PRELIMINARY/ FINAL DRAINAGE REPORT FOR RIVERBEND CROSSING FILINGS NO. 1 AND 2

SEPTEMBER 2018

Prepared for:

Avatar Fountain, LP.
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Syosset, NY 11791

Prepared By:

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PCD FILE NOS:
SP 187
SF 1843
SF 1844

PRELIMINARY/FINAL DRAINAGE REPORT FOR REIVERBEND CROSSING FILING NO. 1 AND 2

Engineer's Statement:

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

Certification Statement:

This report and plan for the preliminary and final drainage design for the RIVERBEND CROSSING was prepared by me (or under my direct supervision) in accordance with the provisions of City of Colorado Springs/El Paso County Drainage Criteria Manual Volumes 1 and 2 Drainage Design and Technical Criteria for the owners thereof. I understand that El Paso County does not and will not assume liability for drainage facilities designed by others.

COLORADO LICENSED DAVID L. MIJARES 40510 PROFESSIONAL ENGINEER

David L. Mijares, Colorado PE #40510 — Date 12.30.2020

For and on behalf of Catamount Engineering

Developer's Statement:

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

AVATAR FOUNTAN, LP. hereby certifies that the drainage facilities for RIVERBEND CROSSING shall be constructed according to the design presented in this report. I understand that El Paso County does not and will not assume liability for the drainage facilities designed and or certified by my engineer and that the El Paso County reviews drainage plans pursuant to Colorado Revised Statues, Title 30, Article 28; but cannot, on behalf of RIVERBEND CROSSING guarantee that final drainage design review will absolve AVATAR FOUNTAIN, LP. 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.

AVATAR FOUNTAIN, LP.
Business Name

By: [signature]

Title: Manager

Address: 6800 Jericho Turnpike, Suite 120W #204

Syosset, NY 11791

El Paso County:

Filed in accordance with the requirements of the El Paso County land Development Code and the Drainage Criteria manual Volumes 1 and 2, and the El Paso County Engineering Criteria Manual, latest revision.

APPROVED
Engineering Department

Jennifer Irvine, PE
County Engineer/ECM Administrator

01/14/2021 7:31:27 AM
dsdnijkamp
EPC Planning & Community Development Department

Date

Conditions:

PRELIMINARY/FINAL DRAINAGE REPORT FOR REIVERBEND CROSSING FILING NO. 1 AND 2

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PURPOSE

The purpose of this drainage report is to identify existing drainage patterns and establish outfall scenarios from the proposed development. The site is contained within the West Little Johnson Drainage Basin and outfalls directly to Fountain Creek. The parcel was previously studied in the Little Johnson/Security Creek Drainage Basin Planning Study prepared by Simons, Li and Associates, dated December 1987, and the Preliminary Drainage Report for Riverbend Crossing., prepared by Nolte and Associates, dated February 14, 2007. The Little Johnson Drainage Basin Planning Study identifies the parcel as direct flow into Fountain Creek and does not propose improvements to the adjacent reach. The overall Riverbend development consists of two overall projects, The Riverbend Crossing residential subdivision filings 1 and 2 to be developed in El Paso County; and the Riverbend Crossing Commons Development to be developed within City of Fountain. This report develops broad analysis of both El Paso County and Fountain development parcels and provides Final Drainage Report detail for the residential parcels.

GENERAL LOCATION AND DESCRIPTION

The Riverbend Crossing Developments are located within the NE ¼ of Section 14, Township 15 South and Range 66 West of the 6th principal meridian. The proposed commercial parcel contains approximately 10.69 acres to be developed within the City of Fountain incorporation limits. The existing commercial development is proposed to have the majority of buildings and infrastructure demolished and reconstruction of the site will incorporate access to the proposed commercial development.

The proposed residential developments contain approximately 52.0 acres of undeveloped land with approximately 10 acres located within the existing Fountain Creek 100-year floodplain. Improvements are proposed in the portions of the property identified as outside of the existing floodplain. Residential development is proposed to be completed in 2 filings. Filing No. 1 will contain 136 residential lots situated on approximately 36.5 acres within the easterly and southerly portions of the residential parcel. Filing No. 2 will contain 86 residential lots on approximately 15.5 acres. The 10 acres within the floodplain not proposed for development are contained within the boundary of Filing No. 1.

The overall development is bounded to the north and west by undeveloped land zoned A-5, to the east by U.S. Highway 85/87 and Southmoor Drive, and to the south by Fountain Creek. The easterly portions of the development contained within the City of Fountain incorporation limits are predominantly zoned commercial and the southerly and westerly portions of the development are zoned PUD. An RS-5000 zone is being sought with entitlement applications within the El Paso County portions.

Existing soils on the site consist of Limon clay (Hydrologic Group 'C'), Schamber-Razor complex (Hydrologic Group 'A'), and Nunn clay loam (Hydrologic Group 'C'). Soils have been identified as determined by the Natural Resources Conservation Service Web Soil Survey. Hydrologic Group 'C' soils have been used in hydrologic calculations.

The 10.69 acres contained within the commercial site contains existing structures, paved parking, and paved drive aisles with little existing vegetation. The 52.0 acre residential portion remains substantially ungraded and vegetated with native grasses and volunteer trees and shrubs within roadside ditches and established drainage swales.

The property contains an abandoned irrigation pond within the northern portion of the site that was historically supplied by two wells located within the commercial development. There is no active irrigation within the parcel currently. The parcel contains an abandoned sewer outfall crossing the site that previously served the commercial development. The abandoned sewer conveyed sewage to a lagoon system located within the Fountain Creek Floodplain. The lagoon was filled when central sewer became available to the commercial development from Security Sanitation District. No development is proposed in the location of the filled lagoon.

The existing commercial site sits 10-15 feet higher than the undeveloped residential portion of the parcels and runoff sheetflows predominantly at 1%-1.5% to the south and into Southmoor Drive. Flows are contained within the Southmoor Drive roadside ditch and conveyed southwest to Fountain Creek. The undeveloped portion of the Riverbend Crossing Developments falls flows predominantly to the south at an average slope of 1.5%

The majority of the site is located within Shaded Zone X (500-year) floodplain and the southern portion of the site is contained within a F.E.M.A. designated Zone AE (100-year) floodplain per FIRM panels 08041C0763G and 08041C0951 F, effective December 07, 2018. The F.E.M.A. Flood Insurance Rate Map has been provided. The portion of the site within the Zone AE floodplain will not be utilized for residential development.

A portion of the FIRM Panels were further modified by LOMR 17-08-0467P effective 1/15/2019. The LOMR modified floodplain affected by Security Creek and shows 100-YR flood being contained east of the centerline of Highway 85/87. LOMR revisions did not remove shaded zone X contained within the subject property.

EXISTING DRAINAGE

The parcels are located within the West Little Johnson Drainage Basin and are directly tributary to Fountain Creek within the reach. The Little Johnson/Security Creek Drainage Basin Planning Study identifies three separate sub-basins (75,76, and 77) within the parcel. The majority of the parcels are identified as within Shaded Zone X 500-year floodplain and the southerly portion of the property not proposed for development lies with Zone AE 100-yr floodplain and floodway. The effective firm panel is included in the appendix of the report. The West Little Johnson drainage basin contains approximately five square miles located in the semi-arid region of the high plains. Precipitation within the basin ranges from 14 to 16 inches per year with thunderstorms typical in the summer months.
The existing drainage patterns for the parcel were summarized in the "Preliminary Drainage Study Riverbend Crossing", prepared by Nolte and Associates, inc. dated 2/14/2007. No development

within the parcel has been pursued since the Nolte analysis was completed and the existing drainage analysis has been accepted in this report. The northerly adjacent parcel has been developed for use as St. Dominic Catholic Church. Flows from the Church are collected on-site and conveyed to an existing full spectrum extended detention basin within the southwest corner of the church parcel. Outfall from the extended detention basin is piped to outfall to an existing swale within a drainage easement on agricultural property west of the Riverbend properties and does not enter the subject property. No other changes to surrounding properties are evident.

The report indicates the 3 sub-basins identified in the Drainage Basin Planning Study as sub-basins 75,76, and 77. The basins are direct flow basins directly tributary to Fountain Creek and traverse the site from north to south where they enter Fountain Creek.

Basin 77 represents the existing commercial center development northwest of proposed Riverbend Crossing Filings No. 1 and 2 and the southeasterly portion of the residential filings. Redevelopment of the commercial development within the City of Fountain is being concurrently pursued by the developer of both properties. Existing flows entering the residential portion at the southern limits of the commercial development were modeled as Q_5=25.99 cfs, Q_{100}=45.15 cfs in the Preliminary Drainage Report and are conveyed in a drainage swale to outfall within Fountain Creek. Total outfall to Fountain Creek from Basin 77 was Q_5=15.28 cfs, Q_{100}=31.70 cfs.

Basin 76 represents the central portion of the undeveloped parcel and the northwesterly portion of the existing commercial development and is directly tributary to Fountain Creek. The property north of Basin 76 is contained within the St. Dominic's Church Subdivision. Storm runoff from the St. Dominic's Church Subdivision is collected on-site and conveyed through a private detention pond prior to historic release west of the parcel. The Preliminary Drainage Report shows Q_5=6.89 cfs, Q_{100}=12.07 cfs entering the residential parcel from the northwest corner of the commercial development and exhibits Q_5=11.87 cfs, Q_{100}=28.05 cfs leaving the site and entering Fountain Creek.

Basin 75 contains the westerly portion of the proposed residential development. The preliminary drainage report indicates that Q_5=20.28 cfs, Q_{100}=45.99 cfs enter the west side of the parcel from the adjacent agricultural property. Topography does not indicate a channelized flow but rather overland flow from the west. The anticipated long term use for the adjacent parcel is to remain agricultural. The foundation that owns the parcel is extending and irrigation ditch along the west boundary of the subject property to divert flows from the adjacent parcel south to Fountain Creek. An additional 15' setback is proposed in the residential development plan to allow for grading of a fill slope to convey flows south the Fountain Creek.

DEVELOPED DRAINAGE BASINS

The intent of the proposed development is to follow closely to historic drainage patterns while satisfying current El Paso County development and water quality criteria. The area of the site proposed for impervious development will be contained within the parking/private roadway section and private on-site storm sewer system conveying flows to a full spectrum detention basin and water quality facility within the southeast portion of the site prior to outfall to Fountain Creek.

Development of the site includes 225 residential lots, roadway and utility infrastructure to be constructed in 2 filings. Due to limited grade within the site necessitating flat roadway sections minimal drainage will be conveyed within the street roadway sections and drainage will primarily be conveyed is public storm drain systems conveying flows to outfall within a private extended detention basin. The private extended detention basin will be developed to accept developed runoff from the proposed redeveloped commercial center along the parcel's northeasterly boundary.

Flows generated within the proposed commercial center redevelopment will be conveyed within the commercial curb lines and private storm drain to be constructed along the southerly property boundary and outfall directly to the proposed shared extended detention basin.

Offsite Basins

Offsite flow (Historic sub-basin 75) generates runoff of Q_5=20.28 cfs, Q_{100}=45.99 cfs from the adjacent westerly agricultural parcel currently enter the property at an existing low point along the westerly boundary. Flows will be conveyed in a 10' wide constructed grass swale at 0.5% with 3:1 side slopes from the existing low point south approximately 300' to outfall within the adjacent reach of Fountain Creek. See calculations in the Appendix.

Historic Basins 76 and 77 have been remodeled in this report as either 'B' designated basins within the interior or 'C' basins representing the commercial development. 'B' designated basins will be conveyed within interior street, inlet, and storm sewer conveyance systems to the proposed full spectrum pond proposed with the development. 'C' designated basins will be conveyed in a separate storm sewer system developed in conjunction with commercial redevelopment to outfall to the shared on-site extended detention system. The detailed drainage plan for the commercial development is currently under review with the city of Fountain and a composite basin representing the commercial development is utilized in calculation for sizing the shared pond. Runoff from the commercial development will not directly enter the Riverbend Crossing residential development with the exception of storm sewer outfall directly to the pond.

'A Basins'

Basin A1 (1.30 Acres, Q_2=0.2 cfs, Q_5=0.6 cfs, Q_{10}=1.1 cfs, Q_{25}=1.8 cfs, Q_{50}=2.3 cfs, and Q_{100}=2.9 cfs) consists of the proposed diversion swale along the southern portion of the western boundary. Development will consist of a grass lined swale intended to divert offsite flows south to Fountain Creek. The swale will be located within a tract to be owned and maintained by the Riverbend Crossing Metropolitan District.

The intent of the diversion channel is to safely direct offsite high flows from the adjacent parcel to south to the main stem of Fountain Creek. The proposed diversion channel is not intended to convey flows from the Rivervbend Crossing development and consists of a grass lined swale at 0.4% longitudinal slope and will provide some water quality treatment for the area of the swale prior to direct outfall to Fountain Creek in accordance with ECM section I.7.1.B. Basin A1 does not require water quality control measures since it is an open space area with land disturbance to undeveloped land that will remain undeveloped per ECM Appendix I Section I.7.1.B.7

‘B Basins’

‘B’ designated basins consist of the majority of the residential development. Runoff from ‘B’ basins will primarily sheetflow to residential street sections, be collected in Type ‘R’ inlets and conveyed in public storm drainage systems to the extended detention basin.

Basin B17 (0.87 acres) contains the rear portions of lots adjacent to Fountain Creek. Runoff generated within Basin B17 will be collected in private area drains placed along rear lot lines. Flows will be conveyed in a private 8” HDPE storm sewer to confluence with the 48” HDPE at storm design point 12.

Basin B18 (4.86 acres) consists of rear portions of lots adjacent to the proposed extended detention basin and the extended detention basin. Runoff generated within Basin B18 will sheet flow overland directly to the proposed extended detention basin.

BASIN	AREA	Q_2	Q_5	Q_{10}	Q_{25}	Q_{50}	Q_{100}	Type R Inlet
B1	1.84	2.2	3.1	4.1	5.3	6.3	7.4	10’
B2	1.33	2.0	2.7	3.4	4.3	5.1	6.0	10’
B3	2.29	2.9	4.0	5.2	6.6	7.9	9.3	10’
B4	1.26	1.8	2.5	3.2	4.0	4.8	5.6	5’
B5	3.57	4.8	6.6	8.4	10.5	12.5	14.6	10’
B6	1.67	2.1	2.9	3.7	4.6	5.5	6.4	10’
B7	3.79	4.0	5.7	7.7	9.9	11.9	14.2	10’
B8	0.33	0.5	0.7	0.9	1.1	1.3	1.6	5’
B9	3.19	4.3	5.9	7.6	9.5	11.3	13.2	10’
B10	2.15	3.0	4.0	5.2	6.5	7.6	9.0	10’
B11	4.41	6.0	8.2	10.6	13.2	15.7	18.4	15’
B12	3.74	5.1	7.0	9.0	11.3	13.3	15.6	15’
B13	1.96	2.6	3.5	4.6	5.7	6.7	7.9	DP-A1
B14	1.35	1.8	2.5	3.2	4.0	4.7	5.5	5’
B15	1.15	1.2	1.6	2.1	2.6	3.1	3.7	5’
B16	2.04	2.3	3.1	4.0	4.9	5.8	6.9	DP-A1
B17	0.87	1.2	1.7	2.2	2.7	3.2	3.7	AREA
B18	4.86	1.9	3.6	5.8	8.5	10.7	13.3	POND

The development contains roadways with minimum grades of 1.0%. Roadway conveyance at minimum grade of 1.0% is Q_5=8.5 cfs and Q_{100}=37 cfs exceeding individual basin runoff. Inlets were developed in sump locations throughout the development and flow-by is not anticipated. Inlet calculations for Basins B1 through B16 are provided in the appendix. Lots will be developed with side lot line swales directed to the streets. Lot templates for 'A' lot grading, 'B' lot grading, and a limited number of Walkout units will be provided in the final grading plan.

Basin B13 and Basin B16 are combined in the southerly knuckle at design Point A1. Combined flows at Design Point A1 of Q_5=6.0 cfs and Q_{100}=13.4 cfs are collected in a 15' sump inlet within the knuckle. Inlet calculation is provided in the appendix.

'C Basins'

Basin C/ DP-P4 (11.25 Acres, Q_5=38.5 cfs, Q_{100}=70.2 cfs) represents the combined flow generated within the commercial development. Runoff generated within the commercial development sheet flows within the proposed curb line and is collected within private inlets on-site and will be conveyed in a private storm sewer to the residential development represented by Pipe Design Point P4. Runoff will be conveyed in a proposed private 42" storm sewer to confluence with the proposed public storm sewer system within the residential development. From the confluence commercial runoff will be conveyed in public (El Paso County) storm sewer to outfall within the sub-regional extended detention basin.

Overall contribution of the redeveloped commercial development is comparable with the historical analysis contributions from basin 77 (Q_5=25.99 cfs, Q_{100}=45.15 cfs) and commercial portion of Basin 76 (Q_5=6.89 cfs, Q_{100}=12.07 cfs) for a total commercial runoff of (Q_5=32.88 cfs, Q_{100}=57.22 cfs). Developed runoff from the commercial development at Design Point P4 is Q_5=38.5 cfs, Q_{100}=70.2 cfs. Final design of the commercial storm system requires installation of 2 additional CDOT type D inlets within landscape area at downstream (southerly) limits of development. The inlets will serve as a repetitive catchment in the case of upstream inlet failure and provide emergency flow path for commercial development.

The "Master Development Drainage Report for Riverbend Crossing and Final Drainage Report for Riverbend Crossing Commons" has completed review with City of Fountain. Approval is contingent upon providing final El Paso County/City of Fountain pond maintenance agreement and offsite extended detention basin Operation and Maintenance plan submitted as submitted to El Paso County.

Storm Sewer

Flows collected within 'B' designated basin inlets will be conveyed in a public storm sewer system located predominantly within the street ROW which outfalls to the private extended detention basin. Hydraulic grade line calculations developed with UDCFD UDSEWER are provided in the appendix of this report.

Pipe Design Point P4 (commercial outfall) (Q_5=38.5 cfs and Q_{100}=70.2) represents combined flows from the commercial development and will be conveyed in a public 42" RCP at a minimum grade of 0.5%.

Pipe Design Point 1 (Q_5=40.6 cfs and Q_{100}=76.8) represents combined flows from basins B1 and B2 and Design Point P4 (commercial) and will be conveyed in a public 42" RCP.

Pipe Design Point 2 (Q_5=6.4 cfs and Q_{100}=14.6) represents combined flows from basins B3 and B4 and will be conveyed in a public 24" RCP at a minimum grade of 1.8%.

Pipe Design Point 3 (Q_5=14.9 cfs and Q_{100}=33.6) represents combined flows from basins B5 and B6 and Pipe Design Point 2. Combined flows will be conveyed in a public 24" RCP at a minimum grade of 0.65%.

Pipe Design Point 5 (Q_5=6.3 cfs and Q_{100}=15.5) represents combined flows from basins B7 and B8 and will be conveyed in a public 24" RCP at a minimum grade of 0.5%.

Pipe Design Point 6 (Q_5=15.8 cfs and Q_{100}=36.5) represents combined flows from basins B9 and B10 and Pipe Design Point 5. Combined flows will be conveyed in a public 30" RCP at a minimum grade of 0.66%.

Pipe Design Point 7 (Q_5=33.7 cfs and Q_{100}=76.2) represents combined flows from Pipe Design Points 6 and 11. Combined flows will be conveyed in a public 48" RCP at a minimum grade of 0.7%.

Pipe Design Point 8 (Q_5=15.2 cfs and Q_{100}=33.9) represents combined flows from basins B11 and B12 and will be conveyed in a public 30" RCP at a minimum grade of 0.70%.

Pipe Design Point 9 (Q_5=17.5 cfs and Q_{100}=39.1) represents combined flows from Basin B9 and Pipe Design Point 8. Combined flows will be conveyed in a public 42" RCP at a minimum grade of 0.50%.

Pipe Design Point 10 (Q_5=20.4 cfs and Q_{100}=45.4) represents combined flows from Pipe Design Point 9 and overland Design Point A1. Combined flows will be conveyed in a private 42" RCP pipe at a minimum grade of 0.065%. Emergency overflow will utilize a depressed driveway access for the adjacent lift station flag lot access and convey overflow directly to Fountain Creek.

Pipe Design Point 11 (Q_5=20.9 cfs and Q_{100}=46.6) represents combined flows from Pipe Design Point 10 and Basin B15. Combined flows will be conveyed in a private 42" RCP pipe at a minimum grade of 0.065%.

Pipe Design Point 4 (Q_5=46.0 cfs and Q_{100}=104.0) represents combined flows from Pipe Design Points 1,3. and 7. Combined flows will be conveyed in a private 60" RCP at a minimum grade of 0.5%.

Pipe Design Point 12 (Q_5=47.3 cfs and Q_{100}=106.8) represents combined flows from Pipe Design Points 4 and Basin B17. Combined flows will be conveyed in a private 60" RCP at a minimum grade of 0.5%.

CHANNEL BANK STABILIZATION

Fountain Creek in this location is considered a large conveyance natural channel. The existing channel bed is composed of sand and gravel with scattered boulders and cobbles. The channel bottom width varies from 300' to 1,250'. This channel reach relatively straight except for the south end where it makes an abrupt bend just downstream of the project limits. The channel conveys flow from north to south with bed slopes in the range of 0.9% to 1.4%. Moderate to dense vegetation (brush and grasses) are present along the channel edges. The project study reach is approximately 1,615' long. Refer to the Drainage Map in the appendix which depicts the proposed conditions.

The study in effect for this reach is the FEMA Flood Insurance Study (FIS) 08041CV dated December 7, 2018. A flow value for the 100yr design storm was determined using the FIS Summary of Discharges table values of mean velocity and section area at section "CH" which was the location adjacent to the project which yielded the highest flow value of ~26,300cfs. Additional hydraulic analysis was performed for this project using USACE HECRAS software, version 5.07. A supercritical flow regime was used to compute the theoretical water surface elevation profile and determine flow velocities, Froude numbers, and flow depths. A roughness coefficient value of 0.035 was used for design purposes per criteria recommendation. Although the channel has a higher roughness coefficient based on actual bed material and vegetation conditions, using the lower value is a more conservative design approach.

Resultant velocities ranged from ~9ft/s to ~15ft/s. Flow depths ranged from 4ft to 7ft. Froude numbers were determined to be around 1.0. Using this data and the UDFCD Volume 1, Chapter 8 design methodology for channel design, bank lining was deemed necessary. Erosion protection in the form of 12" soil riprap (24' thick) will be provided along the proposed 2.5:1 side slopes. Assuming the channel is entirely composed of non-cohesive soils, the riprap toe protection will be constructed with a five foot bury depth. The height of the soil riprap on the slope will be based on the FIS flow depths and not the model results, which is a conservative approach since the model revealed lower depths. A freeboard value of 1.5' will be used per criteria recommendations. Refer to appendix for additional hydraulic analysis and design information.

EXTENDED DETENTION BASIN

The parcel proposes to develop 54.90 acres within the West Little Johnson Drainage Basin directly tributary to Fountain Creek requiring development of water quality treatment and full-spectrum detention per the criteria of the El Paso County Drainage Criteria Manual Volume 2. The proposed extended detention basin will be developed to provide water quality and full spectrum detention for both the Riverbend Crossing residential development Filings No. 1 and 2 and the Riverbend Crossing Commons Commercial development within the City of Fountain. The proposed Extended Detention Basin located in the southerly portion of the development has 54.90 tributary acres of development with an average imperviousness of 65.40%. Full spectrum pond development requires 1.170 acre-ft of water quality capture volume ponding to an elevation of 5685.56, an EURV volume of 2.54-acre ft, and a total volume of 6.17 acre-ft ponding to an elevation of 5690.65providing full spectrum detention including the 100-YR event.

Runoff generated within the site will be conveyed to the pond through storm sewer systems or as direct sheetflow. The storm sewer systems will outfall directly to 6" concrete forebays with baffle providing adequate protection at discharge point. The concrete forebays require a total volume of 1,525 cubic feet of volume (2% of the design WQCV). Forebay 'A' conveying flows from the majority of the residential development will be constructed of a concrete slab with sides conforming to the pond slopes and 30" wall with a 7.9" rectangular notch which outfalls to the proposed trickle channel at the downstream end. Forebay 'B' conveying flows from the commercial development and Basins B1 and B2 will be constructed of a concrete slab with sides conforming to the pond slopes and 18' wall with a 6.6" rectangular notch which outfalls to the proposed trickle channel at the downstream end.

The pond will be constructed with 4:1 minimum side slopes to be vegetated per the final landscape plan. A 4' wide by 6" deep concrete trickle channel with a 0.5% longitudinal slope will convey low flows across the pond bottom to the micropool/outlet structure. The trickle channel will outfall to a 20' long by 8' wide by 2.5' deep concrete micropool. The micropool will provide a surface area of 120 square feet and an initial surcharge volume of 80 cubic feet utilizing an 6" initial surcharge depth.

A portion of the pond is situated below the Base Flood Elevation of the 100-YR recurrence event within the adjacent portion of Fountain Creek, 5689.00. Excess volume exceeding the 100-YR event volume above the base flood elevation was incorporated into the pond to overcome backwater effects should the subdivision experience a 100-YR event concurrent with passage of maximum flood event within the adjacent reach of Fountain Creek.

The outlet structure will consist of a concrete box with orifice plate and screen providing water quality outlet and weir with trash rack for larger storm outfall. The pond will outfall through a private 36" RCP pipe system directly to Fountain Creek.

The emergency spillway will consist of a 60' weir along the southerly end of the pond at an elevation of 5691.0. The overflow area will consist of 24" depth of type M soil riprap.

Outfall from the extended detention basin of Q_2=1.3 cfs, Q_5=1.6 cfs, Q_{10}=12.1 cfs, Q_{25}=36.4 cfs, Q_{50}=55.6 cfs, and Q_{100}=67.7 will be conveyed in a private restricted 36" RCP. Combined flows at Design P-out is less than historic runoff from basins 75,76, and 77. Outfall from the onsite

extended detention basin will be conveyed directly to Fountain Creek through the private 36" RCP and full spectrum release will have no impacts on the Fountain Creek Drainage.

4-STEP PROCESS

STEP 1: EMPLOY RUNOFF REDUCTION PRACTICES

The development addresses Low Impact Development strategies primarily through the utilization of landscape swales within sides and rear of proposed residential lots and directing runoff from buildings and walkways through swales with minimal longitudinal grade prior to outfall to street collection and storm conveyance systems.

STEP 2: STABILIZE DRAINAGEWAYS

The ultimate recipient of runoff from the site is Fountain Creek. Flows from the site are tributary to the full spectrum extended detention basin constructed on site with development of the Riverbend Crossing community and commercial center attenuating flows to predevelopment levels. Existing slopes adjacent to Fountain Creek will be anchored with rip rap toe protection and excessive slopes will be lain back to a slope of 2.5 Horizontal to 1' Vertical. 100=YR slope protection will be installed within reconstructed slopes.

STEP 3: PROVIDE WATER QUALITY CAPTURE VALUME

On-site flow is directed to the on-site private proposed full spectrum extended detention basin constructed with development of the project which outfalls directly to historic outfall within Fountain Creek. The extended detention basin provides Water Quality Capture Volume required for this site and concurrent commercial development and attenuates release of flows to approximate historic runoff.

STEP 4: CONSIDER NEED FOR INDUSTRIAL AND COMMERCIAL BMP'S

A Grading, Erosion Control, and Stormwater Quality Plan and narrative will be approved by El Paso County prior to any soil disturbance. The erosion control plan will include specific source control BMP's as well as defined overall site management practices for the construction period. The grading narrative will address materials storage and spill containment during construction operations. No industrial processes are proposed in development of the Riverbend Community.

COST ESTIMATE

Public Improvements Non-reimbursable

5' Type R Inlet	2 EA	@$	3,800/EA	$ 7,600
10' Type R Inlet	9 EA	@$	5,500/EA	$ 49,500
15' Type R Inlet	1 EA	@$	8,000/EA	$ 8,000
20' Type R Inlet	1 EA	@$	10,0000/EA	$ 10,000
Type I Manhole	11 EA	@$	4,000/EA	$ 40,000
18" RCP	213 LF	@$	45/LF	$ 9,585
24" RCP	2,102 LF	@$	55/LF	$ 115,610
30" RCP	1,411 LF	@$	68/LF	$ 95,948
42" RCP	152LF	@$	90/LF	$ 13,680
48" RCP	151 LF	@$	110/LF	$ 16,610

SUBTOTAL	**$ 366,533**
10% CONTINGENCY	*$ 36,653*
TOTAL	**$ 403,168**

Private Improvements Non-reimbursable

48" HDPE	552 LF	@$	85/LF	$ 46,920
WATER QUALITY POND	1 EA	@$	65,000/EA	$ 65,000
BANK STABILIZATION *soil riprap*	3,345 TONS	@$	80/TON	$ 267,600

SUBTOTAL	**$ 379,520**
10% CONTINGENCY	*$ 37,952*
TOTAL	**$ 417,452**

DRAINAGE FEE CALCULATION

Riverbend Crossing Filing No. 1 contains 36.5 acres to be platted within the West Little Johnson Drainage Basin. Riverbend Crossing Filing No. 2 contains 15.5 acres to be platted within the West Little Johnson Drainage Basin. The 2018 fee for the West Little Johnson Drainage Basin (A miscellaneous Drainage Basin) is $1,133/ per impervious acre.

Filing No.1-36.547 total acres.

Use	Acres	Imperviousness
1/8 acre or less	23.45	65%
Open Space	13.09	7%
Composite Imperviousness:	44.2%	

36.547 acres X 44.2% X $1,133.00 = $18,311

Filing No.2-15.452 total acres.

Use	Acres	Imperviousness
1/8 acre or less	14.48	65%
Open Space	0.97	7%
Composite Imperviousness:	61.4%	

15.452 acres X 61.4% X $1,133.00 = $10,742

There are no bridge fees in the West Little Johnson Drainage Basin.

DRAINAGE METHODOLOGY

This drainage report was prepared in accordance to the criteria established in the City of Colorado Springs/El Paso County Drainage Criteria Manual Volumes 1 and 2, as revised May 2014.

The rational method for drainage basin study areas of less than 100 acres was utilized in the analysis. For the Rational Method, flows were calculated for the 2, 5, 10, 25, 50, and 100-year recurrence intervals. The average runoff coefficients, 'C' values, are taken from Table 6-6 and the Intensity-Duration-Frequency curves are taken from Figure 6-5 of the City Drainage Criteria Manual. Time of concentration for overland flow and storm drain or gutter flow are calculated per Section 3.2 of the City Drainage Criteria Manual. Calculations for the Rational Method are shown in the Appendix of this report.

Urban Drainage and Flood Control District methodology was utilized for determination of street capacity, inlet sizing, and extended detention basin design. UD-Inlet Version 4.05 was utilized in street capacity and inlet sizing calculations. UD-Culvert Version 3.05 was utilized in developing preliminary pipe sizing. Hydraulic Grade Line Calculations were developed using UD-Sewer version 1.4 and are provided in the appendix. UD-Detention version 3.07 was utilized in development of extended detention basin and outfall. Calculations are included in the appendix of this report.

SUMMARY

Development of Riverbend Crossing Filings No. 1 and No. 2 will require that flows be treated for water quality and be detained to historic levels prior to release from the site. Site runoff and storm drain and appurtenances will not adversely affect the downstream and surrounding developments. This report is in general conformance with all previously approved reports which included this site. Facilities will be owned or maintained by the Riverbend Crossing Metropolitan District.

REFERENCES:

City of Colorado Springs Engineering Division Drainage Criteria Manual Volumes 1 and 2, revised May 2014

"Little Johnson/Security Creek Drainage Basin Planning Study" prepared by Simons, Li and Associates, Inc. dated December 1987.

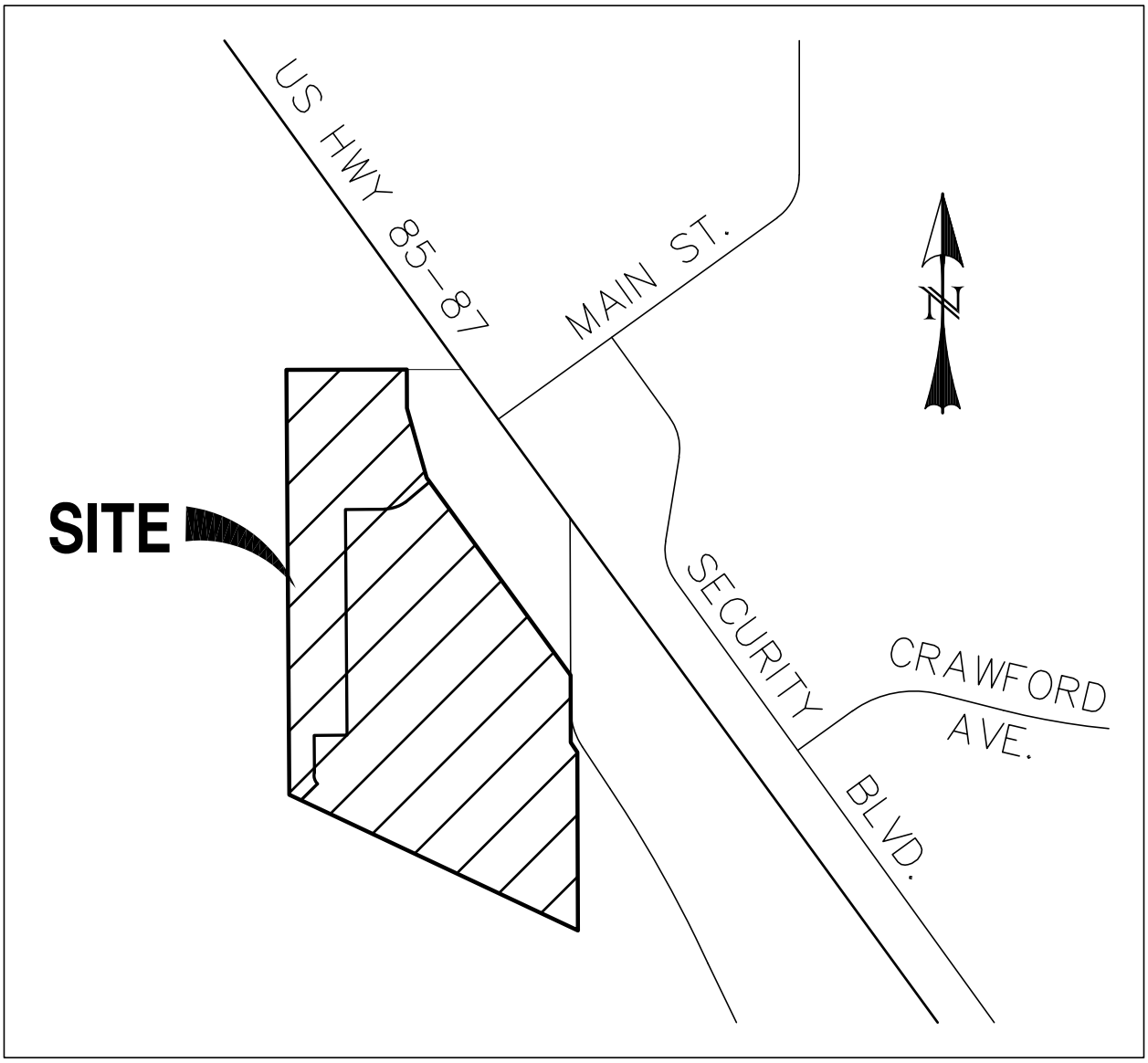
"Preliminary Drainage Study Riverbend Crossing" prepared by Nolte and Associates, Inc." accepted February 2017.

"Preliminary/Final Drainage Report for St. Dominic's Church Subdivision", accepted October 2007.

Natural Resources Conservation Service Web Soil Survey

"Master Development Drainage Report for Riverbend Crossing and Final Drainage Report for Riverbend Crossing Commons", by Catamount Engineering, dated December 15, 2019.

APPENDIX

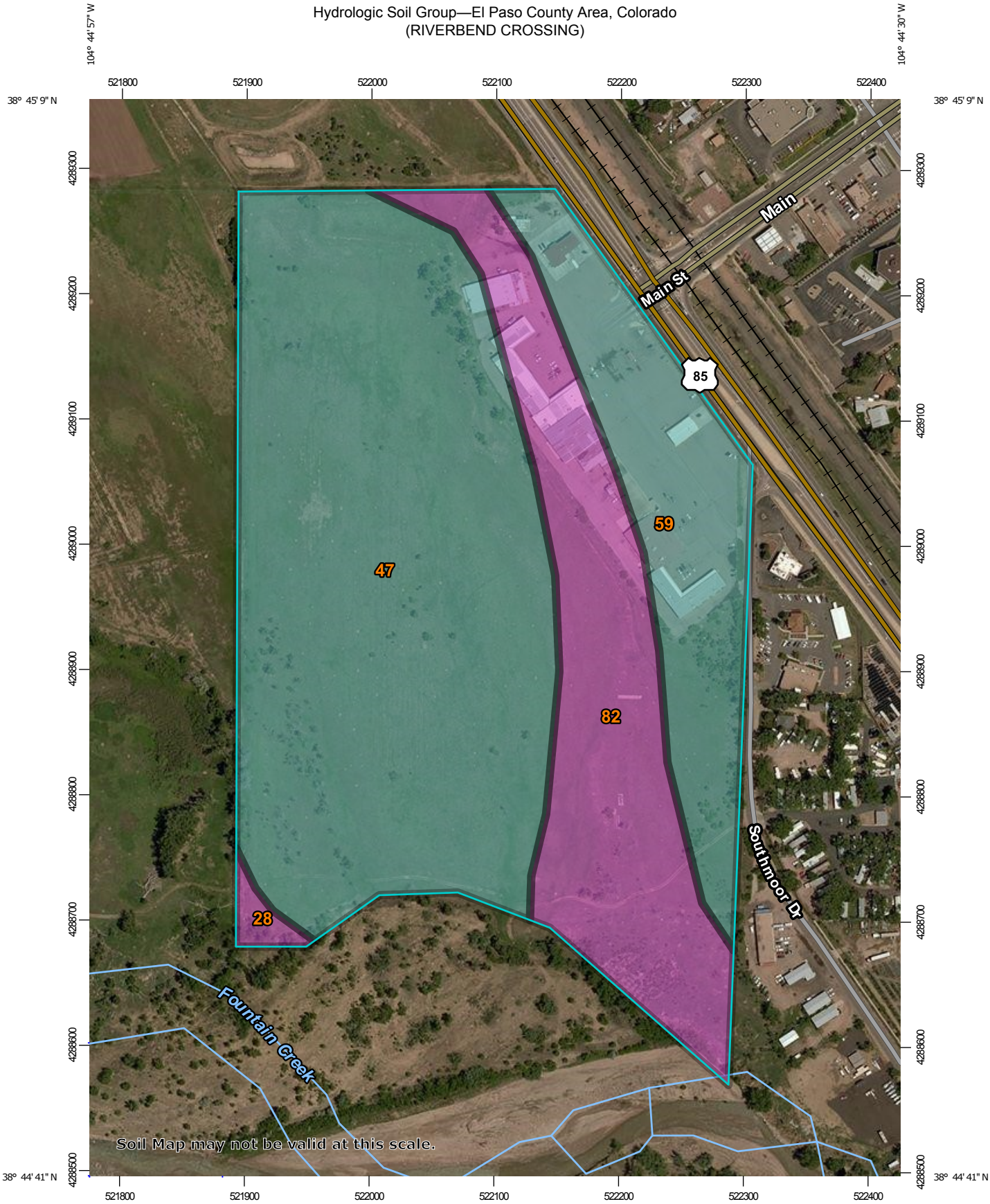


VICINITY MAP

SCALE: N.T.S.

CATAMOUNT ENGINEERING PO BOX 692 DIVIDE, CO 80814 (719) 426-2124	**RIVERBEND CROSSING**	SCALE: NTS	DATE: 09/05/18
	VICINITY MAP	JOB NO.: **17-114**	SHEET: 1 OF 1

Hydrologic Soil Group—El Paso County Area, Colorado
(RIVERBEND CROSSING)



Map Scale: 1:4,190 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

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 15, Oct 10, 2017

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

Date(s) aerial images were photographed: Apr 15, 2011—Jun 17, 2014

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
28	Ellicott loamy coarse sand, 0 to 5 percent slopes	A	0.5	0.9%
47	Limon clay, 0 to 3 percent slopes	C	32.6	57.0%
59	Nunn clay loam, 0 to 3 percent slopes	C	10.2	17.8%
82	Schamber-Razor complex, 8 to 50 percent slopes	A	13.9	24.3%
Totals for Area of Interest			**57.2**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

HYDROLOGIC AND HYDRAULIC CALCULATIONS

PROPOSED DRAINAGE DESIGN - RATIONAL ANALYSIS

											CONVEYANCE TC						TT	INTENSITY						TOTAL FLOWS					
BASIN	**AREA TOTAL (Acres)**	**C_2**	**C_5**	**C_{10}**	**C_{25}**	**C_{50}**	**C_{100}**	**Length (ft)**	**Height (ft)**	**TI (min)**	**Length (ft)**	**Height (ft)**	**C_V**	**Slope (%)**	**Velocity (fps)**	**TC (min)**	**TOTAL (min)**	**I_2 (in/hr)**	**I_5 (in/hr)**	**I_{10} (in/hr)**	**I_{25} (in/hr)**	**I_{50} (in/hr)**	**I_{100} (in/hr)**	**Q_2 (c.f.s.)**	**Q_5 (c.f.s.)**	**Q_{10} (c.f.s.)**	**Q_{25} (c.f.s.)**	**Q_{50} (c.f.s.)**	**Q_{100} (c.f.s.)**
A1	1.30	**0.09**	**0.19**	**0.29**	**0.40**	**0.46**	**0.52**	70	1.8	10.1	1373	10	15	0.7%	1.3	17.9	27.9	2.1	2.6	3.0	3.5	3.9	4.3	**0.2**	**0.6**	**1.1**	**1.8**	**2.3**	**2.9**
Landscape	*1.30*	*0.09*	*0.19*	*0.29*	*0.40*	*0.46*	*0.52*																						
B1	1.84	**0.40**	**0.45**	**0.51**	**0.56**	**0.60**	**0.63**	100	2	9.3	382	3.8	20	1.0%	2.0	3.2	12.5	3.0	3.8	4.4	5.1	5.7	6.4	**2.2**	**3.1**	**4.1**	**5.3**	**6.3**	**7.4**
Residential 1/8 acre	*1.59*	*0.45*	*0.49*	*0.54*	*0.59*	*0.62*	*0.65*																						
Landscape	*0.25*	*0.09*	*0.19*	*0.29*	*0.40*	*0.46*	*0.52*																						
B2	1.33	**0.45**	**0.49**	**0.54**	**0.59**	**0.62**	**0.65**	83	1.6	8.1	252	2.5	20	1.0%	2.0	2.1	10.2	3.3	4.1	4.8	5.5	6.2	6.9	**2.0**	**2.7**	**3.4**	**4.3**	**5.1**	**6.0**
Residential 1/8 acre	*1.33*	*0.45*	*0.49*	*0.54*	*0.59*	*0.62*	*0.65*																						
B3	2.29	**0.41**	**0.46**	**0.51**	**0.57**	**0.60**	**0.64**	100	2	9.2	344	3	20	0.9%	1.9	3.1	12.3	3.0	3.8	4.5	5.1	5.7	6.4	**2.9**	**4.0**	**5.2**	**6.6**	**7.9**	**9.3**
Residential 1/8 acre	*2.04*	*0.45*	*0.49*	*0.54*	*0.59*	*0.62*	*0.65*																						
Landscape	*0.25*	*0.09*	*0.19*	*0.29*	*0.40*	*0.46*	*0.52*																						
B4	1.26	**0.45**	**0.49**	**0.54**	**0.59**	**0.62**	**0.65**	84	1.6	8.2	312	4	20	1.3%	2.3	2.3	10.5	3.2	4.1	4.7	5.4	6.1	6.8	**1.8**	**2.5**	**3.2**	**4.0**	**4.8**	**5.6**
Residential 1/8 acre	*1.26*	*0.45*	*0.49*	*0.54*	*0.59*	*0.62*	*0.65*																						
B5	3.57	**0.45**	**0.49**	**0.54**	**0.59**	**0.62**	**0.65**	100	2	8.8	320	11	7	3.4%	1.3	4.1	12.9	3.0	3.8	4.4	5.0	5.6	6.3	**4.8**	**6.6**	**8.4**	**10.5**	**12.5**	**14.6**
Residential 1/8 acre	*3.57*	*0.45*	*0.49*	*0.54*	*0.59*	*0.62*	*0.65*																						
B6	1.67	**0.45**	**0.49**	**0.54**	**0.59**	**0.62**	**0.65**	100	2	8.8	100	2	7	2.0%	1.0	1.7	15.0	2.8	3.5	4.1	4.7	5.3	5.9	**2.1**	**2.9**	**3.7**	**4.6**	**5.5**	**6.4**
Residential 1/8 acre	*1.67*	*0.45*	*0.49*	*0.54*	*0.59*	*0.62*	*0.65*				710	12	20	1.7%	2.6	4.6													
B7	3.79	**0.37**	**0.42**	**0.48**	**0.55**	**0.58**	**0.62**	100	12	5.4	100	3	7	3.0%	1.2	1.4	14.2	2.9	3.6	4.2	4.8	5.4	6.1	**4.0**	**5.7**	**7.7**	**9.9**	**11.9**	**14.2**
Residential 1/8 acre	*2.91*	*0.45*	*0.49*	*0.54*	*0.59*	*0.62*	*0.65*				780	6	20	0.8%	1.8	7.4													
Landscape	*0.88*	*0.09*	*0.19*	*0.29*	*0.40*	*0.46*	*0.52*																						

Calculated by: DLM

Date: 10/25/2020

PROPOSED DRAINAGE DESIGN - RATIONAL ANALYSIS

											CONVEYANCE TC						TT	INTENSITY						TOTAL FLOWS					
BASIN	**AREA TOTAL (Acres)**	**C_2**	**C_5**	**C_{10}**	**C_{25}**	**C_{50}**	**C_{100}**	**Length (ft)**	**Height (ft)**	**TI (min)**	**Length (ft)**	**Height (ft)**	**C_V**	**Slope (%)**	**Velocity (fps)**	**TC (min)**	**TOTAL (min)**	**I_2 (in/hr)**	**I_5 (in/hr)**	**I_{10} (in/hr)**	**I_{25} (in/hr)**	**I_{50} (in/hr)**	**I_{100} (in/hr)**	**Q_2 (c.f.s.)**	**Q_5 (c.f.s.)**	**Q_{10} (c.f.s.)**	**Q_{25} (c.f.s.)**	**Q_{50} (c.f.s.)**	**Q_{100} (c.f.s.)**
B8	0.33	**0.45**	**0.49**	**0.54**	**0.59**	**0.62**	**0.65**	75	1.5	7.6	124	1.5	20	1.2%	2.2	0.9	8.5	3.5	4.4	5.1	5.8	6.6	7.3	**0.5**	**0.7**	**0.9**	**1.1**	**1.3**	**1.6**
Residential 1/8 acre	*0.33*	*0.45*	*0.49*	*0.54*	*0.59*	*0.62*	*0.65*																						
B9	3.19	**0.45**	**0.49**	**0.54**	**0.59**	**0.62**	**0.65**	100	4	7.0	810	12	20	1.5%	2.4	5.5	12.5	3.0	3.8	4.4	5.1	5.7	6.4	**4.3**	**5.9**	**7.6**	**9.5**	**11.3**	**13.2**
Residential 1/8 acre	*3.19*	*0.45*	*0.49*	*0.54*	*0.59*	*0.62*	*0.65*																						
B10	2.15	**0.45**	**0.49**	**0.54**	**0.59**	**0.62**	**0.65**	73	1.5	7.4	720	11	20	1.5%	2.5	4.9	12.3	3.1	3.8	4.5	5.1	5.7	6.4	**3.0**	**4.0**	**5.2**	**6.5**	**7.6**	**9.0**
Residential 1/8 acre	*2.15*	*0.45*	*0.49*	*0.54*	*0.59*	*0.62*	*0.65*																						
B11	4.41	**0.45**	**0.49**	**0.54**	**0.59**	**0.62**	**0.65**	100	2	8.8	515	7.5	20	1.5%	2.4	3.6	12.3	3.0	3.8	4.5	5.1	5.7	6.4	**6.0**	**8.2**	**10.6**	**13.2**	**15.7**	**18.4**
Residential 1/8 acre	*4.41*	*0.45*	*0.49*	*0.54*	*0.59*	*0.62*	*0.65*																						
B12	3.74	**0.45**	**0.49**	**0.54**	**0.59**	**0.62**	**0.65**	100	6	6.1	40	0.8	7	2.0%	1.0	0.7	12.2	3.1	3.8	4.5	5.1	5.7	6.4	**5.1**	**7.0**	**9.0**	**11.3**	**13.3**	**15.6**
Residential 1/8 acre	*3.74*	*0.45*	*0.49*	*0.54*	*0.59*	*0.62*	*0.65*				803	12	20	1.5%	2.4	5.5													
B13	1.96	**0.45**	**0.49**	**0.54**	**0.59**	**0.62**	**0.65**	100	2	8.8	657	9	20	1.4%	2.3	4.7	13.4	2.9	3.7	4.3	4.9	5.5	6.2	**2.6**	**3.5**	**4.6**	**5.7**	**6.7**	**7.9**
Residential 1/8 acre	*1.96*	*0.45*	*0.49*	*0.54*	*0.59*	*0.62*	*0.65*																						
B14	1.35	**0.45**	**0.49**	**0.54**	**0.59**	**0.62**	**0.65**	100	2	8.8	554	7.5	20	1.4%	2.3	4.0	12.7	3.0	3.8	4.4	5.0	5.7	6.3	**1.8**	**2.5**	**3.2**	**4.0**	**4.7**	**5.5**
Residential 1/8 acre	*1.35*	*0.45*	*0.49*	*0.54*	*0.59*	*0.62*	*0.65*																						
B15	1.15	**0.45**	**0.49**	**0.54**	**0.59**	**0.62**	**0.65**	50	2	4.9	1026	20	7	1.9%	1.0	17.5	22.4	2.3	2.9	3.4	3.9	4.4	4.9	**1.2**	**1.6**	**2.1**	**2.6**	**3.1**	**3.7**
Residential 1/8 acre	*1.15*	*0.45*	*0.49*	*0.54*	*0.59*	*0.62*	*0.65*																						
B16	2.04	**0.45**	**0.49**	**0.54**	**0.59**	**0.62**	**0.65**	50	2	4.9	934	20	7	2.1%	1.0	15.2	20.1	2.5	3.1	3.6	4.1	4.6	5.2	**2.3**	**3.1**	**4.0**	**4.9**	**5.8**	**6.9**
Residential 1/8 acre	*2.04*	*0.45*	*0.49*	*0.54*	*0.59*	*0.62*	*0.65*																						

Calculated by: DLM

Date: 10/25/2020

PROPOSED DRAINAGE DESIGN - RATIONAL ANALYSIS

											CONVEYANCE TC						TT	INTENSITY						TOTAL FLOWS					
BASIN	**AREA TOTAL (Acres)**	**C_2**	**C_5**	**C_{10}**	**C_{25}**	**C_{50}**	**C_{100}**	**Length (ft)**	**Height (ft)**	**TI (min)**	**Length (ft)**	**Height (ft)**	**C_V**	**Slope (%)**	**Velocity (fps)**	**TC (min)**	**TOTAL (min)**	**I_2 (in/hr)**	**I_5 (in/hr)**	**I_{10} (in/hr)**	**I_{25} (in/hr)**	**I_{50} (in/hr)**	**I_{100} (in/hr)**	**Q_2 (c.f.s.)**	**Q_5 (c.f.s.)**	**Q_{10} (c.f.s.)**	**Q_{25} (c.f.s.)**	**Q_{50} (c.f.s.)**	**Q_{100} (c.f.s.)**
B17	0.87	**0.45**	**0.49**	**0.54**	**0.59**	**0.62**	**0.65**	75	1.5	7.6	428	4	20	0.9%	1.9	3.7	11.3	3.2	3.9	4.6	5.3	5.9	6.6	**1.2**	**1.7**	**2.2**	**2.7**	**3.2**	**3.7**
Residential 1/8 acre	*0.87*	*0.45*	*0.49*	*0.54*	*0.59*	*0.62*	*0.65*																						
B18	4.86	**0.16**	**0.25**	**0.34**	**0.44**	**0.49**	**0.55**	100	6	8.5	527	5	7	0.9%	0.7	12.9	21.4	2.4	3.0	3.5	4.0	4.5	5.0	**1.9**	**3.6**	**5.8**	**8.5**	**10.7**	**13.3**
Landscape	*3.88*	*0.09*	*0.19*	*0.29*	*0.40*	*0.46*	*0.52*																						
Residential 1/8 acre	*0.98*	*0.45*	*0.49*	*0.54*	*0.59*	*0.62*	*0.65*																						
C	11.25	**0.80**	**0.82**	**0.84**	**0.87**	**0.88**	**0.89**										9.7	3.3	4.2	4.9	5.6	6.3	7.0	**30.0**	**38.5**	**46.0**	**54.5**	**62.0**	**70.2**
Commercial	*11.25*	*0.80*	*0.82*	*0.84*	*0.87*	*0.88*	*0.89*																						
P4																													

Calculated by: DLM

Date: 10/25/2020

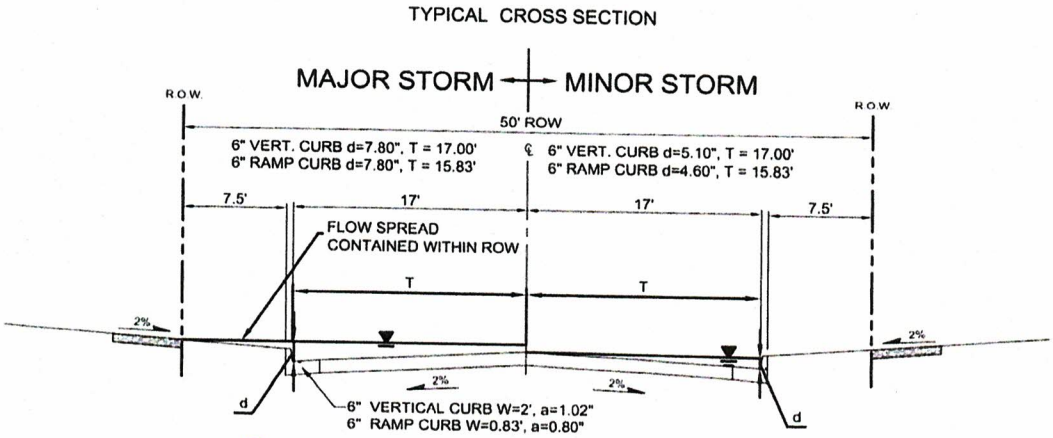
PROPOSED DRAINAGE DESIGN - RATIONAL ANALYSIS

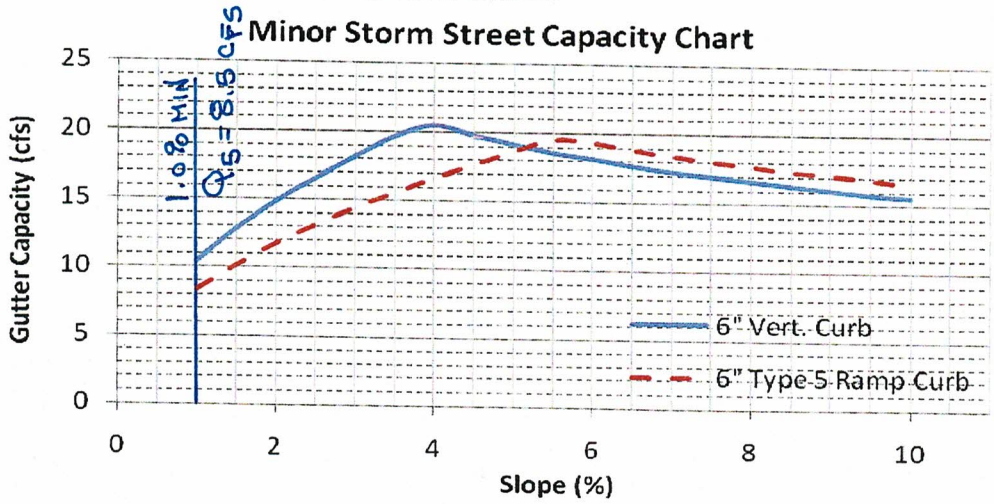
		WEIGHTED						TT	INTENSITY						TOTAL FLOWS					
DESIGN POINT	AREA TOTAL (Acres)	C_2	C_5	C_{10}	C_{25}	C_{50}	C_{100}	TOTAL (min)	I_2 (in/hr)	I_5 (in/hr)	I_{10} (in/hr)	I_{25} (in/hr)	I_{50} (in/hr)	I_{100} (in/hr)	Q_2 (c.f.s.)	Q_5 (c.f.s.)	Q_{10} (c.f.s.)	Q_{25} (c.f.s.)	Q_{50} (c.f.s.)	Q_{100} (c.f.s.)
P4 COMMERCIAL	**11.26**	0.8	0.82	0.84	0.87	0.88	0.89	**9.7**	3.3	4.2	4.9	5.6	6.3	7	**30.0**	**38.5**	**46.1**	**54.5**	**62.1**	**70.2**
1	**14.43**	**0.72**	**0.74**	**0.77**	**0.81**	**0.82**	**0.84**	**12.5**	3.0	3.8	4.4	5.1	5.7	6.4	**31.3**	**40.6**	**49.2**	**58.8**	**67.4**	**76.8**
P4	11.26	0.80	0.82	0.84	0.87	0.88	0.89	9.7												
BASIN B1	1.84	0.40	0.45	0.51	0.56	0.60	0.63	12.5												
BASIN B2	1.33	0.45	0.49	0.54	0.59	0.62	0.65	10.2												
2	**3.55**	**0.42**	**0.47**	**0.52**	**0.58**	**0.61**	**0.64**	**12.3**	3.0	3.8	4.5	5.1	5.7	6.4	**4.6**	**6.4**	**8.3**	**10.4**	**12.4**	**14.6**
BASIN B3	2.29	0.41	0.46	0.51	0.57	0.60	0.64	12.3												
BASIN B4	1.26	0.45	0.49	0.54	0.59	0.62	0.65	10.5												
3	**8.79**	**0.44**	**0.48**	**0.53**	**0.58**	**0.62**	**0.65**	**15.0**	2.8	3.5	4.1	4.7	5.3	5.9	**10.9**	**14.9**	**19.2**	**24.1**	**28.6**	**33.6**
BASIN B5	3.57	0.45	0.49	0.54	0.59	0.62	0.65	12.9												
BASIN B6	1.67	0.45	0.49	0.54	0.59	0.62	0.65	15.0												
DP-2	3.55	0.42	0.47	0.52	0.58	0.61	0.64	12.3												
4	**32.90**	**0.44**	**0.48**	**0.53**	**0.58**	**0.61**	**0.65**	**22.4**	2.3	2.9	3.4	3.9	4.4	4.9	**33.6**	**46.0**	**59.5**	**74.7**	**88.5**	**104.0**
DP-7	24.11	0.44	0.48	0.53	0.58	0.61	0.65	22.4												
DP-3	8.79	0.44	0.48	0.53	0.58	0.62	0.65	15.0												
5	**4.12**	**0.37**	**0.43**	**0.49**	**0.55**	**0.59**	**0.62**	**14.2**	2.9	3.6	4.2	4.8	5.4	6.1	**4.4**	**6.3**	**8.4**	**10.9**	**13.0**	**15.5**
BASIN B7	3.79	0.37	0.42	0.48	0.55	0.58	0.62	14.2												
BASIN B8	0.33	0.45	0.49	0.54	0.59	0.62	0.65	8.5												
6	**9.46**	**0.42**	**0.46**	**0.52**	**0.57**	**0.61**	**0.64**	**14.2**	2.9	3.6	4.2	4.8	5.4	6.1	**11.3**	**15.8**	**20.6**	**26.0**	**31.0**	**36.5**
BASIN B9	3.19	0.45	0.49	0.54	0.59	0.62	0.65	12.5												
BASIN B10	2.15	0.45	0.49	0.54	0.59	0.62	0.65	12.3												
DP 5	4.12	0.37	0.43	0.49	0.55	0.59	0.62	14.2												
7	**24.11**	**0.44**	**0.48**	**0.53**	**0.58**	**0.61**	**0.65**	**22.4**	2.3	2.9	3.4	3.9	4.4	4.9	**24.6**	**33.7**	**43.6**	**54.7**	**64.8**	**76.2**
DP-11	14.65	0.45	0.49	0.54	0.59	0.62	0.65	22.4												
DP-6	9.46	0.42	0.46	0.52	0.57	0.61	0.64	14.2												
8	**8.15**	**0.45**	**0.49**	**0.54**	**0.59**	**0.62**	**0.65**	**12.3**	3.0	3.8	4.5	5.1	5.7	6.4	**11.2**	**15.2**	**19.6**	**24.5**	**28.9**	**33.9**
BASIN B11	4.41	0.45	0.49	0.54	0.59	0.62	0.65	12.3												
BASIN B12	3.74	0.45	0.49	0.54	0.59	0.62	0.65	12.2												
9	**9.50**	**0.45**	**0.49**	**0.54**	**0.59**	**0.62**	**0.65**	**12.7**	3.0	3.8	4.4	5.0	5.7	6.3	**12.9**	**17.5**	**22.5**	**28.2**	**33.3**	**39.1**
B14	1.35	0.45	0.49	0.54	0.59	0.62	0.65	12.7												
DP-8	8.15	0.45	0.49	0.54	0.59	0.62	0.65	12.3												
A1	**4.00**	**0.45**	**0.49**	**0.54**	**0.59**	**0.62**	**0.65**	**20.1**	2.5	3.1	3.6	4.1	4.6	5.2	**4.4**	**6.0**	**7.8**	**9.7**	**11.5**	**13.4**
BASIN B13	1.96	0.45	0.49	0.54	0.59	0.62	0.65	13.4												
BASIN B16	2.04	0.45	0.49	0.54	0.59	0.62	0.65	20.1												
10	**13.50**	**0.45**	**0.49**	**0.54**	**0.59**	**0.62**	**0.65**	**20.1**	2.5	3.1	3.6	4.1	4.6	5.2	**15.0**	**20.4**	**26.2**	**32.7**	**38.7**	**45.4**
DP A1	4.00	0.45	0.49	0.54	0.59	0.62	0.65	20.1												
DP-9	9.50	0.45	0.49	0.54	0.59	0.62	0.65	12.7												
11	**14.65**	**0.45**	**0.49**	**0.54**	**0.59**	**0.62**	**0.65**	**22.4**	2.3	2.9	3.4	3.9	4.4	4.9	**15.4**	**20.9**	**26.9**	**33.6**	**39.8**	**46.6**
BASIN B15	1.15	0.45	0.49	0.54	0.59	0.62	0.65	22.4												
DP-10	13.50	0.45	0.49	0.54	0.59	0.62	0.65	20.1												
12	**33.77**	**0.44**	**0.48**	**0.53**	**0.58**	**0.61**	**0.65**	**22.4**	2.3	2.9	3.4	3.9	4.4	4.9	**34.5**	**47.3**	**61.1**	**76.7**	**90.9**	**106.8**
BASIN B17	0.87	0.45	0.49	0.54	0.59	0.62	0.65	11.3												
DP-4	32.90	0.44	0.48	0.53	0.58	0.61	0.65	22.4												
P-IN	**53.06**	**0.41**	**0.46**	**0.51**	**0.57**	**0.60**	**0.64**	22.4	2.3	2.9	3.4	3.9	4.4	4.9	**51.1**	**71.1**	**92.9**	**117.7**	**140.1**	**165.4**
BASIN B18	4.86	0.16	0.25	0.34	0.44	0.49	0.55	21.4												
DP-1	14.43	0.72	0.74	0.77	0.81	0.82	0.84	12.5												
DP-12	33.77	0.44	0.48	0.53	0.58	0.61	0.65	22.4												
P-OUT POND OUTLET	**54.90**								**POND ROUTED** SEE UD DENTENTION						**1.3**	**1.6**	**12.1**	**36.4**	**55.6**	**67.7**

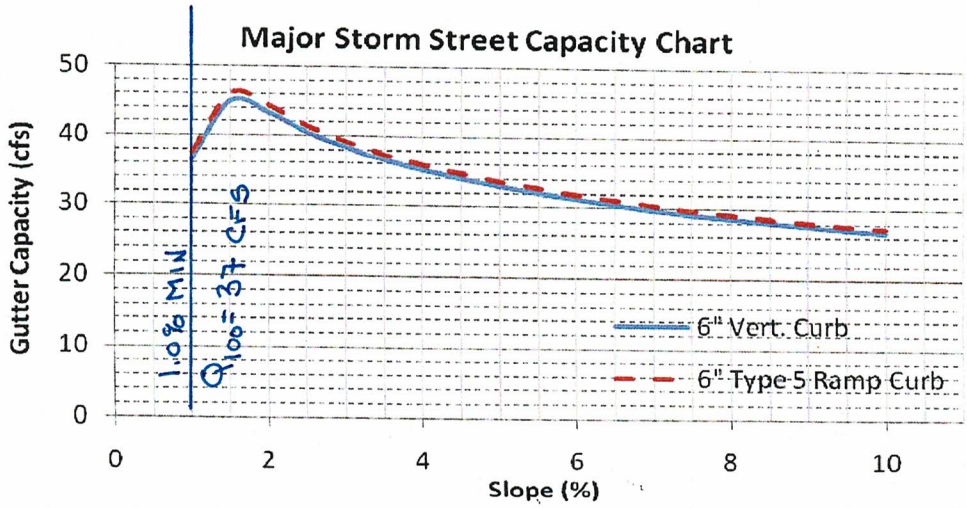
Calculated by: DLM

Date: 10/25/2020

Figure 7-7. Street Capacity Charts Residential (Detached Sidewalk)







These charts shall only be used for the standard street sections as shown. The capacity shown is based on ½ the street section as calculated by the UD-Inlet spreadsheets. Minor storm capacities are based on no crown overtopping, curb height or maximum allowable spread widths. Major storm capacities are based on flow being containing within the public right-of-way, including conveyance capacity behind the curb. The UDFCD Safety Reduction Factor was applied. An 'n_{STREET}' of 0.016 and 'n_{BACK}' of 0.020 was used. Calculations were done using UD-Inlet 3.00.xls, March, 2011.

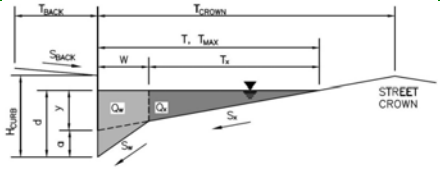
Version 4.05 Released March 2017

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

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

Project: **Riverbend Crossing**

Inlet ID: **B1**



Gutter Geometry (Enter data in the blue cells)

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} =	0.012	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} =	16.2	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 =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.057	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} =	16.2	16.2	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	7.8	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

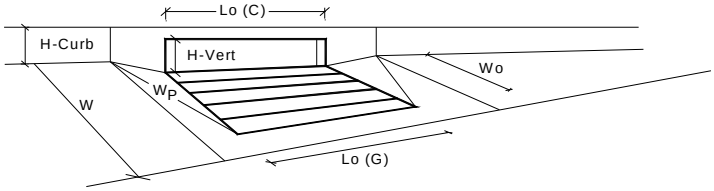
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**14.6**	**22.9**	**cfs**

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 IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



		MINOR	MAJOR	
Design Information (Input) CDOT Type R Curb Opening				
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.1	7.8	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.26	0.48	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.48	0.74	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.88	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.3**	**15.5**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	3.1	7.4	cfs

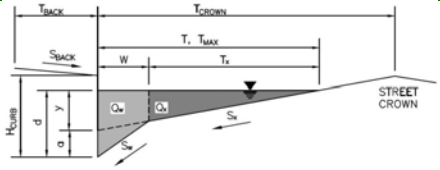
Version 4.05 Released March 2017

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

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

Project: **Riverbend Crossing**

Inlet ID: **B2**



Gutter Geometry (Enter data in the blue cells)

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} =	0.012	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} =	16.2	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 =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.057	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} =	16.2	16.2	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	7.8	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

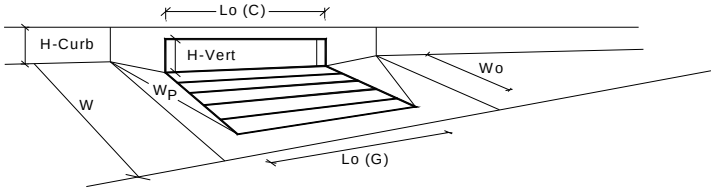
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**14.6**	**22.9**	**cfs**

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 IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



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' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	5.1	7.8	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.26	0.48	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.48	0.74	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.88	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**5.3**	**15.5**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	2.7	6.0	cfs

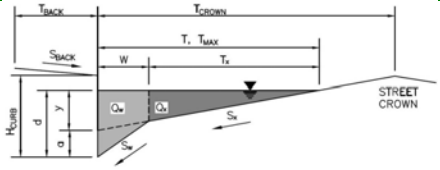
Version 4.05 Released March 2017

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

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

Project: **Riverbend Crossing**

Inlet ID: **B3**



Gutter Geometry (Enter data in the blue cells)

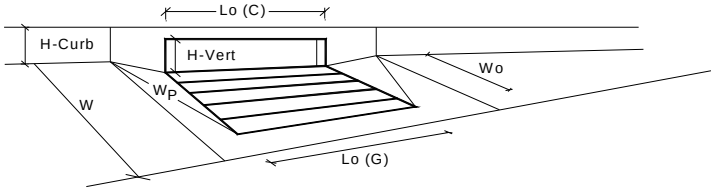
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.012	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.2	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 =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	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} =	16.2	16.2	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	7.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



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' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	5.1	7.8	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.26	0.48	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.48	0.74	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.88	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**5.3**	**15.5**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	4.0	9.3	cfs

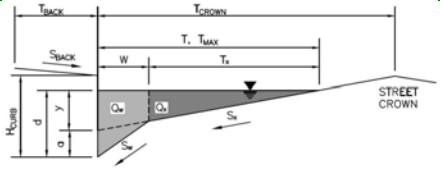
Version 4.05 Released March 2017

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

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

Project: **Riverbend Crossing**

Inlet ID: **B4**



Gutter Geometry (Enter data in the blue cells)

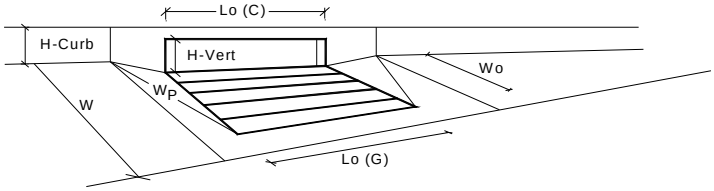
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.012	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.2	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 =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	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} =	16.2	16.2	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	7.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



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' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	5.1	7.8	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.26	0.48	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.65	1.00	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**3.7**	**9.0**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	2.5	5.6	cfs

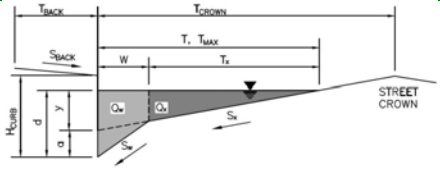
Version 4.05 Released March 2017

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

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

Project: **Riverbend Crossing**

Inlet ID: **B5**



Gutter Geometry (Enter data in the blue cells)

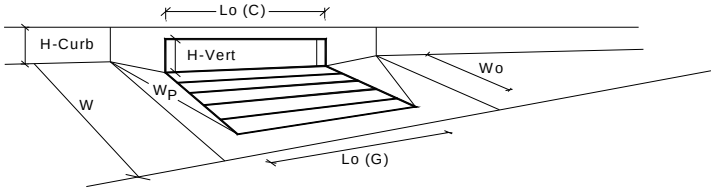
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.012	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.2	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 =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	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} =	16.2	16.2	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	7.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



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' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	5.5	7.8	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.29	0.48	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.52	0.74	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.90	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**6.6**	**15.5**	**cfs**
WARNING: Inlet Capacity less than Q Peak for Minor Storm		$Q_{PEAK\ REQUIRED}$ =	6.6	14.6	cfs

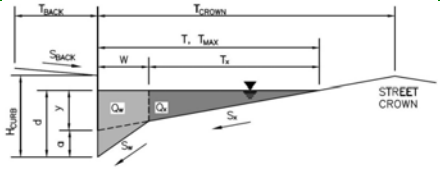
Version 4.05 Released March 2017

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

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

Project: **Riverbend Crossing**

Inlet ID: **B6**



Gutter Geometry (Enter data in the blue cells)

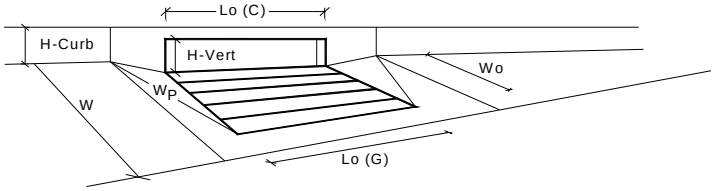
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.012	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.2	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 =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	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} =	16.2	16.2	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	7.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



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' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	5.5	7.8	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.29	0.48	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.52	0.74	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.90	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**6.6**	**15.5**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	2.9	6.4	cfs

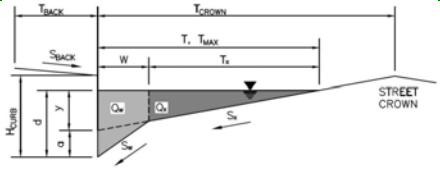
Version 4.05 Released March 2017

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

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

Project: **Riverbend Crossing**

Inlet ID: **B7**



Gutter Geometry (Enter data in the blue cells)

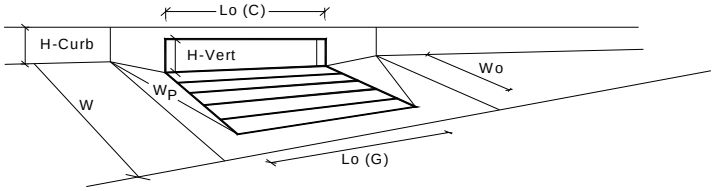
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.012	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.2	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 =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	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} =	16.2	16.2	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.5	7.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



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' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	5.5	7.8	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.29	0.48	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.52	0.74	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.90	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**6.6**	**15.5**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	5.7	14.2	cfs

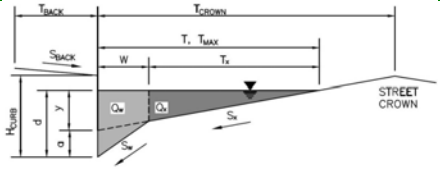
Version 4.05 Released March 2017

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

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

Project: **Riverbend Crossing**

Inlet ID: **B8**



Gutter Geometry (Enter data in the blue cells)

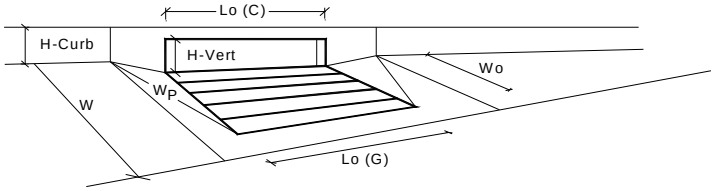
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.012	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.2	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 =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	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} =	16.2	16.2	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	7.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



		MINOR	MAJOR	
Design Information (Input) CDOT Type R Curb Opening				
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.1	7.8	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.26	0.48	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.65	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**3.7**	**9.0**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	0.7	1.6	cfs

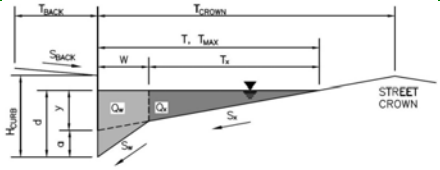
Version 4.05 Released March 2017

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

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

Project: **Riverbend Crossing**

Inlet ID: **B9**



Gutter Geometry (Enter data in the blue cells)

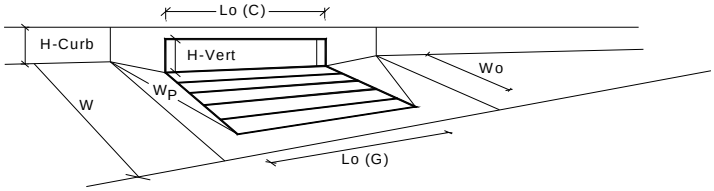
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.012	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.2	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 =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	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} =	16.2	16.2	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.5	7.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



		MINOR	MAJOR	
Design Information (Input)				
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.5	7.8	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.29	0.48	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.52	0.74	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.90	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**6.6**	**15.5**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	5.9	13.2	cfs

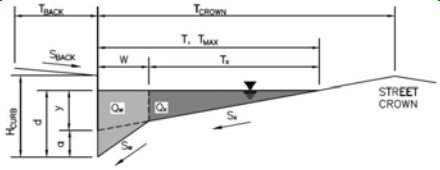
Version 4.05 Released March 2017

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

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

Project: **Riverbend Crossing**

Inlet ID: **B10**



Gutter Geometry (Enter data in the blue cells)

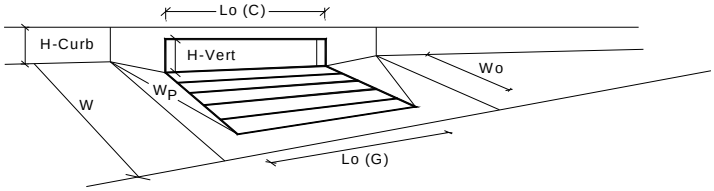
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.012	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.2	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 =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	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} =	16.2	16.2	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.5	7.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



		MINOR	MAJOR	
Design Information (Input)				
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.5	7.8	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.29	0.48	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.52	0.74	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.90	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**6.6**	**15.5**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	4.0	9.0	cfs

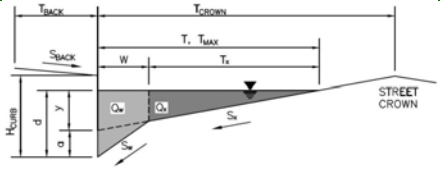
Version 4.05 Released March 2017

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

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

Project: **Riverbend Crossing**

Inlet ID: **B11**



Gutter Geometry (Enter data in the blue cells)

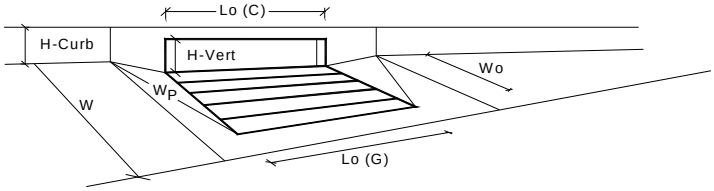
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.012	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.2	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 =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	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} =	16.2	16.2	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.5	7.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



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' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	5.7	7.8	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	15.00	15.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.31	0.48	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.54	0.74	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.77	0.88	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**8.5**	**19.1**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	8.2	18.4	cfs

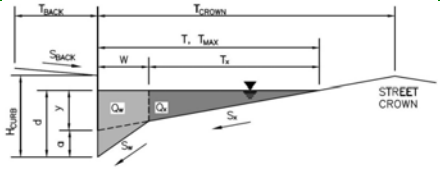
Version 4.05 Released March 2017

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

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

Project: **Riverbend Crossing**

Inlet ID: **B12**



Gutter Geometry (Enter data in the blue cells)

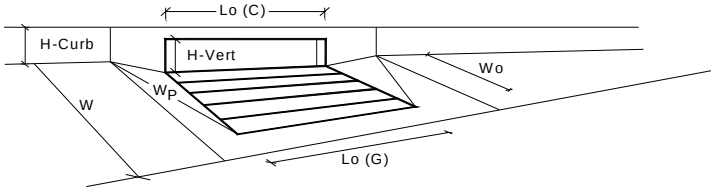
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.012	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.2	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 =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	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} =	16.2	16.2	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.5	7.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



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' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	5.5	7.8	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	15.00	15.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.29	0.48	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.52	0.74	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.75	0.88	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**7.6**	**19.1**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	7.0	15.6	cfs

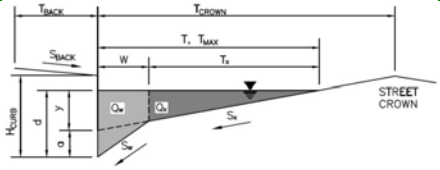
Version 4.05 Released March 2017

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

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

Project: **Riverbend Crossing**

Inlet ID: **A1**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.012	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} =	16.2	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 =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.057	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} =	16.2	16.2	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.5	8.1	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**14.6**	**22.9**	**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'

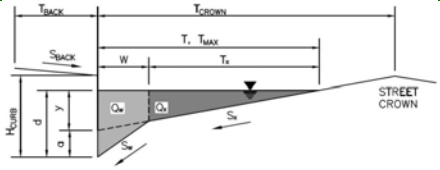
Version 4.05 Released March 2017

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

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

Project: **Riverbend Crossing**

Inlet ID: **B14**



Gutter Geometry (Enter data in the blue cells)

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} =	0.012	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} =	16.2	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 =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.057	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} =	16.2	16.2	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	7.8	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

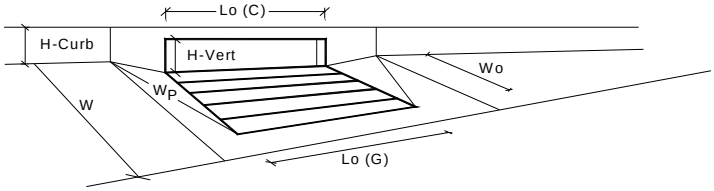
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**14.6**	**22.9**	**cfs**

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 IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



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' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	5.1	7.8	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.26	0.48	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.65	1.00	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**3.7**	**9.0**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	2.5	5.5	cfs

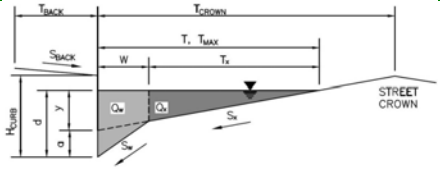
Version 4.05 Released March 2017

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

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

Project: **Riverbend Crossing**

Inlet ID: **B15**



Gutter Geometry (Enter data in the blue cells)

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} =	0.012	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} =	16.2	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 =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.057	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} =	16.2	16.2	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	7.8	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

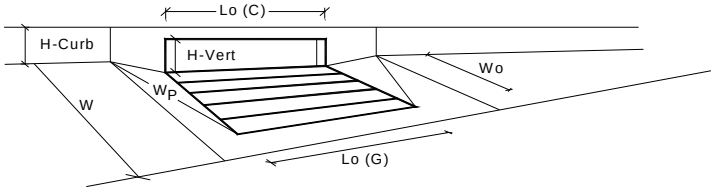
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**14.6**	**22.9**	**cfs**

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

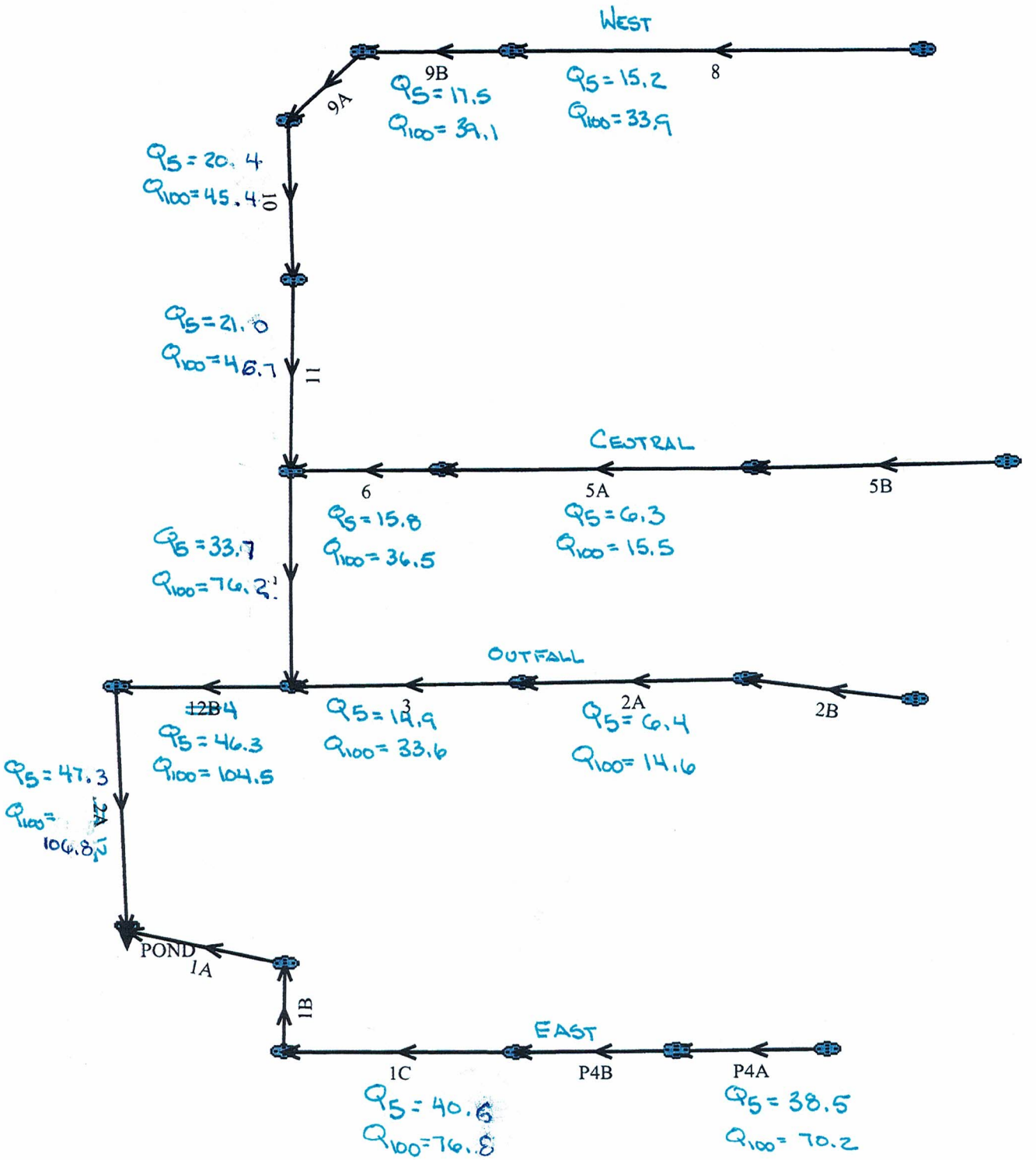
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



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' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	5.1	5.4	inches
Grate Information			MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.26	0.28	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.65	0.69	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**3.7**	**4.2**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	1.6	3.7	cfs


WEST
9B
$Q_5 = 17.5$
$Q_{100} = 39.1$
8
$Q_5 = 15.2$
$Q_{100} = 33.9$
9A
$Q_5 = 20.4$
$Q_{100} = 45.4$
10
$Q_5 = 21.0$
$Q_{100} = 46.7$
11
CENTRAL
6
$Q_5 = 15.8$
$Q_{100} = 36.5$
5A
$Q_5 = 6.3$
$Q_{100} = 15.5$
5B
$Q_5 = 33.7$
$Q_{100} = 76.2$
OUTFALL
~~12B~~4
$Q_5 = 46.3$
$Q_{100} = 104.5$
3
$Q_5 = 14.9$
$Q_{100} = 33.6$
2A
$Q_5 = 6.4$
$Q_{100} = 14.6$
2B
$Q_5 = 47.3$
$Q_{100} = 106.8$
12A
POND
1A
1B
EAST
1C
$Q_5 = 40.6$
$Q_{100} = 76.8$
P4B
P4A
$Q_5 = 38.5$
$Q_{100} = 70.2$

Program: UDSEWER Math Model Interface 2.2.1.2 **Run Date:** 10/28/2020 4:50:21 AM	**UDSewer Results Summary** **Project Title:** RIVERBEND CROSSING **Project Description:** STORM SYSTEM

System Input Summary

Rainfall Parameters

Rainfall Return Period: 100
Rainfall Calculation Method: Formula

One Hour Depth (in):
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 18.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 5690.50

Manhole Input Summary:

		Given Flow		Sub Basin Information						
Element Name	**Ground Elevation (ft)**	**Total Known Flow (cfs)**	**Local Contribution (cfs)**	**Drainage Area (Ac.)**	**Runoff Coefficient**	**5yr Coefficient**	**Overland Length (ft)**	**Overland Slope (%)**	**Gutter Length (ft)**	**Gutter Velocity (fps)**
POND	5692.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1AA	5701.65	76.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

1A	5711.18	76.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1B	5714.41	76.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1C	5714.19	76.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P4B	5714.13	70.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P4A	5718.52	70.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	5692.81	106.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	5701.35	104.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	5702.66	33.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2A	5709.43	14.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2B	5712.26	14.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2C	5713.89	14.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	5698.85	76.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	5702.66	36.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5A	5706.30	15.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5B	5708.70	15.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	5697.28	46.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	5698.53	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9A	5698.65	39.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9B	5699.75	39.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8A	5704.21	33.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8B	5704.21	33.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Manhole Output Summary:

	Local Contribution					Total Design Flow				
Element Name	Overland Time (min)	Gutter Time (min)	Basin Tc (min)	Intensity (in/hr)	Local Contrib (cfs)	Coeff. Area	Intensity (in/hr)	Manhole Tc (min)	Peak Flow (cfs)	Comment
POND	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
1AA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	76.80	
1A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	76.80	
1B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	76.80	
1C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	76.80	
P4B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	70.20	
P4A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	70.20	
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	106.80	
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	104.00	
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33.60	
2A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.60	
2B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.60	
2C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.60	
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	76.20	
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	36.50	

5A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.50	
5B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.50	
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	46.70	
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	45.40	
9A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	39.10	
9B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	39.10	
8A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33.90	
8B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33.90	

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element Name	Sewer Length (ft)	Downstream Invert (ft)	Slope (%)	Upstream Invert (ft)	Mannings n	Bend Loss	Lateral Loss	Cross Section	Rise (ft or in)	Span (ft or in)
1AA	168.67	5686.50	3.00	5691.56	0.013	0.00	0.00	CIRCULAR	42.00 in	42.00 in
1A	55.24	5694.78	3.08	5696.48	0.013	0.05	0.00	CIRCULAR	42.00 in	42.00 in
1B	106.85	5702.47	1.01	5703.55	0.013	1.00	0.00	CIRCULAR	42.00 in	42.00 in
1C	94.58	5703.80	1.00	5704.75	0.013	0.77	0.00	CIRCULAR	42.00 in	42.00 in
P4B	160.58	5705.00	0.50	5705.80	0.013	0.05	0.00	CIRCULAR	42.00 in	42.00 in
P4A	141.16	5706.05	1.80	5708.59	0.013	1.00	0.00	CIRCULAR	42.00 in	42.00 in
12	132.82	5685.50	0.50	5686.16	0.013	0.00	0.00	CIRCULAR	60.00 in	60.00 in
4	107.02	5686.41	0.50	5686.95	0.013	0.57	0.00	CIRCULAR	60.00 in	60.00 in
3	96.06	5691.50	5.50	5696.78	0.013	0.05	0.00	CIRCULAR	30.00 in	30.00 in
2A	496.00	5697.04	1.39	5703.93	0.013	0.05	0.00	CIRCULAR	24.00 in	24.00 in
2B	151.04	5704.18	1.71	5706.76	0.013	0.05	0.00	CIRCULAR	24.00 in	24.00 in
2C	80.02	5707.01	2.76	5709.22	0.013	0.37	0.00	CIRCULAR	24.00 in	24.00 in
7	243.84	5688.45	0.50	5689.67	0.013	1.00	0.00	CIRCULAR	48.00 in	48.00 in
6	99.58	5691.17	2.70	5693.86	0.013	1.00	0.00	CIRCULAR	30.00 in	30.00 in
5A	458.00	5694.34	1.36	5700.57	0.013	0.05	0.00	CIRCULAR	24.00 in	24.00 in
5B	403.87	5700.82	0.65	5703.45	0.013	0.05	0.00	CIRCULAR	24.00 in	24.00 in
11	152.10	5690.17	0.50	5690.93	0.013	0.05	0.00	CIRCULAR	42.00 in	42.00 in
10	79.98	5691.18	0.50	5691.58	0.013	0.05	0.00	CIRCULAR	42.00 in	42.00 in
9A	17.37	5691.83	0.52	5691.92	0.013	0.30	0.00	CIRCULAR	42.00 in	42.00 in
9B	92.28	5691.92	0.50	5692.38	0.013	0.10	0.00	CIRCULAR	42.00 in	42.00 in
8A	408.50	5692.88	0.55	5695.13	0.013	0.05	0.00	CIRCULAR	36.00 in	36.00 in
8B	451.83	5695.38	0.55	5697.87	0.013	0.05	0.00	CIRCULAR	36.00 in	36.00 in

Sewer Flow Summary:

	Full Flow Capacity		Critical Flow		Normal Flow						
Element	Flow	Velocity	Depth	Velocity	Depth	Velocity	Froude	Flow	Flow	Surcharged	Comment

Name	(cfs)	(fps)	(in)	(fps)	(in)	(fps)	Number	Condition	(cfs)	Length (ft)	
1AA	174.73	18.16	32.89	9.50	19.49	17.58	2.77	Supercritical Jump	76.80	20.66	
1A	176.98	18.40	32.89	9.50	19.34	17.74	2.81	Supercritical	76.80	0.00	
1B	101.38	10.54	32.89	9.50	27.33	11.59	1.45	Supercritical	76.80	0.00	
1C	100.88	10.49	32.89	9.50	27.42	11.54	1.44	Supercritical Jump	76.80	38.26	
P4B	71.33	7.41	31.50	9.07	33.84	8.45	0.86	Subcritical	70.20	0.00	
P4A	135.35	14.07	31.50	9.07	21.46	14.20	2.10	Supercritical	70.20	0.00	
12	184.66	9.40	35.35	8.87	32.74	9.75	1.16	Pressurized	106.80	132.82	
4	184.66	9.40	34.86	8.79	32.22	9.68	1.16	Pressurized	104.00	107.02	
3	96.45	19.65	23.66	8.09	12.22	17.89	3.60	Supercritical	33.60	0.00	
2A	26.74	8.51	16.52	6.33	12.65	8.70	1.67	Supercritical Jump	14.60	42.44	
2B	29.66	9.44	16.52	6.33	11.89	9.40	1.88	Supercritical	14.60	0.00	
2C	37.68	12.00	16.52	6.33	10.37	11.23	2.44	Supercritical	14.60	0.00	
7	101.84	8.10	31.71	8.65	30.96	8.89	1.05	Supercritical Jump	76.20	124.30	
6	67.58	13.77	24.57	8.48	15.70	14.03	2.42	Supercritical Jump	36.50	2.70	
5A	26.45	8.42	17.03	6.50	13.20	8.75	1.63	Supercritical Jump	15.50	36.33	
5B	18.29	5.82	17.03	6.50	16.96	6.53	1.01	Supercritical	15.50	0.00	
11	71.33	7.41	25.59	7.61	24.78	7.91	1.06	Supercritical	46.70	0.00	
10	71.33	7.41	25.22	7.53	24.34	7.86	1.07	Supercritical	45.40	0.00	
9A	72.75	7.56	23.32	7.13	21.92	7.70	1.13	Supercritical	39.10	0.00	
9B	71.33	7.41	23.32	7.13	22.18	7.58	1.10	Supercritical	39.10	0.00	
8A	49.60	7.02	22.69	7.22	21.85	7.55	1.08	Supercritical	33.90	0.00	
8B	49.60	7.02	22.69	7.22	21.85	7.55	1.08	Supercritical	33.90	0.00	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

			Existing		Calculated		Used			
Element Name	Peak Flow (cfs)	Cross Section	Rise	Span	Rise	Span	Rise	Span	Area (ft^2)	Comment
1AA	76.80	CIRCULAR	42.00 in	42.00 in	33.00 in	33.00 in	42.00 in	42.00 in	9.62	
1A	76.80	CIRCULAR	42.00 in	42.00 in	33.00 in	33.00 in	42.00 in	42.00 in	9.62	
1B	76.80	CIRCULAR	42.00 in	42.00 in	42.00 in	42.00 in	42.00 in	42.00 in	9.62	
1C	76.80	CIRCULAR	42.00 in	42.00 in	42.00 in	42.00 in	42.00 in	42.00 in	9.62	

P4B	70.20	CIRCULAR	42.00 in	42.00 in	42.00 in	42.00 in	42.00 in	42.00 in	9.62	
P4A	70.20	CIRCULAR	42.00 in	42.00 in	33.00 in	33.00 in	42.00 in	42.00 in	9.62	
12	106.80	CIRCULAR	60.00 in	60.00 in	54.00 in	54.00 in	60.00 in	60.00 in	19.63	
4	104.00	CIRCULAR	60.00 in	60.00 in	54.00 in	54.00 in	60.00 in	60.00 in	19.63	
3	33.60	CIRCULAR	30.00 in	30.00 in	21.00 in	21.00 in	30.00 in	30.00 in	4.91	
2A	14.60	CIRCULAR	24.00 in	24.00 in	21.00 in	21.00 in	24.00 in	24.00 in	3.14	
2B	14.60	CIRCULAR	24.00 in	24.00 in	21.00 in	21.00 in	24.00 in	24.00 in	3.14	
2C	14.60	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
7	76.20	CIRCULAR	48.00 in	48.00 in	48.00 in	48.00 in	48.00 in	48.00 in	12.57	
6	36.50	CIRCULAR	30.00 in	30.00 in	24.00 in	24.00 in	30.00 in	30.00 in	4.91	
5A	15.50	CIRCULAR	24.00 in	24.00 in	21.00 in	21.00 in	24.00 in	24.00 in	3.14	
5B	15.50	CIRCULAR	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	3.14	
11	46.70	CIRCULAR	42.00 in	42.00 in	36.00 in	36.00 in	42.00 in	42.00 in	9.62	
10	45.40	CIRCULAR	42.00 in	42.00 in	36.00 in	36.00 in	42.00 in	42.00 in	9.62	
9A	39.10	CIRCULAR	42.00 in	42.00 in	36.00 in	36.00 in	42.00 in	42.00 in	9.62	
9B	39.10	CIRCULAR	42.00 in	42.00 in	36.00 in	36.00 in	42.00 in	42.00 in	9.62	
8A	33.90	CIRCULAR	36.00 in	36.00 in	33.00 in	33.00 in	36.00 in	36.00 in	7.07	
8B	33.90	CIRCULAR	36.00 in	36.00 in	33.00 in	33.00 in	36.00 in	36.00 in	7.07	

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 5690.50

	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
Element Name	**Downstream (ft)**	**Upstream (ft)**	**Bend Loss (ft)**	**Lateral Loss (ft)**	**Downstream (ft)**	**Upstream (ft)**	**Downstream (ft)**	**Friction Loss (ft)**	**Upstream (ft)**
1AA	5686.50	5691.56	0.00	0.00	5690.50	5694.30	5691.49	4.21	5695.70
1A	5694.78	5696.48	0.05	0.00	5696.68	5699.22	5699.89	0.73	5700.62
1B	5702.47	5703.55	0.99	0.00	5704.75	5706.29	5706.83	0.86	5707.69
1C	5703.80	5704.75	0.76	0.00	5707.47	5707.49	5708.45	0.44	5708.89
P4B	5705.00	5705.80	0.04	0.00	5707.85	5708.62	5708.93	0.80	5709.73
P4A	5706.05	5708.59	0.83	0.00	5709.45	5711.22	5710.97	1.53	5712.49
12	5685.50	5686.16	0.00	0.00	5691.49	5691.71	5691.95	0.22	5692.17
4	5686.41	5686.95	0.25	0.00	5691.98	5692.15	5692.42	0.17	5692.59
3	5691.50	5696.78	0.04	0.00	5692.52	5698.75	5697.48	2.29	5699.77
2A	5697.04	5703.93	0.02	0.00	5699.45	5705.31	5699.79	6.14	5705.93
2B	5704.18	5706.76	0.02	0.00	5705.32	5708.14	5706.54	2.22	5708.76

2C	5707.01	5709.22	0.12	0.00	5708.26	5710.60	5709.83	1.38	5711.22
7	5688.45	5689.67	0.57	0.00	5692.72	5692.86	5693.30	0.35	5693.64
6	5691.17	5693.86	0.86	0.00	5693.72	5695.91	5694.53	2.49	5697.02
5A	5694.34	5700.57	0.02	0.00	5696.67	5701.99	5697.04	5.60	5702.65
5B	5700.82	5703.45	0.02	0.00	5702.24	5704.87	5702.90	2.63	5705.53
11	5690.17	5690.93	0.02	0.00	5693.24	5693.24	5693.66	0.32	5693.99
10	5691.18	5691.58	0.02	0.00	5693.26	5693.68	5694.17	0.39	5694.56
9A	5691.83	5691.92	0.08	0.00	5693.76	5693.86	5694.64	0.01	5694.65
9B	5691.92	5692.38	0.03	0.00	5694.04	5694.32	5694.68	0.43	5695.11
8A	5692.88	5695.13	0.02	0.00	5694.70	5697.02	5695.59	2.24	5697.83
8B	5695.38	5697.87	0.02	0.00	5697.21	5699.76	5698.09	2.48	5700.57

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

Excavation Estimate:

The trench side slope is 1.0 ft/ft
The minimum trench width is 2.00 ft

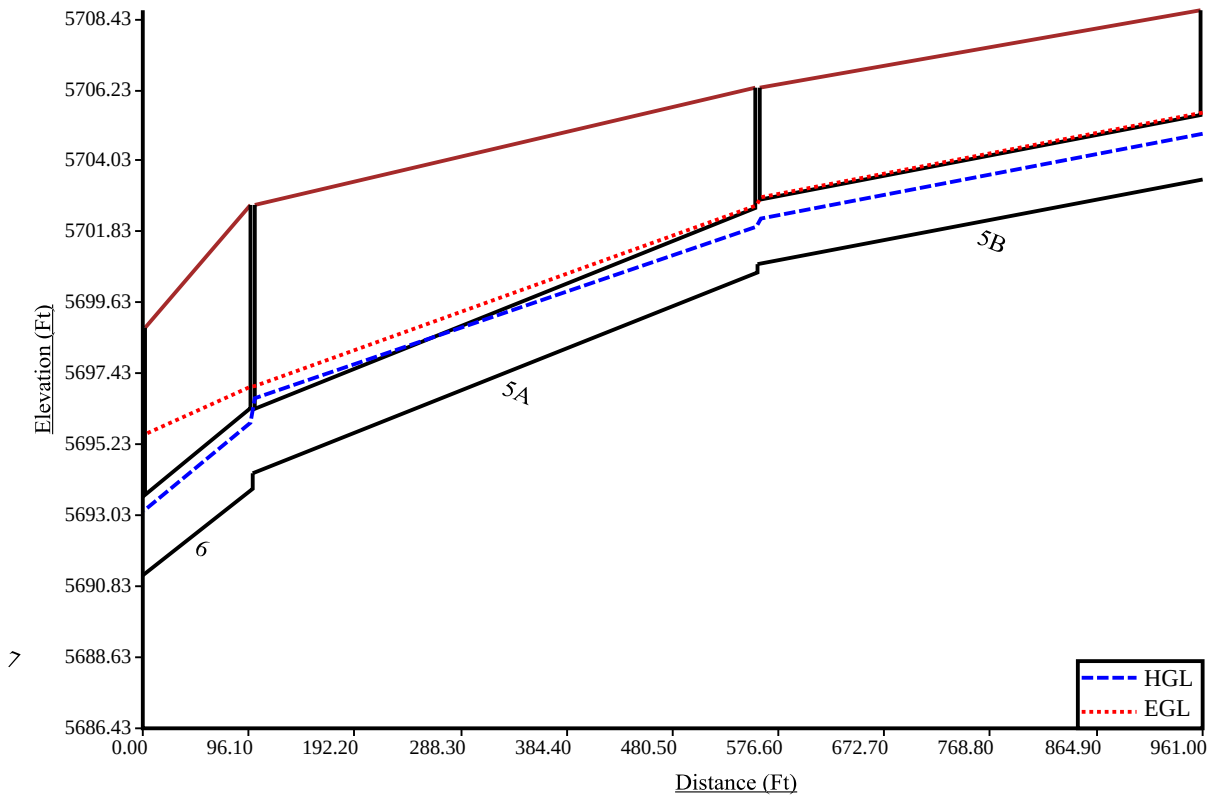
					Downstream			Upstream				
Element Name	**Length (ft)**	**Wall (in)**	**Bedding (in)**	**Bottom Width (ft)**	**Top Width (ft)**	**Trench Depth (ft)**	**Cover (ft)**	**Top Width (ft)**	**Trench Depth (ft)**	**Cover (ft)**	**Volume (cu. yd)**	**Comment**
1AA	168.67	4.50	6.00	7.25	10.12	7.19	2.44	17.68	10.97	6.22	502.40	
1A	55.24	4.50	6.00	7.25	11.24	7.75	3.00	26.90	15.58	10.83	275.77	
1B	106.85	4.50	6.00	7.25	14.92	9.58	4.83	19.22	11.74	6.99	405.80	
1C	94.58	4.50	6.00	7.25	18.71	11.48	6.73	16.38	10.32	5.57	370.79	
P4B	160.58	4.50	6.00	7.25	15.89	10.07	5.32	14.16	9.21	4.46	506.45	
P4A	141.16	4.50	6.00	7.25	13.66	8.96	4.21	17.36	10.81	6.06	468.17	
12	132.82	6.00	8.00	9.00	10.63	8.48	1.81	9.30	7.82	1.15	362.46	Sewer Too Shallow
4	107.02	6.00	8.00	9.00	0.00	7.56	0.90	24.80	15.57	8.90	520.26	Sewer Too Shallow
3	96.06	3.50	6.00	6.08	18.21	10.64	7.06	10.26	6.67	3.09	260.51	
2A	496.00	3.00	4.00	5.50	10.25	6.21	3.37	10.00	6.08	3.25	719.21	
2B	151.04	3.00	4.00	5.50	9.51	5.84	3.00	10.00	6.08	3.25	208.74	
2C	80.02	3.00	4.00	5.50	9.50	5.83	3.00	8.34	5.25	2.42	99.25	
7	243.84	5.00	6.00	7.83	22.80	13.82	8.48	15.36	10.10	4.76	1162.60	
6	99.58	3.50	6.00	6.08	13.86	8.47	4.89	16.10	9.59	6.01	276.74	
5A	458.00	3.00	4.00	5.50	15.64	8.90	6.07	10.46	6.31	3.48	979.85	
5B	403.87	3.00	4.00	5.50	9.95	6.06	3.23	9.50	5.83	3.00	556.12	
11	152.10	4.50	6.00	7.25	14.86	9.56	4.81	10.20	7.23	2.48	389.59	
10	79.98	4.50	6.00	7.25	9.70	6.97	2.22	11.40	7.83	3.08	167.52	

9A	17.37	4.50	6.00	7.25	10.90	7.58	2.83	10.96	7.61	2.86	37.58	
9B	92.28	4.50	6.00	7.25	10.96	7.61	2.86	12.24	8.25	3.50	212.92	
8A	408.50	4.00	6.00	6.67	11.73	7.70	3.53	16.16	9.91	5.75	1107.28	
8B	451.83	4.00	6.00	6.67	15.65	9.66	5.49	10.68	7.17	3.01	1141.41	

Total earth volume for sewer trenches = 10731 cubic yards.

- The trench was estimated to have a bottom width equal to the outer pipe diameter plus 36 inches.
- If the calculated width of the trench bottom is less than the minimum acceptable width, the minimum acceptable width was used.
- The sewer wall thickness is equal to: (equivalent diameter in inches/12)+1 inches
- The sewer bedding thickness is equal to:
  - Four inches for pipes less than 33 inches.
  - Six inches for pipes less than 60 inches.
  - Eight inches for all larger sizes.

CENTRAL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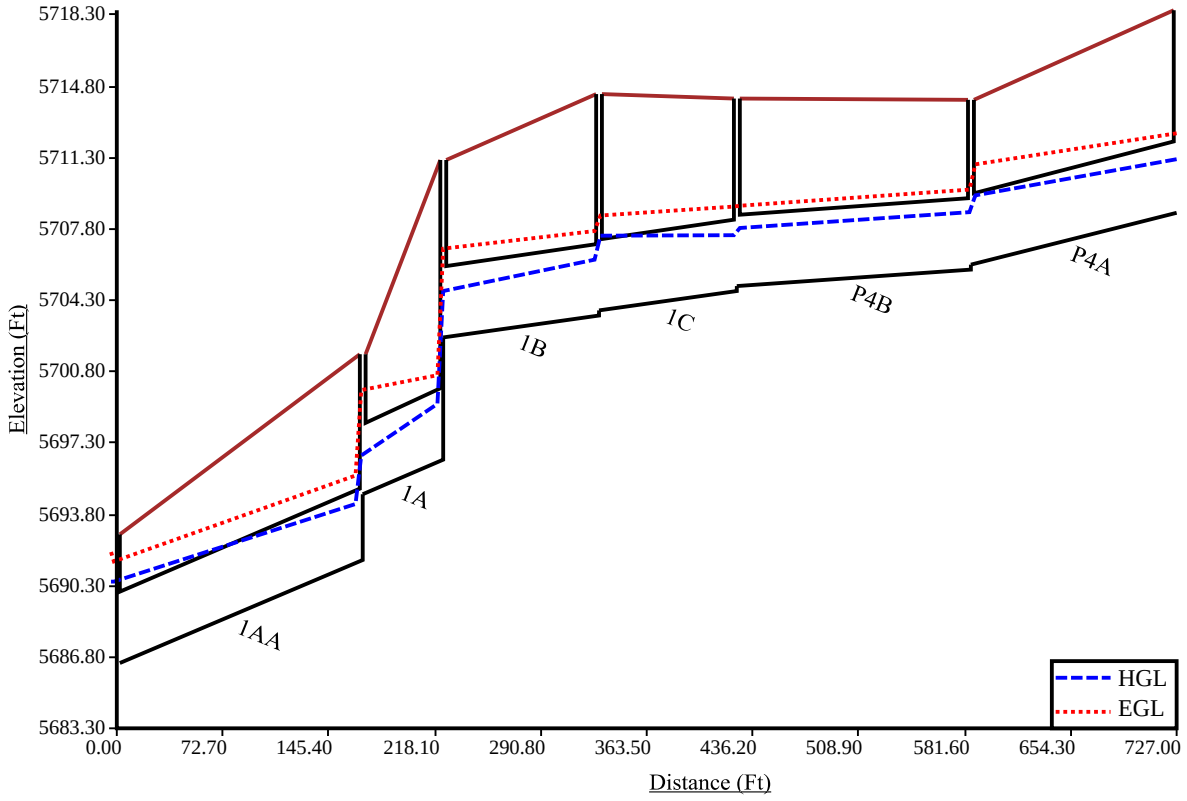
Elevation (Ft)
0.00
96.10
192.20
288.30
384.40
480.50
576.60
672.70
768.80
864.90
961.00
Distance (Ft)
5A
5B
6
7
HGL
EGL

EAST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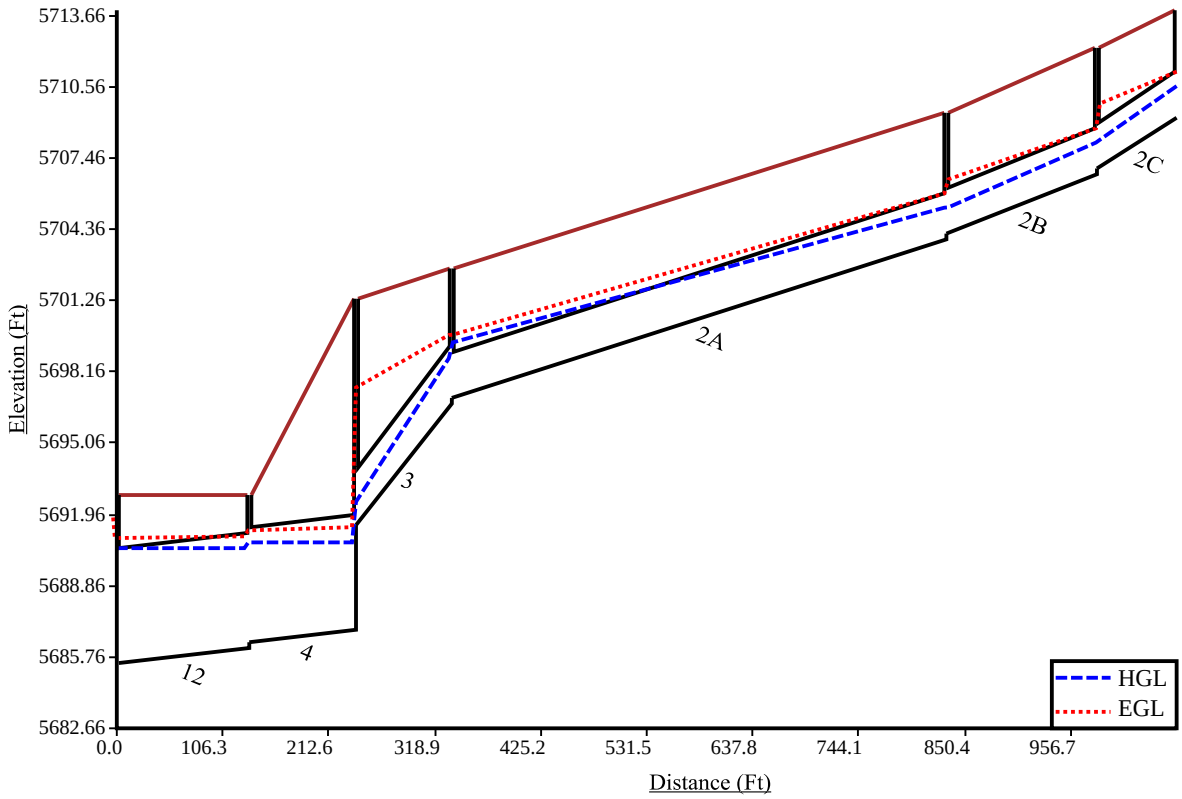
5704.30
5700.80
5697.30
5693.80
5690.30
5686.80
5683.30
Elevation (Ft)
0.00
72.70
145.40
218.10
290.80
363.50
436.20
508.90
581.60
654.30
727.00
Distance (Ft)
1AA
1A
1B
1C
P4B
P4A
HGL
EGL

OUTFALL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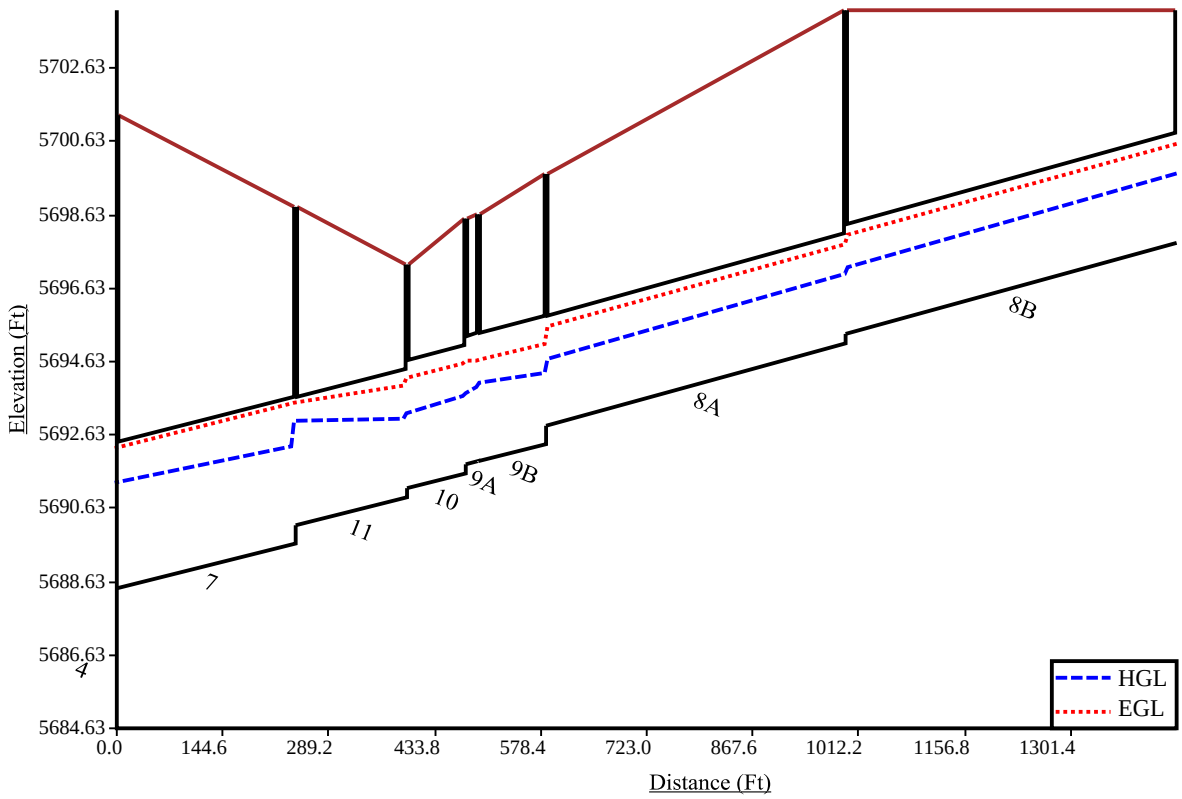
5704.36
5701.26
5698.16
5695.06
5691.96
5688.86
5685.76
5682.66
Elevation (Ft)
0.0
106.3
212.6
318.9
425.2
531.5
637.8
744.1
850.4
956.7
Distance (Ft)
12
4
3
2A
2B
2C
HGL
EGL

WEST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5696.63
5694.63
5692.63
5690.63
5688.63
5686.63
5684.63
Elevation (Ft)
0.0
144.6
289.2
433.8
578.4
723.0
867.6
1012.2
1156.8
1301.4
Distance (Ft)
4
7
11
10
9A
9B
8A
8B
HGL
EGL

CATAMOUNT ENGINEERING
321 W. HENRIETTA SUITE 'A'
PO BOX 221
WOODLAND PARK, CO 80863
(719) 426-2124

JOB RIVERBEND
SHEET NO. ____ OF ____
CALCULATED BY DLM DATE ____
CHECKED BY ____ DATE ____
SCALE ____

DP-12 TYPE VI STILLING BASIN

A - AREA OF FLOW = 10.97 FT²

$D = (A)^{0.5} = 3.31$ FT

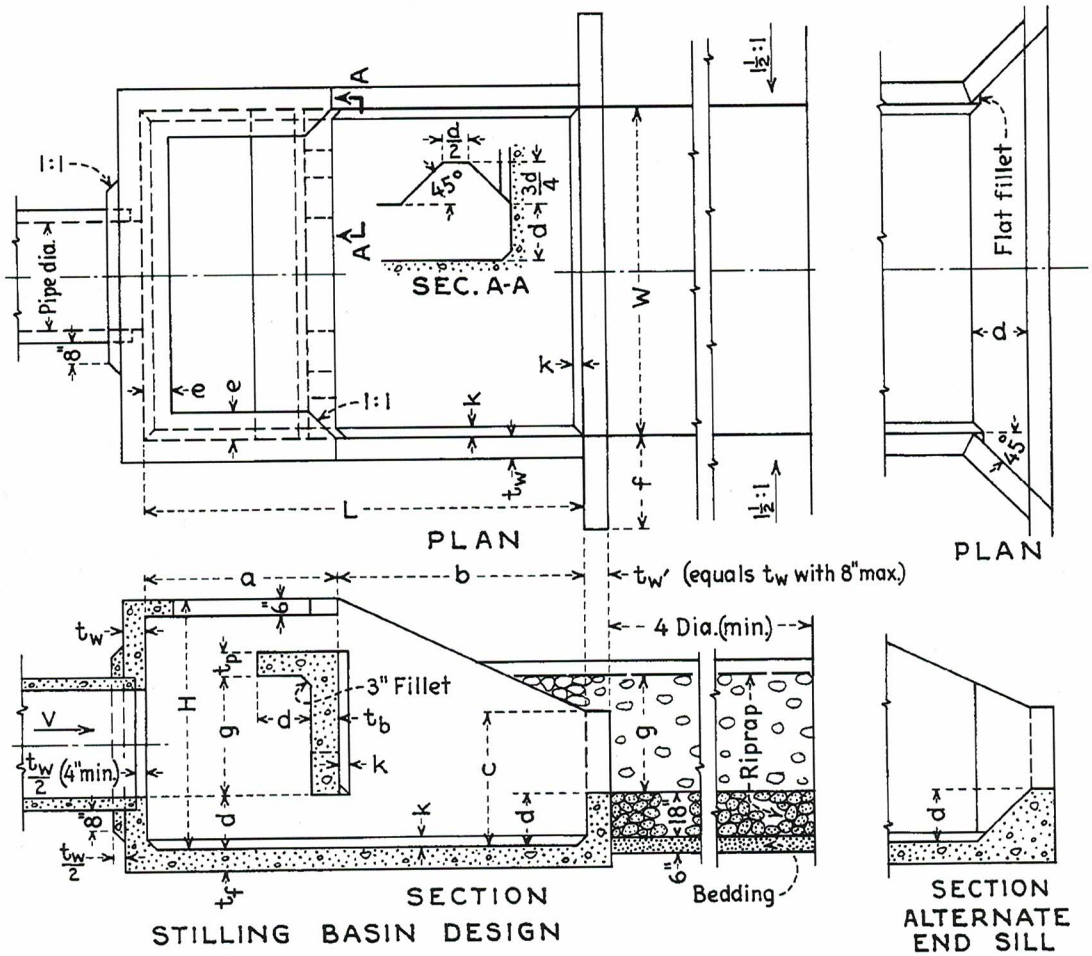
V = 9.75 FT/S

$$W = 2.94 \cdot D \left[\frac{V}{(g \cdot D)^{0.5}} \right]^{0.556} = 9.42 \text{ FT} \checkmark$$

USE W = 10.0 FT
FIGURE 42
"HYDRAULIC DESIGN OF STILLING BASINS AND ENERGY DISSIPATORS"

H = 3/4 W = 7.5 FT
L = 4/3 W = 13.33 FT
a = 1/2 W = 5.0 FT
b = 3/8 W = 3.75 FT
c = 1/2 W = 5.0 FT
d = 1/6 W = 1.67 FT
e = 1/12 W = 0.833 FT
f = 1/8 W = 1.25 FT

t = 1/12 W = 0.833 FT MIN → USE 1.0'



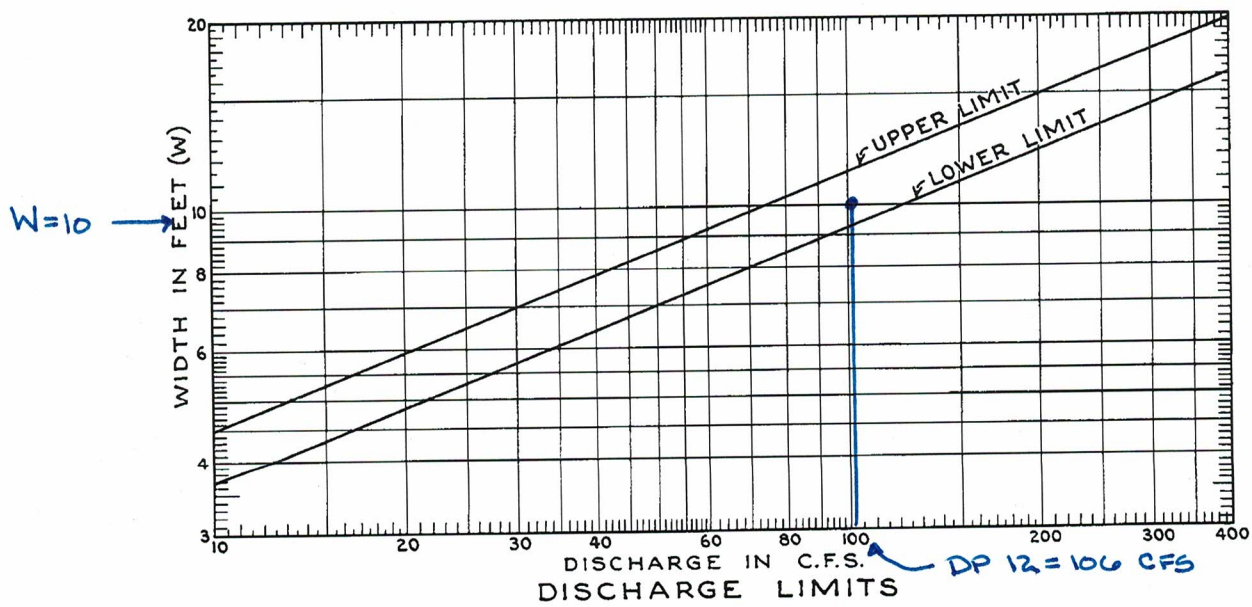


FIGURE 42.—*Impact-type energy dissipator (Basin VI).*

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.06, November 2016)

Designer:	**David Mijares**
Company:	**Catamount**
Date:	**August 17, 2020**
Project:	**Riverbend Crossing**
Location:	**Extended Detention Basin 1**

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 65.4 %
B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	i = 0.654
C) Contributing Watershed Area	Area = 54.900 ac
D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = ____ in
E) Design Concept (Select EURV when also designing for flood control)	Choose One: ○ Water Quality Capture Volume (WQCV) ◉ Excess Urban Runoff Volume (EURV)
F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area$)	V_{DESIGN}= 1.170 ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6*(V_{DESIGN}/0.43))$)	$V_{DESIGN\ OTHER}$= ____ ac-ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{DESIGN\ USER}$= ____ ac-ft
I) Predominant Watershed NRCS Soil Group	Choose One: ○ A ○ B ◉ C / D
J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$	EURV = 3.471 ac-f t
2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)	L : W = 4.0 : 1
3. Basin Side Slopes	
A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred)	Z = 4.00 ft / ft
4. Inlet	
A) Describe means of providing energy dissipation at concentrated inflow locations:	Concrete Forebay with Pipe outfalls and Energy Baffle per Urban Drainage Criteria

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.06, November 2016)

Designer:	**David Mijares**
Company:	**Catamount**
Date:	**October 25, 2020**
Project:	**Riverbend Crossing**
Location:	**Extended Detention Basin 1 FOREBAY A**

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 65.4 %
B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	i = 0.654
C) Contributing Watershed Area	Area = 35.140 ac
D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = ____ in
E) Design Concept (Select EURV when also designing for flood control)	Choose One: ○ Water Quality Capture Volume (WQCV) ◉ Excess Urban Runoff Volume (EURV)
F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area$)	V_{DESIGN}= 0.749 ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6*(V_{DESIGN}/0.43))$)	$V_{DESIGN\ OTHER}$= ____ ac-ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{DESIGN\ USER}$= ____ ac-ft
I) Predominant Watershed NRCS Soil Group	Choose One: ○ A ○ B ◉ C / D
J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$	EURV = 2.221 ac-f t
2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)	L : W = 4.0 : 1
3. Basin Side Slopes	
A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred)	Z = 4.00 ft / ft
4. Inlet	
A) Describe means of providing energy dissipation at concentrated inflow locations:	Concrete Forebay with Pipe outfalls and Energy Baffle per Urban Drainage Criteria

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**David Mijares**
Company:	**Catamount**
Date:	**October 25, 2020**
Project:	**Riverbend Crossing**
Location:	**Extended Detention Basin 1 FOREBAY A**

5. Forebay	
A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV)	V_{FMIN} = 0.022 ac-ft
B) Actual Forebay Volume	V_F = 0.023 ac-ft
C) Forebay Depth (D_F = 30 inch maximum)	D_F = 30.0 in
D) Forebay Discharge	
i) Undetained 100-year Peak Discharge	Q_{100} = 106.80 cfs
ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)	Q_F = 2.14 cfs
E) Forebay Discharge Design	Choose One: ○ Berm With Pipe; ◉ Wall with Rect. Notch; ○ Wall with V-Notch Weir
F) Discharge Pipe Size (minimum 8-inches)	Calculated D_P = in
G) Rectangular Notch Width	Calculated W_N = 7.9 in
6. Trickle Channel	
A) Type of Trickle Channel	Choose One: ◉ Concrete; ○ Soft Bottom
F) Slope of Trickle Channel	S = ft / ft
7. Micropool and Outlet Structure	
A) Depth of Micropool (2.5-feet minimum)	D_M = 2.5 ft
B) Surface Area of Micropool (10 ft^2 minimum)	A_M = 153 sq ft
C) Outlet Type	Choose One: ◉ Orifice Plate; ○ Other (Describe):
D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)	$D_{orifice}$ = 1.69 inches
E) Total Outlet Area	A_{ot} = 6.77 square inches

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.06, November 2016)

Designer:	**David Mijares**
Company:	**Catamount**
Date:	**October 25, 2020**
Project:	**Riverbend Crossing**
Location:	**Extended Detention Basin 1 FOREBAY B**

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 65.4 %
B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	i = 0.654
C) Contributing Watershed Area	Area = 15.410 ac
D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = ____ in
E) Design Concept (Select EURV when also designing for flood control)	Choose One: ○ Water Quality Capture Volume (WQCV) ◉ Excess Urban Runoff Volume (EURV)
F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area$)	V_{DESIGN}= 0.328 ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6*(V_{DESIGN}/0.43))$)	$V_{DESIGN\ OTHER}$= ____ ac-ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{DESIGN\ USER}$= ____ ac-ft
I) Predominant Watershed NRCS Soil Group	Choose One: ○ A ○ B ◉ C / D
J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$	EURV = 0.974 ac-f t
2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)	L : W = 4.0 : 1
3. Basin Side Slopes	
A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred)	Z = 4.00 ft / ft
4. Inlet	
A) Describe means of providing energy dissipation at concentrated inflow locations:	Concrete Forebay with Pipe outfalls and Energy Baffle per Urban Drainage Criteria

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**David Mijares**
Company:	**Catamount**
Date:	**October 25, 2020**
Project:	**Riverbend Crossing**
Location:	**Extended Detention Basin 1 FOREBAY B**

5. Forebay	
A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV)	V_{FMIN} = 0.010 ac-ft
B) Actual Forebay Volume	V_F = 0.010 ac-ft
C) Forebay Depth (D_F = 18 inch maximum)	D_F = 18.0 in
D) Forebay Discharge	
i) Undetained 100-year Peak Discharge	Q_{100} = 76.80 cfs
ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)	Q_F = 1.54 cfs
E) Forebay Discharge Design	Choose One: ○ Berm With Pipe; ◉ Wall with Rect. Notch; ○ Wall with V-Notch Weir — **(flow too small for berm w/ pipe)**
F) Discharge Pipe Size (minimum 8-inches)	Calculated D_P = in
G) Rectangular Notch Width	Calculated W_N = 6.6 in
6. Trickle Channel	
A) Type of Trickle Channel	Choose One: ◉ Concrete; ○ Soft Bottom
F) Slope of Trickle Channel	S = ft / ft
7. Micropool and Outlet Structure	
A) Depth of Micropool (2.5-feet minimum)	D_M = 2.5 ft
B) Surface Area of Micropool (10 ft^2 minimum)	A_M = 153 sq ft
C) Outlet Type	Choose One: ◉ Orifice Plate; ○ Other (Describe):
D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)	$D_{orifice}$ = 1.69 inches
E) Total Outlet Area	A_{ot} = 6.77 square inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**David Mijares**
Company:	**Catamount**
Date:	**August 17, 2020**
Project:	**Riverbend Crossing**
Location:	**Extended Detention Basin 1**

8. Initial Surcharge Volume	
A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)	D_{IS} = 12 in
B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV)	V_{IS} = 152.9 cu ft
C) Initial Surcharge Provided Above Micropool	V_s= 153.0 cu ft
9. Trash Rack	
A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$	A_t = 222 square inches
B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open are to the total screen are for the material specified.)	*Aluminum Amico-Klemp SR Series with Cross Rods 2" O.C.*
Other (Y/N): N	
C) Ratio of Total Open Area to Total Area (only for type 'Other')	User Ratio =
D) Total Water Quality Screen Area (based on screen type)	A_{total} = 313 sq. in.
E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)	H= feet
F) Height of Water Quality Screen (H_{TR})	H_{TR}= inches
G) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended)	$W_{opening}$ = inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer: David Mijares
Company: Catamount
Date: August 17, 2020
Project: Riverbend Crossing
Location: Extended Detention Basin 1

10. Overflow Embankment	
A) Describe embankment protection for 100-year and greater overtopping:	2.0' depth Type H soil riprap to channel toe
B) Slope of Overflow Embankment (Horizontal distance per unit vertical, 4:1 or flatter preferred)	2.5:1 existing bank
11. Vegetation	Choose One: ○ Irrigated ◉ Not Irrigated
12. Access	
A) Describe Sediment Removal Procedures	12' width access road. See IM Plan for sediment removal procedures.

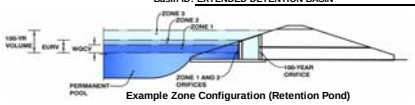
Notes:

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: RIVERBEND CROSSING

Basin ID: EXTENDED DETENTION BASIN



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**EDB**	
Watershed Area =	54.90	acres
Watershed Length =	1,921	ft
Watershed Slope =	0.027	ft/ft
Watershed Imperviousness =	65.40%	percent
Percentage Hydrologic Soil Group A =	24.3%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	75.7%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Denver - Capitol Building	
Water Quality Capture Volume (WQCV) =	1.170	acre-feet
Excess Urban Runoff Volume (EURV) =	3.712	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	3.254	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	4.504	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	5.530	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	6.972	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	8.198	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	9.691	acre-feet
500-yr Runoff Volume (P1 = 3.14 in.) =	12.843	acre-feet
Approximate 2-yr Detention Volume =	3.058	acre-feet
Approximate 5-yr Detention Volume =	4.247	acre-feet
Approximate 10-yr Detention Volume =	4.914	acre-feet
Approximate 25-yr Detention Volume =	5.393	acre-feet
Approximate 50-yr Detention Volume =	5.647	acre-feet
Approximate 100-yr Detention Volume =	6.169	acre-feet

Optional User Override 1-hr Precipitation

1.19	inches
1.50	inches
1.75	inches
2.00	inches
2.25	inches
2.52	inches
	inches

Stage-Storage Calculation

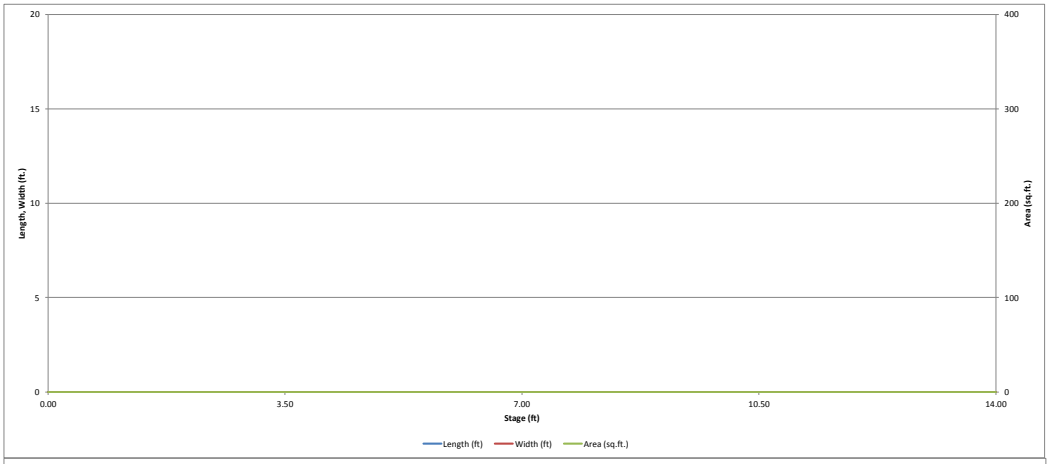
Zone 1 Volume (WQCV) =	1.170	acre-feet
Zone 2 Volume (EURV - Zone 1) =	2.542	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	2.458	acre-feet
Total Detention Basin Volume =	6.169	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (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

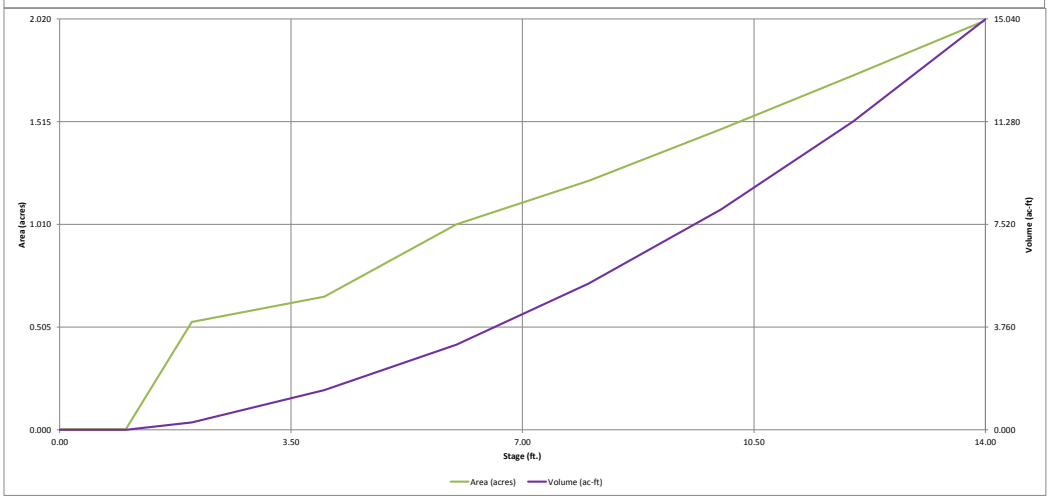
Depth Increment = 1 ft

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	--	--	--	153	0.004		
ISV	--	1.00	--	--	--	153	0.004	151	0.003
5684	--	2.00	--	--	--	23,116	0.531	11,557	0.265
5686	--	4.00	--	--	--	28,504	0.654	63,407	1.456
5688	--	6.00	--	--	--	44,000	1.010	135,911	3.120
5690	--	8.00	--	--	--	53,275	1.223	233,186	5.353
5692	--	10.00	--	--	--	64,349	1.477	350,810	8.053
5694	--	12.00	--	--	--	75,854	1.741	491,013	11.272
5696	--	14.00	--	--	--	87,645	2.012	654,512	15.026

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



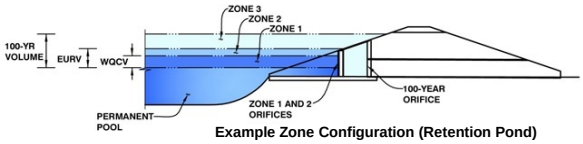


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: RIVERBEND CROSSING

Basin ID: EXTENDED DETENTION BASIN



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.56	1.170	Orifice Plate
Zone 2 (EURV)	6.57	2.542	Orifice Plate
Zone 3 (100-year)	8.65	2.458	Weir&Pipe (Restrict)
		6.169	Total

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 Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	6.57	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	26.30	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

WQ Orifice Area per Row =	N/A	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	2.19	4.38					
Orifice Area (sq. inches)	5.51	5.51	12.00					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	7.25	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	8.00	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	7.25	N/A	feet
Over Flow Weir Slope Length =	4.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	4.47	N/A	should be $\geq$ 4
Overflow Grate Open Area w/o Debris =	22.40	N/A	ft^2
Overflow Grate Open Area w/ Debris =	11.20	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.33	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	36.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	24.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	5.01	N/A	ft^2
Outlet Orifice Centroid =	1.12	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.91	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	9.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	60.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	2.06	feet

Calculated Parameters for Spillway

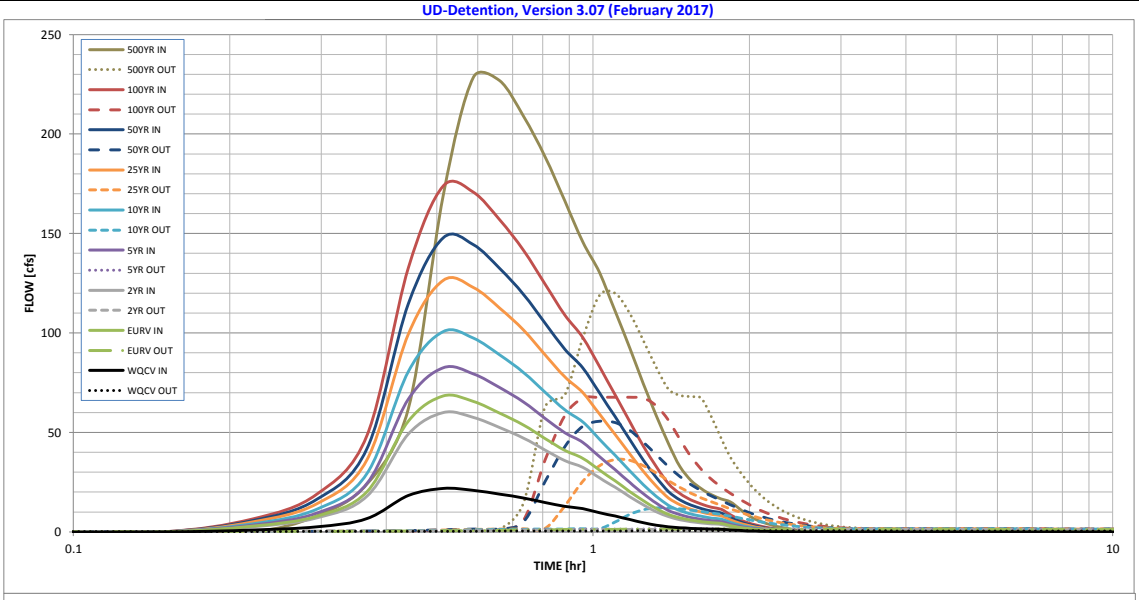
Spillway Design Flow Depth=	0.94	feet
Stage at Top of Freeboard =	12.00	feet
Basin Area at Top of Freeboard =	1.74	acres

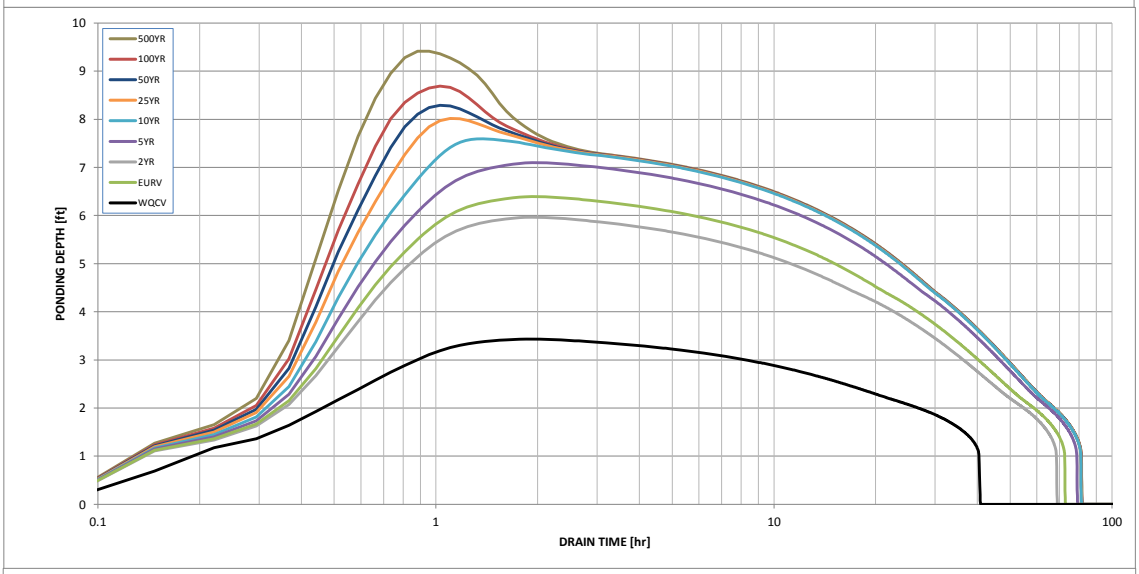
Routed Hydrograph Results

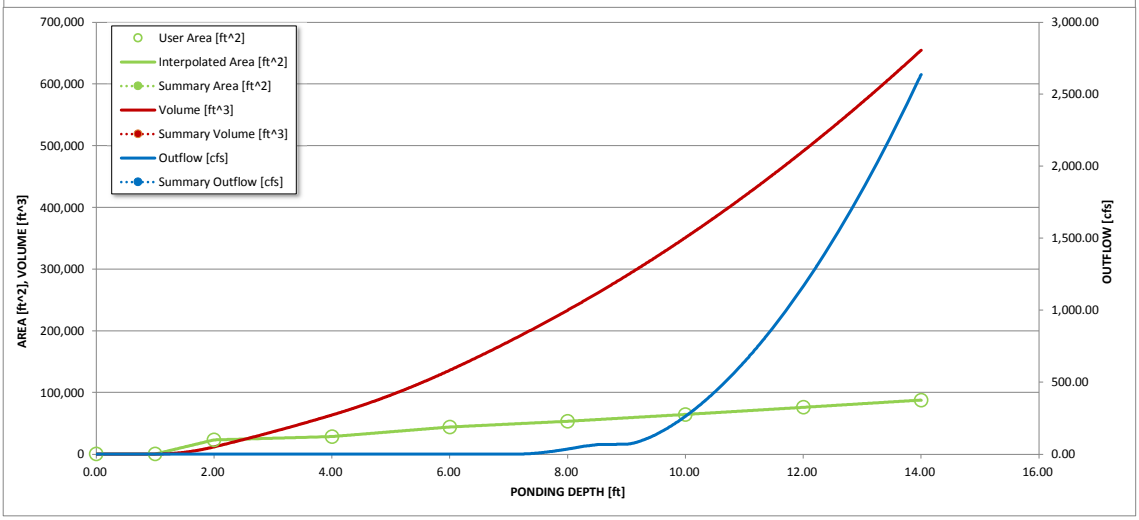
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.14
Calculated Runoff Volume (acre-ft) =	1.170	3.712	3.254	4.504	5.530	6.972	8.198	9.691	12.843
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	1.169	3.707	3.250	4.499	5.516	6.964	8.180	9.671	12.826
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.11	0.30	0.70	0.97	1.32	2.01
Predevelopment Peak Q (cfs) =	0.0	0.0	0.7	6.1	16.7	38.3	53.1	72.3	110.4
Peak Inflow Q (cfs) =	21.8	68.2	60.0	82.5	100.7	126.4	147.8	173.9	228.4
Peak Outflow Q (cfs) =	0.5	1.4	1.3	1.6	12.1	36.4	55.6	67.7	120.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.3	0.7	1.0	1.0	0.9	1.1
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.5	1.5	2.4	2.9	3.1
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) =	39	67	63	72	72	70	69	67	63
Time to Drain 99% of Inflow Volume (hours) =	**40**	71	67	76	78	77	77	76	75
Maximum Ponding Depth (ft) =	3.43	6.39	5.96	7.10	7.59	8.01	8.29	8.69	9.42
Area at Maximum Ponding Depth (acres) =	0.62	1.05	1.00	1.13	1.18	1.22	1.26	1.31	1.40
Maximum Volume Stored (acre-ft) =	1.093	3.522	3.080	4.284	4.861	5.365	5.701	6.214	7.204

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







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

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename:

Storm Inflow Hydrographs **UD-Detention, Version 3.07 (February 2017)**

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

	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
4.41 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:04:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph	0:08:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	0:13:14	0.95	2.86	2.53	3.40	4.06	4.94	5.63	6.43	7.95
1.133	0:17:38	2.59	7.91	6.97	9.48	11.44	14.13	16.31	18.89	24.08
	0:22:03	6.64	20.30	17.91	24.34	29.38	36.29	41.89	48.54	61.91
	0:26:28	18.25	55.67	49.12	66.73	80.49	99.35	114.60	132.67	168.94
	0:30:52	21.85	68.25	59.96	82.51	100.71	126.42	147.83	173.91	228.41
	0:35:17	20.89	65.57	57.54	79.49	97.39	122.92	144.39	170.77	226.68
	0:39:41	19.02	59.67	52.36	72.44	88.90	112.45	132.31	156.78	208.86
	0:44:06	17.03	53.74	47.13	65.27	80.13	101.40	119.35	141.48	188.58
	0:48:31	14.76	46.98	41.15	57.13	70.24	89.04	104.94	124.55	166.39
	0:52:55	12.84	40.99	35.87	49.89	61.39	77.90	91.85	109.07	145.79
	0:57:20	11.64	37.03	32.43	45.01	55.30	70.03	82.45	97.75	130.28
	1:01:44	9.66	31.00	27.13	37.76	46.50	59.08	69.74	82.92	111.09
	1:06:09	7.93	25.67	22.44	31.30	38.59	49.09	57.98	68.98	92.52
	1:10:34	6.17	20.31	17.72	24.83	30.71	39.21	46.43	55.39	74.62
	1:14:58	4.65	15.66	13.63	19.20	23.82	30.49	36.18	43.24	58.43
	1:19:23	3.38	11.67	10.13	14.36	17.88	22.98	27.33	32.74	44.44
	1:23:47	2.59	8.77	7.63	10.76	13.34	17.08	20.26	24.21	32.80
	1:28:12	2.12	7.06	6.16	8.64	10.68	13.63	16.12	19.21	25.87
	1:32:37	1.80	5.95	5.19	7.27	8.98	11.44	13.52	16.09	21.61
	1:37:01	1.57	5.18	4.52	6.32	7.80	9.92	11.71	13.92	18.65
	1:41:26	1.41	4.63	4.05	5.65	6.96	8.85	10.44	12.40	16.58
	1:45:50	1.30	4.24	3.71	5.17	6.37	8.09	9.53	11.31	15.11
	1:50:15	0.96	3.16	2.75	3.86	4.79	6.12	7.26	8.68	11.75
	1:54:40	0.70	2.29	2.00	2.80	3.46	4.42	5.24	6.26	8.46
	1:59:04	0.51	1.69	1.47	2.07	2.56	3.28	3.89	4.64	6.28
	2:03:29	0.38	1.26	1.10	1.54	1.91	2.44	2.89	3.45	4.66
	2:07:53	0.27	0.92	0.80	1.13	1.40	1.79	2.13	2.55	3.45
	2:12:18	0.19	0.66	0.57	0.81	1.01	1.29	1.54	1.84	2.50
	2:16:43	0.14	0.48	0.42	0.59	0.73	0.94	1.11	1.33	1.81
	2:21:07	0.09	0.33	0.29	0.41	0.51	0.66	0.79	0.95	1.29
	2:25:32	0.06	0.21	0.18	0.27	0.33	0.44	0.52	0.63	0.87
	2:29:56	0.03	0.12	0.10	0.15	0.19	0.26	0.31	0.37	0.52
	2:34:21	0.01	0.05	0.05	0.07	0.09	0.12	0.15	0.18	0.26
	2:38:46	0.00	0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.09
	2:43:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:47:35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:51:59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:56:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:09:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:14:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:18:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:22:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:27:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:31:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:36:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:44:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:49:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:53:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:58:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:02:33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:06:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:11:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:24:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:29:01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:33:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:37:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:42:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:46:39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:51:04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:59:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:04:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:08:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:13:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:17:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Summary Stage-Area-Volume-Discharge Relationships

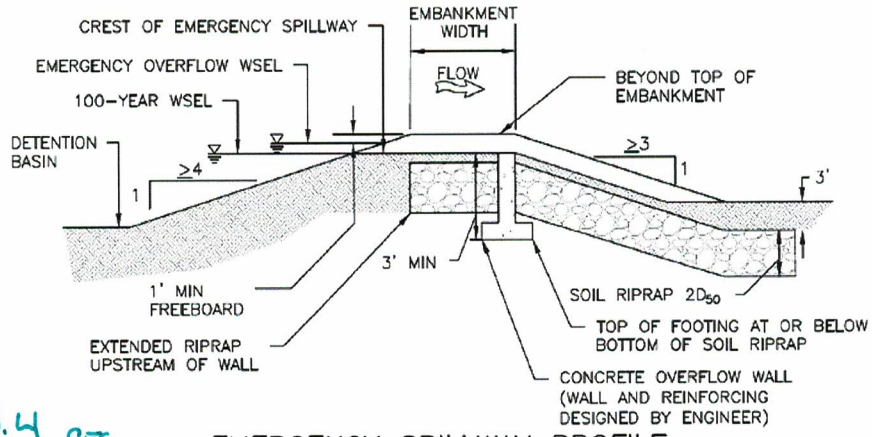
The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

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

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

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

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

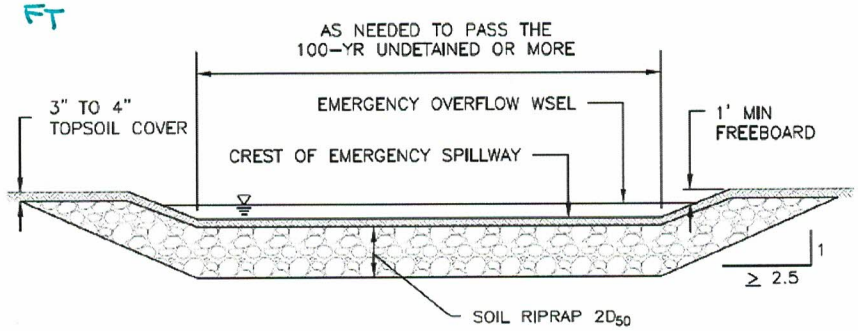


EMERGENCY SPILLWAY PROFILE

$Q_{100} = 165.4$ CFS

WEIR LENGTH = 60 FT

$\frac{165.4}{60} = 2.76$



EMERGENCY SPILLWAY SECTION AND SPILLWAY CHANNEL

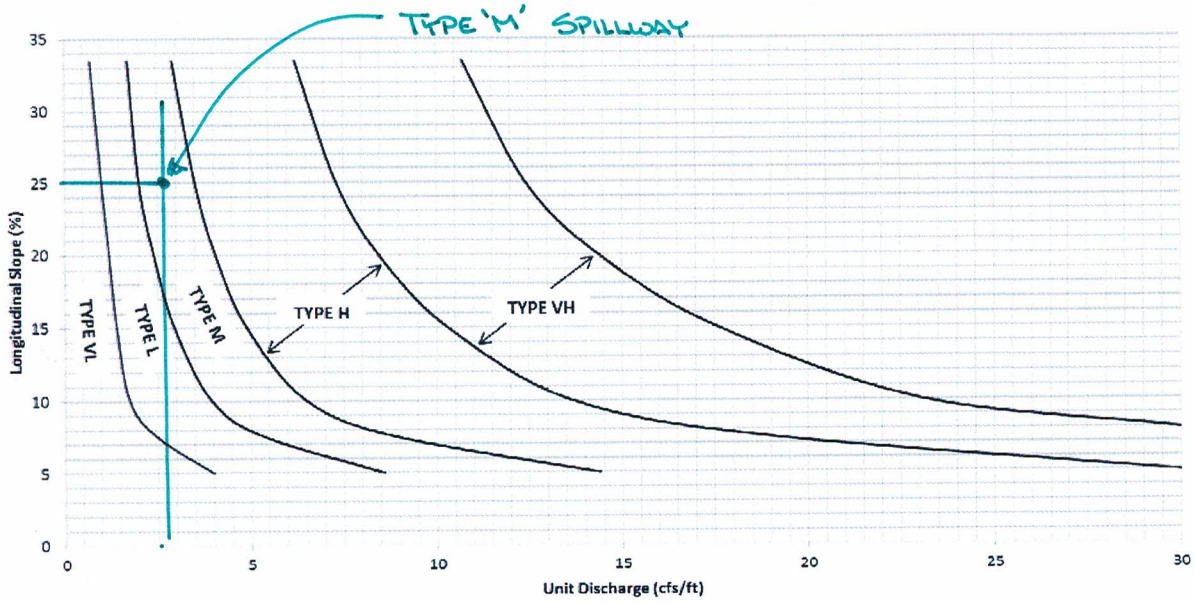
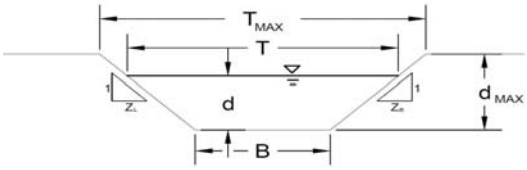


Figure 12-21. Embankment protection details and rock sizing chart (adapted from Arapahoe County)

AREA INLET IN A TRAPEZOIDAL GRASS-LINED CHANNEL

Riverbend Crossing
Basin A1



Grass Type	Limiting Manning's n
A	0.06
B	0.04
C	0.033
D	0.03
E	0.024

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D or E		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.035	
Channel Invert Slope	S_O =	0.0040	ft/ft
Bottom Width	B =	10.00	ft
Left Side Slope	Z1 =	4.00	ft/ft
Right Side Slope	Z2 =	4.00	ft/ft

Check one of the following soil types:

Soil Type:	Max. Velocity (V_{MAX})	Max Froude No. (F_{MAX})
Sandy	5.0 fps	0.50
Non-Sandy	7.0 fps	0.80

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

		Minor Storm	Major Storm	
Max. Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	**22.00**	**22.00**	**feet**
Max. Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	**0.80**	**1.25**	**feet**

Maximum Channel Capacity Based On Allowable Top Width

		Minor Storm	Major Storm	
Max. Allowable Top Width	T_{MAX} =	**22.00**	**22.00**	**ft**
Water Depth	d =	1.50	1.50	ft
Flow Area	A =	24.00	24.00	sq ft
Wetted Perimeter	P =	22.37	22.37	ft
Hydraulic Radius	R =	1.07	1.07	ft
Manning's n based on NRCS Vegetal Retardance	n =	0.035	0.035	
Flow Velocity	V =	2.82	2.82	fps
Velocity-Depth Product	VR =	3.03	3.03	ft^2/s
Hydraulic Depth	D =	1.09	1.09	ft
Froude Number	Fr =	0.48	0.48	
Max. Flow Based On Allowable Top Width	Q_T =	**67.72**	**67.72**	**cfs**

Maximum Channel Capacity Based On Allowable Water Depth

		Minor Storm	Major Storm	
Max. Allowable Water Depth	d_{MAX} =	**0.80**	**1.25**	**feet**
Top Width	T =	16.40	20.00	feet
Flow Area	A =	10.56	18.75	square feet
Wetted Perimeter	P =	16.60	20.31	feet
Hydraulic Radius	R =	0.64	0.92	feet
Manning's n based on NRCS Vegetal Retardance	n =	0.035	0.035	
Flow Velocity	V =	1.99	2.55	fps
Velocity-Depth Product	VR =	1.27	2.36	ft^2/s
Hydraulic Depth	D =	0.64	0.94	feet
Froude Number	Fr =	0.44	0.46	
Max. Flow Based On Allowable Water Depth	Q_d =	**21.03**	**47.87**	**cfs**

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**21.03**	**47.87**	**cfs**
MAJOR STORM Allowable Capacity is based on Depth Criterion	d_{allow} =	**0.80**	**1.25**	**ft**

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	**20.28**	**46.00**	**cfs**
Water Depth	d =	**0.78**	**1.22**	**feet**
Top Width	T =	16.27	19.79	feet
Flow Area	A =	10.30	18.23	square feet
Wetted Perimeter	P =	16.47	20.09	feet
Hydraulic Radius	R =	0.63	0.91	feet
Manning's n based on NRCS Vegetal Retardance	n =	0.035	0.035	
Flow Velocity	V =	1.97	2.52	fps
Velocity-Depth Product	VR =	1.23	2.29	ft^2/s
Hydraulic Depth	D =	0.63	0.92	feet
Froude Number	Fr =	0.44	0.46	

Minor storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'
Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

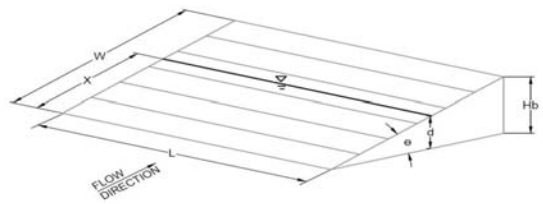
AREA INLET IN A TRAPEZOIDAL GRASS-LINED CHANNEL

Riverbend Crossing

Basin A1

Inlet Design Information (Input)

Type of Inlet	Inlet Type =		
Angle of Inclined Grate (must be <= 30 degrees)	θ =		degrees
Width of Grate	W =		feet
Length of Grate	L =		feet
Open Area Ratio	A_{RATIO} =		
Height of Inclined Grate	H_B =		feet
Clogging Factor	C_f =		
Grate Discharge Coefficient	C_d =		
Orifice Coefficient	C_o =		
Weir Coefficient	C_w =		



		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =			
Grate Capacity as a Weir				
Submerged Side Weir Length	X =			feet
Inclined Side Weir Flow	Q_{ws} =			cfs
Base Weir Flow	Q_{wb} =			cfs
Interception without Clogging	Q_{wi} =			cfs
Interception with Clogging	Q_{wa} =			cfs
Grate Capacity as an Orifice				
Interception without Clogging	Q_{oi} =			cfs
Interception with Clogging	Q_{oa} =			cfs
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**			**cfs**
	Bypassed Flow, Q_b =			**cfs**
	Capture Percentage = Q_a/Q_o = C%			**%**

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Fountain Creek (cont.)								
BU	104,500	560	2,948	8.9	5608.6	5608.6	5608.6	0.0
BV	105,500	640	4,060	6.5	5614.2	5614.2	5614.3	0.1
BW	106,524	432	3,160	8.2	5620.0	5620.0	5620.7	0.7
BX	107,580	163	1,609	16.2	5623.9	5623.9	5624.2	0.3
BY	108,824	354	3,684	7.1	5634.6	5634.6	5634.6	0.0
BZ	109,747	430	2,945	8.8	5638.0	5638.0	5638.0	0.0
CA	110,486	241	2,776	9.4	5642.6	5642.6	5642.6	0.0
CB	111,228	384	4,253	6.1	5646.3	5646.3	5646.3	0.0
CC	113,189	340	3,304	7.9	5657.5	5657.5	5657.6	0.1
CD	115,609	169	1,696	15.3	5669.2	5669.2	5669.3	0.1
CE	117,000	461	5,232	5.0	5676.8	5676.8	5677.4	0.6
CF	118,746	350	2,798	9.3	5682.9	5682.9	5682.9	0.0
CG	119,965	700	8,842	2.9	5691.7	5691.7	5692.7	1.0
CH	121,500	837	5,247	5.0	5694.5	5694.5	5694.7	0.2
CI	123,000	1,908	10,866	2.4	5707.2	5707.2	5707.2	0.0
CJ	124,455	960	5,500	4.7	5711.3	5711.3	5711.7	0.4
CK	125,500	627	4,527	5.7	5716.6	5716.6	5716.6	0.0
CL	127,000	935	6,844	3.7	5723.5	5723.5	5723.7	0.2
CM	128,000	735	3,894	6.6	5727.3	5727.3	5727.4	0.1
CN	129,150	807	4,142	6.2	5733.4	5733.4	5733.7	0.3
CO	129,880	966	4,104	6.2	5736.5	5736.5	5736.6	0.1
CP	130,854	405	2,110	12.1	5741.3	5741.3	5741.3	0.0
CQ	131,623	1,299	5,023	5.1	5747.1	5747.1	5747.1	0.0
CR	132,429	703	4,341	5.9	5751.0	5751.0	5751.1	0.1

[1]Feet Above El Paso – Pueblo County Line.

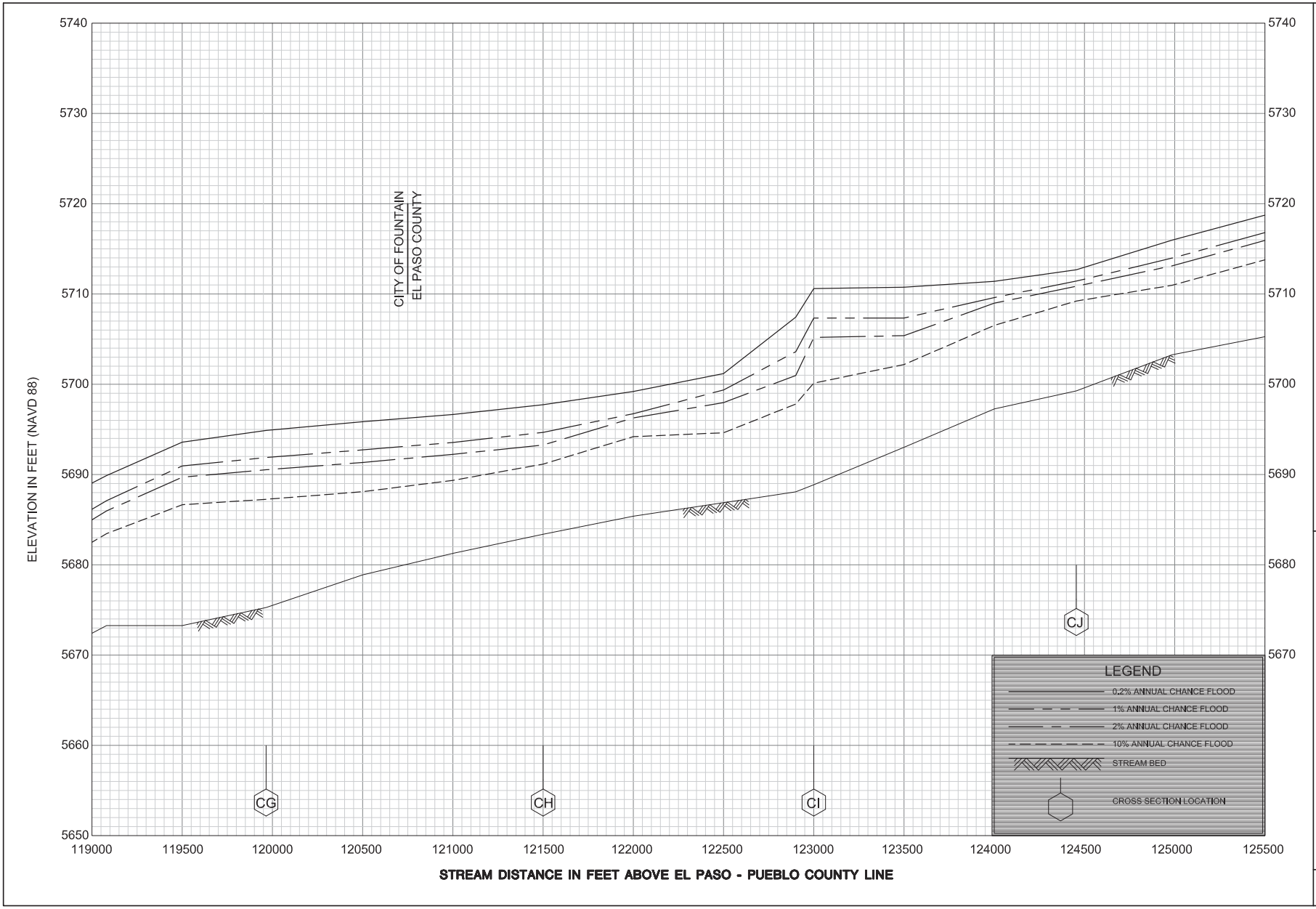
TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

EL PASO COUNTY, CO
AND INCORPORATED AREAS

FLOODWAY DATA

FOUNTAIN CREEK



FLOOD PROFILES

FOUNTAIN CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

EL PASO COUNTY, CO

(AND INCORPORATED AREAS)

BANK LINING DESIGN CALCULATIONS

11/23/2019

HECRAS INPUT

1. EXISTING CONDITIONS CHANNEL WITH 2.5:1 SIDE SLOPES ALONG PROJECT
2. SUPERCRITICAL FLOW REGIME ASSUMED BASED ON N=0.035 (PER TABLE 8-5)
3. 100YR STORM FLOW FROM FIS MAX AT SECTION "CH" ROUNDED TO 26,300CFS
4. NORMAL DEPTH BOUNDARY CONDITION ASSUMED AT DOWNSTREAM REACH

HECRAS OUTPUT

HEC-RAS Plan: 100YrSuper River: Fountain Creek Reach: Main Stem Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Main Stem	1615	PF 1	26300.00	5686.80	5690.50	5690.50	5691.72	0.013669	8.86	2969.15	1248.13	1.01
Main Stem	1225	PF 1	26300.00	5682.40	5686.73	5686.73	5688.55	0.011757	10.85	2436.01	681.43	1.01
Main Stem	800	PF 1	26300.00	5678.60	5682.29	5682.29	5683.72	0.012542	9.60	2744.29	959.93	1.00
Main Stem	375	PF 1	26300.00	5673.90	5678.55	5678.55	5680.70	0.010990	11.82	2243.21	527.70	1.00
Main Stem	0	PF 1	26300.00	5671.00	5677.49	5677.49	5680.71	0.009575	14.46	1843.01	291.72	1.00

RIPRAP DESIGN

UDFCD Volume 1, Chapter 8

$$d_{50} \geq \left[\frac{VS^{0.17}}{4.5(G_s - 1)^{0.66}} \right]^2 \qquad \text{Equation 8-11}$$

Where:

V = mean channel velocity (ft/sec)

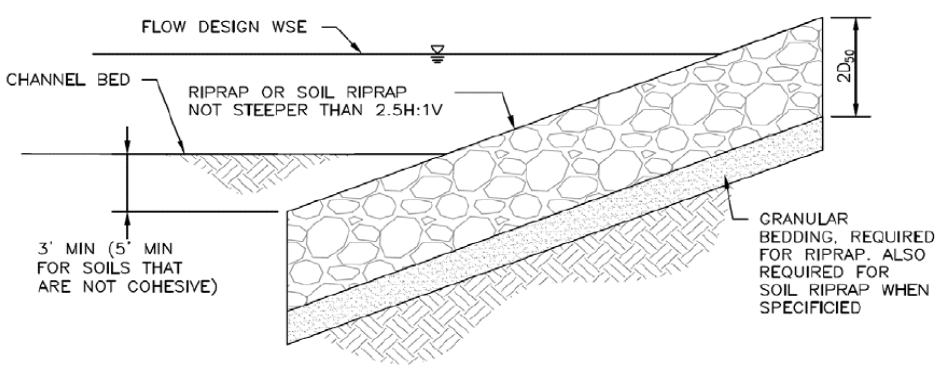
S = longitudinal channel slope (ft/ft)

d_{50} = mean rock size (ft)

Gs = specific gravity of stone (minimum = 2.50, typically 2.5 to 2.7). Note: In this equation (Gs -1) considers the buoyancy of the water, in that the specific gravity of water is subtracted from the specific gravity of the rock.

Begin	End		INPUT		OUTPUT		
Sta	Sta	V	S	Gs	d50(ft)	d50(in)	
1615	1225	9.86	0.0113	2.5	0.61	7.3	Use Type L=9in
1225	800	10.22	0.0089	2.5	0.61	7.3	Use Type L=9in
800	375	10.71	0.0111	2.5	0.72	8.6	Use Type L=9in
375	0	13.14	0.0077	2.5	0.95	11.5	Use Type M=12in

*****USE TYPE M SOIL RIPRAP ENTIRE REACH*****



THICKNESS - 2*D50 = 24"

SIDE SLOPE - 2.5:1

BURY DEPTH - 5' (ASSUME NOT COHESIVE)

HEC-RAS Plan: 100YrSuper River: Fountain Creek Reach: Main Stem Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Main Stem	1615	PF 1	26300.00	5686.80	5690.50	5690.50	5691.72	0.013669	8.86	2969.15	1248.13	1.01
Main Stem	1225	PF 1	26300.00	5682.40	5686.73	5686.73	5688.55	0.011757	10.85	2436.01	681.43	1.01
Main Stem	800	PF 1	26300.00	5678.60	5682.29	5682.29	5683.72	0.012542	9.60	2744.29	959.93	1.00
Main Stem	375	PF 1	26300.00	5673.90	5678.55	5678.55	5680.70	0.010990	11.82	2243.21	527.70	1.00
Main Stem	0	PF 1	26300.00	5671.00	5677.49	5677.49	5680.71	0.009575	14.46	1843.01	291.72	1.00

Plan: 100YrSuper Fountain Creek Main Stem RS: 1615 Profile: PF 1

E.G. Elev (ft)	5691.72	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.22	Wt. n-Val.	0.035	0.035	0.035
W.S. Elev (ft)	5690.50	Reach Len. (ft)	573.00	390.00	552.00
Crit W.S. (ft)	5690.50	Flow Area (sq ft)	1.11	2965.37	2.68
E.G. Slope (ft/ft)	0.013669	Area (sq ft)	1.11	2965.37	2.68
Q Total (cfs)	26300.00	Flow (cfs)	2.18	26286.21	11.61
Top Width (ft)	1248.13	Top Width (ft)	4.40	1241.41	2.32
Vel Total (ft/s)	8.86	Avg. Vel. (ft/s)	1.97	8.86	4.34
Max Chl Dpth (ft)	3.70	Hydr. Depth (ft)	0.25	2.39	1.15
Conv. Total (cfs)	224952.0	Conv. (cfs)	18.6	224834.0	99.3
Length Wtd. (ft)		Wetted Per. (ft)	4.43	1242.50	3.27
Min Ch El (ft)	5686.80	Shear (lb/sq ft)	0.21	2.04	0.70
Alpha	1.00	Stream Power (lb/ft s)	0.42	18.05	3.03
Frctn Loss (ft)		Cum Volume (acre-ft)	0.98	90.23	0.36
C & E Loss (ft)		Cum SA (acres)	0.46	26.88	0.18

Plan: 100YrSuper Fountain Creek Main Stem RS: 1225 Profile: PF 1

E.G. Elev (ft)	5688.55	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.82	Wt. n-Val.	0.035	0.035	0.035
W.S. Elev (ft)	5686.73	Reach Len. (ft)	487.00	425.00	422.00
Crit W.S. (ft)	5686.73	Flow Area (sq ft)	25.50	2400.46	10.04
E.G. Slope (ft/ft)	0.011757	Area (sq ft)	25.50	2400.46	10.04
Q Total (cfs)	26300.00	Flow (cfs)	188.24	26054.58	57.18
Top Width (ft)	681.43	Top Width (ft)	11.79	663.00	6.64
Vel Total (ft/s)	10.80	Avg. Vel. (ft/s)	7.38	10.85	5.70
Max Chl Dpth (ft)	4.32	Hydr. Depth (ft)	2.16	3.62	1.51
Conv. Total (cfs)	242557.4	Conv. (cfs)	1736.0	240294.0	527.3
Length Wtd. (ft)		Wetted Per. (ft)	12.56	663.00	7.30
Min Ch El (ft)	5682.40	Shear (lb/sq ft)	1.49	2.66	1.01
Alpha	1.01	Stream Power (lb/ft s)	11.00	28.84	5.75

Plan: 100YrSuper Fountain Creek Main Stem RS: 1225 Profile: PF 1 (Continued)

Frctn Loss (ft)		Cum Volume (acre-ft)	0.81	66.21	0.28
C & E Loss (ft)		Cum SA (acres)	0.35	18.36	0.13

Plan: 100YrSuper Fountain Creek Main Stem RS: 800 Profile: PF 1

E.G. Elev (ft)	5683.72	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.43	Wt. n-Val.	0.035	0.035	0.035
W.S. Elev (ft)	5682.29	Reach Len. (ft)	460.00	425.00	531.00
Crit W.S. (ft)	5682.29	Flow Area (sq ft)	16.82	2726.70	0.77
E.G. Slope (ft/ft)	0.012542	Area (sq ft)	16.82	2726.70	0.77
Q Total (cfs)	26300.00	Flow (cfs)	114.32	26183.78	1.90
Top Width (ft)	959.93	Top Width (ft)	9.12	950.00	0.81
Vel Total (ft/s)	9.58	Avg. Vel. (ft/s)	6.80	9.60	2.47
Max Chl Dpth (ft)	3.69	Hydr. Depth (ft)	1.84	2.87	0.94
Conv. Total (cfs)	234835.9	Conv. (cfs)	1020.8	233798.2	16.9
Length Wtd. (ft)		Wetted Per. (ft)	9.83	950.00	2.06
Min Ch El (ft)	5678.60	Shear (lb/sq ft)	1.34	2.25	0.29
Alpha	1.00	Stream Power (lb/ft s)	9.10	21.58	0.72
Frctn Loss (ft)		Cum Volume (acre-ft)	0.57	41.20	0.23
C & E Loss (ft)		Cum SA (acres)	0.24	10.49	0.09

Plan: 100YrSuper Fountain Creek Main Stem RS: 375 Profile: PF 1

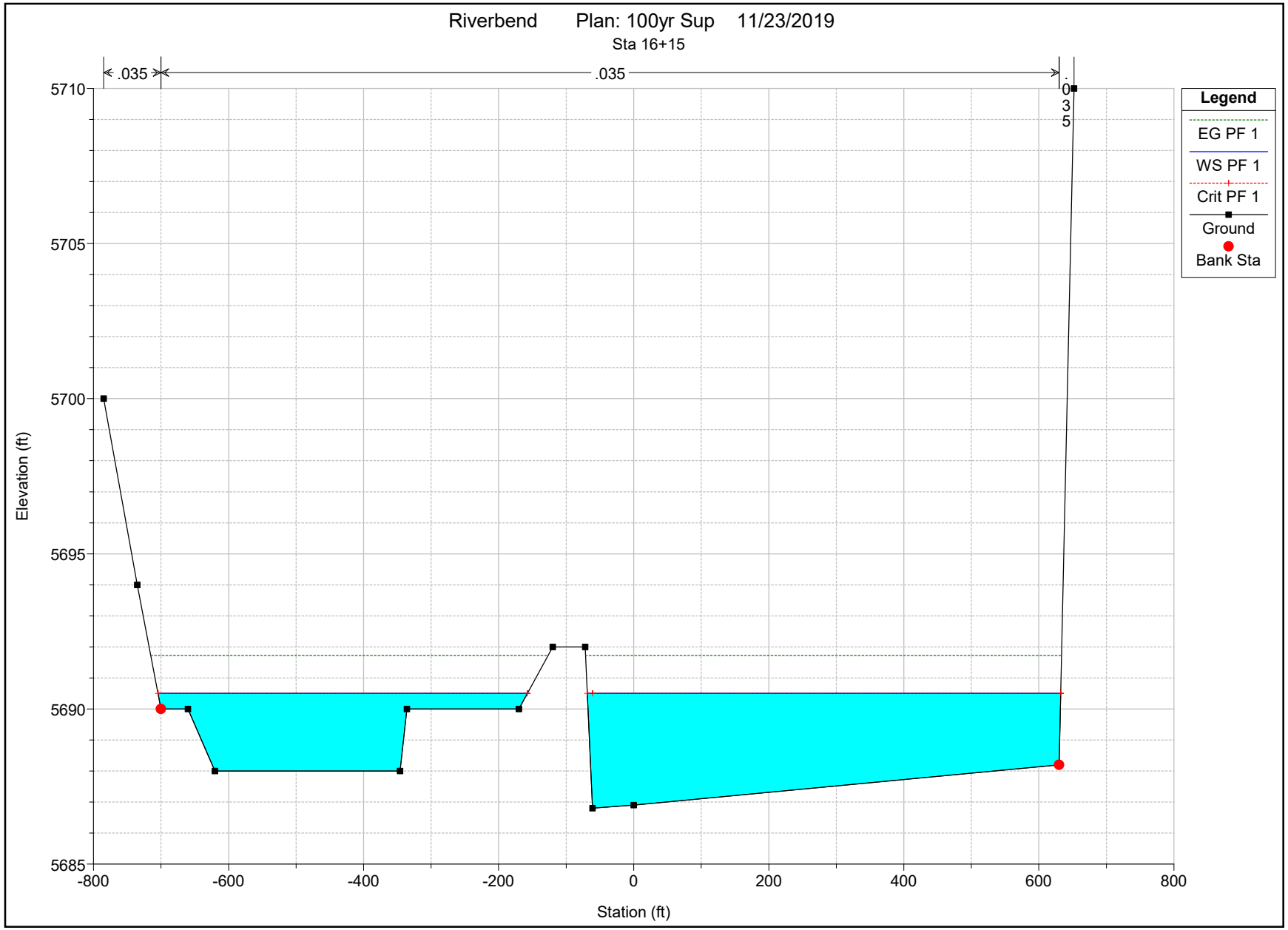
E.G. Elev (ft)	5680.70	Element	Left OB	Channel	Right OB
Vel Head (ft)	2.15	Wt. n-Val.	0.035	0.035	0.035
W.S. Elev (ft)	5678.55	Reach Len. (ft)	438.00	375.00	362.00
Crit W.S. (ft)	5678.55	Flow Area (sq ft)	32.19	2197.72	13.30
E.G. Slope (ft/ft)	0.010990	Area (sq ft)	32.19	2197.72	13.30
Q Total (cfs)	26300.00	Flow (cfs)	242.60	25969.95	87.45
Top Width (ft)	527.70	Top Width (ft)	13.85	508.00	5.85
Vel Total (ft/s)	11.72	Avg. Vel. (ft/s)	7.54	11.82	6.57
Max Chl Dpth (ft)	4.65	Hydr. Depth (ft)	2.32	4.33	2.27

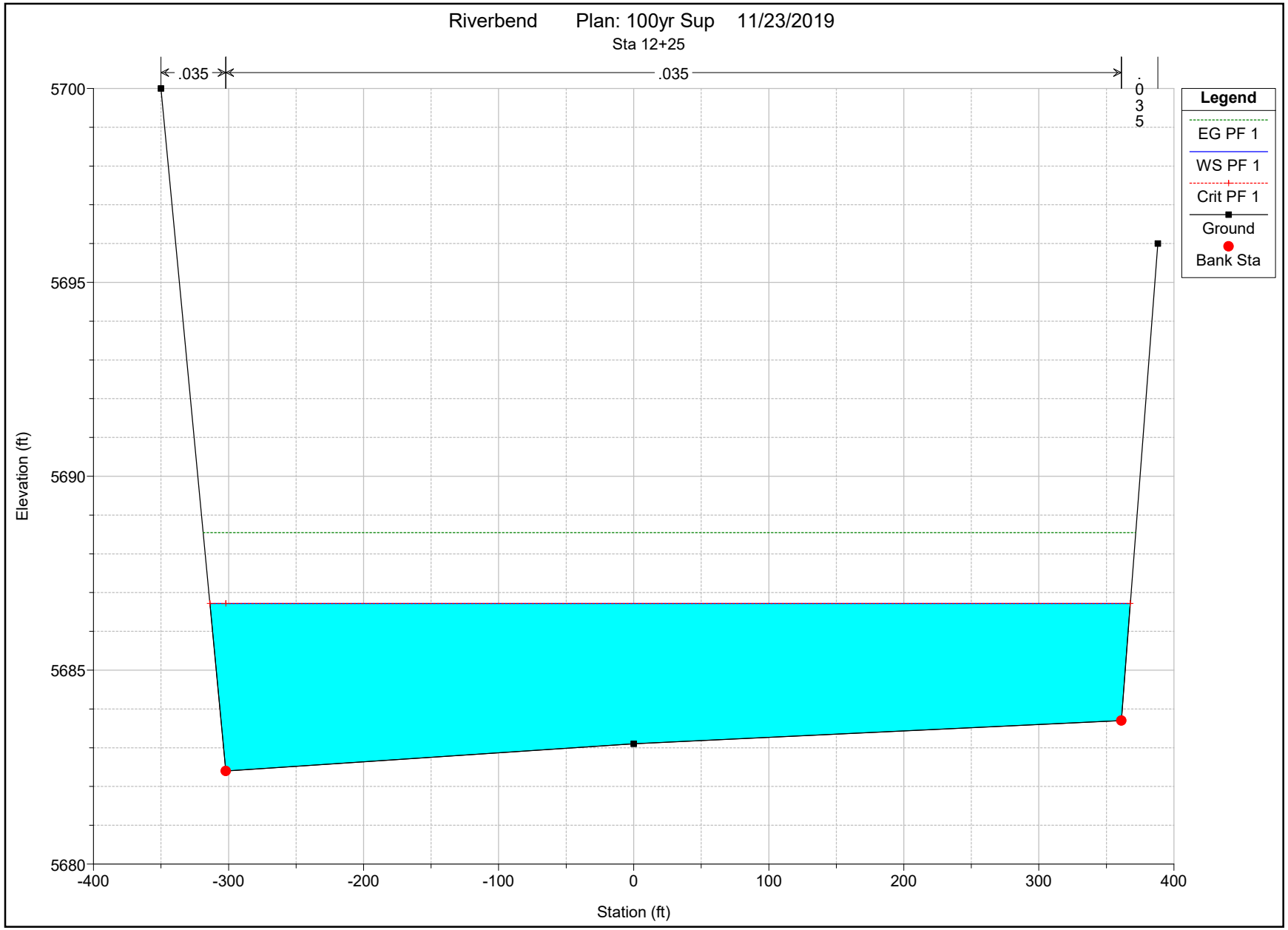
Plan: 100YrSuper Fountain Creek Main Stem RS: 375 Profile: PF 1 (Continued)

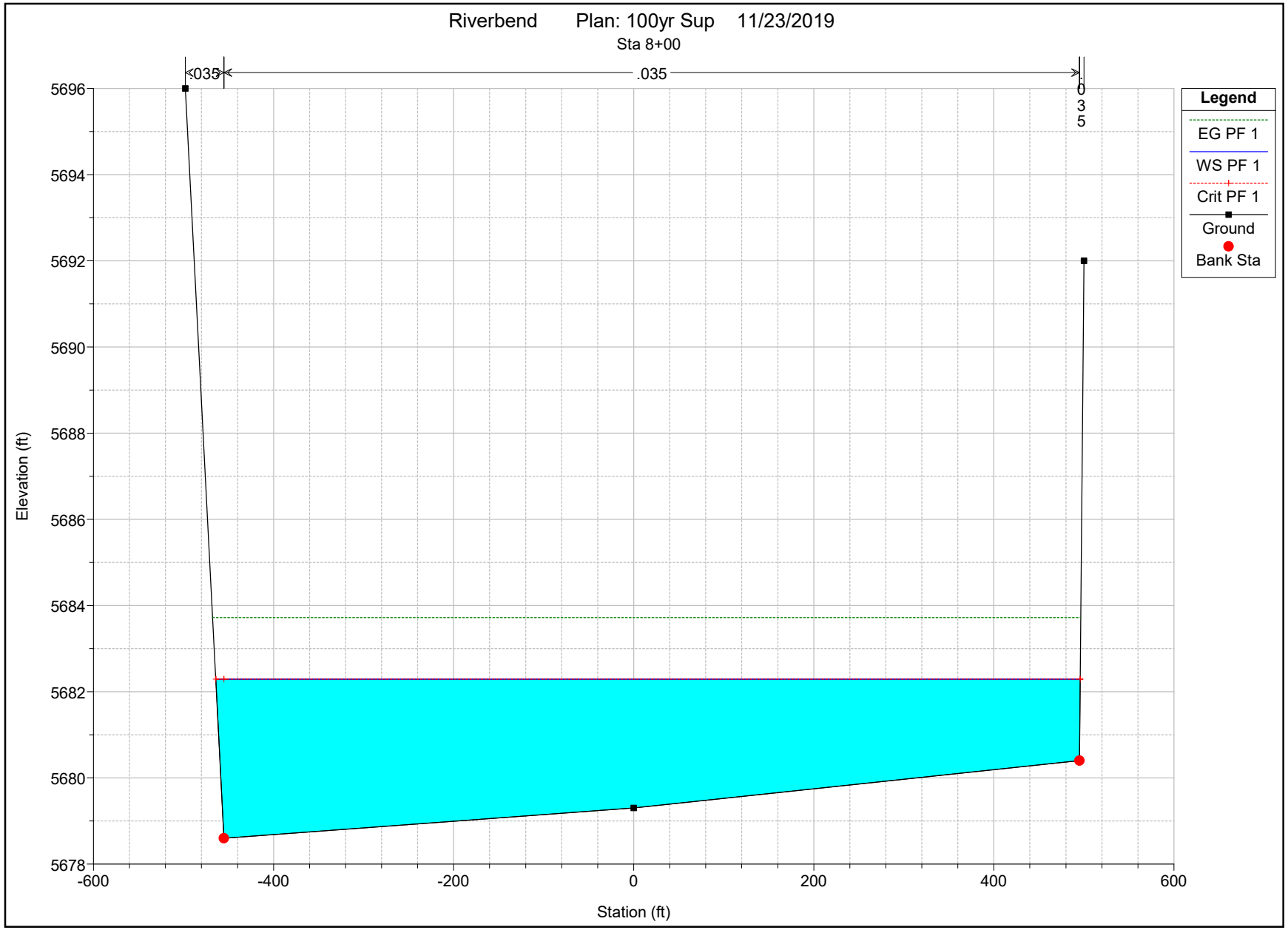
Conv. Total (cfs)	250873.9	Conv. (cfs)	2314.1	247725.6	834.2
Length Wtd. (ft)	375.52	Wetted Per. (ft)	14.61	508.00	7.41
Min Ch El (ft)	5673.90	Shear (lb/sq ft)	1.51	2.97	1.23
Alpha	1.01	Stream Power (lb/ft s)	11.39	35.08	8.10
Frctn Loss (ft)	3.85	Cum Volume (acre-ft)	0.31	17.17	0.14
C & E Loss (ft)	0.11	Cum SA (acres)	0.12	3.37	0.05

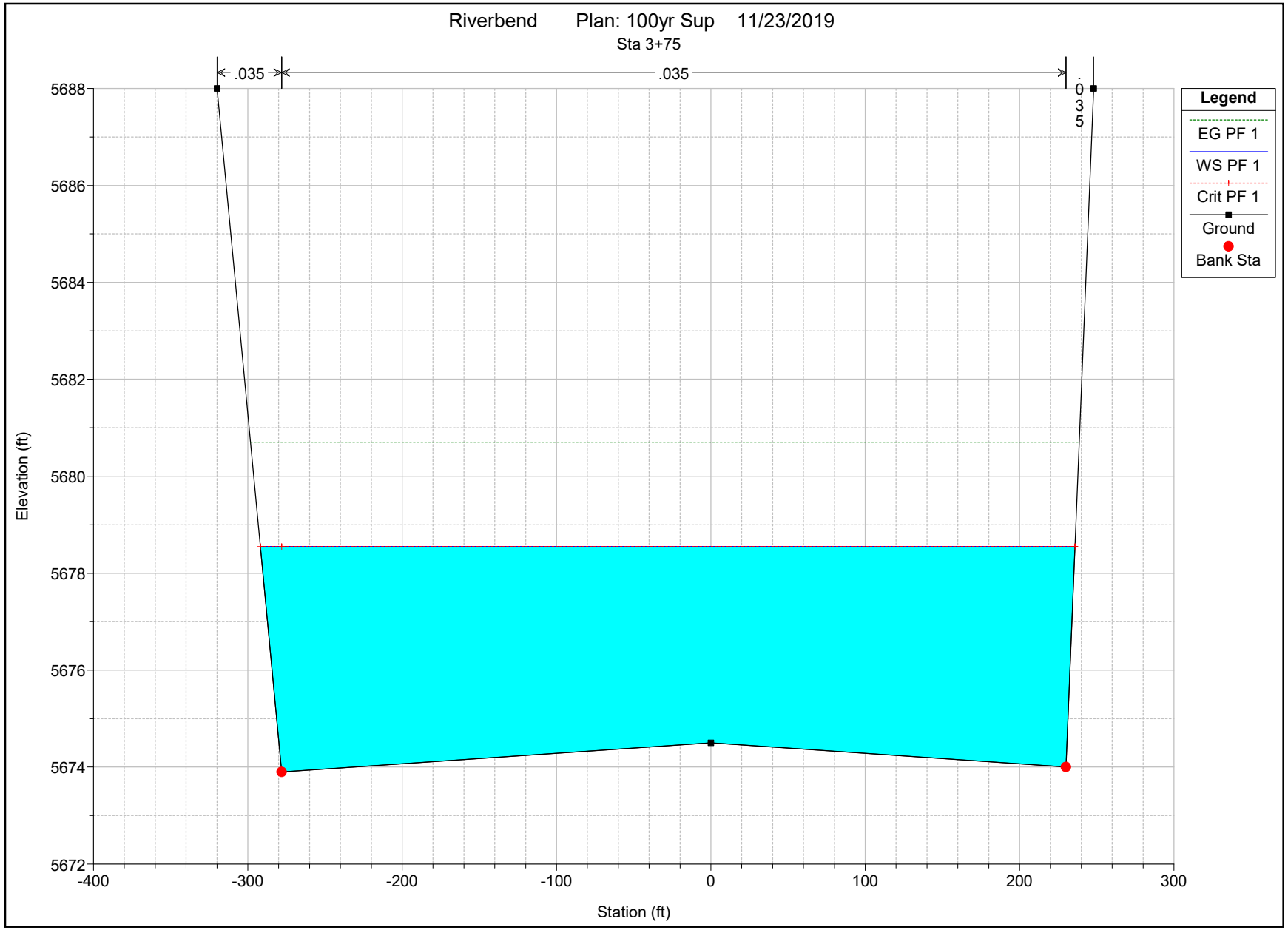
Plan: 100YrSuper Fountain Creek Main Stem RS: 0 Profile: PF 1

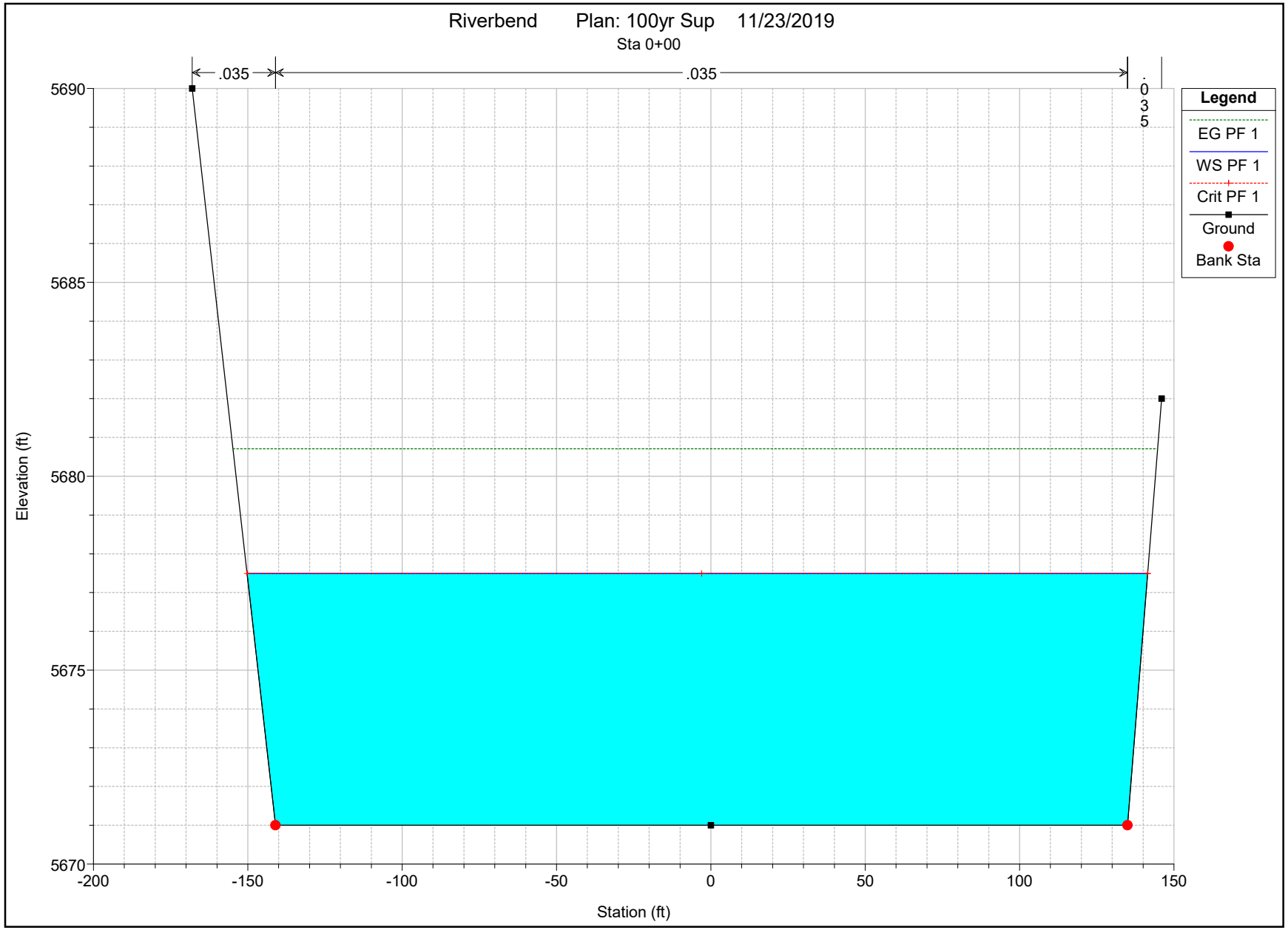
E.G. Elev (ft)	5680.71	Element	Left OB	Channel	Right OB
Vel Head (ft)	3.21	Wt. n-Val.	0.035	0.035	0.035
W.S. Elev (ft)	5677.49	Reach Len. (ft)			
Crit W.S. (ft)	5677.49	Flow Area (sq ft)	29.95	1791.98	21.08
E.G. Slope (ft/ft)	0.009575	Area (sq ft)	29.95	1791.98	21.08
Q Total (cfs)	26300.00	Flow (cfs)	238.58	25909.05	152.37
Top Width (ft)	291.72	Top Width (ft)	9.23	276.00	6.49
Vel Total (ft/s)	14.27	Avg. Vel. (ft/s)	7.97	14.46	7.23
Max Chl Dpth (ft)	6.49	Hydr. Depth (ft)	3.25	6.49	3.25
Conv. Total (cfs)	268769.7	Conv. (cfs)	2438.1	264774.4	1557.2
Length Wtd. (ft)		Wetted Per. (ft)	11.28	276.00	9.18
Min Ch El (ft)	5671.00	Shear (lb/sq ft)	1.59	3.88	1.37
Alpha	1.02	Stream Power (lb/ft s)	12.64	56.12	9.92
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

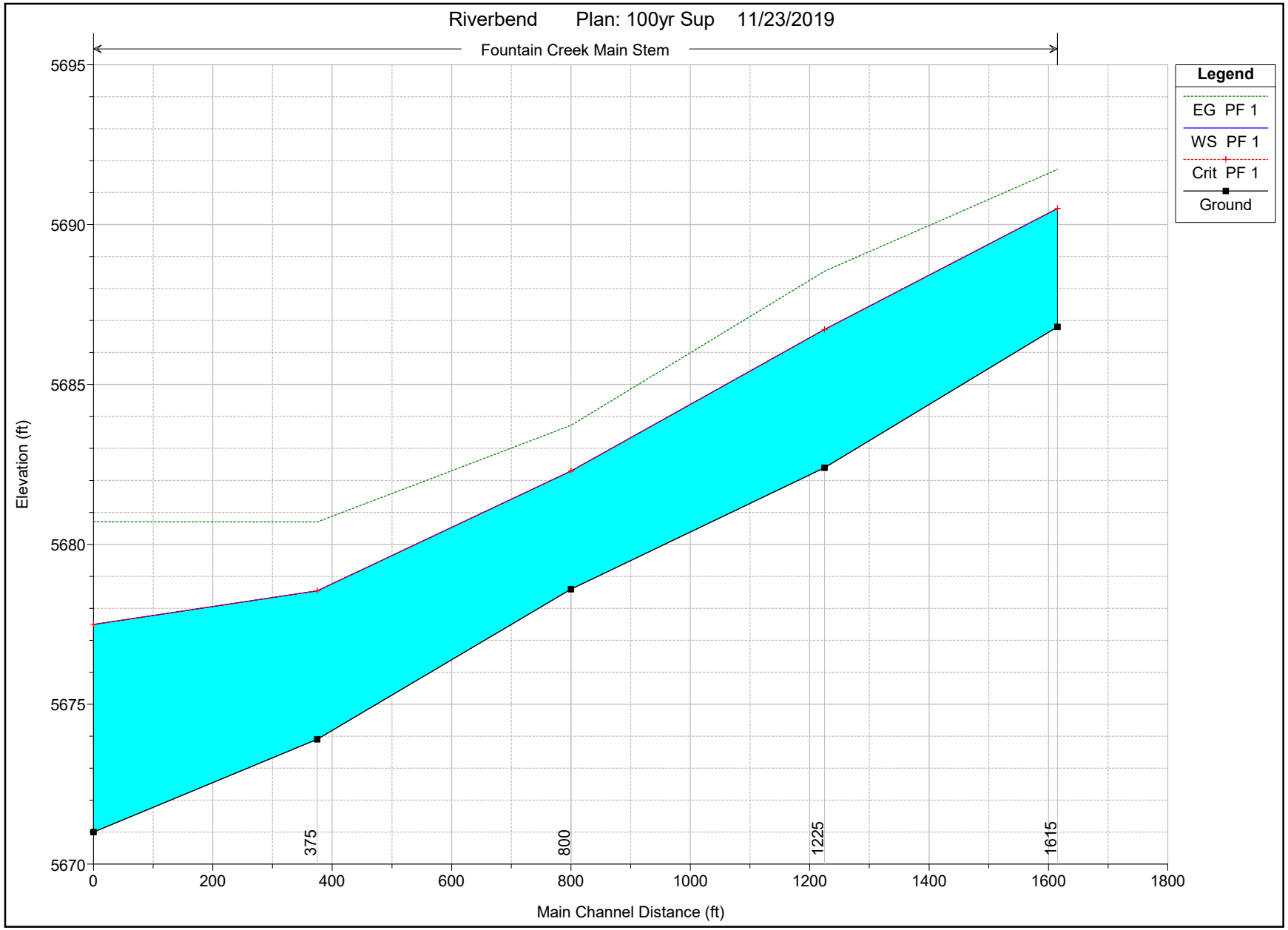

Riverbend Plan: 100yr Sup 11/23/2019
Sta 16+15
.035
.035
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
5710
5705
5700
5695
5690
5685
-800
-600
-400
-200
0
200
400
600
800
Station (ft)


Riverbend Plan: 100yr Sup 11/23/2019
Sta 12+25
.035
.035
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
5700
5695
5690
5685
5680
-400
-300
-200
-100
0
100
200
300
400
Station (ft)


Riverbend Plan: 100yr Sup 11/23/2019
Sta 8+00
.035
.035
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
5696
5694
5692
5690
5688
5686
5684
5682
5680
5678
-600
-400
-200
0
200
400
600
Station (ft)


Riverbend Plan: 100yr Sup 11/23/2019
Sta 3+75
.035
.035
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
5688
5686
5684
5682
5680
5678
5676
5674
5672
-400
-300
-200
-100
0
100
200
300
Station (ft)


Riverbend Plan: 100yr Sup 11/23/2019
Sta 0+00
.035
.035
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
5690
5685
5680
5675
5670
-200
-150
-100
-50
0
50
100
150
Station (ft)

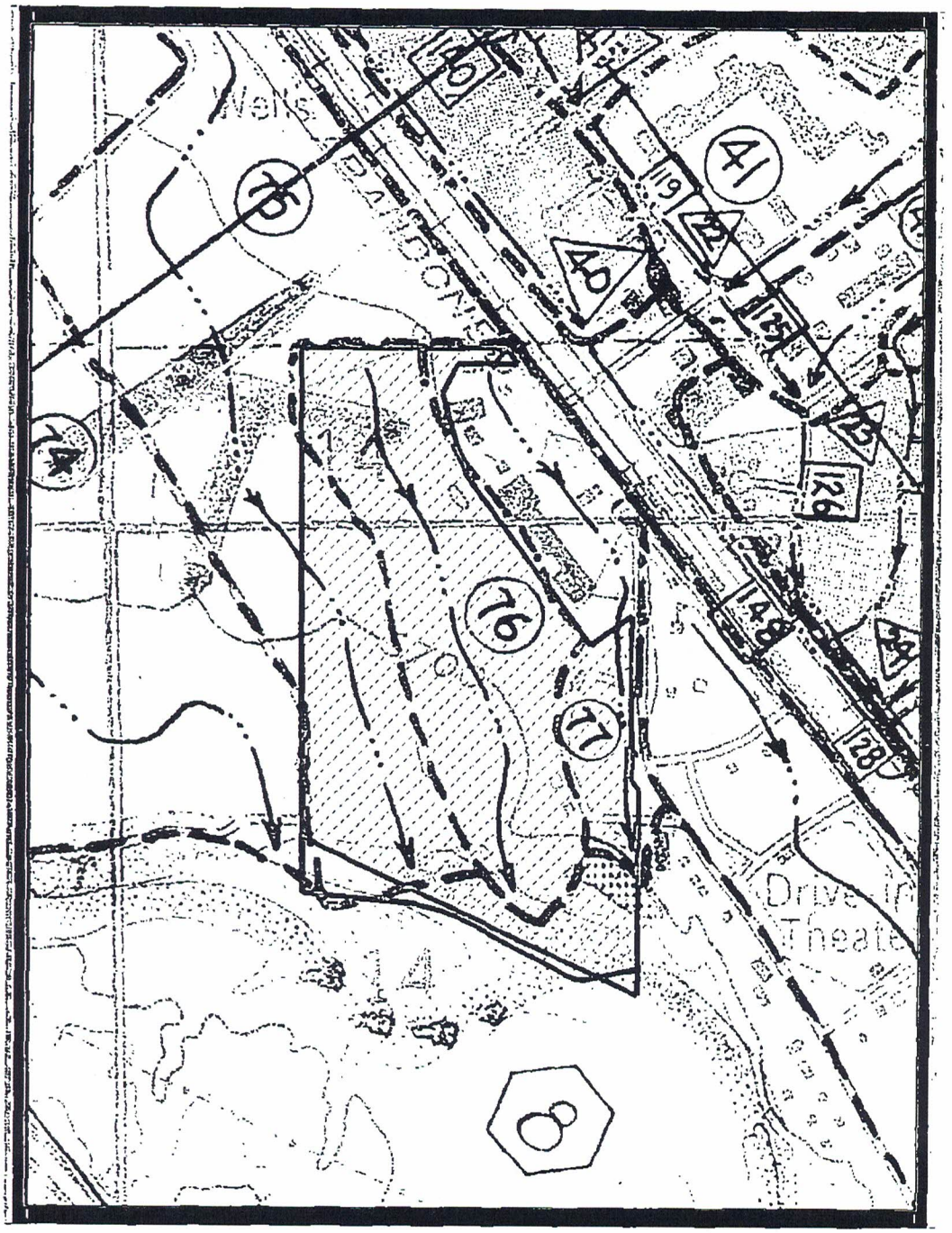

Riverbend Plan: 100yr Sup 11/23/2019
Fountain Creek Main Stem
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
5695
5690
5685
5680
5675
5670
0
200
400
600
800
1000
1200
1400
1600
1800
375
800
1225
1615
Main Channel Distance (ft)

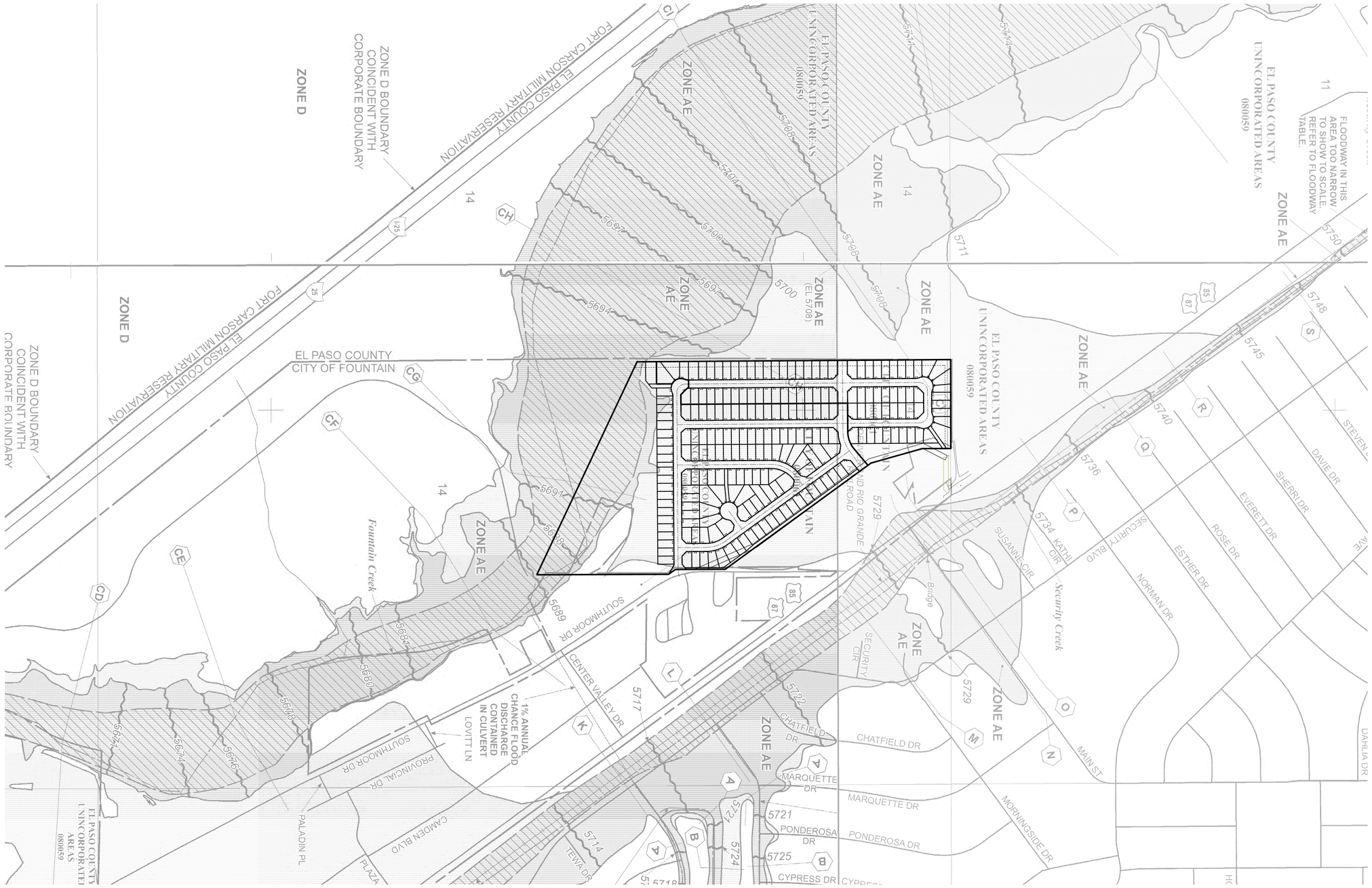
DRAINAGE MAP

FIGURE A4 – Drainage Patterns as Depicted in the DBPS

N

NTS

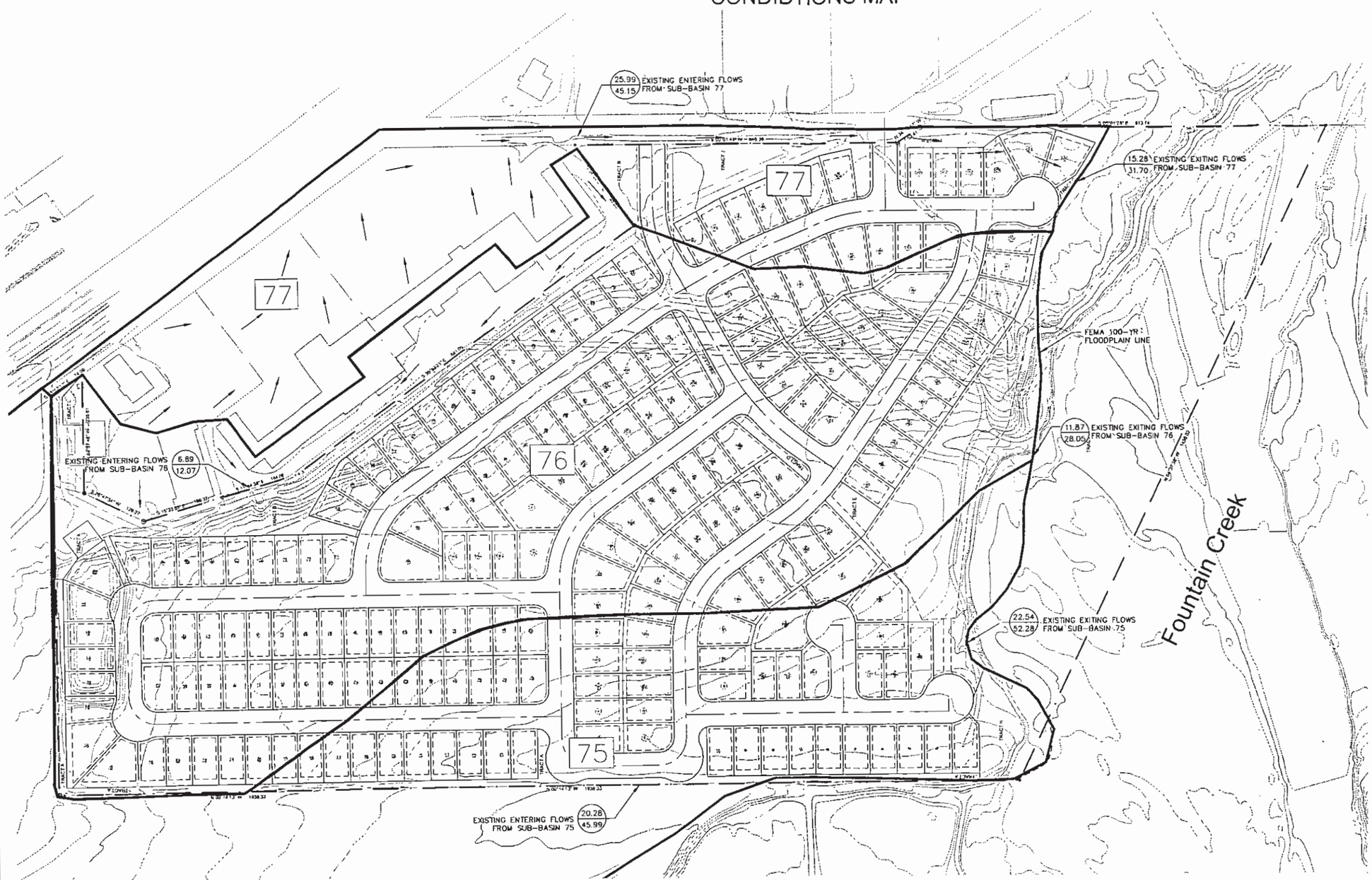




PREPARED FOR:				
COMPANY NAME ADDRESS CITY, STATE ZIP PHONE	CATAMOUNT ENGINEERING PO BOX 692 DIVIDE, CO 80814 (719) 426-2124	COMPOSITE FIRM MAP RIVERBEND DEVELOPMENTS	SCALE: 1"=300'	DRAWN BY: DLM DATE: 09/11/19
		FIRM PANELS- 744G,763G,932G,AND 951G	JOB NUMBER 17-114	SHEET 1 OF 1

RIVERBEND CROSSING

EXISTING DRAINAGE CONDIDTIONS MAP



EXISTING DRAINAGE BASINS 75, 76 AND 77 WERE TAKEN FROM THE APPROVED LITTLE JOHNSON DRAINAGE BASIN PLANNING STUDY, DATED: APRIL, 1988

WATERSHED	TOTAL AREA (acres)	COMPOSITE RUNOFF COEFF, C				COMPOSITE RUNOFF COEFF,	OVERLAND COMPONENT				CHANNEL COMPONENT						TOTAL	RUNOFF COEFFICIENT, C		INTENSITY (in/hr)		FLOWS (cfs)	
		C_1	Area $_1$ (acres)	C_2	Area $_2$ (acres)		Length (ft)	Height (ft)	Slope	T_o (min)	Length (ft)	Height (ft)	Slope	R	VEL. (fps)	T_t (min)	T_c (min)	$C_{5\,year}$	$C_{100\,year}$	$I_{5\,year}$	$I_{100\,year}$	$Q_{5\,year}$	$Q_{100\,year}$
75 (IN)	59.11	0.25	59.11	0	0	0.25	1008	24	0.024	37.65	810	2	0.0146	7.1	0.5	11.34	48.99	0.25	0.36	1.4	3.0	20.28	45.99
75 (OUT)	70.6	0.25	70.6	0	0	0.25	1008	24	0.024	37.65	1416	20	0.022	7.1	1.1	14.17	51.82	0.25	0.36	1.3	2.8	22.54	52.28
76 (IN)	21.0	0.9	21.0	0	0	0.90	137	1.5	0.011	4.25	1100	2	0.013	20.0	2.2	1.11	5.44	0.90	0.90	2.1	6.6	11.87	31.05
76 (OUT)	34	0.25	31.92	0.9	2.08	0.29	805	12	0.014	40.81	950	18	0.021	7.1	3.0	13.77	54.59	0.29	0.40	1.2	2.7	19.07	45.15
77 (IN)	7.37	0.9	7.37	0	0	0.43	564	9	0.015	7.96	844	5	0.013	20.0	2.3	2.91	10.86	0.43	0.43	3.9	6.8	12.72	21.70
77 (OUT)	13.73	0.25	6.36	0.9	7.37	0.61	624	9	0.015	18.81	1410	15	0.010	15.0	1.5	16.67	35.48	0.63	0.66	1.9	3.8	15.38	31.70

LEGEND

- BOUNDARY
- 5700 — EXISTING MAJOR CONTOURS
- EXISTING MINOR CONTOURS
- (10 / 20) 5-YR. FLOW (cfs) / 100-YR. FLOW (cfs)
- FLOW DIRECTION ARROW
- SUB-BASIN BOUNDARY
- 76 SUB-BASIN IDENTIFICATION

DATE: 1/19/07 TIME: 3:22:10 PM DRAWING NAME: DP01.DWG
SERVER: CS50 DESIGNER: PROJ MGR. PLOTTED BY: SANDIS
PATH: N:\CSB011202\CADD\DWG\DP

NO.	BY	DATE	REVISION

CAUTION

The engineer preparing these plans is not liable for changes made to these plans by others subsequent to the date of these plans. All changes to the plans must be in writing and must be approved by the preparer of these plans

RIVERBEND CROSSING

EXISTING DRAINAGE CONDITIONS

PREPARED FOR: DR HORTON - MELODY SERIES

DATE SUBMITTED: FEB 17, 2006

NOLTE
BEYOND ENGINEERING
COLORADO SPRINGS, CO 80918
WWW.NOLTE.COM
5225 N ACADEMY BLVD., SUITE 304
719 268 8500 TEL 719 268 9200 FAX

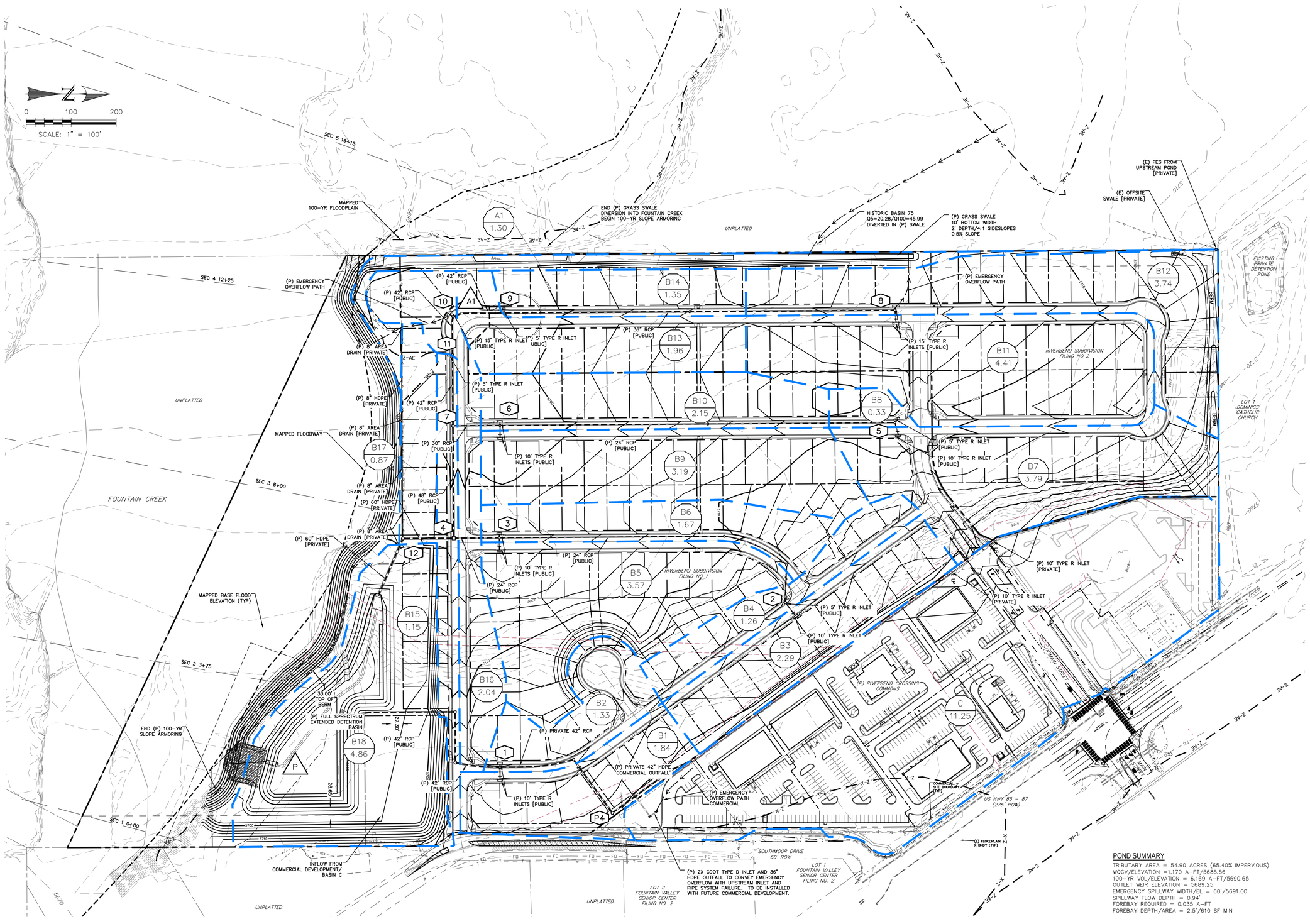
PRELIMINARY
NOT FOR CONSTRUCTION

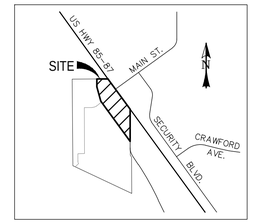
SHEET NUMBER
DP01
1 of 2 SHEETS

SCALE
VERTICAL: N/A
HORIZONTAL: 1" = 100'

JOB NUMBER
CSB011202

REF: EXIST. FEMA FIRMS FROM FEMA-FIS IMAGES, TO DATE





VICINITY MAP
SCALE: N.T.S.

PROPOSED DRAINAGE BASINS

BASIN	AREA (ACRES)	Q2 (CFS)	Q5 (CFS)	Q10 (CFS)	Q25 (CFS)	Q50 (CFS)	Q100 (CFS)
A1	1.30	0.2	0.6	1.1	1.8	2.3	2.9
B1	1.84	2.2	3.1	4.1	5.3	6.3	7.4
B2	1.33	2.0	2.7	3.4	4.3	5.1	6.0
B3	2.29	2.9	4.0	5.2	6.6	7.9	9.3
B4	1.26	1.8	2.5	3.2	4.0	4.8	5.6
B5	3.57	4.8	6.6	8.4	10.5	12.5	14.6
B6	1.67	2.1	2.9	3.7	4.6	5.5	6.4
B7	3.79	4.0	5.7	7.7	9.9	11.9	14.2
B8	0.33	0.5	0.7	0.9	1.1	1.3	1.6
B9	3.19	4.3	5.9	7.6	9.5	11.3	13.2
B10	2.15	3.0	4.0	5.2	6.5	7.6	9.0
B11	4.41	6.0	8.2	10.6	13.2	15.7	18.4
B12	3.74	5.1	7.0	9.0	11.3	13.3	15.6
B13	1.96	2.6	3.5	4.6	5.7	6.7	7.9
B14	1.35	1.8	2.5	3.2	4.0	4.7	5.5
B15	1.15	1.2	1.6	2.1	2.6	3.1	3.7
B16	2.04	2.3	3.1	4.0	4.9	5.8	6.9
B17	0.87	1.2	1.7	2.2	2.7	3.2	3.7
B18	4.86	1.9	3.6	5.8	8.5	10.7	13.3
C	11.25	30.0	38.5	46.0	54.5	62.0	70.2

PROPOSED DESIGN POINTS

DESIGN POINT	Q2 (CFS)	Q5 (CFS)	Q10 (CFS)	Q25 (CFS)	Q50 (CFS)	Q100 (CFS)
P4	30.0	38.5	46.1	54.5	62.1	70.2
1	31.3	40.6	49.2	58.8	67.4	76.8
2	4.6	6.4	8.3	10.4	12.4	14.6
3	10.9	14.9	19.2	24.1	28.6	33.6
4	33.6	46.0	59.5	74.7	88.5	104.0
5	4.4	6.3	8.4	10.9	13.0	15.5
6	11.3	15.8	20.6	26.0	31.0	36.5
7	24.6	33.7	43.6	54.7	64.8	76.2
8	11.2	15.2	19.6	24.5	28.9	33.9
9	12.9	17.5	22.5	28.2	33.3	39.1
10	15.0	20.4	26.2	32.7	38.7	45.4
11	15.4	20.9	26.9	33.6	39.8	46.6
12	34.5	47.3	61.1	76.7	90.9	106.8
A1	4.4	6.0	7.8	9.7	11.5	13.4
P-IN	51.1	71.1	92.9	117.8	140.2	165.4
P-OUT	1.3	1.6	12.1	36.4	55.6	67.7

DRAINAGE LEGEND

BASIN IDENTIFIER — F
BASIN AREA [AC] — 0.36
DESIGN POINT IDENTIFIERS — 3
STORM SEWER DESIGN POINT IDENTIFIERS — P5
DRAINAGE BASIN BOUNDARY
SURFACE SHEET FLOW DIRECTION
EXISTING MAJOR CONTOUR (10') — 6900
EXISTING MINOR CONTOUR (2')
PROPOSED MAJOR CONTOUR (10')
PROPOSED MINOR CONTOUR (2')
EXISTING — (E)
PROPOSED — (P)
FUTURE — (F)
SLOPE/DIRECTION — 1.00%
(E) STORM SEWER
(P) STORM SEWER, INLET, OUTFALL

POND SUMMARY

TRIBUTARY AREA = 54.90 ACRES (65.40% IMPERVIOUS)
WQCV/ELEVATION =1.170 A-FT/5685.56
100-YR VOL/ELEVATION = 6.169 A-FT/5690.65
OUTLET WEIR ELEVATION = 5689.25
EMERGENCY SPILLWAY WIDTH/EL = 60'/5691.00
SPILLWAY FLOW DEPTH = 0.94'
FOREBAY REQUIRED = 0.035 A-FT
FOREBAY DEPTH/AREA = 2.5'/610 SF MIN

REV.	DESCRIPTION	DATE

PREPARED FOR:

AVATAR EQUITIES

6800 JERICHO TURNPIKE
SUITE 120W, #204
SYSOSSET, NY 11791

CATAMOUNT ENGINEERING
321 W. HENRIETTA AVE WOODLAND PARK, CO 80866
PO BOX 221 (719)426-2124

RIVERBEND CROSSING

PROPOSED DRAINAGE PLAN

DESIGNED BY: DLM	DRAWN BY: DBM
SCALE: 1" = 100'	DATE: 10/25/20
JOB NUMBER 17-115	SHEET 1 OF 1