



## **The North Ranch Subdivision**

Final Drainage Report

PCD File No:

All Terrain Engineering Project No: 26001

August 2026

Prepared for:

The North Ranch LLC

Attn: Robert Myers

rob@myerscompany.biz

Prepared by:

All Terrain Engineering LLC

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## ENGINEER'S STATEMENT

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the applicable 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.

*To be provided on final submittal*

Nicholas Q. Jokerst, PE Date

State of Colorado No. 59273

For and on behalf of All Terrain Engineering LLC

## DEVELOPER'S STATEMENT

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

*To be provided on final submittal*

Robert Myers                      Date

## The North Ranch LLC

## EL PASO COUNTY ONLY

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

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

Conditions:





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## I. General Purpose, Location & Description

### a. Purpose & Project Description

The purpose of the Final Drainage Report (FDR) for The North Ranch Subdivision is to describe the site's onsite and offsite drainage patterns, existing and proposed storm infrastructure, and to safely route developed stormwater to adequate outfalls.

### b. Location

The North Ranch Subdivision, referred to as 'the site' herein, is parcel of land being portions of the Southeast Quarter of Section 15 and the East half of the Northwest quarter and the Northeast quarter of the Southwest quarter of Section 22, Township 11 South, Range 66 West of the 6<sup>th</sup> P.M. The site is bound by Highway 83 to the west, Walden III to the north, east and south. A vicinity map is presented in Appendix A.

### c. Description of Property

- d. The site is an existing, 48.22 acre parcel. The project will subdivide the site into (15) 2.5 acre lots and (2) tracts that will remain undeveloped. The existing property is occupied with (2) residential homes, (1) barn, and gravel driveways to each structure.

In general, the site slopes north and west towards Highway 83. Onsite elevations range from 7390' – 7470' with approximate slopes ranging 1 – 33%. Per an NRCS soil survey, the site is made up of Type A Ellicott loamy coarse sand, Type B Tomah-Crowfoot loamy sands and Type B Elbeth sandy loam. On-site, existing utilities include gas, fiberoptic, well & septic. An existing drainage map is presented in Appendix F.

The ultimate receiving waters for the site are West Cherry Creek.

### e. Floodplain Statement

Based on FEMA Firm map 08041C0285G dated December 7, 2018, the site is Zone X. Zone X are areas determined to be outside the 0.2% annual chance flood hazard.

## II. Drainage Basins

### a. Major Basin Description

The site is located within the West Cherry Creek Drainage Basin. At the time of this FDR, West Cherry Creek does not have a published Drainage Basin Planning Study.

### b. Existing Basin Descriptions

The existing site's drainage patterns are north and west. The site is divided into 10 existing drainage basins.

Basin EX1 is 5.05 acres of existing 5 acre lots, Needles Drive and undeveloped area. Basin EX1 stormwater ( $Q_5 = 2.0$  cfs  $Q_{100} = 8.3$  cfs) is captured in Needles Drive roadside ditch and conveyed to DP1 ( $Q_5 = 2.0$  cfs  $Q_{100} = 8.3$  cfs). DP1 follows historic drainage patterns to an existing 84" CMP culvert that conveys flow under Highway 83.

Basin EX2 is 34.20 acres of existing 5 acre lots, Highway 83 and undeveloped area. Basin EX2 stormwater ( $Q_5 = 7.0$  cfs  $Q_{100} = 36.3$  cfs) flows through multiple existing drainages towards DP2 ( $Q_5 = 5.7$  cfs  $Q_{100} = 31.9$  cfs). DP2 conveys the flow under Highway 83 towards DP11 ( $Q_5 = 32.9$  cfs  $Q_{100} = 189.1$  cfs).

Basin EX3 is 38.06 acres of existing 5 acre lots, Pinehurst Circle, Highway 83 and undeveloped area. Basin EX3 stormwater ( $Q_5 = 7.0$  cfs  $Q_{100} = 36.3$  cfs) flows through multiple existing drainages and an ex 24" CMP culvert under Pinehurst Circle to a 24" CMP culvert at DP3 ( $Q_5 = 12.5$  cfs  $Q_{100} = 65.5$  cfs). DP3 conveys the flow under Highway 83 towards DP11 ( $Q_5 = 32.9$  cfs  $Q_{100} = 189.1$  cfs).

Basin EX4 is 3.15 acres of existing 5 acre lots and Pinehurst Circle. Basin EX4 stormwater ( $Q_5 = 1.6$  cfs  $Q_{100} = 7.3$  cfs) flows to an existing 24" CMP culvert under Pinehurst Circle. Basin EX4 flows continue to DP7 ( $Q_5 = 4.2$  cfs  $Q_{100} = 21.4$  cfs).

Basin EX5 is 3.21 acres of existing 5 acre lots and Pinehurst Circle. Basin EX5 stormwater ( $Q_5 = 1.5$  cfs  $Q_{100} = 7.1$  cfs) flows to an existing low point on the north side of Pinehurst Circle. Based upon field observation, there is no culvert at this low point. Basin EX5 stormwater is assumed to overtop Pinehurst Circle and continue towards DP7 ( $Q_5 = 4.2$  cfs  $Q_{100} = 21.4$  cfs).

Basin EX6 is 8.30 acres of existing 5 acre lots, Pinehurst Circle, Highway 83 and undeveloped area. Basin EX6 stormwater ( $Q_5 = 2.5$  cfs  $Q_{100} = 13.5$  cfs) flows through multiple drainages to an existing 24" CMP culvert at DP6 ( $Q_5 = 2.5$  cfs  $Q_{100} = 13.5$  cfs). DP6 conveys the flow under Highway 83 towards DP11 ( $Q_5 = 32.9$  cfs  $Q_{100} = 189.1$  cfs).

Basin EX6.1 is 14.10 acres of existing 5 acre lots, Pinehurst Circle, Highway 83 and undeveloped area. Basin EX6.1 stormwater ( $Q_5 = 4.4$  cfs  $Q_{100} = 23.4$  cfs) flows through multiple drainages to Highway 83 swale and combines with DP4 and DP5 flow at DP7 ( $Q_5 = 4.2$  cfs  $Q_{100} = 21.4$  cfs). DP7 continues north in the Highway 83 swale to DP8 ( $Q_5 = 8.4$  cfs  $Q_{100} = 44.2$  cfs).

Basin EX7 is 22.13 acres of existing 5 acre lots, Pinehurst Circle, Highway 83 and undeveloped area. Basin EX7 stormwater ( $Q_5 = 6.0$  cfs  $Q_{100} = 32.3$  cfs) flows through multiple drainages to DP8 ( $Q_5 = 8.4$  cfs  $Q_{100} = 44.2$  cfs) and combines with DP7 flow. DP8 is conveyed west under Highway 83 in an existing 24" CMP culvert towards DP11 ( $Q_5 = 32.9$  cfs  $Q_{100} = 189.1$  cfs).

Basin EX8 is 16.60 acres of existing 5 acre lots, Highway 83, existing structures and undeveloped area. Basin EX8 stormwater ( $Q_5 = 4.3$  cfs  $Q_{100} = 23.5$  cfs) flows through a variety of drainageways to DP9 ( $Q_5 = 4.3$  cfs  $Q_{100} = 23.5$  cfs). DP9 continues north in the Highway 83 swale to DP10 ( $Q_5 = 7.2$  cfs  $Q_{100} = 40.8$  cfs).

Basin EX9 is 15.65 acres of existing 5 acre lots, Highway 83 and undeveloped area. Basin EX9 stormwater ( $Q_5 = 3.7$  cfs  $Q_{100} = 21.5$  cfs) flows in multiple drainages to DP10 ( $Q_5 = 7.2$  cfs  $Q_{100} = 40.8$  cfs). DP10 continues north in the Highway 83 swale and eventually conveyed west under Highway 83 in an offsite culvert to DP11 ( $Q_5 = 32.9$  cfs  $Q_{100} = 189.1$  cfs). DP11 represents the site's total stormwater discharge to West Cherry Creek.

### c. Proposed Basin Descriptions

The proposed site's drainage patterns are north and west. The site is divided into 16 proposed drainage basins. All proposed storm sewer infrastructure will be privately owned and maintained by the developments HOA. Refer to Appendix B for a composite impervious analysis for the proposed 2.5 acre lot areas. Refer to Appendix C for culvert and swale hydraulic performance calculations. Refer to Appendix E for site photographs of existing swales, culvert and culvert outfall locations.

Basin 1 is 4.85 acres of existing 5 acre lots, Needles Drive, proposed roadway and undeveloped area. Basin 1 stormwater ( $Q_5 = 1.8$  cfs  $Q_{100} = 7.7$  cfs) is captured in the Needles Drive swale/proposed private road swale and conveyed to DPA ( $Q_5 = 1.8$  cfs  $Q_{100} = 7.7$  cfs). DPA is conveyed under the proposed private road in an 18" CMP culvert towards DPB ( $Q_5 = 2.5$  cfs  $Q_{100} = 9.7$  cfs).

Basin 2 is 1.10 acres of proposed roadway and undeveloped area. Basin 2 stormwater ( $Q_5 = 1.7$  cfs  $Q_{100} = 4.7$  cfs) is captured in the proposed private road swale and conveyed to DPB ( $Q_5 = 2.5$  cfs  $Q_{100} = 9.7$  cfs). At DPB, an existing 84" CMP culvert conveys the flow under Highway 83 to its historic outfall in West Cherry Creek. The proposed flow at DPB ( $Q_5 = 2.5$  cfs  $Q_{100} = 9.7$  cfs) is a slight increase compared to the flow at existing DP1 ( $Q_5 = 2.0$  cfs  $Q_{100} = 8.3$  cfs). Therefore, the existing 84" culvert capacity has been verified with the additional site discharge. Refer to Appendix C for culvert performance calculations. DPB continues north in West Cherry Creek towards DPU ( $Q_5 = 35.1$  cfs  $Q_{100} = 184.7$  cfs).

Basin 3 is 29.67 acres of existing 5 acre lots, proposed 2.5 acre lots, Highway 83 and undeveloped area. Basin 3 stormwater ( $Q_5 = 3.1$  cfs  $Q_{100} = 31.9$  cfs) flows through multiple existing drainages, to the proposed roadside swale and towards DPC ( $Q_5 = 5.7$  cfs  $Q_{100} = 31.3$  cfs). At DPC, a proposed 30" CMP culvert conveys the flow under the private roadway to its historic outfall at DPE ( $Q_5 = 6.4$  cfs  $Q_{100} = 33.8$  cfs). The proposed flow at DPE ( $Q_5 = 6.4$  cfs  $Q_{100} = 33.8$  cfs) is a slight increase compared to the flow at existing DP2 ( $Q_5 = 5.7$  cfs  $Q_{100} = 31.9$  cfs). Therefore, the existing 24" CMP culvert capacity has been verified with the additional site discharge. Refer to Appendix C for culvert performance calculations. DPE continues north in West Cherry Creek towards DPU ( $Q_5 = 35.1$  cfs  $Q_{100} = 184.7$  cfs).

Basin 4 is 2.56 acres of proposed roadway and swale. Basin 4 stormwater ( $Q_5 = 5.1$  cfs  $Q_{100} = 10.5$  cfs) is captured in the proposed, private road swale and conveyed to DPD ( $Q_5 = 5.1$  cfs  $Q_{100} = 10.5$  cfs). DPD continues north to DPN ( $Q_5 = 4.8$  cfs  $Q_{100} = 9.9$  cfs).

Basin 5 is 2.83 acres of Highway 83 and undeveloped/swale area. Basin 5 stormwater ( $Q_5 = 1.6$  cfs  $Q_{100} = 5.8$  cfs) is captured in the Highway 83 swale and conveyed to DPE ( $Q_5 = 6.4$  cfs  $Q_{100} = 33.8$  cfs). Refer to Basin 3 for DPE details.

Basin 5.1 is 0.94 acres of Highway 83 and undeveloped/swale area. Basin 5.1 stormwater ( $Q_5 = 0.6$  cfs  $Q_{100} = 2.2$  cfs) is captured in the Highway 83 swale and conveyed to DPG ( $Q_5 = 8.7$  cfs  $Q_{100} = 42.6$  cfs). Refer to Basin 6 for DPG details.

Basin 5.2 is 0.88 acres of Highway 83 and undeveloped/swale area. Basin 5.2 stormwater ( $Q_5 = 0.5$  cfs  $Q_{100} = 2.0$  cfs) is captured in the Highway 83 swale and conveyed to DPI ( $Q_5 = 8.7$  cfs  $Q_{100} = 42.6$  cfs). Refer to Basin 7 for DPI details.

Basin 6 is 36.64 acres of existing 5 acre lots, proposed 2.5 acre lots, and Pinehurst Circle. Basin 6 stormwater ( $Q_5 = 8.9$  cfs  $Q_{100} = 43.9$  cfs) flows through multiple existing drainages, an existing 24" CMP culvert and to the proposed roadside swale at DPF ( $Q_5 = 8.9$  cfs  $Q_{100} = 43.9$  cfs). At DPF, a dual 24" RCP culverts convey the flow under the private roadway to its historic outfall at DPG ( $Q_5 = 8.7$  cfs  $Q_{100} = 42.6$  cfs). The proposed flow at DPG ( $Q_5 = 6.4$  cfs  $Q_{100} = 33.8$  cfs) is decreased compared to the flow at existing DP3 ( $Q_5 = 12.5$  cfs  $Q_{100} = 65.5$  cfs). Therefore, the existing 24" CMP culvert will continue to perform in its existing condition. Refer to Appendix C for culvert performance calculations. DPG conveys flow under Highway 83 and continues north in West Cherry Creek towards DPU ( $Q_5 = 35.1$  cfs  $Q_{100} = 184.7$  cfs).

Basin 7 is 7.05 acres of existing 5 acre lots, proposed 2.5 acre lots, and Pinehurst Circle. Basin 7 stormwater ( $Q_5 = 2.6$  cfs  $Q_{100} = 13.6$  cfs) flows through multiple existing drainages to the proposed roadside swale at DPH ( $Q_5 = 2.6$  cfs  $Q_{100} = 13.6$  cfs). At DPH, a 24" CMP culvert conveys the flow under the private roadway to its historic outfall at DPI ( $Q_5 = 2.9$  cfs  $Q_{100} = 14.6$  cfs). The proposed flow at DPI ( $Q_5 = 2.9$  cfs  $Q_{100} = 14.6$  cfs) is a minor increase compared to the flow at existing DP6 ( $Q_5 = 2.5$  cfs  $Q_{100} = 13.5$  cfs). Therefore, the existing 24" CMP culvert capacity has been verified with the additional site discharge. Refer to Appendix C for culvert performance calculations. DPI continues north in West Cherry Creek towards DPU ( $Q_5 = 35.1$  cfs  $Q_{100} = 184.7$  cfs).

Basin 7.1 is 12.19 acres of existing 5 acre lots, proposed 2.5 acre lots, and Pinehurst Circle. Basin 7.1 stormwater ( $Q_5 = 3.5$  cfs  $Q_{100} = 18.6$  cfs) flows through multiple existing drainages to the proposed roadside swale and combines with DPJ ( $Q_5 = 1.6$  cfs  $Q_{100} = 7.3$  cfs) and DPK ( $Q_5 = 1.5$  cfs  $Q_{100} = 7.1$  cfs) flow at DPL ( $Q_5 = 5.5$  cfs  $Q_{100} = 27.5$  cfs). At DPL, a 30" CMP culvert conveys the flow under the private roadway to its historic outfall at DPO ( $Q_5 = 10.6$  cfs  $Q_{100} = 53.0$  cfs). At DPO, an existing 24" CMP culvert conveys the flow under Highway 83 to West Cherry Creek. The proposed flow at DPO ( $Q_5 = 10.6$  cfs  $Q_{100} = 53.0$  cfs) demonstrates an increase compared to the flow at existing DP8 ( $Q_5 = 8.4$  cfs  $Q_{100} = 44.2$  cfs). Therefore, the existing 24" CMP culvert capacity has been verified with the additional site discharge. Refer to Appendix C for culvert performance calculations. DPO continues north in West Cherry Creek towards DPU ( $Q_5 = 35.1$  cfs  $Q_{100} = 184.7$  cfs).

Basin 8 is 20.47 acres of existing 5 acre lots, proposed 2.5 acre lots, and Pinehurst Circle. Basin 8 stormwater ( $Q_5 = 5.9$  cfs  $Q_{100} = 31.3$  cfs) flows through multiple existing drainages to the proposed roadside swale at DPM ( $Q_5 = 5.9$  cfs  $Q_{100} = 31.3$  cfs). At DPM, a 30" CMP culvert conveys the flow under the private roadway to its historic outfall at DPO ( $Q_5 = 10.6$  cfs  $Q_{100} = 53.0$  cfs). At DPO, an existing 24" CMP culvert conveys the flow under Highway 83 to West Cherry Creek. Refer to Basin 7.1 for DPO details.

Basin 9 is 0.37 acres of proposed roadway and swale. Basin 9 stormwater ( $Q_5 = 1.1$  cfs  $Q_{100} = 2.3$  cfs) is captured in the proposed, private road swale and combines with DPD flow at DPN ( $Q_5 = 4.8$  cfs  $Q_{100} = 9.9$  cfs). DPN is conveyed to Pond 1 in an 18" CMP culvert.

Basin 10 is 2.40 acres of Highway 83, emergency access road and undeveloped/swale area. Basin 10 stormwater ( $Q_5 = 1.5$  cfs  $Q_{100} = 5.3$  cfs) is captured in the Highway 83 swale and conveyed to DPO ( $Q_5 = 10.6$  cfs  $Q_{100} = 53.0$  cfs). Refer to Basin 7.1 for DPO details.

Basin 11 is 17.97 acres of existing 5 acre lots and proposed 2.5 acre lots. Basin 11 stormwater ( $Q_5 = 5.0$  cfs  $Q_{100} = 27.4$  cfs) flows through multiple existing drainages to the proposed roadside swale at DPP ( $Q_5 = 5.0$  cfs  $Q_{100} = 27.4$  cfs). At DPP, a 24" CMP culvert conveys the flow under the private roadway to Pond 1.

Basin 12 is 1.29 acres of proposed roadway and swale. Basin 12 stormwater ( $Q_5 = 2.1$  cfs  $Q_{100} = 4.9$  cfs) is captured in the proposed, private road swale at DPQ ( $Q_5 = 4.8$  cfs  $Q_{100} = 9.9$  cfs) and discharges to Pond 1.

Basin 13 is 1.63 acres of proposed roadway, undeveloped area and Pond 1. Basin 13 stormwater ( $Q_5 = 2.6$  cfs  $Q_{100} = 6.6$  cfs) discharges to Pond 1. The proposed, private roadway is superelevated towards Pond 1 to direct Basin 13 stormwater directly to Pond 1. Due to the existing AT&T fiber optic line between the proposed, private road and Pond 1, a swale cannot be constructed due to cut limitations over the fiber optic line.

Basin 14 is 0.96 acres of Highway 83, emergency access road and undeveloped/swale area. Basin 14 stormwater ( $Q_5 = 0.6$  cfs  $Q_{100} = 2.0$  cfs) is captured in the Highway 83 swale, combines with Pond 1 discharge and is conveyed to DPS ( $Q_5 = 0.9$  cfs  $Q_{100} = 23.1$  cfs). DPS continues north in the Highway 83 swale to DPT ( $Q_5 = 3.7$  cfs  $Q_{100} = 31.0$  cfs).

Basin 15 is 10.29 acres of existing 5 acre lots, proposed 2.5 acre lots, and Highway 83. Basin 15 stormwater ( $Q_5 = 2.8$  cfs  $Q_{100} = 14.0$  cfs) flows through multiple existing drainages to the Highway 83 swale and combines with DPS ( $Q_5 = 0.9$  cfs  $Q_{100} = 23.1$  cfs) at DPT ( $Q_5 = 3.7$  cfs  $Q_{100} = 31.0$  cfs). At DPT, flow continues north in the Highway 83 swale before eventually discharging under Highway 83 in offsite culverts to the north. The proposed flow at DPT ( $Q_5 = 3.7$  cfs  $Q_{100} = 31.0$  cfs) demonstrates a decrease in flow compared to existing DP10 ( $Q_5 = 7.2$  cfs  $Q_{100} = 40.8$  cfs). Therefore, the offsite culverts to the north will continue to function in their existing condition. DPU ( $Q_5 = 35.1$  cfs  $Q_{100} = 184.7$  cfs) represents the site's total proposed stormwater discharge to West Cherry Creek. DPU total flow is a reduction compared to the site's existing discharge at DP11 ( $Q_5 = 32.9$  cfs  $Q_{100} = 189.1$  cfs).

## Drainage Design Criteria

### a. Development Criteria Reference

The drainage analysis follows the criteria from the "Drainage Criteria Manual County of El Paso, Colorado" Volumes 1 and 2," as amended.

### b. Hydrologic Criteria

Onsite drainage analysis included the 5-year storm (minor event) and 100-year storm (major event). Runoff is calculated per EPCDCM Chapter 5 – Storm Runoff Method of Analysis and Volume 1 Update Chapter 6 – Hydrology.

### d. Hydraulic Criteria

Hydraulic criteria for channel analysis are obtained from EPCDCM Chapter 9 – Culvert Design and Chapter 10 – Open Channels and Structures.

### III. Drainage Facility Design

#### a. General Concept

The proposed site will be subdivided into 2.5+ acre lots served by a paved, private roadway. A secondary emergency access to the site is provided from Highway 83 at the location of the existing site's driveway access. A portion of the site and offsite, tributary areas will be passed through the site to their historic outfalls along Highway 83. The remaining portion of the site and tributary, offsite areas will be captured in the proposed, private roadside swales and conveyed to Pond 1. Pond 1 is a full spectrum, water quality and detention pond. Due to the on-site detention provided by Pond 1, the developed site results in a reduction in total stormwater discharged to West Cherry Creek. Existing culverts along Highway 83 will require removal of sediment in conjunction with this project to ensure the long-term functionality and to maintain historic drainage patterns.

#### b. Water Quality & Detention

Water quality and detention for Basins 4, 9 and 11-13 is provided in Pond 1. Pond 1 is an onsite, private, full spectrum detention pond located adjacent to Highway 83. A total of 23.82 acres at 29.2% composite imperviousness will be detained. The WQCV is 0.296 ac-ft, the EURV is 0.417 ac-ft, and the 100-year volume is 0.844 ac-ft. The WQCV, EURV and 100-year storms are released in 40, 61 and 60 hours, respectively. The 100-year pond discharge has been reduced to 60% of predevelopment levels. There are two concentrated flow outfalls into the pond. A concrete forebay is located at the piped outfall into the pond and riprap forebay with concrete bottom is located at the swale discharge location. A 2.0' concrete trickle channel conveys flow towards the private outlet structure. A 10' access and maintenance road is provided to the bottom of the pond to facilitate future maintenance. A 20' emergency overflow spillway is provided that conveys the developed, peak 100-yr flow rate with 1.0' of freeboard towards the Highway 83 swale. The spillway and downstream outfall will be lined with Type L riprap. The pond outlet structure discharges into private, 30" RCP storm sewer that discharges to the Highway 83 swale. Pond design calculations are presented in Appendix D.

#### c. Inspections & Maintenance

An Inspection and Maintenance Manual will be provided in conjunction with construction drawing submittals.

#### d. Grading & Erosion Control Plan

A Grading & Erosion Control Plan will be provided in conjunction with construction drawing submittals.

#### e. Four Step Method

*Step 1 – Employ Runoff Reduction Practices:* Existing roof drains discharge to undeveloped areas. Stormwater overland flows through landscaping and open space which will help slow runoff and increase infiltration. Additionally, concentrated stormwater is conveyed in grass lined road side swales. Swales help reduce stormwater velocities and allow for infiltration compared to storm sewer.

*Step 2 – Stabilize Drainageways:* All new and re-development projects are required to construct or participate in the funding of channel stabilization measures. Drainage basin fees paid, at the time of platting, go towards channel stabilization with the drainage basin. Refer to Section F for drainage basin fee calculations.

*Step 3 – Provide WQCV:* Water quality treatment is provided for the site in Pond 1. The water quality volume will be captured and released over a period of 40 hours.

*Step 4 – Consider the need for source controls:* No industrial uses are proposed within this development and therefore no source controls are proposed.

**f. Drainage Basin & Bridge Fees**

The site is within the West Cherry Creek Drainage Basin. Based upon the 2026 El Paso County Drainage Basin Fee schedule, West Cherry Creek does not have an associated drainage or bridge fee.

**g. Engineer's Opinion of Probable Cost**

An El Paso County 2026 Financial Assurance Estimate will be provided in conjunction with construction drawing submittals.

## IV. Summary

The North Ranch Subdivision remains consistent with pre-development drainage conditions. The proposed development will not adversely affect downstream stormwater infrastructure or surrounding developments as the development reduces the peak stormwater discharges from the site. This report is in accordance with the latest El Paso County Drainage criteria.

## V. References

1. El Paso County – Drainage Criteria Manual, 2018 as amended.
2. Urban Storm Drainage Criteria Manual, Mile High Flood District, March 2024.
3. Federal Emergency Management Agency, Flood Map Service Center - <https://msc.fema.gov/portal/home>, September 2024.
4. Web Soil Survey, Natural Resources Conservation Service - <https://websoilsurvey.nrcs.usda.gov/app/>, September 2024.

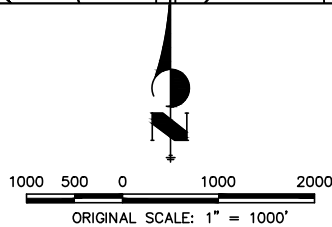




## **APPENDIX A – VICINITY MAP, FEMA MAP, NRCS WEB SOIL SURVEY**

# NEEDLES SUBDIVISION

## VICINITY MAP



VICINITY MAP

NEEDLES SUBDIVISION

JOB NO. 26001

LOCATION: EPC

08/26/2062

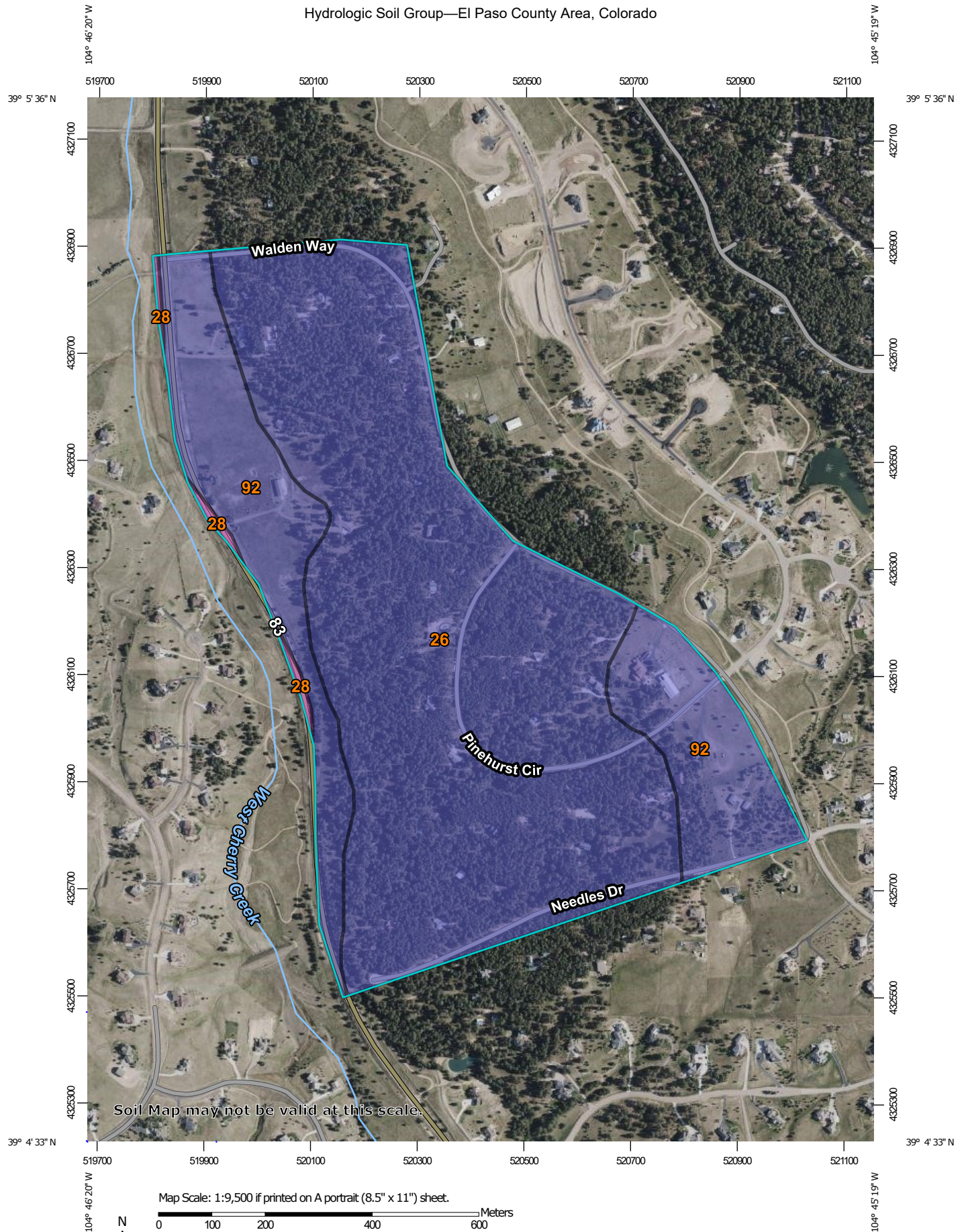
SHEET

1



ENGINEERING  
1004 WEST VAN BUREN STREET  
COLORADO SPRINGS, CO 80907

# Hydrologic Soil Group—El Paso County Area, Colorado





## MAP LEGEND

### Area of Interest (AOI)

 Area of Interest (AOI)

### Soils

#### Soil Rating Polygons

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

#### Soil Rating Lines

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

#### Soil Rating Points

 A  
 A/D  
 B  
 B/D

 C  
 C/D  
 D  
 Not rated or not available

### Water Features

 Streams and Canals

### Transportation

 Rails  
 Interstate Highways  
 US Routes  
 Major Roads  
 Local Roads

### Background

 Aerial Photography

## MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado  
 Survey Area Data: Version 23, Aug 29, 2025

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

Date(s) aerial images were photographed: Jul 23, 2024—Aug 4, 2024

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 |
|------------------------------------|---------------------------------------------------|--------|--------------|----------------|
| 26                                 | Elbeth sandy loam, 8 to 15 percent slopes         | B      | 154.4        | 73.3%          |
| 28                                 | Ellicott loamy coarse sand, 0 to 5 percent slopes | A      | 1.4          | 0.7%           |
| 92                                 | Tomah-Crowfoot loamy sands, 3 to 8 percent slopes | B      | 54.9         | 26.1%          |
| <b>Totals for Area of Interest</b> |                                                   |        | <b>210.7</b> | <b>100.0%</b>  |

## Description

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

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

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

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

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

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

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

## Rating Options

*Aggregation Method:* Dominant Condition

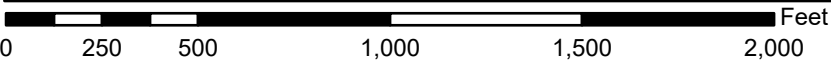
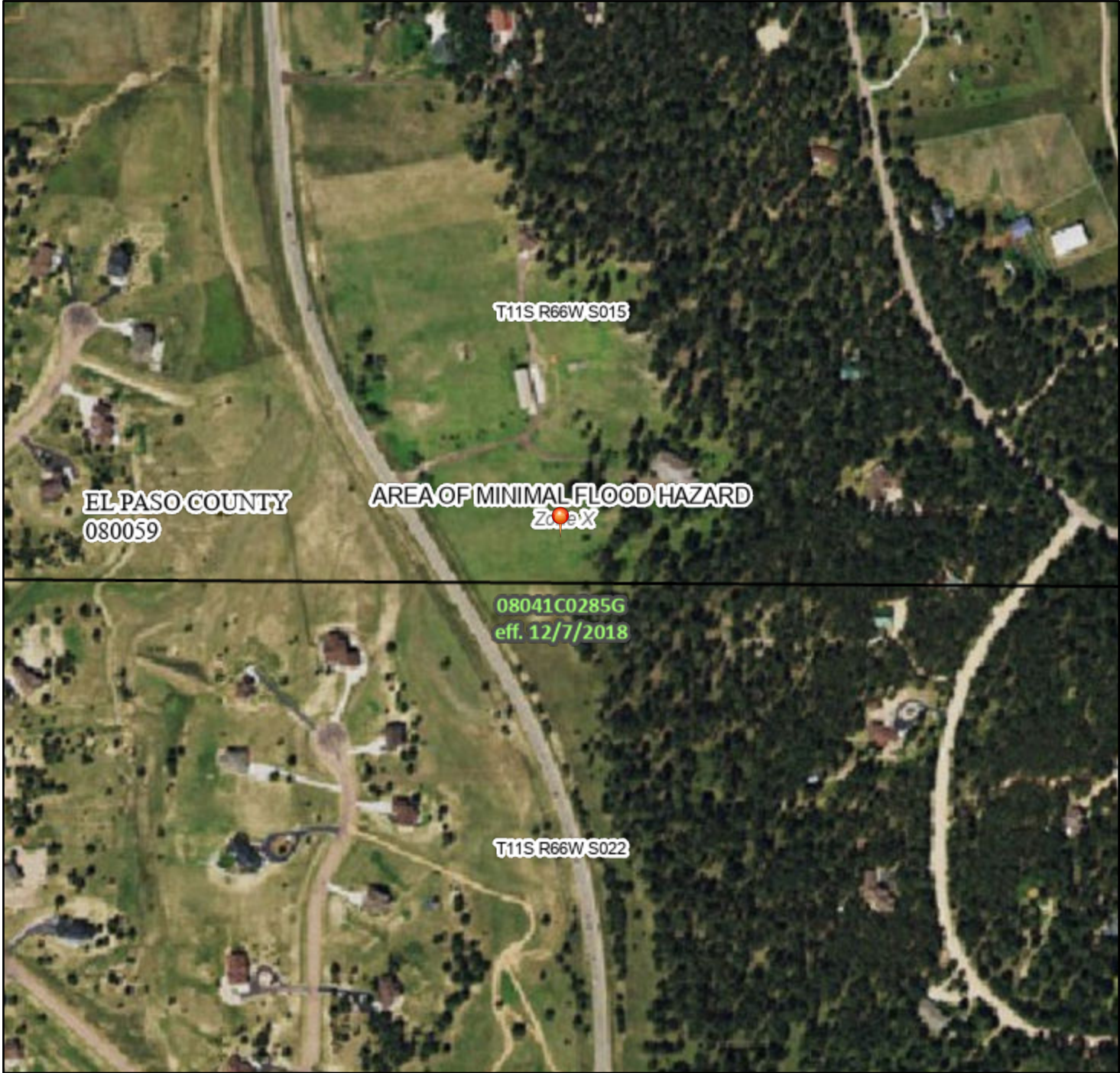
*Component Percent Cutoff:* None Specified

*Tie-break Rule:* Higher

# National Flood Hazard Layer FIRMMette



104°46'23"W 39°5'23"N



1:6,000

104°45'46"W 39°4'55"N

Basemap Imagery Source: USGS National Map 2023

## Legend

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

|                             |  |                                                                                                                                                                   |
|-----------------------------|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SPECIAL FLOOD HAZARD AREAS  |  | Without Base Flood Elevation (BFE)<br>Zone A, V, A99                                                                                                              |
|                             |  | With BFE or Depth Zone AE, AO, AH, VE, AR                                                                                                                         |
|                             |  | Regulatory Floodway                                                                                                                                               |
| OTHER AREAS OF FLOOD HAZARD |  | 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
|                             |  | Future Conditions 1% Annual Chance Flood Hazard Zone X                                                                                                            |
|                             |  | Area with Reduced Flood Risk due to Levee. See Notes. Zone X                                                                                                      |
|                             |  | Area with Flood Risk due to Levee Zone D                                                                                                                          |
| OTHER AREAS                 |  | NO SCREEN Area of Minimal Flood Hazard Zone X                                                                                                                     |
|                             |  | Effective LOMRs                                                                                                                                                   |
|                             |  | Area of Undetermined Flood Hazard Zone D                                                                                                                          |
| GENERAL STRUCTURES          |  | Channel, Culvert, or Storm Sewer                                                                                                                                  |
|                             |  | Levee, Dike, or Floodwall                                                                                                                                         |
| OTHER FEATURES              |  | 20.2 Cross Sections with 1% Annual Chance Water Surface Elevation                                                                                                 |
|                             |  | 17.5 Coastal Transect                                                                                                                                             |
|                             |  | Base Flood Elevation Line (BFE)                                                                                                                                   |
|                             |  | Limit of Study                                                                                                                                                    |
|                             |  | Jurisdiction Boundary                                                                                                                                             |
|                             |  | Coastal Transect Baseline                                                                                                                                         |
|                             |  | Profile Baseline                                                                                                                                                  |
| MAP PANELS                  |  | Digital Data Available                                                                                                                                            |
|                             |  | No Digital Data Available                                                                                                                                         |
|                             |  | Unmapped                                                                                                                                                          |



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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on **8/22/2026 at 7:56 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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





**NOAA Atlas 14, Volume 8, Version 2**  
**Location name: Colorado Springs, Colorado, USA\***  
**Latitude: 39.084°, Longitude: -104.7665°**  
**Elevation: 7442 ft\*\***  
 \* source: ESRI Maps  
 \*\* source: USGS



### POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

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

### PF tabular

| PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches) <sup>1</sup> |                                     |                        |                        |                        |                        |                        |                       |                       |                      |                      |
|----------------------------------------------------------------------------------------------------------|-------------------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|-----------------------|-----------------------|----------------------|----------------------|
| Duration                                                                                                 | Average recurrence interval (years) |                        |                        |                        |                        |                        |                       |                       |                      |                      |
|                                                                                                          | 1                                   | 2                      | 5                      | 10                     | 25                     | 50                     | 100                   | 200                   | 500                  | 1000                 |
| 5-min                                                                                                    | 0.235<br>(0.194-0.287)              | 0.288<br>(0.237-0.351) | 0.379<br>(0.311-0.464) | 0.460<br>(0.375-0.565) | 0.577<br>(0.456-0.737) | 0.672<br>(0.517-0.868) | 0.772<br>(0.573-1.02) | 0.879<br>(0.623-1.19) | 1.03<br>(0.698-1.42) | 1.14<br>(0.755-1.60) |
| 10-min                                                                                                   | 0.344<br>(0.284-0.420)              | 0.422<br>(0.347-0.515) | 0.556<br>(0.456-0.680) | 0.673<br>(0.549-0.827) | 0.845<br>(0.668-1.08)  | 0.985<br>(0.758-1.27)  | 1.13<br>(0.839-1.49)  | 1.29<br>(0.913-1.74)  | 1.50<br>(1.02-2.08)  | 1.67<br>(1.11-2.34)  |
| 15-min                                                                                                   | 0.420<br>(0.346-0.512)              | 0.514<br>(0.423-0.628) | 0.678<br>(0.556-0.829) | 0.821<br>(0.669-1.01)  | 1.03<br>(0.814-1.32)   | 1.20<br>(0.924-1.55)   | 1.38<br>(1.02-1.82)   | 1.57<br>(1.11-2.12)   | 1.83<br>(1.25-2.54)  | 2.04<br>(1.35-2.85)  |
| 30-min                                                                                                   | 0.603<br>(0.497-0.736)              | 0.738<br>(0.607-0.900) | 0.970<br>(0.796-1.19)  | 1.18<br>(0.958-1.44)   | 1.47<br>(1.16-1.88)    | 1.72<br>(1.32-2.22)    | 1.97<br>(1.46-2.60)   | 2.24<br>(1.59-3.03)   | 2.62<br>(1.78-3.63)  | 2.92<br>(1.93-4.08)  |
| 60-min                                                                                                   | 0.768<br>(0.633-0.936)              | 0.926<br>(0.762-1.13)  | 1.21<br>(0.991-1.48)   | 1.46<br>(1.19-1.80)    | 1.85<br>(1.47-2.38)    | 2.17<br>(1.68-2.82)    | 2.52<br>(1.87-3.34)   | 2.89<br>(2.06-3.92)   | 3.42<br>(2.33-4.75)  | 3.85<br>(2.54-5.38)  |
| 2-hr                                                                                                     | 0.932<br>(0.772-1.13)               | 1.11<br>(0.922-1.35)   | 1.45<br>(1.19-1.76)    | 1.76<br>(1.44-2.14)    | 2.23<br>(1.78-2.86)    | 2.63<br>(2.04-3.40)    | 3.06<br>(2.30-4.04)   | 3.54<br>(2.54-4.78)   | 4.22<br>(2.90-5.83)  | 4.77<br>(3.17-6.63)  |
| 3-hr                                                                                                     | 1.02<br>(0.848-1.23)                | 1.20<br>(1.00-1.45)    | 1.55<br>(1.28-1.88)    | 1.88<br>(1.55-2.29)    | 2.40<br>(1.94-3.08)    | 2.86<br>(2.23-3.68)    | 3.35<br>(2.52-4.42)   | 3.90<br>(2.81-5.26)   | 4.69<br>(3.24-6.48)  | 5.34<br>(3.57-7.40)  |
| 6-hr                                                                                                     | 1.20<br>(1.00-1.43)                 | 1.39<br>(1.16-1.67)    | 1.77<br>(1.47-2.12)    | 2.14<br>(1.77-2.58)    | 2.74<br>(2.23-3.50)    | 3.27<br>(2.58-4.20)    | 3.86<br>(2.93-5.07)   | 4.52<br>(3.28-6.07)   | 5.48<br>(3.82-7.53)  | 6.28<br>(4.22-8.64)  |
| 12-hr                                                                                                    | 1.42<br>(1.19-1.69)                 | 1.64<br>(1.38-1.95)    | 2.07<br>(1.73-2.47)    | 2.49<br>(2.07-2.98)    | 3.17<br>(2.59-4.02)    | 3.76<br>(2.98-4.80)    | 4.42<br>(3.38-5.76)   | 5.16<br>(3.77-6.88)   | 6.24<br>(4.37-8.52)  | 7.14<br>(4.83-9.75)  |
| 24-hr                                                                                                    | 1.68<br>(1.42-1.98)                 | 1.96<br>(1.65-2.32)    | 2.48<br>(2.08-2.94)    | 2.97<br>(2.48-3.53)    | 3.72<br>(3.04-4.66)    | 4.37<br>(3.47-5.51)    | 5.08<br>(3.89-6.54)   | 5.86<br>(4.29-7.72)   | 6.97<br>(4.91-9.42)  | 7.89<br>(5.37-10.7)  |
| 2-day                                                                                                    | 1.96<br>(1.67-2.30)                 | 2.33<br>(1.97-2.73)    | 2.97<br>(2.51-3.49)    | 3.54<br>(2.97-4.17)    | 4.38<br>(3.58-5.39)    | 5.08<br>(4.04-6.31)    | 5.81<br>(4.46-7.39)   | 6.60<br>(4.86-8.61)   | 7.71<br>(5.45-10.3)  | 8.60<br>(5.89-11.6)  |
| 3-day                                                                                                    | 2.16<br>(1.83-2.51)                 | 2.55<br>(2.17-2.98)    | 3.24<br>(2.74-3.79)    | 3.84<br>(3.23-4.51)    | 4.73<br>(3.87-5.79)    | 5.46<br>(4.36-6.75)    | 6.23<br>(4.80-7.88)   | 7.05<br>(5.20-9.14)   | 8.19<br>(5.80-10.9)  | 9.10<br>(6.26-12.2)  |
| 4-day                                                                                                    | 2.31<br>(1.97-2.69)                 | 2.72<br>(2.32-3.17)    | 3.43<br>(2.91-4.00)    | 4.05<br>(3.42-4.75)    | 4.97<br>(4.08-6.07)    | 5.73<br>(4.58-7.06)    | 6.52<br>(5.03-8.23)   | 7.37<br>(5.45-9.53)   | 8.55<br>(6.08-11.3)  | 9.49<br>(6.55-12.7)  |
| 7-day                                                                                                    | 2.71<br>(2.32-3.14)                 | 3.14<br>(2.69-3.64)    | 3.89<br>(3.32-4.51)    | 4.55<br>(3.86-5.30)    | 5.53<br>(4.56-6.70)    | 6.34<br>(5.09-7.76)    | 7.18<br>(5.57-9.01)   | 8.09<br>(6.02-10.4)   | 9.36<br>(6.69-12.3)  | 10.4<br>(7.19-13.8)  |
| 10-day                                                                                                   | 3.06<br>(2.63-3.53)                 | 3.52<br>(3.02-4.06)    | 4.31<br>(3.69-4.99)    | 5.02<br>(4.27-5.82)    | 6.05<br>(5.00-7.30)    | 6.90<br>(5.56-8.41)    | 7.79<br>(6.06-9.72)   | 8.74<br>(6.52-11.2)   | 10.1<br>(7.21-13.2)  | 11.1<br>(7.74-14.8)  |
| 20-day                                                                                                   | 4.04<br>(3.49-4.62)                 | 4.63<br>(3.99-5.29)    | 5.61<br>(4.83-6.44)    | 6.46<br>(5.52-7.45)    | 7.68<br>(6.36-9.15)    | 8.65<br>(7.00-10.4)    | 9.66<br>(7.55-11.9)   | 10.7<br>(8.02-13.6)   | 12.1<br>(8.75-15.8)  | 13.3<br>(9.30-17.5)  |
| 30-day                                                                                                   | 4.86<br>(4.21-5.53)                 | 5.56<br>(4.81-6.34)    | 6.73<br>(5.80-7.69)    | 7.71<br>(6.61-8.84)    | 9.08<br>(7.53-10.7)    | 10.1<br>(8.22-12.1)    | 11.2<br>(8.79-13.8)   | 12.3<br>(9.26-15.5)   | 13.8<br>(9.98-17.9)  | 14.9<br>(10.5-19.6)  |
| 45-day                                                                                                   | 5.89<br>(5.12-6.68)                 | 6.76<br>(5.87-7.66)    | 8.15<br>(7.05-9.27)    | 9.29<br>(8.00-10.6)    | 10.8<br>(8.99-12.7)    | 12.0<br>(9.75-14.3)    | 13.2<br>(10.3-16.0)   | 14.3<br>(10.8-17.9)   | 15.8<br>(11.4-20.3)  | 16.9<br>(12.0-22.1)  |
| 60-day                                                                                                   | 6.78<br>(5.90-7.66)                 | 7.78<br>(6.77-8.80)    | 9.37<br>(8.12-10.6)    | 10.6<br>(9.18-12.1)    | 12.3<br>(10.2-14.4)    | 13.6<br>(11.0-16.0)    | 14.8<br>(11.6-17.9)   | 15.9<br>(12.0-19.8)   | 17.4<br>(12.6-22.2)  | 18.5<br>(13.1-24.1)  |

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

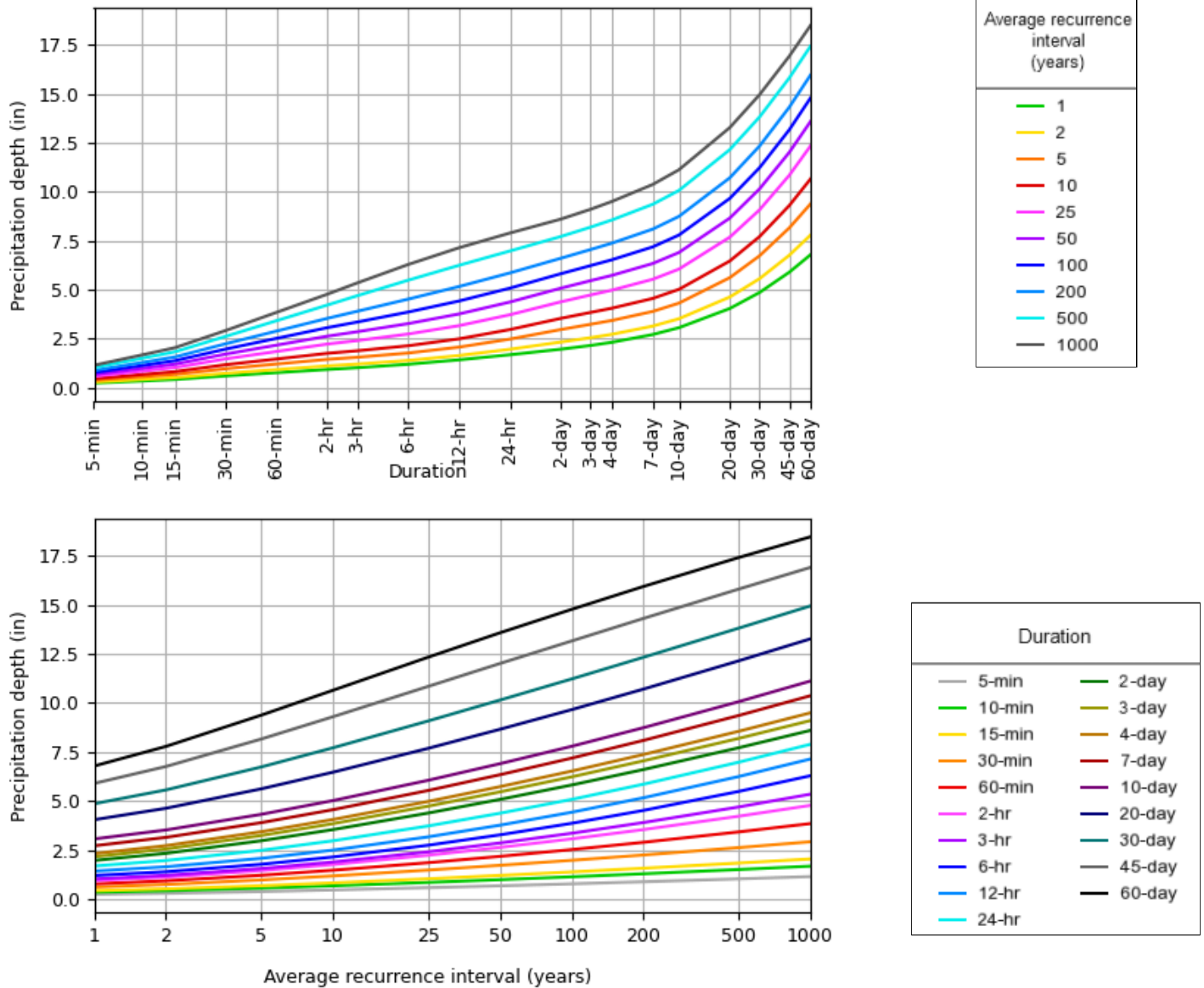
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### PF graphical



### PDS-based depth-duration-frequency (DDF) curves

Latitude: 39.0840°, Longitude: -104.7665°



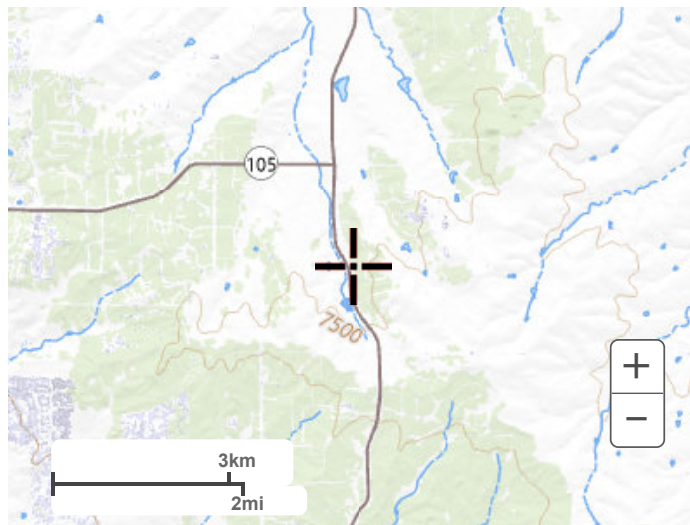
NOAA Atlas 14, Volume 8, Version 2

Created (GMT): Mon Aug 24 17:28:12 2026

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## Maps & aerials

Small scale terrain



Large scale terrain



Large scale map



Large scale aerial



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## **APPENDIX B – HYDROLOGIC CALCULATIONS**

**Subdivision:** The North Ranch  
**Location:** El Paso County  
**Project Name:** The North Ranch  
**Project Number:** 26001  
**Calculated By:** NQJ  
**Checked By:** REB  
**Date:** 8/26/2026

| EXISTING CONDITIONS - BASIN SUMMARY TABLE |           |            |                |                  |                      |                         |                           |
|-------------------------------------------|-----------|------------|----------------|------------------|----------------------|-------------------------|---------------------------|
| Basin                                     | Area (ac) | Impervious | C <sub>5</sub> | C <sub>100</sub> | t <sub>c</sub> (min) | Q <sub>5-YR</sub> (cfs) | Q <sub>100-YR</sub> (cfs) |
| EX1                                       | 5.05      | 14.6%      | 0.17           | 0.42             | 33.4                 | 2.0                     | 8.3                       |
| EX2                                       | 34.20     | 7.9%       | 0.13           | 0.39             | 53.8                 | 7.0                     | 36.3                      |
| EX3                                       | 38.06     | 9.3%       | 0.14           | 0.40             | 47.2                 | 9.3                     | 45.9                      |
| EX4                                       | 3.15      | 11.4%      | 0.15           | 0.41             | 16.3                 | 1.6                     | 7.3                       |
| EX5                                       | 3.21      | 10.4%      | 0.14           | 0.40             | 17.6                 | 1.5                     | 7.1                       |
| EX6                                       | 8.30      | 6.4%       | 0.12           | 0.39             | 29.3                 | 2.5                     | 13.5                      |
| EX6.1                                     | 14.10     | 7.1%       | 0.12           | 0.39             | 28.9                 | 4.4                     | 23.4                      |
| EX7                                       | 22.13     | 6.7%       | 0.12           | 0.39             | 35.0                 | 6.0                     | 32.3                      |
| EX8                                       | 16.60     | 5.8%       | 0.12           | 0.38             | 35.8                 | 4.3                     | 23.5                      |
| EX9                                       | 15.65     | 4.5%       | 0.11           | 0.37             | 36.4                 | 3.7                     | 21.5                      |

| EXISTING CONDITONS -<br>DESIGN POINT SUMMARY TABLE |                   |                     |
|----------------------------------------------------|-------------------|---------------------|
| DP#                                                | Q <sub>5-YR</sub> | Q <sub>100-YR</sub> |
| 1                                                  | 2.0               | 8.3                 |
| 2                                                  | 7.0               | 36.3                |
| 3                                                  | 9.3               | 45.9                |
| 4                                                  | 1.6               | 7.3                 |
| 5                                                  | 1.5               | 7.1                 |
| 6                                                  | 2.5               | 13.5                |
| 7                                                  | 4.2               | 21.4                |
| 8                                                  | 8.4               | 44.2                |
| 9                                                  | 4.3               | 23.5                |
| 10                                                 | 7.2               | 40.8                |
| 11                                                 | 32.9              | 189.1               |



COMPOSITE % IMPERVIOUS CALCULATIONS - EXISTING CONDITIONS

Subdivision: The North Ranch  
Location: El Paso County

Project Name: The North Ranch  
Project No.: 26001.00  
Calculated By: NQJ  
Checked By: REB  
Date: 8/26/26

|          |                 | Gravel Drives  |                  |           |        | Paved          |                  |           |        | 5 Acre Lots    |                  |           |        | Undeveloped    |                  |           |        | Weighted C <sub>5</sub> & C <sub>100</sub> |                  | Basins Total Weighted % Imp. |
|----------|-----------------|----------------|------------------|-----------|--------|----------------|------------------|-----------|--------|----------------|------------------|-----------|--------|----------------|------------------|-----------|--------|--------------------------------------------|------------------|------------------------------|
| Basin ID | Total Area (ac) | C <sub>5</sub> | C <sub>100</sub> | Area (ac) | % Imp. | C <sub>5</sub> | C <sub>100</sub> | Area (ac) | % Imp. | C <sub>5</sub> | C <sub>100</sub> | Area (ac) | % Imp. | C <sub>5</sub> | C <sub>100</sub> | Area (ac) | % Imp. |                                            |                  |                              |
|          |                 |                |                  |           |        |                |                  |           |        |                |                  |           |        |                |                  |           |        | C <sub>5</sub>                             | C <sub>100</sub> |                              |
| EX1      | 5.05            | 0.59           | 0.70             | 0.50      | 80.0%  | 0.90           | 0.96             | 0.05      | 100.0% | 0.12           | 0.39             | 3.96      | 7.0%   | 0.09           | 0.36             | 0.54      | 2.0%   | 0.17                                       | 0.42             | 14.6%                        |
| EX2      | 34.20           | 0.59           | 0.70             | 0.39      | 80.0%  | 0.90           | 0.96             | 0.37      | 100.0% | 0.12           | 0.39             | 26.98     | 7.0%   | 0.09           | 0.36             | 6.46      | 2.0%   | 0.13                                       | 0.39             | 7.9%                         |
| EX3      | 38.06           | 0.59           | 0.70             | 1.20      | 80.0%  | 0.90           | 0.96             | 0.12      | 100.0% | 0.12           | 0.39             | 34.24     | 7.0%   | 0.09           | 0.36             | 2.50      | 2.0%   | 0.14                                       | 0.40             | 9.3%                         |
| EX4      | 3.15            | 0.59           | 0.70             | 0.19      | 80.0%  | 0.90           | 0.96             | 0.00      | 100.0% | 0.12           | 0.39             | 2.96      | 7.0%   | 0.09           | 0.36             | 0.00      | 2.0%   | 0.15                                       | 0.41             | 11.4%                        |
| EX5      | 3.21            | 0.59           | 0.70             | 0.15      | 80.0%  | 0.90           | 0.96             | 0.00      | 100.0% | 0.12           | 0.39             | 3.06      | 7.0%   | 0.09           | 0.36             | 0.00      | 2.0%   | 0.14                                       | 0.40             | 10.4%                        |
| EX6      | 8.30            | 0.59           | 0.70             | 0.03      | 80.0%  | 0.90           | 0.96             | 0.10      | 100.0% | 0.12           | 0.39             | 4.81      | 7.0%   | 0.09           | 0.36             | 3.36      | 2.0%   | 0.12                                       | 0.39             | 6.4%                         |
| EX6.1    | 14.10           | 0.59           | 0.70             | 0.19      | 80.0%  | 0.90           | 0.96             | 0.22      | 100.0% | 0.12           | 0.39             | 7.00      | 7.0%   | 0.09           | 0.36             | 6.69      | 2.0%   | 0.12                                       | 0.39             | 7.1%                         |
| EX7      | 22.13           | 0.59           | 0.70             | 0.23      | 80.0%  | 0.90           | 0.96             | 0.13      | 100.0% | 0.12           | 0.39             | 14.60     | 7.0%   | 0.09           | 0.36             | 7.17      | 2.0%   | 0.12                                       | 0.39             | 6.7%                         |
| EX8      | 16.60           | 0.59           | 0.70             | 0.34      | 80.0%  | 0.90           | 0.96             | 0.18      | 100.0% | 0.12           | 0.39             | 3.78      | 7.0%   | 0.09           | 0.36             | 12.30     | 2.0%   | 0.12                                       | 0.38             | 5.8%                         |
| EX9      | 15.65           | 0.59           | 0.70             | 0.05      | 80.0%  | 0.90           | 0.96             | 0.19      | 100.0% | 0.12           | 0.39             | 3.21      | 7.0%   | 0.09           | 0.36             | 12.20     | 2.0%   | 0.11                                       | 0.37             | 4.5%                         |
|          |                 |                |                  |           |        |                |                  |           |        |                |                  |           |        |                |                  |           |        |                                            |                  |                              |
| Total    | 160.45          |                |                  |           |        |                |                  |           |        |                |                  |           |        |                |                  |           |        |                                            |                  | 7.7%                         |

# STANDARD FORM SF-2 - EXISTING CONDITIONS

## TIME OF CONCENTRATION

**Subdivision:** The North Ranch  
**Location:** El Paso County

**Project Name:** The North Ranch  
**Project No.:** 26001.00  
**Calculated By:** NQJ  
**Checked By:** REB  
**Date:** 8/26/26

| SUB-BASIN |           |                        |                         |                           |                | INITIAL/OVERLAND  |                    |                      | TRAVEL TIME         |                    |      |             |                      | t <sub>c</sub> CHECK       |                   |                                | FINAL                |
|-----------|-----------|------------------------|-------------------------|---------------------------|----------------|-------------------|--------------------|----------------------|---------------------|--------------------|------|-------------|----------------------|----------------------------|-------------------|--------------------------------|----------------------|
| DATA      |           |                        |                         |                           |                | (T <sub>i</sub> ) |                    |                      | (T <sub>t</sub> )   |                    |      |             |                      | (URBANIZED BASINS)         |                   |                                |                      |
| BASIN ID  | D.A. (ac) | Hydrologic Soils Group | Weighted C <sub>s</sub> | Weighted C <sub>100</sub> | Impervious (%) | L (ft)            | S <sub>o</sub> (%) | t <sub>i</sub> (min) | L <sub>t</sub> (ft) | S <sub>t</sub> (%) | K    | VEL. (ft/s) | t <sub>t</sub> (min) | COMP. t <sub>c</sub> (min) | TOTAL LENGTH (ft) | Urbanized t <sub>c</sub> (min) | t <sub>c</sub> (min) |
| EX1       | 5.05      | A                      | 0.17                    | 0.42                      | 14.6%          | 300               | 1.0%               | 29.1                 | 850                 | 1.7%               | 10.0 | 1.3         | 10.9                 | 39.9                       | 1150.0            | 33.4                           | 33.4                 |
| EX2       | 34.20     | A                      | 0.13                    | 0.39                      | 7.9%           | 300               | 6.6%               | 16.3                 | 2500                | 2.0%               | 7.0  | 1.0         | 42.1                 | 58.4                       | 2800.0            | 53.8                           | 53.8                 |
| EX3       | 38.06     | A                      | 0.14                    | 0.40                      | 9.3%           | 300               | 6.0%               | 16.7                 | 2358                | 2.8%               | 7.0  | 1.2         | 33.6                 | 50.3                       | 2658.0            | 47.2                           | 47.2                 |
| EX4       | 3.15      | A                      | 0.15                    | 0.41                      | 11.4%          | 250               | 7.2%               | 14.2                 | 134                 | 2.2%               | 7.0  | 1.0         | 2.2                  | 16.3                       | 384.0             | 25.5                           | 16.3                 |
| EX5       | 3.21      | A                      | 0.14                    | 0.40                      | 10.4%          | 300               | 8.0%               | 15.1                 | 227                 | 4.5%               | 7.0  | 1.5         | 2.5                  | 17.6                       | 527.0             | 25.9                           | 17.6                 |
| EX6       | 8.30      | A                      | 0.12                    | 0.39                      | 6.4%           | 300               | 5.8%               | 17.2                 | 870                 | 2.9%               | 7.0  | 1.2         | 12.2                 | 29.3                       | 1170.0            | 33.5                           | 29.3                 |
| EX6.1     | 14.10     | A                      | 0.12                    | 0.39                      | 7.1%           | 300               | 10.0%              | 14.3                 | 1400                | 5.2%               | 7.0  | 1.6         | 14.6                 | 28.9                       | 1700.0            | 35.0                           | 28.9                 |
| EX7       | 22.13     | A                      | 0.12                    | 0.39                      | 6.7%           | 300               | 6.7%               | 16.4                 | 1285                | 2.7%               | 7.0  | 1.2         | 18.6                 | 35.0                       | 1585.0            | 38.0                           | 35.0                 |
| EX8       | 16.60     | A                      | 0.12                    | 0.38                      | 5.8%           | 300               | 9.3%               | 14.7                 | 1342                | 2.3%               | 7.0  | 1.1         | 21.1                 | 35.8                       | 1642.0            | 40.0                           | 35.8                 |
| EX9       | 15.65     | A                      | 0.11                    | 0.37                      | 4.5%           | 300               | 8.0%               | 15.6                 | 1512                | 3.0%               | 7.0  | 1.2         | 20.8                 | 36.4                       | 1812.0            | 40.4                           | 36.4                 |
|           |           |                        |                         |                           |                |                   |                    |                      |                     |                    |      |             |                      |                            |                   |                                |                      |

### NOTES:

$$t_c = t_i + t_t$$

Where:

t<sub>c</sub> = computed time of concentration (minutes)

t<sub>i</sub> = overland (initial) flow time (minutes)

t<sub>t</sub> = channelized flow time (minutes).

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

Where:

t<sub>t</sub> = channelized flow time (travel time, min)

L<sub>t</sub> = waterway length (ft)

S<sub>o</sub> = waterway slope (ft/ft)

V<sub>t</sub> = travel time velocity (ft/sec) = K√S<sub>o</sub>

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

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

Where:

t<sub>i</sub> = overland (initial) flow time (minutes)

C<sub>5</sub> = runoff coefficient for 5-year frequency (from Table 6-4)

L<sub>i</sub> = length of overland flow (ft)

S<sub>o</sub> = average slope along the overland flow path (ft/ft).

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

∴

t<sub>c</sub> = minimum time of concentration for first design point when less than t<sub>c</sub> from Equation 6-1.

L<sub>t</sub> = length of channelized flow path (ft)

i = imperviousness (expressed as a decimal)

S<sub>t</sub> = slope of the channelized flow path (ft/ft).

Table 6-2. NRCS Conveyance factors, K

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

Equation 6-5

Use a minimum t<sub>c</sub> value of 5 minutes for urbanized areas and a minimum t<sub>c</sub> value of 10 minutes for areas that are not considered urban. Use minimum values even when calculations result in a lesser time of concentration.

## STANDARD FORM SF-3 - EXISTING CONDITIONS

## STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: The North Ranch

Project Name: The North Ranch

Project No.: 26001.00

Calculated By: NOJ

Checked By: REB

Date: 8/26/26

Location: El Paso County

Design Storm: 5-Year

| DESCRIPTION | Design Point | DIRECT RUNOFF |           |               |             |          |           |         | TOTAL RUNOFF |          |           |         | OVERLAND             |          |           | PIPE             |          |           |                    | TRAVEL TIME |                |             | REMARKS                                                                        |
|-------------|--------------|---------------|-----------|---------------|-------------|----------|-----------|---------|--------------|----------|-----------|---------|----------------------|----------|-----------|------------------|----------|-----------|--------------------|-------------|----------------|-------------|--------------------------------------------------------------------------------|
|             |              | Basin ID      | Area (Ac) | Runoff Coeff. | $t_c$ (min) | C*A (Ac) | I (in/hr) | Q (cfs) | $t_c$ (min)  | C*A (ac) | I (in/hr) | Q (cfs) | $Q_{overland}$ (cfs) | C*A (ac) | Slope (%) | $Q_{pipe}$ (cfs) | C*A (ac) | Slope (%) | Pipe Size (inches) | Length (ft) | Velocity (fps) | $t_t$ (min) |                                                                                |
|             | 1            | EX1           | 5.05      | 0.17          | 33.4        | 0.86     | 2.32      | 2.0     |              |          |           |         |                      |          |           |                  |          |           |                    |             |                |             | BASIN EX1 FLOW @ DP1,C ONVEYED WEST BY EX 84" CMP CULVERT UNDER HWY 83         |
|             | 2            | EX2           | 34.20     | 0.13          | 53.8        | 4.38     | 1.60      | 7.0     |              |          |           |         |                      |          |           |                  |          |           |                    |             |                |             | BASIN EX2 @ DP2, CONVEYED WEST BY EX 24" CMP CULVERT UNDER HWY 83              |
|             | 3            | EX3           | 38.06     | 0.14          | 47.2        | 5.15     | 1.80      | 9.3     |              |          |           |         |                      |          |           |                  |          |           |                    |             |                |             | BASIN EX3 @ DP3, CONVEYED WEST BY EX 24" CMP CULVERT UNDER HWY 83              |
|             | 4            | EX4           | 3.15      | 0.15          | 16.3        | 0.47     | 3.40      | 1.6     |              |          |           |         | 1.6                  | 0.47     | 4.8       |                  |          |           |                    | 1031        | 1.5            | 11.2        | BASIN EX4 @ DP4, CONVEYED UNDER PINEHURST CIR IN EX 24" CMP, SWALE FLOW TO DP7 |
|             | 5            | EX5           | 3.21      | 0.14          | 17.6        | 0.46     | 3.28      | 1.5     |              |          |           |         | 1.5                  | 0.46     | 3         |                  |          |           |                    | 1500        | 1.2            | 20.6        | BASIN EX5 @ DP5, OVERTOPS PINEHURST CIR, SWALE FLOW TO DP7                     |
|             | 6            | EX6           | 8.30      | 0.12          | 29.3        | 0.99     | 2.51      | 2.5     |              |          |           |         |                      |          |           |                  |          |           |                    |             |                |             | BASIN EX6 @ DP6, CONVEYED WEST BY EX 24" CMP CULVERT UNDER HWY 83              |
|             |              | EX6.1         | 14.10     | 0.12          | 28.9        | 1.75     | 2.54      | 4.4     |              |          |           |         |                      |          |           |                  |          |           |                    |             |                |             | BASIN EX6.1 @ DP7                                                              |
|             | 7            |               |           |               |             |          |           |         | 54.6         | 2.68     | 1.58      | 4.2     | 54.6                 | 2.68     | 2.4       |                  |          |           |                    | 380         | 1.1            | 5.8         | COMBINED DP4, DP5 & BASIN EX6.1@ DP7, CONVEYED NORTH IN HWY 83 SWALE TO DP8    |
|             |              | EX7           | 22.13     | 0.12          | 35.0        | 2.65     | 2.25      | 6.0     |              |          |           |         |                      |          |           |                  |          |           |                    |             |                |             | BASIN EX7 @ DP8                                                                |
|             | 8            |               |           |               |             |          |           |         | 54.6         | 5.33     | 1.58      | 8.4     | 8.4                  | 5.33     | 2.1       |                  |          |           |                    | 280         | 1.0            | 4.6         | COMBINED DP7 & BASIN 7 @ DP8, CONVEYED WEST BY EX 24" CMP CULVERT UNDER HWY 83 |
|             | 9            | EX8           | 16.60     | 0.12          | 35.8        | 1.92     | 2.22      | 4.3     |              |          |           |         | 4.3                  | 1.92     | 5         |                  |          |           |                    | 520         | 1.6            | 5.5         | BASIN EX8 @ DP9, CONVEYED NORTH IN HWY 83 SWALE TO DP10                        |
|             |              | EX9           | 15.65     | 0.11          | 36.4        | 1.68     | 2.19      | 3.7     |              |          |           |         |                      |          |           |                  |          |           |                    |             |                |             | BASIN EX9 @ DP10                                                               |
|             | 10           |               |           |               |             |          |           |         | 41.3         | 3.61     | 2.00      | 7.2     |                      |          |           |                  |          |           |                    |             |                |             | COMBINED DP9 & BASIN EX9 @ DP10, CONVEYED NORTH IN HWY 83 SWALE                |
|             | 11           |               |           |               |             |          |           |         |              |          |           | 32.9    |                      |          |           |                  |          |           |                    |             |                |             | COMBINED DISCHARGE FROM BASIN AREA                                             |

**STANDARD FORM SF-3 - EXISTING CONDITIONS**  
**STORM DRAINAGE SYSTEM DESIGN**  
(RATIONAL METHOD PROCEDURE)

**Subdivision:** The North Ranch  
**Location:** El Paso County  
**Design Storm:** 100-Year

**Project Name:** The North Ranch  
**Project No.:** 26001.00  
**Calculated By:** NJQ  
**Checked By:** REB  
**Date:** 8/26/26

| STREET | Design Point | DIRECT RUNOFF |           |               |             |          |           |         | TOTAL RUNOFF |          |           |         | OVERLAND             |          |           | PIPE             |          |           |                    | TRAVEL TIME |                |             | REMARKS                                                                        |
|--------|--------------|---------------|-----------|---------------|-------------|----------|-----------|---------|--------------|----------|-----------|---------|----------------------|----------|-----------|------------------|----------|-----------|--------------------|-------------|----------------|-------------|--------------------------------------------------------------------------------|
|        |              | Basin ID      | Area (ac) | Runoff Coeff. | $t_c$ (min) | C*A (ac) | I (in/hr) | Q (cfs) | $t_c$ (min)  | C*A (ac) | I (in/hr) | Q (cfs) | $Q_{OVERLAND}$ (cfs) | C*A (ac) | Slope (%) | $Q_{PIPE}$ (cfs) | C*A (ac) | Slope (%) | Pipe Size (inches) | Length (ft) | Velocity (fps) | $t_c$ (min) |                                                                                |
|        | 1            | EX1           | 5.05      | 0.42          | 33.4        | 2.14     | 3.90      | 8.3     |              |          |           |         |                      |          |           |                  |          |           |                    |             |                |             | BASIN EX1 FLOW @ DP1,C ONVEYED WEST BY EX 84" CMP CULVERT UNDER HWY 83         |
|        | 2            | EX2           | 34.20     | 0.39          | 53.8        | 13.48    | 2.69      | 36.3    |              |          |           |         |                      |          |           |                  |          |           |                    |             |                |             | BASIN EX2 @ DP2, CONVEYED WEST BY EX 24" CMP CULVERT UNDER HWY 83              |
|        | 3            | EX3           | 38.06     | 0.40          | 47.2        | 15.21    | 3.02      | 45.9    |              |          |           |         |                      |          |           |                  |          |           |                    |             |                |             | BASIN EX3 @ DP3, CONVEYED WEST BY EX 24" CMP CULVERT UNDER HWY 83              |
|        | 4            | EX4           | 3.15      | 0.41          | 16.3        | 1.29     | 5.70      | 7.3     |              |          |           |         | 7.3                  | 1.29     | 4.8       |                  |          |           |                    | 1031        | 1.5            | 11.2        | BASIN EX4 @ DP4, CONVEYED UNDER PINEHURST CIR IN EX 24" CMP, SWALE FLOW TO DP7 |
|        | 5            | EX5           | 3.21      | 0.40          | 17.6        | 1.30     | 5.50      | 7.1     |              |          |           |         | 7.1                  | 1.30     | 3         |                  |          |           |                    | 1500        | 1.2            | 20.6        | BASIN EX5 @ DP5, OVERTOPS PINEHURST CIR, SWALE FLOW TO DP7                     |
|        | 6            | EX6           | 8.30      | 0.39          | 29.3        | 3.20     | 4.22      | 13.5    |              |          |           |         |                      |          |           |                  |          |           |                    |             |                |             | BASIN EX6 @ DP6, CONVEYED WEST BY EX 24" CMP CULVERT UNDER HWY 83              |
|        |              | EX6.1         | 14.10     | 0.39          | 28.9        | 5.48     | 4.26      | 23.4    |              |          |           |         |                      |          |           |                  |          |           |                    |             |                |             | BASIN EX6.1 @ DP7                                                              |
|        | 7            |               |           |               |             |          |           |         | 54.6         | 8.07     | 2.66      | 21.4    | 54.6                 | 8.07     | 2.4       |                  |          |           |                    | 380         | 1.1            | 5.8         | COMBINED DP4, DP5 & BASIN EX6.1@ DP7, CONVEYED NORTH IN HWY 83 SWALE TO DP8    |
|        |              | EX7           | 22.13     | 0.39          | 35.0        | 8.56     | 3.78      | 32.3    |              |          |           |         |                      |          |           |                  |          |           |                    |             |                |             | BASIN EX7 @ DP8                                                                |
|        | 8            |               |           |               |             |          |           |         | 54.6         | 16.63    | 2.66      | 44.2    | 44.2                 | 16.63    | 2.1       |                  |          |           |                    | 280         | 1.0            | 4.6         | COMBINED DP7 & BASIN 7 @ DP8, CONVEYED WEST BY EX 24" CMP CULVERT UNDER HWY 83 |
|        | 9            | EX8           | 16.60     | 0.38          | 35.8        | 6.31     | 3.72      | 23.5    |              |          |           |         | 23.5                 | 6.31     | 5         |                  |          |           |                    | 520         | 1.6            | 5.5         | BASIN EX8 @ DP9, CONVEYED NORTH IN HWY 83 SWALE TO DP10                        |
|        |              | EX9           | 15.65     | 0.37          | 36.4        | 5.86     | 3.68      | 21.5    |              |          |           |         |                      |          |           |                  |          |           |                    |             |                |             | BASIN EX9 @ DP10                                                               |
|        | 10           |               |           |               |             |          |           |         | 41.3         | 12.17    | 3.36      | 40.8    |                      |          |           |                  |          |           |                    |             |                |             | COMBINED DP9 & BASIN EX9 @ DP10, CONVEYED NORTH IN HWY 83 SWALE                |
|        |              |               |           |               |             |          |           |         |              |          |           | 189.1   |                      |          |           |                  |          |           |                    |             |                |             | COMBINED DISCHARGE FROM BASIN AREA                                             |



**Project: The North Ranch**

**Project No: 26001**

**Date: 8/26/2026**

**2.5 Acre Lot - Composite % Impervious Calculation**

| Lot Area<br>(ft <sup>2</sup> ) | Roof Area<br>(ft <sup>2</sup> ) | Paved Driveway<br>(ft <sup>2</sup> ) | Undeveloped<br>(ft <sup>2</sup> ) | Comp.<br>Impervious |
|--------------------------------|---------------------------------|--------------------------------------|-----------------------------------|---------------------|
| 108,900                        | 5,000                           | 1,500                                | 102,400                           | 7.4%                |

Per BFFPD, driveways to be 15' wide, assumed 100 length

**Subdivision:** Needles Sub.  
**Location:** El Paso County  
**Project Name:** Needles Sub.  
**Project Number:** 26001  
**Calculated By:** NQJ  
**Checked By:** REB  
**Date:** 8/26/2026

| PROPOSED CONDITIONS - BASIN SUMMARY TABLE |           |            |                |                  |                      |                         |                           |
|-------------------------------------------|-----------|------------|----------------|------------------|----------------------|-------------------------|---------------------------|
| Basin                                     | Area (ac) | Impervious | C <sub>s</sub> | C <sub>100</sub> | t <sub>c</sub> (min) | Q <sub>5-YR</sub> (cfs) | Q <sub>100-YR</sub> (cfs) |
| 1                                         | 4.85      | 12.9%      | 0.16           | 0.41             | 33.9                 | 1.8                     | 7.7                       |
| 2                                         | 1.10      | 28.7%      | 0.30           | 0.52             | 5.8                  | 1.7                     | 4.7                       |
| 3                                         | 29.67     | 7.8%       | 0.13           | 0.39             | 52.9                 | 6.1                     | 31.9                      |
| 4                                         | 2.56      | 64.8%      | 0.60           | 0.73             | 16.8                 | 5.1                     | 10.5                      |
| 5                                         | 2.83      | 16.1%      | 0.20           | 0.44             | 24.8                 | 1.6                     | 5.8                       |
| 5.1                                       | 0.94      | 17.2%      | 0.21           | 0.45             | 20.8                 | 0.6                     | 2.2                       |
| 5.2                                       | 0.88      | 14.0%      | 0.19           | 0.43             | 19.1                 | 0.5                     | 2.0                       |
| 6                                         | 36.64     | 9.4%       | 0.14           | 0.40             | 47.6                 | 8.9                     | 43.9                      |
| 7                                         | 7.05      | 8.1%       | 0.13           | 0.39             | 22.5                 | 2.6                     | 13.6                      |
| 7.1                                       | 12.19     | 8.0%       | 0.13           | 0.39             | 33.6                 | 3.5                     | 18.6                      |
| 8                                         | 20.47     | 7.8%       | 0.12           | 0.39             | 33.5                 | 5.9                     | 31.3                      |
| 9                                         | 0.37      | 61.3%      | 0.57           | 0.71             | 5.0                  | 1.1                     | 2.3                       |
| 10                                        | 2.40      | 18.7%      | 0.23           | 0.46             | 23.5                 | 1.5                     | 5.3                       |
| 11                                        | 17.97     | 7.2%       | 0.12           | 0.39             | 33.1                 | 5.0                     | 27.4                      |
| 12                                        | 1.29      | 45.1%      | 0.44           | 0.62             | 13.9                 | 2.1                     | 4.9                       |
| 13                                        | 1.63      | 40.6%      | 0.37           | 0.56             | 9.0                  | 2.6                     | 6.6                       |
| 14                                        | 0.96      | 17.9%      | 0.22           | 0.45             | 25.4                 | 0.6                     | 2.0                       |
| 15                                        | 10.29     | 8.9%       | 0.13           | 0.40             | 39.1                 | 2.8                     | 14.0                      |

| PROPOSED CONDITIONS - DESIGN<br>POINT SUMMARY TABLE |                   |                     |
|-----------------------------------------------------|-------------------|---------------------|
| DP#                                                 | Q <sub>5-YR</sub> | Q <sub>100-YR</sub> |
| A                                                   | 1.8               | 7.7                 |
| B                                                   | 2.5               | 9.7                 |
| C                                                   | 5.7               | 31.3                |
| D                                                   | 5.1               | 10.5                |
| E                                                   | 6.4               | 33.8                |
| F                                                   | 8.9               | 43.9                |
| G                                                   | 8.7               | 42.6                |
| H                                                   | 2.6               | 13.6                |
| I                                                   | 2.9               | 14.6                |
| J                                                   | 1.6               | 7.3                 |
| K                                                   | 1.5               | 7.1                 |
| L                                                   | 5.5               | 27.5                |
| M                                                   | 5.9               | 31.3                |
| N                                                   | 4.8               | 9.9                 |
| O                                                   | 10.6              | 53.0                |
| P                                                   | 5.0               | 27.4                |
| Q                                                   | 2.1               | 4.9                 |
| R                                                   | 11.5              | 41.3                |
| S                                                   | 0.9               | 23.1                |
| T                                                   | 3.7               | 31.0                |
| U                                                   | 35.1              | 184.7               |



COMPOSITE % IMPERVIOUS CALCULATIONS - EXISTING CONDITIONS

Subdivision: Needles Sub.  
Location: El Paso County

Project Name: Needles Sub.  
Project No.: 26001.00  
Calculated By: NOJ  
Checked By: REB  
Date: 8/26/26

| Basin ID                 | Total Area (ac) | Gravel Drives  |                  |           |        | Paved          |                  |           |        | 2.5 Ac Lots - See Comp. Imp. Calc |                  |           |        | 5 Ac Lots      |                  |           |        | Undeveloped    |                  |           |        | Weighted C <sub>5</sub> & C <sub>100</sub> |                  | Basins Total Weighted % Imp. |
|--------------------------|-----------------|----------------|------------------|-----------|--------|----------------|------------------|-----------|--------|-----------------------------------|------------------|-----------|--------|----------------|------------------|-----------|--------|----------------|------------------|-----------|--------|--------------------------------------------|------------------|------------------------------|
|                          |                 | C <sub>5</sub> | C <sub>100</sub> | Area (ac) | % Imp. | C <sub>5</sub> | C <sub>100</sub> | Area (ac) | % Imp. | C <sub>5</sub>                    | C <sub>100</sub> | Area (ac) | % Imp. | C <sub>5</sub> | C <sub>100</sub> | Area (ac) | % Imp. | C <sub>5</sub> | C <sub>100</sub> | Area (ac) | % Imp. | C <sub>5</sub>                             | C <sub>100</sub> |                              |
|                          |                 |                |                  |           |        |                |                  |           |        |                                   |                  |           |        |                |                  |           |        |                |                  |           |        |                                            |                  |                              |
| EX4                      | 3.15            | 0.59           | 0.70             | 0.19      | 80.0%  | 0.90           | 0.96             | 0.00      | 100.0% | 0.12                              | 0.39             | 0.00      | 7.4%   | 0.12           | 0.39             | 2.96      | 7.0%   | 0.09           | 0.36             | 0.00      | 2.0%   | 0.15                                       | 0.41             | 11.4%                        |
| EX5                      | 3.21            | 0.59           | 0.70             | 0.15      | 80.0%  | 0.90           | 0.96             | 0.00      | 100.0% | 0.12                              | 0.39             | 0.00      | 7.4%   | 0.12           | 0.39             | 3.06      | 7.0%   | 0.09           | 0.36             | 0.00      | 2.0%   | 0.14                                       | 0.40             | 10.4%                        |
| 1                        | 4.85            | 0.59           | 0.70             | 0.43      | 80.0%  | 0.90           | 0.96             | 0.00      | 100.0% | 0.12                              | 0.39             | 0.00      | 7.4%   | 0.12           | 0.39             | 3.85      | 7.0%   | 0.09           | 0.36             | 0.57      | 2.0%   | 0.16                                       | 0.41             | 12.9%                        |
| 2                        | 1.10            | 0.59           | 0.70             | 0.05      | 80.0%  | 0.90           | 0.96             | 0.26      | 100.0% | 0.12                              | 0.39             | 0.00      | 7.4%   | 0.12           | 0.39             | 0.00      | 7.0%   | 0.09           | 0.36             | 0.79      | 2.0%   | 0.30                                       | 0.52             | 28.7%                        |
| 3                        | 29.67           | 0.59           | 0.70             | 0.35      | 80.0%  | 0.90           | 0.96             | 0.00      | 100.0% | 0.12                              | 0.39             | 2.17      | 7.4%   | 0.12           | 0.39             | 26.79     | 7.0%   | 0.09           | 0.36             | 0.36      | 2.0%   | 0.13                                       | 0.39             | 7.8%                         |
| 4                        | 2.56            | 0.59           | 0.70             | 0.24      | 80.0%  | 0.90           | 0.96             | 1.45      | 100.0% | 0.12                              | 0.39             | 0.00      | 7.4%   | 0.12           | 0.39             | 0.00      | 7.0%   | 0.09           | 0.36             | 0.87      | 2.0%   | 0.60                                       | 0.73             | 64.8%                        |
| 5                        | 2.83            | 0.59           | 0.70             | 0.06      | 80.0%  | 0.90           | 0.96             | 0.36      | 100.0% | 0.12                              | 0.39             | 0.00      | 7.4%   | 0.12           | 0.39             | 0.00      | 7.0%   | 0.09           | 0.36             | 2.41      | 2.0%   | 0.20                                       | 0.44             | 16.1%                        |
| 5.1                      | 0.94            | 0.59           | 0.70             | 0.02      | 80.0%  | 0.90           | 0.96             | 0.13      | 100.0% | 0.12                              | 0.39             | 0.00      | 7.4%   | 0.12           | 0.39             | 0.00      | 7.0%   | 0.09           | 0.36             | 0.79      | 2.0%   | 0.21                                       | 0.45             | 17.2%                        |
| 5.2                      | 0.88            | 0.59           | 0.70             | 0.01      | 80.0%  | 0.90           | 0.96             | 0.10      | 100.0% | 0.12                              | 0.39             | 0.00      | 7.4%   | 0.12           | 0.39             | 0.00      | 7.0%   | 0.09           | 0.36             | 0.77      | 2.0%   | 0.19                                       | 0.43             | 14.0%                        |
| 6                        | 36.64           | 0.59           | 0.70             | 1.19      | 80.0%  | 0.90           | 0.96             | 0.00      | 100.0% | 0.12                              | 0.39             | 1.10      | 7.4%   | 0.12           | 0.39             | 34.24     | 7.0%   | 0.09           | 0.36             | 0.11      | 2.0%   | 0.14                                       | 0.40             | 9.4%                         |
| 7                        | 7.05            | 0.59           | 0.70             | 0.10      | 80.0%  | 0.90           | 0.96             | 0.00      | 100.0% | 0.12                              | 0.39             | 2.03      | 7.4%   | 0.12           | 0.39             | 4.82      | 7.0%   | 0.09           | 0.36             | 0.10      | 2.0%   | 0.13                                       | 0.39             | 8.1%                         |
| 7.1                      | 12.19           | 0.59           | 0.70             | 0.16      | 80.0%  | 0.90           | 0.96             | 0.00      | 100.0% | 0.12                              | 0.39             | 4.73      | 7.4%   | 0.12           | 0.39             | 7.12      | 7.0%   | 0.09           | 0.36             | 0.18      | 2.0%   | 0.13                                       | 0.39             | 8.0%                         |
| 8                        | 20.47           | 0.59           | 0.70             | 0.20      | 80.0%  | 0.90           | 0.96             | 0.00      | 100.0% | 0.12                              | 0.39             | 5.66      | 7.4%   | 0.12           | 0.39             | 14.48     | 7.0%   | 0.09           | 0.36             | 0.13      | 2.0%   | 0.12                                       | 0.39             | 7.8%                         |
| 9                        | 0.37            | 0.59           | 0.70             | 0.03      | 80.0%  | 0.90           | 0.96             | 0.20      | 100.0% | 0.12                              | 0.39             | 0.00      | 7.4%   | 0.12           | 0.39             | 0.00      | 7.0%   | 0.09           | 0.36             | 0.14      | 2.0%   | 0.57                                       | 0.71             | 61.3%                        |
| 10                       | 2.40            | 0.59           | 0.70             | 0.05      | 80.0%  | 0.90           | 0.96             | 0.37      | 100.0% | 0.12                              | 0.39             | 0.00      | 7.4%   | 0.12           | 0.39             | 0.00      | 7.0%   | 0.09           | 0.36             | 1.98      | 2.0%   | 0.23                                       | 0.46             | 18.7%                        |
| 11                       | 17.97           | 0.59           | 0.70             | 0.00      | 80.0%  | 0.90           | 0.96             | 0.00      | 100.0% | 0.12                              | 0.39             | 13.52     | 7.4%   | 0.12           | 0.39             | 3.99      | 7.0%   | 0.09           | 0.36             | 0.46      | 2.0%   | 0.12                                       | 0.39             | 7.2%                         |
| 12                       | 1.29            | 0.59           | 0.70             | 0.06      | 80.0%  | 0.90           | 0.96             | 0.52      | 100.0% | 0.12                              | 0.39             | 0.00      | 7.4%   | 0.12           | 0.39             | 0.00      | 7.0%   | 0.09           | 0.36             | 0.71      | 2.0%   | 0.44                                       | 0.62             | 45.1%                        |
| 13                       | 1.63            | 0.59           | 0.70             | 0.43      | 80.0%  | 0.90           | 0.96             | 0.30      | 100.0% | 0.12                              | 0.39             | 0.00      | 7.4%   | 0.12           | 0.39             | 0.00      | 7.0%   | 0.09           | 0.36             | 0.90      | 2.0%   | 0.37                                       | 0.56             | 40.6%                        |
| 14                       | 0.96            | 0.59           | 0.70             | 0.02      | 80.0%  | 0.90           | 0.96             | 0.14      | 100.0% | 0.12                              | 0.39             | 0.00      | 7.4%   | 0.12           | 0.39             | 0.00      | 7.0%   | 0.09           | 0.36             | 0.80      | 2.0%   | 0.22                                       | 0.45             | 17.9%                        |
| 15                       | 10.29           | 0.59           | 0.70             | 0.03      | 80.0%  | 0.90           | 0.96             | 0.21      | 100.0% | 0.12                              | 0.39             | 6.92      | 7.4%   | 0.12           | 0.39             | 2.23      | 7.0%   | 0.09           | 0.36             | 0.90      | 2.0%   | 0.13                                       | 0.40             | 8.9%                         |
| Pond (Basins 4, 9 11-13) | 23.82           |                |                  |           |        |                |                  |           |        |                                   |                  |           |        |                |                  |           |        |                |                  |           |        |                                            |                  | 29.2%                        |
| Total                    | 160.45          |                |                  |           |        |                |                  |           |        |                                   |                  |           |        |                |                  |           |        |                |                  |           |        |                                            |                  | 10.7%                        |

# **STANDARD FORM SF-2 - EXISTING CONDITIONS** **TIME OF CONCENTRATION**

**Subdivision:** Needles Sub.  
**Location:** El Paso County

**Project Name:** Needles Sub.  
**Project No.:** 26001.00  
**Calculated By:** NQJ  
**Checked By:** REB  
**Date:** 8/26/26

| SUB-BASIN |           |                        |                         |                           |                | INITIAL/OVERLAND  |                    |                      | TRAVEL TIME         |                    |      |             |                      | t <sub>c</sub> CHECK       |                   |                                | FINAL |
|-----------|-----------|------------------------|-------------------------|---------------------------|----------------|-------------------|--------------------|----------------------|---------------------|--------------------|------|-------------|----------------------|----------------------------|-------------------|--------------------------------|-------|
| DATA      |           |                        |                         |                           |                | (T <sub>i</sub> ) |                    |                      | (T <sub>t</sub> )   |                    |      |             |                      | (URBANIZED BASINS)         |                   |                                |       |
| BASIN ID  | D.A. (ac) | Hydrologic Soils Group | Weighted C <sub>5</sub> | Weighted C <sub>100</sub> | Impervious (%) | L (ft)            | S <sub>o</sub> (%) | t <sub>i</sub> (min) | L <sub>t</sub> (ft) | S <sub>t</sub> (%) | K    | VEL. (ft/s) | t <sub>t</sub> (min) | COMP. t <sub>c</sub> (min) | TOTAL LENGTH (ft) | Urbanized t <sub>c</sub> (min) |       |
| EX4       | 3.15      | A                      | 0.15                    | 0.41                      | 11.4%          | 250               | 7.2%               | 14.2                 | 134                 | 2.2%               | 7.0  | 1.0         | 2.2                  | 16.3                       | 384.0             | 25.5                           | 16.3  |
| EX5       | 3.21      | A                      | 0.14                    | 0.40                      | 10.4%          | 300               | 8.0%               | 15.1                 | 227                 | 4.5%               | 7.0  | 1.5         | 2.5                  | 17.6                       | 527.0             | 25.9                           | 17.6  |
| 1         | 4.85      | A                      | 0.16                    | 0.41                      | 12.9%          | 300               | 1.0%               | 29.5                 | 850                 | 1.7%               | 15.0 | 2.0         | 7.2                  | 36.7                       | 1150.0            | 33.9                           | 33.9  |
| 2         | 1.10      | A                      | 0.30                    | 0.52                      | 28.7%          | 26                | 10.9%              | 3.3                  | 460                 | 4.3%               | 15.0 | 3.1         | 2.5                  | 5.8                        | 486.0             | 24.0                           | 5.8   |
| 3         | 29.67     | A                      | 0.13                    | 0.39                      | 7.8%           | 300               | 6.6%               | 16.4                 | 2420                | 2.0%               | 7.0  | 1.0         | 40.7                 | 57.1                       | 2720.0            | 52.9                           | 52.9  |
| 4         | 2.56      | A                      | 0.60                    | 0.73                      | 64.8%          | 26                | 10.9%              | 2.1                  | 2258                | 2.9%               | 15.0 | 2.6         | 14.7                 | 16.8                       | 2284.0            | 27.2                           | 16.8  |
| 5         | 2.83      | A                      | 0.20                    | 0.44                      | 16.1%          | 60                | 6.7%               | 6.7                  | 1100                | 2.1%               | 7.0  | 1.0         | 18.1                 | 24.8                       | 1160.0            | 34.5                           | 24.8  |
| 5.1       | 0.94      | A                      | 0.21                    | 0.45                      | 17.2%          | 60                | 3.6%               | 8.1                  | 650                 | 1.5%               | 7.0  | 0.9         | 12.6                 | 20.8                       | 710.0             | 30.8                           | 20.8  |
| 5.2       | 0.88      | A                      | 0.19                    | 0.43                      | 14.0%          | 60                | 0.6%               | 15.1                 | 252                 | 2.2%               | 7.0  | 1.0         | 4.0                  | 19.1                       | 312.0             | 26.2                           | 19.1  |
| 6         | 36.64     | A                      | 0.14                    | 0.40                      | 9.4%           | 300               | 6.0%               | 16.7                 | 2405                | 2.8%               | 7.0  | 1.2         | 34.2                 | 50.9                       | 2705.0            | 47.6                           | 47.6  |
| 7         | 7.05      | A                      | 0.13                    | 0.39                      | 8.1%           | 300               | 9.3%               | 14.6                 | 716                 | 4.7%               | 7.0  | 1.5         | 7.9                  | 22.5                       | 1016.0            | 30.1                           | 22.5  |
| 7.1       | 12.19     | A                      | 0.13                    | 0.39                      | 8.0%           | 300               | 8.5%               | 15.0                 | 1478                | 3.6%               | 7.0  | 1.3         | 18.5                 | 33.6                       | 1778.0            | 37.5                           | 33.6  |
| 8         | 20.47     | A                      | 0.12                    | 0.39                      | 7.8%           | 300               | 6.7%               | 16.3                 | 1185                | 2.7%               | 7.0  | 1.2         | 17.2                 | 33.5                       | 1485.0            | 36.6                           | 33.5  |
| 9         | 0.37      | A                      | 0.57                    | 0.71                      | 61.3%          | 26                | 10.9%              | 2.2                  | 325                 | 1.8%               | 15.0 | 2.0         | 2.7                  | 4.9                        | 351.0             | 17.9                           | 5.0   |
| 10        | 2.40      | A                      | 0.23                    | 0.46                      | 18.7%          | 60                | 2.0%               | 9.7                  | 635                 | 1.2%               | 7.0  | 0.8         | 13.8                 | 23.5                       | 695.0             | 31.1                           | 23.5  |
| 11        | 17.97     | A                      | 0.12                    | 0.39                      | 7.2%           | 300               | 9.3%               | 14.7                 | 1175                | 2.3%               | 7.0  | 1.1         | 18.4                 | 33.1                       | 1475.0            | 37.7                           | 33.1  |
| 12        | 1.29      | A                      | 0.44                    | 0.62                      | 45.1%          | 290               | 7.6%               | 10.4                 | 740                 | 5.4%               | 15.0 | 3.5         | 3.5                  | 13.9                       | 1030.0            | 21.8                           | 13.9  |
| 13        | 1.63      | A                      | 0.37                    | 0.56                      | 40.6%          | 65                | 2.0%               | 8.4                  | 210                 | 15.0%              | 15.0 | 5.8         | 0.6                  | 9.0                        | 275.0             | 19.7                           | 9.0   |
| 14        | 0.96      | A                      | 0.22                    | 0.45                      | 17.9%          | 55                | 2.0%               | 9.4                  | 475                 | 0.5%               | 7.0  | 0.5         | 16.0                 | 25.4                       | 530.0             | 32.7                           | 25.4  |
| 15        | 10.29     | A                      | 0.13                    | 0.40                      | 8.9%           | 300               | 8.0%               | 15.2                 | 1584                | 2.5%               | 7.0  | 1.1         | 23.9                 | 39.1                       | 1884.0            | 40.8                           | 39.1  |

## STANDARD FORM SF-2 - EXISTING CONDITIONS

### TIME OF CONCENTRATION

**Subdivision:** Needles Sub.  
**Location:** El Paso County

**Project Name:** Needles Sub.  
**Project No.:** 26001.00  
**Calculated By:** NQJ  
**Checked By:** REB  
**Date:** 8/26/26

| SUB-BASIN   |              |                           |                            |                              |                   | INITIAL/OVERLAND  |                       |                         | TRAVEL TIME            |                       |   |                |                         | t <sub>c</sub> CHECK          |                      |                                   | FINAL |
|-------------|--------------|---------------------------|----------------------------|------------------------------|-------------------|-------------------|-----------------------|-------------------------|------------------------|-----------------------|---|----------------|-------------------------|-------------------------------|----------------------|-----------------------------------|-------|
| DATA        |              |                           |                            |                              |                   | (T <sub>i</sub> ) |                       |                         | (T <sub>t</sub> )      |                       |   |                |                         | (URBANIZED BASINS)            |                      |                                   |       |
| BASIN<br>ID | D.A.<br>(ac) | Hydrologic<br>Soils Group | Weighted<br>C <sub>5</sub> | Weighted<br>C <sub>100</sub> | Impervious<br>(%) | L<br>(ft)         | S <sub>o</sub><br>(%) | t <sub>i</sub><br>(min) | L <sub>t</sub><br>(ft) | S <sub>t</sub><br>(%) | K | VEL.<br>(ft/s) | t <sub>t</sub><br>(min) | COMP. t <sub>c</sub><br>(min) | TOTAL<br>LENGTH (ft) | Urbanized t <sub>c</sub><br>(min) |       |

#### NOTES:

$$t_c = t_i + t_t$$

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

Where:

$t_c$  = computed time of concentration (minutes)

$t_i$  = overland (initial) flow time (minutes)

$t_t$  = channelized flow time (minutes).

Where:

$t_i$  = overland (initial) flow time (minutes)

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

$L_i$  = length of overland flow (ft)

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

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

$$\text{Equation 6-4 } 16 - 17i + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$

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).

∴

$t_c$  = 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

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

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.

## STANDARD FORM SF-3 - EXISTING CONDITIONS

## STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Project Name: Needles Sub.

Project No.: 26001.00

Calculated By: NOJ

Checked By: REB

Date: 8/26/26

Subdivision: Needles Sub.

Location: El Paso County

Design Storm: 5-Year

| DESCRIPTION | Design Point | DIRECT RUNOFF |           |               |             |             |             |           | TOTAL RUNOFF |             |             |           | OVERLAND             |             |           | PIPE             |             |           |                    | TRAVEL TIME |                |             | REMARKS                                                                                |
|-------------|--------------|---------------|-----------|---------------|-------------|-------------|-------------|-----------|--------------|-------------|-------------|-----------|----------------------|-------------|-----------|------------------|-------------|-----------|--------------------|-------------|----------------|-------------|----------------------------------------------------------------------------------------|
|             |              | Basin ID      | Area (Ac) | Runoff Coeff. | $t_c$ (min) | $C^*A$ (Ac) | $I$ (in/hr) | $Q$ (cfs) | $t_c$ (min)  | $C^*A$ (ac) | $I$ (in/hr) | $Q$ (cfs) | $Q_{overland}$ (cfs) | $C^*A$ (ac) | Slope (%) | $Q_{pipe}$ (cfs) | $C^*A$ (ac) | Slope (%) | Pipe Size (inches) | Length (ft) | Velocity (fps) | $t_t$ (min) |                                                                                        |
|             | A            | 1             | 4.85      | 0.16          | 33.9        | 0.77        | 2.30        | 1.8       |              |             |             |           | 1.8                  | 0.77        | 8.2       |                  |             |           |                    | 171         | 2.0            | 1.4         | BASIN 1 FLOW @ DPA, 18" CULVERT UNDER PRIVATE ROAD TO DPB                              |
|             |              | 2             | 1.10      | 0.30          | 5.8         | 0.33        | 4.95        | 1.7       |              |             |             |           |                      |             |           |                  |             |           |                    |             |                |             | BASIN 2 FLOW, SWALE TO DPB                                                             |
|             | B            |               |           |               |             |             |             |           | 35.3         | 1.10        | 2.24        | 2.5       |                      |             |           |                  |             |           |                    |             |                |             | COMBINED DPA & BASIN 2 @ DPB, EX 84" CULVERT UNDER HIGHWAY 83 (FOLLOWS HISTORIC)       |
|             | C            | 3             | 29.67     | 0.13          | 52.9        | 3.71        | 1.63        | 6.1       |              |             |             |           | 6.1                  | 3.71        | 2         |                  |             |           |                    | 150         | 1.0            | 2.5         | BASIN 3 SWALE FLOW TO DPC, 30" CULVERT UNDER PRIVATE ROAD TO DPE                       |
|             | D            | 4             | 2.56      | 0.60          | 16.8        | 1.52        | 3.35        | 5.1       |              |             |             |           | 5.1                  | 1.52        | 0.8       |                  |             |           |                    | 310         | 0.6            | 8.3         | BASIN 4 SWALE FLOW TO DPD, CONTINUES TOWARDS DPN                                       |
|             |              | 5             | 2.83      | 0.20          | 24.8        | 0.58        | 2.77        | 1.6       |              |             |             |           | 1.6                  | 0.58        | 2.7       |                  |             |           |                    | 630         | 1.2            | 9.1         | BASIN 5 HIGHWAY 83 SWALE FLOW TO DPE                                                   |
|             |              | 5.1           | 0.94      | 0.21          | 20.8        | 0.20        | 3.03        | 0.6       |              |             |             |           |                      |             |           |                  |             |           |                    |             |                |             | BASIN 5.1 HIGHWAY 83 SWALE TO DPG                                                      |
|             |              | 5.2           | 0.88      | 0.19          | 19.1        | 0.17        | 3.15        | 0.5       |              |             |             |           |                      |             |           |                  |             |           |                    |             |                |             | BASIN 5.2 HIGHWAY 83 SWALE TO DPI                                                      |
|             | E            |               |           |               |             |             |             |           | 55.4         | 4.29        | 1.56        | 6.7       |                      |             |           |                  |             |           |                    |             |                |             | COMBINED DPC & BASIN 5 @ DPE, EX 24" CMP CULVERT UNDER HIGHWAY 83 (FOLLOWS HISTORIC)   |
|             | F            | 6             | 36.64     | 0.14          | 47.6        | 4.95        | 1.79        | 8.9       |              |             |             |           | 8.9                  | 4.95        | 2         |                  |             |           |                    | 205         | 1.0            | 3.5         | BASIN 6 SWALE FLOW TO DPF, PR DUAL 24" CULVERT UNDER PRIVATE ROAD TO DPG               |
|             | G            |               |           |               |             |             |             |           | 51.1         | 5.15        | 1.68        | 8.7       |                      |             |           |                  |             |           |                    |             |                |             | COMBINED DPF & BASIN 5.1 @ DPG, EX 24" CMP CULVERT UNDER HIGHWAY 83 (FOLLOWS HISTORIC) |
|             | H            | 7             | 7.05      | 0.13          | 22.5        | 0.89        | 2.92        | 2.6       |              |             |             |           | 2.6                  | 0.89        | 2         |                  |             |           |                    | 148         | 1.0            | 2.5         | BASIN 7 SWALE FLOW TO DPH, PR 24" CULVERT UNDER PRIVATE ROAD TO DPI                    |
|             | I            |               |           |               |             |             |             |           | 24.9         | 1.06        | 2.76        | 2.9       |                      |             |           |                  |             |           |                    |             |                |             | COMBINED DPH & BASIN 5.2 @ DPI, EX 24" CMP CULVERT UNDER HIGHWAY 83 (FOLLOWS HISTORIC) |
|             | J            | EX4           | 3.15      | 0.15          | 16.3        | 0.47        | 3.40        | 1.6       |              |             |             |           | 1.6                  | 0.47        | 3.8       |                  |             |           |                    | 1050        | 1.4            | 12.8        | BASIN EX4 @ DPJ, OVERLAND/SWALE FLOW TO DPL                                            |
|             | K            | EX5           | 3.21      | 0.14          | 17.6        | 0.46        | 3.28        | 1.5       |              |             |             |           | 1.5                  | 0.46        | 3.9       |                  |             |           |                    | 1500        | 1.4            | 18.1        | BASIN EX5 @ DPK, OVERLAND/SWALE FLOW TO DPL                                            |
|             |              | 7.1           | 12.19     | 0.13          | 33.6        | 1.53        | 2.31        | 3.5       |              |             |             |           |                      |             |           |                  |             |           |                    |             |                |             | BASIN 7.1 SWALE FLOW TO DPL                                                            |
|             | L            |               |           |               |             |             |             |           | 35.7         | 2.46        | 2.22        | 5.5       | 5.5                  | 2.46        | 2         |                  |             |           |                    | 485         | 1.0            | 8.2         | COMBINED BASIN 7.1, DPJ & DPK, 30" CULVERT UNDER PRIVATE ROAD TO DPO                   |
|             | M            | 8             | 20.47     | 0.12          | 33.5        | 2.55        | 2.32        | 5.9       |              |             |             |           | 5.9                  | 2.55        | 2         |                  |             |           |                    | 130         | 1.0            | 2.2         | BASIN 8 FLOW @ DPM, 30" CULVERT UNDER PRIVATE ROAD TO DPO                              |
|             |              | 9             | 0.37      | 0.57          | 5.0         | 0.21        | 5.17        | 1.1       |              |             |             |           |                      |             |           |                  |             |           |                    |             |                |             | BASIN 9 FLOW @ DPK                                                                     |
|             | N            |               |           |               |             |             |             |           | 25.1         | 1.74        | 2.75        | 4.8       | 4.8                  | 1.74        | 0.5       |                  |             |           |                    | 280         | 0.5            | 9.4         | COMBINED DPD & BASIN 9 @ DPN, 18" CULVERT TO DPR/POND 1                                |

# STANDARD FORM SF-3 - EXISTING CONDITIONS

## STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Needles Sub.  
 Location: El Paso County  
 Design Storm: 5-Year

Project Name: Needles Sub.

Project No.: 26001.00

Calculated By: NOJ

Checked By: REB

Date: 8/26/26

| DESCRIPTION | Design Point | DIRECT RUNOFF |           |               |                      |          |           |         | TOTAL RUNOFF         |          |           |         | OVERLAND                    |          |           | PIPE                    |          |           |                    | TRAVEL TIME |                |                      | REMARKS                                                                            |
|-------------|--------------|---------------|-----------|---------------|----------------------|----------|-----------|---------|----------------------|----------|-----------|---------|-----------------------------|----------|-----------|-------------------------|----------|-----------|--------------------|-------------|----------------|----------------------|------------------------------------------------------------------------------------|
|             |              | Basin ID      | Area (Ac) | Runoff Coeff. | t <sub>c</sub> (min) | C*A (Ac) | I (in/hr) | Q (cfs) | t <sub>c</sub> (min) | C*A (ac) | I (in/hr) | Q (cfs) | Q <sub>overland</sub> (cfs) | C*A (ac) | Slope (%) | Q <sub>pipe</sub> (cfs) | C*A (ac) | Slope (%) | Pipe Size (inches) | Length (ft) | Velocity (fps) | t <sub>t</sub> (min) |                                                                                    |
|             |              | 10            | 2.40      | 0.23          | 23.5                 | 0.54     | 2.85      | 1.5     |                      |          |           |         |                             |          |           |                         |          |           |                    |             |                |                      | BASIN 10 FLOW @ DPO                                                                |
|             | O            |               |           |               |                      |          |           |         | 43.9                 | 5.54     | 1.91      | 10.6    | 10.6                        | 5.54     | 1         |                         |          |           |                    | 400         | 0.7            | 9.5                  | COMBINED DPL, DPM & BASIN 10 @ DPO, EX 24" CULVERT UNDER HWY 83 (FOLLOWS HISTORIC) |
|             | P            | 11            | 17.97     | 0.12          | 33.1                 | 2.14     | 2.33      | 5.0     |                      |          |           |         | 5.0                         | 2.14     | 10        |                         |          |           |                    | 120         | 2.2            | 0.9                  | BASIN 11 @ DPP, 24" CULVERT UNDER ROAD TO DPR/POND 1                               |
|             | Q            | 12            | 1.29      | 0.44          | 13.9                 | 0.57     | 3.63      | 2.1     |                      |          |           |         | 2.1                         | 0.57     | 25        |                         |          |           |                    | 80          | 3.5            | 0.4                  | BASIN 12 SWALE TO DPQ, CONTINUES TO DPR/POND 1                                     |
|             |              | 13            | 1.63      | 0.37          | 9.0                  | 0.60     | 4.28      | 2.6     |                      |          |           |         |                             |          |           |                         |          |           |                    |             |                |                      | BASIN 13 FLOW @ DPR                                                                |
|             | R            |               |           |               |                      |          |           |         | 34.5                 | 5.05     | 2.27      | 11.5    |                             |          |           |                         |          |           |                    |             |                |                      | COMBINED DPN, P, Q & BASIN 13 @ DPR/POND 1                                         |
|             |              | 14            | 0.96      | 0.22          | 25.4                 | 0.21     | 2.73      | 0.6     |                      |          |           |         |                             |          |           |                         |          |           |                    |             |                |                      | BASIN 14 FLOW @ DPP                                                                |
|             | S            |               |           |               |                      |          |           |         | 25.4                 | 0.21     | 2.73      | 0.9     | 0.9                         | 0.32     | 1         |                         |          |           |                    | 650         | 0.7            | 15.5                 | COMBINED BASIN 14 & POND 1 DISCHARGE @ DPS, HWY 83 SWALE TO DPT                    |
|             |              | 15            | 10.29     | 0.13          | 40.8                 | 1.39     | 2.02      | 2.8     |                      |          |           |         |                             |          |           |                         |          |           |                    |             |                |                      | BASIN 15 FLOW @ DPT                                                                |
|             | T            |               |           |               |                      |          |           |         | 40.9                 | 1.71     | 2.02      | 3.7     |                             |          |           |                         |          |           |                    |             |                |                      | COMBINED DPS & BASIN 15 @ DPT                                                      |
|             | U            |               |           |               |                      |          |           |         |                      |          |           | 35.1    |                             |          |           |                         |          |           |                    |             |                |                      | COMBINED DISCHARGE FROM BASIN AREA                                                 |

**STANDARD FORM SF-3 - EXISTING CONDITIONS**  
**STORM DRAINAGE SYSTEM DESIGN**  
(RATIONAL METHOD PROCEDURE)

Subdivision: Needles Sub.  
Location: El Paso County  
Design Storm: 100-Year

Project Name: Needles Sub.  
Project No.: 26001.00  
Calculated By: NQJ  
Checked By: REB  
Date: 8/26/26

| STREET | Design Point | DIRECT RUNOFF |           |               |             |          |           |         | TOTAL RUNOFF |          |           |         | OVERLAND             |          |           | PIPE             |          |           |                    | TRAVEL TIME |                |             | REMARKS                                                                                |
|--------|--------------|---------------|-----------|---------------|-------------|----------|-----------|---------|--------------|----------|-----------|---------|----------------------|----------|-----------|------------------|----------|-----------|--------------------|-------------|----------------|-------------|----------------------------------------------------------------------------------------|
|        |              | Basin ID      | Area (ac) | Runoff Coeff. | $t_c$ (min) | C*A (ac) | I (in/hr) | Q (cfs) | $t_c$ (min)  | C*A (ac) | I (in/hr) | Q (cfs) | $Q_{OVERLAND}$ (cfs) | C*A (ac) | Slope (%) | $Q_{PIPE}$ (cfs) | C*A (ac) | Slope (%) | Pipe Size (inches) | Length (ft) | Velocity (fps) | $t_t$ (min) |                                                                                        |
|        | A            | 1             | 4.85      | 0.41          | 33.9        | 2.01     | 3.86      | 7.7     |              |          |           |         | 7.7                  | 2.01     | 8.2       |                  |          |           |                    | 171         | 2.0            | 1.4         | BASIN 1 FLOW @ DPA, 18" CULVERT UNDER PRIVATE ROAD TO DPB                              |
|        |              | 2             | 1.10      | 0.52          | 5.8         | 0.57     | 8.31      | 4.7     |              |          |           |         |                      |          |           |                  |          |           |                    |             |                |             | BASIN 2 FLOW, SWALE TO DPB                                                             |
|        | B            |               |           |               |             |          |           |         | 35.3         | 2.58     | 3.75      | 9.7     |                      |          |           |                  |          |           |                    |             |                |             | COMBINED DPA & BASIN 2 @ DPB, EX 84" CULVERT UNDER HIGHWAY 83 (FOLLOWS HISTORIC)       |
|        | C            | 3             | 29.67     | 0.39          | 52.9        | 11.67    | 2.73      | 31.9    |              |          |           |         | 31.9                 | 11.67    | 2         |                  |          |           |                    | 150         | 1.0            | 2.5         | BASIN 3 SWALE FLOW TO DPC, 30" CULVERT UNDER PRIVATE ROAD TO DPE                       |
|        | D            | 4             | 2.56      | 0.73          | 16.8        | 1.87     | 5.62      | 10.5    |              |          |           |         | 10.5                 | 1.87     | 0.8       |                  |          |           |                    | 310         | 0.6            | 8.3         | BASIN 4 SWALE FLOW TO DPD, CONTINUES TOWARDS DPN                                       |
|        |              | 5             | 2.83      | 0.44          | 24.8        | 1.26     | 4.65      | 5.8     |              |          |           |         | 5.8                  | 1.26     | 2.7       |                  |          |           |                    | 630         | 1.2            | 9.1         | BASIN 5 HIGHWAY 83 SWALE FLOW TO DPE                                                   |
|        |              | 5.1           | 0.94      | 0.45          | 20.8        | 0.42     | 5.09      | 2.2     |              |          |           |         |                      |          |           |                  |          |           |                    |             |                |             | BASIN 5.1 HIGHWAY 83 SWALE TO DPG                                                      |
|        |              | 5.2           | 0.88      | 0.43          | 19.1        | 0.38     | 5.30      | 2.0     |              |          |           |         |                      |          |           |                  |          |           |                    |             |                |             | BASIN 5.2 HIGHWAY 83 SWALE TO DPI                                                      |
|        | E            |               |           |               |             |          |           |         | 55.4         | 12.92    | 2.62      | 33.8    |                      |          |           |                  |          |           |                    |             |                |             | COMBINED DPC & BASIN 5 @ DPE, EX 24" CMP CULVERT UNDER HIGHWAY 83 (FOLLOWS HISTORIC)   |
|        | F            | 6             | 36.64     | 0.40          | 47.6        | 14.66    | 3.00      | 43.9    |              |          |           |         | 43.9                 | 14.66    | 2         |                  |          |           |                    | 205         | 1.0            | 3.5         | BASIN 6 SWALE FLOW TO DPF, PR DUAL 24" CULVERT UNDER PRIVATE ROAD TO DPG               |
|        | G            |               |           |               |             |          |           |         | 51.1         | 15.08    | 2.82      | 42.6    |                      |          |           |                  |          |           |                    |             |                |             | COMBINED DPF & BASIN 5.1 @ DPG, EX 24" CMP CULVERT UNDER HIGHWAY 83 (FOLLOWS HISTORIC) |
|        | H            | 7             | 7.05      | 0.39          | 22.5        | 2.78     | 4.89      | 13.6    |              |          |           |         | 13.6                 | 2.78     | 2         |                  |          |           |                    | 148         | 1.0            | 2.5         | BASIN 7 SWALE FLOW TO DPH, PR 24" CULVERT UNDER PRIVATE ROAD TO DPI                    |
|        | I            |               |           |               |             |          |           |         | 24.9         | 3.16     | 4.63      | 14.6    |                      |          |           |                  |          |           |                    |             |                |             | COMBINED DPH & BASIN 5.2 @ DPI, EX 24" CMP CULVERT UNDER HIGHWAY 83 (FOLLOWS HISTORIC) |
|        | J            | EX4           | 3.15      | 0.41          | 16.3        | 1.29     | 5.70      | 7.3     |              |          |           |         | 7.3                  | 1.29     | 3.8       |                  |          |           |                    | 1050        | 1.4            | 12.8        | BASIN EX4 @ DPJ, OVERLAND/SWALE FLOW TO DPL                                            |
|        | K            | EX5           | 3.21      | 0.40          | 17.6        | 1.30     | 5.50      | 7.1     |              |          |           |         | 7.1                  | 1.30     | 3.9       |                  |          |           |                    | 1500        | 1.4            | 18.1        | BASIN EX5 @ DPK, OVERLAND/SWALE FLOW TO DPL                                            |
|        |              | 7.1           | 12.19     | 0.39          | 33.6        | 4.80     | 3.88      | 18.6    |              |          |           |         |                      |          |           |                  |          |           |                    |             |                |             | BASIN 7.1 SWALE FLOW TO DPL                                                            |
|        | L            |               |           |               |             |          |           |         | 35.7         | 7.38     | 3.72      | 27.5    | 27.5                 | 7.38     | 2         |                  |          |           |                    | 485         | 1.0            | 8.2         | COMBINED BASIN 7.1, DPJ & DPK, 30" CULVERT UNDER PRIVATE ROAD TO DPO                   |
|        | M            | 8             | 20.47     | 0.39          | 33.5        | 8.04     | 3.89      | 31.3    |              |          |           |         | 31.3                 | 8.04     | 2         |                  |          |           |                    | 130         | 1.0            | 2.2         | BASIN 8 FLOW @ DPM, 30" CULVERT UNDER PRIVATE ROAD TO DPO                              |
|        |              | 9             | 0.37      | 0.71          | 5.0         | 0.26     | 8.68      | 2.3     |              |          |           |         |                      |          |           |                  |          |           |                    |             |                |             | BASIN 9 FLOW @ DPK                                                                     |

**STANDARD FORM SF-3 - EXISTING CONDITIONS**  
**STORM DRAINAGE SYSTEM DESIGN**  
(RATIONAL METHOD PROCEDURE)

**Subdivision:** Needles Sub.  
**Location:** El Paso County  
**Design Storm:** 100-Year

**Project Name:** Needles Sub.  
**Project No.:** 26001.00  
**Calculated By:** NQJ  
**Checked By:** REB  
**Date:** 8/26/26

| STREET | Design Point | DIRECT RUNOFF |           |               |             |          |           |         | TOTAL RUNOFF |          |           |         | OVERLAND             |          |           | PIPE             |          |           |                    | TRAVEL TIME |                |             | REMARKS                                                                            |
|--------|--------------|---------------|-----------|---------------|-------------|----------|-----------|---------|--------------|----------|-----------|---------|----------------------|----------|-----------|------------------|----------|-----------|--------------------|-------------|----------------|-------------|------------------------------------------------------------------------------------|
|        |              | Basin ID      | Area (ac) | Runoff Coeff. | $t_c$ (min) | C*A (ac) | I (in/hr) | Q (cfs) | $t_c$ (min)  | C*A (ac) | I (in/hr) | Q (cfs) | $Q_{OVERLAND}$ (cfs) | C*A (ac) | Slope (%) | $Q_{PIPE}$ (cfs) | C*A (ac) | Slope (%) | Pipe Size (inches) | Length (ft) | Velocity (fps) | $t_t$ (min) |                                                                                    |
|        | N            |               |           |               |             |          |           |         | 25.1         | 2.14     | 4.61      | 9.9     | 9.9                  | 2.14     | 0.5       |                  |          |           |                    | 280         | 0.5            | 9.4         | COMBINED DPD & BASIN 9 @ DPN, 18" CULVERT TO DPR/POND 1                            |
|        |              | 10            | 2.40      | 0.46          | 23.5        | 1.10     | 4.78      | 5.3     |              |          |           |         |                      |          |           |                  |          |           |                    |             |                |             | BASIN 10 FLOW @ DPO                                                                |
|        | O            |               |           |               |             |          |           |         | 43.9         | 16.53    | 3.21      | 53.0    | 53.0                 | 16.53    | 1         |                  |          |           |                    | 400         | 0.7            | 9.5         | COMBINED DPL, DPM & BASIN 10 @ DPO, EX 24" CULVERT UNDER HWY 83 (FOLLOWS HISTORIC) |
|        | P            | 11            | 17.97     | 0.39          | 33.1        | 6.99     | 3.91      | 27.4    |              |          |           |         | 27.4                 | 6.99     | 10        |                  |          |           |                    | 120         | 2.2            | 0.9         | BASIN 11 @ DPP, 24" CULVERT UNDER ROAD TO DPR/POND 1                               |
|        | Q            | 12            | 1.29      | 0.62          | 13.9        | 0.80     | 6.10      | 4.9     |              |          |           |         | 4.9                  | 0.80     | 25        |                  |          |           |                    | 80          | 3.5            | 0.4         | BASIN 12 SWALE TO DPQ, CONTINUES TO DPR/POND 1                                     |
|        |              | 13            | 1.63      | 0.56          | 9.0         | 0.91     | 7.19      | 6.6     |              |          |           |         |                      |          |           |                  |          |           |                    |             |                |             | BASIN 13 FLOW @ DPR                                                                |
|        | R            |               |           |               |             |          |           |         | 34.5         | 10.84    | 3.81      | 41.3    |                      |          |           |                  |          |           |                    |             |                |             | COMBINED DPN, P, Q & BASIN 13 @ DPR/POND 1                                         |
|        |              | 14            | 0.96      | 0.45          | 25.4        | 0.44     | 4.59      | 2.0     |              |          |           |         |                      |          |           |                  |          |           |                    |             |                |             | BASIN 14 FLOW @ DPP                                                                |
|        | S            |               |           |               |             |          |           |         | 25.4         | 0.44     | 4.59      | 23.1    | 23.1                 | 5.05     | 1         |                  |          |           |                    | 650         | 0.7            | 15.5        | COMBINED BASIN 14 & POND 1 DISCHARGE @ DPS, HWY 83 SWALE TO DPT                    |
|        |              | 15            | 10.29     | 0.40          | 40.8        | 4.12     | 3.39      | 14.0    |              |          |           |         |                      |          |           |                  |          |           |                    |             |                |             | BASIN 15 FLOW @ DPT                                                                |
|        | T            |               |           |               |             |          |           |         | 40.9         | 9.16     | 3.39      | 31.0    |                      |          |           |                  |          |           |                    |             |                |             | COMBINED DPS & BASIN 15 @ DPT                                                      |
|        | U            |               |           |               |             |          |           |         |              |          |           | 184.7   |                      |          |           |                  |          |           |                    |             |                |             | COMBINED DISCHARGE FROM BASIN AREA                                                 |





## **APPENDIX C – HYDRAULIC CALCULATIONS**

# Culvert Report

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

Friday, Aug 28 2026

## DPA (Q100 = 7.7 cfs)

Invert Elev Dn (ft) = 7453.18  
Pipe Length (ft) = 61.53  
Slope (%) = 6.21  
Invert Elev Up (ft) = 7457.00  
Rise (in) = 18.0  
Shape = Circular  
Span (in) = 18.0  
No. Barrels = 1  
n-Value = 0.022  
Culvert Type = Circular Corrugate Metal Pipe  
Culvert Entrance = Projecting  
Coeff. K,M,c,Y,k = 0.034, 1.5, 0.0553, 0.54, 0.9

### Embankment

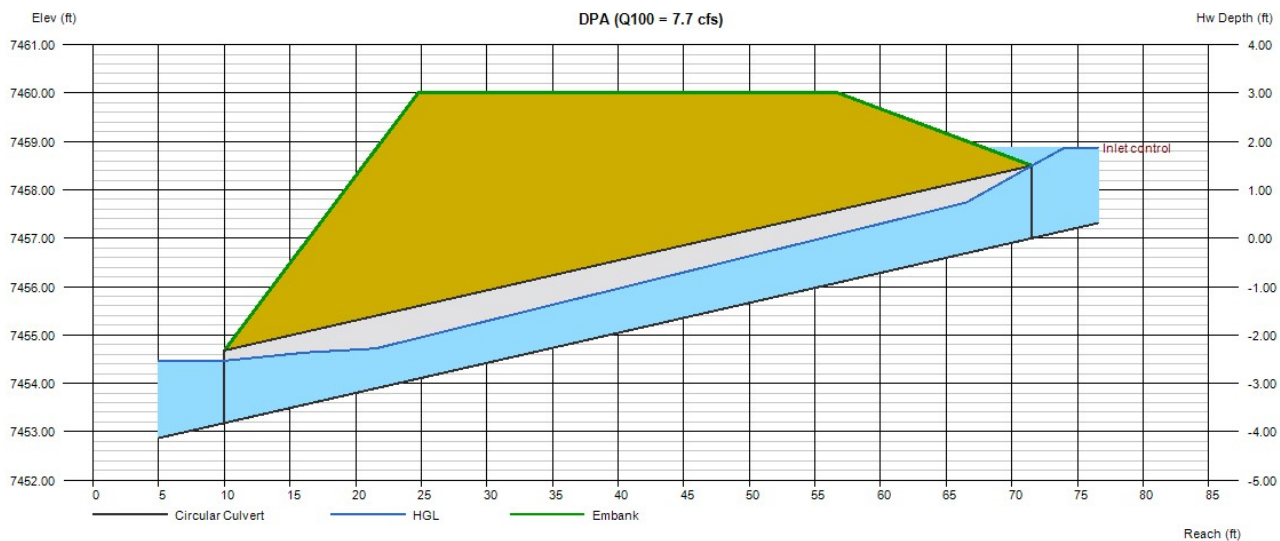
Top Elevation (ft) = 7460.00  
Top Width (ft) = 32.00  
Crest Width (ft) = 100.00

### Calculations

Qmin (cfs) = 7.70  
Qmax (cfs) = 7.70  
Tailwater Elev (ft) = (dc+D)/2

### Highlighted

Qtotal (cfs) = 7.70  
Qpipe (cfs) = 7.70  
Qovertop (cfs) = 0.00  
Veloc Dn (ft/s) = 4.77  
Veloc Up (ft/s) = 5.69  
HGL Dn (ft) = 7454.47  
HGL Up (ft) = 7458.07  
Hw Elev (ft) = 7458.87  
Hw/D (ft) = 1.25  
Flow Regime = Inlet Control



# Culvert Report

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

Friday, Aug 28 2026

**DPB (Q100 = Cherry Creek Crossing FDR Q100 (368 cfs) + Site Increase (1.4 cfs) = 369.4**

Invert Elev Dn (ft) = 7441.00  
Pipe Length (ft) = 158.00  
Slope (%) = 0.82  
Invert Elev Up (ft) = 7442.30  
Rise (in) = 84.0  
Shape = Circular  
Span (in) = 84.0  
No. Barrels = 1  
n-Value = 0.022  
Culvert Type = Circular Corrugate Metal Pipe  
Culvert Entrance = Projecting  
Coeff. K,M,c,Y,k = 0.034, 1.5, 0.0553, 0.54, 0.9

## Embankment

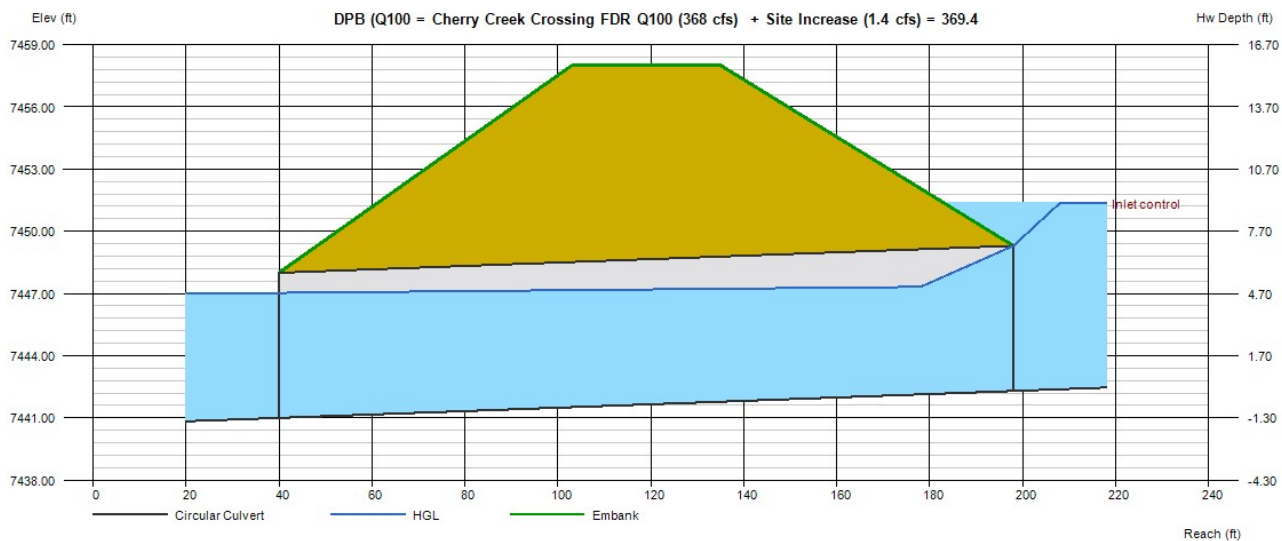
Top Elevation (ft) = 7458.00  
Top Width (ft) = 32.00  
Crest Width (ft) = 100.00

## Calculations

Qmin (cfs) = 369.40  
Qmax (cfs) = 369.40  
Tailwater Elev (ft) = (dc+D)/2

## Highlighted

Qtotal (cfs) = 369.40  
Qpipe (cfs) = 369.40  
Qovertop (cfs) = 0.00  
Veloc Dn (ft/s) = 10.48  
Veloc Up (ft/s) = 12.39  
HGL Dn (ft) = 7447.03  
HGL Up (ft) = 7447.36  
Hw Elev (ft) = 7451.37  
Hw/D (ft) = 1.30  
Flow Regime = Inlet Control



# Culvert Report

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

Friday, Aug 28 2026

## DPC (Q100 = 31.3 cfs)

Invert Elev Dn (ft) = 7430.66  
Pipe Length (ft) = 94.00  
Slope (%) = 1.50  
Invert Elev Up (ft) = 7432.07  
Rise (in) = 30.0  
Shape = Circular  
Span (in) = 30.0  
No. Barrels = 1  
n-Value = 0.022  
Culvert Type = Circular Corrugate Metal Pipe  
Culvert Entrance = Mitered to slope (C)  
Coeff. K,M,c,Y,k = 0.021, 1.33, 0.0463, 0.75, 0.7

### Embankment

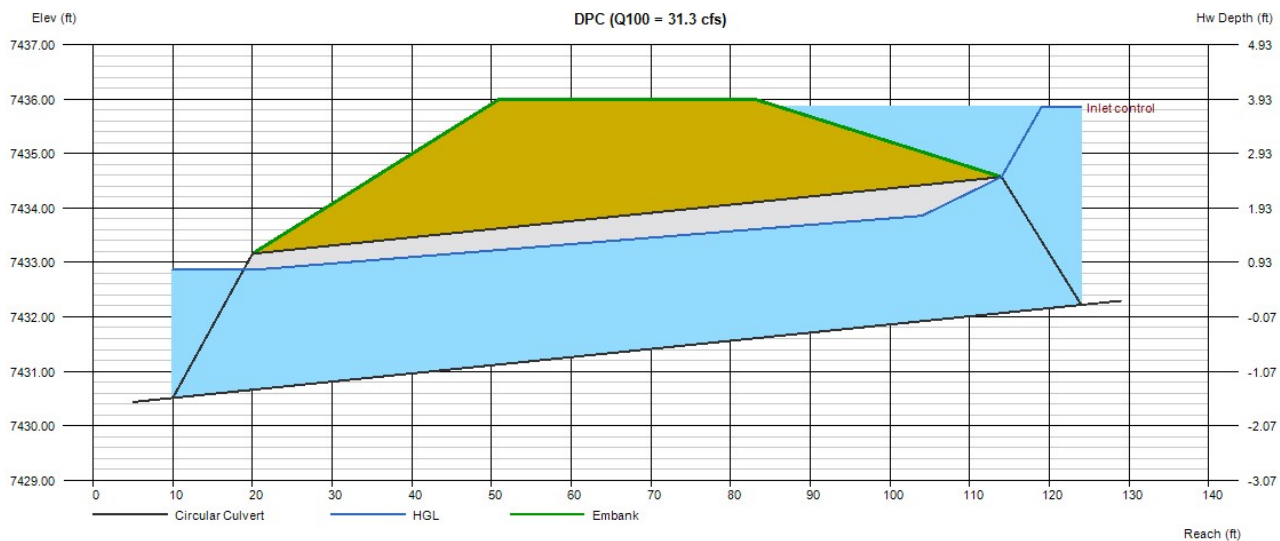
Top Elevation (ft) = 7436.00  
Top Width (ft) = 32.00  
Crest Width (ft) = 100.00

### Calculations

Qmin (cfs) = 31.30  
Qmax (cfs) = 31.30  
Tailwater Elev (ft) = (dc+D)/2

### Highlighted

Qtotal (cfs) = 31.30  
Qpipe (cfs) = 31.30  
Qovertop (cfs) = 0.00  
Veloc Dn (ft/s) = 6.84  
Veloc Up (ft/s) = 7.80  
HGL Dn (ft) = 7432.86  
HGL Up (ft) = 7433.98  
Hw Elev (ft) = 7435.85  
Hw/D (ft) = 1.51  
Flow Regime = Inlet Control



# Culvert Report

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

Friday, Aug 28 2026

## DPE (Q100 = 33.8 cfs)

Invert Elev Dn (ft) = 7425.00  
Pipe Length (ft) = 51.70  
Slope (%) = 4.84  
Invert Elev Up (ft) = 7427.50  
Rise (in) = 24.0  
Shape = Circular  
Span (in) = 24.0  
No. Barrels = 1  
n-Value = 0.022  
Culvert Type = Circular Corrugate Metal Pipe  
Culvert Entrance = Mitered to slope (C)  
Coeff. K,M,c,Y,k = 0.021, 1.33, 0.0463, 0.75, 0.7

### Embankment

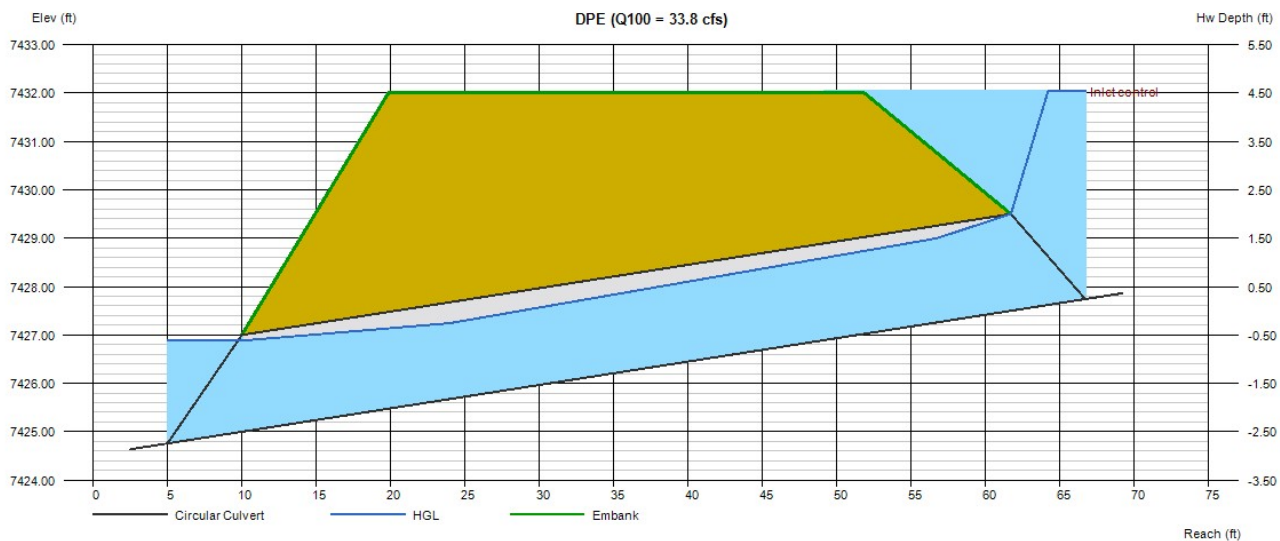
Top Elevation (ft) = 7432.00  
Top Width (ft) = 32.00  
Crest Width (ft) = 100.00

### Calculations

Qmin (cfs) = 33.80  
Qmax (cfs) = 33.80  
Tailwater Elev (ft) = (dc+D)/2

### Highlighted

Qtotal (cfs) = 33.80  
Qpipe (cfs) = 25.18  
Qovertop (cfs) = 8.62  
Veloc Dn (ft/s) = 8.21  
Veloc Up (ft/s) = 8.58  
HGL Dn (ft) = 7426.88  
HGL Up (ft) = 7429.27  
Hw Elev (ft) = 7432.04  
Hw/D (ft) = 2.27  
Flow Regime = Inlet Control



# Culvert Report

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

Friday, Aug 28 2026

## DPF (Q100 = 43.9 cfs)

Invert Elev Dn (ft) = 7427.00  
Pipe Length (ft) = 85.00  
Slope (%) = 2.00  
Invert Elev Up (ft) = 7428.70  
Rise (in) = 24.0  
Shape = Circular  
Span (in) = 24.0  
No. Barrels = 2  
n-Value = 0.012  
Culvert Type = Circular Concrete  
Culvert Entrance = Groove end w/headwall (C)  
Coeff. K,M,c,Y,k = 0.0018, 2, 0.0292, 0.74, 0.2

### Embankment

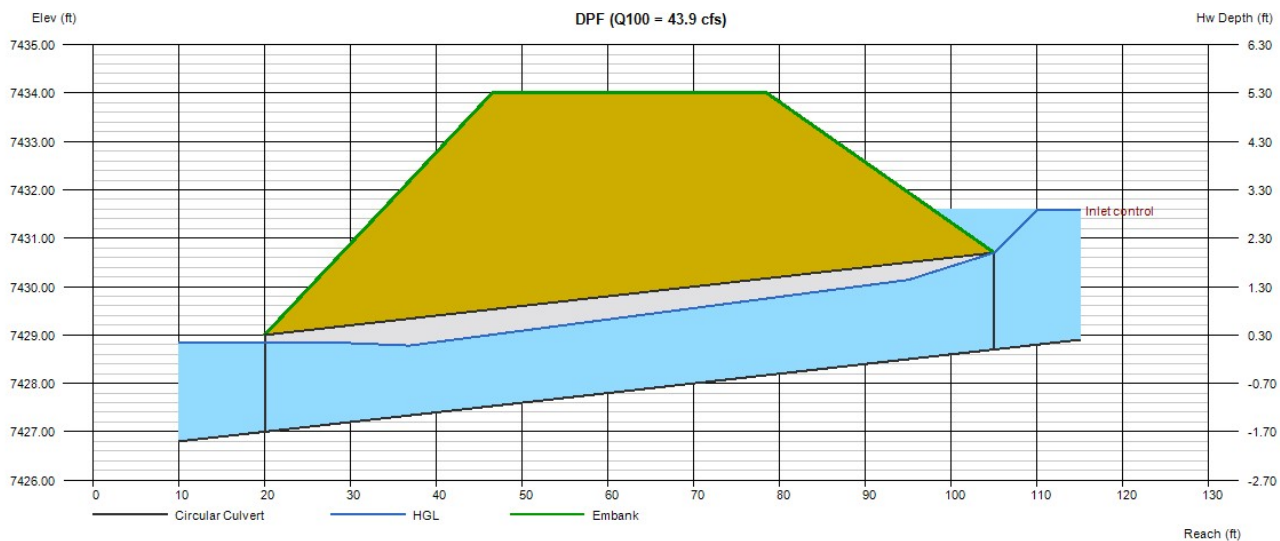
Top Elevation (ft) = 7434.00  
Top Width (ft) = 32.00  
Crest Width (ft) = 100.00

### Calculations

Qmin (cfs) = 43.90  
Qmax (cfs) = 43.90  
Tailwater Elev (ft) = (dc+D)/2

### Highlighted

Qtotal (cfs) = 43.90  
Qpipe (cfs) = 43.90  
Qovertop (cfs) = 0.00  
Veloc Dn (ft/s) = 7.27  
Veloc Up (ft/s) = 7.82  
HGL Dn (ft) = 7428.84  
HGL Up (ft) = 7430.37  
Hw Elev (ft) = 7431.59  
Hw/D (ft) = 1.44  
Flow Regime = Inlet Control



# Culvert Report

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

Friday, Aug 28 2026

## DPG (Q100 = 42.6 cfs)

Invert Elev Dn (ft) = 7421.00  
Pipe Length (ft) = 52.00  
Slope (%) = 5.65  
Invert Elev Up (ft) = 7423.94  
Rise (in) = 24.0  
Shape = Circular  
Span (in) = 24.0  
No. Barrels = 1  
n-Value = 0.022  
Culvert Type = Circular Corrugate Metal Pipe  
Culvert Entrance = Mitered to slope (C)  
Coeff. K,M,c,Y,k = 0.021, 1.33, 0.0463, 0.75, 0.7

### Embankment

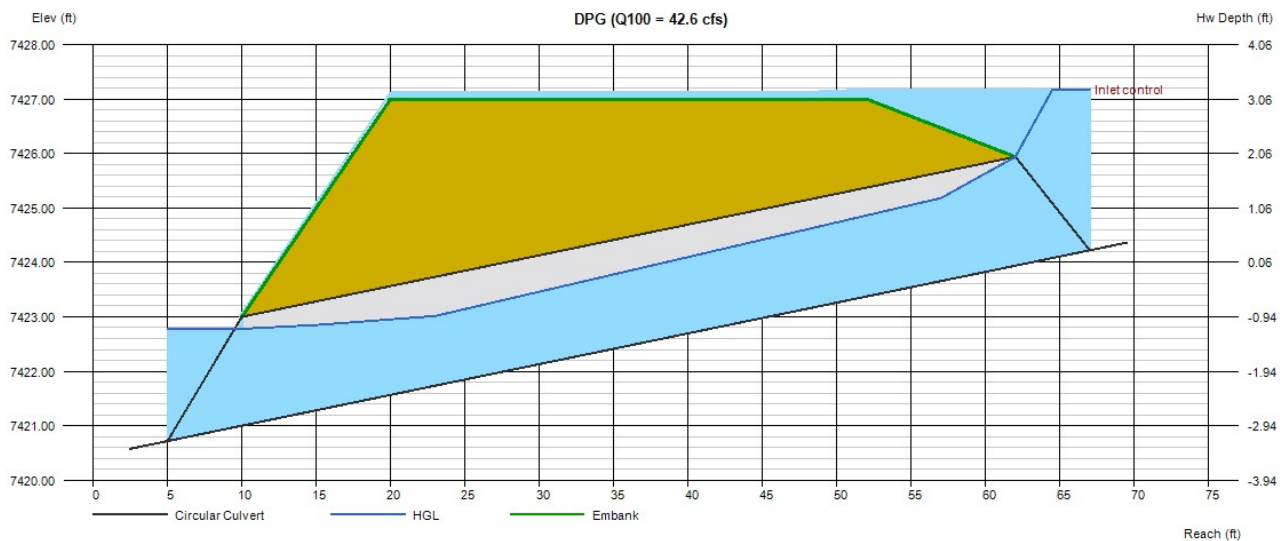
Top Elevation (ft) = 7427.00  
Top Width (ft) = 32.00  
Crest Width (ft) = 100.00

### Calculations

Qmin (cfs) = 42.60  
Qmax (cfs) = 42.60  
Tailwater Elev (ft) = (dc+D)/2

### Highlighted

Qtotal (cfs) = 42.60  
Qpipe (cfs) = 18.81  
Qovertop (cfs) = 23.79  
Veloc Dn (ft/s) = 6.37  
Veloc Up (ft/s) = 7.16  
HGL Dn (ft) = 7422.78  
HGL Up (ft) = 7425.50  
Hw Elev (ft) = 7427.18  
Hw/D (ft) = 1.62  
Flow Regime = Inlet Control





# Culvert Report

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

Friday, Aug 28 2026

## DPH (Q100 = 13.6 cfs)

Invert Elev Dn (ft) = 7424.00  
Pipe Length (ft) = 94.00  
Slope (%) = 2.00  
Invert Elev Up (ft) = 7425.88  
Rise (in) = 24.0  
Shape = Circular  
Span (in) = 24.0  
No. Barrels = 1  
n-Value = 0.022  
Culvert Type = Circular Corrugate Metal Pipe  
Culvert Entrance = Mitered to slope (C)  
Coeff. K,M,c,Y,k = 0.021, 1.33, 0.0463, 0.75, 0.7

### Embankment

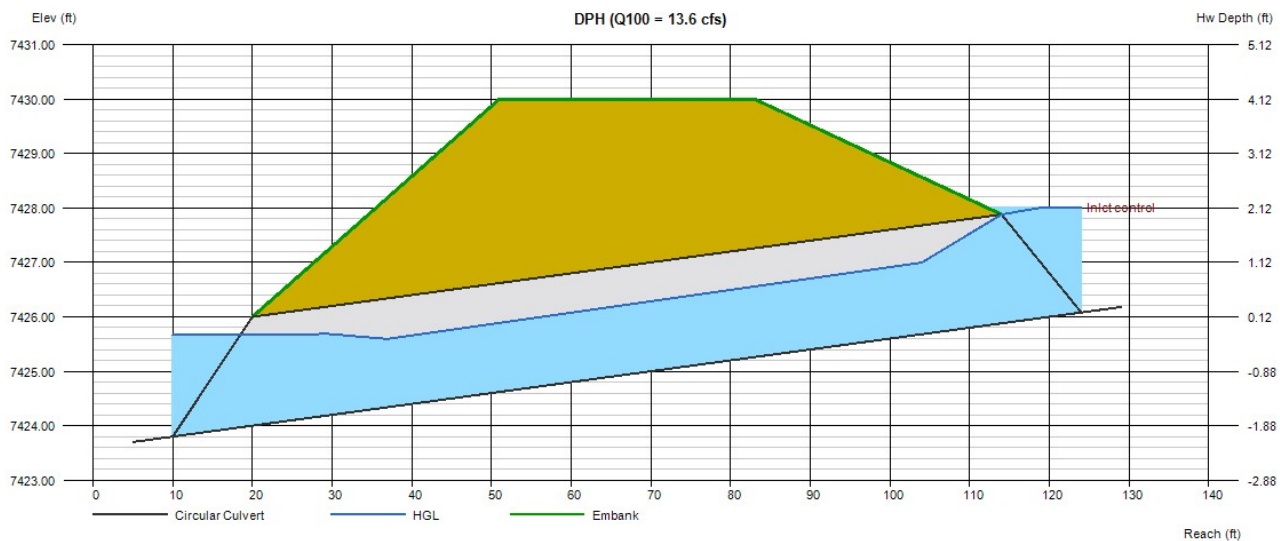
Top Elevation (ft) = 7430.00  
Top Width (ft) = 32.00  
Crest Width (ft) = 100.00

### Calculations

Qmin (cfs) = 13.60  
Qmax (cfs) = 13.60  
Tailwater Elev (ft) = (dc+D)/2

### Highlighted

Qtotal (cfs) = 13.60  
Qpipe (cfs) = 13.60  
Qovertop (cfs) = 0.00  
Veloc Dn (ft/s) = 4.87  
Veloc Up (ft/s) = 6.15  
HGL Dn (ft) = 7425.66  
HGL Up (ft) = 7427.21  
Hw Elev (ft) = 7428.01  
Hw/D (ft) = 1.06  
Flow Regime = Inlet Control



# Culvert Report

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

Friday, Aug 28 2026

## DPI (Q100 = 14.6 cfs)

Invert Elev Dn (ft) = 7413.96  
Pipe Length (ft) = 65.00  
Slope (%) = 6.22  
Invert Elev Up (ft) = 7418.00  
Rise (in) = 24.0  
Shape = Circular  
Span (in) = 24.0  
No. Barrels = 1  
n-Value = 0.022  
Culvert Type = Circular Corrugate Metal Pipe  
Culvert Entrance = Mitered to slope (C)  
Coeff. K,M,c,Y,k = 0.021, 1.33, 0.0463, 0.75, 0.7

### Embankment

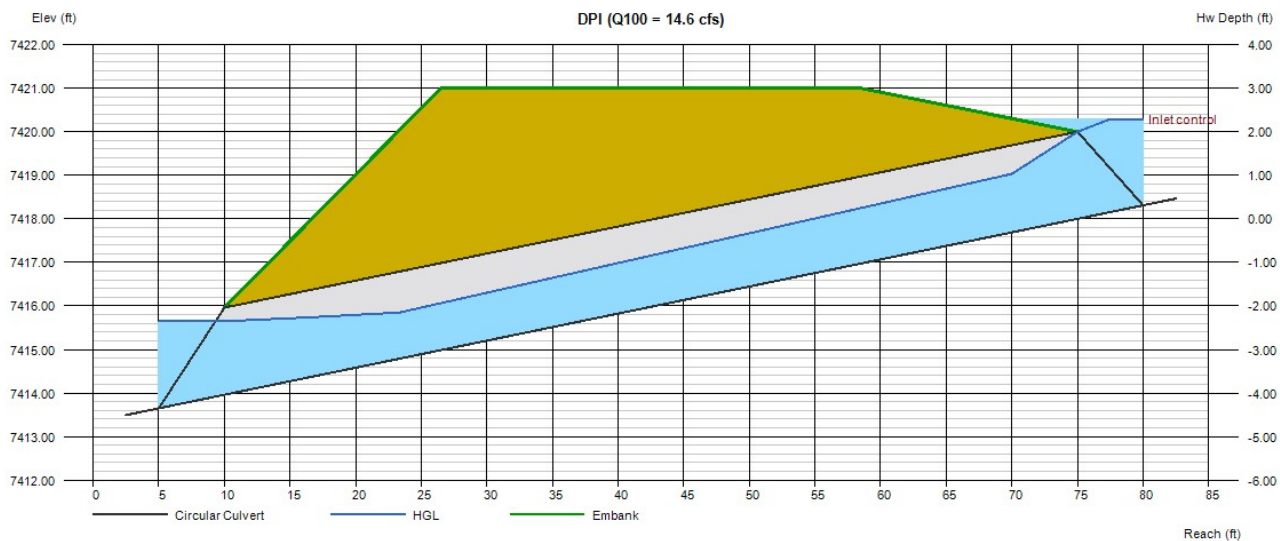
Top Elevation (ft) = 7421.00  
Top Width (ft) = 32.00  
Crest Width (ft) = 100.00

### Calculations

Qmin (cfs) = 14.60  
Qmax (cfs) = 14.60  
Tailwater Elev (ft) = (dc+D)/2

### Highlighted

Qtotal (cfs) = 14.60  
Qpipe (cfs) = 14.60  
Qovertop (cfs) = 0.00  
Veloc Dn (ft/s) = 5.16  
Veloc Up (ft/s) = 6.34  
HGL Dn (ft) = 7415.65  
HGL Up (ft) = 7419.38  
Hw Elev (ft) = 7420.29  
Hw/D (ft) = 1.15  
Flow Regime = Inlet Control



# Culvert Report

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

Friday, Aug 28 2026

## DPL (Q100 = 27.5 cfs)

|                     |                                  |
|---------------------|----------------------------------|
| Invert Elev Dn (ft) | = 7424.00                        |
| Pipe Length (ft)    | = 94.00                          |
| Slope (%)           | = 2.00                           |
| Invert Elev Up (ft) | = 7425.88                        |
| Rise (in)           | = 30.0                           |
| Shape               | = Circular                       |
| Span (in)           | = 30.0                           |
| No. Barrels         | = 1                              |
| n-Value             | = 0.022                          |
| Culvert Type        | = Circular Corrugate Metal Pipe  |
| Culvert Entrance    | = Mitered to slope (C)           |
| Coeff. K,M,c,Y,k    | = 0.021, 1.33, 0.0463, 0.75, 0.7 |

### Embankment

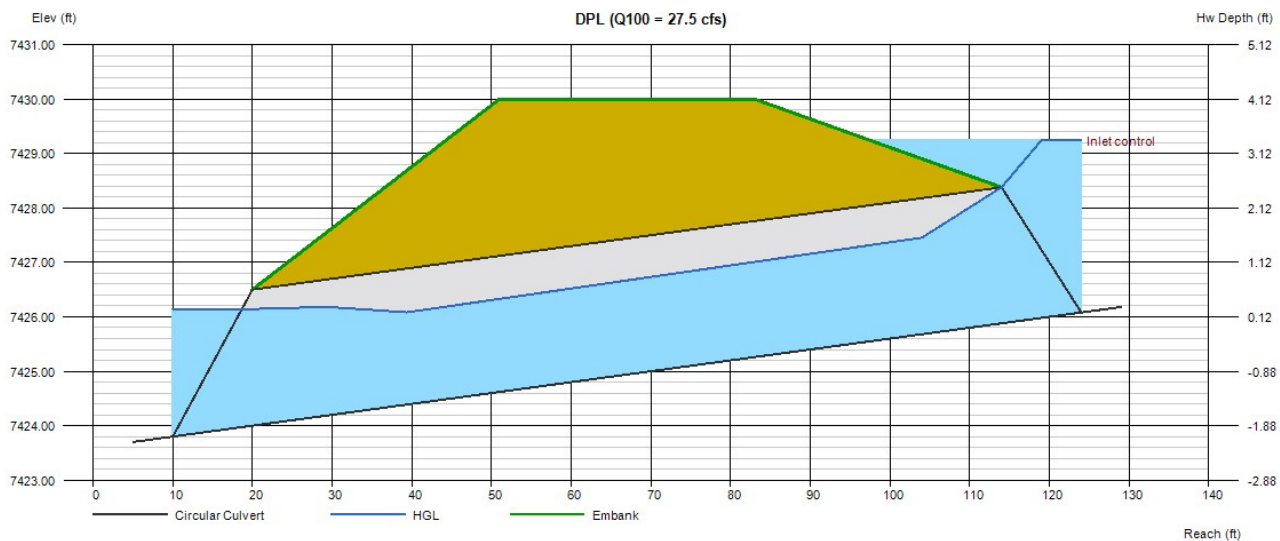
|                    |           |
|--------------------|-----------|
| Top Elevation (ft) | = 7430.00 |
| Top Width (ft)     | = 32.00   |
| Crest Width (ft)   | = 100.00  |

### Calculations

|                     |            |
|---------------------|------------|
| Qmin (cfs)          | = 27.50    |
| Qmax (cfs)          | = 27.50    |
| Tailwater Elev (ft) | = (dc+D)/2 |

### Highlighted

|                 |                 |
|-----------------|-----------------|
| Qtotal (cfs)    | = 27.50         |
| Qpipe (cfs)     | = 27.50         |
| Qovertop (cfs)  | = 0.00          |
| Veloc Dn (ft/s) | = 6.14          |
| Veloc Up (ft/s) | = 7.33          |
| HGL Dn (ft)     | = 7426.14       |
| HGL Up (ft)     | = 7427.67       |
| Hw Elev (ft)    | = 7429.24       |
| Hw/D (ft)       | = 1.35          |
| Flow Regime     | = Inlet Control |



# Culvert Report

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

Friday, Aug 28 2026

## DPM (Q100 = 31.3 cfs)

Invert Elev Dn (ft) = 7393.86  
Pipe Length (ft) = 115.77  
Slope (%) = 3.14  
Invert Elev Up (ft) = 7397.50  
Rise (in) = 30.0  
Shape = Circular  
Span (in) = 30.0  
No. Barrels = 1  
n-Value = 0.022  
Culvert Type = Circular Corrugate Metal Pipe  
Culvert Entrance = Mitered to slope (C)  
Coeff. K,M,c,Y,k = 0.021, 1.33, 0.0463, 0.75, 0.7

### Embankment

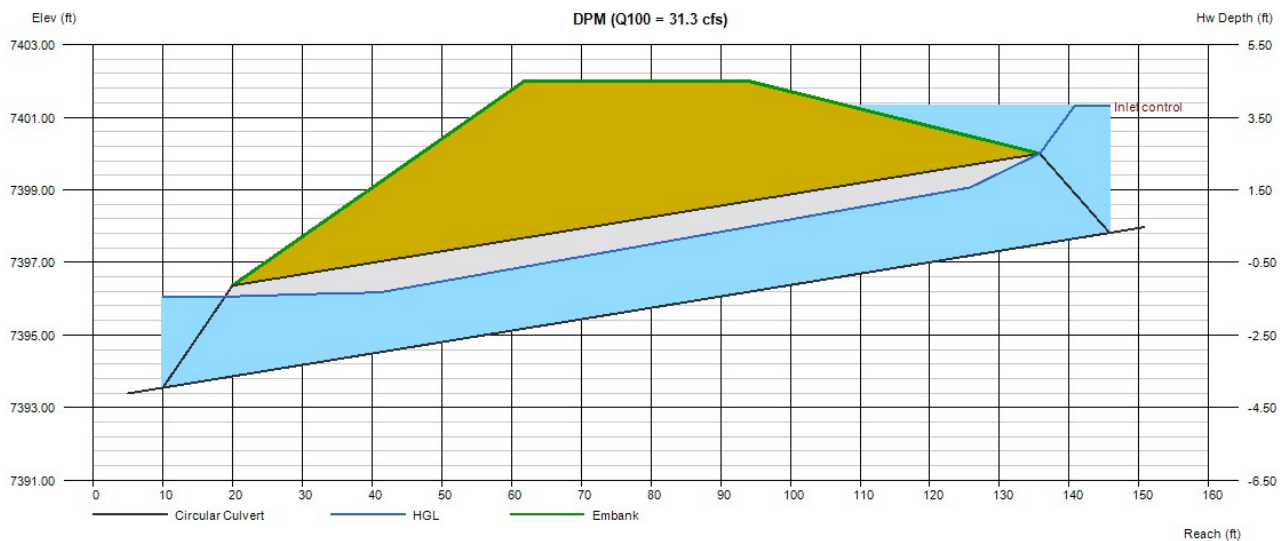
Top Elevation (ft) = 7402.00  
Top Width (ft) = 32.00  
Crest Width (ft) = 100.00

### Calculations

Qmin (cfs) = 31.30  
Qmax (cfs) = 31.30  
Tailwater Elev (ft) = (dc+D)/2

### Highlighted

Qtotal (cfs) = 31.30  
Qpipe (cfs) = 31.30  
Qovertop (cfs) = 0.00  
Veloc Dn (ft/s) = 6.84  
Veloc Up (ft/s) = 7.80  
HGL Dn (ft) = 7396.06  
HGL Up (ft) = 7399.41  
Hw Elev (ft) = 7401.31  
Hw/D (ft) = 1.53  
Flow Regime = Inlet Control



# Culvert Report

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

Friday, Aug 28 2026

## DPO (Q100 = 53.0 cfs)

Invert Elev Dn (ft) = 7389.93  
Pipe Length (ft) = 67.00  
Slope (%) = 3.09  
Invert Elev Up (ft) = 7392.00  
Rise (in) = 24.0  
Shape = Circular  
Span (in) = 24.0  
No. Barrels = 1  
n-Value = 0.022  
Culvert Type = Circular Corrugate Metal Pipe  
Culvert Entrance = Mitered to slope (C)  
Coeff. K,M,c,Y,k = 0.021, 1.33, 0.0463, 0.75, 0.7

### Embankment

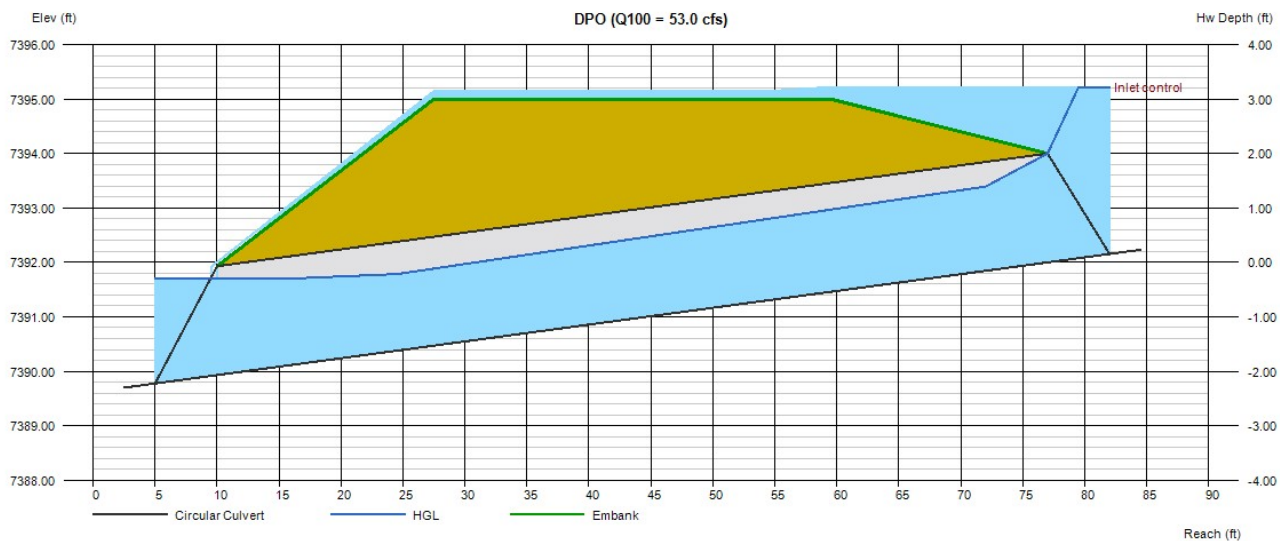
Top Elevation (ft) = 7395.00  
Top Width (ft) = 32.00  
Crest Width (ft) = 100.00

### Calculations

Qmin (cfs) = 53.00  
Qmax (cfs) = 53.00  
Tailwater Elev (ft) = (dc+D)/2

### Highlighted

Qtotal (cfs) = 53.00  
Qpipe (cfs) = 18.92  
Qovertop (cfs) = 34.08  
Veloc Dn (ft/s) = 6.40  
Veloc Up (ft/s) = 7.18  
HGL Dn (ft) = 7391.71  
HGL Up (ft) = 7393.56  
Hw Elev (ft) = 7395.22  
Hw/D (ft) = 1.61  
Flow Regime = Inlet Control



# Culvert Report

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

Friday, Aug 28 2026

## DPN (Q100 = 9.9 cfs)

Invert Elev Dn (ft) = 7396.00  
Pipe Length (ft) = 46.00  
Slope (%) = 3.00  
Invert Elev Up (ft) = 7397.38  
Rise (in) = 18.0  
Shape = Circular  
Span (in) = 18.0  
No. Barrels = 1  
n-Value = 0.022  
Culvert Type = Circular Corrugate Metal Pipe  
Culvert Entrance = Mitered to slope (C)  
Coeff. K,M,c,Y,k = 0.021, 1.33, 0.0463, 0.75, 0.7

### Embankment

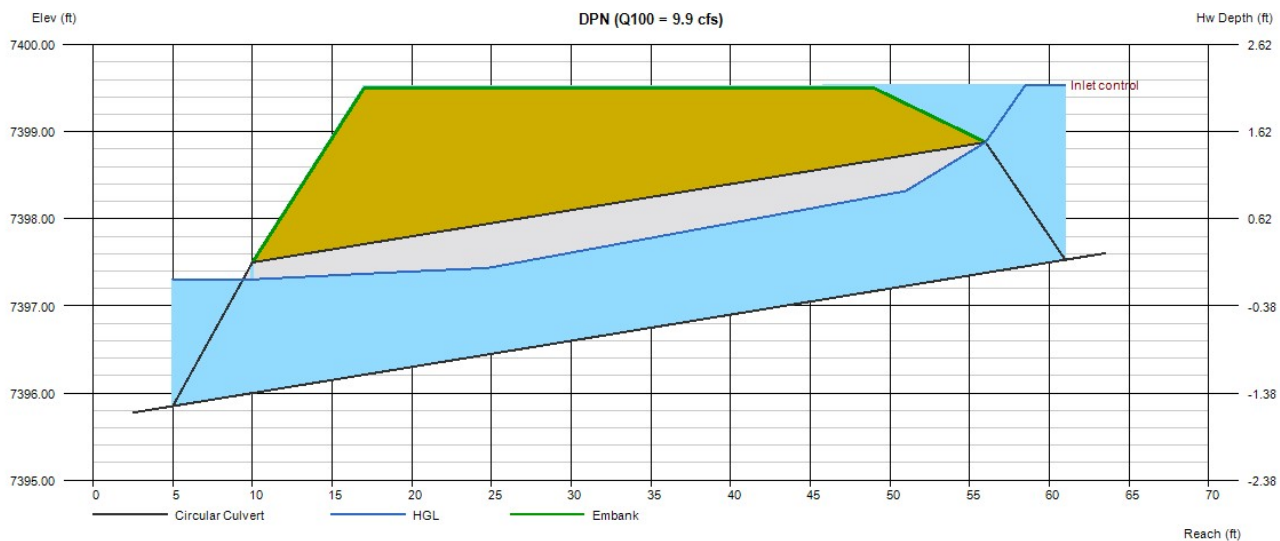
Top Elevation (ft) = 7399.50  
Top Width (ft) = 32.00  
Crest Width (ft) = 100.00

### Calculations

Qmin (cfs) = 9.90  
Qmax (cfs) = 9.90  
Tailwater Elev (ft) = (dc+D)/2

### Highlighted

Qtotal (cfs) = 9.90  
Qpipe (cfs) = 8.21  
Qovertop (cfs) = 1.69  
Veloc Dn (ft/s) = 5.03  
Veloc Up (ft/s) = 5.86  
HGL Dn (ft) = 7397.31  
HGL Up (ft) = 7398.49  
Hw Elev (ft) = 7399.54  
Hw/D (ft) = 1.44  
Flow Regime = Inlet Control



# Culvert Report

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

Friday, Aug 28 2026

## DPP (Q100 = 27.4 cfs)

Invert Elev Dn (ft) = 7393.00  
Pipe Length (ft) = 40.00  
Slope (%) = 10.00  
Invert Elev Up (ft) = 7397.00  
Rise (in) = 24.0  
Shape = Circular  
Span (in) = 24.0  
No. Barrels = 1  
n-Value = 0.022  
Culvert Type = Circular Corrugate Metal Pipe  
Culvert Entrance = Mitered to slope (C)  
Coeff. K,M,c,Y,k = 0.021, 1.33, 0.0463, 0.75, 0.7

### Embankment

Top Elevation (ft) = 7400.00  
Top Width (ft) = 32.00  
Crest Width (ft) = 100.00

### Calculations

Qmin (cfs) = 27.40  
Qmax (cfs) = 27.40  
Tailwater Elev (ft) = (dc+D)/2

### Highlighted

Qtotal (cfs) = 27.40  
Qpipe (cfs) = 17.63  
Qovertop (cfs) = 9.77  
Veloc Dn (ft/s) = 6.03  
Veloc Up (ft/s) = 6.92  
HGL Dn (ft) = 7394.76  
HGL Up (ft) = 7398.51  
Hw Elev (ft) = 7400.10  
Hw/D (ft) = 1.55  
Flow Regime = Inlet Control

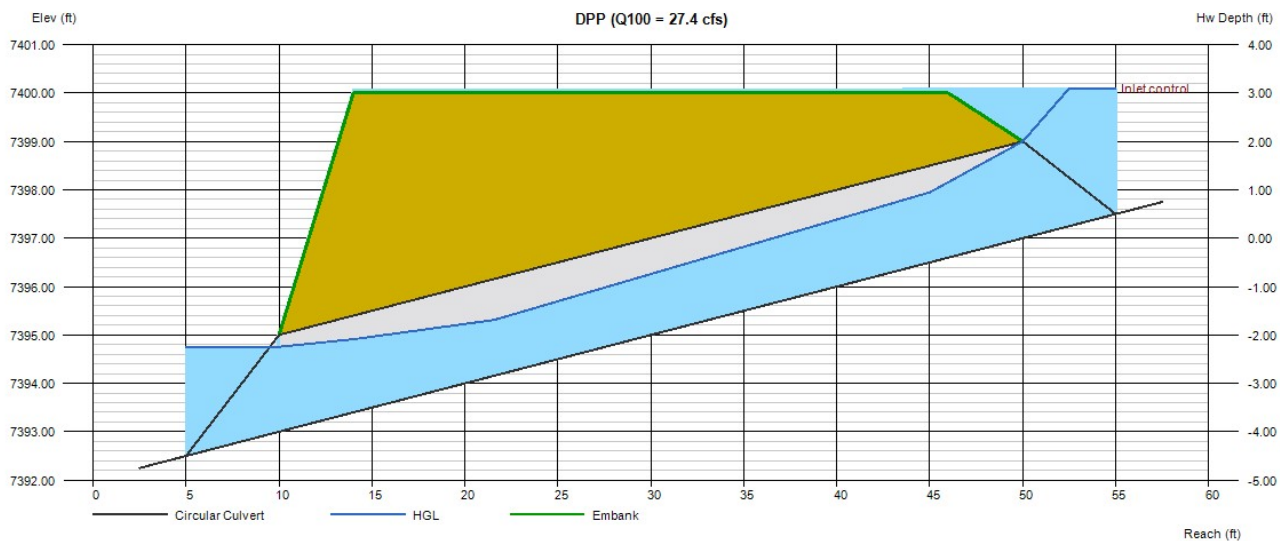




Figure 13-12c. Emergency Spillway Protection

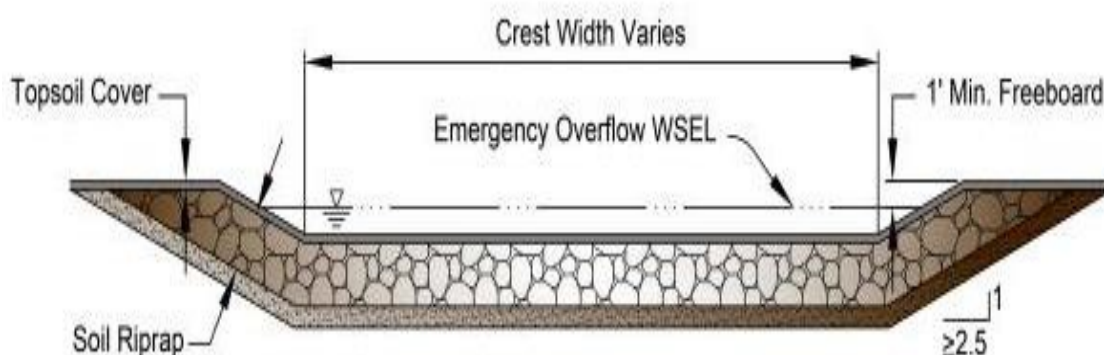
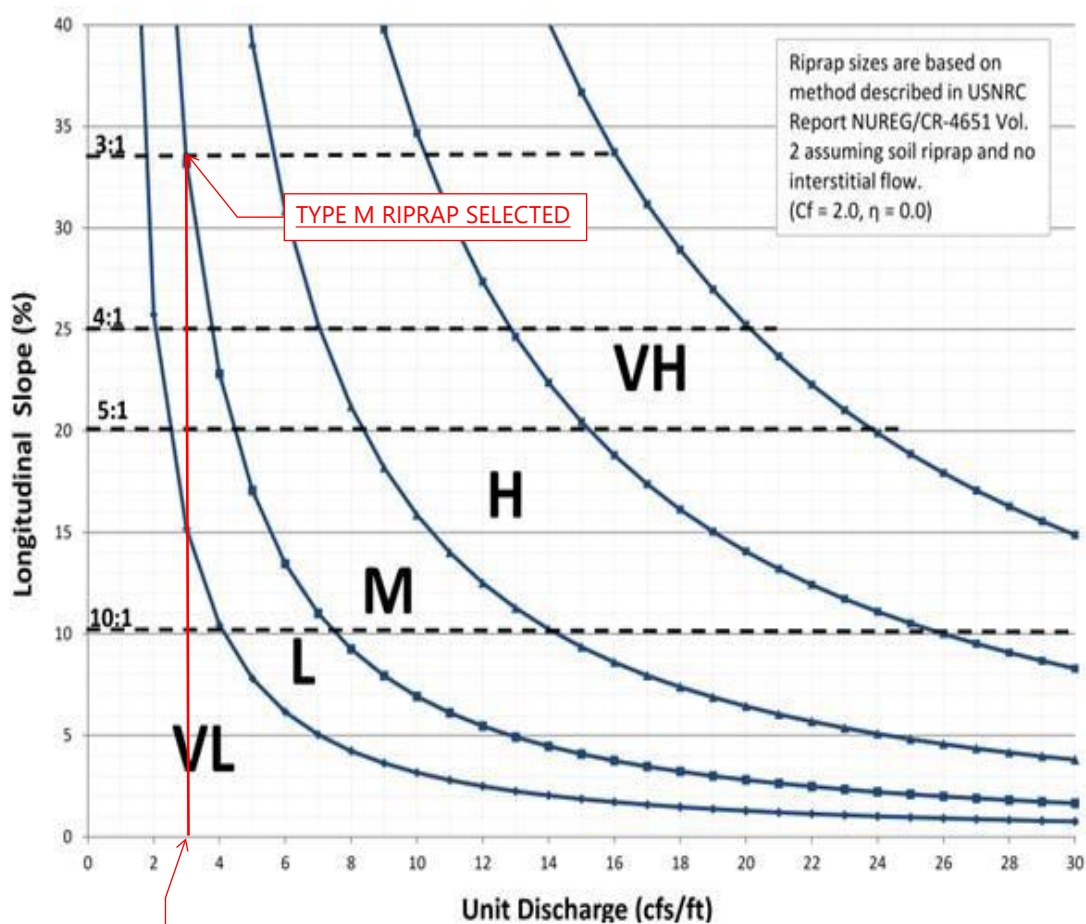


Figure 13-12d. Riprap Types for Emergency Spillway Protection







Project: The North Ranch

Project No: 26001

Date: 8/28/2026

**Forebay Sizing (Per USDCM Volume 3, Table 4-12)**

| WQCV (ac-ft) | 1% WQCV (ft <sup>3</sup> ) | Forebay Area (ft <sup>2</sup> ) | Forebay Depth (ft) | Forebay Volume (ft <sup>3</sup> ) |
|--------------|----------------------------|---------------------------------|--------------------|-----------------------------------|
| 0.296        | 129                        | 65                              | 2                  | 130                               |

**Forebay Notch Sizing  
(Per USDCM Volume 3 Equation 4-1)**

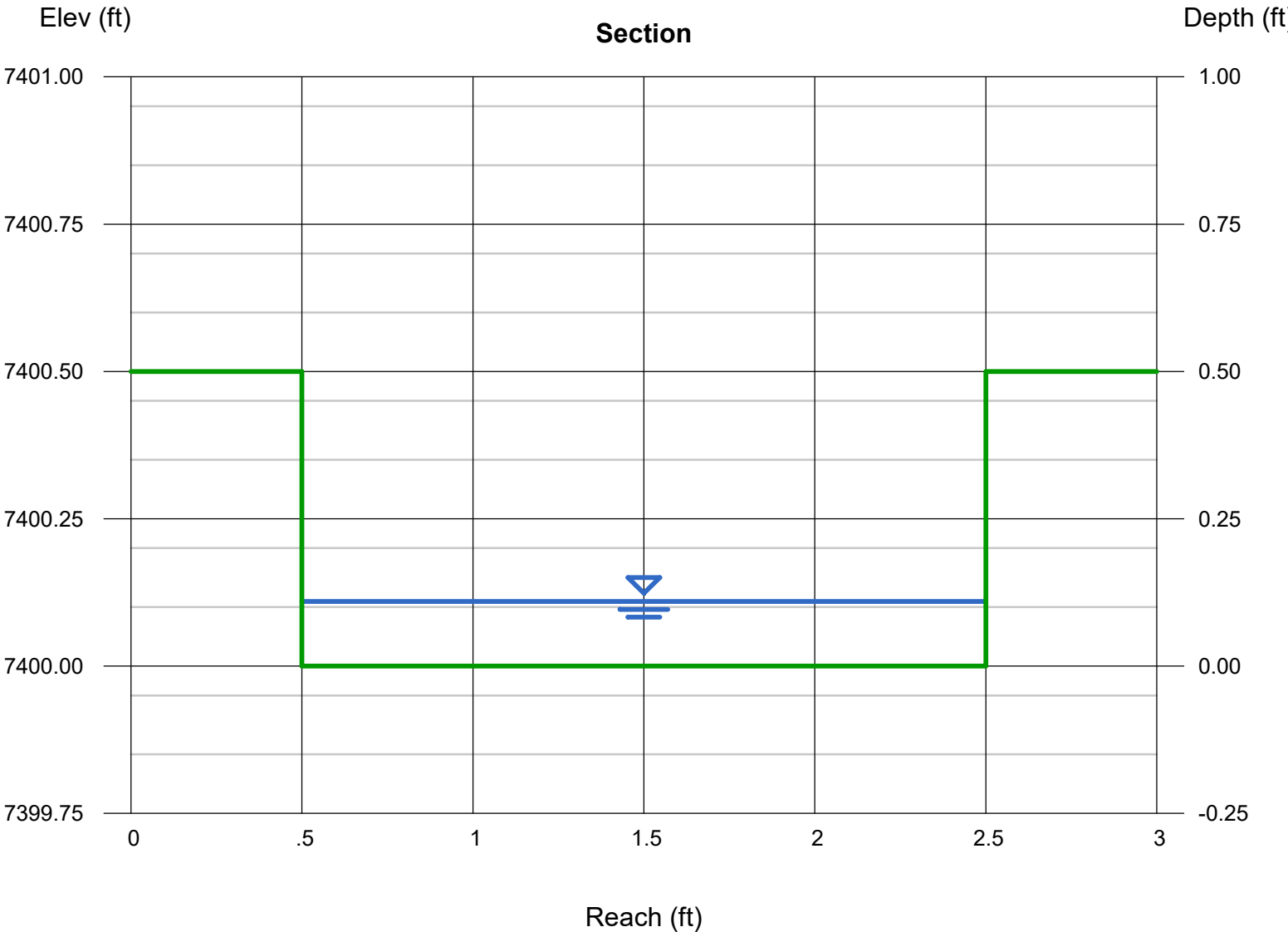
$$w = 9.23(A_{FB}/t)(1/\sqrt{h_{max}})$$

| $A_{FB}$ (ft <sup>2</sup> ) | t (s) | $h_{max}$ (ft) | $w_{min}$ (in) |
|-----------------------------|-------|----------------|----------------|
| 65                          | 240   | 2              | 1.77           |

# Channel Report

## Pond 1 Trickle Channel Sizing (1% of Peak 100 Year Inflow = 0.41 cfs)

|                     |           |                     |         |
|---------------------|-----------|---------------------|---------|
| <b>Rectangular</b>  |           | <b>Highlighted</b>  |         |
| Bottom Width (ft)   | = 2.00    | Depth (ft)          | = 0.11  |
| Total Depth (ft)    | = 0.50    | Q (cfs)             | = 0.410 |
|                     |           | Area (sqft)         | = 0.22  |
| Invert Elev (ft)    | = 7400.00 | Velocity (ft/s)     | = 1.86  |
| Slope (%)           | = 0.50    | Wetted Perim (ft)   | = 2.22  |
| N-Value             | = 0.012   | Crit Depth, Yc (ft) | = 0.11  |
|                     |           | Top Width (ft)      | = 2.00  |
|                     |           | EGL (ft)            | = 0.16  |
| <b>Calculations</b> |           |                     |         |
| Compute by:         | Known Q   |                     |         |
| Known Q (cfs)       | = 0.41    |                     |         |



# Channel Report

## Basin 4 Swale - Max. Slope Q100 = 10.5 cfs

### Triangular

Side Slopes (z:1) = 3.00, 4.00  
Total Depth (ft) = 2.00

Invert Elev (ft) = 7400.00  
Slope (%) = 6.00  
N-Value = 0.030

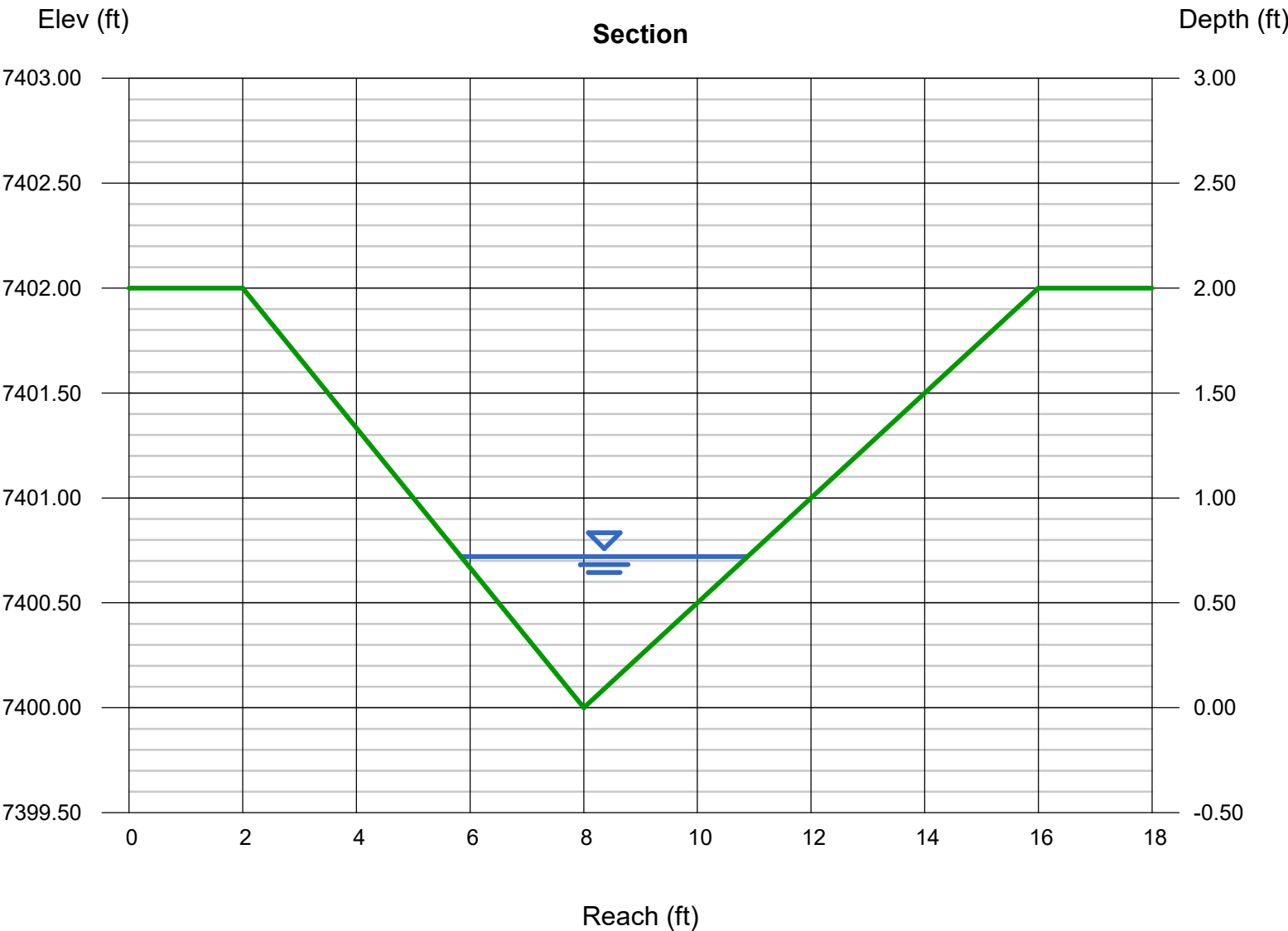
### Calculations

Compute by: Known Q  
Known Q (cfs) = 10.50

### Highlighted

Depth (ft) = 0.72  
Q (cfs) = 10.50  
Area (sqft) = 1.81  
Velocity (ft/s) = 5.79  
Wetted Perim (ft) = 5.25  
Crit Depth, Yc (ft) = 0.90  
Top Width (ft) = 5.04  
EGL (ft) = 1.24  
Froude # = 1.20

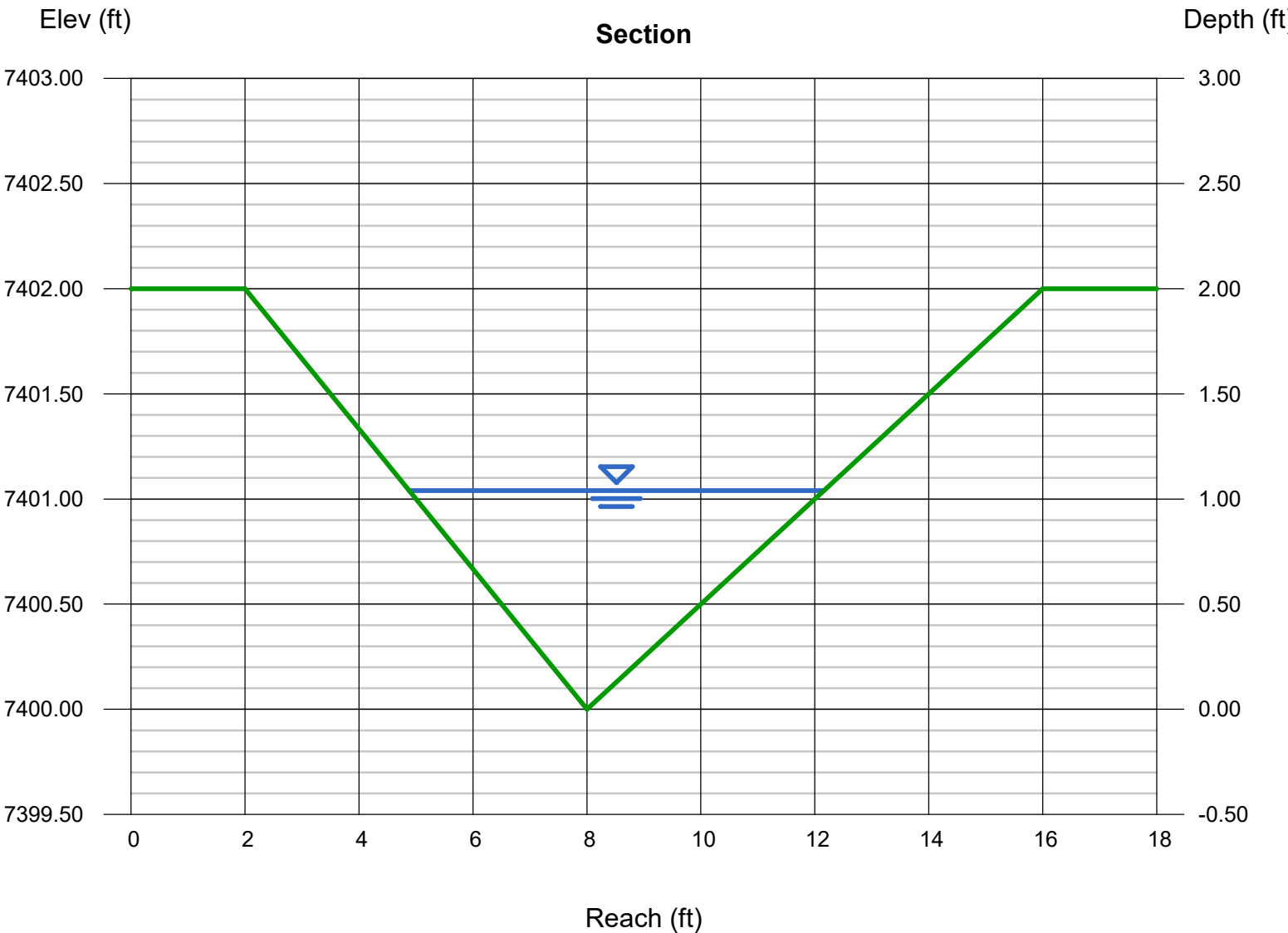
ARMORING REQUIRED



# Channel Report

## Basin 4 Swale - Min. Slope Q100 = 10.5 cfs

|                     |              |                     |         |
|---------------------|--------------|---------------------|---------|
| <b>Triangular</b>   |              | <b>Highlighted</b>  |         |
| Side Slopes (z:1)   | = 3.00, 4.00 | Depth (ft)          | = 1.04  |
| Total Depth (ft)    | = 2.00       | Q (cfs)             | = 10.50 |
|                     |              | Area (sqft)         | = 3.79  |
| Invert Elev (ft)    | = 7400.00    | Velocity (ft/s)     | = 2.77  |
| Slope (%)           | = 0.80       | Wetted Perim (ft)   | = 7.58  |
| N-Value             | = 0.030      | Crit Depth, Yc (ft) | = 0.90  |
|                     |              | Top Width (ft)      | = 7.28  |
|                     |              | EGL (ft)            | = 1.16  |
|                     |              | Froude #            | = 0.47  |
| <b>Calculations</b> |              |                     |         |
| Compute by:         | Known Q      |                     |         |
| Known Q (cfs)       | = 10.50      |                     |         |



# Channel Report

## Basin 12 Swale - Max. Slope Q100 = 4.9 cfs

### Triangular

Side Slopes (z:1) = 3.00, 4.00  
Total Depth (ft) = 2.00

Invert Elev (ft) = 7400.00  
Slope (%) = 12.00  
N-Value = 0.030

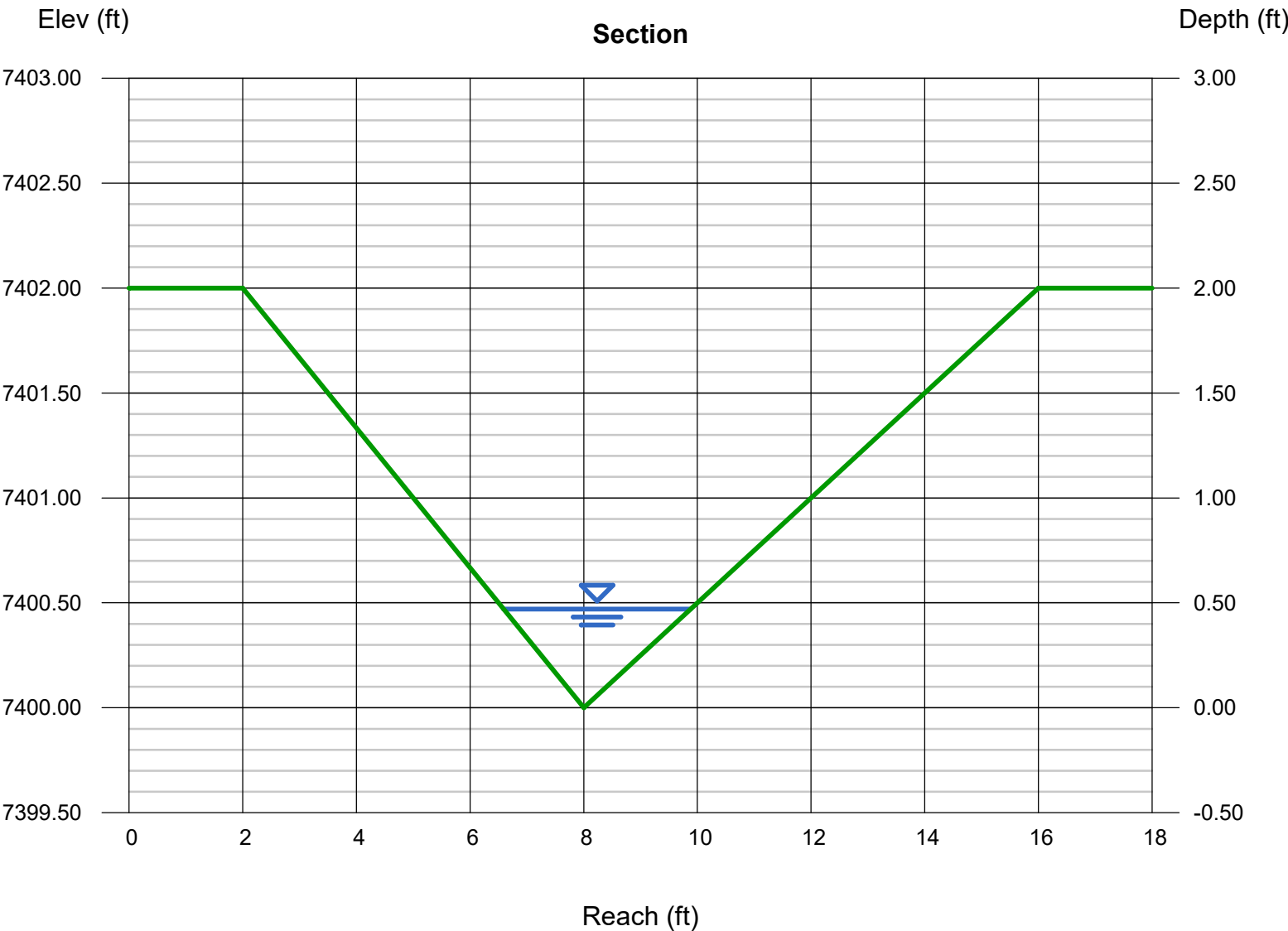
### Calculations

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

### Highlighted

Depth (ft) = 0.47  
Q (cfs) = 4.900  
Area (sqft) = 0.77  
Velocity (ft/s) = 6.34  
Wetted Perim (ft) = 3.42  
Crit Depth, Yc (ft) = 0.66  
Top Width (ft) = 3.29  
EGL (ft) = 1.09  
Froude # = 1.62

ARMORING REQUIRED



# Channel Report

## Basin 12 Swale - Min. Slope Q100 = 4.9 cfs

### Triangular

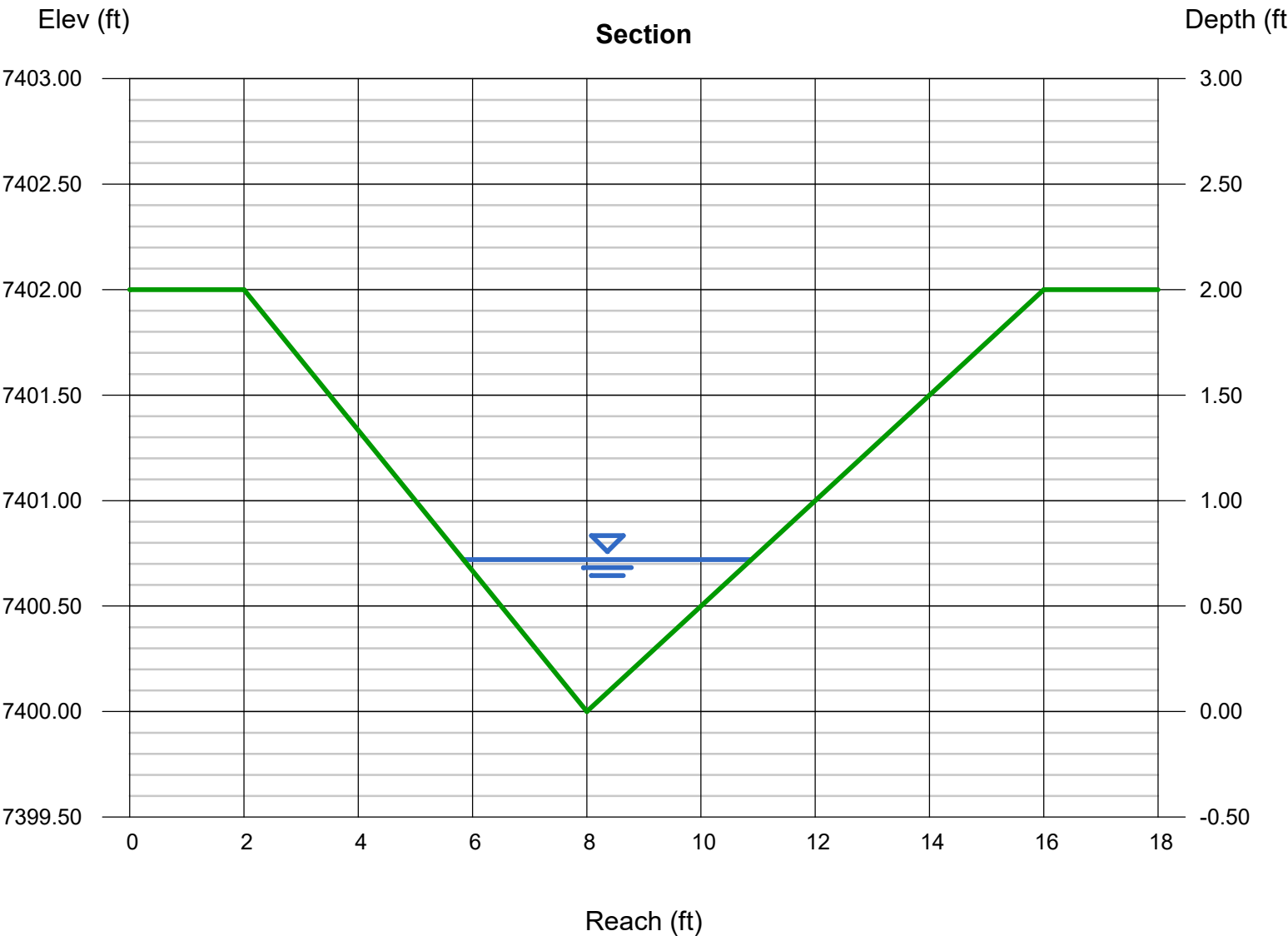
Side Slopes (z:1) = 3.00, 4.00  
Total Depth (ft) = 2.00  
  
Invert Elev (ft) = 7400.00  
Slope (%) = 1.23  
N-Value = 0.030

### Calculations

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

### Highlighted

Depth (ft) = 0.72  
Q (cfs) = 4.900  
Area (sqft) = 1.81  
Velocity (ft/s) = 2.70  
Wetted Perim (ft) = 5.25  
Crit Depth, Yc (ft) = 0.66  
Top Width (ft) = 5.04  
EGL (ft) = 0.83  
Froude # = 0.56



# Channel Report

## Basin 5 Swale - Avg. Slope Q100 = 5.8 cfs

### Triangular

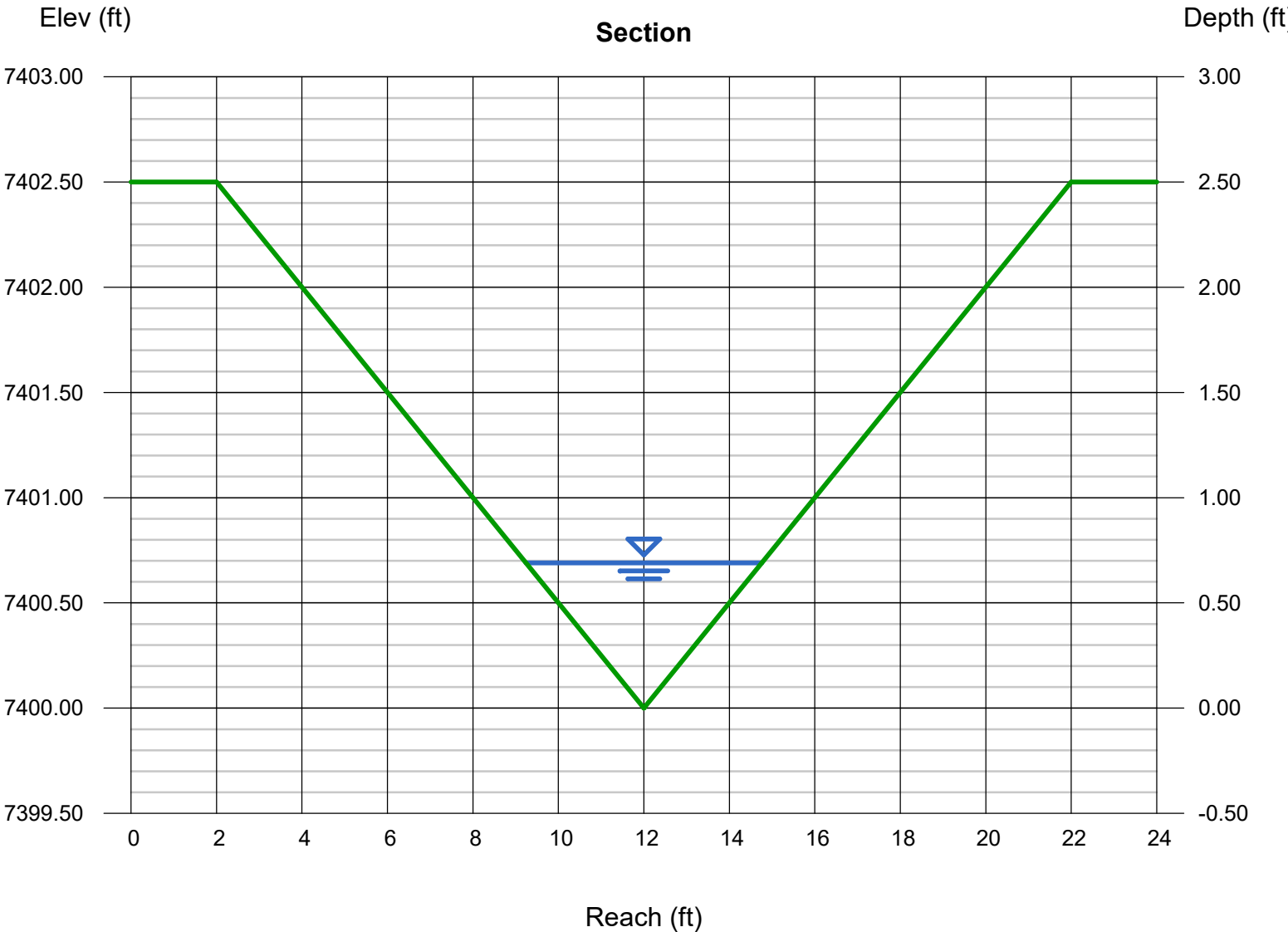
|                   |              |
|-------------------|--------------|
| Side Slopes (z:1) | = 4.00, 4.00 |
| Total Depth (ft)  | = 2.50       |
| Invert Elev (ft)  | = 7400.00    |
| Slope (%)         | = 2.30       |
| N-Value           | = 0.035      |

### Calculations

|               |         |
|---------------|---------|
| Compute by:   | Known Q |
| Known Q (cfs) | = 5.80  |

### Highlighted

|                     |         |
|---------------------|---------|
| Depth (ft)          | = 0.69  |
| Q (cfs)             | = 5.800 |
| Area (sqft)         | = 1.90  |
| Velocity (ft/s)     | = 3.05  |
| Wetted Perim (ft)   | = 5.69  |
| Crit Depth, Yc (ft) | = 0.67  |
| Top Width (ft)      | = 5.52  |
| EGL (ft)            | = 0.83  |
| Froude #            | = 0.74  |





# Channel Report

## Basin 5.1 Swale - Avg. Slope Q100 = 2.2 cfs

### Triangular

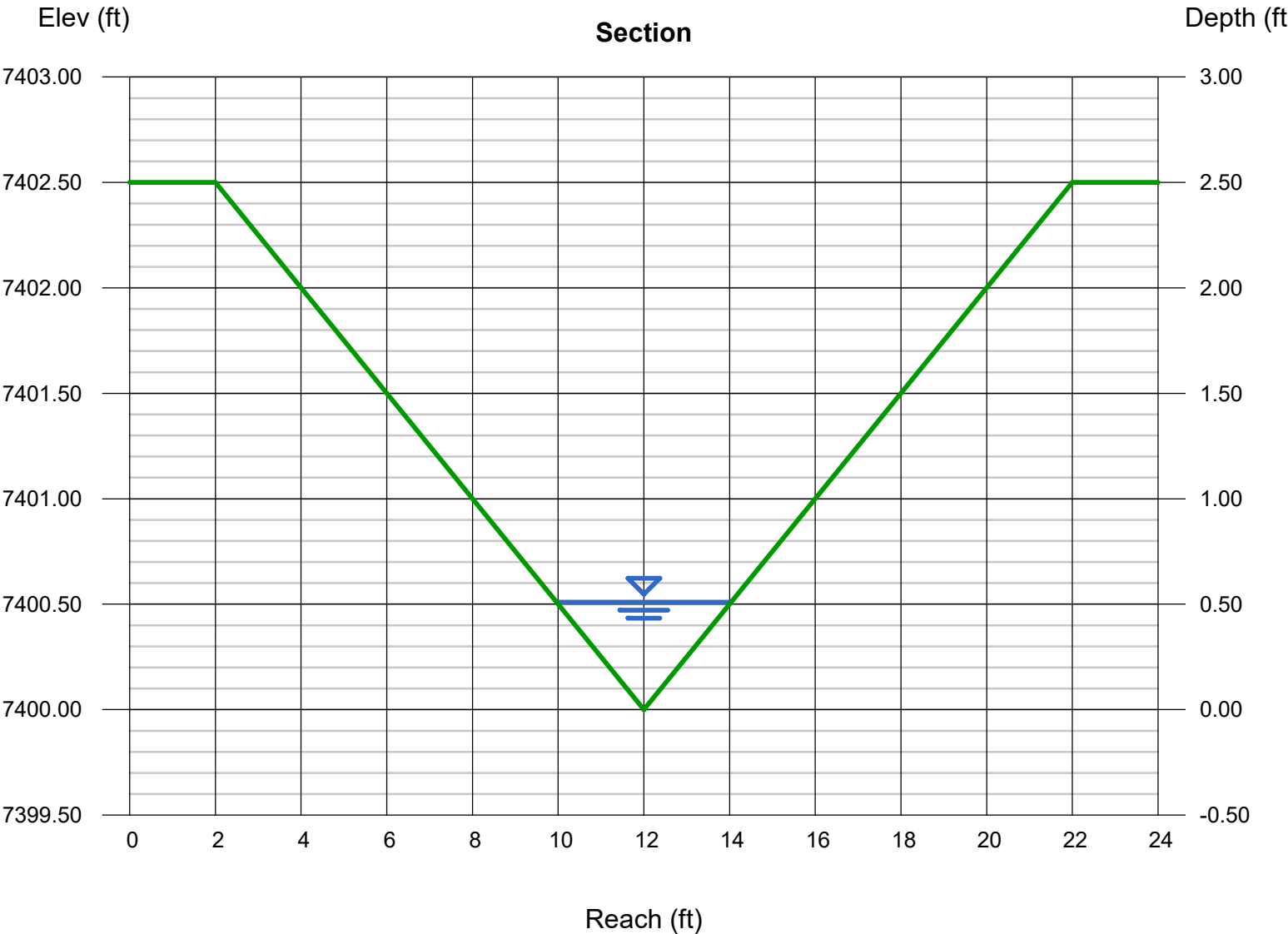
Side Slopes (z:1) = 4.00, 4.00  
Total Depth (ft) = 2.50  
  
Invert Elev (ft) = 7400.00  
Slope (%) = 1.65  
N-Value = 0.035

### Calculations

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

### Highlighted

Depth (ft) = 0.51  
Q (cfs) = 2.200  
Area (sqft) = 1.04  
Velocity (ft/s) = 2.11  
Wetted Perim (ft) = 4.21  
Crit Depth, Yc (ft) = 0.46  
Top Width (ft) = 4.08  
EGL (ft) = 0.58  
Froude # = 0.52



# Channel Report

## Basin 5.2 Swale - Avg. Slope Q100 = 2.0 cfs

### Triangular

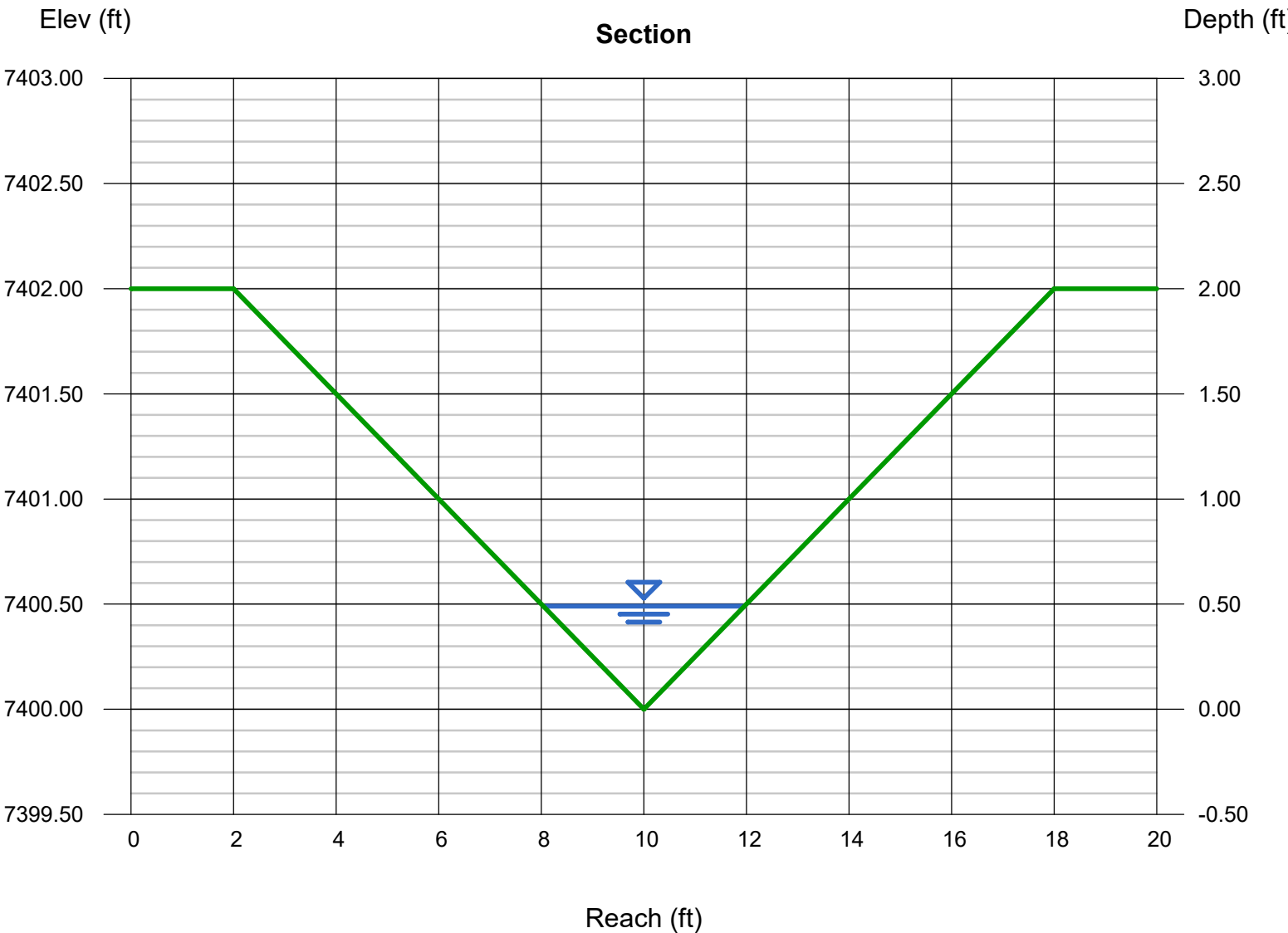
Side Slopes (z:1) = 4.00, 4.00  
Total Depth (ft) = 2.00  
  
Invert Elev (ft) = 7400.00  
Slope (%) = 1.65  
N-Value = 0.035

### Calculations

Compute by: Known Q  
Known Q (cfs) = 2.00

### Highlighted

Depth (ft) = 0.49  
Q (cfs) = 2.000  
Area (sqft) = 0.96  
Velocity (ft/s) = 2.08  
Wetted Perim (ft) = 4.04  
Crit Depth, Yc (ft) = 0.44  
Top Width (ft) = 3.92  
EGL (ft) = 0.56  
Froude # = 0.52



# Channel Report

## Basin 10 Swale - Avg. Slope Q100 = 32.7 cfs (DPL + Basin 10)

### Triangular

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

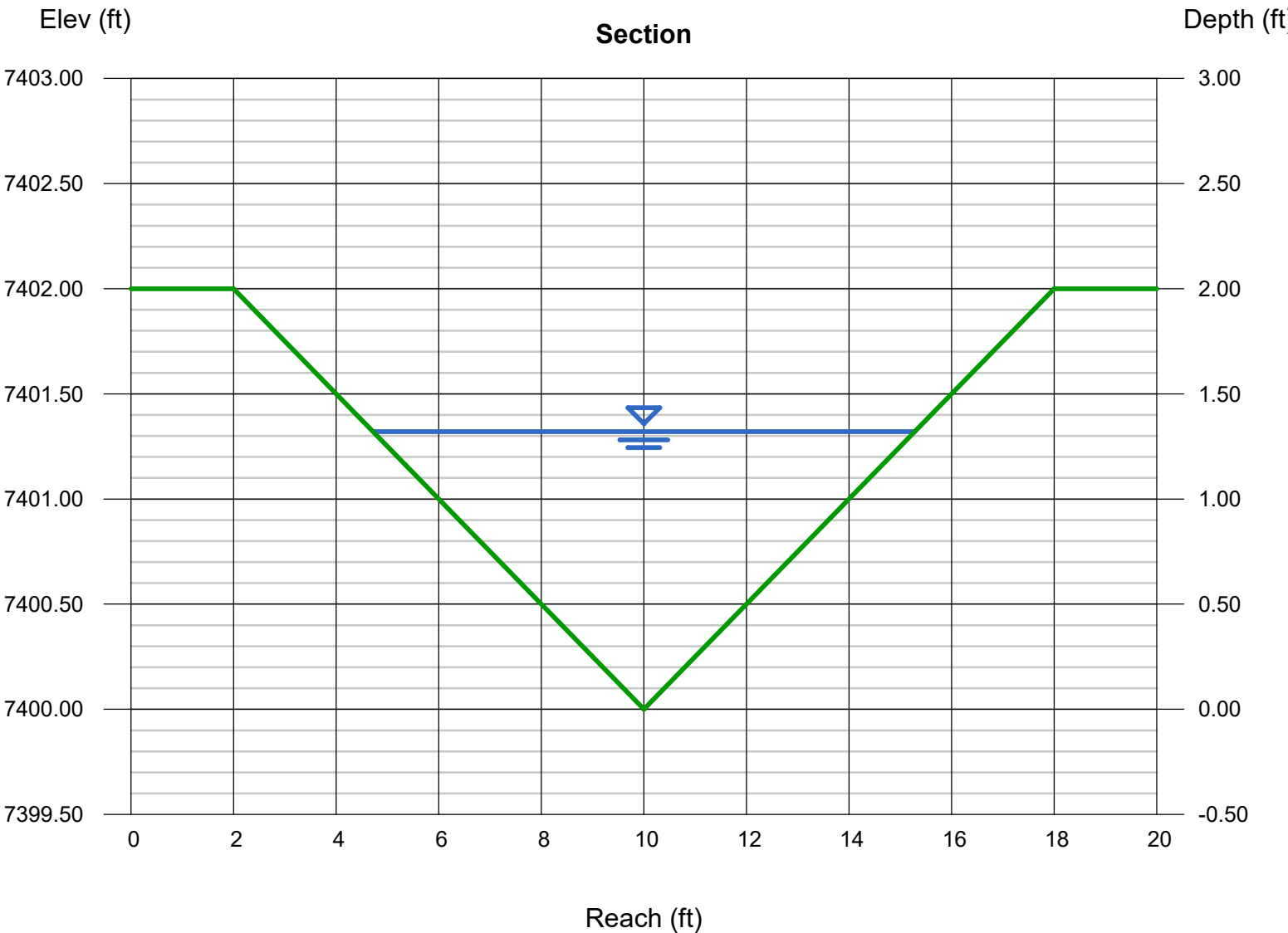
Invert Elev (ft) = 7400.00  
Slope (%) = 2.26  
N-Value = 0.035

### Calculations

Compute by: Known Q  
Known Q (cfs) = 32.70

### Highlighted

Depth (ft) = 1.32  
Q (cfs) = 32.70  
Area (sqft) = 6.97  
Velocity (ft/s) = 4.69  
Wetted Perim (ft) = 10.88  
Crit Depth, Yc (ft) = 1.33  
Top Width (ft) = 10.56  
EGL (ft) = 1.66  
Froude # = 0.72



# Channel Report

## Basin 14 Swale - Avg. Slope Q100 = 2.0

### Triangular

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

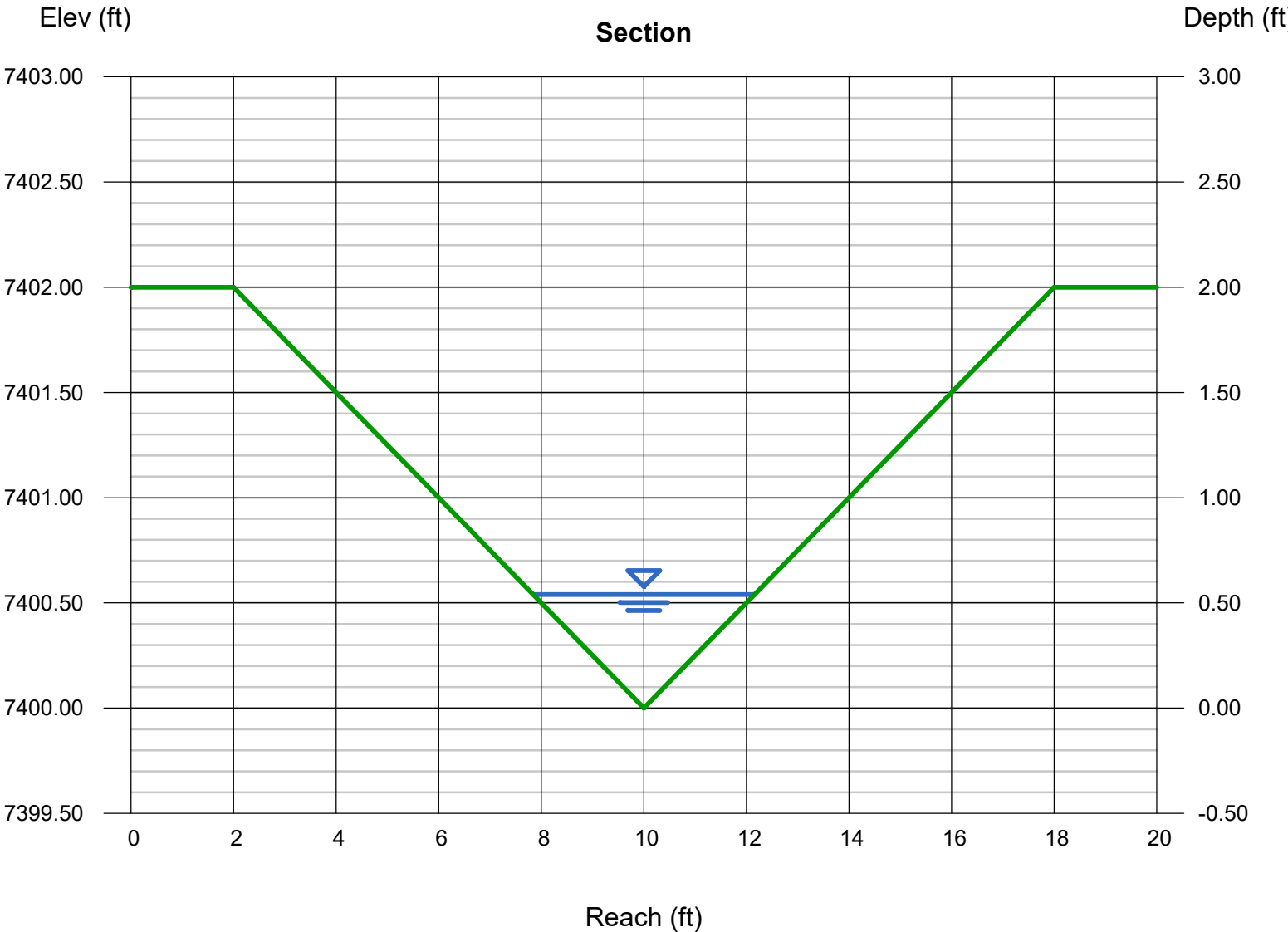
Invert Elev (ft) = 7400.00  
Slope (%) = 1.00  
N-Value = 0.035

### Calculations

Compute by: Known Q  
Known Q (cfs) = 2.00

### Highlighted

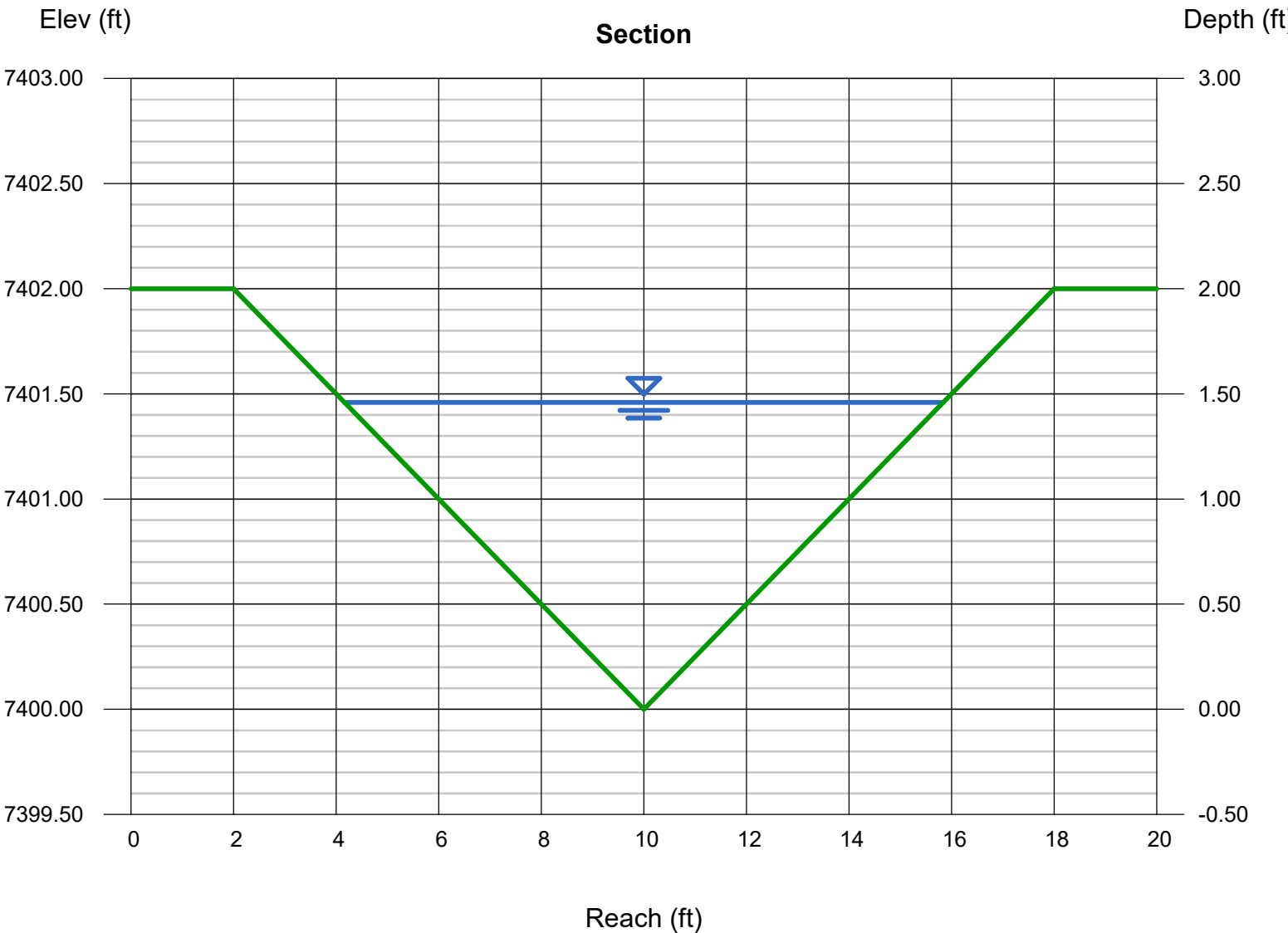
Depth (ft) = 0.54  
Q (cfs) = 2.000  
Area (sqft) = 1.17  
Velocity (ft/s) = 1.71  
Wetted Perim (ft) = 4.45  
Crit Depth, Yc (ft) = 0.44  
Top Width (ft) = 4.32  
EGL (ft) = 0.59  
Froude # = 0.41



# Channel Report

## Basin 15 Swale - Avg. Slope Q100 = 31.0 cfs (DPT)

|                     |              |                     |         |
|---------------------|--------------|---------------------|---------|
| <b>Triangular</b>   |              | <b>Highlighted</b>  |         |
| Side Slopes (z:1)   | = 4.00, 4.00 | Depth (ft)          | = 1.46  |
| Total Depth (ft)    | = 2.00       | Q (cfs)             | = 31.00 |
|                     |              | Area (sqft)         | = 8.53  |
| Invert Elev (ft)    | = 7400.00    | Velocity (ft/s)     | = 3.64  |
| Slope (%)           | = 1.20       | Wetted Perim (ft)   | = 12.04 |
| N-Value             | = 0.035      | Crit Depth, Yc (ft) | = 1.31  |
|                     |              | Top Width (ft)      | = 11.68 |
|                     |              | EGL (ft)            | = 1.67  |
| <b>Calculations</b> |              | Froude #            | = 0.53  |
| Compute by:         | Known Q      |                     |         |
| Known Q (cfs)       | = 31.00      |                     |         |



## The North Ranch - Culvert Outfall Riprap Sizing

| Location    | Ss  | Velocity (ft/s) | Slope (ft/ft) | d <sub>50</sub> (calc) (in) | d <sub>50</sub> (selected) (in) | Designation | Depth |
|-------------|-----|-----------------|---------------|-----------------------------|---------------------------------|-------------|-------|
| DPA Outfall | 2.5 | 4.77            | 0.25          | 2.9                         | 6"                              | TYPE VL     | 12"   |
| DPC Outfall | 2.5 | 6.84            | 0.039         | 3.0                         | 6"                              | TYPE VL     | 12"   |
| DPF Outfall | 2.5 | 7.27            | 0.057         | 3.4                         | 6"                              | TYPE VL     | 12"   |
| DPH Outfall | 2.5 | 4.87            | 0.093         | 2.5                         | 6"                              | TYPE VL     | 12"   |
| DPL Outfall | 2.5 | 6.14            | 0.029         | 2.6                         | 6"                              | TYPE VL     | 12"   |
| DPM Outfall | 2.5 | 6.84            | 0.005         | 2.1                         | 6"                              | TYPE VL     | 12"   |

$$\frac{VS^{0.17}}{(S_s - 1)^{0.66}} = 1.0$$

Where:

V = mean channel flow velocity, in fps;

S = longitudinal channel slope, in feet per foot (ft/ft); and

S<sub>s</sub> = specific gravity of stone (minimum S<sub>s</sub> = 2.50)

| RIPRAP DESIGNATION | % SMALLER THAN<br>GIVEN SIZE BY<br>WEIGHT | INTERMEDIATE ROCK<br>DIMENSION (INCHES) | D <sub>50</sub> * (INCHES) |
|--------------------|-------------------------------------------|-----------------------------------------|----------------------------|
| TYPE VL            | 70 - 100<br>50 - 70<br>35 - 50<br>2 - 10  | 12<br>9<br>6<br>2                       | 6                          |
| TYPE L             | 70 - 100<br>50 - 70<br>35 - 50<br>2 - 10  | 15<br>12<br>9<br>3                      | 9                          |
| TYPE M             | 70 - 100<br>50 - 70<br>35 - 50<br>2 - 10  | 21<br>18<br>12<br>4                     | 12                         |
| TYPE H             | 70 - 100<br>50 - 70<br>35 - 50<br>2 - 10  | 30<br>24<br>18<br>6                     | 18                         |

\*D<sub>50</sub> = MEAN ROCK SIZE

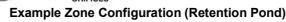
**Figure 8-34. Riprap and soil riprap placement and gradation (part 1 of 3)**



## **APPENDIX D – WATER QUALITY & DETENTION**

*MHFD-Detention, Version 4.06 (July 2022)*

**Basin ID:** Basins: 4, 9, 11-13



|      |           |
|------|-----------|
|      | acre-feet |
|      | acre-feet |
| 0.93 | inches    |
| 1.21 | inches    |
| 1.46 | inches    |
| 1.85 | inches    |
| 2.17 | inches    |
| 2.52 | inches    |
| 3.42 | inches    |

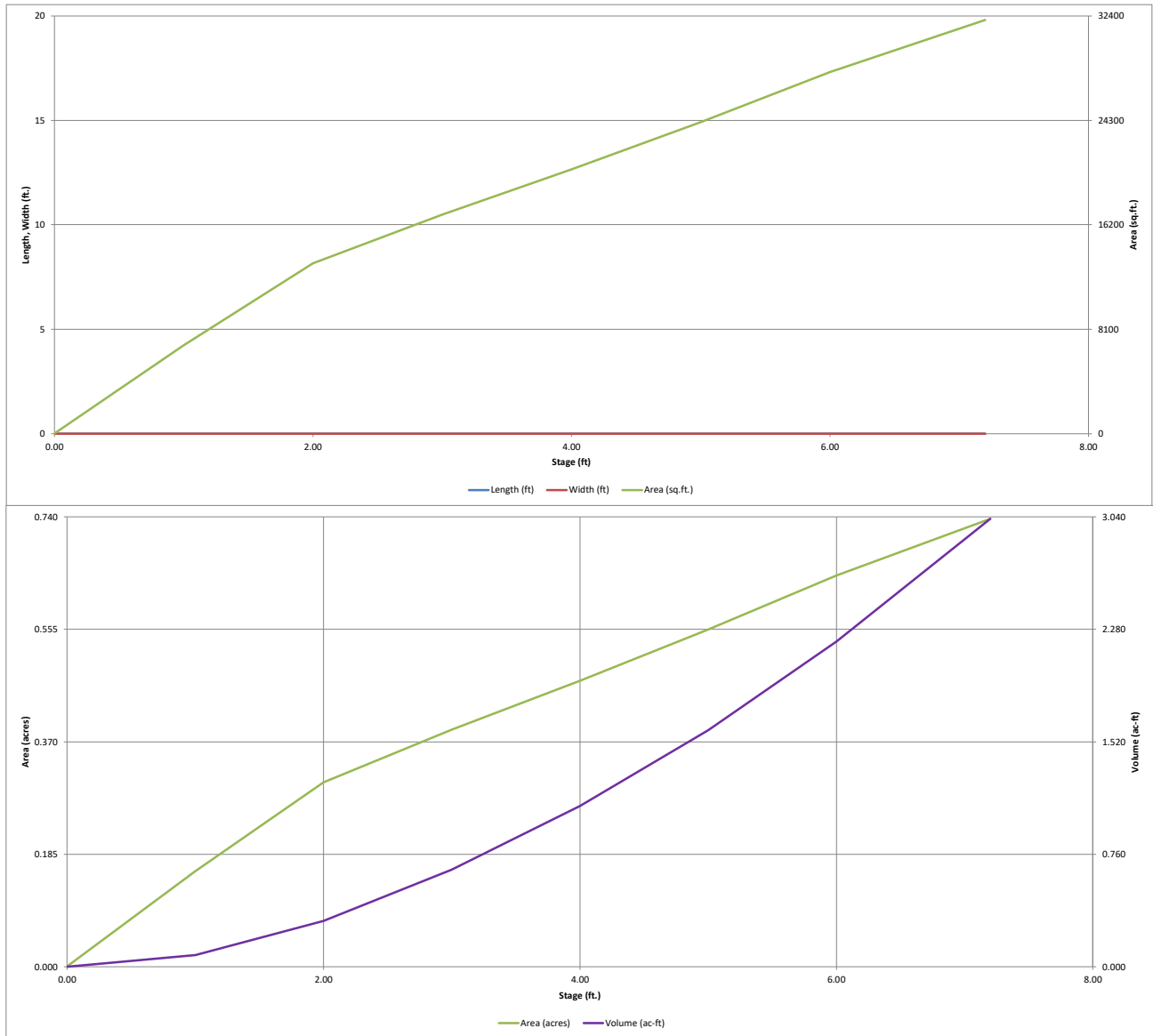
|                                             |   |      |                 |
|---------------------------------------------|---|------|-----------------|
| Initial Surchage Area ( $A_{ISV}$ )         | = | user | ft <sup>2</sup> |
| Surchage Volume Length ( $L_{ISV}$ )        | = | user | ft              |
| Surchage 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 <sup>2</sup> |
| Volume of Basin Floor ( $V_{FLOOR}$ )       | = | user | ft <sup>3</sup> |
| 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 <sup>2</sup> |
| Volume of Main Basin ( $V_{MAIN}$ )         | = | user | ft <sup>3</sup> |
| Calculated Total Basin Volume ( $V_{OBS}$ ) | = | user | acre-feet       |

8/26/2026, 5:04 PM



# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

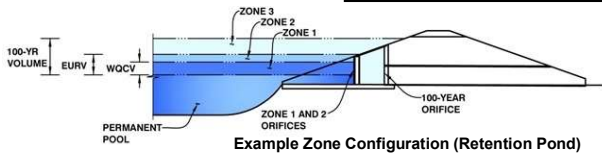


# DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Needles Subdivision**

Basin ID: **Basins: 4, 9, 11-13**



Example Zone Configuration (Retention Pond)

|                   | Estimated Stage (ft) | Estimated Volume (ac-ft) | Outlet Type          |
|-------------------|----------------------|--------------------------|----------------------|
| Zone 1 (WQCV)     | 1.96                 | 0.296                    | Orifice Plate        |
| Zone 2 (EURV)     | 3.15                 | 0.417                    | Orifice Plate        |
| Zone 3 (100-year) | 4.93                 | 0.844                    | Weir&Pipe (Restrict) |
| Total (all zones) |                      | 1.556                    |                      |

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

Underdrain Orifice Invert Depth =  ft (distance below the filtration media surface)  
Underdrain Orifice Diameter =  inches

Calculated Parameters for Underdrain  
Underdrain Orifice Area =  ft<sup>2</sup>  
Underdrain Orifice Centroid =  feet

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

Centroid of Lowest Orifice =  ft (relative to basin bottom at Stage = 0 ft)  
Depth at top of Zone using Orifice Plate =  ft (relative to basin bottom at Stage = 0 ft)  
Orifice Plate: Orifice Vertical Spacing =  inches  
Orifice Plate: Orifice Area per Row =  sq. inches (diameter = 1-9/16 inches)

Calculated Parameters for Plate  
WQ Orifice Area per Row =  ft<sup>2</sup>  
Elliptical Half-Width =  feet  
Elliptical Slot Centroid =  feet  
Elliptical Slot Area =  ft<sup>2</sup>

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

|                                | Row 1 (required) | Row 2 (optional) | Row 3 (optional) | Row 4 (optional) | Row 5 (optional) | Row 6 (optional) | Row 7 (optional) | Row 8 (optional) |
|--------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| Stage of Orifice Centroid (ft) | 0.00             | 1.08             | 2.10             |                  |                  |                  |                  |                  |
| Orifice Area (sq. inches)      | 1.98             | 1.98             | 1.98             |                  |                  |                  |                  |                  |

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

User Input: Vertical Orifice (Circular or Rectangular)

Invert of Vertical Orifice =  ft (relative to basin bottom at Stage = 0 ft)  
Depth at top of Zone using Vertical Orifice =  ft (relative to basin bottom at Stage = 0 ft)  
Vertical Orifice Diameter =  inches

Calculated Parameters for Vertical Orifice  
Vertical Orifice Area =  ft<sup>2</sup>  
Vertical Orifice Centroid =  feet

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

Overflow Weir Front Edge Height, H<sub>o</sub> =  ft (relative to basin bottom at Stage = 0 ft)  
Overflow Weir Front Edge Length =  feet  
Overflow Weir Grate Slope =  H:V  
Horiz. Length of Weir Sides =  feet  
Overflow Grate Type =   
Debris Clogging % =  %

Calculated Parameters for Overflow Weir  
Height of Grate Upper Edge, H<sub>u</sub> =  feet  
Overflow Weir Slope Length =  feet  
Grate Open Area / 100-yr Orifice Area =   
Overflow Grate Open Area w/o Debris =  ft<sup>2</sup>  
Overflow Grate Open Area w/ Debris =  ft<sup>2</sup>

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

Depth to Invert of Outlet Pipe =  ft (distance below basin bottom at Stage = 0 ft)  
Outlet Pipe Diameter =  inches  
Restrictor Plate Height Above Pipe Invert =  inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate  
Outlet Orifice Area =  ft<sup>2</sup>  
Outlet Orifice Centroid =  feet  
Half-Central Angle of Restrictor Plate on Pipe =  radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =  ft (relative to basin bottom at Stage = 0 ft)  
Spillway Crest Length =  feet  
Spillway End Slopes =  H:V  
Freeboard above Max Water Surface =  feet

Calculated Parameters for Spillway  
Spillway Design Flow Depth =  feet  
Stage at Top of Freeboard =  feet  
Basin Area at Top of Freeboard =  acres  
Basin Volume at Top of Freeboard =  acre-ft

Routed Hydrograph Results

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

|                                                 | WQCV  | EURV  | 2 Year | 5 Year | 10 Year         | 25 Year         | 50 Year        | 100 Year       | 500 Year |
|-------------------------------------------------|-------|-------|--------|--------|-----------------|-----------------|----------------|----------------|----------|
| Design Storm Return Period =                    | N/A   | N/A   | 0.93   | 1.21   | 1.46            | 1.85            | 2.17           | 2.52           | 3.42     |
| One-Hour Rainfall Depth (in) =                  | 0.296 | 0.712 | 0.421  | 0.702  | 1.059           | 1.916           | 2.514          | 3.298          | 5.071    |
| CUHP Runoff Volume (acre-ft) =                  | N/A   | N/A   | 0.421  | 0.702  | 1.059           | 1.916           | 2.514          | 3.298          | 5.071    |
| Inflow Hydrograph Volume (acre-ft) =            | N/A   | N/A   | 0.4    | 3.5    | 9.2             | 24.9            | 34.2           | 45.7           | 72.1     |
| CUHP Predevelopment Peak Q (cfs) =              | N/A   | N/A   |        |        |                 |                 |                |                |          |
| OPTIONAL Override Predevelopment Peak Q (cfs) = | N/A   | N/A   |        |        |                 |                 |                |                |          |
| Predevelopment Unit Peak Flow, q (cfs/acre) =   | N/A   | N/A   | 0.02   | 0.15   | 0.39            | 1.05            | 1.43           | 1.92           | 3.03     |
| Peak Inflow Q (cfs) =                           | N/A   | N/A   | 7.4    | 12.8   | 19.9            | 35.9            | 47.0           | 60.9           | 91.5     |
| Peak Outflow Q (cfs) =                          | 0.2   | 0.3   | 0.2    | 0.3    | 3.8             | 19.8            | 26.5           | 28.2           | 58.7     |
| Ratio Peak Outflow to Predevelopment Q =        | N/A   | N/A   | N/A    | 0.1    | 0.4             | 0.8             | 0.8            | 0.6            | 0.8      |
| Structure Controlling Flow =                    | Plate | Plate | Plate  | Plate  | Overflow Weir 1 | Overflow Weir 1 | Outlet Plate 1 | Outlet Plate 1 | Spillway |
| Max Velocity through Grate 1 (fps) =            | N/A   | N/A   | N/A    | N/A    | 0.1             | 0.8             | 1.0            | 1.1            | 1.2      |
| Max Velocity through Grate 2 (fps) =            | N/A   | N/A   | N/A    | N/A    | N/A             | N/A             | N/A            | N/A            | N/A      |
| Time to Drain 97% of Inflow Volume (hours) =    | 38    | 57    | 46     | 58     | 60              | 54              | 51             | 47             | 41       |
| Time to Drain 99% of Inflow Volume (hours) =    | 40    | 61    | 49     | 62     | 65              | 63              | 62             | 60             | 56       |
| Maximum Ponding Depth (ft) =                    | 1.96  | 3.15  | 2.26   | 3.01   | 3.45            | 3.88            | 4.18           | 4.95           | 5.83     |
| Area at Maximum Ponding Depth (acres) =         | 0.30  | 0.40  | 0.33   | 0.39   | 0.43            | 0.46            | 0.49           | 0.55           | 0.63     |
| Maximum Volume Stored (acre-ft) =               | 0.297 | 0.715 | 0.391  | 0.660  | 0.839           | 1.030           | 1.172          | 1.571          | 2.083    |

# 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           | 0.42           |
|               | 0:15:00 | 0.00       | 0.00       | 0.34         | 0.79         | 1.11          | 0.89          | 1.24          | 1.30           | 2.12           |
|               | 0:20:00 | 0.00       | 0.00       | 1.83         | 2.63         | 3.80          | 2.36          | 2.94          | 3.64           | 6.96           |
|               | 0:25:00 | 0.00       | 0.00       | 5.58         | 9.04         | 14.19         | 7.70          | 10.25         | 12.83          | 28.06          |
|               | 0:30:00 | 0.00       | 0.00       | 7.36         | 12.78        | 19.88         | 29.67         | 40.28         | 49.79          | 77.87          |
|               | 0:35:00 | 0.00       | 0.00       | 6.84         | 11.82        | 18.11         | 35.91         | 47.04         | 60.91          | 91.48          |
|               | 0:40:00 | 0.00       | 0.00       | 6.05         | 10.03        | 15.34         | 34.93         | 45.13         | 57.79          | 86.07          |
|               | 0:45:00 | 0.00       | 0.00       | 5.03         | 8.47         | 12.94         | 30.44         | 39.30         | 52.13          | 77.46          |
|               | 0:50:00 | 0.00       | 0.00       | 4.17         | 7.21         | 10.65         | 27.04         | 34.87         | 45.89          | 67.96          |
|               | 0:55:00 | 0.00       | 0.00       | 3.46         | 5.96         | 8.78          | 21.92         | 28.39         | 38.72          | 57.53          |
|               | 1:00:00 | 0.00       | 0.00       | 3.00         | 5.12         | 7.56          | 17.90         | 23.45         | 33.39          | 50.08          |
|               | 1:05:00 | 0.00       | 0.00       | 2.68         | 4.55         | 6.71          | 15.24         | 20.19         | 29.93          | 45.06          |
|               | 1:10:00 | 0.00       | 0.00       | 2.27         | 4.04         | 5.92          | 12.45         | 16.46         | 23.75          | 36.21          |
|               | 1:15:00 | 0.00       | 0.00       | 1.89         | 3.38         | 5.15          | 10.04         | 13.23         | 18.43          | 28.55          |
|               | 1:20:00 | 0.00       | 0.00       | 1.54         | 2.67         | 4.16          | 7.62          | 9.96          | 13.38          | 20.53          |
|               | 1:25:00 | 0.00       | 0.00       | 1.24         | 2.09         | 3.14          | 5.52          | 7.15          | 9.11           | 14.05          |
|               | 1:30:00 | 0.00       | 0.00       | 1.04         | 1.76         | 2.53          | 3.84          | 5.06          | 6.29           | 9.98           |
|               | 1:35:00 | 0.00       | 0.00       | 0.95         | 1.60         | 2.19          | 2.85          | 3.83          | 4.63           | 7.53           |
|               | 1:40:00 | 0.00       | 0.00       | 0.91         | 1.39         | 1.96          | 2.25          | 3.07          | 3.58           | 5.88           |
|               | 1:45:00 | 0.00       | 0.00       | 0.88         | 1.23         | 1.80          | 1.86          | 2.56          | 2.85           | 4.75           |
|               | 1:50:00 | 0.00       | 0.00       | 0.87         | 1.11         | 1.68          | 1.62          | 2.24          | 2.35           | 3.97           |
|               | 1:55:00 | 0.00       | 0.00       | 0.76         | 1.03         | 1.53          | 1.46          | 2.02          | 2.00           | 3.41           |
|               | 2:00:00 | 0.00       | 0.00       | 0.67         | 0.93         | 1.34          | 1.35          | 1.88          | 1.79           | 3.07           |
|               | 2:05:00 | 0.00       | 0.00       | 0.51         | 0.69         | 0.99          | 0.99          | 1.37          | 1.30           | 2.22           |
|               | 2:10:00 | 0.00       | 0.00       | 0.38         | 0.51         | 0.71          | 0.71          | 0.98          | 0.94           | 1.58           |
|               | 2:15:00 | 0.00       | 0.00       | 0.28         | 0.37         | 0.51          | 0.51          | 0.71          | 0.68           | 1.14           |
|               | 2:20:00 | 0.00       | 0.00       | 0.20         | 0.27         | 0.36          | 0.36          | 0.50          | 0.49           | 0.82           |
|               | 2:25:00 | 0.00       | 0.00       | 0.15         | 0.18         | 0.26          | 0.25          | 0.35          | 0.34           | 0.57           |
|               | 2:30:00 | 0.00       | 0.00       | 0.10         | 0.13         | 0.18          | 0.18          | 0.25          | 0.24           | 0.39           |
|               | 2:35:00 | 0.00       | 0.00       | 0.07         | 0.09         | 0.12          | 0.12          | 0.17          | 0.16           | 0.26           |
|               | 2:40:00 | 0.00       | 0.00       | 0.05         | 0.06         | 0.08          | 0.08          | 0.11          | 0.10           | 0.16           |
|               | 2:45:00 | 0.00       | 0.00       | 0.03         | 0.03         | 0.04          | 0.04          | 0.06          | 0.05           | 0.08           |
|               | 2:50:00 | 0.00       | 0.00       | 0.01         | 0.02         | 0.02          | 0.02          | 0.02          | 0.02           | 0.03           |
|               | 2:55:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 3:00:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 3:05:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 3:10:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 3:15:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 3:20:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 3:25:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 3:30:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 3:35:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 3:40:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 3:45:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 3:50:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 3:55:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 4:00:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 4:05:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 4:10:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 4:15:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 4:20:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 4:25:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 4:30:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 4:35:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 4:40:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 4:45:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 4:50:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 4:55:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 5:00:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 5:05:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 5:10:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 5:15:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 5:20:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 5:25:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 5:30:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 5:35:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 5:40:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 5:45:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 5:50:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 5:55:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 6:00:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |

## DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.06 (July 2022)*

### Summary Stage-Area-Volume-Discharge Relationships

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

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

[illegible]



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## EL PASO COUNTY PCM APPLICABILITY FORM

EPC Project Number: \_\_\_\_\_

This form is to be used by the Engineer of Record to determine if the proposed construction activities are eligible for an exclusion to stormwater quality permanent control measure (PCM) requirements. All “applicable construction activity” within El Paso County (EPC) must comply with the post-construction stormwater management criteria. Reference ECM Appendix I for information about PCMs.

Note that this form only addresses stormwater quality for the site. Even if the site is fully excluded from needing a stormwater quality PCM, the site may still need to address stormwater detention (per DCMv1 Chap 1.5 and ECM Chap 3.2.8.B). However, if the site requires stormwater detention, then it must also address stormwater quality (per DCMv2 Chap 4.1 and ECM Appendix I.7.3). Refer to the Reference Information pages below for more guidance.

| Part I. Project Summary                                   |                                                                     |                                                                                                                                             |                                                                     |
|-----------------------------------------------------------|---------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| Project Name:                                             | The North Ranch Subdivision                                         |                                                                                                                                             |                                                                     |
| Is Stormwater Detention Required?                         | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | Is Water Quality Treatment Required? (i.e.: non-excluded disturbance >1ac)                                                                  | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No |
| Is an ESQCP Required?<br>If “No,” Check Applicable Reason | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Not an Applicable Construction Activity<br><input type="checkbox"/> Oil & Gas<br><input type="checkbox"/> R-Factor |                                                                     |
| Engineer of Record Email Address:                         | NJOKERST@ALLTERRAINENG.COM                                          |                                                                                                                                             |                                                                     |

| Part II. PCM Exclusions                                                                                                                                                                                                                                                         |                  |     |    |                                                                                                                                                                                                                                                                                                                         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|-----|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Note: Questions A through K directly correlate to Part I.E.4.a.i (A) to (K) on page 27 of the 2016 CDPS Statewide Standard <a href="#">MS4 General Permit COR090000</a> (i.e.: the MS4 Permit), as amended. Document exclusions that apply to the whole project or parts of it. |                  |     |    |                                                                                                                                                                                                                                                                                                                         |
| Questions                                                                                                                                                                                                                                                                       | Excluded Acreage | Yes | No | Notes                                                                                                                                                                                                                                                                                                                   |
| A. Is this project a “Pavement Management Site?”                                                                                                                                                                                                                                |                  |     | X  | This exclusion applies to the maintenance, rehabilitation, and reconstruction of pavement on existing roads, bridges, bike lanes, and parking along roads. Areas used primarily for parking (i.e.: separate lots not along roadway) or access to parking are not included. No increase in impervious area is allowable. |
| B. Review two options below to see if project is an “Excluded Roadway Development.”                                                                                                                                                                                             |                  |     |    | Does <u>not</u> include sidewalks. Does include curb & gutter.                                                                                                                                                                                                                                                          |
| • Does the project include improvements to an existing roadway that adds < 1 acre of paved or gravel area per mile of roadway?                                                                                                                                                  |                  |     | X  | If selected, list the proposed additional acreage per mile in Part IV Notes below.                                                                                                                                                                                                                                      |
| • Does the project include improvements to an existing roadway that adds ≤ 8.25 ft of paved width at any location?                                                                                                                                                              |                  |     | X  | If selected, list the proposed additional width in Part IV Notes below.                                                                                                                                                                                                                                                 |



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## EL PASO COUNTY PCM APPLICABILITY FORM

EPC Project Number: \_\_\_\_\_

| Part II. PCM Exclusions (continued)                                                                                                                                                                                                                                                                                                                                      |                  |          |          |                                                                                                                                                                                                                                                                                                                                       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|----------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Questions                                                                                                                                                                                                                                                                                                                                                                | Excluded Acreage | Yes      | No       | Notes                                                                                                                                                                                                                                                                                                                                 |
| C. Does the project include "Excluded Existing Roadway Areas?"                                                                                                                                                                                                                                                                                                           |                  |          | <b>X</b> | For redevelopment of <u>existing</u> roadways. This exclusion only excludes the original roadway area, it does NOT apply to the entire project. This exclusion applies only when the proposed project will expand the existing roadway width by <2x on average. If selected, list the proposed expanded width in Part IV Notes below. |
| D. Is the project considered an Aboveground or Underground Utilities activity?                                                                                                                                                                                                                                                                                           |                  |          | <b>X</b> | Activity can <u>not</u> permanently alter the terrain, ground cover, or drainage patterns from existing conditions.                                                                                                                                                                                                                   |
| E. Is the project considered a "Large Lot Single-Family Site"?<br><i>This exclusion only pertains to the lots and does not include roadways.</i>                                                                                                                                                                                                                         | 46.16 ac         | <b>X</b> |          | Must be a single-family residential lot or agricultural zoned land with $\geq 2.5$ acres per dwelling and total lot impervious area < 10%. If "Yes," notate the percent impervious below in Part IV: Notes.                                                                                                                           |
| F. Do Non-Residential or Non-Commercial Infiltration Conditions exist?<br><i>Post-development surface conditions do not result in concentrated stormwater flow or surface water discharge during an 80<sup>th</sup> percentile stormwater runoff event, and the 80<sup>th</sup> percentile event must be infiltrated.</i>                                                |                  |          | <b>X</b> | Exclusion does not apply to residential or commercial sites for buildings. A site-specific study is required and must show rainfall and soil conditions, allowable slopes, surface conditions, and ratios of imperviousness area to pervious area.                                                                                    |
| G. Is the project land disturbance to Undeveloped Land where undeveloped land remains undeveloped following the activity?                                                                                                                                                                                                                                                |                  | <b>X</b> |          | Project must be on land with no human made structures such as buildings or pavement. The proposed development must return the disturbed area to its historical condition. See CDPHE's "Standard MS4 Permit FAQ" for more detail on how this exclusion applies.                                                                        |
| H. Is the project a Stream Stabilization Site?                                                                                                                                                                                                                                                                                                                           |                  |          | <b>X</b> |                                                                                                                                                                                                                                                                                                                                       |
| I. Is the project a Bike or Pedestrian Trail?                                                                                                                                                                                                                                                                                                                            |                  |          | <b>X</b> | Bike lanes for roadways are not included in this exclusion but may qualify if attached to a larger roadway activity that is excluded in A, B or C above. Pedestrian trails (e.g. sidewalks) that are attached to a roadway do not apply.                                                                                              |
| J. Is the project Oil and Gas Exploration?                                                                                                                                                                                                                                                                                                                               |                  |          | <b>X</b> | Activities and facilities associated with oil and gas exploration are excluded.                                                                                                                                                                                                                                                       |
| K. Is the project in a County Growth Area?                                                                                                                                                                                                                                                                                                                               |                  |          |          | El Paso County does not apply this exclusion.                                                                                                                                                                                                                                                                                         |
| If any exclusions above apply (via a "Yes" for any row), runoff from those areas is excluded from stormwater quality treatment requirements. All runoff from remaining non-excluded disturbed areas will need to be treated by a stormwater quality PCM, unless remaining area is <1ac. If remaining area is >1ac, select at least one Design Standard on the next page. |                  |          |          |                                                                                                                                                                                                                                                                                                                                       |



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## EL PASO COUNTY PCM APPLICABILITY FORM

EPC Project Number: \_\_\_\_\_

| Part III: PCM Information                                                                                                                                                                                                    |     |    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----|
| Questions                                                                                                                                                                                                                    | Yes | No |
| 1. Which of the following Design Standard(s) will the project utilize?<br><i>(If a PCM is required, you must select at least one. See Control Measure Requirements identified in MS4 Permit Part I.E.4.a.iv on page 29.)</i> |     |    |
| A. Water Quality Capture Volume (WQCV) Standard                                                                                                                                                                              | X   |    |
| B. Pollutant Removal Standard - 80% Total Suspended Solids Removal (TSS)<br><i>(must treat runoff to &lt;30mg/L of TSS)</i>                                                                                                  |     |    |
| C. Runoff Reduction Standard                                                                                                                                                                                                 |     |    |
| D. Applicable Development Site Draining to a Regional WQCV Control Measure<br><i>(no conveyance via "Waters of the State")</i>                                                                                               |     |    |
| E. Applicable Development Site Draining to a Regional WQCV Facility<br><i>(conveyance allowable via "Waters of the State," if the 8 conditions in the MS4 permit are met and documented in the drainage report)</i>          |     |    |
| F. Constrained Redevelopment Sites Standard<br><i>(must be pre-approved by ECM Administrator)</i>                                                                                                                            |     |    |
| G. Previous Permit Term Standard                                                                                                                                                                                             |     |    |
| 2. Will any of the PCMs be located within any other jurisdiction besides EPC?                                                                                                                                                |     | X  |

| Part IV: Notes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Provide info regarding all applicable PCM(s) and PCM Exclusion(s) including location, PCM name(s)/number(s), and additional relevant filings or reports or maintenance agreements, etc. Attach an additional sheet if you need more space. Attaching a detailed summary table would replace the need for any notes here.                                                                                                                                                                                                                                            |
| The site area is 48.23 acres. The site will be subdivided into (15) 2.5+ acre lots, (1) drainage tract (where a FSD WQ & detention pond will be located) and (1) private road & drainage tract.                                                                                                                                                                                                                                                                                                                                                                     |
| The total lot area is 46.16 ac. 2.5+ acre lots are excluded from water quality per Part 2, Section E above.                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| The private roadway is located within the lot area. The total area of paved roadway is 2.91 acres with 0.39 acres of gravel shoulder. Of the total paved area & gravel shoulder, 2.52 acres and 0.34 acres, respectively, will be detained in Pond 1. The remaining 0.39 acres of paved area & 0.05 acres of gravel shoulder are topographically constrained from being captured by Pond 1. However, the total 0.44 acres is less than the 1 acre allowable threshold per EPC ECM Appendix I Section I.6.3.A.1.a and will be excluded from water quality treatment. |
| The remaining site area will remain undeveloped and not require water quality treatment.                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |



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## EL PASO COUNTY PCM APPLICABILITY FORM

EPC Project Number: \_\_\_\_\_

### Part V: Signatures

Applicant: This PCM Applicability Form was prepared under my direction and supervision and is correct to the best of my knowledge and belief. It was prepared along with the project design, construction plans, drainage report, specifications, and maintenance and access agreements as required. And it has been reviewed for compliance with the Post Construction Stormwater Management criteria and MS4 Permit requirements.



\_\_\_\_\_  
Signature and Stamp of Engineer or Recorder

(If the project is not an Applicable Construction Activity, this line can be signed by the Applicant or their rep, they do not have to be an engineer)

\_\_\_\_\_  
08/26/2026

\_\_\_\_\_  
Date

\_\_\_\_\_  
El Paso County: This PCM Applicability Form has been reviewed and the project design, construction plans, drainage report, specifications, and maintenance and access agreements as required, have been reviewed for compliance with the Post Construction Stormwater Management process and MS4 Permit requirements.

\_\_\_\_\_  
Signature of El Paso County Project Engineer

\_\_\_\_\_  
Date





## **APPENDIX E – REFENCE MATERIAL**



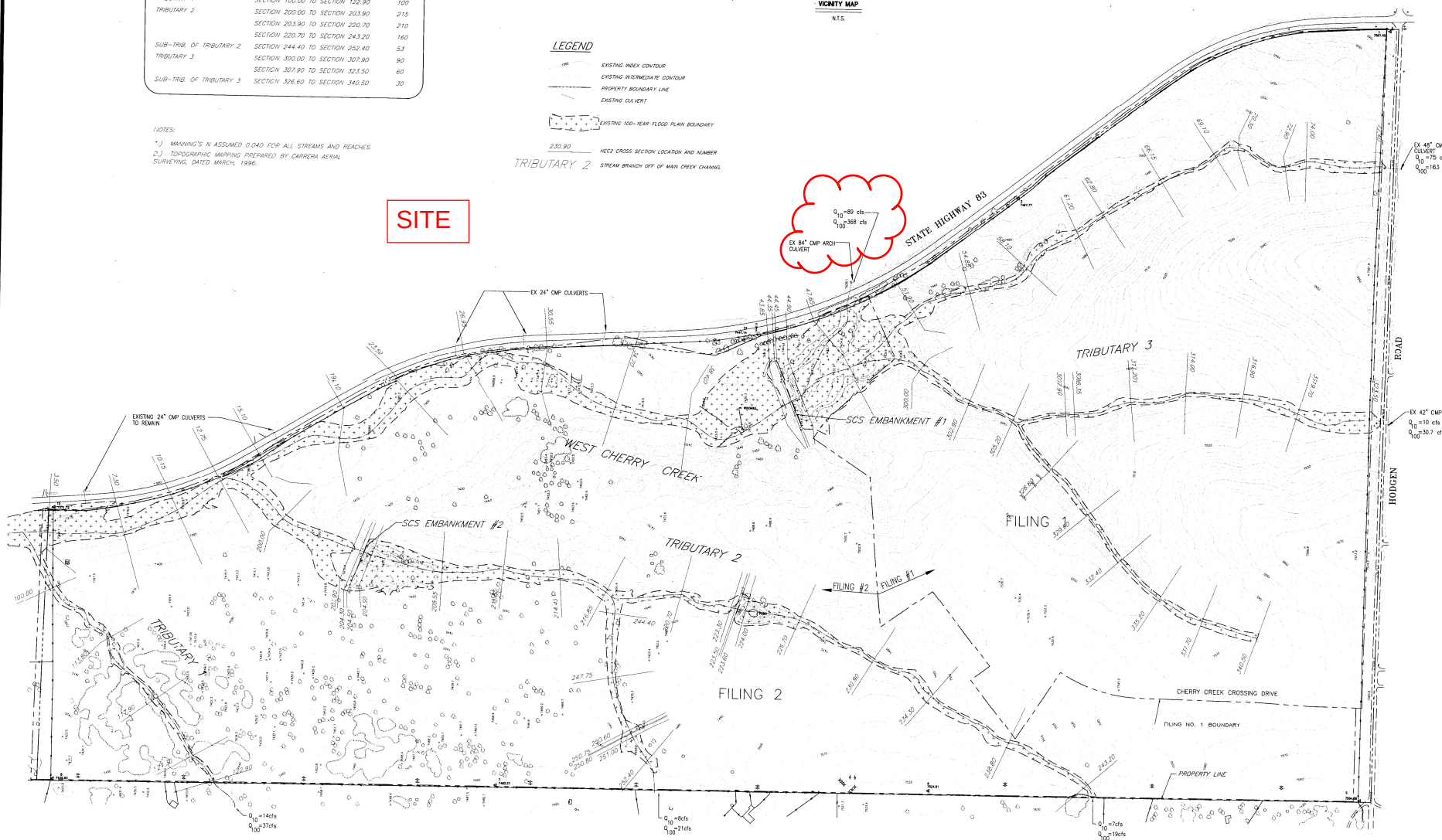
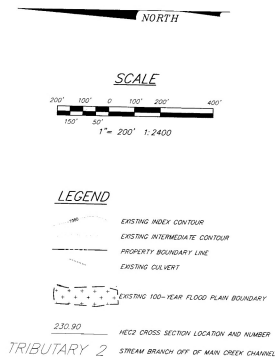




| 100-YEAR DISCHARGE SUMMARY WITHOUT STORAGE |                                  |                           |
|--------------------------------------------|----------------------------------|---------------------------|
| STREAM                                     | REACH                            | Q <sub>100</sub><br>(cfs) |
| CHERRY CREEK (MAIN)                        | SECTION 1.00 TO SECTION 3.50     | 1020                      |
|                                            | SECTION 3.50 TO SECTION 15.10    | 920                       |
|                                            | SECTION 15.10 TO SECTION 43.85   | 530                       |
|                                            | SECTION 43.85 TO SECTION 51.90   | 440                       |
| TRIBUTARY 1                                | SECTION 51.90 TO SECTION 77.40   | 90                        |
|                                            | SECTION 100.00 TO SECTION 122.90 | 100                       |
| TRIBUTARY 2                                | SECTION 200.00 TO SECTION 203.90 | 215                       |
|                                            | SECTION 203.90 TO SECTION 220.70 | 210                       |
|                                            | SECTION 220.70 TO SECTION 243.20 | 160                       |
| SUB-TRIB. OF TRIBUTARY 2                   | SECTION 244.40 TO SECTION 252.40 | 53                        |
| TRIBUTARY 3                                | SECTION 300.00 TO SECTION 307.90 | 90                        |
|                                            | SECTION 307.90 TO SECTION 323.50 | 60                        |
| SUB-TRIB. OF TRIBUTARY 3                   | SECTION 326.60 TO SECTION 340.50 | 30                        |

NOTES:

- 1.) MANNING'S N ASSUMED 0.040 FOR ALL STREAMS AND REACHES.  
 2.) TOPOGRAPHIC MAPPING PREPARED BY CARDEIRA AERIAL SURVEYING, DATED MARCH, 1996.



**Image 1: Existing 18" CMP culvert at Highway 83 driveway**



**Image 2: Existing 24" CMP culvert at Highway 83 driveway (Ex DP8, Pr DPO)**





**Image 3: Highway 83 swale, north of Ex DP8, Pr DPO**



**Image 4: Highway 83 swale, typical condition**



**Image 5: Highway 83 existing 24" CMP culvert (Ex DP6, Pr DPI)**



**Image 6: Highway 83 swale north of Image 5**





**Image 7: Highway 83 existing 24" CMP culvert (Ex DP3, Pr DPG)**



**Image 8: Highway 83 swale north of Image 7**



**Image 9: Highway 83 existing 24" CMP culvert (Ex DP2, Pr DPE)**



**Image 10: Highway 83 existing 84" CMP culvert (Ex DP1, Pr DPB)**





**Image 11: Outfall Location - Highway 83 existing 24" CMP culvert (Ex DP2, Pr DPE)**



**Image 12: Outfall Location - Highway 83 existing 24" CMP culvert (Ex DP3, Pr DPG)**



**Image 13: Outfall Location - Highway 83 existing 24" CMP culvert (Ex DP8, Pr DPO)**



**Image 14: Outfall Location - Highway 83 existing 24" CMP culvert (Ex DP6, Pr DPI)**



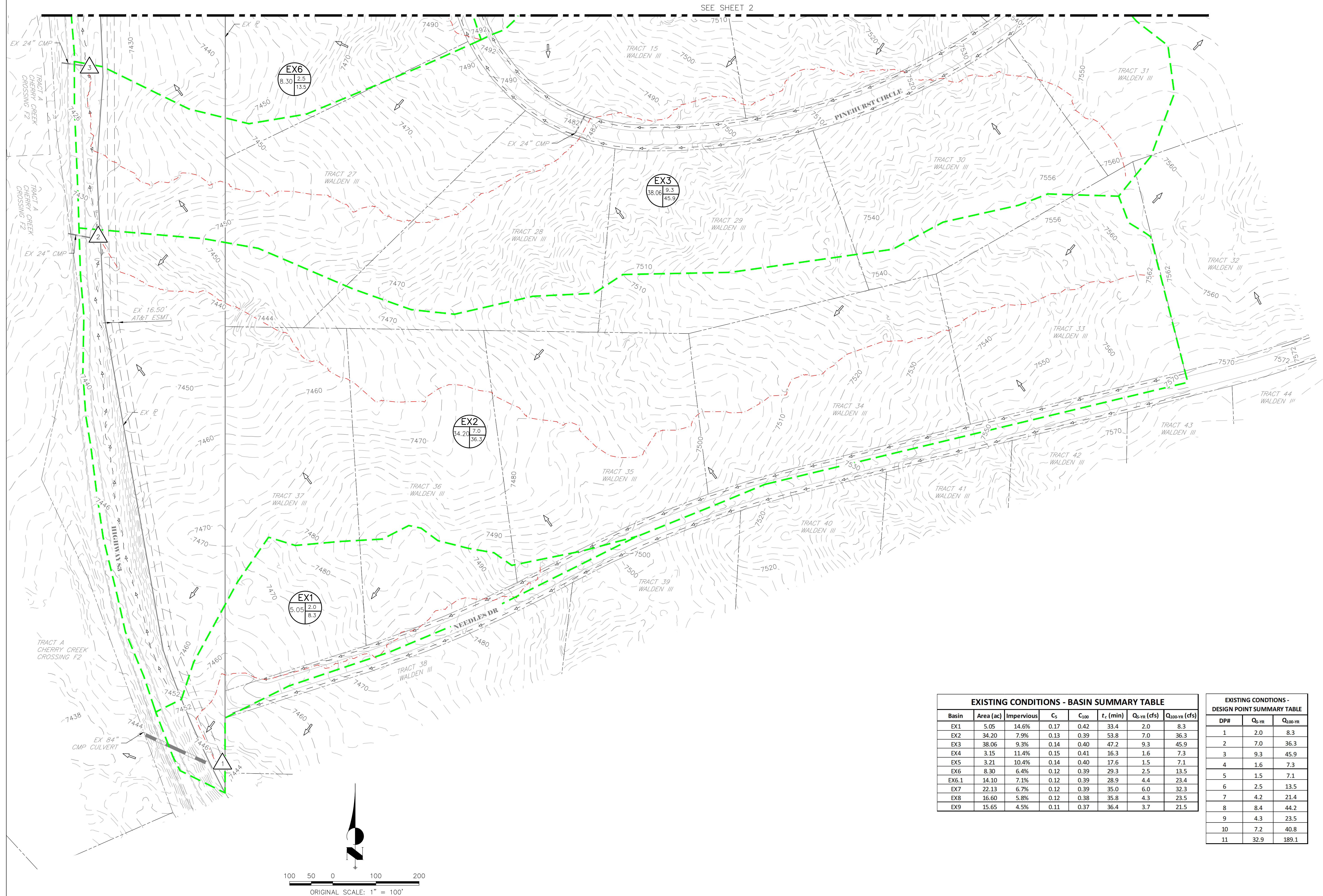


## **APPENDIX F – DRAINAGE MAPS**



# THE NORTH RANCH SUBDIVISION

## EXISTING DRAINAGE MAP



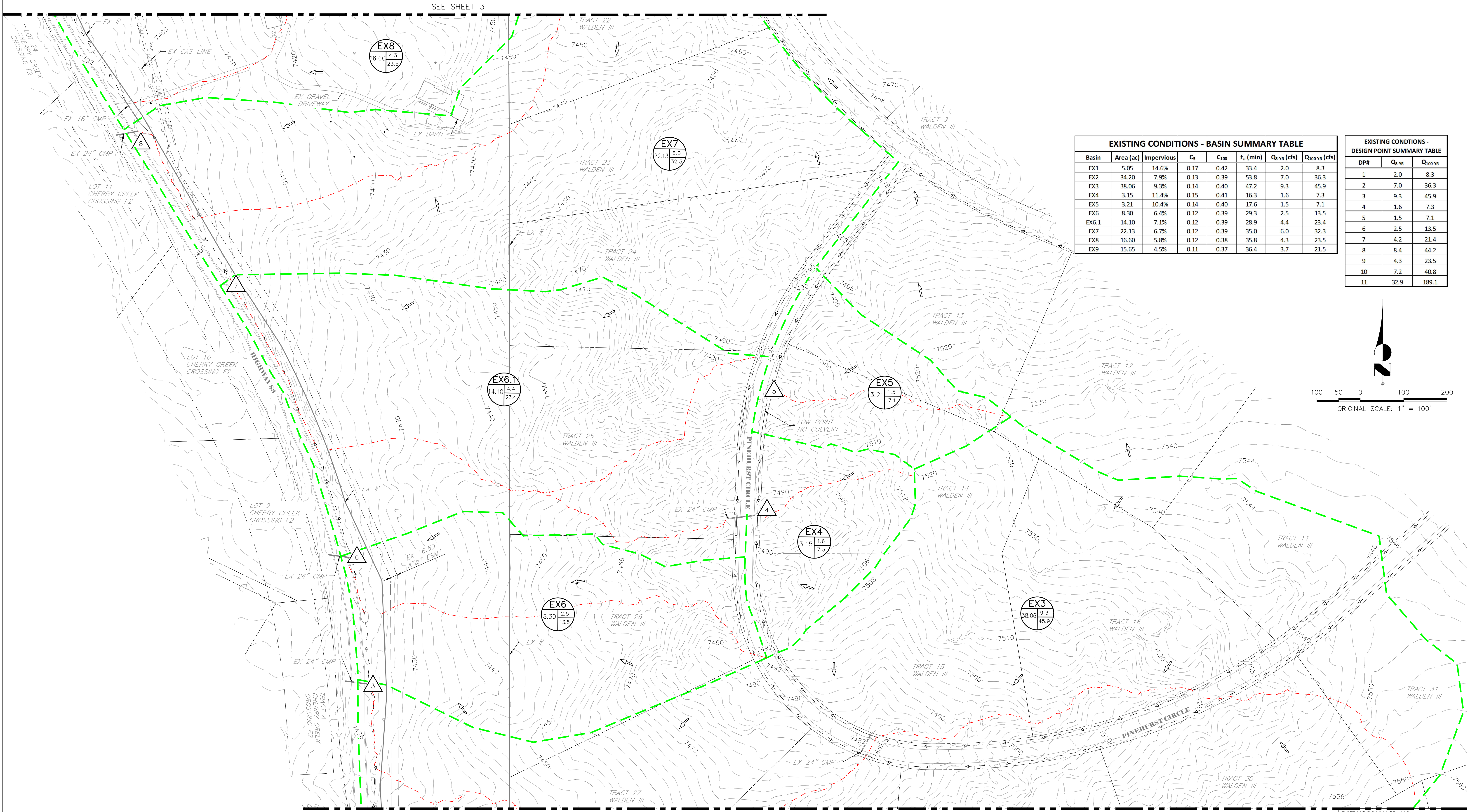
| EXISTING CONDITIONS - BASIN SUMMARY TABLE |           |            |                |                  |                      |                         |                           |
|-------------------------------------------|-----------|------------|----------------|------------------|----------------------|-------------------------|---------------------------|
| Basin                                     | Area (ac) | Impervious | C <sub>s</sub> | C <sub>100</sub> | t <sub>c</sub> (min) | Q <sub>s-yr</sub> (cfs) | Q <sub>100-yr</sub> (cfs) |
| EX1                                       | 5.05      | 14.6%      | 0.17           | 0.42             | 33.4                 | 2.0                     | 8.3                       |
| EX2                                       | 34.20     | 7.9%       | 0.13           | 0.39             | 53.8                 | 7.0                     | 36.3                      |
| EX3                                       | 38.06     | 9.3%       | 0.14           | 0.40             | 47.2                 | 9.3                     | 45.9                      |
| EX4                                       | 3.15      | 11.4%      | 0.15           | 0.41             | 16.3                 | 1.6                     | 7.3                       |
| EX5                                       | 3.21      | 10.4%      | 0.14           | 0.40             | 17.6                 | 1.5                     | 7.1                       |
| EX6                                       | 8.30      | 6.4%       | 0.12           | 0.39             | 29.3                 | 2.5                     | 13.5                      |
| EX6.1                                     | 14.10     | 7.1%       | 0.12           | 0.39             | 28.9                 | 4.4                     | 23.4                      |
| EX7                                       | 22.13     | 6.7%       | 0.12           | 0.39             | 35.0                 | 6.0                     | 32.3                      |
| EX8                                       | 16.60     | 5.8%       | 0.12           | 0.38             | 35.8                 | 4.3                     | 23.5                      |
| EX9                                       | 15.65     | 4.5%       | 0.11           | 0.37             | 36.4                 | 3.7                     | 21.5                      |

| DP# | Q <sub>S-YR</sub> | Q <sub>LOO-YR</sub> |
|-----|-------------------|---------------------|
| 1   | 2.0               | 8.3                 |
| 2   | 7.0               | 36.3                |
| 3   | 9.3               | 45.9                |
| 4   | 1.6               | 7.3                 |
| 5   | 1.5               | 7.1                 |
| 6   | 2.5               | 13.5                |
| 7   | 4.2               | 21.4                |
| 8   | 8.4               | 44.2                |
| 9   | 4.3               | 23.5                |
| 10  | 7.2               | 40.8                |
| 11  | 32.9              | 189.1               |



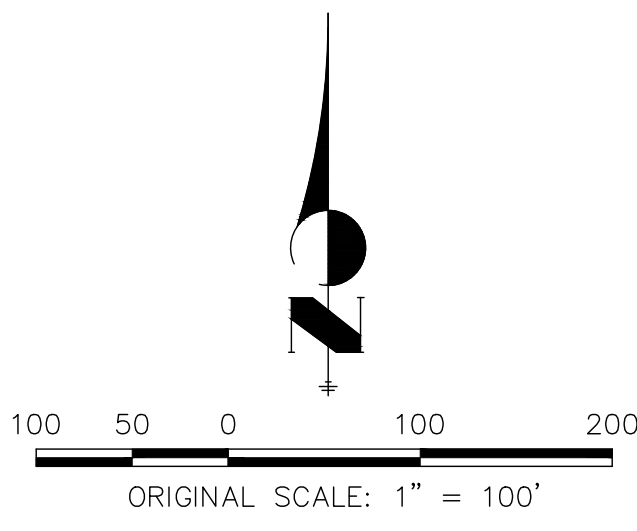
# THE NORTH RANCH SUBDIVISION

## EXISTING DRAINAGE MAP



| EXISTING CONDITIONS - BASIN SUMMARY TABLE |           |            |                |                  |                      |                          |                            |
|-------------------------------------------|-----------|------------|----------------|------------------|----------------------|--------------------------|----------------------------|
| Basin                                     | Area (ac) | Impervious | C <sub>s</sub> | C <sub>100</sub> | t <sub>c</sub> (min) | Q <sub>s</sub> -YR (cfs) | Q <sub>100</sub> -YR (cfs) |
| EX1                                       | 5.05      | 14.6%      | 0.17           | 0.42             | 33.4                 | 2.0                      | 8.3                        |
| EX2                                       | 34.20     | 7.9%       | 0.13           | 0.39             | 53.8                 | 7.0                      | 36.3                       |
| EX3                                       | 38.06     | 9.3%       | 0.14           | 0.40             | 47.2                 | 9.3                      | 45.9                       |
| EX4                                       | 3.15      | 11.4%      | 0.15           | 0.41             | 16.3                 | 1.6                      | 7.3                        |
| EX5                                       | 3.21      | 10.4%      | 0.14           | 0.40             | 17.6                 | 1.5                      | 7.1                        |
| EX6                                       | 8.30      | 6.4%       | 0.12           | 0.39             | 29.3                 | 2.5                      | 13.5                       |
| EX6.1                                     | 14.10     | 7.1%       | 0.12           | 0.39             | 28.9                 | 4.4                      | 23.4                       |
| EX7                                       | 22.13     | 6.7%       | 0.12           | 0.39             | 35.0                 | 6.0                      | 32.3                       |
| EX8                                       | 16.60     | 5.8%       | 0.12           | 0.38             | 35.8                 | 4.3                      | 23.5                       |
| EX9                                       | 15.65     | 4.5%       | 0.11           | 0.37             | 36.4                 | 3.7                      | 21.5                       |

| EXISTING CONDIONS -<br>DESIGN POINT SUMMARY TABLE |                    |                      |
|---------------------------------------------------|--------------------|----------------------|
| DP#                                               | Q <sub>s</sub> -YR | Q <sub>100</sub> -YR |
| 1                                                 | 2.0                | 8.3                  |
| 2                                                 | 7.0                | 36.3                 |
| 3                                                 | 9.3                | 45.9                 |
| 4                                                 | 1.6                | 7.3                  |
| 5                                                 | 1.5                | 7.1                  |
| 6                                                 | 2.5                | 13.5                 |
| 7                                                 | 4.2                | 21.4                 |
| 8                                                 | 8.4                | 44.2                 |
| 9                                                 | 4.3                | 23.5                 |
| 10                                                | 7.2                | 40.8                 |
| 11                                                | 32.9               | 189.1                |



SEE SHEET 1

SEE SHEET 3

EXISTING DRAINAGE MAP

THE NORTH RANCH SUBDIVISION

JOB NO. 26001

LOCATION: EPC

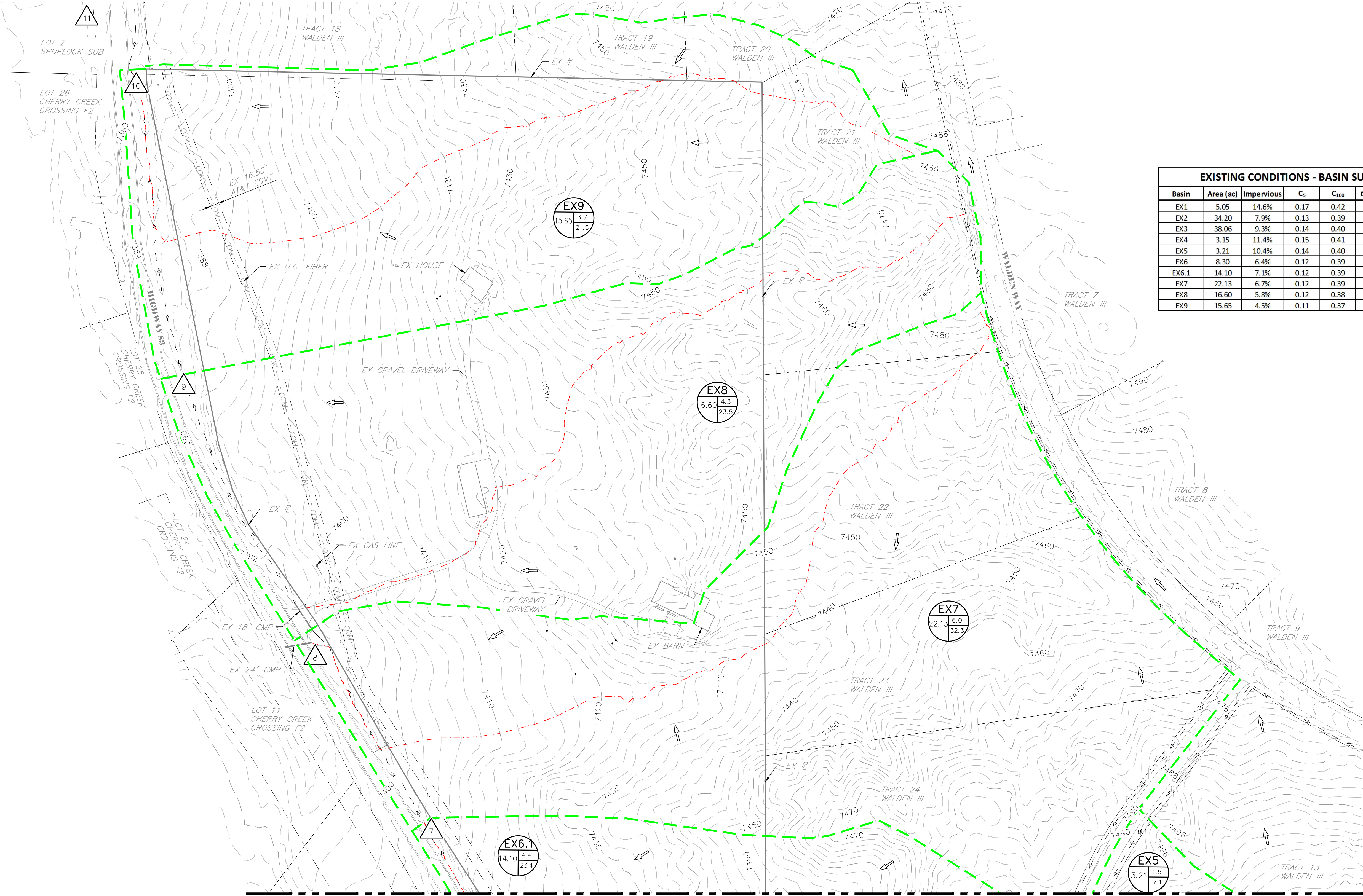
08/26/2026

SHEET

2



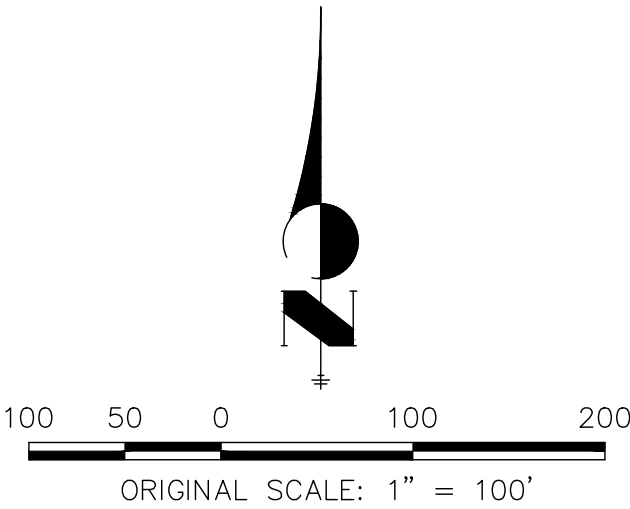
THE NORTH RANCH SUBDIVISION  
EXISTING DRAINAGE MAP



| EXISTING CONDITIONS - BASIN SUMMARY TABLE |           |            |                |                  |                      |                          |                            |
|-------------------------------------------|-----------|------------|----------------|------------------|----------------------|--------------------------|----------------------------|
| Basin                                     | Area (ac) | Impervious | C <sub>s</sub> | C <sub>100</sub> | t <sub>c</sub> (min) | Q <sub>s</sub> -YR (cfs) | Q <sub>100</sub> -YR (cfs) |
| EX1                                       | 5.05      | 14.6%      | 0.17           | 0.42             | 33.4                 | 2.0                      | 8.3                        |
| EX2                                       | 34.20     | 7.9%       | 0.13           | 0.39             | 53.8                 | 7.0                      | 36.3                       |
| EX3                                       | 38.06     | 9.3%       | 0.14           | 0.40             | 47.2                 | 9.3                      | 45.9                       |
| EX4                                       | 3.15      | 11.4%      | 0.15           | 0.41             | 16.3                 | 1.6                      | 7.3                        |
| EX5                                       | 3.21      | 10.4%      | 0.14           | 0.40             | 17.6                 | 1.5                      | 7.1                        |
| EX6                                       | 8.30      | 6.4%       | 0.12           | 0.39             | 29.3                 | 2.5                      | 13.5                       |
| EX6.1                                     | 14.10     | 7.1%       | 0.12           | 0.39             | 28.9                 | 4.4                      | 23.4                       |
| EX7                                       | 22.13     | 6.7%       | 0.12           | 0.39             | 35.0                 | 6.0                      | 32.3                       |
| EX8                                       | 16.60     | 5.8%       | 0.12           | 0.38             | 35.8                 | 4.3                      | 23.5                       |
| EX9                                       | 15.65     | 4.5%       | 0.11           | 0.37             | 36.4                 | 3.7                      | 21.5                       |

| EXISTING CONDIONS -<br>DESIGN POINT SUMMARY TABLE |                    |                      |
|---------------------------------------------------|--------------------|----------------------|
| DP#                                               | Q <sub>s</sub> -YR | Q <sub>100</sub> -YR |
| 1                                                 | 2.0                | 8.3                  |
| 2                                                 | 7.0                | 36.3                 |
| 3                                                 | 9.3                | 45.9                 |
| 4                                                 | 1.6                | 7.3                  |
| 5                                                 | 1.5                | 7.1                  |
| 6                                                 | 2.5                | 13.5                 |
| 7                                                 | 4.2                | 21.4                 |
| 8                                                 | 8.4                | 44.2                 |
| 9                                                 | 4.3                | 23.5                 |
| 10                                                | 7.2                | 40.8                 |
| 11                                                | 32.9               | 189.1                |

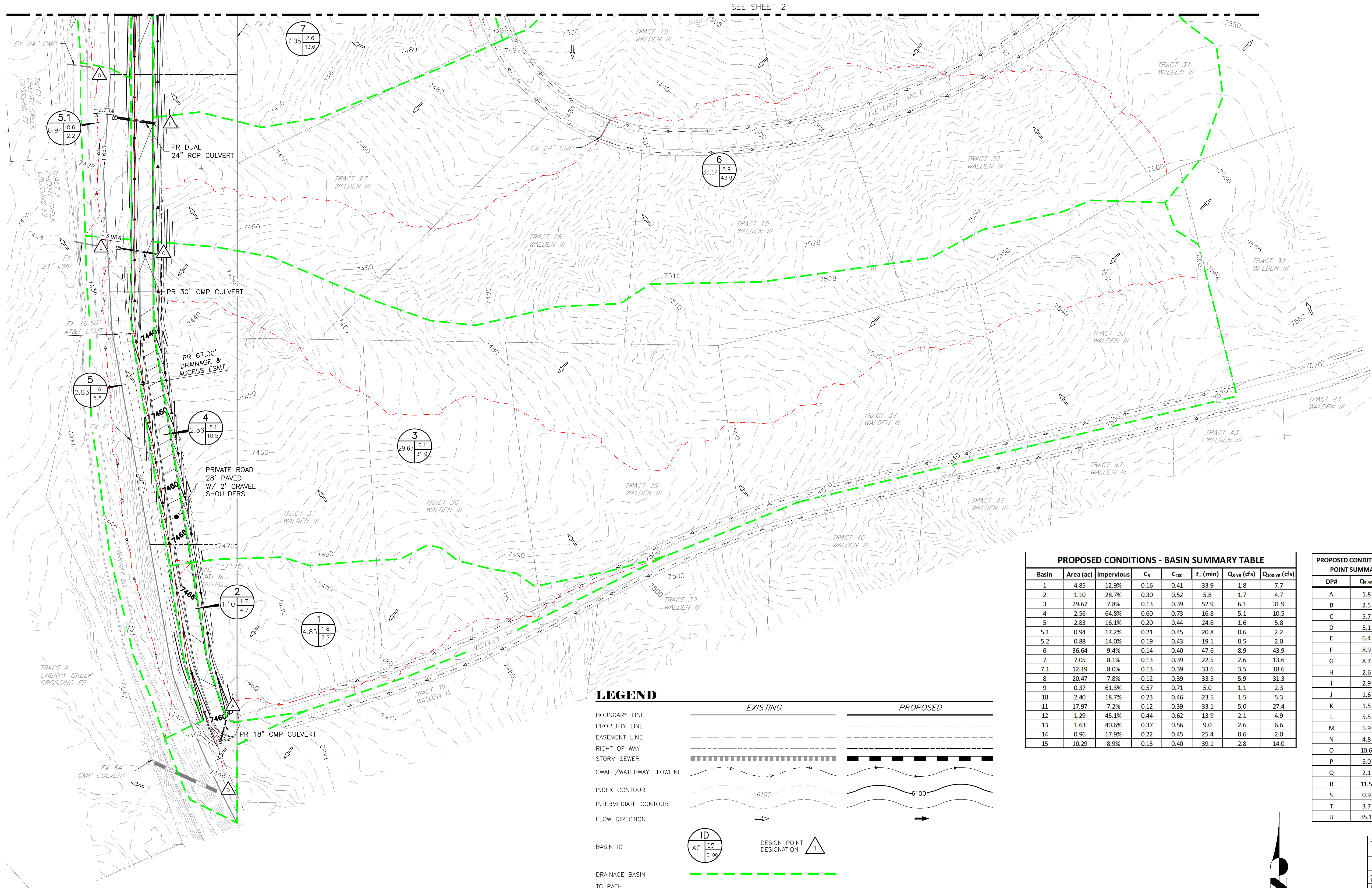
SEE SHEET 2



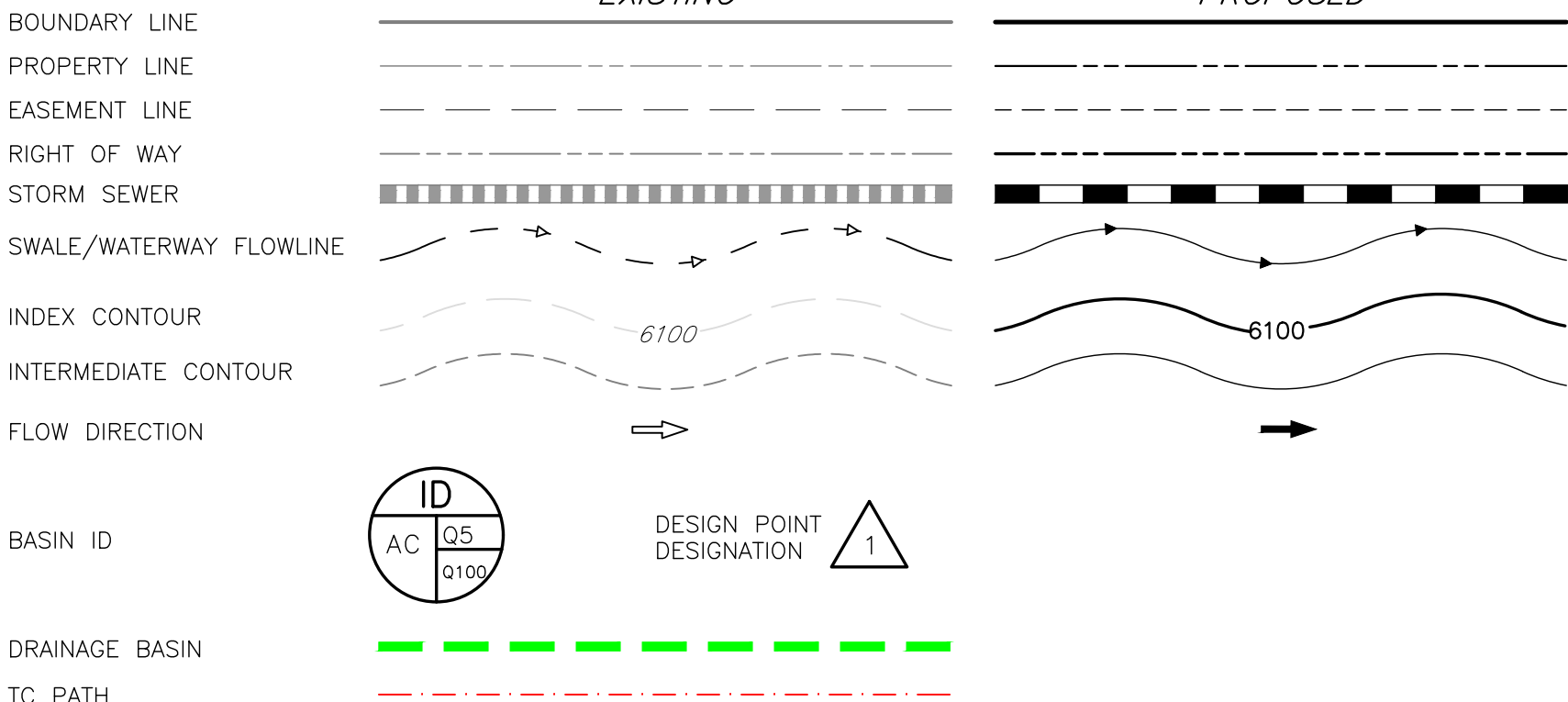


# THE NORTH RANCH SUBDIVISION

## PROPOSED DRAINAGE MAP

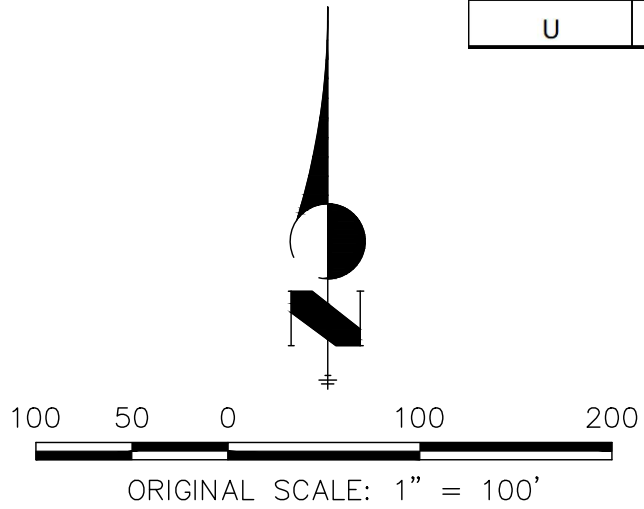


### LEGEND



| PROPOSED CONDITIONS - BASIN SUMMARY TABLE |           |            |                |                  |                      |                          |                            |
|-------------------------------------------|-----------|------------|----------------|------------------|----------------------|--------------------------|----------------------------|
| Basin                                     | Area (ac) | Impervious | C <sub>s</sub> | C <sub>100</sub> | t <sub>c</sub> (min) | Q <sub>S</sub> -YR (cfs) | Q <sub>100</sub> -YR (cfs) |
| 1                                         | 4.85      | 12.9%      | 0.16           | 0.41             | 33.9                 | 1.8                      | 7.7                        |
| 2                                         | 1.10      | 28.7%      | 0.30           | 0.52             | 5.8                  | 1.7                      | 4.7                        |
| 3                                         | 29.67     | 7.8%       | 0.13           | 0.39             | 52.9                 | 6.1                      | 31.9                       |
| 4                                         | 2.56      | 64.8%      | 0.60           | 0.73             | 16.8                 | 5.1                      | 10.5                       |
| 5                                         | 2.83      | 16.1%      | 0.20           | 0.44             | 24.8                 | 1.6                      | 5.8                        |
| 5.1                                       | 0.94      | 17.2%      | 0.21           | 0.45             | 20.8                 | 0.6                      | 2.2                        |
| 5.2                                       | 0.88      | 14.0%      | 0.19           | 0.43             | 19.1                 | 0.5                      | 2.0                        |
| 6                                         | 36.64     | 9.4%       | 0.14           | 0.40             | 47.6                 | 8.9                      | 43.9                       |
| 7                                         | 7.05      | 8.1%       | 0.13           | 0.39             | 22.5                 | 2.6                      | 13.6                       |
| 7.1                                       | 12.19     | 8.0%       | 0.13           | 0.39             | 33.6                 | 3.5                      | 18.6                       |
| 8                                         | 20.47     | 7.8%       | 0.12           | 0.39             | 33.5                 | 5.9                      | 31.3                       |
| 9                                         | 0.37      | 61.3%      | 0.57           | 0.71             | 5.0                  | 1.1                      | 2.3                        |
| 10                                        | 2.40      | 18.7%      | 0.23           | 0.46             | 23.5                 | 1.5                      | 5.3                        |
| 11                                        | 17.97     | 7.2%       | 0.12           | 0.39             | 33.1                 | 5.0                      | 27.4                       |
| 12                                        | 1.29      | 45.1%      | 0.44           | 0.62             | 13.9                 | 2.1                      | 4.9                        |
| 13                                        | 1.63      | 40.6%      | 0.37           | 0.56             | 9.0                  | 2.6                      | 6.6                        |
| 14                                        | 0.96      | 17.9%      | 0.22           | 0.45             | 25.4                 | 0.6                      | 2.0                        |
| 15                                        | 10.29     | 8.9%       | 0.13           | 0.40             | 39.1                 | 2.8                      | 14.0                       |

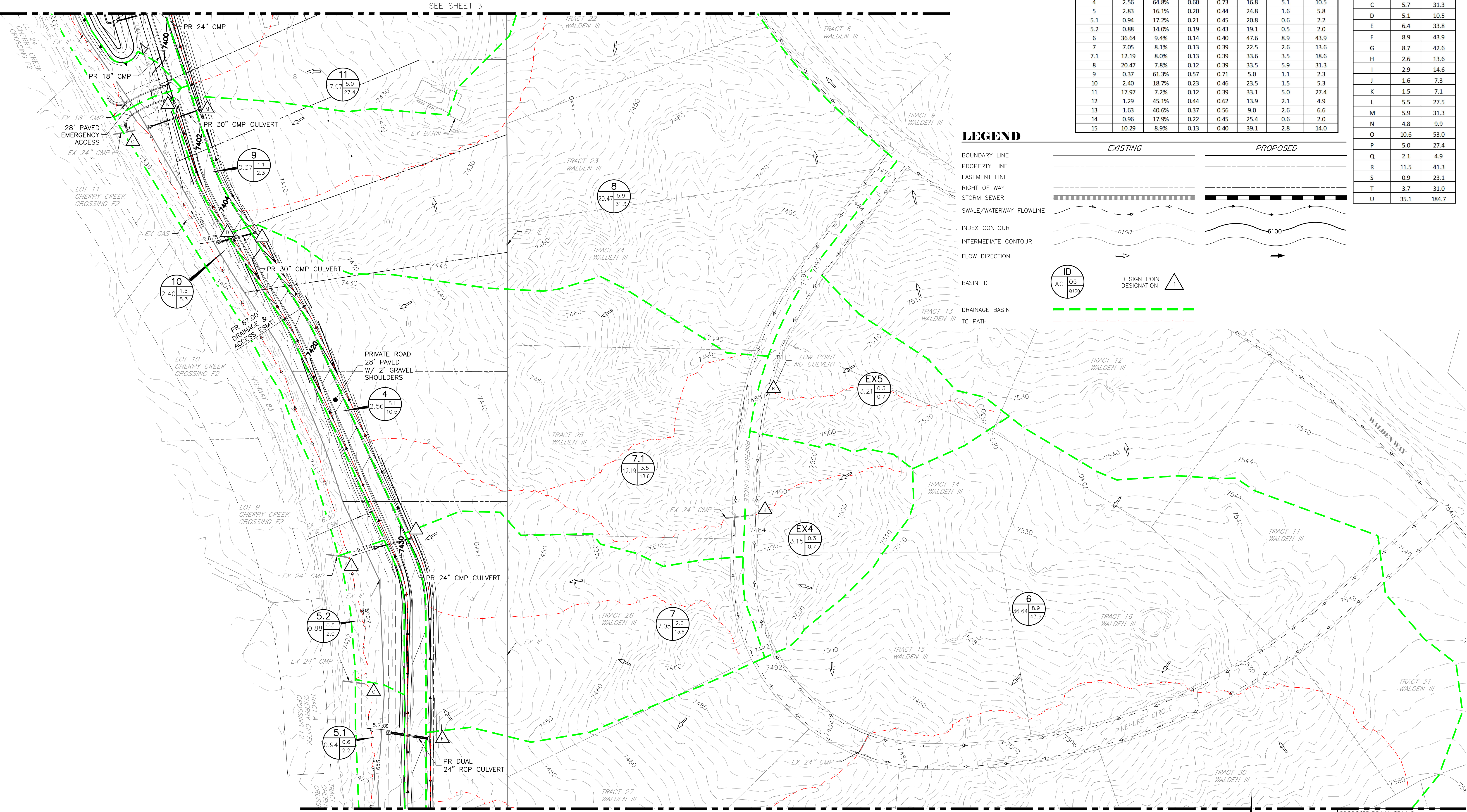
| PROPOSED CONDITIONS - DESIGN POINT SUMMARY TABLE |                    |                      |
|--------------------------------------------------|--------------------|----------------------|
| DP#                                              | Q <sub>S</sub> -YR | Q <sub>100</sub> -YR |
| A                                                | 1.8                | 7.7                  |
| B                                                | 2.5                | 9.7                  |
| C                                                | 5.7                | 31.3                 |
| D                                                | 5.1                | 10.5                 |
| E                                                | 6.4                | 33.8                 |
| F                                                | 8.9                | 43.9                 |
| G                                                | 8.7                | 42.6                 |
| H                                                | 2.6                | 13.6                 |
| I                                                | 2.9                | 14.6                 |
| J                                                | 1.6                | 7.3                  |
| K                                                | 1.5                | 7.1                  |
| L                                                | 5.5                | 27.5                 |
| M                                                | 5.9                | 31.3                 |
| N                                                | 4.8                | 9.9                  |
| O                                                | 10.6               | 53.0                 |
| P                                                | 5.0                | 27.4                 |
| Q                                                | 2.1                | 4.9                  |
| R                                                | 11.5               | 41.3                 |
| S                                                | 0.9                | 23.1                 |
| T                                                | 3.7                | 31.0                 |
| U                                                | 35.1               | 184.7                |





# NEEDLES SUBDIVISION

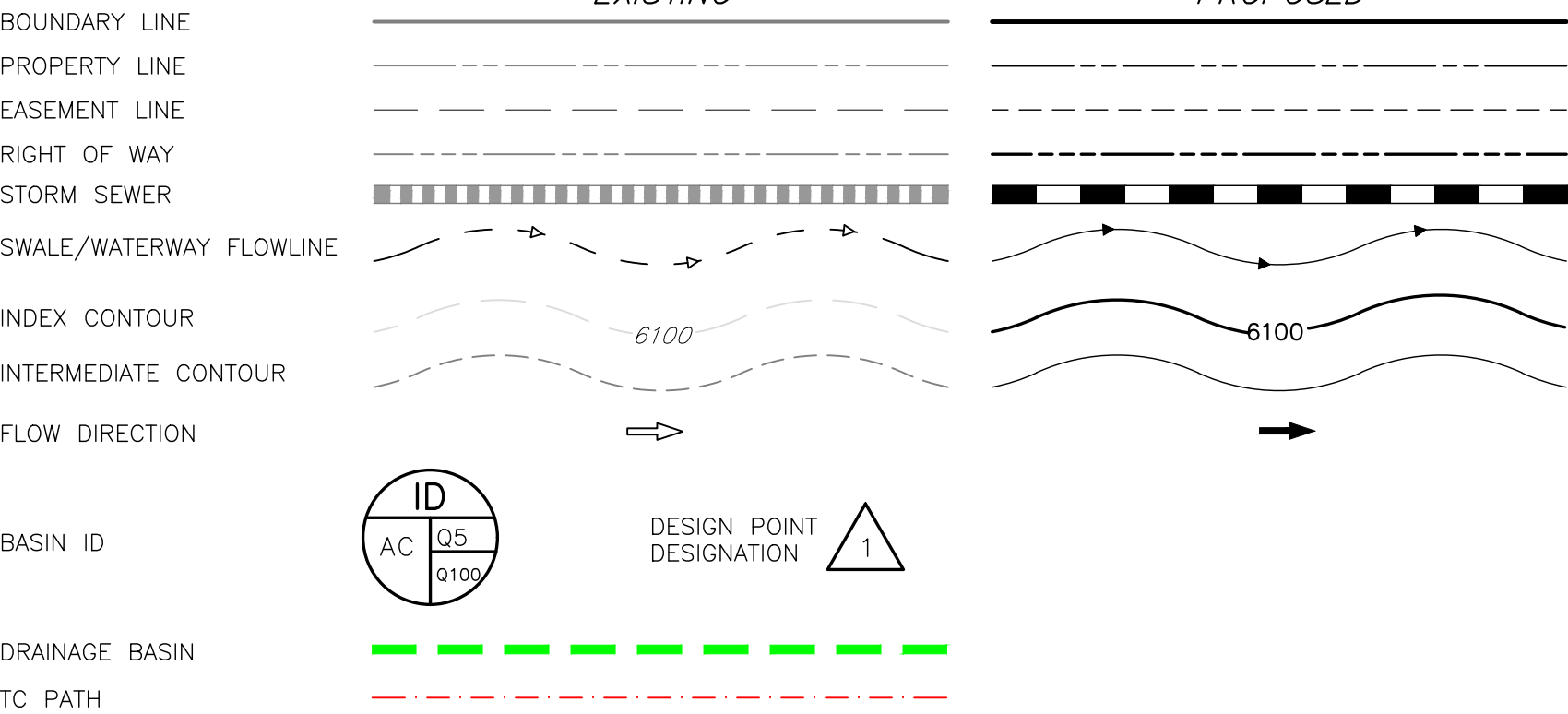
## PROPOSED DRAINAGE MAP



| PROPOSED CONDITIONS - BASIN SUMMARY TABLE |           |            |                |                  |                      |                          |                            |
|-------------------------------------------|-----------|------------|----------------|------------------|----------------------|--------------------------|----------------------------|
| Basin                                     | Area (ac) | Impervious | C <sub>s</sub> | C <sub>100</sub> | t <sub>c</sub> (min) | Q <sub>S</sub> -YR (cfs) | Q <sub>100</sub> -YR (cfs) |
| 1                                         | 4.85      | 12.9%      | 0.16           | 0.41             | 33.9                 | 1.8                      | 7.7                        |
| 2                                         | 1.10      | 28.7%      | 0.30           | 0.52             | 5.8                  | 1.7                      | 4.7                        |
| 3                                         | 29.67     | 7.8%       | 0.13           | 0.39             | 52.9                 | 6.1                      | 31.9                       |
| 4                                         | 2.56      | 64.8%      | 0.60           | 0.73             | 16.8                 | 5.1                      | 10.5                       |
| 5                                         | 2.83      | 16.1%      | 0.20           | 0.44             | 24.8                 | 1.6                      | 5.8                        |
| 5.1                                       | 0.94      | 17.2%      | 0.21           | 0.45             | 20.8                 | 0.6                      | 2.2                        |
| 5.2                                       | 0.88      | 14.0%      | 0.19           | 0.43             | 19.1                 | 0.5                      | 2.0                        |
| 6                                         | 36.64     | 9.4%       | 0.14           | 0.40             | 47.6                 | 8.9                      | 43.9                       |
| 7                                         | 7.05      | 8.1%       | 0.13           | 0.39             | 22.5                 | 2.6                      | 13.6                       |
| 7.1                                       | 12.19     | 8.0%       | 0.13           | 0.39             | 33.6                 | 3.5                      | 18.6                       |
| 8                                         | 20.47     | 7.8%       | 0.12           | 0.39             | 33.5                 | 5.9                      | 31.3                       |
| 9                                         | 0.37      | 61.3%      | 0.57           | 0.71             | 5.0                  | 1.1                      | 2.3                        |
| 10                                        | 2.40      | 18.7%      | 0.23           | 0.46             | 23.5                 | 1.5                      | 5.3                        |
| 11                                        | 17.97     | 7.2%       | 0.12           | 0.39             | 33.1                 | 5.0                      | 27.4                       |
| 12                                        | 1.29      | 45.1%      | 0.44           | 0.62             | 13.9                 | 2.1                      | 4.9                        |
| 13                                        | 1.63      | 40.6%      | 0.37           | 0.56             | 9.0                  | 2.6                      | 6.6                        |
| 14                                        | 0.96      | 17.9%      | 0.22           | 0.45             | 25.4                 | 0.6                      | 2.0                        |
| 15                                        | 10.29     | 8.9%       | 0.13           | 0.40             | 39.1                 | 2.8                      | 14.0                       |

| PROPOSED CONDITIONS - DESIGN POINT SUMMARY TABLE |                    |                      |
|--------------------------------------------------|--------------------|----------------------|
| DP#                                              | Q <sub>S</sub> -YR | Q <sub>100</sub> -YR |
| A                                                | 1.8                | 7.7                  |
| B                                                | 2.5                | 9.7                  |
| C                                                | 5.7                | 31.3                 |
| D                                                | 5.1                | 10.5                 |
| E                                                | 6.4                | 33.8                 |
| F                                                | 8.9                | 43.9                 |
| G                                                | 8.7                | 42.6                 |
| H                                                | 2.6                | 13.6                 |
| I                                                | 2.9                | 14.6                 |
| J                                                | 1.6                | 7.3                  |
| K                                                | 1.5                | 7.1                  |
| L                                                | 5.5                | 27.5                 |
| M                                                | 5.9                | 31.3                 |
| N                                                | 4.8                | 9.9                  |
| O                                                | 10.6               | 53.0                 |
| P                                                | 5.0                | 27.4                 |
| Q                                                | 2.1                | 4.9                  |
| R                                                | 11.5               | 41.3                 |
| S                                                | 0.9                | 23.1                 |
| T                                                | 3.7                | 31.0                 |
| U                                                | 35.1               | 184.7                |

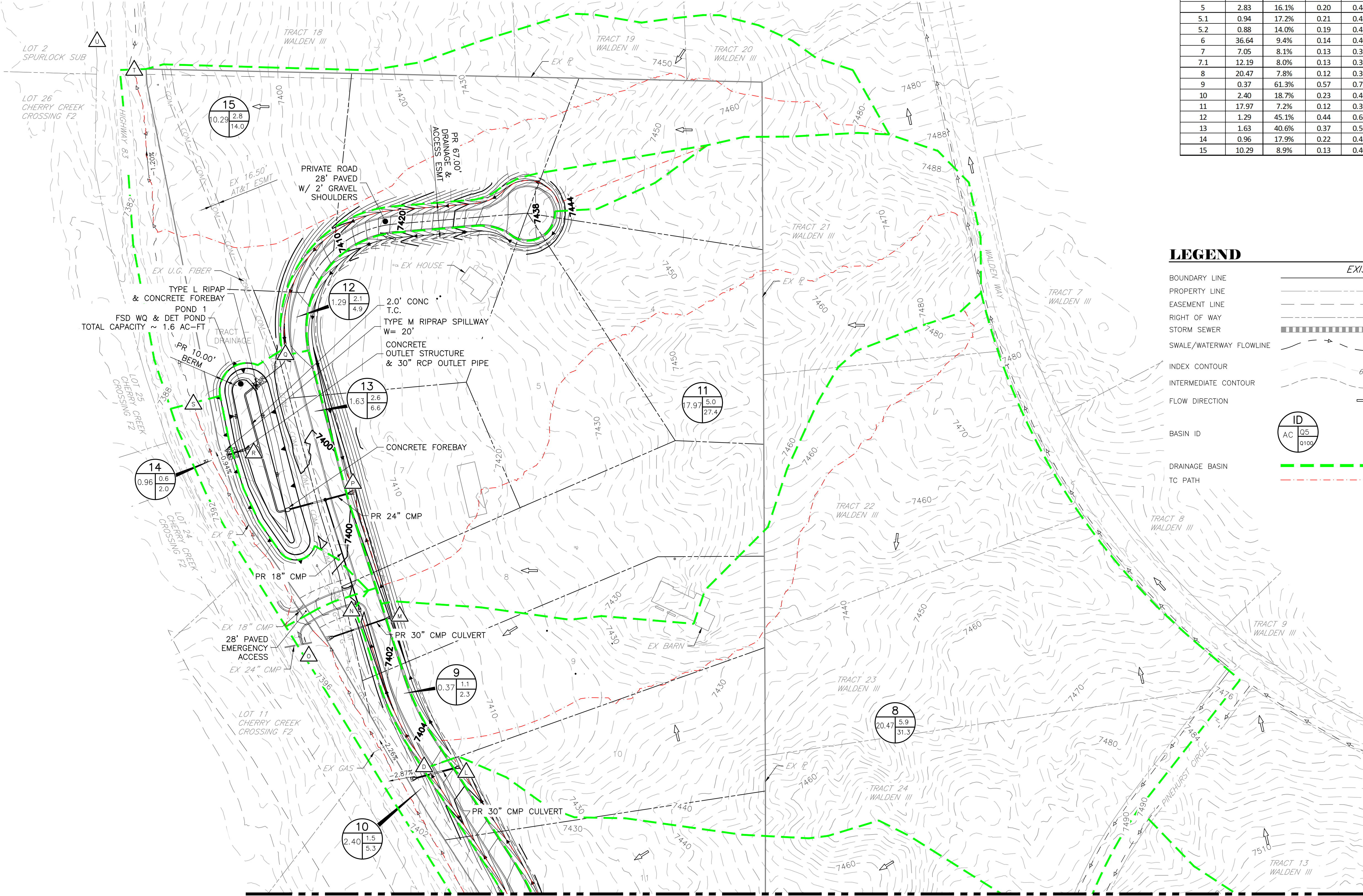
### LEGEND





# NEEDLES SUBDIVISION

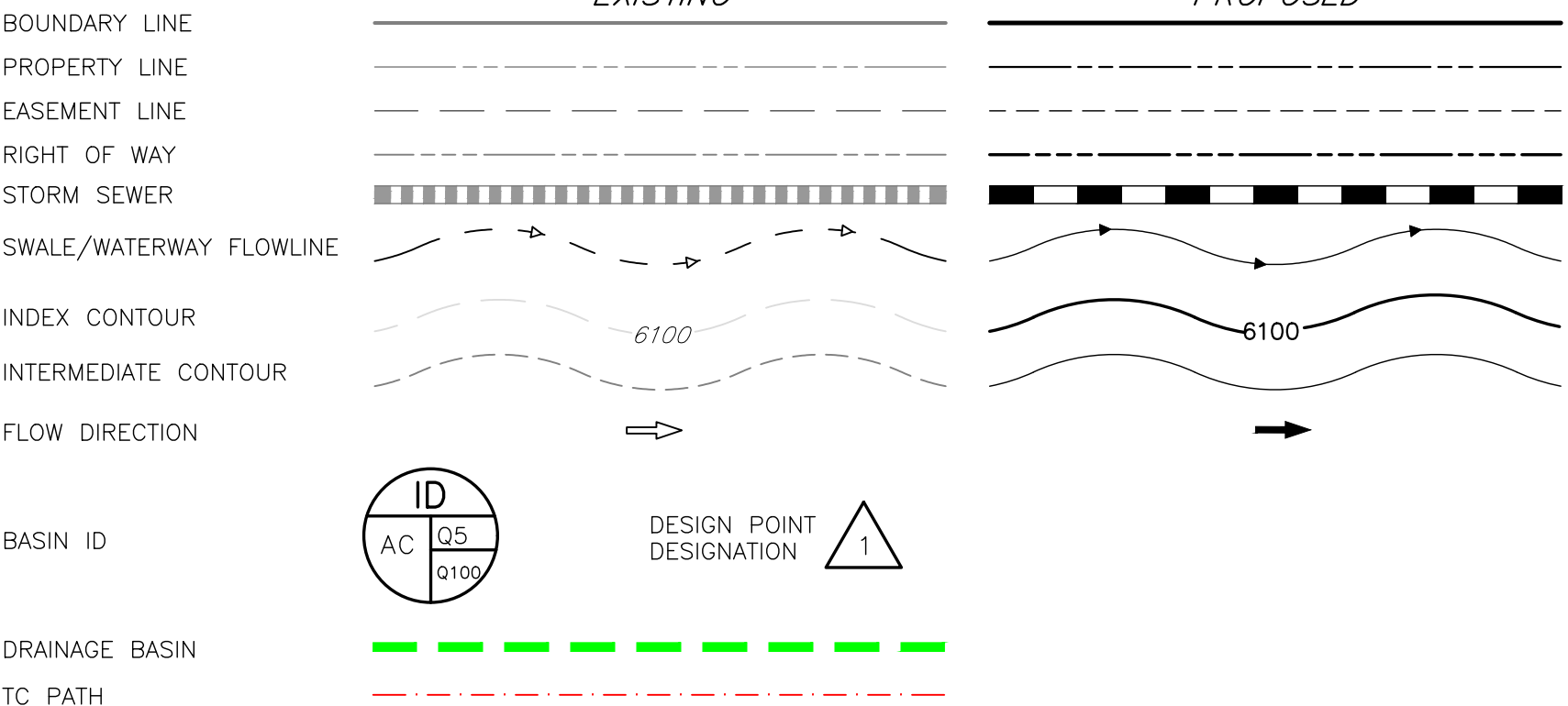
## PROPOSED DRAINAGE MAP



| PROPOSED CONDITIONS - BASIN SUMMARY TABLE |           |            |                |                  |                      |                          |                            |
|-------------------------------------------|-----------|------------|----------------|------------------|----------------------|--------------------------|----------------------------|
| Basin                                     | Area (ac) | Impervious | C <sub>s</sub> | C <sub>100</sub> | t <sub>c</sub> (min) | Q <sub>s</sub> -yr (cfs) | Q <sub>100</sub> -yr (cfs) |
| 1                                         | 4.85      | 12.9%      | 0.16           | 0.41             | 33.9                 | 1.8                      | 7.7                        |
| 2                                         | 1.10      | 28.7%      | 0.30           | 0.52             | 5.8                  | 1.7                      | 4.7                        |
| 3                                         | 29.67     | 7.8%       | 0.13           | 0.39             | 52.9                 | 6.1                      | 31.9                       |
| 4                                         | 2.56      | 64.8%      | 0.60           | 0.73             | 16.8                 | 5.1                      | 10.5                       |
| 5                                         | 2.83      | 16.1%      | 0.20           | 0.44             | 24.8                 | 1.6                      | 5.8                        |
| 5.1                                       | 0.94      | 17.2%      | 0.21           | 0.45             | 20.8                 | 0.6                      | 2.2                        |
| 5.2                                       | 0.88      | 14.0%      | 0.19           | 0.43             | 19.1                 | 0.5                      | 2.0                        |
| 6                                         | 36.64     | 9.4%       | 0.14           | 0.40             | 47.6                 | 8.9                      | 43.9                       |
| 7                                         | 7.05      | 8.1%       | 0.13           | 0.39             | 22.5                 | 2.6                      | 13.6                       |
| 7.1                                       | 12.19     | 8.0%       | 0.13           | 0.39             | 33.6                 | 3.5                      | 18.6                       |
| 8                                         | 20.47     | 7.8%       | 0.12           | 0.39             | 33.5                 | 5.9                      | 31.3                       |
| 9                                         | 0.37      | 61.3%      | 0.57           | 0.71             | 5.0                  | 1.1                      | 2.3                        |
| 10                                        | 2.40      | 18.7%      | 0.23           | 0.46             | 23.5                 | 1.5                      | 5.3                        |
| 11                                        | 17.97     | 7.2%       | 0.12           | 0.39             | 33.1                 | 5.0                      | 27.4                       |
| 12                                        | 1.29      | 45.1%      | 0.44           | 0.62             | 13.9                 | 2.1                      | 4.9                        |
| 13                                        | 1.63      | 40.6%      | 0.37           | 0.56             | 9.0                  | 2.6                      | 6.6                        |
| 14                                        | 0.96      | 17.9%      | 0.22           | 0.45             | 25.4                 | 0.6                      | 2.0                        |
| 15                                        | 10.29     | 8.9%       | 0.13           | 0.40             | 39.1                 | 2.8                      | 14.0                       |

| PROPOSED CONDITIONS - DESIGN POINT SUMMARY TABLE |                    |                      |
|--------------------------------------------------|--------------------|----------------------|
| DP#                                              | Q <sub>s</sub> -yr | Q <sub>100</sub> -yr |
| A                                                | 1.8                | 7.7                  |
| B                                                | 2.5                | 9.7                  |
| C                                                | 5.7                | 31.3                 |
| D                                                | 5.1                | 10.5                 |
| E                                                | 6.4                | 33.8                 |
| F                                                | 8.9                | 43.9                 |
| G                                                | 8.7                | 42.6                 |
| H                                                | 2.6                | 13.6                 |
| I                                                | 2.9                | 14.6                 |
| J                                                | 1.6                | 7.3                  |
| K                                                | 1.5                | 7.1                  |
| L                                                | 5.5                | 27.5                 |
| M                                                | 5.9                | 31.3                 |
| N                                                | 4.8                | 9.9                  |
| O                                                | 10.6               | 53.0                 |
| P                                                | 5.0                | 27.4                 |
| Q                                                | 2.1                | 4.9                  |
| R                                                | 11.5               | 41.3                 |
| S                                                | 0.9                | 23.1                 |
| T                                                | 3.7                | 31.0                 |
| U                                                | 35.1               | 184.7                |

### LEGEND



SEE SHEET 2

