EPC STORMWATER REVIEW COMMENTS
IN ORANGE BOXES WITH BLACK TEXT

MASTER DEVELOPMENT DRAINAGE PLAN
&
PRELIMINARY DRAINAGE REPORT

FOR

CROSSROADS NORTH

A RESUBDIVISION OF HILLCREST ACRES

EL PASO COUNTY, COLORADO

SEPTEMBER 2022

Prepared for:

Colorado Springs Equities LLC
90 S. Cascade, Suite 1500
Colorado Springs, CO 80903
(719) 475-7621

Prepared by:

CIVIL CONSULTANTS, INC.

212 N. Wahsatch Avenue, Suite 305
Colorado Springs, CO 80903
(719) 955-5485

Project #18-001
PCD Project #SP 20-207

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

DRAINAGE PLAN STATEMENTS

ENGINEERS STATEMENT

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

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

DEVELOPER'S STATEMENT

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

BY: ___________________________________

TITLE: ________________________________ DATE: _________________________

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:______________________________ DATE:_________________________
Joshua Palmer, P.E.
~~Interim~~ County Engineer / ECM Administrator

CONDITIONS:

Remove Interim.

"INTERIM" REMOVED

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	6
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
Marksheffel Road Final Drainage Report Excerpts
Jimmy Camp Creek DBPS Excerpts
Reagan Ranch MDDP Excerpts
Drainage Maps

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

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, 08041C0758G, 08041C0758G, 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 BMP's to mitigate the potential for erosion across the site. Specialized BMP's shall be considered with the final drainage report and subsequent lot reports due to the nature of the proposed commercial uses.

EXISTING DRAINAGE CONDITIONS

Two 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 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 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**, **DP5,** 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 an 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 22**, 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 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 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 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 **Basin F** (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 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 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 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 131.7 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=1.7, Q100=4.1 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 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 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 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 Lot 6, 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 off 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 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 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) 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 this design point are 9.8 and 27.5 cfs, respectively. The runoff at this design point continues south 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 flow bys 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 10.42 acres of Lots 4, 5, 6, and Tract A, which are proposed commercial parcels of land located to the north on-site. Runoff from this basin (Q5=43.2, Q100=78.8 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 6.38 acres of Lots 7, 8, 9, 10, and 11, which are proposed, commercial parcels of land located to the north east on-site. Runoff from this basin (Q5=26.6, Q100=48.4 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 2.70 acres of a proposed FSD pond. Runoff from this basin (Q5=1.6, Q100=8.9 cfs) combines with flows from **DP7, DP8, and DP13** at 5 yr and 100 yr rates of 101.3 and 190.5 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.** 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 [...] ottom earthen CDOT swale. Runoff from this ba[...] **P6** at 5 yr and 100 yr rates of 13.9 and 34.7 cfs, [...]al proposed public 24” RCP culverts (**PR-DP10**). A rip rap pad is proposed at the terminus of the culvert.

THE MDDP WILL NOT HAVE THESE CALCULATIONS. THE CALCULATIONS WILL BE COMPLETED WITH THE FINAL DRAINAGE REPORT.

provide calcs and show on GEC

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 15.2 and 34.0 cfs, respectively, which continue south to downstream infrastructure.

Design Point 13

THE SENTENCE HAS BEEN UPDATED TO BE MORE CLEAR.

Basin 641L consists of a … e of Marksheffel Road, located east of the site. This basin is mainly … way surface and existing curb and gutter. Runoff from the basi… to a 5' Type R existing inlet (**IN640:**Q5=2.9, Q100=3.8 cfs) … conveyed to the 5' swale in **Basin RD-4** via a public 24" storm s… the terminus of the storm sewer. Runoff bypassing the inlet cont… owns…

Update sentence. 18" RCP will not handle 70.6 cfs. The 18" RCP is designed based on the pond release rate which is smaller.

A FOREBAY WILL BE INSTALLED IN ALL LOCATIONS NECESSARY PER THE CRITEREA WITH THE FINAL REPORT.

Design Point 14

Basin B consists of approximately 8.21 acres of Lot 3 and a portion of Lot 4. These are proposed, commercial parcels of land located to the north west on-site. Runoff from this basin (Q5=31.6, Q100=57.6 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.

is this true for DP7, DP8, DP15, DP20, DP21, DP30, DP31, and DP32 as well?

Design Point 15

Lot 2 Lot 3

Basin … res of Lot 3 and a portion of Lot 4. These are proposed, commercial … st on-site. Runoff from this basin (Q5=36.2, Q100=66.0 cfs) collects … east into the FSD pond (**Pond 2**) at **DP16** through a proposed 42" private RCP storm sewer (**F1**).

ALL LOTS HAVE BEEN UPDATED PER THE MOST RECENT SITE LAYOUT FROM KIMLEY HORN.

DP15

CHANGED TO DP15

Design Point 16

Basin E consists of approximately 1.72 acres of a proposed FSD pond and associated structures. Runoff from this basin (Q5=1.1, Q100=5.8 cfs) combines with flows from **DP15** and drains to the south east end of the pond, where it collects into a proposed private 18" RCP storm sewer (**PR641**) to discharge into CDOT's existing swale**.** A rip rap pad is located at the terminus of the storm sewer. The combined flow for the 5 year and 100 year events at the design point are 37.0 and 70.6 cfs, respectively. From this point the routed flows will be directed south towards downstream infrastructure.

Design Point 17

Basin RD-4 consists of approximately 1.39 acres of the existing 5' earthen swale located to the east, off-site. Runoff from the basin (Q5=0.4, Q100=2.9 cfs) drains from the north to the south, while collecting with flows from **PR640, PR641 (Pond 2), PRD1 (Pond 1), PR646, and PRD19**. An existing public 36" RCP 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 15.4 and 48.5 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 riprap pad is located at the terminus of the storm sewer. Flow from here will continue to head south in the 5' swale into the next basin.

Discuss existing 36" to be removed and proposed 24" and outlet protection

INFORMATION HAS BEEN ADDED TO DISCUSS A PROPOSED DUAL 24" CULVERT TO REPLACE THE EXISTING 36"

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 **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 16.9 and 48.4 cfs, respectively. The runoff then continues south to downstream infrastructure.

Design Point 20

Basin K consists of approximately 8.52 acres of proposed parks and recreation area. Runoff from this basin (Q5=5.2, Q100=22.6 cfs) collects on the south-eastern side, which borders **Basin L,** and is conveyed south into the FSD pond (**Pond 4**) at **DP21** through a proposed 30" private RCP storm sewer (**K1**).

Design Point 21

Basin L consists of approximately 0.83 acres of a proposed FSD pond. Runoff from this basin (Q5=0.7, Q100=3.9 cfs) combines with flows from **DP20** and drains to the southern end of the pond, where it collects into a proposed private 18" RCP storm sewer (**L1**). 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 6.2 and 27.2 cfs, respectively. 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 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 1.36 acres of the existing 5' earthen swale located to the east, off-site. Runoff from the basin (Q5=0.5, Q100=3.4 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. The combined flow for the 5 year and 100 year events at the design point are 15.1 and 44.5 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** and **DP26**. The combined flows for the 5 year and 100 year storm events are 23.4 and 50.9 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 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 **DP27** 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 3.97 acres of Lot 1 and CDOT Right of Way. CDOT will provide access to grading on-site. Lot 1 is a proposed commercial parcel of land. Runoff from this basin (Q5=15.9, Q100=29.0 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 8.90 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=4.9, Q100=21.1 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.

YES, IT HAS BEEN UPDATED TO "A PROPOSED RIPRAP PAD...."

oximately 1.62 acres of a proposed FSD pond. Runoff from this basin s with flows from **DP30** and **DP31** and drains to the south-western end of the pond, where it collects into a proposed public 18" RCP storm sewer to discharge into **Basin H.** 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 23.2 and 62.6 cfs, respectively. From this point, the runoff will be directed southwest towards downstream infrastructure.

proposed?

DP32? CHANGED TO DP29

Design Point 33

Basin H consists of approximately 7.98 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=16.5 cfs) drains from the western side of the basin east until it combines with flows from **DP32** 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 **DP31**. The combined flows for the 5 year and 100 year storm events at the design point are 10.2 and 34.1 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 27.71 acres of developed land and the maximum 100-Yr storage volume is 4.106 acre-feet. Pond 1 is being constructed with an outlet control structure and a proposed 18" RCP outlet pipe. Watershed imperviousness is 86.4%. 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 30 feet, and a spillway design flow depth of 0.94 feet.

FSD Pond 1	**WQCV**	**EURV**	**5 Year**	**100 Year**
Maximum Volume Stored (acre-ft)	0.863	3.221	2.773	4.119
Maximum WS Elevation	6337.34	6339.61	6339.25	6340.30
Peak Inflow (cfs)(calc)			53.0	98.2
Peak Outflow (cfs)	0.4	0.9	0.8	16.5

Pond 2 will treat approximately 12.64 acres of developed land and the maximum 100-Yr storage volume is 1.739 acre-feet. Pond 2 is being constructed with an outlet control structure and a proposed 18" RCP outlet pipe. Watershed imperviousness is 83.0%. 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 12 feet, and a spillway design flow depth of 0.98 feet.

FSD Pond 2	**WQCV**	**EURV**	**5 Year**	**100 Year**
Maximum Volume Stored (acre-ft)	0.366	1.400	1.167	1.739
Maximum WS Elevation	6343.21	6344.79	6344.49	6345.21
Peak Inflow (cfs)(calc)			23.7	44.7
Peak Outflow (cfs)	0.1	0.6	0.5	7.8

Pond 3 will treat approximately 13.94 acres of developed land and the maximum 100-Yr storage volume is 0.772 acre-feet. Pond 3 is being constructed with an outlet control structure and a proposed 18" RCP outlet pipe. Watershed imperviousness is 34.8%. 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 8 feet, and a spillway design flow depth of 0.82 feet.

FSD Pond 3	**WQCV**	**EURV**	**5 Year**	**100 Year**
Maximum Volume Stored (acre-ft)	0.196	0.505	0.461	0.772
Maximum WS Elevation	6323.96	6324.66	6324.57	6325.16
Peak Inflow (cfs)(calc)			7.6	23.8
Peak Outflow (cfs)	0.1	0.2	0.2	9.3

Pond 4 will treat approximately 9.35 acres of developed land and the maximum 100-Yr storage volume is 0.203 acre-feet. Pond 4 is being constructed with an outlet control structure and a proposed 18" RCP outlet pipe. Watershed imperviousness is 12.5%. 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 5.0 feet, and a spillway design flow depth of 0.54 feet.

FSD Pond 4	**WQCV**	**EURV**	**5 Year**	**100 Year**
Maximum Volume Stored (acre-ft)	0.064	0.092	0.072	0.203
Maximum WS Elevation	6335.10	6335.26	6335.16	6335.73
Peak Inflow (cfs)(calc)			1.2	8.2
Peak Outflow (cfs)	0.0	0.0	0	5.6

The detention ponds are private and shall be maintained by the Crossroads Metropolitan District No. 2. 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.

Engineer must confirm in the Drainage Report that the existing WQ pond (DP26) is functioning as intended

LET'S DISCUSS THIS.

Staff is verifying process/requirements for basin transfers and the associated drainage fee. Additional guidance will be provided on the resubmittal.

Unresolved. Inter-basin transfer is not permitted.

THE COUNTY DRAINAGE BASIN MAPS ARE NPT ACCURATE BASED ON THE EXISTING TOPOGRAPHY, THUS WE ADJUSTED THE BASIN LINES TO MATCH THE EXISTING TOPOGRAPHY TO BE AN ACCURATE REPRESENTATION OF EACH DRAINAGE BASIN. THE TRANSFER AMOUNTS WERE REDUCED AS MUCH AS POSSIBLE TO ONLY AFFECT RELATIVELY SMALL AREAS.

V, and redistributes portions of the historic watershed between Jimmy d Drainage Basins. **Although this transfer occurs, proposed flows eam drainage facilities are less than historic. The following is a curs.**

pproximately 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 1.80 acres (3.71 acres of Jimmy Camp Creek transferred to Peterson Field adjacent to Highway 94 and 1.91 acres of Peterson Field transferred to Jimmy Camp Creek adjacent to Highway 24; thus, a cumulative transfer of 1.80 acres to Peterson Field) will be redirected from the Jimmy Camp Creek Drainage Basin into Peterson Field Drainage Basin.

The 1.80 cumulative transferred acres to Peterson Field (Total = 15.02 acres) will be accounted for in the Drainage Fees, along with the 49.87 acres of Jimmy Camp

SURETY HAS BEEN UPDATED TO THE REQUIRED AMOUNT AND ALL TOTALS HAVE BEEN UPDATED WITH THIS CHANGE.

This modification change is driven by grading constrai 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 belov ter-basin transi

update surety to 49.87 x 63.3%.
Per footnote no. 3 on the fee schedule this is a per impervious acre rate.

ERO

It is the report. tempora

3. This is an interim fee and will be adjusted when a DBPS is completed. In addition to the Drainage Fee a surety in the amount of $7,285 per impervious acre shall be provided to secure payment of additional fees in the event that the DBPS results in a fee greater than the current fee. Fees paid in excess of the future revised fee will be reimbursed. See Resolution 06-326 (9/14/06) and Resolution 16-320 (9/07/16).

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. The 2022 El Paso County drainage fees are as follows. Jimmy Camp Creek currently requires an added surety of $7,285 to the drainage fee. All or a portion of this surety shall be reimbursed once the Jimmy Camp Creek DBPS is fully adopted. Impervious acreages are based on 63.3% imperviousness.

Jimmy Camp Creek

Drainage Fees:	49.87	x	63.3%	x	$21,134.00	=		$ 667,151.98
Surety:	N/A	x	N/A	x	$7,285.00	=		$ 7,285.00
Bridge Fees:	49.87	x	63.3%	x	$989.00	=		$ 31,220.47
							Subtotal	$ 705,657.45

Peterson Field

Drainage Fees:	15.02	x	63.3%	x	$15,243.00	=		$ 144,925.26
Bridge Fees:	15.02	x	63.3%	x	$1,156.00	=		$ 10,990.85
							Subtotal	$ 155,916.11
							TOTAL:	**$ 861,573.56**

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

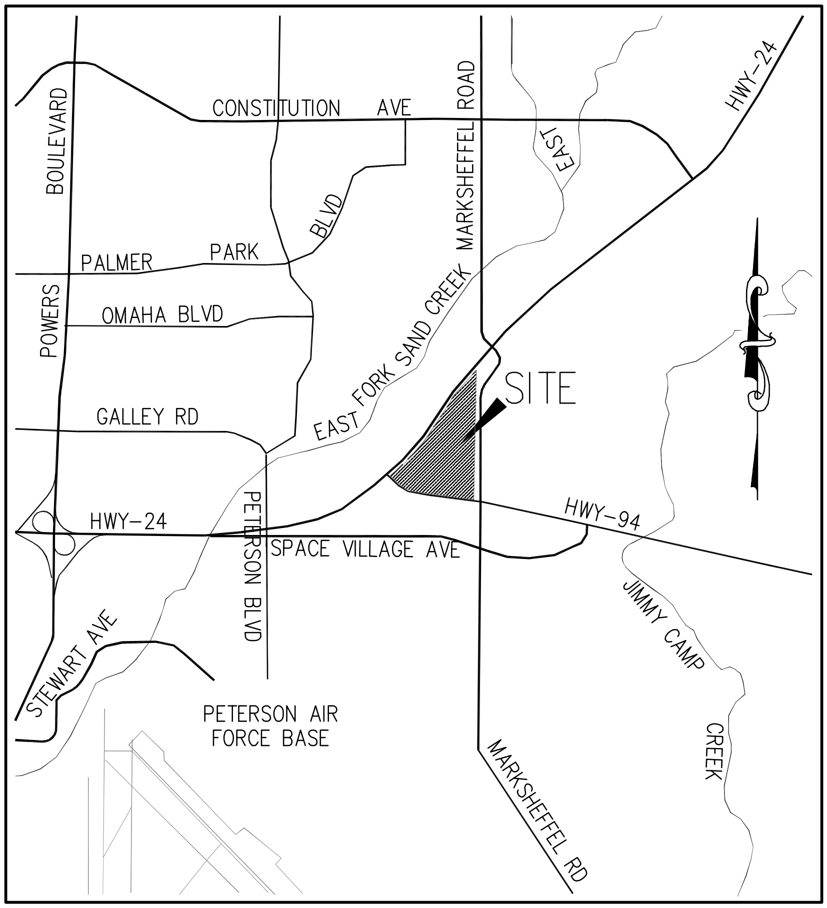
6.) "Jimmy Camp Creek - Drainage Basin Planning Study Development of Alternatives & Design of Selected Plan Report" dated March 9, 2015 by Kiowa Engineering Corporation.

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)

104° 41' 31" W
104° 40' 47" W

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

Meters: 0 50 100 200 300

Feet: 0 300 600 1200 1800

N

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil 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.

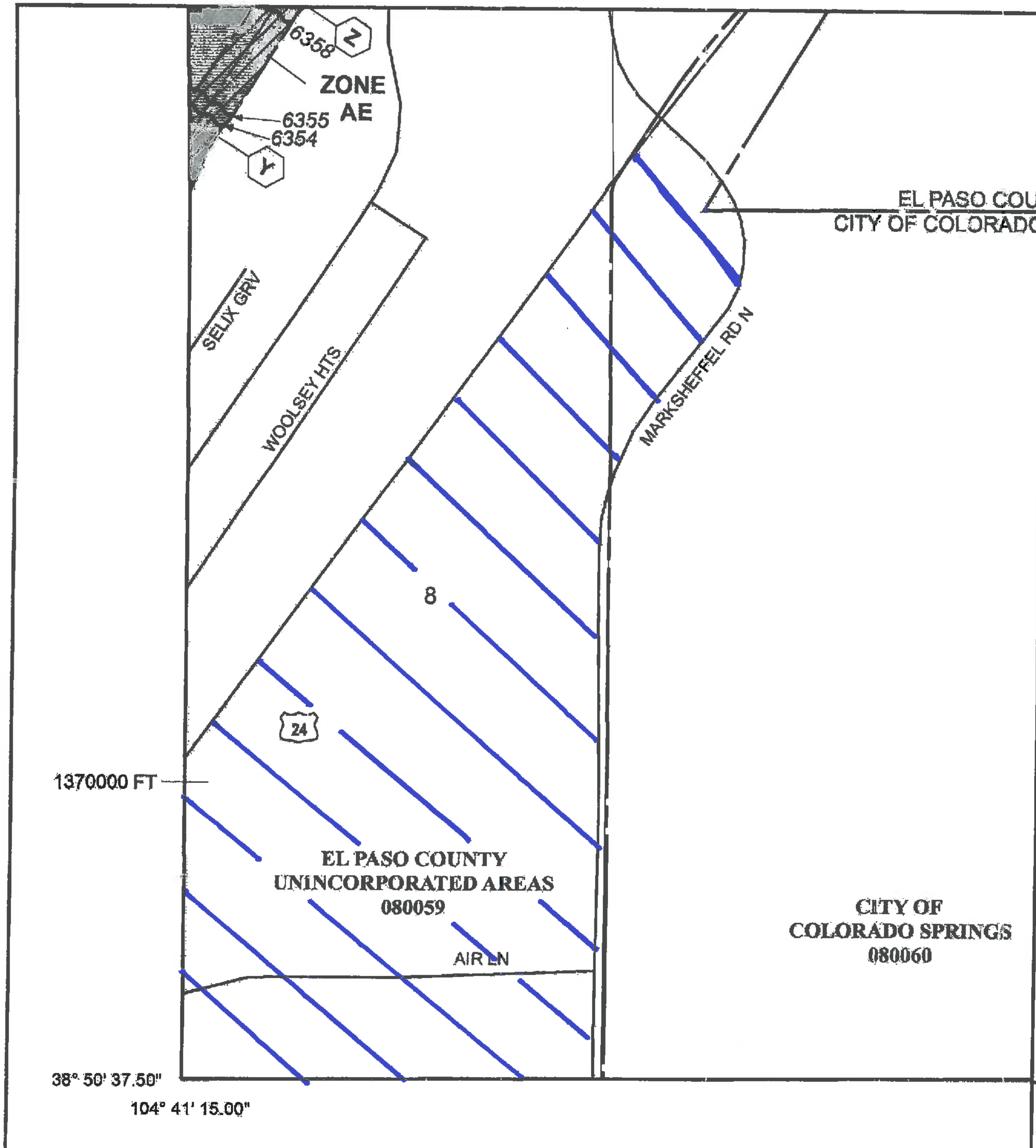
Date(s) aerial images were photographed: Aug 19, 2018—Sep 23, 2018

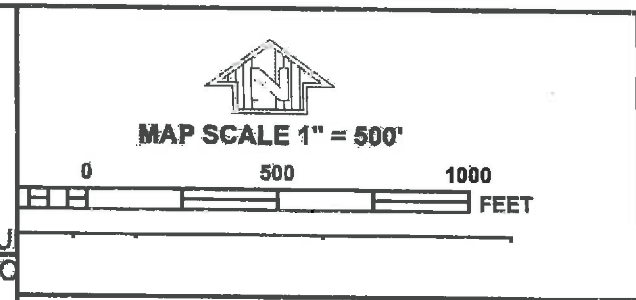
The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

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





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 08/16/2020 to make a correction. This version replaces any previous versions. See the Notice-to-User Letter that accompanied this correction for details.

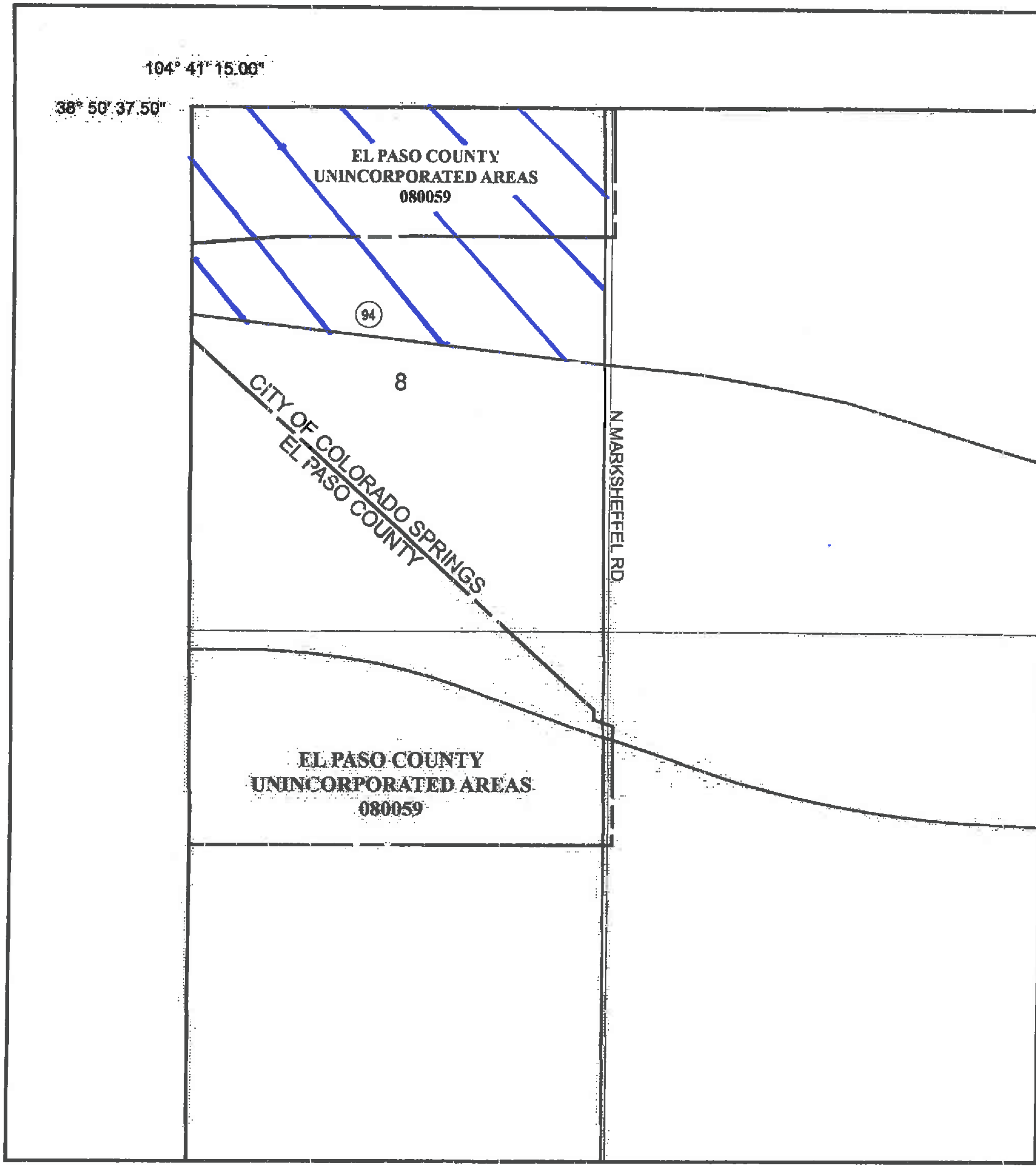
Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

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

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0758G

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	[illegible]	G

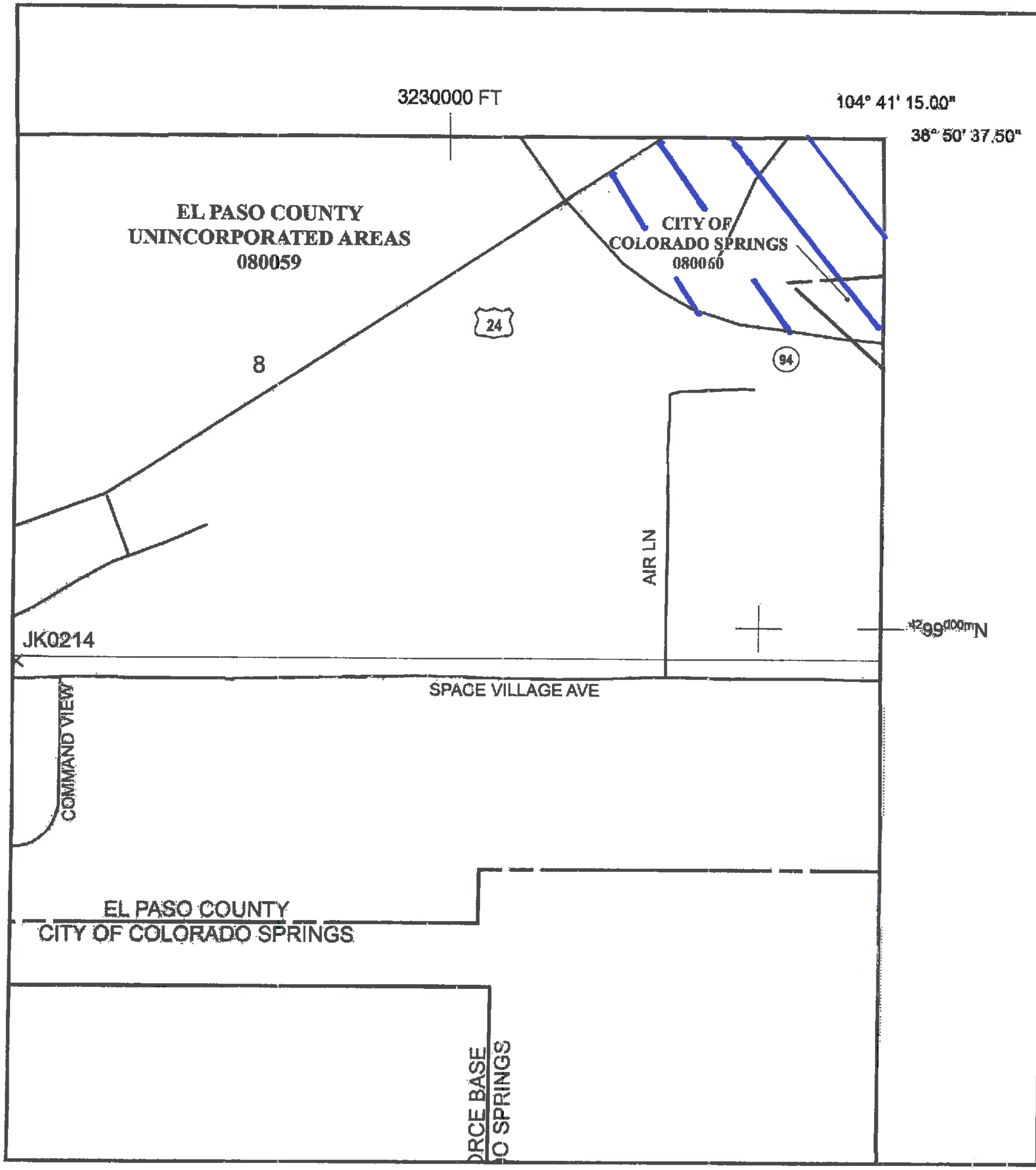
Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

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 05/15/2020 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** *(Acres)*	**C_5**	**C_{100}**	**C_5**	**Length** *(ft)*	**Height** *(ft)*	**T_C** *(min)*	**Length** *(ft)*	**Slope** *(%)*	**Velocity** *(fps)*	**T_t** *(min)*	**TOTAL** *(min)*	**CHECK** *(min)*	**I_5** *(in/hr)*	**I_{100}** *(in/hr)*	**Q_5** *(c.f.s.)*	**Q_{100}** *(c.f.s.)*
		From DCM Table 5-1															
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	Basin 664R Tc was used								5.0	5.2	8.7	***5.1***	***9.1***	EX 5' CDOT TYPE R AG INLET
2	**662L**	1.09	1.16	Basin 662L Tc was used								5.1	5.1	8.6	***5.6***	***10.0***	EX 5' CDOT TYPE R AG INLET
3	**FBIN662, 661L**	0.57	0.79	Basin 662L Tc was used			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
4	**PR664, PR662, PR661, A**	1.85	2.84	Avg DP3 and Basin A Tc was used								9.2	4.3	7.1	***7.9***	***20.3***	EX 5' BTM EARTH TRAP CHANNEL
5	**FBIN664, 654R**	2.11	2.62	Basin 654R Tc was used								6.0	4.9	8.2	***10.3***	***21.6***	EX 5' CDOT TYPE R AG INLET
6	**DP4, PR654, B**	2.96	4.77	Design Pt 4 Tc was used			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
7	**FBIN654, 646R**	1.97	2.69	Basin 654R Tc was used			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
8	**C, D**	2.42	3.13	Basin C Tc was used			13.8					14.4	3.6	6.0	***8.6***	***18.8***	ENTERS PROPERTY FROM CDOT ROW
9	**DP6, DP8, E, PR646**	7.09	12.39	Basin E Tc was used								17.2	3.3	5.6	***23.5***	***69.0***	EX 5' BTM EARTH TRAP CHANNEL
10	**H**	1.20	5.26	Basin H Tc was used								23.2	2.9	4.8	***3.4***	***25.3***	LOCALIZED LOWPOINT
11	**F, G, DP10**	2.26	8.95	Basin G Tc was used								21.1	3.0	5.1	***6.8***	***45.2***	EX 5' BTM EARTH TRAP CHANNEL
12	**641L**	1.42	1.52	Basin 641L Tc was used								10.2	4.1	6.9	***5.8***	***10.4***	EX 5' CDOT TYPE R AG INLET

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
13	**DP9, DP11, PR640, I**	10.39	23.37				17.2 Design Pt 9 Tc was used					15.0	3.5	5.9	***36.6***	***138.0***	EX 36" CULVERT
14	**FBIN646, 637R**	1.94	2.86				10.7 Design Pt 7 Tc was used	871	0.5%	1.4	10.3	21.0	3.0	5.1	***5.9***	***14.5***	EX 5' CDOT TYPE R AG INLET
15	**DP13, J, PR636**	11.61	25.22				15.0 Design Pt 13 Tc was used	200	0.5%	1.4	2.4	17.4	3.3	5.5	***38.3***	***139.7***	EX 5' BTM EARTH TRAP CHANNEL
16	**DP15, J1**	11.83	26.16				17.4 Design Pt 15 Tc was used	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
17	**FBIN636, 631R**	1.45	2.55				21.0 Design Point 14 Tc was used	650	1.5%	2.4	4.5	25.4	2.7	4.6	***4.0***	***11.7***	EX 5' CDOT TYPE R AG INLET
18	**FBIN640, 632L**	1.80	2.13				10.2 Design Pt 12 Tc was used	986	1.1%	2.1	8.0	18.1	3.2	5.4	***5.8***	***11.6***	EX 5' CDOT TYPE R AG INLET
19	**FBIN630B, L**	0.33	0.57				Basin L Tc was used					5.0	5.2	8.7	***1.7***	***4.9***	EX 12" PLASTIC CORR PIPE
20	**DP16, PR630B, PRE1, K**	14.23	30.02				21.4 Design Pt 16 was used	100	9.5%	6.2	0.3	21.7	3.0	5.0	***42.2***	***149.5***	EX WQ POND
21	**DP20, M, N**	15.98	35.58				Design Pt 20 was used					21.7	3.0	5.0	***47.4***	***177.1***	EX 42" RCP
22	**O, P, Q**	2.93	8.59				Weighted Tc was used					14.8	3.5	5.9	***10.4***	***51.1***	EX 48" CMP

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.

DP - Design Point

EX - Existing Design Point

FB- Flow By from Design Point

IN- Inlet

Calculated by: GT

Date: 9/30/2022

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	453818.1925	10.42	10.42	0.81	0.88	0.00	0.59	0.70	0.00	0.08	0.35	0.81	0.88
B	357650.2993	8.21	8.21	0.81	0.88	0.00	0.30	0.50	0.00	0.08	0.35	0.81	0.88
C	278007.7229	6.38	6.38	0.81	0.88	0.00	0.30	0.50	0.00	0.08	0.35	0.81	0.88
D	117655.1837	2.70	0.00	0.81	0.88	0.00	0.30	0.50	2.70	0.12	0.39	0.12	0.39
E	75091.6549	1.72	0.00	0.81	0.88	0.00	0.30	0.50	1.72	0.12	0.39	0.12	0.39
F	475511.6212	10.92	10.92	0.81	0.88	0.00	0.30	0.50	0.00	0.08	0.35	0.81	0.88
G	173089.0352	3.97	3.97	0.81	0.88	0.00	0.30	0.50	0.00	0.08	0.35	0.81	0.88
H	347596.4425	7.98	0.00	0.81	0.88	0.00	0.30	0.50	7.98	0.08	0.35	0.08	0.35
I	70701.6195	1.62	0.00	0.81	0.88	0.00	0.30	0.50	1.62	0.12	0.39	0.12	0.39
J	387467.3488	8.90	0.00	0.81	0.88	8.90	0.16	0.41	0.00	0.08	0.35	0.16	0.41
K	370986.6998	8.52	0.00	0.81	0.88	8.52	0.16	0.41	0.00	0.08	0.35	0.16	0.41
L	36340.4032	0.83	0.00	0.81	0.88	0.00	0.45	0.59	1.16	0.12	0.39	0.17	0.54
M	349489.1274	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	35701.018	0.82	0.00	0.81	0.88	0.00	0.45	0.59	0.82	0.08	0.35	0.08	0.35
RD-4	60542.908	1.39	0.00	0.81	0.88	0.00	0.45	0.59	1.39	0.08	0.35	0.08	0.35
RD-5	59298.0535	1.36	0.00	0.81	0.88	0.00	0.45	0.59	1.36	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: GT
Date: 9/30/2022
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	10.42	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	**43.2**	**78.8**
B	8.21	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	**31.6**	**57.6**
C	6.38	0.81	0.88	0.81	50	1	2.9	323	1.5%	2.5	2.2	5.1	12.1	5.1	8.6	**26.6**	**48.4**
D	2.70	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	**1.6**	**8.9**
E	1.72	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	**1.1**	**5.8**
F	10.92	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	**36.2**	**66.0**
G	3.97	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	**15.9**	**29.0**
H	7.98	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**	**16.5**
I	1.62	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**	**4.3**
J	8.90	0.16	0.41	0.16	75	1	13.4	975	2.4%	3.1	5.3	18.7	15.8	3.4	5.8	**4.9**	**21.1**
K	8.52	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	**5.2**	**22.6**
L	0.83	0.17	0.54	0.17	25	6	3.0	0	0.0%	0.0	0.0	5.0	10.1	5.2	8.7	**0.7**	**3.9**
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	0.82	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**	**2.0**
RD-4	1.39	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	**0.4**	**2.9**
RD-5	1.36	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**	**3.4**
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: GT

Date: 9/30/2022

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**	8.44	9.17									5.2	5.1	8.6	***43.2***	***78.8***	PROP 42" RCP STORM SEWER PRIVATE
				Basin A Tc was used													
8	**Basin C**	5.17	5.62									5.1	5.1	8.6	***26.6***	***48.4***	PROP 36" RCP STORM SEWER PRIVATE
				Basin C Tc was used													
9	**Basin D, DP7, DP8, DP13**	20.58	23.06									5.9	4.9	8.3	***101.3***	***190.5***	POND 1 OUTFALL: PROP 18" RCP STORM SEWER
				Weighted Tc was used													
10	**Basin RD-3, DP6**	2.83	4.20				5.8					5.8	4.9	8.3	***13.9***	***34.7***	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**	3.68	4.90				5.8	415	1.2%	1.6	4.2	10.0	4.1	6.9	***15.2***	***34.0***	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**	6.65	7.23									6.6	4.8	8.0	***31.6***	***57.6***	PROP 42 "RCP STORM SEWER PRIVATE
				Basin B Tc was used													
15	**Basin F**	8.84	9.61									10.2	4.1	6.9	***36.2***	***66.0***	PROP 42" RCP STORM SEWER PRIVATE
				Basin F Tc was used													
16	**Basin E, F1**	9.05	10.28									10.2	4.1	6.9	***37.0***	***70.6***	POND 2 PROP 18" PRIVATE RCP STORM SEWER
				Design Point 15 Tc was used													
17	**PR640, PR646, Basin RD-4**	4.50	5.94				10.0	600	0.5%	1.1	9.4	19.4	3.1	5.3	***15.4***	***48.5***	EX 36" RCP CULVERT PUBLIC
	PRD1	0.28	2.15														
	PR641	0.12	1.13														
	SUM:	4.90	9.23	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	***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	**PR639, PR636**	5.90	10.08				19.4 Design Pt 17 Tc was used	230	0.4%	1.0	3.9	23.3	2.9	4.8	***16.9***	***48.4***	EX 5' BTM EARTH TRAP CHANNEL
20	**Basin K**	1.36	3.49				Basin K Tc was used					12.0	3.8	6.5	***5.2***	***22.6***	PROP 30" RCP STORM SEWER PRIVATE
21	**Basin L, DP20**	1.50	3.94				Basin L Tc was used					10.1	4.1	6.9	***6.2***	***27.2***	POND 4 PROP 18" PRIVATE RCP STORM SEWER
22	**FBIN636, 631R**	1.45	2.55				21.0 Design Pt 18 Tc was used	650	1.5%	2.4	4.5	25.5	2.7	4.6	***4.0***	***11.7***	EX 5' CDOT TYPE R INLET
23	**FBIN640, 632L**	1.80	2.13				10.2 Design Pt 13 Tc was used	986	1.1%	2.1	7.7	17.9	3.3	5.5	***5.9***	***11.6***	EX 5' CDOT TYPE R INLET
24	**DP19, Basin RD-5**	6.01	10.55				23.3 Design Pt 19 Tc was used	545	1.0%	1.5	6.0	29.3	2.5	4.2	***15.1***	***44.5***	EX CDOT TYPE C AREA INLET W/RIPRAP BYPASS RUNDOWN AND 24" RCP OUTFALL
25	**OS-2, FBIN630B**	0.31	0.62				17.9 Design Point 23 Tc was used	131	1.5%	2.0	1.1	19.0	3.2	5.3	***1.0***	***3.3***	EX 12" PLASTIC CORR PIPE PUBLIC
26	**E1, E2, PR630B**	7.16	6.55				29.3 Design Pt 24 Tc was used	242	1.7%	2.6	1.6	30.9	2.4	4.1	***17.4***	***26.8***	EX WQ POND
27	**DP26, OS-3, Basin M** **L1** **SUM:**	8.12 0.00 8.12	9.69 0.81 10.50				22.9 Weighted Tc was used					22.9	2.9	4.8	***23.4***	***50.9***	EX 42" CMP CULVERT PUBLIC
28	**Basin RD-1**	2.44	2.95				16.7 Basin RD-1 Tc was used					16.7	3.4	5.6	***8.2***	***16.6***	TRIANGULAR, EARTHEN CDOT DITCH
29	**Basin RD-2, DP28**	2.64	3.79				16.7 Design Point 28 Tc was used	1586	1.7%	2.0	13.5	30.1	2.5	4.2	***6.5***	***15.7***	TRIANGULAR, EARTHEN CDOT DITCH
30	**Basin G**	3.22	3.50				Basin G Tc was used					5.9	4.9	8.3	***15.9***	***29.0***	PROP 30" RCP STORM SEWER PRIVATE
31	**Basin J**	1.42	3.65				Basin J Tc was used					15.8	3.4	5.8	***4.9***	***21.1***	PROP 30" RCP STORM SEWER PRIVATE
32	**Basin I, DP30, DP31**	4.84	7.78				8.2 WeightedTc was used					6.4	4.8	8.0	***23.2***	***62.6***	POND 3 PROP 24" PRIVATE RCP STORM SEWER
33	**Basin H, Basin OS-4, DP29** **I1** **SUM:**	4.55 0.04 4.59	7.94 1.22 9.16				30.1 Weighted Tc was used	665	1.8%	2.0	5.5	35.6	2.2	3.7	***10.2***	***34.1***	EX 48" CMP PUBLIC

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* I_5	Intensity* I_{100}	Flow Q_5	Flow Q_{100}	PIPE SIZE
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	18" 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
639	DP17	4.90	9.23	19.4	3.1	5.3	15.4	48.5	42" 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	10.50	22.9	2.9	4.8	23.4	50.9	42" CMP
E4	DP33	4.59	9.16	35.6	2.2	3.7	10.2	34.1	48" CMP
A1	DP7	8.44	9.17	5.2	5.1	8.6	43.2	78.8	42" RCP
B1	DP14	6.65	7.23	6.6	4.8	8.0	31.6	57.6	42" RCP
C1	DP8	5.17	5.62	5.1	5.1	8.6	26.6	48.4	36" RCP
D1	DP9	0.28	2.15	5.9	4.9	8.3	1.4	17.8	18" RCP
F1	DP15	8.84	9.61	10.2	4.1	6.9	36.2	66.0	42" RCP
641	DP16	0.12	1.13	10.2	4.1	6.9	0.5	7.8	18" RCP
G1	DP30	3.22	3.50	5.9	4.9	8.3	15.9	29.0	30" RCP
J1	DP31	1.42	3.65	15.8	3.4	5.8	4.9	21.1	30" RCP
I1	DP32	0.04	1.22	6.4	4.8	8.0	0.2	9.8	18" RCP
K1	DP20	1.36	3.49	12.0	3.8	6.5	5.2	22.6	30" RCP
L1	DP21	0.00	0.81	10.1	4.1	6.9	0.0	5.6	18" RCP
PR-DP10	DP10	2.83	4.20	5.8	4.9	8.3	13.9	34.7	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	10.42	0.81	95	989.73
B	8.21	0.81	95	780.00
C	6.38	0.81	95	606.31
D	2.70	0.12	7	18.91
Totals	***27.71***			***2394.95***
Imperviousness of FSD Pond 1	***86.4***			

Weighted Percent Imperviousness of FSD Pond 2				
Contributing Basins	*Area (Acres)*	C_5	*Impervious % (I)*	*(Acres)*(I)*
E	1.72	0.12	7	12.07
F	10.92	0.81	95	1037.04
Totals	***12.64***			***1049.11***
Imperviousness of FSD Pond 2	***83.0***			

Weighted Percent Imperviousness of FSD Pond 3				
Contributing Basins	*Area (Acres)*	C_5	*Impervious % (I)*	*(Acres)*(I)*
Column1	**Column2**	**Column3**	**Column4**	**Column5**
G	3.97	0.81	95	377.49
I	1.62	0.12	7	11.36
J	8.90	0.16	13	115.64
Totals	***14.49***			***504.49***
Imperviousness of FSD Pond 3	***34.8***			

Weighted Percent Imperviousness of FSD Pond 4				
Contributing Basins	*Area (Acres)*	C_5	*Impervious % (I)*	*(Acres)*(I)*
Column1	**Column2**	**Column3**	**Column4**	**Column5**
K	8.52	0.16	13	110.72
L	0.83	0.17	7	5.84
Totals	***9.35***			***116.56***
Imperviousness of FSD Pond 2	***12.5***			

Overall Weighted Site Imperviousness				
Contributing Basins	*Area (Acres)*	C_5	*Impervious % (I)*	*(Acres)*(I)*
Column1	**Column2**	**Column3**	**Column4**	**Column5**
FSD Pond 1	27.71	N/A	N/A	2394.95
FSD Pond 2	12.64	N/A	N/A	1049.11
FSD Pond 3	14.49	N/A	N/A	504.49
FSD Pond 4	9.35	N/A	N/A	116.56
Totals	***64.19***			***4065.10***
Imperviousness of Site	***63.3***			

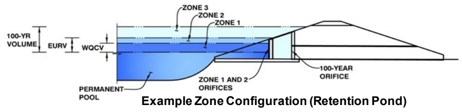
HYDRAULIC CALCULATIONS / POND CALCULATIONS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: **CROSSROADS NORTH**

Basin ID: **POND 1**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	27.71	acres
Watershed Length =	1,507	ft
Watershed Length to Centroid =	776	ft
Watershed Slope =	0.024	ft/ft
Watershed Imperviousness =	86.40%	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) =	0.860	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	3.217	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	2.251	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	2.906	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	3.434	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	4.023	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	4.600	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.51 in.) =	5.230	acre-feet	2.51	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	6.715	acre-feet		inches
Approximate 2-yr Detention Volume =	2.119	acre-feet		
Approximate 5-yr Detention Volume =	2.751	acre-feet		
Approximate 10-yr Detention Volume =	3.271	acre-feet		
Approximate 25-yr Detention Volume =	3.867	acre-feet		
Approximate 50-yr Detention Volume =	4.213	acre-feet		
Approximate 100-yr Detention Volume =	4.502	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.860	acre-feet
Zone 2 Volume (EURV - Zone 1) =	2.357	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.284	acre-feet
Total Detention Basin Volume =	4.502	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

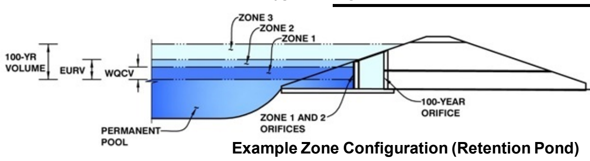
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
34 **Top of Micropool**	--	0.00	--	--	--	10	0.000		
35	--	1.00	--	--	--	360	0.008	185	0.004
36	--	2.00	--	--	--	10,742	0.247	5,736	0.132
37	--	3.00	--	--	--	27,198	0.624	24,706	0.567
38	--	4.00	--	--	--	43,725	1.004	60,167	1.381
39	--	5.00	--	--	--	51,425	1.181	107,742	2.473
40	--	6.00	--	--	--	57,861	1.328	162,385	3.728
41	--	7.00	--	--	--	64,398	1.478	223,515	5.131
42	--	8.00	--	--	--	71,034	1.631	291,231	6.686
43	--	9.00	--	--	--	77,286	1.774	365,391	8.388
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: **CROSSROADS NORTH**

Basin ID: **POND 1**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.42	0.860	Orifice Plate
Zone 2 (EURV)	5.61	2.357	Orifice Plate
Zone 3 (100-year)	6.57	1.284	Weir&Pipe (Restrict)
Total (all zones)		4.502	

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	5.61	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	22.40	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

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

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.90	3.80					
Orifice Area (sq. inches)	2.20	6.60	6.80					

	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 =	5.62	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 =	5.62	N/A	feet
Overflow Weir Slope Length =	5.70	N/A	feet
Grate Open Area / 100-yr Orifice Area =	7.54	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 =	14.50		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	1.53	N/A	ft^2
Outlet Orifice Centroid =	0.66	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.23	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.35	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	30.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.94	feet
Stage at Top of Freeboard =	8.29	feet
Basin Area at Top of Freeboard =	1.67	acres
Basin Volume at Top of Freeboard =	7.16	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) =	0.860	3.217	2.251	2.906	3.434	4.023	4.600	5.230	6.715
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	2.251	2.906	3.434	4.023	4.600	5.230	6.715
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.2	0.4	0.6	5.3	10.6	17.2	31.0
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.01	0.02	0.19	0.38	0.62	1.12
Peak Inflow Q (cfs) =	N/A	N/A	42.2	53.0	60.9	73.4	84.3	98.2	125.8
Peak Outflow Q (cfs) =	0.4	0.9	0.7	0.8	1.2	5.6	9.4	16.5	37.3
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	2.1	2.0	1.0	0.9	1.0	1.2
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	0.4	0.7	1.4	1.5
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) =	40	74	65	72	77	77	76	74	72
Time to Drain 99% of Inflow Volume (hours) =	**43**	83	71	79	86	86	86	85	83
Maximum Ponding Depth (ft) =	3.42	5.61	4.71	5.25	5.66	5.92	6.07	6.30	6.70
Area at Maximum Ponding Depth (acres) =	0.78	1.27	1.13	1.22	1.28	1.32	1.34	1.37	1.43
Maximum Volume Stored (acre-ft) =	0.863	3.221	2.138	2.773	3.285	3.622	3.821	4.119	4.680

Ratio should be less than or equal to 1

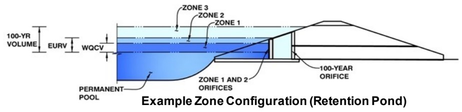
AT THIS STAGE (MDDP), ALL FLOWS ARE CONCEPTUAL. ALL FLOWS WILL MEET THE CRITEREA WITH THE FINAL DESIGN.

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: **CROSSROADS NORTH**

Basin ID: **POND 2**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**			
Watershed Area =	12.64	acres		
Watershed Length =	864	ft		
Watershed Length to Centroid =	575	ft		
Watershed Slope =	0.031	ft/ft		
Watershed Imperviousness =	83.00%	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) =	0.366	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	1.394	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.963	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.246	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.473	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	1.733	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	1.987	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.51 in.) =	2.269	acre-feet	2.51	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	2.928	acre-feet		inches
Approximate 2-yr Detention Volume =	0.917	acre-feet		
Approximate 5-yr Detention Volume =	1.191	acre-feet		
Approximate 10-yr Detention Volume =	1.419	acre-feet		
Approximate 25-yr Detention Volume =	1.682	acre-feet		
Approximate 50-yr Detention Volume =	1.835	acre-feet		
Approximate 100-yr Detention Volume =	1.966	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.366	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.028	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.572	acre-feet
Total Detention Basin Volume =	1.966	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

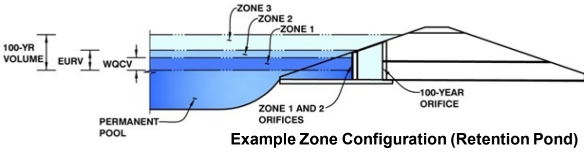
40.33

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	10	0.000		
41	--	1.00	--	--	--	327	0.008	168	0.004
42	--	2.00	--	--	--	7,308	0.168	3,986	0.092
43	--	3.00	--	--	--	21,601	0.496	18,440	0.423
44	--	4.00	--	--	--	32,679	0.750	45,580	1.046
45	--	5.00	--	--	--	36,292	0.833	80,066	1.838
46	--	6.00	--	--	--	39,599	0.909	118,011	2.709
47	--	7.00	--	--	--	43,025	0.988	159,323	3.658
48	--	8.00	--	--	--	46,570	1.069	204,121	4.686
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Project: CROSSROADS NORTH
Basin ID: POND 2



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.89	0.366	Orifice Plate
Zone 2 (EURV)	4.46	1.028	Orifice Plate
Zone 3 (100-year)	5.16	0.572	Weir&Pipe (Restrict)
Total (all zones)		1.966	

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

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

Calculated Parameters for Underdrain

Underdrain Orifice Area =		ft^2
Underdrain Orifice Centroid =		feet

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	4.46	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	17.84	inches
Orifice Plate: Orifice Area per Row =	1.48	sq. inches (diameter = 1-3/8 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row =	1.028E-02	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	1.50	3.00					
Orifice Area (sq. inches)	1.48	1.48	10.00					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

User Input: Overflow Weir (Dropbox 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 =	4.47	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 Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	4.47	N/A	feet
Overflow Weir Slope Length =	5.70	N/A	feet
Grate Open Area / 100-yr Orifice Area =	15.76	N/A	
Overflow Grate Open Area w/o Debris =	11.57	N/A	ft^2
Overflow Grate Open Area w/ Debris =	5.79	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 =	0.33	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 =	7.80		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.73	N/A	ft^2
Outlet Orifice Centroid =	0.38	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.44	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	4.90	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	12.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.98	feet
Stage at Top of Freeboard =	6.88	feet
Basin Area at Top of Freeboard =	0.98	acres
Basin Volume at Top of Freeboard =	3.54	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) =	0.366	1.394	0.963	1.246	1.473	1.733	1.987	2.269	2.928
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.963	1.246	1.473	1.733	1.987	2.269	2.928
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.2	0.3	2.7	5.3	8.6	15.6
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	0.02	0.21	0.42	0.68	1.23
Peak Inflow Q (cfs) =	N/A	N/A	18.8	23.7	28.0	33.9	39.2	44.7	57.6
Peak Outflow Q (cfs) =	0.1	0.6	0.5	0.5	0.6	2.8	5.0	7.8	15.4
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	2.5	2.0	1.0	0.9	0.9	1.0
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	0.4	0.6	0.6
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	65	58	64	67	68	67	66	63
Time to Drain 99% of Inflow Volume (hours) =	**40**	70	62	68	72	73	73	72	71
Maximum Ponding Depth (ft) =	2.88	4.46	3.80	4.16	4.44	4.62	4.71	4.88	5.23
Area at Maximum Ponding Depth (acres) =	0.46	0.79	0.70	0.76	0.79	0.80	0.81	0.82	0.85
Maximum Volume Stored (acre-ft) =	0.366	1.400	0.894	1.167	1.384	1.527	1.600	1.739	2.023

Ratio should be less than or equal to 1

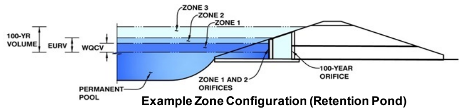
AT THIS STAGE (MDDP), ALL FLOWS ARE CONCEPTUAL. ALL FLOWS WILL MEET THE CRITEREA WITH THE FINAL DESIGN.

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: Crossroads North

Basin ID: Pond 3



Example Zone Configuration (Retention Pond)

Depth Increment = 1.00 ft

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	13.94	acres
Watershed Length =	1,092	ft
Watershed Length to Centroid =	429	ft
Watershed Slope =	0.042	ft/ft
Watershed Imperviousness =	34.80%	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) =	0.192	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.505	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.360	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.490	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.594	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.825	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	1.044	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.51 in.) =	1.325	acre-feet	2.51	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	1.959	acre-feet		inches
Approximate 2-yr Detention Volume =	0.320	acre-feet		
Approximate 5-yr Detention Volume =	0.425	acre-feet		
Approximate 10-yr Detention Volume =	0.528	acre-feet		
Approximate 25-yr Detention Volume =	0.660	acre-feet		
Approximate 50-yr Detention Volume =	0.754	acre-feet		
Approximate 100-yr Detention Volume =	0.892	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.192	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.313	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.386	acre-feet
Total Detention Basin Volume =	0.892	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

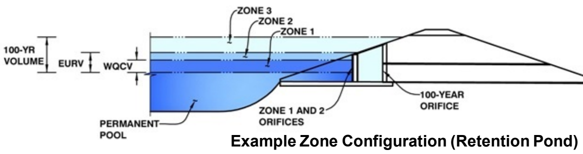
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

	Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
22	**Top of Micropool**	--	0.00	--	--	--	10	0.000		
23		--	1.00	--	--	--	599	0.014	289	0.007
		--	2.00	--	--	--	18,039	0.414	9,198	0.211
		--	3.00	--	--	--	25,954	0.596	29,740	0.683
		--	4.00	--	--	--	31,818	0.730	56,561	1.298
		--	5.00	--	--	--	35,383	0.812	89,311	2.050
		--	6.00	--	--	--	38,568	0.885	126,611	2.907
		--	7.00	--	--	--	41,842	0.961	167,179	3.838
		--	8.00	--	--	--	45,211	1.038	211,146	4.847
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Project: **Crossroads North**
Basin ID: **Pond 3**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.96	0.192	Orifice Plate
Zone 2 (EURV)	2.66	0.313	Orifice Plate
Zone 3 (100-year)	3.37	0.386	Weir&Pipe (Restrict)
Total (all zones)		0.892	

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

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

Calculated Parameters for Plate

Invert 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 =	2.66	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	10.84	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	inches	Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.90	1.80					
Orifice Area (sq. inches)	0.78	0.84	3.00					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

User Input: Overflow Weir (Dropbox 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 =	2.67	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 Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	2.67	N/A	feet
Overflow Weir Slope Length =	5.70	N/A	feet
Grate Open Area / 100-yr Orifice Area =	10.23	N/A	
Overflow Grate Open Area w/o Debris =	11.57	N/A	ft^2
Overflow Grate Open Area w/ Debris =	5.79	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 =	11.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	1.13	N/A	ft^2
Outlet Orifice Centroid =	0.52	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.79	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Calculated Parameters for Spillway

Spillway Invert Stage=	3.20	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.82	feet
Spillway Crest Length =	8.00	feet	Stage at Top of Freeboard =	5.02	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.82	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	2.07	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).

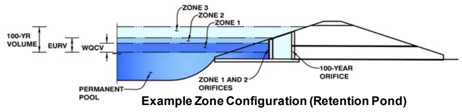
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.51	3.14
CUHP Runoff Volume (acre-ft) =	0.192	0.505	0.360	0.490	0.594	0.825	1.044	1.325	1.959
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.360	0.490	0.594	0.825	1.044	1.325	1.959
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.3	0.4	3.3	6.5	10.6	19.1
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	0.24	0.47	0.76	1.37
Peak Inflow Q (cfs) =	N/A	N/A	5.5	7.6	9.3	14.1	18.4	23.8	35.1
Peak Outflow Q (cfs) =	0.1	0.2	0.1	0.2	0.8	3.6	6.7	9.3	16.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.6	2.0	1.1	1.0	0.9	0.9
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	0.3	0.6	0.8	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) =	38	62	53	61	65	63	62	60	55
Time to Drain 99% of Inflow Volume (hours) =	**40**	65	56	65	68	68	67	66	65
Maximum Ponding Depth (ft) =	1.96	2.66	2.30	2.57	2.73	2.87	2.98	3.16	3.58
Area at Maximum Ponding Depth (acres) =	0.38	0.50	0.44	0.48	0.51	0.53	0.54	0.57	0.63
Maximum Volume Stored (acre-ft) =	0.196	0.505	0.332	0.461	0.541	0.613	0.672	0.772	1.023

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: **Crossroads North**

Basin ID: **Pond 4**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	9.35	acres
Watershed Length =	793	ft
Watershed Length to Centroid =	449	ft
Watershed Slope =	0.034	ft/ft
Watershed Imperviousness =	12.50%	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) =	0.063	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.091	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.049	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.078	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.103	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.233	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.361	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.51 in.) =	0.533	acre-feet	2.51	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	0.931	acre-feet		inches
Approximate 2-yr Detention Volume =	0.055	acre-feet		
Approximate 5-yr Detention Volume =	0.075	acre-feet		
Approximate 10-yr Detention Volume =	0.098	acre-feet		
Approximate 25-yr Detention Volume =	0.131	acre-feet		
Approximate 50-yr Detention Volume =	0.169	acre-feet		
Approximate 100-yr Detention Volume =	0.255	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.063	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.029	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.164	acre-feet
Total Detention Basin Volume =	0.255	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

6333.33

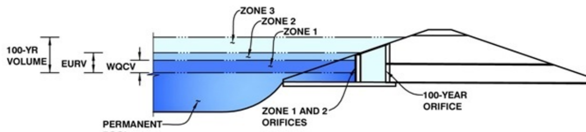
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	10	0.000		
34	--	1.00	--	--	--	171	0.004	90	0.002
35	--	2.00	--	--	--	8,828	0.203	4,590	0.105
36	--	3.00	--	--	--	17,653	0.405	17,830	0.409
37	--	4.00	--	--	--	22,323	0.512	37,818	0.868
38	--	5.00	--	--	--	27,052	0.621	62,506	1.435
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Project: **Crossroads North**

Basin ID: **Pond 4**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.77	0.063	Orifice Plate
Zone 2 (EURV)	1.93	0.029	Orifice Plate
Zone 3 (100-year)	2.58	0.164	Weir&Pipe (Restrict)
Total (all zones)		0.255	

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

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

Calculated Parameters for Underdrain

Underdrain Orifice Area =		ft^2
Underdrain Orifice Centroid =		feet

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	1.93	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	N/A	inches
Orifice Plate: Orifice Area per Row =	0.20	sq. inches (diameter = 1/2 inch)

Calculated Parameters for Plate

WQ Orifice Area per Row =	1.389E-03	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.48	0.96					
Orifice Area (sq. inches)	0.20	0.20	0.20					

	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 =	2.12	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 Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	2.12	N/A	feet
Overflow Weir Slope Length =	5.70	N/A	feet
Grate Open Area / 100-yr Orifice Area =	13.48	N/A	
Overflow Grate Open Area w/o Debris =	11.57	N/A	ft^2
Overflow Grate Open Area w/ Debris =	5.79	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 =	0.33	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 =	8.80		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.86	N/A	ft^2
Outlet Orifice Centroid =	0.42	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.55	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	2.50	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	5.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.54	feet
Stage at Top of Freeboard =	4.04	feet
Basin Area at Top of Freeboard =	0.52	acres
Basin Volume at Top of Freeboard =	0.89	acre-ft

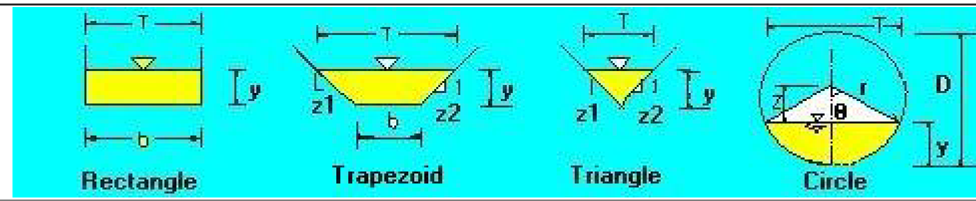
Routed Hydrograph Results

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) =	0.063	0.091	0.049	0.078	0.103	0.233	0.361	0.533	0.931
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.049	0.078	0.103	0.233	0.361	0.533	0.931
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.2	0.2	2.0	4.1	6.6	11.9
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	0.02	0.22	0.43	0.70	1.27
Peak Inflow Q (cfs) =	N/A	N/A	0.7	1.2	1.5	3.6	5.7	8.2	13.6
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	1.3	3.2	5.6	8.9
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.1	0.1	0.6	0.8	0.9	0.7
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.1	0.3	0.5	0.6
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	52	31	46	58	72	69	66	58
Time to Drain 99% of Inflow Volume (hours) =	**40**	54	33	48	60	76	75	73	70
Maximum Ponding Depth (ft) =	1.77	1.93	1.64	1.83	1.96	2.23	2.31	2.40	2.75
Area at Maximum Ponding Depth (acres) =	0.16	0.19	0.13	0.17	0.19	0.25	0.27	0.28	0.35
Maximum Volume Stored (acre-ft) =	0.064	0.092	0.044	0.072	0.097	0.155	0.178	0.203	0.311

The open channel flow calculator

Select Channel Type: Trapezoid



Depth from Q

Select unit system: Feet(ft)

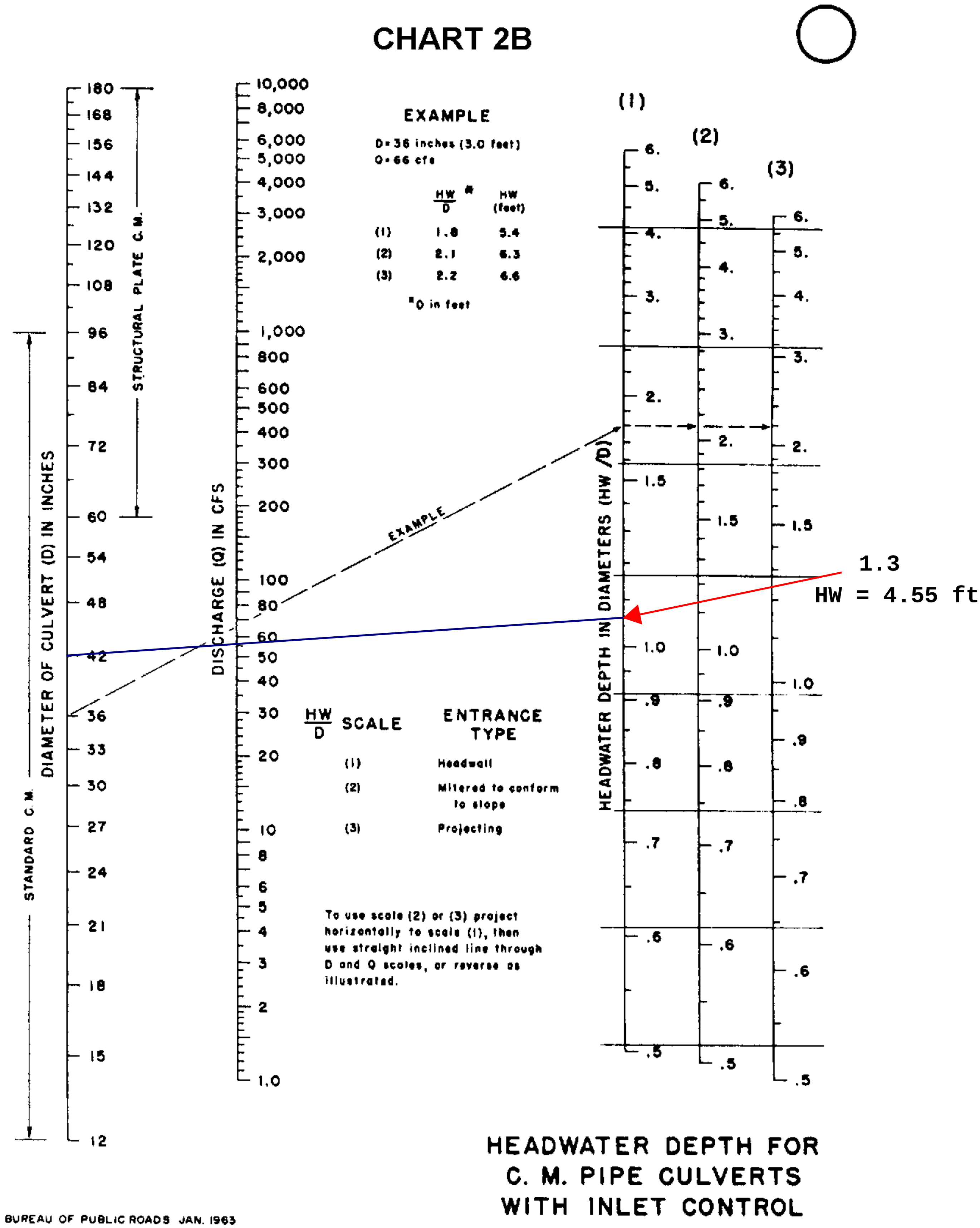
Channel slope: .08 ft/ft	Water depth(y): 0.54 ft	Bottom width(b) 10 ft
Flow velocity 6.647 ft/s	LeftSlope (Z1): 5 to 1 (H:V)	RightSlope (Z2): 10 to 1 (H:V)
Flow discharge 50.9 ft^3/s	Input n value 0.035 or select n	
Calculate!	Status: Calculation finished	Reset
Wetted perimeter 18.24 ft	Flow area 7.66 ft^2	Top width(T) 18.16 ft
Specific energy 1.23 ft	Froude number 1.8	Flow status Supercritical flow
Critical depth 0.76 ft	Critical slope 0.0217 ft/ft	Velocity head 0.69 ft

CHANNEL PARALLEL WITH MARKSHEFFEL ROAD.

This will need to be mitigated on the Final Drainage Report.

AGREE.

Upstream Capacity at Design Point 27



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

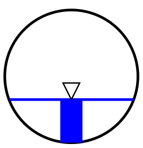
Printable Subtitle

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

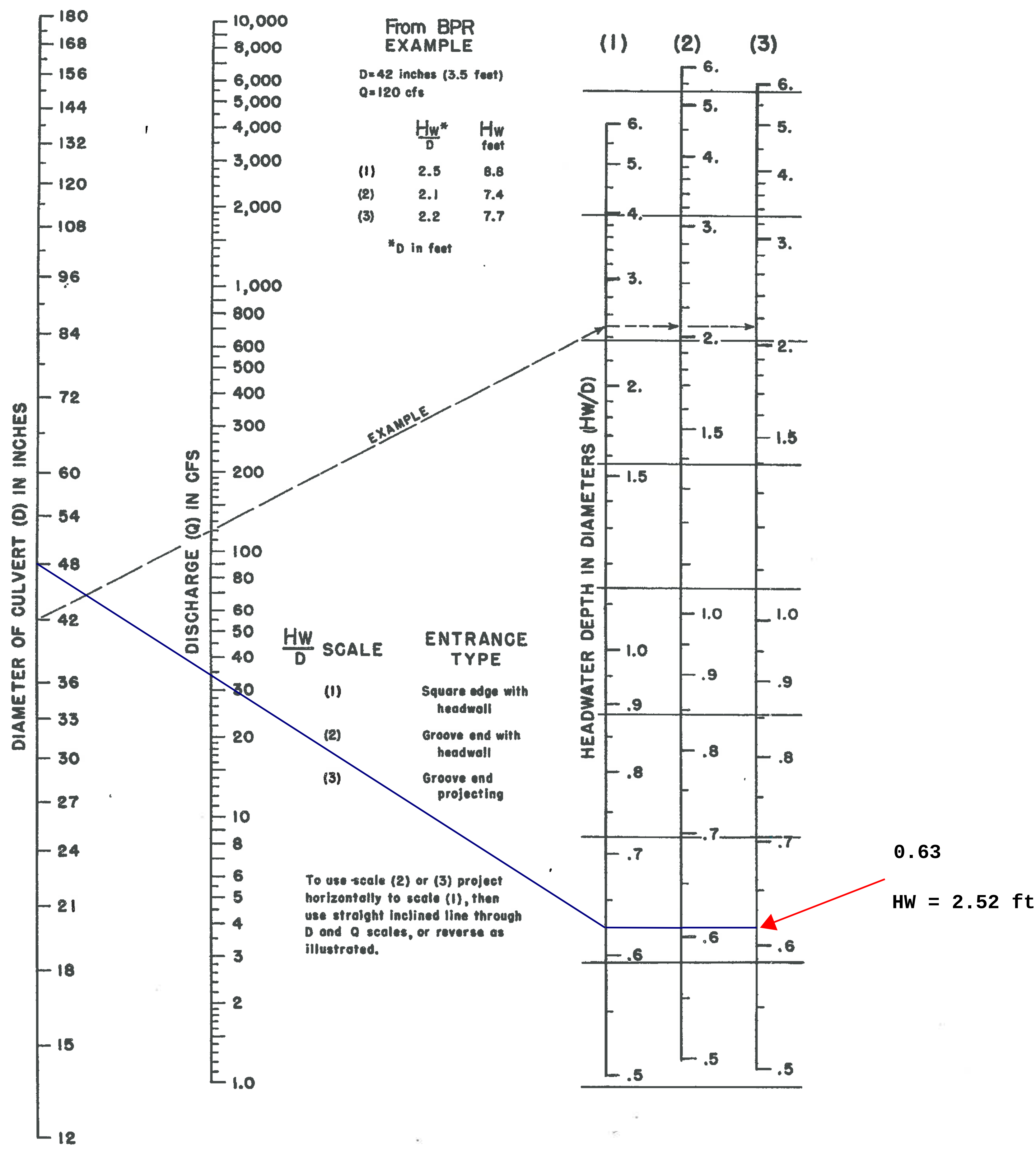


Figure CU-9—Inlet Control Nomograph—Example

MARKSHEFFEL ROAD FINAL DRAINAGE REPORT EXCERPTS

Final Drainage Report

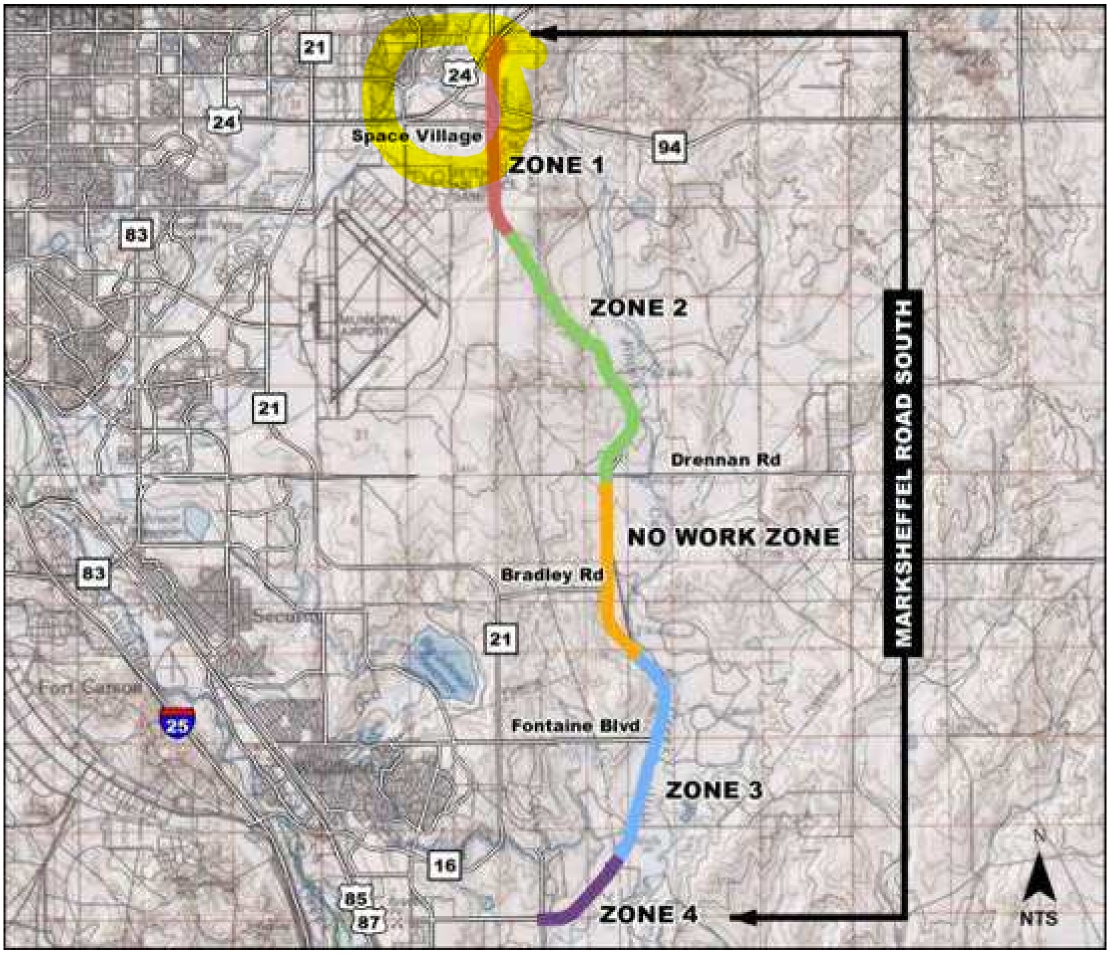
Marksheffel Road South

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 Flow (cfs)	5-Year Flow Depth (ft)	5-Year Spread (ft)	5-Year Pipe Velocity (fps)	100-Year Flow (cfs)	100-Year Flow Depth (ft)	100-Year Spread (ft)	100-Year 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)	100-Year Ponding Depth (ft)	100-Year 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.

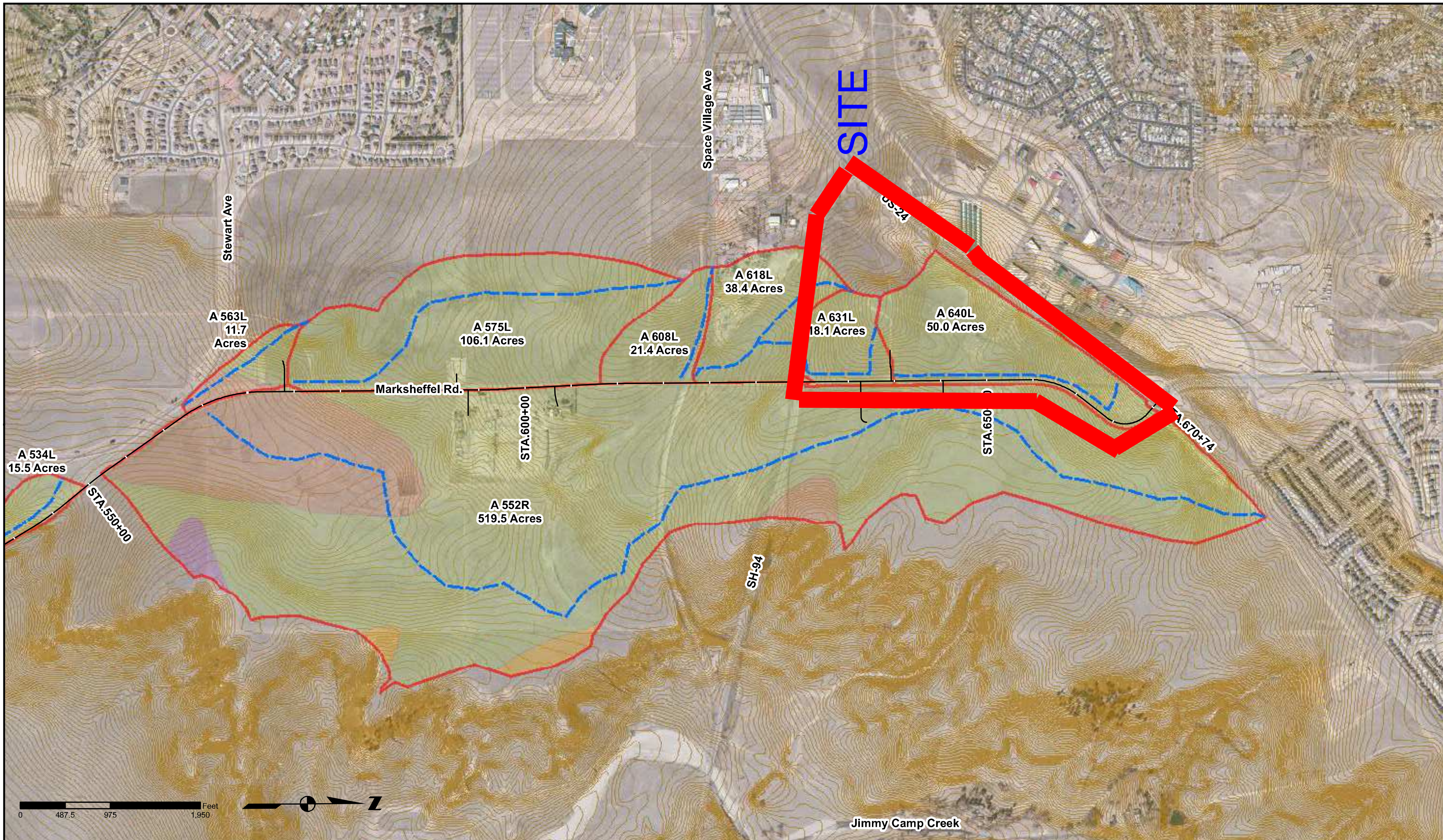
Table 12: Detention Design

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.

thaugh 12:16:46 PM U:\Projects\EL_PASO_Marksheffel_Sub_to_BP\14.00_GIS_Models\14.04_map_docs\Basins_BL_20141009.mxd



Print Date:	10/23/2014		
File Name:	Basins_BL_20141009.mxd		
Horiz. Scale:		Vert. Scale:	None
Unit Information		Unit Leader Initials	

HDR Engineering, Inc.

PARSONS BRINCKERHOFF

Basin Boundary
Flowpath
Water
Hydrologic Soils Group A
Hydrologic Soils Group B
Hydrologic Soils Group C
Hydrologic Soils Group D

EL PASO COUNTY COLORADO

PPRTA

As Constructed

No Revisions:

Revised:

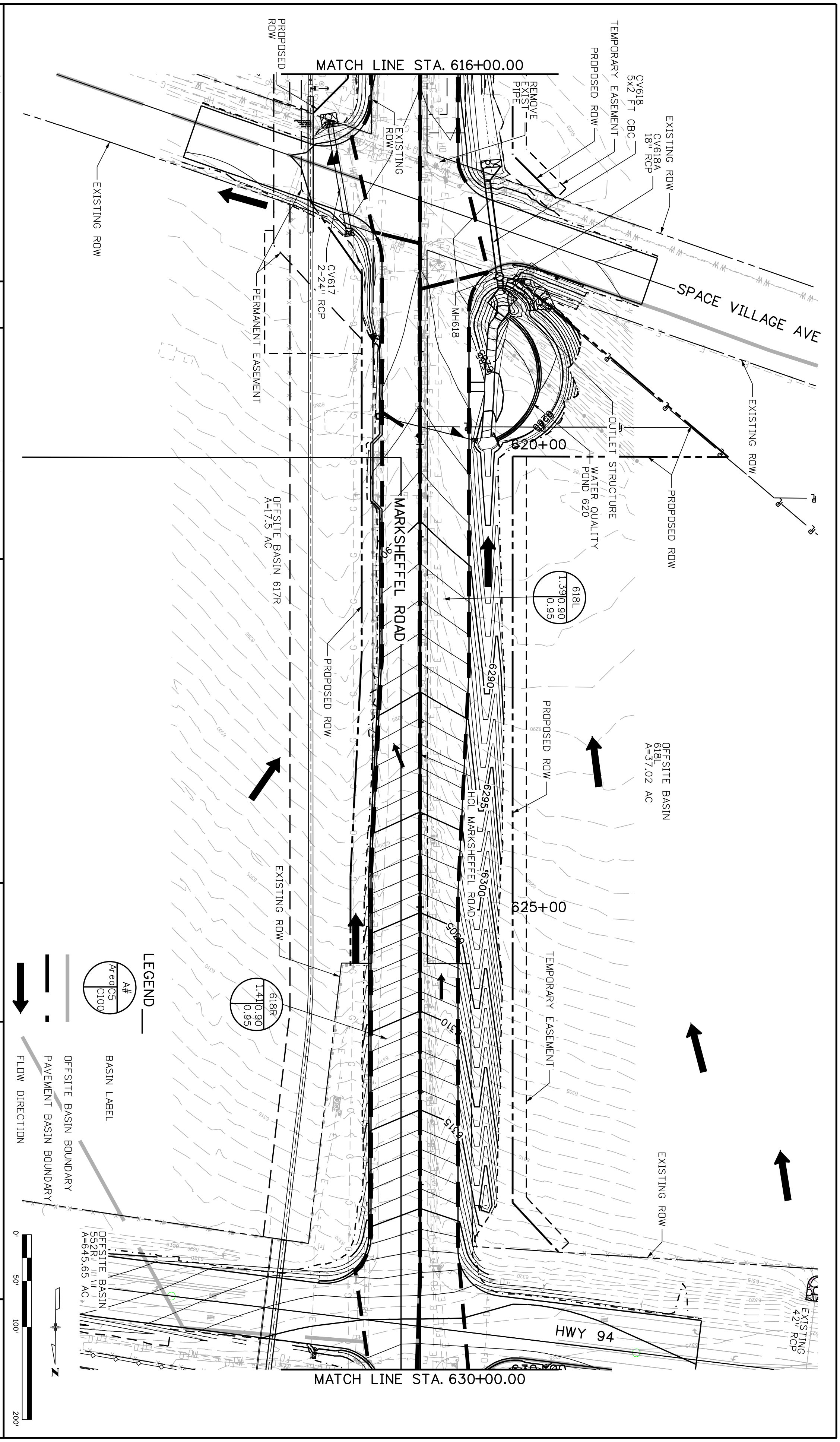
Void:

MARKSHEFFEL ROAD DRAINAGE BASIN

Designer:	E. Staten	Structure Numbers	
Detailer:	M.Johnson		
Sheet Subset:	BASIN	Subset Sheets:	3 of 3

Project No./Code

Sheet Number 3



Print Date: 1/31/2017
File Name: North-Marksheffel_BASINS_Plan040.dgn
Horiz. Scale: 1:100 | Vert. Scale: As Noted
Unit Information | Unit Leader Initials

HDR | PARSONS BRINCKERHOFF

0000

Sheet Revisions

Date:	Comments	Init.

EL PASO COUNTY COLORADO

PPRTA

As Constructed

No Revisions:
Revised:
Void:

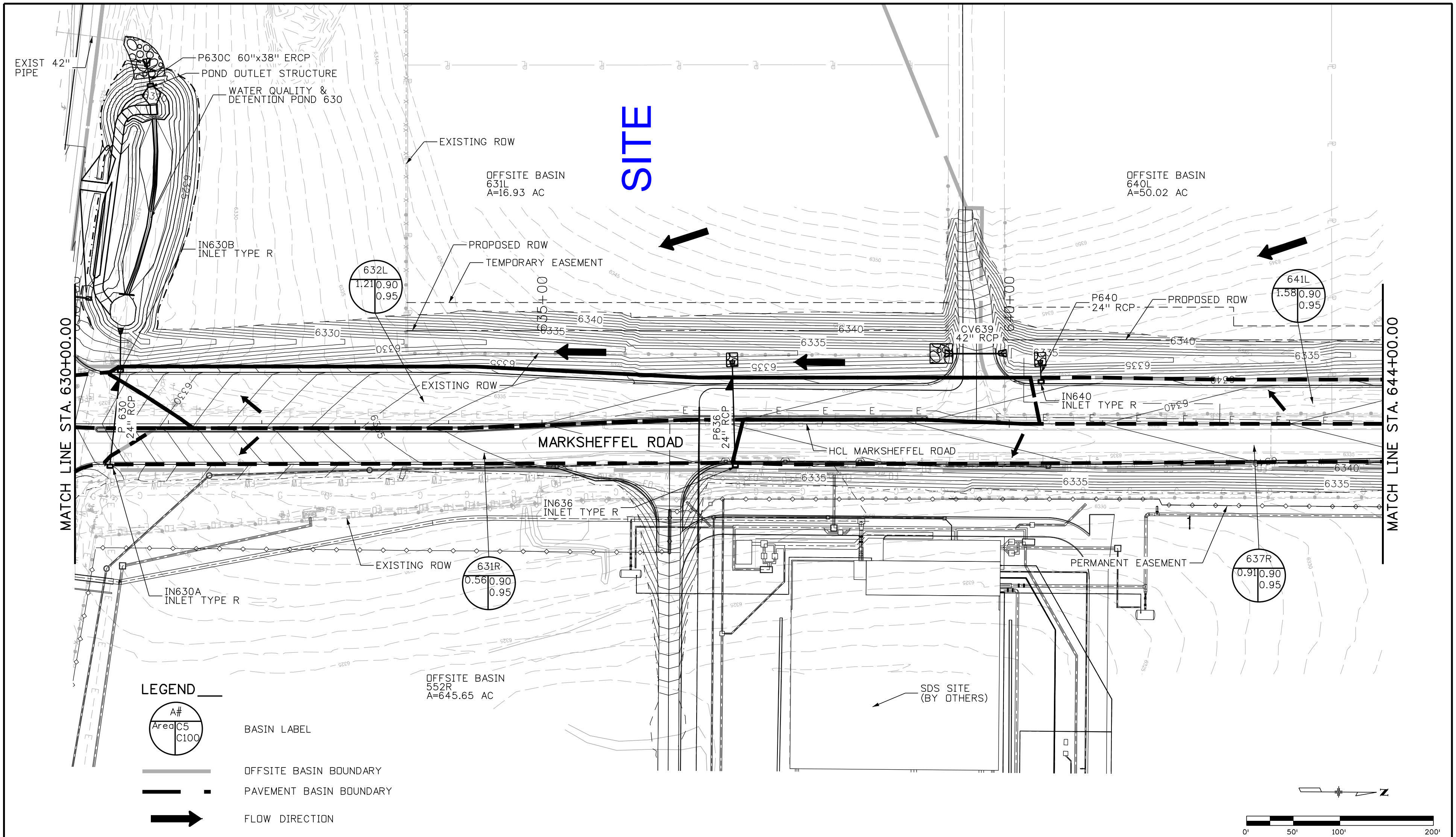
MARKSHEFFEL ROAD
DRAINAGE BASINS PLAN
616+00.00 TO 630+00.00

Designer: E. STATEN
Detailer: D. MADDOCK
Sheet Subset: BASINS

Structure Numbers
Subset Sheets: 33 of 36

Project No./Code

33



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

HDR PARSONS BRINCKERHOFF

0000

Sheet Revisions		
Date:	Comments	Init.

EL PASO COUNTY COLORADO

PPRTA

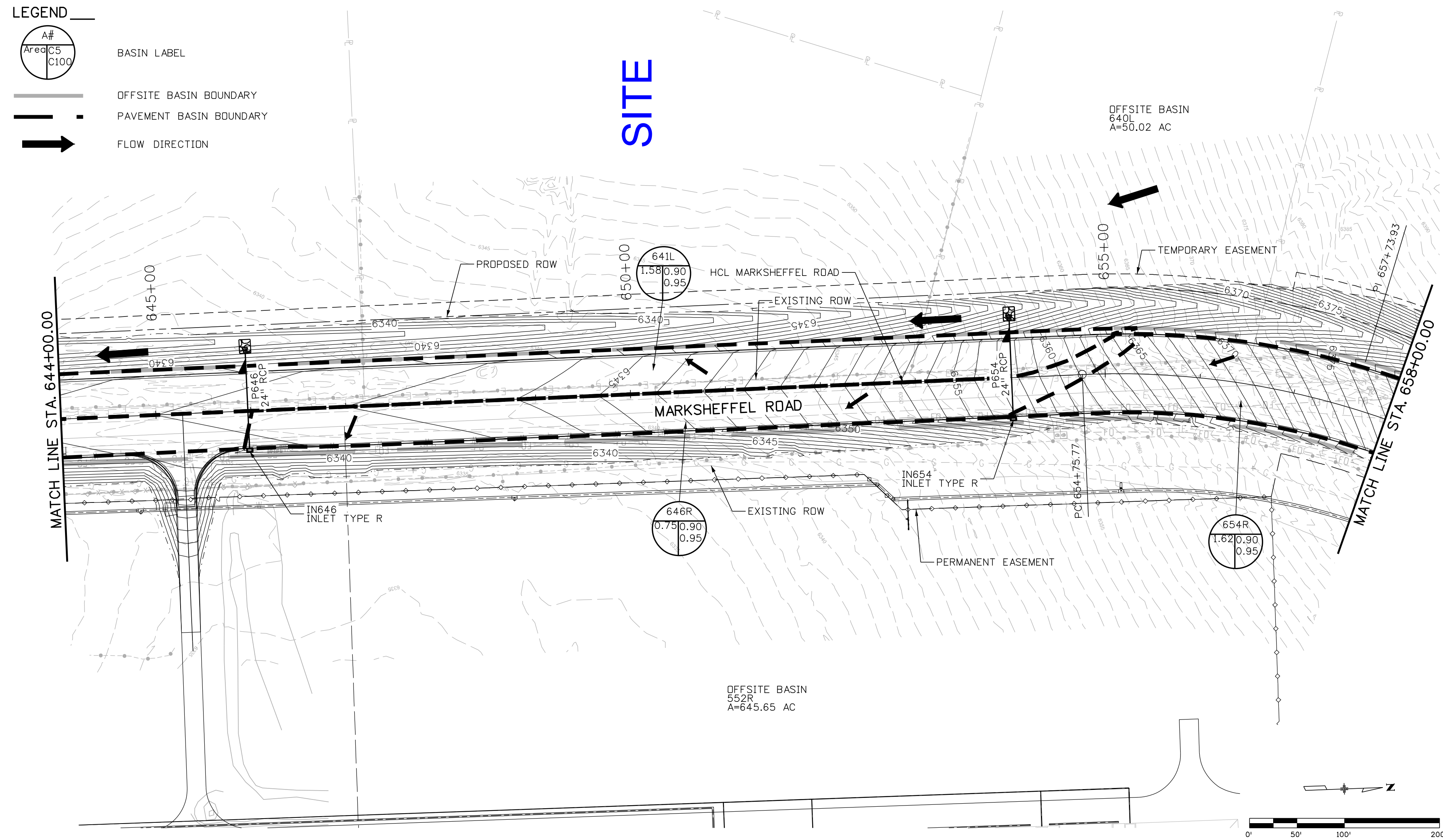
As Constructed
No Revisions:
Revised:
Void:

MARKSHEFFEL ROAD
DRAINAGE BASINS PLAN
630+00.00 TO 644+00.00

Designer: E. STATEN
Detailer: D. MADDOCK
Structure Numbers
Sheet Subset: BASINS Subset Sheets: 34 of 36

Project No./Code
....
....
34

ABALES 12:53:13 PM c:\pwworking\oma\d1266572\North-Marksheffel_BASINS_Plan041.dgn



Print Date: 12/8/2016
File Name: North-Marksheffel_BASINS_Plan042.dgn
Horiz. Scale: 1:100 Vert. Scale: As Noted
Unit Information Unit Leader Initials

HDR PARSONS BRINCKERHOFF

0000

Sheet Revisions		
Date:	Comments	Init.

EL PASO COUNTY COLORADO

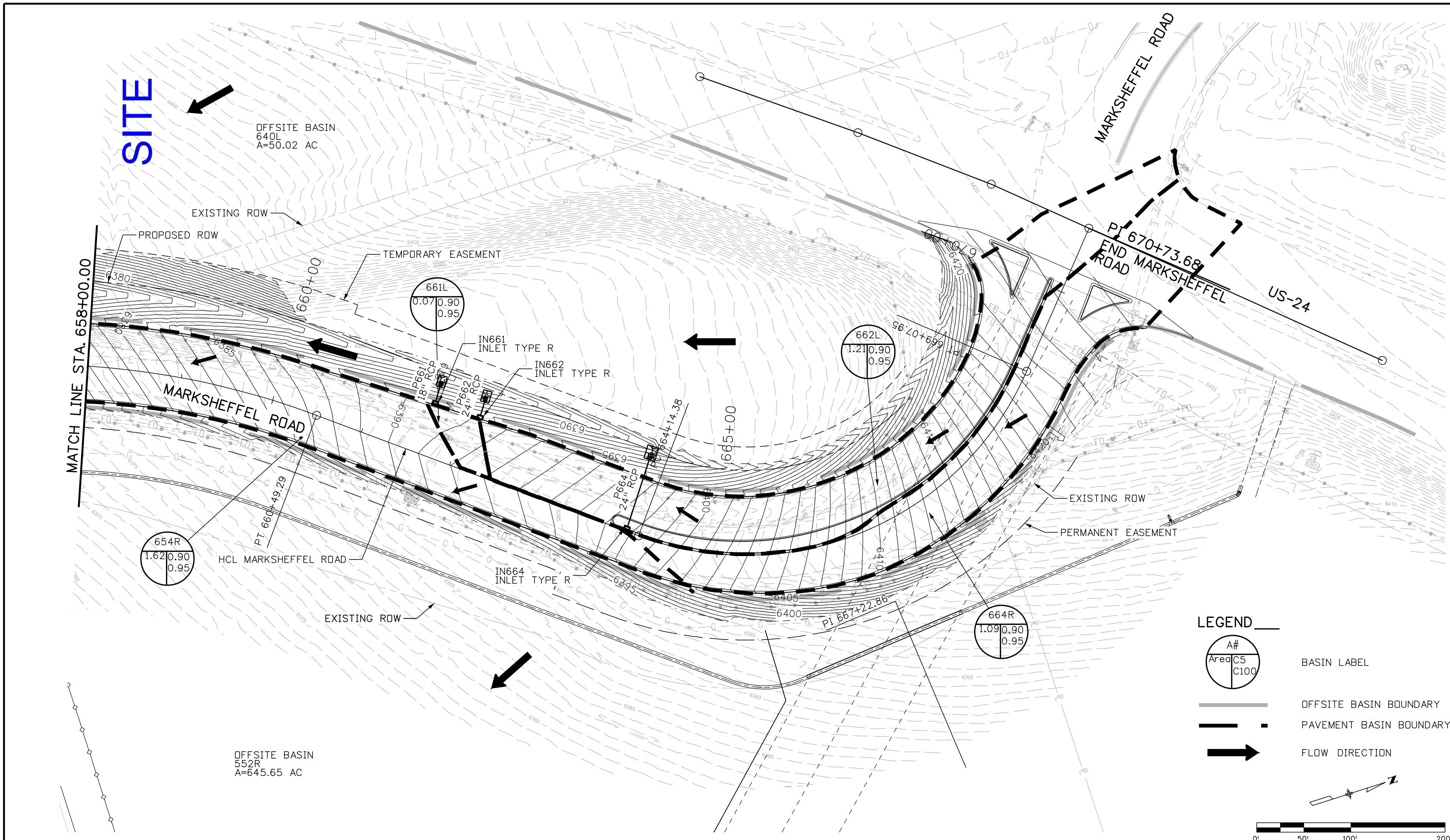
PPRTA

As Constructed
No Revisions:
Revised:
Void:

MARKSHEFFEL ROAD
DRAINAGE BASINS PLAN
644+00.00 TO 658+00.00

Designer: E. STATEN
Detailer: D. MADDOCK
Structure Numbers
Sheet Subset: BASINS
Subset Sheets:35 of 36

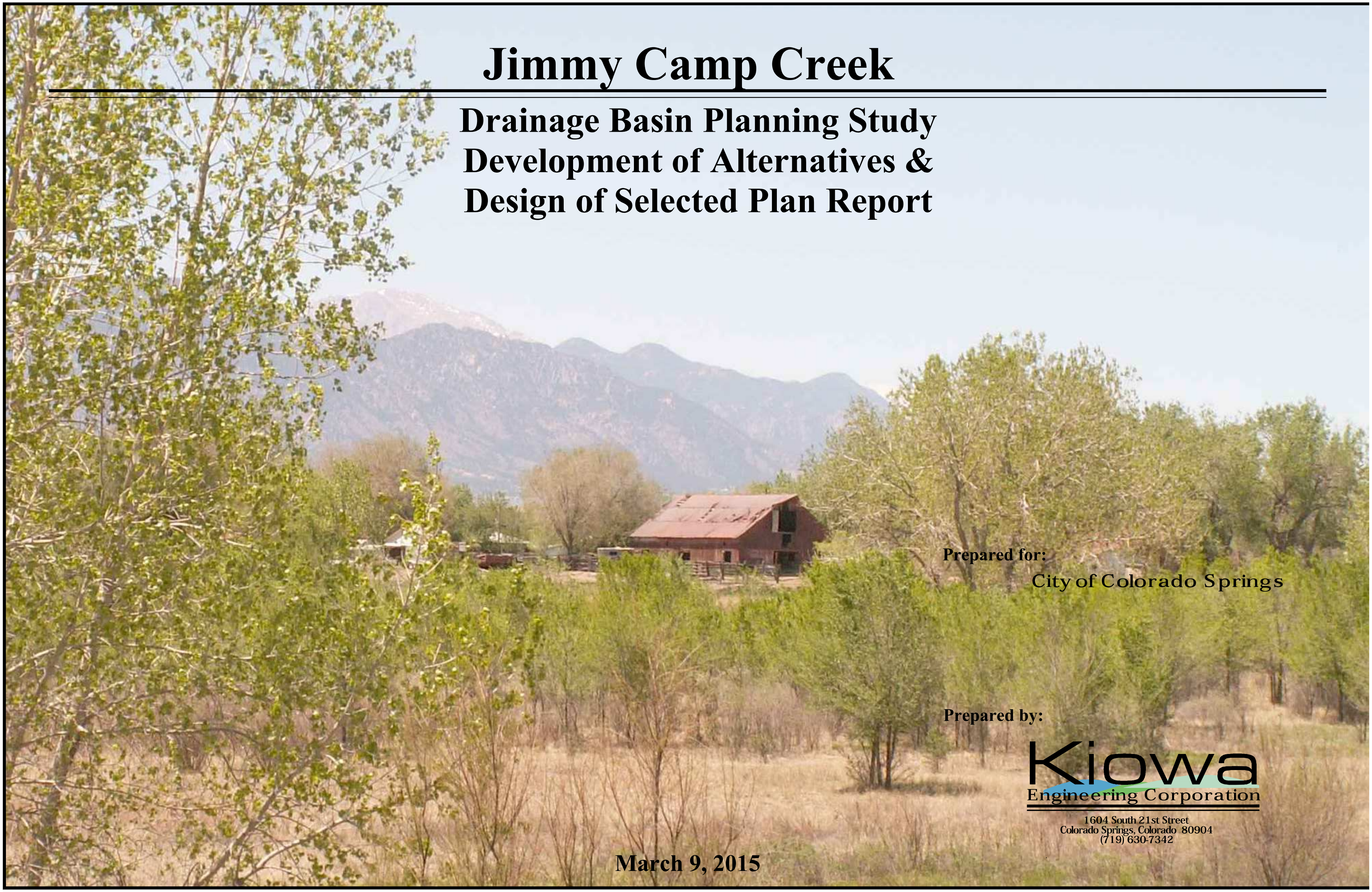
Project No./Code
....
....
35



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

Project No./Code
....
....

JIMMY CAMP CREEK DRAINAGE REPORT EXCERPTS



Jimmy Camp Creek

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

Prepared for:

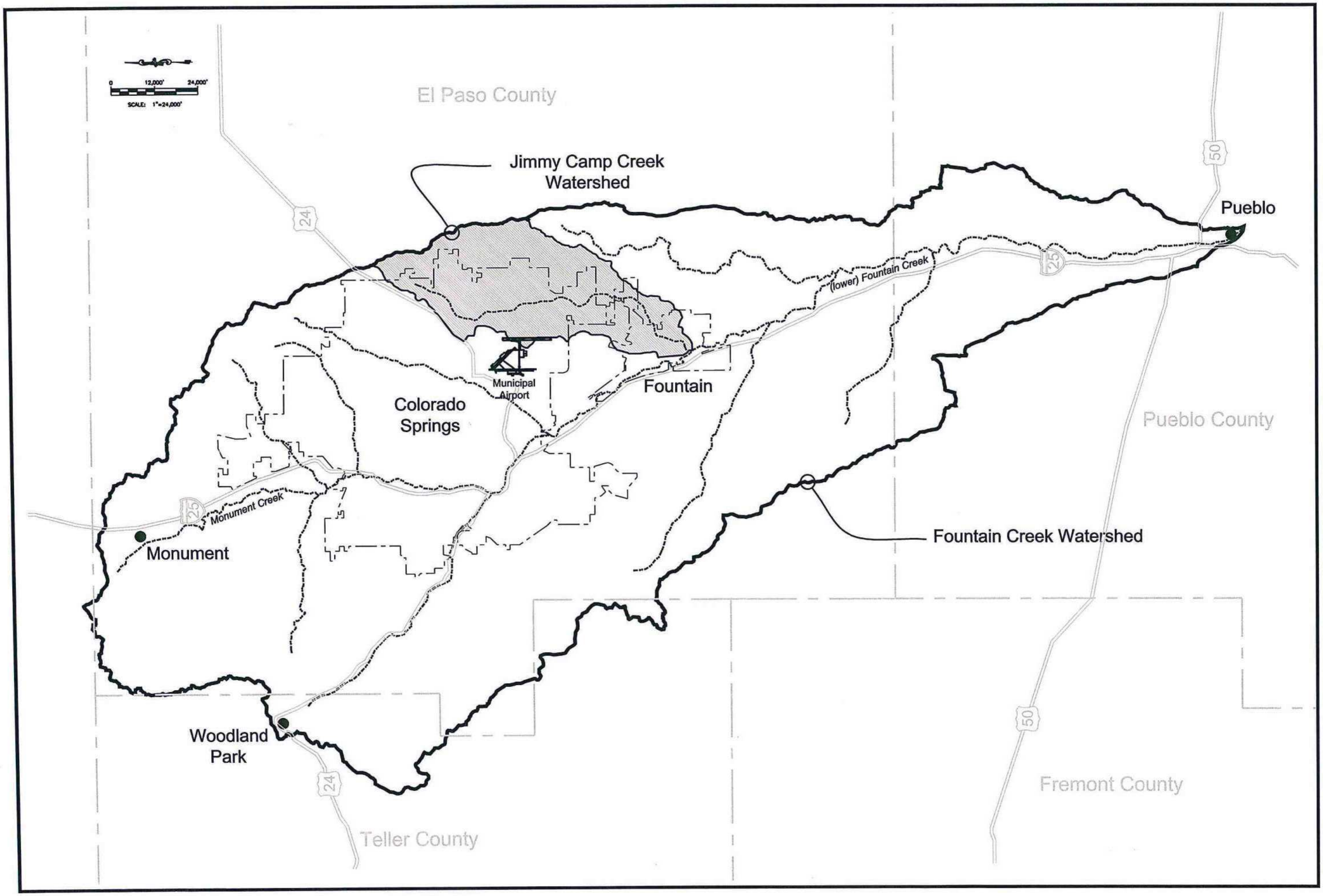
City of Colorado Springs

Prepared by:

Kiowa
Engineering Corporation

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

March 9, 2015

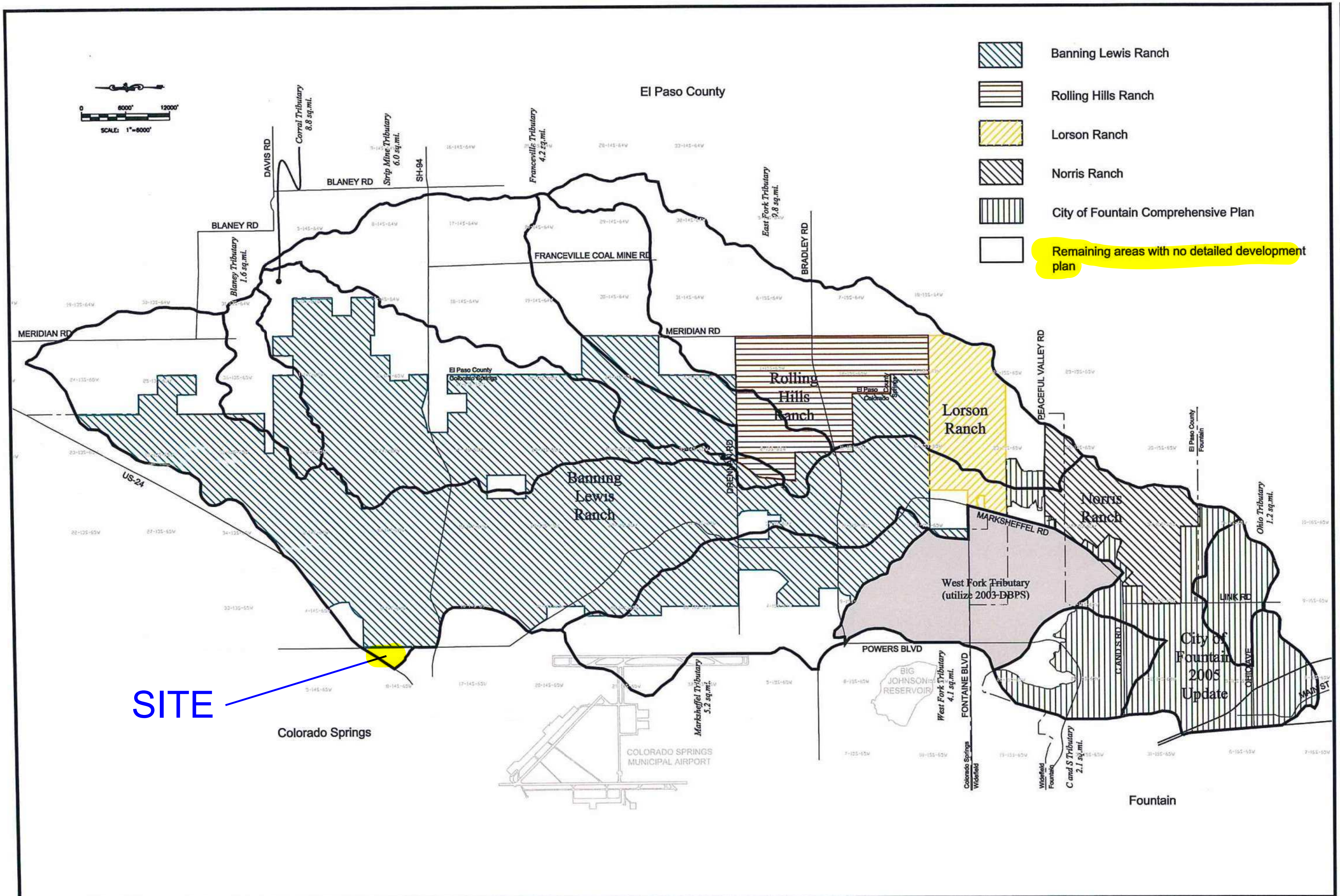


Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904
(719) 630-7342

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

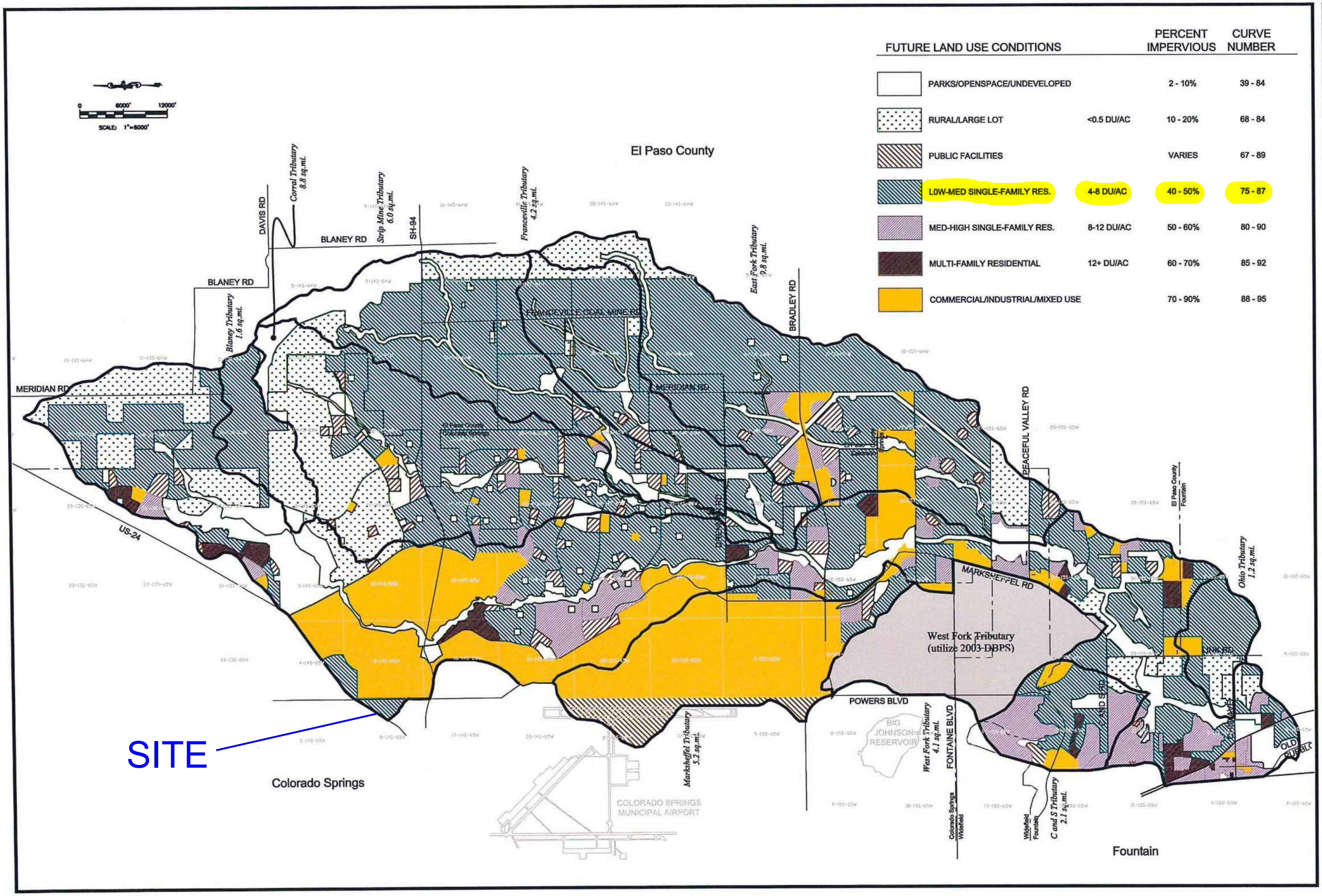


Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904
(719) 630-7342

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

Project No.: 14006
Date: OCT 2014
Design:
Drawn: BJW
Check:
Revisions:

II-2

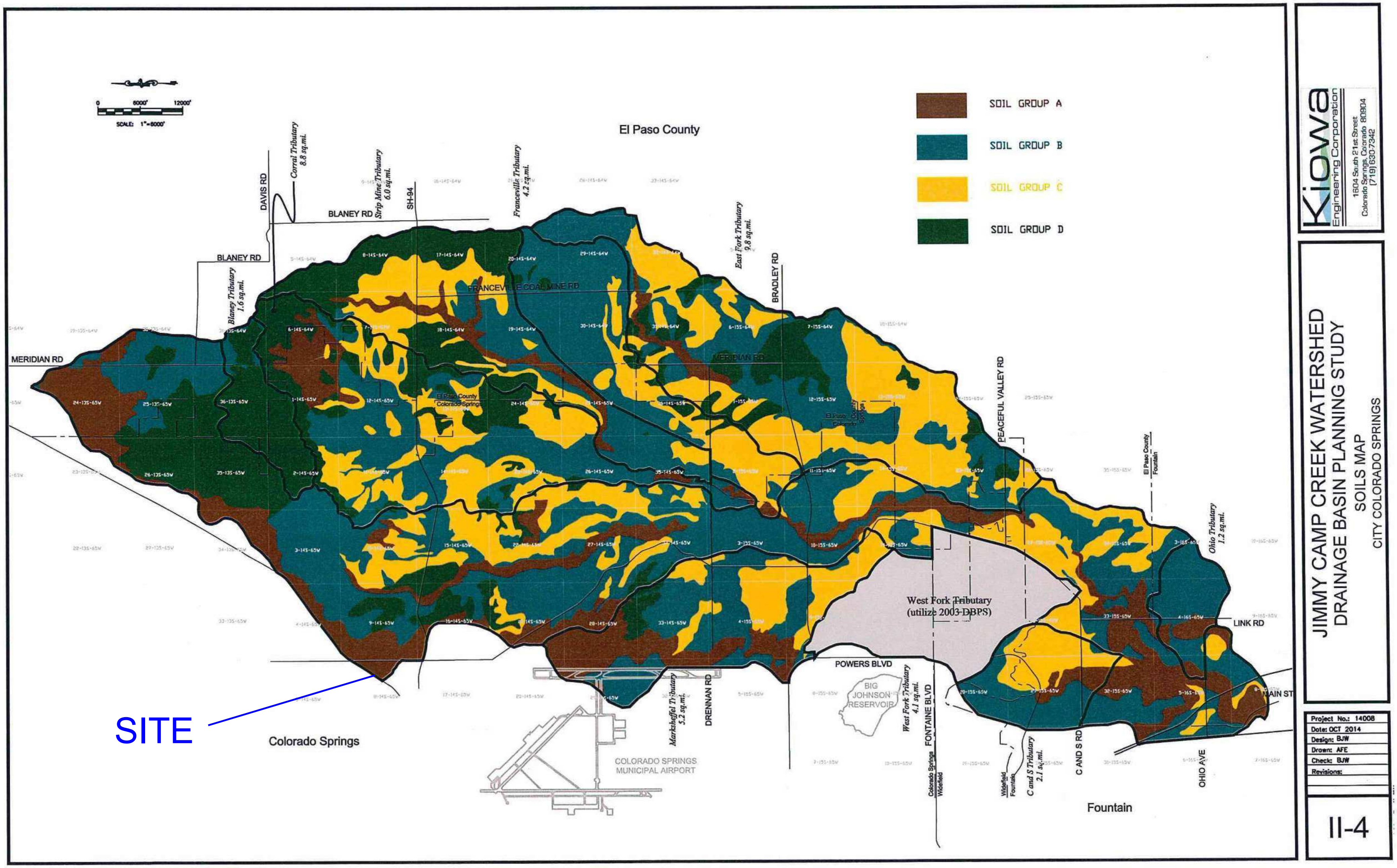


Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904
(719) 630-7342

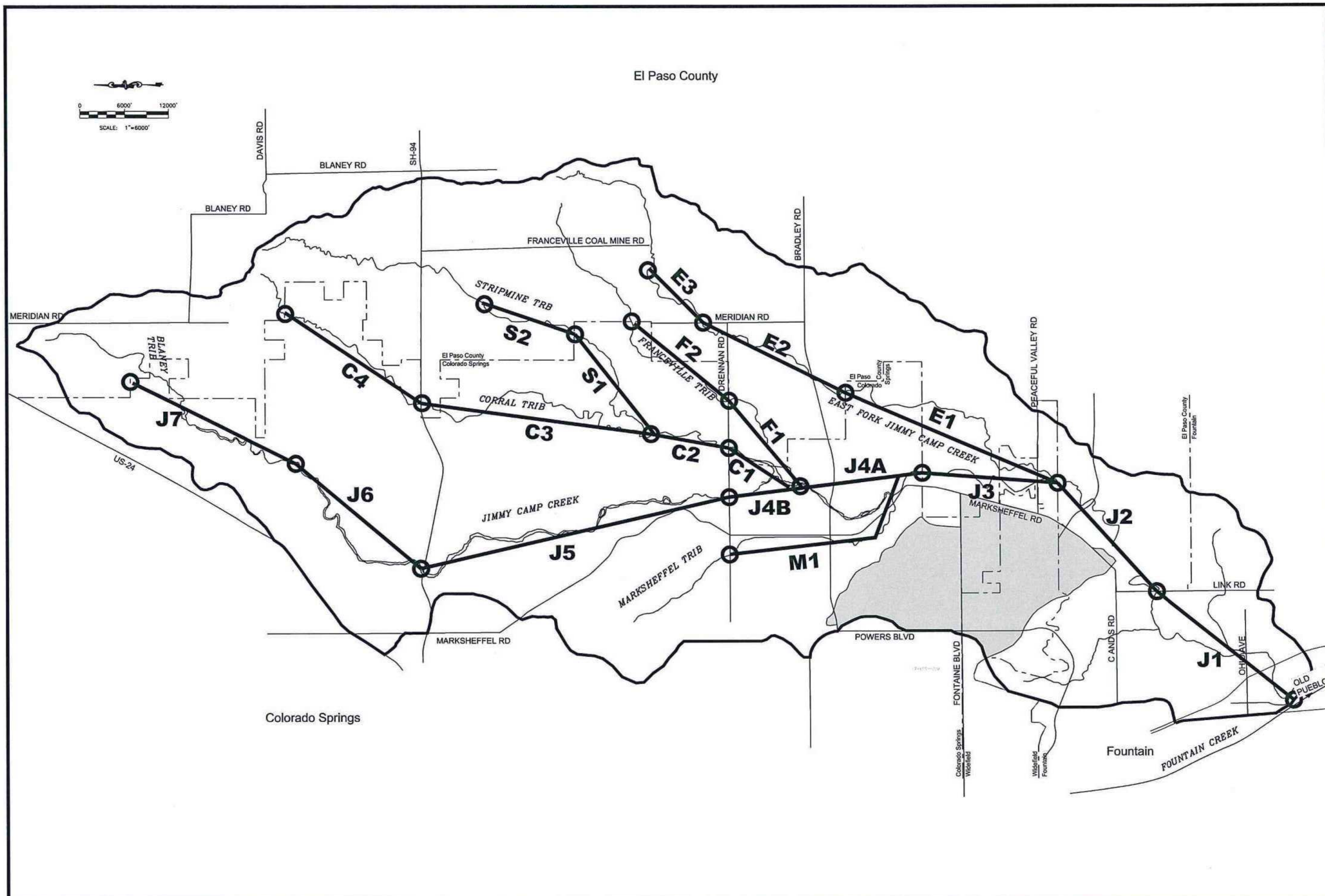
JIMMY CAMP CREEK WATERSHED
DRAINAGE BASIN PLANNING STUDY
FUTURE CONDITIONS LAND USE MAP
CITY OF COLORADO SPRINGS

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

II-3



SCALE: 1"=6000'
0
6000'
12000'
SOIL GROUP A
SOIL GROUP B
SOIL GROUP C
SOIL GROUP D
El Paso County
Colorado Springs
Fountain
COLORADO SPRINGS MUNICIPAL AIRPORT
BIG JOHNSON RESERVOIR
West Fork Tributary (utilize 2003 DBPS)
Corral Tributary 8.8 sq.mi.
Strip Mine Tributary 6.0 sq.mi.
Franceville Tributary 4.2 sq.mi.
East Fork Tributary 9.8 sq.mi.
Blaney Tributary 1.6 sq.mi.
Marksheffel Tributary 5.2 sq.mi.
West Fork Tributary 4.1 sq.mi.
C and S Tributary 2.1 sq.mi.
Ohio Tributary 1.2 sq.mi.
DAVIS RD
BLANEY RD
SH-94
FRANCEVILLE COAL MINE RD
BRADLEY RD
MERIDIAN RD
PEACEFUL VALLEY RD
POWERS BLVD
DRENNAN RD
FONTAINE BLVD
C AND S RD
OHIO AVE
LINK RD
MAIN ST
SITE
Kiowa Engineering Corporation
1604 South 21st Street Colorado Springs, Colorado 80904 (719) 630 7342
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

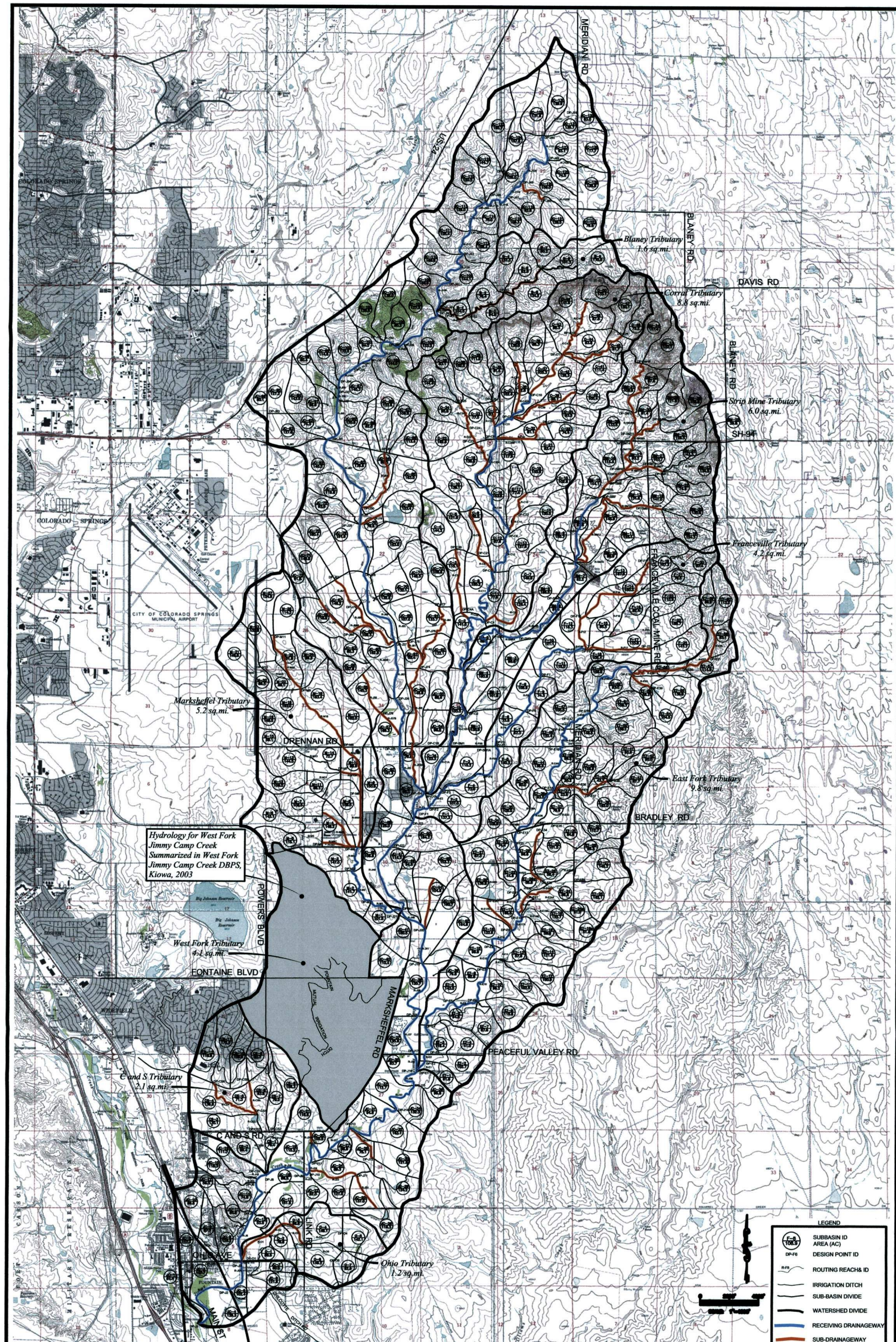


Kiowa
Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904
(719) 630-7342

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

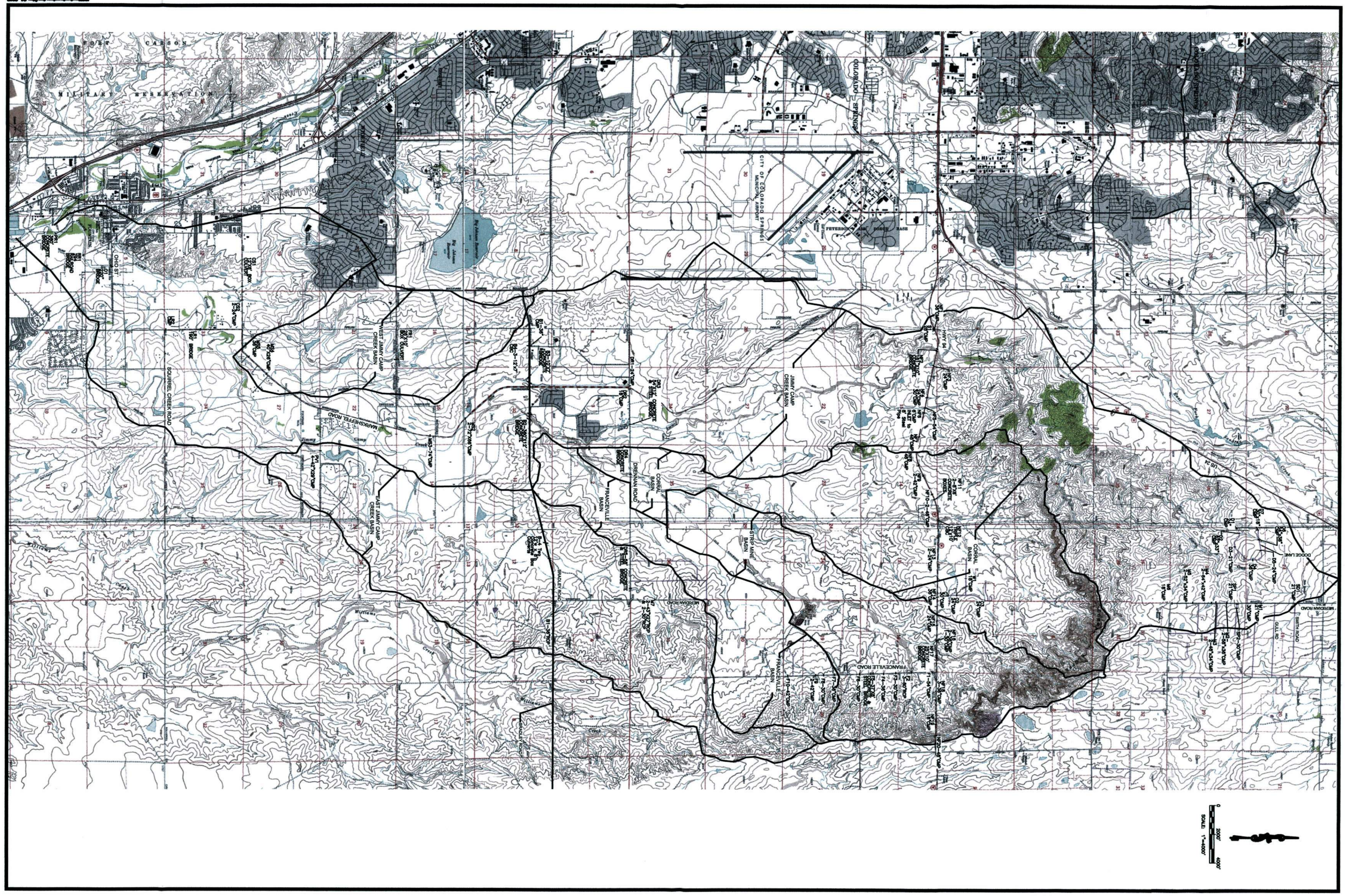


Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904
(719) 630-7342

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

Project No.: 14008
Date: APRIL 2015
Design: RNW
Drawn: EAK
Check:
Revisions:

EXHIBIT 1

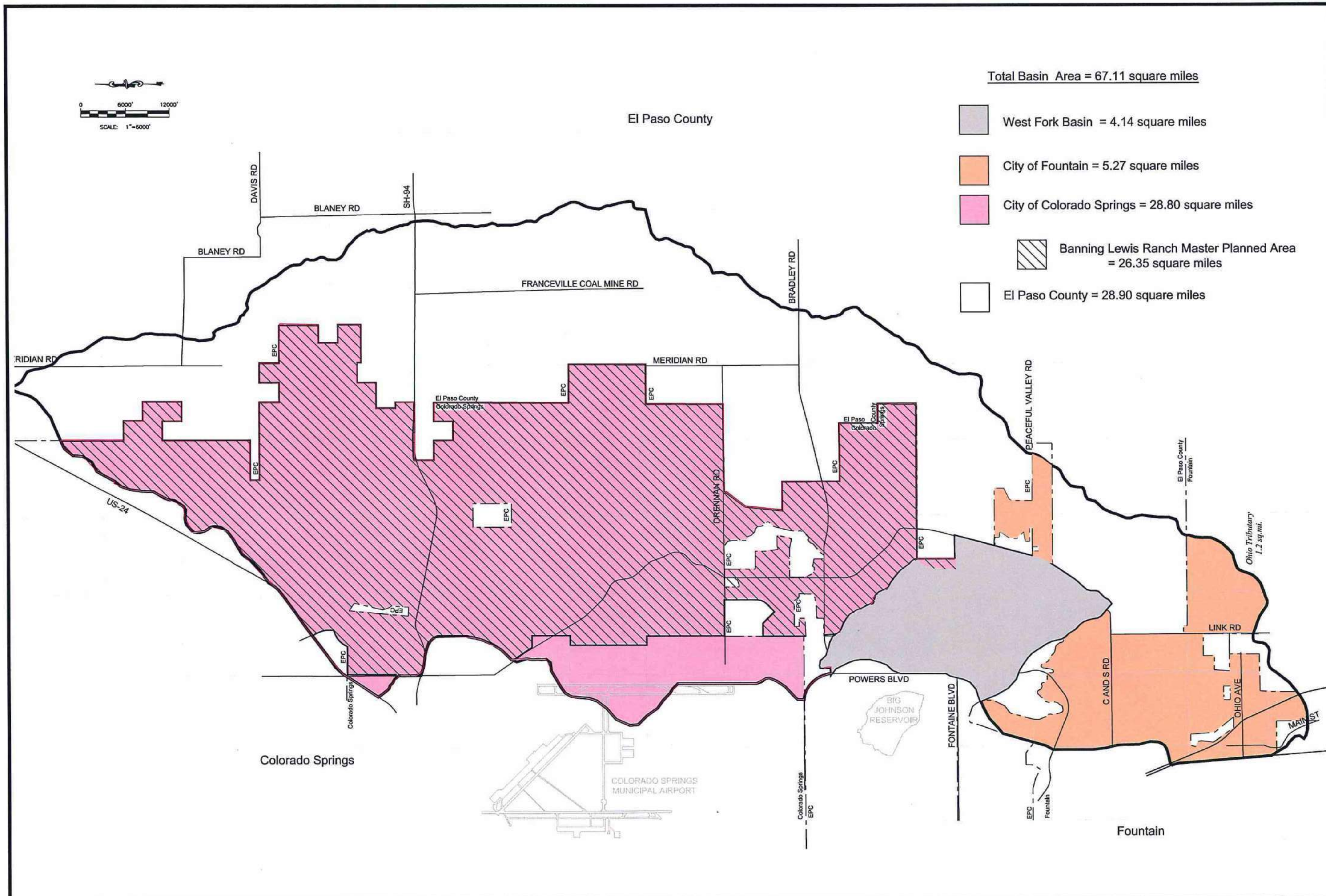


JIMMY CAMP CREEK WATERSHED
DRAINAGE BASIN PLANNING STUDY
STRUCTURE INVENTORY MAP
CITY OF FOUNTAIN, CITY OF COLORADO SPRINGS, EL PASO COUNTY

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

Project No.:	06025
Date:	DECEMBER 2008
Design:	
Drawn:	EAK
Check:	
Revisions:	

SHEET
1
OF 4 SHEETS



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

JIMMY CAMP CREEK WATERSHED DRAINAGE BASIN PLANNING STUDY

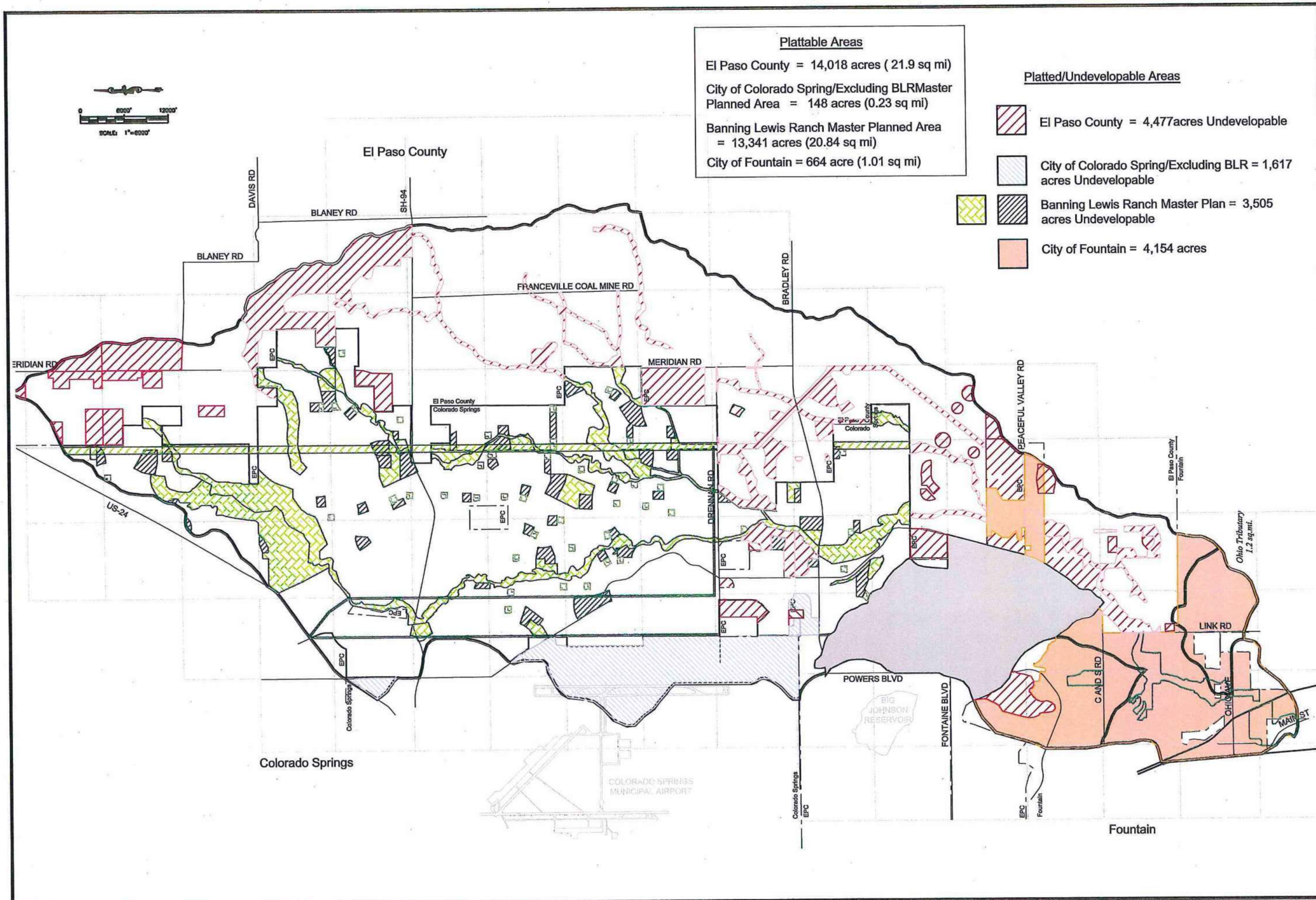
JURISDICTIONAL BOUNDARIES

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



JIMMY CAMP CREEK WATERSHED DRAINAGE BASIN PLANNING STUDY

PLATTABLE ACREAGE

CITY OF FOUNTAIN, CITY OF COLORADO SPRINGS, EL PASO COUNTY

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

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

FIGURE
Fig VII-2

REAGAN RANCH MDDP EXCERPTS

SHEET No. 3

811 Know what's below. Call before you dig.

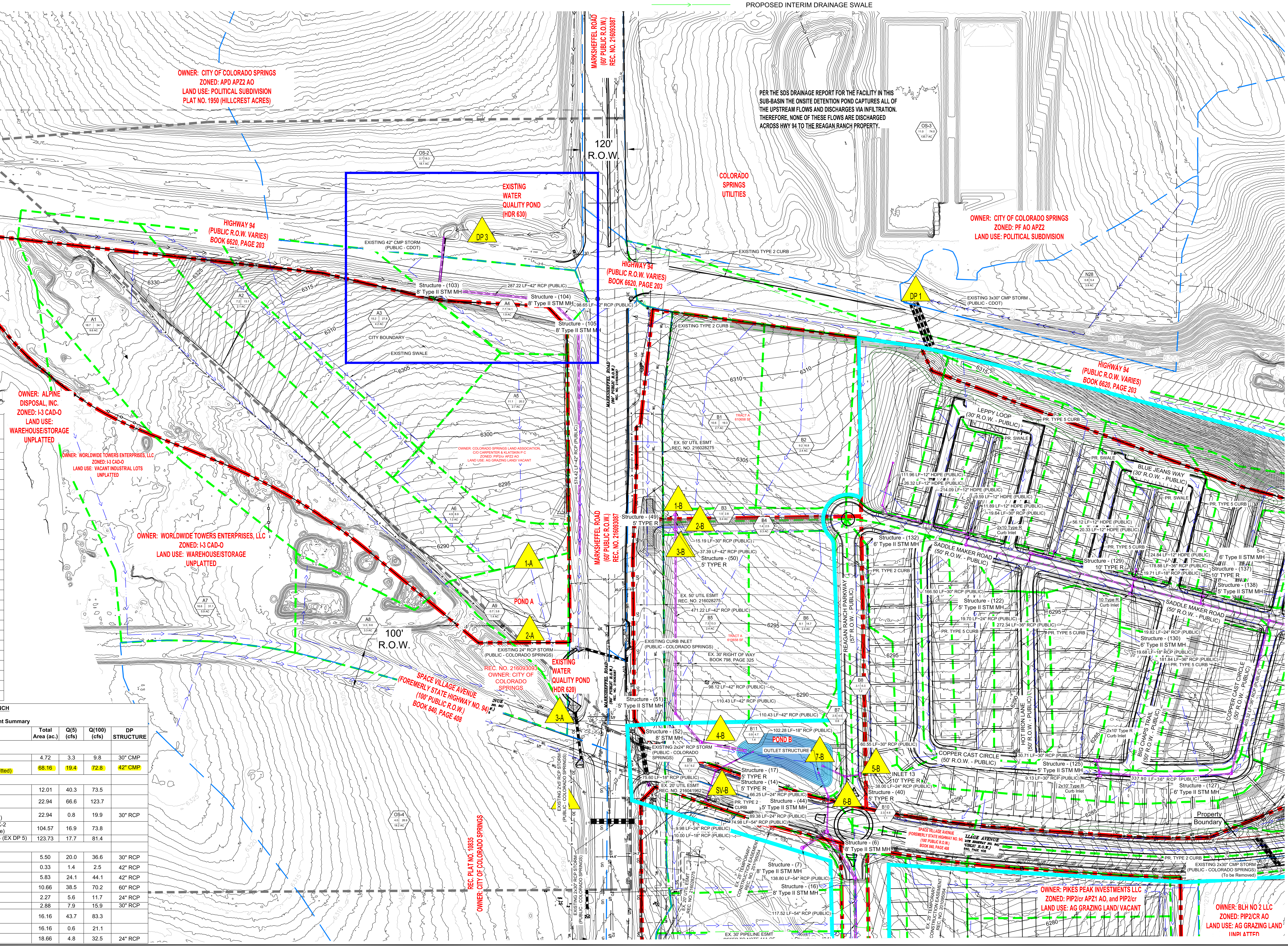
CROSSROADS NORTH SITE

LEGEND

- EXISTING BASIN BOUNDARY
- EXISTING EASEMENT
- PROPOSED BASIN BOUNDARY
- EXISTING CONTOUR
- PROPOSED CONTOUR
- PROPOSED STORM DRAIN PIPE
- EXISTING STORM DRAIN PIPE
- FLOWLINE
- PROPOSED PROPERTY LINE
- PROPOSED HIGH PLAINS AT REAGAN RANCH
- PROPOSED FLOW DIRECTION
- PROPOSED INTERIM DRAINAGE SWALE
- X-X DESIGN POINT
- BASIN SUB BASIN DESIGNATION
- Q5 5-YEAR STORM EVENT PEAK FLOW (CFS)
- Q100 100-YEAR STORM EVENT PEAK FLOW (CFS)
- AREA SUB BASIN AREA (AC.)

NOTE: SUB-BASINS B1-B6 WILL BE DEVELOPED IN A FUTURE PHASE.

GRAPHIC SCALE
(IN FEET)
1 inch = 100 ft.



REAGAN RANCH MDDP Proposed Conditions - Sub-basin Summary			
Basin	Area	Q5	Q100
	acres	cfs	cfs
OS-2	18.14	2.72	18.31
OS-3	135.71	11.02	74.05
OS-4	19.16	4.00	26.85
N28	3.94	0.81	5.43
A1	9.57	18.69	34.12
A2	2.06	7.16	13.08
A3	4.20	15.22	27.78
A4	1.85	7.72	14.09
A5	2.72	11.08	20.22
A6	1.18	4.90	8.94
A7	5.95	16.57	31.12
A8	3.33	3.27	9.65
A9	1.37	0.70	3.81
B1	2.72	10.55	19.26
B2	2.40	9.19	16.77
B3	0.37	1.53	2.80
B4	0.33	1.39	2.53
B5	2.40	7.29	13.30
B6	2.43	8.08	14.74
B7	0.61	2.47	4.50
B8	1.22	3.07	6.32
B9	1.20	5.02	9.16
B10	1.05	2.32	4.88
B11	1.42	0.85	4.66

REAGAN RANCH MDDP Proposed Design Point Summary					
Design Point	Sub-Basins	Total Area (ac.)	Q(5) (cfs)	Q(100) (cfs)	DP STRUCTURE
PETERSON FIELD BASIN Offsite and Upstream					
DP1	CB5 - CB8.1 & N28	4.72	3.3	9.8	30" CMP
DP3	OS-1 & OS-2 (Existing WQ Detention omitted)	68.16	19.4	72.8	42" CMP
PETERSON FIELD BASIN - AREA A					
6-A	A2-A6	12.01	40.3	73.5	
7-A Inflow	A1-A6 & A9 (Proposed Pond)	22.94	66.6	123.7	
7-A Outflow	A1-A6 & A9 (Pond A Post Detention)	22.94	0.8	19.9	30" RCP
8-A	A1-A9, OS-1, OS-2 & MK-2 (WQ Pond 620 Discharge)	104.57	16.9	73.8	
9-A	A1-A9, MK-2, OS-1, OS-2 & OS-4 (EX DP 5)	123.73	17.7	81.4	
PETERSON FIELD BASIN - AREA B					
1-B	B1-B3	5.50	20.0	36.6	30" RCP
2-B	B4	0.33	1.4	2.5	42" RCP
3-B	B1-B4	5.83	24.1	44.1	42" RCP
4-B	B1-B6	10.66	38.5	70.2	60" RCP
5-B	B8+B10	2.27	5.6	11.7	24" RCP
6-B	B7-B10	2.88	7.9	15.9	30" RCP
7-B Inflow	B1-B11 (Pond B)	16.16	43.7	83.3	
7-B Outflow	Pond B Discharge	16.16	0.6	21.1	
8-B	B1-B8, B11, N-28	18.66	4.8	32.5	24" RCP

PIKES PEAK INVESTMENTS, LLC
COLORADO SPRINGS, COLORADO
REAGAN RANCH MDDP/FDR

PRELIMINARY DRAINAGE MAP

DESIGNED BY: JTS
DRAWN BY: JTS
CHECKED BY: GGS
SCALE: HORIZ. 1" = 100', VERT. N/A
DATE ISSUED: FEBRUARY 2021
SHEET 3 OF 11
DRAWING No. DR03

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. 19.224.008

SEAL

PREPARED BY: Matrix

SHEET KEY

No.	DATE	DESCRIPTION	BY

REVISIONS

COMPUTER FILE MANAGEMENT
FILE NAME: S:\19.224.008 Reagan Ranch\200 Drainage\201 Drainage Reports\MDDP\DWG\Reagan Ranch - DR-current.dwg
PLOT DATE: February 5, 2021 2:35:57 PM

REFERENCE DRAWINGS

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.**

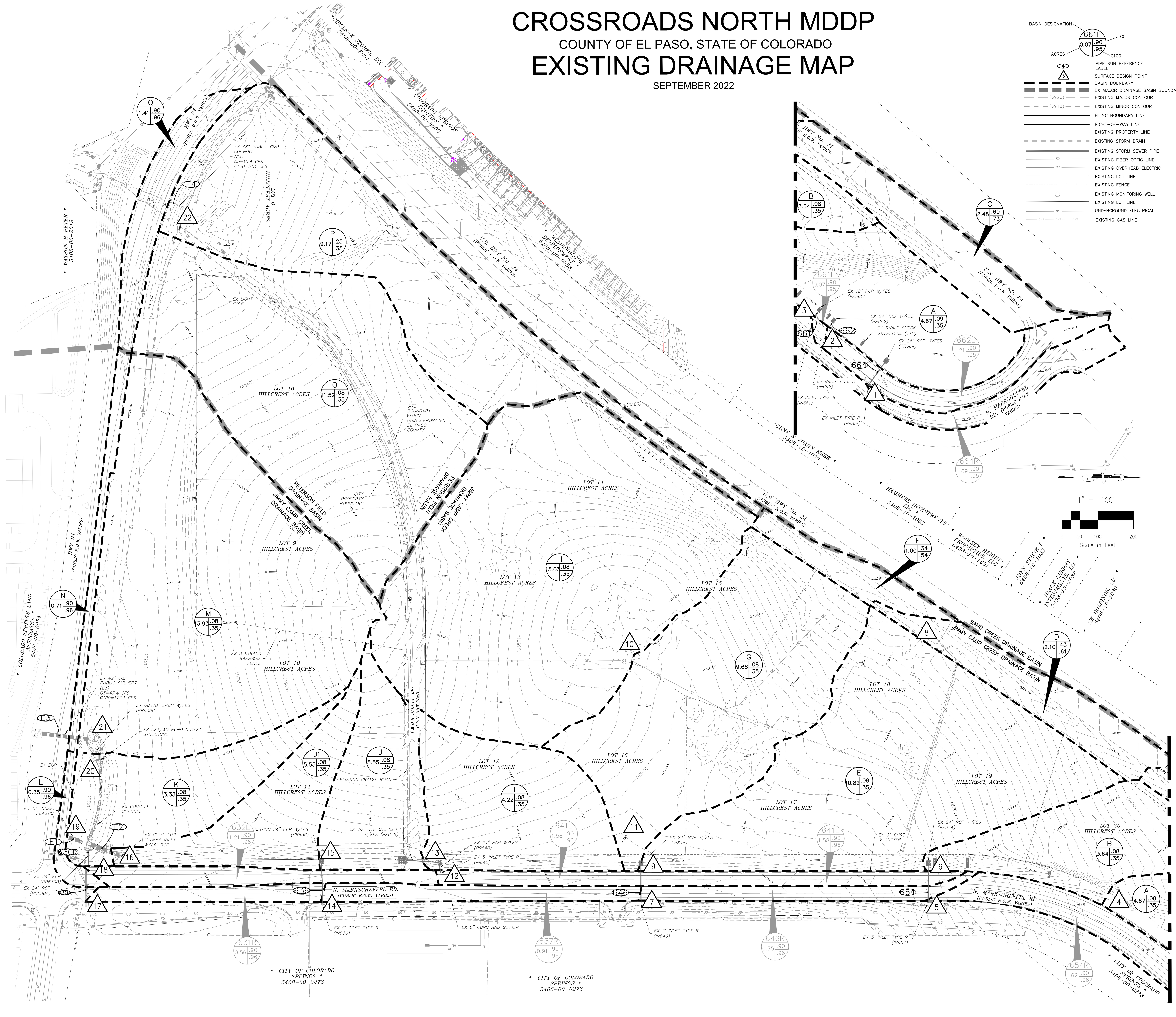
DRAINAGE MAPS

CROSSROADS NORTH MDDP

COUNTY OF EL PASO, STATE OF COLORADO

EXISTING DRAINAGE MAP

SEPTEMBER 2022



BASIN SUMMARY

BASIN	AREA (ACRES)	Q_5	Q_{100}
A	4.67	1.4	10.2
B	3.64	1.0	7.3
C	2.51	5.5	11.3
D	2.10	3.7	8.8
E	10.82	2.9	21.1
F	1.00	1.5	3.9
G	8.99	2.2	15.9
H	15.03	3.4	25.3
I	4.22	1.1	8.4
J	2.88	0.8	5.6
J1	2.67	0.7	4.9
K	3.33	0.9	6.8
L	0.35	1.6	2.9
M	13.93	4.0	28.8
N	0.71	3.3	5.9
O	11.52	2.7	20.2
P	9.17	2.4	17.9
Q	1.41	6.6	11.8
631R*	0.56	2.4	4.2
632L*	1.21	4.5	8.1
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	STRUCTURE
1	5.1	9.1	664R	EX 5' CDOT TYPE R AG 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	7.9	20.3	PR664, PR662, PR661, A	EX 5' BTM EARTH TRAP CHANNEL
5	10.3	21.6	FBIN664, 654R	EX 5' CDOT TYPE R INLET
6	10.5	28.4	DP4, DP5 PR654, B	EX 5' BTM EARTH TRAP CHANNEL
7	7.9	18.2	FBIN654, 646R	EX 5' CDOT TYPE R INLET
8	8.6	18.8	C, D	ENTERS PROPERTY FROM CDOT ROW
9	23.5	69.0	DP6, DP8, E, PR646	EX 5' BTM EARTH TRAP CHANNEL
10	3.4	25.3	H	LOCALIZED LOWPOINT
11	6.8	45.2	F, G, DP10	EX 5' BTM EARTH TRAP CHANEL
12	5.8	10.4	641L	EX 5' CDOT TYPE R INLET
13	36.6	138.0	DP9, DP11, PR640, I	EX 42" CULVERT
14	5.9	14.5	FBIN646, 637R	EX 5' CDOT TYPE R INLET
15	38.3	139.7	DP13, J, PR636	EX 5' BTM EARTH TRAP CHANNEL
16	35.3	131.7	DP15, J1	EX CDOT TYPE C AREA INLET W/ RIPRAP BYPASS RUNDOWN
17	4.0	11.7	FBIN636, 631R	EX 5' CDOT TYPE R INLET
18	5.8	11.6	FBIN640, 632L	EX 5' CDOT TYPE R INLET
19	1.7	4.9	FBIN630B, L	EX 12" PLASTIC CORUGATED PIPE
20	42.2	149.5	DP16, PR630B, PRE1, K	EX W.Q. POND
21	47.4	177.1	DP20, M, N	EX 42" CMP
22	10.4	51.1	O, P, Q	EX 48" CMP

STORM SEWER SUMMARY

PIPE RUN	Q_5	Q_{100}	PIPE SIZE	CONTRIBUTING PIPES/DP	TYPE
664	2.7	3.4	EX 24" RCP	IN664R	PUBLIC
662	3.0	3.8	EX 24" RCP	IN662L	PUBLIC
661	1.9	3.2	EX 18" RCP	IN661L	PUBLIC
654	4.0	5.4	EX 24" RCP	IN654	PUBLIC
646	3.4	4.7	EX 24" RCP	IN646	PUBLIC
640	2.9	3.8	EX 24" RCP	IN640	PUBLIC
639	36.6	138.0	EX 36" RCP	IN639	PUBLIC
636	3.0	4.3	EX 24" RCP	IN636	PUBLIC
630A	2.5	4.1	EX 24" RCP	IN630A	PUBLIC
630B	5.8	10.3	EX 24" RCP	IN630B	PUBLIC
E1	1.8	6.9	EX. 12" CORR. PLASTIC	DP19	PUBLIC
E2	11.8	19.8	EX. 24" RCP	DP16	PUBLIC
E3	47.4	177.1	EX. 42" OR	DP21	PUBLIC
E4	10.4	51.1	EX 48" CMP	DP22	PUBLIC

CROSSROADS NORTH FILING NO.1
EXISTING DRAINAGE MAP
DATE SUBMITTED: 9/30/22
SHEET 1 OF 1

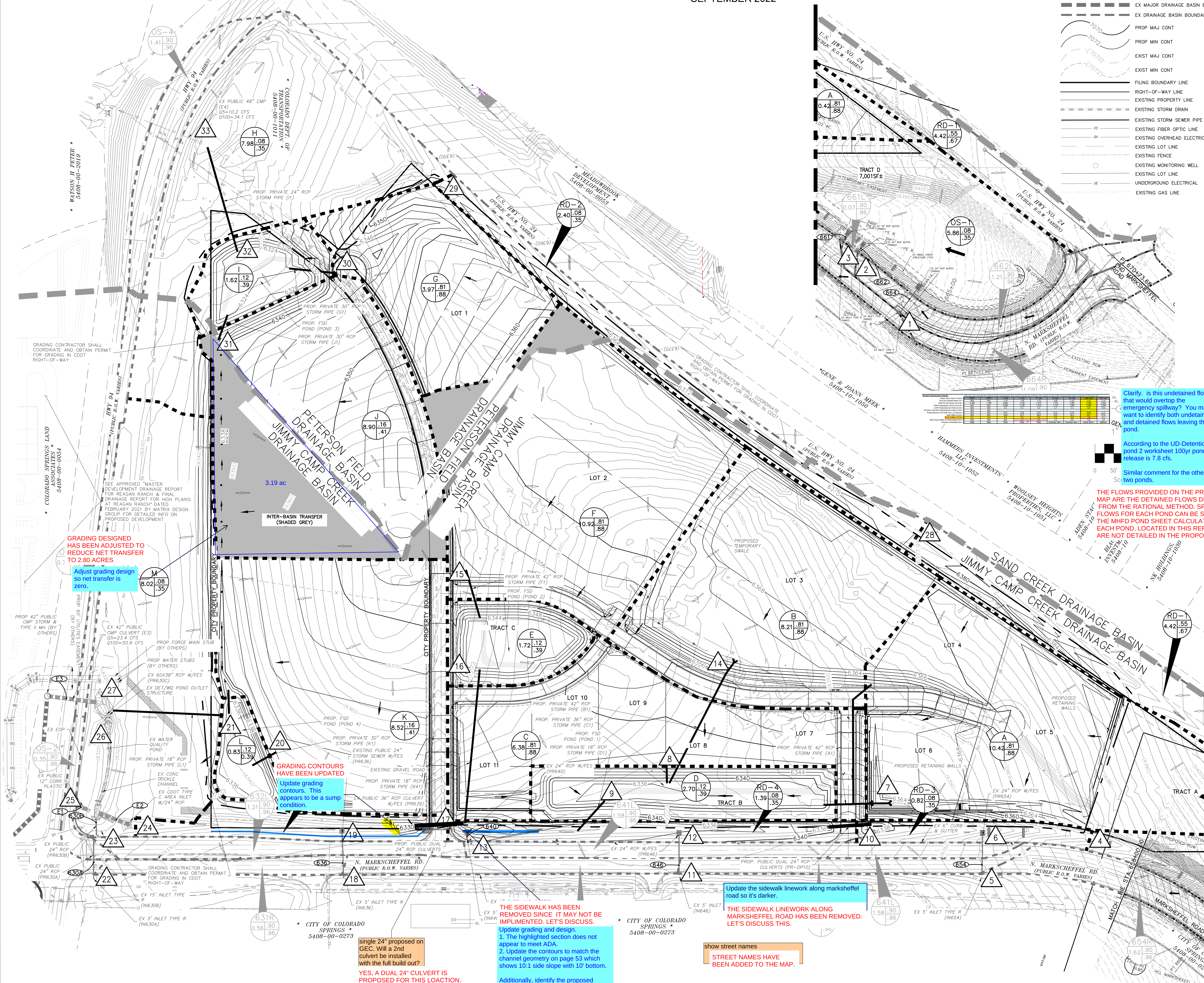
212 N. WAHSATCH AVE., STE 305
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485
CIVIL CONSULTANTS, INC.

CROSSROADS NORTH MDDP

COUNTY OF EL PASO, STATE OF COLORADO

PROPOSED DRAINAGE MAP

SEPTEMBER 2022



BASIN SUMMARY			
BASIN	AREA (ACRES)	Q_5	Q_{100}
A	10.42	43.2	78.8
B	8.21	31.6	57.6
C	6.38	26.6	48.4
D	2.70	1.6	8.9
E	1.72	1.1	5.8
F	10.92	36.2	66.0
G	3.97	15.9	29.0
H	7.98	2.3	16.5
I	1.62	0.8	4.3
J	8.90	4.9	21.1
K	8.52	5.2	22.6
L	0.83	0.7	3.9
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	0.82	0.3	2.0
RD-4	1.39	0.4	2.9
RD-5	1.36	0.5	3.4
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

*GEOMETRY AND COEFFICIENTS FROM MARKSHEFFEL SOUTH FDR

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	43.2	78.8	BASIN A	PROP PRIVATE 42" RCP STORM SEWER
8	26.6	48.4	BASIN C	PROP PRIVATE 36" RCP STORM SEWER
9	101.3	190.5	Basin D, DP7, DP8, DP13	PROP PRIVATE 18" RCP STORM SEWER POND 1
10	13.9	34.7	BASIN RD-3, DP6	DUAL 24" PUBLIC RCP CULVERTS
11	7.9	18.1	FBIN654, 646R	EX 5' CDOT TYPE R INLET
12	15.2	34.0	PR646, PR-DP10	EX 5' BTM EARTH TRAP CHANNEL
13	5.8	10.4	641L	EX 5' CDOT TYPE R INLET
14	31.6	57.6	BASIN B	PROP PRIVATE 42" RCP STORM SEWER
15	36.2	66.0	BASIN F	PROP PRIVATE 42" RCP STORM SEWER
16	37.0	70.6	BASIN E, F1	PROP PRIVATE 18" RCP STORM SEWER POND 2
17	15.4	48.5	PR640, DP12, DP16, DP9	EX PUBLIC 36" CULVERT
18	5.9	14.5	FBIN646, 637R	EX 5' CDOT TYPE R INLET
19	16.9	48.4	PR639, PR636	EX 5' BTM EARTH TRAP CHANNEL
20	5.2	22.6	BASIN K	PROP PRIVATE 30" RCP STORM SEWER
21	6.2	27.2	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 5' CDOT TYPE R INLET
24	15.1	44.5	DP19, 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	50.9	DP26, OS-3, M, L1	EX 42" PUBLIC CMP CULVERT
28	8.2	16.6	RD-1	TRIANGULAR, EARTHEN CDOT DITCH
29	6.5	15.7	RD-2, DP28	TRIANGULAR, EARTHEN CDOT DITCH
30	15.9	29.0	G	PROP PRIVATE 30" RCP STORM SEWER
31	4.9	21.1	J	PROP PRIVATE 30" RCP STORM SEWER
32	23.2	62.6	I, DP30, DP31	PROP PRIVATE 18" RCP STORM SEWER (POND 3)
33	10.2	34.1	H, OS-4, I1, 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 18" 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	50.9	EX. 42" CMP	DP27
E4	10.2	34.1	EX. 48" CMP	DP33
A1	43.2	78.8	PROP. 42" RCP	DP7
B1	31.6	57.6	PROP. 42" RCP	DP14
C1	26.6	48.4	PROP. 36" RCP	DP8
D1	1.4	17.8	PROP. 18" RCP	DP9
F1	36.2	66.0	PROP. 42" RCP	DP15
641	0.5	7.8	PROP. 18" RCP	DP16
G1	15.9	29.0	PROP 30" RCP	DP30
J1	4.9	21.1	PROP 30" RCP	DP31
I1	0.2	9.8	PROP 24" RCP	DP32
K1	5.2	22.6	PROP 30" RCP	DP20
L1	0.0	5.6	PROP 18" RCP	DP21
PR-DP10	13.9	34.7	DUAL 24" RCP	DP10

CROSSROADS NORTH
PROPOSED DRAINAGE MAP
DATE SUBMITTED: 09/29/2022
SHEET 1 OF 1

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