

FINAL DRAINAGE REPORT FOR CLAREMONT BUSINESS PARK 2 FILING NO. 1

EL PASO COUNTY, COLORADO

DECEMBER 2020

Prepared for:

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Project #44-037
PCD – SF- 20-014

**FINAL DRAINAGE REPORT FOR CLAREMONT
BUSINESS PARK 2 FILING NO. 1
EL PASO COUNTY COLORADO**

DRAINAGE PLAN STATEMENTS

ENGINEERS STATEMENT

The attached drainage plan and report was 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 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.

Virgil A. Sanchez, P.E. #37160
For and on Behalf of M&S Civil Consultants, Inc



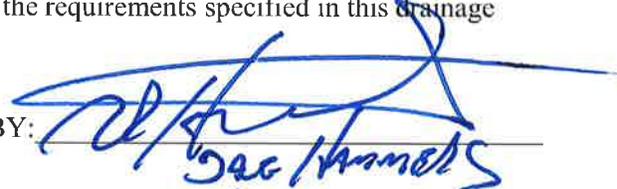
DEVELOPER'S STATEMENT

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

BY: Lena Gail Case

TITLE: Individual
DATE: 01 / 15 / 2021

ADDRESS: Lena Gail Case
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BY: 

TITLE: Joe Hammers
DATE: 1/18/2021

Hammers Construction, Inc.
1411 Woosley Heights
Colorado Springs, CO 80906

EL PASO COUNTY'S STATEMENT

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

BY: _____
Jennifer Irvin, P.E.
County Engineer / ECM Administrator

DATE: _____

APPROVED
Engineering Department

02/11/2021 7:25:18 AM

dsdnijkamp

**EPC Planning & Community
Development Department**

CONDITIONS:

Signature Certificate

Document Ref.: BICJN-VGWUA-DVUP5-OY8SJ

Document signed by:

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BOCC Resolution 16-426

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PURPOSE

This document is intended to serve as the FINAL DRAINAGE REPORT FOR CLAREMONT BUSINESS PARK 2 FILING NO. 1 and will effectively supersede the previously approved Preliminary Drainage Report for Claremont Commercial Subdivision Fil No. 2, A Resubdivision of Tract C of Claremont Business Park Filing No. 2, El Paso County, Colorado previously approved in December of 2018. The purpose of this document is to identify and analyze the onsite drainage patterns and to ensure that post development runoff is routed through the site safely and in a manner that satisfies the requirements set forth by the El Paso County and City of Colorado Springs Drainage Criteria Manual. The proposed principal use for the site will be neighborhood commercial and light industrial. The parcel is zoned by El Paso County for commercial service as CS. This is a final drainage report; with no significant change from the Approved Preliminary Drainage Report dated Sept. 21, 2020.

The 13.66 acres that encompasses Claremont Commercial Filing No.3, will be platted as one filing as Claremont Business Park 2 Filing No.1. For construction purposes the south portion (8.33 acres) will be developed and will treat and convey runoff to WQCV Pond 2. The north portion (5.33 acres) will be analyzed in two conditions, undeveloped and future development. In the undeveloped condition, the undeveloped runoff will be routed to a 24" flared end section at southwest corner of the site. In the future developed condition, runoff will be routed to a WQCV Pond 1 at southwest corner of the site. Upon construction of the north portion, a drainage letter will have to be submitted and approved to confirm the study and design were done in accordance with this report.

GENERAL LOCATION AND DESCRIPTION

Claremont Business Park 2 Filing No.1 is located in the Northeast ¼ of the Northeast ¼ of Section 8, and the Southeast ¼ of the Southeast ¼ of Section 5, Township 14 South, Range 65 West of the 6th P.M. in El Paso County, Colorado. The site is bordered to the southeast by U.S. Highway 24 and to the northeast by N. Marksheffel Road, to the north and west by Meadowbrook Parkway, and to the south by a vacant, undeveloped lot. The site lies within the Sand Creek Drainage Basin. Flows from this site are tributary to Sand Creek.

The site consists of 13.66 acres which is currently vacant land with a relatively new roadway infrastructure for Meadowbrook Parkway and associated utilities services directly adjacent to the site. Vegetation is sparse, consisting of native grasses and weeds. Existing site terrain generally slopes from north to southwest at grade rates that vary between 1.2% and 2%. A soil retention wall runs along the eastside of the proposed site, next to U.S. Highway 24 and N. Marksheffel Road, and borders a large portion of the back of the proposed lots. The Claremont Commercial site is currently zoned "CS" and the proposed principal use for the site will be neighborhood commercial and light industrial.

Two (2) sand filter basins will provide water quality treatment for the proposed (Pond 2) and future developments (Pond 1). The outlet structures of the proposed and future water quality ponds will tie into an existing storm sewer system near Meadowbrook Parkway, which routes the treated runoff southwest into Sand Creek. See Appendix for details.

SOILS

Soils for this project are delineated by the map in the appendix as Ellicott Loamy Course Sand (28), Blendon Sandy Loam (10) and Blakeland Loamy Sand (8) and have been characterized as Hydrologic Soil Types "A" & "B". Soils in the study area are shown as mapped by S.C.S. in the "Soils Survey of El Paso County Area". See Appendix for soils report.

HYDROLOGIC CALCULATIONS

Hydrologic calculations were performed using the El Paso County and City of Colorado Springs Storm Drainage Design Criteria manual and where applicable the Urban Storm Drainage Criteria Manual. The Rational Method was used to estimate stormwater runoff anticipated from design storms with 5-year and 100-year recurrence intervals.

HYDRAULIC CALCULATIONS

Hydraulic calculations were estimated using the Manning's Formula and the methods described in the El Paso County and City of Colorado Springs Storm Drainage Design Criteria manual. The relevant data sheets are included in the Appendix of this report.

FLOODPLAIN STATEMENT

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Panel No. 08041C0756G, revised December 7, 2018. No portion of this site is located within the 100 year floodplain. See Appendix.

DRAINAGE CRITERIA

This drainage analysis has been prepared in accordance with the current City of Colorado Springs/El Paso County Drainage Criteria Manual. Calculations were performed to determine runoff quantities for the 5-year and 100-year frequency storms for developed conditions using the Rational Method as required for basins having areas less than 100 acres. See Appendix for calculations.

FOUR STEP PROCESS

Step1 Employ Runoff Reduction Practices –Roof drains will be directed to property lines swales to minimize direct connection of impervious surfaces.

Step 2 Stabilize Drainageways – The site is upstream of an existing 42"/48" RCP storm sewer system that directly discharges to Sand Creek Channel via an outlet structure with wingwalls (privately owned and maintained by the Central Marksheffel Metropolitan District) . The "Final Drainage Report for Claremont Business Park Filing No. 2", dated November 2006, by Matrix Design Group, Inc. (henceforth referred to as "Matrix FDR") has been designed to discharge developed flows via a 48" RCP storm sewer system directly into the East Fork Sand Creek. The Claremont Commercial Filing No. 2 site proposes a two (2) Sand Filter Water Quality Facilities before flows from both WQ facilities are discharged to the existing private 42"/48" RCP system east of Meadowbrook Parkway.

The outlet underdrains are designed to drain the ponds in a peak event within 12 hours, therefore it's not anticipated to have negative effects on the downstream drainageways.

Step 3 Provide Water Quality Capture Volume – Two (2) Sand Filter Basin water quality facilities are proposed to provide WQCV.

Step 4 Consider Need for Industrial and Commercial BMP's – This submittal provides a Preliminary Grading and Erosion Control plan. A Final GEC plan with BMP's in place shall be required with a Final Plat and Site Development applications. The proposed project will use silt fence, a vehicle tracking control pad, a concrete washout area, mulching and reseeding to mitigate the potential for erosion across the site.

EXISTING DRAINAGE CONDITIONS

The Claremont Business Park 2 Filing No.1 site consists of 13.66 acres and is situated east of the East Fork Reach of the Sand Creek Watershed. This area was previously studied in the "Final Drainage Report for Claremont Business Park Filing No. 2", dated November 2006, by Matrix Design Group, Inc. (henceforth referred to as "Matrix FDR"). The Matrix FDR calculations indicate that, under the fully developed conditions, the total tributary area of Sub-basins B1, B2, and B3 (18.1 acres), with basin B3 including the eastern half of Meadowbrook Parkway, would produce a cumulative runoff of approximately Q5=42.6 cfs and Q100=86.6 cfs (Design Point 2). The Matrix FDR illustrates that the watershed would drain from east to the southwest towards Meadowbrook Parkway. Sub-Basin B2 identifies a future private 30" RCP to be installed and used to drain the sub-basin into the 42"/48" storm system (privately owned and maintained by the Central Marksheffel Metropolitan District). Field locates has confirmed the 30" RCP was installed. The existing 30" RCP will be removed and a 30" PP will replace it. Sub-Basin B1 identifies a future private 36" RCP to be installed along Meadowbrook Pkwy and stubbed to the sub-basin and used to drain also into the 42"/48" storm system. Field inspection of the existing manhole show the private 30" and 36" RCP were installed. The existing 36" RCP will be removed and a 24" PP will replace it. As stated in the Matrix FDR, overlot grading activities for the entire site have been completed. Per Resolution 16-426 of the BoCC, on-site WQCV is required but on-site stormwater detention is not required per the FDR for Claremont Business Park Fil. 2.

A 48" public storm sewer runs along Meadowbrook Parkway and is routed directly to the Sand Creek channel. Two 10' Type R at grade inlets exist at the intersection of Woolsey Heights and Meadowbrook Parkway, one on the northwest and the other on the northeast corner of the intersection. Runoff from the site and the two surrounding streets, Meadowbrook Parkway and Woolsey Heights, is intercepted by these inlets and conveyed to the Sand Creek channel via the existing 48" public storm sewer.

Refer to the Final Drainage Plan DR01, Matrix FDR, within the Appendix of this report for basin and design point information.

PROPOSED DRAINAGE CHARACTERISTICS

General Concept Drainage Discussion

The majority of the site will consist of neighborhood commercial and light industrial, asphalt, curb, two (2) storm water quality sand filter basins (proposed pond 2 and future pond 1), and landscaping. The flows generated by the site will typically sheet flow across asphalt and impermeable surfaces which direct runoff primarily to the south and southwest to proposed private pipe systems which direct runoff to one of two private ponds. The outlet structures of the proposed water quality ponds will release runoff to the existing private 42" RCP storm sewer located at the southwest corner of the site. A survey and

inspection of the existing 42" RCP shall be made before use. The existing private 42" storm sewer ties into an existing public 48" storm sewer which will route the treated runoff to Sand Creek. For more information of drainage basins, existing and proposed structures refer to the Proposed Drainage Map located within the Appendix of this report.

The 13.66 acres that encompasses Claremont Business Park 2 Filing No.1 will be platted as one filing. For construction purposes the south portion (8.33 acres) will be developed and will treat and convey runoff to WQCV Pond 2. The north portion (5.33 acres) will be analyzed in two conditions, undeveloped and future development. In the undeveloped condition, the north portion will remain undisturbed, except for some minor grading around the perimeter which will route undeveloped flows to a 24" flared end section at the southwest corner of the site. In the future developed condition, final drainage patterns, calculations, treatment and conveyance to a WQCV Pond 1 will be addressed. Upon construction of the north portion, a drainage letter will have to be submitted and approved to confirm the drainage study and design were done in accordance with this report.

To assist in the Detailed Drainage Discussion and differentiate between the north portion undeveloped and north portion future developed, a ** before a drainage basin designation label, design point and pipe run will signify the undeveloped condition. A *** before a drainage basin designation label, design point and pipe run will signify the future developed condition.

Detailed Drainage Discussion

Basin **OS1, 0.19 acres, consists of steep slopes of 32% adjacent to portions of U.S Highway 24 and N. Marksheffel Rd. The roadway embankment within **Basin **OS1** slopes into a soil retention wall that runs along the south east boundary of the site. Runoff for **Basin **OS1** is limited has been calculated to reach peak flow rates of Q5=0.1 cfs and Q100=0.6 cfs. Flows produced within the basin will be conveyed westward into adjacent basin **Basin **OS3** as sheet flow.

Basin **OS2, 0.30 acres, consists of portion of steep slopes of up to 33% that lie adjacent to portions of U.S Highway 24. Similar to **Basin **OS1**, the roadway embankment within **Basin **OS2**, slopes into a soil retention wall that runs along the eastern boundary. Runoff for **Basin **OS2** has been calculated to reach peak flow rates of Q5=0.1 cfs and Q100=1.0 cfs. The limited runoff produced is conveyed westward into adjacent **Basin **OS3** as sheet flow.

BasinOS3**, 4.92 acres, consists of the north portion of the undeveloped site. Runoff produced within **Basin **OS3** is anticipated to reach peak runoff rates of Q5=1.6 cfs and Q100=10.7 cfs. Runoff from the **Basins **OS1, **OS2 and **OS3** shall be conveyed via historic drainage patterns and some minor grading around the perimeter, to a low point at the southwest corner of the site located at **Design Point **4** (Q5=1.8 cfs and Q100=11.8 cfs). A temporary sediment basin will outlet route treated runoff to a proposed private 24" polyethylene storm drain (**Pipe ***5, ***5.1, ***5.2**) and will route the flows south, adjacent to the Meadowbrook ROW to a proposed manhole and existing 42" RCP. The 24" polyethylene storm drain has been sized using the future condition to allow for sufficient capacity.

Basin **OS4, 0.23 acres, consists of a landscaping strip running alongside and adjacent to Meadowbrook Parkway. The landscaping strip consists primarily of trees, bushes/grasses, and decorative ground cover. Low runoff values produced by **Basin **OS4** of Q5=0.1 cfs and Q100=0.7 cfs will travel as sheet flow into Meadowbrook Parkway.

Basin *A**, 0.19 acres, consists of steep slopes of 32% adjacent to portions of U.S Highway 24 and N. Marksheffel Rd. The roadway embankment within **Basin ***A**, slopes into a soil retention wall that runs along the south east boundary of the site. Runoff for **Basin ***A** is limited has been calculated to reach

peak flow rates of Q5=0.1 cfs and Q100=0.6 cfs. Flows produced within the basin will be conveyed westward into adjacent basin **Basin ***B** as sheet flow.

Basin *B**, 1.39 acres, consists of Lot 10 along the northeast corner of the proposed site. Runoff produced within **Basin ***B** is anticipated to reach peak runoff rates of Q5=5.5 cfs and Q100=10.1 cfs. The cumulative flows of **Basin ***A** and **Basin ***B** will be routed to the southend of **Basin ***B** to **Design Point ***1** (Q5=5.6 cfs and Q100=10.6 cfs). A proposed private 24" polyethylene storm drain (**Pipe ***1**) will be extended to **Design Point ***1** to capture runoff from **Basins ***A** and *****B**.

Basin *C**, 0.30 acres, consists of portion of steep slopes of up to 33% that lie adjacent to portions of U.S Highway 24. Similar to **Basin ***A**, the roadway embankment within **Basin ***C**, slopes into a soil retention wall that runs along the eastern boundary. Runoff for **Basin ***C** has been calculated to reach peak flow rates of Q5=0.1 cfs and Q100=1.0 cfs. The limited runoff produced will be conveyed westward into adjacent **Basin ***D** as sheet flow.

Basin*D**, 1.53 acres, consists of Lot 8 along the eastern boundary of the proposed site. Runoff produced within **Basin ***D** is anticipated to reach peak runoff rates of Q5=6.3 cfs and Q100=11.5 cfs. The cumulative flows of **Basin ***C** and **Basin ***D** will be routed to the southwest corner of **Basin ***D** to **Design Point ***2** (Q5=6.4 cfs and Q100=12.4 cfs). A proposed private 24" polyethylene storm drain (**Pipe ***2**) will be extended to **Design Point ***2** to capture runoff from **Basins ***C** and *****D**. Runoff collected within **Pipes ***1** and *****2** will be routed to a proposed private sand filter water quality pond via a private 30" polyethylene storm drain (**Pipe ***3**) at peak flow rates of Q5=11.8 cfs and Q100=22.6 cfs. A small riprap pad will be required to reduce velocities prior to entering the pond. A swale/berm shall be constructed along the south line of Lot 8, to ensure flows are conveying westerly to a 24" pipe to the proposed storm system and then conveyed to the proposed Sand Filter WQ pond (**Pond 1**) for the retail center area.

Basin *E**, 1.55 acres, consists of Lot 9 and a portion of the planned private access entrance, which is located adjacent to a portion of Meadowbrook Parkway. Runoff produced within **Basin ***E** is anticipated to reach peak runoff rates of Q5=6.5 cfs and Q100=11.8 cfs. A proposed private 24" polyethylene storm drain (**Pipe ***4**) will be extended from the private pond to collect runoff reaching **Design Point ***3** (Q5=6.5 cfs and Q100=11.8 cfs). A small riprap pad will be required to reduce velocities prior to entering the pond.

Basin *F**, 0.36 acres, consists of a land (Tract B) which is dedicated to house a proposed private onsite Sand Filter Basin Water Quality Pond (**Pond 1**) adjacent to existing Meadowbrook Parkway. Runoff produced within **Basin ***F** (Q5=0.2 cfs and Q100=1.0 cfs) will ultimately combine with flows entering the pond via **Pipes ***3** and *****4** at **Design Point ***4**. The total flow anticipated to reach the pond at **Design Point ***4** is calculated by the rational method to be Q5=18.2 cfs and Q100=35.0 cfs. Using the UD-Detention worksheet, flows treated via the Sand Filter Basin are to be discharged through a 6.0' x 2.91' CDOT Modified Type D outlet structure and proposed private 24" polyethylene Storm Sewer (**Pipe Runs ***5, ***5.1, ***5.2**). The proposed pond shall be constructed with 4:1 SS and is anticipated to store 0.118, 0.157 and 0.200 ac-ft and discharge 0.1 cfs, 7.2 cfs, and 15.5 cfs in the water quality, 5 year and 100 year events respectively. The 8.5' wide emergency spillway shall be designed to discharge the peak inflow safely to Meadowbrook Parkway in the event that the inlet would become clogged. Runoff conveyed in **Pipe ***5.2** will combine with flows from a second onsite pond, prior to being discharged downstream via an existing 42" RCP storm sewer.

Basin *G**, 0.29 acres, consists of a landscaping strip running alongside and adjacent to Meadowbrook Parkway and a small section of pavement associated with site access. Excluding the small section of street the basin consists primarily of trees, bushes/grasses, and decorative ground cover. Low runoff values produced by **Basin ***G** of Q5=0.5 cfs and Q100=1.3 cfs will travel as sheet flow into Meadowbrook Parkway.

Basin H, 0.71 acres, consists of steep slopes of up to 33% adjacent to portions of U.S Highway 24. The roadway embankment within **Basin H** slopes into a soil retention wall that runs along the south east boundary of the site. Runoff for **Basin H** has been calculated to reach peak flow rates of Q5=0.3 cfs and Q100=2.0 cfs. Flows produced within the basin will be conveyed westward into adjacent basins (**Basin I**) as sheet flow.

Basin I, 2.75 acres, consists of Lots 5 and 6, portions of Lots 2-4 and 7 and section of proposed private street, which is generally located within the center of the proposed site. Runoff produced within **Basin I** is anticipated to reach peak runoff rates of Q5=9.8 cfs and Q100=17.9 cfs. Runoff from the **Basins H** and **I** shall be conveyed via side lot swales and curb and gutter to a proposed private street and a pair of proposed CDOT 15' Type R at grade inlets located at **Design Point 5** (Q5=10.1 cfs and Q100=19.8 cfs). Runoff intercepted by the inlets will be conveyed south to proposed water quality sand filter pond 2 via proposed private 24" polyethylene **Pipes 6** and **7** at 5 year flow rates of 6.4 cfs and 10.1 cfs and at 100 year flow rates of 9.1 and 18.3 cfs respectively. A small riprap pad will be required to reduce velocities prior to entering the WQ pond 2. Runoff by passing the inlets will continue west within the street to **Design Point 6**. Pipe 7 shall have gasketed, watertight joints and adhere to performance standards per ASTM D3212.

Basin J, 1.05 acres, consists of portions of Lots 1, 2 and 7 and a segment of the proposed street, which is located along the western edge of the proposed site. Runoff produced within **Basin J** is anticipated to reach peak runoff rates of Q5=4.4 cfs and Q100=8.0 cfs. Runoff from the **Basins J** and flow-by from **Design Point 5** shall intercepted by a pair of proposed CDOT 15' Type R at grade inlets located at **Design Point 6** (Q5=4.4 cfs and Q100=9.8 cfs). Runoff intercepted by the proposed inlets will be conveyed south to proposed water quality pond 2 via proposed private 18" and 24" polyethylene **Pipes 8** and **9** at 5 year flow rates of 3.0 cfs and 4.5 cfs and at 100 year flow rates of 4.9 and 9.8 cfs respectively. No flowby is anticipated to bypass **Design Point 6** into Meadowbrook Parkway.

Basin K, 0.42 acres, consists of the rear halves of Lots 1 and 2, which is generally located along the southwest corner of the proposed site. Runoff produced within **Basin K** is anticipated to reach peak runoff rates of Q5=1.8 cfs and Q100=3.2 cfs. Runoff from the **Basins K** can be conveyed to a CDOT Type C grated inlet at the southwest corner of Lot 1, at **Design Point 7**. Runoff collected at the local depression would combine with flows in **Pipe 9** and continue to the proposed water quality sand filter pond 2 via pipes 10 and 10.1 at peak flow rates of 6.3 cfs and 13.0 cfs in the 5 and 100 year storm events. A small riprap pad will be required to reduce velocities prior to entering the pond.

Basin L, 1.32 acres, consists of steep slopes of 32% adjacent to portions of U.S Highway 24. The roadway embankment within **Basin L** slopes into a soil retention wall that runs along the south east boundary of the site. Runoff for **Basin L** has been calculated to reach peak flow rates of Q5=0.5 cfs and Q100=3.7 cfs. Flows produced within the basin will be conveyed westward into adjacent basins (**Basin M**) as sheet flow.

Basin M, 1.84 acres, consists of a portion of Lots 3 and 4, which is generally located along the south and southeast sides of the proposed site. Runoff produced within **Basin M** is anticipated to reach peak runoff rates of Q5=6.7 cfs and Q100=12.2 cfs. Runoff from the **Basins L** and **M** shall be conveyed to a proposed grassed lined swale which will outfall to proposed Sand Filter WQ Pond 2. Peak runoff reaching **Design Point 8** is anticipated to have peak flow rates of Q5=7.2 cfs and Q100=15.7 cfs. The proposed swale would need to be a minimum of 2.0' deep at 0.5% using a 3' bottom width and 3:1 side slopes. A riprap rundown and pad would need to be provided reduce velocities prior entering the pond.

Basin N, 0.47 acres, consists of a land (Tract A) which is dedicated to house a proposed private onsite Sand Filter Basin Water Quality Pond (**Pond 2**) adjacent to existing Meadowbrook Parkway. Runoff produced within **Basin N** (Q5=0.2 cfs and Q100=1.3) cfs will ultimately combine with flows entering the pond via **Pipes 7, 10.1** and from the Swale at **Design Point 8**. The total flow anticipated to reach the pond

(Design Point 9) is calculated by the rational method to be $Q_5=23.1$ cfs and $Q_{100}=46.9$ cfs. Using the UD-Detention worksheet, flows treated via the Sand Filter Basin are to be discharged through a 7.0' x 2.91' CDOT Modified Type D outlet structure and proposed private 30" polyethylene Storm Sewer (**Pipe Run 11**). The proposed pond shall be constructed with 4:1 SS and is anticipated to store 0.143, 0.199 and 0.299 ac-ft and discharge 0.1 cfs, 13.3 cfs, and 23.8 cfs in the water quality, 5 year and 100 year events respectively. The 12.5' emergency spillway shall be designed to discharge the peak inflow safely to Meadowbrook Parkway in the event that the inlet would become clogged. Runoff conveyed in **Pipe 11** will combine with flows within **Pipe 5.2** ($Q_5=20.4$ cfs and $Q_{100}=39.3$), prior to being discharged downstream via an existing 42" RCP storm sewer and into the backside of the existing 10' Type R at grade inlet along existing Woolsey Heights and then to the west via an existing 48" storm sewer.

The Matrix "Final Drainage Report for Claremont Business Park Filing No. 2" calculated that DP 1 combining Sub Basins B1 and B2 generated of ($Q_5=31.5$ cfs and $Q_{100}=63.6$). The proposed development will release $Q_5=20.4$ cfs and $Q_{100}=39.3$ and is less than that of the Matrix report. These flows will combine downstream in the existing 42" pipe with the flows from Lot 2-1A Claremont Business Park of ($Q_5=7.5$ cfs and $Q_{100}=15.4$). Therefore the proposed development shall not have a negative impact on the downstream storm system and is adequately sized to convey the proposed generated flows..

Basin O, 0.16 acres, consists of a landscaping strip running alongside and adjacent to Meadowbrook Parkway. The basin will most likely be composed of trees, bushes/grasses, and decorative ground cover. Low runoff values produced by **Basin O** of $Q_5=0.2$ cfs and $Q_{100}=0.6$ cfs will travel as sheet flow into Meadowbrook Parkway.

Basin P, 0.03 acres, consists of steep slopes of up to 33% adjacent to portions of U.S Highway 24. The roadway embankment within **Basin P** slopes into a soil retention wall that runs along the south east boundary of the site. Runoff for **Basin P** has been calculated to reach peak flow rates of $Q_5=0.0$ cfs and $Q_{100}=0.1$ cfs. Flows produced within the basin will be conveyed westward into adjacent basins (**Basin Q**) as sheet flow.

Basin Q, 0.11 acres, consists of a thin utility corridor alongside the south boundary of the site. The basin will most likely be composed native ground cover. Low runoff values produced by **Basin Q** of $Q_5=0.0$ cfs and $Q_{100}=0.3$ cfs will combine with flows from **Basin P** and will discharge to adjacent site to the south as sheet flow.

There are no planned or required improvements to the Sand Creek Drainage Channel with the development of the CLAREMONT BUSINESS PARK 2 site.

WATER QUALITY PROVISIONS AND MAINTENANCE

The subject site was previously analyzed within the Final Drainage Report for Claremont Business Park Filing No. 2 prepared by Matrix Design Group approved April 24, 2006. Per Resolution 16-426 of the BoCC, on-site WQCV is required but on-site stormwater detention is not required per the FDR for Claremont Business Park Fil. 2. The water quality volume required for the site has been determined using the UDFCD UD-Detention workbook per the guidelines set forth in the City of Colorado Springs/El Paso County Drainage Criteria Manual - Volume II.

As previously discussed water quality for the site is provided by two proposed Sand Filter Basins (SFB). Pond 1 is designed to treat runoff from approx 5.33 acres, by providing 0.118 acre-feet of water quality storage, while Pond 2 will treat runoff from approx 8.33 acres, by providing 0.143 acre-feet of water quality storage. Per ECM section 1.7.1.C.1, 20% of the project site (not to exceed 1.0 acre) may be excluded from the 100% WQ treatment requirement per El Paso County criteria. This report identifies that Basins G, O, P and Q are unable to reach one of the two proposed WQ ponds. Combined total acreage of the Basins are 0.59 AC, and doesn't exceed the 1.0 acre maximum allowance of acreage runoff.

Flows tributary to the two SFBs are released through outlet structures into an existing storm sewer system located along Meadowbrook Parkway. Water quality pond 1 will be private and shall be maintained by the property owners (equal shares determined by size of lots 8-10). Water quality pond 2 will be private and shall be maintained by the property owners (equal shares determined by size of lots 1-7). Access shall be granted to the owner and El Paso County for access and maintenance of the private WQCV facility. A private maintenance agreement document shall accompany the final drainage report(s) submittal(s) which construct the two ponds.

DRAINAGE EASEMENTS

The Preliminary Plan for this site has an approved Waiver of the El Paso County Land Development Code that request 2' foot side lot line easement for drainage, differing from the standard 5' foot wide easement. Therefore, in two locations within the site, a combined drainage easement shall be 4' feet overall minimum in width and it's likely that in these two locations there will be a building on each lot that are (4' feet apart) or building and parking lot that are (4' feet apart). There are combined drainage easements of 4' feet in overall width (2' foot and 2' foot each side of the side lot lines) between Lots 3 and 4 and Lots 5 and 6. There are combined drainage easements of 7' feet in overall width (2' foot & 5' foot each side of the side lot lines) between Lots 1 and 2 and Lots 2 and 3. All other side lot lines shall be typical of 10' feet in overall width (5' foot and 5' foot each side of the side lot lines).

Within the approved Preliminary Drainage report, a provision for a 6" inch tall x 3' foot wide concrete trickle channel was proposed in order to convey drainage flows through the narrower easement widths. The preliminary drainage report included a calculation sheet to provide the maximum capacity of the described channel with varying slopes. The calculation sheet and sample concrete channel cross section detail has been included within the appendix of this report.

Each individual lot's site development shall be required to submit on-site grading and development plans along with drainage letters for review and approval through the El Paso County Planning and Community Development department. The on-site grading and development plans along with drainage letters shall identify the specific details of each lot's development including (building, parking areas, landscaping, fencing, utilities, etc.). Any individual lot development that determines the necessity for the prescribed concrete channel in order for drainage flow conveyance shall provide the specific contributing drainage flows that will be transported through the channel within the individual lot drainage letter. The subsequent individual lot drainage letters and grading plans will ensure that the maximum capacity is not exceeded within the channel as outlined in the calculation sheet included within this report.

This final drainage report identifies the lots where the reduced easements are located within the proposed Claremont Business Park 2, Filing No. 1 subdivision and provides design criteria to ensure that each lot will be graded accordingly so that runoff will be adequately conveyed to ensure that post development runoff is routed through the site safely to the WQCV facility in a manner that satisfies the requirements set forth by the El Paso County and City of Colorado Springs Drainage Criteria Manuals. It is anticipated that drainage flows from Lots 1-7 are as described as follows, however, the subsequent drainage letters and on-site grading and development plans for each individual lot could vary depending on the final site layout.

Lot 1 – The majority of the flows from the parking lot and west roof drains should flow to the southwest corner of the lot and outfall to the provided area inlet per the stormwater design plans by M&S Civil Consultants, Inc. The storm pipe shall convey flows to the WQCV facility in the SW corner of the subdivision in Tract A. The roof downspouts on east side shall outfall to the combined 7' wide landscaped drainage easement between Lots 1 and 2. It's anticipated that Lot 2's parking lot shall be located on the west side of the lot and shall provide adequate access for maintenance.

Lot 2 - The majority of the flows from the parking lot and west roof drains should flow south to a curb opening that is anticipated to directly outfall to a riprap rundown into the WQCV facility located in the SW corner of the subdivision in Tract A. The details of the riprap rundown should be provided in the drainage letter for this lot. The roof downspouts on east side shall outfall along the 7' wide landscaped drainage easement between Lots 2 and 3. It's anticipated that Lot 3's parking lot shall be located on the west side of the lot and shall provide adequate access for maintenance.

Lot 3 - The majority of the flows from the parking lot and west roof drains should flow south to a seeded swale along the southern border of the subdivision. The details of the swale and the riprap rundown to the WQCV facility located in Tract A has been defined within the stormwater design plans by M&S Civil Consultants, Inc. It's anticipated that the roof downspouts on east side are conveyed via a 6" high x 3' wide concrete channel that will straddle the side lot line between Lots 3 and 4 within the described 4' wide drainage easement. The calculations for the flow depth within the concrete channel should be provided in the drainage letter. It's anticipated that the building on Lot 4 shall be located on the west side of the lot and the west downspouts from the Lot 4 building will additionally use this concrete channel to convey the roof drain flows to the seeded swale to the south.

Lot 4 - The majority of the flows from the parking lot and east roof drains should flow south to a seeded swale along the southern border of the subdivision. The details of swale and the riprap rundown to the WQCV facility located in Tract A has been defined within the stormwater design plans by M&S Civil Consultants, Inc. It's anticipated that the roof downspouts on west side shall be conveyed via 6" high x 3' wide concrete channel that will straddle the side lot line between Lots 3 and 4 within the described 4' wide drainage easement. The calculations for the flow depth within the concrete channel shall be provided in the drainage letter. It's anticipated that the building on Lot 3 shall be located on the east side of the lot and the east downspouts from Lot 3 will additionally use this concrete channel to convey the roof drain flow to the seeded swale to the south.

Lot 5 - The majority of the flows from the south parking lot and east roof drains should flow south through the parking lot to the curb line of Gary Watson Point. The curb line shall convey these flows to the stormwater conveyance system designed to outfall to the WQCV facility located in Tract A which has been defined within the stormwater design plans by M&S Civil Consultants, Inc. It's anticipated that the flows generated from the parking area on the north side of the building along with the west roof downspouts will be conveyed via 6" high x 3' wide concrete channel that will straddle the side lot line between Lots 5 and 6 within the described 4' wide drainage easement. The calculations for the flow depth within the concrete channel shall be provided in the drainage letter. It's anticipated that the building on Lot 6 shall be located on the east side of the lot and the east downspouts from Lot 6 will additionally use this concrete channel to convey the flows to the curb line of Gary Watson Point via a sidewalk chase at the end of the concrete channel.

Lot 6 - The majority of the flows from the parking lot and west roof drains should flow south through the parking lot to the curb line of Gary Watson Point. The curb line shall convey these flows to the stormwater conveyance system designed to outfall to the WQCV facility located in Tract A which has been defined within the stormwater design plans by M&S Civil Consultants, Inc. It's anticipated that the roof downspouts on east side will be conveyed via 6" high x 3' wide concrete channel that will straddle the side lot line between Lots 5 and 6 within the described 4' wide drainage easement. The calculations for the flow depth within the concrete channel should be provided in the drainage letter. It's anticipated that the building on Lot 5 shall be located on the west side of the lot and the west downspouts and north parking lot from Lot 5 will additionally use this concrete channel to convey the flows to the curb line of Gary Watson Point via a sidewalk chase at the end of the concrete channel.

Lot 7 - The majority of the flows from the parking lots along with the east and west building roof drains should flow south to the curb line of Gary Watson Point. The curb line shall convey these flows to the stormwater conveyance system designed to outfall to the WQCV facility located in Tract A which has

been defined within the storm water design plans by M&S Civil Consultants, Inc. It's anticipated that the building on Lot 7 shall be flanked on each side by a parking areas; and therefore the roof drains on both sides of the building shall be conveyed through the parking lots.

EROSION CONTROL

It is the policy of the El Paso County that we submit a grading and erosion control plan with the drainage report. Proposed silt fence, vehicle traffic control, and concrete washout area are proposed as erosion control measures.

CONSTRUCTION COST OPINION

Private Drainage Facilities (NON-Reimbursable) Sand Filter WQ Pond 1 (Future Construction):

Item	Description	Quantity	Unit Cost	Cost
1.	24" PP	344 LF	\$48 /LF	\$16,512.00
2.	24" FES	1 EA	\$520 /EA	\$520.00
3.	30" PP	88 LF	\$65 /LF	\$5,720.00
4.	30" FES	1 EA	\$597 /EA	\$597.00
5.	Type II Manhole	1 EA	\$4,000 /EA	\$4,000.00
6.	WQCV Sand Filter Pond	1 EA	\$19,000 /EA	\$19,000.00
Total				\$46,349.00

Private Drainage Facilities (NON-Reimbursable) (WQ Pond 1) Temporary Sediment Basin (TSB-N) (Interim Construction):

Item	Description	Quantity	Unit Cost	Cost
1.	24" PP	476 LF	\$48 /LF	\$22,848.00
2.	24" FES	1 EA	\$520 /EA	\$520.00
3.	Type II Manholes	2 EA	\$4,000 /EA	\$8,000.00
4.	Temporary Sediment Basin (TSB-N)	1 EA	\$2500 /EA	\$2,500.00
Total				\$33,868.00

Private Drainage Facilities (NON-Reimbursable) Sand Filter WQ Pond 2:

Item	Description	Quantity	Unit Cost	Cost
1.	18" PP	47 LF	\$40 /LF	\$1,880.00
2.	24" PP	478 LF	\$48 /LF	\$22,944.00
3.	24" FES	2 EA	\$520 /EA	\$1,040.00
4.	30" PP	40 LF	\$65 /LF	\$2,600.00
5.	At Grade Inlets (Type R) L=15'	4 EA	\$7,200 /EA	\$28,800.00
6.	CDOT Type C Grated Inlet	1 EA	\$3500 /EA	\$3,500.00
7.	Type II Manhole	1 EA	\$4,000 /EA	\$4,000.00
8.	Type I Manhole	1 EA	\$6,500 /EA	\$6,500.00
9.	Type M Riprap	15 CY	\$80 /CY	\$1,200.00
10.	Type L Riprap	11 CY	\$50 /CY	\$550.00
11.	WQCV Sand Filter Pond	1 EA	\$19,000 /EA	\$19,000.00
Total				\$92,014.00

M & S Civil Consultants, Inc. (M & S) cannot and does not guarantee the construction cost will not vary from these opinions of probable costs. These opinions represent our best judgment as design professionals familiar with the construction industry and this development in particular. The above is only an estimate of the facility cost in 2020.

DRAINAGE & BRIDGE FEES

This site is in the Sand Creek Drainage Basin. The site is proposed to be subdivided into ten commercial lots. Drainage fees were paid at the time of the previous platting as Tract C of Claremont Business Park Filing No. 2 (Reception No. 207712506), therefore no additional Drainage Bridge and/or Pond fees are. The imperviousness from Basins B1 and B2 (80%) in the "Final Drainage Report for Claremont Business Park Filing No. 2", prepared by the Matrix Design Group is more than the imperviousness for the proposed site (70%). See Appendix of the "Final Drainage Report for Claremont Business Park Filing No. 2", Revised November 2006, by Matrix Design Group, Inc, for previously paid drainage and bridge fees. Previously paid fees were based on 80% impervious as shown in the "Final Drainage Report for Claremont Business Park Filing No. 2".

SUMMARY

Development of Claremont Business Park 2 Filing No.1 will not adversely affect the surrounding development. The proposed drainage facilities will adequately convey, detain and route runoff from the onsite & offsite flows to existing facilities. All drainage facilities described herein and shown on the included Proposed Drainage Map (See Appendix) are subject to change being dependent upon individual lot development but owners/developer of the lots shall comply with this final drainage report that will be submitted with the final plat application. Care will be taken to accommodate overland emergency flow routes on site and temporary drainage conditions.

REFERENCES

- 1.) "El Paso County and City of Colorado Springs Drainage Criteria Manual".
- 2.) "Urban Storm Drainage Criteria Manual"
- 3.) SCS Soils Map for El Paso County.
- 4.) Flood Insurance Rate Map (FIRM), Federal Emergency Management Agency, Effective date December 7, 2018.
- 5.) "Final Drainage Report for Claremont Business Park Filing No. 2", dated November 2006, by Matrix Design Group, Inc.

APPENDIX

VICINITY MAP



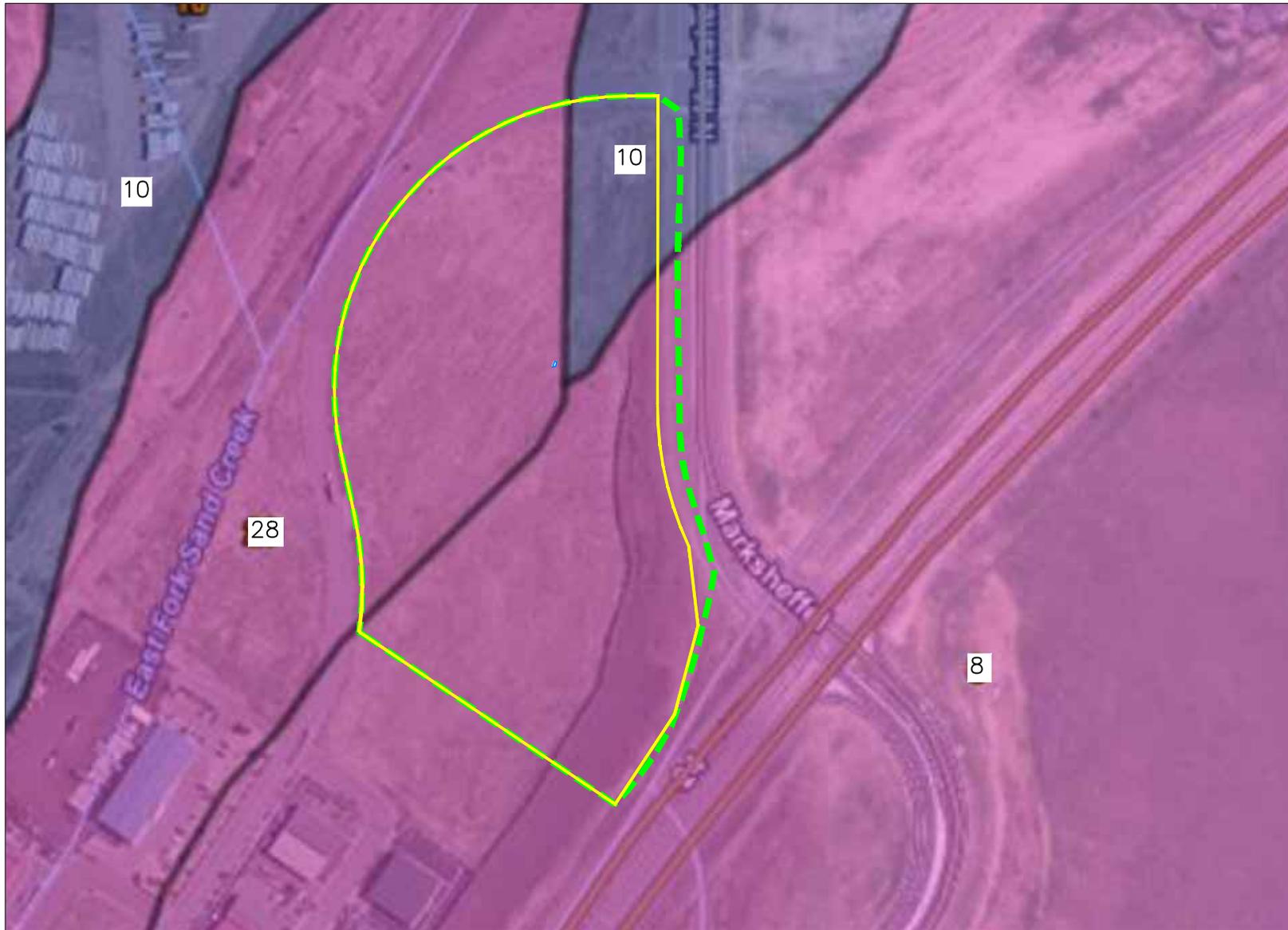
VICINITY MAP

N.T.S.



20 BOULDER CRESCENT, SUITE 110
 COLORADO SPRINGS, CO 80903
 PHONE: 719.955.5485

SOILS MAP



CLAREMONT COMMERCIAL FILING NO. 2

HYDROLOGIC
TYPE A SOILS



HYDROLOGIC
TYPE B SOILS



SITE BOUNDARY



NOT TO SCALE

SOILS MAP



Summary by Map Unit — El Paso County Area, Colorado (CO625)

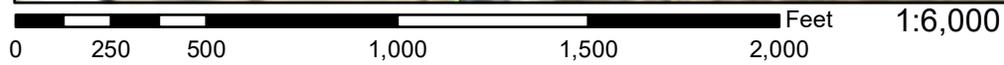
Map unit symbol	Map unit name	Rating
8	Blakeland loamy sand, 1 to 9 percent slopes	A
10	Blendon sandy loam, 0 to 3 percent slopes	B
28	Ellicott loamy coarse sand, 0 to 5 percent slopes	A

FEMA FIRM PANEL

National Flood Hazard Layer FIRMette



38°51'19.98"N



USGS The National Map: Orthoimagery, Data refreshed April, 2019.

38°50'51.96"N

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS	Without Base Flood Elevation (BFE) Zone A, V, A99	With BFE or Depth Zone AE, AO, AH, VE, AR
	Regulatory Floodway	

OTHER AREAS OF FLOOD HAZARD	0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
	Future Conditions 1% Annual Chance Flood Hazard Zone X
	Area with Reduced Flood Risk due to Levee. See Notes. Zone X
	Area with Flood Risk due to Levee Zone D

OTHER AREAS	NO SCREEN	Area of Minimal Flood Hazard Zone X
		Effective LOMRs
		Area of Undetermined Flood Hazard Zone D

GENERAL STRUCTURES	Channel, Culvert, or Storm Sewer
	Levee, Dike, or Floodwall

OTHER FEATURES	20.2	Cross Sections with 1% Annual Chance Water Surface Elevation
		17.5
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature

MAP PANELS	Digital Data Available
	No Digital Data Available
	Unmapped



The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 2/13/2020 at 12:07:22 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

104°40'49.00"W

104°41'26.46"W

HYDROLOGIC CALCULATIONS

FINAL DRAINAGE REPORT FOR CLAREMONT BUSINESS PARK 2 FILING NO.1
PROPOSED DRAINAGE CALCULATIONS
(Area Runoff Coefficient Summary)

			ROOFS 0.73-0.81 COMMERCIAL AREAS 0.81-0.88 ASPHALT DRIVES 0.90-0.96			LANDSCAPED AREAS 0.16-0.41 GRAVEL STORAGE YARD 0.30-0.50 LIGHT INDUST AREAS 0.59-0.70			PARKS 0.12-0.39 GREENBELTS/AGRI. 0.09-0.36			WEIGHTED	
BASIN	TOTAL AREA (SF)	TOTAL AREA (Acres)	AREA (Acres)	C ₅	C ₁₀₀	AREA (Acres)	C ₅	C ₁₀₀	AREA (Acres)	C ₅	C ₁₀₀	C ₅	C ₁₀₀
**OS1	8359.6	0.19	0.00	0.73	0.81	0.00	0.30	0.50	0.19	0.09	0.36	0.09	0.36
**OS2	13279.8	0.30	0.00	0.81	0.88	0.00	0.59	0.70	0.30	0.09	0.36	0.09	0.36
**OS3	214320.8	4.92	0.00	0.81	0.88	0.00	0.59	0.70	4.92	0.09	0.36	0.09	0.36
**OS4	9938.1	0.23	0.00	0.90	0.96	0.00	0.16	0.41	0.23	0.09	0.36	0.09	0.36
***A	8359.6	0.19	0.00	0.90	0.96	0.00	0.16	0.41	0.19	0.09	0.36	0.09	0.36
***B	60660.5	1.39	1.39	0.81	0.88	0.00	0.30	0.50	0.00	0.12	0.39	0.81	0.88
***C	13279.8	0.30	0.00	0.90	0.96	0.00	0.16	0.41	0.30	0.09	0.36	0.09	0.36
***D	66703.6	1.53	1.53	0.81	0.88	0.00	0.30	0.50	0.00	0.12	0.39	0.81	0.88
***E	67533.9	1.55	1.55	0.81	0.88	0.00	0.30	0.50	0.00	0.12	0.39	0.81	0.88
***F	15781.4	0.36	0.00	0.73	0.81	0.00	0.30	0.50	0.36	0.12	0.39	0.12	0.39
***G	12722.3	0.29	0.06	0.90	0.96	0.23	0.16	0.41	0.00	0.12	0.39	0.32	0.53
H	31099.0	0.71	0.00	0.90	0.96	0.00	0.16	0.41	0.71	0.09	0.36	0.09	0.36
I	119584.6	2.75	2.75	0.81	0.88	0.00	0.30	0.50	0.00	0.12	0.39	0.81	0.88
J	45863.7	1.05	1.05	0.81	0.88	0.00	0.30	0.50	0.00	0.09	0.36	0.81	0.88
K	18476.1	0.42	0.42	0.81	0.88	0.00	0.30	0.50	0.00	0.09	0.36	0.81	0.88
L	57315.2	1.32	0.00	0.81	0.88	0.00	0.30	0.50	1.32	0.09	0.36	0.09	0.36
M	80126.1	1.84	1.84	0.81	0.88	0.00	0.30	0.50	0.00	0.09	0.36	0.81	0.88
N	20642.4	0.47	0.00	0.81	0.88	0.00	0.16	0.41	0.47	0.12	0.39	0.12	0.39
O	6997.2	0.16	0.02	0.90	0.96	0.00	0.30	0.50	0.14	0.12	0.41	0.22	0.48
P	1393.0	0.03	0.00	0.81	0.88	0.00	0.30	0.50	0.03	0.09	0.36	0.09	0.36
Q	4961.4	0.11	0.00	0.90	0.96	0.00	0.30	0.50	0.11	0.09	0.36	0.09	0.36

**Existing undeveloped

***Ultimate build out, developed. Used to size future pond 1 and storm sewer.

Calculated by: GT
Date: 7/24/2020
Checked by: VAS

FINAL DRAINAGE REPORT FOR CLAREMONT BUSINESS PARK 2 FILING NO.1
PROPOSED DRAINAGE CALCULATIONS
(Area Drainage Summary)

From Area Runoff Coefficient Summary				OVERLAND				STREET / CHANNEL FLOW				Time of Travel (T _t)		INTENSITY *		TOTAL FLOWS	
BASIN	AREA TOTAL (Acres)	C ₅	C ₁₀₀	C ₅	Length (ft)	Height (ft)	T _c (min)	Length (ft)	Slope (%)	Velocity (fps)	T _t (min)	*TOTAL (min)	CHECK (min)	I ₅ (in/hr)	I ₁₀₀ (in/hr)	Q ₅ (c.f.s.)	Q ₁₀₀ (c.f.s.)
		From DCM Table 5-1															
**OS1	0.19	0.09	0.36	0.09	40	5.0	5.0	0	0.0%	0.0	0.0	5.0	10.2	5.2	8.7	0.1	0.6
**OS2	0.30	0.09	0.36	0.09	40	8.0	4.3	0	0.0%	0.0	0.0	4.3	10.2	5.2	8.7	0.1	1.0
**OS3	4.92	0.09	0.36	0.09	100	2.0	14.5	637	1.7%	0.6	16.5	31.0	14.1	3.6	6.1	1.6	10.7
**OS4	0.23	0.09	0.36	0.09	20	0.5	6.0	0	0.0%	0.0	0.0	6.0	10.1	4.9	8.2	0.1	0.7
***A	0.19	0.09	0.36	0.09	40	5.0	5.0	0	0.0%	0.0	0.0	5.0	10.2	5.2	8.7	0.1	0.6
***B	1.39	0.81	0.88	0.81	80	1.0	4.4	250	1.6%	2.5	1.7	6.0	11.8	4.9	8.2	5.5	10.1
***C	0.30	0.09	0.36	0.09	40	8.0	4.3	0	0.0%	0.0	0.0	4.3	10.2	5.2	8.7	0.1	1.0
***D	1.53	0.81	0.88	0.81	60	1.2	3.2	350	2.0%	2.8	2.1	5.3	12.3	5.1	8.5	6.3	11.5
***E	1.55	0.81	0.88	0.81	60	1.2	3.2	167	2.0%	2.8	1.0	4.2	11.3	5.2	8.7	6.5	11.8
***F	0.36	0.12	0.39	0.12	60	1.2	10.9	30	33.0%	11.5	0.0	10.9	10.5	4.1	6.8	0.2	1.0
***G	0.29	0.32	0.53	0.32	25	0.5	5.6	0	0.0%	0.0	0.0	5.6	10.1	5.0	8.4	0.5	1.3
H	0.71	0.09	0.36	0.09	100	17.0	7.2	0	0.0%	0.0	0.0	7.2	10.6	4.6	7.8	0.3	2.0
I	2.75	0.81	0.88	0.81	60	1.2	3.2	425	2.0%	1.4	5.0	8.2	12.7	4.4	7.4	9.8	17.9
J	1.05	0.81	0.88	0.81	60	1.2	3.2	200	2.0%	2.8	1.2	4.4	11.4	5.2	8.7	4.4	8.0
K	0.42	0.81	0.88	0.81	60	1.2	3.2	175	2.0%	2.8	1.0	4.3	11.3	5.2	8.7	1.8	3.2
L	1.32	0.09	0.36	0.09	100	17.0	7.2	0	0.0%	0.0	0.0	7.2	10.6	4.6	7.8	0.5	3.7
M	1.84	0.81	0.88	0.81	100	1.0	5.2	400	1.5%	2.4	2.7	8.0	12.8	4.5	7.5	6.7	12.2
N	0.47	0.12	0.39	0.12	60	1.2	10.9	30	33.0%	11.5	0.0	10.9	10.5	4.1	6.8	0.2	1.3
O	0.16	0.22	0.48	0.22	25	0.5	6.3	0	0.0%	0.0	0.0	6.3	10.1	4.8	8.1	0.2	0.6
P	0.03	0.09	0.36	0.09	100	17.0	7.2	0	0.0%	0.0	0.0	7.2	10.6	4.6	7.8	0.0	0.1
Q	0.11	0.09	0.36	0.09	25	0.5	7.1	0	0.0%	0.0	0.0	7.1	10.1	4.6	7.8	0.0	0.3

* Intensity equations assume a minimum travel time of 5 minutes.

**Existing undeveloped

***Ultimate build out, developed. Used to size future pond 1 and storm sewer.

Calculated by: GT
 Date: 7/24/2020
 Checked by: VAS

FINAL DRAINAGE REPORT FOR CLAREMONT BUSINESS PARK 2 FILING NO.1

PROPOSED DRAINAGE CALCULATIONS

(Basin Routing Summary)

From Area Runoff Coefficient Summary				OVERLAND			PIPE / CHANNEL FLOW				Time of Travel (T _t)	INTENSITY *		TOTAL FLOWS		COMMENTS		
DESIGN POINT	CONTRIBUTING BASINS DPS AND/OR PIPES	CA ₅	CA ₁₀₀	C _s	Length (ft)	Height (ft)	T _c (min)	Length (ft)	Slope (%)	Velocity (fps)	T _t (min)	*TOTAL (min)	I ₅ (in/hr)	I ₁₀₀ (in/hr)	Q ₅ (c.f.s.)		Q ₁₀₀ (c.f.s.)	
***1	***A, ***B OFFSITE DEVELOPED	1.15	1.29		TAKEN FROM BASIN B								6.0	4.9	8.2	5.6	10.6	Proposed PVT 24" Storm Sewer
***2	***C, ***D OFFSITE DEVELOPED	1.27	1.46		TAKEN FROM BASIN D								5.3	5.1	8.5	6.4	12.4	Proposed PVT 24" Storm Sewer
***3	***E OFFSITE DEVELOPED	1.26	1.36		TAKEN FROM BASIN E (Adj MIN T _c)								5.0	5.2	8.7	6.5	11.8	Proposed PVT 24" Storm Sewer
***4	***F, ***PR3 & ***PR4 OFFSITE DEVELOPED	3.71	4.26		TAKEN FROM DESIGN POINT 1								6.0	4.9	8.2	18.2	35.0	PVT Sand Filter Basin FSD Pond 1
**4	**OS1, **OS2, **OS3 OFFSITE UNDEVELOPED	0.49	1.95		TAKEN FROM DESIGN POINT 4								14.1	3.6	6.1	1.8	11.8	24" PP & FES
5	H, I	2.29	2.67		TAKEN FROM BASIN I								8.2	4.4	7.4	10.1	19.8	2-15' Type R Inlets
6	J, FB DP5	0.85	1.13		TAKEN FROM BASIN J (Adj to Min T _c)								5.0	5.2	8.7	4.4	9.8	2-15' Type R Inlets
7	K	0.34	0.37		TAKEN FROM BASIN K (Adj to Min T _c)								5.0	5.2	8.7	1.8	3.2	Manhole w/ Grate
8	L, M	1.61	2.09		TAKEN FROM BASIN M								8.0	4.5	7.5	7.2	15.7	PVT Swale or PVT 24" Storm Sewer
9	N, DP8, PR7 & PR10.1	5.16	6.24		TAKEN FROM DESIGN POINT 8								8.0	4.5	7.5	23.1	46.9	PVT Sand Filter Basin FSD Pond 2

* Intensity equations assume a minimum travel time of 5 minutes.

**Existing undeveloped

***Ultimate build out, developed. Used to size future pond 1 and storm sewer.

Calculated by: GT
 Date: 7/24/2020
 Checked by: VAS

FINAL DRAINAGE REPORT FOR CLAREMONT BUSINESS PARK 2 FILING NO.1
PROPOSED DRAINAGE CALCULATIONS
(Storm Sewer Routing Summary)

PIPE RUN	Contributing Pipes/Design Points	Equivalent CA ₅	Equivalent CA ₁₀₀	Maximum T _C	Intensity*		Flow		Pipe Size
					I ₅	I ₁₀₀	Q ₅	Q ₁₀₀	
***1	***DP1	1.15	1.29	6.0	4.9	8.2	5.6	10.6	PROP 24" PP
***2	***DP2	1.27	1.46	5.3	5.1	8.5	6.4	12.4	PROP 24" PP
***3	***PR1, ***PR2	2.41	2.75	6.0	4.9	8.2	11.8	22.6	PROP 30" PP
***4	***DP3	1.26	1.36	5.0	5.2	8.7	6.5	11.8	PROP 24" PP
***5	POND 1 OUTFALL DEVELOPED	1.48	1.89	6.0	4.9	8.2	7.2	15.5	PROP 24" PP
**5	**DP4 OFFSITE UNDEVELOPED	0.49	1.95	14.1	3.6	6.1	1.8	11.8	PROP 24" PP
***5.1	***PR5	1.48	1.89	6.0	4.9	8.2	7.2	15.5	PROP 24" PP
***5.2	***PR5.1	1.48	1.89	6.0	4.9	8.2	7.2	15.5	PROP 24" PP
6	INLET 1	1.45	1.23	8.2	4.4	7.4	6.4	9.1	PROP 24" PP
7	PR6, INLET 2	2.28	2.47	8.2	4.4	7.4	10.1	18.3	PROP 24" PP
8	INLET 3	0.58	0.56	5.0	5.2	8.7	3.0	4.9	PROP 18" PP
9	PR8, INLET 4	0.87	1.13	5.0	5.2	8.7	4.5	9.8	PROP 24" PP
10	PR9, DP7	1.21	1.50	5.0	5.2	8.7	6.3	13.0	PROP 24" PP
10.1	PR10	1.21	1.50	5.0	5.2	8.7	6.3	13.0	PROP 24" PP
11	POND 2 OUTFALL	2.95	3.17	8.0	4.5	7.5	13.2	23.8	PROP 30" PP
12	***PR5.2, PR11		FROM UD-DET SHEETS CUMMALATIVE FLOW				20.4	39.3	EX 42" RCP

* Intensity equations assume a minimum travel time of 5 minutes.

DP - Design Point
PR - Pipe Run

FB- Flow By from Design Point
INT- Intercepted Flow from Design Point

Calculated by: GT

Date: 7/24/2020

Checked by: VAS

**Existing undeveloped

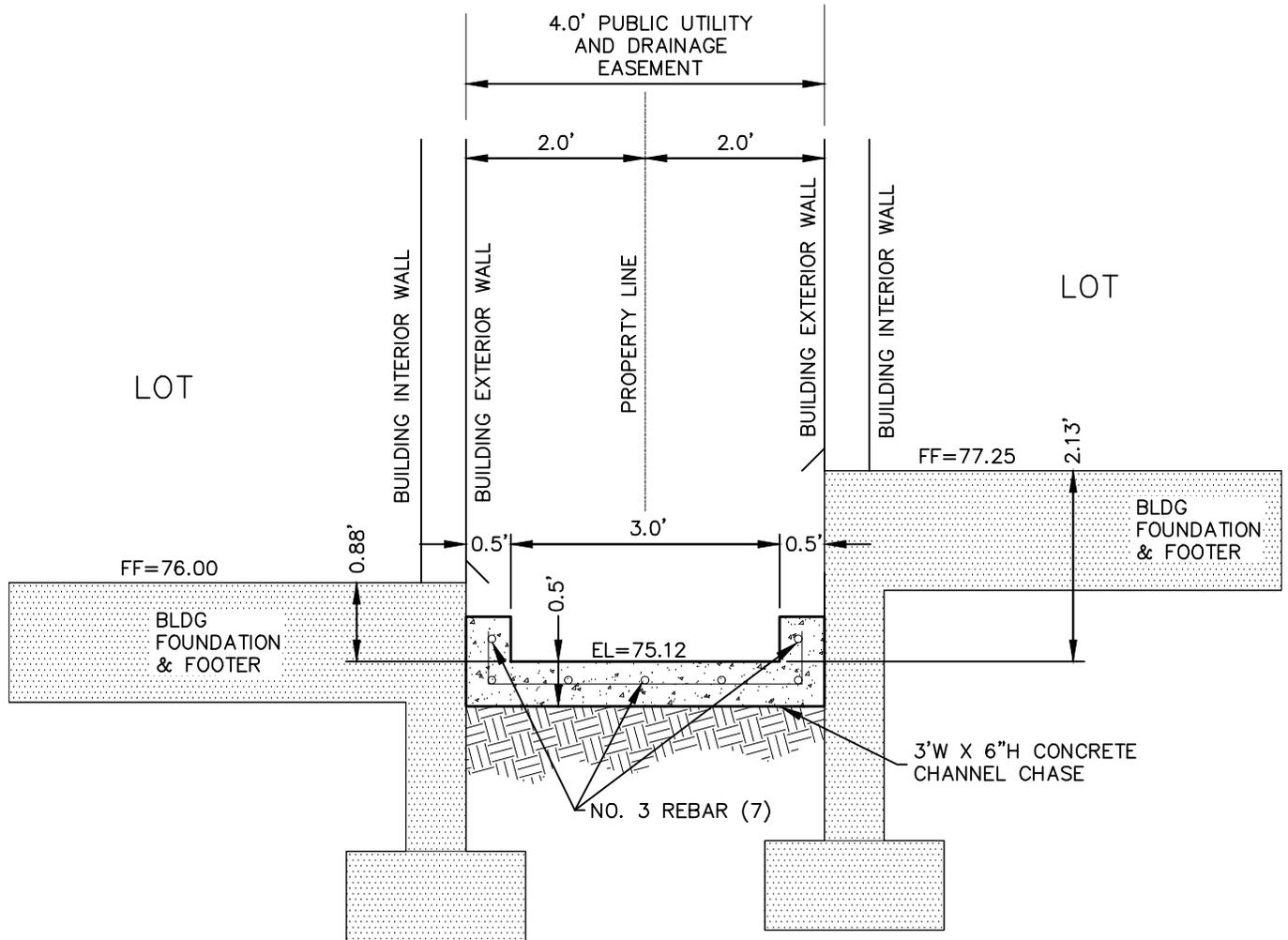
***Ultimate build out, developed. Used to size future pond 1 and storm sewer.

HYDRAULIC CALCULATIONS / SFB WQCV CALCULATIONS

Rating Table for 3' wide 6" deep Rectangular Channel

Project Description							
Friction Method	Manning Formula						
Solve For	Discharge						
Input Data							
Roughness Coefficient	0.013						
Channel Slope	0.003 ft/ft						
Normal Depth	6.0 in						
Bottom Width	3.00 ft						
Channel Slope (ft/ft)	Discharge (cfs)	Velocity (ft/s)	Flow Area (ft ²)	Wetted Perimeter (ft)	Top Width (ft)		
0.003	4.46	2.97	1.5	4.0	3.00		
0.005	6.30	4.20	1.5	4.0	3.00		
0.008	7.72	5.15	1.5	4.0	3.00		
0.010	8.92	5.94	1.5	4.0	3.00		
0.013	9.97	6.65	1.5	4.0	3.00		
0.015	10.92	7.28	1.5	4.0	3.00		
0.018	11.79	7.86	1.5	4.0	3.00		
0.020	12.61	8.41	1.5	4.0	3.00		
0.023	13.37	8.92	1.5	4.0	3.00		
0.025	14.10	9.40	1.5	4.0	3.00		
0.028	14.79	9.86	1.5	4.0	3.00		
0.030	15.44	10.30	1.5	4.0	3.00		

SEE CROSS SECTION NEXT PAGE



EXAMPLE CONCRETE CHANNEL CROSS SECTION

NTS

NOTE: ELEVATIONS SHALL VARY

Claremont Business Park 2 Filing No.1
DRAINAGE PLAN CALCULATIONS
(Pond Volume Calculation)

WQCV POND 1

Elevation	SF	CF	Storage	
			AF	Sum
6373.00	3,690.00	0.00	0.00	0.00
6374.00	4,280.00	3,985.00	0.09	0.09
6375.00	6,051.00	5,165.50	0.12	0.21
6376.00	7,382.00	6,716.50	0.15	0.36
6376.50	8,085.00	3,866.75	0.09	0.45
Total =		<u>19,734</u> CF		
		Total =	<u>0.5</u> Ac-ft	

Calculated by: DLM
Date: 11/20/2019
Checked by: _____

Claremont Business Park 2 Filing No.1

(PROPOSED CONDITIONS)

Weighted Percent Imperviousness of Proposed WQ Sand Filter Pond 1				
Contributing Basins	Area (Acres)	C_s	Impervious % (I)	(Acres)*(I)
<i>A</i>	0.19	0.09	2	0.38
<i>B</i>	1.39	0.81	95	132.29
<i>C</i>	0.30	0.09	2	0.61
<i>D</i>	1.53	0.81	95	145.47
<i>E</i>	1.55	0.81	95	147.28
<i>F</i>	0.36	0.12	7	2.54
Totals	5.33			428.58
Imperviousness % to FSD	80.4			

1.77 A soils 33%
 3.57 B soils 67%
 5.33 total area

Claremont Business Park 2 Filing No.1

EMERGENCY SPILLWAY CALCULATIONS POND 1

Horizontal Broad-Crested Weir (Eqn 12-20 UDFCD)			
Variable		Solve For	
<i>C</i>	3.00	L (ft)	H (ft)
<i>L</i>	8.50 ft	0.0	0.0
<i>H</i>	1.00 ft		
<i>Q</i>	cfs		

Sloping Broad-Crested Weir (Eqn 12-21 UDFCD)			
Variable		Solve For	
<i>C</i>	3.00	Z (ft)	H (ft)
<i>Z</i>	4.00 ft	0.0	0.0
<i>H</i>	1.00 ft		
<i>Q</i>	cfs		

Total Q	35.10
----------------	--------------

Equation 12-20

$$Q = C_{BCW} L H^{1.5}$$

Equation 12-21

$$Q = \left(\frac{2}{5}\right) C_{BCW} Z H^{2.5}$$

Where:

Q = discharge (cfs)

C_{BCW} = broad-crested weir coefficient (This ranges from 2.6 to 3.0. A value of 3.0 is often used in practice.) See Hydraulic Engineering Circular No. 22 for additional information.

L = broad-crested weir length (ft)

H = head above weir crest (ft)

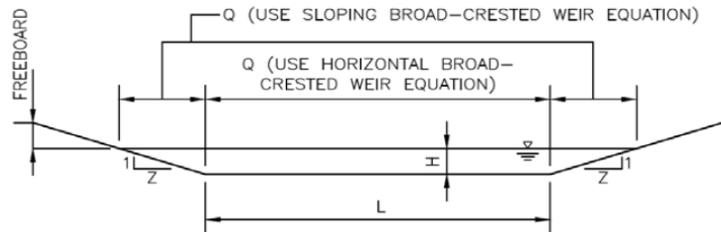


Figure 12-20. Sloping broad-crest weir

TABLE SB-1. SIZING INFORMATION FOR STANDARD SEDIMENT BASIN

Upstream Drainage Area (rounded to nearest acre), (ac)	Basin Bottom Width (W), (ft)	Spillway Crest Length (CL), (ft)	Hole Diameter (HD), (in)
1	12 1/2	2	9/32
2	21	3	13/16
3	28	5	1/2
4	33 1/2	6	9/16
5	38 1/2	8	23/32
6	43	9	23/32
7	47 1/4	11	25/32
8	51	12	27/32
9	55	13	7/8
10	58 1/4	15	15/16
11	61	16	33/32
12	64	18	1
13	67 1/2	19	1 1/16
14	70 1/2	21	1 1/8
15	73 1/4	22	1 3/16

SEDIMENT BASIN INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
 - LOCATION OF SEDIMENT BASIN.
 - TYPE OF BASIN (STANDARD BASIN OR NONSTANDARD BASIN).
 - FOR STANDARD BASIN, BOTTOM WIDTH W, CREST LENGTH CL, AND HOLE DIAMETER, HD.
 - FOR NONSTANDARD BASIN, SEE CONSTRUCTION DRAWINGS FOR DESIGN OF BASIN INCLUDING RISER HEIGHT H, NUMBER OF COLUMNS N, HOLE DIAMETER HD AND PIPE DIAMETER D.
2. FOR STANDARD BASIN, BOTTOM DIMENSION MAY BE MODIFIED AS LONG AS BOTTOM AREA IS NOT REDUCED.
3. SEDIMENT BASINS SHALL BE INSTALLED PRIOR TO ANY OTHER LAND-DISTURBING ACTIVITY THAT RELIES ON ON BASINS AS AS A STORMWATER CONTROL.
4. EMBANKMENT MATERIAL SHALL CONSIST OF SOIL FREE OF DEBRIS, ORGANIC MATERIAL, AND ROCKS OR CONCRETE GREATER THAN 3 INCHES AND SHALL HAVE A MINIMUM OF 15 PERCENT BY WEIGHT PASSING THE NO. 200 SIEVE.
5. EMBANKMENT MATERIAL SHALL BE COMPACTED TO AT LEAST 95 PERCENT OF MAXIMUM DENSITY IN ACCORDANCE WITH ASTM D698.
6. PIPE SCH 40 OR GREATER SHALL BE USED.
7. THE DETAILS SHOWN ON THESE SHEETS PERTAIN TO STANDARD SEDIMENT BASIN(S) FOR DRAINAGE AREAS LESS THAN 15 ACRES. SEE CONSTRUCTION DRAWINGS FOR EMBANKMENT, STORAGE VOLUME, SPILLWAY, OUTLET, AND OUTLET PROTECTION DETAILS FOR ANY SEDIMENT BASIN(S) THAT HAVE BEEN INDIVIDUALLY DESIGNED FOR DRAINAGE AREAS LARGER THAN 15 ACRES.

TEMPORARY SEDIMENT BASIN DP4

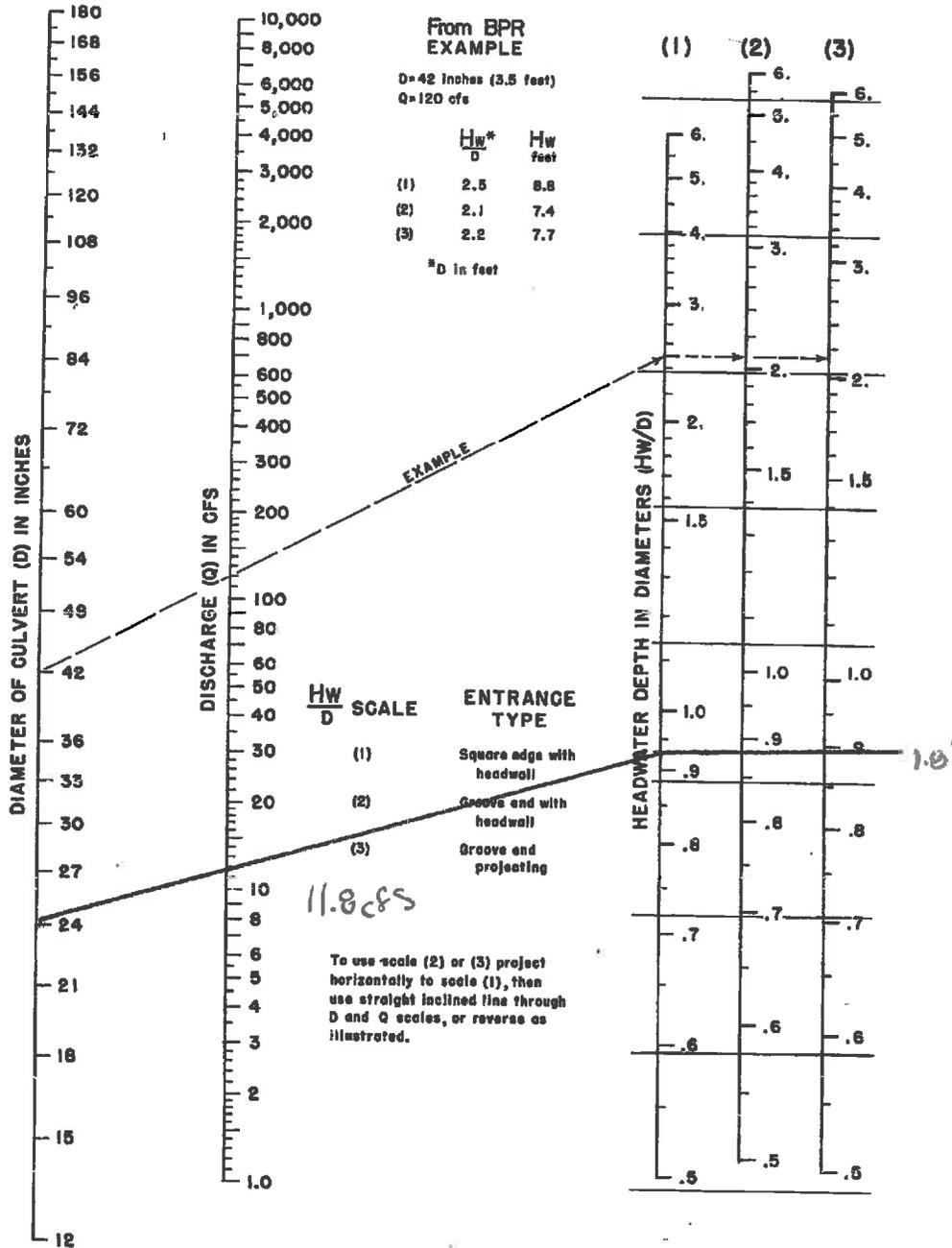
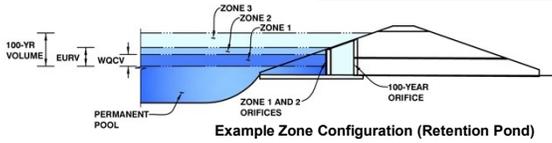


Figure 11-9. Inlet control nomograph—example

DP4 INLET CONTROL NOMOGRAPH FOR 24" FES

DETENTION BASIN OUTLET STRUCTURE DESIGN

Project: Claremont Business Park 2 Filing No.1 *Version 4.02 (February 2020)*
Basin ID: WQCV POND 1



	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.26	0.118	Filtration Media
Zone 2 (100-year)	#VALUE!	0.631	Weir&Pipe (Restrict)
Zone 3			
Total (all zones)		0.749	

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

Underdrain Orifice Invert Depth = ft (distance below the filtration media surface)
 Underdrain Orifice Diameter = inches

Calculated Parameters for Underdrain
 Underdrain Orifice Area = ft²
 Underdrain Orifice Centroid = feet

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

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

Calculated Parameters for Plate
 WQ Orifice Area per Row = ft²
 Elliptical Half-Width = feet
 Elliptical Slot Centroid = feet
 Elliptical Slot Area = ft²

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

	Row 1 (optional)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	N/A							
Orifice Area (sq. inches)	N/A							

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

User Input: Vertical Orifice (Circular or Rectangular)

Invert of Vertical Orifice = ft (relative to basin bottom at Stage = 0 ft)
 Depth at top of Zone using Vertical Orifice = ft (relative to basin bottom at Stage = 0 ft)
 Vertical Orifice Diameter = inches

Calculated Parameters for Vertical Orifice
 Vertical Orifice Area = ft²
 Vertical Orifice Centroid = feet

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

	Zone 2 Weir	Not Selected
Overflow Weir Front Edge Height, H _o =	1.27	
Overflow Weir Front Edge Length =	6.00	
Overflow Weir Grate Slope =	0.00	
Horiz. Length of Weir Sides =	2.91	
Overflow Grate Open Area % =	70%	
Debris Clogging % =	50%	

Calculated Parameters for Overflow Weir
 Height of Grate Upper Edge, H_g = feet
 Overflow Weir Slope Length = feet
 Grate Open Area / 100-yr Orifice Area = ft²
 Overflow Grate Open Area w/o Debris = ft²
 Overflow Grate Open Area w/ Debris = ft²

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

	Zone 2 Restrictor	Not Selected
Depth to Invert of Outlet Pipe =	2.75	
Outlet Pipe Diameter =	24.00	
Restrictor Plate Height Above Pipe Invert =	12.10	

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate
 Outlet Orifice Area = ft²
 Outlet Orifice Centroid = feet
 Half-Central Angle of Restrictor Plate on Pipe = radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

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

Calculated Parameters for Spillway
 Spillway Design Flow Depth = feet
 Stage at Top of Freeboard = feet
 Basin Area at Top of Freeboard = acres
 Basin Volume at Top of Freeboard = acre-ft

Routed Hydrograph Results

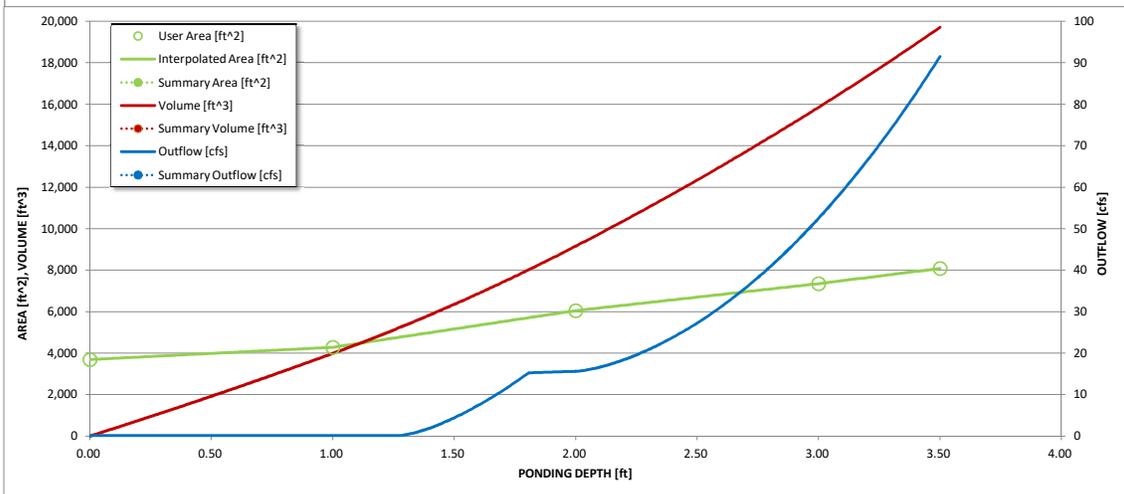
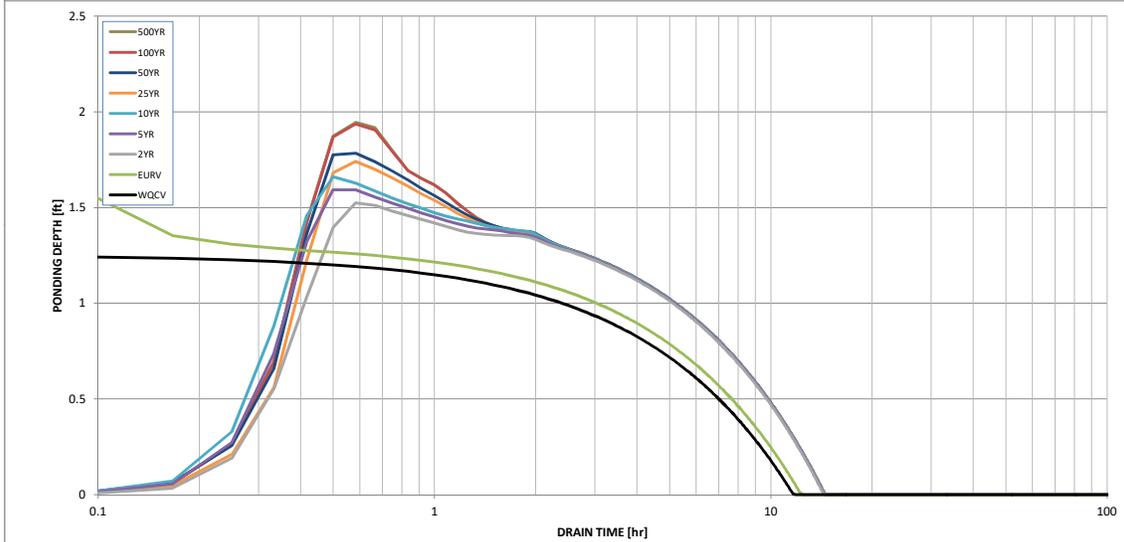
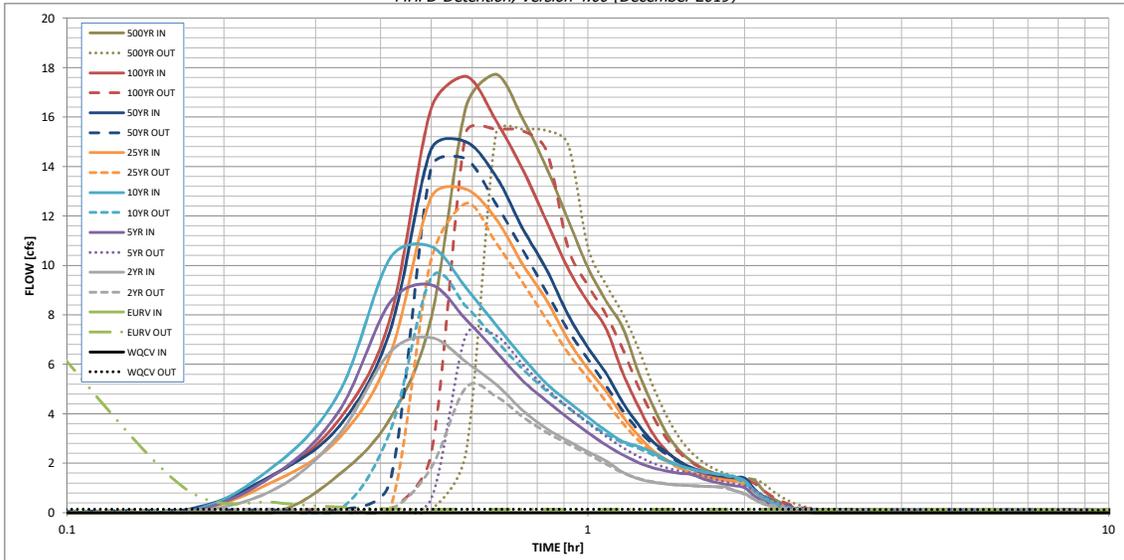
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	2.53
One-Hour Rainfall Depth (in)	N/A	N/A	0.399	0.525	0.629	0.749	0.860	0.989	0.994
CUHP Runoff Volume (acre-ft)	N/A	N/A	0.399	0.525	0.629	0.749	0.860	0.989	0.994
Inflow Hydrograph Volume (acre-ft)	N/A	N/A	0.1	0.9	1.6	3.4	4.5	5.9	5.9
CUHP Predevelopment Peak Q (cfs)	N/A	N/A							
OPTIONAL Override Predevelopment Peak Q (cfs)	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre)	N/A	N/A	0.02	0.16	0.31	0.64	0.84	1.11	1.12
Peak Inflow Q (cfs)	N/A	N/A	7.1	9.2	10.8	13.1	15.0	17.6	17.7
Peak Outflow Q (cfs)	0.1	46.1	5.1	7.2	9.5	12.5	14.3	15.5	15.5
Ratio Peak Outflow to Predevelopment Q	N/A	N/A	N/A	8.2	5.8	3.7	3.2	2.6	2.6
Structure Controlling Flow	Filtration Media	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1					
Max Velocity through Grate 1 (fps)	N/A	0.65	0.39	0.6	0.8	1.0	1.1	1.3	1.3
Max Velocity through Grate 2 (fps)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours)	11	11	13	13	13	12	12	11	11
Time to Drain 99% of Inflow Volume (hours)	12	12	14	14	14	14	14	13	13
Maximum Ponding Depth (ft)	1.26	1.62	1.52	1.59	1.66	1.74	1.78	1.94	1.94
Area at Maximum Ponding Depth (acres)	0.11	0.12	0.12	0.12	0.12	0.13	0.13	0.14	0.14
Maximum Volume Stored (acre-ft)	0.118	0.159	0.148	0.157	0.164	0.174	0.180	0.200	0.202

Per resolution 16-426 of the BoCC, on-site WQCV is required but on-site stormwater detention is not required per the FDR for Claremont Business Park Filing No. 2.

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)



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

Claremont Business Park 2 Filing No.1
DRAINAGE REPORT DRAINAGE CALCULATIONS
(Pond Volume Calculation)

WQCV POND 2

Elevation	SF	CF	Storage	
			AF	Sum
6364.45	2,957.00	0.00	0.00	0.00
6365.00	3,660.00	1,819.68	0.04	0.04
6366.00	4,942.00	4,301.00	0.10	0.14
6367.00	6,327.00	5,634.50	0.13	0.27
6368.00	7,808.00	7,067.50	0.16	0.43
Total =		<u>18,823</u> CF		
		Total =	<u>0.4</u> Ac-ft	

Calculated by: GT

Date: 4/27/2020

Checked by: _____

Claremont Business Park 2 Filing No.1

(PROPOSED CONDITIONS)

<i>Weighted Percent Imperviousness of Proposed WQ Sand Filter Pond 2</i>				
<i>Contributing Basins</i>	<i>Area (Acres)</i>	<i>C_s</i>	<i>Impervious % (I)</i>	<i>(Acres)*(I)</i>
<i>H</i>	0.71	0.09	2	1.43
<i>I</i>	2.75	0.81	95	260.80
<i>J</i>	1.05	0.81	95	100.02
<i>K</i>	0.42	0.81	2	0.85
<i>L</i>	1.32	0.09	2	2.63
<i>M</i>	1.84	0.81	95	174.75
<i>N</i>	0.47	0.12	7	3.32
<i>Totals</i>	8.57			543.80
<i>Imperviousness of WQ Pond 2</i>	63.5			

8.57 B soils
8.57 total area

Claremont Business Park 2 Filing No.1

EMERGENCY SPILLWAY CALCULATIONS POND 2

Horizontal Broad-Crested Weir (Eqn 12-20 UDFCD)					
Variable			Solve For		
<i>C</i>	3.00		L (ft)	H (ft)	Q (cfs)
<i>L</i>	12.50	ft	0.0	0.0	37.5
<i>H</i>	1.00	ft			
<i>Q</i>		cfs			

Sloping Broad-Crested Weir (Eqn 12-21 UDFCD)					
Variable			Solve For		
<i>C</i>	3.00		Z (ft)	H (ft)	Q (cfs)
<i>Z</i>	4.00	ft	0.0	0.0	4.8
<i>H</i>	1.00	ft			
<i>Q</i>		cfs			

Total Q	47.10
----------------	--------------

Equation 12-20

$$Q = C_{BCW} L H^{1.5}$$

Equation 12-21

$$Q = \left(\frac{2}{5}\right) C_{BCW} Z H^{2.5}$$

Where:

Q = discharge (cfs)

C_{BCW} = broad-crested weir coefficient (This ranges from 2.6 to 3.0. A value of 3.0 is often used in practice.) See Hydraulic Engineering Circular No. 22 for additional information.

L = broad-crested weir length (ft)

H = head above weir crest (ft)

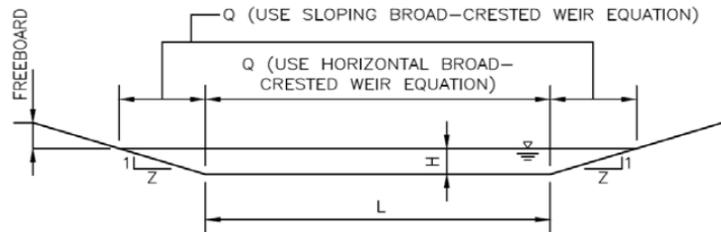
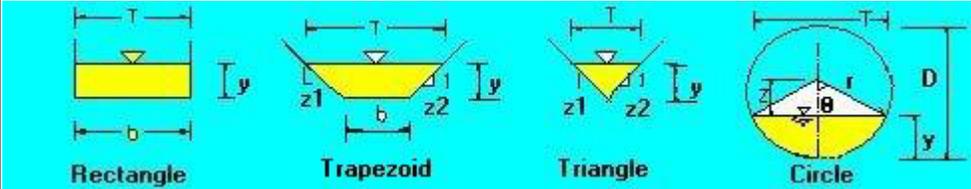


Figure 12-20. Sloping broad-crest weir

The open channel flow calculator		
Select Channel Type: Trapezoid ▾		
Velocity(V)&Discharge(Q) ▾	Select unit system: Feet(ft) ▾	
Channel slope: .023 ft/ft	Water depth(y): .661 ft	Bottom width(b) 12.5 ft
Flow velocity 4.1514 ft/s	LeftSlope (Z1): 4 to 1 (H:V)	RightSlope (Z2): 10 to 1 (H:V)
Flow discharge 46.9976 ft^3/s	Input n value 0.035 or select n	
Calculate!	Status: Calculation finished	Reset
Wetted perimeter 21.87 ft	Flow area 11.32 ft^2	Top width(T) 21.75 ft
Specific energy 0.93 ft	Froude number 1.01	Flow status Supercritical flow
Critical depth 0.67 ft	Critical slope 0.0221 ft/ft	Velocity head 0.27 ft

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POND 2 EMERGENCY SPILLWAY

$Q_{100}=46.9$ cfs



Material and Performance Specification Sheet

North American Green
 14649 Highway 41 North
 Evansville, IN 47725
 800-772-2040
 FAX: 812-867-0247
www.nagreen.com

A **tensar** Company

SC150 Erosion Control Blanket

The extended-term double net erosion control blanket shall be a machine-produced mat of 70% agricultural straw and 30% coconut fiber with a functional longevity of up to 24 months. (NOTE: functional longevity may vary depending upon climatic conditions, soil, geographical location, and elevation). The blanket shall be of consistent thickness with the straw and coconut evenly distributed over the entire area of the mat. The blanket shall be covered on the top side with a heavyweight photodegradable polypropylene netting having ultraviolet additives to delay breakdown and an approximate 0.63 x 0.63 (1.59 x 1.59 cm) mesh, and on the bottom side with a lightweight photodegradable polypropylene netting with an approximate 0.50 x 0.50 in (1.27 x 1.27 cm) mesh. The blanket shall be sewn together on 1.50 inch (3.81 cm) centers with degradable thread.

The SC150 shall meet requirements established by the Erosion Control Technology Council (ECTC) Specification and the US Department of Transportation, Federal Highway Administration's (FHWA) *Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects, FP-03 Section 713.17 as a type 3.B Extended-term Erosion Control Blanket*.

The SC150 is also available with the DOT System™, which consists of installation staple patterns clearly marked on the erosion control blanket with environmentally safe paint. The blanket shall be manufactured with a colored thread stitched along both outer edges (approximately 2-5 inches [5-12.5 cm] from the edge) as an overlap guide for adjacent mats.

Material Content		
Matrix	70% Straw Fiber	0.35 lbs/yd ² (0.19 kg/m ²)
	30% Coconut Fiber	0.15 lbs/yd ² (0.08 kg/m ²)
Nettings	Top - Heavyweight photodegradable with UV additives	3.0 lb/1000 ft ² (1.47 kg/100 m ²)
	Bottom - Lightweight Photodegradable	1.5 lb/1000 ft ² (0.73 kg/100 m ²)
Thread	Degradable	

SC150 is available in the following standard roll sizes:

Width	6.67 ft (2.03 m)	16 ft (4.87 m)
Length	108 ft (32.92 m)	108 ft (32.92 m)
Weight ± 10%	44 lbs (19.95 kg)	105.6 lbs (47.9 kg)
Area	80.0 yd ² (66.9 m ²)	192 yd ² (165.5 m ²)

Index Value Properties:

Property	Test Method	Typical
Thickness	ASTM D6525	0.39 in (9.91 mm)
Resiliency	ECTC Guidelines	75%
Water Absorbency	ASTM D1117	285%
Mass/Unit Area	ASTM 6475	11.44 oz/yd ² (388 g/m ²)
Swell	ECTC Guidelines	30%
Smolder Resistance	ECTC Guidelines	Yes
Stiffness	ASTM D1388	1.11 oz-in
Light Penetration	ECTC Guidelines	8.7%
Tensile Strength - MD	ASTM D6818	146.6 lbs/ft (2.17 kN/m)
Elongation - MD	ASTM D6818	26.9%
Tensile Strength - TD	ASTM D6818	147.6 lbs/ft (2.19 kN/m)
Elongation - TD	ASTM D6818	25.2%

Performance Design Values:

Maximum Permissible Shear Stress	
Unvegetated Shear Stress	2.00 lbs/ft ² (96 Pa)
Unvegetated Velocity	8.00 ft/s (2.44 m/s)

Slope Design Data: C Factors			
	Slope Gradients (S)		
Slope Length (L)	≤ 3:1	3:1 - 2:1	≥ 2:1
≤ 20 ft (6 m)	0.001	0.048	0.100
20-50 ft	0.051	0.079	0.145
≥ 50 ft (15.2 m)	0.10	0.110	0.190

Bench Scale Testing* (NTPEP):

Test Method	Parameters	Results
ECTC Method 2 Rainfall	50 mm (2 in)/hr for 30 min	SLR** = 5.47
	100mm (4 in)/hr for 30 min	SLR** = 5.67
	150 mm (6 in)/hr for 30 min	SLR** = 5.88
ECTC Method 3 Shear Resistance	Shear at 0.50 inch soil loss	2.72 lbs/ft ²
ECTC Method 4 Germination	Top Soil, Fescue, 21 day incubation	538% improvement of biomass

* Bench Scale tests should not be used for design purposes
 ** Soil Loss Ratio = Soil loss with Bare Soil/Soil Loss with RECP (soil loss is based on regression analysis)

Roughness Coefficients- Unveg.	
Flow Depth	Manning's n
≤ 0.50 ft (0.15 m)	0.050
0.50 - 2.0 ft	0.050 - 0.018
≥ 2.0 ft (0.60 m)	0.018



Product Participant of:



PROJECT: CLAREMONT BUSINESS PARK 2 FIL. 1

DATE: 4-21-20

STORM 10 OUTFALL LOW TAILWATER BASIN.
RIP RAP SIZING FIG. 9-38 (UDFCO)

$$Q_{100} = 14.3 \text{ cfs} \quad 24'' \text{ ADS}$$

$$Q/D^{2.5} \leq 6.0 \quad 14.3/2^{2.5} = \underline{2.53} \leq 6.0 \quad \text{OK}$$

$$Q/D^{1.5} = 14.3/2^{1.5} = \underline{5.06} \quad \text{ASSUME } 0.4 = 4\%/D$$

FROM FIG 9-38 USE TYPE L RIP RAP $T = 2D_{50} = 2(9'') = \underline{18''}$

STORM 7 OUTFALL LOW TAILWATER BASIN
RIP RAP SIZING FIG 9-38 (UDFCO)

$$Q_{100} = 16.6 \text{ cfs} \quad 24'' \text{ ADS}$$

$$Q/D^{2.5} \leq 6.0 \quad 16.6/2^{2.5} = \underline{2.93} \leq 6.0 \quad \text{OK}$$

$$Q/D^{1.5} = 16.6/2^{1.5} = \underline{5.87} \quad \text{ASSUME } 0.4 = 4\%/D$$

FROM FIG 9-38 USE TYPE L RIP RAP $T = 2D_{50} = 2(9'') = \underline{18''}$

DP 8 4% RUNDOWN OUTFALL
RIP RAP SIZING FIG 12-21 EMBANKMENT PROTECTION

$$Q_{100} = 16.7 \text{ cfs} \quad 3' \text{ WIDTH}$$

$$\text{UNIT DISCHARGE (cfs/ft)} = 16.7/3 = \underline{5.23} \quad 4:1 = 25\% \text{ LONGITUDINAL SLOPE}$$

FROM FIG 12-21 USE TYPE H RIP RAP $D_{50} = \underline{18''}$

$$H_a = \frac{(H + Y_n)}{2}$$

Equation 9-19

Where the maximum value of H_a shall not exceed H , and:

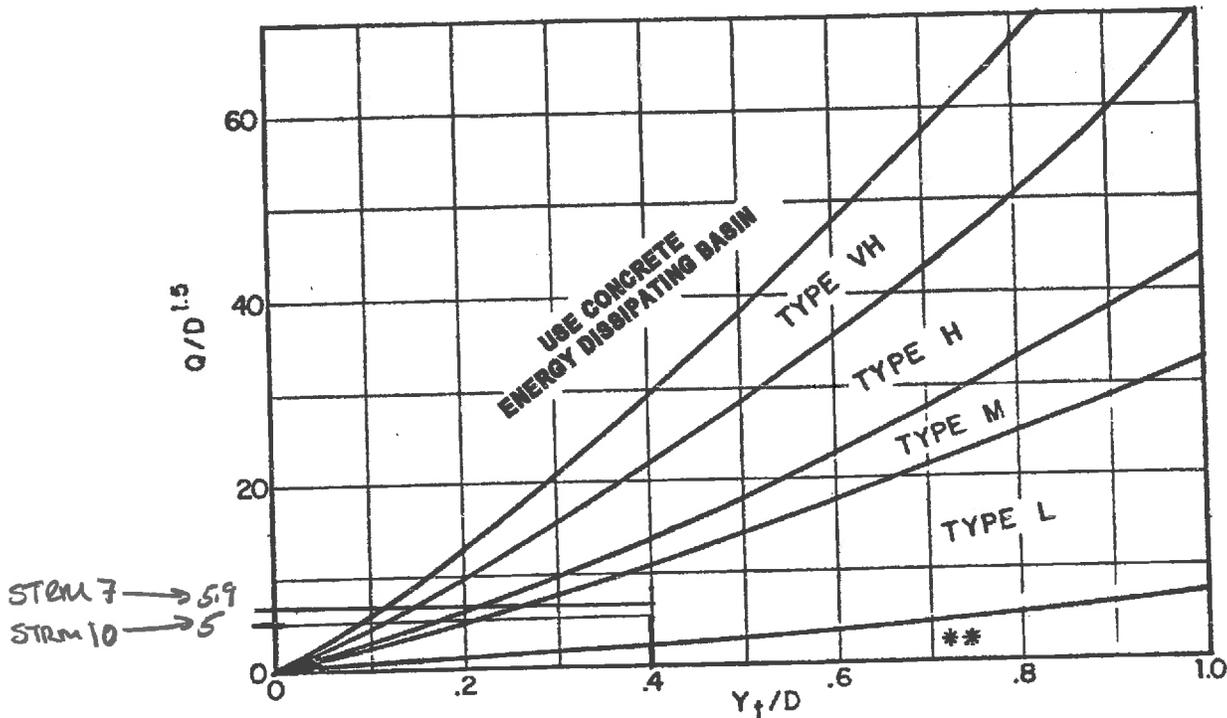
D_a = parameter to use in place of D in Figure 9-38 when flow is supercritical (ft)

D_c = diameter of circular culvert (ft)

H_a = parameter to use in place of H in Figure 9-39 when flow is supercritical (ft)

H = height of rectangular culvert (ft)

Y_n = normal depth of supercritical flow in the culvert (ft)



Use D_a instead of D whenever flow is supercritical in the barrel.
 ** Use Type L for a distance of $3D$ downstream.

RIPRAP SIZING FOR LOW TAILWATER BASINS POND 2

Figure 9-38. Riprap erosion protection at circular conduit outlet (valid for $Q/D2.5 \leq 6.0$)

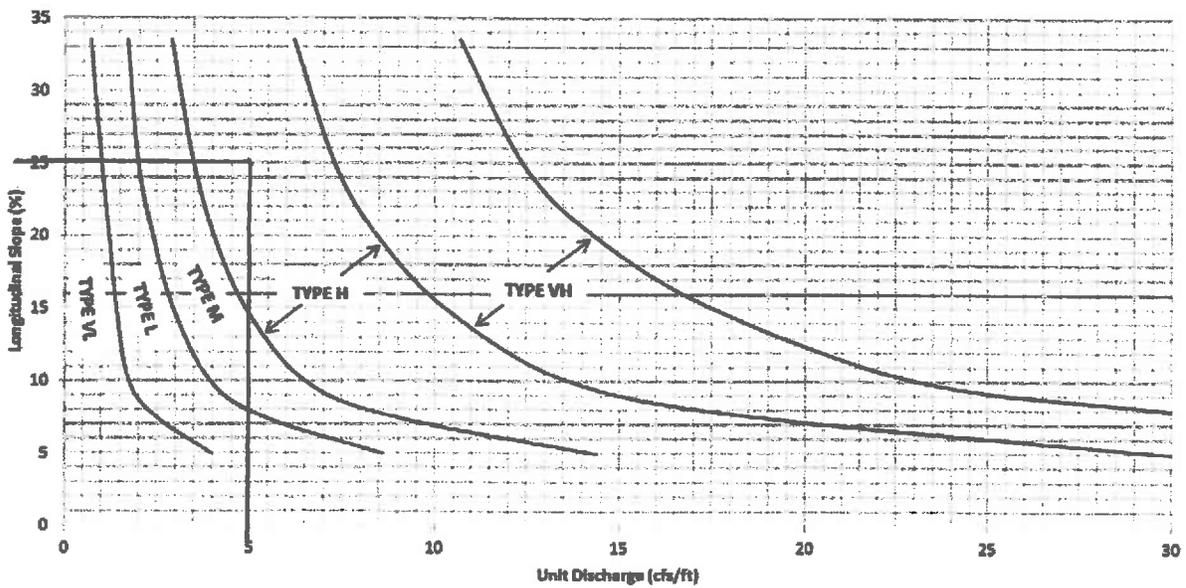
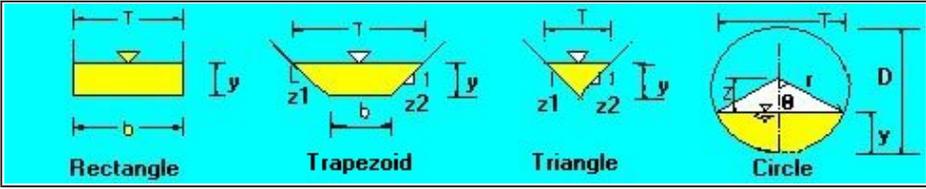


Figure 12-21. Embankment protection details and rock sizing chart (adapted from Arapahoe County)

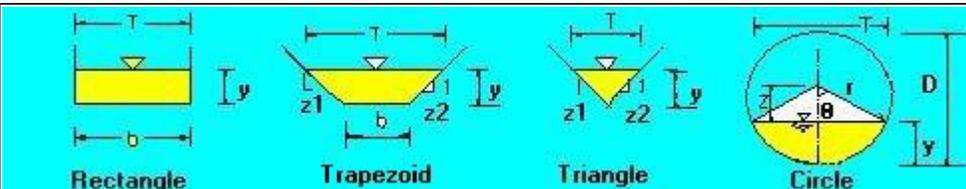
RIPRAP SIZING FOR RUNDOWN DP8 POND 2

The open channel flow calculator

<p>Select Channel Type:</p> <p>Triangle <input type="button" value="v"/></p>			
<p>Velocity(V)&Discharge(Q) <input type="button" value="v"/></p>	<p>Select unit system: Feet(ft) <input type="button" value="v"/></p>		
<p>Channel slope: <input type="text" value="0.12"/> ft/ft</p>	<p>Water depth(y): <input type="text" value="0.4"/> ft</p>	<p>Bottom W(b) <input type="text" value="0"/> ft</p>	
<p>Flow velocity <input type="text" value="6.7989"/> ft/s</p>	<p>LeftSlope (Z1): <input type="text" value="3"/> to 1 (H:V)</p>	<p>RightSlope (Z2): <input type="text" value="3"/> to 1 (H:V)</p>	
<p>Flow discharge <input type="text" value="3.2635"/> ft^3/s</p>	<p>Input n value <input type="text" value="0.025"/> or select n</p>		
<p><input type="button" value="Calculate!"/></p>	<p>Status: Calculation finished</p>	<p><input type="button" value="Reset"/></p>	
<p>Wetted perimeter <input type="text" value="2.53"/> ft</p>	<p>Flow area <input type="text" value="0.48"/> ft^2</p>	<p>Top width(T) <input type="text" value="2.4"/> ft</p>	
<p>Specific energy <input type="text" value="1.12"/> ft</p>	<p>Froude number <input type="text" value="2.68"/></p>	<p>Flow status <input type="text" value="Supercritical flow"/></p>	
<p>Critical depth <input type="text" value="0.59"/> ft</p>	<p>Critical slope <input type="text" value="0.0146"/> ft/ft</p>	<p>Velocity head <input type="text" value="0.72"/> ft</p>	

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DP 7 SWALE TO CDOT TYPE C INLET

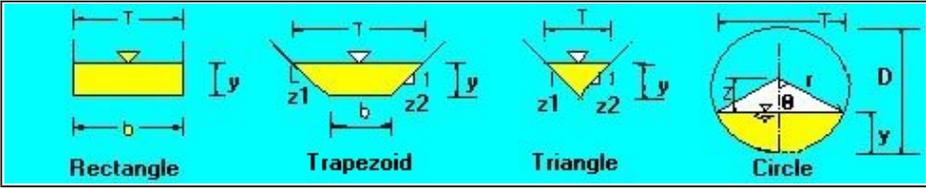
The open channel flow calculator		
<p style="color: red;">Select Channel Type:</p> <p>Trapezoid ▾</p>		
<p>Velocity(V)&Discharge(Q) ▾</p>	<p style="color: red;">Select unit system:</p> <p>Feet(ft) ▾</p>	
<p>Channel slope: <input type="text" value=".01"/></p> <p><input type="text" value="ft/ft"/></p>	<p>Water depth(y): <input type="text" value=".87"/> <input type="text" value="ft"/></p>	<p>Bottom width(b) <input type="text" value="2"/></p> <p><input type="text" value="ft"/></p>
<p>Flow velocity <input style="color: red;" type="text" value="3.9153"/></p> <p><input type="text" value="ft/s"/></p>	<p>LeftSlope (Z1): <input type="text" value="3"/> to 1 (H:V)</p>	<p>RightSlope (Z2): <input type="text" value="3"/> to 1 (H:V)</p>
<p>Flow discharge <input style="color: red;" type="text" value="15.7029"/></p> <p><input type="text" value="ft^3/s"/></p>	<p>Input n value <input type="text" value="0.025"/> or select n</p>	
<p><input type="button" value="Calculate!"/></p>	<p>Status: Calculation finished</p>	<p><input type="button" value="Reset"/></p>
<p>Wetted perimeter <input type="text" value="7.5"/></p> <p><input type="text" value="ft"/></p>	<p>Flow area <input type="text" value="4.01"/> <input type="text" value="ft^2"/></p>	<p>Top width(T) <input type="text" value="7.22"/></p> <p><input type="text" value="ft"/></p>
<p>Specific energy <input type="text" value="1.11"/></p> <p><input type="text" value="ft"/></p>	<p>Froude number <input type="text" value="0.93"/></p>	<p>Flow status</p> <p><input type="text" value="Subcritical flow"/></p>
<p>Critical depth <input type="text" value="0.84"/></p> <p><input type="text" value="ft"/></p>	<p>Critical slope <input type="text" value="0.0116"/> <input type="text" value="ft/ft"/></p>	<p>Velocity head <input type="text" value="0.24"/></p> <p><input type="text" value="ft"/></p>

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DP8 SWALE

Q₁₀₀=15.7 cfs

The open channel flow calculator

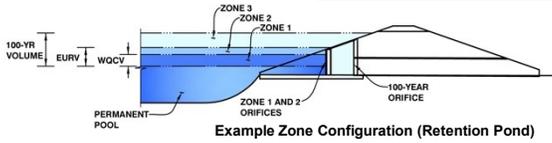
Select Channel Type: <input type="text" value="Trapezoid"/>			
Velocity(V)&Discharge(Q) <input type="text"/>	Select unit system: <input type="text" value="Feet(ft)"/>		
Channel slope: <input type="text" value=".25"/> <small>ft/ft</small>	Water depth(y): <input type="text" value=".41"/> <small>ft</small>	Bottom width(b) <input type="text" value="3"/> <small>ft</small>	
Flow velocity <input type="text" value="10.0147"/> <small>ft/s</small>	LeftSlope (Z1): <input type="text" value="2"/> to 1 (H:V)	RightSlope (Z2): <input type="text" value="2"/> to 1 (H:V)	
Flow discharge <input type="text" value="15.6851"/> <small>ft^3/s</small>	Input n value <input type="text" value="0.035"/> or select n		
<input type="button" value="Calculate!"/>	Status: <input type="text" value="Calculation finished"/>	<input type="button" value="Reset"/>	
Wetted perimeter <input type="text" value="4.83"/> <small>ft</small>	Flow area <input type="text" value="1.57"/> <small>ft^2</small>	Top width(T) <input type="text" value="4.64"/> <small>ft</small>	
Specific energy <input type="text" value="1.97"/> <small>ft</small>	Froude number <input type="text" value="3.04"/>	Flow status <input type="text" value="Supercritical flow"/>	
Critical depth <input type="text" value="0.79"/> <small>ft</small>	Critical slope <input type="text" value="0.023"/> <small>ft/ft</small>	Velocity head <input type="text" value="1.56"/> <small>ft</small>	

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DP8 RUNDOWN POND 2

DETENTION BASIN OUTLET STRUCTURE DESIGN

Version 4.02 (February 2020)
Project: Claremont Business Park 2 Filing No.1
Basin ID: WQCV POND 2



	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.72	0.142	Filtration Media
Zone 2 (100-year)	#VALUE!	0.818	Weir&Pipe (Restrict)
Zone 3			
Total (all zones)		0.960	

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

Underdrain Orifice Invert Depth = <input type="text" value="2.50"/> ft (distance below the filtration media surface)	Underdrain Orifice Area = <input type="text" value="0.0"/> ft ²
Underdrain Orifice Diameter = <input type="text" value="1.66"/> inches	Underdrain Orifice Centroid = <input type="text" value="0.07"/> feet

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

Invert of Lowest Orifice = <input type="text" value="N/A"/> ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row = <input type="text" value="N/A"/> ft ²
Depth at top of Zone using Orifice Plate = <input type="text" value="N/A"/> ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width = <input type="text" value="N/A"/> feet
Orifice Plate: Orifice Vertical Spacing = <input type="text" value="N/A"/> inches	Elliptical Slot Centroid = <input type="text" value="N/A"/> feet
Orifice Plate: Orifice Area per Row = <input type="text" value="N/A"/> inches	Elliptical Slot Area = <input type="text" value="N/A"/> ft ²

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

	Row 1 (optional)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	N/A							
Orifice Area (sq. inches)	N/A							

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

User Input: Vertical Orifice (Circular or Rectangular)

Invert of Vertical Orifice = <input type="text" value="Not Selected"/> <input type="text" value="Not Selected"/> ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area = <input type="text" value="Not Selected"/> <input type="text" value="Not Selected"/> ft ²
Depth at top of Zone using Vertical Orifice = <input type="text" value="Not Selected"/> <input type="text" value="Not Selected"/> ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid = <input type="text" value="Not Selected"/> <input type="text" value="Not Selected"/> feet
Vertical Orifice Diameter = <input type="text" value="Not Selected"/> <input type="text" value="Not Selected"/> inches	

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

Calculated Parameters for Overflow Weir

Overflow Weir Front Edge Height, H _o = <input type="text" value="1.75"/> <input type="text" value="Not Selected"/> ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H _g = <input type="text" value="1.75"/> <input type="text" value="Not Selected"/> feet
Overflow Weir Front Edge Length = <input type="text" value="7.00"/> <input type="text" value="Not Selected"/> feet	Overflow Weir Slope Length = <input type="text" value="2.91"/> <input type="text" value="Not Selected"/> feet
Overflow Weir Grate Slope = <input type="text" value="0.00"/> <input type="text" value="Not Selected"/> H:V	Grate Open Area / 100-yr Orifice Area = <input type="text" value="6.47"/> <input type="text" value="Not Selected"/> acres
Horiz. Length of Weir Sides = <input type="text" value="2.91"/> <input type="text" value="Not Selected"/> feet	Overflow Grate Open Area w/o Debris = <input type="text" value="14.26"/> <input type="text" value="Not Selected"/> ft ²
Overflow Grate Open Area % = <input type="text" value="70%"/> <input type="text" value="Not Selected"/> %, grate open area/total area	Overflow Grate Open Area w/ Debris = <input type="text" value="7.13"/> <input type="text" value="Not Selected"/> ft ²
Debris Clogging % = <input type="text" value="50%"/> <input type="text" value="Not Selected"/> %	

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

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

Depth to Invert of Outlet Pipe = <input type="text" value="2.75"/> <input type="text" value="Not Selected"/> ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area = <input type="text" value="2.20"/> <input type="text" value="Not Selected"/> ft ²
Outlet Pipe Diameter = <input type="text" value="30.00"/> <input type="text" value="Not Selected"/> inches	Outlet Orifice Centroid = <input type="text" value="0.67"/> <input type="text" value="Not Selected"/> feet
Restrictor Plate Height Above Pipe Invert = <input type="text" value="13.80"/> <input type="text" value="Not Selected"/> inches	Half-Central Angle of Restrictor Plate on Pipe = <input type="text" value="1.49"/> <input type="text" value="Not Selected"/> radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Calculated Parameters for Spillway

Spillway Invert Stage = <input type="text" value="3.00"/> <input type="text" value="Not Selected"/> ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth = <input type="text" value="0.75"/> <input type="text" value="Not Selected"/> feet
Spillway Crest Length = <input type="text" value="12.50"/> <input type="text" value="Not Selected"/> feet	Stage at Top of Freeboard = <input type="text" value="4.75"/> <input type="text" value="Not Selected"/> feet
Spillway End Slopes = <input type="text" value="4.00"/> <input type="text" value="Not Selected"/> H:V	Basin Area at Top of Freeboard = <input type="text" value="0.18"/> <input type="text" value="Not Selected"/> acres
Freeboard above Max Water Surface = <input type="text" value="1.00"/> <input type="text" value="Not Selected"/> feet	Basin Volume at Top of Freeboard = <input type="text" value="0.40"/> <input type="text" value="Not Selected"/> acre-ft

Routed Hydrograph Results

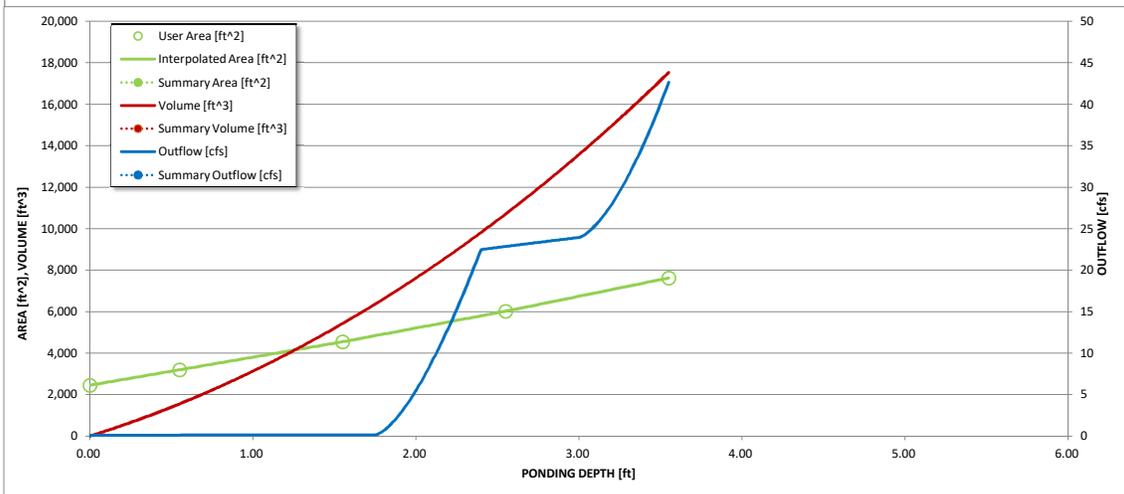
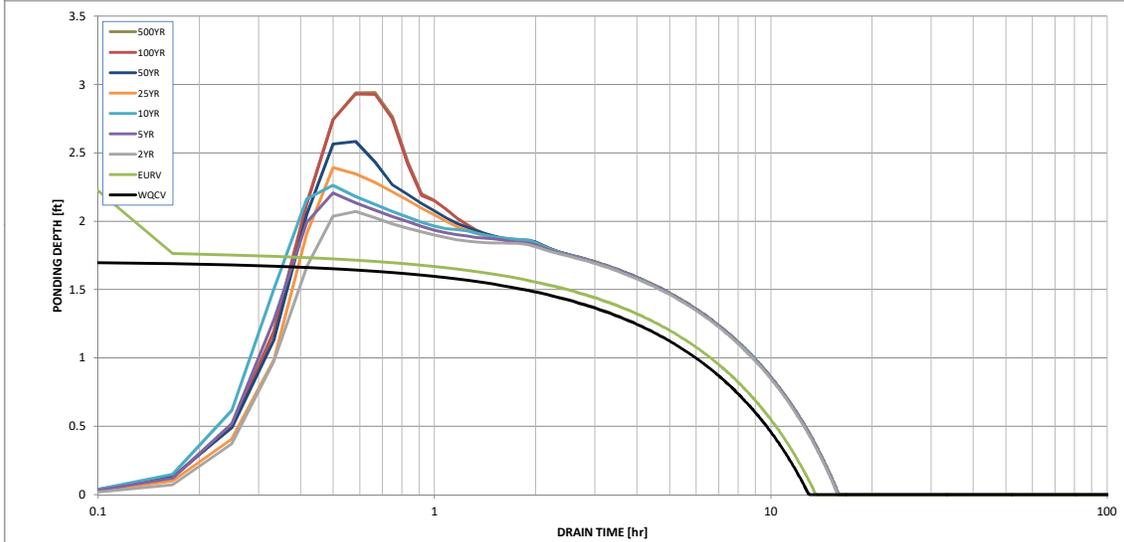
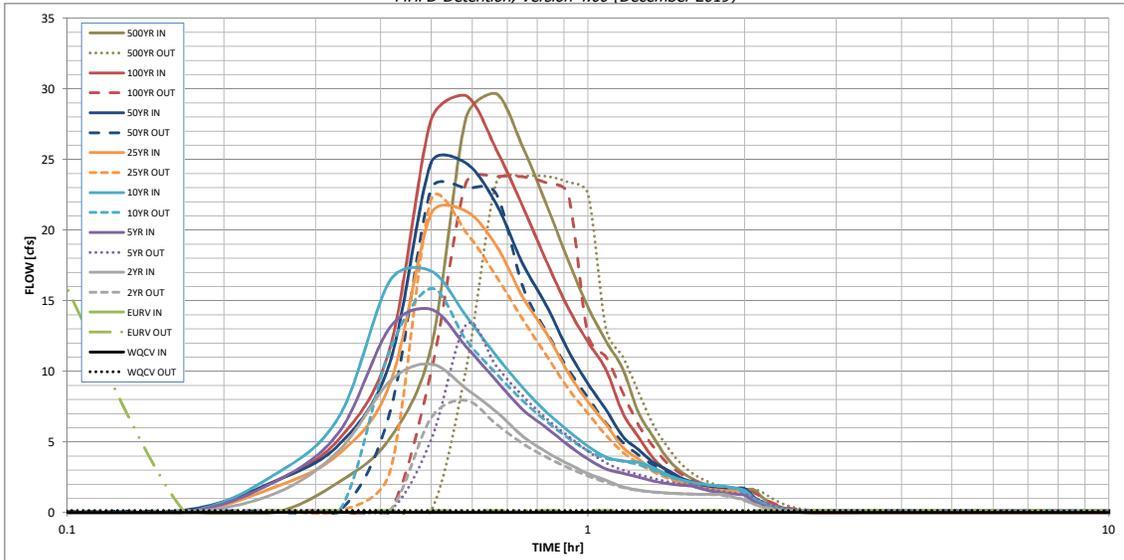
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	2.53
One-Hour Rainfall Depth (in)	N/A	N/A	0.521	0.713	0.877	1.080	1.254	1.466	1.473
CUHP Runoff Volume (acre-ft)	0.142	0.593	0.521	0.713	0.877	1.080	1.254	1.466	1.473
Inflow Hydrograph Volume (acre-ft)	N/A	N/A	0.521	0.713	0.877	1.080	1.254	1.466	1.473
CUHP Predevelopment Peak Q (cfs)	N/A	N/A	1.2	3.2	4.8	8.5	10.7	13.3	13.4
OPTIONAL Override Predevelopment Peak Q (cfs)	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre)	N/A	N/A	0.14	0.38	0.56	0.99	1.24	1.56	1.57
Peak Inflow Q (cfs)	N/A	N/A	10.5	14.4	17.1	21.3	24.8	29.5	29.6
Peak Outflow Q (cfs)	0.1	42.6	8.0	13.3	15.9	22.1	22.9	23.8	23.8
Ratio Peak Outflow to Predevelopment Q	N/A	N/A	N/A	4.1	3.3	2.6	2.2	1.8	1.8
Structure Controlling Flow	Filtration Media	Outlet Plate 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps)	N/A	1.53	0.54	0.9	1.1	1.5	1.6	1.7	1.7
Max Velocity through Grate 2 (fps)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours)	13	12	14	14	13	13	12	12	12
Time to Drain 99% of Inflow Volume (hours)	13	13	15	15	15	15	14	14	14
Maximum Ponding Depth (ft)	1.72	2.39	2.07	2.21	2.26	2.39	2.58	2.93	2.94
Area at Maximum Ponding Depth (acres)	0.11	0.13	0.12	0.13	0.13	0.13	0.14	0.15	0.15
Maximum Volume Stored (acre-ft)	0.143	0.223	0.183	0.199	0.207	0.224	0.250	0.299	0.302

Per resolution 16-426 of the BoCC, on-site WQCV is required but on-site stormwater detention is not required per the FDR for Claremont Business Park Filing No. 2.

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)



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



PROJECT: CLAREMONT BUSINESS PARK 2 FIL.1

DATE: 4-17-2020

CONTROL OFFICE FOR WQREV

EQU. SF-3 UDFCD VOL 3 SAND FILTER

$$D_{12 \text{ HOUR DRAIN TIME}} = \sqrt{\frac{V}{1414 y^{0.41}}}$$

$$y \cdot 2.5' - \left(\frac{4'' - 2''}{12 \text{ in/ft}} \right) = \underline{2.33'}$$
$$V = 0.143 \text{ AC-Ft} \times \frac{43560 \text{ Ft}^2}{1 \text{ AC-Ft}} = \underline{6229 \text{ Ft}^3}$$

FROM MHPD-DETENTION SLOOT

$$D = \sqrt{\frac{6229 \text{ Ft}^3}{1414 (2.33^{0.41})}} = 1.76 \text{ in DIA}$$
$$\pi r^2 = A = \pi (0.88)^2 = 2.44 \text{ in}^2$$
$$2.44 \text{ in}^2 \approx 0.017 \text{ Ft}^2$$

[Fluid Flow Table of Contents](#)
[Hydraulic and Pneumatic Knowledge](#)
[Fluid Power Equipment](#)

This engineering calculator determines the Flow within a partially full pipe (&e1/2 full) using the Manning equation. This calculator can also be used for uniform flow in a pipe, but the Manning roughness coefficient needs to be considered to be variable, dependent upon the depth of flow.

Partially Full Pipe Flow Calculations - U.S. Units

II. Calculation of Discharge, Q, and average velocity, V
for pipes more than half full

Instructions: Enter values in blue boxes. Calculations in yellow

Inputs

Pipe Diameter, **D** = in
Depth of flow, **y** = in

(must have $y \geq D/2$)

Full Pipe Manning
roughness, **n_{full}** =
Channel bottom
slope, **S** = ft/ft

Calculations
n/n_{full} =
Partially Full Manning
roughness, **n** =

Calculations

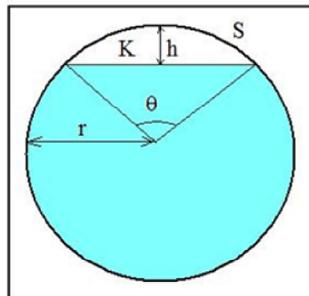
Pipe Diameter, **D** = ft
Pipe Radius, **r** = ft

Circ. Segment Height, **h** = ft

Central Angle, **q** = radians
Cross-Sect. Area, **A** = ft²

Wetted Perimeter, **P** = ft
Hydraulic Radius, **R** = ft
Discharge, **Q** = cfs
Ave. Velocity, **V** = ft/sec

pipe % full [(A/A_{full})*100%] =



Partially Full Pipe Flow Parameters
(More Than Half Full)

$$r = D/2$$

$$h = 2r - y$$

(hydraulic radius)

$$R = A/P$$

(Manning Equation)

$$Q = (1.49/n)(A)(R^{2/3})(S^{1/2})$$

$$V = Q/A \quad P$$

$$\theta = 2 \arccos \left(\frac{r - h}{r} \right)$$

$$A = \pi r^2 - \frac{r^2(\theta - \sin \theta)}{2}$$

$$P = 2\pi r - r * \theta$$

Equation used for n/n_{full} : $n/n_{full} = 1.25 - (y/D - 0.5)*0.5$ (for $0.5 \leq y/D \leq 1$)

DEPTH OF FLOW FOR 12 HR DRAIN TIME 4" PVC

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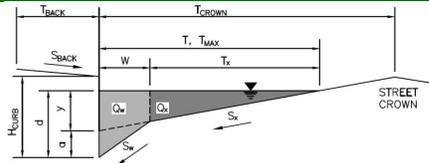


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ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

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

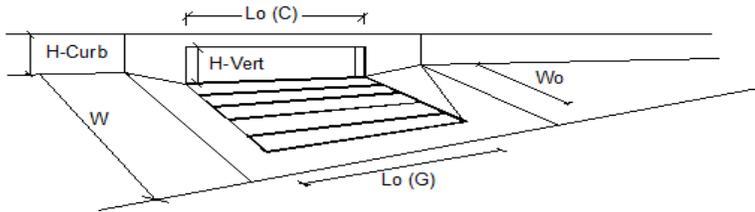
Project: CLAREMONT BUSINESS PARK 2 FILING NO. 1
 Inlet ID: Inlet 1 DP 5 NORTH



Gutter Geometry (Enter data in the blue cells)							
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 7.5$ ft						
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft						
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.020$						
Height of Curb at Gutter Flow Line	$H_{CURB} = 6.00$ inches						
Distance from Curb Face to Street Crown	$T_{CROWN} = 17.0$ ft						
Gutter Width	$W = 2.00$ ft						
Street Transverse Slope	$S_x = 0.020$ ft/ft						
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_w = 0.083$ ft/ft						
Street Longitudinal Slope - Enter 0 for sump condition	$S_o = 0.012$ ft/ft						
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.015$						
Max. Allowable Spread for Minor & Major Storm	<table border="1"> <tr> <th>Minor Storm</th> <th>Major Storm</th> <th>ft</th> </tr> <tr> <td>$T_{MAX} = 15.8$</td> <td>$T_{MAX} = 17.0$</td> <td></td> </tr> </table>	Minor Storm	Major Storm	ft	$T_{MAX} = 15.8$	$T_{MAX} = 17.0$	
Minor Storm	Major Storm	ft					
$T_{MAX} = 15.8$	$T_{MAX} = 17.0$						
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	<table border="1"> <tr> <th>Minor Storm</th> <th>Major Storm</th> <th>inches</th> </tr> <tr> <td>$d_{MAX} = 4.6$</td> <td>$d_{MAX} = 7.8$</td> <td></td> </tr> </table>	Minor Storm	Major Storm	inches	$d_{MAX} = 4.6$	$d_{MAX} = 7.8$	
Minor Storm	Major Storm	inches					
$d_{MAX} = 4.6$	$d_{MAX} = 7.8$						
Allow Flow Depth at Street Crown (leave blank for no)	<table border="1"> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td>check = yes</td> </tr> </table>	<input type="checkbox"/>	<input type="checkbox"/>	check = yes			
<input type="checkbox"/>	<input type="checkbox"/>	check = yes					
MINOR STORM Allowable Capacity is based on Depth Criterion							
MAJOR STORM Allowable Capacity is based on Spread Criterion							
Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'	$Q_{allow} = 6.5$ cfs						
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'	$Q_{allow} = 12.7$ cfs						

INLET ON A CONTINUOUS GRADE

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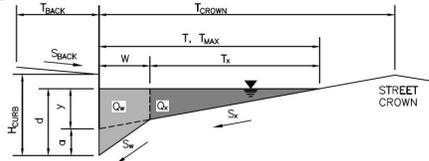


Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity*			
Total Inlet Interception Capacity	6.4	9.1	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	0.0	0.8	cfs
Capture Percentage = Q_i/Q_c =	100	92	%

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

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

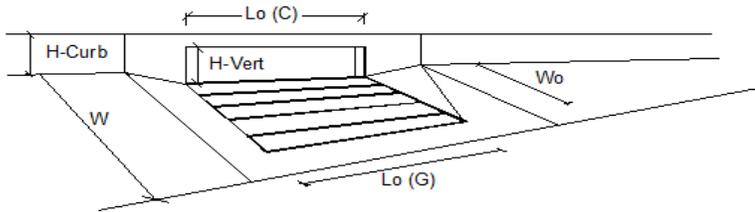
Project: CLAREMONT BUSINESS PARK 2 FILING NO. 1
 Inlet ID: Inlet 2 DP 5 SOUTH



Gutter Geometry (Enter data in the blue cells)							
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 7.5$ ft						
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft						
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.020$						
Height of Curb at Gutter Flow Line	$H_{CURB} = 6.00$ inches						
Distance from Curb Face to Street Crown	$T_{CROWN} = 17.0$ ft						
Gutter Width	$W = 2.00$ ft						
Street Transverse Slope	$S_x = 0.020$ ft/ft						
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_w = 0.083$ ft/ft						
Street Longitudinal Slope - Enter 0 for sump condition	$S_o = 0.011$ ft/ft						
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.016$						
Max. Allowable Spread for Minor & Major Storm	<table border="1"> <tr> <th>Minor Storm</th> <th>Major Storm</th> <th>ft</th> </tr> <tr> <td>$T_{MAX} = 15.8$</td> <td>$T_{MAX} = 17.0$</td> <td></td> </tr> </table>	Minor Storm	Major Storm	ft	$T_{MAX} = 15.8$	$T_{MAX} = 17.0$	
Minor Storm	Major Storm	ft					
$T_{MAX} = 15.8$	$T_{MAX} = 17.0$						
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	<table border="1"> <tr> <th>Minor Storm</th> <th>Major Storm</th> <th>inches</th> </tr> <tr> <td>$d_{MAX} = 4.6$</td> <td>$d_{MAX} = 7.8$</td> <td></td> </tr> </table>	Minor Storm	Major Storm	inches	$d_{MAX} = 4.6$	$d_{MAX} = 7.8$	
Minor Storm	Major Storm	inches					
$d_{MAX} = 4.6$	$d_{MAX} = 7.8$						
Allow Flow Depth at Street Crown (leave blank for no)	<table border="1"> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td>check = yes</td> </tr> </table>	<input type="checkbox"/>	<input type="checkbox"/>	check = yes			
<input type="checkbox"/>	<input type="checkbox"/>	check = yes					
MINOR STORM Allowable Capacity is based on Depth Criterion							
MAJOR STORM Allowable Capacity is based on Spread Criterion							
Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'	<table border="1"> <tr> <th>Minor Storm</th> <th>Major Storm</th> <th>cfs</th> </tr> <tr> <td>$Q_{allow} = 5.8$</td> <td>$Q_{allow} = 11.3$</td> <td></td> </tr> </table>	Minor Storm	Major Storm	cfs	$Q_{allow} = 5.8$	$Q_{allow} = 11.3$	
Minor Storm	Major Storm	cfs					
$Q_{allow} = 5.8$	$Q_{allow} = 11.3$						
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'							

INLET ON A CONTINUOUS GRADE

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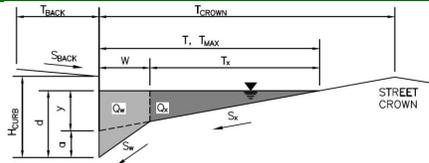


Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity*			
Total Inlet Interception Capacity	3.7	9.2	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	0.0	0.7	cfs
Capture Percentage = Q_i/Q_c =	100	93	%

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

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

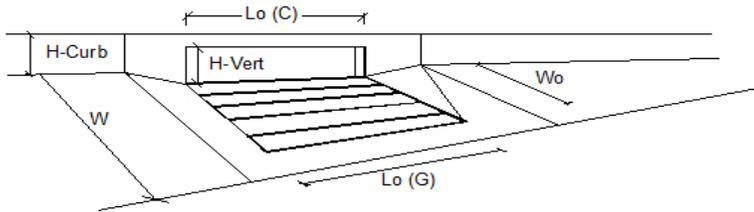
Project: CLAREMONT BUSINESS PARK 2 FILING NO. 1
 Inlet ID: Inlet 3 DP 6 NORTH



Gutter Geometry (Enter data in the blue cells)							
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 7.5$ ft						
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft						
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.020$						
Height of Curb at Gutter Flow Line	$H_{CURB} = 6.00$ inches						
Distance from Curb Face to Street Crown	$T_{CROWN} = 17.0$ ft						
Gutter Width	$W = 2.00$ ft						
Street Transverse Slope	$S_x = 0.020$ ft/ft						
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_w = 0.083$ ft/ft						
Street Longitudinal Slope - Enter 0 for sump condition	$S_o = 0.010$ ft/ft						
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.015$						
Max. Allowable Spread for Minor & Major Storm	<table border="1"> <tr> <th>Minor Storm</th> <th>Major Storm</th> <th>ft</th> </tr> <tr> <td>$T_{MAX} = 15.8$</td> <td>$T_{MAX} = 17.0$</td> <td></td> </tr> </table>	Minor Storm	Major Storm	ft	$T_{MAX} = 15.8$	$T_{MAX} = 17.0$	
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$d_{MAX} = 4.6$	$d_{MAX} = 7.8$						
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<input type="checkbox"/>	<input type="checkbox"/>	check = yes					
MINOR STORM Allowable Capacity is based on Depth Criterion							
MAJOR STORM Allowable Capacity is based on Spread Criterion							
Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'	<table border="1"> <tr> <th>Minor Storm</th> <th>Major Storm</th> <th>cfs</th> </tr> <tr> <td>$Q_{allow} = 5.9$</td> <td>$Q_{allow} = 11.6$</td> <td></td> </tr> </table>	Minor Storm	Major Storm	cfs	$Q_{allow} = 5.9$	$Q_{allow} = 11.6$	
Minor Storm	Major Storm	cfs					
$Q_{allow} = 5.9$	$Q_{allow} = 11.6$						
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'							

INLET ON A CONTINUOUS GRADE

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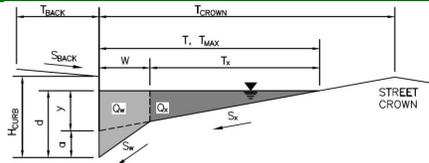


Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity*			
Total Inlet Interception Capacity	3.0	5.7	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	0.0	0.0	cfs
Capture Percentage = Q_i/Q_c =	100	100	%

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

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

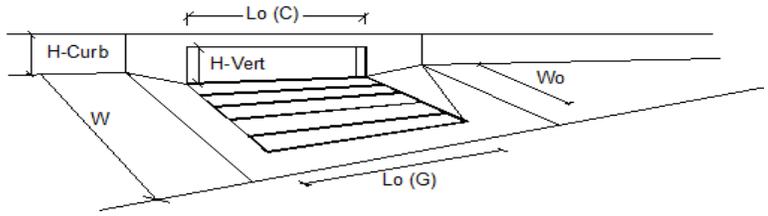
Project: CLAREMONT BUSINESS PARK 2 FILING NO. 1
 Inlet ID: Inlet 4 DP 6 SOUTH



Gutter Geometry (Enter data in the blue cells)													
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 7.5$ ft												
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft												
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.020$												
Height of Curb at Gutter Flow Line	$H_{CURB} = 6.00$ inches												
Distance from Curb Face to Street Crown	$T_{CROWN} = 17.0$ ft												
Gutter Width	$W = 2.00$ ft												
Street Transverse Slope	$S_x = 0.020$ ft/ft												
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_w = 0.083$ ft/ft												
Street Longitudinal Slope - Enter 0 for sump condition	$S_o = 0.010$ ft/ft												
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.016$												
Max. Allowable Spread for Minor & Major Storm	<table border="1"> <thead> <tr> <th></th> <th>Minor Storm</th> <th>Major Storm</th> <th></th> </tr> </thead> <tbody> <tr> <td>$T_{MAX} =$</td> <td>15.8</td> <td>17.0</td> <td>ft</td> </tr> <tr> <td>$d_{MAX} =$</td> <td>4.6</td> <td>7.8</td> <td>inches</td> </tr> </tbody> </table>		Minor Storm	Major Storm		$T_{MAX} =$	15.8	17.0	ft	$d_{MAX} =$	4.6	7.8	inches
	Minor Storm	Major Storm											
$T_{MAX} =$	15.8	17.0	ft										
$d_{MAX} =$	4.6	7.8	inches										
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm													
Allow Flow Depth at Street Crown (leave blank for no)	<input type="checkbox"/> <input type="checkbox"/> check = yes												
MINOR STORM Allowable Capacity is based on Depth Criterion													
MAJOR STORM Allowable Capacity is based on Spread Criterion													
Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'													
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'													
	<table border="1"> <thead> <tr> <th></th> <th>Minor Storm</th> <th>Major Storm</th> <th></th> </tr> </thead> <tbody> <tr> <td>$Q_{allow} =$</td> <td>5.5</td> <td>10.9</td> <td>cfs</td> </tr> </tbody> </table>		Minor Storm	Major Storm		$Q_{allow} =$	5.5	10.9	cfs				
	Minor Storm	Major Storm											
$Q_{allow} =$	5.5	10.9	cfs										

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017

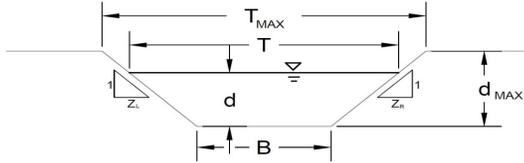


Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity			
Total Inlet Interception Capacity	1.5	5.6	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	0.0	0.0	cfs
Capture Percentage = Q_i/Q_c =	100	100	%

AREA INLET IN A SWALE

CLAREMONT BUSINESS PARK 2 FILING NO. 1

INLET 6 DP 7



This worksheet uses the NRCS vegetative retardance method to determine Manning's n.
For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method														
NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D or E													
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.025												
Channel Invert Slope	S ₀ =	0.1200 ft/ft												
Bottom Width	B =	0.00 ft												
Left Side Slope	Z1 =	3.00 ft/ft												
Right Side Slope	Z2 =	3.00 ft/ft												
Check one of the following soil types:	Choose One:													
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Soil Type:</th> <th style="text-align: left;">Max. Velocity (V_{MAX})</th> <th style="text-align: left;">Max Froude No. (F_{MAX})</th> </tr> </thead> <tbody> <tr> <td>Non-Cohesive</td> <td>5.0 fps</td> <td>0.60</td> </tr> <tr> <td>Cohesive</td> <td>7.0 fps</td> <td>0.80</td> </tr> <tr> <td>Paved</td> <td>N/A</td> <td>N/A</td> </tr> </tbody> </table>	Soil Type:	Max. Velocity (V _{MAX})	Max Froude No. (F _{MAX})	Non-Cohesive	5.0 fps	0.60	Cohesive	7.0 fps	0.80	Paved	N/A	N/A	<input checked="" type="checkbox"/> Non-Cohesive <input type="checkbox"/> Cohesive <input type="checkbox"/> Paved	
Soil Type:	Max. Velocity (V _{MAX})	Max Froude No. (F _{MAX})												
Non-Cohesive	5.0 fps	0.60												
Cohesive	7.0 fps	0.80												
Paved	N/A	N/A												
Max. Allowable Top Width of Channel for Minor & Major Storm	T _{MAX} =	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="text-align: center;">Minor Storm</td> <td style="text-align: center;">Major Storm</td> </tr> <tr> <td style="text-align: center;">1.92</td> <td style="text-align: center;">2.40</td> </tr> </table> feet	Minor Storm	Major Storm	1.92	2.40								
Minor Storm	Major Storm													
1.92	2.40													
Max. Allowable Water Depth in Channel for Minor & Major Storm	d _{MAX} =	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="text-align: center;">Minor Storm</td> <td style="text-align: center;">Major Storm</td> </tr> <tr> <td style="text-align: center;">0.32</td> <td style="text-align: center;">0.40</td> </tr> </table> feet	Minor Storm	Major Storm	0.32	0.40								
Minor Storm	Major Storm													
0.32	0.40													
Allowable Channel Capacity Based On Channel Geometry														
MINOR STORM Allowable Capacity is based on Depth Criterion	Q _{allow} =	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="text-align: center;">Minor Storm</td> <td style="text-align: center;">Major Storm</td> </tr> <tr> <td style="text-align: center;">1.8</td> <td style="text-align: center;">3.3</td> </tr> </table> cfs	Minor Storm	Major Storm	1.8	3.3								
Minor Storm	Major Storm													
1.8	3.3													
MAJOR STORM Allowable Capacity is based on Top Width Criterion	d _{allow} =	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="text-align: center;">Minor Storm</td> <td style="text-align: center;">Major Storm</td> </tr> <tr> <td style="text-align: center;">0.32</td> <td style="text-align: center;">0.40</td> </tr> </table> ft	Minor Storm	Major Storm	0.32	0.40								
Minor Storm	Major Storm													
0.32	0.40													
Water Depth in Channel Based On Design Peak Flow														
Design Peak Flow	Q _c =	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="text-align: center;">Minor Storm</td> <td style="text-align: center;">Major Storm</td> </tr> <tr> <td style="text-align: center;">1.8</td> <td style="text-align: center;">3.2</td> </tr> </table> cfs	Minor Storm	Major Storm	1.8	3.2								
Minor Storm	Major Storm													
1.8	3.2													
Water Depth	d =	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="text-align: center;">Minor Storm</td> <td style="text-align: center;">Major Storm</td> </tr> <tr> <td style="text-align: center;">0.32</td> <td style="text-align: center;">0.40</td> </tr> </table> feet	Minor Storm	Major Storm	0.32	0.40								
Minor Storm	Major Storm													
0.32	0.40													
<p style="color: red; font-weight: bold;">Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'</p> <p style="color: red; font-weight: bold;">Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'</p>														

AREA INLET IN A SWALE

CLAREMONT BUSINESS PARK 2 FILING NO. 1

INLET 6 DP 7

Inlet Design Information (Input)

Type of Inlet: Inlet Type =

Angle of Inclined Grate (must be <= 30 degrees): $\theta = 0.00$ degrees

Width of Grate: $W = 3.00$ feet

Length of Grate: $L = 3.00$ feet

Open Area Ratio: $A_{RATIO} = 0.70$

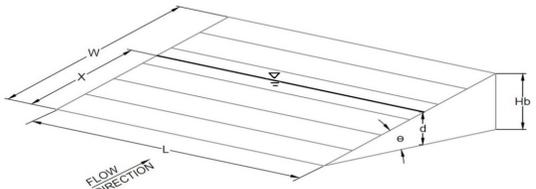
Height of Inclined Grate: $H_B = 0.00$ feet

Clogging Factor: $C_f = 0.50$

Grate Discharge Coefficient: $C_d = 0.84$

Orifice Coefficient: $C_o = 0.56$

Weir Coefficient: $C_w = 1.81$

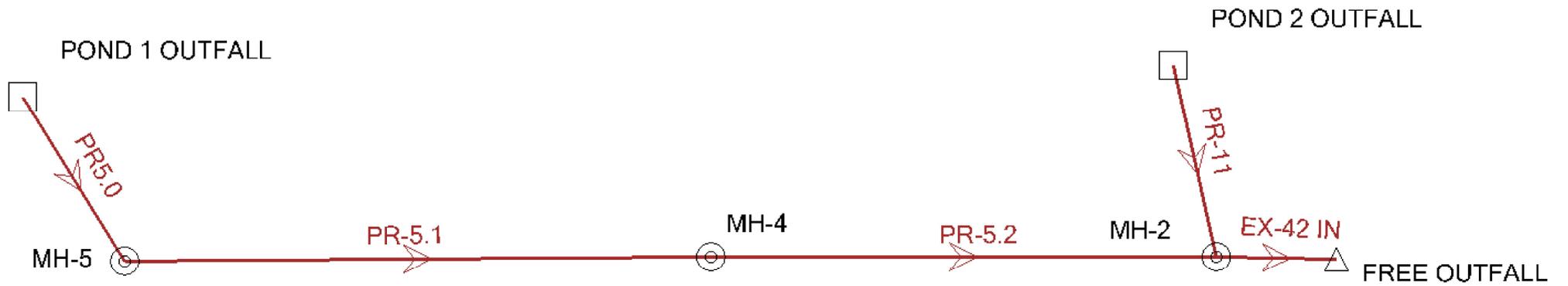


Water Depth at Inlet (for depressed inlets, 1 foot is added for depression):

	MINOR	MAJOR	
$d =$	1.32	1.40	
$Q_a =$	16.3	16.8	cfs
Bypassed Flow, $Q_b =$	0.0	0.0	cfs
Capture Percentage = $Q_a/Q_o = C\%$	100	100	%

Warning 04: Froude No. exceeds USDCM Volume I recommendation.

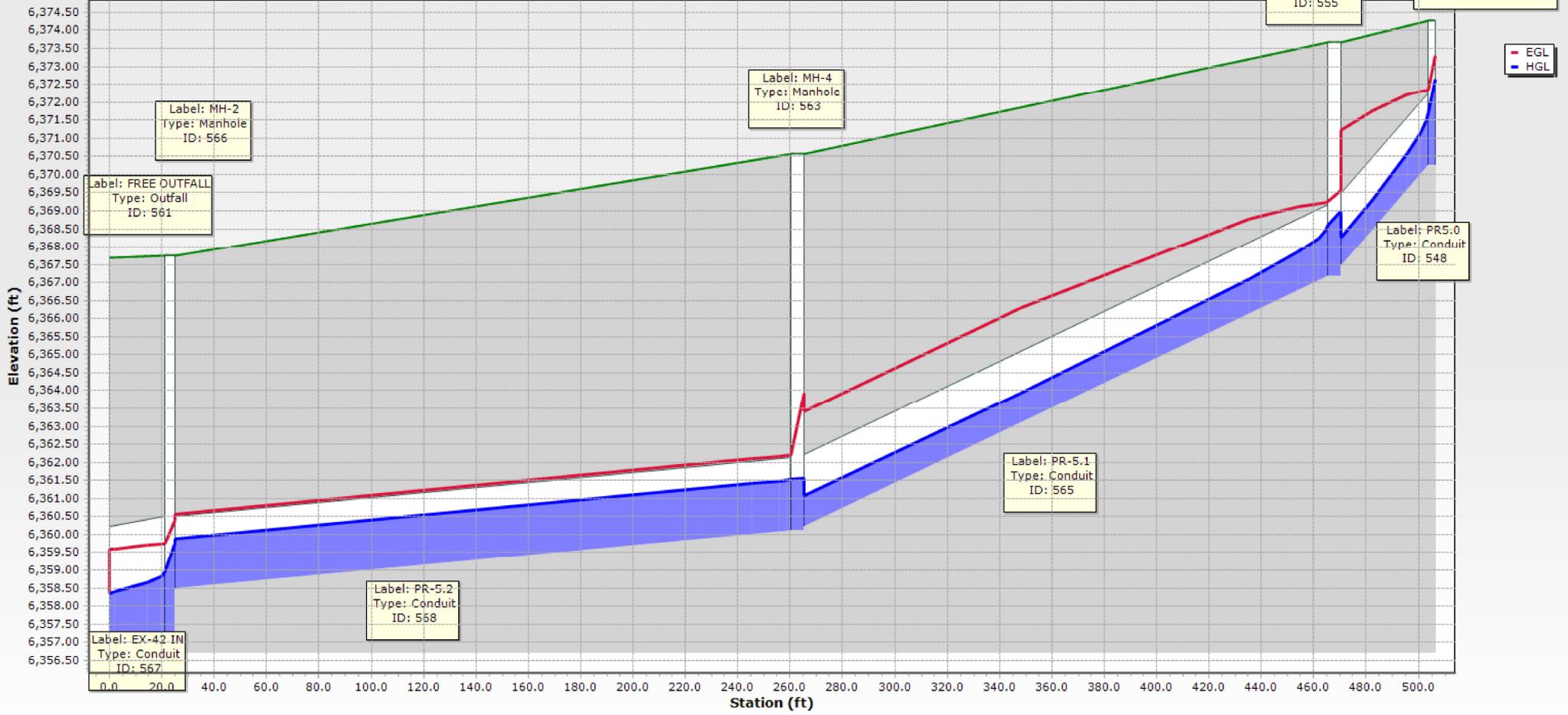
POND 1 & 2 INDEX MAP

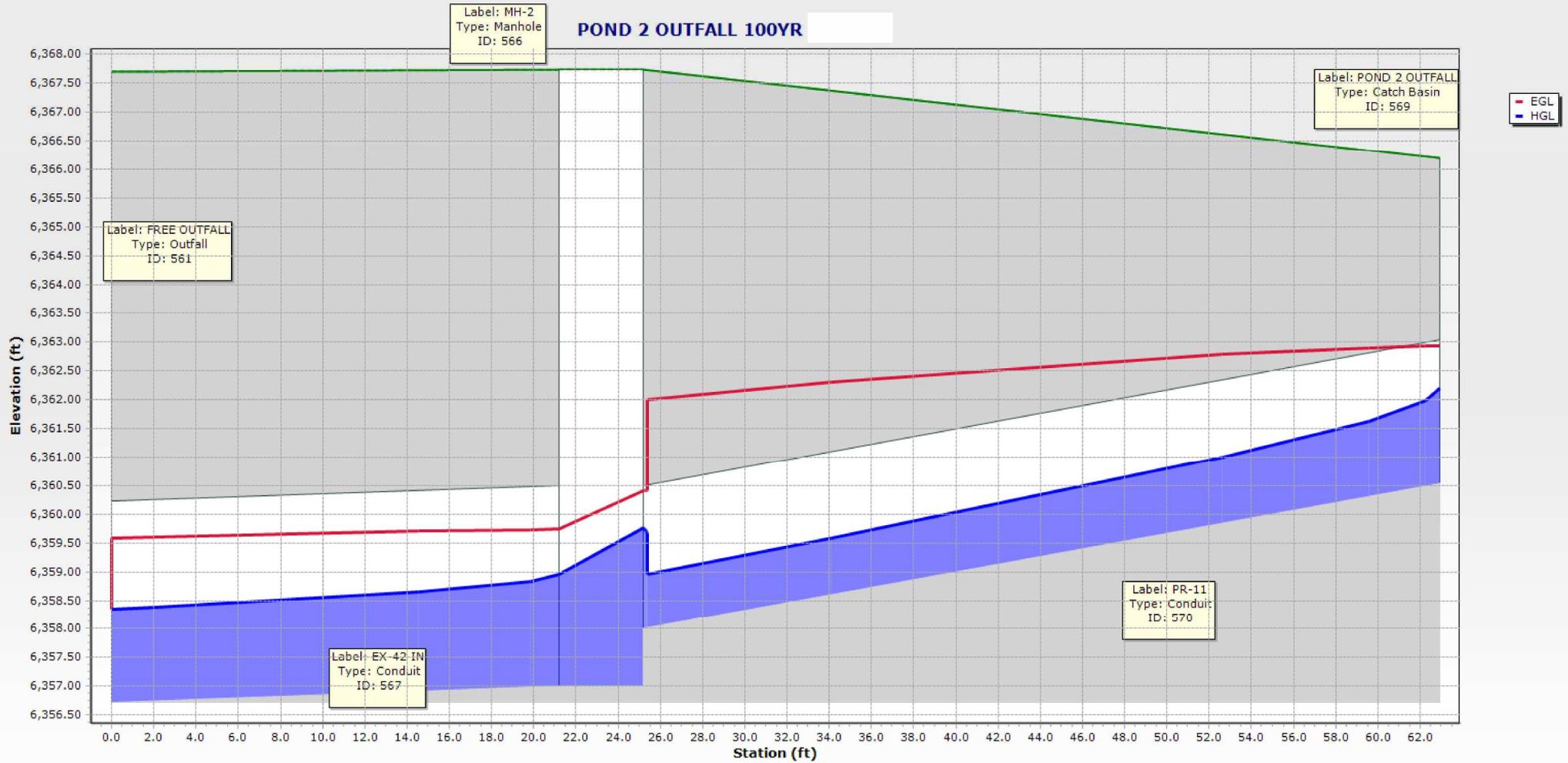


Conduit FlexTable: POND 1 & 2 OUTFALL

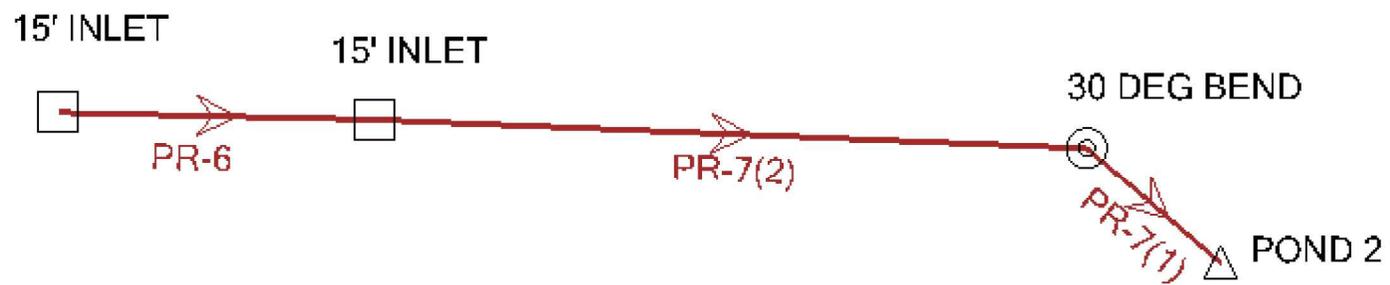
Label	ID	Upstream Structure	Flow (cfs)	Flow / Capacity (Design) (%)	Length (Unified) (ft)	Velocity (ft/s)	Froude Number (Normal)	Depth (Normal) (ft)	Depth (Critical) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss (ft)
PR5.0	548	POND 1 OUTFALL	15.50	25.0	37.0	16.40	4.096	0.68	1.42	6,372.33	6,369.56	6,371.67	6,368.99	2.68
PR-5.1	565	MH-5	15.50	37.2	205.1	12.28	2.709	0.85	1.42	6,369.25	6,363.41	6,368.59	6,361.06	7.52
EX-42 IN	567	MH-2	39.30	35.6	23.2	10.51	1.780	1.44	1.95	6,359.74	6,359.59	6,358.95	6,358.35	0.59
PR-5.2	568	MH-4	15.50	83.3	239.6	6.63	1.035	1.39	1.42	6,362.20	6,360.58	6,361.54	6,359.90	1.64
PR-11	570	POND 2 OUTFALL	23.80	23.0	39.7	17.12	3.918	0.82	1.66	6,362.92	6,360.40	6,362.19	6,359.76	2.43
Upstream Structure Hydraulic Grade Line (In) (ft)	Upstream Structure Velocity (In-Governing) (ft/s)	Upstream Structure Headloss Coefficient	Upstream Structure Headloss (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Conduit Description						
6,372.65	6.50	1.500	0.98	6,373.68	6,374.27	6,367.47	6,370.25	Circle - 24.0 in						
6,368.99	6.05	1.000	0.40	6,370.58	6,373.68	6,360.22	6,367.17	Circle - 24.0 in						
6,359.76	6.46	1.020	0.81	6,367.70	6,367.74	6,356.72	6,357.00	Circle - 42.0 in						
6,361.57	12.28	0.050	0.03	6,367.74	6,370.58	6,358.50	6,360.12	Circle - 24.0 in						
6,363.29	6.87	1.500	1.10	6,366.20	6,367.74	6,360.53	6,358.00	Circle - 30.0 in						

POND 1 OUTFALL 100YR





STORM 6, 7 INDEX MAP



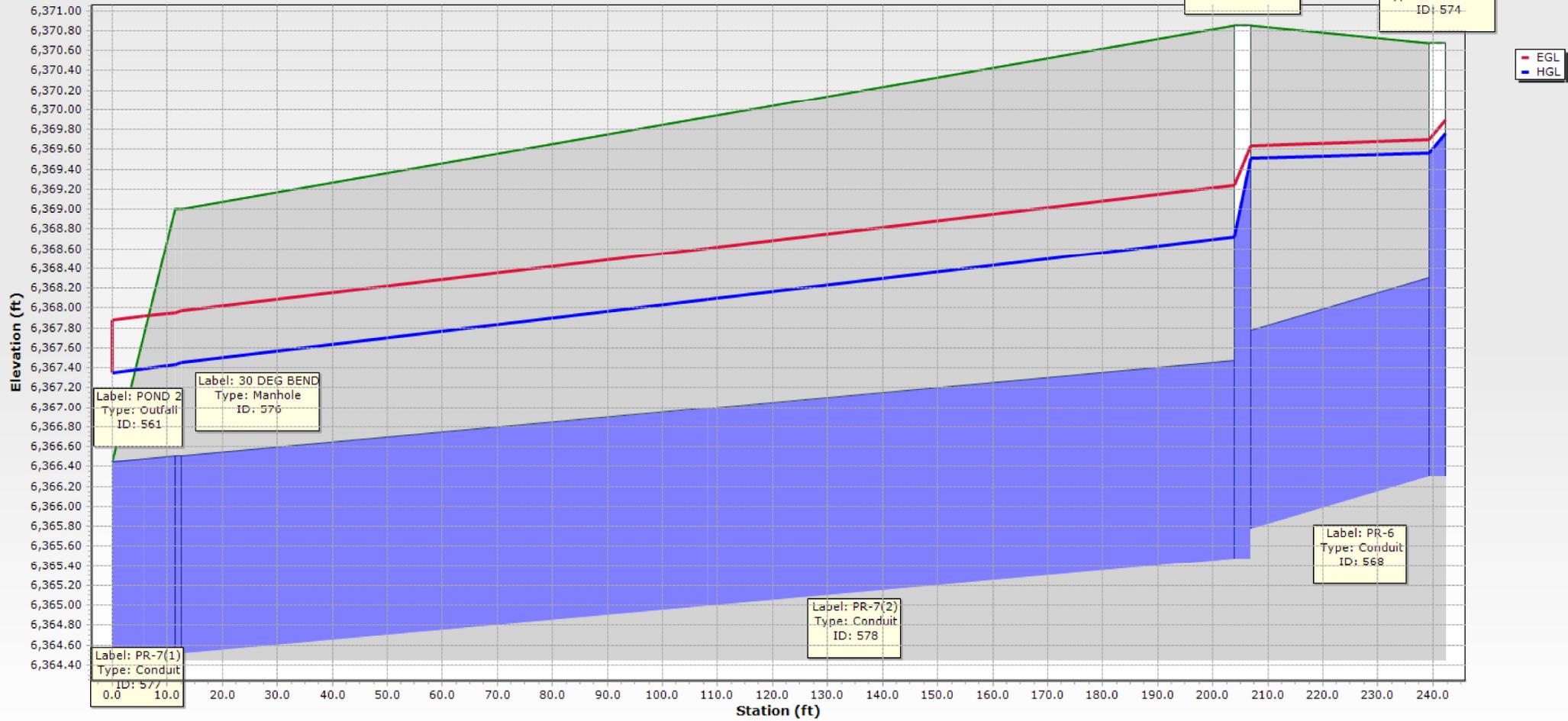
Conduit FlexTable: STRM 7

Label	ID	Upstream Structure	Flow (cfs)	Flow / Capacity (Design) (%)	Length (Unified) (ft)	Velocity (ft/s)	Froude Number (Normal)	Depth (Normal) (ft)	Depth (Critical) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss (ft)
PR-6	568	15' INLET	9.10	32.8	35.3	2.90	1.815	0.79	1.08	6,369.72	6,369.67	6,369.59	6,369.54	0.06
PR-7(1)	577	30 DEG BEND	18.30	114.4	12.0	5.83	0.726	(N/A)	1.54	6,367.99	6,367.91	6,367.46	6,367.38	0.08
PR-7(2)	578	15' INLET	18.30	114.8	193.5	5.83	0.726	(N/A)	1.54	6,369.27	6,368.01	6,368.75	6,367.48	1.27
Upstream Structure Hydraulic Grade Line (In) (ft)	Upstream Structure Velocity (In-Governing) (ft/s)	Upstream Structure Headloss Coefficient	Upstream Structure Headloss (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Conduit Description						
6,369.79	2.90	1.500	0.20	6,370.85	6,370.67	6,365.77	6,366.30	Circle - 24.0 in						
6,367.48	5.83	0.040	0.02	6,366.45	6,369.00	6,364.45	6,364.51	Circle - 24.0 in						
6,369.54	2.90	1.500	0.79	6,369.00	6,370.85	6,364.51	6,365.47	Circle - 24.0 in						

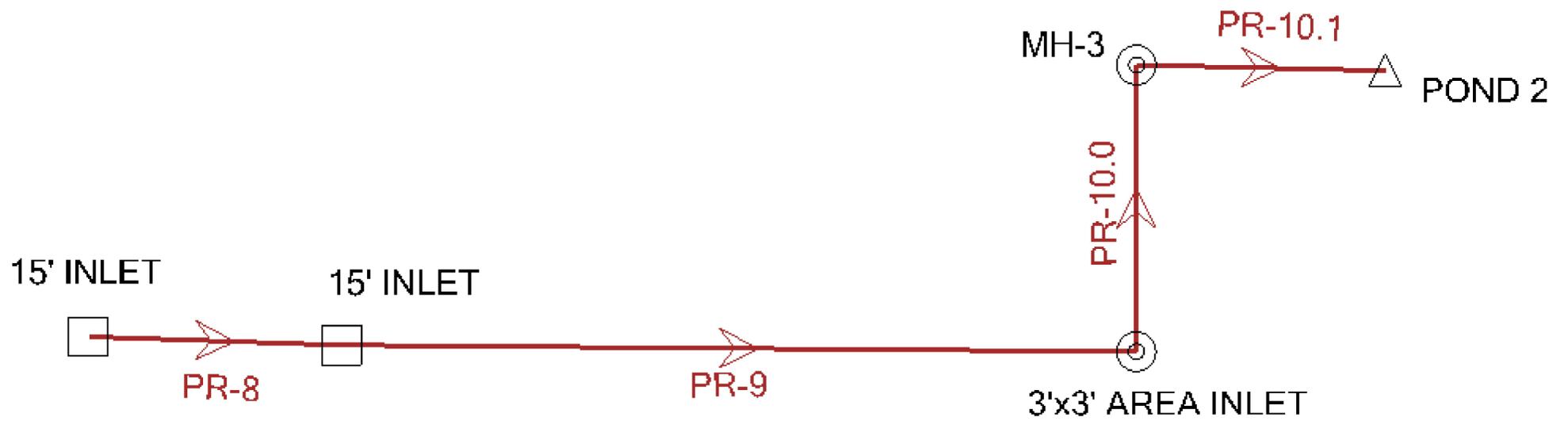
DUE TO THE 100-YR WATER SURFACE ELEVATION IN POND 2 AND THE CLOSE PROXIMITY OF THE STORM INLET 2 STORM 7 SHALL BE PRESSURIZED. STORM 7 IS ALSO A PRIVATE SYSTEM.

NOTE STORM 7 BETWEEN STATIONS 1+06.13 AND 3+06.97 SHALL HAVE GASKETED, WATERTIGHT JOINTS AND ADHERE TO PERFORMANCE STANDARDS PER ASTM D3212 FOR HP PIPE.

STRM 7 PROFILE - 100 yr



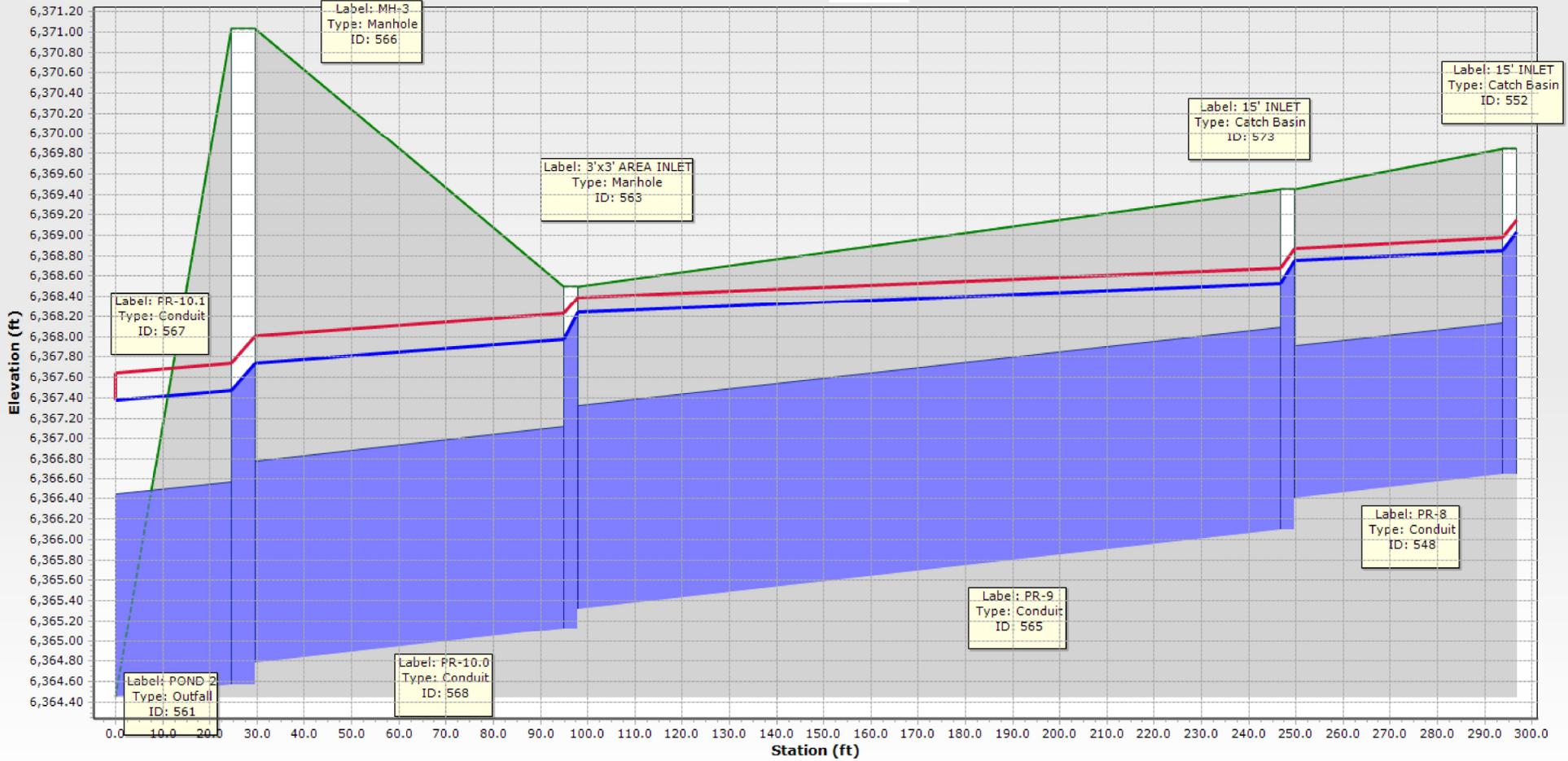
STORM 8, 9, 10 INDEX MAP



Conduit FlexTable: STRM 8,9,10

Label	ID	Upstream Structure	Flow (cfs)	Flow / Capacity (Design) (%)	Length (Unified) (ft)	Velocity (ft/s)	Froude Number (Normal)	Depth (Normal) (ft)	Depth (Critical) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss (ft)
PR-8	548	15' INLET	4.90	66.7	47.0	2.77	0.908	0.90	0.85	6,368.97	6,368.87	6,368.85	6,368.75	0.10
PR-9	565	15' INLET	9.80	60.8	151.9	3.12	0.989	1.13	1.12	6,368.68	6,368.39	6,368.53	6,368.24	0.29
PR-10.1	567	MH-3	13.00	86.4	27.1	4.14	0.821	1.43	1.30	6,367.74	6,367.65	6,367.47	6,367.38	0.09
PR-10.0	568	3'x3' AREA INLET	13.00	82.0	69.2	4.14	0.889	1.38	1.30	6,368.24	6,368.01	6,367.97	6,367.74	0.23
Upstream Structure Hydraulic Grade Line (In) (ft)	Upstream Structure Velocity (In-Governing) (ft/s)	Upstream Structure Headloss Coefficient	Upstream Structure Headloss (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Conduit Description						
6,369.03	2.77	1.500	0.18	6,369.45	6,369.84	6,366.41	6,366.64	Circle - 18.0 in						
6,368.75	2.77	1.500	0.23	6,368.50	6,369.45	6,365.32	6,366.09	Circle - 24.0 in						
6,367.74	4.14	1.020	0.27	6,364.45	6,371.03	6,364.45	6,364.57	Circle - 24.0 in						
6,368.24	3.12	1.020	0.27	6,371.03	6,368.50	6,364.78	6,365.12	Circle - 24.0 in						

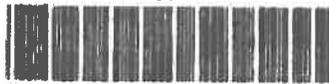
STRM 8,9,10 100 YR



BOCC RESOLUTION 16-426

502
Chuck Broerman
11/28/2016 11:50:04 AM
Doc \$0.00 2
Rec \$0.00 Pages

EL PASO COUNTY, W



216137149

RESOLUTION NO. 16- 426

**BOARD OF COUNTY COMMISSIONERS
COUNTY OF EL PASO, STATE OF COLORADO**

Resolution Denying an Appeal by Hammers Construction LLC (APP-16-002) of the Administrative Determination made by the Planning and Community Development Department Executive Director regarding the requirement for permanent/post construction Water Quality (permanent stormwater quality best management practices or BMP's).

WHEREAS, pursuant to §§30-11-101(1)(e) and 30-11-107(1)(e), C.R.S., the Board of County Commissioners of El Paso County, Colorado (hereinafter "Board") has the legislative authority to manage the concerns of El Paso County when deemed by the Board to be in the best interests of the County and its inhabitants; and

WHEREAS, after consultation with the County Attorney's Office, the Executive Director of Planning and Community Development on August 4, 2016 issued an administrative determination finding made an administrative determination that all undeveloped lots within the Claremont Business Park are subject to installation of permanent stormwater management best management practices (BMP's) associated with development, and that the terms of a 2008 approved deviation relieving the developer of the requirements have not been met.; and

WHEREAS, an appeal of the administrative determination was filed by Hammers Construction on August 10, 2016, and a hearing date was set for September 27, 2016 to hear the appeal; and

WHEREAS, the hearing was continued to a date certain of November 22, 2016; and

WHEREAS, at the Applicant's appeal hearing on November 22, 2016, testimony from the Applicant and the Applicant's representatives was heard by the Board in favor of the appeal, testimony from representatives of Planning and Community Development Department and was presented, and such testimony and associated evidence was weighed by the Board; and

WHEREAS, the Board, having reviewed the testimony and evidence, hereby finds and determines that the requested appeal of the administrative determination by the Planning and Community Development Executive Director by the Applicant did not satisfy the criteria of approval to overturn the administrative determination.

NOW, THEREFORE, BE IT RESOLVED that the Board of County Commissioners of El Paso County, Colorado, hereby denies the appeal of the administrative determination by Hammers Construction and determines that permanent stormwater management best management practices (BMP's) are required with new development within the Claremont Business Park: and

BE IT FURTHER RESOLVED that Sallie Clark, duly elected, qualified member and Chair of the Board of County Commissioners, or Darryl Glenn, duly elected, qualified member and Vice Chair of the Board of County Commissioners, be and is hereby authorized on behalf of the Board to execute any and all documents necessary to carry out the intent of the Board as described herein.

DONE THIS 22nd day of November, 2016, at Colorado Springs Colorado.

**BOARD OF COUNTY COMMISSIONERS
EL PASO COUNTY, COLORADO**

ATTEST:  *Richard D. Broerman*
County Clerk & Recorder

By: *Sallie Clark*
Chair of the Board

**EXCERPT OF “FINAL DRAINAGE REPORT FOR CLAREMONT
BUSINESS PARK FIL NO. 2 “, BY MATRIX DESIGN DATED
NOVEMBER 2006
&
EXISTING DRAINAGE MAP**



FINAL DRAINAGE REPORT

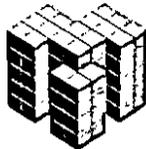
For

“Claremont Business Park Filing No. 2”

Prepared for:
El Paso County
Department of Public Works
Engineering Division

On Behalf of:
Claremont Development, Inc.

Prepared by:



Matrix Design Group, Inc.
Integrated Design Solutions *Infrastructure Engineering*
Community Development
Program Management

2435 Research Parkway, Suite 300
Colorado Springs, CO 80920
(719) 575-0100
fax (719) 572-0208

Revised November 2006

Engineer's Statement:

The *revisions* (changes made to the base Final Drainage Report since July, 2006) to the attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. The revisions encompassed adding additional right of way to the study area at the County's request, the handling of offsite drainage due to the additional right of way, a breakdown of private drainage within lot numbers 10 through 25 of Filing No. 2 due to cross-lot drainage (contrary to note # 25 on the recorded plat), profiling additional inlets along the channel edge, and rip-rap sizing for outlet structures along the channel. The Final Drainage Report dated July, 2006 was prepared under the direct supervision of Richard G. Gallegos, Jr. in July, 2006 and stamped (see next sheet).

The Final Drainage Report was prepared according to the criteria established by the County for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing the *revisions* to this report.

Brady A. Shyrock
Registered Professional Engineer
State of Colorado
No. 38164

SEAL

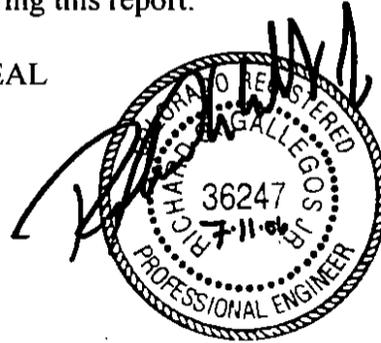


Engineer's Statement:

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 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.

SEAL

Richard G. Gallegos, Jr.
Registered Professional Engineer
State of Colorado
No. 36247



Developer's Statement:

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

Claremont Development, Inc.
Business Name

By: _____

Title: _____

Address: 3460 Capital Drive
Colorado Springs, CO 80915

El Paso County:

Filed in accordance with Section 51.1 of the El Paso Land Development Code, as amended.

John Hamacher
Mr. John McCarty, County Engineer/Director

4/23/07
Date

Conditions:

D. Drainage and Bridge Fees

Claremont Business Park Filing No. 2 has not been previously platted. The drainage basin and bridge fees have been determined per the El Paso County Drainage Basin Fees Sheet, dated February 3, 2006, Resolution No. 06-31. The site is located entirely within the Sand Creek Drainage Basin. The fees are based upon the percent impervious of the development, which have been included within the appendix of this report. The fees due have been calculated as follows.

Claremont Business Park Filing No. 2
Final Drainage Report
Drainage and Bridge Fees

	Area (ac.)	Fee/Imp. Acre	% Imp.	Fee Due	Reimbursable Const. Costs	Fee Credit	Fee Due at Platting	Fee Credit Remaining
Drainage Fee	62.967	\$15,000.00	80%	\$755,604.00	\$0.00	\$1,225,355.45	\$0.00	\$469,751.45
Bridge Fee	62.967	\$1,503.00	80%	\$75,711.52	\$75,711.52	\$0.00	\$0.00	\$0.00
Total Fee Due at Platting							\$0.00	

The developer of Claremont Business Park is completing the construction of the channel improvements on behalf of the Central Marksheffel Metropolitan District. The construction costs for both Filing 1 and Filing 2 combined exceed the drainage fees due for the site. No drainage fees will be required at the time of platting.

It should be noted that the Central Marksheffel Business District is reimbursing the developer of Claremont Business Park Filing 2 for the construction costs of the channel minus the drainage fees due for the site. The District has \$1,225,355.45 of drainage credits available within the Sand Creek Basin. This credit amount is based upon the construction cost estimate for the channel minus the drainage fees assessed for Claremont Business Park Filing No. 1. The District will use an additional \$755,604.00 of the drainage credits for the platting of Claremont Business Park Filing No. 2. The District will have \$469,751.45 of drainage credits left within the Sand Creek Fee basin.

The Central Marksheffel Business District has also constructed the Marksheffel Road Bridge over East Fork Sand Creek. This structure has been identified as a needed public improvement within the Drainage Basin Planning Study for Sand Creek and is eligible for reimbursement. Since the construction of the Marksheffel Bridge is in excess of the \$75,711.52 in bridge fees due for this site, no bridge fees are required at the time of platting. The fee will be deducted from the eligible reimbursable construction costs of the bridge and the remaining credits will be utilized or reimbursement applied for by the Central Marksheffel Business District.

PROPOSED DRAINAGE MAP

FINAL DRAINAGE REPORT FOR CLAREMONT BUSINESS PARK 2 FILING NO.1

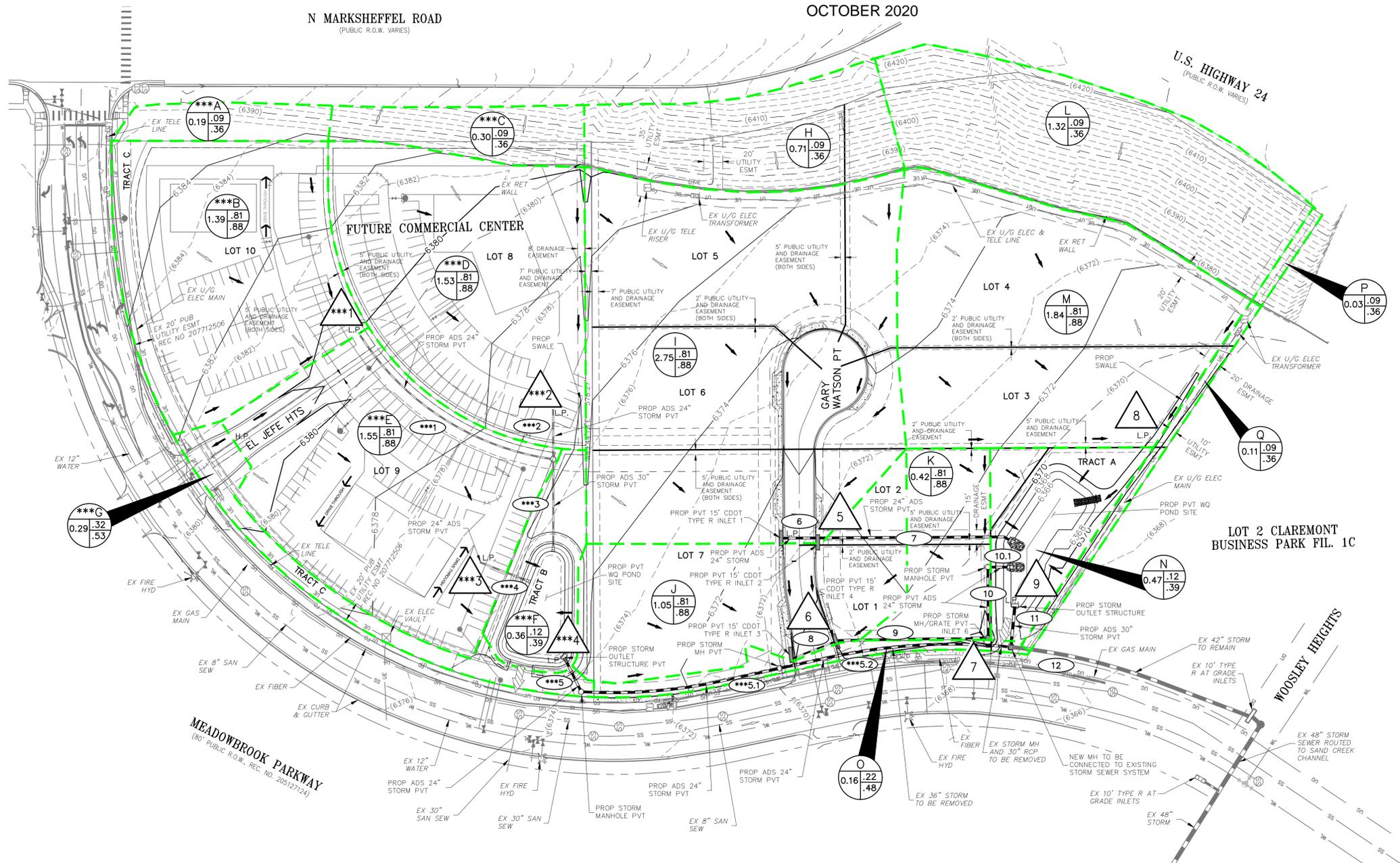
COUNTY OF EL PASO, STATE OF COLORADO

PROPOSED DRAINAGE MAP

OCTOBER 2020

N MARKSHEFFEL ROAD
(PUBLIC R.O.W. VARIES)

U.S. HIGHWAY 24
(PUBLIC R.O.W. VARIES)



LEGEND

- BASIN DESIGNATION: BASIN DESIGNATION
- ACRES: ACRES
- PIPE RUN REFERENCE LABEL: PIPE RUN REFERENCE LABEL
- SURFACE DESIGN POINT: SURFACE DESIGN POINT
- BASIN BOUNDARY: BASIN BOUNDARY
- EXISTING CONTOUR: EXISTING CONTOUR
- PROP CONTOUR: PROP CONTOUR
- UNDERGROUND ELECTRICAL: UNDERGROUND ELECTRICAL
- EXISTING GAS LINE: EXISTING GAS LINE
- STORM SEWER PIPE: STORM SEWER PIPE
- EXISTING STORM SEWER PIPE: EXISTING STORM SEWER PIPE
- CROSSSPAN: CROSSSPAN
- INLET: INLET
- EXISTING FLOW DIRECTION: EXISTING FLOW DIRECTION
- EMERGENCY OVERFLOW DIRECTION: EMERGENCY OVERFLOW DIRECTION
- FLOW DIRECTION: FLOW DIRECTION
- FLARED END SECTION: FLARED END SECTION
- H.P. X: HIGH POINT
- L.P. X: LOW POINT

BASIN SUMMARY				
BASIN	AREA (ACRES)	Q ₅	Q ₁₀₀	
***A	0.19	0.1	0.6	
***B	1.39	5.5	10.1	
***C	0.3	0.1	1.0	
***D	1.53	6.3	11.5	
***E	1.55	6.5	11.8	
***F	0.36	0.2	1.0	
***G	0.29	0.5	1.3	
H	0.71	0.3	2.0	
I	2.75	9.8	17.9	
J	1.05	4.4	8.0	
K	0.42	1.8	3.2	
L	1.32	0.5	3.7	
M	1.84	6.7	12.2	
N	0.47	0.2	1.3	
O	0.16	0.2	0.6	
P	0.03	0.0	0.1	
Q	0.11	0.0	0.3	

DESIGN POINT SUMMARY				
DESIGN POINT	Q ₅	Q ₁₀₀	BASIN	STRUCTURE
***1	5.6	10.6	***A, ***B	24" PP
***2	6.4	12.4	***C, ***D	24" PP
***3	6.5	11.8	***E	24" PP
***4	18.2	35.0	***F, ***G, ***H	POND 1
5	10.1	19.8	H, I	2-15" INLETS
6	4.4	9.8	J, FB0P5	2-15" INLETS
7	1.8	3.2	K	MH W/GRATE
8	7.2	15.7	L, M	24" PP OR SWALE
9	23.1	46.9	DP8, 7, 10, 1, N	POND 2

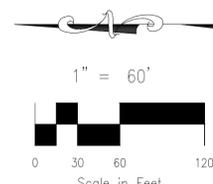
STORM SEWER SUMMARY				
PIPE RUN	Q ₅	Q ₁₀₀	PIPE SIZE	CONTRIBUTING DP/BASIN/PIPES
***1	5.6	10.6	24"	***DP1
***2	6.4	12.4	24"	***DP2
***3	11.8	22.6	30"	***PR1, ***PR2
***4	6.5	11.8	24"	***DP3
***5	7.2	15.5	24"	POND 1 OUTFALL
***5.1	7.2	15.5	24"	***PR5
***5.2	7.2	15.5	24"	***PR5.1
6	6.4	9.1	24"	INLET 1
7	10.1	18.3	30"	PR6, INLET 2
8	3.0	4.9	18"	INLET 3
9	4.5	9.8	24"	PR8, INLET 4
10	6.3	13.0	24"	PR9, DP7
10.1	6.3	13.0	24"	PIPE 10
11	13.2	23.8	30"	POND 2 OUTFALL
12	20.4	39.3	EX42"	***PR5.2, PR11

SF WQCV POND 1 SUMMARY	
EPC/URBAN DRAINAGE SAND FILTER BASIN—SEE STD. DET.	
AREA REQUIRED	2,335 SF
AREA PROVIDED	3,690 SF

SF ELEV = 6373.00	WQCV WSE = 6374.26
100 YR SPILLWAY ELEV = 6375.00	100 YR WSE = 6375.00

SF WQCV POND 2 SUMMARY	
EPC/URBAN DRAINAGE SAND FILTER BASIN—SEE STD. DET.	
AREA REQUIRED	2,962 SF
AREA PROVIDED	2,450 SF

SF ELEV = 6364.45	WQCV WSE = 6366.17
100 YR SPILLWAY ELEV = 6367.74	100 YR WSE = 6367.38



102 E. PIKES PEAK AVE., 5TH FLOOR
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

CLAREMONT BUSINESS PARK 2 FIL. NO.1			
PROP. DRAINAGE OFFSITE DEVELOPED			
PROJECT NO. 44-037A	FILE: \dwg\Eng Exhibits\44037-FDRM-2.dwg		
DESIGNED BY: ET	SCALE: DATE: 10-16-2020		
DRAWN BY: CLP	HORIZ: 1"=60'	SHEET 2 OF 2	FDM02
CHECKED BY: VAS	VERT: N/A		

File: 0_44037A-CBP-F2-Lots 1-8.dwg; Eng Exhibits (DR MAP_5-20-20) 44037-FDRM-2.dwg; Plotstamp: 10/16/2020 5:22 PM

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