INNOVATIVE DESIGN. **CLASSIC RESULTS.**

FINAL DRAINAGE REPORT
FOR
AIRPORT SPECTRUM FILING NO. 1
(OFF-SITE)

August 2019

Prepared for:
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Job no. 2429.10

FINAL DRAINAGE REPORT FOR
AIRPORT SPECTRUM FILING NO. 1 (OFF-SITE)

Engineer's Statement

This report and plan for the drainage design of **Airport Spectrum Filing No. 1 (Off-Site)** was prepared by me (or under my direct supervision) and is correct to the best of my knowledge and belief. Said report and plan has been prepared in accordance with the City of Colorado Springs Drainage Criteria Manual and is in conformity with the master plan of the drainage basin. I understand that the City of Colorado Springs does not and will not assume liability for drainage facilities designed by others. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

SIGNATURE (Affix Seal):_____

Kyle R. Campbell, Colorado P.E. No. 29794 Date:

Developer's Statement

Bert A. Getz Trust hereby certifies that the drainage facilities for **Airport Spectrum Filing No. 1 (Off-Site)** shall be constructed according to the design presented in this report. I understand that the City of Colorado Springs does not and will not assume liability for the drainage facilities designed and/or certified by my engineer and that are submitted to the City of Colorado Springs pursuant to section 7.7.906 of the City Code; and cannot, on behalf of **Airport Spectrum Filing No. 1 (Off-Site)**, guarantee that final drainage design review will absolve **Bert A. Getz Trust** and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the final plat does not imply approval of my engineer's drainage design.

_____
Name of Developer

_____
Authorized Signature Date

_____
Printed Name

_____
Title

6730 N. Scottsdale Rd, #250 Paradise Valley, AZ 85253
Address:

City of Colorado Springs Statement:

Filed in accordance with Section 7.7.906 of the Code of the City of Colorado Springs, 2001, as amended.

_____ _____
For City Engineer Date
Conditions:

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FINAL DRAINAGE REPORT FOR
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FINAL DRAINAGE REPORT FOR AIRPORT SPECTRUM FILING NO. 1 (OFF-SITE)

PURPOSE

This document is the Final Drainage Report for Airport Spectrum Filing No. 1 (Off-Site). The purpose of this report is to identify offsite drainage patterns, determine a proposed storm sewer system that safely routes developed storm water runoff to adequate full spectrum detention and water quality facilities and releases to the adjacent creek in accordance with all applicable City requirements. This report serves as the off-site analysis to support the separate on-site analysis for the proposed Lot 1 development (Kum & Go). Separate Preliminary and/or Final Drainage Reports are required with any site development outside of proposed Lot 1 that will detail exact drainage calculations; water quality facilities, basin fees, etc.

At this time, only Lot 1, Airport Spectrum Filing No. 1 is proposed to be developed and no other specific on-site uses have been identified.

GENERAL DESCRIPTION

Lot 1, Airport Spectrum Filing No. 1 is a 2.485-acre development within the northeast quarter of Section 1, Township 15 South, Range 66 West of the 6th Principal Meridian in the City of Colorado Springs in El Paso County, Colorado. This subdivision is a small portion of the overall previously annexed area of 78.955 acres that included existing Powers Boulevard. Lot 1 is located on the south side of Milton E. Proby Parkway just east of proposed Globe Street public right-of-way. The Existing Clear View Estates Subdivision and large lot El Paso County single-family homes and open space (owned by Frank Watson) sits directly west of the site, with Powers Blvd. located 500' east side of the site. The proposed development includes a single lot for a convenience gas station (PUD Zone Districts) and a proposed public roadway servicing the site (Globe Street). No phasing of this development is proposed. Lot 1 access is proposed from Milton E. Proby Parkway to the north (right-in/right-out to the east and public Globe Street to the west). The existing Windmill Gulch Channel is located along the western edge.

The average soil condition of the entire site reflects Hydrologic Group "A" (Blakeland loamy sand) as determined by the "Soil Survey of El Paso County Area," prepared by the National Cooperative Soil Survey (see map in Appendix).

EXISTING DRAINAGE CONDITIONS/PREVIOUS DRAINAGE STUDY

The site is located within the Windmill Gulch Drainage Basin and was studied in the "Windmill Gulch Drainage Basin Planning Study," by Wilson & Company, last revised February 1992. The runoff from this site sheet flows directly west into the adjacent Windmill Gulch Channel, which drains from north to south. The site is covered in native grasses. The existing topography slopes generally from east to west between 3 and 6% with small areas up to 4:1. The existing Windmill Gulch Channel contains a FEMA designated 100-year floodplain that is outside of the proposed development area and plat.

The Drainage Basin Planning Study provides recommendations for the entire stretch of Windmill Gulch from the Fountain Creek discharge point to the upper limits of the basin. The recommendations were based upon the 24-hour 100-year storm event for all future improved conditions, the proposed site being always planned as commercial development (See D.B.P.S. information located in Appendix). Per the selected Alternative #2 in the D.B.P.S. and the preliminary plan/profile sheets, minimal channel improvements are required for the portion of the channel adjacent to the proposed site. Per the D.B.P.S. "due to the sensitive nature of this portion of the channel, about 2,200 feet should be left in its natural state except for a meandering low flow channel and the addition of 3 grade control structures and 3 drop structures to prevent stream degradation." None of these proposed facilities are located directly adjacent to this site. The environmentally sensitive areas are further described as beginning "approximately 1,200 feet south of Drennan (Milton E. Proby) Road. At this point, the rangeland swale transitions into a riparian area with cottonwood trees and a flowing channel fed by springs. The area can be described as a narrow strip of herbaceous wetland surrounded by several groves of cottonwood trees." There is a planned large regional detention facility (DBPS ACT #2, Pond 3) located in-line within the Windmill Gulch channel downstream of the proposed site (see preliminary drainage map). The D.B.P.S. improvements within the proposed site are the aforementioned check and drop structures and an extension (60" RCP) of the Powers Blvd. culvert to the channel. Therefore, two scenarios could take place:

1. If downstream future regional detention facility is not in place prior to any Airport Spectrum development, on-site full spectrum detention with stormwater quality will be required on-site prior to release into the adjacent Windmill Gulch Channel.
2. If the downstream future regional detention facility is constructed prior to any Airport Spectrum development, only on-site stormwater quality will be required.

Approximately Q_{100} = 240 cfs enters the site as historic flow under Milton E. Proby Parkway, per the DBS. This site was also studied in the "Preliminary Drainage Report for Airport Spectrum Annexation and PUD Concept Plan", by Classic Consulting Engineers and Surveyors, dated November 2017. This report included a similar summary as above of the approved DBPS, as well as providing direction requiring on-site detention and stormwater quality if downstream facilities are not built (which is the current scenario). Adherence to the recommendations of the accepted Preliminary Drainage Report are adhered to in this report.

The following is an Existing Conditions analysis in adherence to the DCM requirements for a Final Drainage Report. An Existing Conditions Drainage Map is located in the Appendix.

Design Point 1 (Q_5 = 8.8 cfs, Q_{100} = 15.8 cfs) is the runoff along Milton Proby Pkwy. at the low point of Basin EX-A, 1.90 acres of roadway (Milton Proby Pkwy. and Powers Blvd.). This runoff is intercepted by an existing grated inlet within the pan of the existing Milton Proby curb. This storm water is routed west via an existing storm system within Milton Proby and discharges into the box culvert crossing of Windmill Gulch & Milton Proby Blvd. upstream of Design Point 4.

Design Point 2 (Q_5 = 0.5 cfs, Q_{100} = 3.6 cfs) is the runoff from Basin EX-B, 1.20 acres of roadside ditch along Milton Proby Pkwy. This runoff is intercepted by a 15" open ended (flared end section) storm pipe the collects the runoff with minimal ponding and conveys into the downstream headwall of the box culvert under Milton Proby Pkwy., combining with that from DP-1 within the Windmill Gulch channel.

Design Point 3 (Q_5 = 7.4 cfs, Q_{100} = 34.7 cfs) is the runoff from Basins EX-C and EX-D. Basin EX-C is 3.75 acres of upstream, off-site undeveloped land, and portions of Milton Proby Pkwy. and Powers Blvd. that drains onto the overall Airport Spectrum boundary and Basin EX-D, 10.80 acres of undeveloped land. This runoff combines and sheet flows across the native ground and vegetation to the south-west corner where it outfall into the Windmill Gulch channel, containing a FEMA 100-year floodplain limits (shown on the Drainage Maps).

Design Point 4 (Q_5 = 13.9 cfs, Q_{100} = 48.3 cfs) is the runoff from Design Points 1-3 and represents the total Existing Conditions runoff from the proposed project area and affected tributary areas that is draining into Windmill Gulch.

PROPOSED DRAINAGE CONDITIONS

Developed runoff from Airport Spectrum Filing No. 1 development areas consists of the proposed southerly extension of public Globe Street and development of Lot 1 and adjacent private drive-aisles and will be conveyed via surface drainage and private storm sewer systems to a proposed temporary full spectrum detention storm water quality facility located at the southerly terminus of the Globe Street extension. This temporary facility will be designed and installed per the latest City of Colorado Springs drainage criteria and detailed within site specific BMP Construction Drawings. As the Buyer of Lot 1, Kum & Go, is responsible for lot Final Drainage Report preparation with their Development Plan and Final Plat submittal. This Final Drainage Report is intended to detail adjacent flows and facilities. As this initial development is a very small portion of overall Airport Spectrum upstream development, we are proposing a Temporary Full Spectrum Detention and Water Quality Facility for the currently proposed roadway and gas station infrastructure. The following is a detailed breakdown of the Proposed Drainage Conditions:

Design Point 1A (Q_5 = 9.8 cfs, Q_{100} = 17.6 cfs) is the runoff along Milton Proby Pkwy. just prior to the proposed Globe Street intersection within Basin EX-A, 1.90 acres of roadway (Milton Proby Pkwy. and Powers Blvd.). A large portion of this runoff is intercepted by a proposed 15' CDOT Type R At-Grade inlet with the remaining runoff continuing to Design Point 1B. A proposed 18" RCP (Pipe 4, Q_5 = 8.8 cfs, Q_{100} = 12.4 cfs) conveys the intercepted runoff to the type 13 inlet at Design Point 1B.

Design Point 1B (Q_5 = 1.6 cfs, Q_{100} = 6.4 cfs) is the runoff along Milton Proby Pkwy. in the low point of the roadway and at the proposed intersection with Globe Street. Two CDOT Type 13 grated inlets will be installed within the concrete cross pan to intercept the entirety of this runoff. A proposed 18" pipe conveys this water and that from Pipe 4 to the existing storm system from the Milton Proby existing roadway improvements. This storm water is routed west via the existing storm system within Milton Proby and discharges into the box culvert crossing of Windmill Gulch & Milton Proby Blvd. upstream of Design Point 4.

Design Point 2A (Q_5 = 0.2 cfs, Q_{100} = 1.1 cfs) is the runoff from Basin EX-B3, 0.37 acres of existing roadside ditch along Milton Proby Pkwy. The proposed right-in/right-out access point creates the need for a 12" culvert (Pipe 6) at this location to keep this runoff running west toward the existing Windmill Gulch box culvert.

Design Point 2B (Q_5 = 0.2 cfs, Q_{100} = 1.8 cfs) is the runoff from Design Point 2A & Basin EX-B2, 0.23 acres of existing roadside ditch along Milton Proby Pkwy. The proposed Globe Street full movement access point creates the need for a 12" culvert (Pipe 7) at this location to keep this runoff running west toward the existing Windmill Gulch box culvert.

Design Point 2C (Q_5 = 0.3 cfs, Q_{100} = 2.5 cfs) is the runoff from Design Point 2C & Basin EX-B1, 0.21 acres of existing roadside ditch along Milton Proby Pkwy. This runoff is intercepted by an existing 15" open ended (flared end section) storm pipe the collects the runoff with minimal ponding and conveys into the downstream headwall of the box culvert under Milton Proby Pkwy., combining with that from DP-1 within the Windmill Gulch channel.

Design Point 3 (Q_5 = 14.7 cfs, Q_{100} = 29.7 cfs) is the total developed runoff into the proposed Temporary Full Spectrum Detention and Water Quality Facility. This consists of runoff from Pipe 2, Design Point 7, Design Point 8, and Basin D. Basin D is 1.93 acres of the temporary detention pond and tributary undeveloped (future commercial) adjacent land that drains directly into the proposed pond. This facility is a PRIVATE, Temporary Full Spectrum Extended Detention Basin per the City of Colorado Springs and Urban Drainage and Flood Control District (UDFCD). As this facility is 'temporary' the permanent concrete structures in the bottom of the pond are not required (concrete forebay, trickle channel, and pond outlet box), instead riprap erosion protection and an 8" standpipe (with orifice holes) and outfall will convey the restricted release into the downstream Windmill Gulch channel corridor. The outlet orifice holes and pond infiltration was determined using the UDFCD UD-Detention version 3.07 workbook (included in the Appendix) and quantifies the release rate from this facility at Q_5 = 0.3 cfs and Q_{100} = 1.8 cfs, less than historic runoff rates.

A total of 6.00 acres of tributary land drains into this temporary facility with a composite imperviousness of 35.3%. This composite imperviousness was determined using the Site-Level Low Impact Development (LID)

Design Effective Impervious Calculator (IRF Form) located in the Appendix of this report. The UDFCD UD-BMP version 3.05 workbook (included in the Appendix) was used to calculate the Extended Urban Runoff Volume (EURV) of 0.222 acre-feet. This volume is provided under the top of the standpipe (within the orifice holes, elevation 5919.00 and providing 0.37 acre-feet of EURV). Pipe Run 2, 24" RCP, will discharge into the northern end of the temporary pond within the riprap rundown and erosion protection.

Per the City of Colorado Springs Drainage Criteria Manual Vol. 1, Chapter 6, Table 6-2, 1-hour rainfall depths were used in the UD-Detention workbook and outlet drain time calculations. These values are: 2-year = 1.19", 5-year = 1.50", 10-year = 1.75", 25-year = 2.00", 50-year = 2.25", and 100-year = 2.52". The bottom of the detention basin (lowest orifice hole) is at an elevation of 5916.00 with the EURV provided at the elevation 5919.00. An 8" diameter (3.0' exposed height) standpipe and outlet pipe is proposed with a top of standpipe at this 5919.00 elevation. For a Full Spectrum facility, the outlet box orifice hole within the front plate is to drain the EURV in less than 72 hours. Per the latest UD-Detention version 3.07 spreadsheet from Urban Drainage (release February 2017) a total of (3) orifice holes are to be installed in the front plate of the outlet box with the bottom orifice hole of 1.3" wide x 1" high, and middle orifice of 2" wide x 4" high, and upper orifice of 2" wide x 4" high. This orifice hole sizing the overall pond outlet design meet all required drain times for all of the various storm events as shown on the UD-Detention workbook located in the Appendix of this report.

An 8" PVC outlet Pipe 3 will convey the detained release (Q_5 = 0.3 cfs, Q_{100}= 1.8 cfs, 100-yr water surface elevation of 5919.59, into the adjacent Windmill Gulch drainage channel and just outside of the effective 100-yr FEMA floodplain. A 2' wide x 3' long riprap pad (D50 = 6", Depth = 1.0' min.) will be installed at the exit point of this 8" pipe (sizing calculation included in the Appendix). A 10' length riprap (Type M, D50 = 12", Depth = 2.0' min.) emergency overflow spillway located at elevation 5920.00 will pass the entire 100-year storm event (25.4 cfs) into the downstream Windmill Gulch at a flood depth of less than 1.0' in case of complete outlet pipe failure. The proposed 10' wide top of berm elevation is at 5922.00, allowing for over 1.0' of freeboard of the emergency spillway flow elevation.

This Temporary Facility adequately treats the developed runoff from Lot 1 and the supporting roadway infrastructure. Any additional development tributary to this proposed facility will require further

drainage analysis and pond modifications or the installation of the permanent facility. The proposed facility is only 4' deep (bottom to spillway) and therefore is not deemed a Jurisdictional size dam by the State of Colorado. Maintenance of this Private Temporary Facility will be by the developer.

Design Point 4 (Q_5 = 13.2 cfs, Q_{100} = 40.3 cfs) is the runoff from Design Points 1, 2, 9, Pipe 3, and Basin F which represents the total Developed Conditions runoff from the proposed project area and affected tributary areas that is draining into Windmill Gulch. This runoff amount is less than in the Existing Conditions due to the installation of the temporary full spectrum detention facility and limited release rate. All developed runoff is treated via the detention/water quality facility and thus the proposed development does not hinder runoff within and downstream of Windmill Gulch and the Fountain Creek tributaries. Pipe 3 is the restricted release from the proposed Temporary Detention Facility and releases Q_5 = 0.3 cfs and Q_{100} = 1.8 cfs per the UD-Detention workbook (See Appendix). Basin F is 1.45 acres of undeveloped land and adjacent slope area to Globe Street that drains directly west into the Windmill Gulch corridor. As the grading limits are just outside of the effective FEMA 100-year floodplain limits, no additional permitting is required.

Design Point 5 (Q_5 = 3.1 cfs, Q_{100} = 6.3 cfs) is the runoff from Basins B1-6, 0.95 acres of proposed gas station area and covered within the Drainage Report from Olsson consultants. This runoff is collected within the on-site private storm system and extended to the 12" stub (Pipe 1) provided from the inlet at Design Point 6. This runoff continues within the proposed storm system into the temporary detention/water quality facility at Design Point 3.

Design Point 6 (Q_5 = 3.4 cfs, Q_{100} = 8.8 cfs) is the runoff from Basins B-5, B-9, and A. Basins B-5 & B-9 are 0.35 and 0.07 acres respectively of proposed gas station area and covered within the Drainage Report from Olsson consultants. Basin A is 1.68 acres of shared drive aisle, proposed right-in/right-out intersection with Milton Proby Pkwy., and adjacent undeveloped and future commercial area. This runoff is collected along the proposed curb and gutter (south side) of the shared drive aisle where a proposed 15' CDOT Type R curb inlet (at-grade) intercepts the majority of the runoff. The runoff not intercepted by this inlet continues along the curb line to Design Point 7 and into the proposed temporary pond. Pipe 2 (24" RCP, Q_5 = 6.1 cfs, Q_{100} = 13.6 cfs) conveys the combined runoff (at-grade inlet and Pipe 1) to the south and into the proposed temporary full spectrum detention and water quality facility at Design Point 3.

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Design Point 7 (Q_5 = 1.9 cfs, Q_{100} = 4.4 cfs) is the runoff from Basins B-8, C-2, and flow-by from Design Point 6. Basin B-8 is 0.22 acres of proposed gas station area and covered within the Drainage Report from Olsson consultants. Basin C-2 is 0.41 acres of proposed Globe Street (Public R.O.W.) that drains south from the Milton Proby Pkwy. connection point and will be collected by a future downstream sump inlet and routed to a future permanent full spectrum detention/water quality facility, location to be determined. Until then, this runoff will simply run off the end of the roadway/curb and down a riprap rundown into the proposed Temporary Full Spectrum Detention and Water Quality Facility (Design Point 3).

Design Point 8 (Q_5 = 1.8 cfs, Q_{100} = 3.2 cfs) is the runoff from Basin C-1, 0.38 acres of proposed Globe Street (Public R.O.W.) that drains south from the Milton Proby Pkwy. connection point and will be collected by a future downstream sump inlet and routed to a future permanent full spectrum detention/water quality facility, location to be determined. Until then, this runoff will simply run off the end of the roadway/curb and down a riprap rundown into the proposed Temporary Full Spectrum Detention and Water Quality Facility (Design Point 3). The riprap rundown calculations are included in the Appendix as runoff from both Design Points 8 & 9 drop about 12' down into the proposed Temporary Pond.

Design Point 9 (Q_5 = 5.7 cfs, Q_{100} = 22.9 cfs) is the undeveloped runoff from Basin E, 5.31 acres of Airport Spectrum future development and that from Basin EX-C, 3.75 acres of existing upstream roadway (Powers and Milton Proby) and land described in the Existing Conditions portion of this report. This runoff sheet flows across the undeveloped and overlot graded land, bypassing the proposed temporary detention/water quality facility. This runoff continues to drain south-west across native ground and vegetation and into the Windmill Gulch channel corridor and to Design Point 4.

EROSION CONTROL PLAN

The City of Colorado Springs Drainage Criteria Manual specifies an Erosion Control Plan and associated cost estimate be submitted with the Final Drainage Report. A Grading & Erosion Control Plan has already been reviewed and approved by the City with erosion control assurances already being posted for the prior bulk grading that already took place. Adequate erosion control measures are to be installed prior

to Lot 5 development. An additional Lot 5 site detailed grading plan as well as construction plans for the storm sewer and water quality facility will be processed through the City of review and approval prior to construction.

FLOODPLAIN STATEMENT

No portion of this site is located within a floodplain as determined by the Flood Insurance Rate Maps (F.I.R.M.) Map Number 08041C 0763G effective date, December 7, 2018 (See Appendix).

DRAINAGE AND BRIDGE FEES

The Airport Spectrum development is located in the Windmill Gulch Basin. Fees or use of existing credits are due prior to plat recordation. Prior to issuance of building permits a plat will need to be recorded and appropriate fees paid. No reimbursable public facilities are anticipated with this development.

Drainage Fees:	
$14,594/acre x 2.485 acres	$ 36,266.09
Pond Land Fees:	
$3,055/acre x 2.485 acres	$ 7,591.68
Bridge Fee:	
$271/acre x 2.485 acres	$ 673.44
TOTAL	**$44,531.21**

Fees are required to be paid prior to Plat Recordation, and may be a combination of fees or offsets for facilities constructed within the drainage basin.

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SUMMARY

Runoff for the proposed Airport Spectrum development is collected in on-site private storm sewer systems and routed to a temporary BMP providing EURV. Adjacent channel improvements are not required per the recommendations in the D.B.P.S. This report reflects required water quality and detention facilities and a private storm sewer collection system.

PREPARED BY:

Classic Consulting Engineers & Surveyors, LLC

Kyle R. Campbell, P.E.
Division Manager

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REFERENCES

1. City of Colorado Springs/County of El Paso Drainage Criteria Manual dated October 1991.

2. "Windmill Gulch Drainage Basin Planning Study," prepared by Wilson & Company, last revised February 1992.

3. Drainage Criteria Manual (Volume 3) latest revision April 2008, Urban Drainage and Flood Criteria District.

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APPENDIX

VICINITY MAP

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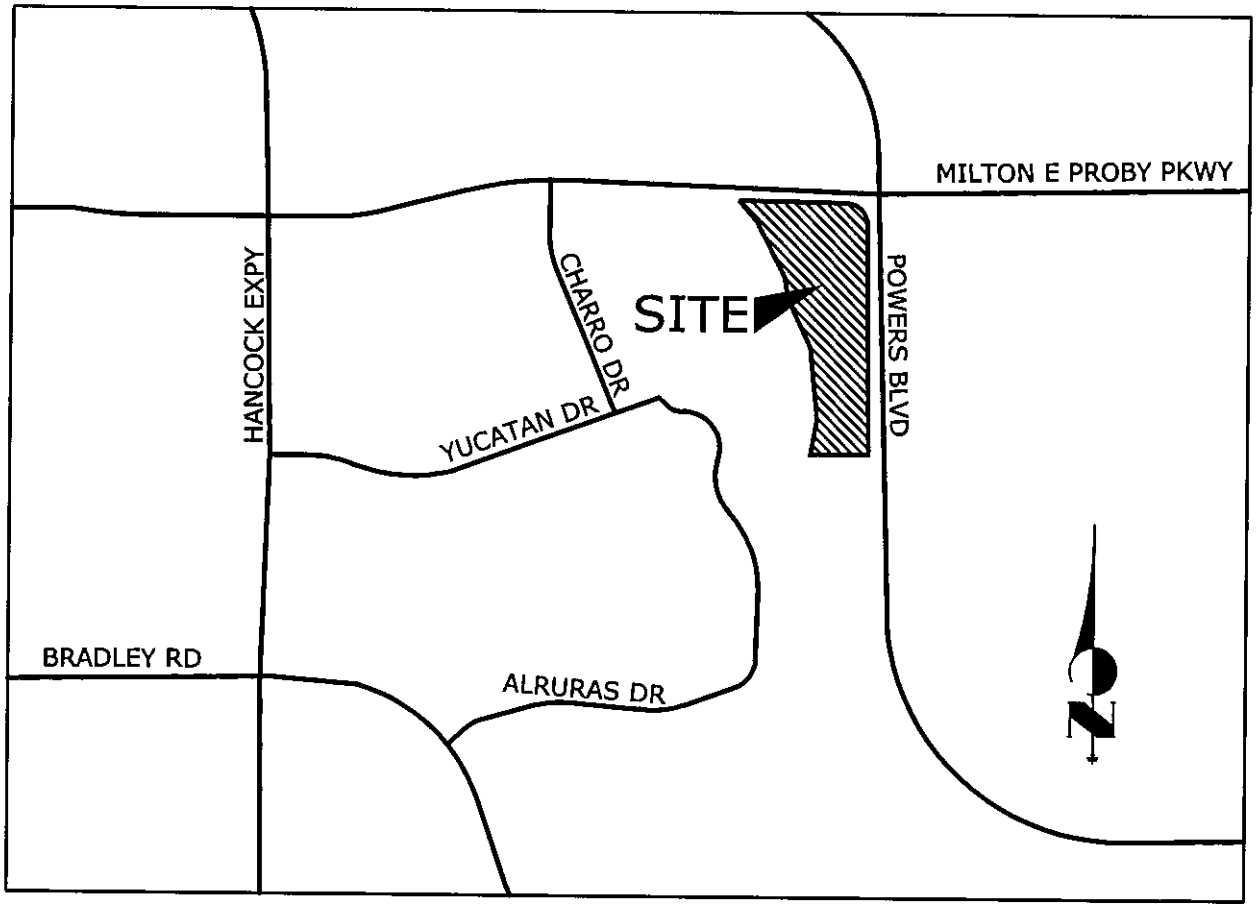

VICINITY MAP

NOT TO SCALE

SOILS MAP (S.C.S SURVEY)

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F.E.M.A. MAP

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Map Scale: 1:4,670 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

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 Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

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 16, Sep 10, 2018

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

Date(s) aerial images were photographed: Jun 3, 2014—Jun 17, 2014

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	A	106.6	100.0%
Totals for Area of Interest			**106.6**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

DRAINAGE CALCULATIONS/

TEMPORARY POND MODELING

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JOB NAME: *Airport Spectrum Subdivision Filing No. 1*
JOB NUMBER: *2429.10*
DATE: *03/01/18*
CALCULATED BY: *MAL*

FINAL DRAINAGE REPORT ~ BASIN RUNOFF COEFFICIENT SUMMARY (EXISTING CONDITIONS)

BASIN	TOTAL AREA (AC)	IMPERVIOUS AREA / STREETS			LOTS/LANDSCAPE/UNDEV. AREAS (NOT PAVEMENT)			WEIGHTED		WEIGHTED CA	
		AREA (AC)	C(5)	C(100)	AREA (AC)	C(5)	C(100)	C(5)	C(100)	CA(5)	CA(100)
EX-A	1.90	1.90	0.90	0.96	0.00	0.08	0.35	0.90	0.96	**1.71**	**1.82**
EX-B	1.20	0.00	0.90	0.96	1.20	0.08	0.35	0.08	0.35	**0.10**	**0.42**
EX-C	3.75	1.08	0.90	0.96	2.67	0.08	0.35	0.32	0.53	**1.19**	**1.97**
EX-D	10.80	0.00	0.90	0.96	10.80	0.08	0.35	0.08	0.35	**0.86**	**3.78**

JOB NAME *Airport Spectrum Subdivision Filing No. 1*
JOB NUM *2429.10*
DATE: *3/1/2018*
CALC'D BY *MAL*

FINAL DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY (EXISTING CONDITIONS)

BASIN	WEIGHTED		OVERLAND				STREET / CHANNEL FLOW				Tc	INTENSITY		TOTAL FLOWS	
	CA(5)	CA(100)	C(5)	Length (ft)	Height (ft)	Tc (min)	Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	TOTAL (min)	I(5) (in/hr)	I(100) (in/hr)	Q(5) (cfs)	Q(100) (cfs)
EX-A	1.71	1.82	0.90	10	1	0.5	1010	2.5%	5.5	3.0	5.0	5.17	8.68	**8.8**	**15.8**
EX-B	0.10	0.42	0.08	15	4	2.4	970	2.9%	6.0	2.7	5.1	5.13	8.62	**0.5**	**3.6**
EX-C	1.19	1.97	0.08	150	10	12.1	390	3.0%	6.1	1.1	13.1	3.72	6.25	**4.4**	**12.3**
EX-D	0.86	3.78	0.08	100	8	9.3	575	5.9%	8.5	1.1	10.4	4.07	6.83	**3.5**	**25.8**

JOB NAME:	*Airport Spectrum Subdivision Filing No. 1*
JOB NUMBER:	*2429.10*
DATE:	*03/01/18*
CALCULATED BY:	*MAL*

FINAL DRAINAGE REPORT ~ SURFACE ROUTING SUMMARY - EXISTING CONDITIONS

Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		Inlet Size
					I(5)	I(100)	Q(5)	Q(100)	
1	BASIN EX-A	1.71	1.82	5.0	5.17	8.68	8.8	15.8	Existing Grated Inlets
2	BASIN EX-B	0.10	0.42	5.1	5.13	8.62	0.5	3.6	Existing Roadside Ditch
3	BASIN EX-C & BASIN EX-D	2.05	5.75	14.3	3.60	6.04	7.4	34.7	Surface runoff to Windmill Gulch
4	DP-1 + DP-2 + DP-3	3.86	8.00	14.3	3.60	6.04	13.9	48.3	TOTAL RUNOFF TO CREEK

JOB NAME: *Airport Spectrum Subdivision Filing No. 1*
JOB NUMBER: *2429.10*
DATE: *03/01/18*
CALCULATED BY: *MAL*

FINAL DRAINAGE REPORT ~ BASIN RUNOFF COEFFICIENT SUMMARY (PROPOSED CONDITIONS)

BASIN	TOTAL AREA (AC)	IMPERVIOUS AREA / STREETS			LOTS/LANDSCAPE/UNDEV. AREAS (NOT PAVEMENT)			WEIGHTED		WEIGHTED CA	
		AREA (AC)	C(5)	C(100)	AREA (AC)	C(5)	C(100)	C(5)	C(100)	CA(5)	CA(100)
EX-A	2.15	2.10	0.90	0.96	0.05	0.08	0.35	0.88	0.95	**1.89**	**2.03**
EX-B1	0.21	0.00	0.90	0.96	0.21	0.08	0.35	0.08	0.35	**0.02**	**0.07**
EX-B2	0.23	0.00	0.90	0.96	0.23	0.08	0.35	0.08	0.35	**0.02**	**0.08**
EX-B3	0.37	0.00	0.90	0.96	0.37	0.08	0.35	0.08	0.35	**0.03**	**0.13**
EX-C	3.75	1.08	0.90	0.96	2.67	0.08	0.35	0.32	0.53	**1.19**	**1.97**
A	1.68	0.38	0.90	0.96	1.30	0.08	0.35	0.27	0.49	**0.45**	**0.82**
B1-6	0.95	C VALUES FROM OLSON KUM & GO REPORT						0.64	0.76	**0.61**	**0.72**
B-5	0.35	C VALUES FROM OLSON KUM & GO REPORT						0.68	0.79	**0.24**	**0.28**
B-7	0.03	C VALUES FROM OLSON KUM & GO REPORT						0.90	0.96	**0.03**	**0.03**
B-8	0.22	C VALUES FROM OLSON KUM & GO REPORT						0.23	0.47	**0.05**	**0.10**
B-9	0.07	C VALUES FROM OLSON KUM & GO REPORT						0.90	0.96	**0.06**	**0.07**
C-1	0.38	0.38	0.90	0.96	0.00	0.08	0.35	0.90	0.96	**0.34**	**0.36**
C-2	0.41	0.41	0.90	0.96	0.00	0.08	0.35	0.90	0.96	**0.37**	**0.39**
D	1.93	0.00	0.90	0.96	1.93	0.08	0.35	0.08	0.35	**0.15**	**0.68**
E	5.31	0.00	0.90	0.96	5.31	0.08	0.35	0.08	0.35	**0.42**	**1.86**
F	1.45	0.00	0.90	0.96	1.45	0.08	0.35	0.08	0.35	**0.12**	**0.51**
M	0.15	0.14	0.90	0.96	0.01	0.08	0.35	0.85	0.92	**0.13**	**0.14**

JOB NAME: *Airport Spectrum Subdivision Filing No. 1*
JOB NUM: *2429.10*
DATE: *3/1/2018*
CALC'D BY: *MAL*

FINAL DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY (PROPOSED CONDITIONS)

BASIN	WEIGHTED		OVERLAND				STREET / CHANNEL FLOW				Tc	INTENSITY		TOTAL FLOWS	
	CA(5)	CA(100)	C(5)	Length (ft)	Height (ft)	Tc (min)	Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	TOTAL (min)	I(5) (in/hr)	I(100) (in/hr)	Q(5) (cfs)	Q(100) (cfs)
EX-A	1.89	2.03	0.90	10	1	0.5	1010	2.5%	5.5	3.0	5.0	5.17	8.68	9.8	17.6
EX-B1	0.02	0.07	0.08	15	4	2.4	430	2.9%	6.0	1.2	5.0	5.17	8.68	0.1	0.6
EX-B2	0.02	0.08	0.08	14	4	2.3	190	2.9%	6.0	0.5	5.0	5.17	8.68	0.1	0.7
EX-B3	0.03	0.13	0.08	14	4	2.3	100	2.9%	6.0	0.3	5.0	5.17	8.68	0.2	1.1
EX-C	1.19	1.97	0.08	150	10	12.1	390	3.0%	6.1	1.1	13.1	3.72	6.25	4.4	12.3
A	0.45	0.82	0.08	75	10	6.8	360	2.8%	5.9	1.0	7.8	4.50	7.56	2.0	6.2
B1-6	0.61	0.72	FROM KUM & GO DRAINAGE REPORT								5.0	5.17	8.68	3.1	6.3
B-5	0.24	0.28	FROM KUM & GO DRAINAGE REPORT								5.0	5.17	8.68	1.2	2.4
B-7	0.03	0.03	FROM KUM & GO DRAINAGE REPORT								5.0	5.17	8.68	0.1	0.2
B-8	0.05	0.10	FROM KUM & GO DRAINAGE REPORT								5.0	5.17	8.68	0.3	0.9
B-9	0.06	0.07	FROM KUM & GO DRAINAGE REPORT								5.0	5.17	8.68	0.3	0.6
C-1	0.34	0.36	0.90	60	1	2.4	360	5.0%	7.8	0.8	5.0	5.17	8.68	1.8	3.2
C-2	0.37	0.39	0.90	60	1	2.4	360	5.0%	7.8	0.8	5.0	5.17	8.68	1.9	3.4
D	0.15	0.68	0.08	40	18	3.3	240	7.5%	9.6	0.4	5.0	5.17	8.68	0.8	5.9
E	0.42	1.86	0.08	60	22	4.3	370	1.5%	4.3	1.4	5.8	4.95	8.31	2.1	15.4
F	0.12	0.51	0.08	40	14	3.6	110	6.4%	8.9	0.2	5.0	5.17	8.68	0.6	4.4
M	0.13	0.14	0.08	10	0.2	4.6	40	1.0%	3.5	0.2	5.0	5.17	8.68	0.7	1.2

JOB NAME: *Airport Spectrum Subdivision Filing No. 1*
JOB NUMBER: *2429.10*
DATE: *03/01/18*
CALCULATED BY: *MAL*

FINAL DRAINAGE REPORT ~ SURFACE ROUTING SUMMARY - PROPOSED CONDITIONS

Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		Inlet Size
					I(5)	I(100)	Q(5)	Q(100)	
1A	BASIN EX-A	1.89	2.03	5.0	5.17	8.68	9.8	17.6	15' AT-GRADE INLET
1B	FLOW-BY DP-1A + BASIN M	0.32	0.74	5.0	5.17	8.68	1.6	6.4	PROPOSED DUAL CDOT TYPE 13 INLETS
2a	BASIN EX-B3	0.03	0.13	5.0	5.17	8.68	0.2	1.1	Existing Roadside Ditch/Prop. 12" Culvert
2b	DP-2a + BASIN EX-B2	0.05	0.21	5.0	5.17	8.68	0.2	1.8	Existing Roadside Ditch/Prop. 12" Culvert
2c	DP-2b + BASIN EX-B1	0.06	0.28	5.0	5.17	8.68	0.3	2.5	Existing Roadside Ditch/Existing 15" RCP
3	DP-7 + DP-8 + BASIN D + PIPE 2	2.27	3.42	7.8	4.50	7.56	10.2	25.9	TEMPORARY POND
4	DP-1 + DP-2 + BASIN F + PIPE 3 + DP-9	3.71	6.74	14.6	3.56	5.98	13.2	40.3	TOTAL RUNOFF TO CREEK
5	BASIN B1-6	0.61	0.72	5.0	5.17	8.68	3.1	6.3	K&G INLETS/PIPE STUB
6	BASIN A + BASIN B-5 + BASIN B-9	0.75	1.16	7.8	4.50	7.56	3.4	8.8	15' AT-GRADE INLET
7	FLOW-BY DP-6 + BASIN C-2 + BASIN B-8	0.42	0.59	7.8	4.50	7.56	1.9	4.4	SURFACE INTO POND
8	BASIN C-1	0.34	0.36	5.0	5.17	8.68	1.8	3.2	SURFACE INTO POND
9	BASIN EX-C + BASIN E	1.61	3.83	14.6	3.56	5.98	5.7	22.9	SURFACE BYPASSING TEMPORARY POND

JOB NAME: *Airport Spectrum Subdivision Filing No. 1*
JOB NUMBER: *2429.10*
DATE: *03/01/18*
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* PIPES ARE LISTED AT MAXIMUM SIZE REQUIRED TO ACCOMMODATE Q100 FLOWS AT MINIMUM GRADE. REFER TO INDIVIDUAL PIPE SHEETS FOR HYDRAULIC INFORMATION.

FINAL DRAINAGE REPORT ~ PIPE ROUTING SUMMARY

Pipe Run	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		
					I(5)	I(100)	Q(5)	Q(100)	Pipe Size*
1	DP-5	0.61	0.72	5.0	5.17	8.68	3.1	6.3	12"
2	PIPE 1 + DP-6 (Intercepted)	1.35	1.79	7.8	4.50	7.56	6.1	13.6	24"
3	Temp. Pond Outlet	0.06	0.24	7.8	4.50	7.56	0.3	1.8	8"
4	DP-1A (Intercepted)	1.70	1.43	5.0	5.17	8.68	8.8	12.4	18"
5	PIPE 4 + DP-1B	2.02	2.17	5.0	5.17	8.68	10.4	18.8	EX.24"
6	DP-2A	0.03	0.13	5.0	5.17	8.68	0.2	1.1	12" Culvert
7	DP-2B	0.05	0.21	5.0	5.17	8.68	0.2	1.8	12" Culvert
8	DP-2C	0.06	0.28	5.0	5.17	8.68	0.3	2.5	EX. 15"

JOB NAME:	*Airport Spectrum Subdivision Filing No. 1*
JOB NUMBER:	*2429.10*
DATE:	*03/01/18*
CALCULATED BY:	*MAL*

At-Grade Inlet - Flow Routing

Design Point	TOTAL						INTERCEPTED				FLOW-BY			
	CA5	CA100	I5	I100	Q5	Q100	Q5	Q100	CA5	CA100	Q5	Q100	CA5	CA100
1A	1.89	2.03	5.17	8.68	9.8	17.6	8.8	12.4	1.70	1.43	1.0	5.2	0.19	0.60
6	0.75	1.16	4.50	7.56	3.4	8.8	3.4	8.1	0.75	1.07	0.0	0.7	0.00	0.09

Version 4.05 Released March 2017

INLET MANAGEMENT

INLET NAME	DP-6 Inlet	DP-1B Inlet	DP-1A Inlet
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	On Grade	In Sump	On Grade
Inlet Type	CDOT Type R Curb Opening	CDOT/Denver 13 Valley Grate	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	3.4	1.6	9.8
Major Q_{Known} (cfs)	8.8	6.4	17.6

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	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)	**3.4**	**1.6**	**9.8**
Major Total Design Peak Flow, Q (cfs)	**8.8**	**6.4**	**17.6**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	N/A	1.0
Major Flow Bypassed Downstream, Q_b (cfs)	0.7	N/A	5.2

Minor Storm (Calculated) Analysis of Flow Time

C	N/A	N/A	N/A
C_5	N/A	N/A	N/A
Overland Flow Velocity, Vi	N/A	N/A	N/A
Channel Flow Velocity, Vt	N/A	N/A	N/A
Overland Flow Time, Ti	N/A	N/A	N/A
Channel Travel Time, Tt	N/A	N/A	N/A
Calculated Time of Concentration, T_c	N/A	N/A	N/A
Regional T_c	N/A	N/A	N/A
Recommended T_c	N/A	N/A	N/A
T_c selected by User	N/A	N/A	N/A
Design Rainfall Intensity, I	N/A	N/A	N/A
Calculated Local Peak Flow, Q_p	N/A	N/A	N/A

Major Storm (Calculated) Analysis of Flow Time

C	N/A	N/A	N/A
C_5	N/A	N/A	N/A
Overland Flow Velocity, Vi	N/A	N/A	N/A
Channel Flow Velocity, Vt	N/A	N/A	N/A
Overland Flow Time, Ti	N/A	N/A	N/A
Channel Travel Time, Tt	N/A	N/A	N/A
Calculated Time of Concentration, T_c	N/A	N/A	N/A
Regional T_c	N/A	N/A	N/A
Recommended T_c	N/A	N/A	N/A
T_c selected by User	N/A	N/A	N/A
Design Rainfall Intensity, I	N/A	N/A	N/A
Calculated Local Peak Flow, Q_p	N/A	N/A	N/A

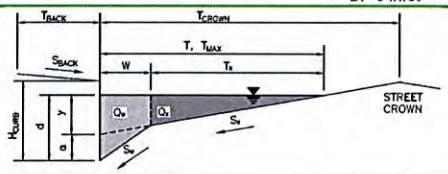
Version 4.05 Released March 2017

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

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

Project: Enter Your Project Name Here

Inlet ID: DP-6 Inlet



Gutter Geometry (Enter data in the blue cells)			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	2.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	26.0	ft
Gutter Width	W =	1.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.042	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.070	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.020	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.9	8.9	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

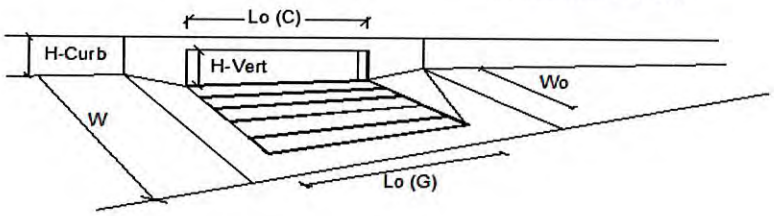
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**17.9**	**17.9**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	15.00	15.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**3.4**	**8.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.7**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**92**	**%**

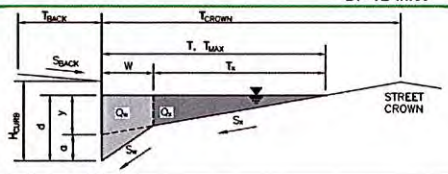
Version 4.05 Released March 2017

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

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

Project: Enter Your Project Name Here

Inlet ID: DP-1B Inlet



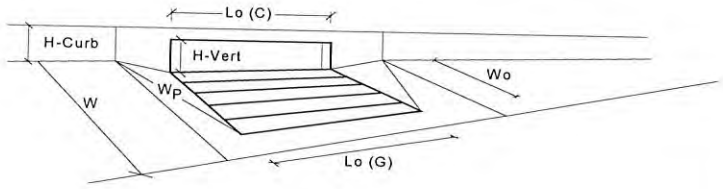
Gutter Geometry (Enter data in the blue cells)			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	30.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.040	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} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	20.0	27.8	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.8	7.7	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

Version 4.05 Released March 2017



Design Information (Input)

		MINOR	MAJOR	
Type of Inlet	Type =	CDOT/Denver 13 Valley Grate		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.8	7.7	inches

Grate Information — ☑ Override Depths

	MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.43	0.43	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.30	3.30	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	

Curb Opening Information

	MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	N/A	N/A	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	N/A	N/A	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	N/A	N/A	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	N/A	N/A	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	N/A	N/A	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	N/A	N/A	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	N/A	N/A	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	N/A	N/A	

Low Head Performance Reduction (Calculated)

	MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.545	0.700	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	N/A	N/A	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.91	1.00	

Total Inlet Interception Capacity (assumes clogged condition)

	MINOR	MAJOR	
	Q_a =	2.7	4.1	cfs
WARNING: Inlet Capacity less than Q Peak for Major Storm	$Q_{PEAK\ REQUIRED}$ =	1.6	6.4	cfs

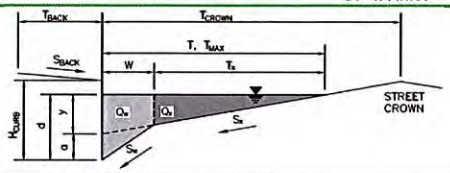
Version 4.05 Released March 2017

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

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

Project: Enter Your Project Name Here

Inlet ID: DP-1A Inlet



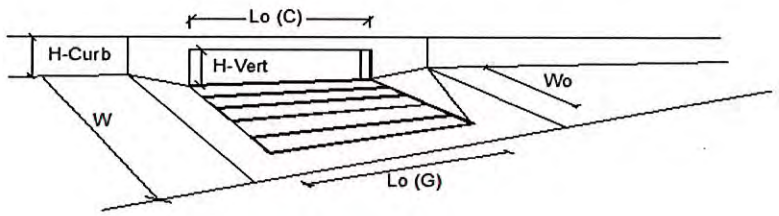
Gutter Geometry (Enter data in the blue cells)				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.0		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	30.0		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.020		ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.063		ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.010		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	20.0	27.8	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.8	7.7	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	15.9	38.1	cfs

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	15.00	15.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**8.8**	**12.4**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**1.0**	**5.2**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**89**	**70**	**%**

INLET PICTURES

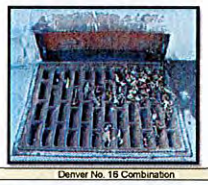

CDOT Type R Curb Opening


Denver No. 14 Curb Opening


Colorado Springs D-10-R


CDOT/Denver 13 Valley Grate

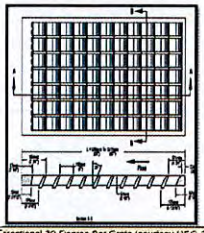

CDOT/Denver 13 Combination


Denver No. 16 Combination


Wheat Ridge Combination Inlet


Denver No. 16 Valley Grate

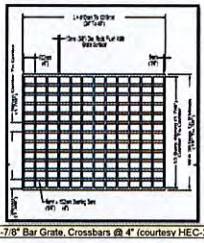

Directional Cast Vane Grate

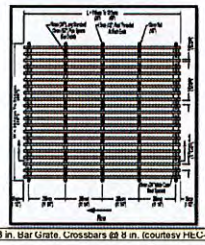

Directional 30-Degree Bar Grate (courtesy HEC-22)


Directional 45-Degree Bar Grate


Reticuline Riveted Grate


1-7/8" Bar Grate, Crossbars @ 8"


1-7/8" Bar Grate, Crossbars @ 4" (courtesy HEC-22)


1-1/8 in. Bar Grate, Crossbars @ 8 in. (courtesy HEC-22)


Slotted Inlet Parallel to Flow


CDOT Type C Grate (Close Mesh)

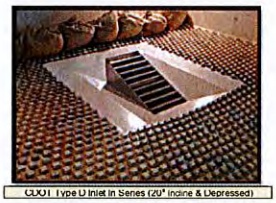

CDOT Type C Grate

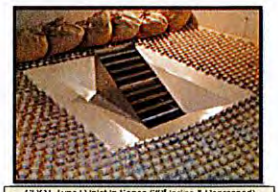

CDOT Type C Inlet

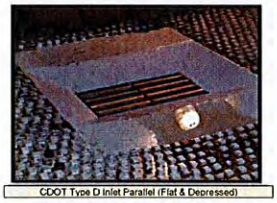

CDOT Type C Inlet in Depression

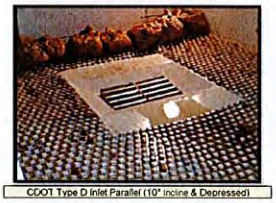

CDOT Type D Inlet in Series (Flat & Depressed)


CDOT Type D Inlet in Series (10° Incline & Depressed)

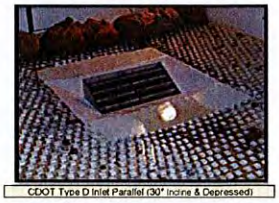

CDOT Type D Inlet in Series (20° Incline & Depressed)


CDOT Type D Inlet in Series (30° Incline & Depressed)


CDOT Type D Inlet Parallel (Flat & Depressed)


CDOT Type D Inlet Parallel (10° Incline & Depressed)


CDOT Type D Inlet Parallel (20° Incline & Depressed)


CDOT Type D Inlet Parallel (30° Incline & Depressed)

Worksheet for Pipe - 1

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Slope

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.03127	ft/ft
Normal Depth	1.00	ft
Diameter	1.00	ft
Discharge	6.30	ft^3/s

Results

Channel Slope	0.03127	ft/ft
Normal Depth	1.00	ft
Flow Area	0.79	ft^2
Wetted Perimeter	3.14	ft
Hydraulic Radius	0.25	ft
Top Width	0.00	ft
Critical Depth	0.96	ft
Percent Full	100.0	%
Critical Slope	0.02731	ft/ft
Velocity	8.02	ft/s
Velocity Head	1.00	ft
Specific Energy	2.00	ft
Froude Number	0.00	
Maximum Discharge	6.78	ft^3/s
Discharge Full	6.30	ft^3/s
Slope Full	0.03127	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%

Worksheet for Pipe - 1

GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.00	ft
Critical Depth	0.96	ft
Channel Slope	0.03127	ft/ft
Critical Slope	0.02731	ft/ft

Worksheet for Pipe - 2

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Slope

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00519	ft/ft
Normal Depth	2.00	ft
Diameter	2.00	ft
Discharge	16.30	ft^3/s

Results

Channel Slope	0.00519	ft/ft
Normal Depth	2.00	ft
Flow Area	3.14	ft^2
Wetted Perimeter	6.28	ft
Hydraulic Radius	0.50	ft
Top Width	0.00	ft
Critical Depth	1.46	ft
Percent Full	100.0	%
Critical Slope	0.00671	ft/ft
Velocity	5.19	ft/s
Velocity Head	0.42	ft
Specific Energy	2.42	ft
Froude Number	0.00	
Maximum Discharge	17.53	ft^3/s
Discharge Full	16.30	ft^3/s
Slope Full	0.00519	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%

Worksheet for Pipe - 2

GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.00	ft
Critical Depth	1.46	ft
Channel Slope	0.00519	ft/ft
Critical Slope	0.00671	ft/ft

Worksheet for Pipe - 3

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Slope

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.02161	ft/ft
Normal Depth	0.67	ft
Diameter	0.67	ft
Discharge	1.80	ft^3/s

Results

Channel Slope	0.02161	ft/ft
Normal Depth	0.67	ft
Flow Area	0.35	ft^2
Wetted Perimeter	2.10	ft
Hydraulic Radius	0.17	ft
Top Width	0.00	ft
Critical Depth	0.61	ft
Percent Full	100.0	%
Critical Slope	0.01885	ft/ft
Velocity	5.11	ft/s
Velocity Head	0.41	ft
Specific Energy	1.08	ft
Froude Number	0.00	
Maximum Discharge	1.94	ft^3/s
Discharge Full	1.80	ft^3/s
Slope Full	0.02161	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%

Worksheet for Pipe - 3

GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.67	ft
Critical Depth	0.61	ft
Channel Slope	0.02161	ft/ft
Critical Slope	0.01885	ft/ft

Worksheet for Pipe - 4

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Slope

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01394	ft/ft
Normal Depth	1.50	ft
Diameter	1.50	ft
Discharge	12.40	ft^3/s

Results

Channel Slope	0.01394	ft/ft
Normal Depth	1.50	ft
Flow Area	1.77	ft^2
Wetted Perimeter	4.71	ft
Hydraulic Radius	0.38	ft
Top Width	0.00	ft
Critical Depth	1.33	ft
Percent Full	100.0	%
Critical Slope	0.01244	ft/ft
Velocity	7.02	ft/s
Velocity Head	0.77	ft
Specific Energy	2.27	ft
Froude Number	0.00	
Maximum Discharge	13.34	ft^3/s
Discharge Full	12.40	ft^3/s
Slope Full	0.01394	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%

Worksheet for Pipe - 4

GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.50	ft
Critical Depth	1.33	ft
Channel Slope	0.01394	ft/ft
Critical Slope	0.01244	ft/ft

Worksheet for Pipe - 5

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Slope

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00691	ft/ft
Normal Depth	2.00	ft
Diameter	2.00	ft
Discharge	18.80	ft^3/s

Results

Channel Slope	0.00691	ft/ft
Normal Depth	2.00	ft
Flow Area	3.14	ft^2
Wetted Perimeter	6.28	ft
Hydraulic Radius	0.50	ft
Top Width	0.00	ft
Critical Depth	1.56	ft
Percent Full	100.0	%
Critical Slope	0.00761	ft/ft
Velocity	5.98	ft/s
Velocity Head	0.56	ft
Specific Energy	2.56	ft
Froude Number	0.00	
Maximum Discharge	20.22	ft^3/s
Discharge Full	18.80	ft^3/s
Slope Full	0.00691	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%

Worksheet for Pipe - 5

GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.00	ft
Critical Depth	1.56	ft
Channel Slope	0.00691	ft/ft
Critical Slope	0.00761	ft/ft

Worksheet for Pipe - 6

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Slope

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00095	ft/ft
Normal Depth	1.00	ft
Diameter	1.00	ft
Discharge	1.10	ft^3/s

Results

Channel Slope	0.00095	ft/ft
Normal Depth	1.00	ft
Flow Area	0.79	ft^2
Wetted Perimeter	3.14	ft
Hydraulic Radius	0.25	ft
Top Width	0.00	ft
Critical Depth	0.44	ft
Percent Full	100.0	%
Critical Slope	0.00588	ft/ft
Velocity	1.40	ft/s
Velocity Head	0.03	ft
Specific Energy	1.03	ft
Froude Number	0.00	
Maximum Discharge	1.18	ft^3/s
Discharge Full	1.10	ft^3/s
Slope Full	0.00095	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%

Worksheet for Pipe - 6

GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.00	ft
Critical Depth	0.44	ft
Channel Slope	0.00095	ft/ft
Critical Slope	0.00588	ft/ft

Worksheet for Pipe - 7

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Slope

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00255	ft/ft
Normal Depth	1.00	ft
Diameter	1.00	ft
Discharge	1.80	ft^3/s

Results

Channel Slope	0.00255	ft/ft
Normal Depth	1.00	ft
Flow Area	0.79	ft^2
Wetted Perimeter	3.14	ft
Hydraulic Radius	0.25	ft
Top Width	0.00	ft
Critical Depth	0.57	ft
Percent Full	100.0	%
Critical Slope	0.00658	ft/ft
Velocity	2.29	ft/s
Velocity Head	0.08	ft
Specific Energy	1.08	ft
Froude Number	0.00	
Maximum Discharge	1.94	ft^3/s
Discharge Full	1.80	ft^3/s
Slope Full	0.00255	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%

Worksheet for Pipe - 7

GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.00	ft
Critical Depth	0.57	ft
Channel Slope	0.00255	ft/ft
Critical Slope	0.00658	ft/ft

Worksheet for Pipe - 8

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Slope

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00150	ft/ft
Normal Depth	1.25	ft
Diameter	1.25	ft
Discharge	2.50	ft^3/s

Results

Channel Slope	0.00150	ft/ft
Normal Depth	1.25	ft
Flow Area	1.23	ft^2
Wetted Perimeter	3.93	ft
Hydraulic Radius	0.31	ft
Top Width	0.00	ft
Critical Depth	0.63	ft
Percent Full	100.0	%
Critical Slope	0.00573	ft/ft
Velocity	2.04	ft/s
Velocity Head	0.06	ft
Specific Energy	1.31	ft
Froude Number	0.00	
Maximum Discharge	2.69	ft^3/s
Discharge Full	2.50	ft^3/s
Slope Full	0.00150	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

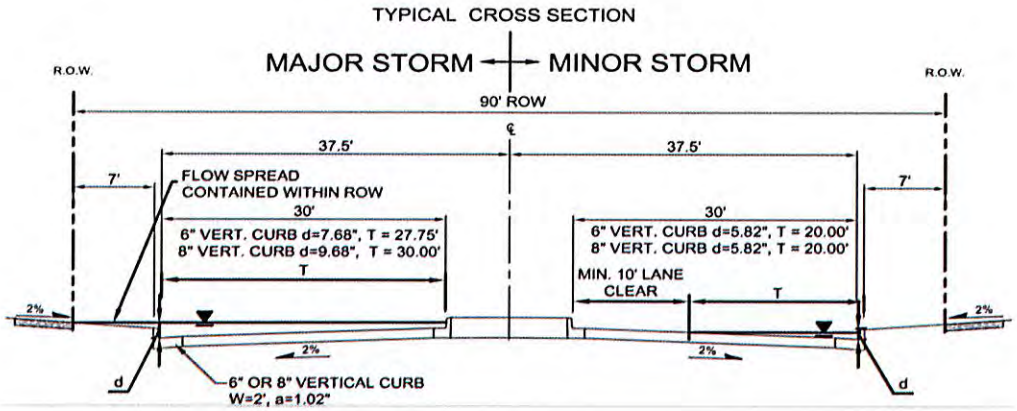
Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%

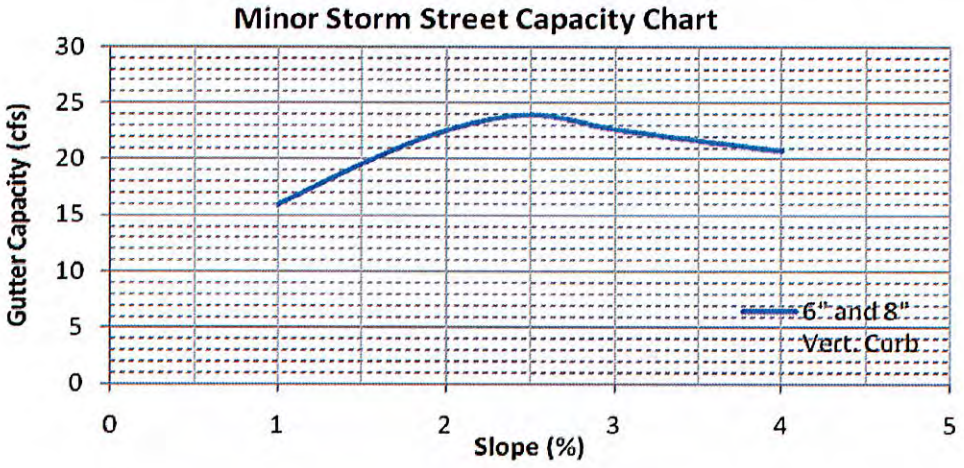
Worksheet for Pipe - 8

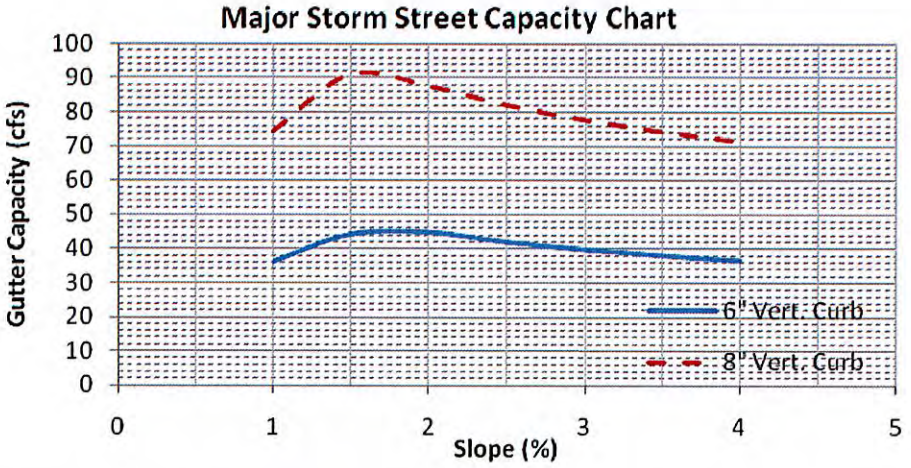
GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.25	ft
Critical Depth	0.63	ft
Channel Slope	0.00150	ft/ft
Critical Slope	0.00573	ft/ft

Figure 7-3. Street Capacity Charts Minor Arterial







These charts shall only be used for the standard street sections as shown. The capacity shown is based on ½ the street section as calculated by the UD-Inlet spreadsheets. Minor storm capacities are based on no crown overtopping, curb height or maximum allowable spread widths. Major storm capacities are based on flow being containing within the public right-of-way, including conveyance capacity behind the curb. The UDFCD Safety Reduction Factor was applied. An 'n_{STREET}' of 0.016 and 'n_{BACK}' of 0.020 was used. Calculations were done using UD-Inlet 3.00.xls, March, 2011.

Rock Chute Design Data

(Version 4.01 - 04/23/03, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)

Project: Airport Spectrum Rundown to Temp. Pond
Designer: Matt Larson
Date: 8/9/2019

County: EL Paso
Checked by:
Date:

Input Channel Geometry

→ Inlet Channel	→ Chute	→ Outlet Channel
Bw = 51.0 ft.	Bw = 45.0 ft.	Bw = 33.0 ft.
Side slopes = 0.0 (m:1)	Factor of safety = 1.20 (F_s)	Side slopes = 4.0 (m:1)
n-value = 0.020	Side slopes = 4.0 (m:1) → 2.0:1 max.	n-value = 0.035
Bed slope = 0.0600 ft./ft.	Bed slope (3.4:1) = 0.290 ft./ft. → 2.5:1 max.	Bed slope = 0.0050 ft./ft.
Freeboard = 1.0 ft.	Outlet apron depth, d = 0.0 ft.	Base flow = 0.0 cfs

Design Storm Data (Table 2, NHCP, NRCS Grade Stabilization Structure No. 410)

Drainage area = 4.1 acres Rainfall = ○ 0 - 3 in. ◉ 3 - 5 in. ○ 5+ in.

Apron elev. --- Inlet = 5916.0 ft. --- Outlet = 5916.0 ft. --- (H_{drop} = 0 ft.)

Chute capacity = Q5-year
Total capacity = Q10-year
Minimum capacity (based on a 5-year, 24-hour storm with a 3 - 5 inch rainfall)

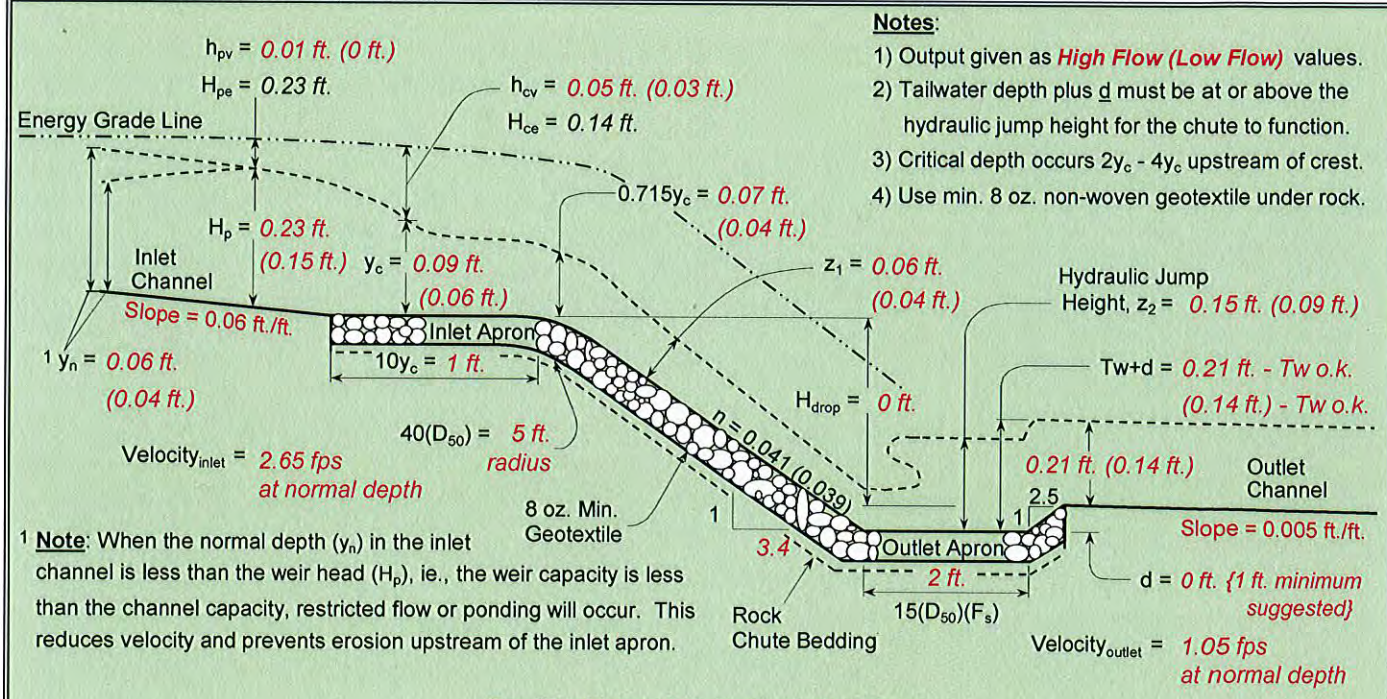
Q_{high} = 7.5 cfs High flow storm through chute → Tw (ft.) = Program

Q_{low} = 3.6 cfs Low flow storm through chute → Tw (ft.) = Program

***Note**: The total required capacity is routed through the chute (principal spillway) or in combination with an auxiliary spillway.*

***Input tailwater (Tw)**:*

Profile and Cross Section (Output)

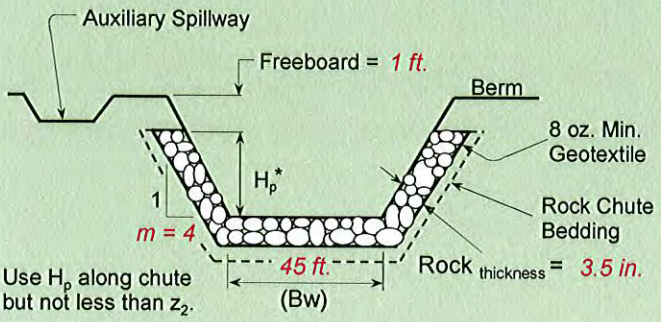


Notes:

1) Output given as ***High Flow (Low Flow)*** values.
2) Tailwater depth plus d must be at or above the hydraulic jump height for the chute to function.
3) Critical depth occurs 2y_c - 4y_c upstream of crest.
4) Use min. 8 oz. non-woven geotextile under rock.

[1] **Note**: When the normal depth (y_n) in the inlet channel is less than the weir head (H_p), ie., the weir capacity is less than the channel capacity, restricted flow or ponding will occur. This reduces velocity and prevents erosion upstream of the inlet apron.

Profile Along Centerline of Chute



* Use H_p along chute but not less than z_2.

Typical Cross Section

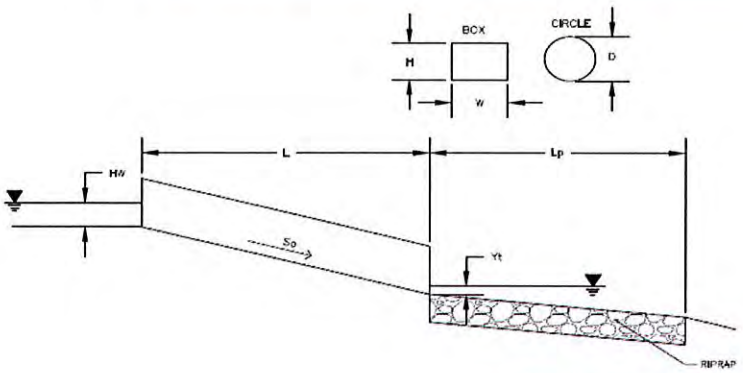
q_t =	0.17 cfs/ft.	Equivalent unit discharge
F_S =	1.20	Factor of safety (multiplier)
z_1 =	0.06 ft.	Normal depth in chute
n-value =	0.041	Manning's roughness coefficient
D_{50}(F_s) =	1.8 in. (0 lbs. - 50% round / 50% angular)	
2(D_{50})(F_s) =	3.5 in.	Rock chute thickness
Tw + d =	0.21 ft.	Tailwater above outlet apron
z_2 =	0.15 ft.	Hydraulic jump height
*** ***The outlet***	***will***	***function adequately***

High Flow Storm Information

Determination of Culvert Headwater and Outlet Protection

Project: **Lot 1 - Airport Spectrum Sub. Fil. 1**

Basin ID: **24" RCP - Pipe 2**



Soil Type:

Choose One:
- O Sandy
- ● Non-Sandy

Supercritical Flow! Using Da to calculate protection type.

Design Information (Input):

Design Discharge	Q =	13.3	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	24	inches
Inlet Edge Type (Choose from pull-down list)	Grooved End Projection		
Box Culvert:	OR		
Barrel Height (Rise) in Feet	Height (Rise) =		ft
Barrel Width (Span) in Feet	Width (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	No =	1	
Inlet Elevation	Elev IN =	5928.25	ft
Outlet Elevation OR Slope	Elev OUT =	5916	ft
Culvert Length	L =	125.95	ft
Manning's Roughness	n =	0.013	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	Elev Y_t =		ft
Max Allowable Channel Velocity	V =	7	ft/s

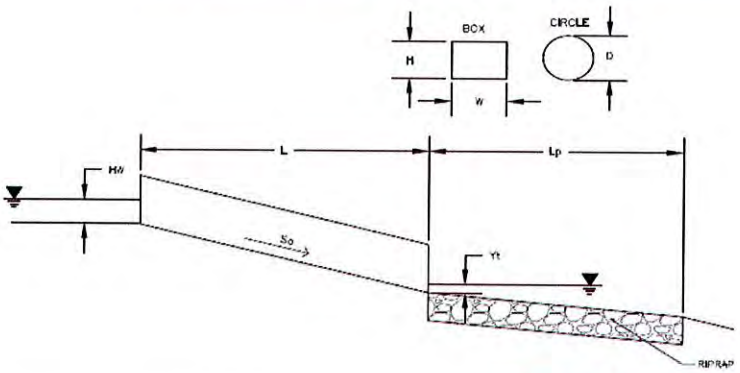
Required Protection (Output):

Tailwater Surface Height	Y_t =	0.80	ft
Flow Area at Max Channel Velocity	A_t =	1.90	ft^2
Culvert Cross Sectional Area Available	A =	3.14	ft^2
Entrance Loss Coefficient	k_e =	0.20	
Friction Loss Coefficient	k_f =	1.56	
Sum of All Losses Coefficients	k_s =	2.76	ft
Culvert Normal Depth	Y_n =	0.59	ft
Culvert Critical Depth	Y_c =	1.31	ft
Tailwater Depth for Design	d =	1.66	ft
Adjusted Diameter OR Adjusted Rise	D_a =	1.29	ft
Expansion Factor	1/(2*tan(Θ)) =	6.70	
Flow/Diameter$^{2.5}$ OR Flow/(Span * Rise$^{1.5}$)	Q/D^2.5 =	2.35	$ft^{0.5}/s$
Froude Number	Fr =	4.68	**Supercritical!**
Tailwater/Adjusted Diameter OR Tailwater/Adjusted Rise	Yt/D =	0.62	
Inlet Control Headwater	HW_I =	1.85	ft
Outlet Control Headwater	HW_O =	-9.83	
Design Headwater Elevation	**HW =**	**5,930.10**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**0.92**	
Minimum Theoretical Riprap Size	d_{50} =	4	in
Nominal Riprap Size	d_{50} =	6	in
UDFCD Riprap Type	**Type =**	**VL**	
Length of Protection	**L_p =**	**6**	**ft**
Width of Protection	**T =**	**3**	**ft**

Determination of Culvert Headwater and Outlet Protection

Project: **Lot 1 - Airport Spectrum Sub. Fil. 1**

Basin ID: **Temp. Pond Outlet Pipe**



Soil Type:
Choose One:
○ Sandy
◉ Non-Sandy

Supercritical Flow! Using Da to calculate protection type.

Design Information (Input):

Design Discharge	Q =	1.8	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	8	inches
Inlet Edge Type (Choose from pull-down list)		Grooved End Projection	
Box Culvert:		OR	
Barrel Height (Rise) in Feet	Height (Rise) =		ft
Barrel Width (Span) in Feet	Width (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	No =	1	
Inlet Elevation	Elev IN =	5914	ft
Outlet Elevation OR Slope	Elev OUT =	5912	ft
Culvert Length	L =	70.8	ft
Manning's Roughness	n =	0.013	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	Elev Y_t =		ft
Max Allowable Channel Velocity	V =	7	ft/s

Required Protection (Output):

Tailwater Surface Height	Y_t =	0.27	ft
Flow Area at Max Channel Velocity	A_t =	0.26	ft^2
Culvert Cross Sectional Area Available	A =	0.35	ft^2
Entrance Loss Coefficient	k_e =	0.20	
Friction Loss Coefficient	k_f =	3.78	
Sum of All Losses Coefficients	k_s =	4.98	ft
Culvert Normal Depth	Y_n =	0.49	ft
Culvert Critical Depth	Y_c =	0.61	ft
Tailwater Depth for Design	d =	0.64	ft
Adjusted Diameter OR Adjusted Rise	D_a =	0.58	ft
Expansion Factor	1/(2*tan(Θ)) =	3.08	
Flow/Diameter$^{2.5}$ OR Flow/(Span * Rise$^{1.5}$)	Q/D^2.5 =	4.96	$ft^{0.5}/s$
Froude Number	Fr =	1.71	**Supercritical!**
Tailwater/Adjusted Diameter OR Tailwater/Adjusted Rise	Yt/D =	0.46	
Inlet Control Headwater	HW_I =	1.29	ft
Outlet Control Headwater	HW_O =	0.70	
Design Headwater Elevation	HW =	5,915.29	ft
Headwater/Diameter OR Headwater/Rise Ratio	HW/D =	1.94	**HW/D > 1.5!**
Minimum Theoretical Riprap Size	d_{50} =	3	in
Nominal Riprap Size	d_{50} =	6	in
UDFCD Riprap Type	Type =	VL	
Length of Protection	L_p =	3	ft
Width of Protection	T =	2	ft

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

User Input

Calculated cells

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.53	inches
***Minor Storm: 1-Hour Rain Depth	10-Year Event	1.75	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches
Optional User Defined Storm	CUHP		
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event		
Max Intensity for Optional User Defined Storm	0		

Designer:	Matt Larson
Company:	Classic Consulting Engineers & Surveyors, LLC
Date:	August 8, 2019
Project:	Airport Spectrum Subdivision Filing No. 1
Location:	Temporary Pond - Ultimate Design Flows

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	TRIB AREA
Receiving Pervious Area Soil Type	Sandy Loam
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	6.000
Directly Connected Impervious Area (DCIA, acres)	0.000
Unconnected Impervious Area (UIA, acres)	2.120
Receiving Pervious Area (RPA, acres)	1.930
Separate Pervious Area (SPA, acres)	1.950
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	6.000
Directly Connected Impervious Area (DCIA, %)	0.0%
Unconnected Impervious Area (UIA, %)	35.3%
Receiving Pervious Area (RPA, %)	32.2%
Separate Pervious Area (SPA, %)	32.5%
A_R (RPA / UIA)	0.910
I_a Check	0.520
f / I for WQCV Event:	2.0
f / I for 10-Year Event:	0.5
f / I for 100-Year Event:	0.3
f / I for Optional User Defined Storm CUHP:	
IRF for WQCV Event:	0.62
IRF for 10-Year Event:	0.90
IRF for 100-Year Event:	0.93
IRF for Optional User Defined Storm CUHP:	
Total Site Imperviousness: I_{total}	35.3%
Effective Imperviousness for WQCV Event:	22.1%
Effective Imperviousness for 10-Year Event:	31.7%
Effective Imperviousness for 100-Year Event:	33.0%
Effective Imperviousness for Optional User Defined Storm CUHP:	

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	25.8%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10-Year Event CREDIT**: Reduce Detention By:	10.8%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	6.7%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:														

Total Site Imperviousness:	35.3%
Total Site Effective Imperviousness for WQCV Event:	22.1%
Total Site Effective Imperviousness for 10-Year Event:	31.7%
Total Site Effective Imperviousness for 100-Year Event:	33.0%
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.

** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.

*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

JOB NAME: Airport Spectrum Sub. Fil 1
JOB NUMBER: 2429.10
DATE: 08/08/19
CALCULATED BY: MAL

TEMP. POND TOP OF BERM

POND SIZING WITH PONDPACK EQUATION:
INSERT POND DESIGN SIZE INFO: (RED)

POND ELEVATION : (from lowest to highest)
5916.00
5916.00
5918.00
5920.00
5922.00

AREA (BTM to TOP):		
	-	acres
3,792	0.09	acres
6,001	0.14	acres
8,613	0.20	acres
11,628	0.27	acres
	-	acres
	-	acres
	-	acres
	-	acres
	-	acres
	-	acres
	-	acres

PRELIMINARY SIZE:

VOLUME = 1/3{(EL2-EL1)*(A1+A2+((A1*A2)^.5))}

						CUMMULATIVE VOLUME:
-	AC-FT	from	5,916	to	5,916	
0.22	AC-FT	from	5,916	to	5,918	0.22
0.33	AC-FT	from	5,918	to	5,920	0.55
0.46	AC-FT	from	5,920	to	5,922	1.01
-	AC-FT	from	5,922	to	-	1.01
-	AC-FT	from	-	to	-	1.01
-	AC-FT	from	-	to	-	1.01
-	AC-FT	from	-	to	-	1.01
-	AC-FT	from	-	to	-	1.01
-	AC-FT	from	-	to	-	1.01
-	AC-FT	from	-	to	-	1.01

*SIZING IS FOR PRELIMINARY PURPOSES ONLY.

VOLUME = 1.01 AC-FT

APPROXIMATE SURFACE AREA REQUIREMENT

POND DEPTH (FT)	POND VOLUME AC-FT		CF	SURFACE AREA (SF)
4	1.01	=	43,966	10,992
6	1.01	=	43,966	7,328
8	1.01	=	43,966	5,496
10	1.01	=	43,966	4,397

JOB NAME: Airport Spectrum Sub. Fil 1
JOB NUMBER: 2429.10
DATE: 08/08/19
CALCULATED BY: MAL

TOP OF STANDPIPE (EURV)

POND SIZING WITH PONDPACK EQUATION:
INSERT POND DESIGN SIZE INFO: (RED)

POND ELEVATION : (from lowest to highest)
5916.00
5916.00
5918.00
5919.00

AREA (BTM to TOP):		
	-	acres
3,792	0.09	acres
6,001	0.14	acres
7,256	0.17	acres
	-	acres
	-	acres
	-	acres
	-	acres
	-	acres
	-	acres
	-	acres
	-	acres

PRELIMINARY SIZE:

VOLUME = 1/3{(EL2-EL1)*(A1+A2+((A1*A2)^.5))}

							CUMMULATIVE VOLUME:
-	AC-FT	from	5,916	to	5,916		
0.22	AC-FT	from	5,916	to	5,918		0.22
0.15	AC-FT	from	5,918	to	5,919		0.37
-	AC-FT	from	5,919	to	-		0.37
-	AC-FT	from	-	to	-		0.37
-	AC-FT	from	-	to	-		0.37
-	AC-FT	from	-	to	-		0.37
-	AC-FT	from	-	to	-		0.37
-	AC-FT	from	-	to	-		0.37
-	AC-FT	from	-	to	-		0.37
-	AC-FT	from	-	to	-		0.37

*SIZING IS FOR PRELIMINARY PURPOSES ONLY.

VOLUME = 0.37 AC-FT

APPROXIMATE SURFACE AREA REQUIREMENT

POND DEPTH (FT)	POND VOLUME AC-FT		CF	SURFACE AREA (SF)
4	0.37	=	16,164	4,041
6	0.37	=	16,164	2,694
8	0.37	=	16,164	2,021
10	0.37	=	16,164	1,616

JOB NAME: Airport Spectrum Sub. Fil 1
JOB NUMBER: 2429.10
DATE: 08/08/19
CALCULATED BY: MAL

TO SPILLWAY

POND SIZING WITH PONDPACK EQUATION:
INSERT POND DESIGN SIZE INFO: (RED)

POND ELEVATION : (from lowest to highest)
5916.00
5916.00
5918.00
5920.00

AREA (BTM to TOP):	
-	acres
3,792	0.09 acres
6,001	0.14 acres
8,613	0.20 acres
	- acres
	- acres
	- acres
	- acres
	- acres
	- acres
	- acres
	- acres

PRELIMINARY SIZE:

VOLUME = 1/3{(EL2-EL1)*(A1+A2+((A1*A2)^.5))}

						CUMMULATIVE VOLUME:
-	AC-FT	from	5,916	to	5,916	
0.22	AC-FT	from	5,916	to	5,918	0.22
0.33	AC-FT	from	5,918	to	5,920	0.55
-	AC-FT	from	5,920	to	-	0.55
-	AC-FT	from	-	to	-	0.55
-	AC-FT	from	-	to	-	0.55
-	AC-FT	from	-	to	-	0.55
-	AC-FT	from	-	to	-	0.55
-	AC-FT	from	-	to	-	0.55
-	AC-FT	from	-	to	-	0.55
-	AC-FT	from	-	to	-	0.55

*SIZING IS FOR PRELIMINARY PURPOSES ONLY.

VOLUME = 0.55 AC-FT

APPROXIMATE SURFACE AREA REQUIREMENT

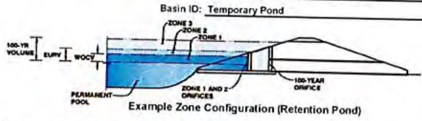
POND DEPTH (FT)	POND VOLUME AC-FT		CF	SURFACE AREA (SF)
4	0.55	=	24,002	6,000
6	0.55	=	24,002	4,000
8	0.55	=	24,002	3,000
10	0.55	=	24,002	2,400

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Airport Spectrum Subdivision Filing 1

Basin ID: Temporary Pond



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	6.00	acres
Watershed Length =	350	ft
Watershed Slope =	0.080	ft/ft
Watershed Imperviousness =	35.30%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	
Water Quality Capture Volume (WQCV) =	0.084	acre-feet
Excess Urban Runoff Volume (EURV) =	0.222	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.150	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	0.198	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	0.248	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	0.321	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	0.427	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	0.562	acre-feet
500-yr Runoff Volume (P1 = 3.1 in.) =	0.867	acre-feet
Approximate 2-yr Detention Volume =	0.140	acre-feet
Approximate 5-yr Detention Volume =	0.186	acre-feet
Approximate 10-yr Detention Volume =	0.231	acre-feet
Approximate 25-yr Detention Volume =	0.289	acre-feet
Approximate 50-yr Detention Volume =	0.330	acre-feet
Approximate 100-yr Detention Volume =	0.391	acre-feet

Note: L / W Ratio < 1
L / W Ratio = 0.5

Optional User Override 1-hr Precipitation

1.19	inches
1.50	inches
1.75	inches
2.00	inches
2.25	inches
2.52	inches
3.10	inches

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.084	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.138	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.169	acre-feet
Total Detention Basin Volume =	0.391	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 = 0.25 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	--	--	--	3,792	0.087		
	--	1.00	--	--	--	4,897	0.112	4,296	0.099
	--	2.00	--	--	--	6,001	0.138	9,734	0.223
	--	4.00	--	--	--	8,613	0.198	24,407	0.560
	--	6.00	--	--	--	11,628	0.267	44,648	1.025
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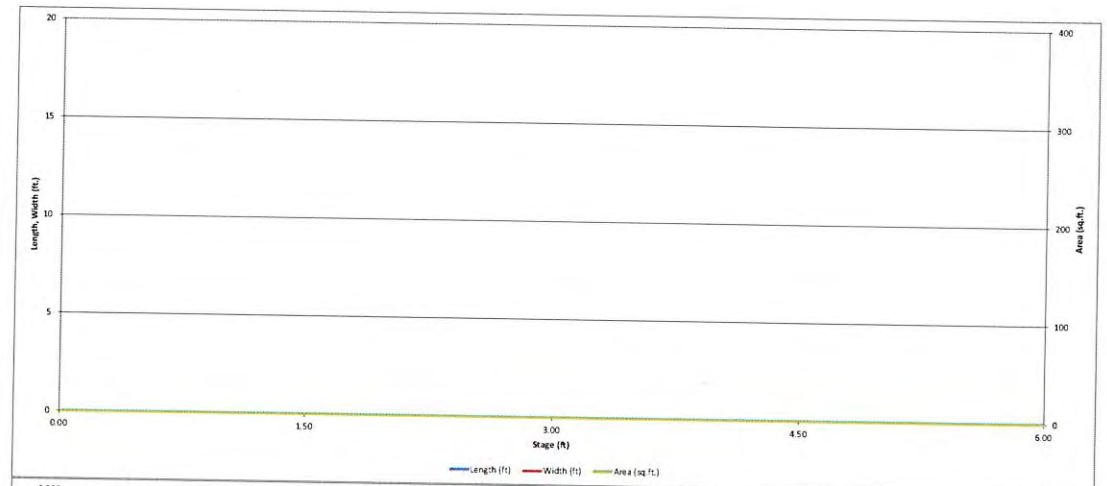
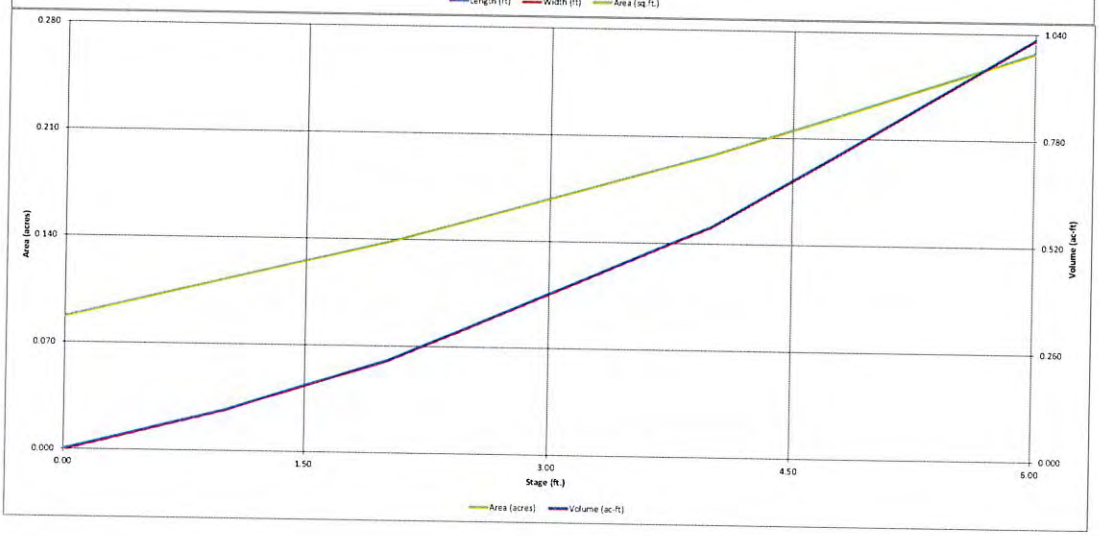
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



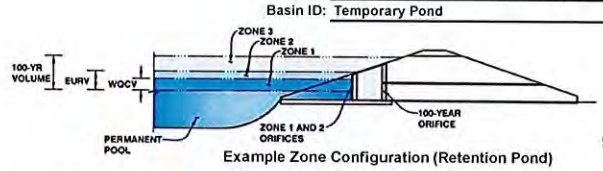


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Airport Spectrum Subdivision Filing 1

Basin ID: Temporary Pond



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.86	0.084	Orifice Plate
Zone 2 (EURV)	1.98	0.138	Orifice Plate
Zone 3 (100-year)	3.08	0.169	Weir&Pipe (Restrict)
		0.391	Total

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	3.00	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	N/A	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

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

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.00	2.00					
Orifice Area (sq. inches)	1.30	8.00	8.00					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.00	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	0.67	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	0.67	N/A	feet
Overflow Grate Open Area % =	100%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	3.00	N/A	feet
Over Flow Weir Slope Length =	0.67	N/A	feet
Grate Open Area / 100-yr Orifice Area =	1.29	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	0.45	N/A	ft^2
Overflow Grate Open Area w/ Debris =	0.22	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	1.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	8.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	8.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.35	N/A	ft^2
Outlet Orifice Centroid =	0.33	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

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

Calculated Parameters for Spillway

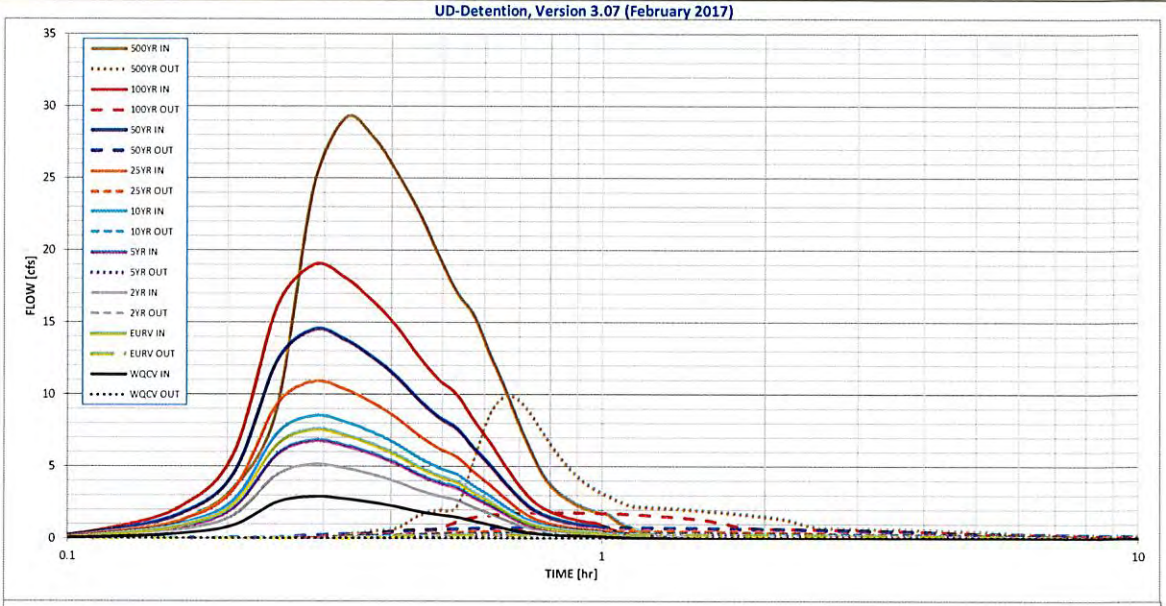
Spillway Design Flow Depth=	0.48	feet
Stage at Top of Freeboard =	5.48	feet
Basin Area at Top of Freeboard =	0.25	acres

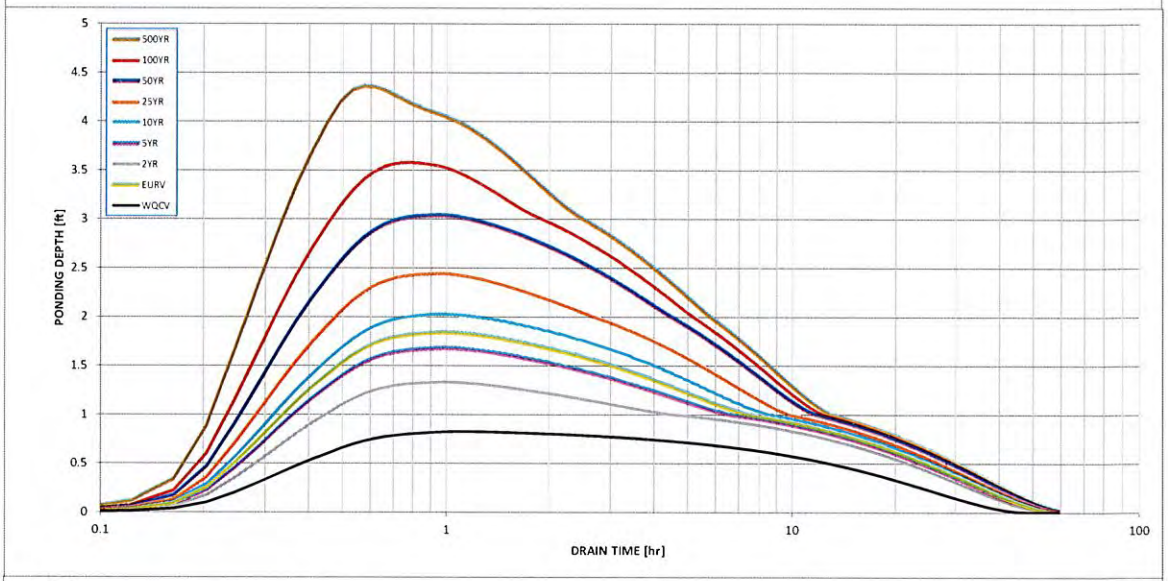
Routed Hydrograph Results

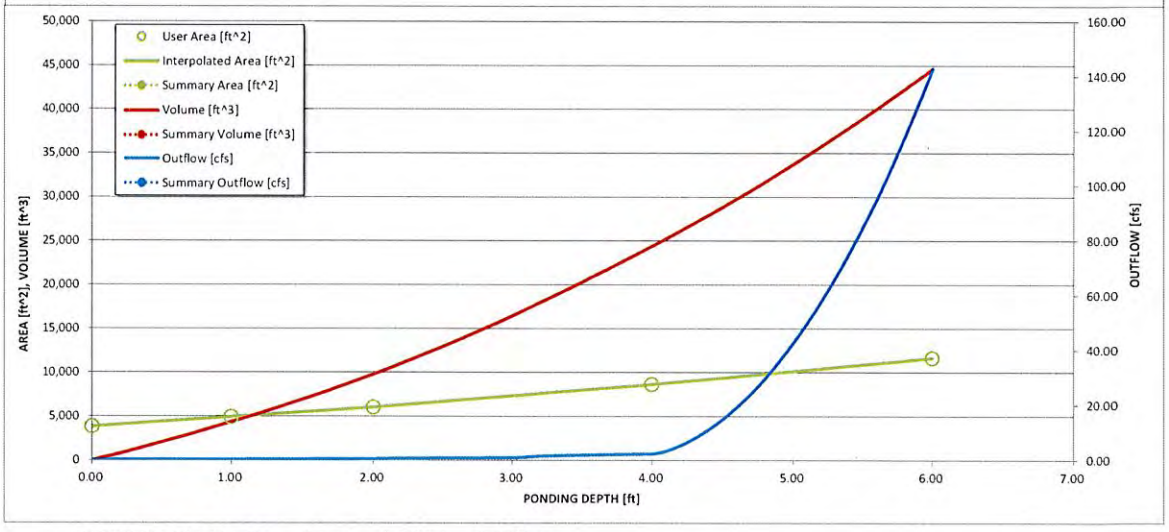
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.10
Calculated Runoff Volume (acre-ft) =	0.084	0.222	0.150	0.198	0.248	0.321	0.427	0.562	0.867
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.084	0.221	0.149	0.198	0.248	0.321	0.427	0.563	0.867
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.00	0.01	0.02	0.04	0.31	0.74	1.59
Predevelopment Peak Q (cfs) =	0.0	0.0	0.0	0.048	0.1	0.3	1.8	4.4	9.5
Peak Inflow Q (cfs) =	2.9	7.6	5.1	6.8	8.5	10.9	14.5	19.0	29.2
Peak Outflow Q (cfs) =	0.0	0.3	0.2	0.277	0.4	0.6	0.8	1.8	9.9
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	5.8	3.3	2.2	0.4	0.4	1.0
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	0.1	2.2	3.3
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	41	47	47	47	48	47	46	44	40
Time to Drain 99% of Inflow Volume (hours) =	44	53	51	53	54	54	54	53	51
Maximum Ponding Depth (ft) =	0.83	1.84	1.33	1.68	2.02	2.45	3.04	3.59	4.36
Area at Maximum Ponding Depth (acres) =	0.11	0.13	0.12	0.13	0.14	0.15	0.17	0.19	0.21
Maximum Volume Stored (acre-ft) =	0.080	0.203	0.138	0.182	0.226	0.288	0.383	0.480	0.634

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







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

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename: _____

Storm Inflow Hydrographs **UD-Detention, Version 3.07 (February 2017)**

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

Time Interval	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
2.46 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:02:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph Constant	0:04:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:07:23	0.13	0.34	0.23	0.31	0.38	0.49	0.65	0.85	1.28
2.036	0:09:50	0.35	0.91	0.62	0.82	1.02	1.31	1.74	2.27	3.47
	0:12:18	0.91	2.35	1.60	2.11	2.63	3.38	4.46	5.84	8.91
	0:14:46	2.50	6.46	4.40	5.80	7.22	9.29	12.27	16.06	24.49
	0:17:13	2.90	7.56	5.13	6.78	8.47	10.93	14.49	19.02	29.19
	0:19:41	2.75	7.19	4.88	6.45	8.06	10.40	13.81	18.15	27.88
	0:22:08	2.50	6.54	4.43	5.87	7.33	9.47	12.57	16.52	25.38
	0:24:36	2.20	5.81	3.93	5.21	6.51	8.42	11.20	14.74	22.70
	0:27:04	1.87	4.98	3.36	4.46	5.59	7.24	9.64	12.72	19.63
	0:29:31	1.64	4.35	2.94	3.90	4.88	6.32	8.41	11.09	17.09
	0:31:59	1.48	3.93	2.65	3.52	4.41	5.72	7.62	10.04	15.49
	0:34:26	1.20	3.21	2.16	2.87	3.61	4.69	6.26	8.28	12.82
	0:36:54	0.96	2.60	1.74	2.32	2.92	3.80	5.09	6.75	10.50
	0:39:22	0.71	1.96	1.30	1.75	2.21	2.89	3.90	5.19	8.12
	0:41:49	0.51	1.43	0.94	1.27	1.62	2.13	2.88	3.85	6.08
	0:44:17	0.38	1.05	0.69	0.94	1.19	1.55	2.10	2.80	4.39
	0:46:44	0.30	0.82	0.55	0.73	0.93	1.21	1.63	2.17	3.39
	0:49:12	0.25	0.68	0.45	0.61	0.77	1.00	1.34	1.78	2.79
	0:51:40	0.21	0.58	0.39	0.52	0.65	0.85	1.14	1.52	2.36
	0:54:07	0.19	0.51	0.34	0.46	0.57	0.75	1.00	1.33	2.07
	0:56:35	0.17	0.46	0.31	0.41	0.52	0.68	0.90	1.20	1.87
	0:59:02	0.16	0.43	0.29	0.38	0.48	0.63	0.84	1.11	1.72
	1:01:30	0.12	0.31	0.21	0.28	0.35	0.46	0.61	0.81	1.26
	1:03:58	0.08	0.23	0.15	0.21	0.26	0.34	0.45	0.60	0.92
	1:06:25	0.06	0.17	0.11	0.15	0.19	0.25	0.33	0.44	0.68
	1:08:53	0.04	0.12	0.08	0.11	0.14	0.18	0.24	0.32	0.50
	1:11:20	0.03	0.09	0.06	0.08	0.10	0.13	0.17	0.23	0.36
	1:13:48	0.02	0.06	0.04	0.05	0.07	0.09	0.12	0.16	0.25
	1:16:16	0.01	0.04	0.03	0.04	0.05	0.06	0.09	0.11	0.18
	1:18:43	0.01	0.03	0.02	0.02	0.03	0.04	0.06	0.08	0.12
	1:21:11	0.00	0.02	0.01	0.01	0.02	0.02	0.03	0.04	0.07
	1:23:38	0.00	0.01	0.00	0.01	0.01	0.01	0.02	0.02	0.04
	1:26:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
	1:28:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1:31:01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1:33:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1:35:56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1:38:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1:40:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1:43:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1:45:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1:48:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1:50:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1:53:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1:55:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1:58:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:00:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:03:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:05:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:07:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:10:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:12:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:15:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:17:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:20:13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:22:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:25:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:27:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:30:04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:32:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:34:59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:37:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:39:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:42:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:44:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:47:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:49:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:52:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:54:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:57:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Matt Larson
Company: Classic Consulting Engineers & Surveyors, LLC
Date: August 8, 2019
Project: Airport Spectrum Subdivision Filing No. 1
Location: TEMPORARY POND

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 35.3 %
B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	i = 0.353
C) Contributing Watershed Area	Area = 6.000 ac
D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = 0.42 in
E) Design Concept (Select EURV when also designing for flood control)	Choose One ○ Water Quality Capture Volume (WQCV) ◉ Excess Urban Runoff Volume (EURV)
F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area$)	V_{DESIGN}= 0.084 ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6 * (V_{DESIGN} / 0.43))$)	$V_{DESIGN\ OTHER}$= 0.082 ac-ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{DESIGN\ USER}$= ac-ft
I) Predominant Watershed NRCS Soil Group	Choose One ◉ A ○ B ○ C / D
J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$	EURV = 0.222 ac-ft
2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)	L : W = 2.0 : 1
3. Basin Side Slopes	
A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred)	Z = 4.00 ft / ft
4. Inlet	
A) Describe means of providing energy dissipation at concentrated inflow locations:	

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	Matt Larson
Company:	Classic Consulting Engineers & Surveyors, LLC
Date:	August 8, 2019
Project:	Airport Spectrum Subdivision Filing No. 1
Location:	TEMPORARY POND

5. Forebay		
A) Minimum Forebay Volume (V_{FMIN} = 2% of the WQCV)	V_{FMIN} = 0.002 ac-ft	
B) Actual Forebay Volume	V_F = 0.003 ac-ft	
C) Forebay Depth (D_F = 18 inch maximum)	D_F = 6.0 in	
D) Forebay Discharge		
i) Undetained 100-year Peak Discharge	Q_{100} = 13.30 cfs	
ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)	Q_F = 0.27 cfs	
E) Forebay Discharge Design	Choose One: ○ Berm With Pipe ◉ Wall with Rect. Notch ○ Wall with V-Notch Weir	(flow too small for berm w/ pipe)
F) Discharge Pipe Size (minimum 8-inches)	Calculated D_P = in	
G) Rectangular Notch Width	Calculated W_N = 3.9 in	
6. Trickle Channel		
A) Type of Trickle Channel	Choose One: ○ Concrete ◉ Soft Bottom	PROVIDE A CONSISTENT LONGITUDINAL SLOPE FROM FOREBAY TO MICROPOOL WITH NO MEANDERING. RIPRAP AND SOIL RIPRAP LINED CHANNELS ARE NOT RECOMMENDED. MINIMUM DEPTH OF 1.5 FEET
F) Slope of Trickle Channel	S = 0.0050 ft / ft	
7. Micropool and Outlet Structure		
A) Depth of Micropool (2.5-feet minimum)	D_M = 0.0 ft	MIN. DEPTH OF 2.5 FEET
B) Surface Area of Microoool (10 ft^2 minimum)	A_M = 0 sq ft	MIN. SURFACE AREA OF 10 SQ. FT
C) Outlet Type	Choose One: ◉ Orifice Plate ○ Other (Describe):	
D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)	$D_{orifice}$ = 1.00 inches	
E) Total Outlet Area	A_{ot} = 6.00 square inches	

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Matt Larson
Company: Classic Consulting Engineers & Surveyors, LLC
Date: August 8, 2019
Project: Airport Spectrum Subdivision Filing No. 1
Location: TEMPORARY POND

8. Initial Surcharge Volume	
A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)	D_{IS} = 6 in
B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV)	V_{IS} = cu ft
C) Initial Surcharge Provided Above Micropool	V_s = 0.0 cu ft
9. Trash Rack	
A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$	A_t = 210 square inches
B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open are to the total screen are for the material specified.)	*S.S. Well Screen with 60% Open Area*
Other (Y/N): N	
C) Ratio of Total Open Area to Total Area (only for type 'Other')	User Ratio =
D) Total Water Quality Screen Area (based on screen type)	A_{total} = 350 sq. in.
E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)	H= 6.25 feet
F) Height of Water Quality Screen (H_{TR})	H_{TR}= 73 inches
G) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended)	$W_{opening}$ = 12.0 inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Matt Larson
Company: Classic Consulting Engineers & Surveyors, LLC
Date: August 8, 2019
Project: Airport Spectrum Subdivision Filing No. 1
Location: TEMPORARY POND

10. Overflow Embankment A) Describe embankment protection for 100-year and greater overtopping:	10' WIDE RIPRAP SPILLWAY AT ELEV. 5920 (BOTTOM AT 5916)
B) Slope of Overflow Embankment (Horizontal distance per unit vertical, 4:1 or flatter preferred)	4.00
11. Vegetation	Choose One ○ Irrigated ◉ Not Irrigated
12. Access A) Describe Sediment Removal Procedures	

Notes:

DRAINAGE MAP

CLASSIC
CONSULTING
ENGINEERS & SURVEYORS

EXISTING SKY VIEW
COMMUNITY PARK

EXISTING POWERS BOULEVARD

EXISTING 72"
STORM SEWER

LOT 1
COLORADO SPRINGS AIRPORT
& INDUSTRIAL PARK
FILING NO. 1

EX-C
3.75

GRAVEL ROAD

GRAVEL ROAD

EXISTING 24"
STORM SEWER

EXISTING 5'x10'
BOX CULVERT

EXISTING 5'x10'
BOX CULVERT

1 LP

EXISTING MILTON E PROBY PARKWAY

EXISTING CURB ON
SOUTH SIDE OF
MILTON PROBY

EXISTING MILTON E PROBY PARKWAY

EX-B
1.20

EX-A
1.90

2

EXISTING 15"
STORM SEWER

LOT 5
COLORADO SPRINGS AIRPORT
FILING NO. 1D

EX-D
10.80

EFFECTIVE
100-YR FEMA
FLOODPLAIN

CLEAR VIEW ESTATES
SUBDIVISION NO. 8

WINDMILL GULCH

3

4

EXISTING POWERS BOULEVARD

N

60 30 0 60 120

SCALE: 1" = 60'

BASIN RUNOFF (RATIONAL)		
BASIN	Q5 (CFS)	Q100 (CFS)
EX-A	8.8	15.8
EX-B	0.5	3.6
EX-C	4.4	12.3
EX-D	3.5	25.8

DESIGN POINT SUMMARY (RATIONAL METHOD)			
DESIGN POINT	Q5 (CFS)	Q100 (CFS)	FEATURE
1	8.8	15.8	EXISTING GRATED INLETS
2	0.5	3.6	EXISTING ROADSIDE DITCH
3	7.4	34.7	SURFACE RUNOFF TO WINDMILL GULCH
4	13.9	48.3	TOTAL RUNOFF TO CREEK

LEGEND

EXISTING GROUND CONTOUR (5500)
PROPOSED FINISHED CONTOUR 5500
SUBDIVISION BOUNDARY
LOT LINE
BASIN IDENTIFIER D
AREA IN ACRES 1.41
DESIGN POINT 1
PROPOSED BASIN BOUNDARY
DIRECTION OF DRAINAGE
EXISTING STORM SEWER
EXISTING STORM INLET
PROPOSED STORM SEWER
PROPOSED STORM INLET
LOW POINT/HIGH POINT LP/HP
100-YR FLOODPLAIN LIMITS

CLASSIC CONSULTING SM
619 N. Cascade Avenue, Suite 200 (719)785-0790
Colorado Springs, Colorado 80903 (719)785-0799(Fax)

AIRPORT SPECTRUM SUBDIVISION
FILING NO. 1
FINAL DRAINAGE REPORT
EXISTING CONDITIONS MAP

CLASSIC CONSULTING

DESIGNED BY	MAL	SCALE		DATE	07/29/19
DRAWN BY	MAL	(H) 1"=	60'	SHEET	1 OF 2
CHECKED BY		(V) 1"=	N/A	JOB NO.	2429.10

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EXISTING SKY VIEW COMMUNITY PARK

EXISTING POWERS BOULEVARD

EXISTING 72" STORM SEWER

LOT 1
COLORADO SPRINGS AIRPORT
& INDUSTRIAL PARK
FILING NO. 1

EX-C
3.75

EXISTING MILTON E PROBY PARKWAY

EX-A
2.15

GRAVEL ROAD

EXISTING 24" STORM SEWER

EXISTING 5'x10' BOX CULVERT

EXISTING CURB ON SOUTH SIDE OF MILTON PROBY

EXISTING 15" STORM SEWER

EX-B1
0.21

EX-B2
0.23

EX-B3
0.37

M
0.15

C-2
0.41

C-1
0.38

F
1.45

B1-6
0.95

B-7
0.03

B-5
0.35

B-9
0.07

B-8
0.22

A
1.68

E
5.31

D
1.93

CLEAR VIEW ESTATES
SUBDIVISION NO. 8

N

60 30 0 60 120

SCALE: 1" = 60'

BASIN RUNOFF (RATIONAL)

BASIN	Q5 (CFS)	Q100 (CFS)
EX-A	9.8	17.6
EX-B1	0.1	0.6
EX-B2	0.1	0.7
EX-B3	0.2	1.1
EX-C	4.4	12.3
A	2.0	6.2
B1-6	3.1	6.3
B-5	1.2	2.4
B-7	0.1	0.2
B-8	0.3	0.9
B-9	0.3	0.6
C-1	1.8	3.2
C-2	1.9	3.4
D	0.8	5.9
E	2.1	15.4
F	0.6	4.4
M	0.7	1.2

PIPE RUN SUMMARY

PIPE	Q5 (CFS)	Q100 (CFS)	PIPE SIZE
1	3.1	6.3	12"
2	6.1	13.6	24"
3	0.3	1.8	8"
4	8.8	12.4	18"
5	10.4	18.8	EX. 24"
6	0.2	1.1	12"
7	0.2	1.8	12"
8	0.3	2.5	EX. 15"

DESIGN POINT SUMMARY (RATIONAL METHOD)

DESIGN POINT	Q5 (CFS)	Q100 (CFS)	FEATURE
1A	9.8	17.6	15' AT-GRADE INLET
1B	1.6	6.4	DUAL TYPE 13 GRATE INLETS
2A	0.2	1.1	EXISTING ROADSIDE DITCH/PROP. 12" CULVERT
2B	0.2	1.8	EXISTING ROADSIDE DITCH/PROP. 12" CULVERT
2C	0.3	2.5	EXISTING ROADSIDE DITCH/EXIST. 15" CULVERT
3	10.2	25.9	TEMPORARY POND
4	13.2	40.3	TOTAL RUNOFF TO CREEK
5	3.1	6.3	K&G INLETS/PIPE STUB
6	3.4	8.8	15' AT-GRADE INLET
7	1.9	4.4	SURFACE INTO POND
8	1.8	3.2	SURFACE INTO POND
9	5.7	22.9	SURFACE BYPASSING TEMPORARY POND

LEGEND

EXISTING GROUND CONTOUR (5500)
PROPOSED FINISHED CONTOUR 5500
SUBDIVISION BOUNDARY
LOT LINE
100-YR FLOODPLAIN LIMITS
BASIN IDENTIFIER / AREA IN ACRES (D / 1.41)
DESIGN POINT (1)

PROPOSED BASIN BOUNDARY
DIRECTION OF DRAINAGE
EXISTING STORM SEWER
EXISTING STORM INLET
PROPOSED STORM SEWER
PROPOSED STORM INLET
LOW POINT/HIGH POINT LP/HP

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AIRPORT SPECTRUM SUBDIVISION
FILING NO. 1
FINAL DRAINAGE REPORT
DEVELOPED CONDITIONS MAP

CLASSIC CONSULTING

DESIGNED BY	MAL	SCALE		DATE	07/29/19
DRAWN BY	MAL	(H) 1"= 60'		SHEET	2 OF 2
CHECKED BY		(V) 1"= N/A		JOB NO.	2429.10

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