SPRINGS AT WATERVIEW
PRELIMINARY and FINAL DRAINAGE REPORT
EL PASO COUNTY, COLORADO

February 2018

PREPARED FOR:

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PREPARED BY:

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PROJECT NO.16-01

PCD No. SP-16-005
PCD No. SF-16-017

CERTIFICATIONS

Design Engineer's Statement:

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

[signature]

Charles K. Cothern, P.E. #24997 Seal

COLORADO REGISTERED PROFESSIONAL ENGINEER CHARLES K. COTHERN 24997

Owner/Developer's Statement:

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

By (signature): [signature] Date: 6/21/18

Title: MANAGER

Address: 31 N. TEJON ST #500
Co. SPR., Co. 80903

El Paso County:

Filed in accordance with the requirements of the El Paso County Land Development Code, Drainage Criteria Manual Volumes 1 and 2, and the Engineering Criteria Manual, as amended.

Jennifer Irvine, P.E.,
County Engineer / ECM Administrator

Date

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Appendix

1.0 INTRODUCTION

The Springs at Waterview area has been studied as part of the Windmill Gulch Drainage Basin Planning Study (DBPS) by Wilson and Company. This site has been analyzed in the Master Drainage Development Plan for Waterview by Merrick and Company. A Preliminary Drainage Report has also been prepared for Waterview Phase II by Merrick and Company of Colorado Springs, as well as a Final Drainage Report for Filings 1 and 2 by Merrick and Company. The subject area is located south of the Colorado Springs Airport, and northwest of Big Johnson Reservoir, Colorado.

Purpose

The purpose of this report is to present the preliminary and final drainage improvements associated with the construction of Springs at Waterview.

In addition, this report provides documents related to issuance of an Early Grading Permit including calculations for a sedimentation pond and an exhibit depicting the drainage area and size. The remaining Early Grading Permit documents; SWMP, Financial Assurance, etc. are being submitted simultaneously.

Runoff quantities and proposed facilities have been calculated using the current City of Colorado Springs/El Paso County Drainage Criteria Manual (DCM).

2.0 General Location and Description

Location

Springs at Waterview is a planned 85 unit multi-family residential development within the north half of the northeast quarter of Section 7, Township 15 South, Range 65 West of the 6th Principal Meridian, in El Paso County, Colorado. It is located south of Goldfield Drive, east of Grinnell Boulevard, north of Bradley Road and west of Painted Sky at Waterview Filing No. 1. This portion of the Waterview development is in the Windmill Gulch Drainage Basin.

Description of Property

The proposed site encompasses 15.68 acres. The topography of the site and surrounding area is typical of a high desert; short prairie grass and weeds with slopes generally ranging from 1% to 9%. The area generally drains to the west.

The site is comprised of several different soil types. From the Soil Survey of El Paso County, the site falls into the following soil types:

1. “3” Ascalon sandy loam, 3 to 9 percent slopes.
2. “8” Blakeland loamy sand, 1 to9 percent slopes.
3. “97” Truckton sandy loam, 3 to 9 percent slopes.

The Blakeland and Truckton soils are classified at Hydrological Group A and the Ascalon soil is classified as Hydrological Group B. Note: “#” indicates Soil Conservation Survey soil classification number. See Appendix A: Soils Data.

Climate

Mild summers and winter, light precipitation; high evaporation and moderately high wind velocities characterize the climate of the study area.

The average annual monthly temperature is 48.4 F with an average monthly low of 30.3 F in the winter and an average monthly high of 68.1 F in the summer. Two years in ten will have a maximum temperature higher than 98 F and a minimum temperature lower than –16 F. Precipitation averages 15.73 inches annually, with 80% of this occurring during the months of April through September. The average annual Class A pan evaporation is 45 inches.

Utilities and other Encumbrances

The site is currently undeveloped. There is an existing sanitary sewer main crossing the site, which services Painted Sky Filings No.1 and No. 2 to the east of the project site. There are no other known utilities or other encumbrances on the site.

3.0 Drainage Basins and Sub-Basins

Major Basin Description

Springs at Waterview residential development is located within the Windmill Gulch Drainage Basin. This report complies with the Windmill Gulch Drainage Basin Planning Study (DBPS) by Wilson and Company, the Master Development Drainage Plan for Waterview by Merrick and Company, the Preliminary Drainage Report for Waterview Phase II, also by Merrick and Company and Painted Sky at Waterview Filing 1 and 2 Final Drainage Report by Merrick and Company. All developed runoff will meet El Paso County standards for discharge rates.

Floodplains

The Flood Insurance Rate Map (FIRM No. 08041C0764-F dated 3/17/97) indicates that there is no floodplain in the vicinity of the proposed site. See Figure 2: FIRM.

4.0 DRAINAGE DESIGN CRITERIA

Development Criteria Reference

The City of Colorado Springs/El Paso County Drainage Criteria Manual (DCM) was used in preparation of this report. Additional preliminary and final drainage plans, master development drainage plans and drainage basin planning studies used in the preparation of the report are listed in the References Section.

Hydrologic Criteria

Rational Method

Because Springs at Waterview is less than 100 acres, the rational method was used to determine onsite flows, and to size inlets and ditches, as required by the current City of Colorado Springs/El Paso County Drainage Criteria Manual (DCM). Both the 5-year and 100-year storm events were considered in this analysis. Runoff coefficients appropriate to the existing and proposed land uses were selected for an

SCS type “B” soil from Table 5-1 of the DCM. The existing runoff coefficients for this site are C_5=0.08 and C_{100}=0.35 based on existing pasture land. The DBPS, the MDDP, and the PDR for Waterview Phase II used existing coefficients of 0.35 and 0.55. The runoff coefficients for the developed residential lots are C_5=0.49 and C_{100}=0.60 based on multi-family acre lots. The time of concentration was calculated per DCM requirements and intensities for each basin were calculated from storm intensity curve formulas provided by the City of Colorado Springs. Rational Method results are shown in Appendix B (Existing) and C (Proposed).

5.0 DRAINAGE BASINS

The basin descriptions for Springs at Waterview are as follows.

Offsite Basins

There are no off site basins which contribute flows to the proposed Springs at Waterview, however there are 3 separate sets of storm systems which release flows into the site. These will be addressed later in the report.

Historic Drainage Analysis

The proposed site was studied in the Windmill Gulch Drainage Basin Planning Study (DBPS), Master Development & Drainage Plan for Waterview (MDDP) and in the Preliminary Drainage Report for Painted Sky at Waterview Phase II. Efforts have been made to comply with the recommendations set forth in the approved DBPS and MDDP. The existing analysis addresses the current situation, which includes the construction of Filings No. 1 & No. 2.

Existing Drainage Analysis

- Basin E-1 (12.6 acres) is undeveloped and is approximately the northern two-thirds of the site. Flows are conveyed to the west where they are intercepted by an existing 72” rcp under Grinnell Boulevard. Flows from the basin are 3.3 cfs for the 5-year event and 25.0 cfs for the 100-year event.

- Basin E-2 (8.61 acres) is the south portion of the site. Flow is conveyed to the west where it enters an existing roadside ditch along Grinnell Blvd to the existing low point in the road. Flooding of Grinnell Boulevard has been observed at this low point during significant storm events; the ponded water eventually discharges to the existing 72” rcp to the north under Grinnell Boulevard. Runoff produced from this basin are 1.9 cfs and 14.8 cfs for the 5-year and 100-year storms.

Existing Design Points

These design points correspond to the same design points in the FDR for Filings No. 1 and 2 of Painted Sky.

- DP-42a (Q_5=12.4, Q_{100}=38.2) is the combined flows from Basin E-2 with the released flow from the storm system in Bradley Road. The design point is an existing low point in Grinnell Blvd where flows will pond in the roadway and eventually enter the existing pond on the west of the road via the existing 72: rcp.

- DP-43 (Q_5=44.3, Q_{100}=112.7) is combined flows from Basin E-1 and the released flow from the existing storm system at the north end of the site under Goldfield Drive and the storm system which releases on the east side of the project from Escanaba Drive. Flows are conveyed under Grinnell Blvd via a 72" rcp.

Proposed Drainage Analysis

- Basin D-1 (0.31 acres) is located at the northern boundary of the site, just south of Goldfield Drive. Flows are released into Goldfield Drive where they are intercepted by an existing inlet. Runoff produced in this basin is 0.7 cfs and 1.6 cfs for the 5 and 100-year events. Currently, there is existing asphalt rundown which was constructed as part of Painted Sky Filing No. 1. According to the FDR for Painted Sky, this structure will collect any flow by from the existing inlet and is to remain in place until the intersection at Grinnell Boulevard and Goldfield Drive is improved; once this intersection is improved the "flow by" will be carried in Grinnell Boulevard curb and gutter.

- Basin D-2 (0.20 acres) is located at the eastern corner of the site, which drains to Escanaba Drive and is intercepted by an existing inlet. Flows from the basin are 0.4 cfs for the 5-year event and 1.0 cfs for the 100-year event.

- Basin D-3 (0.35 acres) is the western portion of Escanaba Drive north of Dancing Moon Way. An existing inlet in Escanaba Drive intercepts the street flow at DP-11. Runoff produced in this basin is 1.6 cfs and 3.1 cfs for the 5 and 100-year storms.

- Basin D-3a (0.28 acres) is the western portion of Escanaba Drive south of Dancing Moon Way. An existing inlet in Escanaba Drive intercepts the street flow at DP-32 per the Painted Sky Filing No. 1 FDR. Part of the design for Painted Sky Filing No. 1 was a curb at the westerly end of Painted Sky tall enough to insure the storm runoff was directed north to the existing Painted Sky Filing No. 1 at DP 32. Springs at Waterview construction will not change this storm routing in that the curb will be left in place as is; no modification to allow access to Escanaba Drive from the Springs at Waterview lots is proposed. Runoff produced in this basin is 1.3 cfs and 2.4 cfs for the 5 and 100-year storms.

- Basin D-4 (0.11 acres) is south of Basin D-3a. Flow is conveyed to the south in Escanaba Drive to DP-41. This basin creates 0.5 cfs for the 5-year storm and 1.0 cfs for the 100-year storm.

- Basin D-5 (0.31 acres) is between Basins D-17 and D-4 and is located between Passing Sky Drive and Escanaba Dr. Flows will continue towards the west as gutter flow in Bradley Road to DP-K. Flows from this basin are 0.8 cfs for the 5 year storm and 1.9 cfs for the 100 year storm.

- Basin D-6 (0.07 acres) is the west portion of Road A that releases into Bradley Road. Flows will be conveyed to the west in Bradley Road to DP-K. This basin produces 0.3 cfs and 0.6 cfs for the 5 and 100 year storm events.

- Basin D-7 (2.35 acres) is north of D-6 and between Escanaba Drive and Road A. Flow is conveyed as gutter flow in Road A to the north to a proposed on-grade inlet. Flows from this basin are 3.4 cfs for the 5 year storm and 7.9 cfs for the 100 year storm.

- Basin D-8 (1.10 acres) is north of D-7 between Escanaba Drive and Road A. Flows will be carried through curb and gutter to the north to a proposed on-grade inlet. This basin generates 2.1 cfs and 4.9 cfs for the 5 and 100 year storms.

- Basin D-9 (0.47 acres) is north and half of Road A. Runoff is conveyed as gutter flow to the south to a proposed on-grade inlet. Flow for this basin is 1.9 cfs for the minor storm and 3.5 cfs for the major storm.

- Basin D-10 (0.29 acres) is the south and west half of Road A. Flows are conveyed to the north via curb and gutter to a proposed on-grade inlet. Flows from the basin are 1.2 and 2.3 cfs for the 5 and 100-year storms.

- Basin D-11 (1.53 acres) contains the north and east portion of Passing Sky Drive. Basin flows are conveyed via curb and gutter to the south. There will be cross lot drainage for this basin. Small lot swales will be constructed along the property lines between lots to keep flows directed away from structures and towards the proposed roads. This basin produces 2.5 cfs for the 5-year storm and 5.9 cfs for the 100-year storm.

- Basin D-11a (1.43 acres) is south of Basin D-11 and north of Road B. Basin flows are conveyed via curb and gutter to the south. There will be cross lot drainage for this basin. Small lot swales will be constructed along the property lines between lots to keep flows directed away from structures and towards the proposed roads. This basin produces 2.4 cfs for the 5-year storm and 5.6 cfs for the 100-year storm.

- Basin D-12 (0.18 acres) is a portion of the site that releases into the north half of Road B. Runoff produced from this basin is 0.6 cfs and 1.2 cfs for the 5 and 100-year storms.

- Basin D-13 (0.23 acres) is the south half of Road B. Basin flow is conveyed via curb and gutter to the west. Flows from this area are 0.8 cfs for the 5-year event and 1.6 cfs for the 100-year event.

- Basin D-14 (1.70 acres) is the south and east portion of Passing Sky Way. There will be cross lot drainage for this basin. Small lot swales will be constructed along the property lines between lots to keep flows directed away from structures and towards the proposed roads. This basin produces 2.6 cfs and 5.9 cfs for the 5 and 100-year storms.

- Basin D-14a (1.05 acres) is north of D-14 and the east portion of Passing Sky Way. There will be cross lot drainage for this basin. Small lot swales will be constructed along the property lines between lots to keep flows directed away from structures and towards the proposed roads. This basin produces 1.7 cfs and 4.0 cfs for the 5 and 100-year storms.

- Basin D-15 (0.65 acres) is the south and west portion of Passing Sky Way. Flow will be conveyed as gutter flow to the north to a proposed on-grade inlet. This basin produces 1.9 cfs and 3.6 cfs for the 5 and 100-year storms.

- Basin D-16 (0.48 acres) is the west half of Passing Sky Way north of Road B. Flows are conveyed as gutter flow to the south to a proposed on-grade inlet. This basin has a 5-year flow of 1.3 cfs and a 100-year flow of 2.5 cfs.

- Basin D-17 (1.80 acres) is north of Basin D-16 and D-18. Runoff is conveyed to the west towards a proposed area inlet. Flows in this basin are 3.1 cfs and 7.1 cfs for the 5 and 100-year storms.

- Basin D-18 (1.56 acres) is located along the western side of the site, where it is intercepted by a proposed area inlet. This basin produces 4.0 cfs and 9.2 cfs for the 5 and 100-year storms.

- D-21 (0.64 acres) is located along the western side of Escanaba Dr, where it is intercepted by an existing Type R inlet. This area has a 5-year flow of 1.3 cfs and a 100-year flow of 2.7 cfs.

- Basin D-19 (4.80 acres) is the south half of the site along the western boundary at Grinnell Boulevard. Flow is conveyed as surface flow towards the west. This basin does include flows from the eastern half of Grinnell Blvd. Flows from this basin are 6.1 cfs for the 5-year storm and 14.2 cfs for the 100-year storm. Surface flows from the east are intercepted by Type D inlets. When Grinnell Boulevard is reconstructed in the future the Grinnell Boulevard storm sewer collection system will collect storm water from Grinnell Boulevard and convey it west to the 72-inch existing storm sewer on the west side of Grinnell Boulevard and then on to the detention pond.

Proposed Design Points

- DP-11 (Q_5=1.6, Q_{100}=3.1) contains Basin D-3. Flow is intercepted by an existing Type R inlet in Escanaba Dr.

- DP 32 (Q_5=1.3, Q_{100}=2.4) contains Basin D-3a. Flow is intercepted by an existing Type R inlet in Escanaba Dr.

- DP-A (Q_5=0.3, Q_{100}=4.3) combines flow-by from on-grade inlets in Basins D-7 and D-8. A proposed sump inlet will intercept these flows.

- DP-B (Q_5=0.8, Q_{100}=2.3) combines Basin D-12 with flow-by from the on-grade inlet in D-9. An on-grade Type R inlet intercepts this flow. Flow by continues to the west.

- DP-C (Q_5=0.8, Q_{100}=2.1) combines Basin D-13 with flow-by from the on-grade inlet in Basin D-10. An on-grade Type R inlet intercepts the flow. Any by-pass flow will continue via curb and gutter to the west.

- DP-D (Q_5=2.4, Q_{100}=6.7) is Basin D-11 combined with the flow-by from on-grade inlets in Basin D-11 and DP-B. Flow will be to the south to an on-grade inlet at the northeast corner of Passing Sky Way.

- DP-E (Q_5=1.6, Q_{100}=4.7) is Basin D-14a combined with the flow-by from the on-grade inlets in Basin D-14 and DP-C. Flow will be intercepted by an on-grade inlet at the southeast corner of Passing Sky Way.

- DP-F (Q_5=0.2, Q_{100}=3.1) is the flow-by from on-grade inlets in Basins D-15 and D-16 along with DP-D and DP-E. Flow is intercepted by a sump Type R inlet.

- DP-G (Q_5=3.1, Q_{100}=7.1) is Basin D-17. An area inlet intercepts this flow.

- DP-K (Q_5=11.5, Q_{100}=24.1) combines Basins D-5 and D-6 and the existing storm system from Bradley Road. Flow will be conveyed thru a drainage swale to an area inlet at DP-42a.

- DP-39 (Q_5=1.1, Q_{100}=2.5) combines flow from Basins D-1 and D-2. An existing inlet in Goldfield Drive will intercept this flow.

- DP-41 (Q_5=0.5, Q_{100}=1.0) is flow from Basin D-4. An existing inlet in Escanaba Drive will intercept the flow.

- DP-42a (Q_5=11.9, Q_{100}=26.3) is flow from Basin D-19 combined with DP-K. An area inlet will be used to intercept the flow.

- DP-43 (Q_5=4.0 Q_{100}=92.0) is the surface flow from Basin D-19. These flows will be intercepted by an area inlet and will connect to the existing 72" rcp. The release flow at this location is the combined flows from Basin D-19 with Design Points 42a, and Filing No. 1 design Points 31, 38, 39 and 41 along with all intercepted flows on site.

Proposed Storm System

There are three existing storm sewers that discharge onto the site and one existing system that releases flow offsite under Grinnell Boulevard. This report proposes that the three storm systems be extended and incorporated into the drainage plan for the subject property. The three existing storm systems include:

1) An existing 48-inch RCP that discharges from Escanaba Drive midway along the eastern boundary of the property. This pipe is the discharge point for drainage from Painted Sky Filings No. 1 and No. 2.

2) An existing 48-inch RCP that discharges into the northwesterly corner of the site. This storm system drainage the westerly portion of Goldfield Drive up to Grinnell Boulevard.

3) An existing 24-inch RCP that discharges into the southwestern corner of the property near the Grinnell Boulevard r.o.w. This storm system drains the north half of Bradley Road east of Grinnell Boulevard.

The system releasing offsite includes:

4) An existing 72-inch RCP that drains the site west under Grinnell Boulevard. Storm water discharge from storm systems 1 through 3 generally drain by overland flow to the existing 72-inch for conveyance under Grinnell Boulevard.

The general concept is to extend each of storm systems 1 through 3 to convey flow directly to the 72-inch pipe while collecting additional site flow.

The proposed storm system will collect flows from the 3 proposed roads. Several on-grade and sump inlets will be installed to collect flows. On-grade inlets will be installed along Passing Sky Way and Road A to ensure gutter flow does not exceed capacity, until flows can reach and be intercepted by sump inlets. The existing storm systems from Escanaba Drive, Goldfield Drive and Bradley Road (existing storm systems 1, 2 and 3) will connect to this new system. The existing 72" culvert under Grinnell Blvd will extend east to provide an outlet for this system, releasing flows into the detention pond on the west side of Grinnell Blvd.

The extension of existing Storm System 2 south from Goldfield Drive and the extension of existing storm system 3 north from Bradley Road will be located within the Grinnell Boulevard existing r.o.w. Due to existing water and sewer utilities the alignment of this storm sewer will be between the future projected back of curb and the easterly r.o.w. line.

The extension of storm system 3 from Bradley road north will include a pipe stub and flared end section from Manhole No. 2 to provide some interim (prior to expansion and reconstruction of Grinnell Boulevard) relief to the existing ponding conditions at the low point of Grinnell Boulevard on the east side particularly during minor storms.

When Grinnell Boulevard is expanded to include additional laneage, curb and gutter and storm water collection systems the interim drain pipe at Manhole No. 2 will be eliminated; storm water from Grinnell Boulevard should be collected and conveyed to the west side of Grinnell prior to connection to the existing 72-inch RCP.

Refer to the storm CAD analysis in Appendix D for results.

6.0 DRAINAGE FACILITY DESIGN

General Concept

Springs at Waterview is located completely within the Windmill Gulch Drainage Basin. The site drains westerly, storm flow is collected by a series of inlets and storm pipes, conveyed to an existing 72-inch RCP that conveys storm flow under Grinnell Boulevard where it eventually releases into the existing water quality pond, which releases into the existing detention pond previously constructed for development of Painted Sky Filings No. 1 and No. 2 west of Grinnell Blvd.

Early Grading Permit

This Drainage Report, the accompanying Grading and Erosion Control Plan and SWMP provides for issuance of an Early Grading Permit. The early grading GEC and permanent GEC pond both have one sedimentation basin located just upstream of the existing 72-inch culvert under Grinnell Boulevard. The sedimentation basin drains approximately 15 acres of the site. The basin will be 54000 cf or 1.3 acre-ft.

(3600 cf per acre x 15 =54000 cf) See the exhibit at the end of the text for the location as well as the Grading and Erosion Control Plan.

Downstream Facilities

The downstream facility for this site is an existing 72-inch RCP pipe under Grinnell Boulevard and an existing detention pond west of Grinnell Blvd. The pond was designed to capture the flows from the Waterview development; specifically, Painted Sky Filing No. 1 and No. 2, including the subject property. The proposed drainage of the site is in conformance with the MDDP for Waterview.

Detention/Water Quality Ponds

Water quality and detention has already been constructed for this development. The water quality pond was designed and constructed as part of the Painted Sky Filing No. 1 and No. 2 developments. The WQ pond was built prior to the approval of the FDR for Painted Sky Filings No. 1 and No. 2, as part of the over lot grading for the site. The detention pond (Windmill Gulch Detention Pond #4) was built under the construction drawings provided by Kirkham Michael, which were approved by El Paso County on July 5, 2001. The two existing facilities on the west side of Grinnell Blvd provide detention and water quality for the entire Waterview development area, as discussed in the Windmill Gulch DBPS and the FDR for Painted Sky at Waterview Filings 1 and 2. The WQ pond is maintained by the Waterview I Metropolitan District.

The water quality pond in the FDR for Filings No. and No. 2 was determined to be 2.285 ac-ft. based on 65.15% imperviousness. Based on the new imperviousness for Springs at Waterview, the overall imperviousness has changed to 62.3% (See below calculations); the volume necessary for the water quality pond is 1.825 ac-ft. Current survey information shows that the pond has a volume of 3.06 ac-ft., which is sufficient volume for either design. The UDFCD SDI spreadsheet has been included in the appendix for verification that the WQ pond is in compliance with the current criteria.

In the FDR for Filings No. 1 and No.2, the water quality pond was designed for an area of 89.69 acres with a 65.15% imperviousness. Springs at Waterview is 15.68 acres of single family development, Filing No. 1 is 33.29 acres of single family development and Filing No. 2 is 18.59 acres of single family development. Total area east of Grinnell Boulevard draining to the existing WQ pond is 67.56 acres; the remaining acreage draining to the WQ pond is west of Springs at Waterview and is estimated to be an additional 22.13 acres (89.69 – 67.56 area). About 23 acres of the 89.69 acres was assumed to be commercial and 11 acres was assumed to be multifamily.

Springs at Waterview was planned to be 5 acres of commercial and 10.69 acres of multifamily; using imperviousness of 95% and 65%, the average imperviousness for the Springs at Waterview site would have been 75%. As a single family site based on the 85 lot design, the imperviousness for the 15.68 acres is estimated to be 48.89% (see calculation below in the drainage fee section). This is a significant drop in the imperviousness of the 15.68 acre site and reduces the overall imperviousness of the 89.69 acres draining to the WQ pond from 65.15% to 62.3%:

(89.69 -15.68) x 65.15%	= 48.2 impervious acres	
15.68 x 48.89%	= <u>7.7</u> impervious acres	
	55.9 impervious acres	55.9/89.69 = 62.3%

Since the overall impervious area is considerably less than the original design of the WQ pond, it is more than adequate to treat the design flow with the development of the Springs at Waterview site, as it was designed to do.

Four Step Process

In accordance with the El Paso County Engineering Criteria Manual, Appendix I this site has implemented the four step process to minimize adverse impacts of urbanization and helps with the management of smaller, frequently occurring events. The four step process includes reducing runoff volumes, treating and slowly releasing the water quality capture volume (WQCV), stabilizing drainageways, and consideration of the need for industrial and commercial BMPs.

In order to reduce runoff volume, the overall impervious area for the site was reduced from previous reports.

The WQCV is treated through an extended detention basin. The UDFCD SDI spreadsheet was used to verify that the existing WQ pond meets current criteria for water quality requirements. Existing drainageways will be maintained in their current condition to help with overall site impacts. These facilities are upstream of the development, so there are no impacts to these channels due to the development of this project. Downstream of the project, all flows enter into existing storm systems, which have been designed for this site to be developed. Therefore, those downstream channel/facilities would also not see any increase or adverse effects to their functionality.

Some site-specific source control BMPs that will be implemented include, but are not limited to, silt fencing placed around downstream areas of disturbance, construction vehicle tracking pads at the entrances, designated concrete truck washout basin, designated vehicle fueling areas, covered storage areas, spill containment and control, etc.

7.0 DRAINAGE FEES, COST ESTIMATE & MAINTENANCE

Maintenance

The streets and major improvements within this site will be dedicated and maintained by El Paso County. This includes the roads and drainage facilities. The remaining utilities (gas, phone, electric, cable, etc.) will be owned and maintained by their respective companies. Easements will be issued to ensure each entity is able to access and maintain their facilities.

Drainage Fees

The proposed development falls within the Windmill Gulch Basin. The entire development occupies approximately 15.68 acres. The current development consists of 2.71 acres of right-of-way, 0.59 acres of open tracts and 12.39 acres of residential lots. From the preliminary plan, the maximum coverage allowed per lots is 40%.

Average Residential Imperviousness = 40 %

R.O.W. area 2.71 acres; imperviousness 100 %

Tract area 0.59 acres; imperviousness 0 %

Average imperviousness for developed area:

(0.40 x 12.39) + (1.0 x 2.71)/(15.68) = 0.4889 = 48.89%. The impervious area that the fees will be based on is 7.67 acres (15.68 x 48.89%)

2017 Drainage fees in the Windmill Gulch Basin are $16,270 and bridge fees are $244. The calculated fees due will be as follows:

Drainage Fees: $124,791 (7.67 x $16,270)

Bridge Fees: $1871 (7.67 x $244)

Proposed Facilities Estimate

		UNIT		ITEM
ITEM	**UNITS**	**COST**	**QUANTITY**	**COST**
GRADING AND EROSION CONTROL				
CURB BACKFILL	LF	$ 2.50	4235	$ 10,588
MISC SEEDING AND MULCH	AC	$ 3,500.00	2	$ 7,000
HAY BALE CHECKS	EA	$ 10.00	50	$ 500
VEHICLE TRACKING CONTROL	EA	$ 1,500.00	2	$ 3,000
SILT FENCING	LF	$ 5.00	1,210	$ 6,050
INLET PROTECTION	EA	$ 300.00	11	$ 3,300
SUBTOTAL GRADING & EROSION CONTROL				**$ 30,438**
DRAINAGE				
18” RCP	LF	$ 75.00	464	$ 34,800
24” RCP	LF	$ 100.00	178	$ 17,800
30” RCP	LF	$ 125.00	36	$ 4,500
48” RCP	LF	$ 225.00	945	$ 212,625
66” RCP	LF	$ 350.00	178	$ 61,950
72” RCP	LF	$ 475.00	154	$ 73,150
5’ Type R Inlet	EA	$ 5,000.00	7	$ 35,000
10’ Type R Inlet	EA	$ 6,800.00	7	$ 47,600
Type D Inlet	EA	$ 8,000.00	1	$ 8,000
Type D Inlet - Double	EA	$ 13,000.00	2	$ 26,000
Storm Manholes	EA	$ 7,000.00	4	$ 28,000
SUBTOTAL DRAINAGE				**$ 506,585**
SUBTOTAL DRAINAGE & GRADING/EROSION CONTROL				**$ 537,023**
ENGINEERING (10%)				$ 53,702
CONTINGENCY (25%)				$ 134,256
TOTAL				***$ 724,981***

8.0 EROSION CONTROL

General Concept

During construction, best management practices for erosion control will be employed based on El Paso County criteria and the erosion control plan. The erosion control plan is included at the end of this report.

Ditches will be designed to meet El Paso County criteria for slope and velocity, keeping velocities below scouring levels.

During construction, best management practices (BMP) for erosion control will be employed based on El Paso County Criteria. BMP's will be utilized as deemed necessary by contractor and/or engineer and are not limited to measure shown on construction drawing set. The contractor shall minimize amount of area disturbed during all construction activities.

In general the following shall be applied in developing the sequence of major activities:

- Install downslope and side slope perimeter BMP's before the land disturbing activity occurs.
- Do not disturb an area until it is necessary for the construction activity to proceed.
- Cover or stabilize as soon as possible.
- Time the construction activities to reduce the impacts from seasonal climatic changes or weather events.
- The construction of filtration BMP's should wait until the end of the construction project when upstream drainage areas have been stabilized.
- Do not remove temporary perimeter controls until after all upstream areas are stabilized.

Silt Fence

Silt fence will be placed along downstream limits of disturbed areas. This will prevent suspended sediment from leaving the site during infrastructure construction. Silt fencing is to remain in place until vegetation is reestablished.

Erosion Bales

Erosion bales will be placed ten (10) feet from the inlet of all culverts and inlets during construction to prevent culverts from filling with sediment. Erosion bales will remain in place until vegetation is reestablished in graded roadside ditches. Erosion bale ditch checks will be used on slopes greater than 1% to reduce flow velocities until vegetation is reestablished.

Vehicle Tracking Control

This BMP is used to stabilize construction entrances, roads, parking areas and staging areas to prevent the tracking of sediment from the construction site. A vehicle tracking control (VTC) is to be used at all locations where vehicles exit the construction site onto public roads, loading and unloading areas, storage and staging areas, where construction trailers are to be located, any construction area that receives high vehicular traffic, construction roads and parking areas. VTC's should not be installed in areas where soils erode easily or are wet.

9.0 REFERENCE MATERIALS

1. “City of Colorado Springs/El Paso County Drainage Criteria Manual” May 2014.

2. “Windmill Gulch Drainage Basin Planning Study”, Wilson and Company, February 1992.

3. Master Development Drainage Plan for Waterview, May 2006. Prepared by Merrick & Co.

4. Preliminary Drainage Report for Waterview Phase II, January 2007. Prepared by Merrick & Co.

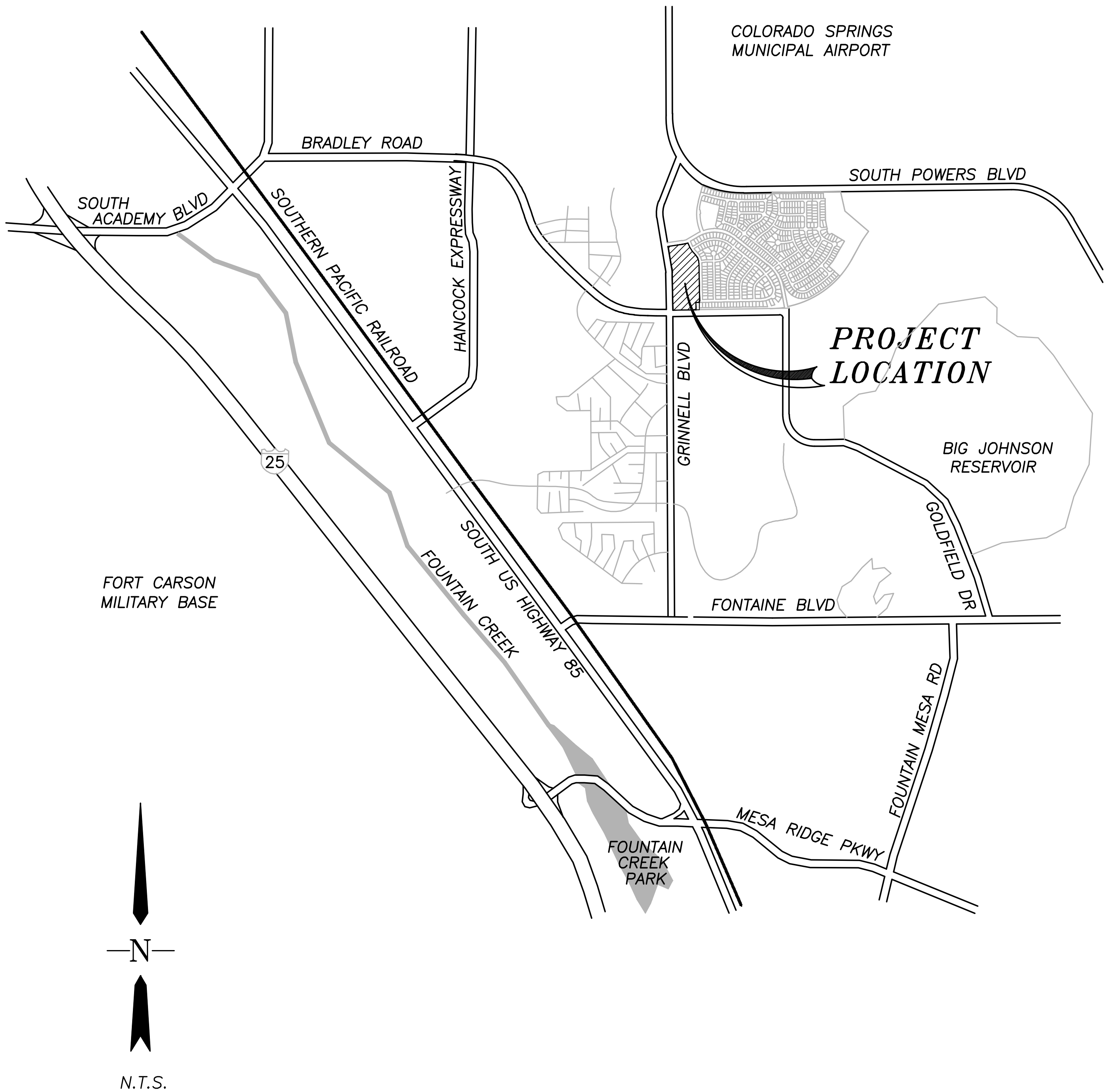
5. Final Drainage Report for Painted Sky at Waterview Filings 1 and 2, January 2007. Prepared by Merrick & Co.

6. Soils Survey of El Paso County Area, Natural Resources Conservation Services of Colorado.

7. Flood Insurance Rate Study for El Paso County, Colorado and Incorporated Areas. Federal Emergency Management Agency, Revised March 17, 1997.

8. “City of Colorado Springs/El Paso County Drainage Criteria Manual, Volume 2: Stormwater Quality Policies, Procedures and Best Management Practices” May 2014.

Figure 1: Vicinity Map



THE SPRINGS AT WATERVIEW
VICINITY MAP

DSE Dakota Springs Engineering
31 NORTH TEJON, SUITE 500
COLORADO SPRINGS, CO 80903
TEL: (719) 227-7388
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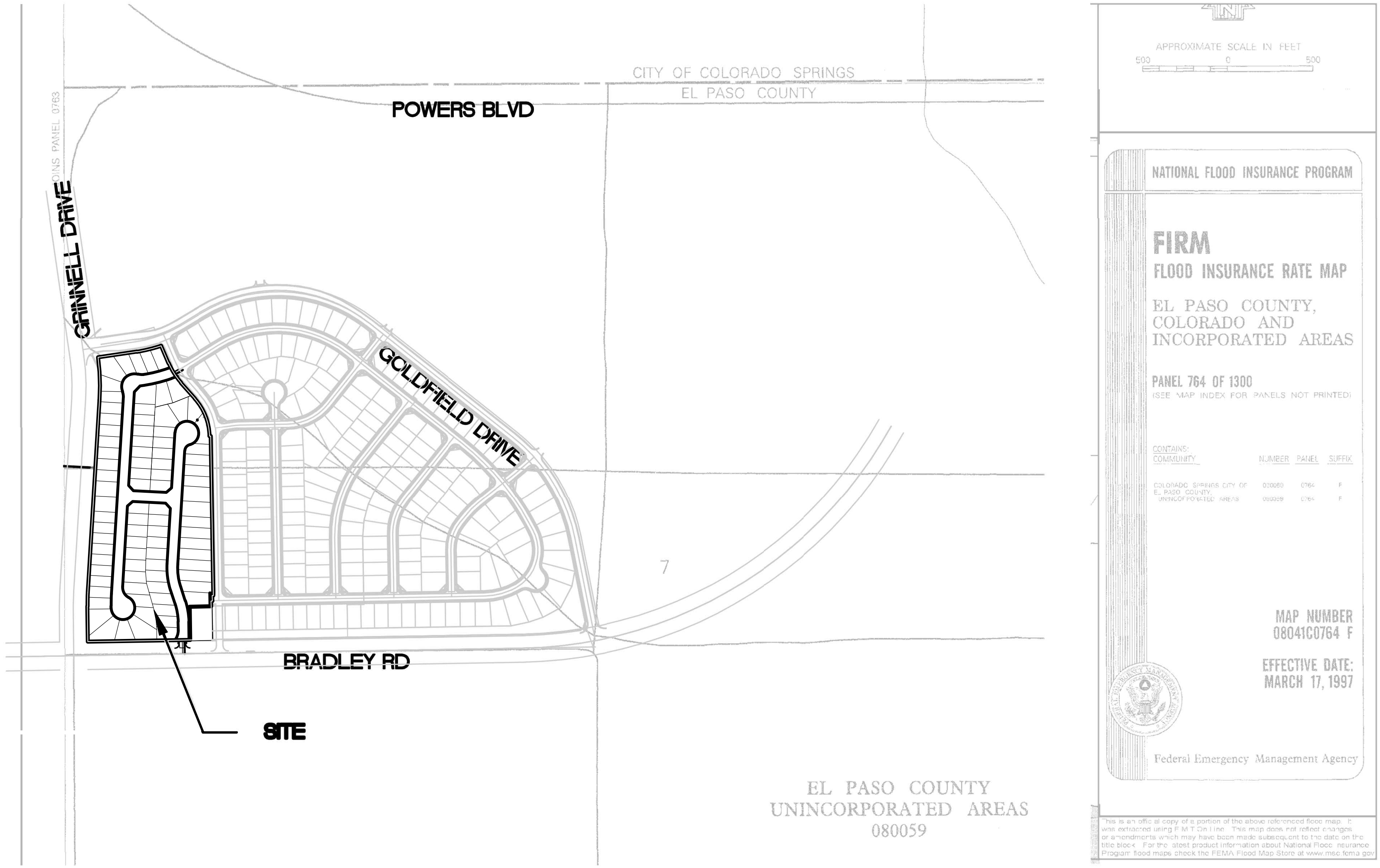
EXHIBIT

PROJECT NO. 0001-02-16-01

Figure 2: FEMA Floodplain Map



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PROJECT NO. 12-005

SPRINGS AT WATERVIEW
PDR

FLOOD INSURANCE RATE MAP

FIGURE 2

Appendix A: Soils Data Report

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

El Paso County Area, Colorado

July 31, 2016

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

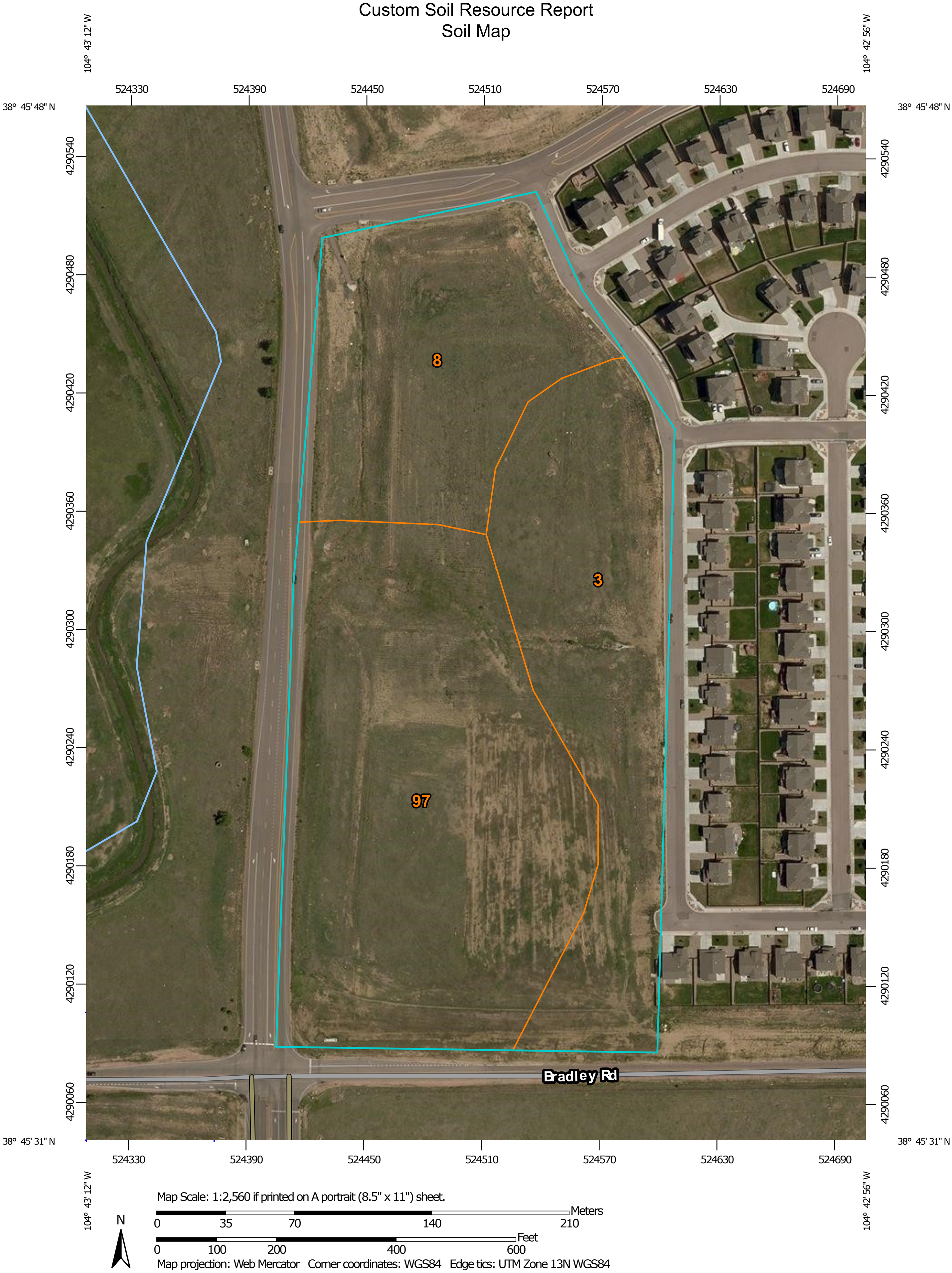
The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map



Map Scale: 1:2,560 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 35, 70, 140, 210

Feet: 0, 100, 200, 400, 600

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil 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: Jun 3, 2014—Jun 17, 2014

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

Map Unit Legend

El Paso County Area, Colorado (CO625)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
3	Ascalon sandy loam, 3 to 9 percent slopes	5.5	28.7%
8	Blakeland loamy sand, 1 to 9 percent slopes	4.7	24.8%
97	Truckton sandy loam, 3 to 9 percent slopes	8.9	46.5%
Totals for Area of Interest		**19.0**	**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

3—Ascalon sandy loam, 3 to 9 percent slopes

Map Unit Setting

National map unit symbol: 2tlny
Elevation: 3,870 to 5,960 feet
Mean annual precipitation: 13 to 18 inches
Mean annual air temperature: 46 to 54 degrees F
Frost-free period: 95 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Ascalon

Setting

Landform: Interfluves
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Wind-reworked alluvium and/or calcareous sandy eolian deposits

Typical profile

Ap - 0 to 6 inches: sandy loam
Bt1 - 6 to 12 inches: sandy clay loam
Bt2 - 12 to 19 inches: sandy clay loam
Bk1 - 19 to 35 inches: fine sandy loam
Bk2 - 35 to 80 inches: fine sandy loam

Properties and qualities

Slope: 3 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 5.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline (0.1 to 1.9 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 1.0
Available water storage in profile: Moderate (about 7.1 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: Sandy Plains (R067BY024CO)

Minor Components

Olnest

Percent of map unit: 10 percent
Landform: Interfluves
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Sandy Plains (R067BY024CO)

Vona

Percent of map unit: 5 percent
Landform: Interfluves
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Sandy Plains (R067BY024CO)

8—Blakeland loamy sand, 1 to 9 percent slopes

Map Unit Setting

National map unit symbol: 369v
Elevation: 4,600 to 5,800 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Blakeland

Setting

Landform: Flats, hills
Landform position (three-dimensional): Side slope, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock and/or eolian deposits derived from sedimentary rock

Typical profile

A - 0 to 11 inches: loamy sand
AC - 11 to 27 inches: loamy sand
C - 27 to 60 inches: sand

Properties and qualities

Slope: 1 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: 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: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Available water storage in profile: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: Sandy Foothill (R049BY210CO)

Minor Components

Other soils

Percent of map unit:

Pleasant

Percent of map unit:
Landform: Depressions

97—Truckton sandy loam, 3 to 9 percent slopes

Map Unit Setting

National map unit symbol: 36bg
Elevation: 6,000 to 7,000 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Truckton and similar soils: 80 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Truckton

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear

Parent material: Arkosic alluvium derived from sedimentary rock and/or arkosic residuum weathered from sedimentary rock

Typical profile

A - 0 to 8 inches: sandy loam
Bt - 8 to 24 inches: sandy loam
C - 24 to 60 inches: coarse sandy loam

Properties and qualities

Slope: 3 to 9 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): High (1.98 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: Sandy Foothill (R049BY210CO)

Minor Components

Haplaquolls

Percent of map unit:
Landform: Marshes

Other soils

Percent of map unit:

Pleasant

Percent of map unit:
Landform: Depressions

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Appendix B: Existing Rational Calculations

WATERVIEW SPRINGS - EXISTING
(RATIONAL METHOD Q=CIA)

	TOTAL FLOWS				AREA	WEIGHTED		OVERLAND				CHANNEL						Tc	INTENSITY		COMMENTS
BASIN	Q(5)	Q(100)	CA(equiv.)		TOTAL	C(5)	C(100)	C(5)	Length	Slope	Tc	Length	Slope	Description	Convey	Velocity	Tc	TOTAL	I(5)	I(100)	
	(c.f.s.)	(c.f.s.)	5 YR	100 YR	(Ac)				(ft)	(ft)	(min)	(ft)	(%)	Code	Factor (K)	(fps)	(min)	(min)	(in/hr)	(in/hr)	
E-1	3.3	25.0	1.01	4.42	12.63	0.08	0.35	0.08	100	5.9%	10.6	575	5.9%	3	7	1.7	5.6	16.3	3.2	5.7	
E-2	1.9	14.8	0.69	3.01	8.61	0.08	0.35	0.08	80	10.0%	8.0	995	3.1%	3	7	1.2	13.5	21.4	2.8	4.9	

UDFCD Table 6-2 NRCS Conveyance Factors, K

Code	Description	K
1	Heavy meadow	2.5
2	Tillage/field	5
3	Short pasture and lawns	7
4	Nearly bare ground	10
5	Grassed waterway	15
6	Paved areas and shallow paved swale	20

WATERVIEW SPRINGS - EXISTING
SURFACE ROUTING

DESIGN	CONTRIBUTING	CA(equivalent)		Tc	INTENSITY		TOTAL FLOWS	
POINT	BASINS	CA(5)	CA(100)		I(5)	I(100)	Q(5)	Q(100)
				TRAVEL TIME				
		0.00	0.00	Type/flow	8.61136777	Velocity (fps)	d. Time (min)	T. Time (min)
43	E-1	1.01	4.42	24.6	2.6	4.5	44.3	112.7
	DP 31*	2.91	4.00					
	DP 32*	0.41	1.15					
	DP 38*	1.93	3.22					
	DP 39*	3.79	4.08					
	DP 41*	6.99	7.93	TRAVEL TIME				
		17.04	24.80	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
				Swale	120	5.3	0.4	25.0
42a	E-2	0.69	3.01	17.2	3.2	5.5	12.4	38.2
	OS Bradley Road*	3.24	3.93	TRAVEL TIME				
		3.93	6.94	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
						0.0	0.0	17.2

* - Information obtained from previously approved drainage report.

Appendix C: Proposed Rational Calculations

WATERVIEW SPRINGS - PROPOSED
(RATIONAL METHOD Q=CIA)

	TOTAL FLOWS				AREA	WEIGHTED		OVERLAND				CHANNEL						Tc	INTENSITY		
BASIN	Q(5)	Q(100)	CA(equiv.)		TOTAL	C(5)	C(100)	C(5)	Length	Slope	Tc	Length	Slope	Description	Convey	Velocity	Tc	TOTAL	I(5)	I(100)	COMMENTS
	(c.f.s.)	(c.f.s.)	5 YR	100 YR	(Ac)				(ft)	(ft)	(min)	(ft)	(%)	Code	Factor (K)	(fps)	(min)	(min)	(in/hr)	(in/hr)	
D-1	0.7	1.6	0.15	0.20	0.31	0.49	0.65	0.49	50	2.0%	6.4	190	4.0%	6	20	4.0	0.8	7.2	4.6	8.0	
D-2	0.4	1.0	0.10	0.13	0.20	0.49	0.65	0.49	85	2.0%	8.4	20	2.1%	6	20	2.9	0.1	8.5	4.3	7.6	
D-3	1.6	3.1	0.32	0.34	0.35	0.90	0.96	0.49	5	25.0%	0.9	560	5.0%	6	20	4.5	2.1	5.0	5.2	9.1	
D-3A	1.3	2.4	0.25	0.27	0.28	0.90	0.96	0.49	5	25.0%	0.9	650	5.0%	6	20	4.5	2.4	5.0	5.2	9.1	
D-4	0.5	1.0	0.10	0.11	0.11	0.90	0.96	0.49	5	2.0%	2.0	140	5.0%	6	20	4.5	0.5	5.0	5.2	9.1	
D-5	0.8	1.9	0.15	0.20	0.31	0.49	0.65	0.49	25	2.0%	4.5	105	4.0%	6	20	4.0	0.4	5.0	5.2	9.1	
D-6	0.3	0.6	0.06	0.07	0.07	0.90	0.96	0.49	5	2.0%	2.0	120	4.0%	6	20	4.0	0.5	5.0	5.2	9.1	
D-7	3.4	7.9	1.15	1.52	2.35	0.49	0.65	0.49	150	5.0%	8.2	460	1.0%	3	7	0.7	11.0	19.2	3.0	5.2	
D-8	2.1	4.9	0.54	0.72	1.10	0.49	0.65	0.49	55	25.0%	2.9	325	1.0%	3	7	0.7	7.7	10.7	3.9	6.9	
D-9	1.9	3.5	0.42	0.45	0.47	0.90	0.96	0.49	130	15.0%	5.3	265	1.0%	6	20	2.0	2.2	7.5	4.5	7.9	
D-10	1.2	2.3	0.26	0.28	0.29	0.90	0.96	0.49	5	2.0%	2.0	550	1.0%	6	20	2.0	4.6	6.6	4.7	8.3	
D-11	2.5	5.9	0.75	1.00	1.53	0.49	0.65	0.49	25	2.0%	4.5	500	1.3%	3	7	0.8	10.3	14.8	3.4	5.9	
D-11A	2.4	5.6	0.70	0.93	1.43	0.49	0.65	0.49	210	4.0%	10.5	175	1.3%	3	7	0.8	3.6	14.1	3.5	6.1	
D-12	0.6	1.2	0.13	0.15	0.18	0.70	0.81	0.49	50	4.0%	5.1	175	2.5%	6	20	3.2	0.9	6.0	4.9	8.5	
D-13	0.8	1.6	0.16	0.19	0.23	0.70	0.81	0.49	55	4.0%	5.4	190	2.5%	6	20	3.2	1.0	6.4	4.8	8.4	
D-14	2.6	5.9	0.83	1.11	1.70	0.49	0.65	0.49	215	4.0%	10.6	315	1.0%	3	7	0.7	7.5	18.1	3.1	5.4	
D-14A	1.7	4.0	0.52	0.68	1.05	0.49	0.65	0.49	215	4.0%	10.6	190	1.0%	3	7	0.7	4.5	15.1	3.4	5.9	
D-15	1.9	3.6	0.59	0.62	0.65	0.90	0.96	0.49	230	4.0%	10.9	605	1.0%	6	20	2.0	5.0	16.0	3.3	5.7	
D-16	1.3	2.5	0.43	0.46	0.48	0.90	0.96	0.49	5	2.0%	2.0	760	1.3%	3	7	0.8	16.2	18.2	3.1	5.3	
D-17	3.1	7.1	0.88	1.17	1.80	0.49	0.65	0.49	220	5.0%	9.9	250	2.0%	3	7	1.0	4.2	14.2	3.5	6.1	
D-18	4.0	9.2	0.76	1.01	1.56	0.49	0.65	0.49	5	4.0%	1.6	125	4.0%	6	20	4.0	0.5	5.0	5.2	9.1	
D-19	6.1	14.2	2.35	3.12	4.80	0.49	0.65	0.49	300	4.0%	12.5	750	2.2%	3	7	1.0	12.0	24.5	2.6	4.5	

UDFCD Table 6-2 NRCS Conveyance Factors, K

Code	Description	K
1	Heavy meadow	2.5
2	Tillage/field	5
3	Short pasture and lawns	7
4	Nearly bare ground	10
5	Grassed waterway	15
6	Paved areas and shallow paved swale	20

WATERVIEW SPRINGS - PROPOSED
SURFACE ROUTING

DESIGN	CONTRIBUTING	CA(equivalent)		Tc	INTENSITY		TOTAL FLOWS	
POINT	BASINS	CA(5)	CA(100)		I(5)	I(100)	Q(5)	Q(100)
11	D-3	0.32	0.34	5.0	5.2	9.1	1.6	3.1
				TRAVEL TIME				
		0.32	0.34	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
						0.0	0.0	5.0
32	D-3A	0.25	0.27	5.0	5.2	9.1	1.3	2.4
				TRAVEL TIME				
		0.25	0.27	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
						0.0	0.0	5.0
A	FLOWBY D-7	0.00	0.26	10.7	3.9	6.9	0.3	4.3
	FLOWBY D-8	0.08	0.36	TRAVEL TIME				
		0.08	0.62	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
				Street	220	2.5	1.5	12.1
B	FLOWBY D-9	0.04	0.15	7.5	4.5	7.9	0.8	2.3
	D-12	0.13	0.15	TRAVEL TIME				
		0.17	0.30	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
				Street	160	3.0	0.9	8.4
C	FLOWBY D-10	0.00	0.06	6.4	4.8	8.4	0.8	2.1
	D-13	0.16	0.19					
		0.16	0.25	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
				Street	150	3.0	0.8	7.2
D	D-11A	0.70	0.93	14.1	3.5	6.1	2.4	6.7
	FLOWBY DP B	0.00	0.07	TRAVEL TIME				
	FLOWBY D-11	0.00	0.12					
		0.70	1.11	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
				Street	5	3.0	0.0	14.1
E	D-14A	0.52	0.68	18.1	3.1	5.4	1.6	4.7
	FLOWBY DP C	0.00	0.06	TRAVEL TIME				
	FLOWBY D-14	0.00	0.13					
		0.52	0.87	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
				Street	5	3.0	0.0	18.1
F	FLOWBY D-15	0.07	0.22	18.1	3.1	5.4	0.2	3.1
	FLOWBY D-16	0.00	0.09					
	FLOWBY DP D	0.00	0.21					
	FLOWBY DP E	0.00	0.06	TRAVEL TIME				
		0.07	0.58	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
				Street	240	3.0	1.3	19.4
G	D-17	0.88	1.17	14.2	3.5	6.1	3.1	7.1
				TRAVEL TIME				
		0.88	1.17	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
				Street	180	1.3	2.3	16.5
K	D-5	0.15	0.20	5.0	5.2	9.1	11.5	24.1
	D-6	0.06	0.07	TRAVEL TIME				
	OS Flow Bradley Rd*	2.00	2.38					
		2.22	2.66	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
						0.0	0.0	5.0
39	D-1	0.15	0.20	8.5	4.3	7.6	1.1	2.5
	D-2	0.10	0.13	TRAVEL TIME				
		0.25	0.33	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
				Pipe	125	2.5	0.8	9.3

DESIGN	CONTRIBUTING	CA(equivalent)		Tc	INTENSITY		TOTAL FLOWS	
POINT	BASINS	CA(5)	CA(100)		I(5)	I(100)	Q(5)	Q(100)
41	D-4	0.10	0.11	5.0	5.2	9.1	0.5	1.0
				TRAVEL TIME				
		0.10	0.11	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
				Pipe	125	2.5	0.8	5.8
42a	D-19	2.35	3.12	24.5	2.6	4.5	11.9	26.3
	DP K	2.22	2.66	TRAVEL TIME				
		4.57	5.78	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
						2.5	0.0	24.5
43 (Surf Flow)	D-18	0.76	1.01	5.0	5.2	9.1	4.0	9.2
				TRAVEL TIME				
		0.76	1.01	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
						1.3	0.0	5.0

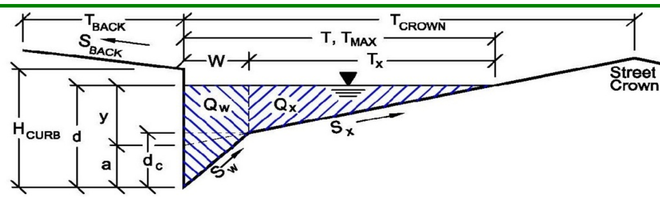
Appendix D: Inlet Design & Rundown Analysis

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

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

Project: **Springs at Waterview**

Inlet ID: **Basin D-7**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	10.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	15.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	7.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	1.68	3.60	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.52	1.52	inches
Water Depth at Gutter Flowline	d =	3.20	5.12	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	5.0	13.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.753	0.397	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.4	5.1	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.2	3.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**1.6**	**8.5**	**cfs**
Flow Velocity within the Gutter Section	V =	3.3	4.9	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.9	2.1	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	43.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	16.7	41.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.319	0.131	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	10.0	114.8	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	9.8	72.4	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	4.7	17.2	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	21.9	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	14.5	111.6	cfs
Average Flow Velocity Within the Gutter Section	V =	5.6	9.4	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.8	9.4	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**14.5**	**111.6**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	6.00	12.00	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.88	6.88	inches

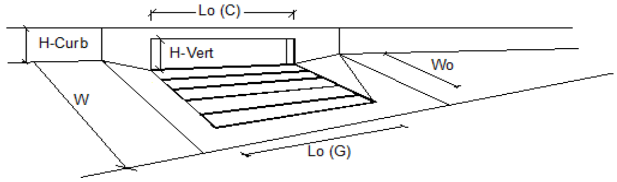
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**1.6**	**8.5**	**cfs**

WARNING: MINOR STORM max. allowable capacity is less than flow given on sheet 'Q-Peak'

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

INLET ON A CONTINUOUS GRADE

Project: Springs at Waterview
Inlet ID: Basin D-7



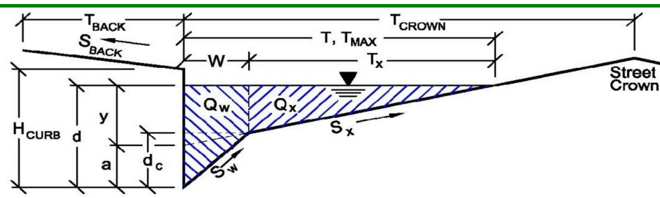
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate 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: WARNING: Q > ALLOWABLE Q FOR MINOR STORM'		MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Q-Peak*)	Q_o =	3.4	7.9	cfs
Water Spread Width	T =	10.1	14.6	ft
Water Depth at Flowline (outside of local depression)	d =	3.9	5.0	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.574	0.410	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	1.5	4.7	cfs
Discharge within the Gutter Section W	Q_w =	2.0	3.2	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	1.14	2.24	sq ft
Velocity within the Gutter Section W	V_W =	3.0	3.5	fps
Water Depth for Design Condition	d_{LOCAL} =	6.9	8.0	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	$E_{o\text{-}GRATE}$ =	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 =	0.128	0.097	ft/ft
Required Length L_T to Have 100% Interception	L_T =	9.65	16.84	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	9.65	10.00	ft
Interception Capacity	Q_i =	3.4	6.3	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 =	3.4	6.1	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	Q_b =	0.0	1.8	cfs
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**3.40**	**6.13**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	Q_b =	**0.0**	**1.8**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**78**	**%**

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

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

Project: Springs at Waterview

Inlet ID: Basin D-8



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	10.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	15.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	7.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	1.68	3.60	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.52	1.52	inches
Water Depth at Gutter Flowline	d =	3.20	5.12	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	5.0	13.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.753	0.397	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.4	5.1	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.2	3.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**1.6**	**8.5**	**cfs**
Flow Velocity within the Gutter Section	V =	3.3	4.9	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.9	2.1	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	43.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	16.7	41.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.319	0.131	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	10.0	114.8	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	9.8	72.4	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	4.7	17.2	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	21.9	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	14.5	111.6	cfs
Average Flow Velocity Within the Gutter Section	V =	5.6	9.4	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.8	9.4	
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq 6"$) Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**14.5**	**111.6**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	6.00	12.00	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.88	6.88	inches

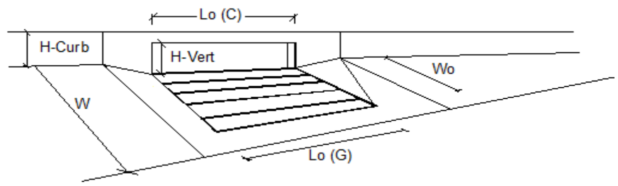
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**1.6**	**8.5**	**cfs**

WARNING: MINOR STORM max. allowable capacity is less than flow given on sheet 'Q-Peak'

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

INLET ON A CONTINUOUS GRADE

Project: Springs at Waterview
Inlet ID: Basin D-8



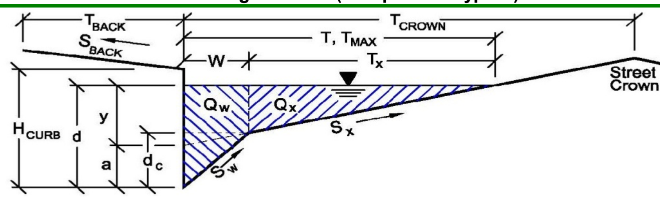
		MINOR	MAJOR	
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	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: WARNING: Q > ALLOWABLE Q FOR MINOR STORM'		MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Q-Peak*)	Q_o =	2.1	4.9	cfs
Water Spread Width	T =	8.0	11.9	ft
Water Depth at Flowline (outside of local depression)	d =	3.4	4.4	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.689	0.497	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.7	2.5	cfs
Discharge within the Gutter Section W	Q_w =	1.4	2.4	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.77	1.54	sq ft
Velocity within the Gutter Section W	V_W =	2.7	3.2	fps
Water Depth for Design Condition	d_{LOCAL} =	6.4	7.4	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	$E_{o\text{-}GRATE}$ =	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 =	0.150	0.114	ft/ft
Required Length L_T to Have 100% Interception	L_T =	7.03	12.28	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	5.00	5.00	ft
Interception Capacity	Q_i =	1.9	3.0	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.10	0.10	
Effective (Unclogged) Length	L_e =	4.50	4.50	ft
Actual Interception Capacity	Q_a =	1.8	2.7	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	Q_b =	0.3	2.2	cfs
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.77**	**2.74**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.3**	**2.2**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**84**	**56**	**%**

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

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

Project: **Springs at Waterview**

Inlet ID: **Design Point A (Sump Inlet - Type R)**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	10.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	15.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	7.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	1.68	3.60	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.52	1.52	inches
Water Depth at Gutter Flowline	d =	3.20	5.12	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	5.0	13.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.753	0.397	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.4	5.1	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.2	3.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**1.6**	**8.5**	**cfs**
Flow Velocity within the Gutter Section	V =	3.3	4.9	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.9	2.1	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	43.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	16.7	41.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.319	0.131	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	10.0	114.8	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	9.8	72.4	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	4.7	17.2	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	21.9	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	14.5	111.6	cfs
Average Flow Velocity Within the Gutter Section	V =	5.6	9.4	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.8	9.4	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**14.5**	**111.6**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	6.00	12.00	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.88	6.88	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**1.6**	**8.5**	**cfs**

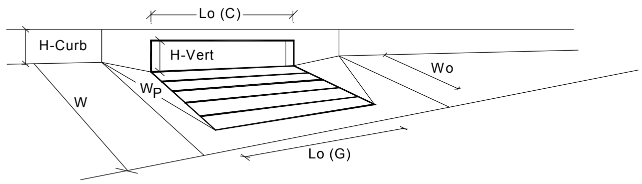
Minor storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

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

INLET IN A SUMP OR SAG LOCATION

Project = Springs at Waterview

Inlet ID = Design Point A (Sump Inlet - Type R)



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 =	3.2	5.1	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} =	1.09	5.70	cfs
Interception with Clogging	Q_{wa} =	1.02	5.34	cfs
Curb Opening as an Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	14.56	18.10	cfs
Interception with Clogging	Q_{oa} =	13.65	16.97	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	3.70	9.45	cfs
Interception with Clogging	Q_{ma} =	3.47	8.86	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**1.02**	**5.34**	**cfs**

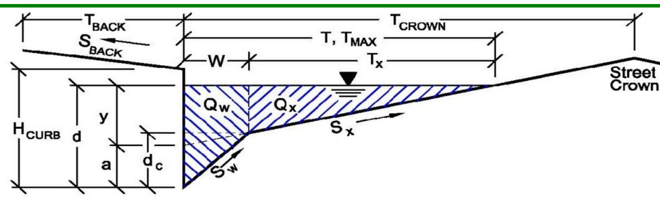
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	10.00	10.00	feet
Resultant Street Flow Spread (based on sheet *Q-Allow* geometry)	T =	7.0	15.0	ft
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	0.0	inches
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**1.0**	**5.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	0.3	4.3	cfs

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

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

Project: **Springs at Waterview**

Inlet ID: **Basin D-9**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	10.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	15.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	7.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	1.68	3.60	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.52	1.52	inches
Water Depth at Gutter Flowline	d =	3.20	5.12	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	5.0	13.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.753	0.397	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.4	5.1	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.2	3.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**1.6**	**8.5**	**cfs**
Flow Velocity within the Gutter Section	V =	3.3	4.9	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.9	2.1	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	43.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	16.7	41.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.319	0.131	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	10.0	114.8	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	9.8	72.4	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	4.7	17.2	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	21.9	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	14.5	111.6	cfs
Average Flow Velocity Within the Gutter Section	V =	5.6	9.4	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.8	9.4	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**14.5**	**111.6**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	6.00	12.00	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.88	6.88	inches

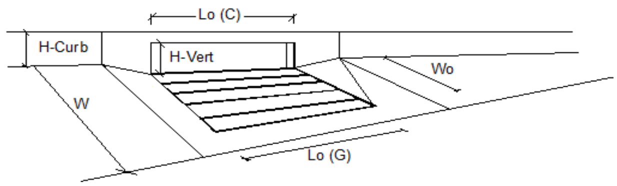
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**1.6**	**8.5**	**cfs**

WARNING: MINOR STORM max. allowable capacity is less than flow given on sheet 'Q-Peak'

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

INLET ON A CONTINUOUS GRADE

Project: **Springs at Waterview**
Inlet ID: **Basin D-9**



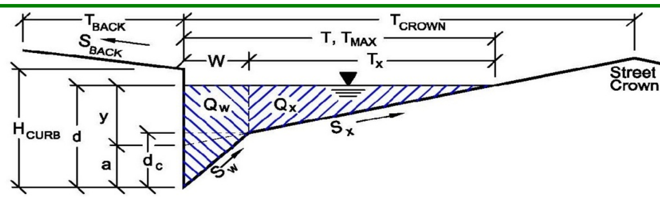
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	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: WARNING: Q > ALLOWABLE Q FOR MINOR STORM'		MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Q-Peak*)	Q_o =	1.9	3.5	cfs
Water Spread Width	T =	7.6	10.2	ft
Water Depth at Flowline (outside of local depression)	d =	3.4	4.0	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.714	0.568	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.5	1.5	cfs
Discharge within the Gutter Section W	Q_w =	1.4	2.0	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.71	1.17	sq ft
Velocity within the Gutter Section W	V_W =	2.7	3.0	fps
Water Depth for Design Condition	d_{LOCAL} =	6.4	7.0	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	$E_{o\text{-}GRATE}$ =	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 =	0.154	0.127	ft/ft
Required Length L_T to Have 100% Interception	L_T =	6.58	9.83	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	5.00	5.00	ft
Interception Capacity	Q_i =	1.8	2.5	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.10	0.10	
Effective (Unclogged) Length	L_e =	4.50	4.50	ft
Actual Interception Capacity	Q_a =	1.7	2.3	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	Q_b =	0.2	1.2	cfs
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.66**	**2.34**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	Q_b =	**0.2**	**1.2**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**87**	**67**	**%**

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

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

Project: Springs at Waterview

Inlet ID: Basin D-10



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	10.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	15.0	ft
Gutter Width	W =	1.17	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	7.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	1.68	3.60	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	1.2	1.2	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.89	0.89	inches
Water Depth at Gutter Flowline	d =	2.57	4.49	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	5.8	13.8	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.492	0.228	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.6	6.1	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.6	1.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**1.2**	**7.9**	**cfs**
Flow Velocity within the Gutter Section	V =	1.0	1.6	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.2	0.6	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	21.3	46.3	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	20.1	45.1	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.158	0.070	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	16.5	142.1	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	15.8	88.6	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	3.1	10.7	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	21.9	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	18.9	121.1	cfs
Average Flow Velocity Within the Gutter Section	V =	2.0	3.3	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.0	3.3	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**18.9**	**121.1**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	6.00	12.00	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	1.52	7.52	inches

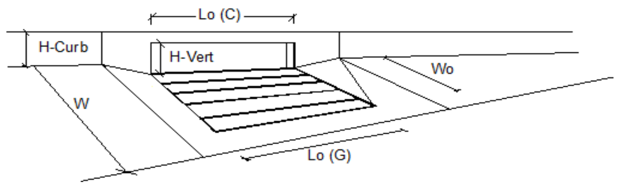
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**1.2**	**7.9**	**cfs**

WARNING: MINOR STORM max. allowable capacity is less than flow given on sheet 'Q-Peak'

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

INLET ON A CONTINUOUS GRADE

Project: **Springs at Waterview**
Inlet ID: **Basin D-10**



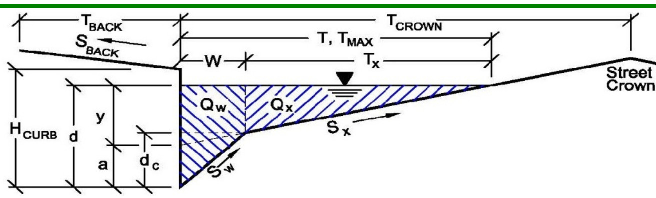
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	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: WARNING: Q > ALLOWABLE Q FOR MINOR STORM'		MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Q-Peak*)	Q_o =	1.2	2.3	cfs
Water Spread Width	T =	7.0	9.2	ft
Water Depth at Flowline (outside of local depression)	d =	2.6	3.1	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.492	0.377	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.6	1.4	cfs
Discharge within the Gutter Section W	Q_w =	0.6	0.9	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.54	0.89	sq ft
Velocity within the Gutter Section W	V_W =	2.2	2.6	fps
Water Depth for Design Condition	d_{LOCAL} =	5.6	6.1	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	$E_{o\text{-}GRATE}$ =	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 =	0.156	0.125	ft/ft
Required Length L_T to Have 100% Interception	L_T =	5.18	8.00	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	5.00	5.00	ft
Interception Capacity	Q_i =	1.2	1.9	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.10	0.10	
Effective (Unclogged) Length	L_e =	4.50	4.50	ft
Actual Interception Capacity	Q_a =	1.2	1.8	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	Q_b =	0.0	0.5	cfs
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.17**	**1.78**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.5**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**97**	**77**	**%**

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

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

Project: Springs at Waterview

Inlet ID: Basin D-11



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	10.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	15.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	7.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	1.68	3.60	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.52	1.52	inches
Water Depth at Gutter Flowline	d =	3.20	5.12	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	5.0	13.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.753	0.397	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.4	5.1	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.2	3.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**1.6**	**8.5**	**cfs**
Flow Velocity within the Gutter Section	V =	3.3	4.9	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.9	2.1	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	43.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	16.7	41.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.319	0.131	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	10.0	114.8	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	9.8	72.4	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	4.7	17.2	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	21.9	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	14.5	111.6	cfs
Average Flow Velocity Within the Gutter Section	V =	5.6	9.4	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.8	9.4	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**14.5**	**111.6**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	6.00	12.00	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.88	6.88	inches

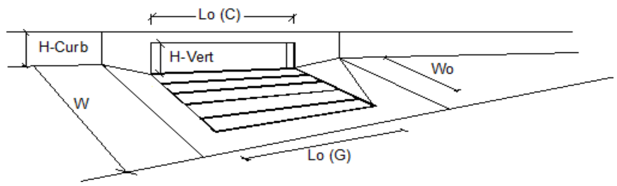
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**1.6**	**8.5**	**cfs**

WARNING: MINOR STORM max. allowable capacity is less than flow given on sheet 'Q-Peak'

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

INLET ON A CONTINUOUS GRADE

Project: **Springs at Waterview**
Inlet ID: **Basin D-11**



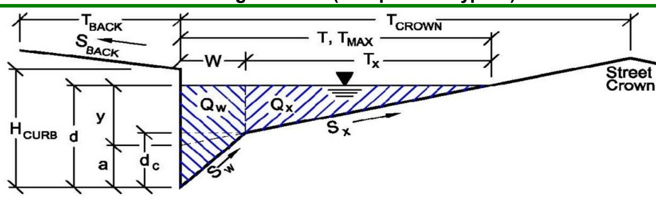
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate 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: WARNING: Q > ALLOWABLE Q FOR MINOR STORM'		MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Q-Peak*)	Q_o =	2.5	5.9	cfs
Water Spread Width	T =	8.7	12.9	ft
Water Depth at Flowline (outside of local depression)	d =	3.6	4.6	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.646	0.462	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.9	3.2	cfs
Discharge within the Gutter Section W	Q_w =	1.6	2.7	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.89	1.78	sq ft
Velocity within the Gutter Section W	V_W =	2.8	3.3	fps
Water Depth for Design Condition	d_{LOCAL} =	6.6	7.6	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	$E_{o\text{-}GRATE}$ =	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 =	0.142	0.107	ft/ft
Required Length L_T to Have 100% Interception	L_T =	7.88	13.89	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	7.88	10.00	ft
Interception Capacity	Q_i =	2.5	5.3	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 =	2.5	5.2	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	Q_b =	0.0	0.7	cfs
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.50**	**5.16**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	Q_b =	**0.0**	**0.7**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**87**	**%**

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

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

Project: **Springs at Waterview**

Inlet ID: **Design Point D (Sump Inlet - Type R)**



Gutter Geometry (Enter data in the blue cells)			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	10.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	15.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	7.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	1.68	3.60	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.52	1.52	inches
Water Depth at Gutter Flowline	d =	3.20	5.12	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	5.0	13.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.753	0.397	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.4	5.1	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.2	3.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**1.6**	**8.5**	**cfs**
Flow Velocity within the Gutter Section	V =	3.3	4.9	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.9	2.1	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	43.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	16.7	41.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.319	0.131	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	10.0	114.8	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	9.8	72.4	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	4.7	17.2	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	21.9	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	14.5	111.6	cfs
Average Flow Velocity Within the Gutter Section	V =	5.6	9.4	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.8	9.4	
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq 6"$) Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**14.5**	**111.6**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	6.00	12.00	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.88	6.88	inches

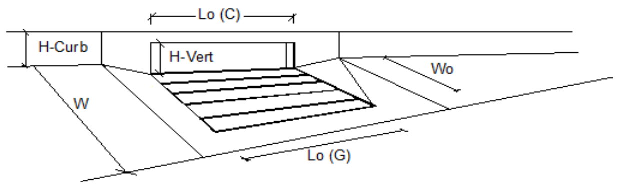
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**1.6**	**8.5**	**cfs**

WARNING: MINOR STORM max. allowable capacity is less than flow given on sheet 'Q-Peak'

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

INLET ON A CONTINUOUS GRADE

Project: Springs at Waterview
Inlet ID: Design Point D (Sump Inlet - Type R)



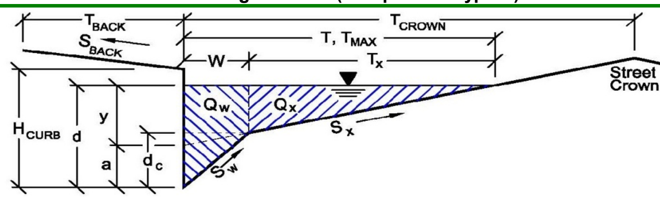
		MINOR	MAJOR	
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit 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: WARNING: Q > ALLOWABLE Q FOR MINOR STORM'		MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Q-Peak*)	Q_o =	2.4	6.7	cfs
Water Spread Width	T =	8.6	13.6	ft
Water Depth at Flowline (outside of local depression)	d =	3.6	4.8	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.656	0.438	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.8	3.8	cfs
Discharge within the Gutter Section W	Q_w =	1.6	2.9	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.86	1.97	sq ft
Velocity within the Gutter Section W	V_W =	2.8	3.4	fps
Water Depth for Design Condition	d_{LOCAL} =	6.6	7.8	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	$E_{o\text{-}GRATE}$ =	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 =	0.143	0.103	ft/ft
Required Length L_T to Have 100% Interception	L_T =	7.67	15.10	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	7.67	10.00	ft
Interception Capacity	Q_i =	2.4	5.7	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 =	2.4	5.6	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	Q_b =	0.0	1.1	cfs
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.40**	**5.58**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**1.1**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**83**	**%**

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

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

Project: **Springs at Waterview**

Inlet ID: **Design Point B (Sump Inlet - Type R)**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	10.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	15.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.025	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	7.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	1.68	3.60	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.52	1.52	inches
Water Depth at Gutter Flowline	d =	3.20	5.12	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	5.0	13.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.753	0.397	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.6	8.1	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.9	5.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**2.6**	**13.5**	**cfs**
Flow Velocity within the Gutter Section	V =	5.3	7.8	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	1.4	3.3	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	43.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	16.7	41.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.319	0.131	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	15.8	181.5	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	15.5	114.5	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	7.4	27.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	34.6	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	22.9	176.4	cfs
Average Flow Velocity Within the Gutter Section	V =	8.8	14.9	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	4.4	14.9	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	0.86	0.70	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**19.7**	**123.1**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.73	10.50	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.61	5.38	inches

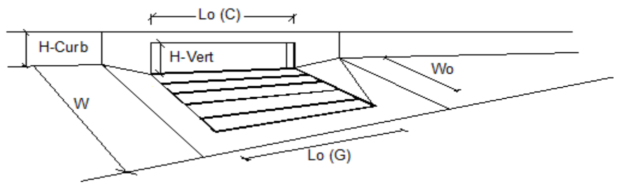
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**2.6**	**13.5**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Project: Springs at Waterview
Inlet ID: Design Point B (Sump Inlet - Type R)



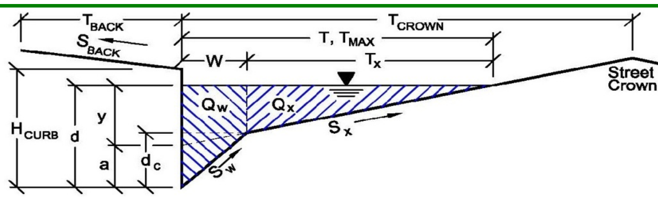
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	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 =**	0.8	2.3	cfs
Water Spread Width	T =	2.3	6.6	ft
Water Depth at Flowline (outside of local depression)	d =	2.1	3.1	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	1.008	0.782	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.0	0.5	cfs
Discharge within the Gutter Section W	Q_w =	0.8	1.8	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.18	0.56	sq ft
Velocity within the Gutter Section W	V_W =	4.5	4.1	fps
Water Depth for Design Condition	d_{LOCAL} =	5.1	6.1	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	$E_{o\text{-}GRATE}$ =	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 =	0.208	0.167	ft/ft
Required Length L_T to Have 100% Interception	L_T =	3.89	7.38	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	3.89	5.00	ft
Interception Capacity	Q_i =	0.8	2.0	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.10	0.10	
Effective (Unclogged) Length	L_e =	4.50	4.50	ft
Actual Interception Capacity	**Q_a =**	0.8	1.9	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	0.0	0.4	cfs
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.80**	**1.88**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.4**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**82**	**%**

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

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

Project: Springs at Waterview

Inlet ID: Basin D-14



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	10.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	15.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	7.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	1.68	3.60	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.52	1.52	inches
Water Depth at Gutter Flowline	d =	3.20	5.12	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	5.0	13.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.753	0.397	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.4	5.1	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.2	3.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**1.6**	**8.5**	**cfs**
Flow Velocity within the Gutter Section	V =	3.3	4.9	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.9	2.1	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	43.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	16.7	41.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.319	0.131	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	10.0	114.8	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	9.8	72.4	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	4.7	17.2	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	21.9	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	14.5	111.6	cfs
Average Flow Velocity Within the Gutter Section	V =	5.6	9.4	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.8	9.4	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**14.5**	**111.6**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	6.00	12.00	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.88	6.88	inches

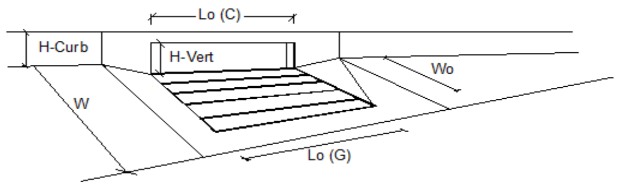
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**1.6**	**8.5**	**cfs**

WARNING: MINOR STORM max. allowable capacity is less than flow given on sheet 'Q-Peak'

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

INLET ON A CONTINUOUS GRADE

Project: **Springs at Waterview**
Inlet ID: **Basin D-14**



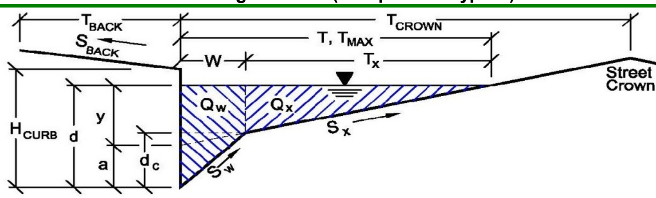
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate 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: WARNING: Q > ALLOWABLE Q FOR MINOR STORM'		MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Q-Peak*)	Q_o =	2.6	5.9	cfs
Water Spread Width	T =	8.9	12.9	ft
Water Depth at Flowline (outside of local depression)	d =	3.7	4.6	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.637	0.462	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.9	3.2	cfs
Discharge within the Gutter Section W	Q_w =	1.7	2.7	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.92	1.78	sq ft
Velocity within the Gutter Section W	V_W =	2.8	3.3	fps
Water Depth for Design Condition	d_{LOCAL} =	6.7	7.6	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	$E_{o\text{-}GRATE}$ =	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 =	0.140	0.107	ft/ft
Required Length L_T to Have 100% Interception	L_T =	8.08	13.89	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	8.08	10.00	ft
Interception Capacity	Q_i =	2.6	5.3	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 =	2.6	5.2	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	Q_b =	0.0	0.7	cfs
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.60**	**5.16**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.7**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**87**	**%**

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

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

Project: **Springs at Waterview**

Inlet ID: **Design Point E (Sump Inlet - Type R)**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	10.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	15.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	7.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	1.68	3.60	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.52	1.52	inches
Water Depth at Gutter Flowline	d =	3.20	5.12	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	5.0	13.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.753	0.397	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.4	5.1	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.2	3.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**1.6**	**8.5**	**cfs**
Flow Velocity within the Gutter Section	V =	3.3	4.9	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.9	2.1	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	43.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	16.7	41.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.319	0.131	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	10.0	114.8	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	9.8	72.4	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	4.7	17.2	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	21.9	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	14.5	111.6	cfs
Average Flow Velocity Within the Gutter Section	V =	5.6	9.4	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.8	9.4	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**14.5**	**111.6**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	6.00	12.00	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.88	6.88	inches

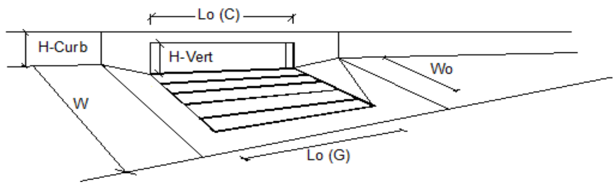
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**1.6**	**8.5**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Project: Springs at Waterview
Inlet ID: Design Point E (Sump Inlet - Type R)



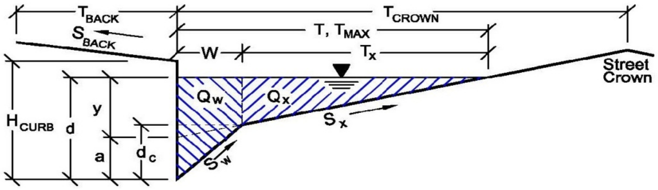
		MINOR	MAJOR	
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit 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 =	1.6	4.7	cfs
Water Spread Width	T =	7.0	11.7	ft
Water Depth at Flowline (outside of local depression)	d =	3.2	4.3	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.757	0.506	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.4	2.3	cfs
Discharge within the Gutter Section W	Q_w =	1.2	2.4	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.61	1.49	sq ft
Velocity within the Gutter Section W	V_W =	2.6	3.2	fps
Water Depth for Design Condition	d_{LOCAL} =	6.2	7.3	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 =	0.163	0.115	ft/ft
Required Length L_T to Have 100% Interception	L_T =	5.89	11.95	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	5.89	10.00	ft
Interception Capacity	Q_i =	1.6	4.5	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 =	1.6	4.4	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	Q_b =	0.0	0.3	cfs
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.60**	**4.43**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	Q_b =	**0.0**	**0.3**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**94**	**%**

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

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

Project: **Springs at Waterview**

Inlet ID: **Design Point C (Sump Inlet - Type R)**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	10.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	15.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.025	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	7.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	1.68	3.60	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.52	1.52	inches
Water Depth at Gutter Flowline	d =	3.20	5.12	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	5.0	13.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.753	0.397	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.6	8.1	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.9	5.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**2.6**	**13.5**	**cfs**
Flow Velocity within the Gutter Section	V =	5.3	7.8	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	1.4	3.3	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	43.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	16.7	41.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.319	0.131	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	15.8	181.5	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	15.5	114.5	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	7.4	27.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	34.6	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	22.9	176.4	cfs
Average Flow Velocity Within the Gutter Section	V =	8.8	14.9	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	4.4	14.9	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	0.86	0.70	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**19.7**	**123.1**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.73	10.50	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.61	5.38	inches

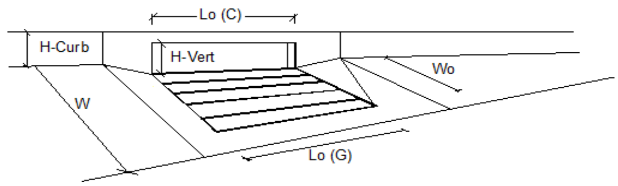
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**2.6**	**13.5**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Project: Springs at Waterview
Inlet ID: Design Point C (Sump Inlet - Type R)



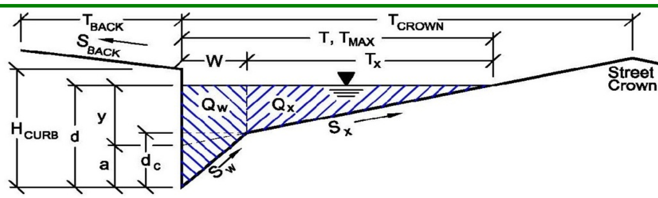
		MINOR	MAJOR	
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	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 =	0.8	2.1	cfs
Water Spread Width	T =	2.3	6.3	ft
Water Depth at Flowline (outside of local depression)	d =	2.1	3.0	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	1.008	0.805	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.0	0.4	cfs
Discharge within the Gutter Section W	Q_w =	0.8	1.7	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.18	0.52	sq ft
Velocity within the Gutter Section W	V_W =	4.5	4.1	fps
Water Depth for Design Condition	d_{LOCAL} =	5.1	6.0	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	$E_{o\text{-}GRATE}$ =	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 =	0.208	0.171	ft/ft
Required Length L_T to Have 100% Interception	L_T =	3.89	6.96	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	3.89	5.00	ft
Interception Capacity	Q_i =	0.8	1.9	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.10	0.10	
Effective (Unclogged) Length	L_e =	4.50	4.50	ft
Actual Interception Capacity	Q_a =	0.8	1.8	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	Q_b =	0.0	0.3	cfs
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.80**	**1.78**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.3**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**85**	**%**

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

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

Project: Springs at Waterview

Inlet ID: Basin D-15



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	10.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	15.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	7.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	1.68	3.60	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.52	1.52	inches
Water Depth at Gutter Flowline	d =	3.20	5.12	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	5.0	13.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.753	0.397	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.4	5.1	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.2	3.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**1.6**	**8.5**	**cfs**
Flow Velocity within the Gutter Section	V =	3.3	4.9	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.9	2.1	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	43.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	16.7	41.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.319	0.131	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	10.0	114.8	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	9.8	72.4	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	4.7	17.2	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	21.9	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	14.5	111.6	cfs
Average Flow Velocity Within the Gutter Section	V =	5.6	9.4	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.8	9.4	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**14.5**	**111.6**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	6.00	12.00	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.88	6.88	inches

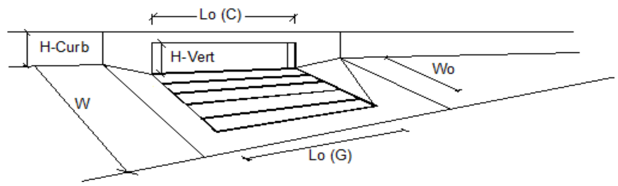
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**1.6**	**8.5**	**cfs**

WARNING: MINOR STORM max. allowable capacity is less than flow given on sheet 'Q-Peak'

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

INLET ON A CONTINUOUS GRADE

Project: Springs at Waterview
Inlet ID: Basin D-15



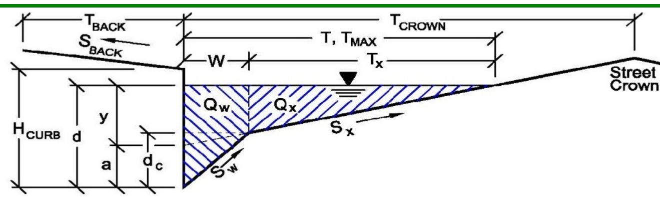
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	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: WARNING: Q > ALLOWABLE Q FOR MINOR STORM'		MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Q-Peak*)	Q_o =	1.9	3.6	cfs
Water Spread Width	T =	7.6	10.4	ft
Water Depth at Flowline (outside of local depression)	d =	3.4	4.0	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.714	0.562	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.5	1.6	cfs
Discharge within the Gutter Section W	Q_w =	1.4	2.0	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.71	1.20	sq ft
Velocity within the Gutter Section W	V_W =	2.7	3.0	fps
Water Depth for Design Condition	d_{LOCAL} =	6.4	7.0	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	$E_{o\text{-}GRATE}$ =	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 =	0.154	0.126	ft/ft
Required Length L_T to Have 100% Interception	L_T =	6.58	10.02	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	5.00	5.00	ft
Interception Capacity	Q_i =	1.8	2.6	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.10	0.10	
Effective (Unclogged) Length	L_e =	4.50	4.50	ft
Actual Interception Capacity	Q_a =	1.7	2.4	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	Q_b =	0.2	1.2	cfs
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.66**	**2.37**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.2**	**1.2**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**87**	**66**	**%**

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

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

Project: Springs at Waterview

Inlet ID: Basin D-16



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	10.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	15.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	7.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	1.68	3.60	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.52	1.52	inches
Water Depth at Gutter Flowline	d =	3.20	5.12	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	5.0	13.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.753	0.397	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.4	5.1	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.2	3.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**1.6**	**8.5**	**cfs**
Flow Velocity within the Gutter Section	V =	3.3	4.9	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.9	2.1	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	43.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	16.7	41.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.319	0.131	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	10.0	114.8	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	9.8	72.4	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	4.7	17.2	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	21.9	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	14.5	111.6	cfs
Average Flow Velocity Within the Gutter Section	V =	5.6	9.4	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.8	9.4	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**14.5**	**111.6**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	6.00	12.00	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.88	6.88	inches

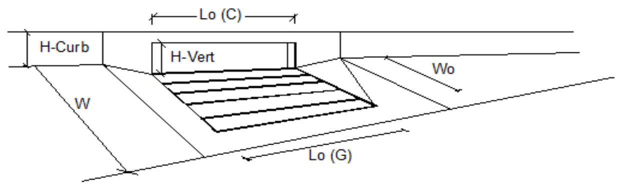
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**1.6**	**8.5**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Project: Springs at Waterview
Inlet ID: Basin D-16



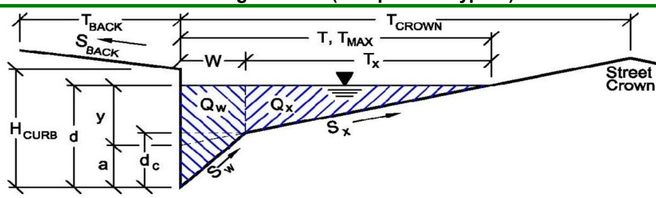
		MINOR	MAJOR	
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	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 =	1.3	2.5	cfs
Water Spread Width	T =	6.2	8.7	ft
Water Depth at Flowline (outside of local depression)	d =	3.0	3.6	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.810	0.646	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.2	0.9	cfs
Discharge within the Gutter Section W	Q_w =	1.1	1.6	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.51	0.89	sq ft
Velocity within the Gutter Section W	V_W =	2.6	2.8	fps
Water Depth for Design Condition	d_{LOCAL} =	6.0	6.6	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	$E_{o\text{-}GRATE}$ =	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 =	0.172	0.142	ft/ft
Required Length L_T to Have 100% Interception	L_T =	5.15	7.88	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	5.00	5.00	ft
Interception Capacity	Q_i =	1.3	2.1	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.10	0.10	
Effective (Unclogged) Length	L_e =	4.50	4.50	ft
Actual Interception Capacity	Q_a =	1.3	2.0	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	Q_b =	0.0	0.5	cfs
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.27**	**1.96**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.5**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**98**	**78**	**%**

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

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

Project: Springs at Waterview

Inlet ID: Design Point F (Sump Inlet - Type R)



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	15.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	15.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	7.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	1.68	3.60	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.52	1.52	inches
Water Depth at Gutter Flowline	d =	3.20	5.12	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	5.0	13.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.753	0.397	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	43.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	16.7	41.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.319	0.131	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq 6"$) Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

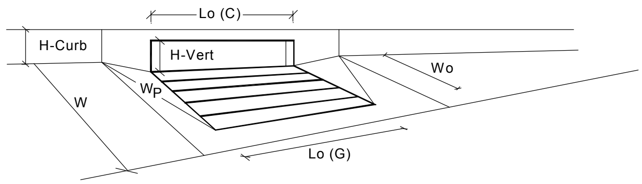
Minor storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

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

INLET IN A SUMP OR SAG LOCATION

Project = Springs at Waterview

Inlet ID = Design Point F (Sump Inlet - Type R)



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 =	3.2	5.1	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	

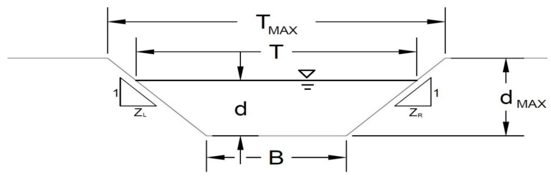
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	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} =	0.94	4.10	cfs
Interception with Clogging	Q_{wa} =	0.84	3.69	cfs
Curb Opening as an Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	7.28	9.05	cfs
Interception with Clogging	Q_{oa} =	6.55	8.14	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	2.43	5.67	cfs
Interception with Clogging	Q_{ma} =	2.19	5.10	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**0.84**	**3.69**	**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 =	7.0	15.0	ft
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	0.0	inches
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**0.8**	**3.7**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	0.2	3.1	cfs

AREA INLET IN A TRAPEZOIDAL GRASS-LINED CHANNEL

Waterview Springs
Basin D17



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

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D or E	B	
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	see details below	
Channel Invert Slope	S_O =	0.0120	ft/ft
Bottom Width	B =	10.00	ft
Left Side Slope	Z1 =	4.00	ft/ft
Right Side Slope	Z2 =	4.00	ft/ft

Check one of the following soil types:

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

Choose One:
- ○ Sandy
- ◉ Non-Sandy

		Minor Storm	Major Storm	
Max. Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	20.00	25.00	feet
Max. Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	1.00	1.50	feet

Maximum Channel Capacity Based On Allowable Top Width

		Minor Storm	Major Storm	
Max. Allowable Top Width	T_{MAX} =	**20.00**	**25.00**	**ft**
Water Depth	d =	1.25	1.88	ft
Flow Area	A =	18.75	32.81	sq ft
Wetted Perimeter	P =	20.31	25.46	ft
Hydraulic Radius	R =	0.92	1.29	ft
Manning's n based on NRCS Vegetal Retardance	n =	0.172	0.077	
Flow Velocity	V =	0.90	2.50	fps
Velocity-Depth Product	VR =	0.83	3.22	ft^2/s
Hydraulic Depth	D =	0.94	1.31	ft
Froude Number	Fr =	0.16	0.38	
Max. Flow Based On Allowable Top Width	Q_T =	**16.89**	**81.98**	**cfs**

Maximum Channel Capacity Based On Allowable Water Depth

		Minor Storm	Major Storm	
Max. Allowable Water Depth	d_{MAX} =	**1.00**	**1.50**	**feet**
Top Width	T =	18.00	22.00	feet
Flow Area	A =	14.00	24.00	square feet
Wetted Perimeter	P =	18.25	22.37	feet
Hydraulic Radius	R =	0.77	1.07	feet
Manning's n based on NRCS Vegetal Retardance	n =	0.300	0.118	
Flow Velocity	V =	0.46	1.46	fps
Velocity-Depth Product	VR =	0.35	1.56	ft^2/s
Hydraulic Depth	D =	0.78	1.09	feet
Froude Number	Fr =	0.09	0.25	
Max. Flow Based On Allowable Water Depth	Q_d =	**6.38**	**34.93**	**cfs**

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**6.38**	**34.93**	**cfs**
MAJOR STORM Allowable Capacity is based on Depth Criterion	d_{allow} =	**1.00**	**1.50**	**ft**

Water Depth in Channel Based On Design Peak Flow

		Minor Storm	Major Storm	
Design Peak Flow	Q_o =	**3.10**	**7.10**	**cfs**
Water Depth	**d =**	**0.70**	**1.04**	**feet**
Top Width	T =	15.60	18.33	feet
Flow Area	A =	8.95	14.74	square feet
Wetted Perimeter	P =	15.77	18.58	feet
Hydraulic Radius	R =	0.57	0.79	feet
Manning's n based on NRCS Vegetal Retardance	n =	0.323	0.290	
Flow Velocity	V =	0.35	0.48	fps
Velocity-Depth Product	VR =	0.20	0.38	ft^2/s
Hydraulic Depth	D =	0.57	0.80	feet
Froude Number	Fr =	0.08	0.09	

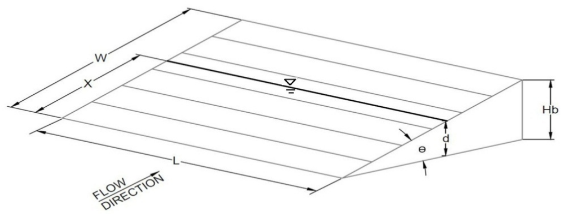
Minor storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'
Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

AREA INLET IN A TRAPEZOIDAL GRASS-LINED CHANNEL

Waterview Springs
Basin D17

Inlet Design Information (Input)

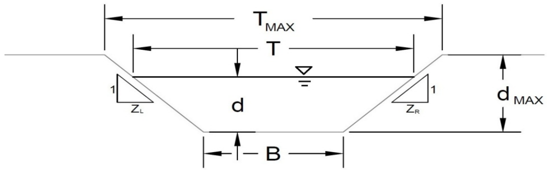
Type of Inlet	Inlet Type =	CDOT Type C		
Angle of Inclined Grate (must be <= 30 degrees)	θ =		0.00	degrees
Width of Grate	W =		3.00	feet
Length of Grate	L =		3.00	feet
Open Area Ratio	A_{RATIO} =		0.70	
Height of Inclined Grate	H_B =		0.00	feet
Clogging Factor	C_f =		0.50	
Grate Discharge Coefficient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



		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	0.70	1.04	
Grate Capacity as a Weir				
Submerged Side Weir Length	X =	3.00	3.00	feet
Inclined Side Weir Flow	Q_{ws} =	6.30	11.44	cfs
Base Weir Flow	Q_{wb} =	9.01	16.35	cfs
Interception without Clogging	Q_{wi} =	21.62	39.24	cfs
Interception with Clogging	Q_{wa} =	10.81	19.62	cfs
Grate Capacity as an Orifice				
Interception without Clogging	Q_{oi} =	27.04	32.99	cfs
Interception with Clogging	Q_{oa} =	13.52	16.49	cfs
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**10.81**	**16.49**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (> Q PEAK)	**Bypassed Flow, Q_b =**	**0.00**	**0.00**	**cfs**
	Capture Percentage = Q_a/Q_o = C%	**100**	**100**	**%**

AREA INLET IN A TRAPEZOIDAL GRASS-LINED CHANNEL

Waterview Springs
DP 42a



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

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D or E	B		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	see details below		
Channel Invert Slope	S_O =	0.0050		ft/ft
Bottom Width	B =	6.00		ft
Left Side Slope	Z1 =	3.00		ft/ft
Right Side Slope	Z2 =	3.00		ft/ft

Check one of the following soil types:

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

Choose One:
○ Sandy
◉ Non-Sandy

		Minor Storm	Major Storm	
Max. Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	**28.00**	**30.00**	**feet**
Max. Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	**2.00**	**2.50**	**feet**

Maximum Channel Capacity Based On Allowable Top Width		Minor Storm	Major Storm	
Max. Allowable Top Width	T_{MAX} =	**28.00**	**30.00**	**ft**
Water Depth	d =	3.67	4.00	ft
Flow Area	A =	62.33	72.00	sq ft
Wetted Perimeter	P =	29.19	31.30	ft
Hydraulic Radius	R =	2.14	2.30	ft
Manning's n based on NRCS Vegetal Retardance	n =	0.055	0.052	
Flow Velocity	V =	3.19	3.56	fps
Velocity-Depth Product	VR =	6.82	8.18	ft^2/s
Hydraulic Depth	D =	2.23	2.40	ft
Froude Number	Fr =	0.38	0.40	
Max. Flow Based On Allowable Top Width	Q_T =	**198.97**	**255.98**	**cfs**

Maximum Channel Capacity Based On Allowable Water Depth		Minor Storm	Major Storm	
Max. Allowable Water Depth	d_{MAX} =	**2.00**	**2.50**	**feet**
Top Width	T =	18.00	21.00	feet
Flow Area	A =	24.00	33.75	square feet
Wetted Perimeter	P =	18.65	21.81	feet
Hydraulic Radius	R =	1.29	1.55	feet
Manning's n based on NRCS Vegetal Retardance	n =	0.149	0.090	
Flow Velocity	V =	0.84	1.57	fps
Velocity-Depth Product	VR =	1.08	2.44	ft^2/s
Hydraulic Depth	D =	1.33	1.61	feet
Froude Number	Fr =	0.13	0.22	
Max. Flow Based On Allowable Water Depth	Q_d =	**20.14**	**53.13**	**cfs**

Allowable Channel Capacity Based On Channel Geometry		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**20.14**	**53.13**	**cfs**
MAJOR STORM Allowable Capacity is based on Depth Criterion	d_{allow} =	**2.00**	**2.50**	**ft**

Water Depth in Channel Based On Design Peak Flow				
Design Peak Flow	Q_o =	**11.90**	**26.30**	**cfs**
Water Depth	**d =**	**1.78**	**2.14**	**feet**
Top Width	T =	16.69	18.82	feet
Flow Area	A =	20.20	26.52	square feet
Wetted Perimeter	P =	17.26	19.52	feet
Hydraulic Radius	R =	1.17	1.36	feet
Manning's n based on NRCS Vegetal Retardance	n =	0.199	0.130	
Flow Velocity	V =	0.59	0.99	fps
Velocity-Depth Product	VR =	0.69	1.35	ft^2/s
Hydraulic Depth	D =	1.21	1.41	feet
Froude Number	Fr =	0.09	0.15	

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

AREA INLET IN A TRAPEZOIDAL GRASS-LINED CHANNEL

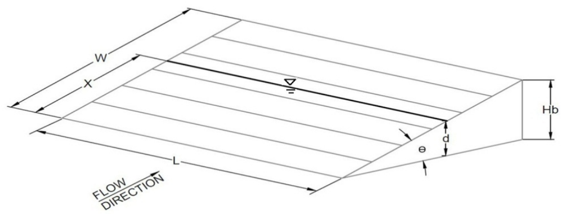
Waterview Springs

DP 42a

Inlet Design Information (Input)

Type of Inlet — Inlet Type = User-Defined

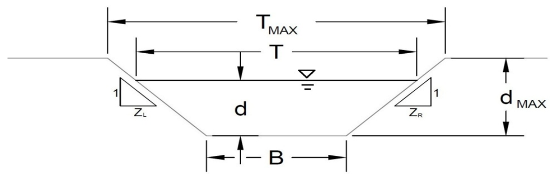
Angle of Inclined Grate (must be <= 30 degrees)	θ =	0.00	degrees
Width of Grate	W =	8.00	feet
Length of Grate	L =	8.00	feet
Open Area Ratio	A_{RATIO} =	0.50	
Height of Inclined Grate	H_B =	0.00	feet
Clogging Factor	C_f =	0.50	
Grate Discharge Coefficient	C_d =	N/A	
Orifice Coefficient	C_o =	0.64	
Weir Coefficient	C_w =	2.05	



		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	1.78	2.14	
Grate Capacity as a Weir				
Submerged Side Weir Length	X =	8.00	8.00	feet
Inclined Side Weir Flow	Q_{ws} =	48.73	64.04	cfs
Base Weir Flow	Q_{wb} =	97.46	128.08	cfs
Interception without Clogging	Q_{wi} =	194.91	256.16	cfs
Interception with Clogging	Q_{wa} =	97.46	128.08	cfs
Grate Capacity as an Orifice				
Interception without Clogging	Q_{oi} =	219.34	240.25	cfs
Interception with Clogging	Q_{oa} =	109.67	120.13	cfs
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**97.46**	**120.13**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (> Q PEAK)	**Bypassed Flow, Q_b =**	**0.00**	**0.00**	**cfs**
	Capture Percentage = Q_a/Q_o = C%	**100**	**100**	**%**

AREA INLET IN A TRAPEZOIDAL GRASS-LINED CHANNEL

Waterview Springs
DP 43



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

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D or E	B	
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	see details below	
Channel Invert Slope	S_O =	0.0100	ft/ft
Bottom Width	B =	15.00	ft
Left Side Slope	Z1 =	4.00	ft/ft
Right Side Slope	Z2 =	4.00	ft/ft

Check one of the following soil types:

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

Choose One:
- ○ Sandy
- ◉ Non-Sandy

		Minor Storm	Major Storm	
Max. Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	28.00	30.00	feet
Max. Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	2.00	2.50	feet

Maximum Channel Capacity Based On Allowable Top Width		Minor Storm	Major Storm	
Max. Allowable Top Width	T_{MAX} =	**28.00**	**30.00**	**ft**
Water Depth	d =	1.63	1.88	ft
Flow Area	A =	34.94	42.19	sq ft
Wetted Perimeter	P =	28.40	30.46	ft
Hydraulic Radius	R =	1.23	1.38	ft
Manning's n based on NRCS Vegetal Retardance	n =	0.095	0.075	
Flow Velocity	V =	1.81	2.47	fps
Velocity-Depth Product	VR =	2.22	3.42	ft^2/s
Hydraulic Depth	D =	1.25	1.41	ft
Froude Number	Fr =	0.29	0.37	
Max. Flow Based On Allowable Top Width	Q_T =	**63.16**	**104.21**	**cfs**

Maximum Channel Capacity Based On Allowable Water Depth		Minor Storm	Major Storm	
Max. Allowable Water Depth	d_{MAX} =	**2.00**	**2.50**	**feet**
Top Width	T =	31.00	35.00	feet
Flow Area	A =	46.00	62.50	square feet
Wetted Perimeter	P =	31.49	35.62	feet
Hydraulic Radius	R =	1.46	1.75	feet
Manning's n based on NRCS Vegetal Retardance	n =	0.068	0.054	
Flow Velocity	V =	2.82	4.02	fps
Velocity-Depth Product	VR =	4.12	7.06	ft^2/s
Hydraulic Depth	D =	1.48	1.79	feet
Froude Number	Fr =	0.41	0.53	
Max. Flow Based On Allowable Water Depth	Q_d =	**129.62**	**251.46**	**cfs**

Allowable Channel Capacity Based On Channel Geometry		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Top Width Criterion	Q_{allow} =	**63.16**	**104.21**	**cfs**
MAJOR STORM Allowable Capacity is based on Top Width Criterion	d_{allow} =	**1.63**	**1.88**	**ft**

Water Depth in Channel Based On Design Peak Flow				
Design Peak Flow	Q_o =	**4.00**	**9.20**	**cfs**
Water Depth	**d =**	**0.69**	**1.04**	**feet**
Top Width	T =	20.53	23.31	feet
Flow Area	A =	12.29	19.90	square feet
Wetted Perimeter	P =	20.70	23.57	feet
Hydraulic Radius	R =	0.59	0.84	feet
Manning's n based on NRCS Vegetal Retardance	n =	0.323	0.288	
Flow Velocity	V =	0.33	0.46	fps
Velocity-Depth Product	VR =	0.19	0.39	ft^2/s
Hydraulic Depth	D =	0.60	0.85	feet
Froude Number	Fr =	0.07	0.09	

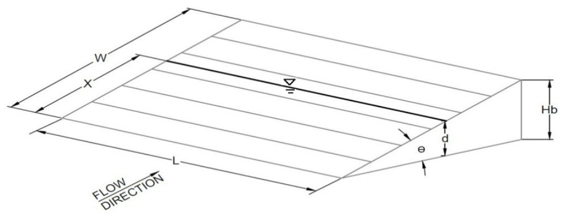
Minor storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'
Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

AREA INLET IN A TRAPEZOIDAL GRASS-LINED CHANNEL

Waterview Springs
DP 43

Inlet Design Information (Input)

Type of Inlet	Inlet Type =	User-Defined		
Angle of Inclined Grate (must be <= 30 degrees)	θ =		0.00	degrees
Width of Grate	W =		8.00	feet
Length of Grate	L =		8.00	feet
Open Area Ratio	A_{RATIO} =		0.50	
Height of Inclined Grate	H_B =		0.00	feet
Clogging Factor	C_f =		0.50	
Grate Discharge Coefficient	C_d =		N/A	
Orifice Coefficient	C_o =		0.64	
Weir Coefficient	C_w =		2.05	



		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	0.69	1.04	
Grate Capacity as a Weir				
Submerged Side Weir Length	X =	8.00	8.00	feet
Inclined Side Weir Flow	Q_{ws} =	11.79	21.70	cfs
Base Weir Flow	Q_{wb} =	23.58	43.40	cfs
Interception without Clogging	Q_{wi} =	47.16	86.81	cfs
Interception with Clogging	Q_{wa} =	23.58	43.40	cfs
Grate Capacity as an Orifice				
Interception without Clogging	Q_{oi} =	136.68	167.50	cfs
Interception with Clogging	Q_{oa} =	68.34	83.75	cfs
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**23.58**	**43.40**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (> Q PEAK)	**Bypassed Flow, Q_b =**	**0.00**	**0.00**	**cfs**
	Capture Percentage = Q_a/Q_o = C%	**100**	**100**	**%**

Worksheet for Ex Asphalt Rundown

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.016	
Channel Slope	0.01430	ft/ft
Bottom Width	4.00	ft
Discharge	15.50	ft³/s

Results

Normal Depth	0.59	ft
Flow Area	2.36	ft²
Wetted Perimeter	5.18	ft
Hydraulic Radius	0.46	ft
Top Width	4.00	ft
Critical Depth	0.78	ft
Critical Slope	0.00629	ft/ft
Velocity	6.57	ft/s
Velocity Head	0.67	ft
Specific Energy	1.26	ft
Froude Number	1.51	
Flow Type	Supercritical	

GVF Input Data

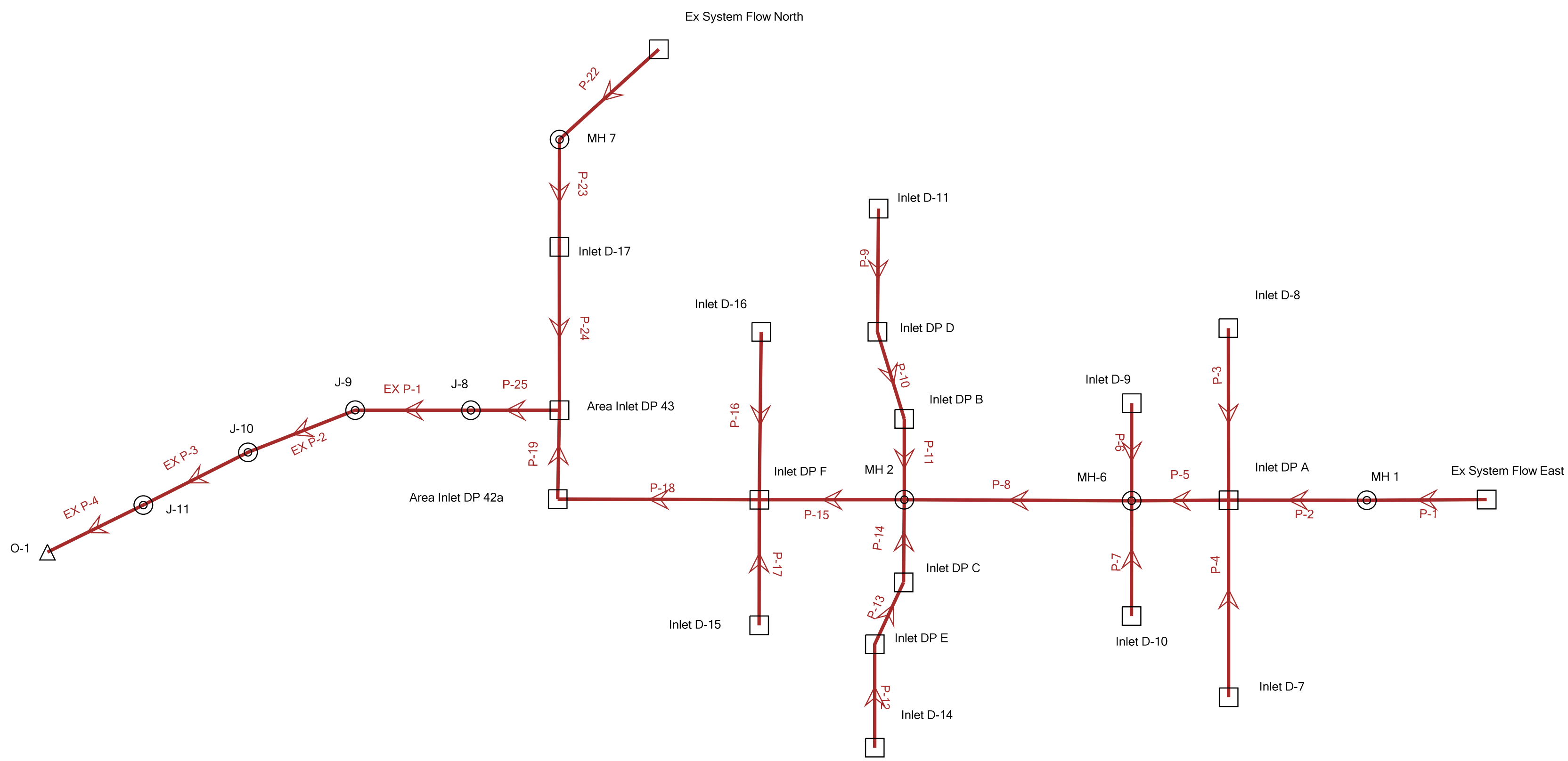
Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

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	0.59	ft
Critical Depth	0.78	ft
Channel Slope	0.01430	ft/ft
Critical Slope	0.00629	ft/ft

Appendix E: StormCAD Design

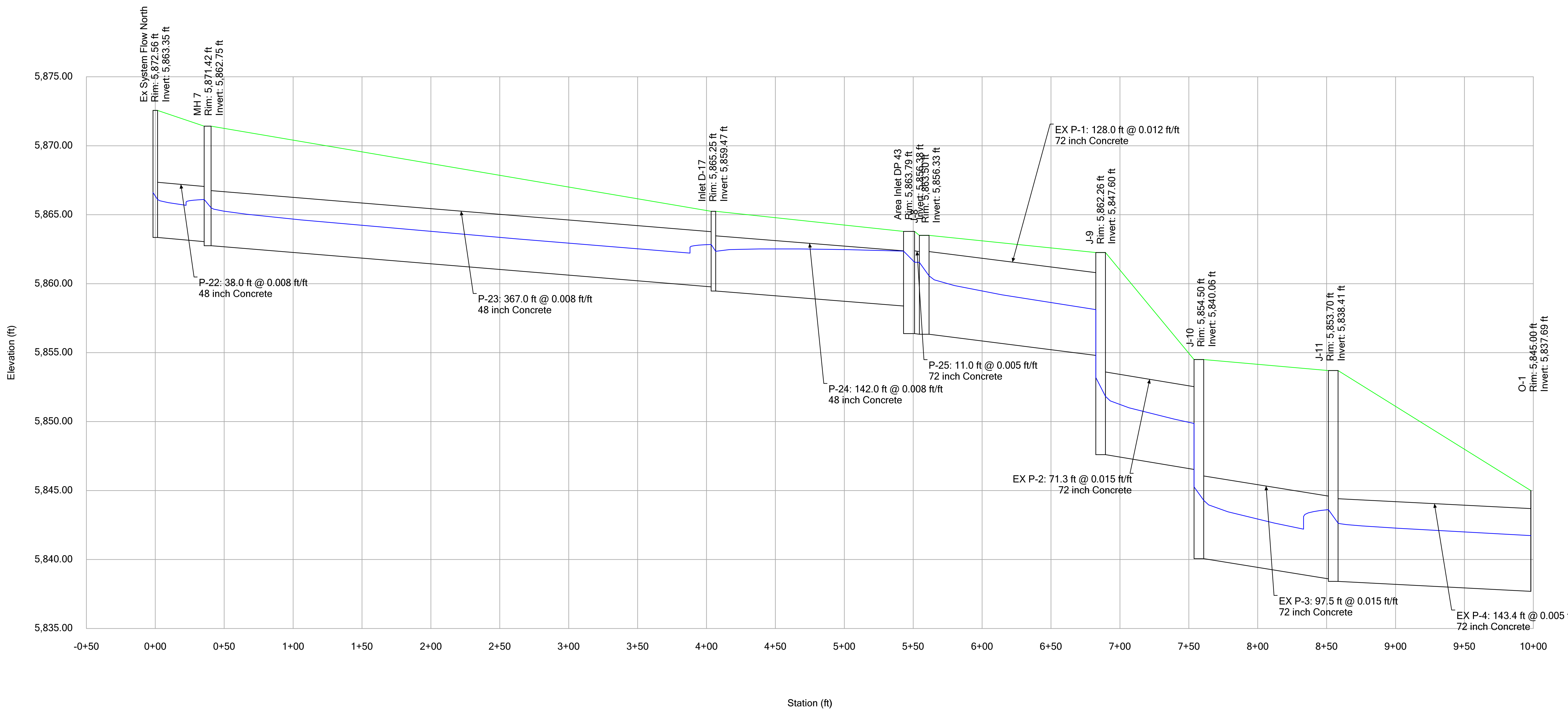
Scenario: 100-YR



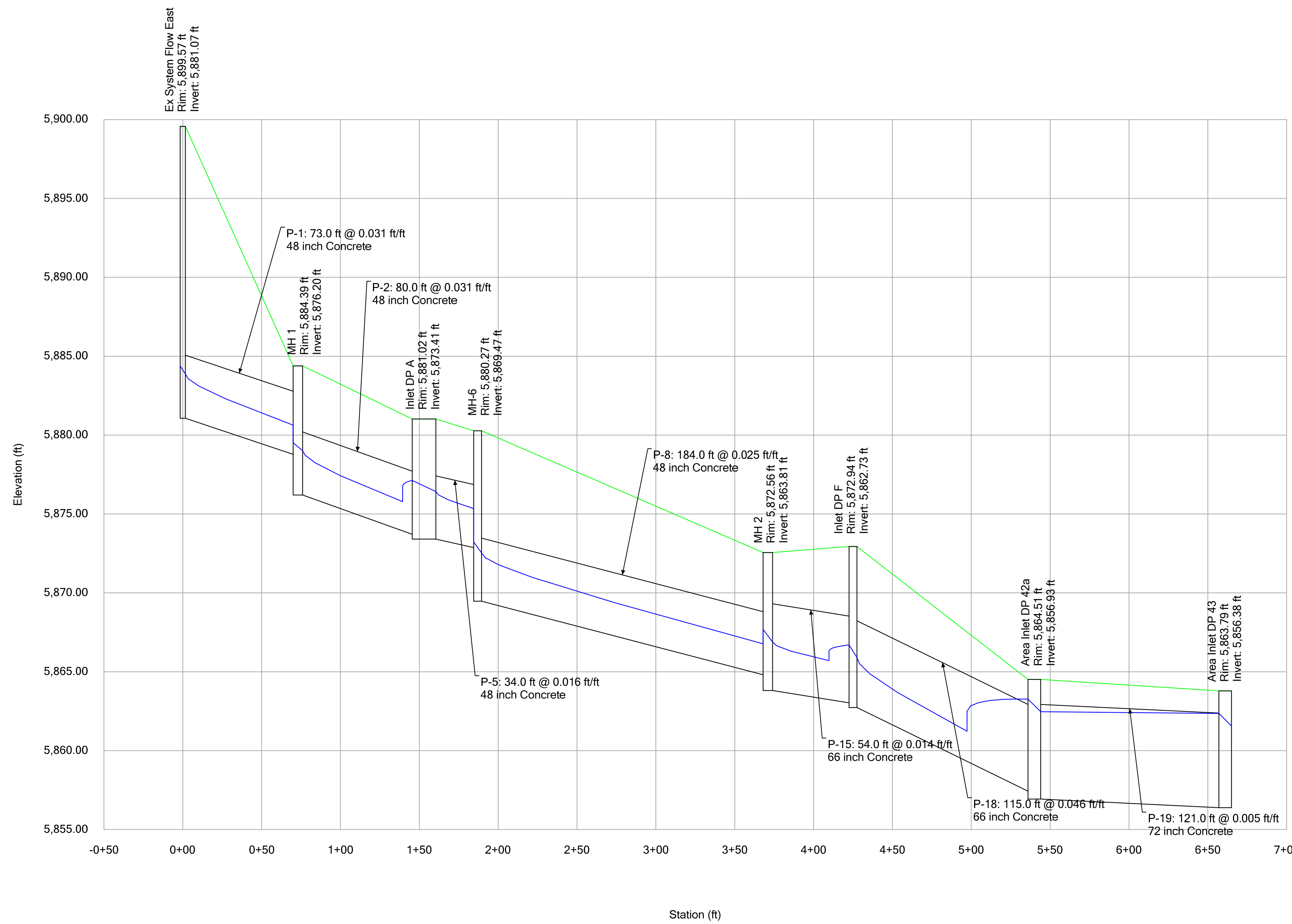
SPRINGS AT WATERVIEW - STORMCAD OUTPUT 100 YEAR

Label	Up. Node	Dn. Node	L (ft)	Size	Q Full (cfs)	System Q (cfs)	Avg. v (ft/s)	Up. Gr Elev. (ft)	HGL In (ft)	Up. Invert (ft)	Up. Cover (ft)	Dn. Gr. Elev. (ft)	Dn. Invert (ft)	Dn. Cover (ft)	S (ft/ft)
P-19	Area Inlet DP 42a	Area Inlet DP 43	121.0	72 inch	148.1	285.5	10.19	5864.51	5863.26	5856.93	1.58	5863.79	5856.38	1.41	0.50%
P-25	Area Inlet DP 43	J-8	11.0	72 inch	239.1	285.5	11.31	5863.79	5862.36	5856.38	1.41	5863.50	5856.33	1.17	0.50%
EX P-1	J-8	J-9	128.0	72 inch	239.1	463.0	16.51	5863.50	5861.54	5856.33	1.17	5862.26	5854.80	1.46	1.20%
EX P-2	J-9	J-10	71.3	72 inch	238.8	518.8	17.97	5862.26	5853.20	5847.60	8.66	5854.50	5846.53	1.97	1.50%
EX P-3	J-10	J-11	97.5	72 inch	238.7	518.2	17.95	5854.50	5845.27	5840.06	8.44	5853.70	5838.60	9.10	1.50%
EX P-4	J-11	O-1	143.4	72 inch	238.6	300.1	11.78	5853.70	5843.61	5838.41	9.29	5845.00	5837.69	1.31	0.50%
P-4	Inlet D-7	Inlet DP A	60.0	18 inch	6.8	18.8	9.80	5881.53	5879.12	5877.84	2.19	5881.02	5875.91	3.61	3.20%
P-3	Inlet D-8	Inlet DP A	63.0	18 inch	4.1	15.6	7.41	5881.53	5878.25	5877.29	2.74	5881.02	5875.91	3.61	2.20%
P-1	Ex System Flow East	MH 1	73.0	48 inch	86.1	254.4	18.29	5899.57	5884.38	5881.07	14.50	5884.39	5878.78	1.61	3.10%
P-2	MH 1	Inlet DP A	80.0	48 inch	86.1	253.4	18.23	5884.39	5879.51	5876.20	4.19	5881.02	5873.71	3.31	3.10%
P-15	MH 2	Inlet DP F	54.0	66 inch	122.7	403.6	14.90	5872.56	5867.69	5863.81	3.25	5872.94	5863.03	4.41	1.40%
P-18	Inlet DP F	Area Inlet DP 42a	115.0	66 inch	130.0	720.9	23.01	5872.94	5866.70	5862.73	4.71	5864.51	5857.43	1.58	4.60%
P-16	Inlet D-16	Inlet DP F	63.0	18 inch	2.1	22.9	8.09	5873.45	5870.28	5869.73	2.22	5872.94	5866.73	4.71	4.80%
P-22	Ex System Flow North	MH 7	38.0	48 inch	82.7	127.6	10.81	5872.56	5866.61	5863.35	5.21	5871.42	5863.05	4.37	0.80%
P-23	MH 7	Inlet D-17	367.0	48 inch	82.7	129.4	10.92	5871.42	5866.11	5862.75	4.67	5865.25	5859.77	1.48	0.80%
P-24	Inlet D-17	Area Inlet DP 43	142.0	48 inch	88.6	125.8	10.85	5865.25	5862.85	5859.47	1.78	5863.79	5858.38	1.41	0.80%
P-17	Inlet D-15	Inlet DP F	63.0	18 inch	3.0	22.9	8.93	5873.46	5870.38	5869.72	2.24	5872.94	5866.73	4.71	4.70%
P-11	Inlet DP B	MH 2	25.0	30 inch	11.7	41.0	7.21	5873.06	5868.71	5867.06	3.50	5872.56	5866.81	3.25	1.00%
P-14	Inlet DP C	MH 2	5.0	30 inch	10.1	89.9	12.12	5873.04	5868.61	5867.05	3.49	5872.56	5866.81	3.25	4.80%
P-12	Inlet D-14	Inlet DP E	135.0	18 inch	5.1	11.0	6.09	5874.52	5871.13	5870.26	2.76	5873.06	5868.79	2.77	1.10%
P-13	Inlet DP E	Inlet DP C	28.0	24 inch	9.0	36.8	9.67	5873.06	5869.86	5868.29	2.77	5873.04	5867.55	3.49	2.60%
P-9	Inlet D-11	Inlet DP D	128.0	18 inch	4.9	11.1	6.11	5874.66	5871.25	5870.40	2.76	5873.24	5868.96	2.78	1.10%
P-10	Inlet DP D	Inlet DP B	28.0	24 inch	10.3	40.6	10.77	5873.24	5870.11	5868.46	2.78	5873.06	5867.56	3.50	3.20%
P-5	Inlet DP A	MH-6	34.0	48 inch	98.9	181.0	14.72	5881.02	5877.12	5873.41	3.61	5880.27	5872.87	3.40	1.60%
P-8	MH-6	MH 2	184.0	48 inch	102.1	228.6	17.68	5880.27	5873.23	5869.47	6.80	5872.56	5864.81	3.75	2.50%
P-7	Inlet D-10	MH-6	25.0	18 inch	1.9	22.1	7.65	5881.03	5877.00	5876.48	3.05	5880.27	5875.37	3.40	4.40%
P-6	Inlet D-9	MH-6	45.0	18 inch	2.9	14.9	6.56	5881.19	5877.08	5876.28	3.41	5880.27	5875.37	3.40	2.00%

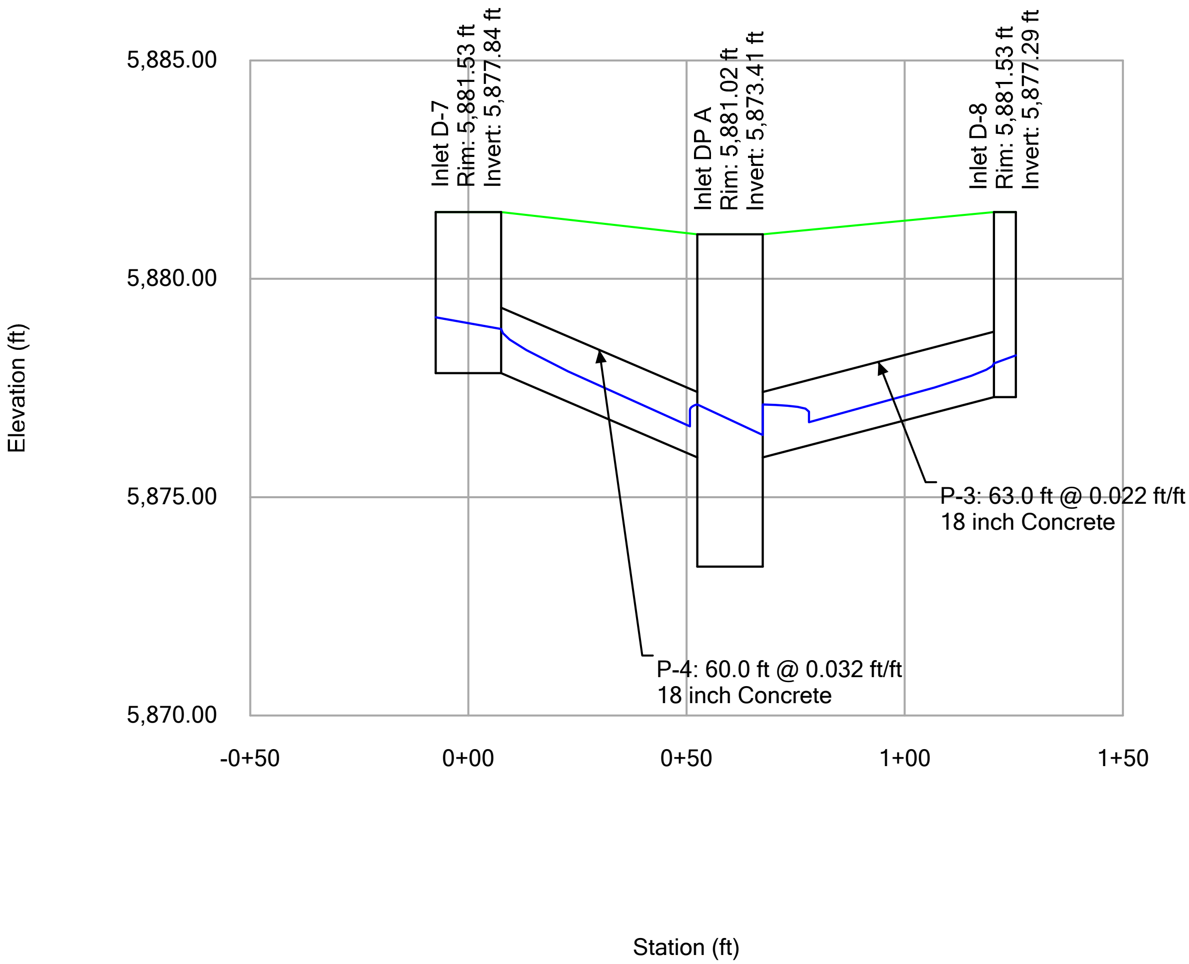
Profile Report
Engineering Profile - Mainline West Side and Outlet (WV-Storm Sys.stsw)



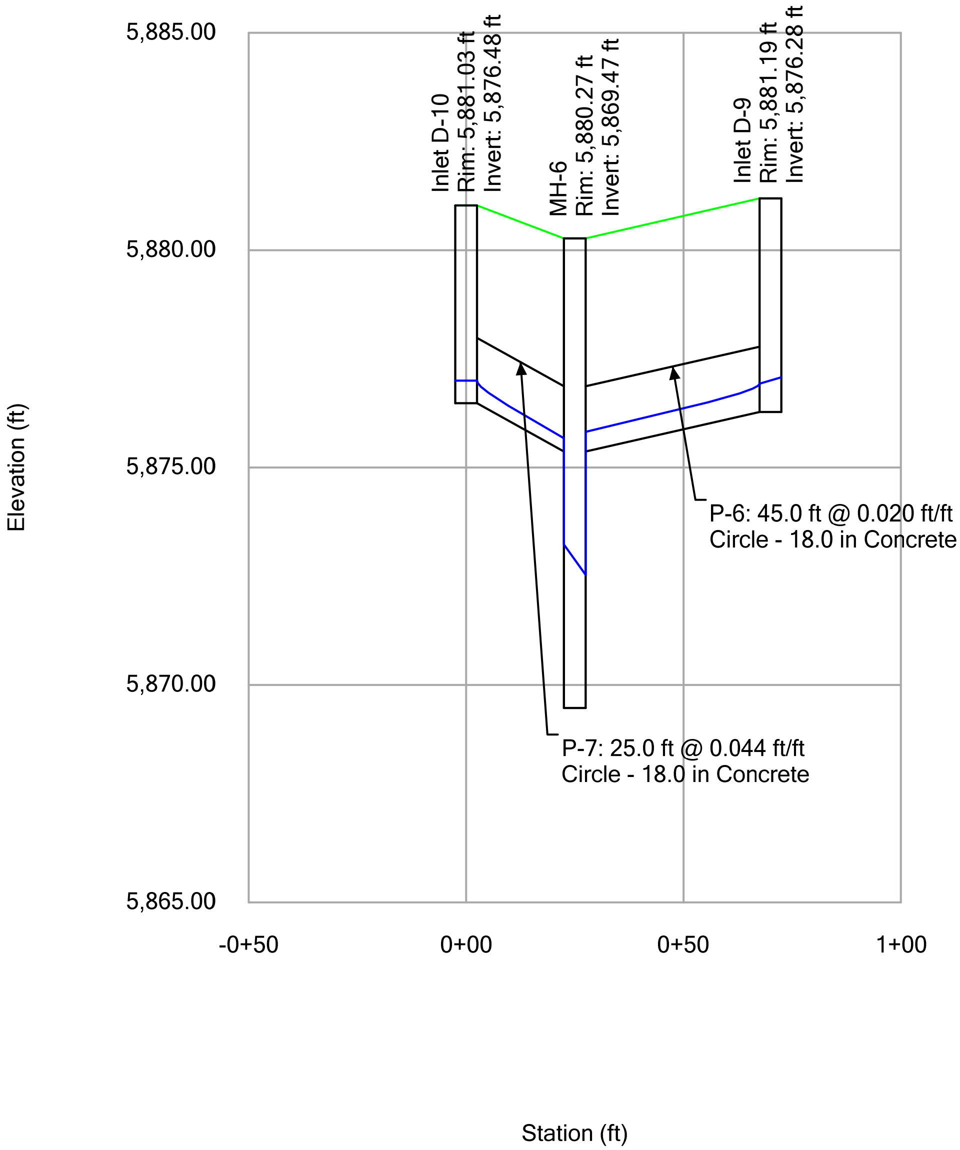
Profile Report
Engineering Profile - Mainline thru Site (WV-Storm Sys.stsw)



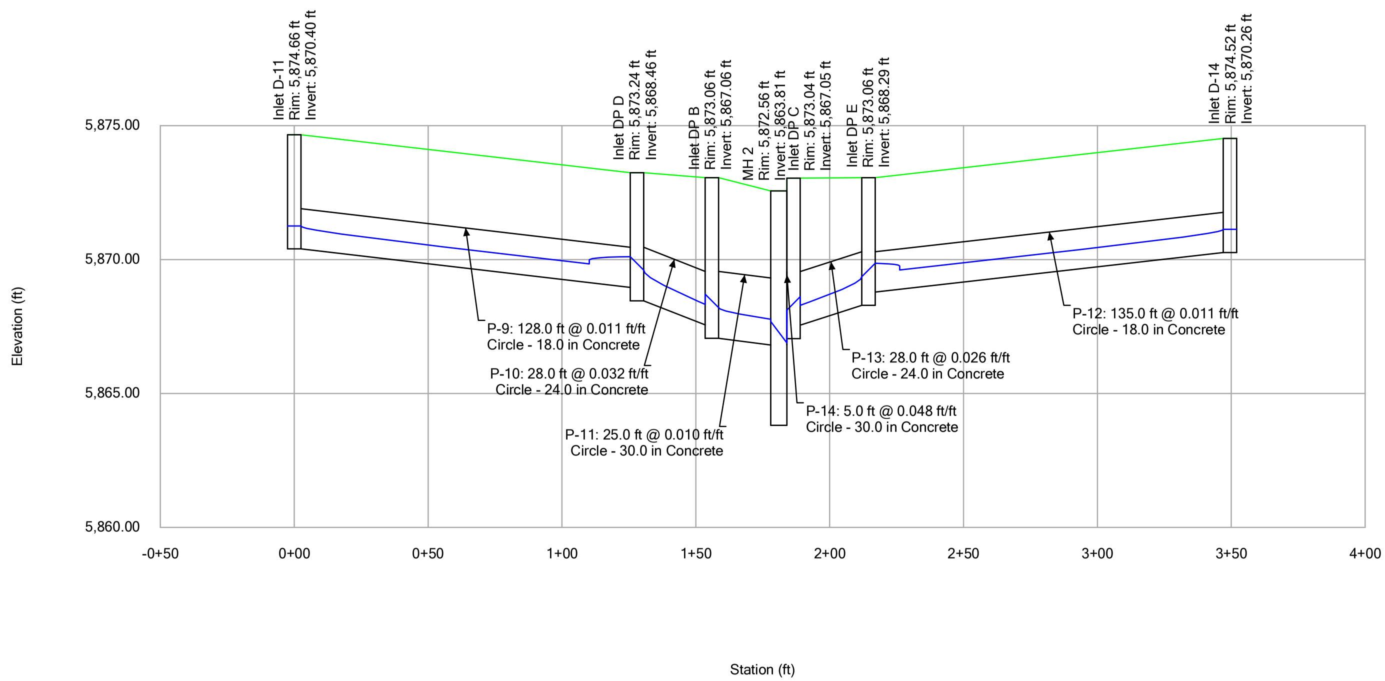
Profile Report
Engineering Profile - East Rd East Lats (WV-Storm Sys.stsw)



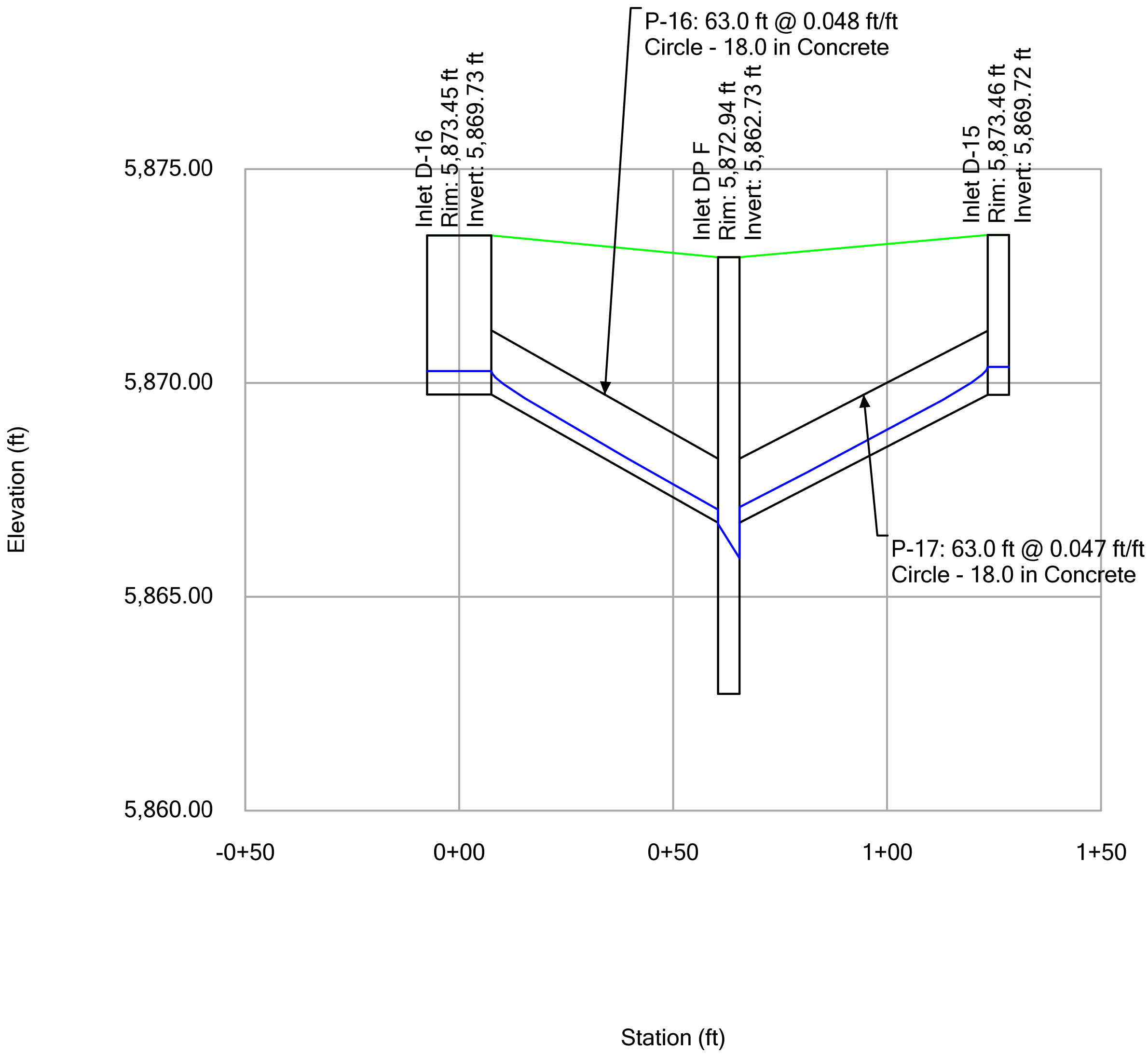
Profile Report
Engineering Profile - East Rd West Lats (WV-Storm Sys.stsw)



Profile Report
Engineering Profile - West Rd East Lats (WV-Storm Sys.stsw)



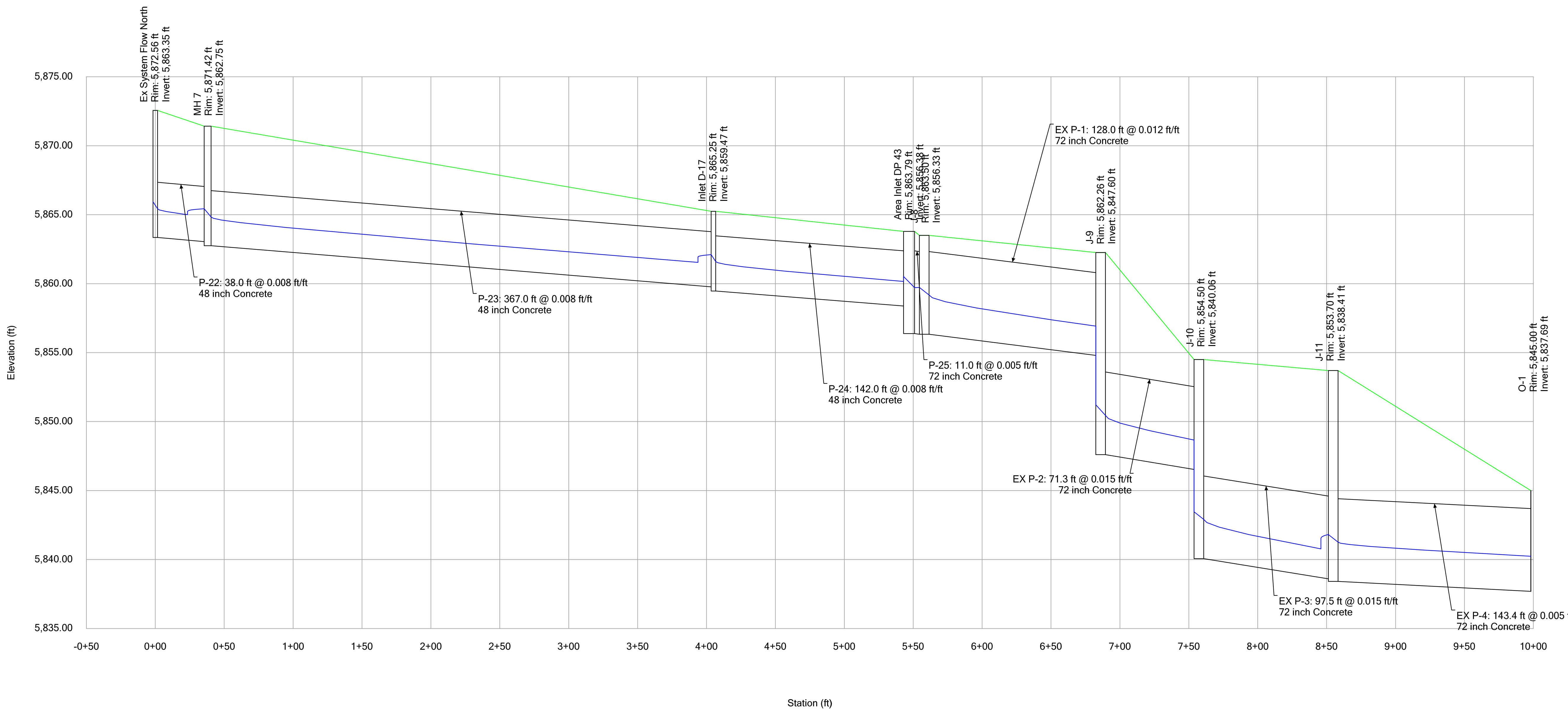
Profile Report
Engineering Profile - West Rd West Lats (WV-Storm Sys.stsw)



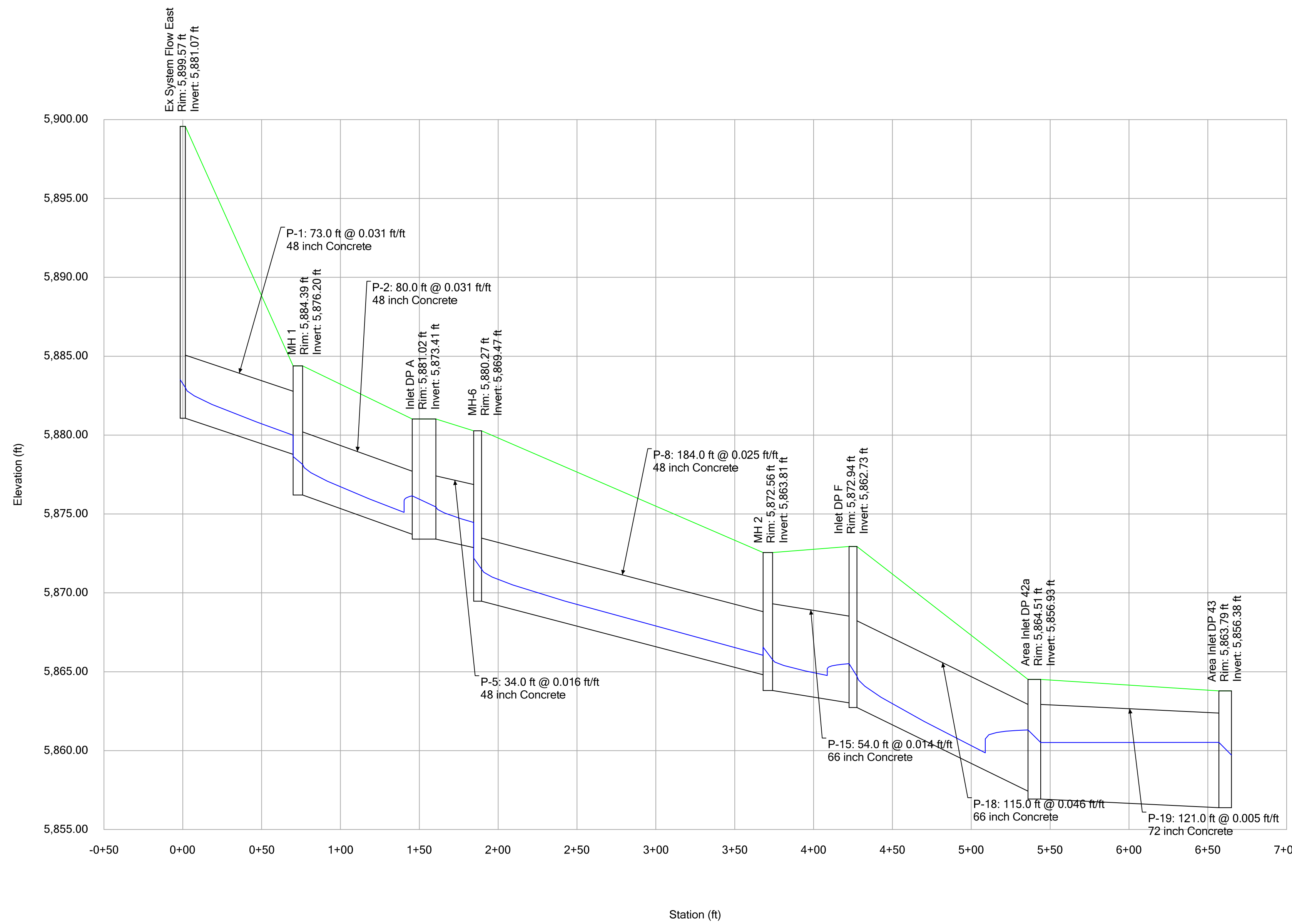
SPRINGS AT WATERVIEW - STORMCAD OUTPUT 5 YEAR

Label	Up. Node	Dn. Node	L (ft)	Size	Q Full (cfs)	System Q (cfs)	Avg. v (ft/s)	Up. Gr Elev. (ft)	HGL In (ft)	Up. Invert (ft)	Up. Cover (ft)	Dn. Gr. Elev. (ft)	Dn. Invert (ft)	Dn. Cover (ft)	S (ft/ft)
P-19	Area Inlet DP 42a	Area Inlet DP 43	121.0	72 inch	60.5	285.5	8.01	5864.51	5861.31	5856.93	1.58	5863.79	5856.38	1.41	0.50%
P-25	Area Inlet DP 43	J-8	11.0	72 inch	111.5	285.5	9.48	5863.79	5860.52	5856.38	1.41	5863.50	5856.33	1.17	0.50%
EX P-1	J-8	J-9	128.0	72 inch	111.5	463.0	13.47	5863.50	5859.73	5856.33	1.17	5862.26	5854.80	1.46	1.20%
EX P-2	J-9	J-10	71.3	72 inch	111.4	518.8	14.62	5862.26	5851.22	5847.60	8.66	5854.50	5846.53	1.97	1.50%
EX P-3	J-10	J-11	97.5	72 inch	111.4	518.2	14.61	5854.50	5843.46	5840.06	8.44	5853.70	5838.60	9.10	1.50%
EX P-4	J-11	O-1	143.4	72 inch	111.4	300.1	9.83	5853.70	5841.81	5838.41	9.29	5845.00	5837.69	1.31	0.50%
P-4	Inlet D-7	Inlet DP A	60.0	18 inch	2.7	18.8	7.57	5881.53	5878.60	5877.84	2.19	5881.02	5875.91	3.61	3.20%
P-3	Inlet D-8	Inlet DP A	63.0	18 inch	1.6	15.6	5.68	5881.53	5877.87	5877.29	2.74	5881.02	5875.91	3.61	2.20%
P-1	Ex System Flow East	MH 1	73.0	48 inch	42.2	254.4	14.99	5899.57	5883.51	5881.07	14.50	5884.39	5878.78	1.61	3.10%
P-2	MH 1	Inlet DP A	80.0	48 inch	42.2	253.4	14.95	5884.39	5878.64	5876.20	4.19	5881.02	5873.71	3.31	3.10%
P-15	MH 2	Inlet DP F	54.0	66 inch	51.3	403.6	11.65	5872.56	5866.56	5863.81	3.25	5872.94	5863.03	4.41	1.40%
P-18	Inlet DP F	Area Inlet DP 42a	115.0	66 inch	53.1	720.9	17.73	5872.94	5865.52	5862.73	4.71	5864.51	5857.43	1.58	4.60%
P-16	Inlet D-16	Inlet DP F	63.0	18 inch	1.0	22.9	6.55	5873.45	5870.11	5869.73	2.22	5872.94	5866.73	4.71	4.80%
P-22	Ex System Flow North	MH 7	38.0	48 inch	48.4	127.6	9.46	5872.56	5865.94	5863.35	5.21	5871.42	5863.05	4.37	0.80%
P-23	MH 7	Inlet D-17	367.0	48 inch	48.4	129.4	9.56	5871.42	5865.44	5862.75	4.67	5865.25	5859.77	1.48	0.80%
P-24	Inlet D-17	Area Inlet DP 43	142.0	48 inch	50.7	125.8	9.47	5865.25	5862.11	5859.47	1.78	5863.79	5858.38	1.41	0.80%
P-17	Inlet D-15	Inlet DP F	63.0	18 inch	1.5	22.9	7.29	5873.46	5870.18	5869.72	2.24	5872.94	5866.73	4.71	4.70%
P-11	Inlet DP B	MH 2	25.0	30 inch	2.7	41.0	4.70	5873.06	5868.09	5867.06	3.50	5872.56	5866.81	3.25	1.00%
P-14	Inlet DP C	MH 2	5.0	30 inch	3.6	89.9	8.92	5873.04	5868.17	5867.05	3.49	5872.56	5866.81	3.25	4.80%
P-12	Inlet D-14	Inlet DP E	135.0	18 inch	2.0	11.0	4.71	5874.52	5870.79	5870.26	2.76	5873.06	5868.79	2.77	1.10%
P-13	Inlet DP E	Inlet DP C	28.0	24 inch	3.2	36.8	7.19	5873.06	5869.42	5868.29	2.77	5873.04	5867.55	3.49	2.60%
P-9	Inlet D-11	Inlet DP D	128.0	18 inch	1.9	11.1	4.73	5874.66	5870.92	5870.40	2.76	5873.24	5868.96	2.78	1.10%
P-10	Inlet DP D	Inlet DP B	28.0	24 inch	3.7	40.6	8.03	5873.24	5869.63	5868.46	2.78	5873.06	5867.56	3.50	3.20%
P-5	Inlet DP A	MH-6	34.0	48 inch	46.3	181.0	12.05	5881.02	5876.15	5873.41	3.61	5880.27	5872.87	3.40	1.60%
P-8	MH-6	MH 2	184.0	48 inch	46.2	228.6	14.25	5880.27	5872.21	5869.47	6.80	5872.56	5864.81	3.75	2.50%
P-7	Inlet D-10	MH-6	25.0	18 inch	0.9	22.1	6.18	5881.03	5876.84	5876.48	3.05	5880.27	5875.37	3.40	4.40%
P-6	Inlet D-9	MH-6	45.0	18 inch	0.7	14.9	4.30	5881.19	5876.65	5876.28	3.41	5880.27	5875.37	3.40	2.00%

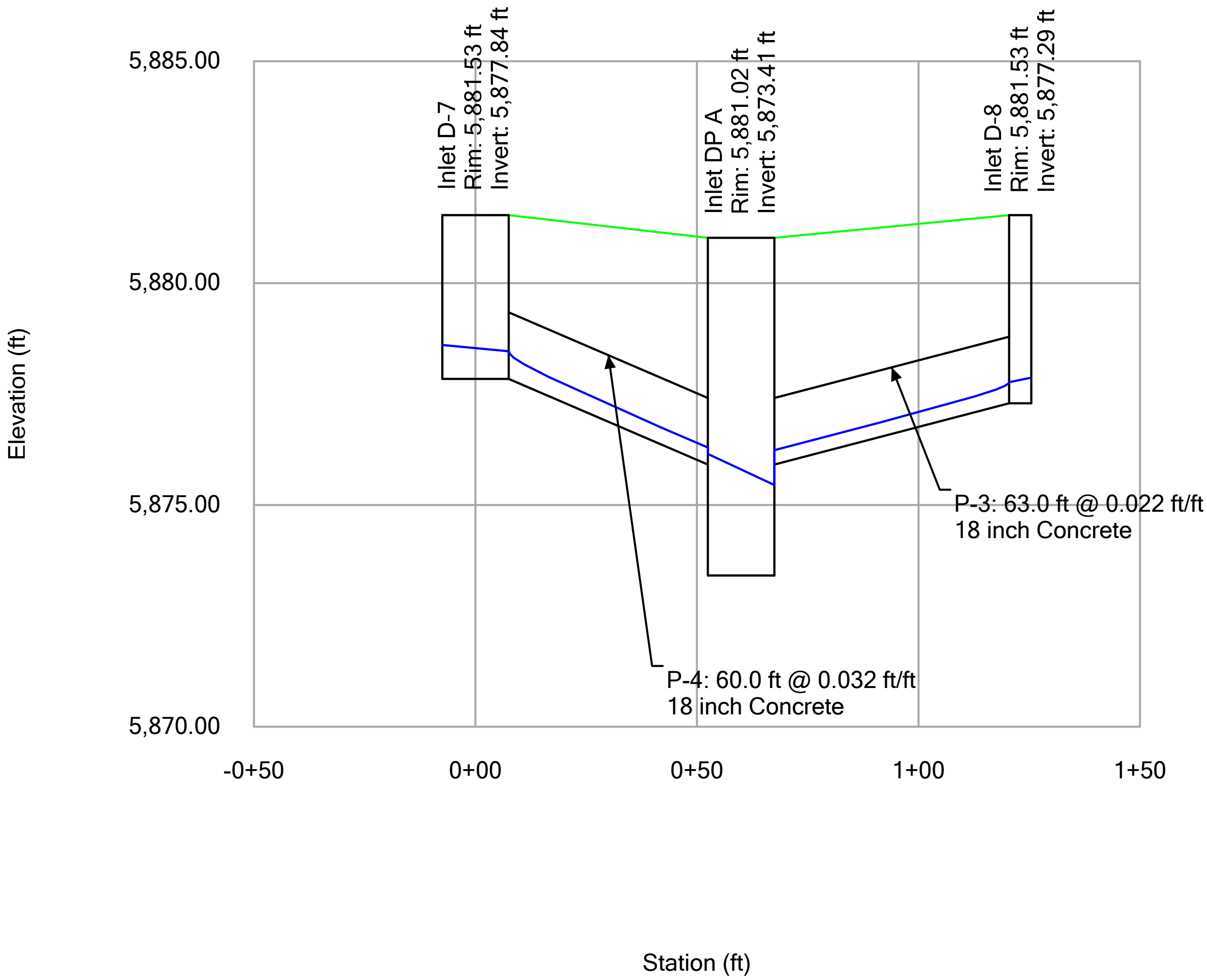
Profile Report
Engineering Profile - Mainline West Side and Outlet (WV-Storm Sys.stsw)



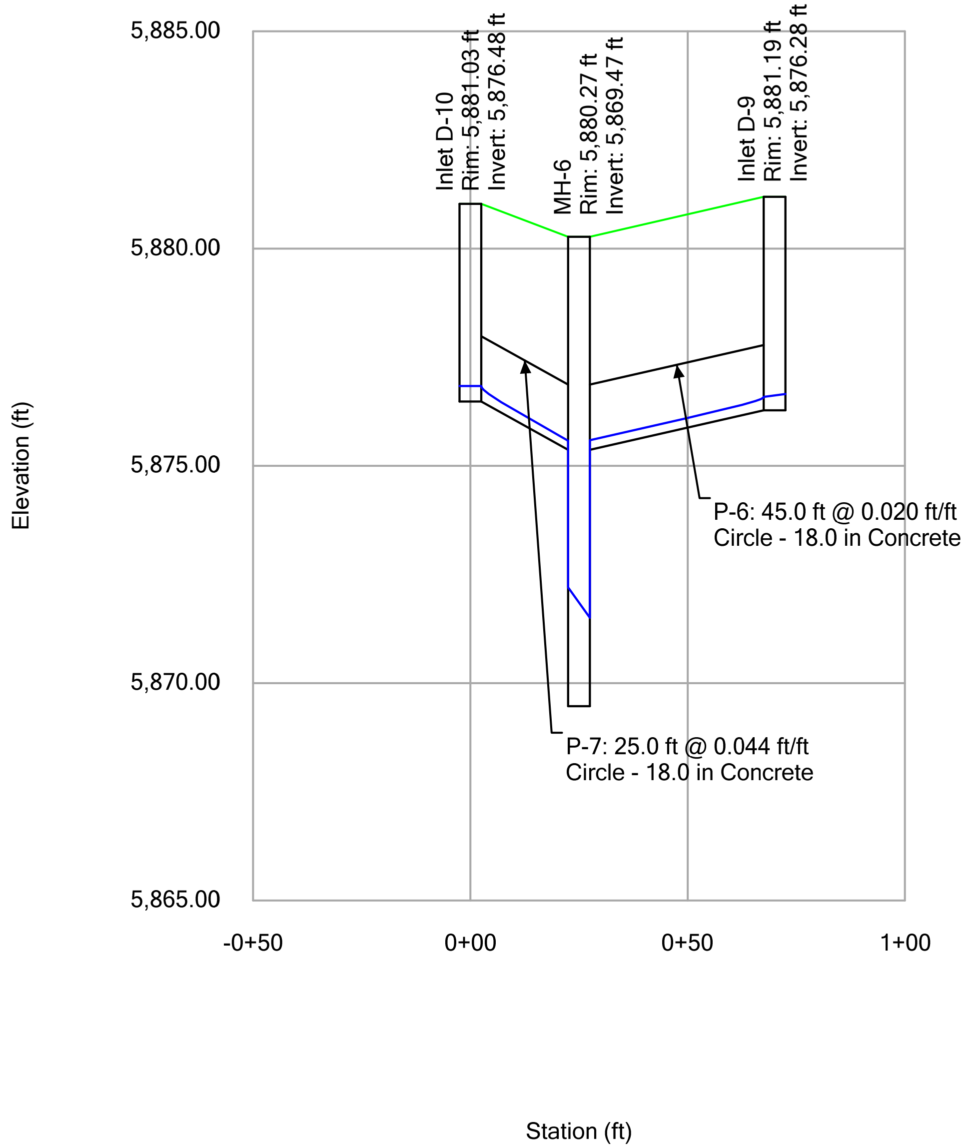
Profile Report
Engineering Profile - Mainline thru Site (WV-Storm Sys.stsw)



Profile Report
Engineering Profile - East Rd East Lats (WV-Storm Sys.stsw)

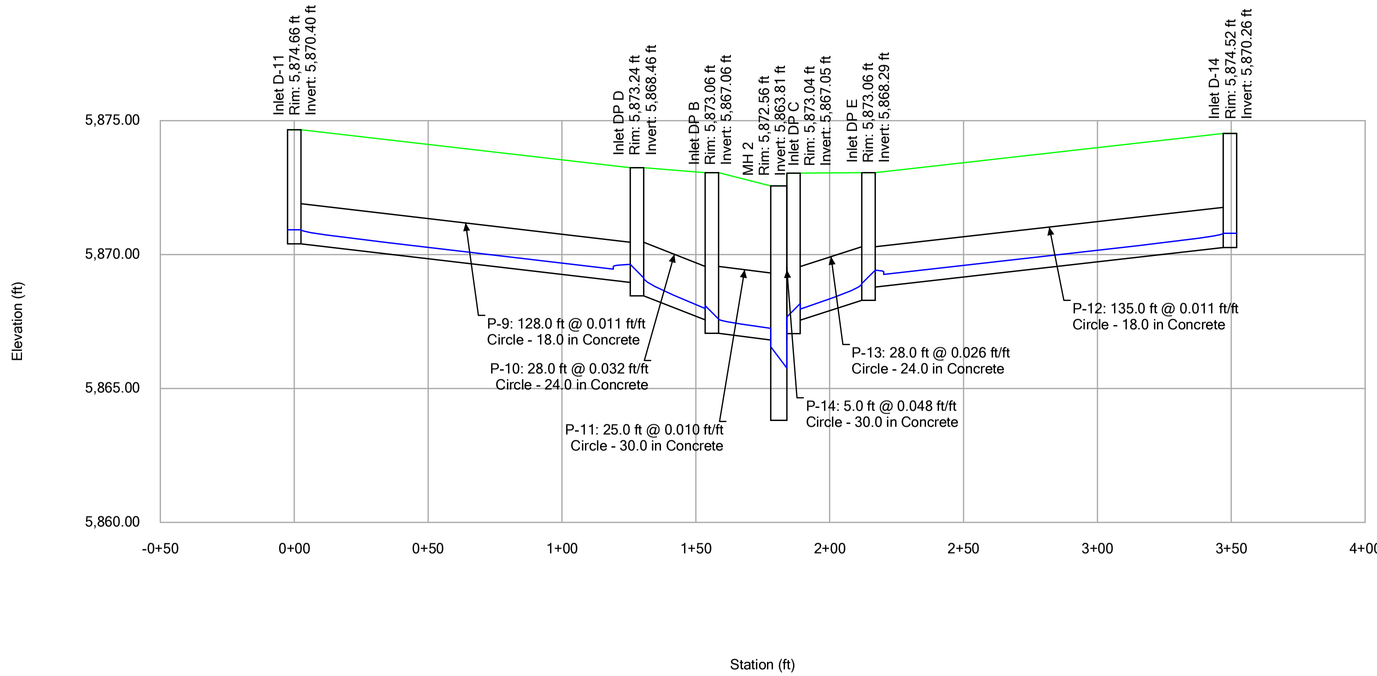


Profile Report
Engineering Profile - East Rd West Lats (WV-Storm Sys.stsw)

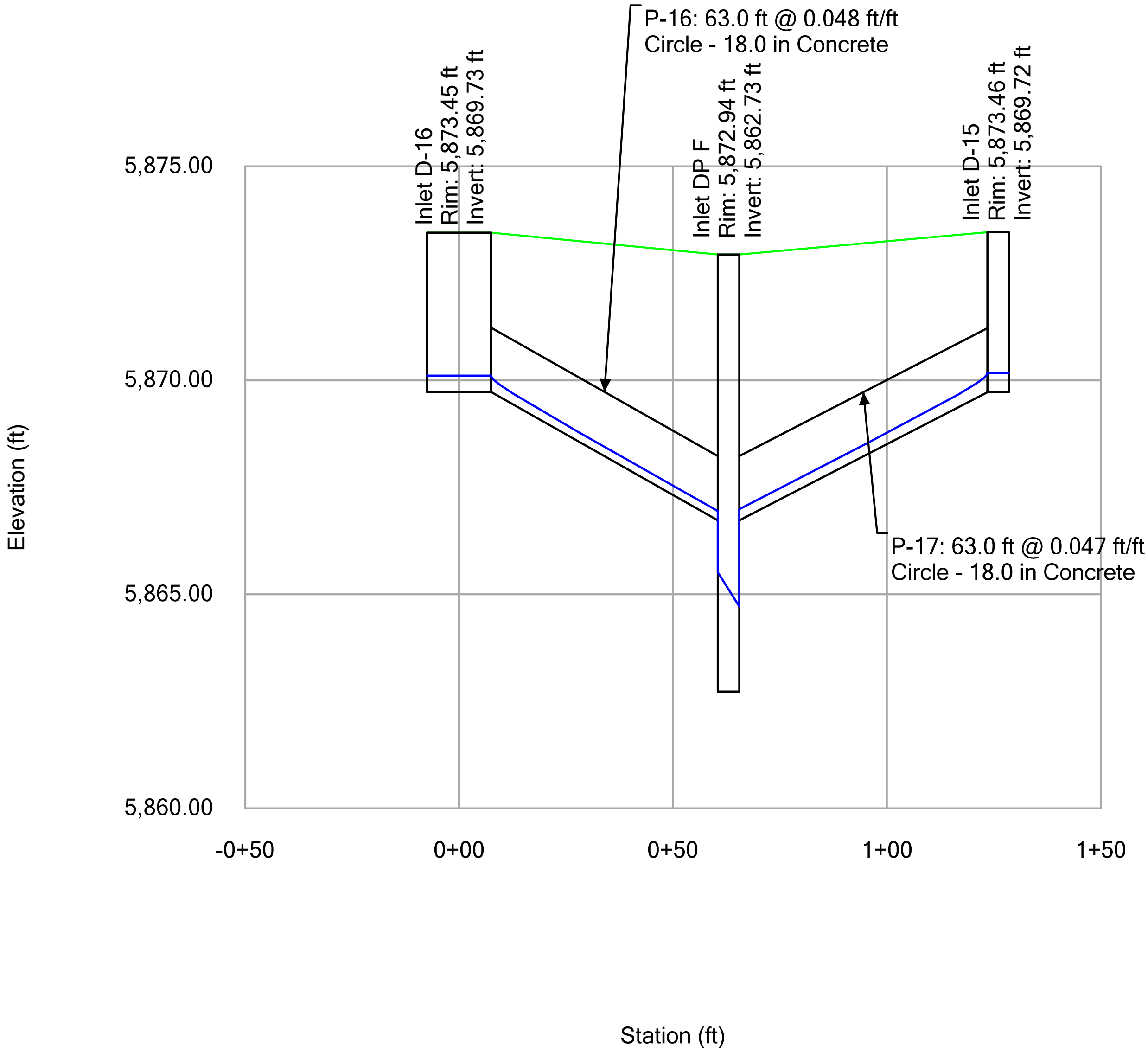


Profile Report

Engineering Profile - West Rd East Lats (WV-Storm Sys.stsw)



Profile Report
Engineering Profile - West Rd West Lats (WV-Storm Sys.stsw)



Appendix F: Existing WQ Pond

Stormwater Detention and Infiltration Design Data Sheet

Workbook Protected Worksheet Protected

Stormwater Facility Name: **Painted Sky at Waterview - Existing Water Quality Pond**

Facility Location & Jurisdiction: **West of Grinnell Blvd - El Paso County**

User Input: Watershed Characteristics

Watershed Slope =	0.060	ft/ft
Watershed Length =	2000	ft
Watershed Area =	89.69	acres
Watershed Imperviousness =	62.3%	percent
Percentage Hydrologic Soil Group A =	71.0%	percent
Percentage Hydrologic Soil Group B =	29.0%	percent
Percentage Hydrologic Soil Groups C/D =		percent

Location for 1-hr Rainfall Depths (use dropdown):

User Input

WQCV Treatment Method = Extended Detention

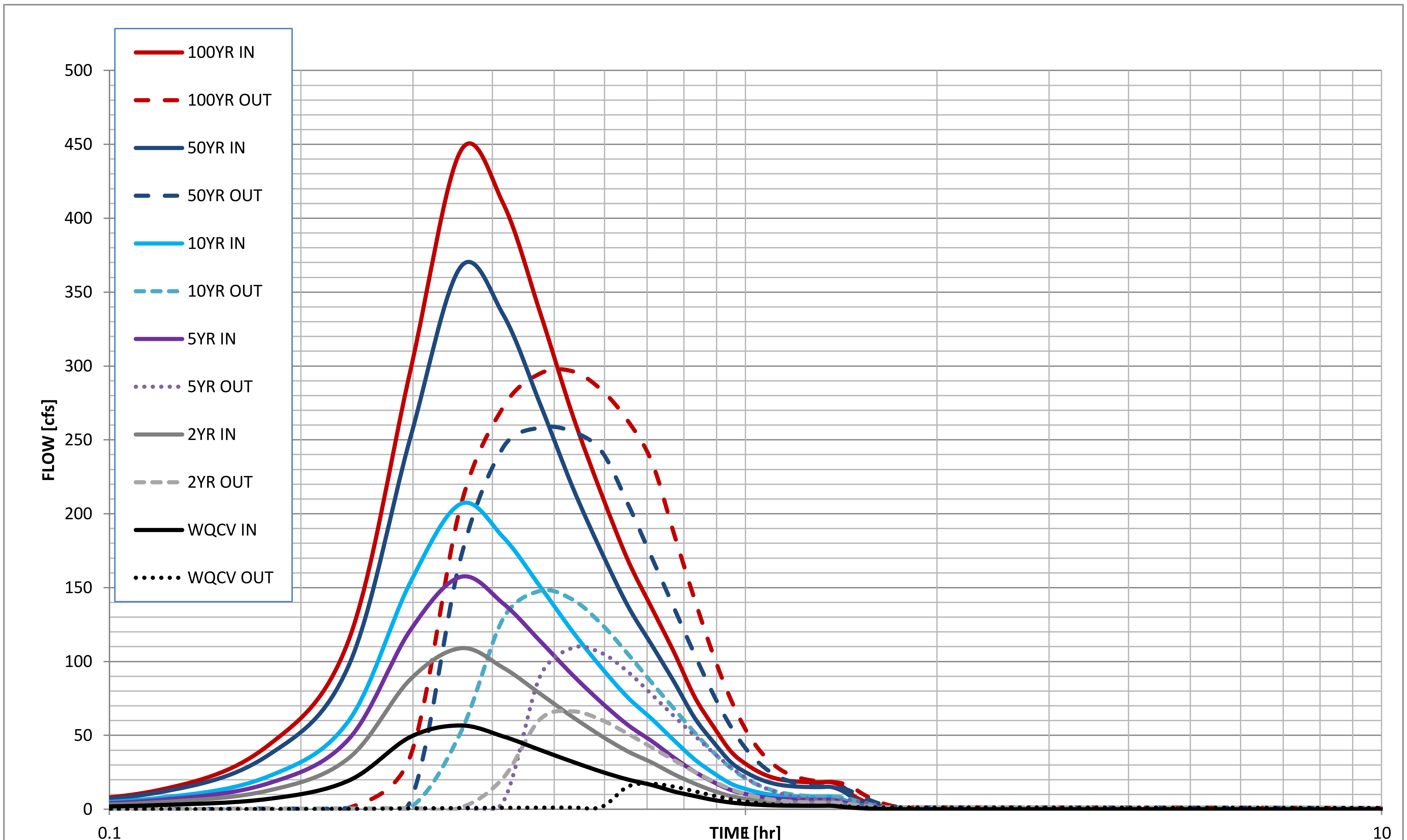
User Defined Stage [ft]	User Defined Area [ft^2]	User Defined Stage [ft]	User Defined Discharge [cfs]
0.00	1,158	0.00	0.00
2.00	3,651	2.00	0.28
4.00	10,828	4.00	0.76
6.00	26,066	6.00	1.22
8.00	51,145	8.00	242.46

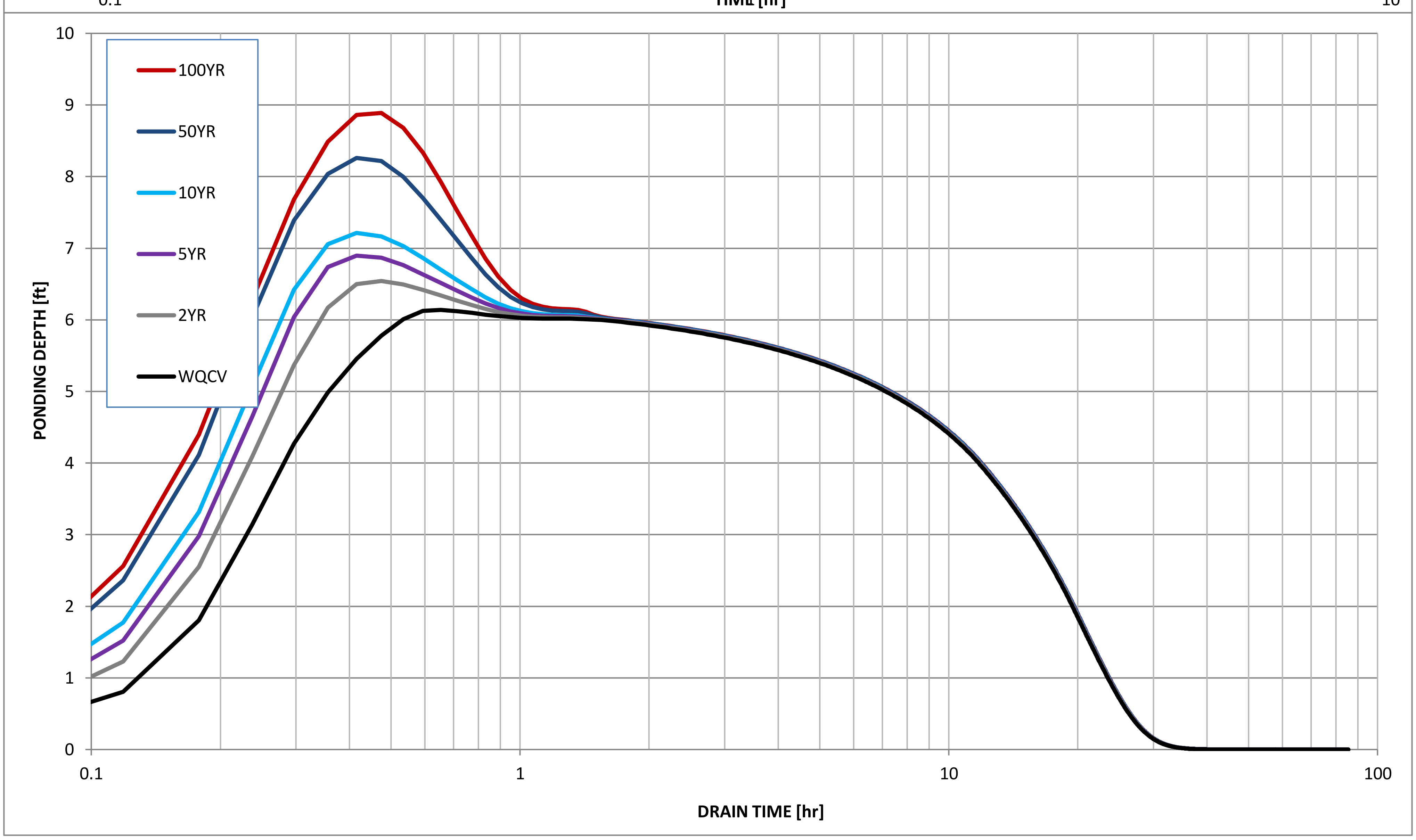
After completing and printing this worksheet to a pdf, go to:
https://maperture.digitaldataservices.com/gvh/?viewer=cswdif
create a new stormwater facility, and
attach the pdf of this worksheet to that record.

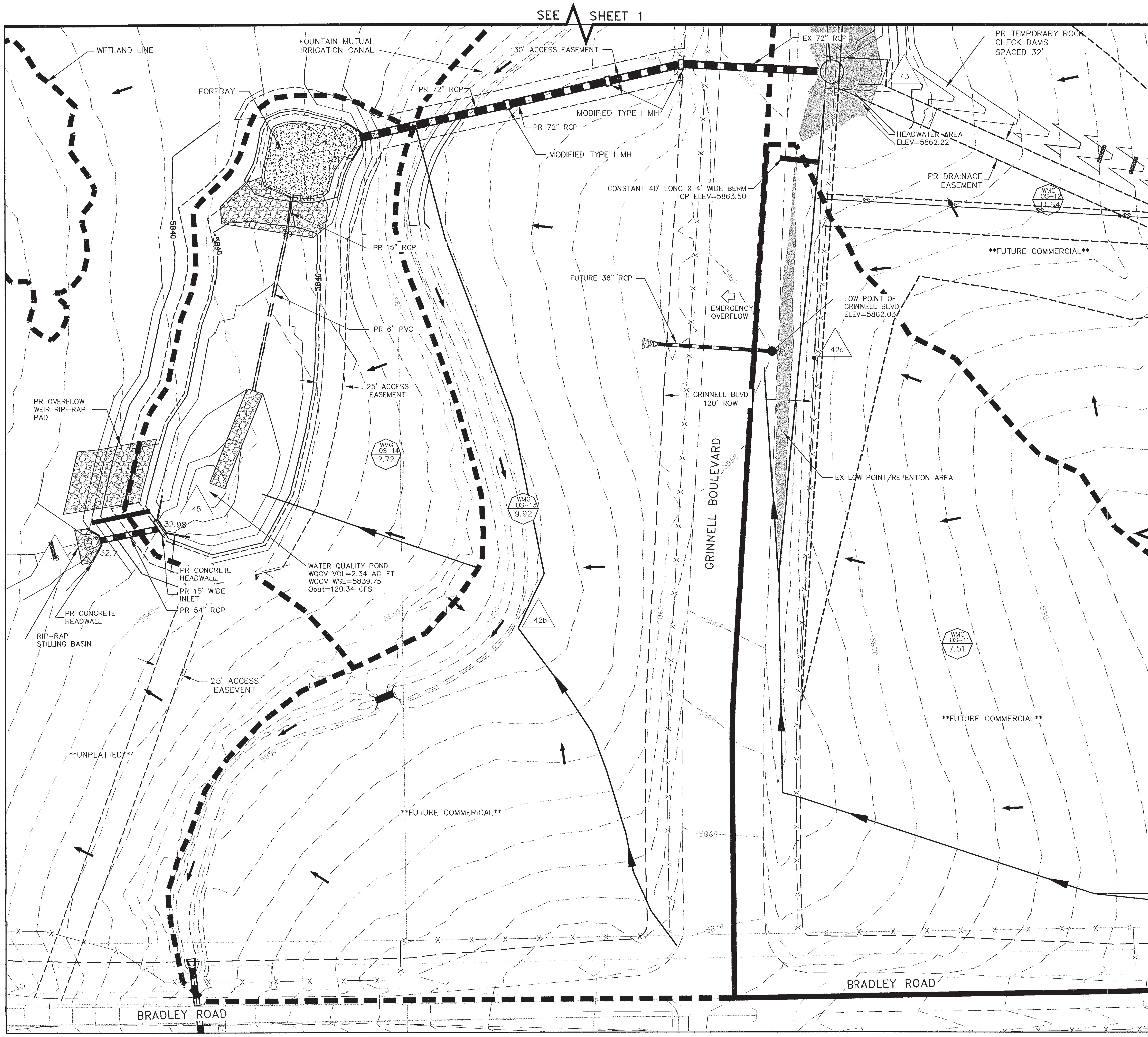
Routed Hydrograph Results

Design Storm Return Period =	WQCV	2 Year	5 Year	10 Year	50 Year	100 Year	
One-Hour Rainfall Depth =	0.53	0.88	1.18	1.44	2.15	2.49	in
Calculated Runoff Volume =	1.825	3.485	5.019	6.585	11.717	14.239	acre-ft
OPTIONAL Override Runoff Volume =							acre-ft
Inflow Hydrograph Volume =	1.824	3.484	5.014	6.581	11.708	14.237	acre-ft
Time to Drain 97% of Inflow Volume =	22.4	19.8	**18.1**	16.7	13.5	12.2	hours
Time to Drain 99% of Inflow Volume =	26.1	24.2	22.9	21.9	19.4	**18.4**	hours
Maximum Ponding Depth =	6.14	6.54	6.90	7.21	8.26	8.89	WARNING!
Maximum Ponded Area =	0.64	0.75	0.86	0.95	1.17	**1.17**	acres
Maximum Volume Stored =	1.370	1.650	1.935	2.218	3.059	3.059	acre-ft

Stormwater Detention and Infiltration Design Data Sheet

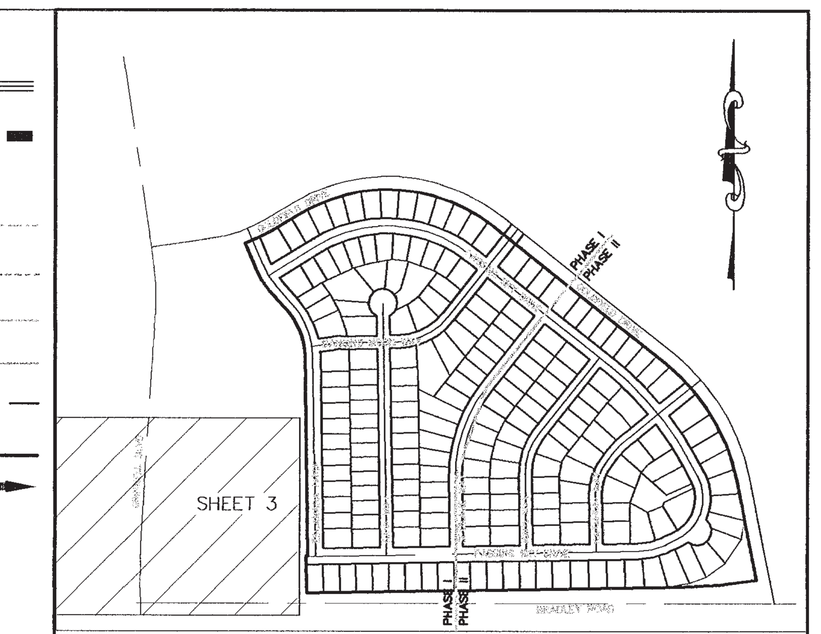






LEGEND

PROPOSED STORM SEWER	
MAJOR BASIN BOUNDARY (DEVELOPED)	
DIRECTION OF FLOW	
CONTOUR – MAJOR (EXIST.)	6600
CONTOUR – MINOR (EXIST.)	6600
CONTOUR – MAJOR (PROPOSED)	6600
CONTOUR – MINOR (PROPOSED)	6600
SUBDIVISON BOUNDARY	
OVERLAND TIME FLOW PATH	
CHANNEL FLOW PATH	
INLET	
FB SUMP INLET	
BASIN IDENTIFIER / BASIN AREA	XX / 6.25
OVERLAND DESIGN POINT	1
STORM DRAIN DESIGN POINT	1
EMERGENCY OVERFLOW ROUTING	



KEY MAP

N.T.S.

AREA DRAINAGE SUMMARY

BASIN	AREA TOTAL (ACRES)	TOTAL FLOWS Q10 (c.f.s.)	TOTAL FLOWS Q100 (c.f.s.)
1	1.43	3.5	6.2
2	2.92	6.4	11.3
3	2.79	6.8	12.1
4	2.33	5.6	10.0
5	1.84	4.6	8.1
6	2.67	6.4	11.3
7	1.68	4.2	7.5
8	0.98	2.4	4.2
9	0.85	2.2	4.0
9a	0.66	1.9	3.3
10	0.11	0.6	0.9
11	0.25	1.3	2.2
12	1.01	2.7	4.9
13	0.22	1.2	1.9
14	0.23	1.1	1.7
15	2.90	6.5	11.6
16	0.66	1.7	3.1
17	2.48	5.8	10.3
18	1.26	3.1	5.4
19	3.45	7.9	14.0
20	0.88	2.2	3.8
21	1.68	4.1	7.2
22	4.10	8.9	15.8
23	0.83	2.1	3.7
24	1.91	4.6	8.2
25	1.60	4.0	7.2
26	0.82	2.1	3.7
27	0.66	1.8	3.1
28	0.19	0.9	1.5
29	0.79	2.0	3.5
30	0.39	1.0	1.8
31	1.16	3.1	5.6
32	0.20	1.1	1.7
33	0.25	1.3	2.1
34	1.62	4.0	7.2
35	2.16	2.5	5.2
OS–1	0.60	2.8	4.5
OS–2	0.98	4.6	7.4
OS–3	0.67	3.6	5.7
OS–4	0.86	4.3	6.9
OS–5	N/A	N/A	N/A
OS–6	1.33	5.1	8.4
OS–7	0.59	2.6	4.2
OS–8	2.64	9.6	15.8
OS–9	0.90	4.0	6.5
OS–10	2.58	10.6	17.1
OS–11	7.51	6.5	13.6
OS–12	11.54	9.6	16.4
OS–13	9.92	22.6	36.1
OS–14	2.72	7.7	12.6
OS–A	41.64	70.1	124.8
OS–B	26.91	48.8	86.9
OS–C	9.83	15.6	27.8
OS–D	5.53	7.4	13.2

SURFACE ROUTING SUMMARY

DESIGN POINTS	TOTAL FLOWS Q10 (c.f.s.)	TOTAL FLOWS Q100 (c.f.s.)
1	3.5	6.2
2	11.3	19.8
3	15.9	28.0
4	5.6	10.0
5	4.6	8.1
6	6.4	11.3
7	4.2	7.5
8	6.8	13.0
9	12.2	21.6
9a	7.5	15.2
10	0.6	0.9
11	1.3	2.2
12	15.8	30.9
13	1.1	19.2
14a	21.6	41.5
14b	15.0	26.8
15	6.5	11.6
16	1.7	3.1
17	5.8	10.3
18	10.5	18.7
19	12.3	24.4
20	7.6	13.5
21	15.6	30.2
22	17.3	28.2
23	9.2	26.1
24	20.9	31.2
25	15.9	25.0
26	10.7	31.2
27	17.3	27.5
28a	17.4	30.5
28b	10.0	18.6
29	12.1	30.5
30	6.7	19.8
31	9.5	19.9
32	2.3	10.1
33	2.5	5.2
34	2.8	4.5
35	4.3	6.9
36	4.6	7.4
37	8.9	14.5
38	6.1	15.5
39	17.7	29.0
40	4.0	6.5
41	25.5	44.1
42a	6.5	13.6
42b	29.5	36.1
43	59.5	126.8
44	87.5	161.1
45	92.8	169.7
46	92.8	169.7
OA	86.7	154.2
OB	142.3	253.2
OC	15.6	27.8
OD	7.4	13.2
ULTIMATE CONDITION		
38	4.7	13.2
39	19.7	32.3

STORM SEWER ROUTING SUMMARY

DESIGN POINTS	TOTAL FLOWS Q10 (c.f.s.)	TOTAL FLOWS Q100 (c.f.s.)
100	6.7	8.1
101	6.1	8.1
102	13.8	19.1
103	18.9	24.9
104	26.3	35.1
105	26.5	39.5
106	42.2	67.2
107	5.7	7.7
108	12.6	15.6
109	20.4	27.4
110	33.1	49.9
111	38.9	57.9
112	48.4	81.6

GRAPHIC SCALE

(IN FEET)
HORIZ: 1 inch = 50 ft.

FOR BURIED UTILITY INFORMATION 48 HRS BEFORE YOU DIG CALL 1-800-922-1987 FOR LOCATING & MARKING GAS, ELECTRIC, & TELEPHONE LINES

REV	REVISION DESCRIPTION	DATE	CHANGED BY	CHECKED BY	APPROVED BY

WATERVIEW JV PARTNERS, LLC

MERRICK Engineers & Architects
7222 COMMERCE CENTER DR., SUITE 120 COLORADO SPRINGS, CO 80919 PHONE: (719) 260-8874

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MERRICK	SIGNATURE	DATE
DRAWN	JAG	11/15/06
DESIGNED	EAS	11/15/06
QC REVIEW	MJP	11/15/06
APPROVED	MJP	11/15/06
CLIENT	SIGNATURE	DATE
REVIEW		
APPROVED		
CAD FILE NAME	4899-FPPR03.DWG	

PAINTED SKY AT WATERVIEW
BRADLEY ROAD
AND GRINNELL BOULEVARD

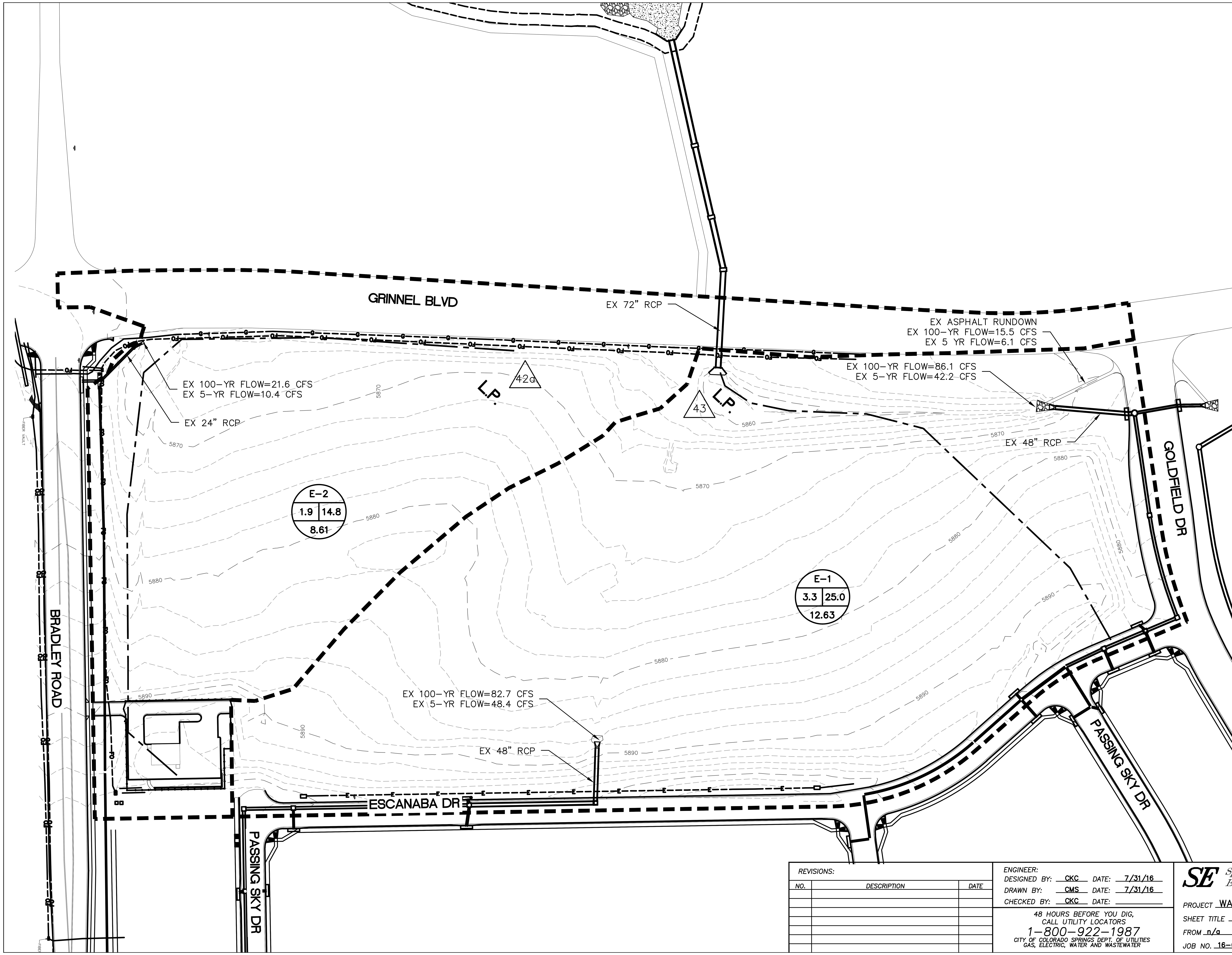
CLIENT PROJECT NO.	–
MERRICK PROJECT NO.	18014899
SCALE:	1"=50'

MICHAEL J. PINSONEAULT
Colorado Registered Professional
Colorado PE #36336
For and on Behalf of
Merrick & Company
Merrick & Company Job No. 18014899

TITLE:
PAINTED SKY AT WATERVIEW
WATERVIEW METROPOLITAN DISTRICT
FINAL DRAINAGE REPORT
JANUARY 2007

REVISION:	DRAWING NO.	SHEET NO.
	4899D-FPPR03	3 OF 5

Figure 3: Existing Drainage Plan



LEGEND

- EXISTING 2' CONTOUR
- EXISTING 10' CONTOUR
- EXISTING FLOW PATH
- EXISTING BASIN BOUNDARY
- DESIGN POINT
- BASIN LABEL

DESIGN POINT	Q (5)	Q (100)
43	44.3	112.7
42a	12.4	38.2

FIGURE 5

REVISIONS:		
NO.	DESCRIPTION	DATE

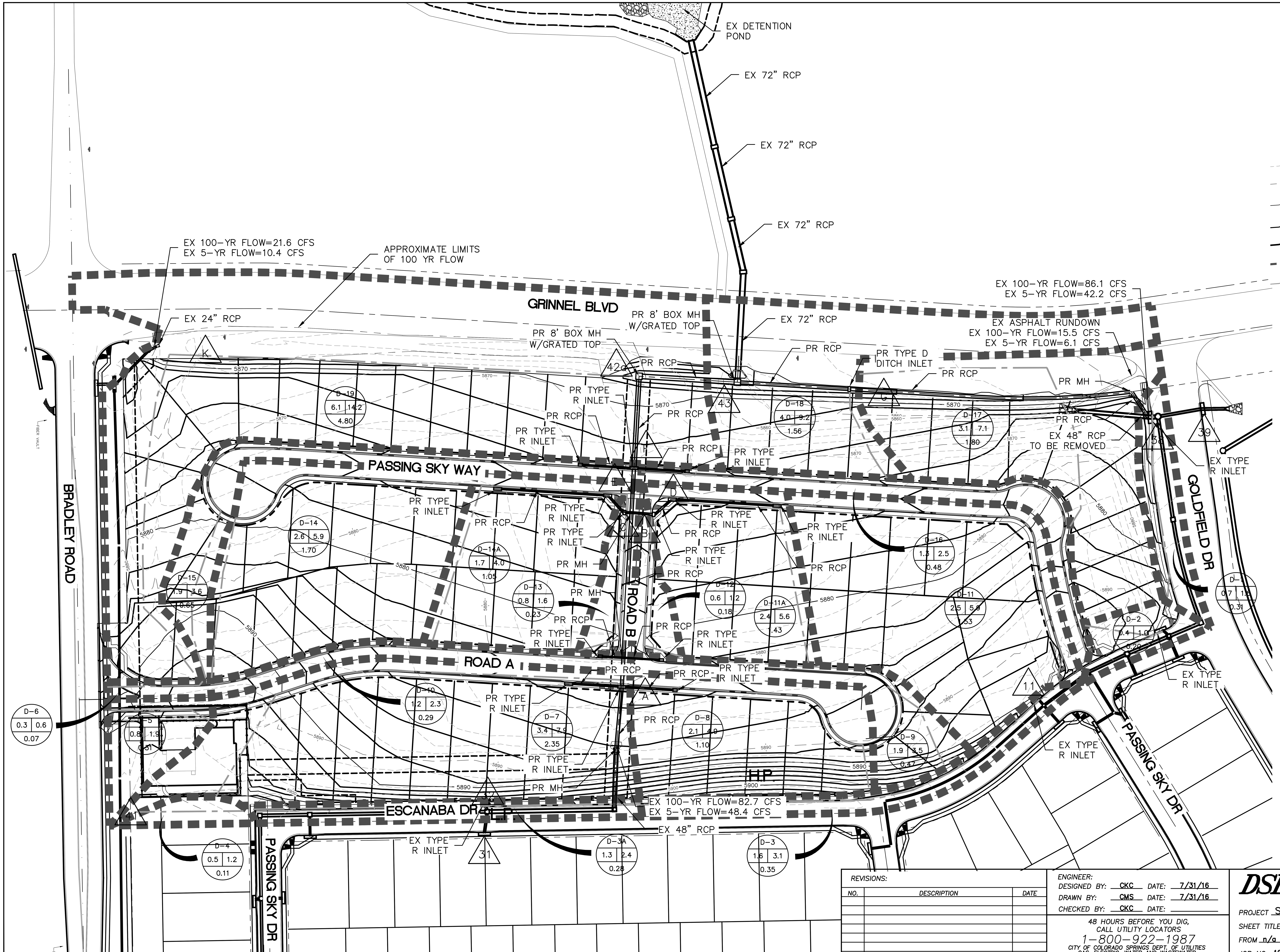
ENGINEER:
DESIGNED BY: CKC DATE: 7/31/16
DRAWN BY: CMS DATE: 7/31/16
CHECKED BY: CKC DATE:

48 HOURS BEFORE YOU DIG, CALL UTILITY LOCATORS
1-800-922-1987
CITY OF COLORADO SPRINGS DEPT. OF UTILITIES GAS, ELECTRIC, WATER AND WASTEWATER

SE Springs Engineering
31 N. TEJON, SUITE 315
COLORADO SPRINGS, CO 80903
P: (719) 227-7388
F: (719) 227-7392

PROJECT WATERVIEW SPRINGS
SHEET TITLE EXISTING DRAINAGE MAP
FROM n/a TO n/a
JOB NO. 16-01 SHEET 1 OF 1

Figure 4: Proposed Drainage Plan



LEGEND

- EXISTING 2' CONTOUR
- EXISTING 10' CONTOUR
- DITCH CENTERLINE
- PROPOSED 2' CONTOUR
- PROPOSED 10' CONTOUR
- PROPOSED BASIN BOUNDARY
- PROPOSED FLOW PATH
- DESIGN POINT
- BASIN LABEL (BASIN, Q_5, Q_{100}, AREA)

SCALE IN FEET (1"= 60')

DESIGN POINT	Q (5)	Q (100)
11	1.6	3.1
32	1.3	2.4
A	0.3	4.3
B	0.8	2.3
C	0.8	2.1
D	2.4	6.7
E	1.6	4.7
F	0.2	3.1
G	3.1	7.1
K	11.5	24.1
39	1.1	2.5
41	0.5	1.0
42a	11.9	26.3
43	4.0	9.2

FIGURE 4

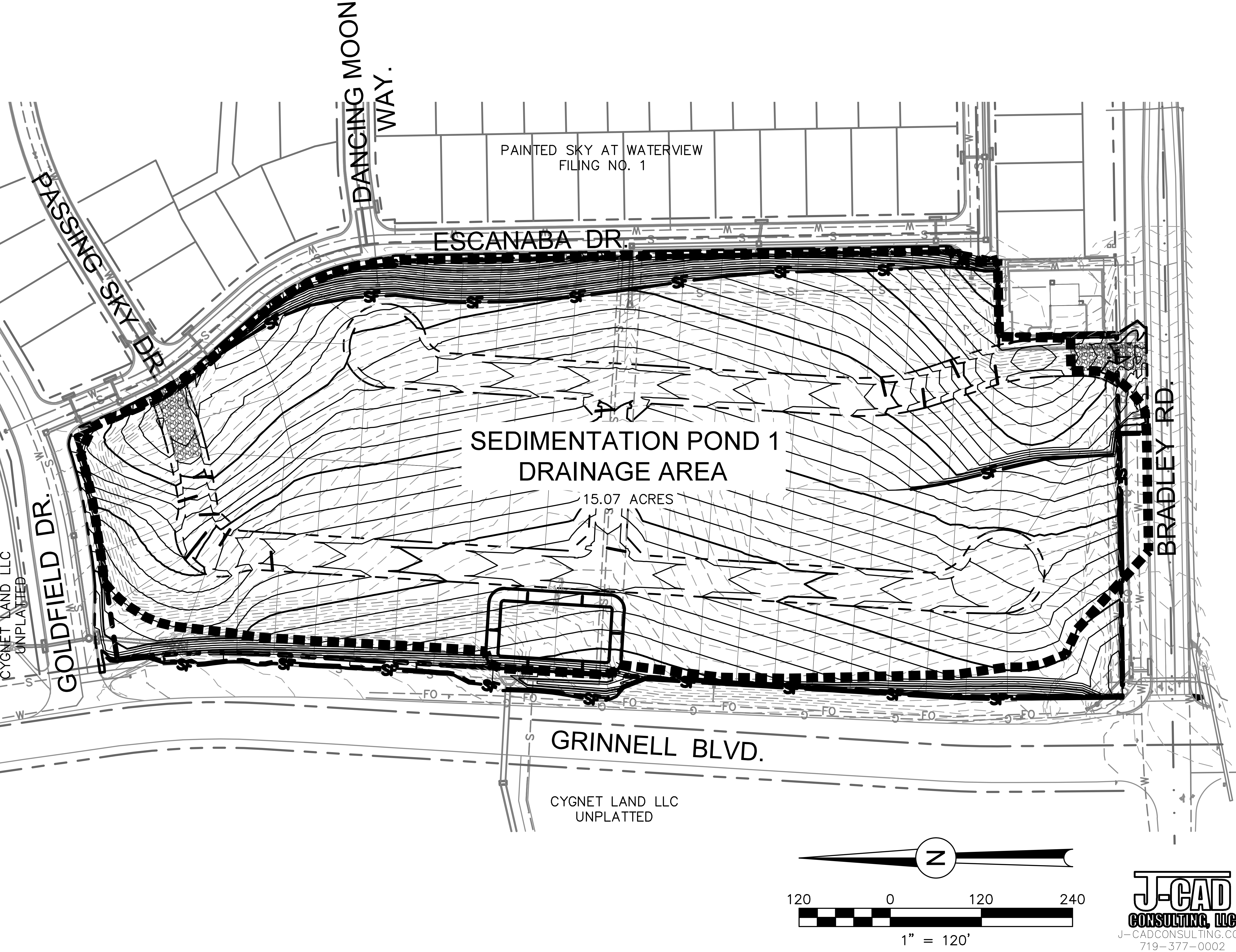
REVISIONS:		
NO.	DESCRIPTION	DATE

ENGINEER:
DESIGNED BY: CKC DATE: 7/31/16
DRAWN BY: CMS DATE: 7/31/16
CHECKED BY: CKC DATE:

48 HOURS BEFORE YOU DIG, CALL UTILITY LOCATORS
1-800-922-1987
CITY OF COLORADO SPRINGS DEPT. OF UTILITIES GAS, ELECTRIC, WATER AND WASTEWATER

DSE Dakota Springs Engineering
31 N. TEJON, SUITE 315
COLORADO SPRINGS, CO 80903
P: (719) 227-7388
F: (719) 227-7392

PROJECT SPRINGS AT WATERVIEW
SHEET TITLE PROPOSED DRAINAGE MAP
FROM n/a TO n/a
JOB NO. 16-01 SHEET 1 OF 1



PDF: 0102.1 – sediment basin.pdf

DSE
Dakota Springs Engineering
31 N. TEJON, SUITE 500
COLORADO SPRINGS, CO 80903
P: (719) 227-7388
F: (719) 227-7392

SPRINGS AT WATERVIEW

SEDIMENTATION BASIN EXHIBIT

JOB NO. 0102.1

DESIGNED BY: JJM DATE: 3/5/18
DRAWN BY: JJM DATE: 3/5/18
CHECKED BY: ___ DATE: ___

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SHEET 1 OF 1