MASTER DEVELOPMENT DRAINAGE PLAN
&
PRELIMINARY DRAINAGE REPORT

FOR

CROSSROADS NORTH

A RESUBDIVISION OF HILLCREST ACRES

EL PASO COUNTY, COLORADO

MAY 2024

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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.

COLORADO REGISTERED VIRGIL A. SANCHEZ 37160 PROFESSIONAL ENGINEER
05-28-24

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: _____

TITLE: OWNER / DEVELOPER DATE: 05-28-24

ADDRESS: Colorado Springs Equities LLC
90 S. Cascade, Suite 1500
Colorado Springs, CO 80903

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: Gilbert LaForce, P.E. Digitally signed by Gilbert LaForce, P.E. Reason: Authorized signatory as County Engineer designee Date: 2024.08.20 13:36:28-06'00' DATE: 8/20/2024

Joshua Palmer, P.E.
County Engineer / ECM Administrator

CONDITIONS:

MASTER DEVELOPMENT DRAINAGE PLAN & PRELIMINARY DRAINAGE REPORT FOR CROSSROADS NORTH A RESUBDIVISION OF HILLCREST ACRES EL PASO COUNTY COLORADO

TABLE OF CONTENTS

PURPOSE	4
GENERAL LOCATION AND DESCRIPTION	4
JIMMY CAMP CREEK DBPS & MARKSHEFFEL ROAD FDR	5
WETLANDS	5
CHANNEL IMPROVEMENTS	5
SOILS	5
HYDROLOGIC CALCULATIONS	5
HYDRAULIC CALCULATIONS	5
FLOODPLAIN STATEMENT	5
DRAINAGE CRITERIA	5
FOUR STEP PROCESS	6
EXISTING DRAINAGE CONDITIONS	6
PROPOSED DRAINAGE CONDITIONS	11
WATER QUALITY PROVISIONS AND MAINTENANCE	16
INTER-BASIN TRANSFER	18
EROSION CONTROL	18
DRAINAGE & BRIDGE FEES	18
SUMMARY	19
REFERENCES	20

APPENDIX

Vicinity Map
Soils Map
FIRM Panels
Hydrologic Calculations
Hydraulic Calculations / Pond Calculations
Colorado Division of Water Resource Letter of Acceptance
Marksheffel Road Final Drainage Report Excerpts
Jimmy Camp Creek DBPS Excerpts
Reagan Ranch MDDP Excerpts
Drainage Maps

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PURPOSE

This document is intended to serve as the Master Development Drainage Plan for Crossroads North. 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 commercial. The parcel is currently zoned by El Paso County for commercial regional, industrial, and light industrial as CR, M, and I-2, respectively. A final drainage report shall be required with a submittal of the final plat.

GENERAL LOCATION AND DESCRIPTION

Crossroads North is located northeast of Highway 24 and Highway 94, in a portion of the south half of Section 8 and the northeast quarter of Section 8, Township 14 South, Range 65 West of the 6th Principal Meridian, within unincorporated El Paso County, Colorado. The site is bound on the south by Colorado Highway 94, to the north by Colorado Highway 24 and Marksheffel Road, and to the east by Marksheffel Road. Drainage flows from this site are tributary to the Jimmy Camp Creek Drainage Basin and Peterson Field Drainage Basin.

Crossroads North consists of approximately 44.34 acres within unincorporated El Paso County and is presently undeveloped. Improvements proposed for this portion of the site include paved streets, parking lots, sidewalks, commercial buildings, full spectrum detention ponds, and utilities as normally constructed for a commercial development. As a part of the Crossroads North development, approximately 19 acres of property owned by the City of Colorado Springs along Highway 94 will also be improved. It is proposed that the City's property will be developed into sporting fields, landscaping, parking areas, and tracts for detention. The total disturbance of the entire project is approximately 65 acres. Existing vegetation is sparse, consisting of native grasses. Existing site terrain generally slopes from north to southwest, and north to southeast, at grade rates that vary between 2% and 9%.

Land use for Crossroads North is currently listed as AG (Grazing Land). The total disturbance of the entire project is approximately 65 acres. A request for approval of early grading plans has been submitted with this MDDP and Preliminary Plan.

Four (4) full spectrum detention ponds will provide water quality treatment and detention for the proposed development. The outlet structures from the two southernmost proposed ponds will tie into two existing storm sewer systems; one at the northwest corner of Marksheffel Road and Highway 94 and the other at the northeast corner of Highway 24 and Highway 94.

JIMMY CAMP CREEK DBPS & MARKSHEFFEL ROAD FINAL DRAINAGE REPORT

Excerpts of these two reports are include in the appendix of this report. The DBPS "Future Conditions Planning Information" map delineates this property as "Remaining areas with no detailed development plan". The "Future Conditions Land Use Map" delineates this site as "Low-Med Single Family Res, 4-8 Du/Ac, 40-50% percent impervious, and a Curve Number as 75-87". Since the proposed site will utilize the DBPS recommended Full Spectrum Detention method, the DBPS land use assumptions do not change the project's release rates. The Marksheffel Road Final Drainage Report is provided in the appendix to show and verify the drainage calculations for the existing facilities in Marksheffel Road and Highway 94. This report uses this data to compare the design flows in the existing system with the proposed flow for this development.

WETLANDS

There are no apparent wetlands within the boundary of this project.

CHANNEL IMPROVEMENTS

The proposed project is not adjacent to Jimmy Camp Creek or any other significant drainageway. No channel improvements are necessary as a part of this project.

SOILS

Soils for this project are delineated by the map in the appendix as Blakeland Loamy Sand (8) and have been characterized as Hydrologic Soil Types "A". 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 Nos. 08041C0756G, and 08041C0758G 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 – Parking lot surface drainage will be directed towards landscaped areas to minimize direct connection of impervious surfaces.

Step 2 Stabilize Drainageways –The site is several miles upstream of the Jimmy Camp Creek or Sand Creek Drainageway. Crossroads North site proposes (4) Full Spectrum Detention Facilities before flows are discharged to the existing systems along Marksheffel Road and Highway 94. The developed flows from the onsite ponds discharge less than historic flows into the existing systems. Therefore, the downstream drainageways will see less peak flows.

Step 3 Provide Water Quality Capture Volume (WQCV) – Four (4) Full Spectrum Detention facilities are proposed to provide WQCV treatment from the site.

Step 4 Consider Need for Industrial and Commercial BMP's – This submittal provides an early grading and erosion control plan with BMPs in place. The proposed project will use silt fence, vehicle tracking control pads, straw bale barriers, sediment basins, erosion control blanketing, inlet protection, mulching and reseeding, and other BMPs to mitigate the potential for erosion across the site. Specialized BMPs shall be considered with the final drainage report and subsequent lot reports due to the nature of the proposed commercial uses.

EXISTING DRAINAGE CONDITIONS

Three major basin divides occur within the Hillcrest Acres Subdivision. The major basin divide between the Sand Creek and Jimmy Camp Creek watersheds is formed by US Highway 24 that borders the northwest boundary of the subdivision. The major basin divide between the Jimmy Camp Creek and the Peterson Field basin runs near the southwest corner of the site. Most of the land within the Hillcrest Acres subdivision discharges to the Marksheffel Road right-of-way. The City property along Highway 94 drains to the Hwy 94 right-of-way and concentrates at either the intersection of Hwy 94/24 or the intersection at Hwy 94 and Marksheffel Road.

Refer to the drainage basin descriptions below, the Marksheffel Road Final Drainage Report, as well as the Existing Drainage Map located within the Appendix of this report for detailed descriptions of historic drainage patterns.

Detailed Drainage Discussion

Design Point 1

Basin 664R consists of approximately 1.09 acres of the eastern half of existing Marksheffel Road and portions of Highway 24 located to the north and east of the site. The basin consists of an asphalt paved roadway surface, curb and gutter and a raised concrete median. Runoff from the basin is collected and conveyed within the roadway and 6" vertical curb and gutter to an existing public 5' Type R inlet (**IN664**) located at **Design Point 1** (Q5=5.1 Q100=9.1 cfs). Runoff collected by the inlet (Q5=2.7 Q100=3.4 cfs) is conveyed within a public 24" storm sewer (**PR664**) that discharges to an existing 5'wide trapezoidal swale located on site. A riprap pad is located at the terminus of the storm sewer and riprap check dams have been installed below **DP1** to aid in damping discharge and preventing erosion. Runoff bypassing the inlet continues south within the curb and gutter to downstream infrastructure.

Design Point 2

Basin 662L consists of approximately 1.21 acres of existing western half of Marksheffel Road and portions of Highway 24 located to the north and east of the site. The basin consists of an asphalt paved roadway surface and curb and gutter. Runoff from the basin (Q5=5.6, Q100=10.0 cfs) is collected and conveyed within the western 6" vertical curb and gutter and pavement to a 5' Type R inlet (**IN662**) located

at **Design Point 2**. Runoff collected by the inlet (Q5=3.0 Q100=3.8 cfs) is conveyed within a public 24" storm sewer (**PR662**) that discharges to the onsite 5' wide swale. A riprap pad is located at the terminus of the storm sewer. Runoff bypassing the inlet continues south within the curb and gutter to downstream infrastructure.

Design Point 3

Basin 661L consists of approximately 0.07 acres of the western half of Marksheffel Road located to the north and east of the site. The basin consists of an asphalt paved roadway surface and existing curb and gutter. Runoff from the basin (Q5=0.3, Q100=0.6 cfs) is collected and conveyed within the western 6" vertical curb and gutter and pavement to a 5' Type R inlet (**IN661**) located at **Design Point 3**. Runoff from **Basin 661L** combines with flow by from **IN662** at peak flow rates of 2.9 and 6.7 cfs in the 5- and 100-year events respectively. Runoff collected by the inlet (Q5=1.9, Q100=3.2 cfs) is conveyed within a public 18" storm sewer (**PR661**) that discharges to the onsite 5' swale. A riprap pad is located at the terminus of the storm sewer. Runoff bypassing the inlet continues south within the curb and gutter to downstream infrastructure.

Design Point 4

Basin A consists of approximately 4.67 acres within public right of way, north of the site which occurs as a result of the relocation of Marksheffel Road. This area is currently undeveloped and is covered in sparse prairie grasses and vegetation. Runoff from the basin (Q5=1.4, Q100=10.2 cfs) drains northwest to the southeast where it combines with the up-gradient roadway discharge from **DP's 1-3** within the existing onsite 5' earthen swale at **Design Point 4**. The combined runoff at **DP4** has been calculated to reach peak flow rates of 7.9 and 20.3 cfs in the 5- and 100-year storm events respectively. The runoff continues south into **Basin B**.

Design Point 5

Basin 654R consists of approximately 1.62 acres of existing Marksheffel Road, located to the east of the site. This basin consists of an asphalt paved roadway surface and existing curb and gutter. Runoff from the basin (Q5=7.1, Q100=12.8 cfs) drains from the west across the street onto the east side gutter, and then flows south until it combines with the flow by of **IN664** is collected by an existing Type R 5' inlet (**IN654**: Q5=4.0, Q100=5.4 cfs). Runoff collected through this inlet will be conveyed within a 24" public storm sewer (**PR654**) across to the western side of the road where it will discharge into the existing 5' wide onsite swale. The combined flows for the 5- and 100-year events that reach the design point are Q5=10.3 and Q100=21.6 cfs. A riprap pad is located at the terminus of the storm sewer. Runoff bypassing the inlet continues south within the curb and gutter to downstream infrastructure.

Design Point 6

Basin B consists of 3.64 undeveloped acres, where a majority of the area is in existing Lots 19, 20, and the 5' swale on the west side of Marksheffel Road. **Basin B** is situated in the northeast corner of the proposed site. Runoff produced within **Basin B** is anticipated to reach peak runoff rates of Q5=1.0 and Q100=7.3 cfs and will flow south towards **Design Point 6**, where it combines with runoff of **DP4** and **PR654**. The combined flows for the 5- and 100-year events in this basin are 10.5 and 28.4 cfs, respectively. Runoff from this design point continues to flow south.

Design Point 7

Basin 646R consists of approximately 0.75 acres of the east side of existing Marksheffel Road, located to the east of the site. This basin consists of an asphalt paved roadway surface and existing curb and gutter. Runoff from the basin (Q5=3.5, Q100=6.2 cfs) drains from the crown of the road down to the east side gutter, and then flows south until it combines with **FBIN654** and is collected by an existing Type R 5' inlet **IN646** at the design point (Q5=3.4, Q100=4.7 cfs). Runoff collected through this inlet will be conveyed to the western side of the road by entering a 24" public storm sewer **PR646** where it will discharge into the existing 5' wide onsite swale. The total combined 5 year and 100-year flows for this

design point are 7.9 and 18.2 cfs, respectively. A riprap pad is located at the terminus of the storm sewer. Runoff bypassing the inlet continues south within the curb and gutter to downstream infrastructure.

Design Point 8

Basins C and D consist of approximately 2.51 and 2.10 acres, respectively, of existing U.S. Highway 24 located to the northwest of the site. These basins consist of an asphalt paved roadway, and a grass-lined swale on the east side. Runoff from the two basins (**Basin C**: Q5=5.5, Q100=11.3 cfs; **Basin D**: Q5=3.7, Q100=8.8) are conveyed south in the swale towards **Design Point 8**, where they combine at peak flowrates of Q5=8.6, Q100=18.8 cfs in the 5- and 100-year events, respectively. CDOT will repair this ditch so that flows do not enter the site.

Design Point 9

Basin E consists of approximately 10.82 acres of existing Lots 17, 18, and 19 located on the north side of the site. Currently the basin consists of undeveloped land covered by sparse prairie grasses and vegetation. Runoff from the basin (Q5=2.5, Q100=18.6 cfs) combines with runoff from **DP6, DP8,** and **PR646** in the 5' swale. The combined runoff at **DP9** has been calculated to reach peak flow rates of 23.5 and 69.0 cfs in the 5 and 100-year storm events, respectively.

Design Point 10

Basin H consists of approximately 15.03 acres of existing Lots 13, 14, and 15, along the west side of the site. This undeveloped basin is sparse prairie grasses and vegetation. Runoff from the basin (Q5=3.4, Q100=25.3 cfs) drains from the south to north until it collecting in a localized depression area. The effects from temporary ponding were not considered in hydrologic analysis. Runoff continues east, where it enters **Basin G**.

Design Point 11

Basin G consists of approximately 8.99 acres of existing Lots 15, 16, and 18 located near the center of the site. This basin consists of undeveloped land covered by sparse prairie grasses and vegetation. **Basin G** (Q5=2.2, Q100=15.9 cfs) drains west to east where it collects with flow from **DP10** and 1.00-acre **Basin F** (Q5=1.5, Q100=3.9 cfs; similar to Basins C and D) in the swale, and continues south. The combined flow at **DP11** has been calculated to reach peak flow rates of 6.8 and 45.2 cfs in the 5- and 100-year storm events, respectively.

Design Point 12

Basin 641L consists of approximately 1.58 acres of the west side of Marksheffel Road, located east of the site. This basin is mainly comprised of an asphalt paved roadway surface and existing curb and gutter. Runoff from the basin (Q5=5.8, Q100=10.4 cfs) is directed to a 5' Type R existing inlet at the design point (**IN640:**Q5=2.9, Q100=3.8 cfs). Runoff collected by this inlet is conveyed to the 5' swale via a public 24" storm sewer, **PR640**. A riprap pad is located at the terminus of the storm sewer. Runoff bypassing the inlet continues south within the curb and gutter to downstream infrastructure.

Design Point 13

Basin I consists of approximately 4.22 acres of existing Lots 12 and 16, located along the east side of the site. This undeveloped basin is covered by sparse prairie grasses and vegetation, and a portion of a dirt road. Runoff from the basin (Q5=1.1, Q100=8.4 cfs) drains from the southern side of the basin, and then flows northeast until it combines with flows from **DP 9, DP11,** and **PR640**. An existing private 36" culvert (**PR639**) directs runoff under the Air Lane Drive entrance. The combined flow for the 5 year and 100-year events at the design point are 36.6 and 138.0 cfs, respectively. Flow from here will continue to head south in the 5' swale into the next basin.

Design Point 14

Basin 637R consists of approximately 0.91 acres of the eastern side of Marksheffel Road, located to the east of the site. This basin consists of a roadway surface and curb and gutter. Runoff from the basin (Q5=3.1, Q100=5.5 cfs) drains from the median on the west side into the east side gutter, and then flows south until it combines with **FBIN646** at 5- and 100-year peak runoffs of 5.9 and 14.5 cfs, and is collected by an existing Type R 5' inlet at the design point (**IN636**: Q5=3.0, Q100=4.3 cfs). Runoff collected through this inlet is conveyed to the western side of the road through an existing public 24" storm sewer (**PR636**) where it will discharge into the existing 5' wide onsite swale. A riprap pad is located at the terminus of the storm sewer. Runoff bypassing the inlet continues south within the curb and gutter to downstream infrastructure.

Design Point 15

Basin J consists of approximately 2.88 acres of existing Lots 10, 11, and 12, on the east side of the site. This undeveloped basin is covered by sparse prairie grasses and vegetation, a portion of a dirt road, and a swale on the west side of the road. Runoff from the basin (Q5=0.8, Q100=5.6 cfs) drains from the western side of the basin, and then flows east until it combines with flows from **DP13** and **PR636**. The combined flow for the 5 year and 100-year events at **DP15** are 38.3 and 139.7 cfs, respectively. This flow continues south within the 5' swale on the west side of the road.

Design Point 16

Basin J1 consists of approximately 2.67 acres of existing Lots 10 and 11, and a portion of the swale on the located on the southeast side of the site. This undeveloped basin is comprised of sparse prairie grasses and vegetation, and a portion of the existing 5' swale on the west of the road. Runoff from the basin (Q5=0.7, Q100=4.9 cfs) drains from the western side of the basin, and then flows southeast until it combines with flows from **DP15**. The combined flow for the 5 year and 100-year events at the design point are 35.3 and 131.1 cfs, respectively. This flow will collect in an existing Type C area inlet and will continue south-southwest through an existing 24" public storm sewer, **PRE2**, into an existing concrete channel and water quality pond. Flows are currently expected to overtop the pipe and berm. An existing rip rap rundown is provided to prevent erosion.

Design Point 17

Basin 631R consists of approximately 0.56 acres of the existing eastern side of Marksheffel Road, located to the southeast of the site. This basin consists of an asphalt paved roadway surface and existing curb and gutter. Runoff from the basin (Q5=2.4, Q100=4.2 cfs) drains from the median on the west side into the east side gutter, and then flows south until it combines with **FBIN636** at 5- and 100-year peak runoffs of 4.0 and 11.7 cfs, and is collected by an existing Type R 5' inlet at the design point (**IN630A**: Q5=2.5, Q100=4.1 cfs). Runoff collected through this inlet is conveyed to the western side of the road through an existing public 24" storm sewer (**PR630A**) where it will discharge into existing public 24" storm sewer (**PR630B**), which then discharges into the existing water quality pond. A riprap pad is located at the terminus of the storm sewer. Runoff bypassing the inlet continues south within the curb and gutter to downstream infrastructure.

Design Point 18

Basin 632L consists of approximately 1.21 acres of the existing western side of Marksheffel Road, located to the southeast of the site. This basin consists of an asphalt paved roadway surface and existing curb and gutter. Runoff from the basin (Q5=4.5, Q100=8.1 cfs) drains from the median on the east side into the west side gutter, and then flows south, combining with **FBIN640** at rates of Q5=5.8 and Q100=11.6 cfs until it is collected by an existing Type R 15' inlet at the design point (**IN630B**: Q5=5.8, Q100=10.3 cfs). Runoff collected through this inlet is conveyed west through an existing public 24" storm sewer (**PR630B**), where it discharges into the existing concrete channel. A riprap pad is located at the terminus of the storm sewer. Runoff bypassing the inlet continues south within the curb and gutter to downstream infrastructure.

Design Point 19

Basin L consists of approximately 0.35 acres of the existing western side of Marksheffel Road, on the southeast side of the site, which curves and turns into U.S. Highway 94, located to the south of the site. This basin consists of an asphalt paved roadway surface with an existing curb and gutter along a portion of the road. Runoff from the basin (Q5=1.6, Q100=2.9 cfs) drains from the median on the south side into the north side gutter, and then drains east. It combines with **FBIN630B** at rates of 1.7 and 4.9 cfs in the 5- and 100-year events, and is then collected by an existing public 12" plastic corrugated pipe (**PRE1**) at **DP19** (Q5=1.8, Q100=6.9 cfs). The collected flows are then conveyed north to a small concrete detention area. A riprap pad is located at the terminus of the plastic storm sewer. Runoff bypassing the inlet continues east within the curb and gutter to downstream infrastructure.

Design Point 20

Basin K consists of approximately 3.33 acres of existing Lot 11 public right of way on the south side of the site. This undeveloped basin is comprised of sparse prairie grasses and vegetation. Runoff from the basin (Q5=0.9, Q100=6.8 cfs) drains from the northern side of the basin to the south until it combines with flows from **DP16, PR630B,** and **PRE1** in the existing water quality pond at the southeastern end of the site**.** A rip rap pad is located at the terminus of the outlet structure. The combined flow for the 5 year and 100-year events at the design point are 42.2 and 149.5 cfs, respectively. From here the flow will continue to drain west.

Design Point 21

Basin M consists of approximately 13.93 acres of existing Lots 9, 10, 16 and public right of way, and is located on the south side of the site. This undeveloped basin is comprised primarily of sparse prairie grasses and vegetation. Runoff from the basin (Q5=3.9, Q100=28.8 cfs) drains from the northern side of the basin to the south until it combines with flows from **DP20** at the existing water quality pond outlet structure at the southeastern end of the site. **Basin N** consists of approximately 0.71 acres of the existing northern side of U.S. Highway 94, located to the south of the site. This basin consists of an asphalt paved roadway surface and existing grassy swale on the north side of the road. Runoff from this basin (Q5=3.3, Q100=5.9 cfs) drains from the median on the south side into the aforementioned swale to the north, and then flows east until it combines with flows from **Basin M** and **DP20**. Combined flows for the 5 year and 100-year events are 47.4 and 177.1 cfs, respectively. From here, the combined flows drain offsite to the south through an existing 42" CMP storm sewer (**E3**), which discharges into a broad, natural swale.

Design Point 22

Basin O consists of approximately 11.52 acres of existing Lots 9, 13, 16 and public right of way, and is located on the southwestern side of the site. This undeveloped basin is comprised primarily of sparse prairie grasses and vegetation, with a 31' wide dirt road running through it. Runoff from the basin (Q5=2.7, Q100=20.2 cfs) drains from the northeast side of the basin to the southwest until it runs into a localized depression. **Basin P** has a similar land description as the aforementioned basin, except it is approximately 9.17 acres in size, contains a portion of the grassy swale on the eastern side of U.S. Highway 24, and is comprised of existing Lots 6, and 14, and public right of way. Runoff from this basin (Q5=2.4, Q100=17.9 cfs) drains from north to south, and also drains into the depression. Lastly, **Basin Q** consists of approximately 1.41 acres of existing U.S. Highway 94, and is located on the southwestern side of the site. This basin is comprised of an asphalt paved roadway surface. Runoff from this basin (Q5=6.6, Q100=11.8 cfs) also drains into the depression. Flows for the 5- and 100-year storms at this design point are 10.4 and 51.1 cfs, respectively. This flow then exits the site through an existing public 48" corrugated metal pipe (**E4**).

PROPOSED DRAINAGE CHARACTERISTICS

General Concept Drainage Discussion

The majority of the site will consist of neighborhood commercial and light industrial zones, asphalt, curb, four full spectrum detention basins, and landscaping. The site will typically drain 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 four private ponds. The outlet structures of the proposed FSD ponds will release runoff to the existing public 42" and 48" CMP public storm sewers located at the southeast and southwest corners of the site, respectively. A survey and inspection of these existing structures shall be made before use. The existing public 42" storm sewer connects to a proposed storm sewer system on the adjacent property, where it eventually reaches Jimmy Camp Creek. The concept storm system is proposed with the Reagan Ranch master development. An excerpt map of the MDDP for this development is included in the Appendix to show the general storm system location. The 48" CMP ties into an existing public storm sewer system which will route the remaining 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.

Detailed Drainage Discussion

Design Point 1

Basin 664R consists of approximately 1.09 acres of the eastern half of existing Marksheffel Road and portions of Highway 24 located to the north and east of the site. The basin consists of an asphalt paved roadway surface, curb and gutter, and a raised concrete median. Runoff from the basin (Q5=5.1, Q100=9.1 cfs) is collected and conveyed within the roadway and 6" vertical curb and gutter to an existing public 5' Type R inlet (**IN664**) located at **Design Point 1** (Q5=5.1, Q100=9.1 cfs). Runoff intercepted by the inlet (Q5=2.7, Q100=3.4 cfs) is conveyed within a public 24" storm sewer (**PR664**) that discharges to an existing 5'bottom swale located along the west side of Marksheffel Road. A riprap pad is located at the terminus of the storm sewer and riprap check dams have been installed below the riprap to aid in damping discharge and preventing erosion. Runoff bypassing the inlet continues south within the curb and gutter to downstream infrastructure.

Design Point 2

Basin 662L consists of approximately 1.21 acres of existing western half of Marksheffel Road and portions of Highway 24 located to the north and east of the site. The basin consists of an asphalt paved roadway surface and curb and gutter. Runoff from the basin (Q5=5.6, Q100=10.0 cfs) is conveyed within the western 6" vertical curb and gutter and pavement to a 5' Type R inlet (**IN662:** Q5=3.0, Q100=3.8 cfs) located at **DP2**. This intercepted portion of flow is then conveyed within a public 24" storm sewer (**PR662**) that discharges to the 5' wide swale. A riprap pad is located at the terminus of the storm sewer. Runoff bypassing the inlet continues south within the curb and gutter to downstream infrastructure.

Design Point 3

Basin 661L consists of approximately 0.07 acres of the western half of Marksheffel Road located to the north and east of the site. The basin consists of an asphalt paved roadway surface and existing curb and gutter. Runoff from the basin (Q5=0.3, Q100=0.6 cfs) combines with flowby from **DP2**, and is collected and conveyed within the western 6" vertical curb and gutter to a 5' Type R inlet (**IN661:** Q5=1.9, Q100=3.2 cfs) located at **Design Point 3**. The total flows that reach **DP3** are 2.9 and 6.7 cfs in the 5- and 100-year events, respectively. The intercepted portion of flow is then conveyed within a public 18" storm sewer (**PR661**) that discharges to the onsite 5' swale. A riprap pad is located at the terminus of the storm sewer. Runoff bypassing the inlet continues south within the curb and gutter to downstream infrastructure.

Design Point 4

Basin OS-1 consists of approximately 5.86 undeveloped acres of Tract D and Tract A that are located to the north of the site. The basin consists of sparse prairie grasses and natural vegetation. Runoff from the basin (Q5=1.6, Q100=11.9 cfs) is collected and conveyed in a 5' bottom earthen swale on the east side of the basin where it combines with flows from **DP3**. The combined 5 year and 100-year flow at **DP4** are 9.8 and 27.5 cfs, respectively. The runoff at this design point continues south in the 5' swale towards downstream infrastructure.

Design Point 5

Basin 654R consists of approximately 1.62 acres of existing Marksheffel Road, located to the east of the site. This basin consists of an asphalt paved roadway surface and existing curb and gutter. Runoff from the basin (Q5=7.1, Q100=12.8 cfs) drains from the west across the street onto the east side gutter, and then flows south until it combines with flowby of **DP1** and **DP3**, which is collected by an existing Type R 5' inlet (**IN654:**Q5=4.0, Q100=5.4 cfs**)** at the design point**.** Runoff collected through this inlet will be conveyed within a proposed 24" public storm sewer (**PR654**) across to the western side of the road where it will discharge into the existing 5' bottom roadside ditch at rates of 10.3 and 21.6 cfs in the 5 year and 100-year events, respectively. A riprap pad is located at the terminus of the storm sewer. Runoff bypassing the inlet continues south within the curb and gutter to downstream infrastructure.

Design Point 6

DP6 is located directly west of **DP5**, and represents the collection of flows from **DP4 and PR654** inside the existing, 5' bottom earthen swale, from which **Basin RD-3** is comprised of. This swale consists of undeveloped land covered by sparse prairie grasses and vegetation. Future infrastructure and/or maintenance may be required at this location. Combined runoffs for the 5 year and 100-year storms at the design point are 12.3 and 29.3 cfs, respectively, which continue south to downstream infrastructure.

Design Point 7

Basin A consists of approximately 9.83 acres of Lots 8, 9, 10, and Tract A, which are proposed commercial parcels of land located to the north on-site. Runoff from this basin (Q5=40.8, Q100=74.4 cfs) collects at the south-eastern end and is conveyed south into the FSD pond (**Pond 1**) at **DP9** through a proposed 42" private RCP storm sewer (**A1**) at the design point.

Design Point 8

Basin C consists of approximately 6.08 acres of Lots 11, 12, 13, 14, and 15, which are proposed, commercial parcels of land located to the north east on-site. Runoff from this basin (Q5=24.1, Q100=43.9 cfs) collects on the eastern side, which borders **Basin D,** and is conveyed south into the FSD pond (**Pond 1**) at **DP9** through a proposed 36" private RCP storm sewer (**C1**).

Design Point 9

Basin D consists of approximately 3.15 acres of a proposed FSD pond. Runoff from this basin (Q5=1.9, Q100=10.4 cfs) combines with flows from **DP7, DP8, and DP14** at 5 yr and 100 yr rates of 98.7 and 186.9 cfs, respectively**,** and drains to the southern end of the pond, where it is routed through the outlet structure into a proposed private 18" RCP storm sewer (**D1**) to discharge into **Basin RD-4** at 5 yr and 100 yr rates of 1.0 and 16.7 cfs, respectively. A rip rap pad is proposed at the terminus of the storm sewer. From this point the routed runoff will be directed south towards downstream infrastructure.

Design Point 10

Basin RD-3 consists of approximately 1.05 acres of existing 5' bottom earthen CDOT swale. Runoff from this basin (Q5=0.3, Q100=2.5 cfs) combines with flows from **DP6** at 5 yr and 100 yr rates of 14.0 and 35.4 cfs, respectively**,** and is conveyed under the road through dual proposed public 24" RCP culverts (**PR-DP10**). A rip rap pad is proposed at the terminus of the culvert.

Design Point 11

Basin 646R consists of approximately 0.75 acres of the east side of existing Marksheffel Road, located to the east of the site. This basin consists of an asphalt paved roadway surface and existing curb and gutter. Runoff from the basin (Q5=3.5, Q100=6.2 cfs) drains from the crown of the road down to the east side gutter, and then flows south until it combines with flowby from **DP5** and is collected by an existing Type R 5' inlet (**IN646:**Q5=3.4, Q100=4.7 cfs). Runoff collected through this inlet will be conveyed to the western side of the road by entering an 18" public storm sewer **PR646** where it will discharge into the existing 5' wide CDOT swale. The total combined 5 year and 100-year flows for this design point are 7.9 and 18.1 cfs, respectively. A riprap pad is located at the terminus of the storm sewer. Runoff bypassing the inlet continues south within the curb and gutter to downstream infrastructure.

Design Point 12

DP12 is located directly west of **DP11**, and represents the collection of flows from **PR646** and **PR-DP10** inside the existing, 5' bottom earthen swale in **Basin RD-4**. This swale currently consists of undeveloped land covered by sparse prairie grasses and vegetation. Combined runoffs for the 5 year and 100-year storms at this design point are 15.3 and 34.5 cfs, respectively, which continue south to downstream infrastructure.

Design Point 13

Basin 641L consists of approximately 1.58 acres of the west side of Marksheffel Road, located east of the site. This basin is mainly comprised of an asphalt paved roadway surface and existing curb and gutter. Runoff from the basin (Q5=5.8, Q100=10.4 cfs) is directed to a 5' Type R existing inlet **(IN640:**Q5=2.9, Q100=3.8 cfs**)** at **DP12**. Runoff collected by this inlet is conveyed to the 5' swale in **Basin RD-4** via a public 24" storm sewer, **PR640**. A riprap pad is located at the terminus of the storm sewer. Runoff bypassing the inlet continues south within the curb and gutter to downstream infrastructure.

Design Point 14

Basin B consists of approximately 8.39 acres of Lot 6 and Lot 7. These are proposed, commercial parcels of land located to the north west on-site. Runoff from this basin (Q5=32.3, Q100=58.9 cfs) collects on the eastern side and is conveyed south into the FSD pond (**Pond 1**) at **DP9** through a proposed 42" private RCP storm sewer (**B1**). A forebay is proposed at the terminus of the storm sewer.

Design Point 15

Basin F consists of approximately 9.14 acres of Lot 3, 4, and 5. These are proposed, commercial parcels of land located to the north west on-site. Runoff from this basin (Q5=30.3, Q100=55.3 cfs) collects on the eastern side and is conveyed east into the FSD pond (**Pond 2**) at **DP15**.

Design Point 16

Basin E consists of approximately 1.40 acres of a proposed FSD pond and associated structures. Runoff from this basin (Q5=0.9, Q100=4.7 cfs) combines with flows from **DP15** and drains to the south east end of the pond at peak flow rates of 31.0 and 59.0 cfs for the 5 year and 100-year events at **DP16**, respectively. The flow, which leave the pond through the outlet structure, into a proposed private 18" RCP storm sewer (**PR-DP16**) are discharged into **Basin RD-5** at 5 yr and 100 yr rates of 0.3 and 7.6 cfs, respectively. A rip rap pad is proposed at the terminus of the storm sewer. From this point the routed runoff will be directed south towards downstream infrastructure.

Design Point 17

Basin RD-4 consists of approximately 1.93 acres of the existing 5' earthen swale located to the east, off-site. Runoff from the basin (Q5=0.5, Q100=4.0 cfs) drains from the north to the south, while collecting with flows from **PR640, PRD1 (Pond 1), DP12, and Basin RD-4**. An existing public 36" RCP culvert (**PR639**) directs runoff under the Air Lane Drive entrance. The existing 36" RCP culvert will be replaced with proposed dual 24" RCP culverts (**PR-DP17**). The combined flow for the 5 year and 100-year events at the design point are 14.9 and 43.3 cfs, respectively. The proposed flow is significantly lower than the

existing flow at this design point [Q5=36.6, Q100=138.0 cfs] largely due to effects of the detained flows and drainage area reduction to the ditch. A rip rap pad is proposed at the terminus of the culvert. Flow from here will continue to head south in the 5' swale into the next basin.

Design Point 18

Basin 637R consists of approximately 0.91 acres of the eastern side of Marksheffel Road, and is located to the east of the site. This basin consists of a roadway surface and curb and gutter. Runoff from the basin (Q5=3.1, Q100=5.5 cfs) drains from the median on the west side into the east side gutter, and then flows south until it combines with flowby from **DP11** at 5 yr and 100 yr rates of 5.9 and 14.5 cfs, and is collected by an existing Type R 5' inlet at the design point (**IN636**:Q5=3.0, Q100=4.3 cfs**)**. Runoff collected through this inlet is conveyed to the western side of the road through an existing public 24" storm sewer (**PR636**) where it discharges into the existing 5' bottom swale. A riprap pad is located at the terminus of the storm sewer. Runoff bypassing the inlet continues south within the curb and gutter to downstream infrastructure.

Design Point 19

DP19 is located directly west of **DP18**, and represents the collection of flows from **DP16, DP17, and PR636,** inside the existing, 5' bottom earthen swale in CDOT's right of way. Combined runoffs for the 5 year and 100-year storms at this design point are 16.5 and 43.6 cfs, respectively. The runoff then continues south to downstream infrastructure.

Design Point 20

Basin K consists of approximately 13.08 acres of proposed parks and recreation area. Runoff from this basin (Q5=8.1, Q100=34.7 cfs) collects on the south-eastern side, which borders **Basin L,** and is conveyed south into the FSD pond (**Pond 4**) at **DP20** through a proposed 30" private RCP storm sewer (**K1**).

Design Point 21

Basin L consists of approximately 0.82 acres of a proposed FSD pond. Runoff from this basin (Q5=0.5, Q100=2.8 cfs) combines with flows from **DP20** and drains to the southern end of the pond. The combined flow for the 5 year and 100-year events at the design point are 9.0 and 39.2 cfs, respectively. The pond outfalls through a proposed private 18" RCP storm sewer (**L1**) at 5 yr and 100 yr rates of 0.0 and 10.0 cfs, respectively. A riprap pad is located at the terminus of the outlet structure. From this point the runoff will be directed south towards downstream infrastructure.

Design Point 22

Basin 631R consists of approximately 0.56 acres of the existing eastern side of Marksheffel Road, located to the southeast of the site. This basin consists of an asphalt paved roadway surface and existing curb and gutter. Runoff from the basin (Q5=2.4, Q100=4.2 cfs) drains from the median on the west side into the east side gutter, and then flows south until it combines with flowby from **DP18** at peak 5- and 100-year flow rates of 4.0 and 11.7 cfs, and is collected by an existing Type R 5' inlet at the design point (**IN630A**: Q5=2.5, Q100=4.1 cfs). Runoff collected through this inlet is conveyed to the western side of the road through an existing public 24" storm sewer (**PR630A**) where it discharges into another existing public 24" storm sewer (**PR630B**). Runoff bypassing the inlet continues south within the curb and gutter to downstream infrastructure.

Design Point 23

Basin 632L consists of approximately 1.21 acres of the existing western side of Marksheffel Road, located to the southeast of the site. This basin consists of an asphalt paved roadway surface and existing curb and gutter. Runoff from the basin (Q5=3.7, Q100=6.7 cfs) drains from the median on the east side into the west side gutter, and collects with flowby from **DP13** to reach peak runoffs of Q5=5.9 and Q100=11.6 cfs at **DP23**. It is collected by an existing Type R 15' inlet at the design point (**IN630B:** Q5=5.9, Q100=10.3 cfs). Runoff collected through this inlet is conveyed west through an existing public

24" storm sewer (**PR630B**). The storm sewer system then discharges into the existing water quality pond. A riprap pad is located at the terminus of the storm sewer. Runoff bypassing the inlet continues south within the curb and gutter to downstream infrastructure.

Design Point 24

Basin RD-5 consists of approximately 1.49 acres of the existing 5' earthen swale located to the east, off-site. Runoff from the basin (Q5=0.5, Q100=3.7 cfs) drains from the north to the south, while collecting with flows from **DP19.** This flow collects in an existing Type C area inlet and is conveyed south via 24" public RCP culvert **(PRE2)** into the existing water quality pond at 5 yr and 100 yr rates of 15.0 and 19.9 cfs, respectively. The combined flow for the 5 year and 100-year events at the design point are 14.8 and 40.5 cfs, respectively. The proposed flow is lower than the existing flow [Q5=35.3, Q100=131.1 cfs] at this design point. Future infrastructure and/or maintenance may be required at this design point since flows are still expected to overtop **PRE2** during the 100-year event. A riprap pad is located at the overtopping location that continues to the terminus of the storm sewer.

Design Point 25

Basin OS-2 consists of approximately 0.35 acres of the existing western side of Marksheffel Road, on the southeast side of the site, which curves and turns into U.S. Highway 94, located to the south of the site. This basin consists of an asphalt paved roadway surface with an existing curb and gutter along a portion of the road. Runoff from the basin (Q5=1.6, Q100=2.9 cfs) drains from the median on the south side into the north side gutter, and then drains east. It is then collected by an existing public 12" plastic corrugated pipe (**PRE1**) and conveyed north to a small concrete detention area, combining with flow from **PR630B and PRE2**. The combined 5 year and 100-year storm flows at the design point are 1.0 and 3.3 cfs, respectively. A riprap pad is located at the terminus of the plastic storm sewer. Runoff bypassing the inlet continues east within the curb and gutter to downstream infrastructure.

Design Point 26

DP26 represents the combination of flows from **DP23-DP25** at the outlet structure of the existing water quality pond on the western side of the pond. The inside of this pond is comprised of sparse prairie grasses and vegetation, and a concrete channel. The total flow at this design point for the 5 year and 100-year storm events is 17.4 and 26.8 cfs, respectively. Detention effects were not considered in this analysis because the pond was not designed for storage. The proposed flow reaching this pond is lower than the existing flow [Q5=42.2, Q100=149.5 cfs] at this design point. A rip rap pad is located at the terminus of the outlet structure.

Design Point 27

Basin M consists of approximately 8.02 acres of CDOT right of way, and is located on the south side of the site. This undeveloped basin is comprised primarily of sparse prairie grasses and vegetation. Runoff from the basin (Q5=2.2, Q100=16.4 cfs) drains from the western side of the basin east until it combines with flows from **DP26** at the design point. **Basin OS-3** consists of approximately 0.72 acres of the existing northern side of U.S. Highway 94, located to the south of the site. This basin consists of an asphalt paved roadway surface and existing grassy ditch on the north side of the road. Runoff from this basin (Q5=2.8, Q100=5.0 cfs) drains from the median on the south side into the aforementioned ditch to the north, and then flows east until it combines with flows from **Basin M, DP26, and PRL1**. The combined flows for the 5 year and 100-year storm events are 23.4 and 54.0 cfs, respectively, which is lower than the existing flow [Q5=47.4, Q100=177.1 cfs] at this design point. Flows collect in an existing public 42" CMP culvert (**E3**) and are conveyed to a directly connected storm sewer system that is proposed with the Reagan Ranch master development. In the interim condition, flows continue to be discharged onto the existing rip rap pad and broad, natural swale at rates less than historic. Upstream and downstream analyses for the existing and proposed conditions at this design point are provided in the Appendix. The headwater over depth ratio at the culvert entrance is less than 1.7 as required by CDOT. Flows are closely in accordance with anticipated interception rates at this location with the Reagan Ranch MDDP (see Appendix).

Design Point 28

Basin RD-1 consists of approximately 4.42 acres of an existing, triangular, earthen swale and paved roadway located to the west, on the east side of Highway 24, off-site. Runoff from the basin (Q5=8.2, Q100=16.6 cfs) drains from the north to the south and continues into **DP29**.

Design Point 29

Basin RD-2 consists of approximately 2.40 acres of the existing 5' earthen swale and paved roadway located to the west, on the east side of the highway, off-site. Runoff from the basin (Q5=0.7, Q100=5.3 cfs) combines with **DP28** and drains from the north to the south with 5 year and 100-year flows of 6.5 and 15.7 cfs, respectively. Flows continue into **DP33**.

Design Point 30

Basin G consists of approximately 4.69 acres of Lots 1 and 2, and CDOT Right of Way. CDOT will provide access to grading on-site. Lots 1 and 2 are proposed commercial parcels of land. Runoff from this basin (Q5=18.7, Q100=34.2 cfs) collects on the southern side, which borders **Basin I,** and is conveyed south into the FSD pond (Pond 3) at **DP32** through a proposed 30" private RCP storm sewer (**G1**).

Design Point 31

Basin J consists of approximately 4.87 acres of developed parks and recreation area, and is located to the south-west on-site. CDOT will provide access to grading on site. Runoff from this basin (Q5=2.8, Q100=12.1 cfs) collects on the south-western side, which borders **Basin I,** and is conveyed south into the FSD pond (Pond 3) at **DP32** through a proposed 30" private RCP storm sewer (**J1**). A riprap pad is located at the terminus of the storm sewer.

Design Point 32

Basin I consists of approximately 1.57 acres of a proposed FSD pond. Runoff from this basin (Q5=0.8, Q100=4.2 cfs) combines with flows from **DP30** and **DP31** and drains to the south-western end of the pond, where it collects into a proposed public 24" RCP storm sewer (**I1**) to discharge into **Basin H** at 5 yr and 100 yr rates of 0.2 and 8.6 cfs, respectively. A proposed riprap pad is located at the terminus of the outlet structure. The combined flow for the 5 year and 100-year events at the design point are 22.8 and 54.2 cfs, respectively. From this point, the runoff will be directed southwest towards downstream infrastructure.

Design Point 33

Basin H consists of approximately 8.09 acres of public right of way, and is located on the south side of the site. This undeveloped basin is comprised primarily of sparse prairie grasses and vegetation. Runoff from the basin (Q5=2.3, Q100=16.8 cfs) drains from the western side of the basin east until it combines with flows from **PRI1** at the existing public 48" CMP culvert (**E4**) at the southwestern end of the site. **Basin OS-4** consists of approximately 1.41 acres of the existing northern side of U.S. Highway 94, located to the south of the site. This basin consists of an asphalt paved roadway surface and existing grassy swale on the north side of the road. Runoff from this basin (Q5=6.6, Q100=11.8 cfs) drains from the median on the south side into the aforementioned swale to the north, and then flows east until it combines with flows from **Basin H** and **DP29**. The combined flows for the 5 year and 100-year storm events at the design point are 10.2 and 33.7 cfs, respectively. These flows are lower than the existing flows [Q5=10.4, Q100=51.1 cfs] at this design point. The headwater over depth ratio is less than 1.7 as required by CDOT. An upstream and downstream analysis at this design point can be found in the Appendix.

WATER QUALITY PROVISIONS AND MAINTENANCE

There are four Full Spectrum Detention (FSD) ponds being proposed for this site in order to reduce the fully developed flows from the site to pre-development levels and address detention and water quality. These ponds have been sized utilizing MHFD v4.03 from Urban Drainage and Flood Control District (UDFCD). These ponds are being constructed with an outlet control structure which limits the release rate of the pond through the use of orifices, weirs, and restrictor plates placed before the proposed outlet pipes.

Riprap aprons will be constructed to dissipate energy and prevent local scour at the outlet. These ponds have been sized to store the WQCV, EURV, and the flood control volumes for the 2, 5, 10, 25, 50, and 100 year storm events. The WQCV will be slowly released over 40 hours. The 100 year will drain in less than 120 hours.

Pond 1 will treat approximately 27.46 acres of developed land and the maximum 100-Yr storage volume is 3.850 acre-feet. Pond 1 is being constructed with an outlet control structure and a proposed 18" RCP outlet pipe. Watershed imperviousness is 84.9%. An overflow emergency weir is proposed along the east embankment to safely convey flows to the nearby roadside swale in the event of outlet clogging. The emergency overflow weir will have a crest length of 68 feet, and a spillway design flow depth of 0.67 feet.

FSD Pond 1	**WQCV**	**EURV**	**5 Year**	**100 Year**
Maximum Volume Stored (acre-ft)	0.827	3.127	2.637	3.850
Maximum WS Elevation	6337.81	6341.55	6340.96	6342.33
Peak Inflow (cfs)(calc)			63.9	115.7
Peak Outflow (cfs)	0.4	0.8	0.8	18.6

Pond 2 will treat approximately 10.54 acres of developed land and the maximum 100-Yr storage volume is 1.392 acre-feet. Pond 2 is being constructed with an outlet control structure and a proposed 18" RCP outlet pipe. Watershed imperviousness is 83.3%. An overflow emergency weir is proposed along the south embankment to safely convey flows to the nearby swale in the event of outlet clogging. The emergency overflow weir will have a crest length of 10 feet, and a spillway design flow depth of 0.97 feet.

FSD Pond 2	**WQCV**	**EURV**	**5 Year**	**100 Year**
Maximum Volume Stored (acre-ft)	0.310	1.171	0.962	1.392
Maximum WS Elevation	6346.43	6348.43	6348.01	6348.87
Peak Inflow (cfs)(calc)			22.7	41.4
Peak Outflow (cfs)	0.2	0.3	0.3	7.6

Pond 3 will treat approximately 11.13 acres of developed land and the maximum 100-Yr storage volume is 0.840 acre-feet. Pond 3 is being constructed with an outlet control structure and a proposed 24" RCP outlet pipe. Watershed imperviousness is 46.7%. An overflow emergency weir is proposed along the south embankment to safely convey flows to the nearby swale in the event of outlet clogging. The emergency overflow weir will have a crest length of 6 feet, and a spillway design flow depth of 0.97 feet.

FSD Pond 3	**WQCV**	**EURV**	**5 Year**	**100 Year**
Maximum Volume Stored (acre-ft)	0.184	0.591	0.531	0.840
Maximum WS Elevation	6323.94	6324.83	6324.72	6325.30
Peak Inflow (cfs)(calc)			10.1	26.2
Peak Outflow (cfs)	0.1	0.2	0.2	8.6

Pond 4 will treat approximately 13.90 acres of developed land and the maximum 100-Yr storage volume is 0.283 acre-feet. Pond 4 is being constructed with an outlet control structure and a proposed 18" RCP outlet pipe. Watershed imperviousness is 12.6%. An overflow emergency weir is proposed along the east embankment to safely convey flows to the nearby swale in the event of outlet clogging. The emergency overflow weir will have a crest length of 2.0 feet, and a spillway design flow depth of 0.96 feet.

FSD Pond 4	**WQCV**	**EURV**	**5 Year**	**100 Year**
Maximum Volume Stored (acre-ft)	0.095	0.138	0.107	0.283
Maximum WS Elevation	6334.95	6335.15	6335.02	6335.66
Peak Inflow (cfs)(calc)			2.1	14.5
Peak Outflow (cfs)	0.0	0.0	0.0	10.0

The detention ponds are private and shall be maintained by the Crossroads Metropolitan District No. 1. It is important to note that the peak flow rate from the four ponds are less than those expected to reach the existing culverts and thus the development of the property is not anticipated to negatively affect the downstream facilities. Due to the conservative design of Ponds 1 and 2, depending on the future development at each lot, Ponds 1 and 2 may be adjusted in size and location for the Final Drainage Report.

INTER-BASIN TRANSFER JIMMY CAMP CREEK TO PETERSON FIELD

It should be noted that the proposed grading (disturbance) of the development is 64.89 acres and will be comprised of 44.21 acres of Crossroads Subdivision Filing No.1, 18.6 acres of City of Colorado Springs property and 2.08 acres of ROW, and redistributes portions of the historic watershed between Jimmy Camp Creek and Peterson Field Drainage Basins. **Although this transfer occurs, proposed flows reaching the existing downstream drainage facilities are less than historic. The following is a summary of the transfer that occurs.**

Prior to development (grading) approximately 51.67 acres of the 64.89 acres fell within the Jimmy Camp Creek watershed with the remaining 13.22 acres in the Peterson Field Watershed.

After development (grading), approximately 1.50 acres (0.63 acres of Jimmy Camp Creek transferred to Peterson Field adjacent to Highway 94 and 2.13 acres of Peterson Field transferred to Jimmy Camp Creek adjacent to Highway 24; thus, a cumulative transfer of 1.50 acres to Jimmy Camp Creek) will be redirected from the Peterson Field Drainage Basin into Jimmy Camp Creek Drainage Basin.

The 1.50 cumulative transferred acres to Jimmy Camp Creek (Total = 53.17 acres) will be accounted for in the Drainage Fees, along with the 11.72 acres of Peterson Field. Dialog with the Deputy Groundwater Commissioner, District 10 of the Colorado Division of Water Resource department concerning the inter-basin transfer was conducted and the response provided was that due to the small scale of the re-delineation, the Colorado Division of Water Resource department deems the transfer acceptable (email in appendix).

This modification change is driven by grading constraints associated with the lot layout and existing topography coupled with a sensible utility layout.

It should be noted that the proposed Full Spectrum Pond No. 3 and 4 provides detention and releases at or below the historic discharge rates thereby reducing any flood management impacts from the inter-basin transfer.

EROSION CONTROL

It is the policy of El Paso County that a grading and erosion control plan be submitted with the drainage report. Proposed silt fence, vehicle traffic control, reseeding and mulching, straw bale barriers, and temporary sediment basins are proposed as a few of the erosion control measures.

DRAINAGE & BRIDGE FEES

Crossroads North subdivision lays within the Jimmy Camp Creek and Peterson Field Drainage Basins. Crossroads North will be platted in one or multiple phases or final plats. Crossroads North will be a re-plat of Hillcrest Acres, originally platted in 1960. The County Drainage Fee program did not exist in 1960, therefore drainage and bridge fees will be required to be paid. Impervious acreages are based on 61.9% imperviousness (See Appendix for site imperviousness calculations). The 2022 El Paso County drainage fees for the subject site are as follows:

			Jimmy Camp Creek					
Drainage Fees:	53.17	x	61.9%	x	$21,134.00	=		$ 695,567.07
Bridge Fees:	53.17	x	61.9%	x	$989.00	=		$ 32,550.20
							Subtotal	$ 728,117.27
			Peterson Field					
Drainage Fees:	11.72	x	61.9%	x	$15,243.00	=		$ 110,583.09
Bridge Fees:	11.72	x	61.9%	x	$1,156.00	=		$ 8,386.41
							Subtotal	$ 118,969.50
							TOTAL:	**$ 847,086.77**

SUMMARY

Development of Crossroads North 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, as well as provide detention and water quality treatment. 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. However, this MDDP & PDR should be used as a guideline for release of flows offsite, and final Full Spectrum Detention Pond sizing. 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.) Web Soil Survey, USDA NRCS Soils Map https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

4.) FEMA flood Map Service Center, Federal Emergency Management Agency https://msc.fema.gov/portal/home

5.) "Master Development Drainage Plan Preliminary and Final Drainage Report Hillcrest Acres Subdivision Parts Depot, El Paso County", last revised February 9, 2017, by Kiowa Engineering Corporation

6.) "Jimmy Camp Creek - Drainage Basin Planning Study Development of Alternatives & Design of Selected Plan Report" dated March 9, 2015 by Kiowa Engineering Corporation.

7.) "Marksheffel Road South, Link Road to US-24, Final Drainage Report" dated January 2017 by HDR Engineering.

8.) "Master Development Drainage Report for Reagan Ranch & Final Drainage Report for High Plains at Reagan Ranch" dated February 2021 by Matrix Design Group.

APPENDIX

VICINITY MAP

VICINITY MAP

N.T.S.

SOILS MAP

Soil Map—El Paso County Area, Colorado
(CROSSROADS)

Map Scale: 1:6,730 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 300 600 1200 1800

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

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

Special Point Features

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

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 18, Jun 5, 2020

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

Date(s) aerial images were photographed: Aug 19, 2018—Sep 23, 2018

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	95.2	100.0%
Totals for Area of Interest		**95.2**	**100.0%**

FIRM PANELS

MAP SCALE 1" = 500'

0 500 1000 FEET

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0756G

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO

AND INCORPORATED AREAS

PANEL 756 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0756	G
EL PASO COUNTY	080059	0756	G

Notice: This map was reissued on 05/16/2020 to make a correction. This version replaces any previous versions. See the Notice-to-User Letter that accompanied this correction for details.

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER
08041C0756G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

MAP SCALE 1" = 500'

0 500 1000 FEET

NFIP

PANEL 0758G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 758 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0758	G
EL PASO COUNTY	080059	0758	G

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER
08041C0758G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

MAP SCALE 1" = 500'

0 500 1000 FEET

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0754G

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 754 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0754	G
EL PASO COUNTY	080059	0754	G

Notice: This map was released on 05/18/2020 to make a correction. This version replaces any previous versions. See the Notice-to-User Letter that accompanied this correction for details.

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER
08041C0754G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

HYDROLOGIC CALCULATIONS

CROSSROADS NORTH
EXISTING CONDITIONS DRAINAGE CALCULATIONS
(Area Runoff Coefficient Summary)

			STREETS/DEVELOPED			*DEVELOPED LOTS*			*UNDEVELOPED/LANDSCAPE*			*RUNOFF COEFFICIENT*	
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}
A	**203381.3256**	4.67	0.00	0.90	0.96	0.00	0.59	0.70	4.67	0.08	0.35	**0.08**	**0.35**
B	**158516.3618**	3.64	0.00	0.90	0.96	0.00	0.30	0.50	3.64	0.08	0.35	**0.08**	**0.35**
C	**109239.8277**	2.51	1.59	0.90	0.96	0.00	0.30	0.50	0.92	0.08	0.35	**0.60**	**0.74**
D	**91440.6938**	2.10	0.91	0.90	0.96	0.00	0.30	0.50	1.19	0.08	0.35	**0.43**	**0.61**
E	**471391.0309**	10.82	0.00	0.90	0.96	0.00	0.30	0.50	10.82	0.08	0.35	**0.08**	**0.35**
F	**43435.2924**	1.00	0.31	0.90	0.96	0.00	0.30	0.50	0.69	0.08	0.35	**0.34**	**0.54**
G	**391802.4147**	8.99	0.00	0.90	0.96	0.00	0.30	0.50	8.99	0.08	0.35	**0.08**	**0.35**
H	**654546.7604**	15.03	0.00	0.90	0.96	0.00	0.30	0.50	15.03	0.08	0.35	**0.08**	**0.35**
I	**183810.6797**	4.22	0.00	0.90	0.96	0.00	0.30	0.50	4.22	0.08	0.35	**0.08**	**0.35**
J	**125261.6321**	2.88	0.00	0.90	0.96	0.00	0.45	0.59	2.88	0.08	0.35	**0.08**	**0.35**
J1	**116434.8196**	2.67	0.00	0.90	0.96	0.00	0.45	0.59	2.67	0.08	0.35	**0.08**	**0.35**
K	**145033.8974**	3.33	0.00	0.90	0.96	0.00	0.45	0.59	3.33	0.08	0.35	**0.08**	**0.35**
L	**15414.997**	0.35	0.35	0.90	0.96	0.00	0.45	0.59	0.00	0.08	0.35	**0.90**	**0.96**
M	**606580.5543**	13.93	0.00	0.90	0.96	0.00	0.45	0.59	13.93	0.08	0.35	**0.08**	**0.35**
N	**31084.7798**	0.71	0.71	0.90	0.96	0.00	0.45	0.59	0.00	0.08	0.35	**0.90**	**0.96**
O	**501674.7436**	11.52	0.00	0.90	0.96	0.00	0.45	0.59	11.52	0.08	0.35	**0.08**	**0.35**
P	**399360.1957**	9.17	0.00	0.90	0.96	0.00	0.45	0.59	9.17	0.08	0.35	**0.08**	**0.35**
Q	**61495.5769**	1.41	1.41	0.90	0.96	0.00	0.45	0.59	0.00	0.08	0.35	**0.90**	**0.96**
631R	*N/A*	*0.56*	*0.56*	*0.90*	*0.96*	*0.00*	*0.45*	*0.59*	*0.00*	*0.08*	*0.35*	***0.90***	***0.96***
632L	*N/A*	*1.21*	*1.21*	*0.90*	*0.96*	*0.00*	*0.45*	*0.59*	*0.00*	*0.08*	*0.35*	***0.90***	***0.96***
637R	*N/A*	*0.91*	*0.91*	*0.90*	*0.96*	*0.00*	*0.45*	*0.59*	*0.00*	*0.09*	*0.36*	***0.90***	***0.96***
641L	*N/A*	*1.58*	*1.58*	*0.90*	*0.96*	*0.00*	*0.45*	*0.59*	*0.00*	*0.09*	*0.36*	***0.90***	***0.96***
646R	*N/A*	*0.75*	*0.75*	*0.90*	*0.96*	*0.00*	*0.42*	*0.57*	*0.00*	*0.09*	*0.36*	***0.90***	***0.96***
654R	*N/A*	*1.62*	*1.62*	*0.90*	*0.96*	*0.00*	*0.39*	*0.55*	*0.00*	*0.09*	*0.36*	***0.90***	***0.96***
661L	*N/A*	*0.07*	*0.07*	*0.90*	*0.96*	*0.00*	*0.36*	*0.53*	*0.00*	*0.09*	*0.36*	***0.90***	***0.96***
662L	*N/A*	*1.21*	*1.21*	*0.90*	*0.96*	*0.00*	*0.33*	*0.51*	*0.00*	*0.09*	*0.36*	***0.90***	***0.96***
664R	*N/A*	*1.09*	*1.09*	*0.90*	*0.96*	*0.00*	*0.30*	*0.49*	*0.00*	*0.09*	*0.36*	***0.90***	***0.96***

Italized values taken from Marksheffel FDR

Calculated by: GT
Date: 9/30/2022
Checked by: VAS

CROSSROADS NORTH
EXISTING CONDITIONS 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**	**C_5**	**C_{100}**	**C_5**	**Length**	**Height**	**T_C**	**Length**	**Slope**	**Velocity**	**T_t**	**TOTAL**	**CHECK**	**I_5**	**I_{100}**	**Q_5**	**Q_{100}**
	(Acres)	*From DCM Table 5-1*			*(ft)*	*(ft)*	*(min)*	*(ft)*	*(%)*	*(fps)*	*(min)*	*(min)*	*(min)*	*(in/hr)*	*(in/hr)*	*(c.f.s.)*	*(c.f.s.)*
A	4.67	0.08	0.35	0.08	100	16	7.4	660	7.6%	1.9	5.7	13.1	14.2	3.7	6.3	**1.4**	**10.2**
B	3.64	0.08	0.35	0.08	100	7	9.7	725	7.2%	1.9	6.4	16.1	14.6	3.4	5.7	**1.0**	**7.3**
C	2.51	0.60	0.74	0.90	100	2.5	2.7	800	2.9%	1.2	11.1	13.8	15.0	3.6	6.1	**5.5**	**11.3**
D	2.10	0.43	0.61	0.90	100	2	2.9	600	3.7%	1.3	7.5	10.3	13.9	4.1	6.8	**3.7**	**8.8**
E	10.82	0.08	0.35	0.08	100	10	8.6	1195	4.3%	1.4	13.8	22.4	17.2	2.9	4.9	**2.5**	**18.6**
F	1.00	0.34	0.54	0.90	100	2	2.9	285	1.4%	0.8	5.7	8.6	12.1	4.4	7.3	**1.5**	**3.9**
G	8.99	0.08	0.35	0.08	100	8	9.3	950	3.7%	1.3	11.8	21.1	15.8	3.0	5.1	**2.2**	**15.9**
H	15.03	0.08	0.35	0.08	100	3	12.8	700	2.6%	1.1	10.4	23.2	14.4	2.9	4.8	**3.4**	**25.3**
I	4.22	0.08	0.35	0.08	100	6	10.2	600	5.3%	1.6	6.2	16.4	13.9	3.4	5.7	**1.1**	**8.4**
J	2.88	0.08	0.35	0.08	100	4	11.7	621	6.9%	1.8	5.6	17.3	14.0	3.3	5.6	**0.8**	**5.6**
J1	2.67	0.08	0.35	0.08	100	6	10.2	900	5.1%	1.6	9.5	19.7	15.6	3.1	5.2	**0.7**	**4.9**
K	3.33	0.08	0.35	0.08	100	8	9.3	650	6.8%	1.8	5.9	15.2	14.2	3.5	5.9	**0.9**	**6.8**
L	0.35	0.90	0.96	0.90	30	0.5	1.7	900	0.0%	0.0	0.0	1.7	5.0	5.2	8.7	**1.6**	**2.9**
M	13.93	0.08	0.35	0.08	100	8	9.3	680	7.9%	2.0	5.7	15.0	14.3	3.5	5.9	**3.9**	**28.8**
N	0.71	0.90	0.96	0.90	25	0.5	1.4	0	0.0%	0.0	0.0	1.4	5.0	5.2	8.7	**3.3**	**5.9**
O	11.52	0.08	0.35	0.08	100	6	10.2	1040	4.8%	1.5	11.3	21.5	16.3	3.0	5.0	**2.7**	**20.2**
P	9.17	0.08	0.35	0.08	100	4	11.7	1195	1.1%	0.7	27.3	38.9	17.2	3.3	5.6	**2.4**	**17.9**
Q	1.41	0.90	0.96	0.90	90	1.8	2.7	0	0.0%	0.0	0.0	2.7	5.0	5.2	8.7	**6.6**	**11.8**
631R	*0.56*	*0.90*	*0.96*	0.90	30	0.1	3.4	200	1.8%	0.9	3.5	6.9	9.8	4.7	7.9	**2.4**	**4.2**
632L	*1.21*	*0.90*	*0.96*	0.90	53	3.0	1.5	1000	1.8%	0.9	17.7	19.2	9.8	4.2	7.0	**4.5**	**8.1**
637R	*0.91*	*0.90*	*0.96*	0.90	77	3.0	2.0	900	0.5%	1.4	10.6	12.6	16.2	3.8	6.3	**3.1**	**5.5**
641L	*1.58*	*0.90*	*0.96*	0.90	47	1.0	1.9	1500	2.3%	3.0	8.2	10.2	13.0	4.1	6.9	**5.8**	**10.4**
646R	*0.75*	*0.90*	*0.96*	0.90	41	1.0	1.7	78	1.8%	2.7	0.5	2.2	5.0	5.2	8.7	**3.5**	**6.2**
654R	*1.62*	*0.90*	*0.96*	0.90	91	5.0	2.0	1000	4.3%	4.1	4.0	6.0	16.1	4.9	8.2	**7.1**	**12.8**
661L	*0.07*	*0.90*	*0.96*	0.90	82	3.0	2.1	100	2.7%	3.3	0.5	2.6	5.0	5.2	8.7	**0.3**	**0.6**
662L	*1.21*	*0.90*	*0.96*	0.90	75	3.0	2.0	800	4.6%	4.3	3.1	5.1	14.9	5.1	8.6	**5.6**	**10.0**
664R	*1.09*	*0.90*	*0.96*	0.90	78	3.0	2.1	600	5.3%	4.6	2.2	4.2	5.0	5.2	8.7	**5.1**	**9.1**

* Intensity equations assume a minimum travel time of 5 minutes.
Italized values taken from Marksheffel FDR

Calculated by: GT
Date: 9/30/2022
Checked by: VAS

CROSSROADS NORTH
EXISTING CONDITIONS DRAINAGE CALCULATIONS
(Basin Routing Summary)

From Area Runoff Coefficient Summary				OVERLAND				PIPE / CHANNEL FLOW				Time of Travel (T_t)	INTENSITY *		TOTAL FLOWS		
DESIGN POINT	CONTRIBUTING BASINS/PIPES	CA_5	CA_{100}	C_5	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.)	COMMENTS
1	664R	0.98	1.05									5.0	5.2	8.7	5.1	9.1	EX 5' CDOT TYPE R AG INLET
				Basin 664R Tc was used													
2	662L	1.09	1.16									5.1	5.1	8.6	5.6	10.0	EX 5' CDOT TYPE R AG INLET
				Basin 662L Tc was used													
3	FBIN662, 661L	0.57	0.79				5.1	50	2.7%	3.3	0.3	5.3	5.1	8.5	2.9	6.7	EX 5' CDOT TYPE R AG INLET
				Basin 662L Tc was used													
4	PR664, PR662, PR661, A	1.85	2.84									9.2	4.3	7.1	7.9	20.3	EX 5' BTM EARTH TRAP CHANNEL
				Avg DP3 and Basin A Tc was used													
5	FBIN664, 654R	2.11	2.62									6.0	4.9	8.2	10.3	21.6	EX 5' CDOT TYPE R AG INLET
				Basin 654R Tc was used													
6	DP4, PR654, B	2.96	4.77				9.2	520	5.0%	1.6	5.5	14.8	3.5	6.0	10.5	28.4	EX 5' BTM EARTH TRAP CHANNEL
				Design Pt 4 Tc was used													
7	FBIN654, 646R	1.97	2.69				6.0	800	2.0%	2.8	4.7	10.7	4.0	6.8	7.9	18.2	EX 5' CDOT TYPE R AG INLET
				Basin 654R Tc was used													
8	C, D	2.42	3.13				13.8					14.4	3.6	6.0	8.6	18.8	ENTERS PROPERTY FROM CDOT ROW
				Basin C Tc was used													
9	DP6, DP8, E, PR646	7.09	12.39									17.2	3.3	5.6	23.5	69.0	EX 5' BTM EARTH TRAP CHANNEL
				Basin E Tc was used													
10	H	1.20	5.26									23.2	2.9	4.8	3.4	25.3	LOCALIZED LOWPOINT
				Basin H Tc was used													
11	F, G, DP10	2.26	8.95									21.1	3.0	5.1	6.8	45.2	EX 5' BTM EARTH TRAP CHANNEL
				Basin G Tc was used													
12	641L	1.42	1.52									10.2	4.1	6.9	5.8	10.4	EX 5' CDOT TYPE R AG INLET
				Basin 641L Tc was used													
13	DP9, DP11, PR640, I	10.39	23.37				17.2					15.0	3.5	5.9	36.6	138.0	EX 36" CULVERT
				Design Pt 9 Tc was used													
14	FBIN646, 637R	1.94	2.86				10.7	871	0.5%	1.4	10.3	21.0	3.0	5.1	5.9	14.5	EX 5' CDOT TYPE R AG INLET
				Design Pt 7 Tc was used													
15	DP13, J, PR636	11.61	25.22				15.0	200	0.5%	1.4	2.4	17.4	3.3	5.5	38.3	139.7	EX 5' BTM EARTH TRAP CHANNEL
				Design Pt 13 Tc was used													
16	DP15, J1	11.83	26.16				17.4	550	1.3%	2.3	4.1	21.4	3.0	5.0	35.3	131.1	EX CDOT TYPE C AREA INLET W/RIPRAP BYPASS RUNDOWN AND 24" RCP
				Design Pt 15 Tc was used													
17	FBIN636, 631R	1.45	2.55				21.0	650	1.5%	2.4	4.5	25.4	2.7	4.6	4.0	11.7	EX 5' CDOT TYPE R AG INLET
				Design Point 14 Tc was used													
18	FBIN640, 632L	1.80	2.13				10.2	986	1.1%	2.1	8.0	18.1	3.2	5.4	5.8	11.6	EX 5' CDOT TYPE R AG INLET
				Design Pt 12 Tc was used													
19	FBIN630B, L	0.33	0.57									5.0	5.2	8.7	1.7	4.9	EX 12" PLASTIC CORR PIPE
				Basin L Tc was used													
20	DP16, PR630B, PRE1, K	14.23	30.02				21.4	100	9.5%	6.2	0.3	21.7	3.0	5.0	42.2	149.5	EX WQ POND
				Design Pt 16 was used													
21	DP20, M, N	15.98	35.58									21.7	3.0	5.0	47.4	177.1	EX 42" RCP
				Design Pt 20 was used													
22	O, P, Q	2.93	8.59									14.8	3.5	5.9	10.4	51.1	EX 48" CMP
				Weighted Tc was used													

CROSSROADS NORTH
EXISTING CONDITIONS DRAINAGE CALCULATIONS
(Storm Sewer Routing Summary)

PIPE RUN	*Contributing Pipes/Design Points/Struct*	*Equivalent CA_5*	*Equivalent CA_{100}*	*Maximum T_C*	*Intensity**		*Flow*	
					I_5	*I_{100}*	*Q_5*	*Q_{100}*
664	**IN664R**	0.52	0.39	5.0	5.2	8.7	**2.7**	**3.4**
662	**IN662L**	0.58	0.44	5.1	5.1	8.6	**3.0**	**3.8**
661	**IN661L**	0.37	0.38	5.3	5.1	8.5	**1.9**	**3.2**
654	**IN654**	0.82	0.66	6.0	4.9	8.2	**4.0**	**5.4**
646	**IN646**	0.84	0.69	10.7	4.0	6.8	**3.4**	**4.7**
639	**IN639**	10.40	23.36	15.0	3.5	5.9	**36.6**	**138.0**
640	**IN640**	0.71	0.55	10.2	4.1	6.9	**2.9**	**3.8**
636	**IN636**	0.99	0.85	21.0	3.0	5.1	**3.0**	**4.3**
630A	**IN630A**	0.92	0.90	25.4	2.7	4.6	**2.5**	**4.1**
630B	**IN630B**	1.79	1.90	18.1	3.2	5.4	**5.8**	**10.3**
E1	**DP19**	0.34	0.80	5.0	5.2	8.7	**1.8**	**6.9**
E2	**INDP16**	3.95	3.95	21.4	3.0	5.0	**11.8**	**19.8**
E3	**DP21**	15.98	35.58	21.7	3.0	5.0	**47.4**	**177.1**
E4	**DP22**	2.93	8.59	14.8	3.5	5.9	**10.4**	**51.1**

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

Calculated by: GT

DP - Design Point

FB- Flow By from Design Point

Date: 9/30/2022

EX - Existing Design Point

IN- Inlet

Checked by: VAS

CROSSROADS NORTH
PROPOSED CONDITIONS DRAINAGE CALCULATIONS
(Area Runoff Coefficient Summary)

			STREETS/DEVELOPED			*DEVELOPED LOTS*			*UNDEVELOPED/LANDSCAPE*			*RUNOFF COEFFICIENT*	
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}**
A	**428271.2465**	9.83	9.83	0.81	0.88	0.00	0.59	0.70	0.00	0.08	0.35	**0.81**	**0.88**
B	**365581.662**	8.39	8.39	0.81	0.88	0.00	0.30	0.50	0.00	0.08	0.35	**0.81**	**0.88**
C	**264869.9111**	6.08	6.08	0.81	0.88	0.00	0.30	0.50	0.00	0.08	0.35	**0.81**	**0.88**
D	**137241.3936**	3.15	0.00	0.81	0.88	0.00	0.30	0.50	3.15	0.12	0.39	**0.12**	**0.39**
E	**60949.608**	1.40	0.00	0.81	0.88	0.00	0.30	0.50	1.40	0.12	0.39	**0.12**	**0.39**
F	**397984.6276**	9.14	9.14	0.81	0.88	0.00	0.30	0.50	0.00	0.08	0.35	**0.81**	**0.88**
G	**204093.9133**	4.69	4.69	0.81	0.88	0.00	0.30	0.50	0.00	0.08	0.35	**0.81**	**0.88**
H	**352603.9008**	8.09	0.00	0.81	0.88	0.00	0.30	0.50	8.09	0.08	0.35	**0.08**	**0.35**
I	**68565.9281**	1.57	0.00	0.81	0.88	0.00	0.30	0.50	1.57	0.12	0.39	**0.12**	**0.39**
J	**212127.4525**	4.87	0.00	0.81	0.88	4.87	0.16	0.41	0.00	0.08	0.35	**0.16**	**0.41**
K	**569681.9635**	13.08	0.00	0.81	0.88	13.08	0.16	0.41	0.00	0.08	0.35	**0.16**	**0.41**
L	**35931.1004**	0.82	0.00	0.81	0.88	0.00	0.45	0.59	0.82	0.12	0.39	**0.12**	**0.39**
M	**349548.65**	8.02	0.00	0.81	0.88	0.00	0.45	0.59	8.02	0.08	0.35	**0.08**	**0.35**
OS-1	**255171.6725**	5.86	0.00	0.81	0.88	0.00	0.45	0.59	5.86	0.08	0.35	**0.08**	**0.35**
RD-1	**192546.4816**	4.42	2.55	0.90	0.96	0.00	0.45	0.59	1.87	0.08	0.35	**0.55**	**0.67**
RD-2	**104543.0176**	2.40	0.00	0.81	0.88	0.00	0.45	0.59	2.40	0.08	0.35	**0.08**	**0.35**
RD-3	**45716.7287**	1.05	0.00	0.81	0.88	0.00	0.45	0.59	1.05	0.08	0.35	**0.08**	**0.35**
RD-4	**83963.847**	1.93	0.00	0.81	0.88	0.00	0.45	0.59	1.93	0.08	0.35	**0.08**	**0.35**
RD-5	**64914.6666**	1.49	0.00	0.81	0.88	0.00	0.45	0.59	1.49	0.08	0.35	**0.08**	**0.35**
OS-2	**15414.997**	0.35	0.35	0.90	0.96	0.00	0.45	0.59	0.00	0.08	0.35	**0.90**	**0.96**
OS-3	**31245.3505**	0.72	0.72	0.90	0.96	0.00	0.45	0.59	0.00	0.08	0.35	**0.90**	**0.96**
OS-4	**61495.5769**	1.41	1.41	0.90	0.96	0.00	0.45	0.59	0.00	0.08	0.35	**0.90**	**0.96**
631R	*N/A*	*0.56*	*0.56*	*0.90*	*0.96*	*0.00*	*0.45*	*0.59*	*0.00*	*0.08*	*0.35*	***0.90***	***0.96***
632L	*N/A*	*1.21*	*1.21*	*0.90*	*0.96*	*0.00*	*0.45*	*0.59*	*0.00*	*0.08*	*0.35*	***0.90***	***0.96***
637R	*N/A*	*0.91*	*0.91*	*0.90*	*0.96*	*0.00*	*0.45*	*0.59*	*0.00*	*0.09*	*0.36*	***0.90***	***0.96***
641L	*N/A*	*1.58*	*1.58*	*0.90*	*0.96*	*0.00*	*0.45*	*0.59*	*0.00*	*0.09*	*0.36*	***0.90***	***0.96***
646R	*N/A*	*0.75*	*0.75*	*0.90*	*0.96*	*0.00*	*0.42*	*0.57*	*0.00*	*0.09*	*0.36*	***0.90***	***0.96***
654R	*N/A*	*1.62*	*1.62*	*0.90*	*0.96*	*0.00*	*0.39*	*0.55*	*0.00*	*0.09*	*0.36*	***0.90***	***0.96***
661L	*N/A*	*0.07*	*0.07*	*0.90*	*0.96*	*0.00*	*0.36*	*0.53*	*0.00*	*0.09*	*0.36*	***0.90***	***0.96***
662L	*N/A*	*1.21*	*1.21*	*0.90*	*0.96*	*0.00*	*0.33*	*0.51*	*0.00*	*0.09*	*0.36*	***0.90***	***0.96***
664R	*N/A*	*1.09*	*1.09*	*0.90*	*0.96*	*0.00*	*0.30*	*0.49*	*0.00*	*0.09*	*0.36*	***0.90***	***0.96***

Italized values taken from Marksheffel FDR

Calculated by: TAU
Date: 8/23/2023
Checked by: VAS

CROSSROADS NORTH
PROPOSED CONDITIONS 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**	**C_5**	**C_{100}**	**C_5**	**Length**	**Height**	**T_C**	**Length**	**Slope**	**Velocity**	**T_t**	**TOTAL**	**CHECK**	**I_5**	**I_{100}**	**Q_5**	**Q_{100}**
	(Acres)	*From DCM Table 5-1*			*(ft)*	*(ft)*	*(min)*	*(ft)*	*(%)*	*(fps)*	*(min)*	*(min)*	*(min)*	*(in/hr)*	*(in/hr)*	*(c.f.s.)*	*(c.f.s.)*
A	9.83	0.81	0.88	0.81	50	4	1.9	900	5.2%	4.5	3.3	5.2	15.3	5.1	8.6	**40.8**	**74.4**
B	8.39	0.81	0.88	0.81	50	3	2.0	602	1.2%	2.2	4.6	6.6	13.6	4.8	8.0	**32.3**	**58.9**
C	6.08	0.81	0.88	0.81	50	1	2.9	410	1.2%	2.2	3.1	6.0	12.6	4.9	8.2	**24.1**	**43.9**
D	3.15	0.12	0.39	0.12	55	8	5.4	0	0.0%	0.0	0.0	5.4	10.3	5.0	8.5	**1.9**	**10.4**
E	1.40	0.12	0.39	0.12	40	10	3.9	0	0.0%	0.0	0.0	5.0	10.2	5.2	8.7	**0.9**	**4.7**
F	9.14	0.81	0.88	0.81	50	0.25	4.7	800	1.4%	2.4	5.6	10.2	14.7	4.1	6.9	**30.3**	**55.3**
G	4.69	0.81	0.88	0.81	50	2	2.3	668	2.5%	3.2	3.5	5.9	14.0	4.9	8.3	**18.7**	**34.2**
H	8.09	0.08	0.35	0.08	200	16	13.1	690	1.4%	1.8	6.4	19.5	14.9	3.5	5.9	**2.3**	**16.8**
I	1.57	0.12	0.39	0.12	50	3.75	6.4	0	0.0%	0.0	0.0	6.4	10.3	4.1	6.9	**0.8**	**4.2**
J	4.87	0.16	0.41	0.16	75	1	13.4	685	3.4%	3.7	3.1	16.5	14.2	3.6	6.0	**2.8**	**12.1**
K	13.08	0.16	0.41	0.16	50	2	7.6	770	2.1%	2.9	4.5	12.0	14.6	3.8	6.5	**8.1**	**34.7**
L	0.82	0.12	0.39	0.12	25	6	3.1	0	0.0%	0.0	0.0	5.0	10.1	5.2	8.7	**0.5**	**2.8**
M	8.02	0.08	0.35	0.08	195	16	12.8	780	1.0%	0.7	18.3	31.2	15.4	3.5	5.8	**2.2**	**16.4**
OS-1	5.86	0.08	0.35	0.08	50	8	5.2	955	0.8%	0.6	24.8	30.1	15.6	3.5	5.8	**1.6**	**11.9**
RD-1	4.42	0.55	0.67	0.55	100	6	5.5	1570	2.4%	2.3	11.2	16.7	19.3	3.4	5.6	**8.2**	**16.6**
RD-2	2.40	0.08	0.35	0.08	50	2	8.2	670	2.5%	2.4	4.7	12.9	14.0	3.7	6.3	**0.7**	**5.3**
RD-3	1.05	0.08	0.35	0.08	42	2	7.1	560	4.3%	3.1	3.0	10.1	13.3	4.1	6.9	**0.3**	**2.5**
RD-4	1.93	0.08	0.35	0.08	50	4	6.6	835	0.2%	0.7	19.0	25.5	14.9	3.5	5.9	**0.5**	**4.0**
RD-5	1.49	0.08	0.35	0.08	50	6	5.7	430	1.9%	2.0	3.5	9.2	12.7	4.2	7.1	**0.5**	**3.7**
OS-2	0.35	0.90	0.96	0.90	30	0.5	1.7	900	0.0%	0.0	0.0	5.0	15.2	5.2	8.7	**1.6**	**2.9**
OS-3	0.72	0.90	0.96	0.90	50	2	1.6	685	1.2%	1.6	7.0	8.7	14.1	4.3	7.3	**2.8**	**5.0**
OS-4	1.41	0.90	0.96	0.90	50	2	1.6	295	1.4%	1.7	2.8	5.0	11.9	5.2	8.7	**6.6**	**11.8**
631R	*0.56*	*0.90*	*0.96*	0.90	30	0.1	3.4	200	1.8%	0.9	3.5	6.9	11.3	4.7	7.9	**2.4**	**4.2**
632L	*1.21*	*0.90*	*0.96*	0.90	53	3.0	1.5	1000	1.8%	0.9	17.7	19.2	15.9	3.4	5.8	**3.7**	**6.7**
637R	*0.91*	*0.90*	*0.96*	0.90	77	3.0	2.0	900	0.5%	1.4	10.6	12.6	15.4	3.8	6.3	**3.1**	**5.5**
641L	*1.58*	*0.90*	*0.96*	0.90	47	1.0	1.9	1500	2.3%	3.0	8.2	10.2	18.6	4.1	6.9	**5.8**	**10.4**
646R	*0.75*	*0.90*	*0.96*	0.90	41	1.0	1.7	78	1.8%	2.7	0.5	5.0	10.7	5.2	8.7	**3.5**	**6.2**
654R	*1.62*	*0.90*	*0.96*	0.90	91	5.0	2.0	1000	4.3%	4.1	4.0	6.0	16.1	4.9	8.2	**7.1**	**12.8**
661L	*0.07*	*0.90*	*0.96*	0.90	82	3.0	2.1	100	2.7%	3.3	0.5	5.0	11.0	5.2	8.7	**0.3**	**0.6**
662L	*1.21*	*0.90*	*0.96*	0.90	75	3.0	2.0	800	4.6%	4.3	3.1	5.1	14.9	5.1	8.6	**5.6**	**10.0**
664R	*1.09*	*0.90*	*0.96*	0.90	78	3.0	2.1	600	5.3%	4.6	2.2	5.0	13.8	5.2	8.7	**5.1**	**9.1**

* Intensity equations assume a minimum travel time of 5 minutes.
Italized values taken from Marksheffel FDR

Calculated by: TAU
Date: 8/23/2023
Checked by: VAS

CROSSROADS NORTH
PROPOSED CONDITIONS DRAINAGE CALCULATIONS
(Basin Routing Summary)

From Area Runoff Coefficient Summary				OVERLAND				PIPE / CHANNEL FLOW				Time of Travel (T_t)	INTENSITY *		TOTAL FLOWS		
DESIGN POINT	CONTRIBUTING BASINS/PIPES	CA_5	CA_{100}	C_5	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.)	COMMENTS
1	664R	0.98	1.05									5.0	5.2	8.7	5.1	9.1	EX 5' CDOT TYPE R INLET
				Basin 664R Tc was used													
2	662L	1.09	1.16									5.1	5.1	8.6	5.6	10.0	EX 5' CDOT TYPE R INLET
				Basin 662L Tc was used													
3	FBIN662, 661L	0.57	0.79				5.1	50	2.7%	2.4	0.3	5.4	5.0	8.5	2.9	6.7	EX 5' CDOT TYPE R INLET
				Basin 662L Tc was used													
4	PR664, PR662, PR661	1.48	1.21				5.5					5.5	5.0	8.4	9.8	27.5	EX 5' BTM EARTH TRAP CHANNEL
	OS-1	0.47	2.05														
	SUM:	1.95	3.26	Weighted Tc was used													
5	FBIN664, FBIN661, 654R	2.11	2.62				6.0					6.0	4.9	8.2	10.3	21.6	EX 5' CDOT TYPE R INLET
				Basin 654R Tc was used													
6	DP4, PR654	2.77	3.92				5.5	520	5.0%	3.4	2.6	8.1	4.4	7.5	12.3	29.3	EX 5' BTM EARTH TRAP CHANNEL
				Design Pt 4 Tc was used													
7	Basin A	7.96	8.65									5.2	5.1	8.6	40.8	74.4	PROP 42" RCP STORM SEWER PRIVATE
				Basin A Tc was used													
8	Basin C	4.93	5.35									6.0	4.9	8.2	24.1	43.9	PROP 36" RCP STORM SEWER PRIVATE
				Basin C Tc was used													
9	Basin D, PRA1, PRB1, PRC1	20.07	22.62									5.9	4.9	8.3	98.7	186.9	POND 1 OUTFALL: PROP 18" RCP STORM SEWER
				Weighted Tc was used													
10	Basin RD-3, DP6	2.85	4.28				5.8					5.8	4.9	8.3	14.0	35.4	DUAL 24" PUBLIC RCP CULVERTS
				Weighted Tc was used													
11	FBIN654, 646R	1.97	2.68				6.0	805	2.0%	2.8	4.8	10.7	4.0	6.8	7.9	18.1	EX 5' CDOT TYPE R INLET
				Basin 654R Tc was used													
12	PR646, PR-DP10	3.70	4.98				5.8	415	1.2%	1.6	4.2	10.0	4.1	6.9	15.3	34.5	EX 5' BTM EARTH TRAP CHANNEL
				Design Pt 10 Tc was used													
13	Basin 641L	1.42	1.52									10.2	4.1	6.9	5.8	10.4	EX 5' CDOT TYPE R INLET
				Basin 641L Tc was used													
14	Basin B	6.80	7.39									6.6	4.8	8.0	32.3	58.9	PROP 42 "RCP STORM SEWER PRIVATE
				Basin B Tc was used													
15	Basin F	7.40	8.04									10.2	4.1	6.9	30.3	55.3	SHEET FLOW PRIVATE
				Basin F Tc was used													
16	Basin E, DP15	7.57	8.59									10.2	4.1	6.9	31.0	59.0	POND 2 PROP 18" PRIVATE RCP STORM SEWER
				Design Point 15 Tc was used													
17	PR640, DP12, Basin RD-4	4.56	6.21				10.0	600	0.5%	1.1	9.4	19.4	3.1	5.3	14.9	43.3	DUAL 24" PUBLIC RCP CULVERTS PUBLIC
	PRD1	0.20	2.02														
	SUM:	4.76	8.23	Design Pt 12 Tc was used													
18	FBIN646, 637R	1.94	2.86				10.7	871	0.5%	1.4	10.3	21.0	3.0	5.1 24.1	5.9	14.5	EX 5' CDOT TYPE R INLET
				Design Pt 11 Tc was used													

CROSSROADS NORTH
PROPOSED CONDITIONS DRAINAGE CALCULATIONS
(Basin Routing Summary)

From Area Runoff Coefficient Summary				*OVERLAND*				*PIPE / CHANNEL FLOW*				*Time of Travel (T_t)*	*INTENSITY **		*TOTAL FLOWS*		
DESIGN POINT	**CONTRIBUTING BASINS/PIPES**	**CA_5**	**CA_{100}**	**C_5**	**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.)*	COMMENTS
19	**PRDP17, PR636** **PRDP16**	5.76 0.07	9.08 1.11				19.4	230	0.4%	1.0	3.9	23.3	2.9	4.8	***16.5***	***43.6***	EX 5' BTM EARTH TRAP CHANNEL
				Design Pt 17 Tc was used													
20	**Basin K**	2.09	5.36									12.0	3.8	6.5	***8.1***	***34.7***	PROP 30" RCP STORM SEWER PRIVATE
				Basin K Tc was used													
21	**Basin L, DP20**	2.19	5.68									10.1	4.1	6.9	***9.0***	***39.2***	POND 4 PROP 18" PRIVATE RCP STORM SEWER
				Basin L Tc was used													
22	**FBIN636, 631R**	1.45	2.55				21.0	650	1.5%	2.4	4.5	25.5	2.7	4.6	***4.0***	***11.7***	EX 5' CDOT TYPE R INLET
				Design Pt 18 Tc was used													
23	**FBIN640, 632L**	1.80	2.13				10.2	986	1.1%	2.1	7.7	17.9	3.3	5.5	***5.9***	***11.6***	EX 5' CDOT TYPE R INLET
				Design Pt 13 Tc was used													
24	**DP19, Basin RD-5**	5.87	9.60				23.3	545	1.0%	1.5	6.0	29.3	2.5	4.2	***14.8***	***40.5***	EX CDOT TYPE C AREA INLET W/RIPRAP BYPASS RUNDOWN AND 24" RCP OUTFALL
				Design Pt 19 Tc was used													
25	**OS-2, FBIN630B**	0.31	0.62				17.9	131	1.5%	2.0	1.1	19.0	3.2	5.3	***1.0***	***3.3***	EX 12" PLASTIC CORR PIPE PUBLIC
				Design Point 23 Tc was used													
26	**E1, E2, PR630B**	7.16	6.55				29.3	242	1.7%	2.6	1.6	30.9	2.4	4.1	***17.4***	***26.8***	EX WQ POND
				Design Pt 24 Tc was used													
27	**DP26, OS-3, Basin M** **L1** **SUM:**	8.12 0.00 8.12	9.69 1.45 11.14				22.9					22.9	2.9	4.8	***23.4***	***54.0***	EX 42" CMP CULVERT PUBLIC
				Weighted Tc was used													
28	**Basin RD-1**	2.44	2.95				16.7					16.7	3.4	5.6	***8.2***	***16.6***	TRIANGULAR, EARTHEN CDOT DITCH
				Basin RD-1 Tc was used													
29	**Basin RD-2, DP28**	2.64	3.79				16.7	1586	1.7%	2.0	13.5	30.1	2.5	4.2	***6.5***	***15.7***	TRIANGULAR, EARTHEN CDOT DITCH
				Design Point 28 Tc was used													
30	**Basin G**	3.80	4.12									5.9	4.9	8.3	***18.7***	***34.2***	PROP 30" RCP STORM SEWER PRIVATE
				Basin G Tc was used													
31	**Basin J**	0.78	2.00									14.2	3.6	6.0	***2.8***	***12.1***	PROP 30" RCP STORM SEWER PRIVATE
				Basin J Tc was used													
32	**Basin I, DP30, DP31**	4.76	6.73				8.2					6.4	4.8	8.0	***22.8***	***54.2***	POND 3 PROP 24" PRIVATE RCP STORM SEWER
				WeightedTc was used													
33	**Basin H, Basin OS-4, DP29** **I1** **SUM:**	4.55 0.04 4.60	7.98 1.07 9.05				30.1	665	1.8%	2.0	5.5	35.6	2.2	3.7	***10.2***	***33.7***	EX 48" CMP PUBLIC
				Weighted Tc was used													

CROSSROADS NORTH
PROPOSED CONDITIONS DRAINAGE CALCULATIONS
(Storm Sewer Routing Summary)

PIPE RUN	*Contributing Pipes/Design Points/Struct*	*Equivalent CA_5*	*Equivalent CA_{100}*	*Maximum T_C*	*Intensity**		*Flow*		*PIPE SIZE*
					I_5	*I_{100}*	*Q_5*	*Q_{100}*	
664	**DP1**	0.52	0.39	5.0	5.2	8.7	**2.7**	**3.4**	24" RCP
662	**DP2**	0.58	0.44	5.1	5.1	8.6	**3.0**	**3.8**	24" RCP
661	**DP3**	0.38	0.38	5.4	5.0	8.5	**1.9**	**3.2**	18"RCP
654	**DP5**	0.82	0.66	6.0	4.9	8.2	**4.0**	**5.4**	24" RCP
646	**DP11**	0.85	0.70	10.7	4.0	6.8	**3.4**	**4.7**	18" RCP
640	**DP13**	0.71	0.55	10.2	4.1	6.9	**2.9**	**3.8**	24" RCP
PR-DP17	**DP17**	4.76	8.23	19.4	3.1	5.3	**14.9**	**43.3**	DUAL 24" RCP
636	**DP18**	0.99	0.85	21.0	3.0	5.1	**3.0**	**4.3**	24" RCP
630A	**DP22**	0.92	0.90	25.5	2.7	4.6	**2.5**	**4.1**	24" RCP
630B	**DP23**	2.06	2.15	23.3	2.9	4.8	**5.9**	**10.3**	24" RCP
E1	**DP25**	0.31	0.62	19.0	3.2	5.3	**1.0**	**3.3**	12" PLASTIC
E2	**DP24**	4.79	3.78	19.4	3.1	5.3	**15.0**	**19.9**	24" RCP
E3	**DP27**	8.12	11.14	22.9	2.9	4.8	**23.4**	**54.0**	42" CMP
E4	**DP33**	4.60	9.05	35.6	2.2	3.7	**10.2**	**33.7**	48" CMP
A1	**DP7**	7.96	8.65	5.2	5.1	8.6	**40.8**	**74.4**	42" RCP
B1	**DP14**	6.80	7.39	6.6	4.8	8.0	**32.3**	**58.9**	42" RCP
C1	**DP8**	4.93	5.35	6.0	4.9	8.2	**24.1**	**43.9**	36" RCP
D1	**DP9**	0.20	2.02	5.9	4.9	8.3	**1.0**	**16.7**	18" RCP
PR-DP16	**DP16**	0.07	1.11	10.2	4.1	6.9	**0.3**	**7.6**	18" RCP
G1	**DP30**	3.80	4.12	5.9	4.9	8.3	**18.7**	**34.2**	30" RCP
J1	**DP31**	0.78	2.00	14.2	3.6	6.0	**2.8**	**12.1**	30" RCP
I1	**DP32**	0.04	1.07	6.4	4.8	8.0	**0.2**	**8.6**	24" RCP
K1	**DP20**	2.09	5.36	12.0	3.8	6.5	**8.1**	**34.7**	30" RCP
L1	**DP21**	0.00	1.45	10.1	4.1	6.9	**0.0**	**10.0**	18" RCP
PR-DP10	**DP10**	2.85	4.28	5.8	4.9	8.3	**14.0**	**35.4**	DUAL 24" RCP

* Intensity equations assume a minimum travel time of 5 minutes.
DP - Design Point
PR - Pipe Run

Calculated by: GT
Date: 9/30/2022
Checked by: VAS

Weighted Percent Imperviousness of FSD Pond 1				
Contributing Basins	Area (Acres)	C_5	Impervious % (I)	(Acres)*(I)
A	9.83	0.81	95	934.02
B	8.39	0.81	95	797.30
C	6.08	0.81	95	577.65
D	3.15	0.12	7	22.05
Totals	27.46			2331.02
Imperviousness of FSD Pond 1	84.9			

Weighted Percent Imperviousness of FSD Pond 2				
Contributing Basins	Area (Acres)	C_5	Impervious % (I)	(Acres)*(I)
E	1.40	0.12	7	9.79
F	9.14	0.81	95	867.96
Totals	10.54			877.76
Imperviousness of FSD Pond 2	83.3			

Weighted Percent Imperviousness of FSD Pond 3				
Contributing Basins	Area (Acres)	C_5	Impervious % (I)	(Acres)*(I)
Column1	Column2	Column3	Column4	Column5
G	4.69	0.81	95	445.11
I	1.57	0.12	7	11.02
J	4.87	0.16	13	63.31
Totals	11.13			519.43
Imperviousness of FSD Pond 3	46.7			

Weighted Percent Imperviousness of FSD Pond 4				
Contributing Basins	Area (Acres)	C_5	Impervious % (I)	(Acres)*(I)
Column1	Column2	Column3	Column4	Column5
K	13.08	0.16	13	170.02
L	0.82	0.12	7	5.77
Totals	13.90			175.79
Imperviousness of FSD Pond 2	12.6			

Overall Weighted Site Imperviousness				
Contributing Basins	Area (Acres)	C_5	Impervious % (I)	(Acres)*(I)
Column1	Column2	Column3	Column4	Column5
FSD Pond 1	27.46	N/A	N/A	2331.02
FSD Pond 2	10.54	N/A	N/A	877.76
FSD Pond 3	11.13	N/A	N/A	519.43
FSD Pond 4	13.90	N/A	N/A	175.79
Totals	63.02			3904.01
Imperviousness of Site	61.9			

HYDRAULIC CALCULATIONS / POND CALCULATIONS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Crossroads North**

Basin ID: **Pond 1**

Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	27.46	acres
Watershed Length =	1,106	ft
Watershed Length to Centroid =	450	ft
Watershed Slope =	0.024	ft/ft
Watershed Imperviousness =	84.90%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.827	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	3.118	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	2.129	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	2.752	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	3.252	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	3.817	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	4.369	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.51 in.) =	4.976	acre-feet	2.51	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	6.403	acre-feet		inches
Approximate 2-yr Detention Volume =	2.052	acre-feet		
Approximate 5-yr Detention Volume =	2.664	acre-feet		
Approximate 10-yr Detention Volume =	3.172	acre-feet		
Approximate 25-yr Detention Volume =	3.753	acre-feet		
Approximate 50-yr Detention Volume =	4.091	acre-feet		
Approximate 100-yr Detention Volume =	4.377	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.827	acre-feet
Zone 2 Volume (EURV - Zone 1) =	2.291	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.259	acre-feet
Total Detention Basin Volume =	4.377	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = 1.00 ft

	Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
35	**Top of Micropool**	--	0.00	--	--	--	125	0.003		
	36	--	1.00	--	--	--	13,696	0.314	6,910	0.159
	37	--	2.00	--	--	--	16,327	0.375	21,922	0.503
	38	--	3.00	--	--	--	19,056	0.437	39,613	0.909
	39	--	4.00	--	--	--	21,881	0.502	60,082	1.379
	40	--	5.00	--	--	--	28,026	0.643	85,035	1.952
	41	--	6.00	--	--	--	34,376	0.789	116,236	2.668
	42	--	7.00	--	--	--	41,320	0.949	154,084	3.537
	43	--	8.00	--	--	--	49,304	1.132	199,396	4.578
	44	--	9.00	--	--	--	58,011	1.332	253,054	5.809

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Crossroads North**

Basin ID: **Pond 1**

Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.81	0.827	Orifice Plate
Zone 2 (EURV)	6.54	2.291	Orifice Plate
Zone 3 (100-year)	7.83	1.259	Weir&Pipe (Restrict)
Total (all zones)		4.377	

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

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

Calculated Parameters for Underdrain

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

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	6.54	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	24.70	inches
Orifice Plate: Orifice Area per Row =	N/A	sq. inches

Calculated Parameters for Plate

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

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	2.18	4.36					
Orifice Area (sq. inches)	5.82	4.20	0.30					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	6.60	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	3.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	5.70	N/A	feet
Overflow Grate Type =	Close Mesh Grate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	6.60	N/A	feet
Overflow Weir Slope Length =	5.70	N/A	feet
Grate Open Area / 100-yr Orifice Area =	9.17	N/A	
Overflow Grate Open Area w/o Debris =	13.53	N/A	ft^2
Overflow Grate Open Area w/ Debris =	6.76	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	14.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	1.47	N/A	ft^2
Outlet Orifice Centroid =	0.64	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.16	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.33	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	68.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	0.67	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.67	feet
Stage at Top of Freeboard =	8.67	feet
Basin Area at Top of Freeboard =	1.27	acres
Basin Volume at Top of Freeboard =	5.38	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).

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.51	3.14
CUHP Runoff Volume (acre-ft) =	0.827	3.118	2.129	2.752	3.252	3.817	4.369	4.976	6.403
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	2.129	2.752	3.252	3.817	4.369	4.976	6.403
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.3	0.6	0.8	7.4	14.4	23.1	41.5
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.02	0.03	0.27	0.52	0.84	1.51
Peak Inflow Q (cfs) =	N/A	N/A	49.3	63.9	75.6	90.5	104.0	115.7	149.2
Peak Outflow Q (cfs) =	0.4	0.8	0.7	0.8	0.8	5.7	9.9	18.6	50.1
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.2	1.0	0.8	0.7	0.8	1.2
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.4	0.7	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) =	39	76	63	72	78	79	78	77	75
Time to Drain 99% of Inflow Volume (hours) =	**41**	81	67	76	83	85	85	84	83
Maximum Ponding Depth (ft) =	2.81	6.55	5.12	5.96	6.56	6.91	7.06	7.32	7.61
Area at Maximum Ponding Depth (acres) =	0.43	0.88	0.66	0.78	0.88	0.93	0.96	1.01	1.06
Maximum Volume Stored (acre-ft) =	0.827	3.127	2.030	2.637	3.127	3.443	3.595	3.850	4.150

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Crossroads North**

Basin ID: **Pond 2**

Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	10.54	acres
Watershed Length =	705	ft
Watershed Length to Centroid =	351	ft
Watershed Slope =	0.031	ft/ft
Watershed Imperviousness =	83.30%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.307	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	1.168	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.781	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.010	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.195	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	1.405	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	1.611	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.51 in.) =	1.838	acre-feet	2.51	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	2.371	acre-feet		inches
Approximate 2-yr Detention Volume =	0.768	acre-feet		
Approximate 5-yr Detention Volume =	0.998	acre-feet		
Approximate 10-yr Detention Volume =	1.189	acre-feet		
Approximate 25-yr Detention Volume =	1.408	acre-feet		
Approximate 50-yr Detention Volume =	1.536	acre-feet		
Approximate 100-yr Detention Volume =	1.646	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.307	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.860	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.478	acre-feet
Total Detention Basin Volume =	1.646	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = 1.00 ft

	Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
45	**Top of Micropool**	--	0.00	--	--	--	125	0.003		
	46	--	1.00	--	--	--	14,121	0.324	7,123	0.164
	47	--	2.00	--	--	--	17,368	0.399	22,867	0.525
	48	--	3.00	--	--	--	20,684	0.475	41,893	0.962
	49	--	4.00	--	--	--	23,290	0.535	63,880	1.466
	50	--	5.00	--	--	--	26,033	0.598	88,542	2.033
	51	--	6.00	--	--	--	29,064	0.667	116,090	2.665
	52	--	7.00	--	--	--	32,953	0.756	147,099	3.377

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Crossroads North**

Basin ID: **Pond 2**

Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.43	0.307	Orifice Plate
Zone 2 (EURV)	3.43	0.860	Orifice Plate
Zone 3 (100-year)	4.33	0.478	Weir&Pipe (Restrict)
Total (all zones)		1.646	

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

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

Calculated Parameters for Underdrain

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

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	3.43	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	13.70	inches
Orifice Plate: Orifice Area per Row =	N/A	sq. inches

Calculated Parameters for Plate

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

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.14	2.29					
Orifice Area (sq. inches)	2.87	2.87	0.50					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.44	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	2.90	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	5.70	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	3.44	N/A	feet
Overflow Weir Slope Length =	5.70	N/A	feet
Grate Open Area / 100-yr Orifice Area =	14.01	N/A	
Overflow Grate Open Area w/o Debris =	11.50	N/A	ft^2
Overflow Grate Open Area w/ Debris =	5.75	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	8.50		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.82	N/A	ft^2
Outlet Orifice Centroid =	0.41	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.52	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	4.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	10.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.97	feet
Stage at Top of Freeboard =	5.97	feet
Basin Area at Top of Freeboard =	0.67	acres
Basin Volume at Top of Freeboard =	2.65	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).

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.51	3.14
CUHP Runoff Volume (acre-ft) =	0.307	1.168	0.781	1.010	1.195	1.405	1.611	1.838	2.371
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.781	1.010	1.195	1.405	1.611	1.838	2.371
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.2	0.3	2.8	5.3	8.6	15.4
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.02	0.03	0.26	0.51	0.82	1.46
Peak Inflow Q (cfs) =	N/A	N/A	17.4	22.7	26.8	32.3	37.2	41.4	53.6
Peak Outflow Q (cfs) =	0.2	0.3	0.3	0.3	0.3	2.2	4.1	7.6	13.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.0	1.1	0.8	0.8	0.9	0.8
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.2	0.3	0.6	0.7
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) =	38	74	62	69	75	76	75	74	71
Time to Drain 99% of Inflow Volume (hours) =	**40**	79	65	74	80	82	81	81	80
Maximum Ponding Depth (ft) =	1.43	3.43	2.52	3.01	3.38	3.61	3.70	3.87	4.28
Area at Maximum Ponding Depth (acres) =	0.36	0.50	0.44	0.47	0.50	0.51	0.52	0.53	0.55
Maximum Volume Stored (acre-ft) =	0.310	1.171	0.743	0.962	1.142	1.257	1.309	1.392	1.619

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Crossroads North**

Basin ID: **Pond 3**

Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	11.13	acres
Watershed Length =	839	ft
Watershed Length to Centroid =	392	ft
Watershed Slope =	0.042	ft/ft
Watershed Imperviousness =	46.70%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.183	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.588	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.422	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.563	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.675	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.862	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	1.045	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.51 in.) =	1.272	acre-feet	2.51	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	1.787	acre-feet		inches
Approximate 2-yr Detention Volume =	0.377	acre-feet		
Approximate 5-yr Detention Volume =	0.497	acre-feet		
Approximate 10-yr Detention Volume =	0.609	acre-feet		
Approximate 25-yr Detention Volume =	0.748	acre-feet		
Approximate 50-yr Detention Volume =	0.838	acre-feet		
Approximate 100-yr Detention Volume =	0.948	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.183	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.405	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.360	acre-feet
Total Detention Basin Volume =	0.948	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = 1.00 ft

	Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
23	**Top of Micropool**	--	0.00	--	--	--	10	0.000		
	24	--	1.00	--	--	--	18,144	0.417	9,076	0.208
	25	--	2.00	--	--	--	22,844	0.524	29,570	0.679
	26	--	3.00	--	--	--	32,180	0.739	57,082	1.310
	27	--	4.00	--	--	--	35,792	0.822	91,068	2.091
	28	--	5.00	--	--	--	39,012	0.896	128,470	2.949
	29	--	6.00	--	--	--	42,312	0.971	169,132	3.883
	30	--	7.00	--	--	--	45,703	1.049	213,140	4.893

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Crossroads North**

Basin ID: **Pond 3**

Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.94	0.183	Orifice Plate
Zone 2 (EURV)	1.83	0.405	Orifice Plate
Zone 3 (100-year)	2.47	0.360	Weir&Pipe (Restrict)
Total (all zones)		0.948	

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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)

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	1.83	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	7.30	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	sq. inches	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.61	1.22					
Orifice Area (sq. inches)	1.89	1.40	1.89					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	1.84	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	2.90	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	5.70	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	1.84	N/A	feet
Overflow Weir Slope Length =	5.70	N/A	feet
Grate Open Area / 100-yr Orifice Area =	9.29	N/A	
Overflow Grate Open Area w/o Debris =	11.50	N/A	ft^2
Overflow Grate Open Area w/ Debris =	5.75	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	24.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	10.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	1.24	N/A	ft^2
Outlet Orifice Centroid =	0.48	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.40	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	2.35	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.97	feet
Spillway Crest Length =	6.00	feet	Stage at Top of Freeboard =	4.32	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.85	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	2.36	acre-ft

Calculated Parameters for Spillway

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).

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.51	3.14
CUHP Runoff Volume (acre-ft) =	0.183	0.588	0.422	0.563	0.675	0.862	1.045	1.272	1.787
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.422	0.563	0.675	0.862	1.045	1.272	1.787
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.2	0.3	2.8	5.5	8.8	15.8
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.02	0.03	0.25	0.49	0.79	1.42
Peak Inflow Q (cfs) =	N/A	N/A	7.5	10.1	12.0	16.6	20.7	26.2	36.8
Peak Outflow Q (cfs) =	0.1	0.2	0.1	0.2	0.7	2.4	5.0	8.6	13.2
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.8	2.1	0.8	0.9	1.0	0.8
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.2	0.4	0.7	0.8
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	72	63	71	75	74	72	70	66
Time to Drain 99% of Inflow Volume (hours) =	**41**	77	66	76	80	80	79	78	76
Maximum Ponding Depth (ft) =	0.94	1.83	1.44	1.72	1.91	2.02	2.15	2.30	2.67
Area at Maximum Ponding Depth (acres) =	0.39	0.51	0.46	0.49	0.51	0.53	0.55	0.59	0.67
Maximum Volume Stored (acre-ft) =	0.184	0.591	0.397	0.531	0.627	0.689	0.754	0.840	1.078

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Crossroads North**

Basin ID: **Pond 4**

Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	13.90	acres
Watershed Length =	833	ft
Watershed Length to Centroid =	385	ft
Watershed Slope =	0.034	ft/ft
Watershed Imperviousness =	12.60%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.094	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.137	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.074	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.116	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.153	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.346	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.534	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.51 in.) =	0.789	acre-feet	2.51	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	1.376	acre-feet		inches
Approximate 2-yr Detention Volume =	0.083	acre-feet		
Approximate 5-yr Detention Volume =	0.113	acre-feet		
Approximate 10-yr Detention Volume =	0.148	acre-feet		
Approximate 25-yr Detention Volume =	0.197	acre-feet		
Approximate 50-yr Detention Volume =	0.254	acre-feet		
Approximate 100-yr Detention Volume =	0.382	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.094	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.043	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.245	acre-feet
Total Detention Basin Volume =	0.382	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = 1.00 ft

	Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
33	**Top of Micropool**	--	0.00	--	--	--	10	0.000		
	34	--	1.00	--	--	--	171	0.004	90	0.002
	35	--	2.00	--	--	--	8,825	0.203	4,588	0.105
	36	--	3.00	--	--	--	17,653	0.405	17,827	0.409
	37	--	4.00	--	--	--	23,495	0.539	38,401	0.882
	38	--	5.00	--	--	--	27,823	0.639	64,060	1.471
	39	--	6.00	--	--	--	32,826	0.754	94,385	2.167

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Crossroads North**

Basin ID: **Pond 4**

Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.95	0.094	Orifice Plate
Zone 2 (EURV)	2.15	0.043	Orifice Plate
Zone 3 (100-year)	2.94	0.245	Weir&Pipe (Restrict)
Total (all zones)		0.382	

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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)

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	2.15	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	8.60	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	sq. inches	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.72	1.43					
Orifice Area (sq. inches)	0.34	0.34	0.34					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	2.16	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	2.90	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	5.70	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	2.16	N/A	feet
Overflow Weir Slope Length =	5.70	N/A	feet
Grate Open Area / 100-yr Orifice Area =	7.80	N/A	
Overflow Grate Open Area w/o Debris =	11.50	N/A	ft^2
Overflow Grate Open Area w/ Debris =	5.75	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	14.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	1.47	N/A	ft^2
Outlet Orifice Centroid =	0.64	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.16	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	2.70	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.96	feet
Spillway Crest Length =	2.00	feet	Stage at Top of Freeboard =	4.66	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.60	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	1.26	acre-ft

Calculated Parameters for Spillway

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).

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.51	3.14
CUHP Runoff Volume (acre-ft) =	0.094	0.137	0.074	0.116	0.153	0.346	0.534	0.789	1.376
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.074	0.116	0.153	0.346	0.534	0.789	1.376
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.2	0.3	0.4	3.7	7.2	11.6	20.7
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.02	0.03	0.27	0.52	0.83	1.49
Peak Inflow Q (cfs) =	N/A	N/A	1.3	2.1	2.8	6.5	10.0	14.5	23.9
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.1	2.9	5.9	10.0	14.8
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.1	0.2	0.8	0.8	0.9	0.7
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.2	0.5	0.9	1.0
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	51	32	46	55	52	49	45	37
Time to Drain 99% of Inflow Volume (hours) =	**40**	53	34	47	57	56	55	54	50
Maximum Ponding Depth (ft) =	1.95	2.15	1.79	2.02	2.17	2.38	2.52	2.66	3.14
Area at Maximum Ponding Depth (acres) =	0.19	0.23	0.16	0.20	0.24	0.28	0.31	0.34	0.42
Maximum Volume Stored (acre-ft) =	0.095	0.138	0.067	0.107	0.143	0.197	0.235	0.283	0.467

The open channel flow calculator

Select Channel Type: Trapezoid

Velocity(V)&Discharge(Q)

Select unit system: Feet(ft)

Channel slope: 0.052 ft/ft	Water depth(y): 0.69 ft	Bottom width(b) 6 ft
Flow velocity 6.3986 ft/s	LeftSlope (z_1): 3 to 1 (H:V)	RightSlope (z_2): 3 to 1 (H:V)
Flow discharge 35.6293 ft^3/s	Input n value 0.035 or select n	
Calculate!	Status: Calculation finished	Reset
Wetted perimeter 10.36 ft	Flow area 5.57 ft^2	Top width(T) 10.14 ft
Specific energy 1.33 ft	Froude number 1.52	Flow status Supercritical flow
Critical depth 0.89 ft	Critical slope 0.0208 ft/ft	Velocity head 0.64 ft

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ROADSIDE CHANNEL ALONG
MARKSHEFFEL ROAD DP10 Q100= 35.4 cfs

The open channel flow calculator

Select Channel Type: Trapezoid

Velocity(V)&Discharge(Q)

Select unit system: Feet(ft)

Channel slope: 0.005 ft/ft	Water depth(y): 1.45 ft	Bottom width(b) 6 ft
Flow velocity 2.9806 ft/s	LeftSlope (z_1): 3 to 1 (H:V)	RightSlope (z_2): 3 to 1 (H:V)
Flow discharge 44.7316 ft^3/s	Input n value 0.035 or select n	
Calculate!	Status: Calculation finished	Reset
Wetted perimeter 15.17 ft	Flow area 15.01 ft^2	Top width(T) 14.7 ft
Specific energy 1.59 ft	Froude number 0.52	Flow status Subcritical flow
Critical depth 1.01 ft	Critical slope 0.0201 ft/ft	Velocity head 0.14 ft

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ROADSIDE CHANNEL ALONG
MARKSHEFFEL ROAD DP17 Q100= 43.3 cfs

Upstream Capacity at Design Point 27

CHART 2B

HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

Printable Title

Printable Subtitle

Inputs

Pipe diameter, d_0	4	ft
Manning roughness, n	0.022	
Pressure slope (possibly ? equal to pipe slope), S_0	0.0316	rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	32.5	%

Results

Flow, Q (See notes)	34.4649	cfs
Velocity, v	9.7320	ft/sec
Velocity head, h_v	1.4720	ft H2O
Flow area	3.5416	ft^2
Wetted perimeter	4.8529	ft
Hydraulic radius	0.7298	ft
Top width, T	3.7470	ft
Froude number, F	1.77	
Shear stress (tractive force), tau	1.4397	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Upstream Capacity at Design Point 33

Figure CU-9—Inlet Control Nomograph—Example

COLORADO DIVISION OF WATER RESOURCE LETTER OF ACCEPTANCE

Gmail

Geno Tellez <geno@mscivil.com>

Crossroads Mixed Use - Discussion on El Paso County PCD comment

4 messages

Darin Moffett <Darin@mscivil.com> Sat, Mar 16, 2024 at 12:47 PM
To: elizabeth.nosker@state.co.us, Virgil Sanchez <virgils@mscivil.com>, Geno Tellez <geno@mscivil.com>

Beth,

We are currently working on a development located to the east of Colorado Springs within El Paso County that lies immediately adjacent to Highways 24 and 94. (see attachment) The parcel is approximately 64.89 acres in size. The property falls within both the Jimmy Camp Creek and Peterson Field Drainage Basins.

The proposed re-grading effort will create a minor redelineation of the major basin boundary lines to accommodate the newly proposed lots and roadways. As you are aware this minor exchange in basin delinations can be commonplace unless they fall along high rock outcroppings or major channels where alteration of terrain is unlikely.

In regards to the amounts....Prior to development approximately 51.67 acres of the subject site falls within the Jimmy Camp Creek Basin while the remaining 13.22 acres falls within the Peterson Field Drainage Basin. After development it is anticipated 1.5-3.5 acres will be redirected from the Peterson Field Drainage Basin into Jimmy Camp Creek. (currently 1.5 per attached exhibit)

We have been requested by the El Paso County Planning and Development to reach out to you to verify this redelination does not pose a significant impact toward water rights. It should be noted that the developed flows are directed to planned stormwater water quality and detention facilities that were designed in accordance with current MS4 requirements and that release rates from said facilities will not exceed historic runoff rates.

It should be noted that the Sand Creek Drainage Basin and Peterson Field Drainage Basin comprise almost 45 square miles of land. (~1.5-3.5 acres out of 1.96 million)

Ultimately I believe all we are looking for is an email from DWR that states that this isn't a significant issue in regards to water rights within the watersheds.

Hope all is well and look forward to hearing back from you.

--
Darin L. Moffett, P.E.,
Vice President / Manager
MS Civil Consultants, Inc.
212 N. Wahsatch Ave, Suite 305
Colorado Springs, CO 80903
719-649-9624 cell

3 attachments

Vic Map.pdf
51K

Aerial Map.pdf
6135K

drainage maps.pdf
9661K

Nosker - DNR, Elizabeth <elizabeth.nosker@state.co.us> Mon, Mar 18, 2024 at 12:10 PM
To: Darin Moffett <Darin@mscivil.com>
Cc: Virgil Sanchez <virgils@mscivil.com>, Geno Tellez <geno@mscivil.com>

Hello Darin,

Thank you for sending this my way. I am looking into this and will get back to you as soon as possible.

Beth Nosker
[Quoted text hidden]
--
Elizabeth (Beth) Nosker

Deputy Groundwater Commissioner and Groundwater Data Analyst
District 10

COLORADO
Division of Water Resources
Department of Natural Resources

P 719.227.5291 | C 719.331.5861
4255 Sinton Rd., Colorado Springs, CO 80907
elizabeth.nosker@state.co.us | dwr.colorago.gov

Nosker - DNR, Elizabeth <elizabeth.nosker@state.co.us> Thu, Mar 21, 2024 at 2:55 PM
To: Darin Moffett <Darin@mscivil.com>
Cc: Virgil Sanchez <virgils@mscivil.com>, Geno Tellez <geno@mscivil.com>

Hello Darin,

Thank you for your patience while I investigate a little further.
Due to the small scale of this redelineation, we do not foresee any issues with water rights.
As long as the stormwater detention facilities meet the standards of the MS4 permit, we should be good.

Thank you again,
Beth Nosker

On Sat, Mar 16, 2024 at 12:52 PM Darin Moffett <Darin@mscivil.com> wrote:
[Quoted text hidden]

[Quoted text hidden]

Darin Moffett <Darin@mscivil.com> Thu, Mar 21, 2024 at 3:12 PM
To: "Nosker - DNR, Elizabeth" <elizabeth.nosker@state.co.us>
Cc: Virgil Sanchez <virgils@mscivil.com>, Geno Tellez <geno@mscivil.com>

Beth,

Thank you for your effort.
[Quoted text hidden]

MARKSHEFFEL ROAD FINAL DRAINAGE REPORT EXCERPTS

Final Drainage Report

Marksheffel Road South

Link Road to US-24

El Paso County, CO

January 2017

Figure 1 - Vicinity Map

The site is located in multiple townships, ranges and sections as shown in table 1 below.

Table 1: Township Range and Section

Township	Range	Section
14 South	65 West	8, 9, 16, 17, 20, 21, 27, 28, 33, 24
15 South	65 West	10, 15, 22, 27, 28

The majority of the project is located within the Jimmy Camp Creek Drainage Basin and runoff from the surrounding area drains east towards Jimmy Camp Creek crossing Marksheffel Road through a number of culverts. The West Fork of Jimmy Camp Creek flows on the west side of Marksheffel following the roadway down to Link Road where it crosses Marksheffel and connects with the main branch of Jimmy Camp Creek. A portion of the project is also located within the Peterson Field Drainage Basin, which receives the majority of Zone 1 runoff.

The offsite topography is rolling plains with mostly undeveloped lands. Generally, the land slopes from north to south and west to east across the project roadway.

are less than the WQCV event. The overall goal of the project is to detain the WQCV along the entire roadway pavement. The required WQCV will be in areas located within the El Paso County & City of Colorado Springs MS4 Permit Boundary, which is within the City boundary and the El Paso County Urbanized Area. Treatment will be provided as possible outside of these boundaries, though it is not required.

Per the City of Colorado Springs Drainage Criteria Manual Vol 2, "Stormwater Quality Policies, Procedures and Best Management Practices," November 1, 2002 approved BMP's - Sand Filters and Extended Detention Basins will be used to provide Water Quality Capture Volume for the project to satisfy the MS4 Permit requirements.

2.4 Floodplain Criteria

See Appendix 11 for all applicable Floodplain Criteria.

3.0 HYDROLOGY

3.1 Precipitation

Design rainfall for this project was determined by using the National Oceanic and Atmospheric Administration (NOAA) Precipitation Frequency Data Server, which delivers the NOAA Atlas 14 precipitation frequency estimates. A single location along Marksheffel Road was chosen to represent the entire project. Estimated rainfall depths for the design durations were obtained from this NOAA webtool. Rainfall intensities for the 1-hour 5 and 100-year events are 1.30 and 2.76-inches per hour respectively. Design rainfall uses NOAA Atlas 14 Volume III, which provides the most up to date information available. See Appendix 3 for further design details.

3.2 Drainage Basins

This project is segmented into four zones for design. The most southern zone, Zone 4 is Sta. 70+83.78 to Sta. 128+00, Zone 3 is Sta. 128+00 to 282+30.48, Zone 2 is 376+00 to Sta. 554+00, and the most northern zone is Zone 1 and is Sta. 554+00 to 670+73.68.

On the East side of Marksheffel is Jimmy Camp Creek, which is an identified and studied floodplain (Zone AE). Jimmy Camp Creek does not cross the Marksheffel Road, but stays to the east and south of the roadway. On the west side of the road an identified unstudied floodplain (Zone A) which crosses the road at Sta. 256+00. Several tributaries to Jimmy Camp Creek do cross the road in Zone 3. At the south end of the project in Zone 4, near Link Road, on the northwest side of Marksheffel Road is the Jimmy Camp Creek West Tributary. This tributary is an identified studied floodplain (Zone AE) which crosses the roadway in multiple locations

On the north portion of this project most of the offsite drainage flows from north to south and crosses east across Marksheffel Road north of Space Village Road, then flows to the southwest through the culvert crossing at Sta. 563+20. From that point, all the off site drainage flows from west to east crossing Marksheffel and following natural drainage paths to Jimmy Camp Creek. The on-site flows will be conveyed in curb and gutter section north of Space Village Road. South of Space Village Road the runoff follows the grade of the road draining into roadside ditches.

In Zone 3, the Farmers Mutual irrigation ditch is located at Sta. 212+00 north of Fontaine Boulevard. Both irrigation and storm flows are collected on the west and piped across Marksheffel Road to the irrigation ditch that continues east.

The majority of flow from Fontaine Boulevard to the south contributes to the Jimmy Camp Creek West Tributary. This basin is 3.98 square miles and crosses Marksheffel Road at Sta. 103+00, 91+00, and 71+00. From there flows converge with the main branch of Jimmy Camp Creek. The West Tributary is a FEMA Zone AE studied floodplain with base flood elevations determined. The roadway and drainage work within this floodplain has been reduced to adding shoulders, and replacing culverts to match the existing culverts. The crown of the roadway is limited to matching the existing roadway crown in order to not impact the floodplain elevations.

Pavement basins are not discussed in the narrative, but are included within the rational method calculations.

3.2.1 ZONE 1

This northern portion of the project drains easterly across Marksheffel Road and South to a multi-cell box culvert at Station 563+20 where the runoff flows back across Marksheffel and onto Peterson Air Force Base.

Basin 640L contains 50.0-acres between Air Lane and US-24 west of Marksheffel Road. Historically the runoff in this area was conveyed west across Marksheffel at Sta. 650+26 through an 18-inch CMP and at Sta. 642+80 through an 18-inch CMP. It is proposed to drain the basin south at Air Lane through a 48-inch RCP, where the runoff enters Basin 631L.

Basin 631L contains 18.1-acres between SH-94 and Air Lane. Currently the basin drains south across SH-94 through an existing 42-inch RCP. In the proposed condition, runoff from Basin 640L and 631L will enter an extended detention basin that provides some detention and water quality. From the pond runoff will drain south to Basin 618L through the existing 42-inch RCP.

Basin 618L contains 38.4-acres between Air Lane and Space Village Road west of Marksheffel Road. This runoff flows southwest and currently crosses diagonally through the intersection with Space Village Road through an existing 18-inch CMP. It is proposed to treat this runoff in an extended detention basin that does not provide for detention and to drain it south across Space Village Road in a 5 x 2-foot CBC, then west across Marksheffel Road through double 45 x 29-inch ERCPs. From there runoff enters Basin 552R.

Basin 608L contains 21.4-acres between Sta. 608+00 and Space Village Road. This runoff flows west to east and crosses Marksheffel Road at the proposed double 45 x 29-inch ERCPs which also carries runoff from the north. From there runoff enters into Basin 552R.

Basin 575L contains 106.1-acres. This runoff flows to the south with flows staying on the west side of Marksheffel Road. Flows from this basin cross the Peterson Air Force Base Access Road near Sta. 574+00 through an existing 24-inch RCP and a proposed 60” x 38” ERCP. From there flows travel to the south into Basin 563L.

existing runoff along historic drainage patterns. Offsite runoff is not being increased as part of this project. It will be the responsibility of future developers to detain flows that result from an increase in runoff from change in land use.

Roadway basins were primarily delineated for water quality determination. Ditches capacities were primarily confirmed using offsite flows and were sized for maintenance concerns.

The results of the basin hydrology are shown in the tables below.

3.3.1 Rational Method

The Rational Basin hydrology is shown below in Table 5. This table includes both the on-site roadway basins and the offsite basins. The Basin IDs generally represent the roadway station each basin outlets to, and the L and R indicate the basin in on the left or right side of the Marksheffel centerline. The basins are listed from the north end of the project to the south generally following the drainage patterns of the project.

Table 5: Basins (Rational Method)

Basin ID	Area (ac)	5 -Year		100- Year	
		C	Q (cfs)	C	Q (cfs)
Zone 1					
664R	1.09	0.90	4.54	0.95	9.87
662L	1.21	0.90	4.79	0.95	10.4
661L	0.07	0.90	0.29	0.95	0.63
654L	1.62	0.90	6.04	0.95	13.1
646R	0.75	0.90	2.63	0.95	5.70
641L	1.58	0.90	4.48	0.95	9.72
640L	50.0	0.25	20.6	0.35	60.0
637R	0.91	0.90	2.22	0.95	4.82
631R	0.56	0.90	2.22	0.95	4.83
632L	1.21	0.90	3.96	0.95	8.61
631L	18.1	0.29	9.95	0.39	27.3
618R	1.41	0.90	4.61	0.95	10.0
618L	38.4	0.27	14.7	0.37	42.1
617R	17.53	0.25	9.55	0.35	27.55
608R	1.12	0.90	3.28	0.95	7.13
608L	21.4	0.28	10.0	0.38	28.2
575L	106	0.27	29.4	0.37	85.8
563R	4.84	0.90	8.45	0.95	18.4
563L	11.7	0.25	4.87	0.35	14.2
Zone 2					
553R	0.80	0.90	2.44	0.95	5.31
553L	0.26	0.90	1.01	0.95	2.20
552R	662	0.27	99.3	0.37	302
547R	0.33	0.90	1.17	0.95	2.53
534R	0.37	0.90	1.38	0.95	3.01
534L	15.5	0.29	7.09	0.39	19.8
498L	1.61	0.90	2.96	0.95	6.43
485L	0.33	0.90	1.38	0.95	3.01
484R	2.64	0.90	4.61	0.95	10.1
484L	142	0.26	44.0	.036	129.5
480L	0.17	0.90	0.68	0.95	1.48

calculated by either the Rational Method or the USGS Regional Regression methodology. A small number of culverts were upsized based on a need for additional capacity to meet current design criteria. Culverts that have been upsized outlet to Jimmy Camp Creek and the runoff follows historic drainage patterns, any increased conveyance through the upsized pipe is not expected to have adverse downstream impacts. The minimum 100-year velocity is 3.71 fps. See Appendix 9 for calculations.

Table 7 lists the proposed culverts through the project corridor.

Table 7: Culvert Design

Culvert ID	Existing Size	Proposed Size	100 Year Flow (cfs)	100 Year Headwater	Allowable Headwater	100 Year Velocity (fps)
Zone 1						
CV639	-	42”	75.4	6337.4	6338.3	9.41
SH-94	42”	-	77.4	6323.2	6325.0	20.51
CV617		2-24”	27.55	6282.6	6284.72	6.17
CV616	-	2-45x29	127	6284.8	8285.0	9.29
CV614	-	18”	15.21	6285.6	6285.8	8.82
CV603	-	18”	3.94	6284.7	6286.4	7.95
CV594	-	18”	8.17	6255.2	6256.8	6.57
CV592	-	18”	9.38	6256.1	6257.4	10.00
CV575	-	60” x 38”	85.75	6203.8	6204.6	17.48
CV563	2-7'x3'	2-7x3 CBC	349	6187.2	6187.7	15.13
Zone 2						
CV533	36"	36"	19.8	6159.3	6163.0	15.00
CV490	-	18"	6.06	6073.5	6075.8	7.08
CV483	36”	2-36"	129	6063.8	6064.7	13.75
CV468	36"	36"	38.0	6033.2	6038.0	12.43
CV447	72”	72"	140	5989.0	5995.9	12.29
CV404	48"	54”	134	5908.8	5909.7	10.37
Zone 3						
CV255	-	18”	6.83	5759.1	5760.0	10.06
CV233	-	24”	16.9	5738.6	5739.5	8.11
CV228	72”	7x4 CBC	75.4	5732.9	5736.7	12.73
CV195	-	18"	9.87	5700.9	5703.0	6.76
CV194	-	18"	10.1	5699.8	5701.8	6.77
CV192	-	18”	10.5	5697.8	5699.8	6.84
CV178L		2-36”	87.1	5688.9	5690.19	8.03
CV177R	24”	2-24”	28.6	5687.56	5689.14	6.27
CV177	-	2-36”	87.06	5688.43	5688.7	8.63
CV168	-	2-24”	33.60	5683.18	5683.94	6.75
CV152	18”	18”	8.68	5674.0	5675.2	6.02
CV150	-	6x2 CBC	119	5676.3	5676.3	9.90
Zone 4						
CV125	-	24”	8.55	5652.54	5654.11	6.01
CV121	-	24”	9.59	5649.44	5650.77	6.23
CV117	-	24”	11.16	5646.58	5647.78	6.36
CV112	-	18”	1.67	5640.75	5643.25	4.21
CV109	-	18”	2.31	5638.7	5641.2	4.18
CV102	24”	24”	Replaced in kind to not impact floodplain			

Culvert ID	Existing Size	Proposed Size	100 Year Flow (cfs)	100 Year Headwater	Allowable Headwater	100 Year Velocity (fps)
CV92	24”	30” x 19”	Replaced in kind to not impact floodplain			

4.1.1 Hydraulic Variance

The existing 42-inch culvert at SH-94 has a velocity greater than 18-fps. This is due to the steepness of the culvert, re-routing of the storm system, and ROW limitations that limit what can be detained at that location. A stilling basin has been designed for the outlet of this culvert to counteract the scour forces caused by such high velocities.

Utility impacts caused a set of ditch modifications that included a set of bumpouts for access to the utility manholes along the a few sections of the corridor. These bulbouts block the roadside ditch and 24-inch RCPs. These culverts do not have to convey the full 100-year event, but may overtop the bumpouts during large events.

4.2 Storm Pipes

Inlets and storm pipes are used to route water from the curb and gutter section in Zone 1 to the adjacent ditch on the left side of the roadway. In Zone 2 and 3 grate inlets are used in the ditches to route on-site flow from the ditches to crossing culverts where the runoff will follow historic drainage patterns. In Zone 2 Inlets are placed in the ditches and shall follow ditch criteria requirements. In Table 8 and 9, the inlet location and storm system information is summarized.

For the InRoads calculations located in Appendix 7 of this report the Q_5 is only provided for the inlets listed in Table 8 below. This was done because these inlets are in the only curb and gutter section of the project and the Q_5 was analyzed for spread criteria. In other locations the Q_{100} criteria superseded the Q_5 HW/D criteria.

Table 8: Storm System Design

Inlet ID	Inlet Type	Inlet Size (ft)	Pipe Size	5-Year				100-Year			
				Flow (cfs)	Flow Depth (ft)	Spread (ft)	Pipe Velocity (fps)	Flow (cfs)	Flow Depth (ft)	Spread (ft)	Pipe Velocity (fps)
ZONE 1											
IN664	Type R	5	24”	4.54	0.21	14.82	4.20	9.87	0.25	20.1	4.56
IN662	Type R	5	24"	4.79	0.30	8.81	7.59	10.4	0.38	12.5	8.44
IN661	Type R	5	18"	3.11	0.26	8.95	5.05	8.22	0.33	14.4	6.35
IN654	Type R	5	24"	10.5	0.45	7.70	3.76	26.57	0.62	11.1	4.36
IN646	Type R	5	24”	10.4	0.48	17.7	4.50	27.8	0.65	26.0	5.31
IN640	Type R	5	24”	4.48	0.38	12.5	6.98	9.72	0.47	17.2	7.85
IN636	Type R	5	18”	2.22	0.23	14.8	3.45	4.68	0.27	22.1	3.72
IN630A	Type R	5	24"	2.22	0.23	4.92	4.70	4.83	0.28	7.78	5.31
IN630B	Type R	5	24"	3.96	0.27	7.03	3.24	8.61	0.33	10.3	3.54
IN620	Type R	5	18”	4.61	0.28	7.89	2.62	10.00	0.35	11.36	2.89

Table 9: Grate Inlet Table

Inlet ID	Inlet Type	Pipe Size	100-Year		
			Flow (cfs)	Ponding Depth (ft)	Pipe Velocity (fps)
IN592	Type C	18”	Nuisance Flows		
IN533	Type D	36”	3.01	0.71	15.00
IN468B	Type D	36”	5.93	0.34	12.43
IN468	Type D	36”	2.11	0.52	12.43
IN447	Type D	72”	5.01	0.75	12.29
IN403	Type D	18”	1.77	0.15	1.00
IN206	Type C	24”	5.63	0.47	3.85
IN228	Type D	7x4 CBC	2.81	0.64	12.58
IN257	Type D	18”	14.16	0.61	10.55

4.2.1 Hydraulic Variance

P403 in Zone 3 has a velocity below 2.5-fps. This pipe has been steepened as far as is advisable to help increase velocity and reduce sedimentation within the pipe. The site limitations including roadway cover and existing ground limit further steepening of this pipe.

4.3 Curb & Gutter

A curb and gutter section will be located in Zone 1 from Space Village Avenue to US-24 to minimize ROW impacts and coordination with the Colorado Springs Utilities SDS pump station site. See Appendix 8 for calculations.

Table 10: Curb & Gutter Design

Curb & Gutter ID	Slope (ft/ft)	5-yr Discharge (cfs)	Gutter Depth (ft)	Spread (ft)	100-yr Discharge (cfs)	Normal Depth (ft)	Velocity (fps)
664R	0.053	4.54	0.27	7.30	9.87	0.33	7.96
662L	0.046	4.79	0.28	7.78	10.41	0.34	9.60
661L	0.027	0.29	0.12	1.47	0.63	0.16	4.09
654R	0.043	6.04	0.30	8.86	13.136	0.37	7.76
646R	0.018	2.63	0.27	7.28	5.7	0.33	4.63
641L	0.005	4.48	0.37	12.54	9.72	0.46	3.14
637R	0.005	2.22	0.30	9.18	4.82	0.38	2.69
632L	0.005	3.96	0.36	11.89	8.61	0.45	3.06
631R	0.005	2.22	0.30	9.18	4.83	0.38	2.69
618R	0.018	4.61	0.31	9.57	10.01	0.39	5.20

4.4 Ditches

Ditches will be used to convey on-site flow for a majority of the project as they do currently. Ditches will be trapezoidal with a 5-foot flat bottom and 3:1 back slopes and 4:1 fore slopes where possible. The ditches break at cross culverts where runoff will follow historic drainage patterns. Ditch design requirements are addressed in Section 2.1 of this report.

Table 11 below summarizes the ditches and their corresponding attributes. Calculations for ditch sizes can be viewed in Appendix 8.

Table 11: Ditch Design

Ditch ID	Range	Channel Slope (ft/ft)	5-yr Discharge (cfs)	Normal Depth (ft)	Velocity (fps)	100-yr Discharge (cfs)	Normal Depth (ft)	Velocity (fps)
ZONE 1								
641L	Sta. 640+00 to 655+00	0.005	14.49	0.78	2.39	33.79	1.21	3.04
632L	Sta. 630+00 to 640+00	0.013	30.82	0.9	4.18	80.68	1.46	5.44
618L *	Sta. 630+00 to 640+00	0.044	4.61	0.23	3.52	77.42	1.06	8.39
608L	Sta. 618+00 to 631+00	0.013	4.61	0.32	2.35	28.19	0.86	4.07
608R	Sta. 608+00 to 618+00	0.013	3.28	0.26	2.1	7.13	0.41	2.7
575L	Sta. 608+00 to 618+00	0.013	29.38	0.88	4.12	85.75	1.51	5.53
563R	Sta. 575+00 to 608+00	0.026	8.45	0.37	3.61	18.44	0.57	4.6
ZONE 2								
553L	Sta. 575+00 to 608+00	0.02	1.01	0.12	1.59	2.2	0.19	2.1
C 575L	Sta. 568+50 to 573+23	0.014	-	-	-	85.75	1.37	12.48
553R	Sta. 553+00 to 559+00	0.02	2.44	0.2	2.18	5.31	0.31	2.84
547R	Sta. 552+00 to 563+00	0.024	1.17	0.12	1.78	2.53	0.19	2.35
534L	Sta. 547+00 to 552+00	0.014	7.09	0.4	2.76	19.8	0.7	3.78
534R	Sta. 533+50 to 542+00	0.019	1.38	0.14	1.75	3.01	0.23	2.31
498L	Sta. 533+50 to 550+00	0.018	2.96	0.23	2.25	6.43	0.35	2.92
485L	Sta. 498+50 to 534+00	0.033	1.38	0.12	2.09	3.01	0.19	2.76
484R	Sta. 484+00 to 491+00	0.019	4.61	0.29	2.66	10.06	0.45	3.43
480L	Sta. 480+00 to 484+00	0.007	0.68	0.13	0.99	1.48	0.2	1.3
470R	Sta. 484+00 to 534+00	0.025	2.73	0.2	2.44	5.93	0.31	3.17
470L	Sta. 470+00 to 484+00	0.025	0.97	0.11	1.68	2.11	0.17	2.23
448L	Sta. 469+00 to 474+00	0.021	47.35	1	5.6	5.01	0.29	2.83
448R	Sta. 448+00 to 455+00	0.021	2.3	0.19	2.17	5.01	0.29	2.83
438R	Sta. 447+60 to 469+00	0.019	2.68	0.21	2.22	5.83	0.33	2.88
422R	Sta. 438+00 to 448+00	0.012	0.81	0.12	1.25	1.77	0.19	1.65
405L	Sta. 422+00 to 430+00	0.023	5.59	0.3	3.02	12.15	0.47	3.88
403L	Sta. 404+00 to 444+00	0.02	1.51	0.15	1.84	3.28	0.23	2.42
403R	Sta. 398+60 to 403+00	0.02	0.81	0.1	1.47	1.77	0.16	1.95
394L	Sta. 398+60 to 404+00	0.013	0.77	0.11	1.26	1.67	0.18	1.66
377L	Sta. 394+20 to 398+60	0.017	1.98	0.18	1.92	4.3	0.29	2.51
376R	Sta. 376+40 to 381+00	0.031	5.79	0.29	3.38	14.42	0.48	4.54
ZONE 3								
A 256L	Sta 256+30 to 264+29	0.009	2.46	0.25	1.68	6.97	0.25	2.36
A 256R	Sta 256+30 to 264+30	0.009	2.46	0.25	1.68	6.97	0.25	2.36
A 247L	Sta. 246+00 to 256+30	0.019	2.41	0.51	2.67	6.83	0.51	3.46
A 246R	Sta. 246+00 to 256+30	0.019	2.54	0.52	2.7	7.19	0.52	3.5
A 226L *	Sta. 226+00 to 246+00	0.023	19.69	0.61	4.49	72.59	0.61	6.51
A 229R	Sta. 229+00 to 232+00	0.0095	0.99	0.14	1.25	2.81	0.14	1.79
A 210L *	Sta. 210+60 to 226+00	0.0258	25.06	0.65	4.82	92.09	0.65	6.89
A 212R	Sta. 212+00 to 229+00	0.0083	2.65	0.27	1.68	7.48	0.27	2.35
A 208R	Sta. 207+60 to 212+00	0.01	1.33	0.17	1.41	3.77	0.17	2.01
A 206L	Sta. 205+00 to 212+00	0.01	1.99	0.21	1.62	5.63	0.21	2.29
A 178L	Sta. 179+00 to 205+00	0.012	23.38	0.8	3.75	87.06	0.8	5.39
A 178R**	Sta. 200+00 to 205+00					12.81	1.35	3.53
A 178R	Sta. 178+00 to 207+00	0.01	4.51	0.34	2.13	12.81	0.34	2.95
A 152L	Sta. 152+00 to 178+00	0.0053	3.05	0.33	1.52	8.68	0.33	2.1
A 152R	Sta. 152+00 to 178+00	0.0052	3.1	0.33	1.51	8.82	0.33	2.1
ZONE 4								
A 125R	Sta. 124+50 to 137+50	0.01	2.06	0.22	1.64	5.82	0.22	2.31
A 103L**	Sta 130+00 to 140+00	0.0075				13.47	1.45	3.21
A 103L	Sta. 103+00 to148+00	0.088	4.69	0.36	2.07	13.47	0.36	2.86
A 130L**	Sta 103+00 to 148+00	0.01				129.7	1.88	12.6
A 92L	Sta. 92+00 to 103+00	0.0073	1.01	0.16	1.15	2.85	0.16	1.65

Ditch ID	Range	Channel Slope (ft/ft)	5-yr Discharge (cfs)	Normal Depth (ft)	Velocity (fps)	100-yr Discharge (cfs)	Normal Depth (ft)	Velocity (fps)
A 92R	Sta. 92+00 to 103+00	0.0071	1.09	0.17	1.17	3.07	0.17	1.68

* Turf Reinforcement matt required due to high velocities.
** Ditch Section is triangular.

There is one concrete lined ditch located in Zone 2 of the project downstream of the culvert at the Peterson Air Force Base. This ditch is rectangular with a 5-foot bottom width and a depth of 1.5 feet. This was done to accommodate ROW limitation in the area and to receive the high velocities from CV575. The minimum ditch slope was used to compute capacity. See C 575L for design information.

There is also a concrete lined ditch at the south end of Zone 3 at Station 130+00 Left. The ditch has been narrowed significantly at this location for a turning lane at the future Mesa Ridge Parkway, and a utility access road.

4.2.1 Ditch Variance

Ditches 618L, 226L, and 210L shall be protected with turf reinforcement due to higher velocities for the 100-YR flow.

Utility impacts caused a set of ditch modifications that included a set of bumpouts for access to the utility manholes along the a few sections of the corridor. These bulbouts block the roadside ditch and 24-inch RCPs. These culverts do not have to convey the full 100-year event, but may overtop the bumpouts during large events.

4.5 Detention

There are two extended detention basins on the project that provide detention in addition to water quality treatment. Pond 630 provides detention to the capacity of the existing 42” CMP that crosses SH-94. Pond 380 provides detention to the capacity of the existing 24” CMP that crosses Drennan on the east side of Marksheffel. See the Water Quality section for further discussion and Appendix 11 for Extended Detention Basin calculations. Table 12 provides the detention design results for these ponds.

Table 12: Detention Design

Pond ID	10-year			100-year		
	Q_{in} (cfs)	Q_{out} (cfs)	Storage Volume (ac-ft)	Q_{in} (cfs)	Q_{out} (cfs)	Storage Volume (ac-ft)
Pond 380	9.14	6.81	0.23	27.11	6.81	1.56
Pond 630	-	-	-	90.41	77.05	0.88

5.0 WATER QUALITY

This section outlines the Treatment BMPs used to fulfill the MS4 Permit requirements on the project. Sand Filters and Extended Detention Ponds were used to provide WQCV on the project. These are approved Treatment BMP’s as outlined in the El Paso County and City of Colorado Spring Drainage Design Manual which references Urban Drainage and Flood Control District Criteria.

Print Date: 10/23/2014	Basin Boundary	Hydrologic Soils Group A	EL PASO COUNTY COLORADO	As Constructed	MARKSHEFFEL ROAD DRAINAGE BASIN	Project No./Code
File Name: Basins_BL_20141009.mxd	Flowpath	Hydrologic Soils Group B		No Revisions:	Designer: E.Staten	
Horiz. Scale: Vert. Scale: None	Water	Hydrologic Soils Group C		Revised:	Detailer: M.Johnson	Structure Numbers
Unit Information Unit Leader Initials		Hydrologic Soils Group D		Void:	Sheet Subset: BASIN	Subset Sheets: 3 of 3	Sheet Number 3

HDR Engineering, Inc. PARSONS BRINCKERHOFF

PPRTA

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Print Date: 1/31/2017		Sheet Revisions			As Constructed	MARKSHEFFEL ROAD DRAINAGE BASINS PLAN 616+00.00 TO 630+00.00	Project No./Code
File Name: North-Marksheffel_BASINS_Plan040.dgn		Date:	Comments	Init.	No Revisions:		....
Horiz. Scale: 1:100 Vert. Scale: As Noted					Revised:	Designer: E. STATEN / Structure Numbers	....
Unit Information Unit Leader Initials					Void:	Detailer: D. MADDOCK	33
HDR PARSONS BRINCKERHOFF	0000					Sheet Subset: BASINS / Subset Sheets: 33 of 36	

EL PASO COUNTY COLORADO

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Print Date: 12/8/2016	Sheet Revisions		
File Name: North-Marksheffel_BASINS_Plan041.dgn	Date:	Comments	Init.
Horiz. Scale: 1:100 Vert. Scale: As Noted			
Unit Information Unit Leader Initials			

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EL PASO COUNTY COLORADO

PPRTA

As Constructed	MARKSHEFFEL ROAD DRAINAGE BASINS PLAN 630+00.00 TO 644+00.00			Project No./Code
No Revisions:				....
Revised:	Designer: E. STATEN	Structure Numbers		....
Void:	Detailer: D. MADDOCK			34
	Sheet Subset: BASINS	Subset Sheets: 34 of 36		

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LEGEND

A# / Area C5 / C100 — BASIN LABEL

OFFSITE BASIN BOUNDARY

PAVEMENT BASIN BOUNDARY

FLOW DIRECTION

Print Date: 12/8/2016		Sheet Revisions			
File Name: North-Marksheffel_BASINS_Plan042.dgn		Date:	Comments	Init.	
Horiz. Scale: 1:100 Vert. Scale: As Noted					
Unit Information Unit Leader Initials					
HDR PARSONS BRINCKERHOFF					

EL PASO COUNTY COLORADO

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As Constructed	MARKSHEFFEL ROAD DRAINAGE BASINS PLAN 644+00.00 TO 658+00.00			Project No./Code
No Revisions:				....
Revised:	Designer: E. STATEN	Structure Numbers		....
Void:	Detailer: D. MADDOCK			35
	Sheet Subset: BASINS	Subset Sheets: 35 of 36		

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Print Date: 12/8/2016	Sheet Revisions			As Constructed	MARKSHEFFEL ROAD DRAINAGE BASINS PLAN 658+00.00 TO 670+73.68	Project No./Code
File Name: North-Marksheffel_BASINS_Plan043.dgn	Date:	Comments	Init.	No Revisions:		....
Horiz. Scale: 1:100 Vert. Scale: As Noted				Revised:	Designer: E. STATEN Structure Numbers	....
Unit Information Unit Leader Initials				Void:	Detailer: D. MADDOCK	36
PARSONS BRINCKERHOFF					Sheet Subset: BASINS Subset Sheets: 36 of 36	

EL PASO COUNTY COLORADO

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JIMMY CAMP CREEK DRAINAGE REPORT EXCERPTS

Jimmy Camp Creek

Drainage Basin Planning Study
Development of Alternatives &
Design of Selected Plan Report

Prepared for:

City of Colorado Springs

Prepared by:

Kiowa
Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904
(719) 630-7342

March 9, 2015

Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904
(719) 630-7342

JIMMY CAMP CREEK WATERSHED
DRAINAGE BASIN PLANNING STUDY
VICINITY MAP
CITY OF COLORADO SPRINGS

Project No.:	14008
Date:	OCT 2014
Design:	
Drawn:	BJW
Check:	
Revisions:	

I-1

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JIMMY CAMP CREEK WATERSHED
DRAINAGE BASIN PLANNING STUDY
FUTURE CONDITIONS PLANNING INFORMATION
, CITY OF COLORADO SPRINGS

Project No.:	14008
Date:	OCT 2014
Design:	
Drawn:	BJW
Check:	
Revisions:	

II-2

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JIMMY CAMP CREEK WATERSHED
DRAINAGE BASIN PLANNING STUDY
FUTURE CONDITIONS LAND USE MAP
CITY OF COLORADO SPRINGS

Project No.:	1408
Date:	OCT 2014
Design:	
Drawn:	BJW
Check:	
Revisions:	

II-3

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JIMMY CAMP CREEK WATERSHED
DRAINAGE BASIN PLANNING STUDY
SOILS MAP
CITY COLORADO SPRINGS

Project No.:	14008
Date:	OCT 2014
Design:	BJW
Drawn:	AFE
Check:	BJW
Revisions:	

II-4

Kiowa Engineering Corporation
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JIMMY CAMP CREEK WATERSHED
DRAINAGE BASIN PLANNING STUDY
MAJOR DRAINAGEWAY REACH DELINEATION
CITY OF COLORADO SPRINGS, COLORADO

Project No.:	14008
Date:	SEPT. 2014
Design:	
Drawn:	BJW
Check:	
Revisions:	

FIGURE

IV-1

Kiowa
Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904
719 630-7342
JIMMY CAMP CREEK WATERSHED
DRAINAGE BASIN PLANNING STUDY
SUBBASIN MAP
CITY OF COLORADO SPRINGS, COLORADO
Project No.: 14008
Date: APRIL 2015
Design: RKW
Drawn: DAK
Check:
Revision:
EXHIBIT 1
LEGEND
SUBBASIN ID
AREA (AC)
SUBBASIN DESIGN ID
MAJOR DESIGN POINT ID
ROUTED DESIGN ID
IRRIGATION DITCH
EXISTING DRAINAGE
INTERMITTENT DRAINS
RECORDED DRAINAGEWAY
DCS DRAINAGEWAY
MERIDIAN RD
BLANEY RD
SLINEY RD
DAVIS RD
FRANKSVILLE COAL MINE RD
BRADLEY RD
TRUMAN RD
FRANKSVILLE VALLEY RD
MARGHERITA RD
OSBEMAN RD
POWERS BLVD
MONTANE BLVD
LINK RD
Hydrology for West Fork
Jimmy Camp Creek
Jimmy Camp Creek, West Fork
Jimmy Camp Creek GIS
Kiowa, 2003

JIMMY CAMP CREEK WATERSHED
DRAINAGE BASIN PLANNING STUDY
STRUCTURE INVENTORY MAP
CITY OF FOUNTAIN, CITY OF COLORADO SPRINGS, EL PASO COUNTY

Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904
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Project No.: 06025	
Date: DECEMBER 2006	
Design:	
Drawn: EAK	
Check:	
Revisions:	

SHEET 1 OF 4 SHEETS

Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904
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JIMMY CAMP CREEK WATERSHED
DRAINAGE BASIN PLANNING STUDY
JURISDICTIONAL BOUNDARIES
CITY OF FOUNTAIN, CITY OF COLORADO SPRINGS, EL PASO COUNTY

Project No.:	14008
Date:	OCTOBER 2014
Design:	
Drawn:	EAK
Check:	
Revisions:	

FIGURE

Fig. VII-1

Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904
(719)630-7342

JIMMY CAMP CREEK WATERSHED
DRAINAGE BASIN PLANNING STUDY
PLATTABLE ACREAGE
CITY OF FOUNTAIN, CITY OF COLORADO SPRINGS, EL PASO COUNTY

Project No.:	14006
Date:	OCTOBER 2014
Designr:	
Drawn:	EAK
Check:	
Revisions:	

FIGURE
Fig VII-2

REAGAN RANCH MDDP EXCERPTS

SHEET No.

811 Call before you dig.

CROSSROADS NORTH SITE

PIKES PEAK INVESTMENTS, LLC

PRELIMINARY
THIS DRAWING HAS NOT BEEN APPROVED BY GOVERNING AGENCIES AND IS SUBJECT TO CHANGE

FOR AND ON BEHALF OF MATRIX DESIGN GROUP, INC.
PROJECT No.

SEAL

Matrix

SHEET KEY

No.	DATE	DESCRIPTION	BY
		REVISIONS	

COMPUTER FILE MANAGEMENT
FILE NAME: @ - 4>&> - >:9&B - $<C>:A&B - $<C>:A&B 6@B-C@) @ @:4>A> - >:9&B - :%:&A - TEX
CTB FILE:
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(AS DRAWING IS CURRENT AS OF PLOT DATE AND MAY BE SUBJECT TO CHANGE)

REFERENCE DRAWINGS

DESIGNED BY:
DRAWN BY:
CHECKED BY:
SCALE
HORIZ. 1" =
VERT.

DATE ISSUED
SHEET

DRAWING No.
DR03

c. The ***fully developed conditions*** for the site are as follows:

At this Master Development stage of design for the drainage, general locations of Design Points have been defined in order to size the trunk mains of the proposed storm system (see Appendix D for Storm Exhibit). Each of the proposed sub-basins will have their own internal storm systems that convey the flows to the Design Points mentioned in this report and will be outlined in each parcel's respective Final Drainage Report.

Design Point 1 (Q_5 = 3.3 cfs, Q_{100} = 9.8 cfs) (Sub-basins CB-5-CB8.1 and N-28 (SDS), Tributary Area: 4.72 Acres) represents the offsite runoff crossing Highway 94 at the existing triple 30" CMP culverts (Public CDOT). This drainage point has a tributary area of approximately 4.7 acres. The drainage area includes a portion of Marksheffel Road north of Highway 94 and the portion of the SDS property which is not captured by the existing SDS detention pond (private) (which provides 100 percent infiltration for its tributary drainage area and does not discharge to the Reagan Ranch development). After crossing Highway 94 this sub-basin drains eastward along the Highway 94 road ditch eventually entering Jimmy Camp Creek. This sub-basin and design point remain unchanged from predevelopment conditions.

Design Point 3 (Q_5 = 19.4 cfs, Q_{100} = 72.8 cfs) (Sub-basins OS-1 and OS-2, Tributary Area: 68.2 Acres) represents the offsite flows conveyed across Highway 94 towards the west side of the proposed project. These flows are conveyed across Highway 94 via a 42-inch CMP (Public CDOT). These flows appear to go through the Marksheffel Water Quality Pond (Public-Colorado Springs) located in the NW quadrant of the Marksheffel Road and Highway 94 intersection. This sub-basin and design point remain unchanged from predevelopment conditions.

Notes:

- **Analysis of the Proposed Basin areas is conceptual in nature. Greater detail than typical (including some preliminary storm sewer design) is provided in this MDDP in order to accommodate SWMM analysis of the various regions within the development for use in the City of Colorado Springs PCM Preliminary Detention Spreadsheet. Future FDRs for each phase of the site must define the specific storm sewer and drainage patterns. Basin Lettering (i.e. A, B, C, etc.) can be considered to indicate a rough idea of future phases and/or regions which would require on-site detention. Future FDRs must define the drainage within each phase/region.**

- **The first phase of the Reagan Ranch development which is planned for construction has been named "High Plains at Reagan Ranch" and consists of a small portion of region B and all of regions C and J. Street and inlet calculations for these three regions are included in the report. Similar calculations for the remaining regions will be submitted with future Final Drainage Reports as development progresses. An FDR will be submitted with the High Plains at Reagan Ranch Final Plat.**

- **For sub-basins within the single-family residential areas, runoff will sheet flow towards the adjacent streets. Once reaching the street these flows will be channelized into gutter flow for conveyance to downstream inlets.**

Matrix Design Group, Inc., 2021©

DRAINAGE MAPS

CROSSROADS NORTH MDDP

COUNTY OF EL PASO, STATE OF COLORADO

EXISTING DRAINAGE MAP

SEPTEMBER 2023

LEGEND
BASIN DESIGNATION
661L
0.07
.90
.95
ACRES
C5
C100
PIPE RUN REFERENCE LABEL
SURFACE DESIGN POINT
BASIN BOUNDARY
EX MAJOR DRAINAGE BASIN BOUNDARY
(6920) EXISTING MAJOR CONTOUR
(6918) EXISTING MINOR CONTOUR
FILING BOUNDARY LINE
RIGHT-OF-WAY LINE
EXISTING PROPERTY LINE
EXISTING STORM DRAIN
EXISTING STORM SEWER PIPE
EXISTING FIBER OPTIC LINE
EXISTING OVERHEAD ELECTRIC
EXISTING LOT LINE
EXISTING FENCE
EXISTING MONITORING WELL
EXISTING LOT LINE
UNDERGROUND ELECTRICAL
EXISTING GAS LINE
EXISTING FLOW DIRECTION ARROW
EMERGENCY OVERFLOW DIRECTION
EXISTING RIPRAP TYP.
EXISTING UTILITY POLE
EX. IRRIGATION VALVE
EX. STORM INLET
EX. GAS TEST NODE
EX. TRAFFIC SIGNAL CONTROL BOX
EX. ELECTRIC VAULT
EX. SANITARY MANHOLE
EX. WATER VALVE
EXISTING WATER WELL
EXISTING MONITORING WELL
EX. TELEPHONE VAULT
EX. ELECTRIC VAULT
EX. ELECTRIC PEDESTAL
EX. ELECTRIC METER
EX. ELECTRIC TRANSFORMER
EX. TELEPHONE PEDESTAL
EX. FIBER OPTIC MANHOLE
EX. ELECTRIC PEDESTAL
EX. WATER MARKER
EX. GAS MARKER
EX. FIBER OPTIC MARKER
EX. ELECTRIC MANHOLE
EX. CABLE TV MARKER
EX. SHRUB/TREE
EX. WATER YARD HYDRANT
EX. STORM INLET
EX. ELECTRIC BOX
EX. FIRE HYDRANT
EX. ELECTRIC MARKER
EX. TRAFFIC SIGNAL
1" = 100'
0 50' 100 200
Scale in Feet
LOT 16 HILLCREST ACRES
LOT 14 HILLCREST ACRES
LOT 9 HILLCREST ACRES
LOT 10 HILLCREST ACRES
LOT 11 HILLCREST ACRES
LOT 12 HILLCREST ACRES
LOT 13 HILLCREST ACRES
LOT 15 HILLCREST ACRES
LOT 16 HILLCREST ACRES
LOT 17 HILLCREST ACRES
LOT 18 HILLCREST ACRES
LOT 19 HILLCREST ACRES
LOT 20 HILLCREST ACRES
SAND CREEK DRAINAGE BASIN
JIMMY CAMP CREEK DRAINAGE BASIN
N. MARKSCHEFFEL RD. (PUBLIC R.O.W. VARIES)
CITY OF COLORADO SPRINGS 5408-00-0273
COLORADO SPRINGS LAND
WATSON H PETER 5408-00-0010
HUMBERS INVESTMENTS LLC 5408-10-1002
WOOLSEY, BENJAMIN & ROSEMARY, LLC 5408-10-1001
NE HOLDINGS, LLC 5408-10-1000
BLACK CHERRY INVESTMENTS, LLC 5408-10-1006
JOHN STACY L. 5408-10-1005
EX 48" PUBLIC CMP CULVERT (E4) Q5=10.4 CFS Q100=51.1 CFS
EX 42" CMP PUBLIC CULVERT (E3) Q5=47.4 CFS Q100=177.1 CFS
EX 60X38" ERCP W/FES (PR630C)
EX DET/WQ POND OUTLET STRUCTURE
EX 36" RCP CULVERT W/FES (PR639)
EX 24" RCP W/FES (PR640)
EX 5' INLET TYPE R (IN640)
EX 5' INLET TYPE R (IN636)
EX 6' CURB AND GUTTER
EX 5' INLET TYPE R (IN646)
EX 5' INLET TYPE R (IN654)
EX 24" RCP W/FES (PR654)
EX 24" RCP W/FES (PR662)
EX SWALE CHECK STRUCTURE (TYP)
EX 18" RCP W/FES (PR661)
EX INLET TYPE R (IN662)
EX INLET TYPE R (IN661)
EX INLET TYPE R (IN664)
EXISTING GRAVEL ROAD
EX 5' STRAND BARBWIRE FENCE
EX CONC LF CHANNEL
EX CDOT TYPE C AREA INLET W/24" RCP
EX 24" RCP (PR630B)
EX 24" RCP (PR630A)
EX 12" CORR. PLASTIC
EX EOP
SITE BOUNDARY WITHIN UNINCORPORATED EL PASO COUNTY
CITY PROPERTY BOUNDARY
PETERSON FIELD DRAINAGE BASIN
JIMMY CAMP CREEK DRAINAGE BASIN
PETERSON FIELD DRAINAGE BASIN
JIMMY CAMP CREEK DRAINAGE BASIN
BOOK 6675 PAGE 240
R=112' A.N. 214116.22
R=124' A.N. 214119.78
R=115' A.N. 214118.78
R=124' A.N. 214117.78
R=112' A.N. 214116.22
R=124' A.N. 214117

CROSSROADS NORTH MDDP

COUNTY OF EL PASO, STATE OF COLORADO

PROPOSED DRAINAGE MAP

MAY 2024

*BASIN GEOMETRY AND RUNOFF COEFFICIENTS TAKEN FROM MARKSHEFFEL ROAD SOUTH FDR

BASIN SUMMARY

BASIN	AREA (ACRES)	Q_5	Q_{100}
A	9.83	40.8	74.4
B	8.39	32.3	58.9
C	6.08	24.1	43.9
D	3.15	1.9	10.4
E	1.40	0.9	4.7
F	9.14	30.3	55.3
G	4.69	18.7	34.2
H	8.09	2.3	16.8
I	1.57	0.8	4.2
J	4.87	2.8	12.1
K	13.08	8.1	34.7
L	0.82	0.5	2.8
M	8.02	2.2	16.4
OS-1	5.86	1.6	11.9
RD-1	4.42	8.2	16.6
RD-2	2.40	0.7	5.3
RD-3	1.05	0.3	2.5
RD-4	1.93	0.5	4.0
RD-5	1.49	0.5	3.7
OS-2	0.35	1.6	2.9
OS-3	0.72	2.8	5.0
OS-4	1.41	6.6	11.8
631R*	0.56	2.4	4.2
632L*	1.21	3.7	6.7
637R*	0.91	3.1	5.5
641L*	1.58	5.8	10.4
646R*	0.75	3.5	6.2
654R*	1.62	7.1	12.8
661L*	0.07	0.3	0.6
662L*	1.21	5.6	10.0
664R*	1.09	5.1	9.1

DESIGN POINT SUMMARY

DESIGN POINT	Q_5	Q_{100}	BASIN/DP/PR	STRUCTURE
1	5.1	9.1	664R	EX 5' CDOT TYPE R INLET
2	5.6	10.0	662L	EX 5' CDOT TYPE R INLET
3	2.9	6.7	FBIN662, 661L	EX 5' CDOT TYPE R INLET
4	9.8	27.5	PR664, PR662, PR661 OS-1	EX 5' BTM EARTH TRAP CHANNEL
5	10.3	21.6	FBIN664, FBIN661 654R	EX 5' CDOT TYPE R INLET
6	12.3	29.3	DP4, PR654	EX 5' BTM EARTH TRAP CHANNEL
7	40.8	74.4	BASIN A	PROP PRIVATE 42" RCP STORM SEWER
8	24.1	43.9	BASIN C	PROP PRIVATE 36" RCP STORM SEWER
9	98.7	186.9	BASIN D, DP7, DP8, DP14	PROP PRIVATE 18" RCP STORM SEWER, POND 1
10	14.0	35.4	BASIN RD-3, DP6	PROP DUAL 24" PUBLIC RCP CULVERTS
11	7.9	18.1	FBIN654, 646R	EX 5' CDOT TYPE R INLET
12	15.3	34.5	PR646, PR-DP10	EX 5' BTM EARTH TRAP CHANNEL
13	5.8	10.4	641L	EX 5' CDOT TYPE R INLET
14	32.2	58.9	BASIN B	PROP PRIVATE 42" RCP STORM SEWER
15	30.3	55.3	BASIN F	SURFACE RUNOFF
16	31.0	59.0	BASIN E, DP15	PROP PRIVATE 18" RCP STORM SEWER, POND 2
17	14.9	43.3	PR640, DP12, DP9, BASIN RD-4	PROP DUAL 24" PUBLIC RCP CULVERTS
18	5.9	14.5	FBIN646, 637R	EX 5' CDOT TYPE R INLET
19	16.5	43.6	PR636, DP16, DP17	EX 5' BTM EARTH TRAP CHANNEL
20	8.1	34.7	BASIN K	PROP PRIVATE 30" RCP STORM SEWER
21	9.0	39.2	DP20, BASIN L	PROP 18" PRIVATE RCP STORM SEWER, POND 4
22	4.0	11.7	FBIN636, 631R	EX 5' CDOT TYPE R INLET
23	5.9	11.6	FBIN640, 632L	EX 15' CDOT TYPE R INLET
24	14.8	40.5	DP19, BASIN RD-5	EX CDOT TYPE C AREA INLET W/RIPRAP BYPASS RUNDOWN AND PUBLIC 24" RCP OUTFALL
25	1.0	3.3	OS-2, FBIN630B	EX 12" PUBLIC PLASTIC CORR PIPE
26	17.4	26.8	E1, E2, PR630B	EX WQ POND
27	23.4	54.0	DP21, DP26, BASIN OS-3, BASIN M	EX 42" PUBLIC CMP CULVERT
28	8.2	16.6	BASIN RD-1	TRIANGULAR, EARTHEN CDOT DITCH
29	6.5	15.7	BASIN RD-2, DP28	TRIANGULAR, EARTHEN CDOT DITCH
30	18.7	34.2	BASIN G	PROP PRIVATE 30" RCP STORM SEWER
31	2.8	12.1	BASIN J	PROP PRIVATE 30" RCP STORM SEWER
32	22.8	54.2	BASIN I, DP30, DP31	PROP PRIVATE 24" RCP STORM SEWER, POND 3
33	10.2	33.7	BASIN H, BASIN OS-4, DP32, DP29	EX PUBLIC 48" CMP CULVERT

STORM SEWER SUMMARY

PIPE RUN	Q_5	Q_{100}	PIPE SIZE	CONTRIBUTING PIPES/DP
664	2.7	3.4	EX 24" RCP	DP1
662	3.0	3.8	EX 24" RCP	DP2
661	1.9	3.2	EX 18" RCP	DP3
654	4.0	5.4	EX 24" RCP	DP5
646	3.4	4.7	EX. 18" RCP	DP11
640	2.9	3.8	EX. 24" RCP	DP13
636	3.0	4.3	EX. 24" RCP	DP18
630A	2.5	4.1	EX. 24" RCP	DP22
630B	5.9	10.3	EX. 24" RCP	DP23
E1	1.0	3.3	EX. 12" CORR. PLASTIC	DP25
E2	15.0	19.9	EX. 24" RCP	DP24
E3	23.4	54.0	EX. 42" CMP	DP27
E4	10.2	33.7	EX. 48" CMP	DP33
A1	40.8	74.4	PROP. 42" RCP	DP7
B1	32.3	58.9	PROP. 42" RCP	DP14
C1	24.1	43.9	PROP. 36" RCP	DP8
D1	1.0	16.7	PROP. 18" RCP	DP9
PR-DP16	0.3	7.6	PROP. 18" RCP	DP16
G1	18.7	34.2	PROP 30" RCP	DP30
J1	2.8	12.1	PROP 30" RCP	DP31
I1	0.2	8.6	PROP 24" RCP	DP32
K1	8.1	34.7	PROP 30" RCP	DP20
L1	0.0	10.0	PROP 18" RCP	DP21
PR-DP10	14.0	35.4	DUAL 24" RCP	DP10
PR-DP17	14.9	43.3	DUAL 24" RCP	DP17

CROSSROADS NORTH
PROPOSED DRAINAGE MAP
DATE SUBMITTED: 05/28/24
SHEET 1 OF 1

CIVIL CONSULTANTS, INC.
212 N. WAHSATCH AVE., STE 305
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

File: G:\18001A-Crossroads 45\Colorado Springs Equities LLC\Drainage\PROPOSED MDDP MAP.dwg Plotstamp: 5/28/2024 4:26 PM

SEMPER SUPRA POINT
N. MARKSHEFFEL RD.

SCALE 1"=10'

AIR LANE
N. MARKSHEFFEL RD

SCALE 1"=10'

CROSSROADS NORTH
MARKSHEFFEL RD INTERSECTION DETAILS

PROJECT NO. 18-001	SCALE: HORIZONTAL: 1"=10' VERTICAL: N/A	DATE: 03/11/2024
DESIGNED BY: CVW DRAWN BY: CVW CHECKED BY: VAS		SHEET 1 OF 1

EXH01

212 N. WAHSATCH AVE, STE 305
COLORADO SPRINGS, CO 80903
PHONE:719.953.5485
CIVIL CONSULTANTS, INC.

VIRGIL A. SANCHEZ, COLORADO P.E. NO. 37160

FOR AND ON BEHALF OF MVS CIVIL CONSULTANTS, INC.

REVISIONS:

NO.	DATE:	BY:	DESCRIPTION:	APRV'D. BY:	DATE:

THE ENGINEER PREPARING THESE PLANS WILL NOT BE RESPONSIBLE OR LIABLE FOR UNAUTHORIZED CHANGES TO OR USES OF THESE PLANS. ALL CHANGES TO THE PLANS MUST BE IN WRITING AND MUST BE APPROVED BY THE PREPARER OF THESE PLANS.

CAUTION

File: Q:\180014-Crossroads 45\Colorado Springs Equities LLC\Drainage\GRADING MARKSHEFFEL INTERSECTIONS EXHIBIT.dwg Plotstamp: 3/13/2024 10:30 AM