FINAL DRAINAGE PLAN

CARRIAGE MEADOWS SOUTH
AT
LORSON RANCH FILING NO. 1

SF 17-011

AUGUST 10, 2017

Prepared for:

Lorson, LLC
212 N. Wahsatch Ave, Suite 301
Colorado Springs, Colorado 80903
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Prepared by:

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Project No. 100.030

CORE ENGINEERING GROUP

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ENGINEER'S STATEMENT

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

Richard L. Schindler, P.E. #33997 Date 8-28-2017
For and on Behalf of Core Engineering Group, LLC

COLORADO REGISTERED RICHARD LEO SCHINDLER 33997 PROFESSIONAL ENGINEER

OWNER'S STATEMENT

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

Lorson, LLC Date 8/29/17

By
Jeff Mark

Title
Manager

Address
212 N. Wahsatch Avenue, Suite 301, Colorado Springs, CO 80903

FLOODPLAIN STATEMENT

To the best of my knowledge and belief, this development is located within a designated floodplain as shown on Flood Insurance Rate Map Panel No. 08041C0957 F, Dated March 17, 1997, Revised to Reflect LOMR Effective Aug. 29, 2007. (See Appendix A, FEMA FIRM Exhibit)

Richard L. Schindler, #33997, Date 8-28-2017
For and on Behalf of Core Engineering Group, LLC

COLORADO REGISTERED RICHARD LEO SCHINDLER 33997 PROFESSIONAL ENGINEER

EL PASO COUNTY

Filed in accordance with the requirements of the El Paso County Land Development Code, Drainage Criteria Manual, Volume 1 and 2, and Engineering Criteria Manual, As Amended.

(Jennifer Irvine), County Engineer / ECM Administrator Date

Conditions:

1.0 LOCATION and DESCRIPTION

The purpose of this Final Drainage Report is to provide an overview of the overall drainage impacts/mitigation due to development in the proposed Carriage Meadows South at Lorson Ranch Filing No. 1 development located in Lorson Ranch. The study area of this report is approximately 110 acres. See ***Appendix A*** for vicinity map.

Carriage Meadows South at Lorson Ranch Filing No. 1 is located southeast of the intersection of Fontaine Boulevard and Marksheffel Road in El Paso County Colorado. The site is located on approximately 106.64 acres of vacant land. A portion of this study area is occupied by an existing single family residence that is not part of this development. For purposes of this report this offsite residence has been included as existing conditions. Also included in this report and plan is the proposed layout for Carriage Meadows South at Lorson Ranch Filing No. 1 which is located southeast of the intersection of Fontaine Boulevard and Marksheffel Road. The land is currently owned by Lorson LLC or its nominees for Lorson Ranch. The first phase of development will consist of 235 single-family homes. Future development in this area will develop as commercial land uses.

The site is located in the Northeast ¼ of Section 22 and the Northwest ¼ of Section 23, Township 15 South and Range 65 West of the 6th Principal Meridian; it is currently unplatted and zoned RR3, Rural Residential District. The property is bounded on the north by the Fontaine Boulevard, on the east by the relocated Jimmy Camp Creek, a major Drainage conveyance system, on the west by Marksheffel Road, on the south by Peaceful Valley Country Club Estates, and the old Appletree Golf Course. For reference, a vicinity map is included in Appendix A of this report.

<u>Conformance with applicable Drainage Basin Planning Studies</u>

There is an existing (unapproved) DBPS for Jimmy Camp Creek prepared by Wilson & Company in 1987 [3], adopted by El Paso County, and is referenced in this report. The only major drainage improvements for this study area according to the 1987 Wilson study was the reconstruction of the main stem of Jimmy Camp Creek. In 2006 the main stem of Jimmy Camp Creek and the FMIC relocation within Lorson Ranch was reconstructed in accordance with the 1987 study. In 2015 a new DBPS for Jimmy Camp Creek was completed by Kiowa Engineering. The Kiowa Engineering DPBS has been adopted by the City of Colorado Springs and partially adopted by El Paso County for the entire Jimmy Camp Creek Basin, including the main channel of Jimmy Camp Creek located on the east side of this site. El Paso county has not approved the drainage fees detailed in the Kiowa DBPS so current county drainage fees apply to this development. The Kiowa DBPS shows the reconstructed channel of Jimmy Camp Creek and the existing Fontaine Boulevard bridge over the main channel. According to the Kiowa DBPS all major drainage infrastructure has been constructed and there are no new requirements for channel/bridge improvements on Jimmy Camp Creek for development of Carriage Meadows South at Lorson Ranch Filing No. 1. The only major infrastructure not shown in the Kiowa DBPS is the future bridge over the main channel at Lorson Boulevard. The Lorson Boulevard bridge is not needed for this site but is included for discussion purposes.

<u>Reconstruction of Jimmy Camp Creek and FMIC relocation</u>

In 2006 Jimmy Camp Creek was re-aligned and reconstructed within Lorson Ranch from the southern boundary to the northern boundary. The construction plans were prepared by Drexel Barrell & Company (project number C-7668-2) and were approved on September 6, 2005 by El Paso County (#2801). Construction was based more or less on recommendations in the 1987 Wilson DBPS for Jimmy Camp Creek. The construction consisted of a trapezoidal channel section, armored creek banks with a sand bottom. Construction started at the south property line of Lorson Ranch and extended north 5,300 feet to the north line of Lorson Ranch. In 2006 the FMIC ditch in Lorson Ranch was also relocated in conjunction with the creek improvements. The FMIC through Lorson Ranch was relocated adjacent to the creek on the west bank and was constructed at the same time as the creek improvements. Pentacor Engineering prepared the FMIC relocation construction plans (project number 6000.0002) which were approved by El Paso County on November 22, 2005. Both the creek and FMIC relocation were completed in 2006 from the south property line of Lorson Ranch and extended north 5,300 feet to the north line of Lorson Ranch

2.0 DRAINAGE CRITERIA

The supporting drainage design and calculations were performed in accordance with the City of Colorado Springs and El Paso County “Drainage Criteria Manual (DCM)”, dated November, 1991, the El Paso County “Engineering Criteria Manual”, Chapter 6 and Section 3.2.1 Chapter 13 of the City of Colorado Springs Drainage Criteria Manual dated May 2014, and the UDFCD “Urban Storm Drainage Criteria Manual” Volumes 1, 2 and 3 for full spectrum pond sizing. No deviations from these published criteria are requested for this site. The proposed improvements to the Lorson Ranch Development will be in substantial compliance with the “Jimmy Camp Creek Drainage Basin Planning Study”, prepared by Kiowa Engineering Corp., Colorado Springs, CO.

The Rational Method as outlined in Section 6.3.0 of the May 2014 “Drainage Criteria Manual” and in Section 3.2.8.F of the El Paso County “Engineering Criteria Manual” was used for basins less than 130 acres to determine the rainfall and runoff conditions for the proposed development of the site. The runoff rates for the 5-year initial storm and 100-year major design storm were calculated.

Current updates to the Drainage Criteria manual for El Paso County states the if detention is necessary, Full Spectrum Detention will be included in the design, based on this criteria, Full Spectrum Detention will be required for this development

3.0 EXISTING HYDROLOGICAL CONDITIONS

The site is currently undeveloped with native vegetation (grass with no shrubs) and moderate slopes in a southerly direction to an existing sediment basin located at the southeast corner of the site, these flows then continue east to Jimmy Camp Creek. The soils across the site consists of the Ellicott loamy course sand, a deep somewhat excessively drained soil with 0 - 5% slopes, the Fort Collins loam and clay loam, a deep well drained soil with 0 – 3% slopes and the Manzanola clay loam, also a deep well drained soil with 1 – 3% slopes according to the Soil Survey of El Paso County Area. Other onsite soil types consist of Ustic Torrifluvents, Fluvaquentic Haploquolls, Blakeland Loamy Sand, Blendon Sandy Loam, Truckton Sandy Loam, Stoneham Sandy Loam, Keith Silt Loam, Olney Sandy Loam, Manzanola Clay Loam, Nunn Clay Loam and Sampson loam. Since the majority of this site will consist of import material, soil type C/D has been assumed for the hydrologic conditions. See Appendix A for SCS Soils Map.

Offsite drainage from the future Carriage Meadows 1, Marksheffel Road, and Fontaine Boulevard impact this development. The storm sewer system and streets accommodate the offsite flows.

The following on-site pre-development basins are briefly discussed as follows:

<u>Basin EX-1</u>
Basin EX-1 is an on-site, undeveloped basin is located east of Marksheffel Road, south of Fontaine Boulevard and extends southerly to Peaceful Valley Country Club Estates at the SW corner of Lorson Ranch. This basin has moderate to gentle slopes and flows southerly and westerly to the existing swale on the east side of Marksheffel Road. The existing contours shown on Marksheffel Road show the reconstructed road as it is nearly completed at the time of this report. The total pre-development flow from this 15.54 acre basin is 3.0cfs for the 5-year storm event and 22.0cfs for the 100-year storm event.

Basin EX-2

Basin EX-2 is primarily Marksheffel Road, flows are directed to the existing barrow ditch on the east side of the road. This small basin has moderate slopes and runoff sheet flows westerly, then southerly within the aforementioned ditch. The existing contours shown on Marksheffel Road and the barrow ditch show the reconstructed road as it is nearly completed at the time of this report. The total pre-development flow from this 4.87 acre basin is 2.5cfs for the 5-year storm event and 8.6cfs for the 100-year storm event.

Basin EX-3

Basin EX-3 is the main undeveloped basin and includes off-site and on-site drainage and is located east of Marksheffel Road, north and south of Fontaine Boulevard and west of the relocated of Jimmy Camp Creek. The existing conditions map show Fontaine as it has been constructed to show the basin boundaries but the runoff has been calculated based on the land being un-developed. There is no flow entering this basin from the north and east due to the relocated FMIC ditch. The contours on the east side of the basin reflect grading done in 2005 as part of the Jimmy Camp Creek CLOMR/LOMR project. The existing drainage patterns in this basin reflect historic patterns which ultimately drain to Jimmy Camp Creek in the SE corner of this site. This basin has moderate to gentle slopes and flows in a southerly and easterly direction; runoff is directed to an existing sediment basin in the SE corner of the site and then to Jimmy Camp Creek. The total pre-development flow from this 78.0 acre basin is 18.7cfs for the 5-year storm event and 125.8cfs for the 100-year storm event.

Basin EX-4

Basin EX-4 is an on-site, undeveloped basin is located adjacent and north of the Appletree Golf Course and approximately 800 feet east of Marksheffel Road. This basin has moderate slopes and runoff sheetflows southerly to the Appletree Golf Course. The total pre-development flow from this 5.22 acre basin is 2.6cfs for the 5-year storm event and 14.8cfs for the 100-year storm event.

Basin EX-5

Basin EX-5 is an on-site, undeveloped basin is located easterly of Marksheffel Road, north and adjacent to the Peaceful Valley Country Club Estates. This small basin has moderate slopes and flows southwesterly via to the Marksheffel Road east barrow ditch. The total pre-development flow from this 5.23 acre basin is 2.8cfs for the 5-year storm event and 15.4cfs for the 100-year storm event.

Basin EX-6

Basin EX-5 is an on-site, undeveloped basin that encompasses Jimmy Camp Creek. This basin flows south in the re-constructed channel of the creek to the Apple Tree Golf Course. The total pre-development flow from this 23.4 acre basin is 9.9cfs for the 5-year storm event and 55.3cfs for the 100-year storm event.

Design Point DP-1

Design Point DP-1 was included in this report to determine the existing flow in the Marksheffel Road east barrow ditch. The flow at this design point is from Basin EX-1 and EX-2. The flow is contained in a newly constructed barrow ditch as part of the Marksheffel Road reconstruction project by El Paso County DOT. The road reconstruction project constructed two-24" RCP pipe culverts in this location for an existing road crossing and have sized the new culverts for existing 100-year flow. The pre-development flows entering the culverts are 5.2cfs and 29.5cfs in the 5/100-year storm events. The pre-development 100-year flows at this design point will not be allowed to be increased when development of Carriage Meadows occurs.

4.0 DEVELOPED HYDROLOGICAL CONDITIONS

Hydrology for the **Carriage Meadows South at Lorson Ranch Filing No. 1** drainage report was based on the City of Colorado Springs/El Paso County Drainage Criteria. Sub-basins that lie within this project were determined and the 5-year and 100-year peak discharges for the developed conditions have been presented in this report. Based on these flows, storm inlets will be added when the street capacity is exceeded.

The time of concentration for each basin and sub-basin was developed using an overland, ditch, street and pipe flow components. The maximum overland flow length for developed conditions was limited to 100 feet. Travel time velocities ranged from 2 to 6 feet per second. The travel time calculations are included in the back of this report.
Runoff coefficients for the various land uses were obtained from the City of Colorado Springs/El Paso County Drainage Criteria Manual.

The hydrology analysis necessary for sizing the storm sewer system is preliminary only and will be finalized when the construction documents are prepared.

Drainage concepts for each of the basins are briefly discussed as follows:

Basin G1.1
Basin G1.1 consists of future commercial development. Runoff is directed southwest to a proposed Type "D" inlet on the east side of Carriage Meadows Drive at Design Point 1. Upon development of this basin the storm sewer at the SE corner may need to be extended easterly to Rubicon Drive. The peak developed flow from this 3.09-acre basin is 11.2cfs and 20.7cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin G1.2
Basin G1.2 consists of residential development. Runoff is directed north in curb/gutter in Rubicon Drive and then west overland to Design Point 1 to a proposed Type "D" inlet on the east side of Carriage Meadows Drive. When areas in Basin G1.1 develop, the storm sewer at Design Point 1 may need to be extended east to Rubicon Drive. The peak developed flow from this 2.22-acre basin is 4.3cfs and 9.5cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin G1.3
Basin G1.3 consists of residential development. Runoff is directed north in curb/gutter in Rubicon Drive and then west overland to Design Point 1 to a proposed Type "D" inlet on the east side of Carriage Meadows Drive. When areas in Basin G1.1 develop, the storm sewer at Design Point 1 may need to be extended east to Rubicon Drive. The peak developed flow from this 0.45-acre basin is 0.8cfs and 1.8cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin G1.4
Basin G1.4 consists of future development on Carriage Meadows Drive and residential development on Mandan Drive. Runoff is directed north to a low point and a proposed Type "R" inlet on the east side of Carriage Meadows Drive at Design Point 2. The peak developed flow from this 3.53-acre basin is 10.3cfs and 19.0cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin G1.5
Basin G1.5 consists of residential development and Carriage Meadows Drive. Runoff is directed to a low point and a proposed Type "R" inlet on the west side of Carriage Meadows Drive at Design Point 3. Additional future commercial area in Basin G1.7 might be able to flow east to Carriage Meadows Drive but the street and inlet capacities at Design Point 3 would need to be checked. The peak developed flow from this 0.83-acre basin is 3.0cfs and 5.4cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin G1.6

Basin G1.6 is an offsite basin and consists of future commercial development (north of Fontaine Boulevard) and runoff from Fontaine Boulevard. Runoff is directed south to existing inlets and an existing storm sewer (42” HERCP) under Fontaine Boulevard. Runoff will then flow south overland to Interim Detention Pond G1.7 at Design Point 4. The peak developed flow from this 19.74-acre basin is 61.2cfs and 111.6cfs for the 5/100-year storm event. See the appendix for detailed calculations. Detention and Water Quality for this offsite basin is included in Pond G1/G2.

Basin G1.7

Basin G1.7 consists of future commercial development. Runoff is directed south to Detention Pond G1.7 at Design Point 4. The peak developed flow from this 11.6-acre basin is 37.8cfs and 68.9cfs for the 5/100-year storm event. A swale in the south side of this basin will re-direct runoff east and south to Pond G1.7 so developed runoff does not flow south onto the Brownsville Subdivision No. 2. See the appendix for detailed calculations.

Basin G1.8a

Basin G1.8a consists of future commercial and residential areas in Lorson Ranch, Marksheffel Road, and from the Brownsville Subdivision No. 2 which is an existing single lot residential subdivision. The Brownsville Subdivision No. 2 is not part of the Lorson Ranch but we have included it in this drainage report because runoff from Lorson Ranch enters the subdivision from the north and exits back onto Lorson Ranch on the south side. Runoff is directed south to Detention Pond G1.8. For the Lorson Ranch future commercial areas the runoff has been calculated as fully developed but for the Brownsville Subdivision No. 2 we have kept runoff at existing values. If Brownsville Subdivision No. 2 should re-develop in the future and increase runoff they will have to detain runoff to pre-development amounts. Water Quality for Brownsville Subdivision No. 2 (if redevelopment occurs) is included in Pond G1/G2 but cannot be used unless an agreement is made with Lorson Ranch. The peak developed flow from this 11.6-acre basin is 37.8cfs and 68.9cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin G1.8b

Basin G1.8b consists of residential areas and the east half of Marksheffel Road. Runoff is directed south to Design Point 6 in roadside barrow ditches on the east side of Marksheffel Road. A new roadside swale is proposed in the future ROW area for Marksheffel Road. If Marksheffel Road were to be widened the existing swale could be filled to make room for the additional road width and the new swale will convey runoff from the road south to Design Point 6. We have routed all the runoff from this basin to Design Point 6 which connects to Pond G1/G2. This reduces the developed runoff flowing south to Lorson Boulevard where storm facilities are very shallow shall making it impractical to construction detention ponds at Lorson Boulevard/Marksheffel Road. The peak developed flow from this 5.11-acre basin is 7.1cfs and 15.6cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin G1.9

Basin G1.9 consists of residential development and Mandan Drive. Runoff is directed in curb/gutter in Mandan Drive to a low point at Design Point 7 on the west side of Mandan Drive. The peak developed flow from this 2.97-acre basin is 5.4cfs and 11.8cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin G1.10

Basin G1.10 consists of residential development and Mandan Drive. Runoff is directed in curb/gutter in Mandan Drive to a low point at Design Point 7a on the east side of Mandan Drive. The peak developed flow from this 4.3-acre basin is 6.2cfs and 13.6cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin G1.11

Basin G1.11 consists of residential development and Pond G1/G2. Runoff is directed overland to the G1 side of Pond G1/G2. The peak developed flow from this 3.10-acre basin is 5.6cfs and 11.5cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin G1

Basin G1 consists of runoff from Basins G1.1-G1.11 that enters into Pond G1/G2 on the G1 side. The peak developed flow from this 66.69-acre basin is 132.2cfs and 273.3cfs for the 5/100-year storm event and flows to Design Point 9. This overall basin was included to design the storm sewer linking G1 side (north) to G2 side (south). See the appendix for detailed calculations.

Basin G2.1

Basin G2.1 consists of residential development and Rubicon Drive. Runoff is directed southwest in curb/gutter in Rubicon Drive to an on-grade inlet at Design Point 10 on the north side of Rubicon Drive. The peak developed flow from this 3.4-acre basin is 5.2cfs and 11.4cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin G2.2

Basin G2.2 consists of residential development and Galpin Drive. Runoff is directed in curb/gutter in Galpin Drive to a low point at Design Point 14 on the east side of Galpin Drive. The peak developed flow from this 1.95-acre basin is 3.0cfs and 6.6cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin G2.3

Basin G2.3 consists of residential development and Galpin Drive. Runoff is directed in curb/gutter in Galpin Drive to a low point at Design Point 14a on the west side of Galpin Drive. The peak developed flow from this 3.7-acre basin is 5.5cfs and 12.1cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin G2.4

Basin G2.4 consists of residential development and Rubicon Drive/Lorson Blvd. Runoff is directed in curb/gutter in Rubicon Drive to a low point at Design Point 12a on the east side of Wando Drive. The peak developed flow from this 4.00-acre basin is 6.7cfs and 14.8cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin G2.5

Basin G2.5 consists of residential development and Wando Drive. Runoff is directed in curb/gutter in Rubicon Drive to a low point at Design Point 12b on the west side of Wando Drive. The peak developed flow from this 0.21-acre basin is 0.4cfs and 0.9cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin G2.6

Basin G2.6 consists of residential development and Rubicon Drive. Runoff is directed in curb/gutter in Rubicon Drive to a low point at Design Point 13b on the south side of Rubicon Drive at Pond G1. The peak developed flow from this 1.43-acre basin is 2.4cfs and 5.3cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin G2.6a

Basin G2.6a consists of residential development and Rubicon Drive. Runoff is directed in curb/gutter in Rubicon Drive to a low point at Design Point 13 on the north side of Rubicon Drive at Pond G1. The peak developed flow from this 0.3-acre basin is 0.7cfs and 1.1cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin G2.7
Basin G2.7 consists of residential development and Rubicon/Clatsop Drive. Runoff is directed in curb/gutter in Rubicon Drive to a low point at Design Point 16 on the north side of Rubicon Drive. The peak developed flow from this 2.40-acre basin is 4.6cfs and 10.2cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin G2.8
Basin G2.8 consists of residential development and Rubicon/Wando Drive. Runoff is directed in curb/gutter in Rubicon/Wando Drive to a low point at Design Point 17 on the west side of Wando Drive. The peak developed flow from this 1.01-acre basin is 2.2cfs and 4.8cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin G2.9
Basin G2.9 consists of residential development and Lorson Blvd/Wando Drive. Runoff is directed in curb/gutter in Lorson Blvd/Wando Drive to a low point at Design Point 17 on the west side of Wando Drive. The peak developed flow from this 0.23-acre basin is 0.4cfs and 0.9cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin G2.10
Basin G2.10 consists of residential development and Rubicon/Wando Drive. Runoff is directed in curb/gutter in Rubicon/Wando Drive to a low point at Design Point 18 on the east side of Wando Drive. The peak developed flow from this 0.68-acre basin is 1.2cfs and 2.6cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin G2.11a
Basin G2.11a consists of residential development and Lorson Blvd. Runoff is directed in curb/gutter in Lorson Blvd to a low point at Design Point 15 on the north side of Lorson Boulevard. The peak developed flow from this 1.61-acre basin is 2.6cfs and 5.8cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin G2.11b
Basin G2.11b consists of residential development and Lorson Blvd. Runoff is directed in curb/gutter in Lorson Blvd to a low point at Design Point 20 on the north side of Lorson Boulevard. The peak developed flow from this 0.64-acre basin is 1.1cfs and 2.5cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin G2.12a
Basin G2.12a consists of residential development and Lorson Blvd. Runoff is directed in curb/gutter in Lorson Blvd to a low point at Design Point 15a on the south side of Lorson Boulevard. The peak developed flow from this 1.14-acre basin is 2.0cfs and 4.5cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin G2.12b
Basin G2.12b consists of residential development and Lorson Blvd/Wando Drive. Runoff is directed in curb/gutter in Lorson Blvd to a low point at Design Point 22 on the south side of Lorson Boulevard. The peak developed flow from this 1.16-acre basin is 2.2cfs and 4.8cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin G2.13
Basin G2.13 consists of residential development and Simcoe Drive. Runoff is directed in curb/gutter in Simcoe Drive to a low point at Design Point 24 on the west end of Simcoe Drive. The peak developed flow from this 1.54-acre basin is 2.8cfs and 6.2cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin G2.14

Basin G2.14 consists of residential development and Pond G2. The peak developed flow from this 4.59-acre basin is 7.7cfs and 17.00cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin G2

Basin G2 consists of runoff from Basins G2.1-G2.14 that enters into Pond G1/G2 from the G2 side (south). The peak developed flow from this 29.34-acre basin is 42.5cfs and 93.5cfs for the 5/100-year storm event and flows to Design Point 25. This overall basin was included to design Pond G1/G2.

Basin G3.1

Basin G3.1 consists of residential development and Wando Drive. Runoff is directed in curb/gutter in Wando Drive to a low point at Design Point 26 on the north side of Wando Drive. The peak developed flow from this 0.69-acre basin is 1.2cfs and 2.6cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin G3.2

Basin G3.2 consists of residential development and Wando Drive. Runoff is directed in curb/gutter in Wando Drive to a low point at Design Point 26 on the north side of Wando Drive. The peak developed flow from this 0.68-acre basin is 1.2cfs and 2.7cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin G3.3

Basin G3.3 consists of residential development and Wando Drive. Runoff is directed in curb/gutter in Wando Drive to a low point at Design Point 27 on the south side of Wando Drive. The peak developed flow from this 0.74-acre basin is 1.3cfs and 2.8cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin G3.4

Basin G3.4 consists of residential development and Wando Drive. Runoff is directed in curb/gutter in Wando Drive to a low point at Design Point 27 on the south side of Wando Drive. The peak developed flow from this 3.46-acre basin is 5.6cfs and 12.4cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin G3.5

Basin G3.5 consists of residential development and Pond G3. The peak developed flow from this 4.59-acre basin is 1.0cfs and 2.2cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin G3

Basin G3 consists of runoff from Basins G3.1-G3.5 that enters into Pond G3. The peak developed flow from this 6.09-acre basin is 9.9cfs and 21.8cfs for the 5/100-year storm event and flows to Design Point 29. This overall basin was included to design Pond G3.

Basin G4

Basin G4 consists of residential development. Runoff is from backyards and is directed south onto the Appletree Golf Course as in pre-development conditions. The peak developed flow from this 1.32-acre basin is 2.6cfs and 5.8cfs for the 5/100-year storm event which is less than the pre-development conditions in Basin EX-4. See the appendix for detailed calculations.

Basin G5
Basin G5 consists of backyards and open space south of Lorson Boulevard. Runoff is from open space and is directed south onto the Appletree Golf Course and land north of Peaceful Valley Country Club estates as in pre-development conditions. The peak developed flow from this 0.89-acre basin is 1.8cfs and 4.0cfs for the 5/100-year storm event which is less than the pre-development conditions in Basin EX-5. See the appendix for detailed calculations.

Basin G6.1
Basin G6.1 consists of backyards and Lorson Boulevard. Runoff is directed south and west in curb/gutter in Lorson Boulevard to curb chase that flows north into the Marksheffel Road east barrow ditch. This basin also includes a swale in the future ROW of Marksheffel Road that will collect runoff from backyards. All flow from this basin flows to Design Point 30 into two proposed 24" culverts under Lorson Boulevard and flows south in an existing roadside swale to two existing 24" culverts constructed in 2016 as part of El Paso County's Marksheffel Road widening project. The peak developed flow from this 5.55-acre basin is 8.7cfs and 19.1cfs for the 5/100-year storm event. Per the El Paso County's Marksheffel Road widening project the two existing 24" culverts can handle up to 28.6cfs in the 100-year storm event. See attached memo dated March 11, 2016 from HDR in Appendix E. See the appendix for detailed calculations. A portion of existing basin EX-1 (Developed basins G1.8a/b) has been diverted east into Pond G1/G2 at Design Point 6 so that runoff from Basin G6.1 can flow south to Design Point 30 and not exceed the capacity of the two existing 24" culverts in the roadside barrow ditch.

Basin G6.2
Basin G6.2 consists of Lorson Boulevard. Runoff is directed south and west in curb/gutter in Lorson Boulevard to a curb chase that flows south into the Marksheffel Road east barrow ditch. All flow from this basin flows to Design Point 31. The peak developed flow from this 0.77-acre basin is 3.1cfs and 5.6cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin G6
Basin G6 consists of runoff from Basins G6.1-G6.2 that flows to Design Point 31. The peak developed flow from this 6.32-acre basin is 9.8cfs and 21.5cfs for the 5/100-year storm event and flows to Design Point 31. This overall basin was included and verifies that developed flows are less than the 100-year pre-development flows at existing Design Point DP-1 (5.2cfs/29.5cfs for 5/100year storm). The proposed flow is also lower than the allowable flow from the HDR drainage memo (Appendix E) for the hydraulic design of the two culverts which is 28.6cfs in the 100-year storm. There should be no downstream impacts due to our development since we have lowered the runoff to Marksheffel Road in this basin.

See the Developed Conditions Hydrology Calculations in the back of this report and the Developed Conditions Drainage Map (Map Pocket) for the 5-year and 100-year storm event amounts.

5.0 HYDRAULIC SUMMARY

The sizing of the hydraulic structures and detentions ponds were prepared by using the *StormSewers* and *Hydrographs* computer software programs developed by Intellisolve, which conforms to the methods outlined in the "City of Colorado Springs/El Paso County Drainage Criteria Manual".

It is the intent of this drainage report to use the proposed curb/gutter and storm sewer in the streets to convey runoff to detention and water quality ponds then to Jimmy Camp Creek. Inlet size and location are preliminary only as shown on the storm sewer layout in the appendix. See Appendix C for detailed hydraulic calculations and the storm sewer model.

All storm sewer is to be part of a public system including Detention Pond G1/G2, G3, and Swale G1.8. Detention Pond G1.7 is an interim detention pond and may move in the future when the commercial areas are developed including the Brownsville Subdivision No. 2. Detention Pond G1.7 will be an interim district detention pond until the remaining commercial areas are developed and the pond location has been finalized, then it will become public.

Table 1: Street Capacities (100-year capacity is only ½ of street)

	Residential Local		Residential Collector		Principal Arterial	
Street Slope	5-year	100-year	5-year	100-year	5-year	100-year
0.5%	6.3	26.4	9.7	29.3	9.5	28.5
0.6%	6.9	28.9	10.6	32.1	10.4	31.2
0.7%	7.5	31.2	11.5	34.6	11.2	33.7
0.8%	8.0	33.4	12.3	37.0	12.0	36.0
0.9%	8.5	35.4	13.0	39.3	12.7	38.2
1.0%	9.0	37.3	13.7	41.4	13.4	40.2
1.4%	10.5	44.1	16.2	49.0	15.9	47.6
1.8%	12.0	45.4	18.4	50.4	18.0	50.4
2.2%	13.3	42.8	19.4	47.5	19.5	47.5
2.6%	14.4	40.7	18.5	45.1	18.5	45.1
3.0%	15.5	39.0	17.7	43.2	17.8	43.2
3.5%	16.7	37.2	16.9	41.3	17.0	41.3
4.0%	17.9	35.7	16.2	39.7	16.3	29.7
4.5%	19.0	34.5	15.7	38.3	15.7	38.3
5.0%	19.9	33.4	15.2	37.1	15.2	37.1

Note: all flows are in cfs (cubic feet per second)

Design Point 1

Design Point 1 is located east of Carriage Meadows Drive and west of Rubicon Drive.

(5-year storm)

Tributary Basins: G1.1-G1.3 **Inlet/MH Number:** Inlet 1

Upstream flowby: 0 **Total Street Flow:**

Flow Intercepted: 14.9 cfs **Flow Bypassed:**

Inlet Size: CDOT Type D

Street Capacity: will need inlets when future development occurs

(100-year storm)

Tributary Basins: G1.1-G1.3 **Inlet/MH Number:** Inlet 1

Upstream flowby: 0 **Total Street Flow:**

Flow Intercepted: 29.2 cfs **Flow Bypassed:**

Inlet Size: CDOT Type D

Street Capacity: will need inlets when future development occurs

Comments: The CDOT Type D is only for interim conditions. Additional inlets will be needed upstream to convey flow.

Design Point 2 and 2a

Design Point 2 is located on Carriage Meadows Drive at a low point just north of Mandan Drive and Design Point 2a is the flow in the storm sewer

(5-year storm)

Tributary Basins: G1.4 **Inlet/MH Number:** Inlet 2

Upstream flowby: 0 **Total Street Flow:**

Flow Intercepted: 10.3 cfs **Flow Bypassed:**

Inlet Size: 15' Type R Inlet in sump

Street Capacity: The street capacity may be exceeded which will require additional inlets and storm sewer from Design Point 1 to be extended north to reduce the size of this basin. The un-developed conditions in Basin G1.4 do not exceed street capacity.

(100-year storm)

Tributary Basins: G1.4 **Inlet/MH Number:** Inlet 2

Upstream flowby: 0 **Total Street Flow:**

Flow Intercepted: 19.0 cfs **Flow Bypassed:**

Inlet Size: 15' Type R Inlet in sump

Street Capacity: The street capacity is not exceeded in the 100-year storm event but the 5-yr storm may require additional inlets and storm sewer from Design Point 1 to be extended north to reduce the size of this basin. The un-developed conditions in Basin G1.4 do not exceed street capacity.

Comments: Pipe flow in culvert is 24.3cfs/46.5cfs in the 5/100-year storm events at Design Point 2a. Storm sewer size is 30" RCP

Design Point 3 and 3a

Design Point 3 is located on Carriage Meadows Drive at a low point just north of Mandan Drive. Design Point 3a is the flow in the storm sewer into Pond G1.7

(5-year storm)

Tributary Basins: G1.5 **Inlet/MH Number:** Inlet 3

Upstream flowby: 0 **Total Street Flow:**

Flow Intercepted: 3.0 cfs **Flow Bypassed:**

Inlet Size: 5' Type R Inlet in sump

Street Capacity: 7 cfs at 0.65% ---street capacity okay.

(100-year storm)

Tributary Basins: G1.5 **Inlet/MH Number:** Inlet 3

Upstream flowby: 0 **Total Street Flow:**

Flow Intercepted: 5.4 cfs **Flow Bypassed:**

Inlet Size: 5' Type R Inlet in sump

Street Capacity: 14 cfs at 0.65% ---street capacity (1/2 of street) okay.

Comments: Pipe flow in culvert is 26.9cfs/51.2cfs in the 5/100-year storm events at Design Point 3a. Storm sewer size is 30" RCP

Design Point 4

Design Point 4 is located on the north side of Pond G1.7 and includes Basins G1.6 & G1.7

(5-year storm)

Tributary Basins: G1.6 & G1.7 **Inlet/MH Number:**
Upstream flowby: 0 **Total Street Flow:**

Flow Intercepted: 83.2 cfs **Flow Bypassed:**
Inlet Size:
Street Capacity:

(100-year storm)

Tributary Basins: G1.6 & G1.7 **Inlet/MH Number:**
Upstream flowby: 0 **Total Street Flow:**

Flow Intercepted: 151.7 cfs **Flow Bypassed:**
Inlet Size:
Street Capacity:

Comments: A swale with 5' bottom, 0.5% slope, and 3:1 side slopes will carry 100cfs. Full development of these basins will require additional storm sewer into Pond G1.7. The swale is okay for interim undeveloped conditions.

Design Point 5

Design Point 5 is located on the south side of Pond G1.7 and includes Basins G1.1-G1.7. The total inflow to Pond G1.7 is 106.4cfs in the 5-year storm event and 195.9cfs in the 100-year storm event. Pond G1.7 will detain runoff so the downstream storm sewer can be accommodated in a 48" storm sewer outfall. Pond G1.7 is an interim pond that could be moved depending on whether or not Brownsville Subdivision No. 2 is developed as part of Lorson Ranch in the future.

Design Point 6

Design Point 6 is located south of Swale G1.8 and includes Basins G1.8a, G1.8b, Detention Pond G1.7, and flow from Swale G1.8. It is our intent to divert as much runoff from Marksheffel Road as possible to the on-site detention Pond G1/G2 for detention and water quality. This will allow Lorson Ranch to drain a portion of the Southwest corner of this site to the southwest without constructing a detention/WQ pond. The resultant tributary area is significantly reduced thus maintaining offsite flow rates in the Marksheffel Road barrow ditch. By diverting the upstream Marksheffel Road areas we can also utilize the WQ facilities in the barrow ditch to treat runoff from Lorson Boulevard and backyards in the SW corner. The total flow at this design point is 47.4cfs in the 5-year storm and 96.7cfs in the 100-year storm event. All flow will be in a 48" RCP that drains to Pond G1/G2. The 48" RCP does have additional capacity should upstream areas change in land use when they are platted. This design point was modeled in hydraflow hydrographs.

Design Point 7

Design Point 7 is located on the west side of Mandan Drive at a low point west of Pond G1.

(5-year storm)

Tributary Basins: G1.9 **Inlet/MH Number:** Inlet 7

Upstream flowby: 0 **Total Street Flow:**

Flow Intercepted: 5.4 cfs **Flow Bypassed:**

Inlet Size: 10' Type R Inlet in sump

Street Capacity: 7.1 cfs at 0.63% ---street capacity okay.

(100-year storm)

Tributary Basins: G1.9 **Inlet/MH Number:** Inlet 7

Upstream flowby: 0 **Total Street Flow:**

Flow Intercepted: 11.8 cfs **Flow Bypassed:**

Inlet Size: 10' Type R Inlet in sump

Street Capacity: 14.8 cfs at 0.63% ---street capacity (1/2 of street) okay.

Design Point 7a

Design Point 7a is located on the east side of Mandan Drive at a low point west of Pond G1.

(5-year storm)

Tributary Basins: G1.10 **Inlet/MH Number:** Inlet 7a

Upstream flowby: 0 **Total Street Flow:**

Flow Intercepted: 6.2 cfs **Flow Bypassed:**

Inlet Size: 10' Type R Inlet in sump

Street Capacity: 7.1cfs at 0.63% ---street capacity okay

(100-year storm)

Tributary Basins: G1.10 **Inlet/MH Number:** Inlet 7a

Upstream flowby: 0 **Total Street Flow:**

Flow Intercepted: 13.6 cfs **Flow Bypassed:**

Inlet Size: 10' Type R Inlet in sump

Street Capacity: 14.8 cfs at 0.63% ---street capacity (1/2 of street) okay

Design Point 8

Design Point 8 is located west of Design Point 7a and is the total flow from Basins G1.9 and G1.10 in a storm sewer flowing into Pond G1. The total flow in the storm sewer is 12.6cfs in the 5-year storm event and 27.7cfs in the 100-year storm event.

Design Point 9

Design Point 9 is located on the south side of Pond G1 and includes Basins G1.1-G1.11, G2.2 & G2.3. The total inflow was calculated in Hydraflow Hydrographs and included Pond G1.7 and Swale G1.8 which detains upstream flow. The total inflow to Pond G1 is 60cfs in the 5-year storm event and 117cfs in the 100-year storm event. Pond G1 is connected directly to Pond G1/G2 and will included in the full spectrum detention calculations. This design point was added to design the interconnection pipe between Pond G1 and G2 and to determine a suitable emergency overflow for the "G1" side of the pond. The total outflow from Pond G1 to G2 into the 48" RCP interconnection pipe is 28cfs in the 5-year storm event (elev 5687.92) and 58cfs in the 100-year storm event (elev 5689.12) . The 48" RCP will also function as an emergency overflow for Pond G1 to the south. The emergency overflow capacity of the 48" RCP is 120cfs at a headwater depth of 5690.60

Design Point 10

Design Point 10 is located on Rubicon Drive northeast of Galpin Drive

(5-year storm)

Tributary Basins: G2.1 **Inlet/MH Number:** Inlet 10
Upstream flowby: 0 **Total Street Flow:**

Flow Intercepted: 4.9 cfs **Flow Bypassed:** 0.3 cfs to DP14
Inlet Size: 10' Type R Inlet on grade
Street Capacity: 6.9 cfs at 0.6% ---street capacity okay

(100-year storm)

Tributary Basins: G2.1 **Inlet/MH Number:** Inlet 10
Upstream flowby: 0 **Total Street Flow:**

Flow Intercepted: 7.7 cfs **Flow Bypassed:** 3.7cfs to DP14
Inlet Size: 10' Type R Inlet
Street Capacity: 14.4 cfs at 0.6% ---street capacity (1/2 of street) okay

Design Point 11

Design Point 11 is located at Manhole 11 on Rubicon Drive and is the flow in the 24" RCP storm sewer at Manhole 11. Flow at this point is from Design Point 10 and Design Point 12. The total flow in the pipe is 11.9cfs in the 5-year storm event and 23.1cfs in the 100-year storm event.

Design Point 12a

Design Point 12a is located at a low point on Wando Drive.

(5-year storm)

Tributary Basins: G2.4 **Inlet/MH Number:** Inlet 12a
Upstream flowby: **Total Street Flow:**

Flow Intercepted: 6.7 cfs **Flow Bypassed:**
Inlet Size: 15' Type R Inlet in sump
Street Capacity: 7.2 cfs at 0.65% ---street capacity okay since 1/3 of flow is from Lorson Blvd

(100-year storm)

Tributary Basins: G2.4 **Inlet/MH Number:** Inlet 12a
Upstream flowby: 0 **Total Street Flow:**

Flow Intercepted: 14.8 cfs **Flow Bypassed:**
Inlet Size: 15' Type R Inlet in sump
Street Capacity: 15 cfs at 0.65% ---street capacity (1/2 of street) okay.

Design Point 12b

Design Point 12b is located at a low point on Wando Drive.

(5-year storm)
Tributary Basins: G2.5 **Inlet/MH Number:** Inlet 12b
Upstream flowby: **Total Street Flow:**

Flow Intercepted: 0.4 cfs **Flow Bypassed:**
Inlet Size: 5' Type R Inlet in sump
Street Capacity: 7.2 cfs at 0.65% ---street capacity okay since 1/3 of flow is from Lorson Blvd

(100-year storm)
Tributary Basins: G2.5 **Inlet/MH Number:** Inlet 12b
Upstream flowby: **Total Street Flow:**

Flow Intercepted: 0.9 cfs **Flow Bypassed:**
Inlet Size: 5' Type R Inlet in sump
Street Capacity: 15 cfs at 0.65% ---street capacity (1/2 of street).

Comments:

Design Point 12

Design Point 12 is located at Manhole 12 on Rubicon Drive and is the flow in the 24" RCP storm sewer at Manhole 12. Flow at this point is from Design Point 12a and Design Point 12b. The total flow in the pipe is 7.0cfs in the 5-year storm event and 15.4cfs in the 100-year storm event.

Design Point 13

Design Point 13 is located at a low point on the north side of Rubicon Drive next to Pond G1.

(5-year storm)
Tributary Basins: G2.6a **Inlet/MH Number:** Inlet 13
Upstream flowby: **Total Street Flow:**

Flow Intercepted: 0.7 cfs **Flow Bypassed:**
Inlet Size: 10' Type R Inlet in sump
Street Capacity: 6.8 cfs at 0.56% ---street capacity okay

(100-year storm)
Tributary Basins: G2.6a **Inlet/MH Number:** Inlet 13
Upstream flowby: **Total Street Flow:**

Flow Intercepted: 1.1 cfs **Flow Bypassed:**
Inlet Size: 10' Type R Inlet in sump
Street Capacity: 13.5 cfs at 0.56% ---street capacity (1/2 of street) okay.

Design Point 13a

Design Point 13a is located at Manhole 13a on Rubicon Drive and is the flow in the 48" RCP storm sewer at Manhole 13a. Flow at this point is from Design Point 13, Design Point 11, and the outflow from Pond G1 (28cfs/58cfs in the 5/100-year storm events). The total flow in the pipe is 40.6cfs in the 5-year storm event and 82.2cfs in the 100-year storm event.

Design Point 13b

Design Point 13b is located at a low point on the south side of Rubicon Drive next to Pond G1.

(5-year storm)

Tributary Basins: G2.6 **Inlet/MH Number:** Inlet 13b
Upstream flowby: **Total Street Flow:**

Flow Intercepted: 2.4 cfs **Flow Bypassed:**
Inlet Size: 10' Type R Inlet in sump
Street Capacity: 6.8 cfs at 0.56% ---street capacity okay

(100-year storm)

Tributary Basins: G2.6a **Inlet/MH Number:** Inlet 13b
Upstream flowby: **Total Street Flow:**

Flow Intercepted: 5.3 cfs **Flow Bypassed:**
Inlet Size: 10' Type R Inlet in sump
Street Capacity: 13.5 cfs at 0.56% ---street capacity (1/2 of street) okay.

Design Point 13c

Design Point 13c is located downstream of Design Point 13b and is the flow in the 48" RCP storm sewer. Flow at this point is from Design Point 13b and Design Point 13a. The total flow in the pipe is 43cfs in the 5-year storm event and 87.5cfs in the 100-year storm event. The emergency overflow swale from Design Point 13c to Lorson Blvd is 12' wide, 1.2% slope, 1' deep, and has a capacity of 100cfs to handle the flow should the inlets become clogged.

Design Point 14

Design Point 14 is located at a low point on the east side Galpin Drive next to Pond G1.

(5-year storm)

Tributary Basins: G2.2 **Inlet/MH Number:** Inlet 14
Upstream flowby: 0.3cfs from Des. Pt. 10 **Total Street Flow:** 3.3cfs

Flow Intercepted: 3.3cfs **Flow Bypassed:**
Inlet Size: 5' Type R Inlet in sump
Street Capacity: 7.3 cfs at 0.67% ---street capacity okay

(100-year storm)

Tributary Basins: G2.2 **Inlet/MH Number:** Inlet 14
Upstream flowby: 3.7cfs from Des. Pt. 10 **Total Street Flow:** 10.3cfs

Flow Intercepted: 9.8 cfs **Flow Bypassed:** 0.5cfs to Des. Pt. 14a
Inlet Size: 5' Type R Inlet in sump
Street Capacity: 15.3 cfs at 0.67% ---street capacity (1/2 of street).

Design Point 14a

Design Point 14a is located at a low point on the west side of Galpin Drive next to Pond G1.

(5-year storm)
Tributary Basins: G2.3 **Inlet/MH Number:** Inlet 14a
Upstream flowby: **Total Street Flow:** 5.5cfs

Flow Intercepted: 5.5cfs **Flow Bypassed:**
Inlet Size: 10' Type R Inlet in sump
Street Capacity: 7.3 cfs at 0.67% ---street capacity okay

(100-year storm)
Tributary Basins: G2.3 **Inlet/MH Number:** Inlet 14a
Upstream flowby: 0.5cfs from Des. Pt. 14 **Total Street Flow:** 12.6cfs

Flow Intercepted: 12.6cfs **Flow Bypassed:**
Inlet Size: 10' Type R Inlet in sump
Street Capacity: 15.3 cfs at 0.67% ---street capacity (1/2 of street).

Design Point 14c

Design Point 14c is located on Galpin Drive where the storm sewer from Design Point 14c flows west to Pond G1. All flow is routed in a 24" RCP to Pond G1. The total flow in the pipe is 8.8cfs in the 5-year storm event and 22.4cfs in the 100-year storm event. The emergency overflow swale from Design Point 14c to Pond G1 is 8' wide, 1.2% slope, 1' deep, and has a capacity of 40cfs to handle the flow should the inlets become clogged.

Design Point 15

Design Point 15 is located at a low point on the north side of Lorson Boulevard at Pond G2

(5-year storm)
Tributary Basins: G2.11a **Inlet/MH Number:** Inlet 15
Upstream flowby: **Total Street Flow:**

Flow Intercepted: 2.6 cfs **Flow Bypassed:**
Inlet Size: 10' Type R Inlet in sump
Street Capacity: 7.3 cfs at 0.67% ---street capacity okay

(100-year storm)
Tributary Basins: G2.11a **Inlet/MH Number:** Inlet 15
Upstream flowby: **Total Street Flow:**

Flow Intercepted: 5.8 cfs **Flow Bypassed:**
Inlet Size: 10' Type R Inlet in sump
Street Capacity: 15.3 cfs at 0.67% ---street capacity (1/2 of street).

Design Point 15a
Design Point 15a is located at a low point on the south side of Lorson Boulevard at Pond G2

(5-year storm)
Tributary Basins: G2.12a **Inlet/MH Number:** Inlet 15a
Upstream flowby: **Total Street Flow:**

Flow Intercepted: 2.0 cfs **Flow Bypassed:**
Inlet Size: 10' Type R Inlet in sump
Street Capacity: 7.3 cfs at 0.67% ---street capacity okay

(100-year storm)
Tributary Basins: G2.12a **Inlet/MH Number:** Inlet 15a
Upstream flowby: **Total Street Flow:**

Flow Intercepted: 4.5 cfs **Flow Bypassed:**
Inlet Size: 10' Type R Inlet in sump
Street Capacity: 15.3 cfs at 0.67% ---street capacity (1/2 of street).

Design Point 15b
Design Point 15b is located downstream of Design Point 15a and is the flow in the 48" RCP storm sewer. Flow at this point is from Design Point 15 & 15a and Design Point 13c. The total flow in the pipe is 47.6cfs in the 5-year storm event and 97.8cfs in the 100-year storm event flowing into Pond G2

Design Point 16
Design Point 16 is located at a low point on Rubicon Drive.

(5-year storm)
Tributary Basins: G2.7 **Inlet/MH Number:** Inlet 16
Upstream flowby: **Total Street Flow:**

Flow Intercepted: 4.6 cfs **Flow Bypassed:**
Inlet Size: 10' Type R Inlet in sump
Street Capacity: 7.3 cfs at 0.67% ---street capacity okay

(100-year storm)
Tributary Basins: G2.7 **Inlet/MH Number:** Inlet 16
Upstream flowby: **Total Street Flow:**

Flow Intercepted: 10.2 cfs **Flow Bypassed:**
Inlet Size: 10' Type R Inlet in sump
Street Capacity: 15.3 cfs at 0.67% ---street capacity (1/2 of street).

Design Point 17

Design Point 17 is located at a low point on the west side of Wando Drive north of Lorson Blvd.

(5-year storm)
Tributary Basins: G2.8 & G2.9 **Inlet/MH Number:** Inlet 17
Upstream flowby: **Total Street Flow:**

Flow Intercepted: 2.3 cfs **Flow Bypassed:**
Inlet Size: 5' Type R Inlet in sump
Street Capacity: 7.2 cfs at 0.65% ---street capacity okay since 1/3 of flow is from Lorson Blvd

(100-year storm)
Tributary Basins: G2.8 & G2.9 **Inlet/MH Number:** Inlet 17
Upstream flowby: **Total Street Flow:**

Flow Intercepted: 5.0 cfs **Flow Bypassed:**
Inlet Size: 5' Type R Inlet in sump
Street Capacity: 15 cfs at 0.65% ---street capacity (1/2 of street).

Design Point 18

Design Point 18 is located at a low point on the east side of Wando Drive north of Lorson Blvd.

(5-year storm)
Tributary Basins: G2.10 **Inlet/MH Number:** Inlet 18
Upstream flowby: **Total Street Flow:**

Flow Intercepted: 1.2 cfs **Flow Bypassed:**
Inlet Size: 5' Type R Inlet in sump
Street Capacity: 7.2 cfs at 0.65% ---street capacity okay since 1/3 of flow is from Lorson Blvd

(100-year storm)
Tributary Basins: G2.10 **Inlet/MH Number:** Inlet 18
Upstream flowby: **Total Street Flow:**

Flow Intercepted: 2.6 cfs **Flow Bypassed:**
Inlet Size: 5' Type R Inlet in sump
Street Capacity: 15 cfs at 0.65% ---street capacity (1/2 of street).

Design Point 19

Design Point 19 is flow in storm sewer located on Wando Drive just north of Lorson Boulevard Flow is routed in a 24" RCP to Design Point 21 and then to Pond G2. The total flow in the pipe is 7.4cfs in the 5-year storm event and 16.2cfs in the 100-year storm event.

Design Point 20
Design Point 20 is located at a low point on the north side of Lorson Boulevard.

(5-year storm)
Tributary Basins: G2.11b **Inlet/MH Number:** Inlet 20
Upstream flowby: **Total Street Flow:**

Flow Intercepted: 1.1 cfs **Flow Bypassed:**
Inlet Size: 5' Type R Inlet in sump
Street Capacity: 7.2 cfs at 0.65% ---street capacity okay

(100-year storm)
Tributary Basins: G2.11b **Inlet/MH Number:** Inlet 20
Upstream flowby: **Total Street Flow:**

Flow Intercepted: 2.5 cfs **Flow Bypassed:**
Inlet Size: 5' Type R Inlet in sump
Street Capacity: 15 cfs at 0.65% ---street capacity (1/2 of street).

Design Point 21
Design Point 21 is pipe flow in storm sewer located on Lorson Boulevard just north of Pond G2 and pipe flow from Design Point 19 and 20. Flow is routed in a 24" RCP to Design Point 22 and then to Pond G2. The total flow in the pipe is 10.4cfs in the 5-year storm event and 22.8cfs in the 100-year storm event.

Design Point 22
Design Point 22 is located at a low point on the south side of Lorson Boulevard.

(5-year storm)
Tributary Basins: G2.12b **Inlet/MH Number:** Inlet 22
Upstream flowby: **Total Street Flow:**

Flow Intercepted: 2.2cfs **Flow Bypassed:**
Inlet Size: 5' Type R Inlet in sump
Street Capacity: 7.2 cfs at 0.65% ---street capacity okay

(100-year storm)
Tributary Basins: G2.12b **Inlet/MH Number:** Inlet 22
Upstream flowby: **Total Street Flow:**

Flow Intercepted: 4.8 cfs **Flow Bypassed:**
Inlet Size: 5' Type R Inlet in sump
Street Capacity: 15 cfs at 0.65% ---street capacity (1/2 of street).

Design Point 23
Design Point 23 is pipe flow in storm sewer located on Lorson Boulevard draining into Pond G2 from Design Point 22. Flow is routed in a 24" RCP to Pond G2. The total flow in the pipe is 14.5cfs in the 5-year storm event and 32.0cfs in the 100-year storm event.

Design Point 24

Design Point 24 is located at a low point on the west end of Simcoe Drive

(5-year storm)
Tributary Basins: G2.13 **Inlet/MH Number:** Inlet 24
Upstream flowby: **Total Street Flow:**

Flow Intercepted: 2.8cfs **Flow Bypassed:**
Inlet Size: 5' Type R Inlet in sump
Street Capacity: 7.2 cfs at 0.65% ---street capacity okay

(100-year storm)
Tributary Basins: G2.13 **Inlet/MH Number:** Inlet 24
Upstream flowby: **Total Street Flow:**

Flow Intercepted: 6.2 cfs **Flow Bypassed:**
Inlet Size: 5' Type R Inlet in sump
Street Capacity: 15 cfs at 0.65% ---street capacity (1/2 of street).

Design Point 25

Design Point 25 is pipe flow in storm sewer draining Pond G2. This pipe was sized by the full spectrum detention pond (UD Detention) worksheets provided by Denver Urban Drainage. The pond outflow pipe is 36" RCP at a 0.4% slope. The total flow in the pipe is 4.5cfs in the 5-year storm event and 61.6cfs in the 100-year storm event per the full spectrum spreadsheets.

Design Point 26

Design Point 26 is located at a low point on the north side of Wando Drive downstream of Pond G2.

(5-year storm)
Tributary Basins: G3.1 & G3.2 **Inlet/MH Number:** Inlet 26
Upstream flowby: **Total Street Flow:**

Flow Intercepted: 2.4cfs **Flow Bypassed:**
Inlet Size: 5' Type R Inlet in sump
Street Capacity: 7.2 cfs at 0.65% ---street capacity okay

(100-year storm)
Tributary Basins: G3.1 & G3.2 **Inlet/MH Number:** Inlet 26
Upstream flowby: **Total Street Flow:**

Flow Intercepted: 5.2 cfs **Flow Bypassed:**
Inlet Size: 5' Type R Inlet in sump
Street Capacity: 15 cfs at 0.65% ---street capacity (1/2 of street).

Design Point 27

Design Point 27 is located at a low point on the south side of Wando Drive downstream of Pond G2.

(5-year storm)
Tributary Basins: G3.3 & G3.4 **Inlet/MH Number:** Inlet 27
Upstream flowby: **Total Street Flow:**

Flow Intercepted: 6.8cfs **Flow Bypassed:**
Inlet Size: 10' Type R Inlet in sump
Street Capacity: 7.2 cfs at 0.65% ---street capacity okay

(100-year storm)
Tributary Basins: G3.3 & G3.4 **Inlet/MH Number:** Inlet 27
Upstream flowby: **Total Street Flow:**

Flow Intercepted: 15.0 cfs **Flow Bypassed:**
Inlet Size: 10' Type R Inlet in sump
Street Capacity: 15 cfs at 0.65% ---street capacity (1/2 of street).

Design Point 28

Design Point 28 is pipe flow in storm sewer located on Wando Drive draining into Pond G3 from Design Point 27. Flow is routed in a 24" RCP to Pond G3. The total flow in the pipe is 9.0cfs in the 5-year storm event and 19.9cfs in the 100-year storm event.

Design Point 29

Design Point 29 is the total flow from G3 basins draining to Pond G3. This pond was sized by the full spectrum detention pond (UD Detention) worksheets provided by Denver Urban Drainage. The pond outflow pipe is 18" RCP at a 0.5% slope. The18" will connect into the 36" pipe from Pond G2 and drain east to Jimmy Camp Creek. The total flow into Pond G3 is 9.9cfs in the 5-year storm event and 21.8cfs in the 100-year storm event.

Design Point 30

Design Point 30 is runoff from Basin G6.1 on the north side of Lorson Boulevard. Runoff in Lorson Boulevard will drain west to Marksheffel Road and then north in a curb chase to a barrow ditch on the east side of Marksheffel Road. Two proposed 24-inch RCP storm sewer pipes will be necessary to convey flow from this basin under Lorson Boulevard and will drain into the existing storm sewer system constructed as part of the Marksheffel Road improvement project consisting of two existing downstream pipes are 24" RCP pipes at 0.28% slope. The calculated flow in the proposed pipes is calculated to be 8.7cfs in the 5-year storm event and 19.1cfs in the 100-year storm event. A portion of existing basin EX-1 (Developed basins G1.8a/b) has been diverted east into Pond G1/G2 at Design Point 6 so that developed runoff from Basin G6.1 can flow south to Design Point 30 and not exceed the capacity of the two existing 24" culverts in the roadside barrow ditch.

Design Point 31

Design Point 31 is runoff from Basins G6.1-G6.2 and is the total flow in the barrow ditch of Marksheffel Road just downstream of Lorson Boulevard. Runoff in Lorson Boulevard, backyards, and the future Marksheffel Road will drain south in a barrow ditch on the east side of Marksheffel Road to two existing 24" culverts under an access road. The total flow from all the G6 basins is 9.8cfs in the 5-year storm event and 21.5cfs in the 100-year storm event. This developed flow will not exceed the capacity of the two existing downstream 24" RCP pipes at 0.28% slope. Per the County's design of Marksheffel Road, the two pipes have a total capacity of 28.6cfs in the 100-year storm event. See Appendix E for the drainage memo from HDR regarding design of the two 24" storm sewer culverts.

Design Point 32

Design Point 32 is the total flow in the 36" pipe to Jimmy Camp Creek. The total flow consists of flow from Pond G1/G2 and Pond G3 and is 4.5cfs in the 5-year storm event and 65.7cfs in the 100-year storm event. All flow discharges to Jimmy Camp Creek onto a rip rap pad. The existing flow to Jimmy Camp per the UDCF pre-development flow rates are 69cfs in the 100-year storm event. The proposed runoff rate is less than the pre-development flow rate and is in conformance with the MDDP/Preliminary Drainage Report for Carriage Meadows South at Lorson Ranch prepared by Core Engineering Group [11]

6.0 DETENTION AND WATER QUALITY PONDS

Detention and Storm Water Quality for Carriage Meadows South at Lorson Ranch Filing No. 1 is required per El Paso County criteria. We have implemented the Full Spectrum approach for detention for Carriage Meadows South at Lorson Ranch Filing No. 1 per the Denver Urban Drainage Districts specifications. There is one interim detention pond and two permanent full spectrum ponds proposed for this development. The interim detention pond does not have full spectrum or water quality features and is strictly to slightly reduce runoff so the downstream storm sewer (48" Storm Sewer) can accommodate the increased flows from the developed conditions. The two permanent full spectrum ponds incorporate storm water quality features. The detention ponds in Carriage Meadows South at Lorson Ranch Filing No. 1 will be owned and maintained by the Lorson Ranch Metropolitan District.

Interim Pond G1.7 (Interim District Pond)

This is an interim detention pond located north of the residential areas and west of Carriage Meadows Drive. If the Brownsville Subdivision No. 2 develops as part of Lorson Ranch all or a portion of this pond could be moved to a more effective location to the southwest. Interim Pond G1.7 reduces the size of the downstream storm sewer to a 48" diameter that flows south to Swale G1.8. The smaller size outfall pipe is necessary to maintain cover over the pipe. This pond was modeled in Hydraflow and does not include water quality features. Pond G1.7's developed inflow hydrograph has a 35 minute duration and the outflow hydrograph stores and drains the pond volume in around 110 minutes. Pond G1.7 will fill and drain out in less than two hours because of the large 48" diameter storm sewer outfall pipe. Pond G1.7 does not overdetain runoff when compared to existing conditions. When development occurs upstream of this interim pond the pond must be updated to meet El Paso County requirements for full spectrum ponding.

- Incoming flows: 107cfs/196cfs in the 5-year and 100-year storm event
- Detained flows: 62.7cfs/95cfs in the 5-year and 100-year storm event
- Pipe Outlet: 48" RCP at 0.5%
- 5-yr WSEL= 5695.10, 100-yr WSEL=5696.94
- Volume: 1.22 ac-ft storage in 5-year, 2.40 acre-ft storage in 100-year

Swale G1.8 (District Facility)

This swale is located west of the residential areas adjacent to Marksheffel Road. The swale does have some storage volume in it which is why it is included in the hydraulic calculations. If the Brownsville Subdivision No. 2 develops as part of Lorson Ranch all or a portion of this swale could be moved to a more effective location or changed into a pond. Swale G1.8 helps reduces the size of storm sewer necessary to convey drainage from Design Point 6 to Pond G1. This swale was modeled in Hydraflow and does not include water quality features.

- Incoming flows: 74cfs/120cfs in the 5-year and 100-year storm event
- Detained flows: 52.8cfs/105cfs in the 5-year and 100-year storm event
- Pipe Outlet: 42" RCP at 0.5%
- 5-yr WSEL= 5692.86, 100-yr WSEL=5694.33

- Volume: 0.9 ac-ft storage in 5-year, 1.48 acre-ft storage in 100-year

<u>Hydraulic Design of the “G1” portion of Pond G1/G2 (District Facility)</u>

This analysis was added to provide a hydraulic model of the “G1” side of Pond G1/G2 to ensure the storm sewer interconnection pipes were sized adequately. See Pond G1/G2 for full spectrum calculations. The hydraulic model utilized the storage volume in Pond G1.7 and Swale G1.8 (tributary areas) and the site runoff directly entering the G1 side to determine the total flow entering the G1 side. The G1 side (north of Lorson Boulevard) was then hydraulically modeled in Hydraflow to determine the flow in the interconnect pipe flowing to the G2 side (south). The interconnection pipe will also serve as an emergency overflow with a capacity of over 120cfs. In addition, a sideyard overflow swale will also be constructed which has a capacity of 100cfs.

- Incoming flows: 56cfs/113.5cfs in the 5-year and 100-year storm event
- Outflow to “G2” side: 28cfs at elevation 5687.92 in the 5-year storm event
- Outflow to “G2” side: 58cfs at elevation 5689.12 in the 100-year storm event
- Volume: 2.25 ac-ft storage in 5-year, 3.79 acre-ft storage in 100-year
- Pipe Outlet: 48” RCP at 0.4%

<u>Detention Pond G1/G2 (Full Spectrum Design), (District Facility)</u>

This is an on-site permanent full spectrum detention pond that includes water quality. Pond G1/G2 is designed as a single pond in the UDCF Full Spectrum spreadsheets. The full spectrum print outs are in the appendix of this report. See map in appendix for watershed areas. This pond is sized to provide full spectrum and water quality for the Brownsville Subdivision No. 2 should it become a part of Lorson Ranch.

- Watershed Ares: 96 acres
- Watershed Imperviousness: 79%
- Hydrologic Soils Group A, B, C/D
- Zone 1 WQCV: 2.301 ac-ft, WSEL: 5683.93
- Zone 2 EURV: 8.104 ac-ft, WSEL: 5686.29
- Zone 3 (100-yr):   12.881ac-ft, WSEL: 5687.93
- Pipe Outlet: 36” RCP at 0.4%
- 5-yr outflow = 4.2cfs, 100-yr outflow = 55.6cfs

<u>Detention Pond G3 (Full Spectrum Design), (District Facility)</u>

This is an on-site permanent full spectrum detention pond that includes water quality. Pond G3 is designed per the UDCF Full Spectrum spreadsheets. The full spectrum print outs are in the appendix of this report. See map in appendix for watershed areas.

- Watershed Ares: 6.02 acres
- Watershed Imperviousness: 65%
- Hydrologic Soils Group B
- Zone 1 WQCV: 0.11 ac-ft, WSEL: 5684.94
- Zone 2 EURV: 0.39 ac-ft, WSEL: 5686.41
- Zone 3 (100-yr): 0.51 ac-ft, WSEL: 5686.98
- Pipe Outlet: 18” RCP at 0.5%
- 5-yr outflow = 0.3cfs, 100-yr outflow = 10.1cfs

Water Quality Design

Water Quality for all the G1, G2, and G3 basins is provided in the on-site full spectrum ponds. The G4 and G5 basins are from the backyards of residential lots and open space and have been reduced in area as much as possible. The WQ for the G6 basins is provided by an existing sand filter basin in the east barrow ditch of Marksheffel Road near the SW corner of this site. The sand filter basin was constructed as part of the Marksheffel Road project by El Paso County. The sand filter basin was designed for all of Marksheffel Road but we have diverted most of the northern sections of Marksheffel Road (Basins G1.8a/b) into Pond G1/G2 which will allow the flows in the G6 basins to be treated by the existing sand filter basin. The main reason for diverting runoff is that there is not enough elevation difference to construct a pond in the SW corner with a suitable outfall.

7.0 DRAINAGE AND BRIDGE FEES

Carriage Meadows South at Lorson Ranch Filing No. 1 is located within the Jimmy Camp Creek drainage basin which is currently a fee basin in El Paso County. Current El Paso County regulations require drainage and bridge fees to be paid for platting of land as part of the plat recordation process. Lorson Ranch Metro District has negotiated a development agreement with El Paso County which defines major drainage infrastructure to be constructed as part of the district.

Lorson Ranch Metro District will compile and submit to the county on a yearly basis the Drainage and bridge fees for the approved plats, and shall show all credits they have received for the same yearly time frame.

Carriage Meadows South at Lorson Ranch Filing No. 1 contains 106.64 acres. The 106.64 acres will be assessed Drainage, Bridge and Surety fees. This project consists of 34.02 acres of open space (7% impervious), 13.69 acres of commercial (95% impervious), and the remaining 58.93 acres is residential (65% impervious) for a total impervious percentage of 50.4%

The 2017 drainage fees are $15,720, bridge fees are $735 and Drainage Surety fees are $7,000 per impervious acre. The fees are due at plat recordation and are calculated as follows:

Table 1: Drainage/Bridge Fees

Type of Land Use	Total Area (ac)	Imperviousness	Drainage Fee	Bridge Fee	Surety Fee
Residential	58.93	65%	$602,657	$28,177	$268,359
Open Space	34.02	7%	$37,435	$1,750	$16,669
Commercial	13.69	95%	$204,446	$9,559	$91,038
		Total	$844,538	$39,486	$376,066

Table 2: Storm Drainage Facility Costs (non-reimbursable)

Item	Quantity	Unit	Unit Cost	Item Total
Rip Rap	60	CY	$50/CY	$3,000
Inlets/Manholes	27	EA	$5000/EA	$135,000
18" Storm	490	LF	$35	$17,150
24" Storm	1504	LF	$40	$60,160
30" Storm	80	LF	$45	$3,600
36" Storm	407	LF	$55	$22,385
42" Storm	175	LF	$65	$11,375
48" Storm	1228	LF	$85	$104,380
			Subtotal	$357,050
			Eng/Cont (15%)	$53,557
			Total Est. Cost	$410,607

Table 3: Lorson Ranch Metro District Drainage Facility Costs (non-reimbursable)

Item	Quantity	Unit	Unit Cost	Item Total
Rip Rap	100	CY	$50/CY	$5,000
Channel Lining	1300	SY	$5/SY	$6,500
Full Spectrum Ponds and Outlet	2	LS	$50,000	$100,000
			Subtotal	$111,500
			Eng/Cont (15%)	$16,725
			Total Est. Cost	$128,225

8.0 CONCLUSIONS

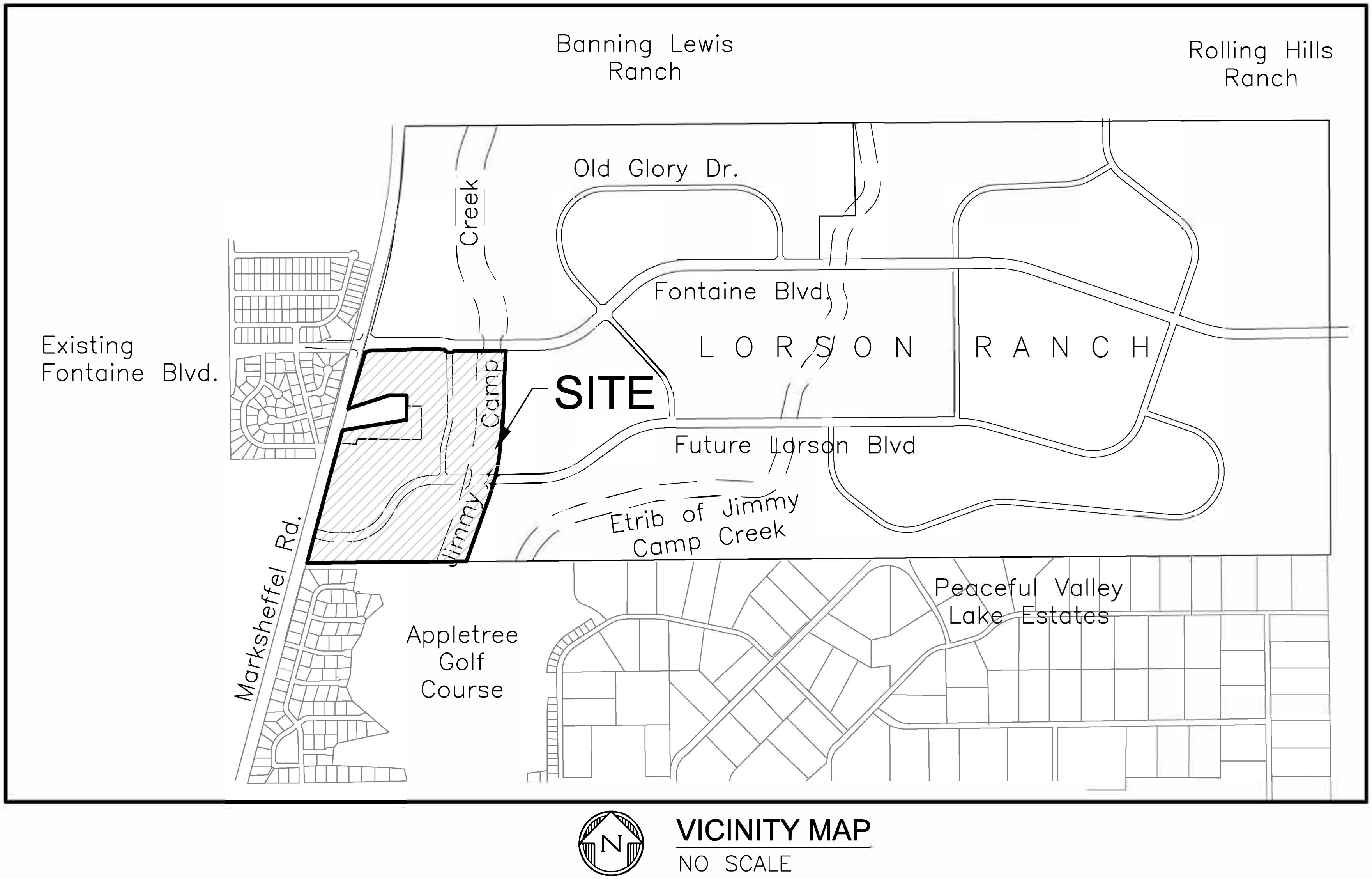
This drainage report has been prepared in accordance with the City of Colorado Springs/El Paso County Drainage Criteria Manual. The proposed development and drainage infrastructure will not cause adverse impacts to adjacent properties or properties located downstream. Several key aspects of the development discussed above are summarized as follows:

- Developed runoff will be conveyed via curb/gutter and storm sewer facilities
- Jimmy Camp Creek is realigned and Marksheffel Road has been reconstructed within this study area
- Detention and water quality for this study area has been provided

9.0 REFERENCES

1. City of Colorado Springs/El Paso County Drainage Criteria Manual DCM, dated November, 1991
2. Chapter 6 and Section 3.2.1 Chapter 13 of the City of Colorado Springs Drainage Criteria Manual dated May 2014
3. Soil Survey of El Paso County Area, Colorado by USDA, SCS
4. Jimmy Camp Creek Drainage Basin Planning Study, 1987, Wilson & Co.
5. City of Colorado Springs “Drainage Criteria Manual, Volume 2
6. El Paso County “Engineering Criteria Manual”
7. Final Drainage Report for Fontaine Boulevard, Old Glory Drive, and Marksheffel Road Phase 1 Improvements, Dated February 6, 2006, Revised September 7, 2006, by Pentacor Engineering.
8. Drainage Basin Planning Study, Dated March 9, 2015, by Kiowa Engineering Corporation
9. Drainage memo from HDR for Marksheffel Road project, dated March 11, 2016
10. Jimmy Camp Creek Reconstruction plans by Drexel, Barrell & Co, dated September 6, 2005, county plans #2801.
11. Master Development Drainage Plan and Preliminary Drainage Report for Carriage Meadows South at Lorson Ranch by Core Engineering Group, dated June, 2017 and revised March, 2017.

APPENDIX A – VICINTIY MAP, SOILS MAP, FEMA MAP



VICINITY MAP
NO SCALE

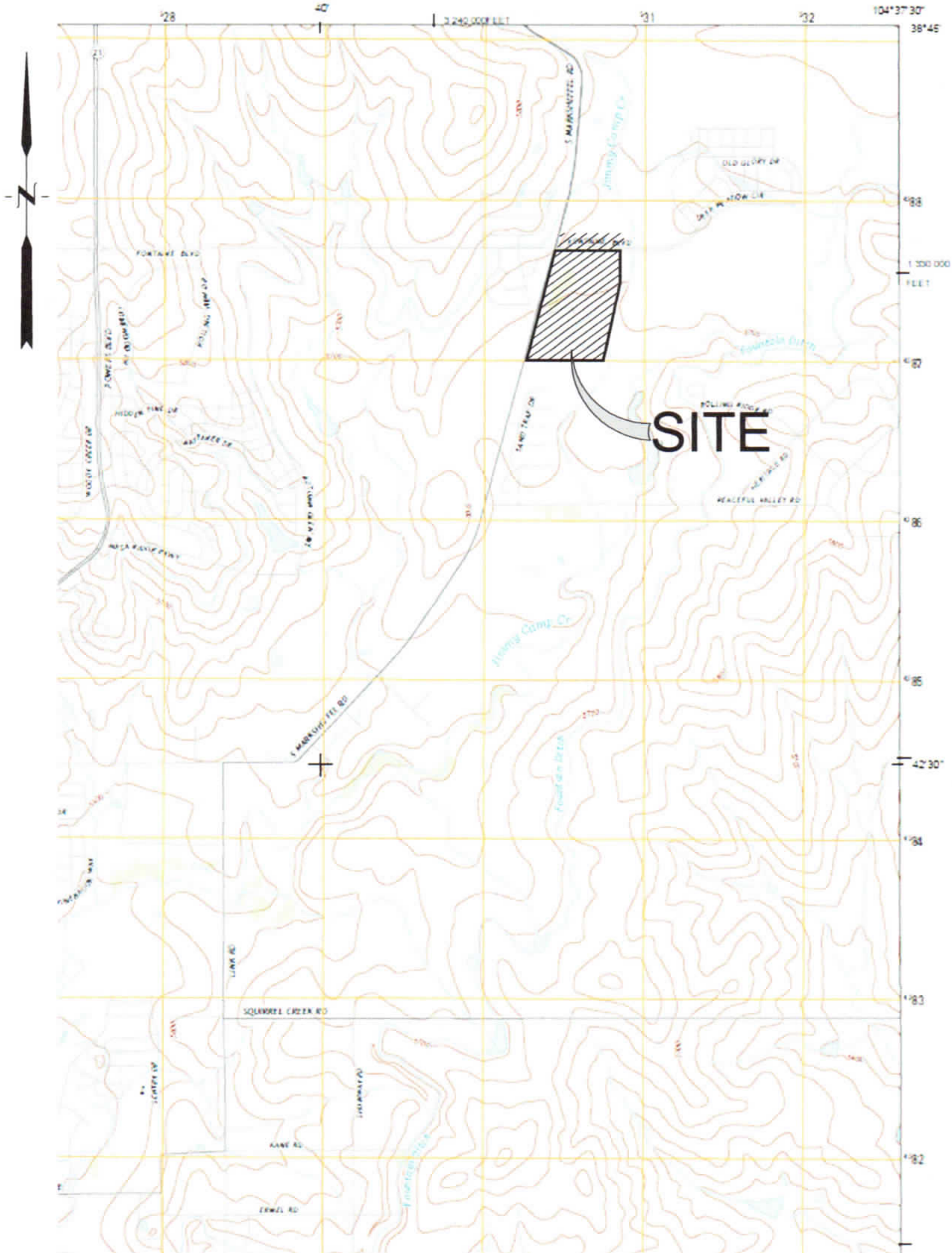
CORE
NG GROUP

15004 1ST AVE. S.
BURNSVILLE, MN 55306
PH: 719.570.1100

CONTACT: RICHARD L. SCHINDLER, P.E.
EMAIL: Rich@ceg1.com

CARRIAGE MEADOWS SOUTH AT LORSON RANCH FIL. NO. 1
VICINITY MAP

SCALE:	DATE:	FIGURE NO.
NTS	OCTOBER, 2016	--



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CARRIAGE MEADOWS SOUTH
LOCATION MAP

SCALE:	DATE:	FIGURE NO.
NTS	FEBRUARY 24, 2016	1

Custom Soil Resource Report
Soil Map

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

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: http://websoilsurvey.nrcs.usda.gov
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 13, Sep 22, 2015

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—Sep 22, 2011

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.

Map Unit Legend

El Paso County Area, Colorado (CO625)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
28	Ellicott loamy coarse sand, 0 to 5 percent slopes	50.3	46.1%
30	Fort Collins loam, 0 to 3 percent slopes	25.0	22.9%
52	Manzanst clay loam, 0 to 3 percent slopes	33.5	30.8%
59	Nunn clay loam, 0 to 3 percent slopes	0.2	0.2%
Totals for Area of Interest		**109.0**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

El Paso County Area, Colorado

28—Ellicott loamy coarse sand, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 3680
Elevation: 5,500 to 6,500 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Ellicott and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ellicott

Setting

Landform: Flood plains, stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium

Typical profile

A - 0 to 4 inches: loamy coarse sand
C - 4 to 60 inches: stratified coarse sand to sandy loam

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water storage in profile: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: A
Ecological site: Sandy Bottomland (R069XY031CO)
Other vegetative classification: SANDY BOTTOMLAND (069AY031CO)

Minor Components

Fluvaquentic haplaquoll

Percent of map unit:
Landform: Swales

Other soils

Percent of map unit:

Pleasant

Percent of map unit:
Landform: Depressions

30—Fort Collins loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 3683
Elevation: 5,200 to 6,500 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 155 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Fort collins and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fort Collins

Setting

Landform: Flats
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy alluvium

Typical profile

A - 0 to 9 inches: loam
Bt - 9 to 16 inches: clay loam
Bk - 16 to 21 inches: clay loam
Ck - 21 to 60 inches: loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 4e

Hydrologic Soil Group: B
Ecological site: Loamy Plains, LRU's A & B 10-14 Inches, P.Z. (R069XY006CO)
Other vegetative classification: LOAMY PLAINS (069AY006CO)

Minor Components

Other soils

Percent of map unit:

Pleasant

Percent of map unit:
Landform: Depressions

52—Manzanst clay loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2w4nr
Elevation: 4,060 to 6,660 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Manzanst and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Manzanst

Setting

Landform: Terraces, drainageways
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear, concave
Parent material: Clayey alluvium derived from shale

Typical profile

A - 0 to 3 inches: clay loam
Bt - 3 to 12 inches: clay
Btk - 12 to 37 inches: clay
Bk1 - 37 to 52 inches: clay
Bk2 - 52 to 79 inches: clay

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches

Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Gypsum, maximum in profile: 3 percent
Salinity, maximum in profile: Slightly saline (4.0 to 7.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 10.0
Available water storage in profile: High (about 9.0 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: C
Ecological site: Saline Overflow (R067BY037CO)

Minor Components

Ritoazul

Percent of map unit: 7 percent
Landform: Interfluves, drainageways
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Clayey Plains (R067BY042CO)

Arvada

Percent of map unit: 6 percent
Landform: Drainageways, interfluves
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Salt Flat (R067XY033CO)

Wiley

Percent of map unit: 2 percent
Landform: Interfluves
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Loamy Plains (R067BY002CO)

59—Nunn clay loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 3693
Elevation: 5,400 to 6,500 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 135 to 155 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Nunn and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nunn

Setting

Landform: Terraces, fans
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium

Typical profile

A - 0 to 12 inches: clay loam
Bt - 12 to 26 inches: clay loam
BC - 26 to 30 inches: clay loam
Bk - 30 to 58 inches: sandy clay loam
C - 58 to 72 inches: clay

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Gypsum, maximum in profile: 2 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 9.8 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: C
Ecological site: Clayey Plains (R069XY042CO)
Other vegetative classification: CLAYEY PLAINS (069AY042CO)

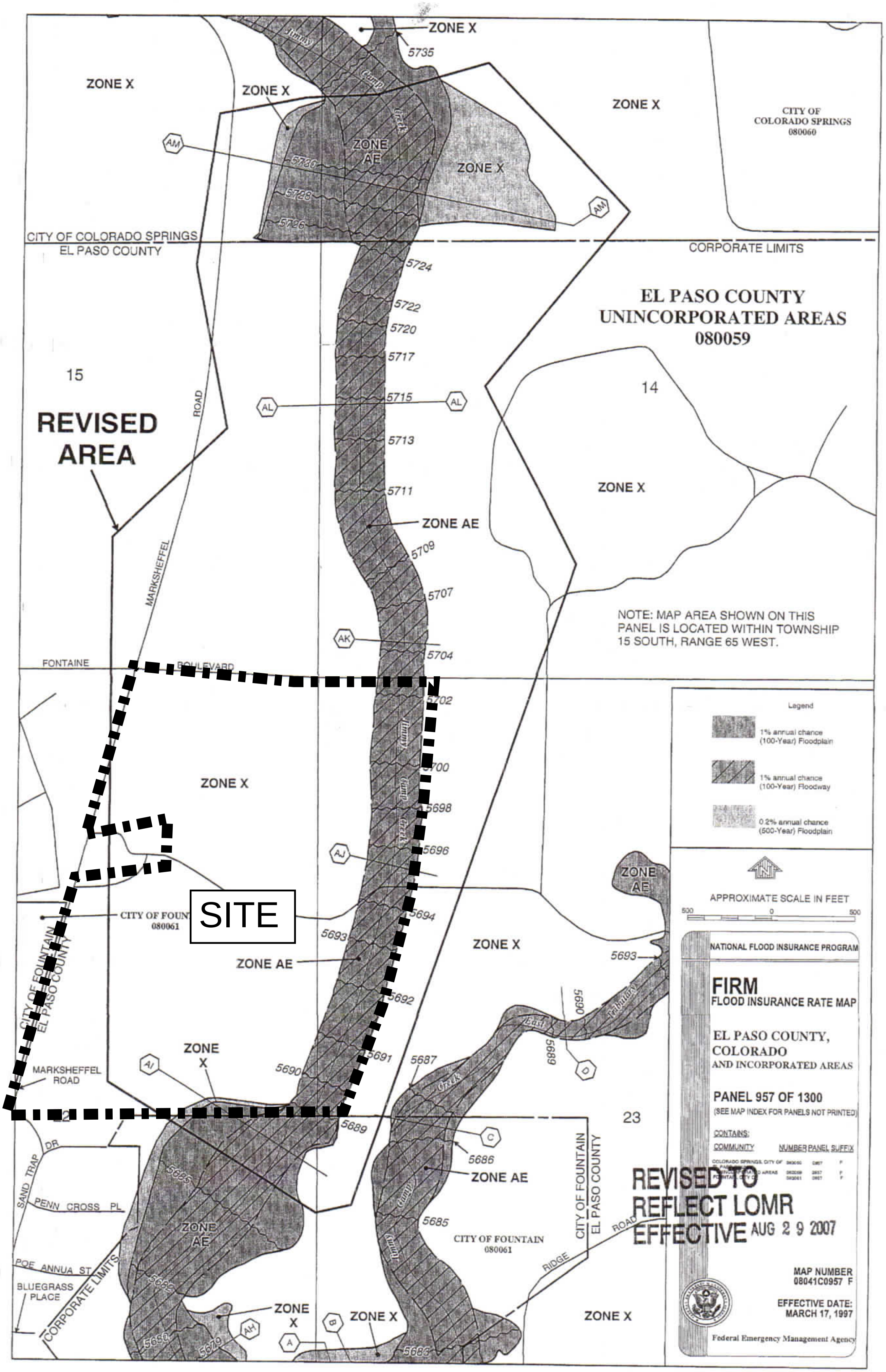
Minor Components

Other soils

Percent of map unit:

Pleasant

Percent of map unit:
Landform: Depressions



ZONE X
5735
ZONE X
ZONE X
ZONE AE
ZONE X
ZONE X
CITY OF COLORADO SPRINGS 080060
CITY OF COLORADO SPRINGS
EL PASO COUNTY
CORPORATE LIMITS
EL PASO COUNTY UNINCORPORATED AREAS 080059
15
14
REVISED AREA
MARKSHEFFEL ROAD
ZONE AE
ZONE X
NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 15 SOUTH, RANGE 65 WEST.
FONTAINE BOULEVARD
ZONE X
SITE
CITY OF FOUNTAIN 080061
ZONE AE
ZONE X
ZONE X
ZONE AE
Legend
1% annual chance (100-Year) Floodplain
1% annual chance (100-Year) Floodway
0.2% annual chance (500-Year) Floodplain
APPROXIMATE SCALE IN FEET
500 0 500
NATIONAL FLOOD INSURANCE PROGRAM
FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO AND INCORPORATED AREAS
PANEL 957 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)
REVISED TO REFLECT LOMR EFFECTIVE AUG 29 2007
MAP NUMBER 08041C0957 F
EFFECTIVE DATE: MARCH 17, 1997
Federal Emergency Management Agency
CITY OF FOUNTAIN
EL PASO COUNTY
ZONE AE
CITY OF FOUNTAIN 080061
RIDGE ROAD
23
ZONE X
ZONE X
ZONE X
SAND TRAP DR
PENN CROSS PL
POE ANNUA ST
BLUEGRASS PLACE
CORPORATE LIMITS

APPENDIX B – HYDROLOGY CALCULATIONS

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: May. 23, 2016
Checked By: Leonard Beasley

Job No: 100.030
Project: Carriage Meadows South
Design Storm: **5 & 100 - Year Event, Pre-Dev. Conditions**

Street or Basin	Design Point	Area Design	Direct Runoff: Area (A)	Direct Runoff: Runoff Coeff. (C)	Direct Runoff: tc	Direct Runoff: CA	Direct Runoff: i	Direct Runoff: Q	Total Runoff: tc	Total Runoff: Σ (CA)	Total Runoff: i	Total Runoff: Q	Street: Slope	Street: Street Flow	Pipe: Design Flow	Pipe: Slope	Pipe: Pipe Size	Travel Time: Length	Travel Time: Velocity	Travel Time: tt	Remarks
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
5 - Year Event, Pre-Developed Conditions																					
Basin EX-1			15.54	0.08	31.4	1.24	2.41	3.0													
Basin EX-2			4.87	0.18	24.9	0.89	2.76	2.5	Existing Road & Borrow Ditch												
DP-1			20.41	0.10					31.4	2.13	2.41	5.2									
Basin EX-3			78.00	0.10	31.6	7.80	2.40	18.7													
Basin EX-4			5.22	0.15	16.6	0.78	3.37	2.6													
Basin EX-5			5.23	0.15	15.0	0.78	3.52	2.8													
Basin EX-6			23.40	0.15	24.0	3.51	2.82	9.9													
100 - Year Event, Pre-Developed Conditions																					
Basin EX-1			15.54	0.35	31.4	5.44	4.05	22.0													
Basin EX-2			4.87	0.38	24.9	1.85	4.63	8.6	Existing Road & Borrow Ditch												
DP-1			20.41	0.39					31.4	7.29	4.05	29.5									
Basin EX-3			78.00	0.35	31.6	27.30	4.03	110.1													
Basin EX-4			5.22	0.50	16.6	2.61	5.66	14.8													
Basin EX-5			5.23	0.50	15.0	2.62	5.91	15.4													
Basin EX-6			23.40	0.50	24.0	11.70	4.73	55.3													

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: May. 23, 2016
Checked By: Leonard Beasley

Job No: 100.030
Project: Carriage Meadows South
Design Storm: **5 - Year Event, Proposed Conditions**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	tc	CA	i	Q	tc	∑ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	tt	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
G1.1			3.09	0.81	7.9	2.50	4.49	11.2													
G1.2			2.22	0.45	8.8	1.00	4.31	4.3													
G1.3			0.45	0.45	10.7	0.20	4.02	0.8													
	1	5.76							10.7	3.70	4.03	14.9									
G1.4	**2**		3.53	0.77	12.6	2.72	3.78	10.3													
	2a	9.29							12.6	6.42	3.78	24.3									
G1.5	**3**		0.83	0.83	8.7	0.69	4.34	3.0													
	3a	10.12							12.6	7.11	3.78	26.9									
G1.6			19.74	0.81	12.2	15.99	3.83	61.2													
G1.7			11.60	0.82	11.1	9.51	3.98	37.8													
(G1.6 & G1.7)	**4**	31.34							17.8	25.50	3.26	83.2									
(G1.1 - G1.7)	**5**	41.46							17.8	32.61	3.26	106.4									
G1.8a			9.16	0.52	20.3	4.76	3.07	14.6													
G1.8b			5.11	0.45	20.2	2.30	3.08	7.1													
(G1.1 - G1.8)	**--**	55.73							20.5	39.68	3.05	121.2									
G1.9	**7**		2.97	0.45	10.7	1.34	4.02	5.4													

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: May. 23, 2016
Checked By: Leonard Beasley

Job No: 100.030
Project: Carriage Meadows South
Design Storm: **5 - Year Event, Proposed Conditions**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	tc	CA	i	Q	tc	Σ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	tt	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
G1.10	**7a**		4.30	0.45	18.8	1.94	3.18	6.2													
G1.11			3.10	0.45	12.9	1.49	3.74	5.6													
G2.1			3.40	0.45	16.4	1.53	3.38	5.2													
	10	3.40							16.4	1.53	3.39	5.2									
G2.2			1.95	0.45	15.9	0.88	3.44	3.0													
G2.3			3.70	0.45	17.5	1.67	3.29	5.5													
G2.4	**12a**		4.00	0.45	13.1	1.80	3.73	6.7													
G2.5	**12b**		0.21	0.45	10.1	0.09	4.12	0.4													
(G2.4 - G2.5)	**12**	4.21							13.3	1.89	3.70	7.0									
G2.6	13b		1.43	0.45	13.2	0.64	3.71	2.4													
G2.6a	**13**		0.30	0.45	5.0	0.14	5.17	0.7													

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: May. 23, 2016
Checked By: Leonard Beasley

Job No: 100.030
Project: Carriage Meadows South
Design Storm: **5 - Year Event, Proposed Conditions**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	tc	CA	i	Q	tc	Σ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	tt	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
G2.7			2.40	0.45	9.0	1.08	4.29	4.6													
(G2.7)	**16**	2.40							8.9	1.08	4.30	4.6									
G2.8			1.01	0.45	6.2	0.45	4.84	2.2													
G2.9			0.23	0.45	10.4	0.10	4.08	0.4													
(G2.8 - G2.9)	**17**	1.24							10.4	0.56	4.08	2.3									
G2.10			0.68	0.45	12.5	0.31	3.80	1.2													
(G2.10)	**18**	0.68							12.5	0.31	3.80	1.2									
(G2.7 - G2.10)	**19**	4.32							12.5	1.94	3.80	7.4									
G2.11a			1.61	0.45	13.7	0.72	3.66	2.6													
G2.11b			0.64	0.45	11.0	0.29	3.99	1.1													
G2.12a			1.14	0.45	11.0	0.51	3.99	2.0													
G2.12			1.16	0.45	9.6	0.52	4.19	2.2													
G2.13			1.54	0.45	10.3	0.69	4.08	2.8													
(G2.13)	**24**	1.54							10.3	0.69	4.08	2.8									

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: May. 23, 2016
Checked By: Leonard Beasley

Job No: 100.030
Project: Carriage Meadows South
Design Storm: **5 - Year Event, Proposed Conditions**

Street or Basin	Design Point	Area Design	Direct Runoff: Area (A) ac.	Runoff Coeff. (C)	tc min.	CA	i in/hr	Q cfs	Total Runoff: tc min	Σ (CA)	i in/hr	Q cfs	Street: Slope %	Street Flow cfs	Pipe: Design Flow cfs	Slope %	Pipe Size in	Travel Time: Length ft	Velocity ft/sec	tt min	Remarks
G2.14			4.59	0.45	13.0	2.07	3.74	7.7													
G2	**25**	29.99							18.4	13.50	3.22	43.4									
G3.1			0.69	0.45	12.2	0.31	3.83	1.2													
G3.2			0.68	0.45	10.3	0.31	4.08	1.2													
(G3.1 - G3.2)	**26**	1.37							12.2	0.62	3.83	2.4									
G3.3			0.74	0.45	12.7	0.33	3.77	1.3													
G3.4			3.46	0.45	14.1	1.56	3.61	5.6													
(G3.3 - G3.4)	**27**	4.20							14.1	1.89	3.61	6.8									
(G3.1 - G3.4)	**28**	5.57							14.1	2.51	3.61	9.0									
G3.5			0.52	0.45	8.7	0.23	4.34	1.0													
G3	**29**	6.09							14.1	2.74	3.61	9.9									
G4			1.32	0.45	8.2	0.59	4.43	2.6													
G5			0.89	0.45	7.6	0.40	4.53	1.8													
G6.1			5.55	0.45	15.5	2.50	3.47	8.7													
G6.2			0.77	0.90	7.8	0.69	4.51	3.1													
G6			6.32	0.45	15.9	2.84	3.43	9.8													

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: May. 23, 2016
Checked By: Leonard Beasley

Job No: 100.030
Project: Carriage Meadows South
Design Storm: **100 - Year Event, Proposed Conditions**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	tc	CA	i	Q	tc	Σ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	tt	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
G1.1			3.09	0.89	7.9	2.75	7.54	20.7													
G1.2			2.22	0.59	8.8	1.31	7.24	9.5													
G1.3			0.45	0.59	10.7	0.27	6.75	1.8													
	1	5.76							10.7	4.33	6.76	29.2									
G1.4	**2**		3.53	0.85	12.6	3.00	6.35	19.0													
	2a	9.29							12.6	7.33	6.35	46.5									
G1.5	**3**		0.83	0.90	8.7	0.75	7.29	5.4													
	3a	10.12							12.6	8.07	6.35	51.2									
G1.6			19.74	0.88	12.2	17.37	6.43	111.6													
G1.7			11.60	0.89	11.1	10.32	6.68	68.9													
(G1.6 & G1.7)	**4**	31.34							17.8	27.70	5.48	151.7									
(G1.1 - G1.7)	**5**	41.46							17.8	35.77	5.48	195.9									
G1.8a			9.16	0.68	20.3	6.23	5.15	32.1													
G1.8b			5.11	0.59	20.2	3.01	5.17	15.6													
(G1.1 - G1.8)	**--**	55.73							20.5	45.01	5.13	230.8									
G1.9	**7**		2.97	0.59	10.7	1.75	6.75	11.8													

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: May. 23, 2016
Checked By: Leonard Beasley

Job No: 100.030
Project: Carriage Meadows South
Design Storm: **100 - Year Event, Proposed Conditions**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	tc	CA	i	Q	tc	Σ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	tt	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
G1.10	**7a**		4.30	0.59	18.8	2.54	5.34	13.6													
G1.11			3.10	0.59	12.9	1.83	6.29	11.5													
G2.1			3.40	0.59	16.4	2.01	5.68	11.4													
	10	3.40							16.4	2.01	5.69	11.4									
G2.2	**14**		1.95	0.59	15.9	1.15	5.77	6.6													
G2.3	14a		3.70	0.59	17.5	2.18	5.52	12.1													
G2.4	**12a**		4.00	0.59	13.1	2.36	6.26	14.8													
G2.5	**12b**		0.21	0.59	10.1	0.12	6.92	0.9													
(G2.4 - G2.5)	**12**	4.21							13.3	2.48	6.21	15.4									
G2.6	13b		1.43	0.59	13.2	0.84	6.23	5.3													
G2.6a	**13**		0.30	0.59	13.2	0.18	6.23	1.1													
G2.7			2.40	0.59	9.0	1.42	7.21	10.2													

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: May. 23, 2016
Checked By: Leonard Beasley

Job No: 100.030
Project: Carriage Meadows South
Design Storm: **100 - Year Event, Proposed Conditions**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	tc	CA	i	Q	tc	Σ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	tt	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
(G2.7)	**16**	2.40							8.9	1.42	7.23	10.2									
G2.8			1.01	0.59	6.2	0.60	8.12	4.8													
G2.9			0.23	0.59	10.4	0.14	6.85	0.9													
(G2.8 - G2.9)	**17**	1.24							10.4	0.73	6.85	5.0									
G2.10			0.68	0.59	12.5	0.40	6.37	2.6													
(G2.10)	**18**	0.68							12.5	0.40	6.37	2.6									
(G2.7 - G2.10)	**19**	4.32							12.5	2.55	6.37	16.2									
G2.11a			1.61	0.59	13.7	0.95	6.14	5.8													
G2.11b			0.64	0.59	11.0	0.38	6.69	2.5													
G2.12a			1.14	0.59	11.0	0.67	6.69	4.5													
G2.12b			1.16	0.59	9.6	0.68	7.04	4.8													
G2.13			1.54	0.59	10.3	0.91	6.85	6.2													
(G2.13)	**24**	1.54							10.3	0.91	6.85	6.2									
G2.14			4.59	0.59	13.0	2.71	6.28	17.0													

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: May. 23, 2016
Checked By: Leonard Beasley

Job No: 100.030
Project: Carriage Meadows South
Design Storm: **100 - Year Event, Proposed Conditions**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	tc	CA	i	Q	tc	Σ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	tt	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
G2	**25**	29.99							18.4	17.69	5.40	95.6									
G3.1			0.69	0.59	12.2	0.41	6.43	2.6													
G3.2			0.68	0.59	10.3	0.40	6.85	2.7													
(G3.1 - G3.2)	**26**	1.37							12.2	0.81	6.43	5.2									
G3.3			0.74	0.59	12.7	0.44	6.32	2.8													
G3.4			3.46	0.59	14.1	2.04	6.06	12.4													
(G3.3 - G3.4)	**27**	4.20							14.1	2.48	6.06	15.0									
(G3.1 - G3.4)	**28**	5.57							14.1	3.29	6.06	19.9									
G3.5			0.52	0.59	8.7	0.31	7.29	2.2													
G3	**29**	6.09							14.14	3.59	6.06	21.8									
G4			1.32	0.59	8.2	0.78	7.44	5.8													
G5			0.89	0.59	7.6	0.53	7.61	4.0													
G6.1			5.55	0.59	15.5	3.27	5.83	19.1													
G6.2			0.77	0.96	7.8	0.74	7.57	5.6													
G6			6.32	0.59	15.9	3.73	5.77	21.5													

CORE ENGINEERING GROUP

Standard Form SF-1. Time of Concentration-Proposed

Calculated By: Leonard Beasley
Date: May 23, 2016
Checked By: Leonard Beasley

Job No: 100.030
Project: Carriage Meadows South

Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					t_c Check (urbanized Basins)		Final t_c
BASIN or DESIGN	C_5	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_i minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_t minutes	Computed tc Minutes	TOTAL LENGTH (L) feet	Regional tc tc=(L/180)+10 minutes	USDCM Recommended $t_c=t_i+t_t$ (min)
G1.1	0.81	3.09	20.0	44.00	18.41%	0.55	1.33	735.00	0.88%	1.88	6.53	7.86	779.00	14.33	7.86
G1.2	0.45	2.22	7.0	71.00	16.90%	0.30	3.89	143.00	1.75%	0.93	2.57				
			20.0					253.00	0.79%	1.78	2.37	8.84	467.00	12.59	8.84
G1.3	0.45	2.40	20.0	100.00	2.40%	0.19	8.82	178.00	0.60%	1.55	1.91	10.74	278.00	11.54	10.74
G1.4	0.77	3.53	7.0	100.00	4.60%	0.46	3.61	86.00	1.16%	0.75	1.90				
			20.0					800.00	0.88%	1.88	7.11	12.62	986.00	15.48	12.62
G1.5	0.83	0.83	20.0	23.00	3.04%	0.24	1.63	812.00	0.92%	1.92	7.05	8.68	835.00	14.64	8.68
G1.6	0.81	19.74	20.0	100.00	1.00%	0.32	5.24	855.00	1.53%	2.47	5.76				
			34"x53"					317.00	0.50%	4.28	1.24	12.23	1272.00	17.07	12.23
G1.7	0.82	15.02	20.0	63.00	9.52%	0.55	1.91	530.00	1.32%	2.30	3.84				
			15.0					485.00	1.03%	1.52	5.31	11.07	1078.00	15.99	11.07
DP-4	0.82	34.76	20.0	100.00	1.00%	0.33	5.06	855.00	1.53%	2.47	5.76				
			34"x53"					317.00	0.50%	4.28	1.24				
			20.0					755.00	1.19%	2.18	5.77	17.82	2027.00	21.26	17.82
G1.8a	0.52	9.16	15.0	90.00	1.67%	0.18	8.39	1157.00	1.10%	1.57	12.26				
			7.0					27.00	31.89%	3.95	0.11				
			15.0					584.00	0.40%	0.95	10.26	31.02	1858.00	20.32	20.32

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Standard Form SF-1. Time of Concentration-Proposed

Calculated By: Leonard Beasley
Date: May 23, 2016
Checked By: Leonard Beasley

Job No: 100.030
Project: Carriage Meadows South

Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					t_c Check (urbanized Basins)		Final t_c
BASIN or DESIGN	C_5	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_i minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_t minutes	Computed t_c Minutes	TOTAL LENGTH (L) feet	Regional tc $t_c=(L/180)+10$ minutes	USDCM Recommended $t_c=t_i+t_t$ (min)
G1.8b	0.45	5.11	20.0	68.00	1.78%	0.14	8.03	127.00	3.15%	3.55	0.60				
			15.0					1633.00	1.41%	1.78	15.28	23.91	1828.00	20.16	20.16
DP-6	0.82	34.76	20.0	100.00	1.00%	0.33	5.06	855.00	1.53%	2.47	5.76				
			34"x53"					317.00	0.50%	4.28	1.23				
			20.0					883.00	2.50%	3.16	4.65				
			48"					508.00	0.68%	9.41	0.90				
			Chnl					847.00	0.30%	4.92	2.87	20.47	3510.00	29.50	20.47
G1.9	0.45	2.97	20.0	45.00	2.43%	0.13	5.89	1317.00	0.62%	1.57	13.94	19.83	1362.00	17.57	17.57
G1.10	0.45	5.04	20.0	100.00	2.30%	0.19	8.95	1483.00	0.68%	1.65	14.99	23.94	1583.00	18.79	18.79
G1.11	0.45	3.10	7.0	67.00	1.49%	0.13	8.42	458.00	2.62%	1.13	6.74	15.16	525.00	12.92	12.92
G1	0.72	66.69	20.0	100.00	1.00%	0.24	6.86	3081.00	3.80%	3.90	13.17	20.03	3181.00	27.67	20.03
G2.1	0.45	3.95	7.0	81.00	1.73%	0.15	8.81	56.00	2.14%	1.02	0.91				
			20.0					1020.00	0.76%	1.74	9.75	19.48	1157.00	16.43	16.43
G2.2	0.45	1.40	20.0	42.00	1.33%	0.10	6.92	1015.00	0.83%	1.82	9.28	16.21	1057.00	15.87	15.87
G2.3	0.45	3.04	20.0	97.00	2.47%	0.19	8.58	1254.00	0.73%	1.71	12.23	20.81	1351.00	17.51	17.51
G2.4	0.45	4.00	7.0	71.00	15.49%	0.30	4.00	141.00	1.49%	0.85	2.75				
			20.0					687.00	0.82%	1.81	6.32	13.08	899.00	14.99	13.08

CORE ENGINEERING GROUP

Standard Form SF-1. Time of Concentration-Proposed

Calculated By: Leonard Beasley
Date: May 23, 2016
Checked By: Leonard Beasley

Job No: 100.030
Project: Carriage Meadows South

Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					t_c Check (urbanized Basins)		Final t_c
BASIN or DESIGN	C_5	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_i minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_t minutes	Computed t_c Minutes	TOTAL LENGTH (L) feet	Regional tc tc=(L/180)+10 minutes	USDCM Recommended $t_c=t_i+t_t$ (min)
G2.5	0.45	0.21	20.0	77.00	1.30%	0.14	9.44	57.00	0.60%	1.55	0.61	10.06	134.00	10.74	10.06
G2.6	0.45	1.43	20.0	73.00	2.05%	0.15	7.91	504.00	0.58%	1.52	5.51	13.43	577.00	13.21	13.21
G2.7	0.45	2.40	20.0	44.00	2.50%	0.13	5.75	418.00	1.17%	2.16	3.22	8.97	462.00	12.57	8.97
G2.8	0.45	1.01	20.0	55.00	2.36%	0.14	6.58	5.95	0.92%	1.92	0.05	6.63	60.95	10.34	6.63
G2.9	0.45	0.23	20.0	85.00	1.76%	0.16	9.01	137.00	0.73%	1.71	1.34	10.35	222.00	11.23	10.35
G2.10	0.45	0.68	20.0	70.00	1.29%	0.13	9.07	376.00	0.69%	1.66	3.77	12.84	446.00	12.48	12.48
G2.11a	0.45	1.61	20.0	77.00	2.34%	0.16	7.78	554.00	0.60%	1.55	5.96	13.74	631.00	13.51	13.51
G2.11b	0.45	0.64	20.0	50.00	2.00%	0.13	6.60	120.00	0.60%	1.55	1.29	7.89	170.00	10.94	10.94
G2.12a	0.45	1.14	20.0	25.00	2.00%	0.09	4.67	560.00	0.54%	1.47	6.35	11.02	585.00	13.25	11.02
G2.12b	0.45	1.16	20.0	30.00	2.00%	0.10	5.11	400.00	0.54%	1.47	4.54	9.65	430.00	12.39	9.65
G2.13	0.45	1.54	20.0	44.00	1.82%	0.11	6.39	345.00	0.64%	1.60	3.59				
			18"					184.00	2.17%	8.76	0.35	10.33	184.00	11.02	10.33
G2.14	0.45	4.59	7.0	97.00	3.09%	0.20	7.97	46.00	18.48%	3.01	0.25				
			7.0					388.00	0.50%	0.49	13.06	21.28	531.00	12.95	12.95
G3.1	0.45	0.69	20.0	84.00	1.90%	0.16	8.70	401.00	0.92%	1.92	3.48	12.19	485.00	12.69	12.19
G3.2	0.45	0.68	20.0	30.00	2.00%	0.10	5.11	582.00	0.86%	1.85	5.23	10.34	612.00	13.40	10.34
G3.3	0.00	0.74	20.0	69.00	2.17%	0.09	12.78	425.00	0.87%	1.87	3.80	16.57	494.00	12.74	12.74

CORE ENGINEERING GROUP

Standard Form SF-1. Time of Concentration-Proposed

Calculated By: Leonard Beasley
Date: May 23, 2016
Checked By: Leonard Beasley

Job No: 100.030
Project: Carriage Meadows South

Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					t_c Check (urbanized Basins)		Final t_c
BASIN or DESIGN	C_5	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_i minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_t minutes	Computed t_c Minutes	TOTAL LENGTH (L) feet	Regional tc $t_c=(L/180)+10$ minutes	USDCM Recommended $t_c=t_i+t_t$ (min)
G3.4	0.45	3.46	7.0	36.00	16.67%	0.22	2.78	318.00	3.77%	1.36	3.90				
			20.0					796.00	0.79%	1.78	7.46	14.14	1150.00	16.39	14.14
G3.5	0.45	0.52	7.0	85.00	8.47%	0.27	5.35	106.00	0.57%	0.53	3.34	8.69	191.00	11.06	8.69
G4	0.45	1.32	7.0	86.00	2.56%	0.18	7.98	33.00	15.15%	2.72	0.20	8.18	119.00	10.66	8.18
G5	0.45	0.89	7.0	45.00	3.33%	0.14	5.29	143.00	2.10%	1.01	2.35	7.64	188.00	11.04	7.64
G6.1	0.45	5.55	15.0	86.00	3.26%	0.19	7.37	900.00	0.70%	1.25	11.95	19.32	986.00	15.48	15.48
G6.2	0.90	0.77	20.0	30.00	1.67%	0.30	1.67	696.00	0.90%	1.90	6.11	7.78	726.00	14.03	7.78
G6	0.45	6.32	15.0	86.00	3.26%	0.19	7.37	975.00	0.70%	1.25	12.95	20.32	1061.00	15.89	15.89

CORE ENGINEERING GROUP

15004 1st Avenue South
Burnsville, MN 55306

PROJECT NAME: Carriage Meadows South
PROJECT NUMBER: 100.030
ENGINEER: LAB
DATE: February 18, 2016

Preliminary Drainage Plan
PROPOSED CONDITIONS COEFFICIENT "C" CALCULATIONS

BASIN	Soil No.	Hydro Group	Area	Cover (%)	C5	Wtd. C5	C100	Wtd. C100	Impervious	Type of Cover
G1.4		A/B	2.53	71.67%	0.81	0.58	0.88	0.63	95.0%	Commercial
		C/D	0.60	17.00%	0.82	0.14	0.89	0.15	95.0%	Commercial
		A/B	0.40	11.33%	0.45	0.05	0.59	0.07	65.0%	Proposed Residential
			3.53	100.00%		0.77		0.85		
G1.5		A-D	0.71	85.54%	0.90	0.77	0.95	0.81	95.0%	Carriage Meadows Dr.
		B	0.12	14.46%	0.45	0.07	0.59	0.09	65.0%	Proposed Residential
			0.83	100.00%		0.83		0.90		
G1.6		A	15.35	77.76%	0.81	0.63	0.88	0.68	95.0%	Commercial
		C	4.39	22.24%	0.82	0.18	0.89	0.20	95.0%	Commercial
			19.74	100.00%		0.81		0.88		
G1.7		C	10.46	90.17%	0.82	0.74	0.89	0.80	95.0%	Commercial
		B	1.14	9.83%	0.81	0.08	0.88	0.09	95.0%	Commercial
			11.60	100.00%		0.82		0.89		
G1.8a		C	1.35	14.74%	0.82	0.12	0.89	0.13	95.0%	Commercial
		B	1.17	12.77%	0.81	0.10	0.88	0.11	95.0%	Commercial
		C	1.57	17.14%	0.90	0.15	0.96	0.16	100.0%	Pavement
		C	1.57	17.14%	0.15	0.03	0.50	0.09	0.0%	Roadside Swale
		B	0.17	1.86%	0.90	0.02	0.96	0.02	100.0%	Pavement
		B	0.16	1.75%	0.08	0.01	0.35	0.01	0.0%	Roadside Swale
		B	1.67	18.23%	0.08	0.01	0.35	0.06	0.0%	Lawn
		B	1.50	16.38%	0.45	0.07	0.59	0.10	65.0%	Proposed Residential
			9.16	100.00%		0.52		0.68		

Table 6-6. Runoff Coefficients for Rational Method
(Source: UDFCD 2001)

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
1/8 Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
1/4 Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
1/3 Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
1/2 Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
Undeveloped Areas													
Historic Flow Analysis-- Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

3.2 Time of Concentration

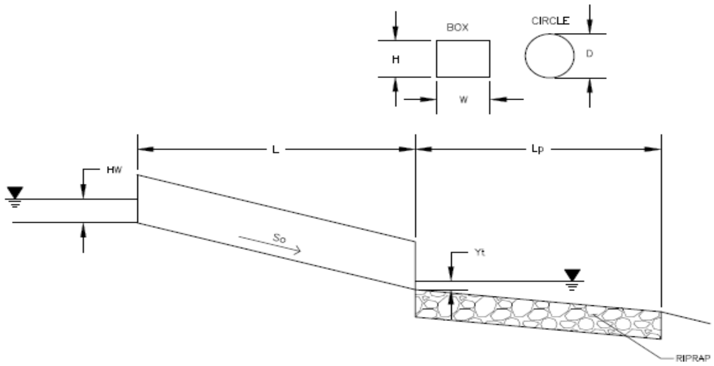
One of the basic assumptions underlying the Rational Method is that runoff is a function of the average rainfall rate during the time required for water to flow from the hydraulically most remote part of the drainage area under consideration to the design point. However, in practice, the time of concentration can be an empirical value that results in reasonable and acceptable peak flow calculations.

For urban areas, the time of concentration (t_c) consists of an initial time or overland flow time (t_i) plus the travel time (t_t) in the storm sewer, paved gutter, roadside drainage ditch, or drainage channel. For non-urban areas, the time of concentration consists of an overland flow time (t_i) plus the time of travel in a concentrated form, such as a swale or drainageway. The travel portion (t_t) of the time of concentration can be estimated from the hydraulic properties of the storm sewer, gutter, swale, ditch, or drainageway. Initial time, on the other hand, will vary with surface slope, depression storage, surface cover, antecedent rainfall, and infiltration capacity of the soil, as well as distance of surface flow. The time of concentration is represented by Equation 6-7 for both urban and non-urban areas.

APPENDIX C – HYDRAULIC CALCULATIONS

Determination of Culvert Headwater and Outlet Protection

Project: Carriage Meadows South at Lorson Ranch Filing No. 1
Basin ID: Rip Rap sizing for 30" outlet pipe into Interim Pond G1.7



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

Design Information (Input):

Design Discharge	Q =	52	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	30	inches
Inlet Edge Type (Choose from pull-down list)	Square End Projection		
Box Culvert:		**OR**	
Barrel Height (Rise) in Feet	Height (Rise) =		ft
Barrel Width (Span) in Feet	Width (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	No =	1	
Inlet Elevation	Elev IN =	100.8	ft
Outlet Elevation **OR** Slope	Elev OUT =	100	ft
Culvert Length	L =	100	ft
Manning's Roughness	n =	0.013	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	Elev Y_t =	101	ft
Max Allowable Channel Velocity	V =	5	ft/s

Required Protection (Output):

Tailwater Surface Height	Y_t =	1.00	ft
Flow Area at Max Channel Velocity	A_t =	10.40	ft^2
Culvert Cross Sectional Area Available	A =	4.91	ft^2
Entrance Loss Coefficient	k_e =	0.50	
Friction Loss Coefficient	k_f =	0.92	
Sum of All Losses Coefficients	k_s =	2.42	ft
Culvert Normal Depth	Y_n =	1.38	ft
Culvert Critical Depth	Y_c =	2.32	ft
Tailwater Depth for Design	d =	2.41	ft
Adjusted Diameter **OR** Adjusted Rise	D_a =	-	ft
Expansion Factor	1/(2*tan(Θ)) =	2.25	
Flow/Diameter$^{2.5}$ **OR** Flow/(Span * Rise$^{1.5}$)	Q/D^2.5 =	5.26	$ft^{0.5}/s$
Froude Number	Fr =	-	Pressure flow!
Tailwater/Adjusted Diameter **OR** Tailwater/Adjusted Rise	Yt/D =	0.40	
Inlet Control Headwater	HW_I =	6.18	ft
Outlet Control Headwater	HW_O =	5.82	
Design Headwater Elevation	**HW =**	**106.98**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**2.47**	HW/D > 1.5!
Minimum Theoretical Riprap Size	d_{50} =	11	in
Nominal Riprap Size	d_{50} =	12	in
UDFCD Riprap Type	**Type =**	**M**	
Length of Protection	L_p =	**18**	**ft**
Width of Protection	**T =**	**11**	**ft**

Culvert Report

Hydraflow Express by Intelisolve — Wednesday, Jan 25 2017, 4:24 AM

G1 side 48-inch Interconnection Emergency Overflow

Invert Elev Dn (ft)	=	5684.00
Pipe Length (ft)	=	320.00
Slope (%)	=	0.40
Invert Elev Up (ft)	=	5685.28
Rise (in)	=	48.0
Shape	=	Cir
Span (in)	=	48.0
No. Barrels	=	1
n-Value	=	0.013
Inlet Edge	=	Projecting
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.5

Embankment

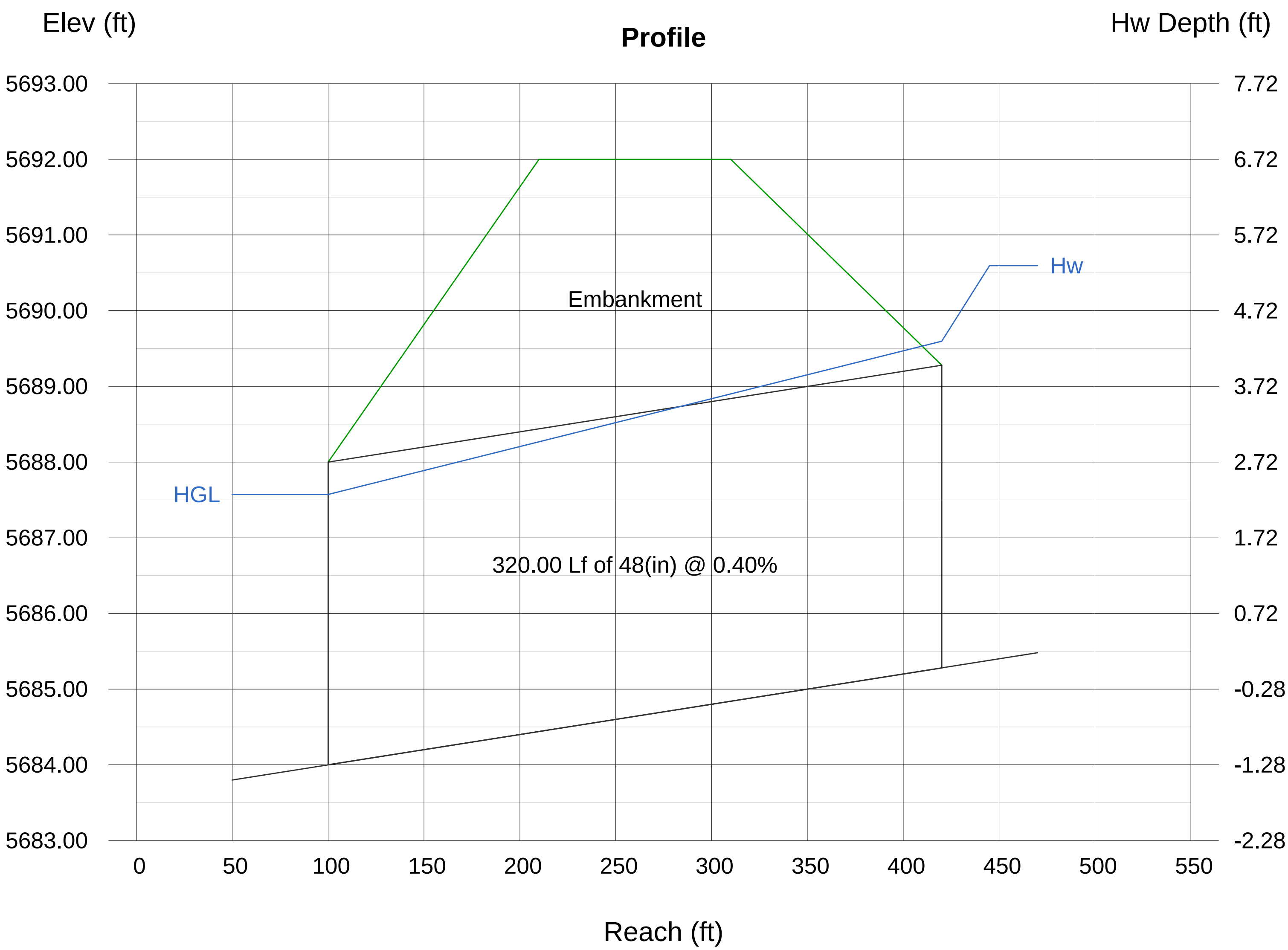
Top Elevation (ft)	=	5692.00
Top Width (ft)	=	100.00
Crest Width (ft)	=	50.00

Calculations

Qmin (cfs)	=	50.00
Qmax (cfs)	=	120.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	113.00
Qpipe (cfs)	=	113.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	10.03
Veloc Up (ft/s)	=	9.55
HGL Dn (ft)	=	5687.57
HGL Up (ft)	=	5689.60
Hw Elev (ft)	=	5690.60
Hw/D (ft)	=	1.33
Flow Regime	=	Inlet Control



Channel Report

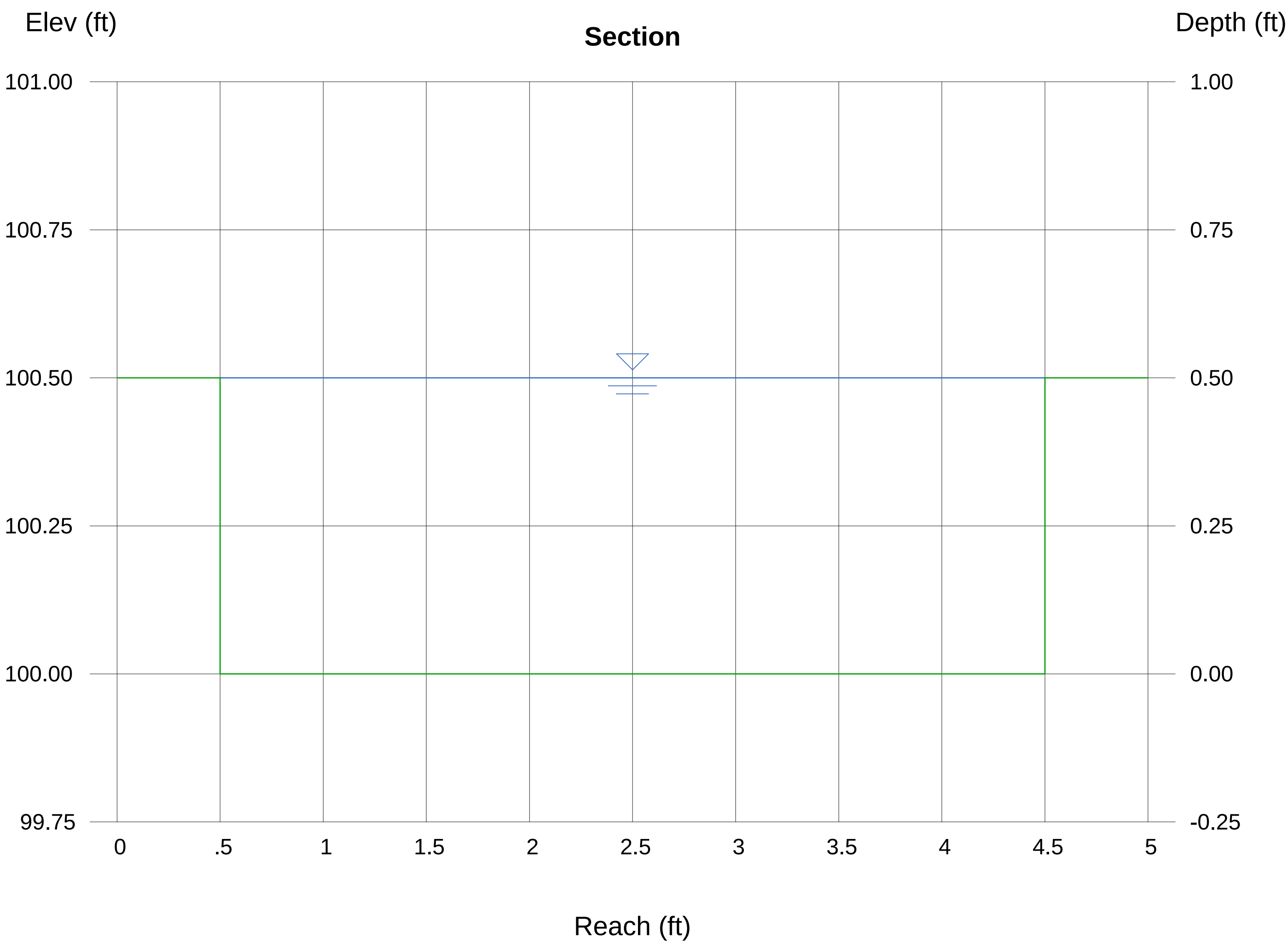
4FT WIDE CURB CHASE AT LORSON BLVD AND MARKSHEFFEL

Rectangular
Botom Width (ft) = 4.00
Total Depth (ft) = 0.50

Invert Elev (ft) = 100.00
Slope (%) = 1.50
N-Value = 0.013

Calculations
Compute by: Known Depth
Known Depth (ft) = 0.50

Highlighted
Depth (ft) = 0.50
Q (cfs) = 15.20
Area (sqft) = 2.00
Velocity (ft/s) = 7.60
Wetted Perim (ft) = 5.00
Crit Depth, Yc (ft) = 0.50
Top Width (ft) = 4.00
EGL (ft) = 1.40



Channel Report

EMERGENCY OVERFLOW "A"

Galpin Emergency Overflow to Lorson Blvd.

Trapezoidal

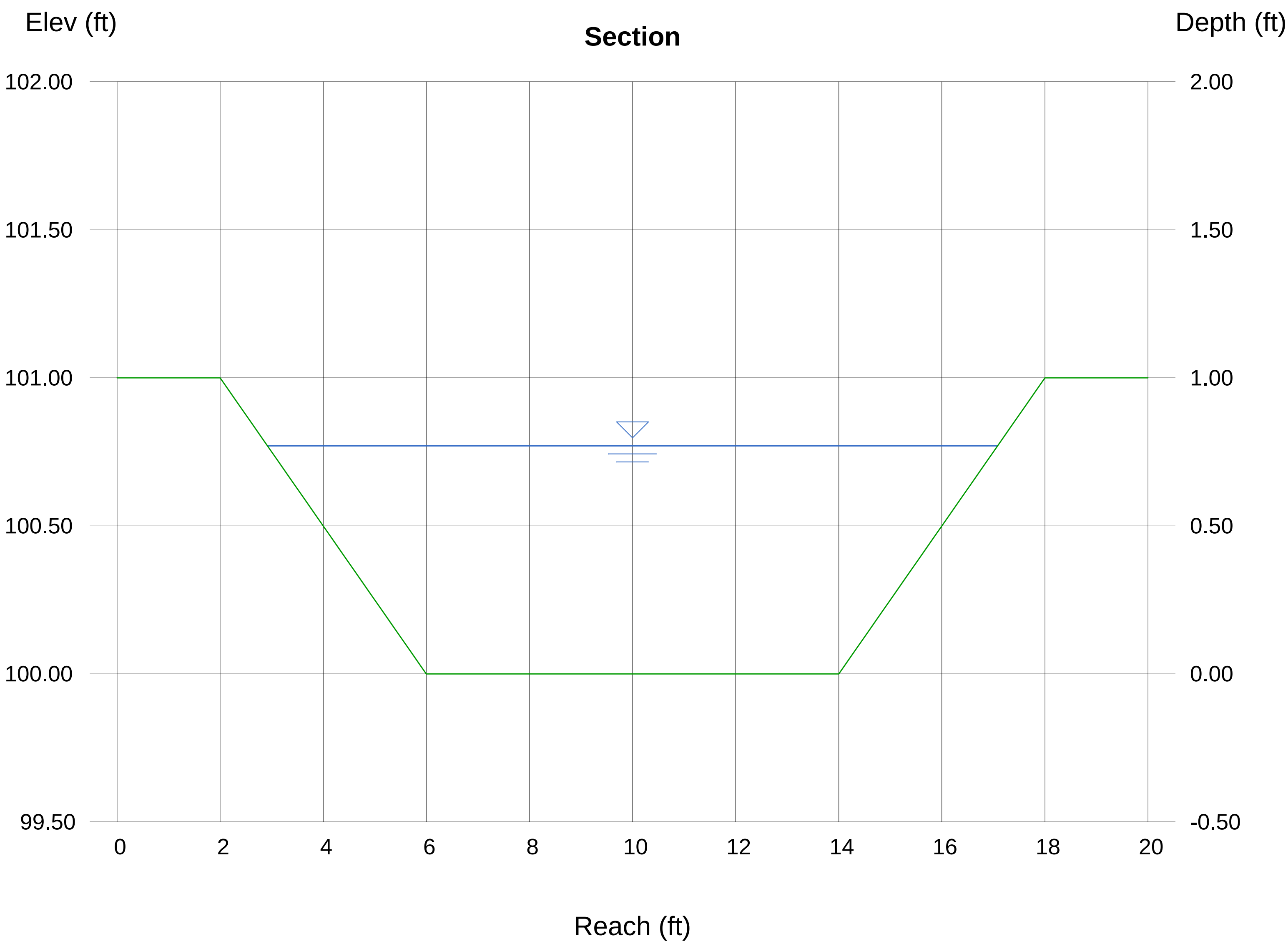
Botom Width (ft)	= 8.00
Side Slope (z:1)	= 4.00
Total Depth (ft)	= 1.00
Invert Elev (ft)	= 100.00
Slope (%)	= 1.20
N-Value	= 0.024

Calculations

Compute by:	Known Q
Known Q (cfs)	= 40.00

Highlighted

Depth (ft)	= 0.77
Q (cfs)	= 40.00
Area (sqft)	= 8.53
Velocity (ft/s)	= 4.69
Wetted Perim (ft)	= 14.35
Crit Depth, Yc (ft)	= 0.80
Top Width (ft)	= 14.16
EGL (ft)	= 1.11



Channel Report

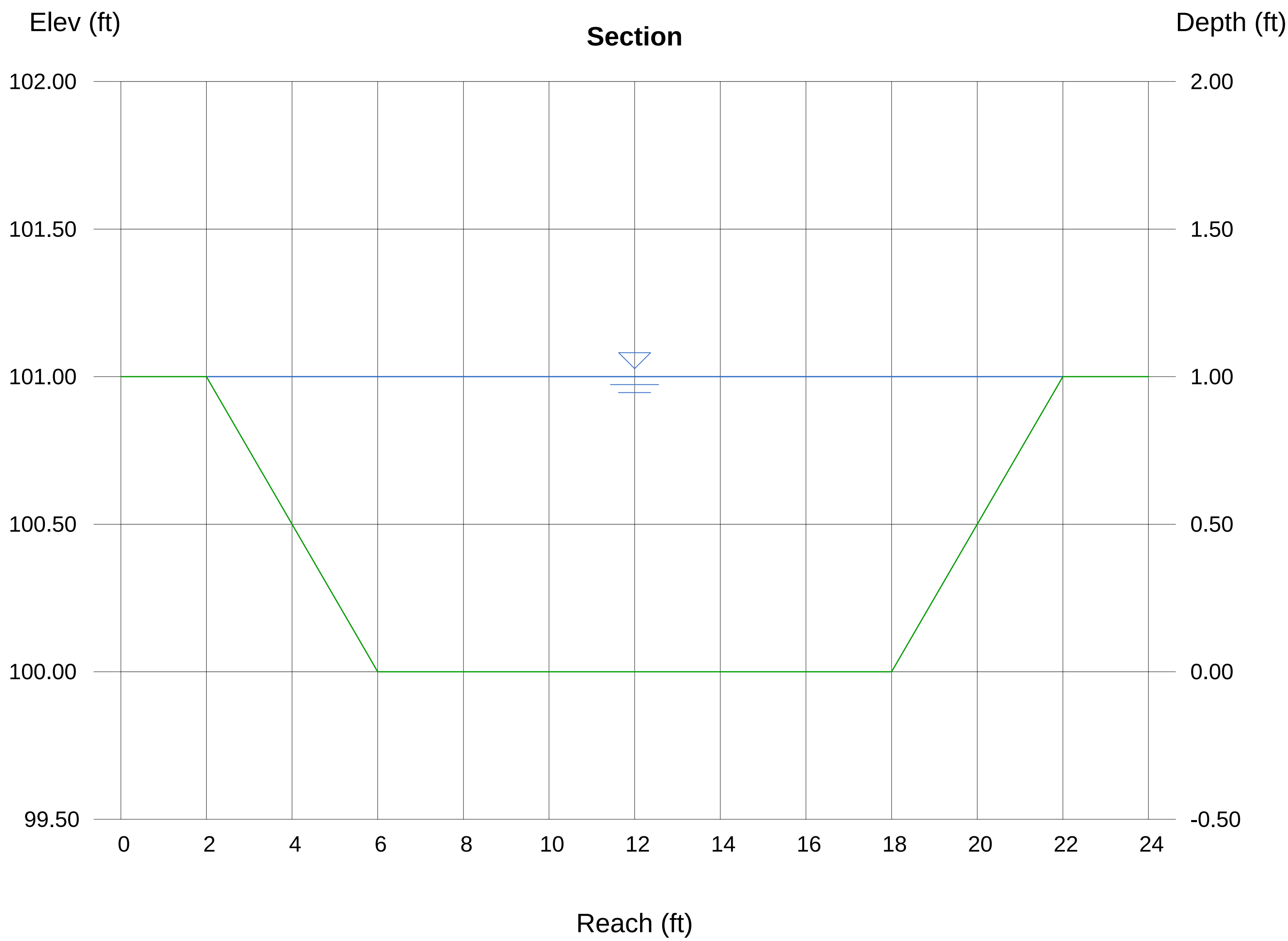
EMERGENCY OVERFLOW "B"

Rubicon Emergency Overflow to Lorson Blvd.

Trapezoidal
Botom Width (ft) = 12.00
Side Slope (z:1) = 4.00
Total Depth (ft) = 1.00
Invert Elev (ft) = 100.00
Slope (%) = 1.20
N-Value = 0.020

Calculations
Compute by: Known Depth
Known Depth (ft) = 1.00

Highlighted
Depth (ft) = 1.00
Q (cfs) = 111.31
Area (sqft) = 16.00
Velocity (ft/s) = 6.96
Wetted Perim (ft) = 20.25
Crit Depth, Yc (ft) = 1.00
Top Width (ft) = 20.00
EGL (ft) = 1.75



Channel Report

Interim Swale at Interim Pond G1.7

Trapezoidal

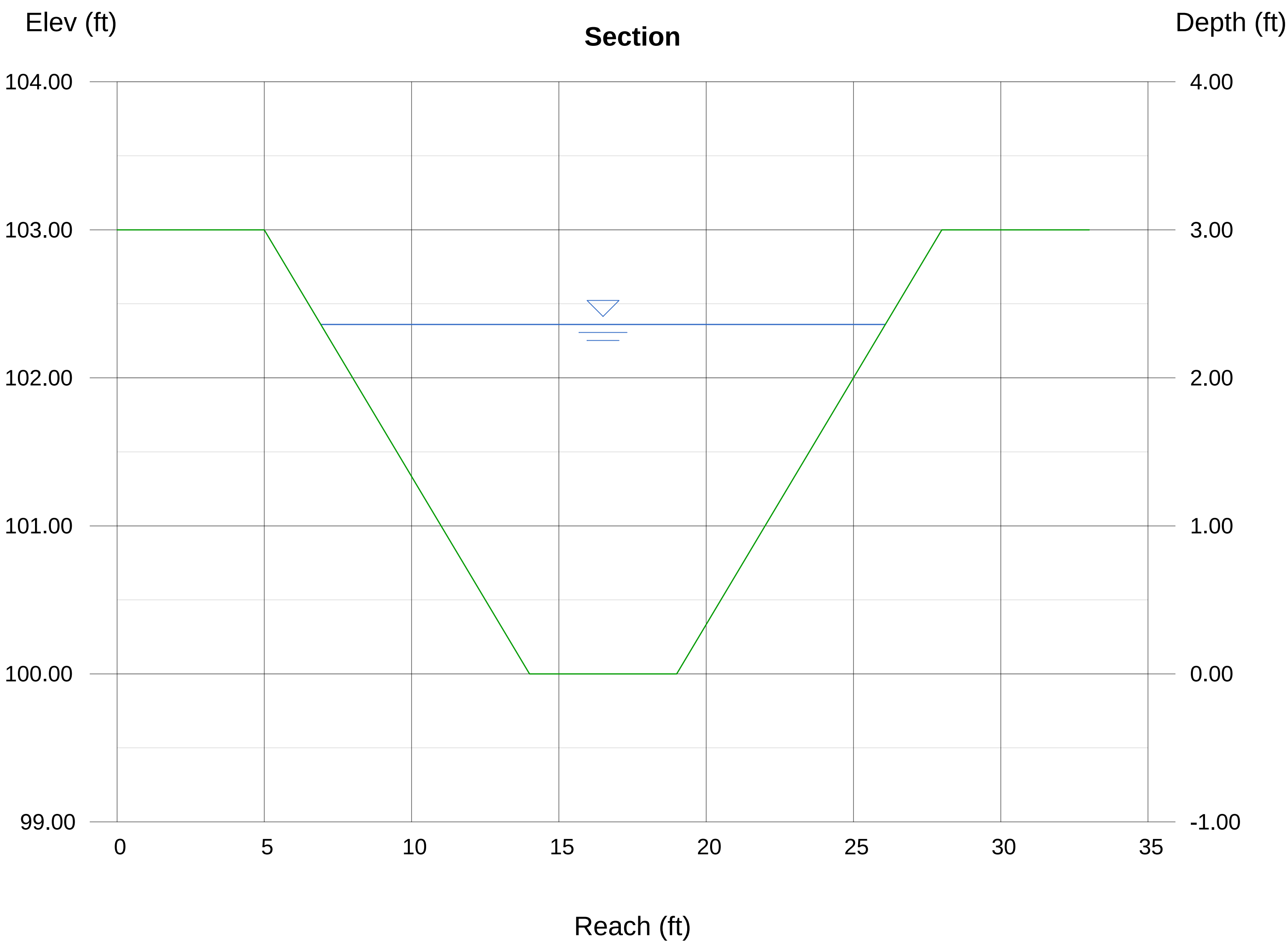
Botom Width (ft)	=	5.00
Side Slope (z:1)	=	3.00
Total Depth (ft)	=	3.00
Invert Elev (ft)	=	100.00
Slope (%)	=	0.50
N-Value	=	0.025

Calculations

Compute by:		Known Q
Known Q (cfs)	=	152.00

Highlighted

Depth (ft)	=	2.36
Q (cfs)	=	152.00
Area (sqft)	=	28.51
Velocity (ft/s)	=	5.33
Wetted Perim (ft)	=	19.93
Crit Depth, Yc (ft)	=	2.08
Top Width (ft)	=	19.16
EGL (ft)	=	2.80



Channel Report

EMERGENCY OVERFLOW "C"

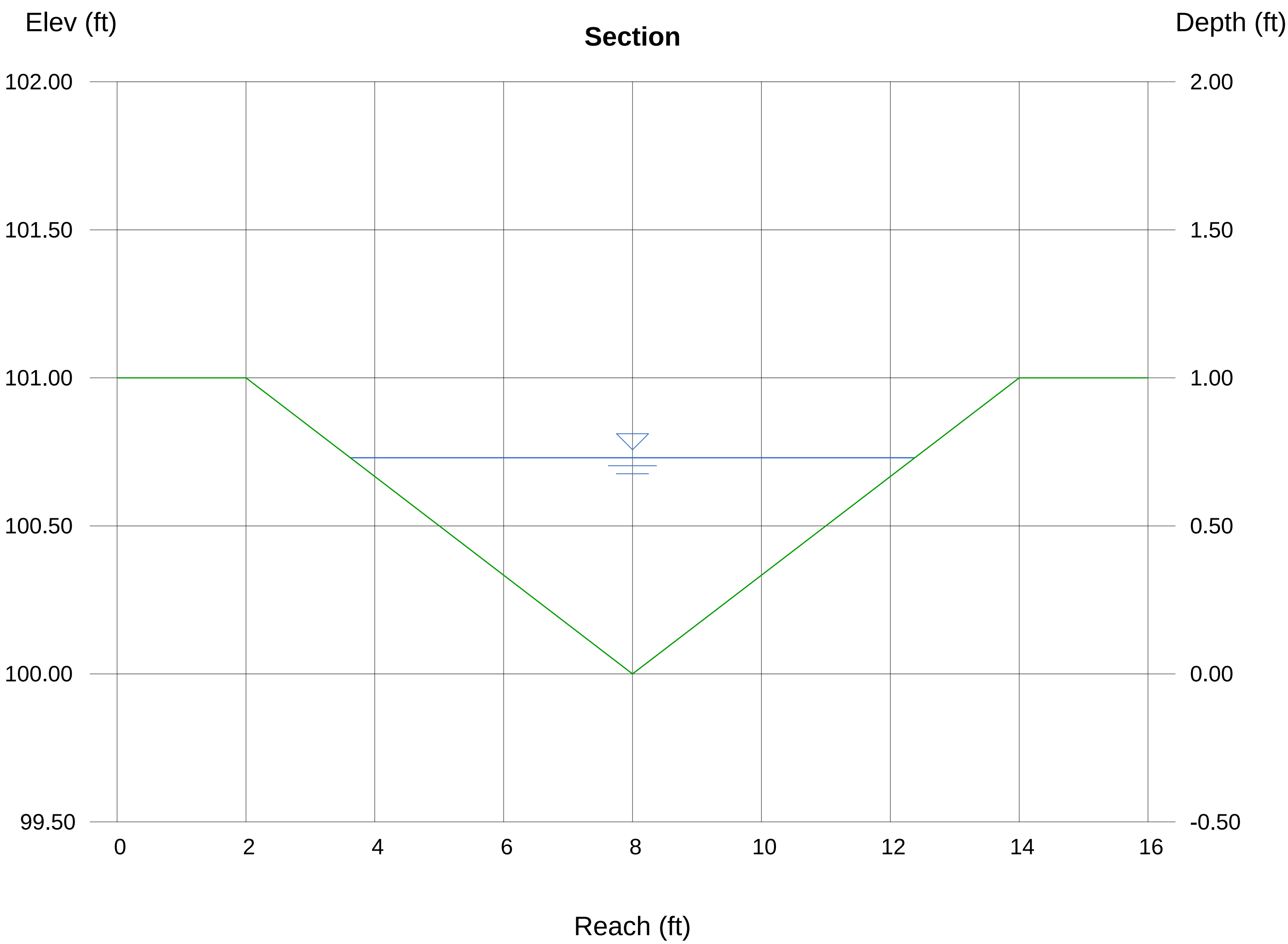
Simcoe Emergency Overflow to Pond G2

Triangular
Side Slope (z:1) = 6.00
Total Depth (ft) = 1.00

Invert Elev (ft) = 100.00
Slope (%) = 1.00
N-Value = 0.024

Calculations
Compute by: Known Q
Known Q (cfs) = 10.00

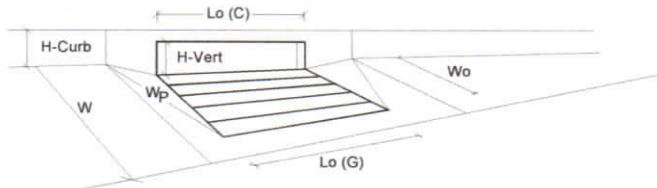
Highlighted
Depth (ft) = 0.73
Q (cfs) = 10.00
Area (sqft) = 3.20
Velocity (ft/s) = 3.13
Wetted Perim (ft) = 8.88
Crit Depth, Yc (ft) = 0.71
Top Width (ft) = 8.76
EGL (ft) = 0.88



INLET IN A SUMP OR SAG LOCATION

Project = Carriage Meadows South #100.030

Inlet ID = Inlet DP-2 (G1.4)

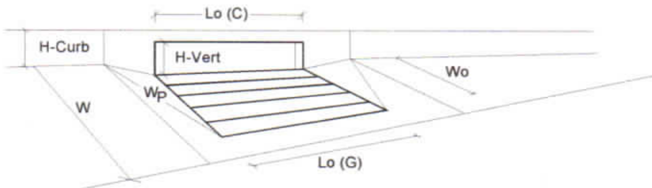


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Inlet Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.1	8.0	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	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.31	1.31	
Clogging Factor for Multiple Units	Clog =	0.04	0.04	
Curb Opening as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	10.83	21.18	cfs
Interception with Clogging	Q_{wa} =	10.36	20.25	cfs
Curb Opening as an Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	29.58	33.57	cfs
Interception with Clogging	Q_{oa} =	28.29	32.11	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	16.65	24.80	cfs
Interception with Clogging	Q_{ma} =	15.92	23.72	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**10.36**	**20.25**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	15.00	15.00	feet
Resultant Street Flow Spread (based on sheet *Q-Allow* geometry)	T =	19.3	27.0	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.5	2.4	inches
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**10.4**	**20.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	10.3	19.0	cfs

INLET IN A SUMP OR SAG LOCATION

Project = Carriage Meadows South #100.030

Inlet ID = Inlet DP-3 (G1.5)

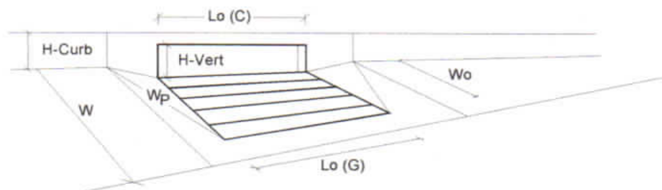


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Inlet Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	3.00		inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1		
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.1	8.0	inches ☑ Override Depths
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	N/A		feet
Width of a Unit Grate	W_o =	N/A		feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	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		
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A		
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00		feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00		inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00		inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40		degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	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		
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67		
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.10	0.10	
Curb Opening as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	6.29	10.97	cfs
Interception with Clogging	Q_{wa} =	5.66	9.87	cfs
Curb Opening as an Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	9.86	11.19	cfs
Interception with Clogging	Q_{oa} =	8.87	10.07	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	7.33	10.30	cfs
Interception with Clogging	Q_{ma} =	6.59	9.27	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**5.66**	**9.27**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	5.00	5.00	feet
Resultant Street Flow Spread (based on sheet *Q-Allow* geometry)	T =	19.3	27.0	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.5	2.4	inches
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**5.7**	**9.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	3.0	5.4	cfs

INLET IN A SUMP OR SAG LOCATION

Project = **Carriage Meadows South #100.030**

Inlet ID = **Inlet DP-7 (G1.9)**

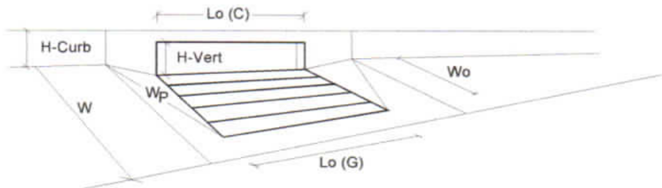


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Inlet Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.5	8.0	inches ☑ Override Depths
Grate Information		MINOR	MAJOR	
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	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.25	1.25	
Clogging Factor for Multiple Units	Clog =	0.06	0.06	
Curb Opening as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	6.99	17.34	cfs
Interception with Clogging	Q_{wa} =	6.56	16.26	cfs
Curb Opening as an Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	18.72	22.38	cfs
Interception with Clogging	Q_{oa} =	17.55	20.98	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	10.64	18.32	cfs
Interception with Clogging	Q_{ma} =	9.98	17.18	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**6.56**	**16.26**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	10.00	10.00	feet
Resultant Street Flow Spread (based on sheet *Q-Allow* geometry)	T =	16.6	27.0	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	2.4	inches
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**6.6**	**16.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	5.4	11.8	cfs

INLET IN A SUMP OR SAG LOCATION

Project = Carriage Meadows South #100.030

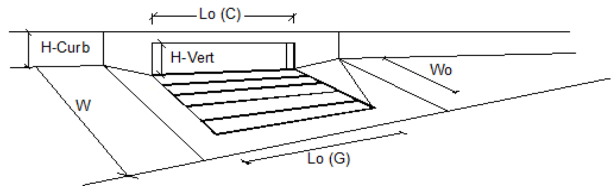
Inlet ID = Inlet DP-7a (G1.10)



		MINOR	MAJOR	
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Inlet Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	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 =	6.5	8.0	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	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.25	1.25	
Clogging Factor for Multiple Units	Clog =	0.06	0.06	
Curb Opening as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	10.72	17.34	cfs
Interception with Clogging	Q_{wa} =	10.05	16.26	cfs
Curb Opening as an Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	20.22	22.38	cfs
Interception with Clogging	Q_{oa} =	18.96	20.98	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	13.69	18.32	cfs
Interception with Clogging	Q_{ma} =	12.84	17.18	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**10.05**	**16.26**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	10.00	10.00	feet
Resultant Street Flow Spread (based on sheet *Q-Allow* geometry)	T =	20.7	27.0	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.9	2.4	inches
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**10.1**	**16.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	7.2	15.9	cfs

INLET ON A CONTINUOUS GRADE

Project: Carriage Meadows South #100.030
Inlet ID: Inlet DP-10 (G2.1)

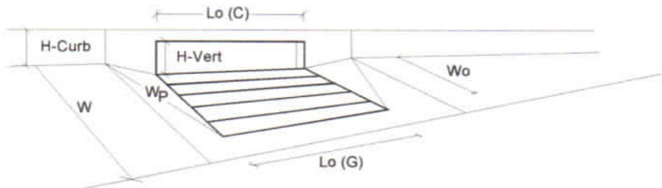


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W from Q-Allow)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < maximum allowable from sheet 'Q-Allow'		MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Q-Peak*)	Q_o =	5.2	11.4	cfs
Water Spread Width	T =	14.7	17.0	ft
Water Depth at Flowline (outside of local depression)	d =	5.0	6.4	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.8	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.406	0.296	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	3.1	8.0	cfs
Discharge within the Gutter Section W	Q_w =	2.1	3.4	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	2.28	4.10	sq ft
Velocity within the Gutter Section W	V_W =	2.3	2.8	fps
Water Depth for Design Condition	d_{LOCAL} =	8.0	9.4	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o-GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	Q_a =	N/A	N/A	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	Q_b =	N/A	N/A	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.096	0.076	ft/ft
Required Length L_T to Have 100% Interception	L_T =	12.19	20.33	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	10.00	10.00	ft
Interception Capacity	Q_i =	5.0	8.0	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	8.75	8.75	ft
Actual Interception Capacity	Q_a =	4.9	7.7	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	Q_b =	0.3	3.7	cfs
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	Q =	**4.86**	**7.72**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	Q_b =	**0.3**	**3.7**	**cfs**
Capture Percentage = Q_a/Q_o =	C% =	**93**	**68**	**%**

INLET IN A SUMP OR SAG LOCATION

Project = Carriage Meadows South #100.030

Inlet ID = Inlet DP-12a (G2.4)



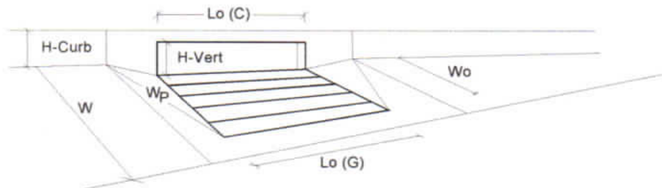
		MINOR	MAJOR	
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Inlet Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.5	8.5	inches ☑ Override Depths
Grate Information		MINOR	MAJOR	
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	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.31	1.31	
Clogging Factor for Multiple Units	Clog =	0.04	0.04	
Curb Opening as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	7.99	24.46	cfs
Interception with Clogging	Q_{wa} =	7.64	23.39	cfs
Curb Opening as an Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	28.08	34.57	cfs
Interception with Clogging	Q_{oa} =	26.85	33.06	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	13.93	27.04	cfs
Interception with Clogging	Q_{ma} =	13.32	25.86	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**7.64**	**23.39**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	15.00	15.00	feet
Resultant Street Flow Spread (based on sheet *Q-Allow* geometry)	T =	16.6	29.1	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	2.9	inches
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**7.6**	**23.4**	**cfs**
WARNING: Inlet Capacity less than Q Peak for MAJOR Storm	$Q_{PEAK\ REQUIRED}$ =	6.7	24.8	cfs

1.4 cfs TOPS CROWN & FLOWS TO INLET @ DP-12b (MAJOR STORM)

INLET IN A SUMP OR SAG LOCATION

Project = Carriage Meadows South #100.030

Inlet ID = Inlet DP-12b (G2.5)

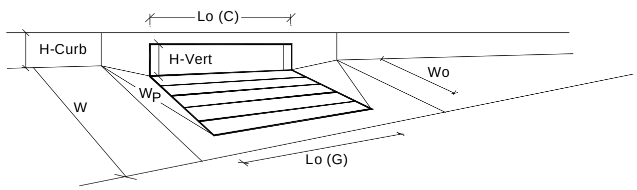


		MINOR	MAJOR	
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Inlet Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	3.00		inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1		
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.5	8.5	inches ☑ Override Depths
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	N/A		feet
Width of a Unit Grate	W_o =	N/A		feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	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		
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A		
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00		feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00		inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00		inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40		degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	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		
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67		
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.10	0.10	
Curb Opening as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	4.89	12.37	cfs
Interception with Clogging	Q_{wa} =	4.40	11.13	cfs
Curb Opening as an Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	9.36	11.52	cfs
Interception with Clogging	Q_{oa} =	8.42	10.37	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	6.29	11.10	cfs
Interception with Clogging	Q_{ma} =	5.66	9.99	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**4.40**	**9.99**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	5.00	5.00	feet
Resultant Street Flow Spread (based on sheet *Q-Allow* geometry)	T =	16.6	29.1	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	2.9	inches
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**4.4**	**10.0**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	0.4	2.3	cfs

INLET IN A SUMP OR SAG LOCATION

Project = **Carriage Meadows South 100.030**

Inlet ID = **Inlet DP-13**

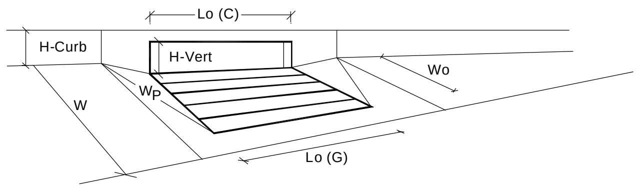


		MINOR	MAJOR	
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Inlet Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.5	8.0	inches
				☑ Override Depths
Grate Information		MINOR	MAJOR	
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) =	25.00	25.00	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	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.33	1.33	
Clogging Factor for Multiple Units	Clog =	0.03	0.03	
Curb Opening as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	19.14	32.57	cfs
Interception with Clogging	Q_{wa} =	18.63	31.70	cfs
Curb Opening as an Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	50.55	55.95	cfs
Interception with Clogging	Q_{oa} =	49.20	54.47	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	28.92	39.70	cfs
Interception with Clogging	Q_{ma} =	28.16	38.64	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**18.63**	**31.70**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	25.00	25.00	feet
Resultant Street Flow Spread (based on sheet *Q-Allow* geometry)	T =	20.7	27.0	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.9	2.4	inches
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**18.6**	**31.7**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	0.7	1.1	cfs

INLET IN A SUMP OR SAG LOCATION

Project = **Carriage Meadows South 100.030**

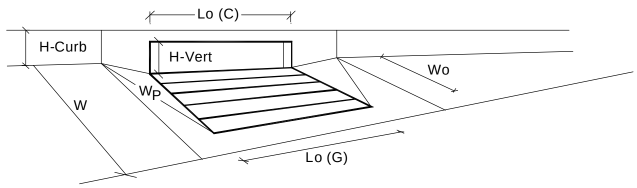
Inlet ID = **Inlet DP-13b**



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Inlet Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	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 =	6.5	8.0	inches
				☑ Override Depths
Grate Information		MINOR	MAJOR	
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) =	25.00	25.00	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	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.33	1.33	
Clogging Factor for Multiple Units	Clog =	0.03	0.03	
Curb Opening as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	19.14	32.57	cfs
Interception with Clogging	Q_{wa} =	18.63	31.70	cfs
Curb Opening as an Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	50.55	55.95	cfs
Interception with Clogging	Q_{oa} =	49.20	54.47	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	28.92	39.70	cfs
Interception with Clogging	Q_{ma} =	28.16	38.64	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**18.63**	**31.70**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	25.00	25.00	feet
Resultant Street Flow Spread (based on sheet *Q-Allow* geometry)	T =	20.7	27.0	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.9	2.4	inches
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**18.6**	**31.7**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	2.4	5.3	cfs

INLET IN A SUMP OR SAG LOCATION

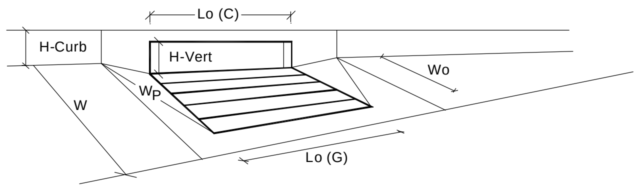
Project = **Carriage Meadows South #100.030**
Inlet ID = **Inlet DP-14 (G2.2)**



		MINOR	MAJOR	
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Inlet Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	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 =	6.5	8.4	inches ☑ Override Depths
Grate Information		MINOR	MAJOR	
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	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.10	0.10	
Curb Opening as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	7.08	12.08	cfs
Interception with Clogging	Q_{wa} =	6.37	10.87	cfs
Curb Opening as an Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	10.12	11.46	cfs
Interception with Clogging	Q_{oa} =	9.11	10.31	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	7.87	10.94	cfs
Interception with Clogging	Q_{ma} =	7.08	9.85	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**6.37**	**9.85**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	5.00	5.00	feet
Resultant Street Flow Spread (based on sheet *Q-Allow* geometry)	T =	20.7	28.7	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.9	2.8	inches
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**6.4**	**9.8**	**cfs**
WARNING: Inlet Capacity less than Q Peak for MAJOR Storm	$Q_{PEAK\ REQUIRED}$ =	3.3	10.3	cfs

INLET IN A SUMP OR SAG LOCATION

Project = **Carriage Meadows South #100.030**
Inlet ID = **Inlet DP-14a (G2.3)**

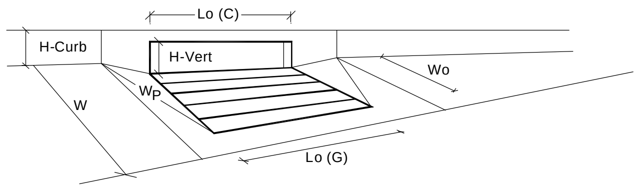


		MINOR	MAJOR	
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Inlet Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.5	8.0	inches
				☑ Override Depths
Grate Information		MINOR	MAJOR	
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	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.25	1.25	
Clogging Factor for Multiple Units	Clog =	0.06	0.06	
Curb Opening as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	6.99	17.34	cfs
Interception with Clogging	Q_{wa} =	6.56	16.26	cfs
Curb Opening as an Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	18.72	22.38	cfs
Interception with Clogging	Q_{oa} =	17.55	20.98	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	10.64	18.32	cfs
Interception with Clogging	Q_{ma} =	9.98	17.18	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**6.56**	**16.26**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	10.00	10.00	feet
Resultant Street Flow Spread (based on sheet *Q-Allow* geometry)	T =	16.6	27.0	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	2.4	inches
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**6.6**	**16.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	5.5	12.6	cfs

INLET IN A SUMP OR SAG LOCATION

Project = **Carriage Meadows South #100.030**

Inlet ID = **Inlet DP-15 (G2.11a)**

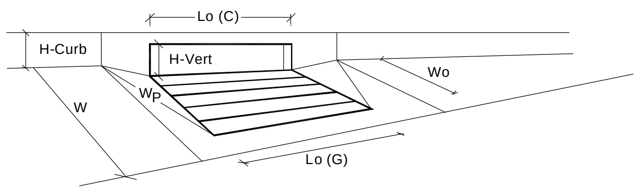


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Inlet Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.5	8.4	inches
				☑ Override Depths
Grate Information		MINOR	MAJOR	
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	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.25	1.25	
Clogging Factor for Multiple Units	Clog =	0.06	0.06	
Curb Opening as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	10.76	19.11	cfs
Interception with Clogging	Q_{wa} =	10.09	17.91	cfs
Curb Opening as an Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	20.23	22.91	cfs
Interception with Clogging	Q_{oa} =	18.97	21.48	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	13.72	19.46	cfs
Interception with Clogging	Q_{ma} =	12.87	18.24	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**10.09**	**17.91**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	10.00	10.00	feet
Resultant Street Flow Spread (based on sheet *Q-Allow* geometry)	T =	20.7	28.7	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.9	2.8	inches
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**10.1**	**17.9**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	2.6	5.8	cfs

INLET IN A SUMP OR SAG LOCATION

Project = **Carriage Meadows South #100.030**

Inlet ID = **Inlet DP-15a (G2.12a)**

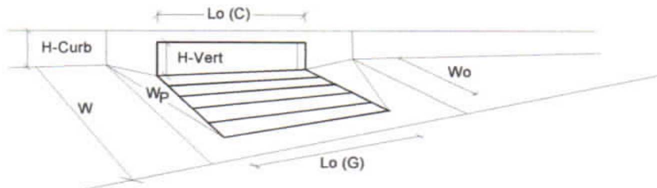


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Inlet Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.5	8.4	inches ☑ Override Depths
Grate Information		MINOR	MAJOR	
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	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.25	1.25	
Clogging Factor for Multiple Units	Clog =	0.06	0.06	
Curb Opening as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	10.76	19.11	cfs
Interception with Clogging	Q_{wa} =	10.09	17.91	cfs
Curb Opening as an Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	20.23	22.91	cfs
Interception with Clogging	Q_{oa} =	18.97	21.48	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	13.72	19.46	cfs
Interception with Clogging	Q_{ma} =	12.87	18.24	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**10.09**	**17.91**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	10.00	10.00	feet
Resultant Street Flow Spread (based on sheet *Q-Allow* geometry)	T =	20.7	28.7	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.9	2.8	inches
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**10.1**	**17.9**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	2.0	4.5	cfs

INLET IN A SUMP OR SAG LOCATION

Project = Carriage Meadows South #100.030

Inlet ID = Inlet DP-16 (G2.7)

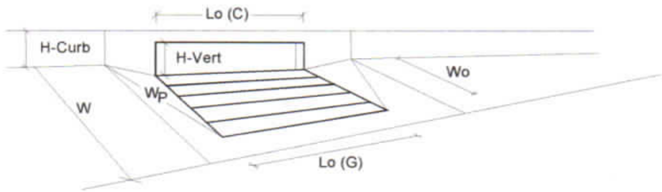


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Inlet Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.5	8.0	inches ☑ Override Depths
Grate Information		MINOR	MAJOR	
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	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.25	1.25	
Clogging Factor for Multiple Units	Clog =	0.06	0.06	
Curb Opening as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	10.72	17.34	cfs
Interception with Clogging	Q_{wa} =	10.05	16.26	cfs
Curb Opening as an Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	20.22	22.38	cfs
Interception with Clogging	Q_{oa} =	18.96	20.98	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	13.69	18.32	cfs
Interception with Clogging	Q_{ma} =	12.84	17.18	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**10.05**	**16.26**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	10.00	10.00	feet
Resultant Street Flow Spread (based on sheet *Q-Allow* geometry)	T =	20.7	27.0	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.9	2.4	inches
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**10.1**	**16.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	4.6	10.2	cfs

INLET IN A SUMP OR SAG LOCATION

Project = Carriage Meadows South #100.030

Inlet ID = Inlet DP-17 (G2.8 & G2.9)

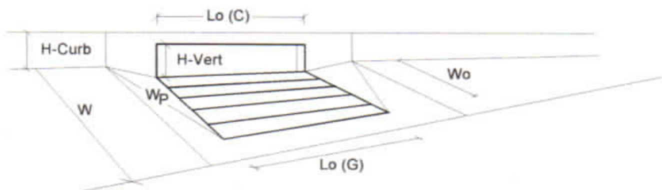


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Inlet Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.5	8.0	inches
				☑ Override Depths
Grate Information		MINOR	MAJOR	
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	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.10	0.10	
Curb Opening as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	7.06	10.97	cfs
Interception with Clogging	Q_{wa} =	6.35	9.87	cfs
Curb Opening as an Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	10.11	11.19	cfs
Interception with Clogging	Q_{oa} =	9.10	10.07	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	7.86	10.30	cfs
Interception with Clogging	Q_{ma} =	7.07	9.27	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**6.35**	**9.27**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	5.00	5.00	feet
Resultant Street Flow Spread (based on sheet *Q-Allow* geometry)	T =	20.7	27.0	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.9	2.4	inches
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**6.4**	**9.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	2.3	5.0	cfs

INLET IN A SUMP OR SAG LOCATION

Project = Carriage Meadows South #100.030

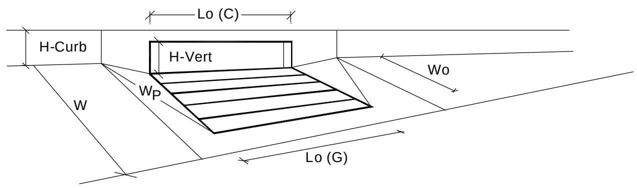
Inlet ID = Inlet DP-18 (G2.10)



		MINOR	MAJOR	
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Inlet Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	3.00		inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1		
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.5	8.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A		feet
Width of a Unit Grate	W_o =	N/A		feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	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		
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A		
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00		feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00		inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00		inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40		degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	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		
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67		
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.10	0.10	
Curb Opening as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	7.06	10.97	cfs
Interception with Clogging	Q_{wa} =	6.35	9.87	cfs
Curb Opening as an Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	10.11	11.19	cfs
Interception with Clogging	Q_{oa} =	9.10	10.07	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	7.86	10.30	cfs
Interception with Clogging	Q_{ma} =	7.07	9.27	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**6.35**	**9.27**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	5.00	5.00	feet
Resultant Street Flow Spread (based on sheet *Q-Allow* geometry)	T =	20.7	27.0	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.9	2.4	inches
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**6.4**	**9.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.2	2.6	cfs

INLET IN A SUMP OR SAG LOCATION

Project = **Carriage Meadows South #100.030**
Inlet ID = **Inlet DP-20 (G2.11b)**

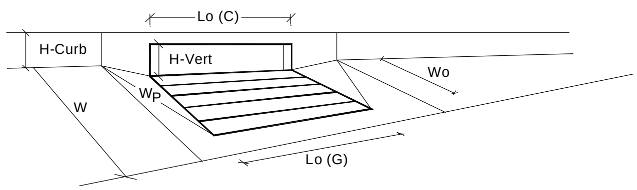


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Inlet Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.5	8.0	inches ☑ Override Depths
Grate Information		MINOR	MAJOR	
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	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.10	0.10	
Curb Opening as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	7.06	10.97	cfs
Interception with Clogging	Q_{wa} =	6.35	9.87	cfs
Curb Opening as an Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	10.11	11.19	cfs
Interception with Clogging	Q_{oa} =	9.10	10.07	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	7.86	10.30	cfs
Interception with Clogging	Q_{ma} =	7.07	9.27	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**6.35**	**9.27**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	5.00	5.00	feet
Resultant Street Flow Spread (based on sheet *Q-Allow* geometry)	T =	20.7	27.0	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.9	2.4	inches
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**6.4**	**9.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.1	2.5	cfs

INLET IN A SUMP OR SAG LOCATION

Project = **Carriage Meadows South #100.030**

Inlet ID = **Inlet DP-22 (G2.12b)**

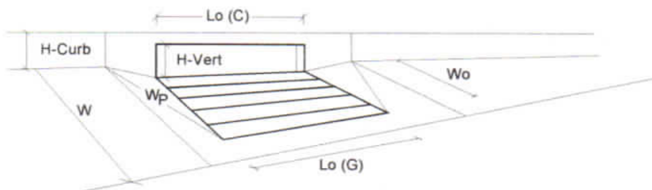


		MINOR	MAJOR	
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Inlet Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.5	8.1	inches
			☑ Override Depths	
Grate Information		MINOR	MAJOR	
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	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.10	0.10	
Curb Opening as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	7.06	11.24	cfs
Interception with Clogging	Q_{wa} =	6.35	10.12	cfs
Curb Opening as an Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	10.11	11.26	cfs
Interception with Clogging	Q_{oa} =	9.10	10.13	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	7.86	10.46	cfs
Interception with Clogging	Q_{ma} =	7.07	9.42	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**6.35**	**9.42**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	5.00	5.00	feet
Resultant Street Flow Spread (based on sheet *Q-Allow* geometry)	T =	20.7	27.5	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.9	2.5	inches
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**6.4**	**9.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	2.2	4.8	cfs

INLET IN A SUMP OR SAG LOCATION

Project = Carriage Meadows South #100.030

Inlet ID = Inlet DP-24 (G2.13)

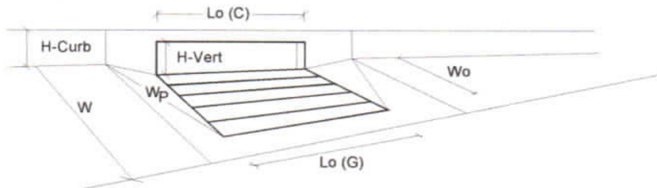


		MINOR	MAJOR	
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Inlet Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	3.00		inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1		
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.5	8.1	inches ☑ Override Depths
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	N/A		feet
Width of a Unit Grate	W_o =	N/A		feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	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		
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A		
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00		feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00		inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00		inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40		degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	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		
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67		
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.10	0.10	
Curb Opening as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	7.06	11.24	cfs
Interception with Clogging	Q_{wa} =	6.35	10.12	cfs
Curb Opening as an Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	10.11	11.26	cfs
Interception with Clogging	Q_{oa} =	9.10	10.13	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	7.86	10.46	cfs
Interception with Clogging	Q_{ma} =	7.07	9.42	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**6.35**	**9.42**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	5.00	5.00	feet
Resultant Street Flow Spread (based on sheet *Q-Allow* geometry)	T =	20.7	27.5	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.9	2.5	inches
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**6.4**	**9.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	2.8	6.2	cfs

INLET IN A SUMP OR SAG LOCATION

Project = Carriage Meadows South #100.030

Inlet ID = Inlet DP-26 (G3.1 & G3.2)

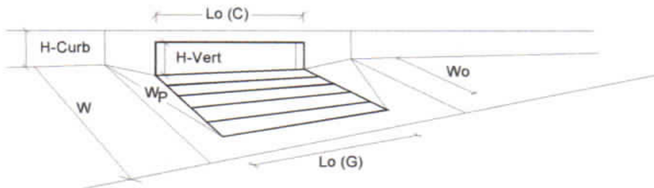


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Inlet Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.5	8.1	inches ☑ Override Depths
Grate Information		MINOR	MAJOR	
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	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.10	0.10	
Curb Opening as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	7.06	11.24	cfs
Interception with Clogging	Q_{wa} =	6.35	10.12	cfs
Curb Opening as an Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	10.11	11.26	cfs
Interception with Clogging	Q_{oa} =	9.10	10.13	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	7.86	10.46	cfs
Interception with Clogging	Q_{ma} =	7.07	9.42	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**6.35**	**9.42**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	5.00	5.00	feet
Resultant Street Flow Spread (based on sheet *Q-Allow* geometry)	T =	20.7	27.5	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.9	2.5	inches
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**6.4**	**9.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	2.4	5.2	cfs

INLET IN A SUMP OR SAG LOCATION

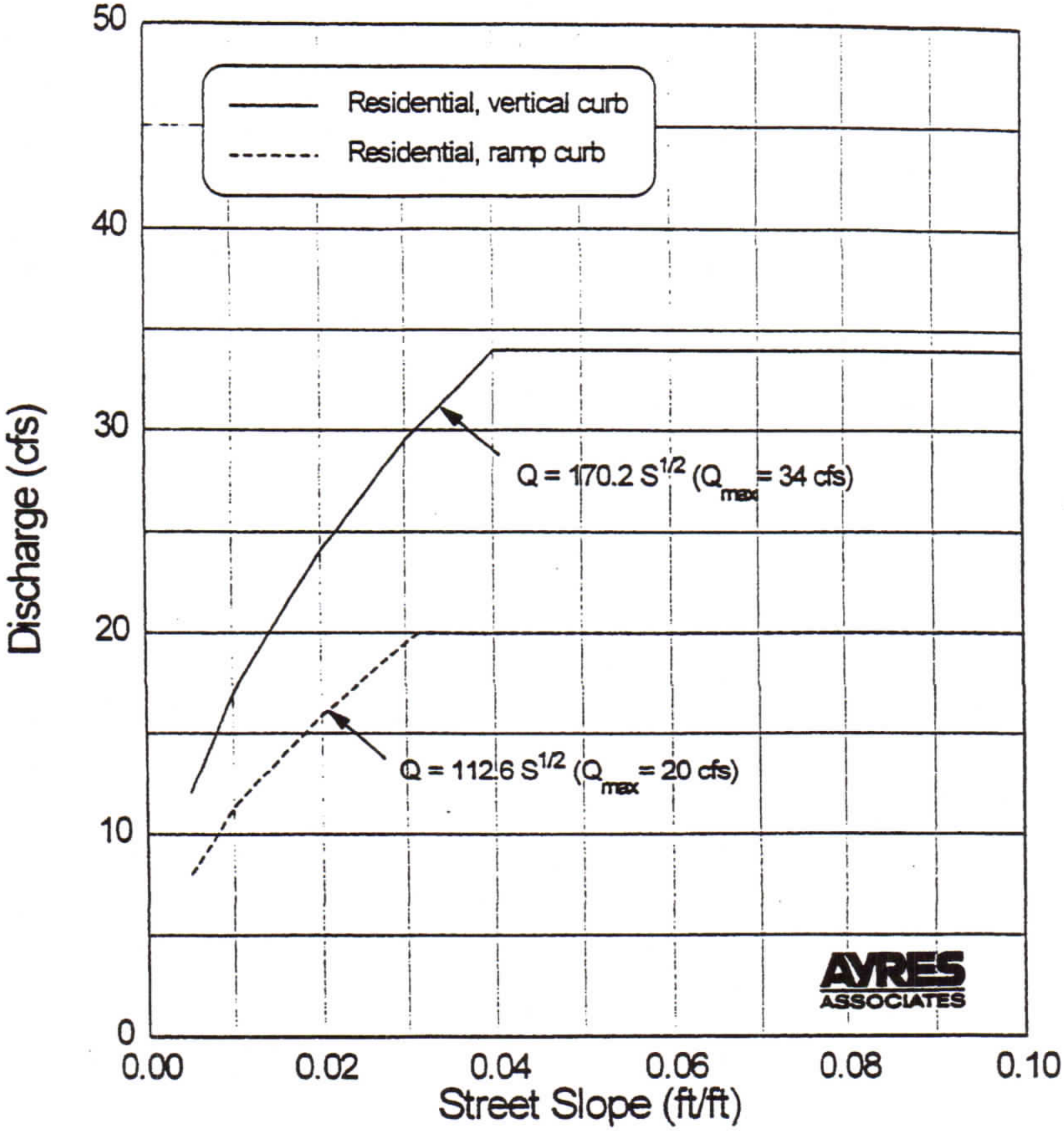
Project = Carriage Meadows South #100.030

Inlet ID = Inlet DP-27 (G3.3 & G3.4)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Inlet Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	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 =	6.5	8.1	inches ☑ Override Depths
Grate Information		MINOR	MAJOR	
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	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.25	1.25	
Clogging Factor for Multiple Units	Clog =	0.06	0.06	
Curb Opening as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	10.72	17.78	cfs
Interception with Clogging	Q_{wa} =	10.05	16.67	cfs
Curb Opening as an Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	20.22	22.52	cfs
Interception with Clogging	Q_{oa} =	18.96	21.11	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	13.69	18.61	cfs
Interception with Clogging	Q_{ma} =	12.84	17.44	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**10.05**	**16.67**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	10.00	10.00	feet
Resultant Street Flow Spread (based on sheet *Q-Allow* geometry)	T =	20.7	27.5	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.9	2.5	inches
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**10.1**	**16.7**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	6.8	15.0	cfs

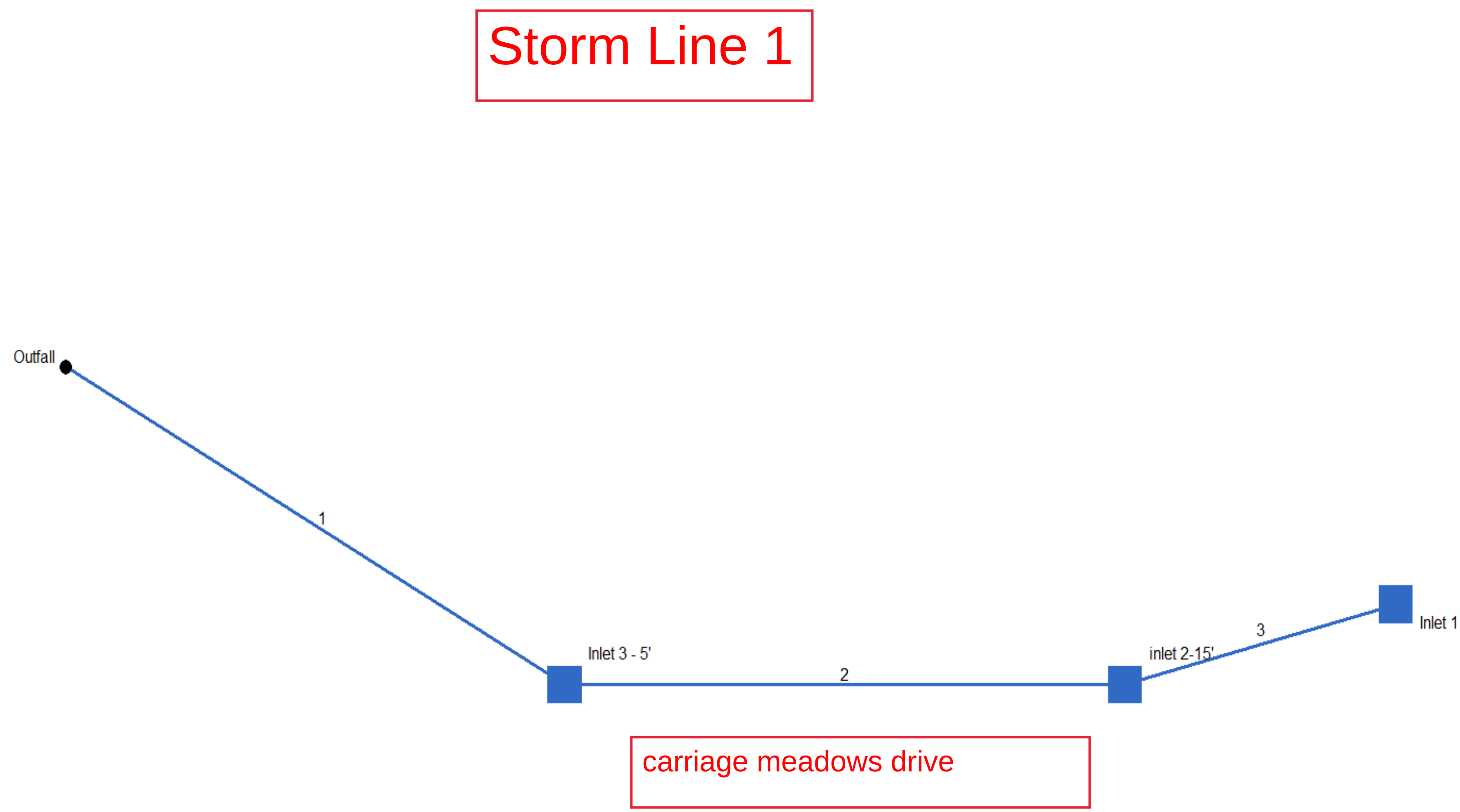
RESIDENTIAL STREET (34' Flowline to flowline)



Interim Release October 12, 1994
City of Colorado Springs

Use this graph to determine the allowable street capacity per side, initial storm, for the typical street section using a 2% crown.

Hydraflow Plan View



Project File: 100.030 DP-3b Storm Drain-5yr.stm	No. Lines: 3	06-21-2016

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	L1 - 30" RCP	26.90	30 c	37.0	5692.80	5693.10	0.812	5694.53	5694.83	n/a	5694.83	End
2	L2 - 30" RCP	24.30	30 c	36.0	5693.60	5693.89	0.806	5695.31	5695.54	n/a	5695.54	1
3	L3 - 24" RCP	14.90	24 c	18.0	5694.39	5694.53	0.776	5695.97	5695.92	0.00	5695.92	2

Project File: 100.030 DP-3b Storm Drain-5yr.stm | Number of lines: 3 | Run Date: 06-21-2016

NOTES: c = cir; e = ellip; b = box; Return period = 5 Yrs.

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Up	Dn	Up	Dn	Up	Dn	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	37.0	0.00	0.00	0.00	0.00	0.00	0.0	0.2	0.0	26.90	36.95	7.41	30	0.81	5693.10	5692.80	5694.83	5694.53	5700.00	5697.00	L1 - 30" RCP
2	1	36.0	0.00	0.00	0.00	0.00	0.00	0.0	0.1	0.0	24.30	36.81	6.95	30	0.81	5693.89	5693.60	5695.54	5695.31	5700.00	5700.00	L2 - 30" RCP
3	2	18.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	14.90	19.92	6.01	24	0.78	5694.53	5694.39	5695.92	5695.97	5698.00	5700.00	L3 - 24" RCP

Project File: 100.030 DP-3b Storm Drain-5yr.stm | Number of lines: 3 | Run Date: 06-21-2016

NOTES: Intensity = 68.28 / (Inlet time + 13.10) ^ 0.89; Return period = 5 Yrs.

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	L1 - 30" RCP	51.20	30 c	37.0	5692.80	5693.10	0.812	5695.30*	5695.88*	0.00	5695.88	End
2	L2 - 30" RCP	46.50	30 c	36.0	5693.60	5693.89	0.806	5696.17*	5696.64*	0.00	5696.64	1
3	L3 - 24" RCP	29.20	24 c	18.0	5694.39	5694.53	0.776	5696.69*	5696.99*	0.00	5696.99	2

Project File: 100.030 DP-3b Storm Drain-100yr.stm	Number of lines: 3	Run Date: 06-21-2016

NOTES: c = cir; e = ellip; b = box; Return period = 100 Yrs. ; *Surcharged (HGL above crown).

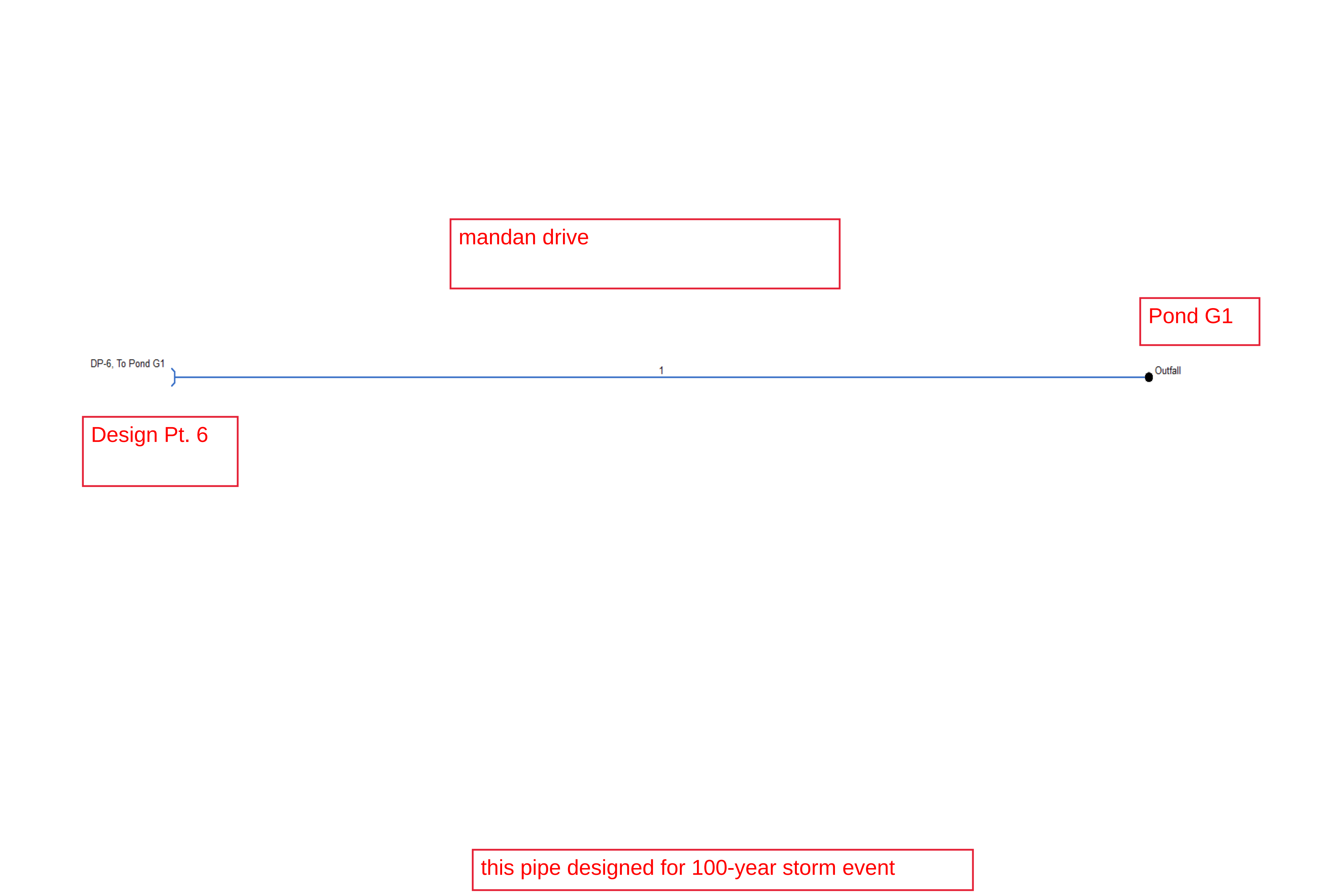
Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Up	Dn	Up	Dn	Up	Dn	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	37.0	0.00	0.00	0.00	0.00	0.00	0.0	0.1	0.0	51.20	36.95	10.43	30	0.81	5693.10	5692.80	5695.88	5695.30	5700.00	5697.00	L1 - 30" RCP
2	1	36.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	46.50	36.81	9.47	30	0.81	5693.89	5693.60	5696.64	5696.17	5700.00	5700.00	L2 - 30" RCP
3	2	18.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	29.20	19.92	9.30	24	0.78	5694.53	5694.39	5696.99	5696.69	5698.00	5700.00	L3 - 24" RCP

Project File: 100.030 DP-3b Storm Drain-100yr.stm | Number of lines: 3 | Run Date: 06-21-2016

NOTES: Intensity = 58.48 / (Inlet time + 7.70) ^ 0.75; Return period = 100 Yrs.

Hydraflow Plan View



Project File: 100.030 DP-6 Storm Drain-100yr.stm	No. Lines: 1	06-21-2016

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	P1 - 48" RCP	120.0	48 c	198.0	5685.86	5686.85	0.500	5689.28	5690.83	0.00	5690.83	End

Project File: 100.030 DP-6 Storm Drain-100yr.stm	Number of lines: 1	Run Date: 06-21-2016
NOTES: c = cir; e = ellip; b = box; Return period = 100 Yrs.		

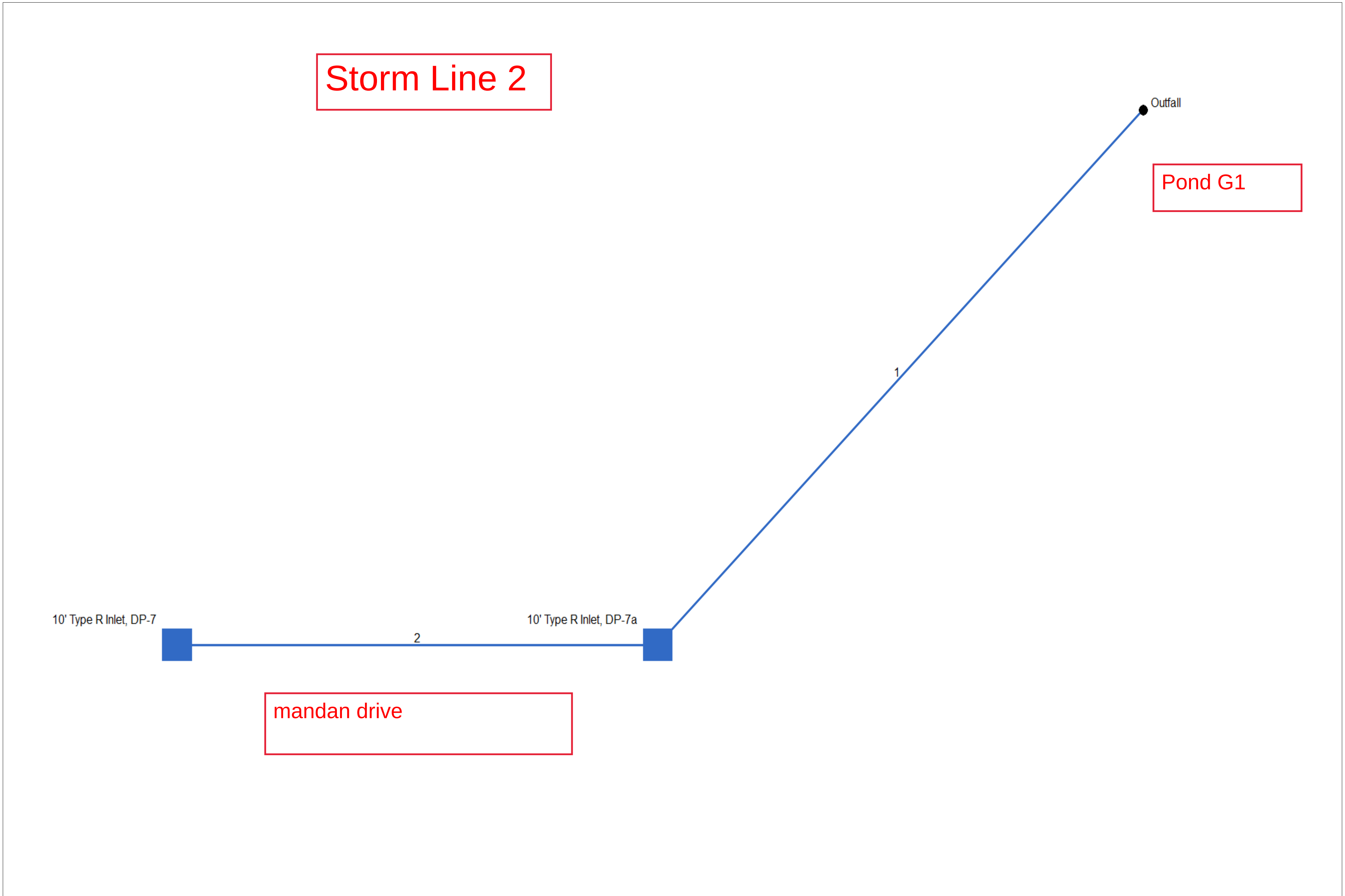
Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Up	Dn	Up	Dn	Up	Dn	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	198.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	120.0	101.6	10.02	48	0.50	5686.85	5685.86	5690.83	5689.28	5693.00	5693.00	P1 - 48" RCP

Project File: 100.030 DP-6 Storm Drain-100yr.stm | Number of lines: 1 | Run Date: 06-21-2016

NOTES: Intensity = 58.48 / (Inlet time + 7.70) ^ 0.75; Return period = 100 Yrs.

Hydraflow Plan View



Project File: 100.030 DP-7 Storm Drain-5yr.stm	No. Lines: 2	06-21-2016

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	L1 - 24" RCP	12.60	24 c	50.0	5685.80	5686.80	2.000	5687.14	5688.06	n/a	5688.06 j	End
2	L2 - 18" RCP	5.40	18 c	35.0	5687.30	5688.00	2.001	5688.48	5688.89	n/a	5688.89 j	1

Project File: 100.030 DP-7 Storm Drain-5yr.stm | Number of lines: 2 | Run Date: 06-21-2016

NOTES: c = cir; e = ellip; b = box; Return period = 5 Yrs. ; j - Line contains hyd. jump.

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Up	Dn	Up	Dn	Up	Dn	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	50.0	0.00	0.00	0.00	0.00	0.00	0.0	0.2	0.0	12.60	31.99	5.84	24	2.00	5686.80	5685.80	5688.06	5687.14	5692.63	5689.00	L1 - 24" RCP
2	1	35.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	5.40	14.85	4.29	18	2.00	5688.00	5687.30	5688.89	5688.48	5692.63	5692.63	L2 - 18" RCP

Project File: 100.030 DP-7 Storm Drain-5yr.stm | Number of lines: 2 | Run Date: 06-21-2016

NOTES: Intensity = 68.28 / (Inlet time + 13.10) ^ 0.89; Return period = 5 Yrs.

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	L1 - 24" RCP	27.70	24 c	50.0	5685.80	5686.80	2.000	5687.62	5688.62	n/a	5688.62	End
2	L2 - 18" RCP	11.80	18 c	35.0	5687.30	5688.00	2.001	5689.25*	5689.69*	0.00	5689.69	1

Project File: 100.030 DP-7 Storm Drain-100yr.stm	Number of lines: 2	Run Date: 06-21-2016

NOTES: c = cir; e = ellip; b = box; Return period = 100 Yrs. ; *Surcharged (HGL above crown).

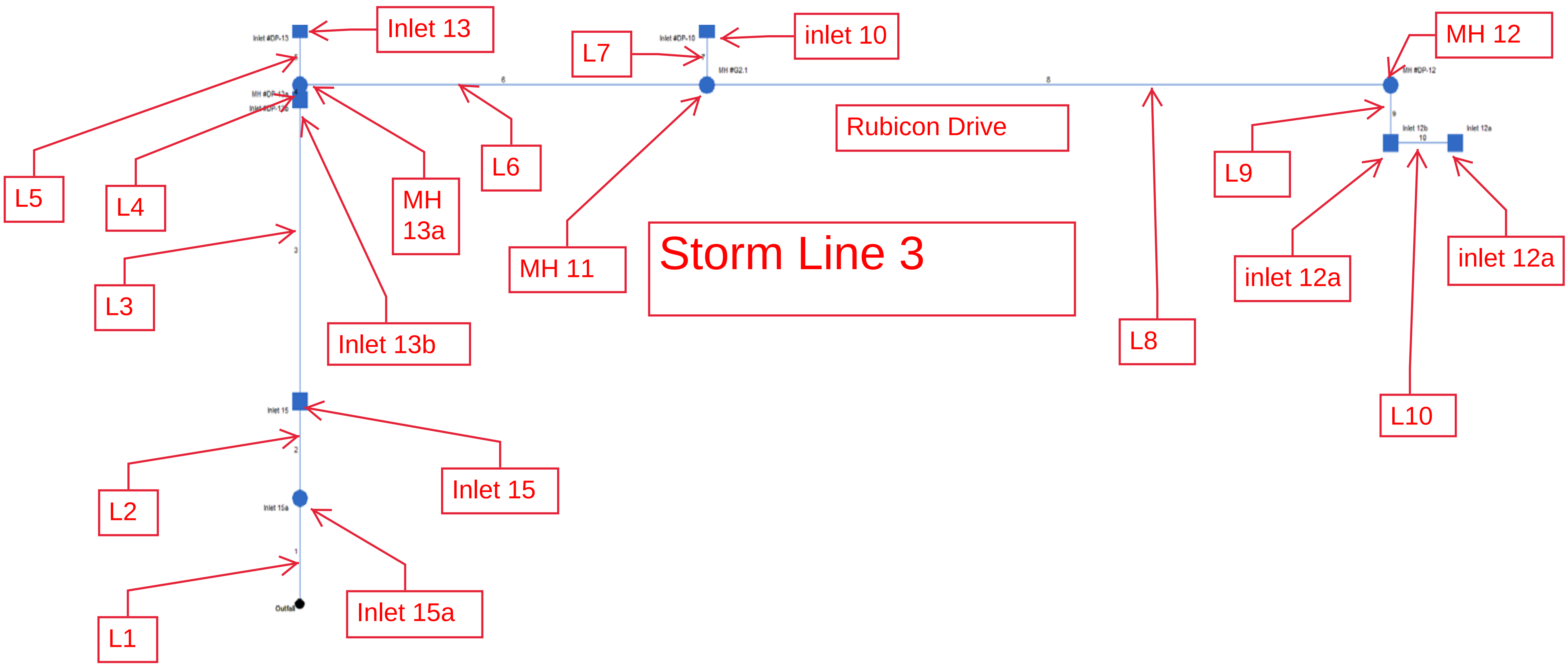
Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Up	Dn	Up	Dn	Up	Dn	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	50.0	0.00	0.00	0.00	0.00	0.00	0.0	0.1	0.0	27.70	31.99	9.21	24	2.00	5686.80	5685.80	5688.62	5687.62	5692.63	5689.00	L1 - 24" RCP
2	1	35.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	11.80	14.85	6.68	18	2.00	5688.00	5687.30	5689.69	5689.25	5692.63	5692.63	L2 - 18" RCP

Project File: 100.030 DP-7 Storm Drain-100yr.stm | Number of lines: 2 | Run Date: 06-21-2016

NOTES: Intensity = 58.48 / (Inlet time + 7.70) ^ 0.75; Return period = 100 Yrs.

Hydraflow Plan View



Project File: 100.030 G2.1-G2.6 Storm Drain-100yr.stm	No. Lines: 10	02-20-2017

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	L1	47.60	48 c	51.0	5683.54	5683.74	0.393	5685.61	5685.80	0.00	5685.80	End
2	L2	45.60	48 c	47.0	5683.74	5683.93	0.404	5686.42	5686.44	0.00	5686.44	1
3	L3	43.00	48 c	146.0	5683.93	5684.51	0.397	5686.73	5686.80	0.00	5686.80	2
4	L4	40.60	48 c	7.0	5684.51	5684.54	0.432	5686.86	5686.86	0.00	5686.86	3
5	L5	28.70	48 c	27.0	5684.54	5684.65	0.407	5687.11	5687.11	0.00	5687.11	4
6	L6	11.90	24 c	215.0	5687.24	5688.53	0.600	5688.45	5689.76	0.00	5689.76	4
7	L7	4.90	18 c	27.0	5689.03	5689.30	1.000	5690.18	5690.15	0.00	5690.15	6
8	L8	7.00	24 c	361.0	5688.73	5690.90	0.601	5690.22	5691.84	n/a	5691.84 j	6
9	L9	7.00	24 c	28.0	5691.20	5691.37	0.607	5692.13	5692.31	0.00	5692.31	8
10	L10	6.70	18 c	34.0	5691.87	5692.07	0.587	5692.92	5693.11	0.00	5693.11	9

Project File: 100.030 G2.1-G2.6 Storm Drain-5yr.stm | Number of lines: 10 | Run Date: 02-21-2017

NOTES: c = cir; e = ellip; b = box; Return period = 5 Yrs. ; j - Line contains hyd. jump.

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Up	Dn	Up	Dn	Up	Dn	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	51.0	0.00	0.00	0.00	0.00	0.00	0.0	5.0	0.0	47.60	90.00	7.27	48	0.39	5683.74	5683.54	5685.80	5685.61	5690.50	5688.00	L1
2	1	47.0	0.00	0.00	0.00	0.00	0.00	0.0	4.8	0.0	45.60	91.32	5.29	48	0.40	5683.93	5683.74	5686.44	5686.42	5690.50	5690.50	L2
3	2	146.0	0.00	0.00	0.00	0.00	0.00	0.0	4.0	0.0	43.00	90.51	5.18	48	0.40	5684.51	5683.93	5686.80	5686.73	5692.06	5690.50	L3
4	3	7.0	0.00	0.00	0.00	0.00	0.00	0.0	4.0	0.0	40.60	94.47	5.32	48	0.43	5684.54	5684.51	5686.86	5686.86	5691.82	5692.06	L4
5	4	27.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	28.70	91.63	3.46	48	0.41	5684.65	5684.54	5687.11	5687.11	5692.06	5691.82	L5
6	4	215.0	0.00	0.00	0.00	0.00	0.00	0.0	3.1	0.0	11.90	17.52	5.94	24	0.60	5688.53	5687.24	5689.76	5688.45	5693.72	5691.82	L6
7	6	27.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	4.90	10.50	4.07	18	1.00	5689.30	5689.03	5690.15	5690.18	5694.24	5693.72	L7
8	6	361.0	0.00	0.00	0.00	0.00	0.00	0.0	0.4	0.0	7.00	17.54	3.82	24	0.60	5690.90	5688.73	5691.84	5690.22	5696.00	5693.72	L8
9	8	28.0	0.00	0.00	0.00	0.00	0.00	0.0	0.1	0.0	7.00	17.62	4.87	24	0.61	5691.37	5691.20	5692.31	5692.13	5695.71	5696.00	L9
10	9	34.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	6.70	8.05	5.10	18	0.59	5692.07	5691.87	5693.11	5692.92	5695.71	5695.71	L10

Project File: 100.030 G2.1-G2.6 Storm Drain-5yr.stm | Number of lines: 10 | Run Date: 02-21-2017

NOTES: Intensity = 68.28 / (Inlet time + 13.10) ^ 0.89; Return period = 5 Yrs.

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	L1	97.80	48 c	51.0	5683.54	5683.74	0.393	5687.54	5687.74	0.00	5687.74	End
2	L2	93.30	48 c	47.0	5683.74	5683.93	0.404	5687.80*	5688.00*	0.00	5688.00	1
3	L3	87.50	48 c	146.0	5683.93	5684.51	0.397	5688.10*	5688.64*	0.00	5688.64	2
4	L4	82.20	48 c	7.0	5684.51	5684.54	0.432	5688.73*	5688.76*	0.00	5688.76	3
5	L5	59.10	48 c	27.0	5684.54	5684.65	0.407	5689.08*	5689.12*	0.00	5689.12	4
6	L6	23.10	24 c	215.0	5686.99	5688.29	0.605	5688.99*	5691.23*	0.00	5691.23	4
7	L7	7.70	18 c	27.0	5689.03	5689.30	1.000	5691.78*	5691.93*	0.00	5691.93	6
8	L8	15.40	24 c	361.0	5688.73	5690.90	0.601	5691.70*	5693.38*	0.00	5693.38	6
9	L9	15.40	24 c	28.0	5691.20	5691.37	0.607	5693.38*	5693.51*	0.00	5693.51	8
10	L10	14.80	18 c	34.0	5691.87	5692.07	0.587	5693.51*	5694.18*	0.00	5694.18	9

Project File: 100.030 G2.1-G2.6 Storm Drain-100yr.stm | Number of lines: 10 | Run Date: 02-20-2017

NOTES: c = cir; e = ellip; b = box; Return period = 100 Yrs. ; *Surcharged (HGL above crown).

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	
1	End	51.0	0.00	0.00	0.00	0.00	0.00	0.0	2.4	0.0	97.80	90.00	7.78	48	0.39	5683.74	5683.54	5687.74	5687.54	5692.85	5693.00	L1
2	1	47.0	0.00	0.00	0.00	0.00	0.00	0.0	2.2	0.0	93.30	91.32	7.43	48	0.40	5683.93	5683.74	5688.00	5687.80	5692.83	5692.85	L2
3	2	146.0	0.00	0.00	0.00	0.00	0.00	0.0	1.9	0.0	87.50	90.51	6.96	48	0.40	5684.51	5683.93	5688.64	5688.10	5692.70	5692.83	L3
4	3	7.0	0.00	0.00	0.00	0.00	0.00	0.0	1.9	0.0	82.20	94.47	6.54	48	0.43	5684.54	5684.51	5688.76	5688.73	5692.40	5692.70	L4
5	4	27.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	59.10	91.63	4.70	48	0.41	5684.65	5684.54	5689.12	5689.08	5692.64	5692.40	L5
6	4	215.0	0.00	0.00	0.00	0.00	0.00	0.0	1.4	0.0	23.10	17.59	7.35	24	0.60	5688.29	5686.99	5691.23	5688.99	5693.72	5692.40	L6
7	6	27.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	7.70	10.50	4.36	18	1.00	5689.30	5689.03	5691.93	5691.78	5694.24	5693.72	L7
8	6	361.0	0.00	0.00	0.00	0.00	0.00	0.0	0.2	0.0	15.40	17.54	4.90	24	0.60	5690.90	5688.73	5693.38	5691.70	5696.00	5693.72	L8
9	8	28.0	0.00	0.00	0.00	0.00	0.00	0.0	0.1	0.0	15.40	17.62	4.90	24	0.61	5691.37	5691.20	5693.51	5693.38	5695.71	5696.00	L9
10	9	34.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	14.80	8.05	8.38	18	0.59	5692.07	5691.87	5694.18	5693.51	5695.71	5695.71	L10

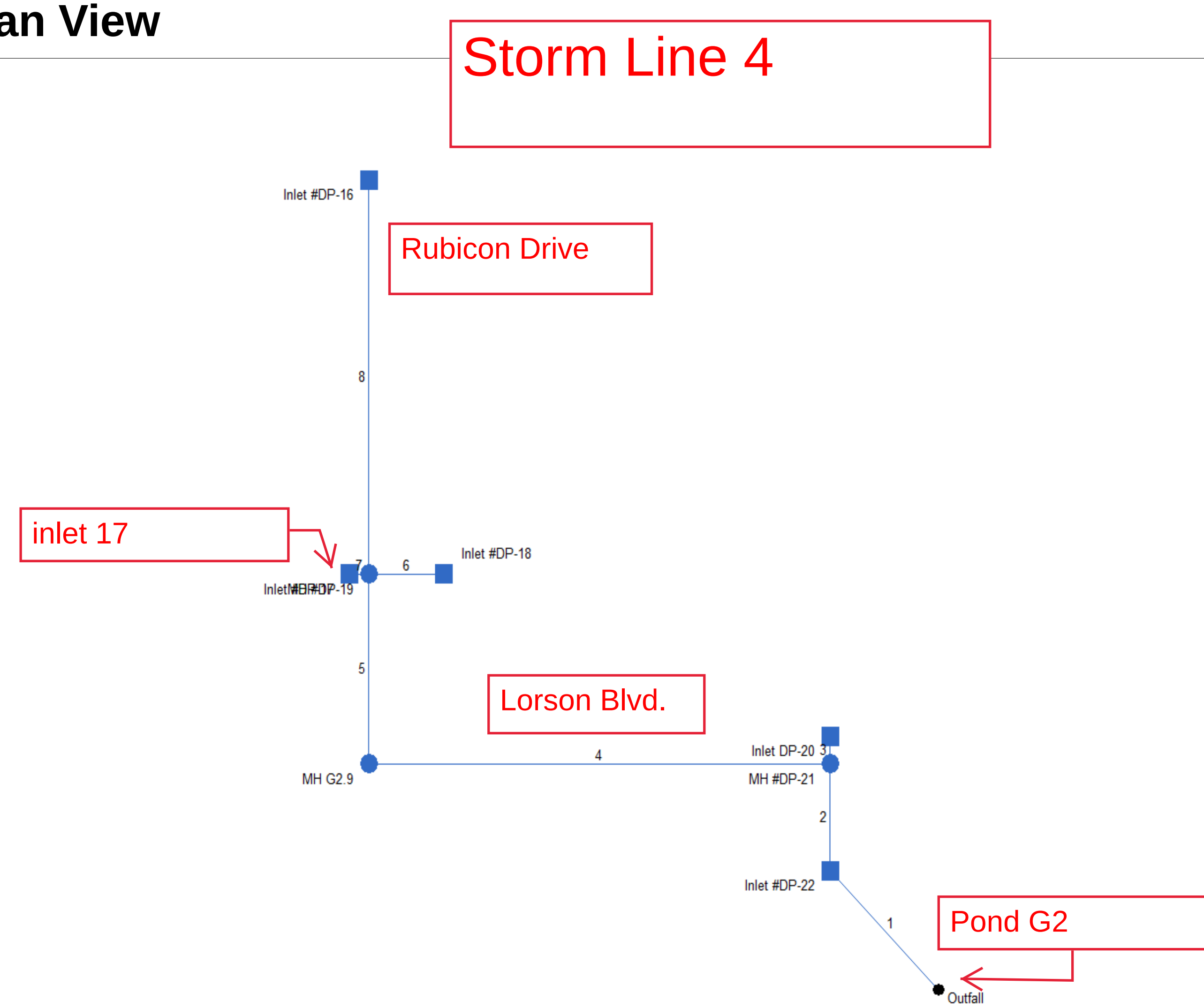
Project File: 100.030 G2.1-G2.6 Storm Drain-100yr.stm

Number of lines: 10

Run Date: 02-20-2017

NOTES: Intensity = 58.48 / (Inlet time + 7.70) ^ 0.75; Return period = 100 Yrs.

Hydraflow Plan View



Project File: 100.030 G2.7-G2.12 Storm Drain-5yr.stm	No. Lines: 8	06-21-2016

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	L1	14.50	24 c	55.0	5684.06	5684.34	0.509	5685.41	5685.87	0.00	5685.87	End
2	L2	10.40	24 c	35.0	5684.84	5685.02	0.515	5686.19	5686.24	0.00	5686.24	1
3	L3	3.50	18 c	9.0	5685.52	5685.61	0.998	5686.48	5686.45	0.00	5686.45	2
4	L4	7.40	24 c	166.0	5685.22	5686.05	0.500	5686.57	5687.01	n/a	5687.01 j	2
5	L5	7.40	24 c	62.0	5686.25	5686.56	0.500	5687.31	5687.53	n/a	5687.53 j	4
6	L6	1.20	18 c	27.0	5687.06	5687.20	0.519	5687.85	5687.85	0.00	5687.85	5
7	L7	2.30	18 c	7.0	5687.06	5687.13	0.997	5687.88	5687.86	0.00	5687.86	5
8	L8	4.60	18 c	129.0	5687.06	5687.71	0.504	5687.91	5688.56	0.00	5688.56	5

Project File: 100.030 G2.7-G2.12 Storm Drain-5yr.stm | Number of lines: 8 | Run Date: 06-21-2016

NOTES: c = cir; e = ellip; b = box; Return period = 5 Yrs. ; j - Line contains hyd. jump.

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Up	Dn	Up	Dn	Up	Dn	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	55.0	0.00	0.00	0.00	0.00	0.00	0.0	2.6	0.0	14.50	16.13	6.03	24	0.51	5684.34	5684.06	5685.87	5685.41	5690.66	5688.00	L1
2	1	35.0	0.00	0.00	0.00	0.00	0.00	0.0	2.4	0.0	10.40	16.23	4.91	24	0.51	5685.02	5684.84	5686.24	5686.19	5690.66	5690.66	L2
3	2	9.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	3.50	10.49	3.19	18	1.00	5685.61	5685.52	5686.45	5686.48	5690.66	5690.66	L3
4	2	166.0	0.00	0.00	0.00	0.00	0.00	0.0	1.3	0.0	7.40	15.99	4.11	24	0.50	5686.05	5685.22	5687.01	5686.57	5691.56	5690.66	L4
5	4	62.0	0.00	0.00	0.00	0.00	0.00	0.0	0.8	0.0	7.40	15.99	4.65	24	0.50	5686.56	5686.25	5687.53	5687.31	5690.51	5691.56	L5
6	5	27.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.20	7.57	1.44	18	0.52	5687.20	5687.06	5687.85	5687.85	5690.75	5690.51	L6
7	5	7.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	2.30	10.49	2.51	18	1.00	5687.13	5687.06	5687.86	5687.88	5690.75	5690.51	L7
8	5	129.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	4.60	7.45	4.44	18	0.50	5687.71	5687.06	5688.56	5687.91	5691.82	5690.51	L8

Project File: 100.030 G2.7-G2.12 Storm Drain-5yr.stm | Number of lines: 8 | Run Date: 06-21-2016

NOTES: Intensity = 68.28 / (Inlet time + 13.10) ^ 0.89; Return period = 5 Yrs.

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	L1	32.00	24 c	55.0	5684.06	5684.34	0.509	5686.06*	5687.16*	0.00	5687.16	End
2	L2	22.80	24 c	35.0	5684.84	5685.02	0.515	5687.96*	5688.31*	0.00	5688.31	1
3	L3	7.60	18 c	9.0	5685.52	5685.61	0.998	5688.84*	5688.89*	0.00	5688.89	2
4	L4	16.20	24 c	166.0	5685.22	5686.05	0.500	5688.72*	5689.57*	0.00	5689.57	2
5	L5	16.20	24 c	62.0	5686.25	5686.56	0.500	5689.57*	5689.89*	0.00	5689.89	4
6	L6	2.60	18 c	27.0	5687.06	5687.20	0.519	5690.27*	5690.28*	0.00	5690.28	5
7	L7	5.00	18 c	7.0	5687.06	5687.13	0.997	5690.18*	5690.19*	0.00	5690.19	5
8	L8	10.20	18 c	129.0	5687.06	5687.71	0.504	5689.89*	5691.11*	0.00	5691.11	5

Project File: 100.030 G2.7-G2.12 Storm Drain-100yr.stm | Number of lines: 8 | Run Date: 06-21-2016

NOTES: c = cir; e = ellip; b = box; Return period = 100 Yrs. ; *Surcharged (HGL above crown).

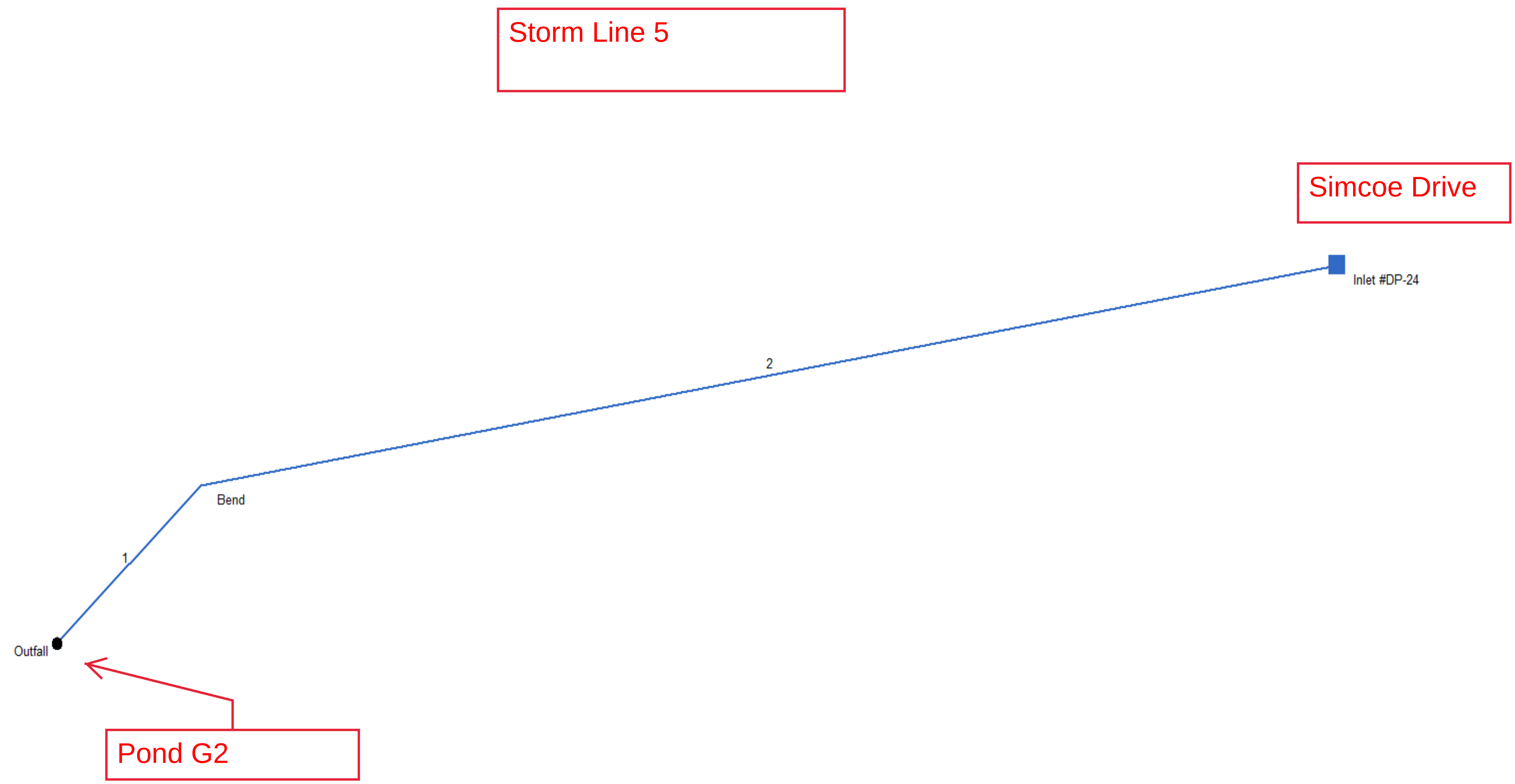
Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	
1	End	55.0	0.00	0.00	0.00	0.00	0.00	0.0	1.2	0.0	32.00	16.13	10.19	24	0.51	5684.34	5684.06	5687.16	5686.06	5690.66	5688.00	L1
2	1	35.0	0.00	0.00	0.00	0.00	0.00	0.0	1.1	0.0	22.80	16.23	7.26	24	0.51	5685.02	5684.84	5688.31	5687.96	5690.66	5690.66	L2
3	2	9.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	7.60	10.49	4.30	18	1.00	5685.61	5685.52	5688.89	5688.84	5690.66	5690.66	L3
4	2	166.0	0.00	0.00	0.00	0.00	0.00	0.0	0.6	0.0	16.20	15.99	5.16	24	0.50	5686.05	5685.22	5689.57	5688.72	5691.56	5690.66	L4
5	4	62.0	0.00	0.00	0.00	0.00	0.00	0.0	0.4	0.0	16.20	15.99	5.16	24	0.50	5686.56	5686.25	5689.89	5689.57	5690.51	5691.56	L5
6	5	27.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	2.60	7.57	1.47	18	0.52	5687.20	5687.06	5690.28	5690.27	5690.75	5690.51	L6
7	5	7.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	5.00	10.49	2.83	18	1.00	5687.13	5687.06	5690.19	5690.18	5690.75	5690.51	L7
8	5	129.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	10.20	7.45	5.77	18	0.50	5687.71	5687.06	5691.11	5689.89	5691.82	5690.51	L8

Project File: 100.030 G2.7-G2.12 Storm Drain-100yr.stm | Number of lines: 8 | Run Date: 06-21-2016

NOTES: Intensity = 58.48 / (Inlet time + 7.70) ^ 0.75; Return period = 100 Yrs.

Hydraflow Plan View



Project File: 100.030 G2.13 Storm Drain-5yr.stm	No. Lines: 2	06-21-2016

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	L1	2.80	18 c	26.0	5684.10	5684.57	1.807	5684.74	5685.21	n/a	5685.21 j	End
2	L2	2.80	18 c	148.0	5684.57	5687.23	1.797	5685.41	5687.87	n/a	5687.87 j	1

Project File: 100.030 G2.13 Storm Drain-5yr.stm	Number of lines: 2	Run Date: 06-21-2016

NOTES: c = cir; e = ellip; b = box; Return period = 5 Yrs. ; j - Line contains hyd. jump.

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Up	Dn	Up	Dn	Up	Dn	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	26.0	0.00	0.00	0.00	0.00	0.00	0.0	1.6	0.0	2.80	14.11	3.90	18	1.81	5684.57	5684.10	5685.21	5684.74	5692.00	5686.00	L1
2	1	148.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	2.80	14.08	3.33	18	1.80	5687.23	5684.57	5687.87	5685.41	5692.20	5692.00	L2

Project File: 100.030 G2.13 Storm Drain-5yr.stm | Number of lines: 2 | Run Date: 06-21-2016

NOTES: Intensity = 68.28 / (Inlet time + 13.10) ^ 0.89; Return period = 5 Yrs.

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	L1	6.20	18 c	26.0	5684.10	5684.57	1.807	5685.05	5685.52	n/a	5685.52	End
2	L2	6.20	18 c	148.0	5684.57	5687.23	1.797	5685.76	5688.18	n/a	5688.18 j	1

Project File: 100.030 G2.13 Storm Drain-100yr.stm	Number of lines: 2	Run Date: 06-21-2016

NOTES: c = cir; e = ellip; b = box; Return period = 100 Yrs. ; j - Line contains hyd. jump.

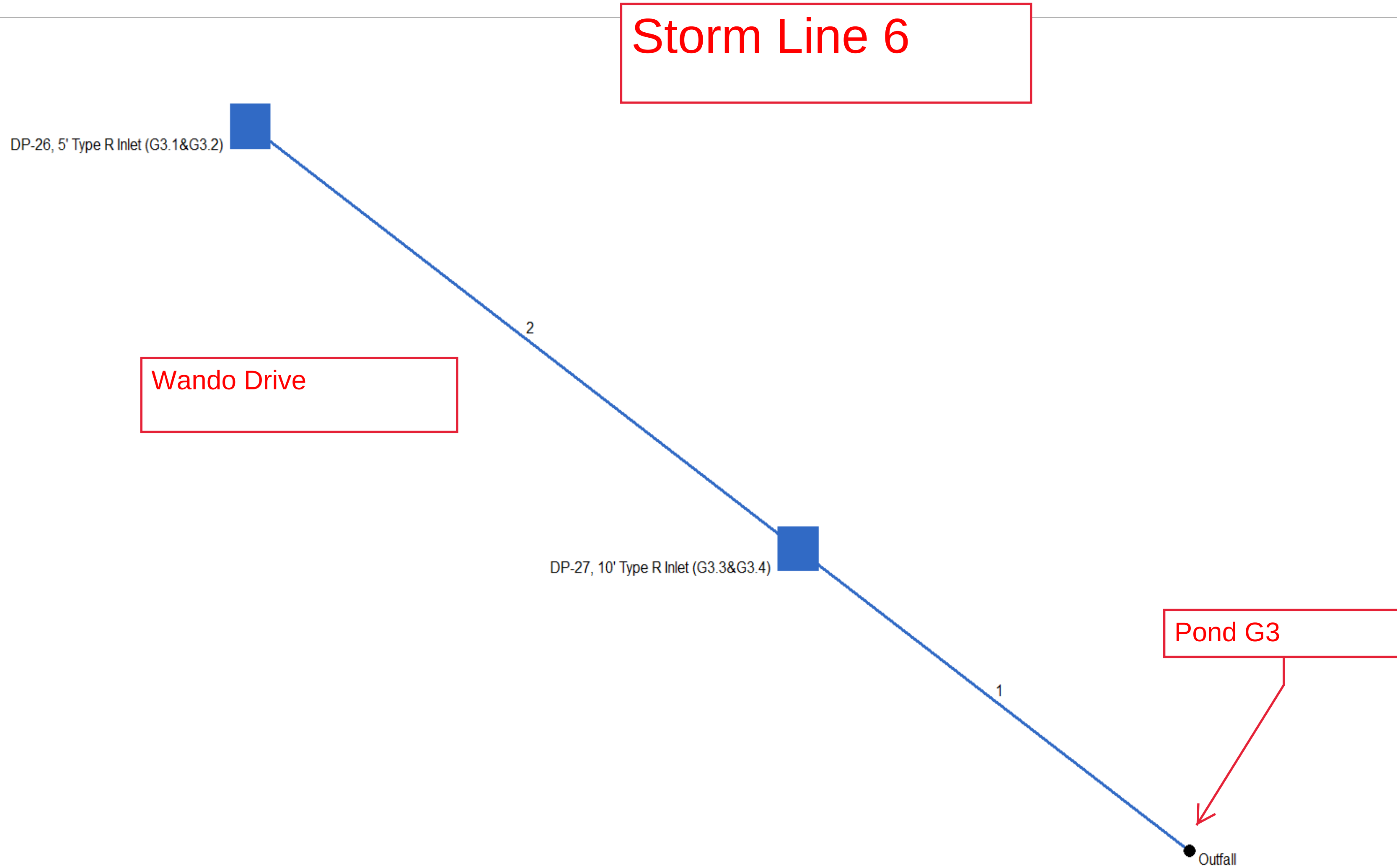
Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Up	Dn	Up	Dn	Up	Dn	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	26.0	0.00	0.00	0.00	0.00	0.00	0.0	0.7	0.0	6.20	14.11	5.25	18	1.81	5684.57	5684.10	5685.52	5685.05	5692.00	5686.00	L1
2	1	148.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	6.20	14.08	4.69	18	1.80	5687.23	5684.57	5688.18	5685.76	5692.20	5692.00	L2

Project File: 100.030 G2.13 Storm Drain-100yr.stm | Number of lines: 2 | Run Date: 06-21-2016

NOTES: Intensity = 58.48 / (Inlet time + 7.70) ^ 0.75; Return period = 100 Yrs.

Hydraflow Plan View



Project File: 100.030 G3.1-G3.4 Storm Drain-5yr.stm	No. Lines: 2	06-21-2016

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	L1-24"RCP	9.00	24 c	25.0	5685.00	5685.15	0.600	5686.06	5686.22	0.00	5686.22	End
2	L2 - 18"RCP	2.40	18 c	35.0	5685.65	5685.86	0.600	5686.62	5686.62	0.00	5686.62	1

Project File: 100.030 G3.1-G3.4 Storm Drain-5yr.stm | Number of lines: 2 | Run Date: 06-21-2016

NOTES: c = cir; e = ellip; b = box; Return period = 5 Yrs.

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Up	Dn	Up	Dn	Up	Dn	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	25.0	0.00	0.00	0.00	0.00	0.00	0.0	0.4	0.0	9.00	17.51	5.29	24	0.60	5685.15	5685.00	5686.22	5686.06	5689.89	5688.00	L1-24"RCP
2	1	35.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	2.40	8.13	2.32	18	0.60	5685.86	5685.65	5686.62	5686.62	5689.89	5689.89	L2 - 18"RCP

Project File: 100.030 G3.1-G3.4 Storm Drain-5yr.stm | Number of lines: 2 | Run Date: 06-21-2016

NOTES: Intensity = 68.28 / (Inlet time + 13.10) ^ 0.89; Return period = 5 Yrs.

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	L1-24"RCP	19.90	24 c	25.0	5685.00	5685.15	0.600	5687.00	5687.15	0.00	5687.15	End
2	L2 - 18"RCP	5.20	18 c	35.0	5685.65	5685.86	0.600	5687.64*	5687.72*	0.00	5687.72	1

Project File: 100.030 G3.1-G3.4 Storm Drain-100yr.stm	Number of lines: 2	Run Date: 06-21-2016

NOTES: c = cir; e = ellip; b = box; Return period = 100 Yrs. ; *Surcharged (HGL above crown).

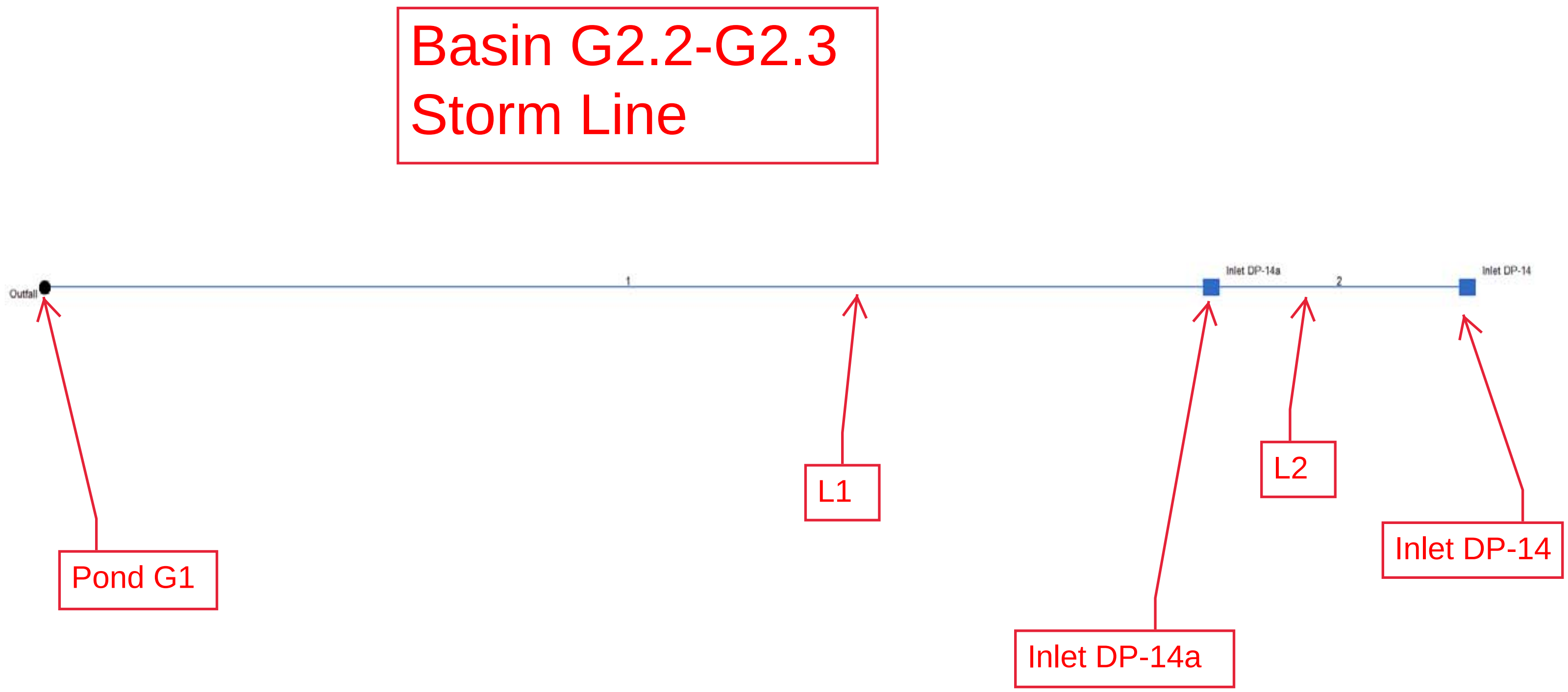
Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Up	Dn	Up	Dn	Up	Dn	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	25.0	0.00	0.00	0.00	0.00	0.00	0.0	0.2	0.0	19.90	17.51	6.34	24	0.60	5685.15	5685.00	5687.15	5687.00	5689.89	5688.00	L1-24"RCP
2	1	35.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	5.20	8.13	2.94	18	0.60	5685.86	5685.65	5687.72	5687.64	5689.89	5689.89	L2 - 18"RCP

Project File: 100.030 G3.1-G3.4 Storm Drain-100yr.stm | Number of lines: 2 | Run Date: 06-21-2016

NOTES: Intensity = 58.48 / (Inlet time + 7.70) ^ 0.75; Return period = 100 Yrs.

Hydraflow Plan View



Project File: 100.030 DP-14 Storm Drain-100yr.stm	No. Lines: 2	02-21-2017

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	L1 - 24" RCP	8.80	24 c	155.0	5686.00	5687.55	1.000	5687.05	5688.60	0.00	5688.60	End
2	L2 - 18" RCP	3.30	18 c	34.0	5688.05	5688.39	1.001	5688.98	5689.08	n/a	5689.08 j	1

Project File: 100.030 DP-14 Storm Drain-5yr.stm	Number of lines: 2	Run Date: 02-21-2017

NOTES: c = cir; e = ellip; b = box; Return period = 5 Yrs. ; j - Line contains hyd. jump.

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Up	Dn	Up	Dn	Up	Dn	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	155.0	0.00	0.00	0.00	0.00	0.00	0.0	0.3	0.0	8.80	22.62	5.26	24	1.00	5687.55	5686.00	5688.60	5687.05	5692.45	5688.00	L1 - 24" RCP
2	1	34.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	3.30	10.51	3.50	18	1.00	5688.39	5688.05	5689.08	5688.98	5692.45	5692.45	L2 - 18" RCP

Project File: 100.030 DP-14 Storm Drain-5yr.stm | Number of lines: 2 | Run Date: 02-21-2017

NOTES: Intensity = 68.28 / (Inlet time + 13.10) ^ 0.89; Return period = 5 Yrs.

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	L1 - 24" RCP	22.40	24 c	155.0	5686.00	5687.55	1.000	5687.68	5689.23	n/a	5689.23 j	End
2	L2 - 18" RCP	9.80	18 c	34.0	5688.05	5688.39	1.001	5689.73*	5690.03*	0.00	5690.03	1

Project File: 100.030 DP-14 Storm Drain-100yr.stm	Number of lines: 2	Run Date: 02-21-2017

NOTES: c = cir; e = ellip; b = box; Return period = 100 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

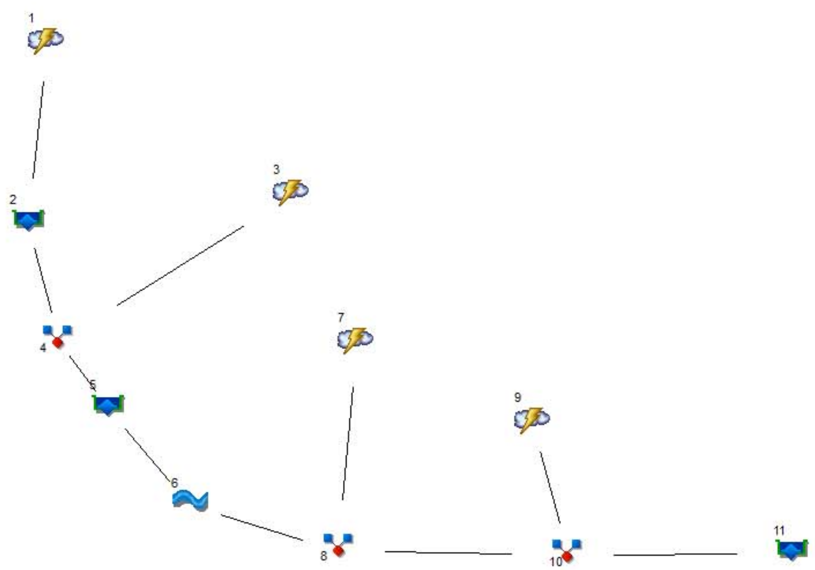
Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Up	Dn	Up	Dn	Up	Dn	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	155.0	0.00	0.00	0.00	0.00	0.00	0.0	0.1	0.0	22.40	22.62	7.96	24	1.00	5687.55	5686.00	5689.23	5687.68	5692.45	5688.00	L1 - 24" RCP
2	1	34.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	9.80	10.51	5.55	18	1.00	5688.39	5688.05	5690.03	5689.73	5692.45	5692.45	L2 - 18" RCP

Project File: 100.030 DP-14 Storm Drain-100yr.stm | Number of lines: 2 | Run Date: 02-21-2017

NOTES: Intensity = 58.48 / (Inlet time + 7.70) ^ 0.75; Return period = 100 Yrs.

APPENDIX D – POND AND HYDRAFLOW CALCULATIONS



Legend

Hyd.	Origin	Description
1	Rational	Commercial (G1.1 to G1.7)
2	Reservoir	Pond G1.7
3	Rational	Sub-Basin G1.8a
4	Combine	inflow to Pond G1.8
5	Reservoir	Pond G1.8
6	Reach	Route flow to des. pt. 6
7	Rational	Basin G1.8b
8	Combine	Flow at Des. Pt. 6
9	Rational	Basin G1.9-G1.10-G1.11
10	Combine	Total Detained Flow into Pond G1
11	Reservoir	Pond G1

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Maximum storage (cuft)	Hydrograph description
1	Rational	106.94	1	18	115,493	----	------	------	Commercial (G1.1 to G1.7)
2	Reservoir	62.65	1	25	115,483	1	5695.10	53,518	Pond G1.7
3	Rational	14.66	1	20	17,588	----	------	------	Sub-Basin G1.8a
4	Combine	73.96	1	24	133,070	2, 3	------	------	inflow to Swale G1.8
5	Reservoir	52.83	1	34	133,065	4	5692.86	39,288	Swale G1.8
6	Reach	52.64	1	36	132,976	5	------	------	Route flow to des. pt. 6
7	Rational	7.126	1	19	8,124	----	------	------	Basin G1.8b
8	Combine	53.71	1	35	141,100	6, 7	------	------	Flow at Des. Pt. 6
9	Rational	26.41	1	17	26,940	----	------	------	Basin G1.9-G1.10-G1.11, G2.2, G2.3
10	Combine	59.98	1	24	168,040	8, 9	------	------	Total Detained Flow into Pond G1
11	Reservoir	28.06	1	58	167,438	10	5687.92	97,961	Pond G1

100.030 G1.7 Ponds G1 & G2-5yr.gpw	Return Period: 5 Year	Monday, Feb 20 2017, 2:27 PM

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Maximum storage (cuft)	Hydrograph description
1	Rational	196.13	1	18	211,821	----	------	------	Commercial (G1.1 to G1.7)
2	Reservoir	95.15	1	27	211,811	1	5696.94	104,641	Pond G1.7
3	Rational	32.37	1	20	38,846	----	------	------	Sub-Basin G1.8a
4	Combine	119.53	1	23	250,657	2, 3	------	------	inflow to Swale G1.8
5	Reservoir	105.09	1	32	250,651	4	5694.33	64,525	Swale G1.8
6	Reach	104.64	1	33	250,563	5	------	------	Route flow to Des.Pt.6
7	Rational	16.56	1	19	18,879	----	------	------	Basin G1.8b
8	Combine	109.00	1	33	269,442	6, 7	------	------	Total Flow at Des. Pt. 6
9	Rational	58.42	1	17	59,593	----	------	------	Basins G1.9-G1.11, G2.2, G2.3
10	Combine	117.04	1	31	329,035	8, 9	------	------	Total Flow into Pond G1
11	Reservoir	57.96	1	54	328,418	10	5689.12	165,167	Pond G1 to G2 flow

100.030 G1.7 Ponds G1 & G2-100yr.gpw	Return Period: 100 Year	Monday, Feb 20 2017, 2:31 PM

Pond Report

Hydraflow Hydrographs by Intelisolve — Sunday, Oct 2 2016, 8:1 AM

Pond No. 2 - Pond G1.7

Pond Data

Pond storage is based on known contour areas. Average end area method used.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	5692.00	300	0	0
1.00	5693.00	18,612	9,456	9,456
2.00	5694.00	20,476	19,544	29,000
3.00	5695.00	23,445	21,961	50,961
4.00	5696.00	27,847	25,646	76,607
5.00	5697.00	31,984	29,916	106,522
6.00	5698.00	34,000	32,992	139,514

Culvert / Orifice Structures

	[A]	[B]	[C]	[D]
Rise (in)	= 48.00	0.00	0.00	0.00
Span (in)	= 48.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 5692.00	0.00	0.00	0.00
Length (ft)	= 426.00	0.00	0.00	0.00
Slope (%)	= 0.53	0.00	0.00	0.00
N-Value	= .013	.000	.000	.000
Orif. Coeff.	= 0.60	0.00	0.00	0.00
Multi-Stage	= n/a	No	No	No

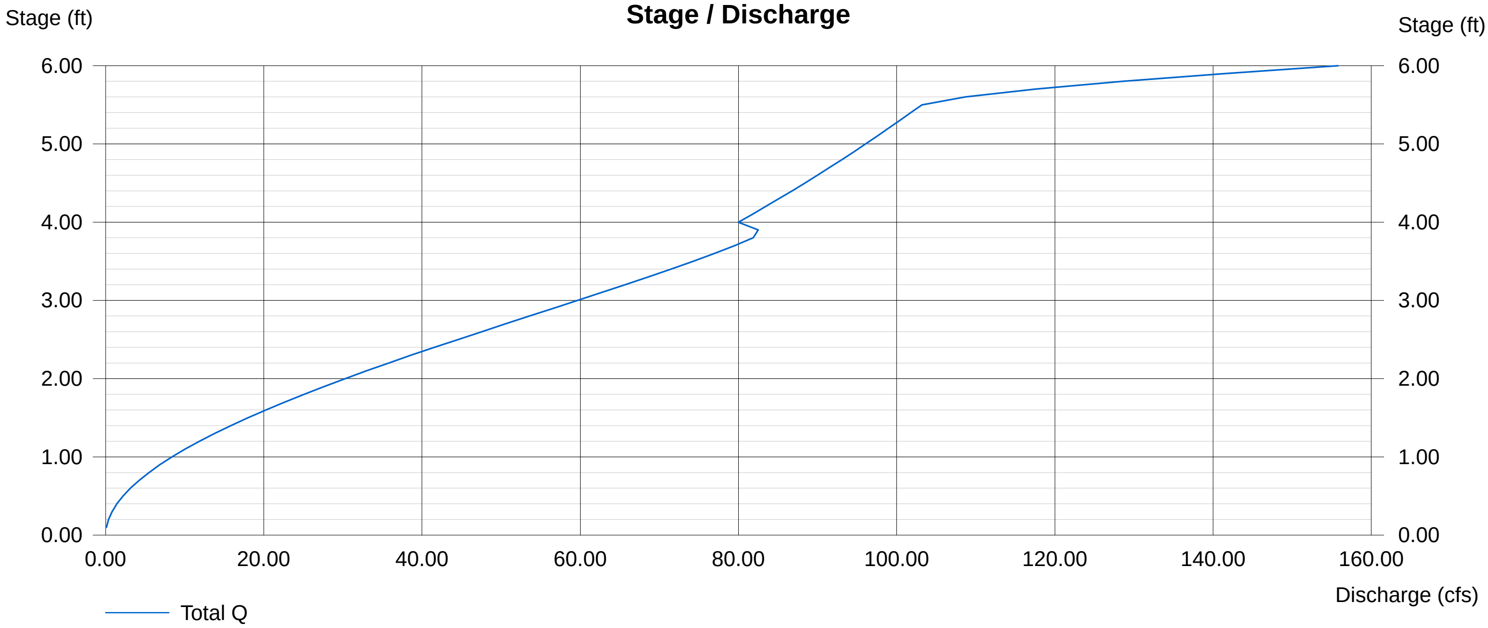
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 50.00	0.00	0.00	0.00
Crest El. (ft)	= 5697.50	0.00	0.00	0.00
Weir Coeff.	= 2.60	0.00	0.00	0.00
Weir Type	= Broad	---	---	---
Multi-Stage	= No	No	No	No

Exfiltration = 0.000 in/hr (Contour) Tailwater Elev. = 0.00 ft

Note: Culvert/Orifice outflows have been analyzed under inlet and outlet control.

Stage / Discharge



Pond Report

Pond No. 1 - Swale G1.8

Pond Data

Pond storage is based on known contour areas. Average end area method used.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	5689.00	706	0	0
1.00	5690.00	8,766	4,736	4,736
2.00	5691.00	11,018	9,892	14,628
3.00	5692.00	13,306	12,162	26,790
4.00	5693.00	15,646	14,476	41,266
5.00	5694.00	18,041	16,844	58,110
6.00	5695.00	21,000	19,521	77,630
7.00	5696.00	24,000	22,500	100,130

Culvert / Orifice Structures

	[A]	[B]	[C]	[D]
Rise (in)	= 42.00	0.00	0.00	0.00
Span (in)	= 42.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 5689.00	0.00	0.00	0.00
Length (ft)	= 150.00	0.00	0.00	0.00
Slope (%)	= 0.50	0.00	0.00	0.00
N-Value	= .013	.000	.000	.000
Orif. Coeff.	= 0.60	0.00	0.00	0.00
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 50.00	0.00	0.00	0.00
Crest El. (ft)	= 5694.00	0.00	0.00	0.00
Weir Coeff.	= 2.60	0.00	0.00	0.00
Weir Type	= Broad	---	---	---
Multi-Stage	= No	No	No	No

Exfiltration = 0.000 in/hr (Contour) Tailwater Elev. = 0.00 ft

Note: Culvert/Orifice outflows have been analyzed under inlet and outlet control.

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Total cfs
0.00	0	5689.00	0.00	---	---	---	0.00	---	---	---	---	0.00
1.00	4,736	5690.00	7.75	---	---	---	0.00	---	---	---	---	7.75
2.00	14,628	5691.00	26.13	---	---	---	0.00	---	---	---	---	26.13
3.00	26,790	5692.00	41.32	---	---	---	0.00	---	---	---	---	41.32
4.00	41,266	5693.00	55.97	---	---	---	0.00	---	---	---	---	55.97
5.00	58,110	5694.00	75.09	---	---	---	0.00	---	---	---	---	75.09
6.00	77,630	5695.00	90.25	---	---	---	130.00	---	---	---	---	220.25
7.00	100,130	5696.00	103.20	---	---	---	367.70	---	---	---	---	470.90

Pond Report

Pond No. 3 - Pond G1

Pond Data

Pond storage is based on known contour areas. Average end area method used.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	5686.00	48,284	0	0
1.00	5687.00	51,208	49,746	49,746
2.00	5688.00	54,210	52,709	102,455
3.00	5689.00	57,244	55,727	158,182
4.00	5690.00	60,334	58,789	216,971
5.00	5691.00	63,481	61,908	278,879
6.00	5692.00	66,687	65,084	343,963
7.00	5693.00	69,994	68,341	412,303

Culvert / Orifice Structures

		[A]	[B]	[C]	[D]
Rise (in)	=	0.00	48.00	0.00	0.00
Span (in)	=	0.00	48.00	0.00	0.00
No. Barrels	=	0	1	0	0
Invert El. (ft)	=	0.00	5686.00	0.00	0.00
Length (ft)	=	0.00	320.00	0.00	0.00
Slope (%)	=	0.00	0.40	0.00	0.00
N-Value	=	.013	.013	.000	.000
Orif. Coeff.	=	0.60	0.60	0.00	0.00
Multi-Stage	=	n/a	No	No	No

Weir Structures

		[A]	[B]	[C]	[D]
Crest Len (ft)	=	0.00	0.00	0.00	0.00
Crest El. (ft)	=	0.00	0.00	0.00	0.00
Weir Coeff.	=	0.00	3.33	0.00	0.00
Weir Type	=	---	---	---	---
Multi-Stage	=	No	No	No	No

Exfiltration = 0.000 in/hr (Contour) Tailwater Elev. = 0.00 ft

Note: Culvert/Orifice outflows have been analyzed under inlet and outlet control.

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Total cfs
0.00	0	5686.00	---	0.00	---	---	---	---	---	---	---	0.00
1.00	49,746	5687.00	---	8.38	---	---	---	---	---	---	---	8.38
2.00	102,455	5688.00	---	30.31	---	---	---	---	---	---	---	30.31
3.00	158,182	5689.00	---	55.67	---	---	---	---	---	---	---	55.67
4.00	216,971	5690.00	---	65.12	---	---	---	---	---	---	---	65.12
5.00	278,879	5691.00	---	86.91	---	---	---	---	---	---	---	86.91
6.00	343,963	5692.00	---	104.24	---	---	---	---	---	---	---	104.24
7.00	412,303	5693.00	---	119.08	---	---	---	---	---	---	---	119.08

Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

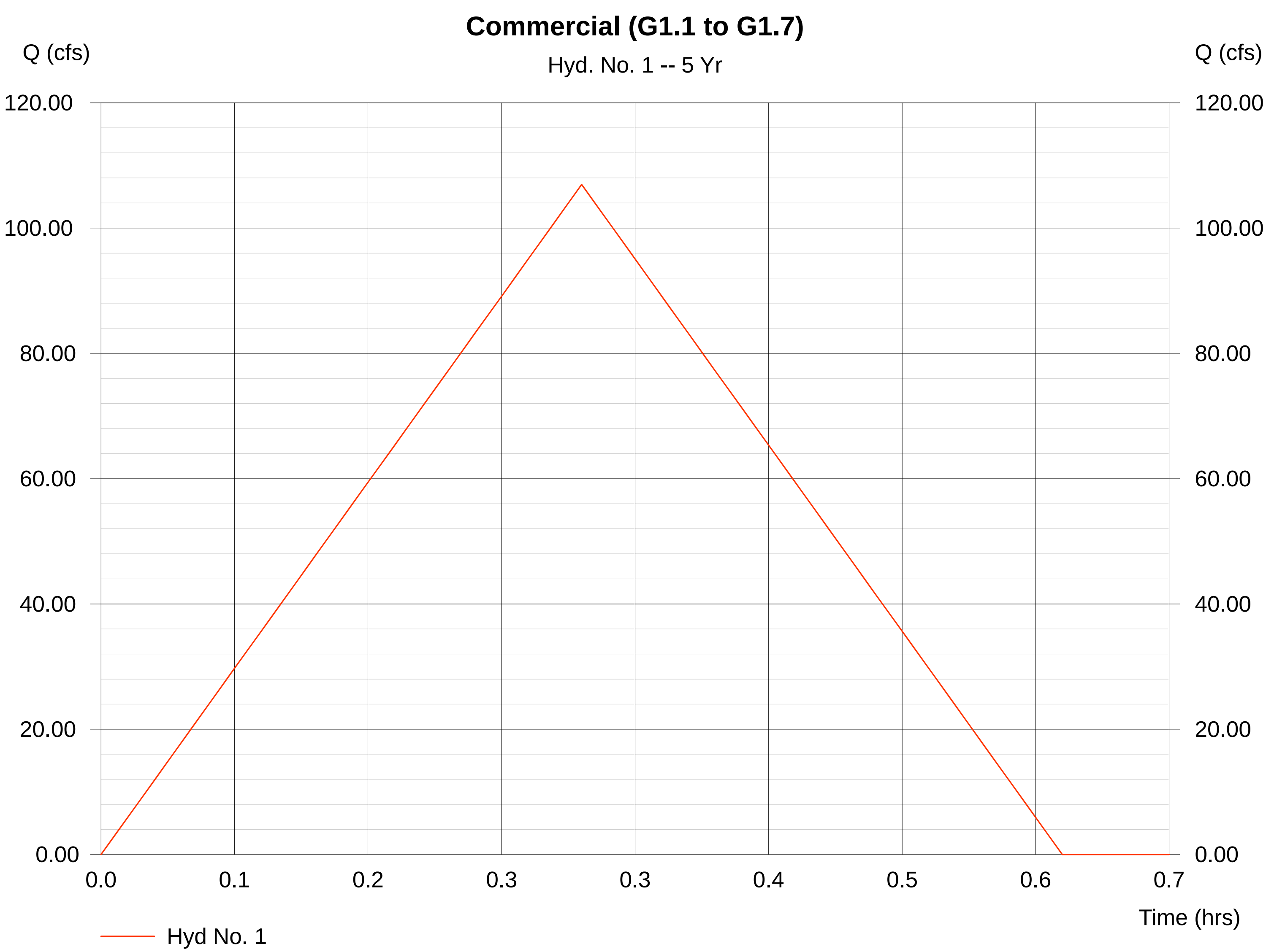
Sunday, Oct 2 2016, 8:28 AM

Hyd. No. 1

Commercial (G1.1 to G1.7)

Hydrograph type	= Rational	Peak discharge	= 106.94 cfs
Storm frequency	= 5 yrs	Time interval	= 1 min
Drainage area	= 41.460 ac	Runoff coeff.	= 0.81
Intensity	= 3.184 in/hr	Tc by User	= 18.00 min
IDF Curve	= Colorado Springs-El Paso County-Table.IDF	Asc/Rec limb fact	= 1/1

Hydrograph Volume = 115,493 cuft



Hydrograph Plot

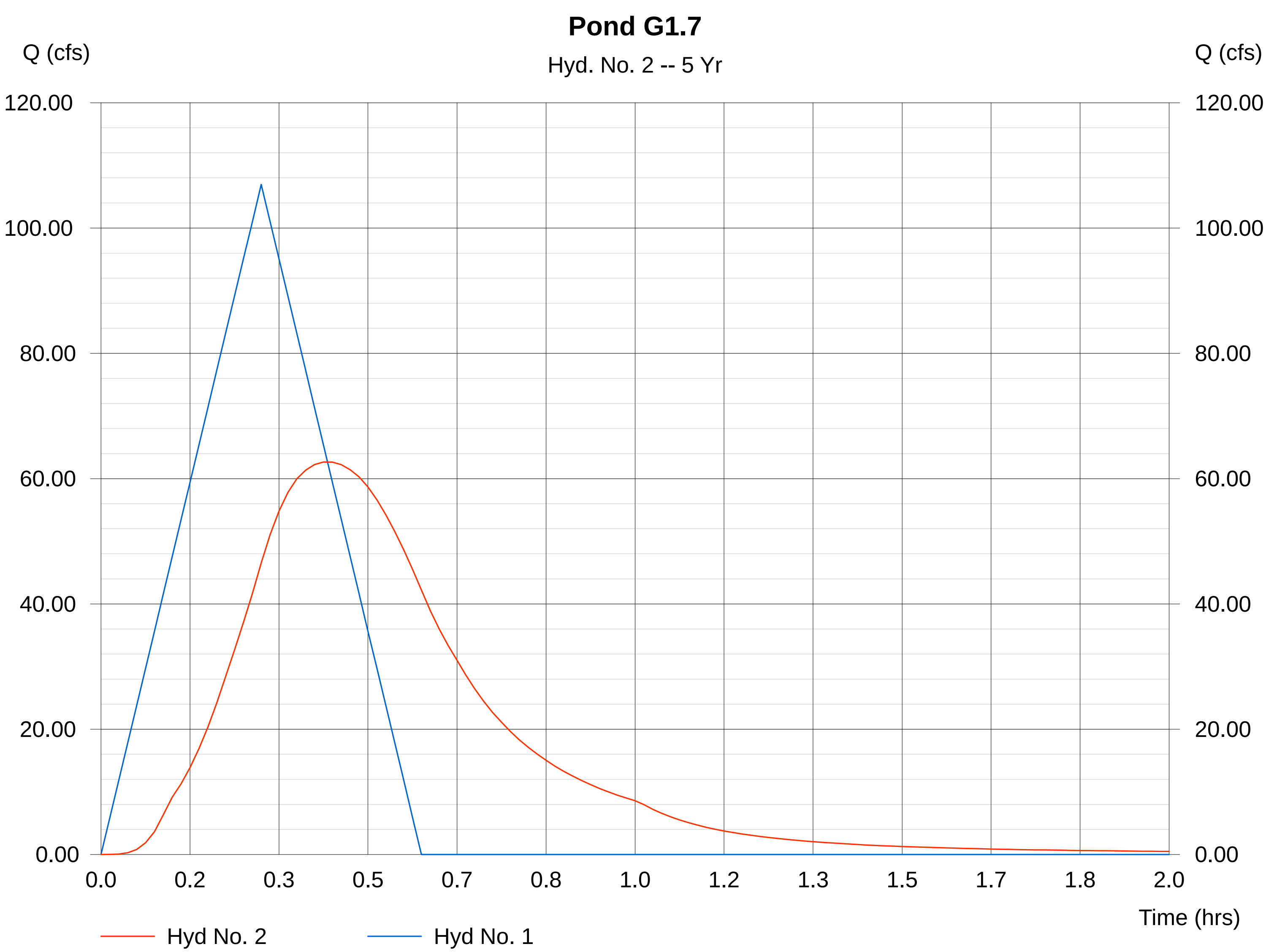
Hydraflow Hydrographs by Intelisolve — Sunday, Oct 2 2016, 8:28 AM

Hyd. No. 2

Pond G1.7

Hydrograph type	= Reservoir	Peak discharge	= 62.65 cfs
Storm frequency	= 5 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 5695.10 ft
Reservoir name	= Pond G1.7	Max. Storage	= 53,518 cuft

Storage Indication method used. — Hydrograph Volume = 115,483 cuft



Hydrograph Plot

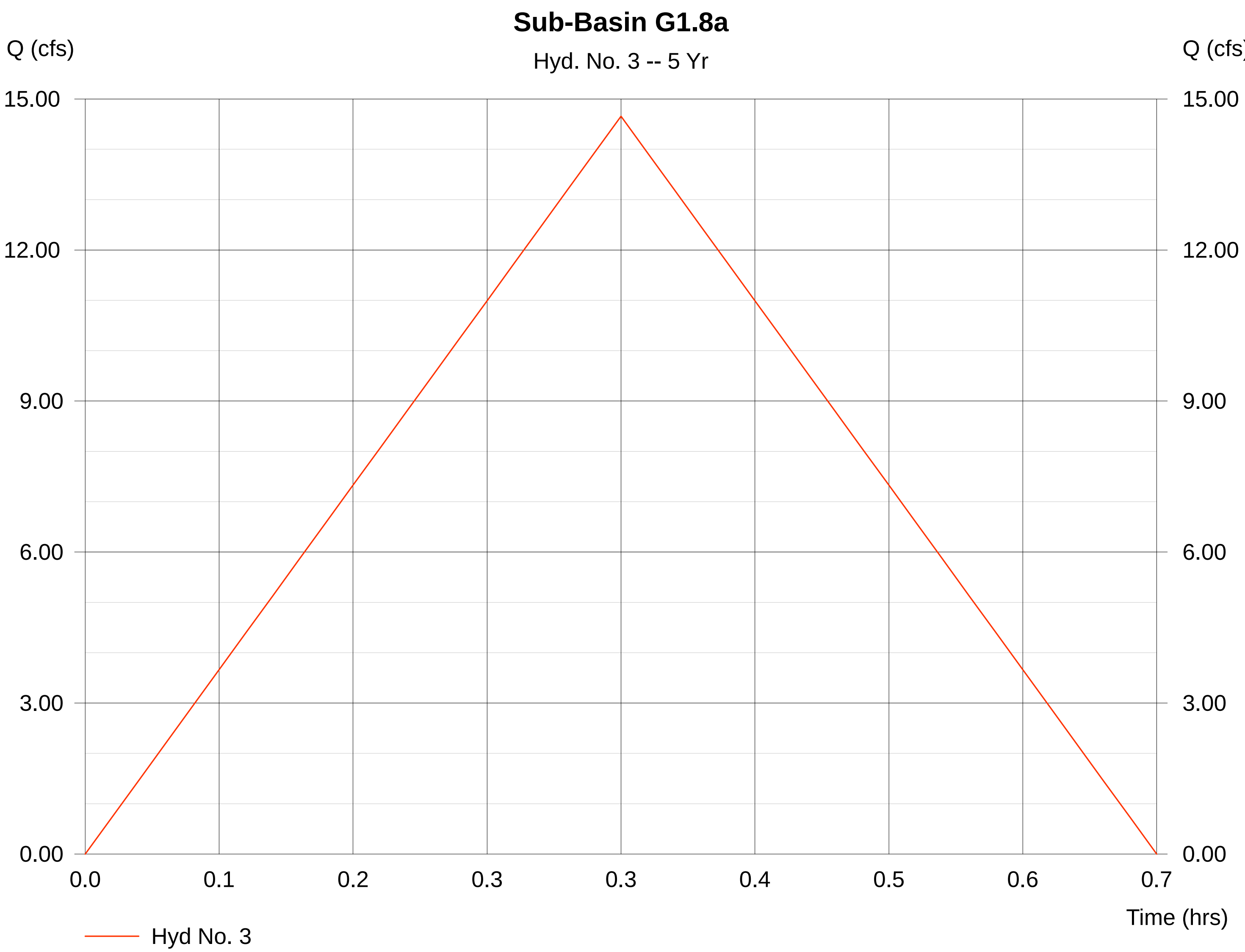
Hydraflow Hydrographs by Intelisolve | Sunday, Oct 2 2016, 8:28 AM

Hyd. No. 3

Sub-Basin G1.8a

Hydrograph type	= Rational	Peak discharge	= 14.66 cfs
Storm frequency	= 5 yrs	Time interval	= 1 min
Drainage area	= 9.160 ac	Runoff coeff.	= 0.53
Intensity	= 3.019 in/hr	Tc by User	= 20.00 min
IDF Curve	= Colorado Springs-El Paso County-Table.IDF	Asc/Rec limb fact	= 1/1

Hydrograph Volume = 17,588 cuft



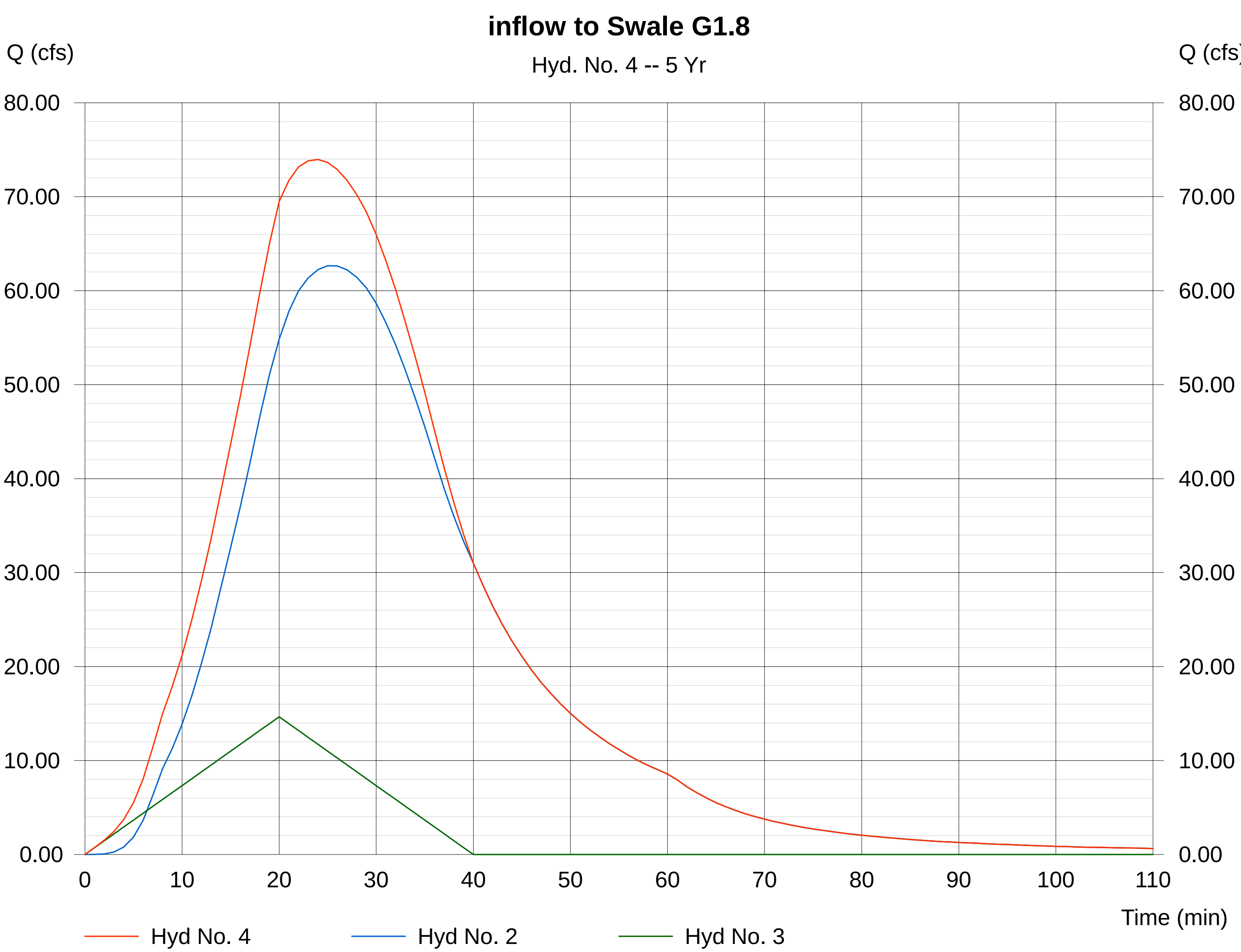
Hydrograph Plot

Hyd. No. 4

inflow to Swale G1.8

Hydrograph type	= Combine	Peak discharge	= 73.96 cfs
Storm frequency	= 5 yrs	Time interval	= 1 min
Inflow hyds.	= 2, 3		

Hydrograph Volume = 133,070 cuft



Hydrograph Plot

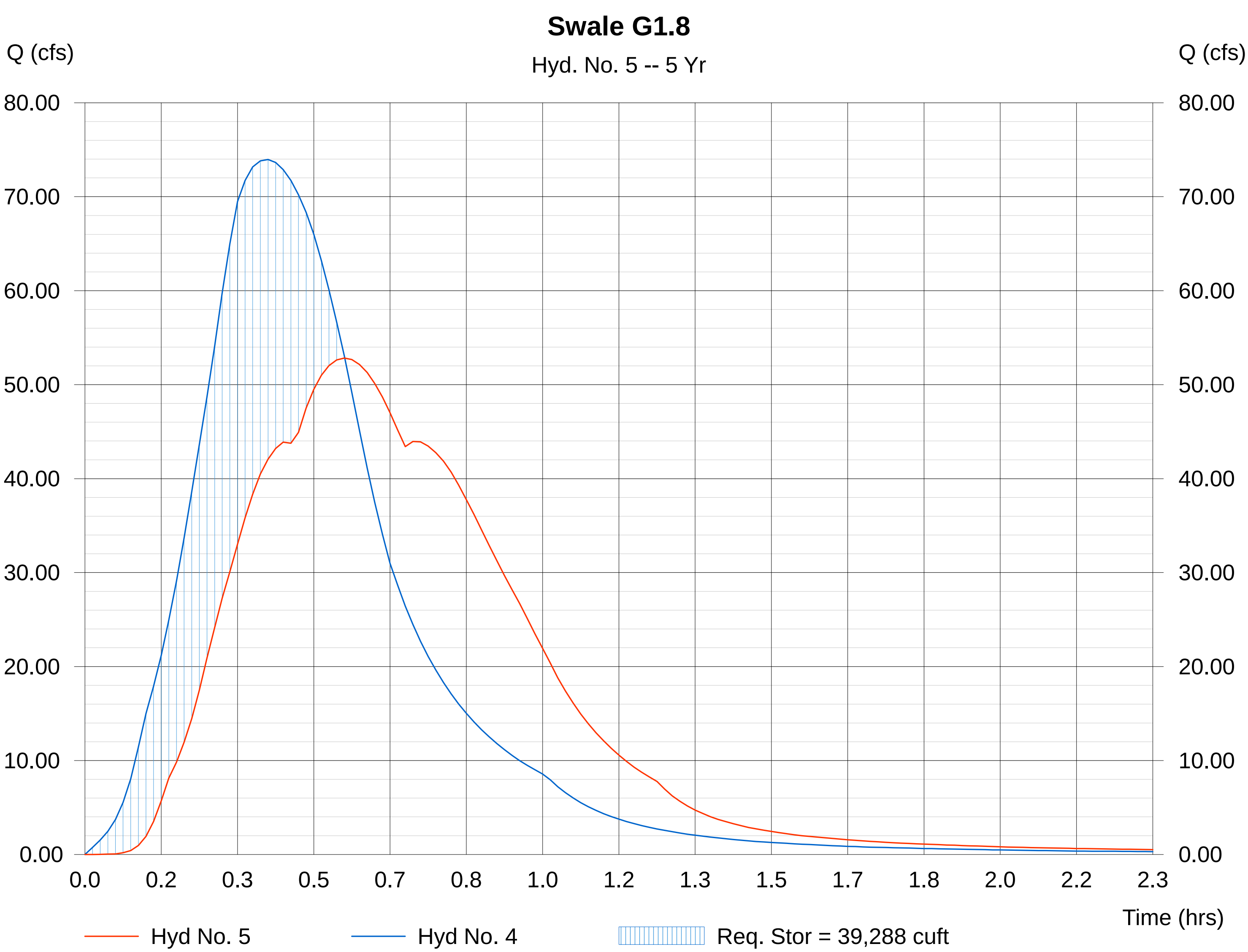
Hydraflow Hydrographs by Intelisolve — Wednesday, Jan 25 2017, 8:2 AM

Hyd. No. 5

Swale G1.8

Hydrograph type	= Reservoir	Peak discharge	= 52.83 cfs
Storm frequency	= 5 yrs	Time interval	= 1 min
Inflow hyd. No.	= 4	Max. Elevation	= 5692.86 ft
Reservoir name	= Pond G1.8	Max. Storage	= 39,288 cuft

Storage Indication method used. — Hydrograph Volume = 133,065 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve | Sunday, Oct 2 2016, 8:28 AM

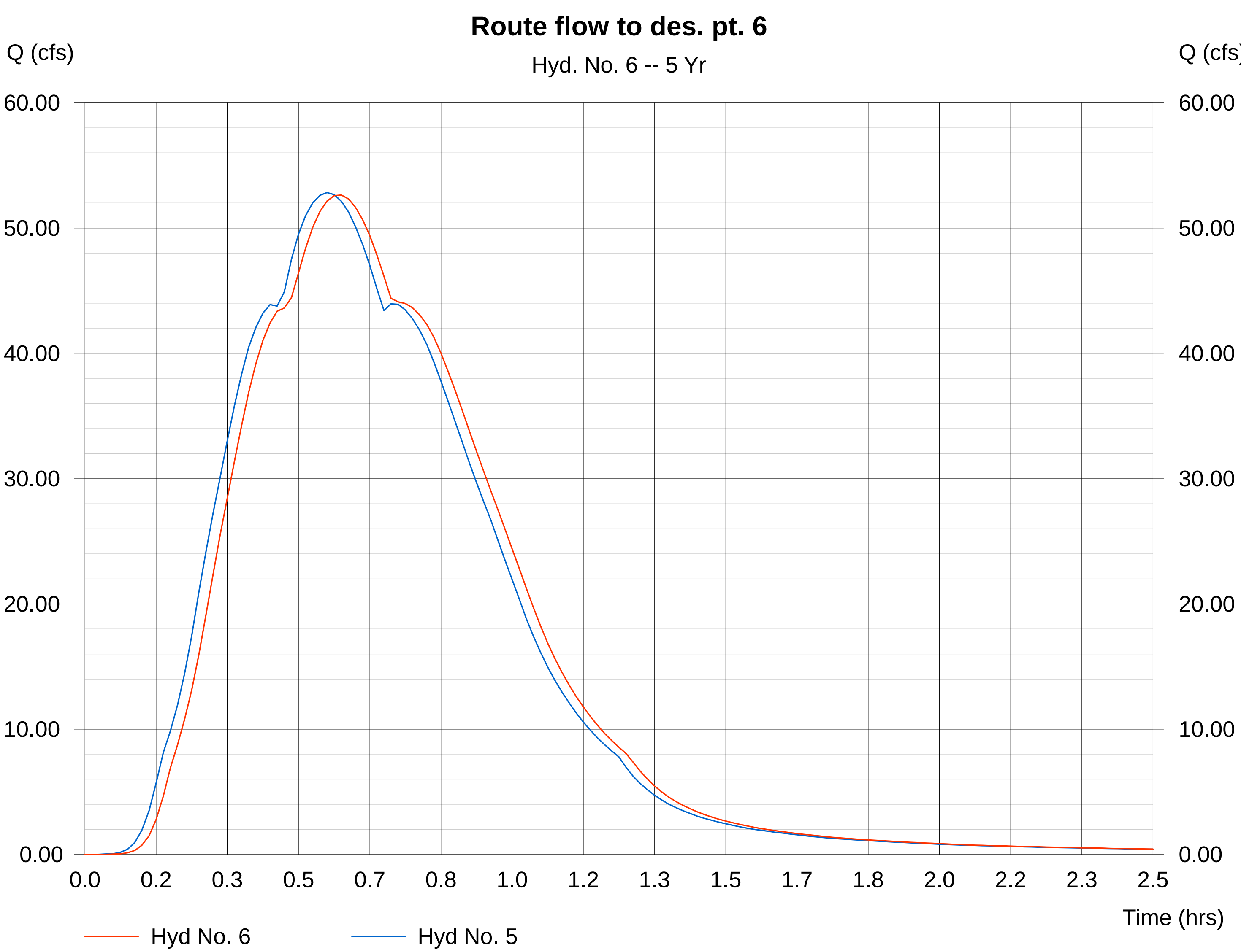
Hyd. No. 6

Route flow to des. pt. 6

Hydrograph type	= Reach	Peak discharge	= 52.64 cfs
Storm frequency	= 5 yrs	Time interval	= 1 min
Inflow hyd. No.	= 5	Section type	= Trapezoidal
Reach length	= 256.0 ft	Channel slope	= 0.3 %
Manning's n	= 0.024	Bottom width	= 5.0 ft
Side slope	= 3.0:1	Max. depth	= 4.0 ft
Rating curve x	= 1.162	Rating curve m	= 1.334
Ave. velocity	= 3.02 ft/s	Routing coeff.	= 0.6417

Modified Att-Kin routing method used.

Hydrograph Volume = 132,976 cuft



Hydrograph Plot

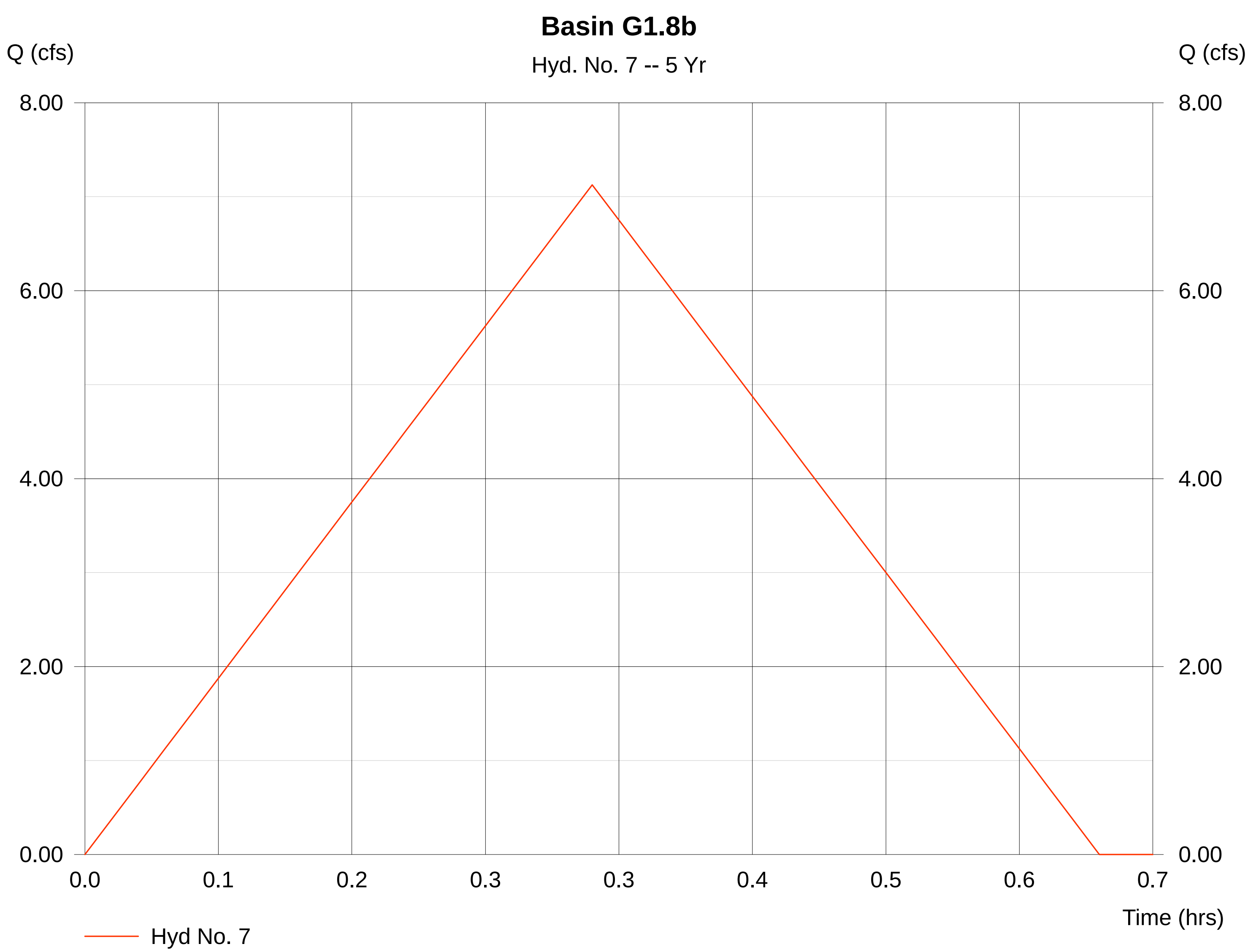
Hydraflow Hydrographs by Intelisolve — Sunday, Oct 2 2016, 8:28 AM

Hyd. No. 7

Basin G1.8b

Hydrograph type	= Rational	Peak discharge	= 7.126 cfs
Storm frequency	= 5 yrs	Time interval	= 1 min
Drainage area	= 5.110 ac	Runoff coeff.	= 0.45
Intensity	= 3.099 in/hr	Tc by User	= 19.00 min
IDF Curve	= Colorado Springs-El Paso County-Table.IDF	Asc/Rec limb fact	= 1/1

Hydrograph Volume = 8,124 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

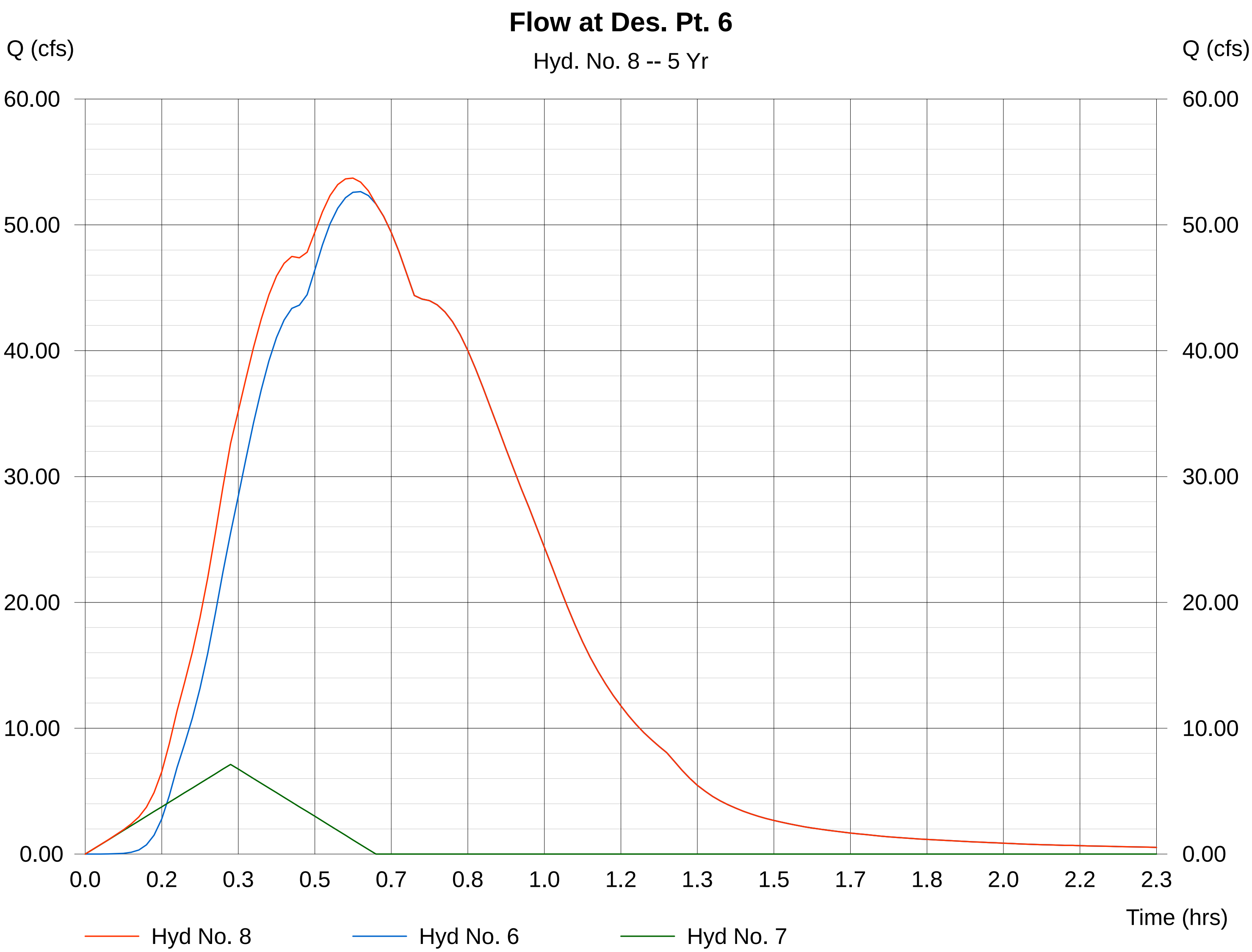
Sunday, Oct 2 2016, 8:28 AM

Hyd. No. 8

Flow at Des. Pt. 6

Hydrograph type	= Combine	Peak discharge	= 53.71 cfs
Storm frequency	= 5 yrs	Time interval	= 1 min
Inflow hyds.	= 6, 7		

Hydrograph Volume = 141,100 cuft



Hydrograph Plot

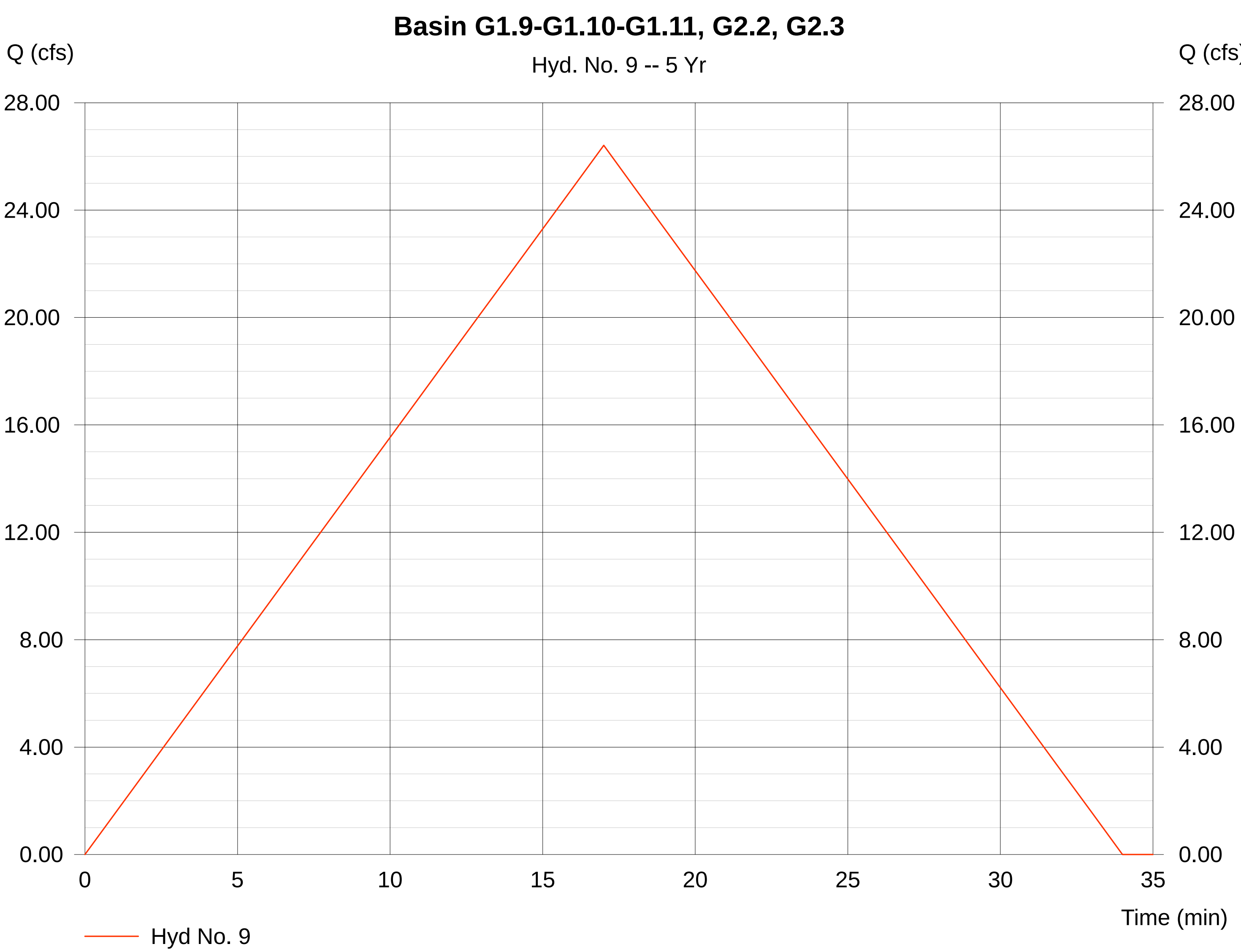
Hydraflow Hydrographs by Intelisolve　　Monday, Feb 20 2017, 2:25 PM

Hyd. No. 9

Basin G1.9-G1.10-G1.11, G2.2, G2.3

Hydrograph type	= Rational	Peak discharge	= 26.41 cfs
Storm frequency	= 5 yrs	Time interval	= 1 min
Drainage area	= 16.800 ac	Runoff coeff.	= 0.48
Intensity	= 3.275 in/hr	Tc by User	= 17.00 min
IDF Curve	= Colorado Springs-El Paso County-Table.IDF	Asc/Rec limb fact	= 1/1

Hydrograph Volume = 26,940 cuft



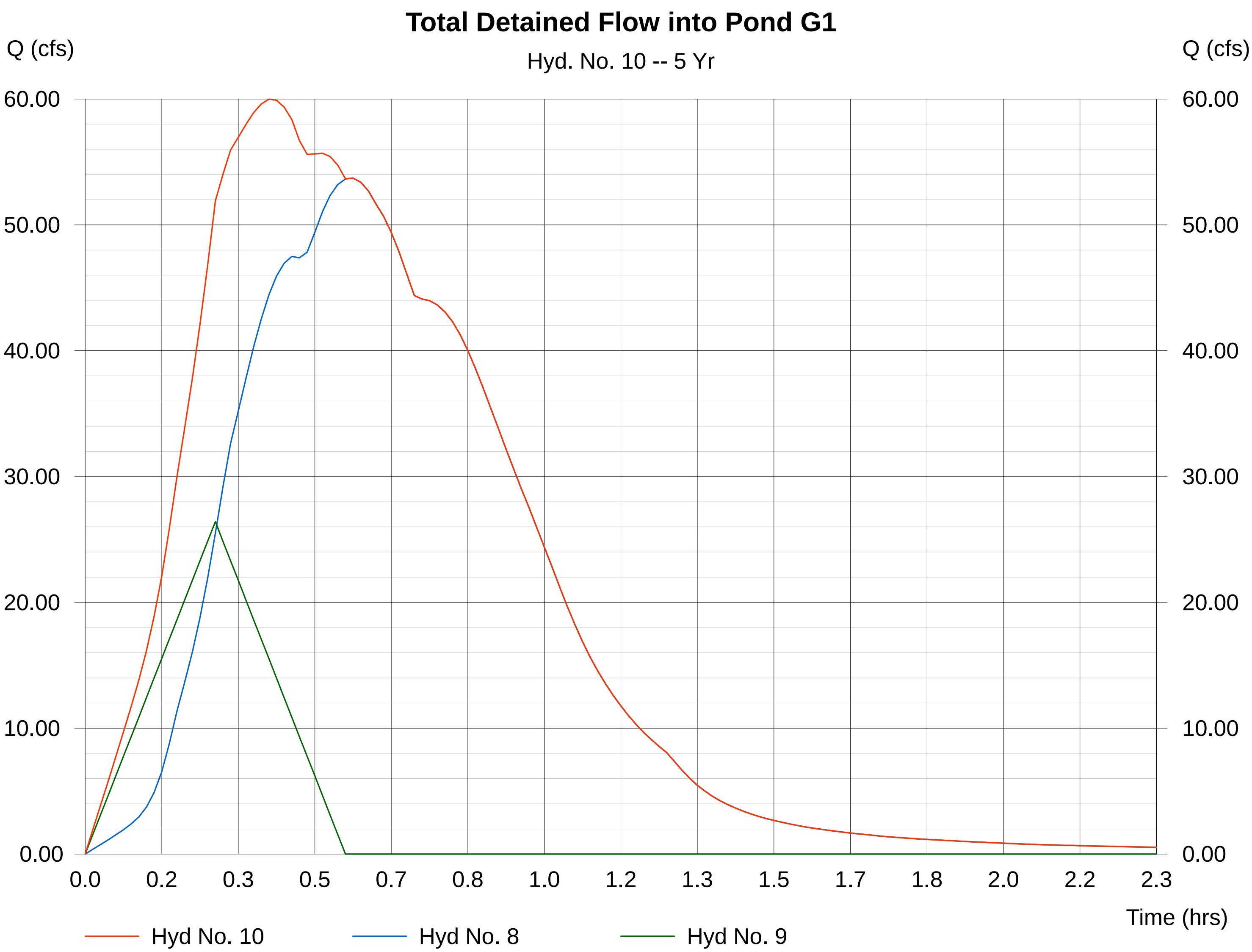
Hydrograph Plot

Hyd. No. 10

Total Detained Flow into Pond G1

Hydrograph type	= Combine	Peak discharge	= 59.98 cfs
Storm frequency	= 5 yrs	Time interval	= 1 min
Inflow hyds.	= 8, 9		

Hydrograph Volume = 168,040 cuft



Hydrograph Plot

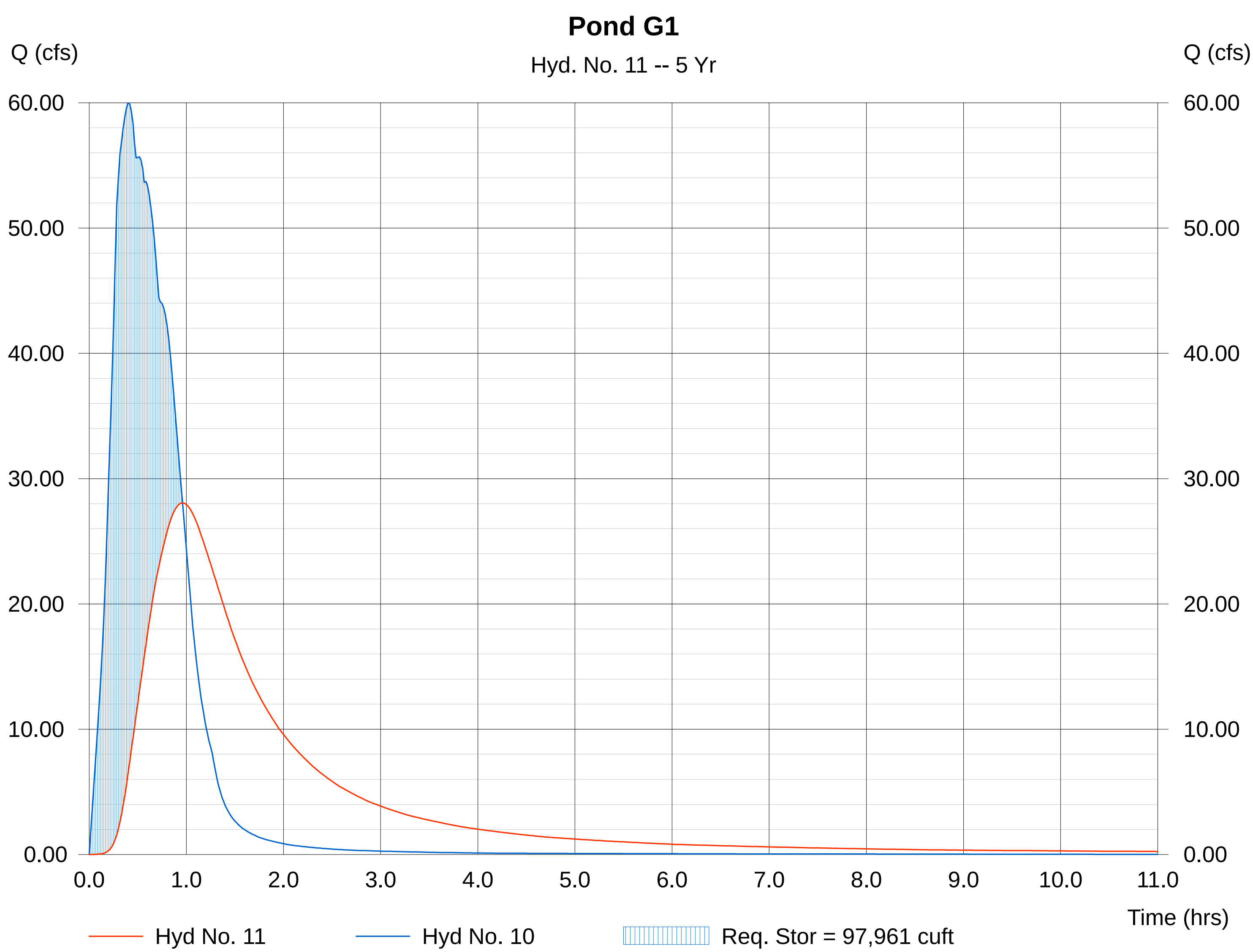
Hydraflow Hydrographs by Intelisolve — Monday, Feb 20 2017, 2:26 PM

Hyd. No. 11

Pond G1

Hydrograph type	= Reservoir	Peak discharge	= 28.06 cfs
Storm frequency	= 5 yrs	Time interval	= 1 min
Inflow hyd. No.	= 10	Max. Elevation	= 5687.92 ft
Reservoir name	= Pond G1	Max. Storage	= 97,961 cuft

Storage Indication method used. — Hydrograph Volume = 167,438 cuft



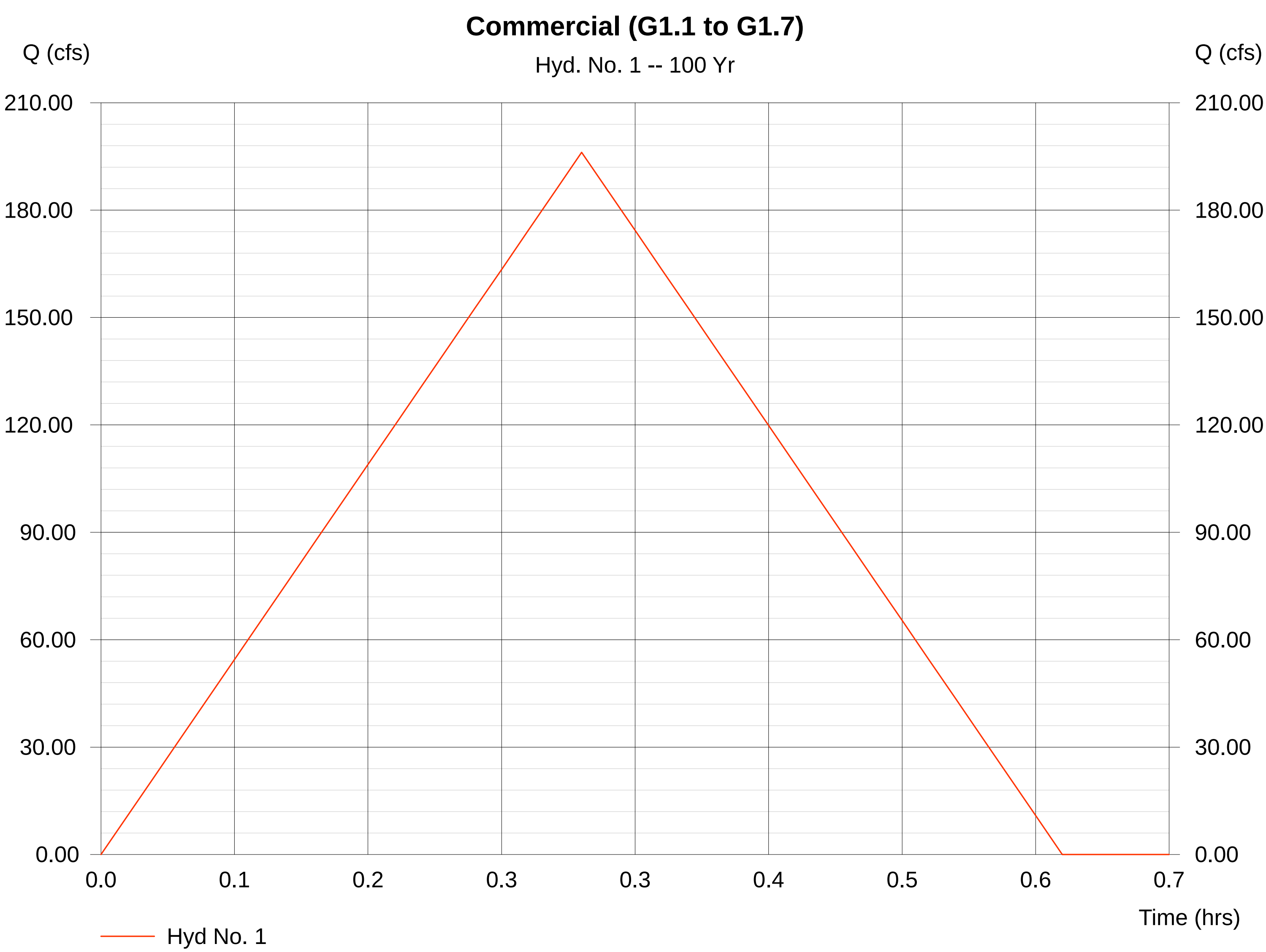
Hydrograph Plot

Hyd. No. 1

Commercial (G1.1 to G1.7)

Hydrograph type	= Rational	Peak discharge	= 196.13 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Drainage area	= 41.400 ac	Runoff coeff.	= 0.84
Intensity	= 5.640 in/hr	Tc by User	= 18.00 min
IDF Curve	= Colorado Springs-El Paso County-Table.IDF	Asc/Rec limb fact	= 1/1

Hydrograph Volume = 211,821 cuft



Hydrograph Plot

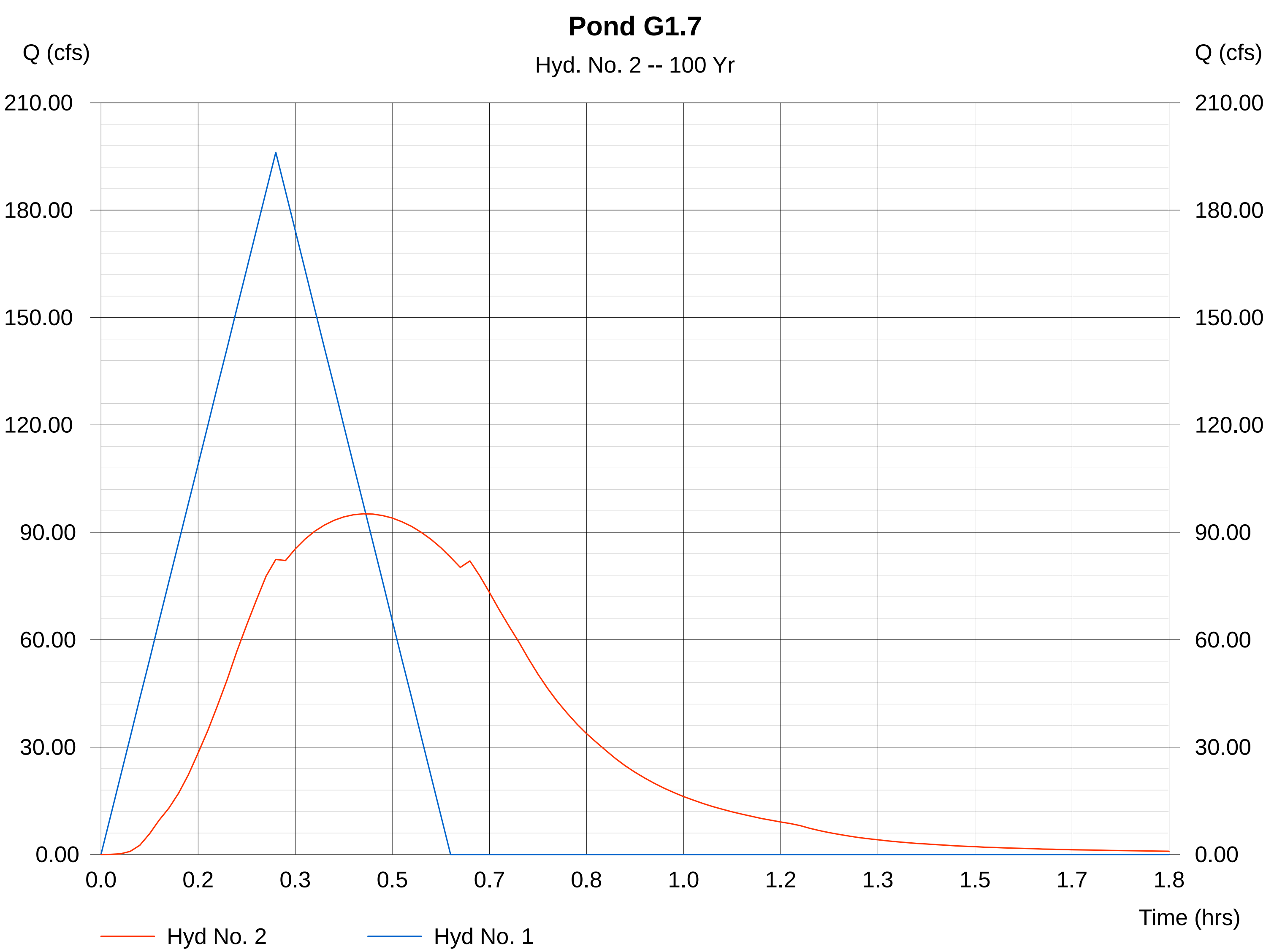
Hyd. No. 2

Pond G1.7

Hydrograph type	= Reservoir	Peak discharge	= 95.15 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 5696.94 ft
Reservoir name	= Pond G1.7	Max. Storage	= 104,641 cuft

Storage Indication method used.

Hydrograph Volume = 211,811 cuft



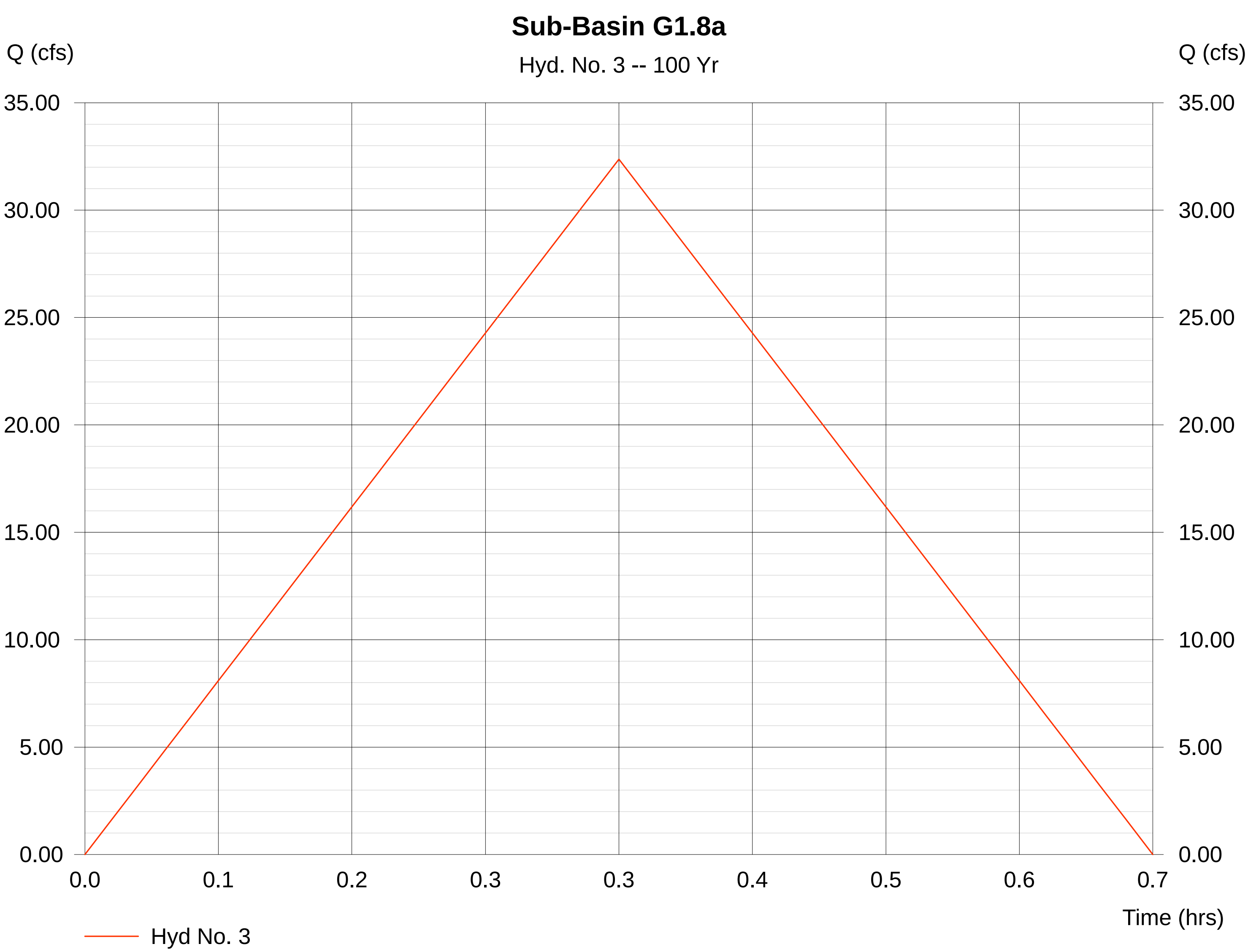
Hydrograph Plot

Hyd. No. 3

Sub-Basin G1.8a

Hydrograph type	=	Rational	Peak discharge	=	32.37 cfs
Storm frequency	=	100 yrs	Time interval	=	1 min
Drainage area	=	9.160 ac	Runoff coeff.	=	0.66
Intensity	=	5.355 in/hr	Tc by User	=	20.00 min
IDF Curve	=	Colorado Springs-El Paso County-Table.IDF	Asc/Rec limb fact	=	1/1

Hydrograph Volume = 38,846 cuft



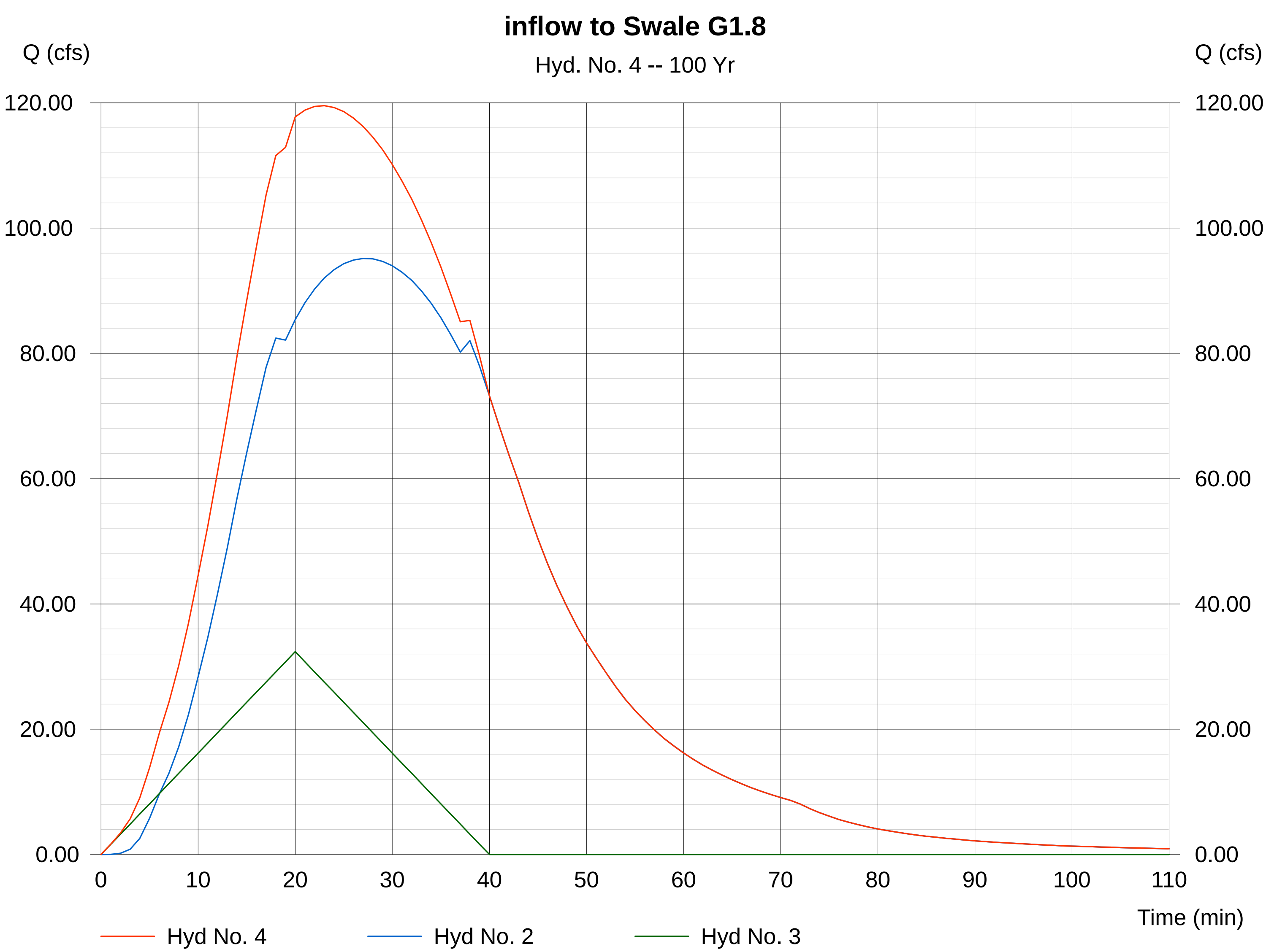
Hydrograph Plot

Hyd. No. 4

inflow to Swale G1.8

Hydrograph type	= Combine	Peak discharge	= 119.53 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Inflow hyds.	= 2, 3		

Hydrograph Volume = 250,657 cuft



Hydrograph Plot

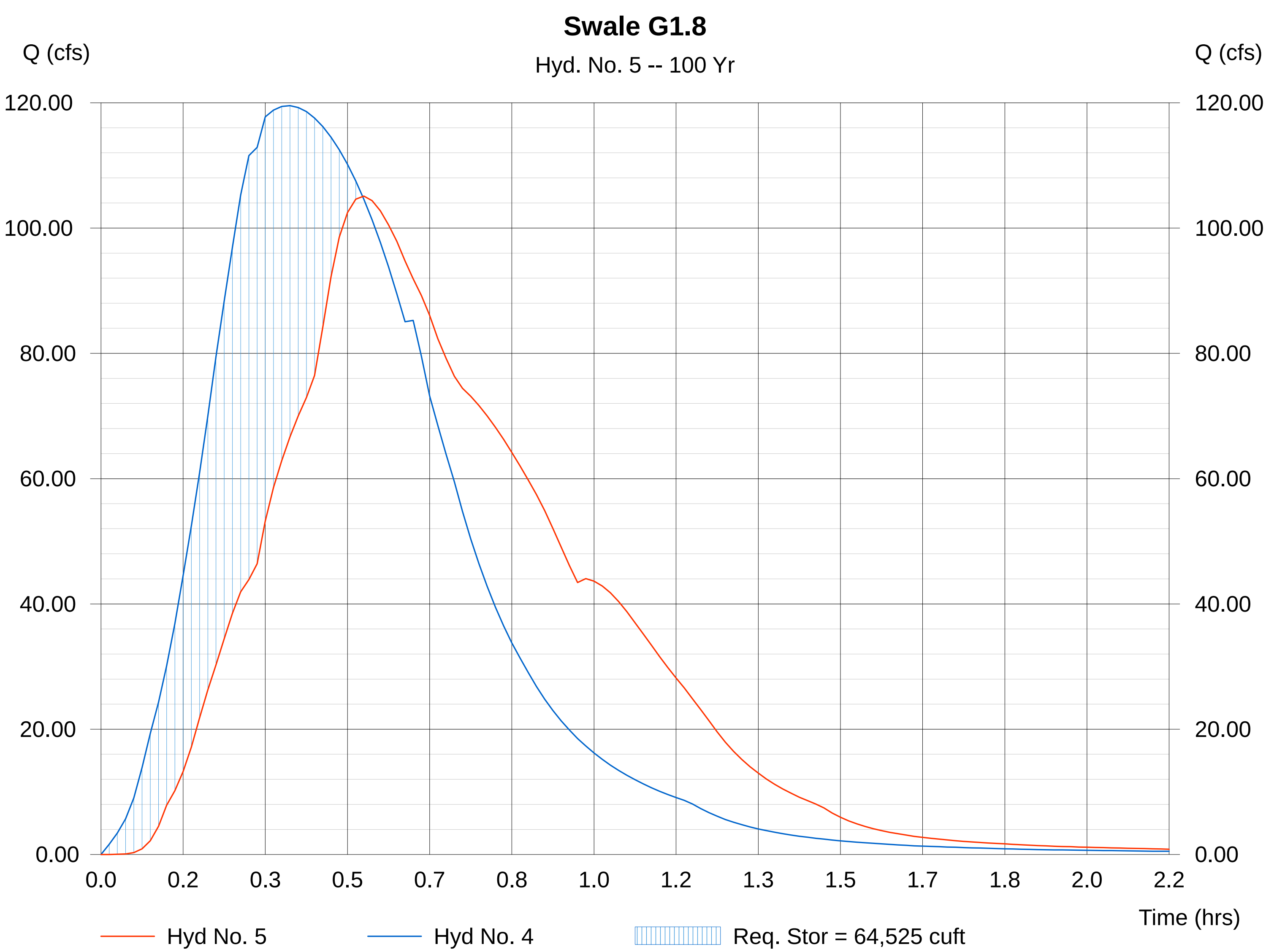
Hydraflow Hydrographs by Intelisolve — Wednesday, Jan 25 2017, 7:59 AM

Hyd. No. 5

Swale G1.8

Hydrograph type	= Reservoir	Peak discharge	= 105.09 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Inflow hyd. No.	= 4	Max. Elevation	= 5694.33 ft
Reservoir name	= Swale G1.8	Max. Storage	= 64,525 cuft

Storage Indication method used. — Hydrograph Volume = 250,651 cuft



Hydrograph Plot

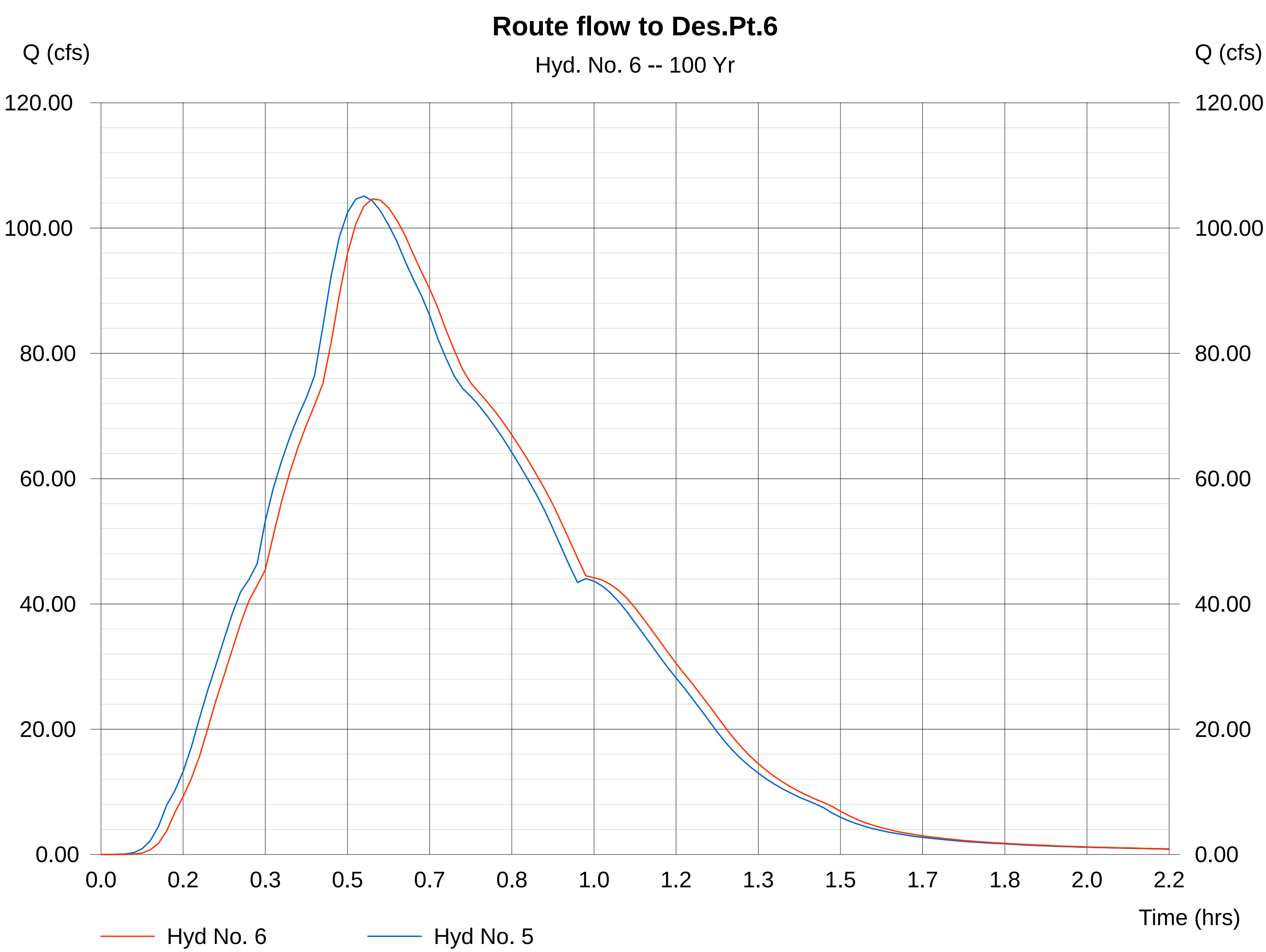
Hyd. No. 6

Route flow to Des.Pt.6

Hydrograph type	= Reach	Peak discharge	= 104.64 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Inflow hyd. No.	= 5	Section type	= Trapezoidal
Reach length	= 256.0 ft	Channel slope	= 0.3 %
Manning's n	= 0.024	Bottom width	= 5.0 ft
Side slope	= 3.0:1	Max. depth	= 4.0 ft
Rating curve x	= 1.162	Rating curve m	= 1.334
Ave. velocity	= 3.59 ft/s	Routing coeff.	= 0.7189

Modified Att-Kin routing method used.

Hydrograph Volume = 250,563 cuft



Hydrograph Plot

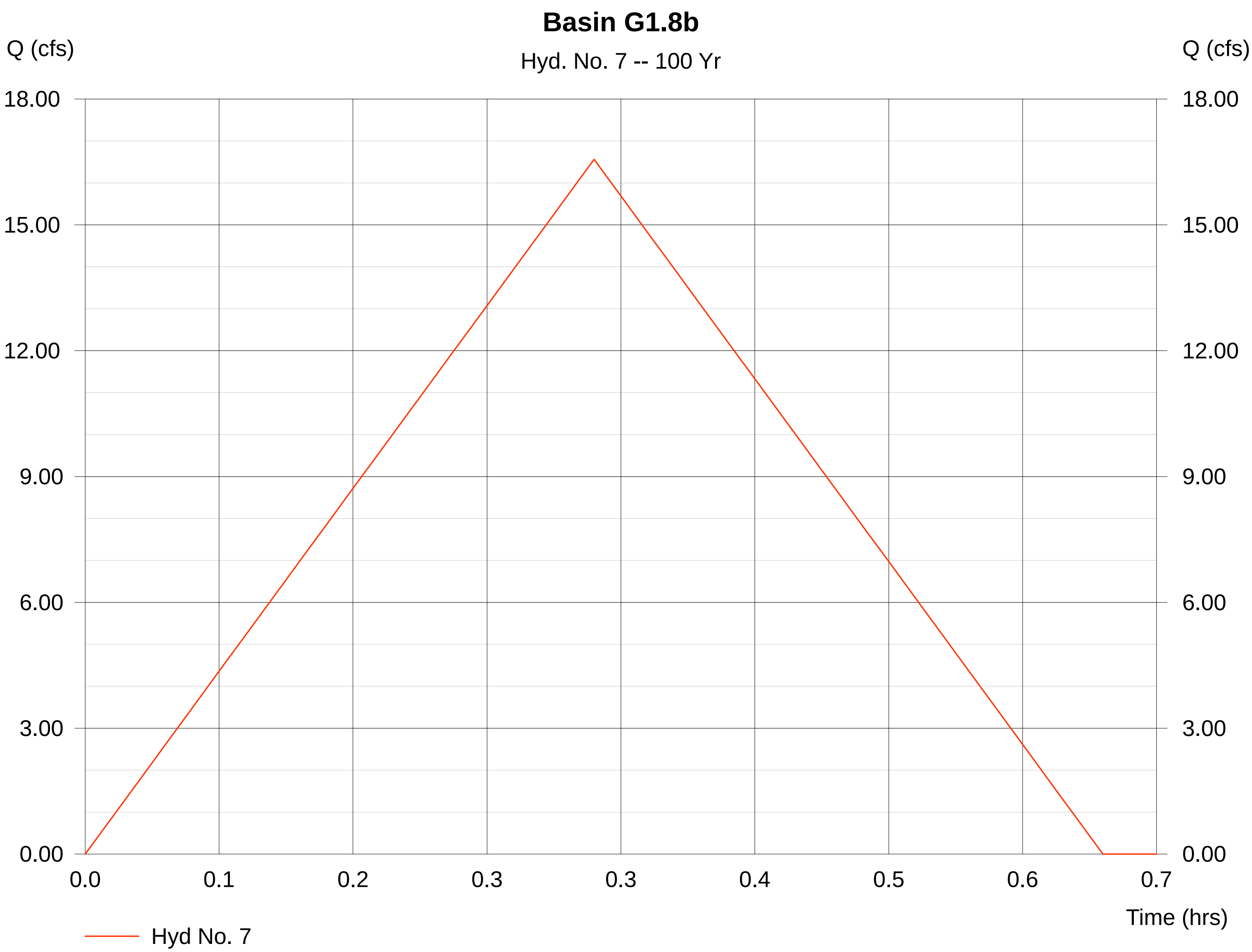
Hydraflow Hydrographs by Intelisolve | Sunday, Oct 2 2016, 8:6 AM

Hyd. No. 7

Basin G1.8b

Hydrograph type	= Rational	Peak discharge	= 16.56 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Drainage area	= 5.110 ac	Runoff coeff.	= 0.59
Intensity	= 5.493 in/hr	Tc by User	= 19.00 min
IDF Curve	= Colorado Springs-El Paso County-Table.IDF	Asc/Rec limb fact	= 1/1

Hydrograph Volume = 18,879 cuft



Hydrograph Plot

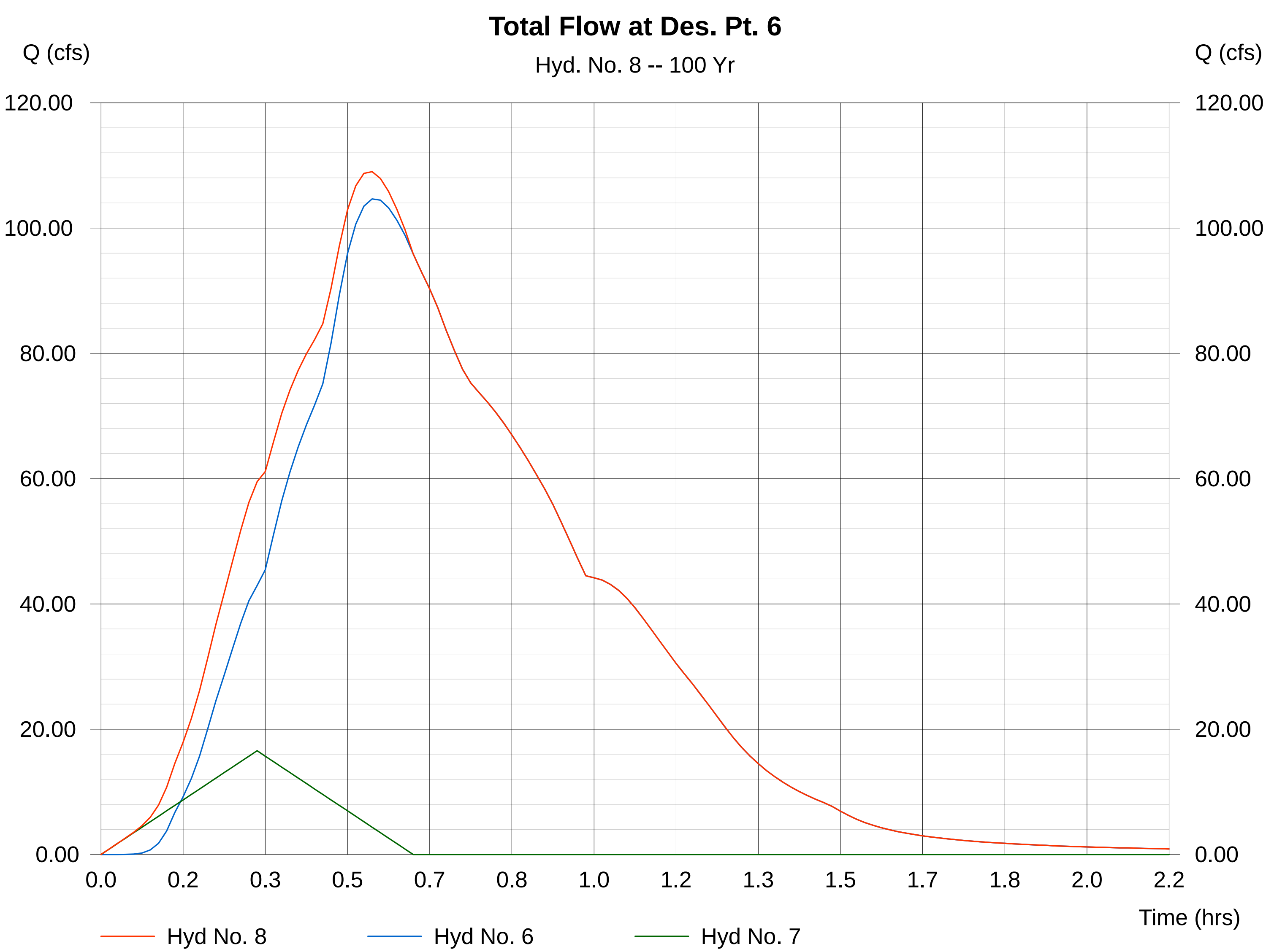
Hydraflow Hydrographs by Intelisolve — Sunday, Oct 2 2016, 8:6 AM

Hyd. No. 8

Total Flow at Des. Pt. 6

Hydrograph type	= Combine	Peak discharge	= 109.00 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Inflow hyds.	= 6, 7		

Hydrograph Volume = 269,442 cuft



Hydrograph Plot

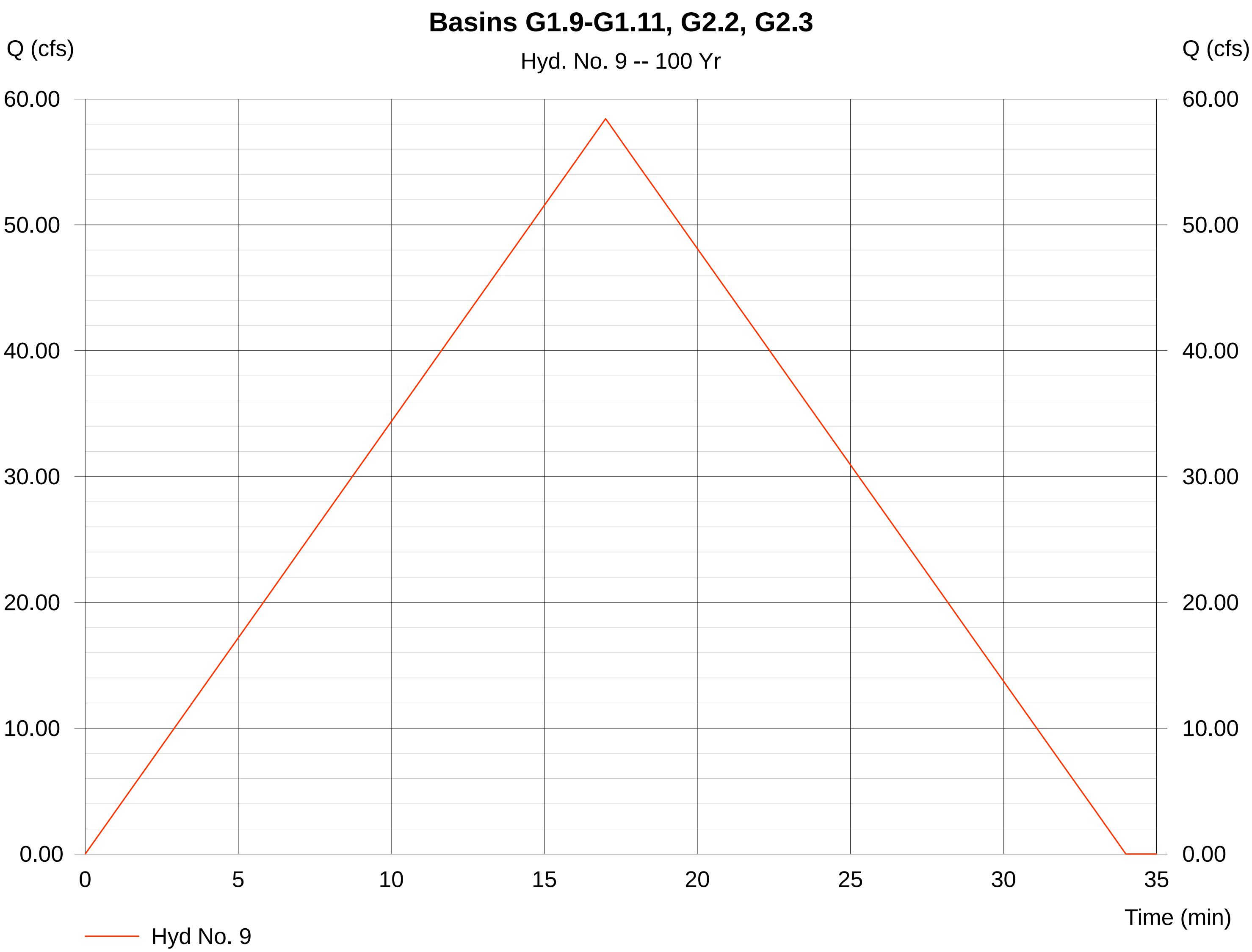
Hydraflow Hydrographs by Intelisolve — Monday, Feb 20 2017, 2:30 PM

Hyd. No. 9

Basins G1.9-G1.11, G2.2, G2.3

Hydrograph type	= Rational	Peak discharge	= 58.42 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Drainage area	= 16.800 ac	Runoff coeff.	= 0.6
Intensity	= 5.796 in/hr	Tc by User	= 17.00 min
IDF Curve	= Colorado Springs-El Paso County-Table.IDF	Asc/Rec limb fact	= 1/1

Hydrograph Volume = 59,593 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

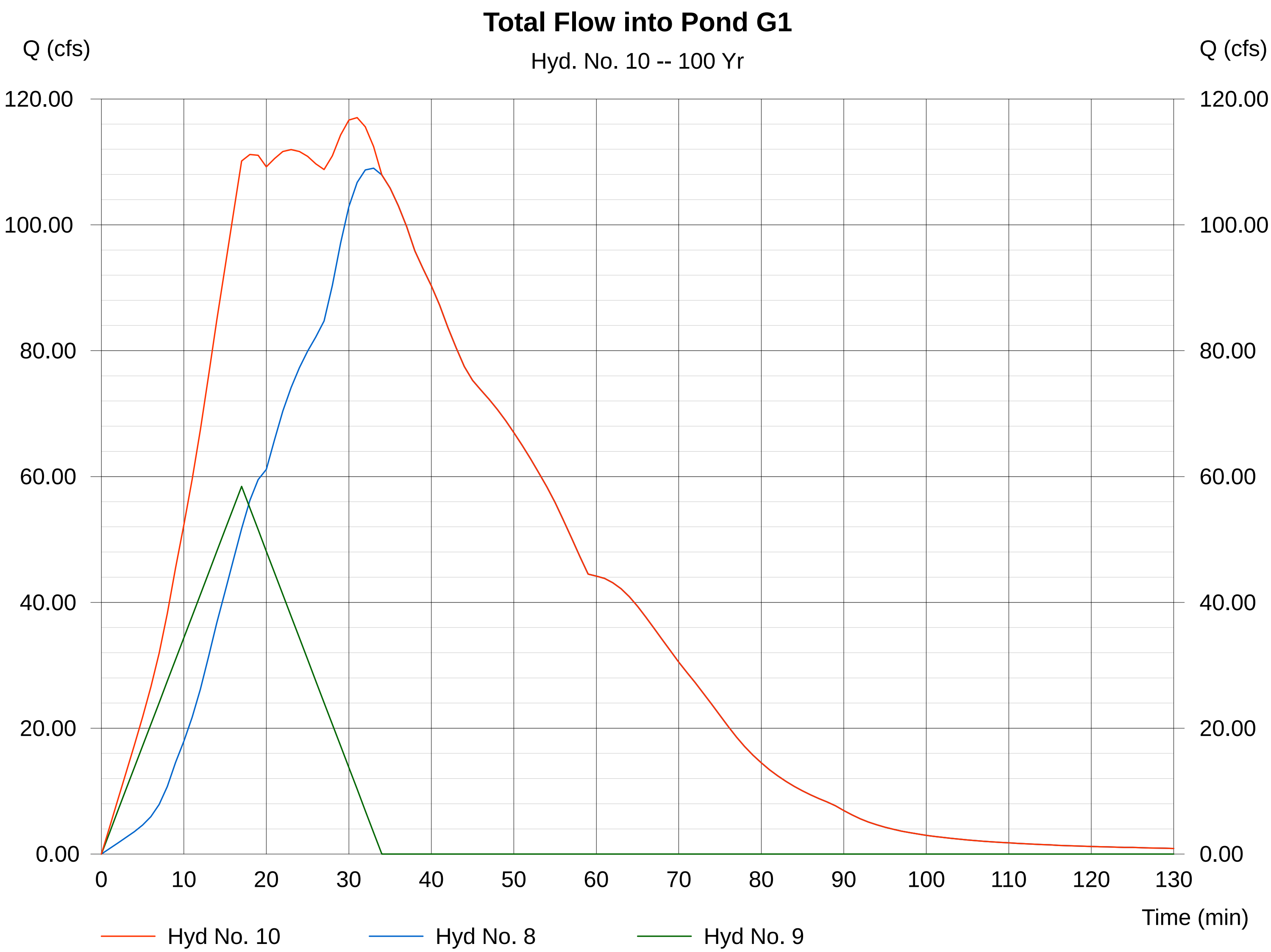
Monday, Feb 20 2017, 2:30 PM

Hyd. No. 10

Total Flow into Pond G1

Hydrograph type	= Combine	Peak discharge	= 117.04 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Inflow hyds.	= 8, 9		

Hydrograph Volume = 329,035 cuft



Hydrograph Plot

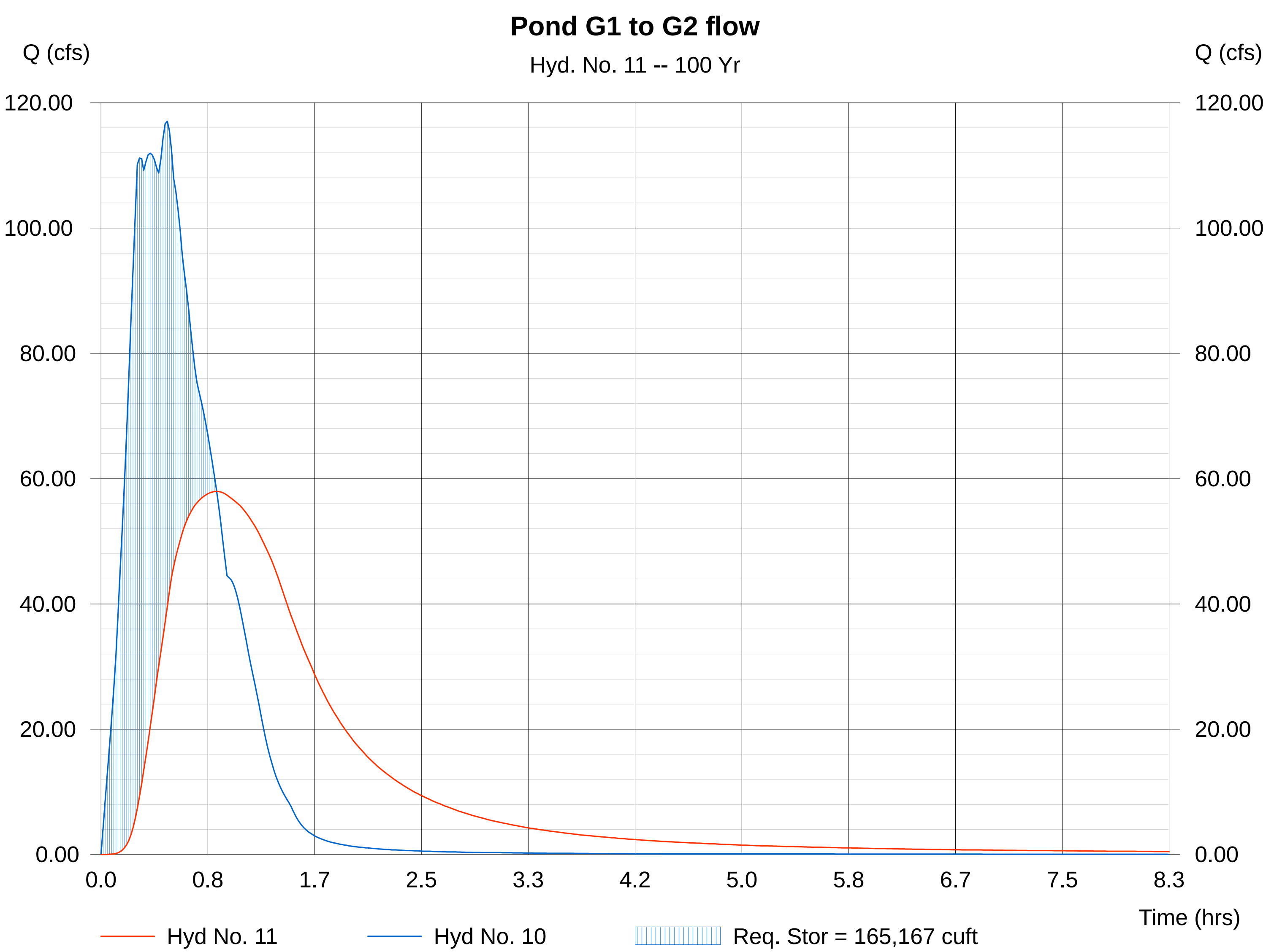
Hyd. No. 11

Pond G1 to G2 flow

Hydrograph type	= Reservoir	Peak discharge	= 57.96 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Inflow hyd. No.	= 10	Max. Elevation	= 5689.12 ft
Reservoir name	= Pond G1	Max. Storage	= 165,167 cuft

Storage Indication method used.

Hydrograph Volume = 328,418 cuft

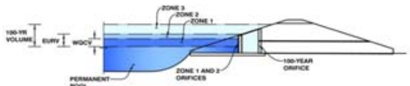


DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Carriage Meadows South at Lorson Ranch

Basin ID: Pond G1/G2 Full Spectrum Detention (v3.07)



Example Zone Configuration (Retention Pond)

Required Volume Calculation

			Optional User Override 1-hr Precipitation	
Selected BMP Type =	**EDB**			
Watershed Area =	96.00	acres		
Watershed Length =	3,730	ft		
Watershed Slope =	0.008	ft/ft		
Watershed Imperviousness =	79.00%	percent		
Percentage Hydrologic Soil Group A =	46.0%	percent		
Percentage Hydrologic Soil Group B =	23.0%	percent		
Percentage Hydrologic Soil Groups C/D =	31.0%	percent		
Desired WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			
Water Quality Capture Volume (WQCV) =	2.577	acre-feet		
Excess Urban Runoff Volume (EURV) =	8.814	acre-feet		
2-yr Runoff Volume (P1 = 1.16 in.) =	6.842	acre-feet	1.16	inches
5-yr Runoff Volume (P1 = 1.44 in.) =	8.912	acre-feet	1.44	inches
10-yr Runoff Volume (P1 = 1.68 in.) =	10.804	acre-feet	1.68	inches
25-yr Runoff Volume (P1 = 1.92 in.) =	13.017	acre-feet	1.92	inches
50-yr Runoff Volume (P1 = 2.16 in.) =	14.962	acre-feet	2.16	inches
100-yr Runoff Volume (P1 = 2.42 in.) =	17.363	acre-feet	2.42	inches
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet		inches
Approximate 2-yr Detention Volume =	6.451	acre-feet		
Approximate 5-yr Detention Volume =	8.419	acre-feet		
Approximate 10-yr Detention Volume =	10.033	acre-feet		
Approximate 25-yr Detention Volume =	11.239	acre-feet		
Approximate 50-yr Detention Volume =	11.916	acre-feet		
Approximate 100-yr Detention Volume =	12.731	acre-feet		

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	2.577	acre-feet
Zone 2 Volume (EURV - Zone 1) =	6.236	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	3.918	acre-feet
Total Detention Basin Volume =	12.731	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = 1 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	561	0.013		
5682.33	--	0.33	--	--	--	43,673	1.003	6,866	0.158
5683	--	1.00	--	--	--	47,723	1.096	37,437	0.859
5684	--	2.00	--	--	--	91,223	2.094	106,477	2.444
5685	--	3.00	--	--	--	108,717	2.496	207,357	4.760
5686	--	4.00	--	--	--	116,519	2.675	319,975	7.346
5-yr=5686.69	--	4.69	--	--	--	123,570	2.837	402,805	9.247
5687	--	5.00	--	--	--	126,736	2.909	441,603	10.138
5688	--	6.00	--	--	--	133,533	3.065	571,737	13.125
100-yr=5688.48	--	6.48	--	--	--	138,115	3.171	636,933	14.622
5689	--	7.00	--	--	--	142,697	3.276	709,944	16.298
5690	--	8.00	--	--	--	146,770	3.369	854,678	19.621
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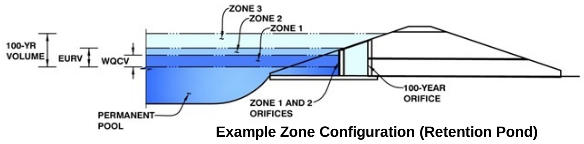
Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project:

Basin ID:



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.06	2.577	Orifice Plate
Zone 2 (EURV)	4.54	6.236	Orifice Plate
Zone 3 (100-year)	5.88	3.918	Weir&Pipe (Restrict)
		12.731	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 =	4.54	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	18.20	inches
Orifice Plate: Orifice Area per Row =	22.12	sq. inches (use rectangular openings)

Calculated Parameters for Plate

WQ Orifice Area per Row =	1.536E-01	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	1.51	3.03					
Orifice Area (sq. inches)	22.12	22.12	22.12					

	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 =	4.15	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00	N/A	feet
Overflow Weir Slope =	6.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	10.00	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 =	5.82	N/A	feet
Over Flow Weir Slope Length =	10.14	N/A	feet
Grate Open Area / 100-yr Orifice Area =	4.02	N/A	should be $\geq$ 4
Overflow Grate Open Area w/o Debris =	28.39	N/A	ft^2
Overflow Grate Open Area w/ Debris =	14.19	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.20	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	36.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	36.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	7.07	N/A	ft^2
Outlet Orifice Centroid =	1.50	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=	8.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	50.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

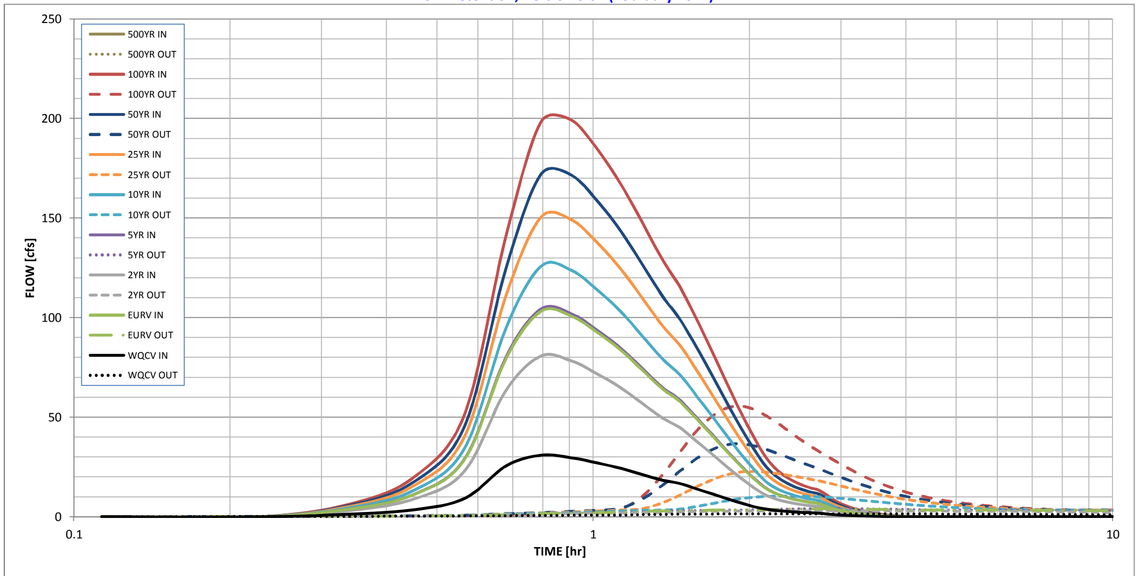
Spillway Design Flow Depth=	1.15	feet
Stage at Top of Freeboard =	10.15	feet
Basin Area at Top of Freeboard =	3.37	acres

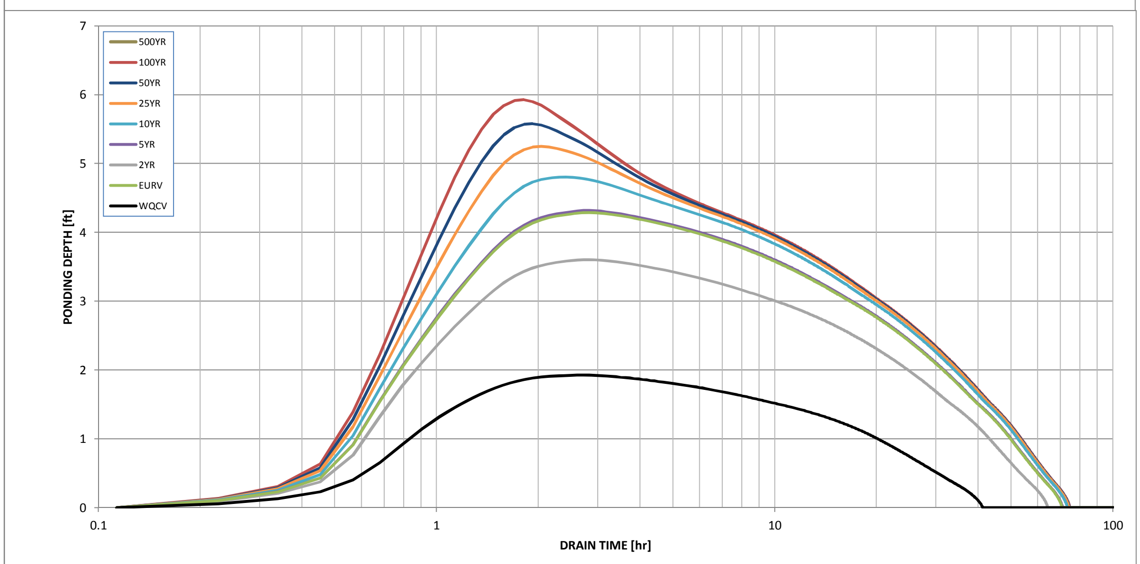
Routed Hydrograph Results

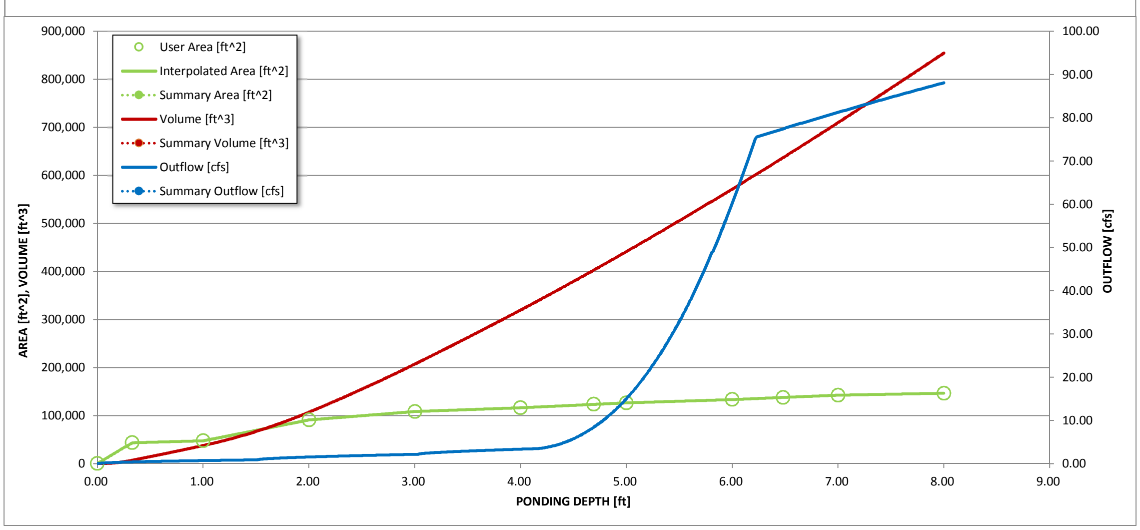
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.16	1.44	1.68	1.92	2.16	2.42	0.00
Calculated Runoff Volume (acre-ft) =	2.577	8.814	6.842	8.912	10.804	13.017	14.962	17.363	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	2.577	8.806	6.841	8.905	10.803	13.008	14.953	17.352	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.03	0.11	0.29	0.44	0.65	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	0.5	2.9	10.2	27.6	42.0	62.5	0.0
Peak Inflow Q (cfs) =	31.0	103.1	80.7	104.3	125.7	150.4	171.9	199.4	#N/A
Peak Outflow Q (cfs) =	1.5	4.0	3.0	4.2	10.4	22.8	36.7	55.6	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.4	1.0	0.8	0.9	0.9	#N/A
Structure Controlling Flow =	Plate	Overflow Grate 1	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	0.01	N/A	0.0	0.2	0.7	1.1	1.8	#N/A
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	62	57	62	63	62	61	60	#N/A
Time to Drain 99% of Inflow Volume (hours) =	**40**	67	61	67	69	69	69	68	#N/A
Maximum Ponding Depth (ft) =	1.93	4.29	3.60	4.32	4.80	5.25	5.58	5.93	#N/A
Area at Maximum Ponding Depth (acres) =	2.01	2.74	2.60	2.75	2.86	2.95	3.00	3.05	#N/A
Maximum Volume Stored (acre-ft) =	2.301	8.104	6.290	8.186	9.532	10.870	11.852	12.881	#N/A

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.

Time Interval	6.79 min
Hydrograph Constant	0.736

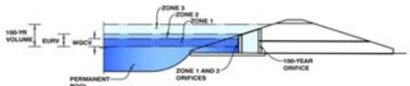
SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	#N/A
TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
0:06:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
0:13:35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
0:20:22	1.32	3.88	3.16	3.92	4.55	5.22	5.77	6.39	#N/A
0:27:10	3.62	11.31	9.03	11.42	13.51	15.83	17.79	20.12	#N/A
0:33:57	9.30	29.04	23.20	29.33	34.71	40.70	45.77	51.81	#N/A
0:40:44	25.52	79.41	63.51	80.20	94.82	111.05	124.78	141.08	#N/A
0:47:32	30.98	103.13	80.70	104.26	125.73	150.37	171.89	198.14	#N/A
0:54:19	29.70	100.96	78.43	102.10	123.94	149.31	171.71	199.37	#N/A
1:01:07	27.03	92.59	71.73	93.65	113.94	137.60	158.55	184.52	#N/A
1:07:54	24.30	83.53	64.68	84.49	102.84	124.24	143.20	166.69	#N/A
1:14:41	21.17	73.49	56.79	74.34	90.61	109.63	126.50	147.43	#N/A
1:21:29	18.43	64.33	49.68	65.08	79.37	96.06	110.88	129.25	#N/A
1:28:16	16.69	57.71	44.67	58.37	71.05	85.83	98.91	115.10	#N/A
1:35:04	13.93	48.87	37.68	49.44	60.39	73.21	84.59	98.73	#N/A
1:41:51	11.51	40.64	31.30	41.12	50.26	60.97	70.49	82.33	#N/A
1:48:38	9.06	32.58	24.99	32.97	40.43	49.19	57.01	66.74	#N/A
1:55:26	6.94	25.41	19.43	25.72	31.60	38.52	44.71	52.43	#N/A
2:02:13	5.13	19.22	14.64	19.45	23.96	29.30	34.11	40.12	#N/A
2:09:01	3.88	14.23	10.89	14.40	17.68	21.63	25.24	29.76	#N/A
2:15:48	3.14	11.31	8.69	11.44	14.00	17.06	19.82	23.26	#N/A
2:22:35	2.65	9.48	7.29	9.59	11.72	14.25	16.52	19.33	#N/A
2:29:23	2.31	8.20	6.32	8.30	10.13	12.29	14.23	16.63	#N/A
2:36:10	2.07	7.31	5.64	7.40	9.02	10.93	12.64	14.75	#N/A
2:42:58	1.90	6.67	5.16	6.75	8.23	9.96	11.50	13.41	#N/A
2:49:45	1.41	5.10	3.90	5.16	6.35	7.75	9.02	10.60	#N/A
2:56:32	1.02	3.68	2.82	3.72	4.57	5.58	6.50	7.65	#N/A
3:03:20	0.75	2.73	2.09	2.76	3.39	4.14	4.82	5.66	#N/A
3:10:07	0.56	2.03	1.55	2.05	2.52	3.07	3.57	4.20	#N/A
3:16:55	0.41	1.50	1.14	1.52	1.86	2.28	2.65	3.11	#N/A
3:23:42	0.29	1.08	0.82	1.10	1.35	1.65	1.92	2.26	#N/A
3:30:29	0.21	0.78	0.60	0.79	0.98	1.19	1.39	1.63	#N/A
3:37:17	0.15	0.56	0.42	0.56	0.70	0.85	1.00	1.18	#N/A
3:44:04	0.09	0.37	0.28	0.37	0.46	0.57	0.67	0.80	#N/A
3:50:52	0.05	0.22	0.16	0.22	0.28	0.34	0.41	0.49	#N/A
3:57:39	0.02	0.11	0.08	0.11	0.14	0.17	0.21	0.26	#N/A
4:04:26	0.00	0.03	0.02	0.03	0.05	0.06	0.08	0.10	#N/A
4:11:14	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	#N/A
4:18:01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:24:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:31:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:38:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:45:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:51:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:58:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:05:33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:12:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:19:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:25:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:32:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:39:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:46:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:53:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:59:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
6:06:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
6:13:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
6:20:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
6:27:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
6:33:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
6:40:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
6:47:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
6:54:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
7:00:59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
7:07:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
7:14:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
7:21:21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
7:28:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
7:34:56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
7:41:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
7:48:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
7:55:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
8:02:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
8:08:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Carriage Meadows South at Lorson Ranch

Basin ID: Full Spectrum Pond G3



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**EDB**				
Watershed Area =	6.02	acres			
Watershed Length =	790	ft			
Watershed Slope =	0.016	ft/ft			
Watershed Imperviousness =	65.00%	percent			
Percentage Hydrologic Soil Group A =	0.0%	percent			
Percentage Hydrologic Soil Group B =	100.0%	percent			
Percentage Hydrologic Soil Groups C/D =	0.0%	percent			
Desired WQCV Drain Time =	40.0	hours			
Location for 1-hr Rainfall Depths =	User Input				
Water Quality Capture Volume (WQCV) =	0.127	acre-feet	Optional User Override 1-hr Precipitation		
Excess Urban Runoff Volume (EURV) =	0.427	acre-feet			
2-yr Runoff Volume (P1 = 1.16 in.) =	0.345	acre-feet		1.16	inches
5-yr Runoff Volume (P1 = 1.44 in.) =	0.454	acre-feet		1.44	inches
10-yr Runoff Volume (P1 = 1.68 in.) =	0.583	acre-feet		1.68	inches
25-yr Runoff Volume (P1 = 1.92 in.) =	0.751	acre-feet		1.92	inches
50-yr Runoff Volume (P1 = 2.16 in.) =	0.873	acre-feet		2.16	inches
100-yr Runoff Volume (P1 = 2.42 in.) =	1.033	acre-feet		2.42	inches
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet			inches
Approximate 2-yr Detention Volume =	0.323	acre-feet			
Approximate 5-yr Detention Volume =	0.426	acre-feet			
Approximate 10-yr Detention Volume =	0.543	acre-feet			
Approximate 25-yr Detention Volume =	0.586	acre-feet			
Approximate 50-yr Detention Volume =	0.610	acre-feet			
Approximate 100-yr Detention Volume =	0.659	acre-feet			

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.127	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.300	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.232	acre-feet
Total Detention Basin Volume =	0.659	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = 0.1 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	10	0.000		
5684	--	1.00	--	--	--	2,000	0.046	985	0.023
5685	--	2.00	--	--	--	7,055	0.162	5,462	0.125
5686	--	3.00	--	--	--	8,627	0.198	13,373	0.307
5687	--	4.00	--	--	--	10,260	0.236	22,817	0.524
5yr=5687.22	--	4.22	--	--	--	10,632	0.244	25,115	0.577
100yr=5687.81	--	4.81	--	--	--	11,628	0.267	31,682	0.727
5688	--	5.00	--	--	--	11,949	0.274	33,922	0.779
5689	--	6.00	--	--	--	14,318	0.329	47,055	1.080
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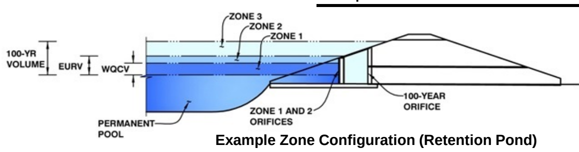
Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Carriage Meadows South at Lorson Ranch

Basin ID: Full Spectrum Pond G3



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.01	0.127	Orifice Plate
Zone 2 (EURV)	3.58	0.300	Rectangular Orifice
Zone 3 (100-year)	4.56	0.232	Weir&Pipe (Restrict)
		0.659	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 =	2.01	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	8.00	inches
Orifice Plate: Orifice Area per Row =	0.61	sq. inches (diameter = 7/8 inch)

Calculated Parameters for Plate

WQ Orifice Area per Row =	4.236E-03	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	0.70	1.40					
Orifice Area (sq. inches)	0.61	0.61	0.61					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected	
Invert of Vertical Orifice =	2.20	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	3.58	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Height =	2.00	N/A	inches
Vertical Orifice Width =	2.00		inches

Calculated Parameters for Vertical Orifice

	Zone 2 Rectangular	Not Selected	
Vertical Orifice Area =	0.03	N/A	ft^2
Vertical Orifice Centroid =	0.08	N/A	feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.58	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	5.00	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 =	3.58	N/A	feet
Over Flow Weir Slope Length =	5.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =		N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	14.00	N/A	ft^2
Overflow Grate Open Area w/ Debris =	7.00	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 =		N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =		N/A	inches
Restrictor Plate Height Above Pipe Invert =			inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

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

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.50	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	30.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

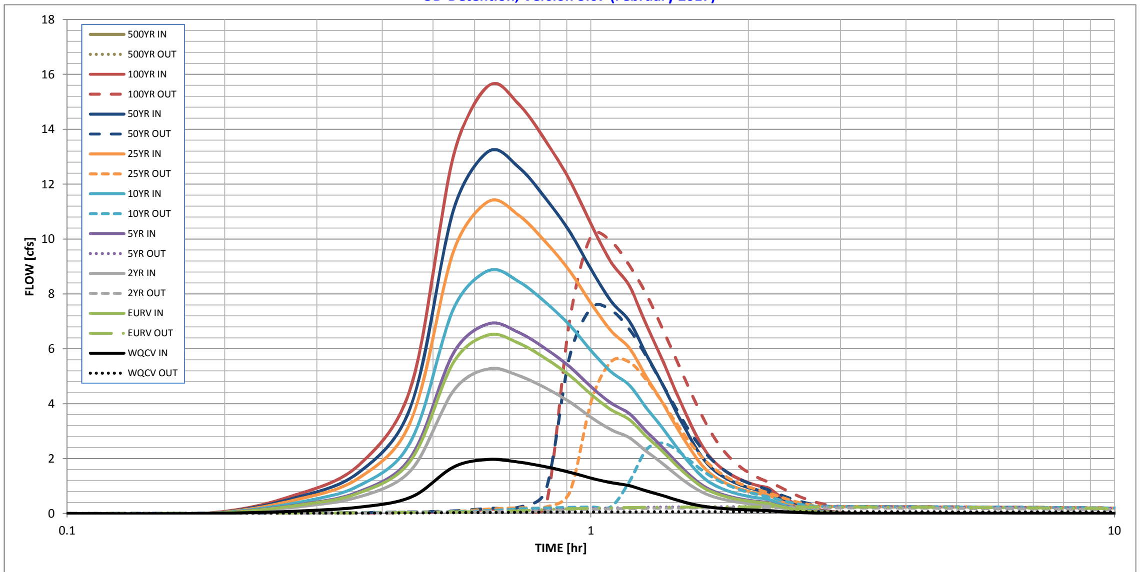
Spillway Design Flow Depth=	0.30	feet
Stage at Top of Freeboard =	6.80	feet
Basin Area at Top of Freeboard =	0.33	acres

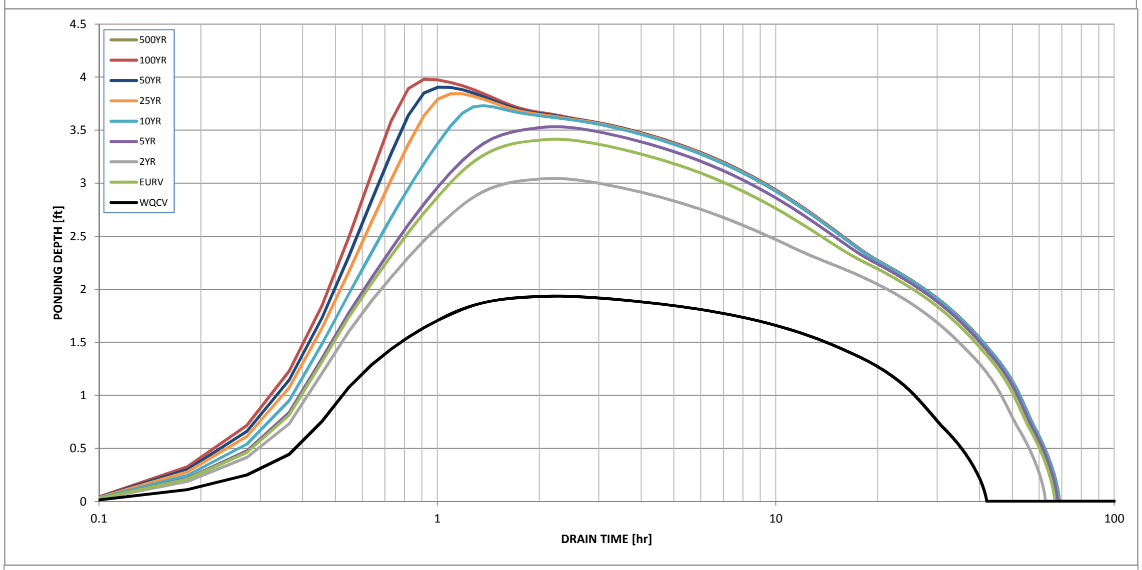
Routed Hydrograph Results

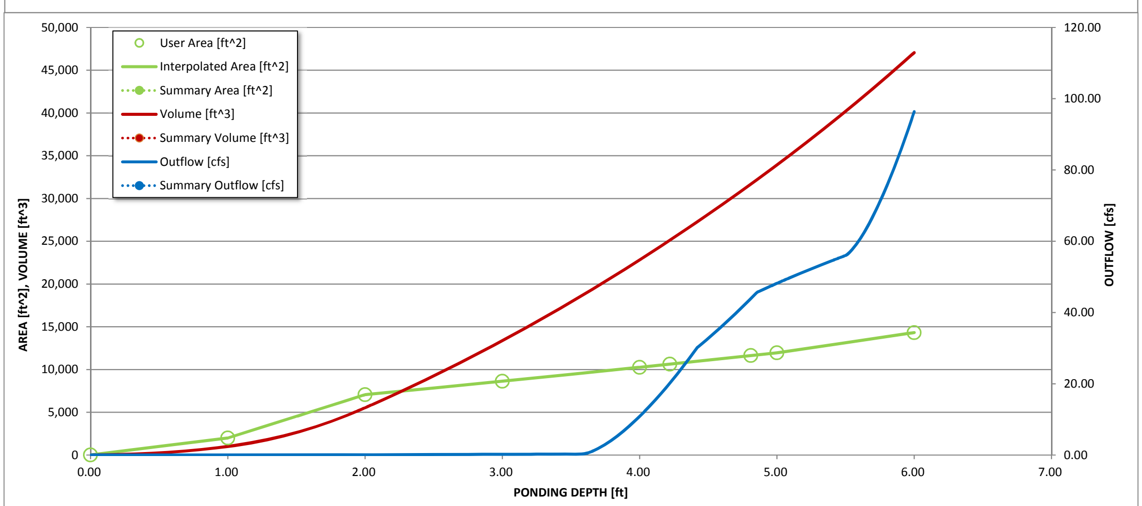
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.16	1.44	1.68	1.92	2.16	2.42	0.00
Calculated Runoff Volume (acre-ft) =	0.127	0.427	0.345	0.454	0.583	0.751	0.873	1.033	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.127	0.427	0.345	0.454	0.583	0.751	0.872	1.033	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.17	0.57	0.80	1.08	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	0.1	0.1	1.0	3.5	4.8	6.5	0.0
Peak Inflow Q (cfs) =	2.0	6.5	5.3	6.9	8.9	11.4	13.2	15.6	#N/A
Peak Outflow Q (cfs) =	0.1	0.2	0.2	0.3	2.6	5.5	7.5	10.1	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	2.3	2.5	1.6	1.6	1.6	#N/A
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.0	0.0	0.0	#N/A
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) =	37	55	53	56	55	53	52	50	#N/A
Time to Drain 99% of Inflow Volume (hours) =	**40**	62	58	63	62	61	60	59	#N/A
Maximum Ponding Depth (ft) =	1.94	3.41	3.05	3.53	3.73	3.84	3.91	3.98	#N/A
Area at Maximum Ponding Depth (acres) =	0.15	0.21	0.20	0.22	0.23	0.23	0.23	0.23	#N/A
Maximum Volume Stored (acre-ft) =	0.116	0.391	0.315	0.417	0.462	0.487	0.500	0.519	#N/A

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.

Time Interval: 5.47 min

Hydrograph Constant: 0.915

SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	#N/A
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]
0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
0:05:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
0:10:56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
0:16:25	0.09	0.29	0.24	0.31	0.39	0.50	0.58	0.68	#N/A
0:21:53	0.24	0.78	0.63	0.83	1.06	1.35	1.57	1.85	#N/A
0:27:21	0.62	2.01	1.63	2.13	2.72	3.48	4.03	4.75	#N/A
0:32:49	1.69	5.51	4.48	5.85	7.47	9.56	11.07	13.05	#N/A
0:38:17	1.97	6.51	5.27	6.92	8.85	11.37	13.20	15.60	#N/A
0:43:46	1.87	6.20	5.02	6.59	8.45	10.86	12.61	14.90	#N/A
0:49:14	1.70	5.65	4.57	6.00	7.69	9.89	11.48	13.57	#N/A
0:54:42	1.51	5.03	4.07	5.35	6.86	8.84	10.27	12.15	#N/A
1:00:10	1.29	4.33	3.50	4.61	5.92	7.64	8.88	10.52	#N/A
1:05:38	1.12	3.78	3.05	4.02	5.16	6.65	7.73	9.15	#N/A
1:11:07	1.02	3.42	2.76	3.64	4.67	6.03	7.01	8.30	#N/A
1:16:35	0.82	2.81	2.27	2.99	3.85	4.98	5.80	6.88	#N/A
1:22:03	0.66	2.29	1.84	2.44	3.14	4.07	4.75	5.64	#N/A
1:27:31	0.50	1.75	1.40	1.87	2.42	3.14	3.67	4.38	#N/A
1:32:59	0.36	1.29	1.03	1.38	1.80	2.35	2.75	3.29	#N/A
1:38:28	0.26	0.94	0.75	1.00	1.30	1.70	1.98	2.38	#N/A
1:43:56	0.21	0.73	0.59	0.78	1.01	1.31	1.53	1.83	#N/A
1:49:24	0.17	0.60	0.48	0.64	0.83	1.08	1.26	1.50	#N/A
1:54:52	0.15	0.51	0.41	0.55	0.71	0.92	1.07	1.27	#N/A
2:00:20	0.13	0.45	0.36	0.48	0.62	0.80	0.94	1.12	#N/A
2:05:49	0.12	0.41	0.33	0.43	0.56	0.72	0.84	1.00	#N/A
2:11:17	0.11	0.38	0.30	0.40	0.52	0.67	0.78	0.92	#N/A
2:16:45	0.08	0.28	0.22	0.29	0.38	0.49	0.57	0.68	#N/A
2:22:13	0.06	0.20	0.16	0.22	0.28	0.36	0.42	0.50	#N/A
2:27:41	0.04	0.15	0.12	0.16	0.20	0.26	0.31	0.37	#N/A
2:33:10	0.03	0.11	0.09	0.12	0.15	0.19	0.23	0.27	#N/A
2:38:38	0.02	0.08	0.06	0.08	0.11	0.14	0.16	0.19	#N/A
2:44:06	0.02	0.05	0.04	0.06	0.08	0.10	0.12	0.14	#N/A
2:49:34	0.01	0.04	0.03	0.04	0.05	0.07	0.08	0.10	#N/A
2:55:02	0.01	0.03	0.02	0.03	0.04	0.05	0.05	0.07	#N/A
3:00:31	0.00	0.01	0.01	0.02	0.02	0.03	0.03	0.04	#N/A
3:05:59	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	#N/A
3:11:27	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	#N/A
3:16:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
3:22:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
3:27:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
3:33:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
3:38:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
3:44:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
3:49:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
3:55:13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:00:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:06:09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:11:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:17:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:22:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:28:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:33:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:38:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:44:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:49:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:55:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:00:51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:06:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:11:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:17:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:22:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:28:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:33:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:39:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:44:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:50:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:55:33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
6:01:01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
6:06:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
6:11:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
6:17:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
6:22:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
6:28:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
6:33:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**Richard Schindler**
Company:	**Core Engineering Group**
Date:	**January 30, 2017**
Project:	**Carriage Meadows South**
Location:	**Pond G1/G2 Full Spectrum Forebay and WQ Outlet Design**

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 79.0 %
B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	i = 0.790
C) Contributing Watershed Area	Area = 96.000 ac
D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = ______ in
E) Design Concept (Select EURV when also designing for flood control)	Choose One (●) Water Quality Capture Volume (WQCV) ( ) Excess Urban Runoff Volume (EURV)
F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area)$	V_{DESIGN}= 2.577 ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6*(V_{DESIGN}/0.43))$	$V_{DESIGN\ OTHER}$= ______ ac-ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{DESIGN\ USER}$= ______ ac-ft
I) Predominant Watershed NRCS Soil Group	Choose One ( ) A ( ) B ( ) C / D **WQCV selected. Soil group not required.**
J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$	EURV = ______ ac-f t
2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)	L : W = 2.0 : 1
3. Basin Side Slopes	
A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred)	Z = 4.00 ft / ft
4. Inlet	
A) Describe means of providing energy dissipation at concentrated inflow locations:	______

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Richard Schindler
Company: Core Engineering Group
Date: January 30, 2017
Project: Carriage Meadows South
Location: Pond G1/G2 Full Spectrum Forebay and WQ Outlet Design

5. Forebay

A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV) — V_{FMIN} = 0.077 ac-ft

B) Actual Forebay Volume — V_F = 0.080 ac-ft

C) Forebay Depth (D_F = 30 inch maximum) — D_F = 26.4 in

D) Forebay Discharge

i) Undetained 100-year Peak Discharge — Q_{100} = 301.00 cfs

ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$) — Q_F = 6.02 cfs

E) Forebay Discharge Design

Choose One
- ○ Berm With Pipe
- ● Wall with Rect. Notch
- ○ Wall with V-Notch Weir

F) Discharge Pipe Size (minimum 8-inches) — Calculated D_P = ___ in

G) Rectangular Notch Width — Calculated W_N = 11.9 in

6. Trickle Channel

A) Type of Trickle Channel

Choose One
- ● Concrete
- ○ Soft Bottom

F) Slope of Trickle Channel — S = 0.0040 ft / ft

7. Micropool and Outlet Structure

A) Depth of Micropool (2.5-feet minimum) — D_M = 2.5 ft

B) Surface Area of Micropool (10 ft^2 minimum) — A_M = 150 sq ft

C) Outlet Type

Choose One
- ● Orifice Plate
- ○ Other (Describe):

D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention) — $D_{orifice}$ = 4.70 inches

E) Total Outlet Area — A_{ot} = 66.36 square inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**Richard Schindler**
Company:	**Core Engineering Group**
Date:	**January 30, 2017**
Project:	**Carriage Meadows South**
Location:	**Pond G1/G2 Full Spectrum Forebay and WQ Outlet Design**

8. Initial Surcharge Volume

A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)	D_{IS} = 4 in
B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV)	V_{IS} = 336.8 cu ft
C) Initial Surcharge Provided Above Micropool	V_s= 50.0 cu ft

9. Trash Rack

A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$	A_t = 1,635 square inches
B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open are to the total screen are for the material specified.)	*Aluminum Amico-Klemp SR Series with Cross Rods 4" O.C.*
Other (Y/N): N	
C) Ratio of Total Open Area to Total Area (only for type 'Other')	User Ratio =
D) Total Water Quality Screen Area (based on screen type)	A_{total} = 2123 sq. in.
E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)	H= 3.54 feet
F) Height of Water Quality Screen (H_{TR})	H_{TR}= 70.48 inches
G) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended)	$W_{opening}$ = 30.1 inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**Richard Schindler**
Company:	**Core Engineering Group**
Date:	**January 30, 2017**
Project:	**Carriage Meadows South**
Location:	**Pond G1/G2 Full Spectrum Forebay and WQ Outlet Design**

10. Overflow Embankment

A) Describe embankment protection for 100-year and greater overtopping:

B) Slope of Overflow Embankment
(Horizontal distance per unit vertical, 4:1 or flatter preferred)

11. Vegetation

Choose One
- ○ Irrigated
- ○ Not Irrigated

12. Access

A) Describe Sediment Removal Procedures

Notes:

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**Richard Schindler**
Company:	**Core Engineering Group**
Date:	**February 21, 2017**
Project:	**Carriage Meadows South**
Location:	**Full Spectrum Pond G3**

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 65.0 %
B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	i = 0.650
C) Contributing Watershed Area	Area = 6.020 ac
D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = ____ in
E) Design Concept (Select EURV when also designing for flood control)	Choose One (●) Water Quality Capture Volume (WQCV) ( ) Excess Urban Runoff Volume (EURV)
F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area)$	V_{DESIGN}= 0.127 ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6*(V_{DESIGN}/0.43))$	$V_{DESIGN\ OTHER}$= ____ ac-ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{DESIGN\ USER}$= ____ ac-ft
I) Predominant Watershed NRCS Soil Group	Choose One ( ) A ( ) B ( ) C / D **WQCV selected. Soil group not required.**
J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$	EURV = ____ ac-f t
2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)	L : W = 2.0 : 1
3. Basin Side Slopes	
A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred)	Z = 3.00 ft / ft **DIFFICULT TO MAINTAIN, INCREASE WHERE POSSIBLE**
4. Inlet	
A) Describe means of providing energy dissipation at concentrated inflow locations:	

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Richard Schindler
Company: Core Engineering Group
Date: February 21, 2017
Project: Carriage Meadows South
Location: Full Spectrum Pond G3

5. Forebay	
A) Minimum Forebay Volume (V_{FMIN} = 2% of the WQCV)	V_{FMIN} = 0.003 ac-ft
B) Actual Forebay Volume	V_F = 0.003 ac-ft
C) Forebay Depth (D_F = 18 inch maximum)	D_F = 18.0 in
D) Forebay Discharge	
i) Undetained 100-year Peak Discharge	Q_{100} = 22.00 cfs
ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)	Q_F = 0.44 cfs
E) Forebay Discharge Design	Choose One: ○ Berm With Pipe; ● Wall with Rect. Notch; ○ Wall with V-Notch Weir — **(flow too small for berm w/ pipe)**
F) Discharge Pipe Size (minimum 8-inches)	Calculated D_P = in
G) Rectangular Notch Width	Calculated W_N = 4.5 in
6. Trickle Channel	
A) Type of Trickle Channel	Choose One: ● Concrete; ○ Soft Bottom
F) Slope of Trickle Channel	S = 0.0040 ft / ft
7. Micropool and Outlet Structure	
A) Depth of Micropool (2.5-feet minimum)	D_M = 2.5 ft
B) Surface Area of Micropool (10 ft^2 minimum)	A_M = 48 sq ft
C) Outlet Type	Choose One: ● Orifice Plate; ○ Other (Describe):
D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)	$D_{orifice}$ = 0.88 inches
E) Total Outlet Area	A_{ot} = 1.95 square inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**Richard Schindler**
Company:	**Core Engineering Group**
Date:	**February 21, 2017**
Project:	**Carriage Meadows South**
Location:	**Full Spectrum Pond G3**

8. Initial Surcharge Volume	
A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)	D_{IS} = 4 in
B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV)	V_{IS} = ______ cu ft
C) Initial Surcharge Provided Above Micropool	V_s= 16.0 cu ft
9. Trash Rack	
A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$	A_t = 69 square inches
B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open are to the total screen are for the material specified.)	*S.S. Well Screen with 60% Open Area*
Other (Y/N): N	
C) Ratio of Total Open Area to Total Area (only for type 'Other')	User Ratio =
D) Total Water Quality Screen Area (based on screen type)	A_{total} = 115 sq. in.
E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)	H= 2.2 feet
F) Height of Water Quality Screen (H_{TR})	H_{TR}= 54.4 inches
G) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended)	$W_{opening}$ = 12.0 inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Richard Schindler
Company: Core Engineering Group
Date: February 21, 2017
Project: Carriage Meadows South
Location: Full Spectrum Pond G3

10. Overflow Embankment

A) Describe embankment protection for 100-year and greater overtopping:

B) Slope of Overflow Embankment
(Horizontal distance per unit vertical, 4:1 or flatter preferred)

11. Vegetation

Choose One
- Irrigated
- Not Irrigated

12. Access

A) Describe Sediment Removal Procedures

Notes:

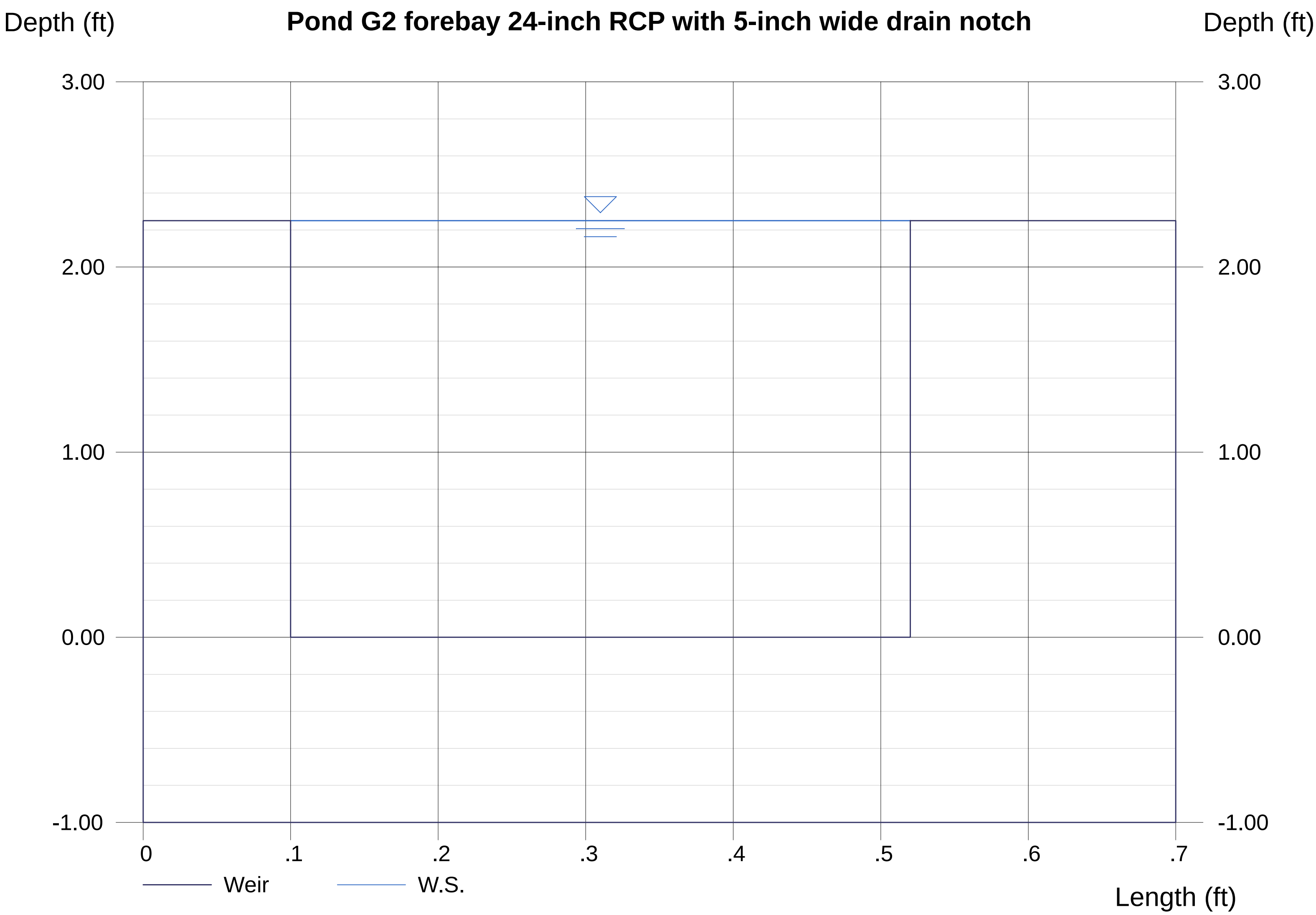
Weir Report

Pond G2 forebay 24-inch RCP with 5-inch wide drain notch

Rectangular Weir
Crest = Sharp
Bottom Length (ft) = 0.42
Total Depth (ft) = 2.25

Calculations
Weir Coeff. Cw = 3.33
Compute by: Known Depth
Known Depth (ft) = 2.25

Highlighted
Depth (ft) = 2.25
Q (cfs) = 4.720
Area (sqft) = 0.95
Velocity (ft/s) = 5.00
Top Width (ft) = 0.42



Channel Report

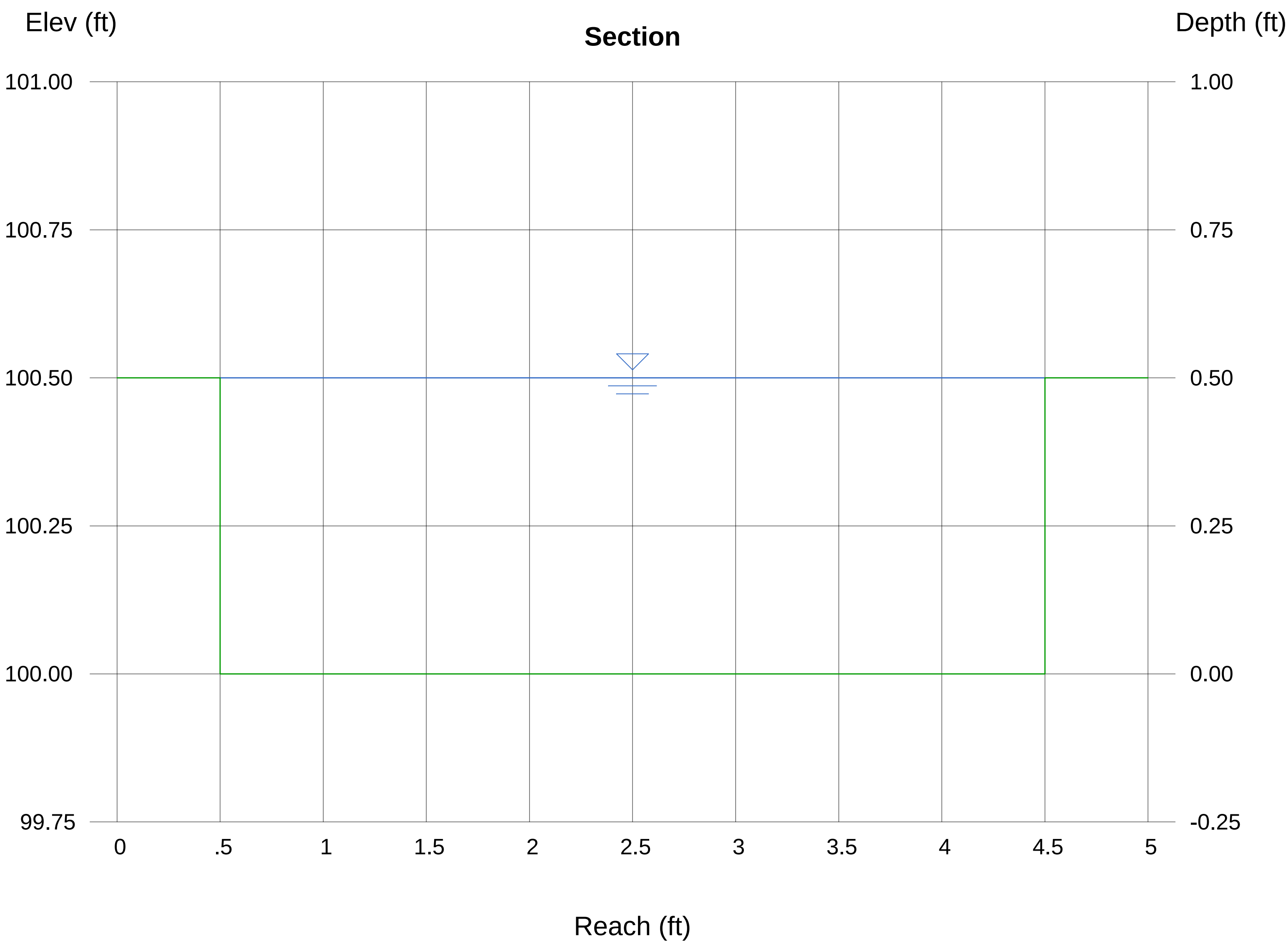
Pond G2 low flow channel from 24-inch RCP

Rectangular
Botom Width (ft) = 4.00
Total Depth (ft) = 0.50

Invert Elev (ft) = 100.00
Slope (%) = 0.40
N-Value = 0.013

Calculations
Compute by: Q vs Depth
No. Increments = 10

Highlighted
Depth (ft) = 0.50
Q (cfs) = 7.847
Area (sqft) = 2.00
Velocity (ft/s) = 3.92
Wetted Perim (ft) = 5.00
Crit Depth, Yc (ft) = 0.45
Top Width (ft) = 4.00
EGL (ft) = 0.74



Channel Report

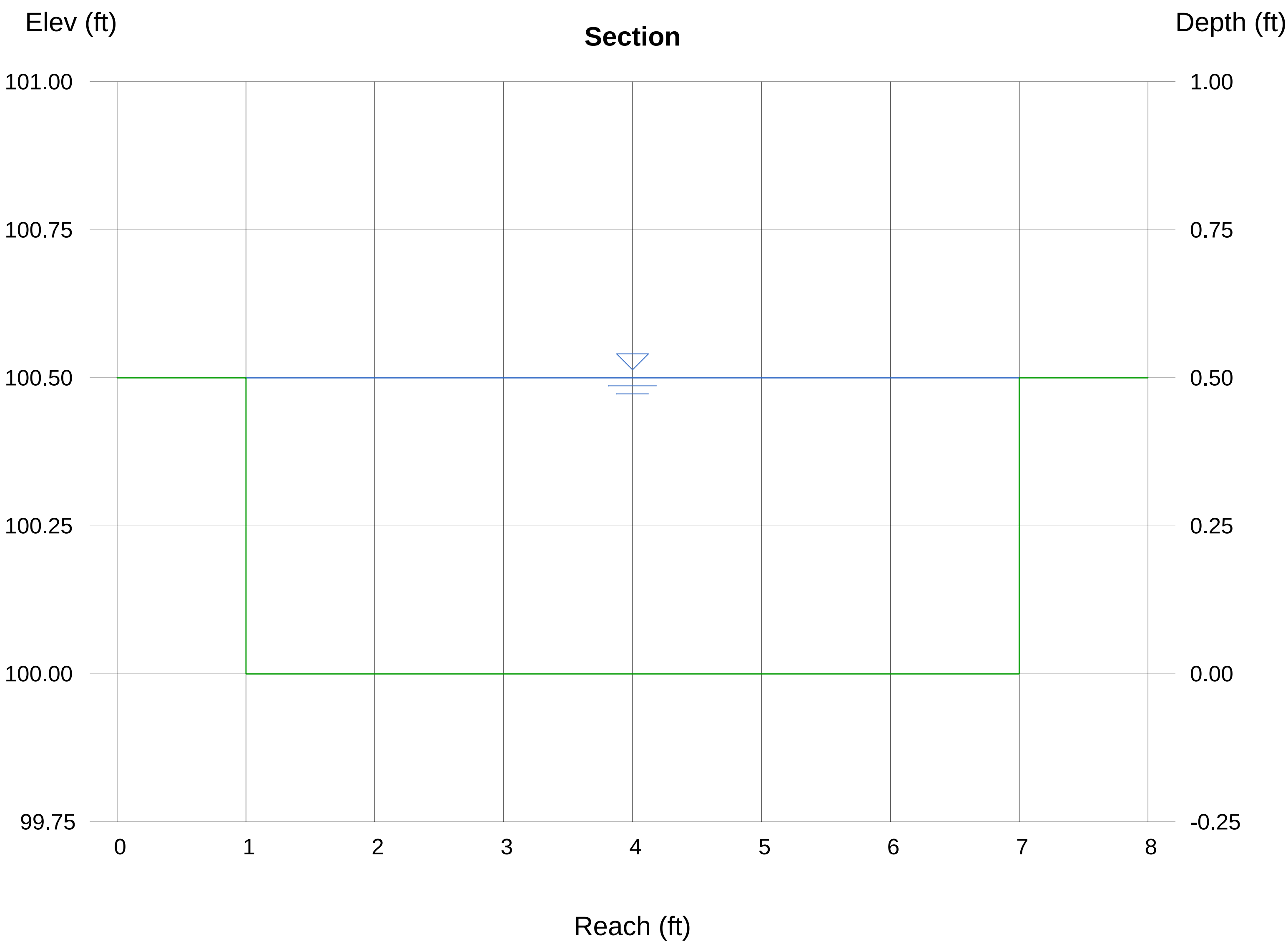
Pond G2 low flow channel from 48-inch RCP

Rectangular
Botom Width (ft) = 6.00
Total Depth (ft) = 0.50

Invert Elev (ft) = 100.00
Slope (%) = 0.40
N-Value = 0.013

Calculations
Compute by: Known Depth
Known Depth (ft) = 0.50

Highlighted
Depth (ft) = 0.50
Q (cfs) = 12.32
Area (sqft) = 3.00
Velocity (ft/s) = 4.11
Wetted Perim (ft) = 7.00
Crit Depth, Yc (ft) = 0.50
Top Width (ft) = 6.00
EGL (ft) = 0.76



Channel Report

Pond G2 low flow channel

Rectangular

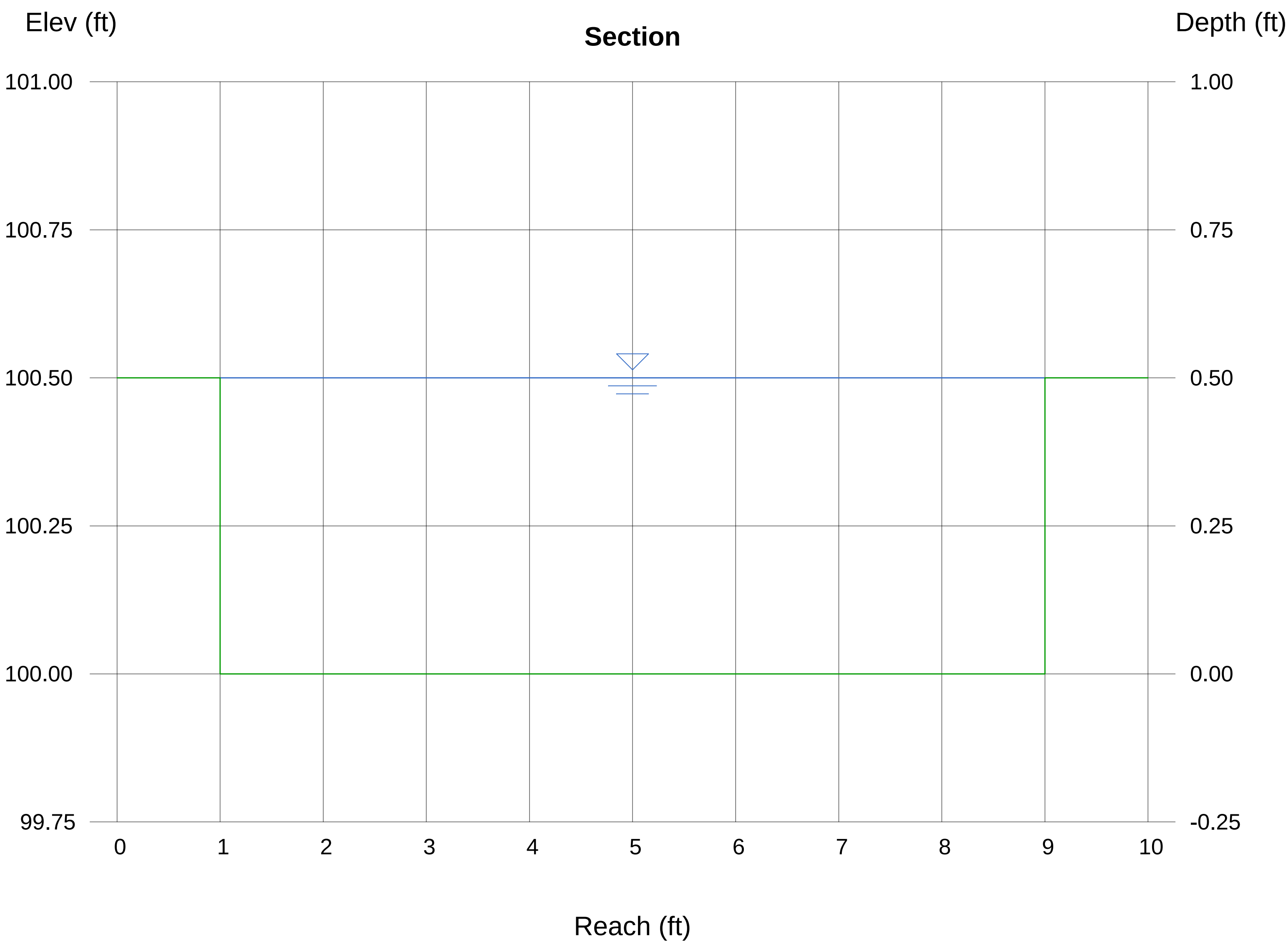
Botom Width (ft)	=	8.00
Total Depth (ft)	=	0.50
Invert Elev (ft)	=	100.00
Slope (%)	=	0.40
N-Value	=	0.013

Calculations

Compute by:		Known Depth
Known Depth (ft)	=	0.50

Highlighted

Depth (ft)	=	0.50
Q (cfs)	=	16.84
Area (sqft)	=	4.00
Velocity (ft/s)	=	4.21
Wetted Perim (ft)	=	9.00
Crit Depth, Yc (ft)	=	0.50
Top Width (ft)	=	8.00
EGL (ft)	=	0.78



APPENDIX E– STORM SEWER SCHEMATIC

Memo

Date:	Friday, March 11, 2016
Project:	Marksheffel Road South
To:	Dennis Barron, El Paso County
From:	Matthew Johnson, HDR Elizabeth Staten, HDR
Subject:	3/11/16 Marksheffel Road South Revisions

This memo serves as a supplement to the August 2015 Marksheffel Road South Final Drainage Report, stamped 8/26/2015, to document changes to the hydraulic design and supporting calculations from the 3/11/16 revisions.

The following plan sheets are affected as part of the revisions:

- D-10a
- D-14
- D-16
- D-18
- D-43
- D-50
- D-58
- D-59

For all revisions see attached calculations.

The changes to the design include the addition of three approach culverts used to convey ditch flow underneath roadway bump outs. The roadway bump outs were added to provide utility manhole access. The approach culverts are all 24” RCP with riprap outlet protection.

Two sand filters are shifted to accommodate access road changes. The affected sand filters are SF 125L and SF 178R. These sand filters are moved downstream so they will still have the ability to treat the required tributary area. Since the shift is downstream there are no required changes to the sand filter’s water quality capture volume. Any excess runoff will bypass the sand filters and treatment will still be provided for at the downstream sand filters.

The driveway at station 150+00 LT is shifted to the north and the culvert at the driveway is shifted as well. The shift causes the culvert length to increase and the slope to increase. This culvert has conveyance capacity and significant downstream erosion protection so hydraulics were not performed for these minor changes.

The driveways from station 177+00 LT to 178+50 LT are shifted to the south. Both culverts used to convey runoff under these driveways are shifted and lengths and widths adjusted as appropriate.

The culvert under the access road at station 177+00 RT is upsized from a single 24” RCP to a double 24” RCP. This change is taking place due to updated basin delineation provided by an adjacent developer that estimates a 100-year peak flow of 28.6 cfs at this location. The double 24” RCP will accommodate this flow. Similarly the culvert at 168+00 RT is upsized to a double 24” RCP to accommodate the additional expected runoff.

The culvert CV618 is extended 6 feet at the previous slope of 0.50%. This shift removes the conditions where the toe wall is above a water utility. There is more than 3 feet of vertical clearance from the bottom of culvert to the top of the water utility. Hydraulic calculations are not computed for the change in length since the friction loss for the additional 6 feet of culvert is considered negligible.

The ditch just north of the future Mesa Ridge is changed from a trapezoidal ditch section to a triangular ditch section. This occurs from approximately station 130+00 LT to 140+00 LT. This ditch section is part of basin 103L and is evaluated with the full flow from that basin. The new ditch section has 2:1 side-slopes and a depth of 1.50 feet.

The ditch just south of Fontaine Boulevard on the east is changed from a trapezoidal ditch section to a triangular ditch section. This occurs from approximately station 200+00 RT to 205+00 RT. This ditch section is part of basin 178R and is evaluated with the full flow from that basin. The new ditch section has 2:1 side-slopes and a depth of 1.50 feet.

See the Table below for a summary of changes to pipe quantities.

Pipe ID	Previous Size	Previous Length (LF)	Updated Size	Updated Length (LF)
CV117	-	-	24"	88
CV121	-	-	24"	103
CV125	-	-	24"	125
CV150	6x2 CBC	35	-	38
CV168	18"	66	2-24"	55
CV177R	24"	39	2-24"	-
CV177	2-36"	77	-	100
CV178L	2-36"	26	-	-
CV618	5x2 CBC	112	-	118

Runoff Coefficients

Corridor / Design Package: Marksheffel
System Name: South Approach Pipes

Computed: MAJ   Date: 3/5/2016
Checked: EVS   Date:

Sub-Basin Data			Composite C		Sub Area (Pavement)			Sub Area (Pervious)		
Basin ID	Description	Total Area (ac)	C_5	C_{100}	C_5	C_{100}	Area (ac)	C_5	C_{100}	Area (ac)
ZONE3										
CV233	Onsite flow from 233+00 to 246+00	2.37	0.90	0.95	0.90	0.95	2.37	0.25	0.35	0.00
P205	Onsite flow from 207+60 to 212+00	0.44	0.90	0.95	0.90	0.95	0.44	0.25	0.35	0.00
CV205	Onsite flow from 205+00 to 212+00	0.84	0.90	0.95	0.90	0.95	0.84	0.25	0.35	0.00
CV195	Onsite flow from 195+00 to 205+00	1.68	0.90	0.95	0.90	0.95	1.68	0.25	0.35	0.00
CV194	Onsite flow from 194+00 to 205+00	1.79	0.90	0.95	0.90	0.95	1.79	0.25	0.35	0.00
CV192	Onsite flow from 192+00 to 205+00	1.99	0.90	0.95	0.90	0.95	1.99	0.25	0.35	0.00
CV177R	Onsite & Offisite flow from 177+00 to 205+00	5.51	0.64	0.71	0.90	0.95	3.32	0.25	0.35	2.19
CV168	Onsite flow from 168+00 to 179+00	0.95	0.90	0.95	0.90	0.95	0.95	0.25	0.35	0.00
CV152	Onsite flow from 152+00 to 177+00	2.49	0.90	0.95	0.90	0.95	2.49	0.25	0.35	0.00
ZONE 4										
CV125	Onsite flow from 125+00 to 148+00	2.95	0.90	0.95	0.90	0.95	2.95	0.25	0.35	0.00
CV121	Onsite flow from 121+00 to 148+00	3.31	0.90	0.95	0.90	0.95	3.31	0.25	0.35	0.00
CV117	Onsite flow from 117+00 to 148+00	3.85	0.90	0.95	0.90	0.95	3.85	0.25	0.35	0.00
CV112	Onsite flow from 112+00 to 114+00	0.18	0.90	0.95	0.90	0.95	0.18	0.25	0.35	0.00
CV109	Onsite flow from 109+00 to 114+00	0.27	0.90	0.95	0.90	0.95	0.27	0.25	0.35	0.00
CV106	Onsite flow from 106+00 to 114+00	0.40	0.90	0.95	0.90	0.95	0.40	0.25	0.35	0.00
CV99	Onsite flow from 99+00 to 103+00	0.20	0.90	0.95	0.90	0.95	0.20	0.25	0.35	0.00

Standard Form SF-1 . Time of Concentration

Corridor / Design Package: Marksheffel
System Name: South Approach Pipes

Computed: MAJ Date: 3/5/2016
Checked: EVS Date:

SUB-BASIN DATA				INITIAL/OVERLAND FLOW (t_i)			TRAVEL TIME (t_t)							Total
									Type of Land Surface					
Basin ID	Description	C_5	Area (ac)	Length (ft)	Slope (ft/ft)	t_i (min)	Length (ft)	S_w (ft/ft)	Code	Description	Convey Coef (C_v)	Velocity (ft/s)	Travel Time (min)	$t_c = t_i + t_t$ (min)
ZONE 3														
CV233	Onsite flow from 233+00 to 246+00	0.90	2.37	96	0.05208	2.13	1180	0.0288	5	Grassed waterway	15.00	2.55	7.72	9.85
P205	Onsite flow from 207+60 to 212+00	0.90	0.44	57	0.07018	1.48	453	0.01044	5	Grassed waterway	15.00	1.53	4.93	6.41
CV205	Onsite flow from 205+00 to 212+00	0.90	0.84	61	0.06557	1.57	660	0.01045	5	Grassed waterway	15.00	1.53	7.17	8.74
CV195	Onsite flow from 195+00 to 205+00	0.90	1.68	70	0.05714	1.75	1170	0.0120	5	Grassed waterway	15.00	1.64	11.88	13.63
CV194	Onsite flow from 194+00 to 205+00	0.90	1.79	70	0.05714	1.76	1280	0.01172	5	Grassed waterway	15.00	1.62	13.14	14.90
CV192	Onsite flow from 192+00 to 205+00	0.90	1.99	70	0.05714	1.76	1490	0.01208	5	Grassed waterway	15.00	1.65	15.06	16.82
CV177R	Onsite & Offisite flow from 177+00 to 205+00	0.64	5.51	54	0.07407	3.25	2865	0.00999	5	Grassed waterway	15.00	1.50	31.86	35.11
CV168	Onsite flow from 168+00 to 179+00	0.90	0.95	58	0.05172	1.66	978	0.00511	5	Grassed waterway	15.00	1.07	15.20	16.85
CV152	Onsite flow from 152+00 to 177+00	0.90	2.49	53	0.0566	1.54	2600	0.00527	5	Grassed waterway	15.00	1.09	39.80	41.33
ZONE 4														
CV125	Onsite flow from 125+00 to 148+00	0.90	2.95	100	0.06	2.07	4386	0.00876	5	Grassed waterway	15.00	1.40	52.06	54.13
CV121	Onsite flow from 121+00 to 148+00	0.90	3.31	100	0.06	2.07	4386	0.00876	5	Grassed waterway	15.00	1.40	52.06	54.13
CV117	Onsite flow from 117+00 to 148+00	0.90	3.85	100	0.06	2.07	4386	0.00876	5	Grassed waterway	15.00	1.40	52.06	54.13
CV112	Onsite flow from 112+00 to 114+00	0.90	0.18	39	0.07692	1.19	262	0.01145	5	Grassed waterway	15.00	1.61	2.72	5.00
CV109	Onsite flow from 109+00 to 114+00	0.90	0.27	39	0.07692	1.19	492	0.01016	5	Grassed waterway	15.00	1.51	5.42	6.61
CV106	Onsite flow from 106+00 to 114+00	0.90	0.40	37	0.08108	1.14	677	0.01034	5	Grassed waterway	15.00	1.53	7.40	8.54
CV99	Onsite flow from 99+00 to 103+00	0.90	0.20	39	0.10256	1.08	330	0.00909	5	Grassed waterway	15.00	1.43	3.85	5.00

Notes:

t_i= (1.87*(1.1-C_5)*(L^0.5))/(S^0.33), from COS DCM page 5-11

Velocity from V = C_v*S_w^0.5, from UDFCD Eqn RO-4, C_v from Table R0-2 (See Sheet Design Info)

t_t=L/60V

Standard Form SF-2 . Storm Drainage System Design (Rational Method Procedure)

Corridor / Design Package: Marksheffel
System Name: South Approach Pipes

Computed: MAJ Date: 3/5/2016
Checked: EVS Date:

Design Storm: 5-yr

	LOCATION	DESIGN POINT	DIRECT RUNOFF: AREA DESIGN (name)	DIRECT RUNOFF: AREA (AC)	DIRECT RUNOFF: RUNOFF COEFF	DIRECT RUNOFF: t_c (MIN)	DIRECT RUNOFF: C.A. (AC)	DIRECT RUNOFF: I IN / HR	DIRECT RUNOFF: Q (CFS)	TOTAL RUNOFF: t_c (MIN)	TOTAL RUNOFF: SUM (C*A) (AC)	TOTAL RUNOFF: I (IN / HR)	TOTAL RUNOFF: Q (CFS)	STREET: SLOPE (%)	STREET: STREET FLOW (CFS)	PIPE: DESIGN FLOW (CFS)	PIPE: SLOPE (%)	PIPE: PIPE SIZE	TRAVEL TIME: LENGTH (FT)	TRAVEL TIME: VELOCITY (FPS)	TRAVEL TIME: t_t (MIN)	REMARKS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
ZONE 3																						
1	Onsite flow from 233+00 to 246+00		CV233	2.37	0.90	9.85	2.13	2.79	5.95													
2	Onsite flow from 207+60 to 212+00		P205	0.44	0.90	6.41	0.40	3.36	1.33													
3	Onsite flow from 205+00 to 212+00		CV205	0.84	0.90	8.74	0.76	2.98	2.25													
4	Onsite flow from 195+00 to 205+00		CV195	1.68	0.90	13.63	1.51	2.31	3.49													
5	Onsite flow from 194+00 to 205+00		CV194	1.79	0.90	14.90	1.61	2.22	3.58													
6	Onsite flow from 192+00 to 205+00		CV192	1.99	0.90	16.82	1.79	2.08	3.73													
7	Onsite & Offisite flow from 177+00 to 205+00		CV177R	5.51	0.64	35.11	3.54	1.48	5.23													
8	Onsite flow from 168+00 to 179+00		CV168	0.95	0.90	16.85	0.86	2.08	1.78													
9	Onsite flow from 152+00 to 177+00		CV152	2.49	0.90	41.33	2.24	1.36	3.05													
ZONE 4																						
10	Onsite flow from 112+00 to 114+00		CV112	0.18	0.90	5.00	0.17	3.55	0.59													
11	Onsite flow from 109+00 to 114+00		CV109	0.27	0.90	6.61	0.24	3.36	0.82													
12	Onsite flow from 106+00 to 114+00		CV106	0.40	0.90	8.54	0.36	2.98	1.07													
13	Onsite flow from 99+00 to 103+00		CV99	0.20	0.90	5.00	0.18	3.55	0.62													

Design Storm: 100-yr

	LOCATION	DESIGN POINT	DIRECT RUNOFF: AREA DESIGN	DIRECT RUNOFF: AREA (AC)	DIRECT RUNOFF: RUNOFF COEFF	DIRECT RUNOFF: t_c (MIN)	DIRECT RUNOFF: C.A. (AC)	DIRECT RUNOFF: I IN / HR	DIRECT RUNOFF: Q (CFS)	TOTAL RUNOFF: t_c (MIN)	TOTAL RUNOFF: SUM (C*A) (AC)	TOTAL RUNOFF: I (IN / HR)	TOTAL RUNOFF: Q (CFS)	STREET: SLOPE (%)	STREET: STREET FLOW (CFS)	PIPE: DESIGN FLOW (CFS)	PIPE: SLOPE (%)	PIPE: PIPE SIZE	TRAVEL TIME: LENGTH (FT)	TRAVEL TIME: VELOCITY (FPS)	TRAVEL TIME: t_t (MIN)	REMARKS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
ZONE 3																						
1	Onsite flow from 233+00 to 246+00		CV233	2.37	0.95	9.85	2.25	7.49	16.87													
2	Onsite flow from 207+60 to 212+00		P205	0.44	0.95	6.41	0.42	9.02	3.77													
3	Onsite flow from 205+00 to 212+00		CV205	0.84	0.95	8.74	0.80	8.00	6.38													
4	Onsite flow from 195+00 to 205+00		CV195	1.68	0.95	13.63	1.59	6.19	9.87													
5	Onsite flow from 194+00 to 205+00		CV194	1.79	0.95	14.90	1.70	5.93	10.08													See TR-55 Peak Flow
6	Onsite flow from 192+00 to 205+00		CV192	1.99	0.95	16.82	1.89	5.57	10.53													
7	Onsite & Offisite flow from 177+00 to 205+00		CV177R	5.51	0.71	35.11	3.92	3.96	15.53													
8	Onsite flow from 168+00 to 179+00		CV168	0.95	0.95	16.85	0.90	5.57	5.03													
9	Onsite flow from 152+00 to 177+00		CV152	2.49	0.95	41.33	2.37	3.67	8.68													
ZONE 4																						
	Onsite flow from 125+00 to 148+00		CV125	2.95	0.95	54.13	2.80	3.05	8.55													
	Onsite flow from 121+00 to 148+00		CV121	3.31	0.95	54.13	3.14	3.05	9.59													
	Onsite flow from 117+00 to 148+00		CV117	3.85	0.95	54.13	3.66	3.05	11.16													
10	Onsite flow from 112+00 to 114+00		CV112	0.18	0.95	5.00	0.18	9.53	1.67													See TR-55 Peak Flow
11	Onsite flow from 109+00 to 114+00		CV109	0.27	0.95	6.61	0.26	9.02	2.31													
12	Onsite flow from 106+00 to 114+00		CV106	0.40	0.95	8.54	0.38	8.00	3.04													
13	Onsite flow from 99+00 to 103+00		CV99	0.20	0.95	5.00	0.19	9.53	1.77													

(1) Basin Description linked to C-Value Sheet
(2) Basin Design Point
(3) Enter the Basin Name from C Value Sheet
(4) Basin Area linked to C-Value Sheet
(5) Composite C linked to C-Value Sheet
(6) Time of Concentration linked to C-Value Sheet
(7) =Column 4 x Column 5
(8) =28.5*P/(10+Column 6)^0.786
(9) =Column 7 x Column 8
(10) =Column 6 + Column 21
(11) Add the Basin Areas (7) to get the combined basin AC
(12) =28.5*P/(10+Column 10)^0.786
(13) Sum of Qs
(14) Additonal Street Overland Flow
(15) Additonal Street Overland Flow
(16) Design Pipe Flow
(17) Pipe Slope
(18) Pipe Size
(19) Additional Flow Length
(20) Velocity
(21) =Column 19 / Column 20 / 60

Culvert Calculator Report
CV117

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	5,647.78	ft	Headwater Depth/Height	0.90	
Computed Headwater Elevation	5,646.58	ft	Discharge	11.16	cfs
Inlet Control HW Elev.	5,646.51	ft	Tailwater Elevation	5,644.14	ft
Outlet Control HW Elev.	5,646.58	ft	Control Type	Entrance Control	

Grades					
Upstream Invert	5,644.78	ft	Downstream Invert	5,644.14	ft
Length	88.00	ft	Constructed Slope	0.007273	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	1.09	ft
Slope Type	Steep		Normal Depth	1.09	ft
Flow Regime	Supercritical		Critical Depth	1.20	ft
Velocity Downstream	6.36	ft/s	Critical Slope	0.005417	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	2.00	ft
Section Size	24 inch		Rise	2.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	5,646.58	ft	Upstream Velocity Head	0.50	ft
Ke	0.20		Entrance Loss	0.10	ft

Inlet Control Properties					
Inlet Control HW Elev.	5,646.51	ft	Flow Control	N/A	
Inlet Type	Beveled ring, 33.7° bevels		Area Full	3.1	ft²
K	0.00180		HDS 5 Chart	3	
M	2.50000		HDS 5 Scale	B	
C	0.02430		Equation Form	1	
Y	0.83000				

Culvert Calculator Report
CV121

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	5,650.77 ft	Headwater Depth/Height	0.82
Computed Headwater Elevation	5,649.44 ft	Discharge	9.59 cfs
Inlet Control HW Elev.	5,649.36 ft	Tailwater Elevation	5,647.01 ft
Outlet Control HW Elev.	5,649.44 ft	Control Type	Entrance Control

Grades

Upstream Invert	5,647.79 ft	Downstream Invert	5,647.01 ft
Length	103.00 ft	Constructed Slope	0.007573 ft/ft

Hydraulic Profile

Profile	S2	Depth, Downstream	0.98 ft
Slope Type	Steep	Normal Depth	0.98 ft
Flow Regime	Supercritical	Critical Depth	1.11 ft
Velocity Downstream	6.23 ft/s	Critical Slope	0.005132 ft/ft

Section

Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	2.00 ft
Section Size	24 inch	Rise	2.00 ft
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	5,649.44 ft	Upstream Velocity Head	0.45 ft
Ke	0.20	Entrance Loss	0.09 ft

Inlet Control Properties

Inlet Control HW Elev.	5,649.36 ft	Flow Control	N/A
Inlet Type	Beveled ring, 33.7° bevels	Area Full	3.1 ft²
K	0.00180	HDS 5 Chart	3
M	2.50000	HDS 5 Scale	B
C	0.02430	Equation Form	1
Y	0.83000		

Culvert Calculator Report
CV125

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	5,654.11	ft	Headwater Depth/Height	0.77	
Computed Headwater Elevation	5,652.54	ft	Discharge	8.55	cfs
Inlet Control HW Elev.	5,652.47	ft	Tailwater Elevation	5,650.07	ft
Outlet Control HW Elev.	5,652.54	ft	Control Type	Entrance Control	

Grades					
Upstream Invert	5,651.00	ft	Downstream Invert	5,650.07	ft
Length	125.00	ft	Constructed Slope	0.007440	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	0.93	ft
Slope Type	Steep		Normal Depth	0.93	ft
Flow Regime	Supercritical		Critical Depth	1.04	ft
Velocity Downstream	6.01	ft/s	Critical Slope	0.004968	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	2.00	ft
Section Size	24 inch		Rise	2.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	5,652.54	ft	Upstream Velocity Head	0.41	ft
Ke	0.20		Entrance Loss	0.08	ft

Inlet Control Properties					
Inlet Control HW Elev.	5,652.47	ft	Flow Control	N/A	
Inlet Type	Beveled ring, 33.7° bevels		Area Full	3.1	ft²
K	0.00180		HDS 5 Chart	3	
M	2.50000		HDS 5 Scale	B	
C	0.02430		Equation Form	1	
Y	0.83000				

Culvert Calculator Report
CV168

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	5,683.94	ft	Headwater Depth/Height	1.19	
Computed Headwater Elevation	5,683.18	ft	Discharge	33.60	cfs
Inlet Control HW Elev.	5,683.11	ft	Tailwater Elevation	5,680.54	ft
Outlet Control HW Elev.	5,683.18	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	5,680.80	ft	Downstream Invert	5,680.54	ft
Length	66.00	ft	Constructed Slope	0.003939	ft/ft

Hydraulic Profile					
Profile	M2		Depth, Downstream	1.48	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	1.48	ft
Velocity Downstream	6.75	ft/s	Critical Slope	0.006871	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	2.00	ft
Section Size	24 inch		Rise	2.00	ft
Number Sections	2				

Outlet Control Properties					
Outlet Control HW Elev.	5,683.18	ft	Upstream Velocity Head	0.51	ft
Ke	0.20		Entrance Loss	0.10	ft

Inlet Control Properties					
Inlet Control HW Elev.	5,683.11	ft	Flow Control	Transition	
Inlet Type	Beveled ring, 33.7° bevels		Area Full	6.3	ft²
K	0.00180		HDS 5 Chart	3	
M	2.50000		HDS 5 Scale	B	
C	0.02430		Equation Form	1	
Y	0.83000				

Culvert Calculator Report
CV177

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	5,688.70	ft	Headwater Depth/Height	1.12	
Computed Headwater Elevation	5,688.43	ft	Discharge	87.06	cfs
Inlet Control HW Elev.	5,688.36	ft	Tailwater Elevation	5,684.52	ft
Outlet Control HW Elev.	5,688.43	ft	Control Type	Entrance Control	

Grades					
Upstream Invert	5,685.08	ft	Downstream Invert	5,684.40	ft
Length	100.00	ft	Constructed Slope	0.006800	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	2.01	ft
Slope Type	Steep		Normal Depth	2.01	ft
Flow Regime	Supercritical		Critical Depth	2.15	ft
Velocity Downstream	8.63	ft/s	Critical Slope	0.005723	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	3.00	ft
Section Size	36 inch		Rise	3.00	ft
Number Sections	2				

Outlet Control Properties					
Outlet Control HW Elev.	5,688.43	ft	Upstream Velocity Head	1.00	ft
Ke	0.20		Entrance Loss	0.20	ft

Inlet Control Properties					
Inlet Control HW Elev.	5,688.36	ft	Flow Control	Transition	
Inlet Type	Beveled ring, 33.7° bevels		Area Full	14.1	ft²
K	0.00180		HDS 5 Chart	3	
M	2.50000		HDS 5 Scale	B	
C	0.02430		Equation Form	1	
Y	0.83000				

Culvert Calculator Report
CV177R

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	5,689.14	ft	Headwater Depth/Height	1.07	
Computed Headwater Elevation	5,687.56	ft	Discharge	28.60	cfs
Inlet Control HW Elev.	5,687.47	ft	Tailwater Elevation	5,685.32	ft
Outlet Control HW Elev.	5,687.56	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	5,685.43	ft	Downstream Invert	5,685.32	ft
Length	39.00	ft	Constructed Slope	0.002821	ft/ft

Hydraulic Profile					
Profile	M2		Depth, Downstream	1.36	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	1.36	ft
Velocity Downstream	6.27	ft/s	Critical Slope	0.006130	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	2.00	ft
Section Size	24 inch		Rise	2.00	ft
Number Sections	2				

Outlet Control Properties					
Outlet Control HW Elev.	5,687.56	ft	Upstream Velocity Head	0.43	ft
Ke	0.20		Entrance Loss	0.09	ft

Inlet Control Properties					
Inlet Control HW Elev.	5,687.47	ft	Flow Control	Unsubmerged	
Inlet Type	Beveled ring, 33.7° bevels		Area Full	6.3	ft²
K	0.00180		HDS 5 Chart	3	
M	2.50000		HDS 5 Scale	B	
C	0.02430		Equation Form	1	
Y	0.83000				

Culvert Calculator Report
CV178L

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	5,690.19	ft	Headwater Depth/Height	1.12	
Computed Headwater Elevation	5,688.90	ft	Discharge	87.06	cfs
Inlet Control HW Elev.	5,688.83	ft	Tailwater Elevation	5,685.38	ft
Outlet Control HW Elev.	5,688.90	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	5,685.55	ft	Downstream Invert	5,685.45	ft
Length	26.00	ft	Constructed Slope	0.003846	ft/ft

Hydraulic Profile					
Profile	M2		Depth, Downstream	2.15	ft
Slope Type	Mild		Normal Depth	2.63	ft
Flow Regime	Subcritical		Critical Depth	2.15	ft
Velocity Downstream	8.03	ft/s	Critical Slope	0.005723	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	3.00	ft
Section Size	36 inch		Rise	3.00	ft
Number Sections	2				

Outlet Control Properties					
Outlet Control HW Elev.	5,688.90	ft	Upstream Velocity Head	0.84	ft
Ke	0.20		Entrance Loss	0.17	ft

Inlet Control Properties					
Inlet Control HW Elev.	5,688.83	ft	Flow Control	Transition	
Inlet Type	Beveled ring, 33.7° bevels		Area Full	14.1	ft²
K	0.00180		HDS 5 Chart	3	
M	2.50000		HDS 5 Scale	B	
C	0.02430		Equation Form	1	
Y	0.83000				

Ditch Worksheet for 103L

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.00750	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	0.00	ft
Discharge	13.47	ft³/s

Results

Normal Depth	1.45	ft
Flow Area	4.19	ft²
Wetted Perimeter	6.48	ft
Hydraulic Radius	0.65	ft
Top Width	5.79	ft
Critical Depth	1.23	ft
Critical Slope	0.01789	ft/ft
Velocity	3.21	ft/s
Velocity Head	0.16	ft
Specific Energy	1.61	ft
Froude Number	0.67	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.45	ft
Critical Depth	1.23	ft
Channel Slope	0.00750	ft/ft
Critical Slope	0.01789	ft/ft

Messages

Notes

Worksheet for 178R

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.01000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Discharge	12.81	ft³/s

Results

Normal Depth	1.35	ft
Flow Area	3.63	ft²
Wetted Perimeter	6.02	ft
Hydraulic Radius	0.60	ft
Top Width	5.39	ft
Critical Depth	1.21	ft
Critical Slope	0.01801	ft/ft
Velocity	3.53	ft/s
Velocity Head	0.19	ft
Specific Energy	1.54	ft
Froude Number	0.76	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.35	ft
Critical Depth	1.21	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.01801	ft/ft

Riprap Design MAJ
Marksheffel - South 3/5/2016
CV117

Instructions: Refer to Section 3.4.3.2 of Vol 2 in UD Manual. Enter values in blue cells. Green cells are calculated.

Outlet Pipe Information:

Type of Pipe: Circular
Storm Sewer Dia, D = 2 ft

Riprap Size:

Velocity = 6.36 ft/s [(1)]
Design Depth, d = 1.09 ft [(2)]
Gravity, g = 32.2 ft/s^2

Eqn: HS-16e

P_d = 8.69 ft/s

Use Figure HS-20c to find the size and type of riprap to use in the outlet protection basin.

Riprap Selection: **Type L**
Riprap Diameter, D_{50} = 9 inches

Riprap Minimum Thickness:

Eqn: HS-17

Thickness, T = 1.31 ft

Basin Dimensions:

Storm Sewer Dia, D = 2 ft

Length is defined as being the greater of the following:

L = 4D = 8 ft Eqn: HS-18
L = (D)^0.5(V/2) = 4.50 ft Eqn: HS-19
L = **8** ft

Width:
w = width of box culvert
W = 4D = 8 ft Eqn: HS-20 or HS-21

Cutoff Wall:
B = 2.31 ft Eqn: HS-22

(1) Obtain Velocity from Section 3.4.3.1 of Vol 2 in the UD Manual or program such as FlowMaster or StormCad

(2) Obtain flow depth from Section 3.4.3.1 of Vol 2 in the UD Manual or program such as FlowMaster or StormCad

Riprap Design MAJ

Marksheffel - South 3/5/2016

CV121

Instructions: Refer to Section 3.4.3.2 of Vol 2 in UD Manual. Enter values in blue cells. Green cells are calculated.

Outlet Pipe Information:

Type of Pipe:	Circular	
Storm Sewer Dia, D =	2	ft

Riprap Size:

Velocity =	6.23	ft/s [(1)]
Design Depth, d =	0.98	ft [(2)]
Gravity, g =	32.2	ft/s^2

Eqn: HS-16e

P_d =	8.39	ft/s

Use Figure HS-20c to find the size and type of riprap to use in the outlet protection basin.

Riprap Selection:	**Type L**	
Riprap Diameter, D_{50} =	9	inches

Riprap Minimum Thickness:

Eqn: HS-17

Thickness, T =	1.31	ft

Basin Dimensions:

Storm Sewer Dia, D =	2	ft

Length is defined as being the greater of the following:

L = 4D =	8	ft	Eqn: HS-18
L = (D)^0.5(V/2) =	4.41	ft	Eqn: HS-19
L =	**8**	ft	

Width:

w = width of box culvert			
W = 4D =	8	ft	Eqn: HS-20 or HS-21

Cutoff Wall:

B =	2.31	ft	Eqn: HS-22

(1) Obtain Velocity from Section 3.4.3.1 of Vol 2 in the UD Manual or program such as FlowMaster or StormCad

(2) Obtain flow depth from Section 3.4.3.1 of Vol 2 in the UD Manual or program such as FlowMaster or StormCad

Riprap Design MAJ
Marksheffel - South 3/5/2016
CV125

Instructions: Refer to Section 3.4.3.2 of Vol 2 in UD Manual. Enter values in blue cells. Green cells are calculated.

Outlet Pipe Information:

Type of Pipe: Circular

Storm Sewer Dia, D = 2 ft

Riprap Size:

Velocity = 6.01 ft/s (1)

Design Depth, d = 0.93 ft (2)

Gravity, g = 32.2 ft/s^2

Eqn: HS-16e

P_d = 8.13 ft/s

Use Figure HS-20c to find the size and type of riprap to use in the outlet protection basin.

Riprap Selection: **Type L**

Riprap Diameter, D_{50} = 9 inches

Riprap Minimum Thickness:

Eqn: HS-17

Thickness, T = 1.31 ft

Basin Dimensions:

Storm Sewer Dia, D = 2 ft

Length is defined as being the greater of the following:

L = 4D =	8	ft	Eqn: HS-18
L = (D)^0.5(V/2) =	4.25	ft	Eqn: HS-19
L =	**8**	ft	

Width:

w = width of box culvert

W = 4D = 8 ft Eqn: HS-20 or HS-21

Cutoff Wall:

B = 2.31 ft Eqn: HS-22

(1) Obtain Velocity from Section 3.4.3.1 of Vol 2 in the UD Manual or program such as FlowMaster or StormCad

(2) Obtain flow depth from Section 3.4.3.1 of Vol 2 in the UD Manual or program such as FlowMaster or StormCad

Riprap Design MAJ
Marksheffel - South 3/7/2016
CV168

Instructions: Refer to Section 3.4.3.2 of Vol 2 in UD Manual. Enter values in blue cells. Green cells are calculated.

Outlet Pipe Information:

Type of Pipe:	Circular	
Storm Sewer Dia, D =	2	ft

Riprap Size:

Velocity =	6.75	ft/s (1)
Design Depth, d =	0.86	ft (2)
Gravity, g =	32.2	ft/s^2

Eqn: HS-16e

P_d =	8.56	ft/s

Use Figure HS-20c to find the size and type of riprap to use in the outlet protection basin.

Riprap Selection:	**Type L**	
Riprap Diameter, D_{50} =	9	inches

Riprap Minimum Thickness:

Eqn: HS-17

Thickness, T =	1.31	ft

Basin Dimensions:

Storm Sewer Dia, D =	2	ft

Length is defined as being the greater of the following:

L = 4D =	8	ft	Eqn: HS-18
L = (D)^0.5(V/2) =	4.772970773	ft	Eqn: HS-19
L =	**8**	ft	

Width:

w = width of box culvert			
W = 4D =	8	ft	Eqn: HS-20 or HS-21

Cutoff Wall:

B =	2.31	ft	Eqn: HS-22

(1) Obtain Velocity from Section 3.4.3.1 of Vol 2 in the UD Manual or program such as FlowMaster or StormCad

(2) Obtain flow depth from Section 3.4.3.1 of Vol 2 in the UD Manual or program such as FlowMaster or StormCad

Riprap Design MAJ
Marksheffel - South 3/7/2016
CV177

Instructions: Refer to Section 3.4.3.2 of Vol 2 in UD Manual. Enter values in blue cells. Green cells are calculated.

Outlet Pipe Information:

Type of Pipe:	Circular	
Storm Sewer Dia, D =	3	ft

Riprap Size:

Velocity =	8.63	ft/s (1)
Design Depth, d =	2.15	ft (2)
Gravity, g =	32.2	ft/s^2

Eqn: HS-16e

P_d =	11.99	ft/s

Use Figure HS-20c to find the size and type of riprap to use in the outlet protection basin.

Riprap Selection:	**Type L**	
Riprap Diameter, D_{50} =	9	inches

Riprap Minimum Thickness:

Eqn: HS-17

Thickness, T =	1.31	ft

Basin Dimensions:

Storm Sewer Dia, D =	3	ft

Length is defined as being the greater of the following:

L = 4D =	12	ft	Eqn: HS-18
L = (D)^0.5(V/2) =	7.473799235	ft	Eqn: HS-19
L =	**12**	ft	

Width:

w = width of box culvert	5		
W = 4D =	12	ft	Eqn: HS-20 or HS-21

Cutoff Wall:

B =	2.81	ft	Eqn: HS-22

(1) Obtain Velocity from Section 3.4.3.1 of Vol 2 in the UD Manual or program such as FlowMaster or StormCad

(2) Obtain flow depth from Section 3.4.3.1 of Vol 2 in the UD Manual or program such as FlowMaster or StormCad

Riprap Design MAJ
Marksheffel - South 3/7/2016
CV177R

Instructions: Refer to Section 3.4.3.2 of Vol 2 in UD Manual. Enter values in blue cells. Green cells are calculated.

Outlet Pipe Information:

Type of Pipe:	Circular	
Storm Sewer Dia, D =	2	ft

Riprap Size:

Velocity =	6.27	ft/s [1]
Design Depth, d =	1.42	ft [2]
Gravity, g =	32.2	ft/s^2

Eqn: HS-16e

P_d =	9.22	ft/s

Use Figure HS-20c to find the size and type of riprap to use in the outlet protection basin.

Riprap Selection:	**Type L**	
Riprap Diameter, D_{50} =	9	inches

Riprap Minimum Thickness:

Eqn: HS-17

Thickness, T =	1.31	ft

Basin Dimensions:

Storm Sewer Dia, D =	2	ft

Length is defined as being the greater of the following:

L = 4D =	8	ft	Eqn: HS-18
L = (D)^0.5(V/2) =	4.433559518	ft	Eqn: HS-19
L =	**8**	ft	

Width:

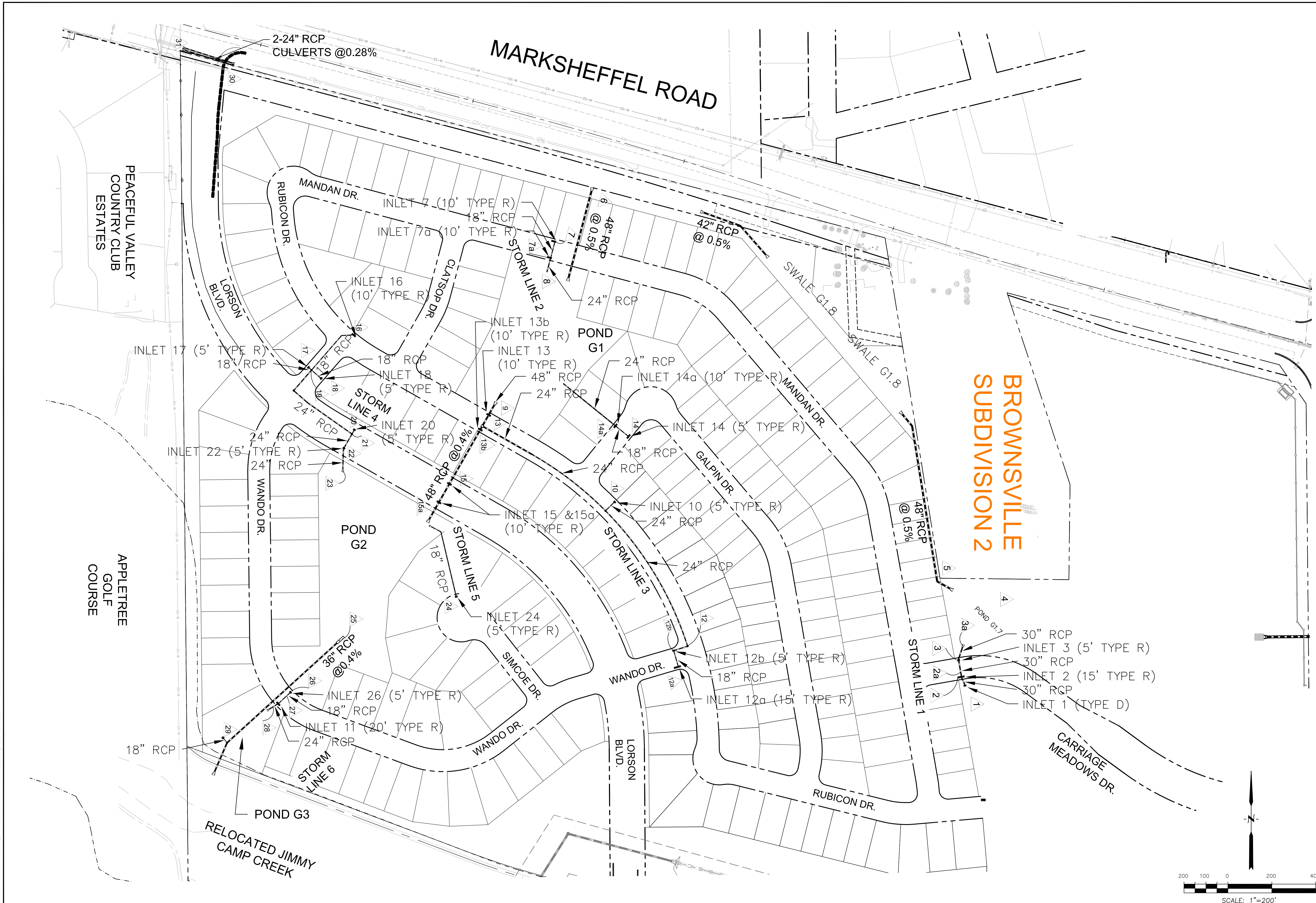
w = width of box culvert			
W = 4D =	8	ft	Eqn: HS-20 or HS-21

Cutoff Wall:

B =	2.31	ft	Eqn: HS-22

(1) Obtain Velocity from Section 3.4.3.1 of Vol 2 in the UD Manual or program such as FlowMaster or StormCad

(2) Obtain flow depth from Section 3.4.3.1 of Vol 2 in the UD Manual or program such as FlowMaster or StormCad



CORE
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PH: 719.570.1100
CONTACT: RICHARD L. SCHINDLER, P.E.
EMAIL: Rich@ceg1.com

NO.	DESCRIPTION	DATE

PREPARED FOR:
LORSON, LLC
212 N. WAHSATCH AVE., SUITE 301
COLORADO SPRINGS, COLORADO 80903
(719) 635-3200
CONTACT: JEFF MARK

PROJECT:
CARRIAGE MEADOWS SOUTH
AT LORSON RANCH
FONTAINE BLVD. — OLD GLORY DRIVE
EL PASO COUNTY, COLORADO

DRAWN: RLS
DESIGNED: LAB
CHECKED: LAB

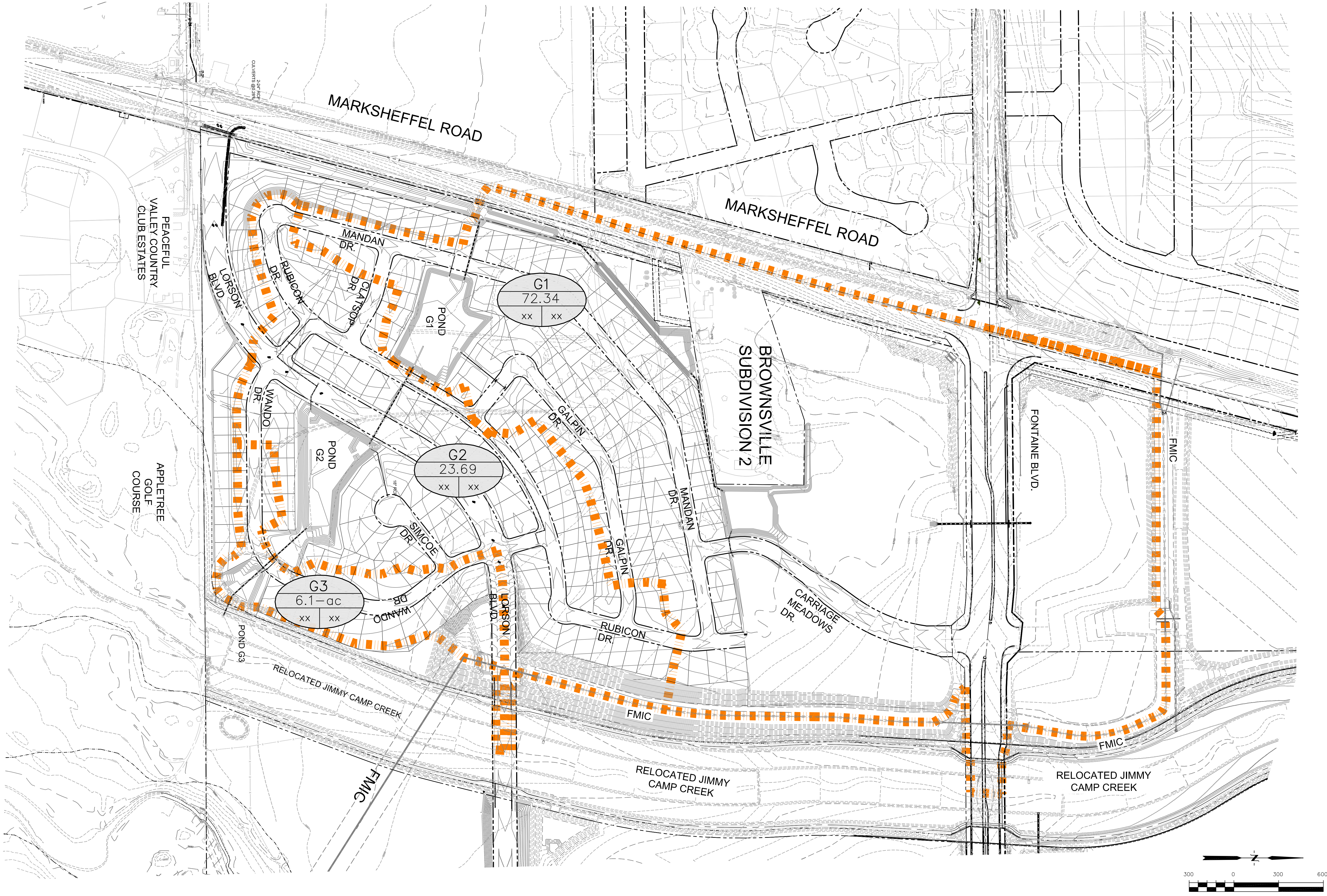
STORM SCHEMATIC
DRAINAGE PLAN
CARRIAGE MEADOWS SOUTH

DATE
JANUARY, 2017

PROJECT NO.
100.030

SHEET NUMBER
1

TOTAL SHEETS: 1



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(719) 635-3200
CONTACT: JEFF MARK

PROJECT:
CARRIAGE MEADOWS SOUTH FILING NO. 1
FONTAINE BLVD. – OLD GLORY DRIVE
EL PASO COUNTY, COLORADO

DRAWN: RLS
DESIGNED: LAB
CHECKED: LAB

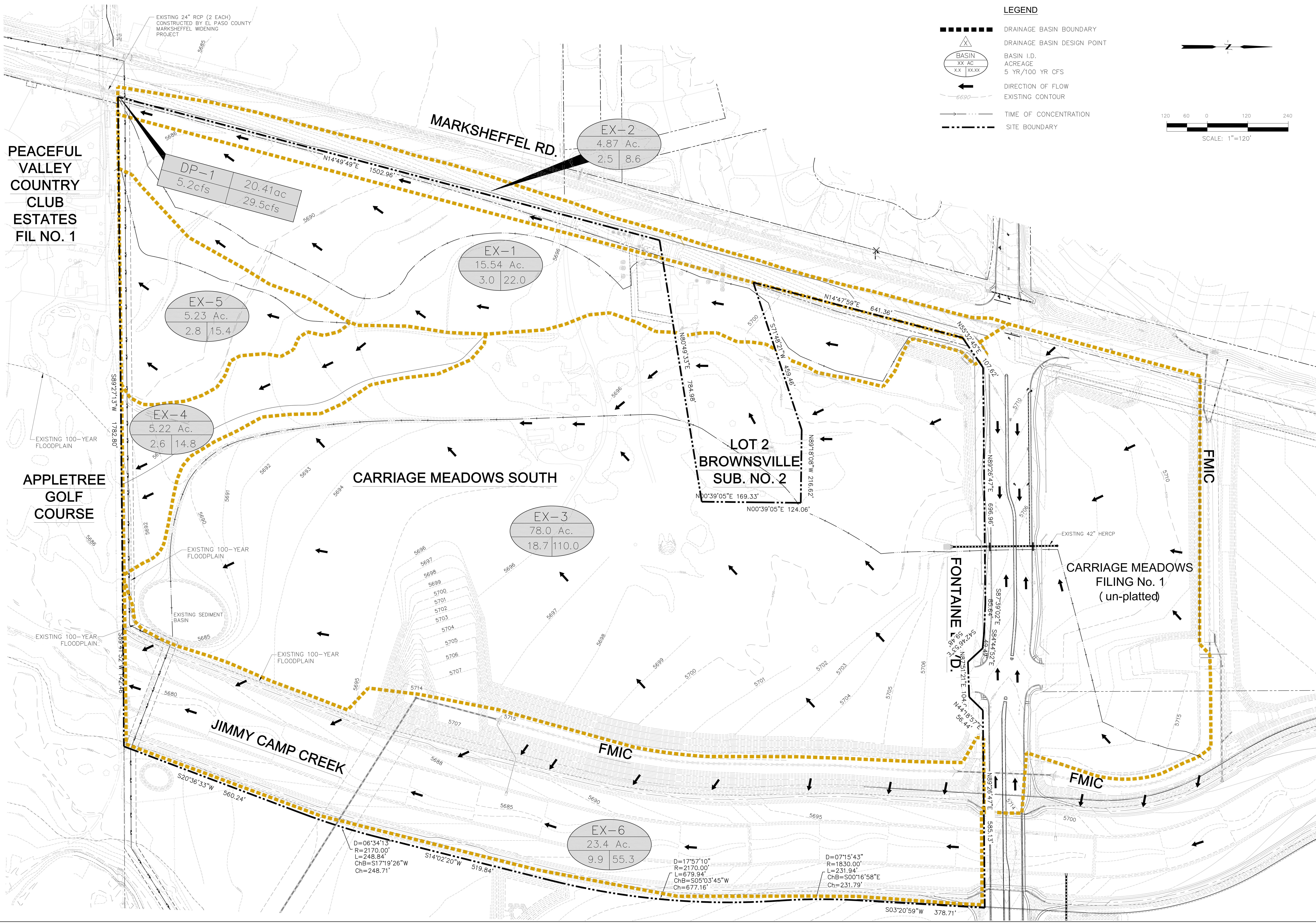
DETENTION POND WATERSHEDS
DRAINAGE PLAN
CARRIAGE MEADOWS SOUTH

DATE
JANUARY, 2017

PROJECT NO.
100.030

SHEET NUMBER
1

TOTAL SHEETS: 1



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NO.	DESCRIPTION	DATE

PREPARED FOR:
XXXX LLC
211 SMITH AVENUE
COLORADO SPRINGS, COLORADO 80903
(719) 635-3200
CONTACT: JOE SMITH

PROJECT:
CARRIAGE MEADOWS SOUTH
FONTAINE BLVD.-MARKSHEFFEL RD
COLORADO SPRINGS, COLORADO

DRAWN: LAB
DESIGNED: LAB
CHECKED: RLS

PRE-DEVELOPED CONDITIONS DRAINAGE PLAN
EL PASO COUNTY, COLORADO

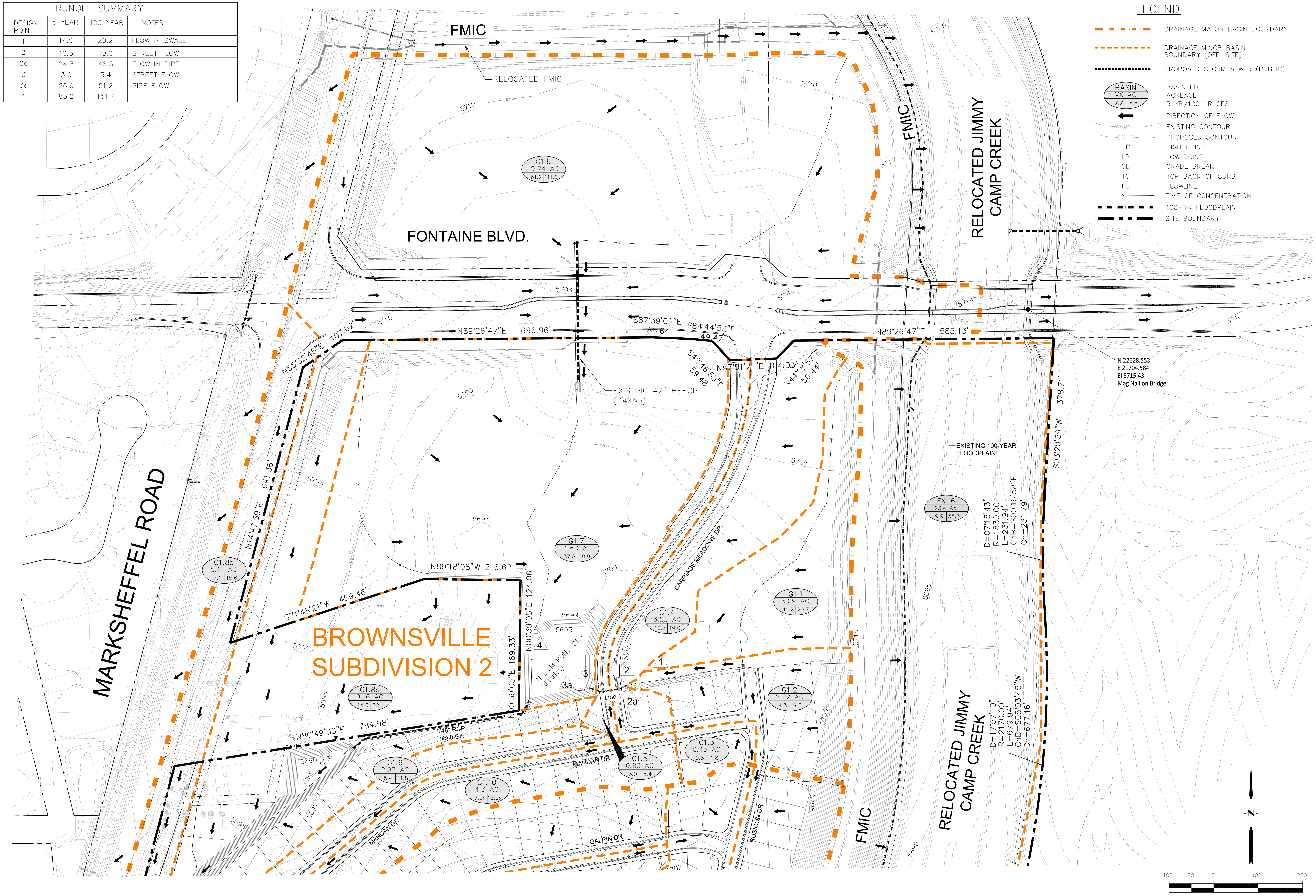
DATE: JANUARY, 2017

PROJECT NO. 100.030

SHEET NUMBER 1

TOTAL SHEETS: 1

RUNOFF SUMMARY			
DESIGN POINT	5 YEAR	100 YEAR	NOTES
1	14.9	29.2	FLOW IN SWALE
2	10.3	19.0	STREET FLOW
2a	24.3	46.5	FLOW IN PIPE
3	3.0	5.4	STREET FLOW
3a	26.9	51.2	PIPE FLOW
4	83.2	151.7	



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NO.	DESCRIPTION	DATE

PREPARED FOR:
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PROJECT:
CARRIAGE MEADOWS SOUTH FILING NO. 1
FONTAINE BLVD. - OLD GLORY DRIVE
EL PASO COUNTY, COLORADO

DRAWN: RLS
DESIGNED: LAB
CHECKED: LAB

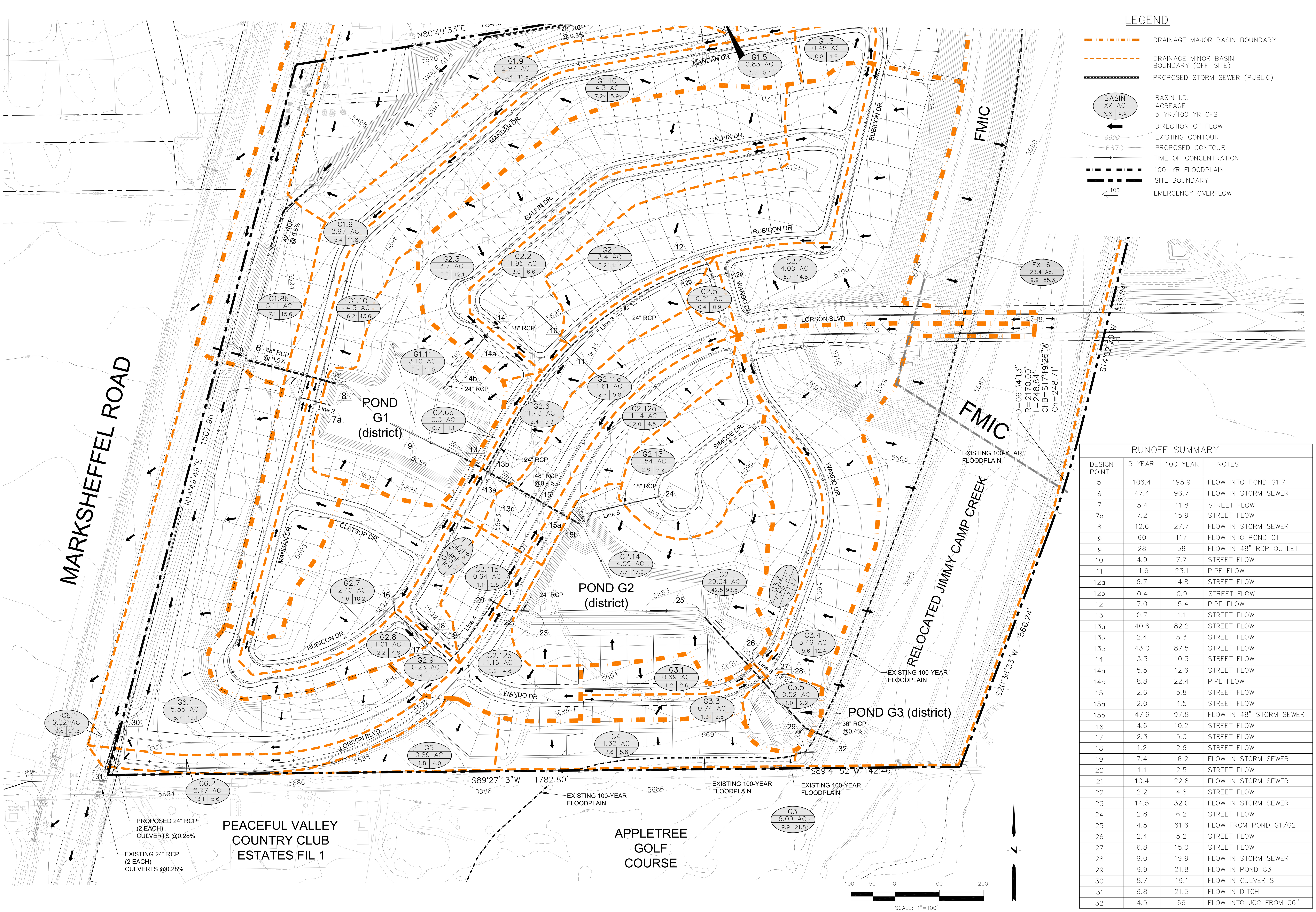
DEVELOPED CONDITIONS DRAINAGE PLAN CARRIAGE MEADOWS SOUTH

DATE
AUGUST, 2017

PROJECT NO.
100.030

SHEET NUMBER
1

TOTAL SHEETS: 2



RUNOFF SUMMARY			
DESIGN POINT	5 YEAR	100 YEAR	NOTES
5	106.4	195.9	FLOW INTO POND G1.7
6	47.4	96.7	FLOW IN STORM SEWER
7	5.4	11.8	STREET FLOW
7a	7.2	15.9	STREET FLOW
8	12.6	27.7	FLOW IN STORM SEWER
9	60	117	FLOW INTO POND G1
9	28	58	FLOW IN 48" RCP OUTLET
10	4.9	7.7	STREET FLOW
11	11.9	23.1	PIPE FLOW
12a	6.7	14.8	STREET FLOW
12b	0.4	0.9	STREET FLOW
12	7.0	15.4	PIPE FLOW
13	0.7	1.1	STREET FLOW
13a	40.6	82.2	STREET FLOW
13b	2.4	5.3	STREET FLOW
13c	43.0	87.5	STREET FLOW
14	3.3	10.3	STREET FLOW
14a	5.5	12.6	STREET FLOW
14c	8.8	22.4	PIPE FLOW
15	2.6	5.8	STREET FLOW
15a	2.0	4.5	STREET FLOW
15b	47.6	97.8	FLOW IN 48" STORM SEWER
16	4.6	10.2	STREET FLOW
17	2.3	5.0	STREET FLOW
18	1.2	2.6	STREET FLOW
19	7.4	16.2	FLOW IN STORM SEWER
20	1.1	2.5	STREET FLOW
21	10.4	22.8	FLOW IN STORM SEWER
22	2.2	4.8	STREET FLOW
23	14.5	32.0	FLOW IN STORM SEWER
24	2.8	6.2	STREET FLOW
25	4.5	61.6	FLOW FROM POND G1/G2
26	2.4	5.2	STREET FLOW
27	6.8	15.0	STREET FLOW
28	9.0	19.9	FLOW IN STORM SEWER
29	9.9	21.8	FLOW IN POND G3
30	8.7	19.1	FLOW IN CULVERTS
31	9.8	21.5	FLOW IN DITCH
32	4.5	69	FLOW INTO JCC FROM 36"

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DESIGNED: LAB
CHECKED: LAB

DEVELOPED CONDITIONS
DRAINAGE PLAN
CARRIAGE MEADOWS SOUTH

DATE
FEBRUARY, 2017

PROJECT NO.
100.030

SHEET NUMBER
2

TOTAL SHEETS: 2