FINAL DRAINAGE REPORT
FOR
LATIGO TRAILS FILING NO. 10
AND
ADDENDUM TO MASTER DEVELOPMENT/
PRELIMINARY DRAINAGE PLAN
FOR LATIGO TRAILS,
EL PASO COUNTY, COLORADO

September 2021

Prepared For:

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Job No. 25175.02

Add text:
PCD File No.:
SF2136

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

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

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

Business Name: BRJM, LLC

By: Bob Irwin

Title:

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 Engineering Criteria Manual, as amended.

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

Conditions:

CONTENTS

PURPOSE

The purpose of this report is to serve as the Final Drainage Report for Latigo Trails Filing 10 known as the "site" from herein, and to amend the "Master Development/Preliminary Drainage Plan for Latigo Trails" (MDDP) by URS, dated October 2001. The proposed Latigo Trails Development that this report covers, known herein as the "proposed development" consists of five filings (9-13). Filing 10 will be discussed further in this report.

This drainage study identifies and analyzes the proposed drainage patterns, determines proposed runoff quantities, sizes drainage facilities, presents solutions to on and off-site drainage impacts resulting from this development, and safely routes developed storm water runoff to the appropriate outfall facilities as delineated in previous reports.

GENERAL LOCATION AND DESCRIPTION

Location

The Latigo Trails proposed development is located within Sections 8, 9, 16, & 17, Township 12 South, Range 64 West of the 6th Principal Meridian, El Paso County, Colorado. The site is bound by Future Latigo Trails Filing 12 to the East, The Trails Filing 2-B and The Trails Filing 7-A and 7-C to the North, The West line of Section 17, Township 12 South, Range 64 West of the Sixth Principal Meridian to the West, and by the Meridian Ranch development to the south. A vicinity map is presented in Appendix A.

Description of Property

The Latigo Trails proposed development contains approximately 599 acres and will be comprised of 176, 2.5 acre lots or larger. Filing 10 consists of 39 of the lots and is 106.6 acres. The site is currently unoccupied and undeveloped. The existing ground cover is sparse vegetation and open space, typical of a Colorado rolling range land condition. It should be noted that Filings 2, 7, and 8 are currently developed, and therefore, this report covers the undeveloped portions, including Filings 9 – 13. Previously developed areas part of the 2001 MDDP for Latigo Trails by URS, will remain unchanged and as is.

Approximately 305 acres will drain to the Gieck Ranch basin. In general the Gieck Ranch basin flows form northwest to southeast across the proposed development.

Filing 10 known as "the site" from herein is comprised of 39 lots. The site is bound by The Trails Filing No. 2-B to the north, single family residences to the west, and by future Latigo Trails Filing No. 12 to the east.

Per a NRCS web soil survey of the area, the site is made up of B soils. Type B soils are typically moderately deep to deep and moderately well drained to well drained soils that have a moderate infiltration when thoroughly wet. A NRCS soil survey map has been presented in Appendix A.

Floodplain Statement

Based on the FEMA FIRM Map numbers 08041C0339G and 0841C0552G, both dated December 7, 2018, the site lies Zone X. Zone X is defined as area outside the Special Flood Hazard Area (SFHA) and higher than the elevation of the 0.2-percent-annual-chance (or 500-year) flood. All proposed development within the site will occur in Zone X.

MAJOR DRAINAGE BASINS AND SUBBASINS

which ones? Name/describe them.

Addendum to Master Development/ Preliminary Drainage Plan

For Trails Filing 10, the MDDP will be amended as follows:

a. Portions of Filing 10 will drain to the existing South Pond. The existing outlet structure and spillway crest will be revised and the pond design per 2021 El Paso County Drainage Criteria.
b. The potential detention areas shown in the MDDP are eliminated and instead developed flows will be conveyed south by a system of swales, and culverts to the two full-spectrum EDBs, the existing South Pond and the proposed G1.
c. Proposed Pond G1 has been sized and designed to meet 2021 El Paso County Drainage Criteria. Pond G19 will be evaluated with the development of future Filings (11-12) and the MDDP shall be amended as needed.

Major Basin Descriptions

The site lies within the Gieck Ranch Drainage Basin. A Master Development Drainage Plan (MDDP) has been 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 "Final Drainage Report Addendum No. 1 for The Trails Filing No. 7 Subdivision," by URS, dated February 2007, and the "Final Drainage Report for the Trails Filing No. 8 and Addendum to Mater Development/Preliminary Drainage Plan for Latigo Trails", by JR Engineering, dated January, 3 2007 are also referenced for this report. Excerpts of referenced reports can be found in Appendix E.

<u>Existing South Pond-Ultimate</u>

The existing South Pond was built with the Trails Filing 7 as described in the "Final Drainage Report Addendum No. 1 for The Trails Filing No. 7 Subdivision" and was sized for the entire upstream developed area based on Water Quality Capture Volume (WQCV), 5-year, and 100-year detention. The existing off-site drainage areas tributary to the existing South Pond were re-analyzed using the Rational Method for the ultimate condition. This assumed the future Filing 12 development would exist and treated those areas with percent impervious reflecting the developed 2.5 acre lots. From this analysis it was determined that 42.3 acres of on-site developed flow and 194.7 acres of off-site developed flows contribute to the pond with 14.0% impervious for flows of 93 and 348 cfs for the 5-

Clarify. Is the needed 10.3 ac-ft volume associated with the existing condition or w/ filing 10 development or ultimate condition (which includes Filing 12)?

and 100-year storm events, respec t the flows entering the pond are 104 and 247 ly. That is based on a total area of 163 acres with a percent imperviousness of 20.0%.

The existing pond sizing was checked by using Urban Drainage and Flood Control District's UD-Detention, Version 4.04 workbook and existing conditions. In the existing condition the pond can detain approximately 11.6 ac-ft. Inputting the basin parameters for the re-analyzed on-site and off-site flows, it was determined that the pond needed approximately 10.3 ac-ft for the 100-year detention volume. It was also determined that the outlet structure and spillway crest needed to be modified to meet the ultimate condition of on-site and off-site contributing area. The spillway is located on the east side of the pond and has an existing approximate elevation of 7095.50'. The UD-Detention spreadsheet for the ultimate condition shows that the spillway needs to be raised to approximately 7095.88' to detain the 100-year volume. It was assumed that a micropool will need to be added to the pond with the top having the elevation of 7087.67'. Additionally, the existing 8.33 ft by 2.92 ft overflow grate will be replaced by a 15 ft by 9 ft overflow grate and orifice plate. The proposed drainage items will meet the required design drain times based on the updated analysis of tributary area. The existing concrete wingwalls will need to be adjusted based on the increase in grate size. The existing South Pond outlet structure is proposed to be revised to provide full-spectrum detention and water quality for the existing tributary basin developed flows and the proposed Filing 10 developed flows in the ultimate condition. It will limit release rates to the south along unnamed ephemeral streams flowing offsite onto the Meridian Ranch development to below historic levels. The existing conditions of the outfall shall be analyzed to ensure they are stable.

The outfall needs to be analyzed with this FDR. Update last sentence to provide a summarize the results. Is the conveyance downstream of the pond hydraulically adequate?

The pond design is summarized below with bullets:

- WQCV: +/- 1.756 acre-ft
- EURV: +/- 3.211 acre-ft
- 100-Year Volume: +/- 11.307 acre-ft
- $Q_{5,in}$: +/- 104.1 cfs
- $Q_{100,in}$: +/- 360.5 cfs
- $Q_{5,out}$: +/- 29.3 cfs
- $Q_{100,out}$: +/- 217.0 cfs
- Spillway: 120 ft to be modified from approx. 7095.50' to 7095.88' elevation, sized for undetained peak. Directs water to the east over the spillway.
- Outlet: 8'W x 3'T RCBC storm sewer released to the east. The existing conditions shall be analyzed to ensure they are stable.

See Appendices B and D for applicable calculations and supporting design information.

Pond G1

The location of deign point G1 in the MDDP has remained consistent in location. The original MDDP developed flows for this design point with an area of 20.3 acres are 21 cfs and 48 cfs for the 5-year and 100-year storms respectively. This report re-analyzed the conditions for the contributing

on-site and off-site basins and calculated a total tributary area of 18.7 acres (16.7 acres on-site, 2.0 acres off-site) with 11 and 41 cfs for the 5- and 100-year storms, respectively. Those are the inflows into proposed Pond G1 which was sized for the ultimate condition and designed per current criteria & full-spectrum design methodology based on WQCV, Excess Urban Runoff Volume (EURV), and 100-year detention. Therefore the release rates will be less than proposed in the MDDP which will be released south into the Meridian Ranch development. Only part of Filing 10 and one off-site basin contribute flows, and no future Latigo Trails Filing Developments will affect these pond flows. Therefore the proposed Filing 10 would be the same as the ultimate design.

The pond design is summarized below with bullets:

- WQCV: +/- 0.121 acre-ft
- EURV: +/- 0.212 acre-ft
- 100-Year Volume: +/- 0.936 acre-ft
- $Q_{5,in}$: +/- 6.7 cfs
- $Q_{100,in}$: +/- 24.4 cfs
- $Q_{5,out}$: +/- 3.8 cfs
- $Q_{100,out}$: +/- 17.0 cfs
- Spillway: 9 ft to at an elevation approx. 4.7 ft above the micropool, sized for undetained peak. Directs water to the south over the spillway.
- Outlet: 30" RCP storm sewer released to the southwest and then connects to an existing 30" RCP. The existing conditions of the depression and existing RCP shall be evaluated to ensure they are stable.

See Appendices B and D for applicable calculations and supporting design information.

Historical Gieck Ranch Drainage Basin

As stated in the approved MDDP report, runoff from the Gieck Ranch Drainage Basin flows to the south and east across the proposed development and drains to small unnamed ephemeral streams flowing onto the Meridian Ranch development to the south and toward Eastonville Road to the east. The approved MDDP proposed that there would be several drainage points from the Gieck Ranch Drainage Basin that discharge to the south: G1, G2, G5, G6, G11a, G11b, G12, G13, G14a, G14b, G15, G17a, G17b, G18, and G19. These roughly totaled a 100-year discharge of 1,256 cfs along the various design points. See the approved values for the calculated flows at each design point.

Proposed Gieck Ranch Drainage Basin

This report proposes that the Filing 10 drainage system 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 split and go either southeast or southwest towards the Meridian Ranch boundary. Though the drainage direction remained the same, the on-site and off-site areas were re-analyzed using the Rational Method as described in the El Paso County Drainage Criteria. A larger area of contributing flow was found compared to the analysis in the "Final Drainage Report Addendum No. 1 for The Trails Filing No. 7

Subdivision" report. Therefore the existing South Pond outlet structure and spillway crest will need to be modified for the proposed Filing 10 development as well as the ultimate condition. There are four full-spectrum ponds within the Gieck Ranch basin proposed for the ultimate development of Latigo Trails Filing 9-12: G1, G18, G19, and the existing South Pond.

Pond G18 shall have been built with the development of Filing 9 and fully built in future Filing 12 as described in the "Final Drainage Report for Latigo Trails Filing No. 9 and Addendum to Master Development/ Preliminary Drainage Plan for Latigo Trails", by JR Engineering, dated September 2021. Pond G19 will be built with future Filings 11-12. Pond G1 shall be built with the development of Filing 10. The existing South Pond outlet structure and spillway crest shall be modified with the development of Filing 10, and then the orifice plate will further be modified for the ultimate condition. In the approved "Master Development/Preliminary Drainage Plan for Latigo Trails" report, there are several possible detention areas that are proposed along the north-half Conestoga Trail South roadway. This report proposes the use of the proposed G1 pond as well as the existing South Pond instead of those proposed possible detention areas.

Excerpts of referenced approved reports are shown in Appendix E and a map of proposed basins is presented in Appendix F.

Proposed Sub-basin Drainage

The proposed basin delineation for Latigo Trials Filing 10 as shown in Appendix F is as follows;

Basin OS2 is approximately 2.12 acres and in its existing condition is comprised of parts of 2 rural lots developed in Trails Filing 2 and part of the existing Conestoga Trail South roadway. Additionally, there is an existing roadside swale. More information about the existing conditions can be found in the approved MDDP or amendments. The historic drainage path generally flows southeast and eventually flows towards the Meridian Ranch development. The basin is off-site and therefore, no work is proposed within that area other than slight modifications where the proposed roadside swale begins. Flow will follow the historic path overland towards DP1 where it will enter Basin A and follow the drainage patterns of that basin as described below towards DP2.1. The peak flow rate for basin at DP1 in the 5 and 100-year storm are 2.1 cfs and 6.9 cfs, respectively. Flows will follow the routed path until they discharge into the existing South Pond.

Basin A is approximately 1.58 acres and the existing conditions were previously analyzed in the approved MDDP report. In the proposed condition it will be rural 2.5 acre lots, part of the Conestoga Trail South road, and a roadway swale. Runoff from this basin will be collected in a roadside swale and conveyed east to DP2 and then along Conestoga Trail South to DP2.1 where the flows are combined with flows from DP1. The peak flow rate for the basin at DP2 in the 5 and 100-year storm are 1.6 cfs and 5.1 cfs, respectively. Flows from DP2.1 (Q_5=3.5 cfs, Q_{100}=11.5 cfs) continue east in the roadside ditch to DP4.1 and eventually the flow will be routed to the existing South Pond.

Basin OS3 is approximately 26.66 acres and in its existing is comprised of parts of 21 rural lots developed in Trails Filing 2, part of the existing Conestoga Trail South, Oregon Wagon Trail, and Purple Mountain Trail roadways. Additionally, there are some existing buildings, existing swales, and culverts that direct flows from the west to east side of Conestoga Trail South. More information about the existing conditions can be found in the approved MDDP or amendments. The historic drainage path generally flows southeast crosses existing culverts that crosses the existing Conestoga Trail South road and eventually flows towards the Meridian Ranch development. The basin is off-site and therefore, no work is proposed within that area. Runoff from this basin will flow south overland and enter into Basin B near DP3. The peak flow rate for the basin at DP3 in the 5 and 100-year storm are 27.6 cfs and 105.5 cfs, respectively. From there they will follow the drainage patterns as described in Basin B towards DP4.1, and eventually be routed to the existing South Pond.

Basin B is approximately 8.71 acres and the existing conditions were previously analyzed in the approved MDDP report. In the proposed condition it will be rural 2.5 acre lots, part of the Conestoga Trail South road, and a roadway swale. Runoff from this basin will be collected in a roadside swale and conveyed east to DP4 and then along Conestoga Trail South to DP4.1 where the flows are combined with flows from DP2.1. The peak flow rate for the basin at DP4 in the 5 and 100-year storm are 4.8 cfs and 19.0 cfs, respectively. Flows from DP4.1 (Q_5=34.7 cfs, Q_{100}=131.6 cfs) continue east in the roadside ditch to DP6.1 and eventually the flow will be routed to the existing South Pond.

Basin OS4 is approximately 3.70 acres and in its existing condition is comprised of parts of 2 rural lots developed in Trails Filing 2 and part of the Purple Mountain Trail roadway. More information about the existing conditions can be found in the approved MDDP or amendments. The historic drainage path generally flows southeast and eventually flows towards the Meridian Ranch development. The basin is off-site and therefore, no work is proposed within that area. Runoff from this basin will flow south overland and enter into Basin C near DP5. The peak flow rate for the basin at DP5 in the 5 and 100-year storm are 2.0 cfs and 8.3 cfs, respectively. From there they will follow the drainage patterns as described in Basin C towards DP6.1, and eventually be routed to the existing South Pond.

Basin C is approximately 5.43 acres and the existing conditions were previously analyzed in the approved MDDP report. In the proposed condition it will be rural 2.5 acre lots, part of the Conestoga Trail South road, and a roadway swale. Runoff from this basin will be collected in a roadside swale and conveyed east to DP6 and then along Conestoga Trail South to DP6.1 where the flows are combined with flows from DP4.1. The peak flow rate for the basin at DP6 in the 5 and 100-year storm are 3.1 cfs and 11.8 cfs, respectively. Flows from DP6.1 (Q_5=37.9 cfs, Q_{100}=145.9 cfs) continue east in the roadside ditch to DP8.1 and eventually the flow will be routed to the existing South Pond.

Basin OS5 is approximately 3.99 acres and in its existing condition is comprised of parts of 4 rural lots developed in Trails Filing 2. More information about the existing conditions can be found in the

approved MDDP or amendments. The historic drainage path generally flows southeast and eventually flows towards the Meridian Ranch development. The basin is off-site and therefore, no work is proposed within that area. Runoff from this basin will flow south overland and enter into Basin D near DP7. The peak flow rate for the basin at DP7 in the 5 and 100-year storm are 2.2 cfs and 9.3 cfs, respectively. From there they will follow the drainage patterns as described in Basin D towards DP8.1, and eventually be routed to the existing South Pond.

Basin D is approximately 7.22 acres and the existing conditions were previously analyzed in the approved MDDP report. In the proposed condition it will be rural 2.5 acre lots, part of the Conestoga Trail South road, and a roadway swale. Runoff from this basin will be collected in a roadside swale and conveyed east to DP8 and then along Conestoga Trail South to DP8.1 where the flows are combined with flows from DP6.1. The peak flow rate for the basin at DP8 in the 5 and 100-year storm are 4.2 cfs and 16.1 cfs, respectively. Flows from DP8.1 (Q_5=41.9 cfs, Q_{100}=163.8 cfs) continue east in the roadside ditch to DP10.1 and eventually the flow will be routed to the existing South Pond.

Basin OS6 is approximately 2.33 acres and in its existing condition is comprised of parts of 5 rural lots developed in Trails Filing 2. More information about the existing conditions can be found in the approved MDDP or amendments. The historic drainage path generally flows southeast and eventually flows towards the Meridian Ranch development. The basin is off-site and therefore, no work is proposed within that area. Runoff from this basin will flow south overland and enter into Basin E near DP9. The peak flow rate for the basin at DP9 in the 5 and 100-year storm are 1.2 cfs and 4.9 cfs, respectively. From there they will follow the drainage patterns as described in Basin E towards DP10.1, and eventually be routed to the existing South Pond.

Basin E is approximately 10.46 acres and the existing conditions were previously analyzed in the approved MDDP report. In the proposed condition it will be rural 2.5 acre lots, part of the Conestoga Trail South road, and a roadway swale. Runoff from this basin will be collected in a roadside swale and conveyed east to DP10 and then along Conestoga Trail South to DP10.1 where the flows are combined with flows from DP8.1. The peak flow rate for the basin at DP10 in the 5 and 100-year storm are 5.6 cfs and 21.3 cfs, respectively. Flows from DP10.1 (Q_5=46.0 cfs, Q_{100}=182.1 cfs) continue east in the roadside ditch and travel through the proposed 29”x45” HERCP to DP12.1 and eventually the flow will be routed to the existing South Pond. The proposed culvert was sized using the peak flow listed and ensured there was enough cover.

Basin OS7 is approximately 63.10 acres and in its existing condition is comprised of parts of 26 rural lots developed in Trails Filing 2, parts of 2 lots developed in Trails Filing 7-C, part of the Conestoga Trail North, and Oregon Wagon Trail roadways. Additionally, there are some existing buildings, existing swales, and culverts that direct flows from the north to south side of Oregon Wagon Trail. More information about the existing conditions can be found in the approved MDDP or amendments. The historic drainage path generally flows southeast and eventually flows towards the Meridian Ranch development. The basin is off-site and therefore, no work is proposed within that area. Runoff

from this basin will flow south and east overland and enter into Basin F near DP11. The peak flow rate for the basin at DP11 in the 5 and 100-year storm are 29.0 cfs and 111.4 cfs, respectively. From there they will follow the drainage patterns as described in Basin F towards DP12.1, and eventually be routed to the existing South Pond.

Basin F is approximately 6.51 acres and the existing conditions were previously analyzed in the approved MDDP report. In its proposed condition it will be rural 2.5 acre lots, part of the Conestoga Trail South road, part of Buffalo River Trail road, and roadside swales. The proposed flows drain east and uses an existing culvert to cross the existing Buffalo River Trail and conveyed south and east to DP12 and then along Conestoga Trail South to DP12.1 where the flows are combined with flows from DP10.1. The peak flow rate for the basin at DP12 in the 5 and 100-year storm are 4.1 cfs and 14.6 cfs, respectively. Flows from DP12.1 (Q_5=73.3 cfs, Q_{100}=284.7 cfs) continue east in the roadside ditch to DP13.1 and eventually the flow will be routed to the existing South Pond.

Basin G is approximately 2.42 acres and the existing conditions were previously analyzed in the approved MDDP report. In the proposed condition it will be the south-half of the proposed Conestoga Trail South paved road as well as the south roadside swale. The basin will flow to the south and then is conveyed east to DP13.1 where the flows are combined with flows from DP12.1. The peak flow rate for the basin at DP13 in the 5 and 100-year storm are 3.6 cfs and 7.8 cfs, respectively. Flows from DP13.1 (Q_5=76.3 cfs, Q_{100}=291.2 cfs) continue east in the roadside ditch to DP14.1 and eventually the flow will be routed to the existing South Pond.

Basin OS8 is approximately 68.29 acres and in its existing condition is comprised of parts of 10 rural lots developed in Trails Filing 2, parts of 12 lots developed in Trails Filing 7, drainage easements for existing South Pond, part of the Oregon Wagon Trail, and part of the Buffalo River Trail roadways. Additionally, there are some existing swales, and culverts that direct flows from the north to south side of Oregon Wagon Trail. In the ultimate condition this will also include parts of 8 rural lots developed with future Filing 12 development. More information about the existing conditions can be found in the approved MDDP or amendments. The historic drainage path generally flows southeast and eventually flows towards the Meridian Ranch development through several existing culverts. The basin is off-site and therefore, no work is proposed within that area. Runoff from this basin will flow south overland and will be routed south and east to DP14 and then to DP14.1 where the flows are combined with flows from DP13.1. The peak flow rate for the basin at DP14 in the 5 and 100-year storm are 23.3 cfs and 95.6 cfs (Ultimate: Q_5=26.9 cfs, Q_{100}=100.5 cfs, respectively. Flows from DP14.1 (Filing 10: Q_5=88.8 cfs, Q_{100}=341.5 cfs, Ultimate: Q_5=92.8 cfs, Q_{100}=348.2 cfs) represent the total routed flow that will be routed to the existing South Pond.

Basin OS1 is approximately 2.00 acres and in its existing condition is comprised of undeveloped areas to the west of our project site. The basin is off-site and therefore, no work is proposed within that area. More information about the existing conditions can be found in the approved MDDP or amendments. Flow will follow the historic path overland from both the north and south towards DP15 where it will enter into Basin H and follow the drainage patterns of that basin as described

below. The peak flow rate for the basin at DP15 in the 5 and 100-year storm are 0.5 cfs and 3.7 cfs, respectively. From there they will follow the drainage patterns as described in Basin H towards DP16.1, and eventually be routed to the proposed G1 Pond.

Basin H is approximately 8.65 acres and the existing conditions were previously analyzed in the approved MDDP report. In the proposed condition it will be rural 2.5 acre lots as well as the part of the south-half of the existing Conestoga Trail South. Runoff from this basin will be collected in roadside swales and conveyed southwest along the proposed Horse Canyon Trail to DP16 and then to DP16.1 where the flows are combined with flows from DP15. The peak flow rate for the basin at DP16 in the 5 and 100-year storm are 5.4 cfs and 20.7 cfs, respectively. Flows from DP16.1 (Q_5=5.9 cfs, Q_{100}=24.1 cfs) continue southwest in the roadside ditch to DP17.1 and eventually the flow will be routed to proposed G1 Pond.

Basin J is approximately 3.69 acres and the existing conditions were previously analyzed in the approved MDDP report. In the proposed condition it will be rural 2.5 acre lots, roadside swales, as well as the proposed Horse Canyon Trail road. Runoff from this basin will be collected in roadside swales and conveyed southwest along the proposed Horse Canyon Trail to DP17 and then to DP17.1 where the flows are combined with flows from DP16.1. The peak flow rate for the basin at DP17 in the 5 and 100-year storm are 4.0 cfs and 12.0 cfs, respectively. Flows from DP17.1 (Q_5=8.6 cfs, Q_{100}=32.4 cfs) continue southwest in the proposed swale to DP18.1 and eventually the flow will be routed to proposed G1 Pond.

Basin K is approximately 4.36 acres and the existing conditions were previously analyzed in the approved MDDP report. In the proposed condition, Basin K will be rural 2.5 acre lots as well as contain the proposed G1 Pond. Runoff from this basin enters flows overland towards the swale near DP18. From DP18, flows travel to DP18.1 where they are combined with the flows from DP17.1. The peak flow rate for the basin at DP18 in the 5 and 100-year storm are 2.6 cfs and 11.0 cfs, respectively. Flows from DP18.1 (Q_5=10.5 cfs, Q_{100}=40.9 cfs) represent the total routed flow that will be routed to the proposed G1 pond.

Basin I is approximately 0.63 acres and the existing conditions were previously analyzed in the approved MDDP report. In the proposed condition it will be rural 2.5 acre lots. Runoff from this basin does not include any roadway flows and therefore follows the historic drainage pattern flowing off-site to the southwest undetained or treated. The peak flow rate for the basin near DP19 in the 5 and 100-year storm are 0.4 cfs and 1.6 cfs, respectively.

Basin L is approximately 2.18 acres and the existing conditions were previously analyzed in the approved MDDP report. In the proposed condition, Basin L will be rural 2.5 acre lots. Runoff from this basin does not include any roadway flows and therefore follows the historic drainage pattern flowing off-site to the south undetained or treated. The peak flow rate for the basin near DP20 in the 5 and 100-year storm are 1.1 cfs and 4.8 cfs, respectively.

Basin M is approximately 15.82 acres and the existing conditions were previously analyzed in the approved MDDP report. In the proposed condition, Basin M will be rural 2.5 acre lots. Runoff from this basin does not include any roadway flows and therefore follows the historic drainage pattern flowing off-site to the south undetained or treated. The peak flow rate for the basin near DP21 in the 5 and 100-year storm are 7.0 cfs and 29.8 cfs, respectively.

Basin N is approximately 10.54 acres and the existing conditions were previously analyzed in the approved MDDP report. In the proposed condition, Basin N will be rural 2.5 acre lots. Runoff from this basin does not include any roadway flows and therefore follows the historic drainage pattern flowing off-site to the south undetained or treated. The peak flow rate for the basin near DP22 in the 5 and 100-year storm are 4.9 cfs and 20.8 cfs, respectively.

Basin O is approximately 5.87 acres and the existing conditions were previously analyzed in the approved MDDP report. In the proposed condition, Basin O will be rural 2.5 acre lots. Runoff from this basin does not include any roadway flows and therefore follows the historic drainage pattern flowing off-site to the south undetained or treated. The peak flow rate for the basin near DP23 in the 5 and 100-year storm are 2.9 cfs and 12.4 cfs, respectively.

Basin P is approximately 13.14 acres and the existing conditions were previously analyzed in the approved MDDP report. In the proposed condition, Basin P will be rural 2.5 acre lots. Runoff from this basin does not include any roadway flows and therefore follows the historic drainage pattern flowing off-site to the south undetained or treated. The peak flow rate for the basin near DP24 in the 5 and 100-year storm are 6.6 cfs and 28.1 cfs, respectively.

A summary of all basin parameters has been presented in Appendix B.

DRAINAGE DESIGN CRITERIA

Development Criteria Reference

Storm drainage analysis and design criteria for the project were taken from the “City of Colorado Spring/El Paso County Drainage Criteria Manual” Volumes 1 and 2 (EPCDCM), dated October 12, 1994, the “Urban Storm Drainage Criteria Manual” Volumes 1 - 3 (USDCM) and Chapter 6 and Section 3.2.1 of Chapter 13 of the “Colorado Springs Drainage Criteria Manual (CCSDCM)”, dated May 2014, as adopted by El Paso County, as well as the July 2019 El Paso County Engineering Criteria Manual update.

Hydrologic Criteria

All hydrologic data was obtained from the “El Paso Drainage Criteria Manual" Volumes 1 and 2, and the “Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual” Volumes 1, 2, and 3. Onsite drainage improvements were designed based on the 5-year (minor) storm event and the 100-year (major) storm event. Rainfall intensities for the 5-year and the 100-year storm return

Revise to City of COS DCM.

frequencies were obtained from Figure 6-5 of the EPC DCM. One hour point rainfall data for the storm events are 1.50 inches for the 5-year and 2.52 inches for the 100-year storm. Rational Method calculations were prepared for sub-basins with areas less than 100 acres, in accordance with EPC DCM Chapter 5.2 for the proposed on-site and off-site drainage basins.

Urban Drainage and Flood Control District's UD-Detention, Version 4.04 workbook was used for pond sizing. Required detention volumes and allowable release rates were designed per USDCM and CCS/EPCDCM. Pond sizing spreadsheets are presented in Appendix D.

Hydraulic Criteria

The Federal Highway Administration's HY-8 program (Volume 7.50) was used to analyze the proposed culverts within the Latigo Trails development. Per Section 6.4.1 of the EPCDCM, culverts were sized as to not overtop the road in the 100 year storm. Culvert design sheets are presented in Appendix C.

Autodesk Inc.'s Hydraflow Express Extension (Volume 10.5) was used for roadside ditch design. For the purposes of this FDR/MDDP, the maximum roadside ditch size was determined based on peak 100-year flows and minimum swale slopes within each basin. Swales were checked for velocity per the EPC DCM Chapter 10, Table 10-4 based on peak 100-year flows and maximum swale slopes. 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 Appendix C.

DRAINAGE FACILITY DESIGN

General Concept-Filing 10

The proposed stormwater conveyance system was designed to convey the developed Latigo Trails Filing 10 flows to one of two full-spectrum EDBs via roadside ditches and local street culverts. Pond G1 is to be fully built and will remain the same in the ultimate condition as no future Latigo Trails developments will contribute additional developed flow. The South Pond outlet structure and spillway crest will be modified with the development of Filing 10. EDBs will be designed to release at less than historic rates to minimize adverse impacts downstream. Undeveloped basins are allowed to follow existing drainage patterns.

clarify that these areas will also be single-family residential lots with >2.5ac per referenced section of App I

typo

Development will be limited to 10% for areas that do not have a water quality feature down steam in order to satisfy Section I.7.1.B.5 of the ECM Stormwater Quality Policy and Procedure. See highlighted areas in the drainage maps presented in Appendix F.

Specific Details

Four Step Process to Minimize Adverse Impacts of Urbanization

In accordance with the El Paso County Drainage Criteria Manual, Volume 2 this site has implemented the four step process to minimize adverse impacts of urbanization. The four step process includes reducing runoff volumes; stabilizing drainageways, treating the water quality capture volume (WQCV), and consider the need for Industrial Commercial BMP's.

Step 1, Reducing Runoff Volumes: The development of the project site is proposed as single family residential (2.5 ac. min.) with lawn areas interspersed within the development which helps disconnect impervious areas and reduce runoff volumes. Roadways will utilize roadside ditches to further disconnect impervious areas. These practices will also allow for increased infiltration and reduce runoff volume.

Step 2, Stabilize Drainageways: This site will utilize roadside ditches with culvert crossings throughout the site. These roadside ditches will then direct the on-site development flows to the multiple detention ponds within the project that will be designed to release at or below historic rates. The roadside ditches will be stabilized in reaches with high velocity (>5 fps) by the use of turf reinforcement mats. Based upon the proposed reduction in released flows compared to the pre-developed flows, no impact to downstream drainageways is anticipated.

Step 3, Provide WQCV: Runoff from this development will be treated through capture and slow release of the WQCV in multiple permanent detention basins that will be designed per current El Paso County drainage criteria.

Step 4, Consider the need for Industrial and Commercial BMP's: No industrial or commercial uses are proposed within this development. However, a site specific storm water quality and erosion control plan and narrative will be prepared for each future Filing. Site specific temporary source control BMPs as well as permanent BMP's will be detailed in this plan and narrative to protect receiving waters.

Water Quality

discuss any of these applicable exclusions.

In accordance with Section 13.3.2.1 of the CCS/EPCDCM, full spectrum water quality and detention will be provided for all of the development site not meeting exclusions present in the ECM - Stormwater Quality Policy and Procedures Section I.7.1.B and C. Any areas of the development site not being included in the site's permeant stormwater management are presented on the proposed Drainage Maps, presented in Appendix F. Outlet structure release rates will be limited to less than historic rates to minimize adverse impacts to downstream stormwater facilities.

On-site basins A-G and off-site basins OS2-8 will contribute flows towards the existing South Pond located to the southeast of the site. The existing off-site drainage areas tributary to the existing South Pond were re-analyzed using the Rational Method and existing conditions for the Filing 10

Clarify. Is the needed 10.3 ac-ft volume associated with the existing condition or w/ filing 10 development or ultimate condition (which includes Filing 12)?

development. From this analysis ed flow and 194.7 acres of off-site developed flows contribute to the pond with 13.1% impervious for flows of 89 and 342 cfs for the 5- and 100-year storm events, respectively.

The existing pond sizing was checked by using Urban Drainage and Flood Control District's UD-Detention, Version 4.04 workbook and existing conditions. In the existing condition the pond can detain approximately 11.6 ac-ft. Inputting the basin parameters for the re-analyzed on-site and off-site flows, it was determined that the pond needed approximately 10.0 ac-ft for the 100-year detention volume. It was also determined that the outlet structure and spillway crest needed to be modified to meet the ultimate condition on-site and off-site contributing area. The spillway is located on the east side of the pond and has an existing approximate elevation of 7095.50'. The UD-Detention spreadsheet for the ultimate condition shows that the spillway needs to be raised to approximately 7095.88' to detain the 100-year volume. It was assumed that a micropool will need to be added to the pond with the top having the elevation of 7087.67'. Additionally, the existing 8.33 ft by 2.92 ft overflow grate will be replaced by a 15 ft by 9 ft overflow grate and orifice plate. The proposed modifications will meet the required design drain times based on the updated analysis of tributary area. The existing concrete wingwalls will need to be adjusted based on the increase in grate size. The existing South Pond outlet structure is proposed to be revised to provide full-spectrum detention and water quality for the existing tributary basin developed flows and the proposed Filing 10 developed flows in the ultimate condition. It will limit release rates from an existing 8'W x 3'T RCBC storm sewer that will outfall to the east and then south along unnamed ephemeral streams flowing offsite on

Explain the two MHFD-Detention worksheet.
One labeled "Latigo Trails Filing 10-Ultimate" and "Latigo Trails Filing 10"

Staff is assuming the outlet structure design with Filing 10 is based on the "Latigo Trails Filing 10" and the "Ultimate" was to set the emergency overflow to it's ultimate elevation when the development is built out (which includes future filing).

The pond design i

- WQCV: +
- EURV: +/
- 100-Year
- $Q_{5,in}$: +/- 1
- $Q_{100,in}$: +/-
- $Q_{5,out}$: +/- 27.0 cfs
- $Q_{100,out}$: +/- 216.3 cfs
- Spillway: 120 ft to be modified from approx. 7095.50' to 7095.88' elevation, sized for undetained peak. Directs water to the east over the spillway.
- Outlet: 8'W x 3'T RCBC storm sewer released to the east. The existing conditions shall be analyzed to ensure they are stable.

See Appendices B and D for applicable calculations and supporting design information.

On-site basins H, J-K and off-site basin OS will contribute flows towards the proposed full-spectrum G1 Pond located at the southwest corner of the project site. Flows from the extended detention basin will be released through the proposed full-spectrum outlet structure. The pond outlet structure is the same as described in the ultimate condition in the Major Basin and Sub-Basin Descriptions above.

Pond design parameters are presented in Appendix D.

Erosion Control Plan

The El Paso County Drainage Criteria Manual specifies an Erosion Control Plan and associated Cost Estimate must be submitted with each Final Drainage Report. The Erosion Control Plan and Cost Estimate shall be submitted prior to obtaining a grading permit.

and drainage

Operation & Maintenance

In order to ensure the function and effectiveness of the stormwater infrastructure, maintenance activities such as inspection, routine maintenance, restorative maintenance, rehabilitation and repair, are required. All proposed drainage structures within the any platted County ROW (roadside ditches and local road culverts) will be owned and maintained by El Paso County. All proposed drainage structures within easements or tracts (full spectrum water quality ponds, drainageway culverts and drainageway improvements) will be owned and maintained by the Latigo Creek Metropolitan District. Inspection access for El Paso County will be provided through a maintenance easement.

Drainage and Bridge Fees

The site is not within an approved drainage basin, therefore, no drainage or bridge fees will be required.

Construction Cost Opinion

(For Information Only / Cost opinion has been p

Revise sentence to identify the drainage basin. Example: "Geick Ranch (CHMS0400) drainage basin is not included in the El Paso County Drainage Basin Fee program therefore no drainage or bridge fees are due at the time of plat recordation."

SUMMARY

The Final Drainage Report for Latigo Trials Filing No. 10 and Addendum to Master Development/ Preliminary Drainage Plan for Latigo Trails analyzed the proposed drainage patterns, determined proposed runoff quantities, sized drainage facilities, presented solutions to on and off-site drainage impacts resulting from this development, safely routed developed storm water runoff to the appropriate outfall facilities as delineated in previous reports, and amended the Master Development/ Preliminary Drainage Plan (MDDP). The proposed Filing 10 site development remains consistent with pre-development drainage conditions with the construction of the recommended drainage improvements as described in the approved MDDP and amended reports. The proposed development will not adversely affect the offsite major drainageways or surrounding development. This report meets the latest El Paso County Drainage Criteria requirements for this site.

REFERENCES:

1. City of Colorado Springs Drainage Criteria Manual Volume 1, City of Colorado Springs, CO, May 2014.

2. Urban Storm Drainage Criteria Manual, Urban Drainage and Flood Control District, Latest Revision.

3. Gieck Ranch Drainage Basin Planning Study, Drexel, Barrell & Co., October 2007 and revised in February 2010.

4. Master Development/ Preliminary Drainage Plan Latigo Trails, URC, October 2001.

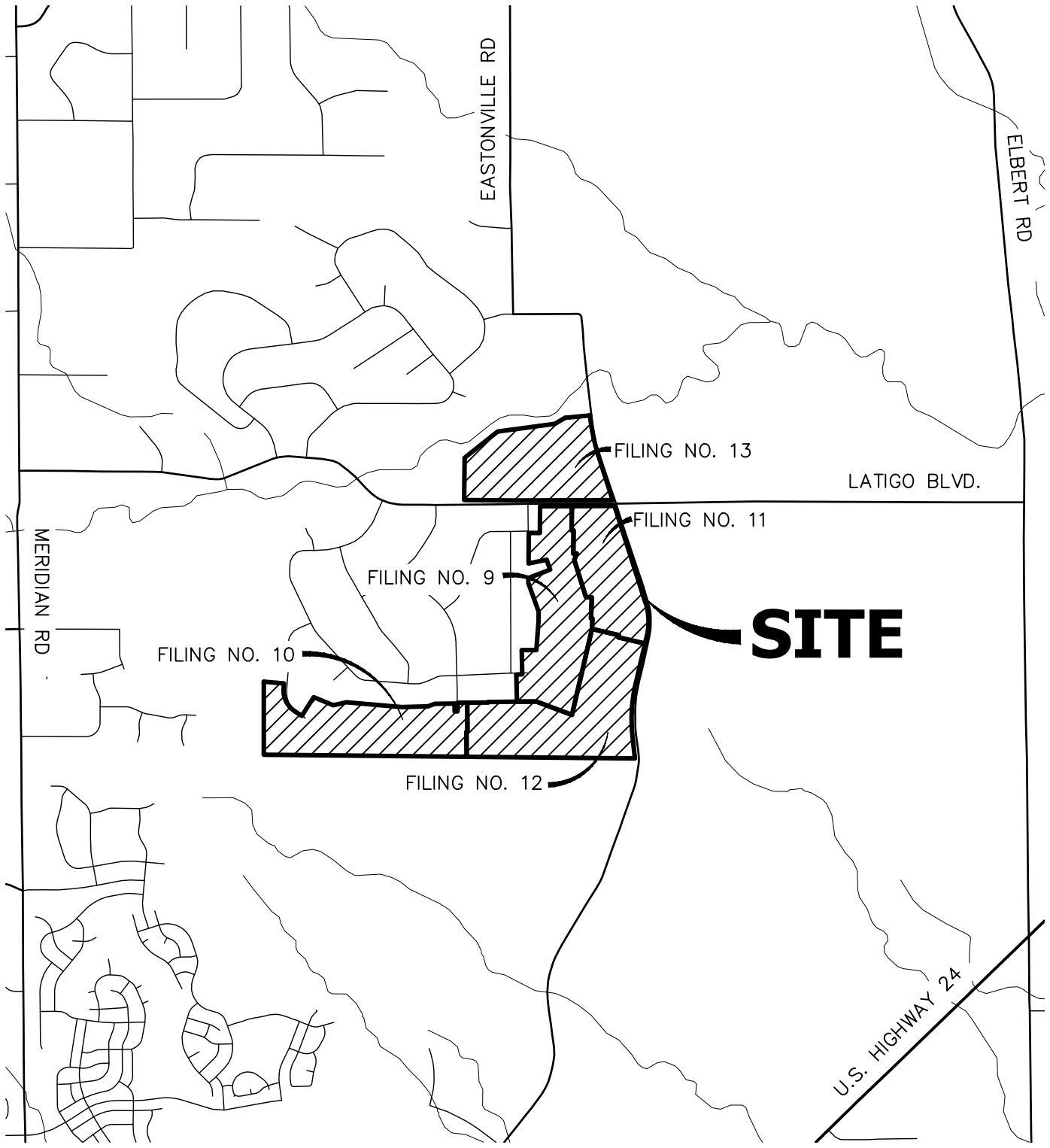
5. Final Drainage Report Addendum No. 1 for The Trails Filing No. 7 Subdivision, URS, February 2007.

6. Final Drainage Report for the Trails Filing No. 8 and Addendum to Master Development/ Preliminary Drainage Plan for Latigo Trails, JR Engineering, January 2007.

7. Final Drainage Report for Latigo Trails Filing No. 9 and Addendum to Master Development/ Preliminary Drainage Plan for Latigo Trails, JR Engineering, September 2021.

APPENDIX A

FIGURES AND EXHIBITS



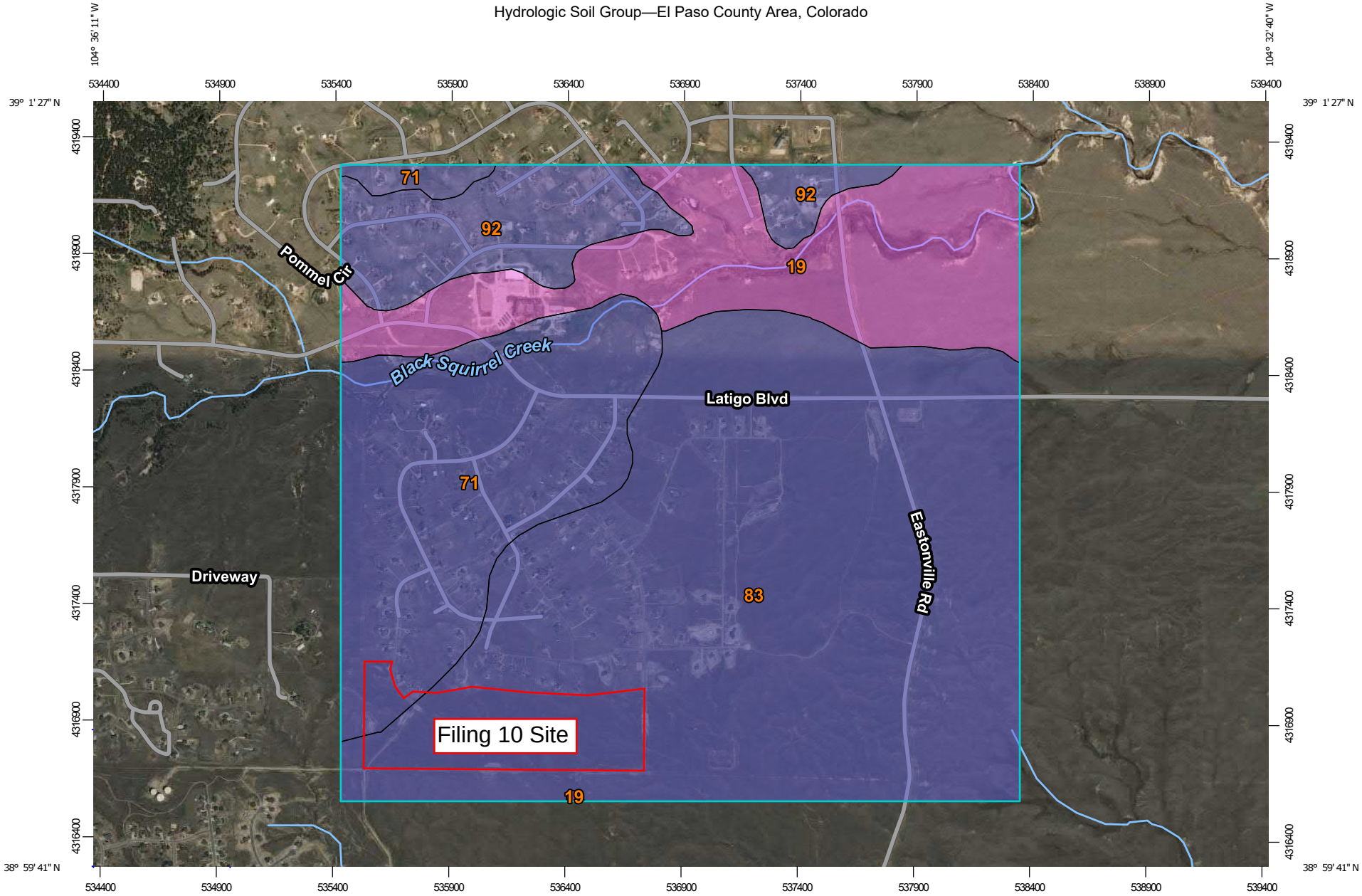
3000 1500 0 3000 6000

ORIGINAL SCALE: 1" = 3000'

VICINITY MAP
LATIGO TRAILS
JOB NO. 25175.01
08/23/21
SHEET 1 OF 1

J·R ENGINEERING
A Westrian Company

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



Map Scale: 1:23,100 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 300 600 1200 1800

Feet: 0 1000 2000 4000 6000

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.

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 18, Jun 5, 2020

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

Date(s) aerial images were photographed: Sep 8, 2018—May 26, 2019

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
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	A	330.2	16.7%
71	Pring coarse sandy loam, 3 to 8 percent slopes	B	393.4	19.9%
83	Stapleton sandy loam, 3 to 8 percent slopes	B	1,081.8	54.7%
92	Tomah-Crowfoot loamy sands, 3 to 8 percent slopes	B	172.5	8.7%
Totals for Area of Interest			**1,977.9**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

NOTES TO USERS

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

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

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

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

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

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

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

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

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

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

This map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map. The profile baselines depicted on this map represent the hydraulic modeling baselines that match the flood profiles and Floodway Data Tables if applicable, in the FIS report. As a result, the profile baselines may deviate significantly from the new base map channel representation and may appear outside of the floodplain.

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

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

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

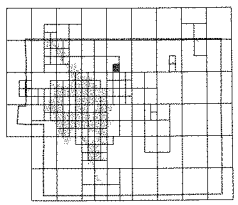
If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

El Paso County Vertical Datum Offset Table

Flooding Source	Vertical Datum Offset (ft)

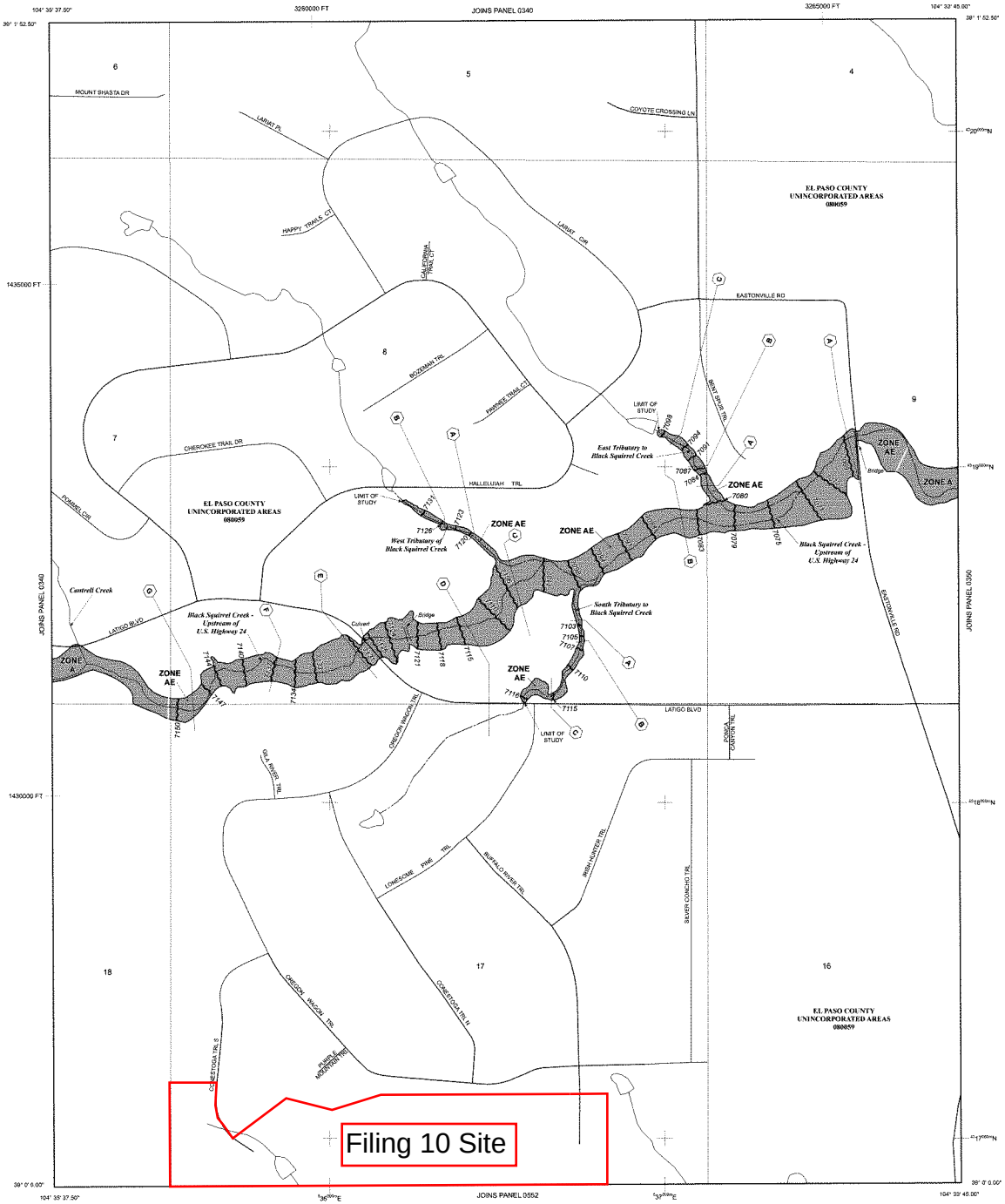
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION

Panel Location Map



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

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



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 12 SOUTH, RANGE 64 WEST.

LEGEND

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

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A No Base Flood Elevations determined.
ZONE AE Base Flood Elevations determined.
ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR Special Flood Hazard Area Formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- Floodplain boundary
- Floodway boundary
- Zone D Boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

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

- A — A — Cross section line
- 23 — 23 — Transect line
- 97° 07' 30.00" / 32° 22' 30.00" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
- 4275000mN — 1000-meter Universal Transverse Mercator grid ticks, zone 13
- 6000000 FT — 5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
- DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

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

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP

PANEL 0339G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 339 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0339	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER
08041C0339G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

NOTES TO USERS

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

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

This map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map. The profile baselines depicted on this map represent the hydraulic modeling baselines that match the flood profiles and Floodway Data Tables if applicable, in the FIS report. As a result, the profile baselines may deviate significantly from the new base map channel representation and may appear outside of the floodplain.

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

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

Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2827 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The MSC may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov/.

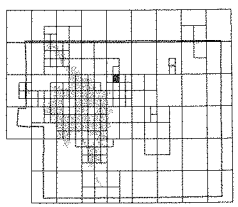
If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

El Paso County Vertical Datum Offset Table

Flooding Source	Vertical Datum Offset (ft)

REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION

Panel Location Map



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

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

LEGEND

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

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A No Base Flood Elevations determined.
ZONE AE Base Flood Elevations determined.
ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR Special Flood Hazard Area Formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

Floodplain boundary
Floodway boundary
Zone D Boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513 — Base Flood Elevation line and value; elevation in feet*
(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*
* Referenced to the North American Vertical Datum of 1988 (NAVD 88)
A — A — Cross section line
23 — 23 — Transect line
97° 07' 30.00" / 32° 22' 30.00" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
4279000mN — 1000-meter Universal Transverse Mercator grid ticks, zone 13
6000000 FT — 5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add cross and road names, and to incorporate previously issued Letters of Map Revision.

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

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'
250 0 500 1000 FEET
150 0 150 300 METERS

NFIP

PANEL 0552G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 552 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0552	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER 08041C0552G

MAP REVISED DECEMBER 7, 2018

Federal Emergency Management Agency

APPENDIX B

HYDROLOGIC CALCULATIONS

PROPOSED COMPOSITE % IMPERVIOUS/C VALUE CALCULATIONS

Subdivision: Latigo Trails — Filing 10-Ultimate
Location: El Paso County — 25175.02
GAG
9/15/21

Basin ID	Total Area (ac)	Hardscape (100% Impervious)				Lawns (0% Impervious)				Basin Total Weighted C		Basins Total Weighted % Imp.
		C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	
A	1.58	0.90	0.96	0.35	22.0%	0.08	0.35	1.23	0.0%	0.26	0.48	22.0%
B	8.71	0.90	0.96	1.09	12.5%	0.08	0.35	7.62	0.0%	0.18	0.43	12.5%
C	5.43	0.90	0.96	0.70	12.9%	0.08	0.35	4.73	0.0%	0.19	0.43	12.9%
D	7.22	0.90	0.96	0.95	13.2%	0.08	0.35	6.27	0.0%	0.19	0.43	13.2%
E	10.46	0.90	0.96	1.44	13.7%	0.08	0.35	9.02	0.0%	0.19	0.43	13.7%
F	6.51	0.90	0.96	1.04	16.0%	0.08	0.35	5.47	0.0%	0.21	0.45	16.0%
G	2.42	0.90	0.96	1.32	54.7%	0.08	0.35	1.10	0.0%	0.53	0.68	54.7%
H	8.65	0.90	0.96	1.18	13.6%	0.08	0.35	7.48	0.0%	0.19	0.43	13.6%
I	0.63	0.90	0.96	0.06	10.0%	0.08	0.35	0.57	0.0%	0.16	0.41	10.0%
J	3.69	0.90	0.96	0.90	24.4%	0.08	0.35	2.79	0.0%	0.28	0.50	24.4%
K	4.36	0.90	0.96	0.44	10.0%	0.08	0.35	3.92	0.0%	0.16	0.41	10.0%
L	2.18	0.90	0.96	0.22	10.0%	0.08	0.35	1.96	0.0%	0.16	0.41	10.0%
M	15.82	0.90	0.96	1.58	10.0%	0.08	0.35	14.24	0.0%	0.16	0.41	10.0%
N	10.54	0.90	0.96	1.05	10.0%	0.08	0.35	9.49	0.0%	0.16	0.41	10.0%
O	5.87	0.90	0.96	0.59	10.0%	0.08	0.35	5.28	0.0%	0.16	0.41	10.0%
P	13.14	0.90	0.96	1.31	10.0%	0.08	0.35	11.83	0.0%	0.16	0.41	10.0%
OS1	2.00	0.90	0.96	0.00	0.0%	0.08	0.35	1.80	0.0%	0.07	0.32	0.0%
OS2	2.12	0.90	0.96	0.40	19.0%	0.08	0.35	1.72	0.0%	0.24	0.47	19.0%
OS3	51.16	0.90	0.96	6.86	13.4%	0.08	0.35	44.30	0.0%	0.19	0.43	13.4%
OS4	3.70	0.90	0.96	0.42	11.4%	0.08	0.35	3.28	0.0%	0.17	0.42	11.4%
OS5	3.99	0.90	0.96	0.40	10.0%	0.08	0.35	3.59	0.0%	0.16	0.41	10.0%
OS6	2.33	0.90	0.96	0.23	10.0%	0.08	0.35	2.10	0.0%	0.16	0.41	10.0%
OS7	63.10	0.90	0.96	8.30	13.2%	0.08	0.35	54.80	0.0%	0.19	0.43	13.2%
OS8	68.29	0.90	0.96	9.63	14.1%	0.08	0.35	58.66	0.0%	0.20	0.44	14.1%
TOTAL ON-SITE	107.21											13.3%
TOTAL OFF-SITE	196.69											13.3%
TOTAL SOUTH POND	237.02											14.0%
TOTAL G1 POND	18.70											11.8%

PROPOSED STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: Latigo Trails
Location: El Paso County

Project Name: Filing 10-Ultimate
Project No.: 25175.02
Calculated By: GAG
Checked By:
Date: 9/15/21

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	K	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (min)
A	1.58	B	22%	0.26	0.48	90	5.0%	8.5	480	4.2%	15.0	3.1	2.6	11.1	570.0	25.5	11.1
B	8.71	B	13%	0.18	0.43	200	3.8%	15.1	830	2.7%	15.0	2.5	5.6	20.7	1030.0	31.7	20.7
C	5.43	B	13%	0.19	0.43	200	2.8%	16.6	585	2.3%	15.0	2.3	4.3	20.9	785.0	29.8	20.9
D	7.22	B	13%	0.19	0.43	200	3.5%	15.4	715	2.9%	15.0	2.5	4.7	20.1	915.0	30.2	20.1
E	10.46	B	14%	0.19	0.43	200	4.5%	14.1	1360	2.2%	15.0	2.2	10.3	24.4	1560.0	37.8	24.4
F	6.51	B	16%	0.21	0.45	200	2.6%	16.5	795	3.5%	15.0	2.8	4.7	21.3	995.0	29.6	21.3
G	2.42	B	55%	0.53	0.68	28	2.0%	4.3	3520	2.2%	20.0	2.9	20.0	24.3	3548.0	40.7	24.3
H	8.65	B	14%	0.19	0.43	200	6.0%	12.9	775	3.4%	15.0	2.8	4.6	17.5	975.0	30.1	17.5
I	0.63	B	10%	0.16	0.41	200	7.1%	12.5	155	7.3%	15.0	4.1	0.6	13.2	355.0	25.2	13.2
J	3.69	B	24%	0.28	0.50	200	9.2%	10.1	435	7.2%	15.0	4.0	1.8	11.9	635.0	24.0	11.9
K	4.36	B	10%	0.16	0.41	200	14.7%	9.9	625	3.6%	15.0	2.8	3.7	13.5	825.0	29.6	13.5
L	2.18	B	10%	0.16	0.41	200	2.5%	17.6	130	2.3%	15.0	2.3	0.9	18.6	330.0	25.7	18.6
M	15.82	B	10%	0.16	0.41	200	2.7%	17.2	1120	2.3%	15.0	2.3	8.2	25.4	1320.0	36.1	25.4
N	10.54	B	10%	0.16	0.41	200	3.4%	16.0	1065	2.6%	15.0	2.4	7.3	23.4	1265.0	34.9	23.4
O	5.87	B	10%	0.16	0.41	200	3.0%	16.7	625	3.8%	15.0	2.9	3.6	20.2	825.0	29.5	20.2
P	13.14	B	10%	0.16	0.41	200	7.4%	12.4	1130	2.8%	15.0	2.5	7.5	19.9	1330.0	35.2	19.9
OS1	2.00	B	0%	0.07	0.32	200	6.0%	14.5	85	0.8%	15.0	1.4	1.0	15.6	285.0	27.7	15.6
OS2	2.12	B	19%	0.24	0.47	30	2.0%	6.8	555	3.9%	15.0	3.0	3.1	9.9	585.0	26.8	9.9
OS3	51.16	B	13%	0.19	0.43	200	5.8%	13.0	1865	3.9%	15.0	2.9	10.5	23.5	2065.0	38.3	23.5
OS4	3.70	B	11%	0.17	0.42	200	3.7%	15.4	515	2.5%	15.0	2.4	3.6	19.0	715.0	29.2	19.0
OS5	3.99	B	10%	0.16	0.41	200	6.4%	13.0	515	2.8%	15.0	2.5	3.4	16.4	715.0	29.3	16.4
OS6	2.33	B	10%	0.16	0.41	200	4.5%	14.6	770	2.0%	15.0	2.1	6.0	20.7	970.0	33.0	20.7
OS7	63.10	B	13%	0.19	0.43	200	7.6%	11.9	2885	2.9%	15.0	2.6	18.8	30.7	3085.0	49.8	30.7

PROPOSED STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: Latigo Trails
Location: El Paso County

Project Name: Filing 10-Ultimate
Project No.: 25175.02
Calculated By: GAG
Checked By:
Date: 9/15/21

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	K	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (min)
OS8	68.29	B	14%	0.20	0.44	200	4.4%	14.2	3885	2.6%	15.0	2.4	26.9	41.0	4085.0	60.3	41.0

NOTES:

$$t_c = t_i + t_t$$

Where:

t_c = computed time of concentration (minutes)

t_i = overland (initial) flow time (minutes)

t_t = channelized flow time (minutes)

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

Where:

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

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

Equation 6-2

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

Where:

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

Equation 6-4

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

Where:

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

Equation 6-3

Table 6-2. NRCS Conveyance factors, K

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

Equation 6-5

PROPOSED STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Latigo Trails
Location: El Paso County
Design Storm: 5-Year

Project Name: Filing 10-Ultimate
Project No.: 25175.02
Calculated By: GAG
Checked By:
Date: 9/15/21

		DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			
STREET	Design Point	Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	REMARKS
	1	OS2	2.12	0.24	9.9	0.50	4.14	2.1												518	3.4	2.5	Flows overland towards DP1 and into A. Flows enter roadside swale and flow towards DP2.1.
	2	A	1.58	0.26	11.1	0.41	3.98	1.6															Flows overland towards roadway swale and then to DP2. Flows combine at DP2.1.
	2.1								12.4	0.91	3.80	3.5								595	4.0	2.5	Combination of flows from DP1 and DP2. Flows along swale to DP4.1.
	3	OS3	51.16	0.19	23.5	9.71	2.84	27.6															Flows overland towards DP3 and into B. Flows combine at DP4.1.
	4	B	8.71	0.18	20.7	1.59	3.04	4.8															Flows overland towards DP4. Flows enter roadway swale and combine at DP4.1
	4.1								23.5	12.21	2.84	34.7								442	4.1	1.8	Combination of flows from DP2.1, DP3, and DP4. Flows along swale to DP6.1.
	5	OS4	3.70	0.17	19.0	0.64	3.17	2.0															Flows overland towards DP5 and into C. Flows combine at DP6.1.
	6	C	5.43	0.19	20.9	1.01	3.02	3.1															Flows overland towards DP6. Flows enter roadway swale and combine at DP6.1
	6.1								25.3	13.86	2.73	37.9								627	6.5	1.6	Combination of flows from DP4.1, DP5, and DP6. Flows along swale to DP8.1.
	7	OS5	3.99	0.16	16.4	0.65	3.38	2.2															Flows overland towards DP7 and into D. Flows combine at DP8.1.
	8	D	7.22	0.19	20.1	1.36	3.08	4.2															Flows overland towards DP8. Flows enter roadway swale and combine at DP8.1
	8.1								27.0	15.87	2.64	41.9								1041	7.4	2.3	Combination of flows from DP6.1, DP7, and DP8. Flows along swale to DP10.1.
	9	OS6	2.33	0.16	20.7	0.38	3.04	1.2															Flows overland towards DP9 and into E. Flows combine at DP10.1.
	10	E	10.46	0.19	24.4	2.01	2.79	5.6															Flows overland towards DP10. Flows enter roadway swale and combine at DP10.1
	10.1								29.3	18.26	2.52	46.0								189	7.7	0.4	Combination of flows from DP8.1, DP9, and DP10. Flows along swale to DP12.1.

PROPOSED STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Latigo Trails
Location: El Paso County
Design Storm: 5-Year

Project Name: Filing 10-Ultimate
Project No.: 25175.02
Calculated By: GAG
Checked By:
Date: 9/15/21

		DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			
STREET	Design Point	Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	REMARKS
	11	OS7	63.10	0.19	30.7	11.85	2.44	29.0												425	2.9	2.4	Flows overland towards DP11 and into F. Flows combine at DP12.1.
	12	F	6.51	0.21	21.3	1.37	3.00	4.1															Flows overland towards DP12. Flows enter roadway swale and combine at DP12.1
	12.1								33.2	31.48	2.33	73.3											Combination of flows from DP10.1, DP11, and DP12. Flows along swale to DP13.1.
	13	G	2.42	0.53	24.3	1.28	2.80	3.6															Flow along south roadway towards DP13. Flows combine at DP13.1
	13.1								33.2	32.76	2.33	76.3											Combination of flows from DP12.1 and DP13. Flows along swale to DP14.1.
	14	OS8	68.29	0.20	41.0	13.36	2.01	26.9															Flows overland towards DP14. Flows enter swale and combine at DP14.1
	14.1								41.0	46.12	2.01	92.8											Combination of flows from DP13.1 and DP14. Flows along swale to South Pond.
	15	OS1	2.00	0.07	15.6	0.14	3.46	0.5															Flows overland towards DP15 and into H. Flows combine at DP16.1.
	16	H	8.65	0.19	17.5	1.66	3.29	5.5															Flows overland towards DP16. Flows combine at DP16.1.
	16.1								17.5	1.80	3.29	5.9								740	3.8	3.2	Combination of flows from DP15 and DP16. Flows along swale to DP17.1.
	17	J	3.69	0.28	11.9	1.03	3.87	4.0															Flows overland towards DP17. Flows along swale to DP17.1.
	17.1								20.8	2.83	3.03	8.6								201	3.3	1.0	Combination of flows from DP16.1 and DP17. Flows along swale to pond at DP18.1.
	18	K	4.36	0.16	13.5	0.71	3.68	2.6															Flows overland towards DP18 via swale. Flows combine in the pond at DP18.1.
	18.1								21.8	3.54	2.96	10.5											Combination of flows from DP16.1, DP17.1, and DP18. Total flow into G1 Pond.

PROPOSED STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Latigo Trails
Location: El Paso County
Design Storm: 5-Year

Project Name: Filing 10-Ultimate
Project No.: 25175.02
Calculated By: GAG
Checked By:
Date: 9/15/21

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	19	I	0.63	0.16	13.2	0.10	3.71	0.4															Flows overland in the direction of DP19 and flows off-site.
	20	L	2.18	0.16	18.6	0.35	3.20	1.1															Flows overland in the direction of DP20 and flows off-site.
	21	M	15.82	0.16	25.4	2.56	2.73	7.0															Flows overland in the direction of DP21 and flows off-site.
	22	N	10.54	0.16	23.4	1.71	2.86	4.9															Flows overland in the direction of DP22 and flows off-site.
	23	O	5.87	0.16	20.2	0.95	3.07	2.9															Flows overland in the direction of DP23 and flows off-site.
	24	P	13.14	0.16	19.9	2.13	3.10	6.6															Flows overland in the direction of DP24 and flows off-site.

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

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

Subdivision: Latigo Trails
Location: El Paso County
Design Storm: 100-Year

Project Name: Filing 10-Ultimate
Project No.: 25175.02
Calculated By: GAG
Checked By:
Date: 9/15/21

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	1	OS2	2.12	0.47	9.9	0.99	6.96	6.9												518	4.7	1.8	Flows overland towards DP1 and into A. Flows enter roadside swale and flow towards DP2.1.
	2	A	1.58	0.48	11.1	0.77	6.68	5.1															Flows overland towards roadway swale and then to DP2. Flows combine at DP2.1.
	2.1								11.7	1.76	6.53	11.5								595	5.4	1.8	Combination of flows from DP1 and DP2. Flows along swale to DP4.1.
	3	OS3	51.16	0.43	23.5	22.09	4.77	105.5															Flows overland towards DP3 and into B. Flows combine at DP4.1.
	4	B	8.71	0.43	20.7	3.71	5.10	18.9															Flows overland towards DP4. Flows enter roadway swale and combine at DP4.1
	4.1								23.5	27.56	4.77	131.6								442	5.7	1.3	Combination of flows from DP2.1, DP3, and DP4. Flows along swale to DP6.1.
	5	OS4	3.70	0.42	19.0	1.55	5.32	8.2															Flows overland towards DP5 and into C. Flows combine at DP6.1.
	6	C	5.43	0.43	20.9	2.33	5.07	11.8															Flows overland towards DP6. Flows enter roadway swale and combine at DP6.1
	6.1								24.8	31.44	4.64	145.9								627	9.1	1.1	Combination of flows from DP4.1, DP5, and DP6. Flows along swale to DP8.1.
	7	OS5	3.99	0.41	16.4	1.64	5.68	9.3															Flows overland towards DP7 and into D. Flows combine at DP8.1.
	8	D	7.22	0.43	20.1	3.11	5.18	16.1															Flows overland towards DP8. Flows enter roadway swale and combine at DP8.1
	8.1								26.0	36.19	4.53	163.8								1041	10.4	1.7	Combination of flows from DP6.1, DP7, and DP8. Flows along swale to DP10.1.
	9	OS6	2.33	0.41	20.7	0.96	5.10	4.9															Flows overland towards DP9 and into E. Flows combine at DP10.1.
	10	E	10.46	0.43	24.4	4.54	4.68	21.3															Flows overland towards DP10. Flows enter roadway swale and combine at DP10.1
	10.1								27.7	41.69	4.37	182.1								189	10.9	0.3	Combination of flows from DP8.1, DP9, and DP10. Flows along swale to DP12.1.

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

Subdivision: Latigo Trails
Location: El Paso County
Design Storm: 100-Year

Project Name: Filing 10-Ultimate
Project No.: 25175.02
Calculated By: GAG
Checked By:
Date: 9/15/21

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	11	OS7	63.10	0.43	30.7	27.15	4.10	111.4												425	4.2	1.7	Flows overland towards DP11 and into F. Flows combine at DP12.1.
	12	F	6.51	0.45	21.3	2.91	5.03	14.6															Flows overland towards DP12. Flows enter roadway swale and combine at DP12.1
	12.1								32.4	71.75	3.97	284.6											Combination of flows from DP10.1, DP11, and DP12. Flows along swale to DP13.1.
	13	G	2.42	0.68	24.3	1.65	4.69	7.7															Flow along south roadway towards DP13. Flows combine at DP13.1
	13.1								32.4	73.40	3.97	291.2											Combination of flows from DP12.1 and DP13. Flows along swale to DP14.1.
	14	OS8	68.29	0.44	41.0	29.78	3.37	100.5															Flows overland towards DP14. Flows enter swale and combine at DP14.1
	14.1								41.0	103.18	3.37	348.2											Combination of flows from DP13.1 and DP14. Flows along swale to South Pond.
	15	OS1	2.00	0.32	15.6	0.63	5.82	3.7															Flows overland towards DP15 and into H. Flows combine at DP16.1.
	16	H	8.65	0.43	17.5	3.74	5.52	20.6															Flows overland towards DP16. Flows combine at DP16.1.
	16.1								17.5	4.37	5.52	24.1								740	5.4	2.3	Combination of flows from DP15 and DP16. Flows along swale to DP17.1.
	17	J	3.69	0.50	11.9	1.84	6.50	12.0															Flows overland towards DP17. Flows along swale to DP17.1.
	17.1								19.8	6.21	5.21	32.4								201	4.0	0.8	Combination of flows from DP16.1 and DP17. Flows along swale to pond at DP18.1.
	18	K	4.36	0.41	13.5	1.79	6.17	11.0															Flows overland towards DP18 via swale. Flows combine in the pond at DP18.1.
	18.1								20.6	8.00	5.11	40.9											Combination of flows from DP16.1, DP17.1, and DP18. Total flow into G1 Pond.

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

Subdivision: Latigo Trails
Location: El Paso County
Design Storm: 100-Year

Project Name: Filing 10-Ultimate
Project No.: 25175.02
Calculated By: GAG
Checked By:
Date: 9/15/21

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	19	I	0.63	0.41	13.2	0.26	6.24	1.6															Flows overland in the direction of DP19 and flows off-site.
	20	L	2.18	0.41	18.6	0.90	5.38	4.8															Flows overland in the direction of DP20 and flows off-site.
	21	M	15.82	0.41	25.4	6.50	4.58	29.8															Flows overland in the direction of DP21 and flows off-site.
	22	N	10.54	0.41	23.4	4.33	4.79	20.8															Flows overland in the direction of DP22 and flows off-site.
	23	O	5.87	0.41	20.2	2.41	5.16	12.4															Flows overland in the direction of DP23 and flows off-site.
	24	P	13.14	0.41	19.9	5.40	5.20	28.1															Flows overland in the direction of DP24 and flows off-site.

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

PROPOSED COMPOSITE % IMPERVIOUS/C VALUE CALCULATIONS

Subdivision: Latigo Trails — Filing 10
Location: El Paso County — 25175.02
GAG
9/15/21

Basin ID	Total Area (ac)	Hardscape (100% Impervious)				Lawns (0% Impervious)				Basin Total Weighted C		Basins Total Weighted % Imp.
		C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	
A	1.58	0.90	0.96	0.35	22.0%	0.08	0.35	1.23	0.0%	0.26	0.48	22.0%
B	8.71	0.90	0.96	1.09	12.5%	0.08	0.35	7.62	0.0%	0.18	0.43	12.5%
C	5.43	0.90	0.96	0.70	12.9%	0.08	0.35	4.73	0.0%	0.19	0.43	12.9%
D	7.22	0.90	0.96	0.95	13.2%	0.08	0.35	6.27	0.0%	0.19	0.43	13.2%
E	10.46	0.90	0.96	1.44	13.7%	0.08	0.35	9.02	0.0%	0.19	0.43	13.7%
F	6.51	0.90	0.96	1.04	16.0%	0.08	0.35	5.47	0.0%	0.21	0.45	16.0%
G	2.42	0.90	0.96	1.32	54.7%	0.08	0.35	1.10	0.0%	0.53	0.68	54.7%
H	8.65	0.90	0.96	1.18	13.6%	0.08	0.35	7.48	0.0%	0.19	0.43	13.6%
I	0.63	0.90	0.96	0.06	10.0%	0.08	0.35	0.57	0.0%	0.16	0.41	10.0%
J	3.69	0.90	0.96	0.90	24.4%	0.08	0.35	2.79	0.0%	0.28	0.50	24.4%
K	4.36	0.90	0.96	0.44	10.0%	0.08	0.35	3.92	0.0%	0.16	0.41	10.0%
L	2.18	0.90	0.96	0.22	10.0%	0.08	0.35	1.96	0.0%	0.16	0.41	10.0%
M	15.82	0.90	0.96	1.58	10.0%	0.08	0.35	14.24	0.0%	0.16	0.41	10.0%
N	10.54	0.90	0.96	1.05	10.0%	0.08	0.35	9.49	0.0%	0.16	0.41	10.0%
O	5.87	0.90	0.96	0.59	10.0%	0.08	0.35	5.28	0.0%	0.16	0.41	10.0%
P	13.14	0.90	0.96	1.31	10.0%	0.08	0.35	11.83	0.0%	0.16	0.41	10.0%
OS1	2.00	0.90	0.96	0.00	0.0%	0.08	0.35	1.80	0.0%	0.07	0.32	0.0%
OS2	2.12	0.90	0.96	0.40	19.0%	0.08	0.35	1.72	0.0%	0.24	0.47	19.0%
OS3	51.16	0.90	0.96	6.86	13.4%	0.08	0.35	44.30	0.0%	0.19	0.43	13.4%
OS4	3.70	0.90	0.96	0.42	11.4%	0.08	0.35	3.28	0.0%	0.17	0.42	11.4%
OS5	3.99	0.90	0.96	0.40	10.0%	0.08	0.35	3.59	0.0%	0.16	0.41	10.0%
OS6	2.33	0.90	0.96	0.23	10.0%	0.08	0.35	2.10	0.0%	0.16	0.41	10.0%
OS7	63.10	0.90	0.96	8.30	13.2%	0.08	0.35	54.80	0.0%	0.19	0.43	13.2%
OS8	68.29	0.90	0.96	7.58	11.1%	0.08	0.35	60.71	0.0%	0.17	0.42	11.1%
TOTAL ON-SITE	107.21											13.3%
TOTAL OFF-SITE	196.69											12.3%
TOTAL SOUTH POND	237.02											13.1%
TOTAL G1 POND	18.70											11.8%

PROPOSED STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: Latigo Trails
Location: El Paso County

Project Name: Filing 10
Project No.: 25175.02
Calculated By: GAG
Checked By:
Date: 9/15/21

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	K	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (min)
A	1.58	B	22%	0.26	0.48	90	5.0%	8.5	480	4.2%	15.0	3.1	2.6	11.1	570.0	25.5	11.1
B	8.71	B	13%	0.18	0.43	200	3.8%	15.1	830	2.7%	15.0	2.5	5.6	20.7	1030.0	31.7	20.7
C	5.43	B	13%	0.19	0.43	200	2.8%	16.6	585	2.3%	15.0	2.3	4.3	20.9	785.0	29.8	20.9
D	7.22	B	13%	0.19	0.43	200	3.5%	15.4	715	2.9%	15.0	2.5	4.7	20.1	915.0	30.2	20.1
E	10.46	B	14%	0.19	0.43	200	4.5%	14.1	1360	2.2%	15.0	2.2	10.3	24.4	1560.0	37.8	24.4
F	6.51	B	16%	0.21	0.45	200	2.6%	16.5	795	3.5%	15.0	2.8	4.7	21.3	995.0	29.6	21.3
G	2.42	B	55%	0.53	0.68	28	2.0%	4.3	3520	2.2%	20.0	2.9	20.0	24.3	3548.0	40.7	24.3
H	8.65	B	14%	0.19	0.43	200	6.0%	12.9	775	3.4%	15.0	2.8	4.6	17.5	975.0	30.1	17.5
I	0.63	B	10%	0.16	0.41	200	7.1%	12.5	155	7.3%	15.0	4.1	0.6	13.2	355.0	25.2	13.2
J	3.69	B	24%	0.28	0.50	200	9.2%	10.1	435	7.2%	15.0	4.0	1.8	11.9	635.0	24.0	11.9
K	4.36	B	10%	0.16	0.41	200	14.7%	9.9	625	3.6%	15.0	2.8	3.7	13.5	825.0	29.6	13.5
L	2.18	B	10%	0.16	0.41	200	2.5%	17.6	130	2.3%	15.0	2.3	0.9	18.6	330.0	25.7	18.6
M	15.82	B	10%	0.16	0.41	200	2.7%	17.2	1120	2.3%	15.0	2.3	8.2	25.4	1320.0	36.1	25.4
N	10.54	B	10%	0.16	0.41	200	3.4%	16.0	1065	2.6%	15.0	2.4	7.3	23.4	1265.0	34.9	23.4
O	5.87	B	10%	0.16	0.41	200	3.0%	16.7	625	3.8%	15.0	2.9	3.6	20.2	825.0	29.5	20.2
P	13.14	B	10%	0.16	0.41	200	7.4%	12.4	1130	2.8%	15.0	2.5	7.5	19.9	1330.0	35.2	19.9
OS1	2.00	B	0%	0.07	0.32	200	6.0%	14.5	85	0.8%	15.0	1.4	1.0	15.6	285.0	27.7	15.6
OS2	2.12	B	19%	0.24	0.47	30	2.0%	6.8	555	3.9%	15.0	3.0	3.1	9.9	585.0	26.8	9.9
OS3	51.16	B	13%	0.19	0.43	200	5.8%	13.0	1865	3.9%	15.0	2.9	10.5	23.5	2065.0	38.3	23.5
OS4	3.70	B	11%	0.17	0.42	200	3.7%	15.4	515	2.5%	15.0	2.4	3.6	19.0	715.0	29.2	19.0
OS5	3.99	B	10%	0.16	0.41	200	6.4%	13.0	515	2.8%	15.0	2.5	3.4	16.4	715.0	29.3	16.4
OS6	2.33	B	10%	0.16	0.41	200	4.5%	14.6	770	2.0%	15.0	2.1	6.0	20.7	970.0	33.0	20.7
OS7	63.10	B	13%	0.19	0.43	200	7.6%	11.9	2885	2.9%	15.0	2.6	18.8	30.7	3085.0	49.8	30.7

PROPOSED STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: Latigo Trails
Location: El Paso County

Project Name: Filing 10
Project No.: 25175.02
Calculated By: GAG
Checked By:
Date: 9/15/21

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	K	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (min)
OS8	68.29	B	11%	0.17	0.42	200	4.4%	14.5	3885	2.6%	15.0	2.4	26.9	41.4	4085.0	62.3	41.4

NOTES:

$$t_c = t_i + t_t$$

Where:

t_c = computed time of concentration (minutes)

t_i = overland (initial) flow time (minutes)

t_t = channelized flow time (minutes)

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

Where:

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

Equation 6-2

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

Where:

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

Equation 6-4

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

Where:

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

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

Equation 6-3

Table 6-2. NRCS Conveyance factors, K

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

Equation 6-5

PROPOSED STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Latigo Trails
Location: El Paso County
Design Storm: 5-Year

Project Name: Filing 10
Project No.: 25175.02
Calculated By: GAG
Checked By:
Date: 9/15/21

		DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			
STREET	Design Point	Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	REMARKS
	1	OS2	2.12	0.24	9.9	0.50	4.14	2.1												518	3.4	2.5	Flows overland towards DP1 and into A. Flows enter roadside swale and flow towards DP2.1.
	2	A	1.58	0.26	11.1	0.41	3.98	1.6															Flows overland towards roadway swale and then to DP2. Flows combine at DP2.1.
	2.1								12.4	0.91	3.80	3.5								595	4.0	2.5	Combination of flows from DP1 and DP2. Flows along swale to DP4.1.
	3	OS3	51.16	0.19	23.5	9.71	2.84	27.6															Flows overland towards DP3 and into B. Flows combine at DP4.1.
	4	B	8.71	0.18	20.7	1.59	3.04	4.8															Flows overland towards DP4. Flows enter roadway swale and combine at DP4.1
	4.1								23.5	12.21	2.84	34.7								442	4.1	1.8	Combination of flows from DP2.1, DP3, and DP4. Flows along swale to DP6.1.
	5	OS4	3.70	0.17	19.0	0.64	3.17	2.0															Flows overland towards DP5 and into C. Flows combine at DP6.1.
	6	C	5.43	0.19	20.9	1.01	3.02	3.1															Flows overland towards DP6. Flows enter roadway swale and combine at DP6.1
	6.1								25.3	13.86	2.73	37.9								627	6.5	1.6	Combination of flows from DP4.1, DP5, and DP6. Flows along swale to DP8.1.
	7	OS5	3.99	0.16	16.4	0.65	3.38	2.2															Flows overland towards DP7 and into D. Flows combine at DP8.1.
	8	D	7.22	0.19	20.1	1.36	3.08	4.2															Flows overland towards DP8. Flows enter roadway swale and combine at DP8.1
	8.1								27.0	15.87	2.64	41.9								1041	7.4	2.3	Combination of flows from DP6.1, DP7, and DP8. Flows along swale to DP10.1.
	9	OS6	2.33	0.16	20.7	0.38	3.04	1.2															Flows overland towards DP9 and into E. Flows combine at DP10.1.
	10	E	10.46	0.19	24.4	2.01	2.79	5.6															Flows overland towards DP10. Flows enter roadway swale and combine at DP10.1

PROPOSED STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Latigo Trails
Location: El Paso County
Design Storm: 5-Year

Project Name: Filing 10
Project No.: 25175.02
Calculated By: GAG
Checked By:
Date: 9/15/21

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	10.1								29.3	18.26	2.52	46.0								189	7.7	0.4	Combination of flows from DP8.1, DP9, and DP10. Flows along swale to DP12.1.
	11	OS7	63.10	0.19	30.7	11.85	2.44	29.0												425	2.9	2.4	Flows overland towards DP11 and into F. Flows combine at DP12.1.
	12	F	6.51	0.21	21.3	1.37	3.00	4.1															Flows overland towards DP12. Flows enter roadway swale and combine at DP12.1
	12.1								33.2	31.48	2.33	73.3											Combination of flows from DP10.1, DP11, and DP12. Flows along swale to DP13.1.
	13	G	2.42	0.53	24.3	1.28	2.80	3.6															Flow along south roadway towards DP13. Flows combine at DP13.1
	13.1								33.2	32.76	2.33	76.3											Combination of flows from DP12.1 and DP13. Flows along swale to DP14.1.
	14	OS8	68.29	0.17	41.4	11.68	2.00	23.3															Flows overland towards DP14. Flows enter swale and combine at DP14.1
	14.1								41.4	44.44	2.00	88.8											Combination of flows from DP13.1 and DP14. Flows along swale to South Pond.
	15	OS1	2.00	0.07	15.6	0.14	3.46	0.5															Flows overland towards DP15 and into H. Flows combine at DP16.1.
	16	H	8.65	0.19	17.5	1.66	3.29	5.5															Flows overland towards DP16. Flows combine at DP16.1.
	16.1								17.5	1.80	3.29	5.9								740	3.8	3.2	Combination of flows from DP15 and DP16. Flows along swale to DP17.1.
	17	J	3.69	0.28	11.9	1.03	3.87	4.0															Flows overland towards DP17. Flows along swale to DP17.1.
	17.1								20.8	2.83	3.03	8.6								201	3.3	1.0	Combination of flows from DP16.1 and DP17. Flows along swale to pond at DP18.1.
	18	K	4.36	0.16	13.5	0.71	3.68	2.6															Flows overland towards DP18 via swale. Flows combine in the pond at DP18.1.
	18.1								21.8	3.54	2.96	10.5											Combination of flows from DP16.1, DP17.1, and DP18. Total flow into G1 Pond.

PROPOSED STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Latigo Trails
Location: El Paso County
Design Storm: 5-Year

Project Name: Filing 10
Project No.: 25175.02
Calculated By: GAG
Checked By:
Date: 9/15/21

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	19	I	0.63	0.16	13.2	0.10	3.71	0.4															Flows overland in the direction of DP19 and flows off-site.
	20	L	2.18	0.16	18.6	0.35	3.20	1.1															Flows overland in the direction of DP20 and flows off-site.
	21	M	15.82	0.16	25.4	2.56	2.73	7.0															Flows overland in the direction of DP21 and flows off-site.
	22	N	10.54	0.16	23.4	1.71	2.86	4.9															Flows overland in the direction of DP22 and flows off-site.
	23	O	5.87	0.16	20.2	0.95	3.07	2.9															Flows overland in the direction of DP23 and flows off-site.
	24	P	13.14	0.16	19.9	2.13	3.10	6.6															Flows overland in the direction of DP24 and flows off-site.

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

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

Subdivision: Latigo Trails
Location: El Paso County
Design Storm: 100-Year

Project Name: Filing 10
Project No.: 25175.02
Calculated By: GAG
Checked By:
Date: 9/15/21

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	1	OS2	2.12	0.47	9.9	0.99	6.96	6.9												518	4.7	1.8	Flows overland towards DP1 and into A. Flows enter roadside swale and flow towards DP2.1.
	2	A	1.58	0.48	11.1	0.77	6.68	5.1															Flows overland towards roadway swale and then to DP2. Flows combine at DP2.1.
	2.1								11.7	1.76	6.53	11.5								595	5.4	1.8	Combination of flows from DP1 and DP2. Flows along swale to DP4.1.
	3	OS3	51.16	0.43	23.5	22.09	4.77	105.5															Flows overland towards DP3 and into B. Flows combine at DP4.1.
	4	B	8.71	0.43	20.7	3.71	5.10	18.9															Flows overland towards DP4. Flows enter roadway swale and combine at DP4.1
	4.1								23.5	27.56	4.77	131.6								442	5.7	1.3	Combination of flows from DP2.1, DP3, and DP4. Flows along swale to DP6.1.
	5	OS4	3.70	0.42	19.0	1.55	5.32	8.2															Flows overland towards DP5 and into C. Flows combine at DP6.1.
	6	C	5.43	0.43	20.9	2.33	5.07	11.8															Flows overland towards DP6. Flows enter roadway swale and combine at DP6.1
	6.1								24.8	31.44	4.64	145.9								627	9.1	1.1	Combination of flows from DP4.1, DP5, and DP6. Flows along swale to DP8.1.
	7	OS5	3.99	0.41	16.4	1.64	5.68	9.3															Flows overland towards DP7 and into D. Flows combine at DP8.1.
	8	D	7.22	0.43	20.1	3.11	5.18	16.1															Flows overland towards DP8. Flows enter roadway swale and combine at DP8.1
	8.1								26.0	36.19	4.53	163.8								1041	10.4	1.7	Combination of flows from DP6.1, DP7, and DP8. Flows along swale to DP10.1.
	9	OS6	2.33	0.41	20.7	0.96	5.10	4.9															Flows overland towards DP9 and into E. Flows combine at DP10.1.
	10	E	10.46	0.43	24.4	4.54	4.68	21.3															Flows overland towards DP10. Flows enter roadway swale and combine at DP10.1

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

Subdivision: Latigo Trails
Location: El Paso County
Design Storm: 100-Year

Project Name: Filing 10
Project No.: 25175.02
Calculated By: GAG
Checked By:
Date: 9/15/21

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	10.1								27.7	41.69	4.37	182.1								189	10.9	0.3	Combination of flows from DP8.1, DP9, and DP10. Flows along swale to DP12.1.
	11	OS7	63.10	0.43	30.7	27.15	4.10	111.4												425	4.2	1.7	Flows overland towards DP11 and into F. Flows combine at DP12.1.
	12	F	6.51	0.45	21.3	2.91	5.03	14.6															Flows overland towards DP12. Flows enter roadway swale and combine at DP12.1
	12.1								32.4	71.75	3.97	284.6											Combination of flows from DP10.1, DP11, and DP12. Flows along swale to DP13.1.
	13	G	2.42	0.68	24.3	1.65	4.69	7.7															Flow along south roadway towards DP13. Flows combine at DP13.1
	13.1								32.4	73.40	3.97	291.2											Combination of flows from DP12.1 and DP13. Flows along swale to DP14.1.
	14	OS8	68.29	0.42	41.4	28.52	3.35	95.6															Flows overland towards DP14. Flows enter swale and combine at DP14.1
	14.1								41.4	101.92	3.35	341.5											Combination of flows from DP13.1 and DP14. Flows along swale to South Pond.
	15	OS1	2.00	0.32	15.6	0.63	5.82	3.7															Flows overland towards DP15 and into H. Flows combine at DP16.1.
	16	H	8.65	0.43	17.5	3.74	5.52	20.6															Flows overland towards DP16. Flows combine at DP16.1.
	16.1								17.5	4.37	5.52	24.1								740	5.4	2.3	Combination of flows from DP15 and DP16. Flows along swale to DP17.1.
	17	J	3.69	0.50	11.9	1.84	6.50	12.0															Flows overland towards DP17. Flows along swale to DP17.1.
	17.1								19.8	6.21	5.21	32.4								201	4.0	0.8	Combination of flows from DP16.1 and DP17. Flows along swale to pond at DP18.1.
	18	K	4.36	0.41	13.5	1.79	6.17	11.0															Flows overland towards DP18 via swale. Flows combine in the pond at DP18.1.
	18.1								20.6	8.00	5.11	40.9											Combination of flows from DP16.1, DP17.1, and DP18. Total flow into G1 Pond.

PROPOSED STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Latigo Trails
Location: El Paso County
Design Storm: 100-Year

Project Name: Filing 10
Project No.: 25175.02
Calculated By: GAG
Checked By:
Date: 9/15/21

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	19	I	0.63	0.41	13.2	0.26	6.24	1.6															Flows overland in the direction of DP19 and flows off-site.
	20	L	2.18	0.41	18.6	0.90	5.38	4.8															Flows overland in the direction of DP20 and flows off-site.
	21	M	15.82	0.41	25.4	6.50	4.58	29.8															Flows overland in the direction of DP21 and flows off-site.
	22	N	10.54	0.41	23.4	4.33	4.79	20.8															Flows overland in the direction of DP22 and flows off-site.
	23	O	5.87	0.41	20.2	2.41	5.16	12.4															Flows overland in the direction of DP23 and flows off-site.
	24	P	13.14	0.41	19.9	5.40	5.20	28.1															Flows overland in the direction of DP24 and flows off-site.

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

APPENDIX C

HYDRAULIC CALCULATIONS

Channel Report

5: DP1 to DP2.1

Triangular

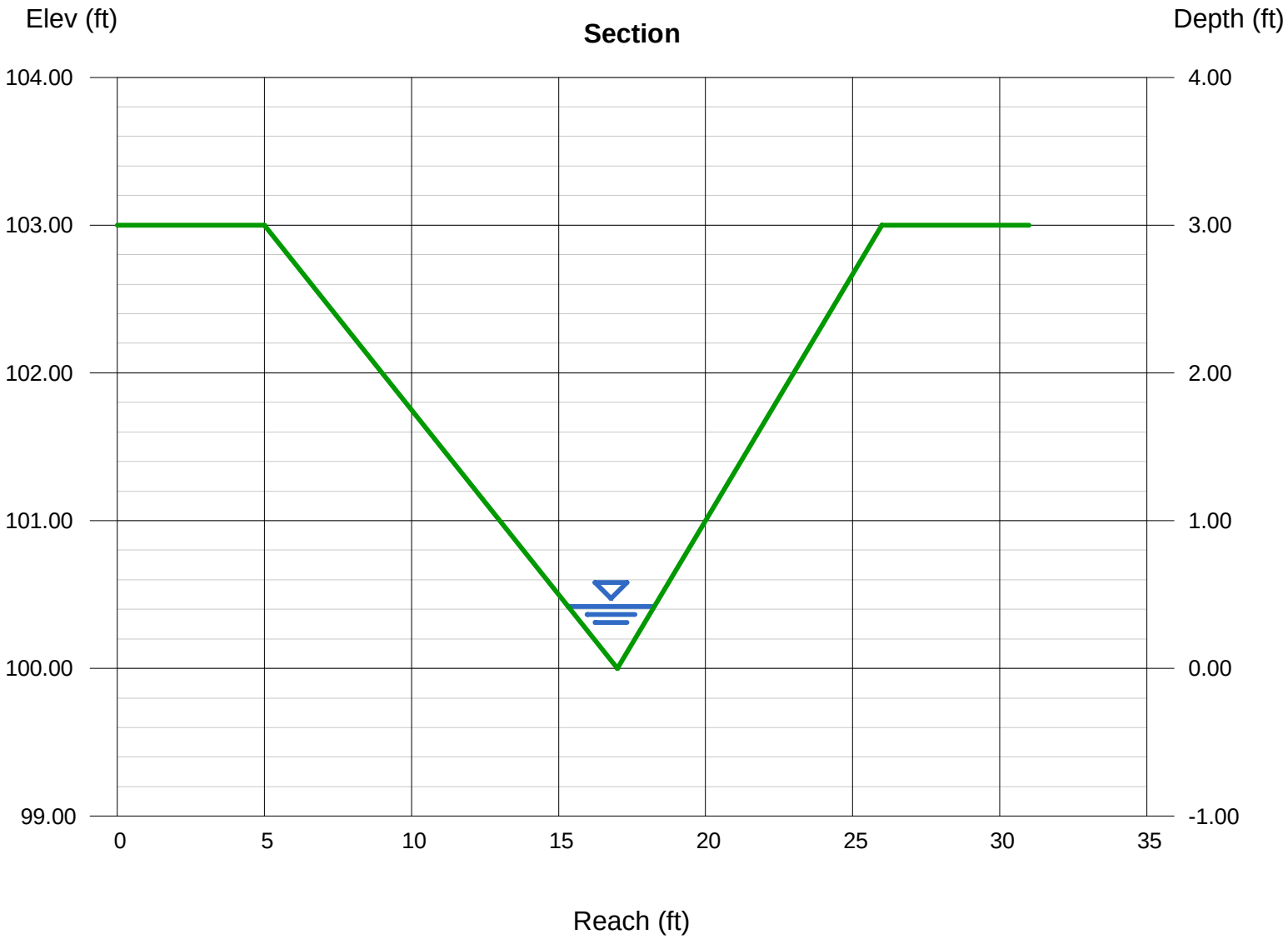
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 100.00
Slope (%)	= 4.21
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 2.10

Highlighted

Depth (ft)	= 0.42
Q (cfs)	= 2.100
Area (sqft)	= 0.62
Velocity (ft/s)	= 3.40
Wetted Perim (ft)	= 3.06
Crit Depth, Yc (ft)	= 0.47
Top Width (ft)	= 2.94
EGL (ft)	= 0.60



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Sep 16 2021

100: DP1 to DP2.1

Triangular

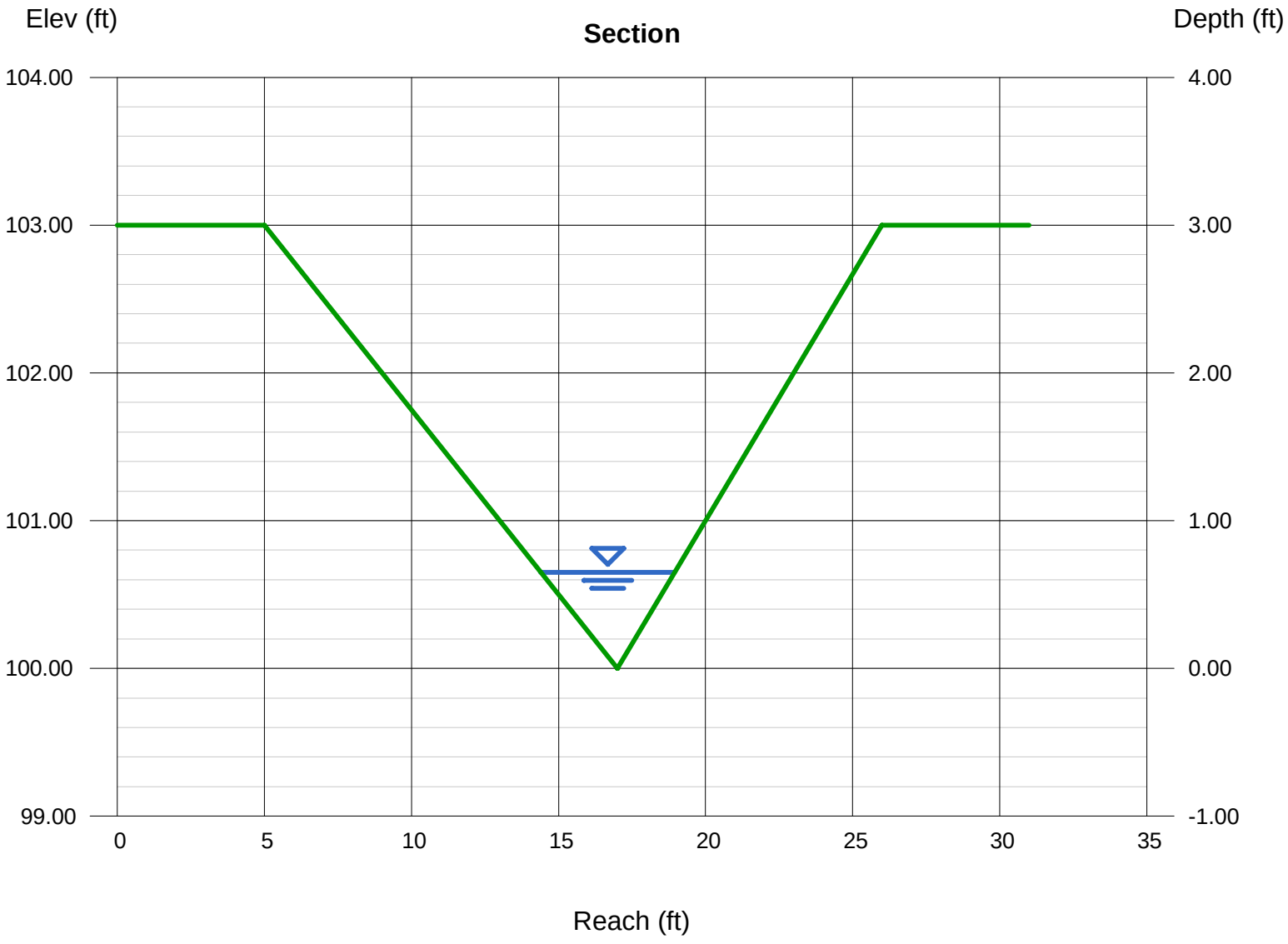
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 100.00
Slope (%)	= 4.21
N-Value	= 0.030

Calculations

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

Highlighted

Depth (ft)	= 0.65
Q (cfs)	= 6.900
Area (sqft)	= 1.48
Velocity (ft/s)	= 4.67
Wetted Perim (ft)	= 4.74
Crit Depth, Yc (ft)	= 0.76
Top Width (ft)	= 4.55
EGL (ft)	= 0.99



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Sep 16 2021

100: DP1 to DP2.1- Capacity

Triangular

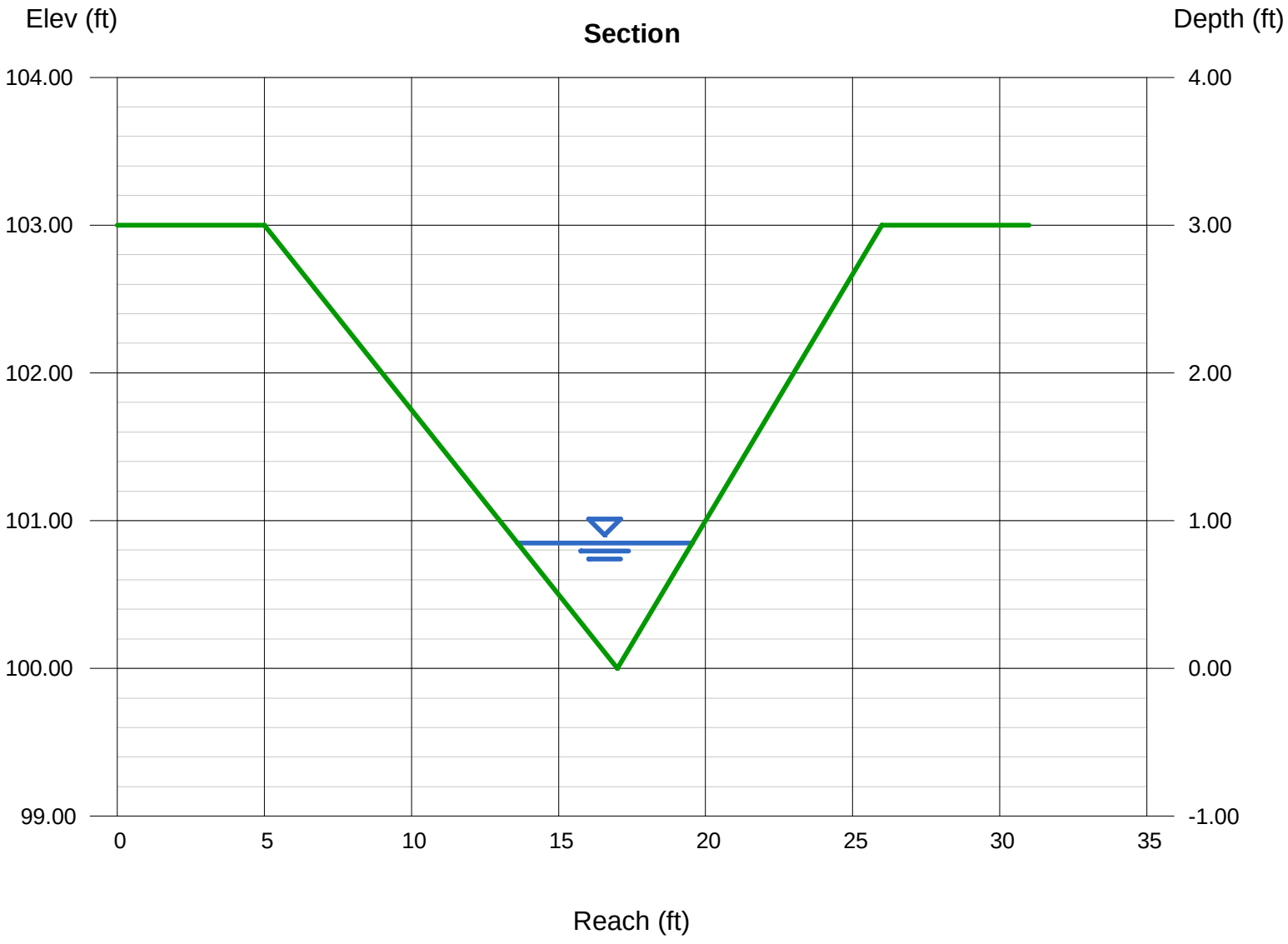
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 100.00
Slope (%)	= 1.06
N-Value	= 0.030

Calculations

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

Highlighted

Depth (ft)	= 0.85
Q (cfs)	= 6.900
Area (sqft)	= 2.53
Velocity (ft/s)	= 2.73
Wetted Perim (ft)	= 6.19
Crit Depth, Yc (ft)	= 0.76
Top Width (ft)	= 5.95
EGL (ft)	= 0.97



Channel Report

5: DP2.1 to DP4.1

Triangular

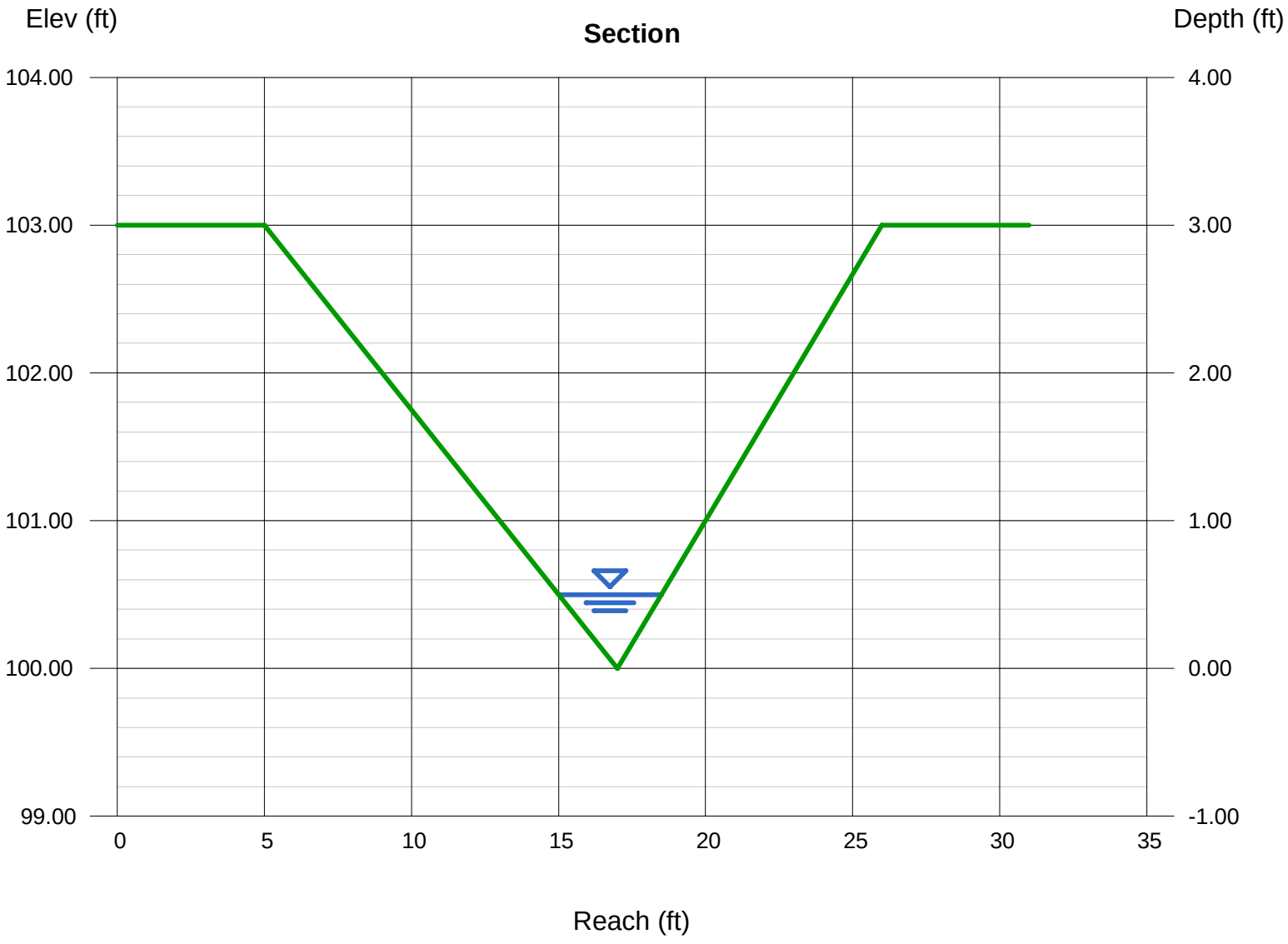
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 100.00
Slope (%)	= 4.59
N-Value	= 0.030

Calculations

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

Highlighted

Depth (ft)	= 0.50
Q (cfs)	= 3.500
Area (sqft)	= 0.87
Velocity (ft/s)	= 4.00
Wetted Perim (ft)	= 3.64
Crit Depth, Yc (ft)	= 0.58
Top Width (ft)	= 3.50
EGL (ft)	= 0.75



Channel Report

100: DP2.1 to DP4.1

Triangular

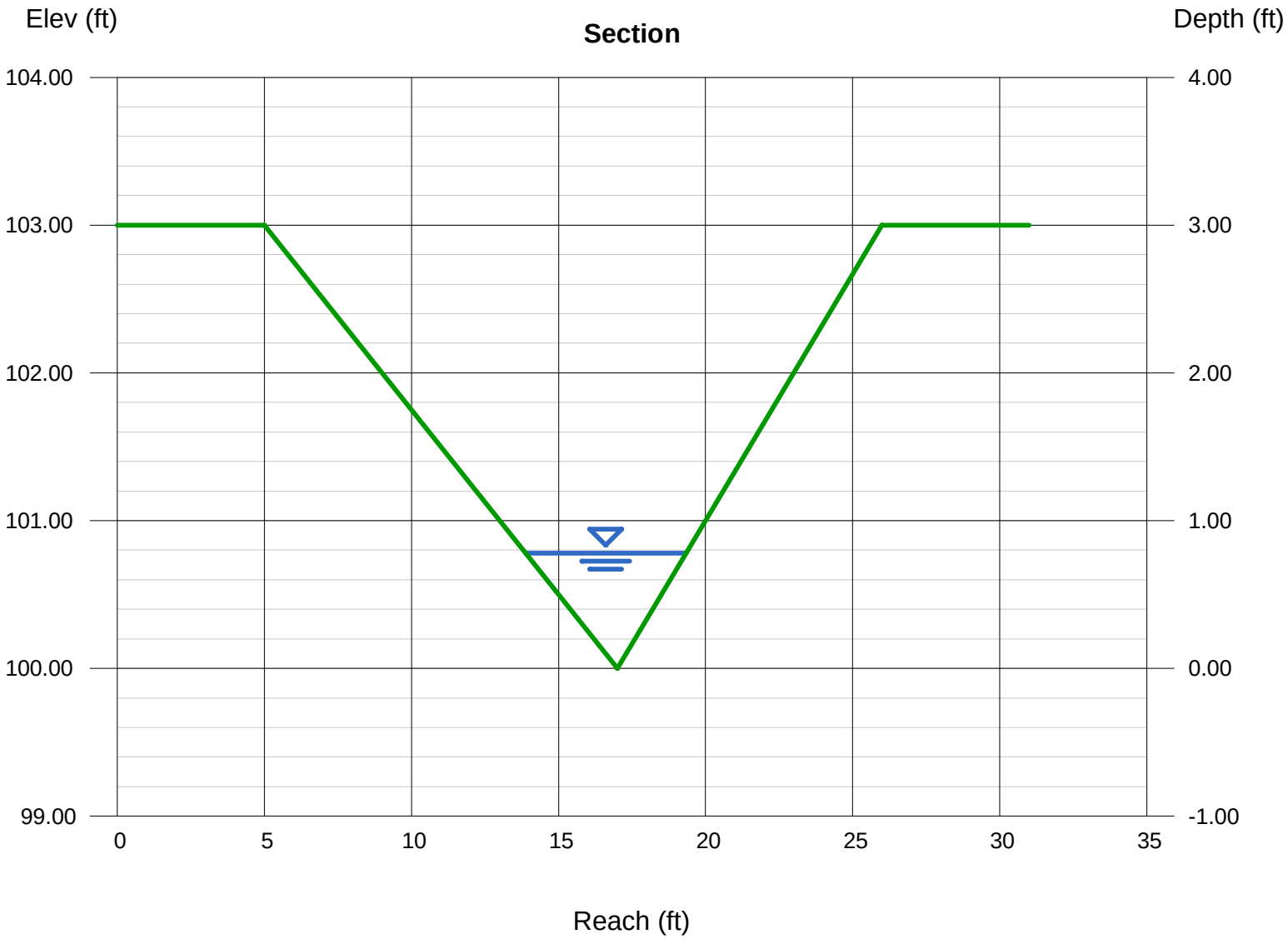
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 100.00
Slope (%)	= 4.59
N-Value	= 0.030

Calculations

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

Highlighted

Depth (ft)	= 0.78
Q (cfs)	= 11.50
Area (sqft)	= 2.13
Velocity (ft/s)	= 5.40
Wetted Perim (ft)	= 5.68
Crit Depth, Yc (ft)	= 0.93
Top Width (ft)	= 5.46
EGL (ft)	= 1.23



Channel Report

100: DP2.1 to DP4.1-Capacity

Triangular

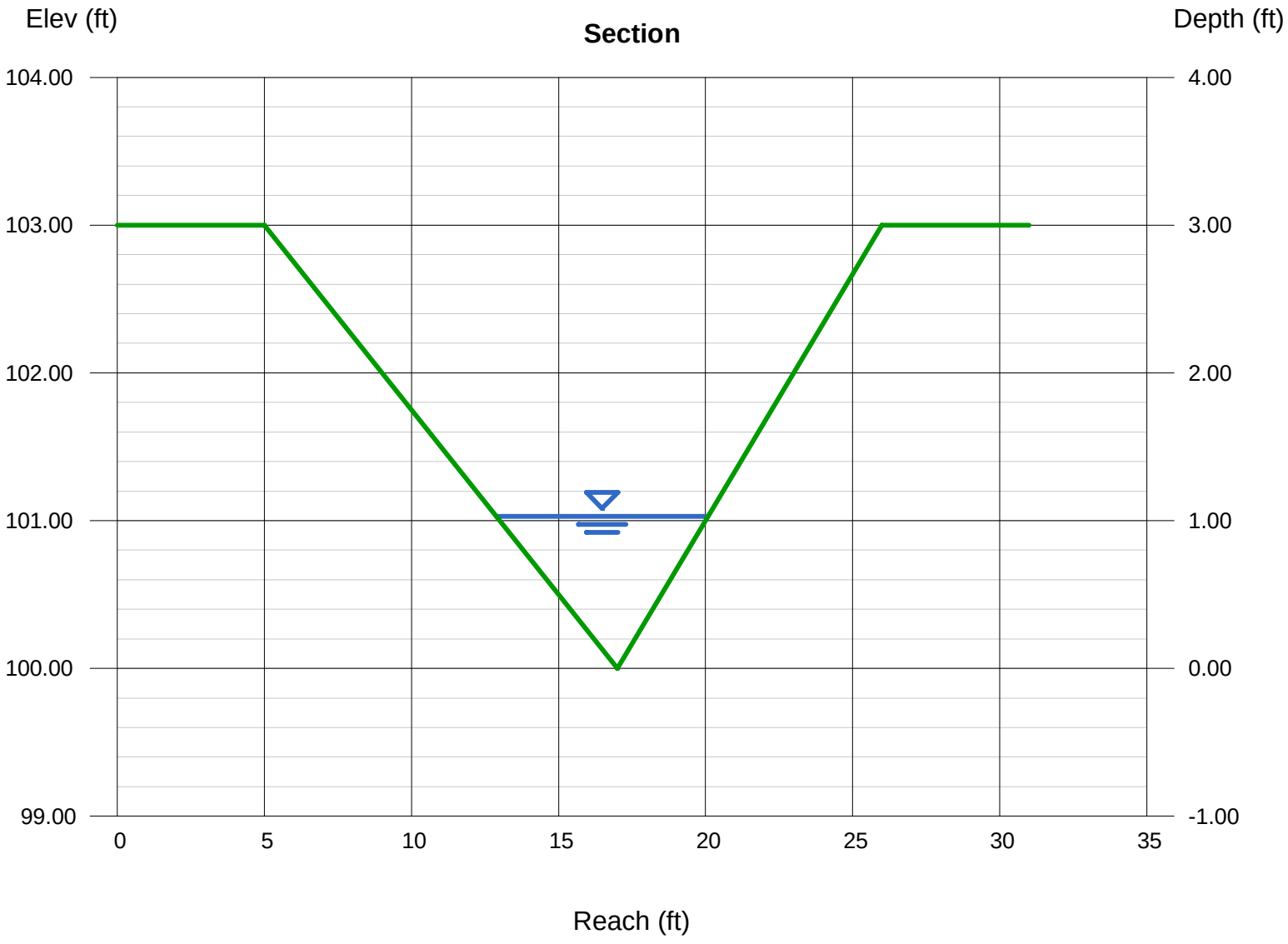
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 100.00
Slope (%)	= 1.00
N-Value	= 0.030

Calculations

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

Highlighted

Depth (ft)	= 1.03
Q (cfs)	= 11.50
Area (sqft)	= 3.71
Velocity (ft/s)	= 3.10
Wetted Perim (ft)	= 7.50
Crit Depth, Yc (ft)	= 0.93
Top Width (ft)	= 7.21
EGL (ft)	= 1.18



Channel Report

5: DP4.1 to DP6.1

Triangular

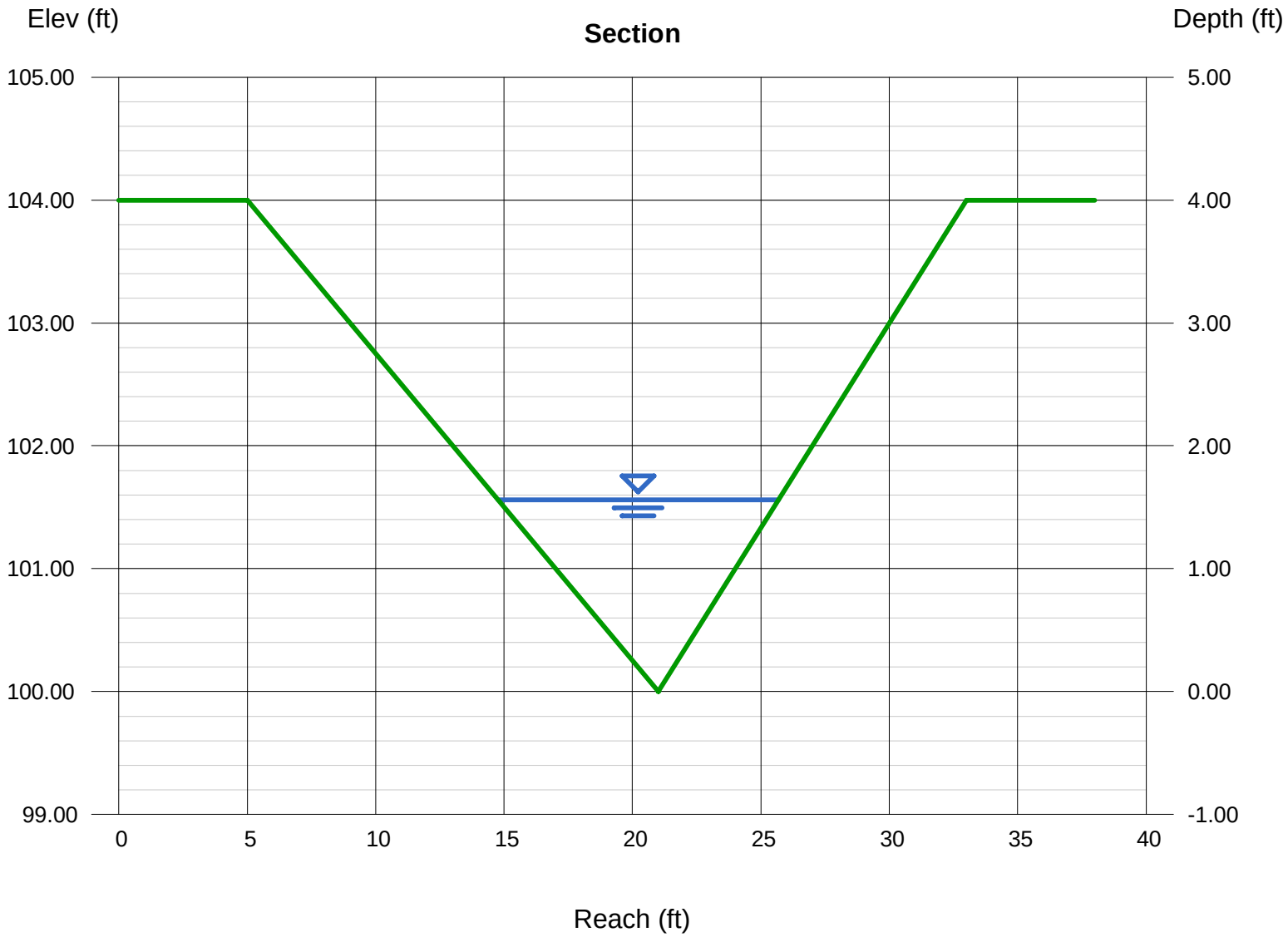
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 4.00
Invert Elev (ft)	= 100.00
Slope (%)	= 1.00
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 34.70

Highlighted

Depth (ft)	= 1.56
Q (cfs)	= 34.70
Area (sqft)	= 8.52
Velocity (ft/s)	= 4.07
Wetted Perim (ft)	= 11.37
Crit Depth, Yc (ft)	= 1.44
Top Width (ft)	= 10.92
EGL (ft)	= 1.82



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Sep 16 2021

100: DP4.1 to DP6.1

Triangular

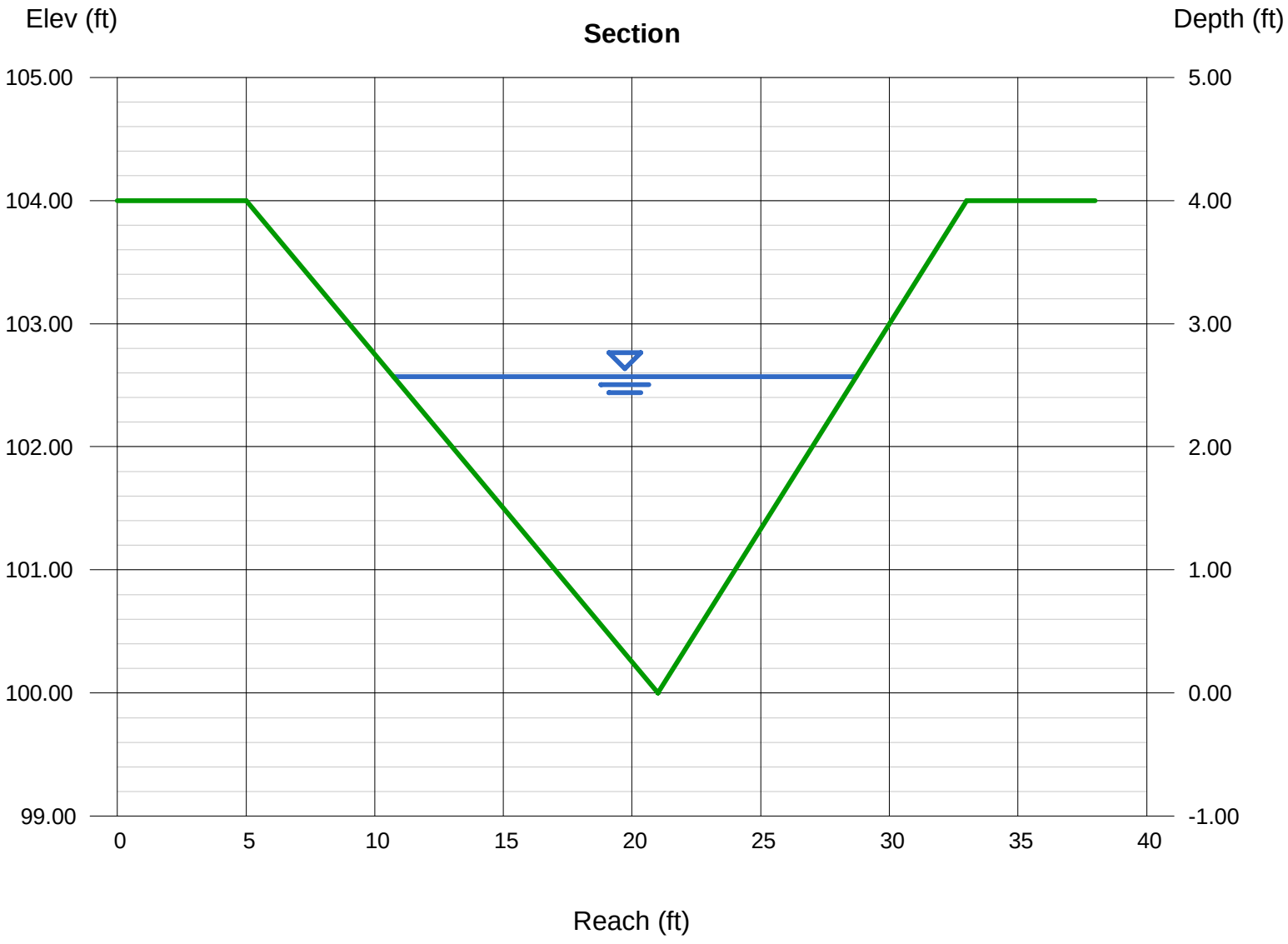
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 4.00
Invert Elev (ft)	= 100.00
Slope (%)	= 1.00
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 131.60

Highlighted

Depth (ft)	= 2.57
Q (cfs)	= 131.60
Area (sqft)	= 23.12
Velocity (ft/s)	= 5.69
Wetted Perim (ft)	= 18.72
Crit Depth, Yc (ft)	= 2.45
Top Width (ft)	= 17.99
EGL (ft)	= 3.07



Channel Report

100: DP4.1 to DP6.1-Capacity

Triangular

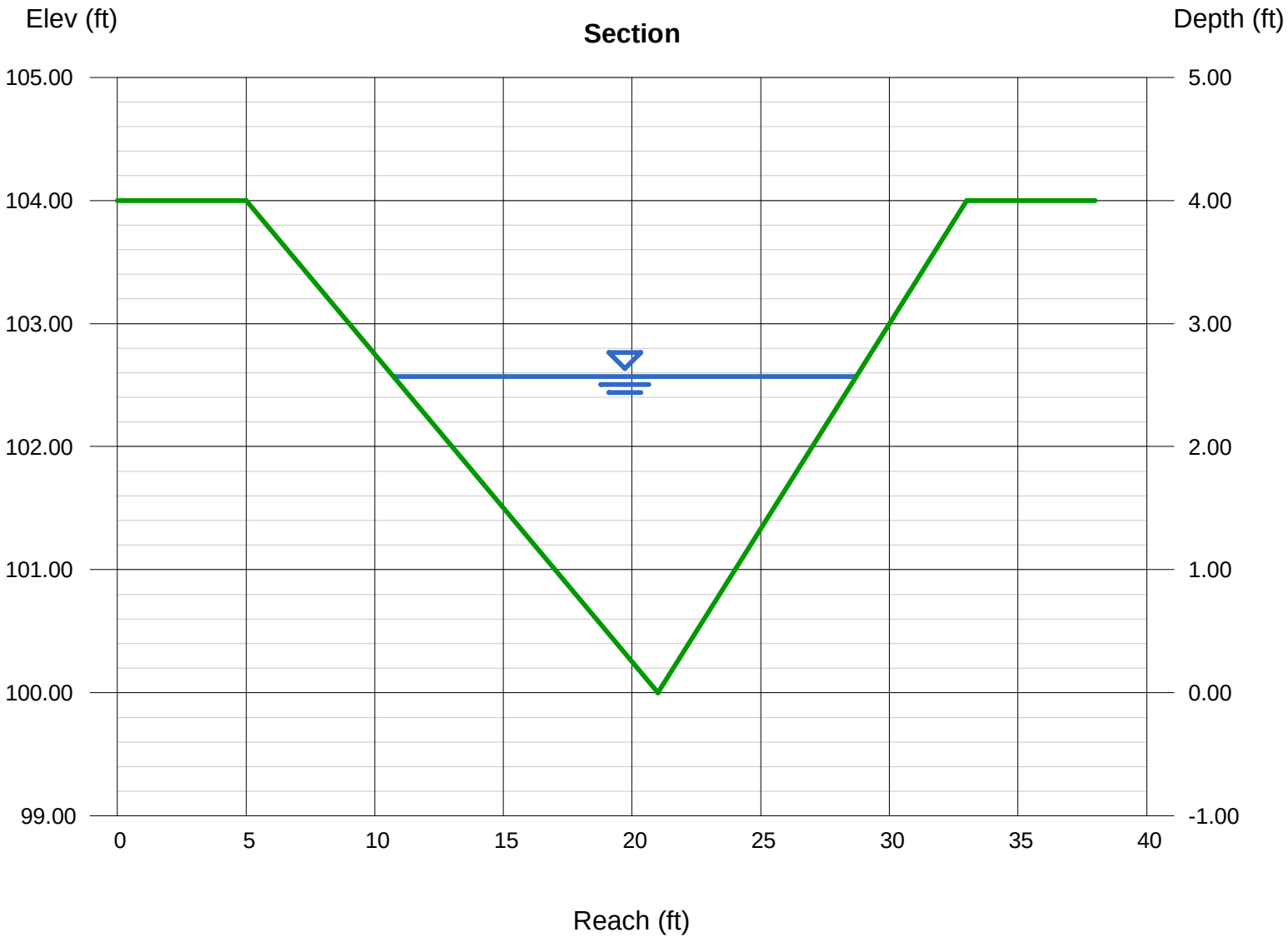
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 4.00
Invert Elev (ft)	= 100.00
Slope (%)	= 1.00
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 131.60

Highlighted

Depth (ft)	= 2.57
Q (cfs)	= 131.60
Area (sqft)	= 23.12
Velocity (ft/s)	= 5.69
Wetted Perim (ft)	= 18.72
Crit Depth, Yc (ft)	= 2.45
Top Width (ft)	= 17.99
EGL (ft)	= 3.07



Channel Report

5: DP6.1 to DP8.1

Triangular

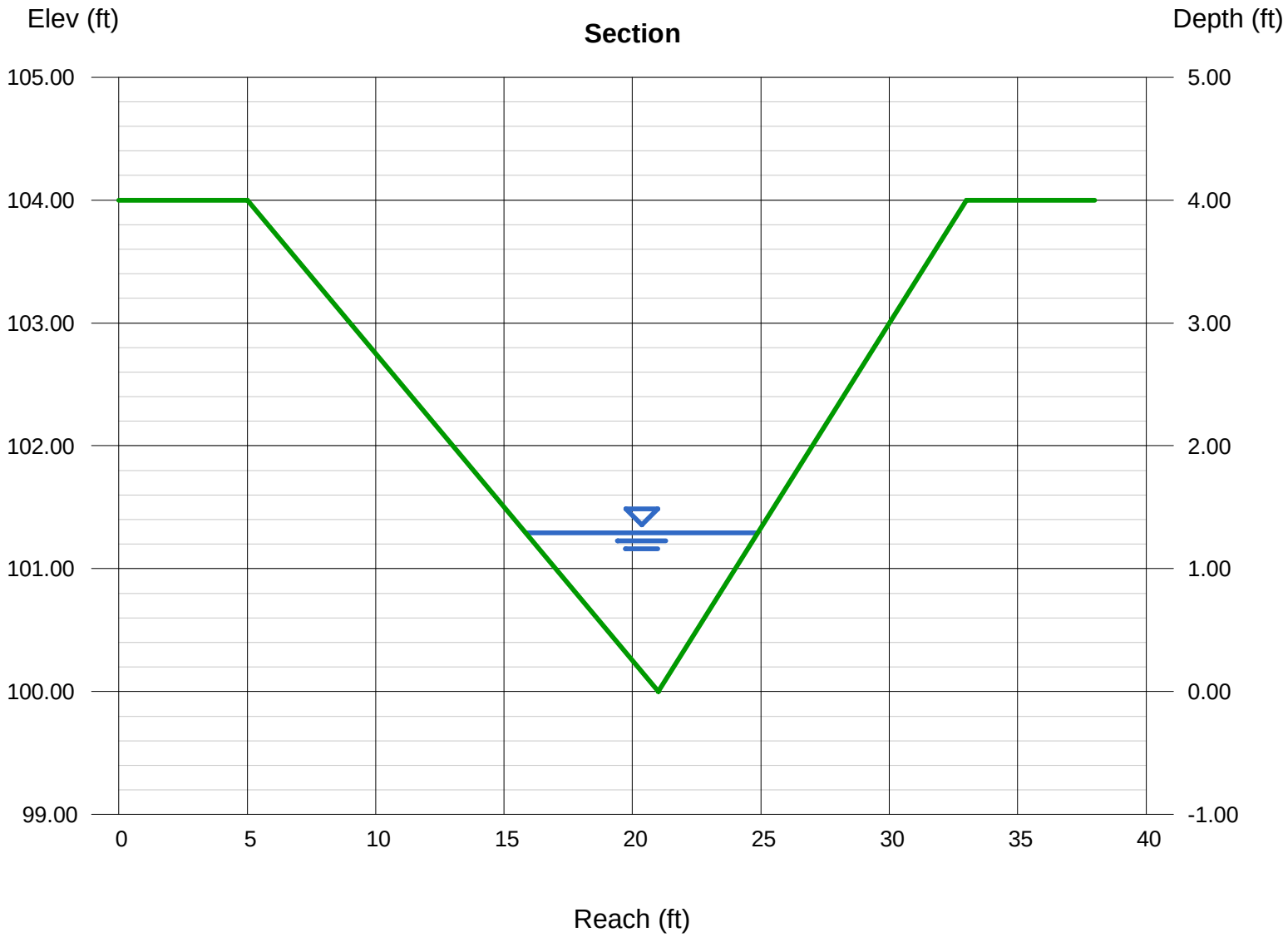
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 4.00
Invert Elev (ft)	= 100.00
Slope (%)	= 3.32
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 37.90

Highlighted

Depth (ft)	= 1.29
Q (cfs)	= 37.90
Area (sqft)	= 5.82
Velocity (ft/s)	= 6.51
Wetted Perim (ft)	= 9.40
Crit Depth, Yc (ft)	= 1.49
Top Width (ft)	= 9.03
EGL (ft)	= 1.95



Channel Report

100: DP6.1 to DP8.1

Triangular

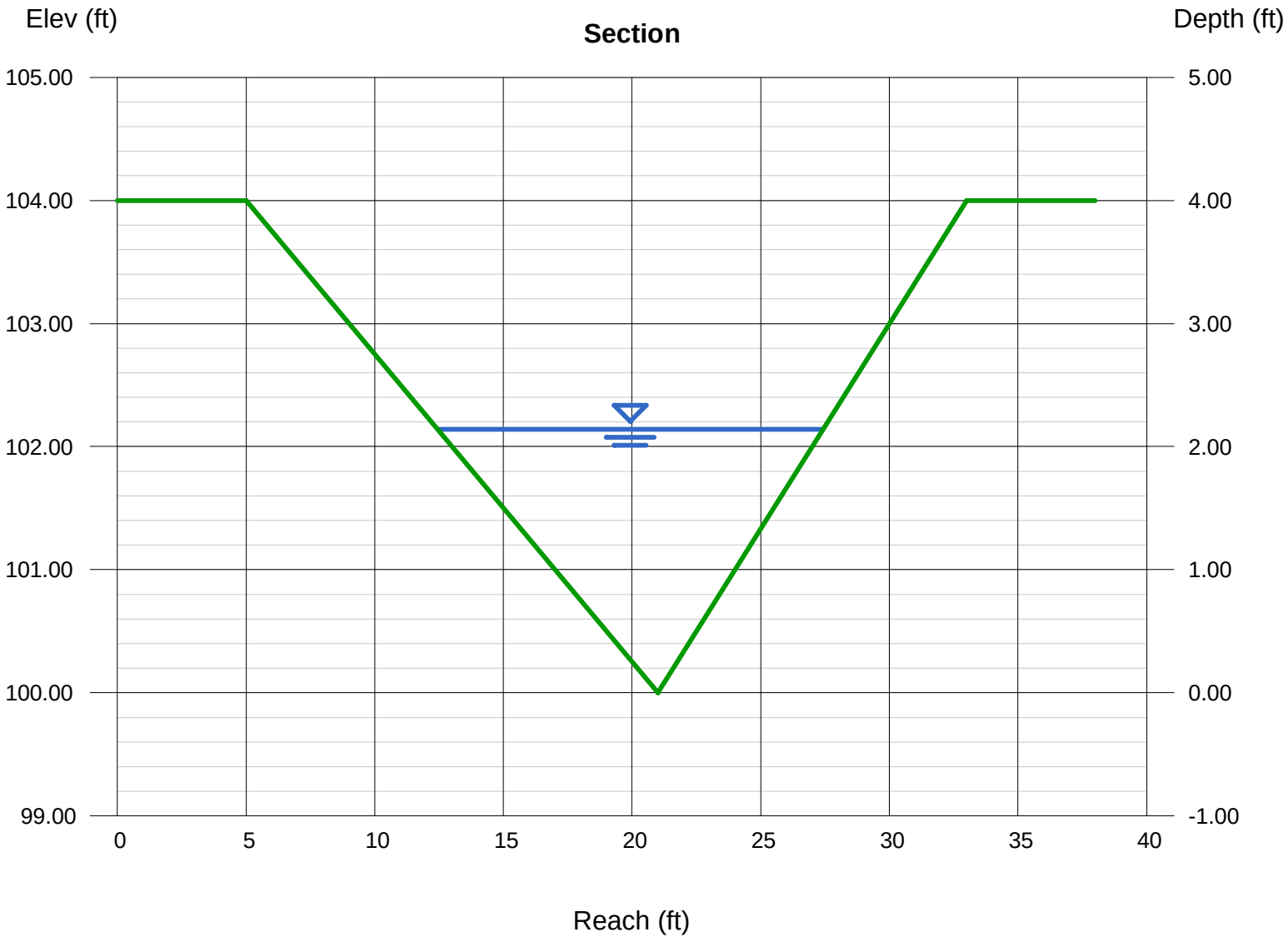
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 4.00
Invert Elev (ft)	= 100.00
Slope (%)	= 3.32
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 145.90

Highlighted

Depth (ft)	= 2.14
Q (cfs)	= 145.90
Area (sqft)	= 16.03
Velocity (ft/s)	= 9.10
Wetted Perim (ft)	= 15.59
Crit Depth, Yc (ft)	= 2.56
Top Width (ft)	= 14.98
EGL (ft)	= 3.43



Channel Report

100: DP6.1 to DP8.1-Capacity

Triangular

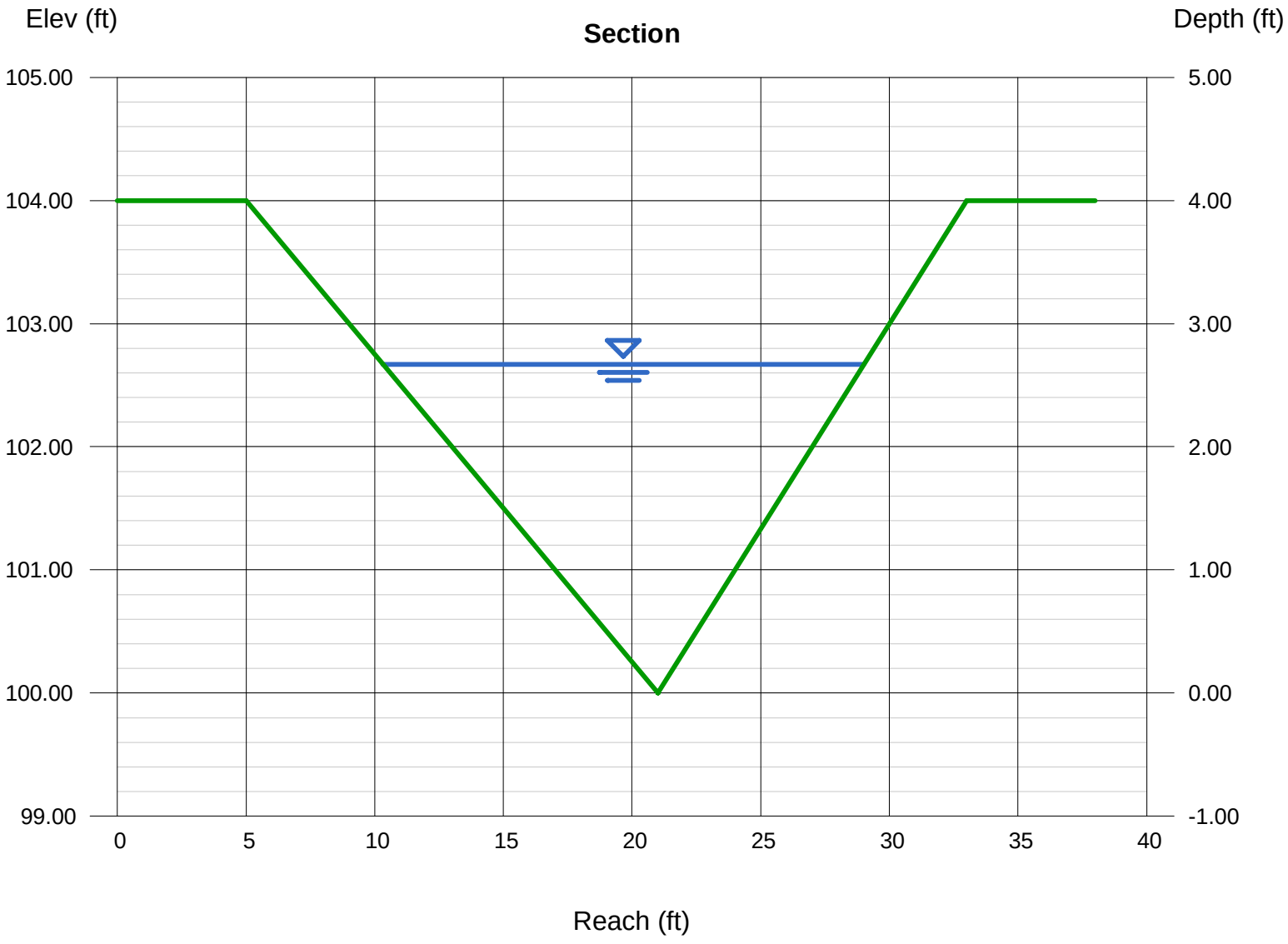
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 4.00
Invert Elev (ft)	= 100.00
Slope (%)	= 1.00
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 145.90

Highlighted

Depth (ft)	= 2.67
Q (cfs)	= 145.90
Area (sqft)	= 24.95
Velocity (ft/s)	= 5.85
Wetted Perim (ft)	= 19.45
Crit Depth, Yc (ft)	= 2.56
Top Width (ft)	= 18.69
EGL (ft)	= 3.20



Channel Report

5: DP8.1 to DP10.1

Triangular

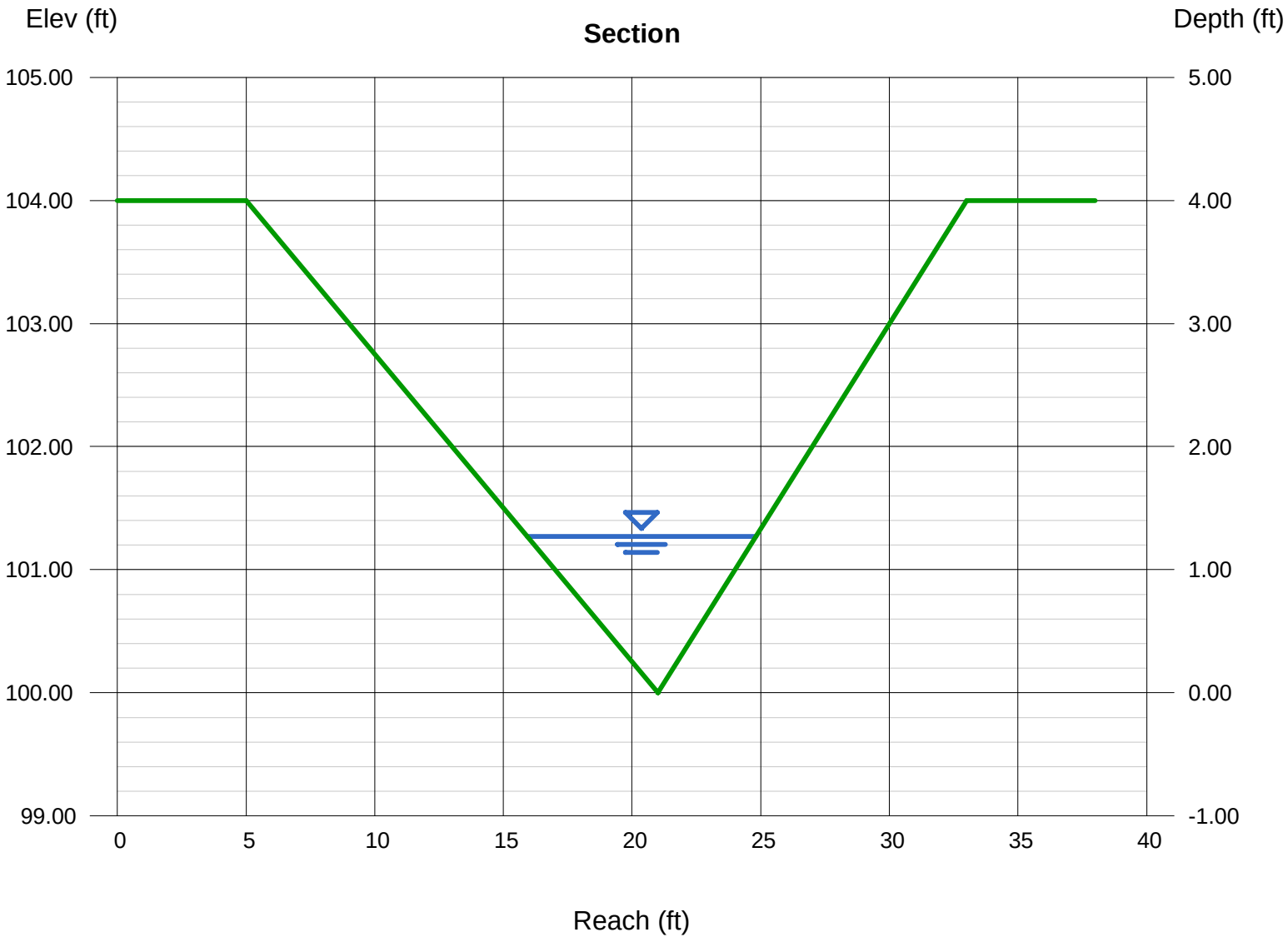
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 4.00
Invert Elev (ft)	= 100.00
Slope (%)	= 4.35
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 41.90

Highlighted

Depth (ft)	= 1.27
Q (cfs)	= 41.90
Area (sqft)	= 5.65
Velocity (ft/s)	= 7.42
Wetted Perim (ft)	= 9.25
Crit Depth, Yc (ft)	= 1.55
Top Width (ft)	= 8.89
EGL (ft)	= 2.13



Channel Report

100: DP8.1 to DP10.1

Triangular

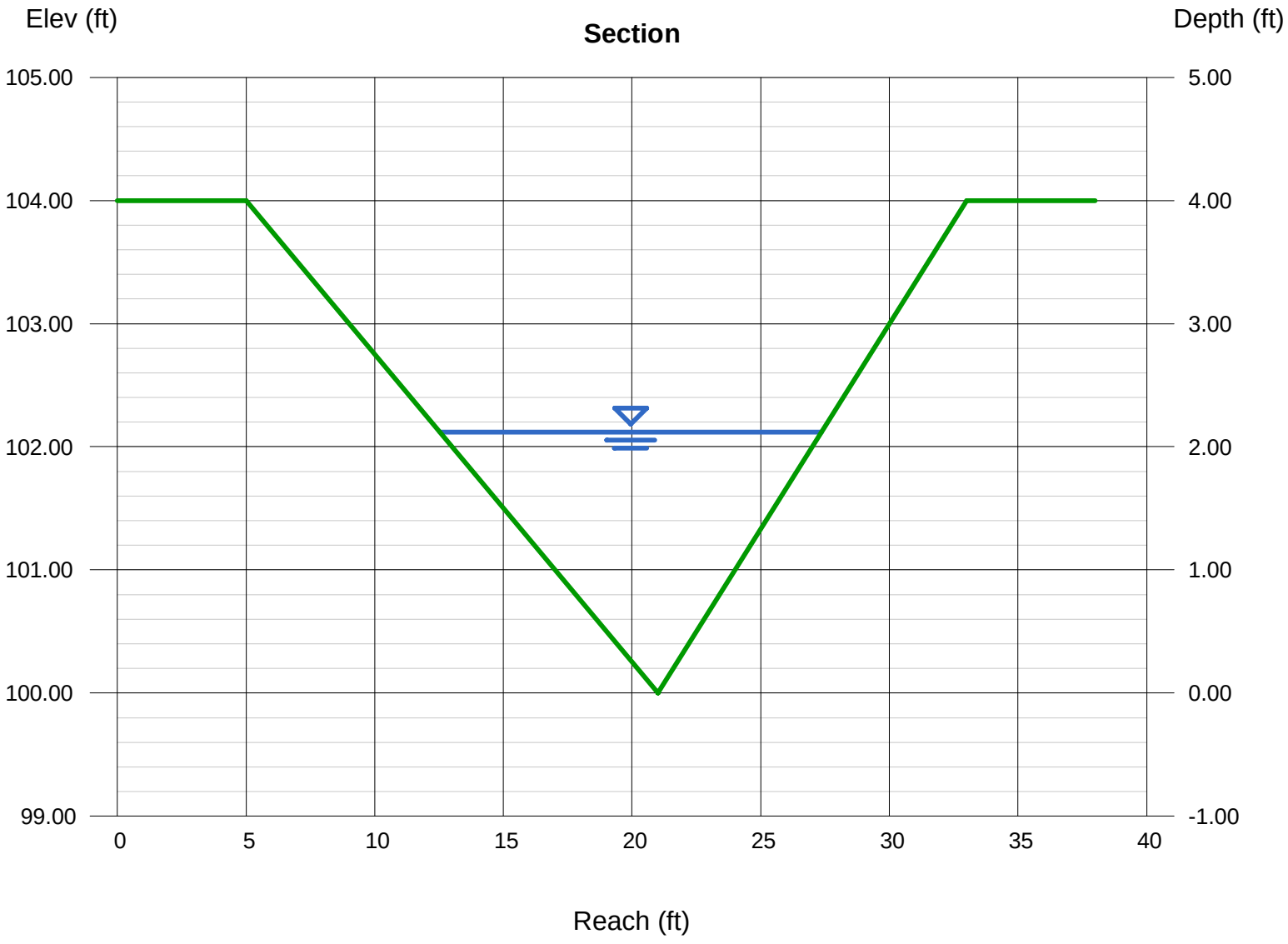
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 4.00
Invert Elev (ft)	= 100.00
Slope (%)	= 4.35
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 163.80

Highlighted

Depth (ft)	= 2.12
Q (cfs)	= 163.80
Area (sqft)	= 15.73
Velocity (ft/s)	= 10.41
Wetted Perim (ft)	= 15.45
Crit Depth, Yc (ft)	= 2.68
Top Width (ft)	= 14.84
EGL (ft)	= 3.81



Channel Report

100: DP8.1 to DP10.1-Capacity

Triangular

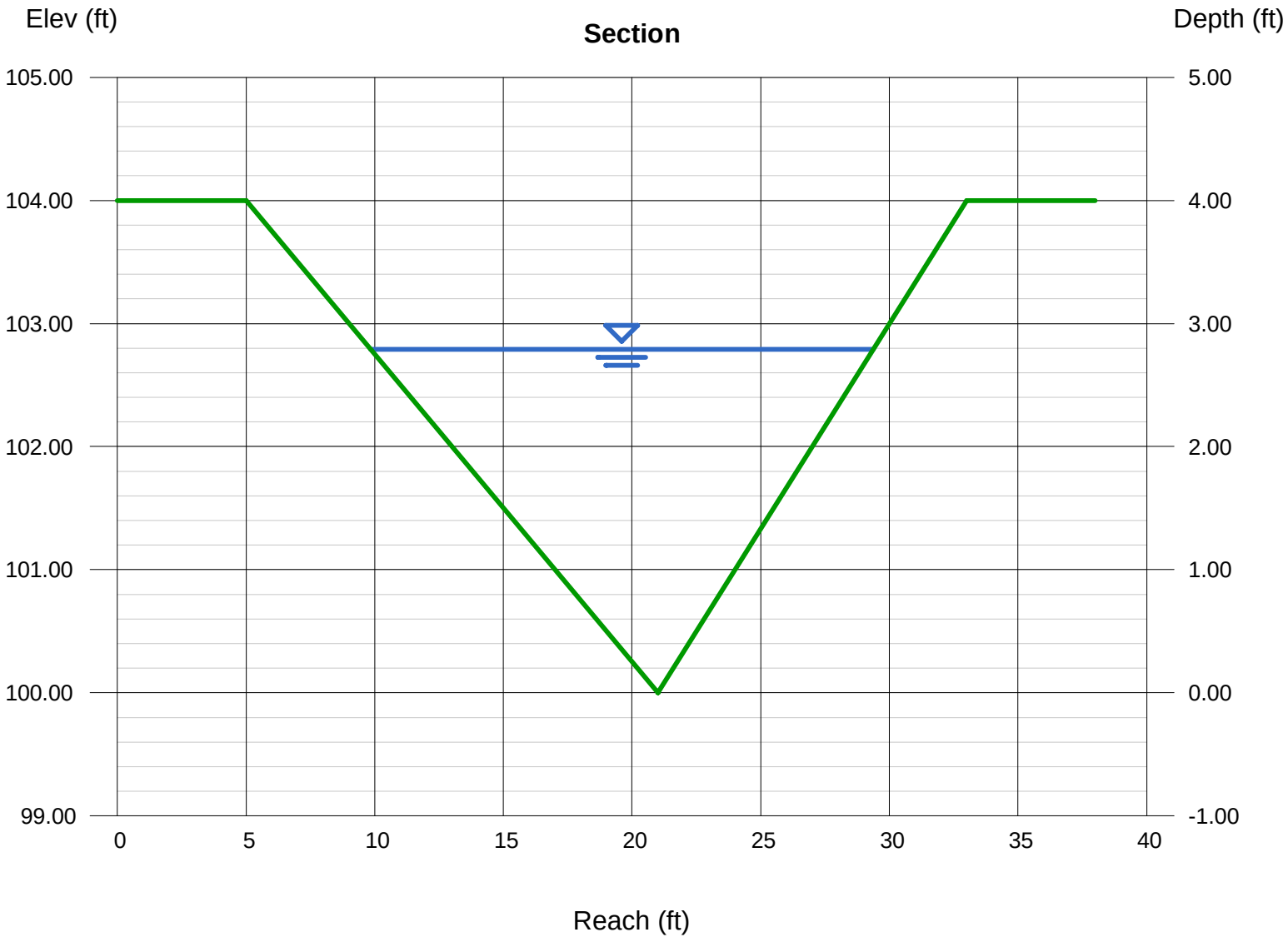
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 4.00
Invert Elev (ft)	= 100.00
Slope (%)	= 1.00
N-Value	= 0.030

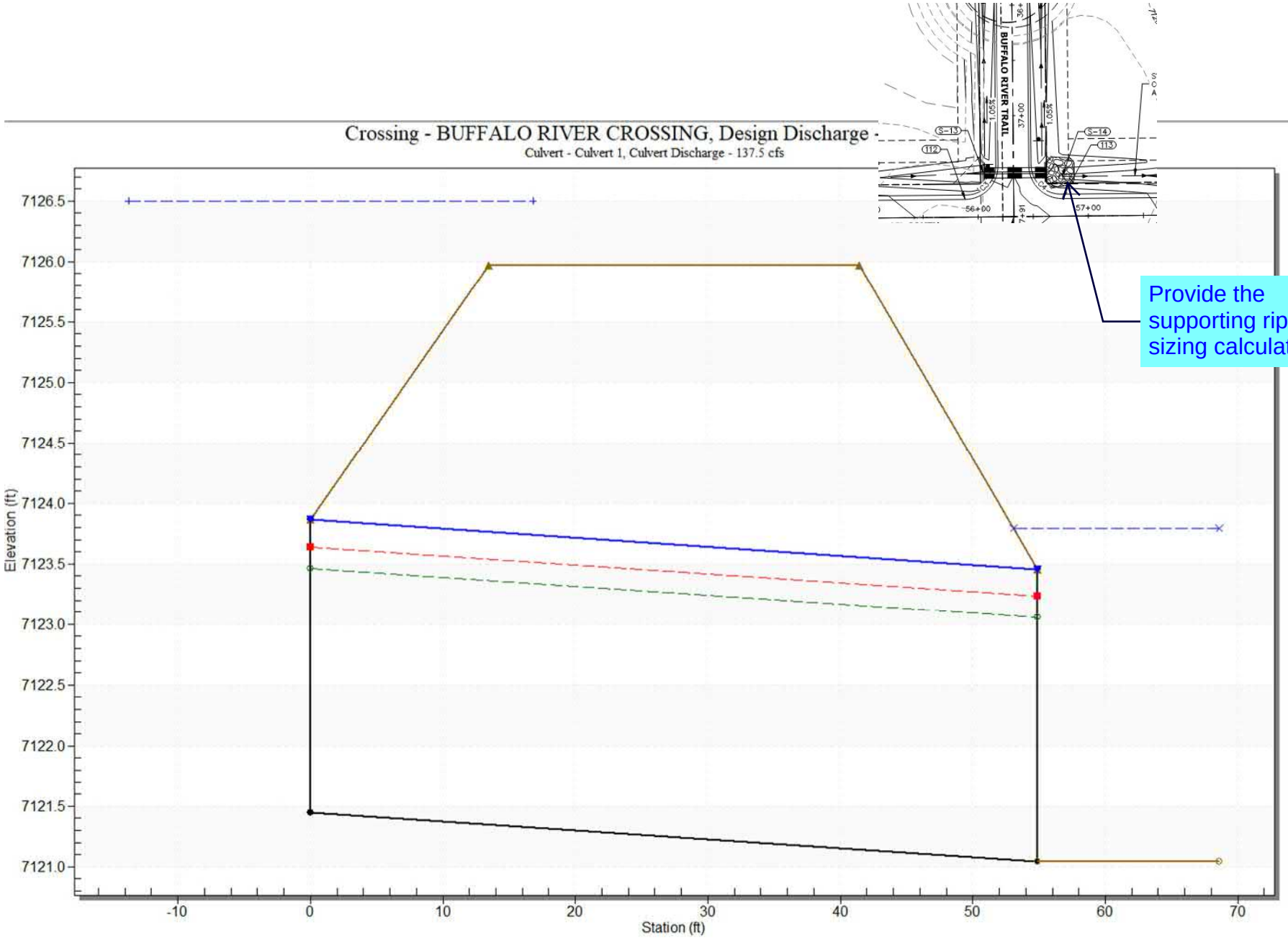
Calculations

Compute by:	Known Q
Known Q (cfs)	= 163.80

Highlighted

Depth (ft)	= 2.79
Q (cfs)	= 163.80
Area (sqft)	= 27.24
Velocity (ft/s)	= 6.01
Wetted Perim (ft)	= 20.33
Crit Depth, Yc (ft)	= 2.68
Top Width (ft)	= 19.53
EGL (ft)	= 3.35





Provide the supporting riprap sizing calculation

Include the additional Hy-8 input/output data.

Hw/D appears to be greater than 1.5. Revise to meet criteria which is allowable Hw/D shall be less than 1.5.

Channel Report

100: DP13

Triangular

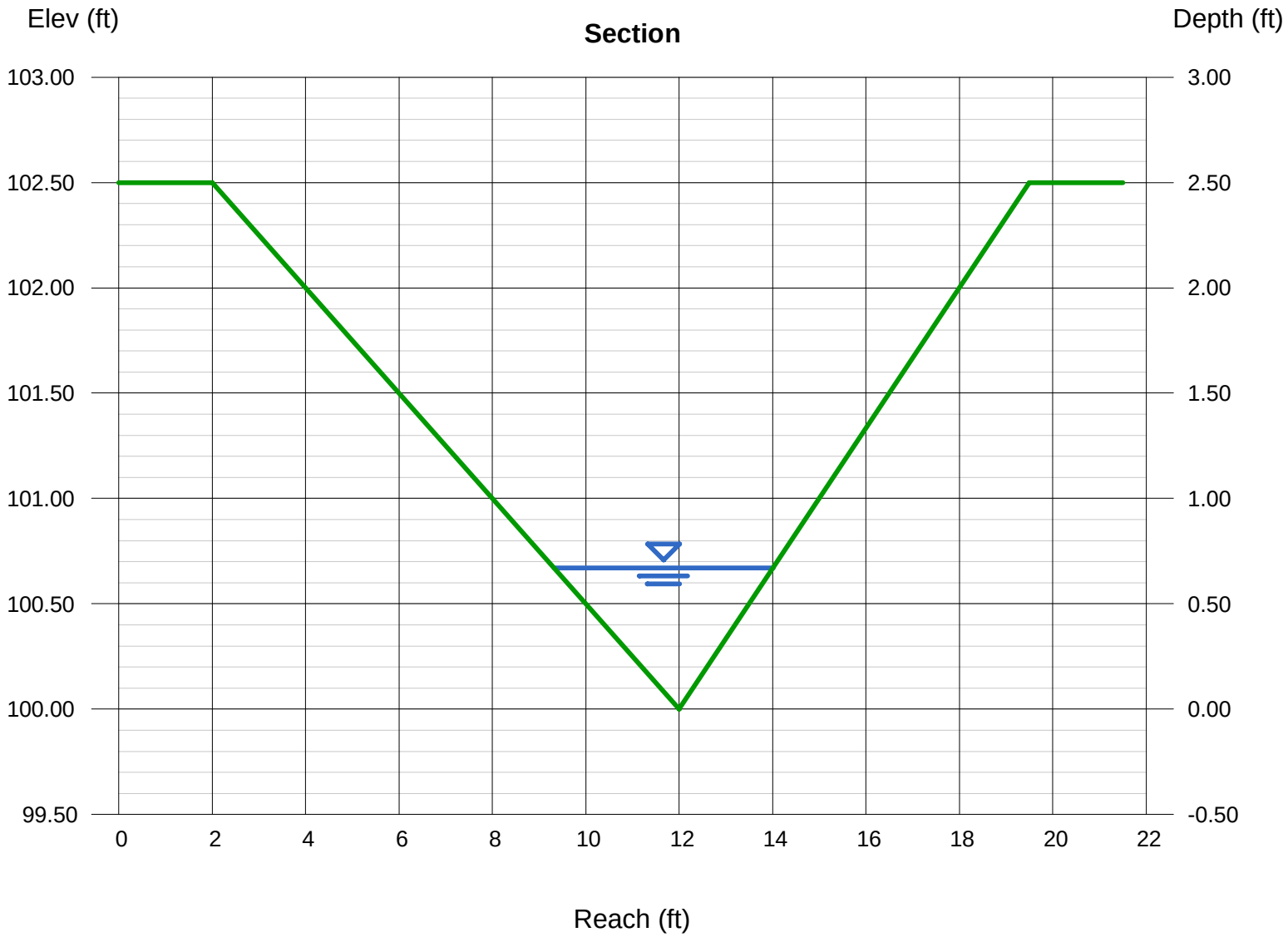
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 2.50
Invert Elev (ft)	= 100.00
Slope (%)	= 4.59
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 7.70

Highlighted

Depth (ft)	= 0.67
Q (cfs)	= 7.700
Area (sqft)	= 1.57
Velocity (ft/s)	= 4.90
Wetted Perim (ft)	= 4.88
Crit Depth, Yc (ft)	= 0.79
Top Width (ft)	= 4.69
EGL (ft)	= 1.04



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Sep 16 2021

100: DP13-Capacity

Triangular

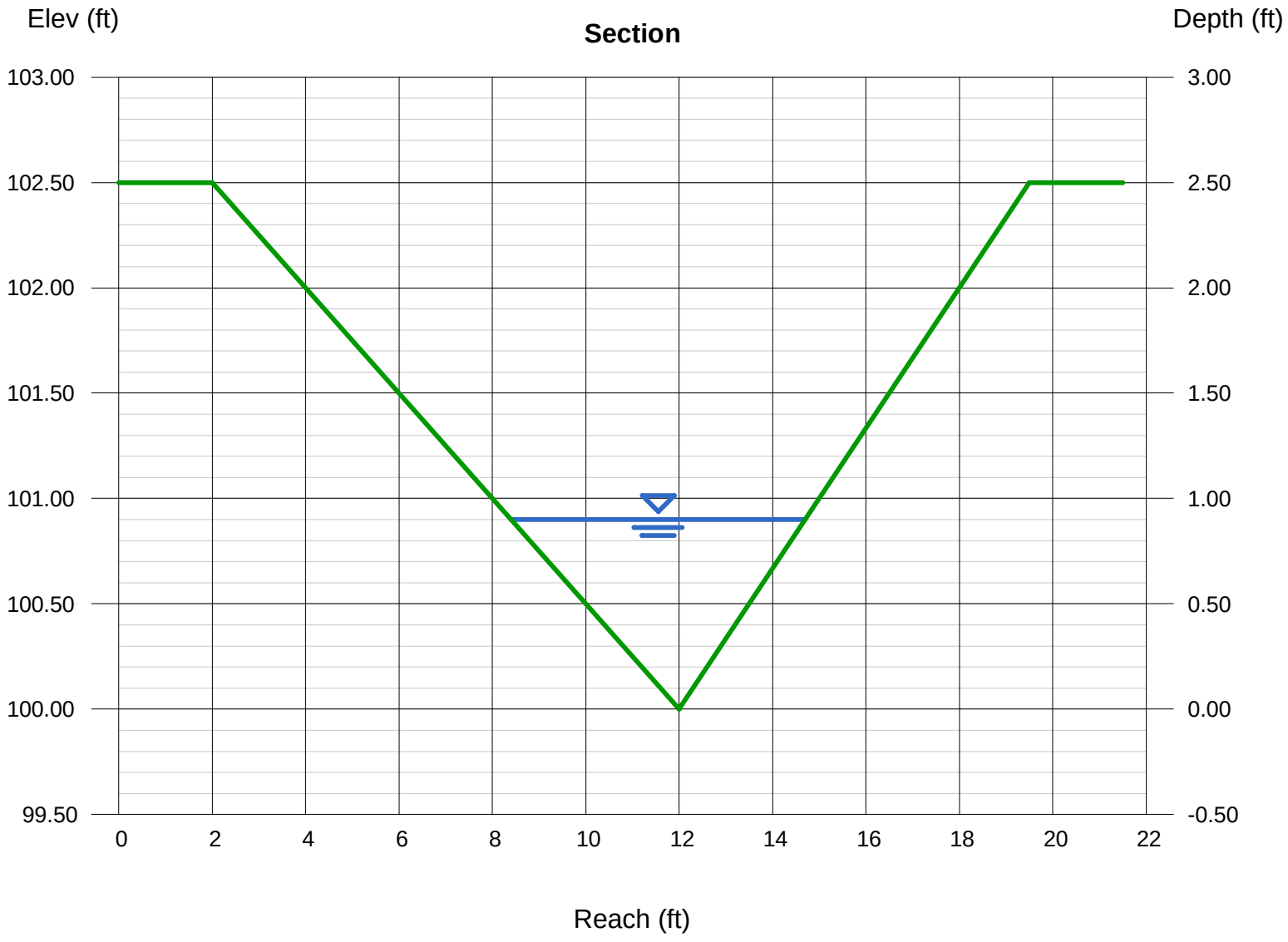
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 2.50
Invert Elev (ft)	= 100.00
Slope (%)	= 0.95
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 7.70

Highlighted

Depth (ft)	= 0.90
Q (cfs)	= 7.700
Area (sqft)	= 2.83
Velocity (ft/s)	= 2.72
Wetted Perim (ft)	= 6.56
Crit Depth, Yc (ft)	= 0.79
Top Width (ft)	= 6.30
EGL (ft)	= 1.01



Channel Report

100: 13.1 to DP14.1

Triangular

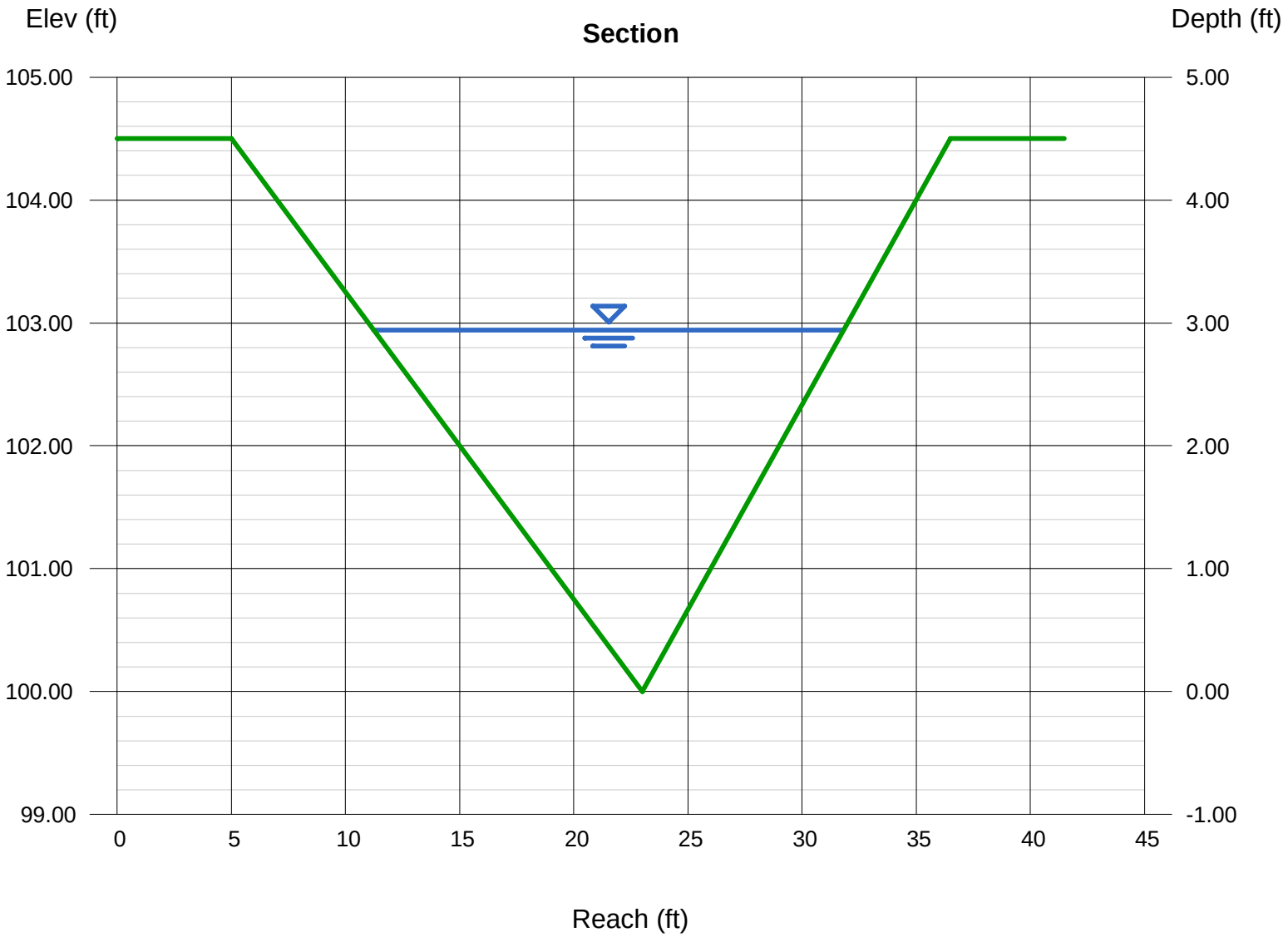
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 4.50
Invert Elev (ft)	= 100.00
Slope (%)	= 2.42
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 291.20

Highlighted

Depth (ft)	= 2.94
Q (cfs)	= 291.20
Area (sqft)	= 30.25
Velocity (ft/s)	= 9.63
Wetted Perim (ft)	= 21.42
Crit Depth, Yc (ft)	= 3.37
Top Width (ft)	= 20.58
EGL (ft)	= 4.38



Channel Report

100: 14.1 to Pond

Triangular

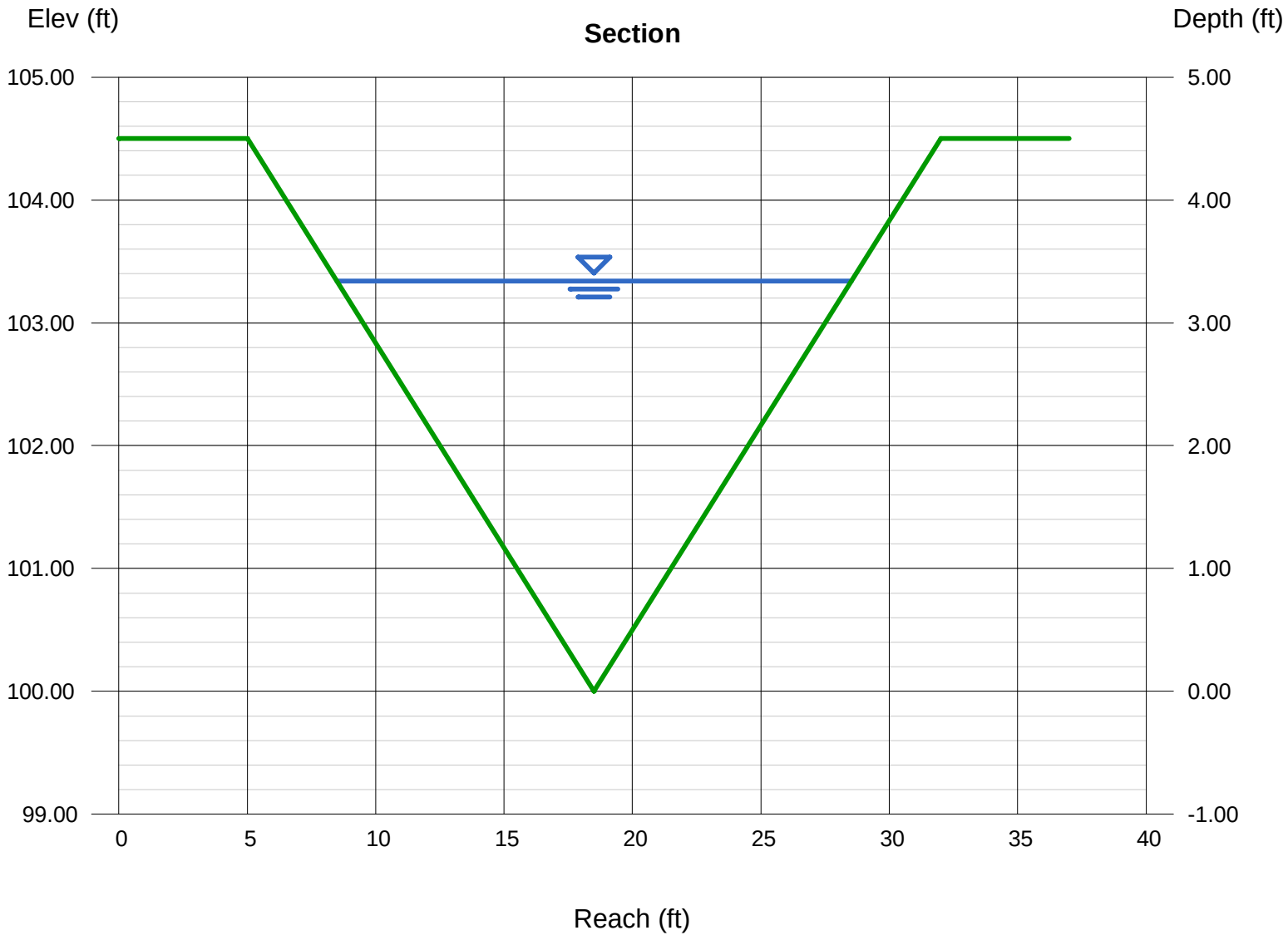
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 4.50
Invert Elev (ft)	= 100.00
Slope (%)	= 2.42
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 348.20

Highlighted

Depth (ft)	= 3.34
Q (cfs)	= 348.20
Area (sqft)	= 33.47
Velocity (ft/s)	= 10.40
Wetted Perim (ft)	= 21.12
Crit Depth, Yc (ft)	= 3.85
Top Width (ft)	= 20.04
EGL (ft)	= 5.02



Channel Report

5: DP16.1 to DP17.1

Triangular

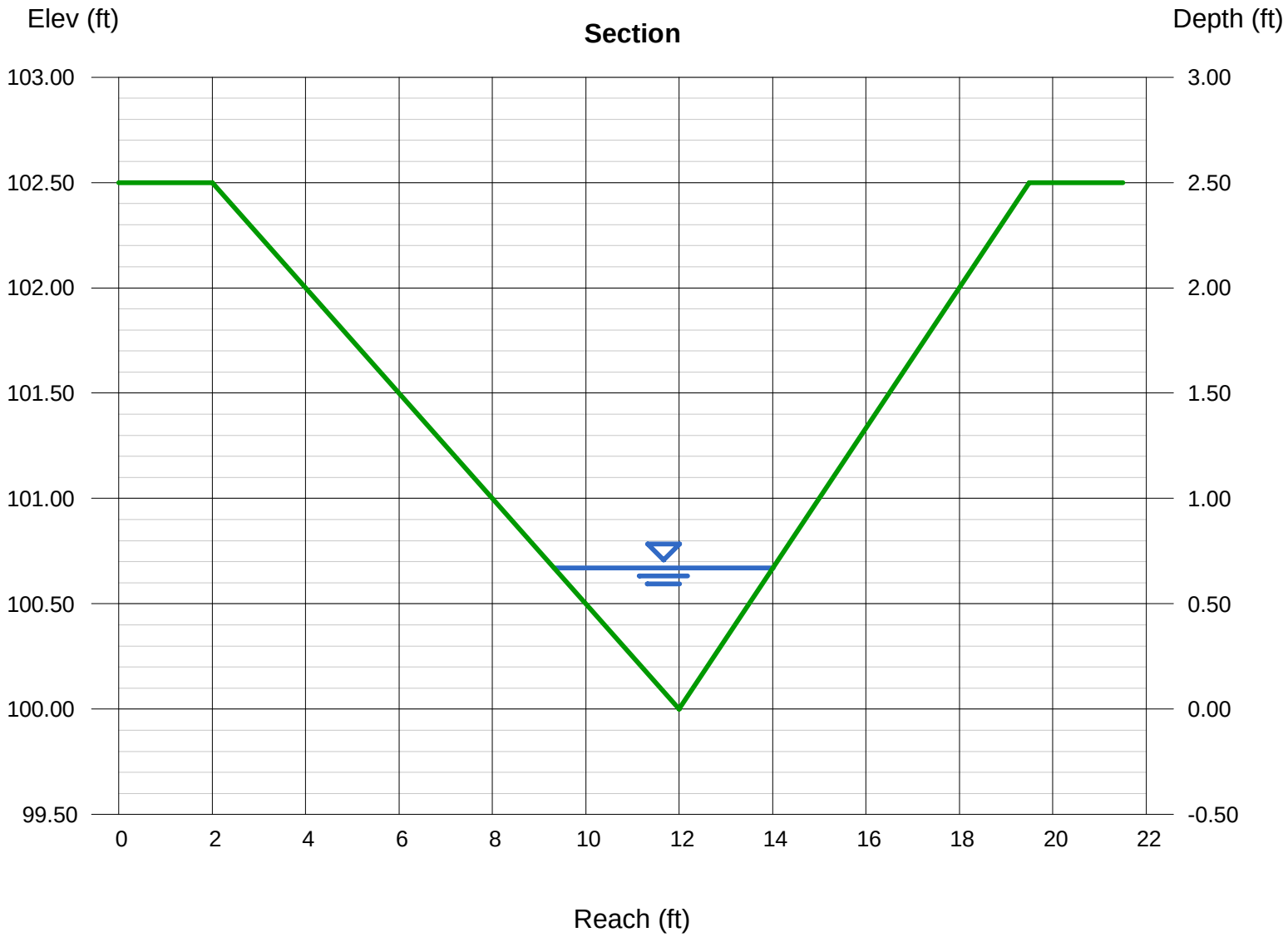
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 2.50
Invert Elev (ft)	= 100.00
Slope (%)	= 2.74
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 5.90

Highlighted

Depth (ft)	= 0.67
Q (cfs)	= 5.900
Area (sqft)	= 1.57
Velocity (ft/s)	= 3.76
Wetted Perim (ft)	= 4.88
Crit Depth, Yc (ft)	= 0.71
Top Width (ft)	= 4.69
EGL (ft)	= 0.89



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Sep 16 2021

100: DP16.1 to DP17.1

Triangular

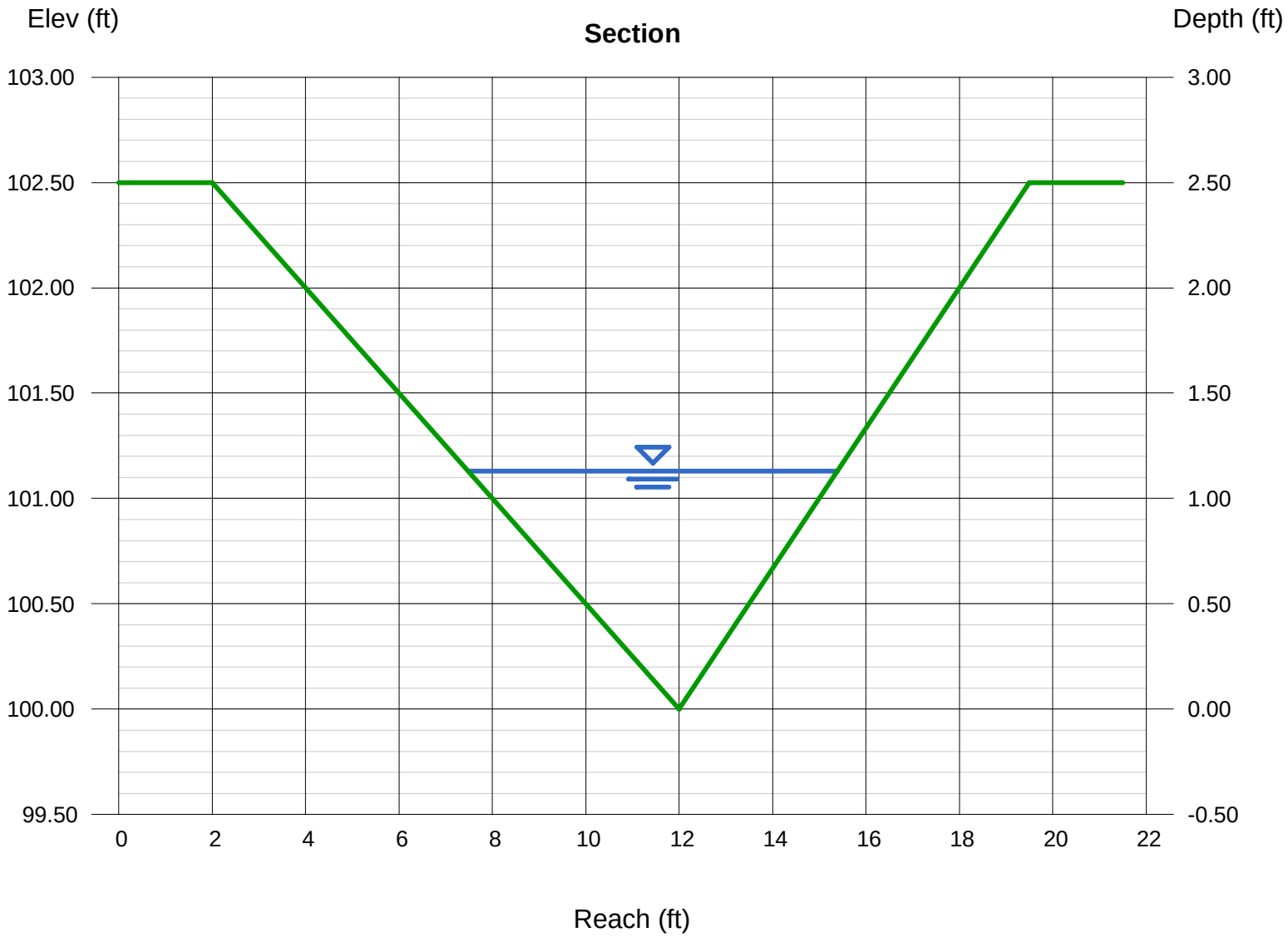
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 2.50
Invert Elev (ft)	= 100.00
Slope (%)	= 2.74
N-Value	= 0.030

Calculations

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

Highlighted

Depth (ft)	= 1.13
Q (cfs)	= 24.10
Area (sqft)	= 4.47
Velocity (ft/s)	= 5.39
Wetted Perim (ft)	= 8.23
Crit Depth, Yc (ft)	= 1.25
Top Width (ft)	= 7.91
EGL (ft)	= 1.58



Channel Report

100: DP16.1 to DP17.1-Capacity

Triangular

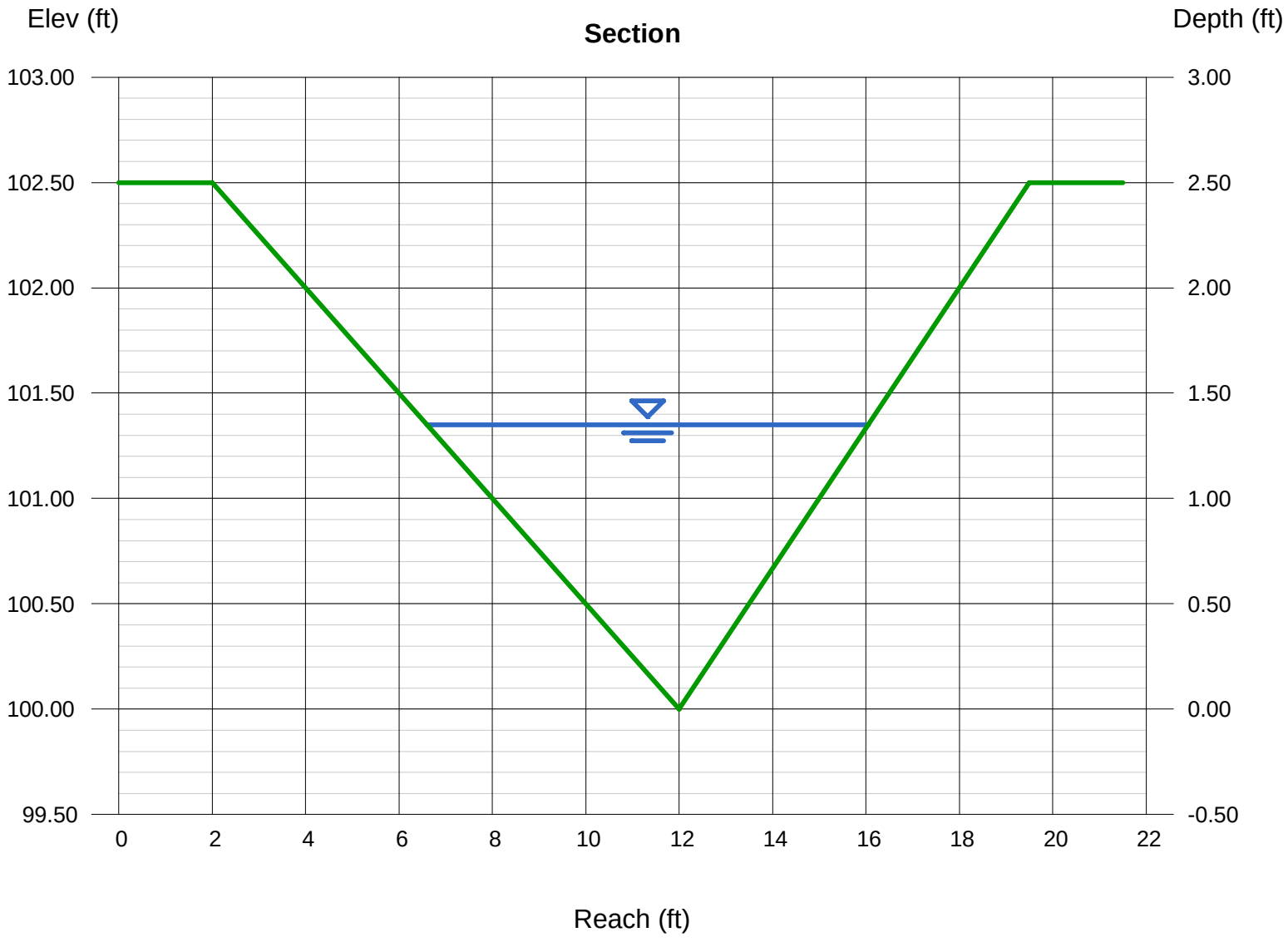
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 2.50
Invert Elev (ft)	= 100.00
Slope (%)	= 1.05
N-Value	= 0.030

Calculations

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

Highlighted

Depth (ft)	= 1.35
Q (cfs)	= 24.10
Area (sqft)	= 6.38
Velocity (ft/s)	= 3.78
Wetted Perim (ft)	= 9.84
Crit Depth, Yc (ft)	= 1.25
Top Width (ft)	= 9.45
EGL (ft)	= 1.57



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Sep 16 2021

5: DP17.1 to DP18.1

Triangular

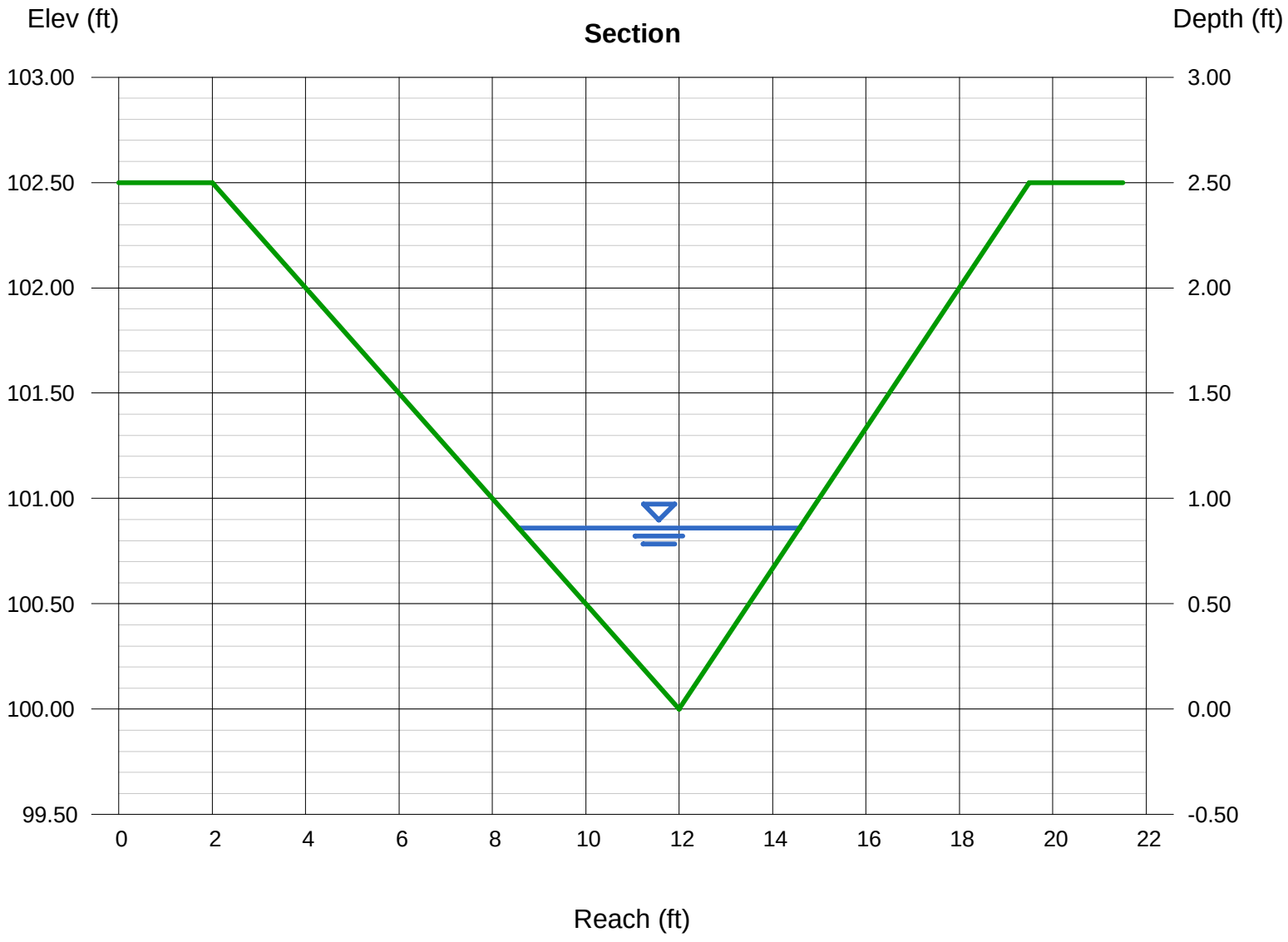
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 2.50
Invert Elev (ft)	= 100.00
Slope (%)	= 1.51
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 8.60

Highlighted

Depth (ft)	= 0.86
Q (cfs)	= 8.600
Area (sqft)	= 2.59
Velocity (ft/s)	= 3.32
Wetted Perim (ft)	= 6.27
Crit Depth, Yc (ft)	= 0.83
Top Width (ft)	= 6.02
EGL (ft)	= 1.03



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Sep 16 2021

100: DP17.1 to DP18.1

Triangular

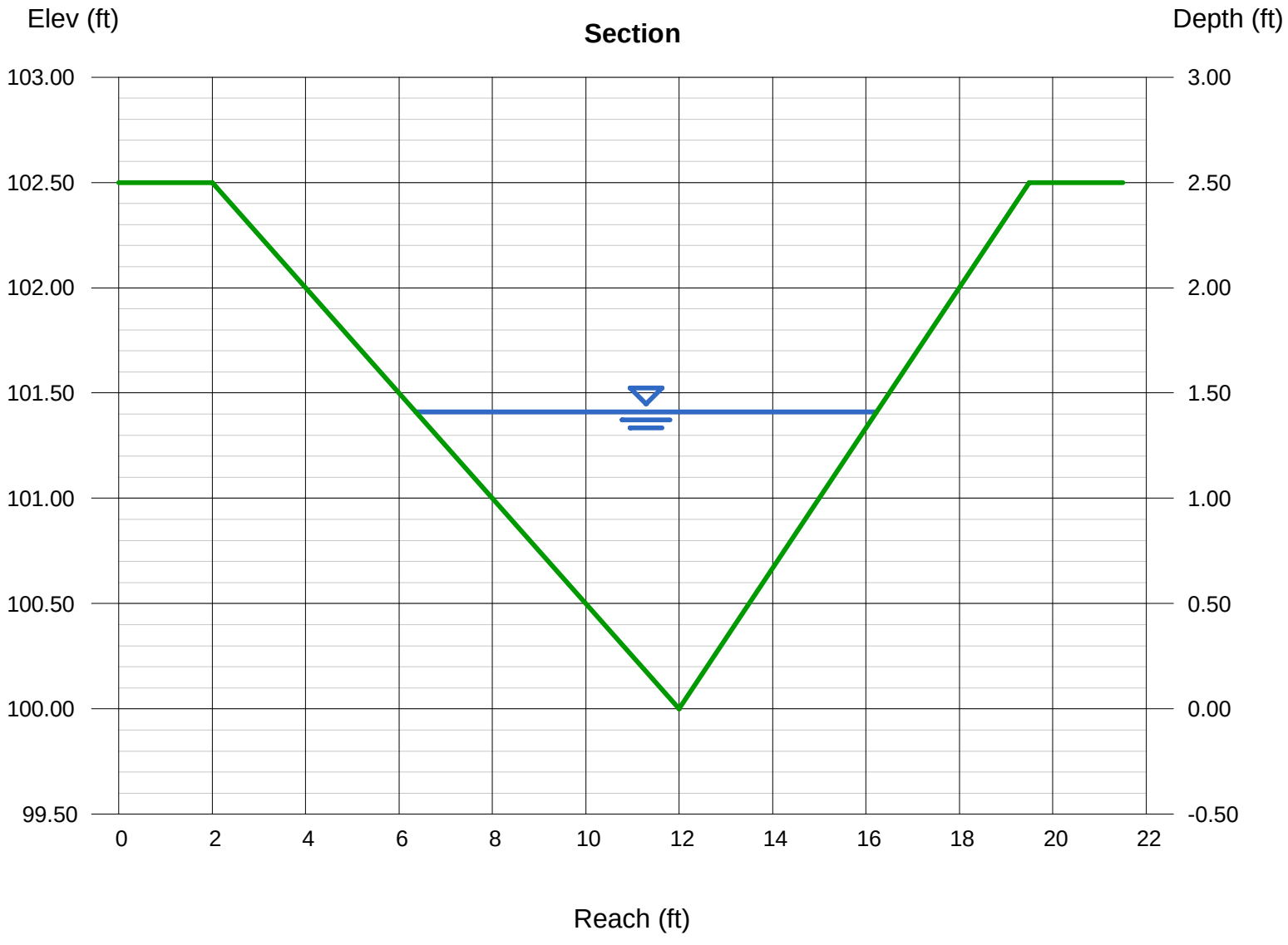
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 2.50
Invert Elev (ft)	= 100.00
Slope (%)	= 1.51
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 32.40

Highlighted

Depth (ft)	= 1.41
Q (cfs)	= 32.40
Area (sqft)	= 6.96
Velocity (ft/s)	= 4.66
Wetted Perim (ft)	= 10.27
Crit Depth, Yc (ft)	= 1.40
Top Width (ft)	= 9.87
EGL (ft)	= 1.75



Channel Report

100: DP17.1 to DP18.1-Capacity

Triangular

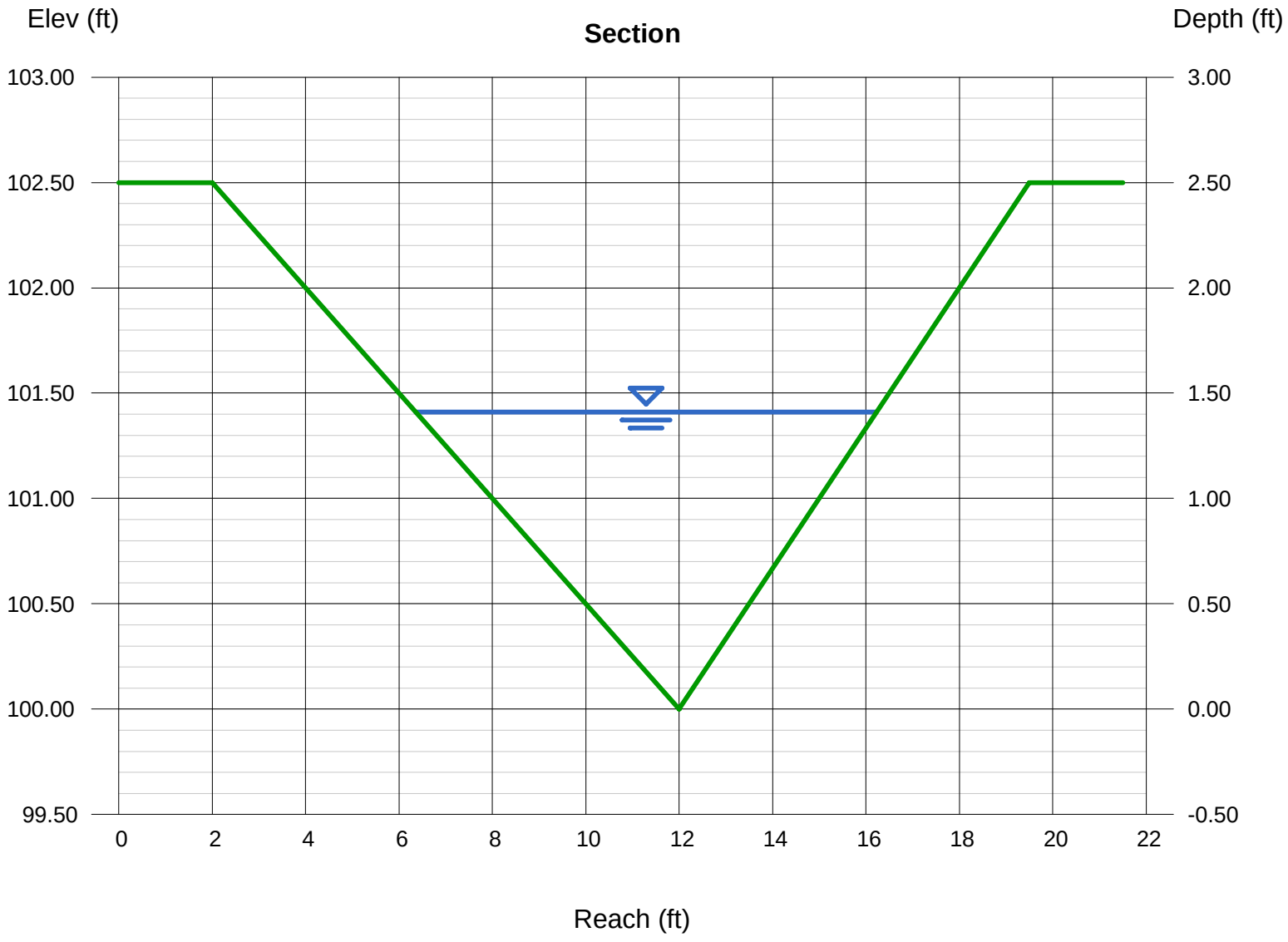
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 2.50
Invert Elev (ft)	= 100.00
Slope (%)	= 1.51
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 32.40

Highlighted

Depth (ft)	= 1.41
Q (cfs)	= 32.40
Area (sqft)	= 6.96
Velocity (ft/s)	= 4.66
Wetted Perim (ft)	= 10.27
Crit Depth, Yc (ft)	= 1.40
Top Width (ft)	= 9.87
EGL (ft)	= 1.75



APPENDIX D

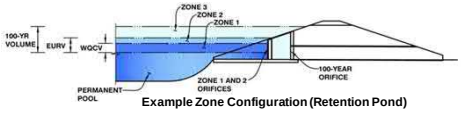
WATER QUALITY AND DETENTION CALCULATIONS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Latigo Trails Filing 10-Ultimate

Basin ID: South Pond



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	237.02	acres
Watershed Length =	4,610	ft
Watershed Length to Centroid =	1,845	ft
Watershed Slope =	0.035	ft/ft
Watershed Imperviousness =	14.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	1.746	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	3.204	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	3.958	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	7.976	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	11.904	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	18.639	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	23.328	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	29.976	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3 in.) =	39.391	acre-feet	3.00	inches
Approximate 2-yr Detention Volume =	2.118	acre-feet		
Approximate 5-yr Detention Volume =	3.230	acre-feet		
Approximate 10-yr Detention Volume =	5.863	acre-feet		
Approximate 25-yr Detention Volume =	7.730	acre-feet		
Approximate 50-yr Detention Volume =	8.144	acre-feet		
Approximate 100-yr Detention Volume =	10.299	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	1.746	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.458	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	7.095	acre-feet
Total Detention Basin Volume =	10.299	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

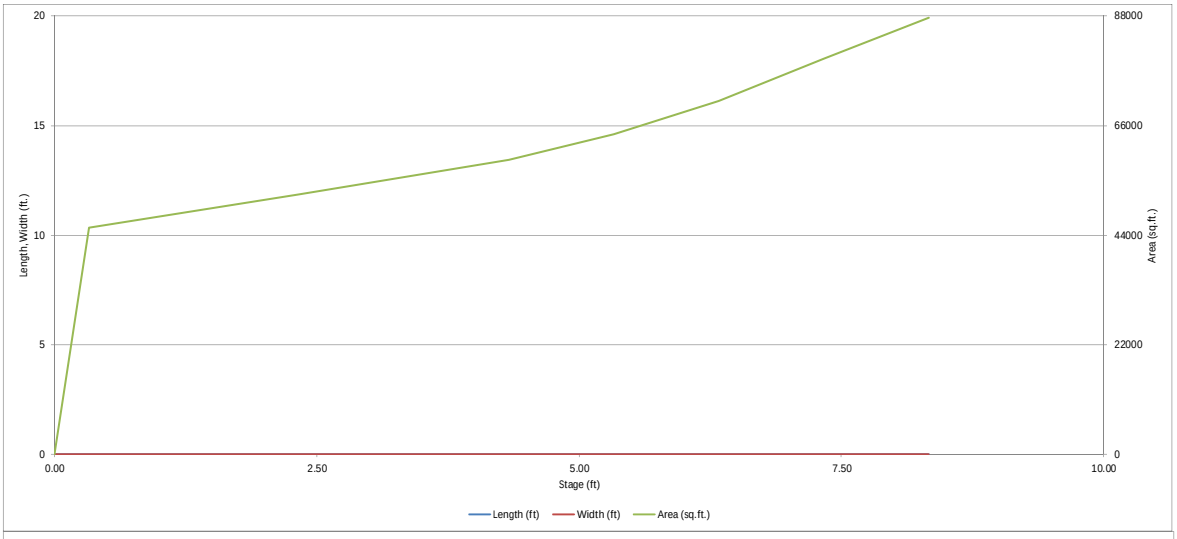
Depth Increment = ft

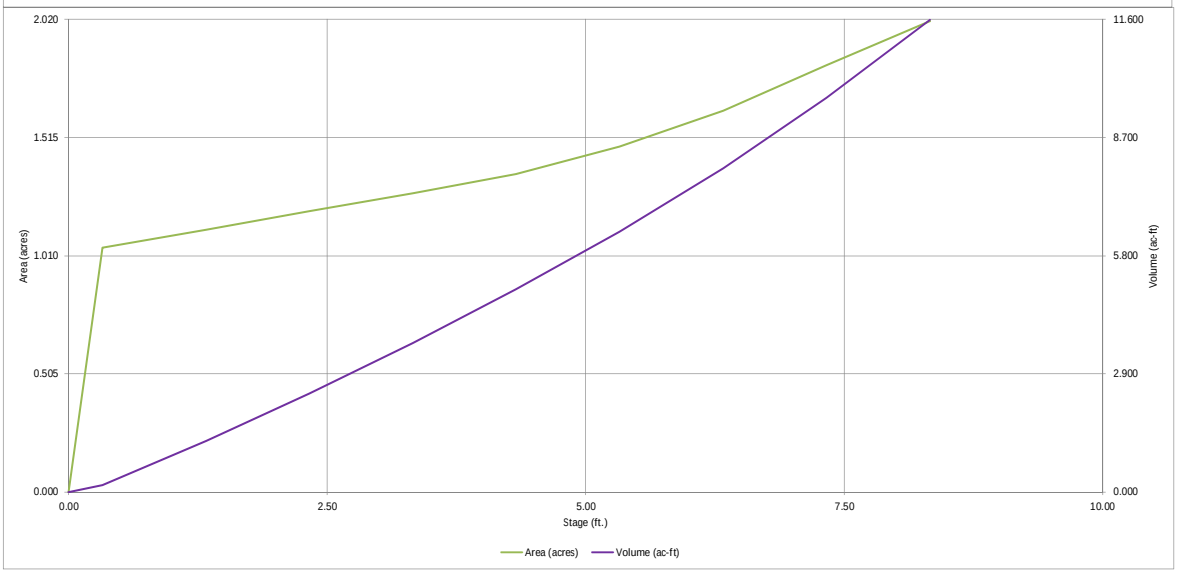
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	0	0.000		
7088	--	0.33	--	--	--	45,540	1.045	7,510	0.172
7089	--	1.33	--	--	--	48,824	1.121	54,692	1.256
7090	--	2.33	--	--	--	52,225	1.199	105,216	2.415
7091	--	3.33	--	--	--	55,645	1.277	159,151	3.654
7092	--	4.33	--	--	--	59,142	1.358	216,545	4.971
7093	--	5.33	--	--	--	64,315	1.476	278,273	6.388
7094	--	6.33	--	--	--	70,980	1.629	345,921	7.941
7095	--	7.33	--	--	--	79,482	1.825	421,152	9.668
7096	--	8.33	--	--	--	87,634	2.012	504,710	11.587

Provide stage area information up to the top of embankment (~10.2')

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)





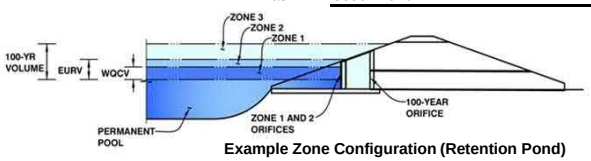
This and other pond calcs will be reviewed in more details once pond outlet details/sections are provided in CD's.

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: Latigo Trails Filing 10-Ultimate

Basin ID: South Pond



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.77	1.746	Orifice Plate
Zone 2 (EURV)	2.98	1.458	Circular Orifice
Zone 3 (100-year)	7.67	7.095	Weir&Pipe (Rect.)
Total (all zones)		10.299	

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

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

Calculated Parameters for Underdrain

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	1.76	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	0.59	1.17					
Orifice Area (sq. inches)	13.15	9.75	9.65					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Circular	Not Selected			Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	1.76	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.00	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	2.96	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.02	N/A	feet
Vertical Orifice Diameter =	0.38	N/A	inches				

Calculated Parameters for Vertical Orifice

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

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.20	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	6.45	N/A	feet
Overflow Weir Front Edge Length =	15.00	N/A	feet	Overflow Weir Slope Length =	9.28	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	6.88	N/A	
Horiz. Length of Weir Sides =	9.00	N/A	feet	Overflow Grate Open Area w/o Debris =	110.07	N/A	ft^2
Overflow Grate Type =	Close Mesh Grate	N/A		Overflow Grate Open Area w/ Debris =	110.07	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 =	0.74	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	16.00	N/A	ft^2
Rectangular Orifice Width =	96.00	N/A	inches	Outlet Orifice Centroid =	1.00	N/A	feet
Rectangular Orifice Height =	24.00		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=	8.21	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.98	feet
Spillway Crest Length =	120.00	feet	Stage at Top of Freeboard =	10.19	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	2.01	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	11.59	acre-ft

Calculated Parameters for Spillway

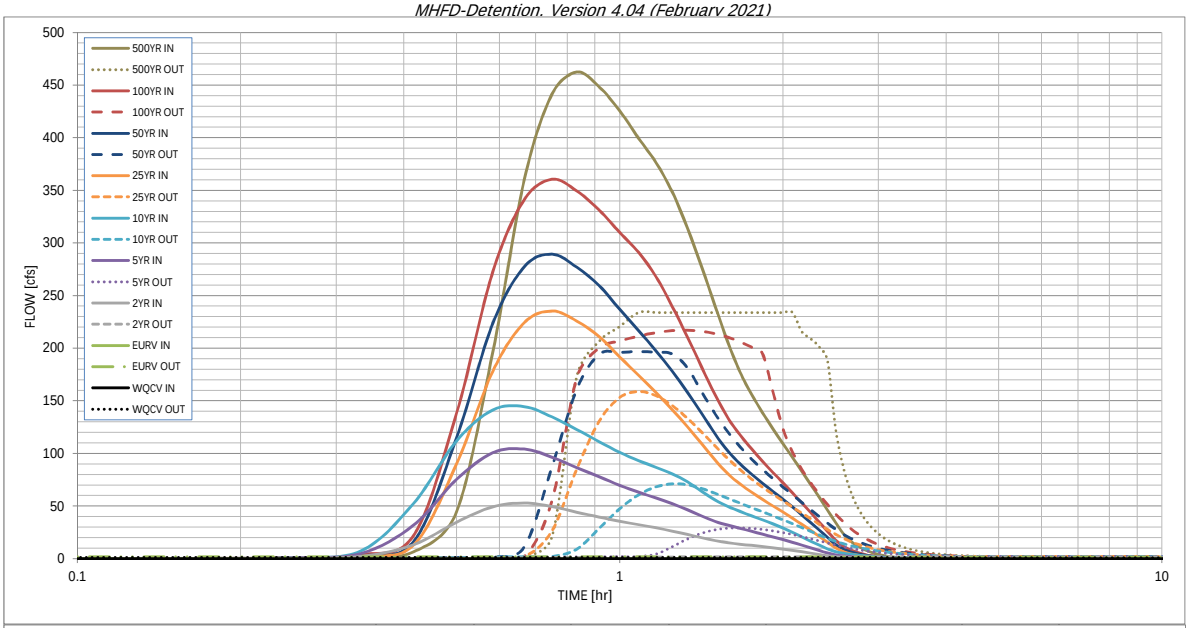
Routed Hydrograph Results *The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).*

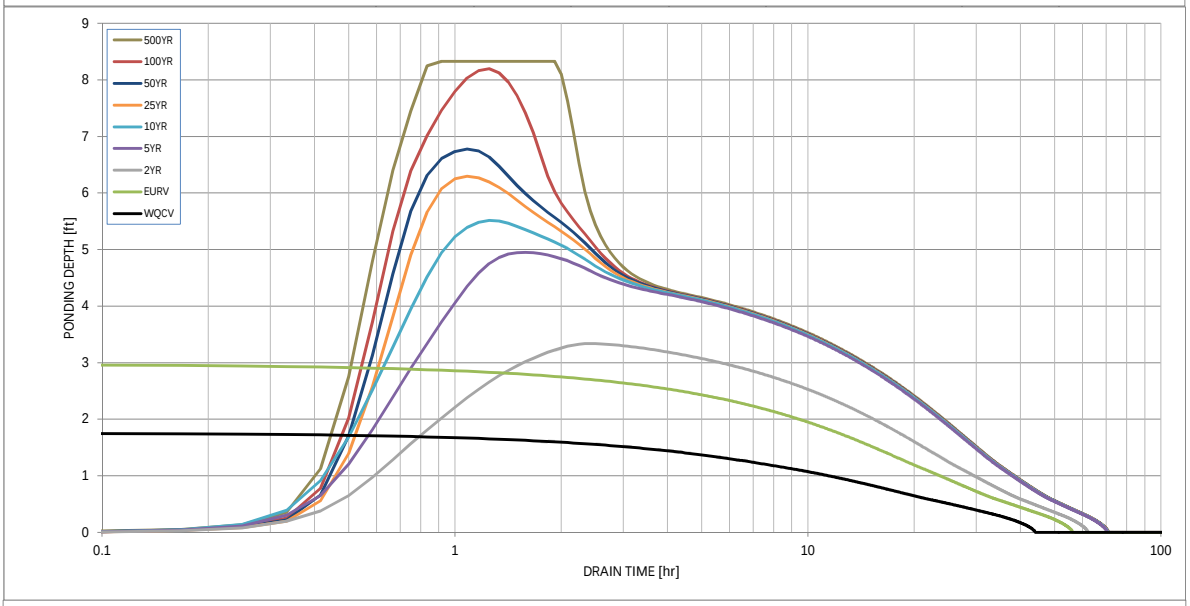
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.00
CUHP Runoff Volume (acre-ft) =	1.746	3.204	3.958	7.976	11.904	18.639	23.328	29.976	39.391
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	3.958	7.976	11.904	18.639	23.328	29.976	39.391
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	26.8	76.5	116.3	206.3	259.4	328.1	427.9
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	52.8	104.1	144.5	235.3	289.3	360.5	462.4
Peak Outflow Q (cfs) =	1.2	1.7	1.8	29.3	71.1	158.8	196.7	217.0	233.9
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.4	0.6	0.8	0.8	0.7	0.5
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.2	0.6	1.4	1.8	1.9	2.0
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	40	49	54	57	52	45	42	38	34
Time to Drain 99% of Inflow Volume (hours) =	42	53	59	64	62	59	57	54	51
Maximum Ponding Depth (ft) =	1.77	2.98	3.34	4.95	5.51	6.30	6.78	8.20	8.33
Area at Maximum Ponding Depth (acres) =	1.16	1.25	1.28	1.43	1.50	1.62	1.72	1.99	2.01
Maximum Volume Stored (acre-ft) =	1.756	3.211	3.654	5.836	6.657	7.876	8.677	11.307	11.587

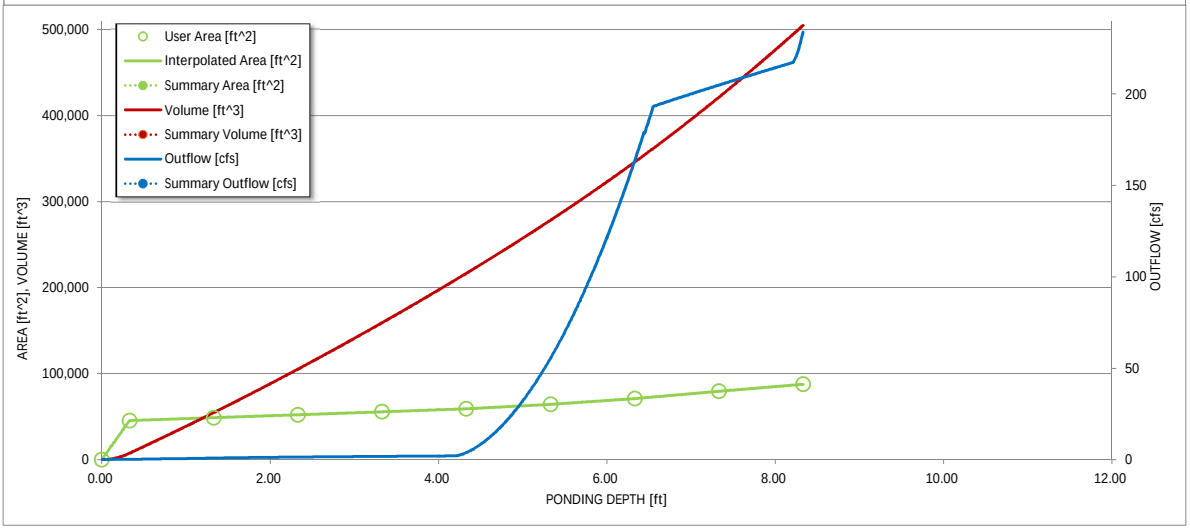
Why not spillway? Should be. Check inputs in case there is an error.

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			

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.

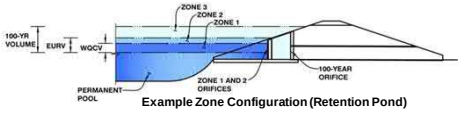
	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.01	0.14
	0:15:00	0.00	0.00	0.47	0.77	0.96	0.64	0.85	0.79	1.18
	0:20:00	0.00	0.00	2.10	4.89	7.30	2.23	2.66	3.55	6.44
	0:25:00	0.00	0.00	13.20	31.78	52.45	12.83	16.15	21.84	44.22
	0:30:00	0.00	0.00	34.54	75.18	111.73	89.79	114.64	137.75	195.95
	0:35:00	0.00	0.00	49.25	100.59	141.22	177.99	223.36	272.32	359.62
	0:40:00	0.00	0.00	52.76	104.12	144.47	224.14	277.18	340.97	441.20
	0:45:00	0.00	0.00	49.53	96.37	134.69	235.30	289.27	360.49	462.39
	0:50:00	0.00	0.00	44.10	86.41	122.68	225.76	276.90	349.39	448.33
	0:55:00	0.00	0.00	39.53	77.79	111.16	210.95	259.49	331.20	425.56
	1:00:00	0.00	0.00	35.46	69.61	100.92	191.70	236.94	310.03	399.48
	1:05:00	0.00	0.00	32.29	63.09	93.16	174.31	216.72	291.06	376.50
	1:10:00	0.00	0.00	29.31	57.68	86.76	157.84	197.49	267.99	348.45
	1:15:00	0.00	0.00	26.14	52.25	80.51	141.57	178.13	239.78	314.15
	1:20:00	0.00	0.00	22.96	46.42	72.93	125.29	158.15	210.58	277.20
	1:25:00	0.00	0.00	19.85	40.51	63.92	109.20	137.93	181.91	239.81
	1:30:00	0.00	0.00	17.11	35.38	55.68	93.75	118.49	155.61	205.61
	1:35:00	0.00	0.00	15.11	31.79	49.59	80.61	102.15	133.79	177.47
	1:40:00	0.00	0.00	13.72	28.89	44.87	70.95	90.16	117.60	156.35
	1:45:00	0.00	0.00	12.54	26.01	40.69	63.11	80.33	104.36	138.87
	1:50:00	0.00	0.00	11.43	23.24	36.86	56.29	71.72	92.61	123.36
	1:55:00	0.00	0.00	10.26	20.59	33.10	50.09	63.90	81.94	109.25
	2:00:00	0.00	0.00	9.05	18.06	29.12	44.31	56.60	72.00	96.09
	2:05:00	0.00	0.00	7.78	15.45	24.90	38.45	49.15	62.28	83.10
	2:10:00	0.00	0.00	6.49	12.80	20.67	32.56	41.63	52.86	70.43
	2:15:00	0.00	0.00	5.22	10.22	16.61	26.79	34.28	43.76	58.19
	2:20:00	0.00	0.00	3.99	7.73	12.76	21.13	27.10	34.77	46.22
	2:25:00	0.00	0.00	2.81	5.37	9.20	15.61	20.13	25.97	34.58
	2:30:00	0.00	0.00	1.85	3.57	6.63	10.37	13.53	17.63	23.90
	2:35:00	0.00	0.00	1.28	2.57	5.10	6.79	9.12	11.88	16.59
	2:40:00	0.00	0.00	0.97	2.02	4.07	4.63	6.41	8.24	11.82
	2:45:00	0.00	0.00	0.77	1.62	3.25	3.24	4.60	5.70	8.38
	2:50:00	0.00	0.00	0.61	1.29	2.59	2.27	3.29	3.86	5.83
	2:55:00	0.00	0.00	0.49	1.02	2.03	1.62	2.38	2.54	3.96
	3:00:00	0.00	0.00	0.38	0.80	1.57	1.16	1.71	1.60	2.59
	3:05:00	0.00	0.00	0.30	0.62	1.20	0.83	1.23	1.00	1.68
	3:10:00	0.00	0.00	0.25	0.47	0.89	0.63	0.92	0.73	1.23
	3:15:00	0.00	0.00	0.20	0.35	0.66	0.48	0.70	0.58	0.94
	3:20:00	0.00	0.00	0.16	0.26	0.50	0.37	0.54	0.46	0.74
	3:25:00	0.00	0.00	0.12	0.19	0.38	0.28	0.41	0.36	0.58
	3:30:00	0.00	0.00	0.09	0.13	0.27	0.21	0.31	0.27	0.44
	3:35:00	0.00	0.00	0.06	0.08	0.19	0.15	0.23	0.20	0.32
	3:40:00	0.00	0.00	0.04	0.05	0.12	0.10	0.15	0.14	0.22
	3:45:00	0.00	0.00	0.02	0.03	0.07	0.07	0.10	0.08	0.13
	3:50:00	0.00	0.00	0.01	0.02	0.03	0.04	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

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Latigo Trails Filing 10

Basin ID: South Pond



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	237.02	acres
Watershed Length =	4,610	ft
Watershed Length to Centroid =	1,845	ft
Watershed Slope =	0.035	ft/ft
Watershed Imperviousness =	13.10%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	1.655	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	2.982	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	3.776	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	7.752	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	11.656	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	18.407	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	23.086	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	29.742	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3 in.) =	39.144	acre-feet	3.00 inches
Approximate 2-yr Detention Volume =	1.957	acre-feet	
Approximate 5-yr Detention Volume =	3.003	acre-feet	
Approximate 10-yr Detention Volume =	5.585	acre-feet	
Approximate 25-yr Detention Volume =	7.450	acre-feet	
Approximate 50-yr Detention Volume =	7.841	acre-feet	
Approximate 100-yr Detention Volume =	9.962	acre-feet	

Define Zones and Basin Geometry

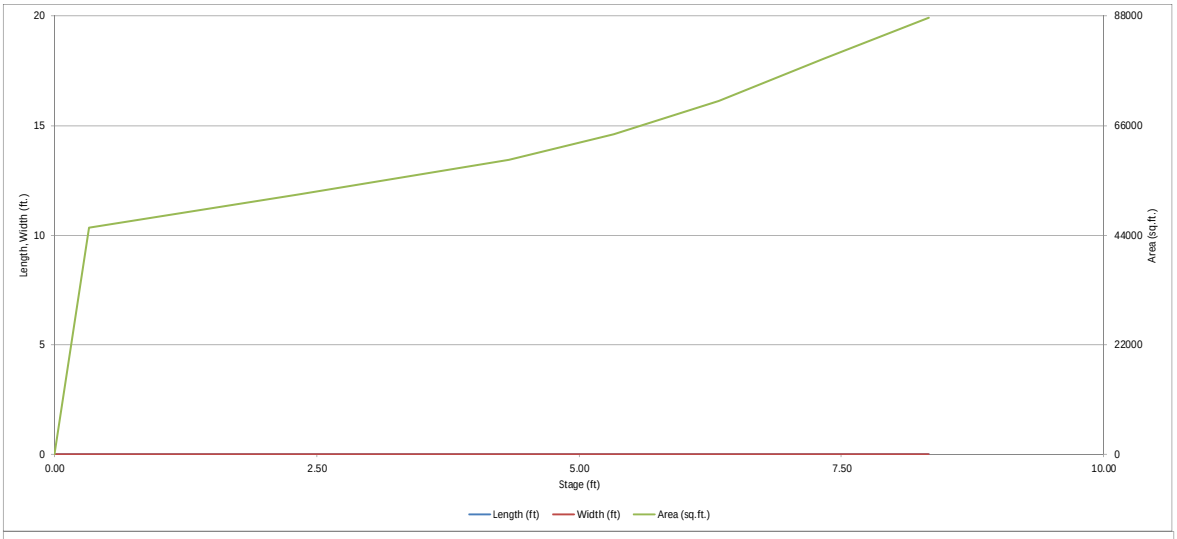
Zone 1 Volume (WQCV) =	1.655	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.327	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	6.980	acre-feet
Total Detention Basin Volume =	9.962	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (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

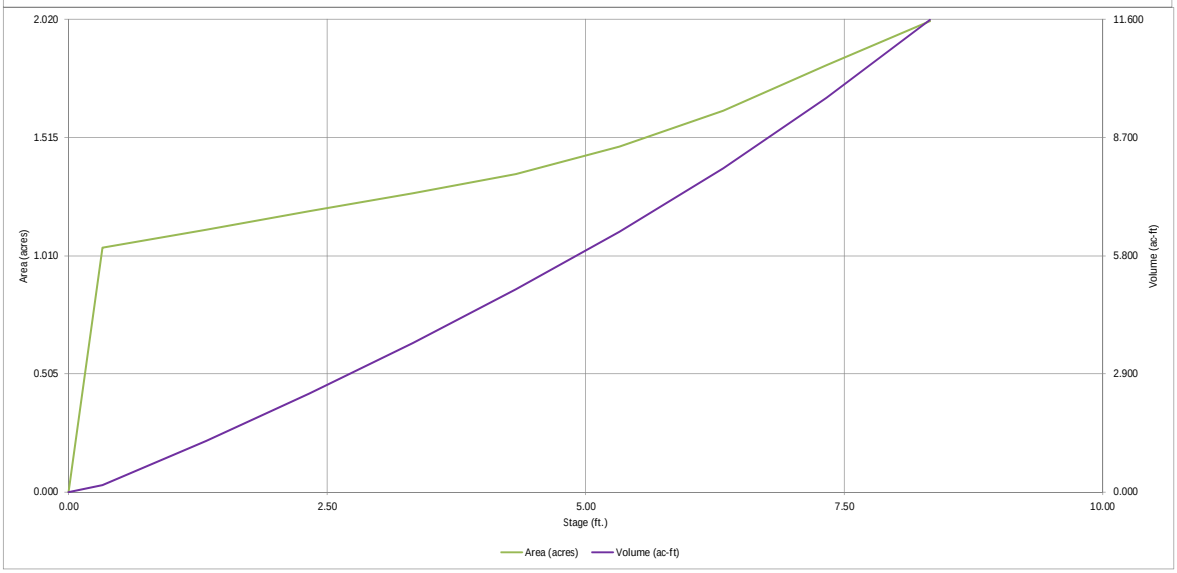
Depth Increment = ft

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	--	0.33	--	--	--	45,540	1.045	7,510	0.172
7089	--	1.33	--	--	--	48,824	1.121	54,692	1.256
7090	--	2.33	--	--	--	52,225	1.199	105,216	2.415
7091	--	3.33	--	--	--	55,645	1.277	159,151	3.654
7092	--	4.33	--	--	--	59,142	1.358	216,545	4.971
7093	--	5.33	--	--	--	64,315	1.476	278,273	6.388
7094	--	6.33	--	--	--	70,980	1.629	345,921	7.941
7095	--	7.33	--	--	--	79,482	1.825	421,152	9.668
7096	--	8.33	--	--	--	87,634	2.012	504,710	11.587

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)



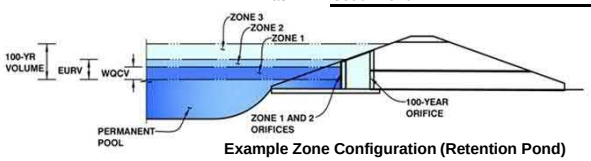


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: Latigo Trails Filing 10

Basin ID: South Pond



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.69	1.655	Orifice Plate
Zone 2 (EURV)	2.80	1.327	Circular Orifice
Zone 3 (100-year)	7.49	6.980	Weir&Pipe (Rect.)
Total (all zones)		9.962	

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

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

Calculated Parameters for Underdrain

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	1.76	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	0.59	1.17					
Orifice Area (sq. inches)	12.80	9.60	9.60					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Circular	Not Selected			Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	1.76	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.00	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	2.96	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.02	N/A	feet
Vertical Orifice Diameter =	0.38	N/A	inches				

Calculated Parameters for Vertical Orifice

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

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.20	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	6.45	N/A	feet
Overflow Weir Front Edge Length =	15.00	N/A	feet	Overflow Weir Slope Length =	9.28	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	6.88	N/A	
Horiz. Length of Weir Sides =	9.00	N/A	feet	Overflow Grate Open Area w/o Debris =	110.07	N/A	ft^2
Overflow Grate Type =	Close Mesh Grate	N/A		Overflow Grate Open Area w/ Debris =	110.07	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 =	0.74	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	16.00	N/A	ft^2
Rectangular Orifice Width =	96.00	N/A	inches	Outlet Orifice Centroid =	1.00	N/A	feet
Rectangular Orifice Height =	24.00		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=	8.21	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 =	10.18	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	2.01	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	11.59	acre-ft

Calculated Parameters for Spillway

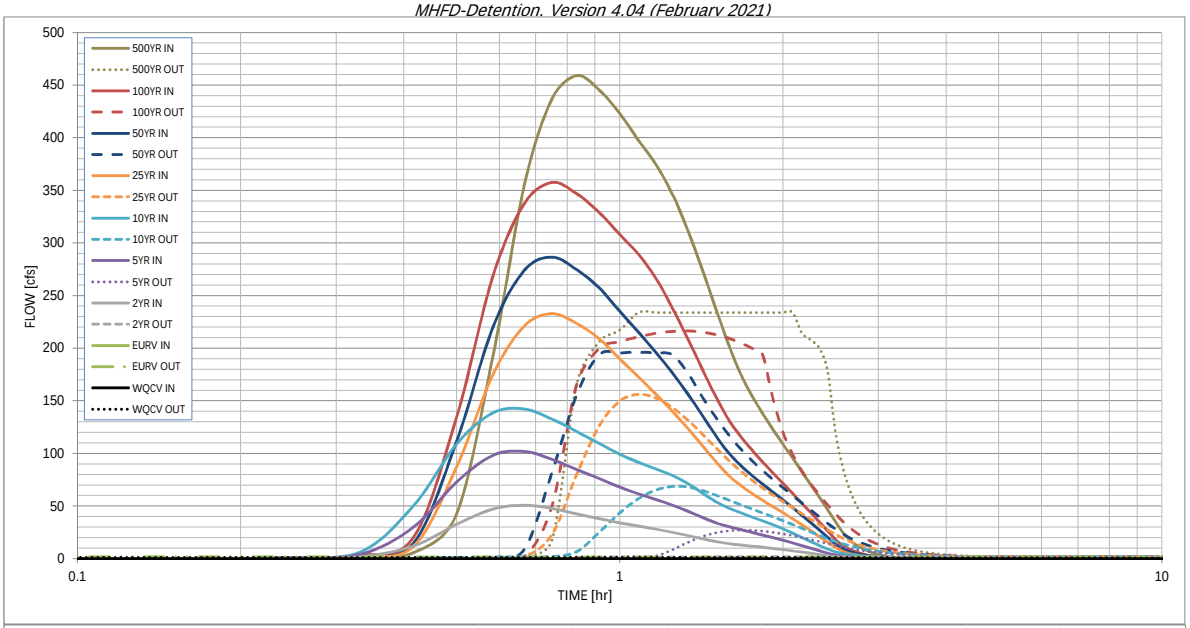
Routed Hydrograph Results *The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).*

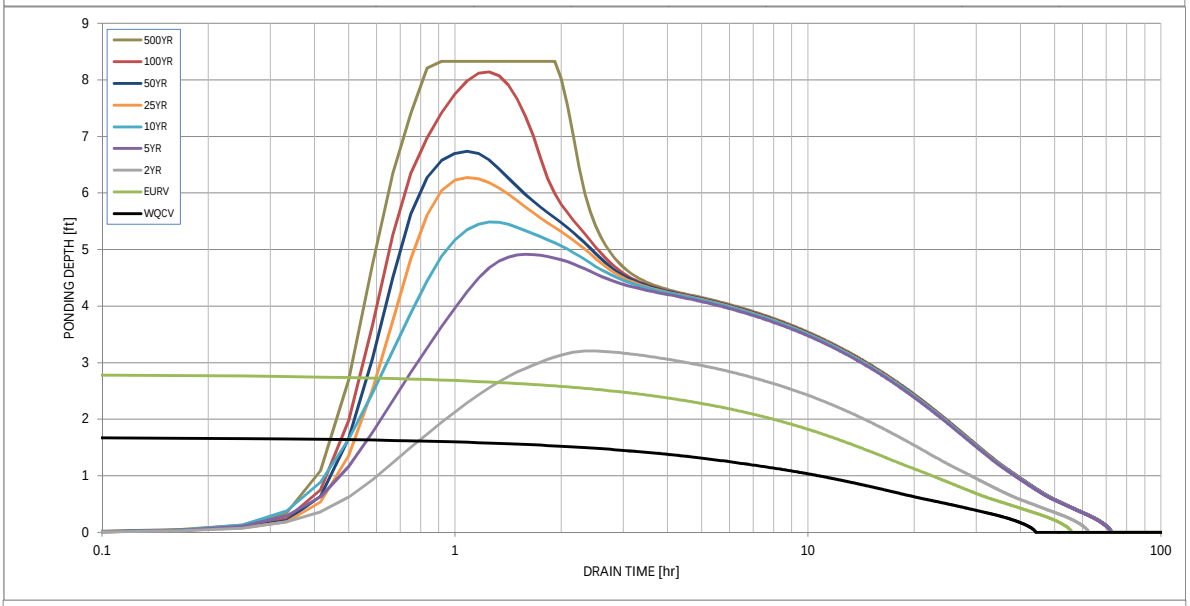
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.00
CUHP Runoff Volume (acre-ft) =	1.655	2.982	3.776	7.752	11.656	18.407	23.086	29.742	39.144
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	3.776	7.752	11.656	18.407	23.086	29.742	39.144
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	26.8	76.5	116.3	206.3	259.4	328.1	427.9
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	50.7	101.9	142.1	232.7	286.5	357.5	459.0
Peak Outflow Q (cfs) =	1.1	1.6	1.7	27.0	68.6	156.1	196.1	216.3	233.9
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.4	0.6	0.8	0.8	0.7	0.5
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.2	0.6	1.4	1.8	1.9	2.0
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	40	49	54	58	53	46	43	39	34
Time to Drain 99% of Inflow Volume (hours) =	42	53	59	66	64	61	58	56	52
Maximum Ponding Depth (ft) =	1.69	2.80	3.21	4.91	5.49	6.28	6.74	8.14	8.33
Area at Maximum Ponding Depth (acres) =	1.15	1.24	1.27	1.43	1.50	1.62	1.71	1.98	2.01
Maximum Volume Stored (acre-ft) =	1.664	2.988	3.488	5.779	6.611	7.844	8.609	11.208	11.587

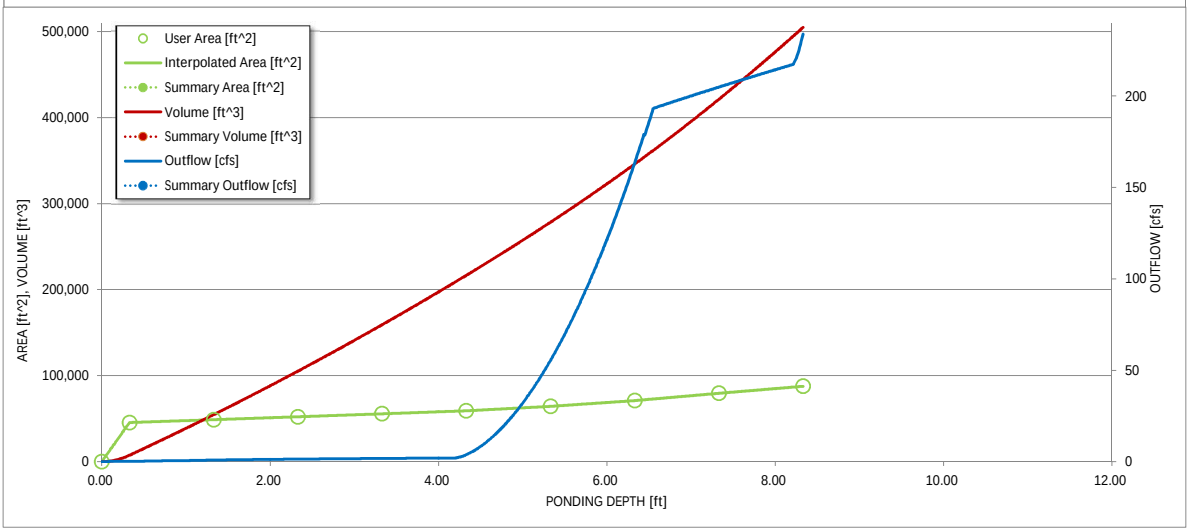
Why not spillway? Should be. Check inputs in case there is an error.

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			

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.

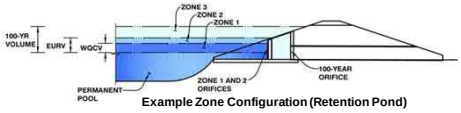
	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.12
	0:15:00	0.00	0.00	0.41	0.66	0.82	0.55	0.74	0.68	1.02
	0:20:00	0.00	0.00	1.82	4.28	6.52	1.93	2.30	3.01	5.70
	0:25:00	0.00	0.00	12.03	29.99	50.23	11.66	14.76	20.20	42.10
	0:30:00	0.00	0.00	32.52	72.56	108.75	86.81	111.15	133.92	191.36
	0:35:00	0.00	0.00	47.07	98.04	138.44	174.44	219.35	267.84	354.39
	0:40:00	0.00	0.00	50.70	101.90	142.12	220.94	273.67	337.12	436.81
	0:45:00	0.00	0.00	47.70	94.39	132.59	232.72	286.52	357.45	458.96
	0:50:00	0.00	0.00	42.41	84.56	120.76	223.43	274.43	346.73	445.37
	0:55:00	0.00	0.00	37.98	76.08	109.41	208.94	257.39	328.93	423.10
	1:00:00	0.00	0.00	34.01	67.98	99.21	189.95	235.15	308.10	397.40
	1:05:00	0.00	0.00	30.89	61.51	91.50	172.60	214.95	289.12	374.43
	1:10:00	0.00	0.00	28.03	56.19	85.19	156.26	195.88	266.32	346.72
	1:15:00	0.00	0.00	25.00	50.88	79.05	140.16	176.72	238.44	312.83
	1:20:00	0.00	0.00	21.97	45.20	71.63	124.10	156.99	209.56	276.30
	1:25:00	0.00	0.00	18.99	39.42	62.78	108.21	137.02	181.22	239.29
	1:30:00	0.00	0.00	16.33	34.30	54.52	92.95	117.77	155.15	205.31
	1:35:00	0.00	0.00	14.35	30.69	48.42	79.71	101.25	133.12	176.88
	1:40:00	0.00	0.00	13.01	27.86	43.77	70.05	89.25	116.87	155.66
	1:45:00	0.00	0.00	11.88	25.09	39.66	62.26	79.47	103.69	138.25
	1:50:00	0.00	0.00	10.82	22.43	35.89	55.51	70.94	92.02	122.81
	1:55:00	0.00	0.00	9.72	19.88	32.22	49.38	63.19	81.44	108.80
	2:00:00	0.00	0.00	8.58	17.44	28.34	43.69	55.99	71.60	95.76
	2:05:00	0.00	0.00	7.38	14.94	24.27	37.96	48.68	62.02	82.94
	2:10:00	0.00	0.00	6.17	12.41	20.20	32.23	41.34	52.77	70.46
	2:15:00	0.00	0.00	4.98	9.95	16.28	26.63	34.18	43.86	58.47
	2:20:00	0.00	0.00	3.82	7.55	12.57	21.11	27.17	35.06	46.71
	2:25:00	0.00	0.00	2.71	5.28	9.10	15.72	20.35	26.42	35.27
	2:30:00	0.00	0.00	1.76	3.46	6.46	10.56	13.83	18.16	24.62
	2:35:00	0.00	0.00	1.17	2.41	4.89	6.79	9.17	12.10	16.92
	2:40:00	0.00	0.00	0.88	1.87	3.88	4.57	6.37	8.32	11.97
	2:45:00	0.00	0.00	0.69	1.50	3.09	3.15	4.52	5.73	8.46
	2:50:00	0.00	0.00	0.55	1.19	2.46	2.18	3.21	3.86	5.87
	2:55:00	0.00	0.00	0.44	0.94	1.93	1.53	2.30	2.53	3.97
	3:00:00	0.00	0.00	0.34	0.74	1.49	1.09	1.64	1.58	2.58
	3:05:00	0.00	0.00	0.27	0.57	1.13	0.77	1.17	0.96	1.65
	3:10:00	0.00	0.00	0.22	0.43	0.84	0.57	0.86	0.67	1.17
	3:15:00	0.00	0.00	0.18	0.32	0.62	0.43	0.65	0.53	0.88
	3:20:00	0.00	0.00	0.14	0.24	0.46	0.33	0.50	0.42	0.69
	3:25:00	0.00	0.00	0.11	0.17	0.35	0.25	0.38	0.33	0.55
	3:30:00	0.00	0.00	0.08	0.12	0.26	0.19	0.29	0.25	0.42
	3:35:00	0.00	0.00	0.06	0.08	0.18	0.14	0.21	0.18	0.30
	3:40:00	0.00	0.00	0.04	0.05	0.11	0.09	0.15	0.13	0.21
	3:45:00	0.00	0.00	0.02	0.03	0.07	0.06	0.09	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	0.01
	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 STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Latigo Trails Filing 10

Basin ID: Pond G1



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	18.70	acres
Watershed Length =	1,660	ft
Watershed Length to Centroid =	745	ft
Watershed Slope =	0.030	ft/ft
Watershed Imperviousness =	11.80%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.120	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.210	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.277	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.585	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.890	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	1.423	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	1.790	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	2.315	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3 in.) =	3.054	acre-feet	3.00	inches
Approximate 2-yr Detention Volume =	0.136	acre-feet		
Approximate 5-yr Detention Volume =	0.211	acre-feet		
Approximate 10-yr Detention Volume =	0.409	acre-feet		
Approximate 25-yr Detention Volume =	0.556	acre-feet		
Approximate 50-yr Detention Volume =	0.584	acre-feet		
Approximate 100-yr Detention Volume =	0.747	acre-feet		

Define Zones and Basin Geometry

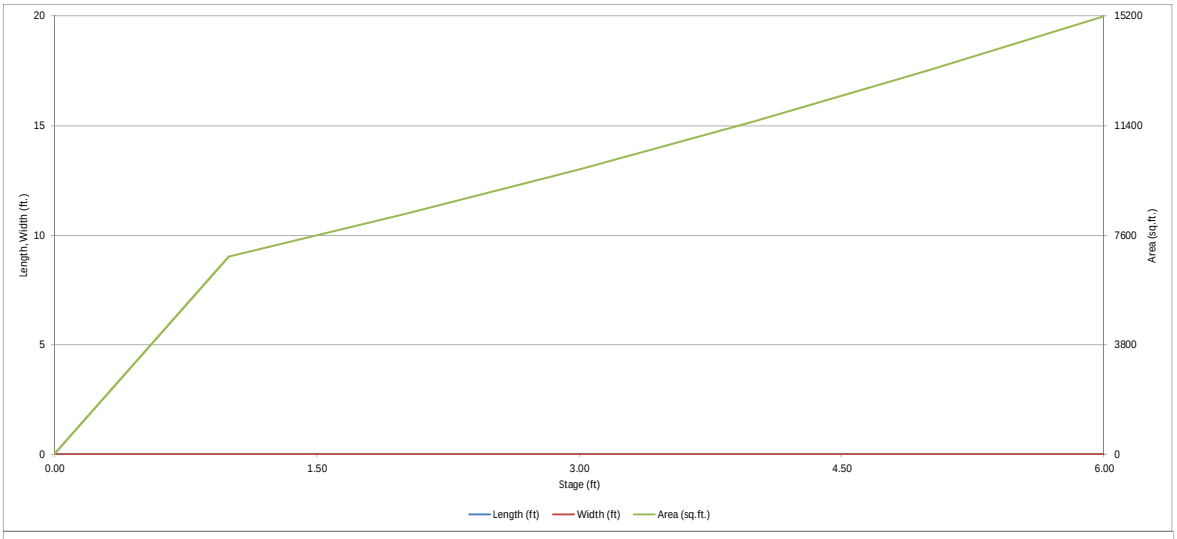
Zone 1 Volume (WQCV) =	0.120	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.090	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.537	acre-feet
Total Detention Basin Volume =	0.747	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (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

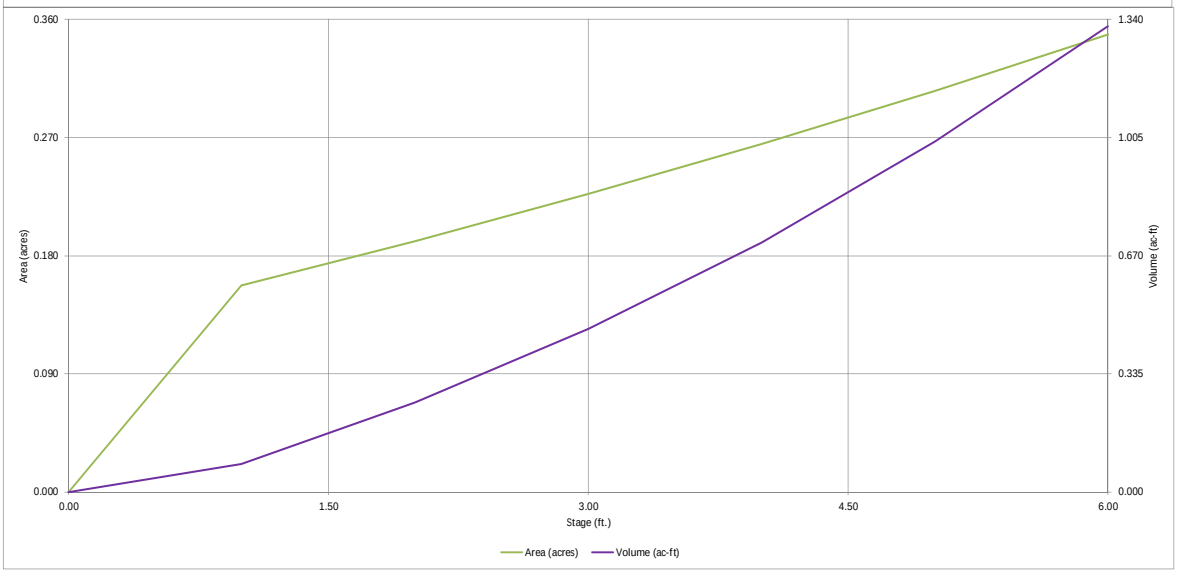
Depth Increment = ft

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		
	--	1.00	--	--	--	6,857	0.157	3,428	0.079
	--	2.00	--	--	--	8,320	0.191	11,017	0.253
	--	3.00	--	--	--	9,884	0.227	20,118	0.462
	--	4.00	--	--	--	11,548	0.265	30,834	0.708
	--	5.00	--	--	--	13,313	0.306	43,264	0.993
	--	6.00	--	--	--	15,178	0.348	57,510	1.320

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)



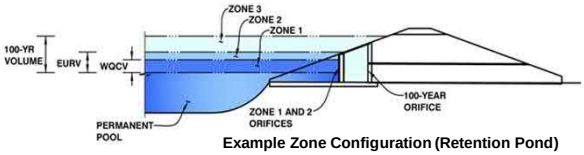


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: Latigo Trails Filing 10

Basin ID: Pond G1



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.26	0.120	Orifice Plate
Zone 2 (EURV)	1.78	0.090	Circular Orifice
Zone 3 (100-year)	4.15	0.537	Weir&Pipe (Restrict)
Total (all zones)		0.747	

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)

Invert 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 =	1.45	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	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	0.48	0.97					
Orifice Area (sq. inches)	0.82	0.78	0.75					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Circular	Not Selected			Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	1.45	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.00	N/A	ft²
Depth at top of Zone using Vertical Orifice =	2.14	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.02	N/A	feet
Vertical Orifice Diameter =	0.38	N/A	inches				

Calculated Parameters for Vertical Orifice

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

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	2.15	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	2.15	N/A	feet
Overflow Weir Front Edge Length =	4.00	N/A	feet	Overflow Weir Slope Length =	4.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	7.76	N/A	
Horiz. Length of Weir Sides =	4.00	N/A	feet	Overflow Grate Open Area w/o Debris =	12.66	N/A	ft²
Overflow Grate Type =	Close Mesh Grate	N/A		Overflow Grate Open Area w/ Debris =	12.66	N/A	ft²
Debris Clogging % =	0%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	1.50	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	1.63	N/A	ft²
Outlet Pipe Diameter =	30.00	N/A	inches	Outlet Orifice Centroid =	0.54	N/A	feet
Restrictor Plate Height Above Pipe Invert =	11.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.30	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	4.70	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.83	feet
Spillway Crest Length =	9.00	feet	Stage at Top of Freeboard =	6.53	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.35	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	1.32	acre-ft

Calculated Parameters for Spillway

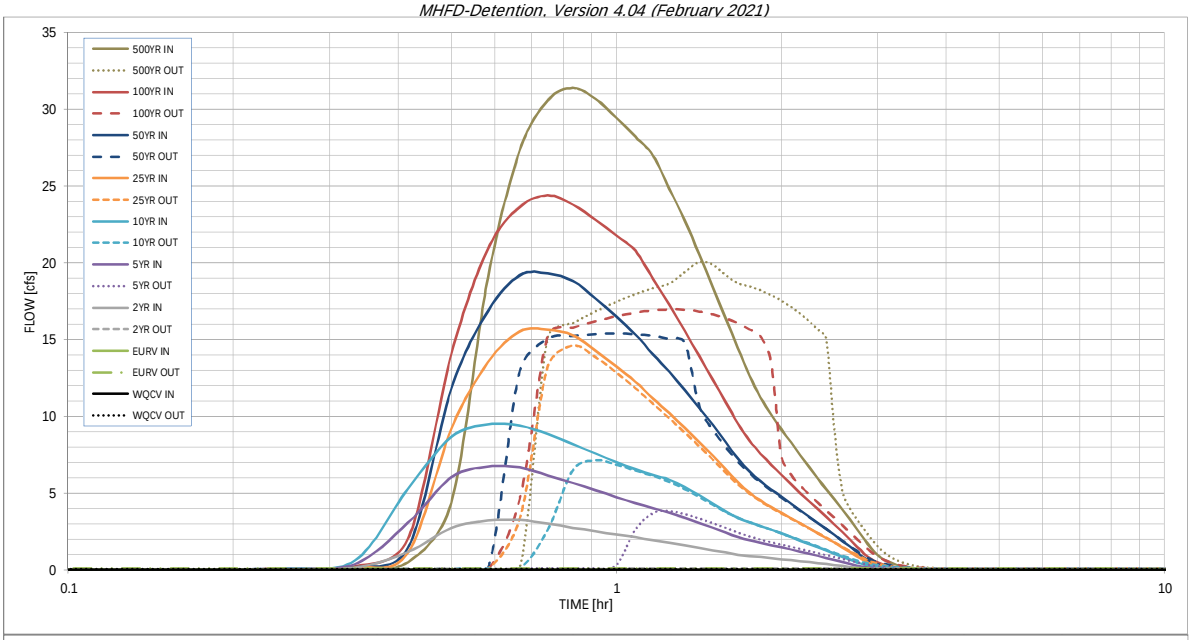
Routed Hydrograph Results

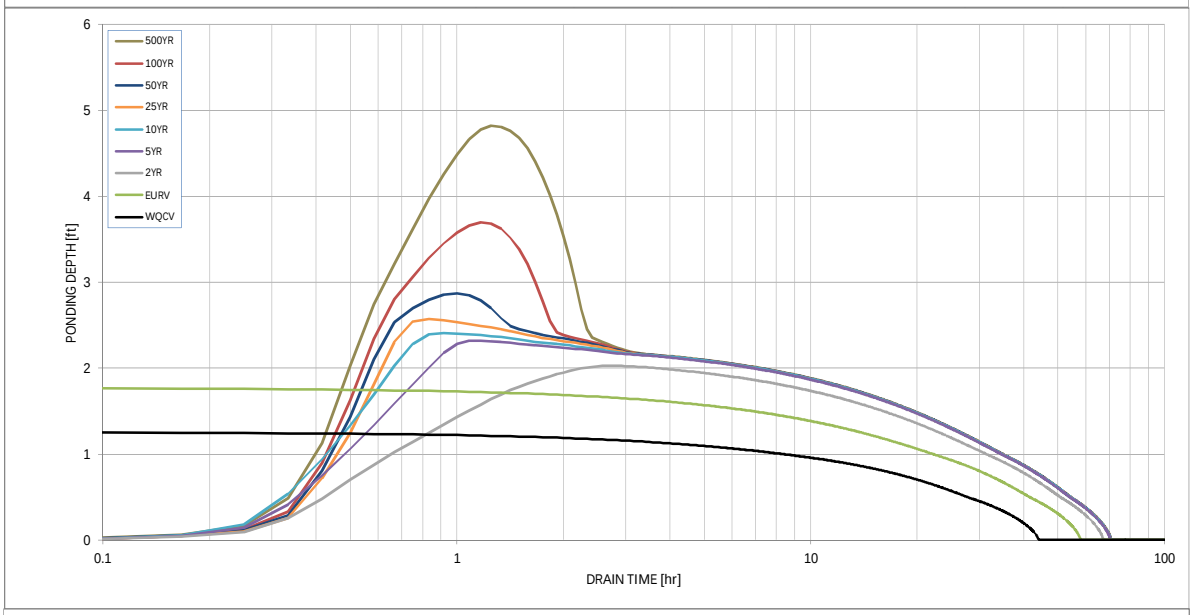
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

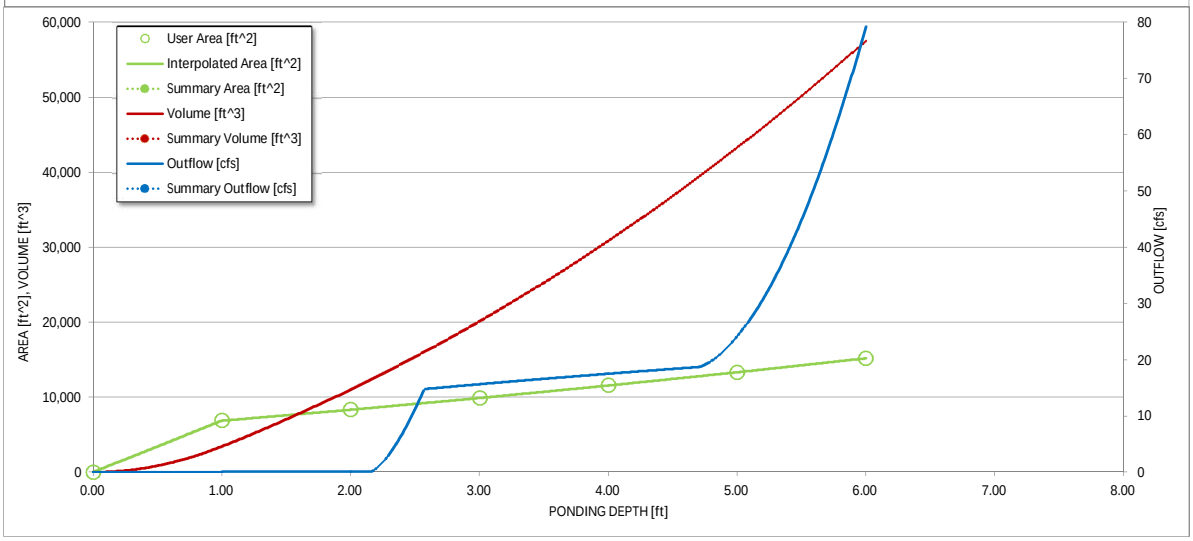
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.00
CUHP Runoff Volume (acre-ft) =	0.120	0.210	0.277	0.585	0.890	1.423	1.790	2.315	3.054
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.277	0.585	0.890	1.423	1.790	2.315	3.054
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	1.9	5.2	7.8	14.1	17.7	22.7	29.5
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.10	0.28	0.42	0.75	0.95	1.21	1.58
Peak Inflow Q (cfs) =	N/A	N/A	3.3	6.7	9.5	15.6	19.3	24.4	31.4
Peak Outflow Q (cfs) =	0.1	0.1	0.1	3.8	7.1	14.6	15.4	17.0	20.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.7	0.9	1.0	0.9	0.7	0.7
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.3	0.6	1.1	1.2	1.3	1.5
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	40	51	59	55	51	45	42	37	32
Time to Drain 99% of Inflow Volume (hours) =	42	55	63	64	61	58	55	53	50
Maximum Ponding Depth (ft) =	1.26	1.78	2.03	2.32	2.41	2.57	2.87	3.69	4.82
Area at Maximum Ponding Depth (acres) =	0.17	0.18	0.19	0.20	0.21	0.21	0.22	0.25	0.30
Maximum Volume Stored (acre-ft) =	0.121	0.212	0.257	0.314	0.332	0.368	0.433	0.628	0.936

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			

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	0:15:00	0.00	0.00	0.04	0.06	0.08	0.05	0.07	0.07	0.09
	0:20:00	0.00	0.00	0.15	0.37	0.60	0.15	0.17	0.22	0.50
	0:25:00	0.00	0.00	1.16	3.06	5.26	1.10	1.42	1.99	4.34
	0:30:00	0.00	0.00	2.72	6.02	8.65	9.18	11.78	14.03	19.02
	0:35:00	0.00	0.00	3.21	6.72	9.47	13.50	16.86	20.90	27.31
	0:40:00	0.00	0.00	3.25	6.66	9.38	15.51	19.17	23.62	30.56
	0:45:00	0.00	0.00	3.01	6.15	8.84	15.64	19.29	24.36	31.37
	0:50:00	0.00	0.00	2.74	5.66	8.17	15.26	18.80	23.77	30.65
	0:55:00	0.00	0.00	2.51	5.19	7.58	14.26	17.65	22.77	29.42
	1:00:00	0.00	0.00	2.30	4.73	7.01	13.24	16.47	21.77	28.18
	1:05:00	0.00	0.00	2.12	4.34	6.54	12.25	15.33	20.77	26.97
	1:10:00	0.00	0.00	1.93	4.02	6.19	11.14	14.02	18.94	24.79
	1:15:00	0.00	0.00	1.76	3.71	5.86	10.18	12.88	17.24	22.75
	1:20:00	0.00	0.00	1.60	3.39	5.39	9.23	11.70	15.53	20.53
	1:25:00	0.00	0.00	1.44	3.06	4.86	8.32	10.55	13.91	18.40
	1:30:00	0.00	0.00	1.28	2.74	4.32	7.43	9.42	12.40	16.39
	1:35:00	0.00	0.00	1.12	2.43	3.80	6.54	8.31	10.92	14.45
	1:40:00	0.00	0.00	0.99	2.13	3.38	5.69	7.24	9.52	12.64
	1:45:00	0.00	0.00	0.89	1.92	3.08	5.02	6.40	8.41	11.21
	1:50:00	0.00	0.00	0.83	1.76	2.84	4.51	5.77	7.56	10.10
	1:55:00	0.00	0.00	0.76	1.61	2.61	4.09	5.25	6.84	9.15
	2:00:00	0.00	0.00	0.70	1.47	2.38	3.72	4.78	6.19	8.30
	2:05:00	0.00	0.00	0.63	1.32	2.14	3.36	4.32	5.57	7.46
	2:10:00	0.00	0.00	0.56	1.18	1.90	3.02	3.88	4.99	6.67
	2:15:00	0.00	0.00	0.50	1.04	1.67	2.70	3.45	4.44	5.93
	2:20:00	0.00	0.00	0.43	0.91	1.46	2.38	3.05	3.93	5.24
	2:25:00	0.00	0.00	0.37	0.78	1.25	2.08	2.66	3.44	4.58
	2:30:00	0.00	0.00	0.31	0.65	1.05	1.77	2.27	2.95	3.93
	2:35:00	0.00	0.00	0.25	0.52	0.86	1.47	1.89	2.47	3.28
	2:40:00	0.00	0.00	0.20	0.40	0.67	1.18	1.52	1.99	2.64
	2:45:00	0.00	0.00	0.14	0.28	0.48	0.88	1.14	1.51	2.01
	2:50:00	0.00	0.00	0.09	0.18	0.34	0.60	0.78	1.04	1.41
	2:55:00	0.00	0.00	0.05	0.12	0.25	0.37	0.51	0.68	0.96
	3:00:00	0.00	0.00	0.04	0.09	0.20	0.25	0.34	0.46	0.67
	3:05:00	0.00	0.00	0.03	0.07	0.16	0.17	0.24	0.32	0.47
	3:10:00	0.00	0.00	0.03	0.06	0.13	0.11	0.17	0.21	0.32
	3:15:00	0.00	0.00	0.02	0.05	0.10	0.08	0.12	0.14	0.22
	3:20:00	0.00	0.00	0.02	0.04	0.08	0.05	0.09	0.08	0.14
	3:25:00	0.00	0.00	0.01	0.03	0.06	0.04	0.06	0.05	0.09
	3:30:00	0.00	0.00	0.01	0.02	0.04	0.03	0.04	0.03	0.06
	3:35:00	0.00	0.00	0.01	0.02	0.03	0.02	0.03	0.03	0.05
	3:40:00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.04
	3:45:00	0.00	0.00	0.01	0.01	0.02	0.01	0.02	0.02	0.03
	3:50:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02
	3:55:00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02
	4:00:00	0.00	0.00	0.00	0.00	0.01	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

APPENDIX E

REFERENCE MATERIALS

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

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.

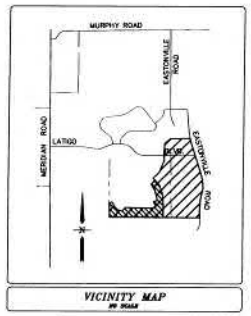
The major drainage course begins at the west-central portion of the site, traversing the Gieck Ranch Basin to design point G11 to the southeast. Six sub-basins, varying from 19 to 39 acres, contribute to this drainage course, which collects approximately 65% of the runoff generated within the Gieck Basin 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.

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' ponds and drainage easements.

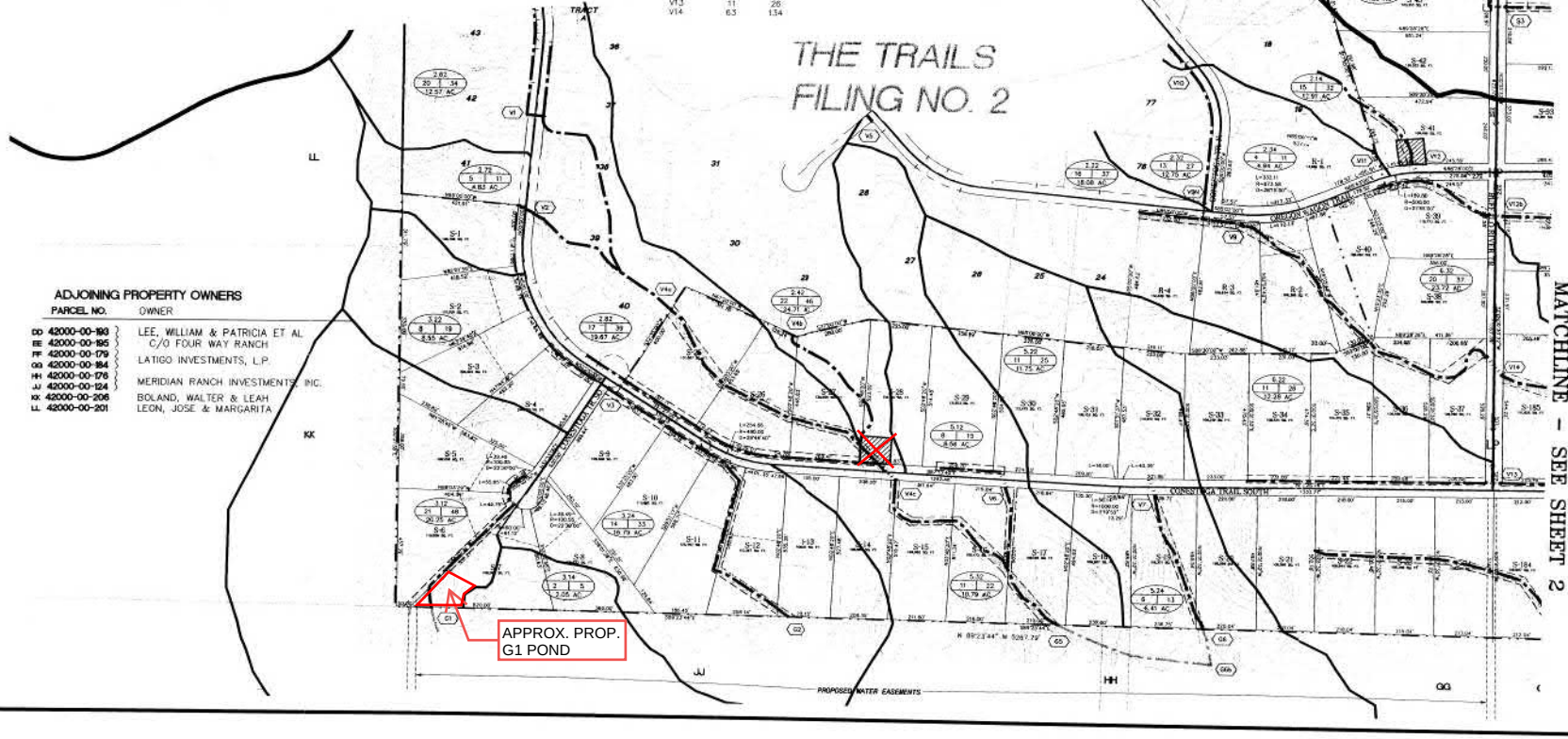
2) CHANNEL DESIGN
All channels will be grass-lined, with 4:1 sides. Natural channels will be utilized, undisturbed, where possible. See Drainage Report Table 8 for specific channel design details.

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

Design Point	Qs (CFS)	Qtot (CFS)
V1	20	34
V2	5	11
V3	8	19
...	...	...
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

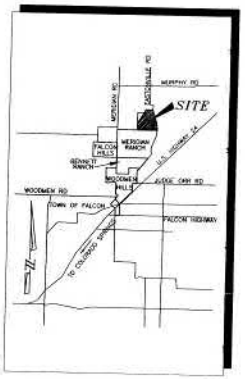
Design Point	Qs (CFS)	Qtot (CFS)
S1	8	18
S2	14	30
S2b	21	49
...	...	...

Design Point	Qs (CFS)	Qtot (CFS)
G1	21	48
G2	21	50
G5	68	156
G8	17	35
G6b	83	191



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



VICINITY MAP
N.T.S.

LEGEND

SUB-BASIN DATA (SUB-BASIN, Qs, Q100, AREA)	SUB-BASIN DATA
D10	DESIGN POINT
HP	ROAD HIGH POINT
LP	ROAD LOW POINT
10%	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: 10/04/01
SHEET 1 OF 4

FIGURE 8

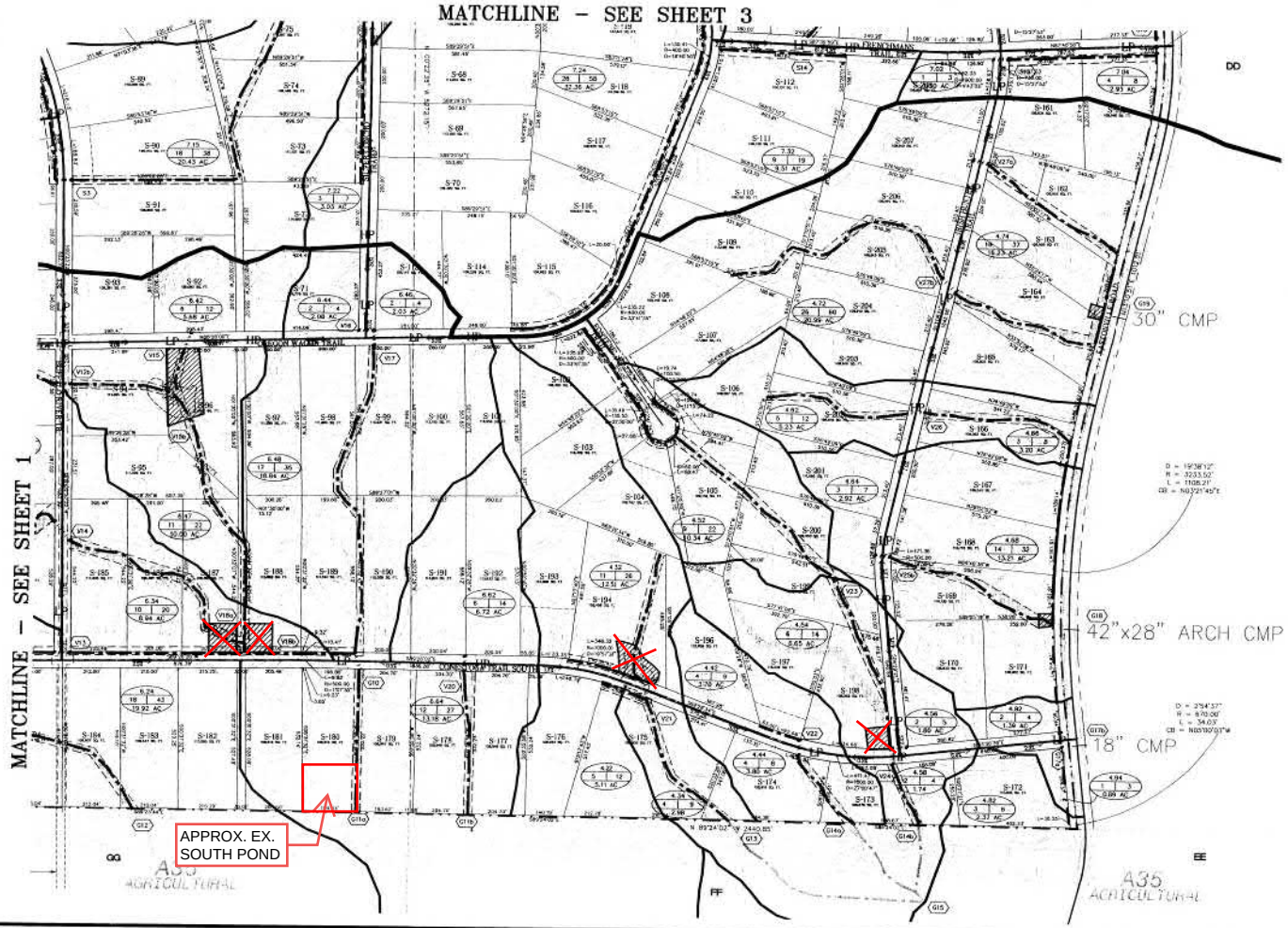
LATIGO TRAILS
PRELIMINARY DRAINAGE PLAN
IN SECTIONS 8, 9, 16 & 17, T12S, R64W OF THE 6TH P.M.
EL PASO COUNTY, COLORADO

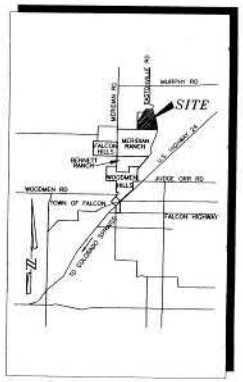
VICINITY MAP

Design Point	Q5 (CFS)	Q100 (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	Q5 (CFS)	Q100 (CFS)
S14	9	19
S15	1	3

Design Point	Q5 (CFS)	Q100 (CFS)
G10	123	282
G11a	123	282
G11b	17	33
G12	18	43
G13	13	31
G14c	7	17
G14b	18	42
G15	40	92
G17c	1	3
G17b	3	7
G18	21	49
G19	37	86





VICINITY MAP
N.T.S.

LEGEND
- SUB-BASIN DATA
- DESIGN POINT
- HP ROAD HIGH POINT
- LP ROAD LOW POINT
- 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

SF-04-005

Final Drainage Report
Addendum No. 1
for
The Trails Filing No. 7 Subdivision
El Paso County, Colorado

Prepared for:

RMBG, LLC #1
5170 Mark Dabling Blvd.
Colorado Springs, CO 80918

Prepared by:

URS
9960 Federal Drive, Suite 300
Colorado Springs, CO 80921
URS Job No. 21711264

February 2007

Addendum Description

Latigo Trails Filing No. 7 was designed with minimal grading on site, to allow drainage patterns to remain near existing conditions. Existing drainage swales were to be maintained and easements were put around these swales. However, on Lots 5, 6, 7 and 8, these easements run through the lots, limiting the area available to construct a house. Therefore, new drainage easements have been dedicated along the northern property lines for these lots. New swales were designed for lots 5, 7 and 8 (See Figure 3: Developed Drainage Plan). Due to changes in the field and a more accurate model, some items have been altered to more accurately determine the flows for Filing 7. One revision was to refine the runoff coefficients used for the developed conditions. The Filing 7 FDR document that the coefficients to be used for the rational method calculations are C_5=0.20, C_{10}=0.30 and C_{100}=0.40. However, the coefficients used in the rational method calculation sheets were C_5=0.25, C_{10}=0.35 and C_{100}=0.44. For this addendum, the coefficients used for the rational calculations were those prescribed by the El Paso County DCM (Table 5-1, Recommended Average Runoff Coefficients and Percent Impervious) for 1 acre lots (C_{10}=0.30 and C_{100}=0.40). The C_{10} value was used for the 5-year coefficient. Using these values provides conservative runoff values since the developed lot size for The Trails Filing 7 is about 2.5 acres.

New swales were installed along roads to convey flow (See Figure 3: Developed Drainage Plan). Culverts were installed as needed to transport flows under the proposed roadways. Based on the analysis of the existing and proposed drainage during construction, the culvert at approximately Sta 21+40, just south of the Buffalo River Trail and Oregon Wagon Trail intersection, was removed (DP V12b from Filing 7 FDR). The flow from Design Point V12, which originally flowed to this culvert, was forced to continue along the existing drainage path to the proposed culvert at Design Point V14. With the addition of this flow, a 36" RCP is needed next to the existing 68" X 43" elliptical RCP in order to pass the 100-year flow without overtopping the road. Finally, due to the removal of the culvert at STA 21+40, an additional drainage easement has been created where the natural drainage channel crosses Lot 2 of Filing 7. This easement will connect to the revised drainage easement in Lot 1 of Filing 7 that terminates at DP V14.

Developed Drainage Analysis

The new swales will be located on the north property lines for Lots 5, 7 and 8. Each of these swales will tie into the proposed roadside ditch along Buffalo River Trail. From there, the flow will continue to Design Point S2b, where it will enter a 36" RCP underneath Buffalo River Trail. The flow at this design point has changed from 76 cfs in the approved Final Drainage Report to 72 cfs in this analysis.

Each of the lots will have a 2-foot high V-ditch swale with 5 (H):1(V) side slopes (See Figure 2: Channel Detail). The flow depths range from 0.71 feet to 1.11 feet. The velocities in the swale range from 3.2 to 3.5 feet per second (fps). The construction of these new swales does not affect

the overall drainage pattern of the site, but does allow a larger area for the construction of a house.

Since the culvert at STA 21+40 was not built, the flow originally going to DP V12b now continues down the natural drainage channel to DP V14 and the 68" X 43" elliptical culvert. The 5- and 100-year flows now directed to Design Point V14 are 67 and 159 cfs, respectively. This additional flow requires that a second culvert be placed at DP V14. The proposed additional RCP will be a 36" circular pipe set at the same slope with the same inlet/outlet elevations. The elliptical pipe will pass 106 cfs during the 100-year storm and the circular pipe will pass the remaining 53 cfs during the same storm. The outlet velocities of the culverts are 9.07 fps for the elliptical and 8.85fps for the circular pipe. The headwater elevation has changed from 7124.71 to 7123.93 ft. The decrease in headwater elevation, with an increase of flow, is due to the addition of the roadway "weir" in the culvert analysis. With this additional culvert, the 100-year flows will now pass without overtopping Buffalo River Trail.

From Design Point V14, the flow will continue through an existing channel to the south detention pond at Design Point G10. Revised flows entering the pond are 104 and 247 cfs, respectively, for the 5- and 100-year storm events. The original flows calculated entering the pond were 89 and 336 cfs. However, the original 100-year flow is significantly higher due to an error in the HEC-1 model, which allowed 2 basins to contribute flow to the pond even though they do not and cannot flow to the pond. This lower inflow to the pond will also lower the release rates from the pond.

DESIGN POINT	CONTRIBUTING BASINS	CA(equivalent)		Tc	INTENSITY		TOTAL FLOWS	
		CA(5)	CA(100)	(min.)	I(5) (in/hr)	I(100) (in/hr)	Q(5) (cfs)	Q(100) (cfs)
V15	6.42a	1.34	1.78	11.2	3.9	7.0	5	12
				TRAVEL TIME				
		1.34	1.78	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
				Channel	607	2.7	3.8	15.0
V15b	6.47a	1.95	2.60	18.5	3.1	5.6	10	24
	V15	1.34	1.78	TRAVEL TIME				
		3.29	4.38	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
				Channel	370	3.4	1.8	20.3
V16	V15b	3.29	4.38	20.3	3.0	5.3	13	31
	6.47	1.11	1.48	TRAVEL TIME				
		4.40	5.86	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
				Channel	523	2.5	3.5	23.8
G10				32.2	2.3	4.1	104	246
	6.34	2.46	3.28					
	6.48	7.24	9.66					
	V13	3.68	4.91					
	V14	26.85	35.80					
	V16	4.40	5.86	TRAVEL TIME				
		44.63	59.51	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
				Channel	433	4.3	1.7	33.9
G11a	G10	44.63	59.51	33.9	2.3	4.0	104	247
	Pond	1.48	1.97	TRAVEL TIME				
		46.11	61.48	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
				Channel				

Table 1: Channels Revised

Location by Design Point / Lot	Road side/ Cross-Lot	Q_{100} Flow (cfs)	Min. Slope	Max. Slope	Bottom Width (ft)	Max. Flow Depth (ft)	Design Depth (ft)	Max. Velocity (fps)	Max. Top Width / Easement*	Channel Erosion Control Protection***
S1-S6a	R	21	1.8%	2.0%	6	0.72	2.00	3.4-4.2	12.0' / 16'*	None
Lot 9-Lot 7	R	34	1.8%	1.8%	6	0.93	2.25	3.8-4.6	13.5' / 22'*	Temporary, 550'x24'
Lot 6-S3	R	56-72	0.5%	0.5%	6	1.90	3.25	3.0	21.5' / 24'*	None
S3-S5a	C	72-104	1.7%	1.7%	6	1.65	3.00	4.6-5.7	19.5' / 40'	Permanent, 785'x30'
S5a-**S12**	C	104-118	0.8%	1.8%	6	1.97	varies	4.35**	37.0' / unplatted	As necessary
V12-V12b	C	40	1.7%	1.7%	2	1.44	2.75	4.1-5.1	13.5' / varies	Permanent, 190'x24'
V12b-Pond	C	40	2.0%	2.0%	2	1.37	2.75	4.4-5.5	13.0' / 30'	Permanent, 180'x24'
V15-Pond	C	12	3.2%	3.2%	2	0.94	2.25	3.8-4.2	8.0' / 20'	Temporary, 70'x20'
Pond-**G10**	C	52-77	1.6%	3.8%	>6	1.44	2.75	4.97**	27.5' / 100'	As necessary
V14a-V14	C	159	1.7%	6.0%	6	1.81	varies	8.73**	22.5' / unplatted	As necessary
V14-**G10**	C	159	1.0%	5.3%	7	1.62	varies	8.56**	40.0' / unplatted	As necessary
G10-G11a	C	246	1.1%	2.0%	6	2.10	varies	5.37**	56.5' / unplatted	As necessary

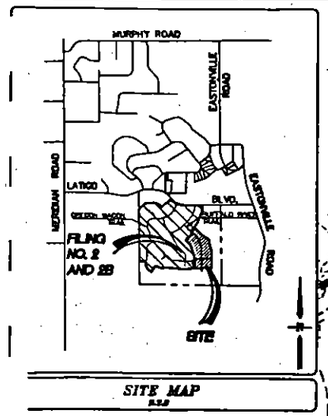
Note: Proposed detention ponds at design points **S12** ("North Pond") and **G11a** ("South Pond").
See complete calculations in Appendix D.

* - 8 feet of ditch section is within ROW; 10 foot utility easement (interior lot side) is not included here.

** - Developer to monitor these natural channels and repair as necessary. (See next section for requirements.)

*** - "Temporary" (photodegradable or biodegradable) soil retention blanket per CDOT Spec. Section 216, with a minimum permissible shear stress of 1.75 lbs/ft^2 and 24 month minimum longevity.
- "Permanent" soil retention blanket per CDOT Spec. Section 216, with a minimum permissible shear stress of 3.00 lbs/ft^2 and "permanent" longevity (non-degradable).
- "As necessary" requires "Permanent" soil retention blanket (or riprap) upon evidence of erosion (natural channels).
- See Construction Drawings for extents of soil retention blanket ("SRB" or "ECB")

THE TRAILS FILING NO. 7 FINAL DRAINAGE PLAN
DEVELOPED CONDITIONS



SITE MAP
N.T.S.

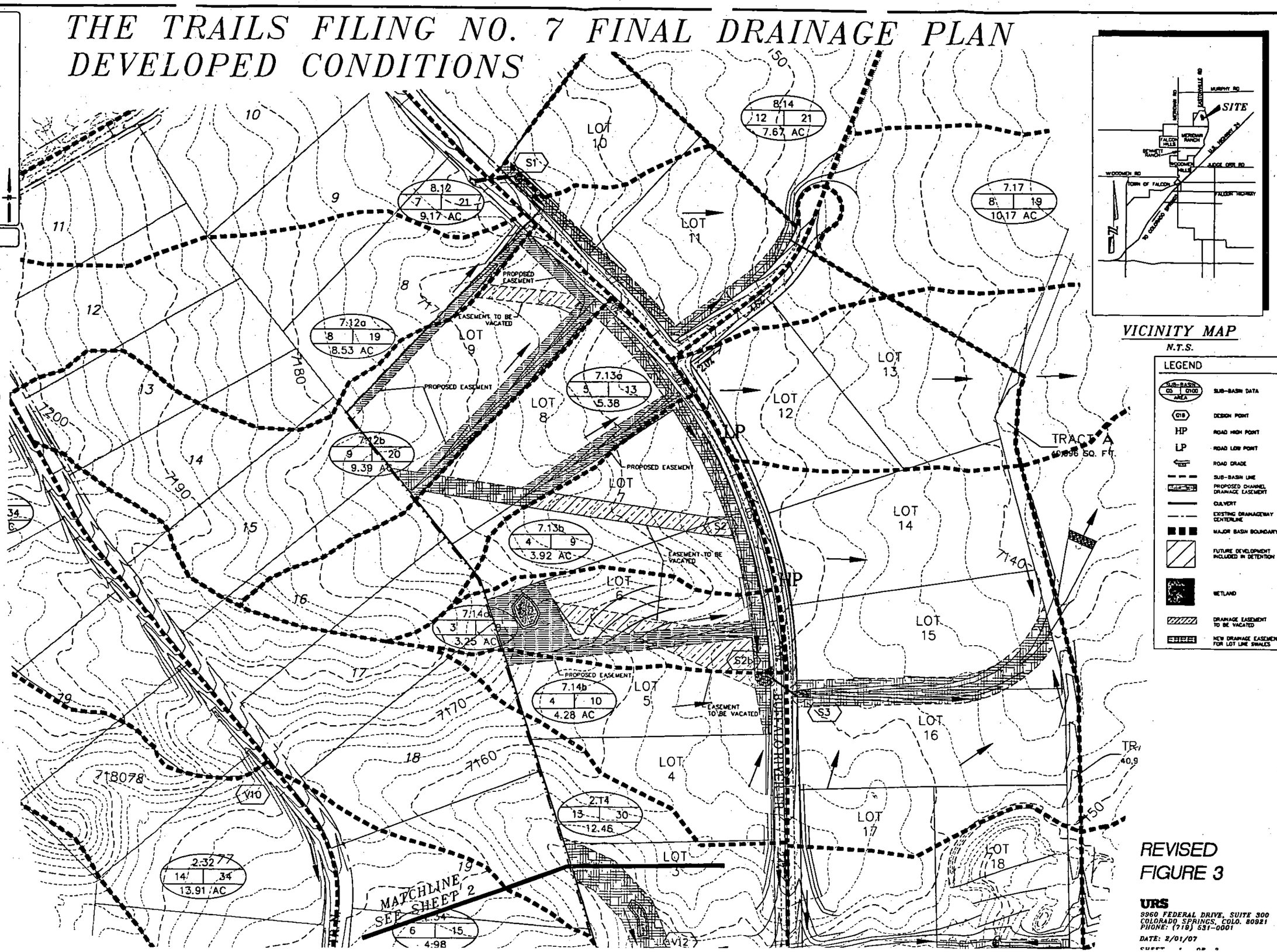
NOTES:

EASEMENTS
Per Final Plat, lot lines and boundaries will be platted with easements for utility, drainage and equestrian purposes (not shown). The Homeowners' Association shall be responsible for maintenance of detention ponds and drainage easements.

CHANNEL DESIGN
All channels will be grass-lined. Natural channels will be utilized, undisturbed, where possible. See Drainage Report for specific channel design details.

CULVERT DESIGN
Culverts shall be RCP. Installation shall be per County requirements.

Design Point	Q_5 (CFS)	Q_{100} (CFS)
S1	7	21
S2	24	58
S2b	30	72
S3	30	72



VICINITY MAP
N.T.S.

LEGEND

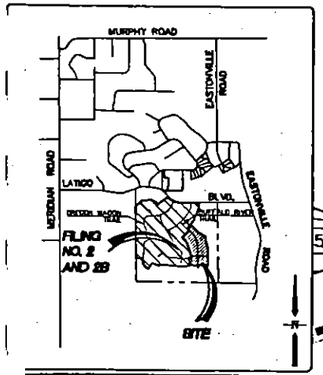
- SUB-BASIN DATA (SUB-BASIN ID, Q_5, Q_{100}, AREA)
- DESIGN POINT (D18)
- HP — ROAD HIGH POINT
- LP — ROAD LOW POINT
- ROAD GRADE
- SUB-BASIN LINE
- PROPOSED CHANNEL DRAINAGE EASEMENT
- CULVERT
- EXISTING DRAINAGEWAY CENTERLINE
- MAJOR BASIN BOUNDARY
- FUTURE DEVELOPMENT INCLUDED IN DETENTION
- WETLAND
- DRAINAGE EASEMENT TO BE VACATED
- NEW DRAINAGE EASEMENTS FOR LOT LINE SWALES

REVISED
FIGURE 3

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

DATE: 2/01/07

THE TRAILS FILING NO. 7 FINAL DRAINAGE PLAN
DEVELOPED CONDITIONS



SITE MAP
N.T.S.

NOTES:

EASEMENTS
Per Final Plat, lot lines and boundaries will be platted with easements for utility, drainage and equestrian purposes not shown). The Homeowners' Association shall be responsible for maintenance of detention ponds and drainage easements.

CHANNEL DESIGN
All channels will be grass-lined. Natural channels will be utilized, undisturbed, where possible. See Drainage Report for specific channel design details.

CULVERT DESIGN
Culverts shall be RCP. Installation shall be per County requirements.

Design Point	Qs (CFS)	Q100 (CFS)
V11	5	14
V12	17	40
V14	67	159
V13	13	30
G10	104	246
G11	104	247

MATCHLINE SEE SHEET 1

OREGON WAGON TRAIL

CONESTOGA TRAIL SOUTH

LOT 2

LOT 1

EASEMENT TO BE VACATED

PROPOSED DRAINAGE EASEMENT

607,672 SQ. FT.

127,619 SQ. FT.

TRACT B
16,925 SQ. FT.

6.32A
18 | 7
7.28 AC

6.32B
18 | 42
16.38 AC

6.47
4 | 10
3.69 AC

6.48
24 | 57
24.14 AC

6.22
13 | 32
12.28 AC

6.34
8 | 18
8.21

6.24
18 | 43
19.92 AC

6.62
6 | 14
6.72 AC

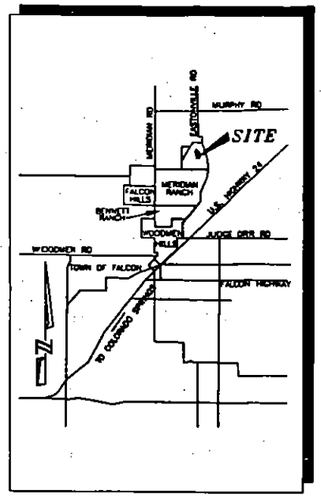
POND
5.6 | 13.3
4.92 AC

6.64
12 | 27
13.18 AC

V11 V12 V13 V14 V15 V16 G10 G11a

7140 7130 7120 7110 7150 7160 7170 7180

EXISTING SOUTH POND



VICINITY MAP
N.T.S.

LEGEND

- SUB-BASIN DATA (Q5 | Q100 | AREA)
- G18 — DESIGN POINT
- HP — ROAD HIGH POINT
- LP — ROAD LOW POINT
- ROAD GRADE
- SUB-BASIN LINE
- PROPOSED CHANNEL DRAINAGE EASEMENT
- CULVERT
- EXISTING DRAINAGEWAY CENTERLINE
- MAJOR BASIN BOUNDARY
- FUTURE DEVELOPMENT INCLUDED IN DETENTION
- WETLAND
- DRAINAGE EASEMENT TO BE VACATED
- NEW DRAINAGE EASEMENTS FOR LOT LINE SWALES

REVISED
FIGURE 3

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

DATE: 2/01/07
SHEET _ OF _

The Trails Filing 7 — South Pond — C2

Elevation ft	Area ft2		Incr Volume ft3	Total Volume ft3	Total Outflow cfs	elevation ft		Total Volum AC-FT
7088.00		24934	0	0	0.00	7088.00		0.00
7088.50		32991	1629	14481	0.59	7088.50		0.33
7089.00		41048	2032	32991	0.94	7089.00		0.76
7089.50		49104	2435	55529	2.77	7089.50	WQCV	1.27
7090.00		57161	2838	82095	9.66	7090.00		1.88
7090.50		59085	2949	111156	19.38	7090.50		2.55
7091.00		61008	3046	141180	31.25	7091.00		3.24
7091.50		62932	3142	172164	42.21	7091.50	V5	3.95
7092.00		64855	3238	204111	49.74	7092.00		4.69
7092.50		64835	3242	236534	80.92	7092.50		5.43
7093.00		64816	3241	268946	114.75	7093.00		6.17
7093.50		64796	3240	301349	131.91	7093.50		6.92
7094.00		64776	3239	333742	146.82	7094.00		7.66
7094.25		66820	1668	350192	153.53	7094.25		8.04
7094.50		68864	1719	367152	160.23	7094.50	V100	8.43
7094.75		70908	1770	384624	166.38	7094.75		8.83
7095.00		72952	1821	402606	172.53	7095.00		9.24
7095.38		75077	2811	430361	178.25	7095.38		9.88
7095.75		77202	2891	458914	183.97	7095.75		10.54
7096.13		79326	2971	488263	189.34	7096.13	V~~100~~ CAP	11.21

Design Procedure Form: Extended Detention Basin (EDB) - Sedimentation Facility

Designer: Jeffrey D. Rice, PE
Company: URS
Date: October 11, 2004
Project: The Trails Filing No. 7
Location: South Pond - G11a

1. Basin Storage Volume	
A) Tributary Area's Imperviousness Ratio (i = I_a / 100)	I_a = 20.00 % i = 0.20
B) Contributing Watershed Area (Area)	Area = 163.00 acres
C) Water Quality Capture Volume (WQCV) (WQCV =1.0 * (0.91 * I^3 - 1.19 * I^2 + 0.78 * I))	WQCV = 0.12 watershed inches
D) Design Volume: Vol = (WQCV / 12) * Area * 1.2	Vol = 1.886 acre-feet
2. Outlet Works	
A) Outlet Type (Check One)	X Orifice Plate Perforated Riser Pipe Other:
B) Depth at Outlet Above Lowest Perforation (H)	H = 1.00 feet
C) Required Maximum Outlet Area per Row, (A_o)	A_o = 11.81 square inches
D) Perforation Dimensions **(enter one only)**: i) Circular Perforation Diameter **OR** ii) 2" Height Rectangular Perforation Width	D = 2.070 inches, **OR** W = inches
NOTE: 2 inches is the maximum recommended diameter for cell L35.	
E) Number of Columns (nc, See Table 6a-1 For Maximum)	nc = 3 number
F) Actual Design Outlet Area per Row (A_o)	A_o = 10.10 square inches
G) Number of Rows (nr)	nr = 3 number
H) Total Outlet Area (A_{ot})	A_{ot} = 30.29 square inches
3. Trash Rack	
A) Needed Open Area: A_t = 0.5 * (Figure 7 Value) * A_{ot}	A_t = 902 square inches
B) Type of Outlet Opening (Check One)	X ≤ 2" Diameter **Round** 2" High **Rectangular** Other:
C) For 2", or Smaller, **Round Opening** (Ref.: Figure 6a):	
i) Width of Trash Rack and Concrete Opening (W_{conc}) from Table 6a-1	W_{conc} = 45 inches
ii) Height of Trash Rack Screen (H_{TR})	H_{TR} = 42 inches

Design Procedure Form: Extended Detention Basin (EDB) - Sedimentation Facility

Designer: Jeffrey D. Rice, PE
Company: URS
Date: October 11, 2004
Project: The Trails Filing No. 7
Location: South Pond - G11a

iii) Type of Screen (Based on Depth H), Describe if "Other"	X S.S. #93 VEE Wire (US Filter) ____ Other: ____
iv) Screen Opening Slot Dimension, Describe if "Other"	X 0.139" (US Filter) ____ Other: ____
v) Spacing of Support Rod (O.C.) Type and Size of Support Rod (Ref.: Table 6a-2)	1.00 inches
vi) Type and Size of Holding Frame (Ref.: Table 6a-2)	
D) For 2" High **Rectangular Opening** (Refer to Figure 6b):	
I) Width of Rectangular Opening (W)	W = ____ inches
ii) Width of Perforated Plate Opening (W_{conc} = W + 12")	W_{conc} = ____ inches
iii) Width of Trashrack Opening ($W_{opening}$) from Table 6b-1	$W_{opening}$ = ____ inches
iv) Height of Trash Rack Screen (H_{TR})	H_{TR} = ____ inches
v) Type of Screen (based on depth H) (Describe if "Other")	____ Klemp'™ KPP Series Aluminum ____ Other: ____
vi) Cross-bar Spacing (Based on Table 6b-1, Klemp'™ KPP Grating). Describe if "Other"	____ inches ____ Other: ____
vii) Minimum Bearing Bar Size (Klemp'™ Series, Table 6b-2) (Based on depth of WQCV surcharge)	
4. Detention Basin length to width ratio	2.50 (L/W)
5 Pre-sedimentation Forebay Basin - Enter design values	
A) Volume (no less than 5% of Design Volume from 1D)	____ acre-feet
B) Surface Area	____ acres
C) Connector Pipe Diameter (Size to drain this volume in 5-minutes under inlet control)	____ inches
D) Paved/Hard Bottom and Sides	____ yes/no

Design Procedure Form: Extended Detention Basin (EDB) - Sedimentation Facility

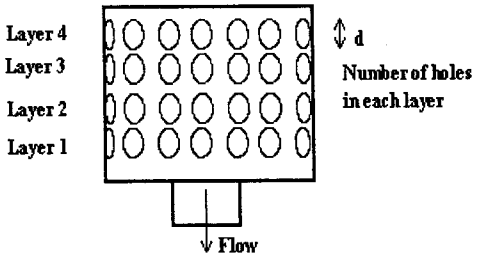
Designer: Jeffrey D. Rice, PE
Company: URS
Date: October 11, 2004
Project: The Trails Filing No. 7
Location: South Pond - G11a

6. Two-Stage Design - See Figure EDB-1	
A) Top Stage (Depth D_{WQ} = 2' Minimum)	D_{WQ} = _____ feet Storage= _____ acre-feet
B) Bottom Stage Depth (D_{BS} = 1.0' Minimum, 2.0' Maximum) Bottom Stage Storage (no less than 3% of Design Volume (0.05656752 acre-feet.)	D_{BS} = _____ feet Storage= _____ acre-feet Surf. Area= _____ acres
C) Micro Pool (Minimum Depth = the Larger of 0.5 * Top Stage Depth or 2.5 Feet)	Depth= _____ feet Storage= _____ acre-feet Surf. Area= _____ acres
D) Total Volume: Vol_{tot} = Storage from 5A + 6A + 6B (Must be > Design Volume in 1D, or 1.885584 acre-feet.)	Vol_{tot} = _____ acre-feet
7. Basin Side Slopes (Z, horizontal distance per unit vertical) Minimum Z = 4, Flatter Preferred	Z = 4.00 (horizontal/vertical)
8. Dam Embankment Side Slopes (Z, horizontal distance) per unit vertical) Minimum Z = 3, Flatter Preferred	Z = 3.00 (horizontal/vertical)
9. Vegetation (Check the method or describe "Other")	X Native Grass _____ Irrigated Turf Grass _____ Other: _____

Notes: _____

Flow Capacity of a Riser (Inlet Control)

Project: The Trails Filing No. 7
Basin ID: To Large Pond G11A



Design Information (Input):

Diameter of holes	d =	2.050 in.
Number of holes per layer	n =	3
Number of layers	N_L =	3
Vertical distance between layers	h =	4.00 in.
Orifice discharge coefficient	C_o =	0.60
Total opening area at each layer	A_o =	9.9019 sq in
	A_o =	0.0688 sq ft

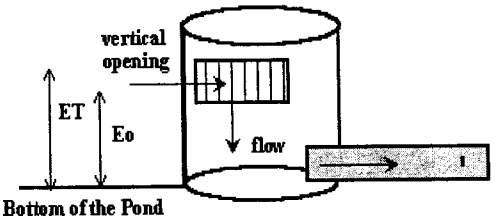
Calculation of Collection Capacity :

The starting water surface elevation must be ≥ the central elevation of the first layer.
Enter water surface elevations in ascending order.

	Water Surface Elevation ft (input)	Central Elevations of Layers of Holes in feet: Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6	Layer 7	Layer 8	Layer 9	Layer 10	Flow Rate cfs
		7087.75	7088.08	7088.42								
		Collection Capacity for Each Layer of Holes in cfs										
start	7087.50	0.00	0.00	0.00								**0.00**
	7088.50	0.29	0.21	0.09								**0.59**
	7089.00	0.37	0.32	0.25								**0.94**
	7089.50	0.44	0.39	0.34								**1.18**
	7090.00	0.50	0.46	0.42								**1.37**
	7090.50	0.55	0.52	0.48								**1.54**
	7091.00	0.60	0.57	0.53								**1.69**
	7091.50	0.64	0.61	0.58								**1.83**
	7092.00	0.68	0.66	0.63								**1.96**
	7092.50	0.72	0.70	0.67								**2.09**
	7093.00	0.76	0.73	0.71								**2.20**
	7093.50	0.79	0.77	0.75								**2.31**
	7094.00	0.83	0.81	0.78								**2.42**
	7094.50	0.86	0.84	0.82								**2.52**
	7095.00	0.89	0.87	0.85								**2.61**
	7095.50	0.92	0.90	0.88								**2.70**
	7096.00	0.95	0.93	0.91								**2.79**
		0.00	0.00	0.00								**0.00**

Collection Capacity of Vertical Orifice (Inlet Control)

Project: The Trails Filing No. 7
Basin ID: To Large Pond G11A



Design Information (Input):

Circular Opening: Diameter Dia. = _____ ft.

OR

Rectangular Opening: Width W = 5.00 ft.
Height H = 2.00 ft.

Percentage of Open Area After Trash Rack Reduction % open = 75.00 %
Orifice Coefficient C_o = 0.60
Top Elevation of Orifice Opening E_t = 7091.25 ft

Calculation of Collection Capacity:

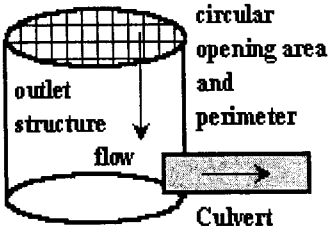
Net Opening Area (After Trash Rack Reduction) A_o = 7.50 sq ft
Center Elevation of Orifice Opening E_o = 7090.25 ft

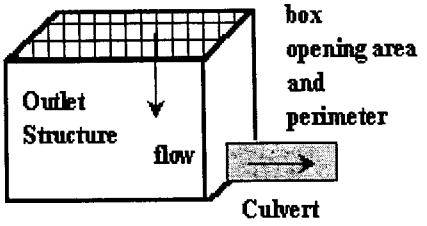
Enter water surface elevations in ascending order.

	Water Surface Elevation ft (input)	Collection Capacity cfs (output)
start	7087.50	0.00
	7088.50	0.00
	7089.00	0.00
	7089.50	1.60
	7090.00	8.29
	7090.50	17.84
	7091.00	29.56
	7091.50	40.37
	7092.00	47.77
	7092.50	54.17
	7093.00	59.89
	7093.50	65.10
	7094.00	69.93
	7094.50	74.45
	7095.00	78.70
	7095.50	82.74
	7096.00	86.59

Collection Capacity of Horizontal Orifice (Inlet Control)

Project: The Trails Filing No. 7
Basin ID: To Large Pond G11A





Design Information (Input):

Circular Opening: Diameter Dia. = _____ ft.

OR

Rectangular Opening: Width W = 8.33 ft.
Height H = 2.92 ft.

Percentage of Open Area After Trash Rack Reduction % open = 45.00 %
Orifice Coefficient C_o = 0.60
Weir Coefficient C_w = 3.10
Orifice Elevation E_o = 7092.00 ft.

Calculation of Collection Capacity:

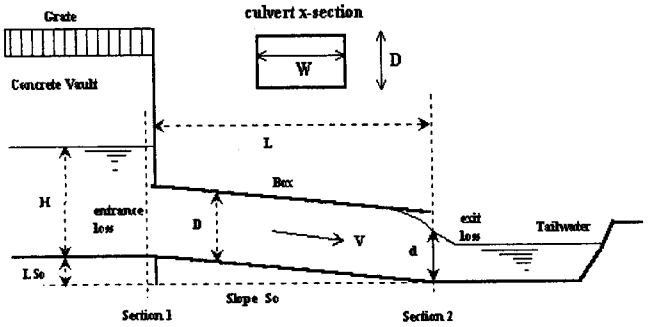
Net Opening Area (after Trash Rack Reduction) A_o = 10.94 sq. ft.
Perimeter as Weir Length L_w = 22.50 ft.

Enter water surface elevations in ascending order.

	Water Surface Elevation ft (input)	Weir Flow cfs (output)	Orifice Flow cfs (output)	Collection Capacity cfs (output)
start	7087.50	0.00	0.00	0.00
	7088.50	0.00	0.00	0.00
	7089.00	0.00	0.00	0.00
	7089.50	0.00	0.00	0.00
	7090.00	0.00	0.00	0.00
	7090.50	0.00	0.00	0.00
	7091.00	0.00	0.00	0.00
	7091.50	0.00	0.00	0.00
	7092.00	0.00	0.00	0.00
	7092.50	24.66	37.24	24.66
	7093.00	69.75	52.66	52.66
	7093.50	128.14	64.50	64.50
	7094.00	197.28	74.48	74.48
	7094.50	275.71	83.27	83.27
	7095.00	362.43	91.22	91.22
	7095.50	456.72	98.52	98.52
	7096.00	558.00	105.33	105.33

Capacity of Box Culverts (Inlet vs. Outlet Control with Tailwater Effects)

Project: The Trails Filing No. 7
Basin ID: To Large Pond G11A



Design Information (Input):

Number of Barrels	No =	1	
Barrel Rise in Feet	Rise =	2.00	ft.
Barrel Width in Feet	Width =	8.00	ft.
Inlet Edge Type (choose from pull-down list)		1.5 : 1 Bevel w/ 90 Deg. Headwall	
Inlet Elevation at Pipe Invert	I_{elev} =	7087.75	ft. elev.
Outlet Elevation at Pipe Invert	O_{elev} =	7087.49	ft. elev.
Box Length in Feet	L =	52.00	ft.
Manning's Roughness	n =	0.0140	
Bend Loss Coefficient	K_b =	0.00	
Exit Loss Coefficient	K_x =	1.00	

← ORIFICE PLATE OVER TOP 12" OF 8'W x 3'T RCBC

Design Information (calculated):

Entrance Loss Coefficient	K_e =	0.20
Friction Loss Coefficient	K_f =	0.74
Sum of All Loss Coefficients	K_s =	1.94
Orifice Inlet Condition Coefficient	C_d =	1.03
Minimum Energy Condition Coefficient	KE_{low} =	0.0232

Calculations of Culvert Capacity (output):

Water Surface Elevation From Sheet 'Riser' (ft., input)	Tailwater Surface Elevation ft (input if known)	Culvert Inlet-Control Flowrate cfs (output)	Culvert Outlet-Control Flowrate cfs (output)	Flowrate Into Culvert From Sheet 'Riser' (cfs, output)	Controlling Culvert Flowrate cfs (output)	Inlet equation used:
7088.00	7088.00	1.60	0.00	0.00	0.00	minimum energy equa
7088.50	7088.50	14.30	0.00	0.17	0.00	minimum energy equa
7089.00	7088.50	33.57	26.70	0.59	0.59	regression equation
7089.50	7088.50	55.37	49.50	0.94	0.94	regression equation
7090.00	7088.50	79.97	67.50	1.18	1.18	regression equation
7090.50	7088.50	103.97	83.30	1.37	1.37	regression equation
7091.00	7088.50	125.37	96.40	1.54	1.54	regression equation
7091.50	7088.50	144.17	108.20	1.69	1.69	regression equation
7092.00	7088.50	160.97	119.00	1.83	1.83	regression equation
7092.50	7088.50	176.07	129.40	1.96	1.96	regression equation
7093.00	7088.50	189.97	139.80	2.09	2.09	regression equation
7093.50	7088.50	202.87	149.50	2.20	2.20	regression equation
7094.00	7088.50	214.18	158.60	2.31	2.31	orifice equation
7094.50	7088.50	224.18	167.20	2.42	2.42	orifice equation
7095.00	7088.50	233.68	175.40	2.52	2.52	orifice equation
7095.50	7088.50	242.88	183.20	2.61	2.61	orifice equation
7096.00	7088.50	251.68	190.70	2.70	2.70	orifice equation
				0.00		

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

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.

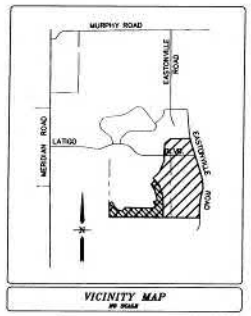
Table 4 - Design Points

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)

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' ponds and drainage easements.

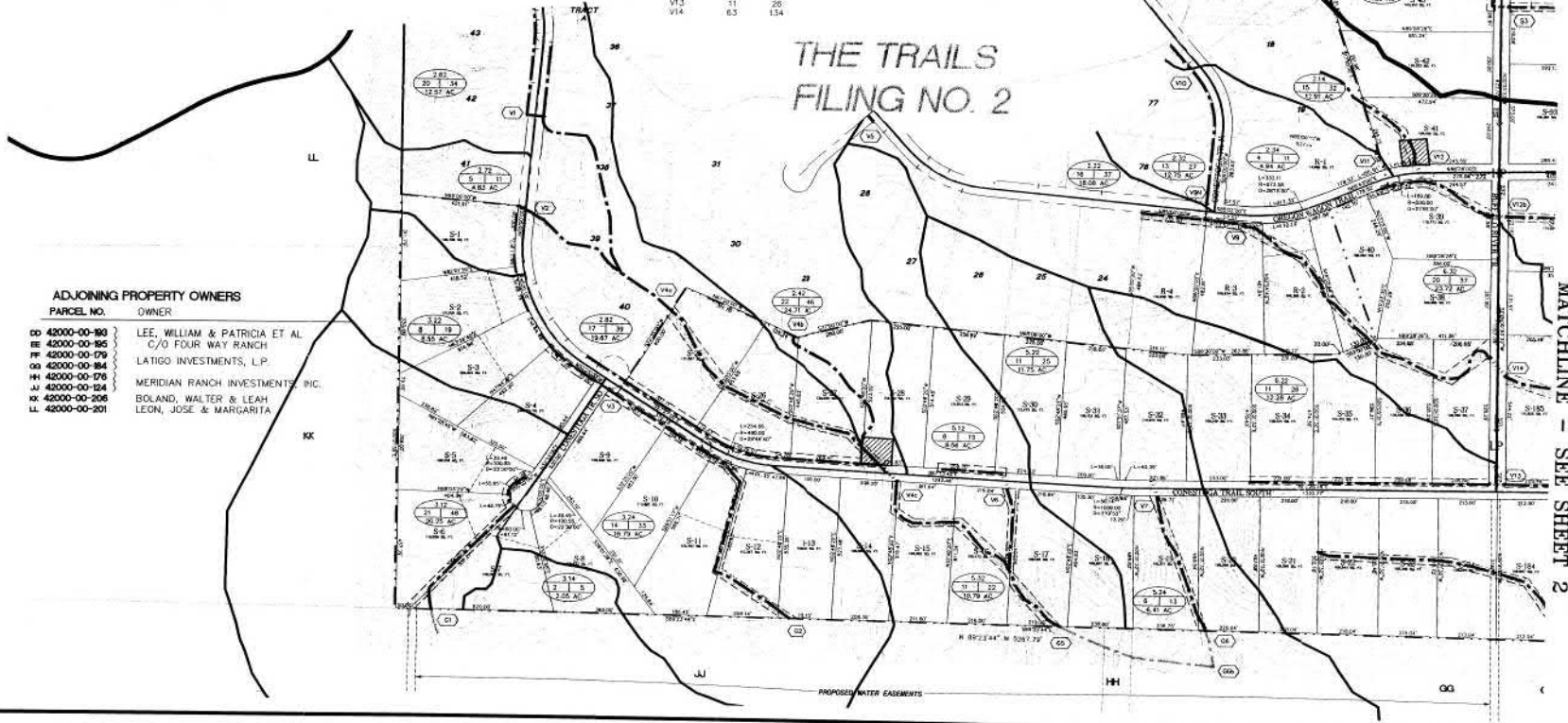
2) CHANNEL DESIGN
All channels will be grass-lined, with 4:1 sides. Natural channels will be utilized, undisturbed, where possible. See Drainage Report Table 8 for specific channel design details.

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

Design Point	Qs (CFS)	Qtot (CFS)
V1	20	34
V2	5	11
V3	8	19
...	...	...
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

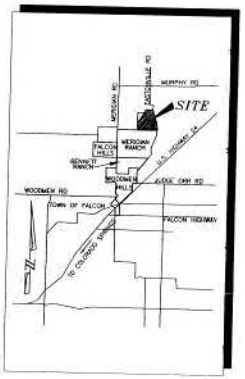
Design Point	Qs (CFS)	Qtot (CFS)
S1	8	18
S2	14	30
S2b	21	49
...	...	...

Design Point	Qs (CFS)	Qtot (CFS)
G1	21	48
G2	21	50
G5	68	156
G8	17	35
G8b	83	191



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



VICINITY MAP
N.T.S.

LEGEND

SUB-BASIN DATA (Q5 / Q100 / AREA)	SUB-BASIN DATA
D10	DESIGN POINT
HP	ROAD HIGH POINT
LP	ROAD LOW POINT
10%	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: 10/04/01
SHEET 1 OF 4

FIGURE 8

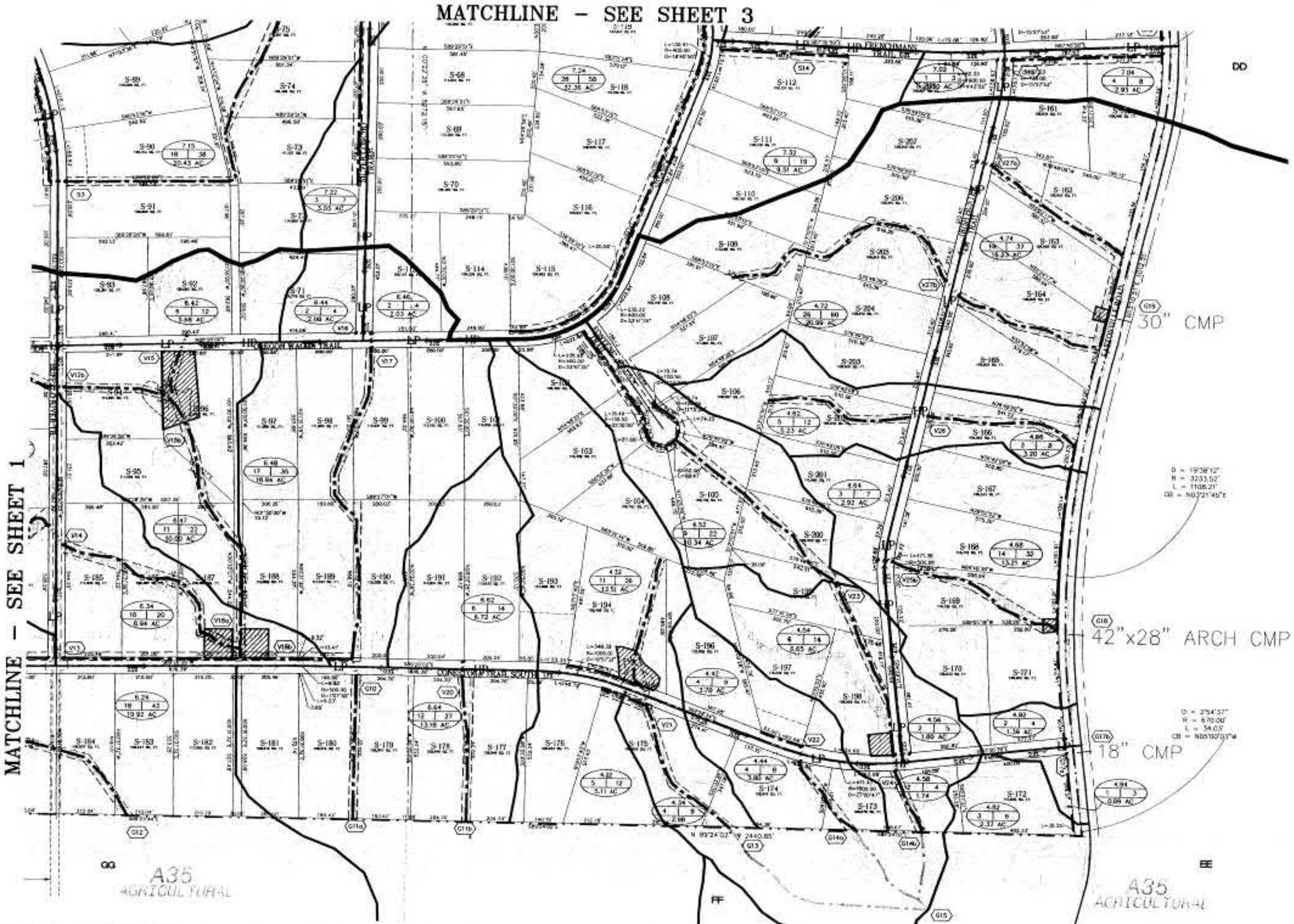
LATIGO TRAILS
PRELIMINARY DRAINAGE PLAN
IN SECTIONS 8, 9, 16 & 17, T12S, R64W OF THE 6TH P.M.
EL PASO COUNTY, COLORADO

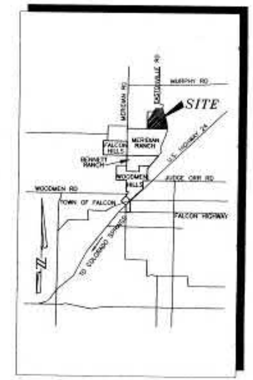
VICINITY MAP
NO SCALE

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





VICINITY MAP
N.T.S.

LEGEND

Symbol	Description
SUB-BASIN / Q5 / Q100 / AREA	SUB-BASIN DATA
G19	DESIGN POINT
HP	ROAD HIGH POINT
LP	ROAD LOW POINT
→	ROAD GRADE
—	SUB-BASIN LINE
—	PR./EX. CHANNEL
- - -	DRAINAGE EASEMENT
·····	CULVERT
▨	POSSIBLE DETENTION AREA

—N—

SCALE: 1"=200'

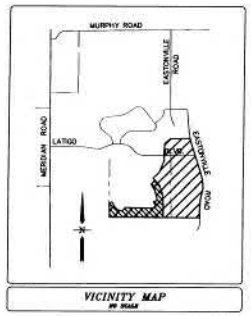
200 0 200 400

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

DATE: 9/25/01
SHEET 2 OF 4

FIGURE 8

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:

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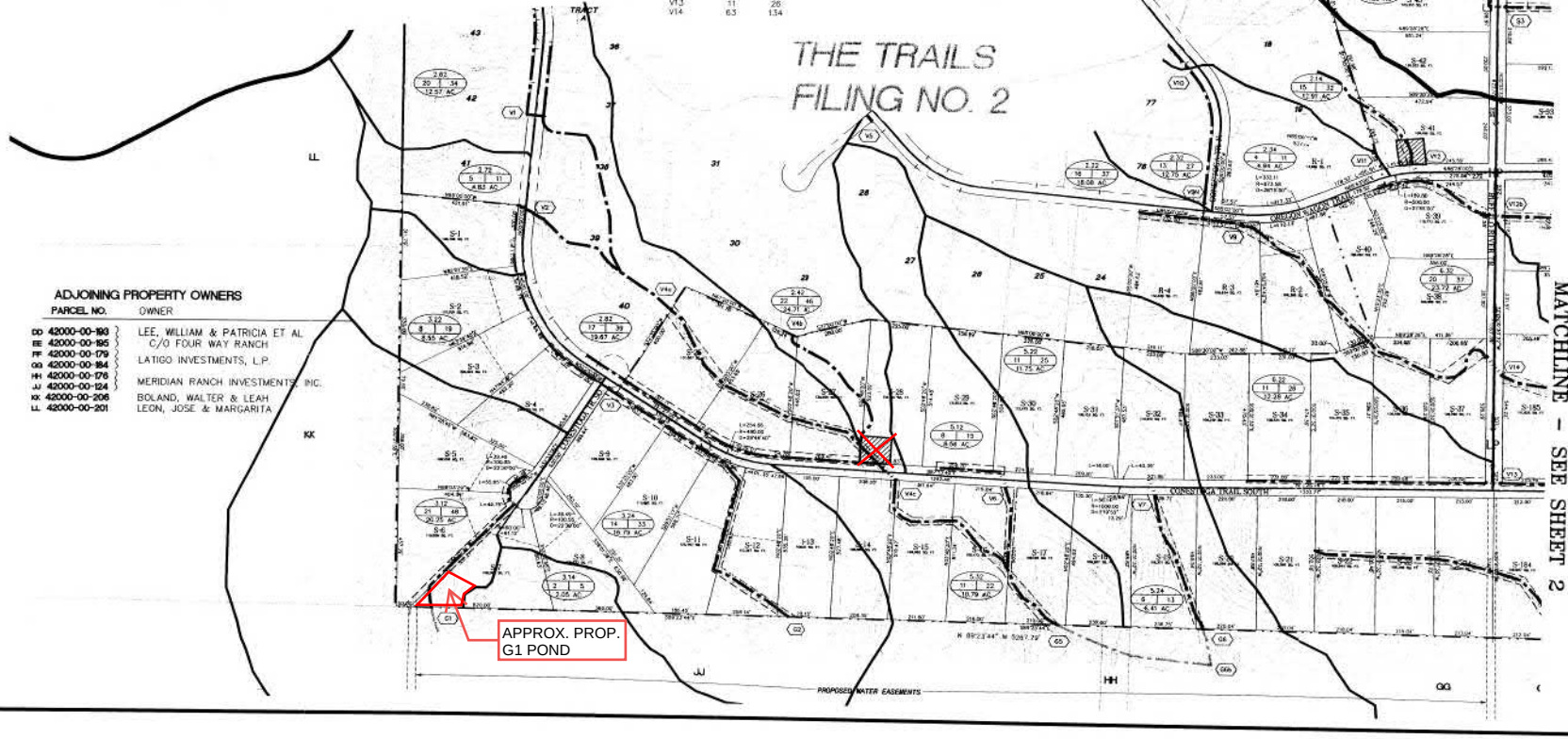
2) CHANNEL DESIGN
All channels will be grass-lined, with 4:1 sides. Natural channels will be utilized, undisturbed, where possible. See Drainage Report Table 8 for specific channel design details.

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

Design Point	Qs (CFS)	Qtot (CFS)
V1	20	34
V2	5	11
V3	8	19
...	...	...
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

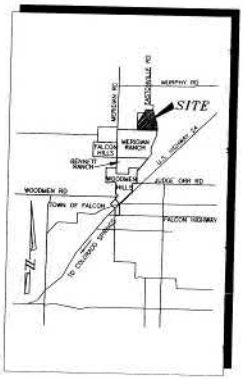
Design Point	Qs (CFS)	Qtot (CFS)
S1	8	18
S2	14	30
S2b	21	49
...	...	...

Design Point	Qs (CFS)	Qtot (CFS)
G1	21	48
G2	21	50
G5	68	156
G8	17	35
G6b	83	191



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



VICINITY MAP
N.T.S.

LEGEND

SUB-BASIN DATA (SUB-BASIN, Qs, Q100, AREA)	SUB-BASIN DATA
D10	DESIGN POINT
HP	ROAD HIGH POINT
LP	ROAD LOW POINT
10%	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: 10/04/01
SHEET 1 OF 4

FIGURE 8

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

VICINITY MAP

Design Point	Q5 (CFS)	Q100 (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	Q5 (CFS)	Q100 (CFS)
S14	9	19
S15	1	3

Design Point	Q5 (CFS)	Q100 (CFS)
G10	123	282
G11a	123	282
G11b	17	33
G12	18	43
G13	13	31
G14c	7	17
G14b	18	42
G15	40	92
G17c	1	3
G17b	3	7
G18	21	49
G19	37	86

MATCHLINE – SEE SHEET 3

MATCHLINE – SEE SHEET 1

30" CMP

42"x28" ARCH CMP

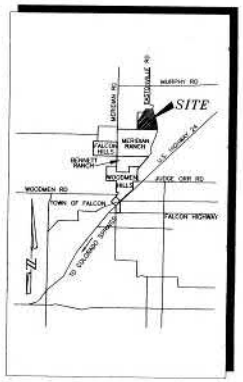
18" CMP

APPROX. EX. SOUTH POND

Label the G18 & G19 pond locations

A35 AGRICULTURAL

A35 AGRICULTURAL



VICINITY MAP
N.T.S.

LEGEND
- SUB-BASIN DATA
- DESIGN POINT
- HP ROAD HIGH POINT
- LP ROAD LOW POINT
- 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

APPENDIX F

DRAINAGE MAPS

LATIGO TRAILS FILING NO. 10 ULTIMATE CONDITIONS

EL PASO COUNTY, COLORADO

PROPOSED DRAINAGE MAP

This is a duplicate of the next sheet. This should be the "Existing Drainage Map"

LAYER LINETYPE LEGEND

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

BASIN TAG — BASIN ID — # / AREA [AC] — ##

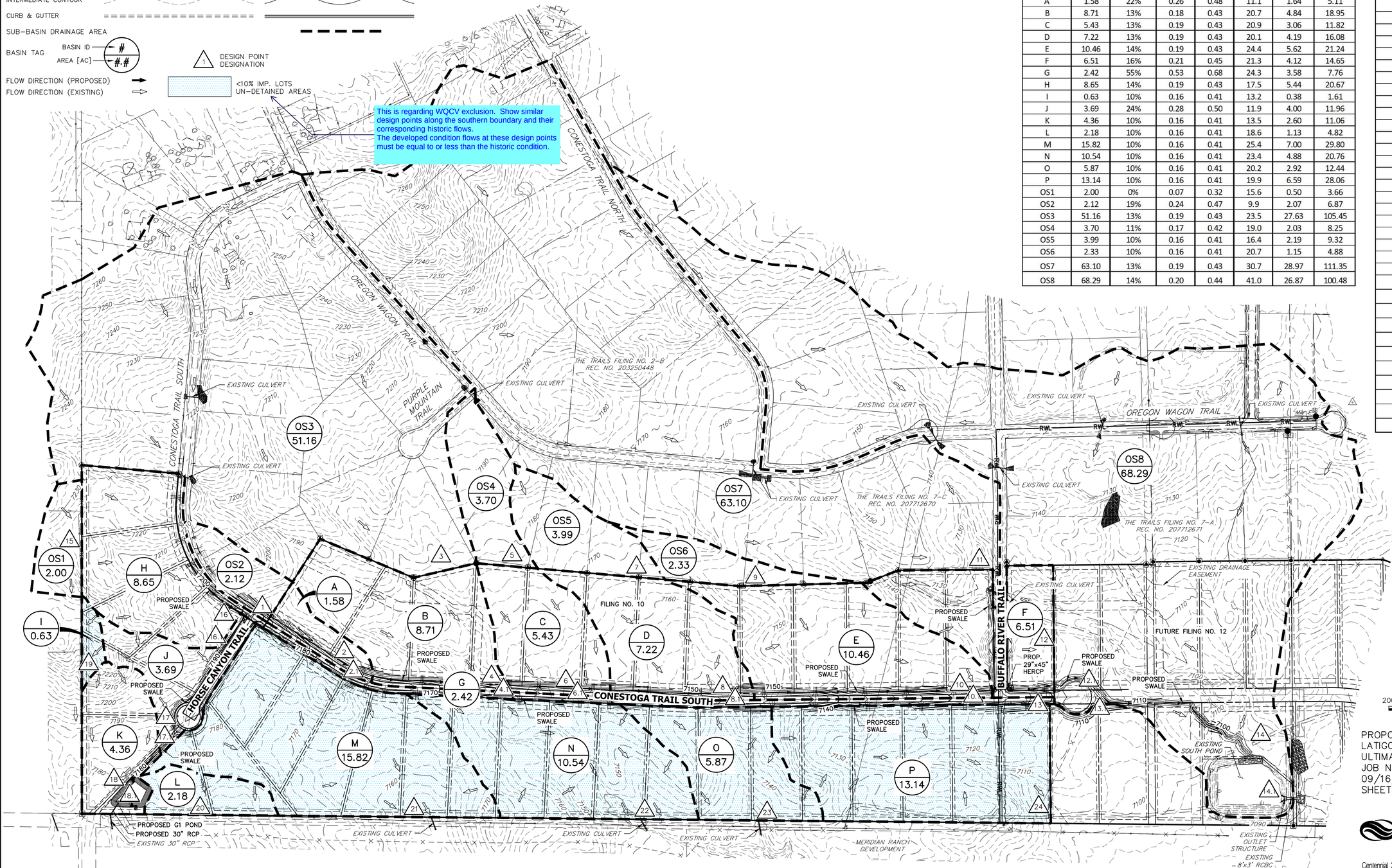
1 DESIGN POINT DESIGNATION

FLOW DIRECTION (PROPOSED)

FLOW DIRECTION (EXISTING)

<10% IMP. LOTS UN-DETAINED AREAS

This is regarding WQCV exclusion. Show similar design points along the southern boundary and their corresponding historic flows.
The developed condition flows at these design points must be equal to or less than the historic condition.



BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
A	1.58	22%	0.26	0.48	11.1	1.64	5.11
B	8.71	13%	0.18	0.43	20.7	4.84	18.95
C	5.43	13%	0.19	0.43	20.9	3.06	11.82
D	7.22	13%	0.19	0.43	20.1	4.19	16.08
E	10.46	14%	0.19	0.43	24.4	5.62	21.24
F	6.51	16%	0.21	0.45	21.3	4.12	14.65
G	2.42	55%	0.53	0.68	24.3	3.58	7.76
H	8.65	14%	0.19	0.43	17.5	5.44	20.67
I	0.63	10%	0.16	0.41	13.2	0.38	1.61
J	3.69	24%	0.28	0.50	11.9	4.00	11.96
K	4.36	10%	0.16	0.41	13.5	2.60	11.06
L	2.18	10%	0.16	0.41	18.6	1.13	4.82
M	15.82	10%	0.16	0.41	25.4	7.00	29.80
N	10.54	10%	0.16	0.41	23.4	4.88	20.76
O	5.87	10%	0.16	0.41	20.2	2.92	12.44
P	13.14	10%	0.16	0.41	19.9	6.59	28.06
OS1	2.00	0%	0.07	0.32	15.6	0.50	3.66
OS2	2.12	19%	0.24	0.47	9.9	2.07	6.87
OS3	51.16	13%	0.19	0.43	23.5	27.63	105.45
OS4	3.70	11%	0.17	0.42	19.0	2.03	8.25
OS5	3.99	10%	0.16	0.41	16.4	2.19	9.32
OS6	2.33	10%	0.16	0.41	20.7	1.15	4.88
OS7	63.10	13%	0.19	0.43	30.7	28.97	111.35
OS8	68.29	14%	0.20	0.44	41.0	26.87	100.48

DESIGN POINT SUMMARY TABLE

DP#	Q_5	Q_{100}
1	2.07	6.89
2	1.63	5.14
2.1	3.46	11.49
3	27.62	105.46
4	4.83	18.93
4.1	34.73	131.57
5	2.03	8.24
6	3.05	11.82
6.1	37.89	145.86
7	2.20	9.32
8	4.19	16.10
8.1	41.93	163.78
9	1.15	4.90
10	5.61	21.25
10.1	45.95	182.13
11	28.96	111.36
12	4.10	14.63
12.1	73.33	284.65
13	3.58	7.75
13.1	76.31	291.19
14	26.87	100.49
14.1	92.76	348.19
15	0.49	3.66
16	5.46	20.65
16.1	5.92	24.13
17	3.99	11.96
17.1	8.59	32.37
18	2.61	11.05
18.1	10.49	40.86
19	0.37	1.62
20	1.12	4.84
21	6.99	29.79
22	4.88	20.75
23	2.92	12.42
24	6.59	28.06

200 100 0 200 400

ORIGINAL SCALE: 1" = 200'

PROPOSED DRAINAGE MAP
LATIGO TRAILS FILING NO. 10
ULTIMATE CONDITIONS
JOB NO. 25175.02
09/16/2021
SHEET 1 OF 1

J·R ENGINEERING
A Westrian Company

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

LATIGO TRAILS FILING NO. 10

EL PASO COUNTY, COLORADO

PROPOSED DRAINAGE MAP

LAYER LINETYPE LEGEND

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

BASIN TAG — BASIN ID: # / AREA [AC]: #.##

1 DESIGN POINT DESIGNATION

FLOW DIRECTION (PROPOSED)

FLOW DIRECTION (EXISTING)

<10% IMP. LOTS UN-DETAINED AREAS

clarify this per my comment about this exclusion on Page 14 above.

- show a few more drainage flow arrows
- on this map or a new one, include color shading that shows areas tributary to each type of PBMP (each pond, runoff reduction, etc.) and those areas that are not captured by a PBMP, with the applicable exclusion(s) labeled --- for this filing.

A summary table on the map would also be acceptable (example provided):

PBMP SUMMARY TABLE

BASINS	PBMP TRIBUTARY AREA [AC]	PBMP
A1.1	1.43	RG-A1.1
A3.1	1.87	RG-A3.1
B1,B2	8.60	ED8-B
OA2,A2	0.95	EXCLUDED*

* EXCLUDED BASED ON < 1-ACRE OF DEVELOPED ROADWAY AREA PER ECM APP. 17.C.1.a

Calculate the required driveway culvert size for all the lots in Filing 10. Provide a summary table listing each lot in the subdivision and the anticipated culvert size. See example to the right. Standard culvert size is 18"

Add a section in the narrative regarding the summary table for the required driveway culvert sizing.

(FYI: See plat redline comment which includes a plat note regarding the driveway culvert sizes)

DRIVEWAY CULVERT SIZING CALCULATIONS

Lot Number	100 yr. Flow (cfs)	Culvert Size (in.)	Anticipated Driveway Location (24' width max.)	Notes (See Appendix for non-std. driveway culvert calculations)
42	15	24	North side of lot	
43	22	Dual 24	South side of lot	
44	32	Dual 24	West side of lot	
45	2	18	Middle of lot off of Longwall Ct.	Driveway access required to be at highpoint of Longwall Ct.
46	28	Dual 24	Middle of lot off of Longwall Ct.	
47	7	18	Southwest corner of lot	
48	5	18	Northeast corner of lot	

label the radius of curvature (highlighted sections). Verify the bends meet ECM Section 3.3.3.2. (see snippet below)

Update the drainage report to include additional analysis of the bends to verify no additional riprap erosion protection is required. See DCM section 10.5.6 and Hydraulic Engineering Circular (HEC) No. 15 - Design of Roadside Channels with Flexible Linings, specifically section 3.4. Per figure 3.3 the highest shear stress is at the outside bend in the vicinity of the PT.

Figure 3.3. Shear Stress Distribution in

E. **Channel Alignment.**

1. **Bends.**
A bend in channel alignment should be located where the velocity is lowest. The degree of bend shall be as minimal as practicable.

2. **Radius of Curvature.**
The minimum radius of curvature of the centerline of a channel shall be at least 3 times the width of a rectangular channel or 2 times the top width of a trapezoidal channel to minimize development of spiral flow.

BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
A	1.58	22%	0.26	0.48	11.1	1.64	5.11
B	8.71	13%	0.18	0.43	20.7	4.84	18.95
C	5.43	13%	0.19	0.43	20.9	3.06	11.82
D	7.22	13%	0.19	0.43	20.1	4.19	16.08
E	10.46	14%	0.19	0.43	24.4	5.62	21.24
F	6.51	16%	0.21	0.45	21.3	4.12	14.65
G	2.42	55%	0.53	0.68	24.3	3.58	7.76
H	8.65	14%	0.19	0.43	17.5	5.44	20.67
I	0.63	10%	0.16	0.41	13.2	0.38	1.61
J	3.69	24%	0.28	0.50	11.9	4.00	11.96
K	4.36	10%	0.16	0.41	13.5	2.60	11.06
L	2.18	10%	0.16	0.41	18.6	1.13	4.82
M	15.82	10%	0.16	0.41	25.4	7.00	29.80
N	10.54	10%	0.16	0.41	23.4	4.88	20.76
O	5.87	10%	0.16	0.41	20.2	2.92	12.44
P	13.14	10%	0.16	0.41	19.9	6.59	28.06
OS1	2.00	0%	0.07	0.32	15.6	0.50	3.66
OS2	2.12	19%	0.24	0.47	9.9	2.07	6.87
OS3	51.16	13%	0.19	0.43	23.5	27.63	105.45
OS4	3.70	11%	0.17	0.42	19.0	2.03	8.25
OS5	3.99	10%	0.16	0.41	16.4	2.19	9.32
OS6	2.33	10%	0.16	0.41	20.7	1.15	4.88
OS7	63.10	13%	0.19	0.43	30.7	28.97	111.35
OS8	68.29	11%	0.17	0.42	41.4	23.32	95.58

DESIGN POINT SUMMARY TABLE

DP#	Q_5	Q_{100}
1	2.07	6.89
2	1.63	5.14
2.1	3.46	11.49
3	27.62	105.46
4	4.83	18.93
4.1	34.73	131.57
5	2.03	8.24
6	3.05	11.82
6.1	37.89	145.86
7	2.20	9.32
8	4.19	16.10
8.1	41.93	163.78
9	1.15	4.90
10	5.61	21.25
10.1	45.95	182.13
11	28.96	111.36
12	4.10	14.63
12.1	73.33	284.65
13	3.58	7.75
13.1	76.31	291.19
14	23.33	95.57
14.1	88.76	341.53
15	0.49	3.66
16	5.46	20.65
16.1	5.92	24.13
17	3.99	11.96
17.1	8.59	32.37
18	2.61	11.05
18.1	10.49	40.86
19	0.37	1.62
20	1.12	4.84
21	6.99	29.79
22	4.88	20.75
23	2.92	12.42
24	6.59	28.06

CONESTOGA TRAIL NORTH

CONESTOGA TRAIL SOUTH

HORSE CANYON TRAIL

BUFFALO RIVER TRAIL

PURPLE MOUNTAIN TRAIL

OREGON WAGON TRAIL

FILING NO. 10

FUTURE FILING NO. 12

THE TRAILS FILING NO. 2-B REC. NO. 203250448

THE TRAILS FILING NO. 7-C REC. NO. 207712670

THE TRAILS FILING NO. 7-A REC. NO. 207712671

MERIDIAN RANCH DEVELOPMENT

EXISTING DRAINAGE EASEMENT

PROPOSED SWALE

PROP. 29"x45" HERCP

PROPOSED G1 POND

PROPOSED 30" RCP

EXISTING 30" RCP

EXISTING CULVERT

EXISTING SOUTH POND

EXISTING OUTLET STRUCTURE

EXISTING 8'x3' RCBC

RWL

200 100 0 200 400

ORIGINAL SCALE: 1" = 200'

PROPOSED DRAINAGE MAP
LATIGO TRAILS FILING NO. 10
JOB NO. 25175.02
09/16/2021
SHEET 1 OF 1

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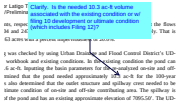
Fort Collins 970-491-9888 • www.jrengineering.com

Drainage Report - Final_V1.pdf Markup Summary

#0000FF (10)



Subject: Callout
Page Label: 6
Author: dsdlaforce
Date: 12/1/2021 5:17:47 PM
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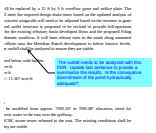
Color:
Layer:
Space:

Clarify. Is the needed 10.3 ac-ft volume associated with the existing condition or w/ filing 10 development or ultimate condition (which includes Filing 12)?



Subject: Callout
Page Label: 6
Author: dsdlaforce
Date: 12/1/2021 3:59:46 PM
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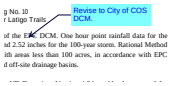
The outfall needs to be analyzed with this FDR. Update last sentence to provide a summarize the results. Is the conveyance downstream of the pond hydraulically adequate?



Subject: Callout
Page Label: 14
Author: dsdlaforce
Date: 12/1/2021 5:02:45 PM
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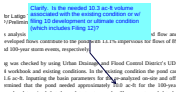
Color:
Layer:
Space:

Revise to City of COS DCM.



Subject: Callout
Page Label: 16
Author: dsdlaforce
Date: 12/1/2021 5:18:11 PM
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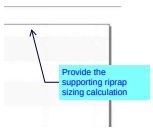
Color:
Layer:
Space:

Clarify. Is the needed 10.3 ac-ft volume associated with the existing condition or w/ filing 10 development or ultimate condition (which includes Filing 12)?

Subject: Callout
Page Label: 17
Author: dsdlaforce
Date: 12/1/2021 5:11:25 PM
Status:
Color:
Layer:
Space:

Revise sentence to identify the drainage basin. Example: "Geick Ranch (CHMS0400) drainage basin is not included in the El Paso County Drainage Basin Fee program therefore no drainage or bridge fees are due at the time of plat recordation."



Subject: Callout
Page Label: 62
Author: dsdlaforce
Date: 12/2/2021 8:56:00 AM
Status:
Color:
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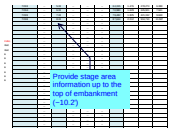
Provide the supporting riprap sizing calculation



Subject: Callout
Page Label: 74
Author: dsdlaforce
Date: 12/2/2021 1:21:33 PM
Status:
Color:
Layer:
Space:

Provide stage area information up to the top of embankment (~10.2')

Subject: Callout
Page Label: 117
Author: dsdlaforce
Date: 12/1/2021 1:59:17 PM
Status:
Color:
Layer:
Space:

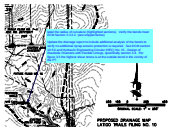
This is regarding WQCV exclusion. Show similar design points along the southern boundary and their corresponding historic flows.
The developed condition flows at these design points must be equal to or less than the historic condition.

Subject: Callout
Page Label: 118
Author: dsdlaforce
Date: 12/1/2021 4:18:49 PM
Status:
Color:
Layer:
Space:

Calculate the required driveway culvert size for all the lots in Filing 10. Provide a summary table listing each lot in the subdivision and the anticipated culvert size. See example to the right. Standard culvert size is 18"

Add a section in the narrative regarding the summary table for the required driveway culvert sizing.

(FYI: See plat redline comment which includes a plat note regarding the driveway culvert sizes)



Subject: Callout
Page Label: 118
Author: dsdlaforce
Date: 12/2/2021 8:39:42 AM
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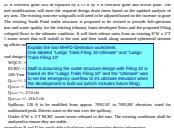
Color:
Layer:
Space:

label the radius of curvature (highlighted sections). Verify the bends meet ECM Section 3.3.3.2. (see snippet below)

Update the drainage report to include additional analysis of the bends to verify no additional riprap erosion protection is required. See DCM section 10.5.6 and Hydraulic Engineering Circular (HEC) No. 15 - Design of Roadside Channels with Flexible Linings, specifically section 3.4. Per figure 3.3 the highest shear stress is at the outside bend in the vicinity of the PT.

#000080 (3)



Subject: Text Box
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Author: dsdlaforce
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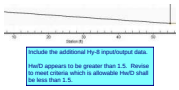
Explain the two MHFD-Detention worksheet. One labeled "Latigo Trails Filing 10-Ultimate" and "Latigo Trails Filing 10"

Staff is assuming the outlet structure design with Filing 10 is based on the "Latigo Trails Filing 10" and the "Ultimate" was to set the emergency overflow to it's ultimate elevation when the development is built out (which includes future filing).



Subject: Text Box
Page Label: 62
Author: dsdlaforce
Date: 12/2/2021 9:23:48 AM
Status:
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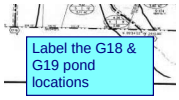
Include the additional Hy-8 input/output data.

Hw/D appears to be greater than 1.5. Revise to meet criteria which is allowable Hw/D shall be less than 1.5.



Subject: Text Box
Page Label: 115
Author: dsdlaforce
Date: 12/1/2021 4:08:29 PM
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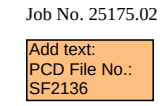
Label the G18 & G19 pond locations

#000000 (12)



Subject: Contractor
Page Label: 1
Author: EPC Stormwater - Glenn Reese
Date: 11/22/2021 12:33:28 PM
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Add text:
PCD File No.:
SF2136

Subject: Contractor
Page Label: 5
Author: EPC Stormwater - Glenn Reese
Date: 11/22/2021 2:08:27 PM
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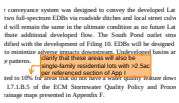
which ones? Name/describe them.



Subject: Contractor
Page Label: 14
Author: EPC Stormwater - Glenn Reese
Date: 11/22/2021 1:05:36 PM
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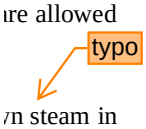
clarify that these areas will also be single-family residential lots with >2.5ac per referenced section of App I



Subject: Contractor
Page Label: 14
Author: EPC Stormwater - Glenn Reese
Date: 11/22/2021 1:05:09 PM
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Color:
Layer:
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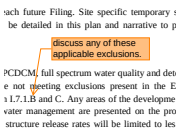
typo



Subject: Contractor
Page Label: 15
Author: EPC Stormwater - Glenn Reese
Date: 11/22/2021 1:06:42 PM
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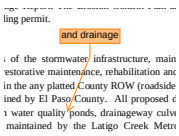
discuss any of these applicable exclusions.



Subject: Contractor
Page Label: 17
Author: EPC Stormwater - Glenn Reese
Date: 11/22/2021 1:19:17 PM
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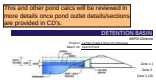
and drainage



Subject: Contractor
Page Label: 76
Author: EPC Stormwater - Glenn Reese
Date: 11/22/2021 1:20:59 PM
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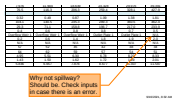
This and other pond calcs will be reviewed in more details once pond outlet details/sections are provided in CD's.



Subject: Contractor
Page Label: 76
Author: EPC Stormwater - Glenn Reese
Date: 11/22/2021 1:23:26 PM
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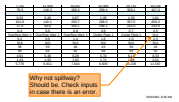
Why not spillway? Should be. Check inputs in case there is an error.



Subject: Contractor
Page Label: 81
Author: EPC Stormwater - Glenn Reese
Date: 11/22/2021 1:23:20 PM
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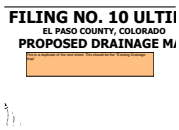
Why not spillway? Should be. Check inputs in case there is an error.



Subject: Contractor
Page Label: 117
Author: EPC Stormwater - Glenn Reese
Date: 11/22/2021 1:15:06 PM
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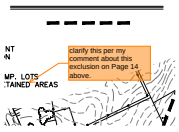
This is a duplicate of the next sheet. This should be the "Existing Drainage Map"



Subject: Contractor
Page Label: 118
Author: EPC Stormwater - Glenn Reese
Date: 11/22/2021 1:14:37 PM
Status:
Color:
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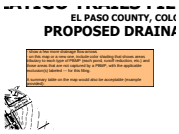
Space:

clarify this per my comment about this exclusion on Page 14 above.



Subject: Contractor
Page Label: 118
Author: EPC Stormwater - Glenn Reese
Date: 12/2/2021 1:16:52 PM
Status:
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Space:

- show a few more drainage flow arrows
- on this map or a new one, include color shading that shows areas tributary to each type of PBMP (each pond, runoff reduction, etc.) and those areas that are not captured by a PBMP, with the applicable exclusion(s) labeled --- for this filing.

A summary table on the map would also be acceptable (example provided):

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Subject: Highlight
Page Label: 6
Author: dsdlaforce
Date: 12/1/2021 3:49:11 PM
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Inputting the basin parameters for the re-analyzed on-site and off-site
flows, it was determined that the pond needed approximately 10.3 ac-ft

---

Subject: Highlight
Page Label: 16
Author: dsdlaforce
Date: 12/1/2021 5:07:51 PM
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Inputting the basin parameters for the re-analyzed on-site and off-site
flows, it was determined that the pond needed approximately 10.0 ac-ft for the 100-year detention volume.

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ture down steam in
ıd Procedure. See

Subject: Architect
Page Label: 14
Author: EPC Stormwater - Glenn Reese
Date: 11/22/2021 1:05:03 PM
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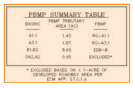
down steam



Subject: Image
Page Label: 118
Author: EPC Stormwater - Glenn Reese
Date: 12/2/2021 1:17:24 PM
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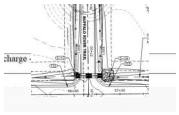
Color:
Layer:
Space:

#FF0000 (4)



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Page Label: 62
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Date: 12/2/2021 8:55:26 AM
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Subject: Image
Page Label: 118
Author: dsdlaforce
Date: 12/1/2021 4:17:57 PM
Status:
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Layer:
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Subject: Group
Page Label: 118
Author: dsdlaforce
Date: 12/2/2021 8:39:37 AM
Status:
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Layer:
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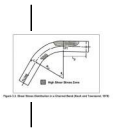

Subject: Image
Page Label: 118
Author: dsdlaforce
Date: 12/2/2021 8:39:37 AM
Status:
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