Final Drainage Report

# WHMD RWRF STORMWATER IMPROVEMENTS
# El Paso County, Colorado

Prepared for:
**Woodmen Hills Metropolitan District**
**8046 Eastonville Road**
**Peyton, CO 80831**
**(719) 495-2500**
**Contact: Wally Eaves**

Prepared by:
**Kimley-Horn and Associates, Inc.**
**2 North Nevada Avenue, Suite 900**
**Colorado Springs, Colorado 80903**
**(719) 453-0180**
**Contact: Kevin Kofford, P.E.**

KH Project #: 196013004

PCD Filing No.: CDR268

Prepared: August 7, 2026

Kimley»Horn

## CERTIFICATION

### *DESIGN 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 master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparation of this report.

COLORADO LICENSED PROFESSIONAL ENGINEER
KEVIN REX KOFFORD
57234
09/16/2026

SIGNATURE (Affix Seal): ______________________________ ____________________
Kevin Kofford, P.E. Date

### *OWNER/DEVELOPER'S STATEMENT*

I, the developer, have read and will comply with all of the requirements specified in this Drainage Report and Plan.

Woodmen Hills Metropolitan District
Name of Developer

Walter Eaves 8/6/2026
Authorized Signature Date

Wally Eaves
Printed Name

Director of Wastewater
Title

8046 Eastonville Rd, Peyton CO 80831
Address

### *EL PASO COUNTY*

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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## INTRODUCTION

### *PURPOSE AND SCOPE OF STUDY*

The purpose of this Final Drainage Report ("FDR") is to document the proposed improvements to the drainage design to the Woodmen Hills Metropolitan District Regional Water Reclamation Facility ("WHMD RWRF"). The Project is located within the jurisdictional limits of El Paso County ("the County"). Therefore, the hydrologic and hydraulic design is based on the County's criteria which is described in further detail within the report.

### *LOCATION*

The Project Site ("Site") is located in the northeast corner of Meridian Ranch Boulevard and Stapleton Drive within El Paso County, Colorado including parcel 4230312001. More specifically, the site is a Portion of the southwest ¼ of the southeast ¼ and southeast ¼ of the southwest ¼ of Section 30, Township 12 South, Range 64 West of the $6^{th}$ PM, Count of El Paso, State of Colorado. North and east of the Project is the Antler Creek Golf Course, south of the Project is Stapleton Drive, and west of the Project is Meridian Ranch Boulevard. The Site consists of an existing facility building, existing storage building, an existing aerated sludge basin, existing nutrient removal basins, three existing holding ponds, and an existing chlorine contact basin. A vicinity map has been provided in the **Appendix** of this report.

The Site is currently owned by Woodmen Hills Metropolitan District ("WHMD") and improvements to the Site will be by WHMD.

### *DESCRIPTION OF PROPERTY*

The entire WHMD RWRF Site is approximately 13.96 acres consisting of existing treatment facilities to process wastewater, gravel road, existing underground utilities, and native vegetation. The Site currently routes all storm to roadside ditches in Stapleton Drive, which eventually are captured and flow into the Bennett Ranch Regional Detention Pond.

The existing topography consists of slopes ranging from 1% to 40%, with steeper slopes towards the northwest corner of the Site where a retaining wall extension is proposed. Flows in the existing conditions run off site into existing infrastructure and culverts under Stapleton Road. Detailed description of the existing major drainage basin can be found later in the report.

According to NRCS soil mapping data, USCS Type A soils are the primary soil type within the site. Type A soils have a high infiltration rate when thoroughly wet and have a low runoff potential. These consist of deep, well drained soils that have fine texture. Soil mapping information has been provided in the **Appendix**.

The Project will consist of proposed storm infrastructure, grading, drainage swales, pavement, retaining wall improvements, and curb & gutter to improve the drainage issues happening at the current facility. These improvements are not in coordination with any other site changes but are intended as standalone drainage improvements to enhance the drainage conveyance around the property.

## FLOODPLAIN STATEMENT

The Site is located outside the 100-year floodplain and within Zone X (an area of minimal flood hazard) as noted on the FEMA FIRM Map No. 08041C0551G revised on December 7, 2018 (See **Appendix**).

## DRAINAGE BASINS

### *MAJOR BASIN DESCRIPTIONS*

The Project Site is tributary to a major drainage basin in the El Paso County Drainage Basin Map, Bennett Ranch. This drainage basin is located in the north central portion of El Paso County. The Site is tributary to the Bennett Ranch Regional Detention Pond located within the Bennett Ranch major drainage basin.

The Bennett Ranch DBPS has been provided in the **Appendix**. A summary of flows in existing and proposed conditions has been added to the **Appendix**.

### *COMPLIANCE WITH DBPS*

The Site is located within the “Bennett Ranch Pilot Project Drainage Basin Planning Study” by Stormwater & Environmental Consultants, Inc. approval date November, 2001, as submitted to the County. Further discussion on compliance with water quality requirements can be found in step 2 of the 4-step process.

### *EXISTING SUB-BASIN DESCRIPTIONS*

Historically the runoff from the Site ultimately drains into the Bennett Ranch Regional Detention Pond. Slopes vary from 1-40% throughout the site with various culverts conveying water offsite to Stapleton Drive and connecting to the storm main in Stapleton Drive. The Site has been divided into 19 onsite basins, EX-1 – EX-19, and 6 offsite basins OF-1 – OF-6. The offsite basins are located generally on the northwest and south sides of the property line where flows are entering the Site. The Site generally flows from the northwest to the southeast towards existing stormwater infrastructure. Descriptions for each individual sub-basin can be found below.

In existing conditions, flows within the existing sub-basins are either collected in existing stormwater infrastructure or bypass the Site. An existing drainage map and hydrologic calculations can be found in the **Appendix.**

*Table 1: Existing Stormwater Runoff Calculation and Sub-Basin Outfall Descriptions*

| DESIGN POINT | TRIBUTARY BASINS | AREA (AC) | DIRECT 5-YR RUNOFF (CFS) | DIRECT 100-YR RUNOFF (CFS) | % IMPERV. | IMMEDIATE OUTFALL | | | | ULTIMATE OUTFALL |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | CONVEYANCE | CONVEYANCE DIRECTION | LOCATION | TYPE | |
| EX-1 | EX-1 | 0.03 | 0.01 | 0.09 | 0% | OVERLAND | SOUTHWEST | OFFSITE | EX. 5' TYPE R INLET | Bennett Ranch Regional Detention Pond |
| EX-2 | EX-2 | 0.23 | 0.09 | 0.69 | 0% | OVERLAND | SOUTH | EX-1 | N/A | Bennett Ranch Regional Detention Pond |
| EX-3 | EX-3 | 0.03 | 0.01 | 0.08 | 0% | OVERLAND | SOUTHWEST | EX-2 | N/A | Bennett Ranch Regional Detention Pond |
| EX-4 | EX-4 | 0.74 | 0.19 | 1.39 | 0% | OVERLAND | SOUTHWEST | OFFSITE | MERIDIAN RANCH BLVD | Bennett Ranch Regional Detention Pond |
| EX-5 | EX-5 | 0.84 | 0.35 | 1.95 | 5% | OVERLAND | SOUTHEAST | EX-10 | N/A | Bennett Ranch Regional Detention Pond |
| EX-6 | EX-6 | 1.23 | 1.26 | 3.98 | 26% | OVERLAND | SOUTHEAST | EX-10 | N/A | Bennett Ranch Regional Detention Pond |
| EX-7 | EX-7 | 0.61 | 0.73 | 2.06 | 33% | OVERLAND | SOUTHEAST | EX-14 | N/A | Bennett Ranch Regional Detention Pond |
| EX-8 | EX-8 | 0.35 | 1.34 | 2.49 | 90% | OVERLAND | NORTH | EX-7 | N/A | Bennett Ranch Regional Detention Pond |
| EX-9 | EX-9 | 0.54 | 2.50 | 4.48 | 100% | OVERLAND | N/A | N/A | SANITATION TREATMENT BASIN | Bennett Ranch Regional Detention Pond |
| EX-10 | EX-10 | 1.37 | 1.63 | 4.38 | 35% | OVERLAND | SOUTHEAST | EX-15 | EX. 12" CMP CULVERT | Bennett Ranch Regional Detention Pond |
| EX-11 | EX-11 | 0.16 | 0.76 | 1.37 | 100% | OVERLAND | N/A | N/A | SANITATION TREATMENT BASIN | Bennett Ranch Regional Detention Pond |
| EX-12 | EX-12 | 0.45 | 0.22 | 1.01 | 8% | OVERLAND | EAST | EX-15 | EX. 15" CMP CULVERT | Bennett Ranch Regional Detention Pond |
| EX-13 | EX-13 | 0.07 | 0.03 | 0.21 | 0% | OVERLAND | SOUTHEAST | OFFSITE | MERIDIAN RANCH BLVD | Bennett Ranch Regional Detention Pond |
| EX-14 | EX-14 | 0.77 | 0.51 | 1.76 | 18% | OVERLAND | EAST | EX-17 | N/A | Bennett Ranch Regional Detention Pond |
| EX-15 | EX-15 | 2.28 | 2.83 | 7.02 | 46% | HOLDING POND | SOUTHEAST | N/A | SANITATION TREATMENT HOLDING POND | Bennett Ranch Regional Detention Pond |
| EX-16 | EX-16 | 1.43 | 3.62 | 7.20 | 80% | HOLDING POND | SOUTHWEST | N/A | SANITATION TREATMENT HOLDING POND | Bennett Ranch Regional Detention Pond |
| EX-17 | EX-17 | 1.74 | 0.75 | 3.42 | 10% | HOLDING POND | SOUTH | N/A | SANITATION TREATMENT HOLDING POND | Bennett Ranch Regional Detention Pond |
| EX-18 | EX-18 | 0.44 | 0.32 | 1.20 | 17% | OVERLAND | SOUTHEAST | OFFSITE | EX. 24" RCP CULVERT | Bennett Ranch Regional Detention Pond |
| EX-19 | EX-19 | 0.62 | 0.30 | 1.44 | 8% | OVERLAND | EAST | OFFSITE | EX. 24" RCP CULVERT | Bennett Ranch Regional Detention Pond |
| OF-1 | OF-1 | 0.27 | 0.11 | 0.78 | 0% | OVERLAND | SOUTHEAST | EX-2 | N/A | Bennett Ranch Regional Detention Pond |
| OF-2 | OF-2 | 0.05 | 0.02 | 0.16 | 0% | OVERLAND | SOUTH | EX-6 | N/A | Bennett Ranch Regional Detention Pond |
| OF-3 | OF-3 | 0.54 | 0.13 | 0.98 | 0% | OVERLAND | SOUTHEAST | EX-7 | N/A | Bennett Ranch Regional Detention Pond |
| OF-4 | OF-4 | 0.11 | 0.04 | 0.29 | 0% | OVERLAND | SOUTHEAST | EX-14 | N/A | Bennett Ranch Regional Detention Pond |
| OF-5 | OF-5 | 0.06 | 0.02 | 0.13 | 0% | OVERLAND | SOUTH | EX-18 | N/A | Bennett Ranch Regional Detention Pond |
| OF-6 | OF-6 | 0.12 | 0.03 | 0.19 | 0% | OVERLAND | EAST | EX-19 | N/A | Bennett Ranch Regional Detention Pond |
| **Total** | | **15.10** | | | | | | | | |

### *PROPOSED SUB-BASIN DESCRIPTIONS*

For the proposed condition, stormwater will generally maintain historic flow patterns. The proposed paving and grading will alter some of the existing flow paths. Proposed swales and inlets will capture runoff from the proposed improvements and be routed into a proposed manhole connection to an existing storm main located in Stapleton Drive. The storm main within Stapleton Drive is owned and maintained by El Paso County.

The proposed Site has been divided into 23 onsite basins, P-1 – P-8 and OS-1 – OS-15. The basins with “P” labels are proposed onsite improvements that will be captured within proposed storm infrastructure. The basins with “OS” labels are onsite basins where there are no improvements proposed. Runoff from basins with this label will either be captured in existing storm infrastructure or bypass the site per existing conditions. Additionally, there are 6 offsite basins, OF-1 – OF-6. These are basins that offsite flowing onsite.

In the proposed conditions, flows within the proposed sub-basins are captured by inlets, swales, and a French drain system. The proposed drainage map and hydrologic analysis can be found in the **Appendix.** Flows will generally follow historic drainage patterns and be captured by proposed storm infrastructure that ties into the existing storm main located in Stapleton Drive.

*Table 2: Proposed Stormwater Runoff Calculation and Sub-Basin Outfall Descriptions*

| DESIGN POINT | TRIBUTARY BASINS | AREA (AC) | DIRECT 5-YR RUNOFF (CFS) | DIRECT 100-YR RUNOFF (CFS) | % IMPERV. | IMMEDIATE OUTFALL | | | | | EMERGENCY OVERFLOW PATH | LOCATION | ULTIMATE OUTFALL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | CONVEYANCE | CONVEYANCE DIRECTION | INLET TYPE | PROPOSED VS EXISTING | PUBLIC VS PRIVATE | | | |
| P-1 | P-1 | 0.88 | 2.86 | 5.79 | 67% | C/G | EAST | TYPE C AREA INLET | PROPOSED | PRIVATE | P3 | SUMP | BENNETT RANCH REGIONAL DETENTION POND |
| P-2 | P-2 | 0.13 | 0.04 | 0.28 | 0% | CONCRETE PAN | WEST | NYOPLAST AREA INLET | PROPOSED | PRIVATE | P1 | SUMP | BENNETT RANCH REGIONAL DETENTION POND |
| P-3 | P-3 | 0.36 | 0.12 | 0.90 | 0% | SWALE | EAST & NORTH | TYPE C AREA INLET | PROPOSED | PRIVATE | P4 | SUMP | BENNETT RANCH REGIONAL DETENTION POND |
| P-4 | P-4 | 1.08 | 2.32 | 5.33 | 50% | C/G | WEST & NORTH | TYPE D AREA INLET | PROPOSED | PRIVATE | P6 | SUMP | BENNETT RANCH REGIONAL DETENTION POND |
| P-5 | P-5 | 0.78 | 0.28 | 1.71 | 3% | SWALE | SOUTHEAST | TYPE C AREA INLET | PROPOSED | PRIVATE | P4 | SUMP | BENNETT RANCH REGIONAL DETENTION POND |
| P-6 | P-6 | 0.15 | 0.09 | 0.40 | 9% | SWALE | SOUTH | TYPE C AREA INLET | PROPOSED | PRIVATE | P7 | SUMP | BENNETT RANCH REGIONAL DETENTION POND |
| P-7 | P-7 | 0.53 | 0.84 | 2.22 | 39% | SWALE | EAST | TYPE C AREA INLET | PROPOSED | PRIVATE | OS-4 | SUMP | BENNETT RANCH REGIONAL DETENTION POND |
| P-8 | P-8 | 0.04 | 0.04 | 0.14 | 19% | OVERLAND | EAST | FRENCH DRAIN | PROPOSED | PRIVATE | P-6 | SUMP | BENNETT RANCH REGIONAL DETENTION POND |
| OS-1 | OS-1 | 0.08 | 0.06 | 0.26 | 9% | SWALE | EAST | TYPE C AREA INLET | PROPOSED | PRIVATE | OS-3 | SUMP | BENNETT RANCH REGIONAL DETENTION POND |
| OS-2 | OS-2 | 0.35 | 1.29 | 2.40 | 90% | ROOF DRAIN | NORTH | ROOF DRAIN | EXISTING | PRIVATE | OS-1 | SUMP | BENNETT RANCH REGIONAL DETENTION POND |
| OS-3 | OS-3 | 0.77 | 0.40 | 1.59 | 15% | SWALE | EAST | N/A | N/A | N/A | OS-6 | N/A | BENNETT RANCH REGIONAL DETENTION POND |
| OS-4 | OS-4 | 2.28 | 2.61 | 6.45 | 46% | OVERLAND | SOUTH | N/A | N/A | N/A | OS-8 | N/A | BENNETT RANCH REGIONAL DETENTION POND |
| OS-5 | OS-5 | 1.43 | 3.81 | 7.58 | 80% | OVERLAND | SOUTH | N/A | N/A | N/A | OS-8 | N/A | BENNETT RANCH REGIONAL DETENTION POND |
| OS-6 | OS-6 | 1.74 | 0.70 | 3.17 | 10% | OVERLAND | SOUTH | N/A | N/A | N/A | OS-7 | N/A | BENNETT RANCH REGIONAL DETENTION POND |
| OS-7 | OS-7 | 0.44 | 0.43 | 1.59 | 17% | OVERLAND | SOUTH | EX. 24" RCP CULVERT | EXISTING | PRIVATE | STAPLETON DRIVE | SUMP | BENNETT RANCH REGIONAL DETENTION POND |
| OS-8 | OS-8 | 0.62 | 0.26 | 1.26 | 8% | OVERLAND | SOUTH | EX. 24" RCP CULVERT | EXISTING | PRIVATE | STAPLETON DRIVE | SUMP | BENNETT RANCH REGIONAL DETENTION POND |
| OS-9 | OS-9 | 0.45 | 0.22 | 1.04 | 8% | OVERLAND | WEST | EX. 15" CMP CULVERT | EXISTING | PRIVATE | OS-4 | SUMP | BENNETT RANCH REGIONAL DETENTION POND |
| OS-10 | OS-10 | 0.74 | 0.19 | 1.40 | 0% | OVERLAND | SOUTH | N/A | N/A | N/A | STAPLETON DRIVE | N/A | BENNETT RANCH REGIONAL DETENTION POND |
| OS-11 | OS-11 | 0.07 | 0.03 | 0.21 | 0% | OVERLAND | SOUTHWEST | N/A | N/A | N/A | STAPLETON DRIVE | N/A | BENNETT RANCH REGIONAL DETENTION POND |
| OS-12 | OS-12 | 0.03 | 0.01 | 0.09 | 0% | OVERLAND | WEST | EX. 5' TYPE R INLET | EXISTING | PUBLIC | MERIDIAN RANCH BLVD | ON-GRADE | BENNETT RANCH REGIONAL DETENTION POND |
| OS-13 | OS-13 | 0.25 | 0.09 | 0.65 | 0% | OVERLAND | SOUTH | N/A | N/A | N/A | OS-10 | N/A | BENNETT RANCH REGIONAL DETENTION POND |
| OS-14 | OS-14 | 0.16 | 0.76 | 1.37 | 100% | SEWER TREATMENT TANK | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| OS-15 | OS-15 | 0.57 | 2.64 | 4.73 | 100% | SEWER TREATMENT TANK | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| OF-1 | OF-1 | 0.06 | 0.02 | 0.14 | 0% | OVERLAND | WEST | N/A | N/A | N/A | OS-7 | N/A | BENNETT RANCH REGIONAL DETENTION POND |
| OF-2 | OF-2 | 0.12 | 0.03 | 0.19 | 0% | OVERLAND | NORTH | N/A | N/A | N/A | OS-8 | N/A | BENNETT RANCH REGIONAL DETENTION POND |
| OF-3 | OF-3 | 0.27 | 0.08 | 0.61 | 0% | OVERLAND | SOUTH | N/A | N/A | N/A | OS-13 | N/A | BENNETT RANCH REGIONAL DETENTION POND |
| OF-4 | OF-4 | 0.12 | 0.05 | 0.37 | 0% | OVERLAND | SOUTHWEST | N/A | N/A | N/A | P-1 | N/A | BENNETT RANCH REGIONAL DETENTION POND |
| OF-5 | OF-5 | 0.47 | 0.14 | 1.04 | 0% | OVERLAND | SOUTHWEST | N/A | N/A | N/A | P-2 | N/A | BENNETT RANCH REGIONAL DETENTION POND |
| OF-6 | OF-6 | 0.11 | 0.04 | 0.29 | 0% | OVERLAND | SOUTHWEST | N/A | N/A | N/A | OS-3 | N/A | BENNETT RANCH REGIONAL DETENTION POND |
| **Total** | | **15.10** | | | | | | | | | | | |

### *DESIGN POINT COMPARISON ANALYSIS*

**Ultimate Design Point**

The ultimate design point is the existing Bennett Ranch Regional Detention Pond. As shown in the chart below, the flows in the 5-year and the 100-year increase slightly between the existing and proposed conditions. Although there is a slight increase, per the Bennett Ranch DBPS, the Bennett Ranch Regional Detention Pond was sized to handle a larger runoff from the Site.

*Table 3: Design Point Analysis*

| ULTIMATE DESIGN POINT | TRIBUTARY BASINS (EXISTING) | AREA (AC) | EXISTING 5-YR FLOW (CFS) | EXISTING 100-YR FLOW (CFS) | TRIBUTARY BASINS (PROPOSED) | AREA (AC) | PROPOSED 5-YR FLOW (CFS) | PROPOSED 100-YR FLOW (CFS) |
|---|---|---|---|---|---|---|---|---|
| Bennett Ranch Regional Detention pond | EX1-19, OF1-6 | 15.10 | 17.81 | 48.76 | P1-8, OS1-15, OF1-6 | 15.10 | 20.44 | 53.22 |

## DRAINAGE DESIGN CRITERIA

### *DEVELOPMENT CRITERIA REFERENCE*

The proposed storm facilities are designed to be in compliance with El Paso County “Drainage Criteria Manual (DCM)” dated October 2018 (”the MANUAL”), El Paso County “Engineering Criteria Manual” (“the Engineering Manual”), Chapter 6 and Section 3.2.1 of Chapter 13 of the City of Colorado Springs Drainage Criteria Manual dated May 2014 (“the Colorado Springs MANUAL”), and Mile High Flood District (MHFD), Urban Drainage and Flood Control District Drainage Criteria Manuals (UDFCDCM), (Volumes 1, 2 and 3), prepared by Wright-McLaughlin Engineers, June 2001, with latest revisions.

Site drainage is not significantly impacted by such constraints as utilities or existing development.

### *HYDROLOGIC CRITERIA*

The 5-year and 100-year design storm events were used in determining rainfall and runoff for the proposed drainage system per chapter 6 of the CRITERIA. Table 6-2 of the CRITERIA is the source for rainfall data for the 5-year and 100-year design storm events. Design runoff was calculated using the Rational Method for developed conditions as established in the CRITERIA and MANUAL. Runoff coefficients for the proposed development were determined using Table 6-6 of the CRITERIA by calculating weighted impervious values for each specific site basin as outlined.

### *HYDRAULIC CRITERIA*

The proposed drainage facilities are designed in accordance with the CRITERIA and the MANUAL. Hydraulic calculations for inlet and street capacity were computed using MHFD spreadsheets for the 5-year and 100-year design storm events. The inlet size needed per basin to meet the basin’s developed flow was determined the calculated capacities. The inlet capacity calculations are provided in the **Appendix**.

Pipe flows, capacities, and hydraulic grade line calculations were computed for the 5-year and 100-year design storm events using StormCAD implementing the standard method headloss coefficients from the CRITERIA.

### *TAILWATER CONDITIONS*

County as-built drawings or final drainage report for the existing public storm system is unavailable. Therefore, conservative assumptions were made to approximate the minor or major tailwater elevations of the existing public storm sewer system at the proposed private storm sewer outfall. The tailwater elevation utilized for the 5-year storm was determined using 80% of full flow depth of the existing 48” storm main (7,045.14’) and the 100-year storm event was determined using a full flow depth of the existing 48” storm main (7,045.94’).

## THE FOUR STEP PROCESS

The Project was designed in accordance with the four-step process to minimize adverse impacts of urbanization, as outlined in the El Paso County Engineering Manual for BMP selection as noted below:

**Step 1**. **Employ Runoff Reduction Practices** – The Project is proposing stormwater improvements to the existing Site to better enhance runoff and conveyance throughout the Site. One way these drainage improvements increase runoff reduction is by adding natural swales on the edge if parking and drive isles to convey stormwater to area inlets by using natural swales, allowing for more percolation and infiltration. The proposed improvements are not anticipated to have negative impacts to downstream infrastructure.

**Step 2. Provide a Water Quality Capture Volume** – The use of the existing Bennett Ranch Regional Detention Pond will provide permanent water quality. Per table 7.2 and Figure 2-4 in the DBPS, the planned imperviousness for the Site is 95% with a commercial land use and flows are tributary to the Bennett Ranch Regional Detention Pond. Relevant excerpts from the Bennet Ranch DBPS can be found in the **Appendix.** In existing conditions, the imperviousness onsite is 34.03%, and with the proposed improvements, the imperviousness onsite is 36.47%. Since the overall imperviousness is below the 95% threshold that was planned for the Site, the Bennett Ranch Regional Detention Pond has the capacity to accommodate the additional imperviousness and therefore, runoff proposed.

Per ECM Appendix I Section 1.7.C.1.a., 20% of the development site or less than 1 acre can be excluded from providing water quality. From site calculations, 0.011 acres (490.05 sq ft) of disturbed area will not be able to be treated which is 0.64% of the disturbed area, meeting the requirement that less than 20% of the overall site can be excluded.

**Step 3 Stabilize Drainageways–** The site is located more than 500 feet away from any major drainageways so channel stabilization will not be provided with the improvements.

**Step 4. Implement Site Specific and Other Source Control BMPs** – The erosion control construction BMPs of the Project were designed to reduce contamination. Source control BMPs include the use of vehicle tracking control, culvert protection, stockpile management, and stabilized staging areas.

## DRAINAGE FEES

### *FEES*

The Project is within the Bennett Ranch (CHWS1200) Drainage Basin and since the Site has already been platted, El Paso County Drainage Basin fees do not apply.

## SUMMARY

This report has been prepared in accordance with El Paso County stormwater criteria. It outlines the Site design for the 5-year and 100-year storm events drainage system. The drainage design presented within this report conforms to the criteria presented in the MANUAL. Additionally, the Site runoff will not adversely affect the downstream and surrounding developments.

## REFERENCES

1. El Paso County “Engineering Criteria Manual” Volumes 1 & 2, dated October 31, 2018

2. Natural Resources Conservation Service, Web Soil Survey, dated June 2, 2026.

3. Urban Drainage and Flood Control District Drainage Criteria Manuals (UDFCDCM), (Volumes 1, 2 and 3), prepared by Wright-McLaughlin Engineers, June 2001, with latest revisions.

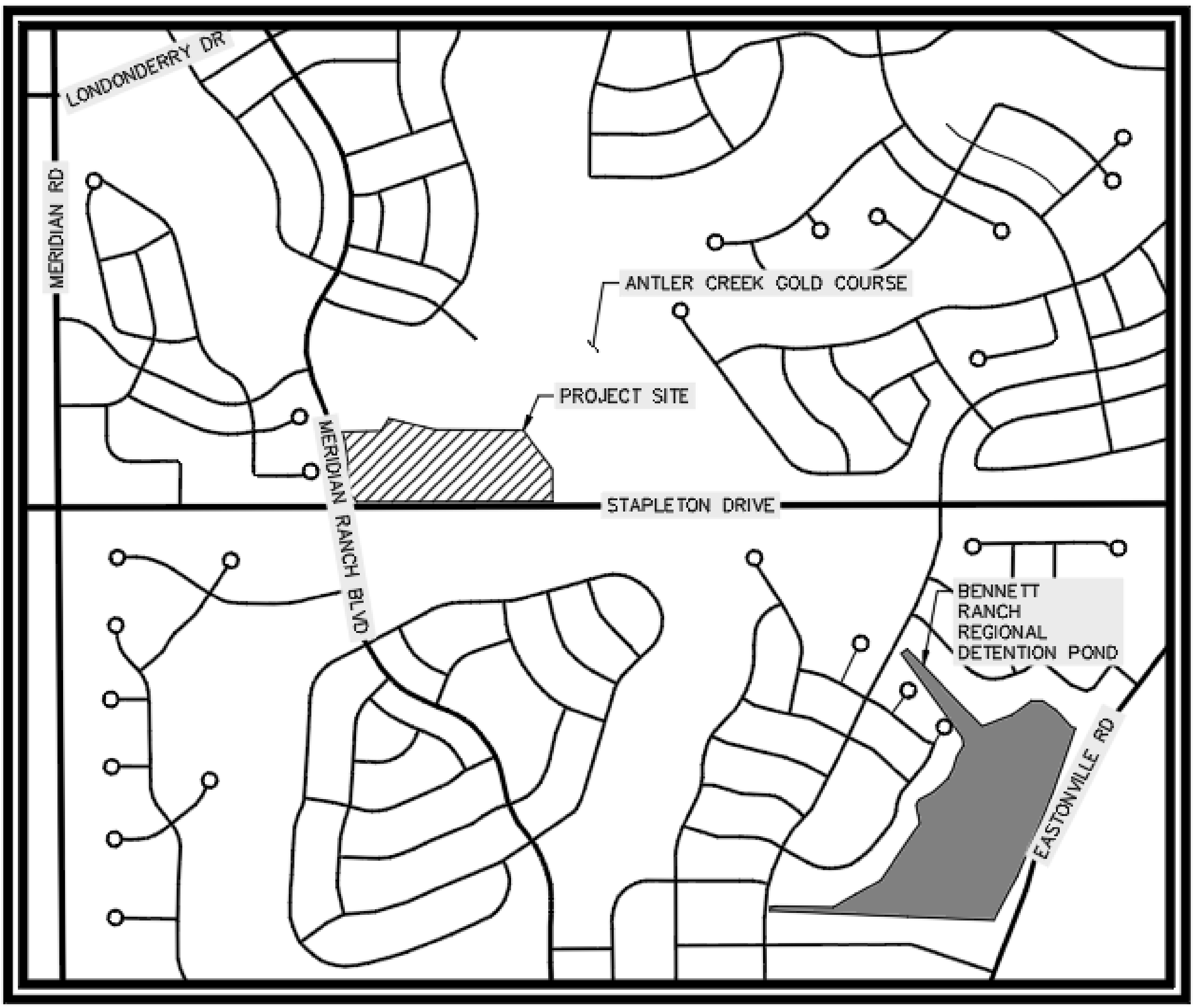
4. Flood Insurance Rate Map, El Paso County, Colorado and Incorporated Areas, Map Number 08041C0551G, Effective Date December 7, 2018, prepared by the Federal Emergency Management Agency (FEMA).

5. Bennett Ranch Pilot Project Drainage Basin Planning Study, by Stormwater & Environmental Consultants, Inc., Dated November 2001.

6. Draft Geotechnical Engineering Study Woodmen Hills Metro District Regional Water Reclamation Facility Stormwater Improvements, by Kumar & Associates, Inc., Dated June 19, 2026.

## APPENDIX

## *APPENDIX A – VICINITY MAP*




VICINITY MAP

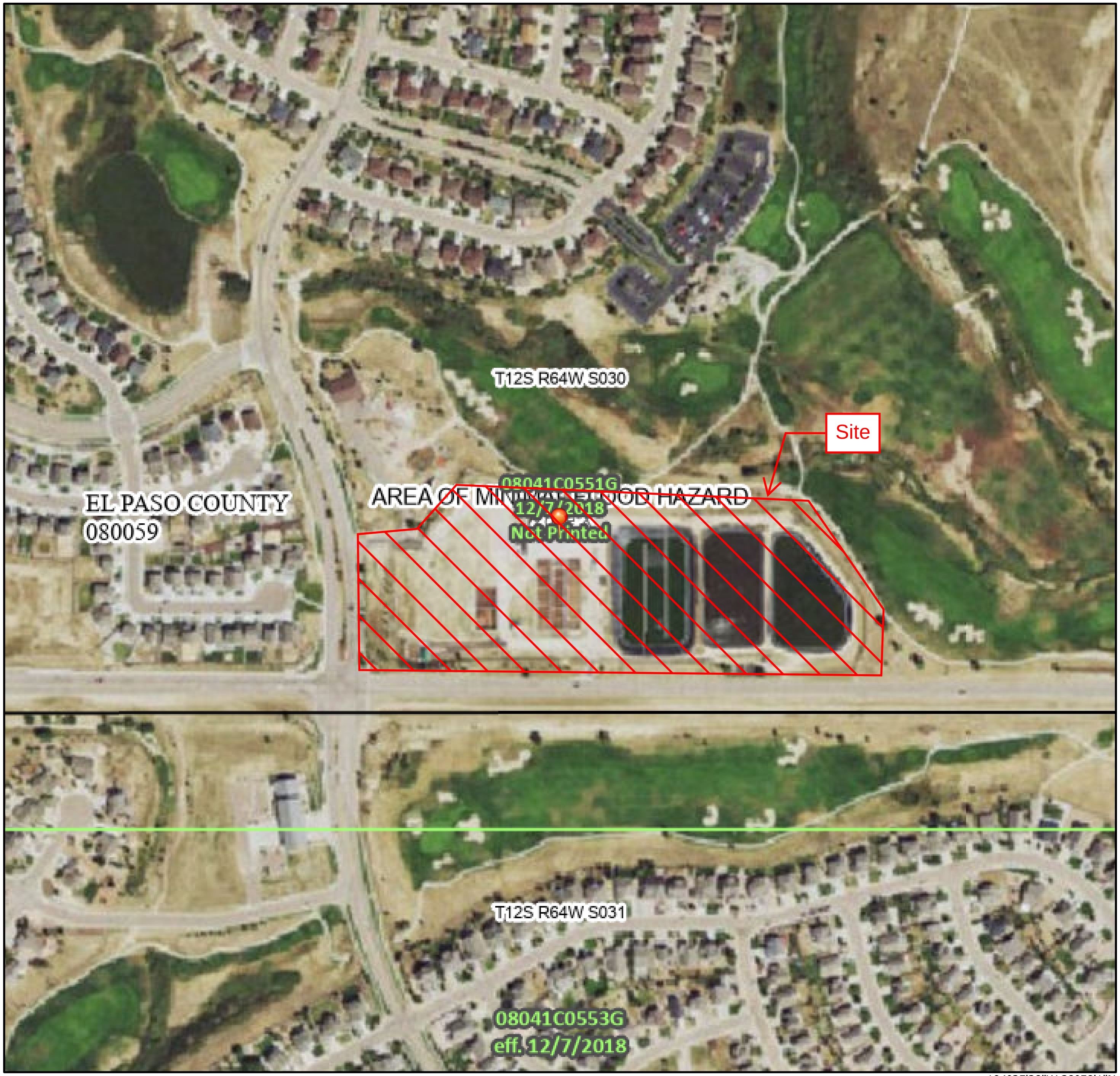
SCALE: 1":5000'

## *APPENDIX B – FEMA FIRM MAP*

# National Flood Hazard Layer FIRMette

FEMA

104°36'16"W 38°58'29"N




104°35'38"W 38°58'1"N

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

1:6,000

*Basemap Imagery Source: USGS National Map 2023*

## Legend

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

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

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

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

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

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

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

N

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 6/3/2026 at 3:58 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.

## *APPENDIX C – GEOTECHNICAL REPORT*

**Kumar & Associates, Inc.®**
Geotechnical and Materials Engineers
and Environmental Scientists

6735 Kumar Heights
Colorado Springs, CO 80918
phone: (719) 632-7009
email: kacolospgs@kumarusa.com
www.kumarusa.com

An Employee Owned Company

Office Locations: Denver (HQ), Parker, Colorado Springs, Fort Collins, Glenwood Springs, and Summit County, Colorado

# GEOTECHNICAL ENGINEERING STUDY
# WOODMEN HILLS METRO DISTRICT
# REGIONAL WATER RECLAMATION FACILITY
# STORMWATER IMPROVEMENTS
# 11866 STAPLETON DRIVE, PEYTON, COLORADO

Prepared By:

Arben F. Kalaveshi, P.E.

COLORADO REGISTERED PROFESSIONAL ENGINEER
ARBEN F. KALAVESHI
45969
07-29-2026

Reviewed By:

Duane P. Craft, P.E.

*Prepared For:*

Kimley-Horn
2 North Nevada Avenue, Suite 900
Colorado Springs, Colorad0 80903

Attn: Katy Corkill, P.E.

Project No: 26-2-169

July 29, 2026

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# SUMMARY

1. A total of 6 borings were drilled for this study, including 3 for the proposed stormwater line, and 3 for proposed paved areas. Below an intermittent layer of topsoil, existing fill was encountered in all of the borings and extended to depths of 1 to 7 feet below the existing ground surface. The underlying native soils were predominantly clean to silty sand but also included zones/lenses of sandy lean clay and clayey sand. Bedrock consisted of sandstone and claystone and was found at depths ranging from 10 to 21 feet. Bedrock extended to the maximum depth explored of 25 feet where it was encountered.

2. Groundwater was encountered in Borings 5 and 6 when measured the day of drilling, and in Borings 2, 4, 5, and 6 when measured 14 days later. The depth to water during our final measurements ranged from 6.9 to 13.7 feet below the ground surface. Groundwater is expected to fluctuate over time due to seasonal and other factors. Additionally, perched groundwater may develop within the granular soils overlying the less permeable bedrock, especially during wetter seasons, or after precipitation events.

3. Existing undocumented fill is present at this site and should be entirely removed and replaced where it is encountered below new construction such as the proposed RCP storm drain. No over-excavation will be necessary if such structures bear on native soils. Since pavements can generally tolerate settlement better than structures, and are easier to repair if movement occurs, a reduced over-excavation depth of 12 inches can be considered in these areas. Based on the samples of fill collected, it should be suitable for reuse if it is processed, moisture conditioned, and recompacted as described in the "Site Grading and Earthwork" section of this report.

4. For the design of the pipeline and drainpipe, we recommend a horizontal modulus of soil reaction (E') of 2,000 psi be used for initial deflection of the pipe zone material that has been compacted in accordance with the specifications listed in the "Site Grading and Earthwork" section.

5. Above a depth of 10 feet, thrust blocks used to resist thrust forces at horizontal bends in the pipe should be designed using a passive bearing pressure based on an equivalent fluid density of 250 pcf. The passive pressure should be calculated by multiplying the equivalent fluid density value by the depth in feet below the ground surface corresponding to the midpoint height of the face of the thrust block. For thrust blocks with a midpoint depth of 10 feet or more, a maximum allowable soil bearing pressure of 2,500 psf should be used.

6. The following pavement sections (HMA over ABC, and PCC over ABC) were determined using the AASHTO 1993 design method for flexible and rigid pavements. Details regarding binder type, and other considerations can be found within the body of this report.

| Area | HMA[1] over ABC[2] (inches) | PCCP[3] over ABC[2] (inches) |
|---|---|---|
| Site Pavements | 5 over 6 | 6 over 4 |

1: HMA = Hot mix Asphalt
2: ABC = Aggregate base course
3: PCC = Portland cement concrete pavement

## PURPOSE AND SCOPE OF STUDY

This report presents the results of a geotechnical engineering study for the regional water reclamation facility expansion project. The project location is shown on Figure 1. The study was conducted in general accordance with the scope of work in our Proposal No. C26-173.R, dated April 14, 2026 for the purpose of providing geotechnical recommendations related to the proposed improvements.

This report has been prepared to summarize the data obtained during this study, and to present our conclusions and recommendations based on the proposed construction and the subsurface conditions encountered. Design parameters and a discussion of geotechnical engineering considerations related to the proposed construction are included in the report.

## PROPOSED CONSTRUCTION

We understand that the site improvements will include about 1,029 lineal feet of new 18 to 24-inch diameter RCP storm line, which will have invert elevations ranging from about 5 to 20 feet below the ground surface. Paved drive areas will encompass the facility and will include three connecting paths.

If the proposed construction varies significantly from that described above or depicted herein, we should be notified to reevaluate our recommendations.

## SITE CONDITIONS

The existing site is located at the northeast corner of Meridian Ranch Boulevard and Stapleton Drive, and is about 12 acres in area. The native topography generally consists of rolling hills and prairie land, but the site has been graded flat to accommodate the facility. Slopes at the pond basins are about 3:1, and a shallower embankment slope exists around the north perimeter of the site. An operations and mechanical building is located near the northeast corner of the site, and is just north of concrete-walled treatment areas. Three aeration basins/polishing ponds are located to the east. An ephemeral tributary branch of the Gieck Ranch Drainage Basin is located just north of the site.

## SUBSURFACE CONDITIONS

The field exploration for this study was conducted on June 8, 2026. Six exploratory borings were drilled at the locations shown on Fig. 1 to explore subsurface conditions and estimate groundwater levels. The borings conducted for this study were advanced through the soils and into the underlying bedrock with 4-inch diameter continuous flight augers. The borings were logged by a representative of Kumar & Associates, Inc.

Samples of the soils and bedrock materials were taken with a 2-inch I.D. California barrel sampler. The sampler was driven into the various strata with blows from a 140-pound hammer falling 30 inches. This test is similar to the standard penetration test described by ASTM Method D 1586. Penetration resistance values, when properly evaluated, indicate the relative density or consistency of the soils. Depths at which the samples were taken and the penetration resistance values are shown on the Logs of Exploratory Borings, Fig. 2.

Measurements of the water level were made in the borings by lowering a weighted tape measure into the open hole. Measurements were made shortly after completion of drilling, and again 14 days later. The depths at which water was encountered are shown on the following table. Groundwater will fluctuate over time due to seasonal and other factors. Additionally, perched groundwater may develop within the granular soils overlying the less permeable bedrock, especially during wetter seasons, or after precipitation events.

Table: Measured Water Levels

| Boring | Water Level at Time of Drilling (feet) | Water Level During Final Measurement (feet) |
|---|---|---|
| 1 | (dry) | (backfilled) |
| 2 | (dry) | 6.9 |
| 3 | (dry) | (backfilled) |
| 4 | (dry) | 9.4 |
| 5 | 19.0 | 13.1 |
| 6 | 14.0 | 13.7 |

Below an intermittent layer of topsoil, existing fill was encountered in all of the borings, and extended to depths of 1 to 7 feet below the existing ground surface. The underlying native soils were predominantly clean to silty sand but also included zones/lenses of clayey sand and sandy lean clay. Bedrock consisted of sandstone and claystone and was found at depths ranging from 10 to 21 feet. Bedrock extended to the maximum depth explored of 25 feet where it was encountered. The following paragraphs provide more detailed descriptions of the major soil and bedrock types encountered. Figs 2 and 3 provide additional information, and detailed depictions of the depths at which each material was encountered.

The existing fill included clayey sand, clayey silty sand, silty sand, and well graded gravel with silt. These soils were fine to coarse grained, and included gravel. They were dry to moist, and mottled browns and grays. The exact vertical and lateral extents of the existing fill are unknown, and were not considered the scope of this study.

The predominant soil type encountered was well graded sand with silt. This soil was fine to coarse grained, medium dense to dense, moist to wet, and light brown to gray. Occasional lenses/zones of sandy lean clay, clayey sand, and silty sand were also encountered throughout the overburden layer. The sandy lean clay was fine to coarse grained with occasional gravel, medium stiff to very stiff, moist, and dark brown in color. The clayey sand was fine to coarse grained, medium dense, moist to wet, and light gray to brown. The silty sand was fine to coarse grained, loose, moist, and light gray. The samples of sandy lean clay tested exhibited nil to low swell potential upon wetting under a surcharge of 200 psf.

The underlying bedrock was predominantly sandstone, but claystone was found near the bottom of Boring 5. The sandstone was poorly cemented, fine to coarse grained, hard to very hard, moist to very moist, and light gray to brown. The claystone was fine grained, very hard, moist, and blue-gray.

## GEOTECHNICAL CONSIDERATIONS

Based on the data collected during our subsurface exploration and the results of our laboratory testing, the subsurface materials do not appear to present a significant risk of heave related movement.

Existing undocumented fill is present at this site and should be entirely removed and replaced where it is encountered below new construction such as the proposed RCP storm drain. No over-excavation will be necessary if such structures bear on native soils. Since pavements can generally tolerate settlement better than structures, and are easier to repair if movement occurs, a reduced over-excavation depth of 12 inches can be considered in these areas. Based on the samples of fill collected, it should be suitable for reuse if it is processed, moisture conditioned, and recompacted as described in the “Site Grading and Earthwork” section of this report. If minor amounts of clay are encountered, it should be thoroughly mixed with the sand to provide a consistent material, but where large zones of clay is encountered, it should be removed, and should not be reused under pipelines, or other structures that are sensitive to movement.

PIPELINE DESIGN PARAMETERS

As discussed in this report, we understand that the new stormwater line will be an 18 to 24-inch diameter RCP line installed using traditional cut and cover trenching methods. We recommend a horizontal modulus of soil reaction (E') of 2,000 psi be used for initial deflection of the pipe zone material that has been compacted in accordance with the specifications listed in the "Site Grading and Earthwork" section below.

Above a depth of 10 feet, thrust blocks used to resist thrust forces at horizontal bends in the pipe should be designed using a passive bearing pressure based on an equivalent fluid density of 250 pcf. The passive pressure should be calculated by multiplying the equivalent fluid density value by the depth in feet below the ground surface corresponding to the midpoint height of the face of the thrust block. For thrust blocks with a midpoint depth of 10 feet or more, a maximum allowable soil bearing pressure of 2,500 psf should be used.

Where clay is encountered at the base of the proposed pipeline excavation, it should be removed and replaced with suitable material to a depth of at least 3 feet. Clay fill should only be reused if it can be demonstrated to meet the requirements listed in Item 6 (Material Suitability) of the "Site Grading and Earthwork" section.

SITE GRADING AND EARTHWORK

Fill Material Specifications: The following material specifications are presented for fills on the project site.

1. *Select Fill*: The on-site soils, including minor amounts of clay will be suitable for reuse as select fill. Import soils if used, should consist of a non-expansive soil, consisting of a minus 2-inch material that has a maximum of 35 percent passing the No. 200 sieve, and a maximum plasticity index of 15. New fill should extend down from the edges of the foundations at a minimum 1:1 horizontal to vertical projection.

2. *Common Fill*: The sands and clays encountered at this site will be suitable for reuse as backfill material within areas where no structures or movement sensitive construction will occur if it is properly processed and adequately moisture conditioned and compacted. If imported material is needed for common fill areas, additional testing may be necessary to ensure it meets the suitability requirements outlined in Item 6 below.

3. *Pipe Bedding Material*: The use and requirements for bedding material should be in accordance with the pipe manufacturer's recommendations, local building authority, or utility district requirements. In the absence of such guidance, we recommend the pipe bedding consist of imported granular bedding material intended for bedding and pipe embedment zone fill. Bedding and embedment zone material may consist of a rounded granular gravel or sand with a maximum size of 3/8 inch, less than 25% passing the No. 50 sieve, and less than 5% passing the No. 200 sieve. The on-site soils encountered do not meet these criteria. The bedding layer should be of adequate thickness to fully support the pipes when seated on top of the bedding.

4. *Pipe Zone Backfill:* The pipe-zone material placed above the bedding and surrounding the pipe should consist of granular material similar to that described above for pipe bedding, and should be compacted to at least 75% relative density (as determined by ASTM D 4253 and ASTM D 4254), and in accordance with requirements of the pipe manufacturer, to provide the required support around the pipe and to help mitigate potential bedding settlement zones. Portions of the pipeline bedding not below current or proposed roadways should be compacted to at least 70% relative density. Special care should be taken to provide adequate compaction below the haunches of the pipe using a concrete vibrator, vibratory plates or other light compaction equipment as needed. In confined areas of the pipeline where compaction is difficult, placement of a cementitious flowable fill around the pipe should be considered. Seepage collars should also be considered in trenches where a significant flow path may develop.

5. *Trench Backfill:* The on-site soils or suitable soil imported to the site can be used as backfill above the pipe zone. Clays should not be placed within 2 feet below pavement subgrade. The use of claystone bedrock that does not break down into a soil-like material may be considered as trench backfill above the embedment material in undeveloped areas where a greater amount of heave can be tolerated at the surface. The backfill should be compacted according to the specifications listed in the "Compaction Requirements"

subsection below. The moisture content of the in-situ materials will need to be adjusted prior to placement.

6. *Material Suitability*: Unless otherwise defined herein, all fill material should be non- to low-swelling, free of vegetation, brush, sod, trash and debris, and other deleterious substances, and should not contain rocks or lumps having a diameter of more than 4 inches. A fill material should be considered non-expansive if the swell potential under a 200 psf surcharge pressure does not exceed ½ percent when a sample remolded to 95 percent of the standard Proctor (ASTM D 698) maximum dry density at optimum moisture content is wetted.

7. *Subgrade Preparation*: The ground surface shall be stripped of all vegetation/organics or other deleterious material prior to fill placement. The resulting ground surface should be scarified to a depth of 12 inches, moisture conditioned as necessary, and compacted in a manner specified below for the subsequent layers of fill. Loose or unstable soils shall be removed, where present, in order to provide a stable platform prior to placement of fill. Scarification and re-compaction will not be necessary at the bases of trenches.

<u>Compaction Requirements</u>: A representative of the geotechnical engineer should observe fill placement operations on a full-time basis. We recommend the following minimum compaction criteria be used on the project.

Table: Compaction Specifications

| Area | Percentage of Proctor Maximum Dry Density | |
|---|---|---|
| | Standard (ASTM D698) | Modified (ASTM D1557) |
| Aggregate Base Course | - | 95% |
| Utility Trenches, Exterior Flatwork, Fill placed for Site Grading, and Beneath Paved Areas | 95% | 90% |
| Landscape and Other Misc. Overlot Fill Areas | 95% | 90% |
| Compaction of fill materials should be achieved at a moisture content within +0 to +3% of the optimum moisture content for cohesive soils, and within -2 to +2 percent for granular soils. | | |

Grading During Inclement Weather: If grading occurs during the time of year with freezing temperatures, fill should not contain frost or be placed on frozen ground. A loose lift or blanket of soil should be placed on prepared subgrade at the end of day to protect against frost, and the presence of frost should be checked at the beginning of each day. Any frost should be removed prior to placement of new fill. During periods of precipitation, excessive wetting of building pad and pavement subgrades should be avoided. Measures should be implemented to keep surface runoff from ponding in subgrade areas, to include usage of diversion berms, creation of temporary low areas where water can be directed and removed by pumping, or other methods as appropriate.

Permanent Cut and Fill Slopes: Permanent unretained cuts in the soils and bedrock may be constructed at slopes of up to 3 horizontal to 1 vertical. The risk of slope instability will be significantly increased if seepage is encountered in cuts. If seepage is encountered, we should be retained to evaluate if the seepage will adversely affect the slope stability cut slopes. No formal stability analyses were performed to evaluate the slopes recommended above. Published literature and our experience with similar cuts and fills indicate the recommended slopes should have adequate factors of safety. If a detailed stability analysis is required, we should be notified.

To provide a uniform base for fill placement, the ground surface underlying all fills should be carefully prepared as specified in this section (Subgrade Preparation, above). Fills should be benched into cuts or natural slopes exceeding 4H:1V. Vertical bench heights should be between 2 and 4 feet.

Good surface drainage should be provided around all permanent cuts and fills to direct surface runoff away from the slope faces. Fill slopes cut slopes and other stripped areas should be protected against erosion by revegetation or other methods.

Excavation Considerations: It is our opinion that the soils and bedrock can be excavated with conventional heavy-duty equipment. Specialized excavation methods such as pneumatic chiseling may be necessary for confined areas, or if well cemented bedrock is encountered.

All excavations should be made in accordance with OSHA, State, and local requirements. The contractor should follow appropriate safety precautions. The following guidelines are provided for planning purposes. Actual soil conditions should be verified at the time of excavation. If subsurface conditions that are different from those indicated in this report are encountered, the

OSHA soil type may vary, and the required cut slopes may need to be adjusted. The contractor's "competent person" should make decisions regarding excavation slopes.

Based on the subsurface conditions encountered in our borings, the soils will generally classify as Type C materials. The bedrock will likely classify as a Type B material. Per OSHA criteria, temporary unretained excavations should have slopes no steeper than those listed in the following table for each soil type.

Table: Maximum Temporary Cut Slopes

| OSHA Soil Type | Maximum Temporary Cut Slope (H:V) |
|---|---|
| A | ¾:1 |
| B | 1:1 |
| C | 1½:1 |

A properly braced excavation or the use of an approved trench box should be used where the indicated unretained slopes cannot be accommodated. Flatter slopes will be required where groundwater seepage or fissuring is encountered, or where static or vibratory loads are present. OSHA regulations require that excavations greater than 20 feet in depth be designed by a professional engineer.

Groundwater will likely be a consideration during excavation in some areas, and a dewatering system may be necessary. A dewatering system consisting of trenches flowing into sumps where the water can be discharged using pumps will likely be adequate, but a more robust system such as well points may be necessary if high volumes of water are encountered.

It is assumed site dewatering would occur in advance of the excavation and be maintained the entire duration that the excavation is open. Surface drainage should be diverted away from all temporary cut slopes in order to reduce the potential for slope erosion and instability.

<u>Subgrade Stabilization</u>: Unstable subgrade material is not anticipated, but may be encountered at the base of the proposed fill in some areas. Unstable soils may be stabilized by scarifying/ripping the subgrade and allowing them to dry, or by over-excavation and replacement of the subgrade with suitable, imported, angular, well-graded materials if they are encountered. Other alternatives include the use of Type 2 biaxial geogrid reinforcement in combination with a

layer of Class 6 aggregate base course. It has been our experience that the use of a crushed concrete product meeting a Class 6 gradation can perform well when trying to achieve stabilization. Specific stabilization requirements should be evaluated at the time of construction.

<u>Proof Rolling</u>: Wherever possible, the foundation subgrade should be proof rolled with a heavily loaded pneumatic-tired vehicle with a gross vehicle weight of at least 50,000 pounds, a single axle weight of 18,000 pounds, and a tire pressure of 100 psi. Pavement design procedures assume a stable subgrade. Areas that deform under heavy wheel loads are not stable and should be removed and replaced to achieve a stable subgrade.

## WATER SOLUBLE SULFATES

The concentration of water soluble sulfates measured in representative samples obtained from the exploratory borings was 0.02 percent or less. Water soluble sulfate concentrations of 0.10 percent or less represent a Class S0 severity of exposure to sulfate attack on concrete exposed to these materials. The degree of attack is based on a range of Class S0 to Class S3 severity of exposure as presented in ACI 201. Based on the laboratory data and our experience, we recommend all concrete exposed to the on-site materials meet the cement requirements for Class S0 exposure as presented in ACI 201. Alternatively, the concrete could meet the Colorado Department of Transportation's (CDOT) cement requirements for Class S0 exposure as presented in Section 601.04 of the CDOT Standard Specifications for Road and Bridge Construction.

## PAVEMENT DESIGN

A pavement section is a layered system designed to distribute concentrated traffic loads to the subgrade. Performance of the pavement structure is directly related to the physical properties of the subgrade soils, pavement section, and traffic loadings. The number and magnitude of wheel loads are major factors for pavement design.

<u>Subgrade Materials</u>: A resilient modulus of 3,562 psi, based on an estimated R-value of 10 was used for design of the flexible sections, and a corrected modulus of subgrade reaction of 23 pci was used for the design of rigid sections.

<u>Design Traffic</u>: For the purpose of our study, we have considered an 18-kip, 20 year ESAL value of 73,000 based on the assumption that traffic would largely consist of automobiles and light trucks, with occasional heavy trucks and service vehicles. If it is determined that actual traffic

volume is significantly different from the estimated values presented, we should be contacted to reevaluate the pavement thickness design presented in this report.

Pavement Sections: The following pavement section (HMA over ABC, and PCC over ABC) were determined using the AASHTO 1993 design method for flexible and rigid pavements.

Table: Flexible Pavement Section Thickness

| Area | HMA[1] over ABC[2] (inches) | PCCP[3] over ABC[2] (inches) |
|---|---|---|
| Site Pavements | 5 over 6 | 6 over 4 |

1: HMA = Hot mix Asphalt
2: ABC = Aggregate base course
3: PCC = Portland cement concrete pavement

Pavement Materials: The asphalt pavement should consist of a bituminous material which meets the local jurisdictional requirements, and CDOT Specifications for Road and Bridge Construction. Aggregate base course should meet the requirements of a CDOT Class 6. A Superpave S or SX mix with a design gyration N value of 75, and a binder performance grade of 58-28 should be used.

A minimum lift thickness of 2-inches for SX and 3-inches for S mixes are recommended. Lift thickness should not exceed 3 inches unless pneumatic or vibratory rollers are used.

## SURFACE DRAINAGE

The collection and diversion of surface drainage away from paved and constructed areas is extremely important to their satisfactory performance. Drainage design should provide for the removal of water from paved areas and prevent the wetting of the subgrade soils both during and after construction, and should follow recommendations provided by local, state and national entities. The following recommendations should be used as guidelines and changes should be made only after consultation with the geotechnical engineer.

1. Excessive wetting or drying of the pavement subgrades should be avoided both during and after construction. It may be necessary to grade temporary drainage paths, and to construct berms to facilitate this during construction.

2. Good surface drainage should be provided within all ground surfaces and pavements, and around all cuts and fills to direct surface runoff away from these areas. Slopes and other stripped areas should be protected against erosion by paving, re-vegetation or other means.

DESIGN AND SUPPORT SERVICES

Kumar & Associates, Inc. should be retained to review the project plans and specifications for conformance with the recommendations provided in this report. We are also available to assist the design team in preparing specifications for geotechnical aspects of the project and, if necessary, perform additional studies to accommodate any changes in the proposed construction.

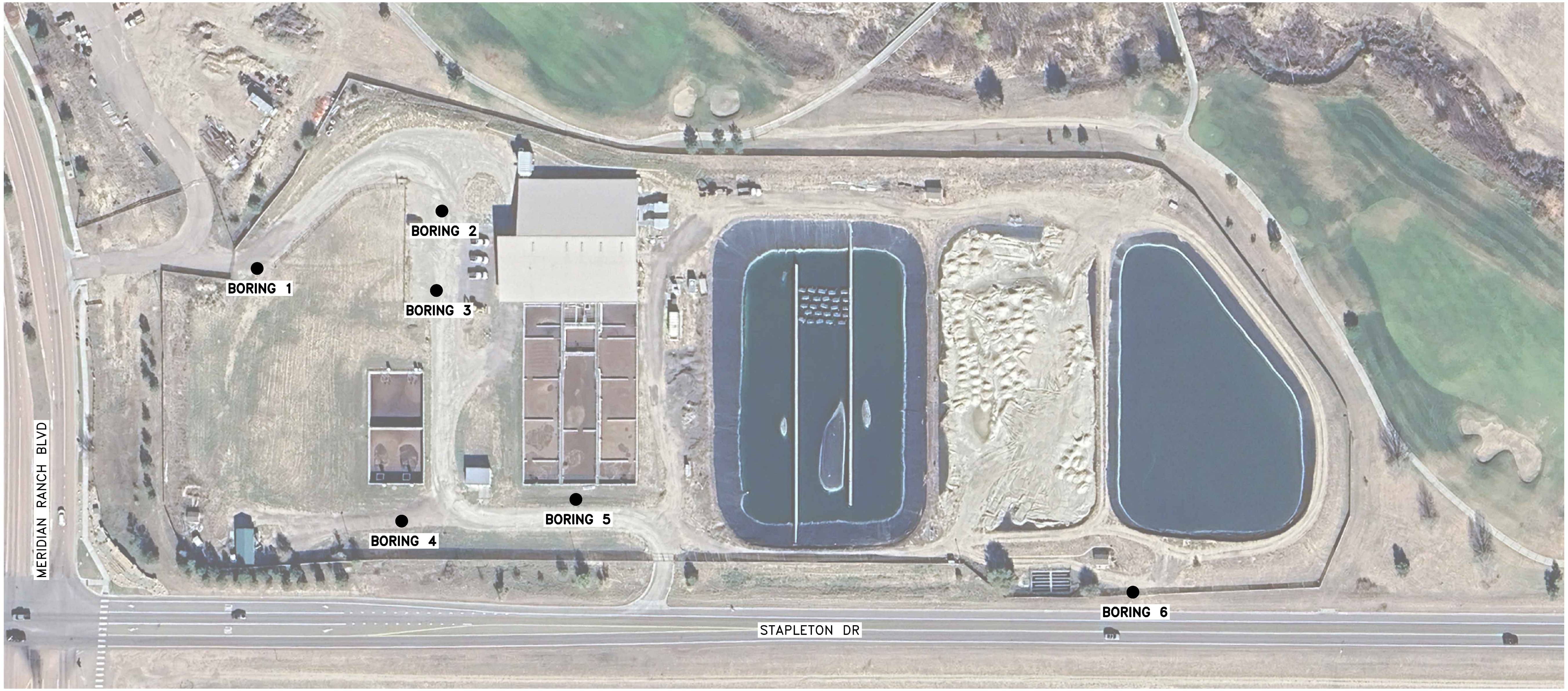
We recommend that Kumar & Associates, Inc. be retained to provide observation and testing services to document that the requirements of the plans and specifications are being followed during construction, and to identify possible variations in subsurface conditions from those encountered in this study.

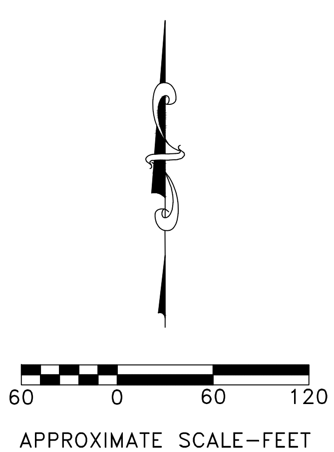
LIMITATIONS

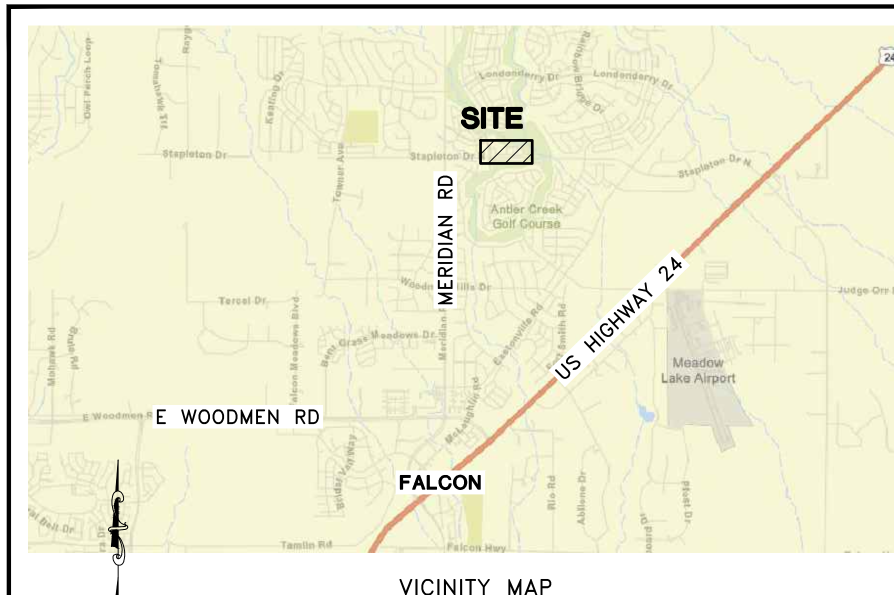
This study has been conducted for exclusive use by the client for geotechnical related design and construction criteria for the project. The conclusions and recommendations submitted in this report are based upon the data obtained from the exploratory borings at the locations indicated on Fig. 1 or as described in the report, and the proposed type of construction. This report may not reflect subsurface variations that occur between the exploratory borings, and the nature and extent of variations across the site may not become evident until site grading and excavations are performed. If during construction, fill, soil, rock or water conditions appear to be different from those described herein, Kumar & Associates, Inc. should be advised at once so that a re-evaluation of the recommendations presented in this report can be made. Kumar & Associates, Inc. is not responsible for liability associated with interpretation of subsurface data by others.

The scope of services for this project does not include any environmental assessment of the site or identification of contaminated or hazardous materials or conditions, or the presence, prevention or possibility of mold or other biological contaminants (MOBC) developing in the future. If the owner is concerned about the potential for such contamination, other studies should be undertaken.

AFK/sw

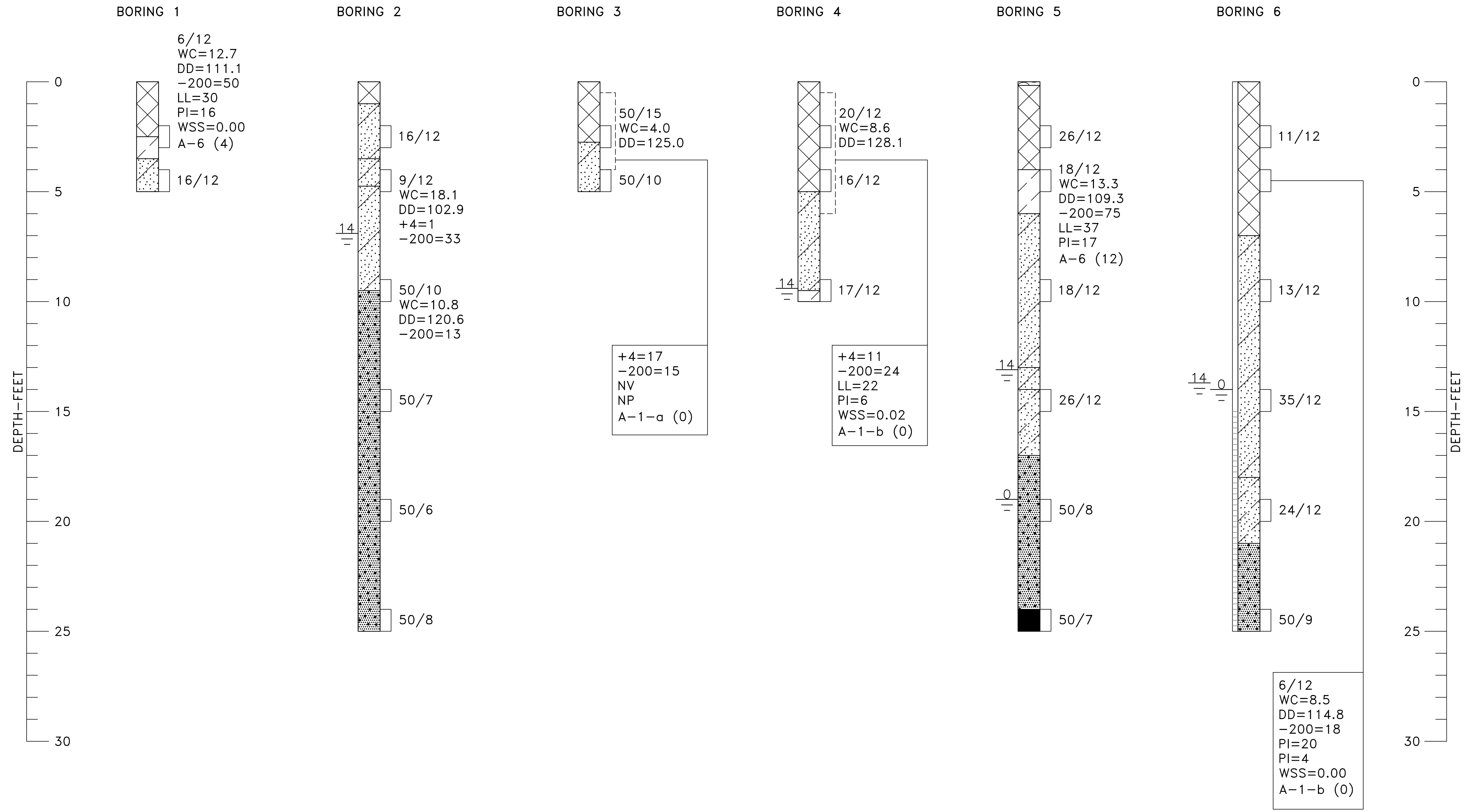



VICINITY MAP
NOT TO SCALE

| | | | | |
|---|---|---|---|---|
| 26-2-169 | Kumar & Associates | | LOCATION OF EXPLORATORY BORINGS | Fig. 1 |




| 26–2–169 | Kumar & Associates | | LOGS OF EXPLORATORY BORINGS | Fig. 2 |
|---|---|---|---|---|

## LEGEND

TOPSOIL.

FILL: CLAYEY SAND (SC), SILTY SAND (SM), SILTY CLAYEY SAND (SC–SM), WELL GRADED GRAVEL WITH SILT (GW–GM), FINE TO COARSE GRAINED WITH GRAVEL, DRY TO MOIST, MOTTLED BROWNS AND GRAYS.

SANDY LEAN CLAY (CL), FINE TO COARSE GRAINED, WITH OCCASIONAL GRAVEL, MEDIUM STIFF TO VERY STIFF, MOIST, DARK BROWN.

CLAYEY SAND (SC), FINE TO COARSE GRAINED, MEDIUM DENSE, MOIST TO WET, LIGHT GREY TO BROWN.

SILTY SAND (SM), FINE TO COARSE GRAINED, LOOSE, MOIST, LIGHT GRAY.

WELL GRADED SAND WITH SILT (SW–SM), WITH OCCASIONAL LENSES OF CLAY, FINE TO COARSE GRAINED, MEDIUM DENSE TO DENSE, MOIST TO WET, LIGHT BROWN TO GRAY.

SANDSTONE BEDROCK, POORLY CEMENTED, FINE TO COARSE GRAINED, HARD TO VERY HARD, MOIST TO VERY MOIST, LIGHT GRAY TO BROWN.

CLAYSTONE BEDROCK, FINE GRAINED, VERY HARD, MOIST, BLUE–GRAY.

DRIVE SAMPLE, 2–INCH I.D. CALIFORNIA LINER SAMPLE.

DISTURBED BULK SAMPLE.

INDICATES PERFORATED PVC PIPE INSTALLED IN BORING TO DEPTH SHOWN.

6/12 DRIVE SAMPLE BLOW COUNT. INDICATES THAT 6 BLOWS OF A 140–POUND HAMMER FALLING 30 INCHES WERE REQUIRED TO DRIVE THE SAMPLER 12 INCHES.

0 DEPTH TO WATER LEVEL ENCOUNTERED AT THE TIME OF DRILLING.

## NOTES

1. THE EXPLORATORY BORINGS WERE DRILLED ON JUNE 8, 2026 WITH A 4–INCH–DIAMETER CONTINUOUS–FLIGHT POWER AUGER.

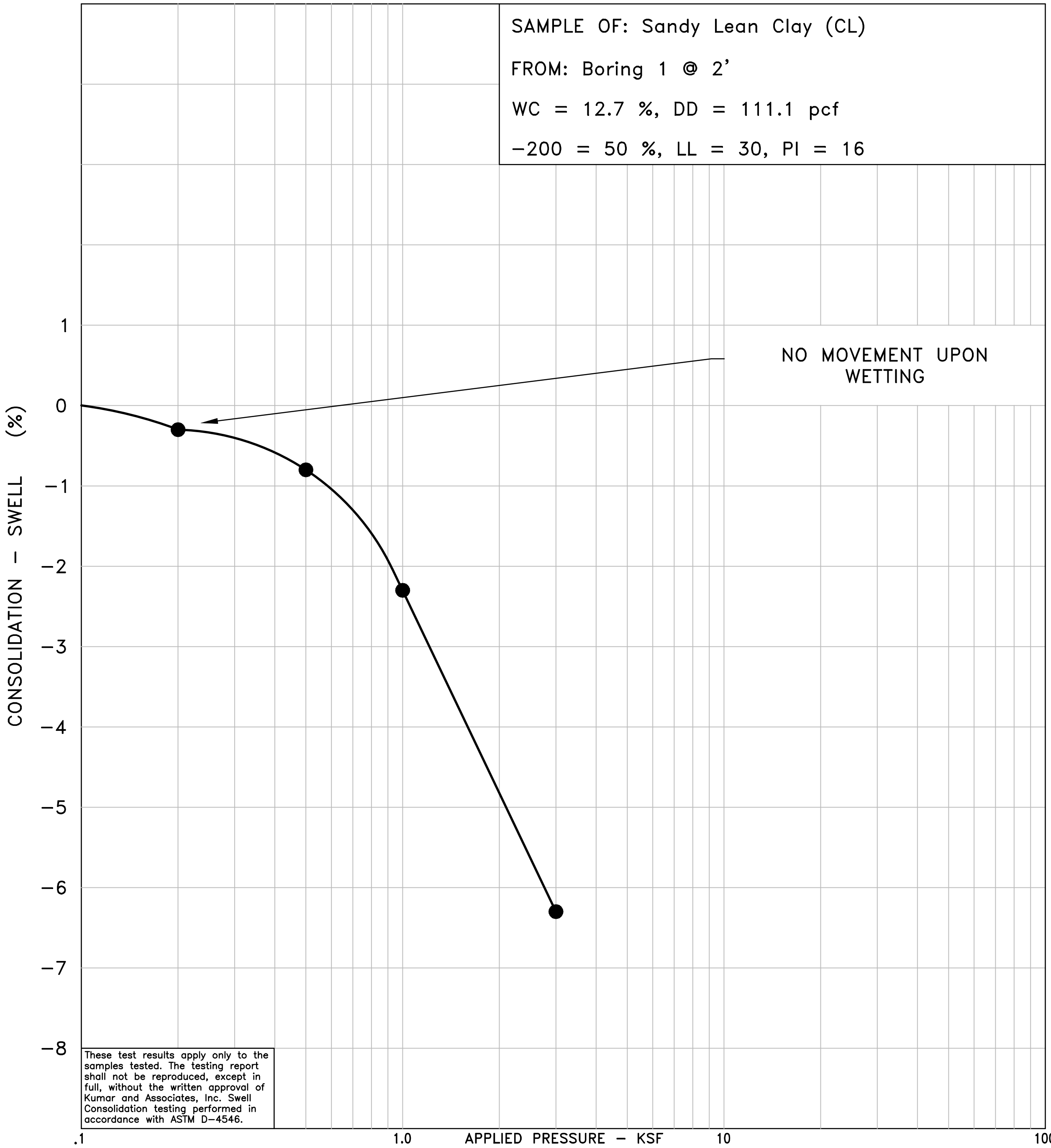
2. THE LOCATIONS OF THE EXPLORATORY BORINGS WERE MEASURED APPROXIMATELY BY HANDHELD GPS DEVICE.

3. THE ELEVATIONS OF THE EXPLORATORY BORINGS WERE NOT MEASURED AND THE LOGS OF THE EXPLORATORY BORINGS ARE PLOTTED TO DEPTH.

4. THE LINES BETWEEN MATERIALS SHOWN ON THE EXPLORATORY BORING LOGS REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN MATERIAL TYPES AND THE TRANSITIONS MAY BE GRADUAL.

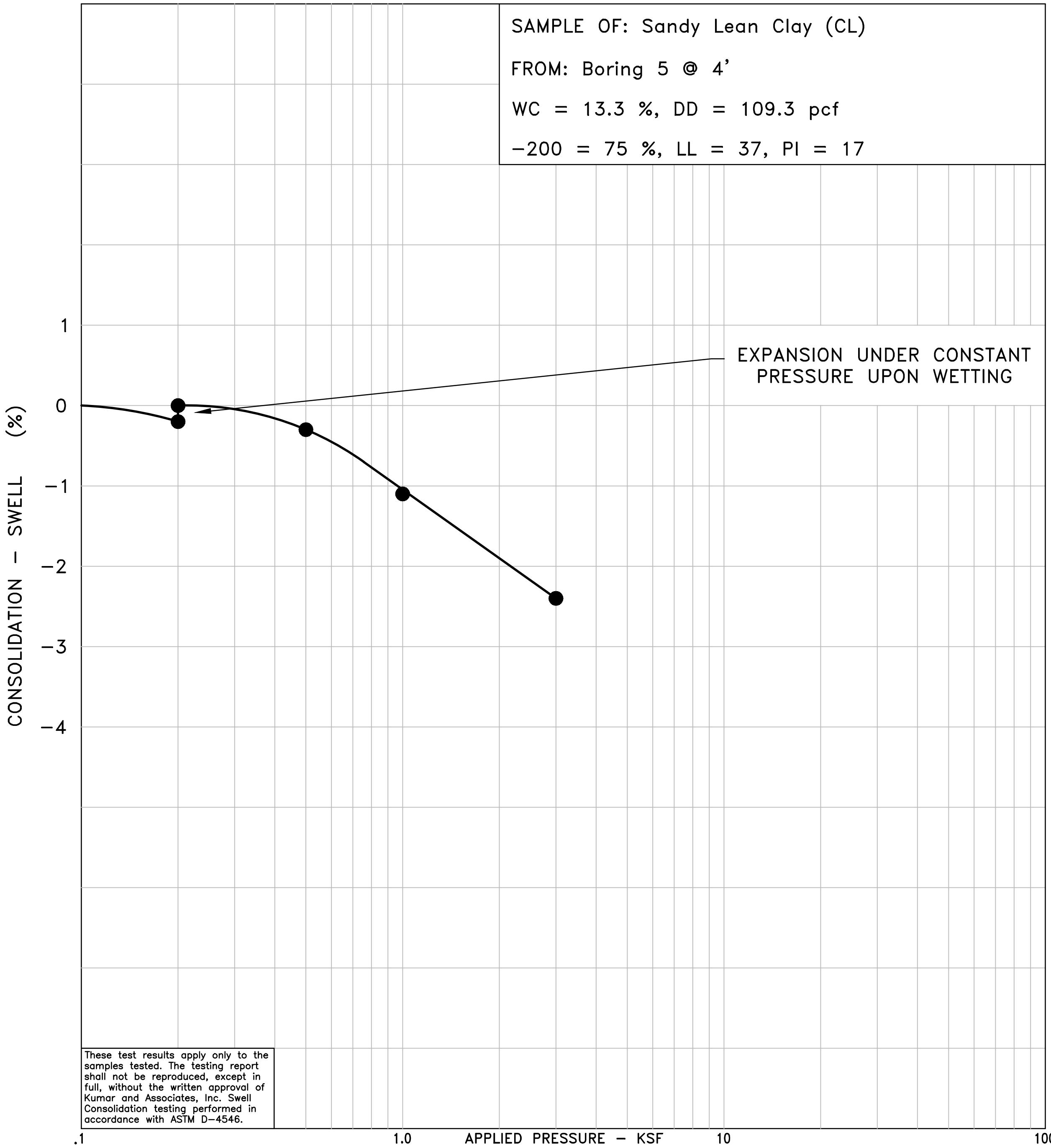
5. GROUNDWATER LEVELS SHOWN ON THE LOGS WERE MEASURED AT THE TIME AND UNDER CONDITIONS INDICATED. FLUCTUATIONS IN THE WATER LEVEL MAY OCCUR WITH TIME.

6. LABORATORY TEST RESULTS:
   WC = WATER CONTENT (%) (ASTM D2216);
   DD = DRY DENSITY (pcf) (ASTM D2216);
   +4 = PERCENTAGE RETAINED ON NO. 4 SIEVE (ASTM D6913);
   –200= PERCENTAGE PASSING NO. 200 SIEVE (ASTM D1140);
   LL = LIQUID LIMIT (ASTM D4318);
   PI = PLASTICITY INDEX (ASTM D4318);
   NP = NON–PLASTIC (ASTM D4318);
   WSS = WATER SOLUBLE SULFATES (%) (CP–L 2103).






| 26-2-169 | Kumar & Associates | SWELL-CONSOLIDATION TEST RESULTS | Fig. 4 |
|---|---|---|---|

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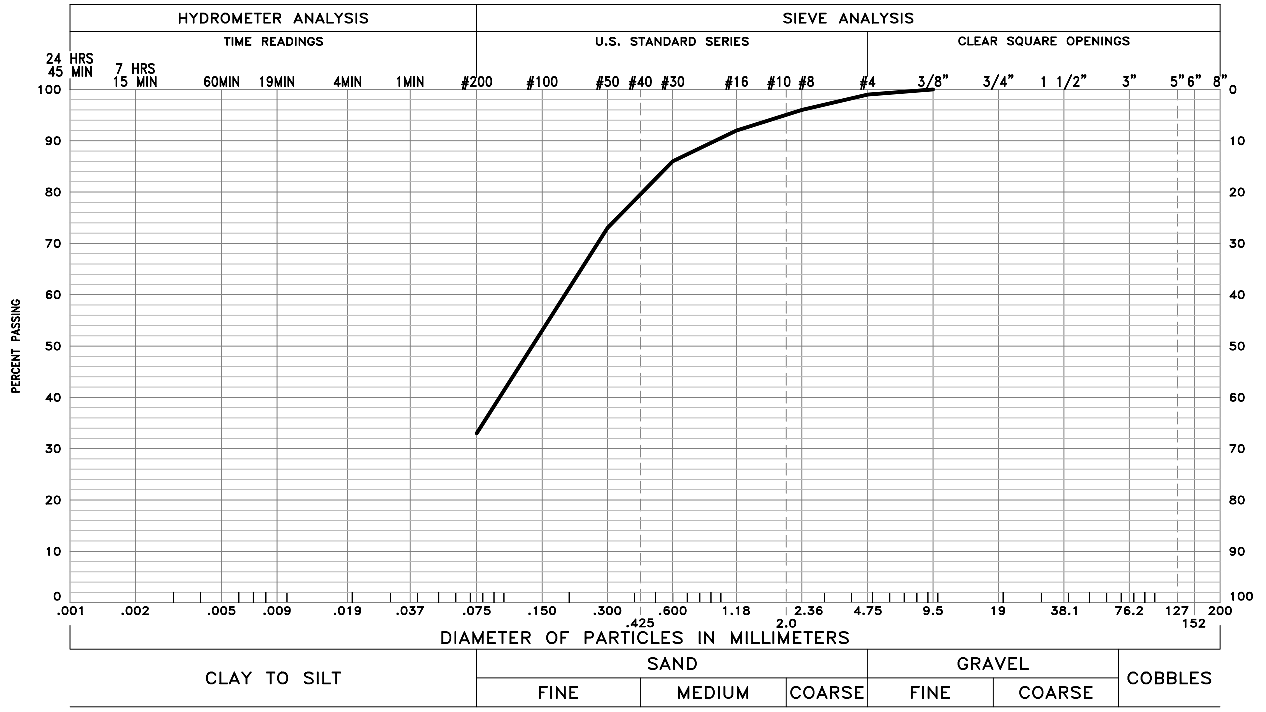
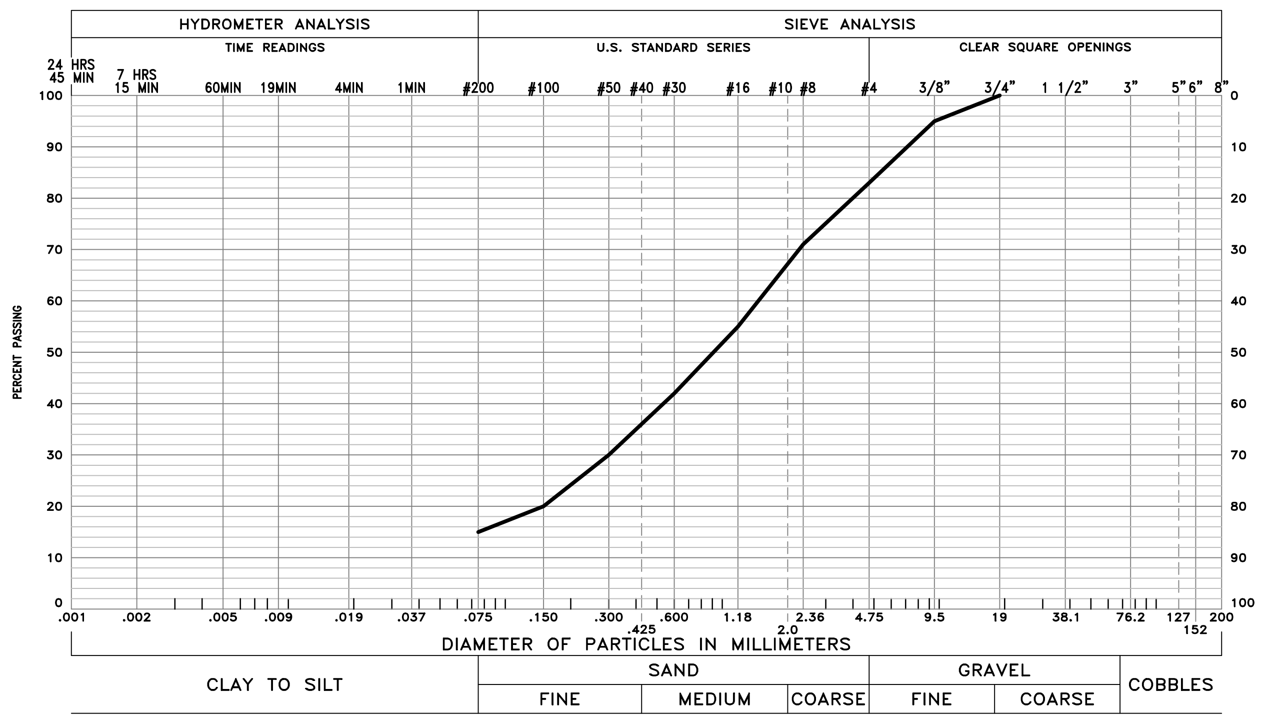
| 26-2-169 | Kumar & Associates | SWELL-CONSOLIDATION TEST RESULTS | Fig. 5 |
|---|---|---|---|




GRAVEL 1 % SAND 66 % SILT AND CLAY 33 %

LIQUID LIMIT – PLASTICITY INDEX –

SAMPLE OF: Silty Sand (SM) FROM: Boring 2 @ 4'



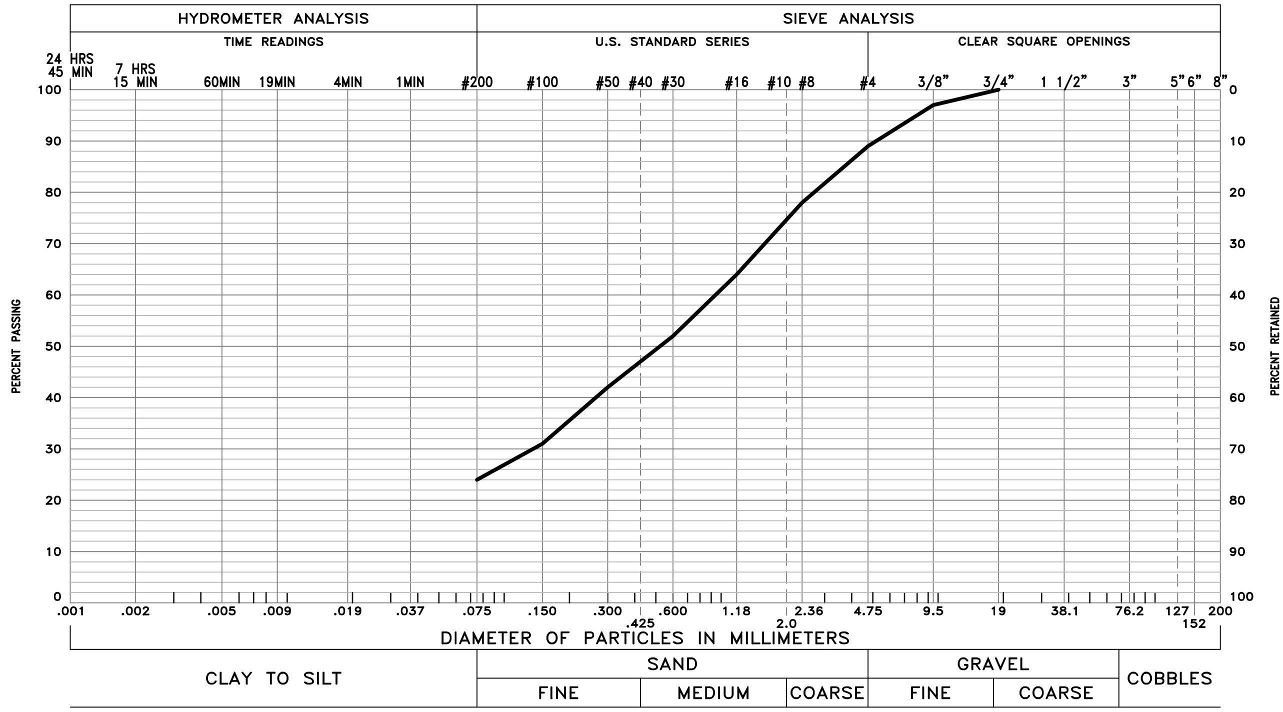

GRAVEL 17 % SAND 68 % SILT AND CLAY 15 %

LIQUID LIMIT NV PLASTICITY INDEX NP

SAMPLE OF: Fill: Silty Sand (SM) FROM: Boring 3 @ 0.5'–4'

These test results apply only to the samples which were tested. The testing report shall not be reproduced, except in full, without the written approval of Kumar & Associates, Inc. Sieve analysis testing is performed in accordance with ASTM D6913, ASTM D7928, ASTM C136 and/or ASTM D1140.

| 26–2–169 | Kumar & Associates | GRADATION TEST RESULTS | Fig. 6 |
|---|---|---|---|




GRAVEL 11 % SAND 65 % SILT AND CLAY 24 %

LIQUID LIMIT 22 PLASTICITY INDEX 6

SAMPLE OF: Fill: Silty Clayey Sand (SC-SM) FROM: Boring 4 @ 0.5'-6'

These test results apply only to the samples which were tested. The testing report shall not be reproduced, except in full, without the written approval of Kumar & Associates, Inc. Sieve analysis testing is performed in accordance with ASTM D6913, ASTM D7928, ASTM C136 and/or ASTM D1140.

| 26-2-169 | Kumar & Associates | GRADATION TEST RESULTS | Fig. 7 |
|---|---|---|---|

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# Kumar and Associates, Inc.



## TABLE I

## SUMMARY OF LABORATORY TEST RESULTS

Project No.: 26-2-169
Project Name: WHMD RWRF Stormwater Improvements
Date Sampled: 6/8/2026
Date Received: 7/7/2026

| SAMPLE LOCATION | | DATE TESTED | NATURAL MOISTURE CONTENT (%) | NATURAL DRY DENSITY (pcf) | GRADATION | | PERCENT PASSING NO. 200 SIEVE | ATTERBERG LIMITS | | WATER SOLUBLE SULFATES (%) | AASHTO CLASSIFICATION (Group Index) | SOIL OR BEDROCK TYPE (Unified Soil Classification) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BORING | DEPTH (ft) | | | | GRAVEL (%) | SAND (%) | | LIQUID LIMIT | PLASTICITY INDEX | | | |
| 1 | 2 | 7/8/26 | 12.7 | 111.1 | | | 50 | 30 | 16 | 0.00 | A-6 (4) | Sandy Lean Clay (CL) |
| | | | | | | | | | | | | |
| 2 | 4 | 7/8/26 | 18.1 | 102.9 | 1 | 66 | 33 | | | | | Silty Sand (SM) |
| | 9 | 7/8/26 | 10.8 | 120.6 | | | 13 | | | | | Sandstone |
| | | | | | | | | | | | | |
| 3 | 2 | 7/8/26 | 4.0 | 125.0 | | | | | | | | Fill: Silty Sand (SM) |
| | 0.5 - 4 | 7/8/26 | | | 17 | 68 | 15 | NV | NP | | A-1-a (0) | Fill: Silty Sand (SM) |
| | | | | | | | | | | | | |
| 4 | 2 | 7/8/26 | 8.6 | 128.1 | | | | | | | | Fill: Silty Clayey Sand (SC-SM) |
| | 0.5 - 6 | 7/8/26 | | | 11 | 65 | 24 | 22 | 6 | 0.02 | A-1-b (0) | Fill: Silty Clayey Sand (SC-SM) |
| | | | | | | | | | | | | |
| 5 | 4 | 7/8/26 | 13.3 | 109.3 | | | 75 | 37 | 17 | | A-6 (12) | Sandy Lean Clay (CL) |
| | | | | | | | | | | | | |
| 6 | 4 | 7/8/26 | 8.5 | 114.8 | | | 18 | 20 | 4 | 0.00 | A-1-b (0) | Fill: Silty Sand (SM) |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

## *APPENDIX D – HYDROLOGY*

NOAA Atlas 14, Volume 8, Version 2
Location name: Peyton, Colorado, USA*
Latitude: 38.9709°, Longitude: -104.5991°
Elevation: 7053 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, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

## PF tabular

| PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1] | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Duration | Average recurrence interval (years) | | | | | | | | | |
| | 1 | 2 | 5 | 10 | 25 | 50 | 100 | 200 | 500 | 1000 |
| 5-min | **0.238** (0.191-0.299) | **0.290** (0.232-0.365) | **0.380** (0.303-0.480) | **0.459** (0.364-0.582) | **0.575** (0.443-0.760) | **0.670** (0.503-0.895) | **0.769** (0.557-1.05) | **0.874** (0.607-1.23) | **1.02** (0.682-1.47) | **1.14** (0.738-1.66) |
| 10-min | **0.349** (0.279-0.438) | **0.425** (0.340-0.535) | **0.557** (0.444-0.702) | **0.673** (0.533-0.852) | **0.842** (0.648-1.11) | **0.980** (0.736-1.31) | **1.13** (0.816-1.54) | **1.28** (0.889-1.80) | **1.50** (0.998-2.16) | **1.66** (1.08-2.43) |
| 15-min | **0.425** (0.341-0.535) | **0.518** (0.414-0.652) | **0.679** (0.541-0.856) | **0.820** (0.650-1.04) | **1.03** (0.791-1.36) | **1.20** (0.897-1.60) | **1.37** (0.995-1.88) | **1.56** (1.08-2.19) | **1.82** (1.22-2.63) | **2.03** (1.32-2.96) |
| 30-min | **0.609** (0.487-0.765) | **0.741** (0.593-0.933) | **0.970** (0.773-1.22) | **1.17** (0.928-1.48) | **1.46** (1.13-1.93) | **1.70** (1.28-2.27) | **1.95** (1.41-2.67) | **2.22** (1.54-3.11) | **2.59** (1.73-3.73) | **2.88** (1.87-4.19) |
| 60-min | **0.780** (0.624-0.981) | **0.935** (0.748-1.18) | **1.21** (0.967-1.53) | **1.46** (1.16-1.86) | **1.84** (1.43-2.45) | **2.16** (1.63-2.90) | **2.50** (1.82-3.44) | **2.87** (2.00-4.05) | **3.40** (2.27-4.91) | **3.82** (2.48-5.56) |
| 2-hr | **0.951** (0.767-1.19) | **1.13** (0.910-1.41) | **1.46** (1.17-1.82) | **1.76** (1.40-2.21) | **2.23** (1.74-2.95) | **2.62** (1.99-3.50) | **3.06** (2.24-4.18) | **3.53** (2.48-4.95) | **4.20** (2.84-6.05) | **4.76** (3.11-6.88) |
| 3-hr | **1.04** (0.846-1.30) | **1.22** (0.991-1.52) | **1.57** (1.26-1.95) | **1.89** (1.52-2.37) | **2.41** (1.90-3.20) | **2.86** (2.19-3.82) | **3.36** (2.48-4.59) | **3.91** (2.76-5.47) | **4.70** (3.20-6.76) | **5.36** (3.52-7.73) |
| 6-hr | **1.21** (0.990-1.49) | **1.40** (1.15-1.73) | **1.78** (1.45-2.20) | **2.16** (1.74-2.67) | **2.76** (2.20-3.64) | **3.29** (2.54-4.37) | **3.88** (2.90-5.28) | **4.55** (3.25-6.34) | **5.52** (3.79-7.89) | **6.33** (4.20-9.07) |
| 12-hr | **1.40** (1.15-1.71) | **1.63** (1.34-1.99) | **2.06** (1.69-2.53) | **2.49** (2.03-3.06) | **3.17** (2.55-4.15) | **3.77** (2.94-4.97) | **4.44** (3.34-5.98) | **5.18** (3.73-7.16) | **6.26** (4.33-8.88) | **7.16** (4.79-10.2) |
| 24-hr | **1.62** (1.34-1.96) | **1.90** (1.57-2.30) | **2.41** (1.99-2.93) | **2.90** (2.38-3.53) | **3.65** (2.95-4.71) | **4.31** (3.37-5.60) | **5.02** (3.80-6.69) | **5.80** (4.21-7.94) | **6.93** (4.83-9.74) | **7.86** (5.30-11.1) |
| 2-day | **1.88** (1.57-2.25) | **2.22** (1.85-2.66) | **2.82** (2.35-3.39) | **3.37** (2.79-4.07) | **4.20** (3.40-5.34) | **4.90** (3.86-6.29) | **5.65** (4.30-7.44) | **6.46** (4.72-8.75) | **7.61** (5.35-10.6) | **8.55** (5.82-12.0) |
| 3-day | **2.06** (1.73-2.46) | **2.43** (2.04-2.90) | **3.08** (2.58-3.69) | **3.67** (3.05-4.41) | **4.55** (3.70-5.74) | **5.29** (4.19-6.75) | **6.08** (4.65-7.96) | **6.93** (5.08-9.33) | **8.13** (5.73-11.3) | **9.10** (6.23-12.7) |
| 4-day | **2.22** (1.87-2.64) | **2.60** (2.19-3.09) | **3.28** (2.75-3.91) | **3.89** (3.25-4.66) | **4.81** (3.92-6.04) | **5.57** (4.43-7.09) | **6.39** (4.90-8.34) | **7.27** (5.35-9.76) | **8.52** (6.03-11.8) | **9.52** (6.54-13.3) |
| 7-day | **2.62** (2.23-3.10) | **3.03** (2.57-3.58) | **3.75** (3.17-4.44) | **4.40** (3.70-5.23) | **5.37** (4.41-6.70) | **6.18** (4.95-7.81) | **7.05** (5.45-9.15) | **7.99** (5.92-10.7) | **9.31** (6.64-12.8) | **10.4** (7.19-14.4) |
| 10-day | **2.98** (2.54-3.50) | **3.42** (2.92-4.02) | **4.20** (3.56-4.95) | **4.89** (4.13-5.79) | **5.92** (4.88-7.34) | **6.78** (5.44-8.52) | **7.69** (5.96-9.92) | **8.66** (6.45-11.5) | **10.0** (7.19-13.7) | **11.1** (7.75-15.4) |
| 20-day | **3.99** (3.43-4.64) | **4.59** (3.95-5.35) | **5.61** (4.81-6.56) | **6.49** (5.52-7.62) | **7.73** (6.39-9.44) | **8.73** (7.04-10.8) | **9.75** (7.61-12.4) | **10.8** (8.11-14.2) | **12.3** (8.86-16.6) | **13.4** (9.43-18.4) |
| 30-day | **4.80** (4.15-5.56) | **5.54** (4.79-6.42) | **6.76** (5.82-7.86) | **7.78** (6.66-9.09) | **9.19** (7.61-11.1) | **10.3** (8.32-12.6) | **11.4** (8.91-14.4) | **12.5** (9.40-16.3) | **14.0** (10.1-18.8) | **15.1** (10.7-20.7) |
| 45-day | **5.80** (5.04-6.68) | **6.70** (5.81-7.72) | **8.13** (7.03-9.40) | **9.30** (8.00-10.8) | **10.9** (9.03-13.0) | **12.1** (9.80-14.7) | **13.2** (10.4-16.6) | **14.4** (10.9-18.6) | **15.9** (11.6-21.2) | **17.0** (12.1-23.2) |
| 60-day | **6.64** (5.79-7.62) | **7.64** (6.65-8.77) | **9.23** (8.01-10.6) | **10.5** (9.06-12.2) | **12.2** (10.1-14.5) | **13.4** (10.9-16.3) | **14.7** (11.5-18.3) | **15.8** (12.0-20.3) | **17.3** (12.6-23.0) | **18.4** (13.1-25.0) |

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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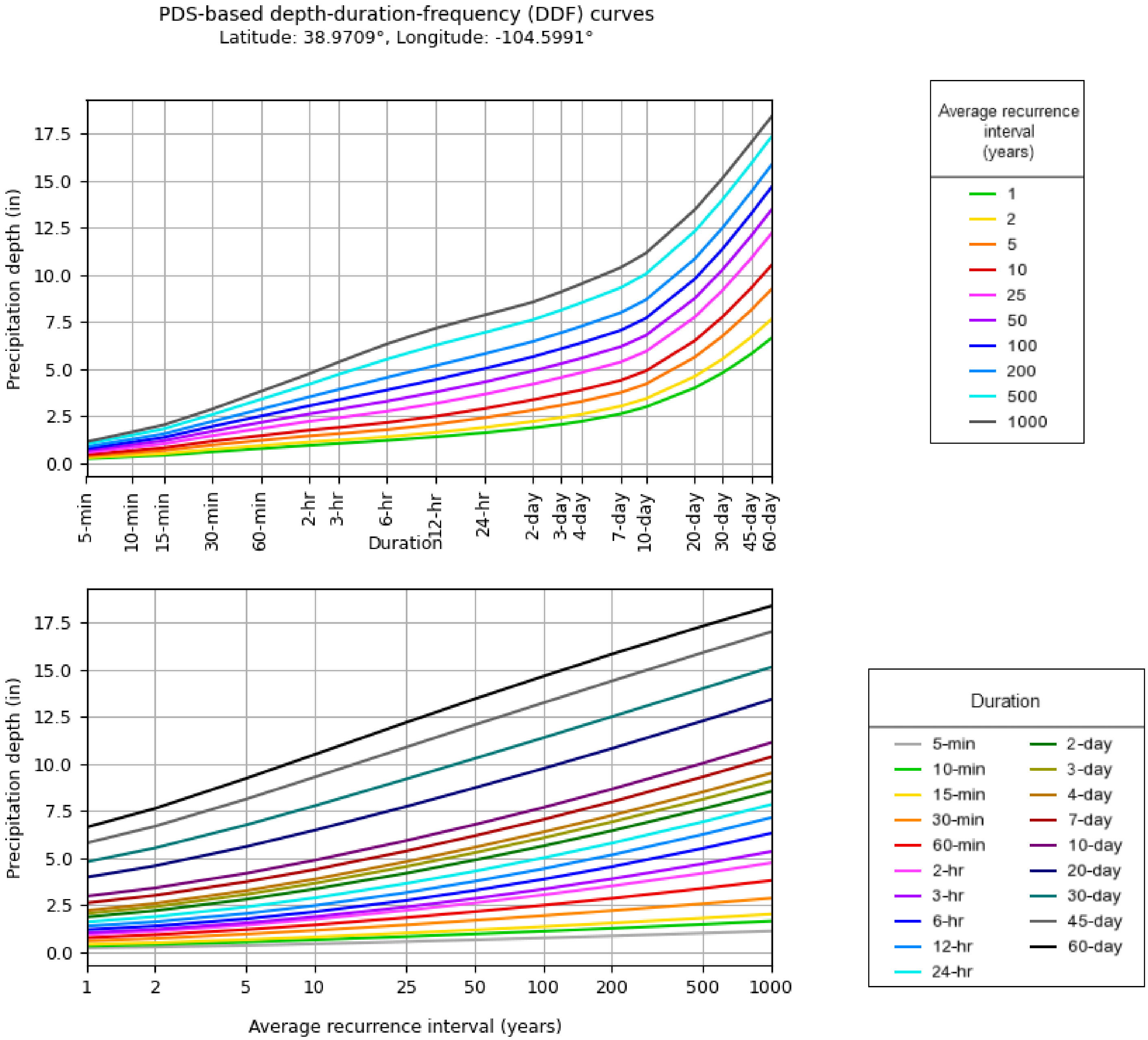
## PF graphical




NOAA Atlas 14, Volume 8, Version 2

Created (GMT): Mon Jun 15 17:59:24 2026

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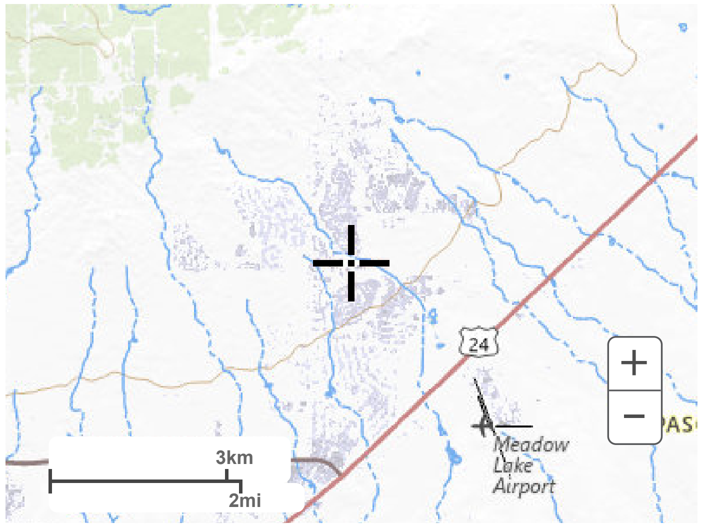
## Maps & aerials

**Small scale terrain**




Large scale terrain


Large scale map


Large scale aerial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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Kimley»Horn

# STANDARD FORM SF-1 (EXISITNG CONDITIONS)
# RUNOFF COEFFICIENTS - IMPERVIOUS CALCULATION

PROJECT NAME: **WHMD RWRF Stormwater Improvements**
PROJECT NUMBER: 296082000
CALCULATED BY: PLH
CHECKED BY: MEO

HYDROLOGIC SOIL GROUP: A

Impervious values and runoff coefficients are taken from the Colorado Springs Drainage Criteria Manual (Vol. 1) - Table 6-6

| LAND USE (HSG A/B): | PAVEMENT | ROOF | GRAVEL | LANDSCAPE |
|---|---|---|---|---|
| 2-YEAR COEFF. | 0.89 | 0.71 | 0.57 | 0.02 |
| 5-YEAR COEFF. | 0.90 | 0.73 | 0.59 | 0.08 |
| 10-YEAR COEFF. | 0.92 | 0.75 | 0.63 | 0.15 |
| 100-YEAR COEFF. | 0.96 | 0.81 | 0.70 | 0.35 |
| IMPERVIOUS % | 100% | 90% | 80% | 0% |

| DESIGN BASIN | DESIGN POINT | PAVEMENT AREA (SF) | ROOF AREA (SF) | GRAVEL AREA (SF) | LANDSCAPE AREA (SF) | TOTAL AREA (SF) | TOTAL AREA (AC) | C(2) | C(5) | C(10) | C(100) | Imp % | HSG |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Basins** | | | | | | | | | | | | | |
| EX-1 | EX-1 | | | | 1,355 | **1,355** | **0.03** | 0.02 | 0.08 | 0.15 | 0.35 | 0% | A |
| EX-2 | EX-2 | | | | 9,852 | **9,852** | **0.23** | 0.02 | 0.08 | 0.15 | 0.35 | 0% | A |
| EX-3 | EX-3 | | | | 1,183 | **1,183** | **0.03** | 0.02 | 0.08 | 0.15 | 0.35 | 0% | A |
| EX-4 | EX-4 | | | | 32,282 | **32,282** | **0.74** | 0.02 | 0.08 | 0.15 | 0.35 | 0% | A |
| EX-5 | EX-5 | | | 2,307 | 34,290 | **36,597** | **0.84** | 0.02 | 0.11 | 0.18 | 0.37 | 5% | A |
| EX-6 | EX-6 | | | 17,689 | 36,076 | **53,764** | **1.23** | 0.02 | 0.25 | 0.31 | 0.47 | 26% | A |
| EX-7 | EX-7 | 625 | | 10,294 | 15,564 | **26,482** | **0.61** | 0.04 | 0.30 | 0.35 | 0.50 | 33% | A |
| EX-8 | EX-8 | | 15,427 | | | **15,427** | **0.35** | 0.71 | 0.73 | 0.75 | 0.81 | 90% | A |
| EX-9 | EX-9 | 23,425 | | | | **23,425** | **0.54** | 0.89 | 0.90 | 0.92 | 0.96 | 100% | A |
| EX-10 | EX-10 | 7,167 | 380 | 17,155 | 35,131 | **59,833** | **1.37** | 0.13 | 0.33 | 0.38 | 0.53 | 35% | A |
| EX-11 | EX-11 | 7,159 | | | | **7,159** | **0.16** | 0.89 | 0.90 | 0.92 | 0.96 | 100% | A |
| EX-12 | EX-12 | 755 | 558 | 441 | 17,933 | **19,687** | **0.45** | 0.07 | 0.14 | 0.21 | 0.39 | 8% | A |
| EX-13 | EX-13 | | | | 3,002 | **3,002** | **0.07** | 0.02 | 0.08 | 0.15 | 0.35 | 0% | A |
| EX-14 | EX-14 | 4,718 | 145 | 1,491 | 27,395 | **33,750** | **0.77** | 0.14 | 0.22 | 0.28 | 0.45 | 18% | A |
| EX-15 | EX-15 | 2,430 | | 53,591 | 43,218 | **99,239** | **2.28** | 0.04 | 0.38 | 0.43 | 0.55 | 46% | A |
| EX-16 | EX-16 | 648 | | 61,851 | | **62,499** | **1.43** | 0.03 | 0.59 | 0.63 | 0.70 | 80% | A |
| EX-17 | EX-17 | | | 9,799 | 66,181 | **75,979** | **1.74** | 0.02 | 0.15 | 0.21 | 0.40 | 10% | A |
| EX-18 | EX-18 | 615 | 144 | 3,092 | 15,363 | **19,213** | **0.44** | 0.05 | 0.19 | 0.26 | 0.43 | 17% | A |
| EX-19 | EX-19 | 651 | | 1,878 | 24,610 | **27,139** | **0.62** | 0.04 | 0.13 | 0.20 | 0.39 | 8% | A |
| OF-1 | OF-1 | | | | 11,667 | **11,667** | **0.27** | 0.02 | 0.08 | 0.15 | 0.35 | 0% | A |
| OF-2 | OF-2 | | | | 2,352 | **2,352** | **0.05** | 0.02 | 0.08 | 0.15 | 0.35 | 0% | A |
| OF-3 | OF-3 | | | | 23,451 | **23,451** | **0.54** | 0.02 | 0.08 | 0.15 | 0.35 | 0% | A |
| OF-4 | OF-4 | | | | 4,841 | **4,841** | **0.11** | 0.02 | 0.08 | 0.15 | 0.35 | 0% | A |
| OF-5 | OF-5 | | | | 2,595 | **2,595** | **0.06** | 0.02 | 0.08 | 0.15 | 0.35 | 0% | A |
| OF-6 | OF-6 | | | | 5,176 | **5,176** | **0.12** | 0.02 | 0.08 | 0.15 | 0.35 | 0% | A |
| **OVERALL SUBTOTAL** | | **48,192** | **16,654** | **179,588** | **413,516** | **657,949** | **15.10** | **0.25** | **0.30** | **0.35** | **0.50** | **31.44%** | A |
| | | **7%** | **3%** | **27%** | **63%** | **100%** | **100%** | | | | | | |
| **OVERALL ONSITE SUBTOTAL** | | **48,192** | **16,654** | **179,588** | **363,434** | **607,868** | **13.95** | **0.27** | **0.31** | **0.37** | **0.51** | **34.03%** | A |
| | | **8%** | **3%** | **30%** | **60%** | **100%** | **100%** | | | | | | |

Kimley»Horn

# STANDARD FORM SF-2 (EXISTING CONDITIONS)
## Time of Concentration

PROJECT NAME: WHMD RWRF Stormwater Improvements
PROJECT NUMBER: 296008000
CALCULATED BY: PLH
CHECKED BY: MEO

| SUB-BASIN DATA | | | INITIAL TIME ($T_i$) | | | TRAVEL TIME ($T_t$) | | | | | Tc CHECK (URBANIZED BASINS) | | | | | FINAL Tc |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DESIGN BASIN (1) | AREA SF (2) | C5 (3) | LENGTH Ft (4) | SLOPE % (5) | $T_i$ Min. (6) | LENGTH Ft. (7) | SLOPE % (8) | $C_v$ (9) | VEL fps (11) | $T_t$ Min. (12) | COMP. tc (13) | TOTAL LENGTH (14) | TOTAL SLOPE (15) | TOTAL IMP. (16) | Tc Min. (17) | Min. |
| **All Basins** | | | | | | | | | | | | | | | | |
| EX-1 | 1,355 | 0.08 | 25 | 6.7% | 4.9 | 23 | 10.2% | 10.0 | 3.2 | 0.1 | 5.1 | 47 | 8.4% | 0% | 26.3 | 5.1 |
| EX-2 | 9,852 | 0.08 | 19 | 7.1% | 4.3 | 103 | 6.8% | 10.0 | 2.6 | 0.7 | 4.9 | 122 | 6.9% | 0% | 26.9 | 5.0 |
| EX-3 | 1,183 | 0.08 | 16 | 9.3% | 3.6 | 51 | 7.9% | 10.0 | 2.8 | 0.3 | 3.9 | 67 | 8.2% | 0% | 26.4 | 5.0 |
| EX-4 | 32,282 | 0.08 | 62 | 13.5% | 6.2 | 594 | 0.6% | 10.0 | 0.8 | 12.4 | 18.6 | 656 | 1.9% | 0% | 34.9 | 18.6 |
| EX-5 | 36,597 | 0.11 | 77 | 3.3% | 10.7 | 247 | 2.6% | 10.0 | 1.6 | 2.6 | 13.2 | 324 | 2.8% | 5% | 28.5 | 13.2 |
| EX-6 | 53,764 | 0.25 | 57 | 5.9% | 6.5 | 325 | 2.4% | 10.0 | 1.6 | 3.5 | 10.0 | 382 | 3.0% | 26% | 24.4 | 10.0 |
| EX-7 | 26,482 | 0.30 | 80 | 7.0% | 6.9 | 249 | 1.2% | 10.0 | 1.1 | 3.8 | 10.6 | 329 | 2.6% | 33% | 22.8 | 10.6 |
| EX-8 | 15,427 | 0.73 | 87 | 0.0% | 0.0 | 79 | 1.0% | 20.0 | 2.0 | 0.7 | 0.7 | 166 | 0.5% | 90% | 12.6 | 5.0 |
| EX-9 | 23,425 | 0.90 | 66 | 0.0% | 0.0 | 151 | 1.0% | 20.0 | 2.0 | 1.3 | 1.3 | 217 | 0.7% | 100% | 10.9 | 5.0 |
| EX-10 | 59,833 | 0.33 | 78 | 9.6% | 5.9 | 534 | 1.2% | 10.0 | 1.1 | 8.2 | 14.1 | 613 | 2.3% | 35% | 24.8 | 14.1 |
| EX-11 | 7,159 | 0.90 | 54 | 0.0% | 0.0 | 74 | 1.0% | 20.0 | 2.0 | 0.6 | 0.6 | 128 | 0.6% | 100% | 10.2 | 5.0 |
| EX-12 | 19,687 | 0.14 | 98 | 8.2% | 8.6 | 407 | 0.7% | 10.0 | 0.9 | 7.9 | 16.5 | 504 | 2.2% | 8% | 30.2 | 16.5 |
| EX-13 | 3,002 | 0.08 | 14 | 3.5% | 4.6 | 46 | 7.6% | 10.0 | 2.8 | 0.3 | 4.9 | 60 | 6.6% | 0% | 26.4 | 5.0 |
| EX-14 | 33,750 | 0.22 | 21 | 1.7% | 6.2 | 678 | 0.6% | 10.0 | 0.7 | 15.1 | 21.3 | 699 | 0.6% | 18% | 36.1 | 21.3 |
| EX-15 | 99,239 | 0.38 | 80 | 12.9% | 5.1 | 318 | 0.2% | 10.0 | 0.4 | 12.2 | 17.2 | 398 | 2.7% | 46% | 20.8 | 17.2 |
| EX-16 | 62,499 | 0.59 | 108 | 7.5% | 4.9 | 213 | 0.7% | 10.0 | 0.8 | 4.3 | 9.2 | 321 | 3.0% | 80% | 13.9 | 9.2 |
| EX-17 | 75,979 | 0.15 | 39 | 0.8% | 11.8 | 334 | 0.3% | 10.0 | 0.6 | 10.0 | 21.8 | 373 | 0.4% | 10% | 34.2 | 21.8 |
| EX-18 | 19,213 | 0.19 | 105 | 6.9% | 8.9 | 228 | 1.0% | 10.0 | 1.0 | 3.8 | 12.8 | 333 | 2.9% | 17% | 26.0 | 12.8 |
| EX-19 | 27,139 | 0.13 | 65 | 6.2% | 7.8 | 635 | 2.2% | 10.0 | 1.5 | 7.1 | 14.9 | 699 | 2.6% | 8% | 31.8 | 14.9 |
| OF-1 | 11,667 | 0.08 | 23 | 8.1% | 4.4 | 163 | 3.8% | 10.0 | 2.0 | 1.4 | 5.8 | 185 | 4.3% | 0% | 27.6 | 5.8 |
| OF-2 | 2,352 | 0.08 | 18 | 9.1% | 3.8 | 47 | 10.7% | 10.0 | 3.3 | 0.2 | 4.1 | 65 | 10.3% | 0% | 26.4 | 5.0 |
| OF-3 | 23,451 | 0.08 | 52 | 0.6% | 16.4 | 278 | 1.8% | 10.0 | 1.3 | 3.4 | 19.8 | 330 | 1.6% | 0% | 30.8 | 19.8 |
| OF-4 | 4,841 | 0.08 | 27 | 8.7% | 4.7 | 158 | 0.6% | 10.0 | 0.8 | 3.3 | 8.0 | 185 | 1.8% | 0% | 28.6 | 8.0 |
| OF-5 | 2,595 | 0.08 | 76 | 2.9% | 11.4 | 102 | 3.5% | 10.0 | 1.9 | 0.9 | 12.3 | 178 | 3.2% | 0% | 27.8 | 12.3 |
| OF-6 | 5,176 | 0.08 | 97 | 0.9% | 19.4 | 573 | 1.8% | 10.0 | 1.4 | 7.0 | 26.4 | 670 | 1.7% | 0% | 35.5 | 26.4 |

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_o^{0.33}} \qquad t_t = \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t} \qquad t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$

Kimley»Horn

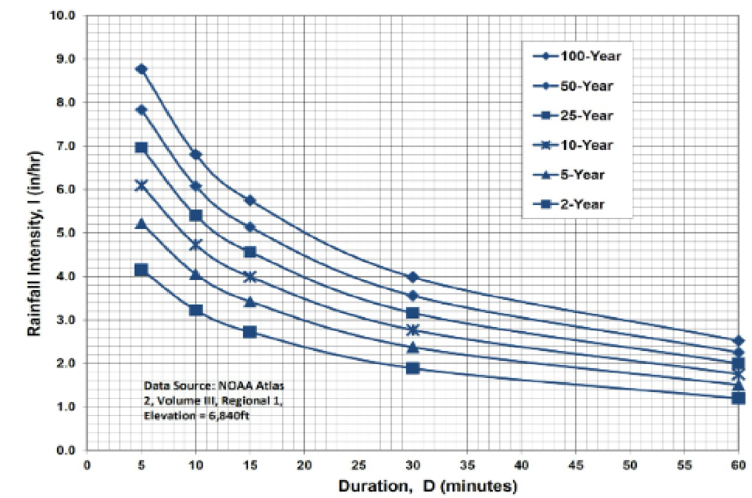
# STANDARD FORM SF-3 (EXISTING CONDITIONS)
## STORM DRAINAGE DESIGN - RATIONAL METHOD 5 YEAR EVENT

PROJECT NAME: **WHMD RWRF Stormwater Improvements**
PROJECT NUMBER: 296008000
CALCULATED BY: PLH
CHECKED BY: MEO

**$P_1$ (1-Hour Rainfall) =** **1.21**

| | | DIRECT RUNOFF | | | | | | | TOTAL RUNOFF | | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STORM LINE | DESIGN POINT | DESIGN BASIN | AREA (AC) | RUNOFF COEFF | tc (min) | C*A(ac) | I (in/hr) | Q (cfs) | tc(max) | S(C*A) (ac) | I (in/hr) | Q (cfs) | |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (22) |
| **All Basins** | | | | | | | | | | | | | |
| | EX-1 | EX-1 | 0.03 | 0.08 | 5.1 | 0.00 | 5.15 | 0.01 | | | | | |
| | EX-2 | EX-2 | 0.23 | 0.08 | 5.0 | 0.02 | 5.17 | 0.09 | | | | | |
| | EX-3 | EX-3 | 0.03 | 0.08 | 5.0 | 0.00 | 5.17 | 0.01 | | | | | |
| | EX-4 | EX-4 | 0.74 | 0.08 | 18.6 | 0.06 | 3.20 | 0.19 | | | | | |
| | EX-5 | EX-5 | 0.84 | 0.11 | 13.2 | 0.09 | 3.71 | 0.35 | | | | | |
| | EX-6 | EX-6 | 1.23 | 0.25 | 10.0 | 0.31 | 4.13 | 1.26 | | | | | |
| | EX-7 | EX-7 | 0.61 | 0.30 | 10.6 | 0.18 | 4.04 | 0.73 | | | | | |
| | EX-8 | EX-8 | 0.35 | 0.73 | 5.0 | 0.26 | 5.17 | 1.34 | | | | | |
| | EX-9 | EX-9 | 0.54 | 0.90 | 5.0 | 0.48 | 5.17 | 2.50 | | | | | |
| | EX-10 | EX-10 | 1.37 | 0.33 | 14.1 | 0.45 | 3.61 | 1.63 | | | | | |
| | EX-11 | EX-11 | 0.16 | 0.90 | 5.0 | 0.15 | 5.17 | 0.76 | | | | | |
| | EX-12 | EX-12 | 0.45 | 0.14 | 16.5 | 0.06 | 3.38 | 0.22 | | | | | |
| | EX-13 | EX-13 | 0.07 | 0.08 | 5.0 | 0.01 | 5.17 | 0.03 | | | | | |
| | EX-14 | EX-14 | 0.77 | 0.22 | 21.3 | 0.17 | 2.99 | 0.51 | | | | | |
| | EX-15 | EX-15 | 2.28 | 0.38 | 17.2 | 0.86 | 3.31 | 2.83 | | | | | |
| | EX-16 | EX-16 | 1.43 | 0.59 | 9.2 | 0.85 | 4.25 | 3.62 | | | | | |
| | EX-17 | EX-17 | 1.74 | 0.15 | 21.8 | 0.25 | 2.96 | 0.75 | | | | | |
| | EX-18 | EX-18 | 0.44 | 0.19 | 12.8 | 0.09 | 3.76 | 0.32 | | | | | |
| | EX-19 | EX-19 | 0.62 | 0.13 | 14.9 | 0.08 | 3.53 | 0.30 | | | | | |
| | OF-1 | OF-1 | 0.27 | 0.08 | 5.8 | 0.02 | 4.94 | 0.11 | | | | | |
| | OF-2 | OF-2 | 0.05 | 0.08 | 5.0 | 0.00 | 5.17 | 0.02 | | | | | |
| | OF-3 | OF-3 | 0.54 | 0.08 | 19.8 | 0.04 | 3.10 | 0.13 | | | | | |
| | OF-4 | OF-4 | 0.11 | 0.08 | 8.0 | 0.01 | 4.46 | 0.04 | | | | | |
| | OF-5 | OF-5 | 0.06 | 0.08 | 12.3 | 0.00 | 3.82 | 0.02 | | | | | |
| | OF-6 | OF-6 | 0.12 | 0.08 | 26.4 | 0.01 | 2.67 | 0.03 | | | | | |

**Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency**




**IDF Equations**

$I_{100} = -2.52 \ln(D) + 12.735$

$I_{50} = -2.25 \ln(D) + 11.375$

$I_{25} = -2.00 \ln(D) + 10.111$

$I_{10} = -1.75 \ln(D) + 8.847$

$I_{5} = -1.50 \ln(D) + 7.583$

Kimley»Horn

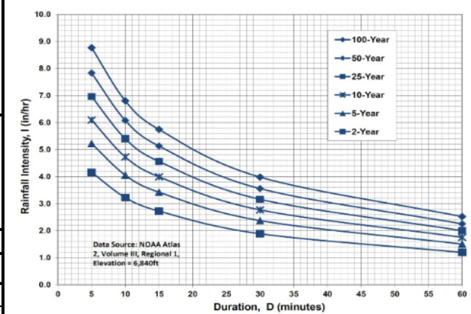
# STANDARD FORM SF-3 (EXISTING CONDITIONS)
## STORM DRAINAGE DESIGN - RATIONAL METHOD 100 YEAR EVENT

PROJECT NAME: **WHMD RWRF Stormwater Improvements**
PROJECT NUMBER: 296008000
CALCULATED BY: PLH
CHECKED BY: MEO

**$P_1$ (1-Hour Rainfall) =** 2.5

| STORM LINE | DESIGN POINT | DIRECT RUNOFF: DESIGN BASIN | AREA (AC) | RUNOFF COEFF | tc (min) | C*A(ac) | I (in/hr) | Q (cfs) | TOTAL RUNOFF: tc(max) | S(C*A) (ac) | I (in/hr) | Q (cfs) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (22) |
| **All Basins** | | | | | | | | | | | | | |
| | EX-1 | EX-1 | 0.03 | 0.35 | 5.1 | 0.01 | 8.65 | 0.09 | | | | | |
| | EX-2 | EX-2 | 0.23 | 0.35 | 5.0 | 0.08 | 8.68 | 0.69 | | | | | |
| | EX-3 | EX-3 | 0.03 | 0.35 | 5.0 | 0.01 | 8.68 | 0.08 | | | | | |
| | EX-4 | EX-4 | 0.74 | 0.35 | 18.6 | 0.26 | 5.37 | 1.39 | | | | | |
| | EX-5 | EX-5 | 0.84 | 0.37 | 13.2 | 0.31 | 6.23 | 1.95 | | | | | |
| | EX-6 | EX-6 | 1.23 | 0.47 | 10.0 | 0.57 | 6.94 | 3.98 | | | | | |
| | EX-7 | EX-7 | 0.61 | 0.50 | 10.6 | 0.30 | 6.78 | 2.06 | | | | | |
| | EX-8 | EX-8 | 0.35 | 0.81 | 5.0 | 0.29 | 8.68 | 2.49 | | | | | |
| | EX-9 | EX-9 | 0.54 | 0.96 | 5.0 | 0.52 | 8.68 | 4.48 | | | | | |
| | EX-10 | EX-10 | 1.37 | 0.53 | 14.1 | 0.72 | 6.06 | 4.38 | | | | | |
| | EX-11 | EX-11 | 0.16 | 0.96 | 5.0 | 0.16 | 8.68 | 1.37 | | | | | |
| | EX-12 | EX-12 | 0.45 | 0.39 | 16.5 | 0.18 | 5.67 | 1.01 | | | | | |
| | EX-13 | EX-13 | 0.07 | 0.35 | 5.0 | 0.02 | 8.68 | 0.21 | | | | | |
| | EX-14 | EX-14 | 0.77 | 0.45 | 21.3 | 0.35 | 5.03 | 1.76 | | | | | |
| | EX-15 | EX-15 | 2.28 | 0.55 | 17.2 | 1.26 | 5.56 | 7.02 | | | | | |
| | EX-16 | EX-16 | 1.43 | 0.70 | 9.2 | 1.01 | 7.14 | 7.20 | | | | | |
| | EX-17 | EX-17 | 1.74 | 0.40 | 21.8 | 0.69 | 4.96 | 3.42 | | | | | |
| | EX-18 | EX-18 | 0.44 | 0.43 | 12.8 | 0.19 | 6.32 | 1.20 | | | | | |
| | EX-19 | EX-19 | 0.62 | 0.39 | 14.9 | 0.24 | 5.93 | 1.44 | | | | | |
| | OF-1 | OF-1 | 0.27 | 0.35 | 5.8 | 0.09 | 8.30 | 0.78 | | | | | |
| | OF-2 | OF-2 | 0.05 | 0.35 | 5.0 | 0.02 | 8.68 | 0.16 | | | | | |
| | OF-3 | OF-3 | 0.54 | 0.35 | 19.8 | 0.19 | 5.21 | 0.98 | | | | | |
| | OF-4 | OF-4 | 0.11 | 0.35 | 8.0 | 0.04 | 7.50 | 0.29 | | | | | |
| | OF-5 | OF-5 | 0.06 | 0.35 | 12.3 | 0.02 | 6.41 | 0.13 | | | | | |
| | OF-6 | OF-6 | 0.12 | 0.35 | 26.4 | 0.04 | 4.48 | 0.19 | | | | | |

**Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency**




**IDF Equations**

$I_{100} = -2.52 \ln(D) + 12.735$

$I_{50} = -2.25 \ln(D) + 11.375$

$I_{25} = -2.00 \ln(D) + 10.111$

$I_{10} = -1.75 \ln(D) + 8.847$

$I_{5} = -1.50 \ln(D) + 7.583$

$I_{2} = -1.19 \ln(D) + 6.035$

Note: Values calculated by equations may not precisely duplicate values read from figure.

Kimley»Horn

# EXISTING CONDITIONS

**WHMD RWRF**
**Stormwater**
**Improvements**

DATE: 2/25/2026

PROJECT NUMBER: 296008000
CALCULATED BY: PLH
CHECKED BY: MEO

| EXISTING RATIONAL CALCULATIONS SUMMARY | | | | |
|---|---|---|---|---|
| DESIGN POINT | TRIBUTARY BASINS | TRIBUTARY AREA (AC) | PEAK FLOWS (CFS) | |
| | | | Q5 | Q100 |
| EX-1 | EX-1 | 0.03 | 0.01 | 0.09 |
| EX-2 | EX-2 | 0.23 | 0.09 | 0.69 |
| EX-3 | EX-3 | 0.03 | 0.01 | 0.08 |
| EX-4 | EX-4 | 0.74 | 0.19 | 1.39 |
| EX-5 | EX-5 | 0.84 | 0.35 | 1.95 |
| EX-6 | EX-6 | 1.23 | 1.26 | 3.98 |
| EX-7 | EX-7 | 0.61 | 0.73 | 2.06 |
| EX-8 | EX-8 | 0.35 | 1.34 | 2.49 |
| EX-9 | EX-9 | 0.54 | 2.50 | 4.48 |
| EX-10 | EX-10 | 1.37 | 1.63 | 4.38 |
| EX-11 | EX-11 | 0.16 | 0.76 | 1.37 |
| EX-12 | EX-12 | 0.45 | 0.22 | 1.01 |
| EX-13 | EX-13 | 0.07 | 0.03 | 0.21 |
| EX-14 | EX-14 | 0.77 | 0.51 | 1.76 |
| EX-15 | EX-15 | 2.28 | 2.83 | 7.02 |
| EX-16 | EX-16 | 1.43 | 3.62 | 7.20 |
| EX-17 | EX-17 | 1.74 | 0.75 | 3.42 |
| EX-18 | EX-18 | 0.44 | 0.32 | 1.20 |
| EX-19 | EX-19 | 0.62 | 0.30 | 1.44 |
| OF-1 | OF-1 | 0.27 | 0.11 | 0.78 |
| OF-2 | OF-2 | 0.05 | 0.02 | 0.16 |
| OF-3 | OF-3 | 0.54 | 0.13 | 0.98 |
| OF-4 | OF-4 | 0.11 | 0.04 | 0.29 |
| OF-5 | OF-5 | 0.06 | 0.02 | 0.13 |
| OF-6 | OF-6 | 0.12 | 0.03 | 0.19 |

Kimley»Horn

# STANDARD FORM SF-1 (PROPOSED CONDITIONS)
# RUNOFF COEFFICIENTS - IMPERVIOUS CALCULATION

PROJECT NAME: **WHMD RWRF Stormwater Improvements**
PROJECT NUMBER: 196013004
CALCULATED BY: MEO
CHECKED BY: KRK

HYDROLOGIC SOIL GROUP: A

Impervious values and runoff coefficients are taken from the Colorado Springs Drainage Criteria Manual (Vol. 1) - Table 6-6

| LAND USE (HSG A/B): | ROOF | PAVEMENT | GRAVEL | LAWN |
|---|---|---|---|---|
| 2-YEAR COEFF. | 0.71 | 0.89 | 0.57 | 0.02 |
| 5-YEAR COEFF. | 0.73 | 0.90 | 0.59 | 0.08 |
| 10-YEAR COEFF. | 0.75 | 0.92 | 0.63 | 0.15 |
| 100-YEAR COEFF. | 0.81 | 0.96 | 0.70 | 0.35 |
| IMPERVIOUS % | 90% | 100% | 80% | 0% |

| DESIGN BASIN | DESIGN POINT | ROOF AREA (SF) | PAVEMENT AREA (SF) | GRAVEL AREA (SF) | LAWN AREA (SF) | TOTAL AREA (SF) | TOTAL AREA (AC) | C(2) | C(5) | C(10) | C(100) | Imp % | HSG |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Basins** | | | | | | | | | | | | | |
| P-1 | P-1 | | 24,851 | 1,246 | 12,310 | **38,407** | **0.88** | 0.47 | 0.63 | 0.66 | 0.76 | 67% | A |
| P-2 | P-2 | | | | 5,537 | **5,537** | **0.13** | 0.02 | 0.08 | 0.15 | 0.35 | 0% | A |
| P-3 | P-3 | | | | 15,755 | **15,755** | **0.36** | 0.02 | 0.08 | 0.15 | 0.35 | 0% | A |
| P-4 | P-4 | 4,932 | 10,777 | 10,421 | 20,925 | **47,055** | **1.08** | 0.27 | 0.45 | 0.50 | 0.62 | 50% | A |
| P-5 | P-5 | | | 1,477 | 32,415 | **33,892** | **0.78** | 0.02 | 0.10 | 0.17 | 0.37 | 3% | A |
| P-6 | P-6 | 707 | | | 6,018 | **6,725** | **0.15** | 0.11 | 0.15 | 0.21 | 0.40 | 9% | A |
| P-7 | P-7 | 1,480 | | 9,437 | 12,126 | **23,043** | **0.53** | 0.08 | 0.33 | 0.39 | 0.52 | 39% | A |
| P-8 | P-8 | | | 385 | 1,269 | **1,654** | **0.04** | 0.02 | 0.20 | 0.26 | 0.43 | 19% | A |
| OS-1 | OS-1 | 340 | | | 2,993 | **3,333** | **0.08** | 0.11 | 0.15 | 0.21 | 0.40 | 9% | A |
| OS-2 | OS-2 | 15,423 | | | | **15,423** | **0.35** | 0.89 | 0.73 | 0.75 | 0.81 | 90% | A |
| OS-3 | OS-3 | | 199 | 6,025 | 27,527 | **33,750** | **0.77** | 0.02 | 0.18 | 0.24 | 0.42 | 15% | A |
| OS-4 | OS-4 | | 2,430 | 53,591 | 43,218 | **99,239** | **2.28** | 0.04 | 0.38 | 0.43 | 0.55 | 46% | A |
| OS-5 | OS-5 | | 648 | 61,851 | | **62,499** | **1.43** | 0.03 | 0.59 | 0.63 | 0.70 | 80% | A |
| OS-6 | OS-6 | | | 9,799 | 66,181 | **75,979** | **1.74** | 0.02 | 0.15 | 0.21 | 0.40 | 10% | A |
| OS-7 | OS-7 | 144 | 615 | 3,092 | 15,363 | **19,213** | **0.44** | 0.05 | 0.19 | 0.26 | 0.43 | 17% | A |
| OS-8 | OS-8 | | 651 | 1,878 | 24,610 | **27,139** | **0.62** | 0.04 | 0.13 | 0.20 | 0.39 | 8% | A |
| OS-9 | OS-9 | 559 | 705 | 468 | 17,955 | **19,687** | **0.45** | 0.07 | 0.14 | 0.21 | 0.39 | 8% | A |
| OS-10 | OS-10 | | | | 32,282 | **32,282** | **0.74** | 0.02 | 0.08 | 0.15 | 0.35 | 0% | A |
| OS-11 | OS-11 | | | | 3,002 | **3,002** | **0.07** | 0.02 | 0.08 | 0.15 | 0.35 | 0% | A |
| OS-12 | OS-12 | | | | 1,355 | **1,355** | **0.03** | 0.02 | 0.08 | 0.15 | 0.35 | 0% | A |
| OS-13 | OS-13 | | | | 11,034 | **11,034** | **0.25** | 0.02 | 0.08 | 0.15 | 0.35 | 0% | A |
| OS-14 | OS-14 | | 7,159 | | | **7,159** | **0.16** | 0.71 | 0.90 | 0.92 | 0.96 | 100% | A |
| OS-15 | OS-15 | | 24,707 | | | **24,707** | **0.57** | 0.71 | 0.90 | 0.92 | 0.96 | 100% | A |
| OF-1 | OF-1 | | | | 2,595 | **2,595** | **0.06** | 0.02 | 0.08 | 0.15 | 0.35 | 0% | A |
| OF-2 | OF-2 | | | | 5,176 | **5,176** | **0.12** | 0.02 | 0.08 | 0.15 | 0.35 | 0% | A |
| OF-3 | OF-3 | | | | 11,667 | **11,667** | **0.27** | 0.02 | 0.08 | 0.15 | 0.35 | 0% | A |
| OF-4 | OF-4 | | | | 5,259 | **5,259** | **0.12** | 0.02 | 0.08 | 0.15 | 0.35 | 0% | A |
| OF-5 | OF-5 | | | | 20,543 | **20,543** | **0.47** | 0.02 | 0.08 | 0.15 | 0.35 | 0% | A |
| OF-6 | OF-6 | | | | 4,841 | **4,841** | **0.11** | 0.02 | 0.08 | 0.15 | 0.35 | 0% | A |
| **OVERALL SUBTOTAL** | | **23,586** | **72,741** | **159,669** | **401,957** | **657,953** | **15.10** | **0.27** | **0.32** | **0.37** | **0.52** | **33.70%** | A |
| | | **4%** | **11%** | **24%** | **61%** | **100%** | **100%** | | | | | | |
| **OVERALL ONSITE SUBTOTAL** | | **23,586** | **72,741** | **159,669** | **351,876** | **607,872** | **13.95** | **0.30** | **0.34** | **0.39** | **0.53** | **36.47%** | A |
| | | **4%** | **12%** | **26%** | **58%** | **100%** | **100%** | | | | | | |

Kimley»Horn

# STANDARD FORM SF-2 (PROPOSED CONDITIONS)
## Time of Concentration

PROJECT NAME: WHMD RWRF Stormwater Improvements
PROJECT NUMBER: 296008000
CALCULATED BY: MEO
CHECKED BY: KRK

| SUB-BASIN DATA | | | INITIAL TIME ($T_i$) | | | TRAVEL TIME ($T_t$) | | | | | Tc CHECK (URBANIZED BASINS) | | | | | FINAL Tc |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DESIGN BASIN (1) | AREA SF (2) | C5 (3) | LENGTH Ft (4) | SLOPE % (5) | $T_i$ Min. (6) | LENGTH Ft. (7) | SLOPE % (8) | $C_v$ (9) | VEL fps (11) | $T_t$ Min. (12) | COMP. tc (13) | TOTAL LENGTH (14) | TOTAL SLOPE (15) | TOTAL IMP. (16) | Tc Min. (17) | Min. |
| **All Basins** | | | | | | | | | | | | | | | | |
| P-1 | 38,407 | 0.63 | 40 | 3.0% | 3.8 | 220 | 3.0% | 20.0 | 3.5 | 1.1 | 4.9 | 260 | 3.0% | 67% | 15.9 | 5.0 |
| P-2 | 5,537 | 0.08 | 30 | 0.7% | 11.5 | 60 | 2.5% | 7.0 | 1.1 | 0.9 | 12.4 | 90 | 1.9% | 0% | 27.2 | 12.4 |
| P-3 | 15,755 | 0.08 | 30 | 2.2% | 7.9 | 130 | 5.0% | 7.0 | 1.6 | 1.4 | 9.3 | 160 | 4.5% | 0% | 27.4 | 9.3 |
| P-4 | 47,055 | 0.45 | 33 | 1.5% | 6.0 | 80 | 2.3% | 20.0 | 3.0 | 0.4 | 6.5 | 113 | 2.0% | 50% | 18.3 | 6.5 |
| P-5 | 33,892 | 0.10 | 60 | 2.6% | 10.3 | 250 | 2.1% | 7.0 | 1.0 | 4.2 | 14.4 | 310 | 2.2% | 3% | 29.1 | 14.4 |
| P-6 | 6,725 | 0.15 | 20 | 0.6% | 9.3 | 100 | 1.0% | 7.0 | 0.7 | 2.4 | 11.6 | 120 | 0.9% | 9% | 26.4 | 11.6 |
| P-7 | 23,043 | 0.33 | 25 | 10.0% | 3.3 | 135 | 1.0% | 7.0 | 0.7 | 3.2 | 6.5 | 160 | 2.4% | 39% | 20.6 | 6.5 |
| P-8 | 1,654 | 0.20 | 5 | 7.0% | 1.9 | 10 | 1.0% | 7.0 | 0.7 | 0.2 | 2.2 | 15 | 3.0% | 19% | 23.0 | 5.0 |
| OS-1 | 3,333 | 0.15 | 8 | 9.0% | 2.4 | 100 | 1.0% | 7.0 | 0.7 | 2.4 | 4.8 | 108 | 1.6% | 9% | 25.8 | 5.0 |
| OS-2 | 15,423 | 0.73 | 50 | 1.0% | 4.8 | 100 | 1.0% | 20.0 | 2.0 | 0.8 | 5.6 | 150 | 1.0% | 90% | 11.9 | 5.6 |
| OS-3 | 33,750 | 0.18 | 70 | 11.0% | 6.4 | 470 | 0.5% | 7.0 | 0.5 | 15.8 | 22.2 | 540 | 1.9% | 15% | 29.4 | 22.2 |
| OS-4 | 99,239 | 0.38 | 90 | 12.0% | 5.5 | 285 | 0.2% | 7.0 | 0.3 | 15.2 | 20.7 | 375 | 3.0% | 46% | 20.6 | 20.6 |
| OS-5 | 62,499 | 0.59 | 80 | 9.0% | 4.0 | 260 | 2.5% | 7.0 | 1.1 | 3.9 | 7.9 | 340 | 4.0% | 80% | 13.8 | 7.9 |
| OS-6 | 75,979 | 0.15 | 30 | 2.0% | 7.6 | 331 | 0.2% | 7.0 | 0.3 | 17.6 | 25.2 | 361 | 0.3% | 10% | 34.0 | 25.2 |
| OS-7 | 19,213 | 0.19 | 56 | 14.0% | 5.2 | 45 | 6.1% | 7.0 | 1.7 | 0.4 | 5.6 | 101 | 10.5% | 17% | 23.6 | 5.6 |
| OS-8 | 27,139 | 0.13 | 78 | 2.9% | 11.0 | 580 | 2.5% | 7.0 | 1.1 | 8.8 | 19.8 | 658 | 2.5% | 8% | 31.5 | 19.8 |
| OS-9 | 19,687 | 0.14 | 65 | 6.0% | 7.8 | 340 | 1.1% | 7.0 | 0.7 | 7.7 | 15.5 | 405 | 1.9% | 8% | 29.5 | 15.5 |
| OS-10 | 32,282 | 0.08 | 100 | 6.7% | 9.9 | 280 | 0.6% | 7.0 | 0.6 | 8.4 | 18.3 | 380 | 2.2% | 0% | 30.7 | 18.3 |
| OS-11 | 3,002 | 0.08 | 25 | 7.0% | 4.9 | 33 | 6.2% | 7.0 | 1.7 | 0.3 | 5.2 | 58 | 6.6% | 0% | 26.4 | 5.2 |
| OS-12 | 1,355 | 0.08 | 10 | 8.0% | 3.0 | 25 | 8.8% | 7.0 | 2.1 | 0.2 | 3.2 | 35 | 8.6% | 0% | 26.2 | 5.0 |
| OS-13 | 11,034 | 0.08 | 60 | 13.0% | 6.2 | 75 | 0.5% | 7.0 | 0.5 | 2.5 | 8.7 | 135 | 6.1% | 0% | 27.0 | 8.7 |
| OS-14 | 7,159 | 0.90 | 20 | 1.0% | 1.6 | 50 | 1.0% | 20.0 | 2.0 | 0.4 | 2.1 | 70 | 1.0% | 100% | 9.5 | 5.0 |
| OS-15 | 24,707 | 0.90 | 50 | 1.0% | 2.6 | 200 | 1.0% | 20.0 | 2.0 | 1.7 | 4.3 | 250 | 1.0% | 100% | 10.8 | 5.0 |
| OF-1 | 2,595 | 0.08 | 61 | 3.0% | 10.1 | 62 | 5.2% | 7.0 | 1.6 | 0.6 | 10.8 | 123 | 4.1% | 0% | 27.1 | 10.8 |
| OF-2 | 5,176 | 0.08 | 105 | 1.4% | 17.1 | 440 | 2.1% | 7.0 | 1.0 | 7.3 | 24.4 | 545 | 1.9% | 0% | 33.3 | 24.4 |
| OF-3 | 11,667 | 0.08 | 55 | 3.5% | 9.2 | 113 | 1.1% | 7.0 | 0.7 | 2.6 | 11.7 | 168 | 1.9% | 0% | 28.3 | 11.7 |
| OF-4 | 5,259 | 0.08 | 30 | 9.0% | 4.9 | 22 | 11.0% | 7.0 | 2.3 | 0.2 | 5.1 | 52 | 9.8% | 0% | 26.3 | 5.1 |
| OF-5 | 20,543 | 0.08 | 55 | 2.9% | 9.7 | 222 | 2.7% | 7.0 | 1.2 | 3.2 | 12.9 | 277 | 2.8% | 0% | 29.1 | 12.9 |
| OF-6 | 4,841 | 0.08 | 50 | 5.6% | 7.4 | 30 | 0.5% | 7.0 | 0.5 | 1.0 | 8.5 | 80 | 3.7% | 0% | 26.8 | 8.5 |

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_o^{0.33}} \qquad t_t = \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t} \qquad t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$

Kimley»Horn

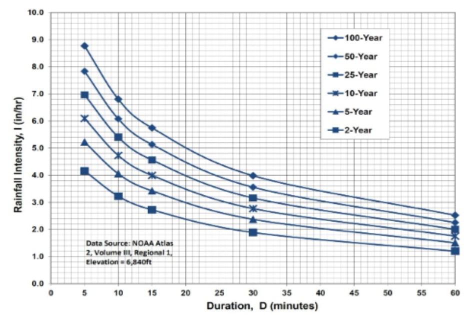
# STANDARD FORM SF-3 (PROPOSED CONDITIONS)
## STORM DRAINAGE DESIGN - RATIONAL METHOD 5 YEAR EVENT

PROJECT NAME: **WHMD RWRF Stormwater Improvements**
PROJECT NUMBER: 296008000
CALCULATED BY: MEO
CHECKED BY: KRK

**$P_1$ (1-Hour Rainfall) = 1.21**

| | | DIRECT RUNOFF | | | | | | | TOTAL RUNOFF | | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STORM LINE | DESIGN POINT | DESIGN BASIN | AREA (AC) | RUNOFF COEFF | tc (min) | C*A(ac) | I (in/hr) | Q (cfs) | tc(max) | S(C*A) (ac) | I (in/hr) | Q (cfs) | |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (22) |
| **All Basins** | | | | | | | | | | | | | |
| | P-1 | P-1 | 0.88 | 0.63 | 5.0 | 0.55 | 5.17 | 2.86 | | | | | |
| | P-2 | P-2 | 0.13 | 0.08 | 12.4 | 0.01 | 3.80 | 0.04 | | | | | |
| | P-3 | P-3 | 0.36 | 0.08 | 9.3 | 0.03 | 4.24 | 0.12 | | | | | |
| | P-4 | P-4 | 1.08 | 0.45 | 6.5 | 0.48 | 4.78 | 2.32 | | | | | |
| | P-5 | P-5 | 0.78 | 0.10 | 14.4 | 0.08 | 3.58 | 0.28 | | | | | |
| | P-6 | P-6 | 0.15 | 0.15 | 11.6 | 0.02 | 3.90 | 0.09 | | | | | |
| | P-7 | P-7 | 0.53 | 0.33 | 6.5 | 0.17 | 4.78 | 0.84 | | | | | |
| | P-8 | P-8 | 0.04 | 0.20 | 5.0 | 0.01 | 5.17 | 0.04 | | | | | |
| | OS-1 | OS-1 | 0.08 | 0.15 | 5.0 | 0.01 | 5.17 | 0.06 | | | | | |
| | OS-2 | OS-2 | 0.35 | 0.73 | 5.6 | 0.26 | 4.99 | 1.29 | | | | | |
| | OS-3 | OS-3 | 0.77 | 0.18 | 22.2 | 0.14 | 2.93 | 0.40 | | | | | |
| | OS-4 | OS-4 | 2.28 | 0.38 | 20.6 | 0.86 | 3.05 | 2.61 | | | | | |
| | OS-5 | OS-5 | 1.43 | 0.59 | 7.9 | 0.85 | 4.48 | 3.81 | | | | | |
| | OS-6 | OS-6 | 1.74 | 0.15 | 25.2 | 0.25 | 2.74 | 0.70 | | | | | |
| | OS-7 | OS-7 | 0.44 | 0.19 | 5.6 | 0.09 | 5.00 | 0.43 | | | | | |
| | OS-8 | OS-8 | 0.62 | 0.13 | 19.8 | 0.08 | 3.11 | 0.26 | | | | | |
| | OS-9 | OS-9 | 0.45 | 0.14 | 15.5 | 0.06 | 3.47 | 0.22 | | | | | |
| | OS-10 | OS-10 | 0.74 | 0.08 | 18.3 | 0.06 | 3.22 | 0.19 | | | | | |
| | OS-11 | OS-11 | 0.07 | 0.08 | 5.2 | 0.01 | 5.11 | 0.03 | | | | | |
| | OS-12 | OS-12 | 0.03 | 0.08 | 5.0 | 0.00 | 5.17 | 0.01 | | | | | |
| | OS-13 | OS-13 | 0.25 | 0.08 | 8.7 | 0.02 | 4.34 | 0.09 | | | | | |
| | OS-14 | OS-14 | 0.16 | 0.90 | 5.0 | 0.15 | 5.17 | 0.76 | | | | | |
| | OS-15 | OS-15 | 0.57 | 0.90 | 5.0 | 0.51 | 5.17 | 2.64 | | | | | |
| | OF-1 | OF-1 | 0.06 | 0.08 | 10.8 | 0.00 | 4.02 | 0.02 | | | | | |
| | OF-2 | OF-2 | 0.12 | 0.08 | 24.4 | 0.01 | 2.79 | 0.03 | | | | | |
| | OF-3 | OF-3 | 0.27 | 0.08 | 11.7 | 0.02 | 3.89 | 0.08 | | | | | |
| | OF-4 | OF-4 | 0.12 | 0.08 | 5.1 | 0.01 | 5.14 | 0.05 | | | | | |
| | OF-5 | OF-5 | 0.47 | 0.08 | 12.9 | 0.04 | 3.75 | 0.14 | | | | | |
| | OF-6 | OF-6 | 0.11 | 0.08 | 8.5 | 0.01 | 4.38 | 0.04 | | | | | |

**Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency**




**IDF Equations**

$I_{100} = -2.52 \ln(D) + 12.735$

$I_{50} = -2.25 \ln(D) + 11.375$

$I_{25} = -2.00 \ln(D) + 10.111$

$I_{10} = -1.75 \ln(D) + 8.847$

$I_5 = -1.50 \ln(D) + 7.583$

$I_2 = -1.19 \ln(D) + 6.035$

Kimley»Horn

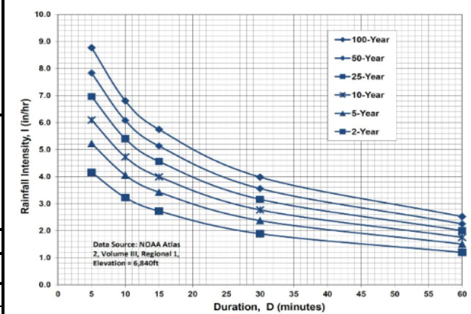
# STANDARD FORM SF-3 (PROPOSED CONDITIONS)
# STORM DRAINAGE DESIGN - RATIONAL METHOD 100 YEAR EVENT

PROJECT NAME: **WHMD RWRF Stormwater Improvements**
PROJECT NUMBER: 296008000
CALCULATED BY: MEO
CHECKED BY: KRK

**$P_1$ (1-Hour Rainfall) =** 2.5

| | | DIRECT RUNOFF | | | | | | | TOTAL RUNOFF | | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STORM LINE | DESIGN POINT | DESIGN BASIN | AREA (AC) | RUNOFF COEFF | tc (min) | C*A(ac) | I (in/hr) | Q (cfs) | tc(max) | S(C*A) (ac) | I (in/hr) | Q (cfs) | |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (22) |
| **All Basins** | | | | | | | | | | | | | |
| | P-1 | P-1 | 0.88 | 0.76 | 5.0 | 0.67 | 8.68 | 5.79 | | | | | |
| | P-2 | P-2 | 0.13 | 0.35 | 12.4 | 0.04 | 6.38 | 0.28 | | | | | |
| | P-3 | P-3 | 0.36 | 0.35 | 9.3 | 0.13 | 7.13 | 0.90 | | | | | |
| | P-4 | P-4 | 1.08 | 0.62 | 6.5 | 0.66 | 8.02 | 5.33 | | | | | |
| | P-5 | P-5 | 0.78 | 0.37 | 14.4 | 0.28 | 6.01 | 1.71 | | | | | |
| | P-6 | P-6 | 0.15 | 0.40 | 11.6 | 0.06 | 6.55 | 0.40 | | | | | |
| | P-7 | P-7 | 0.53 | 0.52 | 6.5 | 0.28 | 8.02 | 2.22 | | | | | |
| | P-8 | P-8 | 0.04 | 0.43 | 5.0 | 0.02 | 8.68 | 0.14 | | | | | |
| | OS-1 | OS-1 | 0.08 | 0.40 | 5.0 | 0.03 | 8.68 | 0.26 | | | | | |
| | OS-2 | OS-2 | 0.35 | 0.81 | 5.6 | 0.29 | 8.38 | 2.40 | | | | | |
| | OS-3 | OS-3 | 0.77 | 0.42 | 22.2 | 0.32 | 4.92 | 1.59 | | | | | |
| | OS-4 | OS-4 | 2.28 | 0.55 | 20.6 | 1.26 | 5.11 | 6.45 | | | | | |
| | OS-5 | OS-5 | 1.43 | 0.70 | 7.9 | 1.01 | 7.52 | 7.58 | | | | | |
| | OS-6 | OS-6 | 1.74 | 0.40 | 25.2 | 0.69 | 4.60 | 3.17 | | | | | |
| | OS-7 | OS-7 | 0.44 | 0.43 | 5.6 | 0.19 | 8.40 | 1.59 | | | | | |
| | OS-8 | OS-8 | 0.62 | 0.39 | 19.8 | 0.24 | 5.22 | 1.26 | | | | | |
| | OS-9 | OS-9 | 0.45 | 0.39 | 15.5 | 0.18 | 5.83 | 1.04 | | | | | |
| | OS-10 | OS-10 | 0.74 | 0.35 | 18.3 | 0.26 | 5.41 | 1.40 | | | | | |
| | OS-11 | OS-11 | 0.07 | 0.35 | 5.2 | 0.02 | 8.58 | 0.21 | | | | | |
| | OS-12 | OS-12 | 0.03 | 0.35 | 5.0 | 0.01 | 8.68 | 0.09 | | | | | |
| | OS-13 | OS-13 | 0.25 | 0.35 | 8.7 | 0.09 | 7.29 | 0.65 | | | | | |
| | OS-14 | OS-14 | 0.16 | 0.96 | 5.0 | 0.16 | 8.68 | 1.37 | | | | | |
| | OS-15 | OS-15 | 0.57 | 0.96 | 5.0 | 0.54 | 8.68 | 4.73 | | | | | |
| | OF-1 | OF-1 | 0.06 | 0.35 | 10.8 | 0.02 | 6.74 | 0.14 | | | | | |
| | OF-2 | OF-2 | 0.12 | 0.35 | 24.4 | 0.04 | 4.68 | 0.19 | | | | | |
| | OF-3 | OF-3 | 0.27 | 0.35 | 11.7 | 0.09 | 6.53 | 0.61 | | | | | |
| | OF-4 | OF-4 | 0.12 | 0.35 | 5.1 | 0.04 | 8.64 | 0.37 | | | | | |
| | OF-5 | OF-5 | 0.47 | 0.35 | 12.9 | 0.17 | 6.30 | 1.04 | | | | | |
| | OF-6 | OF-6 | 0.11 | 0.35 | 8.5 | 0.04 | 7.35 | 0.29 | | | | | |

**Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency**




**IDF Equations**

$I_{100} = -2.52 \ln(D) + 12.735$

$I_{50} = -2.25 \ln(D) + 11.375$

$I_{25} = -2.00 \ln(D) + 10.111$

$I_{10} = -1.75 \ln(D) + 8.847$

$I_{5} = -1.50 \ln(D) + 7.583$

$I_{2} = -1.19 \ln(D) + 6.035$

Note: Values calculated by equations may not precisely duplicate values read from figure.

Kimley»Horn

**PROPOSED CONDITIONS**

**WHMD RWRF Stormwater Improvements**

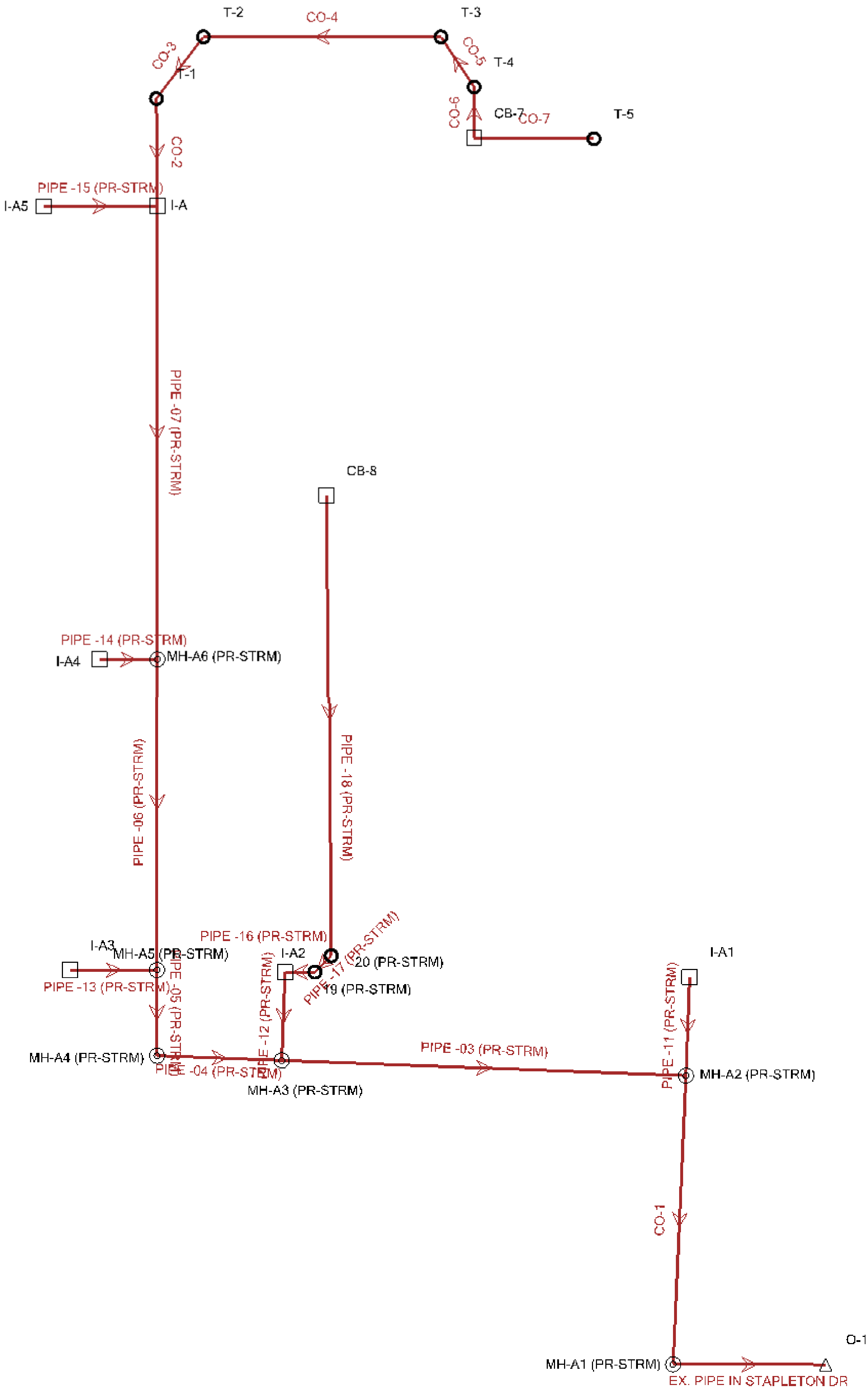
DATE: 2/25/2026

PROJECT NUMBER: 296008000
CALCULATED BY: MEO
CHECKED BY: KRK

| PROPOSED RATIONAL CALCULATIONS SUMMARY | | | | |
|---|---|---|---|---|
| DESIGN POINT | TRIBUTARY BASINS | TRIBUTARY AREA (AC) | PEAK FLOWS (CFS) | |
| | | | Q5 | Q100 |
| P-1 | P-1 | 0.88 | 2.86 | 5.79 |
| P-2 | P-2 | 0.13 | 0.04 | 0.28 |
| P-3 | P-3 | 0.36 | 0.12 | 0.90 |
| P-4 | P-4 | 1.08 | 2.32 | 5.33 |
| P-5 | P-5 | 0.78 | 0.28 | 1.71 |
| P-6 | P-6 | 0.15 | 0.09 | 0.40 |
| P-7 | P-7 | 0.53 | 0.84 | 2.22 |
| P-8 | P-8 | 0.04 | 0.04 | 0.14 |
| OS-1 | OS-1 | 0.08 | 0.06 | 0.26 |
| OS-2 | OS-2 | 0.35 | 1.29 | 2.40 |
| OS-3 | OS-3 | 0.77 | 0.40 | 1.59 |
| OS-4 | OS-4 | 2.28 | 2.61 | 6.45 |
| OS-5 | OS-5 | 1.43 | 3.81 | 7.58 |
| OS-6 | OS-6 | 1.74 | 0.70 | 3.17 |
| OS-7 | OS-7 | 0.44 | 0.43 | 1.59 |
| OS-8 | OS-8 | 0.62 | 0.26 | 1.26 |
| OS-9 | OS-9 | 0.45 | 0.22 | 1.04 |
| OS-10 | OS-10 | 0.74 | 0.19 | 1.40 |
| OS-11 | OS-11 | 0.07 | 0.03 | 0.21 |
| OS-12 | OS-12 | 0.03 | 0.01 | 0.09 |
| OS-13 | OS-13 | 0.25 | 0.09 | 0.65 |
| OS-14 | OS-14 | 0.16 | 0.76 | 1.37 |
| OS-15 | OS-15 | 0.57 | 2.64 | 4.73 |
| OF-1 | OF-1 | 0.06 | 0.02 | 0.14 |
| OF-2 | OF-2 | 0.12 | 0.03 | 0.19 |
| OF-3 | OF-3 | 0.27 | 0.08 | 0.61 |
| OF-4 | OF-4 | 0.12 | 0.05 | 0.37 |
| OF-5 | OF-5 | 0.47 | 0.14 | 1.04 |
| OF-6 | OF-6 | 0.11 | 0.04 | 0.29 |

## *APPENDIX E – HYDRAULICS*

# WHMD RWRF Stormwater Improvements StormCAD Map



# 5-YEAR (80% FULL TAILWATER)

## Conduit Table - Time: 0.00 hours

| Label | Start Node | Invert (Start) (ft) | Stop Node | Invert (Stop) (ft) | Length (User Defined) (ft) | Slope (Calculated) (ft/ft) | Manning's n | Flow (cfs) | Velocity (ft/s) | Capacity (Full Flow) (cfs) | Hydraulic Grade Line (In) (ft) | Hydraulic Grade Line (Out) (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PIPE -03 (PR-STRM) | MH-A2 (PR-STRM) | 7,044.61 | MH-A3 (PR-STRM) | 7,045.09 | 160.1 | -0.003 | 0.013 | 7.05 | 4.05 | 22.48 | 7,046.05 | 7,045.49 |
| PIPE -11 (PR-STRM) | MH-A2 (PR-STRM) | 7,045.61 | I-A1 | 7,045.80 | 39.1 | -0.005 | 0.013 | 0.84 | 2.79 | 7.44 | 7,046.14 | 7,045.95 |
| PIPE -04 (PR-STRM) | MH-A3 (PR-STRM) | 7,045.19 | MH-A4 (PR-STRM) | 7,045.35 | 49.4 | -0.003 | 0.013 | 7.01 | 4.18 | 23.51 | 7,046.36 | 7,046.31 |
| PIPE -12 (PR-STRM) | MH-A3 (PR-STRM) | 7,046.19 | I-A2 | 7,046.37 | 35.0 | -0.005 | 0.013 | 0.04 | 1.13 | 7.55 | 7,046.45 | 7,046.31 |
| PIPE -05 (PR-STRM) | MH-A4 (PR-STRM) | 7,045.64 | MH-A5 (PR-STRM) | 7,045.74 | 34.0 | -0.003 | 0.013 | 7.01 | 4.05 | 22.48 | 7,046.69 | 7,046.58 |
| PIPE -06 (PR-STRM) | MH-A5 (PR-STRM) | 7,046.40 | MH-A6 (PR-STRM) | 7,046.80 | 132.7 | -0.003 | 0.013 | 6.73 | 3.82 | 22.35 | 7,047.57 | 7,047.13 |
| PIPE -13 (PR-STRM) | MH-A5 (PR-STRM) | 7,046.24 | I-A3 | 7,046.41 | 34.4 | -0.005 | 0.013 | 0.28 | 1.94 | 15.99 | 7,046.95 | 7,046.95 |
| PIPE -15 (PR-STRM) | I-A | 7,047.34 | I-A5 | 7,047.57 | 45.5 | -0.005 | 0.013 | 0.12 | 1.46 | 7.19 | 7,048.39 | 7,048.39 |
| PIPE -07 (PR-STRM) | MH-A6 (PR-STRM) | 7,046.80 | I-A | 7,047.34 | 181.1 | -0.003 | 0.013 | 4.41 | 3.61 | 5.72 | 7,048.13 | 7,047.80 |
| PIPE -14 (PR-STRM) | MH-A6 (PR-STRM) | 7,046.80 | I-A4 | 7,046.92 | 23.2 | -0.005 | 0.013 | 2.32 | 3.55 | 7.16 | 7,047.81 | 7,047.80 |
| PIPE -16 (PR-STRM) | I-A2 | 7,047.09 | 19 (PR-STRM) | 7,047.15 | 11.8 | -0.005 | 0.010 | 0.04 | 1.42 | 3.27 | 7,047.23 | 7,047.16 |
| PIPE -18 (PR-STRM) | 20 (PR-STRM) | 7,047.19 | CB-8 | 7,048.12 | 186.2 | -0.005 | 0.010 | 0.04 | 1.42 | 3.28 | 7,048.20 | 7,047.28 |
| PIPE -17 (PR-STRM) | 19 (PR-STRM) | 7,047.15 | 20 (PR-STRM) | 7,047.19 | 9.2 | -0.005 | 0.010 | 0.04 | 1.42 | 3.28 | 7,047.27 | 7,047.24 |
| CO-1 | MH-A2 (PR-STRM) | 7,044.11 | MH-A1 (PR-STRM) | 7,043.77 | 111.5 | 0.003 | 0.013 | 7.89 | 4.12 | 36.51 | 7,045.20 | 7,045.15 |
| CO-2 | I-A | 7,047.39 | T-1 | 7,047.56 | 29.0 | -0.006 | 0.010 | 1.35 | 4.21 | 3.54 | 7,048.40 | 7,048.39 |
| CO-3 | T-1 | 7,047.56 | T-2 | 7,047.70 | 23.6 | -0.006 | 0.010 | 1.35 | 4.21 | 3.54 | 7,048.42 | 7,048.42 |
| CO-4 | T-2 | 7,047.70 | T-3 | 7,048.06 | 62.1 | -0.006 | 0.010 | 1.35 | 4.21 | 3.55 | 7,048.55 | 7,048.45 |
| CO-5 | T-3 | 7,048.06 | T-4 | 7,048.13 | 12.6 | -0.006 | 0.010 | 1.35 | 4.20 | 3.53 | 7,048.62 | 7,048.63 |
| CO-6 | T-4 | 7,048.13 | CB-7 | 7,048.23 | 15.6 | -0.006 | 0.010 | 1.35 | 4.22 | 3.56 | 7,048.72 | 7,048.70 |
| CO-7 | CB-7 | 7,048.53 | T-5 | 7,049.00 | 95.4 | -0.005 | 0.010 | 0.00 | 0.00 | 3.27 | 7,049.00 | 7,048.97 |
| EX. PIPE IN STAPLETON DR | MH-A1 (PR-STRM) | 7,042.77 | O-1 | 7,041.94 | 29.8 | 0.028 | 0.013 | 7.89 | 8.78 | 240.09 | 7,045.13 | 7,045.14 |

# 5-YEAR (80% FULL TAILWATER)

## Catch Basin Table - Time: 0.00 hours

| Label | Elevation (Ground) (ft) | Elevation (Rim) (ft) | Elevation (Invert) (ft) | Flow (Additional Subsurface) (cfs) | Hydraulic Grade Line (In) (ft) | Headloss Coefficient (Standard) |
|---|---|---|---|---|---|---|
| I-A3 | 7,050.17 | 7,050.17 | 7,046.41 | 0.28 | 7,046.95 | 0.050 |
| I-A1 | 7,049.54 | 7,049.54 | 7,045.80 | 0.84 | 7,046.15 | 0.050 |
| I-A2 | 7,052.04 | 7,052.04 | 7,046.37 | 0.00 | 7,046.47 | 1.020 |
| I-A4 | 7,050.16 | 7,050.16 | 7,046.92 | 2.32 | 7,047.81 | 0.000 |
| I-A | 7,050.44 | 7,050.44 | 7,047.34 | 2.94 | 7,048.39 | 1.320 |
| I-A5 | 7,051.44 | 7,051.44 | 7,047.57 | 0.12 | 7,048.39 | 0.050 |
| CB-7 | 7,050.80 | 7,050.80 | 7,048.23 | 1.35 | 7,048.97 | 1.320 |
| CB-8 | 7,051.48 | 7,051.48 | 7,048.12 | 0.04 | 7,048.20 | 0.000 |

# 5-YEAR (80% FULL TAILWATER)

## Manhole Table - Time: 0.00 hours

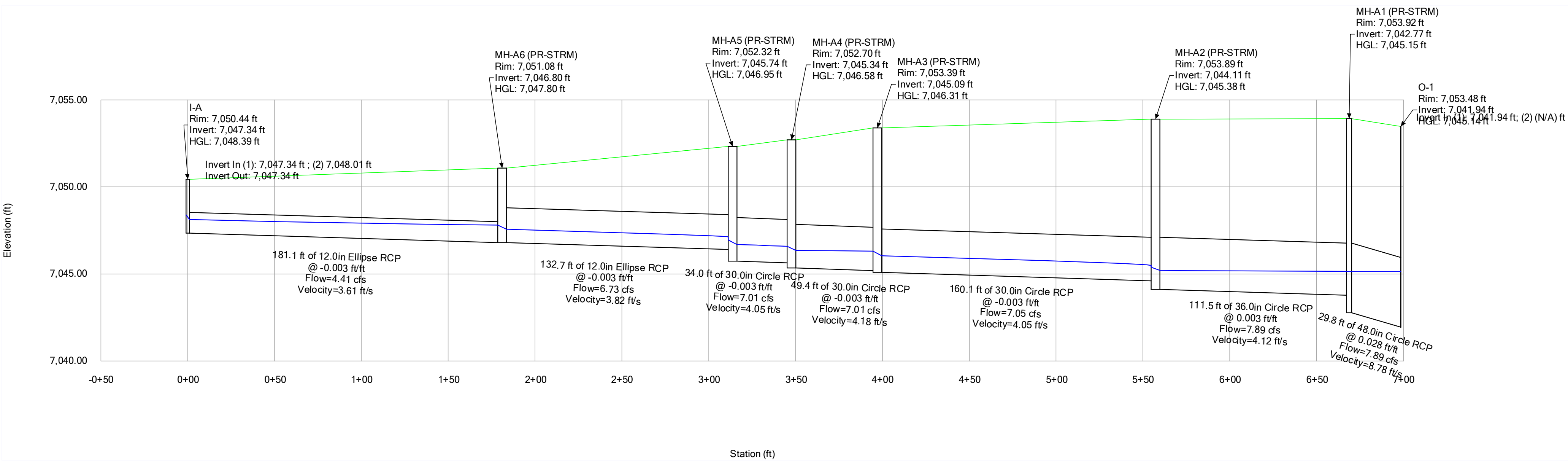
| Label | Elevation (Ground) (ft) | Elevation (Rim) (ft) | Elevation (Invert Out) (ft) | Flow (Total Out) (cfs) | Hydraulic Grade Line (Out) (ft) | Headloss Method | Hydraulic Grade Line (In) (ft) | Headloss Coefficient (Standard) |
|---|---|---|---|---|---|---|---|---|
| MH-A2 (PR-STRM) | 7,053.89 | 7,053.89 | 7,044.11 | 7.89 | 7,045.20 | Standard | 7,045.38 | 1.020 |
| MH-A3 (PR-STRM) | 7,053.39 | 7,053.39 | 7,045.09 | 7.05 | 7,046.05 | Standard | 7,046.31 | 1.020 |
| MH-A4 (PR-STRM) | 7,052.70 | 7,052.70 | 7,045.35 | 7.01 | 7,046.36 | Standard | 7,046.58 | 1.020 |
| MH-A5 (PR-STRM) | 7,052.32 | 7,052.32 | 7,045.74 | 7.01 | 7,046.69 | Standard | 7,046.95 | 1.020 |
| MH-A6 (PR-STRM) | 7,051.08 | 7,051.08 | 7,046.80 | 6.73 | 7,047.57 | Standard | 7,047.80 | 1.020 |
| MH-A1 (PR-STRM) | 7,053.92 | 7,053.92 | 7,042.77 | 7.89 | 7,045.13 | Standard | 7,045.15 | 1.020 |

# 5-YEAR (80% FULL TAILWATER)

## Outfall Table - Time: 0.00 hours

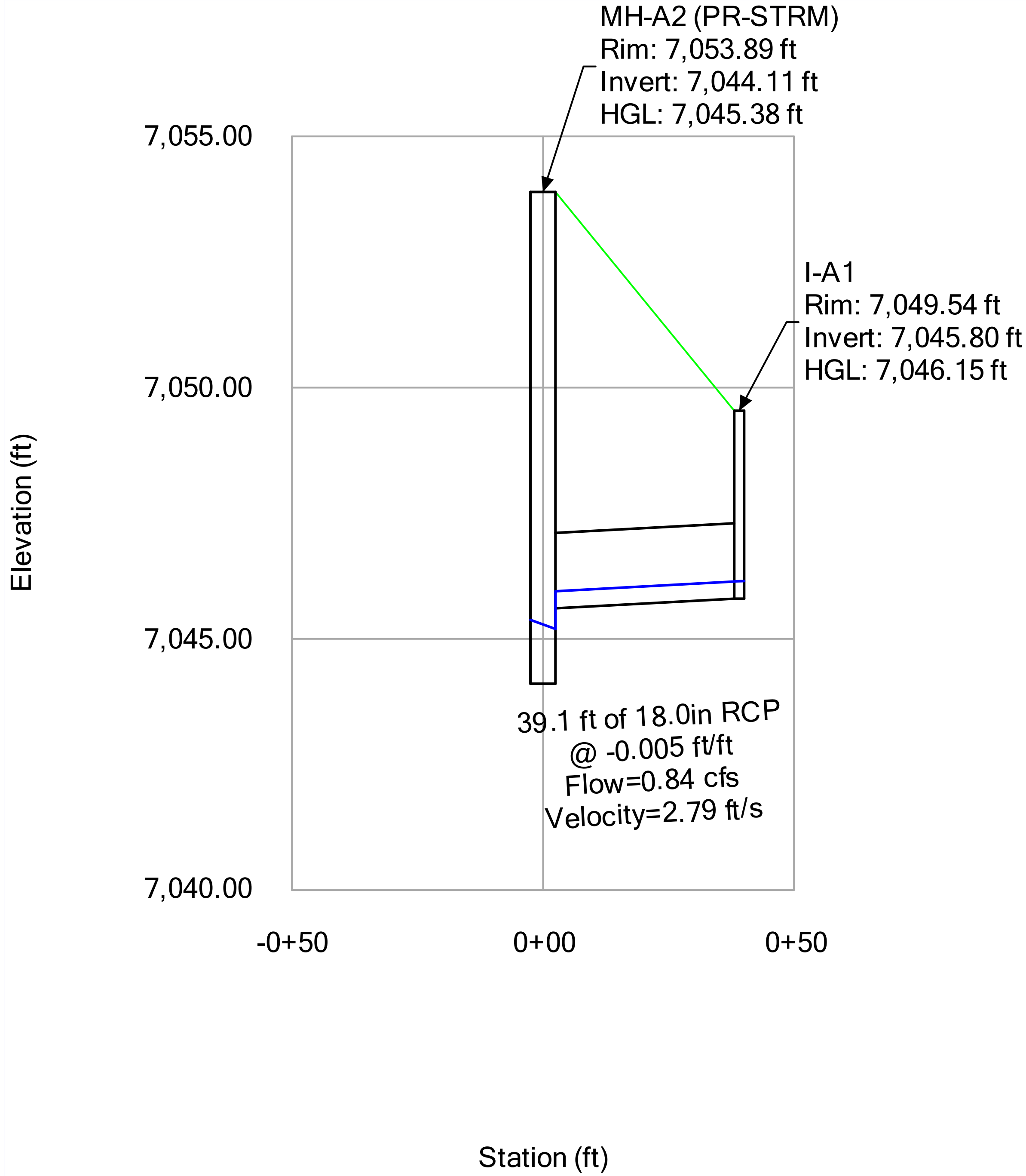
| Label | Elevation (Ground) (ft) | Set Rim to Ground Elevation? | Elevation (Invert) (ft) | Boundary Condition Type | Hydraulic Grade (ft) | Flow (Total Out) (cfs) |
|---|---|---|---|---|---|---|
| O-1 | 7,053.48 | True | 7,041.94 | User Defined Tailwater | 7,045.14 | 7.89 |

# 5-YEAR - STRM-A

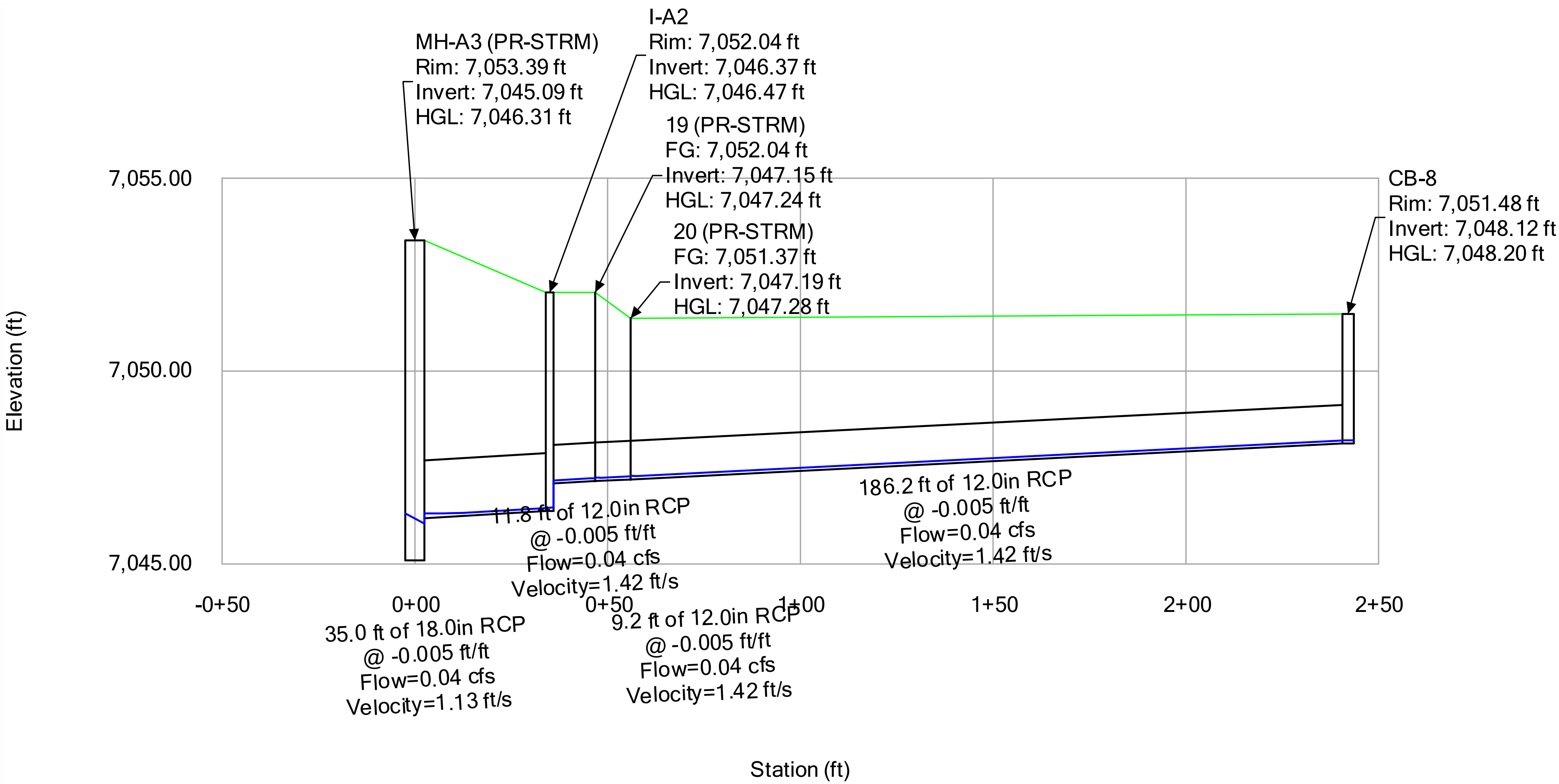


MH-A1 (PR-STRM)
Rim: 7,053.92 ft
Invert: 7,042.77 ft
HGL: 7,045.15 ft
MH-A5 (PR-STRM)
Rim: 7,052.32 ft
Invert: 7,045.74 ft
HGL: 7,046.95 ft
MH-A4 (PR-STRM)
Rim: 7,052.70 ft
Invert: 7,045.34 ft
HGL: 7,046.58 ft
MH-A3 (PR-STRM)
Rim: 7,053.39 ft
Invert: 7,045.09 ft
HGL: 7,046.31 ft
MH-A6 (PR-STRM)
Rim: 7,051.08 ft
Invert: 7,046.80 ft
HGL: 7,047.80 ft
MH-A2 (PR-STRM)
Rim: 7,053.89 ft
Invert: 7,044.11 ft
HGL: 7,045.38 ft
O-1
Rim: 7,053.48 ft
Invert: 7,041.94 ft
HGL: 7,045.14 ft
Invert In (1): 7,041.94 ft; (2) (N/A) ft
I-A
Rim: 7,050.44 ft
Invert: 7,047.34 ft
HGL: 7,048.39 ft
Invert In (1): 7,047.34 ft ; (2) 7,048.01 ft
Invert Out: 7,047.34 ft
181.1 ft of 12.0in Ellipse RCP
@ -0.003 ft/ft
Flow=4.41 cfs
Velocity=3.61 ft/s
132.7 ft of 12.0in Ellipse RCP
@ -0.003 ft/ft
Flow=6.73 cfs
Velocity=3.82 ft/s
34.0 ft of 30.0in Circle RCP
@ -0.003 ft/ft
Flow=7.01 cfs
Velocity=4.05 ft/s
49.4 ft of 30.0in Circle RCP
@ -0.003 ft/ft
Flow=7.01 cfs
Velocity=4.18 ft/s
160.1 ft of 30.0in Circle RCP
@ -0.003 ft/ft
Flow=7.05 cfs
Velocity=4.05 ft/s
111.5 ft of 36.0in Circle RCP
@ 0.003 ft/ft
Flow=7.89 cfs
Velocity=4.12 ft/s
29.8 ft of 48.0in Circle RCP
@ 0.028 ft/ft
Flow=7.89 cfs
Velocity=8.78 ft/s
7,055.00
7,050.00
7,045.00
7,040.00
Elevation (ft)
-0+50
0+00
0+50
1+00
1+50
2+00
2+50
3+00
3+50
4+00
4+50
5+00
5+50
6+00
6+50
7+00
Station (ft)

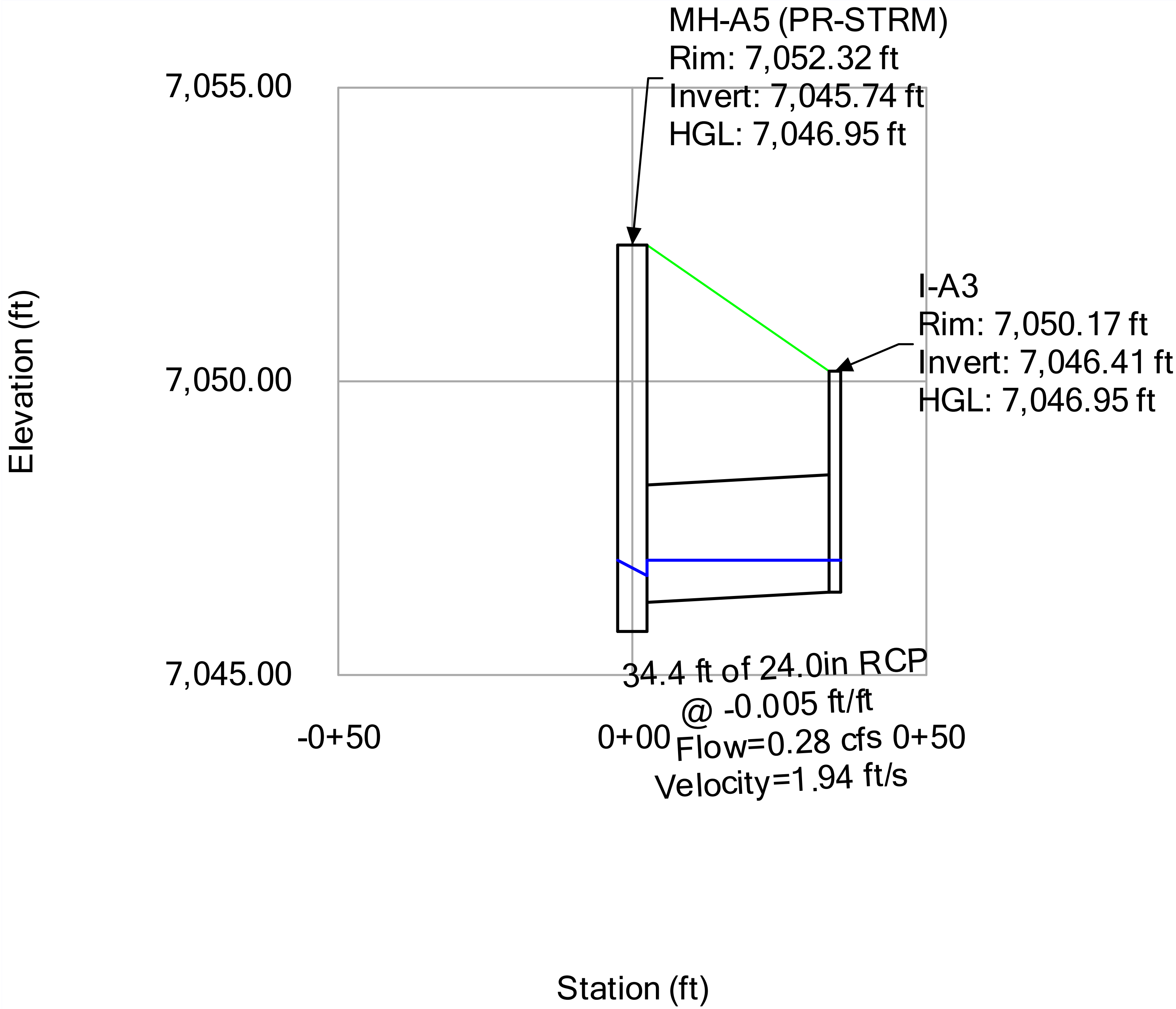
# 5-YEAR - STRM-A1



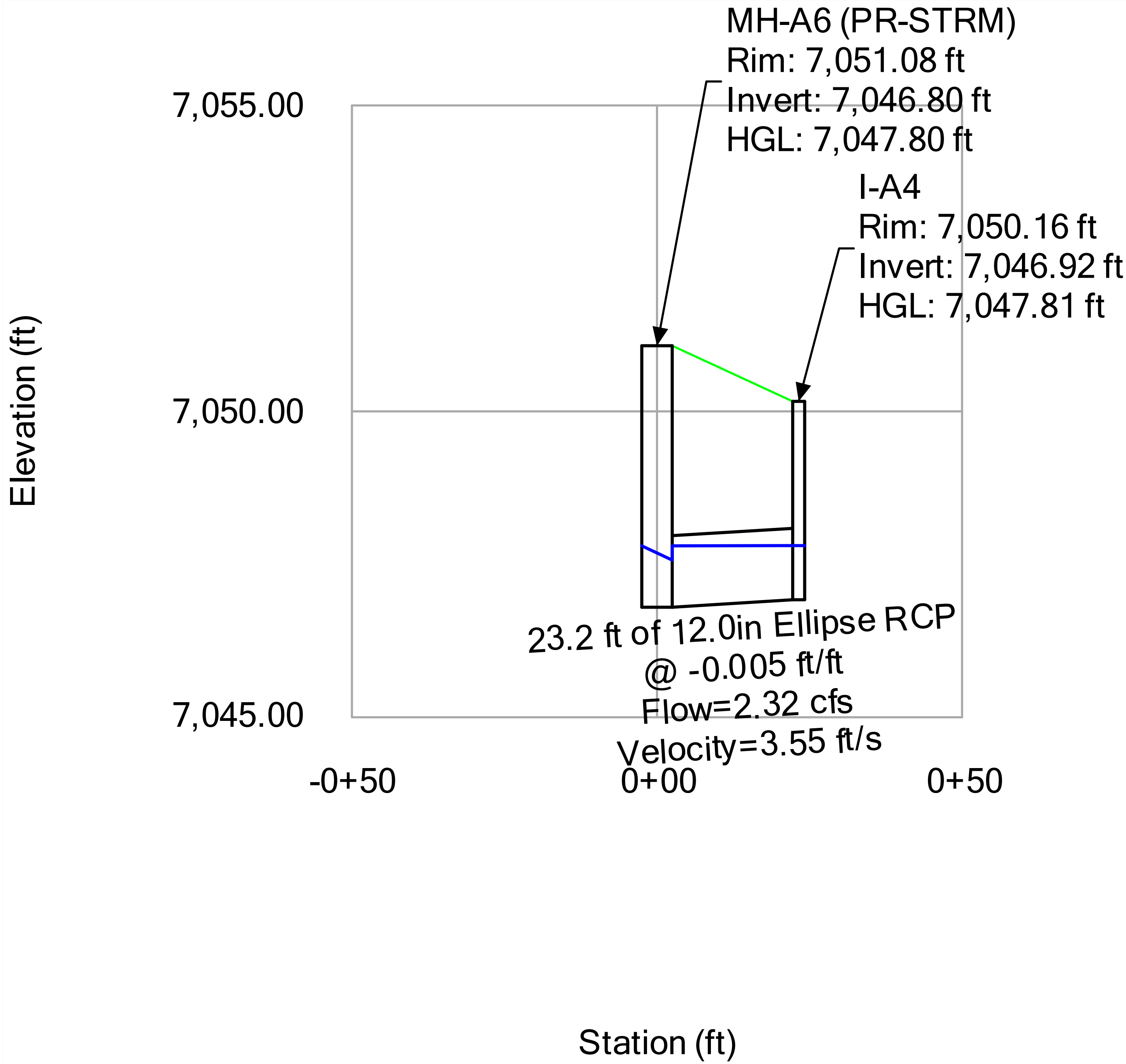
# 5-YEAR - STRM-A2



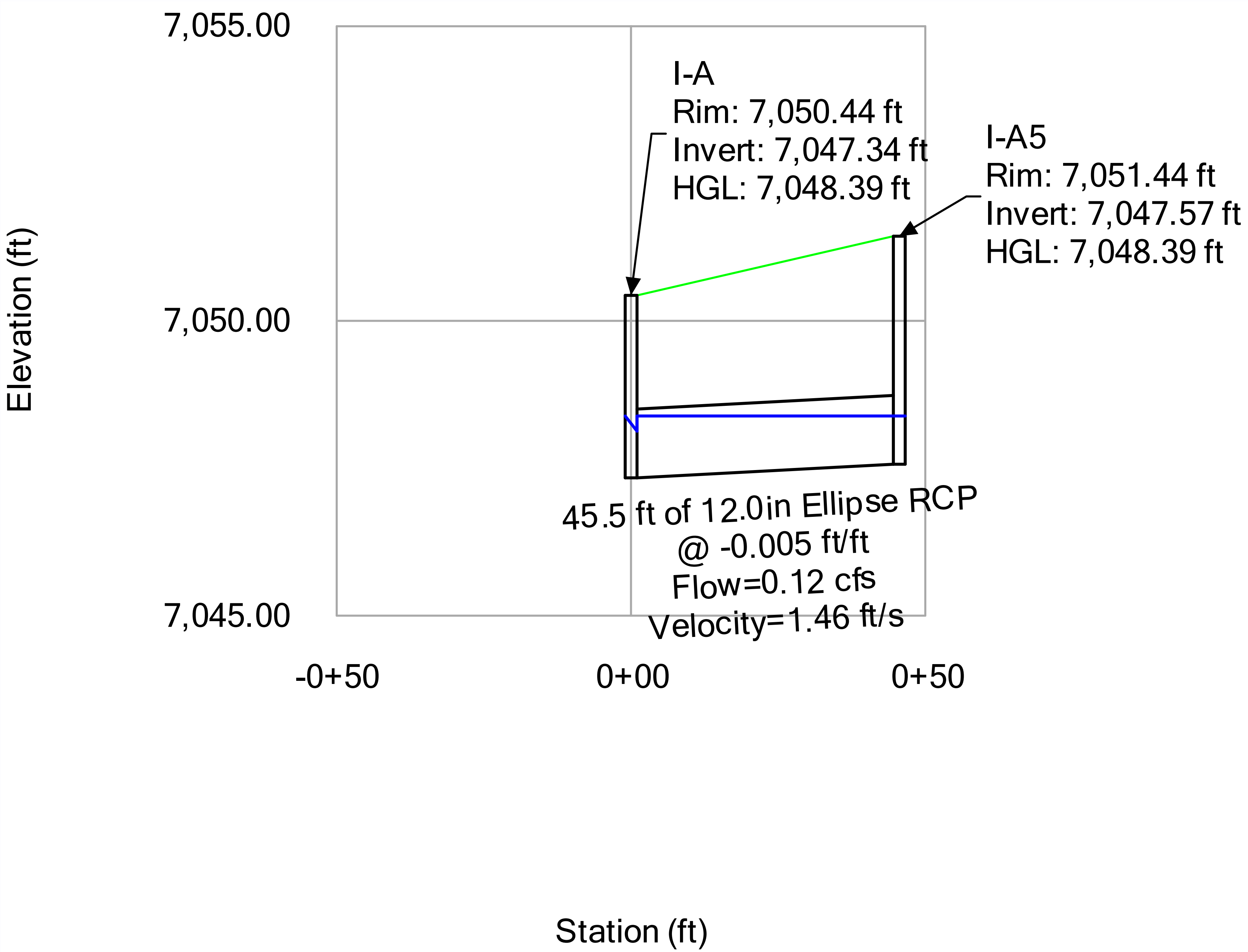
5-YEAR - STRM-A3



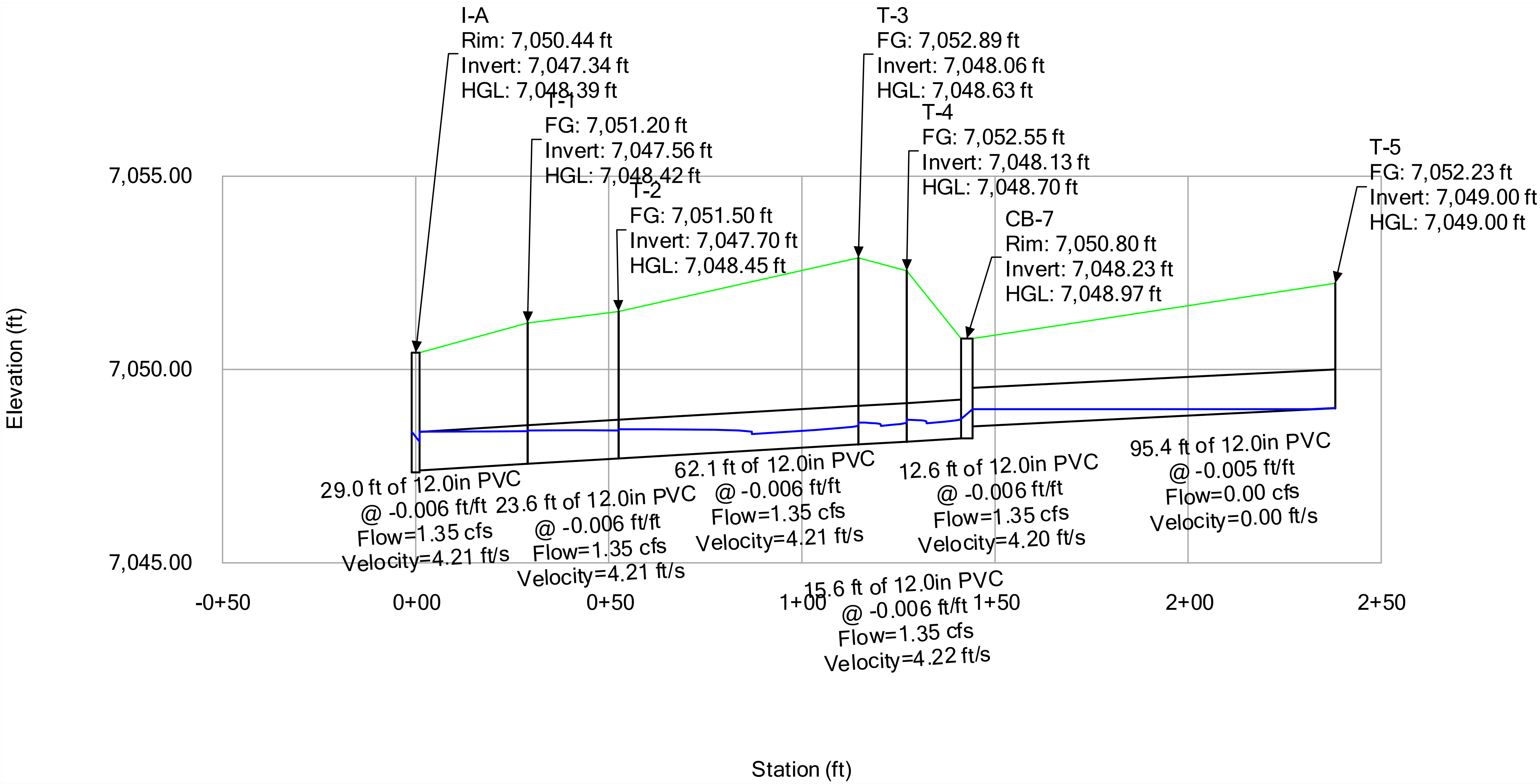
# 5-YEAR - STRM-A4



## 5-YEAR - STRM-A5



# 5-YEAR - STRM-B


I-A
Rim: 7,050.44 ft
Invert: 7,047.34 ft
HGL: 7,048.39 ft
T-1
FG: 7,051.20 ft
Invert: 7,047.56 ft
HGL: 7,048.42 ft
T-2
FG: 7,051.50 ft
Invert: 7,047.70 ft
HGL: 7,048.45 ft
T-3
FG: 7,052.89 ft
Invert: 7,048.06 ft
HGL: 7,048.63 ft
T-4
FG: 7,052.55 ft
Invert: 7,048.13 ft
HGL: 7,048.70 ft
CB-7
Rim: 7,050.80 ft
Invert: 7,048.23 ft
HGL: 7,048.97 ft
T-5
FG: 7,052.23 ft
Invert: 7,049.00 ft
HGL: 7,049.00 ft
29.0 ft of 12.0in PVC
@ -0.006 ft/ft
Flow=1.35 cfs
Velocity=4.21 ft/s
23.6 ft of 12.0in PVC
@ -0.006 ft/ft
Flow=1.35 cfs
Velocity=4.21 ft/s
62.1 ft of 12.0in PVC
@ -0.006 ft/ft
Flow=1.35 cfs
Velocity=4.21 ft/s
15.6 ft of 12.0in PVC
@ -0.006 ft/ft
Flow=1.35 cfs
Velocity=4.22 ft/s
12.6 ft of 12.0in PVC
@ -0.006 ft/ft
Flow=1.35 cfs
Velocity=4.20 ft/s
95.4 ft of 12.0in PVC
@ -0.005 ft/ft
Flow=0.00 cfs
Velocity=0.00 ft/s
7,055.00
7,050.00
7,045.00
Elevation (ft)
-0+50
0+00
0+50
1+00
1+50
2+00
2+50
Station (ft)

# 100-YEAR (100% FULL TAILWATER)

## Conduit Table - Time: 0.00 hours

| Label | Start Node | Invert (Start) (ft) | Stop Node | Invert (Stop) (ft) | Length (User Defined) (ft) | Slope (Calculated) (ft/ft) | Manning's n | Flow (cfs) | Velocity (ft/s) | Capacity (Full Flow) (cfs) | Hydraulic Grade Line (In) (ft) | Hydraulic Grade Line (Out) (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PIPE -03 (PR-STRM) | MH-A2 (PR-STRM) | 7,044.61 | MH-A3 (PR-STRM) | 7,045.09 | 160.1 | -0.003 | 0.013 | 18.61 | 5.12 | 22.48 | 7,046.83 | 7,046.37 |
| PIPE -11 (PR-STRM) | MH-A2 (PR-STRM) | 7,045.61 | I-A1 | 7,045.80 | 39.1 | -0.005 | 0.013 | 2.22 | 3.67 | 7.44 | 7,046.37 | 7,046.37 |
| PIPE -04 (PR-STRM) | MH-A3 (PR-STRM) | 7,045.19 | MH-A4 (PR-STRM) | 7,045.35 | 49.4 | -0.003 | 0.013 | 18.07 | 5.28 | 23.51 | 7,047.32 | 7,047.24 |
| PIPE -12 (PR-STRM) | MH-A3 (PR-STRM) | 7,046.19 | I-A2 | 7,046.37 | 35.0 | -0.005 | 0.013 | 0.54 | 2.48 | 7.55 | 7,047.24 | 7,047.24 |
| PIPE -05 (PR-STRM) | MH-A4 (PR-STRM) | 7,045.64 | MH-A5 (PR-STRM) | 7,045.74 | 34.0 | -0.003 | 0.013 | 18.07 | 5.09 | 22.48 | 7,047.68 | 7,047.62 |
| PIPE -06 (PR-STRM) | MH-A5 (PR-STRM) | 7,046.40 | MH-A6 (PR-STRM) | 7,046.80 | 132.7 | -0.003 | 0.013 | 16.36 | 5.01 | 22.35 | 7,048.16 | 7,047.99 |
| PIPE -13 (PR-STRM) | MH-A5 (PR-STRM) | 7,046.24 | I-A3 | 7,046.41 | 34.4 | -0.005 | 0.013 | 1.71 | 3.32 | 15.99 | 7,047.99 | 7,047.99 |
| PIPE -15 (PR-STRM) | I-A | 7,047.34 | I-A5 | 7,047.57 | 45.5 | -0.005 | 0.013 | 0.90 | 0.51 | 7.19 | 7,050.44 | 7,050.44 |
| PIPE -07 (PR-STRM) | MH-A6 (PR-STRM) | 7,046.80 | I-A | 7,047.34 | 181.1 | -0.003 | 0.013 | 11.03 | 6.16 | 5.72 | 7,050.55 | 7,048.49 |
| PIPE -14 (PR-STRM) | MH-A6 (PR-STRM) | 7,046.80 | I-A4 | 7,046.92 | 23.2 | -0.005 | 0.013 | 5.33 | 3.03 | 7.16 | 7,048.55 | 7,048.49 |
| PIPE -16 (PR-STRM) | I-A2 | 7,047.09 | 19 (PR-STRM) | 7,047.15 | 11.8 | -0.005 | 0.010 | 0.14 | 2.07 | 3.27 | 7,047.30 | 7,047.24 |
| PIPE -18 (PR-STRM) | 20 (PR-STRM) | 7,047.19 | CB-8 | 7,048.12 | 186.2 | -0.005 | 0.010 | 0.14 | 2.07 | 3.28 | 7,048.28 | 7,047.37 |
| PIPE -17 (PR-STRM) | 19 (PR-STRM) | 7,047.15 | 20 (PR-STRM) | 7,047.19 | 9.2 | -0.005 | 0.010 | 0.14 | 2.08 | 3.28 | 7,047.35 | 7,047.32 |
| CO-1 | MH-A2 (PR-STRM) | 7,044.11 | MH-A1 (PR-STRM) | 7,043.77 | 111.5 | 0.003 | 0.013 | 20.83 | 5.33 | 36.51 | 7,046.09 | 7,045.99 |
| CO-2 | I-A | 7,047.39 | T-1 | 7,047.56 | 29.0 | -0.006 | 0.010 | 2.67 | 3.40 | 3.54 | 7,050.53 | 7,050.44 |
| CO-3 | T-1 | 7,047.56 | T-2 | 7,047.70 | 23.6 | -0.006 | 0.010 | 2.67 | 3.40 | 3.54 | 7,050.68 | 7,050.60 |
| CO-4 | T-2 | 7,047.70 | T-3 | 7,048.06 | 62.1 | -0.006 | 0.010 | 2.67 | 3.40 | 3.55 | 7,050.96 | 7,050.75 |
| CO-5 | T-3 | 7,048.06 | T-4 | 7,048.13 | 12.6 | -0.006 | 0.010 | 2.67 | 3.40 | 3.53 | 7,051.07 | 7,051.03 |
| CO-6 | T-4 | 7,048.13 | CB-7 | 7,048.23 | 15.6 | -0.006 | 0.010 | 2.67 | 3.40 | 3.56 | 7,051.20 | 7,051.15 |
| CO-7 | CB-7 | 7,048.53 | T-5 | 7,049.00 | 95.4 | -0.005 | 0.010 | 0.00 | 0.00 | 3.27 | 7,050.80 | 7,050.80 |
| EX. PIPE IN STAPLETON DR | MH-A1 (PR-STRM) | 7,042.77 | O-1 | 7,041.94 | 29.8 | 0.028 | 0.013 | 20.83 | 11.72 | 240.09 | 7,045.93 | 7,045.94 |

# 100-YEAR (100% FULL TAILWATER)

## Catch Basin Table - Time: 0.00 hours

| Label | Elevation (Ground) (ft) | Elevation (Rim) (ft) | Elevation (Invert) (ft) | Flow (Additional Subsurface) (cfs) | Hydraulic Grade Line (In) (ft) | Headloss Coefficient (Standard) |
|---|---|---|---|---|---|---|
| I-A3 | 7,050.17 | 7,050.17 | 7,046.41 | 1.71 | 7,047.99 | 0.050 |
| I-A1 | 7,049.54 | 7,049.54 | 7,045.80 | 2.22 | 7,046.38 | 0.050 |
| I-A2 | 7,052.04 | 7,052.04 | 7,046.37 | 0.40 | 7,047.24 | 1.020 |
| I-A4 | 7,050.16 | 7,050.16 | 7,046.92 | 5.33 | 7,048.55 | 0.000 |
| I-A | 7,050.44 | 7,050.44 | 7,047.34 | 7.46 | 7,051.21 | 1.320 |
| I-A5 | 7,051.44 | 7,051.44 | 7,047.57 | 0.90 | 7,050.44 | 0.050 |
| CB-7 | 7,050.80 | 7,050.80 | 7,048.23 | 2.67 | 7,051.04 | 1.320 |
| CB-8 | 7,051.48 | 7,051.48 | 7,048.12 | 0.14 | 7,048.28 | 0.000 |

# 100-YEAR (100% FULL TAILWATER)

## Manhole Table - Time: 0.00 hours

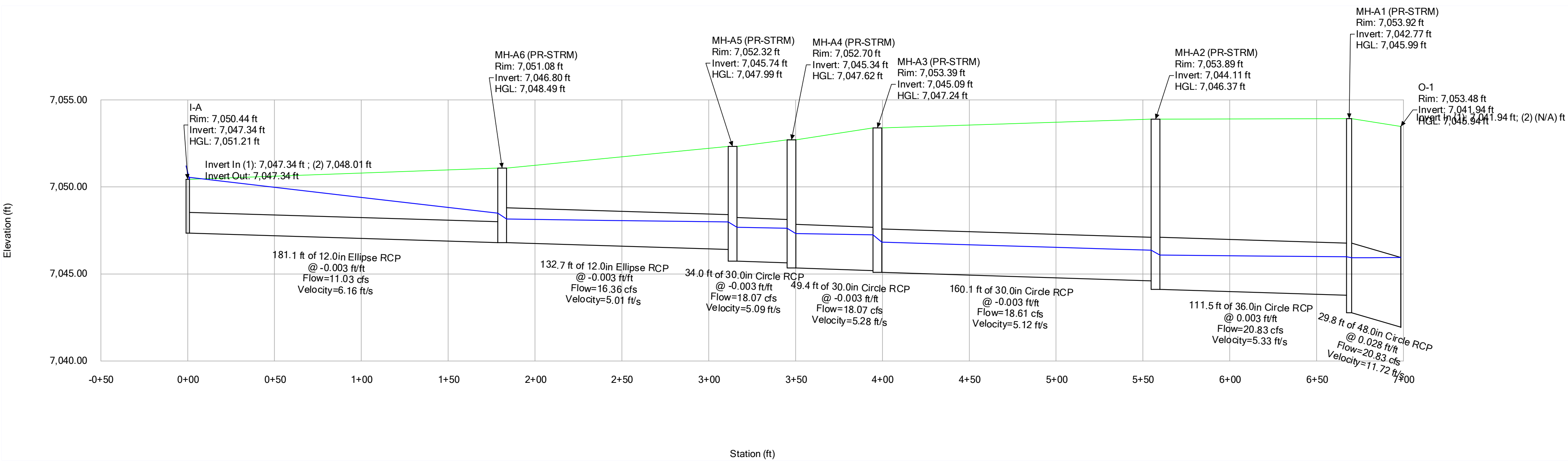
| Label | Elevation (Ground) (ft) | Elevation (Rim) (ft) | Elevation (Invert Out) (ft) | Flow (Total Out) (cfs) | Hydraulic Grade Line (Out) (ft) | Headloss Method | Hydraulic Grade Line (In) (ft) | Headloss Coefficient (Standard) |
|---|---|---|---|---|---|---|---|---|
| MH-A2 (PR-STRM) | 7,053.89 | 7,053.89 | 7,044.11 | 20.83 | 7,046.09 | Standard | 7,046.37 | 1.020 |
| MH-A3 (PR-STRM) | 7,053.39 | 7,053.39 | 7,045.09 | 18.61 | 7,046.83 | Standard | 7,047.24 | 1.020 |
| MH-A4 (PR-STRM) | 7,052.70 | 7,052.70 | 7,045.35 | 18.07 | 7,047.32 | Standard | 7,047.62 | 1.020 |
| MH-A5 (PR-STRM) | 7,052.32 | 7,052.32 | 7,045.74 | 18.07 | 7,047.68 | Standard | 7,047.99 | 1.020 |
| MH-A6 (PR-STRM) | 7,051.08 | 7,051.08 | 7,046.80 | 16.36 | 7,048.16 | Standard | 7,048.49 | 1.020 |
| MH-A1 (PR-STRM) | 7,053.92 | 7,053.92 | 7,042.77 | 20.83 | 7,045.93 | Standard | 7,045.99 | 1.020 |

# 100-YEAR (100% FULL TAILWATER)

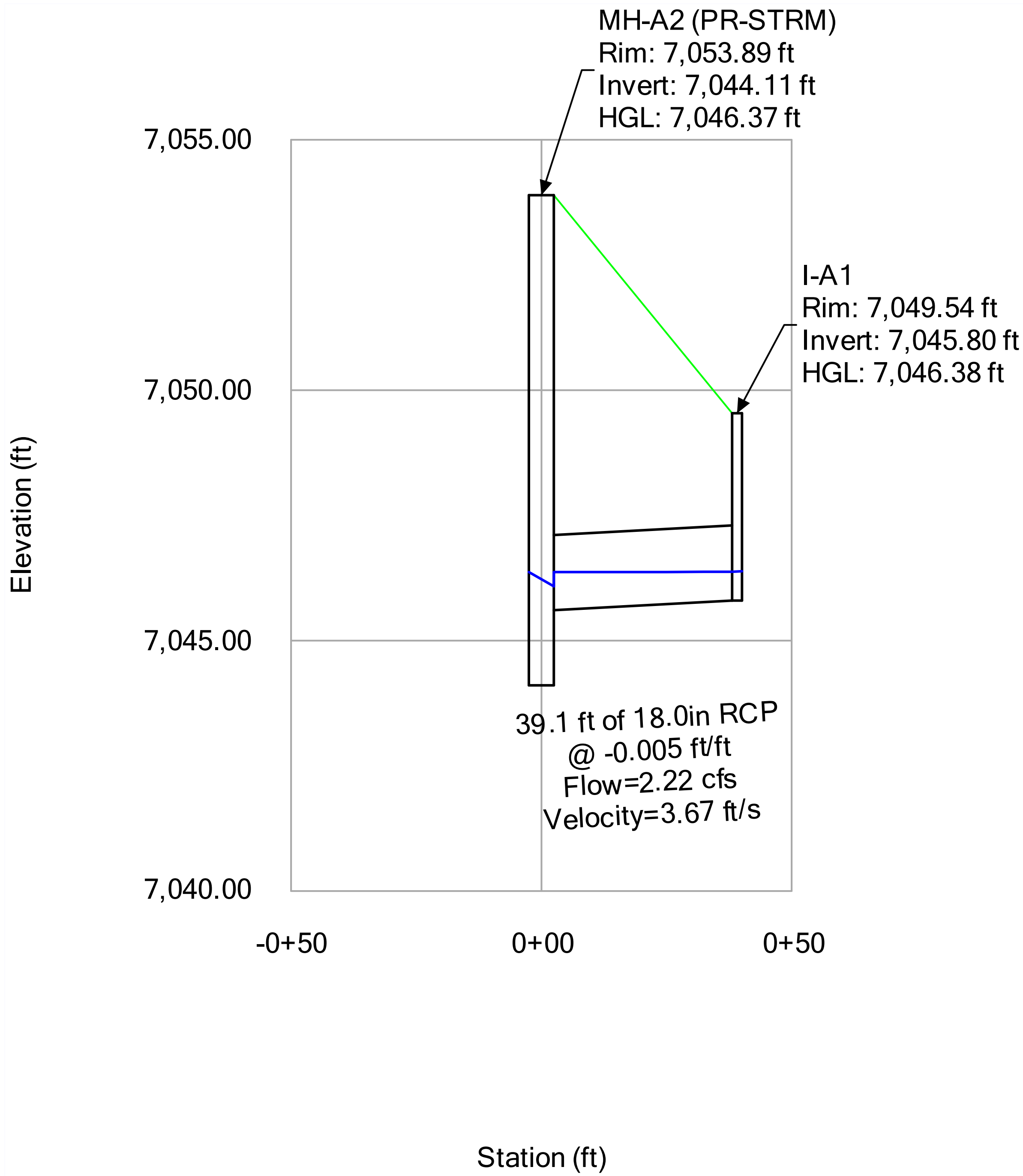
## Outfall Table - Time: 0.00 hours

| Label | Elevation (Ground) (ft) | Set Rim to Ground Elevation? | Elevation (Invert) (ft) | Boundary Condition Type | Hydraulic Grade (ft) | Flow (Total Out) (cfs) |
|---|---|---|---|---|---|---|
| O-1 | 7,053.48 | True | 7,041.94 | User Defined Tailwater | 7,045.94 | 20.83 |

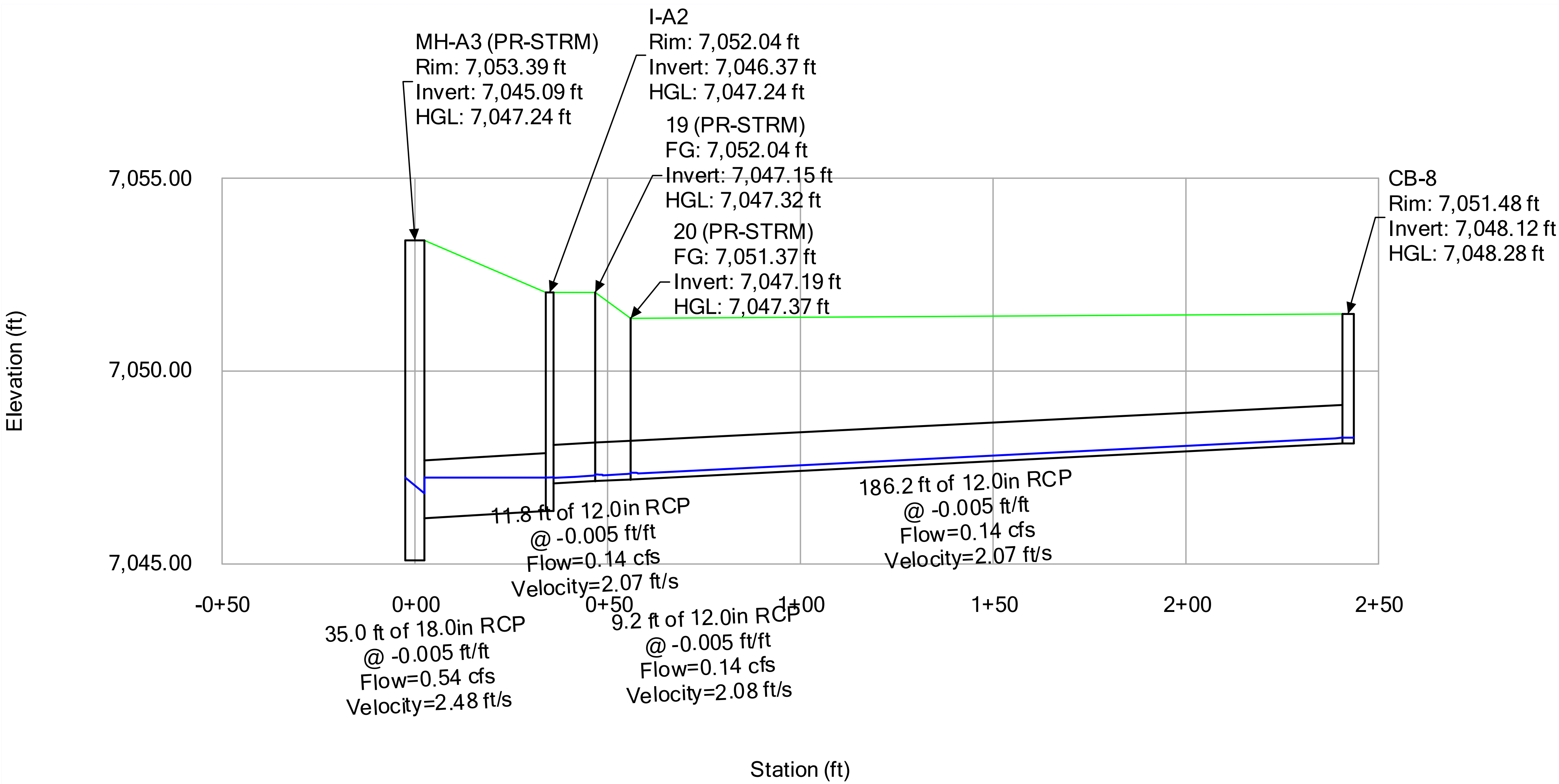
# 100-YEAR - STRM-A



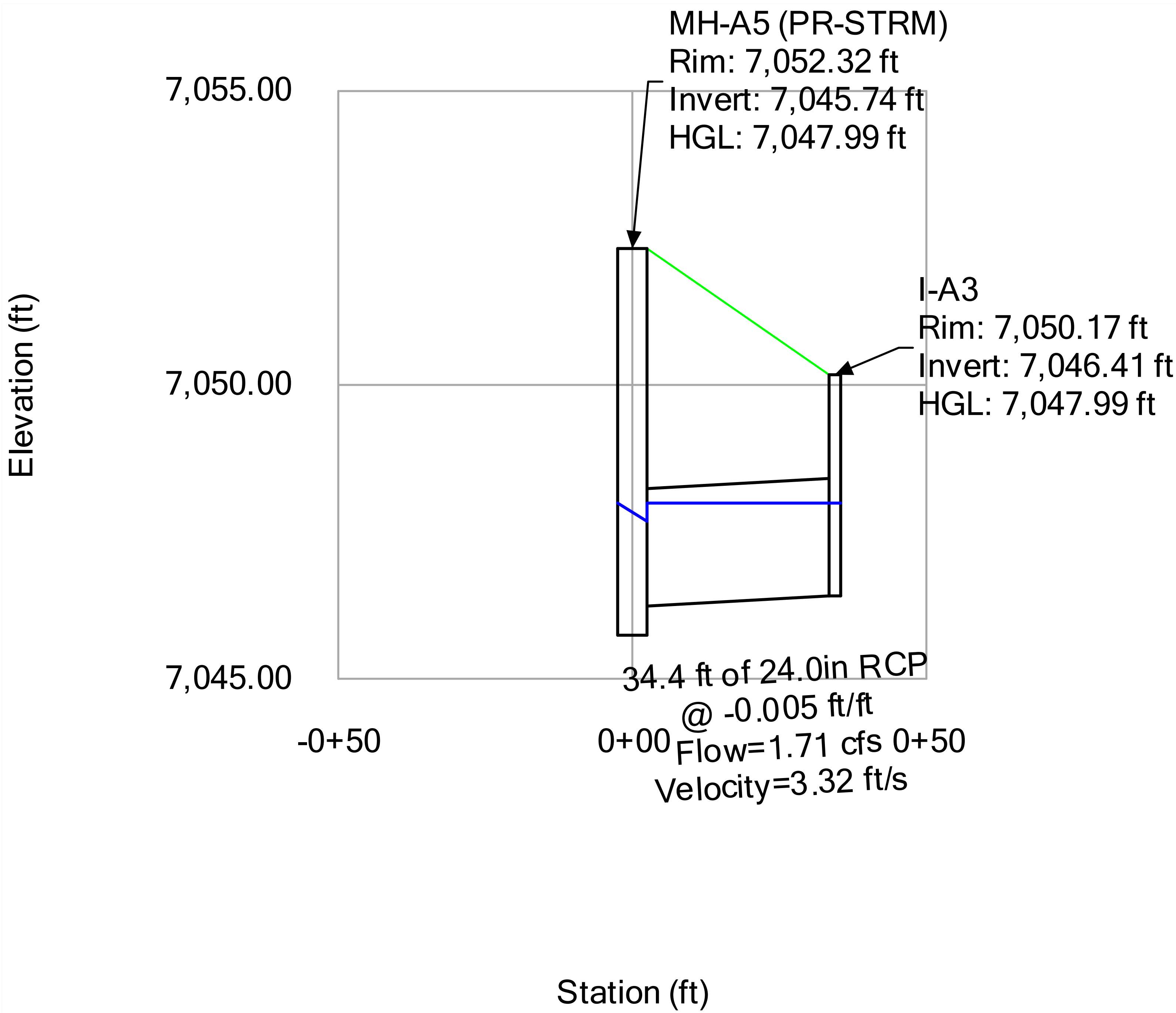
# 100-YEAR - STRM-A1



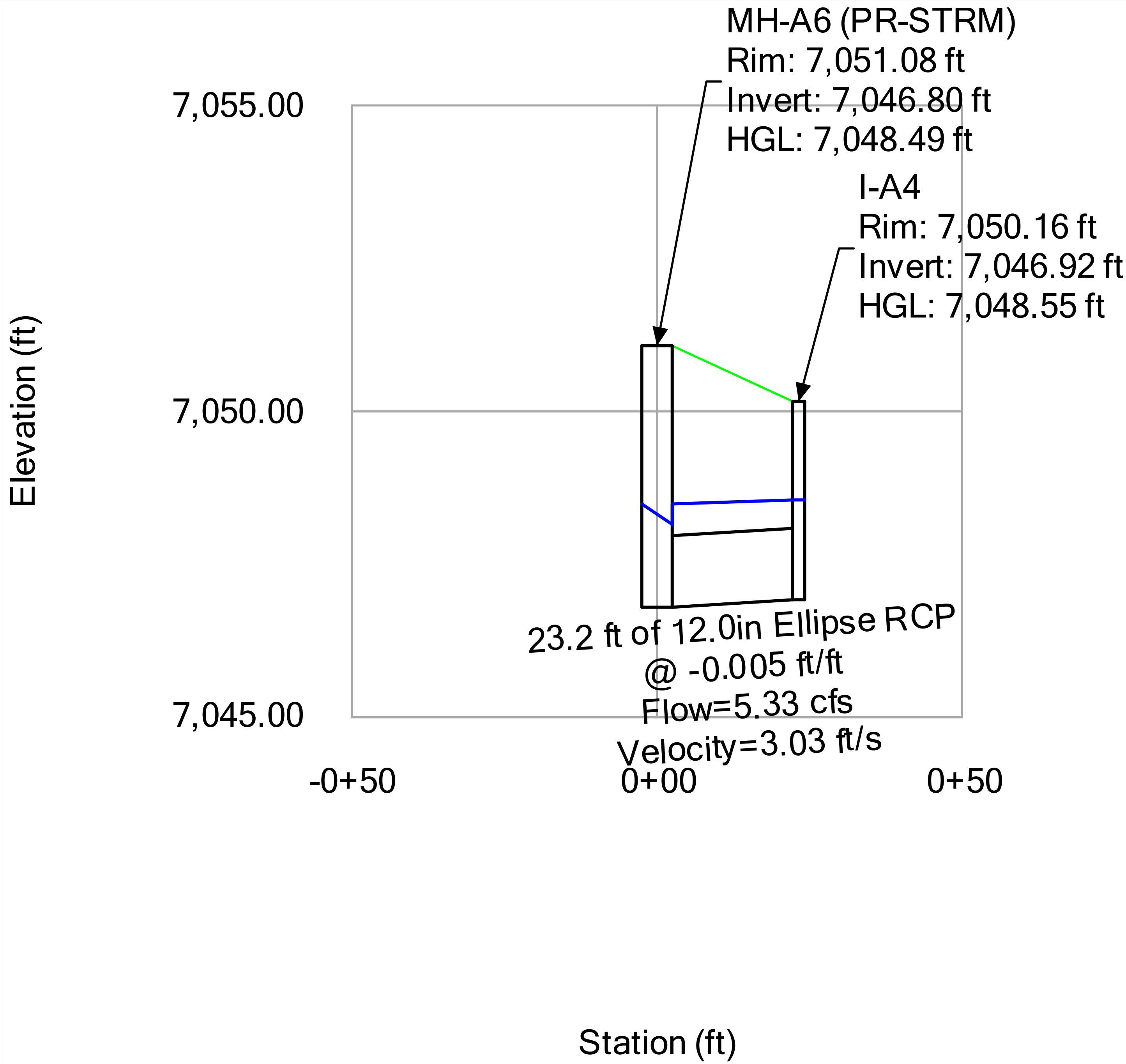
# 100-YEAR - STRM-A2



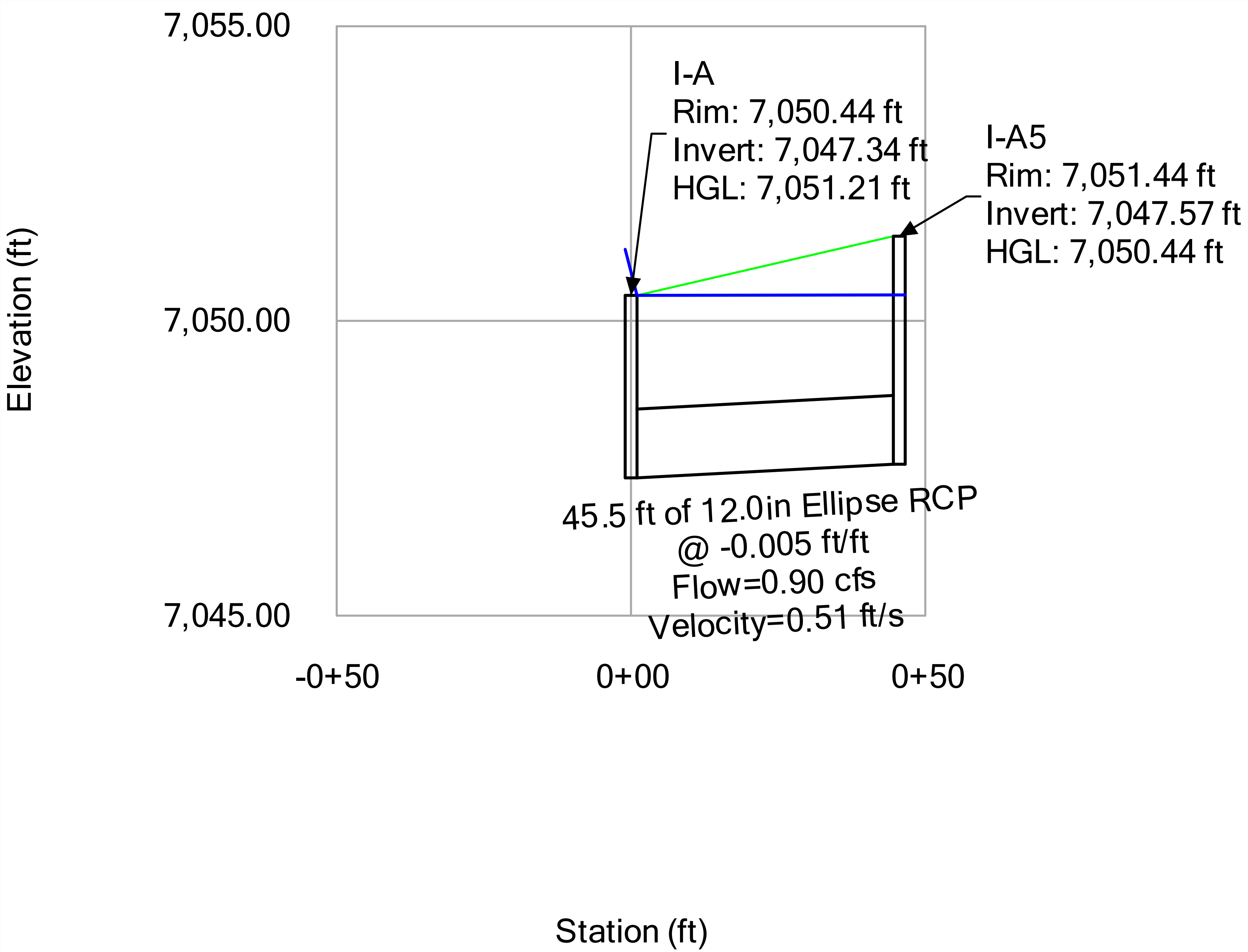
**100-YEAR - STRM-A3**



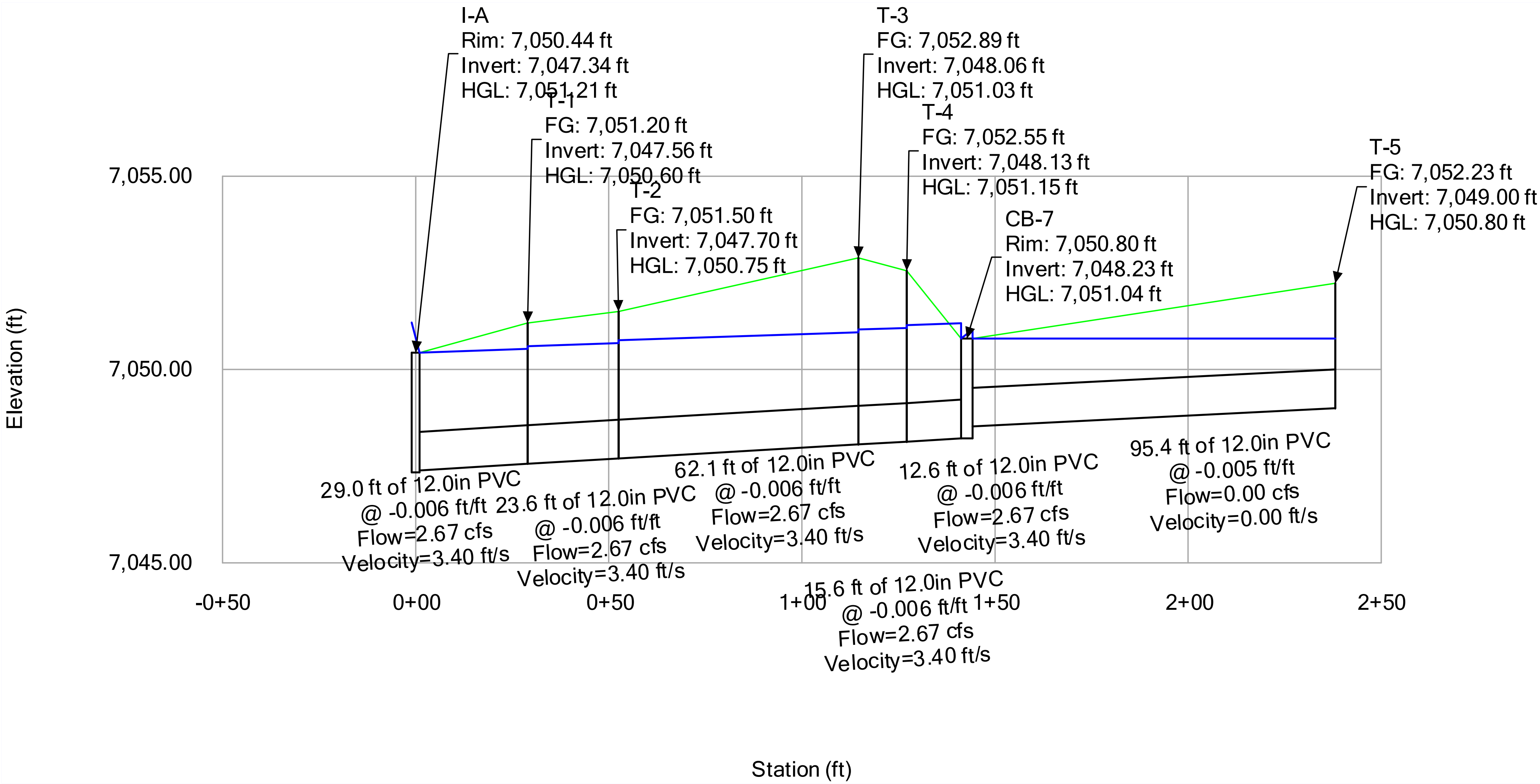
## 100-YEAR - STRM-A4



## 100-YEAR - STRM-A5



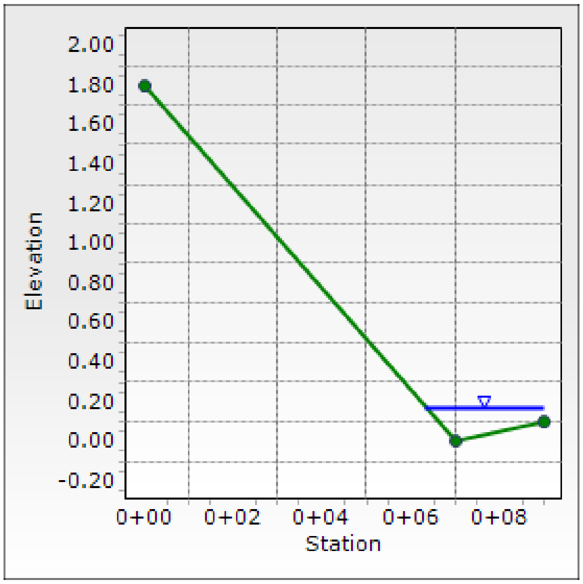
# 100-YEAR - STRM-B



# Cross Section for SWALE A - P3

| Project Description | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

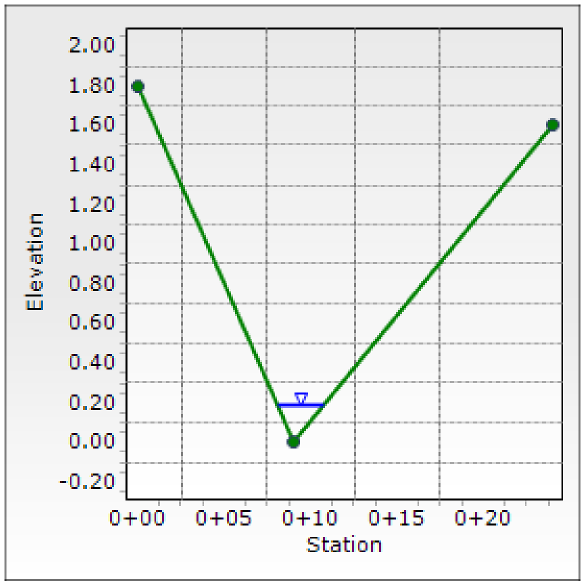
| Input Data | |
|---|---|
| Channel Slope | 0.010 ft/ft |
| Normal Depth | 2.0 in |
| Discharge | 0.31 cfs |



# Cross Section for SWALE B - OS1

| Project Description | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

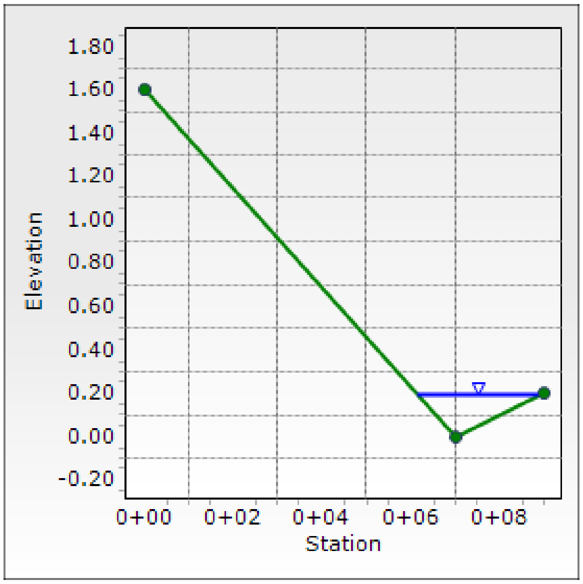
| Input Data | |
|---|---|
| Channel Slope | 0.010 ft/ft |
| Normal Depth | 2.2 in |
| Discharge | 0.25 cfs |



# Cross Section for SWALE C - P4

| Project Description | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---|---|
| Channel Slope | 0.015 ft/ft |
| Normal Depth | 2.2 in |
| Discharge | 0.31 cfs |



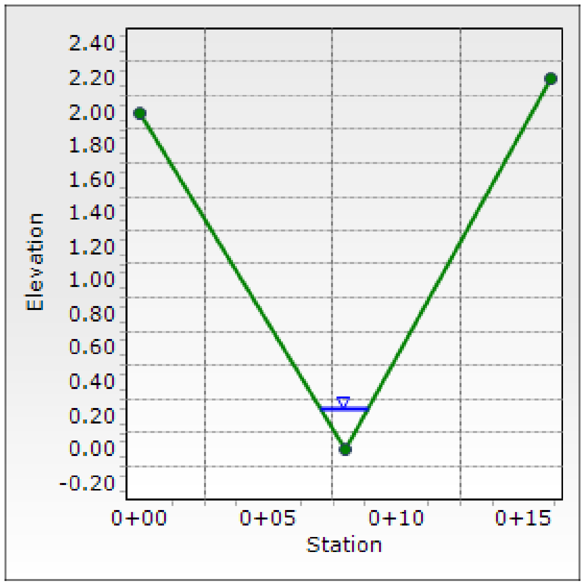
# Cross Section for SWALE D - P4

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

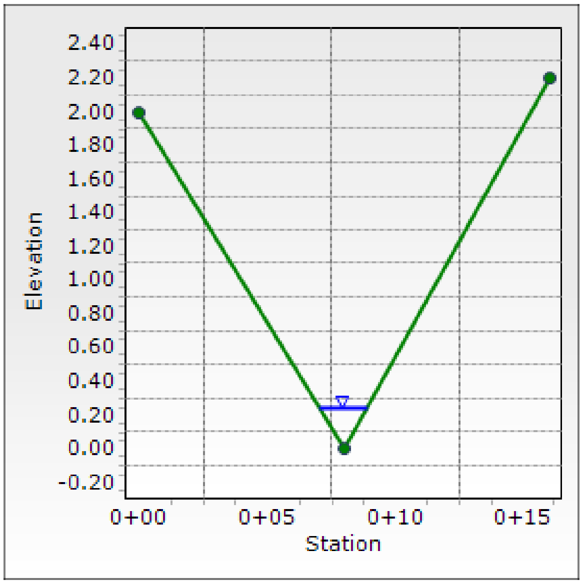
| | |
|---|---|
| Channel Slope | 0.015 ft/ft |
| Normal Depth | 2.9 in |
| Discharge | 0.31 cfs |



# Cross Section for SWALE E - P5

| Project Description | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---|---|
| Channel Slope | 0.015 ft/ft |
| Normal Depth | 2.9 in |
| Discharge | 0.31 cfs |



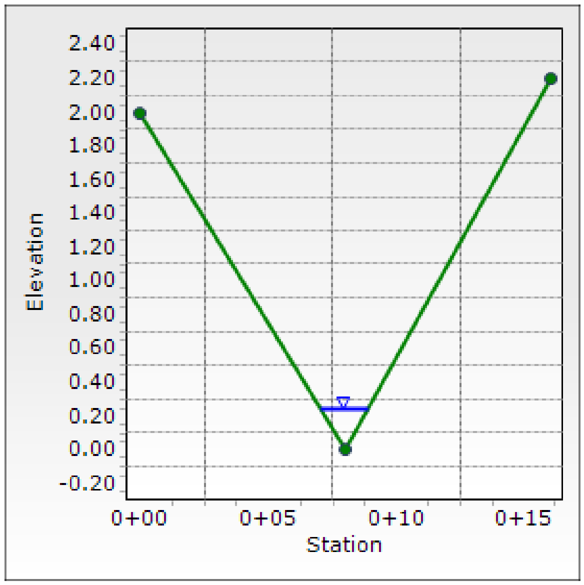
# Cross Section for SWALE F - P7

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

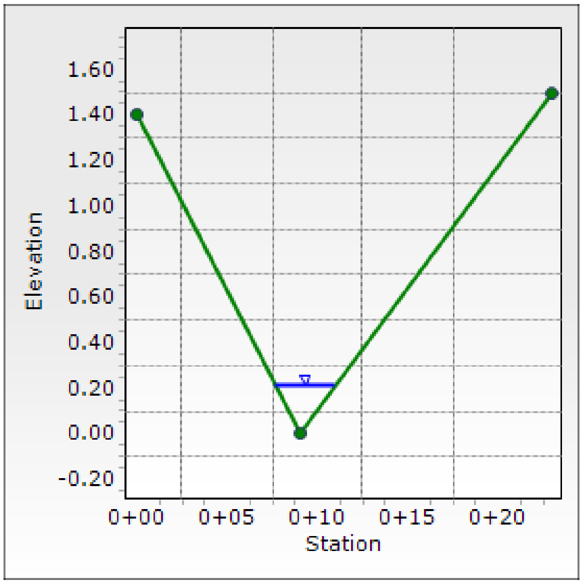
| | |
|---|---|
| Channel Slope | 0.015 ft/ft |
| Normal Depth | 2.9 in |
| Discharge | 0.31 cfs |



# Cross Section for SWALE G - P6

| Project Description | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---|---|
| Channel Slope | 0.010 ft/ft |
| Normal Depth | 2.6 in |
| Discharge | 0.40 cfs |



*MHFD-Inlet, Version 5.03 (August 2023)*

# INLET MANAGEMENT

Worksheet Protected

| **INLET NAME** | I-A | I-A1 | I-A2 |
|---|---|---|---|
| Site Type (Urban or Rural) | RURAL | RURAL | RURAL |
| Inlet Application (Street or Area) | AREA | AREA | AREA |
| Hydraulic Condition | Swale | Swale | Swale |
| Inlet Type | CDOT Type C (Depressed) | CDOT Type C | CDOT Type C |

## USER-DEFINED INPUT

**User-Defined Design Flows**

| | | | |
|---|---|---|---|
| Minor $Q_{Known}$ (cfs) | 2.9 | 0.8 | 0.1 |
| Major $Q_{Known}$ (cfs) | 5.8 | 2.2 | 0.4 |

**Bypass (Carry-Over) Flow from Upstream** Inlets must be organized from upstream (left) to downstream (right) in order for bypass flows to be linked.

| | | | |
|---|---|---|---|
| Receive Bypass Flow from: | No Bypass Flow Received | No Bypass Flow Received | No Bypass Flow Received |
| Minor Bypass Flow Received, $Q_b$ (cfs) | 0.0 | 0.0 | 0.0 |
| Major Bypass Flow Received, $Q_b$ (cfs) | 0.0 | 0.0 | 0.0 |

**Watershed Characteristics**

| | | | |
|---|---|---|---|
| Subcatchment Area (acres) | | | |
| Percent Impervious | | | |
| NRCS Soil Type | | | |

**Watershed Profile**

| | | | |
|---|---|---|---|
| Overland Slope (ft/ft) | | | |
| Overland Length (ft) | | | |
| Channel Slope (ft/ft) | | | |
| Channel Length (ft) | | | |

**Minor Storm Rainfall Input**

| | | | |
|---|---|---|---|
| Design Storm Return Period, $T_r$ (years) | | | |
| One-Hour Precipitation, $P_1$ (inches) | | | |

**Major Storm Rainfall Input**

| | | | |
|---|---|---|---|
| Design Storm Return Period, $T_r$ (years) | | | |
| One-Hour Precipitation, $P_1$ (inches) | | | |

## CALCULATED OUTPUT

| | | | |
|---|---|---|---|
| **Minor Total Design Peak Flow, Q (cfs)** | **2.9** | **0.8** | **0.1** |
| **Major Total Design Peak Flow, Q (cfs)** | **5.8** | **2.2** | **0.4** |
| Minor Flow Bypassed Downstream, $Q_b$ (cfs) | 0.0 | 0.0 | 0.0 |
| Major Flow Bypassed Downstream, $Q_b$ (cfs) | 0.0 | 0.0 | 0.0 |

*MHFD-Inlet, Version 5.03 (August 2023)*

# INLET MANAGEMENT

Worksheet Protected

| INLET NAME | I-A3 | I-A4 | I-A5 |
|---|---|---|---|
| Site Type (Urban or Rural) | RURAL | RURAL | RURAL |
| Inlet Application (Street or Area) | AREA | AREA | AREA |
| Hydraulic Condition | Swale | Swale | Swale |
| Inlet Type | CDOT Type C | CDOT Type D (In Series) | CDOT Type C |

## USER-DEFINED INPUT

**User-Defined Design Flows**

| | | | |
|---|---|---|---|
| Minor $Q_{Known}$ (cfs) | 0.3 | 2.3 | 0.1 |
| Major $Q_{Known}$ (cfs) | 1.7 | 5.3 | 0.9 |

**Bypass (Carry-Over) Flow from Upstream**

| | | | |
|---|---|---|---|
| Receive Bypass Flow from: | No Bypass Flow Received | No Bypass Flow Received | No Bypass Flow Received |
| Minor Bypass Flow Received, $Q_b$ (cfs) | 0.0 | 0.0 | 0.0 |
| Major Bypass Flow Received, $Q_b$ (cfs) | 0.0 | 0.0 | 0.0 |

**Watershed Characteristics**

| | | | |
|---|---|---|---|
| Subcatchment Area (acres) | | | |
| Percent Impervious | | | |
| NRCS Soil Type | | | |

**Watershed Profile**

| | | | |
|---|---|---|---|
| Overland Slope (ft/ft) | | | |
| Overland Length (ft) | | | |
| Channel Slope (ft/ft) | | | |
| Channel Length (ft) | | | |

**Minor Storm Rainfall Input**

| | | | |
|---|---|---|---|
| Design Storm Return Period, $T_r$ (years) | | | |
| One-Hour Precipitation, $P_1$ (inches) | | | |

**Major Storm Rainfall Input**

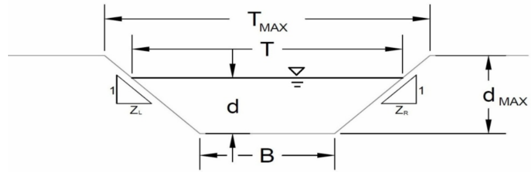
| | | | |
|---|---|---|---|
| Design Storm Return Period, $T_r$ (years) | | | |
| One-Hour Precipitation, $P_1$ (inches) | | | |

## CALCULATED OUTPUT

| | | | |
|---|---|---|---|
| **Minor Total Design Peak Flow, Q (cfs)** | **0.3** | **2.3** | **0.1** |
| **Major Total Design Peak Flow, Q (cfs)** | **1.7** | **5.3** | **0.9** |
| Minor Flow Bypassed Downstream, $Q_b$ (cfs) | 0.0 | 0.0 | 0.0 |
| Major Flow Bypassed Downstream, $Q_b$ (cfs) | 0.0 | 0.0 | 0.0 |

# AREA INLET IN A SWALE

**I-A**




This worksheet uses the NRCS vegetal retardance method to determine Manning's n for grass-lined channels.

An override Manning's n can be entered for other channel materials.

## Analysis of Trapezoidal Channel (Grass-Lined uses SCS Method)

| | | | |
|---|---|---|---|
| NRCS Vegetal Retardance (A, B, C, D, or E) | A, B, C, D, or E = | | |
| Manning's n (Leave cell D16 blank to manually enter an n value) | n = | 0.013 | |
| Channel Invert Slope | $S_O$ = | 0.0150 | ft/ft |
| Bottom Width | B = | 0.00 | ft |
| Left Side Slope | Z1 = | 50.00 | ft/ft |
| Right Side Sloe | Z2 = | 50.00 | ft/ft |

Check one of the following soil types:

| Soil Type: | Max. Velocity ($V_{MAX}$) | Max Froude No. ($F_{MAX}$) |
|---|---|---|
| Non-Cohesive | 5.0 fps | 0.60 |
| Cohesive | 7.0 fps | 0.80 |
| Paved | N/A | N/A |

Choose One:
- ☐ **Non-Cohesive**
- ☐ **Cohesive**
- ☐ **Paved**

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Maximum Allowable Top Width of Channel for Minor & Major Storm | **$T_{MAX}$ =** | **65.00** | **65.00** | **ft** |
| Maximum Allowable Water Depth in Channel for Minor & Major Storm | **$d_{MAX}$ =** | **1.50** | **1.50** | **ft** |

## Maximum Channel Capacity Based On Allowable Top Width

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Maximum Allowable Top Width | **$T_{MAX}$ =** | **65.00** | **65.00** | **ft** |
| Water Depth | d = | 0.65 | 0.65 | ft |
| Flow Area | A = | 21.13 | 21.13 | sq ft |
| Wetted Perimeter | P = | 65.01 | 65.01 | ft |
| Hydraulic Radius | R = | 0.32 | 0.32 | ft |
| Manning's n | n = | 0.013 | 0.013 | |
| Flow Velocity | V = | 6.63 | 6.63 | fps |
| Velocity-Depth Product | VR = | 2.16 | 2.16 | ft^2/s |
| Hydraulic Depth | D = | 0.33 | 0.33 | ft |
| Froude Number | Fr = | 2.05 | 2.05 | |
| Maximum Flow Based on Allowable Water Depth | **$Q_T$ =** | **140.2** | **140.2** | **cfs** |

## Maximum Channel Capacity Based On Allowable Water Depth

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Maximum Allowable Water Depth | **$d_{MAX}$ =** | **1.50** | **1.50** | **ft** |
| Top Width | T = | 150.00 | 150.00 | ft |
| Flow Area | A = | 112.50 | 112.50 | sq ft |
| Wetted Perimeter | P = | 150.03 | 150.03 | ft |
| Hydraulic Radius | R = | 0.75 | 0.75 | ft |
| Manning's n | n = | 0.013 | 0.013 | |
| Flow Velocity | V = | 11.59 | 11.59 | fps |
| Velocity-Depth Product | VR = | 8.69 | 8.69 | ft^2/s |
| Hydraulic Depth | D = | 0.75 | 0.75 | ft |
| Froude Number | Fr = | 2.36 | 2.36 | |
| Maximum Flow Based On Allowable Water Depth | **$Q_d$ =** | **1,303.4** | **1,303.4** | **cfs** |

## Allowable Channel Capacity Based On Channel Geometry

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is based on Top Width Criterion | **$Q_{allow}$ =** | **140.2** | **140.2** | **cfs** |
| MAJOR STORM Allowable Capacity is based on Top Width Criterion | **$d_{allow}$ =** | **0.65** | **0.65** | **ft** |

## Water Depth in Channel Based On Design Peak Flow

| | | | | |
|---|---|---|---|---|
| Design Peak Flow | **$Q_o$ =** | **2.9** | **5.8** | **cfs** |
| Water Depth | **d =** | **0.15** | **0.20** | **ft** |
| Top Width | T = | 15.08 | 19.62 | ft |
| Flow Area | A = | 1.14 | 1.93 | sq ft |
| Wetted Perimeter | P = | 15.09 | 19.63 | ft |
| Hydraulic Radius | R = | 0.08 | 0.10 | ft |
| Manning's n | n = | 0.013 | 0.013 | |
| Flow Velocity | V = | 2.51 | 2.99 | fps |
| Velocity-Depth Product | VR = | 0.19 | 0.29 | ft^2/s |
| Hydraulic Depth | D = | 0.08 | 0.10 | ft |
| Froude Number | Fr = | 1.61 | 1.68 | |

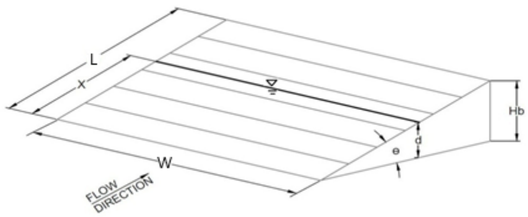
**Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'**
**Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'**

# AREA INLET IN A SWALE

**I-A**

Inlet Design Information (Input)

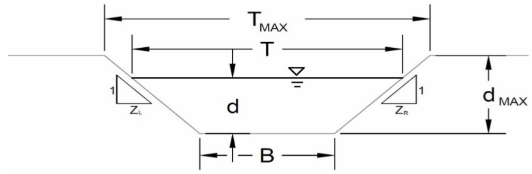
| | | | | |
|---|---|---|---|---|
| Type of Inlet | CDOT Type C (Depressed) | Inlet Type = | CDOT Type C (Depressed) | |
| Angle of Inclined Grate (must be <= 30 degrees) | | θ = | 0.00 | degrees |
| Width of Grate | | W = | 3.00 | ft |
| Length of Grate | | L = | 3.00 | ft |
| Open Area Ratio | | $A_{RATIO}$ = | 0.70 | |
| Height of Inclined Grate | | $H_B$ = | 0.00 | ft |
| Clogging Factor | | $C_f$ = | 0.50 | |
| Grate Discharge Coefficient | | $C_d$ = | 0.84 | |
| Orifice Coefficient | | $C_o$ = | 0.56 | |
| Weir Coefficient | | $C_w$ = | 1.81 | |




| | | MINOR | MAJOR | |
|---|---|---|---|---|
| Water Depth at Inlet (for depressed inlets, 1 foot is added for depression) | d = | 1.15 | 1.20 | |
| Grate Capacity as a Weir | | | | |
| Submerged Side Weir Length | X = | 3.00 | 3.00 | ft |
| Inclined Side Weir Flow | $Q_{ws}$ = | 11.7 | 12.4 | cfs |
| Base Weir Flow | $Q_{wb}$ = | 16.7 | 17.7 | cfs |
| Interception Without Cloggging | $Q_{wi}$ = | 40.1 | 42.5 | cfs |
| Interception With Clogging | $Q_{wa}$ = | 20.1 | 21.3 | cfs |
| Grate Capacity as an Orifice | | | | |
| Interception Without Clogging | $Q_{oi}$ = | 30.5 | 31.1 | cfs |
| Interception With Clogging | $Q_{oa}$ = | 15.3 | 15.6 | cfs |
| Total Inlet Interception Capacity (assumes clogged condition) | **$Q_a$ =** | **15.3** | **15.6** | **cfs** |
| Bypassed Flow | **$Q_b$ =** | **0.0** | **0.0** | **cfs** |
| Capture Percentage = Qa/Qo | **C% =** | **100** | **100** | **%** |

# AREA INLET IN A SWALE

**I-A1**




This worksheet uses the NRCS vegetal retardance method to determine Manning's n for grass-lined channels.

An override Manning's n can be entered for other channel materials.

**Analysis of Trapezoidal Channel (Grass-Lined uses SCS Method)**

| | | | |
|---|---|---|---|
| NRCS Vegetal Retardance (A, B, C, D, or E) | A, B, C, D, or E = | A | |
| Manning's n (Leave cell D16 blank to manually enter an n value) | n = | see details below | |
| Channel Invert Slope | $S_O$ = | 0.0100 | ft/ft |
| Bottom Width | B = | 0.00 | ft |
| Left Side Slope | Z1 = | 4.00 | ft/ft |
| Right Side Sloe | Z2 = | 4.00 | ft/ft |

Check one of the following soil types:

| Soil Type: | Max. Velocity ($V_{MAX}$) | Max Froude No. ($F_{MAX}$) |
|---|---|---|
| Non-Cohesive | 5.0 fps | 0.60 |
| Cohesive | 7.0 fps | 0.80 |
| Paved | N/A | N/A |

Choose One:
- ☐ Non-Cohesive
- ☐ Cohesive
- ☐ Paved

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Maximum Allowable Top Width of Channel for Minor & Major Storm | $T_{MAX}$ = | 23.00 | 23.00 | ft |
| Maximum Allowable Water Depth in Channel for Minor & Major Storm | $d_{MAX}$ = | 2.00 | 2.00 | ft |

**Allowable Channel Capacity Based On Channel Geometry**

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is based on Depth Criterion | $Q_{allow}$ = | 6.3 | 6.3 | cfs |
| MAJOR STORM Allowable Capacity is based on Depth Criterion | $d_{allow}$ = | 2.00 | 2.00 | ft |

**Water Depth in Channel Based On Design Peak Flow**

| | | | | |
|---|---|---|---|---|
| Design Peak Flow | $Q_o$ = | 0.8 | 2.2 | cfs |
| Water Depth | d = | 0.85 | 1.29 | ft |

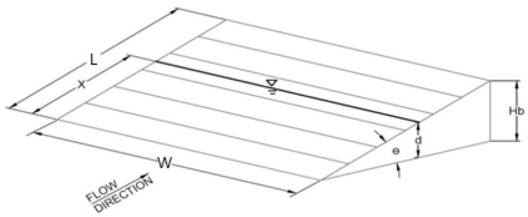
**Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'**
**Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'**

# AREA INLET IN A SWALE

**I-A1**

Inlet Design Information (Input)

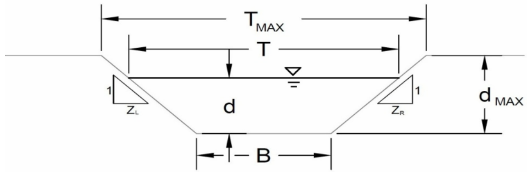
| | | | |
|---|---|---|---|
| Type of Inlet | CDOT Type C | Inlet Type = | CDOT Type C |
| Angle of Inclined Grate (must be <= 30 degrees) | $\theta$ = | 0.00 | degrees |
| Width of Grate | W = | 3.00 | ft |
| Length of Grate | L = | 3.00 | ft |
| Open Area Ratio | $A_{RATIO}$ = | 0.70 | |
| Height of Inclined Grate | $H_B$ = | 0.00 | ft |
| Clogging Factor | $C_f$ = | 0.50 | |
| Grate Discharge Coefficient | $C_d$ = | 0.96 | |
| Orifice Coefficient | $C_o$ = | 0.64 | |
| Weir Coefficient | $C_w$ = | 2.05 | |




| | | MINOR | MAJOR | |
|---|---|---|---|---|
| Water Depth at Inlet (for depressed inlets, 1 foot is added for depression) | d = | 0.85 | 1.29 | |
| Total Inlet Interception Capacity (assumes clogged condition) | $Q_a$ = | **14.5** | **18.3** | **cfs** |
| Bypassed Flow | $Q_b$ = | **0.0** | **0.0** | **cfs** |
| Capture Percentage = Qa/Qo | **C% =** | **100** | **100** | **%** |

# AREA INLET IN A SWALE

**I-A2**




This worksheet uses the NRCS vegetal retardance method to determine Manning's n for grass-lined channels.

An override Manning's n can be entered for other channel materials.

Analysis of Trapezoidal Channel (Grass-Lined uses SCS Method)

| | | | |
|---|---|---|---|
| NRCS Vegetal Retardance (A, B, C, D, or E) | A, B, C, D, or E = | A | |
| Manning's n (Leave cell D16 blank to manually enter an n value) | n = | see details below | |
| Channel Invert Slope | $S_O$ = | 0.0150 | ft/ft |
| Bottom Width | B = | 0.00 | ft |
| Left Side Slope | Z1 = | 4.00 | ft/ft |
| Right Side Sloe | Z2 = | 4.00 | ft/ft |

Check one of the following soil types:

| Soil Type: | Max. Velocity ($V_{MAX}$) | Max Froude No. ($F_{MAX}$) |
|---|---|---|
| Non-Cohesive | 5.0 fps | 0.60 |
| Cohesive | 7.0 fps | 0.80 |
| Paved | N/A | N/A |

Choose One:
- ☐ **Non-Cohesive**
- ☐ **Cohesive**
- ☐ **Paved**

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Maximum Allowable Top Width of Channel for Minor & Major Storm | $T_{MAX}$ = | **20.00** | **20.00** | **ft** |
| Maximum Allowable Water Depth in Channel for Minor & Major Storm | $d_{MAX}$ = | **1.50** | **1.50** | **ft** |

Allowable Channel Capacity Based On Channel Geometry

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is based on Depth Criterion | $Q_{allow}$ = | **3.7** | **3.7** | **cfs** |
| MAJOR STORM Allowable Capacity is based on Depth Criterion | $d_{allow}$ = | **1.50** | **1.50** | **ft** |

Water Depth in Channel Based On Design Peak Flow

| | | | | |
|---|---|---|---|---|
| Design Peak Flow | $Q_o$ = | **0.1** | **0.4** | **cfs** |
| Water Depth | d = | **0.34** | **0.59** | **ft** |

**Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'**
**Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'**

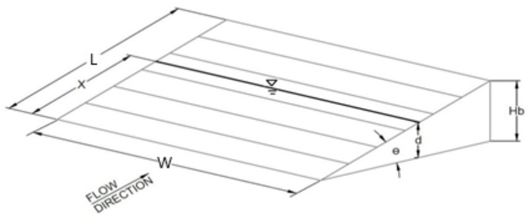
MHFD-Inlet, Version 5.03 (August 2023)

# AREA INLET IN A SWALE

**I-A2**

Inlet Design Information (Input)

Type of Inlet: CDOT Type C — Inlet Type = CDOT Type C

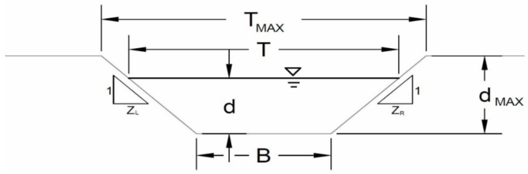



| | | | |
|---|---|---|---|
| Angle of Inclined Grate (must be <= 30 degrees) | $\theta$ = | 0.00 | degrees |
| Width of Grate | W = | 3.00 | ft |
| Length of Grate | L = | 3.00 | ft |
| Open Area Ratio | $A_{RATIO}$ = | 0.70 | |
| Height of Inclined Grate | $H_B$ = | 0.00 | ft |
| Clogging Factor | $C_f$ = | 0.50 | |
| Grate Discharge Coefficient | $C_d$ = | 0.96 | |
| Orifice Coefficient | $C_o$ = | 0.64 | |
| Weir Coefficient | $C_w$ = | 2.05 | |

| | | MINOR | MAJOR | |
|---|---|---|---|---|
| Water Depth at Inlet (for depressed inlets, 1 foot is added for depression) | d = | 0.34 | 0.59 | |
| Total Inlet Interception Capacity (assumes clogged condition) | **$Q_a$ =** | **3.6** | **8.4** | **cfs** |
| Bypassed Flow | **$Q_b$ =** | **0.0** | **0.0** | **cfs** |
| Capture Percentage = Qa/Qo | **C% =** | **100** | **100** | **%** |

# AREA INLET IN A SWALE

**I-A3**




This worksheet uses the NRCS vegetal retardance method to determine Manning's n for grass-lined channels.

An override Manning's n can be entered for other channel materials.

Analysis of Trapezoidal Channel (Grass-Lined uses SCS Method)

| | | | |
|---|---|---|---|
| NRCS Vegetal Retardance (A, B, C, D, or E) | A, B, C, D, or E = | A | |
| Manning's n (Leave cell D16 blank to manually enter an n value) | n = | see details below | |
| Channel Invert Slope | $S_O$ = | 0.0100 | ft/ft |
| Bottom Width | B = | 0.00 | ft |
| Left Side Slope | Z1 = | 4.00 | ft/ft |
| Right Side Sloe | Z2 = | 4.00 | ft/ft |

Check one of the following soil types:

| Soil Type: | Max. Velocity ($V_{MAX}$) | Max Froude No. ($F_{MAX}$) |
|---|---|---|
| Non-Cohesive | 5.0 fps | 0.60 |
| Cohesive | 7.0 fps | 0.80 |
| Paved | N/A | N/A |

Choose One:
- Non-Cohesive
- Cohesive
- Paved

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Maximum Allowable Top Width of Channel for Minor & Major Storm | $T_{MAX}$ = | **16.00** | **16.00** | **ft** |
| Maximum Allowable Water Depth in Channel for Minor & Major Storm | $d_{MAX}$ = | **2.25** | **2.25** | **ft** |

Allowable Channel Capacity Based On Channel Geometry

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is based on Top Width Criterion | $Q_{allow}$ = | **6.3** | **6.3** | **cfs** |
| MAJOR STORM Allowable Capacity is based on Top Width Criterion | $d_{allow}$ = | **2.00** | **2.00** | **ft** |

Water Depth in Channel Based On Design Peak Flow

| | | | | |
|---|---|---|---|---|
| Design Peak Flow | $Q_o$ = | **0.3** | **1.7** | **cfs** |
| Water Depth | d = | **0.56** | **1.15** | **ft** |

**Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'**
**Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'**

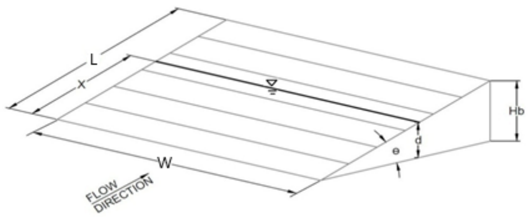
*MHFD-Inlet, Version 5.03 (August 2023)*

# AREA INLET IN A SWALE

**I-A3**

Inlet Design Information (Input)

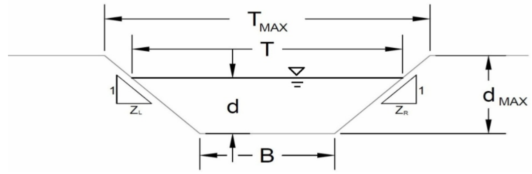
| | | | | | |
|---|---|---|---|---|---|
| Type of Inlet | CDOT Type C | Inlet Type = | CDOT Type C | | |
| Angle of Inclined Grate (must be <= 30 degrees) | | θ = | | 0.00 | degrees |
| Width of Grate | | W = | | 3.00 | ft |
| Length of Grate | | L = | | 3.00 | ft |
| Open Area Ratio | | $A_{RATIO}$ = | | 0.70 | |
| Height of Inclined Grate | | $H_B$ = | | 0.00 | ft |
| Clogging Factor | | $C_f$ = | | 0.50 | |
| Grate Discharge Coefficient | | $C_d$ = | | 0.96 | |
| Orifice Coefficient | | $C_o$ = | | 0.64 | |
| Weir Coefficient | | $C_w$ = | | 2.05 | |




| | | MINOR | MAJOR | |
|---|---|---|---|---|
| Water Depth at Inlet (for depressed inlets, 1 foot is added for depression) | d = | 0.56 | 1.15 | |
| Total Inlet Interception Capacity (assumes clogged condition) | **$Q_a$ =** | **7.7** | **17.3** | **cfs** |
| Bypassed Flow | **$Q_b$ =** | **0.0** | **0.0** | **cfs** |
| Capture Percentage = Qa/Qo | **C% =** | **100** | **100** | **%** |

# AREA INLET IN A SWALE

**I-A4**




This worksheet uses the NRCS vegetal retardance method to determine Manning's n for grass-lined channels.

An override Manning's n can be entered for other channel materials.

## Analysis of Trapezoidal Channel (Grass-Lined uses SCS Method)

| | | | |
|---|---|---|---|
| NRCS Vegetal Retardance (A, B, C, D, or E) | A, B, C, D, or E = | A | |
| Manning's n (Leave cell D16 blank to manually enter an n value) | n = | see details below | |
| Channel Invert Slope | $S_O$ = | 0.0150 | ft/ft |
| Bottom Width | B = | 0.00 | ft |
| Left Side Slope | Z1 = | 4.00 | ft/ft |
| Right Side Sloe | Z2 = | 4.00 | ft/ft |

Check one of the following soil types:

| Soil Type: | Max. Velocity ($V_{MAX}$) | Max Froude No. ($F_{MAX}$) |
|---|---|---|
| Non-Cohesive | 5.0 fps | 0.60 |
| Cohesive | 7.0 fps | 0.80 |
| Paved | N/A | N/A |

Choose One:
- ☐ **Non-Cohesive**
- ☐ **Cohesive**
- ☐ **Paved**

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Maximum Allowable Top Width of Channel for Minor & Major Storm | $T_{MAX}$ = | **18.00** | **18.00** | **ft** |
| Maximum Allowable Water Depth in Channel for Minor & Major Storm | $d_{MAX}$ = | **2.00** | **2.00** | **ft** |

## Allowable Channel Capacity Based On Channel Geometry

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is based on Depth Criterion | $Q_{allow}$ = | **7.8** | **7.8** | **cfs** |
| MAJOR STORM Allowable Capacity is based on Depth Criterion | $d_{allow}$ = | **2.00** | **2.00** | **ft** |

## Water Depth in Channel Based On Design Peak Flow

| | | | | |
|---|---|---|---|---|
| Design Peak Flow | $Q_o$ = | **2.3** | **5.3** | **cfs** |
| Water Depth | d = | **1.22** | **1.73** | **ft** |

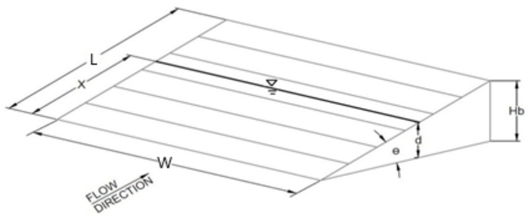
**Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'**
**Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'**

# AREA INLET IN A SWALE

**I-A4**

Inlet Design Information (Input)

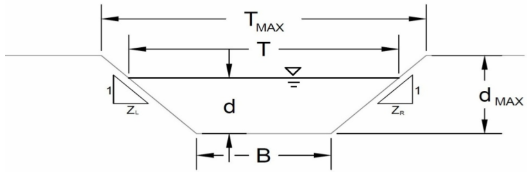
| | | | | | |
|---|---|---|---|---|---|
| Type of Inlet | CDOT Type D (In Series) | Inlet Type = | CDOT Type D (In Series) | | |
| Angle of Inclined Grate (must be <= 30 degrees) | | θ = | 0.00 | | degrees |
| Width of Grate | | W = | 3.00 | | ft |
| Length of Grate | | L = | 6.00 | | ft |
| Open Area Ratio | | $A_{RATIO}$ = | 0.70 | | |
| Height of Inclined Grate | | $H_B$ = | 0.00 | | ft |
| Clogging Factor | | $C_f$ = | 0.38 | | |
| Grate Discharge Coefficient | | $C_d$ = | 0.78 | | |
| Orifice Coefficient | | $C_o$ = | 0.52 | | |
| Weir Coefficient | | $C_w$ = | 1.67 | | |




| | | MINOR | MAJOR | |
|---|---|---|---|---|
| Water Depth at Inlet (for depressed inlets, 1 foot is added for depression) | d = | 1.22 | 1.73 | |
| Total Inlet Interception Capacity (assumes clogged condition) | **$Q_a$ =** | **36.3** | **43.3** | **cfs** |
| Bypassed Flow | **$Q_b$ =** | **0.0** | **0.0** | **cfs** |
| Capture Percentage = Qa/Qo | **C% =** | **100** | **100** | **%** |

# AREA INLET IN A SWALE

**I-A5**




This worksheet uses the NRCS vegetal retardance method to determine Manning's n for grass-lined channels.

An override Manning's n can be entered for other channel materials.

Analysis of Trapezoidal Channel (Grass-Lined uses SCS Method)

| | | | |
|---|---|---|---|
| NRCS Vegetal Retardance (A, B, C, D, or E) | A, B, C, D, or E = | A | |
| Manning's n (Leave cell D16 blank to manually enter an n value) | n = | see details below | |
| Channel Invert Slope | $S_O$ = | 0.0150 | ft/ft |
| Bottom Width | B = | 0.00 | ft |
| Left Side Slope | Z1 = | 4.00 | ft/ft |
| Right Side Sloe | Z2 = | 5.00 | ft/ft |

Check one of the following soil types:

| Soil Type: | Max. Velocity ($V_{MAX}$) | Max Froude No. ($F_{MAX}$) |
|---|---|---|
| Non-Cohesive | 5.0 fps | 0.60 |
| Cohesive | 7.0 fps | 0.80 |
| Paved | N/A | N/A |

Choose One:
- (•) Non-Cohesive
- ( ) Cohesive
- ( ) Paved

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Maximum Allowable Top Width of Channel for Minor & Major Storm | $T_{MAX}$ = | 5.30 | 9.00 | ft |
| Maximum Allowable Water Depth in Channel for Minor & Major Storm | $d_{MAX}$ = | 1.00 | 1.00 | ft |

Allowable Channel Capacity Based On Channel Geometry

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is based on Top Width Criterion | $Q_{allow}$ = | 0.5 | 1.6 | cfs |
| MAJOR STORM Allowable Capacity is based on Depth Criterion | $d_{allow}$ = | 0.59 | 1.00 | ft |

Water Depth in Channel Based On Design Peak Flow

| | | | | |
|---|---|---|---|---|
| Design Peak Flow | $Q_o$ = | 0.1 | 0.9 | cfs |
| Water Depth | d = | 0.36 | 0.78 | ft |

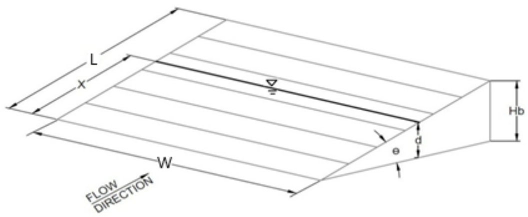
**Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'**
**Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'**

# AREA INLET IN A SWALE

**I-A5**

Inlet Design Information (Input)

| | | | |
|---|---|---|---|
| Type of Inlet | CDOT Type C | Inlet Type = | CDOT Type C |



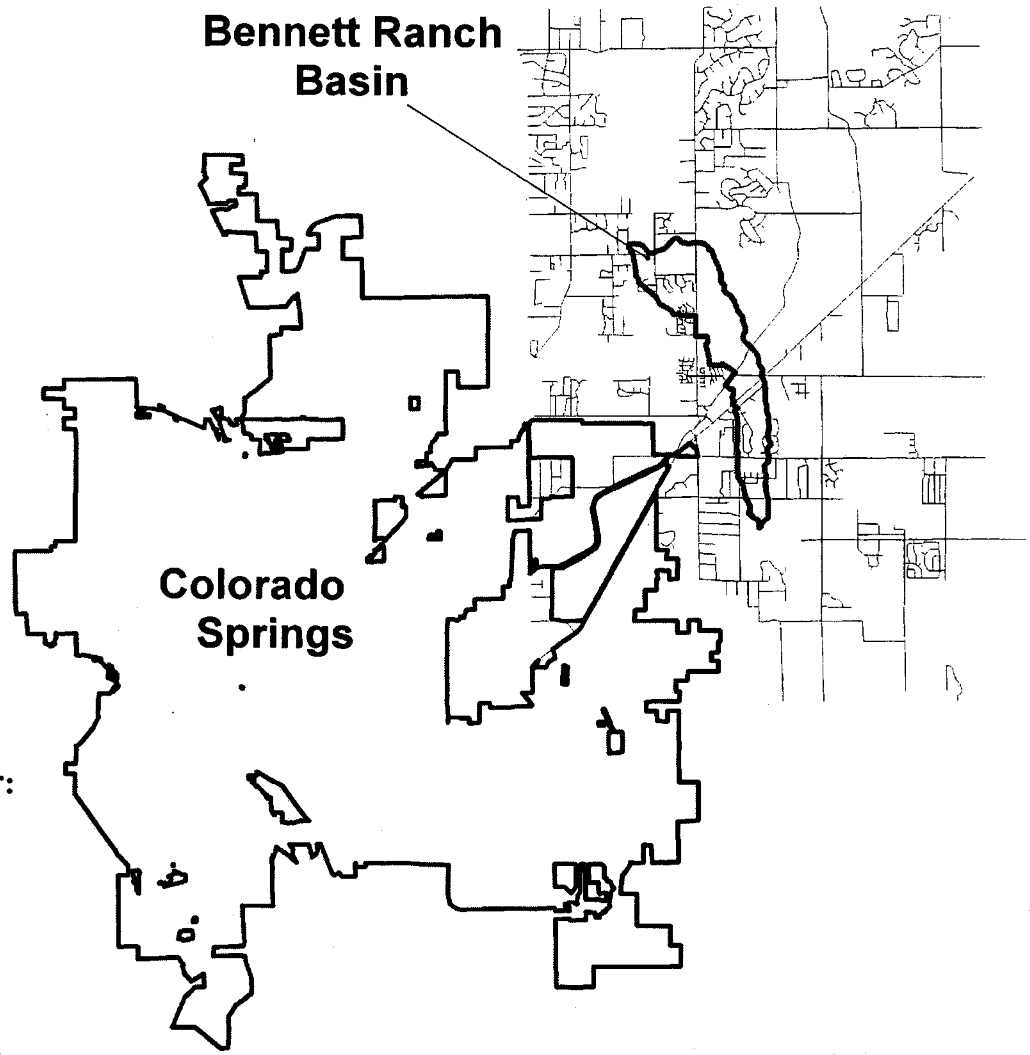

| | | | |
|---|---|---|---|
| Angle of Inclined Grate (must be <= 30 degrees) | θ = | 0.00 | degrees |
| Width of Grate | W = | 3.00 | ft |
| Length of Grate | L = | 3.00 | ft |
| Open Area Ratio | $A_{RATIO}$ = | 0.70 | |
| Height of Inclined Grate | $H_B$ = | 0.00 | ft |
| Clogging Factor | $C_f$ = | 0.50 | |
| Grate Discharge Coefficient | $C_d$ = | 0.96 | |
| Orifice Coefficient | $C_o$ = | 0.64 | |
| Weir Coefficient | $C_w$ = | 2.05 | |

| | | MINOR | MAJOR | |
|---|---|---|---|---|
| Water Depth at Inlet (for depressed inlets, 1 foot is added for depression) | d = | 0.36 | 0.78 | |
| Total Inlet Interception Capacity (assumes clogged condition) | **$Q_a$ =** | **4.0** | **12.6** | **cfs** |
| Bypassed Flow | **$Q_b$ =** | **0.0** | **0.0** | **cfs** |
| Capture Percentage = Qa/Qo | **C% =** | **100** | **100** | **%** |

## *APPENDIX F – BENNETT RANCH DBPS*

# Bennett Ranch Pilot Project
# Drainage Basin Planning Study

**November, 2001**




**Prepared For:**

**3460 Marksheffel Road**
**Colorado Springs, CO 80922**

**Prepared By:**

**STORMWATER**
**& ENVIRONMENTAL CONSULTANTS, INC.**
A DIVISION OF OLSSON ASSOCIATES

5200 DTC Parkway, Suite 530 • Greenwood Village, Colorado 80111 • (303) 694-3800 • FAX (303) 267-0705
LINCOLN, NE • OMAHA, NE • GRAND ISLAND, NE • HOLDREGE, NE • PHOENIX, AZ • KANSAS CITY, MO

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# Table of Figures and Photographs

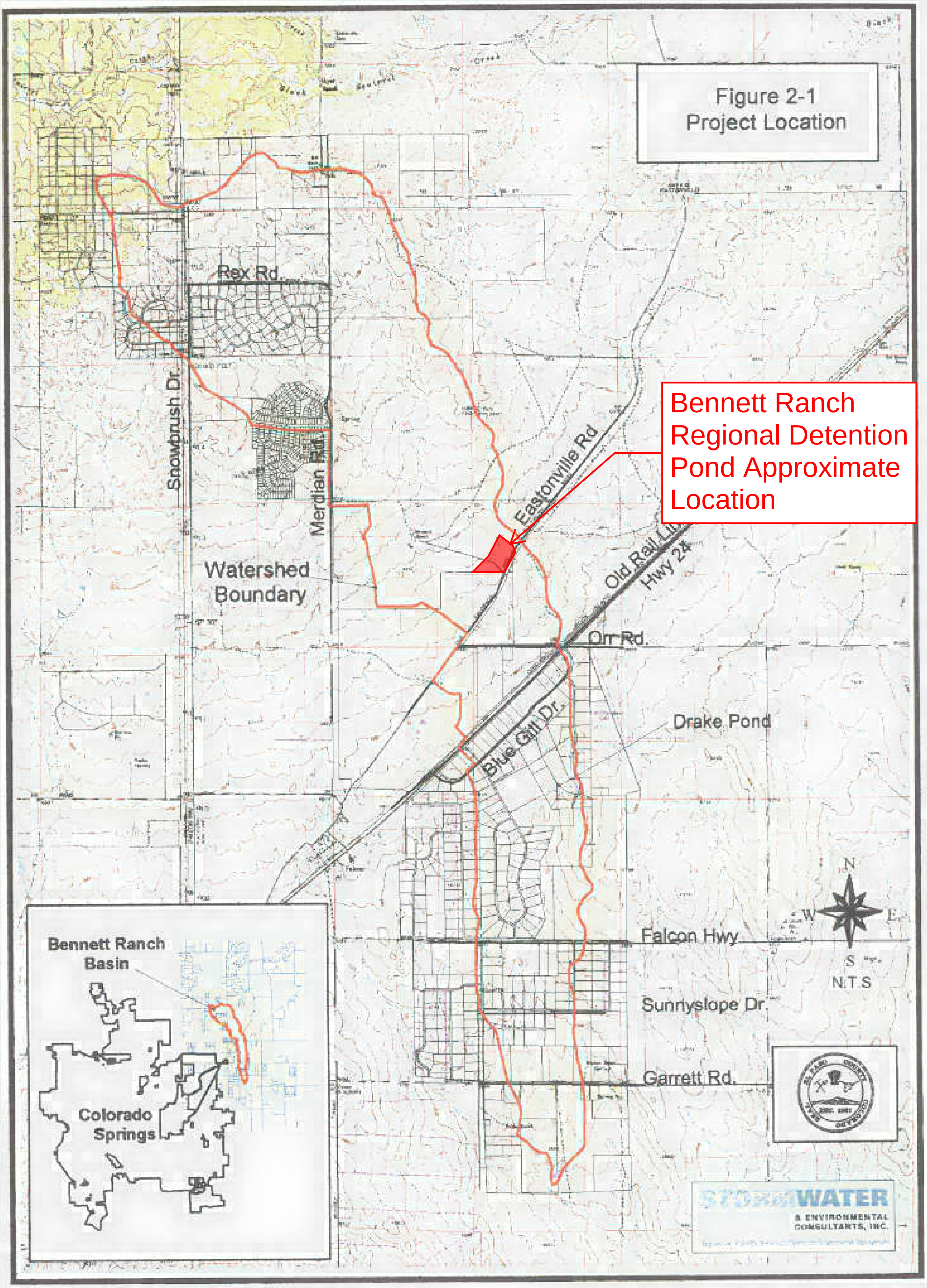


Figure 2-1
Project Location
Bennett Ranch Regional Detention Pond Approximate Location
Rex Rd.
Snowbrush Dr.
Merdian Rd.
Watershed Boundary
Eastonville Rd
Old Rail Line
Hwy 24
Orr Rd.
Blue Gill Dr.
Drake Pond
Falcon Hwy
Sunnyslope Dr.
Garrett Rd.
N
S
W
E
N.T.S
Bennett Ranch Basin
Colorado Springs
STORMWATER
& ENVIRONMENTAL CONSULTANTS, INC.

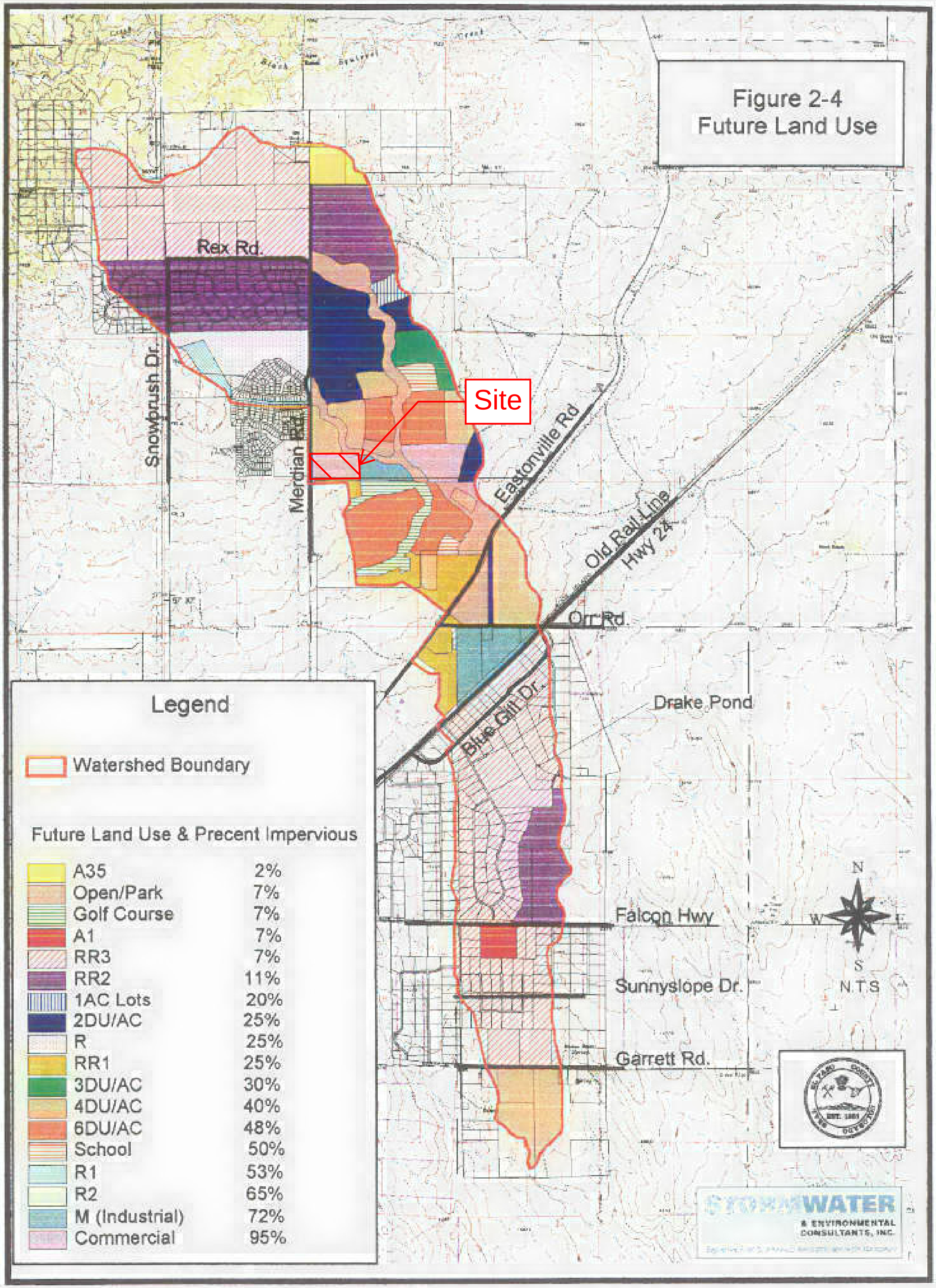
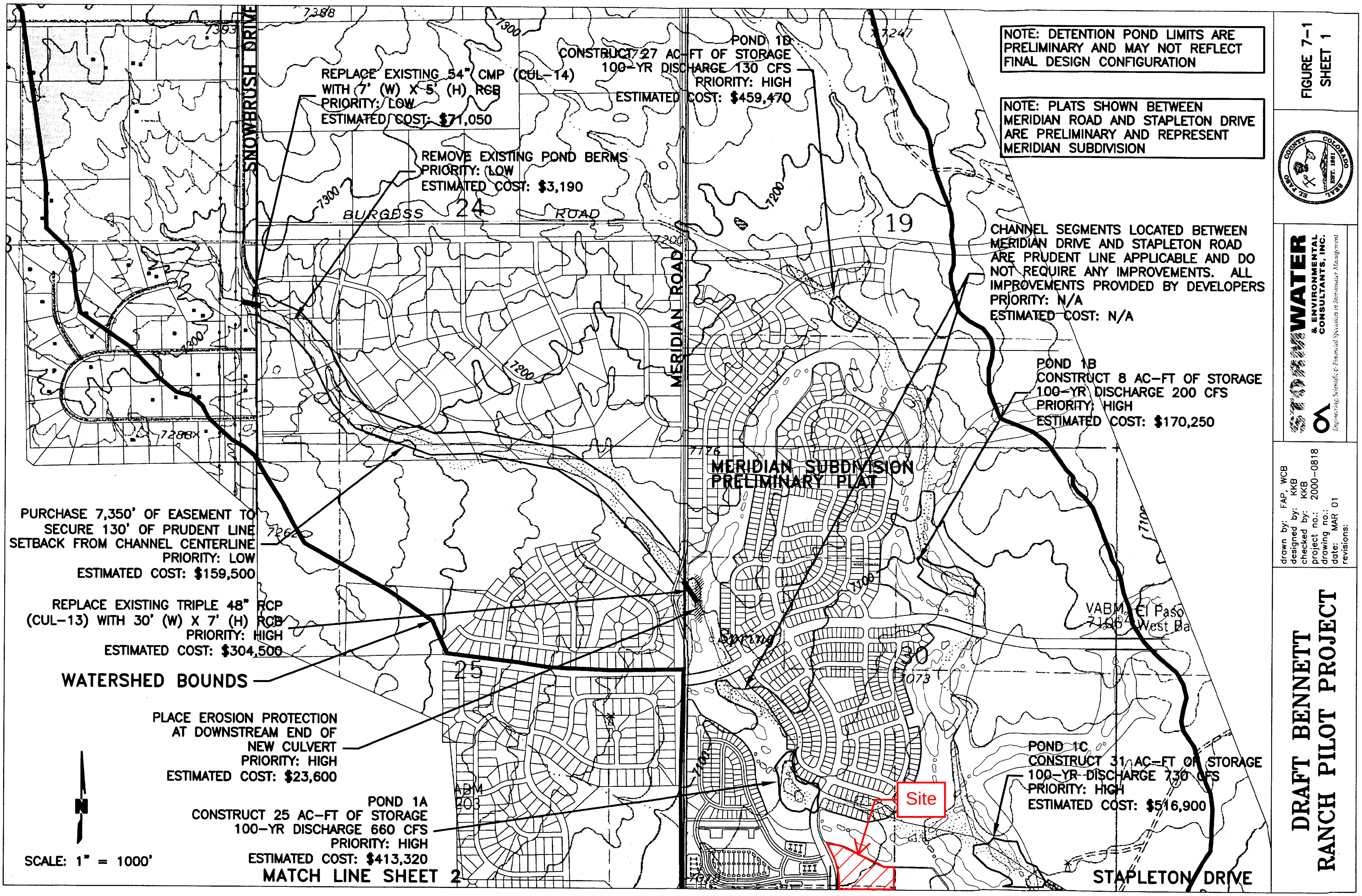
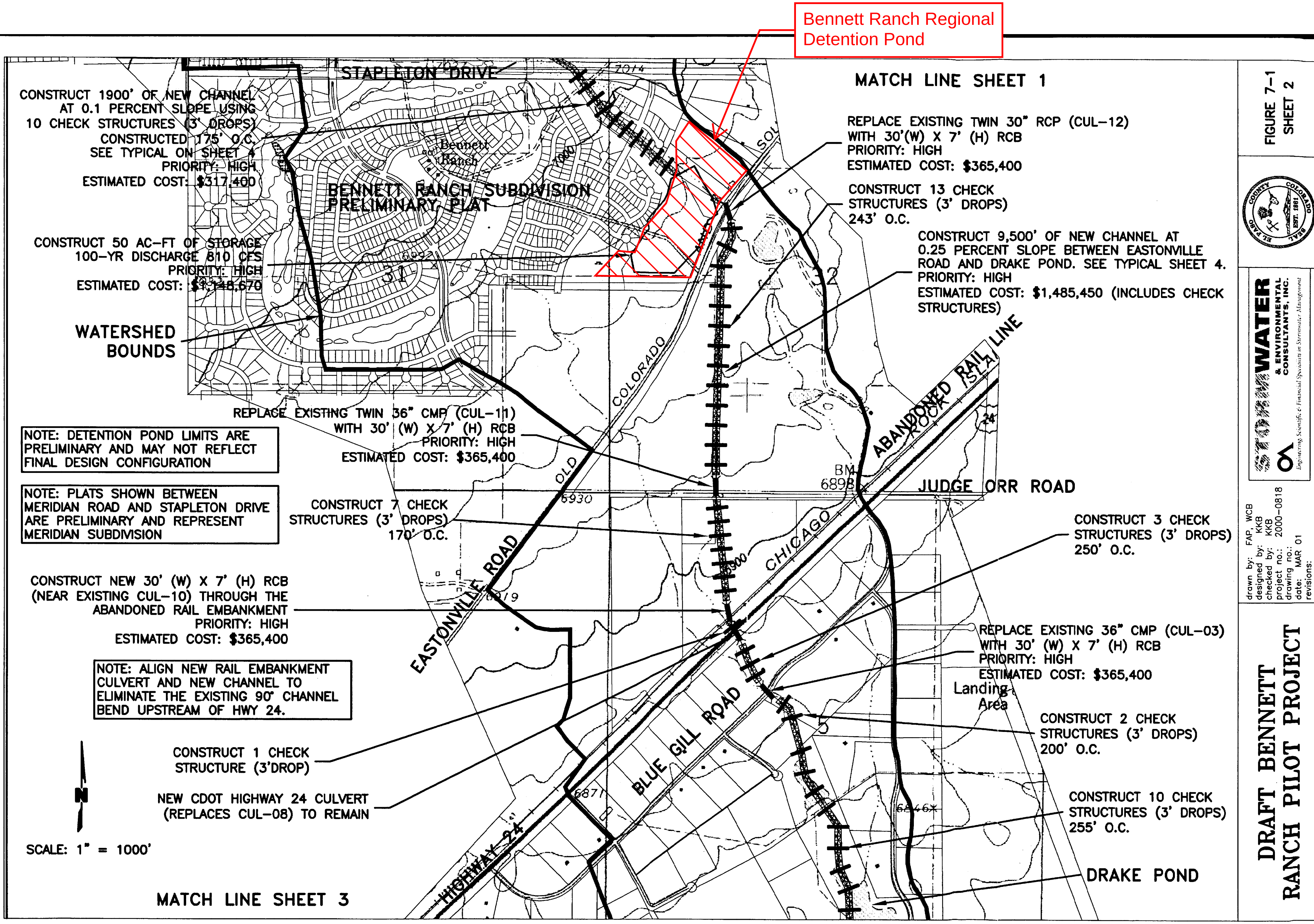



Figure 2-4
Future Land Use

## Table 7-2 – Existing and Added Future Developed Impervious Area

| Area (acres) | Landuse | Percent Impervious | Impervious Area (acres) |
|---|---|---|---|
| **Existing Impervious Area in Bennett Ranch Basin** | | | |
| 102 | RR3 | 7% | 7 |
| 87 | RR3 | 7% | 6 |
| 402 | RR2 | 11% | 44 |
| 217 | R | 25% | 54 |
| 29 | R1 | 53% | 15 |
| 7 | RR3 | 7% | 1 |
| 3 | R | 25% | 1 |
| 1 | RR3 | 7% | 0 |
| 52 | RR1 | 25% | 13 |
| 880 | RR3 | 7% | 62 |
| 5 | R2 | 65% | 3 |
| 145 | RR2 | 11% | 16 |
| 3 | RR3 | 7% | 0 |
| 39 | A1 | 7% | 3 |
| **Sum = 1973** | | | **Sum = 225** |
| **Impervious Area to be Added in Bennett Ranch Basin by Future Development** | | | |
| 492 | RR3 | 7% | 34 |
| 52 | A35 | 2% | 1 |
| 181 | RR2 | 11% | 20 |
| 21 | 1AC Lots | 20% | 4 |
| 210 | 2DU/AC | 25% | 52 |
| 22 | 2DU/AC | 25% | 6 |
| 57 | 3DU/AC | 30% | 17 |
| 25 | SCHOOL | 50% | 13 |
| 26 | 4DU/AC | 40% | 11 |
| 35 | 4DU/AC | 40% | 14 |
| 36 | 6DU/AC | 48% | 17 |
| 35 | 4DU/AC | 40% | 14 |
| 3 | SCHOOL | 50% | 2 |
| 30 | 4DU/AC | 40% | 12 |
| 24 | 2DU/AC | 25% | 6 |
| 12 | Open/Park | 7% | 1 |
| 38 | Commercial | 95% | 36 |
| 10 | RR1 | 25% | 2 |
| 10 | 4DU/AC | 40% | 4 |
| 10 | SCHOOL | 50% | 5 |
| 51 | Open/Park | 7% | 4 |
| 85 | RR1 | 25% | 21 |
| 16 | 4DU/AC | 40% | 6 |
| 13 | RR1 | 25% | 3 |
| 2 | RR3 | 7% | 0 |
| 2 | RR1 | 25% | 0 |
| 151 | 4DU/AC | 40% | 60 |
| 138 | Open/Park | 7% | 10 |
| 66 | 6DU/AC | 48% | 32 |
| 56 | Commercial | 95% | 53 |
| 28 | M | 72% | 20 |


NOTE: DETENTION POND LIMITS ARE PRELIMINARY AND MAY NOT REFLECT FINAL DESIGN CONFIGURATION
NOTE: PLATS SHOWN BETWEEN MERIDIAN ROAD AND STAPLETON DRIVE ARE PRELIMINARY AND REPRESENT MERIDIAN SUBDIVISION
FIGURE 7-1 SHEET 1
REPLACE EXISTING 54" CMP (CUL-14) WITH 7' (W) X 5' (H) RCB PRIORITY: LOW ESTIMATED COST: $71,050
POND 1D CONSTRUCT 27 AC-FT OF STORAGE 100-YR DISCHARGE 130 CFS PRIORITY: HIGH ESTIMATED COST: $459,470
REMOVE EXISTING POND BERMS PRIORITY: LOW ESTIMATED COST: $3,190
SNOWBRUSH DRIVE
BURGESS ROAD
MERIDIAN ROAD
CHANNEL SEGMENTS LOCATED BETWEEN MERIDIAN DRIVE AND STAPLETON ROAD ARE PRUDENT LINE APPLICABLE AND DO NOT REQUIRE ANY IMPROVEMENTS. ALL IMPROVEMENTS PROVIDED BY DEVELOPERS PRIORITY: N/A ESTIMATED COST: N/A
POND 1B CONSTRUCT 8 AC-FT OF STORAGE 100-YR DISCHARGE 200 CFS PRIORITY: HIGH ESTIMATED COST: $170,250
MERIDIAN SUBDIVISION PRELIMINARY PLAT
PURCHASE 7,350' OF EASEMENT TO SECURE 130' OF PRUDENT LINE SETBACK FROM CHANNEL CENTERLINE PRIORITY: LOW ESTIMATED COST: $159,500
REPLACE EXISTING TRIPLE 48" RCP (CUL-13) WITH 30' (W) X 7' (H) RCB PRIORITY: HIGH ESTIMATED COST: $304,500
WATERSHED BOUNDS
PLACE EROSION PROTECTION AT DOWNSTREAM END OF NEW CULVERT PRIORITY: HIGH ESTIMATED COST: $23,600
POND 1A CONSTRUCT 25 AC-FT OF STORAGE 100-YR DISCHARGE 660 CFS PRIORITY: HIGH ESTIMATED COST: $413,320
POND 1C CONSTRUCT 31 AC-FT OF STORAGE 100-YR DISCHARGE 730 CFS PRIORITY: HIGH ESTIMATED COST: $516,900
Site
STAPLETON DRIVE
MATCH LINE SHEET 2
SCALE: 1" = 1000'
N
VABM El Paso West Ba
STORMWATER & ENVIRONMENTAL CONSULTANTS, INC.
drawn by: FAP, WCB
designed by: KKB
checked by: KKB
project no.: 2000-0818
drawing no.:
date: MAR 01
revisions:
DRAFT BENNETT RANCH PILOT PROJECT



Bennett Ranch Regional Detention Pond
MATCH LINE SHEET 1
STAPLETON DRIVE
CONSTRUCT 1900' OF NEW CHANNEL AT 0.1 PERCENT SLOPE USING 10 CHECK STRUCTURES (3' DROPS) CONSTRUCTED 175' O.C. SEE TYPICAL ON SHEET 4 PRIORITY: HIGH ESTIMATED COST: $317,400
BENNETT RANCH SUBDIVISION PRELIMINARY PLAT
Bennett Ranch
CONSTRUCT 50 AC-FT OF STORAGE 100-YR DISCHARGE 810 CFS PRIORITY: HIGH ESTIMATED COST: $1,148,670
WATERSHED BOUNDS
REPLACE EXISTING TWIN 30" RCP (CUL-12) WITH 30'(W) X 7' (H) RCB PRIORITY: HIGH ESTIMATED COST: $365,400
CONSTRUCT 13 CHECK STRUCTURES (3' DROPS) 243' O.C.
CONSTRUCT 9,500' OF NEW CHANNEL AT 0.25 PERCENT SLOPE BETWEEN EASTONVILLE ROAD AND DRAKE POND. SEE TYPICAL SHEET 4. PRIORITY: HIGH ESTIMATED COST: $1,485,450 (INCLUDES CHECK STRUCTURES)
OLD COLORADO
ABANDONED RAIL LINE
ROCK ISLAND
REPLACE EXISTING TWIN 36" CMP (CUL-11) WITH 30' (W) X 7' (H) RCB PRIORITY: HIGH ESTIMATED COST: $365,400
NOTE: DETENTION POND LIMITS ARE PRELIMINARY AND MAY NOT REFLECT FINAL DESIGN CONFIGURATION
NOTE: PLATS SHOWN BETWEEN MERIDIAN ROAD AND STAPLETON DRIVE ARE PRELIMINARY AND REPRESENT MERIDIAN SUBDIVISION
BM 6898
JUDGE ORR ROAD
CONSTRUCT 7 CHECK STRUCTURES (3' DROPS) 170' O.C.
CONSTRUCT 3 CHECK STRUCTURES (3' DROPS) 250' O.C.
EASTONVILLE ROAD
CHICAGO
CONSTRUCT NEW 30' (W) X 7' (H) RCB (NEAR EXISTING CUL-10) THROUGH THE ABANDONED RAIL EMBANKMENT PRIORITY: HIGH ESTIMATED COST: $365,400
NOTE: ALIGN NEW RAIL EMBANKMENT CULVERT AND NEW CHANNEL TO ELIMINATE THE EXISTING 90° CHANNEL BEND UPSTREAM OF HWY 24.
REPLACE EXISTING 36" CMP (CUL-03) WITH 30' (W) X 7' (H) RCB PRIORITY: HIGH ESTIMATED COST: $365,400
Landing Area
BLUE GILL ROAD
CONSTRUCT 1 CHECK STRUCTURE (3'DROP)
CONSTRUCT 2 CHECK STRUCTURES (3' DROPS) 200' O.C.
NEW CDOT HIGHWAY 24 CULVERT (REPLACES CUL-08) TO REMAIN
HIGHWAY 24
CONSTRUCT 10 CHECK STRUCTURES (3' DROPS) 255' O.C.
N
SCALE: 1" = 1000'
DRAKE POND
MATCH LINE SHEET 3
FIGURE 7-1 SHEET 2
STORMWATER & ENVIRONMENTAL CONSULTANTS, INC.
drawn by: FAP, WCB
designed by: KKB
checked by: KKB
project no.: 2000-0818
drawing no.:
date: MAR 01
revisions:
DRAFT BENNETT RANCH PILOT PROJECT

## *APPENDIX G – DRAINAGE MAPS*

# WHMD RWRF STORMWATER IMPROVEMENTS

## EXISTING DRAINAGE MAP

| EXISTING RATIONAL CALCULATIONS SUMMARY | | | | |
|---|---|---|---|---|
| DESIGN POINT | TRIBUTARY BASINS | TRIBUTARY AREA (AC) | PEAK FLOWS (CFS) | |
| | | | Q5 | Q100 |
| EX-1 | EX-1 | 0.03 | 0.01 | 0.09 |
| EX-2 | EX-2 | 0.23 | 0.09 | 0.69 |
| EX-3 | EX-3 | 0.03 | 0.01 | 0.08 |
| EX-4 | EX-4 | 0.74 | 0.19 | 1.39 |
| EX-5 | EX-5 | 0.84 | 0.35 | 1.95 |
| EX-6 | EX-6 | 1.23 | 1.26 | 3.98 |
| EX-7 | EX-7 | 0.61 | 0.73 | 2.06 |
| EX-8 | EX-8 | 0.35 | 1.34 | 2.49 |
| EX-9 | EX-9 | 0.54 | 2.50 | 4.48 |
| EX-10 | EX-10 | 1.37 | 1.63 | 4.38 |
| EX-11 | EX-11 | 0.16 | 0.76 | 1.37 |
| EX-12 | EX-12 | 0.45 | 0.22 | 1.01 |
| EX-13 | EX-13 | 0.07 | 0.03 | 0.21 |
| EX-14 | EX-14 | 0.77 | 0.51 | 1.76 |
| EX-15 | EX-15 | 2.28 | 2.83 | 7.02 |
| EX-16 | EX-16 | 1.43 | 3.62 | 7.20 |
| EX-17 | EX-17 | 1.74 | 0.75 | 3.42 |
| EX-18 | EX-18 | 0.44 | 0.32 | 1.20 |
| EX-19 | EX-19 | 0.62 | 0.30 | 1.44 |
| OF-1 | OF-1 | 0.27 | 0.11 | 0.78 |
| OF-2 | OF-2 | 0.05 | 0.02 | 0.16 |
| OF-3 | OF-3 | 0.54 | 0.13 | 0.98 |
| OF-4 | OF-4 | 0.11 | 0.04 | 0.29 |
| OF-5 | OF-5 | 0.06 | 0.02 | 0.13 |
| OF-6 | OF-6 | 0.12 | 0.03 | 0.19 |

LEGEND

A = BASIN DESIGNATION
B = AREA (ACRES)
C = IMPERVIOUSNESS
D = 100-YR DESIGN STORM RUNOFF (CFS)

# = DESIGN POINT

EXISTING FLOW DIRECTION

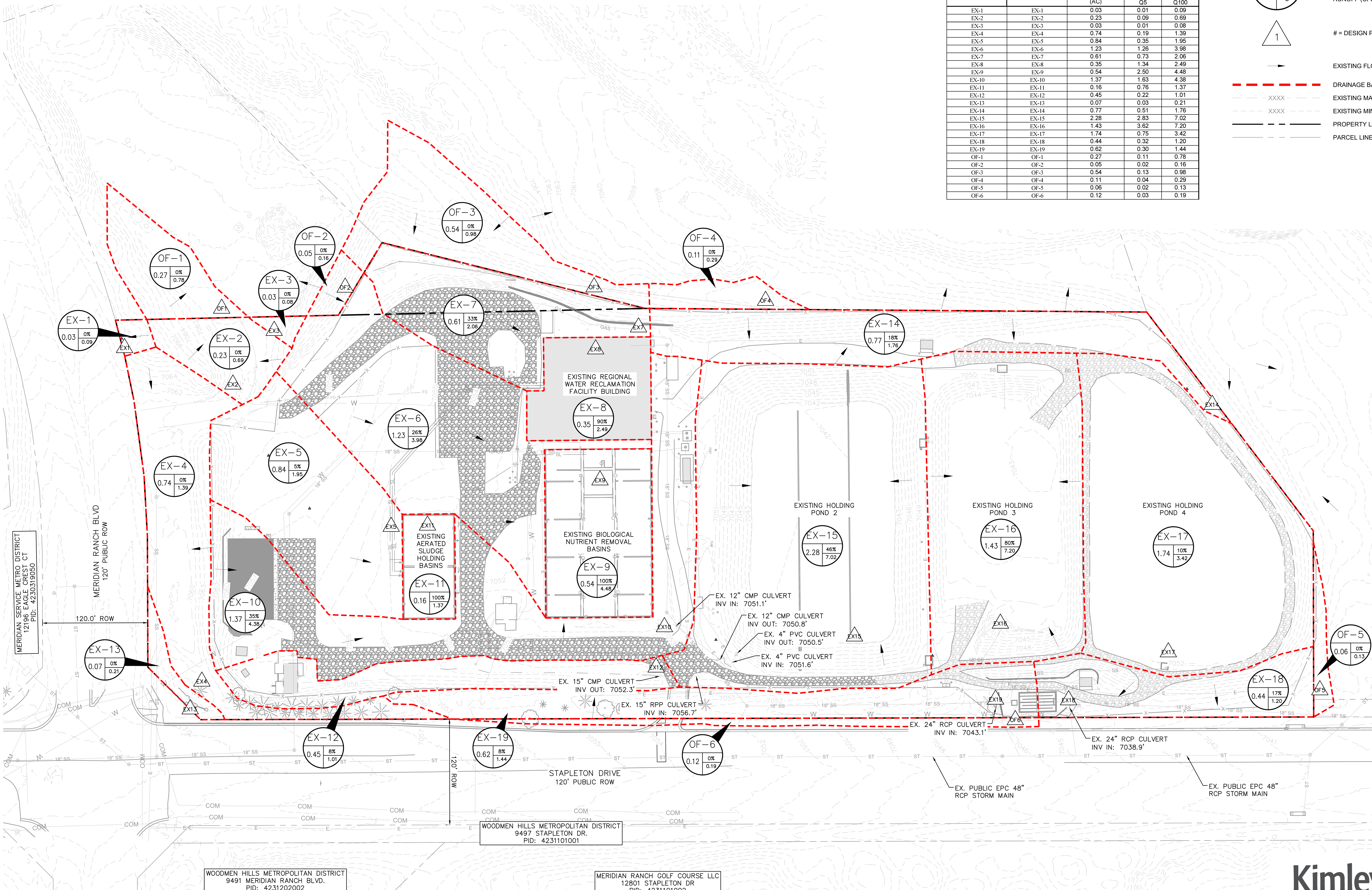
DRAINAGE BASIN BOUNDARY

XXXX EXISTING MAJOR CONTOUR

XXXX EXISTING MINOR CONTOUR

PROPERTY LINE

PARCEL LINE




NORTH

GRAPHIC SCALE IN FEET

Kimley»Horn


2 NORTH NEVADA AVENUE, SUITE 900
COLORADO SPRINGS, COLORADO 80903 (719) 453-0180

# WHMD RWRF STORMWATER IMPROVEMENTS

## PROPOSED DRAINAGE MAP

| PROPOSED RATIONAL CALCULATIONS SUMMARY | | | | |
|---|---|---|---|---|
| DESIGN POINT | TRIBUTARY BASINS | TRIBUTARY AREA (AC) | PEAK FLOWS (CFS) | |
| | | | Q5 | Q100 |
| P-1 | P-1 | 0.88 | 2.86 | 5.79 |
| P-2 | P-2 | 0.13 | 0.04 | 0.28 |
| P-3 | P-3 | 0.36 | 0.12 | 0.90 |
| P-4 | P-4 | 1.08 | 2.32 | 5.33 |
| P-5 | P-5 | 0.78 | 0.28 | 1.71 |
| P-6 | P-6 | 0.15 | 0.09 | 0.40 |
| P-7 | P-7 | 0.53 | 0.84 | 2.22 |
| P-8 | P-8 | 0.04 | 0.04 | 0.14 |
| OS-1 | OS-1 | 0.08 | 0.06 | 0.26 |
| OS-2 | OS-2 | 0.35 | 1.29 | 2.40 |
| OS-3 | OS-3 | 0.77 | 0.40 | 1.59 |
| OS-4 | OS-4 | 2.28 | 2.61 | 6.45 |
| OS-5 | OS-5 | 1.43 | 3.81 | 7.58 |
| OS-6 | OS-6 | 1.74 | 0.70 | 3.17 |
| OS-7 | OS-7 | 0.44 | 0.43 | 1.59 |
| OS-8 | OS-8 | 0.62 | 0.26 | 1.26 |
| OS-9 | OS-9 | 0.45 | 0.22 | 1.04 |
| OS-10 | OS-10 | 0.74 | 0.19 | 1.40 |
| OS-11 | OS-11 | 0.07 | 0.03 | 0.21 |
| OS-12 | OS-12 | 0.03 | 0.01 | 0.09 |
| OS-13 | OS-13 | 0.25 | 0.09 | 0.65 |
| OS-14 | OS-14 | 0.16 | 0.76 | 1.37 |
| OS-15 | OS-15 | 0.57 | 2.64 | 4.73 |
| OF-1 | OF-1 | 0.06 | 0.02 | 0.14 |
| OF-2 | OF-2 | 0.12 | 0.03 | 0.19 |
| OF-3 | OF-3 | 0.27 | 0.08 | 0.61 |
| OF-4 | OF-4 | 0.12 | 0.05 | 0.37 |
| OF-5 | OF-5 | 0.47 | 0.14 | 1.04 |
| OF-6 | OF-6 | 0.11 | 0.04 | 0.29 |

### LEGEND

A = BASIN DESIGNATION
B = AREA (ACRES)
C = IMPERVIOUSNESS
D = 100-YR DESIGN STORM RUNOFF (CFS)

# = DESIGN POINT

EXISTING FLOW DIRECTION
PROPOSED FLOW DIRECTION
DRAINAGE BASIN BOUNDARY
PROPOSED LIMITS OF DISTURBANCE
XXXX EXISTING MAJOR CONTOUR
XXXX EXISTING MINOR CONTOUR
6540 PROPOSED MAJOR CONTOUR
6540 PROPOSED MINOR CONTOUR
PROPERTY LINE
PARCEL LINE
UTILITY TRENCHING AREA