Revise to Preliminary/Final Drainage Report for Riverbend Crossing Filings No. 1 and 2.

MASTER DEVELOPMENT DRAINAGE REPORT FOR RIVERBEND CROSSING AND FINAL DRAINAGE REPORT FOR RIVERBEND CROSSING FILINGS NO. 1 AND 2

SEPTEMBER 2018

Prepared for:

Avatar Fountain, LP.
6800 Jericho Tpke., Suite 120W #204
Syosset, NY 11791

Prepared By:

CATAMOUNT ENGINEERING
PO BOX 221
Woodland Park, CO 80866
719-426-2124

Add PCD File No. SP187, SF1843, & SF1844

Revise the second sentence to "Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the applicable master plan of the drainage basin"

MASTER DEVELOPMENT DRAINAGE REPORT FOR RIVERBEND CROSSING AND 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 for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors, or omissions on my part in preparing this report.

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.

____ Date ____________

David L. Mijares, Colorado PE #40510
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: Alan Toth

Title: Managing Partner

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.

____ ____________

Jennifer Irvine, PE
County Engineer/ECM Administrator

Date

Conditions:

MASTER DEVELOPMENT DRAINAGE REPORT FOR RIVERBEND CROSSING AND FINAL DRAINAGE REPORT FOR REIVERBEND CROSSING FILING NO. 1 AND 2

State whether or not there are DBPS improvements required to be completed with this development.

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 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.

The letter of intent and preliminary plan indicate 89 lots for filing 2. Revise.

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. and to the west by Sand Creek, to the north and east by existing residential development within the Heritage Subdivision Unit 4, and south by Chelton Road. 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

Remove or revise this sentence as it does not appear to apply to the location of this subdivision.

Include page numbers.

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 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 panel 08041C0951 F, effective March 14, 2014. 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. El Paso County is currently in the process of adopting revised flood maps. Adoption of revised flood map affecting the parcel is anticipated in December 2018.

Shaded Zone X

Update the firmette and reference to the December 2018 FIRM

Update. Shaded Zone X

State whether or not there has been a change in character or topography on the adjacent parcels since the preliminary drainage report. If there are then an updated existing drainage map and analysis will need to be provided.

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 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 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 east 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.

southeast

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 southwest 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. Offsite flow from the Venetucci agricultural parcel directly west of the property will be conveyed in a swale parallel to the property boundary directly south and into Fountain Creek and will not enter the residential development. 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.

Clarify. Is this existing or proposed swale? The proposed grading does not show a proposed swale.

'A Basins'

A designated basins consist of areas from the development not tributary to the proposed extended detention basin. A Basins consist primarily of rear yards of 'B lots' and portions of 'walk-out' lots that are graded below adjacent street elevation and outfall to adjacent parcels or Fountain Creek.

Basin A1 (2.23 Acres, Q_2=0.4 cfs, Q_5=1.1 cfs, Q_{10}=2.0 cfs, Q_{25}=3.1cfs, Q_{50}=4.0 cfs, and Q_{100}=5.0 cfs) consists of extended landscape setback and graded slopes adjacent to agricultural property west of the development. Flows will be conveyed in the adjacent irrigation ditch south directly to Fountain Creek.

Basin A2 (0.99 Acres, Q_2=1.0 cfs, Q_5=1.6 cfs, Q_{10}=2.2 cfs, Q_{25}=3.0cfs, Q_{50}=3.6 cfs, and Q_{100}=4.3 cfs) consists of rear portions of B lots directly tributary to Fountain Creek. Flows will sheetflow into Fountain Creek at the rear of lots.

'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.

WQCV shall be provided for the total site per ECM Appendix I.7.1.B. Revise 'A Basins' to provide WQCV and 100yr detention.

BASIN	AREA	Q_2	Q_5	Q_{10}	Q_{25}	Q_{50}	Q_{100}	Type R Inlet
B1	1.60	2.0	2.8	3.6	4.6	5.5	6.5	10'
B2	1.21	1.8	2.4	3.1	3.9	4.6	5.4	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	3.36	4.5	6.2	7.9	9.9	11.7	13.8	10'
B6	1.60	2.0	2.8	3.5	4.4	5.2	6.1	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	3.07	4.2	5.7	7.3	9.2	10.8	12.7	10'
B10	1.43	2.0	2.7	3.4	4.3	5.1	6.0	10'
B11	4.45	6.1	8.3	10.7	13.4	15.8	18.5	15'
B12	3.29	4.5	6.2	7.9	9.9	11.7	13.7	10'
B13	3.52	4.5	6.1	7.8	9.8	11.5	13.5	None
B14	4.29	5.4	7.3	9.4	11.8	13.9	16.3	None
B15	4.25	1.4	3.7	6.5	10.3	13.3	16.8	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 B12 are provided in the appendix.

Basin B13 and Basin B14 are combined in the southerly cul-de-sac at design Point 1B. Combined flows at Design Point 1B of Q_5=13.3 cfs and Q_{100}=29.7 cfs are collected in a 20' sump inlet within the cul-de-sac. Inlet calculation is provided in the appendix.

Is the intent to provide side lot swales for the residential development. If so, state as such and provide a typical lot detail in the grading plan.

'C Basins'

Basin C (11.25 Acres, Q_2=20.6 cfs, Q_5=26.3 cfs, Q_{10}=31.5 cfs, Q_{25}=37.3 cfs, Q_{50}=42.4 cfs, and Q_{100}=48.0 cfs) represents the combined flow generated within the commercial development. Runoff generated within the commercial development sheetflows within the proposed curb line and is collected within private inlets on-site and will be conveyed in a private storm sewer to outfall within the shared extended detention basin at Design Point P.

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. Mannings equation calculations are provided in the appendix of this report. Hydraulic Grade Line Calculations will be developed upon development of initial review comments.

Pipe Design Point 1 (Q_5=5.0 cfs and Q_{100}=11.5) represents combined flows from basins B1 and B2 and will be conveyed in a public 24" RCP at a minimum grade of 0.5%.

Update. Include HGL calculations with the resubmittal. HGL is based on 100 year

Provide a narrative regarding offsite sub-basins 75-77 in the proposed condition

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=14.4 cfs and Q_{100}=32.5) represents combined flows from basins B5 and B6 and Pipe Design Point 2. Combined flows will be conveyed in a public 30" RCP at a minimum grade of 0.65%.

Pipe Design Point 4 (Q_5=19.1 cfs and Q_{100}=43.2) represents combined flows from Pipe Design Points 1 and 3. Combined flows will be conveyed in a public 30" RCP at a minimum grade of 1.0%.

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=14.3 cfs and Q_{100}=33.2) 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=33.0 cfs and Q_{100}=75.6) represents combined flows from Pipe Design Points 4 and 6. Combined flows will be conveyed in a public 42" RCP at a minimum grade of 0.6%.

Pipe Design Point 8 (Q_5=14.5 cfs and Q_{100}=32.2) represents combined flows from basins B11 and B12 and will be conveyed in a public 30" RCP at a minimum grade of 0.65%.

Pipe Design Point 9 (Q_5=47.8 cfs and Q_{100}=106.4) represents combined flows from Pipe Design Points 7 and 8. Combined flows will be conveyed in a public 48" RCP at a minimum grade of 0.86%.

Pipe Design Point 10 (Q_5=60.6 cfs and Q_{100}=135.0) represents combined flows from Pipe Design Point 9 and overland Design Point 1B. Combined flows will be conveyed in a private 48" HDPE pipe at a minimum grade of 0.90%.

pond elevations does not match the grading plan.

EXTENDED DETENTION BASIN

The parcel proposes to develop 52.00 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 51.10 tributary acres of development with an average imperviousness of 65.40%. Full spectrum pond development requires 1.089 acre-ft of water quality capture volume ponding to an elevation of 5679.94, an EURV volume of 3.455-acre ft ponding to an elevation of 5682.09, and a total volume of 5.742 acre-ft ponding to an elevation of 5683.68 providing full spectrum detention of 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 a 6" concrete forebays with baffle providing adequate protection at discharge point. The concrete forebays requires 950 cubic feet of volume (2% of the design WQCV). The forebay will be constructed of a concrete slab with sides conforming to the pond slopes and 1' wall with a rectangular notch which outfalls to the proposed trickle channel at the downstream end.

The pond will be constructed with 3:1 minimum side slopes above the 100-YR water surface elevation and 4:1 minimum side slopes within the ponded surface to be vegetated per the approved 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 17' long by 7' wide by 2.5' deep concrete micropool. The micropool will provide a surface area of 120 square feet and an initial surcharge volume of 40 cubic feet utilizing a 4" initial surcharge depth.

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 30" HDPE pipe system directly to Fountain Creek.

The emergency spillway will consist of a 40' weir along the southerly end of the pond at an elevation of 5684.10. The overflow area will consist of 12" depth of type VL soil riprap.

Outfall from the extended detention basin of Q_2=1.0 cfs, Q_5=2.6 cfs, Q_{10}=7.8 cfs, Q_{25}=18.2 cfs, Q_{50}=27.2 cfs, and Q_{100}=36.4 will be conveyed in a private 30" HDPE. 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 Sand Creek through the private 30" HDPE and full spectrum release will have no impacts on the Fountain Creek Drainage.

List each step as a subheader.
Step 2 does not address Stabilize Drainageways.

4-STEP PROCESS

1. 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.
2. 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.
3. 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. No impacts to Sand Creek are anticipated.
4. 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.

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
		SUBTOTAL		**$ 111,920**
		10% CONTINGENCY		*$ 11,192*
		TOTAL		**$ 123,112**

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

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. Details and analysis of final storm drain conveyance and collection system will be developed in an addendum to the final drainage report submitted with Private Storm Sewer Plans for Fillmore Apartments Subdivision. Preliminary sizing calculations were provided in the appendix of this report. UD-Detention version 3.07 was utilized in development of extended detention basin and outfall. Calculations are included in the appendix of this report.

Since this report is associated with the final plats, final design must be provided with 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.

State who maintains the private facilities. HOA or District?

REFERENCES:

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

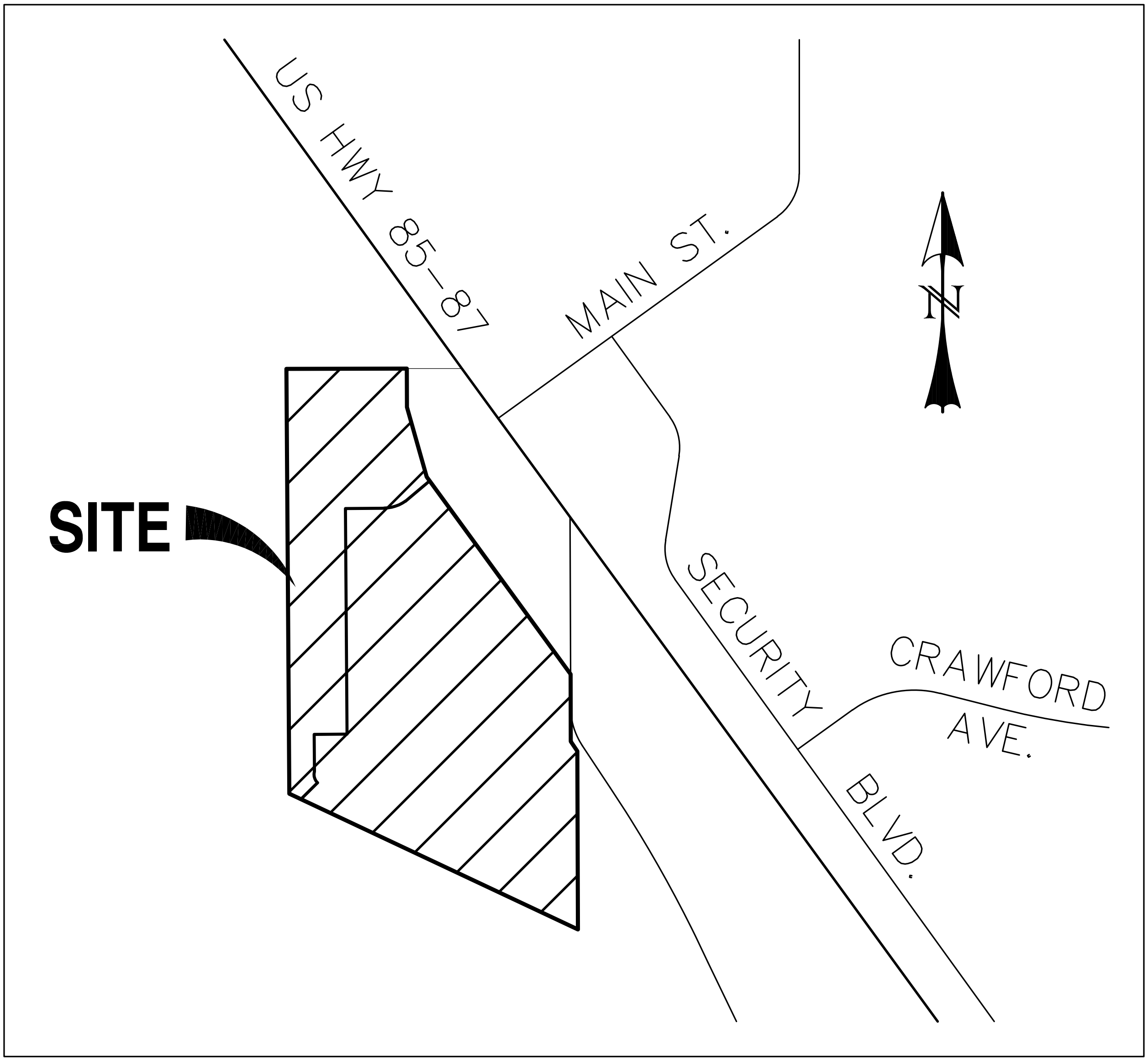
“Little Johnson/Security Creek Drainage Basin Planning Study” prepared by Simons, Li and Associates, Inc. dated December 1987.

“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

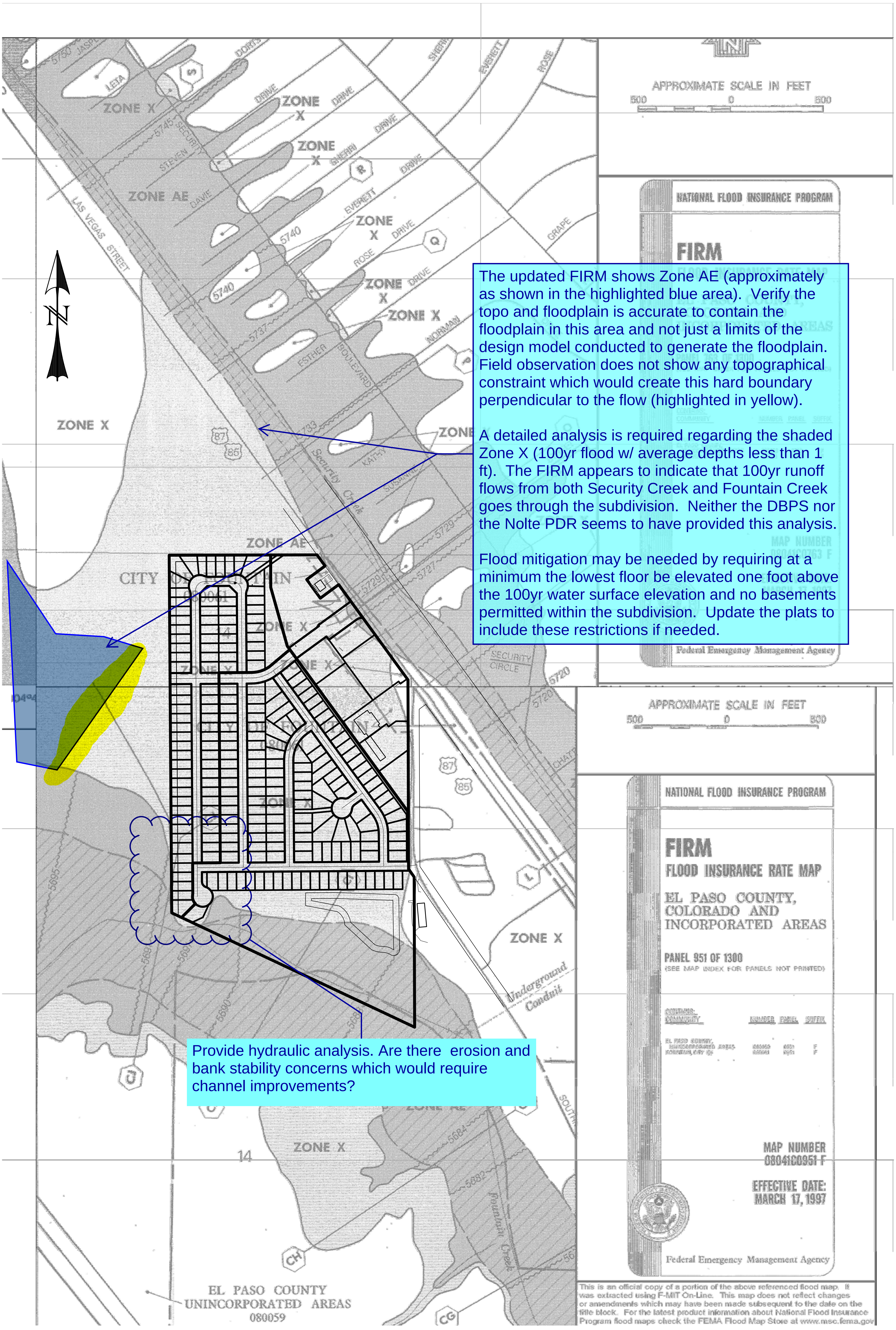
APPENDIX



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



The updated FIRM shows Zone AE (approximately as shown in the highlighted blue area). Verify the topo and floodplain is accurate to contain the floodplain in this area and not just a limits of the design model conducted to generate the floodplain. Field observation does not show any topographical constraint which would create this hard boundary perpendicular to the flow (highlighted in yellow).

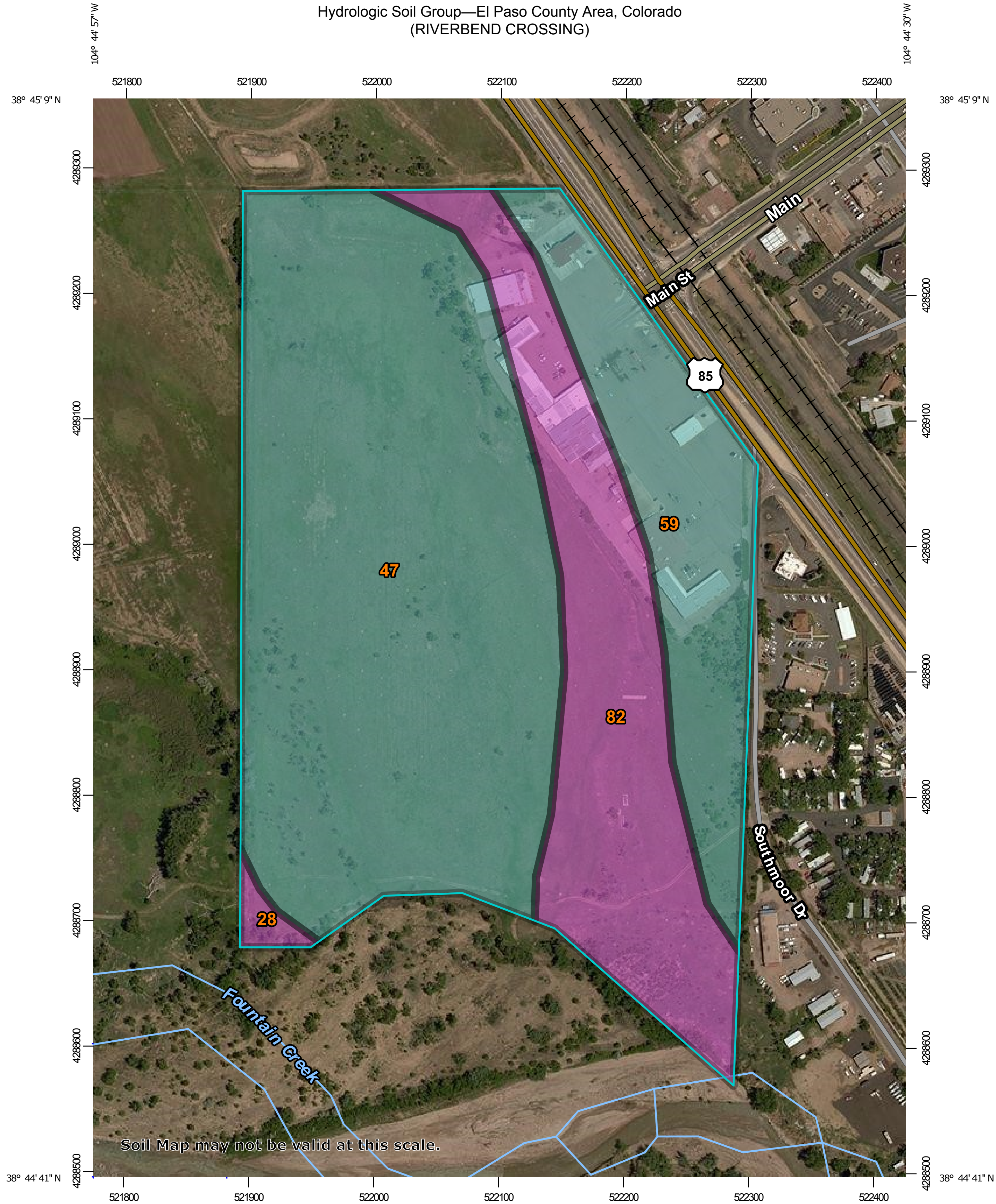
A detailed analysis is required regarding the shaded Zone X (100yr flood w/ average depths less than 1 ft). The FIRM appears to indicate that 100yr runoff flows from both Security Creek and Fountain Creek goes through the subdivision. Neither the DBPS nor the Nolte PDR seems to have provided this analysis.

Flood mitigation may be needed by requiring at a minimum the lowest floor be elevated one foot above the 100yr water surface elevation and no basements permitted within the subdivision. Update the plats to include these restrictions if needed.

Provide hydraulic analysis. Are there erosion and bank stability concerns which would require channel improvements?

CATAMOUNT ENGINEERING PO BOX 692 DIVIDE, CO 80814 (719) 426-2124	PREPARED FOR: AVATAR EQUITIES 6800 JERICHO TURNPIKE SUITE 120W, #204 SYSOSSET, NY 11791	**RIVERBEND CROSSING** **EXISTING FLOODMAP EXHIBIT**	SCALE: 1"=500' JOB NUMBER 17-114	DRAWN BY: DLM DATE: XX/XX/XX 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.

Meters: 0, 50, 100, 200, 300

Feet: 0, 200, 400, 800, 1200

N

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

Revise Basin A1 Rational Method land use to 1/8 acre. Rear building setback is 25 ft. So this basin is not entirely landscape.

Include a Header/Title. Typical for all worksheets.

BASIN	AREA TOTAL (Acres)	C_{2}	C_{5}	C_{10}	C_{25}	C_{50}	C_{100}	Length (ft)	Height (ft)	TI (min)	CONVEYANCE TC Length (ft)	Height (ft)	C_{V}	Slope (%)	Velocity (fps)	TC (min)	TT TOTAL (min)	INTENSITY I_{2} (in/hr)	I_{5} (in/hr)	I_{10} (in/hr)	I_{25} (in/hr)	I_{50} (in/hr)	I_{100} (in/hr)	TOTAL FLOWS 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 *Landscape*	2.23 *2.23*	**0.09** *0.09*	**0.19** *0.19*	**0.29** *0.29*	**0.40** *0.40*	**0.46** *0.46*	**0.52** *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	**0.4**	**1.1**	**2.0**	**3.1**	**4.0**	**5.0**
A2 *Residential 1/8 acre* *Landscape*	0.99 *0.59* *0.40*	**0.30** *0.45* *0.09*	**0.37** *0.49* *0.19*	**0.44** *0.54* *0.29*	**0.51** *0.59* *0.40*	**0.56** *0.62* *0.46*	**0.60** *0.65* *0.52*	62	1.5	7.8	136	11	10	8.1%	2.8	0.8	8.6	3.5	4.4	5.1	5.8	6.5	7.3	**1.0**	**1.6**	**2.2**	**3.0**	**3.6**	**4.3**
B1 *Residential 1/8 acre* *Landscape*	1.60 *1.43* *0.17*	**0.41** *0.45* *0.09*	**0.46** *0.49* *0.19*	**0.51** *0.54* *0.29*	**0.57** *0.59* *0.40*	**0.60** *0.62* *0.46*	**0.64** *0.65* *0.52*	100	2	9.2	382	3.8	20	1.0%	2.0	3.2	12.4	3.0	3.8	4.4	5.1	5.7	6.4	**2.0**	**2.8**	**3.6**	**4.6**	**5.5**	**6.5**
B2 *Residential 1/8 acre*	1.21 *1.21*	**0.45** *0.45*	**0.49** *0.49*	**0.54** *0.54*	**0.59** *0.59*	**0.62** *0.62*	**0.65** *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	**1.8**	**2.4**	**3.1**	**3.9**	**4.6**	**5.4**
B3 *Residential 1/8 acre* *Landscape*	2.29 *2.04* *0.25*	**0.41** *0.45* *0.09*	**0.46** *0.49* *0.19*	**0.51** *0.54* *0.29*	**0.57** *0.59* *0.40*	**0.60** *0.62* *0.46*	**0.64** *0.65* *0.52*	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**
B4 *Residential 1/8 acre*	1.26 *1.26*	**0.45** *0.45*	**0.49** *0.49*	**0.54** *0.54*	**0.59** *0.59*	**0.62** *0.62*	**0.65** *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**
B5 *Residential 1/8 acre*	3.36 *3.36*	**0.45** *0.45*	**0.49** *0.49*	**0.54** *0.54*	**0.59** *0.59*	**0.62** *0.62*	**0.65** *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	**4.5**	**6.2**	**7.9**	**9.9**	**11.7**	**13.8**
B6 *Residential 1/8 acre*	1.60 *1.60*	**0.45** *0.45*	**0.49** *0.49*	**0.54** *0.54*	**0.59** *0.59*	**0.62** *0.62*	**0.65** *0.65*	100	2	8.8	100 710	2 12	7 20	2.0% 1.7%	1.0 2.6	1.7 4.6	15.0	2.8	3.5	4.1	4.7	5.3	5.9	**2.0**	**2.8**	**3.5**	**4.4**	**5.2**	**6.1**
B7 *Residential 1/8 acre* *Landscape*	3.79 *2.91* *0.88*	**0.37** *0.45* *0.09*	**0.42** *0.49* *0.19*	**0.48** *0.54* *0.29*	**0.55** *0.59* *0.40*	**0.58** *0.62* *0.46*	**0.62** *0.65* *0.52*	100	12	5.4	100 780	3 6	7 20	3.0% 0.8%	1.2 1.8	1.4 7.4	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**

Revise A2 to only be Residential. The sub-basin shown consists of residential lots only.

Calculated by: DLM
Date: 8/12/2018

											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 *Residential 1/8 acre*	0.33 *0.33*	**0.45** *0.45*	**0.49** *0.49*	**0.54** *0.54*	**0.59** *0.59*	**0.62** *0.62*	**0.65** *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**
B9 *Residential 1/8 acre*	3.07 *3.07*	**0.45** *0.45*	**0.49** *0.49*	**0.54** *0.54*	**0.59** *0.59*	**0.62** *0.62*	**0.65** *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	**4.2**	**5.7**	**7.3**	**9.2**	**10.8**	**12.7**
B10 *Residential 1/8 acre*	1.43 *1.43*	**0.45** *0.45*	**0.49** *0.49*	**0.54** *0.54*	**0.59** *0.59*	**0.62** *0.62*	**0.65** *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	**2.0**	**2.7**	**3.4**	**4.3**	**5.1**	**6.0**
B11 *Residential 1/8 acre*	4.45 *4.45*	**0.45** *0.45*	**0.49** *0.49*	**0.54** *0.54*	**0.59** *0.59*	**0.62** *0.62*	**0.65** *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	**6.1**	**8.3**	**10.7**	**13.4**	**15.8**	**18.5**
B12 *Residential 1/8 acre*	3.29 *3.29*	**0.45** *0.45*	**0.49** *0.49*	**0.54** *0.54*	**0.59** *0.59*	**0.62** *0.62*	**0.65** *0.65*	100	6	6.1	40 803	0.8 12	7 20	2.0% 1.5%	1.0 2.4	0.7 5.5	12.2	3.1	3.8	4.5	5.1	5.7	6.4	**4.5**	**6.2**	**7.9**	**9.9**	**11.7**	**13.7**
B13 *Residential 1/8 acre*	3.52 *3.52*	**0.45** *0.45*	**0.49** *0.49*	**0.54** *0.54*	**0.59** *0.59*	**0.62** *0.62*	**0.65** *0.65*	100	2	8.8	824	10	20	1.2%	2.2	6.2	15.0	2.8	3.5	4.1	4.7	5.3	5.9	**4.5**	**6.1**	**7.8**	**9.8**	**11.5**	**13.5**
B14 *Residential 1/8 acre*	4.29 *4.29*	**0.45** *0.45*	**0.49** *0.49*	**0.54** *0.54*	**0.59** *0.59*	**0.62** *0.62*	**0.65** *0.65*	100	2	8.8	934	13	20	1.4%	2.4	6.6	15.4	2.8	3.5	4.1	4.6	5.2	5.9	**5.4**	**7.3**	**9.4**	**11.8**	**13.9**	**16.3**
B15 *Landscape*	4.25 *4.25*	**0.09** *0.09*	**0.19** *0.19*	**0.29** *0.29*	**0.40** *0.40*	**0.46** *0.46*	**0.52** *0.52*	100	12	7.2	85	20	7	23.5%	3.4	0.4	7.7	3.6	4.5	5.3	6.0	6.8	7.6	**1.4**	**3.7**	**6.5**	**10.3**	**13.3**	**16.8**
C *Commercial*	11.25 *11.25*	**0.80** *0.80*	**0.82** *0.82*	**0.84** *0.84*	**0.87** *0.87*	**0.88** *0.88*	**0.89** *0.89*	100	2	4.0	2314	23	20	1.0%	2.0	19.3	23.4	2.3	2.9	3.3	3.8	4.3	4.8	**20.6**	**26.3**	**31.5**	**37.3**	**42.4**	**48.0**

Calculated by: DLM
Date: 8/12/2018

DESIGN POINT	AREA TOTAL (Acres)	WEIGHTED						TT	INTENSITY						TOTAL FLOWS					
		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.)
1	2.81	**0.43**	**0.47**	**0.52**	**0.58**	**0.61**	**0.64**	**12.4**	3.0	3.8	4.4	5.1	5.7	6.4	**3.7**	**5.0**	**6.5**	**8.2**	**9.8**	**11.5**
BASIN B1	1.60	0.41	0.46	0.51	0.57	0.60	0.64	12.4												
BASIN B2	1.21	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	8.51	**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	**10.5**	**14.4**	**18.6**	**23.4**	**27.7**	**32.5**
BASIN B5	3.36	0.45	0.49	0.54	0.59	0.62	0.65	12.9												
BASIN B6	1.60	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	11.32	**0.44**	**0.48**	**0.53**	**0.58**	**0.61**	**0.65**	**15.0**	2.8	3.5	4.1	4.7	5.3	5.9	**13.9**	**19.1**	**24.7**	**31.0**	**36.7**	**43.2**
DP-1	2.81	0.43	0.47	0.52	0.58	0.61	0.64	12.4												
DP-3	8.51	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	8.62	**0.41**	**0.46**	**0.51**	**0.57**	**0.60**	**0.64**	**14.2**	2.9	3.6	4.2	4.8	5.4	6.1	**10.3**	**14.3**	**18.6**	**23.6**	**28.1**	**33.2**
BASIN B9	3.07	0.45	0.49	0.54	0.59	0.62	0.65	12.5												
BASIN B10	1.43	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	19.94	**0.43**	**0.47**	**0.52**	**0.58**	**0.61**	**0.64**	**15.0**	2.8	3.5	4.1	4.7	5.3	5.9	**23.9**	**33.0**	**42.9**	**54.1**	**64.2**	**75.6**
DP-4	11.32	0.44	0.48	0.53	0.58	0.61	0.65	15.0												
DP-6	8.62	0.41	0.46	0.51	0.57	0.60	0.64	14.2												
8	7.74	**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	**10.6**	**14.5**	**18.6**	**23.2**	**27.5**	**32.2**
BASIN B11	4.45	0.45	0.49	0.54	0.59	0.62	0.65	12.3												
BASIN B12	3.29	0.45	0.49	0.54	0.59	0.62	0.65	12.2												
9	**27.68**	**0.45**	**0.49**	**0.54**	**0.59**	**0.62**	**0.65**	**15.0**	2.8	3.5	4.1	4.7	5.3	5.9	**35.0**	**47.8**	**61.4**	**76.7**	**90.7**	**106.4**
DP-7	19.94	0.43	0.47	0.52	0.58	0.61	0.64	15.0												
DP-8	7.74	0.45	0.49	0.54	0.59	0.62	0.65	12.3												
10	35.49	**0.45**	**0.49**	**0.54**	**0.59**	**0.62**	**0.65**	**15.4**	2.8	3.5	4.1	4.6	5.2	5.9	**44.5**	**60.6**	**77.9**	**97.3**	**115.1**	**135.0**
BASIN 1B	7.81	0.45	0.49	0.54	0.59	0.62	0.65	15.4												
DP-9	27.68	0.45	0.49	0.54	0.59	0.62	0.65	15.0												
1B	**7.81**	**0.45**	**0.49**	**0.54**	**0.59**	**0.62**	**0.65**	**15.4**	2.8	3.5	4.1	4.6	5.2	5.9	**9.8**	**13.3**	**17.2**	**21.4**	**25.3**	**29.7**
BASIN B13	3.52	0.45	0.49	0.54	0.59	0.62	0.65	15.0												
BASIN B14	4.29	0.45	0.49	0.54	0.59	0.62	0.65	15.4												
P-IN	50.99	**0.50**	**0.54**	**0.59**	**0.64**	**0.66**	**0.69**	23.4	2.3	2.9	3.3	3.8	4.3	4.8	**57.9**	**78.3**	**99.5**	**123.5**	**145.1**	**169.2**
BASIN B15	4.25	0.09	0.19	0.29	0.40	0.46	0.52	7.7												
BASIN C	11.25	0.80	0.82	0.84	0.87	0.88	0.89	23.4												
DP-10	35.49	0.45	0.49	0.54	0.59	0.62	0.65	15.4												
P-OUT POND OUTLET	**47.47**								**POND ROUTED**						**1.0**	**2.6**	**7.8**	**18.2**	**27.2**	**36.4**

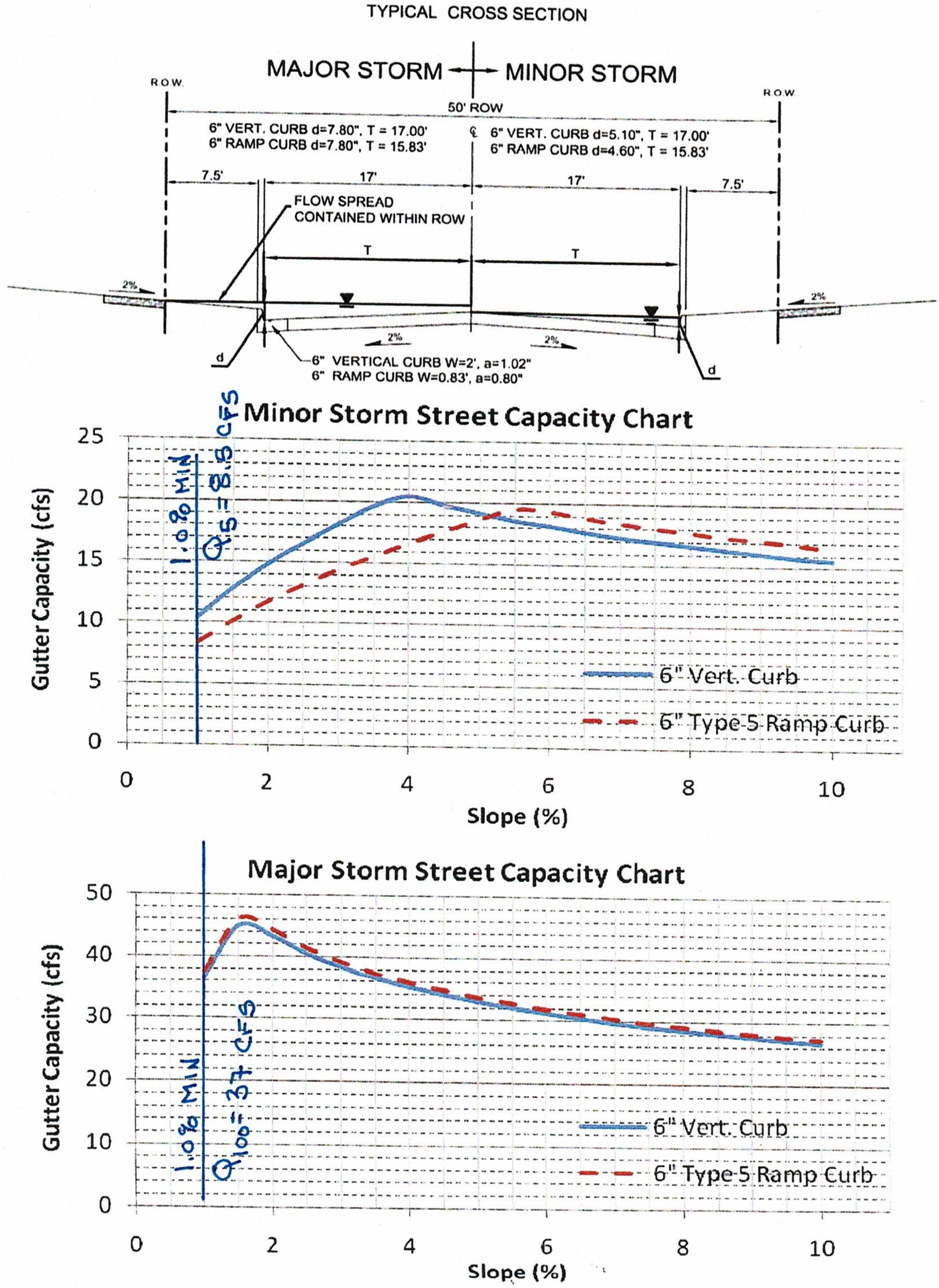
Update to include the routing of the entering off-site flows.

Why is the area for P-OUT less than P-IN?

Reference the UD-Detention Worksheet.

Calculated by: DLM
Date: 8/12/2018

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.

STREET AND INLET HYDRAULICS

Version 4.05 Released March 2017

Urban Drainage and Flood Control District

Denver, Colorado

Purpose: **This workbook can be used to size a variety of inlets based on allowable spread and depth in a street or swale.**

Content: **The workbook consists of the following worksheets:**

Q-Peak The *Q-Peak* sheet calculates the peak discharge for the inlet tributary area based on the Rational Method for the minor and major storm events. Alternatively, the user can enter a known flow. Information from this sheet is then exported to the *Inlet Management* sheet.

Inlet Management The *Inlet Management* sheet imports information from the *Q-Peak* sheet and *Inlet [#]* sheets and can be used to connect inlets in series so that bypass flow from an upstream inlet is added to flow calculated for the next downstream inlet. This sheet can also be used to modify design information from the Q-peak sheet.

Inlet [#] *Inlet [#]* sheets are created each time the user exports information from the *Q-Peak* sheet to the *Inlet Management* sheet. The *Inlet [#]* sheets calculate allowable half-street capacity based on allowable depth and allowable spread for the minor and major storm events. This is also where the user selects an inlet type and calculates the capacity of that inlet.

Inlet Pictures The Inlet Pictures sheet contains a library of photographs of the various types of inlets contained in UD-Inlet and referenced in the USDCM.

Acknowledgements: ***Spreadsheet Development Team:***
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Urban Drainage and Flood Control District
Derek N. Rapp, P.E.
Peak Stormwater Engineering, LLC

Comments? Direct all comments regarding this spreadsheet workbook to: UDFCD email
Revisions? Check for revised versions of this or any other workbook at: Downloads

Version 4.05 Released March 2017

INLET MANAGEMENT

Worksheet Protected

INLET NAME	B1	B2	B3	B4	B5	B6
Site Type (Urban or Rural)						
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET	STREET	STREET
Hydraulic Condition	In Sump	In Sump	In Sump	In Sump	In Sump	In Sump
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows						
Minor Q_{Known} (cfs)	2.8	2.4	4.0	2.5	6.2	2.8
Major Q_{Known} (cfs)	6.5	5.4	9.3	5.6	13.8	6.1
Bypass (Carry-Over) Flow from Upstream						
Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0		0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0		0.0	0.0	0.0
Watershed Characteristics						
Subcatchment Area (acres)						
Percent Impervious						
NRCS Soil Type						
Watershed Profile						
Overland Slope (ft/ft)						
Overland Length (ft)						
Channel Slope (ft/ft)						
Channel Length (ft)						
Minor Storm Rainfall Input						
Design Storm Return Period, T_r (years)						
One-Hour Precipitation, P_1 (inches)						
Major Storm Rainfall Input						
Design Storm Return Period, T_r (years)						
One-Hour Precipitation, P_1 (inches)						

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**2.8**	**2.4**	**4.0**	**2.5**	**6.2**	**2.8**
Major Total Design Peak Flow, Q (cfs)	**6.5**	**5.4**	**9.3**	**5.6**	**13.8**	**6.1**
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	N/A	N/A	N/A	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	N/A	N/A	N/A	N/A
Minor Storm (Calculated) Analysis of Flow Time						
C	N/A	N/A	N/A	N/A	N/A	N/A
C_5	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Velocity, Vi	N/A	N/A	N/A	N/A	N/A	N/A
Channel Flow Velocity, Vt	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Time, Ti	N/A	N/A	N/A	N/A	N/A	N/A
Channel Travel Time, Tt	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Time of Concentration, T_c	N/A	N/A	N/A	N/A	N/A	N/A
Regional T_c	N/A	N/A	N/A	N/A	N/A	N/A
Recommended T_c	N/A	N/A	N/A	N/A	N/A	N/A
T_c selected by User	N/A	N/A	N/A	N/A	N/A	N/A
Design Rainfall Intensity, I	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Local Peak Flow, Q_p	N/A	N/A	N/A	N/A	N/A	N/A
Major Storm (Calculated) Analysis of Flow Time						
C	N/A	N/A	N/A	N/A	N/A	N/A
C_5	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Velocity, Vi	N/A	N/A	N/A	N/A	N/A	N/A
Channel Flow Velocity, Vt	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Time, Ti	N/A	N/A	N/A	N/A	N/A	N/A
Channel Travel Time, Tt	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Time of Concentration, T_c	N/A	N/A	N/A	N/A	N/A	N/A
Regional T_c	N/A	N/A	N/A	N/A	N/A	N/A
Recommended T_c	N/A	N/A	N/A	N/A	N/A	N/A
T_c selected by User	N/A	N/A	N/A	N/A	N/A	N/A
Design Rainfall Intensity, I	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Local Peak Flow, Q_p	N/A	N/A	N/A	N/A	N/A	N/A

Version 4.05 Released March 2017

INLET MANAGEMENT

Worksheet Protected

INLET NAME	B7	B8	B9	B10	B11	B12
Site Type (Urban or Rural)						
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET	STREET	STREET
Hydraulic Condition	In Sump	In Sump	In Sump	In Sump	In Sump	In Sump
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	5.7	0.7	5.7	2.7	8.3	6.2
Major Q_{Known} (cfs)	14.2	1.6	12.7	6.0	18.5	13.7

Bypass (Carry-Over) Flow from Upstream

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

Watershed Characteristics

Subcatchment Area (acres)						
Percent Impervious						
NRCS Soil Type						

Watershed Profile

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

Minor Storm Rainfall Input

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

Major Storm Rainfall Input

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

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**5.7**	**0.7**	**5.7**	**2.7**	**8.3**	**6.2**
Major Total Design Peak Flow, Q (cfs)	**14.2**	**1.6**	**12.7**	**6.0**	**18.5**	**13.7**
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	N/A	N/A	N/A	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	N/A	N/A	N/A	N/A

Minor Storm (Calculated) Analysis of Flow T

C	N/A	N/A	N/A	N/A	N/A	N/A
C_5	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Velocity, Vi	N/A	N/A	N/A	N/A	N/A	N/A
Channel Flow Velocity, Vt	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Time, Ti	N/A	N/A	N/A	N/A	N/A	N/A
Channel Travel Time, Tt	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Time of Concentration, T_c	N/A	N/A	N/A	N/A	N/A	N/A
Regional T_c	N/A	N/A	N/A	N/A	N/A	N/A
Recommended T_c	N/A	N/A	N/A	N/A	N/A	N/A
T_c selected by User	N/A	N/A	N/A	N/A	N/A	N/A
Design Rainfall Intensity, I	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Local Peak Flow, Q_p	N/A	N/A	N/A	N/A	N/A	N/A

Major Storm (Calculated) Analysis of Flow T

C	N/A	N/A	N/A	N/A	N/A	N/A
C_5	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Velocity, Vi	N/A	N/A	N/A	N/A	N/A	N/A
Channel Flow Velocity, Vt	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Time, Ti	N/A	N/A	N/A	N/A	N/A	N/A
Channel Travel Time, Tt	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Time of Concentration, T_c	N/A	N/A	N/A	N/A	N/A	N/A
Regional T_c	N/A	N/A	N/A	N/A	N/A	N/A
Recommended T_c	N/A	N/A	N/A	N/A	N/A	N/A
T_c selected by User	N/A	N/A	N/A	N/A	N/A	N/A
Design Rainfall Intensity, I	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Local Peak Flow, Q_p	N/A	N/A	N/A	N/A	N/A	N/A

Version 4.05 Released March 2017

INLET MANAGEMENT

Worksheet Protected

INLET NAME	1B
Site Type (Urban or Rural)	
Inlet Application (Street or Area)	STREET
Hydraulic Condition	In Sump
Inlet Type	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	13.3
Major Q_{Known} (cfs)	29.7

Bypass (Carry-Over) Flow from Upstream

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

Watershed Characteristics

Subcatchment Area (acres)	
Percent Impervious	
NRCS Soil Type	

Watershed Profile

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

Minor Storm Rainfall Input

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

Major Storm Rainfall Input

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

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**13.3**
Major Total Design Peak Flow, Q (cfs)	**29.7**
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	N/A

Minor Storm (Calculated) Analysis of Flow T

C	N/A
C_5	N/A
Overland Flow Velocity, Vi	N/A
Channel Flow Velocity, Vt	N/A
Overland Flow Time, Ti	N/A
Channel Travel Time, Tt	N/A
Calculated Time of Concentration, T_c	N/A
Regional T_c	N/A
Recommended T_c	N/A
T_c selected by User	N/A
Design Rainfall Intensity, I	N/A
Calculated Local Peak Flow, Q_p	N/A

Major Storm (Calculated) Analysis of Flow T

C	N/A
C_5	N/A
Overland Flow Velocity, Vi	N/A
Channel Flow Velocity, Vt	N/A
Overland Flow Time, Ti	N/A
Channel Travel Time, Tt	N/A
Calculated Time of Concentration, T_c	N/A
Regional T_c	N/A
Recommended T_c	N/A
T_c selected by User	N/A
Design Rainfall Intensity, I	N/A
Calculated Local Peak Flow, Q_p	N/A

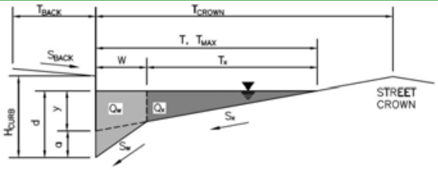
Version 4.05 Released March 2017

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)

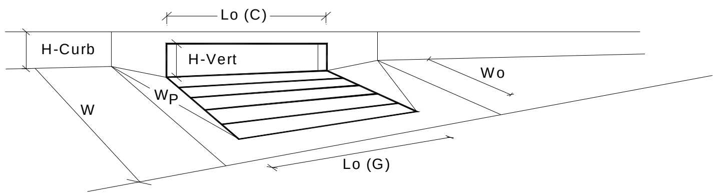
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	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} =	17.0	17.0	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)	$Q_{PEAK\ REQUIRED}$ =	2.8	6.5	cfs

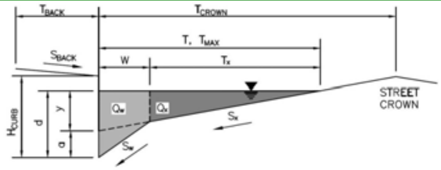
Version 4.05 Released March 2017

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: B2



Gutter Geometry (Enter data in the blue cells)

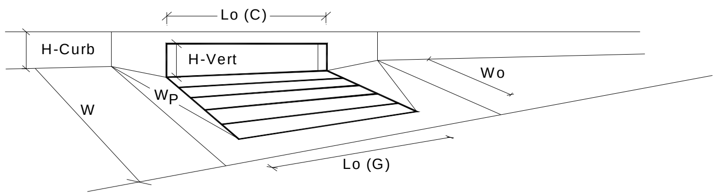
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	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} =	17.0	17.0	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)	$Q_{PEAK\ REQUIRED}$ =	2.4	5.4	cfs

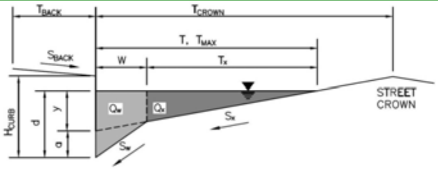
Version 4.05 Released March 2017

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: B3

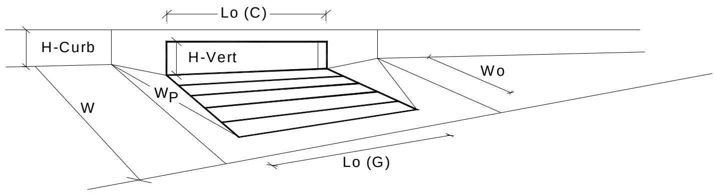


Gutter Geometry (Enter data in the blue cells)

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} =	0.020		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.020		ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083		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} =	17.0	17.0	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

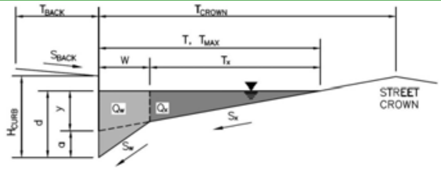
Version 4.05 Released March 2017

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)

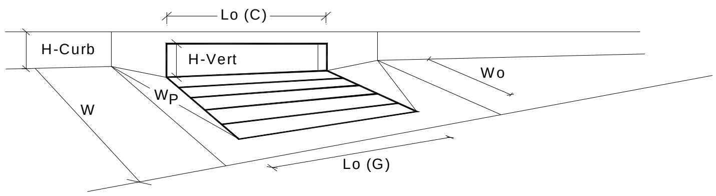
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	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} =	17.0	17.0	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)		MINOR	MAJOR	
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 =	5.1	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

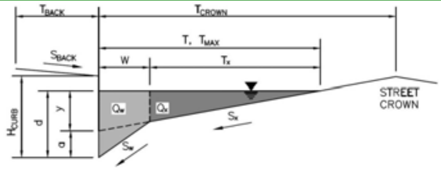
Version 4.05 Released March 2017

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)

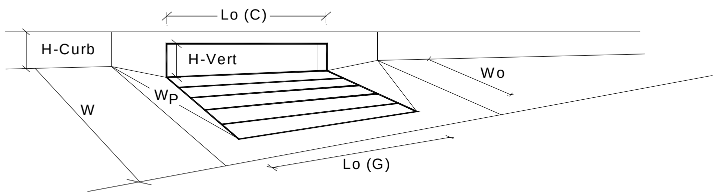
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches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



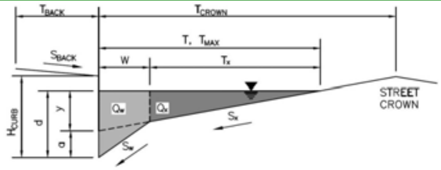
Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (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)		$Q_{PEAK\ REQUIRED}$ =	6.2	13.8	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)

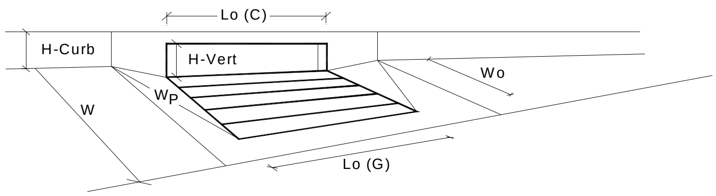
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	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} =	17.0	17.0	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)		$Q_{PEAK\ REQUIRED}$ =	2.8	6.1	cfs

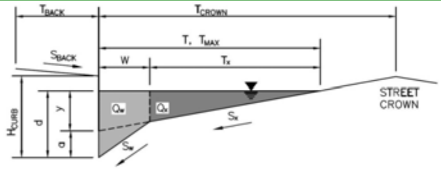
Version 4.05 Released March 2017

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



For local road this is mainly back of sidewalk. Revise the manning's n.

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} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	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	

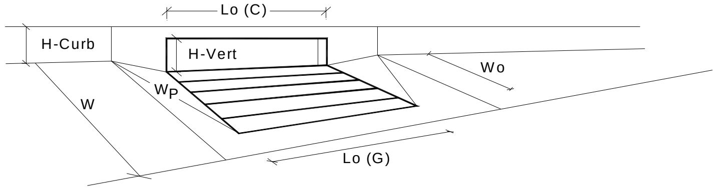
14" gutter for Optional Type C curb

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.5	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

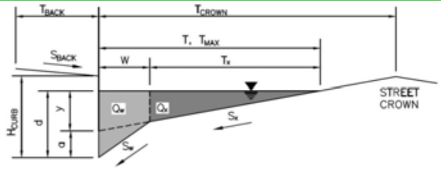
Version 4.05 Released March 2017

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)

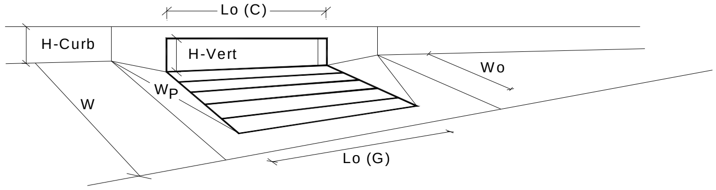
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	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} =	17.0	17.0	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)	$Q_{PEAK\ REQUIRED}$ =	0.7	1.6	cfs

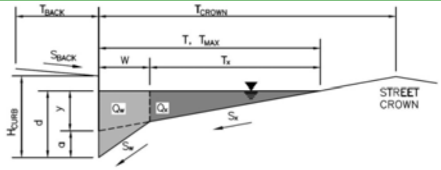
Version 4.05 Released March 2017

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)

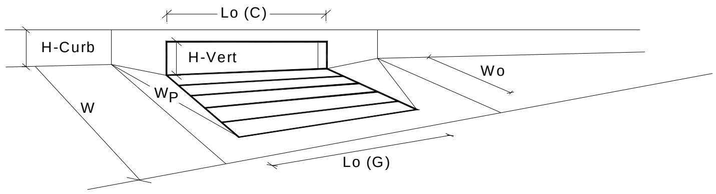
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	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} =	17.0	17.0	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)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening	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	12.7	cfs

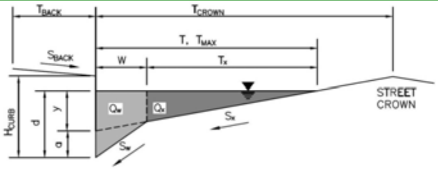
Version 4.05 Released March 2017

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)

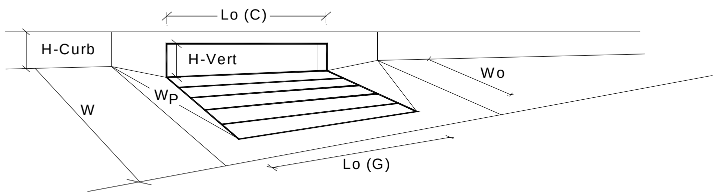
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches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

		MINOR	MAJOR	
Low Head Performance Reduction (Calculated)				
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)	$Q_{PEAK\ REQUIRED}$ =	2.7	6.0	cfs

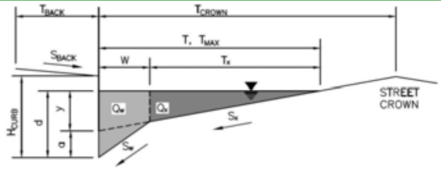
Version 4.05 Released March 2017

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: B11



Gutter Geometry (Enter data in the blue cells)

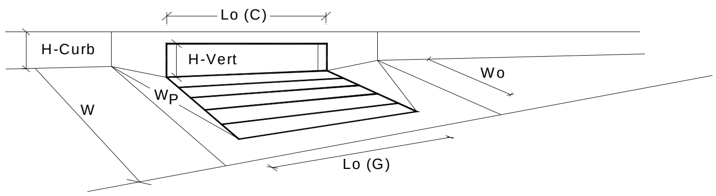
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches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

		MINOR	MAJOR	
Low Head Performance Reduction (Calculated)				
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**
WARNING: Inlet Capacity less than Q Peak for Minor Storm	$Q_{PEAK\ REQUIRED}$ =	8.3	18.5	cfs

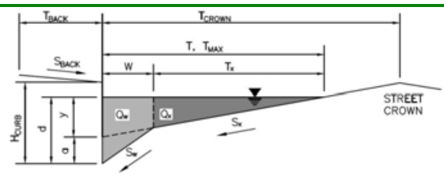
Version 4.05 Released March 2017

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: B12



Gutter Geometry (Enter data in the blue cells)

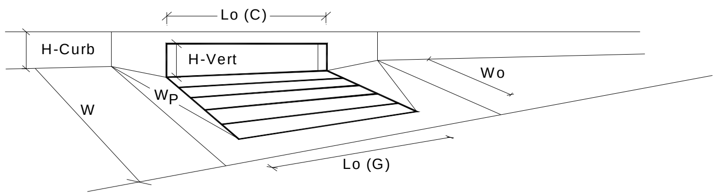
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	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} =	17.0	17.0	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)	$Q_{PEAK\ REQUIRED}$ =	6.2	13.7	cfs

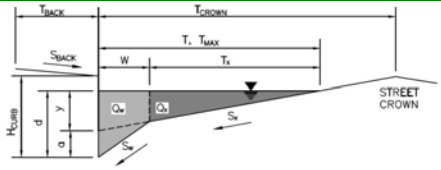
Version 4.05 Released March 2017

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: 1B



Gutter Geometry (Enter data in the blue cells)

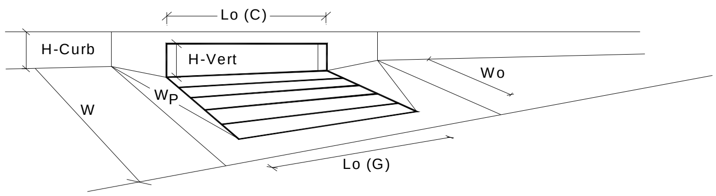
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	50.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	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} =	50.0	50.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.5	8.1	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



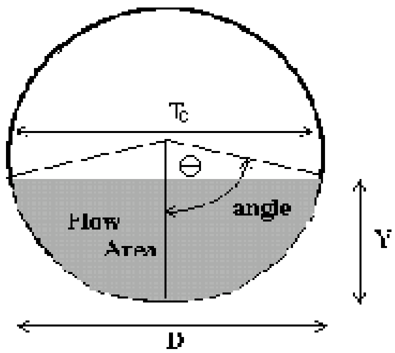
Design Information (Input)			MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	8.5	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) =	20.00	20.00	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} =	0.33	0.54	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.57	0.80	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.79	0.91	
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 =	**12.5**	**30.0**	**cfs**
WARNING: Inlet Capacity less than Q Peak for Minor Storm	$Q_{PEAK\ REQUIRED}$ =	13.3	29.7	cfs

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

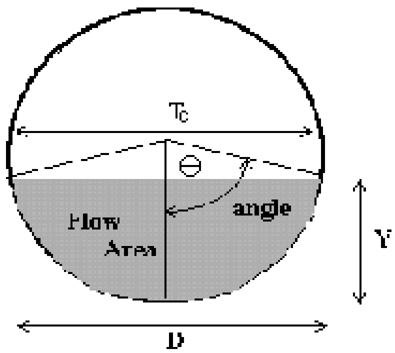
Project: Riverbend Crossing
Pipe ID: Pipe Design Point 1



Design Information (Input)			
Pipe Invert Slope	So =	0.0050	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	24.00	inches
Design discharge	**Q =**	**11.50**	**cfs**
Full-flow Capacity (Calculated)			
Full-flow area	Af =	3.14	sq ft
Full-flow wetted perimeter	Pf =	6.28	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	16.04	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.83	radians
Flow area	An =	2.07	sq ft
Top width	Tn =	1.93	ft
Wetted perimeter	Pn =	3.65	ft
Flow depth	Yn =	1.25	ft
Flow velocity	Vn =	5.55	fps
Discharge	Qn =	11.50	cfs
Percent Full Flow	Flow =	71.7%	of full flow
Normal Depth Froude Number	Fr_n =	0.95	subcritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	1.79	radians
Critical flow area	Ac =	2.00	sq ft
Critical top width	Tc =	1.95	ft
Critical flow depth	Yc =	1.22	ft
Critical flow velocity	Vc =	5.75	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

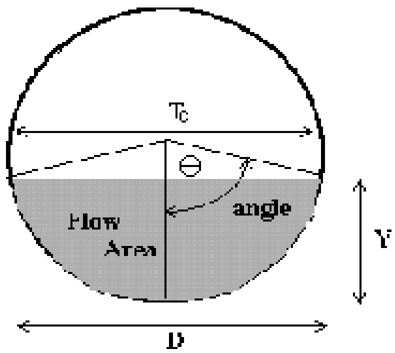
Project: Riverbend Crossing
Pipe ID: Pipe Design Point 2



Design Information (Input)			
Pipe Invert Slope	So =	0.0179	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	24.00	inches
Design discharge	**Q =**	**14.60**	**cfs**
Full-flow Capacity (Calculated)			
Full-flow area	Af =	3.14	sq ft
Full-flow wetted perimeter	Pf =	6.28	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	30.35	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.55	radians
Flow area	An =	1.53	sq ft
Top width	Tn =	2.00	ft
Wetted perimeter	Pn =	3.10	ft
Flow depth	Yn =	0.98	ft
Flow velocity	Vn =	9.57	fps
Discharge	Qn =	14.60	cfs
Percent Full Flow	Flow =	48.1%	of full flow
Normal Depth Froude Number	Fr_n =	1.93	supercritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	1.96	radians
Critical flow area	Ac =	2.31	sq ft
Critical top width	Tc =	1.85	ft
Critical flow depth	Yc =	1.38	ft
Critical flow velocity	Vc =	6.33	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

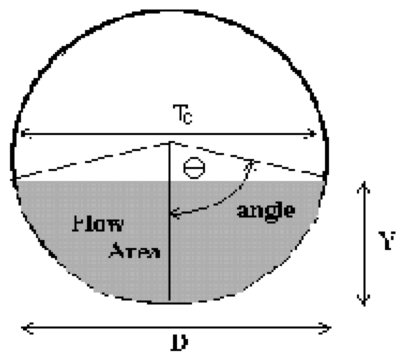
Project: **Riverbend Crossing**
Pipe ID: **Pipe Design Point 3**



Design Information (Input)			
Pipe Invert Slope	So =	0.0065	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	30.00	inches
Design discharge	**Q =**	**32.50**	**cfs**
Full-flow Capacity (Calculated)			
Full-flow area	Af =	4.91	sq ft
Full-flow wetted perimeter	Pf =	7.85	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	33.16	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	2.22	radians
Flow area	An =	4.22	sq ft
Top width	Tn =	1.99	ft
Wetted perimeter	Pn =	5.55	ft
Flow depth	Yn =	2.01	ft
Flow velocity	Vn =	7.70	fps
Discharge	Qn =	32.50	cfs
Percent Full Flow	Flow =	98.0%	of full flow
Normal Depth Froude Number	Fr_n =	0.93	subcritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	2.16	radians
Critical flow area	Ac =	4.09	sq ft
Critical top width	Tc =	2.08	ft
Critical flow depth	Yc =	1.94	ft
Critical flow velocity	Vc =	7.95	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

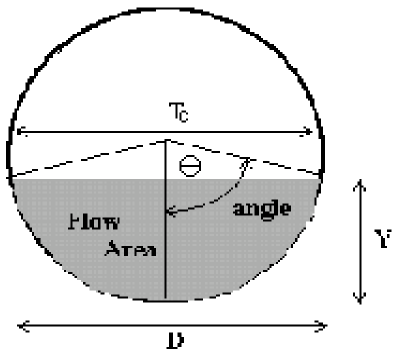
Project: **Riverbend Crossing**
Pipe ID: **Pipe Design Point 4**



Design Information (Input)			
Pipe Invert Slope	So =	0.0100	ft/ft
Pipe Manning's n-value	n =	0.0120	
Pipe Diameter	D =	30.00	inches
Design discharge	**Q =**	**43.20**	**cfs**
Full-flow Capacity (Calculated)			
Full-flow area	Af =	4.91	sq ft
Full-flow wetted perimeter	Pf =	7.85	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	44.55	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	2.20	radians
Flow area	An =	4.18	sq ft
Top width	Tn =	2.02	ft
Wetted perimeter	Pn =	5.50	ft
Flow depth	Yn =	1.98	ft
Flow velocity	Vn =	10.34	fps
Discharge	Qn =	43.20	cfs
Percent Full Flow	Flow =	97.0%	of full flow
Normal Depth Froude Number	Fr_n =	1.27	supercritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	2.43	radians
Critical flow area	Ac =	4.56	sq ft
Critical top width	Tc =	1.64	ft
Critical flow depth	Yc =	2.19	ft
Critical flow velocity	Vc =	9.47	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

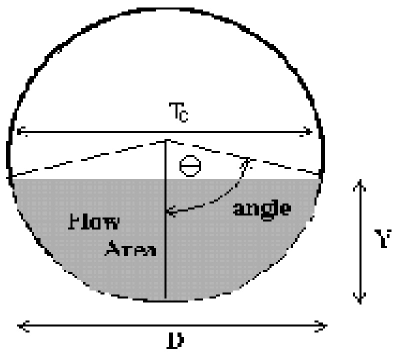
Project: **Riverbend Crossing**
Pipe ID: **Pipe Design Point 5**



Design Information (Input)			
Pipe Invert Slope	So =	0.0050	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	24.00	inches
Design discharge	**Q =**	**15.50**	**cfs**
Full-flow Capacity (Calculated)			
Full-flow area	Af =	3.14	sq ft
Full-flow wetted perimeter	Pf =	6.28	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	16.04	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	2.19	radians
Flow area	An =	2.67	sq ft
Top width	Tn =	1.63	ft
Wetted perimeter	Pn =	4.38	ft
Flow depth	Yn =	1.58	ft
Flow velocity	Vn =	5.82	fps
Discharge	Qn =	15.50	cfs
Percent Full Flow	Flow =	96.6%	of full flow
Normal Depth Froude Number	Fr_n =	0.80	subcritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	2.00	radians
Critical flow area	Ac =	2.38	sq ft
Critical top width	Tc =	1.82	ft
Critical flow depth	Yc =	1.42	ft
Critical flow velocity	Vc =	6.50	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

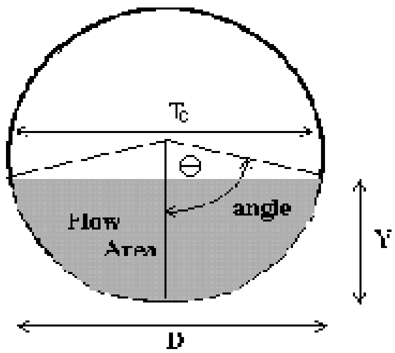
Project: **Riverbend Crossing**
Pipe ID: **Pipe Design Point 6**



Design Information (Input)			
Pipe Invert Slope	So =	0.0660	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	30.00	inches
Design discharge	**Q =**	**33.20**	**cfs**
Full-flow Capacity (Calculated)			
Full-flow area	Af =	4.91	sq ft
Full-flow wetted perimeter	Pf =	7.85	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	105.66	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.34	radians
Flow area	An =	1.74	sq ft
Top width	Tn =	2.43	ft
Wetted perimeter	Pn =	3.35	ft
Flow depth	Yn =	0.96	ft
Flow velocity	Vn =	19.05	fps
Discharge	Qn =	33.21	cfs
Percent Full Flow	Flow =	31.4%	of full flow
Normal Depth Froude Number	Fr_n =	3.97	supercritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	2.18	radians
Critical flow area	Ac =	4.13	sq ft
Critical top width	Tc =	2.06	ft
Critical flow depth	Yc =	1.96	ft
Critical flow velocity	Vc =	8.04	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

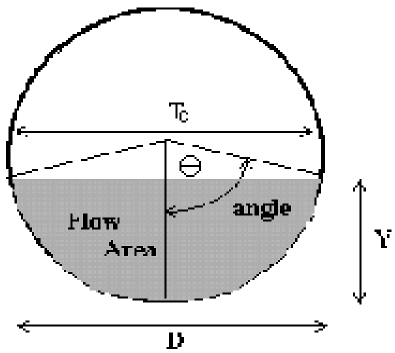
Project: **Riverbend Crossing**
Pipe ID: **Pipe Design Point 7**



Design Information (Input)			
Pipe Invert Slope	So =	0.0060	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	42.00	inches
Design discharge	**Q =**	**75.60**	**cfs**
Full-flow Capacity (Calculated)			
Full-flow area	Af =	9.62	sq ft
Full-flow wetted perimeter	Pf =	11.00	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	78.14	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	2.19	radians
Flow area	An =	8.17	sq ft
Top width	Tn =	2.84	ft
Wetted perimeter	Pn =	7.68	ft
Flow depth	Yn =	2.77	ft
Flow velocity	Vn =	9.25	fps
Discharge	Qn =	75.60	cfs
Percent Full Flow	Flow =	96.7%	of full flow
Normal Depth Froude Number	Fr_n =	0.96	subcritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	2.16	radians
Critical flow area	Ac =	8.03	sq ft
Critical top width	Tc =	2.91	ft
Critical flow depth	Yc =	2.72	ft
Critical flow velocity	Vc =	9.42	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

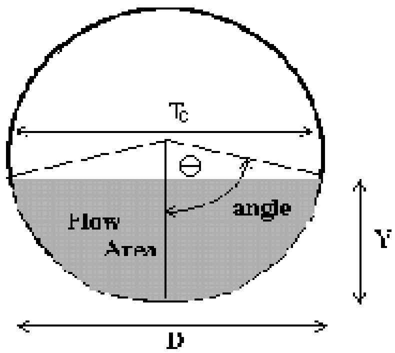
Project: **Riverbend Crossing**
Pipe ID: **Pipe Design Point 8**



Design Information (Input)			
Pipe Invert Slope	So =	0.0065	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	30.00	inches
Design discharge	**Q =**	**32.20**	**cfs**
Full-flow Capacity (Calculated)			
Full-flow area	Af =	4.91	sq ft
Full-flow wetted perimeter	Pf =	7.85	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	33.16	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	2.20	radians
Flow area	An =	4.18	sq ft
Top width	Tn =	2.02	ft
Wetted perimeter	Pn =	5.50	ft
Flow depth	Yn =	1.99	ft
Flow velocity	Vn =	7.70	fps
Discharge	Qn =	32.20	cfs
Percent Full Flow	Flow =	97.1%	of full flow
Normal Depth Froude Number	Fr_n =	0.94	subcritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	2.15	radians
Critical flow area	Ac =	4.07	sq ft
Critical top width	Tc =	2.09	ft
Critical flow depth	Yc =	1.93	ft
Critical flow velocity	Vc =	7.91	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

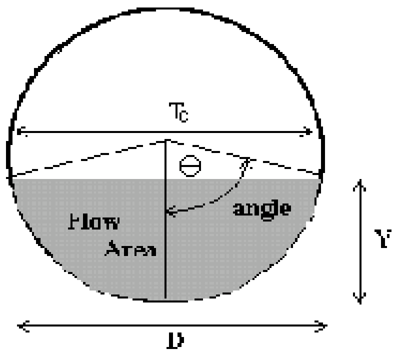
Project: Riverbend Crossing
Pipe ID: Pipe Design Point 9



Design Information (Input)			
Pipe Invert Slope	So =	0.0086	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	48.00	inches
Design discharge	**Q =**	**106.40**	**cfs**
Full-flow Capacity (Calculated)			
Full-flow area	Af =	12.57	sq ft
Full-flow wetted perimeter	Pf =	12.57	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	133.57	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.93	radians
Flow area	An =	9.02	sq ft
Top width	Tn =	3.75	ft
Wetted perimeter	Pn =	7.71	ft
Flow depth	Yn =	2.70	ft
Flow velocity	Vn =	11.80	fps
Discharge	Qn =	106.40	cfs
Percent Full Flow	Flow =	79.7%	of full flow
Normal Depth Froude Number	Fr_n =	1.34	supercritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	2.17	radians
Critical flow area	Ac =	10.52	sq ft
Critical top width	Tc =	3.31	ft
Critical flow depth	Yc =	3.12	ft
Critical flow velocity	Vc =	10.11	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

Project: Riverbend Crossing
Pipe ID: Pipe Design Point 10



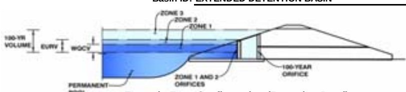
Design Information (Input)			
Pipe Invert Slope	So =	0.0090	ft/ft
Pipe Manning's n-value	n =	0.0120	
Pipe Diameter	D =	48.00	inches
Design discharge	**Q =**	**135.00**	**cfs**
Full-flow Capacity (Calculated)			
Full-flow area	Af =	12.57	sq ft
Full-flow wetted perimeter	Pf =	12.57	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	148.03	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	2.09	radians
Flow area	An =	10.11	sq ft
Top width	Tn =	3.46	ft
Wetted perimeter	Pn =	8.38	ft
Flow depth	Yn =	3.00	ft
Flow velocity	Vn =	13.35	fps
Discharge	Qn =	135.00	cfs
Percent Full Flow	Flow =	91.2%	of full flow
Normal Depth Froude Number	Fr_n =	1.38	supercritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	2.39	radians
Critical flow area	Ac =	11.56	sq ft
Critical top width	Tc =	2.73	ft
Critical flow depth	Yc =	3.46	ft
Critical flow velocity	Vc =	11.68	fps
Critical Depth Froude Number	Fr_c =	1.00	

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)

Depth Increment = 1 ft

Required Volume Calculation

Selected BMP Type =	**EDB**			
Watershed Area =	51.10	acres		
Watershed Length =	2,642	ft		
Watershed Slope =	0.017	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) =	1.089	acre-feet	Optional User Override 1-hr Precipitation	
Excess Urban Runoff Volume (EURV) =	3.455	acre-feet		
2-yr Runoff Volume (P1 = 1.19 in.) =	3.028	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	4.192	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	5.148	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	6.490	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	7.630	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	9.020	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	11.954	acre-feet		inches
Approximate 2-yr Detention Volume =	2.847	acre-feet		
Approximate 5-yr Detention Volume =	3.953	acre-feet		
Approximate 10-yr Detention Volume =	4.574	acre-feet		
Approximate 25-yr Detention Volume =	5.020	acre-feet		
Approximate 50-yr Detention Volume =	5.256	acre-feet		
Approximate 100-yr Detention Volume =	5.742	acre-feet		

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	1.089	acre-feet
Zone 2 Volume (EURV - Zone 1) =	2.366	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	2.288	acre-feet
Total Detention Basin Volume =	5.742	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

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	--	--	--	120	0.003		
ISV	--	0.33	--	--	--	120	0.003	38	0.001
FLOOR-5677.0	--	1.00	--	--	--	3,311	0.076	1,156	0.027
5678	--	2.00	--	--	--	6,621	0.152	6,089	0.140
5680	--	4.00	--	--	--	37,113	0.852	49,889	1.145
5682	--	6.00	--	--	--	58,370	1.340	145,372	3.337
5684	--	8.00	--	--	--	67,954	1.560	271,696	6.237
5686	--	10.00	--	--	--	78,844	1.810	418,494	9.607
5688	--	12.00	--	--	--	90,169	2.070	587,507	13.487
5690	--	14.00	--	--	--	101,930	2.340	779,606	17.897
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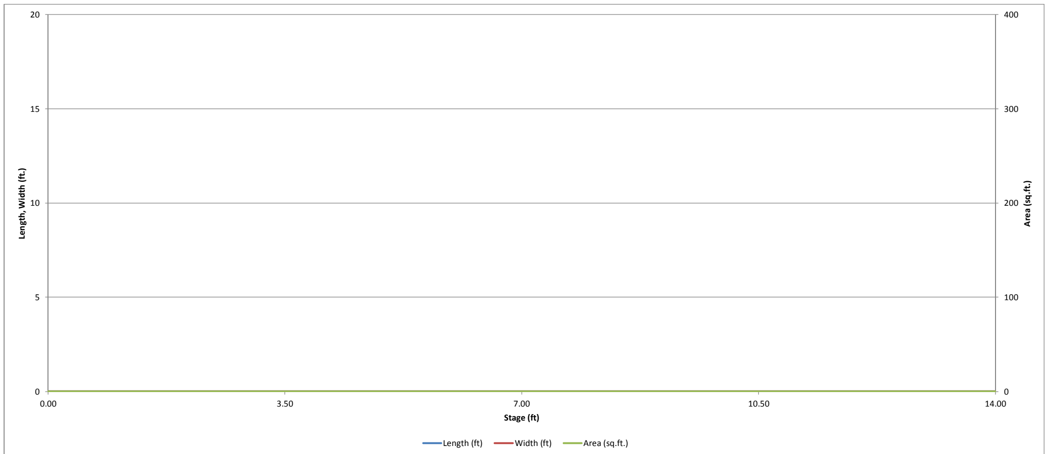
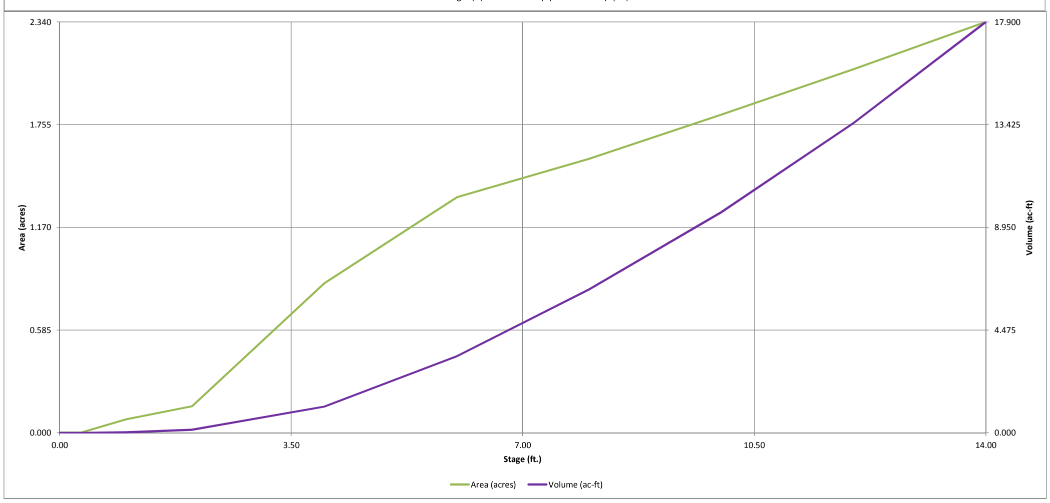
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)





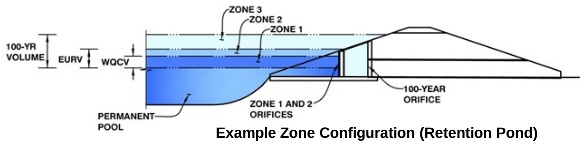
Submit the UD-BMP worksheet which provides the design calc for the forebay.

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)	3.94	1.089	Orifice Plate
Zone 2 (EURV)	6.09	2.366	Orifice Plate
Zone 3 (100-year)	7.68	2.288	Weir&Pipe (Restrict)
		5.742	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 =	6.09	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	24.40	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	2.03	4.06					
Orifice Area (sq. inches)	4.19	4.19	10.00					

	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 =	6.09	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00	N/A	feet
Overflow Weir Slope =	4.00	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 =	7.09	N/A	feet
Over Flow Weir Slope Length =	4.12	N/A	feet
Grate Open Area / 100-yr Orifice Area =	2.35	N/A	should be $\geq$ 4
Overflow Grate Open Area w/o Debris =	11.54	N/A	ft^2
Overflow Grate Open Area w/ Debris =	5.77	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 =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	30.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	30.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	4.91	N/A	ft^2
Outlet Orifice Centroid =	1.25	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	8.10	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	40.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

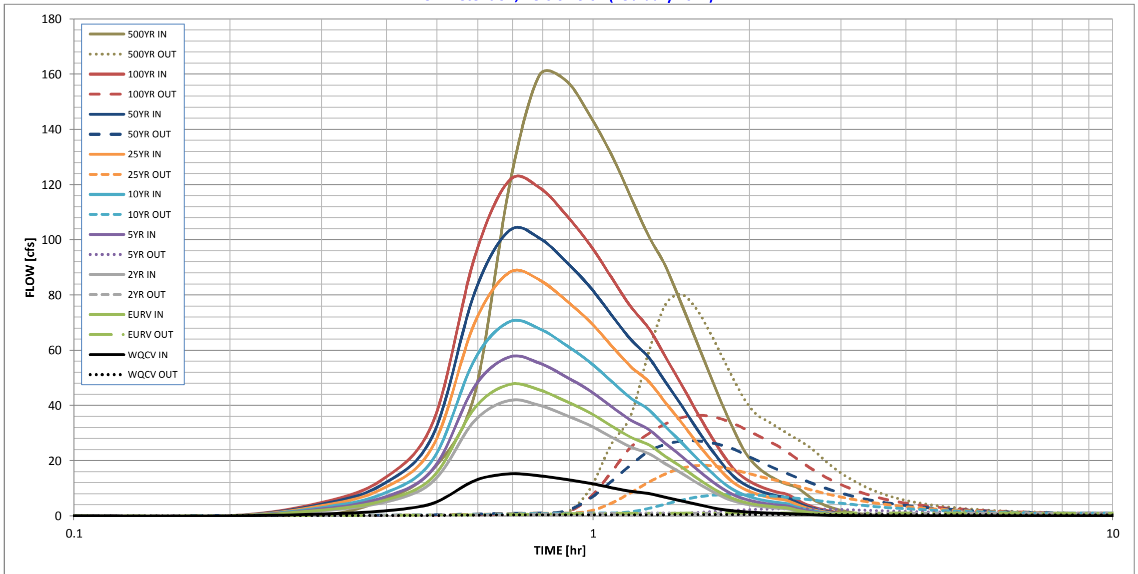
Spillway Design Flow Depth=	0.95	feet
Stage at Top of Freeboard =	10.05	feet
Basin Area at Top of Freeboard =	1.82	acres

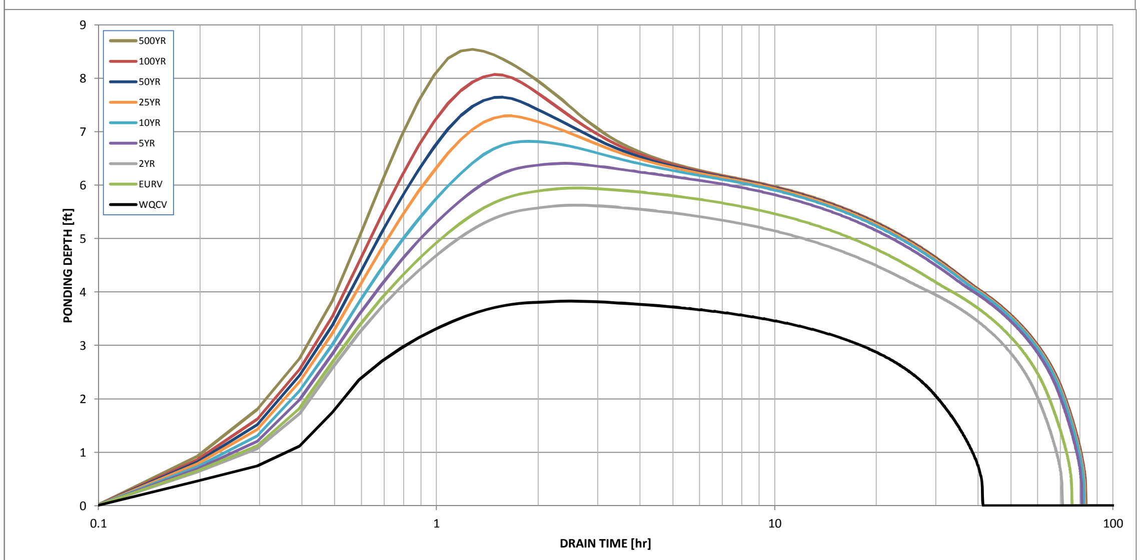
Routed Hydrograph Results

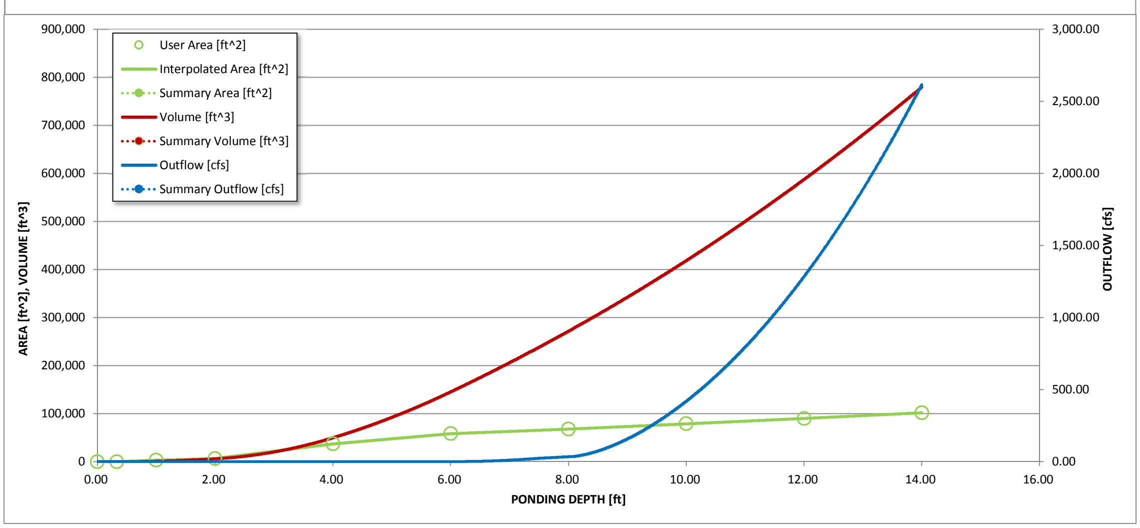
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.14
Calculated Runoff Volume (acre-ft) =	1.089	3.455	3.028	4.192	5.148	6.490	7.630	9.020	11.954
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	1.088	3.455	3.029	4.192	5.142	6.483	7.632	9.017	11.948
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.08	0.21	0.50	0.69	0.95	1.45
Predevelopment Peak Q (cfs) =	0.0	0.0	0.5	3.9	10.7	25.4	35.1	48.3	74.2
Peak Inflow Q (cfs) =	15.2	47.6	41.8	57.6	70.3	88.1	103.3	121.5	159.5
Peak Outflow Q (cfs) =	0.5	1.1	1.0	2.6	7.8	18.2	27.2	36.4	80.2
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.7	0.7	0.7	0.8	0.8	1.1
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.1	0.6	1.5	2.2	3.0	3.6
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	67	63	71	71	69	68	67	64
Time to Drain 99% of Inflow Volume (hours) =	**40**	72	68	77	78	77	77	76	74
Maximum Ponding Depth (ft) =	3.83	5.95	5.63	6.41	6.82	7.30	7.65	8.07	8.54
Area at Maximum Ponding Depth (acres) =	0.79	1.33	1.25	1.38	1.43	1.48	1.52	1.57	1.63
Maximum Volume Stored (acre-ft) =	0.998	3.257	2.846	3.882	4.459	5.157	5.683	6.331	7.098

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]
5.90 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph	0:11:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	0:17:42	0.67	2.00	1.77	2.39	2.86	3.48	3.98	4.55	5.64
0.848	0:23:36	1.80	5.53	4.87	6.64	8.02	9.91	11.47	13.28	16.95
	0:29:30	4.63	14.19	12.51	17.03	20.59	25.44	29.44	34.13	43.57
	0:35:24	12.73	38.92	34.32	46.70	56.42	69.65	80.57	93.31	118.94
	0:41:18	15.23	47.60	41.81	57.55	70.28	88.13	103.29	121.45	159.47
	0:47:12	14.55	45.70	40.11	55.38	67.87	85.54	100.68	118.98	157.80
	0:53:06	13.25	41.59	36.50	50.44	61.92	78.19	92.19	109.14	145.25
	0:59:00	11.86	37.44	32.84	45.44	55.80	70.50	83.15	98.48	131.13
	1:04:54	10.27	32.71	28.65	39.76	48.89	61.87	73.07	86.65	115.63
	1:10:48	8.94	28.52	24.97	34.71	42.72	54.12	63.94	75.86	101.31
	1:16:42	8.10	25.78	22.59	31.33	38.50	48.68	57.43	68.03	90.60
	1:22:36	6.72	21.57	18.88	26.26	32.35	41.03	48.53	57.64	77.15
	1:28:30	5.51	17.86	15.61	21.76	26.83	34.07	40.33	47.94	64.23
	1:34:24	4.28	14.11	12.32	17.24	21.33	27.19	32.26	38.45	51.75
	1:40:18	3.22	10.87	9.46	13.32	16.53	21.12	25.12	29.99	40.48
	1:46:12	2.34	8.09	7.02	9.95	12.39	15.90	18.95	22.69	30.74
	1:52:06	1.80	6.08	5.29	7.46	9.26	11.84	14.07	16.80	22.66
	1:58:00	1.47	4.91	4.28	6.00	7.42	9.45	11.21	13.34	17.91
	2:03:54	1.25	4.13	3.61	5.05	6.24	7.94	9.40	11.18	14.98
	2:09:48	1.09	3.60	3.14	4.39	5.42	6.88	8.15	9.68	12.94
	2:15:42	0.98	3.22	2.81	3.93	4.84	6.14	7.26	8.62	11.51
	2:21:36	0.90	2.95	2.58	3.60	4.43	5.62	6.64	7.87	10.49
	2:27:30	0.66	2.19	1.91	2.68	3.32	4.24	5.04	6.02	8.13
	2:33:24	0.49	1.59	1.39	1.94	2.40	3.06	3.64	4.34	5.86
	2:39:18	0.36	1.17	1.02	1.44	1.78	2.27	2.70	3.22	4.35
	2:45:12	0.26	0.87	0.76	1.07	1.32	1.69	2.01	2.39	3.23
	2:51:06	0.19	0.64	0.56	0.78	0.97	1.24	1.48	1.77	2.39
	2:57:00	0.13	0.46	0.40	0.56	0.70	0.90	1.07	1.28	1.73
	3:02:54	0.10	0.33	0.29	0.41	0.51	0.65	0.77	0.92	1.25
	3:08:48	0.06	0.23	0.20	0.28	0.36	0.46	0.55	0.66	0.89
	3:14:42	0.04	0.15	0.13	0.18	0.23	0.30	0.36	0.43	0.60
	3:20:36	0.02	0.08	0.07	0.10	0.13	0.18	0.21	0.26	0.36
	3:26:30	0.01	0.04	0.03	0.05	0.06	0.08	0.10	0.13	0.18
	3:32:24	0.00	0.01	0.01	0.01	0.02	0.03	0.03	0.04	0.06
	3:38:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:44:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:56:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:01:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:07:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:13:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:19:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:31:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:37:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:43:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:49:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:06:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:12:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:18:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:24:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:36:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:42:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:48:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:54:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:59:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:05:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:11:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:17:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:23:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:29:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:35:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:41:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:47:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:53:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:58:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:04:48	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.

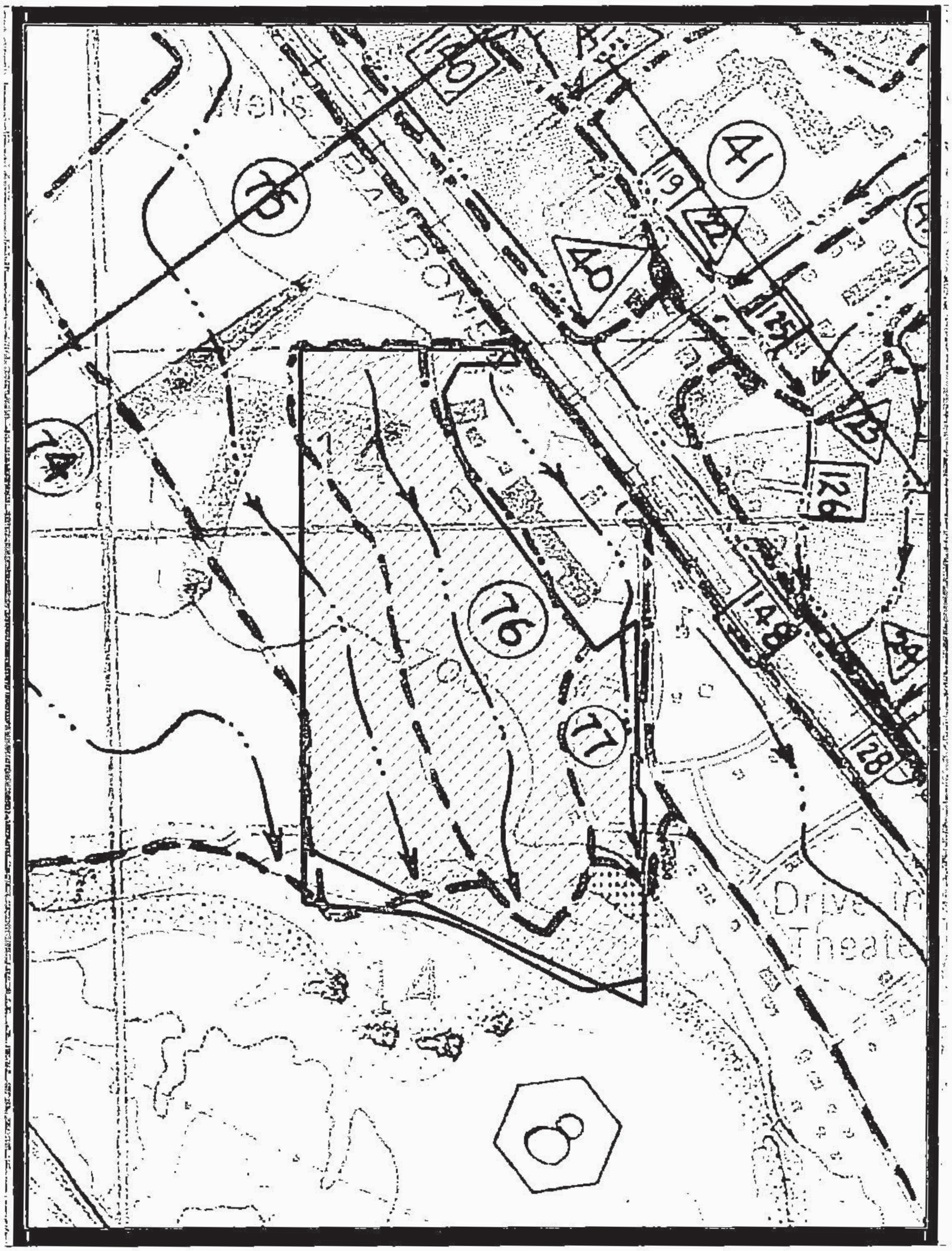
Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

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).

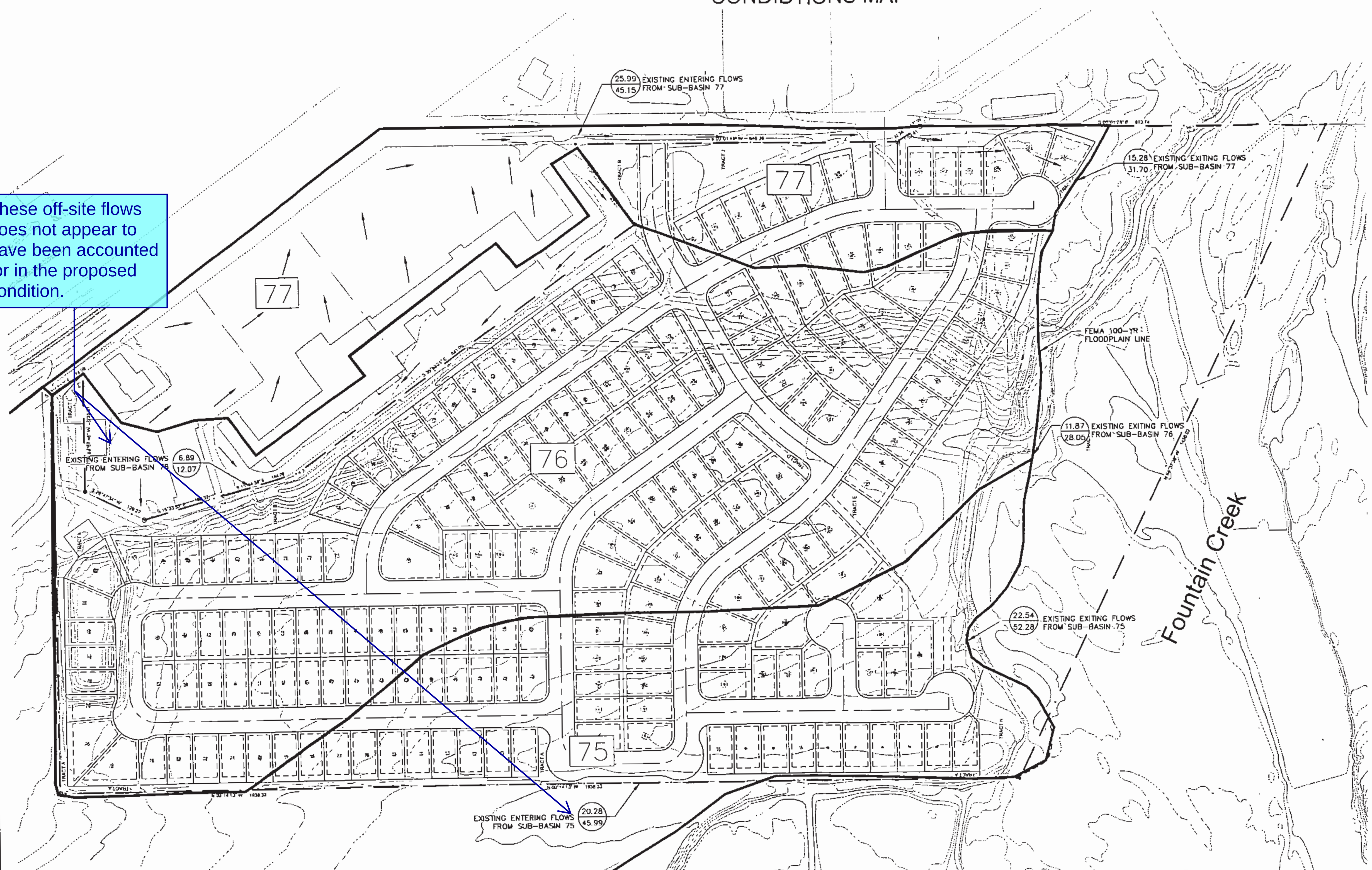
DRAINAGE MAP

FIGURE A4 – Drainage Patterns as Depicted in the DBPS



RIVERBEND CROSSING

EXISTING DRAINAGE CONDIDTIONS MAP



100 50 0 100 200

SCALE: 1" = 100'

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: C_1	Area$_1$ (acres)	C_2	Area$_2$ (acres)	COMPOSITE RUNOFF COEFF.	OVERLAND COMPONENT: Length (ft)	Height (ft)	Slope	T_i (min)	CHANNEL COMPONENT: Length (ft)	Height (ft)	Slope	R	VEL. (fps)	T_t (min)	TOTAL T_c (min)	RUNOFF COEFFICIENT, C: $C_{5\,year}$	$C_{100\,year}$	INTENSITY (in/hr): $I_{5\,year}$	$I_{100\,year}$	FLOWS (cfs): $Q_{5\,year}$	$Q_{100\,year}$
75 (IN)	59.11	0.25	59.11	0	0	0.25	1000	24	0.024	37.05	330	2	0.006	7.1	0.5	11.34	48.39	0.25	0.36	1.4	3.0	20.28	45.99
75 (OUT)	70.6	0.25	70.6	0	0	0.25	1000	24	0.024	37.05	900	20	0.022	7.1	1.1	14.17	51.82	0.25	0.36	1.3	2.8	22.54	52.29
76 (IN)	2.09	0.9	2.09	0	0	0.90	137	1.5	0.011	4.25	100	2	0.013	20.0	2.2	1.19	5.44	0.90	0.90	5.1	8.6	9.52	16.04
76 (OUT)	34	0.25	31.92	0.9	2.09	0.29	875	12	0.014	40.39	850	18	0.021	7.1	1.0	13.71	54.09	0.29	0.40	1.2	2.7	11.87	30.05
77 (IN)	7.37	0.9	7.37	0	0	0.90	494	9	0.015	7.95	394	5	0.013	20.0	2.3	2.91	10.86	0.90	0.90	3.9	6.8	25.99	45.15
77 (OUT)	12.72	0.25	5.35	0.9	7.37	0.63	634	9	0.015	18.81	1400	15	0.010	15.0	1.5	16.67	35.48	0.63	0.66	1.9	3.8	15.28	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

RIVERBEND CROSSING

EXISTING DRAINAGE CONDITIONS

PREPARED FOR: DR HORTON - MELODY SERIES

DATE SUBMITTED: FEB 17, 2006

NOLTE

BEYOND ENGINEERING

5725 N. ACADEMY BLVD., SUITE 304 COLORADO SPRINGS, CO 80918 719 268 8500 TEL 719 268 9200 FAX WWW.NOLTE.COM

PRELIMINARY NOT FOR CONSTRUCTION

SHEET NUMBER DP01

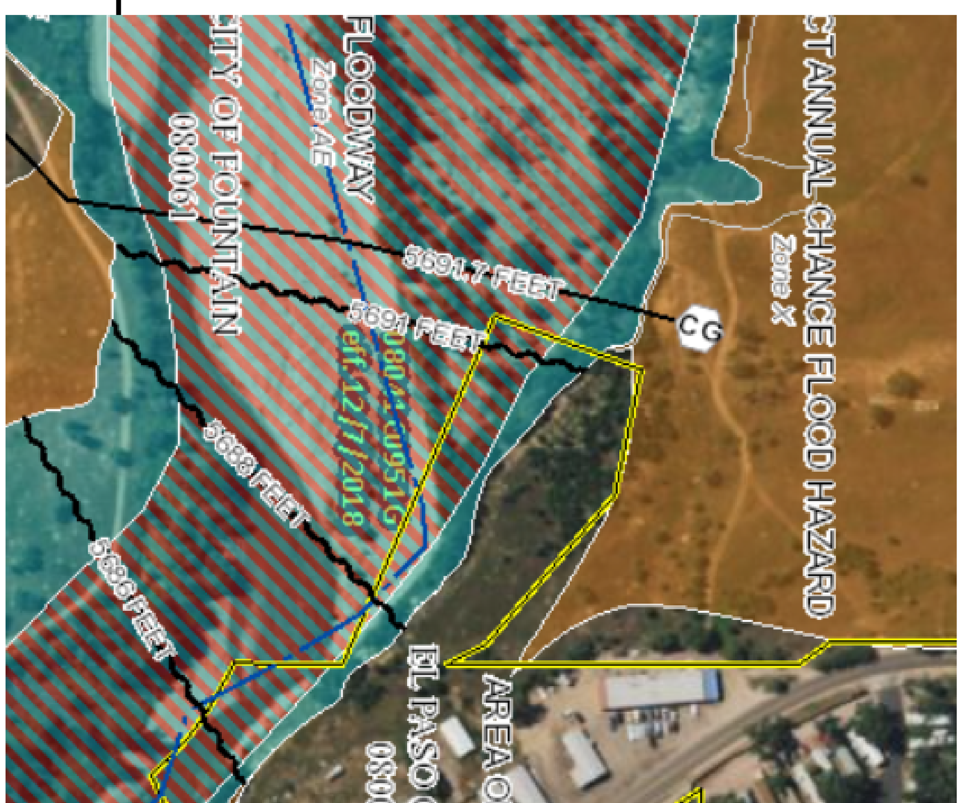
1 of 2 SHEETS

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

JOB NUMBER CSB011202

CAUTION The engineer preparing these plans will not be responsible for, or liable for, unauthorized changes to or uses of these plans. All changes to the plans must be in writing and must be approved by the preparer of these plans.

DATE: 1/15/07 TIME: 3:29:10 PM DRAWING NAME: DP01.DWG SERVER: CSSO DESIGNER: #### PROJ MGR: #### PLOTTED BY: JENNINGS



The Nolte PDR identified the need to provide toe/slope protection. The Nolte report noted that the analysis/ HEC-RAS modeling was preliminary in nature. Final hydraulic analysis, design and construction is required.

Both the Nolte PDR and this report's narrative identified the need for a drainage swale along the western boundary. This drainage swale must be located within a tract.

County GIS shows this would drain back into the subdivision at the southwest corner

The inlet calculation for basin B11 indicates a 15' inlet. Revise accordingly.

The inlet calculation for basin B7 indicates a 10' inlet. Revise accordingly.

Revise the contours or place drainage swale in a drainage easement.

Show BFE.
The FEMA BFE appears to be from 5691 to 5688. The pond appears to be submerged during the 100yr storm event negating the effectiveness of the detention pond.

Relocate the FSD pond outside the 100yr floodplain. The pond must be above the BFE. If the outlet structure is located below the BFE then tailwater effect must be analyzed.

Provide maintenance access path from a public street and a ramp to the bottom of pond.

Provide the riprap sizing calculation.

Add on the legend what this symbol represents.

Revise the sub-basin. Based on the contours portions of the commercial development drains into the residential development via Main Street.

Flows listed for design point 10 do not match the calculations or the narrative. Revise.

Per DCM Chapter 11 Section 11.3.3 the top width of the top of embankment shall be a minimum of 12 feet.

Provide access around the perimeter of the EDB.

Revise Basin B14 boundary. The inlets at the side streets are in a sump condition which continues the cross slope of Booker Blvd down to the inlets. The crosspans will not be able to convey runoff through the intersections. Runoff will turn to the north and into the inlets.

Proposed C&G and sidewalk must extend to the proposed intersection.

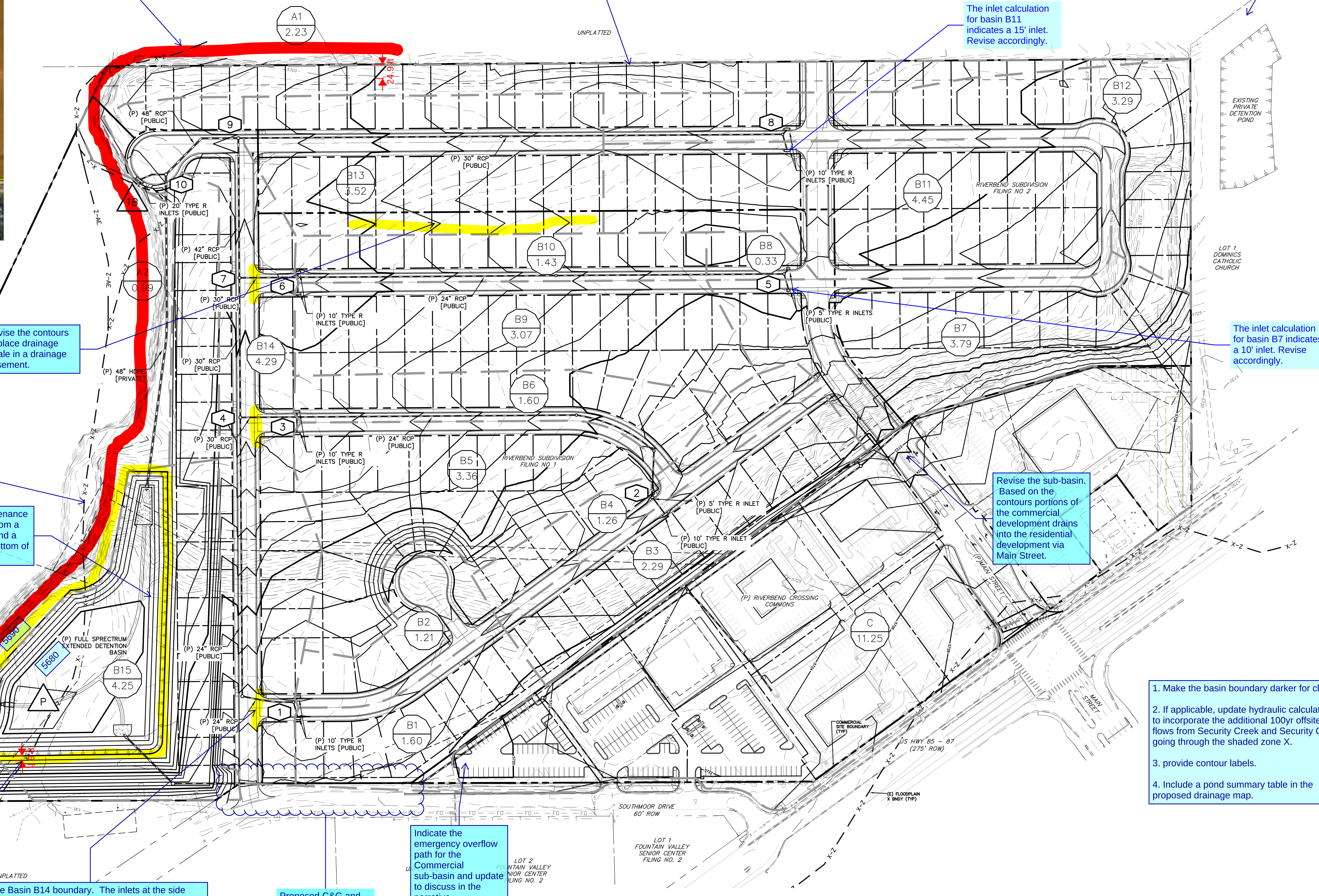
Indicate the emergency overflow path for the Commercial sub-basin and update to discuss in the narrative.

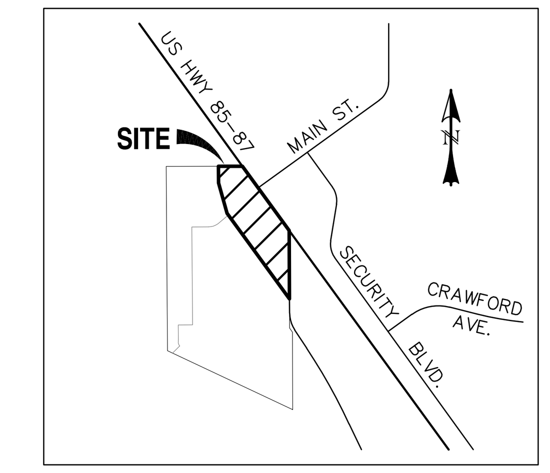
1. Make the basin boundary darker for clarity.

2. If applicable, update hydraulic calculations to incorporate the additional 100yr offsite flows from Security Creek and Security Creek going through the shaded zone X.

3. provide contour labels.

4. Include a pond summary table in the proposed drainage map.





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	2.23	0.4	1.1	2.0	3.1	4.0	5.0
A2	0.99	1.0	1.6	2.2	3.0	3.6	4.3
B1	1.60	2.0	2.8	3.6	4.6	5.5	6.5
B2	1.21	1.8	2.4	3.1	3.9	4.6	5.4
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	3.36	4.5	6.2	7.9	9.9	11.7	13.8
B6	1.60	2.0	2.8	3.5	4.4	5.2	6.1
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	3.70	4.2	5.7	7.3	9.2	10.8	12.7
B10	1.43	2.0	2.7	3.4	4.3	5.1	6.0
B11	4.45	6.1	8.3	10.7	13.4	15.8	18.5
B12	3.29	4.5	6.2	7.9	9.9	11.7	13.7
B13	3.52	4.5	6.1	7.8	9.8	11.5	13.5
B14	4.29	5.4	7.3	9.4	11.8	13.9	16.3
B15	4.25	1.4	3.7	6.5	10.3	13.3	16.8
C	11.25	20.6	26.3	31.5	37.3	42.4	48.0

PROPOSED DESIGN POINTS						
DESIGN POINT	Q2 (CFS)	Q5 (CFS)	Q10 (CFS)	Q25 (CFS)	Q50 (CFS)	Q100 (CFS)
1	3.7	5.0	6.5	8.2	9.8	11.5
2	4.6	6.4	8.3	10.4	12.4	14.6
3	10.5	14.4	18.6	23.4	27.7	32.5
4	13.9	19.1	24.7	31.0	36.7	43.2
5	4.4	6.3	8.4	10.9	13.0	15.5
6	10.3	14.3	18.6	23.6	28.1	33.2
7	23.9	33.0	42.9	54.1	64.2	75.6
8	10.6	14.5	18.6	23.2	27.5	32.2
9	35.0	47.8	61.4	76.7	90.7	106.4
10	40.1	54.6	70.2	87.7	103.6	121.6
1B	9.8	13.3	17.2	21.4	25.3	29.7
P-IN	54.3	73.4	93.1	115.6	135.7	158.2
P-OUT	1.0	2.6	7.8	18.2	27.2	36.4

LEGEND

EXISTING	(E)
FUTURE	(F)
PROPOSED	(P)
CURB AND GUTTER	C&G
EASEMENT	ESMT
BOUNDARY	
RIGHT-OF-WAY	
LOT LINE	
EASEMENT	
SETBACK	
(E) CONTOUR, INDEX	5970
(E) CONTOUR	
(E) STORM SEWER, INLET, MH	
(P) CONTOUR, INDEX	5970
(P) CONTOUR	
(P) FENCE	
(P) STORM SEWER, INLET, MH	
BASIN BOUNDARY	

missing

REV.	DESCRIPTION	DATE

PREPARED FOR:
AVATAR EQUITIES
6800 JERICHO TURNPIKE
SUITE 120W, #204
SYOSSET, NY 11791

PREPARED BY: DAVID ... ENGINEERING

NOT FOR CONSTRUCTION

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" = 60'	DATE: 08/28/18
JOB NUMBER	SHEET
17-115	1 OF X