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Bradley Heights Filing 5
Final Drainage Report

STM-REV22-0522

October 2022

HR Green Project No: 211450

Prepared For:

Challenger Homes

Contact: Erin Ganaway

8605 Explorer Drive, Suite 220

Colorado Springs, CO 80920

Prepared By:

HR Green Development, LLC

Contact: Ken Huhn, PE

khuhn@hrgreen.com

(720) 602-4965

Engineer's Statement

This report and plan for the drainage design of the development, Bradley Heights Filing 5, was prepared by me (or under my direct supervision) and is correct to the best of my knowledge and belief. Said report and plan has been prepared in accordance with the *City of Colorado Springs Drainage Criteria* Manual and is in conformity with the master plan of the drainage basin. I understand that the City of Colorado Springs does not and will not assume liability for drainage facilities designed by others. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

COLORADO LICENSED KENNETH HUHN 0054022 PROFESSIONAL ENGINEER

Kenneth R Huhn

Ken Huhn, PE 10/20/22 Date

State of Colorado No.

For and on behalf of HR Green Development, LLC

Developer's Statement

Challenger Homes hereby certifies that the drainage facilities for Bradley Heights Filing 5 shall be constructed according to the design presented in this report. I understand that the City of Colorado Springs does not and will not assume liability for the drainage facilities designed and/or certified by my engineer and that are submitted to the City of Colorado Springs pursuant to section 7.7.906 of the City Code: and cannot, on behalf of Bradley Heights Filing 5, guarantee that final drainage design review will absolve Challenger Homes and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the final plat does not imply approval of my engineer's drainage design.

Challenger Communities LLC — 10/24/22

Name of Developer — Authorized Signature — Date

Jim Byers — VP of Community Development — 8605 Explorer Dr. St. 250 Colorado Springs, CO. 80920

Printed Name — Title — Address

City of Colorado Springs Statement

Filed in accordance with 7.7.906 of the Code of the City of Colorado Springs, 2001, as amended.

Heidi M. McMacken — 10/28/22

For City Engineer Heidi McMacken Date

Conditions: Building permits will not be released until assurances for channel improvements have been posted or channel improvements have been installed and accepted.

Table of Contents

Appendices

I. General Purpose, Location and Description

a. Purpose

The purpose of this Final Drainage Report (FDR) for Bradley Heights Filing 5 is to describe the onsite and offsite drainage patterns, existing and proposed storm infrastructure, and to safely route developed stormwater to adequate detention facilities.

b. Location

Bradley Heights Filing 5, referred to as 'the site' herein, is in a portion of the east half of Section 9, Township 15 South, Range 65 West of the 6th P.M., Colorado Springs, El Paso County, Colorado. The site is bound by Bradley Heights Filing 1 & 2 to the north, Bradley Landing to the west and south and Bliss Road to the east. A vicinity map is presented in Appendix A.

c. Description of Property

The site is approximately 28.91 acres of undeveloped land with existing vegetation consisting of native grasses. The approximate disturbed area is 28.91 acres. The site is currently unplatted. The development will plat 155 single family residential lots and open space tracts. Lot sizes vary from 50' x 110', 35' x 87'and 35' x 105'. In general, the site slopes westerly towards Bliss Road. Onsite elevations range from 5865' – 5840' with slopes ranging 1 – 10%. Per a NRCS soil survey, the site is made up of Hydrologic Soil Group D Razor-Midway Complex. The NRCS soil survey is presented in Appendix A.

There are no major drainageways or irrigation facilities that traverse the site nor does the site fall within the Streamside Overlay Zone. Onsite, existing utilities include a 12" water line. An existing drainage map is presented in Appendix F.

d. Floodplain Statement

Based on FEMA Firm map 08041C0768G dated December 8, 2018, the site is Zone X, which are areas determined to be outside the 0.2% annual chance flood.

II. Drainage Basins and Subbasins

a. Major Basin Description

The site is located within the Jimmy Camp Creek Drainage Basin. The site's drainage characteristics were previously studied in the following reports:

1. "Jimmy Camp Creek Drainage Basin Planning Study" prepared by Kiowa Engineering Corporation, March 9, 2015.
2. "Master Development Drainage Plan for Bradley Heights" prepared by Classic Consulting Engineers and Surveyors, approved by the City of Colorado Springs February 12, 2015.
3. "Master Development Drainage Report Amendment for Bradley Heights & Final Drainage Report for Phase I Bradley Heights Road Improvements" prepared by Matrix Design Group, December 2021, approved by City of Colorado Springs on May 6, 2022. (MDDPA)
4. "Bradley Heights Metro District (Phase 2) Final Drainage Report" prepared by Matrix Design Group, April 2022, (STM-REV22-0405). Approved 09/28/2022.

5. "Bradley Heights Metro District (Phase 3) Final Drainage Report" prepared by Matrix Design Group, (STM-REV22-1155), currently under review with the City of Colorado Springs.

Jimmy Camp Creek Drainage Basin is a 67.1 square mile watershed located in El Paso County. The basin is generally bound by Powers Boulevard to the west, Blaney Road to the East, Old Pueblo Road to the South and Garrett Road to the north. Jimmy Camp Creek is tributary to Fountain Creek.

The *Master Development Drainage Report Amendment for Bradley Heights & Final Drainage Report for Phase I Bradley Heights Road Improvements* (Bradley Heights MDDPA), the *Bradley Heights Metro District (Phase 2) Final Drainage Report* (Phase 2 FDR), and the *Bradley Heights Metro District (Phase 3) Final Drainage Report* (Phase 3 FDR) established the drainage patterns for the site and surrounding areas. The site's drainage patterns will follow those established therein and the site will utilize offsite detention facilities proposed within those reports. Coordination is ongoing with Bradley Heights Metropolitan District to ensure proposed drainage conditions and improvements of Bradley Heights Filing 5 is in conformance with the aforementioned reports. The MDDPA (STM-REV22-0046) was approved on 05/06/2022.

b. Existing Subbasin Description

The existing site's drainage patterns are relatively uniform. A ridge bisects the site and diverts stormwater west and east. There is no existing storm sewer located on-site. An existing drainage map is presented in Appendix F from the Phase 2 FDR. See below for existing basin descriptions from the Phase 2 FDR:

Basin W-1 is 10.90 acres of undeveloped land. Existing stormwater from this basin (Q_5 = 5.1 cfs Q_{100} = 27.3 cfs) flows southeasterly to Design Point 1. Basin W-1 is a portion of Basin W-1 from the MDDA.

Basin M-2 is 21.31 acres of undeveloped land. Existing stormwater from this basin (Q_5 = 10.7 cfs Q_{100} = 57.5 cfs) flows westerly to Design Point 2. Basin M-2 is a portion of Basin M-2 from the MDDA.

c. Proposed Subbasin Description

The proposed site has been divided into 12 subbasins for analysis. Basin WF5a corresponds to the Phase 2 FDR Basin WF5a. Basins WF5.2 and WF5.3 are subbasins of the Phase 2 FDR Basin WF5b. Basins 1-5 are subbasins of the Phase 2 FDR Basin BHE3. Basins BS3 and BS5 are the onsite portions of the Phase 2 FDR Basin BS3 and BS5. The Phase 2 FDR drainage map as well as the Bradley Heights Filing 5 drainage map are presented in Appendix F. Please note all Type R inlets are public unless otherwise noted. See below for basin descriptions:

Basin WF5a is 4.53 acres of single-family residential area and offsite roadway from the Phase 2 FDR. Stormwater from this basin (Q_5 = 6.4 cfs Q_{100} = 15.3 cfs) sheet flows to Bradley Landing Boulevard and is conveyed in curb and gutter to DPAX. Per the Phase 2 FDR, this area is captured in the 10' Type R on-grade inlets within Bradley Landing Boulevard at DPAX. Per the Phase 2 FDR, Basin WF5a will be detained in offsite WFJCC Pond #1 for water quality and detention. The inlet calculation for DPAX from the Phase 2 FDR is presented in Appendix D.

Basin WF5.2 is 0.76 acres of single-family residential area. Stormwater from this basin (Q_5 = 1.2 cfs Q_{100} = 2.7 cfs) is conveyed in curb and gutter to a 10' Type R on-grade inlet at DP2.Captured stormwater is piped to the BHMD storm sewer system within Bradley Landing Boulevard at DP4.1. Per the Phase 2 FDR, Basin WF5.2 will be detained in offsite WFJCC Pond #1 for water quality and detention.

Basin WF5.3 is 0.90 acres of single-family residential area. Stormwater from this basin (Q_5 = 1.4 cfs Q_{100} = 3.2 cfs) is conveyed in curb and gutter to a 10' Type R on-grade inlet at DP3.Captured stormwater is piped to the BHMD storm sewer system within Bradley Landing Boulevard at DP4.1. Per the Phase 2 FDR, Basin WF5.3 will be detained in offsite WFJCC Pond #1 for water quality and detention.

Basin WF5a, WF5.2, and WF5.3 flows are conveyed to DP4.1, or Phase 2 FDR DP AWb. The Phase 2 FDR flows at DP AWb are (Q_5 = 2.6 cfs Q_{100} = 5.8 cfs). DP4.1 flows are (Q_5 = 2.6 cfs Q_{100} = 5.8 cfs) and is therefore in compliance with the Phase 2 FDR.

Basin 1 is 6.07 acres of single-family residential area. Stormwater from this basin (Q_5 = 10.9 cfs Q_{100} = 24.3 cfs) is conveyed in curb and gutter to a 15' Type R on-grade inlet at DP4. Captured stormwater is piped to the BHMD storm sewer system within Bliss Road at DP11. Per the Phase 3 FDR, Basin 1 will be detained in offsite, full spectrum detention basin MKJCC Pond #5. The pond design details are presented in Appendix D.

Basin 2 is 3.20 acres of single-family residential area. Stormwater from this basin (Q_5 = 5.8 cfs Q_{100} = 12.8 cfs) is conveyed in curb and gutter to a 10' Type R on-grade inlet at DP5. Captured stormwater is piped to the BHMD storm sewer system within Bliss Road at DP11. Per the Phase 3 FDR, Basin 2 will be detained in offsite, full spectrum detention basin MKJCC Pond #5. The pond design details are presented in Appendix D.

Basin 3 is 4.83 acres of single-family residential area. Stormwater from this basin (Q_5 = 9.5 cfs Q_{100} = 21.2 cfs) is conveyed in curb and gutter to a 15' Type R on-grade inlet at DP7. Captured stormwater is piped to the BHMD storm sewer system within Bliss Road at DP11. Per the Phase 3 FDR, Basin 3 will be detained in offsite, full spectrum detention basin MKJCC Pond #5. The pond design details are presented in Appendix D.

Basin 3A is 3.20 acres of single-family residential area. Stormwater from this basin (Q_5 = 6.9 cfs Q_{100} = 15.4 cfs) is conveyed in curb and gutter to a 15' Type R on-grade inlet at DP8. DP8 bypass flows (Q_5 = 0.1 cfs Q_{100} = 6.6 cfs) are conveyed in curb and gutter to a 10' Type R Sump inlet at DPI within Bliss Road. Captured stormwater is piped to the BHMD storm sewer system within Bliss Road at DP11. Per the Phase 3 FDR, Basin 3A will be detained in offsite, full spectrum detention basin MKJCC Pond #5. The pond design details are presented in Appendix D.

Basin 4 is 2.24 acres of single-family residential area. Stormwater from this basin (Q_5 = 4.2 cfs Q_{100} = 9.3 cfs) is conveyed in curb and gutter to a 15' Type R sump inlet at DP9. Captured stormwater is piped to the BHMD storm sewer system within Bliss Road at DP11. Per the Phase 3 FDR, Basin 4 will be detained in offsite, full spectrum detention basin MKJCC Pond #5. The pond design details are presented in Appendix D.

Basin 4A is 0.98 acres of single-family residential area. Stormwater from this basin (Q_5 = 1.9 cfs Q_{100} = 4.1cfs) is conveyed in curb and gutter to a 5' Type R sump inlet at DP9. Captured stormwater is piped to the BHMD storm sewer system within Bliss Road at DP11. Per the Phase 3 FDR, Basin 4A will be detained in offsite, full spectrum detention basin MKJCC Pond #5. The pond design details are presented in Appendix D.

Basin 5 is 1.14 acres of single-family residential area. Stormwater from this basin (Q_5 = 2.1 cfs Q_{100} = 4.8 cfs) is conveyed in curb and gutter to a 5' Type R sump inlet at DP10. Captured stormwater is piped to the BHMD storm sewer system within Bliss Road at DP11. Per the Phase 3 FDR, Basin 5 will be detained in offsite, full spectrum detention basin MKJCC Pond #5. The pond design details are presented in Appendix D.

Basin 1, 2, 3, 3A, 4, 4A, and 5 flows are conveyed to DP11, or Phase 3 FDR DPL. The Phase 2 FDR flows at DPL are (Q_5 = 45.2 cfs Q_{100} = 97.5 cfs). DP11 flows are (Q_5 = 37.5 cfs Q_{100} = 77.5 cfs) to DP11 and is therefore in in compliance with the Phase 2 FDR.

Basin BS3 is 2.69 acres of single-family residential area from the Phase 2 FDR. Stormwater from this basin (Q_5 = 5.2 cfs Q_{100} =12.0 cfs) is conveyed in curb and gutter to a 10' Type R sump inlet at DPI. Captured stormwater is piped to the BHMD storm sewer system within Bliss Road. Per the Phase 3 FDR, Basin BS3 will be detained in offsite, full spectrum detention basin MKJCC Pond #5. The pond design details are presented in Appendix D.

Basin BS5 is 2.67 acres of single-family residential area from the Phase 2 FDR. Stormwater from this basin (Q_5 = 4.9 cfs Q_{100} = 11.9 cfs) is conveyed in curb and gutter to a 10' Type R sump inlet at DPI. Captured stormwater is piped to the BHMD storm sewer system within Bliss Road. Per the Phase 3 FDR, Basin BS5 will be detained in offsite, full spectrum detention basin MKJCC Pond #5. The pond design details are presented in Appendix D. Per the Phase 3 FDR, total anticipated flows at DPI are Q_5 = 10.1 cfs Q_{100} = 23.6 cfs. Total inlet capacity at DPI is Q_5 = 10.1 cfs Q_{100} = 19.3 cfs. The Q_{100} flows will equalize across the crown of Bliss Road during a major event. The inlet calculation for DPI from the Phase 3 FDR is presented in Appendix D.

It should be noted that Bradley Landing Boulevard and Bliss Road will be constructed as part of a separate project by Bradley Heights Metropolitan District covered within the Phase 3 FDR.

In the event of inlet failure, the public sump inlet at DP9 would overtop the roadway and overflow to DP10. If the sump inlet at DP10 were to become clogged, the flow would overtop the curb and flow in an overflow swale to DPI within Bliss Road. All overflow elements provide a 1.0' of freeboard.

III. Drainage Design Criteria

a. Development Criteria Reference

The drainage analysis, proposed storm sewer system, and proposed private, full spectrum water quality and detention pond follow the criteria from the "*City of Colorado Springs Drainage Criteria Manual" Volumes 1 and 2"* (CCSDCM, latest revision).

b. Hydrologic Criteria

Hydrologic data was obtained from the "*City of Colorado Springs Drainage Criteria Manual – Chapter 6 Hydrology".* Onsite drainage improvements are designed for the 5-year storm (minor event) and 100-year storm (major event) using rainfall values from CCSDCM Table 6-2 below. Runoff was calculated per CCSDCM Section 6.3.0 - Rational Method. Private, full spectrum pond design was completed using the latest version of Mile High Flood District's (MHFD) UD-Detention per CCSDCM Section 13.3.2.1 – Private, full spectrum Detention. Detention pond allowable release rate will be limited to less than historic rates.

Table 6-2: Rainfall Depths for Colorado Springs		
Return Period (yr)	5	100
1-hr Rainfall Depth (in)	1.50	2.52

c. Hydraulic Criteria

Hydraulic criteria for inlet sizing was obtained from the "*City of Colorado Springs Drainage Criteria Manual – Chapter 8 Inlets".* Hydraulic criteria for storm sewer sizing was obtained from the "*City of Colorado Springs Drainage Criteria Manual – Chapter 9 Storm Sewer".* Hydraulic criteria for channel sizing was obtained from the "*City of Colorado Springs Drainage Criteria Manual – Chapter 12 Open Channels".*

IV. Drainage Facility Design

a. General Concept

Onsite stormwater will be conveyed via Type 5 curb and gutter to Type R inlets. Captured stormwater will be piped to offsite detention facilities (WFJCC Pond #1 and MKJCC Pond #5) designed within the Phase 2 and Phase 3 FDRs. Please review the associated Phase 2 FDR and Phase 3 FDR detention calculations presented in Appendix D. The Phase 2 FDR map and Phase 3 FDR maps are presented in Appendix F.

b. Water Quality & Detention

Water quality and detention for Basins WF5.1, WF5.2, and WF5.3 is provided in an offsite full spectrum detention pond (WFJCC Pond #1) located southwest of Bradley Landing Boulevard and Legacy Hill Drive. A total of 76.22 acres at 50.15% composite imperviousness are detained in WFJCC Pond #1. Per the Phase 2 FDR a total of 6.2 acres at 54.2% impervious were anticipated to be detained from the Bradley Heights Filing 5 development (Phase 2 FDR Basin WF5a, WF5b). In the proposed condition of Bradley Heights Filing 5, WF5a, WF5.2, and WF5.3, totaling 6.2 acres at 54.2% impervious will drain to WFJCC #1. Therefore, the Bradley Heights Filling 5 FDR complies with the Phase 2 FDR. Please see the Phase 2 FDR for pond specifications. The associated design spreadsheet is presented in Appendix D.

Water quality and detention for Basins 1-5, BS3 and BS5 are provided in an offsite, full spectrum detention pond (MKJCC Pond #5) located southeast of the site, across Bliss Road. A total of 89.39 acres at 72.24% composite imperviousness are detained in MKJCC Pond #5. Per the Phase 3 FDR a total of 27.05 acres at 66.8% impervious were anticipated to be detained from the Bradley Heights Filing 5 development (Phase 3 FDR Basin BHE3, BS3 and BS5). In the proposed condition of Bradley Heights Filing 5, Basin 1-5, BS3 & BS5 totaling 27.03 acres at 55.4% impervious will drain to WFJCC Pond #5. Therefore, the Bradley Heights Filling 5 FDR complies with the Phase 3 FDR. Please see the Phase 3 FDR for pond specifications. The associated design spreadsheet is presented in Appendix D.

c. Major Drainageways

The Marksheffel Tributary to Jimmy Camp Creek parallels the site to the east and is the ultimate outfall location for the off-site full spectrum detention pond. Drainageway improvements are anticipated in this channel to facilitate development in the tributary areas per the MDDPA. Refer to “Marksheffel Tributary Channel Improvements at Bradley Heights” by Matrix Design Group for drainageway analysis and recommended improvements.

d. Inspection and Maintenance

An Inspection and Maintenance manual has been submitted in conjunction with the Phase 2 FDR, as the ponds referenced in this report are not the maintenance responsibility of Bradley Heights Filing 5.

e. Grading and Erosion Control Plan

Due to the project disturbance area, a separate Grading and Erosion Control plan will be required. The Grading and Erosion Control Plan will be submitted for review and approval with subsequent submittals of this FDR.

f. Four Step Method to Minimize Adverse Impacts of Urbanization

Step 1 – Reducing Runoff Volumes: Roof drains will route across landscape areas whenever possible to promote infiltration. An IRF spreadsheet is presented in Appendix B.

Step 2 – Treat and slowly release the WQCV: An offsite private, full spectrum detention pond provides water quality treatment for Basins WF5.1 – WF5.3. The WQCV is released over a period of 40 hours. An offsite, private full spectrum detention pond provides water quality and detention for Bains 1-5, BS3 and BS5. The WQCV is released over a period of 40 hours.

Step 3 – Stabilize stream channels: All new and re-development projects are required to construct or participate in the funding of channel stabilization measures. Drainage basin fees paid, at the time of platting, go towards channel stabilization with the drainage basin.

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

g. Drainage and Bridge Fees

Drainage and bridge fees for the Jimmy Camp Creek Drainage Basin are due at time of platting. See table below for anticipated drainage and bridge fees for Bradley Heights Filing 5 Fees to be deferred and used by the Bradley Heights Metro District No. 2 for drainage improvements.

Jimmy Camp Creek Drainage Basin – 2022 Drainage Fees				
Site Acreage	Drainage Fee/acre	Pond Facility Fee/acre	Drainage Fee	Pond Facility Fee
28.91	$9,185	$2,993	$265,539	$86,528

h. Opinion of Probable Cost

An engineer's opinion of probable cost has been included in Appendix E.

i. Hydraulic Grade Line Calculations

Hydraulic Grade Line analysis for the storm network is presented in Appendix C.

V. Summary

The Bradley Heights Filing 5 development remains consistent with pre-development drainage conditions with the construction of the recommended drainage improvements. The proposed development will not adversely affect downstream stormwater infrastructure or surrounding developments. This report meets the latest City of Colorado Springs Drainage criteria and is in accordance with the Bradley Heights MDDPA and Phase 2 FDR.

VI. Variances

There are no anticipated variances required with the Bradley Heights 5 improvements.

VII. Drawings

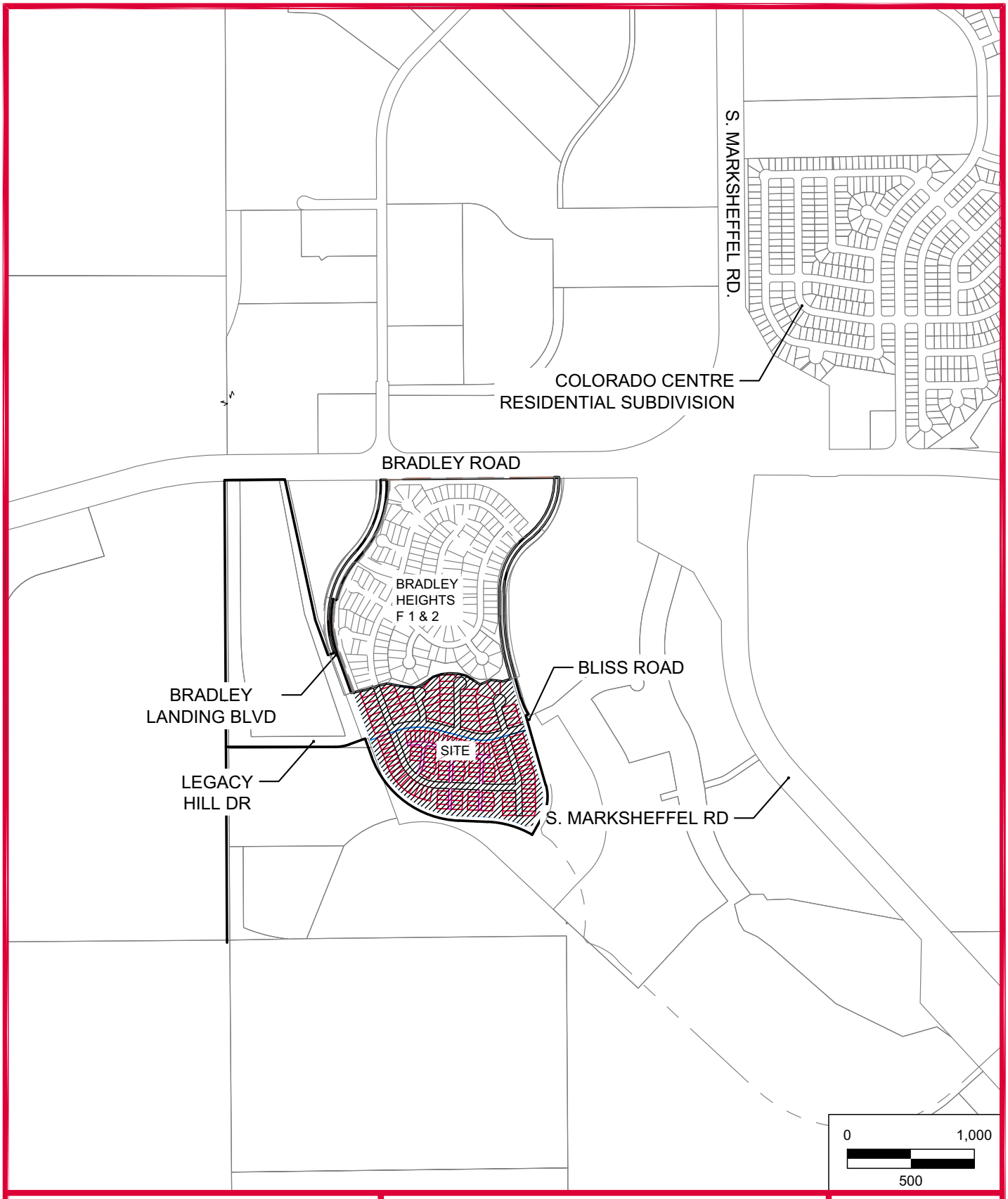
Please refer to the appendices for vicinity and drainage basin maps.

VIII. References

1. City of Colorado Springs – Drainage Criteria Manual, May 2014, Revised January 2021.
2. Urban Storm Drainage Criteria Manual, Urban Drainage Flood Control District, January 2018.
3. "Jimmy Camp Creek Drainage Basin Planning Study" Kiowa Engineering Corporation, March 9, 2015.

4. “Master Development Drainage Plan for Bradley Heights Classic Consulting Engineers and Surveyors, February 12, 2015.
5. “Master Development Drainage Report Amendment for Bradley Heights & Final Drainage Report for Phase I Bradley Heights Road Improvements” prepared by Matrix Design Group, December 2021.
6. “Bradley Heights Metro District (Phase 2) Final Drainage Report” prepared by Matrix Design Group, April 2022.
7. “Bradley Heights Metro District (Phase 3) Final Drainage Report” prepared by Matrix Design Group, September 2022.

APPENDIX A – VICINITY MAP, SOIL MAP, FEMA MAP



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NORTH

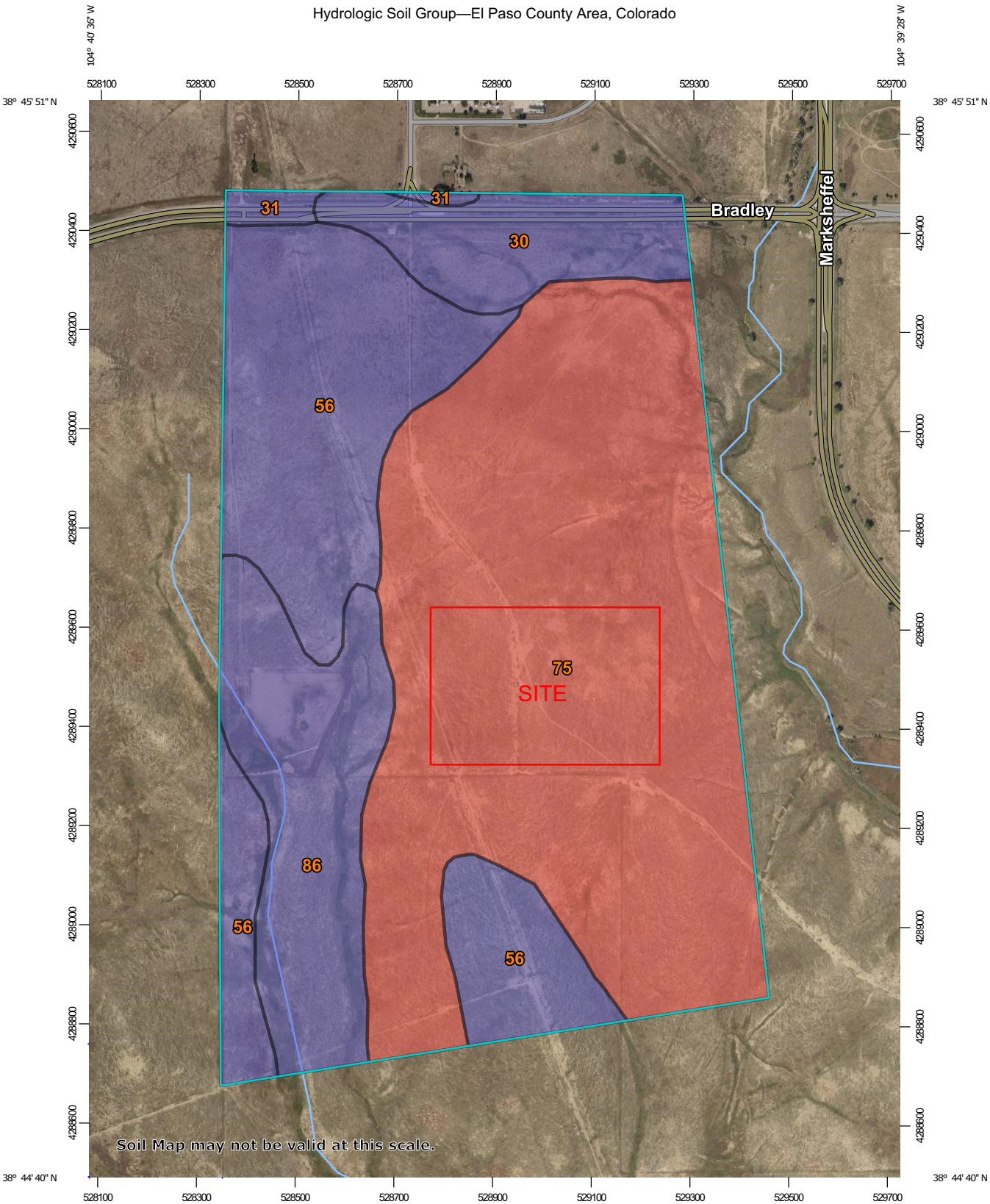
SHEET

VICINITY MAP

SCALE: 1"=1,000'

DATE: 04/29/2022

Xrefs: 05-XC-ROW; xc-row; 8.5x11_Titleblock



Map Scale: 1:10,600 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 150 300 600 900

Feet: 0 500 1000 2000 3000

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 19, Aug 31, 2021

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

Date(s) aerial images were photographed: Aug 14, 2018—Sep 23, 2018

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
30	Fort Collins loam, 0 to 3 percent slopes	B	30.8	7.1%
31	Fort Collins loam, 3 to 8 percent slopes	B	4.0	0.9%
56	Nelson-Tassel fine sandy loams, 3 to 18 percent slopes	B	108.5	24.9%
75	Razor-Midway complex	D	233.6	53.6%
86	Stoneham sandy loam, 3 to 8 percent slopes	B	58.9	13.5%
Totals for Area of Interest			**435.9**	**100.0%**

NOTES TO USERS

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

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

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

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

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

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

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

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

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

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, and Anderson Consulting Engineers, Inc. These data are current as of 2008.

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

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

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

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

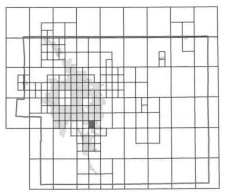
If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

El Paso County Vertical Datum Offset Table

Flooding Source	Vertical Datum Offset (ft)

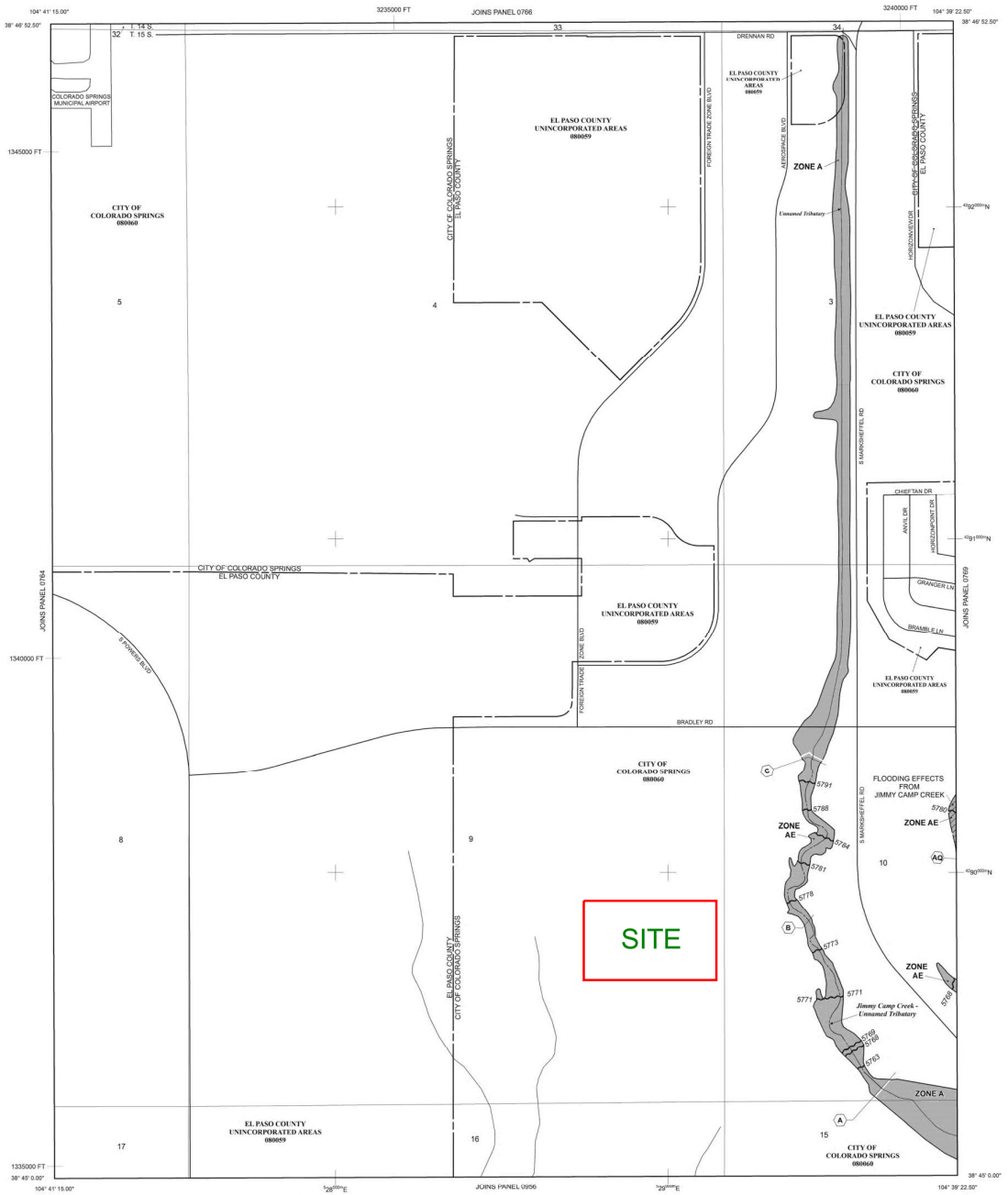
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION

Panel Location Map



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

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



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 14 SOUTH, RANGE 65 WEST, AND TOWNSHIP 15 SOUTH, RANGE 65 WEST.

LEGEND

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

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

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

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

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

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

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

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

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

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

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

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

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

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

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

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0768G

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

PANEL 768 OF 1300
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0768	G
EL PASO COUNTY	080059	0768	G

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

MAP NUMBER
08041C0768G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

APPENDIX B – HYDROLOGIC CALCULATIONS

HRGreen	**BRADLEY HEIGHTS - FILING 5**	**Calc'd by:**	**NQJ**
	EXISTING CONDITIONS	**Checked by:**	
	LOCATION: COLORADO SPRINGS, COLORADO	**Date:**	**6/13/2022**

SUMMARY RUNOFF TABLE

BASIN	AREA (ac)	% IMPERVIOUS	Q_5 (cfs)	Q_{100} (cfs)
W1	10.90	2	5.1	27.3
M2	21.31	2	10.7	57.5

DESIGN POINT SUMMARY TABLE

DESIGN POINT	CONTRIBUTING BASINS	ΣQ_5 (cfs)	ΣQ_{100} (cfs)
1	W1	5.1	27.3
2	M2	10.7	57.5

HRGreen	**BRADLEY HEIGHTS - FILING 5**					**Calc'd by:**	**NQJ**	
	EXISTING CONDITIONS					**Checked by:**		
	LOCATION: COLORADO SPRINGS, COLORADO					**Date:**	**6/13/2022**	

COMPOSITE 'C' FACTORS

BASIN	UNDEVELOPED	ROADWAY	SINGLE FAMILY	TOTAL	SOIL TYPE	UNDEVELOPED			ROADWAY			SINGLE FAMILY			COMPOSITE IMPERVIOUSNESS & C		
	ACRES					%I	C_5	C_{100}	%I	C_5	C_{100}	%I	C_5	C_{100}	%I	C_5	C_{100}
W1	10.90	0.00	0.00	10.90	D	2	0.16	0.51	100	0.90	0.96	65	0.49	0.65	2	0.16	0.51
M2	21.31	0.00	0.00	21.31	D	2	0.16	0.51	95	0.90	0.96	65	0.49	0.65	2	0.16	0.51
Total				**32.21**											**2.00**		

HRGreen	**BRADLEY HEIGHTS - FILING 5**	**Calc'd by:**	**NQJ**
	EXISTING CONDITIONS	**Checked by:**	
	LOCATION: COLORADO SPRINGS, COLORADO	**Date:**	**6/13/2022**

TIME OF CONCENTRATION

BASIN DATA			OVERLAND TIME (T_i)			TRAVEL TIME (T_t)					TOTAL
DESIGNATION	C_5	AREA (ac)	LENGTH (ft)	SLOPE %	t_i (min)	C_V	LENGTH (ft)	SLOPE %	V (ft/s)	t_t (min)	t_c (min)
W1	0.16	10.90	300	4.4	18.2	10	510	4.4	2.1	4.1	22.3
M2	0.16	21.31	145	3.8	13.3	10	837	5.6	2.4	5.9	19.2

FORMULAS:

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \qquad V = C_v S_w^{0.5}$$

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)*	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

* For buried riprap, select C_v value based on type of vegetative cover.

HRGreen			**BRADLEY HEIGHTS - FILING 5**																			**Calc'd by:**	**NQJ**		
			EXISTING CONDITIONS																			**Checked by:**			
			DESIGN STORM: 5-YEAR																			**Date:**	**6/13/2022**		
			DIRECT RUNOFF						**TOTAL RUNOFF**				**STREET**			**PIPE**				**TRAVEL TIME**			**REMARKS**	
STREET	**DESIGN POINT**	**BASIN ID**	**AREA (ac)**	**C_5**	**t_c (min)**	**C_5*A (ac)**	**I (in./ hr.)**	**Q (cfs)**	**t_c (min)**	**C_5*A (ac)**	**I (in./ hr.)**	**Q (cfs)**	**Q_{Street} (cfs)**	**C_5*A (ac)**	**SLOPE %**	**Q_{PIPE} (cfs)**	**C_5*A (ac)**	**SLOPE %**	**PIPE SIZE (in)**	**LENGTH (FT)**	**VEL. (FPS)**	**TRAVEL TIME (min**		
		W1	10.90	0.16	22.3	1.74	2.93	5.1															BASIN W1 EXISTING FLOWS, DRAINS OFFSITE TO WEST	
		M2	21.31	0.16	19.2	3.41	3.15	10.7															BASIN M2 EXISTING FLOWS, DRAINS OFFSITE TO EAST	

HRGreen

BRADLEY HEIGHTS - FILING 5

EXISTING CONDITIONS

DESIGN STORM: 100-YEAR

Calc'd by:	NQJ
Checked by:	
Date:	6/13/2022

			DIRECT RUNOFF						TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
STREET	DESIGN POINT	BASIN ID	AREA (ac)	C_{100}	t_c (min)	C_{100}*A (ac)	I (in./ hr.)	Q (cfs)	t_c (min)	C_{100}*A (ac)	I (in./ hr.)	Q (cfs)	Q_{street} (cfs)	C_{100}*A (ac)	SLOPE %	Q_{PIPE} (cfs)	C_{100}*A (ac)	SLOPE %	PIPE SIZE (ft)	LENGTH (ft)	VEL. (ft/s)	TRAVEL TIME (min)	
		W1	10.90	0.51	22.3	5.56	4.91	27.3															BASIN W1 EXISTING FLOWS, DRAINS OFFSITE TO WEST
		M2	21.31	0.51	19.2	10.87	5.29	57.5															BASIN M2 EXISTING FLOWS, DRAINS OFFSITE TO EAST

HRGreen	**BRADLEY HEIGHTS - FILING 5**	**Calc'd by:**	**CBM**
	PROPOSED CONDITIONS	**Checked by:**	
	LOCATION: COLORADO SPRINGS, COLORADO	**Date:**	**10/5/2022**

SUMMARY RUNOFF TABLE

BASIN	AREA (ac)	% IMPERVIOUS	Q_5 (cfs)	Q_{100} (cfs)
WF5a	4.53	50	6.4	15.3
WF5.2	0.76	65	1.2	2.7
WF5.3	0.90	65	1.4	3.2
1	6.07	65	10.9	24.3
2	3.20	65	5.8	12.8
3	4.83	65	9.5	21.2
3A	3.21	65	6.9	15.4
4A	0.98	65	1.9	4.1
4	2.24	65	4.2	9.3
5	1.14	65	2.1	4.8
BS3	2.69	58	5.2	12.0
BS5	2.67	50	4.9	11.9

DESIGN POINT SUMMARY TABLE

DESIGN POINT	CONTRIBUTING BASINS	ΣQ_5 (cfs)	ΣQ_{100} (cfs)
AX	WF5a	6.4	15.3
2	WF5.2	1.2	2.7
3	WF5.3	1.4	3.2
3.1	DP1 & DP2	2.6	5.8
4.1	DP1 & DP2	2.6	5.8
4	1	10.9	24.3
5	2	5.8	12.8
5.1	DP4 & DP5	14.6	22.7
6	1, 2 &, 4A	3.7	17.9
6.1		15.6	26.7
7	3	9.5	21.2
8	3 & 3A	6.9	20.2
8.1	DP7 & DP8	15.4	27.5
9	1, 2 & 4	6.2	21.9
9.1	DP6.1, DP8.1, & DP9	35.5	73.2
10	5	2.1	4.8
10.1	DP9.1 & DP10	37.5	77.5
11	DP6.1, DP8.1, DP9 & DP10	37.5	77.5
I	3A, BS3 & BS5	10.1	23.6

HRGreen	**BRADLEY HEIGHTS - FILING 5**					**Calc'd by:**	**CBM**											
	PROPOSED CONDITIONS					**Checked by:**												
	LOCATION: COLORADO SPRINGS, COLORADO					**Date:**	**10/5/2022**											

COMPOSITE 'C' FACTORS

BASIN	UNDEVELOPED	COMMERCIAL	SINGLE FAMILY	TOTAL	SOIL TYPE	UNDEVELOPED			COMMERCIAL			SINGLE FAMILY			COMPOSITE IMPERVIOUSNESS & C		
	ACRES					%I	C_5	C_{100}	%I	C_5	C_{100}	%I	C_5	C_{100}	%I	C_5	C_{100}
WF5a	1.77	1.49	1.27	4.53	D	2	0.16	0.51	95	0.82	0.89	65	0.49	0.65	50	0.47	0.67
WF5.2	0.00	0.00	0.76	0.76	D	2	0.16	0.51	95	0.82	0.89	65	0.49	0.65	65	0.49	0.65
WF5.3	0.00	0.00	0.90	0.90	D	2	0.16	0.51	95	0.82	0.89	65	0.49	0.65	65	0.49	0.65
1	0.00	0.00	6.07	6.07	D	2	0.16	0.51	95	0.82	0.89	65	0.49	0.65	65	0.49	0.65
2	0.00	0.00	3.20	3.20	D	2	0.16	0.51	95	0.82	0.89	65	0.49	0.65	65	0.49	0.65
3	0.00	0.00	4.83	4.83	D	2	0.16	0.51	95	0.82	0.89	65	0.49	0.65	65	0.49	0.65
3A	0.00	0.00	3.21	3.21	D	2	0.16	0.51	95	0.82	0.89	65	0.49	0.65	65	0.49	0.65
4A	0.00	0.00	0.98	0.98	D	2	0.16	0.51	95	0.82	0.89	65	0.49	0.65	65	0.49	0.65
4	0.00	0.00	2.24	2.24	D	2	0.16	0.51	95	0.82	0.89	65	0.49	0.65	65	0.49	0.65
5	0.00	0.00	1.14	1.14	D	2	0.16	0.51	95	0.82	0.89	65	0.49	0.65	65	0.49	0.65
BS3	0.71	0.84	1.14	2.69	D	2	0.16	0.51	95	0.82	0.89	65	0.49	0.65	58	0.51	0.69
BS5	1.15	1.05	0.47	2.67	D	2	0.16	0.51	95	0.82	0.89	65	0.49	0.65	50	0.48	0.68
WFJCC POND #1				**6.19**											**54.2**		
MKJCC POND #5				**27.03**											**55.4**		
Total				**33.22**											**61.2**		

HRGreen	**BRADLEY HEIGHTS - FILING 5**	**Calc'd by:**	**CBM**
	PROPOSED CONDITIONS	**Checked by:**	
	LOCATION: COLORADO SPRINGS, COLORADO	**Date:**	**10/5/2022**

TIME OF CONCENTRATION

BASIN DATA			OVERLAND TIME (T_i)			TRAVEL TIME (T_t)					TOTAL
DESIGNATION	C_5	AREA (ac)	LENGTH (ft)	SLOPE %	t_i (min)	C_V	LENGTH (ft)	SLOPE %	V (ft/s)	t_t (min)	t_c (min)
WF5a	BASIN WF5a FOR REFERENCE, SEE BRADLEY HEIGHTS MDDPA FOR ROUTING ANALYSIS										
WF5.2	0.49	0.76	100	5.0	6.5	20	1471	1.1	2.1	11.7	18.2
WF5.3	0.49	0.90	100	5.0	6.5	20	1471	1.1	2.1	11.7	18.2
1	0.49	6.07	55	2.0	6.6	20	1180	2.0	2.8	7.0	13.5
2	0.49	3.20	55	2.0	6.6	20	1180	2.0	2.8	7.0	13.5
3	0.49	4.83	100	2.0	8.9	20	405	3.3	3.6	1.9	10.7
3A	0.49	3.21	55	2.0	6.6	20	412	4.0	4.0	1.7	8.3
4A	0.49	0.98	100	2.0	8.9	20	250	0.5	1.4	2.9	11.8
4	0.49	2.24	100	2.0	8.9	20	920	4.5	4.2	3.6	12.5
5	0.49	1.14	55	2.0	6.6	20	470	0.5	1.4	5.5	12.1
BS3	BASIN BS3 FOR REFERENCE, SEE BRADLEY HEIGHTS MDDPA FOR ROUTING ANALYSIS										
BS5	BASIN BS5 FOR REFERENCE, SEE BRADLEY HEIGHTS MDDPA FOR ROUTING ANALYSIS										

FORMULAS:

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \qquad V = C_v S_w^{0.5}$$

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)*	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

* For buried riprap, select C_v value based on type of vegetative cover.

HRGreen

BRADLEY HEIGHTS - FILING 5

PROPOSED CONDITIONS

DESIGN STORM: 5-YEAR

Calc'd by: NQJ

Checked by:

Date: 10/5/2022

			DIRECT RUNOFF						TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
STREET	DESIGN POINT	BASIN ID	AREA (ac)	C_5	t_c (min)	C_5*A (ac)	I (in./ hr.)	Q (cfs)	t_c (min)	C_5*A (ac)	I (in./ hr.)	Q (cfs)	Q_{street} (cfs)	C_5*A (ac)	SLOPE %	Q_{PIPE} (cfs)	C_5*A (ac)	SLOPE %	PIPE SIZE (ft)	LENGTH (FT)	VEL. (FPS)	TRAVEL TIME (min	
	AX	WF5a	4.53	0.47	20.7	2.13	3.04	6.4															BASIN WF5a FLOW CAPTURED AT DPAX (OFFSITE 10' TYPE R INLET, BY BHMD)
	2	WF5.2	0.76	0.49	18.2	0.37	3.23	1.2								1.2	0.37	2.0	1.5	15	8.4	0.03	BASIN WF5.2 FLOW CAPTURED IN 10' TYPE R ONGRADE @ DP2, PIPE TO DP3.1
	3	WF5.3	0.90	0.49	18.2	0.44	3.23	1.4								1.4	0.44	2.0	1.5	15	8.4	0.03	BASIN WF5.3 FLOW CAPTURED IN 10' TYPE R ONGRADE @ DP3, PIPE TO DP3.1
	3.1								18.3	0.81	3.23	2.6				2.6	0.81	2.0	1.5	250	8.4	0.50	COMBINED DP2& DP3 @ DP3.1, PIPE TO DP AWb (BHMD STORM SEWER)
													1.3	0.36	4.0					230	4.0	0.96	DP4 FLOWBY, C&G FLOW TO DP6
	4	1	6.07	0.49	13.5	2.97	3.67	10.9								9.6	2.61	2.0	1.5	30	8.4	0.06	BASIN 1 FLOW CAPTURED IN 15' TYPE R ONGRADE @ DP4, PIPE TO DP5.1
		2	3.20	0.49	13.5	1.57	3.67	5.8															BASIN 2 FLOW @ DP5
													0.8	0.21	4.0					230	4.0	0.96	DP5 FLOWBY, C&G FLOW TO DP9
	5								13.5	1.57	3.67	5.8				5.0	1.36	2.0	1.5	5	8.4	0.01	BASIN 2 FLOW CAPTURED IN 10' TYPE R ONGRADE, PIPE TO DP5.1
	5.1								13.6	3.97	3.67	14.6				14.6	3.97	2.0	2.0	275	10.2	0.45	COMBINED DP4 & DP5 @ DP5.1, PIPE TO DP6.1
		4A	0.98	0.49	11.8	0.48	3.88	1.9															BASIN 4A FLOW @ DP6
													2.3	0.66	0.5					230	1.4	2.71	BASIN 1, 2, 4A FLOWBY, C&G FLOW TO DP9
	6								14.5	1.05	3.57	3.7				1.4	0.39	2.0	1.5	15	10.2	0.02	BASIN 4A FLOW CAPTURED IN 5' TYPE 4 ONGRADE @ DP6, PIPE TO DP6.1
	6.1								14.5	4.36	3.57	15.6				15.6	4.36	2.0	2.0	165	10.2	0.27	COMBINED DP5.1, DP6 FLOWS @ DP6.1, PIPE TO DP9.1
													0.8	0.20	4.0					411	4.0	1.71	DP7 FLOWBY, C&G FLOW TO DP8
	7	3	4.83	0.49	10.7	2.37	4.02	9.5								8.7	2.16	2.0	1.5	411	8.4	0.81	CAPTURED BASIN 3 FLOW @ DP7, PIPE TO DP8.1
		3A	3.21	0.49	8.3	1.57	4.41	6.9															BASIN 3A FLOW @ DP8
													0.1	0.01	4.0					330	4.0	1.38	DP8 FLOWBY, C&G FLOW TO DPI (BHMD FDR PHASE 2)
	8								12.4	1.78	3.80	6.8				6.7	1.76	2.0	1.5	15	8.4	0.03	CAPTURED DP7 FLOWBY & BASIN 3A @ DP8, PIPE TO DP8.1
	8.1								11.5	3.93	3.91	15.4				15.4	3.93	2.0	2.0	215	10.2	0.35	COMBINED DP7 & DP8 @ DP8.1 PIPE TO DP10.1
		4	2.24	0.49	12.5	1.10	3.80	4.2															BASIN 4 FLOW @ DP9
	9								14.8	1.76	3.54	6.2				6.2	1.76	2.0	2.5	30	10.2	0.05	DP5 & DP6 FLOWBY & BASIN 5 FLOW CAPTURED @ DP9 IN 20' TYPE R SUMP, PIPE TO DP10.1
	9.1								14.8	10.05	3.54	35.5				35.5	10.05	2.0	1.5	15	8.4	0.03	COMBINED DP6.1, 8.1, & 9 @ DP9.1, PIPE TO DP10.1
	10	5	1.14	0.49	12.1	0.56	3.84	2.1								2.1	0.56	2.0	1.5	15	8.4	0.03	BASIN 5 FLOW CAPTURED @ DP10 IN 5' TYPE R SUMP INLET, PIPE TO DP10.1
	10.1								14.9	10.60	3.53	37.5											COMBINED DP9.1 & 10 @ DP10.1, PIPE TO DP11 (BHMD STORM)
		BS3	2.69	0.51	12.0	1.36	3.86	5.2															BASIN BS3 FLOW @ DPI
		BS5	2.67	0.48	11.8	1.27	3.89	4.9															BASIN BS5 FLOW @ DPI
	I								12.1	2.64	3.84	10.1											COMBINED DP8 FLOWBY, BASIN BS3 & BASIN BS5 @ DPI (BHMD)

HRGreen

BRADLEY HEIGHTS - FILING 5

PROPOSED CONDITIONS

DESIGN STORM: 100-YEAR

Calc'd by:	NQJ
Checked by:	
Date:	10/5/2022

			DIRECT RUNOFF						TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
STREET	DESIGN POINT	BASIN ID	AREA (ac)	C_{100}	t_c (min)	C_{100}*A (ac)	I (in./ hr.)	Q (cfs)	t_c (min)	C_{100}*A (ac)	I (in./ hr.)	Q (cfs)	Q_{street} (cfs)	C_{100}*A (ac)	SLOPE %	Q_{PIPE} (cfs)	C_{100}*A (ac)	SLOPE %	PIPE SIZE (ft)	LENGTH (ft)	VEL. (ft/s)	TRAVEL TIME (min)	
	AX	WF5a	4.53	0.67	20.7	3.05	5.10	15.3															BASIN WF5a FLOW CAPTURED AT DPAX (OFFSITE 10' TYPE R INLET, BY BHMD)
	2	WF5.2	0.76	0.65	18.2	0.49	5.42	2.7								2.7	0.49	2.0	1.5	15	8.4	0.03	BASIN WF5.2 FLOW CAPTURED IN 10' TYPE R ONGRADE @ DP2, PIPE TO DP3.1
	3	WF5.3	0.90	0.65	18.2	0.59	5.42	3.2								3.2	0.59	2.0	1.5	30	8.4	0.06	BASIN WF5.3 FLOW CAPTURED IN 10' TYPE R ONGRADE @ DP3, PIPE TO DP3.1
	3.1								18.3	1.08	5.41	5.8				5.8	1.08	2.0	1.5	250	8.4	0.50	COMBINED DP2& DP3 @ DP3.1, PIPE TO DP AWb (BHMD STORM SEWER)
													9.4	1.53	4.0					230	4.0	0.96	DP4 FLOWBY, C&G FLOW TO DP6
	4	1	6.07	0.65	13.5	3.95	6.17	24.3								14.9	2.42	2.0	1.5	30	8.4	0.06	BASIN 1 FLOW CAPTURED IN 15' TYPE R ONGRADE @ DP4, PIPE TO DP5.1
		2	3.20	0.65	13.5	2.08	6.17	12.8															BASIN 2 FLOW @ DP5
													5.0	0.82	4.0					230	4.0	0.96	DP5 FLOWBY, C&G FLOW TO DP9
	5								13.5	2.08	6.17	12.8				7.8	1.26	2.0	1.5	15	8.4	0.03	BASIN 2 FLOW CAPTURED IN 10' TYPE R ONGRADE, PIPE TO DP5.1
	5.1								13.6	3.68	6.16	22.7				22.7	3.68	2.0	2.0	150	10.2	0.25	COMBINED DP4 & DP5 @ DP5.1, PIPE TO DP6.1
		4A	0.98	0.65	11.8	0.64	6.51	4.1															BASIN 4A FLOW @ DP6
													13.3	2.22	0.5					230	1.4	2.71	BASIN 1, 2, 4A FLOWBY, C&G FLOW TO DP9
	6								14.5	2.98	6.00	17.9				4.6	0.77	2.0	1.5	15	8.4	0.03	BASIN 4A FLOW CAPTURED IN 5' TYPE 4 ONGRADE @ DP6, PIPE TO DP6.1
	6.1								14.5	4.45	6.00	26.7				26.7	4.45	2.0	2.0	165	10.2	0.27	COMBINED DP5.1, DP6 FLOWS @ DP6.1, PIPE TO DP9.1
													7.3	1.08	4.0					411	4.0	1.71	DP7 FLOWBY, C&G FLOW TO DP8
	7	3	4.83	0.65	10.7	3.14	6.75	21.2								13.9	2.06	2.0	1.5	411	8.4	0.81	CAPTURED BASIN 3 FLOW @ DP7, PIPE TO DP8.1
		3A	3.21	0.65	8.3	2.09	7.40	15.4															BASIN 3A FLOW @ DP8
													6.6	1.04	4.0					330	4.0	1.38	DP8 FLOWBY, C&G FLOW TO DPI (BHMD FDR PHASE 2)
	8								12.4	3.17	6.38	20.2				13.6	2.13	2.0	1.5	15	8.4	0.03	CAPTURED DP7 FLOWBY & BASIN 3A @ DP8, PIPE TO DP8.1
	8.1								11.5	4.19	6.57	27.5				27.5	4.19	2.0	2.0	215	10.2	0.35	COMBINED DP7 & DP8 @ DP8.1 PIPE TO DP10.1
		4	2.24	0.65	12.5	1.46	6.37	9.3															BASIN 4 FLOW @ DP9
	9								14.8	3.67	5.95	21.9				21.9	3.67	2.0	2.5	15	11.8	0.02	DP5 & DP6 FLOWBY & BASIN 5 FLOW CAPTURED @ DP9 IN 20' TYPE R SUMP, PIPE TO DP10.1
	9.1								14.8	12.31	5.95	73.2				73.2	12.31	2.0	1.5	15	8.4	0.03	COMBINED DP6.1, 8.1, & 9 @ DP9.1, PIPE TO DP10.1
	10	5	1.14	0.65	12.1	0.74	6.45	4.8								4.8	0.74	2.0	1.5	15	8.4	0.03	BASIN 5 FLOW CAPTURED @ DP10 IN 5' TYPE R SUMP INLET, PIPE TO DP10.1
	10.1								14.8	13.05	5.94	77.5											COMBINED DP9.1 & 10 @ DP10.1, PIPE TO DP11 (BHMD STORM)
		BS3	2.69	0.69	12.0	1.85	6.48	12.0															BASIN BS3 FLOW @ DPI
		BS5	2.67	0.68	11.8	1.83	6.52	11.9															BASIN BS5 FLOW @ DPI
	I								12.1	4.71	6.45	23.6											COMBINED DP8 FLOWBY, BASIN BS3 & BASIN BS5 @ DPI (BHMD)

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

				Designer:	NQJ
				Company:	HR GREEN
***Design Storm: 1-Hour Rain Depth	WQCV Event	1.19	inches	**Date:**	April 28, 2022
***Minor Storm: 1-Hour Rain Depth	5-Year Event	1.25	inches	**Project:**	BRADLEY HEIGHTS FILING 5 & 6
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.50	inches	**Location:**	COLORADO SPRINGS
Optional User Defined Storm	CUHP				
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event				
Max Intensity for Optional User Defined Storm	0				

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	WF5.1	WF5.2	WF5.3											
Receiving Pervious Area Soil Type	Sandy Loam	Sandy Loam	Sandy Loam											
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	2.660	0.730	0.900											
Directly Connected Impervious Area (DCIA, acres)	0.000	0.230	0.350											
Unconnected Impervious Area (UIA, acres)	1.330	0.250	0.275											
Receiving Pervious Area (RPA, acres)	1.330	0.250	0.275											
Separate Pervious Area (SPA, acres)	0.000	0.000	0.000											
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C	C	C											

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	2.660	0.730	0.900											
Directly Connected Impervious Area (DCIA, %)	0.0%	31.5%	38.9%											
Unconnected Impervious Area (UIA, %)	50.0%	34.2%	30.6%											
Receiving Pervious Area (RPA, %)	50.0%	34.2%	30.6%											
Separate Pervious Area (SPA, %)	0.0%	0.0%	0.0%											
A_R (RPA / UIA)	1.000	1.000	1.000											
I_a Check	0.500	0.500	0.500											
f / I for WQCV Event:	0.9	0.9	0.9											
f / I for 5-Year Event:	0.5	0.5	0.5											
f / I for 100-Year Event:	0.3	0.3	0.3											
f / I for Optional User Defined Storm CUHP:														
IRF for WQCV Event:	0.81	0.81	0.81											
IRF for 5-Year Event:	0.89	0.89	0.89											
IRF for 100-Year Event:	0.93	0.93	0.93											
IRF for Optional User Defined Storm CUHP:														
Total Site Imperviousness: I_{total}	50.0%	65.8%	69.4%											
Effective Imperviousness for WQCV Event:	40.6%	59.3%	63.7%											
Effective Imperviousness for 5-Year Event:	44.5%	62.0%	66.1%											
Effective Imperviousness for 100-Year Event:	46.6%	63.4%	67.3%											
Effective Imperviousness for Optional User Defined Storm CUHP:														

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	12.0%	9.0%	8.6%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
This line only for 10-Year Event	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	6.8%	3.5%	2.9%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:														

Total Site Imperviousness:	**56.8%**
Total Site Effective Imperviousness for WQCV Event:	**48.6%**
Total Site Effective Imperviousness for 5-Year Event:	**52.0%**
Total Site Effective Imperviousness for 100-Year Event:	**53.8%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.

** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.

*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

***Design Storm: 1-Hour Rain Depth	WQCV Event	1.19	inches	
***Minor Storm: 1-Hour Rain Depth	5-Year Event	1.25	inches	
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.50	inches	
Optional User Defined Storm	CUHP			
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event			
Max Intensity for Optional User Defined Storm	0			

Designer: CBM
Company: HR GREEN
Date: October 4, 2022
Project: BRADLEY HEIGHTS FILING 5
Location: COLORADO SPRINGS

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	1	2	3	3A	4	4A	5	BS3	BS5					
Receiving Pervious Area Soil Type	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam					
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	6.070	3.200	4.830	3.210	2.240	0.980	1.140	1.300	1.650					
Directly Connected Impervious Area (DCIA, acres)	1.390	0.870	1.160	0.630	0.500	0.300	0.370	0.000	0.000					
Unconnected Impervious Area (UIA, acres)	2.340	1.165	1.835	1.290	0.870	0.340	0.385	0.650	0.825					
Receiving Pervious Area (RPA, acres)	2.340	1.165	1.835	1.290	0.870	0.340	0.385	0.650	0.825					
Separate Pervious Area (SPA, acres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C	C	C	C	C	C	C	C	C					

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	6.070	3.200	4.830	3.210	2.240	0.980	1.140	1.300	1.650					
Directly Connected Impervious Area (DCIA, %)	22.9%	27.2%	24.0%	19.6%	22.3%	30.6%	32.5%	0.0%	0.0%					
Unconnected Impervious Area (UIA, %)	38.6%	36.4%	38.0%	40.2%	38.8%	34.7%	33.8%	50.0%	50.0%					
Receiving Pervious Area (RPA, %)	38.6%	36.4%	38.0%	40.2%	38.8%	34.7%	33.8%	50.0%	50.0%					
Separate Pervious Area (SPA, %)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%					
A_R (RPA / UIA)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000					
I_a Check	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500					
f / I for WQCV Event:	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9					
f / I for 5-Year Event:	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5					
f / I for 100-Year Event:	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3					
f / I for Optional User Defined Storm CUHP:														
IRF for WQCV Event:	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81					
IRF for 5-Year Event:	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89					
IRF for 100-Year Event:	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93					
IRF for Optional User Defined Storm CUHP:														
Total Site Imperviousness: I_{total}	61.4%	63.6%	62.0%	59.8%	61.2%	65.3%	66.2%	50.0%	50.0%					
Effective Imperviousness for WQCV Event:	54.2%	56.8%	54.9%	52.3%	53.9%	58.8%	59.9%	40.6%	40.6%					
Effective Imperviousness for 5-Year Event:	57.2%	59.6%	57.9%	55.4%	56.9%	61.5%	62.5%	44.5%	44.5%					
Effective Imperviousness for 100-Year Event:	58.8%	61.1%	59.4%	57.0%	58.5%	62.9%	63.9%	46.6%	46.6%					
Effective Imperviousness for Optional User Defined Storm CUHP:														

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	9.5%	9.3%	9.5%	9.8%	9.6%	9.1%	9.0%	12.0%	12.0%	N/A	N/A	N/A	N/A	N/A
This line only for 10-Year Event	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	4.2%	3.8%	4.1%	4.5%	4.2%	3.5%	3.4%	6.8%	6.8%	N/A	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:														

Total Site Imperviousness:	**60.6%**
Total Site Effective Imperviousness for WQCV Event:	**53.2%**
Total Site Effective Imperviousness for 5-Year Event:	**56.3%**
Total Site Effective Imperviousness for 100-Year Event:	**57.9%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.
** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.
*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

APPENDIX C – HYDRAULIC CALCULATIONS

MHFD-Inlet, Version 5.01 (April 2021)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	DP2	DP3	DP4
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	On Grade
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	1.2	1.4	10.9
Major Q_{Known} (cfs)	2.7	3.2	24.3

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:			
Minor Bypass Flow Received, Q_b (cfs)			
Major Bypass Flow Received, Q_b (cfs)			

SEE 5-YEAR AND 100-YEAR TABS FROM DRAINAGE CALCS FOR BYPASS FLOW CALCULATIONS

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)	**1.2**	**1.4**	**10.9**
Major Total Design Peak Flow, Q (cfs)	**2.7**	**3.2**	**24.3**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	0.0	1.3
Major Flow Bypassed Downstream, Q_b (cfs)	0.0	0.0	9.4

MHFD-Inlet, Version 5.01 (April 2021)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	DP5	DP7	DP8
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	On Grade
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	5.8	9.5	6.9
Major Q_{Known} (cfs)	12.8	21.2	20.2

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	SEE 5-YEAR AND 100-YEAR TABS FROM DRAINAGE CALCS FOR BYPASS FLOW CALCULATIONS
Minor Bypass Flow Received, Q_b (cfs)	
Major Bypass Flow Received, Q_b (cfs)	

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)	**5.8**	**9.5**	**6.9**
Major Total Design Peak Flow, Q (cfs)	**12.8**	**21.2**	**20.2**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.8	0.8	0.1
Major Flow Bypassed Downstream, Q_b (cfs)	5.0	7.3	6.6

MHFD-Inlet, Version 5.01 (April 2021)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	DP9	DP6
Site Type (Urban or Rural)	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET
Hydraulic Condition	In Sump	On Grade
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening

NOTE
PLEASE SEE APPENDIX D FOR PHASE 2 FDR DP AX AND PHASE 3 FDR DP I DESIGN DETALS

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	6.0	3.7
Major Q_{Known} (cfs)	22.8	17.9

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:		
Minor Bypass Flow Received, Q_b (cfs)		
Major Bypass Flow Received, Q_b (cfs)		

SEE 5-YEAR AND 100-YEAR TABS FROM DRAINAGE CALCS FOR BYPASS FLOW CALCULATIONS

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

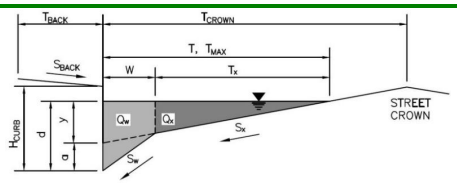
Minor Total Design Peak Flow, Q (cfs)	**6.0**	**3.7**
Major Total Design Peak Flow, Q (cfs)	**22.8**	**17.9**
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	1.4
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	13.3

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **BRADLEY HEIGHTS FILING 5**

Inlet ID: **DP2**



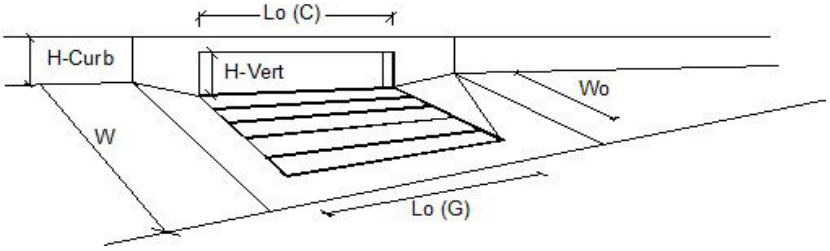
Gutter Geometry:				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.020		ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.063		ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.010		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	7.8	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	
MINOR STORM Allowable Capacity is based on Spread Criterion		Minor Storm	Major Storm	
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**10.5**	**36.7**	**cfs**

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'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



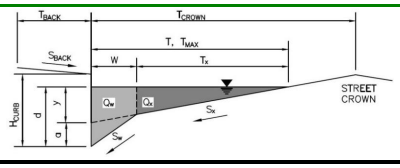
Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.2**	**2.7**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**100**	**%**

MHFD-Inlet, Version 5.01 (April 2021)

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **BRADLEY HEIGHTS FILING 5**
Inlet ID: **DP3**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.063	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

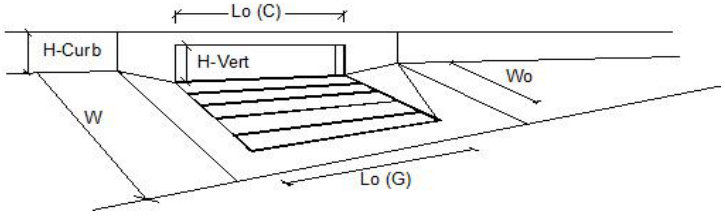
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	7.8	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**10.5**	**36.7**	**cfs**

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'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)

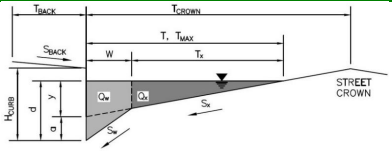


Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.4**	**3.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**100**	**%**

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **BRADLEY HEIGHTS FILING 5**
Inlet ID: **DP4**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.063	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.040	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

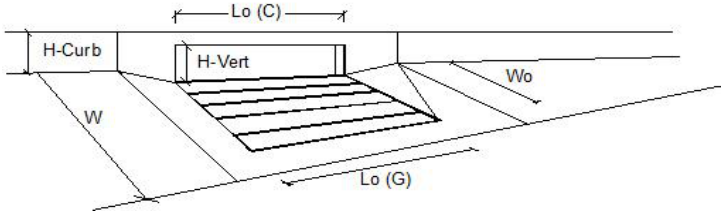
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	7.8	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**20.5**	**35.2**	**cfs**

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'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)

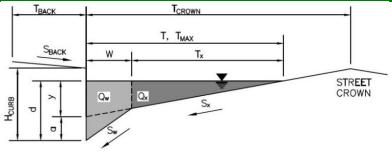


Design Information (Input) — CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**9.6**	**14.9**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**1.3**	**9.4**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**88**	**61**	**%**

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **BRADLEY HEIGHTS FILING 5**
Inlet ID: **DP5**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.063	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.040	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

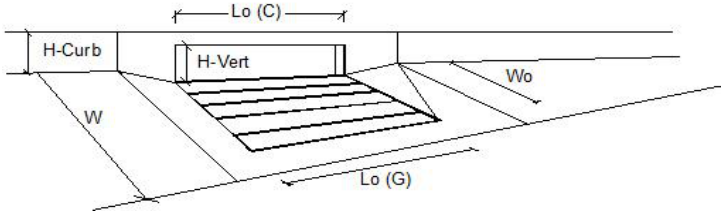
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	7.8	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**20.5**	**35.2**	**cfs**

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'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)

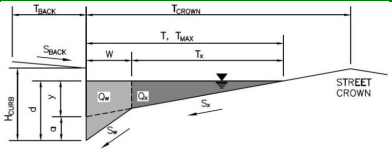


Design Information (Input) — CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**5.0**	**7.8**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.8**	**5.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**87**	**61**	**%**

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **BRADLEY HEIGHTS FILING 5**
Inlet ID: **DP6**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.063	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.005	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

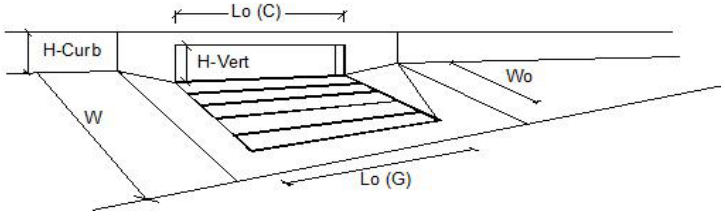
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	7.8	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**7.4**	**7.4**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'
WARNING: MAJOR STORM max. allowable capacity is less than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



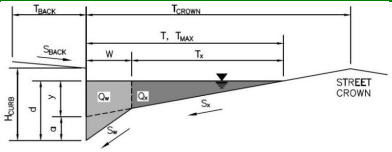
Design Information (Input) CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: WARNING: Q > ALLOWABLE Q FOR MAJOR STORM		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.3**	**4.6**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**1.4**	**13.3**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**62**	**26**	**%**

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **BRADLEY HEIGHTS FILING 5**
Inlet ID: **DP7**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.063	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.040	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

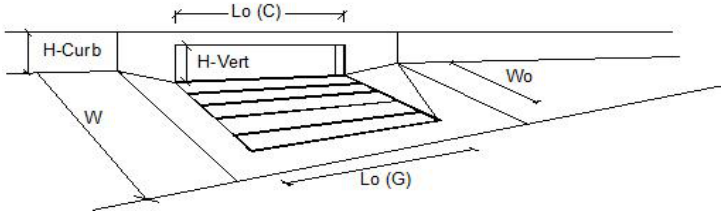
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	7.8	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**20.5**	**35.2**	**cfs**

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'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)

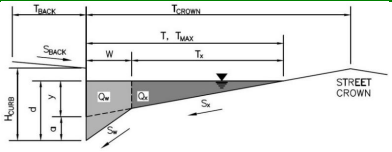


Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**8.7**	**13.9**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.8**	**7.3**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**92**	**66**	**%**

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **BRADLEY HEIGHTS FILING 5**
Inlet ID: **DP8**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.063	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.040	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

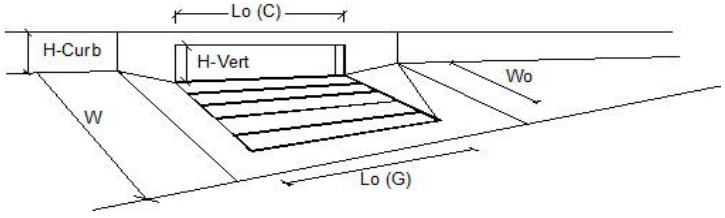
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	7.8	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**20.5**	**35.2**	**cfs**

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'

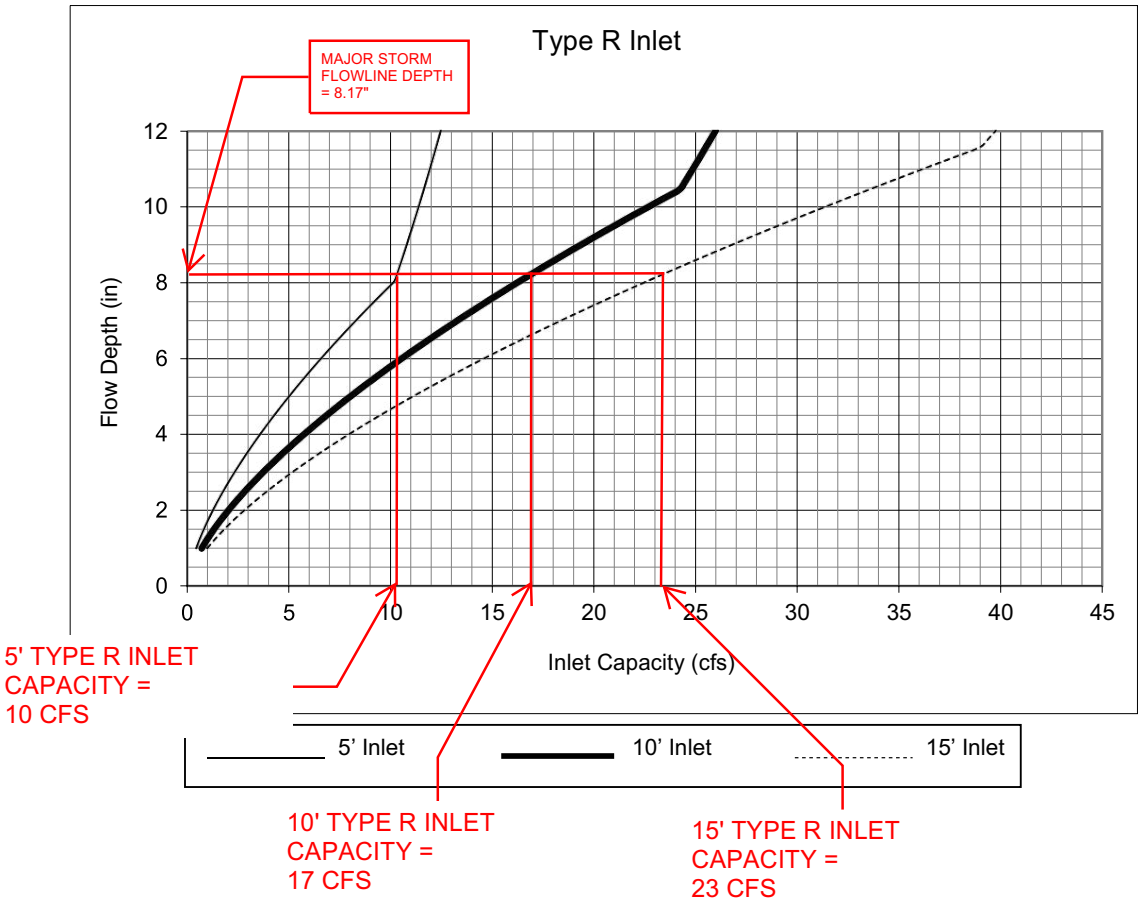
INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



Design Information (Input) — CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**6.8**	**13.6**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.1**	**6.6**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**99**	**67**	**%**

Figure 8-11. Inlet Capacity Chart Sump Conditions , Curb Opening (Type R) Inlet



SUMP INLETS

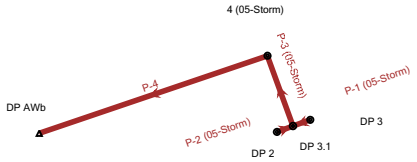
DP9 - Q100 = 21.9 CFS -> 15' TYPE R

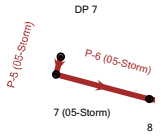
DP10 - Q100 = 4.8 CFS -> 5' TYPE R IS SUFFICIENT FOR FLOWS: USE 10' TYPE R DUE TO PIPE SIZE

Notes:

1. The standard inlet parameters must apply to use this chart.

STORMCAD LAYOUT

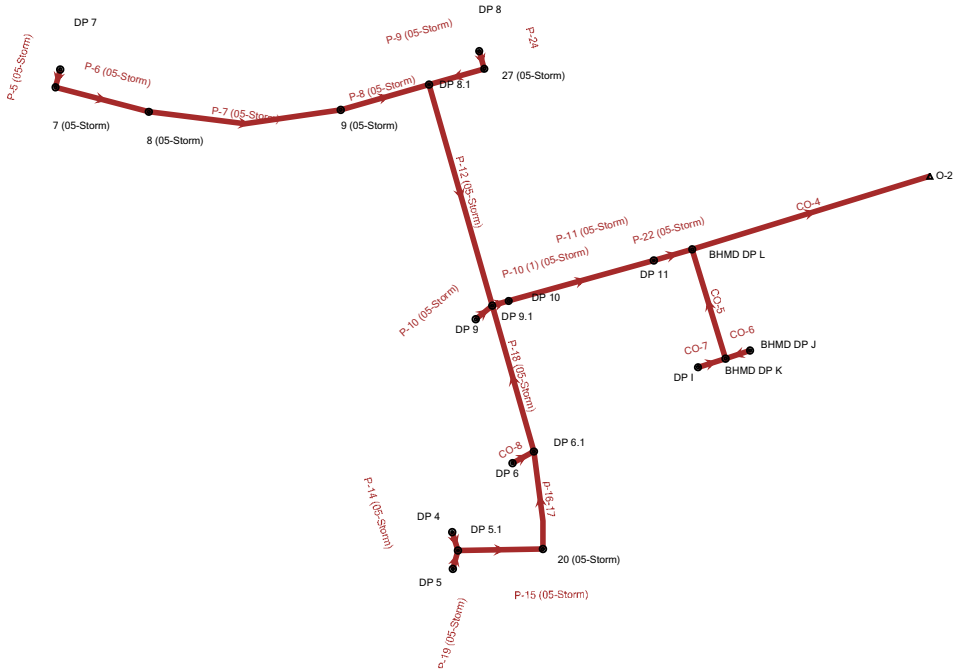




SEE NEXT PAGE

THIS PORTION AND THE CONNECTION TO THE LARGER PHASE 2 FDR STORM NETWORK WERE MODELED AS PART OF THE PHASE 2 FDR. SEE APPENDIX E FOR STORMCAD MODELING VALUES.

STORMCAD LAYOUT



5-YEAR SCENARIO

FlexTable: Conduit Table

Label	Upstream Structure	Diameter (in)	Length (Unified) (ft)	Flow (cfs)	Velocity (ft/s)	Invert (Start) (ft)	Invert (Stop) (ft)	Slope (Calculated) (ft/ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
P-22 (05-Storm)	DP 11	42.0	37.0	37.50	7.57	5,814.40	5,814.21	0.005	5,817.87	5,817.82
P-3 (05-Storm)	DP 3.1	18.0	69.1	2.60	8.54	5,855.52	5,852.30	0.047	5,856.13	5,852.91
P-1 (05-Storm)	DP 3	18.0	17.0	1.40	4.74	5,856.07	5,855.82	0.015	5,856.52	5,856.44
P-2 (05-Storm)	DP 2	18.0	15.8	1.20	6.16	5,856.38	5,855.83	0.035	5,856.79	5,856.44
P-5 (05-Storm)	DP 7	18.0	17.0	9.50	11.49	5,848.47	5,847.80	0.039	5,849.66	5,849.51
P-6 (05-Storm)	7 (05-Storm)	18.0	89.4	9.50	13.96	5,847.50	5,841.58	0.066	5,848.69	5,842.19
P-7 (05-Storm)	8 (05-Storm)	18.0	179.8	9.50	12.97	5,841.48	5,831.73	0.054	5,842.67	5,832.38
P-8 (05-Storm)	9 (05-Storm)	18.0	85.1	9.50	12.67	5,831.62	5,827.29	0.051	5,832.81	5,828.80
P-19 (05-Storm)	DP 5	24.0	17.7	5.00	8.13	5,832.26	5,831.80	0.026	5,833.47	5,833.51
P-14 (05-Storm)	DP 4	24.0	17.7	9.60	8.06	5,832.07	5,831.80	0.015	5,833.46	5,833.51
P-15 (05-Storm)	DP 5.1	24.0	78.5	14.60	9.84	5,831.50	5,829.98	0.019	5,832.88	5,831.88
P-9 (05-Storm)	27 (05-Storm)	18.0	53.1	6.70	7.51	5,828.62	5,827.78	0.016	5,829.62	5,828.80
P-12 (05-Storm)	DP 8.1	30.0	212.5	15.40	13.67	5,826.78	5,816.61	0.048	5,828.10	5,818.55
P-18 (05-Storm)	DP 6.1	24.0	140.3	15.60	15.99	5,826.87	5,817.11	0.070	5,828.29	5,818.55
P-10 (05-Storm)	DP 9	24.0	19.7	6.20	12.06	5,818.41	5,817.11	0.066	5,819.29	5,818.55
P-10 (1) (05-Storm)	DP 9.1	42.0	15.8	35.50	14.68	5,815.61	5,815.09	0.033	5,817.52	5,817.88
P-11 (05-Storm)	DP 10	42.0	139.4	2.10	3.10	5,815.09	5,814.50	0.004	5,817.88	5,817.88
p-16-17	20 (05-Storm)	24.0	90.7	14.60	11.22	5,829.68	5,827.17	0.028	5,831.06	5,828.97
P-4	4 (05-Storm)	18.0	220.2	2.60	9.47	5,852.00	5,838.28	0.062	5,852.61	5,838.60
P-24	DP 8	18.0	17.0	6.70	8.61	5,829.31	5,828.92	0.023	5,830.31	5,830.21
CO-4	BHMD DP L	42.0	229.7	55.54	8.18	5,814.12	5,812.97	0.005	5,816.45	5,815.30
CO-5	BHMD DP K	30.0	99.2	14.18	14.68	5,820.62	5,814.41	0.063	5,821.89	5,817.82
CO-6	BHMD DP J	18.0	24.2	4.98	2.82	5,820.93	5,820.63	0.012	5,822.60	5,822.55
CO-7	DP I		24.2	10.10	9.50	5,821.40	5,820.63	0.032	5,822.48	5,822.55
CO-8	DP 6	18.0	19.0	1.40	7.87	5,828.16	5,827.37	0.042	5,829.74	5,828.97

5-YEAR SCENARIO

FlexTable: Network Elements Table

Label	Flow (Known) (cfs)	Elevation (User Defined Tailwater) (ft)	Headloss Coefficient (Standard)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Invert (Start) (ft)	Invert (Stop) (ft)
4 (05-Storm)	0.00		1.320	5,852.91	5,852.61		
DP 3	1.40		0.000	5,856.52	5,856.52		
DP 2	1.20		0.000	5,856.79	5,856.79		
DP 3.1	2.60		1.320	5,856.44	5,856.13		
DP 7	9.50		0.000	5,849.66	5,849.66		
7 (05-Storm)	0.00		1.320	5,849.51	5,848.69		
8 (05-Storm)	0.00		0.050	5,842.70	5,842.67		
9 (05-Storm)	0.00		0.050	5,832.84	5,832.81		
DP 5	5.00		0.000	5,833.47	5,833.47		
DP 4	9.60		0.000	5,833.46	5,833.46		
DP 5.1	14.60		1.020	5,833.51	5,832.88		
DP 8.1	15.40		1.320	5,828.80	5,828.10		
20 (05-Storm)	0.00		1.320	5,831.88	5,831.06		
DP 6.1	15.60		1.020	5,828.97	5,828.29		
DP 9	6.20		0.000	5,819.29	5,819.29		
DP 10	2.10		0.050	5,817.88	5,817.88		
DP 9.1	35.50		1.520	5,818.55	5,817.52		
DP 8	6.70		0.000	5,830.31	5,830.31		
27 (05-Storm)	0.00		1.320	5,830.21	5,829.62		
DP 11	37.50		0.050	5,817.88	5,817.87		
BHMD DP L	55.54		1.320	5,817.82	5,816.45		
BHMD DP K	14.18		1.320	5,822.55	5,821.89		
BHMD DP J	4.98		0.000	5,822.60	5,822.60		
DP I	10.10		0.050	5,822.49	5,822.48		
DP 6	1.40		0.000	5,829.74	5,829.74		
O-2		0.00					
DP AWb		5,838.88					
P-22 (05-Storm)				5,817.87	5,817.82	5,814.40	5,814.21
P-3 (05-Storm)				5,856.13	5,852.91	5,855.52	5,852.30
P-1 (05-Storm)				5,856.52	5,856.44	5,856.07	5,855.82
P-2 (05-Storm)				5,856.79	5,856.44	5,856.38	5,855.83
P-5 (05-Storm)				5,849.66	5,849.51	5,848.47	5,847.80

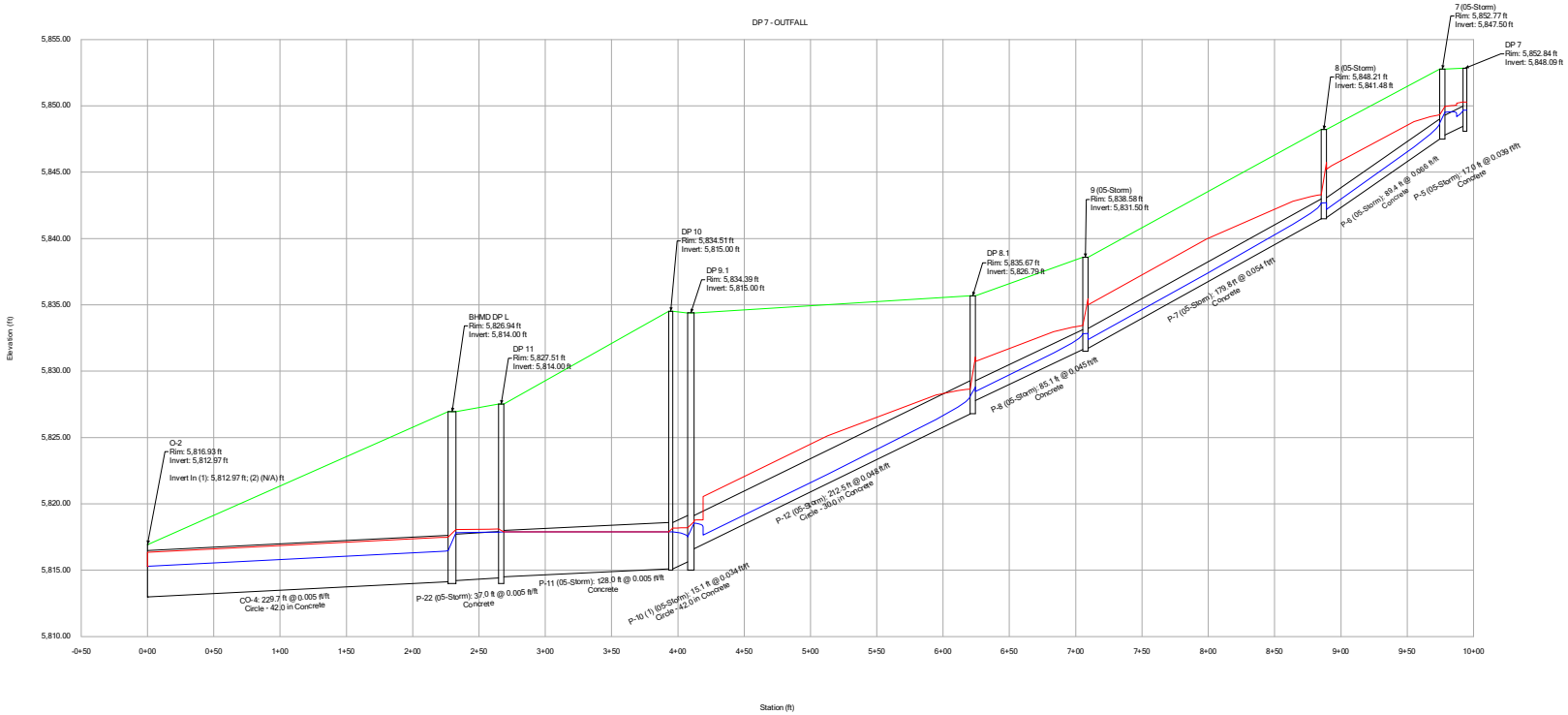
FlexTable: Network Elements Table

Label	Flow (Known) (cfs)	Elevation (User Defined Tailwater) (ft)	Headloss Coefficient (Standard)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Invert (Start) (ft)	Invert (Stop) (ft)
P-6 (05-Storm)				5,848.69	5,842.19	5,847.50	5,841.58
P-7 (05-Storm)				5,842.67	5,832.38	5,841.48	5,831.73
P-8 (05-Storm)				5,832.81	5,828.80	5,831.62	5,827.29
P-19 (05-Storm)				5,833.47	5,833.51	5,832.26	5,831.80
P-14 (05-Storm)				5,833.46	5,833.51	5,832.07	5,831.80
P-15 (05-Storm)				5,832.88	5,831.88	5,831.50	5,829.98
P-9 (05-Storm)				5,829.62	5,828.80	5,828.62	5,827.78
P-12 (05-Storm)				5,828.10	5,818.55	5,826.78	5,816.61
P-18 (05-Storm)				5,828.29	5,818.55	5,826.87	5,817.11
P-10 (05-Storm)				5,819.29	5,818.55	5,818.41	5,817.11
P-10 (1) (05-Storm)				5,817.52	5,817.88	5,815.61	5,815.09
P-11 (05-Storm)				5,817.88	5,817.88	5,815.09	5,814.50
p-16-17				5,831.06	5,828.97	5,829.68	5,827.17
P-4				5,852.61	5,838.60	5,852.00	5,838.28
P-24				5,830.31	5,830.21	5,829.31	5,828.92
CO-4				5,816.45	5,815.30	5,814.12	5,812.97
CO-5				5,821.89	5,817.82	5,820.62	5,814.41
CO-6				5,822.60	5,822.55	5,820.93	5,820.63
CO-7				5,822.48	5,822.55	5,821.40	5,820.63
CO-8				5,829.74	5,828.97	5,828.16	5,827.37

5-YEAR SCENARIO

Profile Report

Engineering Profile - 01-stm (Bradley_F5.stsw)



LEGEND:

HGL --------

EGL --------

Bentley Systems, Inc. Haestad Methods Solution Center
27 Siemon Company Drive Suite 200 W Watertown, CT 06795 USA
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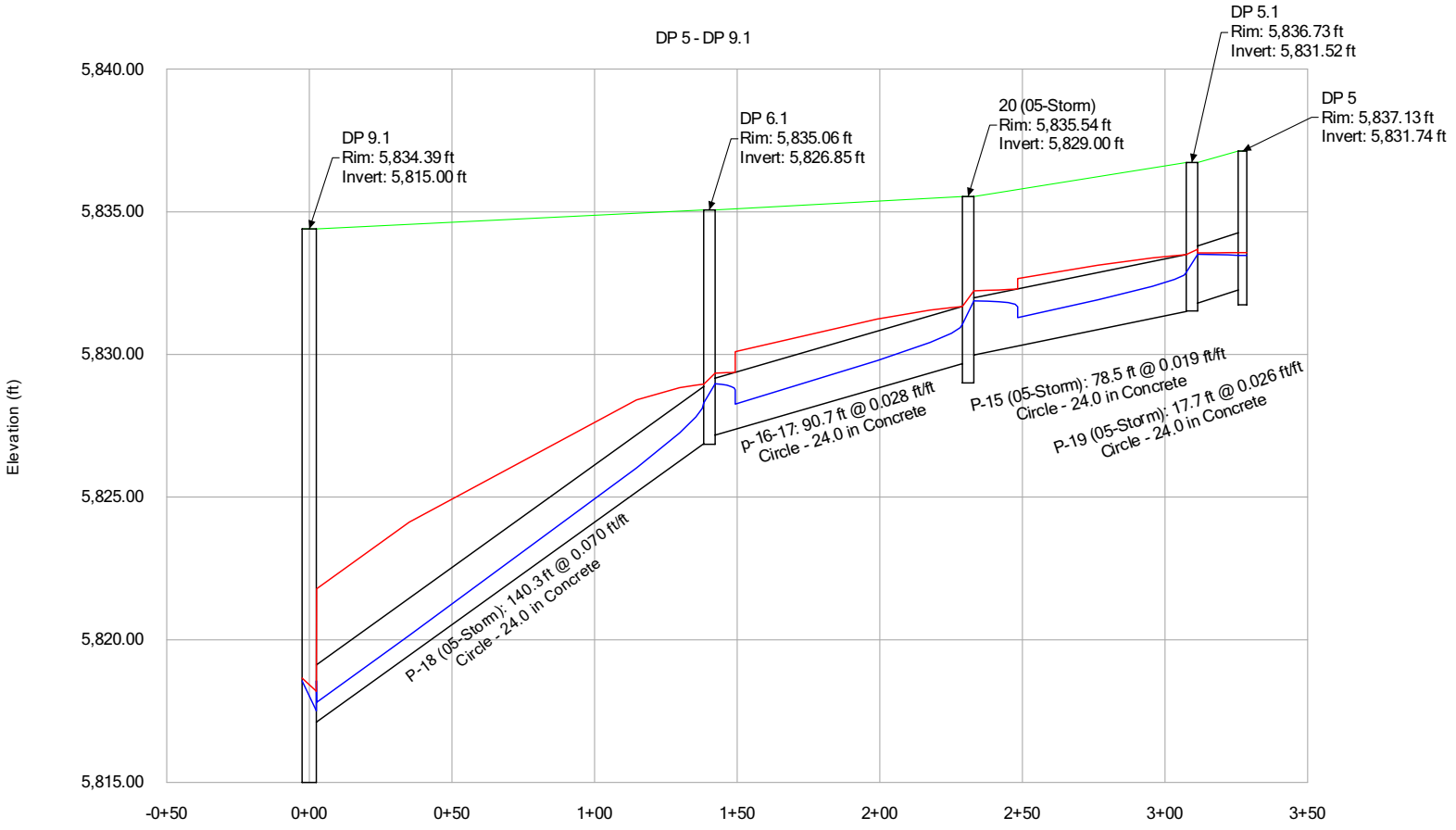
5-YEAR SCENARIO

Profile Report

Engineering Profile - 02-stm (Bradley_F5.stsw)



LEGEND:

HGL --------

EGL --------

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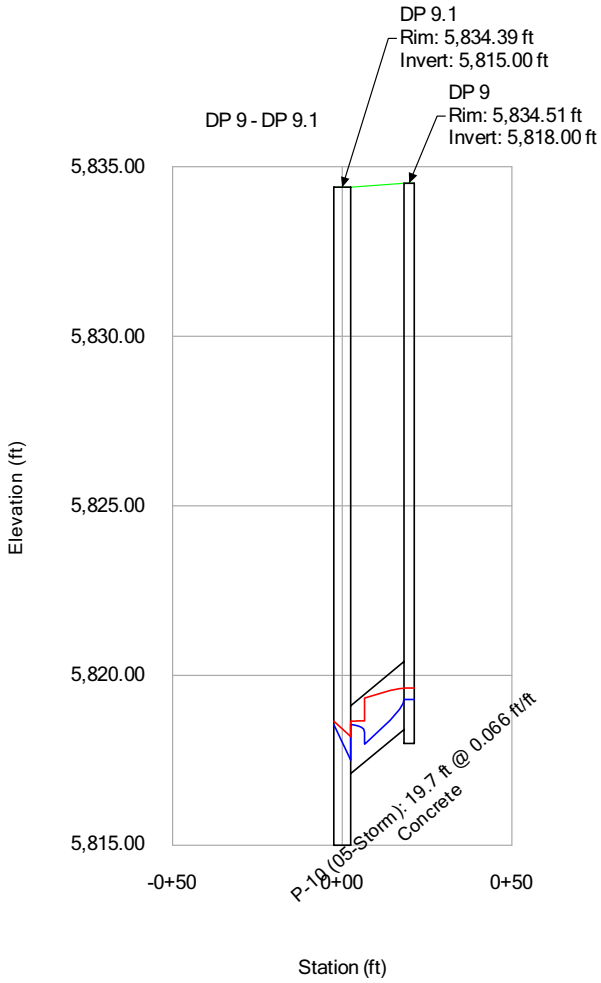
5-YEAR SCENARIO

Profile Report

Engineering Profile - 03-stm (Bradley_F5.stsw)



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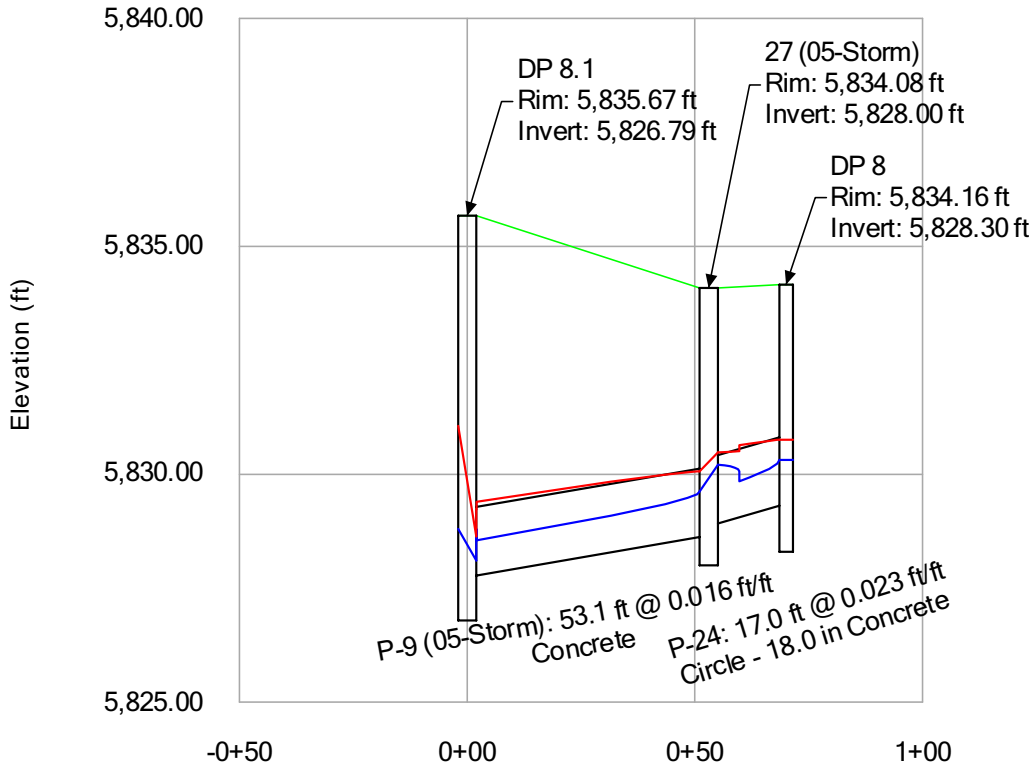
5-YEAR SCENARIO

Profile Report

Engineering Profile - 04-stm (Bradley_F5.stsw)

DP 8 - DP 8.1



LEGEND:

HGL --------

EGL --------

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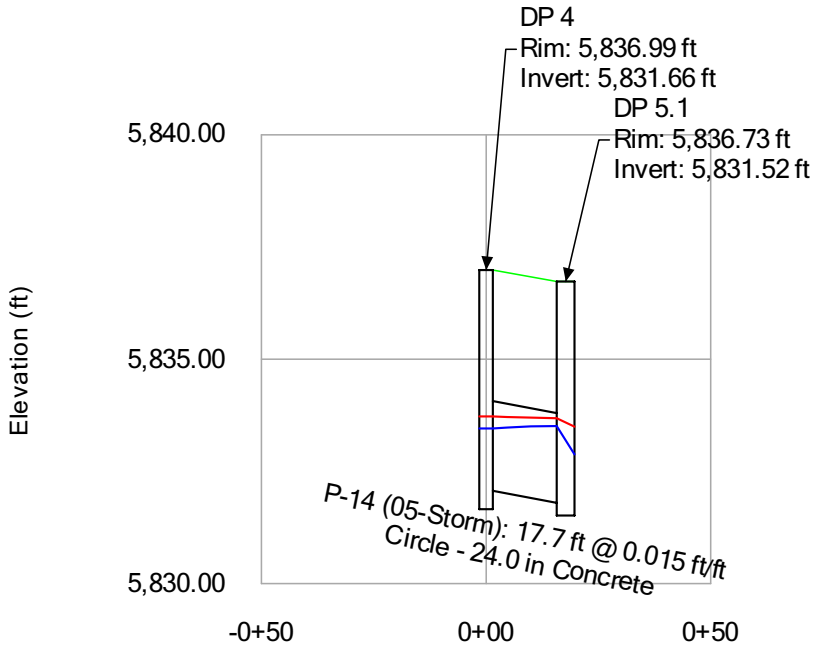
5-YEAR SCENARIO

Profile Report

Engineering Profile - 05-stm (Bradley_F5.stsw)

DP 4 - DP 5.1



LEGEND:

HGL --------

EGL --------

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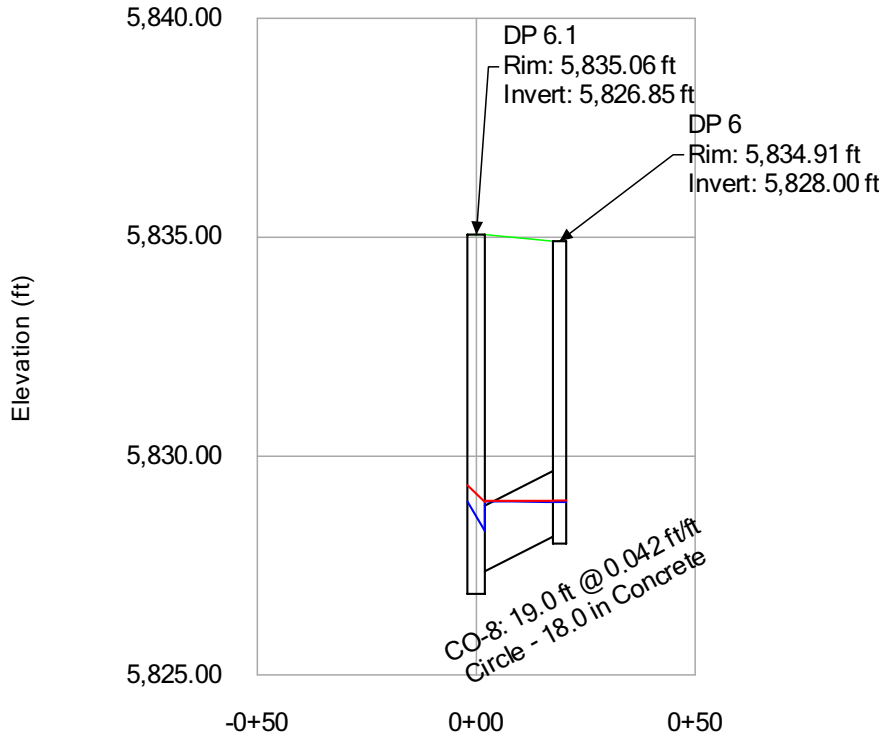
5-YEAR SCENARIO

Profile Report

Engineering Profile - 08-stm (Bradley_F5.stsw)

DP 6 - DP 6.1



LEGEND:

HGL --------

EGL --------

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100-YEAR SCENARIO

FlexTable: Conduit Table

Label	Upstream Structure	Diameter (in)	Length (Unified) (ft)	Flow (cfs)	Velocity (ft/s)	Invert (Start) (ft)	Invert (Stop) (ft)	Slope (Calculated) (ft/ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
P-22 (05-Storm)	DP 11	42.0	37.0	77.50	8.06	5,814.40	5,814.21	0.005	5,823.08	5,822.86
P-3 (05-Storm)	DP 3.1	18.0	69.1	5.80	10.73	5,855.52	5,852.30	0.047	5,856.45	5,853.45
P-1 (05-Storm)	DP 3	18.0	17.0	3.20	6.00	5,856.07	5,855.82	0.015	5,856.93	5,856.97
P-2 (05-Storm)	DP 2	18.0	15.8	2.70	7.81	5,856.38	5,855.83	0.035	5,857.00	5,856.97
P-5 (05-Storm)	DP 7	18.0	17.0	13.90	7.87	5,848.47	5,847.80	0.039	5,850.55	5,850.25
P-6 (05-Storm)	7 (05-Storm)	18.0	89.4	13.90	15.41	5,847.50	5,841.58	0.066	5,848.88	5,842.35
P-7 (05-Storm)	8 (05-Storm)	18.0	179.8	13.90	14.29	5,841.48	5,831.73	0.054	5,842.86	5,832.54
P-8 (05-Storm)	9 (05-Storm)	18.0	85.1	13.90	13.94	5,831.62	5,827.29	0.051	5,833.00	5,829.67
P-19 (05-Storm)	DP 5	24.0	17.7	7.80	2.48	5,832.26	5,831.80	0.026	5,834.32	5,834.30
P-14 (05-Storm)	DP 4	24.0	17.7	14.90	4.74	5,832.07	5,831.80	0.015	5,834.38	5,834.30
P-15 (05-Storm)	DP 5.1	24.0	78.5	22.70	10.91	5,831.50	5,829.98	0.019	5,833.47	5,832.69
P-9 (05-Storm)	27 (05-Storm)	18.0	53.1	13.60	7.70	5,828.62	5,827.78	0.016	5,830.56	5,829.67
P-12 (05-Storm)	DP 8.1	30.0	212.5	27.50	16.07	5,826.78	5,816.61	0.048	5,828.57	5,824.59
P-18 (05-Storm)	DP 6.1	24.0	140.3	26.70	18.47	5,826.87	5,817.11	0.070	5,828.67	5,824.59
P-10 (05-Storm)	DP 9	24.0	19.7	21.90	6.97	5,818.41	5,817.11	0.066	5,824.77	5,824.59
P-10 (1) (05-Storm)	DP 9.1	42.0	15.8	73.20	7.61	5,815.61	5,815.09	0.033	5,823.22	5,823.14
P-11 (05-Storm)	DP 10	42.0	139.4	4.80	0.50	5,815.09	5,814.50	0.004	5,823.13	5,823.13
p-16-17	20 (05-Storm)	24.0	90.7	22.70	12.54	5,829.68	5,827.17	0.028	5,831.38	5,829.94
P-4	4 (05-Storm)	18.0	220.2	5.80	11.92	5,852.00	5,838.28	0.062	5,852.93	5,838.76
P-24	DP 8	18.0	17.0	13.60	7.70	5,829.31	5,828.92	0.023	5,832.06	5,831.77
CO-4	BHMD DP L	42.0	229.7	120.33	12.51	5,814.12	5,812.97	0.005	5,819.65	5,816.22
CO-5	BHMD DP K	30.0	99.2	31.21	6.36	5,820.62	5,814.41	0.063	5,823.44	5,822.86
CO-6	BHMD DP J	18.0	24.2	9.08	5.14	5,820.93	5,820.63	0.012	5,824.45	5,824.27
CO-7	DP I		24.2	23.60	6.29	5,821.40	5,820.63	0.032	5,824.47	5,824.27
CO-8	DP 6	18.0	19.0	4.60	2.60	5,828.16	5,827.37	0.042	5,829.98	5,829.94

100-YEAR SCENARIO

FlexTable: Network Elements Table

Label	Flow (Known) (cfs)	Elevation (User Defined Tailwater) (ft)	Headloss Coefficient (Standard)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Invert (Start) (ft)	Invert (Stop) (ft)
4 (05-Storm)	0.00		1.320	5,853.45	5,852.93		
DP 3	3.20		0.000	5,856.93	5,856.93		
DP 2	2.70		0.000	5,857.00	5,857.00		
DP 3.1	5.80		1.320	5,856.97	5,856.45		
DP 7	13.90		0.000	5,850.55	5,850.55		
7 (05-Storm)	0.00		1.320	5,850.25	5,848.88		
8 (05-Storm)	0.00		0.050	5,842.91	5,842.86		
9 (05-Storm)	0.00		0.050	5,833.05	5,833.00		
DP 5	7.80		0.000	5,834.32	5,834.32		
DP 4	14.90		0.000	5,834.38	5,834.38		
DP 5.1	22.70		1.020	5,834.30	5,833.47		
DP 8.1	27.50		1.320	5,829.67	5,828.57		
20 (05-Storm)	0.00		1.320	5,832.69	5,831.38		
DP 6.1	26.70		1.020	5,829.94	5,828.67		
DP 9	21.90		0.000	5,824.77	5,824.77		
DP 10	4.80		0.050	5,823.14	5,823.13		
DP 9.1	73.20		1.520	5,824.59	5,823.22		
DP 8	13.60		0.000	5,832.06	5,832.06		
27 (05-Storm)	0.00		1.320	5,831.77	5,830.56		
DP 11	77.50		0.050	5,823.13	5,823.08		
BHMD DP L	120.33		1.320	5,822.86	5,819.65		
BHMD DP K	31.21		1.320	5,824.27	5,823.44		
BHMD DP J	9.08		0.000	5,824.45	5,824.45		
DP I	23.60		0.050	5,824.50	5,824.47		
DP 6	4.60		0.000	5,829.98	5,829.98		
O-2		0.00					
DP AWb		5,838.88					
P-22 (05-Storm)				5,823.08	5,822.86	5,814.40	5,814.21
P-3 (05-Storm)				5,856.45	5,853.45	5,855.52	5,852.30
P-1 (05-Storm)				5,856.93	5,856.97	5,856.07	5,855.82
P-2 (05-Storm)				5,857.00	5,856.97	5,856.38	5,855.83
P-5 (05-Storm)				5,850.55	5,850.25	5,848.47	5,847.80

100-YEAR SCENARIO

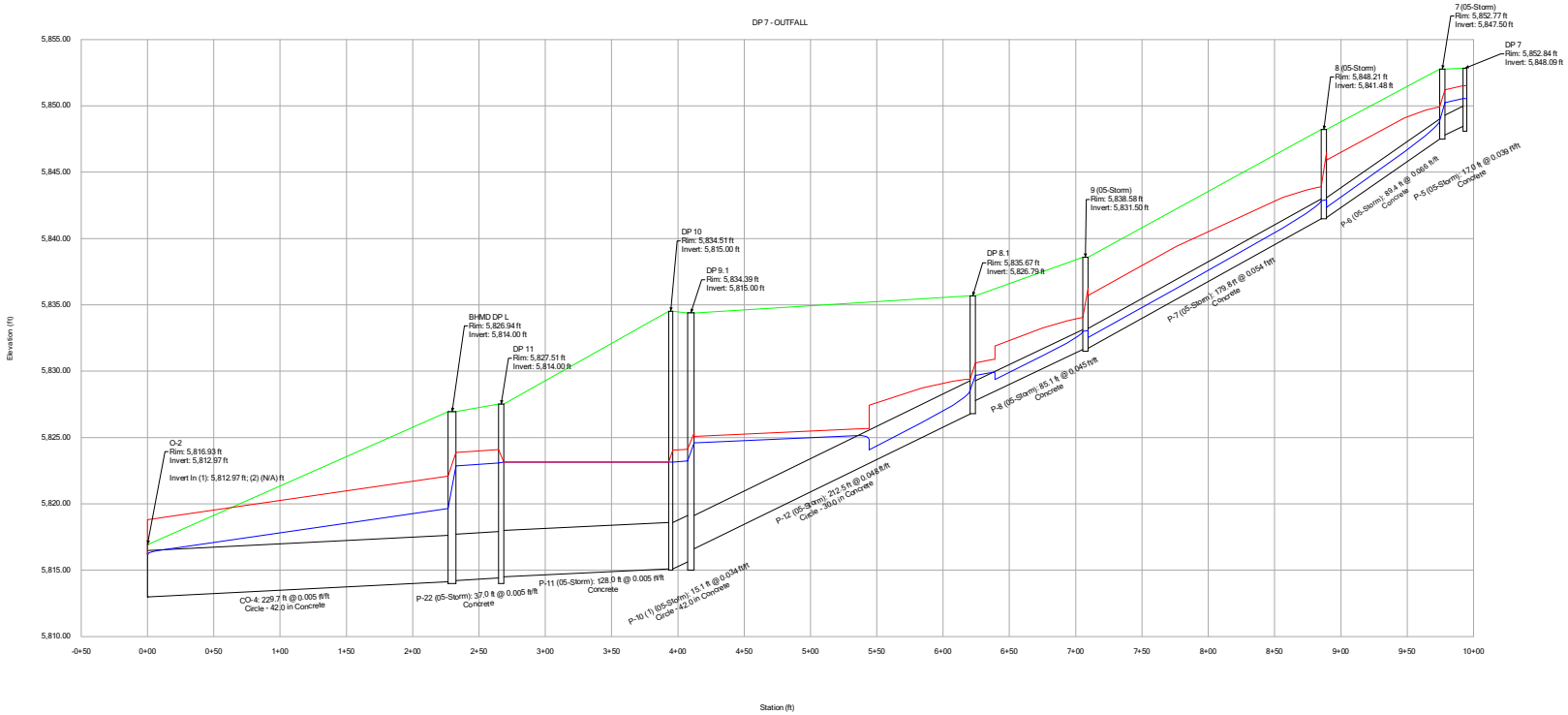
FlexTable: Network Elements Table

Label	Flow (Known) (cfs)	Elevation (User Defined Tailwater) (ft)	Headloss Coefficient (Standard)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Invert (Start) (ft)	Invert (Stop) (ft)
P-6 (05-Storm)				5,848.88	5,842.35	5,847.50	5,841.58
P-7 (05-Storm)				5,842.86	5,832.54	5,841.48	5,831.73
P-8 (05-Storm)				5,833.00	5,829.67	5,831.62	5,827.29
P-19 (05-Storm)				5,834.32	5,834.30	5,832.26	5,831.80
P-14 (05-Storm)				5,834.38	5,834.30	5,832.07	5,831.80
P-15 (05-Storm)				5,833.47	5,832.69	5,831.50	5,829.98
P-9 (05-Storm)				5,830.56	5,829.67	5,828.62	5,827.78
P-12 (05-Storm)				5,828.57	5,824.59	5,826.78	5,816.61
P-18 (05-Storm)				5,828.67	5,824.59	5,826.87	5,817.11
P-10 (05-Storm)				5,824.77	5,824.59	5,818.41	5,817.11
P-10 (1) (05-Storm)				5,823.22	5,823.14	5,815.61	5,815.09
P-11 (05-Storm)				5,823.13	5,823.13	5,815.09	5,814.50
p-16-17				5,831.38	5,829.94	5,829.68	5,827.17
P-4				5,852.93	5,838.76	5,852.00	5,838.28
P-24				5,832.06	5,831.77	5,829.31	5,828.92
CO-4				5,819.65	5,816.22	5,814.12	5,812.97
CO-5				5,823.44	5,822.86	5,820.62	5,814.41
CO-6				5,824.45	5,824.27	5,820.93	5,820.63
CO-7				5,824.47	5,824.27	5,821.40	5,820.63
CO-8				5,829.98	5,829.94	5,828.16	5,827.37

100-YEAR SCENARIO

Profile Report

Engineering Profile - 01-stm (Bradley_F5.stsw)



LEGEND:

HGL --------

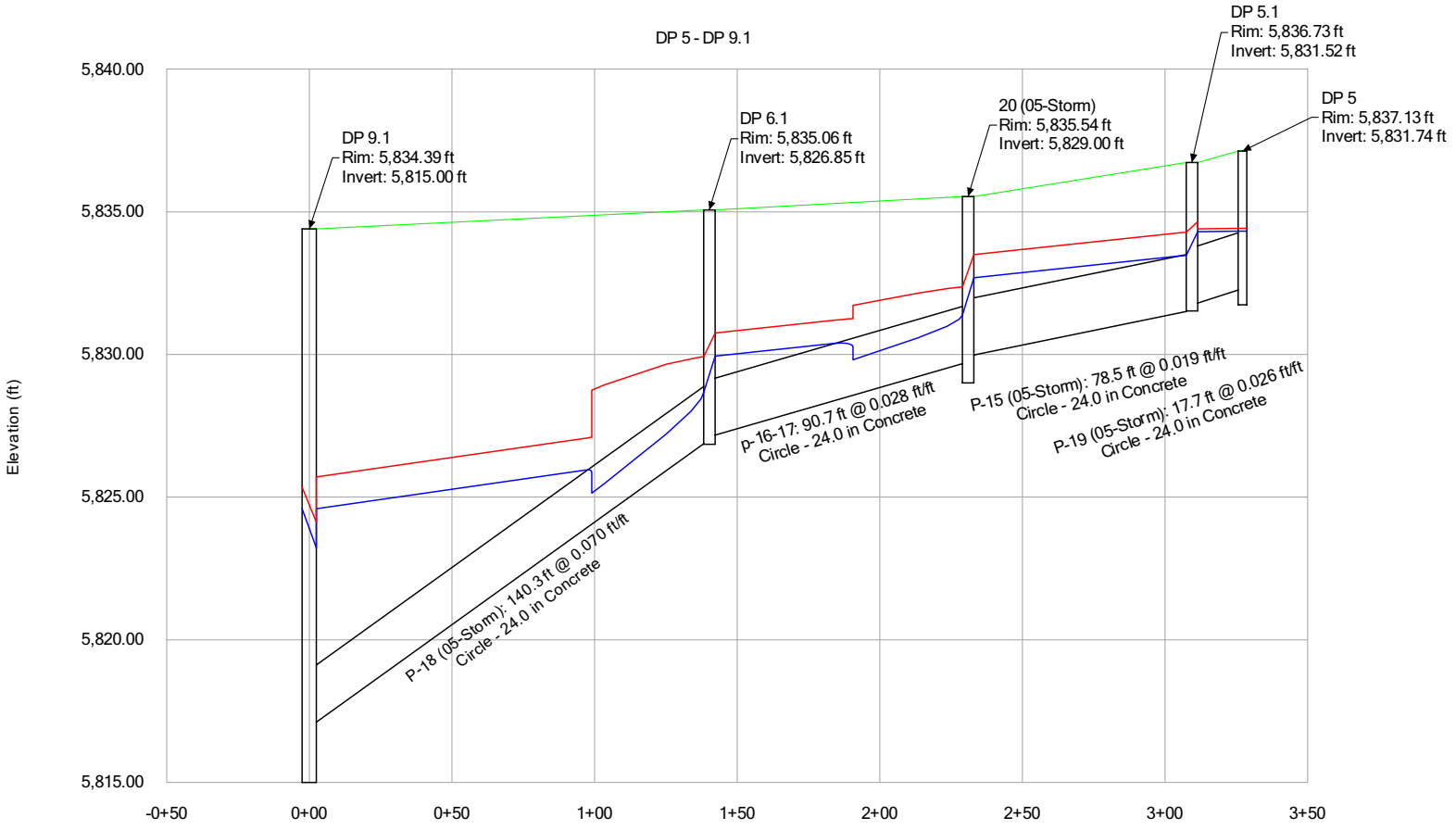
EGL --------

Bentley Systems, Inc. Haestad Methods Solution Center
27 Siemon Company Drive Suite 200 W Watertown, CT 06795 USA
+1-203-755-1666

100-YEAR SCENARIO

Profile Report

Engineering Profile - 02-stm (Bradley_F5.stsw)



LEGEND:

HGL --------

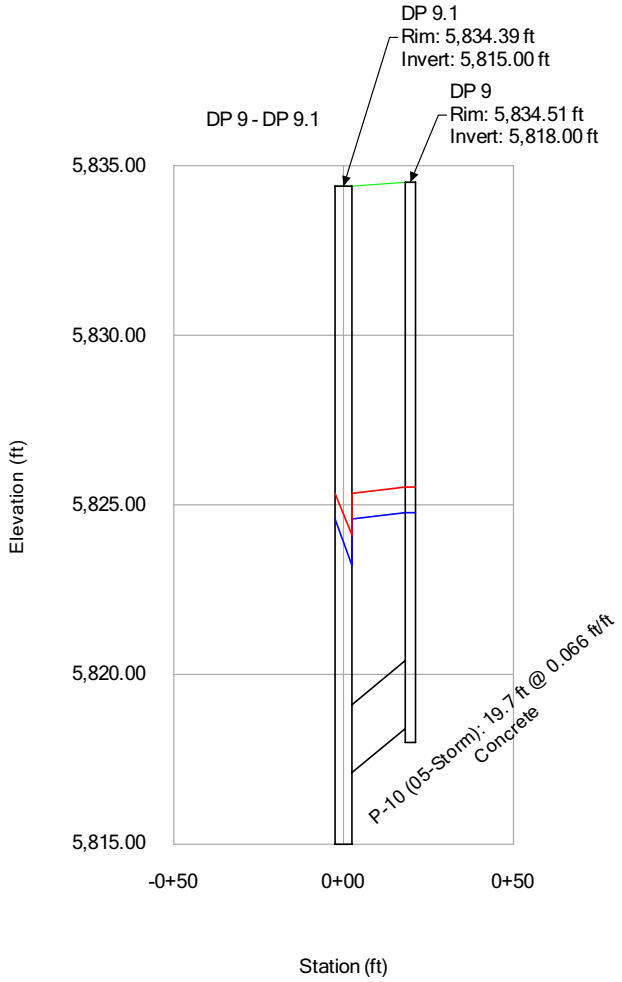
EGL --------

Bentley Systems, Inc. Haestad Methods Solution Center
27 Siemon Company Drive Suite 200 W Watertown, CT 06795 USA
+1-203-755-1666

100-YEAR SCENARIO

Profile Report

Engineering Profile - 03-stm (Bradley_F5.stsw)



LEGEND:

HGL --------

EGL --------

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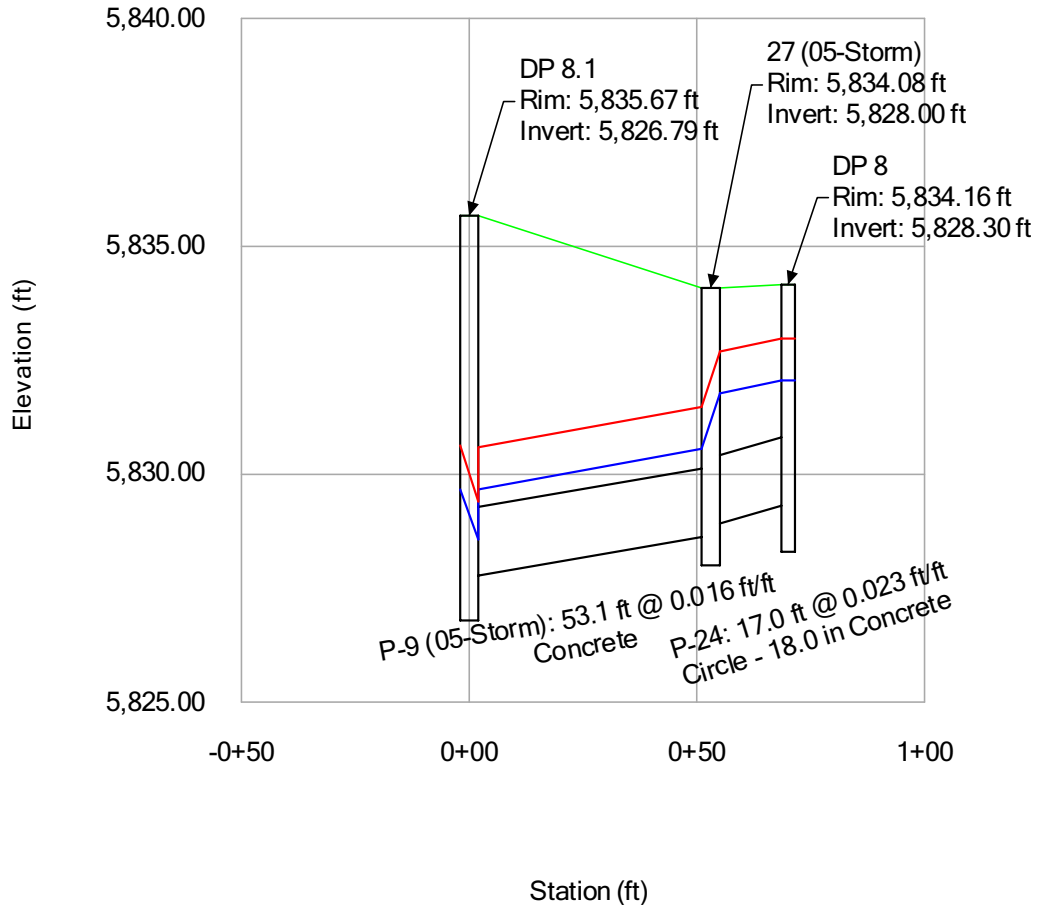
100-YEAR SCENARIO

Profile Report

Engineering Profile - 04-stm (Bradley_F5.stsw)

DP 8 - DP 8.1



LEGEND:

HGL --------

EGL --------

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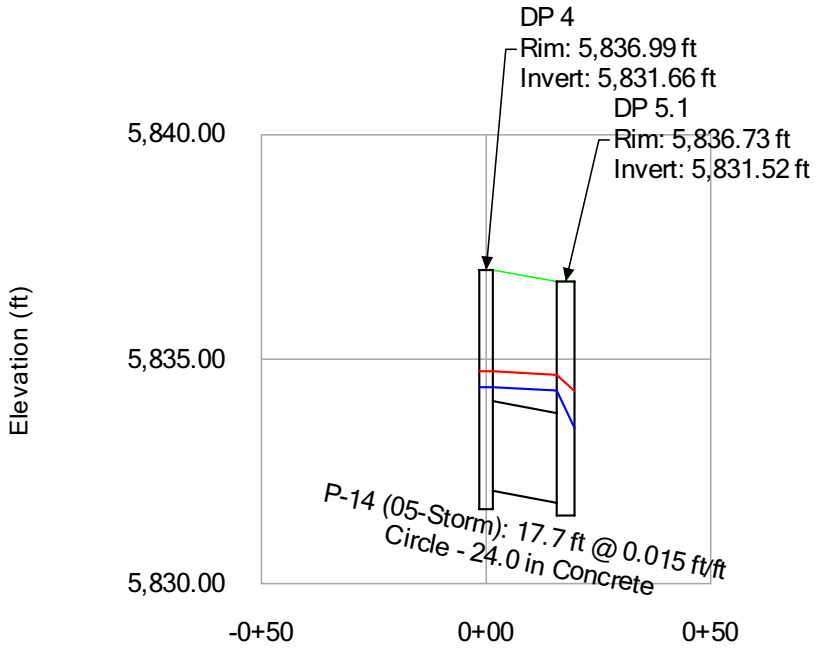
+1-203-755-1666

100-YEAR SCENARIO

Profile Report

Engineering Profile - 05-stm (Bradley_F5.stsw)

DP 4 - DP 5.1



LEGEND:

HGL --------

EGL --------

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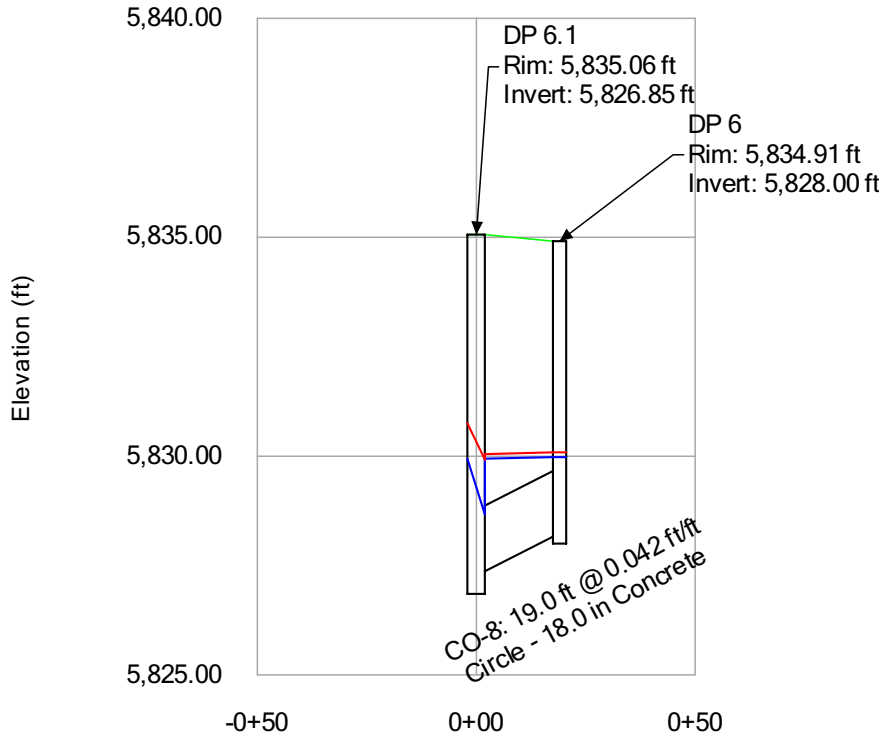
100-YEAR SCENARIO

Profile Report

Engineering Profile - 08-stm (Bradley_F5.stsw)

DP 6 - DP 6.1



LEGEND:

HGL --------

EGL --------

Bentley Systems, Inc. Haestad Methods Solution Center
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APPENDIX D – BRADLEY HEIGHTS MDDPA, PHASE 2 FDR, & PHASE 3 FDR CALCULATIONS

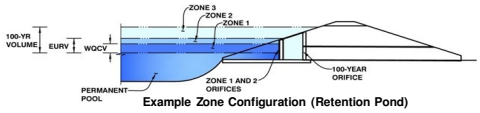
PHASE 2 FDR - WFJCC POND #1 DESIGN

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: BRADLEY HEIGHTS - WFJCC POND #1

Basin ID: WEST FORK JIMMY CAMP CREEK



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	76.22	acres
Watershed Length =	2,500	ft
Watershed Length to Centroid =	1,000	ft
Watershed Slope =	0.040	ft/ft
Watershed Imperviousness =	54.21%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	61.1%	percent
Percentage Hydrologic Soil Groups C/D =	38.9%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Denver - Capitol Building	

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

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	1.385	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	4.247	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	4.249	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	5.977	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	7.495	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	9.354	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	10.954	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	12.920	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3.55 in.) =	19.729	acre-feet	3.55 inches
Approximate 2-yr Detention Volume =	3.424	acre-feet	
Approximate 5-yr Detention Volume =	4.803	acre-feet	
Approximate 10-yr Detention Volume =	5.948	acre-feet	
Approximate 25-yr Detention Volume =	6.447	acre-feet	
Approximate 50-yr Detention Volume =	6.706	acre-feet	
Approximate 100-yr Detention Volume =	7.459	acre-feet	

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	1.385	acre-feet
Zone 2 Volume (EURV - Zone 1) =	2.862	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	3.212	acre-feet
Total Detention Basin Volume =	7.459	acre-feet
Initial Surcharge Volume (ISV) =	181	ft^3
Initial Surcharge Depth (ISD) =	0.33	ft
Total Available Detention Depth (H_{total}) =	7.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.005	ft/ft
Slopes of Main Basin Sides (S_{main}) =	4	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	4	

Initial Surcharge Area (A_{ISV}) =	549	ft^2
Surcharge Volume Length (L_{ISV}) =	23.4	ft
Surcharge Volume Width (W_{ISV}) =	23.4	ft
Depth of Basin Floor (H_{FLOOR}) =	2.12	ft
Length of Basin Floor (L_{FLOOR}) =	455.9	ft
Width of Basin Floor (W_{FLOOR}) =	129.4	ft
Area of Basin Floor (A_{FLOOR}) =	59,004	ft^2
Volume of Basin Floor (V_{FLOOR}) =	46,104	ft^3
Depth of Main Basin (H_{MAIN}) =	4.05	ft
Length of Main Basin (L_{MAIN}) =	488.3	ft
Width of Main Basin (W_{MAIN}) =	161.8	ft
Area of Main Basin (A_{MAIN}) =	79,018	ft^2
Volume of Main Basin (V_{MAIN}) =	278,509	ft^3
Calculated Total Basin Volume (V_{total}) =	**7.463**	acre-feet

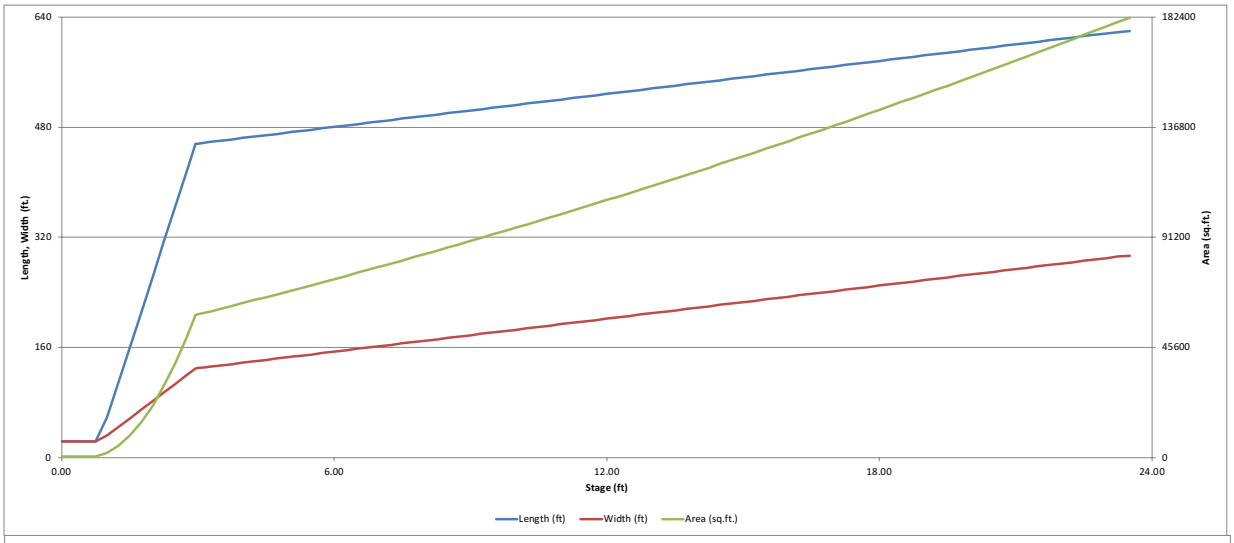
Depth Increment = 0.25 ft

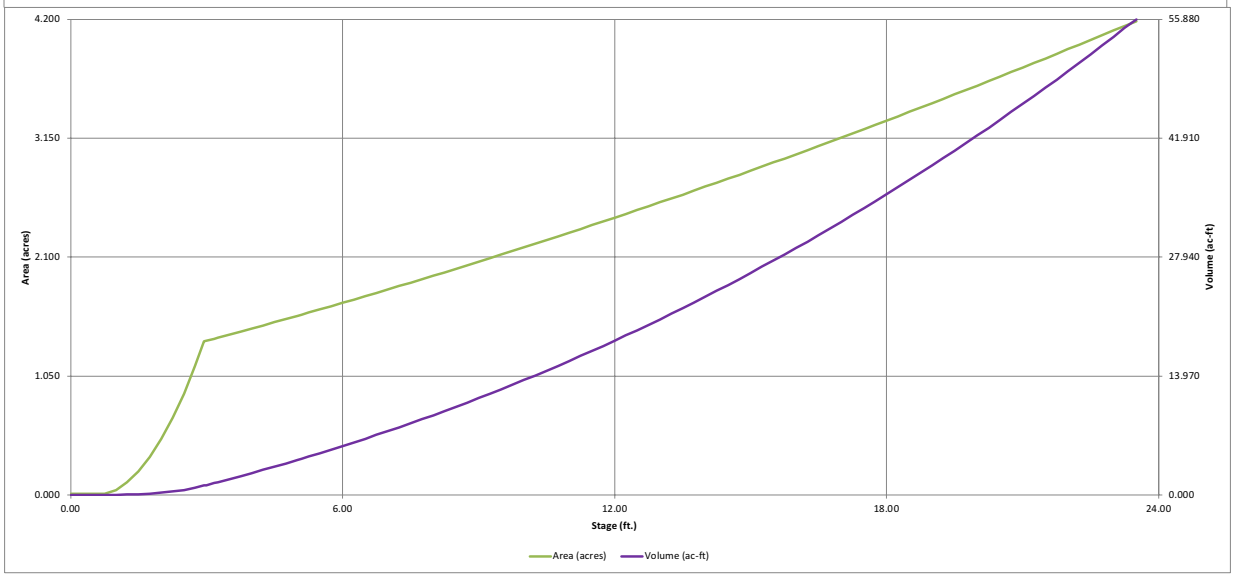
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	0.00		23.4	23.4	549		0.013		
ISV	0.33		23.4	23.4	549		0.013	181	0.004
	0.50		23.4	23.4	549		0.013	274	0.006
	0.75		23.4	23.4	549		0.013	411	0.009
	1.00		58.1	31.9	1,855		0.043	651	0.015
	1.25		109.1	44.4	4,846		0.111	1,462	0.034
	1.50		160.1	56.9	9,113		0.209	3,181	0.073
	1.75		211.1	69.4	14,655		0.336	6,125	0.141
	2.00		262.1	81.9	21,472		0.493	10,615	0.244
	2.25		313.1	94.4	29,564		0.679	16,967	0.390
	2.50		364.1	106.9	38,930		0.894	25,503	0.585
	2.75		415.1	119.4	49,572		1.138	36,539	0.839
Floor	2.95		455.9	129.4	59,004		1.355	47,383	1.088
	3.00		456.3	129.8	59,238		1.360	50,339	1.156
Zone 1 (WQCV)	3.17		457.7	131.2	60,037		1.378	60,477	1.388
	3.25		458.3	131.8	60,414		1.387	65,295	1.499
	3.50		460.3	133.8	61,598		1.414	80,547	1.849
	3.75		462.3	135.8	62,791		1.441	96,095	2.206
	4.00		464.3	137.8	63,991		1.469	111,943	2.570
	4.25		466.3	139.8	65,199		1.497	128,091	2.941
	4.50		468.3	141.8	66,415		1.525	144,543	3.318
	4.75		470.3	143.8	67,640		1.553	161,300	3.703
	5.00		472.3	145.8	68,872		1.581	178,363	4.095
Zone 2 (EURV)	5.10		473.1	146.6	69,367		1.592	185,275	4.253
	5.25		474.3	147.8	70,112		1.610	195,736	4.493
	5.50		476.3	149.8	71,360		1.638	213,420	4.899
	5.75		478.3	151.8	72,617		1.667	231,417	5.313
	6.00		480.3	153.8	73,881		1.696	249,729	5.733
	6.25		482.3	155.8	75,153		1.725	268,358	6.161
	6.50		484.3	157.8	76,433		1.755	287,306	6.596
	6.75		486.3	159.8	77,722		1.784	306,575	7.038
Zone 3 (100-year)	6.99		488.2	161.7	78,966		1.813	325,378	7.470
	7.00		488.3	161.8	79,018		1.814	326,168	7.488
	7.25		490.3	163.8	80,322		1.844	346,085	7.945
	7.50		492.3	165.8	81,634		1.874	366,329	8.410
	7.75		494.3	167.8	82,955		1.904	386,903	8.882
	8.00		496.3	169.8	84,283		1.935	407,807	9.362
	8.25		498.3	171.8	85,619		1.966	429,045	9.850
	8.50		500.3	173.8	86,963		1.996	450,618	10.345
	8.75		502.3	175.8	88,316		2.027	472,527	10.848
	9.00		504.3	177.8	89,676		2.059	494,776	11.358
	9.25		506.3	179.8	91,044		2.090	517,366	11.877
	9.50		508.3	181.8	92,420		2.122	540,299	12.404
	9.75		510.3	183.8	93,805		2.153	563,577	12.938
	10.00		512.3	185.8	95,197		2.185	587,202	13.480
	10.25		514.3	187.8	96,597		2.218	611,176	14.031
	10.50		516.3	189.8	98,005		2.250	635,501	14.589
	10.75		518.3	191.8	99,422		2.282	660,179	15.156
	11.00		520.3	193.8	100,846		2.315	685,212	15.730
	11.25		522.3	195.8	102,278		2.348	710,603	16.313
	11.50		524.3	197.8	103,718		2.381	736,352	16.904
	11.75		526.3	199.8	105,167		2.414	762,462	17.504
	12.00		528.3	201.8	106,623		2.448	788,936	18.111
	12.25		530.3	203.8	108,087		2.481	815,775	18.728
	12.50		532.3	205.8	109,559		2.515	842,980	19.352
	12.75		534.3	207.8	111,040		2.549	870,555	19.985
	13.00		536.3	209.8	112,528		2.583	898,501	20.627
	13.25		538.3	211.8	114,024		2.618	926,819	21.277
	13.50		540.3	213.8	115,528		2.652	955,513	21.936
	13.75		542.3	215.8	117,041		2.687	984,584	22.603
	14.00		544.3	217.8	118,561		2.722	1,014,034	23.279
	14.25		546.3	219.8	120,089		2.757	1,043,865	23.964
	14.50		548.3	221.8	121,625		2.792	1,074,079	24.657
	14.75		550.3	223.8	123,170		2.828	1,104,679	25.360
	15.00		552.3	225.8	124,722		2.863	1,135,665	26.071
	15.25		554.3	227.8	126,282		2.899	1,167,040	26.792
	15.50		556.3	229.8	127,850		2.935	1,198,806	27.521
	15.75		558.3	231.8	129,426		2.971	1,230,966	28.259
	16.00		560.3	233.8	131,011		3.008	1,263,520	29.006
	16.25		562.3	235.8	132,603		3.044	1,296,472	29.763
	16.50		564.3	237.8	134,203		3.081	1,329,823	30.529
	16.75		566.3	239.8	135,811		3.118	1,363,574	31.303
	17.00		568.3	241.8	137,428		3.155	1,397,729	32.087
	17.25		570.3	243.8	139,052		3.192	1,432,289	32.881
	17.50		572.3	245.8	140,684		3.230	1,467,256	33.684
	17.75		574.3	247.8	142,324		3.267	1,502,632	34.496
	18.00		576.3	249.8	143,973		3.305	1,538,419	35.317
	18.25		578.3	251.8	145,629		3.343	1,574,619	36.148
	18.50		580.3	253.8	147,293		3.381	1,611,234	36.989
	18.75		582.3	255.8	148,965		3.420	1,648,266	37.839
	19.00		584.3	257.8	150,646		3.458	1,685,717	38.699
	19.25		586.3	259.8	152,334		3.497	1,723,589	39.568
	19.50		588.3	261.8	154,030		3.536	1,761,885	40.447
	19.75		590.3	263.8	155,734		3.575	1,800,605	41.336
	20.00		592.3	265.8	157,447		3.614	1,839,753	42.235
	20.25		594.3	267.8	159,167		3.654	1,879,329	43.143
	20.50		596.3	269.8	160,895		3.694	1,919,337	44.062
	20.75		598.3	271.8	162,631		3.734	1,959,777	44.990
	21.00		600.3	273.8	164,376		3.774	2,000,653	45.929
	21.25		602.3	275.8	166,128		3.814	2,041,966	46.877
	21.50		604.3	277.8	167,888		3.854	2,083,718	47.836
	21.75		606.3	279.8	169,656		3.895	2,125,911	48.804
	22.00		608.3	281.8	171,433		3.936	2,168,547	49.783
	22.25		610.3	283.8	173,217		3.977	2,211,628	50.772
	22.50		612.3	285.8	175,009		4.018	2,255,156	51.771
	22.75		614.3	287.8	176,809		4.059	2,299,133	52.781
	23.00		616.3	289.8	178,618		4.100	2,343,561	53.801
	23.25		618.3	291.8	180,434		4.142	2,388,442	54.831
	23.50		620.3	293.8	182,258		4.184	2,433,779	55.872

PHASE 2 FDR - WFJCC POND #1 DESIGN

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)





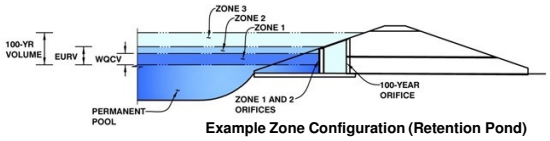
PHASE 2 FDR - WFJCC POND #1 DESIGN

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Project: **BRADELY HEIGHTS - WFJCC POND #1**

Basin ID: **WEST FORK JIMMY CAMP CREEK**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.17	1.385	Orifice Plate
Zone 2 (EURV)	5.10	2.862	Circular Orifice
Zone 3 (100-year)	6.99	3.212	Weir&Pipe (Restrict)
Total (all zones)		7.459	

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

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

Calculated Parameters for Underdrain

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	2.764E-02	ft^2
Depth at top of Zone using Orifice Plate =	3.17	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	12.70	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	3.98	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.06	2.11					
Orifice Area (sq. inches)	3.98	3.98	3.98					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Circular	Not Selected			Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	3.17	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.10	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	5.10	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.18	N/A	feet
Vertical Orifice Diameter =	4.31	N/A	inches				

Calculated Parameters for Vertical Orifice

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

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	5.10	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	6.10	N/A	feet
Overflow Weir Front Edge Length =	10.00	N/A	feet	Overflow Weir Slope Length =	8.06	N/A	feet
Overflow Weir Grate Slope =	8.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	5.75	N/A	
Horiz. Length of Weir Sides =	8.00	N/A	feet	Overflow Grate Open Area w/o Debris =	56.44	N/A	ft^2
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	28.22	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	1.00	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	9.82	N/A	ft^2
Outlet Pipe Diameter =	48.00	N/A	inches	Outlet Orifice Centroid =	1.62	N/A	feet
Restrictor Plate Height Above Pipe Invert =	35.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	2.05	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.50	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.97	feet
Spillway Crest Length =	85.00	feet	Stage at Top of Freeboard =	9.47	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	2.12	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	12.34	acre-ft

Calculated Parameters for Spillway

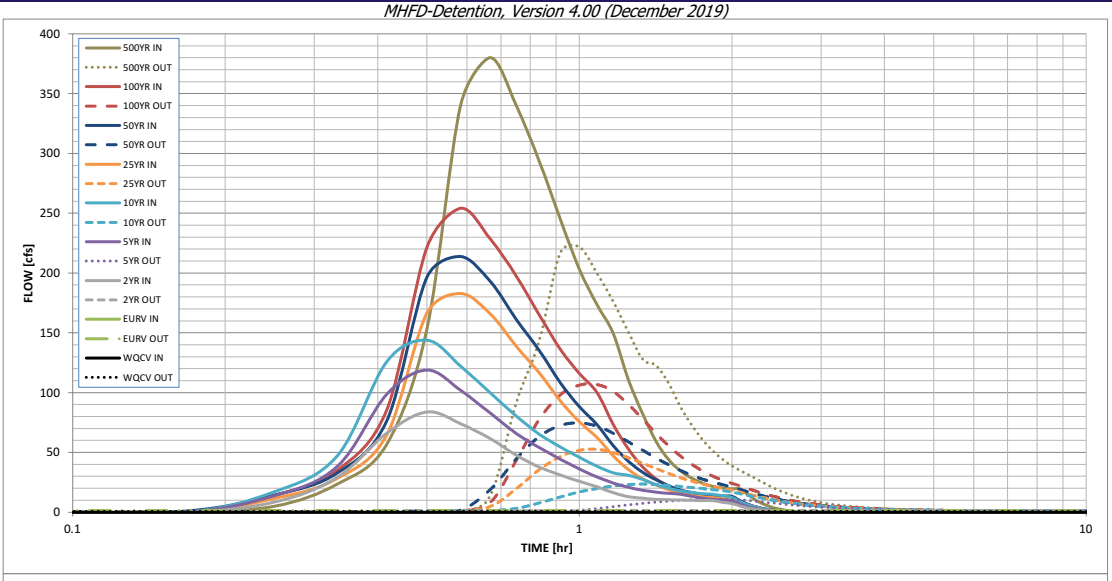
Routed Hydrograph Results *The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).*

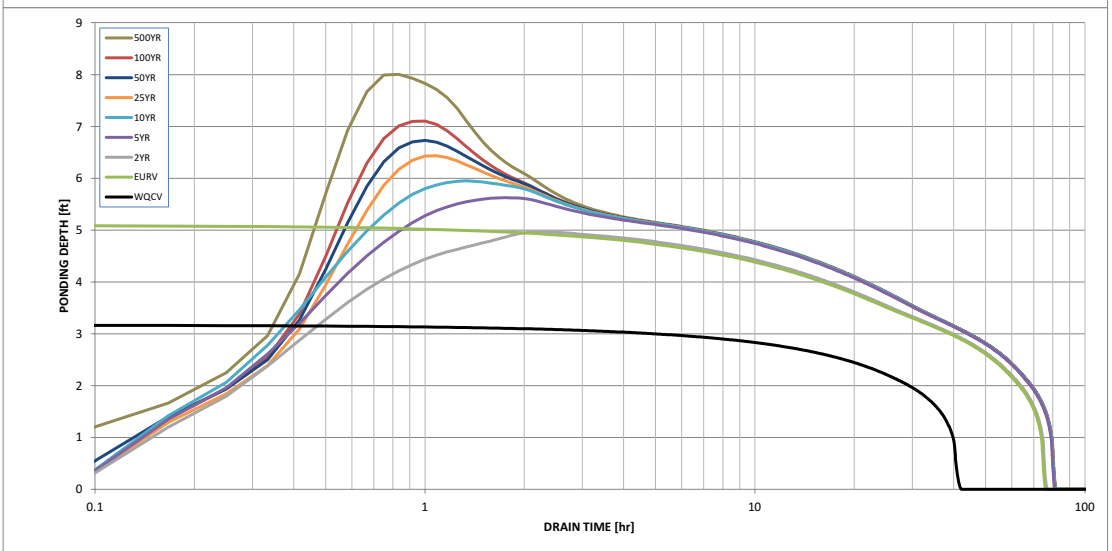
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.55
CUHP Runoff Volume (acre-ft) =	1.385	4.247	4.249	5.977	7.495	9.354	10.954	12.920	19.729
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	4.249	5.977	7.495	9.354	10.954	12.920	19.729
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	14.1	33.5	49.2	80.8	100.6	124.8	206.9
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.18	0.44	0.65	1.06	1.32	1.64	2.71
Peak Inflow Q (cfs) =	N/A	N/A	83.8	118.8	143.9	182.9	213.7	254.0	380.1
Peak Outflow Q (cfs) =	0.6	1.4	1.4	10.7	23.5	52.6	74.7	106.7	221.9
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.3	0.5	0.7	0.7	0.9	1.1
Structure Controlling Flow =	Plate	Overflow Weir 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.2	0.4	0.9	1.3	1.9	2.2
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	68	69	71	70	68	66	64	58
Time to Drain 99% of Inflow Volume (hours) =	**40**	72	73	76	76	75	74	74	71
Maximum Ponding Depth (ft) =	3.17	5.10	4.97	5.62	5.95	6.44	6.73	7.10	8.01
Area at Maximum Ponding Depth (acres) =	1.38	1.59	1.58	1.65	1.69	1.75	1.78	1.83	1.93
Maximum Volume Stored (acre-ft) =	1.388	4.253	4.032	5.097	5.631	6.473	6.985	7.670	9.362

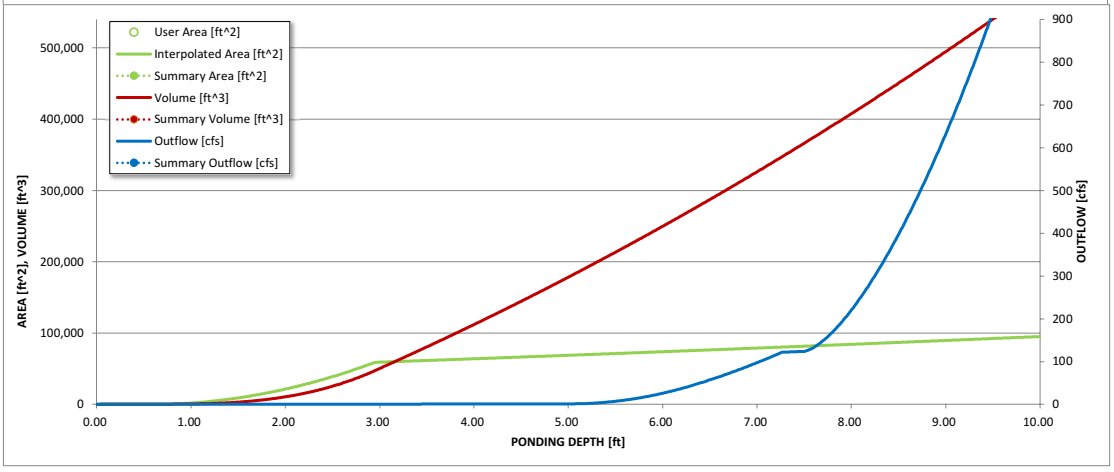
PHASE 2 FDR - WFJCC POND #1 DESIGN

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







PHASE 2 DESIGN POINT CALCS

Rational Method - Proposed Conditions

Project Name:	BRADLEY HEIGHTS METRO DISTRICT (PHASE 2)
Project Location:	COLORADO SPRINGS, EL PASO COUNTY, CO
Designer	JTS
Notes:	Proposed Condition

Average Channel Velocity 4.00 ft/s (If specific channel vel is used, this will be ignored)
Average Slope for Initial Flow 0.04 ft/ft (If Elevations are used, this will be ignored)
SOIL TYPE CHOSEN BASED ON WORST CASE FOR TRIBUTARY AREA

Channel Flow Type Key
Heavy Meadow 2
Tillage/Field 3
Short Pasture and Lawns 4
Nearly Bare Ground 5
Grassed Waterway 6
Paved Areas 7

PCT Impervious: 95% 65% 100% 70% 30% 2%

Sub-basin	Comments	Area sf	Area acres	Area Sq. Mi.	Soil Group	Rational 'C' Values: Commercial Areas (95% Impervious) C5	C100	Area	Residential (1/8 or less) (65% Impervious) C5	C100	Area (SF)	Pavement (100% Impervious) C5	C100	Area (SF)	Neighborhoods/Multi-Family (70% Impervious) C5	C100	Area	Residential (1/3 Acre) (30% Impervious) C5	C100	Area	Undeveloped/Pervious Areas (2% Impervious) C5	C100	Area	Composite C5	C100	Percent Impervious	Flow Lengths: Initial ft	True Initial Length ft	Channel ft	True Channel Length ft	Average (decimal) Slope	Initial Tc (min)	Average (%) Slope	Channel Flow Type (See Key above) Ground Type	Velocity (ft/s)	Channel Tc (min)	Tc Total (min)	Rainfall Intensity & Rational Flow Rate: i5 in/hr	Q5 cfs	i100 in/hr	Q100 cfs	Sub-basin
			0.00																																								
WF1a	*BRADLEY HEIGHTS EAST FILINGS 3&4*	637302	14.63	0.0229	B	0.81	0.88		0.45	0.59	637302	0.90	0.96		0.49	0.62		0.25	0.47		0.09	0.36		0.45	0.59	65.00%	100	100	1466	1466	0.05	6.84	2.0	7	2.83	8.64	15.48	3.41	**22.6**	5.73	**49.9**	*WF1a*
WF1b	*BRADLEY HEIGHTS EAST FILINGS 3&4*	48146	1.11	0.0017	B	0.81	0.88		0.45	0.59	48146	0.90	0.96		0.49	0.62		0.25	0.47		0.09	0.36		0.45	0.59	65.00%	100	100	329	329	0.05	6.84	3.3	7	3.63	1.51	8.35	4.38	**2.2**	7.36	**4.8**	*WF1b*
WF2	*BRADLEY LANDING (WEST SIDE) & LEGACY HILL DR (NORTH SIDE)*	189542	4.35	0.0068	B	0.81	0.88	72435	0.45	0.59	19068	0.90	0.96		0.49	0.62		0.25	0.47		0.09	0.36	98039	0.40	0.58	43.88%	50	50	1070	1070	0.05	5.20	4.1	7	4.05	4.40	9.60	4.17	**7.3**	7.00	**17.9**	*WF2*
WF3	*SOUTH HALF OF LEGACY HILL DRIVE*	32652	0.75	0.0012	B	0.81	0.88	32652	0.45	0.59		0.90	0.96		0.49	0.62		0.25	0.47		0.09	0.36		0.81	0.88	95.00%	30	30	589	589	0.05	1.67	1.0	7	2.00	4.91	6.58	4.73	**2.9**	7.95	**5.3**	*WF3*
LH1	*LEGACY HILL NORTHSIDE DRAINING WEST*	7884	0.18	0.0003	B	0.81	0.88	7884	0.45	0.59		0.90	0.96		0.49	0.62		0.25	0.47		0.09	0.36		0.81	0.88	95.00%	20	20	180	180	0.05	1.37	2.0	7	2.83	1.06	5.00	5.10	**0.8**	8.58	**1.4**	*LH1*
LH2	*LEGACY HILL NORTHSIDE DRAINING EAST*	7884	0.18	0.0003	B	0.81	0.88	7884	0.45	0.59		0.90	0.96		0.49	0.62		0.25	0.47		0.09	0.36		0.81	0.88	95.00%	20	20	180	180	0.05	1.37	2.0	7	2.83	1.06	5.00	5.10	**0.8**	8.58	**1.4**	*LH2*
WF4	*BRADLEY HEIGHTS MULTI-FAMILY*	883225	20.28	0.0317	B	0.81	0.88		0.45	0.59		0.90	0.96		0.49	0.62	697669	0.25	0.47		0.09	0.36	185556	0.41	0.57	55.71%	100	100	1484	1484	0.05	7.31	1.0	7	2.00	12.37	19.67	3.04	**25.2**	5.11	**59.0**	*WF4*
WF5a	*BRADLEY HEIGHTS EAST FILINGS 3&4*	197310	4.53	0.0071	D	0.82	0.89	64904	0.49	0.65	55308	0.90	0.96		0.53	0.68		0.30	0.57		0.16	0.51	77098	0.47	0.67	50.25%	100	100	1767	1767	0.05	6.64	1.1	7	2.10	14.04	20.67	2.96	**6.4**	4.98	**15.3**	*WF5a*
WF5b	*BRADLEY HEIGHTS EAST FILINGS 3&4 Interally captured by inlets (BY OTHERS) in development*	72143	1.66	0.0026	D	0.82	0.89		0.49	0.65	72143	0.90	0.96		0.53	0.68		0.30	0.57		0.16	0.51		0.49	0.65	65.00%	100	100	1471	1471	0.05	6.42	1.1	7	2.10	11.69	18.10	3.17	**2.6**	5.32	**5.8**	*WF5b*
WF6	*BRADLEY LANDING (WEST SIDE)*	46250	1.06	0.0017	D	0.82	0.89	46250	0.49	0.65		0.90	0.96		0.53	0.68		0.30	0.57		0.16	0.51		0.82	0.89	95.00%	50	50	961	961	0.05	2.08	1.1	7	2.10	7.64	9.71	4.15	**3.6**	6.97	**6.6**	*WF6*
WF7	*BRADLEY RIDGE DEVELOPMENT SOUTHWEST OF BRADLEY RIDGE ROAD*	584103	13.41	0.0210	D	0.82	0.89		0.49	0.65	584103	0.90	0.96		0.53	0.68		0.30	0.57		0.16	0.51		0.49	0.65	65.00%	100	100	823	823	0.05	6.42	3.0	7	3.46	3.96	10.38	4.04	**26.8**	6.79	**59.7**	*WF7*
WF8	*WFJCC POND #1*	579521	13.30	0.0208	D	0.82	0.89		0.49	0.65		0.90	0.96		0.53	0.68		0.30	0.57		0.16	0.51	579521	0.16	0.51	2.00%	100	100	1025	1025	0.05	9.89	2.0	4	0.99	17.26	27.15	2.56	**5.5**	4.30	**29.4**	*WF8*
WF9	*OFFSITE AREAS: CSU FUTURE SUBSTATION*	550374	12.63	0.0197	D	0.82	0.89		0.49	0.65		0.90	0.96		0.53	0.68		0.30	0.57		0.16	0.51	550374	0.16	0.51	2.00%	100	100	819	819	0.05	9.89	2.0	4	0.99	13.79	23.68	2.76	**5.6**	4.64	**30.1**	*WF9*
OS-ES	*Trails at Aspen Ridge Sub-basin OS-East Side. Undeveloped electric easement.*	184090	4.23	0.0066	B	0.81	0.88		0.45	0.59		0.90	0.96		0.49	0.62		0.25	0.47		0.09	0.36	184090	0.09	0.36	2.00%	50	50	1274	1274	0.05	7.52	3.0	4	1.21	17.51	25.03	2.68	**0.1**	4.50	**3.4**	*OS-ES*

DESIGN POINTS	Sub-basins/Comments	Area sf	Area acres	Area Sq. Mi.	Soil Group	Rational 'C' Values: Commercial Areas (95% Impervious) C5	C100	Area	Residential (1/8 or less) (65% Impervious) C5	C100	Area (SF)	Pavement (100% Impervious) C5	C100	Area (SF)	Neighborhoods/Multi-Family (70% Impervious) C5	C100	Area	Residential (1/3 Acre) (30% Impervious) C5	C100	Area	Undeveloped/Pervious Areas (2% Impervious) C5	C100	Area	Composite C5	C100	Percent Impervious	Flow Lengths: Initial ft	True Initial Length ft	Channel ft	True Channel Length ft	Average (decimal) Slope	Initial Tc (min)	Average (%) Slope	Channel Flow Type (See Key above) Ground Type	Velocity (ft/s)	Channel Tc (min)	Tc Total (min)	Rainfall Intensity & Rational Flow Rate: i5 in/hr	Q5 cfs	i100 in/hr	Q100 cfs	DESIGN POINTS
AQ	*LH1 - AT GRADE AT BORDER WITH TRAILS AT ASPEN RIDGE*	7884	0.18	0.0003	B	0.81	0.88	7884	0.45	0.59	0	0.90	0.96	0	0.49	0.62	0	0.25	0.47	0	0.09	0.36	0	0.81	0.88	95.00%	20	20	180	180	0.05	1.37	2.0	7	2.83	1.06	5.00	5.10	**0.8**	8.58	**1.4**	*AQ*
AR	*LH2 - AT GRADE AT BORDER WITH TRAILS AT ASPEN RIDGE*	7884	0.18	0.0003	B	0.81	0.88	7884	0.45	0.59	0	0.90	0.96	0	0.49	0.62	0	0.25	0.47	0	0.09	0.36	0	0.81	0.88	95.00%	20	20	180	180	0.05	1.37	2.0	7	2.83	1.06	5.00	5.10	**0.8**	8.58	**1.4**	*AR*
AS	*LH1-LH2*	15768	0.36	0.0006	B	0.81	0.88	15768	0.45	0.59	0	0.90	0.96	0	0.49	0.62	0	0.25	0.47	0	0.09	0.36	0	0.81	0.88	95.00%	20	20	180	180	0.05	1.37	2.0	7	2.83	1.06	5.00	5.10	**1.5**	8.58	**2.8**	*AS*
AT	*WF3*	32652	0.75	0.0012	B	0.81	0.88	32652	0.45	0.59	0	0.90	0.96	0	0.49	0.62	0	0.25	0.47	0	0.09	0.36	0	0.81	0.88	95.00%	30	30	589	589	0.05	1.67	1.0	7	2.00	4.91	6.58	4.73	**2.9**	7.95	**5.3**	*AT*
AU	*WF1b, WF2 + BYPASS FROM WF1*	237688	5.46	0.0085	B	0.81	0.88	72435	0.45	0.59	67214	0.90	0.96	0	0.49	0.62	0	0.25	0.47	0	0.09	0.36	98039	0.41	0.58	48.16%	50	50	1070	1070	0.05	5.13	4.1	7	4.05	4.40	9.53	4.18	**9.8**	7.02	**27.8**	*AU*
AV	*WF2-WF3, LH1-LH2*	286108	6.57	0.0103	B	0.81	0.88	120855	0.45	0.59	67214	0.90	0.96	0	0.49	0.62	0	0.25	0.47	0	0.09	0.36	98039	0.48	0.63	56.08%	50	50	1100	1100	0.05	4.62	4.1	7	4.05	4.53	9.15	4.24	**13.8**	7.12	**32.3**	*AV*
AWa	*WF1-WF3, LH1-LH2*	923410	21.20	0.0331	B	0.81	0.88	120855	0.45	0.59	704516	0.90	0.96	0	0.49	0.62	0	0.25	0.47	0	0.09	0.36	98039	0.46	0.60	62.24%	100	100	1466	1466	0.05	6.75	4.1	7	4.05	6.03	12.78	3.72	**36.4**	6.24	**80.5**	*AWa*
AWb	*WF1-WF3, WF5b, LH1-LH2*	995553	22.85	0.0357	B	0.81	0.88	120855	0.45	0.59	776659	0.90	0.96	0	0.49	0.62	0	0.25	0.47	0	0.09	0.36	98039	0.46	0.60	62.44%	100	100	1882	1882	0.05	6.76	4.1	7	4.05	7.75	14.50	3.52	**37.1**	5.91	**82.0**	*AWb*
AX	*WF5*	197310	4.53	0.0071	D	0.82	0.89	64904	0.49	0.65	55308	0.90	0.96	0	0.53	0.68	0	0.30	0.57	0	0.16	0.51	77098	0.47	0.67	50.25%	100	100	1767	1767	0.05	6.64	1.1	7	2.10	14.04	20.67	2.96	**6.4**	4.98	**15.3**	*AX*
AY	*WF6*	46250	1.06	0.0017	D	0.82	0.89	46250	0.49	0.65	0	0.90	0.96	0	0.53	0.68	0	0.30	0.57	0	0.16	0.51	0	0.82	0.89	95.00%	50	50	961	961	0.05	2.08	1.1	7	2.10	7.64	9.71	4.15	**3.6**	6.97	**6.6**	*AY*
AZ	*WF5-WF6*	243560	5.59	0.0087	D	0.82	0.89	111154	0.49	0.65	55308	0.90	0.96	0	0.53	0.68	0	0.30	0.57	0	0.16	0.51	77098	0.54	0.72	58.75%	100	100	1767	1767	0.05	5.94	1.1	7	2.10	14.04	19.97	3.02	**9.1**	5.07	**20.4**	*AZ*
BA	*WF1-WF3, WF5-WF6, LH1, LH2*	1239113	28.45	0.0444	D	0.82	0.89	232009	0.49	0.65	831967	0.90	0.96	0	0.53	0.68	0	0.30	0.57	0	0.16	0.51	175137	0.51	0.68	61.71%	100	100	1767	1767	0.05	6.26	1.1	7	2.10	14.04	20.30	2.99	**43.3**	5.03	**97.3**	*BA*
BB	*WF1-WF6, LH1-LH2*	2122338	48.72	0.0761	D	0.82	0.89	232009	0.49	0.65	831967	0.90	0.96	0	0.53	0.68	697669	0.30	0.57	0	0.16	0.51	360693	0.48	0.66	59.22%	100	100	1767	1767	0.05	6.49	1.1	7	2.10	14.04	20.53	2.97	**70.6**	5.00	**162.5**	*BB*
BC	*WF1-WF8, LH1-LH2 INTO WFJCC POND #1*	3285962	75.44	0.1179	D	0.82	0.89	232009	0.49	0.65	1416070	0.90	0.96	0	0.53	0.68	697669	0.30	0.57	0	0.16	0.51	940214	0.43	0.63	50.15%	100	100	2267	2267	0.05	7.08	1.1	7	2.10	18.01	25.09	2.68	**87.0**	4.50	**216.5**	*BC*
WFJCC POND #1	*POND DISCHARGE*	3285962	75.44	0.1179	D	0.82	0.89	232009	0.49	0.65	1416070	0.90	0.96	0	0.53	0.68	697669	0.30	0.57	0	0.16	0.51	940214	0.43	0.63	50.15%	N/A												**12.6**		**105.3**	*WFJCC POND #1*
TAR-EP	*TRAILS AT ASPEN RIDGE-EAST POND FULL BUILD-OUT DISCHARGE*	7007497	160.87	0.2514	B	N/A																				N/A												**5.8**		**139.5**	*TAR-EP*
DP WF1	*TAR-EP, WF9, WFJCC POND #1 DISCHARGE*	10843834	248.94	0.3890	D	N/A																				N/A												**24.0**		**274.9**	*DP WF1*

PHASE 2 INLETS

V. Hydraulic Analysis

a. Proposed Inlets

INLET SUMMARY BRADLEY HEIGHTS MDDP											
DESIGN POINT or SUB-BASIN	SUB-BASINS/ DESCRIPTION	TOTAL AREA (AC)	INLET			Q(5) TOTAL INFLOW	Q5 INLET CAPACTIY	Q(100) BYPASS FLOWS (cfs)	Q(100) TOTAL INFLOW (cfs)	MAX INLET CAPACITY	NOTES:
			SIZE (Ft.)	TYPE	CONDITION						
AQ	LH1 - AT GRADE AT BORDER WITH TRAILS AT ASPEN RIDGE	0.18	10	R	AT-GRADE	0.8	**0.8**	**0.0**	1.4	**1.4**	
AR	LH2 - AT GRADE AT BORDER WITH TRAILS AT ASPEN RIDGE	0.18	10	R	AT-GRADE	0.8	**0.8**	**0.0**	1.4	**1.4**	
AU	WF1b, WF2 + BYPASS FROM WF1	5.46	10	R	SUMP	9.8	**9.8**	**8.5**	27.8	**19.3**	*INLET EQUALIZES ACROSS LEGACY HILL FOR Q100 EVENT BYPASS FROM WF1: Q5: 0.4 CFS, Q100: 5.3 CFS*
AT	WF3	0.75	10	R	SUMP	2.9	**2.9**	**0.0**	13.8	**19.3**	*INCLUDES BYPASS FROM DP AU*
AX	WF5	4.53	10	R	AT-GRADE	6.4	**6.4**	**0.0**	15.3	**15.3**	*4 INLETS FOR FULL CAPTURE*
AY	WF6	1.06	10	R	AT-GRADE	3.6	**3.6**	**0.0**	6.6	**6.6**	*2 INLETS FOR FULL CAPTURE*

Note: Inlet sizes indicated are minimums. Larger sizes may be used in the construction plans for conservative design.

Inlet Overflow Routing	
Inlet	*Overflow Routing Under Sump Inlet Blockage Conditions*
AT & AU	Blockage of either of these inlets will cause runoff to surcharge the crown of the road and enter the opposite inlet. In the case where both inlets are blocked, runoff will surcharge the curb and gutter on the south side of Legacy Hill Drive and flow overland to the south towards the proposed private FSD WFJCC Pond #1. Adjacent development to the south should take this potentiality into account.

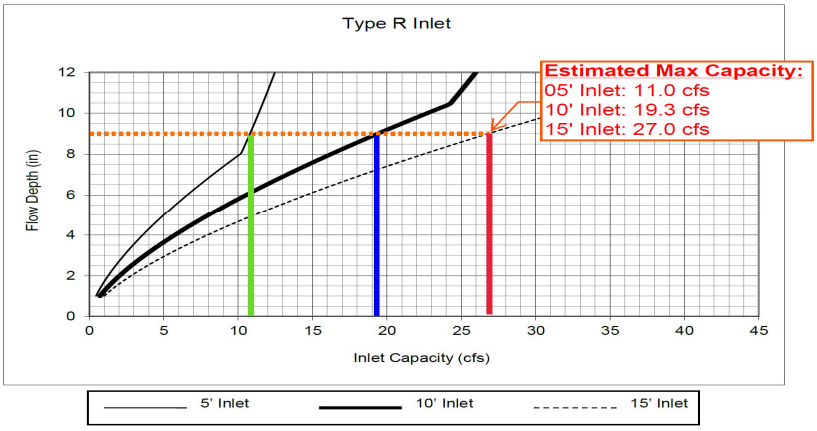
PHASE 2 INLETS

SEE PHASE 3 CALCS FOR DP I DETAILS

INLET SUMMARY

BRADLEY HEIGHTS METRO DISTRICT (PHASE 2)

DESIGN POINT or SUB-BASIN	SUB-BASINS/ DESCRIPTION	TOTAL AREA (AC)	INLET			Q(5) TOTAL INFLOW	Q5 INLET CAPACTIY	Q(100) BYPASS FLOWS (cfs)	Q(100) TOTAL INFLOW (cfs)	MAX INLET CAPACITY	NOTES:
			SIZE (Ft.)	TYPE	CONDITION						
~~I~~	~~10a~~	~~5.35~~	~~10~~	~~R~~	~~SUMP~~	~~10.1~~	~~10.1~~	~~4.3~~	~~23.6~~	~~19.3~~	~~Q100 FLOWS EQUALIZE ACROSS CROWN IN MAJOR EVENT~~
J	10b	1.20	10	R	SUMP	5.0	5.0	0.0	13.4	19.3	INCLUDES BYPASS FROM DP I
N	MK3	1.63	5	R	SUMP	5.0	5.0	0.0	9.2	11.0	
O	MK5	0.56	5	R	SUMP	2.2	2.2	0.0	4.1	11.0	
P	MK4	1.57	5	R	SUMP	5.7	5.7	0.0	10.3	11.0	
S	MK11	4.49	5	R	SUMP	10.0	10.0	0.0	21.8	21.8	FLOWS EQUALIZE ACROSS CROWN IN MAJOR EVENT
T	MK12	0.38	5	R	SUMP	1.6	1.6	0.0	2.9	11.0	
X	MK10	1.97	15	R	SUMP	6.4	6.4	0.0	11.7	27.0	
W	MK15	0.67	10	R	SUMP	2.8	2.8	0.0	5.1	19.3	
AA	JC1	1.85	5	R	SUMP	5.2	5.2	0.0	10.9	11.0	
AB	JC2	0.75	5	R	SUMP	3.0	3.0	0.0	5.6	11.0	
AG	WF11	1.08	5	R	SUMP	4.2	4.2	0.0	7.6	11.0	
AF	WF10	1.56	5	R	SUMP	6.0	6.0	0.0	10.9	11.0	
AQ	LH1 - AT GRADE AT BORDER WITH TRAILS AT ASPEN RIDGE	0.18	10	R	AT-GRADE	0.8	0.8	0.0	1.4	1.4	
AR	LH2 - AT GRADE AT BORDER WITH TRAILS AT ASPEN RIDGE	0.18	10	R	AT-GRADE	0.8	0.8	0.0	1.4	1.4	
AU	WF1b, WF2 + BYPASS FROM WF1	5.46	10	R	SUMP	9.8	9.8	8.5	27.8	19.3	INLET EQUALIZES ACROSS LEGACY HILL FOR Q100 EVENT BYPASS FROM WF1: Q5: 0.4 CFS, Q100: 5.3 CFS
AT	WF3	0.75	10	R	SUMP	2.9	2.9	0.0	13.8	19.3	INCLUDES BYPASS FROM DP AU
AX	WF5	4.53	10	R	AT-GRADE	6.4	6.4	0.0	15.3	15.3	4 INLETS FOR FULL CAPTURE
AY	WF6	1.06	10	R	AT-GRADE	3.6	3.6	0.0	6.6	6.6	2 INLETS FOR FULL CAPTURE



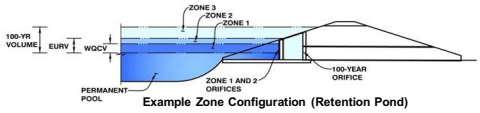
PHASE 3 FDR - MKJCC POND #5 DESIGN

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: BRADLEY HEIGHTS - MKJCC POND #5

Basin ID: MARKSHEFFEL TRIBUTARY TO JIMMY CAMP CREEK



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	89.39	acres
Watershed Length =	3,180	ft
Watershed Length to Centroid =	1,600	ft
Watershed Slope =	0.040	ft/ft
Watershed Imperviousness =	72.24%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	100.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Denver - Capitol Building	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	2.127	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	6.292	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	6.720	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	9.061	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	11.003	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	13.099	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	15.090	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	17.382	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.55 in.) =	25.650	acre-feet	3.55	inches
Approximate 2-yr Detention Volume =	5.665	acre-feet		
Approximate 5-yr Detention Volume =	7.858	acre-feet		
Approximate 10-yr Detention Volume =	9.015	acre-feet		
Approximate 25-yr Detention Volume =	9.580	acre-feet		
Approximate 50-yr Detention Volume =	9.834	acre-feet		
Approximate 100-yr Detention Volume =	10.565	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	2.127	acre-feet
Zone 2 Volume (EURV - Zone 1) =	4.165	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	4.274	acre-feet
Total Detention Basin Volume =	10.565	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

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

Depth Increment = 0.50 ft

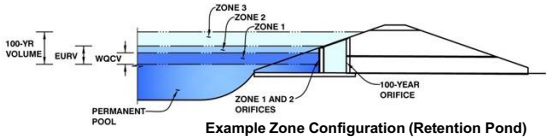
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	362	0.008		
5779	--	0.33	--	--	--	1,027	0.024	229	0.005
5780	--	1.33	--	--	--	9,911	0.228	5,698	0.131
5781	--	2.33	--	--	--	31,363	0.720	26,335	0.605
5782	--	3.33	--	--	--	61,757	1.418	72,895	1.673
5783	--	4.33	--	--	--	82,211	1.887	144,879	3.326
5784	--	5.33	--	--	--	87,915	2.018	229,942	5.279
5785	--	6.33	--	--	--	93,493	2.146	320,646	7.361
5786	--	7.33	--	--	--	99,208	2.278	416,996	9.573
5787	--	8.33	--	--	--	105,103	2.413	519,152	11.918

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Project: **BRADLEY HEIGHTS - MKJCC POND #5**

Basin ID: **MARKSHEFFEL TRIBUTARY TO JIMMY CAMP CREEK**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.64	2.127	Orifice Plate
Zone 2 (EURV)	5.83	4.165	Circular Orifice
Zone 3 (100-year)	7.77	4.274	Weir&Pipe (Restrict)
Total (all zones)		10.565	

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

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

Calculated Parameters for Underdrain

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	4.667E-02	ft²
Depth at top of Zone using Orifice Plate =	3.77	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	N/A	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	6.72	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.25	2.50	3.75				
Orifice Area (sq. inches)	6.72	6.72	6.72	6.72				

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Circular	Not Selected			Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	3.64	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.01	N/A	ft²
Depth at top of Zone using Vertical Orifice =	5.83	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.04	N/A	feet
Vertical Orifice Diameter =	1.00	N/A	inches				

Calculated Parameters for Vertical Orifice

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

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	5.60	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	5.60	N/A	feet
Overflow Weir Front Edge Length =	9.00	N/A	feet	Overflow Weir Slope Length =	9.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	4.54	N/A	
Horiz. Length of Weir Sides =	9.00	N/A	feet	Overflow Grate Open Area w/o Debris =	56.70	N/A	ft²
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	28.35	N/A	ft²
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	12.50	N/A	ft²
Outlet Pipe Diameter =	48.00	N/A	inches	Outlet Orifice Centroid =	1.99	N/A	feet
Restrictor Plate Height Above Pipe Invert =	47.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	2.85	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.50	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.97	feet
Spillway Crest Length =	90.00	feet	Stage at Top of Freeboard =	9.47	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	2.41	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	11.92	acre-ft

Calculated Parameters for Spillway

Routed Hydrograph Results

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

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.55
CUHP Runoff Volume (acre-ft) =	2.127	6.292	6.720	9.061	11.003	13.099	15.090	17.382	25.650
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	6.720	9.061	11.003	13.099	15.090	17.382	25.650
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	18.7	39.1	54.0	84.0	103.5	128.7	209.6
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.21	0.44	0.60	0.94	1.16	1.44	2.34
Peak Inflow Q (cfs) =	N/A	N/A	123.4	164.4	193.7	236.8	271.9	316.2	461.0
Peak Outflow Q (cfs) =	1.0	9.2	8.1	28.4	48.8	89.1	116.8	141.4	281.2
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.7	0.9	1.1	1.1	1.1	1.3
Structure Controlling Flow =	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	0.15	0.11	0.5	0.8	1.5	2.0	2.5	2.6
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	65	67	66	64	63	61	60	55
Time to Drain 99% of Inflow Volume (hours) =	**40**	71	73	72	71	70	69	68	66
Maximum Ponding Depth (ft) =	3.64	5.83	5.79	6.09	6.32	6.68	6.90	7.26	8.10
Area at Maximum Ponding Depth (acres) =	1.56	2.08	2.08	2.11	2.14	2.19	2.22	2.27	2.38
Maximum Volume Stored (acre-ft) =	2.135	6.304	6.200	6.828	7.318	8.098	8.584	9.391	11.367

PHASE 3 DESIGN POINT CALCS

Rational Method - Proposed Conditions

Project Name:	BRADLEY HEIGHTS METRO DISTRICT (PHASE 3)
Project Location:	COLORADO SPRINGS, EL PASO COUNTY, CO
Designer	JTS
Notes:	Proposed Condition

Average Channel Velocity: 4.00 ft/s (If specific channel vel is used, this will be ignored)
Average Slope for Initial Flow: 0.04 ft/s (If Elevations are used, this will be ignored)
SOIL TYPE CHOSEN BASED ON WORST CASE FOR TRIBUTARY AREA

Channel Flow Type Key
Heavy Meadow 2
Tillage/Field 3
Short Pasture and Lawns 4
Nearly Bare Ground 5
Grassed Waterway 6
Paved Areas 7

PCT Impervious: 95% | 65% | 70% | 2%

		Area			Rational 'C' Values														Flow Lengths									Tc	Rainfall Intensity & Rational Flow Rate				
					Commercial Areas (95% Impervious)			Residential (1/8 or less) (65% Impervious)			Neighborhoods/Multi-Family (70% Impervious)			Undeveloped/Pervious Areas (2% Impervious)			Composite		Percent Impervious	Initial	True Initial	Channel	True Channel	Average (decimal)	Initial	Average (%)	Channel Flow Type (See Key above)	Velocity	Channel	Total	i5	Q5	i100	Q100	
Sub-basin	**Comments**	sf	acres	Soil Group	C5	C100	Area	C5	C100	Area (SF)	C5	C100	Area	C5	C100	Area	C5	C100		ft	Length ft	ft	Length ft	Slope	Tc (min)	Slope	Ground Type	(ft/s)	Tc (min)	(min)	in/hr	cfs	in/hr	cfs	**Sub-basin**
BHE3	***BRADLEY HEIGHTS EAST F 5&6 - DEVELOPED FLOWS***	943168	21.65	D	0.82	0.89		0.49	0.65		0.53	0.68	943168	0.16	0.51		0.53	0.68	70.00%	100	100	1100	1100	0.05	6.00	3.0	7	3.46	5.29	11.29	3.91	**45.2**	6.57	**97.5**	***BHE3***
RHC1	***SOUTH HALF OF BRADLEY ROAD BETWEEN BLISS AND BRADLEY LANDING***	107935	2.48	B	0.81	0.88	107935	0.45	0.59		0.49	0.62		0.09	0.36		0.81	0.88	95.00%	92	92	1343	1343	0.02	3.97	1.9	7	2.76	8.12	12.09	3.80	**7.7**	6.39	**14.0**	***RHC1***
RHC2	***EAST HALF OF BLISS ROAD ADJACENT TO REDEMPTION HILL CHURCH***	25483	0.59	B	0.81	0.88	25483	0.45	0.59		0.49	0.62		0.09	0.36		0.81	0.88	95.00%	20	20	546	546	0.02	1.85	1.0	7	2.00	4.55	6.40	4.77	**2.3**	8.01	**4.2**	***RHC2***
RHC3	***REDEMPTION HILL CHURCH***	431154	9.90	D	0.82	0.89		0.49	0.65		0.53	0.68	431154	0.16	0.51		0.53	0.68	70.00%	100	100	1110	1110	0.02	8.14	2.0	7	2.83	6.54	14.68	3.50	**18.5**	5.87	**39.9**	***RHC3***
RHC4	***RHC ADJACENT PROPERTY OWNED BY THE CHURCH***	1013207	23.26	D	0.82	0.89		0.49	0.65	1013207	0.53	0.68		0.16	0.51		0.49	0.65	65.00%	100	100	1035	1035	0.05	6.42	3.0	7	3.46	4.98	11.40	3.90	**44.8**	6.55	**99.8**	***RHC4***
BS1	***BLISS ROAD (Phase I)***	137852	3.16	B	0.81	0.88	60390	0.45	0.59	77462	0.49	0.62		0.09	0.36		0.61	0.72	78.14%	100	100	980	980	0.05	5.18	1.8	7	2.68	6.09	11.26	3.92	**7.6**	6.58	**15.0**	***BS1***
BS2	***BLISS ROAD (Phase I)***	35937	0.83	B	0.81	0.88	35937	0.45	0.59		0.49	0.62		0.09	0.36		0.81	0.88	95.00%	20	20	980	980	0.05	1.37	1.8	7	2.68	6.09	7.45	4.55	**3.1**	7.64	**5.6**	***BS2***
BS3	***BLISS ROAD***	117103	2.69	D	0.82	0.89	36744	0.49	0.65	49607	0.53	0.68		0.16	0.51	30752	0.51	0.69	57.87%	100	100	1041	1041	0.05	6.24	2.3	7	3.03	5.72	11.96	3.82	**5.2**	6.42	**12.0**	***BS3***
BS4	***BLISS ROAD***	30562	0.70	D	0.82	0.89	30562	0.49	0.65		0.53	0.68		0.16	0.51		0.82	0.89	95.00%	50	50	737	737	0.05	2.08	2.3	7	3.03	4.05	6.13	4.83	**2.8**	8.12	**5.1**	***BS4***
BS5	***BLISS ROAD***	116100	2.67	D	0.82	0.89	45556	0.49	0.65	20420	0.53	0.68		0.16	0.51	50124	0.48	0.68	49.57%	50	50	1147	1147	0.05	4.64	1.8	7	2.68	7.12	11.76	3.85	**4.9**	6.46	**11.9**	***BS5***
BS6	***BLISS ROAD***	21783	0.50	D	0.82	0.89	21783	0.49	0.65		0.53	0.68		0.16	0.51		0.82	0.89	95.00%	50	50	555	555	0.05	2.08	1.8	7	2.68	3.45	5.53	4.97	**2.1**	8.35	**3.7**	***BS6***
MK1	***SCHOOL & PUD***	862439	19.80	D	0.82	0.89	862439	0.49	0.65		0.53	0.68		0.16	0.51		0.82	0.89	95.00%	100	100	1170	1170	0.05	2.95	3.0	7	3.46	5.63	8.57	4.34	**7.0**	7.29	**129.5**	***MK1***
MK2-UNDEVELOPED	***UNDEVELOPED PUD-MARKSHEFFEL-WOODMEN INVESTMENTS, LLC***	496834	11.41	D	0.82	0.89		0.49	0.65		0.53	0.68		0.16	0.51	496834	0.16	0.51	2.00%	100	100	1056	1056	0.05	9.89	3.0	7	3.46	5.08	14.97	3.47	**6.4**	5.82	**34.1**	***MK2-UNDEVELOPED***
MK2	***DEVELOPED PUD-MARKSHEFFEL-WOODMEN INVESTMENTS, LLC***	496834	11.41	D	0.82	0.89		0.49	0.65		0.53	0.68	496834	0.16	0.51		0.53	0.68	70.00%	100	100	1056	1056	0.05	6.00	3.0	7	3.46	5.08	11.08	3.94	**24.0**	6.62	**51.8**	***MK2***
MK3	***BRADLEY LANDING BOULEVARD***	71119	1.63	D	0.82	0.89	71119	0.49	0.65		0.53	0.68		0.16	0.51		0.82	0.89	95.00%	50	50	1303	1303	0.05	2.08	1.2	7	2.19	9.91	11.99	3.82	**5.2**	6.41	**9.4**	***MK3***
MK4	***BRADLEY LANDING BOULEVARD***	61374	1.41	D	0.82	0.89	61374	0.49	0.65		0.53	0.68		0.16	0.51		0.82	0.89	95.00%	50	50	830	830	0.05	2.08	1.2	7	2.19	6.31	8.39	4.37	**5.1**	7.35	**9.3**	***MK4***
MK5	***BRADLEY RIDGE ROAD***	24515	0.56	D	0.82	0.89	24515	0.49	0.65		0.53	0.68		0.16	0.51		0.82	0.89	95.00%	50	50	157	157	0.05	2.08	1.0	7	2.00	1.31	5.00	5.10	**2.4**	8.58	**4.3**	***MK5***
MK6	***PUD-MARKSHEFFEL-WOODMEN INVESTMENTS, LLC***	1148623	26.37	D	0.82	0.89		0.49	0.65	1012806	0.53	0.68		0.16	0.51	135817	0.45	0.63	57.55%	100	100	900	900	0.10	5.42	6.0	7	4.90	3.06	8.48	4.36	**52.2**	7.32	**123.2**	***MK6***
MK7	***PUD-MARKSHEFFEL-WOODMEN INVESTMENTS, LLC***	2185925	50.18	D	0.82	0.89		0.49	0.65	2185925	0.53	0.68		0.16	0.51		0.49	0.65	65.00%	100	100	1650	1650	0.05	6.42	3.0	7	3.46	7.94	14.35	3.53	**87.5**	5.93	**195.1**	***MK7***

		Area			Rational 'C' Values														Flow Lengths									Tc	Rainfall Intensity & Rational Flow Rate				
					Commercial Areas (95% Impervious)			Residential (1/8 or less) (65% Impervious)			Neighborhoods/Multi-Family (70% Impervious)			Undeveloped/Pervious Areas (2% Impervious)			Composite		Percent Impervious	Initial	True Initial	Channel	True Channel	Average (decimal)	Initial	Average (%)	Channel Flow Type (See Key above)	Velocity	Channel	Total	i5	Q5	i100	Q100	
DESIGN POINTS	**Sub-basins/Comments**	sf	acres	Soil Group	C5	C100	Area	C5	C100	Area (SF)	C5	C100	Area	C5	C100	Area	C5	C100		ft	Length ft	ft	Length ft	Slope	Tc (min)	Slope	Ground Type	(ft/s)	Tc (min)	(min)	in/hr	cfs	in/hr	cfs	**DESIGN POINTS**
POND 7 DISCHARGE	***Sub-Basin RHC4 Pond #7 was anticipated by MDDPA to have a discharge of Q5 =23.5 cfs, Q100 = 177.2 cfs***	862439	19.80	D	0.82	0.89	862439	0.49	0.65	0	0.53	0.68	0	0.16	0.51	0	0.82	0.89	95.00%	100	100	1170	1170	0.05	2.95	3.0	7	3.46	5.63	8.57		**7.2**		**53.6**	***POND 7 DISCHARGE***
I	***BS3, BS5***	233203	5.35	D	0.82	0.89	82300	0.49	0.65	70027	0.53	0.68	0	0.16	0.51	80876	0.49	0.69	53.74%	100	100	1040	1040	0.05	6.40	2.3	7	3.03	5.71	12.11	3.80	**10.1**	6.39	**23.6**	***I***
J	***BS4, BS6***	52345	1.20	D	0.82	0.89	52345	0.49	0.65	0	0.53	0.68	0	0.16	0.51	0	0.82	0.89	95.00%	20	20	737	737	0.05	1.32	2.3	7	3.03	4.05	5.36	5.01	**5.0**	8.42	**9.1**	***J***
K	***BS3-BS6***	285548	6.56	D	0.82	0.89	134645	0.49	0.65	70027	0.53	0.68	0	0.16	0.51	80876	0.55	0.72	61.30%	100	100	1040	1040	0.05	5.77	2.3	7	3.03	5.71	11.48	3.89	**14.2**	6.53	**31.2**	***K***
L	***BS3-BS6, BHE3***	1228716	28.21	D	0.82	0.89	134645	0.49	0.65	70027	0.53	0.68	943168	0.16	0.51	80876	0.54	0.69	67.98%	100	100	1400	1400	0.05	5.95	2.5	7	3.16	7.38	13.32	3.65	**55.5**	6.13	**120.3**	***L***
N	***MK3***	71119	1.63	D	0.82	0.89	71119	0.49	0.65	0	0.53	0.68	0	0.16	0.51	0	0.82	0.89	95.00%	50	50	1384	1384	0.05	2.08	1.2	7	2.19	10.53	12.61	3.74	**5.0**	6.28	**9.2**	***N***
O	***MK5***	24515	0.56	D	0.82	0.89	24515	0.49	0.65	0	0.53	0.68	0	0.16	0.51	0	0.82	0.89	95.00%	50	50	541	541	0.05	2.08	1.2	7	2.19	4.12	6.19	4.82	**2.2**	8.09	**4.1**	***O***
P	***MK4***	61374	1.41	D	0.82	0.89	61374	0.49	0.65	0	0.53	0.68	0	0.16	0.51	0	0.82	0.89	95.00%	50	50	830	830	0.05	2.08	1.2	7	2.19	6.31	8.39	4.37	**5.1**	7.35	**9.3**	***P***
Q	***MK3-MK5***	157008	3.60	D	0.82	0.89	157008	0.49	0.65	0	0.53	0.68	0	0.16	0.51	0	0.82	0.89	95.00%	50	50	1384	1384	0.05	2.08	1.2	7	2.19	10.53	12.61	3.74	**11.1**	6.28	**20.3**	***Q***
R	***MK2-5***	653842	15.01	D	0.82	0.89	157008	0.49	0.65	0	0.53	0.68	496834	0.16	0.51	0	0.60	0.73	76.00%	100	100	1100	1100	0.05	5.27	3.0	7	3.46	5.29	10.55	4.02	**36.5**	6.75	**74.6**	***R***
R (MK2 undeveloped)	***MK2-5***	653842	15.01	D	0.82	0.89	157008	0.49	0.65	0	0.53	0.68	0	0.16	0.51	496834	0.32	0.60	24.33%	100	100	1100	1100	0.05	8.23	3.0	7	3.46	5.29	13.51	3.63	**17.5**	6.09	**55.4**	***R (MK2 undeveloped)***
MKJCC POND #5	***INFLOW: MK1-6, BS3-BS6, BHE3***	3893620	89.39	D	0.82	0.89	1154092	0.49	0.65	1082833	0.53	0.68	1440002	0.16	0.51	216693	0.58	0.72	72.24%	100	100	3180	3180	0.05	5.43	3.1	7	3.52	15.05	20.48	2.98	**156.8**	5.00	**326.6**	***MKJCC POND #5***
DPM1a: POND 5-OUT	***OUTFLOW***	3893620	89.39	D	0.82	0.89	1154092	0.49	0.65	1082833	0.53	0.68	1440002	0.16	0.51	216693	0.58	0.72	72.24%	100	100	3180	3180	0.05	5.43	3.1	7					**28.4**		**141.4**	***DPM1a: POND 5-OUT***

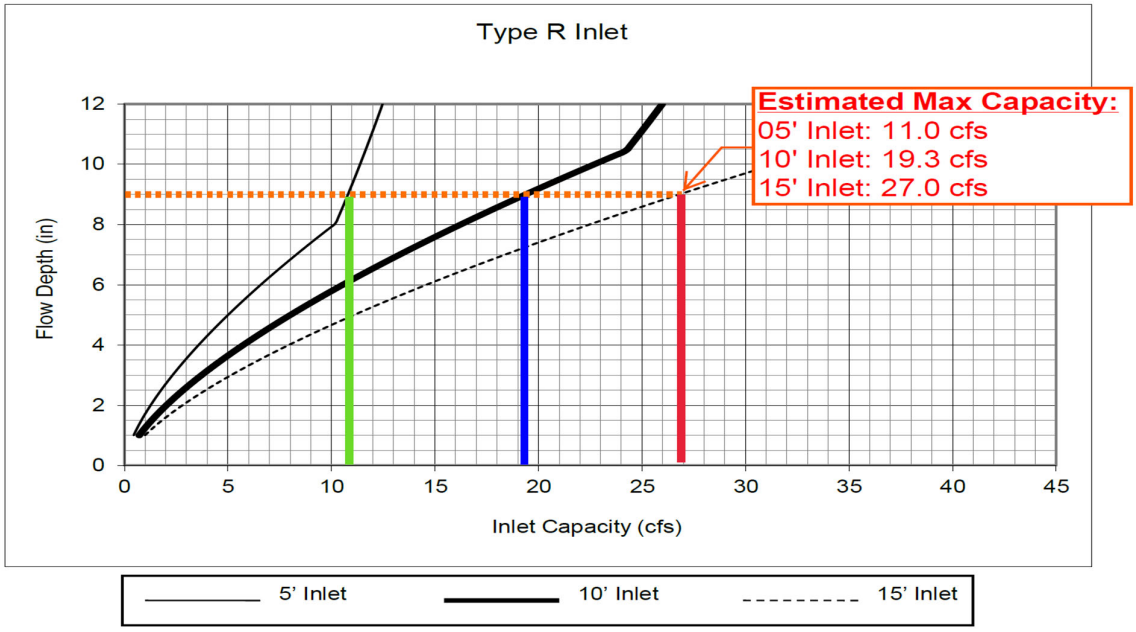
PHASE 3 INLETS

V. Hydraulic Analysis

a. Proposed Inlets

INLET SUMMARY BRADLEY HEIGHTS MDDP											
DESIGN POINT or SUB-BASIN	SUB-BASINS/ DESCRIPTION	TOTAL AREA (AC)	INLET			Q(5) TOTAL INFLOW	Q5 INLET CAPACTIY	Q(100) BYPASS FLOWS (cfs)	Q(100) TOTAL INFLOW (cfs)	MAX INLET CAPACITY	NOTES:
			SIZE (Ft.)	TYPE	CONDITION						
I	BS3, BS5	5.35	10	R	SUMP	10.1	10.1	4.3	23.6	19.3	Q100 FLOWS EQUALIZE ACROSS CROWN IN MAJOR EVENT
J	BS4, BS6	1.20	10	R	SUMP	5.0	5.0	0.0	13.4	19.3	INCLUDES BYPASS FROM DP I
N	MK3	1.63	5	R	SUMP	5.0	5.0	0.0	9.2	11.0	
O	MK5	0.56	5	R	SUMP	2.2	2.2	0.0	4.1	11.0	
P	MK4	1.41	5	R	SUMP	5.1	5.1	0.0	9.3	11.0	

Note: Inlet sizes indicated are minimums. Larger sizes may be used in the construction plans for conservative design.



DCM Figure 8-11 - Type R Inlet Capacities in Sump Conditions

Note: Based on the CDOT details for a Type R inlet there is an additional 3-inches of sump depth built into the inlet. This creates a flow depth of 9-inches at the inlet with Type 2 curb full depth flows and is thus the depth used above for calculating sump inlet capacity for Type R inlets.

PHASE 3 INLET SURCHARGE

Inlet Overflow Routing	
Inlet	***Overflow Routing Under Sump Inlet Blockage Conditions***
I & J	Blockage of either of these inlets will cause runoff to surcharge the crown of the road and enter the opposite inlet. In the case where both inlets are blocked, runoff will surcharge the curb and gutter on the east side of Bliss Road and flow overland to the east towards the Marksheffel Tributary to Jimmy Camp Creek where flows will then follow historic paths. Development of Sub-basin MK1 should consider overtopping flows in flow path design.
N & P	Blockage of either of these inlets will cause runoff to surcharge the crown of the road and enter the opposite inlet. In the case where both inlets are blocked, runoff will surcharge the curb and gutter on the east side of Bradley Landing Boulevard and flow overland to the east towards the Marksheffel Tributary to Jimmy Camp Creek where flows will then follow historic paths. Development of Sub-basin MK6 should consider overtopping flows in flow path design.
O	Blockage of this inlet will surcharge the crown of Bradley Ridge Road and direct runoff into inlets N or P. In the case of all three inlets blocked, flows will surcharge the crown of the road and either drain south to the West Fork of Jimmy Camp Creek or east into the Marksheffel Tributary to Jimmy Camp Creek. Drainage to the north and east is the more probable path.

b. Proposed Streets

STREET CAPACITIES

BRADLEY HEIGHTS MDDP

Street	*Road Section*	*Sub-basin*	*BYPASS SOURCE (Design Point)*	*Slope %*	*ROAD CAPACITY MINOR STORM (cfs)*	*Q(5) TOTAL FLOW*	*Q(100) BYPASS FLOWS RECEIVED (cfs)*	*ROAD CAPACITY MAJOR STORM (cfs)*	*Q(100) TOTAL FLOW (cfs)*
BLISS ROAD	COLLECTOR	BS5	N/A	2.1%	13	3.9	0.0	60	10.6
BRADLEY LANDING	COLLECTOR	MK3	N/A	1.2%	10.0	4.1	0.0	58.0	8.4

PHASE 3 SWALE CALCS

c. Swales

Swale analysis was performed using the Federal Highway Administration (FHWA) Hydraulic Toolbox. This tool helps determine the stability of each proposed swale cross section based on the flows, cross section, and type of material used for the swale. The table below summarizes the two swales included as part of these improvements.

Swale Capacities
BRADLEY HEIGHTS METRO DISTRICT (PHASE 3)

Design Point	Armoring Type	Anticipated Slope %	CHANNEL CAPACITY MAJOR STORM (cfs)	Q(100) TOTAL FLOW (cfs)	Q(100) VELOCTIY (FT/S)	Q100 Flow Depth (ft)	Freeboard (feet)
DP L (Steep)	Type M Rip Rap	4.6%	**120.3**	120.3	4.9	**2.09**	1
DP L (Flat)	Vegetation	0.7%	**120.3**	120.3	3.5	**1.65**	1
DP R	Type L Rip Rap	9.0%	**55.4**	21.5	5.7	**0.9**	1

d. Detention

Detention for the proposed improvements will be provided by the MKJCC Pond #5 Detention Facility (Full Spectrum Detention constructed as part of Phase 3). The proposed detention pond will be owned and maintained by the Bradley Heights Metro District. This pond is being constructed ahead of most of the planned development. As such, the flows from the two flared end section discharges at DP L and DP R are conveyed via swale to the detention facility. Development of the parcel adjacent to Pond #5 will trigger construction of forebays as necessary to bring flows and future storm sewer into the detention pond. The table below summarizes the detention for this phase of improvements.

Proposed Pond Summary
BRADLEY HEIGHTS METRO DISTRICT (PHASE 3)

Pond	Tributary Area	% Impervious	Pre-Development Peak		Pond Outflow		Pre vs. Post Ratio		NOTES/ CONST. PHASE
			Q5	Q100	Q5	Q100	Q5	Q100	
MKJCC Pond #5	89.39	72.24%	39.1	128.7	28.4	141.4	0.7	1.1	**Phase 3 Construction** PERMANENT DETENTION
MKJCC POND #7	19.80	95.00%	13.5	42.6	7.2	53.6	0.5	1.3	**PER MDDPA** **FUTURE** **EURV/WQ**

Please note that the anticipated discharges for the two facilities compare favorably with those flows indicated in ***MDDPA***. Pond #5 was anticipated to have a discharge of Q_5 =14.5 cfs, Q_{100} = 184.0 cfs and Pond #7 was anticipated to have a discharge of Q_5 =23.5 cfs, Q_{100} = 177.2 cfs

PHASE 3 SWALE CALCS

SWALE ANALYSIS

Hydraulic Analysis Report

Project Data

Project Title: BRADLEY HEIGHTS PHASE II ROAD IMPROVEMENTS
Designer:
Project Date: Thursday, April 7, 2022
Project Units: U.S. Customary Units
Notes: GRADING OF SWALES WILL PROVIDE A MINIMUM OF 1 FOOT OF FREEBOARD BASED ON THE DEPTH CALCULATIONS BELOW.

Channel Analysis: CHANNEL-DP L-steep

Notes:

Input Parameters

Channel Type: Trapezoidal
Side Slope 1 (Z1): 4.0000 ft/ft
Side Slope 2 (Z2): 4.0000 ft/ft
Channel Width: 8.0000 ft
Longitudinal Slope: 0.0460 ft/ft
Manning's n: 0.0684
Flow: 120.3000 cfs

Result Parameters

Depth: 1.6481 ft
Area of Flow: 24.0492 ft^2
Wetted Perimeter: 21.5904 ft
Hydraulic Radius: 1.1139 ft
Average Velocity: 5.0023 ft/s
Top Width: 21.1846 ft
Froude Number: 0.8274
Critical Depth: 1.4881 ft
Critical Velocity: 5.7939 ft/s
Critical Slope: 0.0690 ft/ft
Critical Top Width: 19.91 ft
Calculated Max Shear Stress: 4.7306 lb/ft^2
Calculated Avg Shear Stress: 3.1973 lb/ft^2

PHASE 3 SWALE CALCS

SWALE ANALYSIS

Channel Lining Analysis: CLDA - DP L-steep

Notes: BRADLEY HEIGHTS PHASE II ROAD IMPROVEMENTS

TEMPORARY SWALES ASSOCIATED WITH DISCHARGE POINTS. POND WFJCC #1 DISCHARGE DEMONSTRATES SUITEABLE DISCHARGE.

Lining Input Parameters

Channel Lining Type: Riprap, Cobble, or Gravel
D50: 1 ft
Riprap Specific Weight: 165 lb/ft^3
Water Specific Weight: 62.4 lb/ft^3
Riprap Shape is Angular
Safety Factor: 1
Calculated Safety Factor: 1.27635

Lining Results

Angle of Repose: 41.7 degrees
Relative Flow Depth: 1.13522
Manning's n method: Bathurst
Manning's n: 0.0684368

Channel Bottom Shear Results

V*: 1.56241
Reynold's Number: 128382
Shield's Parameter: 0.103896
shear stress on channel bottom: 4.73063 lb/ft^2
Permissible shear stress for channel bottom: 10.6597 lb/ft^2
channel bottom is stable
Stable D50: 0.566425 ft

Channel Side Shear Results

K1: 0.934
K2: 0.931169
Kb: 1.05
shear stress on side of channel: 4.73063 lb/ft^2
Permissible shear stress for side of channel: 9.926 lb/ft^2
Stable Side D50: 0.568147 lb/ft^2
side of channel is stable

PHASE 3 SWALE CALCS

SWALE ANALYSIS

Channel Bend Shear Results

Curvature Radius: 250 ft
No further correction will occur once R/T > 10
shear stress on bottom of channel in bend: 4.96716 lb/ft^2
bottom of bend of the channel is stable
Length of Protection beyond PT: 9.9428 ft
Additional Freeboard required because of Superelevation: 0.0659032 ft

Channel Bend Side Shear Results

shear stress on side of channel in bend: 4.63933 lb/ft^2
The side of the bend of the channel is stable

Channel Lining Stability Results

the channel is stable

Channel Summary

Name of Selected Channel: CHANNEL-DP L-steep

PHASE 3 SWALE CALCS

SWALE ANALYSIS

Channel Analysis: CHANNEL-DP L-flat

Notes:

Input Parameters

Channel Type: Trapezoidal
Side Slope 1 (Z1): 4.0000 ft/ft
Side Slope 2 (Z2): 4.0000 ft/ft
Channel Width: 8.0000 ft
Longitudinal Slope: 0.0070 ft/ft
Manning's n: 0.0434
Flow: 120.3000 cfs

Result Parameters

Depth: 2.0927 ft
Area of Flow: 34.2588 ft^2
Wetted Perimeter: 25.2567 ft
Hydraulic Radius: 1.3564 ft
Average Velocity: 3.5115 ft/s
Top Width: 24.7415 ft
Froude Number: 0.5259
Critical Depth: 1.4883 ft
Critical Velocity: 5.7932 ft/s
Critical Slope: 0.0277 ft/ft
Critical Top Width: 19.91 ft
Calculated Max Shear Stress: 0.9141 lb/ft^2
Calculated Avg Shear Stress: 0.5925 lb/ft^2

PHASE 3 SWALE CALCS

SWALE ANALYSIS

Channel Lining Analysis: CLDA - DP L-flat

Notes: BRADLEY HEIGHTS PHASE II ROAD IMPROVEMENTS

TEMPORARY SWALES ASSOCIATED WITH DISCHARGE POINTS. POND WFJCC #1 DISCHARGE DEMONSTRATES SUITEABLE DISCHARGE.

Lining Input Parameters

Channel Lining Type: Vegetation
Specific Weight of Water: 62.4 lb/ft^3
Height of Vegetation: 0.333 ft
Vegetation Condition is good
Growth Form of Vegetation is mixed
Cf: 0.75
See HEC-15, Table 4.5 (default: 0.75 for Good cover factor and Mixed growth form)
soil is noncohesive
D75: 0.1
Safety Factor: 1

Lining Results

Cn: 0.165205
Permissible Soil Shear Stress: 0.04 lb/ft^2
Mean Boundary Shear Stress: 0.592485 lb/ft^2
Maximum Shear Stress on the Channel Bottom: 0.914084 lb/ft^2
Manning's n: 0.0433842
Soil Grain Roughness: 0.0177136
Effective Shear Stress: 0.0310816 lb/ft^2
Permissible Shear Stress on Vegetation: 0.959776 lb/ft^2
This value is compared with the maximum shear stress times the safety factor to determi stability

Channel Bottom Shear Results

channel bottom is stable

Channel Lining Stability Results

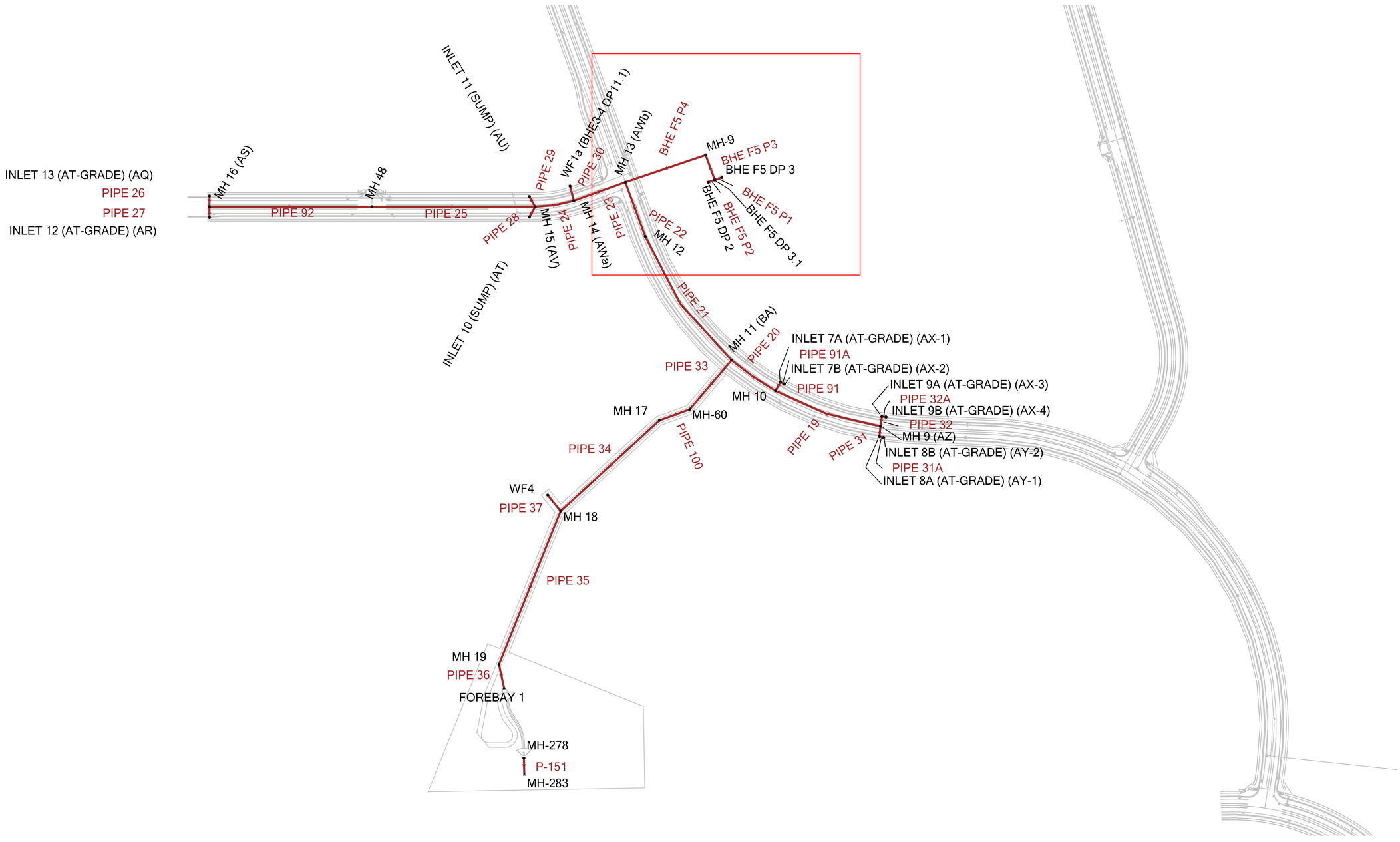
the channel is stable

Channel Summary

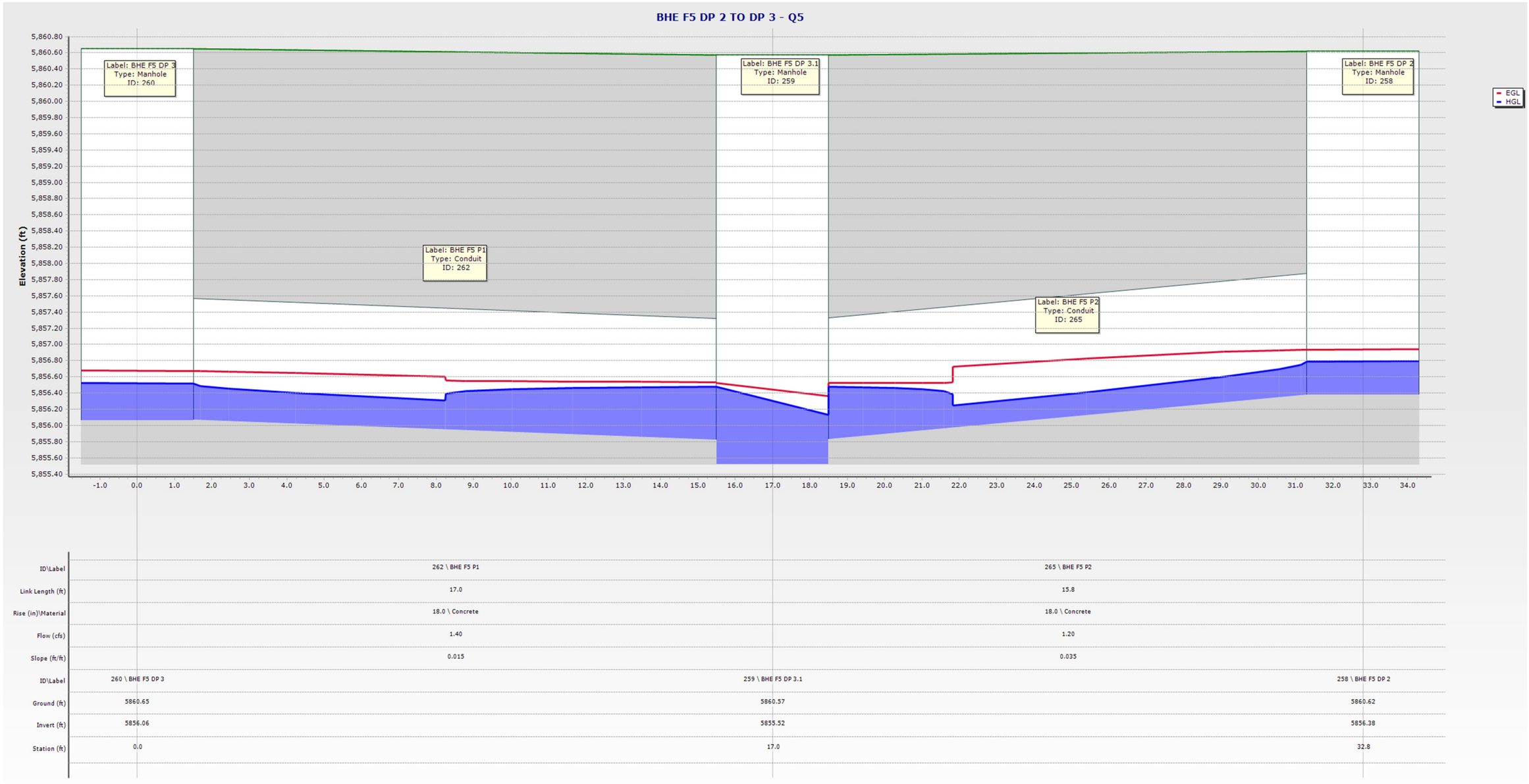
Name of Selected Channel: CHANNEL-DP L-flat

PHASE 2- FOR REFERENCE ONLY

Bradley Heights Metro District (Phase 2)
StormCAD Layout

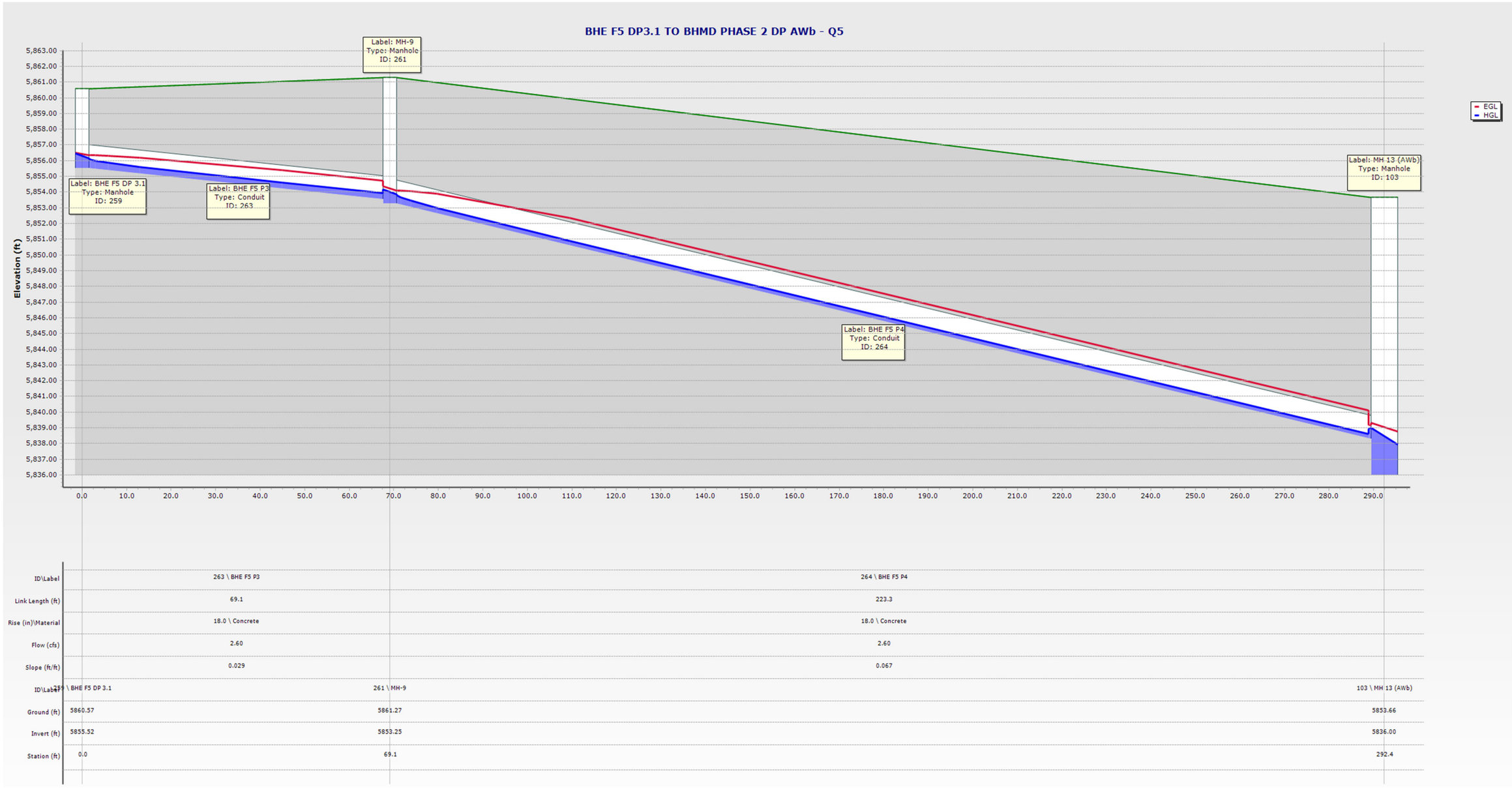


PHASE 2- FOR REFERENCE ONLY



ID\Label		262 \ BHE F5 P1	265 \ BHE F5 P2
Link Length (ft)		17.0	15.8
Rise (in)\Material		18.0 \ Concrete	18.0 \ Concrete
Flow (cfs)		1.40	1.20
Slope (ft/ft)		0.015	0.035
ID\Label	260 \ BHE F5 DP 3	259 \ BHE F5 DP 3.1	258 \ BHE F5 DP 2
Ground (ft)	5860.65	5860.57	5860.62
Invert (ft)	5856.06	5855.52	5856.38
Station (ft)	0.0	17.0	32.8

PHASE 2- FOR REFERENCE ONLY



PHASE 2- FOR REFERENCE ONLY

	ID	Label	Velocity (ft/s)	Start Node	Invert (Start) (ft)	Hydraulic Grade Line (In) (ft)	Invert (Stop) (ft)	Hydraulic Grade Line (Out) (ft)	Stop Node	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Manning's n	Flow (cfs)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Depth (Normal) / Rise (%)	Diameter (in)
262: BHE F5 P1	262	BHE F5 P1	4.74	BHE F5 DP 3	5,856.07	5,856.51	5,855.82	5,856.48	BHE F5 DP 3.1	17.0	0.015	0.013	1.40	12.74	11.0	22.4	18.0
265: BHE F5 P2	265	BHE F5 P2	6.14	BHE F5 DP 2	5,856.38	5,856.79	5,855.83	5,856.48	BHE F5 DP 3.1	15.8	0.035	0.013	1.20	19.60	6.1	16.8	18.0
263: BHE F5 P3	263	BHE F5 P3	7.17	BHE F5 DP 3.1	5,855.52	5,856.13	5,853.55	5,854.16	MH-9	69.1	0.029	0.013	2.60	17.74	14.7	25.9	18.0
264: BHE F5 P4	264	BHE F5 P4	9.81	MH-9	5,853.25	5,853.86	5,837.87	5,838.88	MH 13 (AWb)	223.3	0.069	0.013	2.60	27.57	9.4	20.7	18.0
270: P-151	270	P-151	5.54	MH-278	5,794.24	5,795.30	5,794.01	5,794.98	MH-283 (FLARED END SECTION)	46.0	0.005	0.013	12.60	84.95	14.8	26.0	44.9
139: PIPE 19	139	PIPE 19	5.48	MH 9 (AZ)	5,836.93	5,837.66	5,834.10	5,834.70	MH 10	291.7	0.010	0.013	4.30	22.28	19.3	29.8	24.0
136: PIPE 20	136	PIPE 20	4.93	MH 10	5,833.60	5,834.46	5,832.85	5,834.33	MH 11 (BA)	140.4	0.005	0.013	6.80	29.91	22.7	32.4	30.0
131: PIPE 21	131	PIPE 21	8.96	MH 12	5,834.94	5,836.90	5,831.84	5,834.33	MH 11 (BA)	398.9	0.008	0.013	39.60	88.69	44.7	46.8	42.0
130: PIPE 22	130	PIPE 22	7.61	MH 13 (AWb)	5,835.87	5,837.83	5,835.11	5,836.97	MH 12	151.1	0.005	0.013	39.60	71.36	55.5	53.2	42.0
129: PIPE 23	129	PIPE 23	7.48	MH 14 (AWa)	5,836.89	5,838.83	5,836.17	5,838.88	MH 13 (AWb)	143.5	0.005	0.013	37.00	71.26	51.9	51.1	42.0
132: PIPE 24	132	PIPE 24	6.53	MH 15 (AV)	5,839.02	5,839.92	5,837.89	5,839.55	MH 14 (AWa)	102.7	0.011	0.013	7.30	43.03	17.0	27.9	30.0
128: PIPE 25	128	PIPE 25	4.59	MH 48	5,845.19	5,845.67	5,840.03	5,840.41	MH 15 (AV)	427.0	0.012	0.013	1.60	11.55	13.9	25.1	18.0
125: PIPE 26	125	PIPE 26	3.51	INLET 13 (AT-GRADE) (AQ)	5,852.91	5,853.24	5,852.63	5,853.06	MH 16 (AS)	28.0	0.010	0.013	0.80	10.50	7.6	18.7	18.0
126: PIPE 27	126	PIPE 27	3.51	INLET 12 (AT-GRADE) (AR)	5,852.91	5,853.24	5,852.63	5,853.06	MH 16 (AS)	28.0	0.010	0.013	0.80	10.50	7.6	18.7	18.0
133: PIPE 28	133	PIPE 28	4.98	INLET 10 (SUMP) (AT)	5,839.83	5,840.42	5,839.52	5,840.30	MH 15 (AV)	30.5	0.010	0.013	2.90	22.79	12.7	24.1	24.0
134: PIPE 29	134	PIPE 29	4.92	INLET 11 (SUMP) (AU)	5,839.83	5,840.41	5,839.52	5,840.30	MH 15 (AV)	30.5	0.010	0.013	2.80	22.80	12.3	23.7	24.0
124: PIPE 30	124	PIPE 30	15.89	WF1a (BHE3-4 DP11.1)	5,839.62	5,841.16	5,837.39	5,839.55	MH 14 (AWa)	39.8	0.056	0.013	22.80	157.90	14.4	25.7	36.0
142: PIPE 31	142	PIPE 31	4.31	INLET 8A (AT-GRADE) (AY-1)	5,837.50	5,838.01	5,837.23	5,838.07	MH 9 (AZ)	26.5	0.010	0.013	1.80	22.62	8.0	19.1	24.0
143: PIPE 31A	143	PIPE 31A	6.28	INLET 8A (AT-GRADE) (AY-1)	5,838.00	5,838.80	5,838.30	5,838.36	INLET 8B (AT-GRADE) (AY-2)	11.3	-0.026	0.013	1.80	17.08	10.5	21.9	18.0
140: PIPE 32	140	PIPE 32	4.74	INLET 9A (AT-GRADE) (AX-3)	5,837.50	5,838.05	5,837.23	5,838.07	MH 9 (AZ)	26.5	0.010	0.013	2.50	22.62	11.1	22.4	24.0
141: PIPE 32A	141	PIPE 32A	6.94	INLET 9B (AT-GRADE) (AX-4)	5,838.30	5,838.91	5,838.00	5,838.44	INLET 9A (AT-GRADE) (AX-3)	11.4	0.026	0.013	2.55	17.06	15.0	26.1	18.0
252: PIPE 33	252	PIPE 33	14.85	MH 11 (BA)	5,830.84	5,832.97	5,826.20	5,827.48	MH-60	168.8	0.027	0.013	46.40	166.82	27.8	36.1	42.0
144: PIPE 34	144	PIPE 34	14.84	MH 17	5,815.51	5,817.64	5,805.91	5,809.29	MH 18	349.2	0.027	0.013	46.40	166.80	27.8	36.1	42.0
145: PIPE 35	145	PIPE 35	14.37	MH 18	5,805.41	5,807.99	5,797.45	5,799.14	MH 19	432.7	0.018	0.013	72.70	194.82	37.3	42.3	48.0
147: PIPE 36	147	PIPE 36	8.85	MH 19	5,796.45	5,799.03	5,796.14	5,798.63	FOREBAY 1	61.0	0.005	0.013	72.70	102.43	71.0	62.2	48.0
146: PIPE 37	146	PIPE 37	12.31	WF4	5,808.89	5,810.37	5,807.41	5,809.29	MH 18	54.0	0.027	0.013	25.20	237.74	10.6	22.0	48.0
137: PIPE 91	137	PIPE 91	4.77	INLET 7A (AT-GRADE) (AX-1)	5,834.36	5,834.91	5,834.09	5,834.79	MH 10	26.6	0.010	0.013	2.50	22.79	11.0	22.4	24.0
138: PIPE 91A	138	PIPE 91A	6.00	INLET 7B (AT-GRADE) (AX-2)	5,835.06	5,835.67	5,834.86	5,835.33	INLET 7A (AT-GRADE) (AX-1)	11.4	0.018	0.013	2.55	13.93	18.3	29.0	18.0
127: PIPE 92	127	PIPE 92	4.89	MH 16 (AS)	5,852.33	5,852.80	5,846.19	5,846.55	MH 48	425.0	0.014	0.013	1.60	12.62	12.7	24.0	18.0
253: PIPE 100	253	PIPE 100	14.84	MH-60	5,822.04	5,824.17	5,819.68	5,821.05	MH 17	86.0	0.027	0.013	46.40	166.70	27.8	36.1	42.0

THESE BRADLEY HEIGHTS F5 STORM NETWORK ITEMS WERE MODELED AS A PART OF THE PHASE 2 FDR.

Figure 1- Q5 CONDUIT SUMMARY ***(FREE OUTFALL)***

145: PIPE 35	145	PIPE 35	14.37	MH 18	5,805.41	5,807.99	5,797.45	5,801.47	MH 19	432.7	0.018	0.013	72.70	194.82	37.3	42.3	48.0
147: PIPE 36	147	PIPE 36	5.79	MH 19	5,796.45	5,801.27	5,796.14	5,801.11	FOREBAY 1	61.0	0.005	0.013	72.70	102.43	71.0	62.2	48.0

Figure 2 - Q5 CONDUIT SUMMARY W/ TAILWATER

PHASE 2- FOR REFERENCE ONLY

	ID	Label	Flow (Known) (cfs)	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Depth (Out) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss Method	Headloss Coefficient (Standard)	Flow (Total Out) (cfs)
258: BHE F5 DP 2	258	BHE F5 DP 2	1.20	5,860.62	5,860.62	0.41	5,856.80	5,856.79	Standard	0.050	1.20
260: BHE F5 DP 3	260	BHE F5 DP 3	1.40	5,860.65	5,860.65	0.45	5,856.52	5,856.51	Standard	0.050	1.40
259: BHE F5 DP 3.1	259	BHE F5 DP 3.1	2.60	5,860.57	5,860.57	0.61	5,856.48	5,856.13	Standard	1.520	2.60
110: INLET 7A (AT-GRADE) (AX-1)	110	INLET 7A (AT-GRADE) (AX-1)	2.50	5,846.22	5,846.22	0.79	5,835.17	5,834.91	Standard	1.320	2.50
111: INLET 7B (AT-GRADE) (AX-2)	111	INLET 7B (AT-GRADE) (AX-2)	2.55	5,846.09	5,846.09	1.38	5,835.68	5,835.67	Standard	0.050	2.55
114: INLET 8A (AT-GRADE) (AY-1)	114	INLET 8A (AT-GRADE) (AY-1)	1.80	5,842.99	5,842.99	0.51	5,838.17	5,838.01	Standard	1.320	1.80
117: INLET 8B (AT-GRADE) (AY-2)	117	INLET 8B (AT-GRADE) (AY-2)	1.80	5,842.87	5,842.87	1.20	5,838.81	5,838.80	Standard	0.050	1.80
113: INLET 9A (AT-GRADE) (AX-3)	113	INLET 9A (AT-GRADE) (AX-3)	2.50	5,843.00	5,843.00	0.55	5,838.06	5,838.05	Standard	0.050	2.50
116: INLET 9B (AT-GRADE) (AX-4)	116	INLET 9B (AT-GRADE) (AX-4)	2.55	5,842.87	5,842.87	1.30	5,838.92	5,838.91	Standard	0.050	2.55
106: INLET 10 (SUMP) (AT)	106	INLET 10 (SUMP) (AT)	2.90	5,849.56	5,849.56	0.09	5,840.43	5,840.42	Standard	0.050	2.90
107: INLET 11 (SUMP) (AU)	107	INLET 11 (SUMP) (AU)	2.80	5,849.56	5,849.56	0.08	5,840.42	5,840.41	Standard	0.050	2.80
100: INLET 12 (AT-GRADE) (AR)	100	INLET 12 (AT-GRADE) (AR)	0.80	5,857.80	5,857.80	0.33	5,853.25	5,853.24	Standard	0.050	0.80
99: INLET 13 (AT-GRADE) (AQ)	99	INLET 13 (AT-GRADE) (AQ)	0.80	5,857.81	5,857.81	0.33	5,853.25	5,853.24	Standard	0.050	0.80
115: MH 9 (AZ)	115	MH 9 (AZ)	0.00	5,842.91	5,842.91	0.73	5,838.07	5,837.66	Standard	1.520	4.30
112: MH 10	112	MH 10	0.00	5,846.08	5,846.08	0.86	5,834.79	5,834.46	Standard	1.020	6.80
109: MH 11 (BA)	109	MH 11 (BA)	0.00	5,847.63	5,847.63	1.61	5,834.33	5,832.97	Standard	1.520	46.40
104: MH 12	104	MH 12	0.00	5,852.02	5,852.02	1.94	5,836.98	5,836.90	Standard	0.100	39.60
103: MH 13 (AWb)	103	MH 13 (AWb)	0.00	5,853.66	5,853.66	1.96	5,838.88	5,837.83	Standard	1.320	39.60
105: MH 14 (AWa)	105	MH 14 (AWa)	37.00	5,850.80	5,850.80	1.94	5,839.55	5,838.83	Standard	1.020	37.00
108: MH 15 (AV)	108	MH 15 (AV)	0.00	5,849.45	5,849.45	0.70	5,840.30	5,839.92	Standard	1.160	7.30
101: MH 16 (AS)	101	MH 16 (AS)	0.00	5,857.71	5,857.71	0.48	5,853.06	5,852.80	Standard	1.520	1.60
118: MH 17	118	MH 17	0.00	5,834.00	5,834.00	2.13	5,817.73	5,817.64	Standard	0.100	46.40
119: MH 18	119	MH 18	72.70	5,816.97	5,816.97	5.58	5,809.29	5,807.99	Standard	1.160	72.70
121: MH 19	121	MH 19	0.00	5,806.15	5,806.15	2.58	5,799.48	5,799.03	Standard	0.400	72.70
102: MH 48	102	MH 48	0.00	5,856.72	5,856.72	0.48	5,845.68	5,845.67	Standard	0.050	1.60
261: MH-9	261	MH-9	0.00	5,861.27	5,861.27	0.61	5,854.16	5,853.86	Standard	1.320	2.60
251: MH-60	251	MH-60	0.00	5,839.56	5,839.56	2.13	5,824.25	5,824.17	Standard	0.100	46.40
268: MH-278	268	MH-278	12.60	5,800.52	5,800.52	1.06	5,795.32	5,795.30	Standard	0.050	12.60
254: WF1a (BHE3-4 DP11.1)	254	WF1a (BHE3-4 DP11.1)	22.80	5,851.08	5,851.08	1.54	5,841.19	5,841.16	Standard	0.050	22.80
255: WF4	255	WF4	25.20	5,819.30	5,819.30	4.16	5,810.40	5,810.37	Standard	0.050	25.20

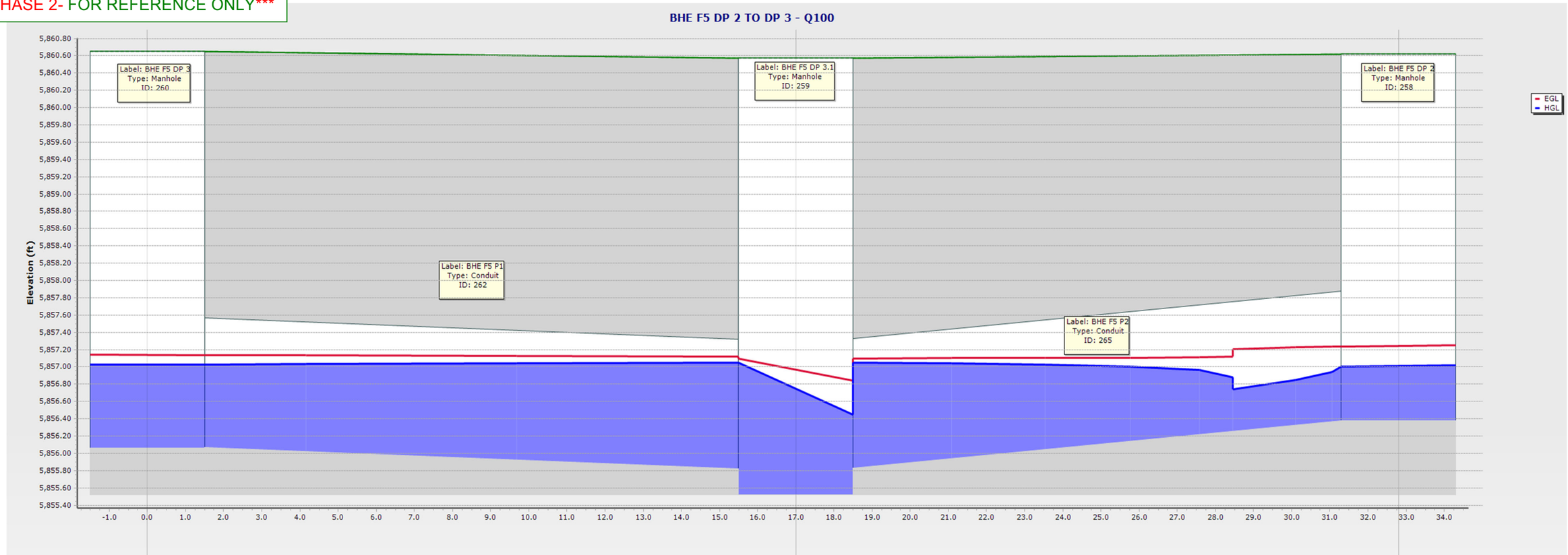
THESE BRADLEY HEIGHTS F5 STORM NETWORK ITEMS WERE MODELED AS A PART OF THE PHASE 2 FDR.

Figure 3 - Q5 NODE SUMMARY ***(FREE OUTFALL)***

	ID	Label	Flow (Known) (cfs)	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Depth (Out) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss Method	Headloss Coefficient (Standard)	Flow (Total Out) (cfs)
119: MH 18	119	MH 18	72.70	5,816.97	5,816.97	5.58	5,809.29	5,807.99	Standard	1.160	72.70
121: MH 19	121	MH 19	0.00	5,806.15	5,806.15	4.82	5,801.47	5,801.27	Standard	0.400	72.70

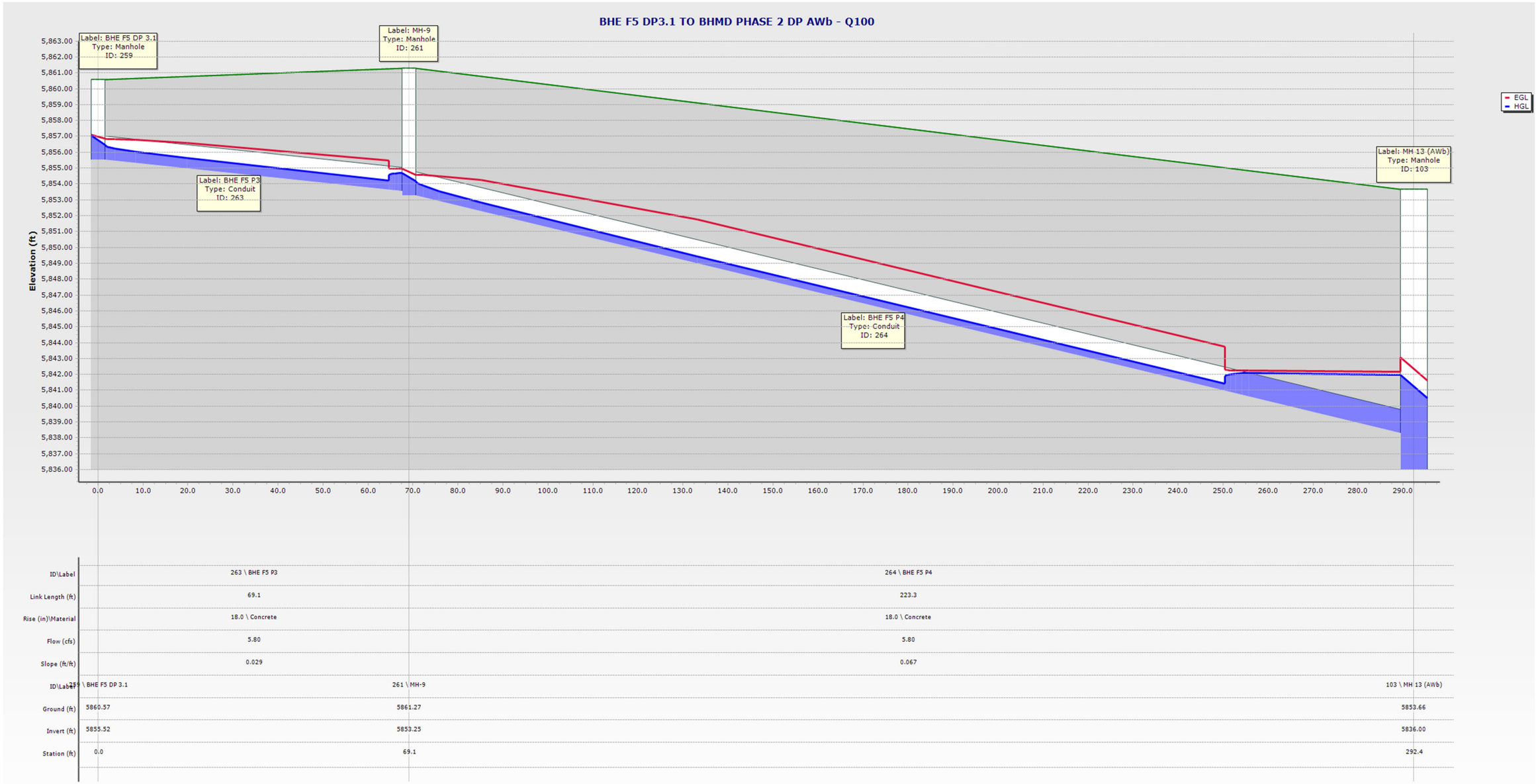
Figure 4 - Q5 NODE SUMMARY WITH TAILWATER

PHASE 2- FOR REFERENCE ONLY



ID\Label	262 \ BHE F5 P1	265 \ BHE F5 P2	
Link Length (ft)	17.0	15.8	
Rise (in)\Material	18.0 \ Concrete	18.0 \ Concrete	
Flow (cfs)	3.20	2.70	
Slope (ft/ft)	0.015	0.035	
ID\Label	260 \ BHE F5 DP 3	259 \ BHE F5 DP 3.1	258 \ BHE F5 DP 2
Ground (ft)	5860.65	5860.57	5860.62
Invert (ft)	5856.06	5855.52	5856.38
Station (ft)	0.0	17.0	32.8

PHASE 2- FOR REFERENCE ONLY



ID\Label	263 \ BHE F5 P3	264 \ BHE F5 P4	
Link Length (ft)	69.1	223.3	
Rise (in)\Material	18.0 \ Concrete	18.0 \ Concrete	
Flow (cfs)	5.80	5.80	
Slope (ft/ft)	0.029	0.067	
ID\Label	259 \ BHE F5 DP 3.1	261 \ MH-9	103 \ MH 13 (AWb)
Ground (ft)	5860.57	5861.27	5853.66
Invert (ft)	5855.52	5853.25	5836.00
Station (ft)	0.0	69.1	292.4

PHASE 2- FOR REFERENCE ONLY

	ID	Label	Velocity (ft/s)	Start Node	Invert (Start) (ft)	Hydraulic Grade Line (In) (ft)	Invert (Stop) (ft)	Hydraulic Grade Line (Out) (ft)	Stop Node	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Manning's n	Flow (cfs)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Depth (Normal) / Rise (%)	Diameter (in)
262: BHE F5 P1	262	BHE F5 P1	6.00	BHE F5 DP 3	5,856.07	5,857.02	5,855.82	5,857.05	BHE F5 DP 3.1	17.0	0.015	0.013	3.20	12.74	25.1	34.2	18.0
265: BHE F5 P2	265	BHE F5 P2	7.78	BHE F5 DP 2	5,856.38	5,857.00	5,855.83	5,857.05	BHE F5 DP 3.1	15.8	0.035	0.013	2.70	19.60	13.8	25.1	18.0
263: BHE F5 P3	263	BHE F5 P3	8.98	BHE F5 DP 3.1	5,855.52	5,856.45	5,853.55	5,854.70	MH-9	69.1	0.029	0.013	5.80	17.74	32.7	39.4	18.0
264: BHE F5 P4	264	BHE F5 P4	12.36	MH-9	5,853.25	5,854.18	5,837.87	5,841.98	MH 13 (AWb)	223.3	0.069	0.013	5.80	27.57	21.0	31.1	18.0
270: P-151	270	P-151	9.58	MH-278	5,794.24	5,797.72	5,794.01	5,797.14	MH-283 (FLARED END SECTION)	46.0	0.005	0.013	105.30	84.95	124.0	(N/A)	44.9
139: PIPE 19	139	PIPE 19	5.66	MH 9 (AZ)	5,836.93	5,837.70	5,834.10	5,837.34	MH 10	291.7	0.010	0.013	4.80	22.28	21.5	31.5	24.0
136: PIPE 20	136	PIPE 20	4.16	MH 10	5,833.60	5,837.07	5,832.85	5,836.72	MH 11 (BA)	140.4	0.005	0.013	20.40	29.91	68.2	60.6	30.0
131: PIPE 21	131	PIPE 21	8.52	MH 12	5,834.94	5,839.37	5,831.84	5,836.72	MH 11 (BA)	398.9	0.008	0.013	82.00	88.69	92.5	75.9	42.0
130: PIPE 22	130	PIPE 22	8.52	MH 13 (AWb)	5,835.87	5,840.49	5,835.11	5,839.48	MH 12	151.1	0.005	0.013	82.00	71.36	114.9	(N/A)	42.0
129: PIPE 23	129	PIPE 23	8.37	MH 14 (AWa)	5,836.89	5,842.90	5,836.17	5,841.98	MH 13 (AWb)	143.5	0.005	0.013	80.50	71.26	113.0	(N/A)	42.0
132: PIPE 24	132	PIPE 24	6.58	MH 15 (AV)	5,839.02	5,844.64	5,837.89	5,844.01	MH 14 (AWa)	102.7	0.011	0.013	32.30	43.03	75.1	64.7	30.0
128: PIPE 25	128	PIPE 25	5.38	MH 48	5,845.19	5,845.83	5,840.03	5,845.42	MH 15 (AV)	427.0	0.012	0.013	2.80	11.55	24.2	33.5	18.0
125: PIPE 26	125	PIPE 26	4.13	INLET 13 (AT-GRADE) (AQ)	5,852.91	5,853.36	5,852.63	5,853.33	MH 16 (AS)	28.0	0.010	0.013	1.40	10.50	13.3	24.7	18.0
126: PIPE 27	126	PIPE 27	4.13	INLET 12 (AT-GRADE) (AR)	5,852.91	5,853.35	5,852.63	5,853.33	MH 16 (AS)	28.0	0.010	0.013	1.40	10.50	13.3	24.7	18.0
133: PIPE 28	133	PIPE 28	4.39	INLET 10 (SUMP) (AT)	5,839.83	5,845.54	5,839.52	5,845.42	MH 15 (AV)	30.5	0.010	0.013	13.80	22.79	60.5	56.1	24.0
134: PIPE 29	134	PIPE 29	6.14	INLET 11 (SUMP) (AU)	5,839.83	5,845.65	5,839.52	5,845.42	MH 15 (AV)	30.5	0.010	0.013	19.30	22.80	84.7	70.6	24.0
124: PIPE 30	124	PIPE 30	6.73	WF1a (BHE3-4 DP11.1)	5,839.62	5,844.21	5,837.39	5,844.01	MH 14 (AWa)	39.8	0.056	0.013	47.60	157.90	30.1	37.6	36.0
142: PIPE 31	142	PIPE 31	5.14	INLET 8A (AT-GRADE) (AY-1)	5,837.50	5,838.13	5,837.23	5,838.14	MH 9 (AZ)	26.5	0.010	0.013	3.30	22.62	14.6	25.8	24.0
143: PIPE 31A	143	PIPE 31A	7.47	INLET 8A (AT-GRADE) (AY-1)	5,838.00	5,838.99	5,838.30	5,838.51	INLET 8B (AT-GRADE) (AY-2)	11.3	-0.026	0.013	3.30	17.08	19.3	29.8	18.0
140: PIPE 32	140	PIPE 32	4.08	INLET 9A (AT-GRADE) (AX-3)	5,837.50	5,838.12	5,837.23	5,838.14	MH 9 (AZ)	26.5	0.010	0.013	1.50	22.62	6.6	17.4	24.0
141: PIPE 32A	141	PIPE 32A	8.65	INLET 9B (AT-GRADE) (AX-4)	5,838.30	5,839.21	5,838.00	5,838.69	INLET 9A (AT-GRADE) (AX-3)	11.4	0.026	0.013	5.60	17.06	32.8	39.4	18.0
252: PIPE 33	252	PIPE 33	18.00	MH 11 (BA)	5,830.84	5,833.88	5,826.20	5,828.22	MH-60	168.8	0.027	0.013	97.30	166.82	58.3	54.9	42.0
144: PIPE 34	144	PIPE 34	18.00	MH 17	5,815.51	5,818.55	5,805.91	5,812.68	MH 18	349.2	0.027	0.013	97.30	166.80	58.3	54.9	42.0
145: PIPE 35	145	PIPE 35	17.48	MH 18	5,805.41	5,809.14	5,797.45	5,802.04	MH 19	432.7	0.018	0.013	170.90	194.82	87.7	72.6	48.0
147: PIPE 36	147	PIPE 36	13.60	MH 19	5,796.45	5,800.89	5,796.14	5,799.87	FOREBAY 1	61.0	0.005	0.013	170.90	102.43	166.8	(N/A)	48.0
146: PIPE 37	146	PIPE 37	15.69	WF4	5,808.89	5,812.76	5,807.41	5,812.68	MH 18	54.0	0.027	0.013	59.00	237.74	24.8	33.9	48.0
137: PIPE 91	137	PIPE 91	4.39	INLET 7A (AT-GRADE) (AX-1)	5,834.36	5,837.44	5,834.09	5,837.34	MH 10	26.6	0.010	0.013	13.80	22.79	60.5	56.1	24.0
138: PIPE 91A	138	PIPE 91A	3.90	INLET 7B (AT-GRADE) (AX-2)	5,835.06	5,837.89	5,834.86	5,837.84	INLET 7A (AT-GRADE) (AX-1)	11.4	0.018	0.013	6.90	13.93	49.5	49.7	18.0
127: PIPE 92	127	PIPE 92	5.74	MH 16 (AS)	5,852.33	5,852.96	5,846.19	5,846.67	MH 48	425.0	0.014	0.013	2.80	12.62	22.2	32.0	18.0
253: PIPE 100	253	PIPE 100	17.99	MH-60	5,822.04	5,825.08	5,819.68	5,821.83	MH 17	86.0	0.027	0.013	97.30	166.70	58.4	54.9	42.0

THESE BRADLEY HEIGHTS F5 STORM NETWORK ITEMS WERE MODELED AS A PART OF THE PHASE 2 FDR.

Figure 5 - Q100 CONDUIT SUMMARY (FREE OUTFALL)

	ID	Label	Velocity (ft/s)	Start Node	Invert (Start) (ft)	Hydraulic Grade Line (In) (ft)	Invert (Stop) (ft)	Hydraulic Grade Line (Out) (ft)	Stop Node	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Manning's n	Flow (cfs)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Depth (Normal) / Rise (%)	Diameter (in)
144: PIPE 34	144	PIPE 34	18.00	MH 17	5,815.51	5,818.55	5,805.91	5,814.28	MH 18	349.2	0.027	0.013	97.30	166.80	58.3	54.9	42.0
145: PIPE 35	145	PIPE 35	13.60	MH 18	5,805.41	5,810.95	5,797.45	5,804.82	MH 19	432.7	0.018	0.013	170.90	194.82	87.7	72.6	48.0
147: PIPE 36	147	PIPE 36	13.60	MH 19	5,796.45	5,803.67	5,796.14	5,802.81	FOREBAY 1	61.0	0.005	0.013	170.90	102.43	166.8	(N/A)	48.0

Figure 6 - Q100 CONDUIT SUMMARY - WITH TAILWATER

PHASE 2- FOR REFERENCE ONLY

	ID	Label	Flow (Known) (cfs)	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Depth (Out) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss Method	Headloss Coefficient (Standard)	Flow (Total Out) (cfs)
258: BHE F5 DP 2	258	BHE F5 DP 2	2.70	5,860.62	5,860.62	0.62	5,857.02	5,857.00	Standard	0.050	2.70
260: BHE F5 DP 3	260	BHE F5 DP 3	3.20	5,860.65	5,860.65	0.96	5,857.03	5,857.02	Standard	0.050	3.20
259: BHE F5 DP 3.1	259	BHE F5 DP 3.1	5.80	5,860.57	5,860.57	0.93	5,857.05	5,856.45	Standard	1.520	5.80
110: INLET 7A (AT-GRADE) (AX-1)	110	INLET 7A (AT-GRADE) (AX-1)	13.80	5,846.22	5,846.22	3.32	5,837.84	5,837.44	Standard	1.320	13.80
111: INLET 7B (AT-GRADE) (AX-2)	111	INLET 7B (AT-GRADE) (AX-2)	6.90	5,846.09	5,846.09	3.60	5,837.90	5,837.89	Standard	0.050	6.90
114: INLET 8A (AT-GRADE) (AY-1)	114	INLET 8A (AT-GRADE) (AY-1)	3.30	5,842.99	5,842.99	0.64	5,838.44	5,838.13	Standard	1.320	3.30
117: INLET 8B (AT-GRADE) (AY-2)	117	INLET 8B (AT-GRADE) (AY-2)	3.30	5,842.87	5,842.87	1.39	5,839.01	5,838.99	Standard	0.050	3.30
113: INLET 9A (AT-GRADE) (AX-3)	113	INLET 9A (AT-GRADE) (AX-3)	1.50	5,843.00	5,843.00	0.62	5,838.12	5,838.12	Standard	0.050	1.50
116: INLET 9B (AT-GRADE) (AX-4)	116	INLET 9B (AT-GRADE) (AX-4)	5.60	5,842.87	5,842.87	1.61	5,839.23	5,839.21	Standard	0.050	5.60
106: INLET 10 (SUMP) (AT)	106	INLET 10 (SUMP) (AT)	13.80	5,849.56	5,849.56	5.20	5,845.55	5,845.54	Standard	0.050	13.80
107: INLET 11 (SUMP) (AU)	107	INLET 11 (SUMP) (AU)	19.30	5,849.56	5,849.56	5.31	5,845.67	5,845.65	Standard	0.050	19.30
100: INLET 12 (AT-GRADE) (AR)	100	INLET 12 (AT-GRADE) (AR)	1.40	5,857.80	5,857.80	0.44	5,853.36	5,853.35	Standard	0.050	1.40
99: INLET 13 (AT-GRADE) (AQ)	99	INLET 13 (AT-GRADE) (AQ)	1.40	5,857.81	5,857.81	0.44	5,853.36	5,853.36	Standard	0.050	1.40
115: MH 9 (AZ)	115	MH 9 (AZ)	0.00	5,842.91	5,842.91	0.77	5,838.14	5,837.70	Standard	1.520	4.80
112: MH 10	112	MH 10	20.40	5,846.08	5,846.08	3.47	5,837.34	5,837.07	Standard	1.020	20.40
109: MH 11 (BA)	109	MH 11 (BA)	97.30	5,847.63	5,847.63	2.53	5,836.72	5,833.88	Standard	1.520	97.30
104: MH 12	104	MH 12	0.00	5,852.02	5,852.02	4.42	5,839.48	5,839.37	Standard	0.100	82.00
103: MH 13 (AWb)	103	MH 13 (AWb)	82.00	5,853.66	5,853.66	4.62	5,841.98	5,840.49	Standard	1.320	82.00
105: MH 14 (AWa)	105	MH 14 (AWa)	80.50	5,850.80	5,850.80	6.01	5,844.01	5,842.90	Standard	1.020	80.50
108: MH 15 (AV)	108	MH 15 (AV)	32.30	5,849.45	5,849.45	5.42	5,845.42	5,844.64	Standard	1.160	32.30
101: MH 16 (AS)	101	MH 16 (AS)	0.00	5,857.71	5,857.71	0.64	5,853.33	5,852.96	Standard	1.520	2.80
118: MH 17	118	MH 17	0.00	5,834.00	5,834.00	3.04	5,818.73	5,818.55	Standard	0.100	97.30
119: MH 18	119	MH 18	170.90	5,816.97	5,816.97	6.73	5,812.68	5,809.14	Standard	1.160	170.90
121: MH 19	121	MH 19	0.00	5,806.15	5,806.15	4.44	5,802.04	5,800.89	Standard	0.400	170.90
102: MH 48	102	MH 48	0.00	5,856.72	5,856.72	0.64	5,845.84	5,845.83	Standard	0.050	2.80
261: MH-9	261	MH-9	0.00	5,861.27	5,861.27	0.93	5,854.70	5,854.18	Standard	1.320	5.80
251: MH-60	251	MH-60	0.00	5,839.56	5,839.56	3.04	5,825.26	5,825.08	Standard	0.100	97.30
268: MH-278	268	MH-278	105.30	5,800.52	5,800.52	3.48	5,797.80	5,797.72	Standard	0.050	105.30
254: WF1a (BHE3-4 DP11.1)	254	WF1a (BHE3-4 DP11.1)	47.60	5,851.08	5,851.08	4.59	5,844.24	5,844.21	Standard	0.050	47.60
255: WF4	255	WF4	59.00	5,819.30	5,819.30	6.55	5,812.78	5,812.76	Standard	0.050	59.00

THESE BRADLEY HEIGHTS F5 STORM NETWORK ITEMS WERE MODELED AS A PART OF THE PHASE 2 FDR.

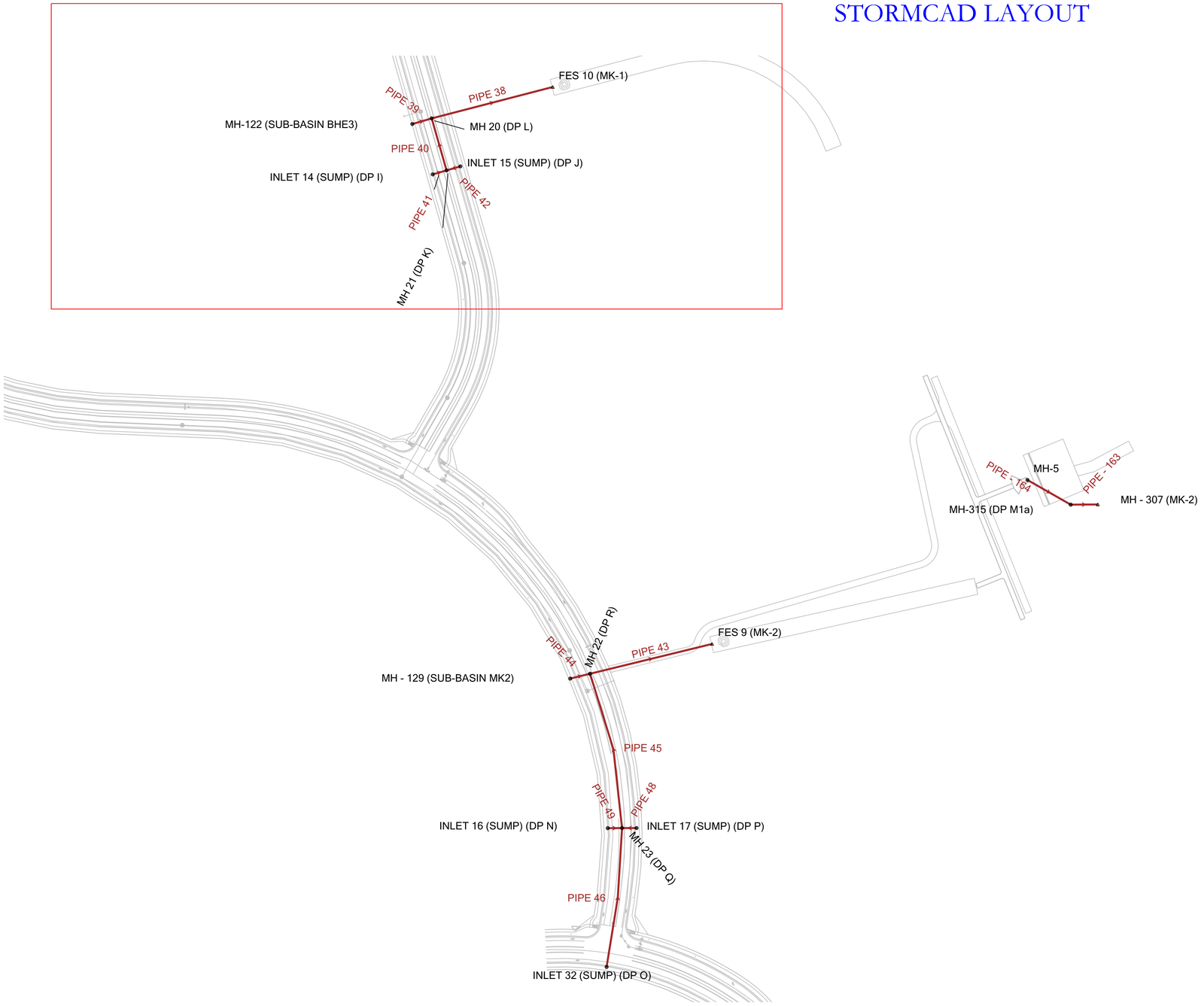
Figure 7 - Q100 NODE SUMMARY - (FREE OUTFALL)

	ID	Label	Flow (Known) (cfs)	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Depth (Out) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss Method	Headloss Coefficient (Standard)	Flow (Total Out) (cfs)
119: MH 18	119	MH 18	170.90	5,816.97	5,816.97	8.54	5,814.28	5,810.95	Standard	1.160	170.90
121: MH 19	121	MH 19	0.00	5,806.15	5,806.15	7.22	5,804.82	5,803.67	Standard	0.400	170.90

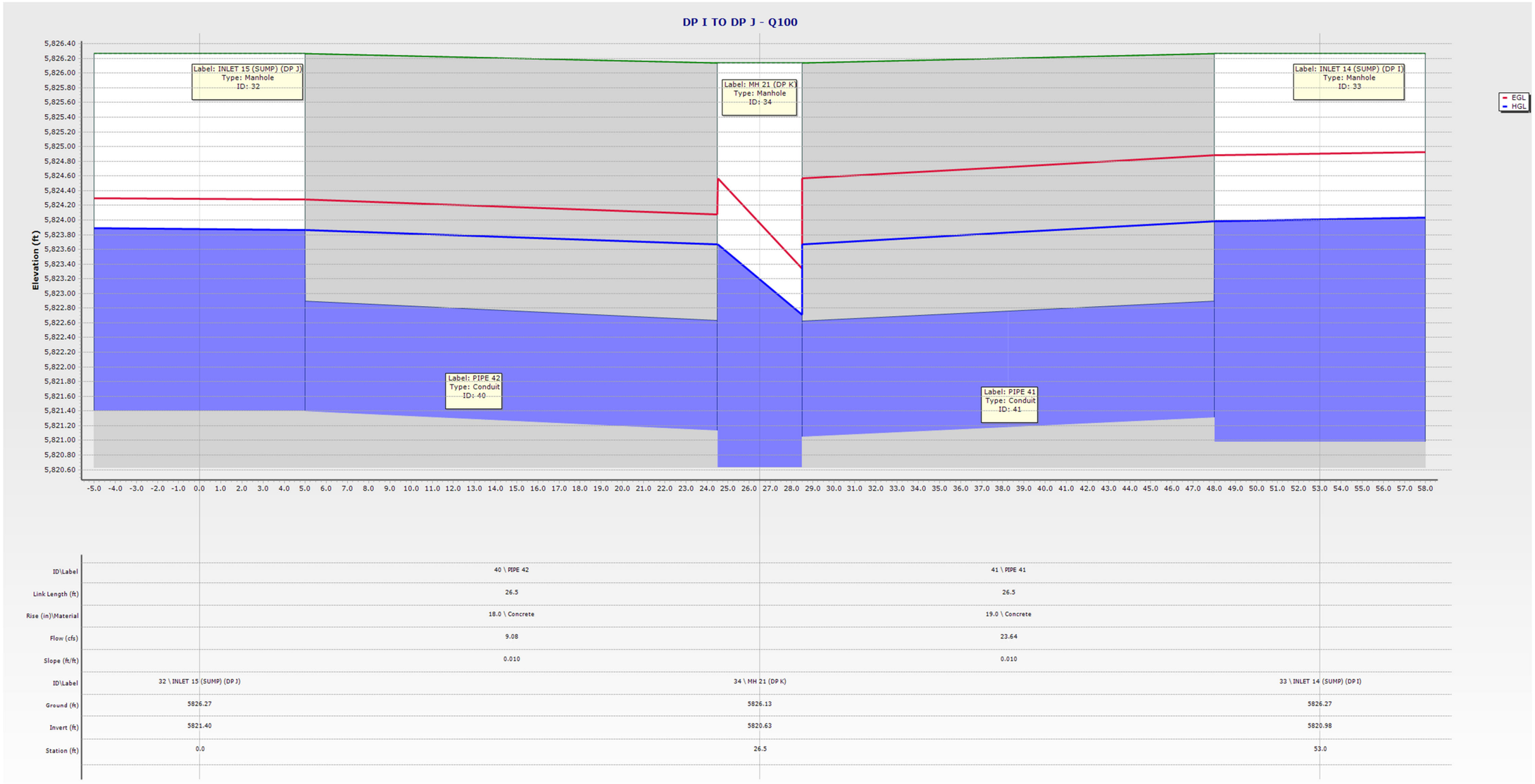
Figure 8 - Q100 NODE SUMMARY WITH TAILWATER

PHASE 3- FOR REFERENCE ONLY

BRADLEY HEIGHTS METRO DISTRICT (PHASE 3)
STORMCAD LAYOUT

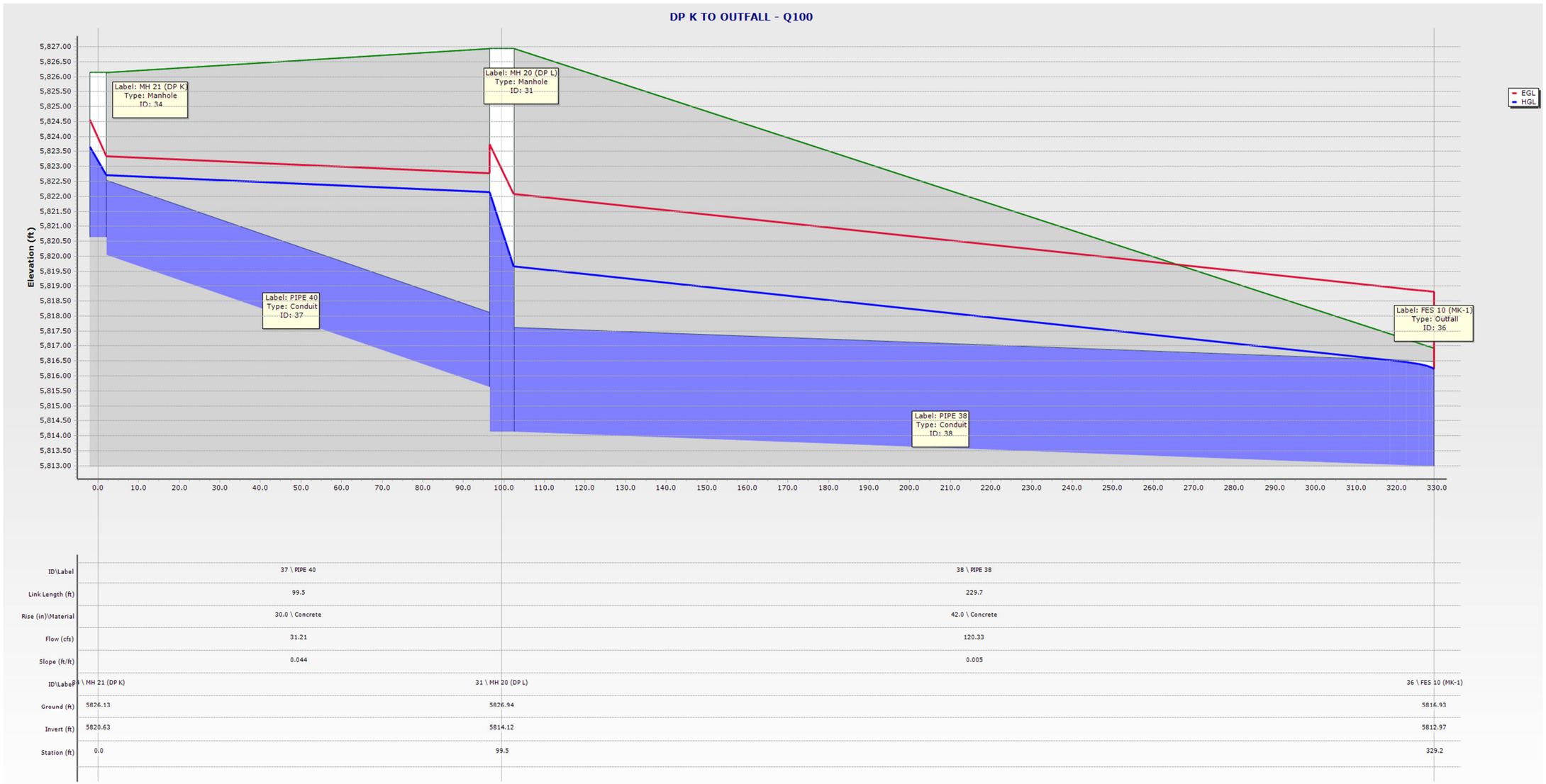


PHASE 3- FOR REFERENCE ONLY



ID\Label	40 \ PIPE 42	41 \ PIPE 41	
Link Length (ft)	26.5	26.5	
Rise (in)\Material	18.0 \ Concrete	19.0 \ Concrete	
Flow (cfs)	9.08	23.64	
Slope (ft/ft)	0.010	0.010	
ID\Label	32 \ INLET 15 (SUMP) (DP J)	34 \ MH 21 (DP K)	33 \ INLET 14 (SUMP) (DP I)
Ground (ft)	5826.27	5826.13	5826.27
Invert (ft)	5821.40	5820.63	5820.98
Station (ft)	0.0	26.5	53.0

PHASE 3- FOR REFERENCE ONLY



PHASE 3- FOR REFERENCE ONLY

PHASE 3- FOR REFERENCE ONLY

	ID	Label	Velocity (ft/s)	Start Node	Invert (Start) (ft)	Hydraulic Grade Line (In) (ft)	Invert (Stop) (ft)	Hydraulic Grade Line (Out) (ft)	Stop Node	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Manning's n	Flow (cfs)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Depth (Normal) / Rise (%)	Diameter (in)	Notes
57: PIPE - 163	57	PIPE - 163	11.06	MH-315 (DP M1a)	5,768.24	5,772.19	5,768.00	5,771.50	MH - 307 (MK-2)	48.0	0.005	0.013	139.00	101.61	136.8	(N/A)	48.0	48" RCP
75: PIPE - 164	75	PIPE - 164	17.39	MH-5 (POND 5 OUTLET)	5,776.75	5,780.25	5,775.09	5,777.81	MH-315 (DP M1a)	83.1	0.020	0.013	139.00	202.98	68.5	60.8	48.0	48" RCP
38: PIPE 38	38	PIPE 38	12.51	MH 20 (DP L)	5,814.12	5,819.66	5,812.97	5,816.22	FES 10 (MK-1)	229.7	0.005	0.013	120.33	71.14	169.2	(N/A)	42.0	42" RCP
39: PIPE 39	39	PIPE 39	10.13	MH-122 (SUB-BASIN BHE3)	5,814.41	5,822.48	5,814.22	5,822.14	MH 20 (DP L)	37.0	0.005	0.013	97.50	71.14	137.1	(N/A)	42.0	42" RCP
37: PIPE 40	37	PIPE 40	6.36	MH 21 (DP K)	5,820.04	5,822.71	5,815.62	5,822.14	MH 20 (DP L)	99.5	0.044	0.013	31.21	86.45	36.1	41.5	30.0	30" RCP
41: PIPE 41	41	PIPE 41	7.60	INLET 14 (SUMP) (DP I)	5,821.31	5,823.99	5,821.04	5,823.67	MH 21 (DP K)	26.5	0.010	0.013	23.64	21.80	108.4	(N/A)		19"x30" HERCP
40: PIPE 42	40	PIPE 42	5.14	INLET 15 (SUMP) (DP J)	5,821.40	5,823.87	5,821.13	5,823.67	MH 21 (DP K)	26.5	0.010	0.013	9.08	10.50	86.4	71.8	18.0	18" RCP
52: PIPE 43	52	PIPE 43	8.38	MH 22 (DP R)	5,817.13	5,820.15	5,815.98	5,818.68	FES 9 (MK-2)	230.7	0.005	0.013	74.61	71.14	104.9	87.2	42.0	42" RCP
53: PIPE 44	53	PIPE 44	17.62	MH - 129 (SUB-BASIN MK2)	5,819.62	5,821.96	5,818.13	5,821.28	MH 22 (DP R)	37.6	0.040	0.013	51.80	132.79	39.0	43.4	36.0	36" RCP
51: PIPE 45	51	PIPE 45	7.76	MH 23 (DP Q)	5,821.04	5,822.57	5,818.63	5,821.28	MH 22 (DP R)	291.1	0.008	0.013	20.30	37.31	54.4	52.6	30.0	30" RCP
54: PIPE 46	54	PIPE 46	5.57	INLET 32 (SUMP) (DP O)	5,824.61	5,825.39	5,822.04	5,823.55	MH 23 (DP Q)	257.1	0.010	0.013	4.09	10.50	38.9	43.3	18.0	18" RCP
56: PIPE 48	56	PIPE 48	6.71	INLET 17 (SUMP) (DP P)	5,822.31	5,823.73	5,822.04	5,823.55	MH 23 (DP Q)	26.8	0.010	0.013	9.28	10.50	88.4	73.0	18.0	18" RCP
55: PIPE 49	55	PIPE 49	6.70	INLET 16 (SUMP) (DP N)	5,822.30	5,823.72	5,822.04	5,823.55	MH 23 (DP Q)	26.2	0.010	0.013	9.20	10.50	87.6	72.5	18.0	18" RCP

Figure 1 - Q_{100} CONDUIT SUMMARY

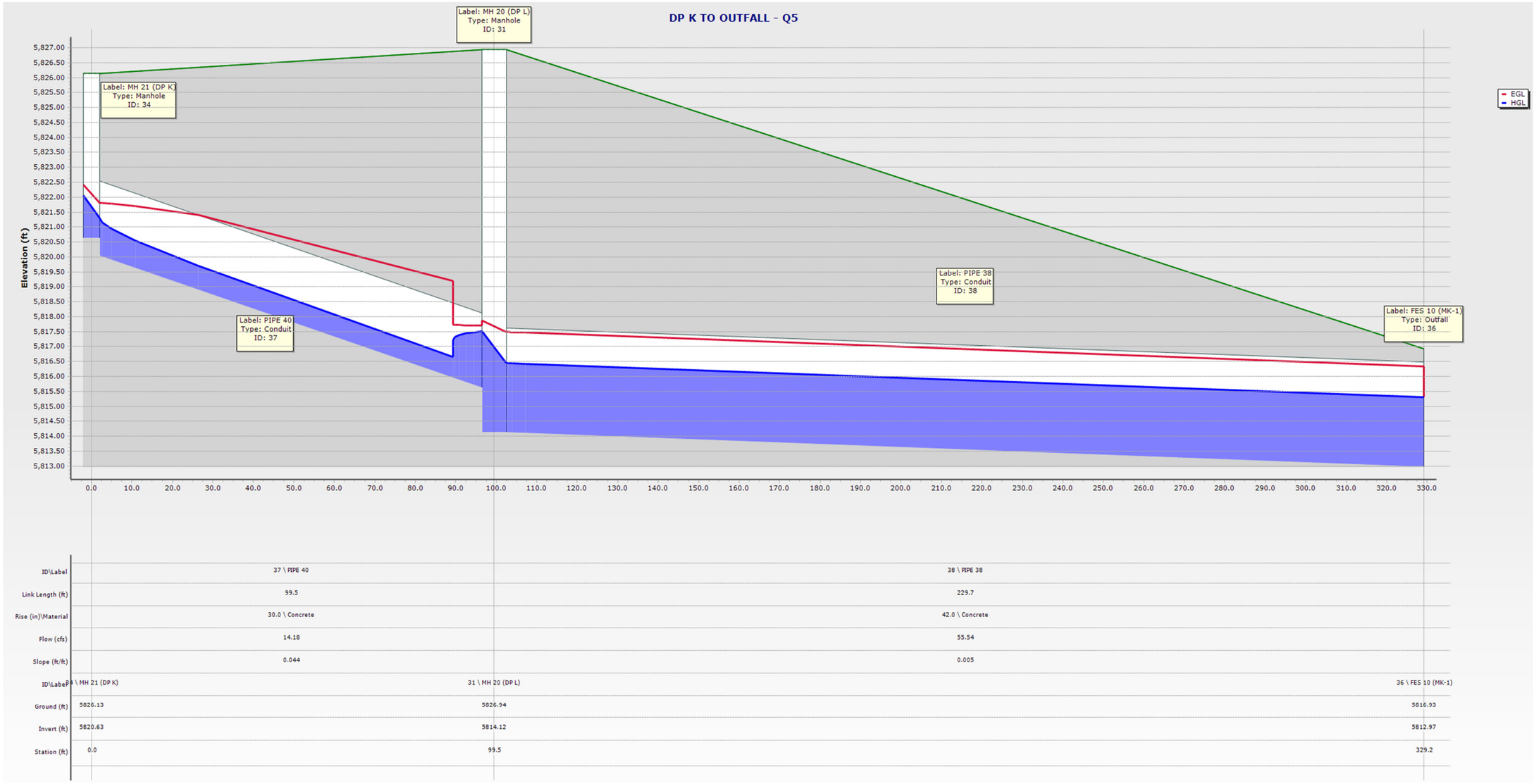
	ID	Label	Flow (Known) (cfs)	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Depth (Out) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss Method	Headloss Coefficient (Standard)	Flow (Total Out) (cfs)
33: INLET 14 (SUMP) (DP I)	33	INLET 14 (SUMP) (DP I)	23.64	5,826.27	5,826.27	3.01	5,824.03	5,823.99	Standard	0.050	23.64
32: INLET 15 (SUMP) (DP J)	32	INLET 15 (SUMP) (DP J)	9.08	5,826.27	5,826.27	2.47	5,823.89	5,823.87	Standard	0.050	9.08
44: INLET 16 (SUMP) (DP N)	44	INLET 16 (SUMP) (DP N)	9.20	5,827.31	5,827.31	1.42	5,823.74	5,823.72	Standard	0.050	9.20
45: INLET 17 (SUMP) (DP P)	45	INLET 17 (SUMP) (DP P)	9.28	5,827.31	5,827.31	1.42	5,823.75	5,823.73	Standard	0.050	9.28
43: INLET 32 (SUMP) (DP O)	43	INLET 32 (SUMP) (DP O)	4.09	5,829.28	5,829.28	0.98	5,825.40	5,825.39	Standard	0.050	4.09
64: MH - 129 (SUB-BASIN MK2)	64	MH - 129 (SUB-BASIN MK2)	51.80	5,830.38	5,830.38	2.34	5,822.02	5,821.96	Standard	0.050	51.80
31: MH 20 (DP L)	31	MH 20 (DP L)	120.33	5,826.94	5,826.94	5.54	5,822.14	5,819.66	Standard	1.020	120.33
34: MH 21 (DP K)	34	MH 21 (DP K)	31.21	5,826.13	5,826.13	2.08	5,823.67	5,822.71	Standard	1.520	31.21
42: MH 22 (DP R)	42	MH 22 (DP R)	74.61	5,829.98	5,829.98	3.01	5,821.28	5,820.15	Standard	1.020	74.61
46: MH 23 (DP Q)	46	MH 23 (DP Q)	20.30	5,827.17	5,827.17	1.03	5,823.55	5,822.57	Standard	1.520	20.30
74: MH-5 (POND 5 OUTLET)	74	MH-5 (POND 5 OUTLET)	139.00	5,784.00	5,784.00	3.50	5,780.36	5,780.25	Standard	0.050	139.00
62: MH-122 (SUB-BASIN BHE3)	62	MH-122 (SUB-BASIN BHE3)	97.50	5,827.26	5,827.26	8.08	5,822.56	5,822.48	Standard	0.050	97.50
63: MH-315 (DP M1a)	63	MH-315 (DP M1a)	139.00	5,783.89	5,783.89	3.95	5,772.39	5,772.19	Standard	0.100	139.00

Figure 2 - Q_{100} NODE SUMMARY

PHASE 3- FOR REFERENCE ONLY

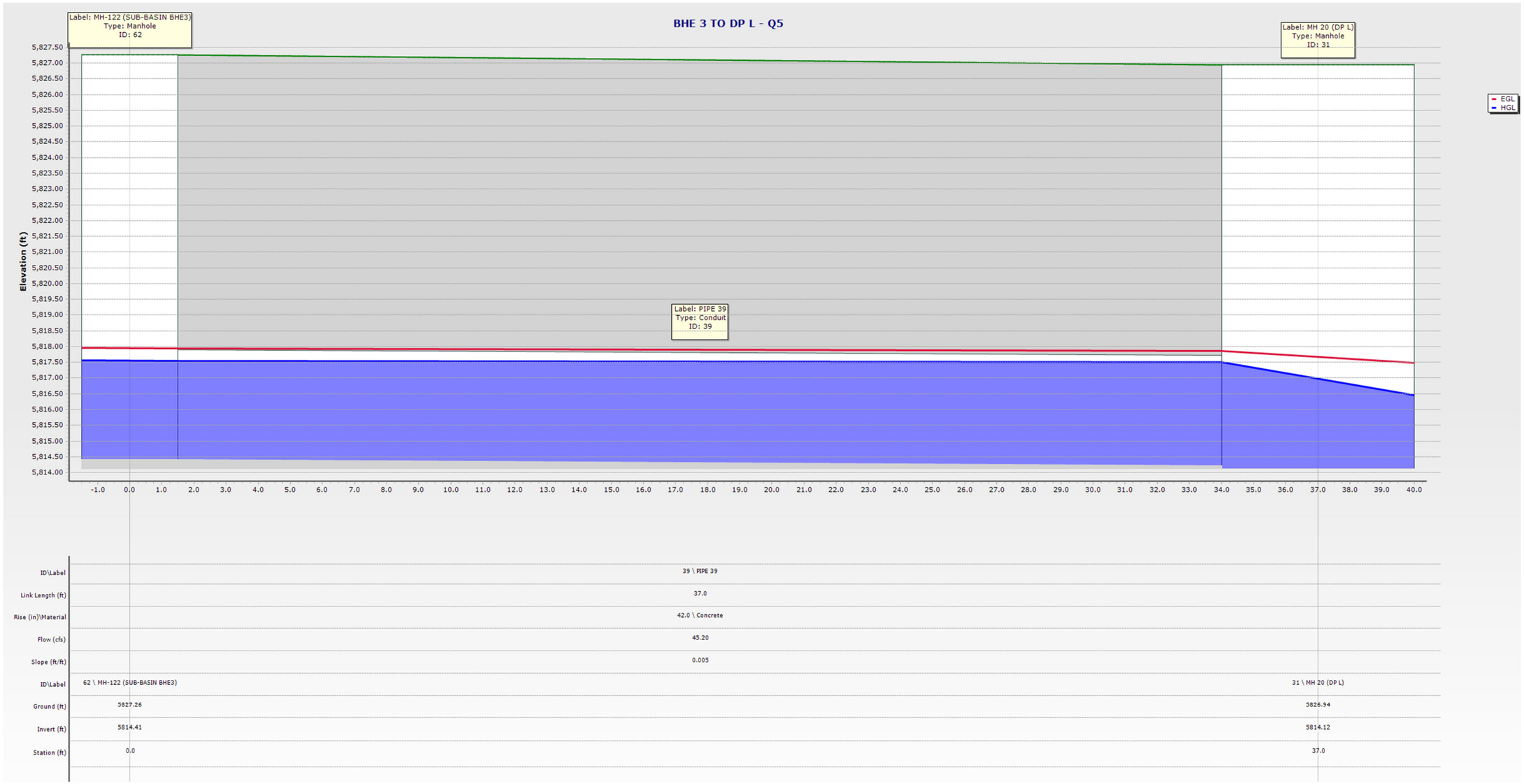
ID\Label		40 \ PIPE 42		41 \ PIPE 41	
Link Length (ft)		26.5		26.5	
Rise (in)\Material		18.0 \ Concrete		19.0 \ Concrete	
Flow (cfs)		4.98		10.09	
Slope (ft/ft)		0.010		0.010	
ID\Label	32 \ INLET 15 (SUMP) (DP J)		34 \ MH 21 (DP K)		33 \ INLET 14 (SUMP) (DP I)
Ground (ft)	5826.27		5826.13		5826.27
Invert (ft)	5821.40		5820.63		5820.98
Station (ft)	0.0		26.5		53.0

PHASE 3- FOR REFERENCE ONLY



ID\Label	37 \ PIPE 40	38 \ PIPE 38
Link Length (ft)	99.5	229.7
Rise (in)\Material	30.0 \ Concrete	42.0 \ Concrete
Flow (cfs)	14.18	55.54
Slope (ft/ft)	0.044	0.005
ID\Label	34 \ MH 21 (DP K)	31 \ MH 20 (DP L)	36 \ FES 10 (MK-1)
Ground (ft)	5826.13	5826.94	5816.93
Invert (ft)	5820.63	5814.12	5812.97
Station (ft)	0.0	99.5	329.2

PHASE 3- FOR REFERENCE ONLY



PHASE 3- FOR REFERENCE ONLY

	ID	Label	Velocity (ft/s)	Start Node	Invert (Start) (ft)	Hydraulic Grade Line (In) (ft)	Invert (Stop) (ft)	Hydraulic Grade Line (Out) (ft)	Stop Node	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Manning's n	Flow (cfs)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Depth (Normal) / Rise (%)	Diameter (in)	Notes
57: PIPE - 163	57	PIPE - 163	5.88	MH-315 (DP M1a)	5,768.24	5,769.41	5,768.00	5,769.07	MH - 307 (MK-2)	48.0	0.005	0.013	15.80	101.61	15.5	26.7	48.0	48" RCP
75: PIPE - 164	75	PIPE - 164	9.60	MH-5 (POND 5 OUTLET)	5,776.75	5,777.92	5,775.09	5,775.86	MH-315 (DP M1a)	83.1	0.020	0.013	15.80	202.98	7.8	18.9	48.0	48" RCP
38: PIPE 38	38	PIPE 38	8.18	MH 20 (DP L)	5,814.12	5,816.46	5,812.97	5,815.30	FES 10 (MK-1)	229.7	0.005	0.013	55.54	71.14	78.1	66.5	42.0	42" RCP
39: PIPE 39	39	PIPE 39	7.83	MH-122 (SUB-BASIN BHE3)	5,814.41	5,817.55	5,814.22	5,817.51	MH 20 (DP L)	37.0	0.005	0.013	45.20	71.14	63.5	57.9	42.0	42" RCP
37: PIPE 40	37	PIPE 40	13.00	MH 21 (DP K)	5,820.04	5,821.31	5,815.62	5,817.51	MH 20 (DP L)	99.5	0.044	0.013	14.18	86.45	16.4	27.4	30.0	30" RCP
41: PIPE 41	41	PIPE 41	6.83	INLET 14 (SUMP) (DP I)	5,821.31	5,822.27	5,821.04	5,822.07	MH 21 (DP K)	26.5	0.010	0.013	10.09	21.80	46.3	48.0		19"x30" HERCP
40: PIPE 42	40	PIPE 42	5.87	INLET 15 (SUMP) (DP J)	5,821.40	5,822.26	5,821.13	5,822.07	MH 21 (DP K)	26.5	0.010	0.013	4.98	10.50	47.4	48.5	18.0	18" RCP
52: PIPE 43	52	PIPE 43	7.44	MH 22 (DP R)	5,817.13	5,819.01	5,815.98	5,817.75	FES 9 (MK-2)	230.7	0.005	0.013	36.46	71.14	51.3	50.7	42.0	42" RCP
53: PIPE 44	53	PIPE 44	14.25	MH - 129 (SUB-BASIN MK2)	5,819.62	5,821.20	5,818.13	5,819.77	MH 22 (DP R)	37.6	0.040	0.013	24.00	132.79	18.1	28.8	36.0	36" RCP
51: PIPE 45	51	PIPE 45	6.64	MH 23 (DP Q)	5,821.04	5,822.16	5,818.63	5,819.77	MH 22 (DP R)	291.1	0.008	0.013	11.13	37.31	29.8	37.4	30.0	30" RCP
54: PIPE 46	54	PIPE 46	4.73	INLET 32 (SUMP) (DP O)	5,824.61	5,825.18	5,822.04	5,822.81	MH 23 (DP Q)	257.1	0.010	0.013	2.24	10.50	21.3	31.4	18.0	18" RCP
56: PIPE 48	56	PIPE 48	5.90	INLET 17 (SUMP) (DP P)	5,822.31	5,823.18	5,822.04	5,822.79	MH 23 (DP Q)	26.8	0.010	0.013	5.09	10.50	48.5	49.1	18.0	18" RCP
55: PIPE 49	55	PIPE 49	5.89	INLET 16 (SUMP) (DP N)	5,822.30	5,823.17	5,822.04	5,822.79	MH 23 (DP Q)	26.2	0.010	0.013	5.04	10.50	48.0	48.8	18.0	18" RCP

Figure 3 - Q_5 CONDUIT SUMMARY

	ID	Label	Flow (Known) (cfs)	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Depth (Out) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss Method	Headloss Coefficient (Standard)	Flow (Total Out) (cfs)
33: INLET 14 (SUMP) (DP I)	33	INLET 14 (SUMP) (DP I)	10.09	5,826.27	5,826.27	1.30	5,822.29	5,822.27	Standard	0.050	10.09
32: INLET 15 (SUMP) (DP J)	32	INLET 15 (SUMP) (DP J)	4.98	5,826.27	5,826.27	0.86	5,822.27	5,822.26	Standard	0.050	4.98
44: INLET 16 (SUMP) (DP N)	44	INLET 16 (SUMP) (DP N)	5.04	5,827.31	5,827.31	0.86	5,823.19	5,823.17	Standard	0.050	5.04
45: INLET 17 (SUMP) (DP P)	45	INLET 17 (SUMP) (DP P)	5.09	5,827.31	5,827.31	0.87	5,823.20	5,823.18	Standard	0.050	5.09
43: INLET 32 (SUMP) (DP O)	43	INLET 32 (SUMP) (DP O)	2.24	5,829.28	5,829.28	0.77	5,825.19	5,825.18	Standard	0.050	2.24
64: MH - 129 (SUB-BASIN MK2)	64	MH - 129 (SUB-BASIN MK2)	24.00	5,830.38	5,830.38	1.58	5,821.23	5,821.20	Standard	0.050	24.00
31: MH 20 (DP L)	31	MH 20 (DP L)	55.54	5,826.94	5,826.94	2.33	5,817.51	5,816.46	Standard	1.020	55.54
34: MH 21 (DP K)	34	MH 21 (DP K)	14.18	5,826.13	5,826.13	0.68	5,822.07	5,821.31	Standard	1.520	14.18
42: MH 22 (DP R)	42	MH 22 (DP R)	36.46	5,829.98	5,829.98	1.87	5,819.77	5,819.01	Standard	1.020	36.46
46: MH 23 (DP Q)	46	MH 23 (DP Q)	11.13	5,827.17	5,827.17	0.62	5,822.81	5,822.16	Standard	1.520	11.13
74: MH-5 (POND 5 OUTLET)	74	MH-5 (POND 5 OUTLET)	15.80	5,784.00	5,784.00	1.17	5,777.94	5,777.92	Standard	0.050	15.80
62: MH-122 (SUB-BASIN BHE3)	62	MH-122 (SUB-BASIN BHE3)	45.20	5,827.26	5,827.26	3.14	5,817.57	5,817.55	Standard	0.050	45.20
63: MH-315 (DP M1a)	63	MH-315 (DP M1a)	15.80	5,783.89	5,783.89	1.17	5,769.45	5,769.41	Standard	0.100	15.80

Figure 4 - Q_5 NODE SUMMARY

APPENDIX E – REFERENCE MATERIAL

BRADLEY HEIGHTS FILING 5 - STORM SEWER

ENGINEER'S OPINION OF PROBABLE COST

SUMMARY TABLE

PRIVATE STORM SEWER (NON-REIMBURSABLE)				$	28,380
			TOTAL:	**$**	**28,380**
PUBLIC STORM SEWER (NON-REIMBURSABLE)				$	205,873
PRIVATE DETENTION/WATER QUALITY POND				$	-
			TOTAL:	**$**	**205,873**

PRIVATE STORM SEWER (NON-REIMBURSABLE)				
18" RCP CL-III	160	LF	$ 54.00	$ 8,640.00
42" RCP CL-III	130	LF	$ 132.00	$ 17,160.00
			SUBTOTAL:	**$ 25,800**
			10% ENGINEERING CONTINGENCY:	**$ 2,580**
			TOTAL:	**$ 28,380**

PUBLIC STORM SEWER (NON-REIMBURSABLE)				
4' DIAMETER MANHOLE	10	EA	$ 3,600.00	$ 36,000.00
6' DIAMETER MANHOLE	1	EA	$ 5,240.00	$ 5,240.00
18" RCP CL-III	625	LF	$ 54.00	$ 33,750.00
24" RCP CL-III	365	LF	$ 66.00	$ 24,090.00
30" RCP CL-III	212	LF	$ 85.00	$ 18,020.00
42" RCP CL-III	62	LF	$ 132.00	$ 8,184.00
5' TYPE R INLET	1	EA	$ 8,073.00	$ 8,073.00
10' TYPE R INLET	4	EA	$ 11,500.00	$ 46,000.00
15' TYPE R INLET	3	EA	$ 14,600.00	$ 43,800.00
			SUBTOTAL:	**$ 187,157**
			10% ENGINEERING CONTINGENCY:	**$ 18,716**
			TOTAL:	**$ 205,873**

APPENDIX F – DRAINAGE MAPS

SUMMARY RUNOFF TABLE

BASIN	AREA (ac)	% IMPERVIOUS	Q_5 (cfs)	Q_{100} (cfs)
W1	10.90	2	5.1	27.3
M2	21.31	2	10.7	57.5

DESIGN POINT SUMMARY TABLE

DESIGN POINT	CONTRIBUTING BASINS	ΣQ_5 (cfs)	ΣQ_{100} (cfs)
1	W1	5.1	27.3
2	M2	10.7	57.5

DRAWN BY: NOJ
APPROVED: KMH
CAD DATE: 6/13/2022
CAD FILE: J:\2021\211450\CAD\Dwgs\C\Drainage\Ex-Drainage_Map
JOB DATE: 6/13/2022
JOB NUMBER: 211450

BAR IS ONE INCH ON OFFICIAL DRAWINGS.
0 1"
IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.

NO.	DATE	BY	REVISION DESCRIPTION

HRGreen
HR GREEN - COLORADO SPRINGS
7222 COMMERCE CENTER DR. SUITE 220
COLORADO SPRINGS CO 80919
PHONE: 719.622.6222
FAX: 844.273.1057

BRADLEY HEIGHTS - FILING 5
CHALLENGER HOMES
COLORADO SPRINGS, COLORADO

CHALLENGER HOMES

EX DRAINAGE MAP

SHEET DRN 1

SUMMARY RUNOFF TABLE

BASIN	AREA (ac)	% IMPERVIOUS	Q_5 (cfs)	Q_{100} (cfs)
WF5a	4.53	50	6.4	15.3
WF5.2	0.76	65	1.2	2.7
WF5.3	0.90	65	1.4	3.2
1	6.07	65	10.9	24.3
2	3.20	65	5.8	12.8
3	4.83	65	9.5	21.2
3A	3.21	65	6.9	15.4
4A	0.98	65	1.9	4.1
4	2.24	65	4.2	9.3
5	1.14	65	2.1	4.8
BS3	2.69	58	5.2	12.0
BS5	2.67	50	4.9	11.9

DESIGN POINT SUMMARY TABLE

DESIGN POINT	CONTRIBUTING BASINS	ΣQ_5 (cfs)	ΣQ_{100} (cfs)
AX	WF5a	6.4	15.3
2	WF5.2	1.2	2.7
3	WF5.3	1.4	3.2
3.1	DP1 & DP2	2.6	5.8
4.1	DP1 & DP2	2.6	5.8
4	1	10.9	24.3
5	2	5.8	12.8
5.1	DP4 & DP5	14.6	22.7
6	1, 2 &, 4A	3.7	17.9
6.1		15.6	26.7
7	3	9.5	21.2
8	3 & 3A	6.9	20.2
8.1	DP7 & DP8	15.4	27.5
9	1, 2 & 4	6.2	21.9
9.1	DP6.1, DP8.1, & DP9	35.5	73.2
10	5	2.1	4.8
10.1	DP9.1 & DP10	37.5	77.5
11	DP6.1, DP8.1, DP9 & DP10	37.5	77.5
1	3A, BS3 & BS5	10.1	23.6

DRAINAGE MAP NOTES:

1. ALL PROPOSED CURB AND GUTTER IS COLORADO SPRINGS TYPE 1 AND TYPE 5. TYPE 5 CURB IS LOCATED IN ALL LOCATIONS FRONTING LOTS AND TYPE 1 CURB IS USED IN ALL OTHER LOCATIONS.
2. ALL PROPOSED RIGHT OF WAYS ARE 50' UNLESS OTHERWISE NOTED.
3. ALL PROPOSED CROSS PANS ARE CITY OF COLORADO SPRINGS STANDARD D-7.

LEGEND:

- PROPOSED MAJOR CONTOUR — 5250
- PROPOSED MINOR CONTOUR
- EXISTING MAJOR CONTOUR — 5250
- EXISTING MINOR CONTOUR
- PROPOSED STORM SEWER
- PROPOSED STORM SEWER (BY BHMD)
- PROPOSED DRAINAGE SWALE
- PROPERTY LINE
- PROPOSED FLOW DIRECTION
- EXISTING FLOW DIRECTION
- PROPOSED DRAINAGE BASIN
- PROPOSED DRAINAGE BASIN (BRADLEY HEIGHTS MDDP)
- FILING BOUNDARY
- DESIGN POINT
- PROPOSED BASIN LABEL — 11 / 1.25 — BASIN DESIGNATION / AREA (AC.)

DRAWN BY:	CBM	JOB DATE:	10/5/2022
APPROVED:	KMH	JOB NUMBER:	211450
CAD DATE:	10/20/2022		
CAD FILE:	J:\2021\211450\CAD\Dwgs\C\Drainage\FDR_Drainage_Map		

BAR IS ONE INCH ON OFFICIAL DRAWINGS. IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.

NO.	DATE	BY	REVISION DESCRIPTION

HR GREEN - COLORADO SPRINGS
7222 COMMERCE CENTER DR. SUITE 220
COLORADO SPRINGS CO 80919
PHONE: 719.622.6222
FAX: 844.273.1057

BRADLEY HEIGHTS - FILING 5
CHALLENGER HOMES
COLORADO SPRINGS, COLORADO

PROPOSED DRAINAGE MAP

SHEET DRN 1

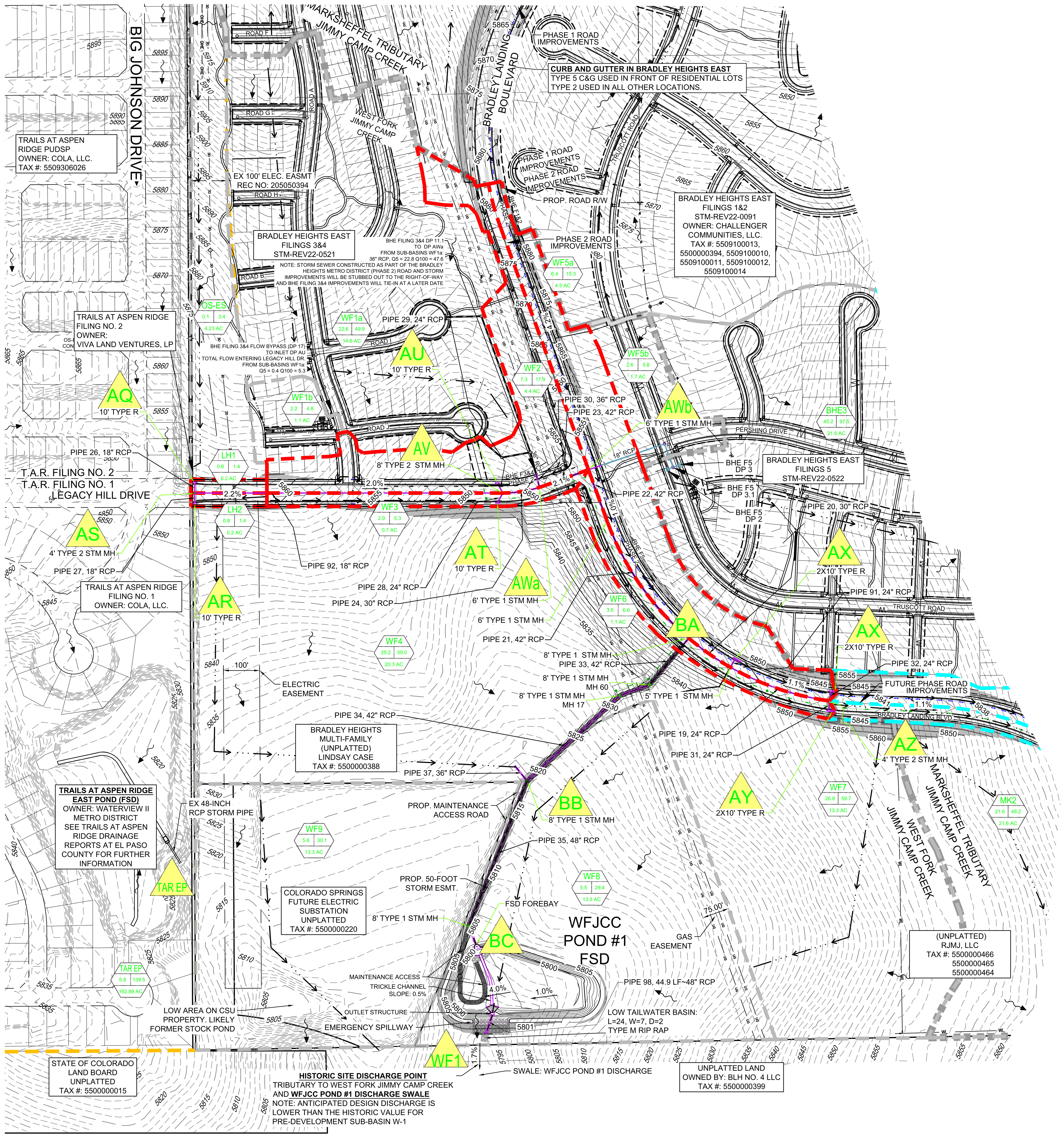
SHEET No. 4

811 Know what's below. Call before you dig.

LEGEND

- SUB BASIN DESIGNATION (BASIN)
- Q5 — 5-YEAR STORM EVENT PEAK FLOW (CFS)
- Q100 — 100-YEAR STORM EVENT PEAK FLOW (CFS)
- AREA — SUB BASIN AREA (AC. OR SQ. MI.)
- 2 — DESIGN POINT
- MAJOR BASIN BOUNDARY
- PHASE 2A BASIN BOUNDARY
- FUTURE DEVELOPMENT BASIN BOUNDARY
- EXISTING CONTOUR
- PROPOSED CONTOUR
- PROPOSED STORM DRAIN PIPE
- EXISTING STORM DRAIN PIPE
- PROPOSED STORM BY OTHERS
- FLOW DIRECTION
- EXISTING EDGE OF ROAD
- PROPERTY LINE
- STREAM BUFFER OVERLAYS

NOTES:
1. SOME DESIGN POINT LABELS ARE SET ABOVE THE STRUCTURE LABEL WITH GREEN LEADER SHOWING LOCATION OF DESIGN POINT STRUCTURE.
2. UNLESS OTHERWISE INDICATED, STORM SEWER SHOWN ON THIS PAGE IS PROPOSED AND WILL BE PUBLICLY OWNED.
3. EX IN AN ITEM LABEL DENOTES EXISITING
4. PROP. INDICATES PROPOSED.
5. ALL CURB & GUTTER PROPOSED IN THIS PHASE OR CONSTRUCTED IN PHASE 1 IS TYPE 2 UNLESS OTHERWISE NOTED.
6. STORM SEWER SHALL BE RCP OR APPROVED EQUAL
7. SEE THE REFERENCED DRAINAGE REPORTS FOR STORM SEWER SIZES AND MATERIALS TRIBUTARY TO THE PHASE 2 IMPROVEMENTS.



PIPE SUMMARY TABLE			
PIPE NAME	PIPE DESCRIPTION	PIPE SLOPE	PIPE LENGTH
PIPE 19	24" RCP	0.97%	291.70
PIPE 20	30" RCP	0.53%	140.38
PIPE 21	42" RCP	0.78%	398.91
PIPE 22	42" RCP	0.50%	151.06
PIPE 23	42" RCP	0.50%	143.50
PIPE 24	30" RCP	1.10%	102.67
PIPE 25	18" RCP	1.21%	426.98
PIPE 26	18" RCP	1.00%	28.02
PIPE 27	18" RCP	1.00%	27.97
PIPE 28	24" RCP	1.00%	30.53
PIPE 29	24" RCP	1.00%	30.52
PIPE 30	36" RCP	5.60%	39.74
PIPE 31	24" RCP	1.00%	26.52
PIPE 31A	18" RCP	2.64%	11.35
PIPE 32	24" RCP	1.00%	26.50
PIPE 32A	18" RCP	2.64%	11.38
PIPE 33	42" RCP	2.75%	168.75
PIPE 34	42" RCP	2.75%	349.24
PIPE 35	48" RCP	1.84%	432.64
PIPE 36	48" RCP	0.51%	55.43
PIPE 37	36" RCP	2.75%	53.95
PIPE 91	24" RCP	1.00%	26.60
PIPE 91A	18" RCP	1.76%	11.38
PIPE 92	18" RCP	1.44%	424.93
PIPE 95	18" RCP	6.90%	37.65
PIPE 98	48" RCP	0.39%	44.89
PIPE 100	42" RCP	2.75%	85.96

Proposed Design Point Summary				
BRADLEY HEIGHTS METRO DISTRICT (PHASE 2)				
Design Point	Comments/Sub-Basins	Total Area (ac.)	Q(5) (cfs)	Q(100) (cfs)
AQ	LH1 - AT GRADE AT BORDER WITH TRAILS AT ASPEN RIDGE	0.18	0.8	1.4
AR	LH2 - AT GRADE AT BORDER WITH TRAILS AT ASPEN RIDGE	0.18	0.8	1.4
AS	LH1-LH2	0.36	1.5	2.8
AT	WF3	0.75	2.9	5.3
AU	WF1b, WF2 + BYPASS FROM WF1	5.46	9.8	27.8
AV	WF2-WF3, LH1-LH2	6.57	13.8	32.3
AWa	WF1-WF3, LH1-LH2	21.20	36.4	80.5
AWb	WF1-WF3, WF5b, LH1-LH2	22.85	37.1	82.0
AX	WF5	4.53	6.4	15.3
AY	WF6	1.06	3.6	6.6
AZ	WF5-WF6	5.59	9.1	20.4
BA	WF1-WF3, WF5-WF6, LH1, LH2	28.45	43.3	97.3
BB	WF1-WF6, LH1-LH2	48.72	70.6	162.5
BC	WF1-WF8, LH1-LH2 INTO WFJCC POND #1	75.44	87.0	216.5
WFJCC POND #1	POND DISCHARGE	75.44	12.6	105.3
TAR-EP	TRAILS AT ASPEN RIDGE-EAST POND FULL BUILD-OUT DISCHARGE	160.87	5.8	139.5
DP WF1	TAR-EP, WF9, WFJCC POND #1 DISCHARGE	248.94	24.0	274.9

BRADLEY HEIGHTS METRO DISTRICT (PHASE 2) Proposed Conditions Sub-basin Summary			
Basin	Area	Q5	Q100
	acres	cfs	cfs
WF1a	14.63	22.6	49.9
WF1b	1.11	2.2	4.8
WF2	4.35	7.3	17.9
WF3	0.75	2.9	5.3
LH1	0.18	0.8	1.4
LH2	0.18	0.8	1.4
WF4	20.28	25.2	59.0
WF5a	4.53	6.4	15.3
WF5b	1.66	2.6	5.8
WF6	1.06	3.6	6.6
WF7	13.41	26.8	59.7
WF8	13.30	5.5	29.4
WF9	12.63	5.6	30.1

CITY OF COLORADO SPRINGS

BRADLEY HEIGHTS METRO DISTRICT
MASTER DEVELOPMENT DRAINAGE REPORT

POST DEVELOPMENT DRAINAGE CONDITIONS

DESIGNED BY: JAO
DRAWN BY: JTS
CHECKED BY: JTS
SCALE HORIZ. 1" = 150' VERT. N/A
DATE ISSUED: September 2022
SHEET 2 OF 2
DRAWING No. DR-02

SEAL

PRELIMINARY
THIS DRAWING HAS NOT BEEN APPROVED BY GOVERNING AGENCIES AND IS SUBJECT TO CHANGE

FOR AND ON BEHALF OF MATRIX DESIGN GROUP, INC. PROJECT No. 21.1213.004

PREPARED BY: Matrix

No.	DATE	DESCRIPTION	BY

REVISIONS

COMPUTER FILE MANAGEMENT
FILE NAME: S:\21.1213.001 Bradley Heights Metro District\200 Drainage\201 Drainage Reports\FDR-PHASE II ROAD IMPROVEMENTS\DWG\DR-02 PHASE IIa.dwg
CTB FILE: ----
PLOT DATE: September 14, 2022 3:49:25 PM
THIS DRAWING IS CURRENT AS OF PLOT DATE AND MAY BE SUBJECT TO CHANGE.

REFERENCE DRAWINGS

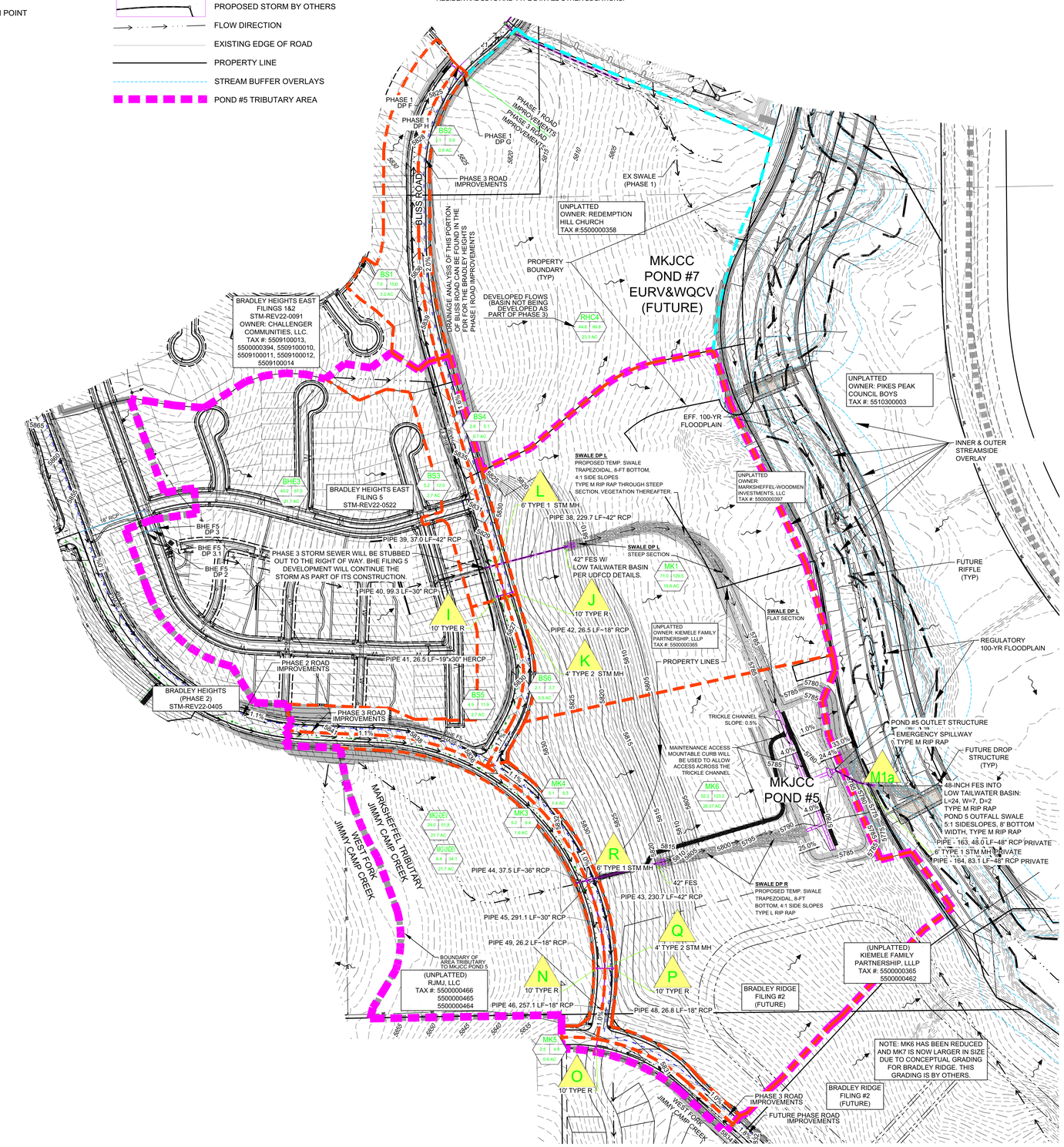
SHEET No. 2

Know what's below. Call before you dig. 811

LEGEND

- SUB BASIN DESIGNATION (BASIN / Q5 / Q100 / AREA)
- 5-YEAR STORM EVENT PEAK FLOW (CFS)
- 100-YEAR STORM EVENT PEAK FLOW (CFS)
- SUB BASIN AREA (AC. OR SQ. MI.)
- PHASE 3 DESIGN POINT (2)
- MAJOR BASIN BOUNDARY
- PHASE 2A BASIN BOUNDARY
- FUTURE DEVELOPMENT BASIN BOUNDARY
- EXISTING CONTOUR
- PROPOSED CONTOUR
- PROPOSED STORM DRAIN PIPE
- EXISTING STORM DRAIN PIPE
- PROPOSED STORM BY OTHERS
- FLOW DIRECTION
- EXISTING EDGE OF ROAD
- PROPERTY LINE
- STREAM BUFFER OVERLAYS
- POND #5 TRIBUTARY AREA

NOTES:
1. UNLESS OTHERWISE INDICATED, STORM SEWER SHOWN ON THIS PAGE IS PROPOSED AND WILL BE PUBLICLY OWNED.
2. EX IN AN ITEM LABEL DENOTES EXISITING
3. PROP. INDICATES PROPOSED.
4. ALL CURB & GUTTER PROPOSED IN THIS PHASE IS TYPE 2 UNLESS OTHERWISE NOTED.
5. STORM SEWER SHALL BE RCP OR APPROVED EQUAL
6. SEE THE REFERENCED DRAINAGE REPORTS FOR STORM SEWER SIZES AND MATERIALS TRIBUTARY TO THE PHASE 3 IMPROVEMENTS.
7. CURB & GUTTER IN THE ADJACENT DEVELOPMENTS (ALL BY OTHERS) IS ANTICIPATED TO BE TYPE 5 IN FRONT OF RESIDENTIAL LOTS AND TYPE 2 IN ALL OTHER LOCATIONS.



PIPE SUMMARY TABLE			
PIPE NAME	PIPE DESCRIPTION	PIPE SLOPE	PIPE LENGTH
PIPE 38	42" RCP	0.50%	229.70
PIPE 39	42" RCP	0.50%	37.00
PIPE 40	30" RCP	4.45%	99.34
PIPE 41	19"X30" HERCP	1.00%	26.49
PIPE 42	18" RCP	1.00%	26.50

PIPE SUMMARY TABLE			
PIPE NAME	PIPE DESCRIPTION	PIPE SLOPE	PIPE LENGTH
PIPE - 163	48" RCP	0.50%	47.96
PIPE - 164	48" RCP	-2.00%	83.12
PIPE 43	42" RCP	0.50%	230.69
PIPE 44	36" RCP	4.00%	37.50
PIPE 45	30" RCP	0.83%	291.12
PIPE 46	18" RCP	1.00%	257.05
PIPE 48	18" RCP	1.00%	26.76
PIPE 49	18" RCP	1.00%	26.23

BRADLEY HEIGHTS METRO DISTRICT (PHASE 3)

Proposed Conditions
Sub-basin Summary

Basin	Area	Q5	Q100
	acres	cfs	cfs
BHE3	21.65	45.2	97.5
RHC1	2.48	7.7	14.0
RHC2	0.59	2.3	4.2
RHC3	9.90	18.5	39.9
RHC4	23.26	44.8	99.8
BS1	3.16	7.6	15.0
BS2	0.83	3.1	5.6
BS3	2.69	5.2	12.0
BS4	0.70	2.8	5.1
BS5	2.67	4.9	11.9
BS6	0.50	2.1	3.7
MK1	19.80	71.0	129.5
MK2-UNDEVELOPED	11.41	6.4	34.1
MK2	11.41	24.0	51.8
MK3	1.63	5.2	9.4
MK4	1.41	5.1	9.3
MK5	0.56	2.4	4.3
MK6	26.37	52.2	123.2

Proposed Design Point Summary
BRADLEY HEIGHTS METRO DISTRICT (PHASE 3)

Design Point	Comments/Sub-Basins	Total Area (ac.)	Q(5) (cfs)	Q(100) (cfs)
I	BS3, BS5	5.35	10.1	23.6
J	BS4, BS6	1.20	5.0	9.1
K	BS3-BS6	6.56	14.2	31.2
L	BS3-BS6, BHE3	28.21	55.5	120.3
N	MK3	1.63	5.0	9.2
O	MK5	0.56	2.2	4.1
P	MK4	1.41	5.1	9.3
Q	MK3-MK5	3.60	11.1	20.3
R	MK2-5	15.01	36.5	74.6
R (MK2 undeveloped)	MK2-5	15.01	17.5	55.4
MKJCC POND #5	INFLOW: MK1-6, BS3-BS6, BHE3	89.39	156.8	326.6
DPM1a: POND 5-OUT	OUTFLOW	89.39	28.4	141.4

CITY OF COLORADO SPRINGS

BRADLEY HEIGHTS METRO DISTRICT
FINAL DRAINAGE REPORT

POST DEVELOPMENT DRAINAGE CONDITIONS

DRAWING No. DR-02

DESIGNED BY: JAO
DRAWN BY: JTS
CHECKED BY: JTS

SCALE: HORIZ 1" = 150', VERT N/A

DATE ISSUED: September 2022

SHEET 2 OF 2

SEAL:

PRELIMINARY
THIS DRAWING HAS NOT BEEN APPROVED BY GOVERNING AGENCIES AND IS SUBJECT TO CHANGE

FOR AND ON BEHALF OF MATRIX DESIGN GROUP, INC.
PROJECT No. 21.1213.004

PREPARED BY: Matrix

No.	DATE	REVISIONS	BY

COMPUTER FILE MANAGEMENT
FILE NAME: S:\21.1213.001 Bradley Heights Metro District\E200 Drainage\201 Drainage Reports\FDR Phase III\dwg\DR-02 PHASE III.dwg
CTB FILE:
PLOT DATE: September 16, 2022 12:22:56 PM
THIS DRAWING IS CURRENTLY PLOTTED AND MAY BE SUBJECT TO CHANGE

REFERENCE DRAWINGS