EPC STORMWATER REVIEW COMMENTS
IN ORANGE BOXES WITH BLACK TEXT

FINAL DRAINAGE REPORT

for

LATIGO TRAILS FILING No. 10

AND

AMENDMENT TO MDDP/PRELIMINARY DRAINAGE PLAN FOR LATIGO TRAILS

El Paso County, Colorado

January 2025

PCD FILE NO. SF2421

Prepared for:

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FINAL DRAINAGE REPORT for LATIGO TRAILS FILING No. 10 &
ADDENDUM TO MDDP/PRELIMINARY PLAN LATIGO TRAILS

El Paso County, Colorado

1.0 CERTIFICATION STATEMENTS

ENGINEER'S STATEMENT

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

_____

Tim D. McConnell, P.E. Date
Colorado P.E. License No. 33797
For and on Behalf of Drexel, Barrell & Co.

DEVELOPER'S STATEMENT

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

Business Name: BRJM, LLC

By: _____

Bob Irwin Date
Title: Owner
Address: 101 N. Cascade, Suite 200
Colorado Springs, CO 80903

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 the Engineering Criteria Manual, as amended.

_____

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

CONDITIONS:

FINAL DRAINAGE REPORT for LATIGO TRAILS FILING No. 10
& ADDENDUM TO MDDP/PRELIMINARY PLAN LATIGO TRAILS
El Paso County, Colorado

2.0 PURPOSE

This report is prepared by Drexel, Barrel & Co in support of the Latigo Trails Filing No. 10 project. The purpose of this report is to identify onsite and offsite drainage patterns, size drainage facilities and to safely route developed storm water runoff to adequate outfall facilities.

3.0 GENERAL SITE DESCRIPTION

Location

The Latigo Trails Development is located within portions of Sections 8,9,16 & 17, Township 12 South, Range 64 West of the 6th Principal Meridian, El Paso County, Colorado. Latigo Trails Filing 10 is bound by Latigo Trails Filing 9 to the west, Latigo Trails Filings 11 & 12 to the north, unplatted land to the east and Falcon Regional Park to the south. A vicinity map is presented in the appendix.

Existing Site Conditions

The overall Latigo Trails Development contains approximately 497 acres and at full build-out will be comprised of 179, 2.5-acre or larger lots. Latigo Trails Filing 10 consists of 125.6 acres and covers 43 proposed lots. Filing No. 10 is currently undeveloped, with open grassland and sparse vegetation covering the ground. Latigo Trails Filings 2, 7, 8 & 9 are currently developed and as studied as part of the 2001 MDDP for Latigo Trails by URS and amended by subsequent drainage reports, will remain unchanged.

The Latigo Trails subdivision as a whole, is split by a major drainage basin boundary. In the ultimate full-build out condition approximately 263 acres will drain to the Gieck Ranch basin, while the remaining 234 acres will drain to the Upper Black Squirrel basin. In general, the Upper Black Squirrel basin drains from southwest to northeast across the site, while the Gieck Ranch basin flows from northwest to southeast. Latigo Trails Filing 10 sits at the southeast corner of the overall development, almost entirely within the Gieck Ranch Basin.

Soils

According to the Soil Survey of El Paso County Area, Colorado, prepared by the U.S. Department of Agriculture Soil Conservation Service, the site is entirely underlain by Stapleton Sandy Loam (Soil No. 83). This soil is type 'B' hydrological soil group. See appendix for map.

Floodplain Statement

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Panels 08041C0339G and 08041C0552G (December 7, 2018), no portion of Filing 10 lies within a designated 100-year floodplain.

4.0 MAJOR DRAINAGE BASINS & APPROVED REPORTS

As mentioned above, the subdivision as a whole lies within two major drainage basins: the Gieck Ranch Drainage Basin and the Upper Black Squirrel Drainage basins. A Master Development Drainage Plan (MDDP) was approved for Latigo Trails and is titled "Master Development/Preliminary Drainage Plan for Latigo Trails," by URS, dated October 2001; it is referenced and used as a Master Plan for the project.

The following reports have also been reviewed and referenced for the preparation of this report:

"Final Drainage Report for The Trails Filing No. 7 Subdivision," by URS, dated March 07, 2005.

"Final Drainage Report for Latigo Trails Filing No. 9 and Addendum to Master Development/Preliminary Drainage Plan," by JR Engineering, March 29, 2023.

Excerpts from referenced reports are presented in the appendix.

5.0 ADDENDUM TO MDDP/PRELIMINARY DRAINAGE PLAN

For Latigo Trails Filing No. 10, The Master Development/Preliminary Drainage Plan for Latigo Trails, by URS will be amended as follows:

1. The potential detention areas shown in the MDDP on the north side of Conestoga Trail are eliminated and instead flows are to be conveyed via roadside ditch and cross culverts to the proposed detention basin G14b (Location corresponds with MDDP Design Point G14b).
2. Proposed detention facilities G14b, G18 and G19 have been sized to meet current El Paso County Drainage Criteria. The existing South Pond sizing was established by the Filing 9 FDR/MDD Amendment and has been analyzed to confirm no modifications are necessary as part of this Filing 10 development.

6.0 MAJOR BASIN IMPROVEMENTS

Gieck Ranch Drainage Basin

This report proposes that the drainage system for Filing 10 will be compromised of swales, culverts, and detention ponds. The proposed drainage design is in conformance with the approved "Master Development/Preliminary Drainage Plan for Latigo Trails" report as runoff flows within the Gieck Ranch Basin generally follow the historic drainage pattern to the south and east.

Upper Black Squirrel Basin

A small portion of Filing 10 is currently located within the Upper Black Squirrel Basin. Flows from Basin A30 (NW corner of Lot 43) will follow the historic drainage pattern and discharge to the northwest into future Filing 11 and or 12. This area will be analyzed as an offsite basin in the design for Filings 11 and 12, with flows likely routed to the proposed Black Squirrel pond at the northeast corner of the Latigo Trails subdivision.

7.0 DRAINAGE CRITERIA

The drainage analysis has been prepared in accordance with the current El Paso County Drainage Criteria Manual and the current Mile High Flood District Drainage Criteria Manual. Calculations were performed to determine runoff quantities during the 5-year and 100-year frequency storms for historic and developed conditions utilizing the Rational Method.

Mile High Flood District's UD-Detention, Version 4.06 workbook was used for pond sizing, with required detention volumes and allowable release rates designed per El Paso County criteria. Pond sizing spreadsheets are presented in the appendix.

The Federal Highway Administration's HY-8 program (Volume 8) was used to analyze the proposed culverts within the Latigo Trails development. Major cross culverts were sized as to not overtop the road in the 100 year storm event, driveway culverts were sized as to not exceed 6" overtopping of the driveway during the 100-year storm event. Culvert design sheets are presented in the appendix.

Autodesk Inc.'s Hydraflow Express Extension (Volume 10.5) was used for roadside ditch and conveyance ditch design. For the purposes of this FDR/MDDP, the maximum roadside ditch size was determined based on peak 100-year flows and maximum roadway slopes within each basin. Swales were checked for velocity per the EPC DCM Chapter 10, Table 10-4. Swale cross sections with a 100-year velocity greater than 5 ft/ will be lined with turf reinforcing mat and native grasses, or another approved method of stabilization, to limit erosive potential. Swale design sheets are presented in the appendix.

8.0 EXISTING CONDITION

The existing project condition considers the adjacent filings in their current developed condition (2.5-acre residential subdivision). The undeveloped area is covered with native vegetation that consists mostly of grasses as well as some shrubs. The site generally slopes at approximately 1-15% to the east and to the south, where the flows leave the project site onto the adjacent properties. The site lies primarily within the Geick Ranch Drainage Basin, with a very small portion at the northwest corner lying within the Upper Black Squirrel Basin. See Existing Conditions Map in Appendix.

A-group basins represent flows for basins that are part of Filing 10, and offsite developed flows from adjacent filings. **B-group basins** represent offsite flows for tributary basins that are part of future Filing 12.

RATIONAL METHOD RUNOFF SUMMARY

BASIN	DP	Area (Ac.)	Q_5 (cfs)	Q_{100} (cfs)
OSA1	OSA1	3.68	3.7	8.0
OSA2	OSA2	92.80	33.1	128.7
OSA3	OSA3	69.15	29.3	113.6
OSA4	OSA4	32.65	16.0	60.5
OSA5	OSA5	11.33	7.3	28.1
A1	1	7.08	1.8	12.2
A2		19.70	5.1	34.4
	2	232.68	73.5	288.9
South Pond Out	2A		51.8	295.9
A3		11.68	2.9	19.9
	3	12.43	2.7	18.2
A4	4	4.24	1.1	7.6
A5		10.58	2.6	17.7
	5	15.37	3.2	21.6
A6	6	7.35	1.9	12.9
A7		13.62	2.9	19.3
	7	20.51	4.3	29.1
A8	8	2.24	0.6	4.4
A9	9	2.16	0.6	4.4
A10	10	8.08	1.9	13.1
A11	11	7.30	1.8	12.2
A12		8.71	2.1	14.3
	12	10.31	2.6	17.3
A13		13.96	3.4	22.7
	13	26.36	5.3	35.8
A14	14	8.24	2.0	13.4
A15		0.61	0.2	1.2
OSA6	OSA6	3.29	0.8	5.4
B1	B1	3.36	0.9	6.2
B2	B2	0.75	0.2	1.3
B3	B3	4.78	1.2	8.4
B4	B4	6.89	1.9	12.9
B5	B5	1.61	0.5	3.3
B6	B6	12.40	2.9	19.9
OSB1	OSB1	0.75	0.2	1.5
OSB2	OSB2	12.15	2.5	17.1
OSB3	OSB3	2.22	0.6	4.1
OSC1		0.27	0.5	1.2
	OSC1	2.43	1.0	5.1
OSC2		0.74	1.2	2.8
	OSC2	26.44	6.2	38.3
OSC3		0.77	1.3	2.9
	OSC3	38.67	9.0	56.7

Basin OSA1 is an offsite basin covering 3.68 acres of Conestoga Trail South to the west of the project site. Flows generated by this basin (Q_5=3.7 cfs and Q_{100}=8.0 cfs) travel via roadside ditch to the south and east before entering Filing 10 at **Design Point DPOSA1.**

Basin OSA2 is an offsite basin covering 92.80 acres of Filing 9 to the north of Conestoga Trail South. Flows generated by this basin (Q_5=33.1 cfs and Q_{100}=128.7 cfs) ultimately travel via roadside ditch to the south and east before entering Filing 10 at **Design Point DPOSA2**

Basin OSA3 is an offsite basin covering 69.15 acres of Filing 2-B to the northwest of Filing 10. Flows generated by this basin (Q_5=29.3 cfs and Q_{100}=113.6 cfs) travel via roadside ditch and cross lot drainage ditch to the southeast before entering Filing 10 at **Design Point DPOSA3.**

Basin OSA4 is an offsite basin covering 32.65 acres of Filing 7-A to the northwest of Filing 10. Flows generated by this basin (Q_5=16.0 cfs and Q_{100}=60.5 cfs) travel via roadside ditch and cross lot drainage ditch to the southeast before entering Filing 10 at **Design Point DPOSA4.**

Basin OSA5 is an offsite basin covering 11.33 acres of Filing 7-A to the north of Filing 10. Flows generated by this basin (Q_5=7.3 cfs and Q_{100}=28.1 cfs) travel via roadside ditch and cross lot drainage ditch to the south before entering Filing 10 at **Design Point DPOSA5.**

Existing Basin A1 is located at the southwest corner of the site. Flows generated by this basin (Q_5=1.8 cfs and Q_{100}=12.2 cfs) are directed southeast to **Design Point DP1** along the southern boundary of Filing 10.

Basin B1 is located at the northwest corner of future Filing 12. Flows generated by this basin (Q_5=0.9 cfs and Q_{100}=6.2 cfs) are directed south before entering Filing 10 at **Design Point DPB1.**

Existing Basin A2 is located in the southwest portion of the site. Flows generated by this basin (Q_5=5.1 cfs and Q_{100}=34.4 cfs) combine with those from offsite basins OSA1-OSA5 and B1 and are directed southeast to the existing South Pond at **Design Point DP2.**

Design Point DP2 is located at the bottom of the existing South Pond that was constructed previously and modified with the development of Filing 9. This design point represents the combining of flows of Basins OSA1-OSA5, B1 and A2. **Design Point 2A** represents the outflows from the South Pond as established by the detention calculations.

Basin B2 is located along the south edge of future Filing 12. Flows generated by this basin (Q_5=0.2 cfs and Q_{100}=1.3 cfs) are directed south before entering Filing 10 at **Design Point DPB2.**

Existing Basin A3 is located in the southwest portion of the site, just east of Basin A2. Flows generated by this basin (Q_5=2.9 cfs and Q_{100}=19.9 cfs) combine with those from Basin B2 and are directed south to **Design Point DP3** along the southern boundary of Filing 10.

Existing Basin A4 is located in the middle portion of the site, along the southern boundary. Flows generated by this basin (Q_5=1.1 cfs and Q_{100}=7.6 cfs) are directed south to **Design Point DP4,** along the south boundary of Filing 10.

Basin B3 is located in the middle portion of the site. Flows generated by this basin (Q_5=1.2 cfs and Q_{100}=8.4 cfs) are directed to the south before entering Filing 10 at **Design Point DPB3**.

Existing Basin A5 is located in the middle portion of the site. Flows generated by this basin (Q_5=2.6 cfs and Q_{100}=17.7 cfs) combine with flows from Basin B3 and are directed south to **Design Point DP5**, along the southern boundary. A stock pond currently exists within this basin, and is intended to remain in place. The pond does not hold water and will not be used for detention. As such, any incidental storage was neglected in subsequent pond calculations.

Existing Basin A6 is located in the middle portion of the site, along the southern boundary. Flows generated by this basin (Q_5=1.9 cfs and Q_{100}=12.9 cfs) are directed south to **Design Point DP6**, along the southern boundary.

Basin B4 is located in the middle portion of the future Filing 12 site. Flows generated by this basin (Q_5=1.9 cfs and Q_{100}=12.9 cfs) are directed east before entering Filing 10 at **Design Point DPB4.**

Existing Basin A7 is located in the eastern portion of the site, along the southern boundary. Flows generated by this basin (Q_5=2.9 cfs and Q_{100}=19.3 cfs) combine with those from Basin B4 and are directed south to **Design Point DP7**, along the southern boundary.

Existing Basin A8 is located in the southeast corner of the site, along the southern boundary. Flows generated by this basin (Q_5=0.6 cfs and Q_{100}=4.4 cfs) are directed south to **Design Point DP8,** along the southern boundary.

Existing Basin A9 is located in the southeast corner of the site, along the eastern boundary. Flows generated by this basin (Q_5=0.6 cfs and Q_{100}=4.4 cfs) are directed east to **Design Point DP9** before discharging into the roadside ditch along Eastonville Road and continuing south.

Existing Basin A10 is located in the middle portion of the site, along the eastern boundary. Flows generated by this basin (Q_5=1.9 cfs and Q_{100}=13.1 cfs) are directed east to **Design Point DP10** before discharging into the roadside ditch along Eastonville Road. Flows continue in the roadside ditch until ultimately reaching an existing 30"x42" HECMP cross culvert to the south.

Existing Basin A11 is located in the middle portion of the site, along the eastern boundary. Flows generated by this basin (Q_5=1.8 cfs and Q_{100}=12.2 cfs) are directed east to **Design Point DP11** before discharging into the roadside ditch along Eastonville Road. Flows continue in the roadside ditch until ultimately reaching an existing 30"x42" HECMP cross culvert to the south.

Basin B5 is located in the middle portion of the future Filing 11 site. Flows generated by this basin (Q_5=0.5 cfs and Q_{100}=3.3 cfs) are directed east before entering Filing 10 at **Design Point DPB5.**

Existing Basin A12 is located in the middle portion of the site, along the eastern boundary.

Flows generated by this basin (Q_5=2.1 cfs and Q_{100}=14.3 cfs) combine with those from basin B5 and are directed east to **Design Point DP12** before discharging into the roadside ditch along Eastonville Road. Flows continue in the roadside ditch until ultimately reaching an existing 30"x42" HECMP cross culvert to the south.

Basin B6 is located in the middle portion of the future Filing 11 site. Flows generated by this basin (Q_5=2.9 cfs and Q_{100}=19.9 cfs) are directed northeast before entering Filing 10 at **Design Point DPB6.**

Existing Basin A13 is located in the middle portion of the site, along the eastern boundary. Flows generated by this basin (Q_5=3.4 cfs and Q_{100}=22.7 cfs) combine with those from basin B6 and are directed east to **Design Point DP13** before discharging into the roadside ditch along Eastonville Road. Flows continue in the roadside ditch ultimately reach an existing 36" CMP cross culvert to the north.

Existing Basin A14 is located at the northeast corner of the site, along the eastern boundary. Flows generated by this basin (Q_5=2.0 cfs and Q_{100}=13.4 cfs) are directed east to **Design Point DP14** along the eastern boundary of Filing 10, before discharging into the roadside ditch along Eastonville Road. Flows ultimately reach an existing 36" CMP cross culvert to the south.

Basin OSA6 is the offsite basin just north of Basin A14. Flows generated by this basin (Q_5=0.8 cfs and Q_{100}=5.4 cfs) are directed east to **Design Point DPOSA6**, along the eastern boundary of Filing 10, before discharging into the roadside ditch along Eastonville Road.

Existing Basin A15 covers a small 0.61-acre area at the northwestern corner of Filing 10. This basin sits within the Upper Black Squirrel drainage basin. Flows generated by this basin (Q_5=0.2 cfs and Q_{100}=1.2 cfs) follow natural drainage paths to the northwest into the adjacent future Filing 12.

The following offsite B basins cover an area that will be impacted by the installation of a water line loop to serve the Filing 10 subdivision.

Basin OSB1 covers an offsite area to the north of Basin B6. Flows generated by this basin (Q_5=0.2 cfs and Q_{100}=1.5 cfs) are directed north to **Design Point DPOSB1**.

Basin OSB2 covers an offsite area to the north of Basin B6. Flows generated by this basin (Q_5=2.5 cfs and Q_{100}=17.1 cfs) are directed north to **Design Point DPOSB2**.

Basin OSB3 covers an offsite area to the north of Basin A14. Flows generated by this basin (Q_5=0.6 cfs and Q_{100}=4.1 cfs) are directed northeast to **Design Point DPOSB3**.

The following offsite C basins have been established to determine the flows reaching the existing cross culverts on Eastonville Road.

Basin OSC1 covers an offsite area along the west side of Eastonville Road at the south end of the Filing 10 site. Flows generated by this basin (Q_5=0.5 cfs and Q_{100}=1.2 cfs) combine with flows from DP9 and are directed via roadside ditch to a central low point and existing public 12" CMP culvert at **Design Point DPOSC1** that crosses underneath Eastonville Road.

Basin OSC2 covers an offsite area along the west side of Eastonville Road adjacent to the Filing 10 site. Flows generated by this basin (Q_5=1.2 cfs and Q_{100}=2.8 cfs) combine with those from DP10-DP12 and are directed via roadside ditch to a central low point and existing public 30"x42" HERCP culvert at **Design Point DPOSC2**.

Basin OSC3 covers an offsite area along the west side of Eastonville Road on the north side of the Filing 10 site. Flows generated by this basin (Q_5=1.3 cfs and Q_{100}=2.9 cfs) combine with flows from DP13, DP14 and DPOSA8 and are directed via roadside ditch to a central low point and existing public 36" CMP culvert at **Design Point DPOSC3**.

9.0 DEVELOPED CONDITION

In the developed condition, as with the adjacent filings, the majority of the generated flows are designed to be collected in roadside ditches and conveyed to the proposed detention areas. However, basins along the south side of Conestoga Trail South and the east side of Irish Hunter Trail cover lot areas outside of the roadway, that are intended to follow historic drainage patterns to the south and east, without detention or treatment for water quality. See further discussion and applicable exclusions for these basins below.

Roadside and conveyance ditches have been designed in accordance with County criteria and sized to accommodate developed flows with 1' of freeboard above the water surface elevation. Ditches with flowrates greater than 5fps will be reinforced with SC250 Vmax TRM (Turf Reinforcement Mat), or equivalent.

provide driveway culvert exhibit as indicated in the plat

Cross culverts at Conestoga Trail South and Irish Hunter Trai d to not overtop the roadway during the 100-year storm event. The inlets and outlets of the proposed culverts will be protected with riprap to aid in erosion control. Future driveway culverts have been sized with an overtopping allowance of 6" during the 100-year storm event, and sizing requirements are tabulated in the appendix. Future engineered site plans for the individual lots will provide final details for the driveway locations and culverts that will be constructed by others. Detailed swale, culvert and riprap calculations, sections and TRM specifications are included in the appendix.

For the purposes of site specific analysis, the project site has been divided into several grouped drainage basins as shown on the proposed drainage plan. **A-group basins** represent flows for basins that are part of Filing 10, along with offsite basins from adjacent filings and **B-group basins** represent flows for basins that are part of future Filing 11. These basins are considered in their anticipated future developed condition for the purposes of this analysis. **Offsite B basins** cover an area that will be impacted by the installation of a water line loop to serve the Filing 10 subdivision. The offsite B basins will be graded to match the anticipated roadway alignment and profile for future Filing 11 but will not be paved at this time. **Offsite C basins** have been established to determine the flows reaching the existing cross culverts on Eastonville Road.

Development of Filing 11 will require confirmation that the actual developed condition does not adversely affect the downstream drainage design presented in this report.

Rational Method Runoff Summary

BASIN	DP	Area (Ac.)	Q_5 (CFS)	Q_{100} (CFS)
OSA1	OSA1	3.68	3.6	7.9
OSA2	OSA2	96.30	29.4	127.3
OSA3	OSA3	69.15	29.3	113.4
OSA4	OSA4	32.65	16.0	60.5
OSA5	OSA5	11.33	7.3	28.1
A1		13.55	7.1	28.8
	1	226.18	69.0	279.5
A2		7.24	3.8	14.7
	2	237.10	73.6	291.6
South Pond Out	2A		17.0	293.5
A3	3	6.48	2.9	12.8
A4		6.03	3.2	13.0
	4	7.26	3.8	16.5
A5		8.02	4.3	17.4
	5	13.26	6.7	27.8
	5A	20.52	9.5	40.0
A6	6	4.02	2.0	7.8
	6A	24.53	10.2	42.2
A7	7	0.63	1.1	2.6
A8	8	7.21	3.1	12.8
	8A	32.36	13.5	54.5
A9	9	3.23	4.3	9.7
A10		0.79	0.2	1.5
	10	36.39	17.3	63.6
A10A		1.28	0.7	2.9
G14b Out			0.8	27.5
	10A	1.28	1.5	30.4
A11		3.61	1.9	7.9
	11	5.20	2.7	11.3
A12	12	2.36	1.4	5.5
	12A	7.56	3.8	15.4
A13		3.34	1.7	7.2
	13	10.48	6.2	24.1
	13A	18.04	9.3	36.8
A14	14	1.25	2.2	4.9
	14A	19.29	10.6	39.0
A15		4.16	1.4	7.3
	15	23.45	11.1	42.9
A15A		2.08	1.1	4.6
G18 Out			0.5	8.7
	15A		1.6	13.3
A16	16	4.41	1.9	8.2
A17	17	4.02	1.9	8.3
A18	18	1.81	0.9	4.0
A19	19	2.40	1.1	4.7
A20	20	2.18	1.5	5.4

BASIN	DP	Area (Ac.)	Q_5 (CFS)	Q_{100} (CFS)
A21	21	0.44	0.1	0.9
A22		0.73	0.7	2.2
	22	3.35	2.2	7.9
A23	23	2.03	1.0	4.5
OSA6	OSA6	1.08	0.9	3.1
A24		11.59	6.5	26.2
	24	19.51	10.0	41.5
	24A	20.59	10.7	43.9
OSA7	OSA7	0.41	0.8	1.7
A25		1.61	2.8	6.3
	25	2.03	3.1	7.0
	25A	22.62	13.4	49.4
A26		4.70	1.9	9.1
	26	27.31	14.1	54.1
A26A		1.00	0.6	2.6
G19 Out		0.00	0.6	33.8
	26A	0.00	1.2	36.4
A27	27	5.25	2.6	11.1
A28	28	2.75	1.4	5.9
A29	29	4.75	2.3	10.0
A30	30	0.61	0.3	1.3
OSA8	OSA8	2.46	1.2	5.2
B1	B1	3.20	1.9	8.0
B2	B2	0.78	0.5	2.1
B3	B3	5.24	2.9	12.5
B4	B4	7.14	5.0	18.9
B5	B5	1.59	1.0	4.2
B6	B6	7.92	4.4	19.0
OSB1	OSB1	5.23	1.0	7.2
OSB2	OSB2	6.41	1.3	9.3
OSB3		3.87	0.8	6.2
	OSB3	10.28	2.2	16.5
OSB4		0.82	0.2	1.7
	OSB4	11.11	2.3	17.4
OSB5	OSB5	1.25	0.4	2.7
OSB6		0.72	0.2	1.6
	OSB6	1.96	0.5	4.0
OSC1		0.27	0.5	1.2
	OSC1	3.63	2.5	8.7
OSC2		0.74	1.2	2.8
	OSC2	10.33	2.9	16.6
OSC3		0.77	1.3	2.9
	OSC3	9.48	3.0	41.7

Basin OSA1 is an offsite basin covering 3.68 acres of Conestoga Trail South to the west of the project site. Flows generated by this basin (Q_5=3.6 cfs and Q_{100}=7.9 cfs) travel via roadside ditch to the south and east before entering Filing 10 at **Design Point DPOSA1.** The roadside ditch from this point is proposed as a triangular section with a minimum of 2' depth to accommodate flows and provide for 1' freeboard.

Basin OSA2 is an offsite basin covering 96.30 acres of Filing 9 to the north of Conestoga Trail South. Flows generated by this basin (Q_5=29.4 cfs and Q_{100}=127.3 cfs) ultimately travel via roadside ditch to the south and east before entering Filing 10 at **Design Point DPOSA2.** The roadside ditch from this point is proposed as a triangular section with a minimum of 3' depth to accommodate flows and provide for 1' freeboard. As the velocity exceeds 5fps, this section will be reinforced with TRM as described above.

Basin OSA3 is an offsite basin covering 69.15 acres of Filing 2-B to the northwest of Filing 10. Flows generated by this basin (Q_5=29.3 cfs and Q_{100}=113.4 cfs) travel via roadside ditch and cross lot drainage ditch to the southeast before entering Filing 10 at **Design Point DPOSA3.** Flows continue on from this point via a redefined trapezoidal ditch with a 10' bottom width and 4:1 side slopes to the southeast. This stretch of ditch through will be reinforced with TRM as described above.

Basin OSA4 is an offsite basin covering 32.65 acres of Filing 7-A to the northwest of Filing 10. Flows generated by this basin (Q_5=16.0 cfs and Q_{100}=60.5 cfs) travel via roadside ditch and cross lot drainage ditch to the southeast before entering Filing 10 at **Design Point DPOSA4.** Flows continue on from this point via a redefined trapezoidal ditch with a 6' bottom width and 4:1 side slopes to the south. This stretch of ditch through will be reinforced with TRM as described above.

Basin OSA5 is an offsite basin covering 11.33 acres of Filing 7-A to the north of Filing 10. Flows generated by this basin (Q_5=7.3 cfs and Q_{100}=28.1 cfs) travel via roadside ditch and cross lot drainage ditch to the south before entering Filing 10 at **Design Point DPOSA5.**

Basin B1 is a 3.20-acres offsite basin located in future Filing 12. This basin is considered in its developed condition in order to adequately size the downstream facilities. Flows generated by this basin (Q_5=1.9 cfs and Q_{100}=8.0 cfs) follow natural drainage patterns to the southwest before entering Filing 10 at **Design Point DPB1.**

Basin A1 is a 13.55-acre onsite basin covering the majority of proposed Lots 22 through 26, north of Conestoga Trail South. Flows generated by this basin (Q_5=7.1 cfs and Q_{100}=28.8 cfs) combine with those from offsite basins OS2-OS5 and Basin B1 and generally follow natural drainage patterns, some redefined, to the south towards **Design Point DP1.** The roadside ditch along the southern boundary of this basin is proposed as a triangular section with a minimum of 4' depth to accommodate flows and provide for 1' freeboard. As the velocity exceeds 5fps, this section will be reinforced with TRM as described above.

Design Point DP1 represents the combined flows of Basins OSA3-OS5, B1 and A1. Flows continue from this point via the proposed 4-36" culverts that crosses under Conestoga Trail South. From there, a redefined trapezoidal ditch with a 10' bottom width and 4:1 side slopes will direct flows towards the existing South Pond detention facility. This stretch of ditch through Lot 2 will be reinforced with TRM as described above. The existing low-tailwater

drop structure is sufficient to accommodate these flows.

Basin A2 (7.24-acres) covers Lot 18 and a portion of proposed Lot 19, south of Conestoga Trail South, along with the South Pond detention facility. Flows generated by this basin (Q_5=3.8 cfs and Q_{100}=14.7 cfs) are directed to the South Pond at **Design Point DP2.**

Design Point DP2 is located at the bottom of the South Pond and represents the flows from Basins OS1 and A2 in addition to those from DP1 to the north. See further discussion below for facility design and discharge rates.

Basin A3 (6.48-acres) covers Lots 20 & 21 and a portion of Lot 19, south of Conestoga Trail South. Flows generated by this basin (Q_5=2.9 cfs and Q_{100}=12.8 cfs) follow natural drainage patterns to the south and **Design Point DP3.** This basin covers an area proposed as large lot single family sites (2.5-acre lots with imperviousness less than 10%). ECM I.7.1.B.5 considers this as an applicable exclusion from post-construction stormwater management requirements. A comparison of flows exiting the site at DP3 versus existing DP1 indicates that this area would experience the following increases in flows in the developed condition: Q_5=1.1 cfs and Q_{100}=0.6 cfs. As these flows are minor, no detention is proposed for this area, and flows will continue to follow the natural drainage path to the southeast without adverse downstream impact.

Basin B2 is a 0.78-acre offsite basin located in future Filing 12 to the north of Filing 10. This basin is considered in its developed condition in order to adequately size the downstream facilities. Flows generated by this basin (Q_5=0.5 cfs and Q_{100}=2.1 cfs) follow natural drainage patterns to the south and **Design Point DPB2.**

Basin A4 (6.03-acres) covers the majority of Lots 27 & 28, north of Conestoga Trail South. Flows generated by this basin (Q_5=3.2 cfs and Q_{100}=13.0 cfs) combine with those from upstream basin B2 and follow natural drainage paths to the south where they are captured by the roadside ditch and carried east to **Design Point DP4.**

Design Point DP4 represents the combined flows of Basins A
this point via roadside ditch to the east. The roadside ditch f
triangular section with a minimum of 2' depth to accomm
freeboard.

Please clarify how any flows that are collected in the stock pond will make its way to the roadside ditch. Assumption is that they will overtop the embankment and continue along the roadside ditch. is any protection needed? concern is the overtopping flows staying within the roadside ditch and not overtopping/damaging the roadway.

Basin B3 is a 5.24-acre offsite basin located in future Filing 1
basin is considered in its developed condition in order to ac
facilities. Flows generated by this basin (Q_5=2.9 cfs and
drainage patterns to the southeast and **Design Point DPB3.**

Basin A5 (8.02-acres) covers the majority of Lots 29-31, north of Conestoga Trail South. Flows generated by this basin (Q_5=4.3 cfs and Q_{100}=17.4 cfs) combine with those from basin B3 and follow natural drainage paths to the south where they are captured by the roadside ditch and carried east to **Design Point DP5.** As noted in the existing condition analysis a stock pond currently exists within this basin and is intended to remain in place. The pond does not routinely hold water and will not be used for detention. As such, any incidental storage was neglected in subsequent pond calculations.

Please provide correspondence from the state that this stock pond is to remain in place.

Design Point DP5 represents the combined flows of Basins A5 and B3.

Design Point DP5A is located where the flows leave Basin A5 and represents the combined flows from DP4 and DP5. Flows continue from this point via roadside ditch to the east. The roadside ditch from this point is proposed as a triangular section with a minimum of 2.5' depth to accommodate flows and provide for 1' freeboard.

Basin A6 (4.02-acres) covers the majority of Lot 32 and portions of Lots 31 & 33, north of Conestoga Trail South. Flows generated by this basin (Q_5=2.0 cfs and Q_{100}=7.8 cfs) are directed south where they are captured by the roadside ditch and carried east to **Design Point DP6.**

Design Point DP6A is located where the flows leave Basin A6 and represents the combined flows of DP5A and DP6. Flows continue from this point via roadside ditch to the east. The roadside ditch from this point is proposed as a triangular section with a minimum of 2.5' depth to accommodate flows and provide for 1' freeboard. As the velocity exceeds 5fps, this section will be reinforced with TRM as described above.

Basin A7 (0.63-acres) covers the eastern side of Irish Hunter Trail just north of Conestoga Trail South. Flows generated by this basin (Q_5=1.1 cfs and Q_{100}=2.6 cfs) follow the roadside ditch to the south where they are intercepted by a proposed public 18" culvert at **Design Point DP7.** Flows continue to the west via the culvert towards Basin A8. The roadside ditch along the west side of this basin is proposed as a triangular section with a minimum of 1.5' depth to accommodate flows and provide for 1' freeboard. As the velocity exceeds 5fps, this section will be reinforced with TRM as described above.

Basin A8 (7.21-acres) covers the majority of Lots 34 & 35 and portions of Lots 32 & 33, at the northwest intersection of Conestoga Trail South & Irish Hunter Trail. Flows generated by this basin (Q_5=3.1 cfs and Q_{100}=12.8 cfs) follow natural drainage paths to the south & east where they are captured by the roadside ditches and carried to the southeast corner and **Design Point DP8.** The roadside ditch along the southern edge of this basin is proposed as a triangular section with a minimum of 3' depth to accommodate flows and provide for 1' freeboard. As the velocity exceeds 5fps, this section will be reinforced with TRM as described above.

Design Point DP8A represents the combined flows of DP 6A, 7 and 8. Flows continue southeast from this point via proposed public 36" culvert to ultimately reach the proposed G14b detention facility.

Basin A9 (3.23-acres) covers the southern half of Conestoga Trail and northern portion of Lots 12 through 17. Flows generated by this basin (Q_5=4.3 cfs and Q_{100}=9.7 cfs) are directed to the roadside ditch and carried east towards a proposed Type D area inlet and low point at **Design Point DP9.** The roadside ditch along this basin is proposed as a triangular section with a minimum of 2' depth to accommodate flows and provide for 1' freeboard.

Basin A10 covers a portion of Lots 11 & 12, south of Conestoga Trail South, and proposed detention facility G14b. Flows generated by this basin (Q_5=0.2 cfs and Q_{100}=1.5 cfs) are directed to the proposed G14b detention facility at **Design Point DP10.**

Design Point DP10 is located at the bottom of Pond G14b and represents the flows from DP8A, 9 and 10. See further discussion below for facility design and discharge rates.

Basin A10A covers the portion of Lots 11 & 12, that will not drain to the G14b detention facility. Flows generated by this basin (Q_5=0.7 cfs and Q_{100}=2.9 cfs) will follow natural drainage patterns to the south towards **Design Point 10A** along the southern boundary of Filing 10, where they will combine with the discharge flows from G14b detention facility (Q_5=0.8 cfs and Q_{100}=27.5 cfs). This basin covers an area proposed as large lot single family site (2.5-acre lots with imperviousness less than 10%). ECM I.7.1.B.5 considers this as an applicable exclusion from post-construction stormwater management requirements.

A comparison of flows exiting the site at DP10A versus existing DP7 indicates that this area would experience the following change in flows in the developed condition: Q_5=(2.8) cfs and Q_{100}=1.3 cfs. As this change is minor, no further treatment is proposed and flows will continue to follow the natural drainage path to the south without adverse downstream impact. See further existing vs. developed discussion below.

Basin B5 is a 1.59-acre offsite basin located in future Filing 12 to the west of Filing 10. This basin is considered in its developed condition in order to adequately size the downstream facilities. Flows generated by this basin (Q_5=1.0 cfs and Q_{100}=4.2 cfs) follow natural drainage paths to the southeast and **Design Point DPB5.**

Basin A11 (3.61-acres) covers the majority of Lot 38 and a portion of Lot 39, west of Irish Hunter Trail. Flows generated by this basin (Q_5=1.9 cfs and Q_{100}=7.9 cfs) combine with those from upstream Basin B5 and follow natural drainage paths to the west where they are intercepted by the roadside ditch and carried to the south to **Design Point DP11.** The roadside ditch from this point is proposed as a triangular section with a minimum of 2' depth to accommodate flows and provide for 1' freeboard.

Design Point DP11 is located where the flows leave Basin A11 and represents the combined flows of Basins A11 and B5.

Basin A12 (2.36-acres) covers the majority of Lot 37 and a portion of Lot 36, west of Irish Hunter Trail. Flows generated by this basin (Q_5=1.4 cfs and Q_{100}=5.5 cfs) are directed east where they are captured by the roadside ditch and carried to the south to **Design Point DP12.** The roadside ditch along this basin is proposed as a triangular section with a minimum of 2' depth to accommodate flows and provide for 1' freeboard.

Design Point DP12A is located where the flows leave Basin A12 and represents the combined flows of DP11 and DP12.

Basin B4 is a 7.14-acre offsite basin located in future Filing 12 to the west of Filing 10. This basin is considered in its developed condition in order to adequately size the downstream facilities. Flows generated by this basin (Q_5=5.0 cfs and Q_{100}=18.9 cfs) will follow natural drainage patterns to the southeast and **Design Point DPB4.** The future development of Filing 12 currently proposes a cul-de-sac and redefined drainage channel for Basin B4. Future design of Filing 12 will need to be analyzed at that time to confirm compatibility with this Filing 10.

Basin A13 covers the majority of Lot 36 and a portion of Lots 35 & 37, west of Irish Hunter Trail. Flows generated by this basin (Q_5=1.7 cfs and Q_{100}=7.2 cfs) combine with those from Basin B4 and are directed east via redefined drainage channel where they are captured by the roadside ditch and carried to **Design Point DP13.** The roadside ditch along this basin is proposed as a triangular section with a minimum of 2.5' depth to accommodate flows and provide for 1' freeboard. As the velocity exceeds 5fps, this section will be reinforced with TRM as described above. The redefined drainage ditch through this area has been designed as a trapezoidal ditch with a 3' bottom width and 4:1 side slopes.
Design Point DP13A is located where the flows leave Basin A13 at a 36" culvert that crosses under Irish Hunter Trail to the east and represents the combined flows of DPB4, 12A and 13.

Basin A14 covers the eastern half of Irish Hunter Trail and the western portion of Lots 5-8. Flows generated by this basin (Q_5=2.2 cfs and Q_{100}=4.9 cfs) are directed to the roadside ditch and carried to the south towards **Design Point DP14.** The roadside ditch from this point is proposed as a triangular section with a minimum of 2' depth to accommodate flows and provide for 1' freeboard.

Design Point DP14A is located where the flows leave Basin A14 and represents the combined flows from DP13A and 14. Flows continue on from this point via a redefined trapezoidal ditch with a 3' bottom width and 4:1 side slopes, and will direct flows towards the proposed G18 detention facility. This stretch of ditch through will be reinforced with TRM as described above. A low-tailwater drop structure with receive these flows before discharge into the proposed detention facility.

Basin A15 covers Lots 6 through 8 and a portion of Lots 9 & 10, east of Irish Hunter Trail, along with the proposed detention facility G18. Flows generated by this basin (Q_5=1.4 cfs and Q_{100}=7.3 cfs) follow natural drainage paths that carry the flows to **Design Point DP15.**

Design Point DP15 is located at the bottom of Pond G18 and represents the flows from DP14A and Basin A15.

Basin A15A covers the portion of Lots 8, 9 & 10, that will not drain to the G18 detention facility. Flows generated by this basin (Q_5=1.1 cfs and Q_{100}=4.6 cfs) will follow natural drainage patterns to the east towards **Design Point 15A** along the eastern boundary of Filing 10, where they will combine with the discharge flows from G18 detention facility (Q_5=0.5 cfs and Q_{100}=8.7 cfs). This basin covers an area proposed as a large lot single family site (2.5-acre lots with imperviousness less than 10%). ECM I.7.1.B.5 considers this as an applicable exclusion from post-construction stormwater management requirements.

A comparison of flows exiting the site at DP15A versus existing DP10 indicates that this area would experience the following change in flows in the developed condition: Q_5=(0.4) cfs and Q_{100}=0.2 cfs. As this change is minor, no further treatment is proposed and flows will continue to follow the natural drainage path to the south without adverse downstream impact. See further existing vs. developed discussion below.

Basin OSC2 covers an offsite area along the west side of Eastonville Road adjacent to the Filing 10 site. Flows generated by this basin (Q_5=1.2 cfs and Q_{100}=2.8 cfs) combine with flows from DP28, DP29, DP15A, DPOSC2 and Pond G18 outflow and are captured by an existing public 30"x42" HERCP culvert at **Design Point DPOSC2** and continue across Eastonville Road

following existing drainage patterns to the east.

A comparison of flows at DPOSC2 versus *existing DPOSC2* indicates that this area would experience the following reduction in flows in the developed condition: Q_5=(3.3) cfs and Q_{100}=(21.7) cfs.

Basin A16 covers the majority of Lots 16 & 17, south of Conestoga Trail South. Flows generated by this basin (Q_5=1.9 cfs and Q_{100}=8.2 cfs) follow natural drainage patterns to the south and **Design Point DP16** along the southern boundary of Filing 10**.** This basin covers an area proposed as large lot single family sites (2.5-acre lots with imperviousness less than 10%). ECM I.7.1.B.5 considers this as an applicable exclusion from post-construction stormwater management requirements.

A comparison of flows exiting the site at DP16 versus existing DP3 indicates a significant reduction in flows in the developed condition: Q_5=(0.8) cfs and Q_{100}=(9.9) cfs. As the developed flows are less than existing in this location, no detention is proposed for this area, and flows will continue to follow the natural drainage path to the south, without adverse downstream impact.

Basin A17 covers the majority of Lots 14 & 15, south of Conestoga Trail South. Flows generated by this basin (Q_5=2.1 cfs and Q_{100}=8.9 cfs) are directed south to **Design Point DP17** along the southern boundary of Filing 10**.** This basin covers an area proposed as large lot single family sites (2.5-acre lots with imperviousness less than 10%). ECM I.7.1.B.5 considers this as an applicable exclusion from post-construction stormwater management requirements.

A comparison of flows exiting the site at DP17 versus existing DP4 indicates that this area would experience the following increases in flows in the developed condition: Q_5=0.8 cfs and Q_{100}=0.7 cfs. As these flows are minor, no detention is proposed for this area, and flows will continue to follow the natural drainage path to the southeast, without adverse downstream impact.

Basin A18 covers a portion of Lots 13 & 14, south of Conestoga Trail South. Flows generated by this basin (Q_5=0.9 cfs and Q_{100}=4.1 cfs) are directed south to **Design Point DP18** along the southern boundary of Filing 10**.** This basin covers an area proposed as large lot single family sites (2.5-acre lots with imperviousness less than 10%). ECM I.7.1.B.5 considers this as an applicable exclusion from post-construction stormwater management requirements.

A comparison of flows exiting the site at DP18 versus existing DP5 indicates a significant reduction in flows in the developed condition: Q_5=(2.3) cfs and Q_{100}=(17.6) cfs. As the developed flows are less than existing in this location, no detention is proposed for this area, and flows will continue to follow the natural drainage path to the south, without adverse downstream impact. See further existing vs. developed discussion below.

Basin A19 covers a portion of Lots 12 & 13, south of Conestoga Trail South. Flows generated by this basin (Q_5=1.1 cfs and Q_{100}=4.7 cfs) are directed south to **Design Point DP19** along the southern boundary of Filing 10**.** This basin covers an area proposed as large lot single family sites (2.5-acre lots with imperviousness less than 10%). ECM I.7.1.B.5 considers this as an applicable exclusion from post-construction stormwater management requirements.

A comparison of flows exiting the site at DP19 versus existing DP6 indicates a significant reduction in flows in the developed condition: Q_5=(0.8) cfs and Q_{100}=(8.2) cfs. As the developed flows are less than existing in this location, no detention is proposed for this area, and flows will continue to follow the natural drainage path to the south, with adverse impact downstream. See further existing vs. developed discussion below.

Basin A20 covers a portion of Lots 9 & 10, north of Conestoga Trail South. Flows generated by this basin (Q_5=1.5 cfs and Q_{100}=5.4 cfs) are directed south where they are captured by the roadside ditch and carried east to **Design Point DP20** where they are captured by a proposed public 18" culvert and discharged to the south into existing roadside ditch along Eastonville Road. The roadside ditch along the north side of this basin is proposed as a triangular section with a minimum of 2' depth to accommodate flows and provide for 1' freeboard. This basin will discharge without detention or treatment for water quality due to the grading required to connect to the existing Eastonville Road. However, the adjacent Pond G14b has been oversized to include an equivalent basin area and imperviousness to offset the detention requirement and the following two exclusions from water quality treatment are believed to be applicable for this basin:

- 0.43-acres of public right-of-way, falls under ECM I.7.C.1.a which considers up to 20% (not to exceed 1-acre), of the applicable development where it is not practicable to capture runoff.
- 1.75-acres of lots 9 & 10, falls under ECM I.7.1.B.5, which considers an area proposed as large lot single family sites (2.5-acre lots with imperviousness less than 10%).

Basin A21 covers a portion of Lot 11, south of Conestoga Trail South adjacent to Eastonville Road. Flows generated by this basin (Q_5=0.1 cfs and Q_{100}=0.9 cfs) are directed east to **Design Point DP21** before discharging into the existing roadside ditch along Eastonville Road. This basin covers a potion of Lot 11 along Eastonville Road that is encumbered by easements and setbacks, as such it can be considered to remain undeveloped. This basin also technically covers an area proposed as large lot single family sites (2.5-acre lots with imperviousness less than 10%). ECM I.7.1.B.5 considers this as an applicable exclusion from post-construction stormwater management requirements.

Basin A22 covers the southern half of Conestoga Trail and northern portion of Lot 11. Flows generated by this basin (Q_5=0.7 cfs and Q_{100}=2.2 cfs) are directed to the roadside ditch and carried east to **Design Point DP22.** The roadside ditch along this basin is proposed as a triangular section with a minimum of 1.5' depth to accommodate flows and provide for 1' freeboard. This basin will discharge without detention or treatment for water quality due to the grading required to connect to the existing Eastonville Road. However, the adjacent Pond G14b has been oversized to include an equivalent basin area and imperviousness to offset the detention requirement and the following two exclusions from water quality treatment are believed to be applicable for this basin:

- 0.30-acres of public right-of-way, falls under ECM I.7.C.1.a which considers up to 20% (not to exceed 1-acre), of the applicable development where it is not practicable to capture runoff.
- 0.43-acres of lot 11, falls under ECM I.7.1.B.5, which considers an area proposed as large lot single family sites (2.5-acre lots with imperviousness less than 10%).

Design Point DP22 is located on the east side of Basin A22 and represents the combining of upstream flows from Basins A20, A21 and A22.

Basin OSC1 covers an offsite area along the west side of Eastonville Road at the south end of the Filing 10 site. Flows generated by this basin (Q_5=0.5 cfs and Q_{100}=1.2 cfs) combine with flows from DP22 and are captured by an existing public 18" CMP culvert at **Design Point DPOSC1** and continue across Eastonville Road following existing drainage patterns to the east.

A comparison of flows at DPOSC1 versus *existing DPOSC1* indicates that this area would experience the following increases in flows in the developed condition: Q_5=1.5 cfs and Q_{100}=3.6 cfs. See further existing vs. developed discussion below.

Basin A23 covers the majority of Lot 11, south of Conestoga Trail South. Flows generated by this basin (Q_5=1.0 cfs and Q_{100}=4.5 cfs) follow natural drainage patterns south to **Design Point DP23** along the southern boundary of Filing 10**.** This basin covers an area proposed as a large lot single family site (2.5-acre lots with imperviousness less than 10%). ECM I.7.1.B.5 considers this as an applicable exclusion from post-construction stormwater management requirements.

A comparison of flows exiting the site at DP23 versus existing DP8 indicates that this area would experience the following increases in flows in the developed condition: Q_5=0.4 cfs and Q_{100}=0.2 cfs. As these flows are minor, no detention is proposed for this area, and flows will continue to follow the natural drainage path to the southeast, without adverse downstream impact. See further existing vs. developed discussion below.

Basin OSA6 is an offsite basin just north of Lot 43, west of Irish Hunter Trail at the north end of Filing 10. This basin will be graded to accommodate the offsite water loop, but will remain unpaved at this time. However, for this analysis it is considered in its developed condition in order to adequately size the downstream facilities. Flows generated by this basin (Q_5=0.9 cfs and Q_{100}=3.1 cfs) follow the roadside ditch to the south and **Design Point DPOSA6.**

Basin B6 is a 7.92-acre offsite basin located in future Filing 12 to the west of Filing 10. This basin is considered in its developed condition in order to adequately size the downstream facilities. Flows generated by this basin (Q_5=4.4 cfs and Q_{100}=19.0 cfs) are directed to **Design Point DPB6.**

Basin A24 covers the majority of Lots 39 through 43, west of Irish Hunter Trail. Flows generated by this basin (Q_5=6.5 cfs and Q_{100}=26.2 cfs) combine with those from OSA6 and Basin B6 and follow natural drainage paths to the east where they are captured by the roadside ditch and carried south to a low point at **Design Point DP24.** The roadside ditch along this basin is proposed as a triangular section with a minimum of 2.5' depth to accommodate flows and provide for 1' freeboard. As the velocity exceeds 5fps, this section will be reinforced with TRM as described above.

Design Point DP24A is located where the flows leave Basin A24 via a 36" culvert that crosses under Irish Hunter Trail to the east and represents the combined flows of DPB6, DP24 and OSA2. Flows continue on from this point via a redefined trapezoidal ditch with a 3' bottom width and 4:1 side slopes, and will direct flows towards the proposed G19 detention facility.

please also account for flows from OSA6.

A low-tailwater drop structure with receive these flows before discharge into the proposed detention facility.

Basin OSA7 is an offsite basin just north of Lot 1, east of Irish Hunter Trail at the north end of Filing 10. This basin will be graded to accommodate the offsite water loop, but will remain unpaved at this time. However, for this analysis it is considered in its developed condition in order to adequately size the downstream facilities. Flows generated by this basin (Q_5=0.8 cfs and Q_{100}=1.7 cfs) follow the roadside ditch to the south and **Design Point DPOSA7.**

Basin A25 covers the eastern half of Irish Hunter Trail and the western portion of Lots 3&4. Flows generated by this basin (Q_5=2.8cfs and Q_{100}=6.3 cfs) are directed to the roadside ditch and carried to a low point at **Design Point DP25.** The roadside ditch along this basin is proposed as a triangular section with a minimum of 2.5' de ows and provide for 1' freeboard.

please also account for flows from OSA7

Design Point DP25A is located where the flows leave Basin A25 via a redefined drainage ditch and represents the combined flows from DP24A and DP25.

Basin A26 covers Lots 1 through 4, east of Irish Hunter Trail. Flows gener (Q_5=1.9 cfs and Q_{100}=9.1 cfs) are directed to **Design Point DP26.**

Design Point DP26 is located at the bottom of Pond G19 and represer DP25A, OSA4 and Basin A26.

please identify the conveyance of flows to the pond and the protection provided at the inflow to the pond as described with DP14A

Basin A26A covers the portion of Lots 3&4, that will not drain to the G19 Flows generated by this basin (Q_5=0.6 cfs and Q_{100}=2.6 cfs) will follow natural drainage patterns to the east towards **Design Point 26A** along the eastern boundary of Filing 10, where they will combine with the discharge flows from G19 detention facility (Q_5=0.6 cfs and Q_{100}=33.8 cfs). This basin covers an area proposed as a large lot single family site (2.5-acre lots with imperviousness less than 10%). ECM I.7.1.B.5 considers this as an applicable exclusion from post-construction stormwater management requirements.

A comparison of flows exiting the site at DP26A versus existing DP13 indicates that this area would experience the following change in flows in the developed condition: Q_5=(4.1) cfs and Q_{100}=0.6 cfs. See further existing vs. developed discussion below.

Basin A27 covers the portion of Lots 1 & 2, that will follow natural drainage patterns to the east towards **Design Point 27** along the eastern boundary of Filing 10 at rates of Q_5=2.6 cfs and Q_{100}=11.1 cfs. This basin covers an area proposed as a large lot single family site (2.5-acre lots with imperviousness less than 10%). ECM I.7.1.B.5 considers this as an applicable exclusion from post-construction stormwater management requirements.

A comparison of flows exiting the site at DP27 versus existing DP14 indicates that this area would experience the following changes in flows in the developed condition: Q_5=0.6 cfs and Q_{100}=(2.3) cfs. See further existing vs. developed discussion below.

Basin A28 covers the portion of Lots 4 & 5, that will follow natural drainage patterns to the east towards **Design Point 28** along the eastern boundary of Filing 10 at rates of Q_5=1.4 cfs and Q_{100}=5.9 cfs. This basin covers an area proposed as a large lot single family site (2.5-

acre lots with imperviousness less than 10%). ECM I.7.1.B.5 considers this as an applicable exclusion from post-construction stormwater management requirements.

A comparison of flows exiting the site at DP28 versus existing DP12 indicates that this area would experience the following reduction in flows in the developed condition: Q_5=(1.2) cfs and Q_{100}=(11.4) cfs. See further existing vs. developed discussion below.

Basin A29 covers the portion of Lots 6 & 7, that will follow natural drainage patterns to the east towards **Design Point 29** along the eastern boundary of Filing 10 at rates of Q_5=2.3 cfs and Q_{100}=10.0 cfs. This basin covers an area proposed as a large lot single family site (2.5-acre lots with imperviousness less than 10%). ECM I.7.1.B.5 considers this as an applicable exclusion from post-construction stormwater management requirements.

A comparison of flows exiting the site at DP29 versus existing DP11 indicates that this area would experience the following changes in flows in the developed condition: Q_5=0.5 cfs and Q_{100}=(2.2) cfs. See further existing vs. developed discussion below.

Basin OSA8 is an offsite basin just north of Lot 1, east of Irish Hunter Trail. Flows generated by this basin (Q_5=1.2 cfs and Q_{100}=5.2 cfs) follow natural drainage patterns to the east and **Design Point DPOSA8.** This basin is not being developed as part of Filing 10, but is considered in this analysis as it is tributary to the existing public 36" cross culvert on Eastonville Road. See further existing vs. developed discussion below.

A comparison of flows exiting the site at DPOSA8 versus *existing DPOSA6* indicates that this area would experience the following changes in flows in the developed condition: Q_5=0.4 cfs and Q_{100}=(0.3) cfs. See further existing vs. developed discussion below.

Basin OSC3 covers an offsite area along the west side of Eastonville Road adjacent to the Filing 10 site. Flows generated by this basin (Q_5=1.3 cfs and Q_{100}=2.9 cfs) combine with flows from DP26A, DP27, DPOSA8, DPOSC3 and Pond G19 outflow and are captured by an existing public 36" CMP culvert at **Design Point DPOSC3** and continue across Eastonville Road following existing drainage patterns to the east.

A comparison of flows at DPOSC3 versus *existing DPOSC3* indicates that this area would experience the following reduction in flows in the developed condition: Q_5=(6.0) cfs and Q_{100}=(15.0) cfs.

Basin A30 covers a small 0.61-acre area at the northwestern corner of Filing 10. This basin sits within the Upper Black Squirrel drainage basin. Flows generated by this basin (Q_5=0.3 cfs and Q_{100}=1.3 cfs) will follow natural drainage paths to the northwest into the adjacent Filing 12. This area will need to be analyzed as part of the Filing 12 development to ensure adequate sizing of downstream facilities.

The following offsite B basins cover an area that will be impacted by the installation of a water line loop to serve the Filing 10 subdivision. These basins will be graded to accommodate the offsite water loop but will remain unpaved at this time. Future analysis for Filings 11 and 12 will require consideration of these basins in their developed condition.

Basin OSB1 covers an offsite area to the north of the B basins tributary to Filing 10. Flows generated by this basin (Q_5=1.3 cfs and Q_{100}=9.4 cfs) are directed north to **Design Point DPOSB1** via roadside ditch. Although this basin will be regraded, there is no proposed change in impervious coverage, and as such no detention is necessary. A temporary sediment basin will be installed at DPOSB1, allowing for settlement of sediment and flow attenuation prior to discharge.

revise to private. Once this roadway is constructed and platted it would become public

Basin OSB2 covers an offsite area to the north and generated by this basin (Q_5=1.8 cfs and Q_{100}=13.0 cfs) are directe ds **Design Point DPOSB2**.

Basin OSB3 covers an offsite area to the north and west of Basin OSB2. Flows generated by this basin (Q_5=0.9 cfs and Q_{100}=6.6 cfs) are directed north and east towards **Design Point DPOSB3** where they will combine with flows from OSB1 and OSB2, be captured by a proposed public 36" culvert, and discharge via historic drainage patterns to the north.

Basin OSB4 covers an offsite area to the north of Basin OSB3. Flows generated by this basin (Q_5=0.2 cfs and Q_{100}=1.7 cfs) are directed northeast to **Design Point DPOSB4** where they combine with discharge flows from the proposed public 36" culvert and discharge following historic drainage patterns to the north. Although the upstream basins will be regraded, there is no proposed change in impervious coverage, and as such no detention is necessary. A temporary sediment basin will be installed at DPOSB4, allowing for settlement of sediment and flow attenuation prior to discharge.

Basin OSB5 covers an offsite area to the north of Basin OSA6. Flows generated by this basin (Q_5=0.4 cfs and Q_{100}=2.7 cfs) are directed east towards **Design Point DPOSB5** where they will be captured by a proposed public 18" culvert, and discharged to the east.

Basin OSB6 covers an offsite area to the north and east of Basin OSB5. Flows generated by this basin (Q_5=0.2 cfs and Q_{100}=1.6 cfs) are directed north and east towards **Design Point DPOSB6** where they combine with discharge flows from the proposed public 18" culvert and discharge following historic drainage patterns to the east. Although the upstream basins will be regraded, there is no proposed change in impervious coverage, and as such no detention is necessary. A temporary sediment basin will be installed at DPOSB6, allowing for settlement of sediment and flow attenuation prior to discharge.

revise to private

10.0 PROPOSED FULL-SPECTRUM DETENTION FACILITIES

Existing South Pond

The existing South Pond was originally built with the development of Filing 7 and re-analyzed with the development of Filing 9 with modifications currently under construction. The Filing 9 analysis determined that an upstream watershed of 237.1-acres at 13.8% impervious was tributary to the South Pond, resulting in developed flows of Q_5=92 cfs and Q_{100}=347 cfs. This analysis accounts for the final design of this filing and results in a slightly lower imperviousness (13.3%) and subsequent flowrates (Q_5=74 cfs and Q_{100}=292 cfs). The MHFD spreadsheet with the modified imperviousness has been included in the appendix for reference, but as the impact to the detention facility is minor, no changes are proposed.

Proposed Pond G14b

The G14b facility is proposed as a private full-spectrum Extended Detention Basin (EDB). MHFD-Detention v4.06 calculations are provided in the appendix. Based on a watershed area of 38.85 acres, with an effective site imperviousness of 15.16%, the required pond volume for 100-yr detention is 1.72 acre-ft.

Flows enter the facility via 36" storm pipe and discharge directly into a concrete forebay. The forebay volume was calculated based on 3% of the WQCV volume. The forebay includes a dissipater as the flows enter, and a notch through which to exit to the trickle channel. In order to release the flows from the forebay at 2% of the peak 100-yr inflow the forebay has a minimum 6" wide notch. A 7' wide concrete trickle channel will run along the bottom of the pond from the forebay to the micropool.

The outlet structure will consist of a modified Type C outlet structure with an orifice plate and a grate on top. The orifice plate will have two 1.62 sq. inch orifices. The elevation of the grate is set at 7063.81, which is below the 100-year detention volume elevation. The outlet pipe has been set as a 24" private storm pipe, with a restrictor plate set 14" above invert that will release the 100-year flow at less than historic rates, in order to match the existing release rate at that discharge location. The outlet pipe discharges to the south following historic drainage patterns. A low impact tailwater basin will be installed just downstream of the pipe outfall to mitigate the impact of the concentrated discharge point downstream. With these release rates the WQCV will drain in 40 hours, the EURV in 61 hours, and the 100-year storm volume in 59 hours. Given the smaller change in impervious coverage between the pre-developed and developed condition, the WQCV drain time becomes the controlling factor for the orifice plate. The lowest orifice hole has been sized to release the WQCV within 40 hours, the second hole is sized accordingly and results in a 61 hour release rate for the EURV.

A 30' long spillway is located on the south side of the pond and is placed 1.80' below the crest of the pond to allow for 1' of freeboard above the spillway design flow depth. In the event that water overtops the spillway, it will discharge to the south following historic drainage patterns.

Proposed Pond G18

The G18 facility is proposed as a private full-spectrum Extended Detention Basin (EDB). MHFD-Detention v4.06 calculations are provided in the appendix. Based on a watershed area of 23.45 acres, with an effective site imperviousness of 12.74%, the required pond volume for 100-yr detention is 0.953 acre-ft.

Incoming swale flows will be received by a proposed Type L riprap rock chute (see appendix for calculations), before discharging into a proposed riprap low-tailwater basin (LTWB) at the base of the riprap rundown into the detention facility. This LTWB design was based on sizing guidance from MHFD Volume 2, Figures 9-37 and 9-39, equating the trapezoidal swale wetted perimeter as equivalent to a rectangular box culvert.

Pond G18	Top Width (ft)	Flow Depth + 1' freeboard (ft)
Trapezoidal Swale	11.8	2.1
Equivalent Box Culvert	12.0	2.5

From there, LTWB sizing was determined as D=1.5', W=12' and L=20', to be protected by Type L riprap. See appendix for calculations. The LTWB is proposed to discharge into a 7-ft wide concrete trickle channel along the bottom of the facility towards the proposed micropool and outlet structure.

The outlet structure will consist of a modified Type C outlet structure with an orifice plate and a grate on top. The orifice plate will have two 1.25 sq. inch orifices. The elevation of the grate is set at 7052.56, which is below the 100-year detention volume elevation. The outlet pipe has been set as an 18" private storm pipe with a restrictor plate set 8" above invert that will release the 100-year flow at less than historic rates, in order to match the existing release rate at that discharge location. The outlet pipe discharges to the east into the roadside ditch along the west side of Eastonville Road following historic drainage patterns. With these release rates the WQCV will drain in 40 hours, the EURV in 62 hours, and the 100-year storm volume in 60 hours. Given the smaller change in impervious coverage between the pre-developed and developed condition, the WQCV drain time becomes the controlling factor for the orifice plate. The lowest orifice hole has been sized to release the WQCV within 40 hours, the second hole is sized accordingly and results in a 62 hour release rate for the EURV.

A 25' long spillway is located on the east side of the pond and is placed 1.52' below the crest of the pond to allow for 1' of freeboard above the spillway design flow depth. In the event that water overtops the spillway, it will discharge to the east following historic drainage patterns.

Maintenance access will be provided and is further outlined in the detention facility construction documents.

Proposed Pond G19

The G19 facility is proposed as a private full-spectrum Extended Detention Basin (EDB). MHFD-Detention v4.06 calculations are provided in the appendix. Based on a watershed area of 27.31 acres, with an effective site imperviousness of 13.04%, the required pond volume for 100-yr detention is 1.12 acre-ft.

Incoming swale flows will be received by a proposed Type L riprap rock chute (see appendix for calculations), before discharging into a proposed riprap low-tailwater basin (LTWB) at the base of the riprap rundown into the detention facility. This LTWB design was based on sizing guidance from MHFD Volume 2, Figures 9-37 and 9-39, equating the trapezoidal swale wetted perimeter as equivalent to a rectangular box culvert.

Pond G19	Top Width (ft)	Flow Depth + 1' freeboard (ft)
Trapezoidal Swale	11.8	2.1
Equivalent Box Culvert	12.0	2.5

From there, LTWB sizing was determined as D=1.5', W=12' and L=20', to be protected by Type L riprap. See appendix for calculations. The LTWB is proposed to discharge into a 6-ft wide concrete trickle channel along the bottom of the facility towards the proposed micropool and outlet structure.

The outlet structure will consist of a modified Type C outlet structure with an orifice plate and a grate on top. The orifice plate will have two 1.50 sq. inch orifices. The elevation of the grate is set at 7059.50, which is below the 100-year detention volume elevation. The outlet pipe has been set as a 30" private storm pipe with a restrictor plate set 21" above invert that will release the 100-year flow at less than historic rates, in order to match the existing release rate at that discharge location. The outlet pipe discharges to the east into the roadside ditch along the west side of Eastonville Road following historic drainage patterns. With these release rates the WQCV will drain in 40 hours, the EURV in 61 hours, and the 100-year storm volume in 80 hours. Given the smaller change in impervious coverage between the pre-developed and developed condition, the WQCV drain time becomes the controlling factor for the orifice plate. The lowest orifice hole has been sized to release the WQCV within 40 hours, the second hole is sized accordingly and results in a 61 hour release rate for the EURV.

A 25' long spillway is located on the east side of the pond and is placed 3' below the crest of the pond to allow for 1' of freeboard above the spillway design flow depth. In the event that water overtops the spillway, it will discharge to the east following historic drainage patterns.

Maintenance access will be provided and is further outlined in the detention facility construction documents.

please discuss the condition of the existing culverts crossing Eastonville road.

Also, please discuss the adequacy of the Eastonville roadside ditch. There are increase in flows within the ditch such as DP21 that need to be addressed.

11.0 EXISTING VS. D

See below for a com ped condition:

Existing			Developed			Change	
DP	**Q_5 (CFS)**	**Q_{100} (CFS)**	**DP**	**Q_5 (CFS)**	**Q_{100} (CFS)**	**Q_5 (CFS)**	**Q_{100} (CFS)**
1	1.8	12.2	3	2.9	12.8	1.1	0.6
2A	73.5	295.9	2A	17.0	293.5	(56.5)	(2.4)
3	2.7	18.2	16	1.9	8.2	(0.8)	(9.9)
4	1.1	7.6	17	1.9	8.3	0.8	0.7
5	3.2	21.6	18	0.9	4.0	(2.3)	(17.6)
6	1.9	12.9	19	1.1	4.7	(0.8)	(8.2)
7	4.3	29.1	10A	1.5	30.4	(2.8)	1.3
8	0.6	4.4	23	1.0	4.5	0.4	0.2
9	0.6	4.4	22	2.2	7.9	1.5	3.6
10	1.9	13.1	15A	1.6	13.3	(0.4)	0.2
11	1.8	12.2	29	2.3	10.0	0.5	(2.2)
12	2.6	17.3	28	1.4	5.9	(1.2)	(11.4)
13	5.3	35.8	26A	1.2	36.4	(4.1)	0.6
14	2.0	13.4	27	2.6	11.1	0.6	(2.3)
OSA6	0.8	5.4	OSA8	1.2	5.2	0.4	(0.3)
OSB1	0.2	1.5	OSB1	1.0	7.2	0.8	5.8
OSB2	2.5	17.1	OSB4	2.3	17.4	(0.2)	0.2
OSB3	0.6	4.1	OSB6	0.5	4.0	(0.1)	(0.1)
Existing	**107.5**	**526.1**	**Developed**	**44.5**	**484.8**	**(63.1)**	**(41.3)**

The following table illustrates the comparison between existing and developed rates at the three cross culverts at Eastonville Road.

Existing			Developed			Change	
DP	**Q_5 (CFS)**	**Q_{100} (CFS)**	**DP**	**Q_5 (CFS)**	**Q_{100} (CFS)**	**Q_5 (CFS)**	**Q_{100} (CFS)**
OSC1	1.0	5.1	OSC1	2.5	8.7	1.5	3.6
OSC2	6.2	38.3	OSC2	2.9	16.6	(3.3)	(21.7)
OSC3	9.0	56.7	OSC3	3.0	41.7	(6.0)	(15.0)

As indicated above, the majority of the developed flows exiting the site are equal to - within an acceptable tolerance vs from the existing condition is a resu posed detention facilities, and subsec pective outfalls.

pleases also address DP 10A. Analyze the downstream for adequacy as the concentrated increase in flows can have adverse affects to the downstream. The pond may be sized to overdetain to meet historic flows.

In two locations the existing flows are exceeded significantly enough to warrant further discussion:

- DP22/DPOSC1 Delta: Q_5=1.5 cfs and Q_{100}=3.6 cfs. This necessitated by the Conestoga Trail South tie Detention Pond G14b has been oversized to acco

70% increase in flows would not be supported by staff. per stormwaters comments the associated basins need water quality treatment also. Please revise flows as necessary with the proposed treatment for this area. hopefully the treatment can provide some attenuation for the flows.

size and imperviousness, and applicable exceptions for water quality treatment are noted above. The existing 18" CMP that crosses Eastonville Road, and the downstream open drainage are both of sufficient capacity accommodate the developed flow rate without adverse impact downstream. See appendix for culvert and open channel calculations.

- OSB1 Delta: Q_5=0.8 cfs and Q_{100}=5.8 cfs. This basin covers an offsite area affected by grading for the water line loop required with the development of Filing 10. The watershed area is greater in the developed condition than the existing, which has resulted in greater flows at this location. The proposed temporary sediment basin to be installed at DPOSB1 will aid in attenuation of these flows before releasing along historic flow paths. This area will be paved as part of the future Filing 11/12 development and will be treated for water quality and detention at that time.

12.0 FOUR-STEP PROCESS

1. ***Employ Runoff Reduction Practices*:** The development of this project is proposed as single-family residential (2.5-acre). Roadways will utilize grass-lined roadside ditches to minimize directly connected impervious areas within the project site, while allowing for increased infiltration and reduced runoff volume.

2. ***Implement CM's that provide a Water Quality Capture Volume with slow release*:** The majority of runoff generated by this project will be treated through capture and slow release of the WQCV in one of four (3 proposed, 1 existing) permanent full spectrum extended detention facilities designed per current drainage criteria. The areas tributary to each of the detention facilities are described above. This project is also eligible for MS4 permit exclusions as noted above.

3. ***Stabilize Drainage Ways*:** This site will utilize roadside ditches with culvert crossings throughout the site. The roadside ditches will direct developed flows to the detention facilities, to be released at or below historic rates. In reaches where velocities exceed 5fps, the ditches are proposed to be reinforced with turf reinforcement mats.

4. ***Implement Site Specific and Other Source Control CM's*:** Standard residential source control will be utilized in order to minimize potential pollutants entering the drainage system. Site specific permanent and temporary source control BMPs will be established by the Stormwater Quality and Control Plan for the project to protect receiving waters.

13.0 COST ESTIMATE

Private Detention Pond G14b				
Concrete Forebay	1	EA	$ 5,000.00	$ 5,000.00
Concrete Trickle Channel	894	SF	$ 15.00	$ 13,416.00
Concrete Micropool	1	EA	$ 3,500.00	$ 3,500.00
Modified Type C Outlet Structure	1	EA	$ 10,000.00	$ 10,000.00
24" Outlet Pipe	84	LF	$ 98.00	$ 8,260.52
Gravel Maintenance Access	5600	SF	$ 0.50	$ 2,800.00
Emergency Spillway	116	CY	$ 70.00	$ 8,116.11
			G14b Subtotal	$ 51,092.63

Private Detention Pond G18				
Low Tailwater basin - Type L Riprap	44	CY	$ 70.00	$ 3,048.89
Concrete Trickle Channel	803	SF	$ 15.00	$ 12,049.50
Concrete Micropool	1	EA	$ 3,500.00	$ 3,500.00
Modified Type C Outlet Structure	1	EA	$ 10,000.00	$ 10,000.00
18" Outlet Pipe	81	LF	$ 82.00	$ 6,642.98
Maintenance Access	4850	SF	$ 0.50	$ 2,425.00
Spillway - Type L Riprap	89	CY	$ 70.00	$ 6,198.89
			G18 Subtotal	$ 43,865.26

Private Detention Pond G19				
Low Tailwater basin - Type L Riprap	58	CY	$ 70.00	$ 4,032.78
Concrete Trickle Channel	1212	SF	$ 15.00	$ 18,177.00
Concrete Micropool	1	EA	$ 3,500.00	$ 3,500.00
Modified Type C Outlet Structure	1	EA	$ 10,000.00	$ 10,000.00
30" Outlet Pipe	87	LF	$ 123.00	$ 10,697.56
Maintenance Access	6060	SF	$ 0.50	$ 3,030.00
Spillway - Type L Riprap	92	CY	$ 70.00	$ 6,412.78
			G19 Subtotal	$ 55,850.11

	Detention Facility Total	$ 150,808.00

14.0 DRAINAGE/BRIDGE FEES

The majority of Filing 10 (124.967 acres) sits within the Gieck Ranch Basin (CHMS0400), which is not in the El Paso County Drainage Basin Fee program. A small (0.61-acre) portion of the Filing 10 site lies within The Upper Black Squirrel Basin. As such, the following drainage and bridge fees are due at the time of plat recordation.

Black Squirrel Creek 2025 Fees

Impervious acreage: 0.61-acres at 9% impervious = 0.06 acres

Drainage:	$12,120 x 0.06 =	$677.50
Bridge:	$763 x 0.06 =	$42.65

15.0 SUMMARY

The Latigo Trails Filing No. 10 project has been designed in accordance with El Paso County criteria. The full-spectrum detention facilities have been designed to limit the release of storm runoff to historic flows. This development will not negatively impact the downstream facilities.

16.0 REFERENCES

The sources of information used in the development of this study are listed below:

1. El Paso County Drainage Criteria Manual, October 2018.

2. El Paso County Engineering Criteria Manual, October 2020.

3. Urban Storm Drainage Criteria Manuals, Urban Drainage and Flood Control District. June 2001, Revised April 2008.

4. Natural Resources Conservation Service (NRCS) Web Soil Survey

5. Final Drainage Report for The Trails Filing No. 7 Subdivision, by URS, March 2005.

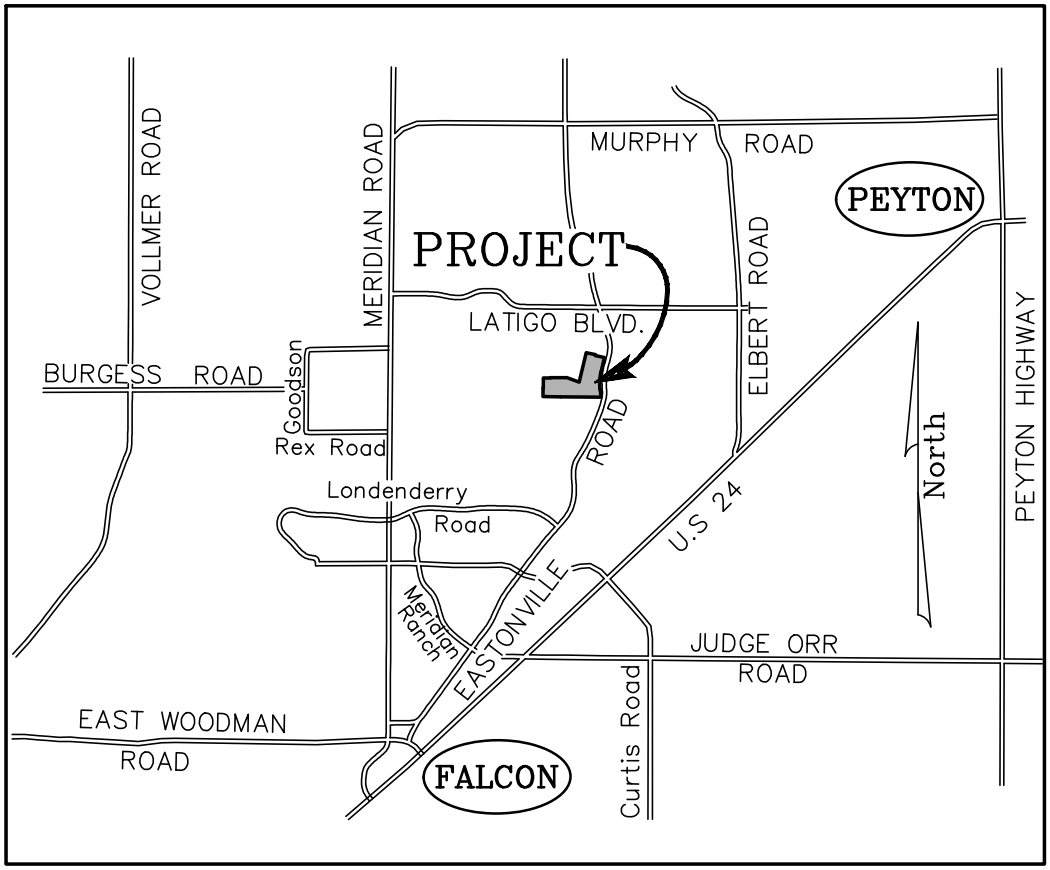
6. Final Drainage Report for Latigo Trails Filing No. 9 and Addendum to Master Development/Preliminary Drainage Plan, by JR Engineering, March 2023.

Appendix

Vicinity Map

Floodplain Map

Soils Map



Vicinity Map
Not to scale

LATIGO TRAILS FILING NO. 10
VICINITY MAP

Drexel, Barrell & Co.
Engineers • Surveyors

DATE:

JOB NO: 21820-01CSCV

DWG. NO. VMAP

SHEET 1 OF 1

National Flood Hazard Layer FIRMette

FEMA

104°34'22"W 39°0'18"N

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

1:6,000

104°33'45"W 38°59'50"N

Basemap Imagery Source: USGS National Map 2023

Legend

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

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

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

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

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

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

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

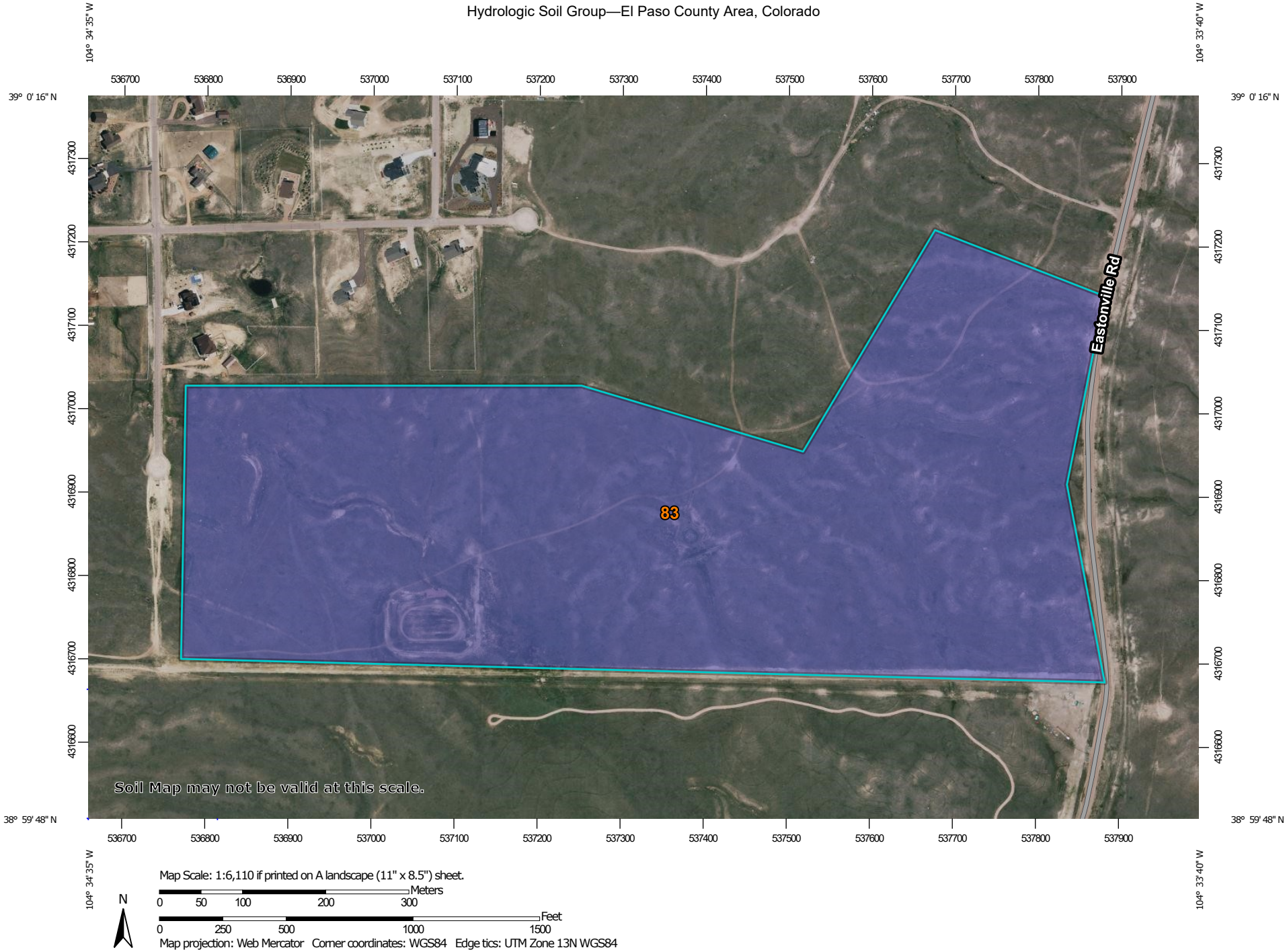
N

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 9/3/2024 at 1:17 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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



Map Scale: 1:6,110 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 250 500 1000 1500

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 21, Aug 24, 2023

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
83	Stapleton sandy loam, 3 to 8 percent slopes	B	98.4	100.0%
Totals for Area of Interest			**98.4**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Rational Calculations

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Drexel, Barrell & Co.

	C2*	C5*	C10*	C100*	% IMPERV
Residential - 2.5 Acre		0.16		0.41	9.2
Historic		0.09		0.36	2
Streets - Gravel		0.59		0.70	80
Streets - Paved		0.90		0.96	100

*C-Values and Basin Imperviousness based on Table 6-6, City of Colorado Springs Drainage Criteria Manual

SUB-BASIN	SURFACE DESIGNATION	AREA ACRE	COMPOSITE RUNOFF COEFFICIENTS C2	C5	C10	C100	% IMPERV
EXISTING A-BASINS							
OSA1	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Historic	*1.65*		*0.09*		*0.36*	*2*
	Streets - Gravel	*0.00*		*0.59*		*0.70*	*80*
	Streets - Paved	*2.03*		*0.90*		*0.96*	*100*
OSA1 TOTAL	*WEIGHTED AVERAGE*	3.68		0.54		0.69	56
OSA2	Residential - 2.5 Acre	*92.80*		*0.16*		*0.41*	*9.2*
	Historic	*0.00*		*0.09*		*0.36*	*2*
	Streets - Gravel	*0.00*		*0.59*		*0.70*	*80*
	Streets - Paved	*3.50*		*0.90*		*0.96*	*100*
OSA2 TOTAL	*WEIGHTED AVERAGE*	96.30		0.19		0.43	13
OSA3	Residential - 2.5 Acre	*66.55*		*0.16*		*0.41*	*9.2*
	Historic	*0.00*		*0.09*		*0.36*	*2*
	Streets - Gravel	*0.00*		*0.59*		*0.70*	*80*
	Streets - Paved	*2.60*		*0.90*		*0.96*	*100*
OSA3 TOTAL	*WEIGHTED AVERAGE*	69.15		0.19		0.43	13
OSA4	Residential - 2.5 Acre	*31.11*		*0.16*		*0.41*	*9.2*
	Historic	*0.00*		*0.09*		*0.36*	*2*
	Streets - Gravel	*0.00*		*0.59*		*0.70*	*80*
	Streets - Paved	*1.55*		*0.90*		*0.96*	*100*
OSA4 TOTAL	*WEIGHTED AVERAGE*	32.65		0.20		0.44	14
OSA5	Residential - 2.5 Acre	*10.86*		*0.16*		*0.41*	*9.2*
	Historic	*0.00*		*0.09*		*0.36*	*2*
	Streets - Gravel	*0.00*		*0.59*		*0.70*	*80*
	Streets - Paved	*0.47*		*0.90*		*0.96*	*100*
OSA5 TOTAL	*WEIGHTED AVERAGE*	11.33		0.19		0.43	13
A1	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Historic	*7.08*		*0.09*		*0.36*	*2*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
A1 TOTAL	*WEIGHTED AVERAGE*	7.08		0.09		0.36	2
A2	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Historic	*19.70*		*0.09*		*0.36*	*2*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
A2 TOTAL	*WEIGHTED AVERAGE*	19.70		0.09		0.36	2
A3	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Historic	*11.68*		*0.09*		*0.36*	*2*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*

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Drexel, Barrell & Co.

	C2*	C5*	C10*	C100*	% IMPERV
Residential - 2.5 Acre		0.16		0.41	9.2
Historic		0.09		0.36	2
Streets - Gravel		0.59		0.70	80
Streets - Paved		0.90		0.96	100

*C-Values and Basin Imperviousness based on Table 6-6, City of Colorado Springs Drainage Criteria Manual

A3 TOTAL	*WEIGHTED AVERAGE*	11.68		0.09		0.36	2
A4	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Historic	*4.24*		*0.09*		*0.36*	*2*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
A4 TOTAL	*WEIGHTED AVERAGE*	4.24		0.09		0.36	2
A5	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Historic	*10.58*		*0.09*		*0.36*	*2*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
A5 TOTAL	*WEIGHTED AVERAGE*	10.58		0.09		0.36	2
A6	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Historic	*7.35*		*0.09*		*0.36*	*2*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
A6 TOTAL	*WEIGHTED AVERAGE*	7.35		0.09		0.36	2
A7	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Historic	*13.62*		*0.09*		*0.36*	*2*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
A7 TOTAL	*WEIGHTED AVERAGE*	13.62		0.09		0.36	2
A8	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Historic	*2.24*		*0.09*		*0.36*	*2*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
A8 TOTAL	*WEIGHTED AVERAGE*	2.24		0.09		0.36	2
A9	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Historic	*2.16*		*0.09*		*0.36*	*2*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
A9 TOTAL	*WEIGHTED AVERAGE*	2.16		0.09		0.36	2
A10	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Historic	*8.08*		*0.09*		*0.36*	*2*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
A10 TOTAL	*WEIGHTED AVERAGE*	8.08		0.09		0.36	2
A11	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Historic	*7.30*		*0.09*		*0.36*	*2*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
A11 TOTAL	*WEIGHTED AVERAGE*	7.30		0.09		0.36	2
A12	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Historic	*8.71*		*0.09*		*0.36*	*2*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
A12 TOTAL	*WEIGHTED AVERAGE*	8.71		0.09		0.36	2
A13	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Historic	*13.96*		*0.09*		*0.36*	*2*

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Drexel, Barrell & Co.

	C2*	C5*	C10*	C100*	% IMPERV
Residential - 2.5 Acre		0.16		0.41	9.2
Historic		0.09		0.36	2
Streets - Gravel		0.59		0.70	80
Streets - Paved		0.90		0.96	100

*C-Values and Basin Imperviousness based on Table 6-6, City of Colorado Springs Drainage Criteria Manual

	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
A13 TOTAL	*WEIGHTED AVERAGE*	13.96		0.09		0.36	2
A14	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Historic	*8.24*		*0.09*		*0.36*	*2*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
A14 TOTAL	*WEIGHTED AVERAGE*	8.24		0.09		0.36	2
A15	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Historic	*0.61*		*0.09*		*0.36*	*2*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
A15 TOTAL	*WEIGHTED AVERAGE*	0.61		0.09		0.36	2
OSA6	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Historic	*3.29*		*0.09*		*0.36*	*2*
	Streets - Gravel	*0.00*		*0.59*		*0.70*	*80*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
OSA6 TOTAL	*WEIGHTED AVERAGE*	3.29		0.09		0.36	2
EXISTING B-BASINS							
B1	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Historic	*3.36*		*0.09*		*0.36*	*2*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
B1 TOTAL	*WEIGHTED AVERAGE*	3.36		0.09		0.36	2
B2	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Historic	*0.75*		*0.09*		*0.36*	*2*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
B2 TOTAL	*WEIGHTED AVERAGE*	0.75		0.09		0.36	2
B3	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Historic	*4.78*		*0.09*		*0.36*	*2*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
B3 TOTAL	*WEIGHTED AVERAGE*	4.78		0.09		0.36	2
B4	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Historic	*6.89*		*0.09*		*0.36*	*2*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
B4 TOTAL	*WEIGHTED AVERAGE*	6.89		0.09		0.36	2
B5	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Historic	*1.61*		*0.09*		*0.36*	*2*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
B5 TOTAL	*WEIGHTED AVERAGE*	1.61		0.09		0.36	2
B6	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Historic	*12.40*		*0.09*		*0.36*	*2*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
B6 TOTAL	*WEIGHTED AVERAGE*	12.40		0.09		0.36	2

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	C2*	C5*	C10*	C100*	% IMPERV
Residential - 2.5 Acre		0.16		0.41	9.2
Historic		0.09		0.36	2
Streets - Gravel		0.59		0.70	80
Streets - Paved		0.90		0.96	100

*C-Values and Basin Imperviousness based on Table 6-6, City of Colorado Springs Drainage Criteria Manual

OFFSITE B BASINS							
OSB1	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Historic	*0.75*		*0.09*		*0.36*	*2*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
OSB1 TOTAL	*WEIGHTED AVERAGE*	0.75		0.09		0.36	2
OSB2	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Historic	*12.15*		*0.09*		*0.36*	*2*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
OSB2 TOTAL	*WEIGHTED AVERAGE*	12.15		0.09		0.36	2
OSB3	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Historic	*2.22*		*0.09*		*0.36*	*2*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
OSB3 TOTAL	*WEIGHTED AVERAGE*	2.22		0.09		0.36	2
OFFSITE C-BASINS (EASTONVILLE ROAD)							
OSC1	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Historic	*0.14*		*0.09*		*0.36*	*2*
	Streets - Paved	*0.14*		*0.90*		*0.96*	*100*
OSC1 TOTAL	*WEIGHTED AVERAGE*	0.27		0.50		0.66	51
OSC2	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Historic	*0.37*		*0.09*		*0.36*	*2*
	Streets - Paved	*0.37*		*0.90*		*0.96*	*100*
OSC2 TOTAL	*WEIGHTED AVERAGE*	0.74		0.50		0.66	51
OSC3	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Historic	*0.38*		*0.09*		*0.36*	*2*
	Streets - Paved	*0.38*		*0.90*		*0.96*	*100*
OSC3 TOTAL	*WEIGHTED AVERAGE*	0.77		0.50		0.66	51

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RATIONAL METHOD CALCULATIONS FOR STORM WATER RUNOFF

DEVELOPED TIME OF CONCENTRATION STANDARD FORM SF-2

SUB-BASIN DATA					INITIAL/OVERLAND TIME (t_i)			TRAVEL TIME (t_t)				TIME OF CONC. t_c		FINAL t_c
BASIN	DESIGN PT:	C_5	C_{100}	AREA	LENGTH	SLOPE	t_i	LENGTH	SLOPE	VEL.	t_t	COMP.	*MINIMUM*	
				Ac	Ft	%	Min	Ft	%	FPS	Min	t_c	*t_c*	Min
EXISTING A BASINS														
OSA1	**OSA1**	0.54	0.69	3.68	50	2.0	5.9	5815	1.0	1.5	64.6	70.5	*42.3*	**42.3**
OSA2	**OSA2**	0.19	0.43	92.80	100	2.0	13.6	5495	1.0	1.5	61.1	74.6	*40.5*	**40.5**
OSA3	**OSA3**	0.19	0.43	69.15	100	3.0	11.8	3750	1.5	1.8	34.0	45.8	*30.8*	**30.8**
OSA4	**OSA4**	0.20	0.44	32.65	100	2.0	13.4	2798	2.0	2.1	22.0	35.4	*25.5*	**25.5**
OSA5	**OSA5**	0.19	0.43	11.33	100	4.0	10.7	780	2.0	2.1	6.1	16.8	*14.3*	**14.3**
A1	**1**	0.09	0.36	7.08	100	2.0	15.0	710	2.0	2.1	5.6	20.6	*13.9*	**20.6**
A2		0.09	0.36	19.70	100	3.0	13.1	1090	3.0	2.6	7.0	20.1	*16.1*	**20.1**
OSA1-OSA5+A2+B1	**2**	0.18	0.43	232.68	From OSA1		42.3	710	2.0	2.1	5.6	47.9	*13.9*	**47.9**
A3		0.09	0.36	11.68	100	3.0	13.1	1000	2.0	2.1	7.9	21.0	*15.6*	**21.0**
B2+A3	**3**	0.09	0.36	12.43	From B2		19.9	1000	2.0	2.1	7.9	27.7	*15.6*	**27.7**
A4	**4**	0.09	0.36	4.24	100	2.0	15.0	364	1.0	1.5	4.0	19.0	*12.0*	**19.0**
A5		0.09	0.36	10.58	100	4.0	11.9	1260	2.0	2.1	9.9	21.8	*17.0*	**21.8**
B3+A5	**5**	0.09	0.36	15.37	From B3		19.7	1260	2.0	2.1	9.9	29.6	*17.0*	**29.6**
A6	**6**	0.09	0.36	7.35	100	3.0	13.1	878	2.0	2.1	6.9	20.0	*14.9*	**20.0**
A7		0.09	0.36	13.62	100	1.0	18.9	1315	2.0	2.1	10.3	29.2	*17.3*	**29.2**
B4+A7	**7**	0.09	0.36	20.51	From A7		29.2					29.2	*10.0*	**29.2**
A8	**8**	0.09	0.36	2.24	100	2.0	15.0	150	2.0	2.1	1.2	16.2	*10.8*	**16.2**
A9	**9**	0.09	0.36	2.16	100	3.0	13.1	300	3.0	2.6	1.9	15.0	*11.7*	**15.0**
A10	**10**	0.09	0.36	8.08	100	2.0	15.0	1130	2.5	2.4	7.9	22.9	*16.3*	**22.9**
A11	**11**	0.09	0.36	7.30	100	2.0	15.0	1050	3.0	2.6	6.7	21.7	*15.8*	**21.7**

A12		0.09	0.36	8.71	100	2.0	15.0	1190	3.0	2.6	7.6	22.6	*16.6*	**22.6**
B5+A12	**12**	0.09	0.36	10.31	From B6		14.0	1190	3.0	2.6	7.6	21.7	*16.6*	**21.7**
A13		0.09	0.36	13.96	100	2.0	15.0	1130	2.5	2.4	7.9	22.9	*16.3*	**22.9**
B6+A13	**13**	0.09	0.36	26.36	From B6		23.5	1130	2.5	2.4	7.9	31.4	*16.3*	**31.4**
A14	**14**	0.09	0.36	8.24	100	2.0	15.0	1150	2.5	2.4	8.1	23.1	*16.4*	**23.1**
A15		0.09	0.36	0.61	100	2.0	15.0	120	2.0	2.1	0.9	15.9	*10.7*	**15.9**
OSA6	**OSA6**	0.09	0.36	3.29	100	2.0	15.0	650	1.0	1.5	7.2	22.2	*13.6*	**22.2**
EXISTING B BASINS														
B1	**B1**	0.09	0.36	3.36	100	3.0	13.1	445	1.0	1.5	4.9	18.0	*12.5*	**18.0**
B2	**B2**	0.09	0.36	0.75	100	1.0	18.9	87	1.0	1.5	1.0	19.9	*10.5*	**19.9**
B3	**B3**	0.09	0.36	4.78	100	2.0	15.0	738	3.0	2.6	4.7	19.7	*14.1*	**19.7**
B4	**B4**	0.09	0.36	6.89	100	3.0	13.1	680	3.0	2.6	4.4	17.5	*13.8*	**17.5**
B5	**B5**	0.09	0.36	1.61	100	3.0	13.1	170	4.0	3.0	0.9	14.0	*10.9*	**14.0**
B6	**B6**	0.09	0.36	12.40	100	2.0	15.0	1080	2.0	2.1	8.5	23.5	*16.0*	**23.5**
OFFSITE B BASINS														
OSB1	**OSB1**	0.09	0.36	0.75	100	3.0	13.1	445	3.0	2.6	2.9	16.0	*12.5*	**16.0**
OSB2	**OSB2**	0.09	0.36	12.15	100	1.0	18.9	1350	2.0	2.1	10.6	29.5	*17.5*	**29.5**
OSB3	**OSB3**	0.09	0.36	2.22	100	2.0	15.0	360	2.0	2.1	2.8	17.8	*12.0*	**17.8**
OFFSITE C BASINS (EASTONVILLE)														
OSC1		0.50	0.66	0.27	15	2.0	3.5	185	1.0	1.5	2.1	5.5	*11.0*	**11.0**
DP9+OSC1	**OSC1**	0.14	0.39	2.43	From DP9		15.0	140	1.0	1.5	1.6	16.6	*10.8*	**16.6**
OSC2		0.50	0.66	0.74	15	2.0	3.5	780	1.0	1.5	8.7	12.1	*14.3*	**14.3**
DP10+DP11+DP12+OSC2	**OSC2**	0.10	0.37	26.44	From DP12		21.7	685	1.0	1.5	7.6	29.3	*13.8*	**29.3**
OSC3		0.50	0.66	0.77	15	2.0	3.5	705	1.0	1.5	7.8	11.3	*13.9*	**13.9**
OSA6+DP14+DP13+OSC3	**OSC3**	0.10	0.37	38.67	From OSA6		22.2	550	1.0	1.5	6.1	28.3	*13.1*	**28.3**

existing conditions?

PROJECT INFORMATION

PROJECT:	Latigo Trails Filing 10
PROJECT NO:	21820-01CSCV
DESIGN BY:	CGH
REV. BY:	TDM
AGENCY:	El Paso County
REPORT TYPE:	Final
DATE:	1/8/2025

Drexel, Barrell & Co.

RATIONAL METHOD CALCULATIONS FOR STORM WATER RUNOFF

DEVELOPED RUNOFF — **5 YR STORM** — **P1= 1.46**

BASIN (S)	DIRECT RUNOFF						
	DESIGN POINT	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C * A	I (IN/HR)	Q (CFS)
EXISTING A - BASINS							
OSA1	OSA1	3.68	0.54	42.3	1.98	1.86	**3.7**
OSA2	OSA2	92.80	0.19	40.5	17.34	1.91	**33.1**
OSA3	OSA3	69.15	0.19	30.8	12.99	2.25	**29.3**
OSA4	OSA4	32.65	0.20	25.5	6.37	2.51	**16.0**
OSA5	OSA5	11.33	0.19	14.3	2.16	3.39	**7.3**
A1	1	7.08	0.09	20.6	0.64	2.83	**1.8**
A2		19.70	0.09	20.1	1.77	2.87	**5.1**
OSA1-OSA5+A2+B1	2	232.68	0.18	47.9	42.92	1.71	**73.5**
South Pond Out	2A						**51.8**
A3		11.68	0.09	21.0	1.05	2.80	**2.9**
B2+A3	3	12.43	0.09	27.7	1.12	2.40	**2.7**
A4	4	4.24	0.09	19.0	0.38	2.95	**1.1**
A5		10.58	0.09	21.8	0.95	2.74	**2.6**
B3+A5	5	15.37	0.09	29.6	1.38	2.31	**3.2**
A6	6	7.35	0.09	20.0	0.66	2.87	**1.9**
A7		13.62	0.09	29.2	1.23	2.33	**2.9**
B4+A7	7	20.51	0.09	29.2	1.85	2.33	**4.3**
A8	8	2.24	0.09	16.2	0.20	3.20	**0.6**
A9	9	2.16	0.09	15.0	0.19	3.31	**0.6**
A10	10	8.08	0.09	22.9	0.73	2.67	**1.9**
A11	11	7.30	0.09	21.7	0.66	2.75	**1.8**
A12		8.71	0.09	22.6	0.78	2.69	**2.1**
B5+A12	12	10.31	0.09	21.7	0.93	2.75	**2.6**
A13		13.96	0.09	22.9	1.26	2.67	**3.4**
B6+A13	13	26.36	0.09	31.4	2.37	2.23	**5.3**
A14	14	8.24	0.09	23.1	0.74	2.66	**2.0**
A15		0.61	0.09	15.9	0.05	3.22	**0.2**
OSA6	OSA6	3.29	0.09	22.2	0.30	2.72	**0.8**
EXISTING B BASINS							
B1	B1	3.36	0.09	18.0	0.30	3.03	**0.9**
B2	B2	0.75	0.09	19.9	0.07	2.88	**0.2**
B3	B3	4.78	0.09	19.7	0.43	2.89	**1.2**
B4	B4	6.89	0.09	17.5	0.62	3.08	**1.9**
B5	B5	1.61	0.09	14.0	0.14	3.42	**0.5**
B6	B6	12.40	0.09	23.5	1.12	2.63	**2.9**
OFFSITE B BASINS							
OSB1	OSB1	0.75	0.09	16.0	0.07	3.22	**0.2**
OSB2	OSB2	12.15	0.09	29.5	1.09	2.31	**2.5**
OSB3	OSB3	2.22	0.09	17.8	0.20	3.05	**0.6**
OFFSITE C BASINS (EASTONVILLE)							
OSC1		0.27	0.50	11.0	0.14	3.80	**0.5**
DP9+OSC1	OSC1	2.43	0.14	16.6	0.33	3.16	**1.0**
OSC2		0.74	0.50	14.3	0.37	3.39	**1.2**
DP10+DP11+DP12+OSC2	OSC2	26.44	0.10	29.3	2.68	2.32	**6.2**
OSC3		0.77	0.50	13.9	0.38	3.43	**1.3**
OSA6+DP14+DP13+OSC3	OSC3	38.67	0.10	28.3	3.79	2.37	**9.0**

PROJECT INFORMATION

PROJECT: Latigo Trails Filing 10
PROJECT NO: 21820-01CSCV
DESIGN BY: CGH
REV. BY: TDM
AGENCY: El Paso County
REPORT TYPE: Final
DATE: 1/8/2025

Drexel, Barrell & Co.

RATIONAL METHOD CALCULATIONS FOR STORM WATER RUNOFF

DEVELOPED RUNOFF **100 YR STORM** **P1= 2.47**

BASIN (S)	DIRECT RUNOFF						
	DESIGN POINT	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C * A	I (IN/HR)	Q (CFS)
EXISTING A-BASINS							
OSA1	OSA1	3.68	0.69	42.3	2.54	3.14	**8.0**
OSA2	OSA2	92.80	0.43	40.5	39.90	3.23	**128.7**
OSA3	OSA3	69.15	0.43	30.8	29.78	3.81	**113.6**
OSA4	OSA4	32.65	0.44	25.5	14.24	4.25	**60.5**
OSA5	OSA5	11.33	0.43	14.3	4.91	5.73	**28.1**
A1	1	7.08	0.36	20.6	2.55	4.79	**12.2**
A2		19.70	0.36	20.1	7.09	4.85	**34.4**
OSA1-OSA5+A2+B1	2	232.68	0.43	47.9	99.68	2.90	**288.9**
South Pond Out	2A						**295.9**
A3		11.68	0.36	21.0	4.21	4.74	**19.9**
B2+A3	3	12.43	0.36	27.7	4.48	4.06	**18.2**
A4	4	4.24	0.36	19.0	1.53	4.99	**7.6**
A5		10.58	0.36	21.8	3.81	4.64	**17.7**
B3+A5	5	15.37	0.36	29.6	5.53	3.90	**21.6**
A6	6	7.35	0.36	20.0	2.65	4.86	**12.9**
A7		13.62	0.36	29.2	4.90	3.94	**19.3**
B4+A7	7	20.51	0.36	29.2	7.38	3.94	**29.1**
A8	8	2.24	0.36	16.2	0.81	5.41	**4.4**
A9	9	2.16	0.36	15.0	0.78	5.60	**4.4**
A10	10	8.08	0.36	22.9	2.91	4.52	**13.1**
A11	11	7.30	0.36	21.7	2.63	4.65	**12.2**
A12		8.71	0.36	22.6	3.13	4.55	**14.3**
B5+A12	12	10.31	0.36	21.7	3.71	4.66	**17.3**
A13		13.96	0.36	22.9	5.03	4.52	**22.7**
B6+A13	13	26.36	0.36	31.4	9.49	3.77	**35.8**
A14	14	8.24	0.36	23.1	2.97	4.50	**13.4**
A15		0.61	0.36	15.9	0.22	5.45	**1.2**
OSA6	OSA6	3.29	0.36	22.2	1.19	4.59	**5.4**
EXISTING B-BASINS							
B1	B1	3.36	0.36	18.0	1.21	5.12	**6.2**
B2	B2	0.75	0.36	19.9	0.27	4.88	**1.3**
B3	B3	4.78	0.36	19.7	1.72	4.89	**8.4**
B4	B4	6.89	0.36	17.5	2.48	5.21	**12.9**
B5	B5	1.61	0.36	14.0	0.58	5.78	**3.3**
B6	B6	12.40	0.36	23.5	4.46	4.46	**19.9**
OFFSITE B BASINS							
OSB1	OSB1	0.75	0.36	16.0	0.27	5.45	**1.5**
OSB2	OSB2	12.15	0.36	29.5	4.38	3.91	**17.1**
OSB3	OSB3	2.22	0.36	17.8	0.80	5.16	**4.1**
OFFSITE C BASINS (EASTONVILLE)							
OSC1		0.27	0.66	11.0	0.18	6.42	**1.2**
DP9+OSC1	OSC1	2.43	0.39	16.6	0.96	5.34	**5.1**
OSC2		0.74	0.66	14.3	0.49	5.73	**2.8**
DP10+DP11+DP12+OSC2	OSC2	26.44	0.37	29.3	9.74	3.93	**38.3**
OSC3		0.77	0.66	13.9	0.51	5.81	**2.9**
OSA6+DP14+DP13+OSC3	OSC3	38.67	0.37	28.3	14.15	4.01	**56.7**

PROJECT INFORMATION

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PROJECT NO:	21820-01CSCV
DESIGN BY:	CGH
REV. BY:	KGV
AGENCY:	El Paso County
REPORT TYPE:	Final
DATE:	1/8/2025

Drexel, Barrell & Co.

	C2*	C5*	C10*	C100*	% IMPERV
Residential - 2.5 Acre		0.16		0.41	9.2
Pasture/Meadow/Lawn		0.08		0.35	0
Streets - Gravel		0.59		0.70	80
Streets - Paved		0.90		0.96	100

*C-Values and Basin Imperviousness based on Table 6-6, City of Colorado Springs Drainage Criteria Manual

SUB-BASIN	SURFACE DESIGNATION	AREA ACRE	COMPOSITE RUNOFF COEFFICIENTS C2	C5	C10	C100	% IMPERV
PROPOSED A-BASINS							
OSA1	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*1.65*		*0.08*		*0.35*	*0*
	Streets - Gravel	*0.00*		*0.59*		*0.70*	*80*
	Streets - Paved	*2.03*		*0.90*		*0.96*	*100*
OSA1 TOTAL	*WEIGHTED AVERAGE*	3.68		0.53		0.69	55
OSA2	Residential - 2.5 Acre	*92.80*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.00*		*0.08*		*0.35*	*0*
	Streets - Gravel	*0.00*		*0.59*		*0.70*	*80*
	Streets - Paved	*3.50*		*0.90*		*0.96*	*100*
OSA2 TOTAL	*WEIGHTED AVERAGE*	96.30		0.19		0.43	13
OSA3	Residential - 2.5 Acre	*66.55*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.00*		*0.08*		*0.35*	*0*
	Streets - Gravel	*0.00*		*0.59*		*0.70*	*80*
	Streets - Paved	*2.60*		*0.90*		*0.96*	*100*
OSA3 TOTAL	*WEIGHTED AVERAGE*	69.15		0.19		0.43	13
OSA4	Residential - 2.5 Acre	*31.11*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.00*		*0.08*		*0.35*	*0*
	Streets - Gravel	*0.00*		*0.59*		*0.70*	*80*
	Streets - Paved	*1.55*		*0.90*		*0.96*	*100*
OSA4 TOTAL	*WEIGHTED AVERAGE*	32.65		0.20		0.44	14
OSA5	Residential - 2.5 Acre	*10.86*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.00*		*0.08*		*0.35*	*0*
	Streets - Gravel	*0.00*		*0.59*		*0.70*	*80*
	Streets - Paved	*0.47*		*0.90*		*0.96*	*100*
OSA5 TOTAL	*WEIGHTED AVERAGE*	11.33		0.19		0.43	13
A1	Residential - 2.5 Acre	*12.91*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.32*		*0.08*		*0.35*	*0*

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Drexel, Barrell & Co.

	C2*	C5*	C10*	C100*	% IMPERV
Residential - 2.5 Acre		0.16		0.41	9.2
Pasture/Meadow/Lawn		0.08		0.35	0
Streets - Gravel		0.59		0.70	80
Streets - Paved		0.90		0.96	100

*C-Values and Basin Imperviousness based on Table 6-6, City of Colorado Springs Drainage Criteria Manual

	Streets - Paved	*0.32*		*0.90*		*0.96*	*100*
A1 TOTAL	*WEIGHTED AVERAGE*	13.55		0.18		0.42	11
A2	Residential - 2.5 Acre	*6.54*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.35*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.35*		*0.90*		*0.96*	*100*
A2 TOTAL	*WEIGHTED AVERAGE*	7.24		0.19		0.43	13
A3	Residential - 2.5 Acre	*6.48*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.00*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
A3 TOTAL	*WEIGHTED AVERAGE*	6.48		0.16		0.41	9
A4	Residential - 2.5 Acre	*5.68*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.18*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.18*		*0.90*		*0.96*	*100*
A4 TOTAL	*WEIGHTED AVERAGE*	6.03		0.18		0.42	12
A5	Residential - 2.5 Acre	*7.64*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.19*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.19*		*0.90*		*0.96*	*100*
A5 TOTAL	*WEIGHTED AVERAGE*	8.02		0.18		0.42	11
A6	Residential - 2.5 Acre	*3.66*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.18*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.18*		*0.90*		*0.96*	*100*
A6 TOTAL	*WEIGHTED AVERAGE*	4.02		0.19		0.43	13
A7	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.31*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.31*		*0.90*		*0.96*	*100*
A7 TOTAL	*WEIGHTED AVERAGE*	0.63		0.49		0.66	50
A8	Residential - 2.5 Acre	*6.66*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.17*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.17*		*0.90*		*0.96*	*100*
A8 TOTAL	*WEIGHTED AVERAGE*	7.01		0.18		0.42	11
A9	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*

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Drexel, Barrell & Co.

	C2*	C5*	C10*	C100*	% IMPERV
Residential - 2.5 Acre		0.16		0.41	9.2
Pasture/Meadow/Lawn		0.08		0.35	0
Streets - Gravel		0.59		0.70	80
Streets - Paved		0.90		0.96	100

*C-Values and Basin Imperviousness based on Table 6-6, City of Colorado Springs Drainage Criteria Manual

	Pasture/Meadow/Lawn	*1.62*		*0.08*		*0.35*	*0*
	Streets - Paved	*1.62*		*0.90*		*0.96*	*100*
A9 TOTAL	*WEIGHTED AVERAGE*	3.23		0.49		0.66	50
A10	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.79*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
A10 TOTAL	*WEIGHTED AVERAGE*	0.79		0.08		0.35	0
A10A	Residential - 2.5 Acre	*1.28*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.00*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
A10A TOTAL	*WEIGHTED AVERAGE*	1.28		0.16		0.41	9
A11	Residential - 2.5 Acre	*3.47*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.07*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.07*		*0.90*		*0.96*	*100*
A11 TOTAL	*WEIGHTED AVERAGE*	3.61		0.17		0.42	11
A12	Residential - 2.5 Acre	*2.17*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.09*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.09*		*0.90*		*0.96*	*100*
A12 TOTAL	*WEIGHTED AVERAGE*	2.36		0.19		0.43	12
A13	Residential - 2.5 Acre	*3.00*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.27*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.07*		*0.90*		*0.96*	*100*
A13 TOTAL	*WEIGHTED AVERAGE*	3.34		0.17		0.42	10
A14	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.63*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.63*		*0.90*		*0.96*	*100*
A14 TOTAL	*WEIGHTED AVERAGE*	1.25		0.49		0.66	50
A15	Residential - 2.5 Acre	*2.28*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*1.88*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
A15 TOTAL	*WEIGHTED AVERAGE*	4.16		0.12		0.38	5

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Drexel, Barrell & Co.

	C2*	C5*	C10*	C100*	% IMPERV
Residential - 2.5 Acre		0.16		0.41	9.2
Pasture/Meadow/Lawn		0.08		0.35	0
Streets - Gravel		0.59		0.70	80
Streets - Paved		0.90		0.96	100

*C-Values and Basin Imperviousness based on Table 6-6, City of Colorado Springs Drainage Criteria Manual

A15A	Residential - 2.5 Acre	*2.08*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.00*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
A15A TOTAL	*WEIGHTED AVERAGE*	2.08		0.16		0.41	9
A16	Residential - 2.5 Acre	*4.41*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.00*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
A16 TOTAL	*WEIGHTED AVERAGE*	4.41		0.16		0.41	9
A17	Residential - 2.5 Acre	*4.02*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.00*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
A17 TOTAL	*WEIGHTED AVERAGE*	4.02		0.16		0.41	9
A18	Residential - 2.5 Acre	*1.81*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.00*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
A18 TOTAL	*WEIGHTED AVERAGE*	1.81		0.16		0.41	9
A19	Residential - 2.5 Acre	*2.40*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.00*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
A19 TOTAL	*WEIGHTED AVERAGE*	2.40		0.16		0.41	9
A20	Residential - 2.5 Acre	*1.65*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.33*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.20*		*0.90*		*0.96*	*100*
A20 TOTAL	*WEIGHTED AVERAGE*	2.18		0.21		0.45	16
A21	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.44*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
A21 TOTAL	*WEIGHTED AVERAGE*	0.44		0.08		0.35	0
A22	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.58*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.15*		*0.90*		*0.96*	*100*

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DATE:	1/8/2025

Drexel, Barrell & Co.

	C2*	C5*	C10*	C100*	% IMPERV
Residential - 2.5 Acre		0.16		0.41	9.2
Pasture/Meadow/Lawn		0.08		0.35	0
Streets - Gravel		0.59		0.70	80
Streets - Paved		0.90		0.96	100

*C-Values and Basin Imperviousness based on Table 6-6, City of Colorado Springs Drainage Criteria Manual

A22 TOTAL	*WEIGHTED AVERAGE*	0.73		0.25		0.47	20
A23	Residential - 2.5 Acre	*2.03*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.00*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
A23 TOTAL	*WEIGHTED AVERAGE*	2.03		0.16		0.41	9
OSA6	Residential - 2.5 Acre	*0.92*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.08*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.08*		*0.90*		*0.96*	*100*
OSA6 TOTAL	*WEIGHTED AVERAGE*	1.08		0.21		0.45	15
A24	Residential - 2.5 Acre	*10.91*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.34*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.34*		*0.90*		*0.96*	*100*
A24 TOTAL	*WEIGHTED AVERAGE*	11.59		0.18		0.42	12
OSA7	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.21*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.21*		*0.90*		*0.96*	*100*
OSA7 TOTAL	*WEIGHTED AVERAGE*	0.41		0.49		0.66	50
A25	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.81*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.81*		*0.90*		*0.96*	*100*
A25 TOTAL	*WEIGHTED AVERAGE*	1.61		0.49		0.66	50
A26	Residential - 2.5 Acre	*3.38*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*1.31*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
A26 TOTAL	*WEIGHTED AVERAGE*	4.70		0.14		0.39	7
A26A	Residential - 2.5 Acre	*1.00*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.00*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
A26A TOTAL	*WEIGHTED AVERAGE*	1.00		0.16		0.41	9
A27	Residential - 2.5 Acre	*5.25*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.00*		*0.08*		*0.35*	*0*

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	C2*	C5*	C10*	C100*	% IMPERV
Residential - 2.5 Acre		0.16		0.41	9.2
Pasture/Meadow/Lawn		0.08		0.35	0
Streets - Gravel		0.59		0.70	80
Streets - Paved		0.90		0.96	100

*C-Values and Basin Imperviousness based on Table 6-6, City of Colorado Springs Drainage Criteria Manual

	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
A27 TOTAL	*WEIGHTED AVERAGE*	5.25		0.16		0.41	9
A28	Residential - 2.5 Acre	*2.75*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.00*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
A28 TOTAL	*WEIGHTED AVERAGE*	2.75		0.16		0.41	9
A29	Residential - 2.5 Acre	*4.75*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.00*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
A29 TOTAL	*WEIGHTED AVERAGE*	4.75		0.16		0.41	9
A30	Residential - 2.5 Acre	*0.61*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.00*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
A30 TOTAL	*WEIGHTED AVERAGE*	0.61		0.16		0.41	9
OSA8	Residential - 2.5 Acre	*2.46*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.00*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
OSA8 TOTAL	*WEIGHTED AVERAGE*	2.46		0.16		0.41	9
PROPOSED B-BASINS (TRIBUTARY TO FILING 10)							
B1	Residential - 2.5 Acre	*3.20*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.00*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
B1 TOTAL	*WEIGHTED AVERAGE*	3.20		0.16		0.41	9
B2	Residential - 2.5 Acre	*0.77*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.00*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
B2 TOTAL	*WEIGHTED AVERAGE*	0.77		0.16		0.41	9
B3	Residential - 2.5 Acre	*5.24*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.00*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
B3 TOTAL	*WEIGHTED AVERAGE*	5.24		0.16		0.41	9

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	C2*	C5*	C10*	C100*	% IMPERV
Residential - 2.5 Acre		0.16		0.41	9.2
Pasture/Meadow/Lawn		0.08		0.35	0
Streets - Gravel		0.59		0.70	80
Streets - Paved		0.90		0.96	100

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B4	Residential - 2.5 Acre	*6.79*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.00*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.35*		*0.90*		*0.96*	*100*
B4 TOTAL	*WEIGHTED AVERAGE*	7.14		0.20		0.44	14
B5	Residential - 2.5 Acre	*1.59*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.00*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
B5 TOTAL	*WEIGHTED AVERAGE*	1.59		0.16		0.41	9
B6	Residential - 2.5 Acre	*7.92*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.00*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
B6 TOTAL	*WEIGHTED AVERAGE*	7.92		0.16		0.41	9
OFFSITE B-BASINS (NOT TRIBUTARY TO FILING 10)							
OSB1	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*5.23*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
OSB1 TOTAL	*WEIGHTED AVERAGE*	5.23		0.08		0.35	0
OSB2	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*6.41*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
OSB2 TOTAL	*WEIGHTED AVERAGE*	6.41		0.08		0.35	0
OSB3	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*3.87*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
OSB3 TOTAL	*WEIGHTED AVERAGE*	3.87		0.08		0.35	0
OSB4	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.82*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
OSB4 TOTAL	*WEIGHTED AVERAGE*	0.82		0.08		0.35	0
OSB5	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*1.25*		*0.08*		*0.35*	*0*

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	C2*	C5*	C10*	C100*	% IMPERV
Residential - 2.5 Acre		0.16		0.41	9.2
Pasture/Meadow/Lawn		0.08		0.35	0
Streets - Gravel		0.59		0.70	80
Streets - Paved		0.90		0.96	100

*C-Values and Basin Imperviousness based on Table 6-6, City of Colorado Springs Drainage Criteria Manual

	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
OSB5 TOTAL	*WEIGHTED AVERAGE*	1.25		0.08		0.35	0
OSB6	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.72*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.00*		*0.90*		*0.96*	*100*
OSB6 TOTAL	*WEIGHTED AVERAGE*	0.72		0.08		0.35	0
OFFSITE C-BASINS (EASTONVILLE ROAD)							
OSC1	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.14*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.14*		*0.90*		*0.96*	*100*
OSC1 TOTAL	*WEIGHTED AVERAGE*	0.27		0.49		0.66	50
OSC2	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.37*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.37*		*0.90*		*0.96*	*100*
OSC2 TOTAL	*WEIGHTED AVERAGE*	0.74		0.49		0.66	50
OSC3	Residential - 2.5 Acre	*0.00*		*0.16*		*0.41*	*9.2*
	Pasture/Meadow/Lawn	*0.38*		*0.08*		*0.35*	*0*
	Streets - Paved	*0.38*		*0.90*		*0.96*	*100*
OSC3 TOTAL	*WEIGHTED AVERAGE*	0.77		0.49		0.66	50

Pond Tributary Areas

South OSA1-OSA5, A1-A2, B1	237.10	13.25
G14b A4-A10, B2-3, A20-A22	39.08	15.02
G18 B4-B5, A11-A15	23.45	12.74
G19 B6, OSA6, OSA7, A24-A26	27.31	13.04

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RATIONAL METHOD CALCULATIONS FOR STORM WATER RUNOFF

DEVELOPED TIME OF CONCENTRATION STANDARD FORM SF-2

SUB-BASIN DATA					INITIAL/OVERLAND TIME (t_i)			TRAVEL TIME (t_t)				TIME OF CONC. t_c		FINAL t_c
BASIN	DESIGN PT:	C_5	C_{100}	AREA	LENGTH	SLOPE	t_i	LENGTH	SLOPE	VEL.	t_t	COMP.	*MINIMUM*	
				Ac	Ft	%	Min	Ft	%	FPS	Min	t_c	*t_c*	Min
PROPOSED A BASINS														
OSA1	**OSA1**	0.53	0.69	3.68	50	2.0	6.0	5815	1.0	1.5	64.6	70.6	*42.3*	**42.3**
OSA2	**OSA2**	0.16	0.41	96.30	100	2.0	14.0	5495	1.0	1.5	61.1	75.0	*40.5*	**40.5**
OSA3	**OSA3**	0.19	0.43	69.15	100	3.0	11.8	3750	1.5	1.8	34.0	45.8	*30.8*	**30.8**
OSA4	**OSA4**	0.20	0.44	32.65	100	2.0	13.4	2798	2.0	2.1	22.0	35.4	*25.5*	**25.5**
OSA5	**OSA5**	0.19	0.43	11.33	100	4.0	10.7	780	2.0	2.1	6.1	16.8	*14.3*	**14.3**
A1		0.18	0.42	13.55	100	3.0	12.0	835	2.0	2.1	6.6	18.5	*14.6*	**18.5**
A1+OSA2+OSA3+OSA4+OSA5+DPB1	**1**	0.18	0.42	226.18	From OSA2		40.5	835	2.0	2.1	6.6	47.1	*14.6*	**47.1**
A2		0.19	0.43	7.24	50	1.0	12.0	1220	2.0	2.1	9.6	21.6	*16.8*	**21.6**
A2+OSA1+DP1	**2**	0.18	0.43	237.10	From DP1		47.1	100	1.0	1.5	1.1	48.2	*10.6*	**48.2**
A3	**3**	0.16	0.41	6.48	100	2.0	14.0	710	1.5	1.8	6.4	20.4	*13.9*	**20.4**
A4		0.18	0.42	6.03	100	2.0	13.7	435	1.0	1.5	4.8	18.5	*12.4*	**18.5**
A4+DPB2	**4**	0.16	0.41	7.25	From DPB2		10.4	435	1.0	1.5	4.8	15.3	*12.4*	**15.3**
A5		0.18	0.42	8.02	100	3.0	12.0	750	2.0	2.1	5.9	17.9	*14.2*	**17.9**
A5+DPB3	**5**	0.17	0.42	13.26	From DPB3		13.9	435	1.0	1.5	4.8	18.7	*12.4*	**18.7**
DP5+DP4	**5A**	0.17	0.41	20.51	From DP4		15.3	540	1.0	1.5	6.0	21.3	*13.0*	**21.3**
A6	**6**	0.19	0.43	4.02	100	1.0	17.0	540	1.0	1.5	6.0	23.0	*13.0*	**23.0**
DP5A+DP6	**6A**	0.17	0.42	24.52	From DP5A		21.3	510	1.0	1.5	5.7	26.9	*12.8*	**26.9**
A7	**7**	0.49	0.66	0.63	50	3.0	5.6	300	1.5	1.8	2.7	8.3	*11.7*	**11.7**
A8	**8**	0.18	0.42	7.01	100	1.0	17.3	800	1.0	1.5	8.9	26.2	*14.4*	**26.2**
A8+DP7+DP6A	**8A**	0.18	0.42	32.16	From DP6A		26.9	150	1.0	1.5	1.7	28.6	*10.8*	**28.6**
A9		0.49	0.66	3.23	50	4.0	5.1	1910	1.5	1.8	17.3	22.4	*20.6*	**22.4**
DP8A+A9	**9**	0.21	0.44	35.39	From DP8A		28.6	150	3.0	2.6	1.0	29.6	*10.8*	**29.6**
A10		0.08	0.35	0.79	100	2.0	15.1	150	1.5	1.8	1.4	16.5	*10.8*	**16.5**
A10+DP8A+DP9	**10**	0.20	0.44	71.57	DP8A		28.6	180	1.0	8.3	0.4	29.0	*11.0*	**29.0**
A10A		0.16	0.41	1.28	100	2.0	14.0	150	1.5	1.8	1.4	15.3	*10.8*	**15.3**
A10A+G14b Out	**10A**	0.16	0.41	1.28	From A10A		15.3					15.3	*10.0*	**15.3**

A11		0.17	0.42	3.61	100	2.0	13.8	409	1.5	1.8	3.7	17.5	*12.3*	**17.5**
DPB5+A11	**11**	0.17	0.42	5.20	From A11		17.5					17.5	*10.0*	**17.5**
A12	**12**	0.19	0.43	2.36	100	2.0	13.6	385	2.5	2.4	2.7	16.3	*12.1*	**16.3**
DP11+DP12	**12A**	0.17	0.42	7.56	From DP11		17.5	385	2.5	2.4	2.7	20.2	*12.1*	**20.2**
A13		0.17	0.42	3.34	100	2.0	13.8	440	1.5	1.8	4.0	17.8	*12.4*	**17.8**
A13+DPB4	**13**	0.19	0.43	10.48	From DPB4		12.6	440	1.5	1.8	4.0	16.6	*12.4*	**16.6**
DP12A+DP13	**13A**	0.18	0.43	18.04	From DP12A		20.2	50	1.5	1.8	0.5	20.6	*10.3*	**20.6**
A14	**14**	0.49	0.66	1.25	50	4.0	5.1	510	1.5	1.8	4.6	9.7	*12.8*	**12.8**
DP13A+DP14	**14A**	0.20	0.44	19.29	From DP13A		20.6	150	1.0	1.5	1.7	22.3	*10.8*	**22.3**
A15		0.12	0.38	4.16	100	2.0	14.5	700	1.0	1.5	7.8	22.3	*13.9*	**22.3**
DP14A+A15	**15**	0.19	0.43	23.45	From DP14A		22.3	300	1.0	1.5	3.3	25.6	*11.7*	**25.6**
A15A	**15A**	0.16	0.41	2.08	100	2.0	14.0	200	1.0	1.5	2.2	16.2	*11.1*	**16.2**
A16	**16**	0.16	0.41	4.41	100	1.0	17.6	450	1.0	1.5	5.0	22.6	*12.5*	**22.6**
A17	**17**	0.16	0.41	4.02	100	2.0	14.0	500	1.5	1.8	4.5	18.5	*12.8*	**18.5**
A18	**18**	0.16	0.41	1.81	100	2.0	14.0	350	2.0	2.1	2.7	16.7	*11.9*	**16.7**
A19	**19**	0.16	0.41	2.40	100	1.0	17.6	290	1.0	1.5	3.2	20.8	*11.6*	**20.8**
A20	**20**	0.21	0.45	2.18	50	4.0	7.4	900	1.5	1.8	8.2	15.5	*15.0*	**15.5**
A21	**21**	0.08	0.35	0.44	50	1.0	13.5	100	1.0	1.5	1.1	14.6	*10.6*	**14.6**
A22		0.25	0.47	0.73	50	4.0	7.1	350	1.5	1.8	3.2	10.3	*11.9*	**11.9**
A20+A21+A22	**22**	0.20	0.44	3.35	From A20		15.5	100	1.0	1.5	1.1	16.6	*10.6*	**16.6**
A23	**23**	0.16	0.41	2.03	100	2.0	14.0	250	2.0	2.1	2.0	15.9	*11.4*	**15.9**
OSA6	**OSA6**	0.21	0.45	1.08	50	3.0	8.2	200	3.0	2.6	1.3	9.5	*11.1*	**11.1**
A24		0.18	0.42	11.59	100	3.0	11.9	740	3.0	2.6	4.7	16.7	*14.1*	**16.7**
DPB6+A24	**24**	0.17	0.42	19.51	From DPB6		13.6	740	3.0	2.6	4.7	18.4	*14.1*	**18.4**
DPOSA6+DP24	**24A**	0.17	0.42	20.59	From DP24		18.4					18.4	*10.0*	**18.4**
OSA7	**OSA7**	0.49	0.66	0.41	50	2.0	6.4	250	2.0	2.1	2.0	8.4	*11.4*	**11.4**
A25		0.49	0.66	1.61	50	4.0	5.1	550	1.5	1.8	5.0	10.1	*13.1*	**13.1**
DPOSA67+A25	**25**	0.49	0.66	2.03	From DPOSA7		11.4	600	1.5	1.8	5.4	16.8	*13.3*	**16.8**
DP24A+DP25	**25A**	0.20	0.44	22.62	From DP24A		18.4	100	1.5	1.8	0.9	19.3	*10.6*	**19.3**
A26		0.14	0.39	4.70	100	2.0	14.3	650	2.0	2.1	5.1	19.4	*13.6*	**19.4**
DP25A+A26	**26**	0.19	0.43	27.31	From DP25A		19.3	400	2.0	2.1	3.1	22.4	*12.2*	**22.4**
A26A	**26A**	0.16	0.41	1.00	50	2.0	9.9	200	1.5	1.8	1.8	11.7	*11.1*	**11.7**
A27	**27**	0.16	0.41	5.25	100	2.0	14.0	500	2.0	2.1	3.9	17.9	*12.8*	**17.9**
A28	**28**	0.16	0.41	2.75	100	2.0	14.0	450	2.0	2.1	3.5	17.5	*12.5*	**17.5**
A29	**29**	0.16	0.41	4.75	100	2.0	14.0	450	1.5	1.8	4.1	18.0	*12.5*	**18.0**
A30	**30**	0.16	0.41	0.61	100	2.0	14.0	350	2.0	2.1	2.7	16.7	*11.9*	**16.7**
OSA8	**OSA8**	0.16	0.41	2.46	100	2.0	14.0	375	1.0	1.5	4.2	18.1	*12.1*	**18.1**
PROPOSED B BASINS (TRIBUTARY TO FILING 10)														
B1	**B1**	0.16	0.41	3.20	100	2.0	14.0	430	2.0	2.1	3.4	17.3	*12.4*	**12.4**
B2	**B2**	0.16	0.41	0.77	100	1.0	17.6	80	1.0	1.5	0.9	18.5	*10.4*	**10.4**
B3	**B3**	0.16	0.41	5.24	100	2.0	14.0	700	2.0	2.1	5.5	19.5	*13.9*	**13.9**
B4	**B4**	0.20	0.44	7.14	50	4.0	7.5	650	2.0	2.1	5.1	12.6	*13.6*	**12.6**

B5	**B5**	0.16	0.41	1.59	100	3.0	12.2	190	3.0	2.6	1.2	13.4	*11.1*	**11.1**
B6	**B6**	0.16	0.41	7.92	100	2.0	14.0	650	2.0	2.1	5.1	19.1	*13.6*	**13.6**
OFFSITE B BASINS (NOT TRIBUTARY TO FILING 10)														
OSB1	**OSB1**	0.08	0.35	5.23	100	1.0	19.1	1250	2.0	2.1	9.8	28.9	*16.9*	**28.9**
OSB2	**OSB2**	0.08	0.35	6.41	100	1.0	19.1	710	1.0	1.5	7.9	27.0	*13.9*	**27.0**
OSB3		0.08	0.35	3.87	50	2.0	10.7	1800	3.0	2.6	11.5	22.3	*20.0*	**22.3**
OSB2+OSB3	**OSB3**	0.08	0.35	10.28	From OSB3		22.3					22.3	*10.0*	**22.3**
OSB4		0.08	0.35	0.82	50	4.0	8.5	650	2.0	2.1	5.1	13.6	*13.6*	**13.6**
OSB3+OSB4	**OSB4**	0.08	0.35	11.11	From OSB3		22.3	100	1.0	1.5	1.1	23.4	*10.6*	**23.4**
OSB5	**OSB5**	0.08	0.35	1.25	100	3.0	13.2	450	4.0	3.0	2.5	15.7	*12.5*	**12.5**
OSB6		0.08	0.35	0.72	50	2.0	10.7	300	5.0	3.4	1.5	12.2	*11.7*	**11.7**
OSB5+OSB6	**OSB6**	0.08	0.35	1.96	From OSB5		12.5	100	1.0	1.5	1.1	13.6	*10.6*	**13.6**
OFFSITE C BASINS (EASTONVILLE)														
OSC1		0.49	0.66	0.27	15	2.0	3.5	185	1.0	1.5	2.1	5.6	*11.0*	**11.0**
DP22+OSC1	**OSC1**	0.23	0.46	3.63	From DP22		16.6	50	1.0	1.5	0.6	17.2	*10.3*	**17.2**
OSC2		0.49	0.66	0.74	15	2.0	3.5	780	1.0	1.5	8.7	12.2	*14.3*	**14.3**
DP15A+DP29+DP28+G18 Out+OSC2	**OSC2**	0.09	0.18	10.33	From DP28		17.5	780	1.0	1.5	8.7	26.2	*14.3*	**26.2**
OSC3		0.49	0.66	0.77	15	2.0	3.5	705	1.0	1.5	7.8	11.3	*13.9*	**13.9**
DP26A+A27+OSA8+G19 Out+OSC3	**OSC3**	0.10	0.20	9.48	From OSA8		18.1	705	1.0	1.5	7.8	26.0	*13.9*	**26.0**

PROJECT INFORMATION

PROJECT:	Latigo Trails Filing 10
PROJECT NO:	21820-01CSCV
DESIGN BY:	CGH
REV. BY:	KGV
AGENCY:	El Paso County
REPORT TYPE:	Final
DATE:	1/8/2025

Drexel, Barrell & Co.

RATIONAL METHOD CALCULATIONS FOR STORM WATER RUNOFF

DEVELOPED RUNOFF **5 YR STORM** **P1= 1.46**

BASIN (S)	DIRECT RUNOFF						
	DESIGN POINT	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C * A	I (IN/HR)	Q (CFS)
PROPOSED A-BASINS							
OSA1	OSA1	3.68	0.53	42.3	1.96	1.86	**3.6**
OSA2	OSA2	96.30	0.16	40.5	15.41	1.91	**29.4**
OSA3	OSA3	69.15	0.19	30.8	12.99	2.25	**29.3**
OSA4	OSA4	32.65	0.20	25.5	6.37	2.51	**16.0**
OSA5	OSA5	11.33	0.19	14.3	2.16	3.39	**7.3**
A1		13.55	0.18	18.5	2.38	2.99	**7.1**
A1+OSA2+OSA3+OSA4+OSA5+DPB1	1	226.18	0.18	47.1	39.82	1.73	**69.0**
A2		7.24	0.19	21.6	1.39	2.76	**3.8**
A2+OSA1+DP1	2	237.10	0.18	48.2	43.17	1.71	**73.6**
South Pond Out	2A						**17.0**
A3	3	6.48	0.16	20.4	1.04	2.84	**2.9**
A4		6.03	0.18	18.5	1.08	2.99	**3.2**
A4+DPB2	4	7.25	0.16	15.3	1.16	3.29	**3.8**
A5		8.02	0.18	17.9	1.41	3.04	**4.3**
A5+DPB3	5	13.26	0.17	18.7	2.24	2.97	**6.7**
DP5+DP4	5A	20.51	0.17	21.3	3.40	2.78	**9.5**
A6	6	4.02	0.19	23.0	0.76	2.66	**2.0**
DP5A+DP6	6A	24.52	0.17	26.9	4.16	2.44	**10.2**
A7	7	0.63	0.49	11.7	0.31	3.71	**1.1**
A8	8	7.01	0.18	26.2	1.24	2.48	**3.1**
A8+DP7+DP6A	8A	32.16	0.18	28.6	5.71	2.36	**13.4**
A9		3.23	0.49	22.4	1.58	2.70	**4.3**
DP8A+A9	9	35.39	0.21	29.6	7.29	2.31	**16.8**
A10		0.79	0.08	16.5	0.06	3.17	**0.2**
A10+DP8A+DP9	10	71.57	0.20	29.0	14.64	2.34	**34.2**
A10A		1.28	0.16	15.3	0.20	3.28	**0.7**
G14b Out							**0.8**
A10A+G14b Out	10A	1.28	0.16	15.3	0.20	3.28	**1.5**
A11		3.61	0.17	17.5	0.62	3.08	**1.9**
DPB5+A11	11	5.20	0.17	17.5	0.88	3.08	**2.7**
A12	12	2.36	0.19	16.3	0.44	3.19	**1.4**
DP11+DP12	12A	7.56	0.17	20.2	1.32	2.86	**3.8**
A13		3.34	0.17	17.8	0.56	3.05	**1.7**
A13+DPB4	13	10.48	0.19	16.6	1.97	3.15	**6.2**
DP12A+DP13	13A	18.04	0.18	20.6	3.28	2.82	**9.3**

A14	14	1.25	0.49	12.8	0.61	3.56	**2.2**
DP13A+DP14	14A	19.29	0.20	22.3	3.90	2.71	**10.6**
A15		4.16	0.12	22.3	0.51	2.71	**1.4**
DP14A+A15	15	23.45	0.19	25.6	4.41	2.51	**11.1**
A15A		2.08	0.16	16.2	0.33	3.20	**1.1**
G18 Out							**0.5**
A15A+G18 Out	15A						**1.6**
A16	16	4.41	0.16	22.6	0.71	2.69	**1.9**
A17	17	4.02	0.16	18.5	0.64	2.99	**1.9**
A18	18	1.81	0.16	16.7	0.29	3.15	**0.9**
A19	19	2.40	0.16	20.8	0.38	2.81	**1.1**
A20	20	2.18	0.21	15.5	0.47	3.26	**1.5**
A21	21	0.44	0.08	14.6	0.04	3.36	**0.1**
A22		0.73	0.25	11.9	0.18	3.67	**0.7**
A20+A21+A22	22	3.35	0.20	16.6	0.68	3.15	**2.2**
A23	23	2.03	0.16	15.9	0.33	3.22	**1.0**
OSA6	OSA6	1.08	0.21	11.1	0.22	3.79	**0.9**
A24		11.59	0.18	16.7	2.08	3.15	**6.5**
DPB6+A24	24	19.51	0.17	18.4	3.35	3.00	**10.0**
DPOSA6+DP24	24A	20.59	0.17	18.4	3.57	3.00	**10.7**
OSA7	OSA7	0.41	0.49	11.4	0.20	3.75	**0.8**
A25		1.61	0.49	13.1	0.79	3.53	**2.8**
DPOSA67+A25	25	2.03	0.49	16.8	0.99	3.14	**3.1**
DP24A+DP25	25A	22.62	0.20	19.3	4.56	2.93	**13.4**
A26		4.70	0.14	19.4	0.65	2.92	**1.9**
DP25A+A26	26	27.31	0.19	22.4	5.21	2.70	**14.1**
A26A		1.00	0.16	11.7	0.16	3.71	**0.6**
G19 Out							**0.6**
A26A + G19 Out	26A						**1.2**
A27	27	5.25	0.16	17.9	0.84	3.04	**2.6**
A28	28	2.75	0.16	17.5	0.44	3.08	**1.4**
A29	29	4.75	0.16	18.0	0.76	3.03	**2.3**
A30	30	0.61	0.16	16.7	0.10	3.15	**0.3**
OSA8	OSA8	2.46	0.16	18.1	0.39	3.02	**1.2**
PROPOSED B-BASINS							
B1	B1	3.20	0.16	12.4	0.51	3.61	**1.9**
B2	B2	0.77	0.16	10.4	0.12	3.88	**0.5**
B3	B3	5.24	0.16	13.9	0.84	3.44	**2.9**
B4	B4	7.14	0.20	12.6	1.40	3.58	**5.0**
B5	B5	1.59	0.16	11.1	0.25	3.79	**1.0**
B6	B6	7.92	0.16	13.6	1.27	3.47	**4.4**
OFFSITE B BASINS (NON TRIBUTARY TO FILING 10)							
OSB1	OSB1	5.23	0.08	28.9	0.42	2.34	**1.0**
OSB2	OSB2	6.41	0.08	27.0	0.51	2.44	**1.3**
OSB3		3.87	0.08	22.3	0.31	2.71	**0.8**
OSB2+OSB3	OSB3	10.28	0.08	22.3	0.82	2.71	**2.2**
OSB4		0.82	0.08	13.6	0.07	3.47	**0.2**
OSB3+OSB4	OSB4	11.11	0.08	23.4	0.89	2.64	**2.3**
OSB5	OSB5	1.25	0.08	12.5	0.10	3.60	**0.4**

OSB6		0.72	0.08	11.7	0.06	3.71	**0.2**
OSB5+OSB6	OSB6	1.96	0.08	13.6	0.16	3.47	**0.5**
OFFSITE C BASINS (EASTONVILLE)							
OSC1		0.27	0.49	11.0	0.13	3.80	**0.5**
DP22+OSC1	OSC1	3.63	0.23	17.2	0.82	3.10	**2.5**
OSC2		0.74	0.49	14.3	0.36	3.39	**1.2**
DP15A+DP29+DP28+G18 Out+OSC2	OSC2	10.33	0.09	26.2	0.97	2.48	**2.9**
OSC3		0.77	0.49	13.9	0.38	3.43	**1.3**
DP26A+A27+OSA8+G19 Out+OSC3	OSC3	9.48	0.10	26.0	0.97	2.49	**3.0**

PROJECT INFORMATION

PROJECT:	Latigo Trails Filing 10
PROJECT NO:	21820-01CSCV
DESIGN BY:	CGH
REV. BY:	KGV
AGENCY:	El Paso County
REPORT TYPE:	Final
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Drexel, Barrell & Co.

RATIONAL METHOD CALCULATIONS FOR STORM WATER RUNOFF

DEVELOPED RUNOFF **100 YR STORM** **P1= 2.47**

BASIN (S)	DIRECT RUNOFF						
	DESIGN POINT	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C * A	I (IN/HR)	Q (CFS)
PROPOSED A-BASINS							
OSA1	OSA1	3.68	0.69	42.3	2.53	3.14	**7.9**
OSA2	OSA2	96.30	0.41	40.5	39.48	3.23	**127.3**
OSA3	OSA3	69.15	0.43	30.8	29.73	3.81	**113.4**
OSA4	OSA4	32.65	0.44	25.5	14.24	4.25	**60.5**
OSA5	OSA5	11.33	0.43	14.3	4.91	5.73	**28.1**
A1		13.55	0.42	18.5	5.71	5.05	**28.8**
A1+OSA2+OSA3+OSA4+OSA5+DPB1	1	226.18	0.42	47.1	95.38	2.93	**279.5**
A2		7.24	0.43	21.6	3.14	4.67	**14.7**
A2+OSA1+DP1	2	237.10	0.43	48.2	101.05	2.89	**291.6**
South Pond Out	2A						**293.5**
A3	3	6.48	0.41	20.4	2.66	4.81	**12.8**
A4		6.03	0.42	18.5	2.56	5.06	**13.0**
A4+DPB2	4	7.25	0.41	15.3	2.97	5.56	**16.5**
A5		8.02	0.42	17.9	3.38	5.15	**17.4**
A5+DPB3	5	13.26	0.42	18.7	5.53	5.03	**27.8**
DP5+DP4	5A	20.51	0.41	21.3	8.50	4.70	**40.0**
A6	6	4.02	0.43	23.0	1.73	4.50	**7.8**
DP5A+DP6	6A	24.52	0.42	26.9	10.23	4.13	**42.2**
A7	7	0.63	0.66	11.7	0.41	6.27	**2.6**
A8	8	7.01	0.42	26.2	2.96	4.20	**12.4**
A8+DP7+DP6A	8A	32.16	0.42	28.6	13.60	3.98	**54.2**
A9		3.23	0.66	22.4	2.12	4.57	**9.7**
DP8A+A9	9	35.39	0.44	29.6	15.72	3.91	**61.4**
A10		0.79	0.35	16.5	0.28	5.36	**1.5**
A10+DP8A+DP9	10	71.57	0.44	29.0	31.71	3.96	**125.4**
A10A		1.28	0.41	15.3	0.52	5.55	**2.9**
G14b Out							**27.5**
A10A+G14b Out	10A	1.28	0.41	15.3	0.52	5.55	**30.4**
A11		3.61	0.42	17.5	1.51	5.21	**7.9**
DPB5+A11	11	5.20	0.42	17.5	2.17	5.21	**11.3**
A12	12	2.36	0.43	16.3	1.02	5.39	**5.5**
DP11+DP12	12A	7.56	0.42	20.2	3.18	4.84	**15.4**
A13		3.34	0.42	17.8	1.39	5.16	**7.2**
A13+DPB4	13	10.48	0.43	16.6	4.51	5.34	**24.1**
DP12A+DP13	13A	18.04	0.43	20.6	7.69	4.78	**36.8**

A14	14	1.25	0.66	12.8	0.82	6.02	**4.9**
DP13A+DP14	14A	19.29	0.44	22.3	8.51	4.58	**39.0**
A15		4.16	0.38	22.3	1.59	4.59	**7.3**
DP14A+A15	15	23.45	0.43	25.6	10.11	4.24	**42.9**
A15A		2.08	0.41	16.2	0.85	5.41	**4.6**
G18 Out							**8.7**
A15A+G18 Out	15A						**13.3**
A16	16	4.41	0.41	22.6	1.81	4.55	**8.2**
A17	17	4.02	0.41	18.5	1.65	5.06	**8.3**
A18	18	1.81	0.41	16.7	0.74	5.32	**4.0**
A19	19	2.40	0.41	20.8	0.98	4.76	**4.7**
A20	20	2.18	0.45	15.5	0.98	5.51	**5.4**
A21	21	0.44	0.35	14.6	0.15	5.68	**0.9**
A22		0.73	0.47	11.9	0.35	6.21	**2.2**
A20+A21+A22	22	3.35	0.44	16.6	1.48	5.33	**7.9**
A23	23	2.03	0.41	15.9	0.83	5.45	**4.5**
OSA6	OSA6	1.08	0.45	11.1	0.48	6.40	**3.1**
A24		11.59	0.42	16.7	4.92	5.33	**26.2**
DPB6+A24	24	19.51	0.42	18.4	8.17	5.08	**41.5**
DPOSA6+DP24	24A	20.59	0.42	18.4	8.65	5.08	**43.9**
OSA7	OSA7	0.41	0.66	11.4	0.27	6.34	**1.7**
A25		1.61	0.66	13.1	1.06	5.98	**6.3**
DPOSA67+A25	25	2.03	0.66	16.8	1.33	5.30	**7.0**
DP24A+DP25	25A	22.62	0.44	19.3	9.97	4.95	**49.4**
A26		4.70	0.39	19.4	1.85	4.94	**9.1**
DP25A+A26	26	27.31	0.43	22.4	11.82	4.57	**54.1**
A26A		1.00	0.41	11.7	0.41	6.27	**2.6**
G19 Out							**33.8**
A26A+G19 Out	26A						**36.4**
A27	27	5.25	0.41	17.9	2.15	5.15	**11.1**
A28	28	2.75	0.41	17.5	1.13	5.20	**5.9**
A29	29	4.75	0.41	18.0	1.95	5.12	**10.0**
A30	30	0.61	0.41	16.7	0.25	5.32	**1.3**
OSA8	OSA8	2.46	0.41	18.1	1.01	5.11	**5.2**
PROPOSED B-BASINS							
B1	B1	3.20	0.41	12.4	1.31	6.12	**8.0**
B2	B2	0.77	0.41	10.4	0.31	6.57	**2.1**
B3	B3	5.24	0.41	13.9	2.15	5.81	**12.5**
B4	B4	7.14	0.44	12.6	3.12	6.06	**18.9**
B5	B5	1.59	0.41	11.1	0.65	6.42	**4.2**
B6	B6	7.92	0.41	13.6	3.25	5.87	**19.0**
OFFSITE B-BASINS (NOT TRIBUTARY TO FILING 10)							
OSB1	OSB1	5.23	0.35	28.9	1.83	3.96	**7.2**
OSB2	OSB2	6.41	0.35	27.0	2.24	4.12	**9.3**
OSB3		3.87	0.35	22.3	1.36	4.59	**6.2**
OSB2+OSB3	OSB3	10.28	0.35	22.3	3.60	4.59	**16.5**
OSB4		0.82	0.35	13.6	0.29	5.87	**1.7**
OSB3+OSB4	OSB4	11.11	0.35	23.4	3.89	4.47	**17.4**
OSB5	OSB5	1.25	0.35	12.5	0.44	6.09	**2.7**

OSB6		0.72	0.35	11.7	0.25	6.27	**1.6**
OSB5+OSB6	OSB6	1.96	0.35	13.6	0.69	5.87	**4.0**
OFFSITE C BASINS (EASTONVILLE)							
OSC1		0.27	0.66	11.0	0.18	6.42	**1.2**
DP22+OSC1	OSC1	3.63	0.46	17.2	1.66	5.25	**8.7**
OSC2		0.74	0.66	14.3	0.49	5.73	**2.8**
DP15A+DP29+DP28+G18 Out+OSC2	OSC2	10.33	0.18	26.2	1.89	4.20	**16.6**
OSC3		0.77	0.66	13.9	0.50	5.81	**2.9**
DP26A+A27+OSA8+G19 Out+OSC3		9.48	0.20	26.0	1.89	4.21	**41.7**

Roadside Ditch & Drainage Swale Analysis

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jan 1 2025

Roadside Ditch DP OSA1

Triangular

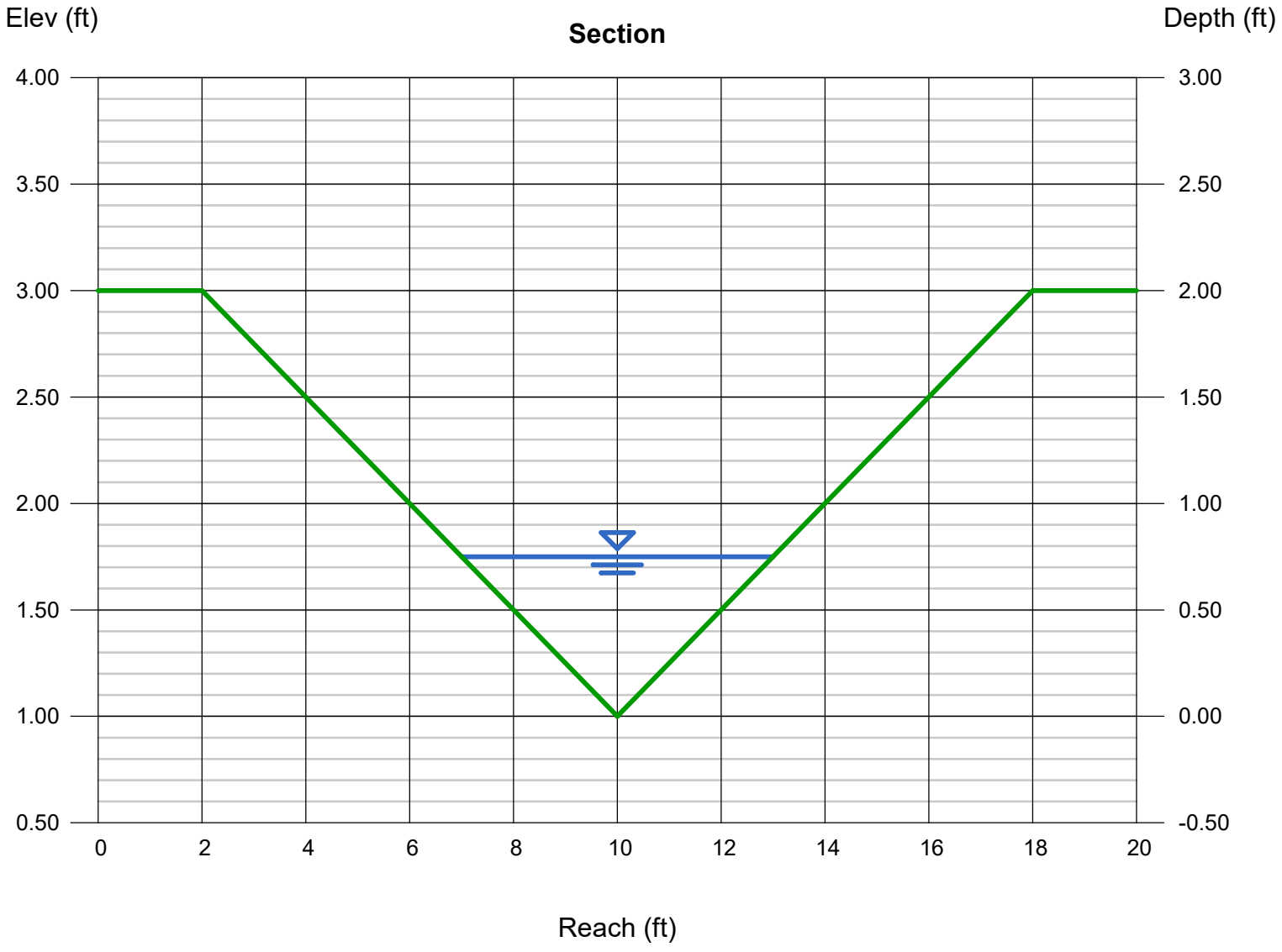
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 1.00
Slope (%)	= 2.00
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 7.90

Highlighted

Depth (ft)	= 0.75
Q (cfs)	= 7.900
Area (sqft)	= 2.25
Velocity (ft/s)	= 3.51
Wetted Perim (ft)	= 6.18
Crit Depth, Yc (ft)	= 0.76
Top Width (ft)	= 6.00
EGL (ft)	= 0.94



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jan 1 2025

Roadside Ditch DP OSA2

Triangular

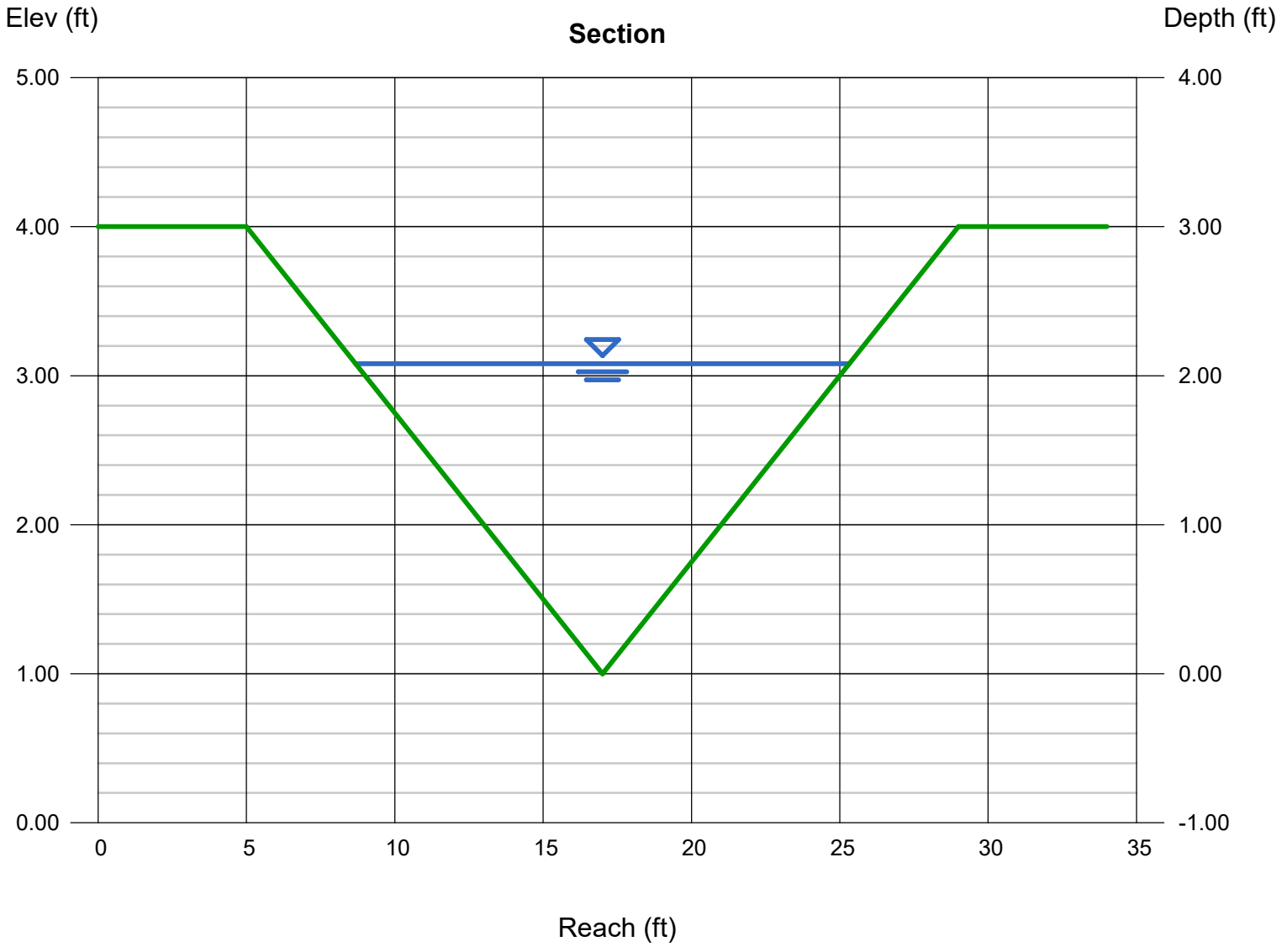
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 1.00
Slope (%)	= 2.20
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 127.30

Highlighted

Depth (ft)	= 2.08
Q (cfs)	= 127.30
Area (sqft)	= 17.31
Velocity (ft/s)	= 7.36
Wetted Perim (ft)	= 17.15
Crit Depth, Yc (ft)	= 2.30
Top Width (ft)	= 16.64
EGL (ft)	= 2.92



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jan 1 2025

Roadside Ditch DP1

Triangular

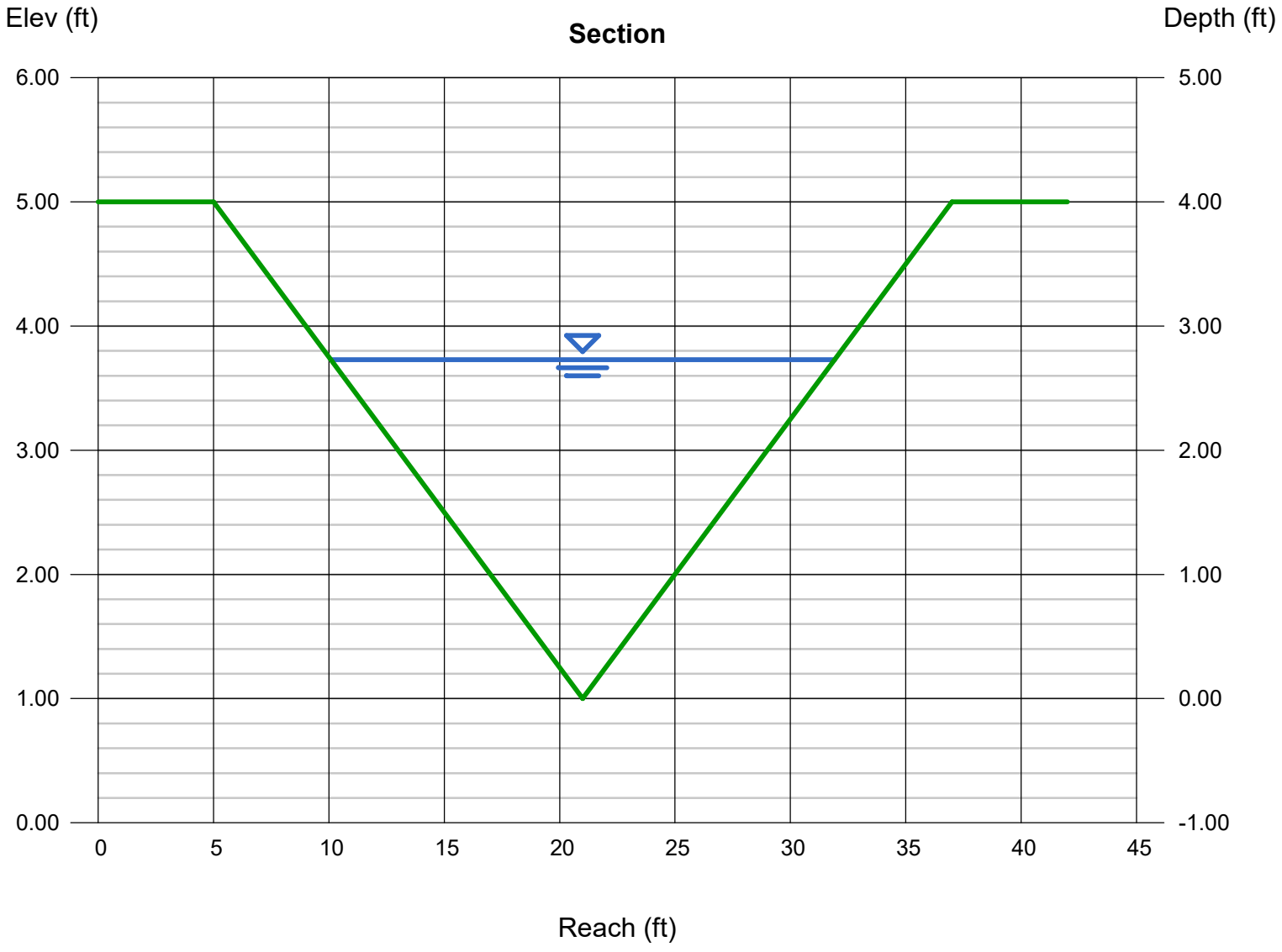
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 4.00
Invert Elev (ft)	= 1.00
Slope (%)	= 2.50
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 279.50

Highlighted

Depth (ft)	= 2.73
Q (cfs)	= 279.50
Area (sqft)	= 29.81
Velocity (ft/s)	= 9.38
Wetted Perim (ft)	= 22.51
Crit Depth, Yc (ft)	= 3.14
Top Width (ft)	= 21.84
EGL (ft)	= 4.10



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jan 1 2025

Roadside Ditch DP4

Triangular

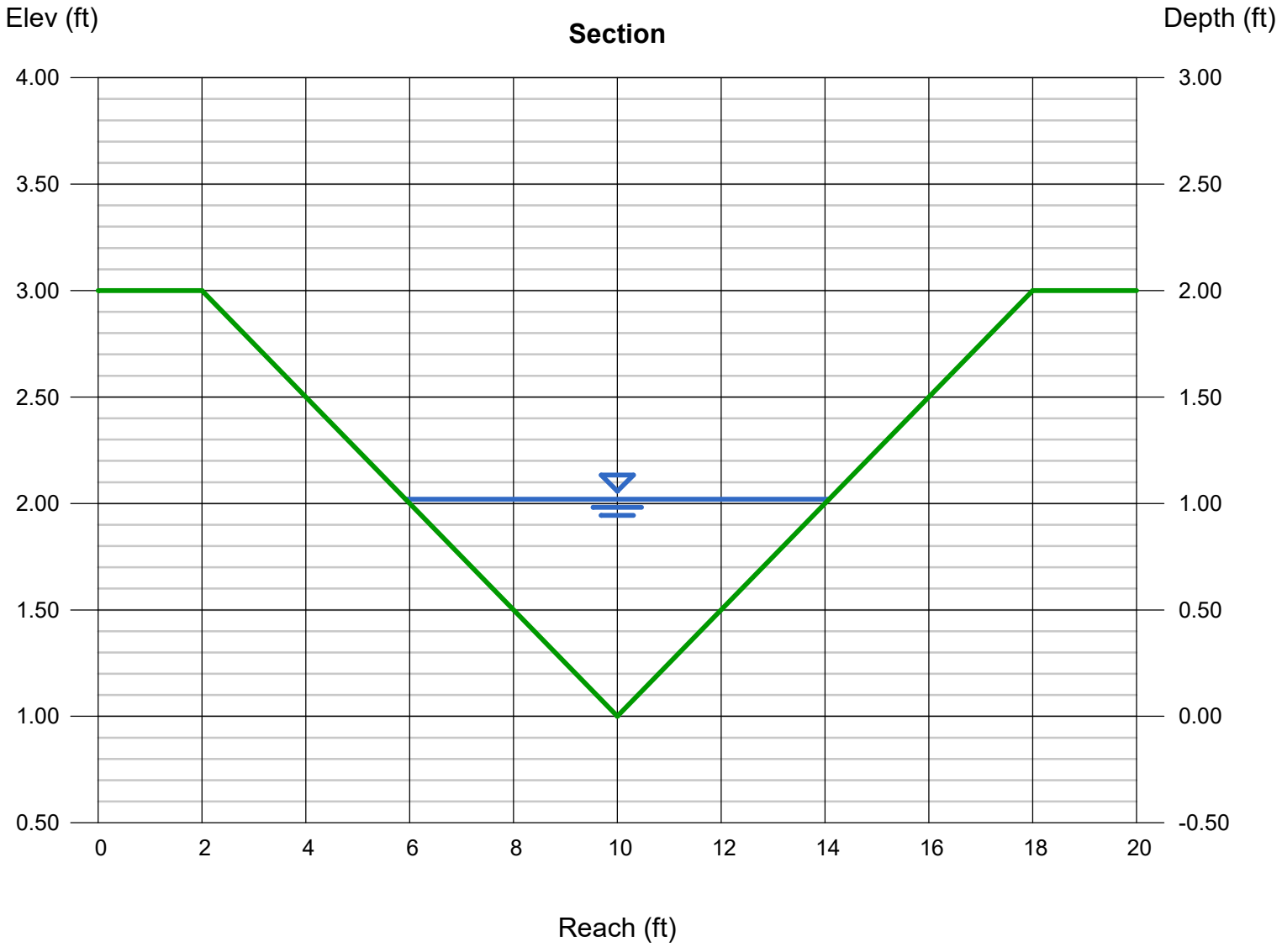
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 1.00
Slope (%)	= 1.70
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 16.50

Highlighted

Depth (ft)	= 1.02
Q (cfs)	= 16.50
Area (sqft)	= 4.16
Velocity (ft/s)	= 3.96
Wetted Perim (ft)	= 8.41
Crit Depth, Yc (ft)	= 1.02
Top Width (ft)	= 8.16
EGL (ft)	= 1.26



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jan 1 2025

Roadside Ditch DP5A

Triangular

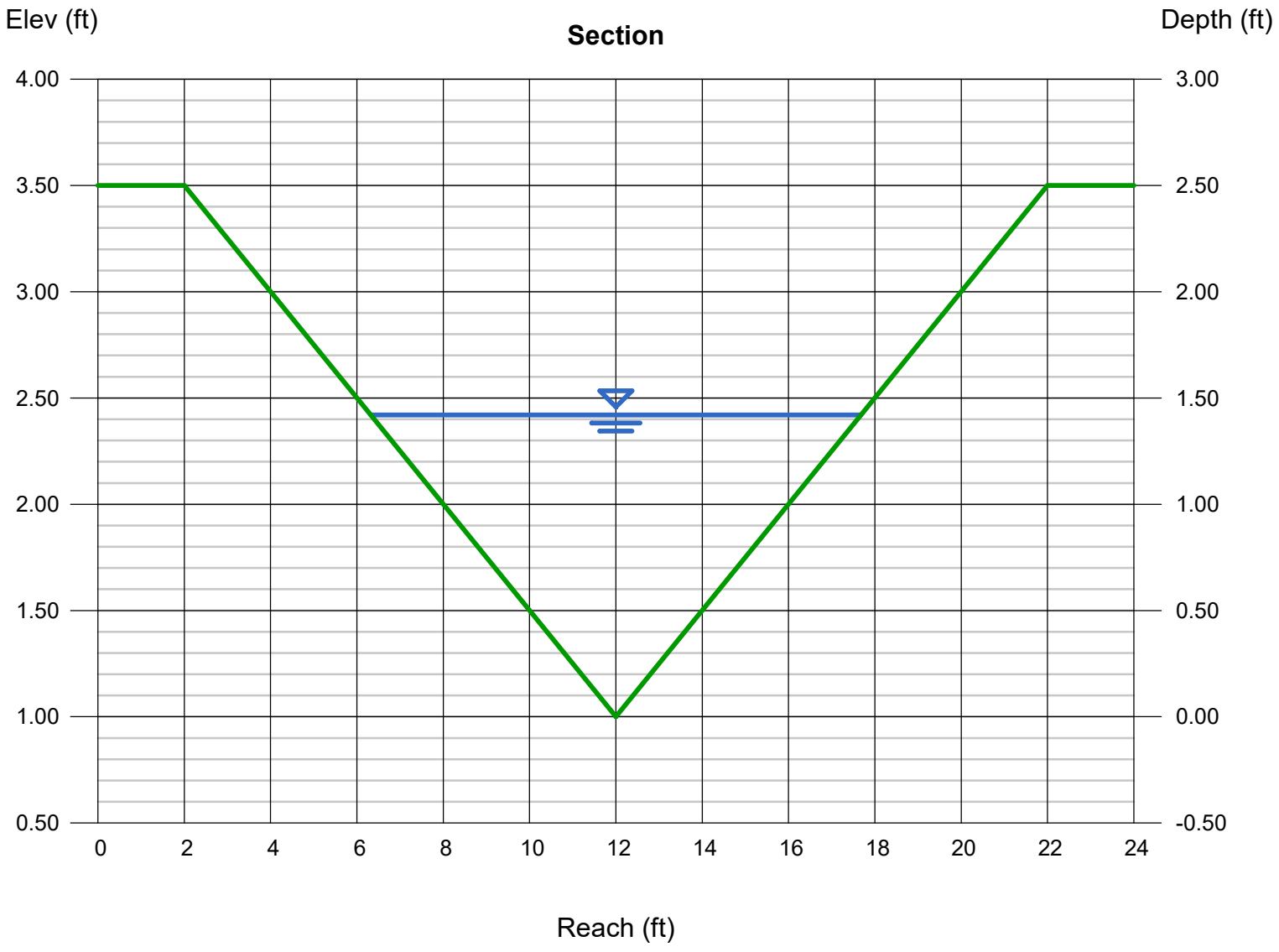
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.50
Invert Elev (ft)	= 1.00
Slope (%)	= 1.70
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 40.00

Highlighted

Depth (ft)	= 1.42
Q (cfs)	= 40.00
Area (sqft)	= 8.07
Velocity (ft/s)	= 4.96
Wetted Perim (ft)	= 11.71
Crit Depth, Yc (ft)	= 1.45
Top Width (ft)	= 11.36
EGL (ft)	= 1.80



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jan 1 2025

Roadside Ditch DP6A

Triangular

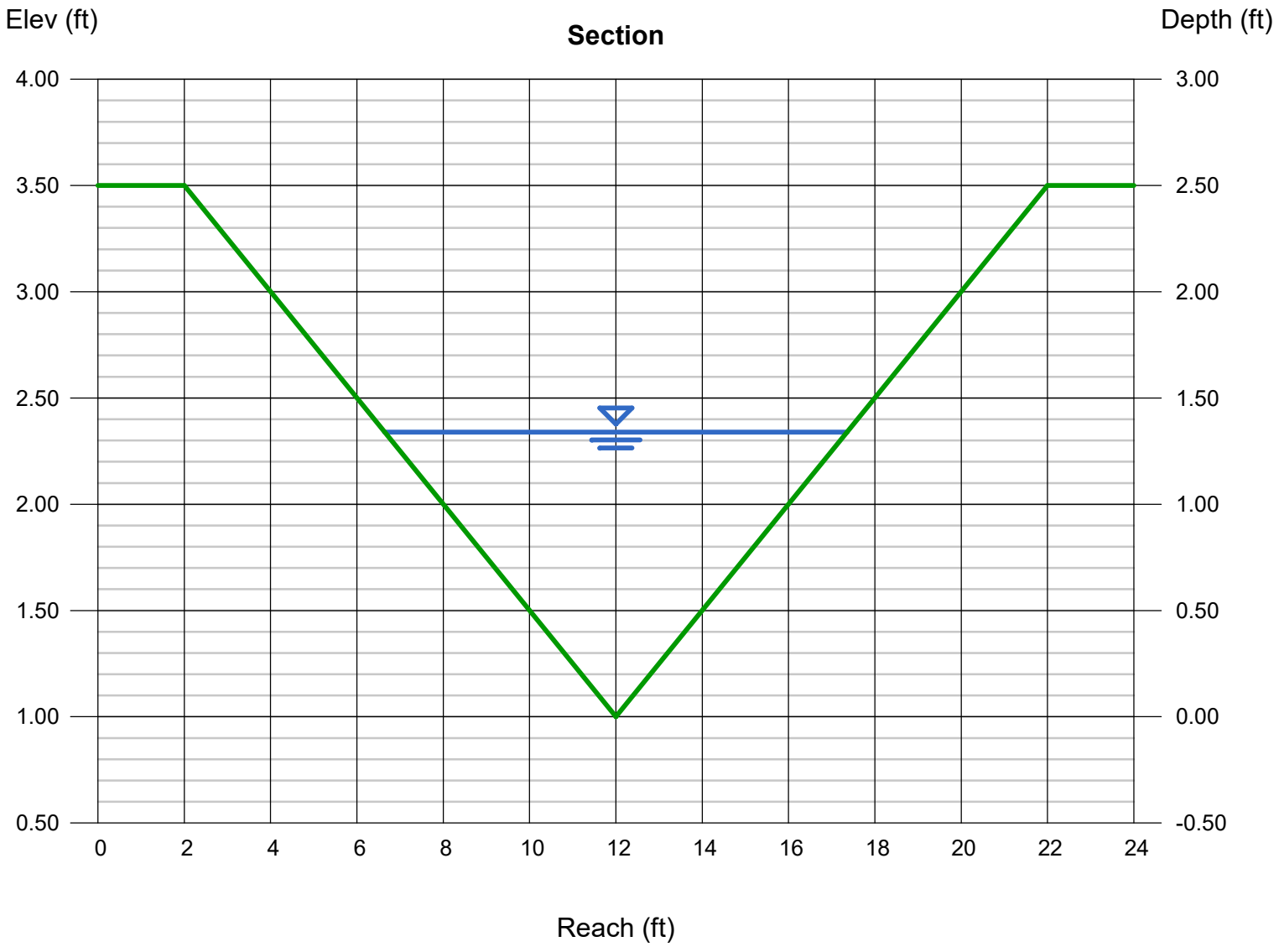
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.50
Invert Elev (ft)	= 1.00
Slope (%)	= 2.60
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 42.20

Highlighted

Depth (ft)	= 1.34
Q (cfs)	= 42.20
Area (sqft)	= 7.18
Velocity (ft/s)	= 5.88
Wetted Perim (ft)	= 11.05
Crit Depth, Yc (ft)	= 1.48
Top Width (ft)	= 10.72
EGL (ft)	= 1.88



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jan 1 2025

Roadside Ditch DP7

Triangular

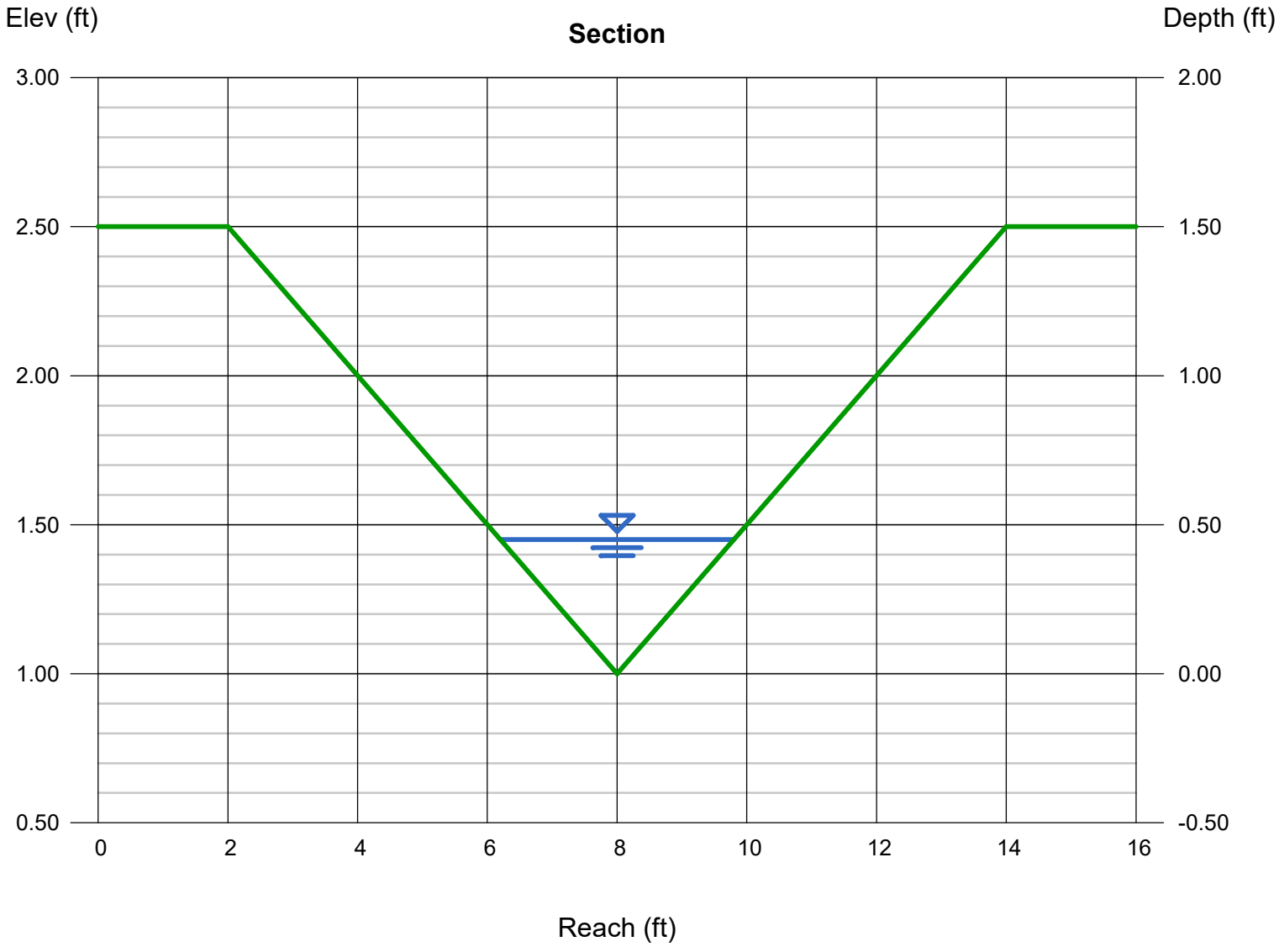
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 1.50
Invert Elev (ft)	= 1.00
Slope (%)	= 3.40
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 2.60

Highlighted

Depth (ft)	= 0.45
Q (cfs)	= 2.600
Area (sqft)	= 0.81
Velocity (ft/s)	= 3.21
Wetted Perim (ft)	= 3.71
Crit Depth, Yc (ft)	= 0.49
Top Width (ft)	= 3.60
EGL (ft)	= 0.61



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jan 1 2025

Roadside Ditch DP8A

Triangular

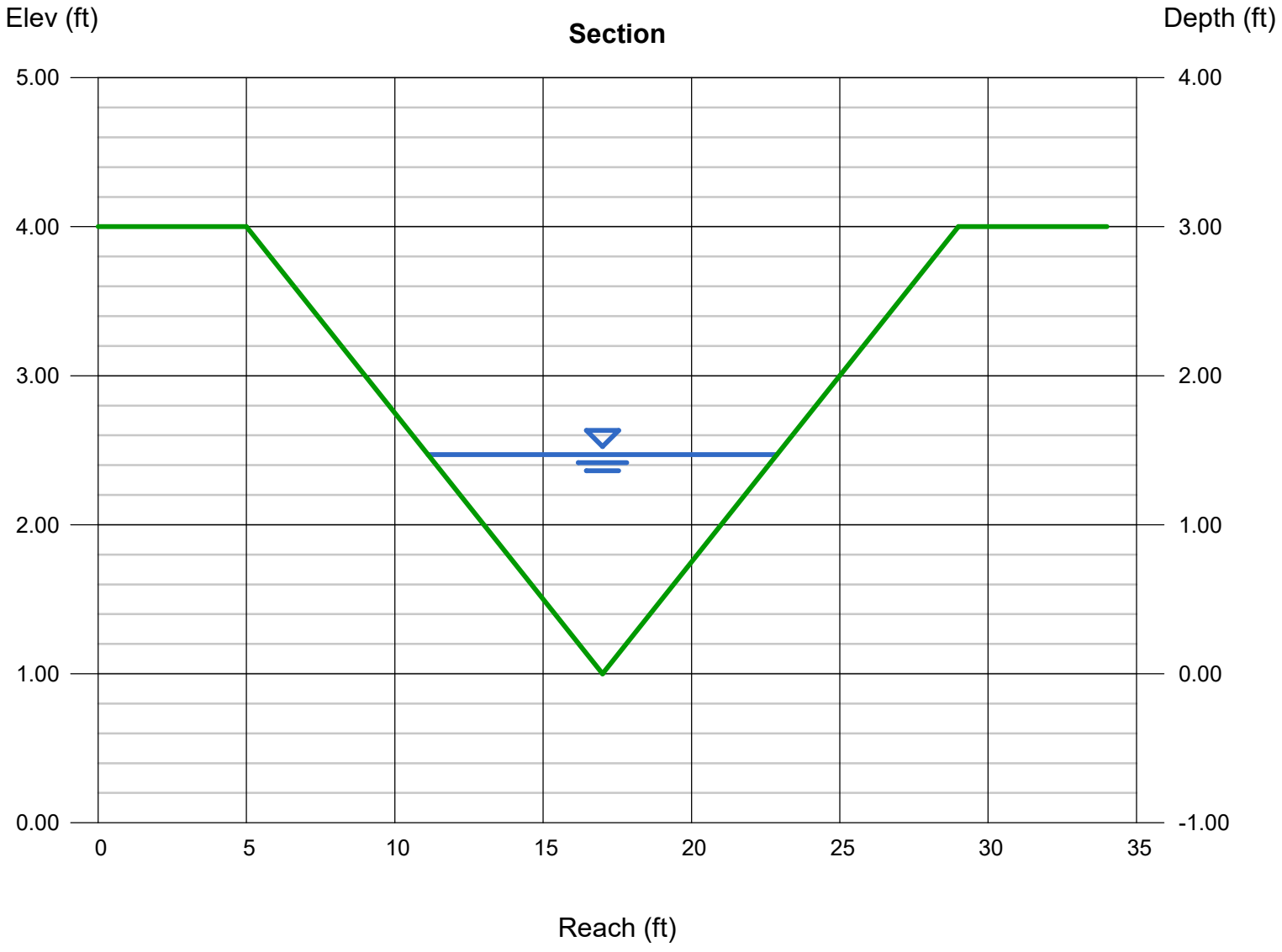
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 1.00
Slope (%)	= 2.60
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 54.20

Highlighted

Depth (ft)	= 1.47
Q (cfs)	= 54.20
Area (sqft)	= 8.64
Velocity (ft/s)	= 6.27
Wetted Perim (ft)	= 12.12
Crit Depth, Yc (ft)	= 1.63
Top Width (ft)	= 11.76
EGL (ft)	= 2.08



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jan 1 2025

Roadside Ditch DP9

Triangular

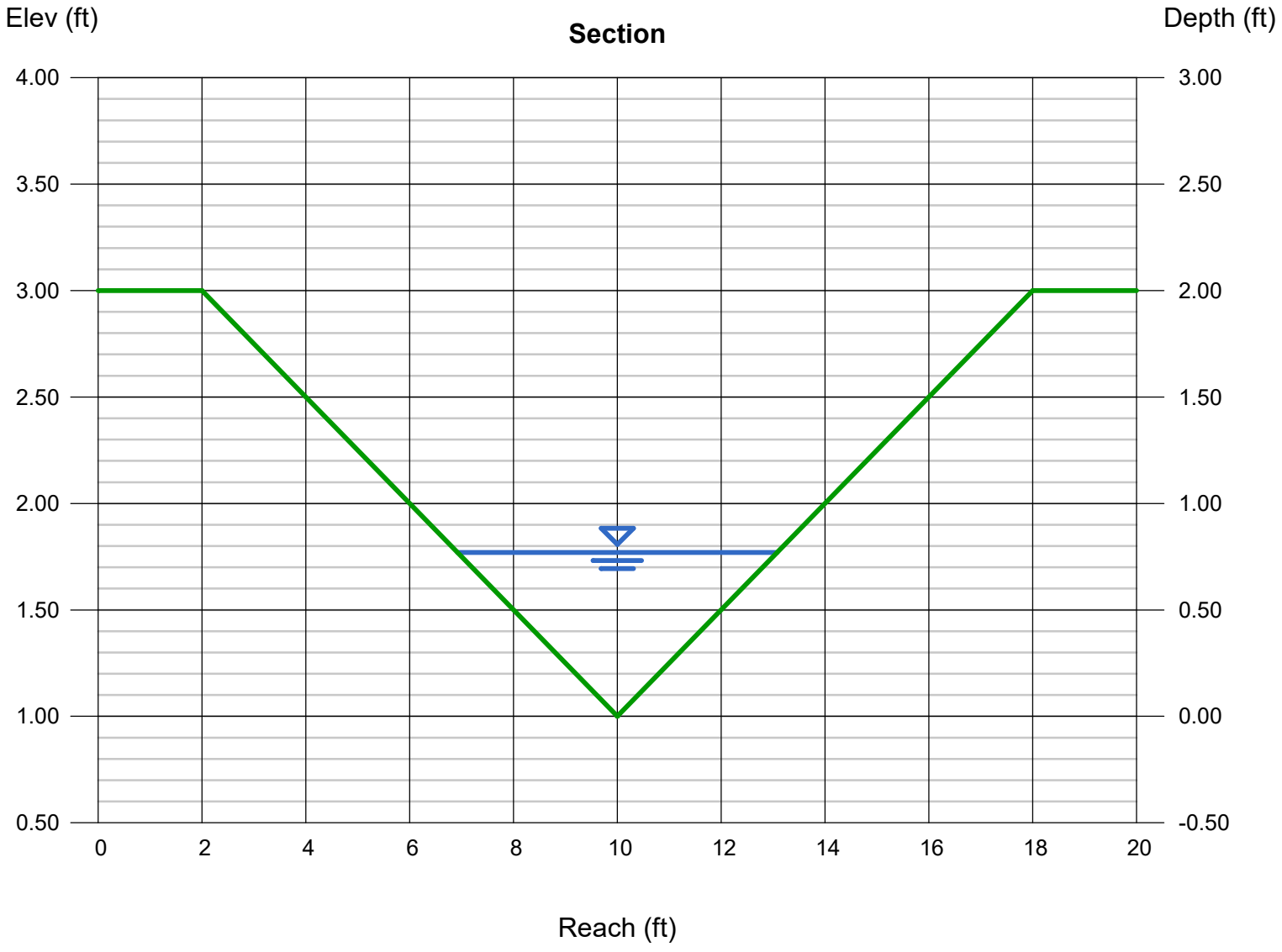
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 1.00
Slope (%)	= 2.60
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 9.70

Highlighted

Depth (ft)	= 0.77
Q (cfs)	= 9.700
Area (sqft)	= 2.37
Velocity (ft/s)	= 4.09
Wetted Perim (ft)	= 6.35
Crit Depth, Yc (ft)	= 0.82
Top Width (ft)	= 6.16
EGL (ft)	= 1.03



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jan 1 2025

Roadside Ditch DP11

Triangular

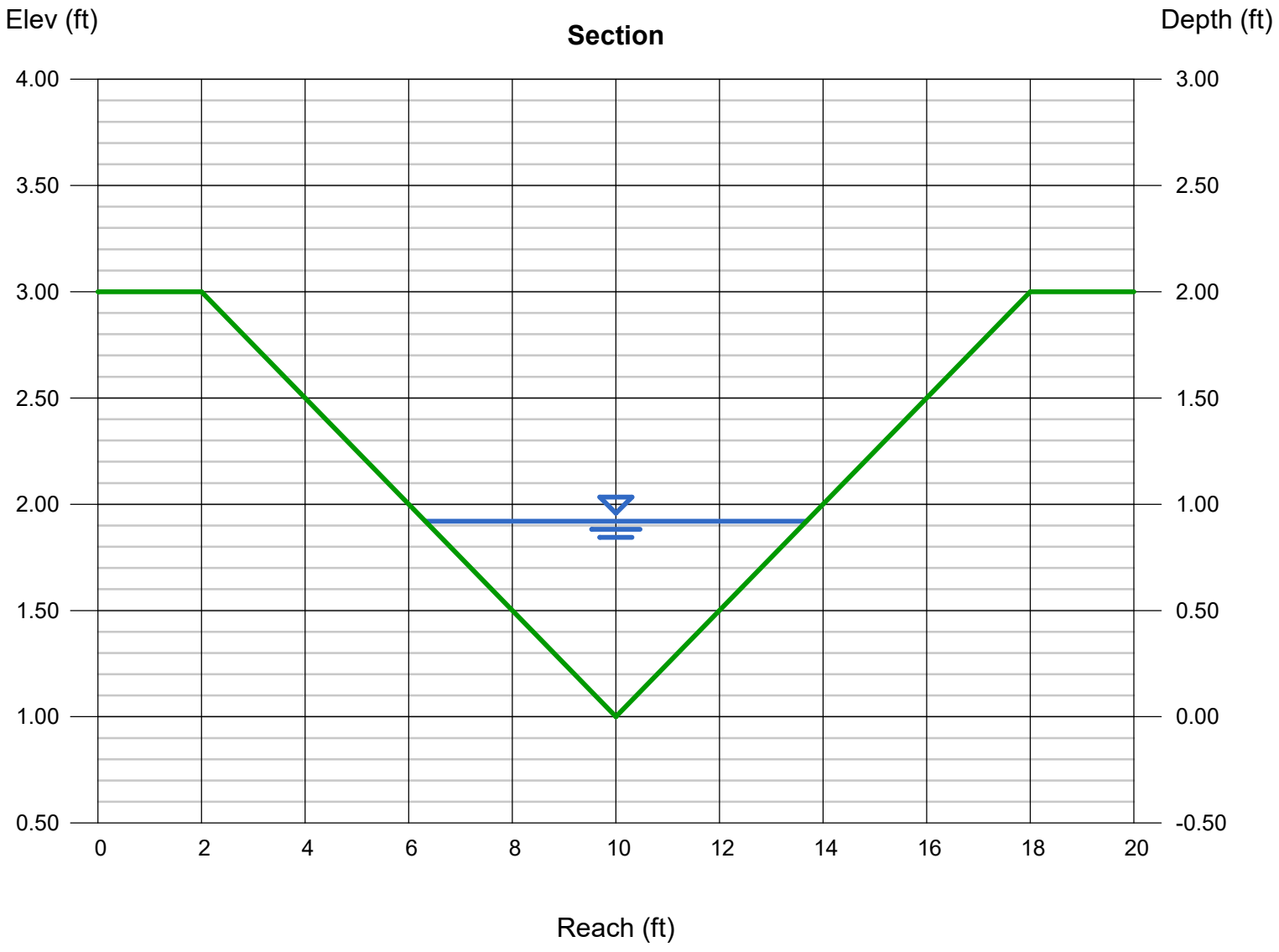
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 1.00
Slope (%)	= 1.40
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 11.30

Highlighted

Depth (ft)	= 0.92
Q (cfs)	= 11.30
Area (sqft)	= 3.39
Velocity (ft/s)	= 3.34
Wetted Perim (ft)	= 7.59
Crit Depth, Yc (ft)	= 0.87
Top Width (ft)	= 7.36
EGL (ft)	= 1.09



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jan 1 2025

Roadside Ditch DP12A

Triangular

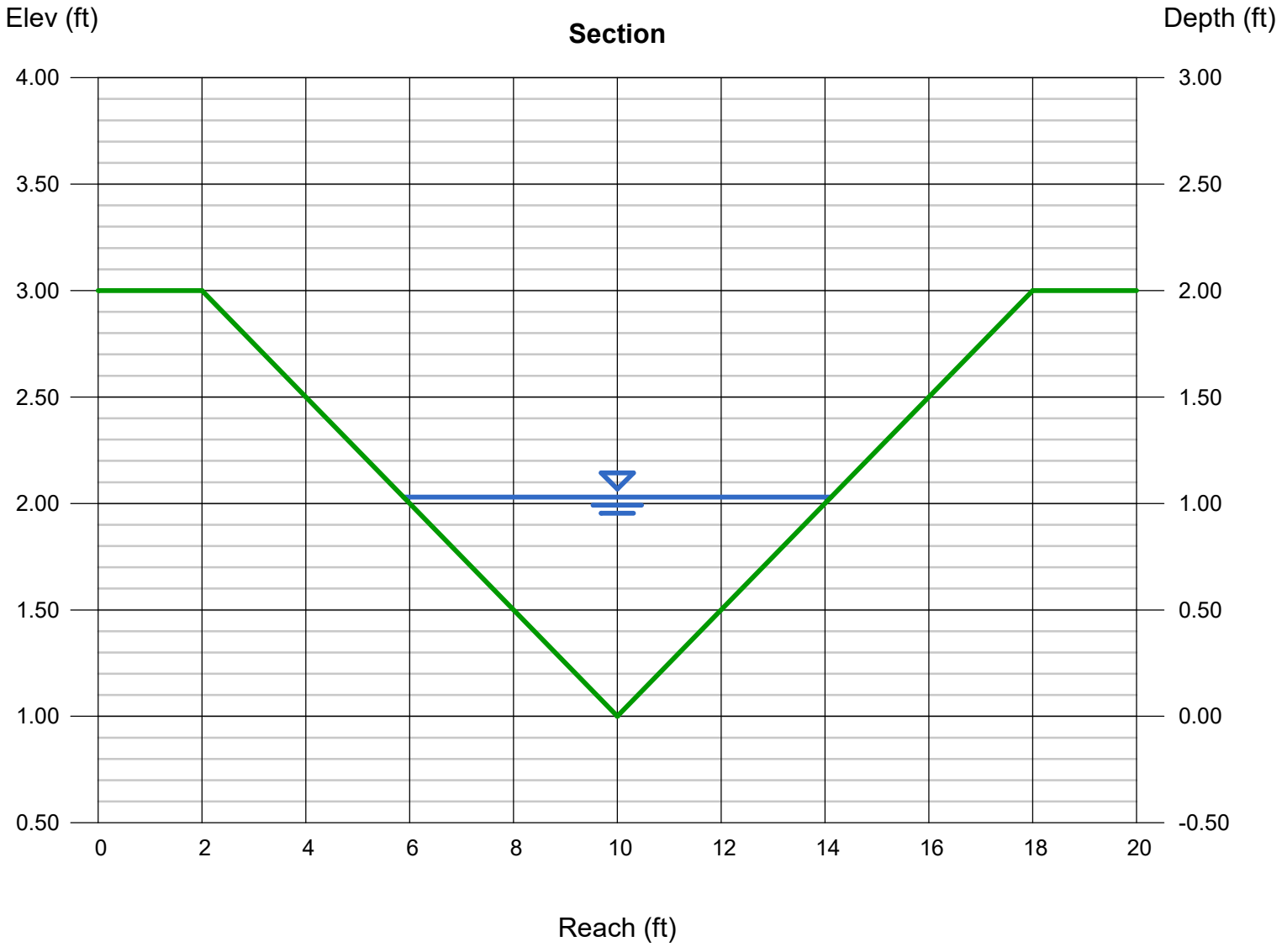
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 1.00
Slope (%)	= 1.40
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 15.40

Highlighted

Depth (ft)	= 1.03
Q (cfs)	= 15.40
Area (sqft)	= 4.24
Velocity (ft/s)	= 3.63
Wetted Perim (ft)	= 8.49
Crit Depth, Yc (ft)	= 0.99
Top Width (ft)	= 8.24
EGL (ft)	= 1.23



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jan 1 2025

Roadside Ditch DP13A

Triangular

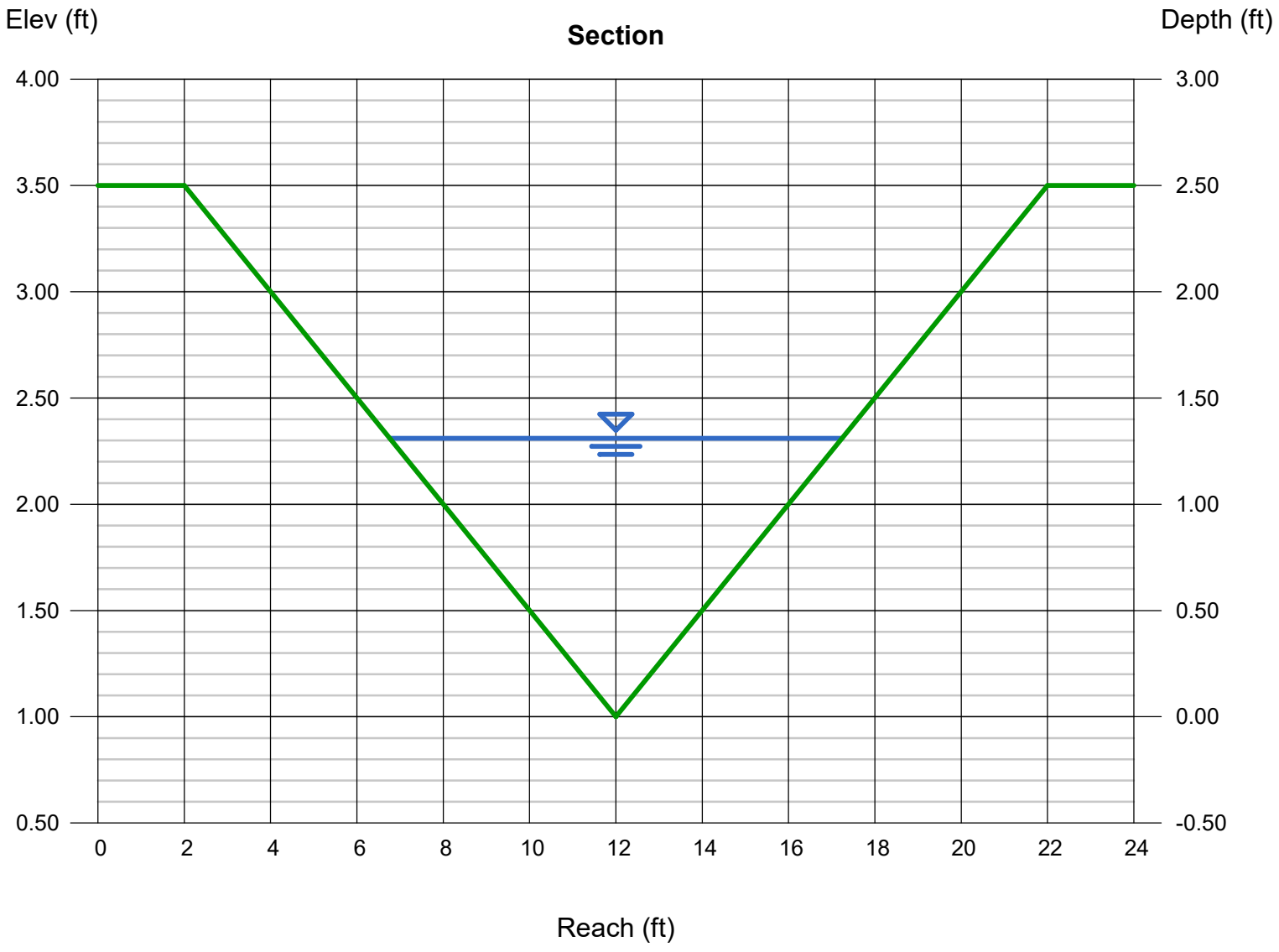
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.50
Invert Elev (ft)	= 1.00
Slope (%)	= 2.20
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 36.80

Highlighted

Depth (ft)	= 1.31
Q (cfs)	= 36.80
Area (sqft)	= 6.86
Velocity (ft/s)	= 5.36
Wetted Perim (ft)	= 10.80
Crit Depth, Yc (ft)	= 1.40
Top Width (ft)	= 10.48
EGL (ft)	= 1.76



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jan 1 2025

Roadside Ditch DP14

Triangular

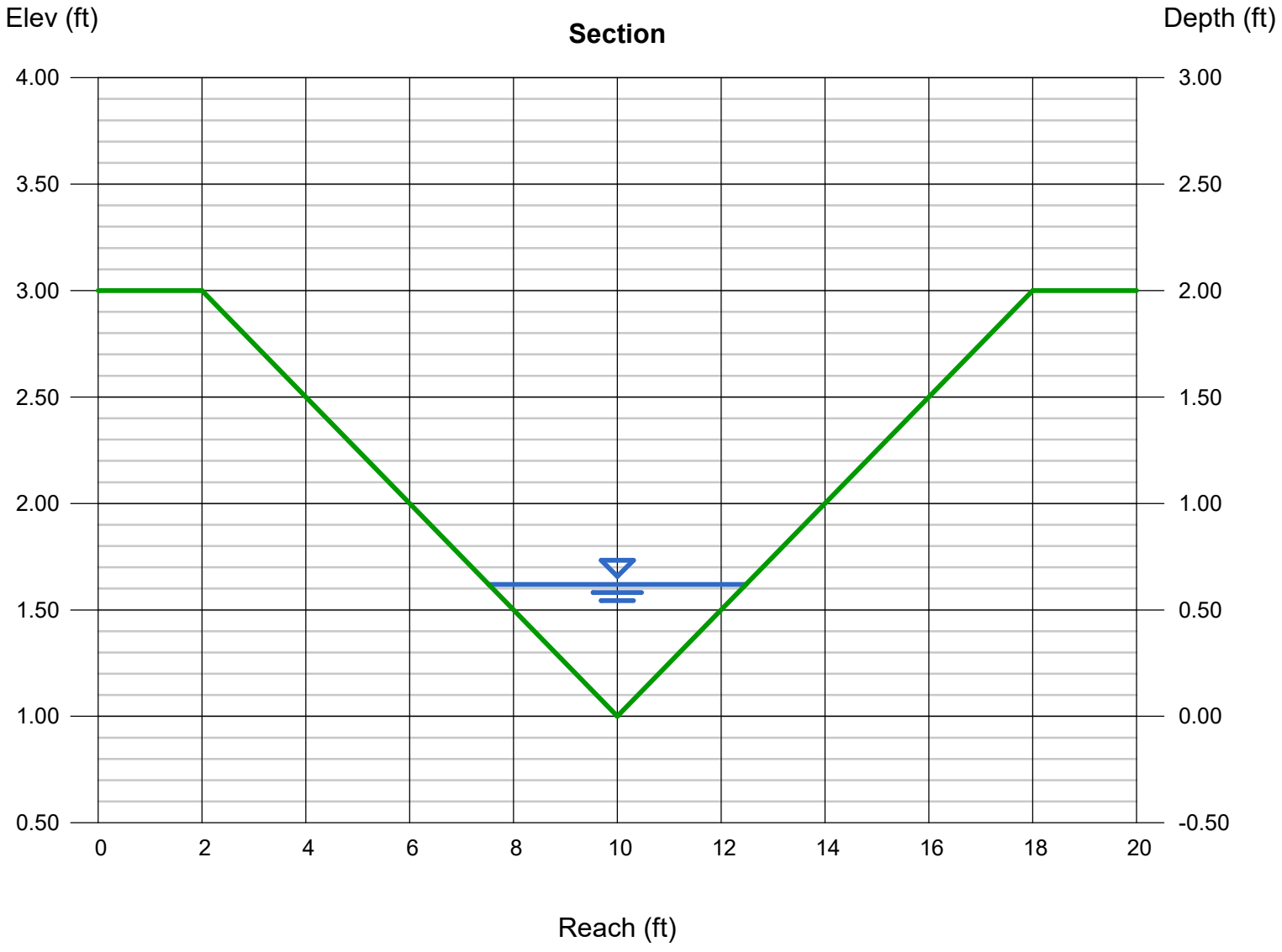
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 1.00
Slope (%)	= 2.20
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 4.90

Highlighted

Depth (ft)	= 0.62
Q (cfs)	= 4.900
Area (sqft)	= 1.54
Velocity (ft/s)	= 3.19
Wetted Perim (ft)	= 5.11
Crit Depth, Yc (ft)	= 0.63
Top Width (ft)	= 4.96
EGL (ft)	= 0.78



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jan 1 2025

Roadside Ditch DP20

Triangular

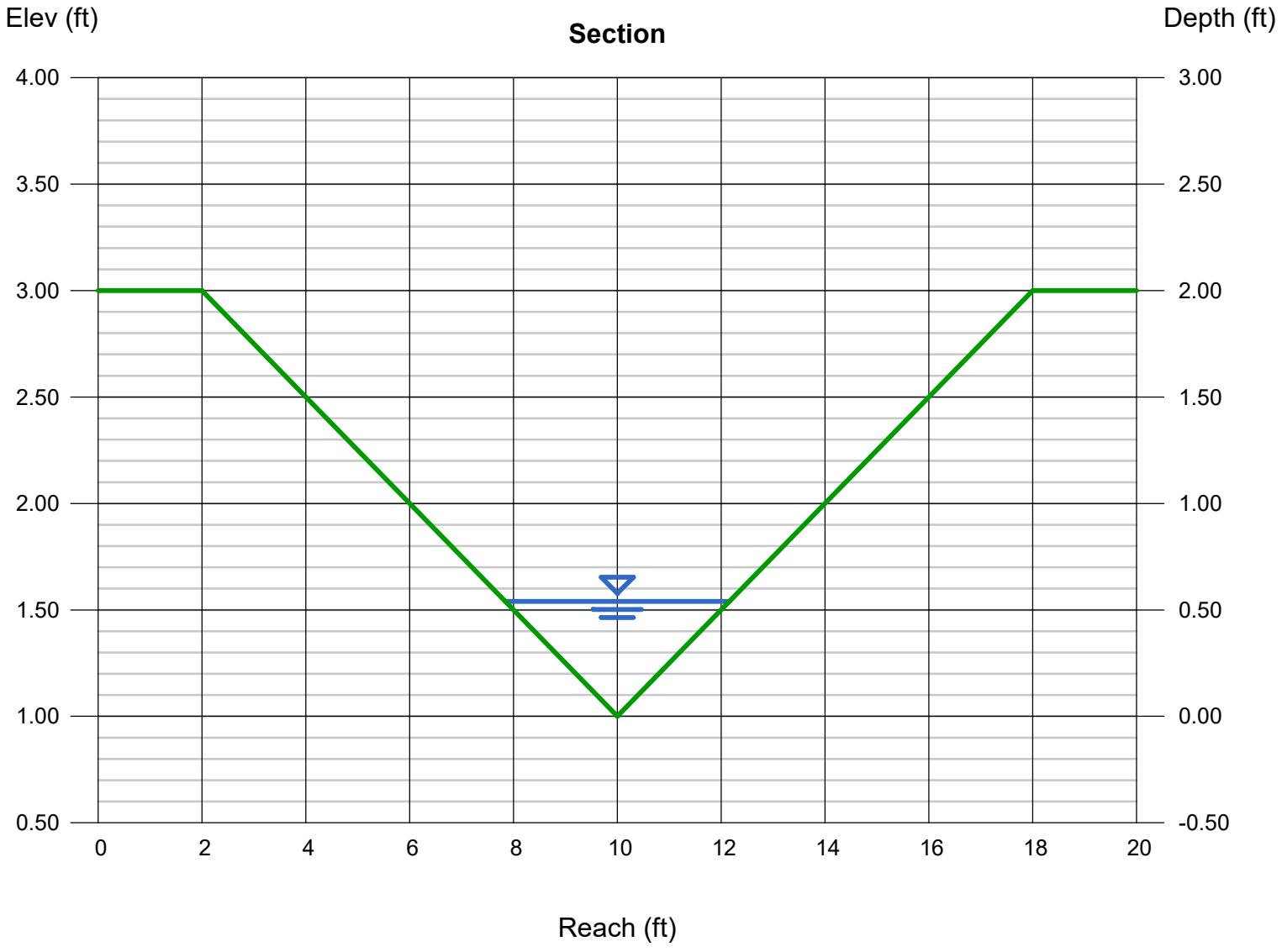
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 1.00
Slope (%)	= 5.50
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 5.40

Highlighted

Depth (ft)	= 0.54
Q (cfs)	= 5.400
Area (sqft)	= 1.17
Velocity (ft/s)	= 4.63
Wetted Perim (ft)	= 4.45
Crit Depth, Yc (ft)	= 0.65
Top Width (ft)	= 4.32
EGL (ft)	= 0.87



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jan 1 2025

Roadside Ditch Basin A22

Triangular

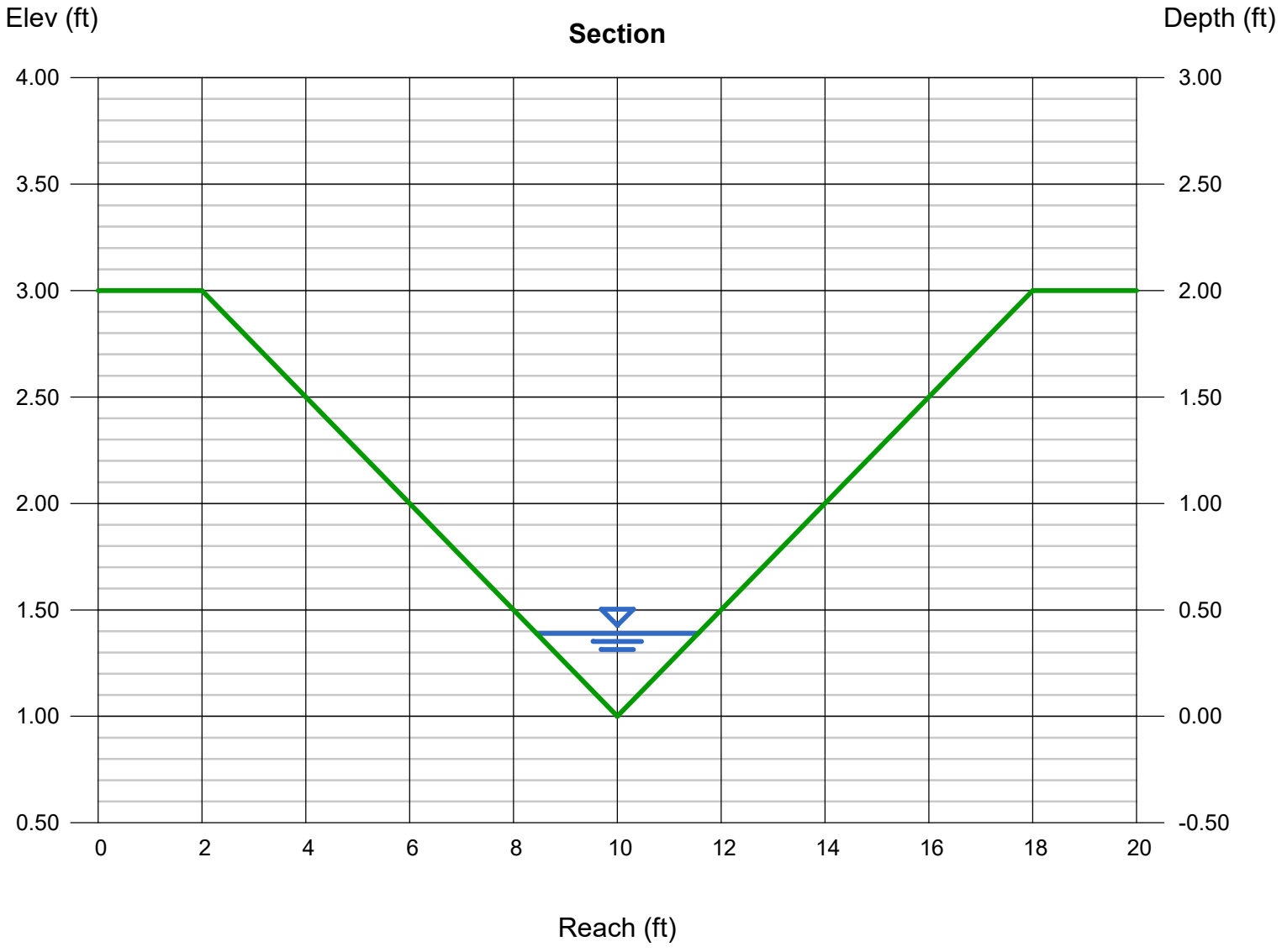
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 1.00
Slope (%)	= 5.50
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 2.20

Highlighted

Depth (ft)	= 0.39
Q (cfs)	= 2.200
Area (sqft)	= 0.61
Velocity (ft/s)	= 3.62
Wetted Perim (ft)	= 3.22
Crit Depth, Yc (ft)	= 0.46
Top Width (ft)	= 3.12
EGL (ft)	= 0.59



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jan 1 2025

Roadside Ditch DP24A

Triangular

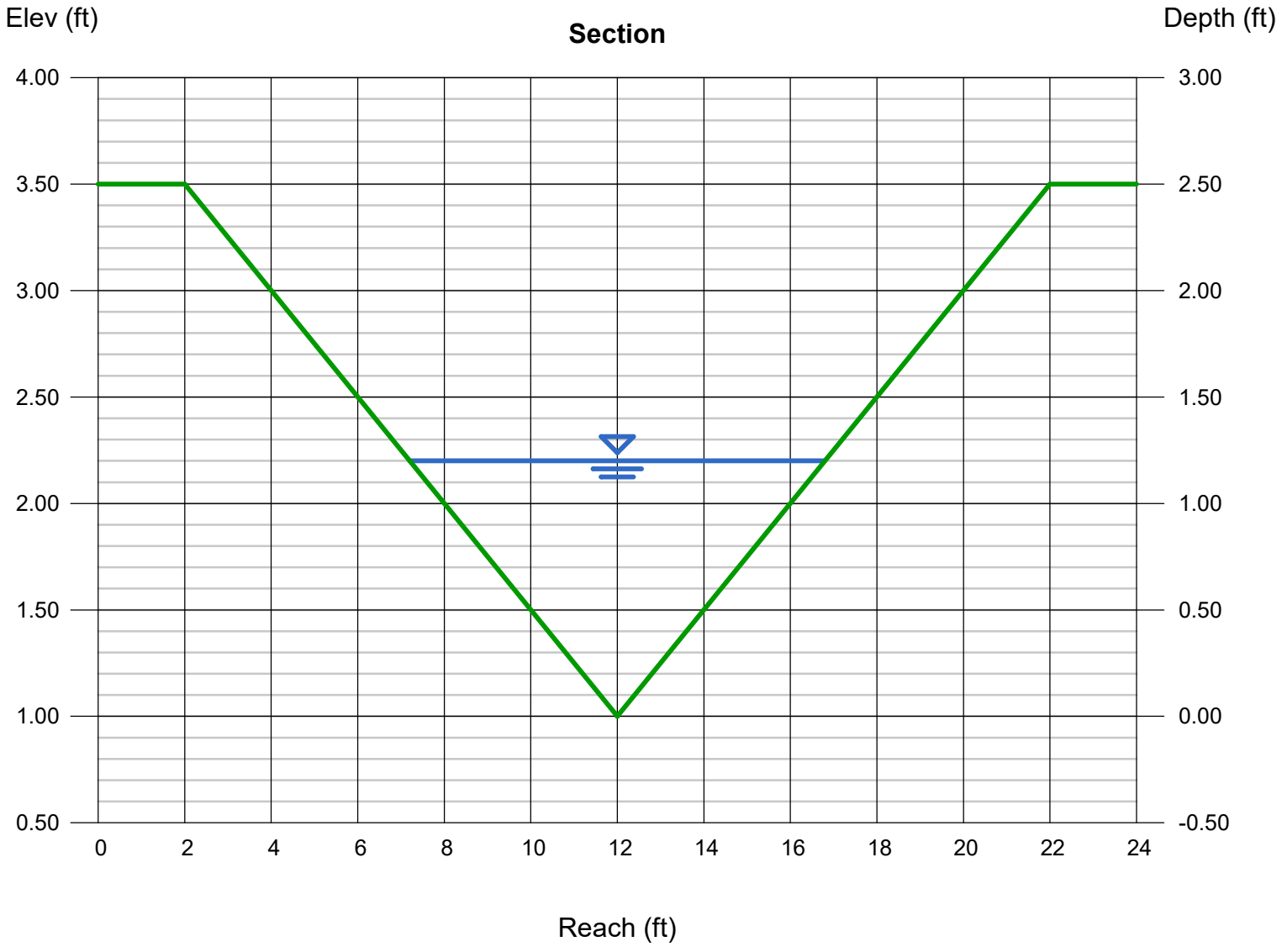
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.50
Invert Elev (ft)	= 1.00
Slope (%)	= 5.00
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 43.90

Highlighted

Depth (ft)	= 1.20
Q (cfs)	= 43.90
Area (sqft)	= 5.76
Velocity (ft/s)	= 7.62
Wetted Perim (ft)	= 9.90
Crit Depth, Yc (ft)	= 1.50
Top Width (ft)	= 9.60
EGL (ft)	= 2.10



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jan 1 2025

Roadside Ditch Basin A25

Triangular

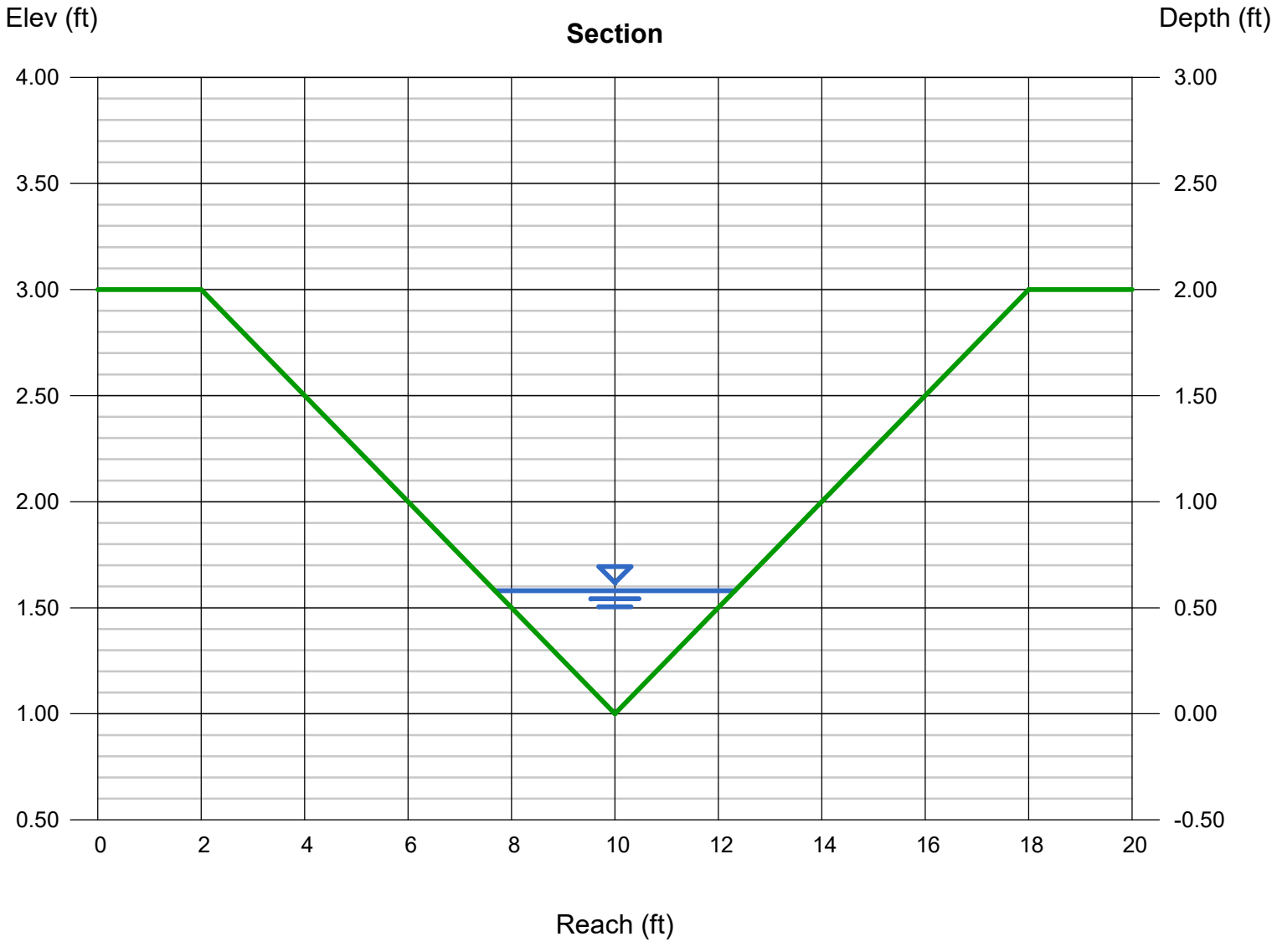
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 1.00
Slope (%)	= 5.00
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 6.30

Highlighted

Depth (ft)	= 0.58
Q (cfs)	= 6.300
Area (sqft)	= 1.35
Velocity (ft/s)	= 4.68
Wetted Perim (ft)	= 4.78
Crit Depth, Yc (ft)	= 0.69
Top Width (ft)	= 4.64
EGL (ft)	= 0.92



Channel Report

Existing Ditch west of DP1

Trapezoidal

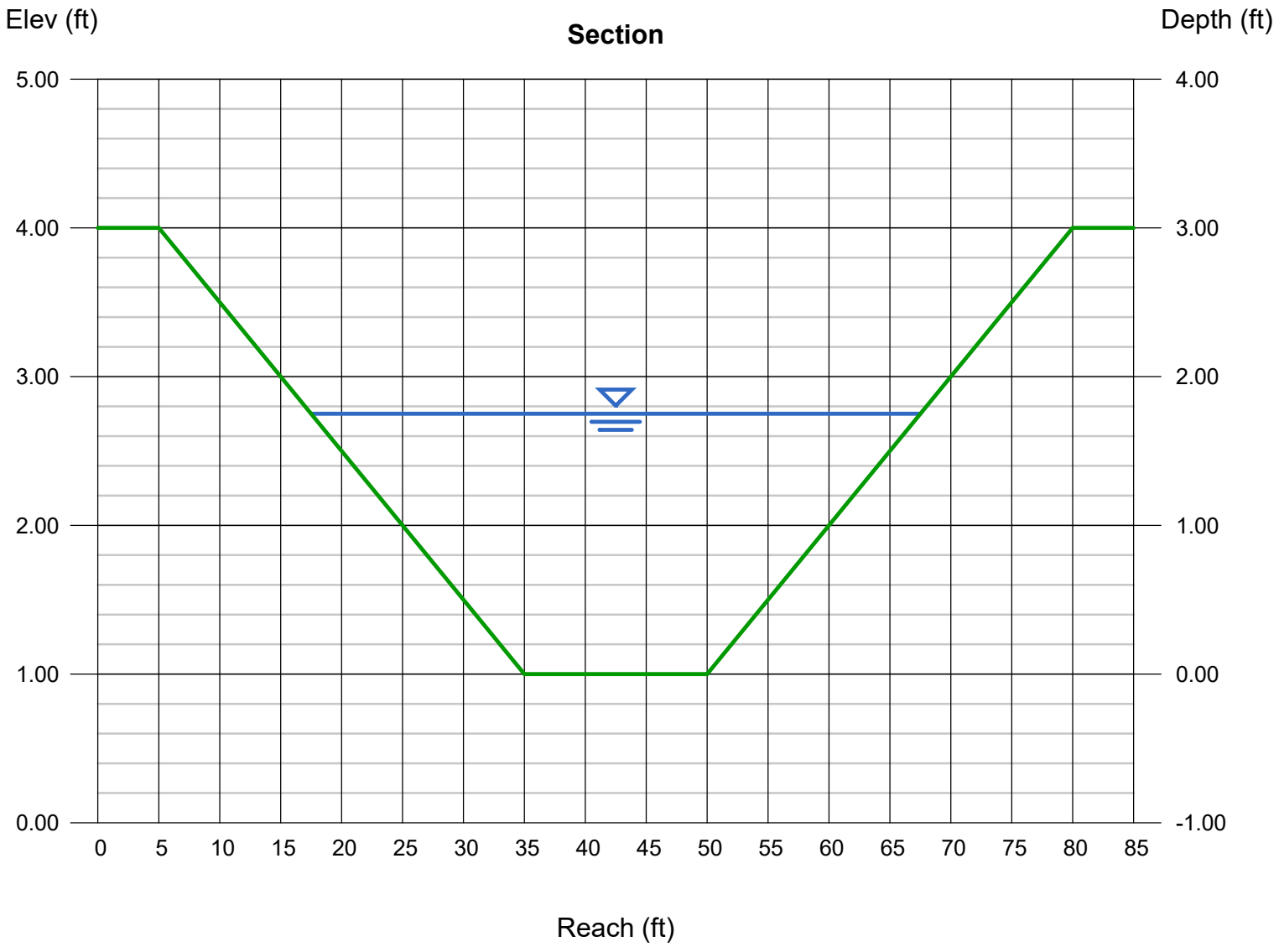
Bottom Width (ft)	= 15.00
Side Slopes (z:1)	= 10.00, 10.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 1.00
Slope (%)	= 0.85
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 279.50

Highlighted

Depth (ft)	= 1.75
Q (cfs)	= 279.50
Area (sqft)	= 56.87
Velocity (ft/s)	= 4.91
Wetted Perim (ft)	= 50.17
Crit Depth, Yc (ft)	= 1.58
Top Width (ft)	= 50.00
EGL (ft)	= 2.13



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jan 1 2025

Swale #1 - DPOSA3

Trapezoidal

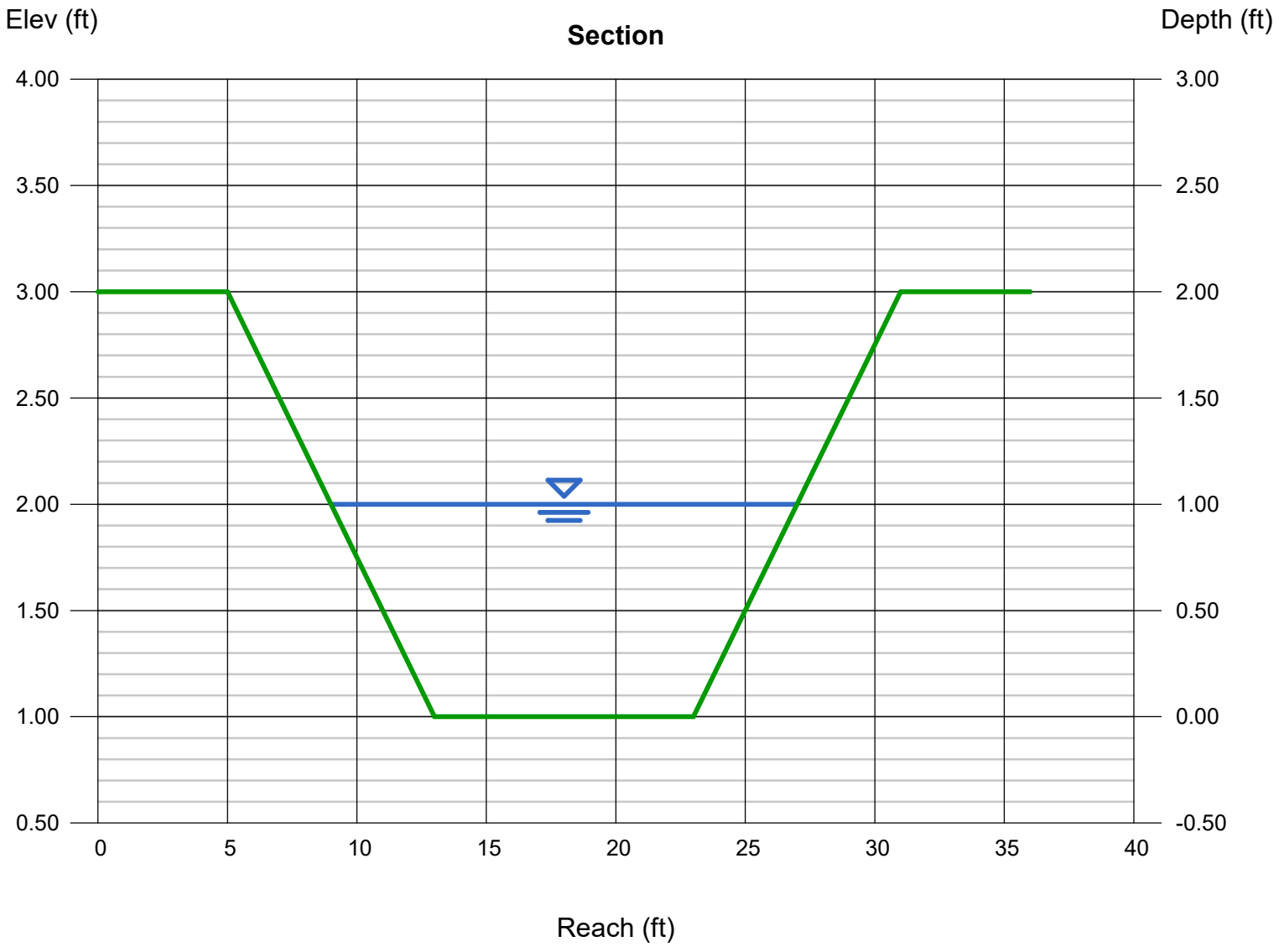
Bottom Width (ft)	= 10.00
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 1.00
Slope (%)	= 3.84
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 113.40

Highlighted

Depth (ft)	= 1.00
Q (cfs)	= 113.40
Area (sqft)	= 14.00
Velocity (ft/s)	= 8.10
Wetted Perim (ft)	= 18.25
Crit Depth, Yc (ft)	= 1.33
Top Width (ft)	= 18.00
EGL (ft)	= 2.02



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jan 1 2025

Swale #2 - DP1

Trapezoidal

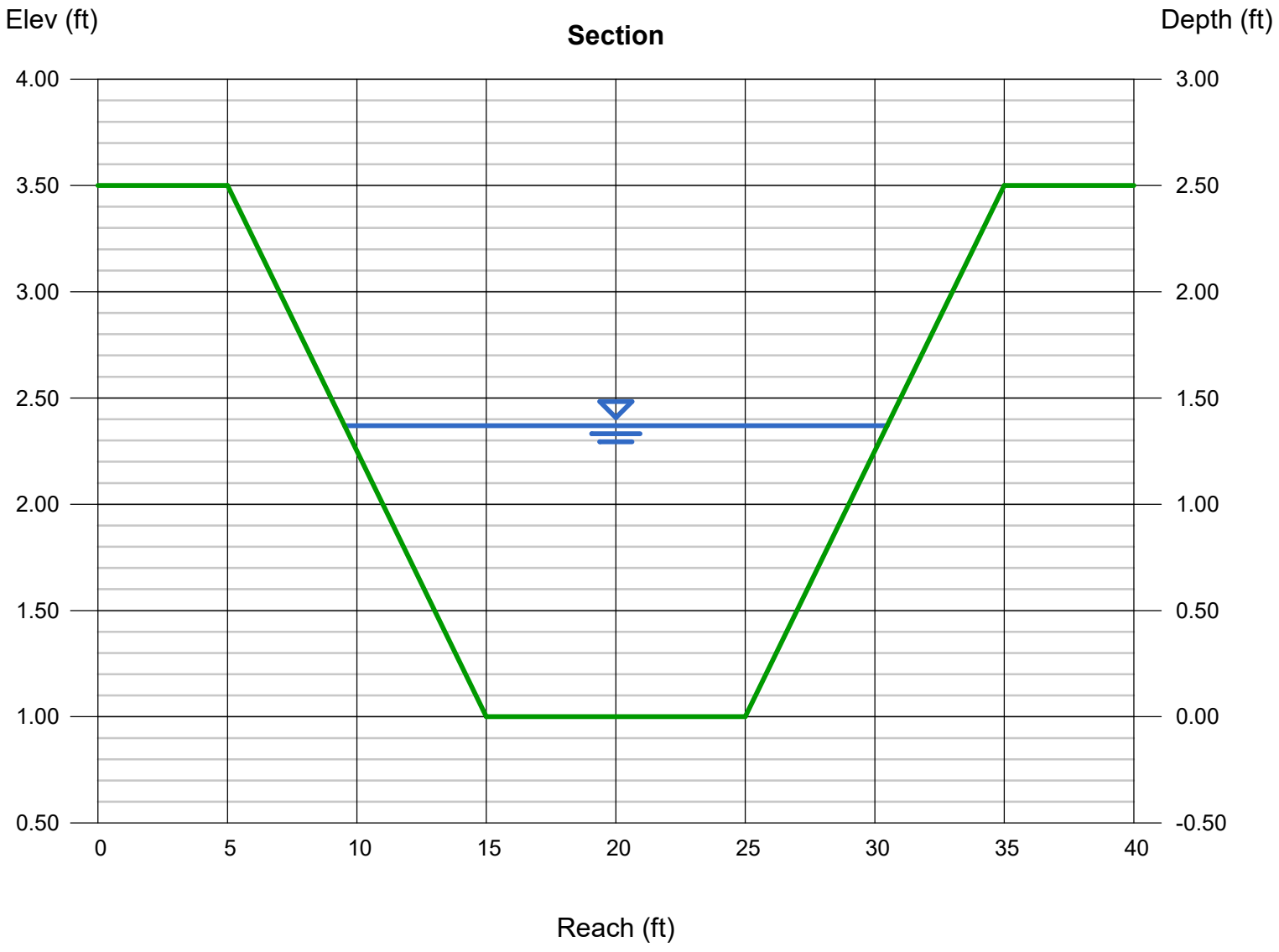
Bottom Width (ft)	= 10.00
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.50
Invert Elev (ft)	= 1.00
Slope (%)	= 7.25
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 279.50

Highlighted

Depth (ft)	= 1.37
Q (cfs)	= 279.50
Area (sqft)	= 21.21
Velocity (ft/s)	= 13.18
Wetted Perim (ft)	= 21.30
Crit Depth, Yc (ft)	= 2.17
Top Width (ft)	= 20.96
EGL (ft)	= 4.07



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jan 1 2025

Swale #3 - DPOSA4

Trapezoidal

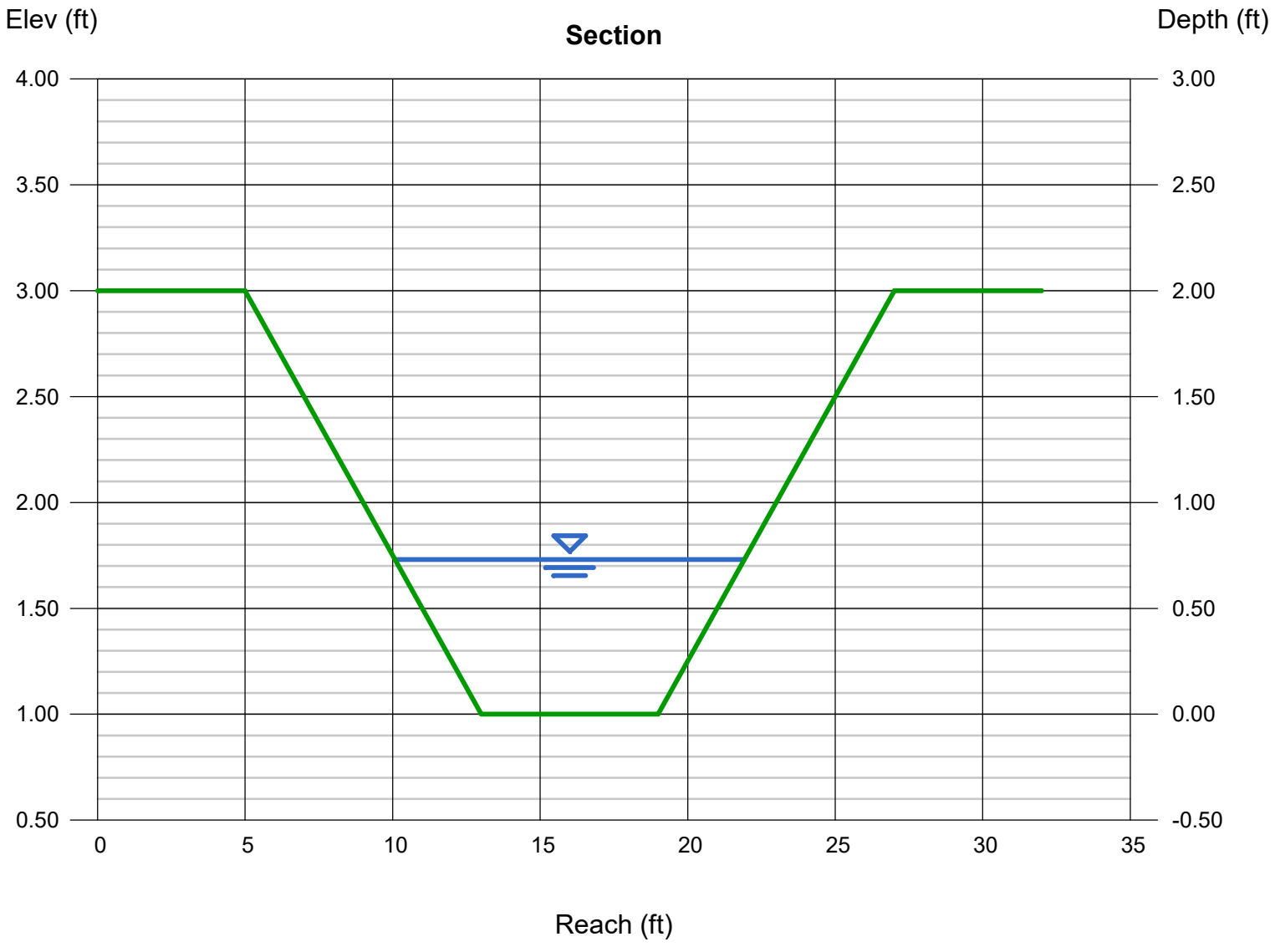
Bottom Width (ft)	= 6.00
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 1.00
Slope (%)	= 8.00
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 60.50

Highlighted

Depth (ft)	= 0.73
Q (cfs)	= 60.50
Area (sqft)	= 6.51
Velocity (ft/s)	= 9.29
Wetted Perim (ft)	= 12.02
Crit Depth, Yc (ft)	= 1.14
Top Width (ft)	= 11.84
EGL (ft)	= 2.07



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jan 1 2025

Swale #4 - DPOSA2

Trapezoidal

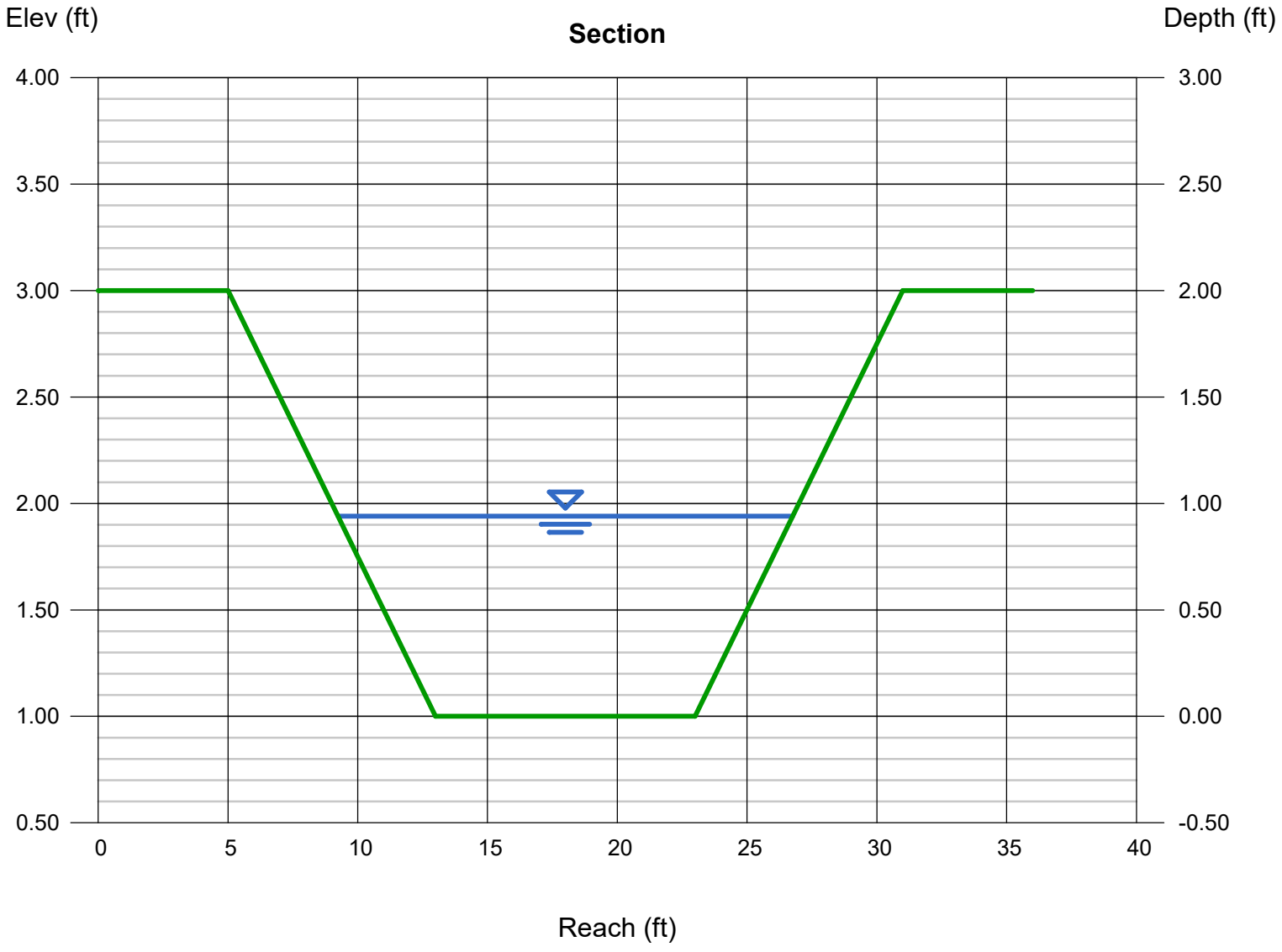
Bottom Width (ft)	= 10.00
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 1.00
Slope (%)	= 6.15
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 127.30

Highlighted

Depth (ft)	= 0.94
Q (cfs)	= 127.30
Area (sqft)	= 12.93
Velocity (ft/s)	= 9.84
Wetted Perim (ft)	= 17.75
Crit Depth, Yc (ft)	= 1.41
Top Width (ft)	= 17.52
EGL (ft)	= 2.45



Rock Chute Design Data

(Version 4.03 - 11/29/11, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)

Project: Latigo F10 - Swale 4 (DP14A) **County:**
Designer: KGV **Checked by:**
Date: 01/03/25 **Date:**

Input Channel Geometry

Inlet Channel	Chute	Outlet Channel
Bw = 3.0 ft.	Bw = 3.0 ft.	Bw = 3.0 ft.
Side slopes = 4.0 (m:1)	Factor of safety = 1.20 (F_s)	Side slopes = 4.0 (m:1)
n-value = 0.030	Side slopes = 4.0 (m:1) → 2.0:1 max.	n-value = 0.030
Bed slope = 0.0392 ft./ft.	Bed slope (7.8:1) = 0.129 ft./ft. → 2.5:1 max.	Bed slope = 0.0275 ft./ft.
Minimum Fill = 1.0 ft.	Outlet apron depth, d = 1.0 ft.	Base flow = 0.0 cfs
Freeboard = 1.0 ft.		

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

Drainage area = 19.3 acres Rainfall = ◉ 0 - 3 in. ○ 3 - 5 in. ○ 5+ in.

Apron elev. --- Inlet = 7073.9 ft. --- Outlet = 7068.0 ft. --- (H_{drop} = 4.9 ft.)

Chute capacity = Q5-year
Total capacity = Q10-year
Minimum capacity (based on a 5-year, 24-hour storm with a 0 - 3 inch rainfall)

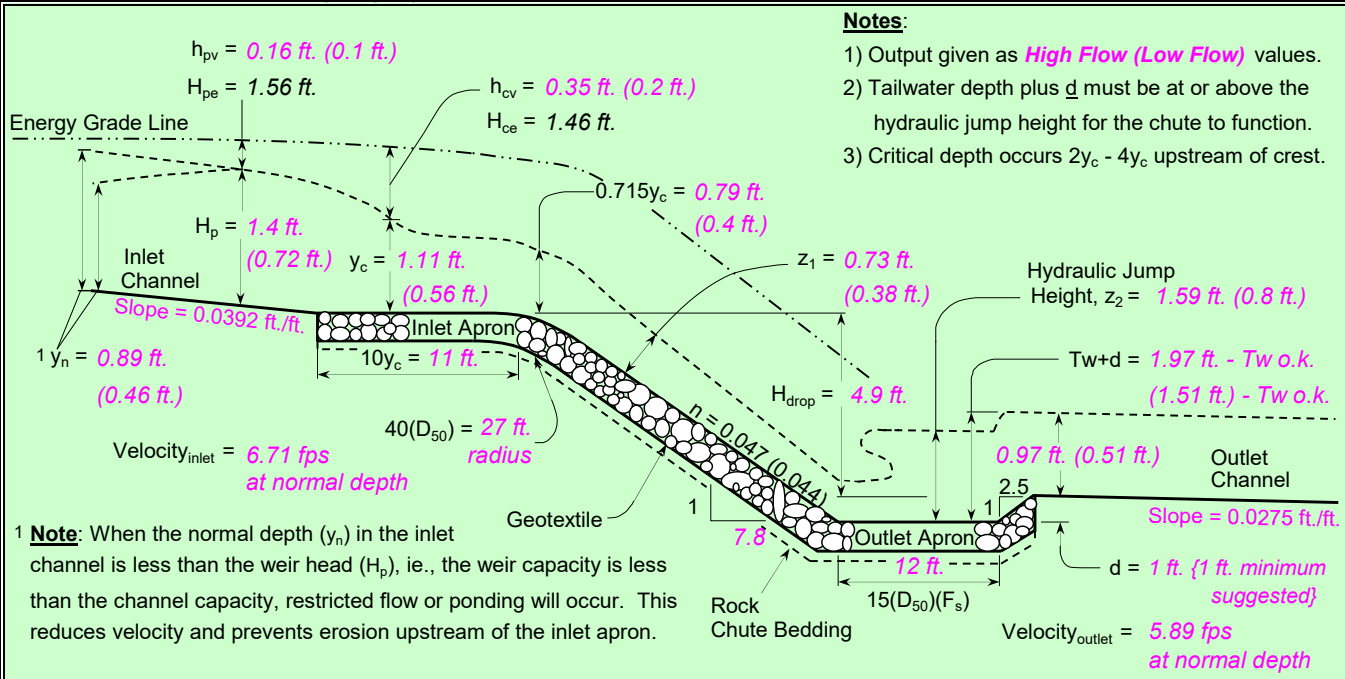
Q_{high} = 39.0 cfs High flow storm through chute → Tw (ft.) = Program

Q_{low} = 10.6 cfs Low flow storm through chute → Tw (ft.) = Program

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

***Input tailwater (Tw)**:* 0.13

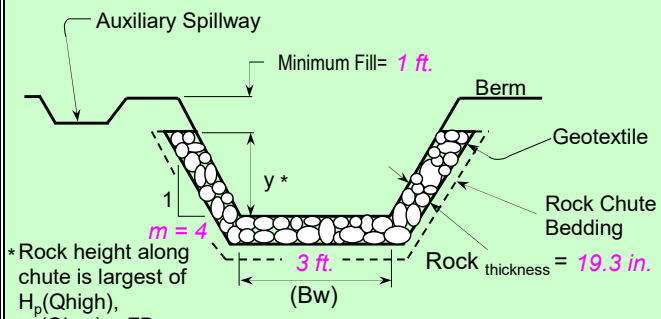
Profile and Cross Section (Output)



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

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

Profile Along Centerline of Chute



* Rock height along chute is largest of H_p(Qhigh), H_p(Qlow) + FB, and z_2.

Typical Cross Section

q_t =	6.63 cfs/ft.	Equivalent unit discharge
F_S =	1.20	Factor of safety (multiplier)
z_1 =	0.73 ft.	Normal depth in chute
n-value =	0.047	Manning's roughness coefficient
D_{50}(F_s) =	9.6 in. (65 lbs.) - angular riprap	
2(D_{50})(F_s) =	19.3 in.	Rock chute thickness
Tw + d =	1.97 ft.	Tailwater above outlet apron
z_2 =	1.59 ft.	Hydraulic jump height
*** The outlet	will	*function adequately*

High Flow Storm Information

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jan 1 2025

Swale #5(E) - DP14A

Trapezoidal

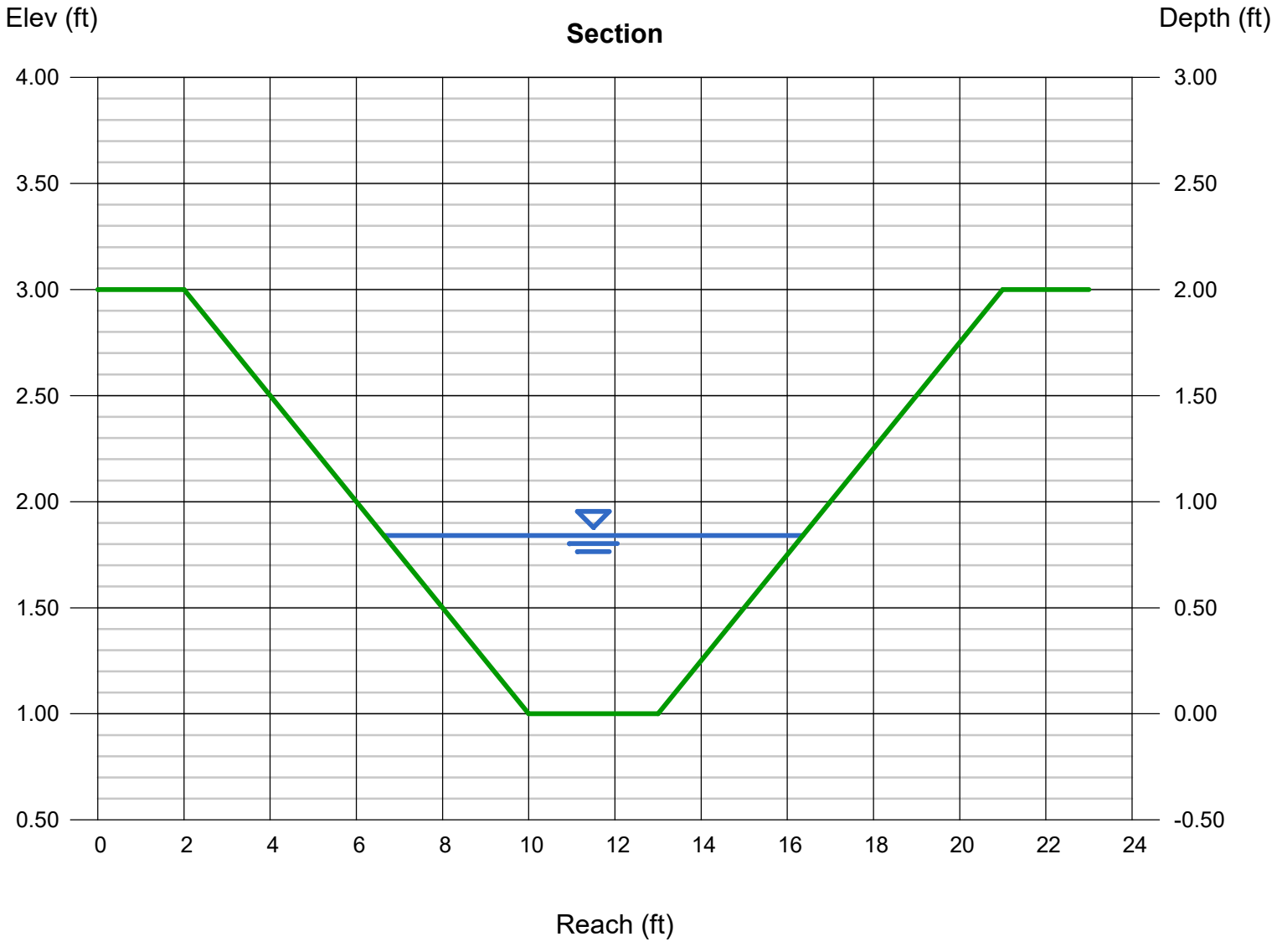
Bottom Width (ft)	= 3.00
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 1.00
Slope (%)	= 5.02
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 39.00

Highlighted

Depth (ft)	= 0.84
Q (cfs)	= 39.00
Area (sqft)	= 5.34
Velocity (ft/s)	= 7.30
Wetted Perim (ft)	= 9.93
Crit Depth, Yc (ft)	= 1.11
Top Width (ft)	= 9.72
EGL (ft)	= 1.67



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jan 1 2025

Swale #5(W) - DP13

Trapezoidal

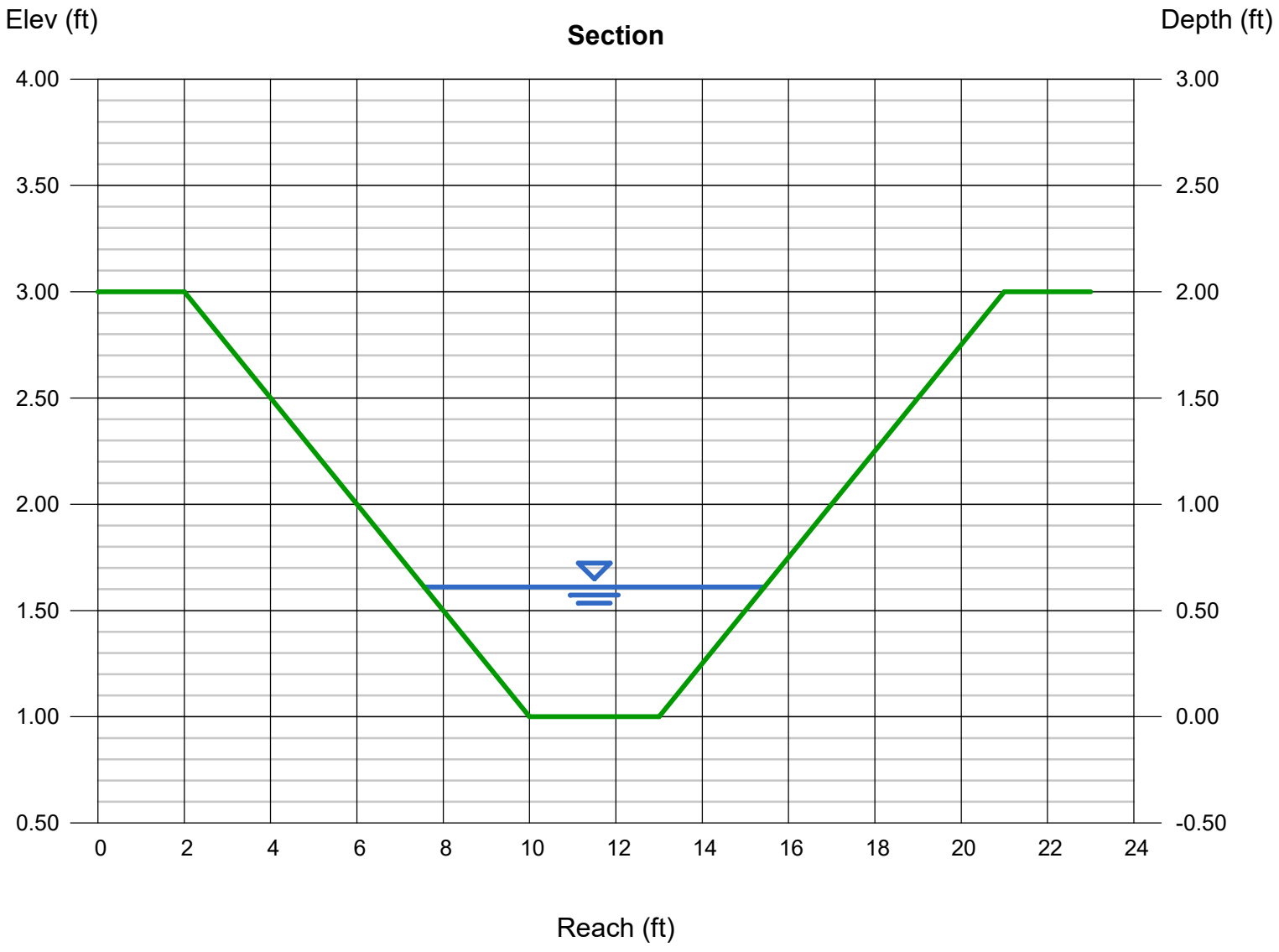
Bottom Width (ft)	= 3.00
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 1.00
Slope (%)	= 7.01
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 24.10

Highlighted

Depth (ft)	= 0.61
Q (cfs)	= 24.10
Area (sqft)	= 3.32
Velocity (ft/s)	= 7.26
Wetted Perim (ft)	= 8.03
Crit Depth, Yc (ft)	= 0.88
Top Width (ft)	= 7.88
EGL (ft)	= 1.43



Rock Chute Design Data

(Version 4.03 - 11/29/11, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)

Project: Latigo F10 - Swale 5 (DP25A) **County:**
Designer: KGV **Checked by:**
Date: 01/03/25 **Date:**

Input Channel Geometry

Inlet Channel	Chute	Outlet Channel
Bw = 3.0 ft.	Bw = 3.0 ft.	Bw = 3.0 ft.
Side slopes = 4.0 (m:1)	Factor of safety = 1.20 (F_s)	Side slopes = 4.0 (m:1)
n-value = 0.030	Side slopes = 4.0 (m:1) → 2.0:1 max.	n-value = 0.030
Bed slope = 0.0193 ft./ft.	Bed slope (9.7:1) = 0.103 ft./ft. → 2.5:1 max.	Bed slope = 0.0100 ft./ft.
Minimum Fill = 1.0 ft.	Outlet apron depth, d = 1.0 ft.	Base flow = 0.0 cfs
Freeboard = 1.0 ft.		

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

Drainage area = 20.6 acres Rainfall = (●) 0 - 3 in. ( ) 3 - 5 in. ( ) 5+ in.

Apron elev. --- Inlet = 7071.0 ft. --- Outlet = 7067.2 ft. --- (H_{drop} = 2.8 ft.)

Chute capacity = Q5-year
Total capacity = Q10-year
Minimum capacity (based on a 5-year, 24-hour storm with a 0 - 3 inch rainfall)

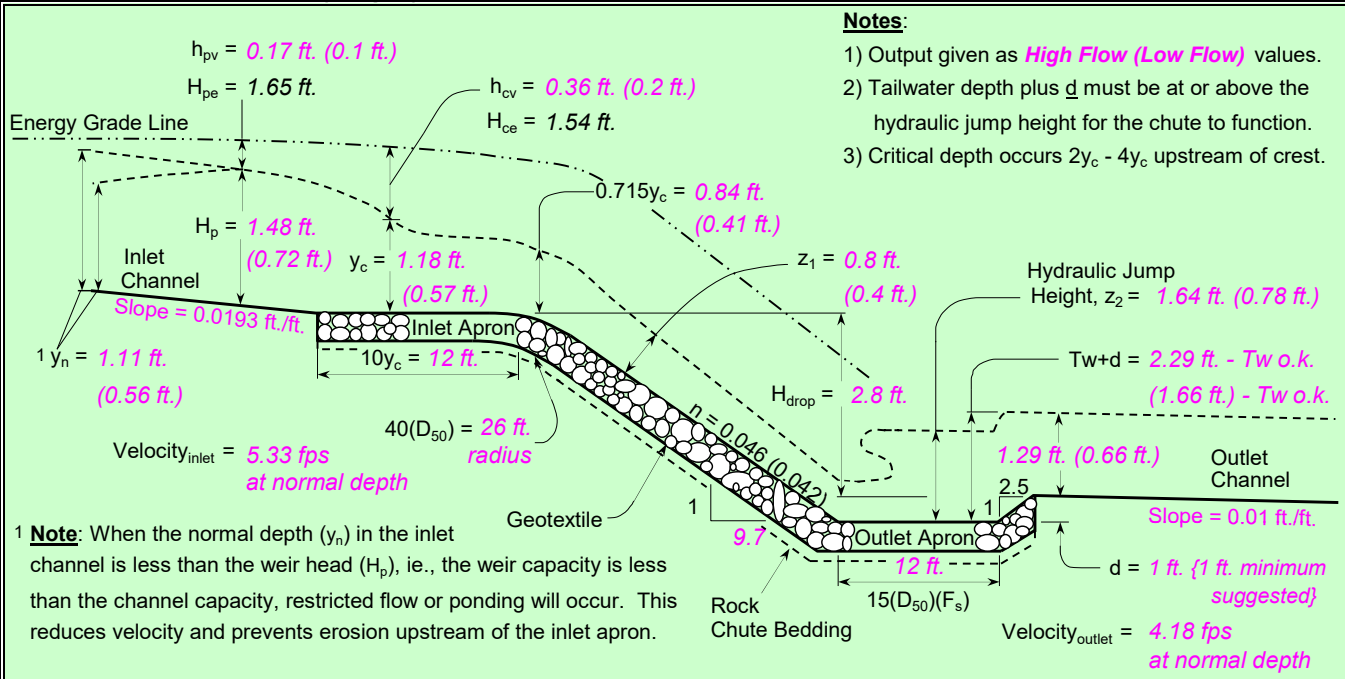
Q_{high} = 43.9 cfs High flow storm through chute → Tw (ft.) = Program

Q_{low} = 10.7 cfs Low flow storm through chute → Tw (ft.) = Program

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

***Input tailwater (Tw)**:* 0.10

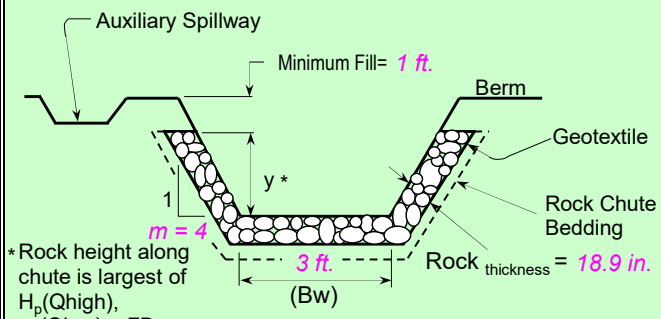
Profile and Cross Section (Output)



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

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

Profile Along Centerline of Chute



* Rock height along chute is largest of H_p(Qhigh), H_p(Qlow) + FB, and z_2.

Typical Cross Section

q_t =	7.23 cfs/ft.	Equivalent unit discharge
F_S =	1.20	Factor of safety (multiplier)
z_1 =	0.8 ft.	Normal depth in chute
n-value =	0.046	Manning's roughness coefficient
D_{50}(F_s) =	9.4 in. (61 lbs.) - angular riprap	
2(D_{50})(F_s) =	18.9 in.	Rock chute thickness
Tw + d =	2.29 ft.	Tailwater above outlet apron
z_2 =	1.64 ft.	Hydraulic jump height
*** The outlet	will	*function adequately*

High Flow Storm Information

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jan 1 2025

Swale #6 - DP25A

Trapezoidal

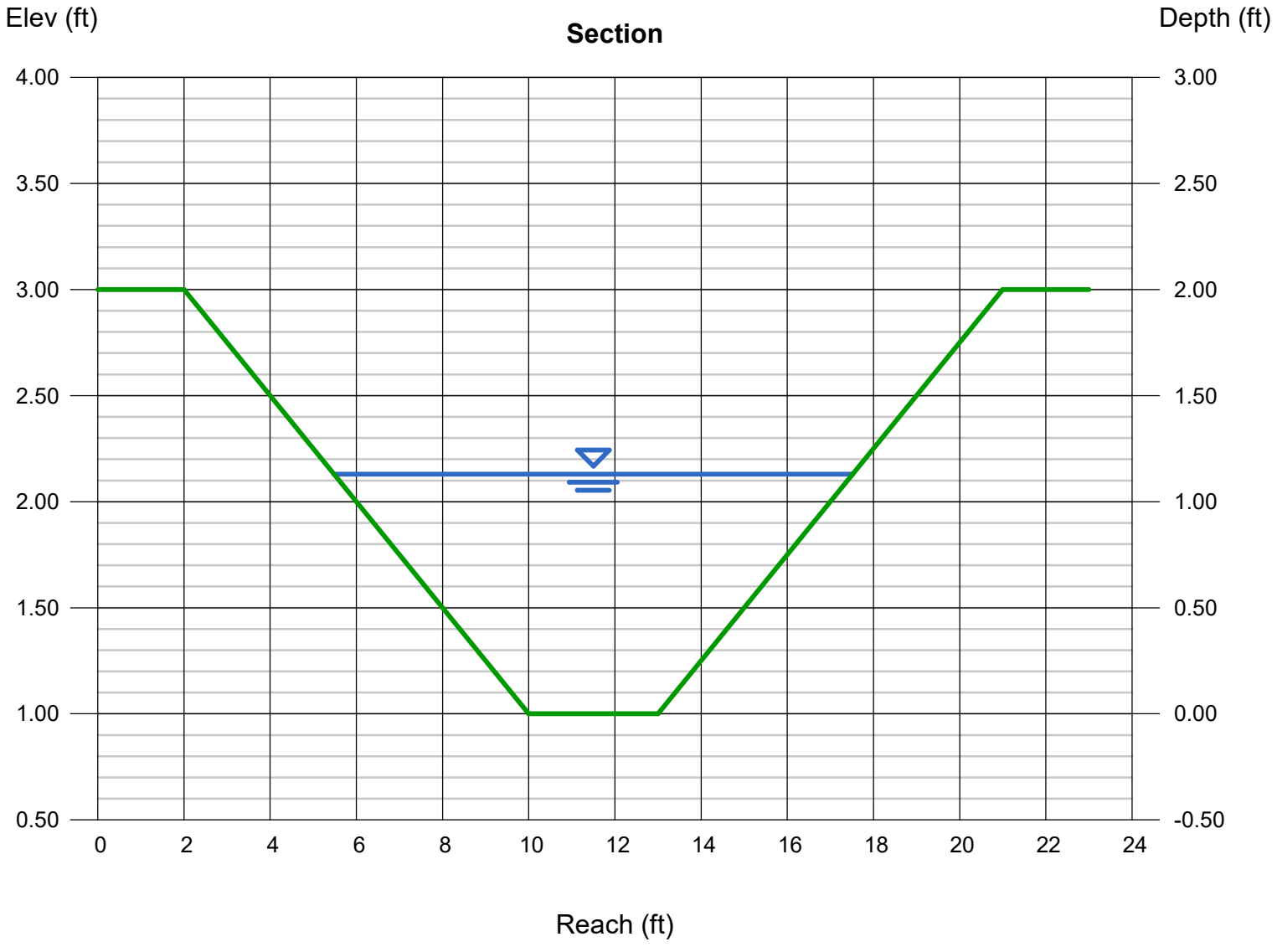
Bottom Width (ft)	= 3.00
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 1.00
Slope (%)	= 2.32
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 49.40

Highlighted

Depth (ft)	= 1.13
Q (cfs)	= 49.40
Area (sqft)	= 8.50
Velocity (ft/s)	= 5.81
Wetted Perim (ft)	= 12.32
Crit Depth, Yc (ft)	= 1.25
Top Width (ft)	= 12.04
EGL (ft)	= 1.66



Channel Report

DPC1 Eastonville downstream channel

Trapezoidal

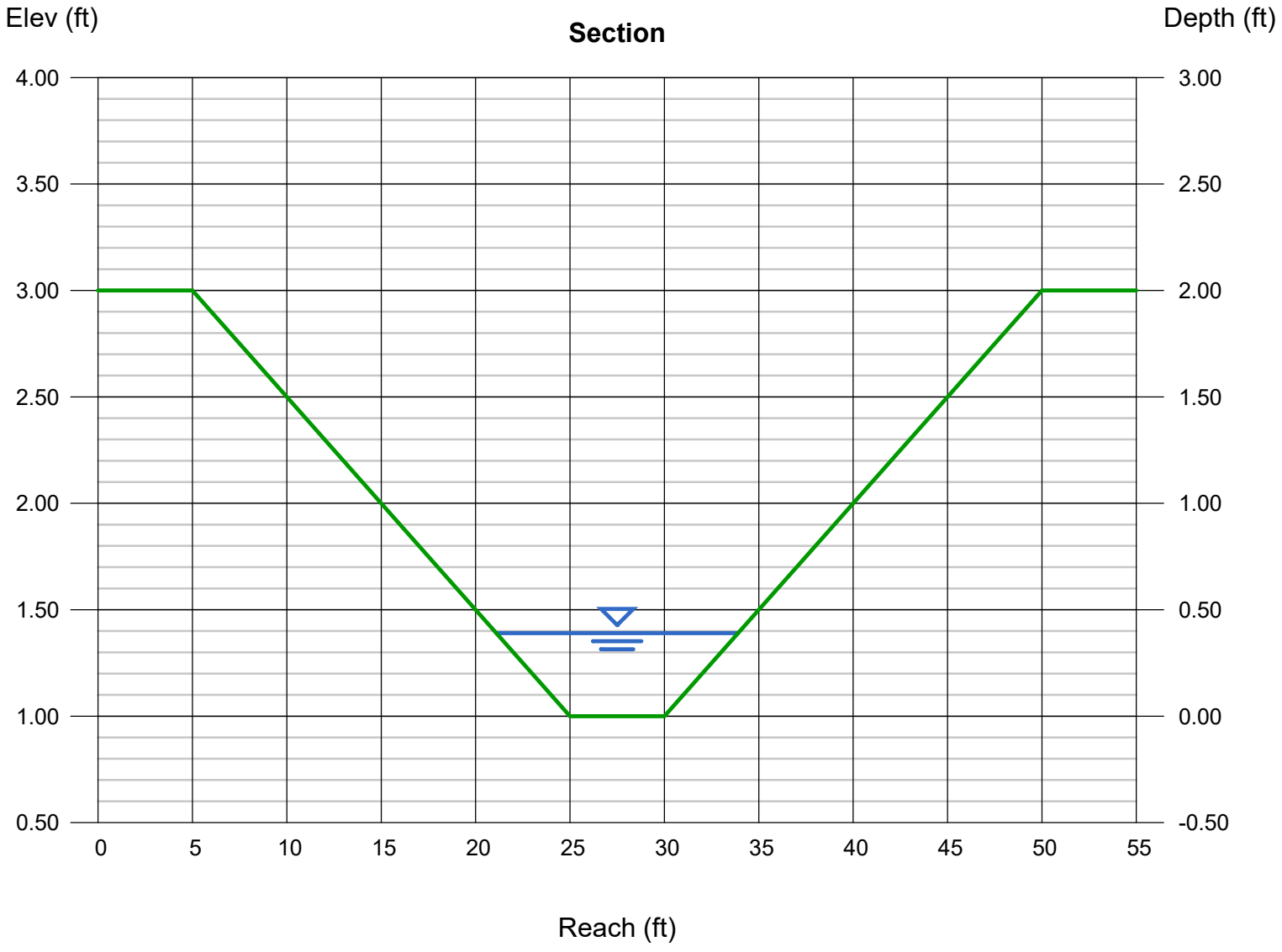
Bottom Width (ft)	= 5.00
Side Slopes (z:1)	= 10.00, 10.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 1.00
Slope (%)	= 2.00
N-Value	= 0.035

Calculations

Compute by:	Known Q
Known Q (cfs)	= 8.70

Highlighted

Depth (ft)	= 0.39
Q (cfs)	= 8.700
Area (sqft)	= 3.47
Velocity (ft/s)	= 2.51
Wetted Perim (ft)	= 12.84
Crit Depth, Yc (ft)	= 0.36
Top Width (ft)	= 12.80
EGL (ft)	= 0.49



VMax® TRMs

ROLLMAX™
ROLLED EROSION CONTROL

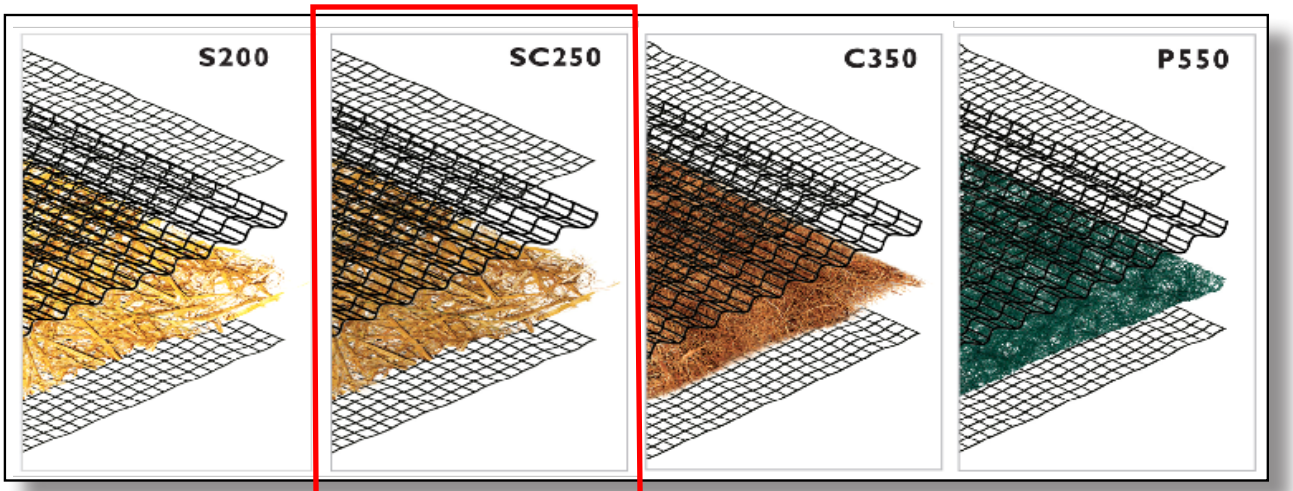
A Permanent Turf Reinforcement Mat Solution for Every Design

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



	S200	SC250	C350	P550
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

NORTH AMERICAN GREEN®

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

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4609 E. Boonville-New Harmony Rd., Evansville, IN
(800) 772-2040 | www.nagreen.com

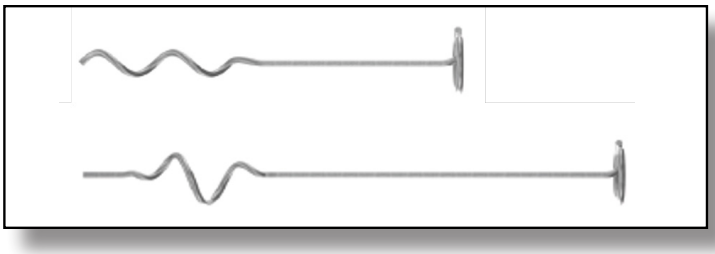
VMax® TRMs cont.

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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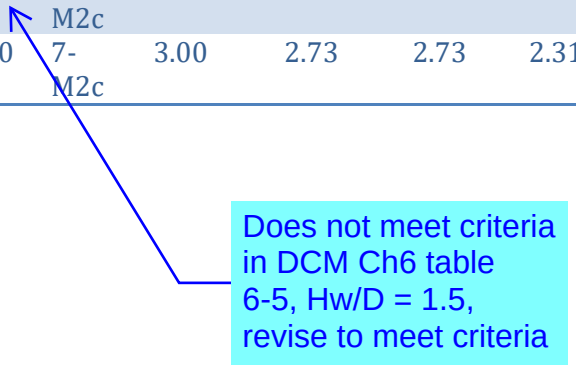
Culvert Analysis

HY-8 Culvert Analysis Report

Table 1 - Culvert Summary Table: DP1

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	HW / D (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	7097.00	0.00	0.000	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
27.95	27.95	7098.14	1.14	0.361	0.38	1-S2n	0.70	0.83	0.70	0.60	5.56	3.77
55.90	55.90	7098.67	1.67	0.810	0.56	1-S2n	1.00	1.19	1.01	0.88	6.67	4.69
83.85	83.85	7099.15	2.15	1.240	0.72	1-S2n	1.24	1.47	1.26	1.10	7.41	5.30
111.80	111.80	7099.57	2.57	1.689	0.86	1-S2n	1.46	1.71	1.49	1.28	7.98	5.77
139.75	139.75	7099.98	2.98	2.169	0.99	1-S2n	1.68	1.92	1.70	1.44	8.44	6.15
167.70	167.70	7100.42	3.42	2.687	1.14	5-S2n	1.89	2.11	1.91	1.58	8.83	6.48
195.65	195.65	7100.91	3.91	3.606	1.30	5-S2n	2.11	2.28	2.12	1.71	9.15	6.77
223.60	223.60	7101.47	4.47	4.129	1.49	5-S2n	2.36	2.42	2.36	1.83	9.38	7.03
251.55	251.55	7102.12	5.12	4.752	1.71	7-M2c	3.00	2.55	2.55	1.95	9.82	7.26
279.50	279.50	7102.86	5.86	5.295	1.95	7-M2c	3.00	2.66	2.66	2.05	10.56	7.47
355.73	304.98	7103.60	6.60	5.945	2.20	7-M2c	3.00	2.73	2.73	2.31	11.28	7.98



Water Surface Profile Plot for Culvert: DP1

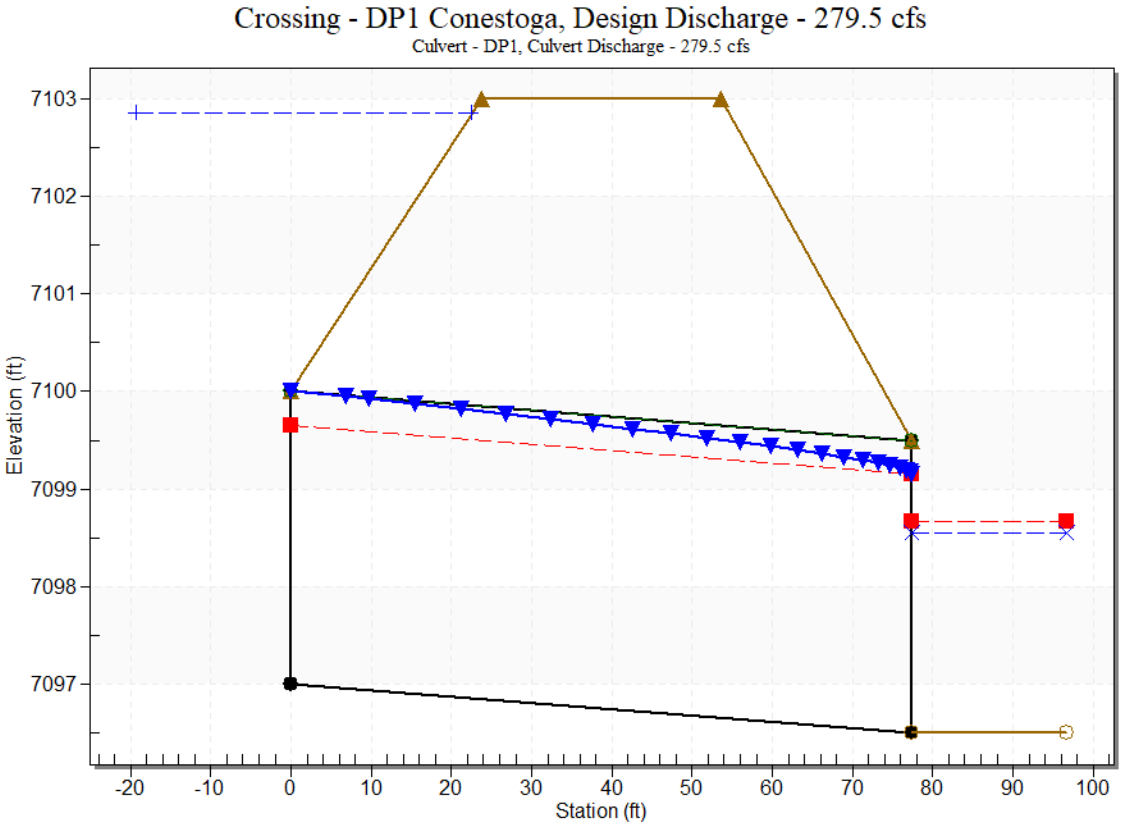


Table 3 - Culvert Summary Table: DP7

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	HW / D (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	7068.50	0.00	0.000	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
0.26	0.26	7068.77	0.27	0.0*	0.18	1-S2n	0.16	0.19	0.16	0.09	2.51	0.82
0.52	0.52	7068.88	0.38	0.0*	0.25	1-S2n	0.23	0.27	0.23	0.14	3.07	1.04
0.78	0.78	7068.97	0.47	0.0*	0.31	1-S2n	0.28	0.33	0.28	0.18	3.47	1.18
1.04	1.04	7069.04	0.54	0.0*	0.36	1-S2n	0.32	0.38	0.32	0.21	3.77	1.30
1.30	1.30	7069.11	0.61	0.0*	0.41	1-S2n	0.36	0.43	0.36	0.24	4.02	1.39
1.56	1.56	7069.18	0.68	0.0*	0.45	1-S2n	0.39	0.47	0.39	0.26	4.24	1.48
1.82	1.82	7069.23	0.73	0.0*	0.49	1-S2n	0.42	0.51	0.42	0.28	4.43	1.55
2.08	2.08	7069.29	0.79	0.005	0.53	1-S2n	0.45	0.54	0.45	0.31	4.60	1.61
2.34	2.34	7069.35	0.85	0.055	0.56	1-S2n	0.48	0.58	0.48	0.33	4.76	1.67
2.60	2.60	7069.40	0.90	0.106	0.60	1-S2n	0.51	0.61	0.51	0.34	4.90	1.72
14.18	13.89	7072.52	4.02	3.546	2.68	7-M2c	1.50	1.38	1.38	0.82	8.17	2.77

* Full Flow Headwater elevation is below inlet invert.

Water Surface Profile Plot for Culvert: DP7

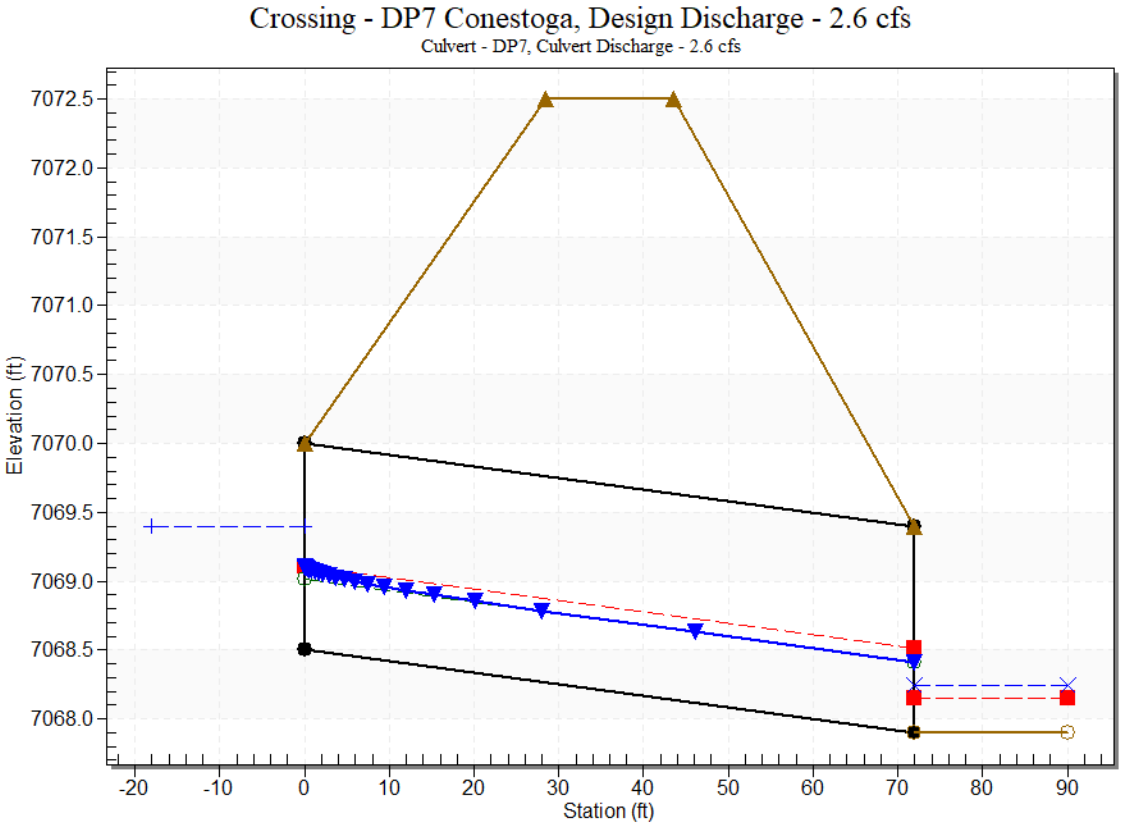


Table 2 - Culvert Summary Table: DP8A

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	HW / D (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	7067.75	0.00	0.000	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
5.42	5.42	7068.72	0.97	0.0*	0.32	1-S2n	0.42	0.73	0.42	0.38	9.09	2.86
10.84	10.84	7069.16	1.41	0.0*	0.47	1-S2n	0.59	1.04	0.59	0.59	11.14	3.67
16.26	16.26	7069.55	1.80	0.0*	0.60	1-S2n	0.72	1.29	0.72	0.77	12.53	4.22
21.68	21.68	7069.91	2.16	0.0*	0.72	1-S2n	0.83	1.50	0.83	0.93	13.60	4.64
27.10	27.10	7070.23	2.48	0.0*	0.83	1-S2n	0.93	1.68	0.95	1.09	14.01	4.99
32.52	32.52	7070.55	2.80	0.0*	0.93	1-S2n	1.02	1.85	1.02	1.23	15.25	5.28
37.94	37.94	7070.87	3.12	0.0*	1.04	5-S2n	1.11	2.00	1.15	1.37	15.23	5.54
43.36	43.36	7071.22	3.47	0.0*	1.16	5-S2n	1.20	2.14	1.24	1.51	15.73	5.76
48.78	48.78	7071.61	3.86	0.0*	1.29	5-S2n	1.28	2.27	1.32	1.64	16.23	5.96
54.20	54.20	7072.04	4.29	0.0*	1.43	5-S2n	1.35	2.39	1.41	1.76	16.54	6.14
68.98	62.41	7072.79	5.04	0.172	1.68	5-S2n	1.47	2.54	1.54	2.10	17.10	6.56

* Full Flow Headwater elevation is below inlet invert.

Water Surface Profile Plot for Culvert: DP8A

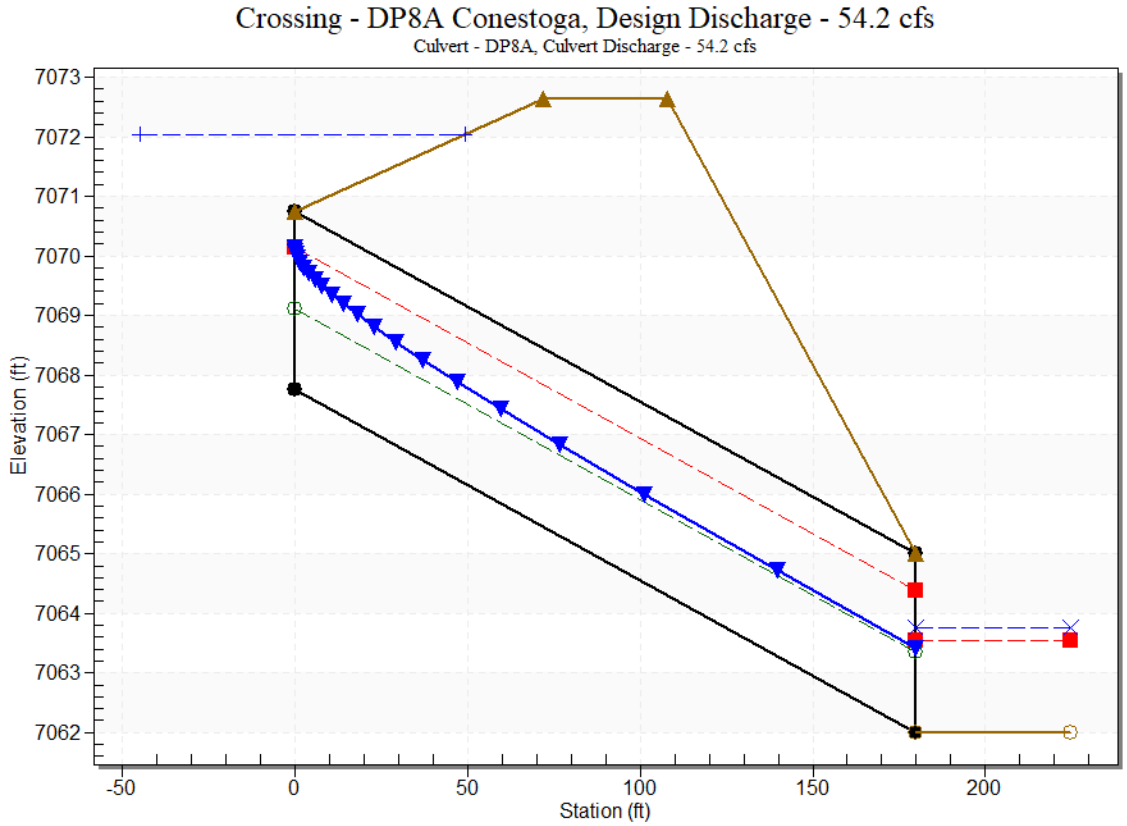


Table 4 - Culvert Summary Table: DP13A

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	HW / D (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	7074.80	0.00	0.000	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
3.68	3.68	7075.65	0.85	0.0*	0.28	1-S2n	0.46	0.60	0.46	0.34	5.33	2.44
7.36	7.36	7076.03	1.23	0.091	0.41	1-S2n	0.65	0.85	0.65	0.50	6.46	2.98
11.04	11.04	7076.33	1.53	0.336	0.51	1-S2n	0.79	1.05	0.81	0.61	7.19	3.33
14.72	14.72	7076.60	1.80	0.570	0.60	1-S2n	0.92	1.22	0.94	0.70	7.75	3.60
18.40	18.40	7076.84	2.04	0.805	0.68	1-S2n	1.03	1.37	1.06	0.78	8.19	3.82
22.08	22.08	7077.06	2.26	1.044	0.75	1-S2n	1.14	1.51	1.18	0.86	8.56	4.01
25.76	25.76	7077.28	2.48	1.291	0.83	1-S2n	1.24	1.64	1.29	0.92	8.89	4.18
29.44	29.44	7077.50	2.70	1.548	0.90	1-S2n	1.33	1.76	1.39	0.98	9.18	4.33
33.12	33.12	7077.75	2.95	1.816	0.98	1-S2n	1.43	1.87	1.49	1.04	9.45	4.47
36.80	36.80	7078.01	3.21	2.096	1.07	5-S2n	1.52	1.97	1.59	1.09	9.69	4.59
63.56	60.35	7080.35	5.55	4.437	1.85	5-S2n	2.10	2.51	2.18	1.40	10.99	5.29

* Full Flow Headwater elevation is below inlet invert.

Water Surface Profile Plot for Culvert: DP13A

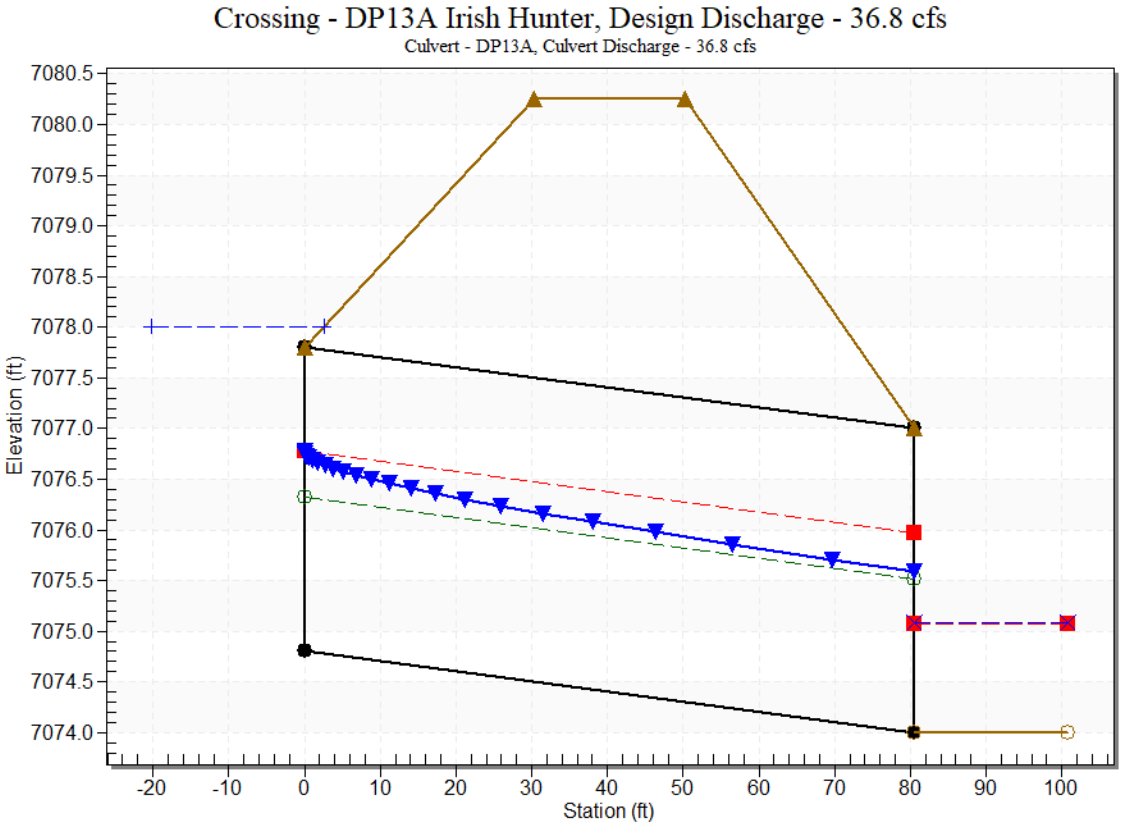


Table 10 - Culvert Summary Table: DP20

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	HW / D (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	7051.83	0.00	0.000	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
0.54	0.54	7052.22	0.39	0.0*	0.26	1-S2n	0.26	0.27	0.26	0.12	2.60	1.32
1.08	1.08	7052.38	0.55	0.084	0.37	1-S2n	0.37	0.39	0.37	0.18	3.18	1.66
1.62	1.62	7052.52	0.69	0.193	0.46	1-S2n	0.46	0.48	0.46	0.22	3.57	1.90
2.16	2.16	7052.63	0.80	0.297	0.54	1-S2n	0.53	0.55	0.53	0.26	3.87	2.07
2.70	2.70	7052.74	0.91	0.401	0.61	1-S2n	0.60	0.62	0.60	0.29	4.11	2.22
3.24	3.24	7052.84	1.01	0.506	0.67	1-S2n	0.66	0.69	0.66	0.32	4.31	2.35
3.78	3.78	7052.93	1.10	0.614	0.74	1-S2n	0.72	0.74	0.72	0.35	4.49	2.46
4.32	4.32	7053.02	1.19	0.726	0.80	1-S2n	0.78	0.80	0.78	0.38	4.64	2.55
4.86	4.86	7053.12	1.29	0.843	0.86	1-S2n	0.84	0.85	0.84	0.40	4.77	2.64
5.40	5.40	7053.36	1.38	1.530	1.02	7-M2c	0.90	0.90	0.90	0.42	4.91	2.72
12.27	11.84	7055.02	3.19	2.960	2.13	7-M2c	1.50	1.31	1.31	0.64	7.24	3.43

* Full Flow Headwater elevation is below inlet invert.

Water Surface Profile Plot for Culvert: DP20

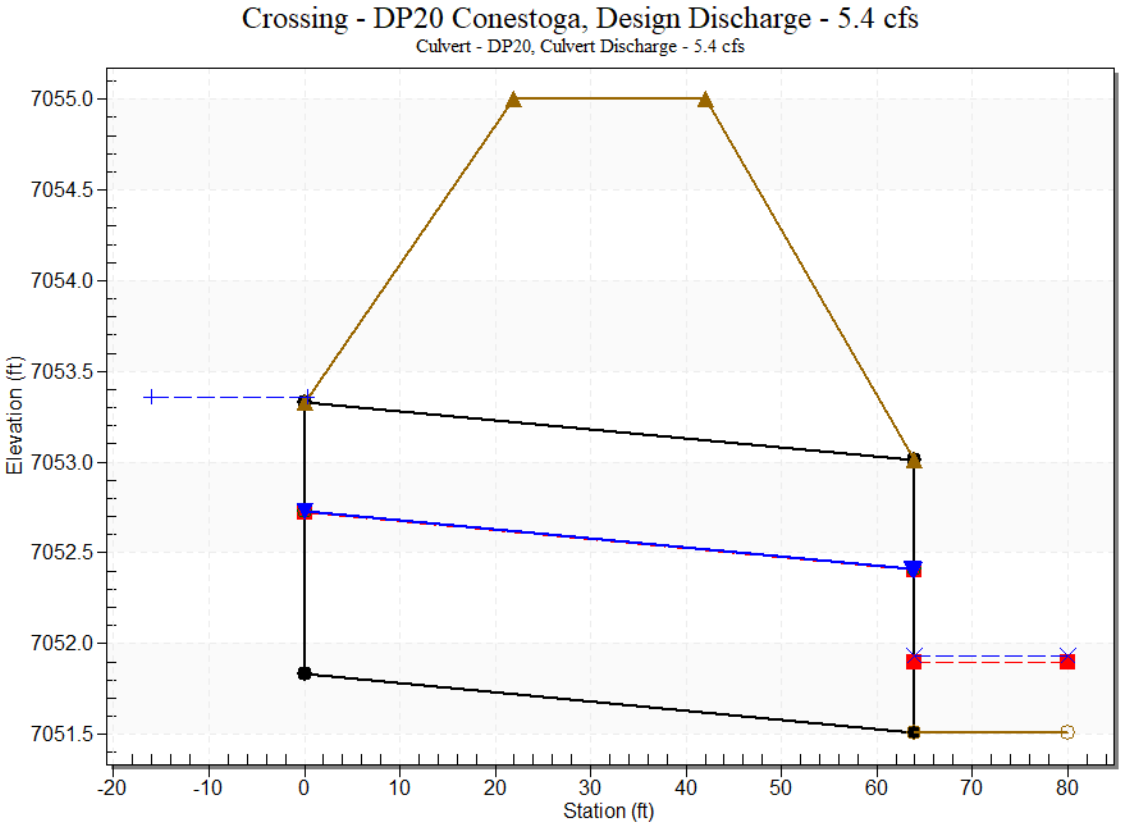


Table 11 - Culvert Summary Table: DPC1

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	HW / D (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	7051.20	0.00	0.000	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
0.87	0.87	7051.70	0.50	0.0*	0.33	1-S2n	0.31	0.35	0.31	0.08	3.34	1.08
1.74	1.74	7051.92	0.72	0.0*	0.48	1-S2n	0.44	0.50	0.44	0.12	4.09	1.40
2.61	2.61	7052.11	0.91	0.0*	0.61	1-S2n	0.54	0.61	0.54	0.15	4.58	1.63
3.48	3.48	7052.28	1.08	0.0*	0.72	1-S2n	0.63	0.71	0.63	0.18	4.95	1.82
4.35	4.35	7052.45	1.25	0.0*	0.83	1-S2n	0.71	0.80	0.71	0.20	5.25	1.97
5.22	5.22	7052.62	1.42	0.099	0.95	1-S2n	0.79	0.88	0.79	0.23	5.49	2.11
6.09	6.09	7052.80	1.60	0.429	1.07	5-S2n	0.87	0.95	0.87	0.25	5.69	2.23
6.96	6.96	7053.00	1.80	0.793	1.20	5-S2n	0.96	1.02	0.96	0.27	5.86	2.34
7.83	7.83	7053.21	2.01	1.190	1.34	5-S2n	1.04	1.08	1.04	0.29	5.99	2.44
8.70	8.70	7053.45	2.25	1.802	1.50	5-S2n	1.13	1.14	1.13	0.31	6.08	2.53
10.28	9.74	7053.77	2.57	2.370	1.71	7-M2c	1.27	1.20	1.20	0.34	6.41	2.69

* Full Flow Headwater elevation is below inlet invert.

Water Surface Profile Plot for Culvert: DPC1

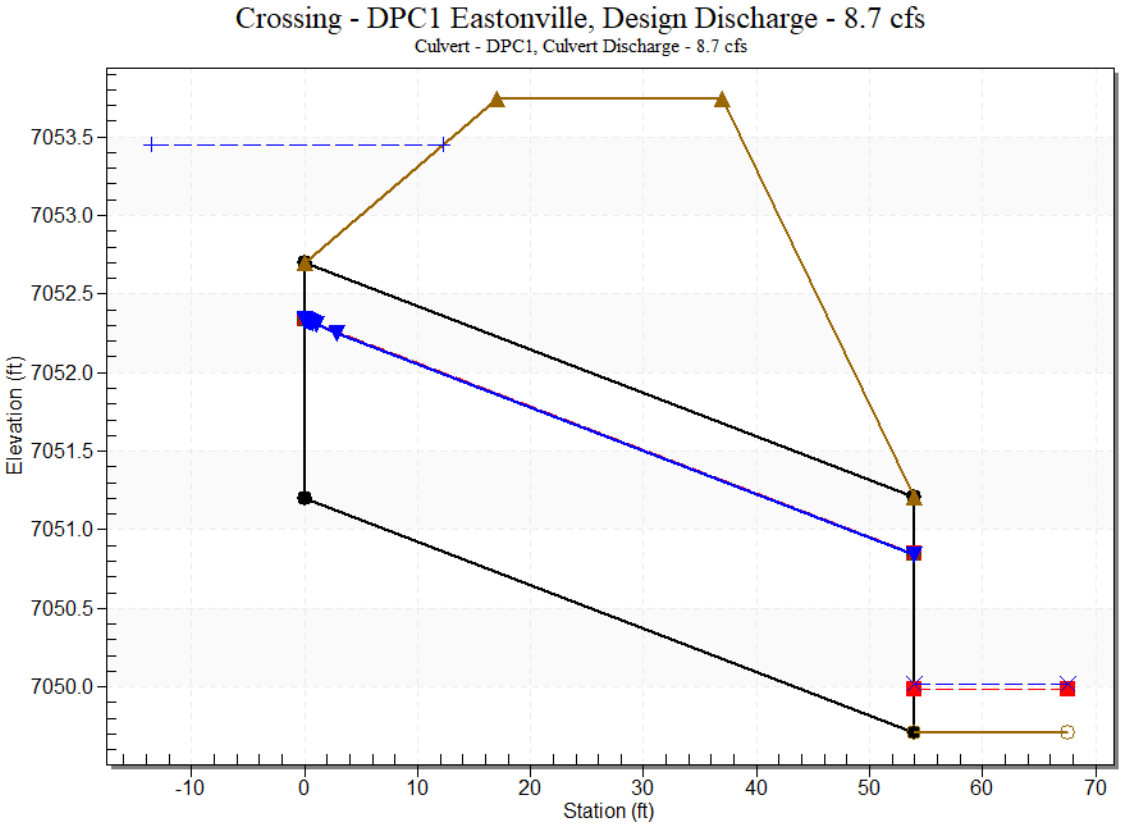


Table 5 - Culvert Summary Table: DP24A

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	HW / D (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	7072.50	0.00	0.000	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
4.39	4.39	7073.45	0.95	0.0*	0.32	1-S2n	0.43	0.65	0.43	0.38	7.14	2.57
8.78	8.78	7073.87	1.37	0.0*	0.46	1-S2n	0.60	0.94	0.61	0.54	8.44	3.13
13.17	13.17	7074.21	1.71	0.0*	0.57	1-S2n	0.73	1.15	0.76	0.67	9.32	3.49
17.56	17.56	7074.50	2.00	0.010	0.67	1-S2n	0.85	1.34	0.89	0.77	9.99	3.78
21.95	21.95	7074.77	2.27	0.294	0.76	1-S2n	0.95	1.51	1.01	0.85	10.49	4.01
26.34	26.34	7075.03	2.53	0.590	0.84	1-S2n	1.05	1.66	1.12	0.93	10.88	4.21
30.73	30.73	7075.31	2.81	0.899	0.94	1-S2n	1.14	1.80	1.23	1.00	11.25	4.38
35.12	35.12	7075.60	3.10	1.225	1.03	5-S2n	1.22	1.93	1.33	1.07	11.63	4.54
39.51	39.51	7075.94	3.44	1.569	1.15	5-S2n	1.31	2.05	1.43	1.13	11.90	4.68
43.90	43.90	7076.31	3.81	1.930	1.27	5-S2n	1.39	2.16	1.52	1.18	12.20	4.81
67.85	61.10	7078.16	5.66	3.761	1.89	5-S2n	1.69	2.52	1.87	1.44	13.21	5.38

* Full Flow Headwater elevation is below inlet invert.

Water Surface Profile Plot for Culvert: DP24A

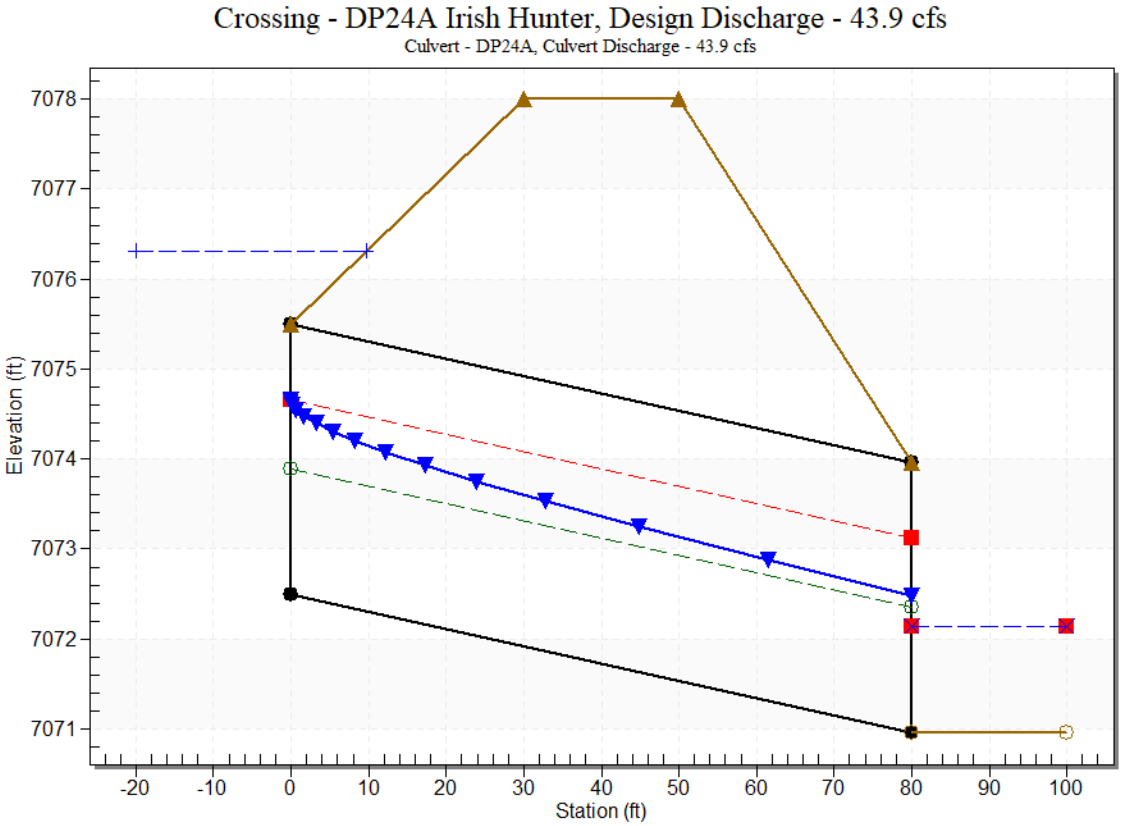


Table 6 - Culvert Summary Table: 18 INCH DRIVEWAY

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	HW / D (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	100.00	0.00	0.000	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
1.20	1.20	100.59	0.59	0.134	0.39	1-S2n	0.33	0.41	0.33	0.42	4.14	1.71
2.40	2.40	100.86	0.86	0.348	0.57	1-S2n	0.47	0.59	0.48	0.54	4.99	2.04
3.60	3.60	101.08	1.08	0.564	0.72	1-S2n	0.58	0.72	0.59	0.63	5.53	2.25
4.80	4.80	101.28	1.28	0.790	0.85	1-S2n	0.68	0.84	0.70	0.70	5.94	2.42
6.00	6.00	101.50	1.50	1.033	1.00	5-S2n	0.77	0.95	0.80	0.77	6.28	2.56
7.20	7.20	101.76	1.76	1.297	1.17	5-S2n	0.86	1.04	0.89	0.82	6.58	2.68
8.40	8.40	102.06	2.06	1.581	1.38	5-S2n	0.96	1.12	0.98	0.87	6.84	2.78
9.60	9.60	102.42	2.42	2.039	1.61	5-S2n	1.05	1.20	1.08	0.91	7.07	2.88
10.80	10.80	102.82	2.82	2.335	1.88	5-S2n	1.16	1.26	1.18	0.95	7.26	2.96
12.00	11.41	103.04	3.04	2.496	2.03	5-S2n	1.23	1.29	1.24	0.99	7.32	3.04
13.09	11.52	103.08	3.08	2.524	2.05	5-S2n	1.24	1.29	1.25	1.03	7.33	3.11

Water Surface Profile Plot for Culvert: 18 INCH DRIVEWAY

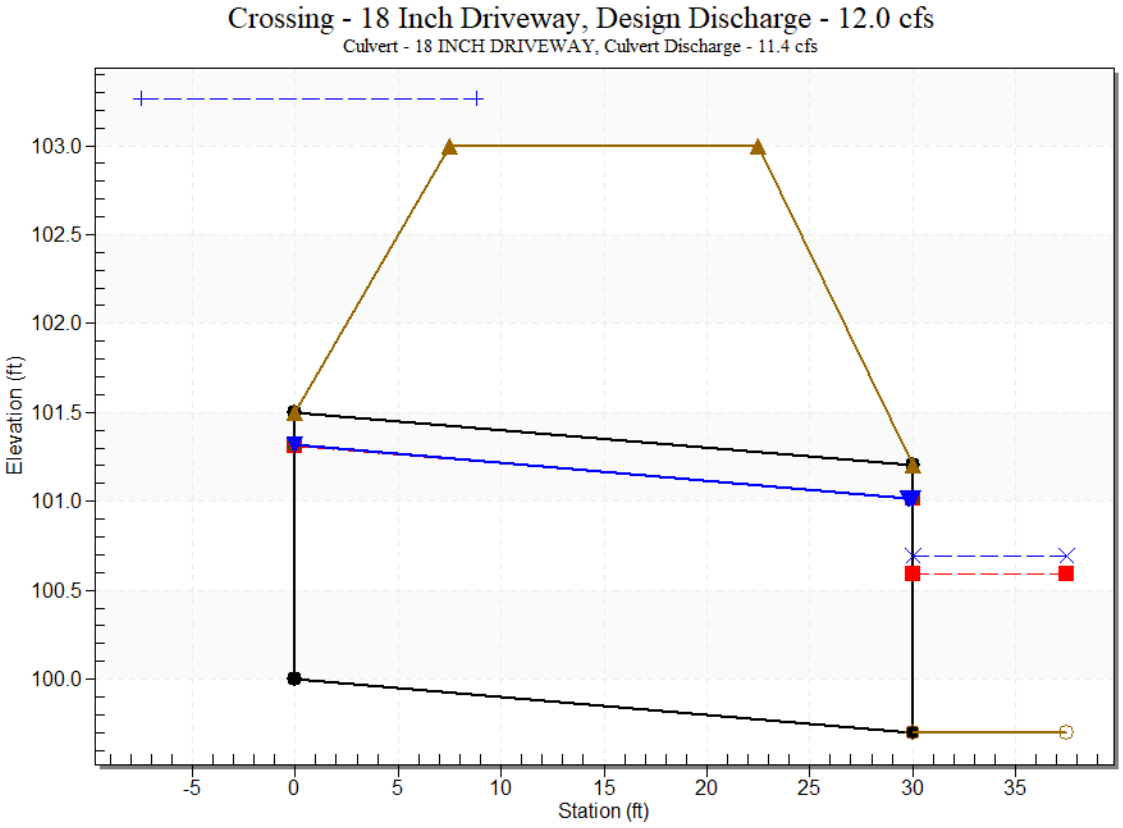


Table 7 - Culvert Summary Table: 24 INCH DRIVEWAY

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	HW / D (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	100.00	0.00	0.000	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
2.20	2.20	100.74	0.74	0.241	0.37	1-S2n	0.40	0.52	0.41	0.53	4.72	1.99
4.40	4.40	101.07	1.07	0.498	0.54	1-S2n	0.57	0.74	0.59	0.68	5.64	2.37
6.60	6.60	101.35	1.35	0.748	0.67	1-S2n	0.71	0.91	0.74	0.79	6.24	2.62
8.80	8.80	101.59	1.59	1.004	0.80	1-S2n	0.83	1.06	0.87	0.88	6.70	2.82
11.00	11.00	101.84	1.84	1.273	0.92	1-S2n	0.94	1.19	0.99	0.96	7.08	2.98
13.20	13.20	102.12	2.12	1.560	1.06	5-S2n	1.04	1.31	1.10	1.03	7.42	3.12
15.40	15.40	102.44	2.44	1.867	1.22	5-S2n	1.15	1.41	1.21	1.09	7.73	3.24
17.60	17.60	102.82	2.82	2.438	1.41	5-S2n	1.25	1.51	1.32	1.15	8.02	3.35
19.80	19.80	103.24	3.24	2.743	1.62	5-S2n	1.36	1.60	1.42	1.20	8.29	3.45
22.00	21.23	103.55	3.55	2.954	1.77	5-S2n	1.44	1.65	1.49	1.25	8.46	3.54
24.00	21.50	103.61	3.61	2.995	1.80	5-S2n	1.45	1.66	1.50	1.29	8.49	3.62

Water Surface Profile Plot for Culvert: 24 INCH DRIVEWAY

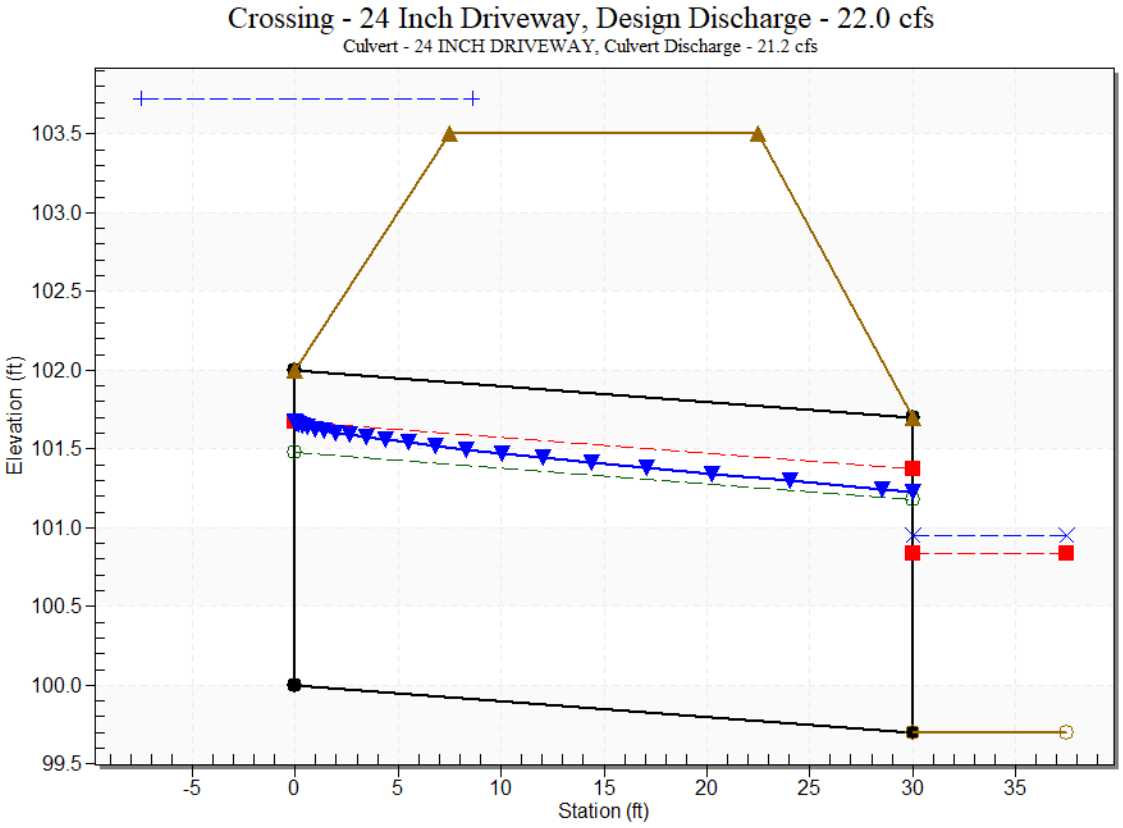


Table 8 - Culvert Summary Table: 30 INCH DRIVEWAY

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	HW / D (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	100.00	0.00	0.000	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
3.50	3.50	100.88	0.88	0.341	0.35	1-S2n	0.47	0.61	0.49	0.63	5.19	2.24
7.00	7.00	101.27	1.27	0.639	0.51	1-S2n	0.67	0.88	0.70	0.81	6.17	2.66
10.50	10.50	101.60	1.60	0.921	0.64	1-S2n	0.83	1.08	0.88	0.94	6.80	2.94
14.00	14.00	101.88	1.88	1.204	0.75	1-S2n	0.96	1.26	1.04	1.05	7.29	3.16
17.50	17.50	102.16	2.16	1.497	0.86	1-S2n	1.09	1.42	1.18	1.14	7.71	3.34
21.00	21.00	102.45	2.45	1.807	0.98	1-S2n	1.21	1.56	1.31	1.22	8.08	3.50
24.50	24.50	102.79	2.79	2.134	1.12	5-S2n	1.32	1.69	1.43	1.30	8.42	3.64
28.00	28.00	103.18	3.18	2.481	1.27	5-S2n	1.44	1.80	1.55	1.36	8.74	3.76
31.50	31.50	103.62	3.62	3.143	1.45	5-S2n	1.55	1.91	1.67	1.43	9.05	3.87
35.00	34.48	104.04	4.04	3.429	1.61	5-S2n	1.65	2.00	1.77	1.48	9.30	3.98
41.36	35.50	104.19	4.19	3.532	1.68	5-S2n	1.69	2.02	1.80	1.58	9.39	4.15

Water Surface Profile Plot for Culvert: 30 INCH DRIVEWAY

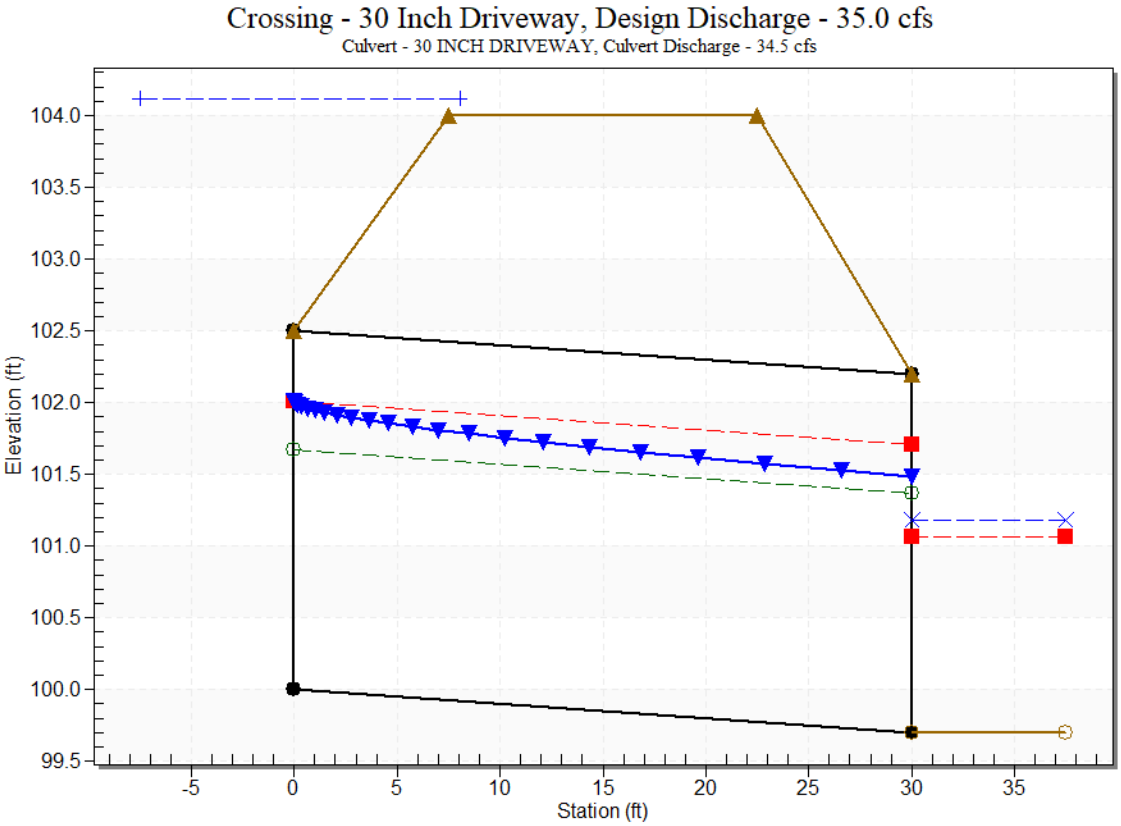
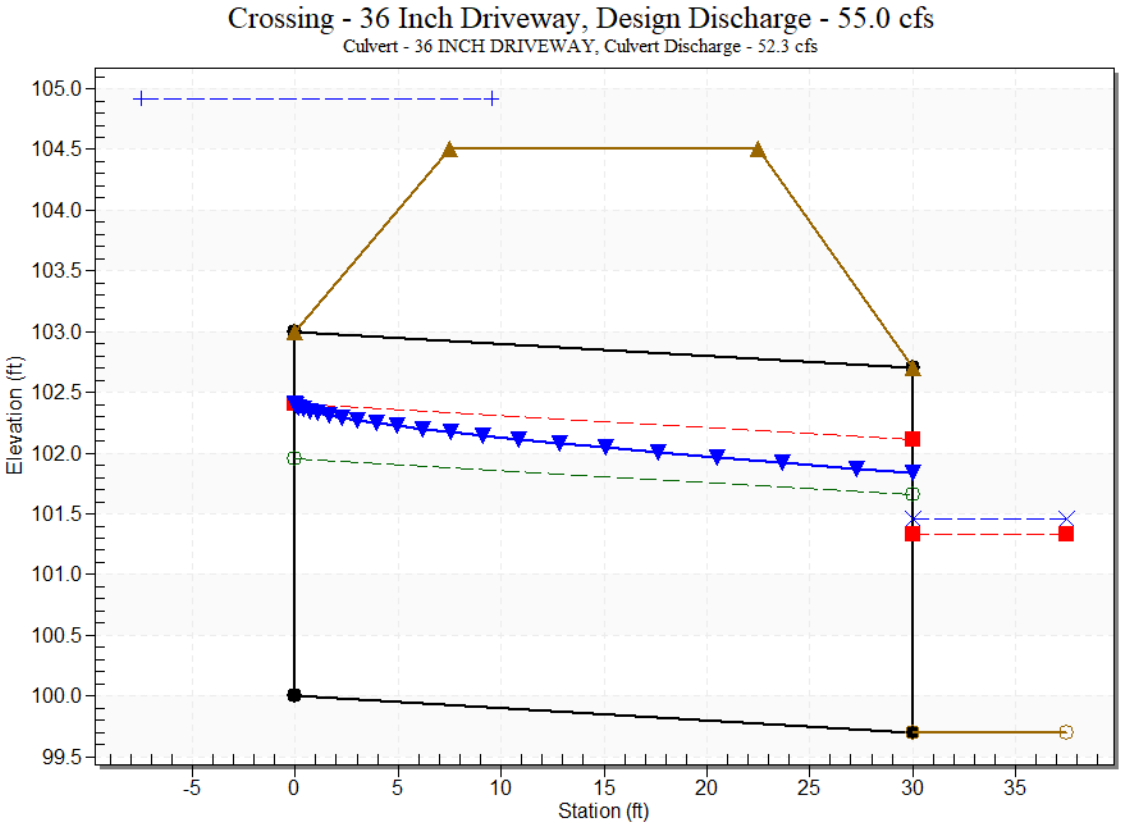


Table 9 - Culvert Summary Table: 36 INCH DRIVEWAY

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	HW / D (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	100.00	0.00	0.000	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
5.50	5.50	101.05	1.05	0.459	0.35	1-S2n	0.56	0.74	0.58	0.74	5.69	2.50
11.00	11.00	101.53	1.53	0.822	0.51	1-S2n	0.79	1.05	0.85	0.96	6.72	2.98
16.50	16.50	101.92	1.92	1.157	0.64	1-S2n	0.97	1.30	1.06	1.12	7.40	3.30
22.00	22.00	102.25	2.25	1.492	0.75	1-S2n	1.13	1.51	1.25	1.25	7.93	3.54
27.50	27.50	102.58	2.58	1.838	0.86	1-S2n	1.28	1.70	1.42	1.36	8.39	3.74
33.00	33.00	102.94	2.94	2.202	0.98	1-S2n	1.42	1.86	1.57	1.45	8.79	3.92
38.50	38.50	103.34	3.34	2.587	1.11	5-S2n	1.56	2.02	1.72	1.54	9.17	4.07
44.00	44.00	103.80	3.80	2.994	1.27	5-S2n	1.69	2.16	1.86	1.62	9.53	4.21
49.50	49.50	104.32	4.32	3.779	1.44	5-S2n	1.82	2.29	2.00	1.69	9.88	4.34
55.00	52.28	104.61	4.61	3.975	1.54	5-S2n	1.89	2.35	2.07	1.76	10.06	4.45
60.00	53.16	104.71	4.71	4.039	1.57	5-S2n	1.91	2.37	2.09	1.82	10.12	4.55

Water Surface Profile Plot for Culvert: 36 INCH DRIVEWAY

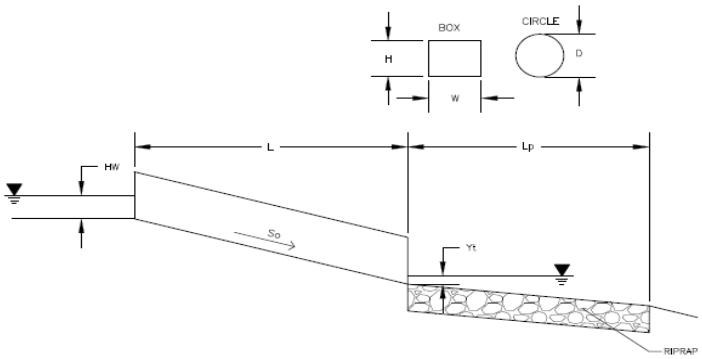


DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: **Latigo Filing 10**

ID: **DP1**



Soil Type:
Choose One:
(●) Sandy
( ) Non-Sandy

Supercritical Flow! Using Adjusted Diameter to calculate protection type.

Design Information:

Design Discharge	Q =	279.5	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	36	inches
Inlet Edge Type (Choose from pull-down list)		Square Edge with Headwall	
OR:			
Box Culvert:		**OR**	
Barrel Height (Rise) in Feet	H (Rise) =		ft
Barrel Width (Span) in Feet	W (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	# Barrels =	4	
Inlet Elevation	Elev IN =	7097	ft
Outlet Elevation **OR** Slope	Elev OUT =	7096	ft
Culvert Length	L =	77	ft
Manning's Roughness	n =	0.012	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	$Y_{t,\ Elevation}$ =		ft
Max Allowable Channel Velocity	V =	5	ft/s

Calculated Results:

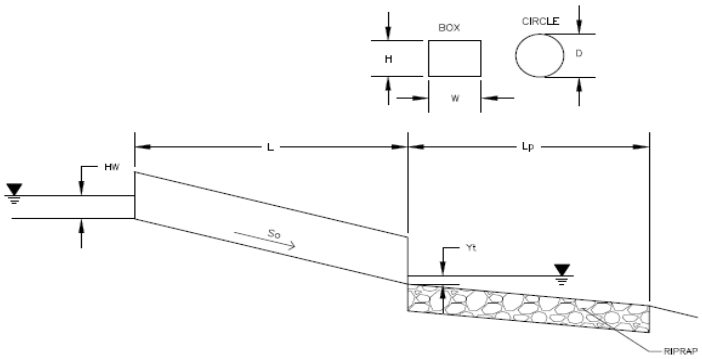
Culvert Cross Sectional Area Available	A =	7.07	ft^2
Culvert Normal Depth	Y_n =	2.12	ft
Culvert Critical Depth	Y_c =	2.66	ft
Froude Number	Fr =	1.65	**Supercritical!**
Entrance Loss Coefficient	k_e =	0.50	
Friction Loss Coefficient	k_f =	0.47	
Sum of All Loss Coefficients	k_s =	1.97	ft
Headwater:			
Inlet Control Headwater	HW_I =	5.85	ft
Outlet Control Headwater	HW_O =	4.82	ft
Design Headwater Elevation	**HW =**	**7102.85**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**1.95**	**HW/D > 1.5!**
Outlet Protection:			
Flow/(Diameter^2.5)	Q/D^2.5 =	4.48	$ft^{0.5}/s$
Tailwater Surface Height	Y_t =	1.20	ft
Tailwater/Diameter	Yt/D =	0.40	
Expansion Factor	1/(2*tan(Θ)) =	2.98	
Flow Area at Max Channel Velocity	A_t =	55.90	ft^2
Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	12.00	ft
Length of Riprap Protection	**L_p =**	**30**	**ft**
Width of Riprap Protection at Downstream End	**T =**	**23**	**ft**
Adjusted Diameter for Supercritical Flow	Da =	2.56	ft
Minimum Theoretical Riprap Size	d_{50} min=	12	in
Nominal Riprap Size	d_{50} nominal=	12	in
MHFD Riprap Type	**Type =**	**M**	

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: **Latigo Filing 10**

ID: **DP7**



Soil Type:
Choose One:
(●) Sandy
( ) Non-Sandy

Supercritical Flow! Using Adjusted Diameter to calculate protection type.

Design Information:

Design Discharge	Q =	2	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	18	inches
Inlet Edge Type (Choose from pull-down list)		Square Edge with Headwall	
OR:			
Box Culvert:		**OR**	
Barrel Height (Rise) in Feet	H (Rise) =		ft
Barrel Width (Span) in Feet	W (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	# Barrels =	1	
Inlet Elevation	Elev IN =	7069	ft
Outlet Elevation **OR** Slope	Elev OUT =	7068	ft
Culvert Length	L =	72	ft
Manning's Roughness	n =	0.012	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	$Y_{t,\ Elevation}$ =		ft
Max Allowable Channel Velocity	V =	5	ft/s

Calculated Results:

Culvert Cross Sectional Area Available	A =	1.77	ft^2
Culvert Normal Depth	Y_n =	0.39	ft
Culvert Critical Depth	Y_c =	0.53	ft
Froude Number	Fr =	1.82	**Supercritical!**
Entrance Loss Coefficient	k_e =	0.50	
Friction Loss Coefficient	k_f =	1.11	
Sum of All Loss Coefficients	k_s =	2.61	ft
Headwater:			
Inlet Control Headwater	HW_I =	0.73	ft
Outlet Control Headwater	HW_O =	N/A	ft
Design Headwater Elevation	**HW =**	**N/A**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**N/A**	

Outlet Control Headwater Approximation Method Inaccurate for Low Flow - Backwater Calculations Required

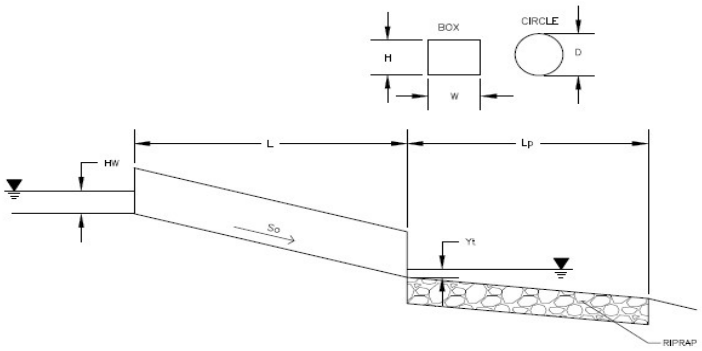
Outlet Protection:			
Flow/(Diameter^2.5)	Q/D^2.5 =	0.73	$ft^{0.5}/s$
Tailwater Surface Height	Y_t =	0.60	ft
Tailwater/Diameter	Yt/D =	0.40	
Expansion Factor	1/(2*tan(Θ)) =	6.70	
Flow Area at Max Channel Velocity	A_t =	0.40	ft^2
Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	-	ft
Length of Riprap Protection	**L_p =**	**5**	**ft**
Width of Riprap Protection at Downstream End	**T =**	**3**	**ft**
Adjusted Diameter for Supercritical Flow	Da =	0.95	ft
Minimum Theoretical Riprap Size	d_{50} min=	1	in
Nominal Riprap Size	d_{50} nominal=	6	in
MHFD Riprap Type	**Type =**	**VL**	

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: **Latigo Filing 10**

ID: **DP8A**



Soil Type:

Choose One:
- (●) Sandy
- ( ) Non-Sandy

Supercritical Flow! Using Adjusted Diameter to calculate protection type.

Design Information:

Design Discharge	Q =	54.3	cfs

Circular Culvert:

Barrel Diameter in Inches	D =	36	inches
Inlet Edge Type (Choose from pull-down list)		Grooved Edge Projecting	

OR:

Box Culvert:

		OR	
Barrel Height (Rise) in Feet	H (Rise) =		ft
Barrel Width (Span) in Feet	W (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	# Barrels =	1	
Inlet Elevation	Elev IN =	7068	ft
Outlet Elevation **OR** Slope	Elev OUT =	7062	ft
Culvert Length	L =	172	ft
Manning's Roughness	n =	0.012	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	$Y_{t,\ Elevation}$ =		ft
Max Allowable Channel Velocity	V =	5	ft/s

Calculated Results:

Culvert Cross Sectional Area Available	A =	7.07	ft^2
Culvert Normal Depth	Y_n =	1.83	ft
Culvert Critical Depth	Y_c =	2.15	ft
Froude Number	Fr =	1.36	**Supercritical!**
Entrance Loss Coefficient	k_e =	0.20	
Friction Loss Coefficient	k_f =	1.05	
Sum of All Loss Coefficients	k_s =	2.25	ft

Headwater:

Inlet Control Headwater	HW_I =	3.26	ft
Outlet Control Headwater	HW_O =	2.99	ft
Design Headwater Elevation	**HW =**	**7071.26**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**1.09**	

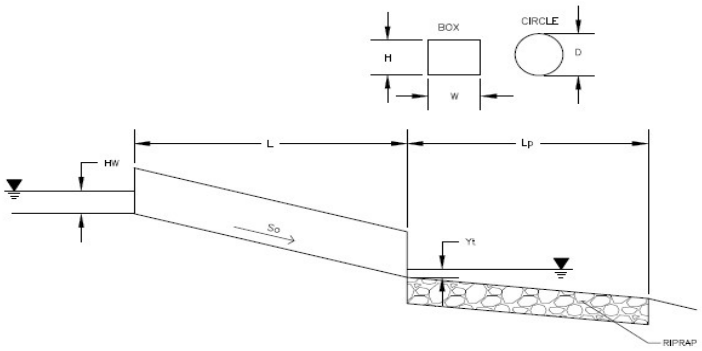
Outlet Protection:

Flow/(Diameter^2.5)	Q/D^2.5 =	3.48	$ft^{0.5}/s$
Tailwater Surface Height	Y_t =	1.20	ft
Tailwater/Diameter	Yt/D =	0.40	
Expansion Factor	1/(2*tan(Θ)) =	3.96	
Flow Area at Max Channel Velocity	A_t =	10.86	ft^2
Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	-	ft
Length of Riprap Protection	**L_p =**	**20**	**ft**
Width of Riprap Protection at Downstream End	**T =**	**9**	**ft**
Adjusted Diameter for Supercritical Flow	Da =	2.42	ft
Minimum Theoretical Riprap Size	d_{50} min=	9	in
Nominal Riprap Size	d_{50} nominal=	12	in
MHFD Riprap Type	**Type =**	**M**	

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: Latigo Filing 10
ID: DP13A



Soil Type:
Choose One:
(•) Sandy
( ) Non-Sandy

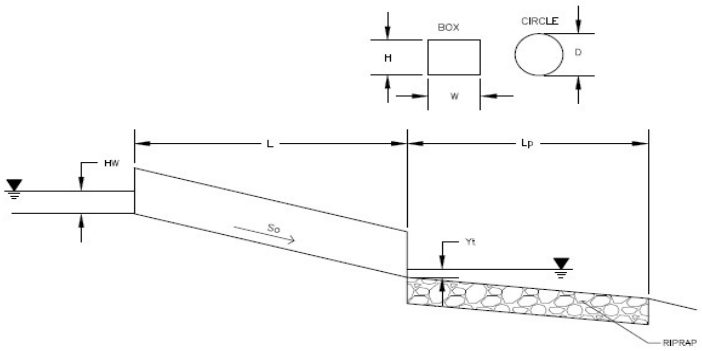
Supercritical Flow! Using Adjusted Diameter to calculate protection type.

Design Information:				
	Design Discharge	Q =	36.9	cfs
Circular Culvert:				
	Barrel Diameter in Inches	D =	36	inches
	Inlet Edge Type (Choose from pull-down list)		Grooved Edge Projecting	
OR:				
Box Culvert:			**OR**	
	Barrel Height (Rise) in Feet	H (Rise) =		ft
	Barrel Width (Span) in Feet	W (Span) =		ft
	Inlet Edge Type (Choose from pull-down list)			
	Number of Barrels	# Barrels =	1	
	Inlet Elevation	Elev IN =	7075.2	ft
	Outlet Elevation **OR** Slope	Elev OUT =	7074.65	ft
	Culvert Length	L =	73	ft
	Manning's Roughness	n =	0.012	
	Bend Loss Coefficient	k_b =	0	
	Exit Loss Coefficient	k_x =	1	
	Tailwater Surface Elevation	$Y_{t,\ Elevation}$ =		ft
	Max Allowable Channel Velocity	V =	5	ft/s
Calculated Results:				
	Culvert Cross Sectional Area Available	A =	7.07	ft^2
	Culvert Normal Depth	Y_n =	1.65	ft
	Culvert Critical Depth	Y_c =	1.98	ft
	Froude Number	Fr =	1.41	**Supercritical!**
	Entrance Loss Coefficient	k_e =	0.20	
	Friction Loss Coefficient	k_f =	0.45	
	Sum of All Loss Coefficients	k_s =	1.65	ft
Headwater:				
	Inlet Control Headwater	HW_I =	2.92	ft
	Outlet Control Headwater	HW_O =	2.63	ft
	Design Headwater Elevation	**HW =**	**7078.12**	**ft**
	Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**0.97**	
Outlet Protection:				
	Flow/(Diameter^2.5)	Q/D^2.5 =	2.37	$ft^{0.5}/s$
	Tailwater Surface Height	Y_t =	1.20	ft
	Tailwater/Diameter	Yt/D =	0.40	
	Expansion Factor	1/(2*tan(Θ)) =	5.24	
	Flow Area at Max Channel Velocity	A_t =	7.38	ft^2
	Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	-	ft
	Length of Riprap Protection	**L_p =**	**17**	**ft**
	Width of Riprap Protection at Downstream End	**T =**	**7**	**ft**
	Adjusted Diameter for Supercritical Flow	Da =	2.33	ft
	Minimum Theoretical Riprap Size	d_{50} min=	6	in
	Nominal Riprap Size	d_{50} nominal=	9	in
	MHFD Riprap Type	**Type =**	**L**	

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: **Latigo Filing 10**
ID: **DP24A**



Soil Type:
Choose One:
(•) Sandy
( ) Non-Sandy

Supercritical Flow! Using Adjusted Diameter to calculate protection type.

Design Information:

Design Discharge	Q =	43.4	cfs

Circular Culvert:

Barrel Diameter in Inches	D =	36	inches
Inlet Edge Type (Choose from pull-down list)		Grooved Edge Projecting	

OR:

Box Culvert:

		OR	
Barrel Height (Rise) in Feet	H (Rise) =		ft
Barrel Width (Span) in Feet	W (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	# Barrels =	1	
Inlet Elevation	Elev IN =	7071.75	ft
Outlet Elevation **OR** Slope	Elev OUT =	7071.2	ft
Culvert Length	L =	74.2	ft
Manning's Roughness	n =	0.012	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	$Y_{t,\ Elevation}$ =		ft
Max Allowable Channel Velocity	V =	5	ft/s

Calculated Results:

Culvert Cross Sectional Area Available	A =	7.07	ft^2
Culvert Normal Depth	Y_n =	1.83	ft
Culvert Critical Depth	Y_c =	2.15	ft
Froude Number	Fr =	1.36	**Supercritical!**
Entrance Loss Coefficient	k_e =	0.20	
Friction Loss Coefficient	k_f =	0.45	
Sum of All Loss Coefficients	k_s =	1.65	ft

Headwater:

Inlet Control Headwater	HW_I =	3.26	ft
Outlet Control Headwater	HW_O =	2.99	ft
Design Headwater Elevation	**HW =**	**7075.01**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**1.09**	

Outlet Protection:

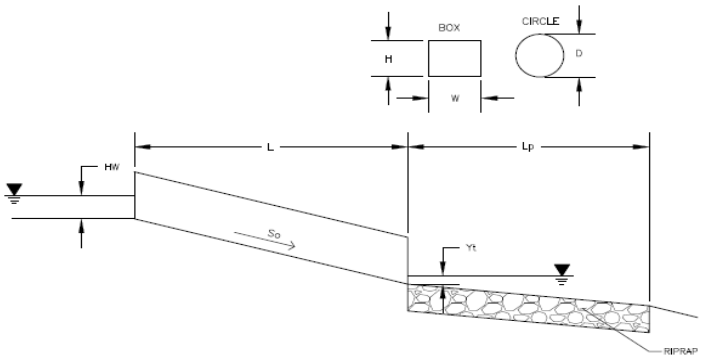
Flow/(Diameter^2.5)	Q/D^2.5 =	2.78	$ft^{0.5}/s$
Tailwater Surface Height	Y_t =	1.20	ft
Tailwater/Diameter	Yt/D =	0.40	
Expansion Factor	1/(2*tan(Θ)) =	4.67	
Flow Area at Max Channel Velocity	A_t =	8.68	ft^2
Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	-	ft
Length of Riprap Protection	**L_p =**	**20**	**ft**
Width of Riprap Protection at Downstream End	**T =**	**8**	**ft**
Adjusted Diameter for Supercritical Flow	Da =	2.42	ft
Minimum Theoretical Riprap Size	d_{50} min=	7	in
Nominal Riprap Size	d_{50} nominal=	9	in
MHFD Riprap Type	**Type =**	**L**	

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: **Latigo Filing 10**

ID: **3-36" Driveway**



Soil Type:
Choose One:
(●) Sandy
( ) Non-Sandy

Supercritical Flow! Using Adjusted Diameter to calculate protection type.

Design Information:

Design Discharge	Q =	127.3	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	36	inches
Inlet Edge Type (Choose from pull-down list)		Square Edge with Headwall	
OR:		**OR**	
Box Culvert:			
Barrel Height (Rise) in Feet	H (Rise) =		ft
Barrel Width (Span) in Feet	W (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	# Barrels =	3	
Inlet Elevation	Elev IN =	7050	ft
Outlet Elevation **OR** Slope	Elev OUT =	7049.7	ft
Culvert Length	L =	30	ft
Manning's Roughness	n =	0.012	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	$Y_{t,\ Elevation}$ =		ft
Max Allowable Channel Velocity	V =	5	ft/s

Calculated Results:

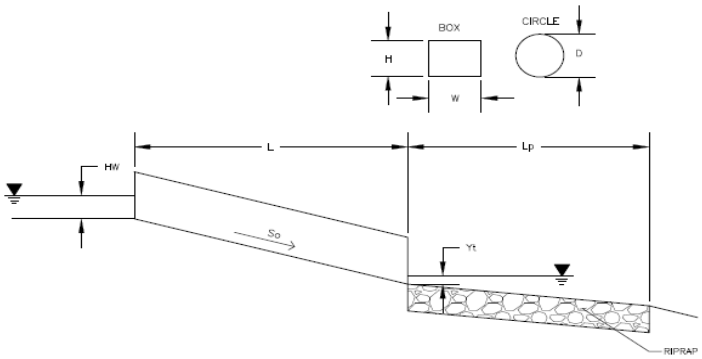
Culvert Cross Sectional Area Available	A =	7.07	ft^2
Culvert Normal Depth	Y_n =	1.65	ft
Culvert Critical Depth	Y_c =	2.12	ft
Froude Number	Fr =	1.63	**Supercritical!**
Entrance Loss Coefficient	k_e =	0.50	
Friction Loss Coefficient	k_f =	0.18	
Sum of All Loss Coefficients	k_s =	1.68	ft
Headwater:			
Inlet Control Headwater	HW_I =	3.45	ft
Outlet Control Headwater	HW_O =	3.20	ft
Design Headwater Elevation	**HW =**	**7053.45**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**1.15**	
Outlet Protection:			
Flow/(Diameter^2.5)	Q/D^2.5 =	2.72	$ft^{0.5}/s$
Tailwater Surface Height	Y_t =	1.20	ft
Tailwater/Diameter	Yt/D =	0.40	
Expansion Factor	1/(2*tan(Θ)) =	4.76	
Flow Area at Max Channel Velocity	A_t =	25.46	ft^2
Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	9.00	ft
Length of Riprap Protection	**L_p =**	**30**	**ft**
Width of Riprap Protection at Downstream End	**T =**	**16**	**ft**
Adjusted Diameter for Supercritical Flow	Da =	2.33	ft
Minimum Theoretical Riprap Size	d_{50} min=	7	in
Nominal Riprap Size	d_{50} nominal=	9	in
MHFD Riprap Type	**Type =**	**L**	

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: **Latigo Filing 10**

ID: **4-36" Driveway**



Soil Type:
Choose One:
(●) Sandy
( ) Non-Sandy

Supercritical Flow! Using Adjusted Diameter to calculate protection type.

Design Information:

Design Discharge	Q =	279.5	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	36	inches
Inlet Edge Type (Choose from pull-down list)		Square Edge with Headwall	
OR:			
Box Culvert:		**OR**	
Barrel Height (Rise) in Feet	H (Rise) =		ft
Barrel Width (Span) in Feet	W (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	# Barrels =	4	
Inlet Elevation	Elev IN =	7050	ft
Outlet Elevation **OR** Slope	Elev OUT =	7049.7	ft
Culvert Length	L =	30	ft
Manning's Roughness	n =	0.012	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	$Y_{t,\ Elevation}$ =		ft
Max Allowable Channel Velocity	V =	5	ft/s

Calculated Results:

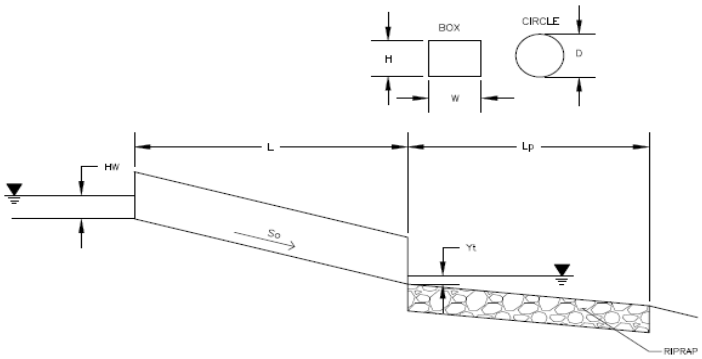
Culvert Cross Sectional Area Available	A =	7.07	ft^2
Culvert Normal Depth	Y_n =	2.37	ft
Culvert Critical Depth	Y_c =	2.66	ft
Froude Number	Fr =	1.32	**Supercritical!**
Entrance Loss Coefficient	k_e =	0.50	
Friction Loss Coefficient	k_f =	0.18	
Sum of All Loss Coefficients	k_s =	1.68	ft
Headwater:			
Inlet Control Headwater	HW_I =	5.85	ft
Outlet Control Headwater	HW_O =	5.08	ft
Design Headwater Elevation	**HW =**	**7055.85**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**1.95**	**HW/D > 1.5!**
Outlet Protection:			
Flow/(Diameter^2.5)	Q/D^2.5 =	4.48	$ft^{0.5}/s$
Tailwater Surface Height	Y_t =	1.20	ft
Tailwater/Diameter	Yt/D =	0.40	
Expansion Factor	1/(2*tan(Θ)) =	2.98	
Flow Area at Max Channel Velocity	A_t =	55.90	ft^2
Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	12.00	ft
Length of Riprap Protection	**L_p =**	**30**	**ft**
Width of Riprap Protection at Downstream End	**T =**	**23**	**ft**
Adjusted Diameter for Supercritical Flow	Da =	2.68	ft
Minimum Theoretical Riprap Size	d_{50} min=	12	in
Nominal Riprap Size	d_{50} nominal=	12	in
MHFD Riprap Type	**Type =**	**M**	

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: **Latigo Filing 10**

ID: **18" Driveway**



Soil Type:
Choose One:
(●) Sandy
( ) Non-Sandy

Supercritical Flow! Using Adjusted Diameter to calculate protection type.

Design Information:

Design Discharge	Q =	11.4	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	18	inches
Inlet Edge Type (Choose from pull-down list)		Square Edge with Headwall	
OR:		**OR**	
Box Culvert:			
Barrel Height (Rise) in Feet	H (Rise) =		ft
Barrel Width (Span) in Feet	W (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	# Barrels =	1	
Inlet Elevation	Elev IN =	7050	ft
Outlet Elevation **OR** Slope	Elev OUT =	7049.7	ft
Culvert Length	L =	30	ft
Manning's Roughness	n =	0.012	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	$Y_{t,\ Elevation}$ =		ft
Max Allowable Channel Velocity	V =	5	ft/s

Calculated Results:

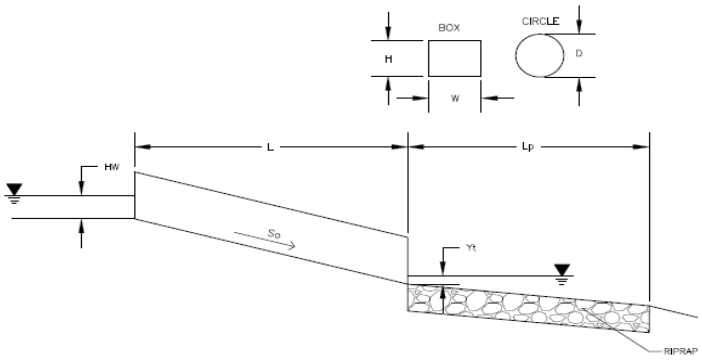
Culvert Cross Sectional Area Available	A =	1.77	ft^2
Culvert Normal Depth	Y_n =	1.23	ft
Culvert Critical Depth	Y_c =	1.29	ft
Froude Number	Fr =	1.12	**Supercritical!**
Entrance Loss Coefficient	k_e =	0.50	
Friction Loss Coefficient	k_f =	0.46	
Sum of All Loss Coefficients	k_s =	1.96	ft
Headwater:			
Inlet Control Headwater	HW_I =	2.64	ft
Outlet Control Headwater	HW_O =	2.36	ft
Design Headwater Elevation	**HW =**	**7052.64**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**1.76**	**HW/D > 1.5!**
Outlet Protection:			
Flow/(Diameter^2.5)	Q/D^2.5 =	4.14	$ft^{0.5}/s$
Tailwater Surface Height	Y_t =	0.60	ft
Tailwater/Diameter	Yt/D =	0.40	
Expansion Factor	1/(2*tan(Θ)) =	3.35	
Flow Area at Max Channel Velocity	A_t =	2.28	ft^2
Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	-	ft
Length of Riprap Protection	**L_p =**	**8**	**ft**
Width of Riprap Protection at Downstream End	**T =**	**4**	**ft**
Adjusted Diameter for Supercritical Flow	Da =	1.36	ft
Minimum Theoretical Riprap Size	d_{50} min=	5	in
Nominal Riprap Size	d_{50} nominal=	6	in
MHFD Riprap Type	**Type =**	**VL**	

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: **Latigo Filing 10**

ID: **24" Driveway**



Soil Type:
Choose One:
(●) Sandy
( ) Non-Sandy

Supercritical Flow! Using Adjusted Diameter to calculate protection type.

Design Information:

Design Discharge	Q =	21.2	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	24	inches
Inlet Edge Type (Choose from pull-down list)		Square Edge with Headwall	
OR:		**OR**	
Box Culvert:			
Barrel Height (Rise) in Feet	H (Rise) =		ft
Barrel Width (Span) in Feet	W (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	# Barrels =	1	
Inlet Elevation	Elev IN =	7050	ft
Outlet Elevation **OR** Slope	Elev OUT =	7049.7	ft
Culvert Length	L =	30	ft
Manning's Roughness	n =	0.012	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	$Y_{t,\ Elevation}$ =		ft
Max Allowable Channel Velocity	V =	5	ft/s

Calculated Results:

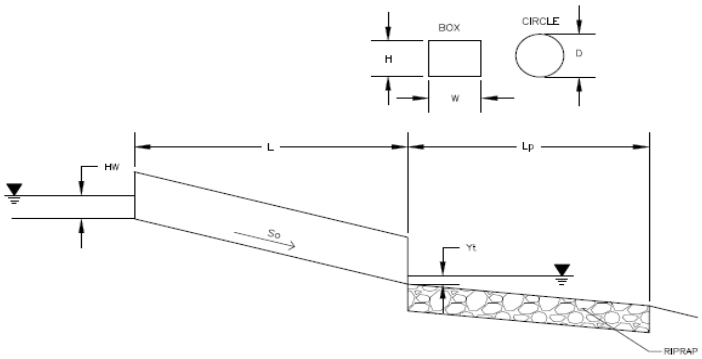
Culvert Cross Sectional Area Available	A =	3.14	ft^2
Culvert Normal Depth	Y_n =	1.43	ft
Culvert Critical Depth	Y_c =	1.65	ft
Froude Number	Fr =	1.34	**Supercritical!**
Entrance Loss Coefficient	k_e =	0.50	
Friction Loss Coefficient	k_f =	0.32	
Sum of All Loss Coefficients	k_s =	1.82	ft
Headwater:			
Inlet Control Headwater	HW_I =	3.13	ft
Outlet Control Headwater	HW_O =	2.81	ft
Design Headwater Elevation	**HW =**	**7053.13**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**1.56**	**HW/D > 1.5!**
Outlet Protection:			
Flow/(Diameter^2.5)	Q/D^2.5 =	3.75	$ft^{0.5}/s$
Tailwater Surface Height	Y_t =	0.80	ft
Tailwater/Diameter	Yt/D =	0.40	
Expansion Factor	1/(2*tan(Θ)) =	3.73	
Flow Area at Max Channel Velocity	A_t =	4.24	ft^2
Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	-	ft
Length of Riprap Protection	**L_p =**	**13**	**ft**
Width of Riprap Protection at Downstream End	**T =**	**6**	**ft**
Adjusted Diameter for Supercritical Flow	Da =	1.72	ft
Minimum Theoretical Riprap Size	d_{50} min=	7	in
Nominal Riprap Size	d_{50} nominal=	9	in
MHFD Riprap Type	**Type =**	**L**	

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: **Latigo Filing 10**

ID: **30" Driveway**



Soil Type:
Choose One:
(●) Sandy
( ) Non-Sandy

Supercritical Flow! Using Adjusted Diameter to calculate protection type.

Design Information:

Design Discharge	Q =	34.5	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	30	inches
Inlet Edge Type (Choose from pull-down list)		Square Edge with Headwall	
OR:			
Box Culvert:		**OR**	
Barrel Height (Rise) in Feet	H (Rise) =		ft
Barrel Width (Span) in Feet	W (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	# Barrels =	1	
Inlet Elevation	Elev IN =	7050	ft
Outlet Elevation **OR** Slope	Elev OUT =	7049.7	ft
Culvert Length	L =	30	ft
Manning's Roughness	n =	0.012	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	$Y_{t,\ Elevation}$ =		ft
Max Allowable Channel Velocity	V =	5	ft/s

Calculated Results:

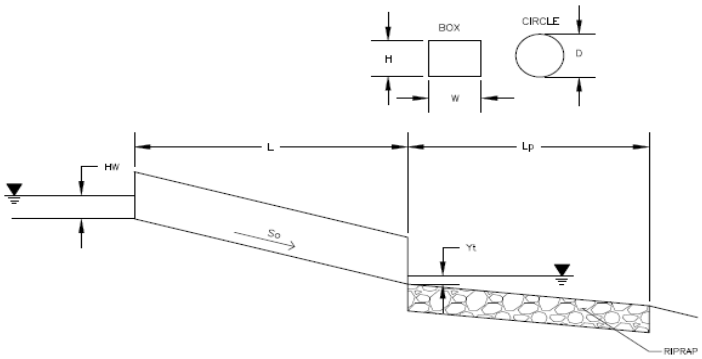
Culvert Cross Sectional Area Available	A =	4.91	ft^2
Culvert Normal Depth	Y_n =	1.65	ft
Culvert Critical Depth	Y_c =	2.00	ft
Froude Number	Fr =	1.46	**Supercritical!**
Entrance Loss Coefficient	k_e =	0.50	
Friction Loss Coefficient	k_f =	0.23	
Sum of All Loss Coefficients	k_s =	1.73	ft
Headwater:			
Inlet Control Headwater	HW_I =	3.62	ft
Outlet Control Headwater	HW_O =	3.28	ft
Design Headwater Elevation	**HW =**	**7053.62**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**1.45**	
Outlet Protection:			
Flow/(Diameter^2.5)	Q/D^2.5 =	3.49	$ft^{0.5}/s$
Tailwater Surface Height	Y_t =	1.00	ft
Tailwater/Diameter	Yt/D =	0.40	
Expansion Factor	1/(2*tan(Θ)) =	3.95	
Flow Area at Max Channel Velocity	A_t =	6.90	ft^2
Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	-	ft
Length of Riprap Protection	**L_p =**	**18**	**ft**
Width of Riprap Protection at Downstream End	**T =**	**8**	**ft**
Adjusted Diameter for Supercritical Flow	Da =	2.08	ft
Minimum Theoretical Riprap Size	d_{50} min=	8	in
Nominal Riprap Size	d_{50} nominal=	9	in
MHFD Riprap Type	**Type =**	**L**	

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: **Latigo Filing 10**

ID: **36" Driveway**



Soil Type:
Choose One:
(●) Sandy
( ) Non-Sandy

Supercritical Flow! Using Adjusted Diameter to calculate protection type.

Design Information:

Design Discharge	Q =	52.3	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	36	inches
Inlet Edge Type (Choose from pull-down list)		Square Edge with Headwall	
OR:		**OR**	
Box Culvert:			
Barrel Height (Rise) in Feet	H (Rise) =		ft
Barrel Width (Span) in Feet	W (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	# Barrels =	1	
Inlet Elevation	Elev IN =	7050	ft
Outlet Elevation **OR** Slope	Elev OUT =	7049.7	ft
Culvert Length	L =	30	ft
Manning's Roughness	n =	0.012	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	$Y_{t,\ Elevation}$ =		ft
Max Allowable Channel Velocity	V =	5	ft/s

Calculated Results:

Culvert Cross Sectional Area Available	A =	7.07	ft^2
Culvert Normal Depth	Y_n =	1.89	ft
Culvert Critical Depth	Y_c =	2.35	ft
Froude Number	Fr =	1.55	**Supercritical!**
Entrance Loss Coefficient	k_e =	0.50	
Friction Loss Coefficient	k_f =	0.18	
Sum of All Loss Coefficients	k_s =	1.68	ft
Headwater:			
Inlet Control Headwater	HW_I =	4.17	ft
Outlet Control Headwater	HW_O =	3.81	ft
Design Headwater Elevation	**HW =**	**7054.17**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**1.39**	
Outlet Protection:			
Flow/(Diameter^2.5)	Q/D^2.5 =	3.36	$ft^{0.5}/s$
Tailwater Surface Height	Y_t =	1.20	ft
Tailwater/Diameter	Yt/D =	0.40	
Expansion Factor	1/(2*tan(Θ)) =	4.07	
Flow Area at Max Channel Velocity	A_t =	10.46	ft^2
Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	-	ft
Length of Riprap Protection	**L_p =**	**24**	**ft**
Width of Riprap Protection at Downstream End	**T =**	**9**	**ft**
Adjusted Diameter for Supercritical Flow	Da =	2.44	ft
Minimum Theoretical Riprap Size	d_{50} min=	9	in
Nominal Riprap Size	d_{50} nominal=	9	in
MHFD Riprap Type	**Type =**	**L**	

Detention Facility Analysis

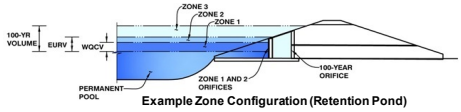
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Latigo Trails

Basin ID: South Pond

Watershed updated to values established by this report. See later in the appendix for original calculations for comparison



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	237.10	acres
Watershed Length =	4,610	ft
Watershed Length to Centroid =	1,845	ft
Watershed Slope =	0.035	ft/ft
Watershed Imperviousness =	13.30%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	1.676	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	3.032	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 0.93 in.) =	1.627	acre-feet	0.93 inches
5-yr Runoff Volume (P1 = 1.21 in.) =	3.639	acre-feet	1.21 inches
10-yr Runoff Volume (P1 = 1.46 in.) =	6.817	acre-feet	1.46 inches
25-yr Runoff Volume (P1 = 1.83 in.) =	15.350	acre-feet	1.83 inches
50-yr Runoff Volume (P1 = 2.14 in.) =	21.061	acre-feet	2.14 inches
100-yr Runoff Volume (P1 = 2.47 in.) =	28.847	acre-feet	2.47 inches
500-yr Runoff Volume (P1 = 3.33 in.) =	45.905	acre-feet	3.33 inches
Approximate 2-yr Detention Volume =	1.558	acre-feet	
Approximate 5-yr Detention Volume =	2.464	acre-feet	
Approximate 10-yr Detention Volume =	4.712	acre-feet	
Approximate 25-yr Detention Volume =	6.876	acre-feet	
Approximate 50-yr Detention Volume =	7.525	acre-feet	
Approximate 100-yr Detention Volume =	9.842	acre-feet	

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	1.676	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.356	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	6.810	acre-feet
Total Detention Basin Volume =	9.842	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

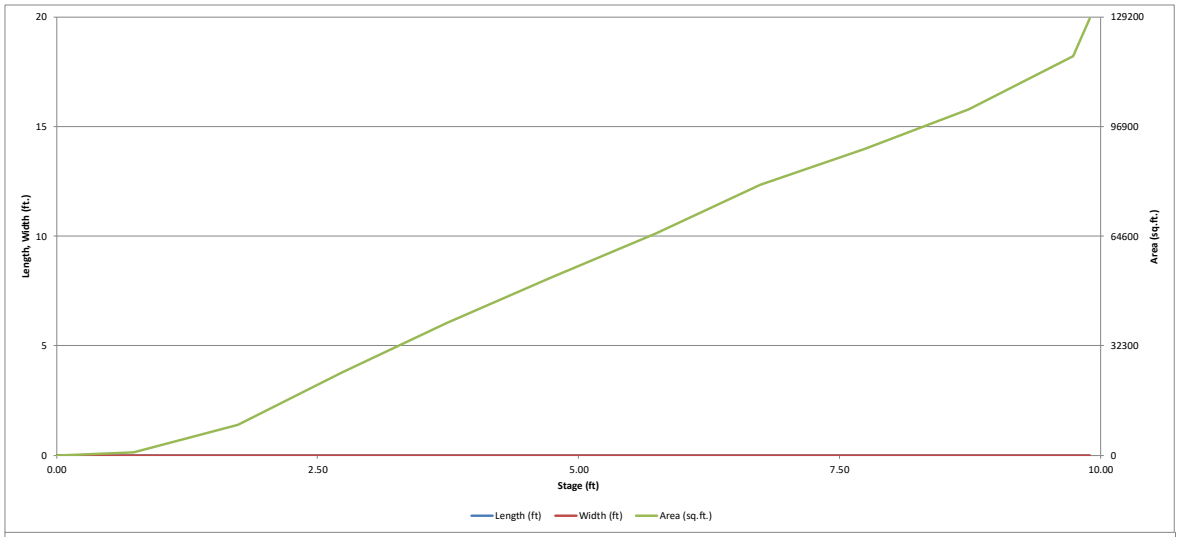
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user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

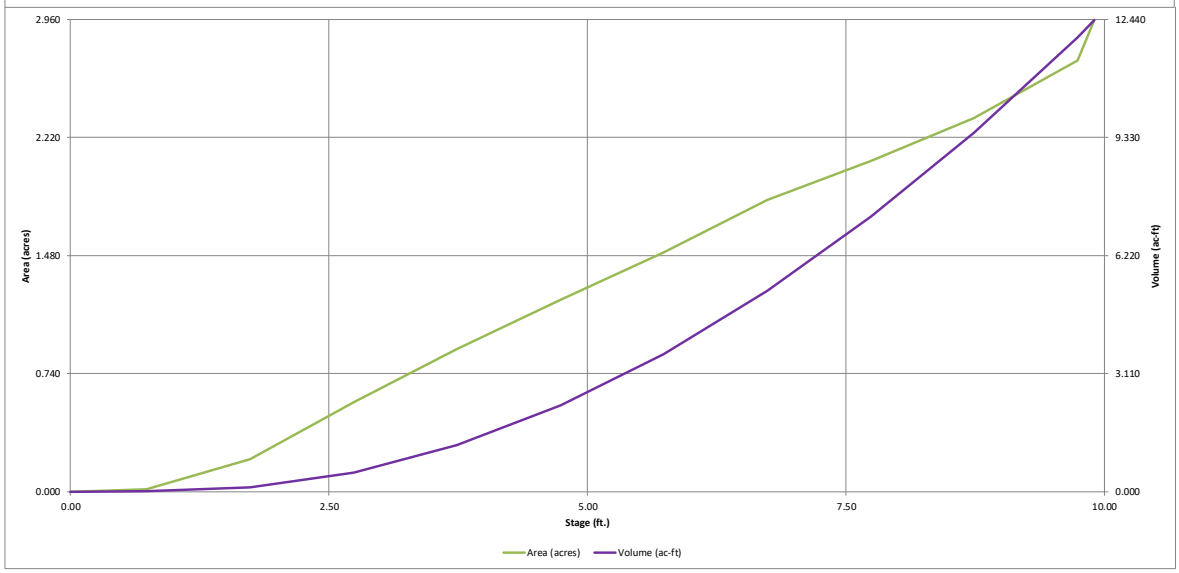
Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	0	0.000		
7088	--	0.74	--	--	--	757	0.017	280	0.006
7089	--	1.74	--	--	--	8,862	0.203	5,089	0.117
7090	--	2.74	--	--	--	24,382	0.560	21,711	0.498
7091	--	3.74	--	--	--	39,017	0.896	53,411	1.226
7092	--	4.74	--	--	--	52,356	1.202	99,097	2.275
7093	--	5.74	--	--	--	65,385	1.501	157,968	3.626
7094	--	6.74	--	--	--	79,696	1.830	230,508	5.292
7095	--	7.74	--	--	--	90,272	2.072	315,492	7.243
7096	--	8.74	--	--	--	102,009	2.342	411,633	9.450
7097	--	9.74	--	--	--	117,693	2.702	521,484	11.972
7097.16	--	9.90	--	--	--	128,850	2.958	541,207	12.424

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)





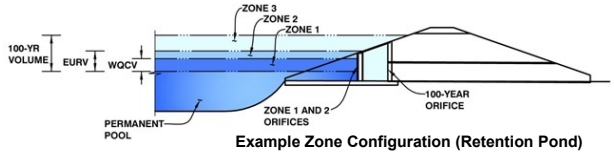
DETENTION BASIN OUTLET STRUCTURE DES

MHFD-Detention, Version 4.06 (July 2022)

Watershed updated to values established by this report. See later in the appendix for original calculations for comparison. No changes made to pond structures.

Project: Latigo Trails

Basin ID: South Pond



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	4.21	1.676	Orifice Plate
Zone 2 (EURV)	5.33	1.356	Rectangular Orifice
Zone 3 (100-year)	8.91	6.810	Weir&Pipe (Rect.)
Total (all zones)		9.842	

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

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

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft²
Depth at top of Zone using Orifice Plate =	4.26	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	ft²

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.00	0.00	0.50	0.50	0.50	1.00	1.00
Orifice Area (sq. inches)	1.11	1.11	1.11	1.00	1.00	1.00	1.00	1.00

	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)	1.00							
Orifice Area (sq. inches)	1.00							

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected			Zone 2 Rectangular	Not Selected
Invert of Vertical Orifice =	3.98	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	10.42	N/A
Depth at top of Zone using Vertical Orifice =	5.42	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.63	N/A
Vertical Orifice Height =	15.00	N/A	inches			
Vertical Orifice Width =	100.00		inches			

Calculated Parameters for Vertical Orifi

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

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected
Overflow Weir Front Edge Height, Ho =	5.90	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	5.90	N/A
Overflow Weir Front Edge Length =	8.33	N/A	feet	Overflow Weir Slope Length =	5.84	N/A
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	1.41	N/A
Horiz. Length of Weir Sides =	5.84	N/A	feet	Overflow Grate Open Area w/o Debris =	33.86	N/A
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	33.86	N/A
Debris Clogging % =	0%	N/A	%			

Calculated Parameters for Overflow We

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

	Zone 3 Rectangular	Not Selected			Zone 3 Rectangular	Not Selected
Depth to Invert of Outlet Pipe =	0.33	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	24.00	N/A
Rectangular Orifice Width =	96.00	N/A	inches	Outlet Orifice Centroid =	1.50	N/A
Rectangular Orifice Height =	36.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.90	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.96	feet
Spillway Crest Length =	120.00	feet	Stage at Top of Freeboard =	9.86	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	2.89	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	12.31	acre-ft

Calculated Parameters for Spillway

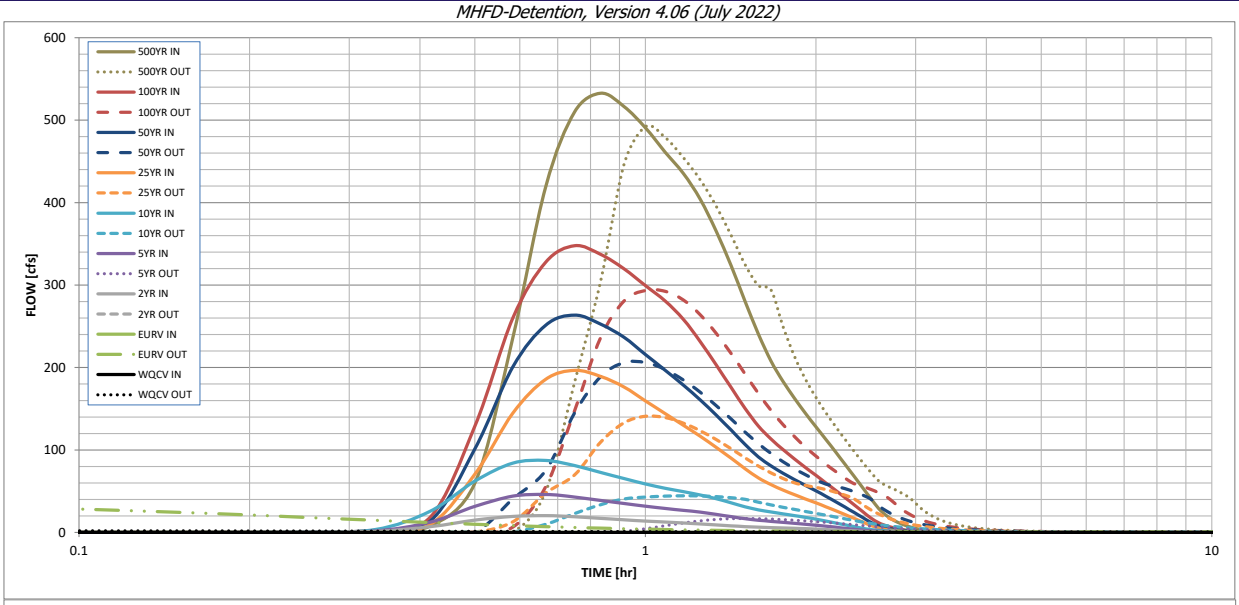
Routed Hydrograph Results

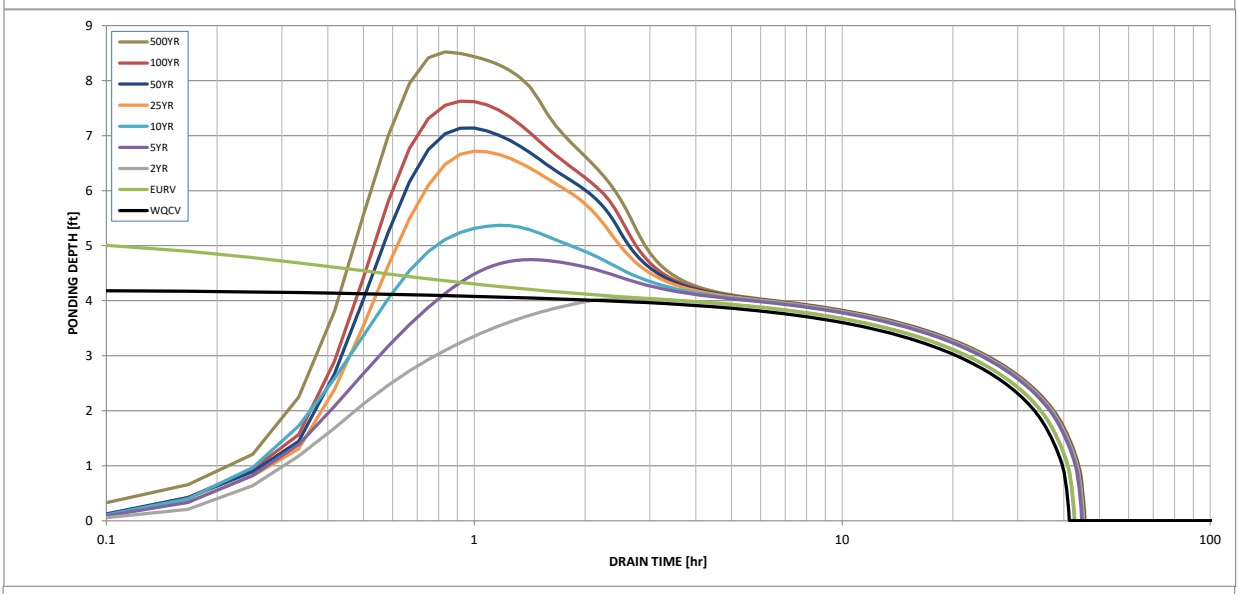
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF)

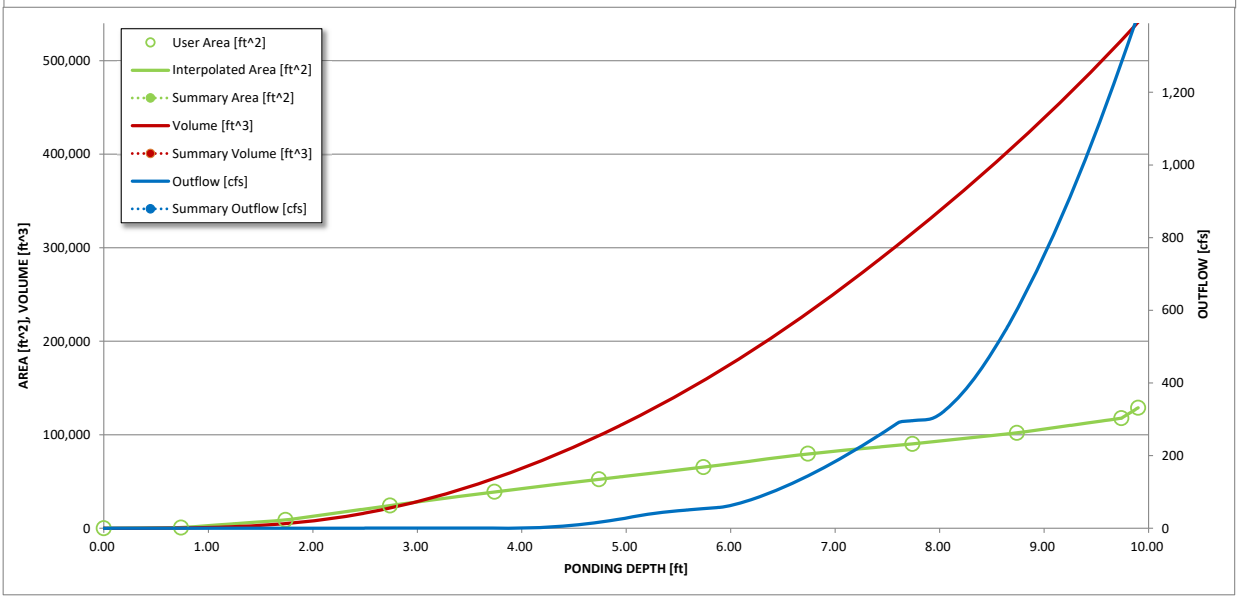
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.93	1.21	1.46	1.83	2.14	2.47
CUHP Runoff Volume (acre-ft) =	1.676	3.032	1.627	3.639	6.817	15.350	21.061	28.847
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	1.627	3.639	6.817	15.350	21.061	28.847
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	2.9	22.0	62.0	170.2	236.2	317.9
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	0.26	0.72	1.00	1.34
Peak Inflow Q (cfs) =	N/A	N/A	20.4	46.1	87.3	196.7	263.6	347.7
Peak Outflow Q (cfs) =	2.3	40.1	0.7	17.0	44.5	140.9	206.1	293.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.8	0.7	0.8	0.9	0.9
Structure Controlling Flow =	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	2.0	3.7	6.1
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	38	39	39	36	29	25	20
Time to Drain 99% of Inflow Volume (hours) =	**40**	41	41	42	41	38	37	34
Maximum Ponding Depth (ft) =	4.21	5.33	4.03	4.75	5.37	6.72	7.14	7.63
Area at Maximum Ponding Depth (acres) =	1.04	1.38	0.98	1.20	1.39	1.82	1.92	2.04
Maximum Volume Stored (acre-ft) =	1.681	3.036	1.499	2.275	3.078	5.237	6.024	6.996

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.

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.20
	0:15:00	0.00	0.00	0.20	0.44	0.61	0.47	0.67	0.68	1.29
	0:20:00	0.00	0.00	1.22	1.88	3.47	1.73	2.21	2.82	7.76
	0:25:00	0.00	0.00	6.95	12.43	25.59	9.69	13.71	18.26	59.83
	0:30:00	0.00	0.00	14.97	31.60	62.30	70.75	101.25	128.80	235.82
	0:35:00	0.00	0.00	19.47	44.02	84.10	144.56	200.56	259.90	419.11
	0:40:00	0.00	0.00	20.44	46.12	87.25	185.71	251.37	327.71	510.00
	0:45:00	0.00	0.00	19.08	42.96	81.13	196.65	263.59	347.67	532.59
	0:50:00	0.00	0.00	17.11	38.77	72.75	189.23	252.65	337.16	516.55
	0:55:00	0.00	0.00	15.36	35.21	65.46	176.42	236.65	319.74	490.71
	1:00:00	0.00	0.00	13.79	31.83	58.82	159.58	215.76	299.33	461.28
	1:05:00	0.00	0.00	12.63	29.09	53.62	144.15	196.79	280.76	435.36
	1:10:00	0.00	0.00	11.53	26.90	49.45	130.00	178.75	258.52	403.98
	1:15:00	0.00	0.00	10.37	24.59	45.43	116.59	160.65	231.37	365.63
	1:20:00	0.00	0.00	9.21	21.95	41.02	103.27	142.36	203.29	323.51
	1:25:00	0.00	0.00	8.07	19.18	35.96	90.08	124.15	175.75	280.23
	1:30:00	0.00	0.00	7.08	16.68	31.10	77.32	106.66	150.40	240.63
	1:35:00	0.00	0.00	6.39	14.86	27.48	66.17	91.67	129.02	207.81
	1:40:00	0.00	0.00	5.90	13.50	24.86	57.97	80.74	113.27	183.12
	1:45:00	0.00	0.00	5.47	12.23	22.57	51.42	71.87	100.47	162.71
	1:50:00	0.00	0.00	5.07	11.03	20.44	45.78	64.13	89.15	144.59
	1:55:00	0.00	0.00	4.62	9.88	18.32	40.67	57.10	78.88	128.13
	2:00:00	0.00	0.00	4.13	8.76	16.14	35.92	50.56	69.33	112.78
	2:05:00	0.00	0.00	3.59	7.58	13.86	31.17	43.94	60.03	97.62
	2:10:00	0.00	0.00	3.02	6.35	11.54	26.44	37.29	51.06	82.81
	2:15:00	0.00	0.00	2.46	5.15	9.28	21.80	30.79	42.41	68.56
	2:20:00	0.00	0.00	1.92	4.00	7.12	17.24	24.42	33.86	54.64
	2:25:00	0.00	0.00	1.42	2.91	5.10	12.77	18.20	25.47	41.15
	2:30:00	0.00	0.00	1.01	2.00	3.49	8.49	12.26	17.43	28.85
	2:35:00	0.00	0.00	0.75	1.44	2.54	5.35	8.05	11.60	20.13
	2:40:00	0.00	0.00	0.60	1.14	2.01	3.50	5.53	7.97	14.42
	2:45:00	0.00	0.00	0.48	0.91	1.61	2.37	3.89	5.48	10.30
	2:50:00	0.00	0.00	0.40	0.73	1.29	1.61	2.74	3.68	7.23
	2:55:00	0.00	0.00	0.33	0.57	1.02	1.12	1.95	2.40	4.95
	3:00:00	0.00	0.00	0.27	0.45	0.80	0.79	1.39	1.49	3.27
	3:05:00	0.00	0.00	0.22	0.35	0.61	0.55	0.99	0.91	2.13
	3:10:00	0.00	0.00	0.18	0.27	0.46	0.40	0.74	0.64	1.52
	3:15:00	0.00	0.00	0.14	0.20	0.34	0.30	0.57	0.50	1.14
	3:20:00	0.00	0.00	0.12	0.16	0.26	0.22	0.43	0.40	0.89
	3:25:00	0.00	0.00	0.09	0.12	0.19	0.16	0.33	0.31	0.70
	3:30:00	0.00	0.00	0.07	0.09	0.14	0.12	0.25	0.24	0.53
	3:35:00	0.00	0.00	0.05	0.06	0.10	0.09	0.18	0.17	0.39
	3:40:00	0.00	0.00	0.03	0.04	0.07	0.06	0.13	0.12	0.27
	3:45:00	0.00	0.00	0.02	0.03	0.04	0.04	0.08	0.08	0.17
	3:50:00	0.00	0.00	0.01	0.01	0.02	0.02	0.04	0.04	0.09
	3:55:00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.04
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

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

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

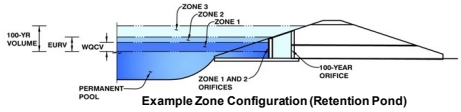
Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Latigo Trails

Basin ID: Pond G14b



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	38.85	acres
Watershed Length =	1,625	ft
Watershed Length to Centroid =	500	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	15.16%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	0.305	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	0.572	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 0.93 in.) =	0.314	acre-feet	0.93 inches
5-yr Runoff Volume (P1 = 1.21 in.) =	0.660	acre-feet	1.21 inches
10-yr Runoff Volume (P1 = 1.46 in.) =	1.188	acre-feet	1.46 inches
25-yr Runoff Volume (P1 = 1.83 in.) =	2.577	acre-feet	1.83 inches
50-yr Runoff Volume (P1 = 2.14 in.) =	3.512	acre-feet	2.14 inches
100-yr Runoff Volume (P1 = 2.47 in.) =	4.779	acre-feet	2.47 inches
500-yr Runoff Volume (P1 = 3.33 in.) =	7.565	acre-feet	3.33 inches
Approximate 2-yr Detention Volume =	0.298	acre-feet	
Approximate 5-yr Detention Volume =	0.466	acre-feet	
Approximate 10-yr Detention Volume =	0.851	acre-feet	
Approximate 25-yr Detention Volume =	1.213	acre-feet	
Approximate 50-yr Detention Volume =	1.330	acre-feet	
Approximate 100-yr Detention Volume =	1.723	acre-feet	

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.305	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.268	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.151	acre-feet
Total Detention Basin Volume =	1.723	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

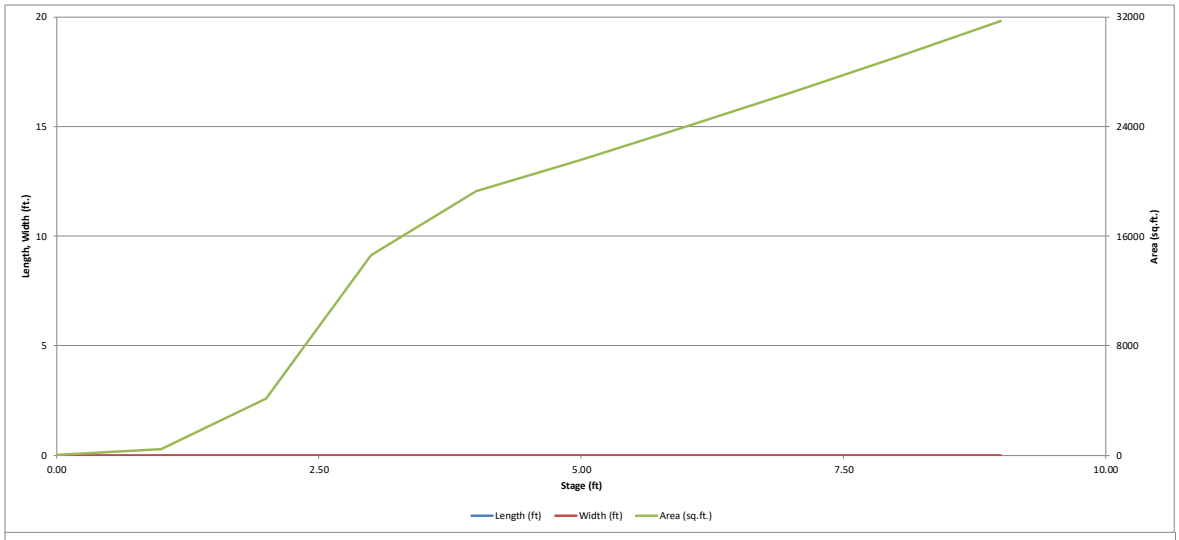
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user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

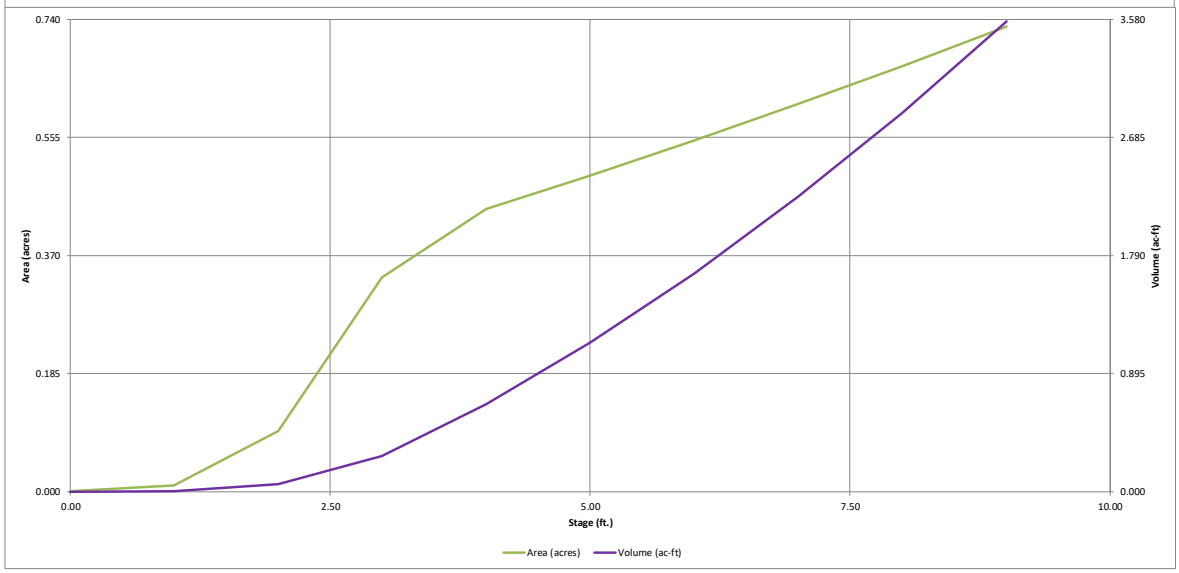
Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	40	0.001		
7061	--	1.00	--	--	--	422	0.010	231	0.005
7062	--	2.00	--	--	--	4,127	0.095	2,505	0.058
7063	--	3.00	--	--	--	14,619	0.336	11,878	0.273
7064	--	4.00	--	--	--	19,295	0.443	28,835	0.662
7065	--	5.00	--	--	--	21,586	0.496	49,276	1.131
7066	--	6.00	--	--	--	23,976	0.550	72,057	1.654
7067	--	7.00	--	--	--	26,466	0.608	97,278	2.233
7068	--	8.00	--	--	--	29,053	0.667	125,037	2.870
7069	--	9.00	--	--	--	31,757	0.729	155,442	3.568

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)





✓ = calcs match details in plans

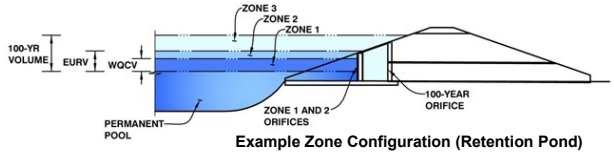
X = calcs do not match details in plans

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Latigo Trails

Basin ID: Pond G14b



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.10	0.305	Orifice Plate
Zone 2 (EURV)	3.80	0.268	Orifice Plate
Zone 3 (100-year)	6.13	1.151	Weir&Pipe (Restrict)
Total (all zones)		1.723	

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

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

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	1.125E-02	ft²
Depth at top of Zone using Orifice Plate =	3.80	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 =	1.62	sq. inches (diameter = 1-7/16 inches)	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
✓ Stage of Orifice Centroid (ft)	0.00	2.65						
✓ Orifice Area (sq. inches)	1.62	1.62						

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifi

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

	Zone 3 Weir	Not Selected				
X Overflow Weir Front Edge Height, Ho =	3.81	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	3.81	N/A
X Overflow Weir Front Edge Length =	5.00	N/A	feet	Overflow Weir Slope Length =	5.00	N/A
✓ Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	9.15	N/A
✓ Horiz. Length of Weir Sides =	5.00	N/A	feet	Overflow Grate Open Area w/o Debris =	17.40	N/A
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	8.70	N/A
Debris Clogging % =	50%	N/A	%			

Calculated Parameters for Overflow We

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

	Zone 3 Restrictor	Not Selected				
✓ Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	1.90	N/A
✓ Outlet Pipe Diameter =	24.00	N/A	inches	Outlet Orifice Centroid =	0.66	N/A
✓ Restrictor Plate Height Above Pipe Invert =	14.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.74	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

✓ Spillway Invert Stage=	7.20	ft (relative to basin bottom at Stage = 0 ft)	✓ Spillway Design Flow Depth=	0.79	feet
✓ Spillway Crest Length =	30.00	feet	Stage at Top of Freeboard =	8.99	feet
✓ Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.73	acres
✓ Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	3.56	acre-ft

Calculated Parameters for Spillway

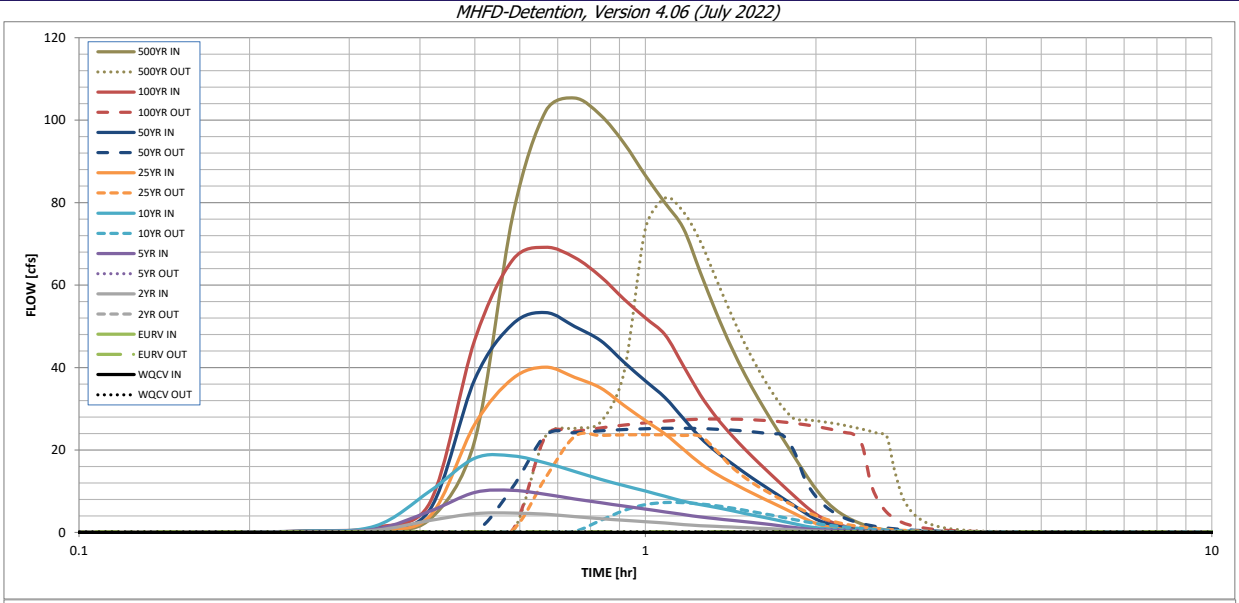
Routed Hydrograph Results

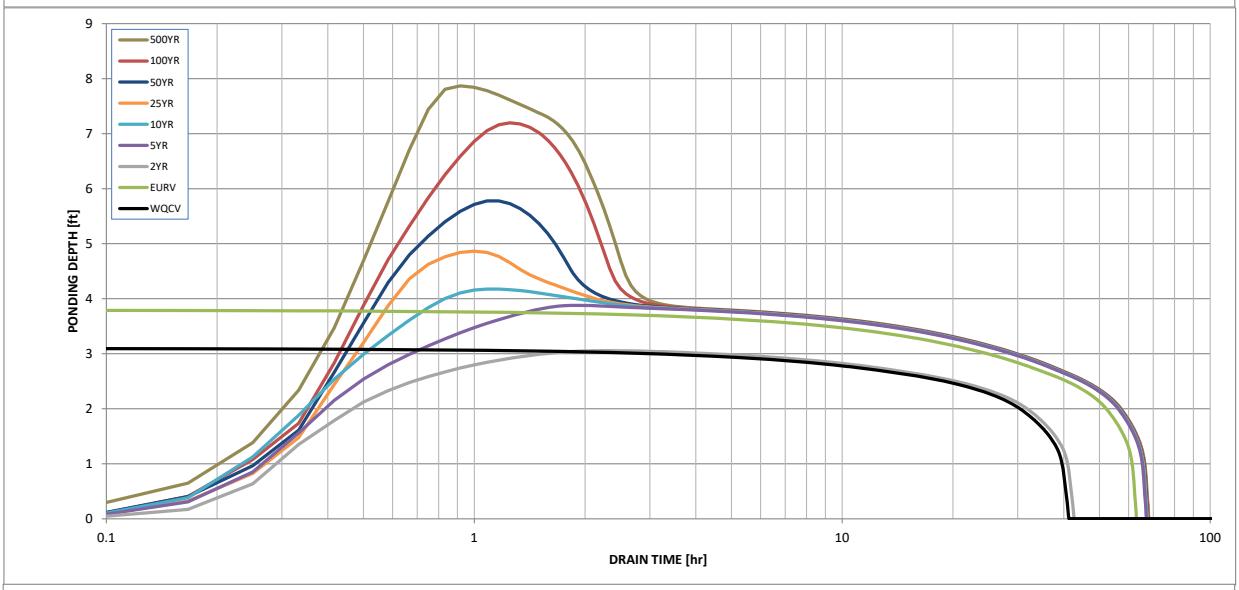
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF)

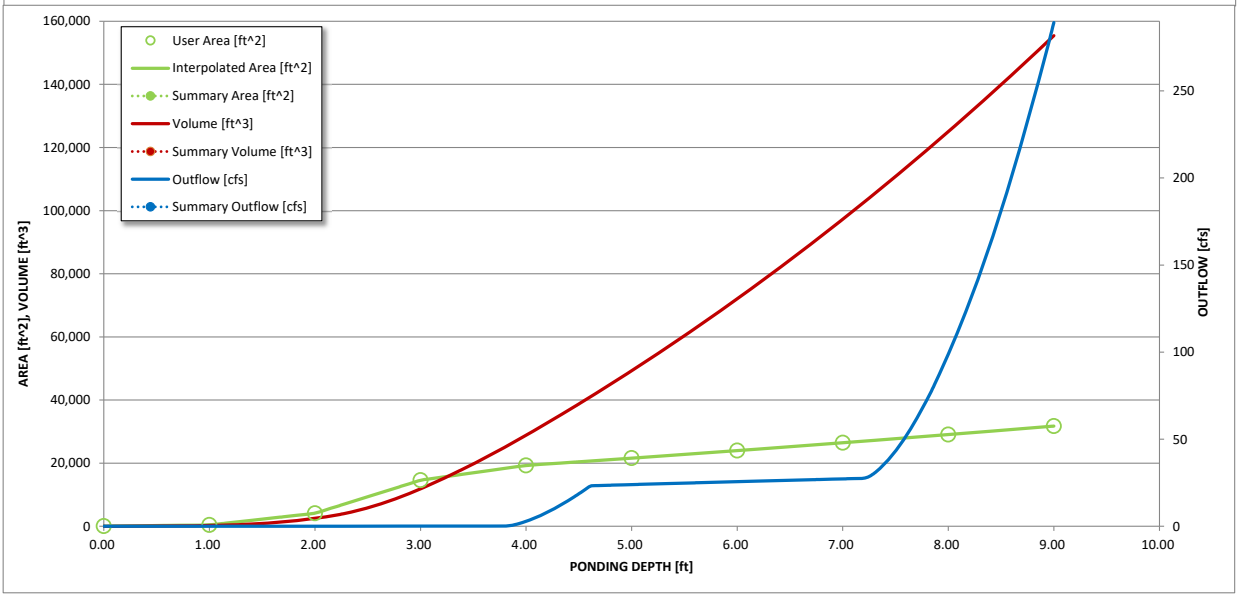
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.93	1.21	1.46	1.83	2.14	2.47
CUHP Runoff Volume (acre-ft) =	0.305	0.572	0.314	0.660	1.188	2.577	3.512	4.779
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.314	0.660	1.188	2.577	3.512	4.779
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.6	4.7	12.8	34.2	47.3	62.9
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.12	0.33	0.88	1.22	1.62
Peak Inflow Q (cfs) =	N/A	N/A	4.7	10.2	18.6	40.1	53.3	69.2
Peak Outflow Q (cfs) =	0.1	0.2	0.1	0.7	7.3	23.7	25.3	27.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.2	0.6	0.7	0.5	0.4
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.0	0.4	1.4	1.4	1.6
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
✓ Time to Drain 97% of Inflow Volume (hours) =	39	59	40	63	60	54	50	44
✓ Time to Drain 99% of Inflow Volume (hours) =	**40**	61	42	65	64	62	61	59
Maximum Ponding Depth (ft) =	3.10	3.80	3.05	3.88	4.17	4.86	5.78	7.19
Area at Maximum Ponding Depth (acres) =	0.35	0.42	0.34	0.43	0.45	0.49	0.54	0.62
Maximum Volume Stored (acre-ft) =	0.307	0.576	0.290	0.605	0.738	1.062	1.529	2.350

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.

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.10
	0:15:00	0.00	0.00	0.10	0.23	0.32	0.25	0.34	0.35	0.58
	0:20:00	0.00	0.00	0.56	0.80	1.55	0.70	0.87	1.25	3.23
	0:25:00	0.00	0.00	2.92	5.16	10.05	4.00	5.62	7.30	22.37
	0:30:00	0.00	0.00	4.57	9.74	18.04	26.27	37.21	46.78	76.82
	0:35:00	0.00	0.00	4.71	10.23	18.56	37.34	50.58	66.12	102.18
	0:40:00	0.00	0.00	4.42	9.27	16.85	40.10	53.34	69.17	105.36
	0:45:00	0.00	0.00	3.84	8.14	14.82	37.63	49.96	66.68	101.22
	0:50:00	0.00	0.00	3.34	7.23	12.90	35.05	46.54	62.07	94.43
	0:55:00	0.00	0.00	2.95	6.41	11.37	30.81	41.28	56.57	86.56
	1:00:00	0.00	0.00	2.62	5.69	10.05	27.13	36.75	52.03	79.91
	1:05:00	0.00	0.00	2.30	5.00	8.78	23.90	32.70	47.93	73.78
	1:10:00	0.00	0.00	1.93	4.35	7.58	20.18	27.66	40.46	63.11
	1:15:00	0.00	0.00	1.66	3.78	6.76	16.76	23.04	33.39	53.41
	1:20:00	0.00	0.00	1.48	3.34	6.09	14.22	19.61	28.00	45.07
	1:25:00	0.00	0.00	1.32	2.96	5.33	12.22	16.87	23.74	38.25
	1:30:00	0.00	0.00	1.17	2.61	4.61	10.43	14.43	20.15	32.46
	1:35:00	0.00	0.00	1.03	2.28	3.95	8.81	12.21	16.98	27.34
	1:40:00	0.00	0.00	0.90	1.91	3.31	7.34	10.20	14.06	22.66
	1:45:00	0.00	0.00	0.76	1.54	2.70	5.94	8.28	11.33	18.28
	1:50:00	0.00	0.00	0.63	1.20	2.12	4.58	6.44	8.78	14.20
	1:55:00	0.00	0.00	0.48	0.89	1.55	3.30	4.71	6.43	10.54
	2:00:00	0.00	0.00	0.39	0.69	1.17	2.19	3.25	4.43	7.63
	2:05:00	0.00	0.00	0.31	0.55	0.92	1.48	2.28	3.09	5.53
	2:10:00	0.00	0.00	0.24	0.43	0.73	1.02	1.62	2.17	4.01
	2:15:00	0.00	0.00	0.20	0.34	0.58	0.72	1.17	1.50	2.86
	2:20:00	0.00	0.00	0.16	0.27	0.46	0.51	0.84	1.02	2.01
	2:25:00	0.00	0.00	0.12	0.21	0.36	0.37	0.61	0.67	1.38
	2:30:00	0.00	0.00	0.10	0.16	0.27	0.26	0.44	0.43	0.91
	2:35:00	0.00	0.00	0.08	0.12	0.20	0.19	0.32	0.28	0.62
	2:40:00	0.00	0.00	0.06	0.09	0.15	0.14	0.23	0.21	0.45
	2:45:00	0.00	0.00	0.05	0.07	0.11	0.10	0.18	0.16	0.34
	2:50:00	0.00	0.00	0.04	0.05	0.08	0.08	0.14	0.13	0.27
	2:55:00	0.00	0.00	0.03	0.04	0.06	0.06	0.10	0.10	0.21
	3:00:00	0.00	0.00	0.02	0.03	0.04	0.04	0.08	0.07	0.15
	3:05:00	0.00	0.00	0.01	0.02	0.03	0.03	0.05	0.05	0.11
	3:10:00	0.00	0.00	0.01	0.01	0.02	0.02	0.04	0.03	0.07
	3:15:00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.04
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	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

G14b FOREBAY VOLUME

Req'd V=3% x WQCV

WQCV=	0.286	ac-ft
V=	0.0086	ac-ft
Actual V	0.0087	ac-ft

FOREBAY RELEASE NOTCH WIDTH

$Q=CLH^{3/2}$

Q_{100}=	61.9	cfs		
2% of Q=	1.24	cfs		
C=	2.6			
H (height of forebay wall)=	1	ft		
L=	0.48	ft		
	5.7	in	3	in min.
			6	in required

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, Nov 18 2024

Pond G14b

Rectangular

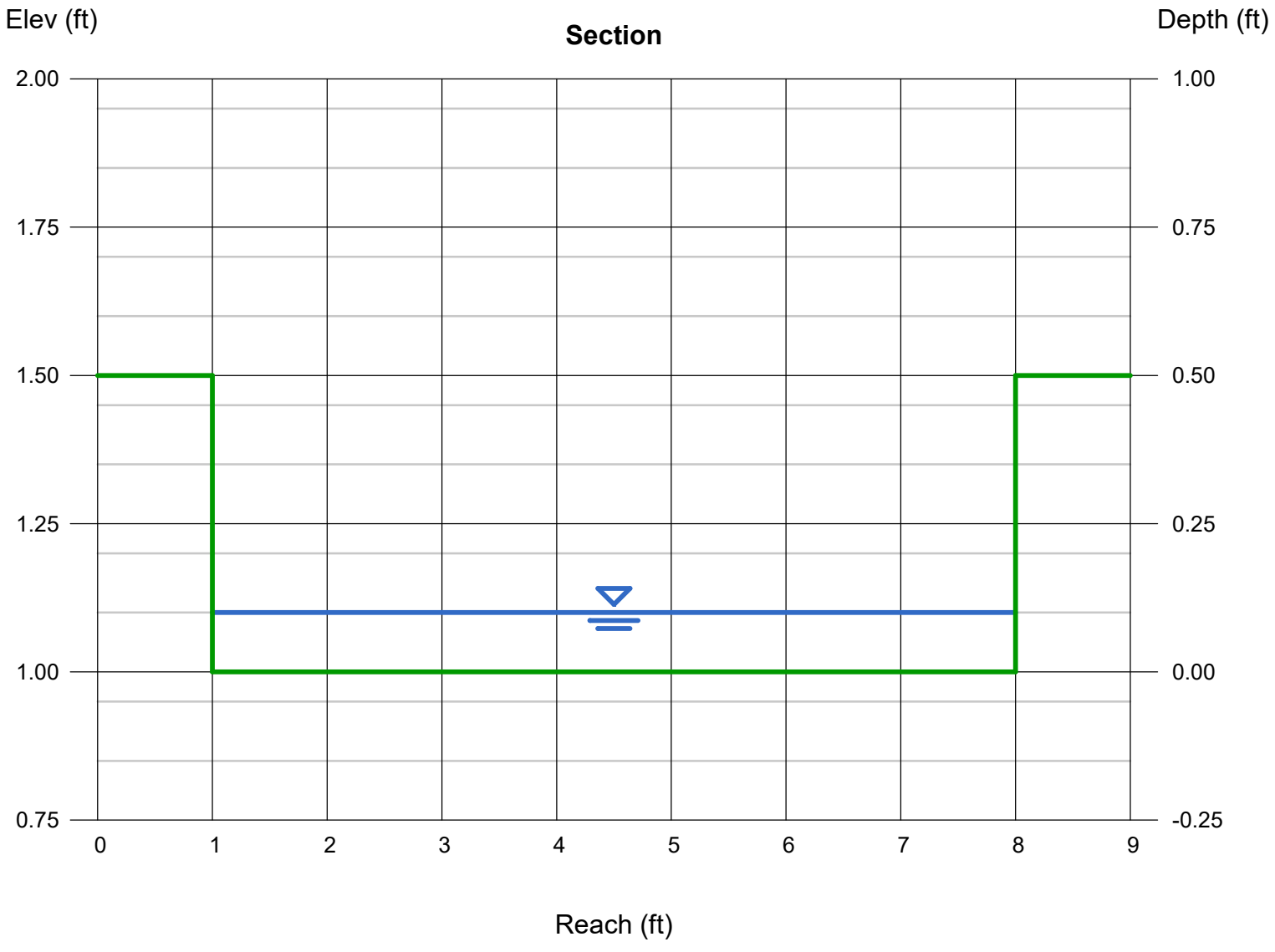
Bottom Width (ft)	= 7.00
Total Depth (ft)	= 0.50
Invert Elev (ft)	= 1.00
Slope (%)	= 0.50
N-Value	= 0.012

Calculations

Compute by:	Known Q
Known Q (cfs)	= 1.26 63.1 cfs x 2%

Highlighted

Depth (ft)	= 0.10
Q (cfs)	= 1.260
Area (sqft)	= 0.70
Velocity (ft/s)	= 1.80
Wetted Perim (ft)	= 7.20
Crit Depth, Yc (ft)	= 0.11
Top Width (ft)	= 7.00
EGL (ft)	= 0.15



Pond G14b

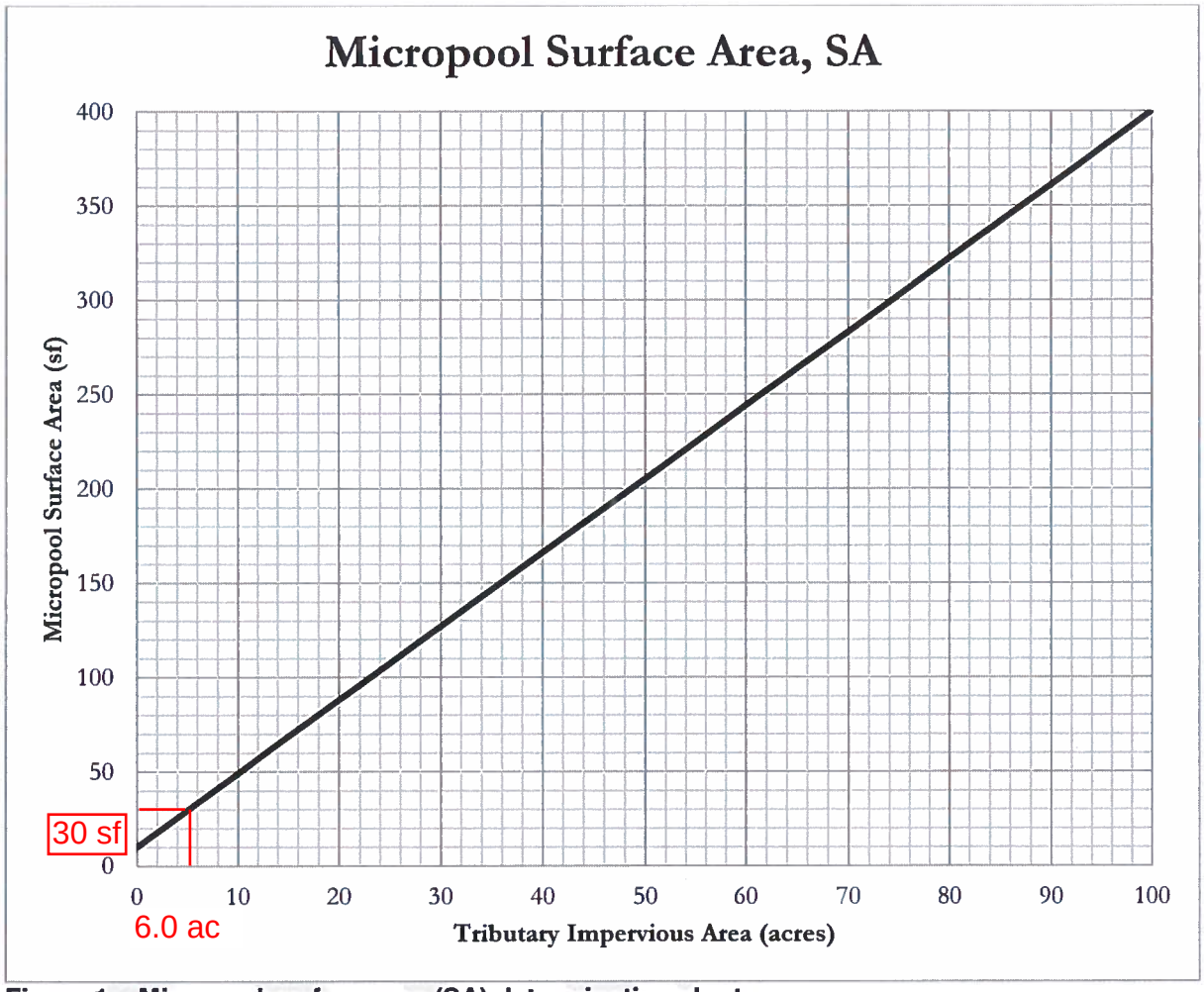


Figure 1 – Micropool surface area (SA) determination chart

The tributary impervious area is the effective number of impervious acres that will be treated by the extended detention basin (EDB). It is calculated by multiplying the tributary area to be treated by the impervious fraction of that area.

$$TIA = I \times A$$ = (14.7/100) x 40.57 ac = 6.0 ac

TIA = Tributary impervious area (acres)
I = Imperviousness (fraction)
A = Tributary catchment area upstream (acres)

For EDBs with tributary impervious areas greater than 100 acres, the micropool surface area is 400 sf. The initial surcharge depth (ISD) is defined as the depth of the initial surcharge volume (ISV). The surface area determined using Figure 1 assumes an ISD of 4 inches. The initial surcharge volume is thus calculated by multiplying the micropool surface area by 4 inches.

$$ISV = SA \times 4\ inches$$

ISV = Initial surcharge volume (cf)
SA = Surface area (from Figure 1, sf)

Figure 13-12c. Emergency Spillway Protection

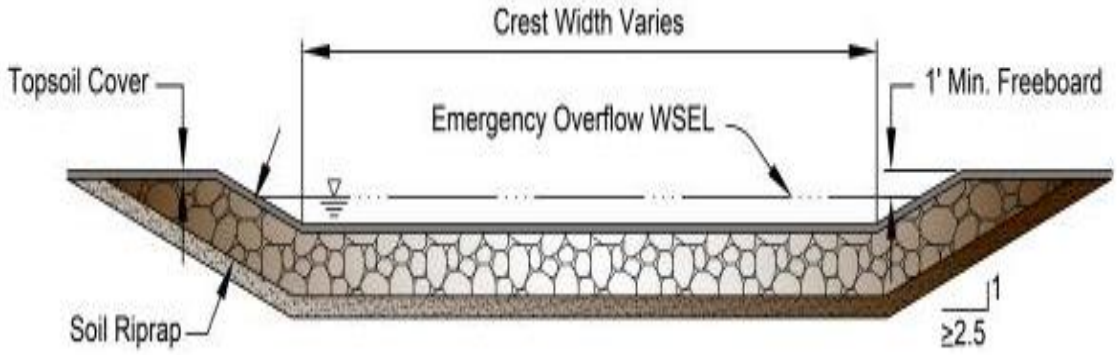
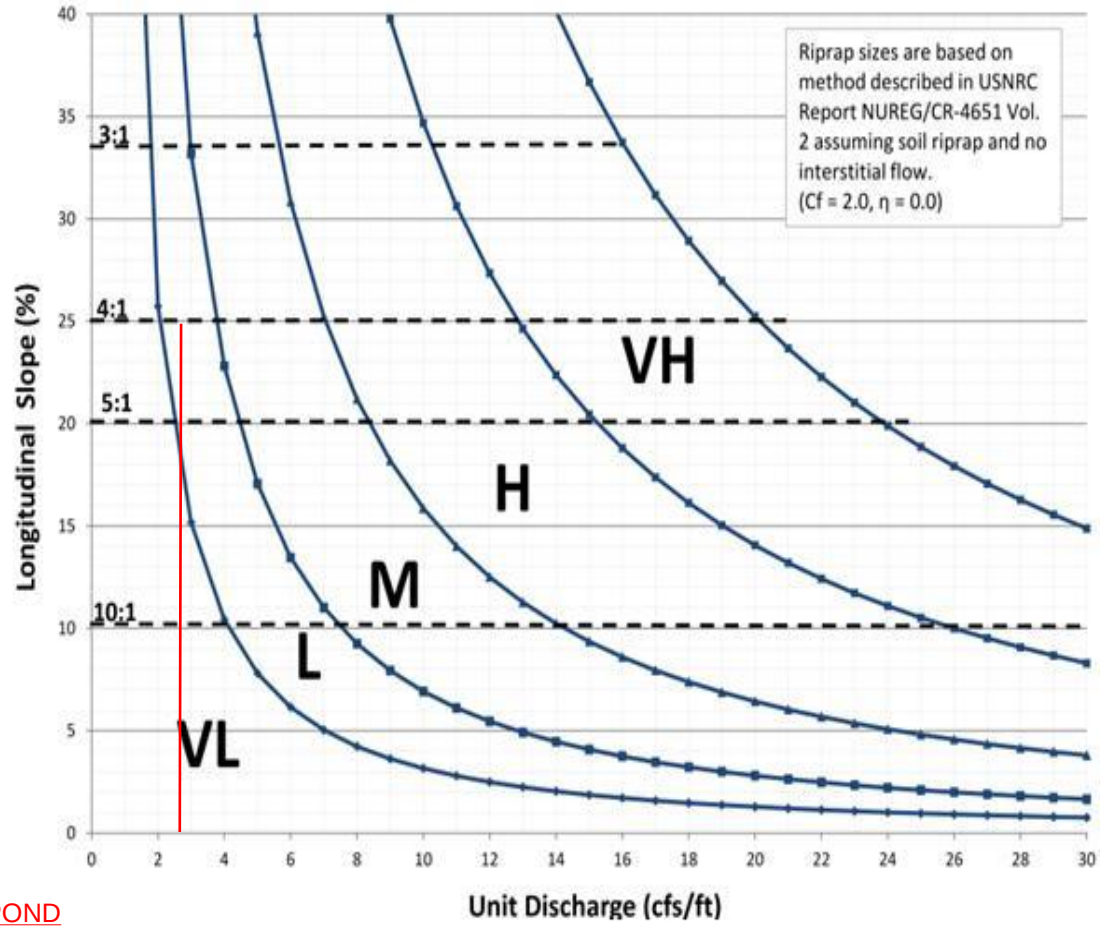


Figure 13-12d. Riprap Types for Emergency Spillway Protection



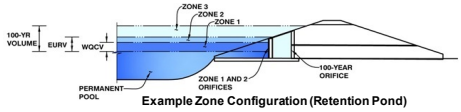
POND
UNIT DISCHARGE= 63.1/25=2.52cfs/ft

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Latigo Trails

Basin ID: Pond G18



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	23.45	acres
Watershed Length =	1,747	ft
Watershed Length to Centroid =	670	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	12.74%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	0.160	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	0.286	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 0.93 in.) =	0.152	acre-feet	0.93 inches
5-yr Runoff Volume (P1 = 1.21 in.) =	0.347	acre-feet	1.21 inches
10-yr Runoff Volume (P1 = 1.46 in.) =	0.659	acre-feet	1.46 inches
25-yr Runoff Volume (P1 = 1.83 in.) =	1.501	acre-feet	1.83 inches
50-yr Runoff Volume (P1 = 2.14 in.) =	2.064	acre-feet	2.14 inches
100-yr Runoff Volume (P1 = 2.47 in.) =	2.832	acre-feet	2.47 inches
500-yr Runoff Volume (P1 = 3.33 in.) =	4.514	acre-feet	3.33 inches
Approximate 2-yr Detention Volume =	0.146	acre-feet	
Approximate 5-yr Detention Volume =	0.232	acre-feet	
Approximate 10-yr Detention Volume =	0.452	acre-feet	
Approximate 25-yr Detention Volume =	0.664	acre-feet	
Approximate 50-yr Detention Volume =	0.726	acre-feet	
Approximate 100-yr Detention Volume =	0.953	acre-feet	

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.160	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.126	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.667	acre-feet
Total Detention Basin Volume =	0.953	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

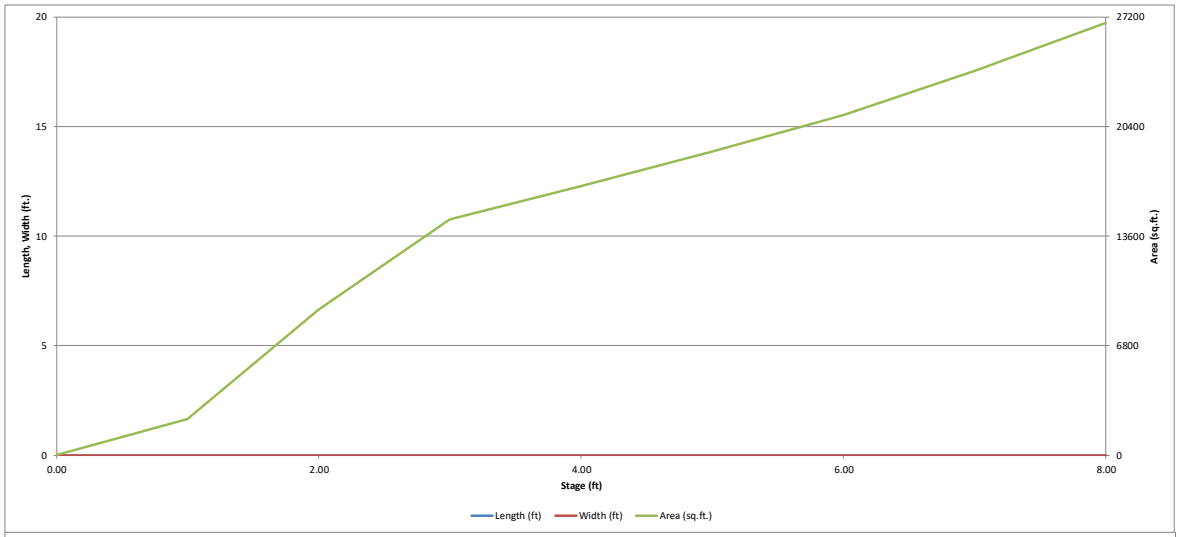
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user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

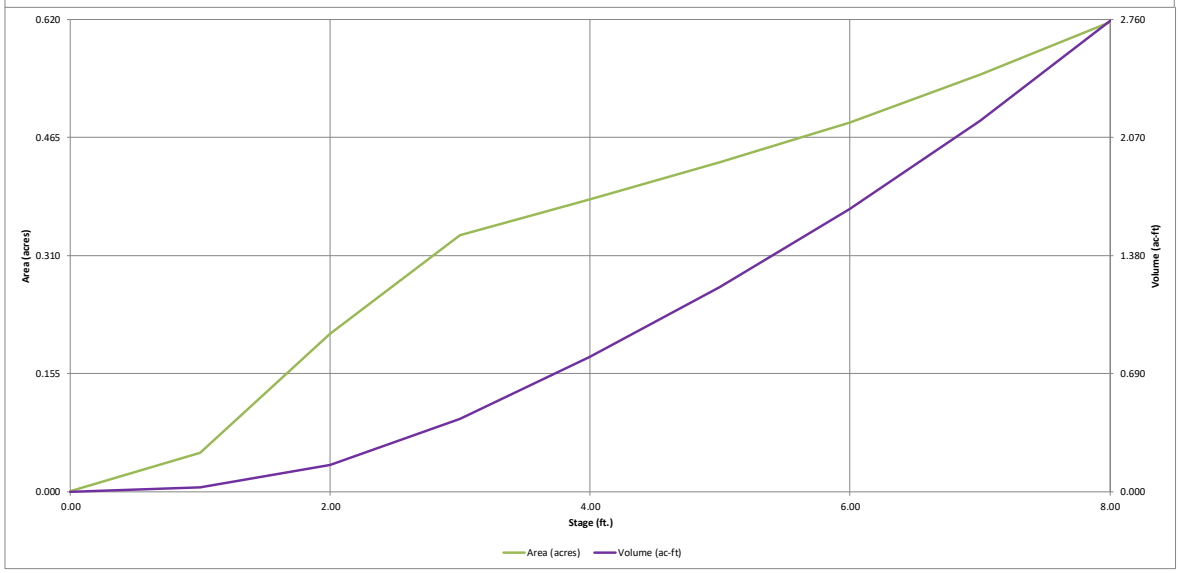
Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	40	0.001		
7051	--	1.00	--	--	--	2,242	0.051	1,141	0.026
7052	--	2.00	--	--	--	9,017	0.207	6,770	0.155
7053	--	3.00	--	--	--	14,650	0.336	18,604	0.427
7054	--	4.00	--	--	--	16,702	0.383	34,280	0.787
7055	--	5.00	--	--	--	18,853	0.433	52,057	1.195
7056	--	6.00	--	--	--	21,116	0.485	72,042	1.654
7057	--	7.00	--	--	--	23,858	0.548	94,529	2.170
7058	--	8.00	--	--	--	26,854	0.616	119,885	2.752

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



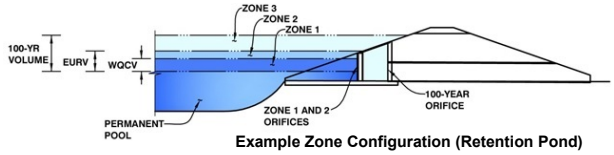


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Latigo Trails

Basin ID: Pond G18



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.03	0.160	Orifice Plate
Zone 2 (EURV)	2.55	0.126	Orifice Plate
Zone 3 (100-year)	4.43	0.667	Weir&Pipe (Restrict)
Total (all zones)		0.953	

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

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

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	8.681E-03	ft^2
Depth at top of Zone using Orifice Plate =	2.55	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 =	1.25	sq. inches (diameter = 1-1/4 inches)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	2.40						
Orifice Area (sq. inches)	1.25	1.25						

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifi

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

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected
Overflow Weir Front Edge Height, Ho =	2.56	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	2.56	N/A
Overflow Weir Front Edge Length =	4.00	N/A	feet	Overflow Weir Slope Length =	4.00	N/A
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	14.68	N/A
Horiz. Length of Weir Sides =	4.00	N/A	feet	Overflow Grate Open Area w/o Debris =	11.14	N/A
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	5.57	N/A
Debris Clogging % =	50%	N/A	%			

Calculated Parameters for Overflow We

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.76	N/A
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.39	N/A
Restrictor Plate Height Above Pipe Invert =	8.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.46	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.48	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.52	feet
Spillway Crest Length =	25.00	feet	Stage at Top of Freeboard =	8.00	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.62	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	2.75	acre-ft

Calculated Parameters for Spillway

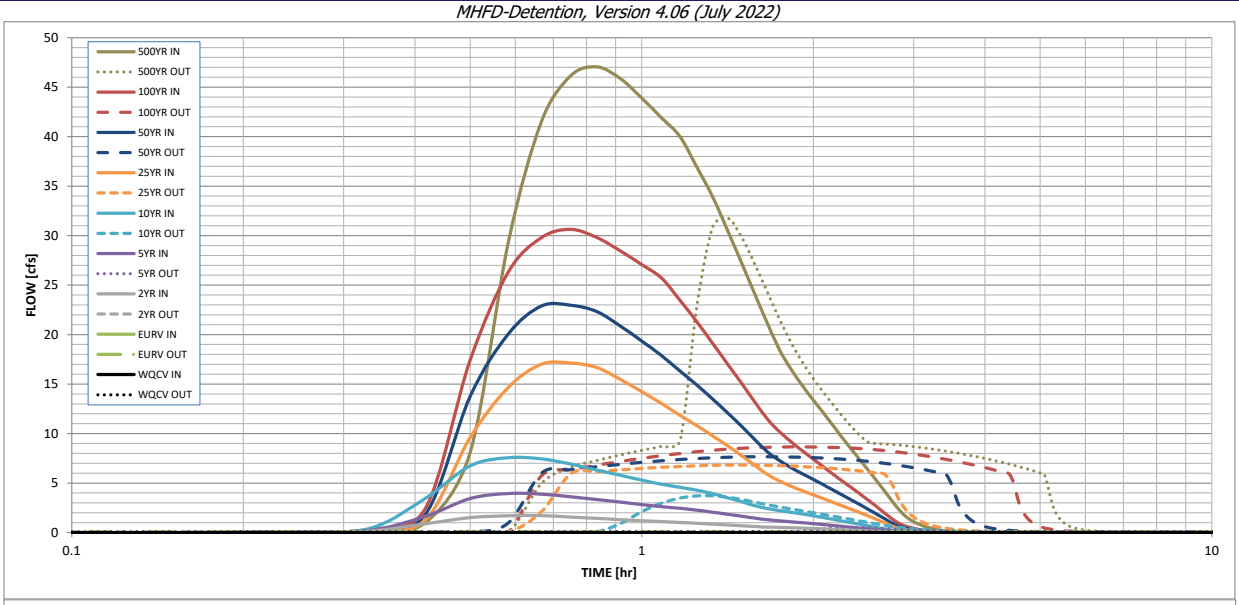
Routed Hydrograph Results

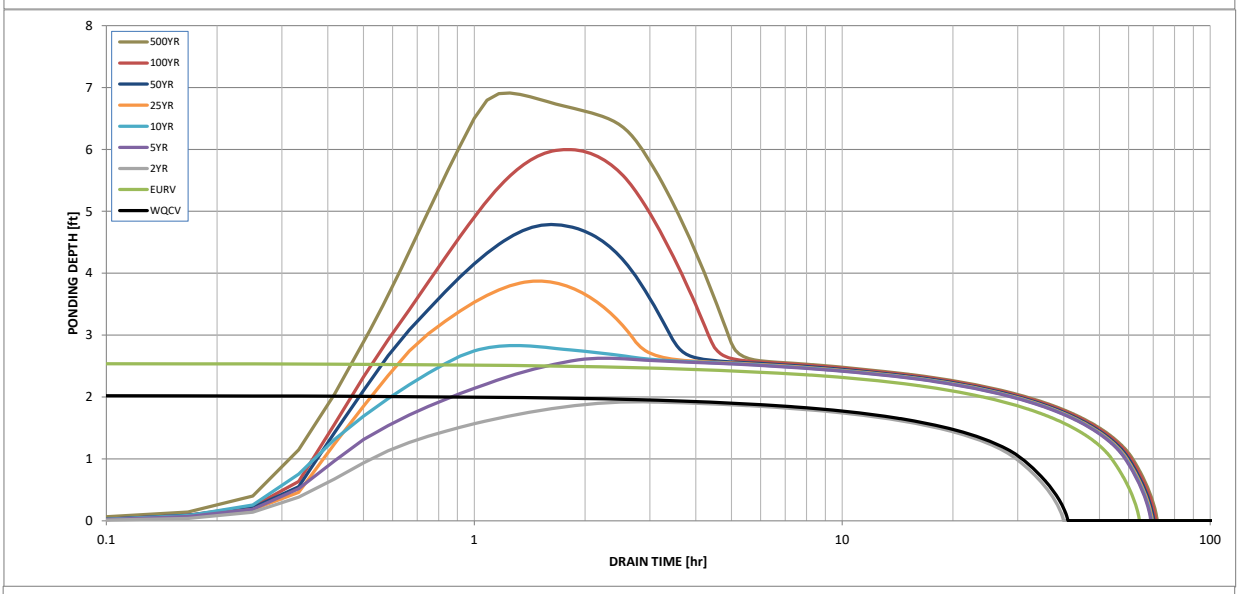
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF)

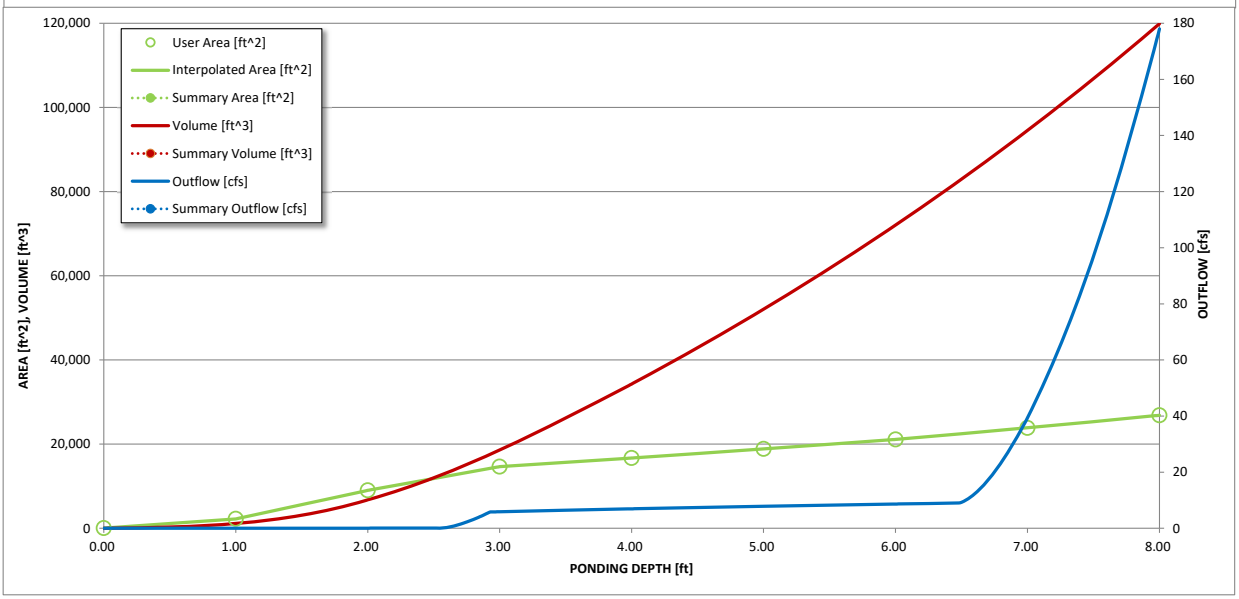
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.93	1.21	1.46	1.83	2.14	2.47
CUHP Runoff Volume (acre-ft) =	0.160	0.286	0.152	0.347	0.659	1.501	2.064	2.832
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.152	0.347	0.659	1.501	2.064	2.832
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.3	1.9	5.4	15.0	20.8	28.2
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.08	0.23	0.64	0.89	1.20
Peak Inflow Q (cfs) =	N/A	N/A	1.7	3.9	7.6	17.1	23.0	30.6
Peak Outflow Q (cfs) =	0.1	0.1	0.1	0.5	3.7	6.8	7.7	8.7
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.3	0.7	0.5	0.4	0.3
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.0	0.3	0.6	0.7	0.8
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	60	37	64	61	54	51	46
Time to Drain 99% of Inflow Volume (hours) =	**40**	62	39	67	66	63	62	60
Maximum Ponding Depth (ft) =	2.03	2.54	1.92	2.63	2.83	3.87	4.78	6.00
Area at Maximum Ponding Depth (acres) =	0.21	0.28	0.19	0.29	0.31	0.38	0.42	0.48
Maximum Volume Stored (acre-ft) =	0.162	0.286	0.139	0.309	0.369	0.738	1.101	1.649

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.

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
	0:15:00	0.00	0.00	0.03	0.06	0.08	0.07	0.09	0.09	0.16
	0:20:00	0.00	0.00	0.15	0.22	0.42	0.19	0.24	0.31	0.98
	0:25:00	0.00	0.00	0.88	1.63	3.44	1.24	1.79	2.39	8.10
	0:30:00	0.00	0.00	1.51	3.44	6.74	9.61	13.77	17.44	29.31
	0:35:00	0.00	0.00	1.69	3.95	7.56	14.66	20.06	26.31	41.50
	0:40:00	0.00	0.00	1.71	3.88	7.45	17.01	22.89	29.79	46.13
	0:45:00	0.00	0.00	1.57	3.61	6.92	17.13	22.97	30.63	47.04
	0:50:00	0.00	0.00	1.43	3.34	6.31	16.68	22.34	29.81	45.86
	0:55:00	0.00	0.00	1.31	3.08	5.79	15.47	20.87	28.46	43.91
	1:00:00	0.00	0.00	1.20	2.83	5.29	14.23	19.35	27.08	41.90
	1:05:00	0.00	0.00	1.11	2.61	4.88	13.04	17.88	25.71	40.01
	1:10:00	0.00	0.00	1.02	2.45	4.57	11.85	16.32	23.46	36.90
	1:15:00	0.00	0.00	0.94	2.27	4.27	10.80	14.89	21.28	33.86
	1:20:00	0.00	0.00	0.85	2.06	3.92	9.75	13.45	19.08	30.43
	1:25:00	0.00	0.00	0.77	1.85	3.51	8.74	12.06	16.98	27.10
	1:30:00	0.00	0.00	0.69	1.64	3.09	7.73	10.68	15.00	23.94
	1:35:00	0.00	0.00	0.61	1.45	2.70	6.74	9.32	13.09	20.93
	1:40:00	0.00	0.00	0.55	1.28	2.41	5.82	8.09	11.36	18.32
	1:45:00	0.00	0.00	0.52	1.17	2.21	5.16	7.22	10.12	16.38
	1:50:00	0.00	0.00	0.49	1.08	2.04	4.65	6.52	9.11	14.78
	1:55:00	0.00	0.00	0.45	0.99	1.87	4.21	5.92	8.22	13.37
	2:00:00	0.00	0.00	0.41	0.91	1.70	3.81	5.37	7.42	12.09
	2:05:00	0.00	0.00	0.37	0.81	1.51	3.43	4.82	6.63	10.79
	2:10:00	0.00	0.00	0.33	0.72	1.33	3.05	4.29	5.89	9.56
	2:15:00	0.00	0.00	0.29	0.62	1.16	2.69	3.78	5.19	8.40
	2:20:00	0.00	0.00	0.25	0.54	0.99	2.34	3.29	4.53	7.32
	2:25:00	0.00	0.00	0.21	0.45	0.83	1.99	2.80	3.89	6.26
	2:30:00	0.00	0.00	0.17	0.37	0.68	1.65	2.33	3.25	5.22
	2:35:00	0.00	0.00	0.13	0.29	0.52	1.32	1.86	2.61	4.19
	2:40:00	0.00	0.00	0.10	0.21	0.38	0.98	1.40	1.98	3.18
	2:45:00	0.00	0.00	0.07	0.14	0.25	0.66	0.95	1.36	2.24
	2:50:00	0.00	0.00	0.05	0.10	0.18	0.41	0.61	0.90	1.55
	2:55:00	0.00	0.00	0.04	0.08	0.14	0.26	0.42	0.61	1.10
	3:00:00	0.00	0.00	0.03	0.06	0.11	0.18	0.29	0.42	0.79
	3:05:00	0.00	0.00	0.03	0.05	0.09	0.12	0.20	0.28	0.55
	3:10:00	0.00	0.00	0.02	0.04	0.07	0.08	0.14	0.18	0.38
	3:15:00	0.00	0.00	0.02	0.03	0.06	0.06	0.10	0.11	0.25
	3:20:00	0.00	0.00	0.02	0.02	0.04	0.04	0.07	0.07	0.16
	3:25:00	0.00	0.00	0.01	0.02	0.03	0.03	0.05	0.05	0.11
	3:30:00	0.00	0.00	0.01	0.01	0.02	0.02	0.04	0.04	0.09
	3:35:00	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.03	0.07
	3:40:00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.05
	3:45:00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.04
	3:50:00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.03
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

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

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

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

Rock Chute Design Data

(Version 4.03 - 11/29/11, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)

Project: Latigo F10 - Pond G18 rundown **County:**
Designer: KGV **Checked by:**
Date: 10/25/24 **Date:**

Input Channel Geometry

Inlet Channel	Chute	Outlet Channel
Bw = 3.0 ft.	Bw = 3.0 ft.	Bw = 7.0 ft.
Side slopes = 4.0 (m:1)	Factor of safety = 1.20 (F_s)	Side slopes = 0.1 (m:1)
n-value = 0.035	Side slopes = 4.0 (m:1) → 2.0:1 max.	n-value = 0.013
Bed slope = 0.0230 ft./ft.	Bed slope (8.5:1) = 0.117 ft./ft. → 2.5:1 max.	Bed slope = 0.0050 ft./ft.
Minimum Fill = 1.0 ft.	Outlet apron depth, d = 1.5 ft.	Base flow = 0.0 cfs
Freeboard = 1.0 ft.		

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

Drainage area = 19.3 acres Rainfall = (●) 0 - 3 in. ( ) 3 - 5 in. ( ) 5+ in.

Apron elev. --- Inlet = 7055.0 ft. --- Outlet = 7049.5 ft. --- (H_{drop} = 4 ft.)

Chute capacity = Q5-year
Total capacity = Q10-year
Minimum capacity (based on a 5-year, 24-hour storm with a 0 - 3 inch rainfall)

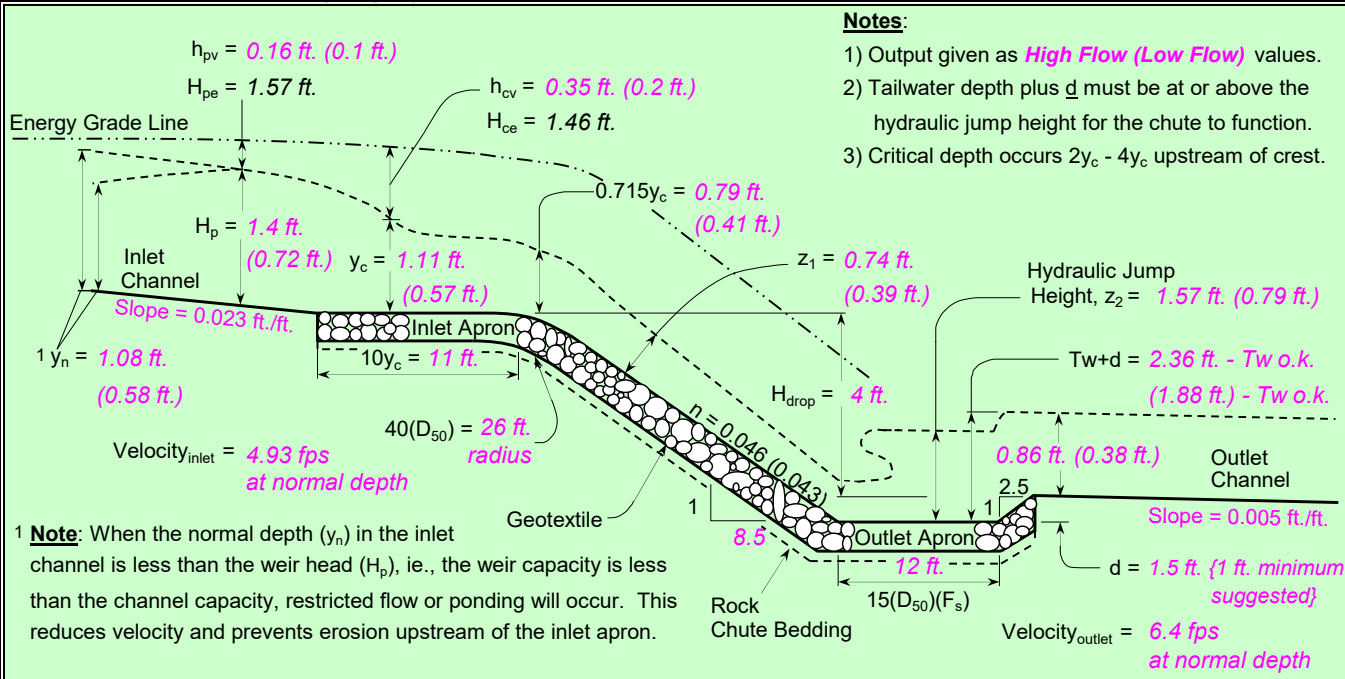
Q_{high} = 39.2 cfs High flow storm through chute → Tw (ft.) = Program

Q_{low} = 10.7 cfs Low flow storm through chute → Tw (ft.) = Program

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

***Input tailwater (Tw)**:* 0.12

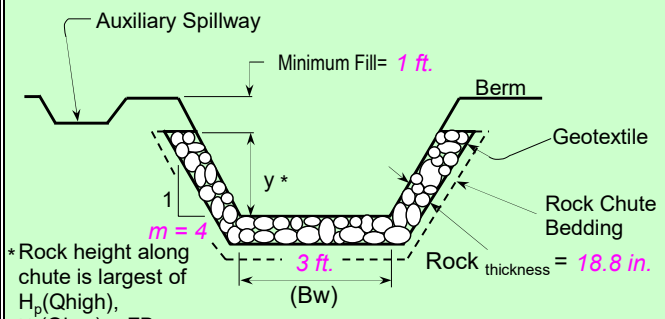
Profile and Cross Section (Output)



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

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

Profile Along Centerline of Chute



* Rock height along chute is largest of H_p(Qhigh), H_p(Qlow) + FB, and z_2.

Typical Cross Section

q_t =	6.65 cfs/ft.	Equivalent unit discharge
F_S =	1.20	Factor of safety (multiplier)
z_1 =	0.74 ft.	Normal depth in chute
n-value =	0.046	Manning's roughness coefficient
D_{50}(F_s) =	9.4 in. (60 lbs.) - angular riprap	
2(D_{50})(F_s) =	18.8 in.	Rock chute thickness
Tw + d =	2.36 ft.	Tailwater above outlet apron
z_2 =	1.57 ft.	Hydraulic jump height
*** The outlet	will	*function adequately*

High Flow Storm Information

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, Nov 18 2024

Pond G18

Rectangular

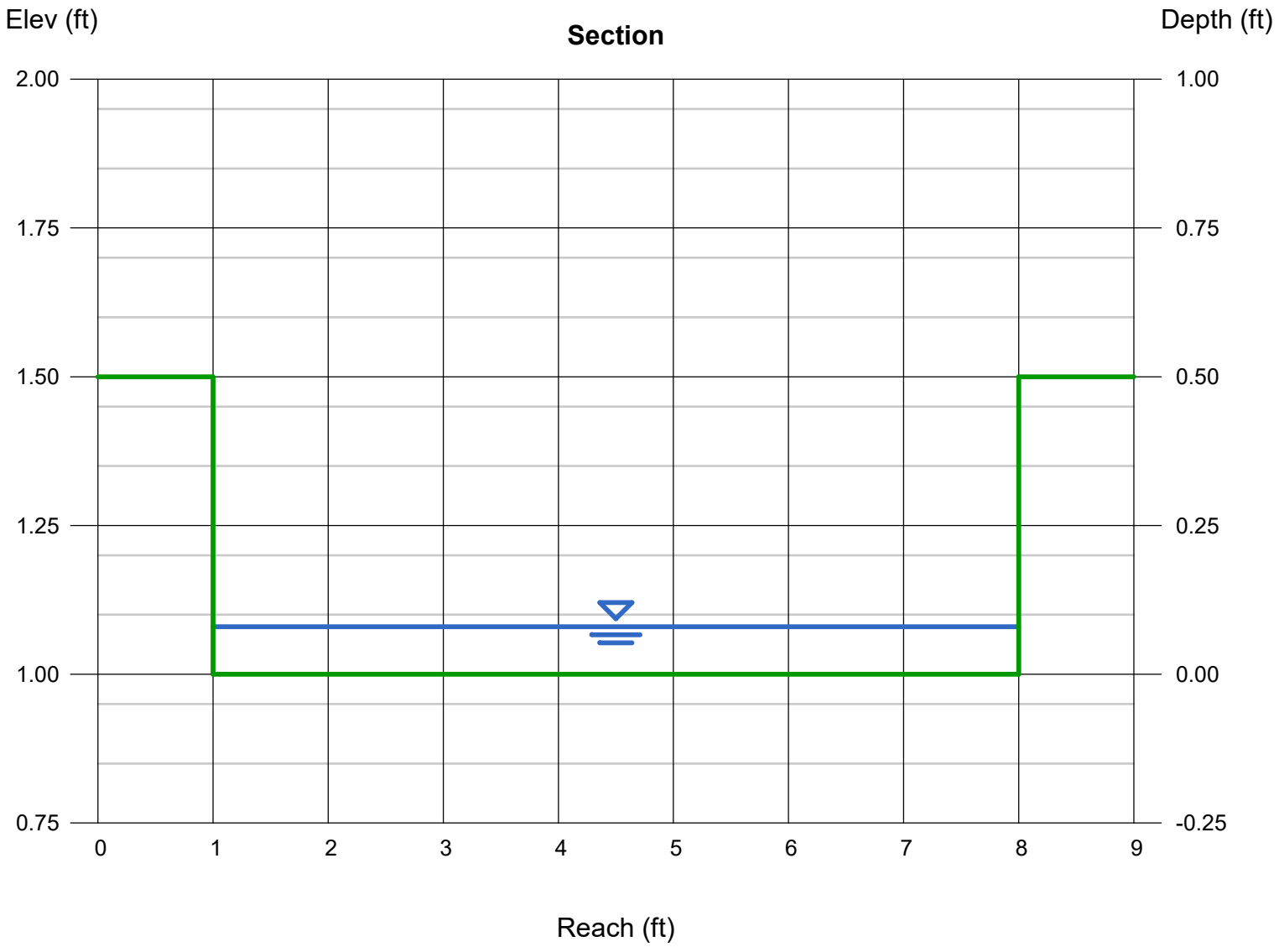
Bottom Width (ft)	= 7.00
Total Depth (ft)	= 0.50
Invert Elev (ft)	= 1.00
Slope (%)	= 0.50
N-Value	= 0.012

Calculations

Compute by:	Known Q
Known Q (cfs)	= 0.87 43.4 cfs x 2%

Highlighted

Depth (ft)	= 0.08
Q (cfs)	= 0.870
Area (sqft)	= 0.56
Velocity (ft/s)	= 1.55
Wetted Perim (ft)	= 7.16
Crit Depth, Yc (ft)	= 0.08
Top Width (ft)	= 7.00
EGL (ft)	= 0.12



Pond G18

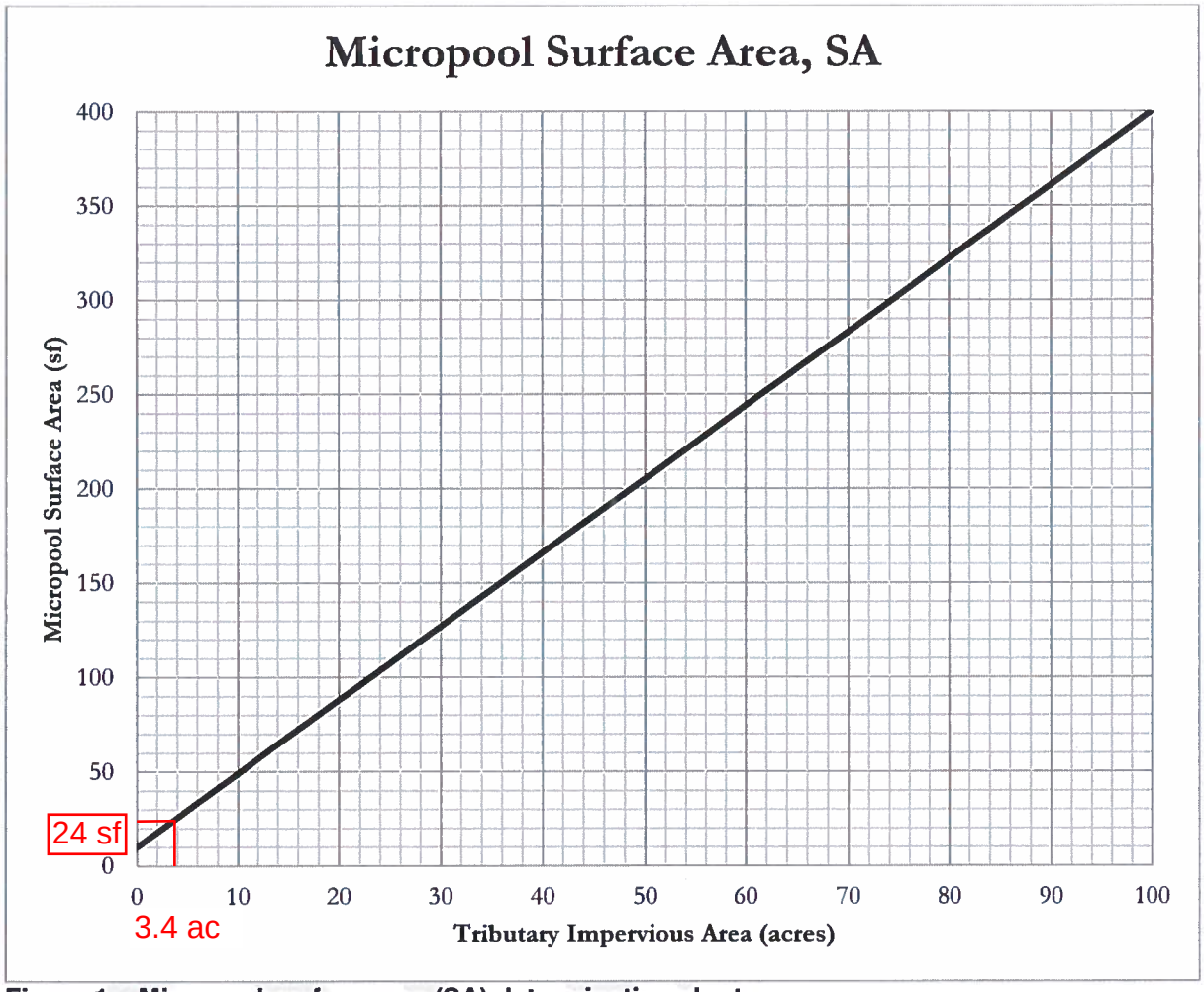


Figure 1 – Micropool surface area (SA) determination chart

The tributary impervious area is the effective number of impervious acres that will be treated by the extended detention basin (EDB). It is calculated by multiplying the tributary area to be treated by the impervious fraction of that area.

$$TIA = I \times A$$ = (13.2/100) x 25.53 ac = 3.4 ac

TIA = Tributary impervious area (acres)
I = Imperviousness (fraction)
A = Tributary catchment area upstream (acres)

For EDBs with tributary impervious areas greater than 100 acres, the micropool surface area is 400 sf. The initial surcharge depth (ISD) is defined as the depth of the initial surcharge volume (ISV). The surface area determined using Figure 1 assumes an ISD of 4 inches. The initial surcharge volume is thus calculated by multiplying the micropool surface area by 4 inches.

$$ISV = SA \times 4\ inches$$

ISV = Initial surcharge volume (cf)
SA = Surface area (from Figure 1, sf)

Figure 13-12c. Emergency Spillway Protection

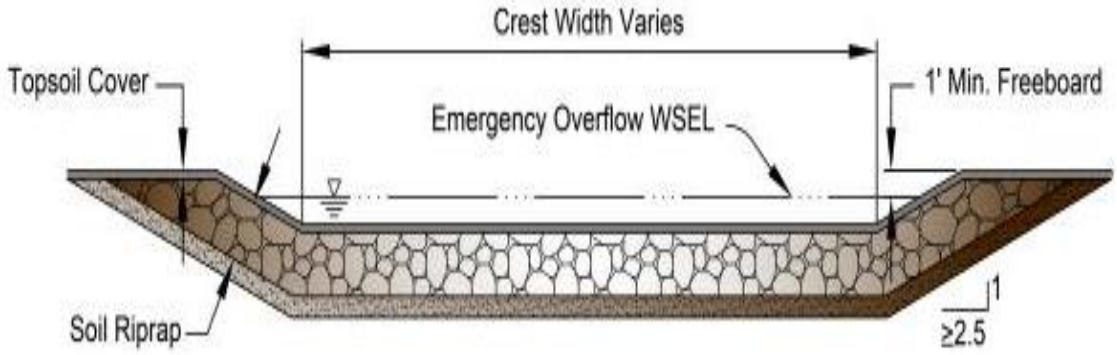
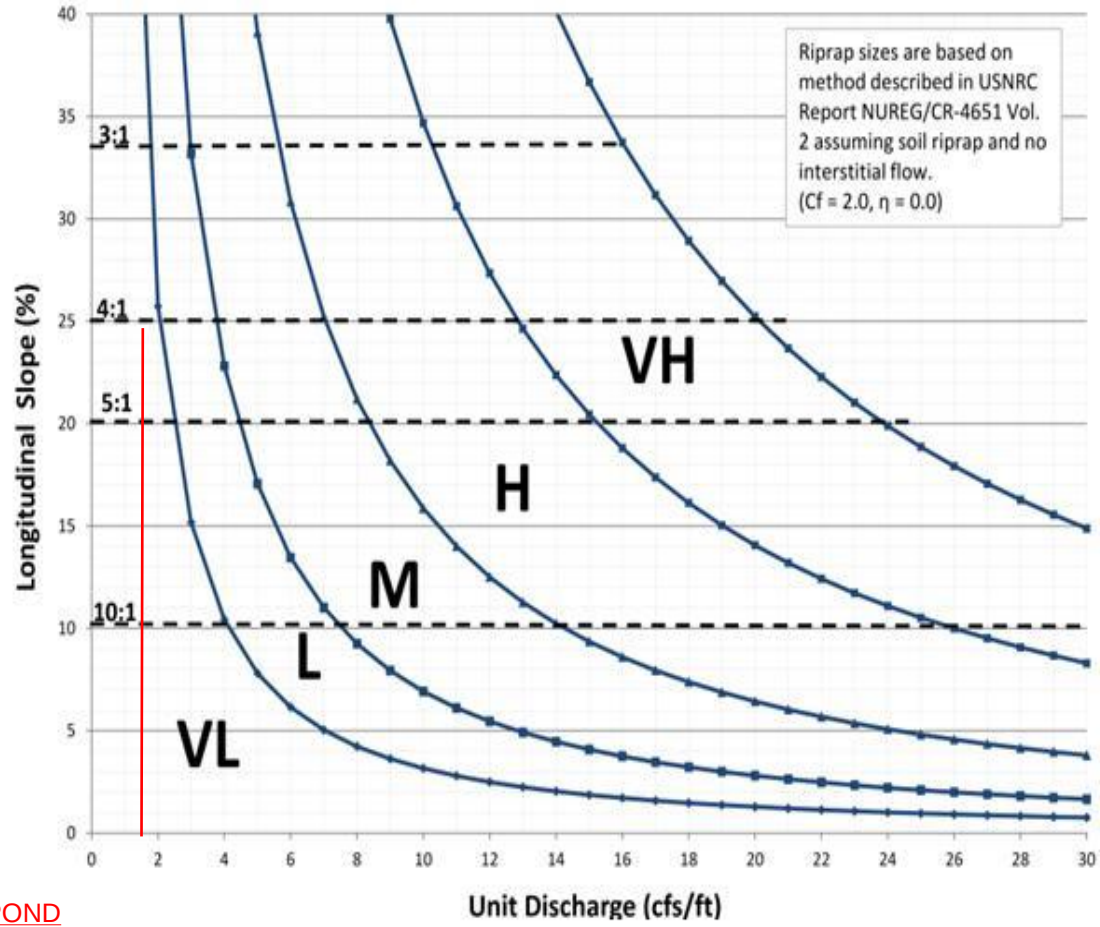


Figure 13-12d. Riprap Types for Emergency Spillway Protection



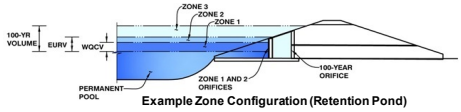
POND
UNIT DISCHARGE= 31.7/20=1.58cfs/ft

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Latigo Trails

Basin ID: Pond G19



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	27.31	acres
Watershed Length =	1,625	ft
Watershed Length to Centroid =	500	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	13.04%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	0.190	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	0.342	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 0.93 in.) =	0.182	acre-feet	0.93 inches
5-yr Runoff Volume (P1 = 1.21 in.) =	0.411	acre-feet	1.21 inches
10-yr Runoff Volume (P1 = 1.46 in.) =	0.775	acre-feet	1.46 inches
25-yr Runoff Volume (P1 = 1.83 in.) =	1.754	acre-feet	1.83 inches
50-yr Runoff Volume (P1 = 2.14 in.) =	2.409	acre-feet	2.14 inches
100-yr Runoff Volume (P1 = 2.47 in.) =	3.302	acre-feet	2.47 inches
500-yr Runoff Volume (P1 = 3.33 in.) =	5.258	acre-feet	3.33 inches
Approximate 2-yr Detention Volume =	0.175	acre-feet	
Approximate 5-yr Detention Volume =	0.278	acre-feet	
Approximate 10-yr Detention Volume =	0.535	acre-feet	
Approximate 25-yr Detention Volume =	0.783	acre-feet	
Approximate 50-yr Detention Volume =	0.857	acre-feet	
Approximate 100-yr Detention Volume =	1.123	acre-feet	

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.190	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.152	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.781	acre-feet
Total Detention Basin Volume =	1.123	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

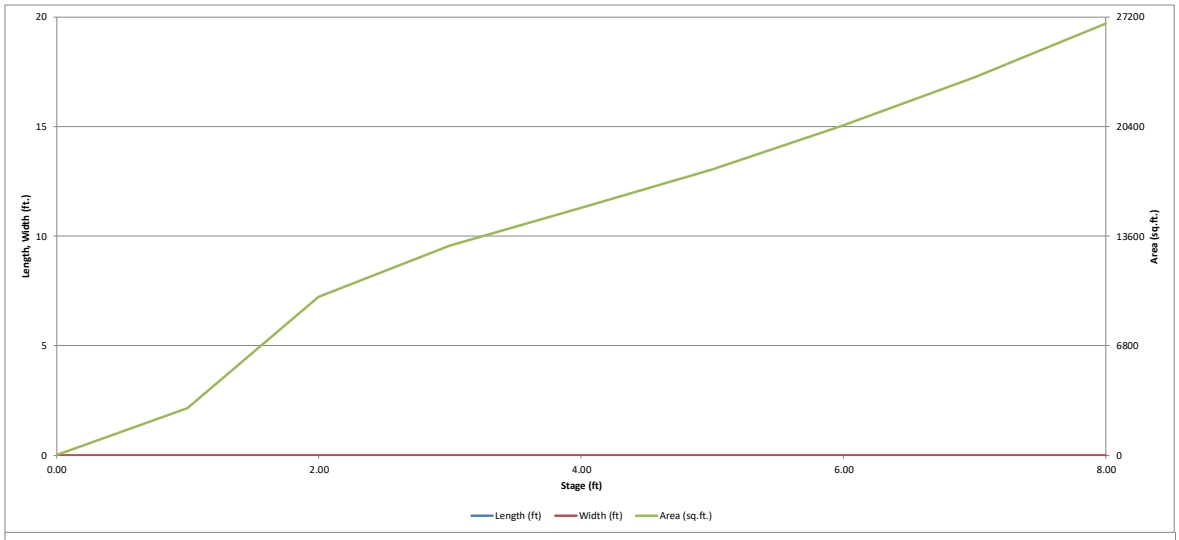
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user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

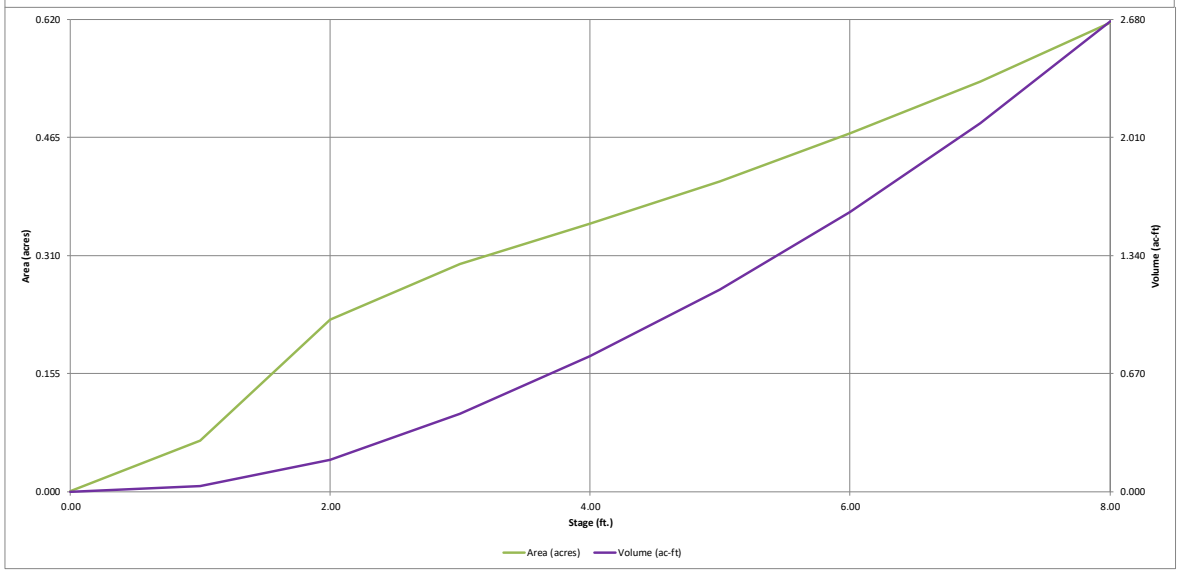
Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	40	0.001		
7057	--	1.00	--	--	--	2,915	0.067	1,477	0.034
7058	--	2.00	--	--	--	9,836	0.226	7,853	0.180
7059	--	3.00	--	--	--	13,026	0.299	19,284	0.443
7060	--	4.00	--	--	--	15,341	0.352	33,467	0.768
7061	--	5.00	--	--	--	17,751	0.408	50,013	1.148
7062	--	6.00	--	--	--	20,467	0.470	69,122	1.587
7063	--	7.00	--	--	--	23,457	0.538	91,084	2.091
7064	--	8.00	--	--	--	26,829	0.616	116,227	2.668

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



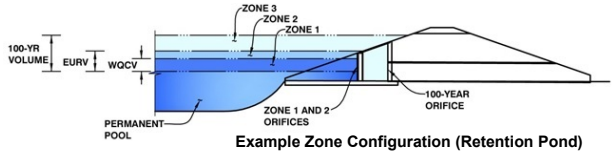


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Latigo Trails

Basin ID: Pond G19



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.05	0.190	Orifice Plate
Zone 2 (EURV)	2.65	0.152	Orifice Plate
Zone 3 (100-year)	4.94	0.781	Weir&Pipe (Restrict)
Total (all zones)		1.123	

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

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

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	1.042E-02	ft^2
Depth at top of Zone using Orifice Plate =	2.65	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 =	1.50	sq. inches (diameter = 1-3/8 inches)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	2.35						
Orifice Area (sq. inches)	1.50	1.50						

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifi

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

	Zone 3 Weir	Not Selected				
Overflow Weir Front Edge Height, Ho =	3.50	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	3.50	N/A
Overflow Weir Front Edge Length =	5.00	N/A	feet	Overflow Weir Slope Length =	5.00	N/A
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	4.74	N/A
Horiz. Length of Weir Sides =	5.00	N/A	feet	Overflow Grate Open Area w/o Debris =	17.40	N/A
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	8.70	N/A
Debris Clogging % =	50%	N/A	%			

Calculated Parameters for Overflow We

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

	Zone 3 Restrictor	Not Selected				
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	3.67	N/A
Outlet Pipe Diameter =	30.00	N/A	inches	Outlet Orifice Centroid =	0.98	N/A
Restrictor Plate Height Above Pipe Invert =	21.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.98	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.84	feet
Spillway Crest Length =	25.00	feet	Stage at Top of Freeboard =	6.84	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.53	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	2.01	acre-ft

Calculated Parameters for Spillway

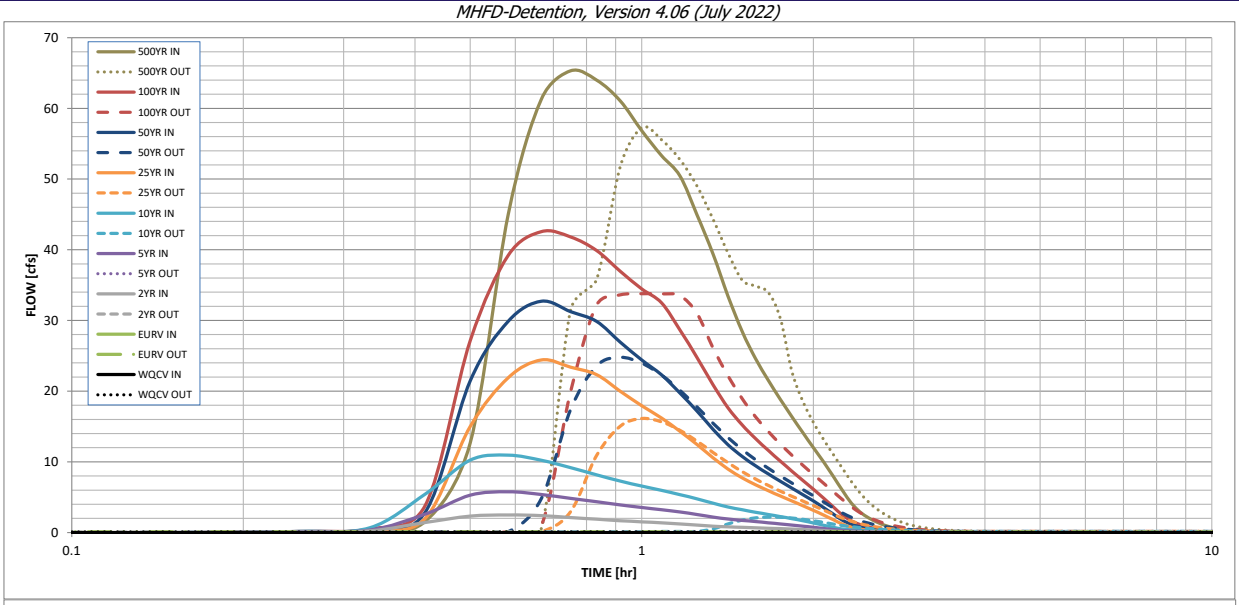
Routed Hydrograph Results

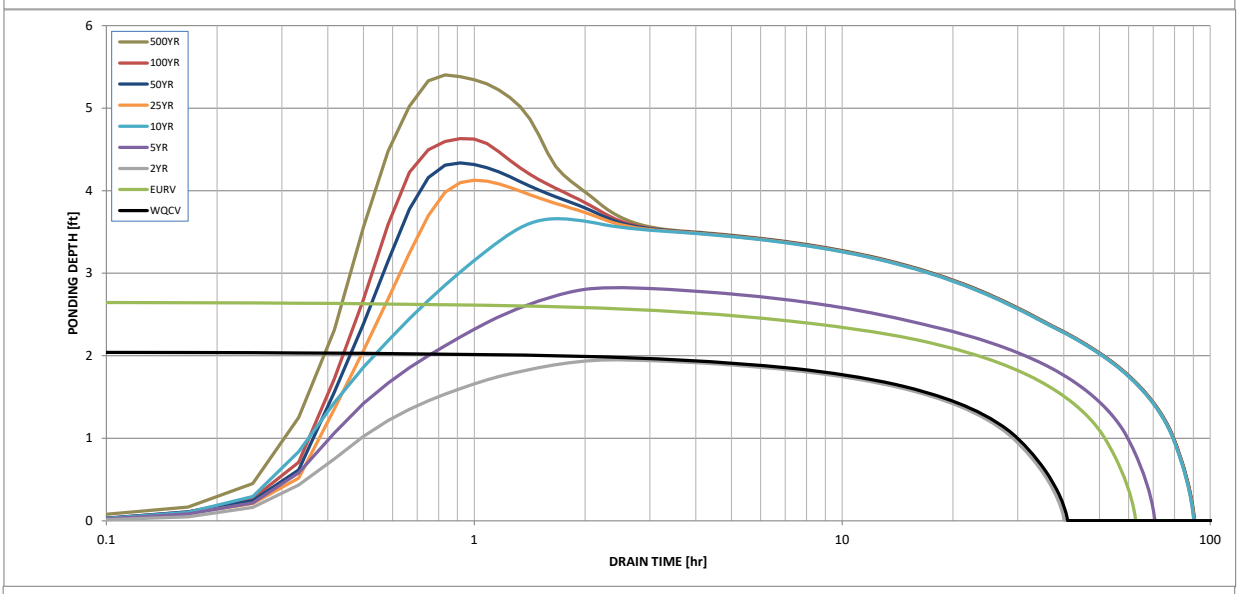
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

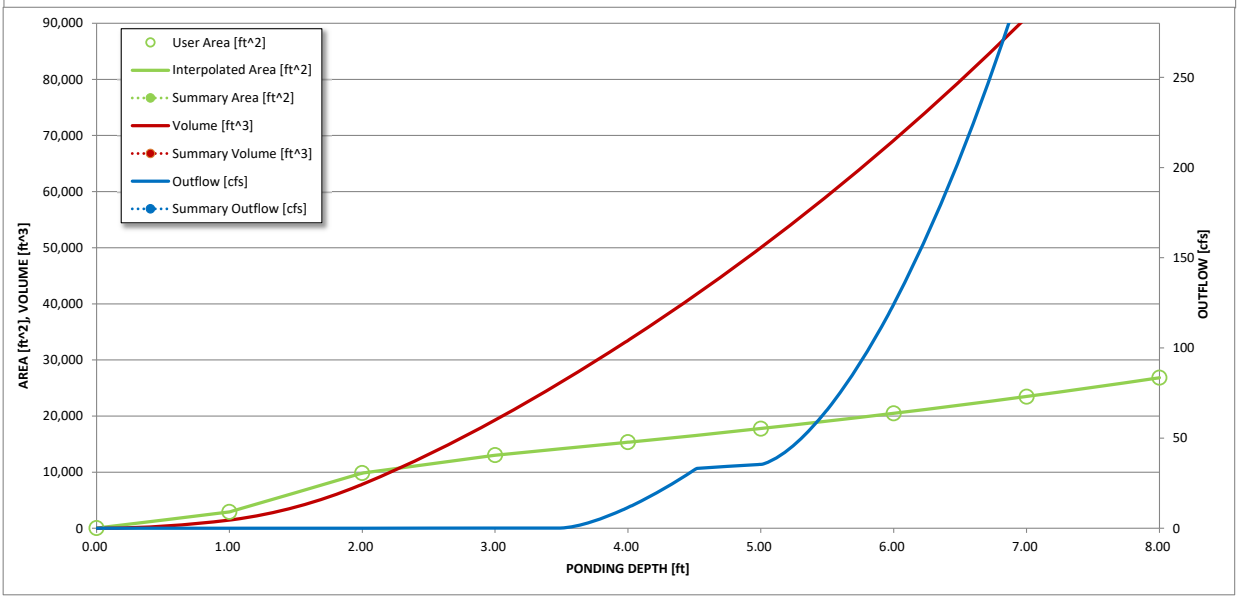
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.93	1.21	1.46	1.83	2.14	2.47
CUHP Runoff Volume (acre-ft) =	0.190	0.342	0.182	0.411	0.775	1.754	2.409	3.302
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.182	0.411	0.775	1.754	2.409	3.302
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.4	2.8	7.9	21.2	29.3	39.0
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.10	0.29	0.78	1.07	1.43
Peak Inflow Q (cfs) =	N/A	N/A	2.5	5.8	10.9	24.4	32.7	42.6
Peak Outflow Q (cfs) =	0.1	0.1	0.1	0.1	2.2	16.1	24.8	33.8
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.0	0.3	0.8	0.8	0.9
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.1	0.9	1.4	1.9
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	58	37	66	82	75	71	66
Time to Drain 99% of Inflow Volume (hours) =	**40**	61	39	69	87	84	82	80
Maximum Ponding Depth (ft) =	2.05	2.65	1.95	2.82	3.66	4.13	4.34	4.63
Area at Maximum Ponding Depth (acres) =	0.23	0.27	0.22	0.29	0.33	0.36	0.37	0.39
Maximum Volume Stored (acre-ft) =	0.192	0.343	0.167	0.390	0.648	0.811	0.888	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.

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
	0:15:00	0.00	0.00	0.05	0.10	0.14	0.11	0.15	0.15	0.25
	0:20:00	0.00	0.00	0.25	0.35	0.68	0.31	0.38	0.51	1.56
	0:25:00	0.00	0.00	1.41	2.60	5.42	1.97	2.84	3.78	12.66
	0:30:00	0.00	0.00	2.32	5.28	10.24	15.00	21.45	27.12	45.04
	0:35:00	0.00	0.00	2.48	5.77	10.93	21.91	29.88	39.22	61.30
	0:40:00	0.00	0.00	2.39	5.38	10.22	24.41	32.72	42.57	65.30
	0:45:00	0.00	0.00	2.12	4.82	9.18	23.39	31.24	41.81	64.00
	0:50:00	0.00	0.00	1.88	4.36	8.16	22.34	29.86	39.89	61.05
	0:55:00	0.00	0.00	1.68	3.91	7.27	19.99	26.93	36.95	56.84
	1:00:00	0.00	0.00	1.52	3.54	6.57	17.93	24.41	34.46	53.32
	1:05:00	0.00	0.00	1.38	3.22	5.96	16.21	22.30	32.49	50.44
	1:10:00	0.00	0.00	1.21	2.92	5.36	14.31	19.73	28.65	44.97
	1:15:00	0.00	0.00	1.05	2.56	4.77	12.46	17.19	24.78	39.43
	1:20:00	0.00	0.00	0.90	2.19	4.15	10.59	14.62	20.91	33.45
	1:25:00	0.00	0.00	0.80	1.91	3.61	8.98	12.43	17.65	28.44
	1:30:00	0.00	0.00	0.73	1.72	3.22	7.74	10.77	15.23	24.62
	1:35:00	0.00	0.00	0.66	1.56	2.88	6.76	9.44	13.30	21.54
	1:40:00	0.00	0.00	0.61	1.38	2.56	5.92	8.29	11.62	18.84
	1:45:00	0.00	0.00	0.55	1.22	2.26	5.17	7.25	10.10	16.40
	1:50:00	0.00	0.00	0.49	1.06	1.97	4.47	6.29	8.69	14.13
	1:55:00	0.00	0.00	0.43	0.90	1.67	3.80	5.36	7.37	12.01
	2:00:00	0.00	0.00	0.36	0.75	1.36	3.14	4.47	6.13	10.01
	2:05:00	0.00	0.00	0.28	0.58	1.04	2.48	3.54	4.88	7.95
	2:10:00	0.00	0.00	0.20	0.42	0.73	1.81	2.61	3.64	5.94
	2:15:00	0.00	0.00	0.15	0.29	0.50	1.19	1.74	2.46	4.13
	2:20:00	0.00	0.00	0.11	0.21	0.37	0.75	1.15	1.65	2.90
	2:25:00	0.00	0.00	0.09	0.16	0.29	0.49	0.79	1.13	2.08
	2:30:00	0.00	0.00	0.07	0.13	0.23	0.33	0.56	0.78	1.48
	2:35:00	0.00	0.00	0.06	0.10	0.18	0.23	0.39	0.52	1.04
	2:40:00	0.00	0.00	0.05	0.08	0.15	0.16	0.28	0.34	0.71
	2:45:00	0.00	0.00	0.04	0.06	0.11	0.11	0.20	0.21	0.46
	2:50:00	0.00	0.00	0.03	0.05	0.08	0.08	0.14	0.12	0.30
	2:55:00	0.00	0.00	0.02	0.04	0.06	0.05	0.10	0.09	0.21
	3:00:00	0.00	0.00	0.02	0.03	0.05	0.04	0.08	0.07	0.16
	3:05:00	0.00	0.00	0.02	0.02	0.03	0.03	0.06	0.05	0.13
	3:10:00	0.00	0.00	0.01	0.02	0.03	0.02	0.05	0.04	0.10
	3:15:00	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.03	0.07
	3:20:00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.05
	3:25:00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.04
	3:30:00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

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

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

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

Rock Chute Design Data

(Version 4.03 - 11/29/11, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)

Project: Latigo F10 - Pond G19 rundown **County:**
Designer: KGV **Checked by:**
Date: 10/25/24 **Date:**

Input Channel Geometry

Inlet Channel	Chute	Outlet Channel
Bw = 3.0 ft.	Bw = 3.0 ft.	Bw = 7.0 ft.
Side slopes = 4.0 (m:1)	Factor of safety = 1.20 (F_s)	Side slopes = 0.1 (m:1)
n-value = 0.035	Side slopes = 4.0 (m:1) → 2.0:1 max.	n-value = 0.013
Bed slope = 0.0230 ft./ft.	Bed slope (11.1:1) = 0.090 ft./ft. → 2.5:1 max.	Bed slope = 0.0050 ft./ft.
Minimum Fill = 1.0 ft.	Outlet apron depth, d = 1.5 ft.	Base flow = 0.0 cfs
Freeboard = 1.0 ft.		

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

Drainage area = 21.9 acres Rainfall = (●) 0 - 3 in. ( ) 3 - 5 in. ( ) 5+ in.

Apron elev. --- Inlet = 7059.8 ft. --- Outlet = 7055.5 ft. --- (H_{drop} = 2.8 ft.)

Chute capacity = Q5-year
Total capacity = Q10-year
Minimum capacity (based on a 5-year, 24-hour storm with a 0 - 3 inch rainfall)

Q_{high} = 42.9 cfs High flow storm through chute → Tw (ft.) = Program

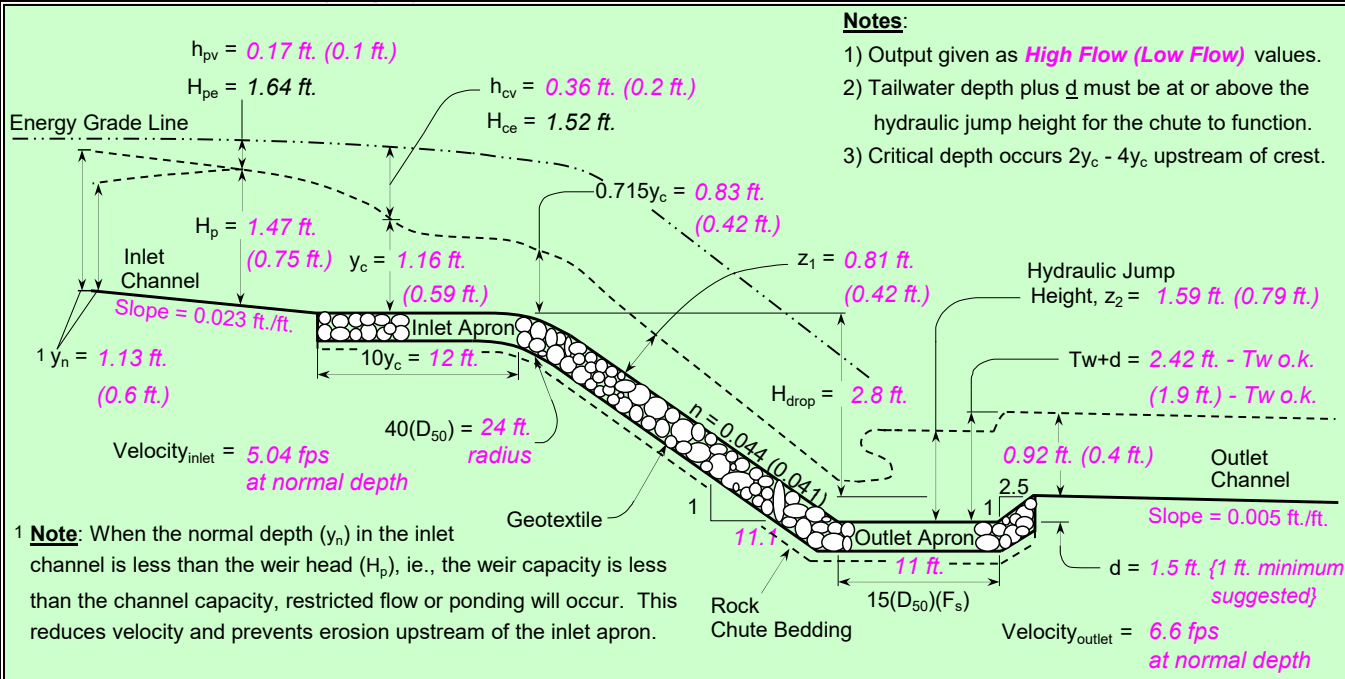
Q_{low} = 11.4 cfs Low flow storm through chute → Tw (ft.) = Program

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

***Input tailwater (Tw)**:*

0.09

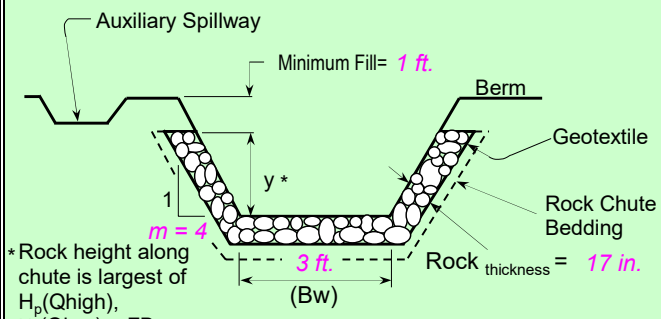
Profile and Cross Section (Output)



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

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

Profile Along Centerline of Chute



* Rock height along chute is largest of H_p(Qhigh), H_p(Qlow) + FB, and z_2.

Typical Cross Section

q_t =	7.11 cfs/ft.	Equivalent unit discharge
F_S =	1.20	Factor of safety (multiplier)
z_1 =	0.81 ft.	Normal depth in chute
n-value =	0.044	Manning's roughness coefficient
D_{50}(F_s) =	8.5 in. (45 lbs.) - angular riprap	
2(D_{50})(F_s) =	17 in.	Rock chute thickness
Tw + d =	2.42 ft.	Tailwater above outlet apron
z_2 =	1.59 ft.	Hydraulic jump height
*** The outlet	will	*function adequately*

High Flow Storm Information

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, Nov 18 2024

Pond G19

Rectangular

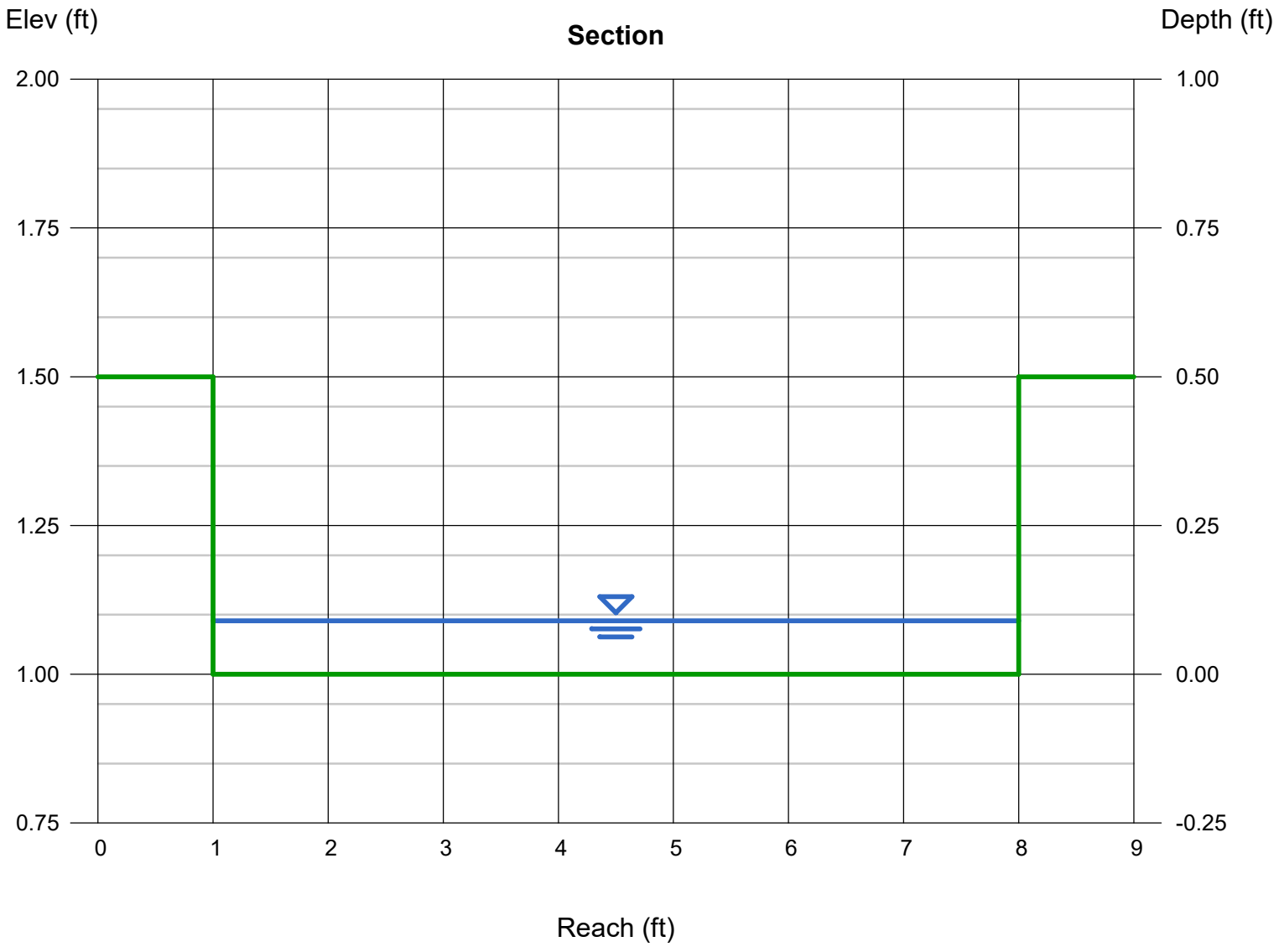
Bottom Width (ft)	= 7.00
Total Depth (ft)	= 0.50
Invert Elev (ft)	= 1.00
Slope (%)	= 0.50
N-Value	= 0.012

Calculations

Compute by:	Known Q
Known Q (cfs)	= 0.96 47.9 cfs x 2%

Highlighted

Depth (ft)	= 0.09
Q (cfs)	= 0.960
Area (sqft)	= 0.63
Velocity (ft/s)	= 1.52
Wetted Perim (ft)	= 7.18
Crit Depth, Yc (ft)	= 0.09
Top Width (ft)	= 7.00
EGL (ft)	= 0.13



Pond G19

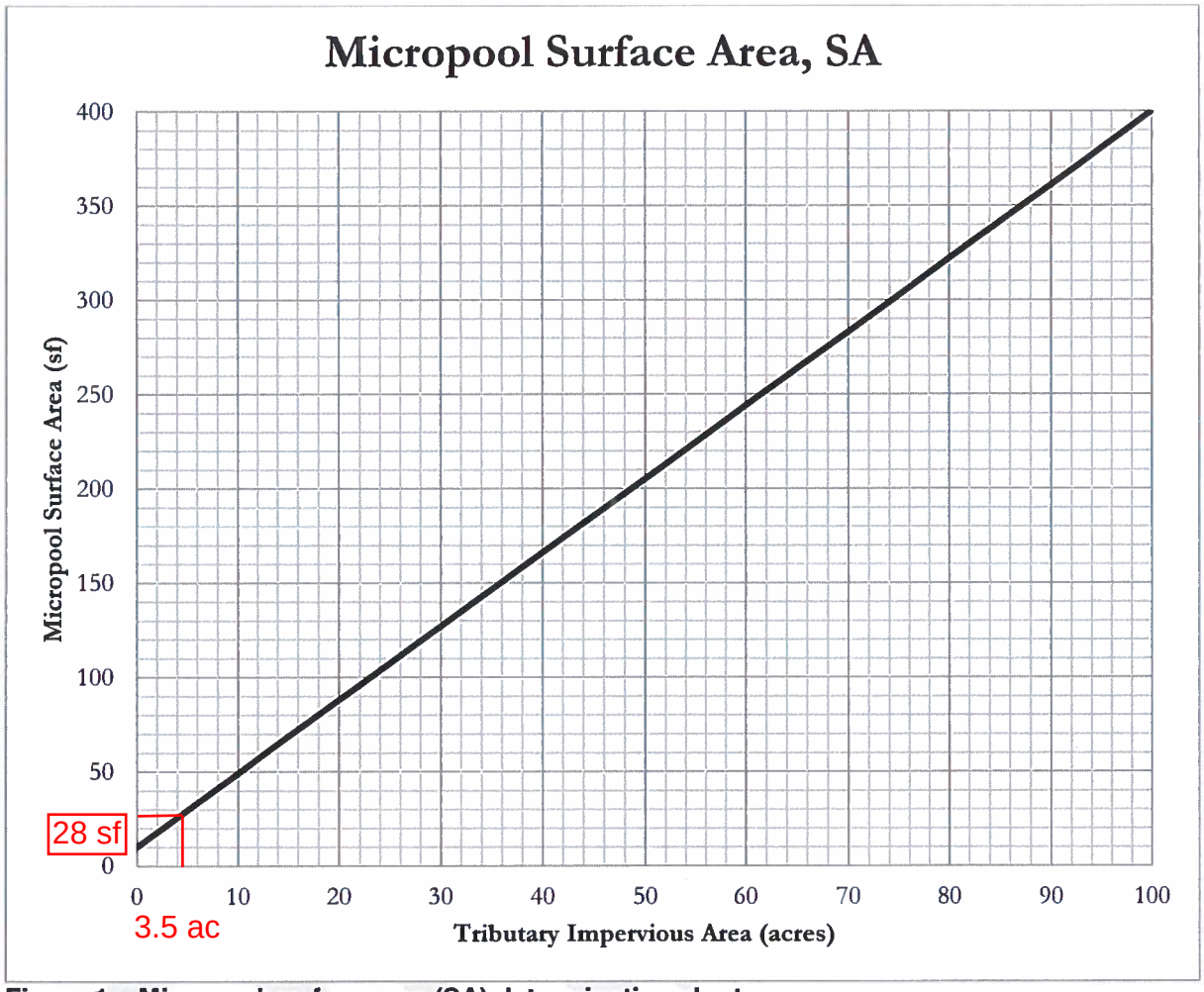


Figure 1 – Micropool surface area (SA) determination chart

The tributary impervious area is the effective number of impervious acres that will be treated by the extended detention basin (EDB). It is calculated by multiplying the tributary area to be treated by the impervious fraction of that area.

$$TIA = I \times A$$ = (12.6/100) x 27.64 ac = 3.5 ac

TIA = Tributary impervious area (acres)
I = Imperviousness (fraction)
A = Tributary catchment area upstream (acres)

For EDBs with tributary impervious areas greater than 100 acres, the micropool surface area is 400 sf. The initial surcharge depth (ISD) is defined as the depth of the initial surcharge volume (ISV). The surface area determined using Figure 1 assumes an ISD of 4 inches. The initial surcharge volume is thus calculated by multiplying the micropool surface area by 4 inches.

$$ISV = SA \times 4\ inches$$

ISV = Initial surcharge volume (cf)
SA = Surface area (from Figure 1, sf)

Figure 13-12c. Emergency Spillway Protection

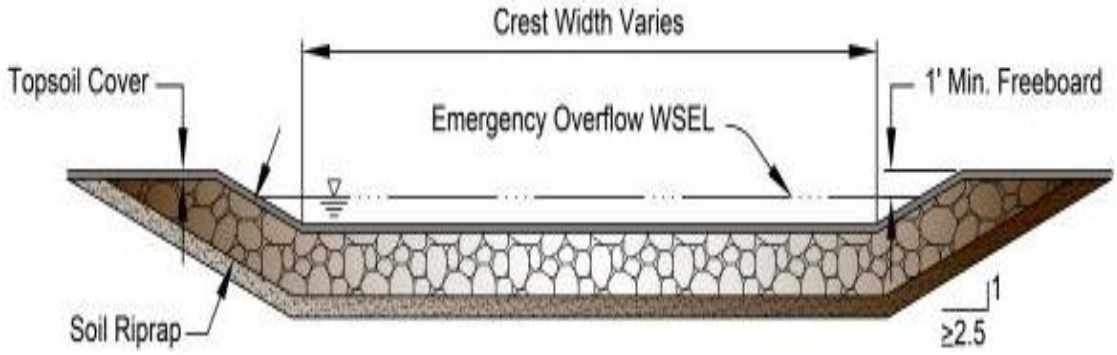
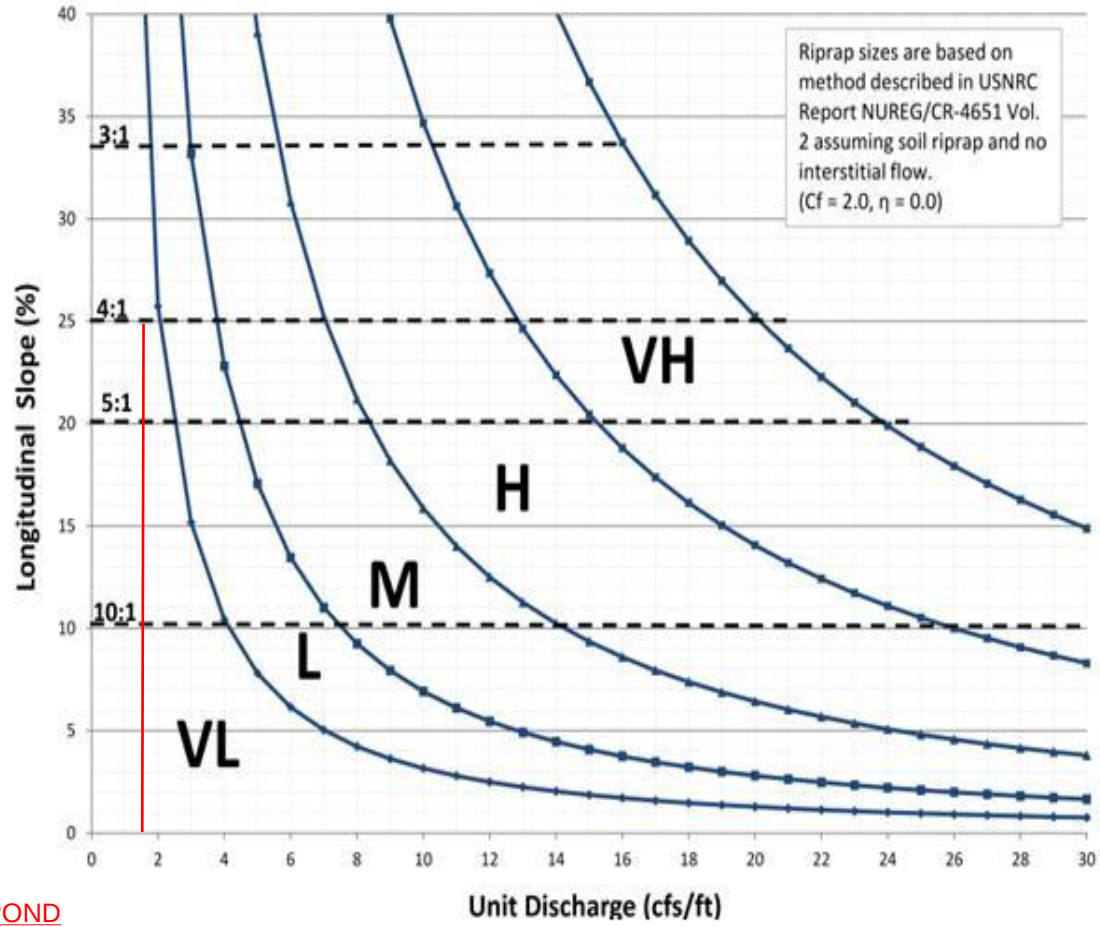


Figure 13-12d. Riprap Types for Emergency Spillway Protection



POND
UNIT DISCHARGE= 39.7/25=1.6cfs/ft

Previously Approved Drainage Analysis Excerpts

NEW DOC

MASTER DEVELOPMENT / PRELIMINARY DRAINAGE PLAN LATIGO TRAILS EL PASO COUNTY, COLORADO

October 4, 2001

Prepared for:

RMBG, LLC #2
5170 Mark Dabling Blvd.
COLORADO SPRINGS, CO 80918

PREPARED BY:

URS

9960 Federal Drive, Suite 300
Colorado Springs, CO 80921

URS PROJECT NO. 67-00042443

MDDP EXCERPT

Four sub-basins, varying from 3 to 53 acres, lie north of Latigo Blvd, draining mainly to the east, with excess runoff ponding at Eastonville Road and eventually overtopping it. One of these basins (9.71) drains directly to Upper Black Squirrel Creek. There is a Zone-A, unstudied FEMA floodplain to the north of the proposed development, in the open space / Upper Black Squirrel Creek area.

Gieck Ranch Basin

The Gieck Ranch Basin covers the southern half of the subject area. Runoff is generally southeasterly, draining to Meridian Ranch to the south, and crossing Eastonville Road at three points to the east. As with the Upper Black Squirrel Creek Basin, many of the existing drainageways (mainly to the south) are not clearly defined.

The major drainage course begins at the west-central portion of the site, traversing the Gieck Ranch Basin to design point G11 to the southeast. Six sub-basins, varying from 19 to 39 acres, contribute to this drainage course, which collects approximately 65% of the runoff generated within the Gieck Basin in Latigo Trails. To the west of this, eight sub-basins drain to five design points along the Meridian Ranch boundary, two of which (G5 and G6) combine shortly after entering Meridian Ranch, at G6b.

There are eight small sub-basins east of the major drainage course, varying from 2 to 41 acres. All but one drain at their own design point, either crossing Eastonville Road or onto Meridian Ranch. The three culverts crossing Eastonville Road include an 18" CMP, a 30" CMP, and a 42"x28" Arch CMP. The 30" CMP has the capacity for 31 cfs, which is inadequate for existing flows. The other two pipes are adequate for existing and developed flows. The drainageways entering Meridian Ranch are not very well defined.

Four stock ponds exist on the site, but are assumed to be full at the beginning of a storm as part of this analysis. If the ponds were empty, flows at G2 may be reduced by about 30 cfs, flows at G10 and G11 may be reduced by about 34 cfs, flows at G13 may be reduced by about 23 cfs, and flows at B1, B2 and B3 may be reduced by about 45 cfs (for flows up to 100-year storm estimates).

See Tables 3 and 4 for flow calculations at specific design points and further comments.

MDDP EXCERPT

Table 4 - Design Points

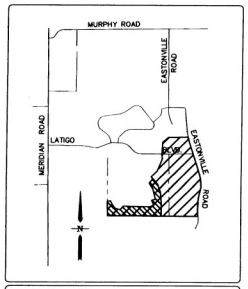
THE TRAILS MDDP
HYDROLOGY OUTPUT: DESIGN POINTS
URS Job No. 6742443

DESIGN FLOWS (cfs)											
DESIGN POINT				EXISTING		DEVELOPED-BASE			DEVELOPED-DETN		
DP		Basin		5-YR	100-YR	Method	5-YR**	100-YR	Area*	5-YR	100-YR
GIECK RANCH BASIN				TRMEGxxx.OUT			TRMDGxxx.OUT				
G1	B	3.12		15	38	rat	21	48	20.3		
G2	B	+		22	55		21	50	25.3		
V1	D	2.62				scs	20	34	12.6		
V2	D	2.72				scs	5	11	4.8		
V3	D	3.22				rat	8	19	8.6		
G3	E	2.61		12	34						
G4/V4	B	+		24	95		57	121	61.8	48	108
V5	D	2.52				scs	4	11	4.3		
V6	D	5.12				scs	8	15	8.6		
G5	B	+		24	107		68	156	81.1	58	137
V7	D	5.22				rat	11	25	11.8		
G6	B	+		4	20		17	35	18.2		
G6b	B	+		28	122		83	191	99.3	75	145
V10	D	2.12				scs	12	29	13.3		
V9N	D	+					43	92	44.1		
V9	D	+					50	103	48.4		
G7	E	2.21		8	44						
V11	D	2.34					4	11	4.9		
V12	B	+		7	34		20	41	17.9	20	35
G8/V14	B	+		17	75		63	134	72.1		
V15	D	6.42				scs	6	12	5.7		
V15b							25	52	23.5	10	45
V16	D	6.44				scs	2	4	2.1		
V17	D	6.46				scs	2	4	2.0		
DA5							84	182	107.9	80	170
DA6							107	240	117.9	90	165
G10/V19	B	+		38	184		123	282	140.9	107	207
G11a	B	+		43	208		123	282	147.4	107	207
V20	D	6.62					6	13	6.7		
G11b							17	33	13.3		
V13	D	6.22				rat	11	26	12.3		
G12	B	6.24		18	44	rat	18	43	19.9		
V21	D	4.32				rat	11	26	12.5	5	15
G13	B	+		10	24		13	31	15.5	7	20
V22	D	4.42				rat	4	9	3.7		
V23	D	4.52				rat	9	22	10.3		
V24	D	+					17	39	18.8	15	25
G14a				6	15		7	17	7.5		
G14b	B	+		13	31		18	42	20.5	16	28
G15	B	+		29	70		40	92	48.5	38	78
G16	B	4.82		2	5	rat	3	6	2.4		
G17a	D	4.94					1	3	0.9		
G17b	B	+		3	6		3	7	2.3		
V25	D	4.64					3	7	2.9		
V26	D	4.62				rat	5	12	5.2		
G18	B	+		18	42		21	49	24.6	18	40
V27	D	4.72					26	60	21.0		
G19	B	+		28	67		37	86	37.2	28	65

*Area in acres
**If SCS, multiplied by 1.67 (Average correlation SCS/Rational calculation) (5-year flows only)

MDDP EXCERPT

LATIGO TRAILS
PRELIMINARY DRAINAGE PLAN
IN SECTIONS 8, 9, 16 & 17, T12S, R64W OF THE 6TH P.M.
EL PASO COUNTY, COLORADO



VICINITY MAP
NO SCALE

NOTES:

1) EASEMENTS
All lot lines and boundaries will be platted with easements for utility, drainage and equestrian purposes (not shown). The Homeowners' [illegible] ponds and drainage easements.

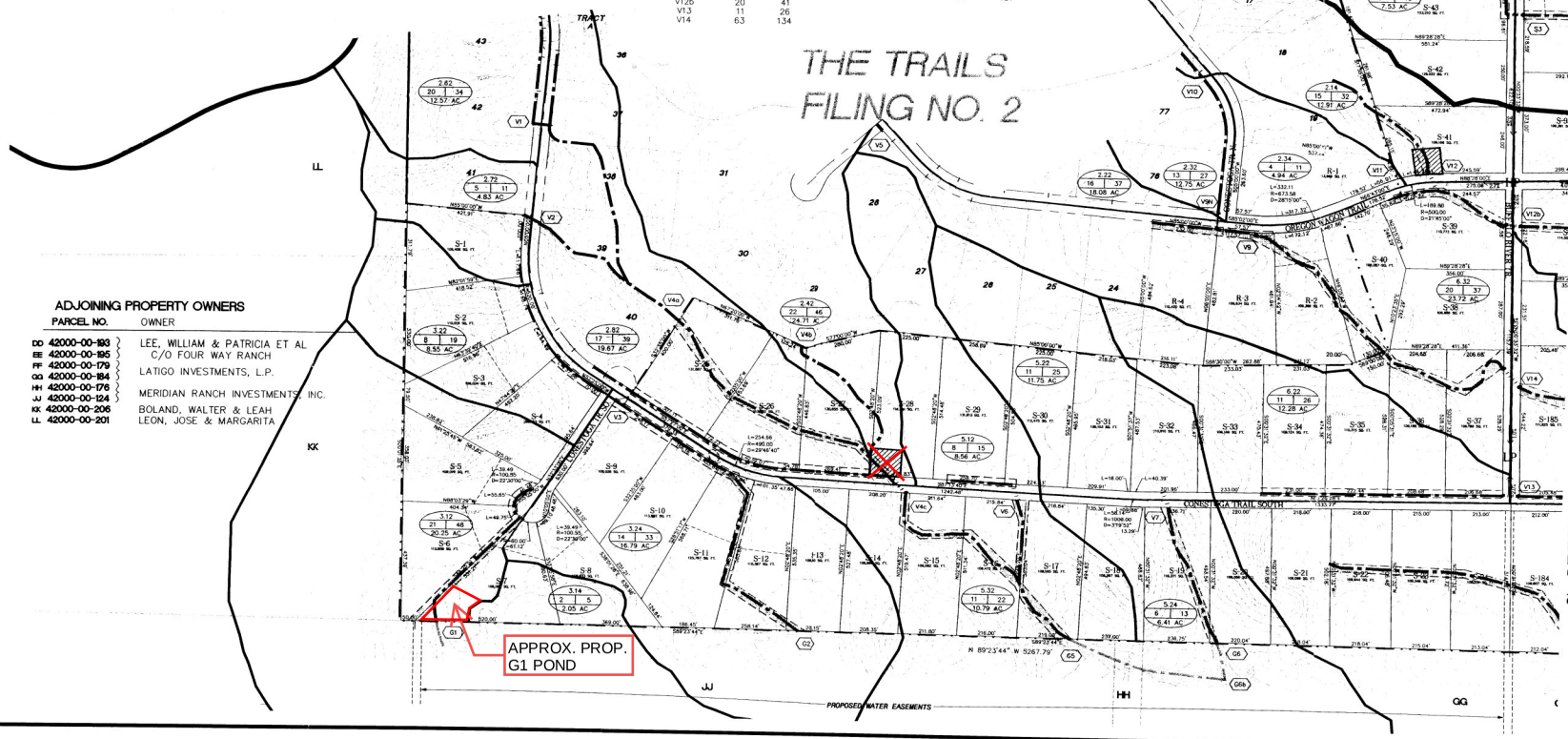
2) CHANNEL DESIGN
All channels will be grass-lined, with 4:1 sides. Natural channels will be utilized, undisturbed, where possible. See Drainage Report Table 8 for specific channel design details.

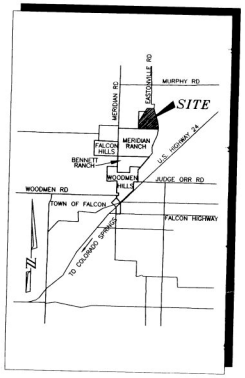
3) CULVERT DESIGN
Culverts shall be HDPE or RCP, depending on location and size. See Drainage Report Table 7 for preliminary sizes.

Design Point	Q_5 (CFS)	Q_{100} (CFS)
V1	20	34
V2	5	11
V3	8	19
[illegible]	[illegible]	[illegible]
V4b	22	51
V4c	57	121
V5	4	11
V6	8	15
V7	11	25
V9N	43	92
V9	50	103
V10	12	29
V11	4	11
V12	20	41
V12b	20	41
V13	11	26
V14	63	134

Design Point	Q_5 (CFS)	Q_{100} (CFS)
S1	8	18
S2	14	30
S2b	23	49
[illegible]	[illegible]	[illegible]

Design Point	Q_5 (CFS)	Q_{100} (CFS)
G1	21	48
G2	21	50
G5	68	156
G6	17	35
G6b	83	191





VICINITY MAP
N.T.S.

LEGEND

SUB-BASIN Q5 Q100 AREA	SUB-BASIN DATA
G19	DESIGN POINT
HP	ROAD HIGH POINT
LP	ROAD LOW POINT
1.0%	ROAD GRADE
	SUB-BASIN LINE
	PR./EX. CHANNEL
	DRAINAGE EASEMENT
	CULVERT
	POSSIBLE DETENTION AREA

N

SCALE: 1"=200'

200 0 200 400

ADJOINING PROPERTY OWNERS

PARCEL NO.	OWNER
DD 42000-00-193	LEE, WILLIAM & PATRICIA ET AL C/O FOUR WAY RANCH
EE 42000-00-195	
FF 42000-00-179	LATIGO INVESTMENTS, L.P.
GG 42000-00-184	
HH 42000-00-176	MERIDIAN RANCH INVESTMENTS, INC.
JJ 42000-00-124	
KK 42000-00-206	BOLAND, WALTER & LEAH
LL 42000-00-201	LEON, JOSE & MARGARITA

URS
9960 FEDERAL DRIVE, SUITE 300
COLORADO SPRINGS, COLO. 80921
PHONE: (719) 531-0001

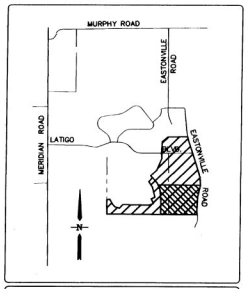
DATE: 10/04/01

SHEET 1 OF 4

FIGURE 8

MDDP EXCERPT

LATIGO TRAILS
PRELIMINARY DRAINAGE PLAN
IN SECTIONS 8, 9, 16 & 17, T12S, R64W OF THE 6TH P.M.
EL PASO COUNTY, COLORADO



VICINITY MAP
NO SCALE

Design Point	Q_5 (CFS)	Q_{100} (CFS)
V15	6	12
V15b	25	52
V16	2	4
V17	2	4
V18	107	240
V20	6	13
V21	11	26
V22	4	9
V23	9	22
V24	17	39
V25	3	7
V26	5	12
V27	26	60

Design Point	Q_5 (CFS)	Q_{100} (CFS)
S14	9	19
S15	1	3

Design Point	Q_5 (CFS)	Q_{100} (CFS)
G10	123	282
G11a	123	282
G11b	17	33
G12	18	43
G13	13	31
G14a	7	17
G14b	18	42
G15	40	92
G17a	1	3
G17b	3	7
G18	21	49
G19	37	86

MDDP EXCERPT

MATCHLINE – SEE SHEET 3

MATCHLINE – SEE SHEET 1

APPROX. FUTURE G19 POND

30" CMP

APPROX. FUTURE G18 POND

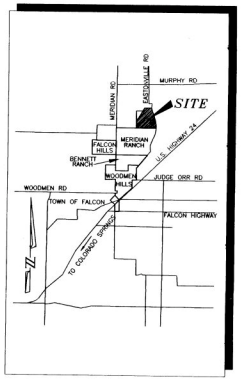
42"x28" ARCH CMP

18" CMP

APPROX. EX. SOUTH POND

A35 AGRICULTURAL

A35 AGRICULTURAL



VICINITY MAP
N.T.S.

LEGEND

SUB-BASIN Q5 Q100 AREA	SUB-BASIN DATA
G19	DESIGN POINT
HP	ROAD HIGH POINT
LP	ROAD LOW POINT
1.00%	ROAD GRADE
	SUB-BASIN LINE
	PR./EX. CHANNEL
	DRAINAGE EASEMENT
	CULVERT
	POSSIBLE DETENTION AREA

N

SCALE: 1"=200'

200 0 200 400

URS
9960 FEDERAL DRIVE, SUITE 300
COLORADO SPRINGS, COLO. 80921
PHONE: (719) 531-0001

DATE: 9/25/01

SHEET 2 OF 4

FIGURE 8

FINAL DRAINAGE REPORT
FOR
LATIGO TRAILS FILING NO. 9
AND
ADDENDUM TO MASTER DEVELOPMENT/
PRELIMINARY DRAINAGE PLAN
FOR LATIGO TRAILS,
EL PASO COUNTY, COLORADO

September 2022

Prepared For:

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Prepared By:

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Colorado Springs, CO 80919
(719) 593-2593

Job No. 25175.02

PCD File No.: SF2136

FILING 9 FDR EXCERPT

APPENDIX D

WATER QUALITY AND DETENTION CALCULATIONS

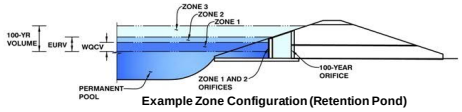
FILING 9 FDR EXCERPT

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Latigo Trails Filing 9

Basin ID: South Pond



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	237.10	acres
Watershed Length =	4,610	ft
Watershed Length to Centroid =	1,845	ft
Watershed Slope =	0.035	ft/ft
Watershed Imperviousness =	13.80%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	1.726	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	3.156	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	3.918	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	7.929	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	11.853	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	18.594	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	23.283	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	29.934	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3 in.) =	39.350	acre-feet	3.00	inches
Approximate 2-yr Detention Volume =	2.083	acre-feet		
Approximate 5-yr Detention Volume =	3.181	acre-feet		
Approximate 10-yr Detention Volume =	5.803	acre-feet		
Approximate 25-yr Detention Volume =	7.671	acre-feet		
Approximate 50-yr Detention Volume =	8.080	acre-feet		
Approximate 100-yr Detention Volume =	10.228	acre-feet		

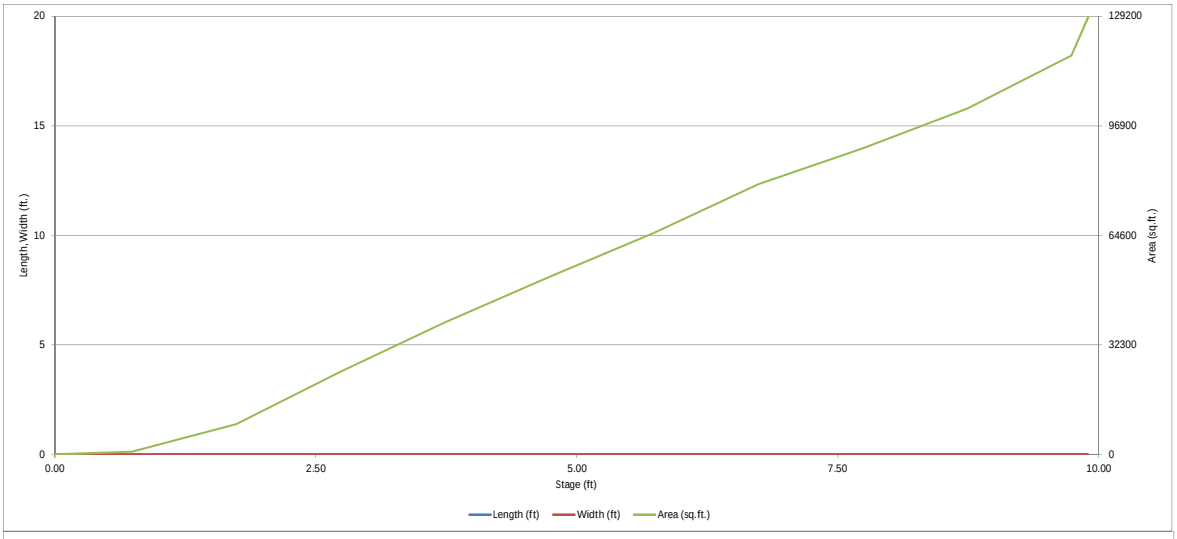
Define Zones and Basin Geometry

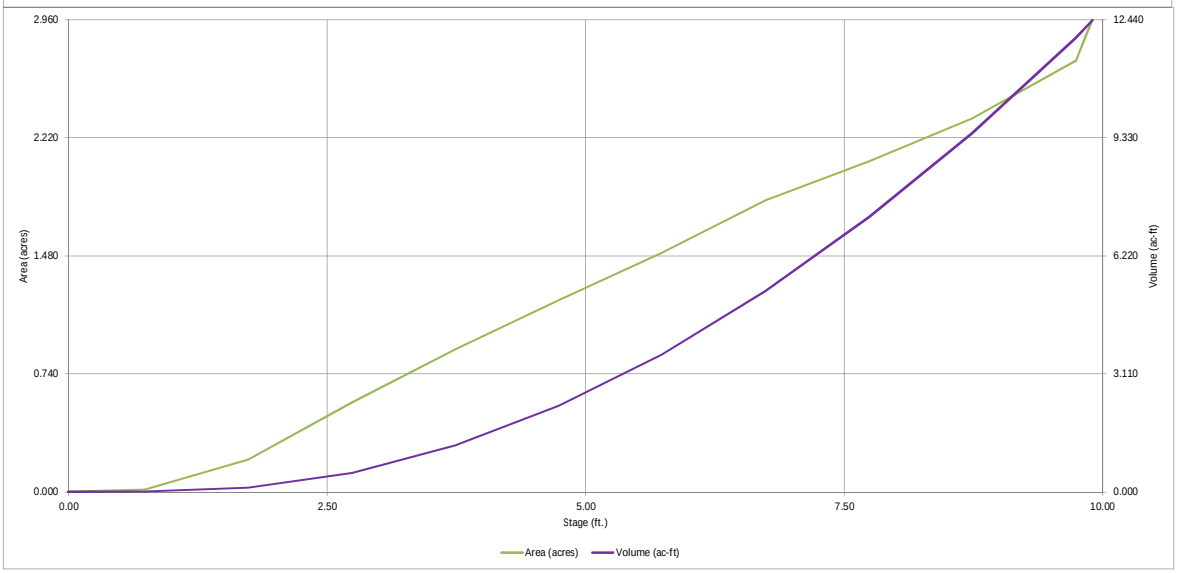
Zone 1 Volume (WQCV) =	1.726	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.429	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	7.073	acre-feet
Total Detention Basin Volume =	10.228	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention 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 = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	0	0.000		
7088	--	0.74	--	--	--	757	0.017	280	0.006
7089	--	1.74	--	--	--	8,862	0.203	5,089	0.117
7090	--	2.74	--	--	--	24,382	0.560	21,711	0.498
7091	--	3.74	--	--	--	39,017	0.896	53,411	1.226
7092	--	4.74	--	--	--	52,356	1.202	99,097	2.275
7093	--	5.74	--	--	--	65,385	1.501	157,968	3.626
7094	--	6.74	--	--	--	79,696	1.830	230,508	5.292
7095	--	7.74	--	--	--	90,272	2.072	315,492	7.243
7096	--	8.74	--	--	--	102,009	2.342	411,633	9.450
7097	--	9.74	--	--	--	117,693	2.702	521,484	11.972
7097.16	--	9.90	--	--	--	128,850	2.958	541,207	12.424

FILING 9 FDR EXCERPT





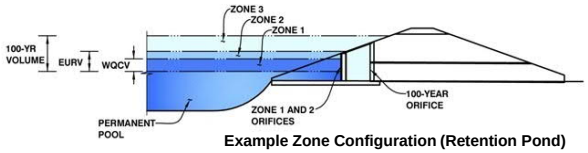
FILING 9 FDR EXCERPT

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: Latigo Trails Filing 9

Basin ID: South Pond



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	4.26	1.726	Orifice Plate
Zone 2 (EURV)	5.42	1.429	Rectangular Orifice
Zone 3 (100-year)	9.07	7.073	Weir&Pipe (Rect.)
Total (all zones)		10.228	

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

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

Calculated Parameters for Underdrain

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	4.26	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	N/A	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	inches	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.00	0.00	0.50	0.50	0.50	1.00	1.00
Orifice Area (sq. inches)	1.11	1.11	1.11	1.00	1.00	1.00	1.00	1.00

	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)	1.00							
Orifice Area (sq. inches)	1.00							

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected			Zone 2 Rectangular	Not Selected	
Invert of Vertical Orifice =	3.98	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	10.42	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	5.42	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.63	N/A	feet
Vertical Orifice Height =	15.00	N/A	inches				
Vertical Orifice Width =	100.00		inches				

Calculated Parameters for Vertical Orifice

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

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	5.90	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	5.90	N/A	feet
Overflow Weir Front Edge Length =	8.33	N/A	feet	Overflow Weir Slope Length =	5.84	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	1.41	N/A	
Horiz. Length of Weir Sides =	5.84	N/A	feet	Overflow Grate Open Area w/o Debris =	33.86	N/A	ft^2
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	33.86	N/A	ft^2
Debris Clogging % =	0%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Rectangular	Not Selected			Zone 3 Rectangular	Not Selected	
Depth to Invert of Outlet Pipe =	0.33	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	24.00	N/A	ft^2
Rectangular Orifice Width =	96.00	N/A	inches	Outlet Orifice Centroid =	1.50	N/A	feet
Rectangular Orifice Height =	36.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.90	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.97	feet
Spillway Crest Length =	120.00	feet	Stage at Top of Freeboard =	9.87	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	2.91	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	12.34	acre-ft

Calculated Parameters for Spillway

Routed Hydrograph Results

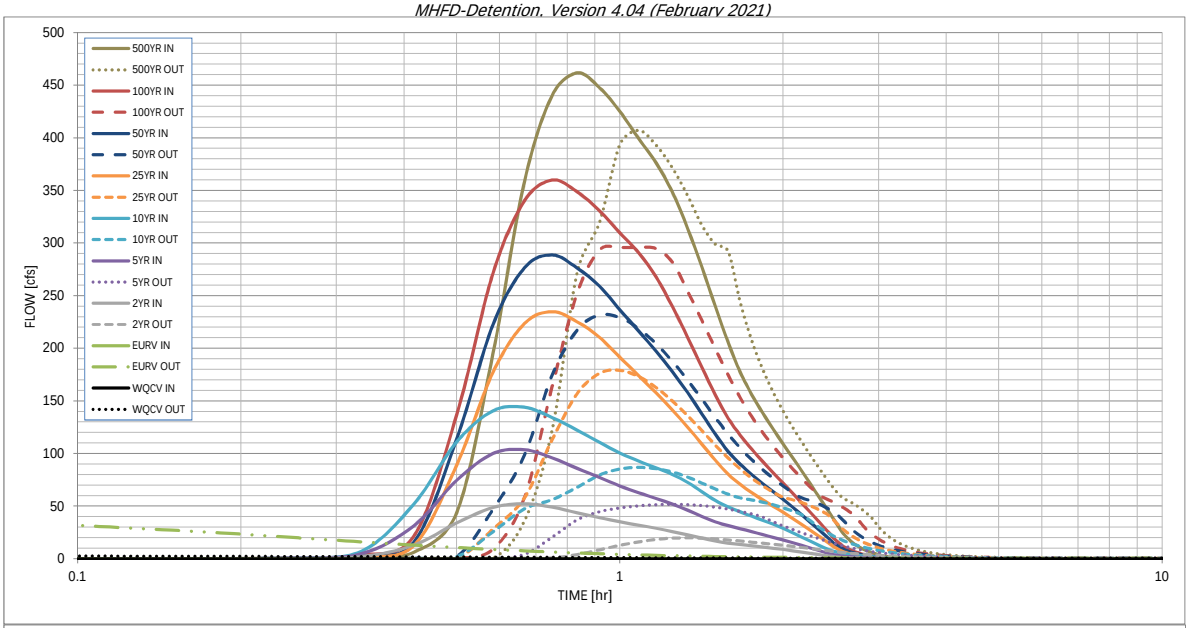
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

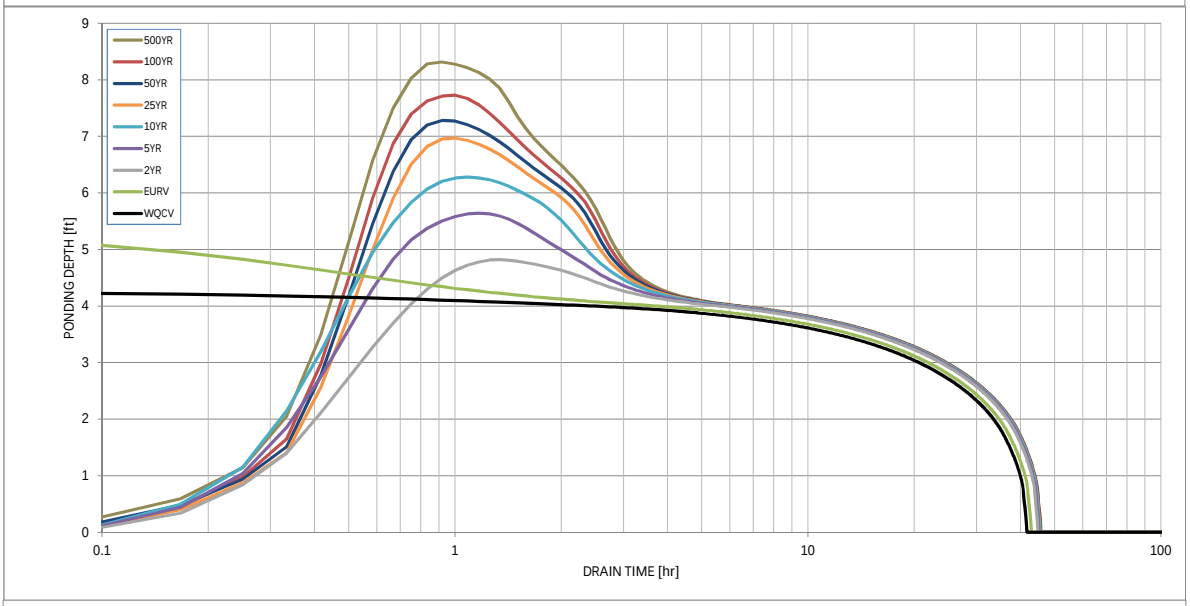
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.00
CUHP Runoff Volume (acre-ft) =	1.726	3.156	3.918	7.929	11.853	18.594	23.283	29.934	39.350
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	3.918	7.929	11.853	18.594	23.283	29.934	39.350
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	26.9	76.5	116.4	206.4	259.5	328.3	428.1
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.11	0.32	0.49	0.87	1.09	1.38	1.81
Peak Inflow Q (cfs) =	N/A	N/A	52.3	103.7	144.0	234.8	288.8	360.0	461.8
Peak Outflow Q (cfs) =	3.0	42.8	20.0	51.8	86.9	179.1	231.7	295.9	407.1
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.7	0.7	0.9	0.9	0.9	1.0
Structure Controlling Flow =	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.6	3.0	4.4	6.1	6.2
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	38	39	35	32	27	24	19	13
Time to Drain 99% of Inflow Volume (hours) =	40	41	42	41	39	37	36	34	31
Maximum Ponding Depth (ft) =	4.26	5.42	4.82	5.64	6.28	6.97	7.28	7.73	8.32
Area at Maximum Ponding Depth (acres) =	1.05	1.41	1.23	1.47	1.68	1.89	1.96	2.07	2.23
Maximum Volume Stored (acre-ft) =	1.733	3.161	2.372	3.478	4.468	5.719	6.315	7.201	8.468

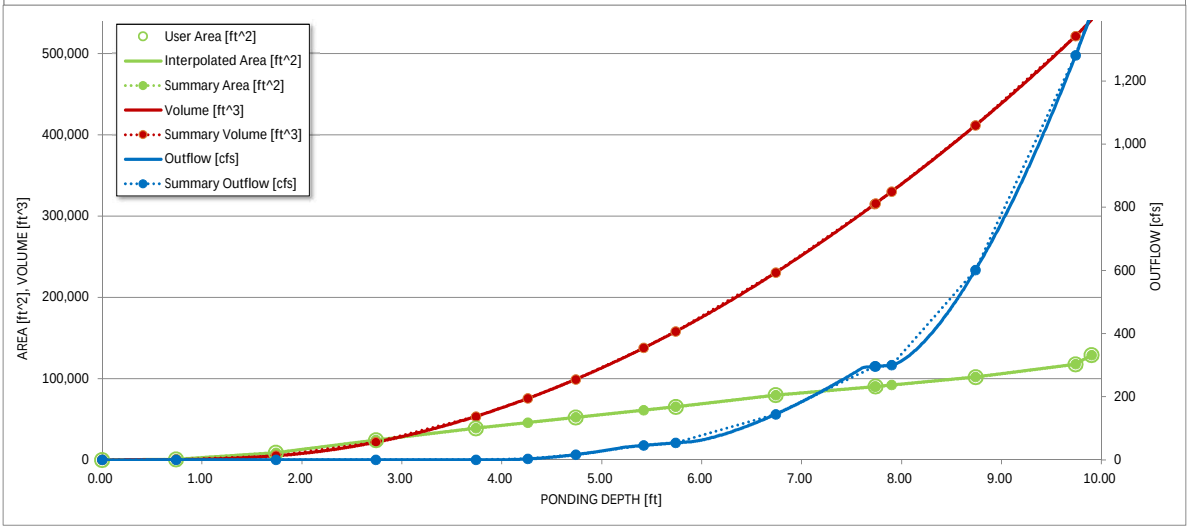
FILING 9 FDR EXCERPT

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)







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

FILING 9 FDR EXCERPT

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.01	0.13
	0:15:00	0.00	0.00	0.46	0.75	0.93	0.62	0.83	0.77	1.14
	0:20:00	0.00	0.00	2.04	4.76	7.12	2.16	2.58	3.43	6.28
	0:25:00	0.00	0.00	12.94	31.39	51.97	12.57	15.84	21.48	43.77
	0:30:00	0.00	0.00	34.10	74.62	111.11	89.16	113.91	136.95	195.01
	0:35:00	0.00	0.00	48.79	100.07	140.66	177.27	222.56	271.44	358.61
	0:40:00	0.00	0.00	52.32	103.67	144.00	223.52	276.51	340.26	440.40
	0:45:00	0.00	0.00	49.14	95.96	134.27	234.82	288.78	359.95	461.81
	0:50:00	0.00	0.00	43.74	86.04	122.30	225.33	276.46	348.93	447.84
	0:55:00	0.00	0.00	39.20	77.44	110.81	210.59	259.12	330.82	425.17
	1:00:00	0.00	0.00	35.15	69.27	100.58	191.38	236.63	309.72	399.16
	1:05:00	0.00	0.00	31.99	62.76	92.83	173.99	216.41	290.73	376.18
	1:10:00	0.00	0.00	29.04	57.37	86.44	157.54	197.20	267.71	348.19
	1:15:00	0.00	0.00	25.89	51.96	80.21	141.30	177.88	239.57	313.96
	1:20:00	0.00	0.00	22.75	46.16	72.66	125.07	157.94	210.42	277.09
	1:25:00	0.00	0.00	19.66	40.28	63.68	109.01	137.77	181.82	239.77
	1:30:00	0.00	0.00	16.94	35.15	55.44	93.60	118.36	155.55	205.61
	1:35:00	0.00	0.00	14.94	31.55	49.35	80.44	101.98	133.68	177.40
	1:40:00	0.00	0.00	13.57	28.67	44.64	70.77	89.98	117.48	156.24
	1:45:00	0.00	0.00	12.40	25.81	40.48	62.94	80.17	104.24	138.77
	1:50:00	0.00	0.00	11.30	23.07	36.66	56.13	71.57	92.51	123.27
	1:55:00	0.00	0.00	10.14	20.44	32.91	49.94	63.76	81.85	109.18
	2:00:00	0.00	0.00	8.95	17.92	28.95	44.18	56.48	71.93	96.04
	2:05:00	0.00	0.00	7.70	15.34	24.77	38.35	49.06	62.24	83.09
	2:10:00	0.00	0.00	6.42	12.72	20.57	32.50	41.58	52.85	70.45
	2:15:00	0.00	0.00	5.17	10.16	16.54	26.76	34.26	43.79	58.26
	2:20:00	0.00	0.00	3.95	7.69	12.72	21.13	27.12	34.84	46.33
	2:25:00	0.00	0.00	2.79	5.35	9.18	15.63	20.18	26.07	34.73
	2:30:00	0.00	0.00	1.83	3.54	6.59	10.41	13.59	17.74	24.05
	2:35:00	0.00	0.00	1.25	2.54	5.06	6.79	9.13	11.93	16.66
	2:40:00	0.00	0.00	0.95	1.99	4.03	4.61	6.40	8.26	11.85
	2:45:00	0.00	0.00	0.75	1.59	3.21	3.22	4.58	5.71	8.40
	2:50:00	0.00	0.00	0.60	1.27	2.56	2.25	3.27	3.86	5.84
	2:55:00	0.00	0.00	0.48	1.01	2.01	1.60	2.36	2.54	3.96
	3:00:00	0.00	0.00	0.37	0.79	1.56	1.15	1.70	1.59	2.59
	3:05:00	0.00	0.00	0.30	0.61	1.18	0.82	1.22	0.99	1.68
	3:10:00	0.00	0.00	0.24	0.46	0.88	0.61	0.91	0.72	1.21
	3:15:00	0.00	0.00	0.20	0.35	0.65	0.47	0.69	0.57	0.93
	3:20:00	0.00	0.00	0.15	0.26	0.49	0.36	0.53	0.45	0.73
	3:25:00	0.00	0.00	0.12	0.18	0.37	0.27	0.41	0.35	0.57
	3:30:00	0.00	0.00	0.09	0.12	0.27	0.20	0.31	0.27	0.43
	3:35:00	0.00	0.00	0.06	0.08	0.19	0.15	0.22	0.19	0.32
	3:40:00	0.00	0.00	0.04	0.05	0.12	0.10	0.15	0.13	0.21
	3:45:00	0.00	0.00	0.02	0.03	0.07	0.06	0.10	0.08	0.13
	3:50:00	0.00	0.00	0.01	0.02	0.03	0.03	0.05	0.04	0.07
	3:55:00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.03
	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

FILING 9 FDR EXCERPT

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Summary Stage-Area-Volume-Discharge Relationships

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

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

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]
Top of Micropool-7087.26	0.00	0	0.000	0	0.000	0.00
7088.00	0.74	757	0.017	280	0.006	0.14
7089.00	1.74	8,862	0.203	5,089	0.117	0.34
7090.00	2.74	24,382	0.560	21,711	0.498	0.47
7091.00	3.74	39,017	0.896	53,411	1.226	0.56
WQCV WSEL-7091.52	4.26	45,953	1.055	75,503	1.733	3.25
7092.00	4.74	52,356	1.202	99,097	2.275	16.75
EURV WSEL-7092.68	5.42	61,216	1.405	137,712	3.161	45.97
7093.00	5.74	65,385	1.501	157,968	3.626	54.15
7094.00	6.74	79,696	1.830	230,508	5.292	144.36
100 Yr WSEL-7094.99	7.73	90,166	2.070	314,590	7.222	295.98
7095.00	7.74	90,272	2.072	315,492	7.243	296.20
Spillway Crest-7095.16	7.90	92,150	2.115	330,086	7.578	299.79
7096.00	8.74	102,009	2.342	411,633	9.450	601.31
7097.00	9.74	117,693	2.702	521,484	11.972	1,280.91
Top of Pond-7097.16	9.90	128,850	2.958	541,207	12.424	1,413.98

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

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

FILING 9 FDR EXCERPT

Drainage Maps

BASIN	DP	Area (Ac.)	Q_5 (cfs)	Q_{100} (cfs)
OSA1	OSA1	3.68	3.7	8.0
OSA2	OSA2	92.80	33.1	128.7
OSA3	OSA3	69.15	29.3	113.6
OSA4	OSA4	32.65	16.0	60.5
OSA5	OSA5	11.33	7.3	28.1
A1	1	7.08	1.8	12.2
A2		19.70	5.1	34.4
	2	232.68	73.5	288.9
A3		11.68	2.9	19.9
	3	12.43	2.7	18.2
A4	4	4.24	1.1	7.6
A5		10.58	2.6	17.7
	5	15.37	3.2	21.6
A6	6	7.35	1.9	12.9
A7		13.62	2.9	19.3
	7	20.51	4.3	29.1
A8	8	2.24	0.6	4.4
A9	9	2.16	0.6	4.4
A10	10	8.08	1.9	13.1
A11	11	7.30	1.8	12.2
A12		8.71	2.1	14.3
	12	10.31	2.6	17.3
A13		13.96	3.4	22.7
	13	26.36	5.3	35.8
A14	14	8.24	2.0	13.4
A15		0.61	0.2	1.2
OSA6	OSA6	3.29	10.3	18.5
B1	B1	3.36	0.9	6.2
B2	B2	0.75	0.2	1.3
B3	B3	4.78	1.2	8.4
B4	B4	6.89	1.9	12.9
B5	B5	1.61	0.5	3.3
B6	B6	12.40	2.9	19.9

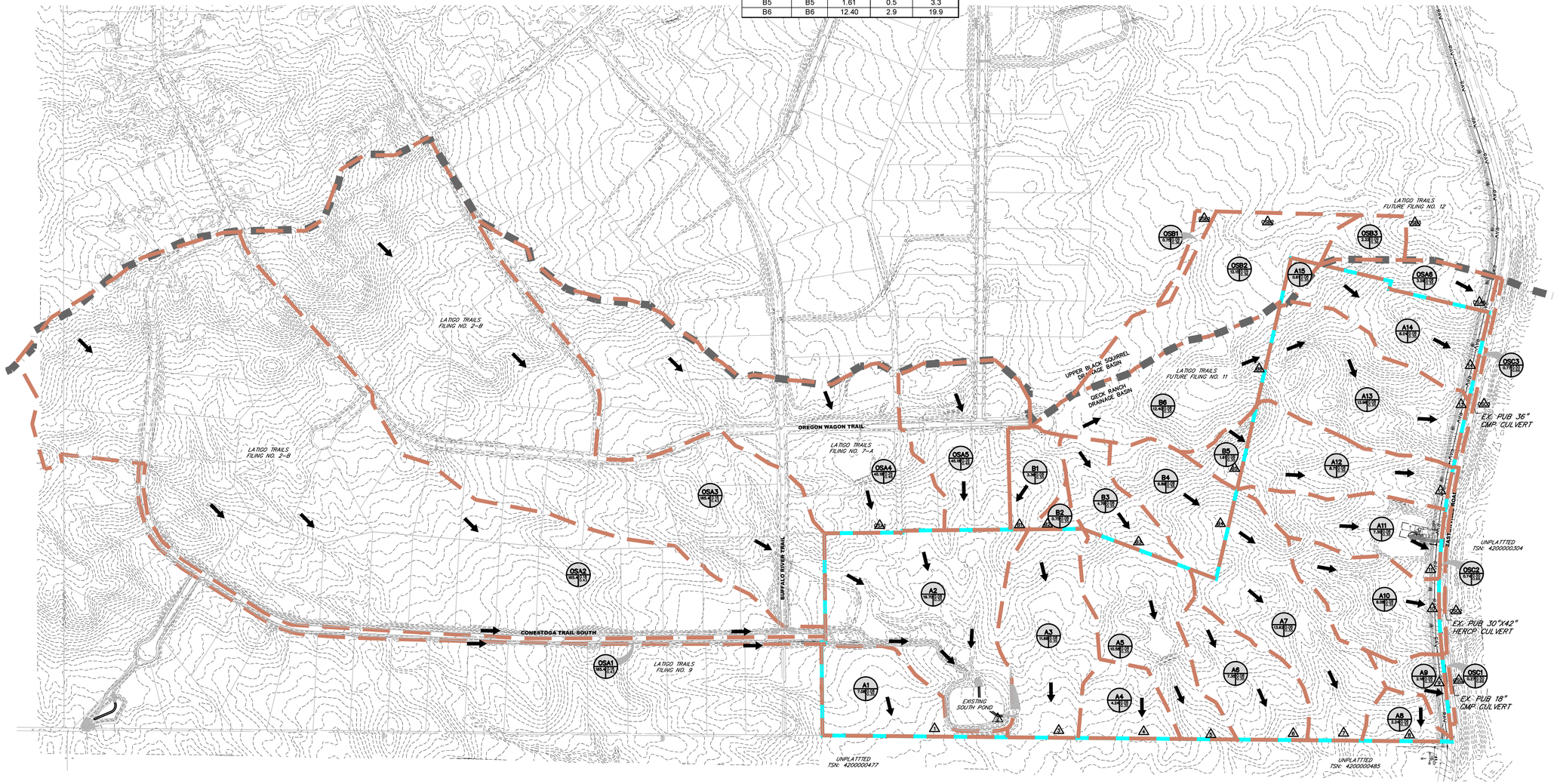
LEGEND

- EX. MINOR CONTOUR
- 6800 EX. MAJOR CONTOUR
- FILING 10 BOUNDARY
- BASIN BOUNDARY
- MAJOR DRAINAGE BASIN BOUNDARY
- FLOW DIRECTION
- DESIGN POINT
- E5 — BASIN; 5.91 (AREA (ACRE)); 0.12 — C5; 0.39 — C100

N

300 120 0 300 600

SCALE: 1"=300'



PREPARED BY:

DREXEL, BARRELL & CO.
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CLIENT:

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5350 S. ROSLYN ST, STE #400
ENGLEWOOD, CO 80111-2125
(303) 694-0862

DRAINAGE DOCUMENTS FOR:

LATIGO TRAILS FILING NO. 10

EL PASO COUNTY
FALCON, COLORADO

ISSUE	DATE
INITIAL ISSUE	9-18-2024
RESUBMITTAL	1-8-2025

DESIGNED BY:	TDM
DRAWN BY:	CGH
CHECKED BY:	KGV
FILE NAME:	21820-01-DRN-EX

PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF DREXEL, BARRELL & CO.

DRAWING SCALE:
HORIZONTAL: 1" = 300'
VERTICAL: N/A

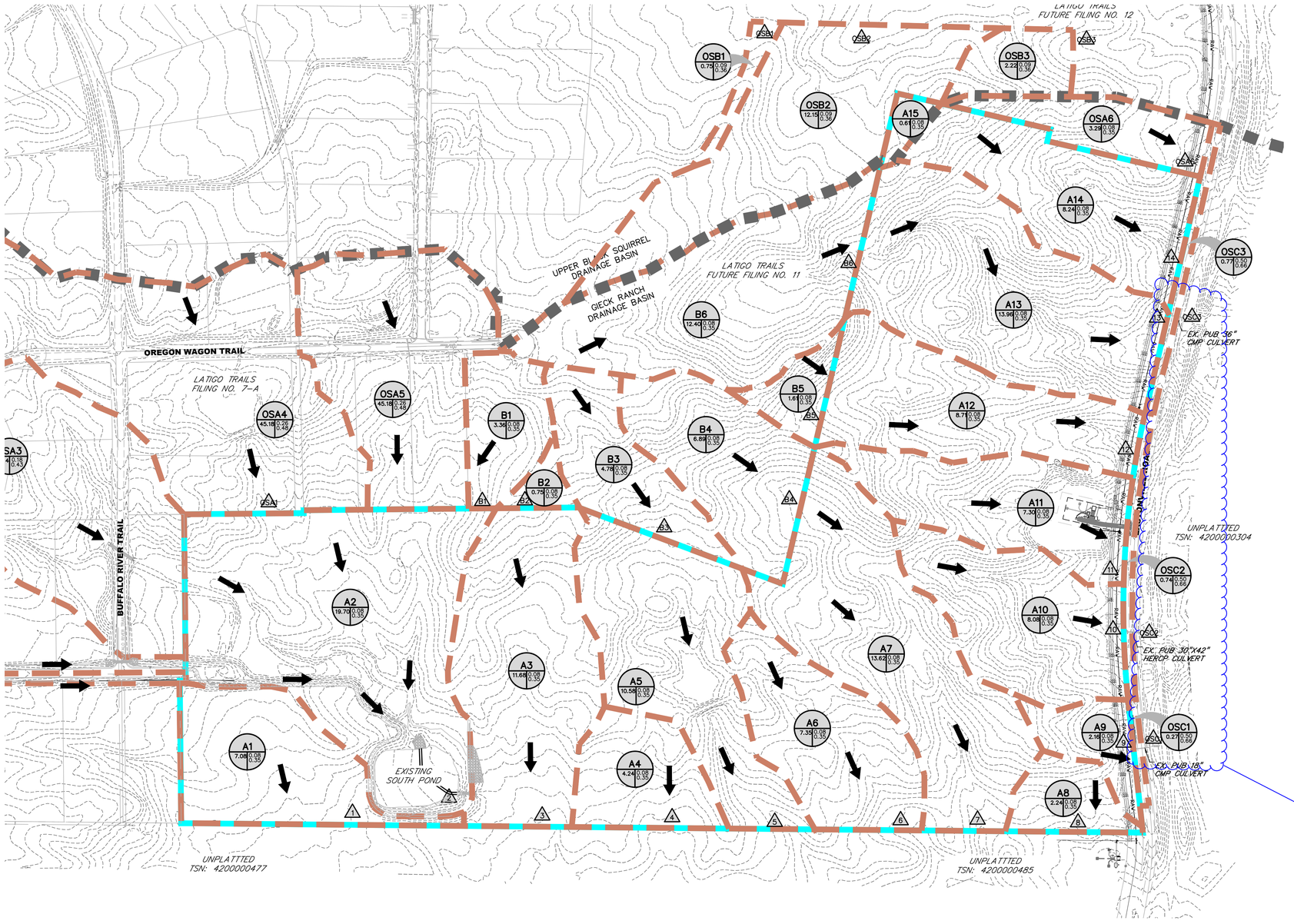
OVERALL EXISTING DRAINAGE MAP

PROJECT NO. 21820-01CSCV

DRAWING NO.

DR1

SHEET: 1 OF 4



200 0 200 400

SCALE: 1"=200'

LEGEND

- EX. MINOR CONTOUR
- 6800 EX. MAJOR CONTOUR
- FILING 10 BOUNDARY
- BASIN BOUNDARY
- MAJOR DRAINAGE BASIN BOUNDARY
- FLOW DIRECTION
- DESIGN POINT
- BASIN
- AREA (ACRE) E5 5.91 0.12 0.35 — C5 / C100

BASIN	DP	Area (Ac.)	Q_5 (cfs)	Q_{100} (cfs)
OSA1	OSA1	3.68	3.7	8.0
OSA2	OSA2	92.80	33.1	128.7
OSA3	OSA3	69.15	29.3	113.6
OSA4	OSA4	32.65	16.0	60.5
OSA5	OSA5	11.33	7.3	28.1
A1	1	7.08	1.8	12.2
A2		19.70	5.1	34.4
	2	232.68	73.5	288.9
A3		11.68	2.9	19.9
	3	12.43	2.7	18.2
A4	4	4.24	1.1	7.6
A5		10.58	2.6	17.7
	5	15.37	3.2	21.6
A6	6	7.35	1.9	12.9
A7		13.62	2.9	19.3
	7	20.51	4.3	29.1
A8	8	2.24	0.6	4.4
A9	9	2.16	0.6	4.4
A10	10	8.08	1.9	13.1
A11	11	7.30	1.8	12.2
A12		8.71	2.1	14.3
	12	10.31	2.6	17.3
A13		13.96	3.4	22.7
	13	26.36	5.3	35.8
A14	14	8.24	2.0	13.4
A15		0.61	0.2	1.2
OSA6	OSA6	3.29	10.3	18.5
B1	B1	3.36	0.9	6.2
B2	B2	0.75	0.2	1.3
B3	B3	4.78	1.2	8.4
B4	B4	6.89	1.9	12.9
B5	B5	1.61	0.5	3.3
B6	B6	12.40	2.9	19.9

PREPARED BY:

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DRAINAGE DOCUMENTS FOR:

LATIGO TRAILS FILING NO. 10

EL PASO COUNTY
FALCON, COLORADO

ISSUE	DATE
INITIAL ISSUE	9-18-2024
RESUBMITTAL	1-8-2025

DESIGNED BY:	TDM
DRAWN BY:	CGH
CHECKED BY:	KGV
FILE NAME:	21820-01-DRN-EX

PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF DREXEL, BARRELL & CO.

DRAWING SCALE:
HORIZONTAL: 1" = 200'
VERTICAL: N/A

EXISTING FILING 10 DRAINAGE MAP

PROJECT NO. 21820-01CSCV

DRAWING NO.

DR2

TRIBUTARY TO EXISTING SOUTH POND

TRIBUTARY TO POND G14b

TRIBUTARY TO POND G18

TRIBUTARY TO POND G19

LARGE LOT SINGLE FAMILY DEVELOPMENT UNTREATED FOR WATER QUALITY (ECM I.7.1.B.5)

0.74–AC AREA UNTREATED FOR WATER QUALITY DUE TO GRADING CONSTRAINTS (ECM I.7.C.1.A)

LEGEND

EX. MINOR CONTOUR

6800 EX. MAJOR CONTOUR

FILING 10 BOUNDARY

BASIN BOUNDARY

MAJOR DRAINAGE BASIN BOUNDARY

FLOW DIRECTION

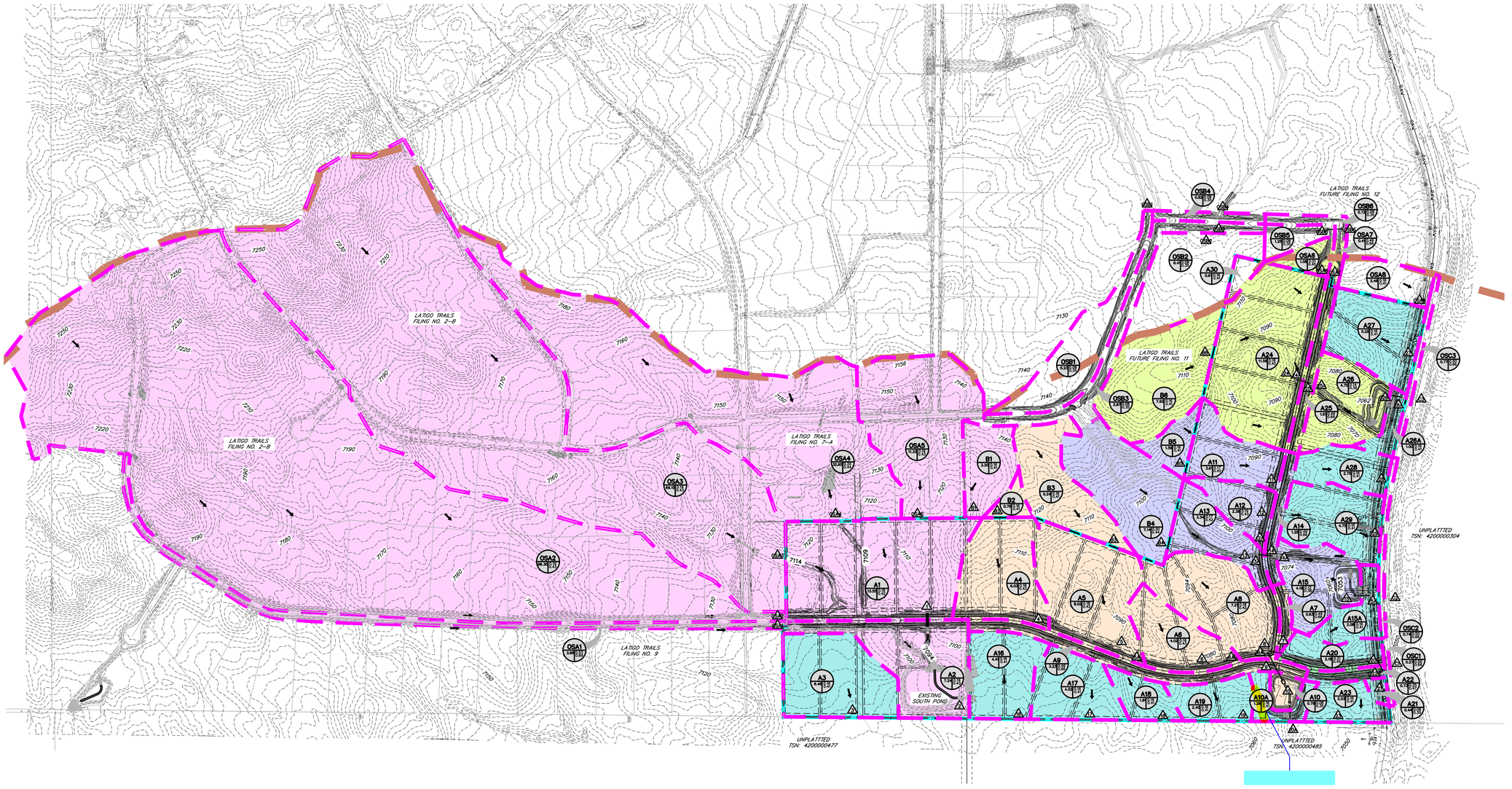
DESIGN POINT

E5 — BASIN
AREA (ACRE) 5.91 0.12 0.38 — C5 C100

N

300 120 0 300 600

SCALE: 1"=300'



PREPARED BY:

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DRAINAGE DOCUMENTS FOR:

LATIGO TRAILS FILING NO. 10

EL PASO COUNTY
FALCON, COLORADO

ISSUE	DATE
INITIAL ISSUE	9–18–2024
RESUBMITTAL	1–8–2025

DESIGNED BY:	TDM
DRAWN BY:	CGH
CHECKED BY:	KGV
FILE NAME:	21820–01–DRN–PF

PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF DREXEL, BARRELL & CO.

DRAWING SCALE:
HORIZONTAL: 1" = 300'
VERTICAL: N/A

OVERALL DEVELOPED DRAINAGE MAP

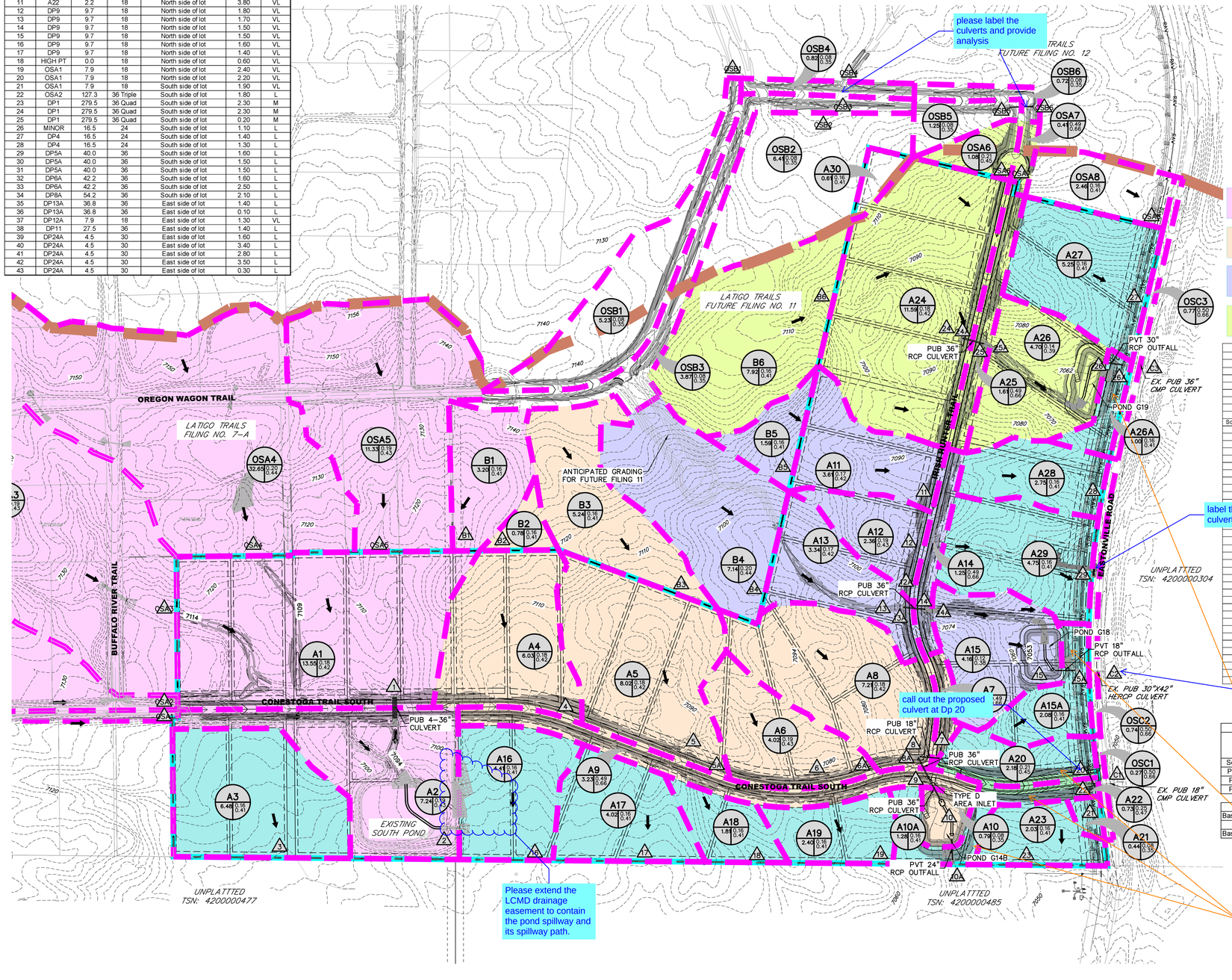
PROJECT NO. 21820–01CSCV

DRAWING NO.

DR3

SHEET: 3 OF 4

Lot Number	Flow Source	100 yr. Flow (cfs)	Culvert Size (in.)	Anticipated Driveway Location (24' width max.)	Ditch Slope (%)	RipRap Sizing
Tract C	OSA4	60.5	36	Future Trail (Lot 23 & 24)	2.00	M
1	DP25	3.1	36	West side of lot	0.90	L
2	DP25	3.1	36	West side of lot	1.80	L
3	DP25	3.1	36	West side of lot	3.20	L
4	DP25	3.1	36	West side of lot	3.10	L
5	DP14	4.9	18	West side of lot	0.90	VL
6	DP14	4.9	18	West side of lot	1.40	VL
7	DP14	4.9	18	West side of lot	1.00	VL
8	DP14	4.9	18	West side of lot	0.90	VL
9	DP20	5.4	18	South side of lot	1.50	VL
10	DP20	5.4	18	South side of lot	3.80	VL
11	A22	2.2	18	North side of lot	3.80	VL
12	DP9	9.7	18	North side of lot	1.80	VL
13	DP9	9.7	18	North side of lot	1.70	VL
14	DP9	9.7	18	North side of lot	1.50	VL
15	DP9	9.7	18	North side of lot	1.50	VL
16	DP9	9.7	18	North side of lot	1.60	VL
17	DP9	9.7	18	North side of lot	1.40	VL
18	HIGH PT	0.0	18	North side of lot	0.60	VL
19	OSA1	7.9	18	North side of lot	2.40	VL
20	OSA1	7.9	18	North side of lot	2.20	VL
21	OSA1	7.9	18	South side of lot	1.90	VL
22	OSA2	127.3	36 Triple	South side of lot	1.80	L
23	DP1	279.5	36 Quad	South side of lot	2.30	M
24	DP1	279.5	36 Quad	South side of lot	2.30	M
25	DP1	279.5	36 Quad	South side of lot	0.20	M
26	MINOR	16.5	24	South side of lot	1.10	L
27	DP4	16.5	24	South side of lot	1.40	L
28	DP4	16.5	24	South side of lot	1.30	L
29	DP5A	40.0	36	South side of lot	1.60	L
30	DP5A	40.0	36	South side of lot	1.50	L
31	DP5A	40.0	36	South side of lot	1.50	L
32	DP6A	42.2	36	South side of lot	1.60	L
33	DP6A	42.2	36	South side of lot	2.50	L
34	DP8A	54.2	36	South side of lot	2.10	L
35	DP13A	36.8	36	East side of lot	1.40	L
36	DP13A	36.8	36	East side of lot	0.10	L
37	DP12A	7.9	18	East side of lot	1.30	VL
38	DP11	27.5	36	East side of lot	1.40	L
39	DP24A	4.5	30	East side of lot	1.60	L
40	DP24A	4.5	30	East side of lot	3.40	L
41	DP24A	4.5	30	East side of lot	2.80	L
42	DP24A	4.5	30	East side of lot	3.50	L
43	DP24A	4.5	30	East side of lot	0.30	L


please label the culverts and provide analysis
LATIGO TRAILS FUTURE FILING NO. 12
LATIGO TRAILS FUTURE FILING NO. 11
LATIGO TRAILS FILING NO. 7-A
OREGON WAGON TRAIL
BUFFALO RIVER TRAIL
CONESTOGA TRAIL SOUTH
ANTICIPATED GRADING FOR FUTURE FILING 11
PUB 36" RCP CULVERT
PUB 4-36" CULVERT
PUB 18" RCP CULVERT
PVT 30" RCP OUTFALL
EX. PUB 36" CMP CULVERT
POND G19
POND G18
PVT 18" RCP OUTFALL
EX. PUB 30"X42" HERCP CULVERT
EX. PUB 18" CMP CULVERT
TYPE D AREA INLET
POND G14B
PVT 24" RCP OUTFALL
EXISTING SOUTH POND
UNPLATTTED TSN: 4200000477
UNPLATTTED TSN: 4200000485
UNPLATTTED TSN: 4200000304
EASTONVILLE ROAD
OSB1 5.23 0.08 0.35
OSB2 6.41 0.08 0.35
OSB3 3.87 0.08 0.35
OSB4 0.82 0.08 0.35
OSB5 1.25 0.08 0.35
OSB6 0.72 0.08 0.35
OSA6 1.08 0.21 0.45
OSA7 0.41 0.48 0.69
OSA8 2.46 0.15 0.41
OSC3 0.77 0.50 0.66
A30 0.61 0.16 0.41
A24 11.56 0.18 0.42
A27 5.25 0.16 0.41
A26 4.70 0.14 0.39
A25 1.61 0.49 0.66
A26A 1.00 0.16 0.41
A28 2.75 0.16 0.41
A29 4.75 0.16 0.41
A14 1.29 0.49 0.66
A15 4.16 0.13 0.36
A15A 2.08 0.16 0.41
A7 1.49 0.66
A20 2.18 0.21 0.45
OSC2 0.74 0.50 0.66
OSC1 0.27 0.50 0.66
A22 0.73 0.25 0.43
A21 0.44 0.18 0.33
A23 2.03 0.16 0.41
A10 0.79 0.08 0.35
A10A 1.28 0.16 0.41
A19 2.40 0.16 0.41
A18 1.81 0.16 0.41
A17 4.02 0.16 0.41
A9 3.23 0.49 0.66
A16 4.41 0.16 0.41
A6 4.02 0.18 0.42
A8 7.24 0.18 0.42
A5 8.02 0.18 0.42
A4 6.03 0.18 0.42
A1 13.59 0.18 0.42
A2 7.24 0.16 0.41
A3 6.48 0.16 0.41
B6 7.92 0.16 0.41
B5 1.59 0.16 0.41
B4 7.14 0.20 0.44
B3 5.24 0.16 0.41
B2 0.78 0.16 0.41
B1 3.20 0.16 0.41
A11 3.61 0.17 0.42
A12 2.36 0.18 0.43
A13 3.30 0.17 0.42
OSA5 11.33 0.19 0.43
OSA4 32.65 0.20 0.44
OSA3
OSA2
OSA1
7156
7150
7140
7130
7120
7110
7100
7090
7080
7070
7062
7053
7074
7114
7169
7084
7200
7210
7220
7230
7240
7250
7260
7270
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