ft) = 100.00

Slope (%) = 1.00

N-Value = 0.030

Calculations

Compute by: Known Q

Known Q (cfs) = 7.00

Highlighted

Depth (ft) = 0.82

Q (cfs) = 7.000

Area (sqft) = 2.69

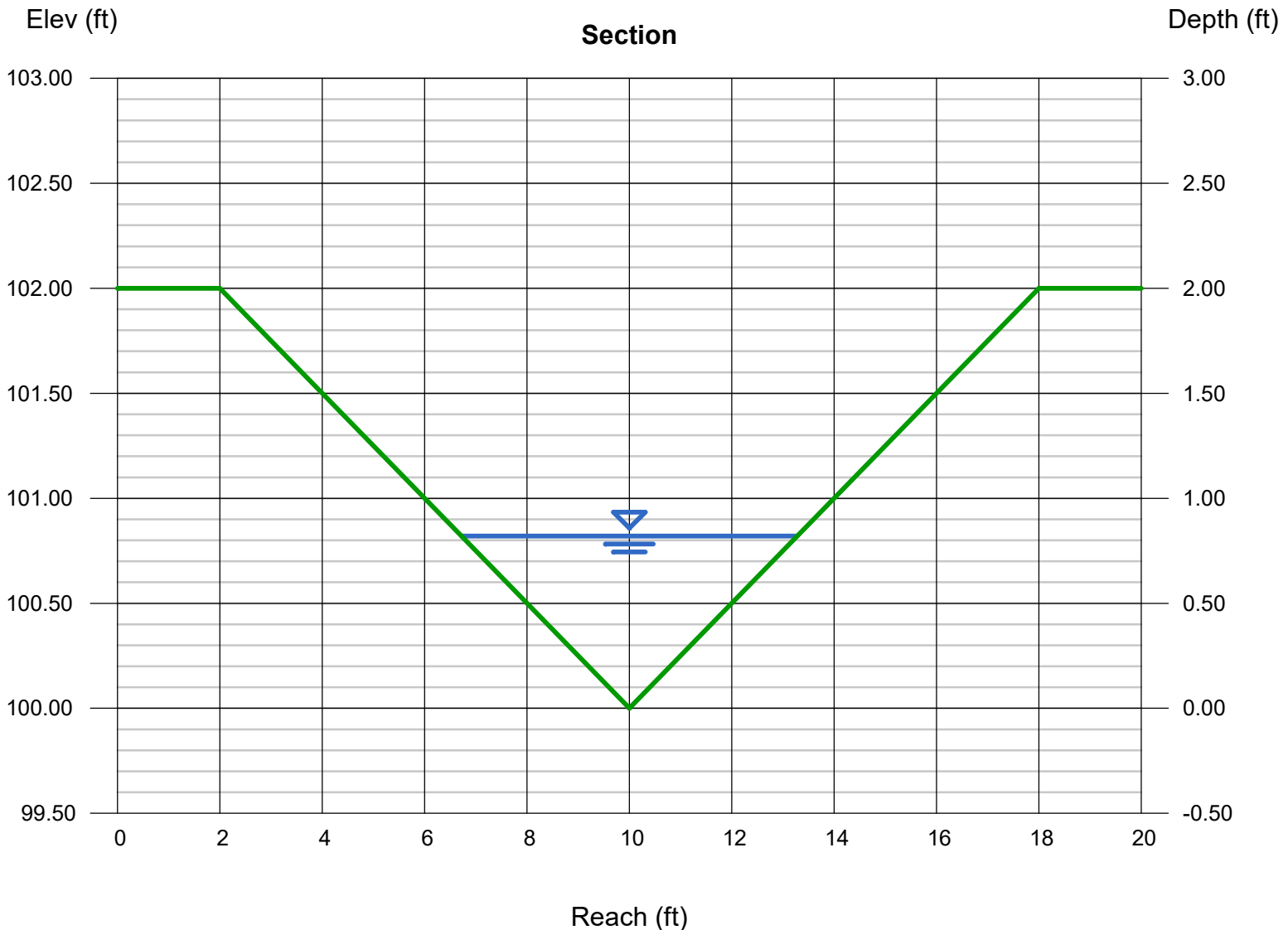
Velocity (ft/s) = 2.60

Wetted Perim (ft) = 6.76

Crit Depth, Yc (ft) = 0.72

Top Width (ft) = 6.56

EGL (ft) = 0.93



Culvert Report

DP9 Culvert

Invert Elev Dn (ft)	= 6837.72
Pipe Length (ft)	= 122.05
Slope (%)	= 1.38
Invert Elev Up (ft)	= 6839.41
Rise (in)	= 18.0
Shape	= Circular
Span (in)	= 18.0
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

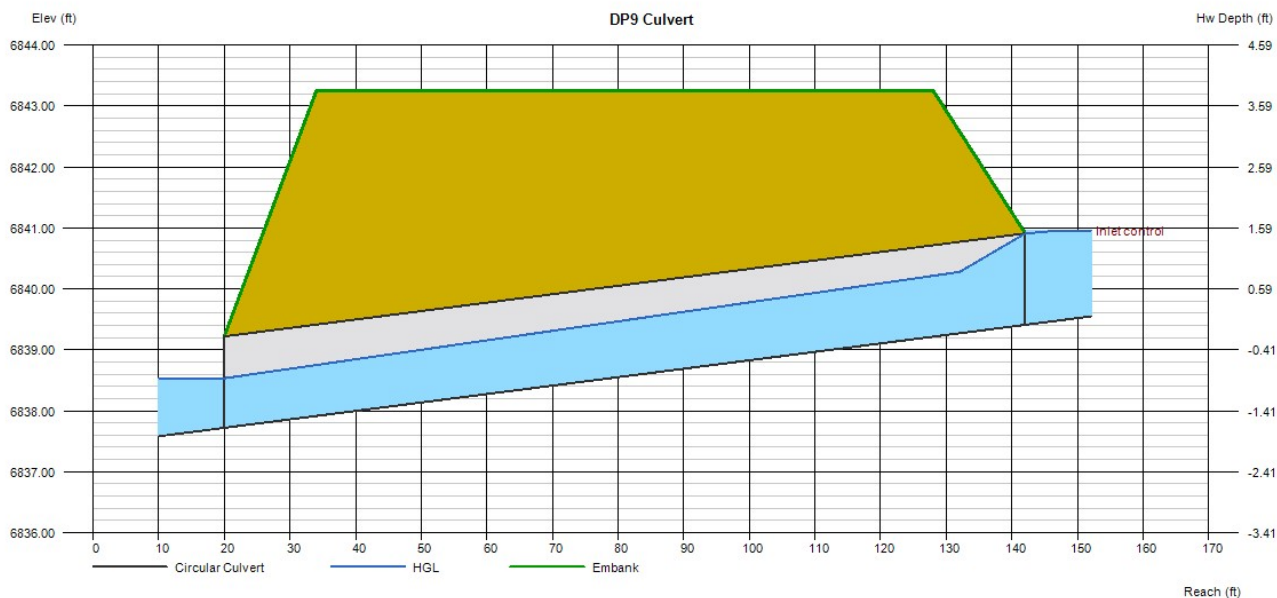
Top Elevation (ft)	= 6843.25
Top Width (ft)	= 94.00
Crest Width (ft)	= 100.00

Calculations

Qmin (cfs)	= 7.00
Qmax (cfs)	= 7.00
Tailwater Elev (ft)	= Normal

Highlighted

Qtotal (cfs)	= 7.00
Qpipe (cfs)	= 7.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 7.16
Veloc Up (ft/s)	= 5.45
HGL Dn (ft)	= 6838.53
HGL Up (ft)	= 6840.43
Hw Elev (ft)	= 6840.96
Hw/D (ft)	= 1.03
Flow Regime	= Inlet Control



Channel Report

DP11 Swale

Triangular

Side Slopes (z:1) = 4.00, 4.00

Total Depth (ft) = 1.00

Invert Elev (ft) = 100.00

Slope (%) = 1.00

N-Value = 0.030

Calculations

Compute by: Known Q

Known Q (cfs) = 2.00

Highlighted

Depth (ft) = 0.51

Q (cfs) = 2.000

Area (sqft) = 1.04

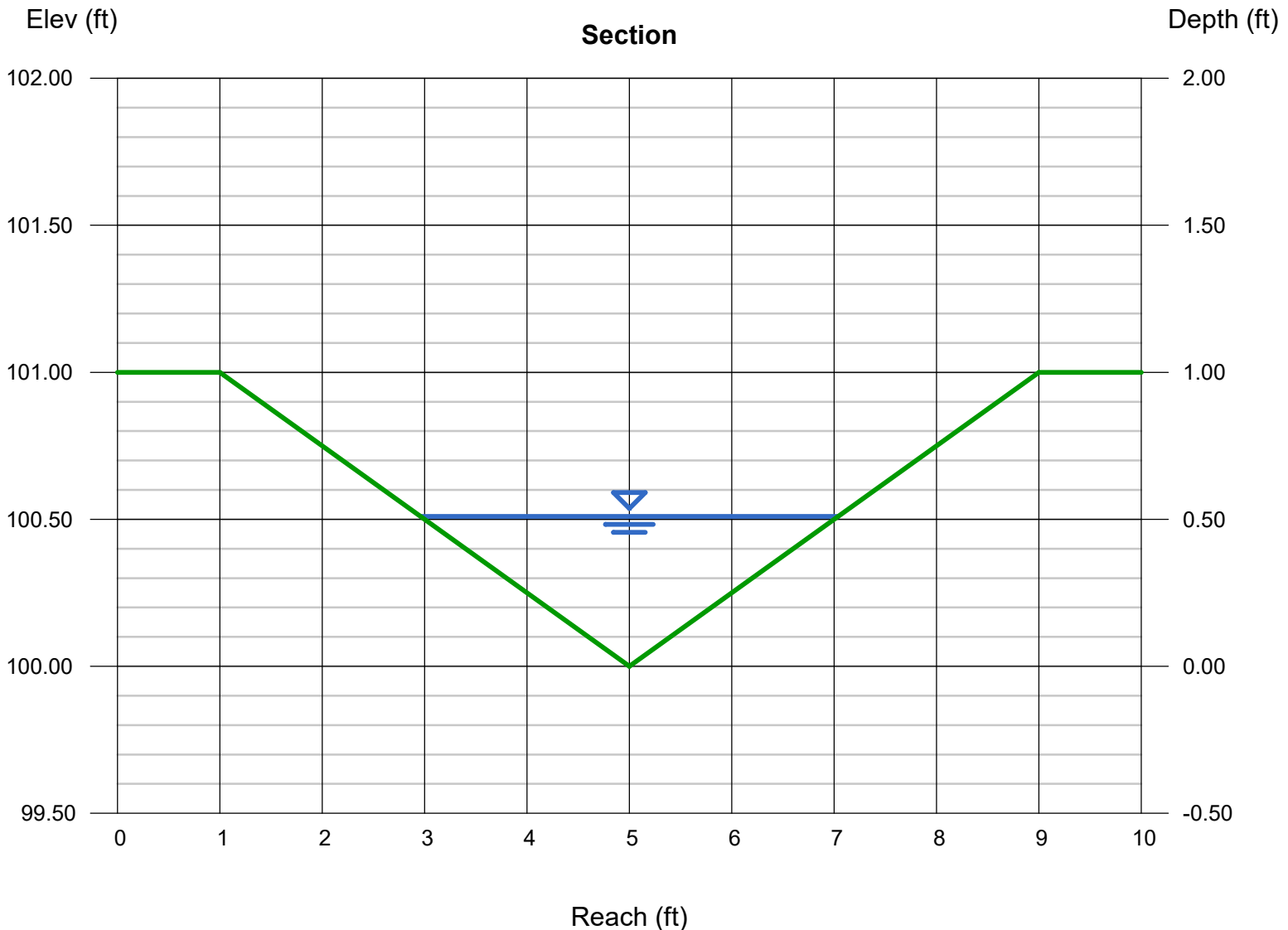
Velocity (ft/s) = 1.92

Wetted Perim (ft) = 4.21

Crit Depth, Yc (ft) = 0.44

Top Width (ft) = 4.08

EGL (ft) = 0.57



Channel Report

DP10.1 Swale

Triangular

Side Slopes (z:1) = 4.00, 4.00
Total Depth (ft) = 2.00

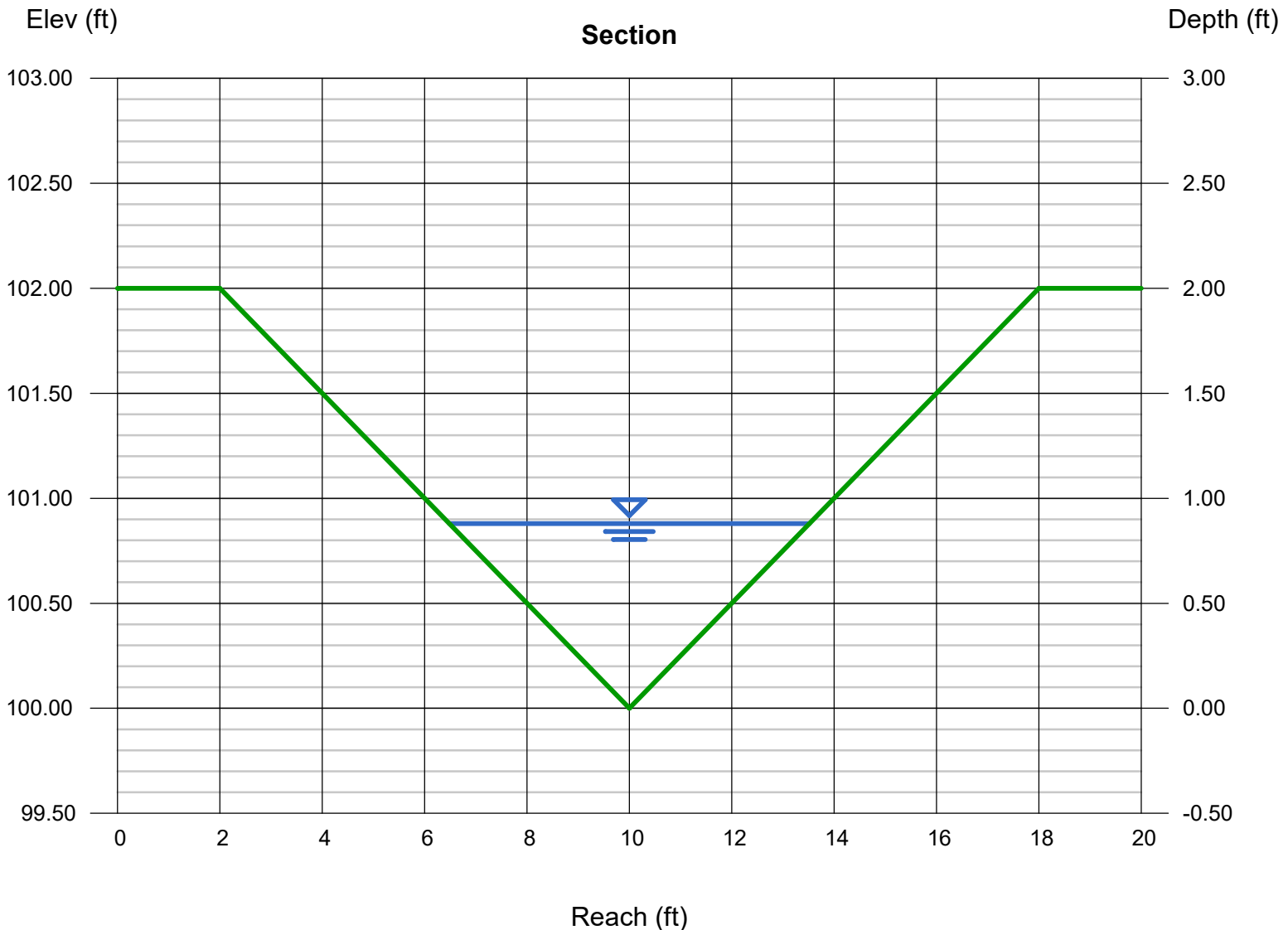
Invert Elev (ft) = 100.00
Slope (%) = 1.00
N-Value = 0.030

Calculations

Compute by: Known Q
Known Q (cfs) = 8.50

Highlighted

Depth (ft) = 0.88
Q (cfs) = 8.500
Area (sqft) = 3.10
Velocity (ft/s) = 2.74
Wetted Perim (ft) = 7.26
Crit Depth, Yc (ft) = 0.78
Top Width (ft) = 7.04
EGL (ft) = 1.00



Culvert Report

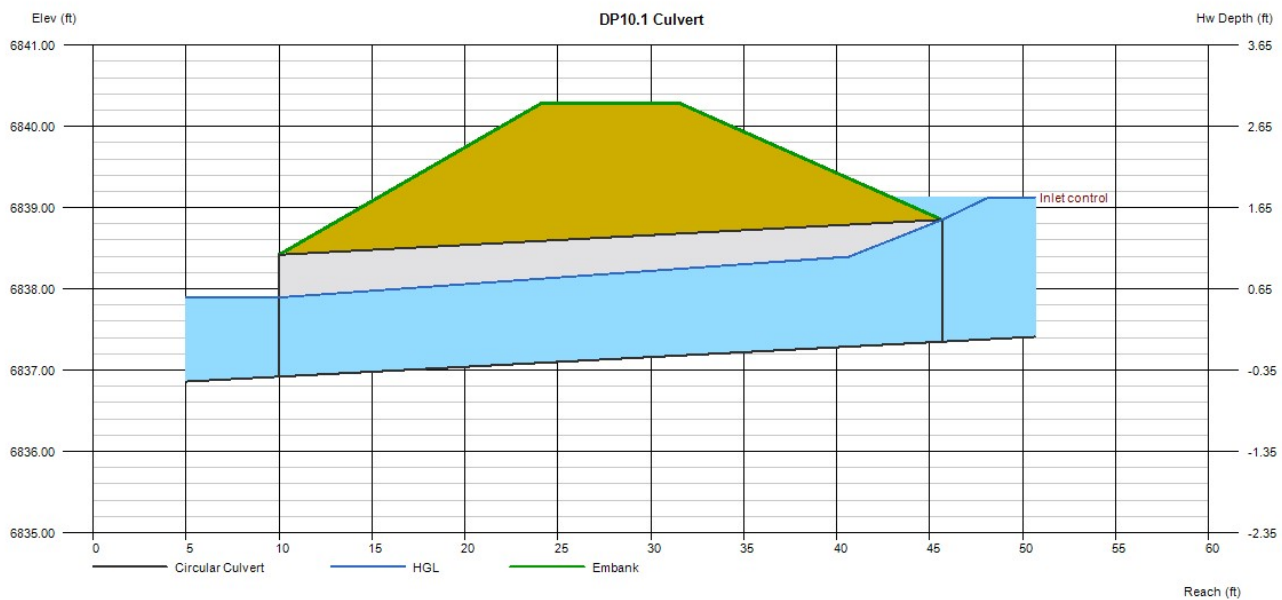
DP10.1 Culvert

Invert Elev Dn (ft)	= 6836.92
Pipe Length (ft)	= 35.66
Slope (%)	= 1.21
Invert Elev Up (ft)	= 6837.35
Rise (in)	= 18.0
Shape	= Circular
Span (in)	= 18.0
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)	= 6840.28
Top Width (ft)	= 7.50
Crest Width (ft)	= 100.00

Calculations	
Qmin (cfs)	= 8.50
Qmax (cfs)	= 8.50
Tailwater Elev (ft)	= Normal

Highlighted	
Qtotal (cfs)	= 8.50
Qpipe (cfs)	= 8.50
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 6.99
Veloc Up (ft/s)	= 5.96
HGL Dn (ft)	= 6837.90
HGL Up (ft)	= 6838.48
Hw Elev (ft)	= 6839.13
Hw/D (ft)	= 1.18
Flow Regime	= Inlet Control



Channel Report

DP11.1 Swale

Triangular

Side Slopes (z:1) = 4.00, 4.00
Total Depth (ft) = 2.00

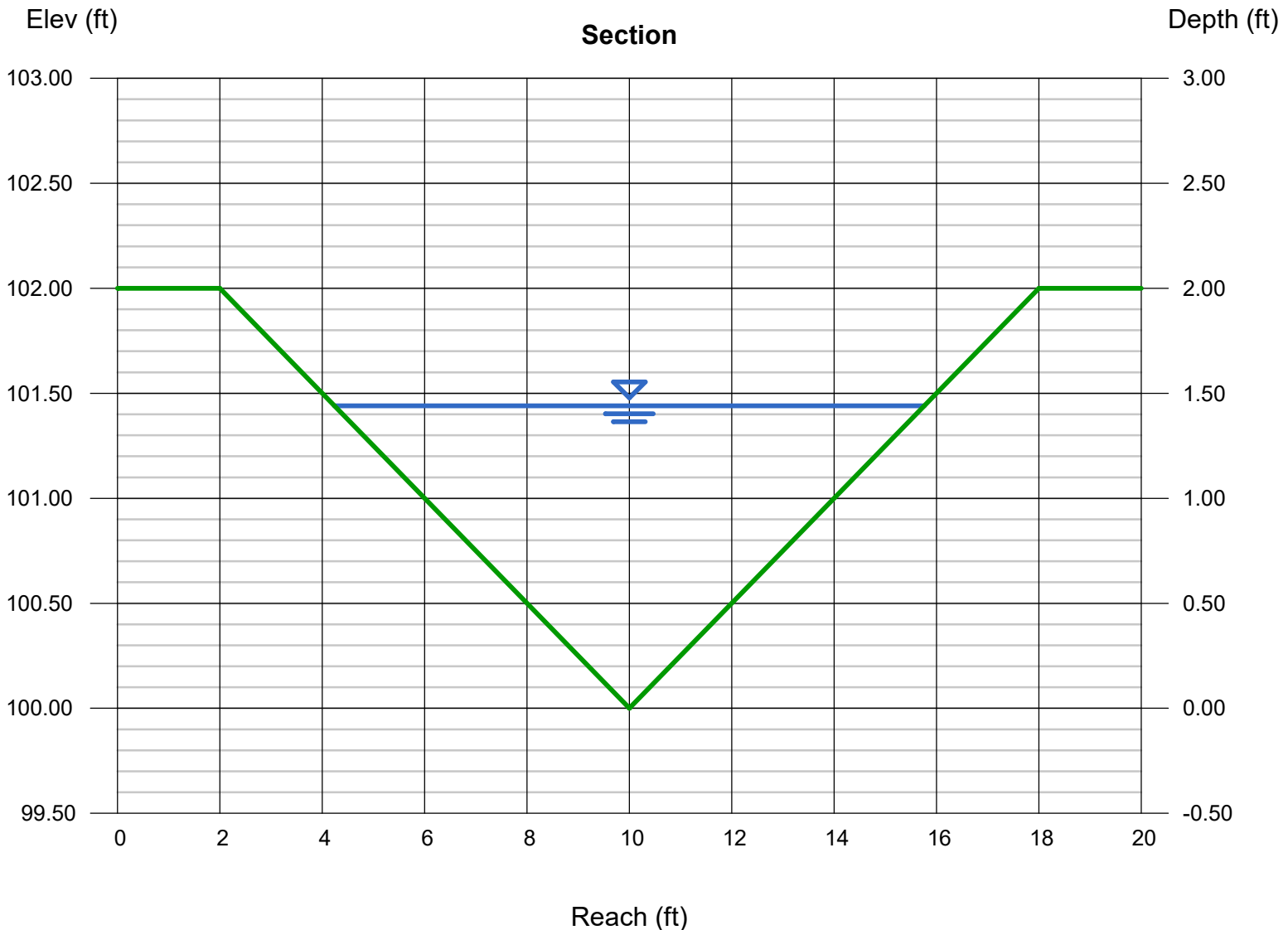
Invert Elev (ft) = 100.00
Slope (%) = 1.00
N-Value = 0.030

Calculations

Compute by: Known Q
Known Q (cfs) = 32.00

Highlighted

Depth (ft) = 1.44
Q (cfs) = 32.00
Area (sqft) = 8.29
Velocity (ft/s) = 3.86
Wetted Perim (ft) = 11.87
Crit Depth, Yc (ft) = 1.32
Top Width (ft) = 11.52
EGL (ft) = 1.67



Culvert Report

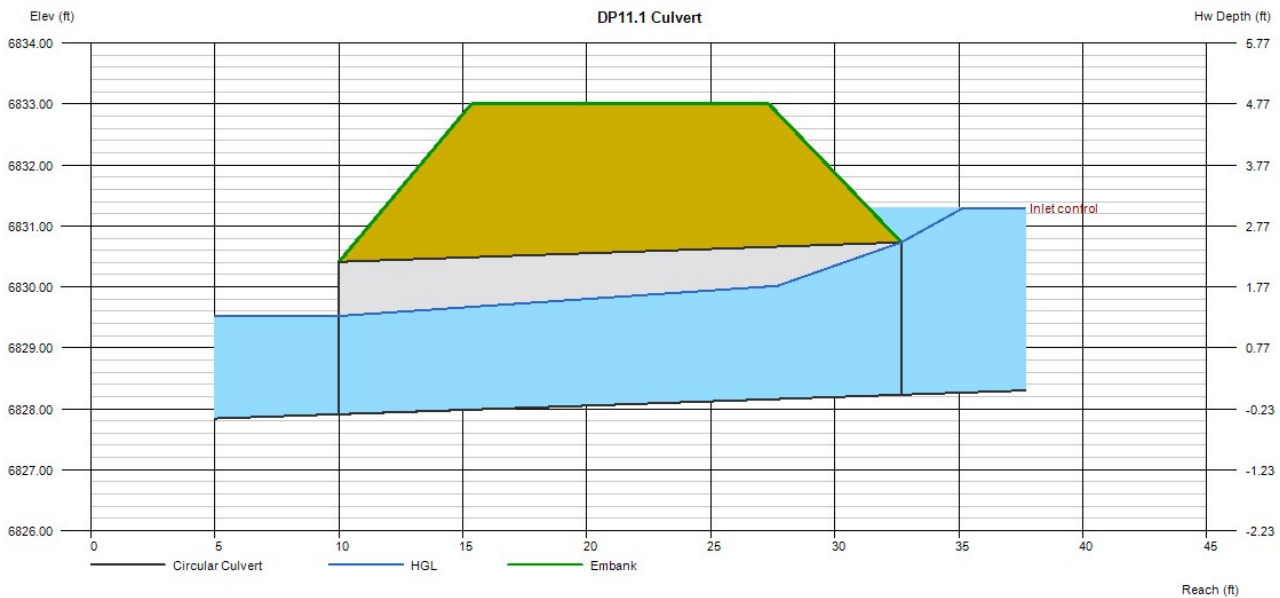
DP11.1 Culvert

Invert Elev Dn (ft)	= 6827.91
Pipe Length (ft)	= 22.68
Slope (%)	= 1.41
Invert Elev Up (ft)	= 6828.23
Rise (in)	= 30.0
Shape	= Circular
Span (in)	= 30.0
No. Barrels	= 1
n-Value	= 0.012
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)	= 6833.00
Top Width (ft)	= 12.00
Crest Width (ft)	= 100.00

Calculations	
Qmin (cfs)	= 32.00
Qmax (cfs)	= 32.00
Tailwater Elev (ft)	= Normal

Highlighted	
Qtotal (cfs)	= 32.00
Qpipe (cfs)	= 32.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 9.56
Veloc Up (ft/s)	= 7.89
HGL Dn (ft)	= 6829.52
HGL Up (ft)	= 6830.16
Hw Elev (ft)	= 6831.30
Hw/D (ft)	= 1.23
Flow Regime	= Inlet Control



Channel Report

DP11.1-Preliminary Pipe

Circular

Diameter (ft) = 2.50

Invert Elev (ft) = 100.00

Slope (%) = 1.20

N-Value = 0.013

Calculations

Compute by: Known Q

Known Q (cfs) = 32.00

Highlighted

Depth (ft) = 1.56

Q (cfs) = 32.00

Area (sqft) = 3.23

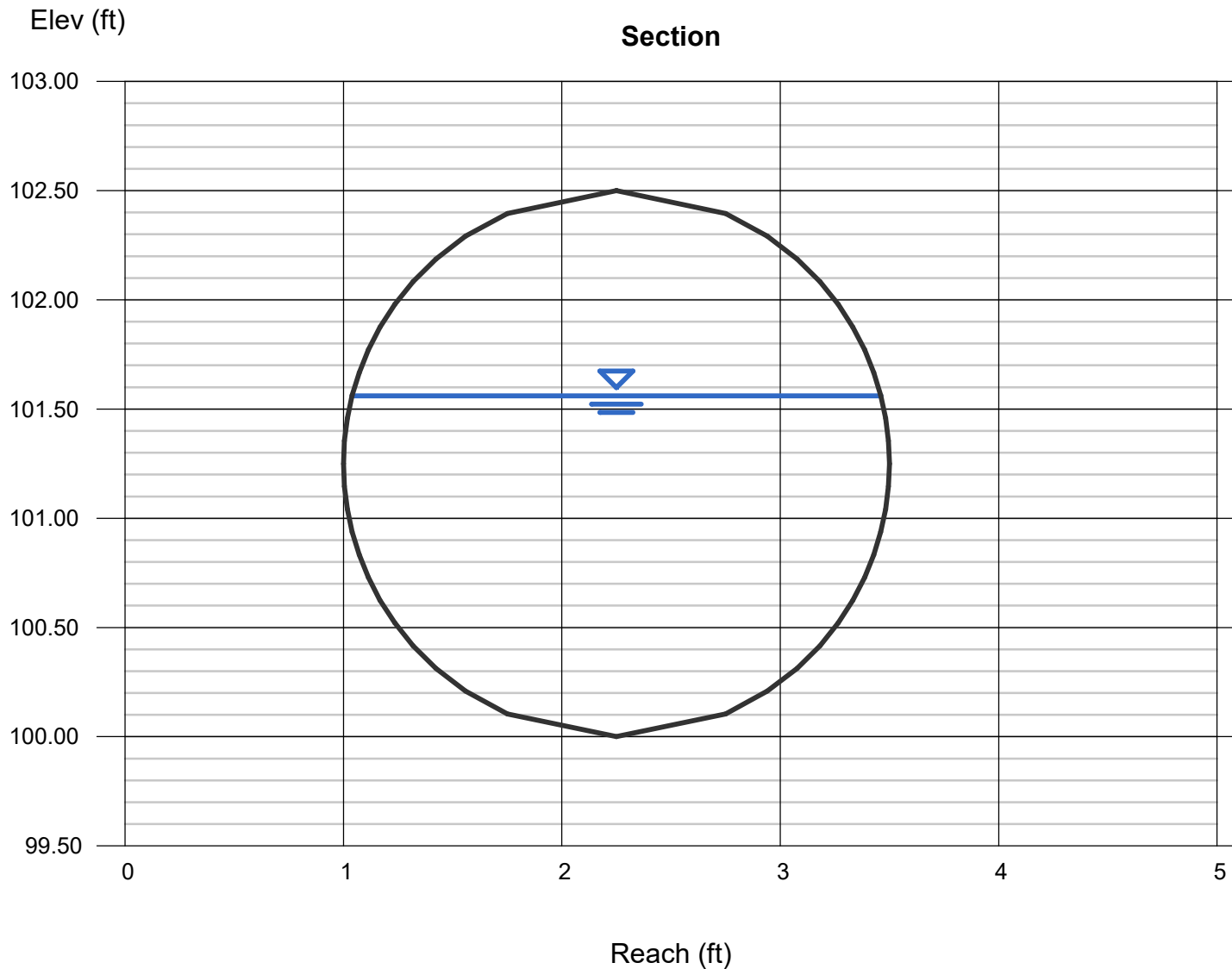
Velocity (ft/s) = 9.90

Wetted Perim (ft) = 4.56

Crit Depth, Yc (ft) = 1.93

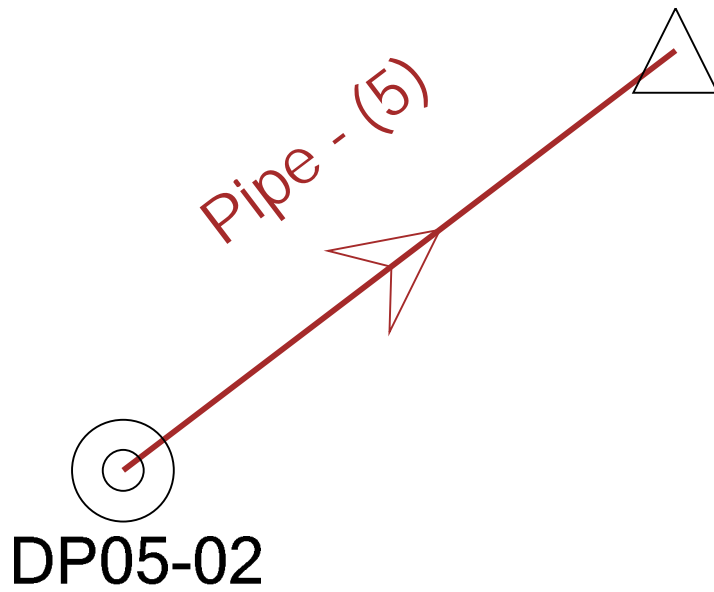
Top Width (ft) = 2.42

EGL (ft) = 3.08

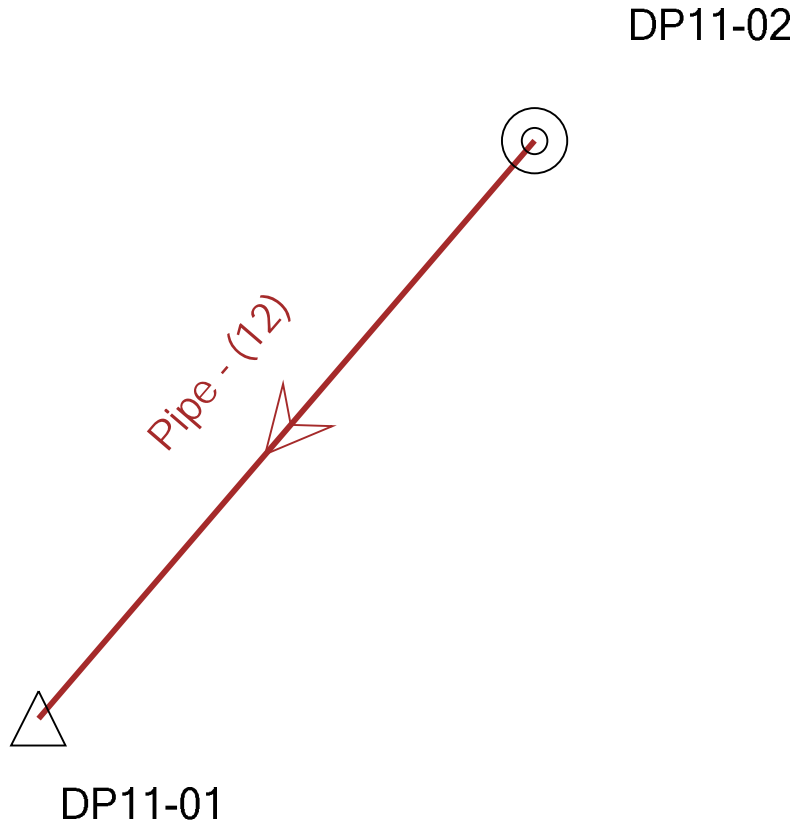


Pond A Outfall
Scenario: 100 YEAR

DP05-01



Pond B Outfall
Scenario: 100 YEAR



5 Year Report

Scenario: 5 YEAR

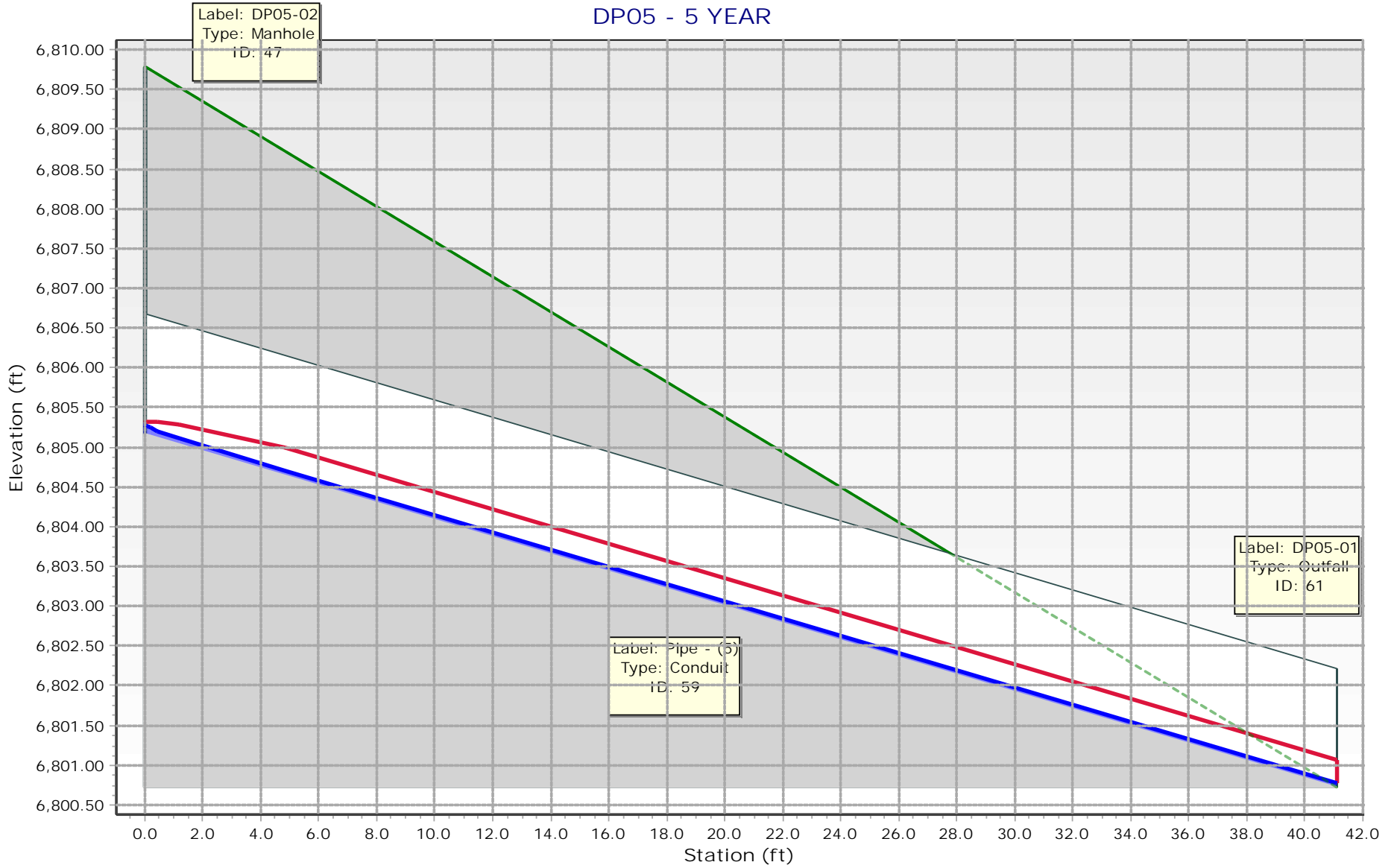
Current Time Step: 0.000 h

FlexTable: Conduit Table

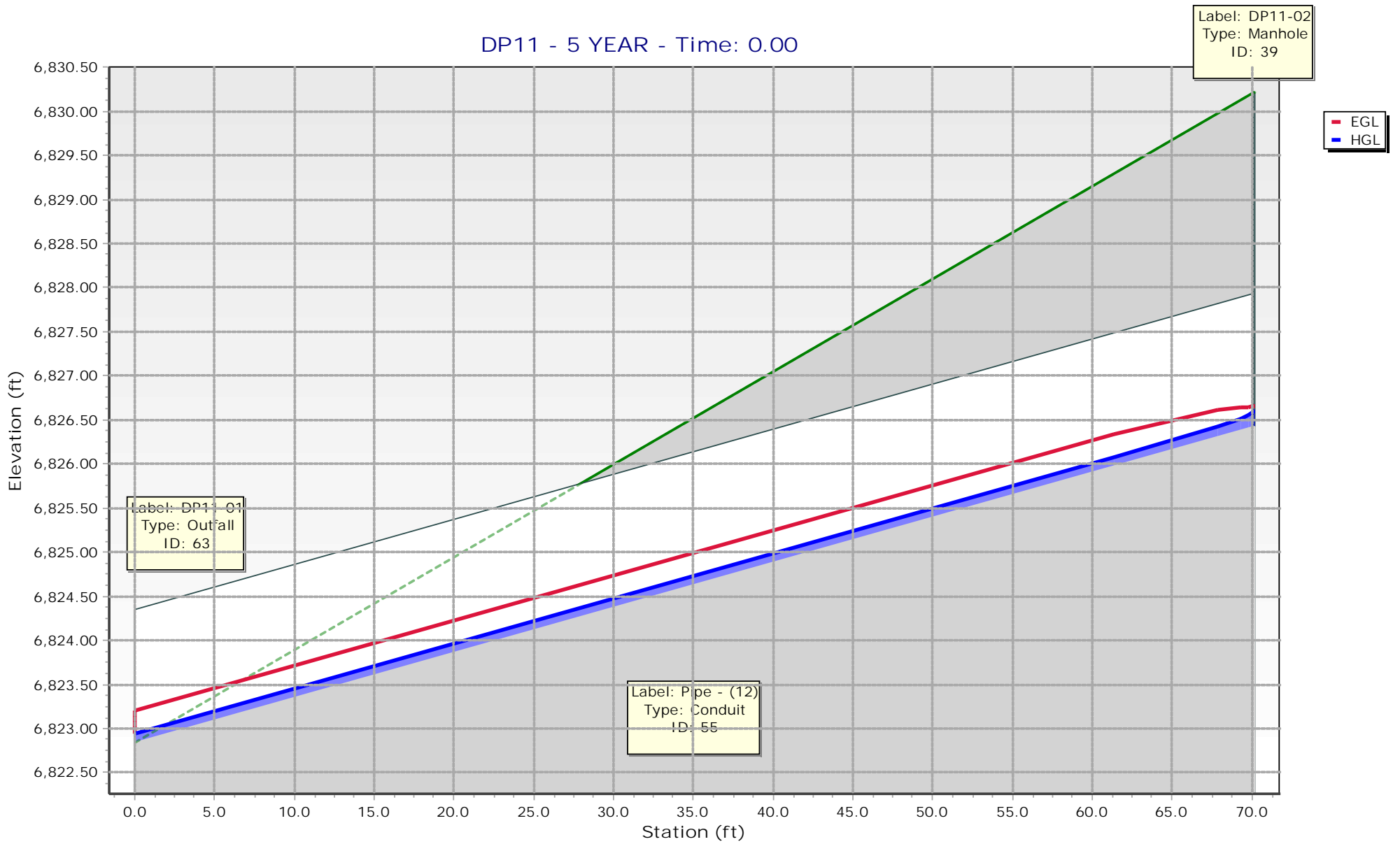
Label	Diameter (in)	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Manning's n	Flow (cfs)	Velocity (ft/s)	Invert (Start) (ft)	Invert (Stop) (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Upstream Structure Headloss Coefficient
Pipe - (5)	18.0	41.1	0.108	0.013	0.10	4.30	6,805.17	6,800.72	6,809.78	6,800.72	6,805.28	6,800.78	6,805.32	6,801.07	0.050
Pipe - (12)	18.0	70.1	0.051	0.013	0.20	4.10	6,826.43	6,822.84	6,830.21	6,822.84	6,826.60	6,822.94	6,826.65	6,823.20	0.050

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DPO5 - 5 YEAR



DP11 - 5 YEAR - Time: 0.00



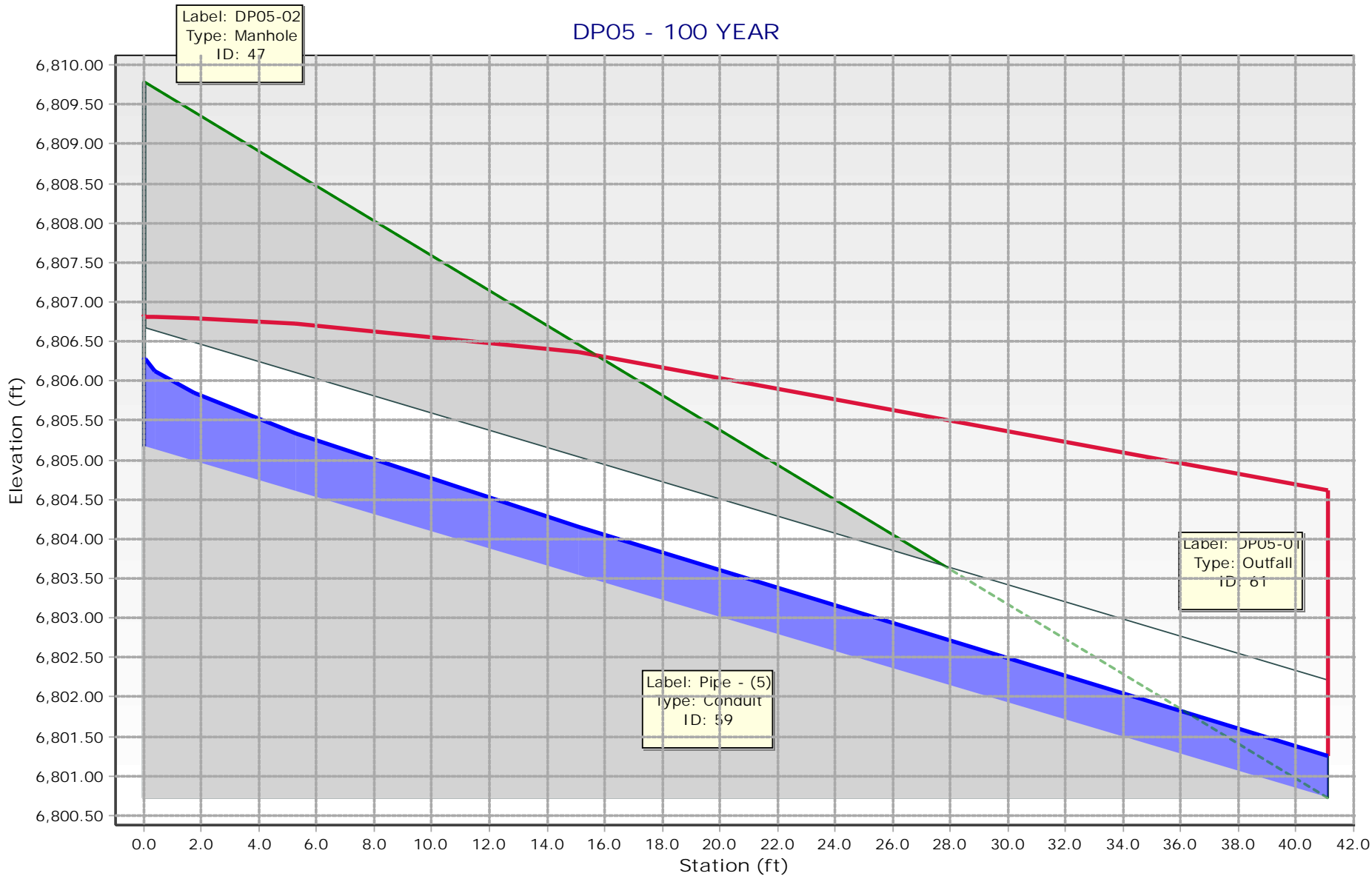
100 Year Report

Scenario: 100 YEAR
 Current Time Step: 0.000 h
 FlexTable: Conduit Table

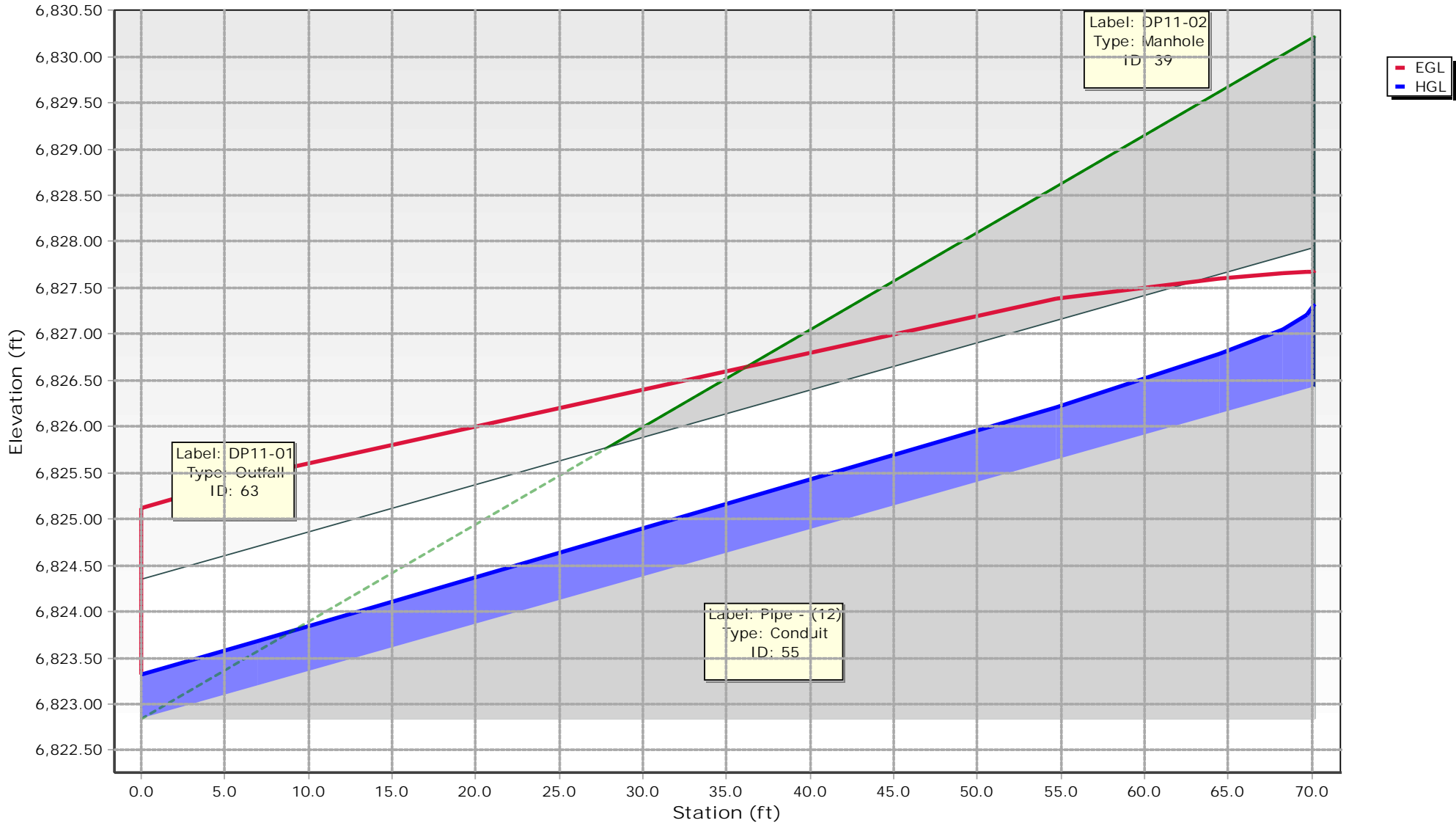
Label	Diameter (in)	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Manning's n	Flow (cfs)	Velocity (ft/s)	Invert (Start) (ft)	Invert (Stop) (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Upstream Structure Headloss Coefficient
Pipe - (5)	18.0	41.1	0.108	0.013	8.20	16.03	6,805.17	6,800.72	6,809.78	6,800.72	6,806.28	6,801.25	6,806.81	6,804.62	0.050
Pipe - (12)	18.0	70.1	0.051	0.013	5.20	10.77	6,826.43	6,822.84	6,830.21	6,822.84	6,827.31	6,823.32	6,827.67	6,825.12	0.050

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DPO5 - 100 YEAR



DP11 - 100 YEAR



VMax[®] TRMs



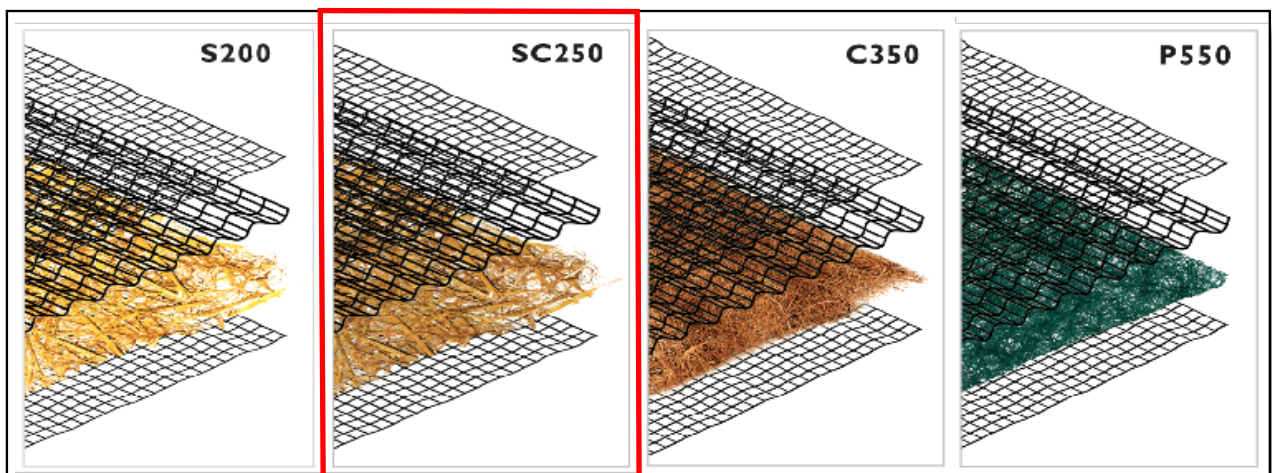
A Permanent Turf Reinforcement Mat Solution for Every Design

The VMax system of permanent TRMs are ideal for high-flow channels, streambanks, shorelines, and other areas needing permanent vegetation reinforcement and protection from water and wind. Our VMax TRMs combine a three-dimensional matting and a fiber matrix material for all-out erosion protection, vegetation establishment and reinforcement. The VMax TRMs are available with various performance capabilities and support reinforced vegetative lining development from germination to maturity.

VMax[®] Unique Three-Dimensional Design

North American Green VMax TRMs are each designed to maximize performance through all development phases of a reinforced vegetative lining. The corrugated matting structure lends a true reinforcement zone for vegetation entanglement, especially compared to flat net mats. The unique design of the corrugated matting also helps to create a shear plane that deflects flowing water away from the soil surface. And the incorporation of a fiber matrix supplements the 3-D structure by creating a ground cover that blocks soil movement and aids in vegetation establishment.

Four VMax Turf Reinforcement Mats Designed for Every Level of Performance



Matrix Fiber	100% Straw	70% Straw / 30% Coconut	100% Coconut	100% Polypropylene
Netting Types	Top and Bottom light-weight UV-stabilized PP, Crimped PP center net	Top and Bottom UV-stabilized PP, Crimped PP center net	Top and Bottom heavy-weight UV-stabilized PP, Crimped PP center net	Top and Bottom ultra heavy-weight UV-stabilized PP, Crimped PP center net
Typical Slope Applications (H:V)	1:1 and greater	1:1 and greater	1:1 and greater	1:1 and greater
Channel Shear Stress Threshold	Unvegetated: 2.3 psf Vegetated: 10.0 psf	Unvegetated: 3.0 psf Vegetated: 10.0 psf	Unvegetated: 3.2 psf Vegetated: 12.0 psf	Unvegetated: 4.0 psf Vegetated: 14.0 psf
Channel Velocity Threshold	Unvegetated: 8.5 fps Vegetated: 18 fps	Unvegetated: 9.5 fps Vegetated: 15 fps	Unvegetated: 10.5 fps Vegetated: 20 fps	Unvegetated: 12.5 fps Vegetated: 25 fps



Selected product that will work for all swales above 5 ft/s. Has maximum of 15 ft/s.

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VMax[®] TRMs cont.

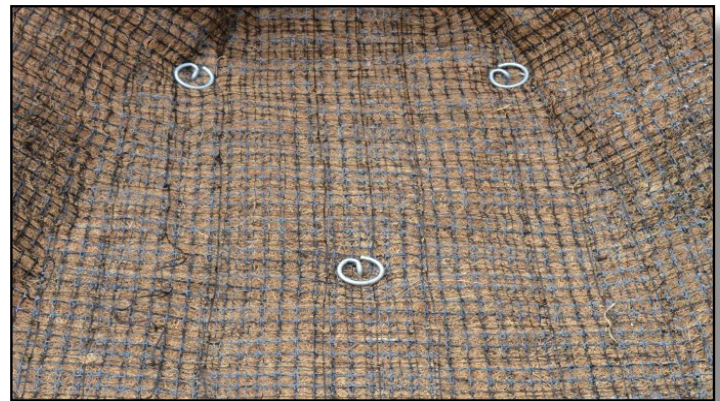
Selecting the Right VMax TRM

Choosing the right VMax TRM can be made easy by utilizing our Erosion Control Materials Design Software (www.ecmds.com), which allows users to input project specific parameters for channels, slopes, spillways, and more and ensures proper evaluation, design, and product selection in return. Our four VMax TRMs offer varying performance values, fiber matrix longevities, and price points, to help you meet your project specific goals.

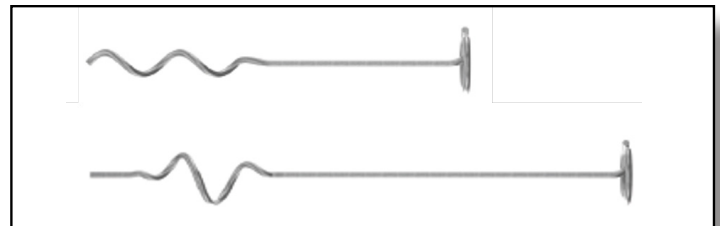


Twist Pin + VMax TRM - an Ideal Installation

Utilizing the VMax TRMs in conjunction with Twist Pin fastener technology can result in an installed system that pushes TRM performance with increased factors of safety. The combined system has been shown to have superior pullout strength performance up to 200 lbs when compared to installation with traditional wire staples and pins. This is up to 10x the pullout resistance of wire staples and pins. Additionally, the use of the twist pins provides intimate contact between the TRM and the soil, and have been shown to be effective in a wide range of soil types. With a quick and easy installation using an electric drill and custom chuck, the TRM+Twist Pin system can eliminate time and labor costs from day 1 through project release.



VMax turf reinforcement mat being installed on a channel application (top right), twist pins installed with TRMs can have increased system performance and pullout resistance (middle right), twist pins are available in 8" and 12" lengths and two coil configurations designed for hard or soft soil types (lower right).



Comparison of common TRM fasteners based on pullout performance and typical application (below).

Fastener	Pullout Resistance (lb)	Comment
6" Round Top Pin	14	Best for hardened soils where other fasteners are damaged during installation.
6" Regular U-staple	42	Standard fastener that develops additional pullout as legs may deflect and add friction during installation.
12" Pin with Washer	35	Standard fastener good for soils where staples can be bent frequently and are too difficult to install.
18" Pin with Washer	27	Standard fastener good for soils where staples are frequently bent and 12" straight pins fail to provide sufficient pullout because surface soil is wet or loose.
Twist Pin	170	Upgraded fastener that provides high pullout and ideal for loose or soft soils.



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PIPE OUTFALL RIPRAP SIZING CALCULATIONS

Subdivision: Lazy Y and Rocking J Subdivision
 Location: El Paso County

Project Name: Lazy Y and Rocking J Subdivision
 Project No.: 25228.00
 Calculated By: GAG
 Checked By: _____
 Date: 11/8/24

	STORM DRAIN SYSTEM			Notes
	DP2.1	DP4.1	DP4.2	
Q ₁₀₀ (cfs):	11.4	17.9	21.6	Flows are the greater of proposed vs. future
Conduit	Pipe	Pipe	Pipe	
D _c , Pipe Diameter (in):	24	24	30	
W, Box Width (ft):				
H, Box Height (ft):				
Y _t , Tailwater Depth (ft):	0.80	0.80	1.00	If unknown, use Y _t /D _c (or H)=0.4
Y _t /D _c or Y _t /H	0.40	0.40	0.40	
Q/D ^{2.5} or Q/(WH ^{3/2})	2.02	3.16	2.19	
Supercritical?	No	No	No	
Y _n , Normal Depth (ft) [Supercritical]:				
D _a , H _a (in) [Supercritical]:	N/A	N/A	N/A	D _a =(D _c +Y _n)/2
Riprap d ₅₀ (in) [Supercritical]:	N/A	N/A	N/A	
Riprap d ₅₀ (in) [Subcritical]:	3.34	5.24	4.53	
Required Riprap Size:	L	L	L	Fig. 9-38 or Fig. 9-36
d₅₀ (in):	9	9	9	
Expansion Factor, 1/(2 tan θ):	5.60	4.20	5.10	Read from Fig. 9-35 or 9-36
θ:	0.09	0.12	0.10	
Erosive Soils?	No	No	No	
Area of Flow, A _t (ft ²):	1.63	2.56	3.09	A _t =Q/V
Length of Protection, L _p (ft):	0.2	5.0	3.0	L=(1/(2 tan θ))(A _t /Y _t - D)
Min Length (ft)	6.0	6.0	7.5	Min L=3D or 3H
Max Length (ft)	20.0	20.0	25.0	Max L=10D or 10H
Min Bottom Width, T (ft):	2.0	3.2	3.1	T=2*(L _p *tanθ)+W
Design Length (ft)	6.0	6.0	7.5	
Design Width (ft)	2.0	3.2	3.1	
Riprap Depth (in)	18	18	18	Depth=2(d ₅₀)
Type II Bedding Depth (in)*	6	6	6	*Not used if Soil Riprap
Cutoff Wall	No	No	No	
Cutoff Wall Depth (ft)				Depth of Riprap and Base
Cutoff Wall Width (ft)				

Note: No Type II Base to be used if Soil Riprap is specified within the plans

* For use when the flow in the culvert is supercritical (and less than full).

PIPE OUTFALL RIPRAP SIZING CALCULATIONS

Subdivision: Lazy Y and Rocking J Subdivision
 Location: El Paso County

Project Name: Lazy Y and Rocking J Subdivision
 Project No.: 25228.00
 Calculated By: GAG
 Checked By: _____
 Date: 4/24/24

	STORM DRAIN SYSTEM			Notes
	DP5.2	DP6.1	DP9 (Half)	
Q ₁₀₀ (cfs):	8.2	5.0	3.5	Flows are the greater of proposed vs. future
Conduit	Pipe	Pipe	Pipe	
D _c , Pipe Diameter (in):	18	18	18	
W, Box Width (ft):				
H, Box Height (ft):				
Y _t , Tailwater Depth (ft):	0.60	0.60	0.60	If unknown, use Y _t /D _c (or H)=0.4
Y _t /D _c or Y _t /H	0.40	0.40	0.40	
Q/D ^{2.5} or Q/(WH ^{3/2})	2.98	1.81	1.27	
Supercritical?	No	No	No	
Y _n , Normal Depth (ft) [Supercritical]:				
D _a , H _a (in) [Supercritical]:	N/A	N/A	N/A	D _a =(D _c +Y _n)/2
Riprap d ₅₀ (in) [Supercritical]:	N/A	N/A	N/A	
Riprap d ₅₀ (in) [Subcritical]:	3.70	2.26	1.58	
Required Riprap Size:	L	L	L	Fig. 9-38 or Fig. 9-36
d₅₀ (in):	9	9	9	
Expansion Factor, 1/(2 tan θ):	4.40	5.80	6.20	Read from Fig. 9-35 or 9-36
θ:	0.11	0.09	0.08	
Erosive Soils?	No	No	No	
Area of Flow, A _t (ft ²):	1.17	0.71	0.50	A _t =Q/V
Length of Protection, L _p (ft):	2.0	-1.8	-4.1	L=(1/(2 tan θ))(A _t /Y _t - D)
Min Length (ft)	4.5	4.5	4.5	Min L=3D or 3H
Max Length (ft)	15.0	15.0	15.0	Max L=10D or 10H
Min Bottom Width, T (ft):	2.0	1.2	0.8	T=2*(L _p *tanθ)+W
Design Length (ft)	4.5	4.5	4.5	
Design Width (ft)	2.0	1.2	0.8	
Riprap Depth (in)	18	18	18	Depth=2(d ₅₀)
Type II Bedding Depth (in)*	6	6	6	*Not used if Soil Riprap
Cutoff Wall	No	No	No	
Cutoff Wall Depth (ft)				Depth of Riprap and Base
Cutoff Wall Width (ft)				

Note: No Type II Base to be used if Soil Riprap is specified within the plans

* For use when the flow in the culvert is supercritical (and less than full).

PIPE OUTFALL RIPRAP SIZING CALCULATIONS

Subdivision: Lazy Y and Rocking J Subdivision
 Location: El Paso County

Project Name: Lazy Y and Rocking J Subdivision
 Project No.: 25228.00
 Calculated By: GAG
 Checked By: _____
 Date: 11/8/24

	STORM DRAIN SYSTEM			Notes
	DP9	DP10.1	DP12.2	
Q ₁₀₀ (cfs):	7.0	8.3	5.6	Flows are the greater of proposed vs. future
Conduit	Pipe	Pipe	Pipe	
D _c , Pipe Diameter (in):	18	18	18	
W, Box Width (ft):				
H, Box Height (ft):				
Y _t , Tailwater Depth (ft):	0.60	0.60	1.00	If unknown, use Y _t /D _c (or H)=0.4
Y _t /D _c or Y _t /H	0.40	0.40	0.67	
Q/D ^{2.5} or Q/(WH ^{3/2})	2.54	3.01	2.03	
Supercritical?	No	No	No	
Y _n , Normal Depth (ft) [Supercritical]:				
D _a , H _a (in) [Supercritical]:	N/A	N/A	N/A	D _a =(D _c +Y _n)/2
Riprap d ₅₀ (in) [Supercritical]:	N/A	N/A	N/A	
Riprap d ₅₀ (in) [Subcritical]:	3.16	3.74	1.37	
Required Riprap Size:	L	L	L	Fig. 9-38 or Fig. 9-36
d₅₀ (in):	9	9	9	
Expansion Factor, 1/(2 tan θ):	5.10	4.30	6.50	Read from Fig. 9-35 or 9-36
θ:	0.10	0.12	0.08	
Erosive Soils?	No	No	No	
Area of Flow, A _t (ft ²):	1.00	1.19	0.80	A _t =Q/V
Length of Protection, L _p (ft):	0.9	2.0	-4.6	L=(1/(2 tan θ))(A _t /Y _t - D)
Min Length (ft)	4.5	4.5	4.5	Min L=3D or 3H
Max Length (ft)	15.0	15.0	15.0	Max L=10D or 10H
Min Bottom Width, T (ft):	1.7	2.0	0.8	T=2*(L _p *tanθ)+W
Design Length (ft)	4.5	4.5	4.5	
Design Width (ft)	1.7	2.0	0.8	
Riprap Depth (in)	18	18	18	Depth=2(d ₅₀)
Type II Bedding Depth (in)*	6	6	6	*Not used if Soil Riprap
Cutoff Wall	No	No	No	
Cutoff Wall Depth (ft)				Depth of Riprap and Base
Cutoff Wall Width (ft)				

Note: No Type II Base to be used if Soil Riprap is specified within the plans

* For use when the flow in the culvert is supercritical (and less than full).

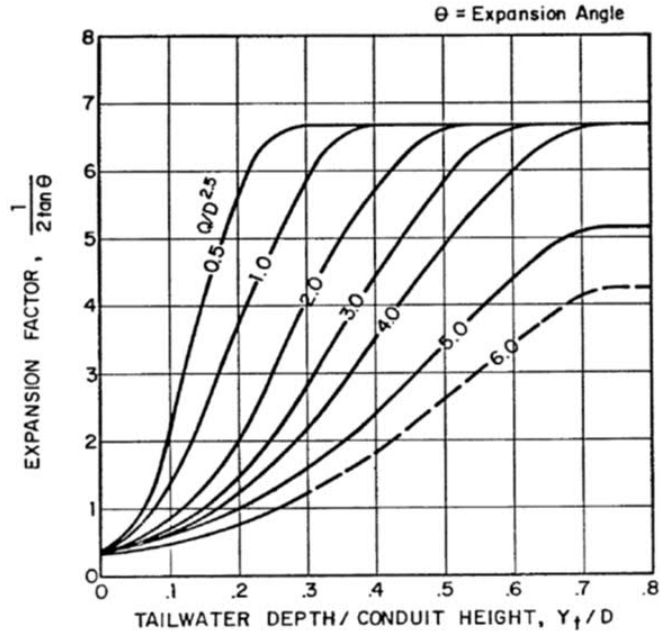


Figure 9-35. Expansion factor for circular conduits

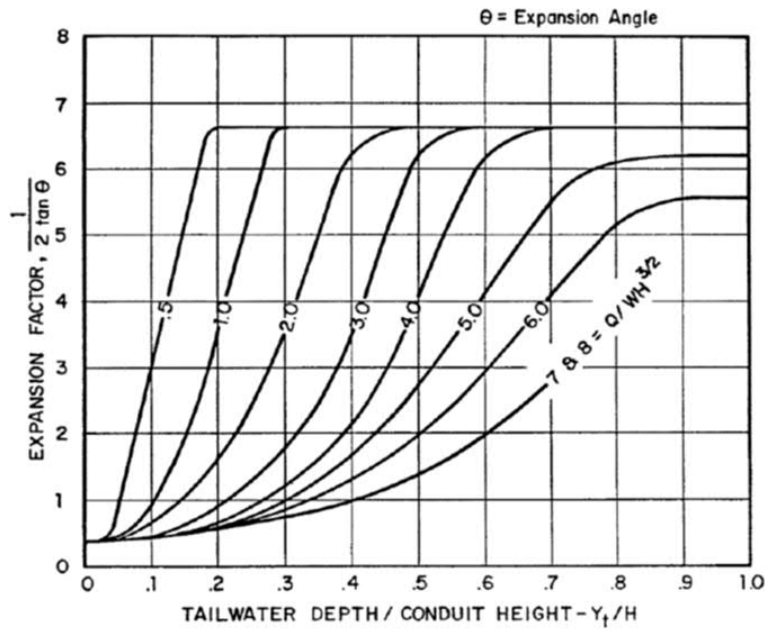


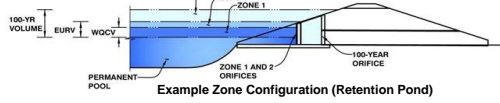
Figure 9-36. Expansion factor for rectangular conduits

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Lazy Y and Rocking J Subdivision**

Basin ID: **Pond A**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB
Watershed Area =	12.28 acres
Watershed Length =	1,500 ft
Watershed Length to Centroid =	480 ft
Watershed Slope =	0.030 ft/ft
Watershed Imperviousness =	17.10% 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.

Water Quality Capture Volume (WQCV) =	0.106	acre-feet
Excess Urban Runoff Volume (EURV) =	0.206	acre-feet
2-yr Runoff Volume (P1 = 0.94 in.) =	0.118	acre-feet
5-yr Runoff Volume (P1 = 1.22 in.) =	0.238	acre-feet
10-yr Runoff Volume (P1 = 1.48 in.) =	0.416	acre-feet
25-yr Runoff Volume (P1 = 1.86 in.) =	0.867	acre-feet
50-yr Runoff Volume (P1 = 2.17 in.) =	1.165	acre-feet
100-yr Runoff Volume (P1 = 2.5 in.) =	1.565	acre-feet
500-yr Runoff Volume (P1 = 3.36 in.) =	2.449	acre-feet
Approximate 2-yr Detention Volume =	0.110	acre-feet
Approximate 5-yr Detention Volume =	0.170	acre-feet
Approximate 10-yr Detention Volume =	0.299	acre-feet
Approximate 25-yr Detention Volume =	0.418	acre-feet
Approximate 50-yr Detention Volume =	0.458	acre-feet
Approximate 100-yr Detention Volume =	0.587	acre-feet

Optional User Overrides

		acre-feet
		acre-feet
	0.94	inches
	1.22	inches
	1.48	inches
	1.86	inches
	2.17	inches
	2.50	inches
	3.36	inches

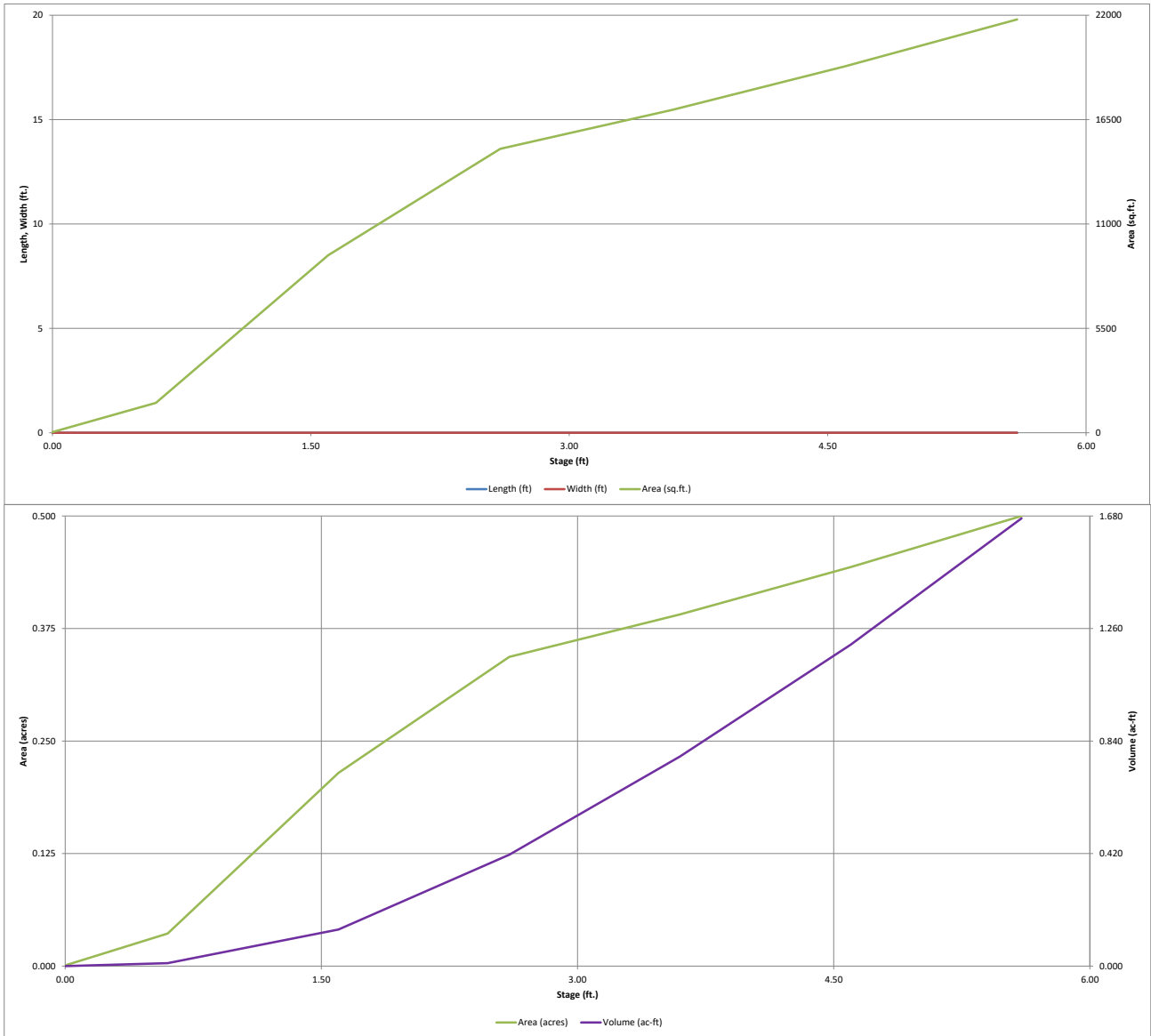
Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.106	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.100	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.381	acre-feet
Total Detention Basin Volume =	0.587	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 _{LW}) =	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

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)
6805.9 Top of Micropool	--	0.00	--	--	--	35	0.001		
6806.5	--	0.60	--	--	--	1,575	0.036	483	0.011
6807.5	--	1.60	--	--	--	9,350	0.215	5,945	0.136
6808.5	--	2.60	--	--	--	14,960	0.343	18,100	0.416
6809.5	--	3.60	--	--	--	17,018	0.391	34,089	0.783
6810.5	--	4.60	--	--	--	19,310	0.443	52,253	1.200
6811.5	--	5.60	--	--	--	21,780	0.500	72,798	1.671

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

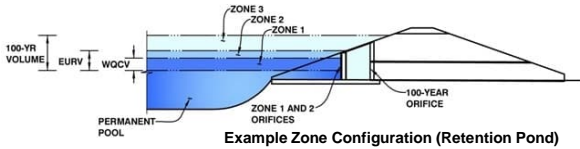


✓ = calcs match details in plans
 X = calcs do not match details in plans

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Laxy Y and Rocking J Subdivision
 Basin ID: Pond A



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.45	0.106	Orifice Plate
Zone 2 (EURV)	1.90	0.100	Orifice Plate
Zone 3 (100-year)	3.09	0.381	Weir&Pipe (Restrict)
Total (all zones)		0.587	

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

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

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 =	N/A	ft ²
Depth at top of Zone using Orifice Plate =	✓ 2.40	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	✓ N/A	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	✓ N/A	sq. inches	Elliptical Slot Area =	N/A	ft ²

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	✓ 0.00	✓ 1.25	X 1.60					
Orifice Area (sq. inches)	✓ 0.87	✓ 0.87	X 0.44					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

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

Overflow Weir Front Edge Height, Ho =	✓ Zone 3 Weir 3.00	Not Selected N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Gate Upper Edge, Hi =	Zone 3 Weir 3.00	Not Selected N/A	feet
Overflow Weir Front Edge Length =	✓ 3.00	N/A	feet	Overflow Weir Slope Length =	3.00	N/A	feet
Overflow Weir Gate Slope =	✓ 0.00	N/A	H:V	Gate Open Area / 100-yr Orifice Area =	4.03	N/A	
Horiz. Length of Weir Sides =	✓ 3.00	N/A	feet	Overflow Gate Open Area w/o Debris =	7.12	N/A	ft ²
Overflow Gate Type =	Close Mesh Gate	N/A		Overflow Gate Open Area w/ Debris =	3.56	N/A	ft ²
Debris Clogging % =	50%	N/A	%				

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

Depth to Invert of Outlet Pipe =	✓ Zone 3 Restrictor 0.25	Not Selected N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	Zone 3 Restrictor 1.77	Not Selected N/A	ft ²
Outlet Pipe Diameter =	✓ 18.00	N/A	inches	Outlet Orifice Centroid =	0.75	N/A	feet
Restrictor Plate Height Above Pipe Invert =	✓ 18.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =	✓ 4.10	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth =	0.27	feet
Spillway Crest Length =	✓ 40.00	feet	Stage at Top of Freeboard =	5.37	feet
Spillway End Slopes =	✓ 4.00	H:V	Basin Area at Top of Freeboard =	0.49	acres
Freeboard above Max Water Surface =	✓ 1.00	feet	Basin Volume at Top of Freeboard =	1.55	acre-ft

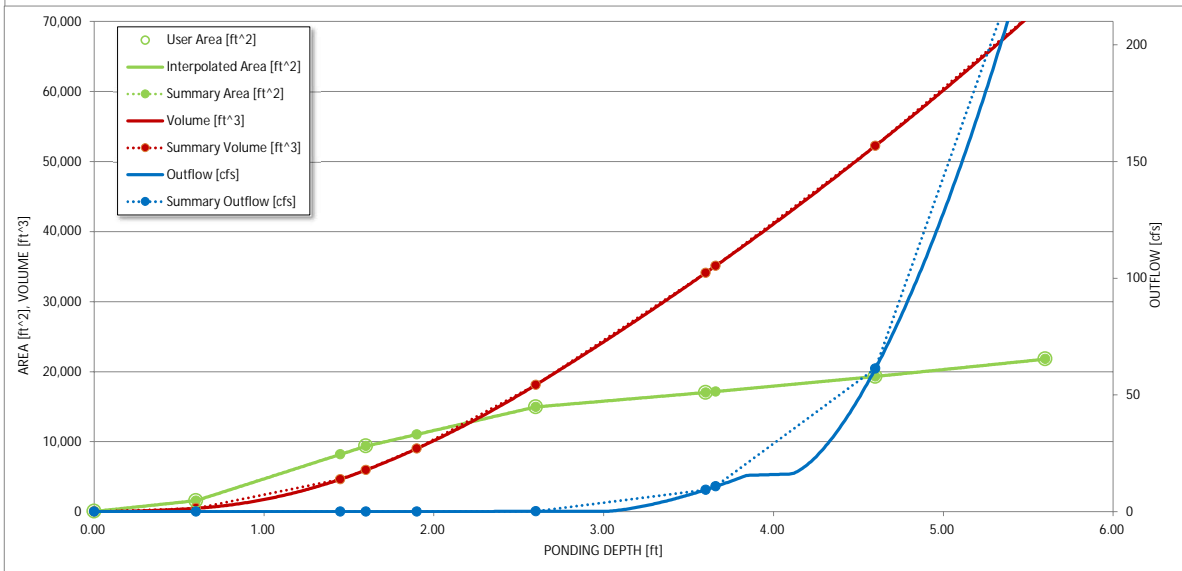
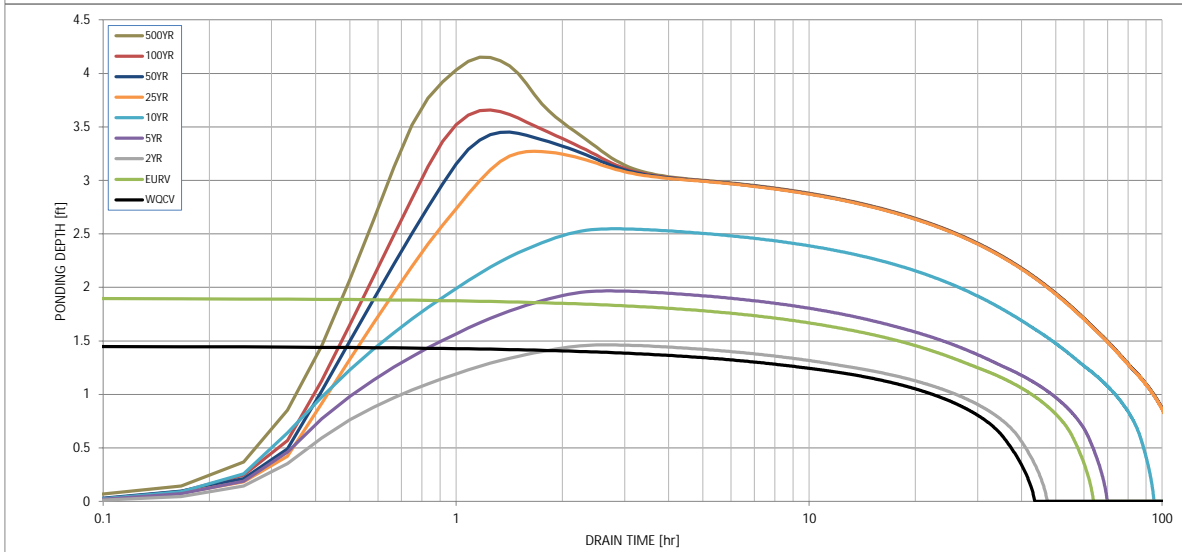
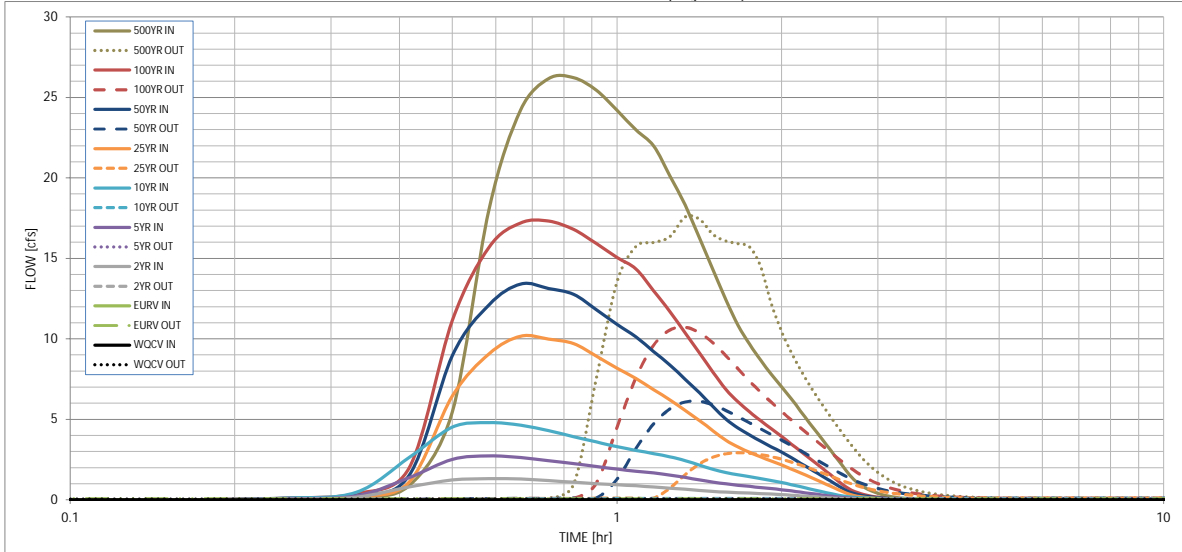
Routed Hydrograph Results

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

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period									
One-Hour Rainfall Depth (in)	N/A	N/A	0.94	1.22	1.48	1.86	2.17	2.50	3.36
CUHP Runoff Volume (acre-ft)	0.106	0.206	0.118	0.238	0.416	0.867	1.165	1.565	2.449
Inflow Hydrograph Volume (acre-ft)	N/A	N/A	0.118	0.238	0.416	0.867	1.165	1.565	2.449
CUHP Predevelopment Peak Q (cfs)	N/A	N/A	0.1	1.1	3.1	8.3	11.4	15.4	24.0
OPTIONAL Override Predevelopment Peak Q (cfs)	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre)	N/A	N/A	0.01	0.09	0.25	0.68	0.93	1.26	1.96
Peak Inflow Q (cfs)	N/A	N/A	1.3	2.7	4.8	10.2	13.4	17.3	26.2
Peak Outflow Q (cfs)	0.0	0.1	0.0	0.1	0.1	2.9	6.1	10.7	17.6
Ratio Peak Outflow to Predevelopment Q	N/A	N/A	N/A	0.1	0.0	0.4	0.5	0.7	0.7
Structure Controlling Flow	Plate	Plate	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Spillway
Max Velocity through Gate 1 (fps)	N/A	N/A	N/A	N/A	N/A	0.4	0.8	1.5	2.3
Max Velocity through Gate 2 (fps)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours)	40	59	44	64	86	100	97	92	82
Time to Drain 99% of Inflow Volume (hours)	42	62	46	67	91	109	107	105	101
Maximum Ponding Depth (ft)	1.45	1.90	1.46	1.97	2.55	3.27	3.45	3.66	4.15
Area at Maximum Ponding Depth (acres)	0.19	0.25	0.19	0.26	0.34	0.38	0.38	0.39	0.42
Maximum Volume Stored (acre-ft)	0.106	0.207	0.108	0.222	0.395	0.656	0.721	0.802	1.001

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: _____

Inflow Hydrographs

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

Time Interval	SOURCE	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
	0:15:00	0.00	0.00	0.03	0.07	0.10	0.07	0.10	0.10	0.17
	0:20:00	0.00	0.00	0.17	0.23	0.46	0.21	0.26	0.39	0.88
	0:25:00	0.00	0.00	0.80	1.37	2.63	1.10	1.50	1.98	5.45
	0:30:00	0.00	0.00	1.23	2.51	4.51	6.45	8.96	11.14	18.05
	0:35:00	0.00	0.00	1.31	2.72	4.80	9.07	12.12	15.69	24.23
	0:40:00	0.00	0.00	1.30	2.62	4.63	10.17	13.41	17.21	26.18
	0:45:00	0.00	0.00	1.19	2.42	4.29	9.98	13.13	17.32	26.23
	0:50:00	0.00	0.00	1.09	2.25	3.92	9.70	12.76	16.79	25.46
	0:55:00	0.00	0.00	1.00	2.07	3.59	8.93	11.82	15.92	24.20
	1:00:00	0.00	0.00	0.93	1.91	3.30	8.18	10.90	15.06	22.98
	1:05:00	0.00	0.00	0.87	1.78	3.07	7.53	10.12	14.35	21.99
	1:10:00	0.00	0.00	0.79	1.67	2.87	6.84	9.21	12.99	20.11
	1:15:00	0.00	0.00	0.72	1.53	2.67	6.20	8.37	11.70	18.31
	1:20:00	0.00	0.00	0.65	1.38	2.43	5.55	7.49	10.37	16.24
	1:25:00	0.00	0.00	0.58	1.24	2.15	4.92	6.64	9.12	14.28
	1:30:00	0.00	0.00	0.52	1.09	1.88	4.28	5.78	7.92	12.43
	1:35:00	0.00	0.00	0.47	0.99	1.69	3.70	5.01	6.85	10.83
	1:40:00	0.00	0.00	0.44	0.90	1.55	3.28	4.46	6.08	9.64
	1:45:00	0.00	0.00	0.41	0.83	1.43	2.95	4.02	5.45	8.66
	1:50:00	0.00	0.00	0.39	0.76	1.32	2.66	3.64	4.90	7.80
	1:55:00	0.00	0.00	0.36	0.69	1.20	2.41	3.29	4.41	7.02
	2:00:00	0.00	0.00	0.32	0.63	1.08	2.17	2.97	3.95	6.29
	2:05:00	0.00	0.00	0.28	0.55	0.94	1.91	2.62	3.47	5.51
	2:10:00	0.00	0.00	0.24	0.47	0.81	1.67	2.27	3.02	4.78
	2:15:00	0.00	0.00	0.21	0.40	0.68	1.42	1.95	2.59	4.09
	2:20:00	0.00	0.00	0.17	0.33	0.56	1.19	1.63	2.17	3.42
	2:25:00	0.00	0.00	0.14	0.27	0.45	0.96	1.31	1.76	2.77
	2:30:00	0.00	0.00	0.11	0.20	0.34	0.73	1.01	1.36	2.13
	2:35:00	0.00	0.00	0.08	0.14	0.24	0.52	0.71	0.97	1.53
	2:40:00	0.00	0.00	0.06	0.11	0.18	0.34	0.48	0.65	1.07
	2:45:00	0.00	0.00	0.05	0.08	0.14	0.23	0.34	0.45	0.78
	2:50:00	0.00	0.00	0.04	0.07	0.11	0.16	0.24	0.32	0.56
	2:55:00	0.00	0.00	0.03	0.06	0.09	0.12	0.18	0.22	0.41
	3:00:00	0.00	0.00	0.03	0.04	0.08	0.08	0.13	0.15	0.29
	3:05:00	0.00	0.00	0.02	0.04	0.06	0.06	0.10	0.10	0.20
	3:10:00	0.00	0.00	0.02	0.03	0.05	0.05	0.07	0.07	0.14
	3:15:00	0.00	0.00	0.01	0.02	0.04	0.04	0.06	0.05	0.10
	3:20:00	0.00	0.00	0.01	0.02	0.03	0.03	0.04	0.04	0.08
	3:25:00	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.03	0.06
	3:30:00	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.02	0.05
	3:35:00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.04
	3:40:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.03
	3:45:00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

POND A FOREBAY VOLUME AND RELEASE REQUIREMENTS

Equation 3-1	$WQCV = a(0.91I^3 - 1.19I^2 + 0.781I)$		
Pond A Forebay	WQCV=watershed-inches, I=% Impervious, a=1 (40 hour drain time)		
	<i>I (Impervious,%) =</i>	17.10%	WQCV = 0.10313
Equation 3-3	$V = (WQCV/12)A$		
Pond A Forebay	V=Volume (ac-ft.), A=Area (acres)		
	A (ac.) =	12.50	V (ac-ft.) = 0.1074
2% OF WQCV	$(V_{req}) = .02(V)$		
Forebay Required Volume			
	V _{req} (ac-ft.) =	0.002	
	V _{req} (ft ³) =	94	
Volume Provided For Pond (Forebay) =		V _{prop} (ft ³) =	150
Forebay Release Rate	2% OF Q ₁₀₀ Inflow Into Pond A		
Q ₁₀₀ Discharges			
	Q ₁₀₀ (cfs) =	22.9	
	Q _{out} (cfs) =	0.46	

Weir Report

Pond A Forebay Release

Compound Weir

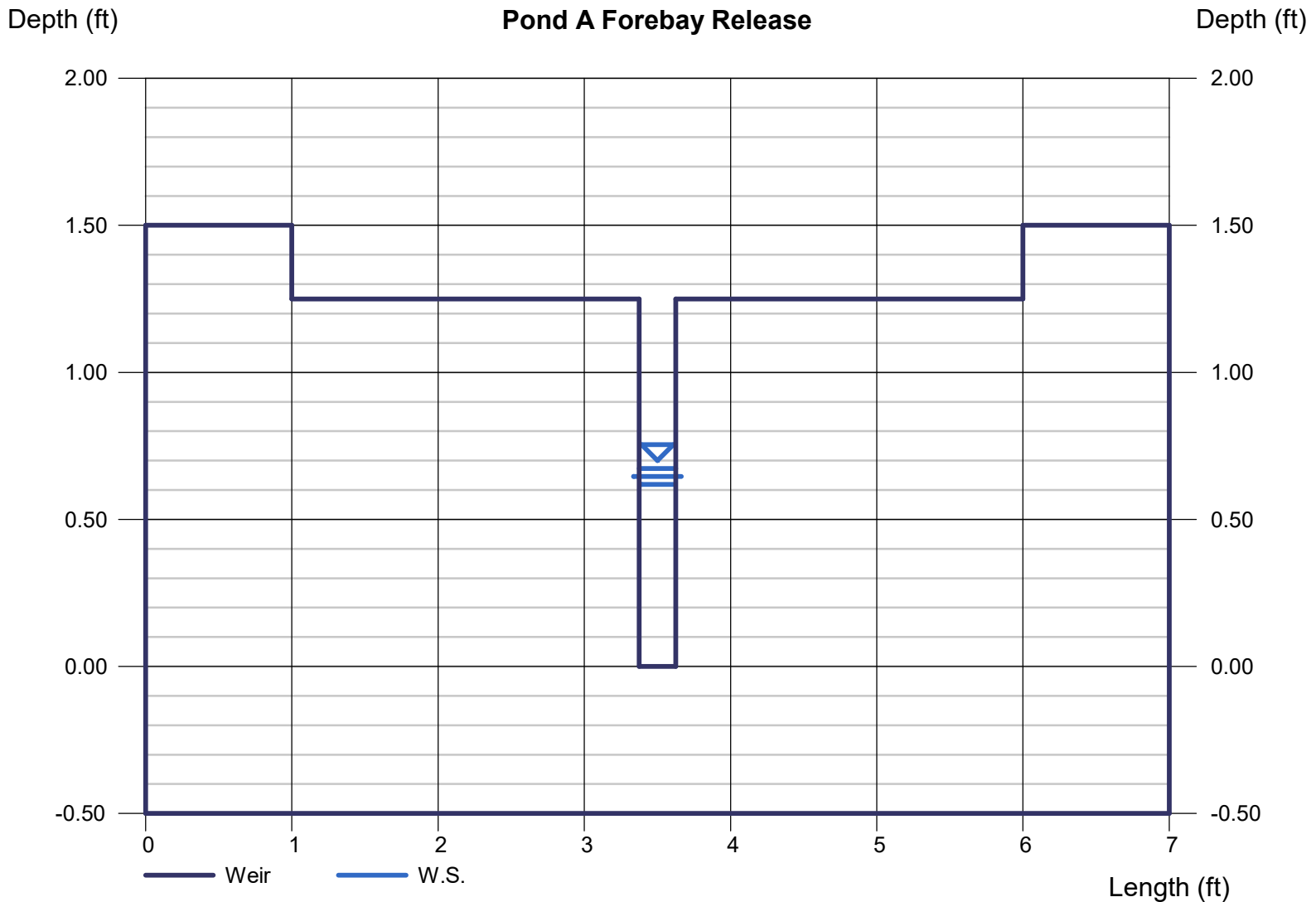
Crest	= Sharp
Bottom Length (ft)	= 5.00
Total Depth (ft)	= 1.50
Length, x (ft)	= 0.25
Depth, a (ft)	= 1.25

Highlighted

Depth (ft)	= 0.67
Q (cfs)	= 0.460
Area (sqft)	= 0.17
Velocity (ft/s)	= 2.73
Top Width (ft)	= 0.25

Calculations

Weir Coeff. Cw	= 3.33
Compute by:	Known Q
Known Q (cfs)	= 0.46



Channel Report

Pond A Trickle Channel Capacity

Rectangular

Bottom Width (ft) = 6.00
Total Depth (ft) = 0.50

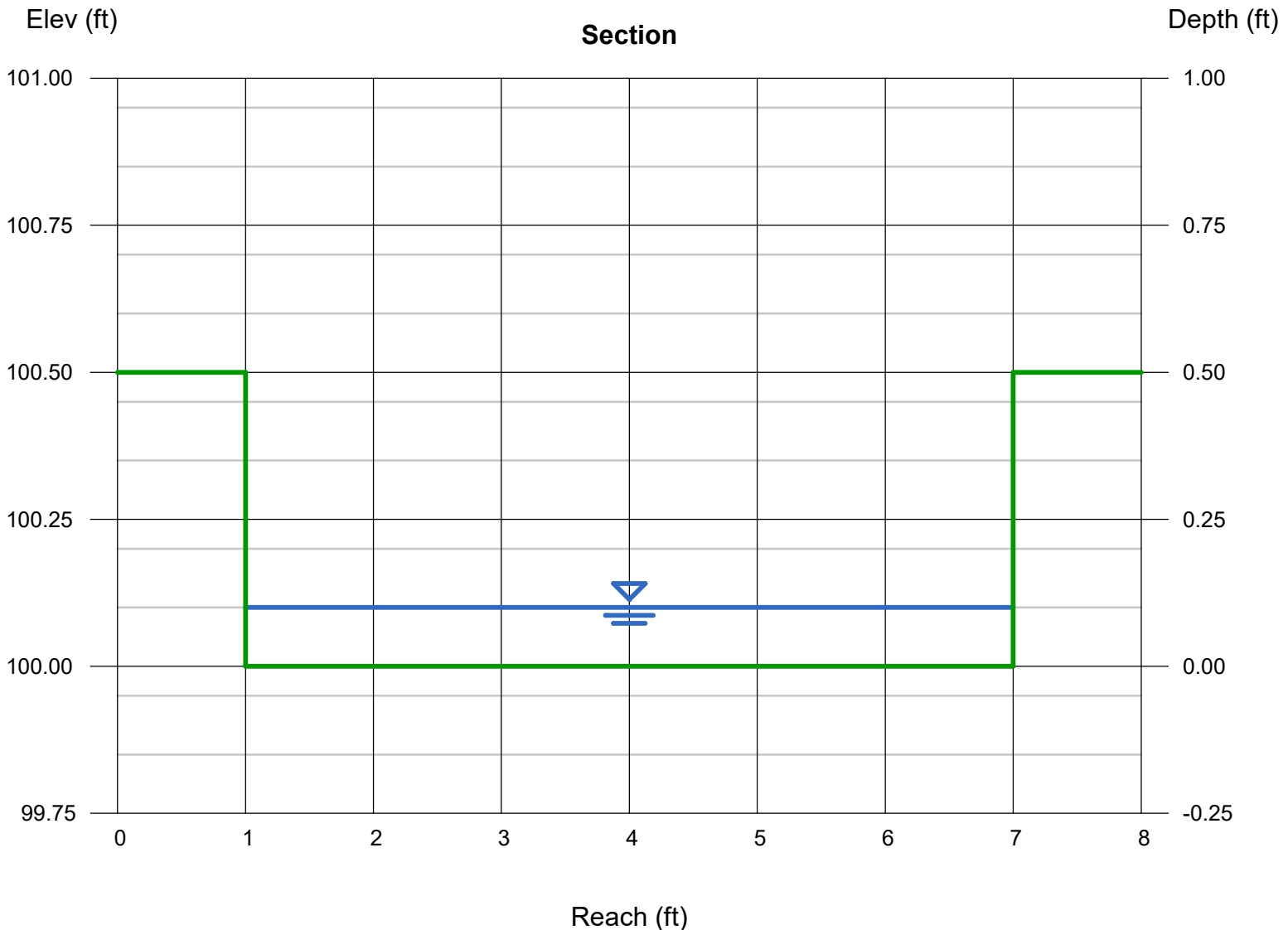
Invert Elev (ft) = 100.00
Slope (%) = 0.50
N-Value = 0.013

Calculations

Compute by: Known Q
Known Q (cfs) = 0.92

Highlighted

Depth (ft) = 0.10
Q (cfs) = 0.920
Area (sqft) = 0.60
Velocity (ft/s) = 1.53
Wetted Perim (ft) = 6.20
Crit Depth, Yc (ft) = 0.10
Top Width (ft) = 6.00
EGL (ft) = 0.14



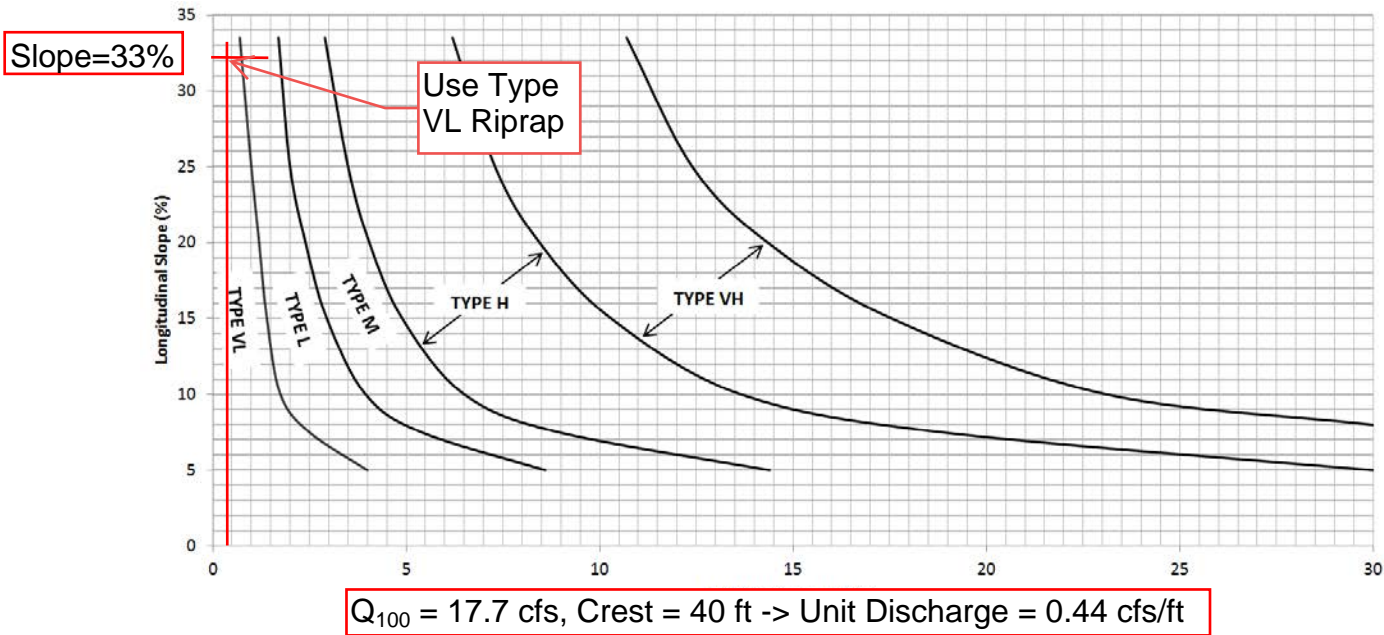
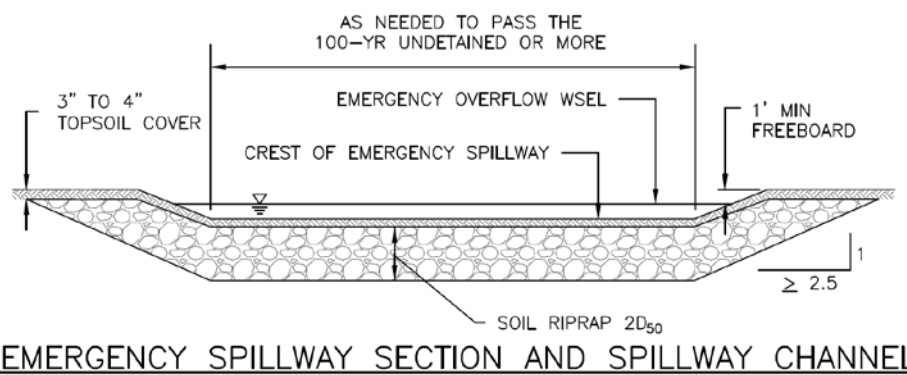
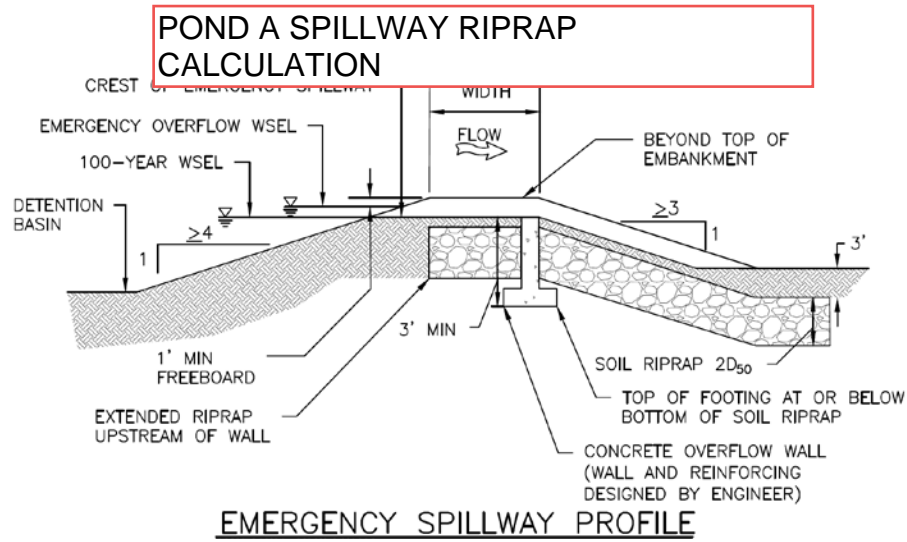
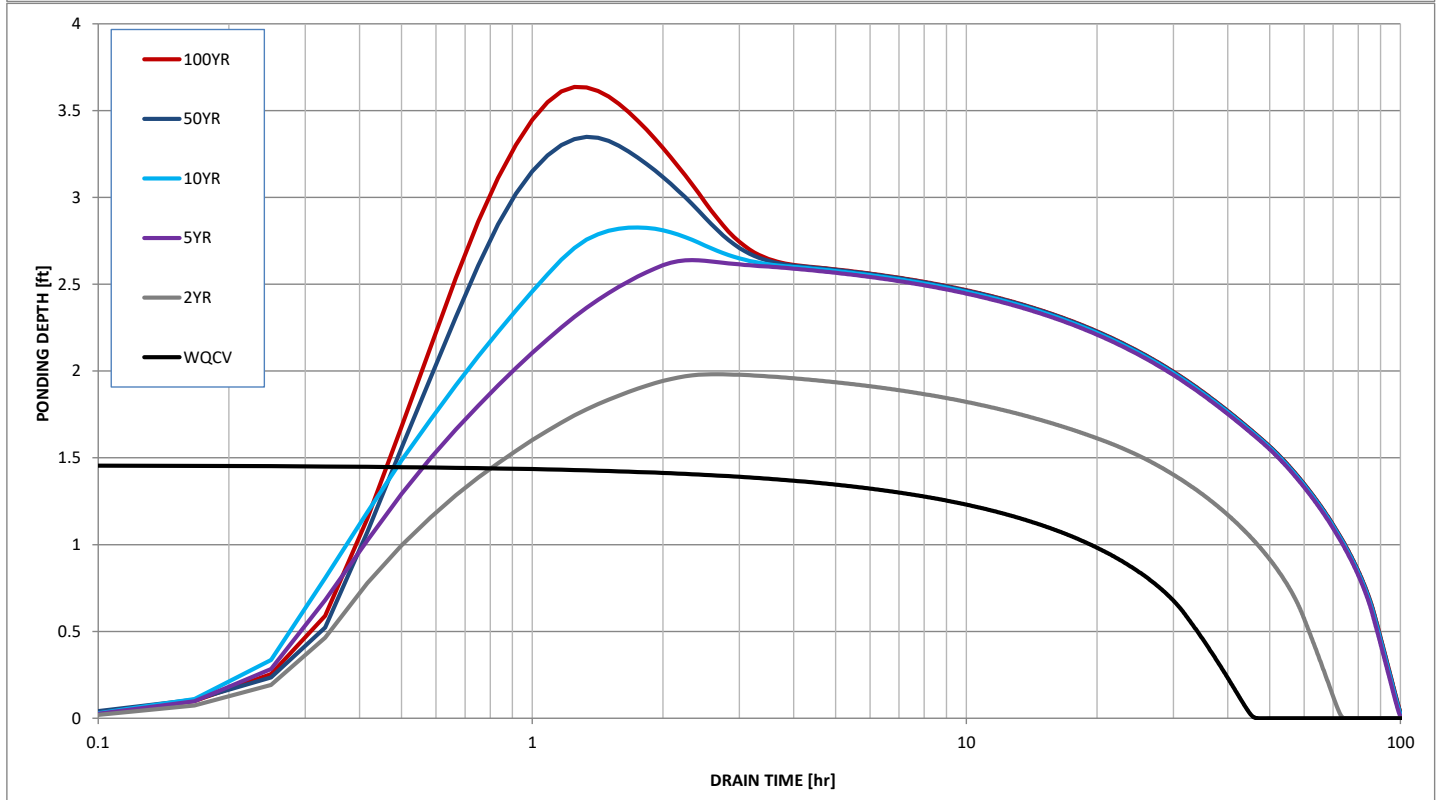
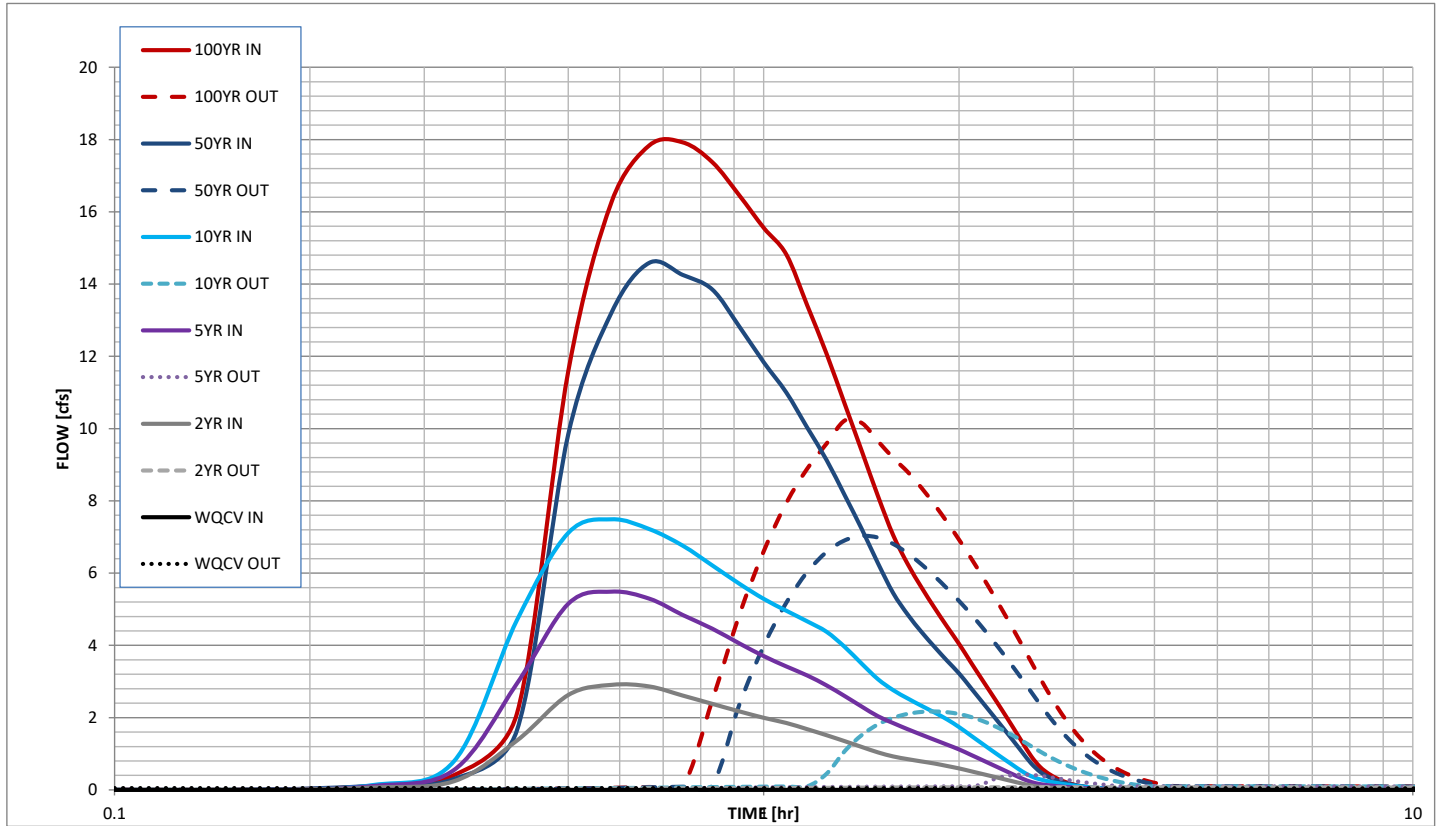


Figure 12-21. Embankment protection details and rock sizing chart (adapted from Arapahoe County)

Stormwater Detention and Infiltration Design Data Sheet

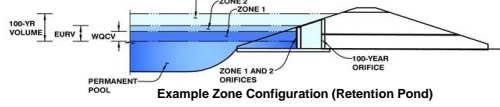


DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Lazy Y and Rocking J Subdivision**

Basin ID: **Pond B**



Watershed Information

Selected BMP Type =	EDB
Watershed Area =	13.05 acres
Watershed Length =	1,615 ft
Watershed Length to Centroid =	430 ft
Watershed Slope =	0.030 ft/ft
Watershed Imperviousness =	26.20% 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.

Water Quality Capture Volume (WQCV) =	0.151	acre-feet
Excess Urban Runoff Volume (EURV) =	0.347	acre-feet
2-yr Runoff Volume (P1 = 0.94 in.) =	0.211	acre-feet
5-yr Runoff Volume (P1 = 1.22 in.) =	0.363	acre-feet
10-yr Runoff Volume (P1 = 1.48 in.) =	0.568	acre-feet
25-yr Runoff Volume (P1 = 1.86 in.) =	1.041	acre-feet
50-yr Runoff Volume (P1 = 2.17 in.) =	1.363	acre-feet
100-yr Runoff Volume (P1 = 2.5 in.) =	1.782	acre-feet
500-yr Runoff Volume (P1 = 3.36 in.) =	2.729	acre-feet
Approximate 2-yr Detention Volume =	0.193	acre-feet
Approximate 5-yr Detention Volume =	0.288	acre-feet
Approximate 10-yr Detention Volume =	0.451	acre-feet
Approximate 25-yr Detention Volume =	0.587	acre-feet
Approximate 50-yr Detention Volume =	0.642	acre-feet
Approximate 100-yr Detention Volume =	0.792	acre-feet

Optional User Overrides

		acre-feet
		acre-feet
	0.94	inches
	1.22	inches
	1.48	inches
	1.86	inches
	2.17	inches
	2.50	inches
	3.36	inches

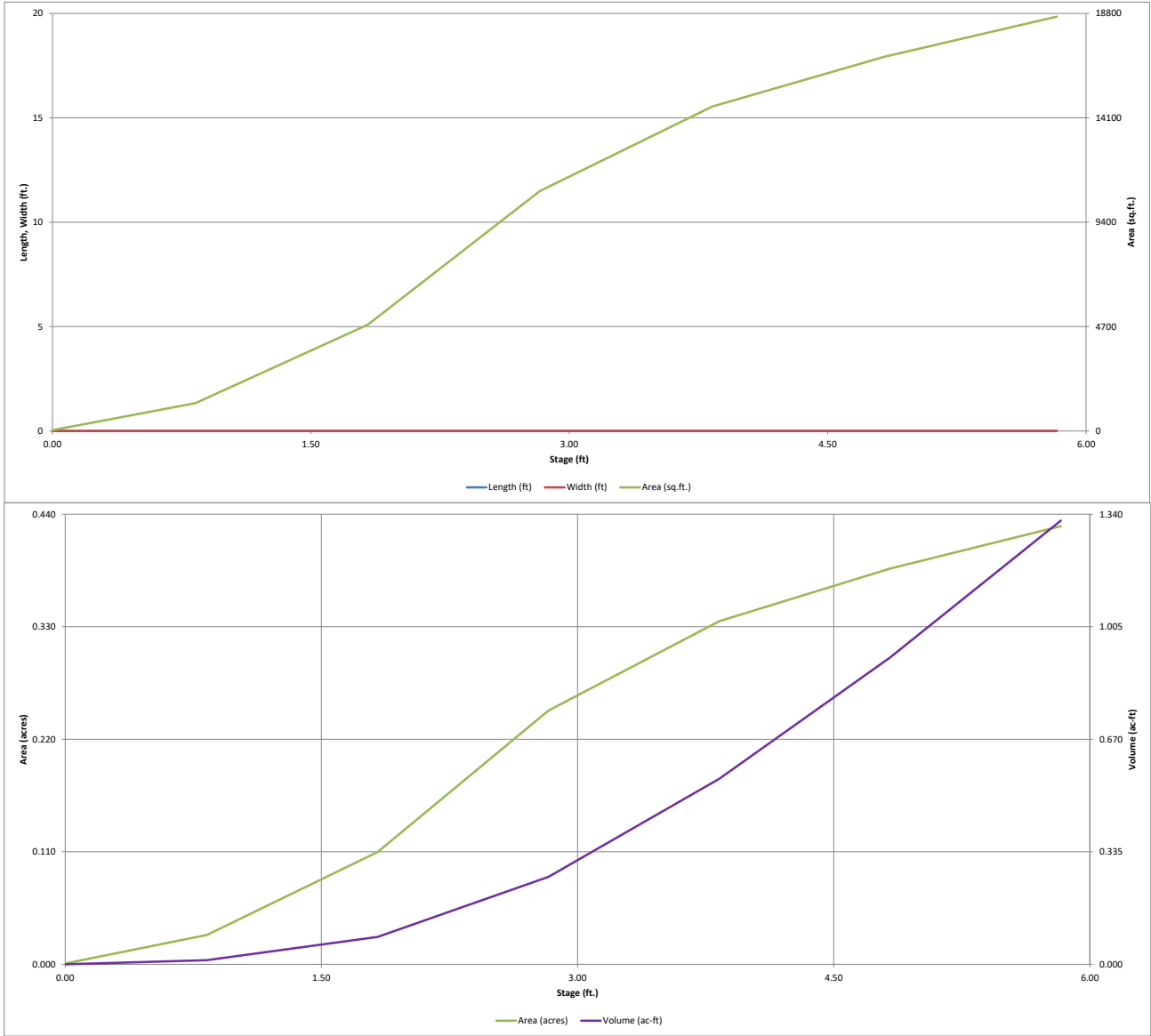
Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.151	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.196	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.445	acre-feet
Total Detention Basin Volume =	0.792	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 _{LW}) =	user	
Initial Surcharge Area (A _{ISV}) =	user	ft ²
Surcharge Volume Length (L _{ISV}) =	user	ft
Surcharge Volume Width (W _{ISV}) =	user	ft
Depth of Basin Floor (H _{FLOOR}) =	user	ft
Length of Basin Floor (L _{FLOOR}) =	user	ft
Width of Basin Floor (W _{FLOOR}) =	user	ft
Area of Basin Floor (A _{FLOOR}) =	user	ft ²
Volume of Basin Floor (V _{FLOOR}) =	user	ft ³
Depth of Main Basin (H _{MAIN}) =	user	ft
Length of Main Basin (L _{MAIN}) =	user	ft
Width of Main Basin (W _{MAIN}) =	user	ft
Area of Main Basin (A _{MAIN}) =	user	ft ²
Volume of Main Basin (V _{MAIN}) =	user	ft ³
Calculated Total Basin Volume (V _{total}) =	user	acre-feet

Depth Increment = 0.00 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)
6826.67	Top of Micropool	0.00	--	--	--	35	0.001		
	6827.5	0.83	--	--	--	1,250	0.029	533	0.012
	6828.5	1.83	--	--	--	4,785	0.110	3,551	0.082
	6829.5	2.83	--	--	--	10,805	0.248	11,346	0.260
	6830.5	3.83	--	--	--	14,608	0.335	24,052	0.552
	6831.5	4.83	--	--	--	16,852	0.387	39,782	0.913
	6832.5	5.83	--	--	--	18,658	0.428	57,537	1.321

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

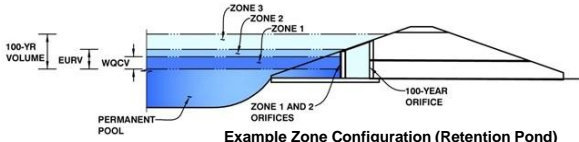


✓ = calcs match details in plans
 ✗ = calcs do not match details in plans

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Lazy Y and Rocking J Subdivision
Basin ID: Pond B



	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.32	0.151	Orifice Plate
Zone 2 (EURV)	3.17	0.196	Orifice Plate
Zone 3 (100-year)	4.52	0.445	Weir&Pipe (Restrict)
Total (all zones)		0.792	

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

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

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 =	4.375E-03	ft ²
Depth at top of Zone using Orifice Plate =	✓ 2.33	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	N/A	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	✓ 0.63	sq. inches (diameter = 7/8 inch)	Elliptical Slot Area =	N/A	ft ²

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	✓ 0.00	✓ 0.78	✓ 1.55					
Orifice Area (sq. inches)	✓ 0.63	✓ 0.63	✓ 0.63					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

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

	Zone 3 Weir	Not Selected		Zone 3 Weir	Not Selected		
Overflow Weir Front Edge Height, Ho =	✓ 3.19	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Gate Upper Edge, H ₁ =	3.19	N/A	feet
Overflow Weir Front Edge Length =	✓ 3.00	N/A	feet	Overflow Weir Slope Length =	3.00	N/A	feet
Overflow Weir Gate Slope =	✓ 0.00	N/A	H:V	Gate Open Area / 100-yr Orifice Area =	7.53	N/A	
Horiz. Length of Weir Sides =	✓ 3.00	N/A	feet	Overflow Gate Open Area w/o Debris =	7.12	N/A	ft ²
Overflow Gate Type =	Close Mesh Gate	N/A		Overflow Gate Open Area w/ Debris =	3.56	N/A	ft ²
Debris Clogging % =	50%	N/A	%				

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

Depth to Invert of Outlet Pipe =	Zone 3 Restrictor	Not Selected	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	Zone 3 Restrictor	Not Selected	ft ²
Outlet Pipe Diameter =	✓ 18.00	N/A	inches	Outlet Orifice Centroid =	0.45	N/A	feet
Restrictor Plate Height Above Pipe Invert =	✓ 9.50	N/A	inches	Half-Central Angle of Restrictor Plate on Pipe =	1.63	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =	✓ 4.75	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth =	0.24	feet
Spillway Crest Length =	✓ 55.00	feet	Stage at Top of Freeboard =	5.99	feet
Spillway End Slopes =	✓ 20.00	H:V	Basin Area at Top of Freeboard =	0.43	acres
Freeboard above Max Water Surface =	✓ 1.00	feet	Basin Volume at Top of Freeboard =	1.32	acre-ft

Routed Hydrograph Results

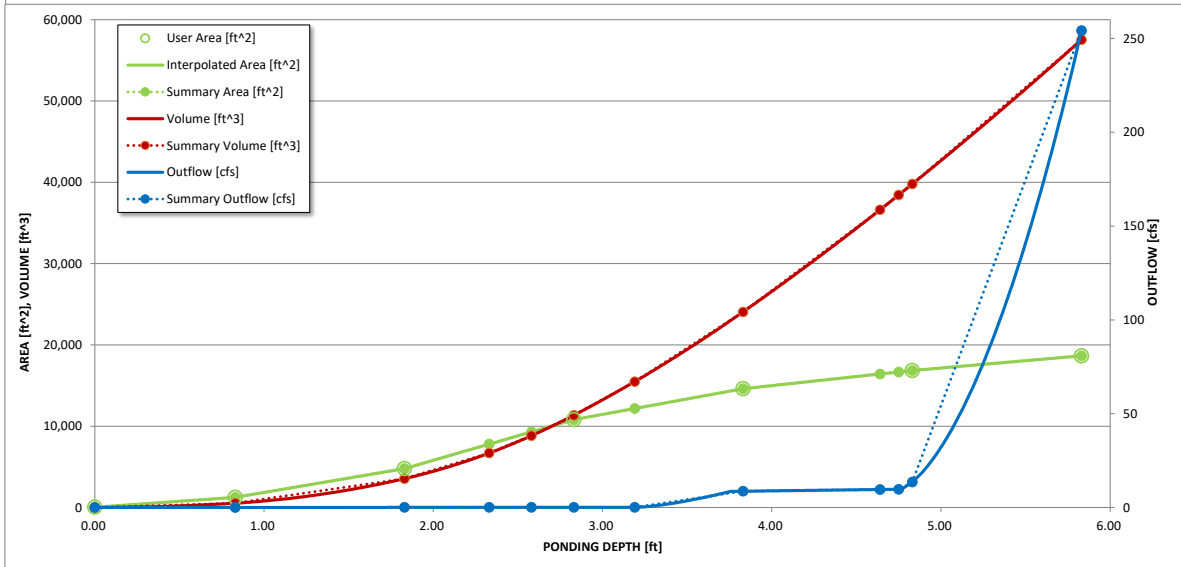
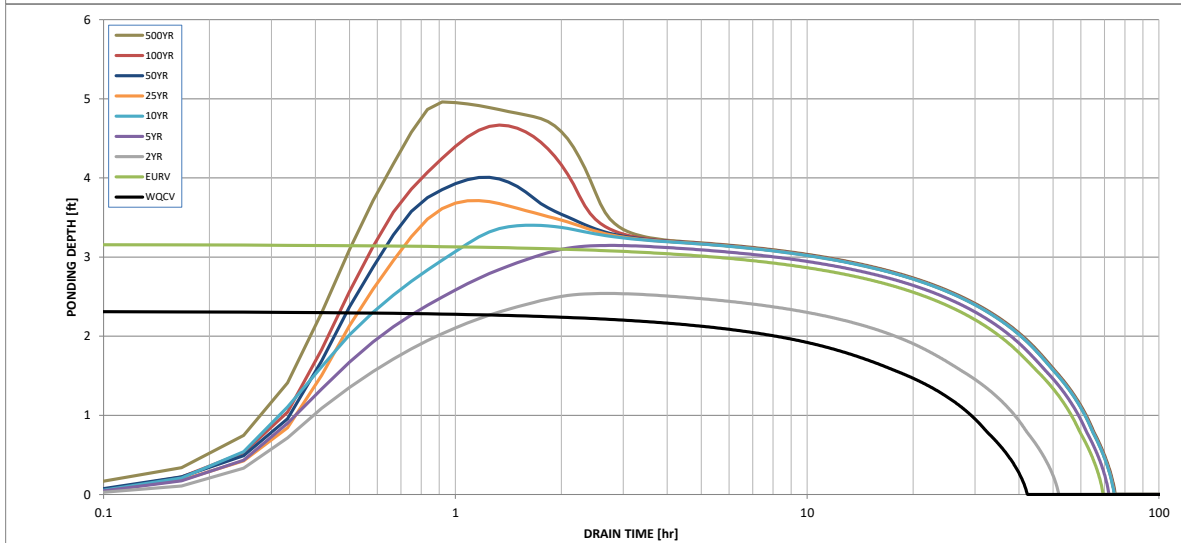
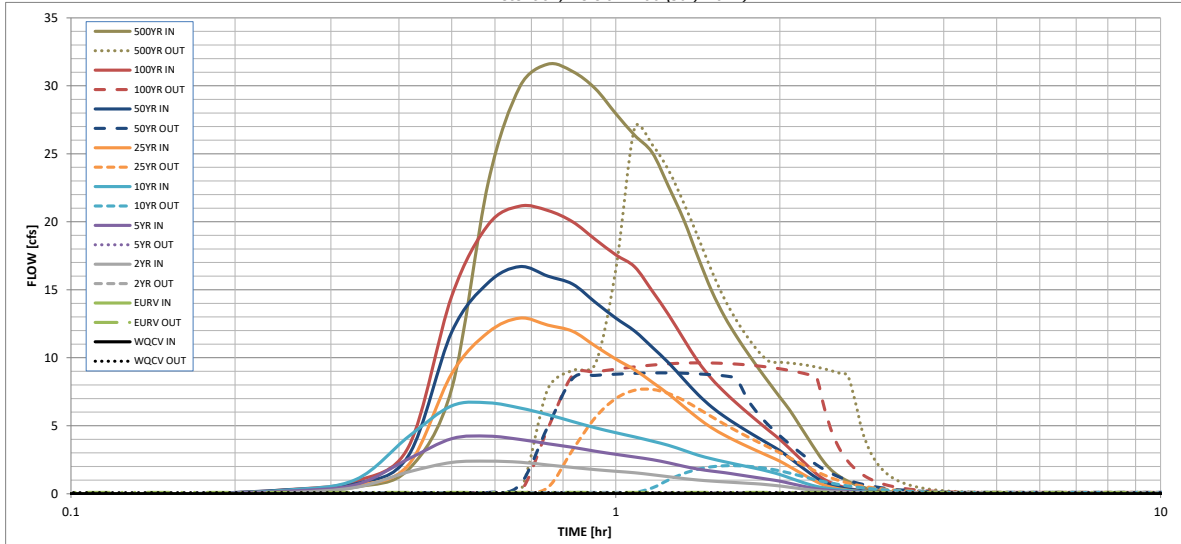
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =									
One-Hour Rainfall Depth (in)	N/A	N/A	0.94	1.22	1.48	1.86	2.17	2.50	3.36
CUHP Runoff Volume (acre-ft)	0.151	0.347	0.211	0.363	0.568	1.041	1.363	1.782	2.729
Inflow Hydrograph Volume (acre-ft)	N/A	N/A	0.211	0.363	0.568	1.041	1.363	1.782	2.729
CUHP Predevelopment Peak Q (cfs)	N/A	N/A	0.2	1.3	3.4	9.2	12.6	16.9	26.3
OPTIONAL Override Predevelopment Peak Q (cfs)	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre)	N/A	N/A	0.01	0.10	0.26	0.70	0.96	1.30	2.02
Peak Inflow Q (cfs)	N/A	N/A	2.4	4.2	6.7	12.9	16.7	21.2	31.6
Peak Outflow Q (cfs)	0.1	0.1	0.1	0.1	2.1	7.7	8.9	9.6	26.9
Ratio Peak Outflow to Predevelopment Q	N/A	N/A	N/A	0.1	0.6	0.8	0.7	0.6	1.0
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Gate 1 (fps)	N/A	N/A	N/A	N/A	0.3	1.1	1.2	1.3	1.4
Max Velocity through Gate 2 (fps)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours)	37	60	46	62	62	57	54	51	45
Time to Drain 99% of Inflow Volume (hours)	40	65	49	68	69	65	64	62	59
Maximum Ponding Depth (ft)	2.32	3.16	2.54	3.15	3.40	3.71	4.01	4.67	4.96
Area at Maximum Ponding Depth (acres)	0.18	0.28	0.21	0.28	0.30	0.32	0.34	0.38	0.39
Maximum Volume Stored (acre-ft)	0.152	0.347	0.194	0.342	0.416	0.513	0.610	0.848	0.964

Is there a way to get this closer to 40?
 The pond may not be built exactly per plan and we wouldn't want the drain time to be lower than 37 in the field

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: _____

Inflow Hydrographs

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

Time Interval	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
	0:15:00	0.00	0.00	0.09	0.19	0.27	0.21	0.29	0.30	0.49
	0:20:00	0.00	0.00	0.47	0.66	1.04	0.59	0.73	0.93	1.79
	0:25:00	0.00	0.00	1.60	2.57	4.21	2.14	2.82	3.46	7.73
	0:30:00	0.00	0.00	2.30	4.05	6.46	8.84	11.90	14.54	22.89
	0:35:00	0.00	0.00	2.39	4.23	6.68	11.87	15.52	19.79	29.94
	0:40:00	0.00	0.00	2.32	3.99	6.31	12.92	16.70	21.15	31.59
	0:45:00	0.00	0.00	2.11	3.67	5.82	12.40	16.01	20.83	31.05
	0:50:00	0.00	0.00	1.93	3.41	5.31	11.95	15.42	20.00	29.80
	0:55:00	0.00	0.00	1.77	3.13	4.85	10.87	14.09	18.71	27.95
	1:00:00	0.00	0.00	1.65	2.90	4.49	9.91	12.92	17.57	26.36
	1:05:00	0.00	0.00	1.54	2.70	4.17	9.11	11.96	16.68	25.08
	1:10:00	0.00	0.00	1.39	2.51	3.87	8.20	10.77	14.91	22.59
	1:15:00	0.00	0.00	1.25	2.27	3.56	7.33	9.63	13.16	20.13
	1:20:00	0.00	0.00	1.11	2.01	3.19	6.40	8.40	11.35	17.37
	1:25:00	0.00	0.00	1.01	1.81	2.83	5.55	7.28	9.71	14.91
	1:30:00	0.00	0.00	0.93	1.66	2.57	4.84	6.38	8.45	13.03
	1:35:00	0.00	0.00	0.87	1.55	2.35	4.30	5.67	7.48	11.56
	1:40:00	0.00	0.00	0.82	1.41	2.16	3.85	5.08	6.65	10.29
	1:45:00	0.00	0.00	0.77	1.28	1.98	3.45	4.55	5.91	9.14
	1:50:00	0.00	0.00	0.72	1.16	1.81	3.08	4.07	5.23	8.10
	1:55:00	0.00	0.00	0.64	1.04	1.62	2.73	3.61	4.59	7.11
	2:00:00	0.00	0.00	0.57	0.92	1.41	2.40	3.17	3.99	6.18
	2:05:00	0.00	0.00	0.48	0.77	1.17	2.00	2.64	3.33	5.13
	2:10:00	0.00	0.00	0.39	0.62	0.93	1.61	2.13	2.68	4.11
	2:15:00	0.00	0.00	0.30	0.48	0.72	1.23	1.63	2.05	3.14
	2:20:00	0.00	0.00	0.23	0.36	0.54	0.89	1.17	1.47	2.27
	2:25:00	0.00	0.00	0.18	0.28	0.43	0.62	0.84	1.04	1.65
	2:30:00	0.00	0.00	0.15	0.23	0.35	0.45	0.62	0.76	1.23
	2:35:00	0.00	0.00	0.12	0.19	0.29	0.34	0.47	0.56	0.92
	2:40:00	0.00	0.00	0.10	0.15	0.23	0.26	0.36	0.41	0.68
	2:45:00	0.00	0.00	0.08	0.13	0.19	0.20	0.27	0.29	0.50
	2:50:00	0.00	0.00	0.07	0.10	0.15	0.15	0.21	0.21	0.36
	2:55:00	0.00	0.00	0.06	0.08	0.12	0.12	0.16	0.15	0.26
	3:00:00	0.00	0.00	0.05	0.06	0.09	0.09	0.12	0.11	0.20
	3:05:00	0.00	0.00	0.04	0.05	0.07	0.07	0.10	0.09	0.15
	3:10:00	0.00	0.00	0.03	0.04	0.06	0.06	0.08	0.07	0.12
	3:15:00	0.00	0.00	0.02	0.03	0.04	0.04	0.06	0.06	0.10
	3:20:00	0.00	0.00	0.02	0.02	0.03	0.03	0.05	0.04	0.07
	3:25:00	0.00	0.00	0.01	0.02	0.02	0.02	0.03	0.03	0.05
	3:30:00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.04
	3:35:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02
	3:40:00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

POND B FOREBAY VOLUME AND RELEASE REQUIREMENTS

Equation 3-1	$WQCV = a(0.91I^3 - 1.19I^2 + 0.781I)$		
Pond B Forebay	WQCV=watershed-inches, I=% Impervious, a=1 (40 hour drain time)		
	<i>I (Impervious,%) =</i>	26.20%	WQCV = 0.13904
Equation 3-3	$V = (WQCV/12)A$		
Pond B Forebay	V=Volume (ac-ft.), A=Area (acres)		
	A (ac.) =	13.05	V (ac-ft.) = 0.1512
2% OF WQCV	$(V_{req}) = .02(V)$		
Forebay Required Volume			
	V_{req} (ac-ft.) =	0.003	
	V_{req} (ft ³) =	132	
Volume Provided For Pond (Forebay) =		V_{prop} (ft ³) =	206
Forebay Release Rate	2% OF Q_{100} Inflow Into Pond B		
Q_{100} Discharges			
	Q_{100} (cfs) =	31.6	
	Q_{out} (cfs) =	0.63	

Weir Report

Pond B Forebay Release

Compound Weir

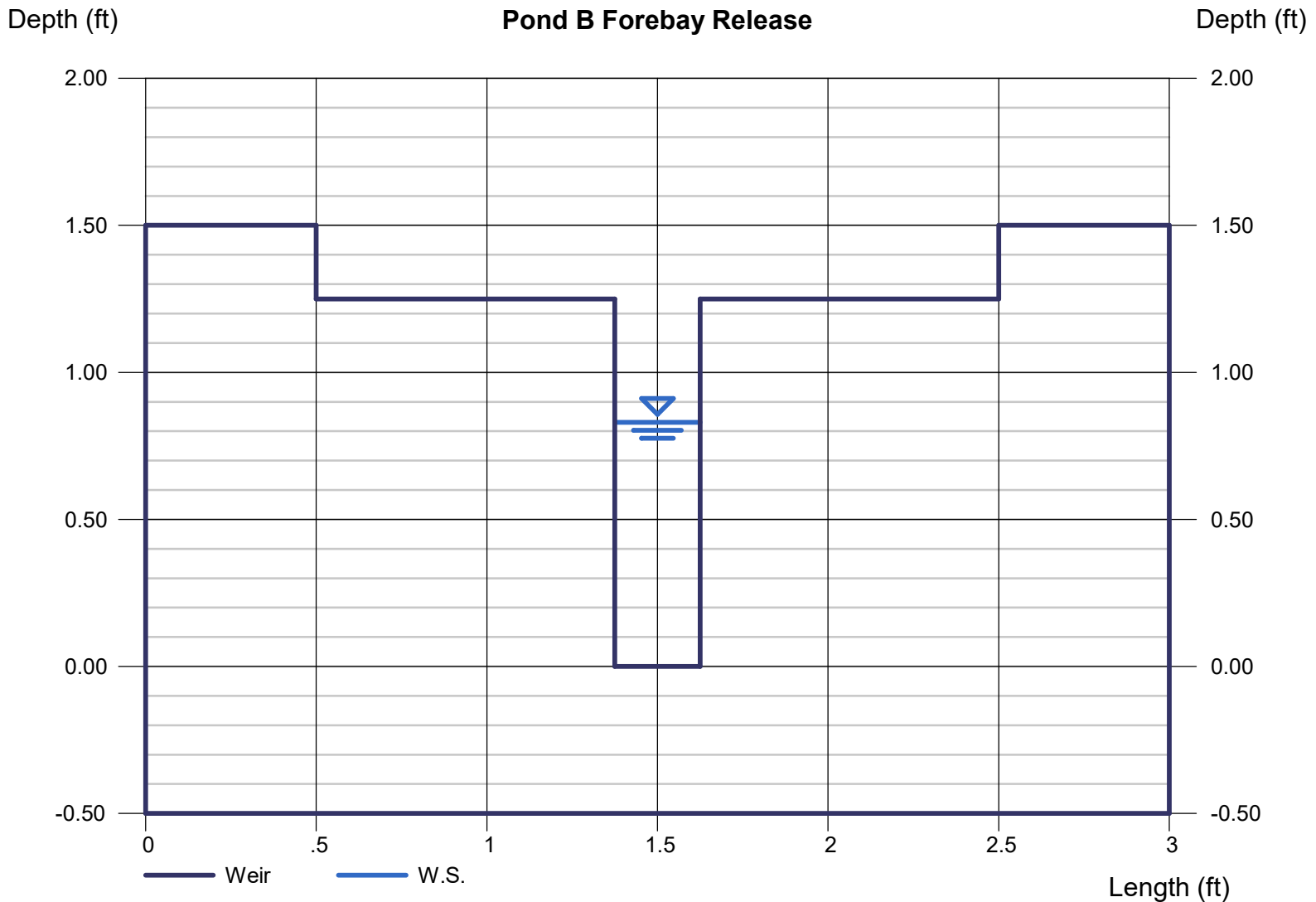
Crest	= Sharp
Bottom Length (ft)	= 2.00
Total Depth (ft)	= 1.50
Length, x (ft)	= 0.25
Depth, a (ft)	= 1.25

Highlighted

Depth (ft)	= 0.83
Q (cfs)	= 0.630
Area (sqft)	= 0.21
Velocity (ft/s)	= 3.03
Top Width (ft)	= 0.25

Calculations

Weir Coeff. Cw	= 3.33
Compute by:	Known Q
Known Q (cfs)	= 0.63



Channel Report

Pond B Trickle Channel Capacity

Rectangular

Bottom Width (ft) = 2.00
Total Depth (ft) = 0.50

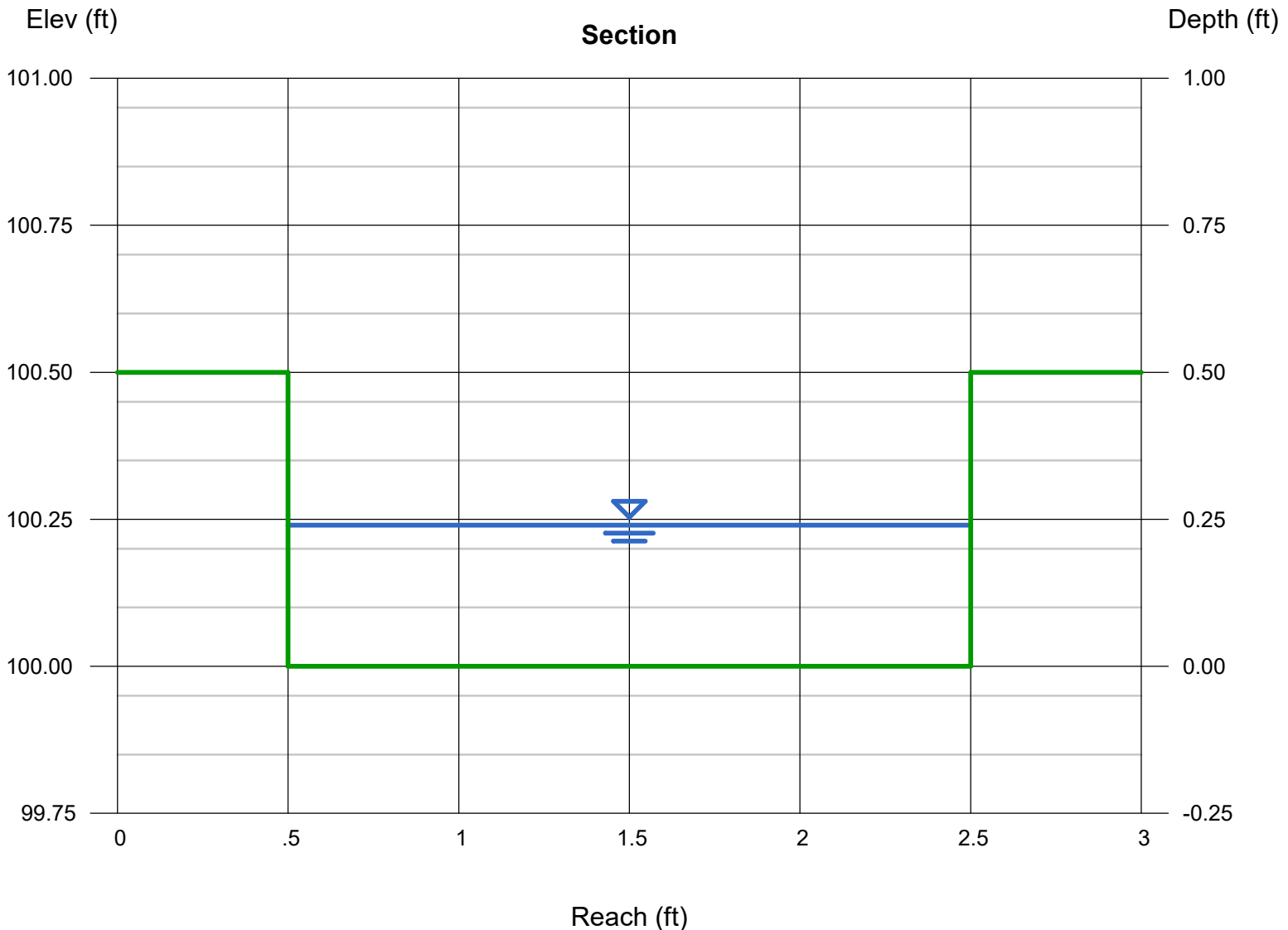
Invert Elev (ft) = 100.00
Slope (%) = 0.50
N-Value = 0.013

Calculations

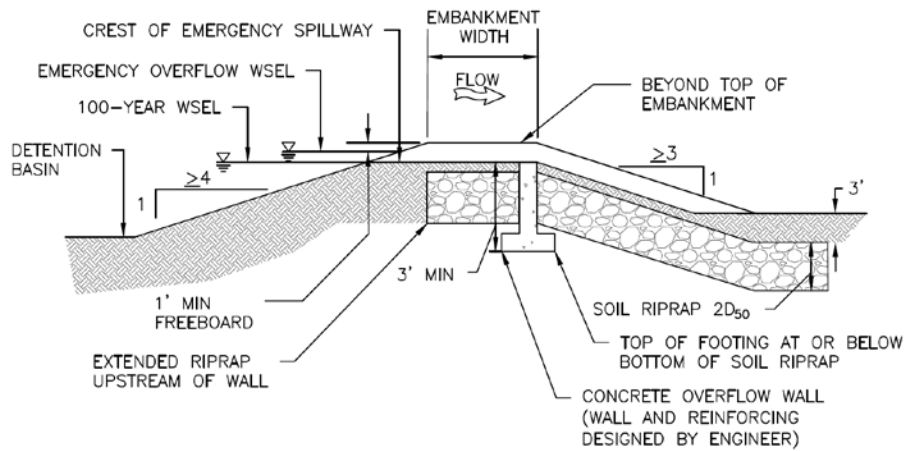
Compute by: Known Q
Known Q (cfs) = 1.26

Highlighted

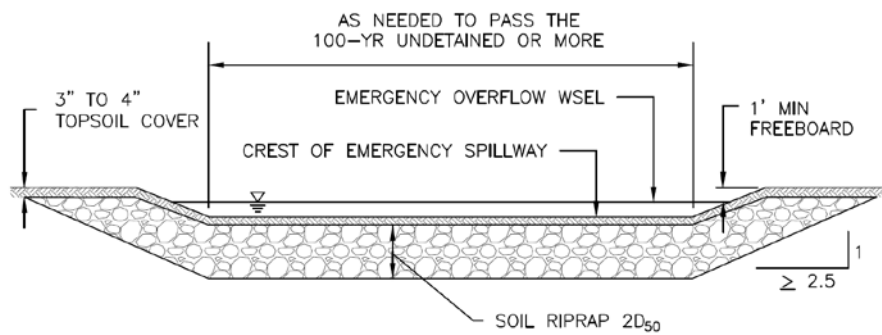
Depth (ft) = 0.24
Q (cfs) = 1.260
Area (sqft) = 0.48
Velocity (ft/s) = 2.63
Wetted Perim (ft) = 2.48
Crit Depth, Yc (ft) = 0.24
Top Width (ft) = 2.00
EGL (ft) = 0.35



POND B SPILLWAY RIPRAP CALCULATION

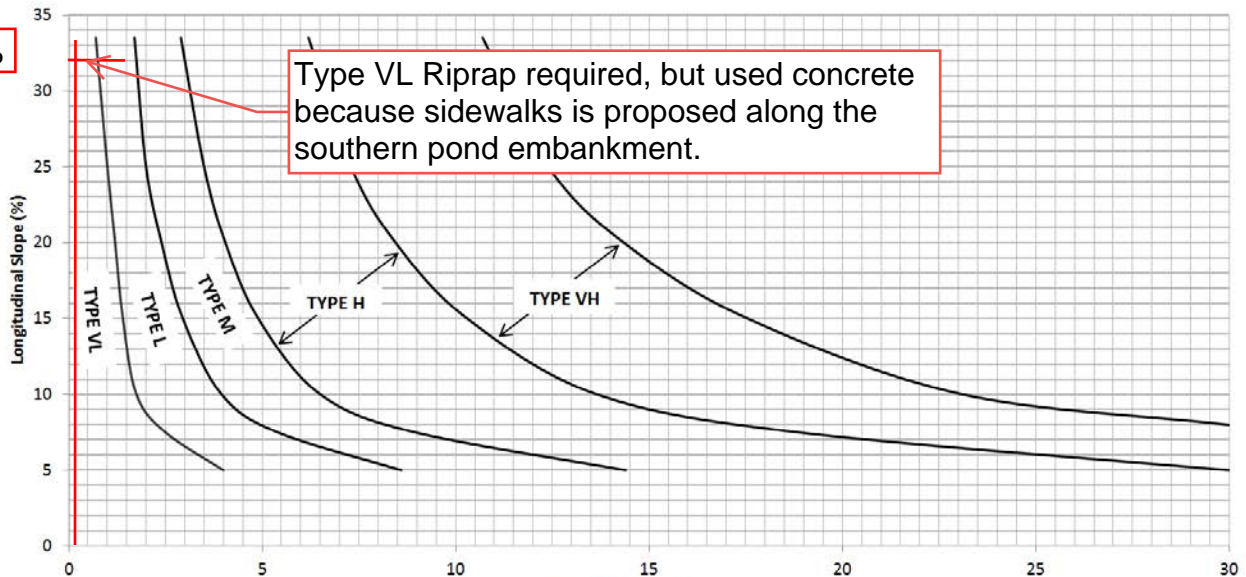


EMERGENCY SPILLWAY PROFILE



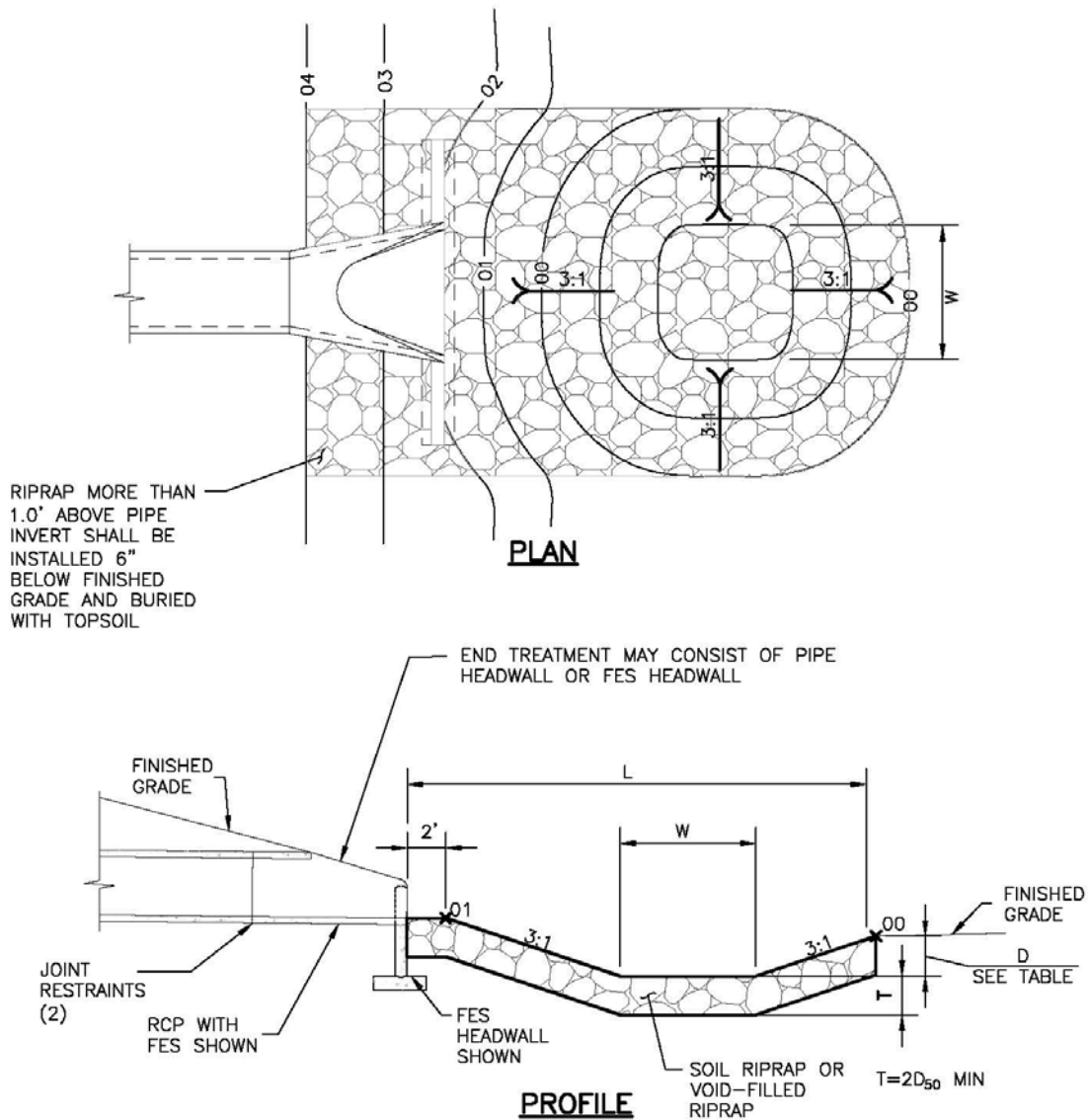
EMERGENCY SPILLWAY SECTION AND SPILLWAY CHANNEL

Slope=33%



$Q_{100} = 10.0$ cfs, Crest = 55 ft -> Unit Discharge = 0.18 cfs/ft

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

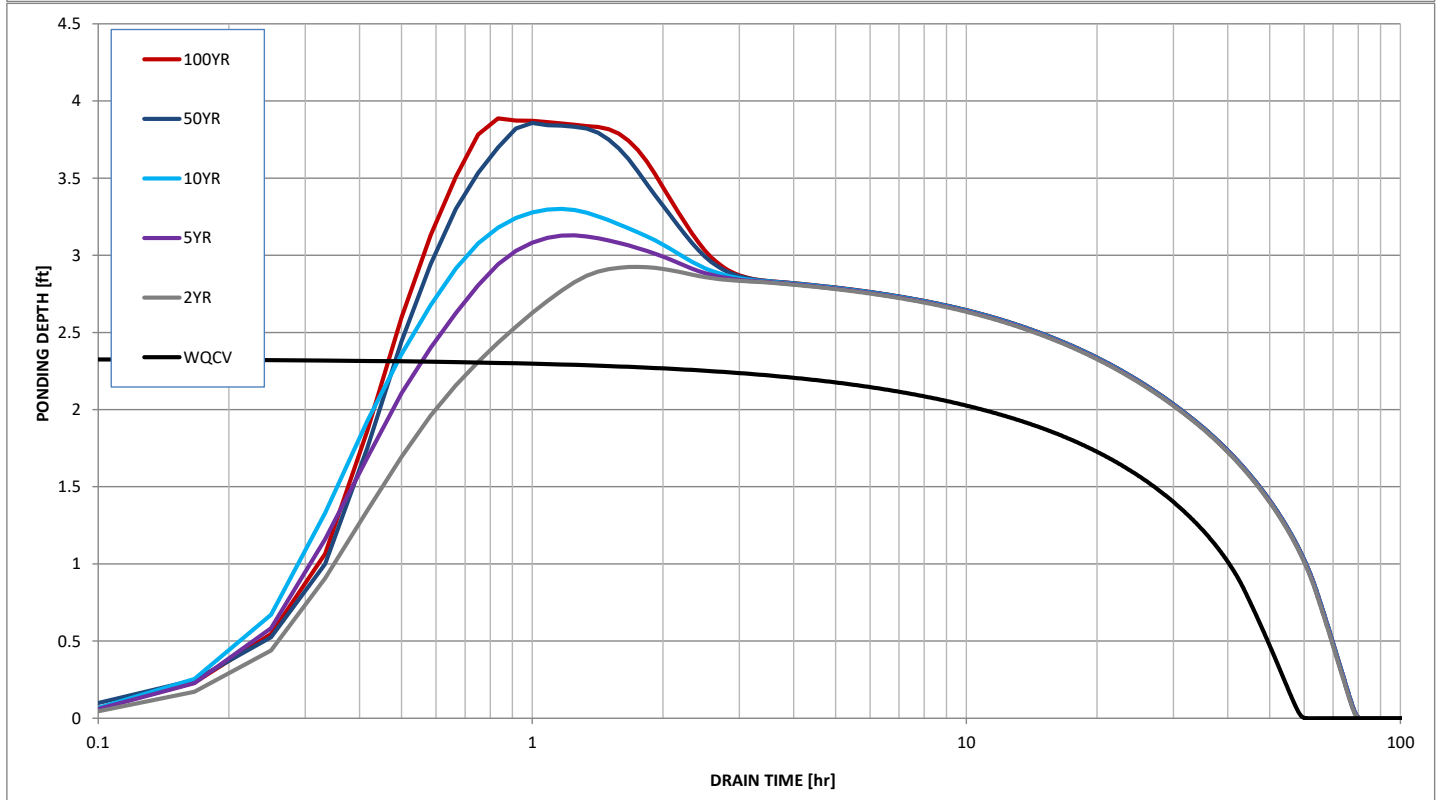
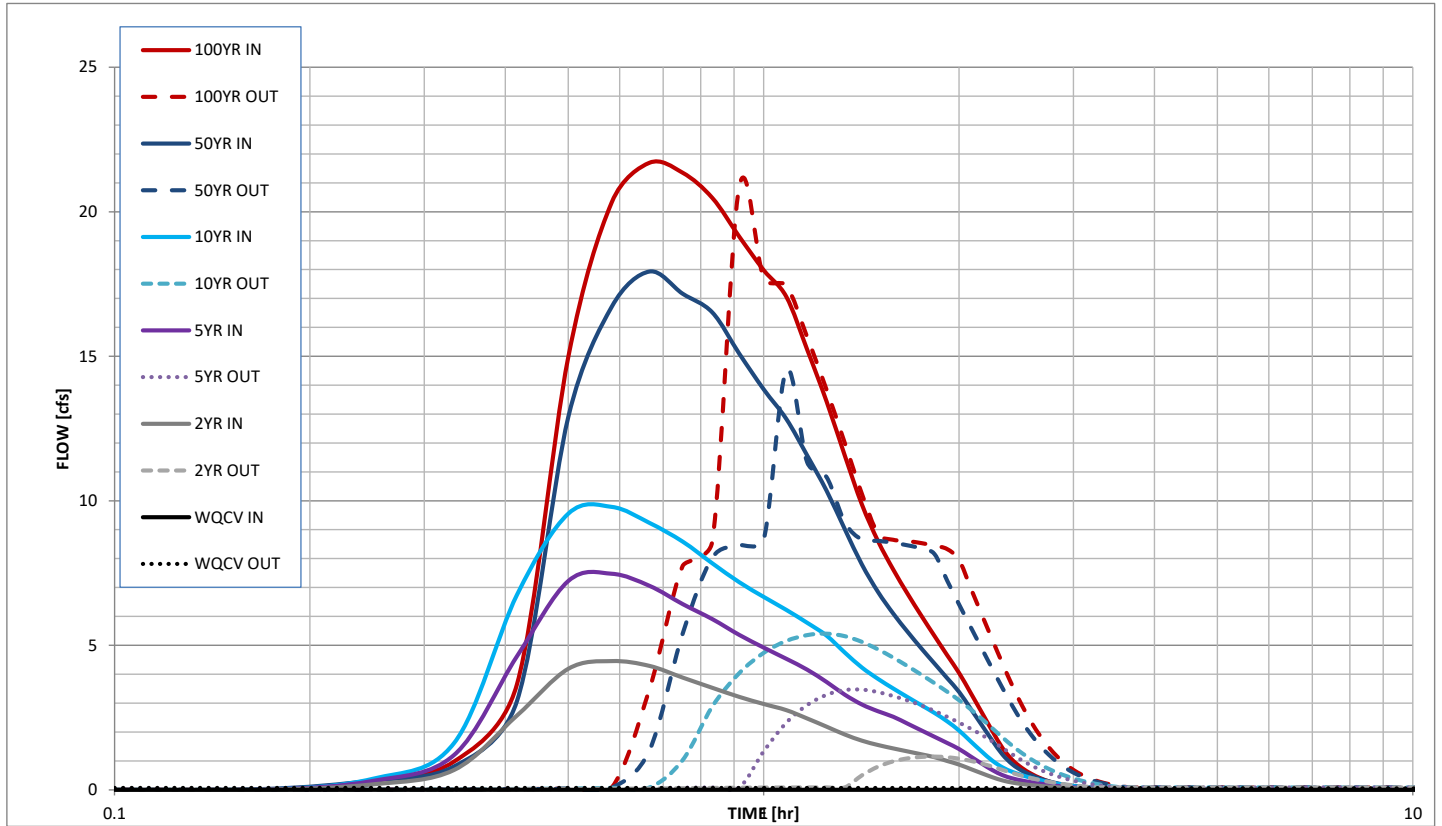


PIPE SIZE OR BOX HEIGHT	D	W*	L
18" - 24"	1'-0"	4'	15'
30" - 36"	1'-6"	6'	20'
42" - 48"	2'-0"	7'	24'
54" - 60"	2'-6"	8'	28'
66" - 72"	3'-0"	9'	32'

* IF OUTLET PIPE IS A BOX CULVERT WITH A WIDTH GREATER THAN W, THEN W = CULVERT WIDTH

Figure 9-37. Low tailwater riprap basin

Stormwater Detention and Infiltration Design Data Sheet



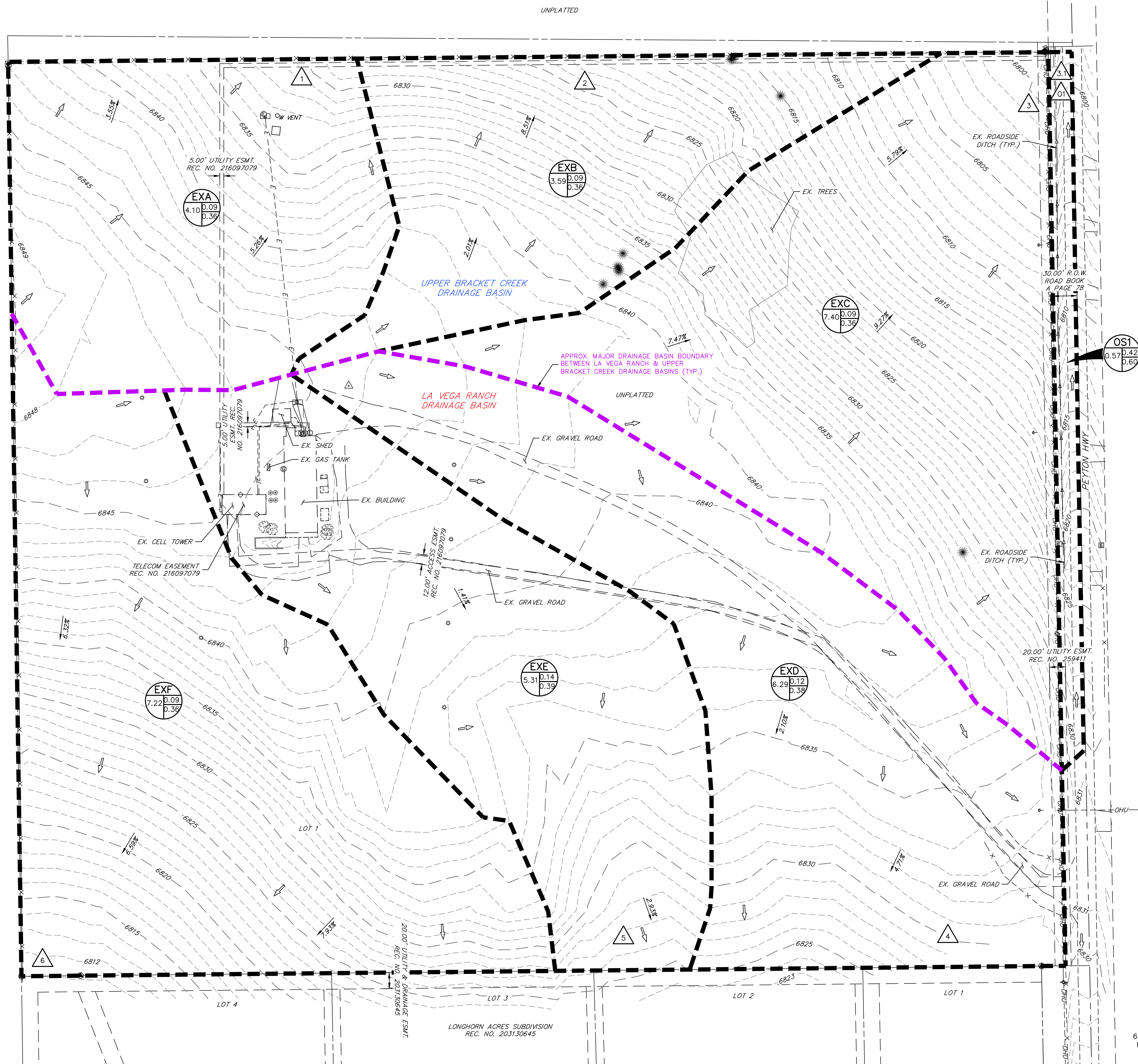
Appendix D

Reference Materials

Appendix E

Drainage Maps

UNPLATTED



LEGEND

	EXISTING	PROPOSED
SECTION LINE	---	---
BOUNDARY LINE	---	---
PROPERTY LINE	---	---
EASEMENT LINE	---	---
RIGHT OF WAY	---	---
CENTERLINE	---	---
STORM SEWER	---	---
SWALE/WATERWAY FLOWLINE	---	---
INDEX CONTOUR	---	---
INTERMEDIATE CONTOUR	---	---
BASIN ID	⊙ ID AC 12.34 P.000	⊙ ID AC 12.34 P.000
DESIGN POINT DESIGNATION	△	△
FLOW DIRECTION	→	→
SUB-BASIN DRAINAGE AREA	---	---
APPROX. MAJOR DRAINAGE BASIN BOUNDARY	---	---

BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C _s	C ₁₀₀	t _c (min)	Q _s (cfs)	Q ₁₀₀ (cfs)
EXA	4.25	2%	0.09	0.36	24.0	1.1	7.2
EXB	3.59	2%	0.09	0.36	28.0	0.8	5.6
EXC	7.40	2%	0.09	0.36	20.9	2.0	13.5
EXD	6.29	7%	0.12	0.38	30.6	1.9	9.9
EXE	5.31	9%	0.14	0.39	29.8	1.8	8.7
EXF	7.08	2%	0.09	0.36	23.1	1.8	12.3
OS1	0.57	42%	0.42	0.60	8.4	1.1	2.5

DESIGN POINT

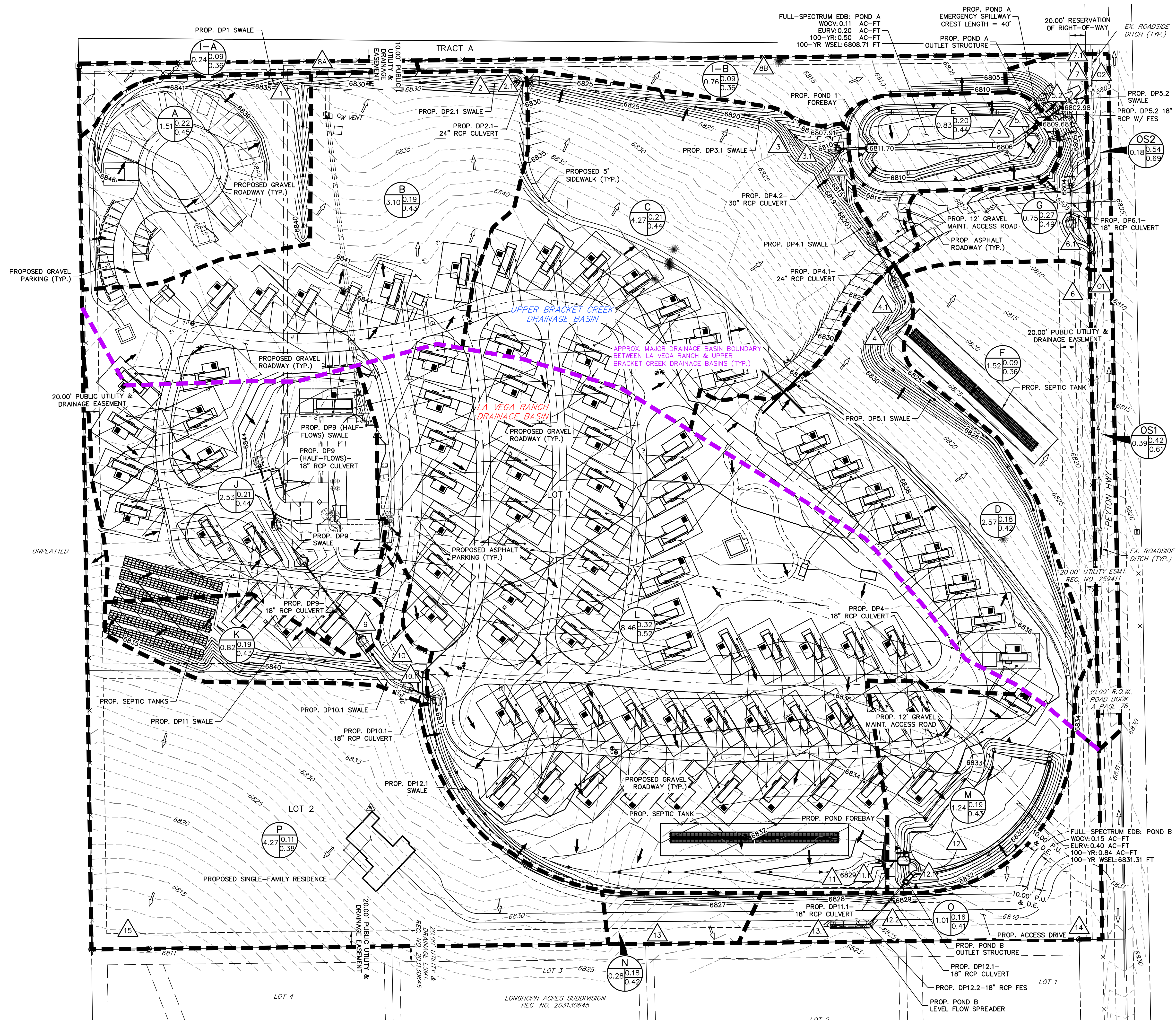
DP	Q _s		Q ₁₀₀	
	Total	Total	Total	Total
1	1.1	7.2		
2	0.8	5.6		
3	2.0	13.5		
O1	1.1	2.5		
3.1	2.8	15.2		
4	1.9	9.9		
5	1.8	8.7		
6	1.8	12.3		

EXISTING DRAINAGE MAP
 LAZY Y AND ROCKING J SUBDIVISION
 JOB NO. 25228.00
 11/07/2024
 SHEET 1 OF 1

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



BASIN SUMMARY TABLE

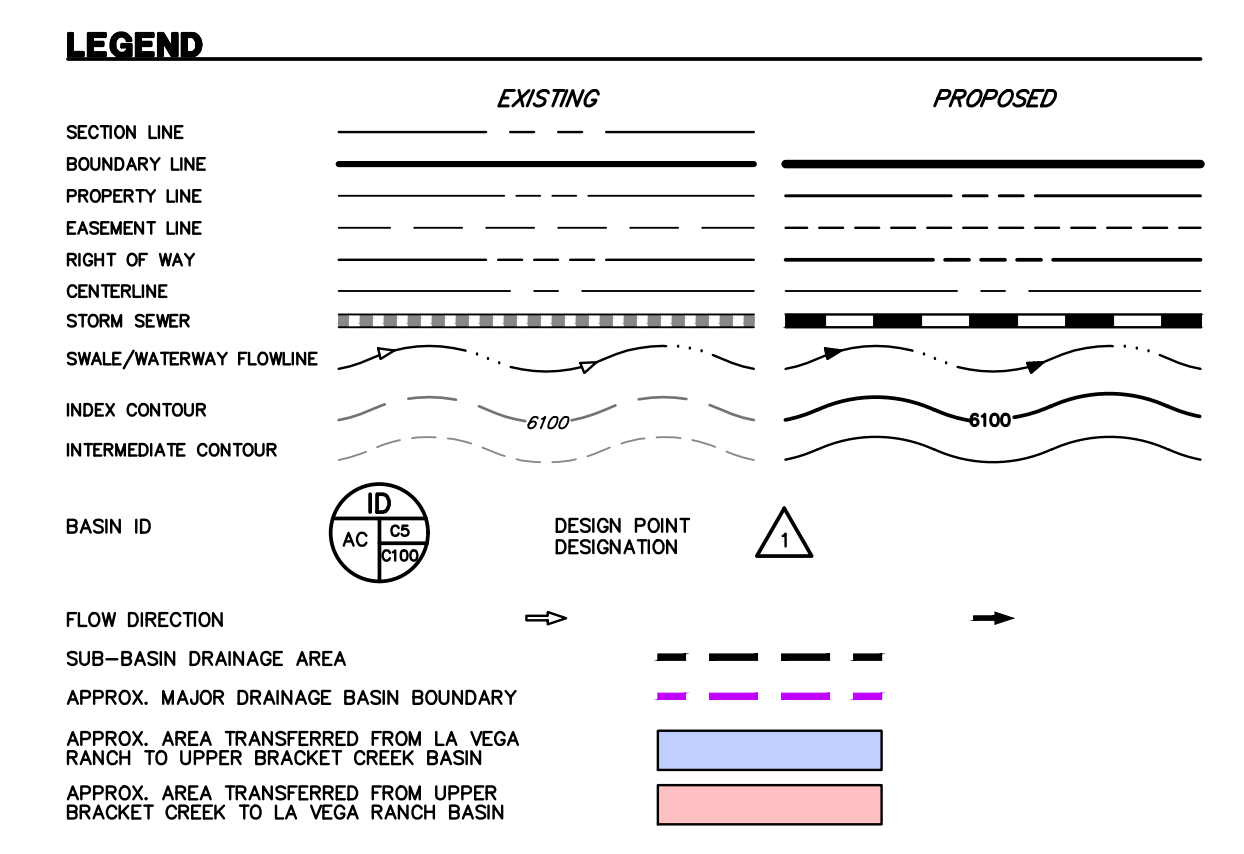
Tributary Sub-basin	Area (acres)	Percent Impervious	C _s	C ₁₀₀	t _c (min)	Q _c (cfs)	Q ₁₀₀ (cfs)
A	1.51	21%	0.22	0.45	12.5	1.3	4.3
B	3.10	16%	0.19	0.43	16.8	2.0	7.5
C	4.27	18%	0.21	0.44	14.9	3.1	11.3
D	2.57	15%	0.18	0.42	19.0	1.5	5.8
E	0.83	17%	0.20	0.44	11.8	0.6	2.3
F	1.52	2%	0.09	0.36	13.5	0.5	3.4
G	0.75	25%	0.27	0.49	9.5	0.9	2.6
I-A	0.24	2%	0.09	0.36	12.5	0.1	0.6
I-B	0.76	2%	0.09	0.36	12.7	0.3	1.7
J	2.53	21%	0.21	0.44	13.3	2.0	6.9
K	0.82	16%	0.19	0.43	16.5	0.5	2.0
L	8.46	30%	0.32	0.52	18.7	8.5	23.8
M	1.24	16%	0.19	0.43	17.0	0.8	3.0
N	0.28	16%	0.18	0.42	10.0	0.2	0.8
O	1.01	13%	0.16	0.41	68.5	0.2	0.9
P	4.32	6%	0.11	0.38	15.4	1.7	9.5
OS1	0.39	42%	0.42	0.61	6.7	0.8	1.9
OS2	0.18	56%	0.54	0.69	5.0	0.5	1.0

DESIGN POINT

DP	Q _c		Q ₁₀₀	
	Total	Total	Total	Total
1	1.3	4.3		
2	2.0	7.5		
2.1	3.1	11.4		
3	3.1	11.3		
3.1	5.7	20.8		
4	1.5	5.8		
4.1	4.8	17.9		
4.2	5.8	21.6		
5	0.6	2.3		
5.1	6.1	22.9		
5.2	0.1	8.2		
O1	0.8	1.9		
6	0.5	3.4		
6.1	1.1	4.9		
7	2.0	7.5		
7.1	0.9	2.6		
7.1	2.3	15.8		
8A	0.1	0.6		
8B	0.3	1.7		
9	2.0	6.9		
10	0.5	2.0		
10.1	2.3	8.3		
11	8.5	23.8		
11.1	10.7	31.6		
12	0.8	3.0		
12.1	11.4	34.5		
12.2	0.2	5.6		
13	0.2	0.8		
13.1	0.4	6.4		
14	0.2	0.9		
15	1.7	9.5		

Approximate Major Basin Transfer Analysis

La Vega Ranch Drainage Basin Approx. Area Transfer (acres)	Upper Bracket Creek Drainage Basin Approx. Area Transfer (acres)	Net Approx. Basin Area Transfer from La Vega Ranch to Upper Bracket Creek (acres)
0	0	0

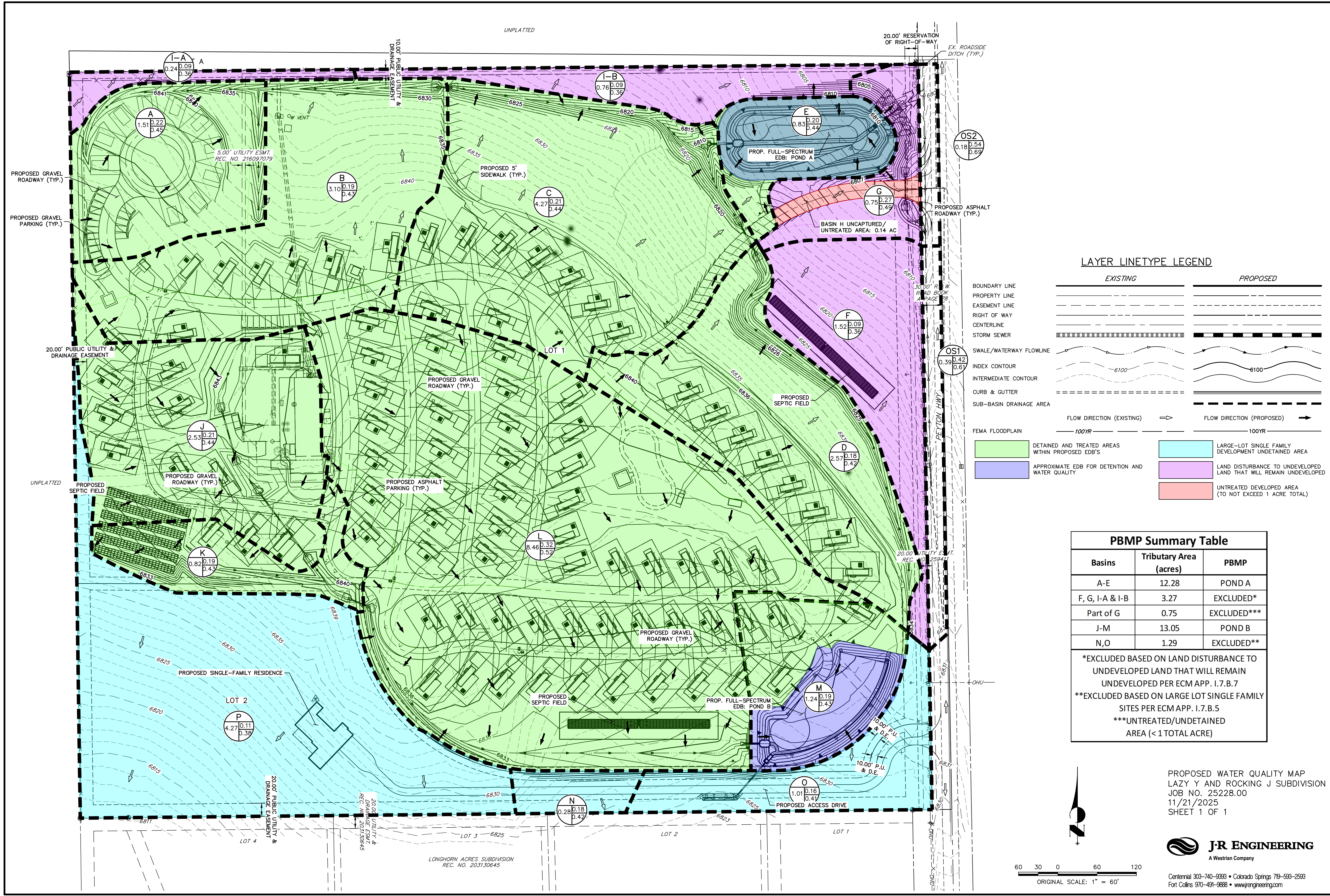


PROPOSED DRAINAGE MAP
 LAZY Y AND ROCKING J SUBDIVISION
 JOB NO. 25228.00
 11/20/2025
 SHEET 1 OF 1

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ORIGINAL SCALE: 1" = 60'



LAYER LINETYPE LEGEND

	EXISTING	PROPOSED
BOUNDARY LINE	—	—
PROPERTY LINE	—	—
EASEMENT LINE	- - -	- - -
RIGHT OF WAY	—	—
CENTERLINE	—	—
STORM SEWER	—	—
SWALE/WATERWAY FLOWLINE	—	—
INDEX CONTOUR	—	—
INTERMEDIATE CONTOUR	—	—
CURB & GUTTER	—	—
SUB-BASIN DRAINAGE AREA	—	—
FLOW DIRECTION (EXISTING)	→	→
FLOW DIRECTION (PROPOSED)	→	→
FEMA FLOODPLAIN	—	—
100YR	—	—
100YR	—	—
DETAINED AND TREATED AREAS WITHIN PROPOSED EDB'S	Green	Green
APPROXIMATE EDB FOR DETENTION AND WATER QUALITY	Blue	Blue
LARGE-LOT SINGLE FAMILY DEVELOPMENT UNDETAINED AREA	Cyan	Cyan
LAND DISTURBANCE TO UNDEVELOPED LAND THAT WILL REMAIN UNDEVELOPED	Purple	Purple
UNTREATED DEVELOPED AREA (TO NOT EXCEED 1 ACRE TOTAL)	Red	Red

PBMP Summary Table

Basins	Tributary Area (acres)	PBMP
A-E	12.28	POND A
F, G, I-A & I-B	3.27	EXCLUDED*
Part of G	0.75	EXCLUDED***
J-M	13.05	POND B
N,O	1.29	EXCLUDED**

*EXCLUDED BASED ON LAND DISTURBANCE TO UNDEVELOPED LAND THAT WILL REMAIN UNDEVELOPED PER ECM APP. I.7.B.7
 **EXCLUDED BASED ON LARGE LOT SINGLE FAMILY SITES PER ECM APP. I.7.B.5
 ***UNTREATED/UNDETAINED AREA (< 1 TOTAL ACRE)

PROPOSED WATER QUALITY MAP
 LAZY Y AND ROCKING J SUBDIVISION
 JOB NO. 25228.00
 11/21/2025
 SHEET 1 OF 1



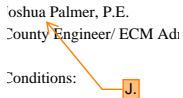
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V3_Drainage Letter.pdf Markup Summary

Mikayla Hartford (6)

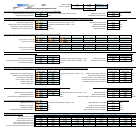


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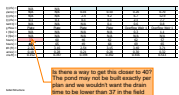
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Is there a way to get this closer to 40? The pond may not be built exactly per plan and we wouldn't want the drain time to be lower than 37 in the field