Final Drainage Report

Kum & Go Store #2232

Pedrick-Eckerd Filing No. 3
Lot 2
El Paso County, Colorado

April 27, 2022
Revised October 4, 2022

Prepared For:

Kum & Go L.C.
1459 Grand Avenue
Des Moines, IA 50309
Contact: Dan Garneau
Phone: 515-457-6392

Prepared By:

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Contact: David S. Iovinelli, PE
Dylan Jones
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Dylan.Jones@ees.us.com

PCD File No. PPR-2225

KUM & GO AT PEDRICK-ECKERD FILING NO. 3, LOT 2

ENGINEER'S STATEMENT

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

_____

David S Iovinelli P.E. No. 57262 Date

DEVELOPER'S STATEMENT

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

_____

Name of Developer

_____

Authorized Signature Date

_____

Printed Name

_____

Title

_____

Address:

El Paso County:

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

_____ _____

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

Conditions:

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General Location

The project site is located at the north corner of the intersection of Security Boulevard and Main Street, identified as Lot 2 of the Pedrick – Eckerd Filing No. 3 and located within part of the Southeast ¼ of Section 11, Township 15 South, Range 66 West of the 6th Principal Meridian, El Paso County, State of Colorado. Lot 2 is bounded by existing commercial developments consisting of Ross Dress for Less, Security Discount Liquor, H&R Block, Comfort Dental, Hair Therapy Hair Dresser, First Cash Pawn, Tobacco Shop, Laundromat, and Sonic Drive-In to the north and east, Main Street to the south, and Security Boulevard to the west. Refer to the Vicinity Map below for reference.

VICINITY MAP

Description of Property

Lot 2 is a 1.29-acre site with the proposed development disturbing 1.20 -acres. The site in the existing condition consists primarily of asphalt pavement, with a portion of the site consisting of an existing 166 sf drive-thru coffee shop. In general, the site slopes to the south and east at slopes ranging from 1-3%. The soil consists of Blendon sandy loam, identified as hydrological soil group B per the NRCS Soil survey. Refer to the Appendix for the NRCS Soil Survey Map. The site is located within the Little Johnson/ Security Drainage Basin. There are no irrigation facilities within or near the site. The site includes overhead utility lines that will need to be modified as part of the proposed development.

Narrative updated to specify work is on-site.

Confirm whether lines will be within the site or if the work will be within the public ROW.

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The proposed development intends to be a Kum & Go Convenience Store, 6MPD gas canopy and associated drives, sidewalks and landscaping. The proposed development will also include utility services for the new building and an underground water quality and detention facility (Pond 1) with associated storm infrastructure.

Major Basin Description

The site is located within the Little Johnson/ Security Drainage Basin as outlined in the Little Johnson/ Security Drainage Basin Planning Study (1988) and ultimately discharges to Crews Gulch (Widefield Creek) to the southeast. The site is located within a portion of basin 41 and was modelled as commercial developments with 95 imperviousness. The existing downstream detention systems have a history of overtopping and improperly functioning and as such the proposed development will require onsite detention and water quality.

The site is located within a Special Flood Hazard Area with Base Flood Elevation of the Flood Plain, as designated on the Flood Insurance Rate Map (FIRM) exported 3/22/2022, map last revised October 2020. The Base Flood elevation is 5731.7'. Refer to the Appendix for the FIRMette. To accommodate for developing in the floodplain the finished floor of the building has been set a 5732.70', a minimum of 12" above base flood elevation. The southwest corner of the building will have an exposed foundation and stem wall to allow for a sidewalk that sits below the floodplain.

There are no known nearby irrigation facilities.

Sub-Basin Description

Historic Drainage Patterns

Drainage patterns in the existing condition generally drain to the south and east and flow patterns function as one basin (E1). Flows from Basin E1 are conveyed via sheet flow to the south where it is collected in an existing inlet at the north corner of the intersection of Main Street and Security Boulevard. Refer to the Appendix for the Historic Drainage Plan. See below for specifics into the basin.

Basin E1: Basin E1 is 1.29 acres and consists of hardscape and dirt for an impervious value of 79.07%. The 5-year and 100-year C values were determined to be 0.84 and 0.91, respectively; and anticipated 5-year runoff flows of 4.44 CFS and 100-year runoff flows of 10.23 CFS. Flows from basin E1 are directed via sheet flow to Main Street and Security Boulevard where they channelize flow to Design Point E1, an existing storm inlet and discharge into existing public storm infrastructure at the north corner of Main Street and Security Boulevard. There is also an offsite basin (OS1) that is tributary to the site.

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Basin OS1: Basin OS1 is 1.77 acres and consists entirely of existing drives, parking, and walks for an impervious value of 100.00%. The 5-year and 100-year C values were determined to be 0.90 and 0.96, respectively; and anticipated 5-year runoff flows of 6.28 CFS and 100-year runoff flows of 14.24 CFS. Flows from basin OS1 are directed via sheet flow to the south and are conveyed into and across Basin E1 and are ultimately directed to and captured at Design point E1.

Drainage Design Criteria

The Drainage Criteria Manual County of El Paso County Volumes 1 and 2, hereafter referred to as the "Drainage Criteria". Additionally, the City of Colorado Springs Drainage Criteria Manual (DCM) Volumes 1 and 2, and the Mile High Flood District's Urban Storm Drainage Criteria Manual Volumes 1-3.

The site is located within the Little Johnson Drainage Basin as designated in the Little Johnson/Security Drainage Basin Planning Study. There are no previous drainage reports for Lot 2 of the Pedrick-Eckerd Filing No. 3.

Four Step Process

The proposed development will follow the "Four Step Process" as outlined below:

Step 1: Employ Runoff Reduction Practices

Runoff has been reduced by capturing flow from upstream on-site impervious areas and directing them to an underground water quality and detention facility (Pond 1) located at the north and west portion of the proposed development.

Step 2: Stabilize Drainageways

There are no drainageways on-site to stabilize.

Step 3: Provide Water Quality Capture Volume

All newly developed flows have been routed to the underground full spectrum detention and water quality basin being constructed as part of the development. Flows are directed to the underground basin via proposed storm sewer and on-site inlets.

Step 4: Consider Need for Industrial and Commercial BMPs

During initial construction, commercial BMPS including vehicle tracking control, stabilized staging area, construction fence, and silt fence will be in place to provide source control of sediment within the site. During interim conditions, inlet protection and rock socks will be installed

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at proposed inlets and along the proposed curb and gutter within the site. The final condition will provide permanent seeding of all disturbed areas provided per permanent BMP requirements. No other potential pollutants are anticipated with this site post- construction.

Hydrologic Criteria

The design rainfall source for this project is the NOAA Atlas 14, one hour point rainfall data. The minor storm, 5-year rainfall value is 1.27 inches. The major storm, 100-year rainfall value is 2.70 inches.

The analysis and design of the Stormwater management system for this project was prepared in accordance with the criteria set forth by the El Paso County Drainage Criteria Manual (hereafter referred to as the DCM) and the Mile High Flood District (MHFD). The Rational Method was used to calculate runoff from the 5-year minor, and 100-year major design storm recurrence intervals. Peak runoff values were calculated using the rational method:

Q = CIA, where

Q = Storm runoff in cubic feet per second (cfs)
C = Rainfall coefficients – ratio runoff to rainfall
I = Rainfall intensity in inches per hour
A = Drainage area in acres

Table 6-6 of the El Paso County Drainage Criteria Manual was used for runoff coefficients.

The proposed storm sewers were modeled, and hydraulic grade lines generated, using Bentley StormCAD and FlowMaster software's. The user-defined design inputs for the software include peak flow runoff, pipe diameter, pipe slope & length, pipe material coefficient, and tailwater. For the onsite storm sewer system, the tailwater input was based on free outfall conditions. The hydraulic grade and energy lines have been designed to maintain a minimum of one foot below the final grade.

Inlet capacities for the proposed outlet structure calculations was based on utilizing the Mile High Flood District spreadsheet "MHFD_v5.01".

Drainage patterns have not changed per discussions with the city and the narrative currently reflects the accurate drainage patterns

Water Quality and Detention storage volume and dischar
the Mile High Flood District spreadsheet MHFD-Detentio

Drainage Facility Design – General Concept

revise this paragraph as needed per comments on drainage maps below.

In the developed condition runoff will be conveyed throughout the site via surface flow and will be collected by proposed storm infrastructure and directed to the onsite water quality and detention facility (Pond 1) to the north and west of the proposed convenience store and gas

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canopy. The flow from the underground detention facility will discharge through a pump to the surface, where it will discharge into Security Boulevard below this historic rate and follow the historic drainage path. There is also one tributary offsite basin (OS1) that will bypass the proposed inlet capturing flow to the proposed pond.

Elaborate on how this bypass will occur

Drainage Facility Design – Specific Details

Narrative has been revised to elaborate on bypass methods and location

The site in the proposed condition consists of five on-site b
four (P1, P2, P3, P4) are treated in an underground detentio
rates and one off-site (P5) which sheet-flow off-site and are collected in existing storm
infrastructure at the north corner of Main Street and Security Road. To accommodate the basins not treated in the underground detention system, the outlet structure has been designed to release at a reduced rate in addition to the historic rate. There is also one tributary offsite basin (OS1) that will bypass the proposed inlet capturing flow to the proposed pond. The following is a description of the proposed drainage basins.

Basin P1: Basin P1 is 0.09 acres and consists of roof for an impervious value of 90.00%. The 5-year and 100-year C values were determined to be 0.73 and 0.81, respectively; and anticipated 5-year runoff flows of 0.28 CFS and 100-year runoff flows of 0.67 CFS. Flows from basin P1 are captured by roof drains and conveyed by private 6" PVC and 18" RCP proposed storm infrastructure. The captured runoff is conveyed to and treated by the onsite underground water quality & detention facility (Pond 1). Ultimately the flows will be discharged by proposed storm infrastructure below historic rates to the surface where runoff will be captured by the existing storm infrastructure at the northwest corner of Main Street and Security Boulevard, following historic drainage patterns.

Basin P2: Basin P2 is 0.10 acres and consists entirely of roof for an impervious value of 90.00%. The 5-year and 100-year C values were determined to be 0.73 and 0.81, respectively; and anticipated 5-year runoff flows of 0.31 CFS and 100-year runoff flows of 0.74 CFS. Flows from basin P2 are canopy drains and conveyed by private 6" PVC and 18" RCP proposed storm infrastructure. The captured runoff is conveyed to and treated by the onsite underground water quality & detention facility (Pond 1). Ultimately the flows will be discharged by proposed storm infrastructure below historic rates to the surface where runoff will be captured by the existing storm infrastructure at the northwest corner of Main Street and Security Boulevard, following historic drainage patterns.

Basin P3: Basin P3 is 0.31 acres and consists of drives and walks and landscaping for an impervious value of 87.10%. The 5-year and 100-year C values were determined to be 0.79 and 0.88, respectively; and anticipated 5-year runoff flows of 1.06 CFS and 100-year runoff flows of 2.50 CFS. Flows from basin P3 surface drain to the north portion of the site where runoff is fully captured by a proposed 5' Type R Inlet in sump (Design Point 3). Captured runoff will be conveyed by private proposed 18" RCP storm infrastructure to the underground detention &

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water quality facility (Pond 1), where flows are treated and detained. Ultimately the flows will be discharged by proposed storm infrastructure below historic rates to the surface where runoff will be captured by the existing storm infrastructure at the northwest corner of Main Street and Security Boulevard, following historic drainage patterns.

Basin P4: Basin P4 is 0.64 acres and consists of drives and walks and landscaping for an impervious value of 90.63%. The 5-year and 100-year C values were determined to be 0.82 and 0.90, respectively; and anticipated 5-year runoff flows of 2.24 CFS and 100-year runoff flows of 5.21 CFS. Flows from basin P4 surface drain to the southwest corner where runoff is fully captured by a proposed CDOT 13 Valley inlet located at the northwest corner of the underground detention & water quality facility as well as a double CDOT 13 Valley inlet in sump (Design Point 4). Captured runoff will be conveyed by private proposed 18" RCP storm infrastructure to the underground detention & water quality facility (Pond 1), where flows are treated and detained. Ultimately the flows will be discharged by proposed storm infrastructure below historic rates to the surface where runoff will be captured by the existing storm infrastructure at the northwest corner of Main Street and Security Boulevard, following historic drainage patterns.

Basin P5: Basin P5 is 0.15 acres and consists of hardscape and landscape for an impervious value of 33.33%. The 5-year and 100-year C values were determined to be 0.35 and 0.55, respectively; and anticipated 5-year runoff flows of 0.23 CFS and 100-year runoff flows of 0.76 CFS. Flows from basin P5 are surface flow offsite undetained and into the public right-of-way as they do in the historic condition. Once in the public right-of-way, the runoff is conveyed via existing curb and gutter to an existing storm inlet located at the north corner of the intersection of Main Street and Security Boulevard, following historic drainage patterns. The being detained in the proposed underground detention & water quality facility acres, or approximately 11.6% of the project site, which is less than the allowa not exceed 1 acre of the applicable development site area, meeting Water quality exclusions per ECM Appendix I, Section 7.1.C.1.

Narrative has been updated for legibility and accuracy of Q5 flow.

only Q5 provided. Provide Q100 in cfs too.

Basin OS1: Basin OS1 is 1.77 acres and consists entirely of existing drives, parking, and walks for an impervious value of 100.00%. The 5-year and 100-year C values were determined to be 0.90 and 0.96, respectively; and anticipated 5-year runoff flows of 6.28 CFS and 100-year runoff flows of 14.24 CFS. Flows from basin OS1in the proposed condition sheetflow onto the site along the northwest property line before channelizing within a concrete v-pan and are directed southwest to a proposed 5'Type R inlet in sump (Design Point 4). The proposed i point 4 which drains to a proposed underground detention system has been sized CFS in the 5-year and 100-year ow flows to be captured and convey ss total, 94% of flow in the major fo conditions by discharging into t nd existing storm infrastructure at the north corner of Main Street and Security Boul

Narrative has been updated to explain how flows bypass inlet and discharge to existing inlet at Security Boulevard and Main Street

Explain how flows are bypassed. To they just continue passed the inlet into Security Blvd?

Per discussions with the Reviewer, flows are allowed to mix without increasing treatment volumes. Narrative has been updated to reflect the discussion.

respectively or 0.9cfs for both storm events?

Correct, 0.9CFS for both 5 year and 100 year.

If flows from Basin OS1 and Basin P4 combine/mix in the crosspan, then flows from Basin OS1 can no longer be discharged offsite without treatment. Separate the flows or treat the flow from Basin OS1

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Verbiage has been updated to "requirement"

"requirement"

no improvements proposed for the offsite basin and therefore no required to detain and treat onsite.

Narrative updated to clarify void space

Refer to the Appendix for excerpts of the Master Drainage S ainage Plan and Proposed Drainage Plan.

Detention Storage System

Clarify whether or not this includes the stone void space.

Detention

To meet stormwater detention requirements, an ADS Stormtech MC-3500 chamber system will be utilized, as well as an isolation row for water quality regulations. The proposed detention facility and water quality pond (herein referred to as Pond 1) has been designed for full spectrum detention and water quality for 1.29 acres with 83.02% imperviousness. As a result the required 100-yr detention volume is 8,408 cu-ft (0.193 ac-ft). The proposed ADS full spectrum detention pond & water quality pond has been sized as 11,486 cu-ft (0.264 ac-ft), providing sufficient storage for the proposed site and existing off-site flows. As described in the basin descriptions above, the full 1.29 acre site will not flow to the detention basin, however this report is over detaining and taking a conservative approach.

some, not all existing off-site flows

Please use latest version v.06

Was ADS's sizing software also utilized? If so, please include printouts of it.

Narrative updated to clarify some, not all of existing off-site flow is collected in underground detention system

Yes, narrative updated to include ADS sizing software information.

Pond 1 utilizes an ADS Stormtech MC-3500 chamber system that has
total volume of 2,961 cu-ft; exceeding the 1,61
tion volume is 0.193 acre-feet. The underground
footprint of 35’ x 82’ x 4’ for a total volume of 0.264 acre-feet. A 1’
cluded in the underground detention pond. The sizing of the underground
l using the MHFD-Detention, version 4-05. The conservative watershed
area is 1.29 acres and consists of a composi 2%. Runoff enters the
system via flow captured within two on-site n connections from the
building and canopy. Runoff above the design year storm event will overtop the proposed outlet structure and continue south and west, consistent with runoff in the existing condition. All detention & water quality calculations have been provided within the Appendix.

Version updated V.06

For water quality sizing calculations, DCM Volume 1, Section 6.6, as well as the Underground BMP Fact Sheet within the USDCM Volume 3 were utilized. An ADS Stormtech MC-3500 chamber system with an isolation row for water quality is proposed for the water quality control on site. The ADS Underground system will treat the entirety of the site within the isolation rows, resulting in the need for 1,612 cu-ft (or 0.037 ac-ft) of WQCV. The proposed full spectrum detention pond will be underground so there will be no emergency spillway proposed. If stormwater were to overtop the proposed full spectrum detention pond, flows would backup through the underground detention system and storm sewer and discharge through the 5’ Type R Inlet at design point 3 and ultimately to the south within curb and gutter on Main Street. All water quality calculations have been provided within the Appendix.

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6" outlet pipe sizing has now been included

Narrative revised to include maintenance process

Unresolved comment from Review #1: Provide sizing calcs that show that 6" is adequate.

Update: unless I'm missing something, I don't see these calcs.

What training do they / will they have?

All proposed stormwater infrastructure on-site will be private and owned and maintained by the owner of the Lot. A maintenance guide has been provided within the Appendix of this report for required schedule for maintenance of the ADS Underground System.

The underground detention system will discharge into a proposed pump system that ultimately discharges to Security Boulevard, following historic conditions. The pump is a Zoeller Sewage Ejector Submersible Pump with a 6" pressurized discharge pipe. Two pumps are utilized to achieve redundancy within the system. There will be a water surface float detector that will discharge flows out of the detention basin below allowable rates. The pump will be controlled through an integral pump to discharge flows from the detention pond at 1.43 cfs for all storms. The drain times of each storm event will be controlled by a restrictor plate and orifices for the 5-year and the 100-year. Refer to the pump details in the appendix. In order to achieve redundancy within the outlet structure, a Duplex Electrical Alternating System will be utilized, refer to the appendix for details. The system will pump the detained stormwater and discharge to final grade near the proposed access on Security Boulevard below historic rates. This will improve the existing conditions, where all flow is undetained. A gravity system was deemed unfeasible as the depth of the existing storm sewer at the corner of Main Street and Security Boulevard is too shallow to allow positive drainage from the underground system. Grading and site constraints prevent the site from being raised high enough to allow a gravity system to discharge to the existing storm infrastructure. The ADA access routes, location and connection to ex[illegible] and location of the proposed accesses limit the maximum allowable slopes and elev[illegible] pr[illegible]

Revised to 1.29 acres

Verbiage has been updated to describe alternating system

Can you discuss this a little bit here to describe exactly what is does an how it adds redundancy to the system

revise to 1.29ac

Ou[illegible]

Per the DCM, Chapter 6, Section 4.2 – Allowable Release Rates, the allowable release rates may be based on the Predevelopment peak flow for the minor and major storm, as calculated in the MHFD-Detention_v4-05 spreadsheet. The site has been analyzed to detain the entire site (1.28 ac). A portion of the existing off-site basin to the north will also be routed through the underground detention system Based on spreadsheet, the allowable release rate for the 5-year and 100-year is 0.20 cfs and 2.13 cfs, respectively. The proposed discharge from the full spectrum detention facility has been calculated to be 0.10 cfs and 1.43 cfs for the 5-year and the 100-year storms, respectively, falling below the allo[illegible]dditionally, The WQCV will discharge at a rate of 0.02 cfs and drain 99[illegible]ume (0.037ac-ft) within 40 hours.

Updated to v.06

Please use latest version v.06

Storm Sewer Improvement Cost Estimate

Refer to the table for a breakdown of costs associated with the proposed storm sewer improvements.

Outlet pipe location has been revised to discharge into existing storm inlet at NW corner of Security Boulevard and Main Street

Unresolved. Please discuss the constructability of tying into the existing storm inlet at the intersection of Main and Security. Why is that not being considered? If utilities are in the way please provide proof of locates. The pump will be considered if there is really no other option available. Per ECM 3.2.4 a suitable outfall is required for the ultimate discharge of runoff.

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Item	QUANTITY	UNIT	AVERAGE PRICE	COST
4’ Manhole	6	EA	$4,000.00	$24,000
5’ Type R Inlet	2	EA	$4,000.00	$8,000
Cleanout	6	EA	$300.00	$1,800
6” PVC	250	LF	$24.00	$6,000
18” RCP	350	LF	$65.00	$22,750
1 Underground Detention and Water Quality Pond	1	EA	$130,000.00	$130,000
Stormwater Pump Station	1	EA	$25,000	$25,000
10% Contingency				$21,755
TOTAL				$239,305

Conclusions & Recommendations

The storm sewer and detention system as part of the Kum & Go development has been designed to the El Paso County and Mile High Flood District design standards, rules, and regulations. The underground detention system will treat developed flow from the site and discharge into the existing storm infrastructure below historic rates.

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REFERENCES

1. County of El Paso Drainage Criteria Manual, Volume 1, October 2018.

2. County of El Paso Drainage Criteria Manual Volume 2, October 2018.

3. USGS Soil Survey for El Paso County, Colorado, dated April 2022.

4. Little Johnson/Security Creek Drainage Basin Planning Study, prepared by Simons, Li & Associates, Inc., dated April, 1988.

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APPENDIX

- APPENDIX A
  - FEMA Firmette
  - NRCS Soil Survey
- APPENDIX B
  - Hydrology & Hydraulic Criteria
  - Hydrology Calculations
  - Hydraulic Calculations
- APPENDIX C
  - Little Johnson/Security Creek Drainage Basin Planning Study
- APPENDIX D
  - Underground Detention System Details
  - Pump Details
  - Existing Drainage Map
  - Developed Drainage Map

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APPENDIX A
FIRM, NRCS Soil Survey

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for El Paso County Area, Colorado

NRCS Soil Survey

March 22, 2022

Custom Soil Resource Report
Soil Map

Map Scale: 1:654 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 5 10 20 30

Feet
0 30 60 120 180

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 19, Aug 31, 2021

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

Date(s) aerial images were photographed: Aug 14, 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
10	Blendon sandy loam, 0 to 3 percent slopes	0.9	100.0%
Totals for Area of Interest		**0.9**	**100.0%**

Map Unit Descriptions

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

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

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

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

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

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

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

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

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

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

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

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

El Paso County Area, Colorado

10—Blendon sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 3671
Elevation: 6,000 to 6,800 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Blendon and similar soils: 98 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Blendon

Setting

Landform: Terraces, alluvial fans
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium derived from arkose

Typical profile

A - 0 to 10 inches: sandy loam
Bw - 10 to 36 inches: sandy loam
C - 36 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 2 percent
Available water supply, 0 to 60 inches: Moderate (about 6.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: 1 percent
Hydric soil rating: No

Pleasant

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

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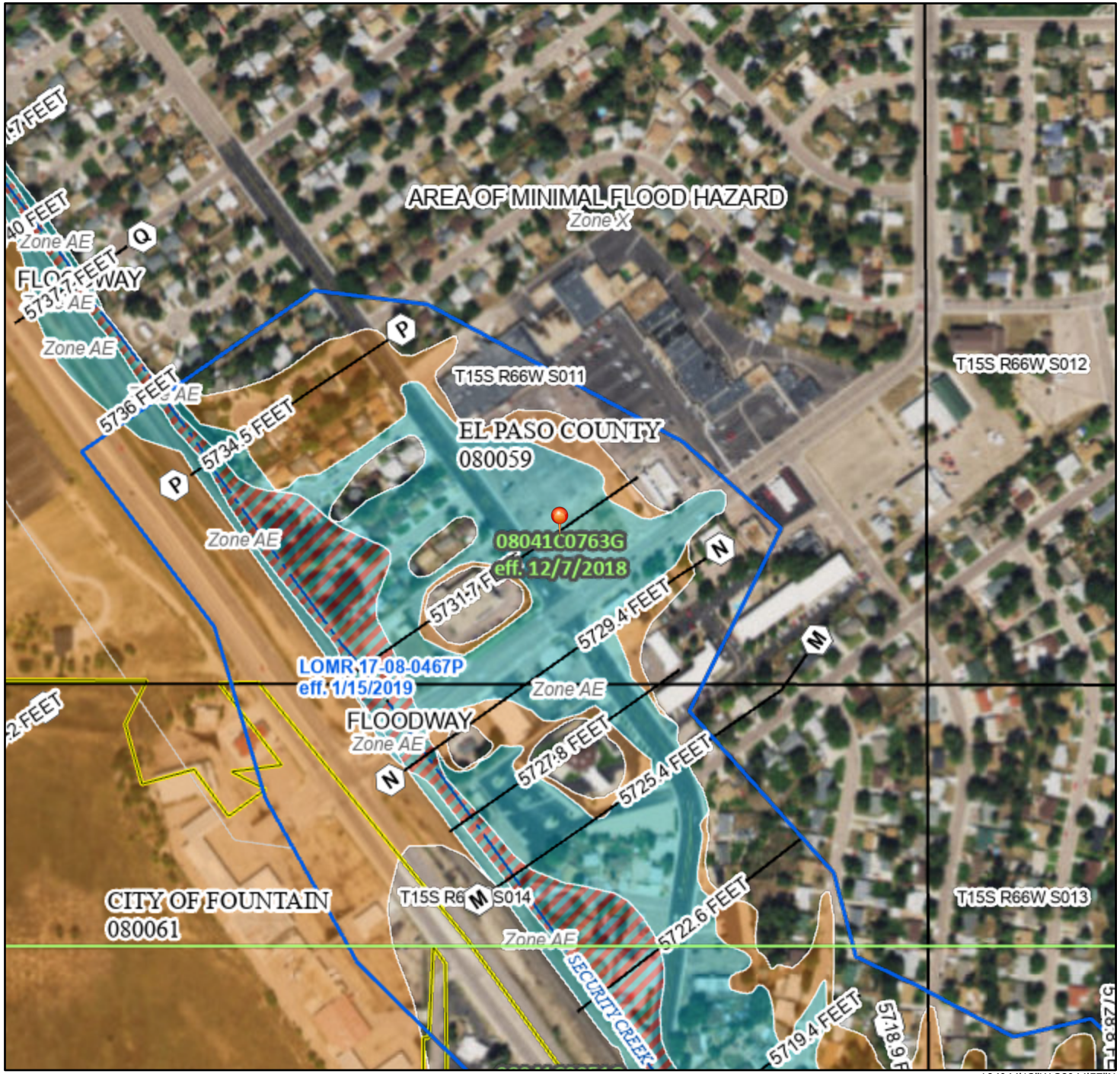
National Flood Hazard Layer FIRMette

FEMA

104°44'50"W 38°45'25"N



104°44'13"W 38°44'57"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

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

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

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

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

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

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

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 3/22/2022 at 12:29 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

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APPENDIX B
Hydrology & Hydraulic Criteria
Hydrology Calculations
Hydraulic Calculations

NOAA Atlas 14, Volume 8, Version 2
Location name: Colorado Springs, Colorado, USA*
Latitude: 38.7525°, Longitude: -104.7421°
Elevation: 5728.81 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.248 (0.203-0.306)	0.297 (0.244-0.367)	0.385 (0.315-0.477)	0.464 (0.377-0.578)	0.583 (0.459-0.764)	0.681 (0.521-0.905)	0.786 (0.578-1.07)	0.900 (0.631-1.27)	1.06 (0.711-1.54)	1.19 (0.772-1.74)
10-min	0.363 (0.298-0.447)	0.435 (0.357-0.538)	0.564 (0.461-0.698)	0.680 (0.552-0.846)	0.853 (0.672-1.12)	0.997 (0.763-1.33)	1.15 (0.847-1.57)	1.32 (0.924-1.85)	1.55 (1.04-2.25)	1.74 (1.13-2.55)
15-min	0.442 (0.363-0.546)	0.531 (0.435-0.656)	0.688 (0.562-0.852)	0.829 (0.673-1.03)	1.04 (0.820-1.36)	1.22 (0.931-1.62)	1.40 (1.03-1.92)	1.61 (1.13-2.26)	1.89 (1.27-2.74)	2.12 (1.38-3.11)
30-min	0.652 (0.535-0.804)	0.782 (0.641-0.965)	1.01 (0.827-1.25)	1.22 (0.991-1.52)	1.53 (1.21-2.01)	1.79 (1.37-2.38)	2.07 (1.52-2.83)	2.37 (1.66-3.34)	2.79 (1.88-4.05)	3.13 (2.04-4.59)
60-min	0.846 (0.695-1.04)	0.993 (0.815-1.23)	1.27 (1.04-1.57)	1.53 (1.25-1.91)	1.95 (1.54-2.58)	2.31 (1.77-3.08)	2.70 (1.99-3.71)	3.13 (2.21-4.43)	3.76 (2.53-5.48)	4.28 (2.78-6.27)
2-hr	1.04 (0.860-1.27)	1.21 (0.994-1.48)	1.53 (1.26-1.88)	1.85 (1.51-2.28)	2.36 (1.89-3.12)	2.82 (2.19-3.76)	3.33 (2.48-4.56)	3.90 (2.77-5.49)	4.73 (3.22-6.86)	5.42 (3.55-7.90)
3-hr	1.14 (0.944-1.39)	1.30 (1.07-1.59)	1.63 (1.34-2.00)	1.97 (1.62-2.43)	2.54 (2.06-3.38)	3.06 (2.39-4.09)	3.65 (2.74-5.00)	4.31 (3.09-6.08)	5.30 (3.63-7.69)	6.13 (4.04-8.90)
6-hr	1.30 (1.08-1.57)	1.46 (1.22-1.78)	1.82 (1.51-2.22)	2.21 (1.82-2.70)	2.87 (2.34-3.80)	3.47 (2.74-4.62)	4.16 (3.15-5.69)	4.96 (3.58-6.96)	6.14 (4.24-8.86)	7.14 (4.74-10.3)
12-hr	1.45 (1.22-1.75)	1.66 (1.39-2.00)	2.08 (1.74-2.52)	2.52 (2.09-3.06)	3.24 (2.66-4.25)	3.90 (3.09-5.14)	4.64 (3.54-6.28)	5.49 (3.99-7.63)	6.73 (4.69-9.63)	7.78 (5.21-11.1)
24-hr	1.63 (1.38-1.95)	1.89 (1.60-2.27)	2.40 (2.02-2.89)	2.89 (2.42-3.50)	3.68 (3.02-4.74)	4.37 (3.47-5.68)	5.13 (3.92-6.85)	5.98 (4.37-8.22)	7.21 (5.05-10.2)	8.23 (5.57-11.7)
2-day	1.85 (1.58-2.20)	2.18 (1.85-2.59)	2.77 (2.35-3.31)	3.33 (2.80-3.99)	4.18 (3.44-5.31)	4.91 (3.92-6.31)	5.70 (4.38-7.53)	6.56 (4.83-8.93)	7.80 (5.50-10.9)	8.81 (6.01-12.5)
3-day	2.02 (1.73-2.40)	2.38 (2.03-2.82)	3.03 (2.57-3.60)	3.62 (3.06-4.33)	4.53 (3.74-5.72)	5.30 (4.25-6.78)	6.13 (4.73-8.05)	7.03 (5.19-9.52)	8.32 (5.90-11.6)	9.37 (6.43-13.2)
4-day	2.17 (1.86-2.57)	2.55 (2.18-3.01)	3.22 (2.75-3.82)	3.84 (3.26-4.58)	4.79 (3.96-6.03)	5.59 (4.49-7.12)	6.45 (4.99-8.44)	7.38 (5.47-9.96)	8.72 (6.20-12.1)	9.80 (6.75-13.8)
7-day	2.56 (2.20-3.01)	2.95 (2.54-3.47)	3.67 (3.14-4.33)	4.32 (3.68-5.12)	5.32 (4.42-6.65)	6.16 (4.98-7.80)	7.07 (5.51-9.20)	8.05 (6.01-10.8)	9.46 (6.77-13.1)	10.6 (7.35-14.8)
10-day	2.89 (2.50-3.38)	3.31 (2.86-3.88)	4.06 (3.49-4.78)	4.75 (4.06-5.61)	5.79 (4.82-7.19)	6.66 (5.40-8.39)	7.59 (5.94-9.84)	8.61 (6.45-11.5)	10.0 (7.22-13.8)	11.2 (7.81-15.6)
20-day	3.78 (3.29-4.40)	4.33 (3.76-5.04)	5.28 (4.57-6.16)	6.10 (5.25-7.16)	7.29 (6.09-8.93)	8.26 (6.72-10.3)	9.26 (7.28-11.8)	10.3 (7.77-13.6)	11.8 (8.53-16.1)	12.9 (9.10-17.9)
30-day	4.52 (3.94-5.23)	5.20 (4.53-6.02)	6.32 (5.49-7.35)	7.27 (6.28-8.50)	8.60 (7.18-10.4)	9.64 (7.87-11.9)	10.7 (8.43-13.6)	11.8 (8.90-15.4)	13.3 (9.63-17.9)	14.4 (10.2-19.8)
45-day	5.47 (4.79-6.31)	6.30 (5.52-7.28)	7.65 (6.67-8.86)	8.76 (7.60-10.2)	10.3 (8.58-12.3)	11.4 (9.32-13.9)	12.5 (9.89-15.8)	13.6 (10.3-17.7)	15.1 (11.0-20.3)	16.2 (11.5-22.2)
60-day	6.29 (5.52-7.23)	7.25 (6.37-8.35)	8.79 (7.69-10.2)	10.0 (8.72-11.6)	11.7 (9.76-13.9)	12.9 (10.6-15.7)	14.1 (11.1-17.6)	15.2 (11.5-19.7)	16.7 (12.2-22.3)	17.7 (12.7-24.2)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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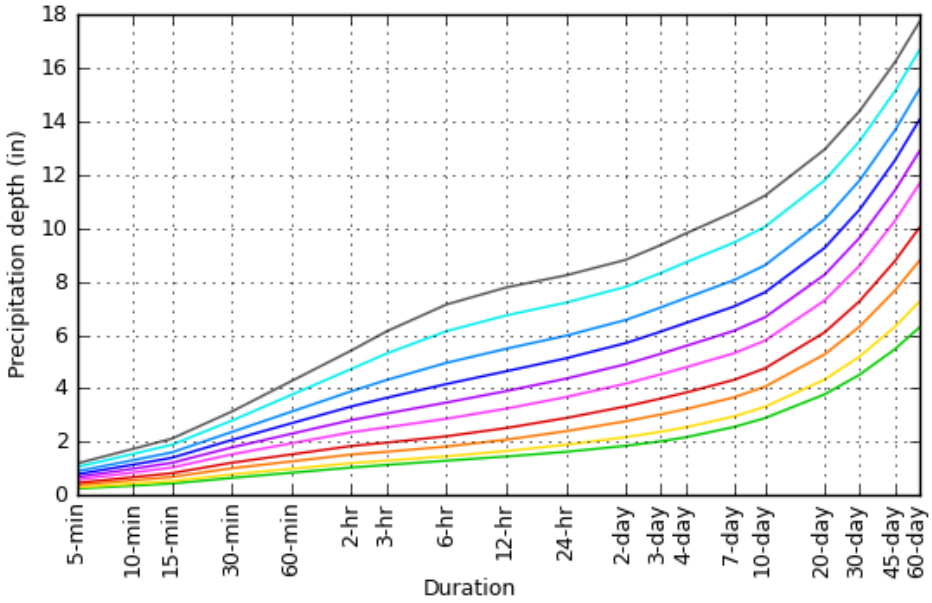
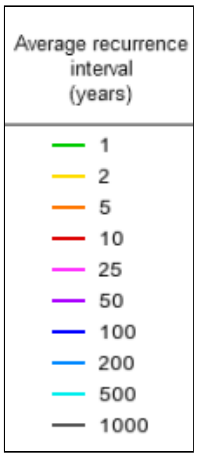
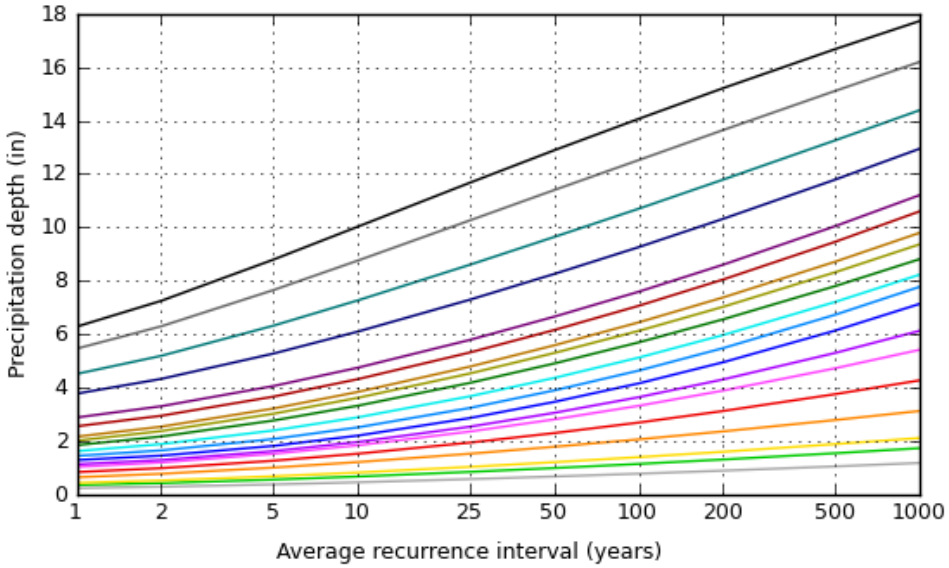
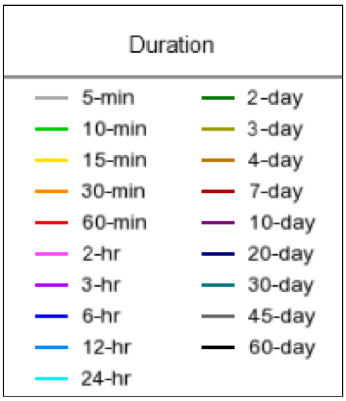
PF graphical

PDS-based depth-duration-frequency (DDF) curves
Latitude: 38.7525°, Longitude: -104.7421°









NOAA Atlas 14, Volume 8, Version 2

Created (GMT): Tue Mar 22 16:20:25 2022

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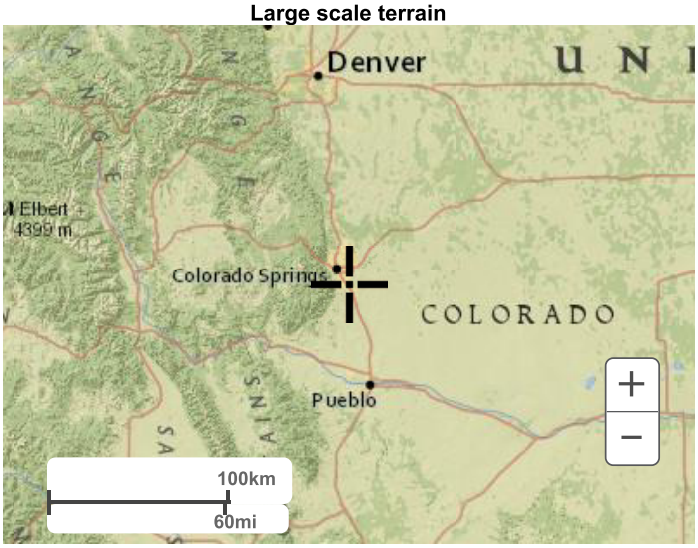
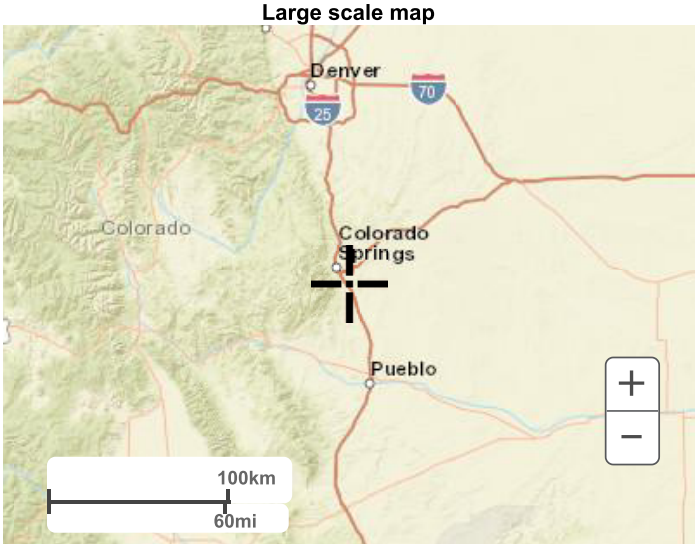
Maps & aerials

Small scale terrain

Large scale terrain



Large scale map



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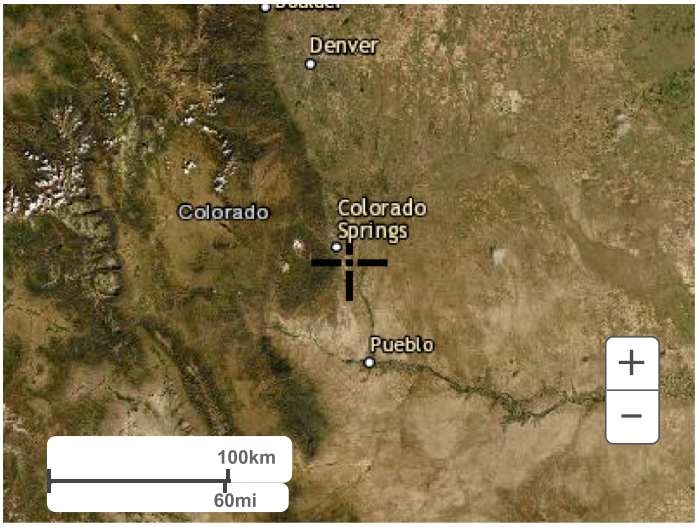

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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
⅛ Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
¼ Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
⅓ Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
½ Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
Undeveloped Areas													
Historic Flow Analysis—Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

Runoff Coefficients

Corridor / Design Package: Kum & Go - El Paso, Colorado
System Name: Existing Condition

Computed: DSI Date: 8/12/2022
Checked: Date:

Sub-Basin Data			Composite C			Sub Area (Drives & Walks)				Sub Area (Roof)				Sub Area(Gravel)			
Basin ID	Description	Total Area (ac)	C_5	C_{100}	i	C_5	C_{100}	i	Area (ac)	C_5	C_{100}	i	Area (ac)	C_5	C_{100}	i	Area (ac)
E1	C-STORE AND PARKING	1.29	0.84	0.91	79.07	0.90	0.96	100	1.02	0.73	0.81	90	0.00	0.59	0.70	0	0.27
OS1	OFF-SITE DRIVES & WALKS	1.77	0.90	0.96	100.00	0.90	0.96	100	1.77	0.73	0.81	90	0.00	0.59	0.70	0	0.00

Standard Form SF-1 . Time of Concentration

Corridor / Design Package: Kum & Go - El Paso, Colorado
System Name: Existing Condition

Computed: DSI Date: 8/12/2022
Checked: Date:

SUB-BASIN DATA				INITIAL/OVERLAND FLOW (t_i)			TRAVEL TIME (t_t)							Total	Tc CHECK (Urbanized basins)				FINAL Tc (min)
Basin ID	Description	C_5	Area (ac)	Length (ft)	Slope (ft/ft)	t_i (min)	Length (ft)	Slope (ft/ft)	Code	Description	Convey Coef (C_v)	V	t_t (min)	$t_c = t_i + t_t$ (min)	(Yes /No)	Length (ft)	$T_{c\,max}$ (min)	$Tc_{max} > t_c$	
E1	C-STORE AND PARKING	0.84	1.29	100	0.015	4.2	250.0	0.015	6	Paved areas and shallow paved swales	20.00	2.45	1.70	5.88	Yes	350	11.94	Regional Tc	5.88
OS1	OFF-SITE DRIVES & WALKS	0.90	1.77	100	0.015	3.2	535.0	0.015	6	Paved areas and shallow paved swales	20.00	2.45	3.64	6.80	Yes	635	13.53	Regional Tc	6.80

Notes:
t_i= (0.395*(1.1-C_5)*(L^0.5))/(S^0.33), from UDFCD Eqn 6-3
Velocity from V = C_v*S_w^0.5, from UDFCD Eqn 6-4, C_v from Table 6-2(See Sheet Design Info)
t_t=L/60V
t_i max = 10+L/180
Final Tc > 10 min for nonurban watersheds

UDFCD Table 6-2. NRCS Conveyance factors, K

Code	Type of Land Surface	Conveyance Factor, K
1	Heavy meadow	2.5
2	Tillage/field	5
3	Short pasture and lawns	7
4	Nearly bare ground	10
5	Grassed waterway	15
6	Paved areas and shallow paved swales	20

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

Corridor / Design Package: Kum & Go - El Paso, Colorado
System Name: Existing Condition

Computed: DSI Date: 8/12/2022
Checked: Date:

Design Storm: Proposed 5-yr P = 1.27 in

LOCATION		DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
			AREA DESIGN	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C.A. (AC)	IIN / HR	Q (CFS)	t_c (MIN)	SUM (C*A)(AC)	I(IN / HR)	Q(CFS)	SLOPE(%)	STREETFLOW	DESIGNFLOW	SLOPE(%)	PIPE SIZE(in)	LENGTH(FT)	VELOCITY(FPS)	t_t (MIN	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
E1	C-STORE AND PARKING	1	E1	1.29	0.84	5.88	1.08	4.12	4.44					--	--	--	--	--	--	--		
OS1	OFF-SITE DRIVES & WALKS	6	OS1	1.77	0.90	6.80	1.59	3.94	6.28					--	--	--	--	--	--	--		

Design Storm: Proposed 100-yr P = 2.70 in

LOCATION		DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
			AREA DESIGN	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C.A. (AC)	IIN / HR	Q (CFS)	t_c (MIN)	SUM (C*A)(AC)	I(IN / HR)	Q(CFS)	SLOPE(%)	STREETFLOW	DESIGNFLOW	SLOPE(%)	PIPE SIZE(in)	LENGTH(FT)	VELOCITY(FPS)	t_t (MIN	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
E1	C-STORE AND PARKING	1	E1	1.29	0.91	5.88	1.17	8.75	10.23					--	--	--	--	--	--	--		
OS1	OFF-SITE DRIVES & WALKS	6	OS1	1.77	0.96	6.80	1.70	8.38	14.24					--	--	--	--	--	--	--		

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

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

Corridor / Design Package: Kum & Go - El Paso, Colorado
System Name: Developed Condition

Computed: DSI Date: 8/12/2022
Checked: Date:

Design Storm: Proposed 5-yr P = 1.27 in

	LOCATION	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
			AREA DESIGN	AREA (AC)	RUNOFF COEFF	(MIN) t_c	C.A. (AC)	IIN / HR	Q (CFS)	(MIN) t_c	SUM (C*A)(AC)	I(IN / HR)	Q(CFS)	SLOPE(%)	STREETFLOW	DESIGNFLOW	SLOPE(%)	PIPE SIZE(in)	LENGTH(FT)	VELOCITY(FPS)	(MIN t_t	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
P1	C-STORE	1	P1	0.09	0.73	5.00	0.07	4.31	0.28					--	--	--	--	--	--	--		
P2	CANOPY	2	P2	0.10	0.73	5.00	0.07	4.31	0.31					--	--	--	--	--	--	--		
P3	DRIVES & WALKS	3	P3	0.31	0.79	5.00	0.25	4.31	1.06					--	--	--	--	--	--	--		
P4	DRIVES & WALKS	4	P4	0.64	0.82	5.29	0.53	4.24	2.24					--	--	--	--	--	--	--		
P5	LANDSCAPING	5	P5	0.15	0.35	5.00	0.05	4.31	0.23					--	--	--	--	--	--	--		
OS1	OFF-SITE DRIVES & WALKS	6	OS1	1.77	0.90	6.80	1.59	3.94	6.28					--	--	--	--	--	--	--		

Design Storm: Proposed 100-yr P = 2.70 in

	LOCATION	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
			AREA DESIGN	AREA (AC)	RUNOFF COEFF	(MIN) t_c	C.A. (AC)	IIN / HR	Q (CFS)	(MIN) t_c	SUM (C*A)(AC)	I(IN / HR)	Q(CFS)	SLOPE(%)	STREETFLOW	DESIGNFLOW	SLOPE(%)	PIPE SIZE(in)	LENGTH(FT)	VELOCITY(FPS)	(MIN t_t	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
P1	C-STORE	1	P1	0.09	0.81	5.00	0.07	9.16	0.67					--	--	--	--	--	--	--		
P2	CANOPY	2	P2	0.10	0.81	5.00	0.08	9.16	0.74					--	--	--	--	--	--	--		
P3	DRIVES & WALKS	3	P3	0.31	0.88	5.00	0.27	9.16	2.50					--	--	--	--	--	--	--		
P4	DRIVES & WALKS	4	P4	0.64	0.90	5.29	0.58	9.02	5.21					--	--	--	--	--	--	--		
P5	LANDSCAPING	5	P5	0.15	0.55	5.00	0.08	9.16	0.76					--	--	--	--	--	--	--		
OS1	OFF-SITE DRIVES & WALKS	6	OS1	1.77	0.96	6.80	1.70	8.38	14.24					--	--	--	--	--	--	--		

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

MILE HIGH FLOOD DISTRICT

DETENTION BASIN DESIGN WORKBOOK

MHFD-Detention, Version 4.05 (January 2022)
Mile High Flood District
Denver, Colorado
www.mhfd.org

Purpose:

This workbook aids in the estimation of stormwater detention basin sizing and outlet routing based on the modified puls routing method for urban watersheds. Several different BMP types and various outlet configurations can be sized.

Function:

1. Approximates the stage-area-volume relationship for a detention basin based on watershed parameters and basin geometry parameters. Also evaluates existing user-defined basin stage-area relationships.

2. Sizes filtration media orifice, outlet orifices, elliptical slots, weirs, trash racks, and develops stage-discharge relationships. Uses the Modified Puls method to route a series of hydrographs (i.e., 2-, 5-, 10-, 25-, 50-, 100- and 500-year) and calibrates the peak discharge out of the basin to match the pre-development peak discharges for the watershed.

Content: **This workbook consists of the following sheets:**

Basin	Tabulates stage-area-volume relationship estimates based on watershed parameters
Outlet Structure	Tabulates a stage-discharge relationship for the user-defined outlet structure (inlet control).
Reference	Provides reference equations and figures.
User Tips and Tools	Provides instructions and video links to assist in using this workbook. Includes a stage-area calculator.
BMP Zone Images	Provides images of typical BMP zone confirgurations corresponding with Zone pulldown selections.

Acknowledgements: ***Spreadsheet Development Team:***
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Mile High Flood District

Derek N. Rapp, P.E.
Peak Stormwater Engineering, LLC

Dr. James C.Y. Guo, Ph.D., P.E.
Professor, Department of Civil Engineering, University of Colorado at Denver

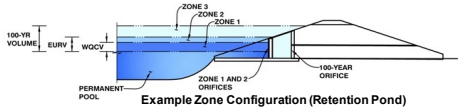
Comments? Direct all comments regarding this spreadsheet workbook to: **MHFD E-Mail**
Revisions? Check for revised versions of this or any other workbook at: **Downloads**

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.05 (January 2022)

Project: _____

Basin ID: _____



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	1.29	acres
Watershed Length =	275	ft
Watershed Length to Centroid =	150	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	83.02%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
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) =	0.037	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.119	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.99 in.) =	0.079	acre-feet	0.99	inches
5-yr Runoff Volume (P1 = 1.27 in.) =	0.106	acre-feet	1.27	inches
10-yr Runoff Volume (P1 = 1.53 in.) =	0.132	acre-feet	1.53	inches
25-yr Runoff Volume (P1 = 1.95 in.) =	0.178	acre-feet	1.95	inches
50-yr Runoff Volume (P1 = 2.31 in.) =	0.216	acre-feet	2.31	inches
100-yr Runoff Volume (P1 = 2.7 in.) =	0.258	acre-feet	2.70	inches
500-yr Runoff Volume (P1 = 3.76 in.) =	0.371	acre-feet	3.76	inches
Approximate 2-yr Detention Volume =	0.079	acre-feet		
Approximate 5-yr Detention Volume =	0.105	acre-feet		
Approximate 10-yr Detention Volume =	0.135	acre-feet		
Approximate 25-yr Detention Volume =	0.161	acre-feet		
Approximate 50-yr Detention Volume =	0.176	acre-feet		
Approximate 100-yr Detention Volume =	0.193	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.037	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.082	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.073	acre-feet
Total Detention Basin Volume =	0.193	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	

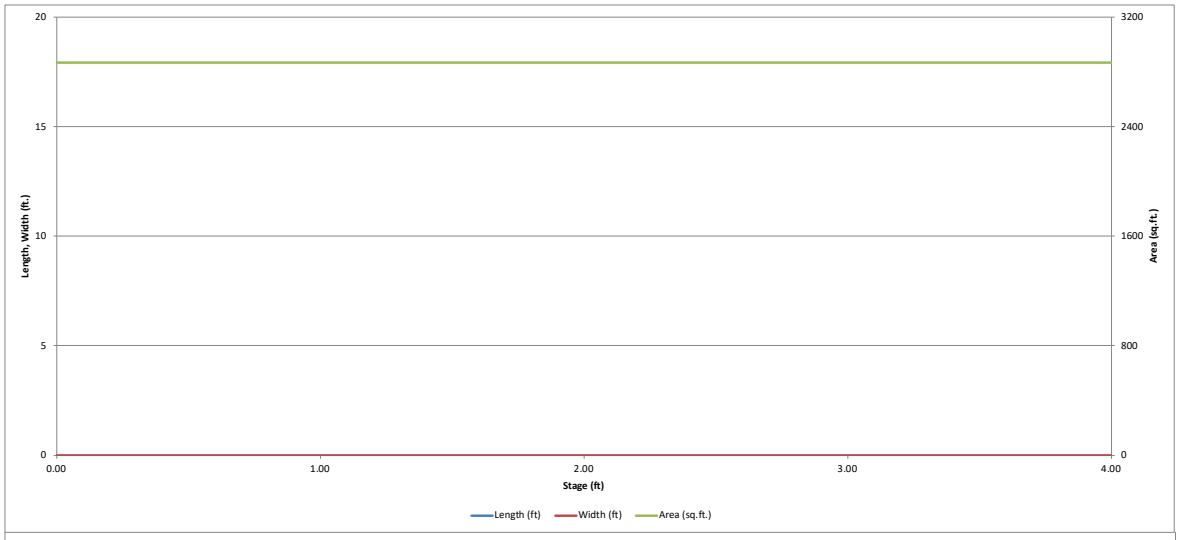
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	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

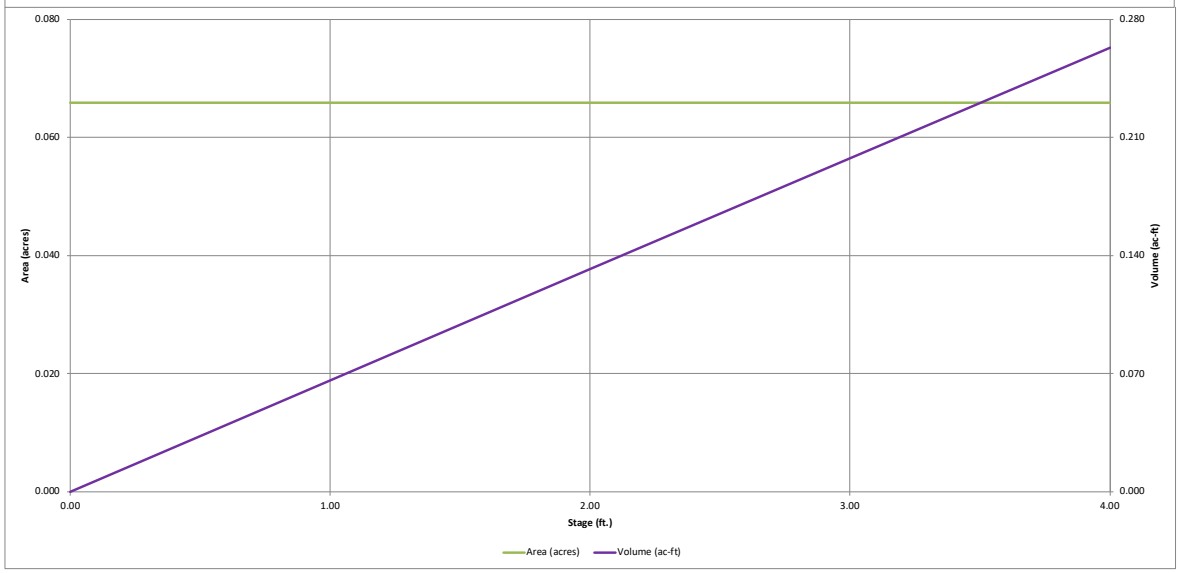
Depth Increment = 1.00 ft

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)
Top of Micropool	--	0.00	--	--	--	2,870	0.066		
	--	1.00	--	--	--	2,870	0.066	2,870	0.066
	--	2.00	--	--	--	2,870	0.066	5,740	0.132
	--	3.00	--	--	--	2,870	0.066	8,610	0.198
	--	4.00	--	--	--	2,870	0.066	11,480	0.264

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.05 (January 2022)



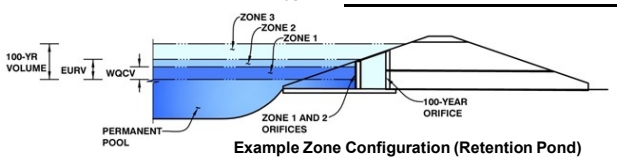


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.05 (January 2022)

Project:

Basin ID:



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.57	0.037	Orifice Plate
Zone 2 (EURV)	1.81	0.082	Orifice Plate
Zone 3 (100-year)	2.93	0.073	Rectangular Orifice
Total (all zones)		0.193	

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

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

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	5.139E-03	ft^2
Depth at top of Zone using Orifice Plate =	1.87	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	7.50	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	0.74	sq. inches (diameter = 15/16 inch)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.62	1.25					
Orifice Area (sq. inches)	0.74	0.74	0.74					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 3 Rectangular	Not Selected				
Invert of Vertical Orifice =	1.81	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.03	N/A
Depth at top of Zone using Vertical Orifice =	2.93	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.08	N/A
Vertical Orifice Height =	2.00	N/A	inches			
Vertical Orifice Width =	2.00		inches			

Calculated Parameters for Vertical Orif

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

	Not Selected	Not Selected				
Overflow Weir Front Edge Height, Ho =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	N/A	N/A
Overflow Weir Front Edge Length =	N/A	N/A	feet	Overflow Weir Slope Length =	N/A	N/A
Overflow Weir Grate Slope =	N/A	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	N/A	N/A
Horiz. Length of Weir Sides =	N/A	N/A	feet	Overflow Grate Open Area w/o Debris =	N/A	N/A
Overflow Grate Type =	N/A	N/A		Overflow Grate Open Area w/ Debris =	N/A	N/A
Debris Clogging % =	N/A	N/A	%			

Calculated Parameters for Overflow W

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

	Not Selected	Not Selected				
Depth to Invert of Outlet Pipe =	N/A	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	N/A	N/A
Circular Orifice Diameter =	N/A	N/A	inches	Outlet Orifice Centroid =	N/A	N/A
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

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

Calculated Parameters for Spillway

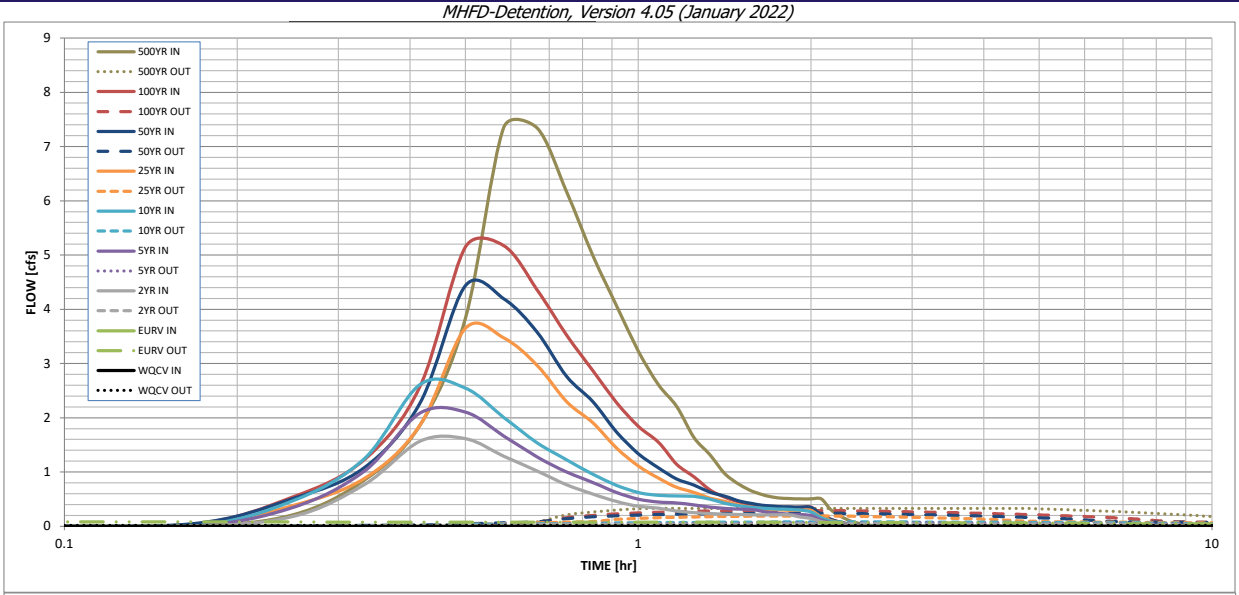
Routed Hydrograph Results

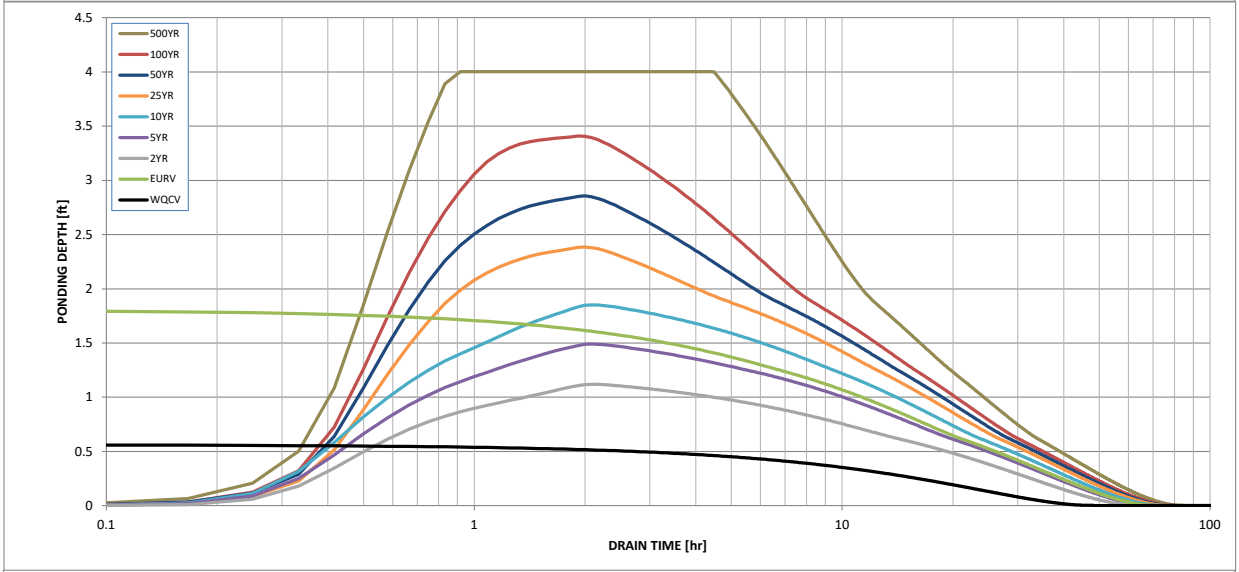
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AI

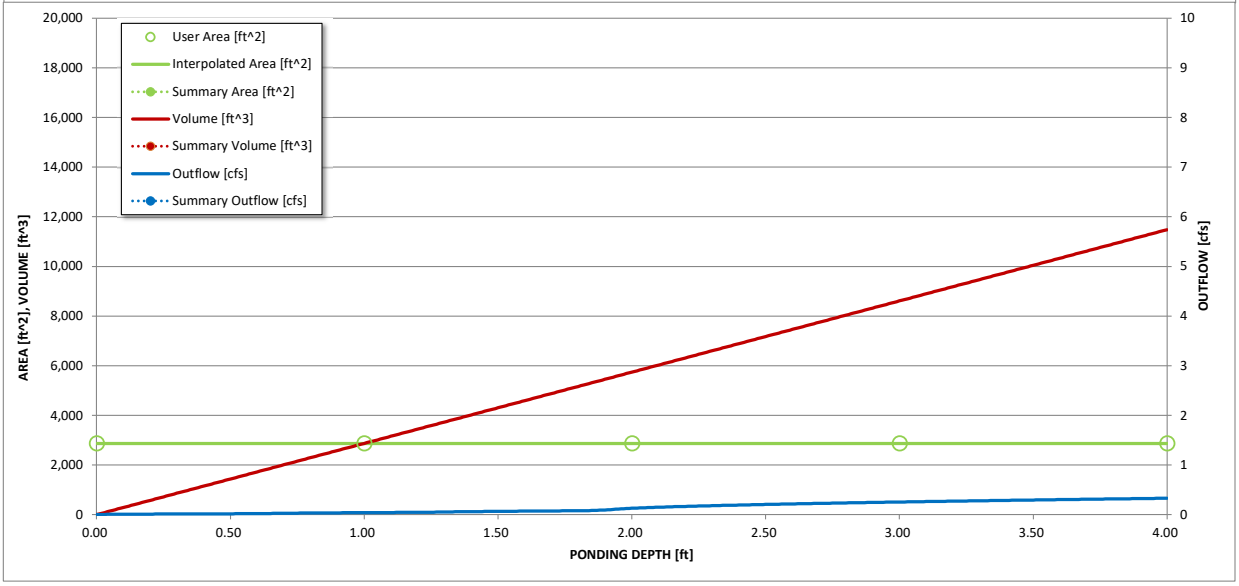
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.99	1.27	1.53	1.95	2.31	2.70
CUHP Runoff Volume (acre-ft) =	0.037	0.119	0.079	0.106	0.132	0.178	0.216	0.258
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.079	0.106	0.132	0.178	0.216	0.258
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.21	0.5	1.2	1.6	2.13
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.02	0.16	0.35	0.90	1.24	1.65
Peak Inflow Q (cfs) =	N/A	N/A	1.6	2.1	2.6	3.6	4.4	5.2
Peak Outflow Q (cfs) =	0.02	0.08	0.0	0.07	0.1	0.2	0.2	0.29
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.3	0.2	0.2	0.2	0.1
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	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	57	53	56	59	59	59	59
Time to Drain 99% of Inflow Volume (hours) =	**44**	63	58	62	65	67	68	68
Maximum Ponding Depth (ft) =	0.57	1.81	1.12	1.49	1.85	2.38	2.85	3.41
Area at Maximum Ponding Depth (acres) =	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Maximum Volume Stored (acre-ft) =	0.038	0.119	0.073	0.098	0.122	0.157	0.188	0.224

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.05 (January 2022)







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

MILE HIGH FLOOD DISTRICT

STREET AND INLET HYDRAULICS WORKBOOK

MHFD-Inlet, Version 5.01 (April 2021)
Mile High Flood District
Denver, Colorado
www.mhfd.org

Purpose: This workbook can be used to size a variety of inlets based on allowable spread and depth in a street or swale.

Function:

1. To calculate peak discharge for the tributary area to each inlet.
2. To calculate allowable half-street capacity based on allowable depth and spread.
3. To determine the inlet capacity for selected inlet types.
4. To manage inlet information and connect inlets in series to account for bypass flow.

Content: **The workbook consists of the following sheets:**

Q-Peak Calculates the peak discharge for the inlet tributary area based on the Rational Method for the minor and major storm events. Alternatively, the user can enter a known flow. Information from this sheet is then exported to the *Inlet Management* sheet.

Inlet Management Imports information from the *Q-Peak* sheet and *Inlet [#]* sheets and can be used to connect inlets in series so that bypass flow from an upstream inlet is added to flow calculated for the next downstream inlet. This sheet can also be used to modify design information from the Q-peak sheet.

Inlet [#] *Inlet [#]* sheets are created each time the user exports information from the *Q-Peak* sheet to the *Inlet Management* sheet. The *Inlet [#]* sheets calculate allowable half-street capacity based on allowable depth and allowable spread for the minor and major storm events. This is also where the user selects an inlet type and calculates the capacity of that inlet.

Inlet Pictures Contains a library of photographs of the various types of inlets contained in MHFD-Inlet and referenced in the USDCM.

Acknowledgements: **Spreadsheet Development Team:**
Ken A. MacKenzie, P.E., Holly Piza, P.E., Chris Carandang
Mile High Flood District

Derek N. Rapp, P.E.
Peak Stormwater Engineering, LLC

Dr. James C.Y. Guo, Ph.D., P.E.
Professor, Department of Civil Engineering, University of Colorado at Denver

Comments? Direct all comments regarding this spreadsheet workbook to: **MHFD E-mail**
Revisions? Check for revised versions of this or any other workbook at: **Downloads**

MHFD-Inlet, Version 5.01 (April 2021)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	P3	P4
Site Type (Urban or Rural)	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET
Hydraulic Condition	In Sump	In Sump
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	1.1	2.2
Major Q_{Known} (cfs)	2.5	5.2

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0

Watershed Characteristics

Subcatchment Area (acres)		
Percent Impervious		
NRCS Soil Type		

Watershed Profile

Overland Slope (ft/ft)		
Overland Length (ft)		
Channel Slope (ft/ft)		
Channel Length (ft)		

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)		
One-Hour Precipitation, P_1 (inches)		

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)		
One-Hour Precipitation, P_1 (inches)		

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**1.1**	**2.2**
Major Total Design Peak Flow, Q (cfs)	**2.5**	**5.2**
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A

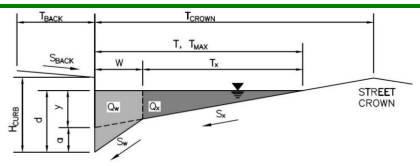
MHFD-Inlet, Version 5.01 (April 2021)

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

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

Project:

Inlet ID: **P3**



Gutter Geometry:

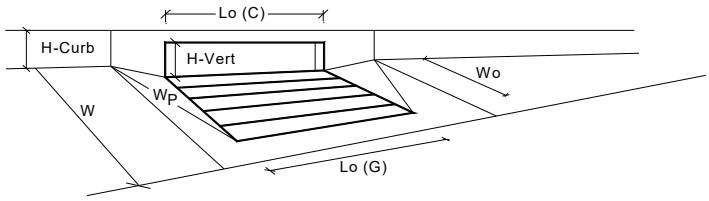
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	24.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.035	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.012	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	24.0	24.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	6.0	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.77	0.77	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	

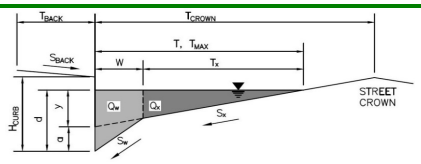
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.4**	**5.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.1	2.5	cfs

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

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

Project: **P4-2**

Inlet ID: **P4**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.040	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.006	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.012	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	10.0	10.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	2.0	2.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

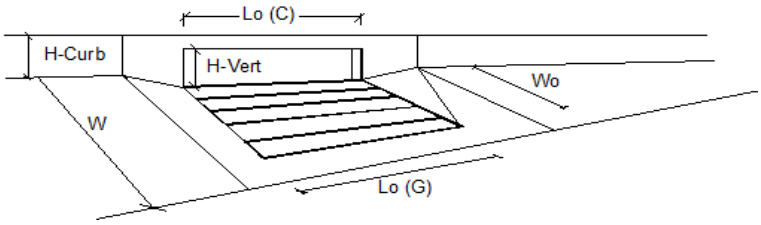
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**0.4**	**0.4**	**cfs**

WARNING: MINOR STORM max. allowable capacity is less than the design flow given on sheet 'Inlet Management'

WARNING: MAJOR STORM max. allowable capacity is less than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



CDOT/Denver 13 Valley Grate

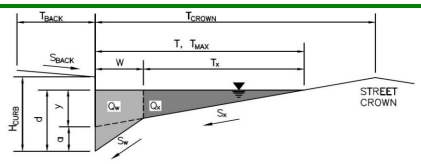
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT/Denver 13 Valley Grate		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	0.50	0.50	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	N/A	N/A	

Street Hydraulics: WARNING: Q > ALLOWABLE Q FOR MINOR & MAJOR STORM		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.7**	**3.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.6**	**2.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**75**	**61**	**%**

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

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

Project: P4-2
Inlet ID: P4-2



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.040	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.006	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.012	

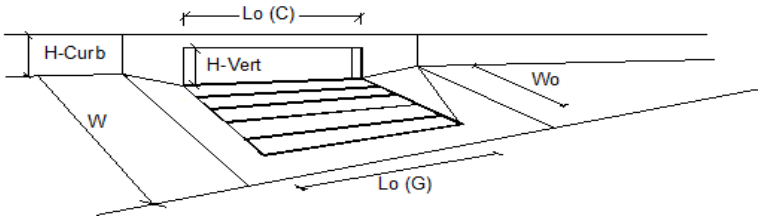
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	10.0	10.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	2.0	2.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**0.4**	**0.4**	**cfs**

WARNING: MINOR STORM max. allowable capacity is less than the design flow given on sheet 'Inlet Management'
WARNING: MAJOR STORM max. allowable capacity is less than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



CDOT/Denver 13 Valley Grate

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT/Denver 13 Valley Grate		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	0.50	0.50	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	N/A	N/A	

Street Hydraulics: WARNING: Q > ALLOWABLE Q FOR MINOR & MAJOR STORM		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.5**	**1.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.1**	**0.8**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**83**	**61**	**%**

See comments on SDI form that was submitted separately on EDARP.

SDI form updated to match this sheet

Stormwater Detention and Infiltration Design Data Sheet

SDI-Design Data v2.00, Released January 2020

Stormwater Facility Name: **Kum & Go - El Paso**

Facility Location & Jurisdiction: **Security Boulevard & Main Street, El Paso, Colorado**

User Input: Watershed Characteristics

Extended Detention Basin (EDB)	EDB	
Watershed Area =	1.29	acres
Watershed Length =	275	ft
Watershed Length to Centroid =	150	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	83.0%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths (use dropdown):		
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.

Once CUHP has been run and the Stage-Area-Discharge information has been provided, click 'Process Data' to interpolate the Stage-Area-Volume-Discharge data and generate summary results in the table below. Once this is complete, click 'Print to PDF'.

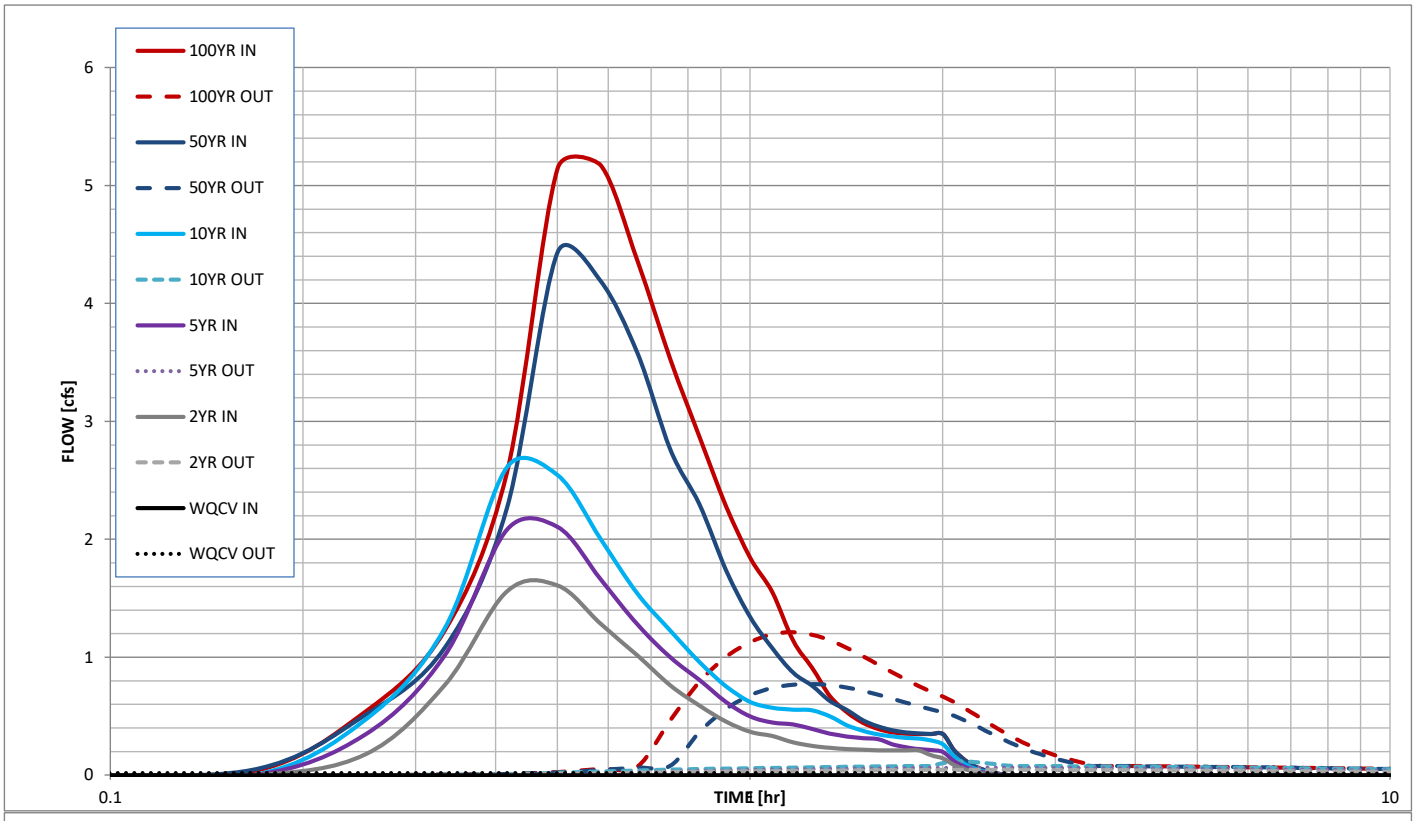
User Defined Stage [ft]	User Defined Area [ft^2]	User Defined Stage [ft]	User Defined Discharge [cfs]
0.00	2,870	0.00	0.00
1.00	2,870	0.57	0.02
2.00	2,870	1.81	0.08
3.00	2,870	2.93	1.43
4.00	2,870	4.00	1.44

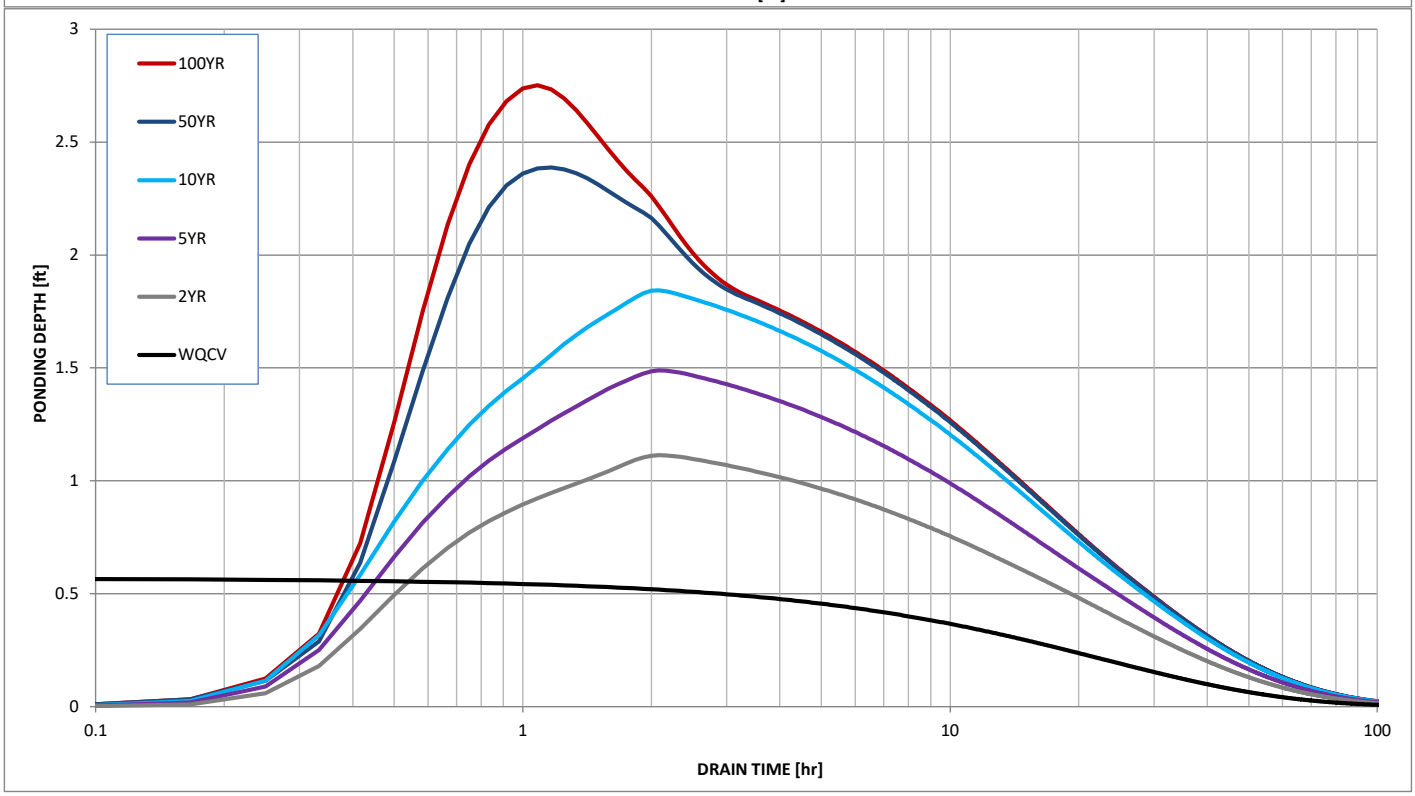
After completing and printing this worksheet to a pdf, go to:
https://maperture.digitaldataservices.com/gvh/?viewer=cswdif
Create a new stormwater facility, and attach the PDF of this worksheet to that record.

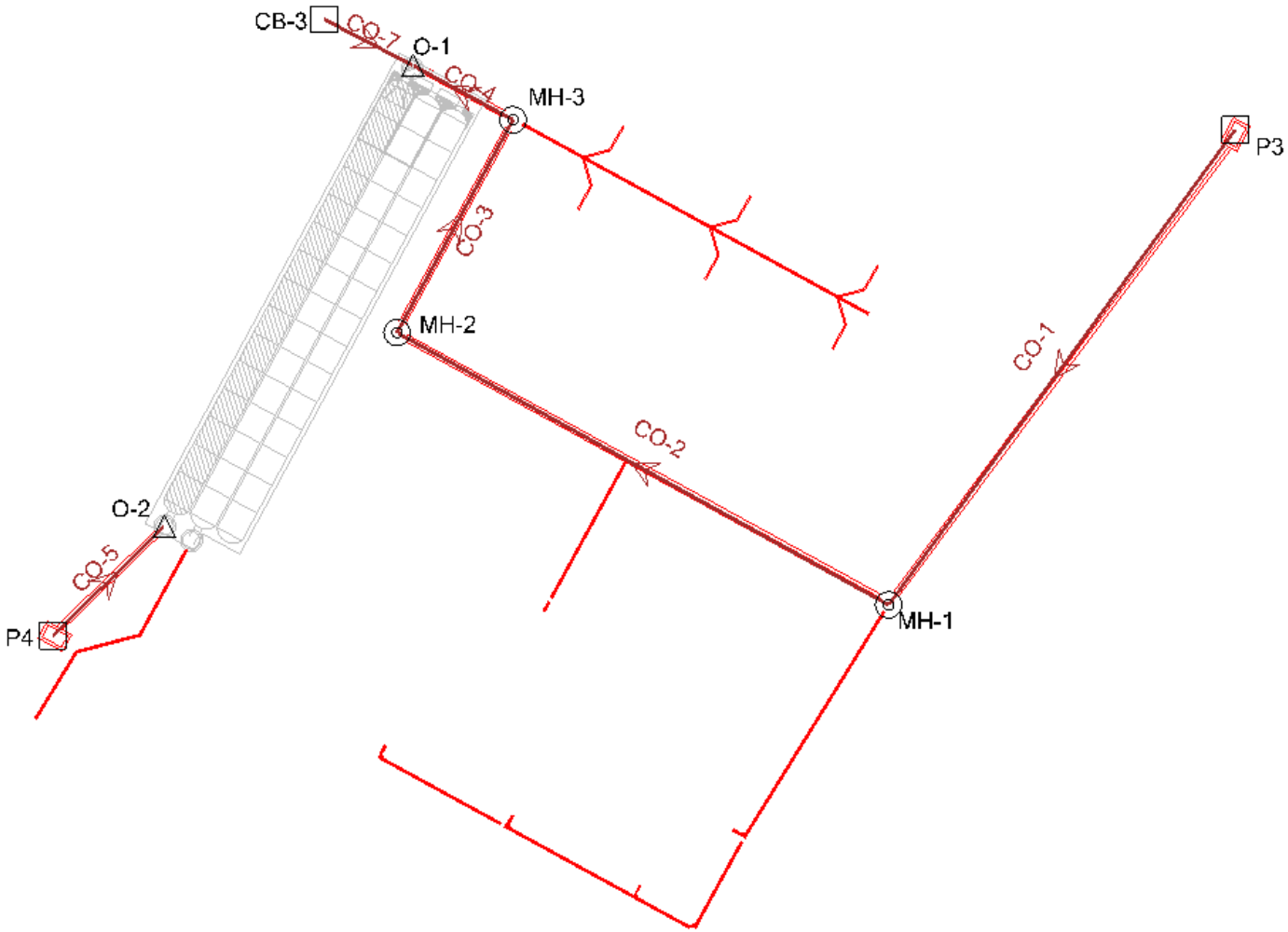
Routed Hydrograph Results

Design Storm Return Period =	WQCV	2 Year	5 Year	10 Year	50 Year	100 Year	
One-Hour Rainfall Depth =	N/A	0.99	1.27	1.53	2.31	2.70	in
CUHP Runoff Volume =	0.037	0.079	0.106	0.132	0.216	0.258	acre-ft
Inflow Hydrograph Volume =	N/A	0.079	0.106	0.132	0.216	0.258	acre-ft
Time to Drain 97% of Inflow Volume =	80.2	79.3	**78.1**	76.8	66.5	62.5	hours
Time to Drain 99% of Inflow Volume =	105.3	104.4	103.2	101.9	91.6	**87.6**	hours
Maximum Ponding Depth =	0.57	1.11	1.49	1.84	2.39	2.75	ft
Maximum Ponded Area =	0.07	0.07	0.07	0.07	0.07	**0.07**	acres
Maximum Volume Stored =	0.038	0.073	0.098	0.121	0.157	0.181	acre-ft

Stormwater Detention and Infiltration Design Data Sheet






CB-3
CO-7
O-1
CO-4
MH-3
P3
CO-3
MH-2
CO-1
CO-2
O-2
CO-5
P4
MH-1

Scenario: Minor
Current Time Step: 0.000 h
FlexTable: Conduit Table

Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Length (User Defined) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)	Section Type	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Depth (Out) (ft)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)
CO-1	P3	5,722.65	MH-1	5,721.99	132.1	133.8	0.005	Circle	18.0	0.013	1.06	2.98	0.38	7.42	14.3
CO-2	MH-1	5,721.79	MH-2	5,721.15	127.8	127.9	0.005	Circle	18.0	0.013	1.06	2.98	0.38	7.43	14.3
CO-3	MH-2	5,720.95	MH-3	5,720.68	54.9	55.1	0.005	Circle	18.0	0.013	1.06	2.96	0.43	7.37	14.4
CO-4	MH-3	5,720.48	O-1	5,720.35	25.8	25.9	0.005	Circle	18.0	0.013	1.06	2.99	0.76	7.46	14.2
CO-5	P4	5,724.15	O-2	5,723.98	33.4	35.5	0.005	Circle	18.0	0.013	5.38	4.61	0.89	7.49	71.8
CO-7	CB-3	5,724.29	O-1	5,724.00	6.0	22.7	0.048	Circle	12.0	0.013	3.14	9.42	0.55	7.83	40.1

Scenario: Minor
Current Time Step: 0.000 h
FlexTable: Catch Basin Table

ID	Label	Elevation (Ground) (ft)	Set Rim to Ground Elevation?	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Flow (Additional Subsurface) (cfs)	Inlet Type	Flow (Captured) (cfs)	Hydraulic Grade Line (In) (ft)
31	P3	5,725.65	True	5,725.65	5,722.65	1.06	Full Capture	0.00	5,723.03
40	P4	5,727.16	True	5,727.16	5,724.15	5.38	Full Capture	0.00	5,725.09
52	CB-3	5,728.29	True	5,728.29	5,724.29	3.14	Full Capture	0.00	5,725.05

Scenario: Minor
Current Time Step: 0.000 h
FlexTable: Manhole Table

Label	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Elevation (Invert in 1) (ft)	Flow (Total Out) (cfs)	Depth (Out) (ft)	Hydraulic Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)
MH-1	5,731.60	5,731.60	5,721.99	1.06	0.18	5,722.17	5,722.17
MH-2	5,731.10	5,731.10	5,721.15	1.06	0.18	5,721.33	5,721.33
MH-3	5,730.70	5,730.70	5,720.68	1.06	0.43	5,721.11	5,721.11

\\EESFile1\Projects\Kum & Go\CO, El Paso County_ 2232_Main and Security\07 Design\Drainage\2 - Calculations\4 - StormCAD\1 - StormCAD Model.stsw

Scenario: Minor
Current Time Step: 0.000 h
FlexTable: Outfall Table

Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Boundary Condition Type	Elevation (User Defined Tailwater) (ft)	Hydraulic Grade (ft)	Flow (Total Out) (cfs)
O-2	5,728.50	5,723.98	User Defined Tailwater	5,721.11	5,724.87	5.38
O-1	5,729.00	5,720.35	User Defined Tailwater	5,721.11	5,721.11	4.20

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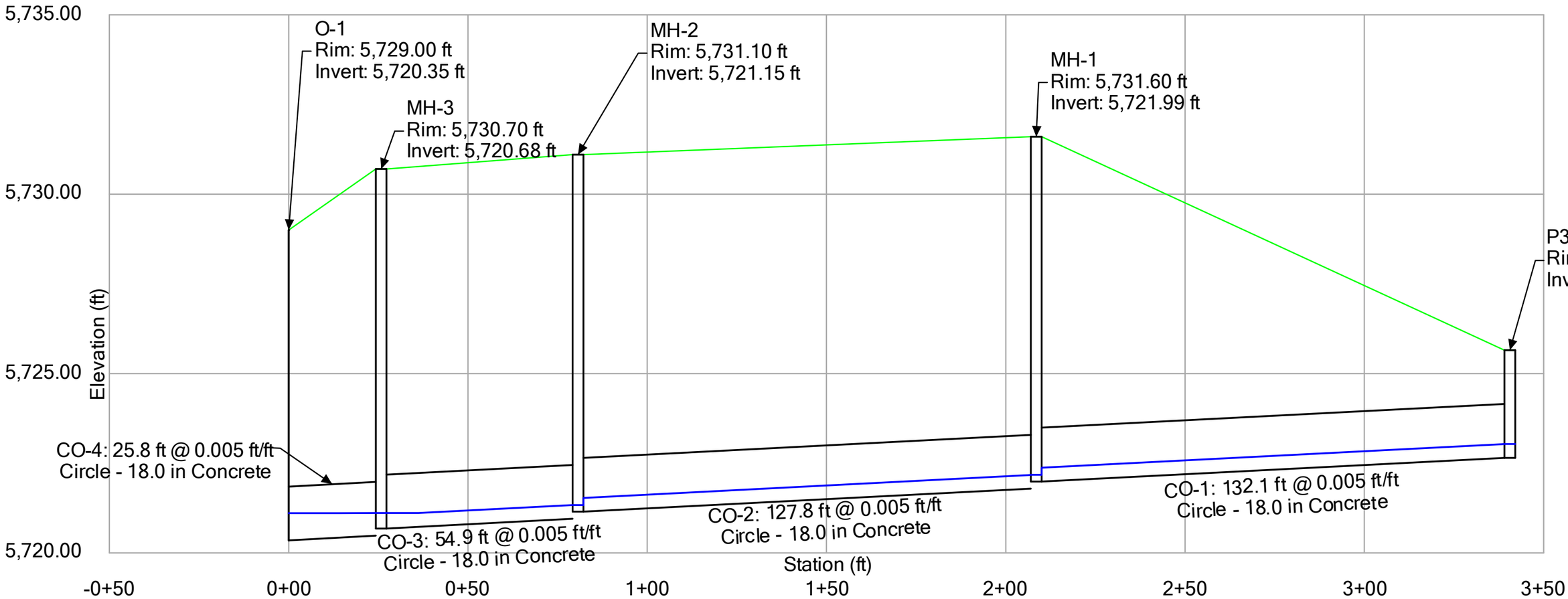
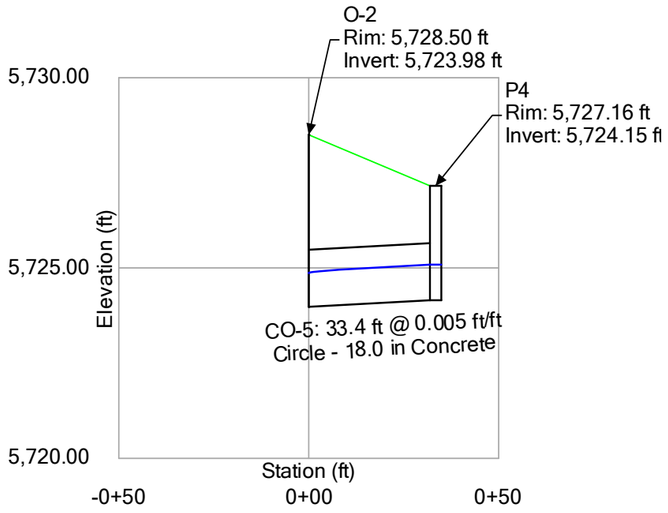
Profile Report
Engineering Profile - P3 (1 - StormCAD Model.stsw)



Profile Report
Engineering Profile - P4 (1 - StormCAD Model.stsw)



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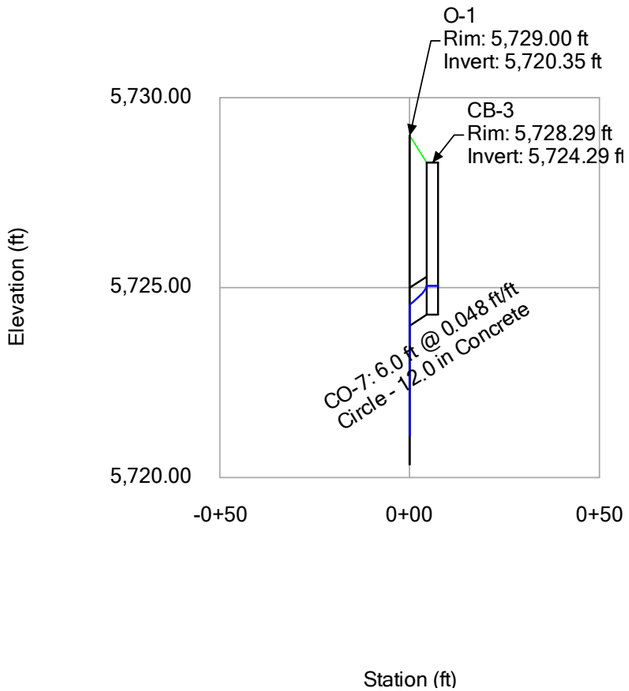

Scenario: Major
Current Time Step: 0.000 h
FlexTable: Conduit Table

Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Length (User Defined) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)	Section Type	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Depth (Out) (ft)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)
CO-1	P3	5,722.65	MH-1	5,721.99	132.1	133.8	0.005	Circle	18.0	0.013	2.50	3.79	0.60	7.42	33.7
CO-2	MH-1	5,721.79	MH-2	5,721.15	127.8	127.9	0.005	Circle	18.0	0.013	2.50	3.79	0.60	7.43	33.6
CO-3	MH-2	5,720.95	MH-3	5,720.68	54.9	55.1	0.005	Circle	18.0	0.013	2.50	3.77	0.60	7.37	33.9
CO-4	MH-3	5,720.48	O-1	5,720.35	25.8	25.9	0.005	Circle	18.0	0.013	2.50	3.80	0.76	7.46	33.5
CO-5	P4	5,724.15	O-2	5,723.98	33.4	35.5	0.005	Circle	18.0	0.013	12.33	6.98	1.33	7.49	164.5
CO-7	CB-3	5,724.29	O-1	5,724.00	6.0	22.7	0.048	Circle	12.0	0.013	7.12	11.30	0.88	7.83	90.9

Scenario: Major
Current Time Step: 0.000 h
FlexTable: Catch Basin Table

ID	Label	Elevation (Ground) (ft)	Set Rim to Ground Elevation?	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Flow (Additional Subsurface) (cfs)	Inlet Type	Flow (Captured) (cfs)	Hydraulic Grade Line (In) (ft)
31	P3	5,725.65	True	5,725.65	5,722.65	2.50	Full Capture	0.00	5,723.25
40	P4	5,727.16	True	5,727.16	5,724.15	12.33	Full Capture	0.00	5,725.86
52	CB-3	5,728.29	True	5,728.29	5,724.29	7.12	Full Capture	0.00	5,725.27

Scenario: Major
Current Time Step: 0.000 h
FlexTable: Manhole Table

Label	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Elevation (Invert in 1) (ft)	Flow (Total Out) (cfs)	Depth (Out) (ft)	Hydraulic Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)
MH-1	5,731.60	5,731.60	5,721.99	2.50	0.40	5,722.39	5,722.39
MH-2	5,731.10	5,731.10	5,721.15	2.50	0.40	5,721.55	5,721.55
MH-3	5,730.70	5,730.70	5,720.68	2.50	0.44	5,721.12	5,721.12

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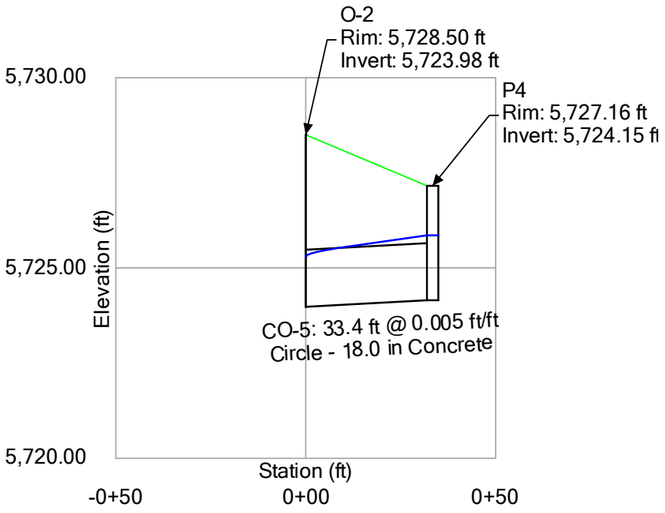
Scenario: Major
Current Time Step: 0.000 h
FlexTable: Outfall Table

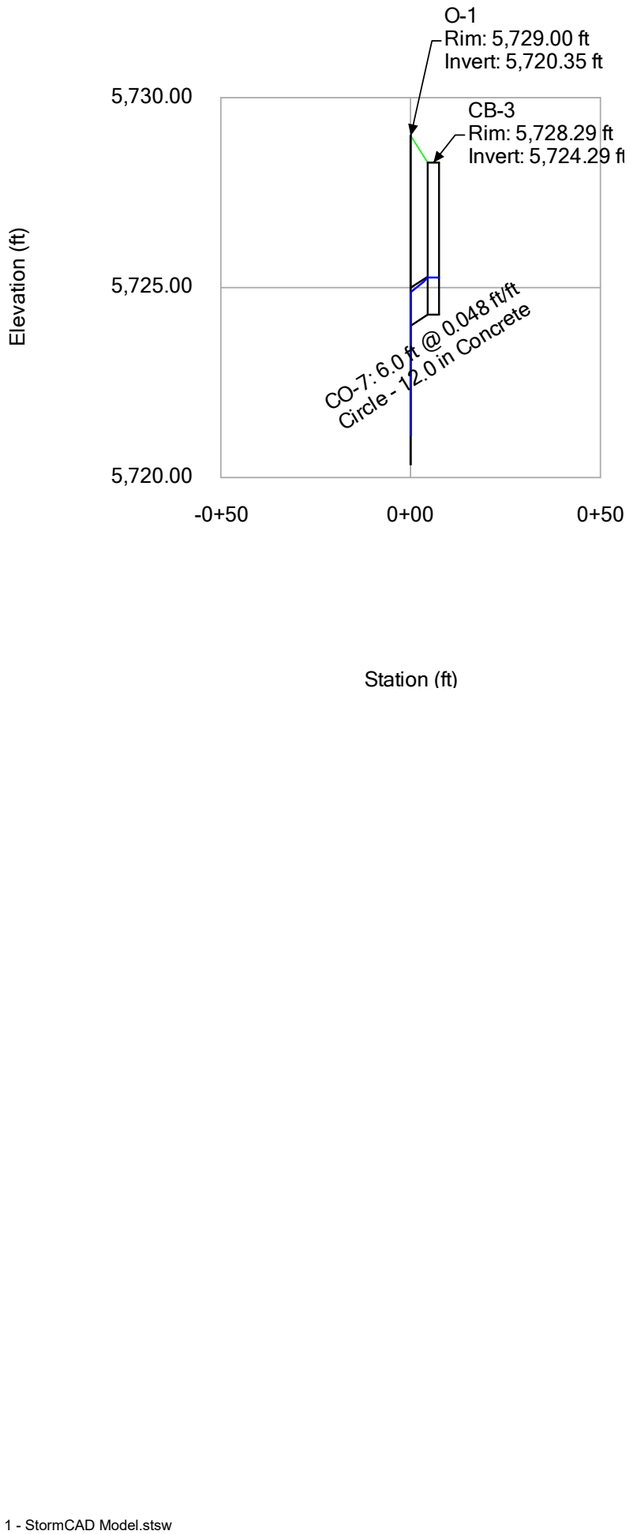
Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Boundary Condition Type	Elevation (User Defined Tailwater) (ft)	Hydraulic Grade (ft)	Flow (Total Out) (cfs)
O-2	5,728.50	5,723.98	User Defined Tailwater	5,721.11	5,725.31	12.33
O-1	5,729.00	5,720.35	User Defined Tailwater	5,721.11	5,721.11	9.62

\\EESFile1\Projects\Kum & Go\CO, El Paso County_ 2232_Main and Security\07 Design\Drainage\2 - Calculations\4 - StormCAD\1 - StormCAD Model.stsw

Profile Report
Engineering Profile - P4 (1 - StormCAD Model.stsw)



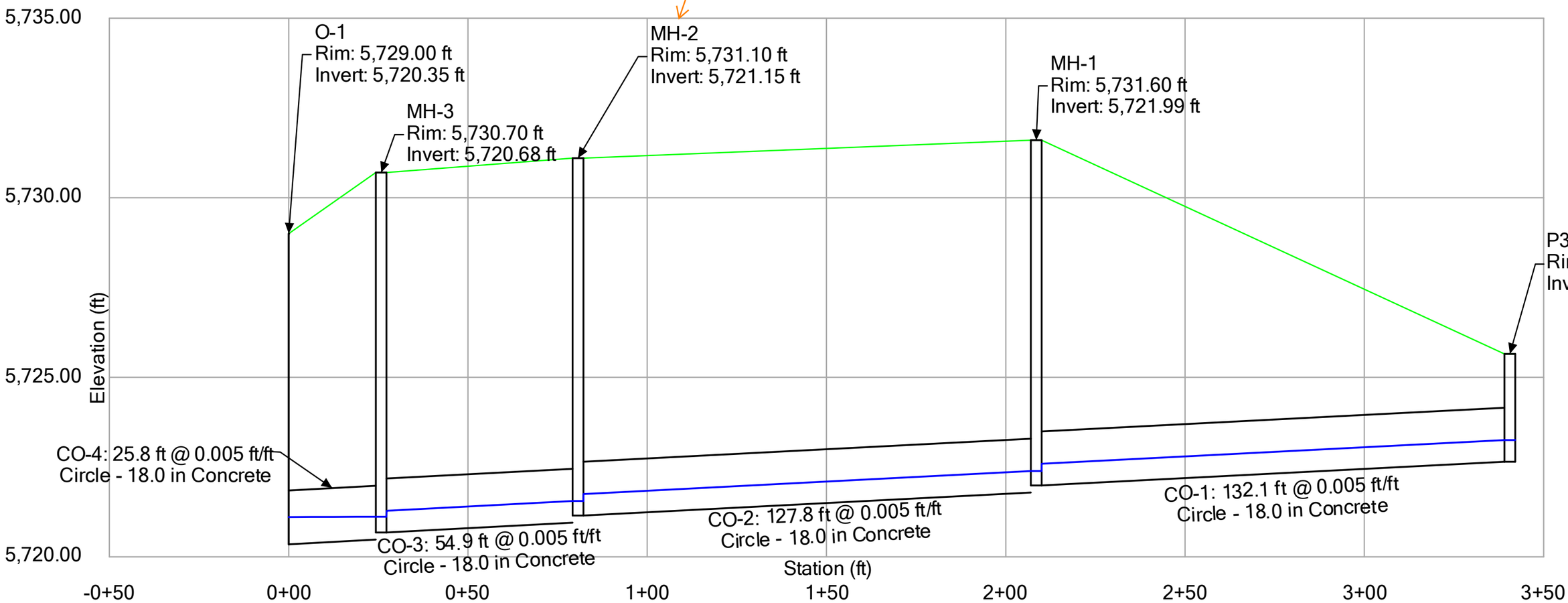
Profile Report
Engineering Profile - P4-2 (1 - StormCAD Model.stsw)



Profile Report
Engineering Profile - P3 (1 - StormCAD Model.stsw)

Are these MH labels (MH-1, MH-2, etc) on plan drawings somewhere? I'm not seeing them on the drainage maps below. Please show labels on plans.

These names are specific to the StormCAD model. The StormCAD model has been updated to include a title for clarity



501 S. Cherry Street, Suite 300
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APPENDIX C
Master Drainage Report Excerpts

LITTLE JOHNSON/SECURITY CREEK DRAINAGE BASIN PLANNING STUDY

Prepared for
El Paso County
Department of Public Works

Prepared by
SIMONS, LI & ASSOCIATES, INC.
in cooperation with
KIOWA ENGINEERING CORPORATION

APRIL, 1988

IV. HYDRAULIC ANALYSIS AND FLOODPLAIN DELINEATION

A hydraulic analysis for the study area has been conducted for the 10- and 100-year frequencies. This work consisted of analyzing the local storm sewer and street drainage systems and an analysis of the open channel (Security Creek) which drains the majority of the study area. A discussion of existing systems follows.

Description of Existing Storm Drainage Systems

Presented on Table 3 is an inventory of the existing storm drainage system(s) within the study area. The hydraulic capacities have been calculated using topographic mapping in combination with field inspections of these systems. The facilities listed in Table 3 lie within the Widefield, Security, and Little Johnson sub-basins. A discussion of each follows.

1. Little Johnson Basin

This portion of the study area lies within hydrologic group A, B, and C as shown on Figure 3 (See Map Pocket). The predominant features of the area are the Fountain Mutual Canal No. 4, and the Little Johnson Reservoir Basin. These two facilities have acted to keep the historic flows from crossing Bradley Road to very small amounts, and thereby protected the Security area. Urban development has placed an increasing storm drainage conveyance burden on the Fountain Mutual Canal No. 4. Developed flows entering the canal at times of high irrigation use have caused overtopping and maintenance problems at several locations along the canal's length. Future flows will only serve to worsen the flooding potential the canal represents, unless the canal is improved to meet the anticipated design flows.

The Little Johnson Reservoir is a former irrigation water storage facility that was taken out of operation in the 1970's. An outlet pipe exists under the embankment into a historic drainage path, however, the size and condition of this outlet has not been verified. The land underlying the reservoir is currently under consideration for residential development. Disregarding any stormwater diversion by the Canal No. 4, the Little Johnson Reservoir has adequate volume to store the historic runoff tributary to the Reservoir. The structural integrity of the embankment has not been investigated as part of this study.

An existing 36-inch storm sewer in Hancock collects flow from the Clearview Estates area, and the commercial industrial areas east of Hancock, to Yucatan. This system is highly dependent upon the hydraulic grade of the Canal No. 4, and has been calculated to be under capacity to serve the current development. Overtopping of this system forces flow west over Hancock, and is eventually picked up by Canal No. 4. The interaction between the Hancock storm sewer and Canal No. 4 is largely responsible for the local flooding problems along Bradley Road and in the northern portions of Security.

The areas tributary to Canal No. 4 east of Hancock Boulevard are conveyed to the Canal via a storm sewer system. The Canal has been reconstructed within this area, and eventually carries stormwater into the Windmill Gulch Basin.

A stormwater detention pond serves the Foxhills and Pinehurst Station Subdivisions. This pond is drained by two 24-inch outlet pipes, and was designed to control the design flow(s) to historic levels. The City of Colorado Springs has expressed an interest in abandoning this pond because of operation and maintenance concerns. A hydraulic review of the pond revealed that the pond volume is insufficient in capacity to lower the peak flow rate to match the outlet (for the hydrologic criteria applied in this report). The pond at the Foxhills Subdivision was therefore assumed to be eliminated for the purpose of estimating peak discharges and sizing of downstream facilities.

The balance of the Little Johnson Basin is drained by small culverts under roadways. A storm sewer system for State Highway 83 (Academy Boulevard) outfalls to the Fountain Creek, however, is of inadequate size to convey any additional runoff. Flows which do pass across Bradley enter the Security Creek via the street and storm sewer systems within Cody and Ivanhoe Drives.

2. Security Basin

This area has predominantly single-family residential development, and is drained by streets and small diameter storm sewers. The entire basin, bounded by Crawford Street on the south, is tributary to the Security Creek, which extends along the Denver and Rio Grande Western Railroad (D&RGWR) upstream to Cody Drive. The high impervious area in combination with the moderate-to-steep street slopes deliver stormwater to the lower portions of the basin at

too high a rate for the storm sewer system(s) and Security Creek to carry it away.

The two existing storm sewer systems, the Cassidy-Ivanhoe Drive storm sewer and the Main Street storm sewer have both been surcharged in recent years. These systems have been calculated to be over capacity, and unable to convey additional runoff without expansion. These systems are adversely impacted by the Security Creek hydraulic inadequacies. Structural damages to properties adjacent to these systems have been limited to the Main Street and Security Boulevard commercial areas.

The Security Creek begins at approximately Cody Drive, and extends south along the east side of the D&RGWR tracks to Main Street. The channel is poorly defined, and grasslined until approximately Sumac Drive. From this point a concrete lining extends up to Main Street. Two culverts cross the Security Creek. A recently constructed culvert near Kenny's Nursery has adequate capacity to handle existing condition flow rates. The Main Street crossing has an inadequate capacity. Relatively minor flooding has been calculated to be caused by the inadequate conveyance capacities of the Security Creek, the damage which does occur could be solved by reconstructing the Main Street culverts.

Two detention ponds have been constructed in the upper portions of the Security Basin. One pond serves the Pheasant Run Subdivision Filing No. 1, and the other pond serves Pheasant Run Filing No. 2. These ponds were constructed to limit flows originating within the subdivisions to historic levels. Both ponds have been overtopped in heavy rainstorms since their construction in 1986. The flows which have overtopped the ponds have moved into the Security area streets.

3. Widefield Basin

Similar to the Security Basin, the Widefield Basin has predominantly single-family development which is drained through mainly street and limited sections of storm sewers to Security Creek. The Security Creek is concrete-lined from Main Street to its outfall at Crews Gulch. The Fontaine Boulevard culvert at Security Creek has an inadequate capacity and forces flood flows west across Highway 85/87. The creek has an inadequate hydraulic capacity from Fontaine Street to Crews Gulch.

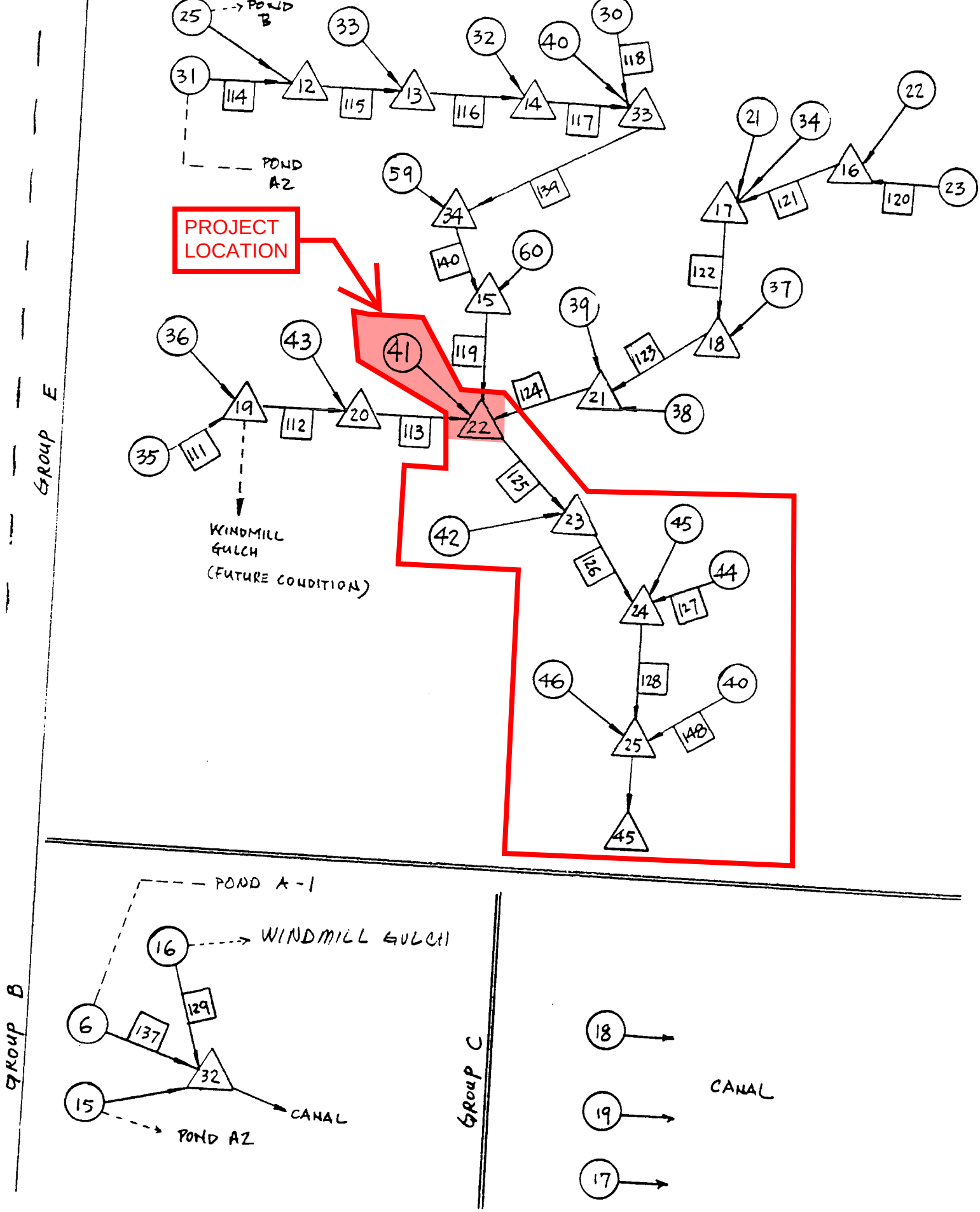


Figure 5. TR-20 Flow Diagram (continued).

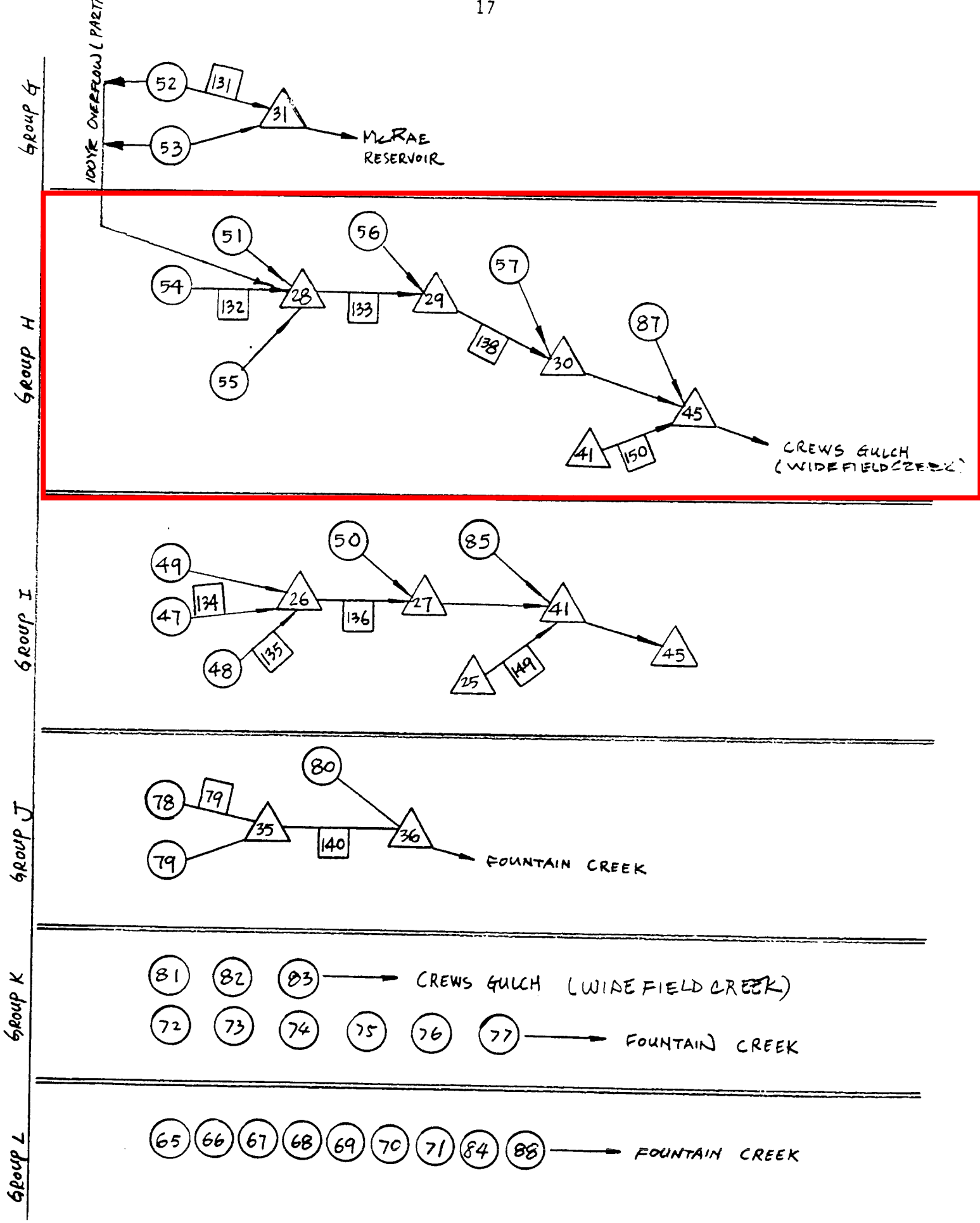


Figure 5. TR-20 Flow Diagram (continued).

Table 1. TR-20 Hydrologic Basin Parameter (continued).

Basin I.D.	% Imperviousness		Soil Type		Curve Number(CN)		Time of Concentration(Hr)	
	Existing	Future	Existing	Future	Existing	Future	Existing	Future
37	65	65	A	A	77	77	0.52	0.52
38	40	40	A	A	73	73	0.21	0.21
39	65	65	A	A	77	77	0.59	0.59
40	65	65	1/5 A 4/5 B	1/5 A 4/5 B	82	82	0.92	0.92
41	95	95	1/2 A 1/2 B	1/2 A 1/2 B	92	92	0.54	0.54
42	95	95	2/3 A 1/3 B	2/3 A 1/3 B	92	92	0.28	0.28
43	46	46	A	A	73	73	0.52	0.52
44	65	65	A	A	77	77	0.24	0.24
45	65	65	1/2 A 1/2 B	1/2 A 1/2 B	77	77	0.36	0.36
46	75	75	B	B	90	90	0.13	0.13
47	65	65	B	B	85	85	1.01	1.01
48	65	65	1/3 A 2/3 B	B	85	85	0.27	0.27
49	65	65	B	B	85	85	0.35	0.35
50	58	58	B	B	83	83	0.60	0.60
51	65	65	B	B	85	85	0.50	0.50
52	2	65	B	B	61	85	0.53	0.26
53	18	65	B	B	78	85	0.45	0.30
54	2	52	B	B	61	81	0.26	0.38
55	53	53	2/3 A 1/3 B	2/3 A 1/3 B	77	77	0.37	0.37
56	76	76	B	B	90	90	0.65	0.65
57	68	68	1/3 A 2/3 B	1/3 A 2/3 B	85	85	0.64	0.64
58	2	77	A	B	39	90	0.13	0.13
59	65	65	4/5 A 1/5 B	4/5 A 1/5 B	77	77	0.35	0.35
60	65	65	1/2 A 1/2 B	1/2 A 1/2 B	82	82	0.63	0.63
61	65	65	B	B	85	85	0.50	0.50
62	25	72	A	B	54	81	0.93	0.62
63	15	72	A	B	51	88	0.32	0.22
64	19	72	A	B	53	88	0.39	0.39
65	72	72	A	B	81	88	0.25	0.33
66	12	85	A	B	69	92	0.20	0.17
67	29	85	A	B	72	92	0.25	0.25
68	65	65	B	B	85	85	0.20	0.20
69	65	65	A	A	77	77	0.31	0.31
70	75	75	A	A	81	81	0.18	0.18

Table 2. Summary of Discharge.

Design Point				TR-20 24-Hour Storm (Type II-A)			
				100-Yr Peak Flow (cfs)		10-Yr Peak Flow (cfs)	
Basin No.	Design Point No.	Drainage Area (sq.mi.)	Location (Group)	Existing Condition	Future Condition	Existing Condition	Future Condition
1		0.09	A	6	251	0	140
2		0.08	A	178	178	92	92 *
3		0.02	A	51	51	26	26 *
4		0.09	A	6	253	0	146
5		0.11	A	1	294	0	163
6		0.18	A	45	340	5	188
7		0.05	A	97	133	50	72
8		0.03	D	0	83	0	50
9		0.06	A	1	162	0	90
10		0.02	A	0	46	0	25
11		0.13	D	1	217	0	114
12		0.10	A	1	239	0	134
13		0.02	D	0	58	0	33
14		0.12		1	220	0	116
15		0.05	B	56	113	23	63
16		0.10	B	169	169	88	88
17		0.08	B	102	102	46	46
18		0.08	C	110	151	50	80
19		0.04	C	0	96	0	53
21		0.04	E	83	83	41	41
22		0.04	E	1	128	0	72
23		0.03	E	58	67	31	40
24		0.07	D	2	119	0	70
25		0.06	E	0	68	0	38
26		0.04	D	86	86	46	46
27		0.06	D	95	116	47	62
28		0.05	D	22	127	2	73
29		0.06	D	54	54	26	26
30		0.05	E	63	63	31	31
31		0.01	E	0	26	0	14
32		0.04	E	102	102	51	51
33		0.08	E	140	140	67	67
34		0.04	E	63	63	30	30
35		0.04	E	70	70	34	34
36		0.05	E	0	80	0	40
37		0.09	E	117	117	53	53
38		0.02	E	30	30	13	13
39		0.03	E	36	36	16	16
40		0.12	E	136	136	67	67
41		0.05	E	119	119	71	71
42		0.02	E	71	71	43	43
43		0.05	E	77	77	34	34
44		0.03	E	53	53	26	26

Table 2. Summary of Discharge (continued).

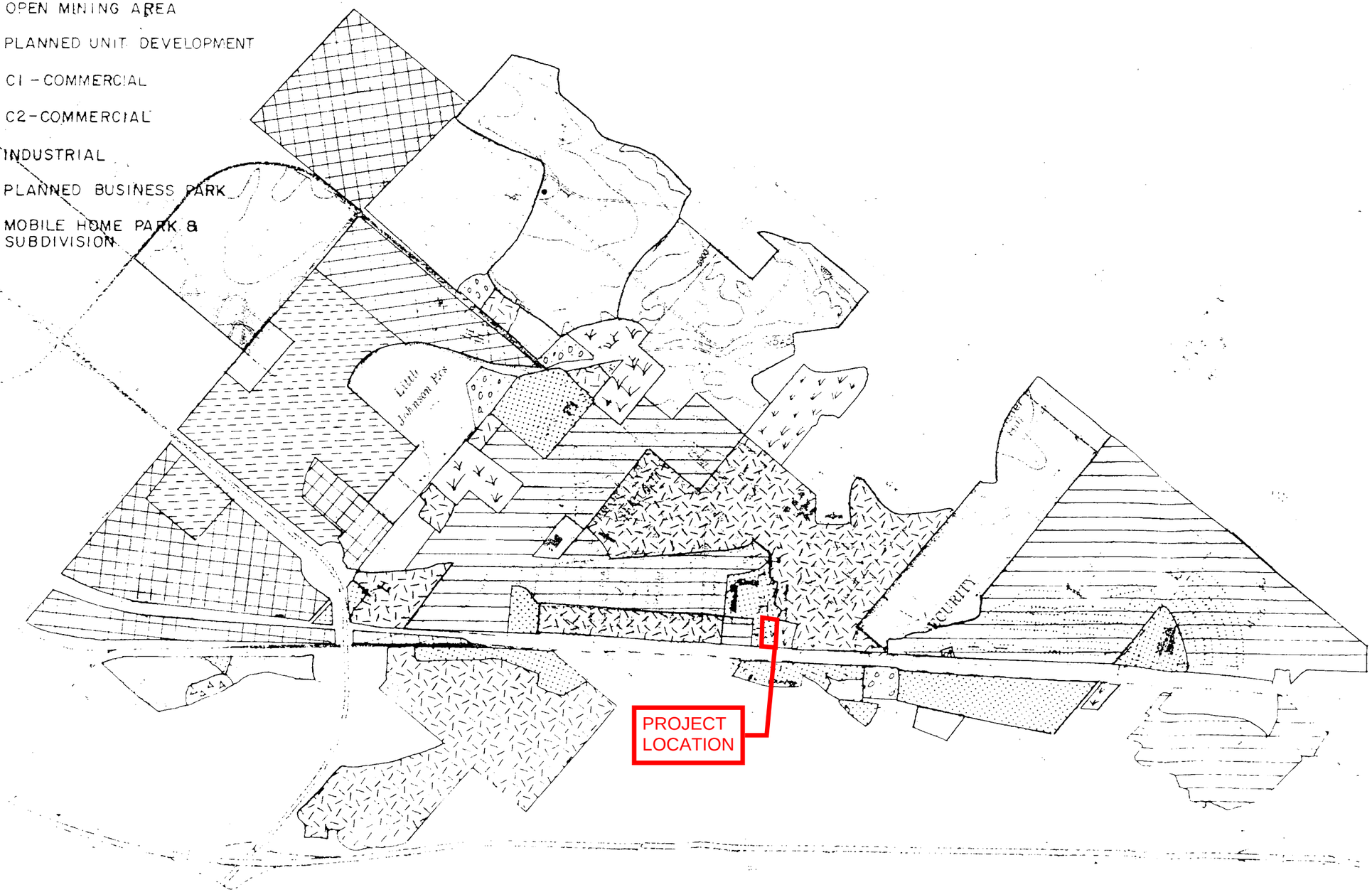
Design Point				TR-20 24-Hour Storm (Type II-A)			
				100-Yr Peak Flow (cfs)		10-Yr Peak Flow (cfs)	
Basin No.	Design Point No.	Drainage Area (sq.mi.)	Location (Group)	Existing Condition	Future Condition	Existing Condition	Future Condition
	3	0.11	A	1	279	0	155
	4	0.10	A	228	228	118	118
	5	0.22	A	228	495	115	259
	6	0.15	D	1	252	0	132
	7	0.19	D	86	333	46	176
	8	0.34	D	176	610	90	332
	9	0.41	D	194	629	98	340
	11	0.10	D	2	161	0	95
	12	0.07	E	1	72	0	41
	13	0.15	E	140	195	67	98
	14	0.19	E	215	258	103	120
	15	0.49	E	523	577	246	271
	16	0.07	E	58	188	31	107
	17	0.14	E	184	316	90	167
	18	0.23	E	270	395	126	199
	19	0.09	E	70	243	34	132
	20	0.13	E	148	310	67	159
	21	0.28	E	328	449	151	220
	22	0.95	E	1106	1154	529	557
	23	0.98	E	1174	1224	569	598
	24	1.09	E	1363	1413	658	686
	25	1.90	E	1733	2836	814	1375
	26	0.21	I	427	427	229	229
	27	0.27	I	499	499	264	264
	28	0.18	H	300	340	147	173
	29	0.28	H	479	519	250	276
	30	0.30	H	505	546	265	290
	31	0.50	G	495	1213	183	670
	32	0.40	B	349	710	156	377
	33	0.37	E	326	378	154	187
	34	0.46	E	483	536	227	253
	35	0.22	J	193	482	91	265
	36	0.31	J	291	529	142	298
	37	0.27	D	87	507	22	261
	38	0.31	D	104	632	23	334
	39	0.72	D	298	1253	100	670
	40	0.80	D	436	1412	172	747
	41	2.20	I	2303	3416	1122	1662
	43	0.10	A	7	298	0	169
	44	0.19	A	12	550	0	314
	45	2.52	H	2850	3996	1403	1976

* Assumes no attenuation due to the Foxhills Subdivision pond.

LEGEND

- PLANNED INDUSTRIAL DISTRICT
- R1 – RESIDENTIAL, 6,000 sq. ft
- R3 – RESIDENTIAL, 2,500 sq ft
- R2 – RESIDENTIAL, 4,500 sq ft (S) RESIDENTIAL, 7,000 sq ft (D)
- OPEN MINING AREA
- PLANNED UNIT DEVELOPMENT
- C1 – COMMERCIAL
- C2 – COMMERCIAL
- INDUSTRIAL
- PLANNED BUSINESS PARK
- MOBILE HOME PARK & SUBDIVISION

1" = 2,000'

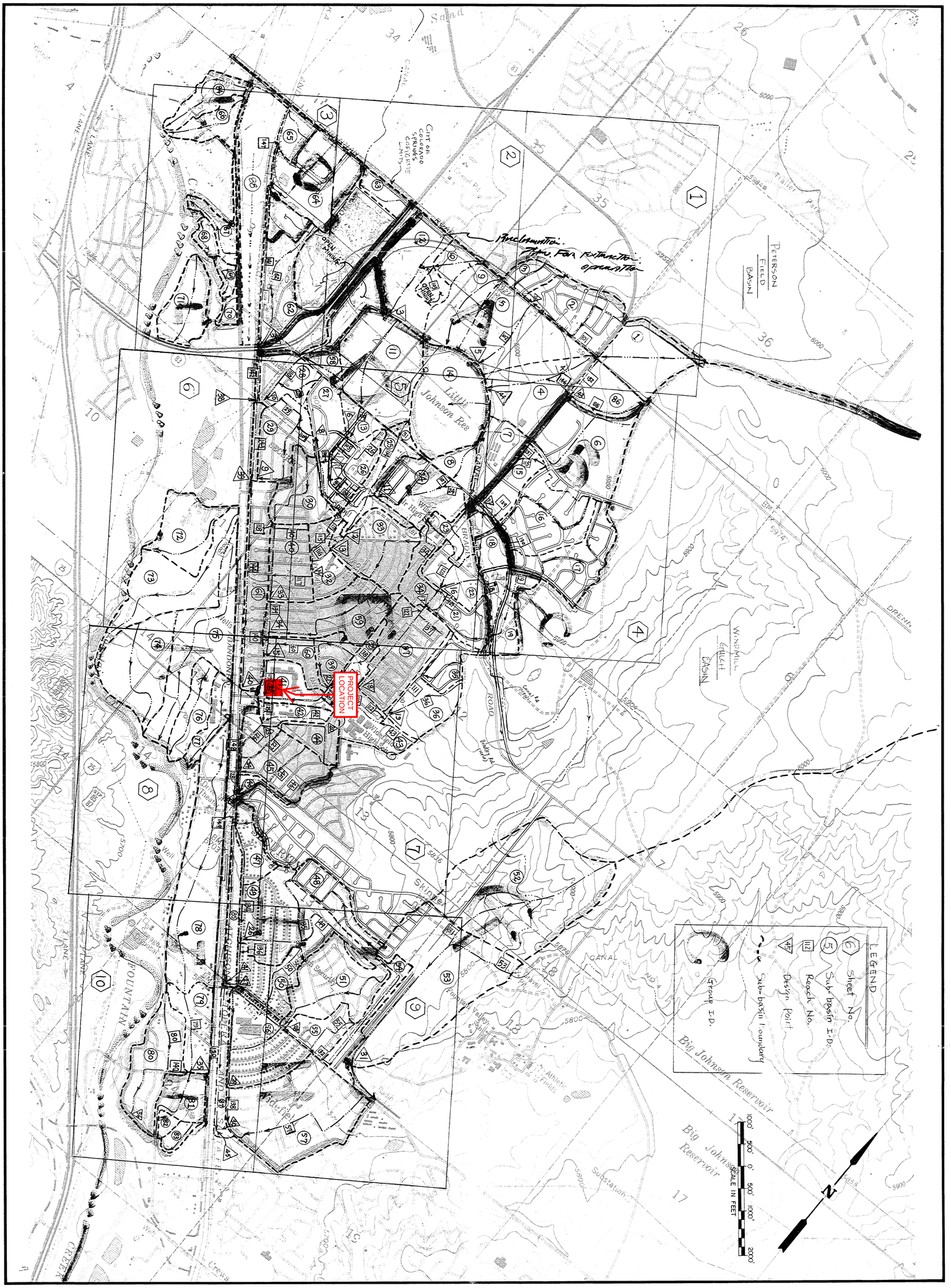


SIA SIMONS, LI & ASSOCIATES, INC.
419 WEST BIJOU STREET
COLORADO SPRINGS
COLORADO 80905

LITTLE JOHNSON / SECURITY CREEK
DRAINAGE BASIN PLANNING STUDY
LAND USE MAP

Project No. PC-[illegible]
Date [illegible]/78
Design [illegible]
Drawn EAK
Check [illegible]
Revisions

FIG 4



LITTLE JOHNSON / SECURITY CREEK

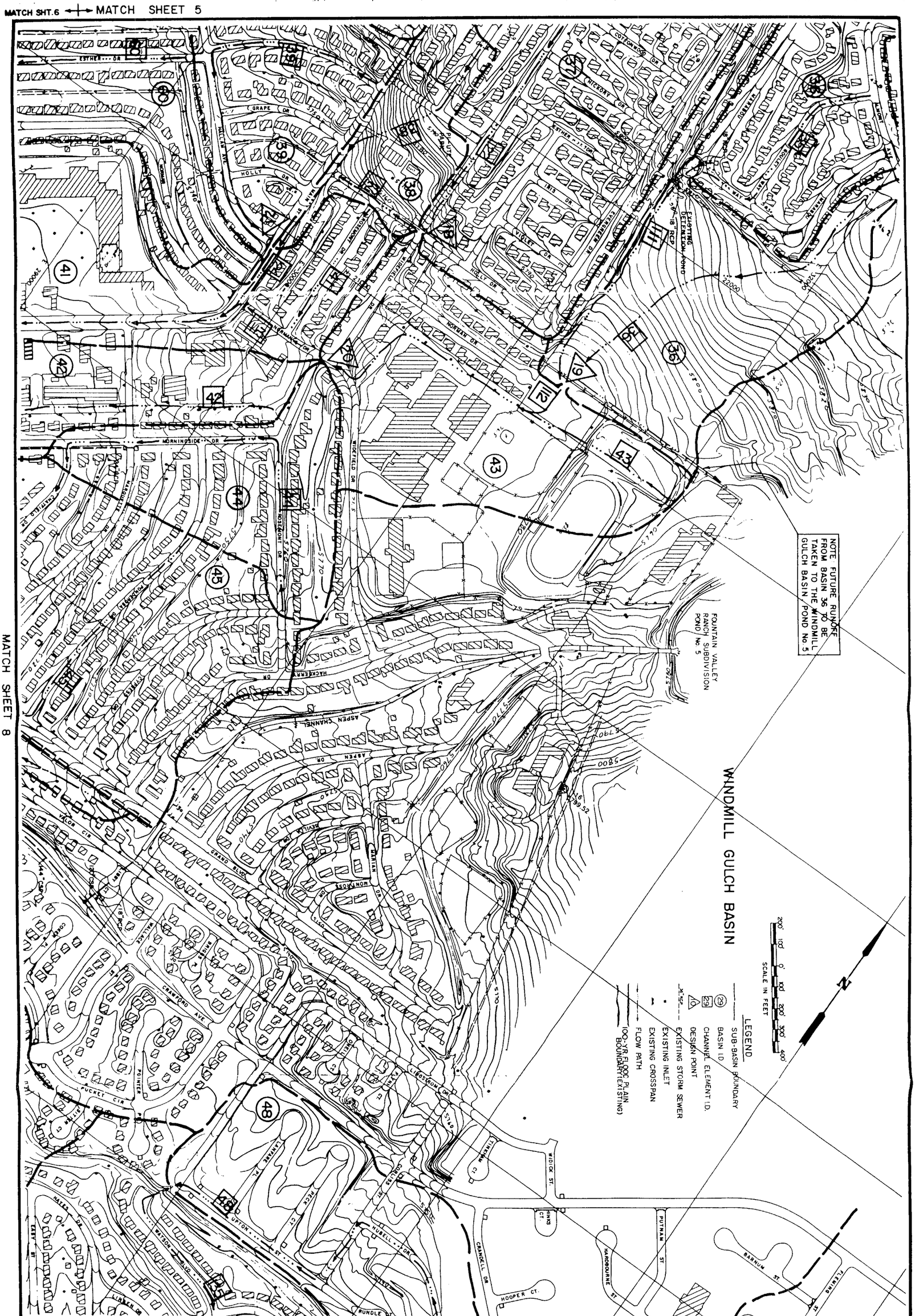
DRAINAGE BASIN PLANNING STUDY

HYDROLOGIC BASIN MAP

Project No: FOOEPC01
Date: SEPT., 1987
Design: EAK
Drawn: EAK
Check: JYC
Revisions:

sla SIMONS, LI & ASSOCIATES, INC.
419 WEST BIJOU STREET
COLORADO SPRINGS
COLORADO 80905

MATCH SHT.6 ← → MATCH SHEET 5



MATCH SHT.10 ← → MATCH SHEET 9

MATCH SHEET 8

SHEET 7

Project No.	PCO-EPC-01
Date:	10/87
Design:	JYC
Drawn:	EAK
Check:	JYC
Revisions:	

LITTLE JOHNSON/SECURITY CREEK

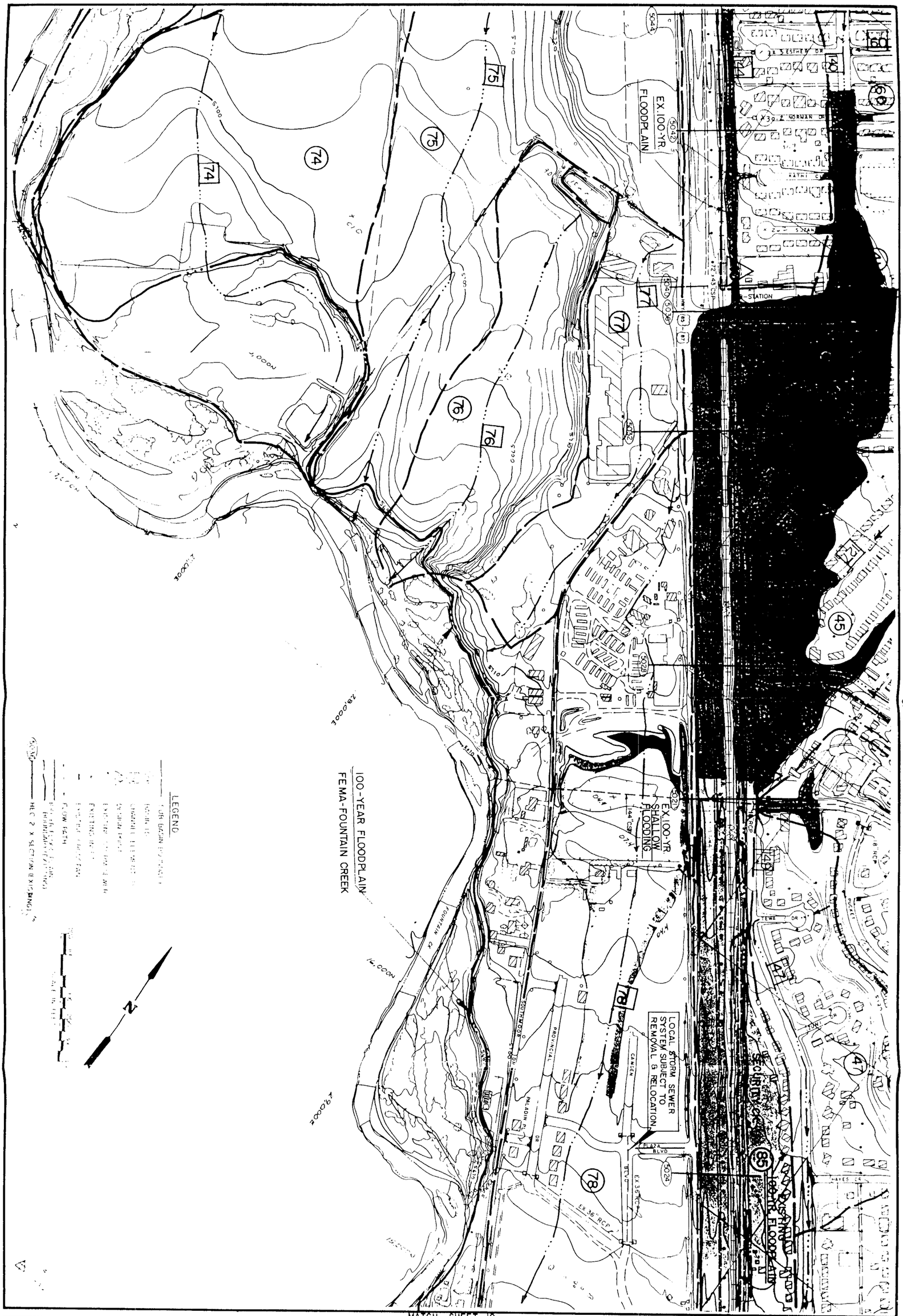
DRAINAGE BASIN PLANNING STUDY

PRELIMINARY DESIGN

HYDROLOGIC & FLOODPLAIN INFORMATION & EXISTING FACILITIES MAP

sla SIMONS, LI & ASSOCIATES, INC.
419 West Bijou, Colorado Springs, Colorado 80905

MATCH SHEET 6



MAP LIMIT

MATCH SHEET 7

MATCH SHEET 10

SHEET 8

Project No.
Date
Design
Drawn
Check
Revisions

LITTLE JOHNSON/SECURITY CREEK
DRAINAGE BASIN PLANNING STUDY
PRELIMINARY DESIGN
HYDROLOGIC & FLOODPLAIN INFORMATION & EXISTING FACILITIES MAP

sla Simons, Li & Associates, Inc.
419 West Bijou, Colorado Springs, Colorado 80905

501 S. Cherry Street, Suite 300
Glendale, CO 80246
303-572-7997
www.ees.us.com

APPENDIX D
Underground Detention System Details
Pump Details
Existing Drainage Map
Developed Drainage Map

BASIN SUMMARY RUNOFF TABLE						
BASIN	DESIGN POINT	CONTRIBUTING BASIN ACREAGE	5-YR C-VALUE	100-YR C-VALUE	5-YR RUNOFF (CFS)	100-YR RUNOFF (CFS)
E1	E1	1.29	0.84	0.91	4.64	10.70
OS1	E1	1.77	0.90	0.96	6.52	14.79

Unresolved. Please move drainage maps to the end of the report contents.

Moved to end of report.

DRAINAGE LEGEND

- PROPOSED PROPERTY LINE
- EXISTING MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- MINOR CONTOUR
- MAJOR CONTOUR
- PROPOSED BASIN DELINEATION
- EXISTING FLOODPLAIN
- EXISTING STORM INLET AND MANHOLE
- EXISTING DRAINAGE FLOW ARROW
- DESIGN POINT

- BASIN DESIGNATION
- 5-YEAR RUNOFF COEFFICIENT
- 100-YEAR RUNOFF COEFFICIENT
- BASIN AREA IN ACRES

N W E S

SCALE IN FEET
0 40 80

IF BAR DOES NOT MEASURE 1 INCH THEN DRAWING IS NOT TO SCALE

811 Know what's **below.** **Call** before you dig.
CALL 811 SEVENTY-TWO HOURS PRIOR TO DIGGING, GRADING OR EXCAVATING FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

BENCHMARK:
ELEVATIONS ARE BASED UPON COLORADO SPRINGS UTILITIES FIMS CONTROL MONUMENT SE09, BEING A 2-INCH DIAMETER ALUMINUM CAP STAMPED "CSU FIMS CONTROL SE09" ON THE EAST CORNER OF THE CONCRETE BASE OF A TELEPHONE RELAY BOX AT THE EAST CORNER OF 226 MAIN STREET, ABOUT 3 FEET NORHTWEST OF THE NORTHWEST CURB OF MAIN STREET, AND ABOUT 205 FEET SOUTHWEST OF THE SOUTHWEST CURB LINE OF SECURITY BOULEVARD. CITY ELEVATION: 5726.76 (NGVD 29)

PCD FILE NO. PPR-2225

EES ENTITLEMENT AND ENGINEERING SOLUTIONS, INC.
501 S Cherry St, Suite 300
Glendale, CO 80246
303-572-7997 www.ees.us.com

Kum & Go

1459 Grand Ave
Des Moines, IA 50309
P: 888-458-6646

2232 - EL PASO, COLORADO
SECURITY BLVD. AND MAIN ST.

EXISTING DRAINAGE PLAN

KG PROJECT TEAM:
RDM:
SDM:
CPM:

REVISIONS

	DATE	REVISION DESCRIPTION
1		

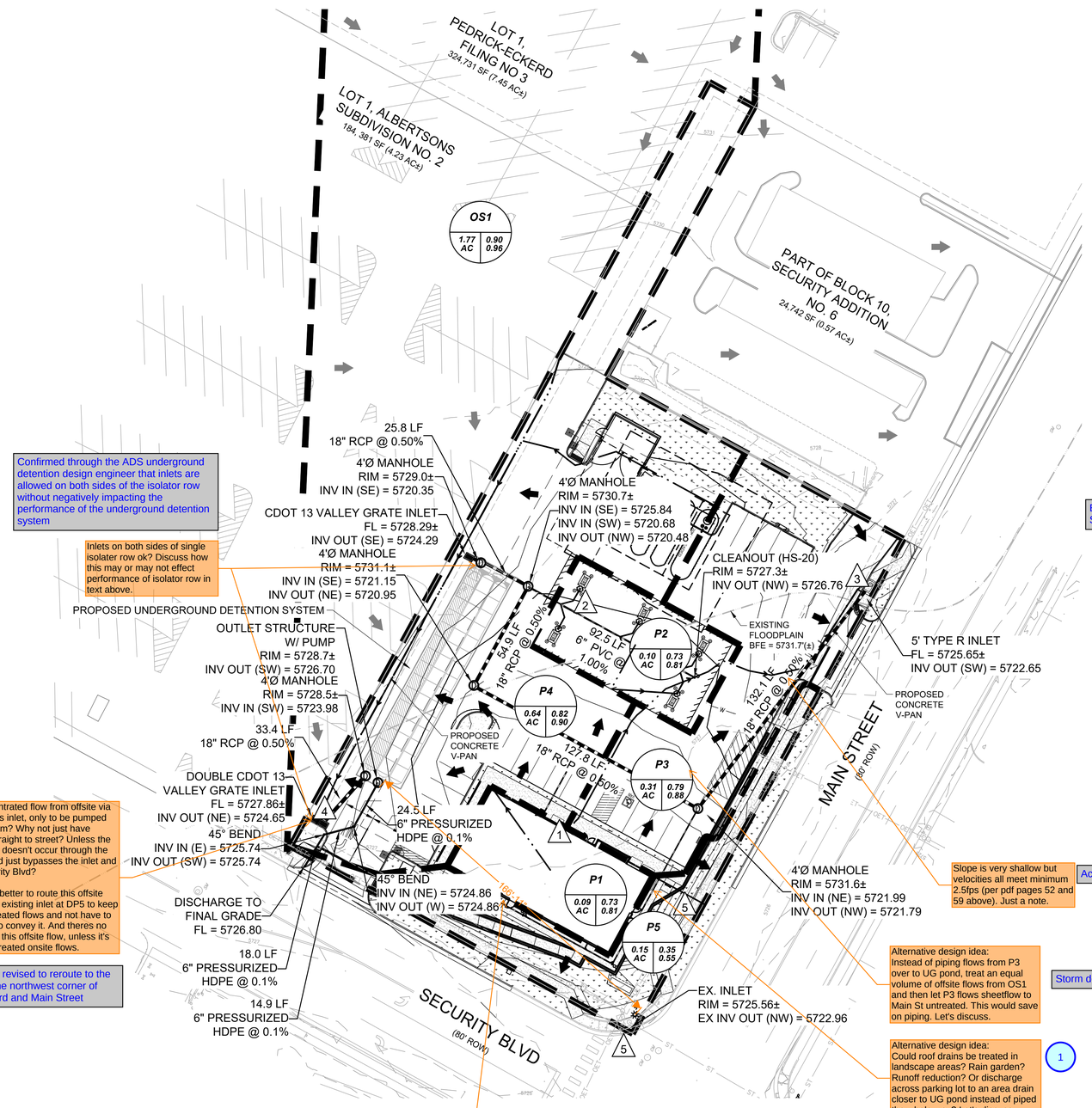
DATE: 08-12-2022

SHEET NUMBER: **D1**

P:\KUM & GO\CO, EL PASO COUNTY_ 2232_MAIN AND SECURITY\08 CAD\DRAINAGE\D1 - EXISTING DRAINAGE PLAN.DWG

BASIN SUMMARY RUNOFF TABLE						
BASIN	DESIGN POINT	CONTRIBUTING BASIN ACREAGE	5-YR C-VALUE	100-YR C-VALUE	5-YR RUNOFF (CFS)	100-YR RUNOFF (CFS)
P1	1	0.09	0.73	0.81	0.28	0.67
P2	2	0.10	0.73	0.81	0.31	0.74
P3	3	0.31	0.79	0.88	1.06	2.50
P4	4	0.64	0.82	0.90	2.24	5.21
P5	5	0.15	0.35	0.55	0.23	0.76
ONSITE TOTAL		1.29	0.75	0.84		
OS1	4	1.77	0.90	0.96	6.28	14.24

DETENTION POND SUMMARY						
POND NUMBER	WQCV DETENTION VOLUME (CF)	100-YR DETENTION VOUME (CF)	PROVIDED VOLUME (CF)	100-YR RELEASE RATE (CFS)	WQCV WATER SURFACE ELEVATION (FT)	100-YR WATER SURFACE ELEVATION (FT)
1	1612	8407	11500	1.43	5721.11	5723.47



Confirmed through the ADS underground detention design engineer that inlets are allowed on both sides of the isolator row without negatively impacting the performance of the underground detention system

Inlets on both sides of single isolator row ok? Discuss how this may or may not effect performance of isolator row in text above.

Why collect concentrated flow from offsite via the crosspan at this inlet, only to be pumped out 10ft downstream? Why not just have crosspan outfall straight to street? Unless the offsite flow bypass doesn't occur through the outlet structure and just bypasses the inlet and continues to Security Blvd?

Would actually be better to route this offsite flow straight to the existing inlet at DP5 to keep it separate from treated flows and not have to rely on the pump to convey it. And theres no need to try to treat this offsite flow, unless it's combined with untreated onsite flows.

Flows have been revised to reroute to the existing inlet at the northwest corner of Security Boulevard and Main Street

Slope of pipe would be ~0.5%. Could move underground system to other side of site to get it closer to DP5, but then system would be in the floodplain. We need to discuss this further.

Pipe has been relocated and a check valve has been added to prevent against flooding conditions.

Existing flow arrows added to Main St and Security Boulevard

Show existing flow arrows in Main St and Security Blvd.

Slope is very shallow but velocities all meet minimum 2.5fps (per pdf pages 52 and 59 above). Just a note.

Acknowledged

Alternative design idea: Instead of piping flows from P3 over to UG pond, treat an equal volume of offsite flows from OS1 and then let P3 flows sheetflow to Main St untreated. This would save on piping. Let's discuss.

Storm design has not been revised

Alternative design idea: Could roof drains be treated in landscape areas? Rain garden? Runoff reduction? Or discharge across parking lot to an area drain closer to UG pond instead of piped the whole way? Let's discuss.

1

Storm design has not been revised

Unresolved. Please move drainage maps to the end of the report contents.

Moved to end of report

DRAINAGE LEGEND

- PROPOSED PROPERTY LINE
- 5280 EXISTING MINOR CONTOUR
- 5280 EXISTING MAJOR CONTOUR
- 5280 MINOR CONTOUR
- 5280 MAJOR CONTOUR
- PROPOSED BASIN DELINEATION
- PROPOSED STORM SEWER
- PROPOSED STORM INLET AND MANHOLE
- EXISTING STORM INLET AND MANHOLE
- PROPOSED DRAINAGE FLOW ARROW
- EXISTING DRAINAGE FLOW ARROW
- DESIGN POINT
- DS PROPOSED DOWN SPOUT
- EXISTING FLOODPLAIN
- PROPOSED TIME OF CONCENTRATION PATH
- BASIN DESIGNATION
- 5-YEAR RUNOFF COEFFICIENT
- 100-YEAR RUNOFF COEFFICIENT
- BASIN AREA IN ACRES

N W E S

SCALE IN FEET
0 30 60

IF BAR DOES NOT MEASURE 1 INCH THEN DRAWING IS NOT TO SCALE

P:\KUM & GO\CO. EL PASO COUNTY_ 2232_MAIN AND SECURITY\08 CAD\DRAINAGE\D2 - PROPOSED DRAINAGE PLAN.DWG

BENCHMARK:

ELEVATIONS ARE BASED UPON COLORADO SPRINGS UTILITIES FIMS CONTROL MONUMENT SE09, BEING A 2-INCH DIAMETER ALUMINUM CAP STAMPED "CSU FIMS CONTROL SE09" ON THE EAST CORNER OF THE CONCRETE BASE OF A TELEPHONE RELAY BOX AT THE EAST CORNER OF 226 MAIN STREET, ABOUT 3 FEET NORHTWEST OF THE NORTHWEST CURB OF MAIN STREET, AND ABOUT 205 FEET SOUTHWEST OF THE SOUTHWEST CURB LINE OF SECURITY BOULEVARD. CITY ELEVATION: 5726.76 (NGVD 29)

PCD FILE NO. PPR-2225

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2232 - EL PASO, COLORADO
SECURITY BLVD. AND MAIN ST.

PROPOSED DRAINAGE PLAN

KG PROJECT TEAM:
RDM:
SDM:
CPM:

REVISIONS

	DATE	REVISION DESCRIPTION
1	08/19/22	1ST REVIEW COMMENTS

DATE: 10-03-2022

SHEET NUMBER: D2

CRITERIA PLAN 04/2020

PROJECT INFORMATION	
ENGINEERED PRODUCT MANAGER	
ADS SALES REP	
PROJECT NO.	

Advanced Drainage Systems, Inc.

SiteAssist™
FOR STORMTECH
INSTALLATION INSTRUCTIONS
VISIT OUR APP

K&G

EL PASO, CO

MC-3500 STORMTECH CHAMBER SPECIFICATIONS

1. CHAMBERS SHALL BE STORMTECH MC-3500.
2. CHAMBERS SHALL BE ARCH-SHAPED AND SHALL BE MANUFACTURED FROM VIRGIN, IMPACT-MODIFIED POLYPROPYLENE COPOLYMERS.
3. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS" CHAMBER CLASSIFICATION 45x76 DESIGNATION SS.
4. CHAMBER ROWS SHALL PROVIDE CONTINUOUS, UNOBSTRUCTED INTERNAL SPACE WITH NO INTERNAL SUPPORTS THAT WOULD IMPEDE FLOW OR LIMIT ACCESS FOR INSPECTION.
5. THE STRUCTURAL DESIGN OF THE CHAMBERS, THE STRUCTURAL BACKFILL, AND THE INSTALLATION REQUIREMENTS SHALL ENSURE THAT THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, SECTION 12.12, ARE MET FOR: 1) LONG-DURATION DEAD LOADS AND 2) SHORT-DURATION LIVE LOADS, BASED ON THE AASHTO DESIGN TRUCK WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.
6. CHAMBERS SHALL BE DESIGNED, TESTED AND ALLOWABLE LOAD CONFIGURATIONS DETERMINED IN ACCORDANCE WITH ASTM F2787, "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS". LOAD CONFIGURATIONS SHALL INCLUDE: 1) INSTANTANEOUS (<1 MIN) AASHTO DESIGN TRUCK LIVE LOAD ON MINIMUM COVER 2) MAXIMUM PERMANENT (75-YR) COVER LOAD AND 3) ALLOWABLE COVER WITH PARKED (1-WEEK) AASHTO DESIGN TRUCK.
7. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 3".
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT SHALL BE GREATER THAN OR EQUAL TO 450 LBS/FT/%. THE ASC IS DEFINED IN SECTION 6.2.8 OF ASTM F2418. AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23° C), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.
8. ONLY CHAMBERS THAT ARE APPROVED BY THE SITE DESIGN ENGINEER WILL BE ALLOWED. UPON REQUEST BY THE SITE DESIGN ENGINEER OR OWNER, THE CHAMBER MANUFACTURER SHALL SUBMIT A STRUCTURAL EVALUATION FOR APPROVAL BEFORE DELIVERING CHAMBERS TO THE PROJECT SITE AS FOLLOWS:
   - THE STRUCTURAL EVALUATION SHALL BE SEALED BY A REGISTERED PROFESSIONAL ENGINEER.
   - THE STRUCTURAL EVALUATION SHALL DEMONSTRATE THAT THE SAFETY FACTORS ARE GREATER THAN OR EQUAL TO 1.95 FOR DEAD LOAD AND 1.75 FOR LIVE LOAD, THE MINIMUM REQUIRED BY ASTM F2787 AND BY SECTIONS 3 AND 12.12 OF THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS FOR THERMOPLASTIC PIPE.
   - THE TEST DERIVED CREEP MODULUS AS SPECIFIED IN ASTM F2418 SHALL BE USED FOR PERMANENT DEAD LOAD DESIGN EXCEPT THAT IT SHALL BE THE 75-YEAR MODULUS USED FOR DESIGN.
9. CHAMBERS AND END CAPS SHALL BE PRODUCED AT AN ISO 9001 CERTIFIED MANUFACTURING FACILITY.

IMPORTANT - NOTES FOR THE BIDDING AND INSTALLATION OF MC-3500 CHAMBER SYSTEM

1. STORMTECH MC-3500 CHAMBERS SHALL NOT BE INSTALLED UNTIL THE MANUFACTURER'S REPRESENTATIVE HAS COMPLETED A PRE-CONSTRUCTION MEETING WITH THE INSTALLERS.
2. STORMTECH MC-3500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. CHAMBERS ARE NOT TO BE BACKFILLED WITH A DOZER OR AN EXCAVATOR SITUATED OVER THE CHAMBERS. STORMTECH RECOMMENDS 3 BACKFILL METHODS:
   - STONESHOOTER LOCATED OFF THE CHAMBER BED.
   - BACKFILL AS ROWS ARE BUILT USING AN EXCAVATOR ON THE FOUNDATION STONE OR SUBGRADE.
   - BACKFILL FROM OUTSIDE THE EXCAVATION USING A LONG BOOM HOE OR EXCAVATOR.
4. THE FOUNDATION STONE SHALL BE LEVELED AND COMPACTED PRIOR TO PLACING CHAMBERS.
5. JOINTS BETWEEN CHAMBERS SHALL BE PROPERLY SEATED PRIOR TO PLACING STONE.
6. MAINTAIN MINIMUM - 6" (150 mm) SPACING BETWEEN THE CHAMBER ROWS.
7. INLET AND OUTLET MANIFOLDS MUST BE INSERTED A MINIMUM OF 12" (300 mm) INTO CHAMBER END CAPS.
8. EMBEDMENT STONE SURROUNDING CHAMBERS MUST BE A CLEAN, CRUSHED, ANGULAR STONE MEETING THE AASHTO M43 DESIGNATION OF #3 OR #4.
9. STONE MUST BE PLACED ON THE TOP CENTER OF THE CHAMBER TO ANCHOR THE CHAMBERS IN PLACE AND PRESERVE ROW SPACING.
10. THE CONTRACTOR MUST REPORT ANY DISCREPANCIES WITH CHAMBER FOUNDATION MATERIALS BEARING CAPACITIES TO THE SITE DESIGN ENGINEER.
11. ADS RECOMMENDS THE USE OF "FLEXSTORM CATCH IT" INSERTS DURING CONSTRUCTION FOR ALL INLETS TO PROTECT THE SUBSURFACE STORMWATER MANAGEMENT SYSTEM FROM CONSTRUCTION SITE RUNOFF.

NOTES FOR CONSTRUCTION EQUIPMENT

1. STORMTECH MC-3500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
2. THE USE OF EQUIPMENT OVER MC-3500 CHAMBERS IS LIMITED:
   - NO EQUIPMENT IS ALLOWED ON BARE CHAMBERS.
   - NO RUBBER TIRED LOADER, DUMP TRUCK, OR EXCAVATORS ARE ALLOWED UNTIL PROPER FILL DEPTHS ARE REACHED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
   - WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT CAN BE FOUND IN THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. FULL 36" (900 mm) OF STABILIZED COVER MATERIALS OVER THE CHAMBERS IS REQUIRED FOR DUMP TRUCK TRAVEL OR DUMPING.

USE OF A DOZER TO PUSH EMBEDMENT STONE BETWEEN THE ROWS OF CHAMBERS MAY CAUSE DAMAGE TO CHAMBERS AND IS NOT AN ACCEPTABLE BACKFILL METHOD. ANY CHAMBERS DAMAGED BY USING THE "DUMP AND PUSH" METHOD ARE NOT COVERED UNDER THE STORMTECH STANDARD WARRANTY.

CONTACT STORMTECH AT 1-888-892-2694 WITH ANY QUESTIONS ON INSTALLATION REQUIREMENTS OR WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT.

This has been provided as a separate document. Construction level plans have been included in the drainage report.

Provide this guide as a separate document on EDARP or as an attachment to the GEC Plans.

PROPOSED LAYOUT		CONCEPTUAL ELEVATIONS	
45	STORMTECH MC-3500 CHAMBERS	MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED):	12.50
6	STORMTECH MC-3500 END CAPS	MINIMUM ALLOWABLE GRADE (UNPAVED WITH TRAFFIC):	6.50
12	STONE ABOVE (in)	MINIMUM ALLOWABLE GRADE (UNPAVED NO TRAFFIC):	6.00
9	STONE BELOW (in)	MINIMUM ALLOWABLE GRADE (TOP OF RIGID CONCRETE PAVEMENT):	6.00
40	STONE VOID	MINIMUM ALLOWABLE GRADE (BASE OF FLEXIBLE PAVEMENT):	6.00
8884	INSTALLED SYSTEM VOLUME (CF) (PERIMETER STONE INCLUDED) (COVER STONE INCLUDED) (BASE STONE INCLUDED)	TOP OF STONE:	5.50
		TOP OF MC-3500 CHAMBER:	4.50
		24" ISOLATOR ROW PLUS INVERT:	0.92
		18" x 18" BOTTOM MANIFOLD INVERT:	0.90
2664	SYSTEM AREA (SF)	18" x 18" BOTTOM MANIFOLD INVERT:	0.90
287.5	SYSTEM PERIMETER (ft)	18" x 18" BOTTOM MANIFOLD INVERT:	0.90
		18" BOTTOM CONNECTION INVERT:	0.90
		18" BOTTOM CONNECTION INVERT:	0.90
		BOTTOM OF MC-3500 CHAMBER:	0.75
		BOTTOM OF STONE:	0.00

*INVERT ABOVE BASE OF CHAMBER

PART TYPE	ITEM ON LAYOUT	DESCRIPTION	INVERT*	MAX FLOW
PREFABRICATED END CAP	A	24" BOTTOM CORED END CAP, PART#: MC3500IEPP24BC / TYP OF ALL 24" BOTTOM CONNECTIONS AND ISOLATOR PLUS ROWS	2.06"	
PREFABRICATED END CAP	B	18" BOTTOM CORED END CAP, PART#: MC3500IEPP18BC / TYP OF ALL 18" BOTTOM CONNECTIONS	1.77"	
FLAMP	C	INSTALL FLAMP ON 24" ACCESS PIPE / PART#: MC350024RAMP		
MANIFOLD	D	18" x 18" BOTTOM MANIFOLD, ADS N-12	1.77"	
MANIFOLD	E	18" x 18" BOTTOM MANIFOLD, ADS N-12	1.77"	
MANIFOLD	F	18" x 18" BOTTOM MANIFOLD, ADS N-12	1.77"	
CONCRETE STRUCTURE	G	OCS (DESIGN BY ENGINEER / PROVIDED BY OTHERS)		8.0 CFS OUT
CONCRETE STRUCTURE	H	OCS (DESIGN BY ENGINEER / PROVIDED BY OTHERS)		8.0 CFS OUT
CONCRETE STRUCTURE W/WEIR	I	(DESIGN BY ENGINEER / PROVIDED BY OTHERS)		11.0 CFS IN

Spell out what "OCS" stands for.

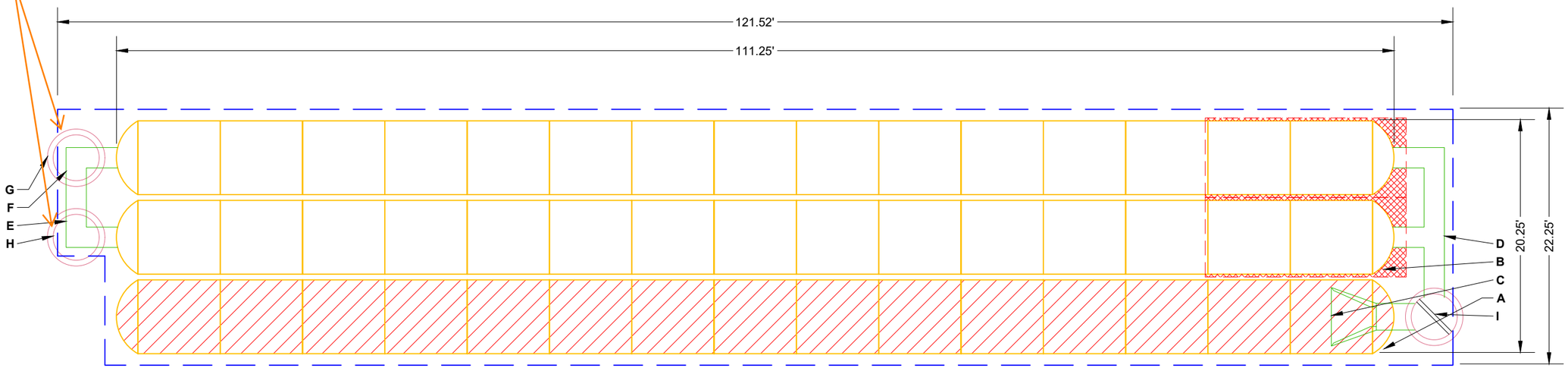
OCS has been revised to Outlet Control Structure

Provide plans that show the design of these. Plans only provided for outlet structure, not the two inlets.

The proposed drainage plan includes the inlets. The storm plan and profile drawing has also been included in this submittal for clarity.

Inlet and outlet structures have been labeled and arrows have been included on the drawing for legibility of inflow and outflow

Label which is inlet vs outlet structure.



The ADS details are manufacturer standard and could not reverse the hatching

Show location of inspection port in middle of isolator row.

Add a 2nd inspection port to one of the detention rows above the fabric.

Inspection port added and inspection ports have been labeled.

Show north arrow so this sheet is more site specific.

North arrow has been added to this plan

Show hatching going the other direction to match plans.

ISOLATOR ROW PLUS (SEE DETAIL)

PLACE MINIMUM 17.50' OF ADSPLUS175 WOVEN GEOTEXTILE OVER BEDDING STONE AND UNDERNEATH CHAMBER FEET FOR SCOUR PROTECTION AT ALL CHAMBER INLET ROWS

BED LIMITS

Manifold is called out in the table at the top of this sheet as 18"x18" so remove this note.

And provide sizing calcs for manifold.

sizing calculations have been included as part of the MHFD detention spreadsheet

NOTES

- MANIFOLD SIZE TO BE DETERMINED BY SITE DESIGN ENGINEER. SEE TECH NOTE #6.32 FOR MANIFOLD SIZING GUIDANCE.
- DUE TO THE ADAPTATION OF THIS CHAMBER SYSTEM TO SPECIFIC SITE AND DESIGN CONSTRAINTS, IT MAY BE NECESSARY TO CUT AND COUPLE ADDITIONAL PIPE TO STANDARD MANIFOLD COMPONENTS IN THE FIELD.
- THE SITE DESIGN ENGINEER MUST REVIEW ELEVATIONS AND IF NECESSARY ADJUST GRADING TO ENSURE THE CHAMBER COVER REQUIREMENTS ARE MET.
- THIS CHAMBER SYSTEM WAS DESIGNED WITHOUT SITE-SPECIFIC INFORMATION ON SOIL CONDITIONS OR BEARING CAPACITY. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR DETERMINING THE SUITABILITY OF THE SOIL AND PROVIDING THE BEARING CAPACITY OF THE INSITU SOILS. THE BASE STONE DEPTH MAY BE INCREASED OR DECREASED ONCE THIS INFORMATION IS PROVIDED.
- **NOT FOR CONSTRUCTION:** THIS LAYOUT IS FOR DIMENSIONAL PURPOSES ONLY TO PROVE CONCEPT & THE REQUIRED STORAGE VOLUME CAN BE ACHIEVED ON SITE.

K&G
EL PASO, CO
DRAWN: DI
CHECKED: N/A
DATE:
PROJECT #:
DES
CHK
DRW
DATE

StormTech®
Chamber System
888-892-2694 | WWW.STORMTECH.COM

4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473

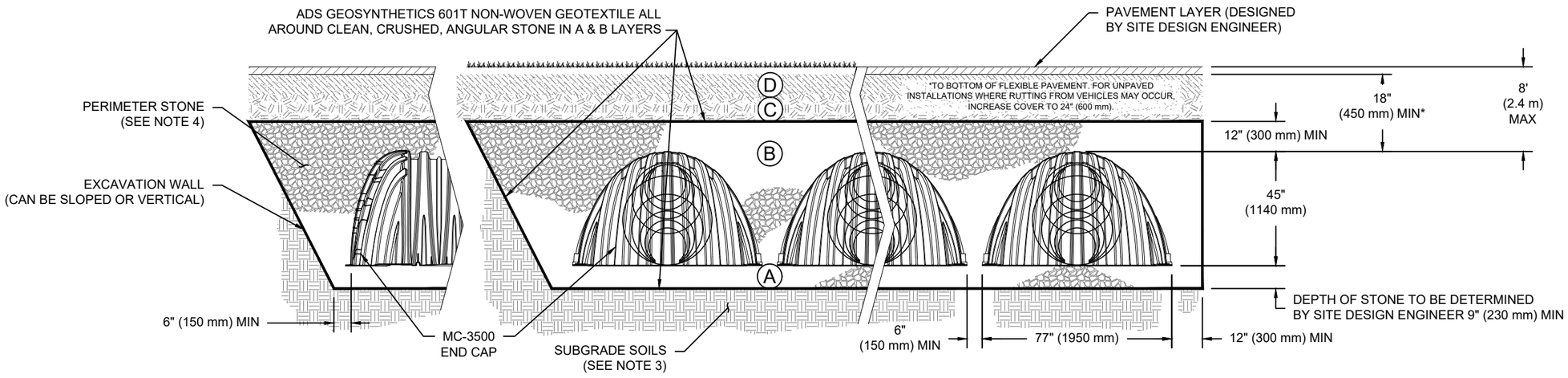
20'
10'
0

SHEET
2 OF 5

ACCEPTABLE FILL MATERIALS: STORMTECH MC-3500 CHAMBER SYSTEMS

MATERIAL LOCATION		DESCRIPTION	AASHTO MATERIAL CLASSIFICATIONS	COMPACTION / DENSITY REQUIREMENT
D	**FINAL FILL:** FILL MATERIAL FOR LAYER 'D' STARTS FROM THE TOP OF THE 'C' LAYER TO THE BOTTOM OF FLEXIBLE PAVEMENT OR UNPAVED FINISHED GRADE ABOVE. NOTE THAT PAVEMENT SUBBASE MAY BE PART OF THE 'D' LAYER	ANY SOIL/ROCK MATERIALS, NATIVE SOILS, OR PER ENGINEER'S PLANS. CHECK PLANS FOR PAVEMENT SUBGRADE REQUIREMENTS.	N/A	PREPARE PER SITE DESIGN ENGINEER'S PLANS. PAVED INSTALLATIONS MAY HAVE STRINGENT MATERIAL AND PREPARATION REQUIREMENTS.
C	**INITIAL FILL:** FILL MATERIAL FOR LAYER 'C' STARTS FROM THE TOP OF THE EMBEDMENT STONE ('B' LAYER) TO 24" (600 mm) ABOVE THE TOP OF THE CHAMBER. NOTE THAT PAVEMENT SUBBASE MAY BE A PART OF THE 'C' LAYER.	GRANULAR WELL-GRADED SOIL/AGGREGATE MIXTURES, <35% FINES OR PROCESSED AGGREGATE. MOST PAVEMENT SUBBASE MATERIALS CAN BE USED IN LIEU OF THIS LAYER.	AASHTO M145[1] A-1, A-2-4, A-3 OR AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	BEGIN COMPACTIONS AFTER 24" (600 mm) OF MATERIAL OVER THE CHAMBERS IS REACHED. COMPACT ADDITIONAL LAYERS IN 12" (300 mm) MAX LIFTS TO A MIN. 95% PROCTOR DENSITY FOR WELL GRADED MATERIAL AND 95% RELATIVE DENSITY FOR PROCESSED AGGREGATE MATERIALS.
B	**EMBEDMENT STONE:** FILL SURROUNDING THE CHAMBERS FROM THE FOUNDATION STONE ('A' LAYER) TO THE 'C' LAYER ABOVE.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43[1] 3, 4	NO COMPACTION REQUIRED.
A	**FOUNDATION STONE:** FILL BELOW CHAMBERS FROM THE SUBGRADE UP TO THE FOOT (BOTTOM) OF THE CHAMBER.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43[1] 3, 4	PLATE COMPACT OR ROLL TO ACHIEVE A FLAT SURFACE.[2,3]

PLEASE NOTE:
1. THE LISTED AASHTO DESIGNATIONS ARE FOR GRADATIONS ONLY. THE STONE MUST ALSO BE CLEAN, CRUSHED, ANGULAR. FOR EXAMPLE, A SPECIFICATION FOR #4 STONE WOULD STATE: "CLEAN, CRUSHED, ANGULAR NO. 4 (AASHTO M43) STONE".
2. STORMTECH COMPACTION REQUIREMENTS ARE MET FOR 'A' LOCATION MATERIALS WHEN PLACED AND COMPACTED IN 9" (230 mm) (MAX) LIFTS USING TWO FULL COVERAGES WITH A VIBRATORY COMPACTOR.
3. WHERE INFILTRATION SURFACES MAY BE COMPROMISED BY COMPACTION, FOR STANDARD DESIGN LOAD CONDITIONS, A FLAT SURFACE MAY BE ACHIEVED BY RAKING OR DRAGGING WITHOUT COMPACTION EQUIPMENT. FOR SPECIAL LOAD DESIGNS, CONTACT STORMTECH FOR COMPACTION REQUIREMENTS.
4. ONCE LAYER 'C' IS PLACED, ANY SOIL/MATERIAL CAN BE PLACED IN LAYER 'D' UP TO THE FINISHED GRADE. MOST PAVEMENT SUBBASE SOILS CAN BE USED TO REPLACE THE MATERIAL REQUIREMENTS OF LAYER 'C' OR 'D' AT THE SITE DESIGN ENGINEER'S DISCRETION.



NOTES:

1. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS" CHAMBER CLASSIFICATION 45x76 DESIGNATION SS.
2. MC-3500 CHAMBERS SHALL BE DESIGNED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
3. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR ASSESSING THE BEARING RESISTANCE (ALLOWABLE BEARING CAPACITY) OF THE SUBGRADE SOILS AND THE DEPTH OF FOUNDATION STONE WITH CONSIDERATION FOR THE RANGE OF EXPECTED SOIL MOISTURE CONDITIONS.
4. PERIMETER STONE MUST BE EXTENDED HORIZONTALLY TO THE EXCAVATION WALL FOR BOTH VERTICAL AND SLOPED EXCAVATION WALLS.
5. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 3".
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT SHALL BE GREATER THAN OR EQUAL TO 450 LBS/FT/%. THE ASC IS DEFINED IN SECTION 6.2.8 OF ASTM F2418. AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23° C), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.

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CHECKED: N/A
DATE:
PROJECT #:

DATE	DRW	CHK	DESCRIPTION

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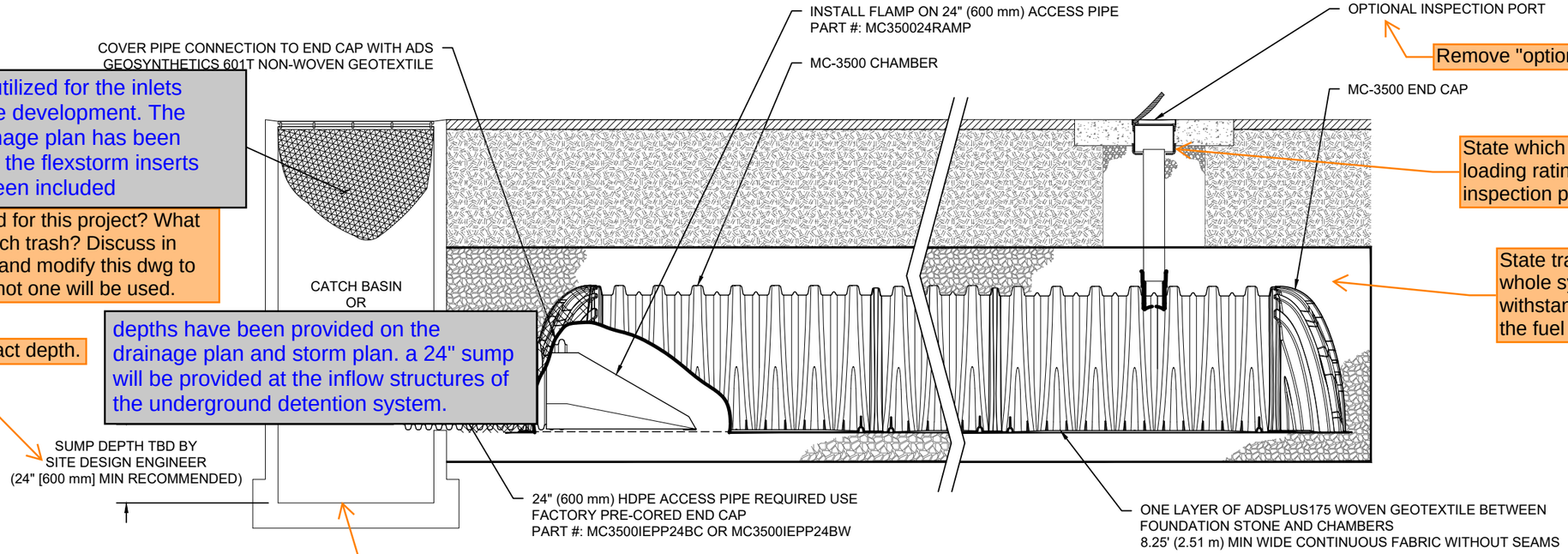

MC-3500 ISOLATOR ROW PLUS DETAIL
NTS

Yes these will be utilized for the inlets associated with the development. The narrative and drainage plan has been updated to include the flexstorm inserts and a detail has been included

Will this be utilized for this project? What will it do? Just catch trash? Discuss in report text above and modify this dwg to show whether or not one will be used.

Provide this exact depth.

depths have been provided on the drainage plan and storm plan. a 24" sump will be provided at the inflow structures of the underground detention system.

Remove "optional"

The contractor shall refer to sheet 2 for locations of inspection port. The inspection port detail has been added to sheet 4.

State which traffic loading rating the inspection port has.

Traffic loading will be HS-20 rated

State traffic loading of whole system. Can they withstanding loading of the fuel trucks?

Traffic loading will be HS-20 rated

This is for trash/debris, what about if there is a liquid gas spill? I think a hydrodynamic separator is appropriate for pre-treatment so it doesn't get into groundwater. This would better meet our criteria for high-risk sites to have a "specialized BMP."

Or show on plans and discuss in report the secondary containment designed for gas spills per state requirements. State regulatory agency for gas stations is Colorado Department of Labor and Employment (CDLE) - Division of Oil and Public Safety.

The narrative has been revised to include spill prevention methods

INSPECTION & MAINTENANCE

STEP 1) INSPECT ISOLATOR ROW PLUS FOR SEDIMENT
- A. INSPECTION PORTS (IF PRESENT)
  - A.1. REMOVE/OPEN LID ON NYLOPLAST INLINE DRAIN
  - A.2. REMOVE AND CLEAN FLEXSTORM FILTER IF INSTALLED
  - A.3. USING A FLASHLIGHT AND STADIA ROD, MEASURE DEPTH OF SEDIMENT AND RECORD ON MAINTENANCE LOG
  - A.4. LOWER A CAMERA INTO ISOLATOR ROW PLUS FOR VISUAL INSPECTION OF SEDIMENT LEVELS (OPTIONAL)
  - A.5. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.
- B. ALL ISOLATOR PLUS ROWS
  - B.1. REMOVE COVER FROM STRUCTURE AT UPSTREAM END OF ISOLATOR ROW PLUS
  - B.2. USING A FLASHLIGHT, INSPECT DOWN THE ISOLATOR ROW PLUS THROUGH OUTLET PIPE
    - i) MIRRORS ON POLES OR CAMERAS MAY BE USED TO AVOID A CONFINED SPACE ENTRY
    - ii) FOLLOW OSHA REGULATIONS FOR CONFINED SPACE ENTRY IF ENTERING MANHOLE
  - B.3. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.

STEP 2) CLEAN OUT ISOLATOR ROW PLUS USING THE JETVAC PROCESS
- A. A FIXED CULVERT CLEANING NOZZLE WITH REAR FACING SPREAD OF 45" (1.1 m) OR MORE IS PREFERRED
- B. APPLY MULTIPLE PASSES OF JETVAC UNTIL BACKFLUSH WATER IS CLEAN
- C. VACUUM STRUCTURE SUMP AS REQUIRED

STEP 3) REPLACE ALL COVERS, GRATES, FILTERS, AND LIDS; RECORD OBSERVATIONS AND ACTIONS.

STEP 4) INSPECT AND CLEAN BASINS AND MANHOLES UPSTREAM OF THE STORMTECH SYSTEM.

NOTES

1. INSPECT EVERY 6 MONTHS DURING THE FIRST YEAR OF OPERATION. ADJUST THE INSPECTION INTERVAL BASED ON PREVIOUS OBSERVATIONS OF SEDIMENT ACCUMULATION AND HIGH WATER ELEVATIONS.
2. CONDUCT JETTING AND VACTORING ANNUALLY OR WHEN INSPECTION SHOWS THAT MAINTENANCE IS NECESSARY.

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PROJECT #:	DESCRIPTION	DATE	DRW	CHK

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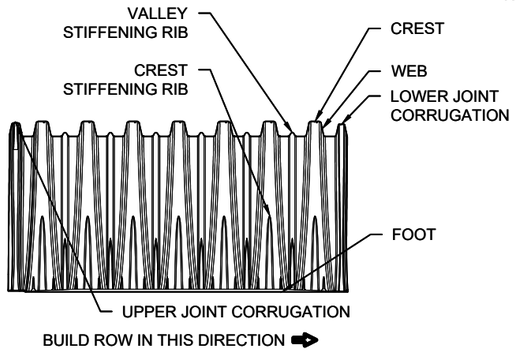
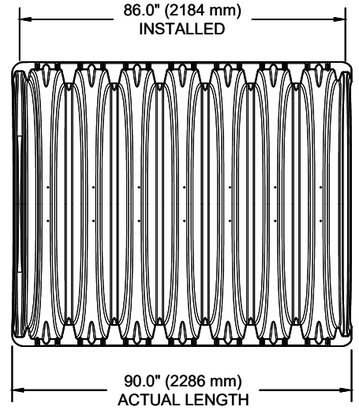
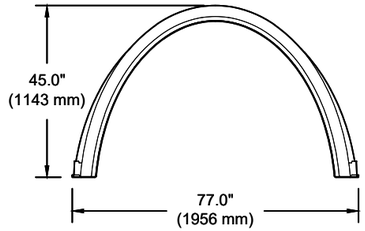
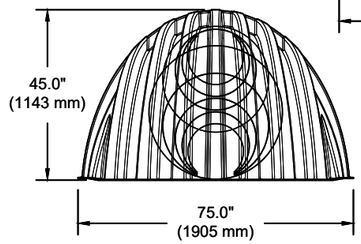
MC-3500 TECHNICAL SPECIFICATION

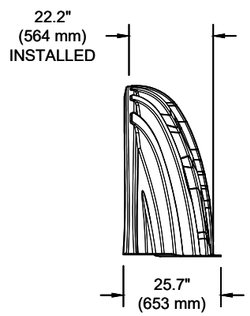
NTS











NOMINAL CHAMBER SPECIFICATIONS

SIZE (W X H X INSTALLED LENGTH)	77.0" X 45.0" X 86.0"	(1956 mm X 1143 mm X 2184 mm)
CHAMBER STORAGE	109.9 CUBIC FEET	(3.11 m³)
MINIMUM INSTALLED STORAGE*	175.0 CUBIC FEET	(4.96 m³)
WEIGHT	134 lbs.	(60.8 kg)

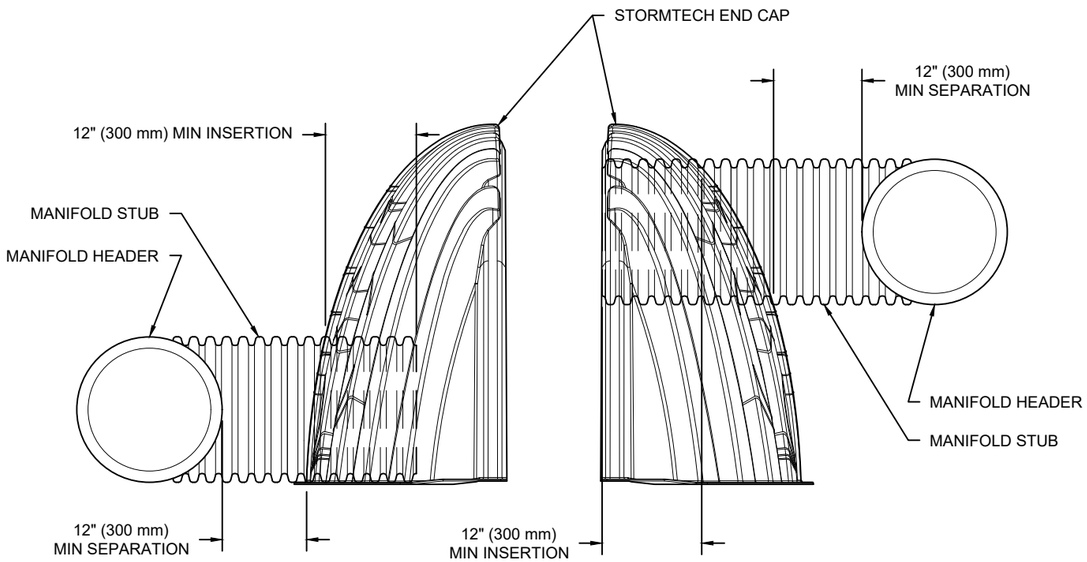
NOMINAL END CAP SPECIFICATIONS

SIZE (W X H X INSTALLED LENGTH)	75.0" X 45.0" X 22.2"	(1905 mm X 1143 mm X 564 mm)
END CAP STORAGE	14.9 CUBIC FEET	(0.42 m³)
MINIMUM INSTALLED STORAGE*	45.1 CUBIC FEET	(1.28 m³)
WEIGHT	49 lbs.	(22.2 kg)

*ASSUMES 12" (305 mm) STONE ABOVE, 9" (229 mm) STONE FOUNDATION, 6" SPACING BETWEEN CHAMBERS, 6" (152 mm) STONE PERIMETER IN FRONT OF END CAPS AND 40% STONE POROSITY

MC-SERIES END CAP INSERTION DETAIL

NTS

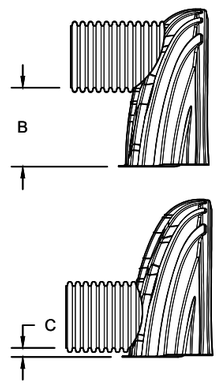


NOTE: MANIFOLD STUB MUST BE LAID HORIZONTAL FOR A PROPER FIT IN END CAP OPENING.

STUBS AT BOTTOM OF END CAP FOR PART NUMBERS ENDING WITH "B"
STUBS AT TOP OF END CAP FOR PART NUMBERS ENDING WITH "T"
END CAPS WITH A WELDED CROWN PLATE END WITH "C"
END CAPS WITH A PREFABRICATED WELDED STUB END WITH "W"

PART #	STUB	B	C
MC3500IEPP06T	6" (150 mm)	33.21" (844 mm)	---
MC3500IEPP06B		---	0.66" (17 mm)
MC3500IEPP08T	8" (200 mm)	31.16" (791 mm)	---
MC3500IEPP08B		---	0.81" (21 mm)
MC3500IEPP10T	10" (250 mm)	29.04" (738 mm)	---
MC3500IEPP10B		---	0.93" (24 mm)
MC3500IEPP12T	12" (300 mm)	26.36" (670 mm)	---
MC3500IEPP12B		---	1.35" (34 mm)
MC3500IEPP15T	15" (375 mm)	23.39" (594 mm)	---
MC3500IEPP15B		---	1.50" (38 mm)
MC3500IEPP18TC	18" (450 mm)	20.03" (509 mm)	---
MC3500IEPP18TW			
MC3500IEPP18BC		---	1.77" (45 mm)
MC3500IEPP18BW			
MC3500IEPP24TC	24" (600 mm)	14.48" (368 mm)	---
MC3500IEPP24TW			
MC3500IEPP24BC		---	2.06" (52 mm)
MC3500IEPP24BW			
MC3500IEPP30BC	30" (750 mm)	---	2.75" (70 mm)

NOTE: ALL DIMENSIONS ARE NOMINAL



CUSTOM PRECORED INVERTS ARE AVAILABLE UPON REQUEST. INVENTORIED MANIFOLDS INCLUDE 12-24" (300-600 mm) SIZE ON SIZE AND 15-48" (375-1200 mm) ECCENTRIC MANIFOLDS. CUSTOM INVERT LOCATIONS ON THE MC-3500 END CAP CUT IN THE FIELD ARE NOT RECOMMENDED FOR PIPE SIZES GREATER THAN 10" (250 mm). THE INVERT LOCATION IN COLUMN 'B' ARE THE HIGHEST POSSIBLE FOR THE PIPE SIZE.

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DATE: | DRAWN: DI | PROJECT #: | CHECKED: N/A

DESCRIPTION	CHK	DRW	DATE

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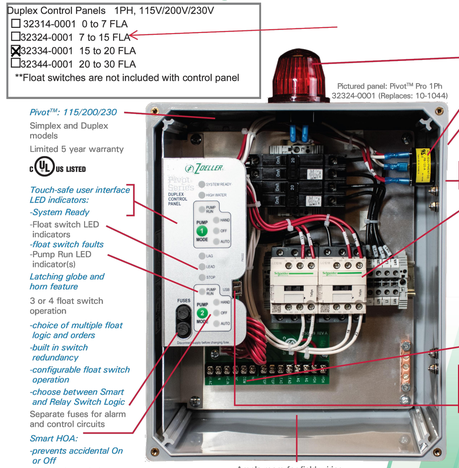
- ☐ 32324-0001 7 to 15 FLA
- ☒ 32334-0001 15 to 20 FLA
- ☐ 32344-0001 20 to 30 FLA

**Float switches are not included with control panel



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Simplex Control Panels 1 PH, 115V/200V/230V
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- ☐ 31324-0001 7 to 15 FLA
- ☐ 31334-0001 15 to 20 FLA
- ☐ 31344-0001 20 to 30 FLA

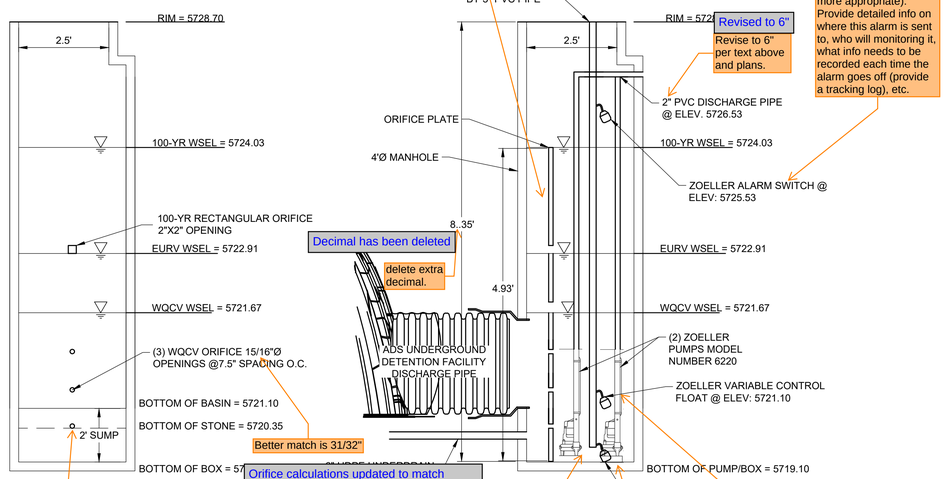
**Float switches are not included with control panel

FM3294
1220
Supersedes
New

B ZOELLER CONTROL PANEL
NOT TO SCALE

The underground detention system will be maintained and cleaned regularly. The pump system has been designed and constructed to not accept large forms of trash. The isolator row of the underground detention system has been designed to eliminate small particulates.

Discuss in O&M Manual how orifice plate will be cleaned of debris. There doesn't appear to be space down there for maintenance. What about steps for orifice plate and pump maintenance?



Orifice calculations updated to match MHFD outlet structure calculatio

ORIFICE PLATE DETAIL
NOT TO SCALE

PUMP AND ORIFICE PLATE SIDE VIEW DETAIL
NOT TO SCALE

C ORIFICE PLATE AND PUMP DETAIL
NOT TO SCALE

Drainage report updated to include verbiage about monitoring process in event of alarms or malfunctioning of pump.

In O&M Manual or DR text above (whichever is more appropriate): Provide detailed info on where this alarm is sent to, who will monitoring it, what info needs to be recorded each time the alarm goes off (provide a tracking log), etc.

Underdrain has been discussed in report narrative

Discuss function of underdrain in report text.

How will debris be kept from entering pumps and damaging them or clogging their intakes? Discuss in report text above.

Report has been updated to include discussion of how debris will not enter pump by being captured in filter bags in inle-ts and through the underground detention system.

So bottom of stone is at Stage = 0ft? Does that mean that the void space is counted towards the storage volume of the system? Please discuss in report text above.

Yes, both pumps have check valves downstream of the pump to prevent against backflow

Do pumps have an internal or external check valve to prevent backflow down the 6" outlet pipe from the street? Because the street commonly floods.

Do pump calcs include water pressure at outlet from flooding within Security Blvd? Discuss in report text.

A check valve has been included in the outlet pipe to prevent against a flooding condition.

We are very weary of allowing pumps (City criteria does not allow it) in an UG system like this.

Who is going to do proactive maintenance and inspection on pumps? The only time that you know that they're broken is when they break and things flood, and then it's too late to fix them.

So please consider all alternatives proposed on page 82 that would eliminate the need for pumps.

All alternatives have been evaluated and discussed with the city, however a pump system is the only available, feasible design

Void space in rocks is 40% and has been included in the narrative. The stage storage volume for the ADS Underground detention system has been included in the report

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SECTION: Z2.20.110
ZM2349
0521
Supersedes
1120

Submersible Wastewater Pump Association SWPA MEMBER

62 HD SERIES
TECHNICAL DATA
4" & 6" FLANGED DISCHARGE UNITS
5 - 20 BHP

(Tested to UL778 and CSA22.2 108 Standards)

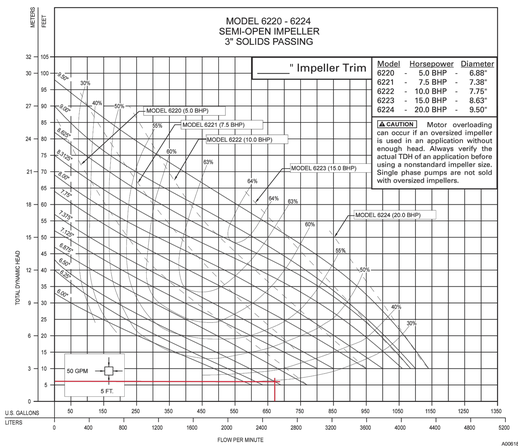
MODEL NUMBER:	☐ 6220	☐ 6221	☐ 6222	☐ 6223	☐ 6224
PUMP NAME PLATE HORSEPOWER: BHP	5.0	7.5	10.0	15.0	20.0
NEC LOCKED ROTOR CODE:	D	F	C	E	B
MAXIMUM KW INPUT:	5.2	7.8	9.8	13.5	16.8
IMPELLER DIAMETERS: in (mm) STANDARD	6-7/8" (175mm)	7-3/8" (187mm)	7-3/4" (197mm)	8-5/8" (219mm)	9-1/2" (241mm)
DISCHARGE SIZE:	☐ 4" FLANGED HORIZONTAL or ☐ 6" FLANGED HORIZONTAL				
☐ Standard Hydraulic Design - page 2 ☐ Vortex Hydraulic Design - page 4 ☐ High Head Hydraulic Design (4" discharge only) - page 3					

SOLID SIZE: in (mm)	3" (75 mm)	TANDEM SEALS:	STANDARD
IMPELLER TYPE:	SEMI-OPEN ☐ OPTIONAL VORTEX	MOTOR DESIGN LETTER:	NEMA B
IMPELLER MATERIAL:	DUCTILE IRON ☐ OPTIONAL BRONZE	CORD LENGTH: ft (m)	25' (7.6 m) ☐ ____'
FLANGE:	ANSI B16.1	SENSOR CORD SIZE:	#18 - 5 SOOW
PUMP NET WEIGHT: lbs. (kg)	350 lbs. (159kg)	POWER CORD SIZE:	#12-4 / #8-4 / #4-4
MOTER SHAFT:	416 SS	TYPE SOOW AMPS:	<20 / <36.7 / >36.7
RPM:	1750	STATOR & LEAD WIRES INSULATION:	CLASS F
MOTOR TYPE:	STANDARD SUBMERSIBLE	MAXIMUM STATOR TEMPERATURE:	311 °F (155 °C)
	☐ *** INVERTER DUTY SUBMERSIBLE	*DRY PIT (5 - 10 BHP)	☐
		*HIGH TEMPERATURE (5 - 10 BHP)	☐ (175°F MAX.)

SHAFT SEAL CONSTRUCTION:	STANDARD	CARBON/CERAMIC
	OPTIONAL UPPER	☐ CARBON / SILICON CARBIDE ☐ SILICON CARBIDE/SILICON CARBIDE
	OPTIONAL LOWER	☐ CARBON / SILICON CARBIDE ☐ SILICON CARBIDE/SILICON CARBIDE
O-RING ELASTOMERS	STANDARD	BUNA-N
	OPTIONAL	☐ VITON
ES**	MOTOR THERMAL SHUTOFF	THERMAL SENSORS WITH AUTOMATIC RESET
	MOISTURE DETECTION	MOISTURE SENSING PROBES
☐ OPTIONAL		DESIGN POINT: _____ GPM @ ____' TDH; IMPELLER DIA. _____"
L FOR CONTINUOUS		24" (0.6m) (For Continuous Duty, Refer to Warranty)
MAXIMUM WATER TEMPERATURE:		104 °F (40 °C)

* Contact factory. These configurations are not CSA listed. ** Requires a circuit in control panel to function.
30 Hz -60 Hz Max, NEMA MG-1 Part 30, cCSAus certified when used with type VPWM inverter.

MODEL	BHP	SERVICE FACTOR	☐ 230V/ 1 PHASE		☐ 200V/ 3 PHASE		☐ 230V/ 3 PHASE		☐ 460V/ 3 PHASE		☐ 575V/ 3 PHASE	
			FLA	LRA	FLA	LRA	FLA	LRA	FLA	LRA	FLA	LRA
6220	5.0	1.2	27.5	91.0	17.5	61.9	15.2	53.8	7.6	26.9	6.1	21.8
6221	7.5	1.2	36.7	137.0	25.0	109.0	22.0	95.0	11.0	47.5	9.0	37.8
6222	10.0	1.2	N/A	N/A	32.0	109.0	28.0	95.0	14.0	47.5	11.0	37.8
			N/A	N/A	48.3	197.0	41.7	172.0	20.9	86.0	16.4	70.0
			N/A	N/A	59.4	197.0	54.0	172.0	27.0	86.0	22.0	70.0



D ZOLLER PUMP MODEL NO. 6220
NOT TO SCALE

PCD FILE NO. PPR-2225

P:\KUM & GO\CO, EL PASO COUNTY_ 2232_MAIN AND SECURITY\08 CAD\DRAINAGE\D3 - STORM DETAILS.DWG

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501 S Cherry St, Suite 300
Glendale, CO 80246
303-572-7997 www.ees.us.com

Kum & Go

1459 Grand Ave
Des Moines, IA 50309
P: 888-458-6646

2232 - EL PASO, COLORADO
SECURITY BLVD. AND MAIN ST.
STORM DETAILS

KG PROJECT TEAM:
RDM:
SDM:
CPM:

REVISIONS	DATE	REVISION DESCRIPTION

DATE: 08-12-2022

SHEET NUMBER:

CRITERIA PLAN 04/2020

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SECTION: Z2.20.110
ZM2349
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62 HD SERIES
TECHNICAL DATA
4" & 6" FLANGED DISCHARGE UNITS
5 - 20 BHP

C SA US (Tested to UL778 and CSA22.2 108 Standards)

FAMILY OWNED AMERICAN PROUD

MODEL NUMBER:	☐ 6220	☐ 6221	☐ 6222	☐ 6223	☐ 6224
PUMP NAME PLATE HORSEPOWER: BHP	5.0	7.5	10.0	15.0	20.0
NEC LOCKED ROTOR CODE:	D	F	C	E	B
MAXIMUM KW INPUT:	5.2	7.8	9.8	13.5	16.8
IMPELLER DIAMETERS: in (mm) STANDARD	6-7/8" (175mm)	7-3/8" (187mm)	7-3/4" (197mm)	8-5/8" (219mm)	9-1/2" (241mm)
DISCHARGE SIZE:	☐ 4" FLANGED HORIZONTAL or ☐ 6" FLANGED HORIZONTAL				
☐ Standard Hydraulic Design - page 2 ☐ Vortex Hydraulic Design - page 4 ☐ High Head Hydraulic Design (4" discharge only) - page 3					

SOLID SIZE: in (mm)	3" (75 mm)		TANDEM SEALS:	STANDARD		
IMPELLER TYPE:	SEMI-OPEN ☐ OPTIONAL VORTEX		MOTOR DESIGN LETTER:	NEMA B		
IMPELLER MATERIAL:	DUCTILE IRON ☐ OPTIONAL BRONZE		CORD LENGTH: ft (m)	25' (7.6 m) ☐ _____'		
FLANGE:	ANSI B16.1		SENSOR CORD SIZE:	#18 - 5 SOOW		
PUMP NET WEIGHT: lbs. (kg)	350 lbs. (159kg)		POWER CORD SIZE:	#12-4	#8-4	#4-4
MOTER SHAFT:	416 SS		TYPE SOOW AMPS:	<20	<36.7	>36.7
RPM:	1750		STATOR & LEAD WIRES INSULATION:	CLASS F		
MOTOR TYPE:	STANDARD SUBMERSIBLE		MAXIMUM STATOR TEMPERATURE:	311 °F (155 °C)		
	☐ *** INVERTER DUTY SUBMERSIBLE		*DRY PIT (5 - 10 BHP)	☐		
			*HIGH TEMPERATURE (5 - 10 BHP)	☐ (175°F MAX.)		

SHAFT SEAL CONSTRUCTION:	STANDARD	CARBON/CERAMIC
	OPTIONAL UPPER	☐ CARBON / SILICON CARBIDE ☐ SILICON CARBIDE/SILICON CARBIDE
	OPTIONAL LOWER	☐ CARBON / SILICON CARBIDE ☐ SILICON CARBIDE/SILICON CARBIDE
O-RING ELASTOMERS	STANDARD	BUNA-N
	OPTIONAL	☐ VITON
STANDARD SENSING DEVICES**	MOTOR THERMAL SHUTOFF	THERMAL SENSORS WITH AUTOMATIC RESET
	MOISTURE DETECTION	MOISTURE SENSING PROBES
IMPELLER TRIM: ☐ OPTIONAL		DESIGN POINT: _____ GPM @ _____' TDH, IMPELLER DIA. _____"
RECOMMENDED FLUID LEVEL FOR CONTINUOUS OPERATIONS: in (m)		24" (0.6m) (For Continuous Duty, Refer to Warranty)
MAXIMUM WATER TEMPERATURE:		104 °F (40 °C)

* Contact factory. These configurations are not CSA listed. ** Requires a circuit in control panel to function.
*** 30 Hz -60 Hz Max, NEMA MG-1 Part 30, cCSAus certified when used with type VPWM inverter.

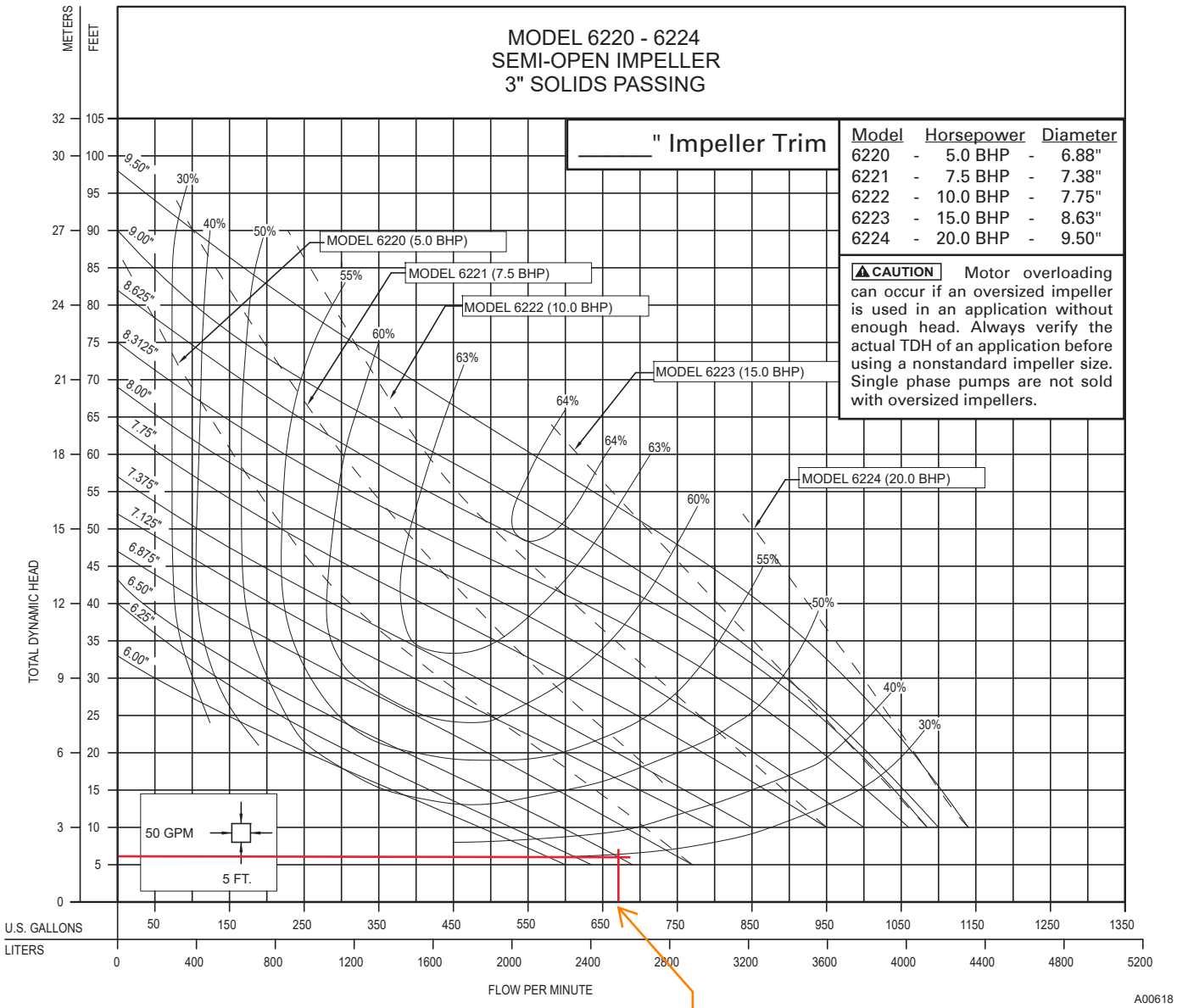
MODEL	BHP	SERVICE FACTOR	☐ 230V/ 1 PHASE		☐ 200V/ 3 PHASE		☐ 230V/ 3 PHASE		☐ 460V/ 3 PHASE		☐ 575V/ 3 PHASE	
			FLA	LRA	FLA	LRA	FLA	LRA	FLA	LRA	FLA	LRA
6220	5.0	1.2	27.5	91.0	17.5	61.9	15.2	53.8	7.6	26.9	6.1	21.8
6221	7.5	1.2	36.7	137.0	25.0	109.0	22.0	95.0	11.0	47.5	9.0	37.8
6222	10.0	1.2	N/A	N/A	32.0	109.0	28.0	95.0	14.0	47.5	11.0	37.8
6223	15.0	1.2	N/A	N/A	48.3	197.0	41.7	172.0	20.9	86.0	16.4	70.0
6224	20.0	1.0	N/A	N/A	59.4	197.0	54.0	172.0	27.0	86.0	22.0	70.0

Semi-Open Impeller

PERFORMANCE DATA
5 - 20 BHP

4" & 6" Flanged Discharge Units

3" Solids Passing Capacity



Internal Review Note:
670gpm = 1.5cfs
Peak outflow through orifice (for 100-yr storm) is 0.29 cfs.

Acknowledged

Zoeller Engineered Products • 3649 Cane Run Road • Louisville, Kentucky 40211-1961 • (502) 778-2731

"SWPA Data Categories Presented -- Data on this sheet supply design information as the minimum recommended by the Submersible Wastewater Pump Association (SWPA) and is defined in accordance with SWPA's Standardized Definitions for Pump and Motor Characteristics. The accuracy of the data is the responsibility of Zoeller Engineered Products."

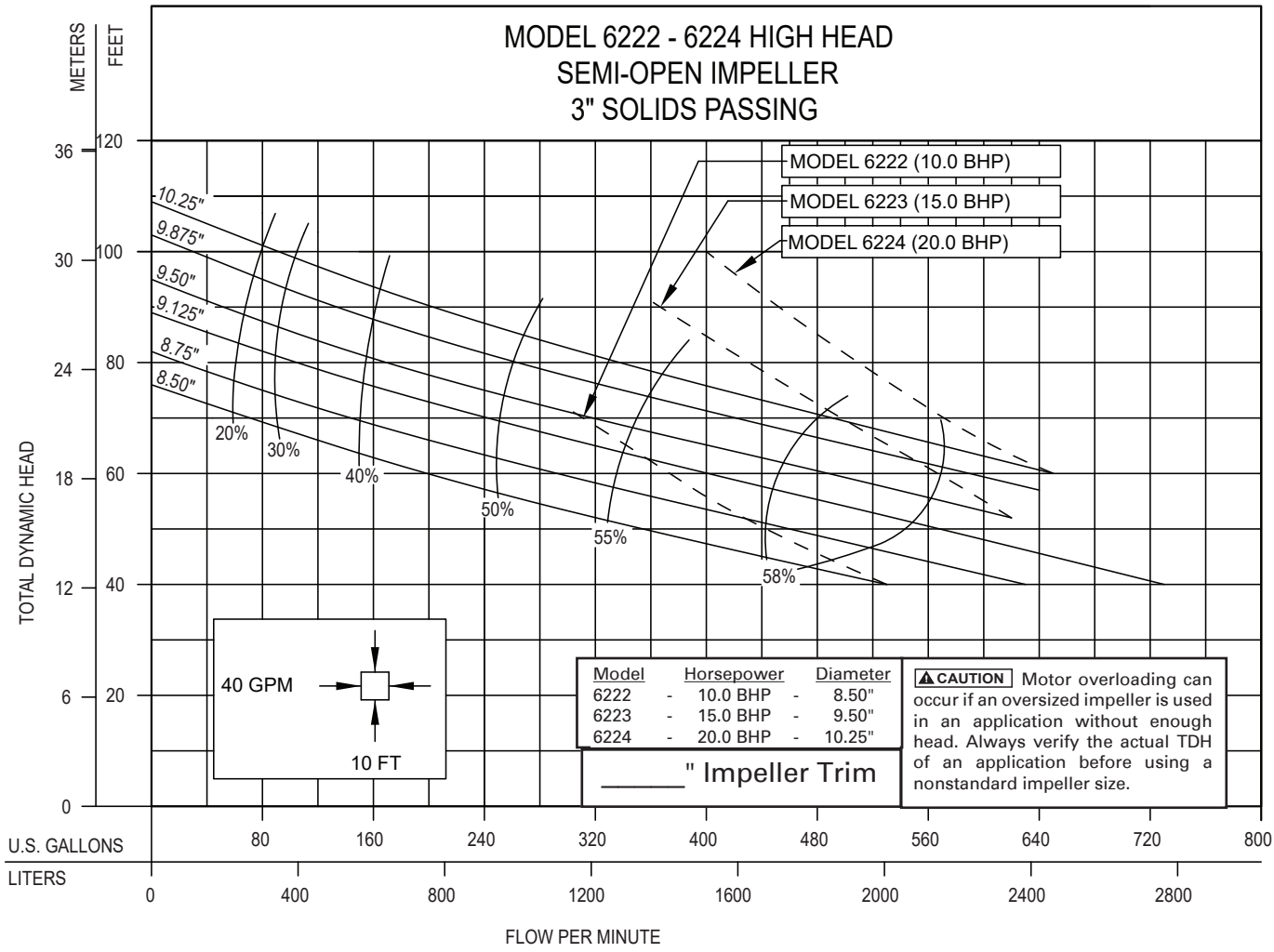
High Head Semi-Open Impeller

PERFORMANCE DATA

10 - 15 - 20 BHP

4" Flanged Discharge

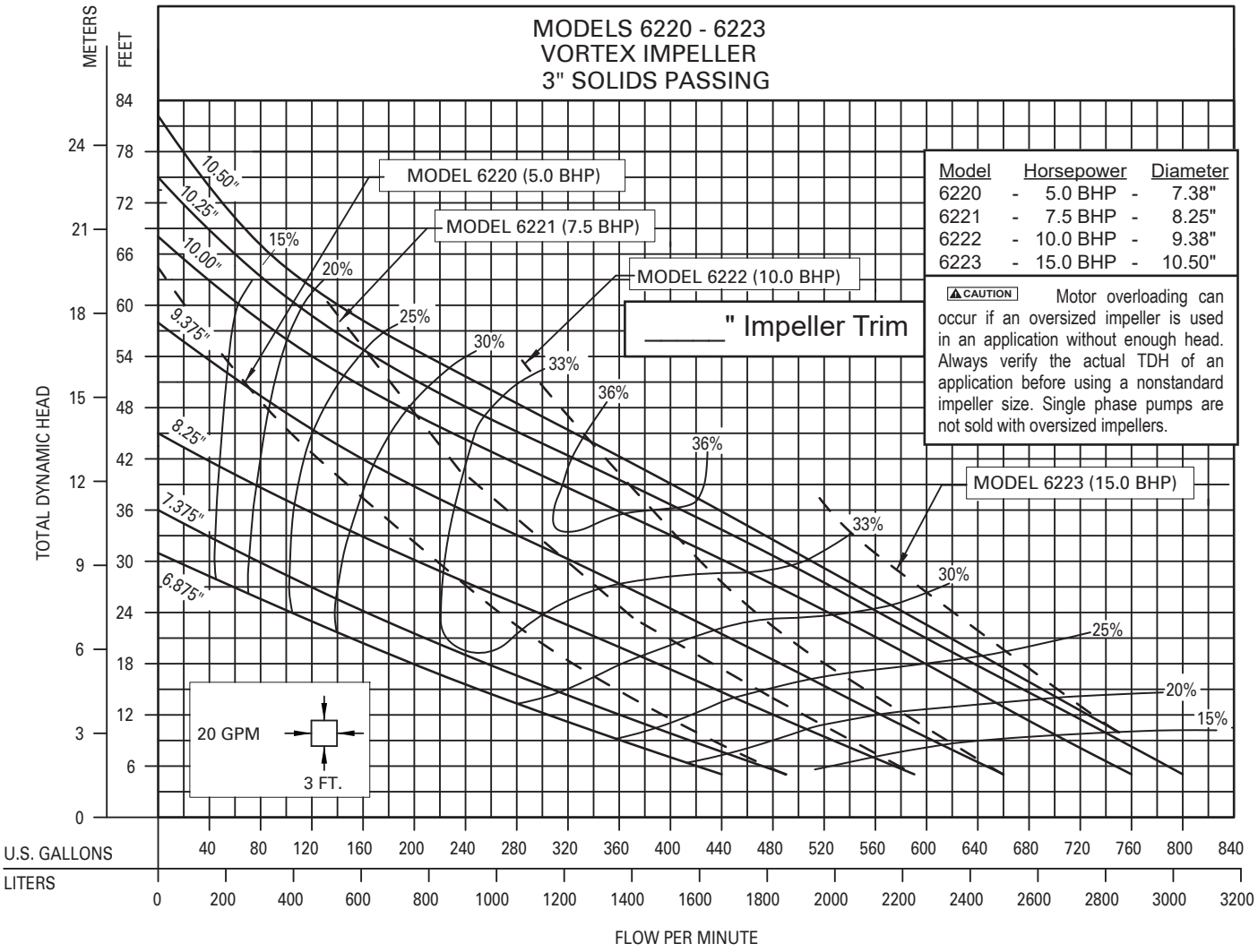
3" Solids Passing Capacity



A00619

"SWPA Data Categories Presented -- Data on this sheet supply design information as the minimum recommended by the Submersible Wastewater Pump Association (SWPA) and is defined in accordance with SWPA's Standardized Definitions for Pump and Motor Characteristics. The accuracy of the data is the responsibility of Zoeller Engineered Products."

Vortex Impeller
PERFORMANCE DATA
5.0 - 15.0 BHP
4" & 6" Flanged Discharge Units
3" Solids Passing Capacity



Model		Horsepower		Diameter
6220	-	5.0 BHP	-	7.38"
6221	-	7.5 BHP	-	8.25"
6222	-	10.0 BHP	-	9.38"
6223	-	15.0 BHP	-	10.50"

⚠ CAUTION Motor overloading can occur if an oversized impeller is used in an application without enough head. Always verify the actual TDH of an application before using a nonstandard impeller size. Single phase pumps are not sold with oversized impellers.

B00617

Zoeller Engineered Products • 3649 Cane Run Road • Louisville, Kentucky 40211-1961 • (502) 778-2731

"SWPA Data Categories Presented -- Data on this sheet supply design information as the minimum recommended by the Submersible Wastewater Pump Association (SWPA) and is defined in accordance with SWPA's Standardized Definitions for Pump and Motor Characteristics. The accuracy of the data is the responsibility of Zoeller Engineered Products."

Drainage Report Final_V2.pdf Markup Summary

lpackman (4)

Subject: Callout
Page Label: 11
Author: lpackman
Date: 11/14/2022 10:29:38 AM
Status:
Color:
Layer:
Space:

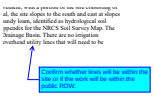
Unresolved. Please discuss the constructability of tying into the existing storm inlet at the intersection of Main and Security. Why is that not being considered? If utilities are in the way please provide proof of locates. The pump will be considered if there is really no other option available. Per ECM 3.2.4 a suitable outfall is required for the ultimate discharge of runoff.

Subject: Text Box
Page Label: [1] Layout1
Author: lpackman
Date: 11/14/2022 11:36:14 AM
Status:
Color:
Layer:
Space:

Unresolved. Please move drainage maps to the end of the report contents.

Subject: Text Box
Page Label: [1] Layout1
Author: lpackman
Date: 11/14/2022 11:38:33 AM
Status:
Color:
Layer:
Space:

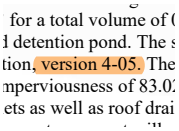
Unresolved. Please move drainage maps to the end of the report contents.



Subject: Callout
Page Label: 4
Author: lpackman
Date: 11/14/2022 11:57:33 AM
Status:
Color:
Layer:
Space:

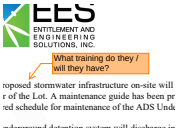
Confirm whether lines will be within the site or if the work will be within the public ROW.

Glenn Reese - EPC Stormwater (64)



Subject: SW - Highlight
Page Label: 10
Author: Glenn Reese - EPC Stormwater
Date: 11/7/2022 1:43:17 PM
Status:
Color:
Layer:
Space:

version 4-05.

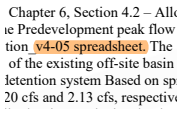


Subject: SW - Textbox with Arrow
Page Label: 11
Author: Glenn Reese - EPC Stormwater
Date: 11/7/2022 1:43:28 PM
Status:
Color:
Layer:
Space:

What training do they / will they have?

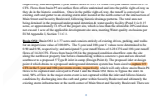
Subject: SW - Highlight
Page Label: 11
Author: Glenn Reese - EPC Stormwater
Date: 11/7/2022 1:43:34 PM
Status:
Color:
Layer:
Space:

All proposed stormwater infrastructure on-site will be private and owned and maintained by the owner of the Lot.



Subject: SW - Highlight
Page Label: 11
Author: Glenn Reese - EPC Stormwater
Date: 11/7/2022 1:43:46 PM
Status:
Color:
Layer:
Space:

v4-05 spreadsheet.



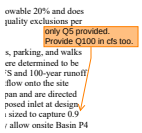
Subject: SW - Highlight
Page Label: 9
Author: Glenn Reese - EPC Stormwater
Date: 11/7/2022 1:52:48 PM
Status:
Color:
Layer:
Space:

capture 0.9
CFS in the 5-year and 100-year storm events, respectively

Subject: SW - Highlight
Page Label: 9
Author: Glenn Reese - EPC Stormwater
Date: 11/7/2022 1:55:36 PM
Status:
Color:
Layer:
Space:

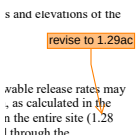
which will only allow onsite Basin P4
flows to be captured and conveyed to Pond 1 and the Basin OS1 flows to bypass the inlet

---



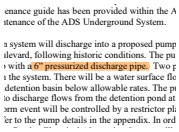
Subject: SW - Textbox with Arrow
Page Label: 9
Author: Glenn Reese - EPC Stormwater
Date: 11/7/2022 1:55:42 PM
Status:
Color:
Layer:
Space:

only Q5 provided. Provide Q100 in cfs too.



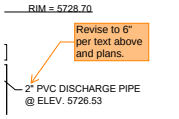
Subject: SW - Textbox with Arrow
Page Label: 11
Author: Glenn Reese - EPC Stormwater
Date: 11/7/2022 2:16:20 PM
Status:
Color:
Layer:
Space:

revise to 1.29ac



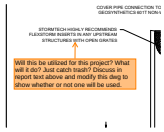
Subject: SW - Highlight
Page Label: 11
Author: Glenn Reese - EPC Stormwater
Date: 11/7/2022 2:17:39 PM
Status:
Color:
Layer:
Space:

6” pressurized discharge pipe.



Subject: SW - Textbox with Arrow
Page Label: [1] STORM DETAILS (3)
Author: Glenn Reese - EPC Stormwater
Date: 11/8/2022 1:33:39 PM
Status:
Color:
Layer:
Space:

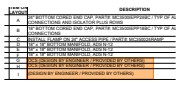
Revise to 6" per text above and plans.



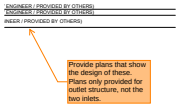
Subject: SW - Textbox with Arrow
Page Label: [4] output-4
Author: Glenn Reese - EPC Stormwater
Date: 11/8/2022 10:46:47 AM
Status:
Color:
Layer:
Space:

Will this be utilized for this project? What will it do? Just catch trash? Discuss in report text above and modify this dwg to show whether or not one will be used.

Subject: SW - Rectangle
Page Label: [1] output-COVER
Author: Glenn Reese - EPC Stormwater
Date: 11/8/2022 10:49:34 AM
Status:
Color:
Layer:
Space:



Subject: SW - Rectangle
Page Label: [2] output-2
Author: Glenn Reese - EPC Stormwater
Date: 11/8/2022 10:52:58 AM
Status:
Color:
Layer:
Space:

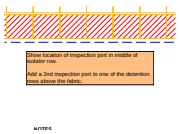


Subject: SW - Textbox with Arrow
Page Label: [2] output-2
Author: Glenn Reese - EPC Stormwater
Date: 11/8/2022 10:53:24 AM
Status:
Color:
Layer:
Space:

Provide plans that show the design of these. Plans only provided for outlet structure, not the two inlets.

Subject: SW - Highlight
Page Label: [2] output-2
Author: Glenn Reese - EPC Stormwater
Date: 11/8/2022 10:54:59 AM
Status:
Color:
Layer:
Space:

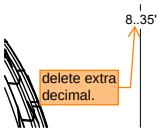
MANIFOLD SIZE TO BE DETERMINED BY SITE DESIGN ENGINEER.



Subject: SW - Textbox
Page Label: [2] output-2
Author: Glenn Reese - EPC Stormwater
Date: 11/8/2022 10:57:00 AM
Status:
Color:
Layer:
Space:

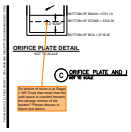
Show location of inspection port in middle of isolator row.

Add a 2nd inspection port to one of the detention rows above the fabric.



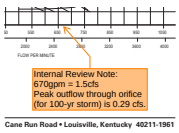
Subject: SW - Textbox with Arrow
Page Label: [1] STORM DETAILS (3)
Author: Glenn Reese - EPC Stormwater
Date: 11/8/2022 2:02:09 PM
Status:
Color:
Layer:
Space:

delete extra decimal.



Subject: SW - Textbox with Arrow
Page Label: [1] STORM DETAILS (3)
Author: Glenn Reese - EPC Stormwater
Date: 11/8/2022 2:02:29 PM
Status:
Color:
Layer:
Space:

So bottom of stone is at Stage = 0ft? Does that mean that the void space is counted towards the storage volume of the system? Please discuss in report text above.



Subject: SW - Textbox with Arrow
Page Label: 90
Author: Glenn Reese - EPC Stormwater
Date: 11/8/2022 2:05:36 PM
Status:
Color:
Layer:
Space:

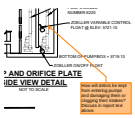
Internal Review Note:
670gpm = 1.5cfs
Peak outflow through orifice (for 100-yr storm) is 0.29 cfs.

Subject: SW - Textbox with Arrow
Page Label: [1] STORM DETAILS (3)
Author: Glenn Reese - EPC Stormwater
Date: 11/8/2022 2:06:15 PM
Status:
Color:
Layer:
Space:

Discuss in O&M Manual how orifice plate will be cleaned of debris. There doesn't appear to be space down there for maintenance. What about steps for orifice plate and pump maintenance?

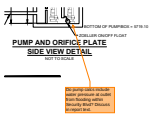
Subject: SW - Textbox with Arrow
Page Label: [1] STORM DETAILS (3)
Author: Glenn Reese - EPC Stormwater
Date: 11/8/2022 2:06:37 PM
Status:
Color:
Layer:
Space:

In O&M Manual or DR text above (whichever is more appropriate):
Provide detailed info on where this alarm is sent to, who will monitoring it, what info needs to be recorded each time the alarm goes off (provide a tracking log), etc.



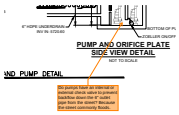
Subject: SW - Textbox with Arrow
Page Label: [1] STORM DETAILS (3)
Author: Glenn Reese - EPC Stormwater
Date: 11/8/2022 2:06:42 PM
Status:
Color:
Layer:
Space:

How will debris be kept from entering pumps and damaging them or clogging their intakes? Discuss in report text above.



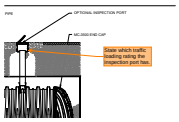
Subject: SW - Textbox with Arrow
Page Label: [1] STORM DETAILS (3)
Author: Glenn Reese - EPC Stormwater
Date: 11/8/2022 2:07:03 PM
Status:
Color:
Layer:
Space:

Do pump calcs include water pressure at outlet from flooding within Security Blvd? Discuss in report text.



Subject: SW - Textbox with Arrow
Page Label: [1] STORM DETAILS (3)
Author: Glenn Reese - EPC Stormwater
Date: 11/8/2022 2:07:13 PM
Status:
Color:
Layer:
Space:

Do pumps have an internal or external check valve to prevent backflow down the 6" outlet pipe from the street? Because the street commonly floods.



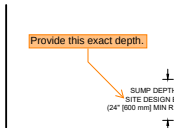
Subject: SW - Textbox with Arrow
Page Label: [4] output-4
Author: Glenn Reese - EPC Stormwater
Date: 11/8/2022 2:08:02 PM
Status:
Color:
Layer:
Space:

State which traffic loading rating the inspection port has.

Subject: SW - Textbox with Arrow
Page Label: [4] output-4
Author: Glenn Reese - EPC Stormwater
Date: 11/8/2022 2:14:12 PM
Status:
Color:
Layer:
Space:

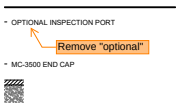
This is for trash/debris, what about if there is a liquid gas spill? I think a hydrodynamic separator is appropriate for pre-treatment so it doesn't get into groundwater. This would better meet our criteria for high-risk sites to have a "specialized BMP."

Or show on plans and discuss in report the secondary containment designed for gas spills per state requirements. State regulatory agency for gas stations is Colorado Department of Labor and Employment (CDLE) - Division of Oil and Public Safety.



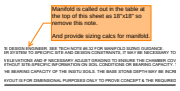
Subject: SW - Textbox with Arrow
Page Label: [4] output-4
Author: Glenn Reese - EPC Stormwater
Date: 11/8/2022 2:14:30 PM
Status:
Color:
Layer:
Space:

Provide this exact depth.



Subject: SW - Textbox with Arrow
Page Label: [4] output-4
Author: Glenn Reese - EPC Stormwater
Date: 11/8/2022 2:14:41 PM
Status:
Color:
Layer:
Space:

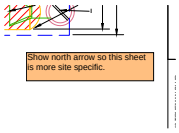
Remove "optional"



Subject: SW - Textbox with Arrow
Page Label: [2] output-2
Author: Glenn Reese - EPC Stormwater
Date: 11/8/2022 2:14:56 PM
Status:
Color:
Layer:
Space:

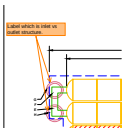
Manifold is called out in the table at the top of this sheet as 18"x18" so remove this note.

And provide sizing calcs for manifold.



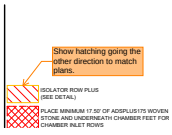
Subject: SW - Textbox
Page Label: [2] output-2
Author: Glenn Reese - EPC Stormwater
Date: 11/8/2022 2:15:07 PM
Status:
Color:
Layer:
Space:

Show north arrow so this sheet is more site specific.



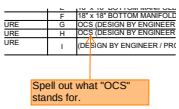
Subject: SW - Textbox with Arrow
Page Label: [2] output-2
Author: Glenn Reese - EPC Stormwater
Date: 11/8/2022 2:16:39 PM
Status:
Color:
Layer:
Space:

Label which is inlet vs outlet structure.



Subject: SW - Textbox with Arrow
Page Label: [2] output-2
Author: Glenn Reese - EPC Stormwater
Date: 11/8/2022 2:16:47 PM
Status:
Color:
Layer:
Space:

Show hatching going the other direction to match plans.

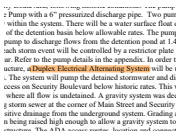


Subject: SW - Textbox with Arrow
Page Label: [2] output-2
Author: Glenn Reese - EPC Stormwater
Date: 11/8/2022 2:16:55 PM
Status:
Color:
Layer:
Space:

Spell out what "OCS" stands for.

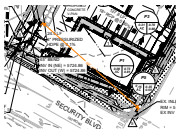
Subject: SW - Textbox with Arrow
Page Label: [1] output-COVER
Author: Glenn Reese - EPC Stormwater
Date: 11/8/2022 2:17:06 PM
Status:
Color:
Layer:
Space:

Provide this guide as a separate document on EDARP or as an attachment to the GEC Plans.



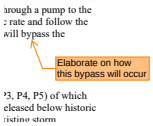
Subject: SW - Highlight
Page Label: 11
Author: Glenn Reese - EPC Stormwater
Date: 11/8/2022 6:53:53 AM
Status:
Color:
Layer:
Space:

Duplex Electrical Alternating System



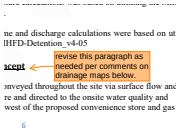
Subject: SW - Length Measurement
Page Label: [1] Layout1
Author: Glenn Reese - EPC Stormwater
Date: 11/8/2022 7:48:58 AM
Status:
Color:
Layer:
Space:

166'-11"



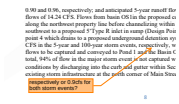
Subject: SW - Textbox with Arrow
Page Label: 8
Author: Glenn Reese - EPC Stormwater
Date: 11/9/2022 3:04:41 PM
Status:
Color:
Layer:
Space:

Elaborate on how this bypass will occur



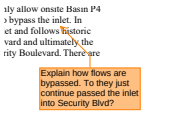
Subject: SW - Textbox with Arrow
Page Label: 7
Author: Glenn Reese - EPC Stormwater
Date: 11/9/2022 3:30:48 PM
Status:
Color:
Layer:
Space:

revise this paragraph as needed per comments on drainage maps below.



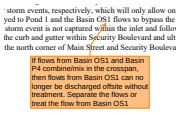
Subject: SW - Textbox with Arrow
Page Label: 9
Author: Glenn Reese - EPC Stormwater
Date: 11/9/2022 3:36:19 PM
Status:
Color:
Layer:
Space:

respectively or 0.9cfs for both storm events?



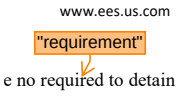
Subject: SW - Textbox with Arrow
Page Label: 9
Author: Glenn Reese - EPC Stormwater
Date: 11/9/2022 3:36:53 PM
Status:
Color:
Layer:
Space:

Explain how flows are bypassed. To they just continue passed the inlet into Security Blvd?



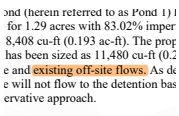
Subject: SW - Textbox with Arrow
Page Label: 9
Author: Glenn Reese - EPC Stormwater
Date: 11/9/2022 3:36:57 PM
Status:
Color:
Layer:
Space:

If flows from Basin OS1 and Basin P4 combine/mix in the crosspan, then flows from Basin OS1 can no longer be discharged offsite without treatment. Separate the flows or treat the flow from Basin OS1



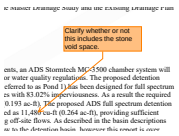
Subject: SW - Textbox with Arrow
Page Label: 10
Author: Glenn Reese - EPC Stormwater
Date: 11/9/2022 3:37:34 PM
Status:
Color:
Layer:
Space:

"requirement"



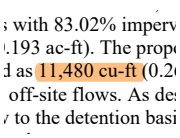
Subject: SW - Highlight
Page Label: 10
Author: Glenn Reese - EPC Stormwater
Date: 11/9/2022 3:38:57 PM
Status:
Color:
Layer:
Space:

existing off-site flows.



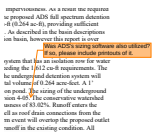
Subject: SW - Textbox with Arrow
Page Label: 10
Author: Glenn Reese - EPC Stormwater
Date: 11/9/2022 3:39:46 PM
Status:
Color:
Layer:
Space:

Clarify whether or not this includes the stone void space.



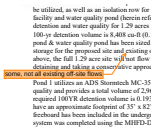
Subject: SW - Highlight
Page Label: 10
Author: Glenn Reese - EPC Stormwater
Date: 11/9/2022 3:39:55 PM
Status:
Color:
Layer:
Space:

11,480 cu-ft



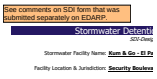
Subject: SW - Textbox with Arrow
Page Label: 10
Author: Glenn Reese - EPC Stormwater
Date: 11/9/2022 3:42:26 PM
Status:
Color:
Layer:
Space:

Was ADS's sizing software also utilized? If so, please include printouts of it.



Subject: SW - Textbox with Arrow
Page Label: 10
Author: Glenn Reese - EPC Stormwater
Date: 11/9/2022 3:42:41 PM
Status:
Color:
Layer:
Space:

some, not all existing off-site flows

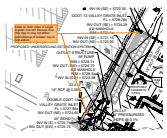


Subject: SW - Textbox
Page Label: 49
Author: Glenn Reese - EPC Stormwater
Date: 11/9/2022 3:49:08 PM
Status:
Color:
Layer:
Space:

See comments on SDI form that was submitted separately on EDARP.

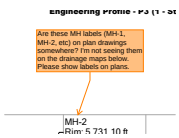
Subject: SW - Textbox with Arrow
Page Label: [1] Layout1
Author: Glenn Reese - EPC Stormwater
Date: 11/9/2022 3:52:32 PM
Status:
Color:
Layer:
Space:

Show existing flow arrows in Main St and Security Blvd.



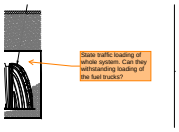
Subject: SW - Textbox with Arrow
Page Label: [1] Layout1
Author: Glenn Reese - EPC Stormwater
Date: 11/9/2022 3:52:57 PM
Status:
Color:
Layer:
Space:

Inlets on both sides of single isolater row ok? Discuss how this may or may not effect performance of isolator row in text above.



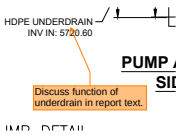
Subject: SW - Textbox with Arrow
Page Label: 65
Author: Glenn Reese - EPC Stormwater
Date: 11/9/2022 3:54:52 PM
Status:
Color:
Layer:
Space:

Are these MH labels (MH-1, MH-2, etc) on plan drawings somewhere? I'm not seeing them on the drainage maps below. Please show labels on plans.



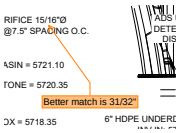
Subject: SW - Textbox with Arrow
Page Label: [4] output-4
Author: Glenn Reese - EPC Stormwater
Date: 11/9/2022 4:24:42 PM
Status:
Color:
Layer:
Space:

State traffic loading of whole system. Can they withstanding loading of the fuel trucks?



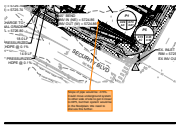
Subject: SW - Textbox with Arrow
Page Label: [1] STORM DETAILS (3)
Author: Glenn Reese - EPC Stormwater
Date: 11/9/2022 4:30:40 PM
Status:
Color:
Layer:
Space:

Discuss function of underdrain in report text.



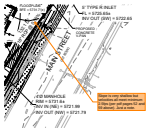
Subject: SW - Textbox with Arrow
Page Label: [1] STORM DETAILS (3)
Author: Glenn Reese - EPC Stormwater
Date: 11/9/2022 4:30:48 PM
Status:
Color:
Layer:
Space:

Better match is 31/32"



Subject: SW - Textbox with Arrow
Page Label: [1] Layout1
Author: Glenn Reese - EPC Stormwater
Date: 11/9/2022 4:32:05 PM
Status:
Color:
Layer:
Space:

Slope of pipe would be ~0.5%. Could move underground system to other side of site to get it closer to DP5, but then system would be in the floodplain. We need to discuss this further.



Subject: SW - Textbox with Arrow
Page Label: [1] Layout1
Author: Glenn Reese - EPC Stormwater
Date: 11/9/2022 4:37:18 PM
Status:
Color:
Layer:
Space:

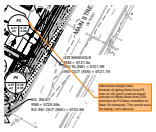
Slope is very shallow but velocities all meet minimum 2.5fps (per pdf pages 52 and 59 above). Just a note.

Subject: SW - Textbox
Page Label: [1] STORM DETAILS (3)
Author: Glenn Reese - EPC Stormwater
Date: 11/9/2022 4:40:54 PM
Status:
Color:
Layer:
Space:

We are very weary of allowing pumps (City criteria does not allow it) in an UG system like this.

Who is going to do proactive maintenance and inspection on pumps? The only time that you know that they're broken is when they break and things flood, and then it's too late to fix them.

So please consider all alternatives proposed on page 82 that would eliminate the need for pumps.

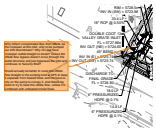


Subject: SW - Textbox with Arrow
Page Label: [1] Layout1
Author: Glenn Reese - EPC Stormwater
Date: 11/9/2022 4:42:59 PM
Status:
Color:
Layer:
Space:

Alternative design idea:
Instead of piping flows from P3 over to UG pond, treat an equal volume of offsite flows from OS1 and then let P3 flows sheetflow to Main St untreated. This would save on piping. Let's discuss.

Subject: SW - Textbox with Arrow
Page Label: [1] Layout1
Author: Glenn Reese - EPC Stormwater
Date: 11/9/2022 4:43:05 PM
Status:
Color:
Layer:
Space:

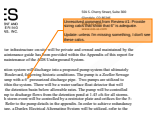
Alternative design idea:
Could roof drains be treated in landscape areas? Rain garden? Runoff reduction? Or discharge across parking lot to an area drain closer to UG pond instead of piped the whole way? Let's discuss.



Subject: SW - Textbox with Arrow
Page Label: [1] Layout1
Author: Glenn Reese - EPC Stormwater
Date: 11/9/2022 4:43:51 PM
Status:
Color:
Layer:
Space:

Why collect concentrated flow from offsite via the crosspan at this inlet, only to be pumped out 10ft downstream? Why not just have crosspan outfall straight to street? Unless the offsite flow bypass doesn't occur through the outlet structure and just bypasses the inlet and continues to Security Blvd?

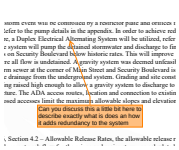
Would actually be better to route this offsite flow straight to the existing inlet at DP5 to keep it separate from treated flows and not have to rely on the pump to convey it. And theres no need to try to treat this offsite flow, unless it's combined with untreated onsite flows.



Subject: SW - Textbox with Arrow
Page Label: 11
Author: Glenn Reese - EPC Stormwater
Date: 11/9/2022 4:45:30 PM
Status:
Color:
Layer:
Space:

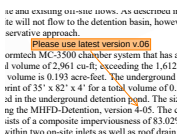
Unresolved comment from Review #1: Provide sizing calcs that show that 6" is adequate.

Update: unless I'm missing something, I don't see these calcs.



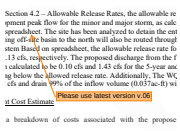
Subject: SW - Textbox with Arrow
Page Label: 11
Author: Glenn Reese - EPC Stormwater
Date: 11/9/2022 4:46:34 PM
Status:
Color:
Layer:
Space:

Can you discuss this a little bit here to describe exactly what is does an how it adds redundancy to the system



Subject: SW - Textbox with Arrow
Page Label: 10
Author: Glenn Reese - EPC Stormwater
Date: 11/9/2022 4:46:40 PM
Status:
Color:
Layer:
Space:

Please use latest version v.06



Subject: SW - Textbox with Arrow
Page Label: 11
Author: Glenn Reese - EPC Stormwater
Date: 11/9/2022 4:46:49 PM
Status:
Color:
Layer:
Space:

Please use latest version v.06