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NOVEMBER 2019

PRELIMINARY DRAINAGE REPORT FOR

KOA EXPANSION

FOUNDATION, COLORADO

11-15-2019

Prepared For:

The Jenkins Organization

Austin, Texas

Prepared By:

M3 ENGINEERING

2900 S Congress Ave, Suite 203

Austin, Texas 78704

Tel:512.820.3265

CERTIFICATION STATEMENT

This report and plan for the preliminary drainage design of **KOA Expansion** was prepared by me (or under my direct supervision) in accordance with the provisions of the City of Fountain Drainage Design and Technical Criteria for the owners thereof. I understand that City of Fountain does not and will not assume liability for drainage facilities designed by others."

SIGNATURE: _____

Registered Professional Engineer State of Colorado No. 54971

TABLE OF CONTENTS

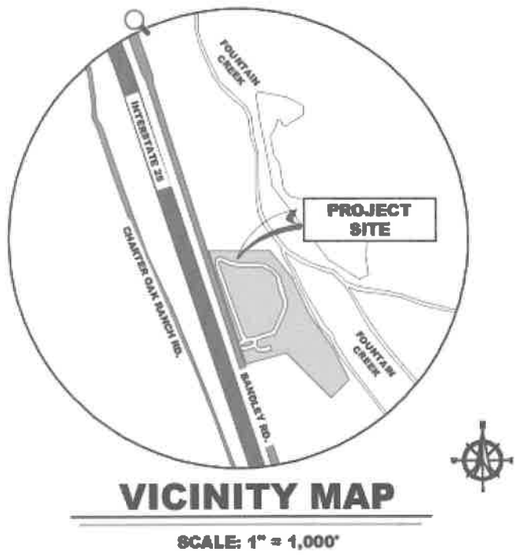
DRAWINGS

I. GENERAL LOCATION AND DESCRIPTION

A. Location

a. The project site is located at 8100 Bandley Drive, Fountain, Colorado. The site is situated along the existing I-25 east frontage road, just south of the existing Hwy 16 (Magrath Ave) Interchange.

b. The site is in the northwest quarter of Section 25, Township 15 South, Range 66 West of the 6th Principal Meridian.



c. The proposed development site is located adjacent to Fountain Creek. Detention requirements for this basin are to detain the difference between the 100- year developed inflow rate and the historic 2-year release rate.

d. The only platted property adjacent to the development is located to the south. The project is known as the Windish RV Center.

B. Description of Property

a. The development area is roughly 20.08 net acres, which includes the redevelopment of 2.76 acres of development area within the drainage basin "A.1" as identified on the Drainage Exhibit.

Figure 1 – Aerial Photograph

b. The subject property is currently developed as the KOA Campground that was originally built in the 1990s. The site contains an existing storage yard for approximately 70 RVs. The ground cover generally consists of asphalt pavement, gravel, and bare earth. The ground cover over the existing storage yard is some asphalt, bare earth and gravel.

c. Existing ground slopes are mild to moderate (i.e., 1 - 6±%) through the interior of the property. General topography slopes from west to east towards Fountain Creek.

d. According to the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Soil Survey website: http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx, the site consists of Manzanola silty clay loam, saline, 0 to 2 percent slopes (Hydrologic Soil Group C).

e. The proposed development is in the Fountain Creek Watershed and Fountain Creek borders the development along its northern boundary. Detention requirements for this basin are to detain the difference between the 100-year developed inflow rate and the 2-year release rate. However, if it can be shown by basin modeling that undetained flows from the developed site would result in no increase in peak discharge within Fountain Creek, the detention requirement would be waived. No modeling has been done at the present but may be considered as this project progresses. The current submittal does show proposed on-site detention.

f. There are no known irrigation facilities within the development.

g. Associated roadways, water and sewer lines will be constructed with the development to service the new pad sites. There are no known encumbrances that would affect the development except the floodplain.

II. DRAINAGE BASINS AND SUB-BASINS

A. Major Basin Description

a. The proposed development site is in the Fountain Creek. Detention requirements for this basin are to detain the difference between the 100- year developed inflow rate and the historic 2-year release rate.

1. A portion of the subject property is encroached by the FEMA 100-year floodplain and floodway of (Fountain Creek). FEMA FIRM Panel Number 08041C0953G for City of Fountain, dated December 7, 2018 is referenced in this study. A FIRMette of the area is provided in the Appendix. The FEMA maps depicts portions of the development within the floodplain. A cross section title BU that has a BFE of 5608.6 listed for the area that is proposed for redevelopment. **However, survey field shots indicate that the property is approximately 5 feet higher than the posted base flood elevations.** A copy of the survey is provided as an exhibit.

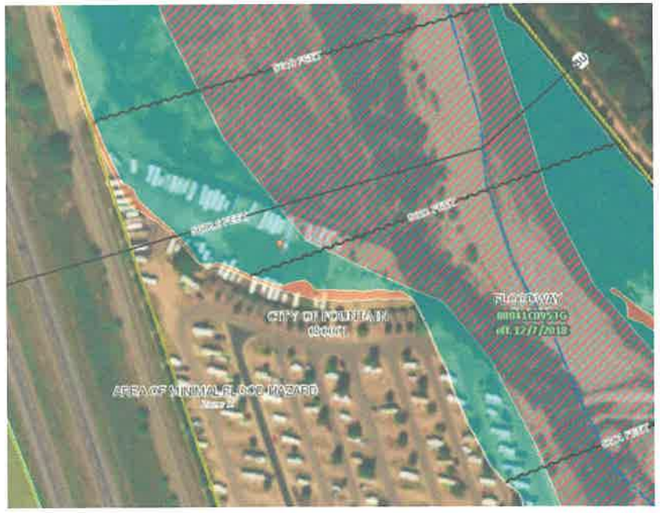


Figure 3 –Area Floodplain Mapping

2. No fill is proposed within the floodway. Proposed grading will tie-in with existing grades outside of the floodway boundary.

3. The vertical datum for the site survey work is listed as "NGS Benchmark S347 – Elevation 5601.42, NGVD 29.

b. The Fountain Creek Watershed is located along the central front range of Colorado. It is a 927 square mile area of land and water that drains to the Arkansas River at Pueblo and ultimately to the Gulf of Mexico. The watershed's boundaries are defined by the shape of the land – Palmer Divide to the north, Pikes Peak to the west, and a minor divide 20 miles east of Colorado Springs.

c. The existing KOA campground does contain any irrigation facilities. The only known irrigation facility is located to the south of our property known as the Windish RV Center. The Windish RV Center contains an existing detention pond to account for stormwater flows.

B. Sub-Basin Description

a. The subject property historically drains overland from west to east. Fountain creek is located adjacent to the site. Interior drainage swales divert water from the site to Fountain Creek that runs along the eastern boundary of the site, which has historically collected the majority of onsite runoff. The proposed site will direct the expansion area 2.76 acres and 0.66 of previously developed Basin A into an onsite Detention/Water Quality pond, which will discharge into Fountain Creek. This basin is known as basin A.1. Basin A.2 is the remainder of Basin A that does not have any proposed development and is undetained heading to Fountain Creek.

b. The project does not receive any offsite flows.

III. DRAINAGE DESIGN CRITERIA

A. Development Criteria Reference

a. Per Section 6.4, of the CSDCM Volume I, detention is required for new developments larger than 1 acre. Detention has been provided for the expansion site in the form of an extended detention pond.

To our knowledge, the proposed development does not conflict with any existing master plans or development plans of parcels surrounding the proposed development.

There are no optional provisions outside of the FCSCM proposed with the proposed project. The overall stormwater management strategy employed with the proposed project utilizes the "Four Step Process" to minimize adverse impacts of urbanization on receiving waters. The following is a description of how the proposed development has incorporated each step.

Step 1 – Employ Runoff Reduction Practices

1. Several techniques have been utilized with the proposed development to facilitate the reduction of runoff peaks, volumes, and pollutant loads as the site is developed from the current use by implementing multiple Low Impact Development (LID) strategies including:
2. Conserving existing amenities in the site including the existing vegetated areas. Providing vegetated open areas throughout the site to reduce the overall impervious area and to minimize directly connected impervious areas (MDCIA).
3. Routing flows, to the extent feasible, through vegetated swales to increase time of concentration, promote infiltration and provide initial water quality.

Step 2 – Implement BMPs That Provide a Water Quality Capture Volume (WQCV) with Slow Release

1. The efforts taken in Step 1 will facilitate the reduction of runoff. The majority of stormwater runoff from the expansion site will ultimately be intercepted and treated using extended detention methods prior to exiting the site.

Step 3 – Stabilize Drainageways

1. By providing water quality where none previously existed, sediment with erosion potential is removed from the downstream drainageway systems. Furthermore, this project will pay one-time stormwater development fees, as well as ongoing monthly stormwater utility fees, both of which help achieve City-wide drainageway stability.

Step 4 – Implement Site Specific and Other Source Control BMPs.

1. The proposed project will improve upon site specific source controls compared to historic conditions:
   a. Trash, waste products, etc. that were previously left exposed with the historic storage will no longer be allowed to exposure to runoff and transport to receiving drainageways. The proposed development will eliminate these sources of potential pollution.

B. Hydrological Criteria

a. The City of Colorado Springs Rainfall Intensity-Duration-Frequency Curves, as calculated by IDF equations on Figure 6-5 of the FCSCM, serve as the source for all hydrologic computations associated with the proposed development.
b. The Rational Method has been employed to compute stormwater runoff utilizing composite coefficients as defined in the exhibits.
c. The 2yr, 25yr, 100yr design storms have been utilized to address distinct drainage scenarios.

d. Reservoir routing has been accomplished utilizing a computer program by repeatedly solving the continuity equation, I - O = S/t, where I and O are the average inflow and outflow rates for the time period, t, and S is the change in storage during the time period. A more convenient form is obtained by assuming that the average flow rates for the time period, t, is equal to the average of the flows at the beginning and end of the time period.

(I1 + I2)/2 - (O1 + O2)/2 = (S2 - S1)/t

routing period, t, must be selected which does not violate this concept. A routing period between one-fourth and one-half of the time of concentration will normally be acceptable, but the shape of the inflow hydrograph must be considered in selecting the routing period. In the equation above, I1, I2, O1 and S1 are for this assumption to be true, the hydrograph must be essentially a straight line between I1 and I2, and a known variable or assumed to be zero. O2 and S2 must be determined. A trial and error approach is used to solve for O2 and S2 using the referenced equation, or the equation can be rearranged to yield:

I1 + I2 + 2S1/t - O1 = 2S2/t + O2

From the stage-storage and stage-discharge curves for the proposed reservoir, or detention pond, a 2S2/t + O versus O curve can be prepared. After a value for 2S2 + O2 is computed, the value for O2 can be obtained directly from this curve. The computation is then repeated for succeeding routing periods. Although the techniques provide a direct solution to reservoir routing, the design of a detention basin requires basically a trial and error approach. A detention basin must be sized, and an outlet structure selected before the stage-discharge, stage-storage, and 2S/t + O versus O curves can be prepared. The design storm must then be routed through the tentative detention pond to determine its ability to produce an acceptable discharge rate. If the peak discharge rate is too high or the detention volume is excessive, the design must be modified, and the routing calculations repeated for the new design.

IV. DRAINAGE FACILITY DESIGN

A. General Concept

a. The main objectives of the project drainage design are to maintain existing drainage patterns, and to ensure no adverse impacts to any adjacent properties. There are no offsite basins to consider.

b. The drainage patterns anticipated for **proposed** drainage basins are described below.

1. **Basin A** - consists of existing RV pads and the future expansion area. Basin A (12.59 acres) is further subdivided into Basin A.1 (3.42 acres) that directs stormwater from the expansion area into a detention/water quality pond. Basin A.2 (9.17 acres) is the area of Basin A that bypasses the proposed detention pond. There is no proposed development in Basin A.2. It is anticipated that Basin A.1 will drain generally via an invert street crown and then into a swale section which will direct runoff into detention/water quality pond 1. The percent imperviousness of this basin is basin on calculations found in Exhibit 4.
2. **Basin B** - consists of existing RV pads, office building, and pool / clubhouse areas. The percent imperviousness of this basin is basin on calculations found in Exhibit 4. No major development is anticipated in this basin.
3. Please refer to Exhibit 3 for Drainage Maps.

c. We have assumed the extended detention volume to be present prior to a 100-year storm event, and the PLD volume to be dry prior to a 100-year event; thus, the total required volume for each pond is composed of the detention volume required plus extended detention volume. Further documentation of treatment volumes and removal rates of stormwater BMPs will be documented with the Final Drainage Report prepared during the City's final review process.

B. Specific details

a. Detention and water quality treatment in the form of extended detention will be provided for the proposed development within the lower stages of Ponds 1. Table 1 below outlines preliminary detention, extended detention, and PLD volume requirements. We have assumed the extended detention volume to be present prior to a 100-year storm event, and the PLD volume to be dry prior to a 100-year event; thus, the total required volume for each pond is composed of the detention volume required plus extended detention volume. Further documentation of treatment volumes and removal rates of stormwater BMPs will be documented with the Final Drainage Report prepared during the City of Fountain review process. Please refer **Exhibit 5 for Pond Data Tables and Exhibit 7 for Hydrographs.**

POND 1 Stage / Storage

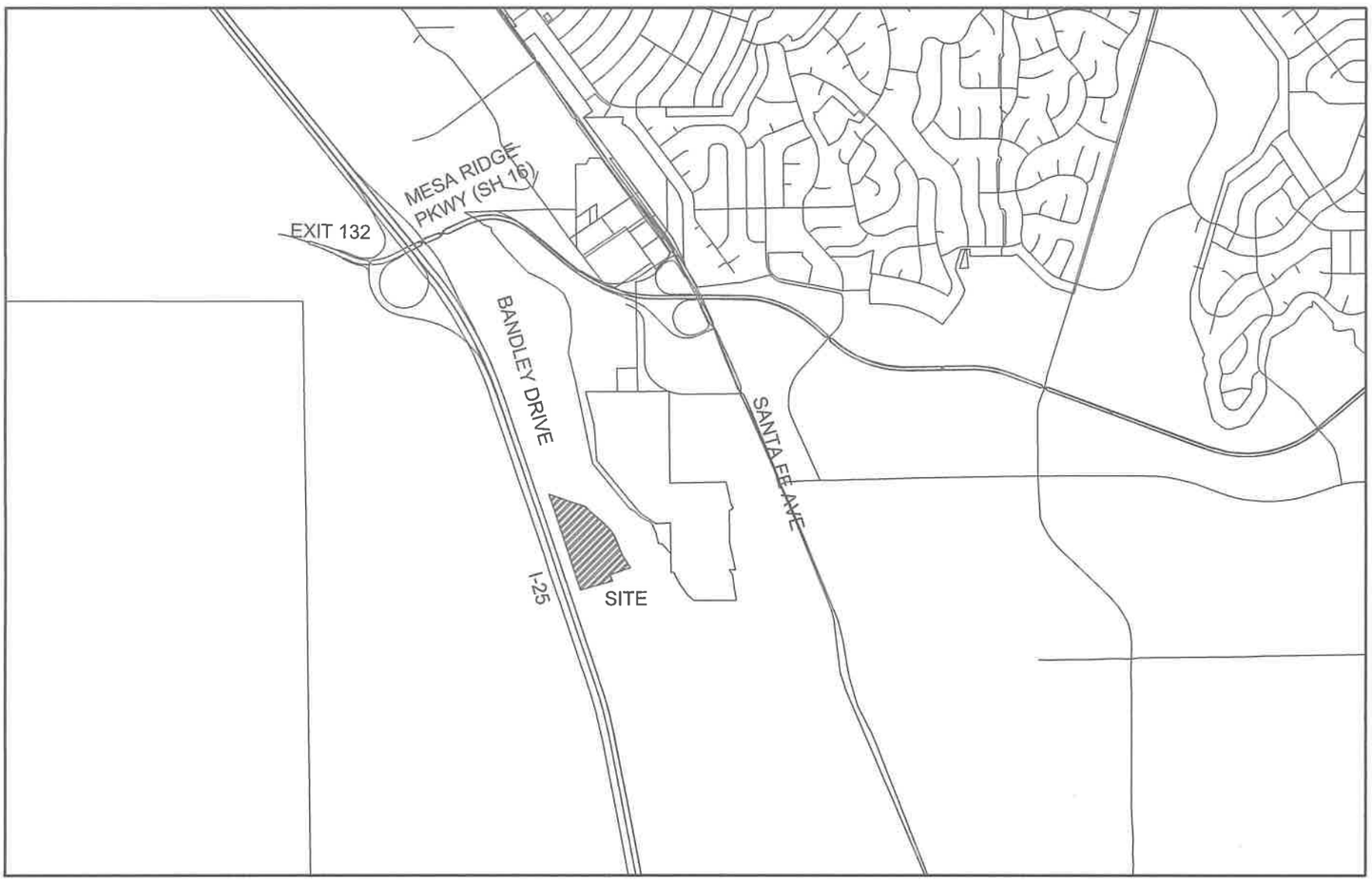
Stage (ft)	Elevation(ft)	Contour Area (sf)	Incremental Storage (cu.ft.)	Total Storage (cu.ft.)
0	5601.5	0	0	0
0.5	5602	500	83	83
1.5	5603	2,600	1,413	1,497
2.5	5604	4,400	3,460	4,957
3.5	5605	5,800	5,083	10,040
4.5	5605.5	6,000	2,950	12,990

b. Detention will be provided for in Pond 1 for the proposed expansion to mitigation any effects on existing or proposed facilities. The detention starts at **5603.8** based on the water quality elevation calculations.
c. The proposed expansion will utilize concrete as a surface material.
d. There are no public facilities proposed for this development. The drainage features associated with the proposed project are all private facilities, located on private property. All drainage associated with the new development is directed into the centerline of the driveway and then divert to a channel. This channel leads to a vegetative swale that directs stormwater to a proposed detention pond.
e. There are no known environmental features that would be affected by this expansion. As such, removing the existing vehicle storage yard will improve environmental hazards such as oil drippings, dust, and trash.
Proper maintenance of the drainage facilities designed with the proposed development is a critical component of their ongoing performance and effectiveness. The water quality pond will be designed at Final to be easily accessed by maintenance staff via gentle slopes provided to the bottom of the pond. Final design details, construction documentation, and Standard Operating Procedures (SOP) Manual shall be provided to the City of Fountain for review prior to Final Development Plan approval. A final copy of the approved SOP manual shall be provided to City and must be maintained on-site by the entity responsible for the facility maintenance. Annual reports must also be prepared and submitted to the City discussing the results of the maintenance program (i.e. inspection dates, inspection frequency, volume loss due to sedimentation, corrective actions taken, etc.).

V. REFERENCES

1. City of Colorado Springs Stormwater Criteria Manual, Volumes 1-2, May 2014.
2. Soils Resource Report for Larimer County Area, Colorado, Natural Resources Conservation Service, United States Department of Agriculture.
3. Urban Storm Drainage Criteria Manual, Volumes 1-3, Urban Drainage and Flood Control District, Wright-McLaughlin Engineers, Denver, Colorado, Revised April 2008.

EXHIBIT 1
LOCATION MAP



VICINITY MAP

SCALE: 1" = 2,000'

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EXHBIT 1

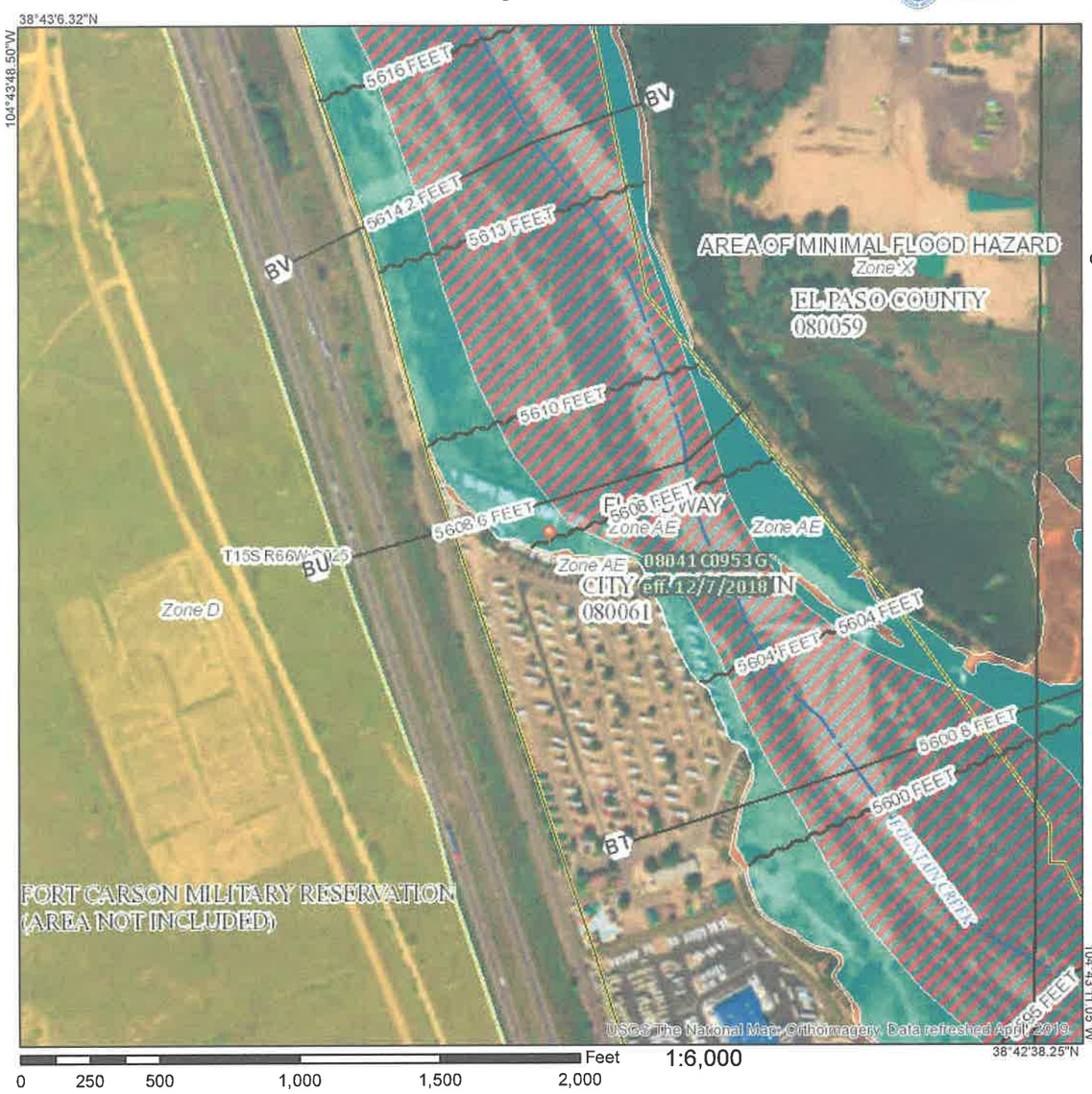
8100 Bandley Drive
Fountain, Colorado

2900 South Congress, Suite 203
Austin, Texas 77063
Tel: 512.820.3265
www.m3engineering.com

EXHIBIT 2
FEMA FIRMETTE MAP

National Flood Hazard Layer FIRMette

FEMA



Legend

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

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

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

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

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

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

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

N

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/19/2019 at 1:04:50 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

EXHIBIT 3
DRAINAGE MAP

DISCHARGE POINT FOR BASIN A

DISCHARGE POINT FOR BASIN B

EXISTING DITCHLINE

BASIN A.1
3.42 AC

BASIN A.2
9.17 AC

BASIN B
5.09 AC

AREA SCHEDULE FOR EXPANSION

TIME OF CONCENTRATION LINE

TIME OF CONCENTRATION LINE

PARCEL A
LOT 1 BLOCK 1

BANDLEY DRIVE
70' PUBLIC R.O.W.

INTERSTATE 25 R.O.

UNPLATTED
REC. NO.
88175974

UNPLATTED
BOOK 5430
PAGE 946

DRAINAGE & PUBLIC UTILITY EASEMENT AS PLATTED

APPROXIMATE LOCATION STORM LINE SIZE, DEPTH AND LOCATION SHOULD BE VERIFIED

GENERAL LEGEND

EXISTING	PROPOSED	DESCRIPTION
		SURVEY FEATURES
IPS		IRON PIN SET
IPF		IRON PIN FOUND
TP		CONTROL POINT
BM		BENCHMARK
ROW		RIGHT OF WAY MARKER
		BEARING & DISTANCE
		SITE
		CURB & GUTTER
		EDGE OF PAVEMENT
		SIDEWALK
		CENTERLINE
		FIRE LANE
		TREELINE
		SIGN
		PRKG. COUNT-REGULAR
		PRKG. COUNT - HC
		PRKG. COUNT- LARGE
		TRAFFIC FLOW ARROWS
		HC SYMBOL
		ADA RAMP
		ADA ROUTE
		BICYCLE PARKING
		BOLLARDS
		WHEEL STOPS
		LIGHT POLE
		RETAINING WALL
		FENCE W/ TYPE
		STORM
		STORM PIPE
		GRATE INLET
		CURB INLET
		SANITARY SEWER
		WASTEWATER & MANHOLE
		CLEAN-OUT
		FORCE MAIN
		WATER DISTRIBUTION
		WATER MAIN
		IRRIGATION LINE
		FIRE HYDRANT
		FIRE DEPT. CONNECTION
		METER BOX
		WATER FITTINGS & BENDS
		GATE VALVE & REDUCER
		POWER, GAS, TV
		ELECTRIC
		ELEC. MANHOLE & METER
		TELEPHONE
		TELEPHONE RISER
		CABLE
		CABLE TV RISER
		FIBER OPTIC
		UTILITY POLE & GUY WIRE
		LIGHT POLE
		GAS LINE
		GAS VALVE & METER
975		TREE
975		TREE TO BE REMOVED
		TREE TO BE SAVED

CALL UTILITY NOTIFICATION CENTER OF COLORADO
1-800-922-1987
CALL 2-BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

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

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FIRM #18863

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CIVIL ENGINEERING | BUILDING DESIGN
CONSTRUCTION MANAGEMENT

THE JENKINS ORGANIZATION

ISSUE/REVISION RECORD

PROJECT NAME
COA EXPANSION
PHASE 1

2900 BANDLEY
MOUNTAIN, TEXAS 75087

MAP GRID # TBD
MAPSCO # TBD

PROJECT NUMBER
8006

DRAWING FILE
8006-DAM02.DWG

SCALE 1" = 60'
0 30 60

PROFESSIONAL SEAL
COLORADO REGISTERED
TROY L MOORE III
54971
EXP 10/31/20
PROFESSIONAL ENGINEER
11-20-19

PROJECT STATUS
SUBMITTAL 1

SHEET TITLE
POST DEVELOPED
DRAINAGE AREA MAP

SHEET NUMBER
2 of 2

DISCHARGE POINT FOR BASIN A

DISCHARGE POINT FOR BASIN B

EXISTING DITCHLINE

BASIN A
12.09 ac

BASIN B
.09 ac

AREA SCHEDULE FOR EXPANSION

TIME OF CONCENTRATION LINE

TIME OF CONCENTRATION LINE

PARCEL A
LOT 1 BLOCK 1

BANDLEY DRIVE
70' PUBLIC R.O.W.

INTERSTATE 25 R.O.W.

UNPLATTED
BOOK 5432
PAGE 348

UNPLATTED
REC. NO.
98175874

DRAINAGE & PUBLIC UTILITY EASEMENT AS PLATTED

APPROXIMATE LOCATION STORM LINE SIZE, DEPTH AND LOCATION SHOULD BE VERIFIED

CONCRETE PADS

ASPHALT

GENERAL LEGEND

EXISTING	PROPOSED	DESCRIPTION
		SURVEY FEATURES
○ IPS		IRON PIN SET
● IPF		IRON PIN FOUND
△ TP		CONTROL POINT
BM		BENCHMARK
RM		RIGHT OF WAY MARKER
		BEARING & DISTANCE
		SITE
		CURB & GUTTER
		EDGE OF PAVEMENT
		SIDEWALK
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		H/C SYMBOL
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		ADA ROUTE
		BICYCLE PARKING
		BOLLARDS
		WHEEL STOPS
		LIGHT POLE
		RETAINING WALL
		FENCE W/ TYPE
		STORM
		STORM PIPE
		GRATE INLET
		CURB INLET
		SANITARY SEWER
		WASTEWATER & MANHOLE
		CLEAN-OUT
		FORCE MAIN
		WATER DISTRIBUTION
		WATER MAIN
		IRRIGATION LINE
		FIRE HYDRANT
		FIRE DEPT. CONNECTION
		METER BOX
		WATER FITTINGS & BENDS
		GATE VALVE & REDUCER
		POWER, GAS, TV
		ELECTRIC
		ELEC. MANHOLE & METER
		TELEPHONE
		TELEPHONE RISER
		CABLE
		CABLE TV RISER
		FIBER OPTIC
		UTILITY POLE & GUY WIRE
		LIGHT POLE
		GAS LINE
		GAS VALVE & METER
		TREE
		TREE TO BE REMOVED
		TREE TO BE SAVED

975
975

DESIGN PROFESSIONAL
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CONSTRUCTION MANAGEMENT

THE JENKINS ORGANIZATION

ISSUE/REVISION RECORD

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LOA EXPANSION
PHASE 1

300 BANDLEY
MOUNTAIN, TEXAS 75087

MAP GRID # TBD
APSCO # TBD

PROJECT NUMBER
8006

DRAWING FILE
8006-DAM01.DWG

SCALE 1" = 60'
0 30 60

PROFESSIONAL SEAL
TROY L. MOORE III
COLORADO REGISTERED
54971
EXP 10/31/20
PROFESSIONAL ENGINEER
11-20-19

PROJECT STATUS
SUBMITTAL 1

SHEET TITLE
PRE DEVELOPED
DRAINAGE AREA MAP

SHEET NUMBER
of 2

DCCX

EXHIBIT 4
BASIN DATA

DEVELOPED COMPOSITE % IMPERVIOUSNESS AND RUNOFF COEFFICIENT CALCULATIONS

CHARACTER OF SURFACE:	Percentage Impervious	2-yr (HSG C)	5-yr (HSG C)	10-yr (HSG C)	25-yr (HSG C)	100-yr (HSG C)	
Streets	100%	0.89	0.90	0.92	0.94	0.96	Project: 18006 Calculations By: TLM Date: June 21 2019
Gravel	90%	0.60	0.63	0.66	0.70	0.74	
Earth	0.00	0.35	0.35	0.35	0.35	0.35	

Runoff Coefficients are taken from UDFCD USDCM, Volume I.

PREDEVELOPED

Basin ID	Basin Area (ac)	Basin Area (sf)	Area of Imprevious (ac)	Area of Gravel (ac)	Area of Earth, Lawns (ac)	2-year Composite Rc	5-year Composite Rc	10-year Composite Rc	100-year Composite Rc	Composite % Imperv.
A	12.59	548,420	3.82	8.50	0.27	0.68	0.71	0.73	0.80	30.4%
B	5.09	221,720	2.25	2.01	0.83	0.69	0.70	0.72	0.77	44.2%

POSTDEVELOPED

Basin ID	Basin Area (ac)	Basin Area (sf)	Area of Imprevious (ac)	Area of Gravel (ac)	Area of Earth, Lawns (ac)	2-year Composite Rc	5-year Composite Rc	10-year Composite Rc	100-year Composite Rc	Composite % Imperv.
A	12.59	548,420	4.97	4.75	2.87	0.66	0.67	0.69	0.74	39.5%
B	5.09	221,720	2.25	2.01	0.83	0.69	0.70	0.72	0.77	44.2%

POSTDEVELOPED

Basin ID	Basin Area (ac)	Basin Area (sf)	Area of Imprevious (ac)	Area of Gravel (ac)	Area of Earth, Lawns (ac)	2-year Composite Rc	5-year Composite Rc	10-year Composite Rc	100-year Composite Rc	Composite % Imperv.
A.1	3.42	148,975	1.25	1.80	0.37	0.68	0.70	0.72	0.78	36.5%
A.2	9.17	399,445	3.72	2.95	2.50	0.65	0.66	0.68	0.72	40.6%
A	12.59		4.97	4.75	2.87					

TIME OF CONCENTRATION CALCULATIONS

CHARACTER OF SURFACE:	Cv
Conveyance Coefficient, Cv	
Heavy meadow	2.50
Tillage/field	5.00
Riprap (not buried)* 6.5	6.50
Short pasture and lawns 7	7.00
Nearly bare ground 10	10.00
Grassed waterway 15	15.00
Paved areas and shallow paved swales	20.00

Project: 18006
Calculations By: TLM
Date: June 21 2019

Runoff Coefficients are taken from the City of Colorado Springs Drainage Criteria Manual. % Impervious taken from UDFCD USDCM, Volume I.

PREDEVELOPED

Basin	Overland Flow				Shallow Flow					TOC
	C5	Length, L (ft)	Slope, S (%)	T_i (min)	Cv Conveyance Coeff.	Length, L (ft)	Slope, S (%)	Velocity, V (ft/s)	T_t (min)	T_c (min)
A	0.71	300	1.0%	12.5	10	400	1.0%	1.000	6.7	19
B	0.70	300	1.0%	12.6	10	400	1.0%	1.000	6.7	19

POSTDEVELOPED

Basin	Overland Flow				Shallow Flow					TOC
	C5	Length, L (ft)	Slope, S (%)	T_i (min)	Cv Conveyance Coeff.	Length, L (ft)	Slope, S (%)	Velocity, V (ft/s)	T_t (min)	T_c (min)
A.1	0.70	100	1.0%	7.4	20	1122	1.0%	2.000	9.4	17
A.2	0.66	300	1.0%	13.8	10	400	1.0%	1.000	6.7	21
B	0.70	300	1.0%	12.6	10	400	1.0%	1.000	6.7	19

BASIN FLOWS

CHARACTER OF SURFACE:	Cv
Conveyance Coefficient, Cv	
2-Yr Intensity	2.50
2-Yr Intensity	5.00
2-Yr Intensity	6.50
Short pasture and lawns 7	7.00
Nearly bare ground 10	10.00
Grassed waterway 15	15.00
Paved areas and shallow paved swales	20.00

Project: 18006
Calculations By: TLM
Date: June 21 2019

Runoff Coefficients are taken from the City of Colorado Springs Drainage Criteria Manual. % Impervious taken from UDFCD USDCM, Volume I.

PREDEVELOPED

Basin ID	Basin Area (ac)	TOC (min)	C_{2YR}	I_{2YR}	FLOW 2-YR	C_{5YR}	I_{5YR}	FLOW 5-YR	C_{10YR}	I_{10YR}	FLOW 10-YR	C_{100YR}	I_{100YR}	FLOW 100-YR
A	12.59	19	0.68	2.52	21.68	0.71	3.15	28.04	0.73	3.68	33.93	0.80	5.29	53.23
B	5.09	19	0.69	2.52	8.81	0.70	3.15	11.28	0.72	3.67	13.54	0.77	5.28	20.81

POSTDEVELOPED ** UNROUTED

Basin ID	Basin Area (ac)	TOC (min)	C_{2YR}	I_{2YR}	FLOW 2-YR	C_{5YR}	I_{5YR}	FLOW 5-YR	C_{10YR}	I_{10YR}	FLOW 10-YR	C_{100YR}	I_{100YR}	FLOW 100-YR
A.1	3.42	17	0.68	2.68	6.23	0.70	3.36	8.02	0.72	6.70	16.52	0.78	5.64	15.01
A.2	9.17	21	0.65	2.44	14.54	0.66	3.05	18.57	0.68	4.97	31.04	0.72	5.12	33.97
B	5.09	19	0.69	2.52	8.81	0.70	3.15	11.28	0.72	6.00	22.12	0.77	5.28	20.81

EXHIBIT 5
POND DATA

Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 11 / 21 / 2019

Pond No. 1 - Pond

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 5601.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	5601.50	00	0	0
0.50	5602.00	500	83	83
1.50	5603.00	2,600	1,413	1,497
2.50	5604.00	4,400	3,460	4,957
3.50	5605.00	5,800	5,083	10,040
4.00	5605.50	6,000	2,950	12,990

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	1.00	0.00	0.00
Span (in)	= 12.00	1.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 5601.50	5601.50	0.00	0.00
Length (ft)	= 20.00	0.00	0.00	0.00
Slope (%)	= 1.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 15.00	0.50	0.00	0.00
Crest El. (ft)	= 5604.50	5603.20	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	Rect	---	---
Multi-Stage	= Yes	Yes	No	No

Exfil.(In/hr) = 0.000 (by Wet area)

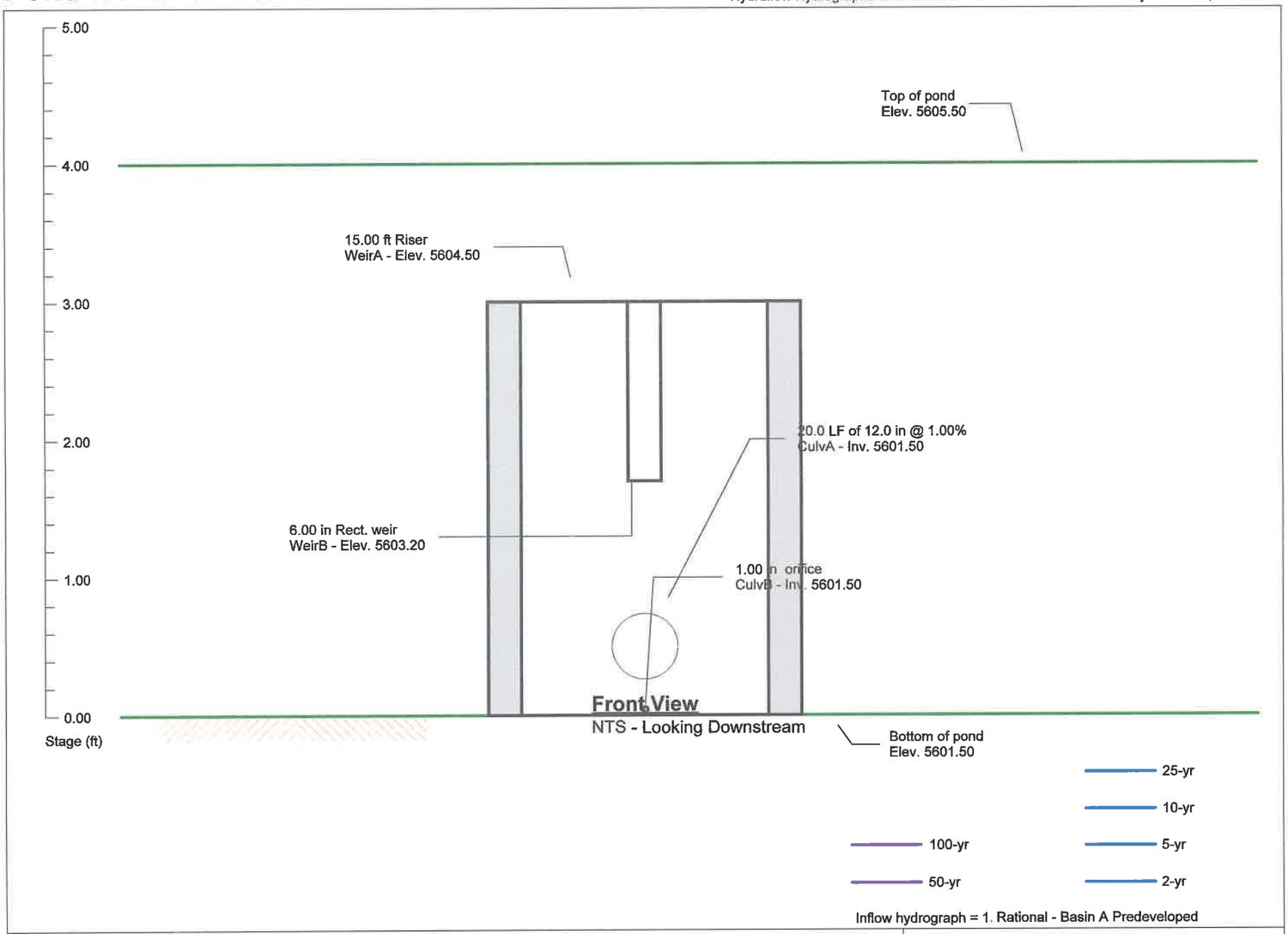
TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	5601.50	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
0.50	83	5602.00	0.02 ic	0.02 ic	---	---	0.00	0.00	---	---	---	---	0.017
1.50	1,497	5603.00	0.03 ic	0.03 ic	---	---	0.00	0.00	---	---	---	---	0.031
2.50	4,957	5604.00	1.24 oc	0.04 ic	---	---	0.00	1.19	---	---	---	---	1.227
3.50	10,040	5605.00	6.53 ic	0.00 ic	---	---	5.73 s	0.80 s	---	---	---	---	6.527
4.00	12,990	5605.50	7.07 ic	0.00 ic	---	---	6.46 s	0.55 s	---	---	---	---	7.012

Pond No. 1 - Pond



Project: KOA.gpw

Thursday, 11 / 21 / 2019

EXHIBIT 6
WATER QUALITY CALCULATIONS

WATER QUALITY POND DESIGN CALCULATIONS

REQUIRED STORAGE & OUTLET WORKS:

BASIN AREA	**3.42** ac	<-- INPUT from impervious calcs
BASIN IMPERVIOUSNESS %	**36.5** %	<-- INPUT from impervious calcs
I, BASIN IMPERVIOUSNESS RATI	**0.37**	<-- CALCULATED
DRAIN TIME COEFFICIENTS	**1.0**	<-- UFCD Vol 3 Table 3-2
WQCV (watershed inches)	**0.17**	<-- UFCD Vol 3 Equation 3-1
WQCV (ac-ft)	**0.05** ac-ft **2,117** cf	<-- CALCULATED from UDFCD DCM V.3 Section 6.5

POND 1 Stage / Storage

Stage (ft)	Elevation(ft)	Contour Area (sf)	Incremental Storage (cu.ft.)	Total Storage (cu.ft.)
0	5601.5	0	0	0
0.5	5602	500	83	83
1.5	5603	2,600	1,413	1,497
2.5	5604	4,400	3,460	4,957
3.5	5605	5,800	5,083	10,040
4.5	5605.5	6,000	2,950	12,990

WQ ELEVATION	**5603.2** @	**2,117 cf**
HEAD	**1.7** FT	<-- WQV ELEV. - Stage 0 Elevation
DRAIN TIME	**24** HRS	<-- WQV ELEV. - Stage 0 Elevation
WQV PEAK DISCHARGE	**0.025** CFS	<-- WQv / (Drain Time,hrs x 3600 sec/hr)
ORIFICE AREA	**0.006** sf	<-- √ WQ_v PEAK DISCHARGE / (0.6 $(2gH/2)^{0.5}$
ORIFICE DIAMETER	**1.0** IN	<-- √ Area* (4/π)

The Average Hydraulic Head and Average Discharge Method is used determine the orifice size.

EXHIBIT 7
HYDROGRAPHS

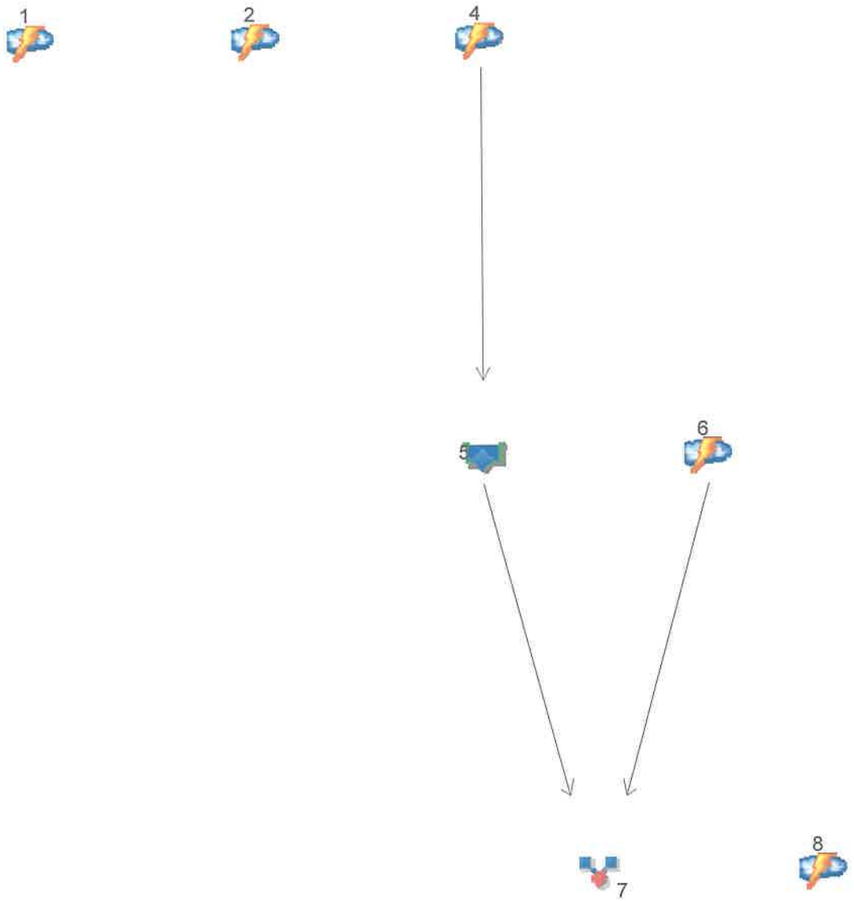
Hydraflow Table of Contents

KOA.gpw

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 11 / 21 / 2019

Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020



Legend

Hyd.	Origin	Description
1	Rational	Basin A Predeveloped
2	Rational	Basin B Predeveloped
4	Rational	Basin A.1 Postdeveloped
5	Reservoir	Pond Routing
6	Rational	Basin A.2 Postdeveloped
7	Combine	Basin A Postdeveloped
8	Rational	Basin B Postdeveloped

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)								Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	Rational	------	-------	22.36	-------	27.92	32.54	37.27	41.88	46.83	Basin A Predeveloped
2	Rational	------	-------	9.171	-------	11.45	13.35	15.29	17.18	19.21	Basin B Predeveloped
4	Rational	------	-------	6.423	-------	8.027	9.354	10.71	12.04	13.46	Basin A.1 Postdeveloped
5	Reservoir	4	-------	1.461	-------	2.024	2.613	4.503	5.894	6.273	Pond Routing
6	Rational	------	-------	14.75	-------	18.41	21.46	24.58	27.62	30.88	Basin A.2 Postdeveloped
7	Combine	5, 6	-------	15.66	-------	19.86	23.29	26.84	31.35	36.75	Basin A Postdeveloped
8	Rational	------	-------	8.691	-------	10.85	12.64	14.48	16.27	18.20	Basin B Postdeveloped

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	22.36	1	19	25,485	----	----	----	Basin A Predeveloped
2	Rational	9.171	1	19	10,455	----	----	----	Basin B Predeveloped
4	Rational	6.423	1	17	6,552	----	----	----	Basin A 1 Postdeveloped
5	Reservoir	1.461	1	30	6,547	4	5604.10	5,480	Pond Routing
6	Rational	14.75	1	21	18,584	----	----	----	Basin A 2 Postdeveloped
7	Combine	15.66	1	21	25,131	5, 6	----	----	Basin A Postdeveloped
8	Rational	8.691	1	21	10,950	----	----	----	Basin B Postdeveloped

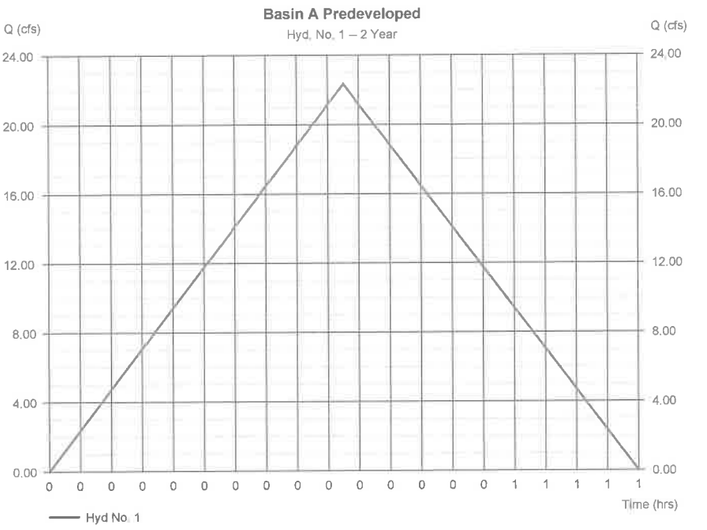
Hydrograph Report

Hyd. No. 1

Basin A Predeveloped

Hydrograph type	= Rational	Peak discharge	= 22.36 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.32 hrs
Time interval	= 1 min	Hyd. volume	= 25,485 cuft
Drainage area	= 12.590 ac	Runoff coeff.	= 0.68*
Intensity	= 2.611 in/hr	Tc by User	= 19.00 min
IDF Curve	= ColoradoSprings.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(3.770 x 0.75) + (1.260 x 0.90) + (7.550 x 0.50)] / 12.590



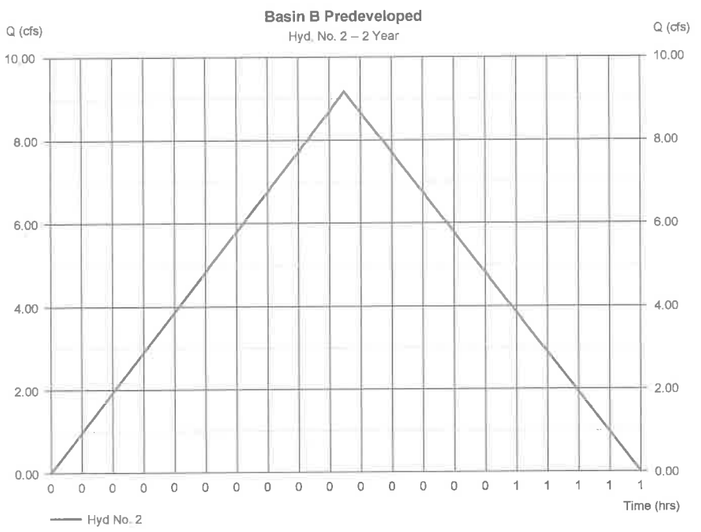
Hydrograph Report

Hyd. No. 2

Basin B Predeveloped

Hydrograph type	= Rational	Peak discharge	= 9.171 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.32 hrs
Time interval	= 1 min	Hyd. volume	= 10,455 cuft
Drainage area	= 5.090 ac	Runoff coeff.	= 0.69*
Intensity	= 2.611 in/hr	Tc by User	= 19.00 min
IDF Curve	= ColoradoSprings.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(2.640 x 0.75) + (2.400 x 0.90) + (7.550 x 0.50)] / 5.090



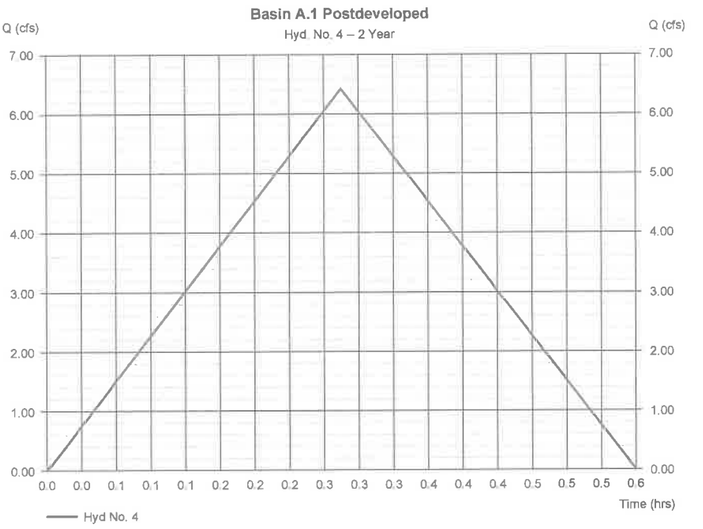
Hydrograph Report

Hyd. No. 4

Basin A.1 Postdeveloped

Hydrograph type	= Rational	Peak discharge	= 6.423 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.28 hrs
Time interval	= 1 min	Hyd. volume	= 6,552 cuft
Drainage area	= 3.420 ac	Runoff coeff.	= 0.68*
Intensity	= 2.762 in/hr	Tc by User	= 17.00 min
IDF Curve	= ColoradoSprings.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(3.770 x 0.75) + (1.260 x 0.90) + (7.550 x 0.50)] / 3.420



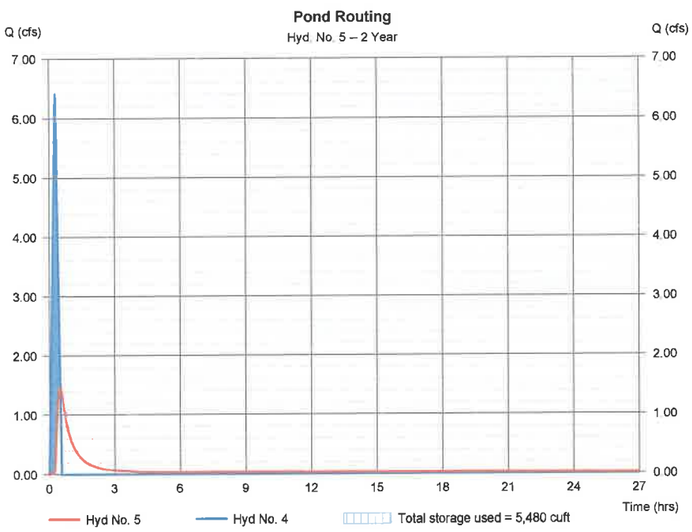
Hydrograph Report

Hyd. No. 5

Pond Routing

Hydrograph type	= Reservoir	Peak discharge	= 1.461 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.50 hrs
Time interval	= 1 min	Hyd. volume	= 6,547 cuft
Inflow hyd. No.	= 4 - Basin A.1 Postdeveloped	Max. Elevation	= 5604.10 ft
Reservoir name	= Pond	Max. Storage	= 5,480 cuft

Storage Indication method used



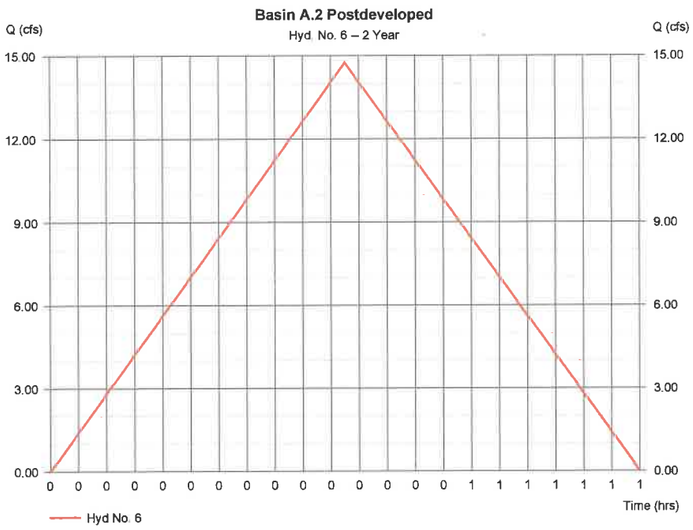
Hydrograph Report

Hyd. No. 6

Basin A.2 Postdeveloped

Hydrograph type	= Rational	Peak discharge	= 14.75 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.35 hrs
Time interval	= 1 min	Hyd. volume	= 18,584 cuft
Drainage area	= 9.170 ac	Runoff coeff.	= 0.65*
Intensity	= 2.474 in/hr	Tc by User	= 21.00 min
IDF Curve	= ColoradoSprings.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(3.770 x 0.75) + (1.260 x 0.90) + (7.550 x 0.50)] / 9.170

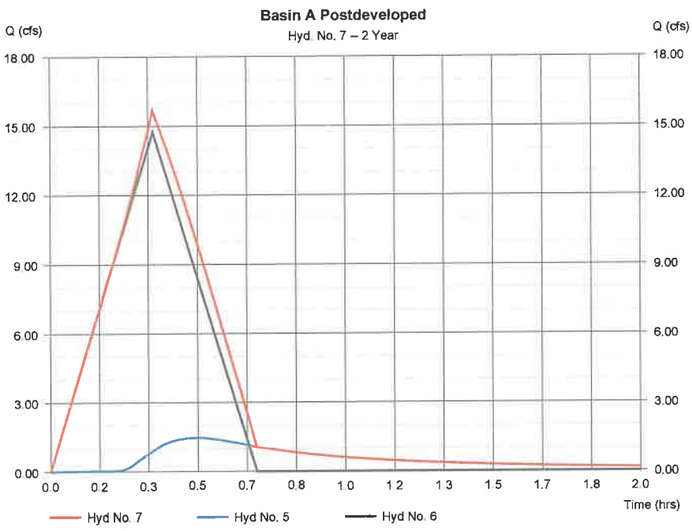


Hydrograph Report

Hyd. No. 7

Basin A Postdeveloped

Hydrograph type	= Combine	Peak discharge	= 15.66 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.35 hrs
Time interval	= 1 min	Hyd. volume	= 25,131 cuft
Inflow hyds.	= 5, 6	Contrib. drain. area	= 9.170 ac



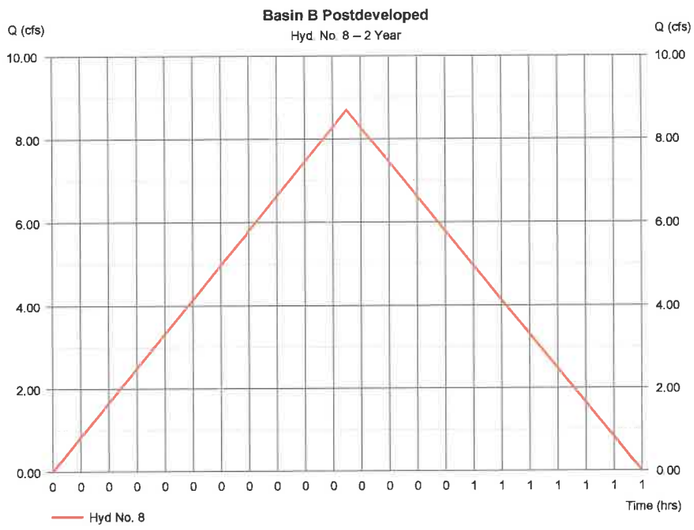
Hydrograph Report

Hyd. No. 8

Basin B Postdeveloped

Hydrograph type	= Rational	Peak discharge	= 8.691 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.35 hrs
Time interval	= 1 min	Hyd. volume	= 10,950 cuft
Drainage area	= 5.090 ac	Runoff coeff.	= 0.69*
Intensity	= 2.474 in/hr	Tc by User	= 21.00 min
IDF Curve	= ColoradoSprings.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(2.640 x 0.75) + (2.400 x 0.90) + (7.550 x 0.50)] / 5.090



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	37.27	1	19	42,483	----	----	----	Basin A Predeveloped
2	Rational	15.29	1	19	17,426	----	----	----	Basin B Predeveloped
4	Rational	10.71	1	17	10,926	----	----	----	Basin A 1 Postdeveloped
5	Reservoir	4.503	1	27	10,922	4	5604.61	8,051	Pond Routing
6	Rational	24.58	1	21	30,966	----	----	----	Basin A 2 Postdeveloped
7	Combine	26.84	1	21	41,888	5, 6	----	----	Basin A Postdeveloped
8	Rational	14.48	1	21	18,246	----	----	----	Basin B Postdeveloped

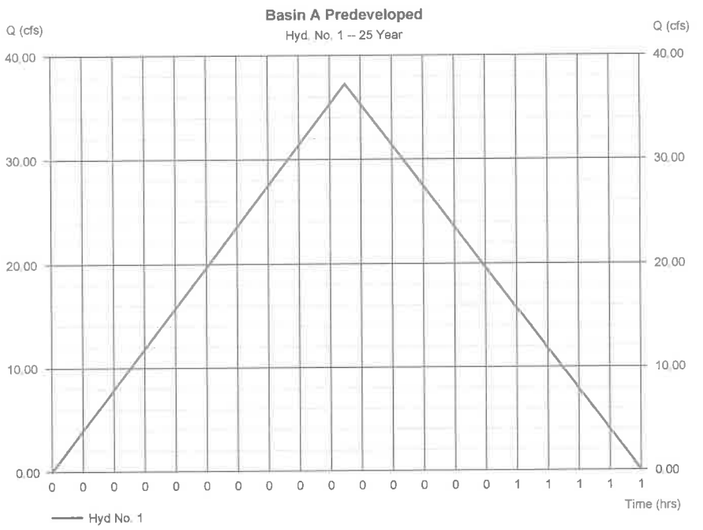
Hydrograph Report

Hyd. No. 1

Basin A Predeveloped

Hydrograph type	= Rational	Peak discharge	= 37.27 cfs
Storm frequency	= 25 yrs	Time to peak	= 0.32 hrs
Time interval	= 1 min	Hyd. volume	= 42,483 cuft
Drainage area	= 12.590 ac	Runoff coeff.	= 0.68*
Intensity	= 4.353 in/hr	Tc by User	= 19.00 min
IDF Curve	= ColoradoSprings.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(3.770 x 0.75) + (1.260 x 0.90) + (7.550 x 0.50)] / 12.590



Hydrograph Report

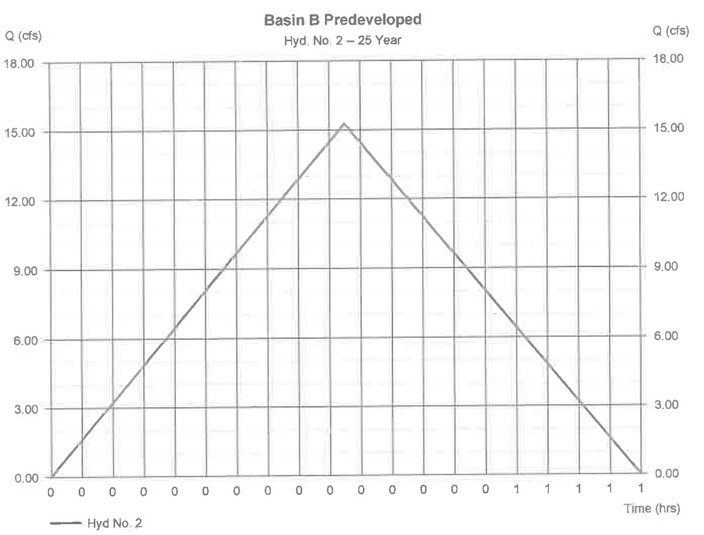
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 21 / 2019

Hyd. No. 2

Basin B Predeveloped

Hydrograph type	= Rational	Peak discharge	= 15.29 cfs
Storm frequency	= 25 yrs	Time to peak	= 0.32 hrs
Time interval	= 1 min	Hyd. volume	= 17,428 cuft
Drainage area	= 5.090 ac	Runoff coeff.	= 0.69*
Intensity	= 4.353 in/hr	Tc by User	= 19.00 min
IDF Curve	= ColoradoSprings.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(2.640 x 0.75) + (2.400 x 0.90) + (7.550 x 0.50)] / 5.090



Hydrograph Report

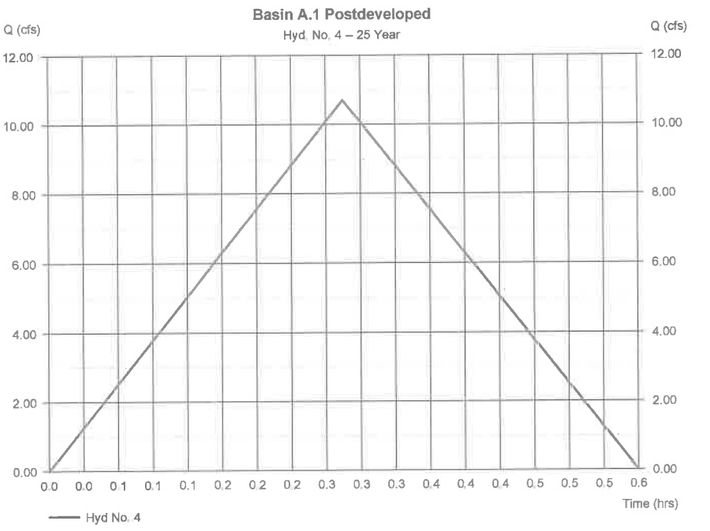
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 21 / 2019

Hyd. No. 4

Basin A.1 Postdeveloped

Hydrograph type	= Rational	Peak discharge	= 10.71 cfs
Storm frequency	= 25 yrs	Time to peak	= 0.28 hrs
Time interval	= 1 min	Hyd. volume	= 10,926 cuft
Drainage area	= 3.420 ac	Runoff coeff.	= 0.68*
Intensity	= 4.606 in/hr	Tc by User	= 17.00 min
IDF Curve	= ColoradoSprings.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(3.770 x 0.75) + (1.260 x 0.90) + (7.550 x 0.50)] / 3.420



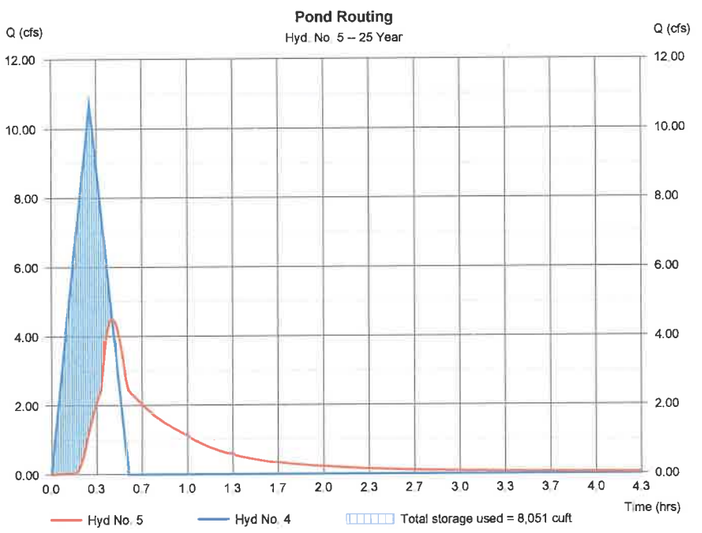
Hydrograph Report

Hyd. No. 5

Pond Routing

Hydrograph type	= Reservoir	Peak discharge	= 4.503 cfs
Storm frequency	= 25 yrs	Time to peak	= 0.45 hrs
Time interval	= 1 min	Hyd. volume	= 10,922 cuft
Inflow hyd. No.	= 4 - Basin A.1 Postdeveloped	Max. Elevation	= 5604.61 ft
Reservoir name	= Pond	Max. Storage	= 8,051 cuft

Storage Indication method used.



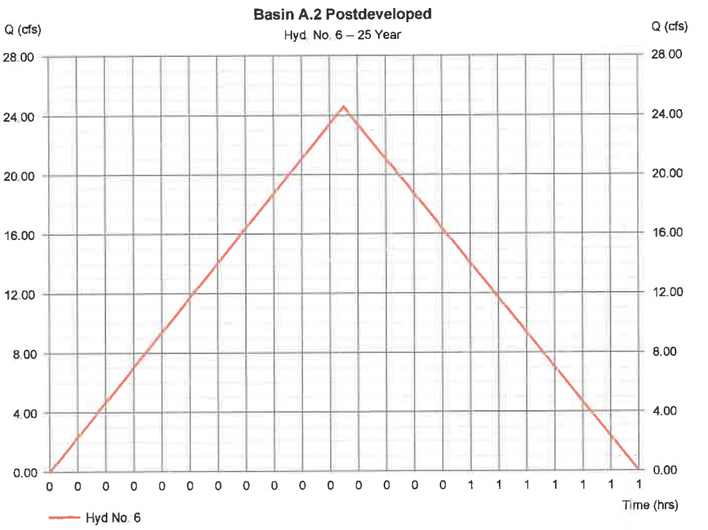
Hydrograph Report

Hyd. No. 6

Basin A.2 Postdeveloped

Hydrograph type	= Rational	Peak discharge	= 24.58 cfs
Storm frequency	= 25 yrs	Time to peak	= 0.35 hrs
Time interval	= 1 min	Hyd. volume	= 30,966 cuft
Drainage area	= 9.170 ac	Runoff coeff.	= 0.65*
Intensity	= 4.123 in/hr	Tc by User	= 21.00 min
IDF Curve	= ColoradoSprings.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(3.770 x 0.75) + (1.260 x 0.90) + (7.550 x 0.50)] / 9.170



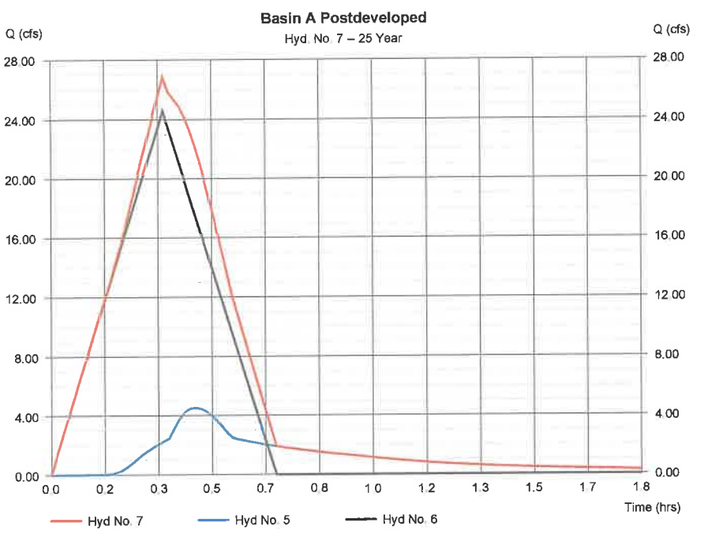
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No. 7

Basin A Postdeveloped

Hydrograph type	= Combine	Peak discharge	= 26.84 cfs
Storm frequency	= 25 yrs	Time to peak	= 0.35 hrs
Time interval	= 1 min	Hyd. volume	= 41,888 cuft
Inflow hyds.	= 5, 6	Contrib. drain. area	= 9.170 ac



Hydrograph Report

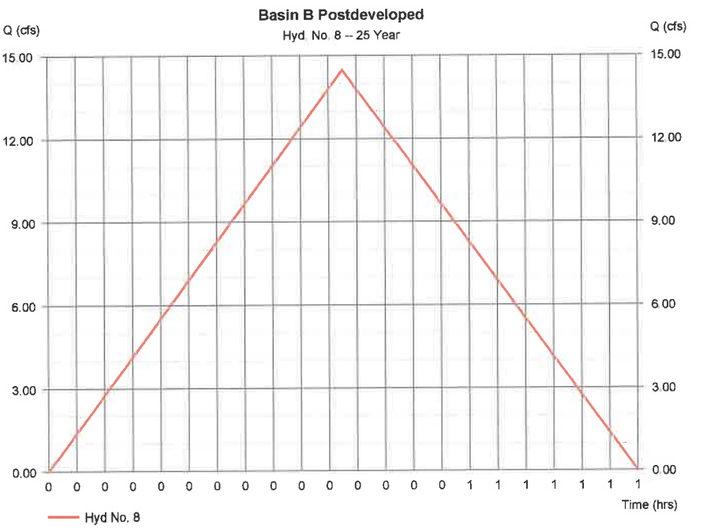
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No. 8

Basin B Postdeveloped

Hydrograph type	= Rational	Peak discharge	= 14.48 cfs
Storm frequency	= 25 yrs	Time to peak	= 0.35 hrs
Time interval	= 1 min	Hyd. volume	= 18,246 cuft
Drainage area	= 5.090 ac	Runoff coeff.	= 0.69*
Intensity	= 4.123 in/hr	Tc by User	= 21.00 min
IDF Curve	= ColoradoSprings.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(2.640 x 0.75) + (2.400 x 0.90) + (7.550 x 0.50)] / 5.090



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	46.83	1	19	53,382	---	---	---	Basin A Predeveloped
2	Rational	19.21	1	19	21,899	---	---	---	Basin B Predeveloped
4	Rational	13.46	1	17	13,731	---	---	---	Basin A 1 Postdeveloped
5	Reservoir	6.273	1	26	13,726	4	5604.82	9,119	Pond Routing
6	Rational	30.88	1	21	38,908	---	---	---	Basin A 2 Postdeveloped
7	Combine	36.75	1	21	52,634	5, 6	---	---	Basin A Postdeveloped
8	Rational	18.20	1	21	22,926	---	---	---	Basin B Postdeveloped

Hydrograph Report

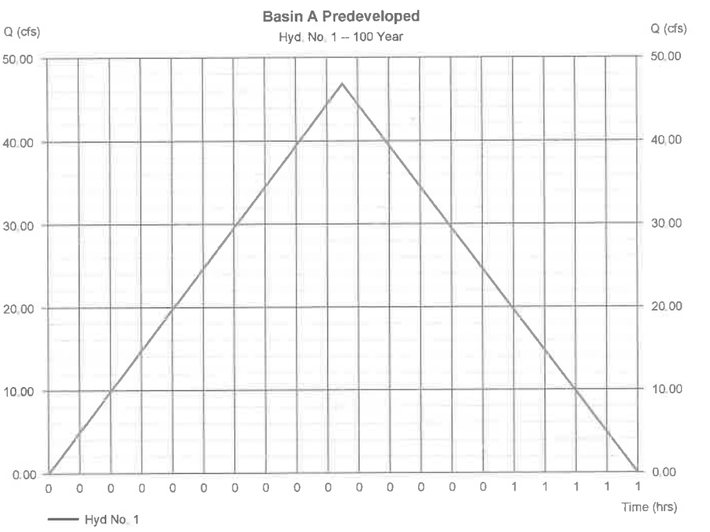
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 11 / 21 / 2019

Hyd. No. 1

Basin A Predeveloped

Hydrograph type	= Rational	Peak discharge	= 46.83 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.32 hrs
Time interval	= 1 min	Hyd. volume	= 53,382 cuft
Drainage area	= 12.590 ac	Runoff coeff.	= 0.68*
Intensity	= 5.470 in/hr	Tc by User	= 19.00 min
IDF Curve	= ColoradoSprings.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(3.770 x 0.75) + (1.260 x 0.90) + (7.550 x 0.50)] / 12.590



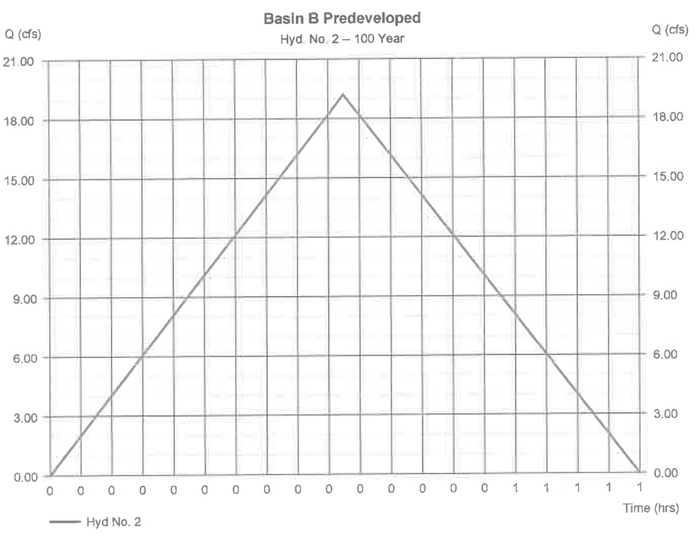
Hydrograph Report

Hyd. No. 2

Basin B Predeveloped

Hydrograph type	= Rational	Peak discharge	= 19.21 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.32 hrs
Time interval	= 1 min	Hyd. volume	= 21,899 cuft
Drainage area	= 5.090 ac	Runoff coeff.	= 0.69*
Intensity	= 5.470 in/hr	Tc by User	= 19.00 min
IDF Curve	= ColoradoSprings.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(2.640 x 0.75) + (2.400 x 0.90) + (7.550 x 0.50)] / 5.090



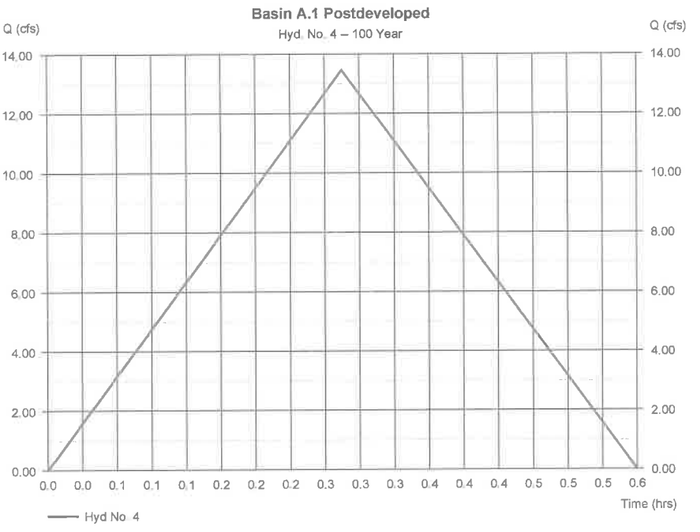
Hydrograph Report

Hyd. No. 4

Basin A.1 Postdeveloped

Hydrograph type	= Rational	Peak discharge	= 13.46 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.28 hrs
Time interval	= 1 min	Hyd. volume	= 13,731 cuft
Drainage area	= 3.420 ac	Runoff coeff.	= 0.68*
Intensity	= 5.788 in/hr	Tc by User	= 17.00 min
IDF Curve	= ColoradoSprings.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(3.770 x 0.75) + (1.260 x 0.90) + (7.550 x 0.50)] / 3.420



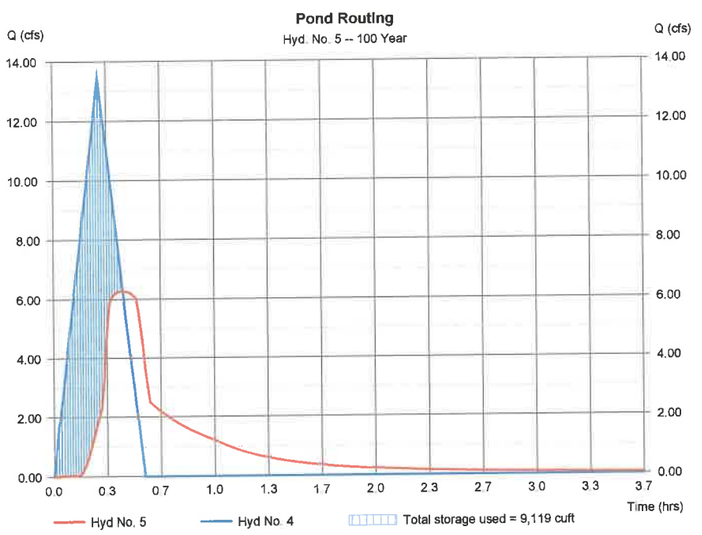
Hydrograph Report

Hyd. No. 5

Pond Routing

Hydrograph type	= Reservoir	Peak discharge	= 6.273 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.43 hrs
Time interval	= 1 min	Hyd. volume	= 13,726 cuft
Inflow hyd. No.	= 4 - Basin A.1 Postdeveloped	Max. Elevation	= 5604.82 ft
Reservoir name	= Pond	Max. Storage	= 9,119 cuft

Storage Indication method used.



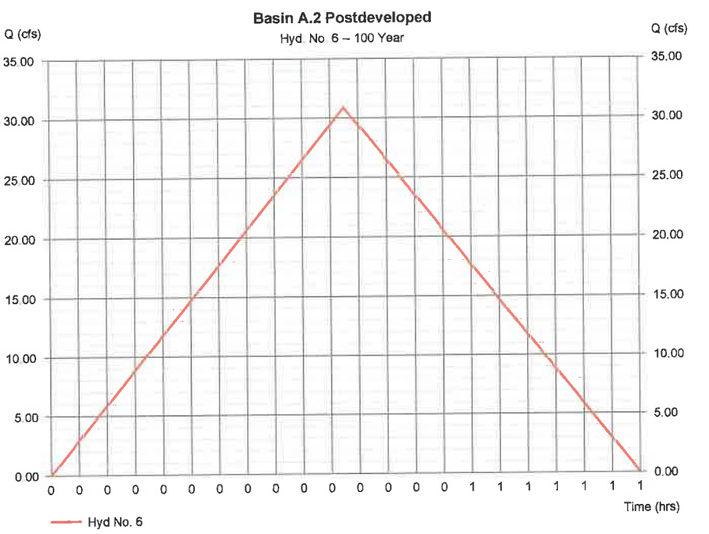
Hydrograph Report

Hyd. No. 6

Basin A.2 Postdeveloped

Hydrograph type	= Rational	Peak discharge	= 30.88 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.35 hrs
Time interval	= 1 min	Hyd. volume	= 38,908 cuft
Drainage area	= 9.170 ac	Runoff coeff.	= 0.65*
Intensity	= 5.181 in/hr	Tc by User	= 21.00 min
IDF Curve	= ColoradoSprings.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(3.770 x 0.75) + (1.260 x 0.90) + (7.550 x 0.50)] / 9.170

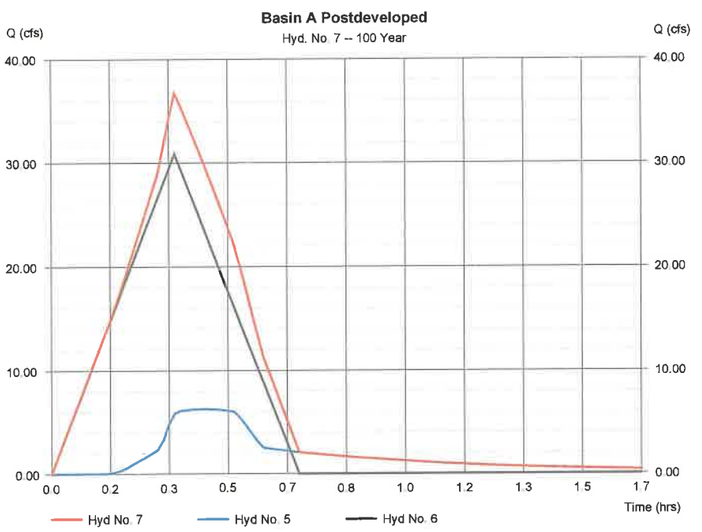


Hydrograph Report

Hyd. No. 7

Basin A Postdeveloped

Hydrograph type	= Combine	Peak discharge	= 36.75 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.35 hrs
Time interval	= 1 min	Hyd. volume	= 52,634 cuft
Inflow hyds.	= 5, 6	Contrib. drain. area	= 9.170 ac



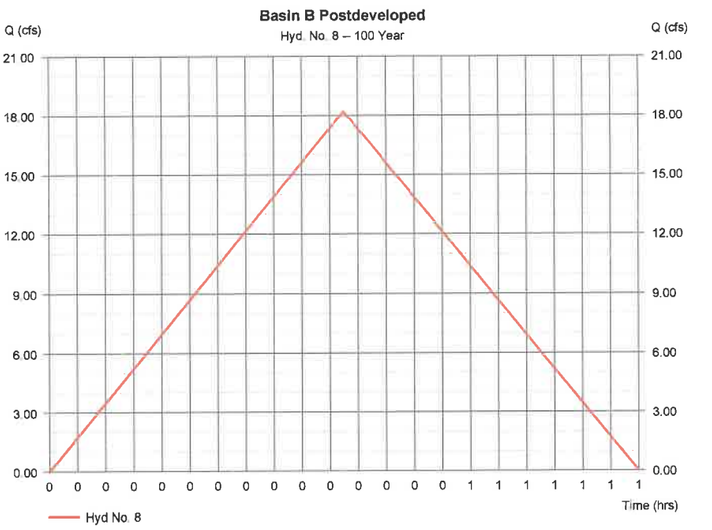
Hydrograph Report

Hyd. No. 8

Basin B Postdeveloped

Hydrograph type	= Rational	Peak discharge	= 18.20 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.35 hrs
Time interval	= 1 min	Hyd. volume	= 22,926 cuft
Drainage area	= 5.090 ac	Runoff coeff.	= 0.69*
Intensity	= 5.181 in/hr	Tc by User	= 21.00 min
IDF Curve	= ColoradoSprings.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(2.640 x 0.75) + (2.400 x 0.90) + (7.550 x 0.50)] / 5.090



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	--------
2	396.7958	28.4001	1.3019	--------
3	0.0000	0.0000	0.0000	--------
5	503.9007	28.2001	1.3076	--------
10	558.5463	27.8001	1.2975	--------
25	706.1827	28.6001	1.3174	--------
50	763.2289	28.3001	1.3095	--------
100	790.7469	27.7001	1.2940	--------

File name: ColoradoSprings.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	4.12	3.43	2.93	2.54	2.24	1.99	1.79	1.62	1.48	1.36	1.25	1.16
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	5.17	4.30	3.66	3.17	2.79	2.48	2.23	2.02	1.84	1.69	1.55	1.44
10	6.03	5.01	4.27	3.70	3.25	2.89	2.60	2.35	2.14	1.97	1.81	1.68
25	6.89	5.74	4.89	4.24	3.72	3.31	2.97	2.69	2.45	2.25	2.07	1.92
50	7.75	6.45	5.49	4.76	4.18	3.72	3.34	3.02	2.76	2.53	2.33	2.16
100	8.67	7.22	6.14	5.32	4.68	4.16	3.74	3.38	3.08	2.83	2.61	2.42

Tc = time in minutes. Values may exceed 60.

Precip. file name: C:\Users\Troy Moore\OneDrive\M3 Engineering\Engineering References\Hydrology\Austin.pcp

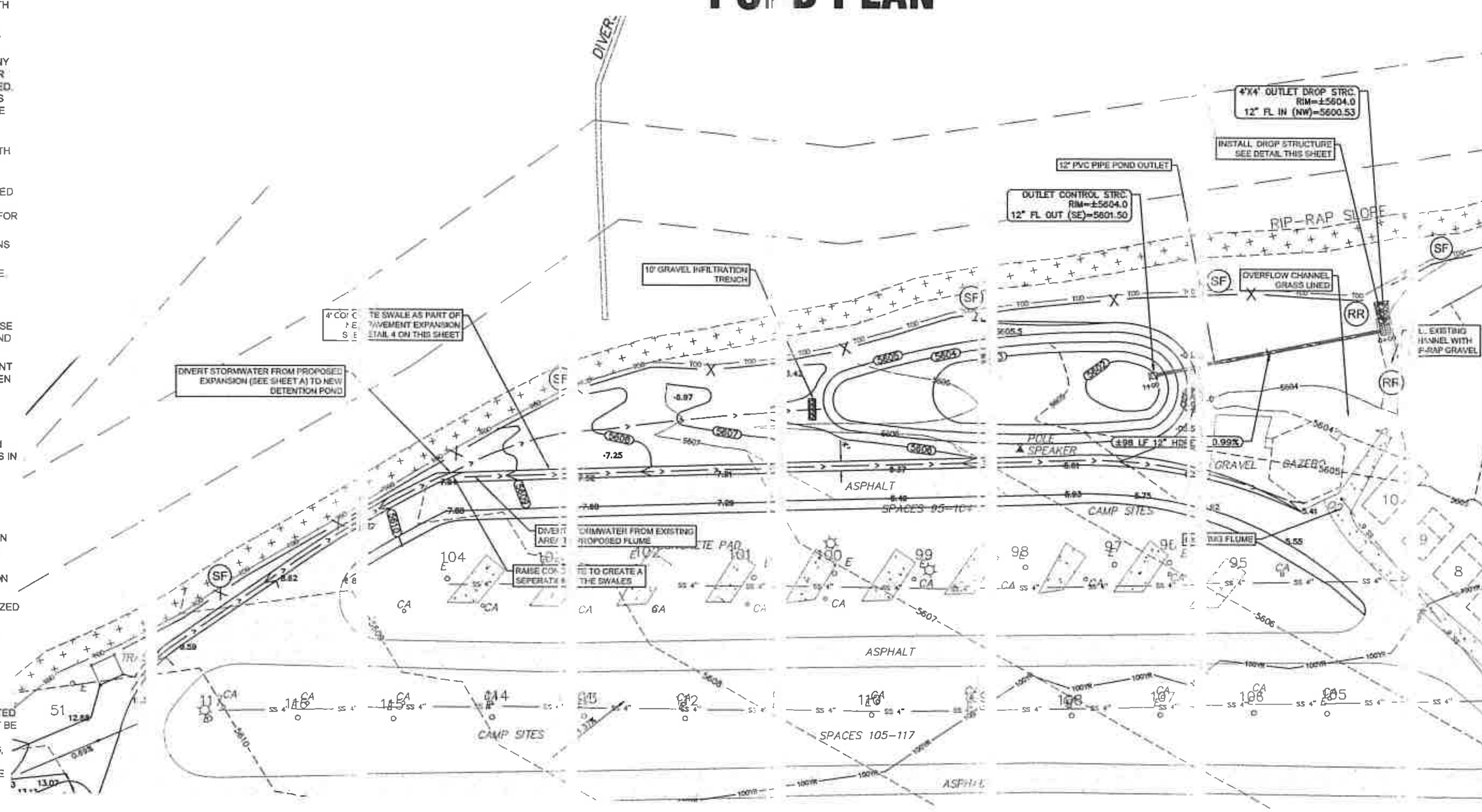
Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	0.00	3.44	0.00	4.99	6.10	7.64	8.87	10.20
SCS 6-Hr	0.00	2.67	0.00	3.56	4.21	5.14	5.94	6.85
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

EXHIBIT 8
STORMWATER POND DETAILS

CITY OF FOUN AIN GRADING/ERO ION CONTROL NO ES:

1. ALL GRADING AND EROSIO ONTROL SHALL BE COMPLETED IN ACC DANCE WITH THE CITY OF FOUNTAIN MU PAL CODE SECTIONS 12.04.160 AND 12.
2. ALL FILL AREAS SHALL BE C PACTED IN ACCORDANCE WITH THE GE ECHNICAL ENGINEER'S RECOMMENDA NS.
3. SOIL EROSION CONTROL ME URES FOR ALL SLOPES, CHANNELS, D HES, OR ANY DISTURBED LAND AREA SH BE COMPLETED WITHIN TWENTY ONE CALENDAR DAYS AFTER FINAL GRADIN R FINAL EARTH DISTURBANCE HAS BE COMPLETED. AN AREA THAT IS GOING TO MAIN IN AN INTERIM STATE FOR MORE AT 60 DAYS SHALL ALSO BE SEEDED. A EMPORARY SOIL EROSION CONTROL M SURES ARE IMPLEMENTED.
4. EROSION CONTROL SHALL C NSIST OF SILT FENCES, FIBER ROLLS R K SOCKS, CHECK DAMS AND HAY BALE ETC. AS SHOWN ON THE DRAWING, AN OPSOIL WITH GRASS SEED WHICH WILL B VATERED UNTIL VEGETATION HAS BEE REESTABLISHED.
5. EROSION CONTROL STRAW LES, FIBER ROLES OR SILT FENCES S L BE PLACED AT THE TOE AND DRAINAG TFALL POINTS OF ALL SLOPES 4:1 OR S EPER TO PREVENT SILTATION ON STR TS. REFER TO STORM WATER MANAGE ENT PLAN FOR DETAIL AND LOCATION OF E SION CONTROL MEASURES.
6. CONTRACTOR SHALL COMP WITH ~ ALL LOCAL, COUNTY AND STATE EGULATIONS PERTAINING TO GRADING, D T AND EROSION.
7. NATURAL VEGETATION SHA BE RETAINED AND PROTECTED WHERE R POSSIBLE. EXPOSURE OF SOIL TO ERO N BY REMOVAL OR DISTURBANCE OF ETATION SHALL BE LIMITED TO THE A A REQUIRED FOR IMMEDIATE CONSTR ION OPERATIONS AND FOR THE S ORTEST PRACTICAL PERIOD OF TIME.
8. TOPSOIL SHALL BE STOCKP D TO THE EXTENT PRACTICABLE ON TH SITE FOR USE ON AREAS TO BE REVEGETA D. ANY AND ALL STOCKPILES SHALL B OCATE-D AND PROTECTED FROM EROSIVE LEMENTS.
9. AT ALL TIMES, THE PROPER SHALL BE MAINTAINED AND/OR WATER TO PREVENT WIND-CAUSED EROSION. EA THWORK OPERATIONS SHALL BE DISCO INUED WHEN FUGITIVE DUST SIGNIFICANT IMPACTS ADJACENT PROPERTY IF EAR WORK IS COMPLETE OR DISCONTINUE AND DUST FROM THE SITE CONTINUES CREATE PROBLEMS, THE OWNER/DEV LOPER SHALL IMMEDIATELY INSTITUTE TIGATIVE MEASURES AND SHALL COR CT DAMAGE TO ADJACENT PROPERTY.
10. ALL PERSONS ENGAGED IN E RTH DISTURBANCE SHALL IMPLEMENT A D MAINTAIN ACCEPTABLE SOIL EROSIO ND SEDIMENT CONTROL MEASURES INC DING BMPS IN CONFORMANCE WITH THE E OSION CONTROL TECHNICAL STANDAR OF THE MANUAL AND IN ACCORDAN WITH THE EROSION AND STORMWATER QUALITY CONTROL PLAN AP OVED BY THE CITY OF FOUNTAIN, IF RE IRED.
11. ALL EARTH DISTURBANCE S LL BE CONDUCTED IN SUCH A MANNER AS TO EFFECTIVELY REDUCE ACCE RATED SOIL EROSION.
12. ALL EARTH DISTURBANCE S LL BE DESIGNED, CONSTRUCTED, AND C MPLETED IN SUCH A MANNER SO THAT T EXPOSED AREA OF ANY DISTURBED LA SHALL BE LIMITED TO THE SHORTEST P ACTICAL PERIOD OF TIME.
13. ALL EARTH DISTURBANCE S LL BE DONE IN A MANNER THAT MINIM POLLUTION OF ANY ON-SITE OR OFF-SIT WATERS.
14. SUSPENDED SEDIMENT CA D BY ACCELERATED SOIL EROSION SH BE MINIMIZED IN RUNOFF WATER BEFORE LEAVES THE SITE.
15. TEMPORARY SOIL EROSION ONTROL FACILITIES SHALL BE REMOVED ND EARTH DISTURBANCE AREAS GRAD AND STABILIZED WITH PERMANENT SO EROSION CONTROL MEASURES PURS NT TO THE STANDARDS AND SPECIFIC ONS PRESCRIBED IN THE MANUA AND IN ACCORDANCE WITH THE PERM NT EROSION CONTROL FEATUR SHOWN ON THE EROSION AND STORM TER CONTROL PLANS APPROVED Y THE CITY OF FOUNTAIN, IF REQUIRED.
16. ANY STREET OR DRAINAGE F CILITY WHICH HAS HAD EROSION SEDI IT DEPOSITED IN IT DUE TO CONSTRUCTIO GRADING, OR OTHER DEVELOPMENT AC VITY, MUST BE CLEANED IMMEDIATELY AT T E EXPENSE OF THE CONTRACTOR, DEVE OPER, HOMEBUILDER, OR WHOEVE S RESPONSIBLE FOR THE CONSTRUCT GRADING, OR LAND DEVELOPMENT AC ITY. IF THE FACILITY IS NOT CLEANED EDIATELY OR WITHIN A RESPONSIBLE P RIOD OF TIME AFTER NOTIFICATION BY E CITY, THE CITY MAY PERFORM THE W K OR HAVE THE WORK DONE AND BILL T RESPONSIBLE PARTY.
17. IT IS THE RESPONSIBILITY O HE OWNER TO ENSURE THAT VEHICLE ACKING CONTROL IS IN PLACE, FUNC ONAL, AND MAINTAINED THROUGHOUT E CONSTRUCTION PHASE OF T S PROJECT.
18. INDIVIDUALS SHALL COMPLY ITH THE "COLORADO WATER QUALITY C NTROL ACT" (TITLE 25, ARTICLE 8,AND T CLEAN WATER ACT" (33USC 1344), REG ATIONS PROMULGATED, CERTIFICAT NS OR PERMITS ISSUED, IN ADDITION ITY OF FOUNTAIN REQUIREMENTS. I THE EVENT OF CONFLICTS BETWEEN SE REQUIREMENTS, THE MORE STRICTIVE LAWS, RULES, OR REGULA NS SHALL APPLY.
19. ALL CONSTRUCTION CONCR E WASH OUT SITES MUST INCORPORAT MINIMUM 10-MIL THICKNESS IMPERVIO LINED CONTAINMENT. CONCRETE TR KS SHALL NOT BE ALLOWED TO DUMP OU MNANT CONCRETE OR WASH OUT EQU MENT DIRECTLY ONTO GROUND OR AVED SURFACES WITHOUT LINED CON NMENT.

PO D PLAN



EROSION CON ROL LEGEND

LINETYPES / SYMBOLS	DESCRIPTION
LOC	LIMITS OF CONSTRUCTION
LOX	LIMITS OF CLEARING
SIG	SIGNAGE
SF	SILT FENCE
RR	RIPRAP
VTC	VEHICLE TRACKING PAD
SM	SEED & MULCH
SB	SEDIMENT BASIN
IP	INLET PROPTECTION
FSD	FULL-SPECTRUM DETENTION BASIN
CWA	CONCRETE WASHOUT AREA

GRADING LEG ND

EXISTING	PROPOSED	DESCRIPTION
878		CONTOUR
		GRADE BREAK / RIDGE
		BERM
		SWALE
		DRAINAGE SLOPE
x EG.905.25		EXISTING SPOT GRADE
x MEG.±905.25		MATCH EXISTING GRADE
		FINISH SPOT GRADE
		SOIL BORING
	30.25 / 30.75	TOP OF CURB / TOP OF PAVEMENT
	30.25 / 30.75	TOP OF CURB / TOP OF GRATE
	30.25 / 30.75	TOP OF WALL / BOTTOM OF WALL
	30.50	TOP OF GRATE

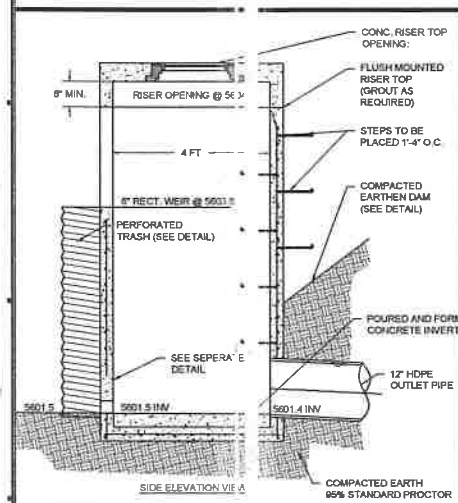
CITY UBLIC WORKS DE T. ACCEPTANCE

THE PLANS S TTED APPEAR TO BE IN CONFORMANCE WITH THE TY OF FOUNTAIN SUBMITTAL REQUIREMEN ND STANDARD ENGINEERING PRINCIPLES AND TICES APPEAR TO HAVE BEEN FOLLOWED. PROFESSIONAL ENGINEER SUBMITTING AND SE THE PLANS IS SOLELY RESPONSIBLE THEIR ACCURACY AND VALIDITY. THE REVIEW LY VALID FOR ONE (1) YEAR FROM THE DA ELOW.

DUANE GREE CD, PW DIRECTOR/CITY ENGINEER — DATE

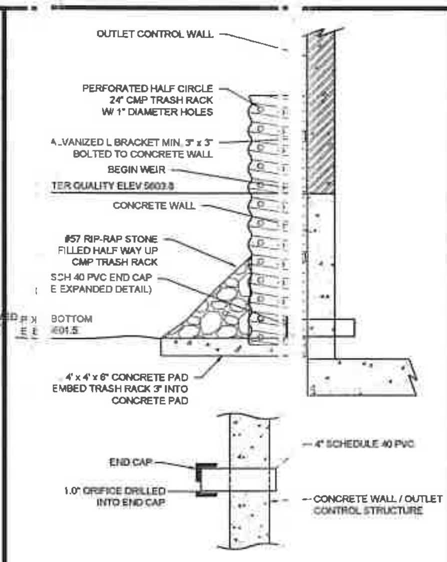
VERT CAL DATUM:

NGVD 29 BA ON THE NGS BENCHMARK S 347 - ELEVATION 56 FEET

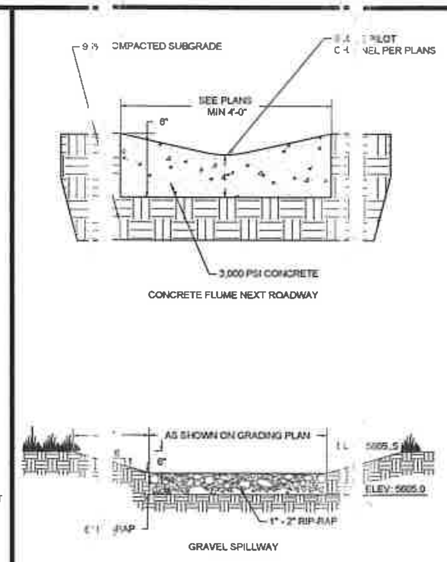


NOTES:
1. CONTRACTOR SHALL EMBED STRUCTURE INTO DAM.
2. DO NOT ORIENT STEPS DIRE OVER INLET OR OUTLET OPENINGS.
3. STEPS MUST BE ORIENTED ON E SAME SIDE OF STRUCTURE.
4. ALL INVERT AND INLET SIZES E CONSTRUCTED PER APPROVED PLANS.

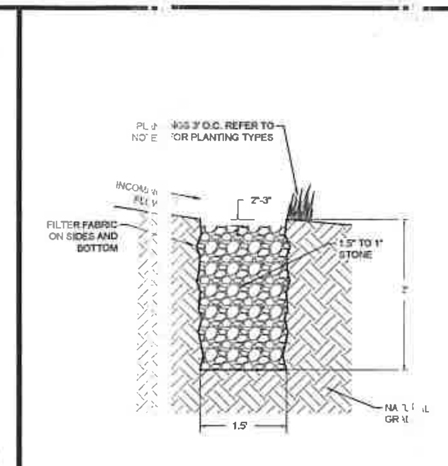
1/5 OUTLET CONTRO DETAIL — N.T.S.



TRASH RACK AND ORIF DETAIL — N.T.S.

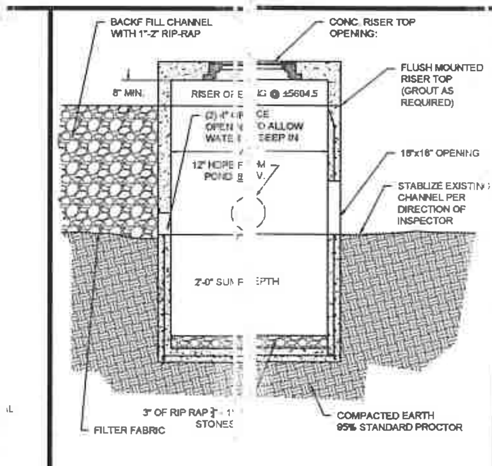


3/5 ONCRETE SWALE & GRAVEL LLWAY — N.T.S.



NOTES
1. REFER TO GR OR SITE PLAN PLAN FOR LENGTH OF TRENCH
2. PLANTING OF FOR INFILTRATION TRENCH: SWITCH GRASS (PA VIRGATUM), E GAMA (TRIPSACUM DACTYLOIDES), LINDHEI MUHLY (MUHL RGIA LINDHEIMERI) OR BUSHY BLUESTEM (ANDROPOGO OVERATUS) IN MINIMUM SIZE OF 1-GALLON.

4/5 GRAV INFILTRATION TRENCH — N.T.S.

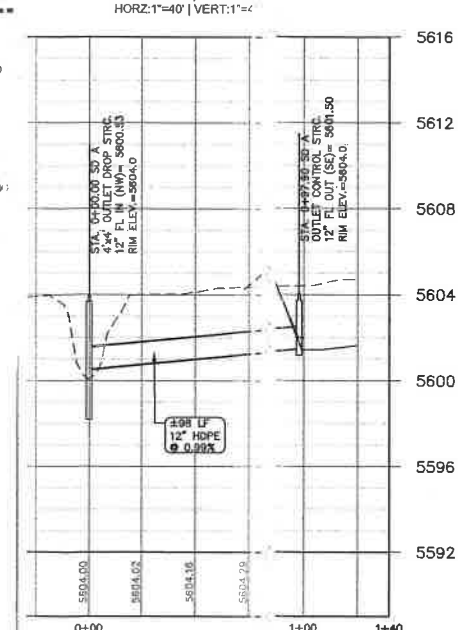


NOTES:
1. CONTRACTOR SHALL E EDDED STRUCTURE INTO SOIL.
2. DO NOT ORIENT STE ECTLY OVER INLET OR OUTLET OPENINGS.
3. STEPS MUST BE ORI D ON THE SAME SIDE OF STRUCTURE.
4. ALL INVERT AND INLE ES TO BE CONSTRUCTED PER APPROVED PLANS.

5/5 OUTLET DRO STRUCTURE — N.T.S.

SD A

START:-0+50 | END:1+4
HORZ:1"=40' | VERT:1"=



DESIGN PROFESSIONAL

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2900 SOUTH CONGRESS
SUITE 203
AUSTIN, TEXAS 78704
PH: 512.620.3265
FIRM #18863

www.M3ENGINEERING.COM

CIVIL ENGINEERING | BUILDING DESIGN
CONSTRUCTION MANAGEMENT

THE JENKINS ORGANIZATION

ISSUE/REVISION RECORD

PROJECT NAME
KOA EXPANSION PHASE 1

DO BANDLEY
FOUNTAIN, TEXAS 75087

LEGAL DESCRIPTION:LOT 1, BLOCK 1, NAZANA FIL 02

PROJECT NUMBER
18006

DRAWING FILE
006-GRAD.DWG

SCALE 1" = 30'

PROFESSIONAL SEAL

PROJECT STATUS
SUBMITTAL 1

SHEET TITLE
DETENTION POND PLAN

SHEET NUMBER
6 of 8