Hydrology Study

For

Monserate MUP

Prepared For:

Gird Valley Inc.
1492 Rainbow Valley Blvd
Fallbrook, CA 92028

Prepared By:

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Prepared:

October 2018

Revised:

August 2019

ENV. LOG NO. PDS 2018-ER-18-02-003

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Section 1 Project Description and Scope

1.1 Project Data

Project Owner: Gird Valley Inc.

Project Site Address: 2757 Gird Road

APN Number(s): 107-240-16, 17, 51
124-182-01,02
124-330-04, 14, 15, 20

Project Location: Latitude: 33.337856°
Longitude: -117.188146°

Project Site Area: 62.4 acres (Property Area)
23.7 acres (MUP Area)

Adjacent Streets:

North:	Laketree Drive
South:	Oak Cliff Drive
East:	Northcliff Drive
West:	Gird Road

Adjacent Land Uses:

North:	Residential
South:	Residential
East:	Residential
West:	Residential

1.2 Scope of Report

This report will deal specifically with proposed improvements associated with the Monserate Winery MUP development. This study develops 100-year storm peak flows and for the pre and post development conditions to identify the hydrologic effect of the proposed project.

The project area is tributary to Live Oak Creek which flows through the center of the site. A floodplain analysis of Live Oak Creek can be found in the report titled "100-Year Floodplain Analysis for: Monserate Winery" (*MBI, October 2018)*. The flows developed in this report are specific to the immediate project area and thus not representative of the entire tributary watershed.

This report does not discuss required water quality measures to be taken on an interim level during construction, nor those necessary to be implemented on a permanent basis. Those discussions can be found under separate cover in the project "Storm Water Pollution Prevention Plan," (SWPPP) and the "Storm Water Quality Management Plan" (SWQMP), respectively.

1.3 Project Location

The project site is located in the Fallbrook area of northern San Diego County. The project site is located approximately 2 miles north of State Route 76 and 2 miles west of the 15 Freeway along Gird Road. A vicinity map can be found in Appendix A.

1.4 Project Description

An existing golf course located in Fallbrook, CA (San Diego County), immediately west of Gird Road, is no longer open to the public. Golf operations have ceased, and the intent of the proposed project is to redevelop the project site as a winery with open spaces, decorative ponds and event venues. The project applicant is requesting County approval of a Major Use Permit (MUP) modification to authorize a winery/passive open space with event/venues or similar gathering and/or spa facilities on the subject site.

The land area affected by the proposed MUP modification is comprised of an approximately 23.7-acre portion of the 62.4-acre overall property. The remaining land area not affected by the proposed MUP modification would be placed within a dedicated open space/agricultural easement to prohibit future development; however, portions of this land area would be planted with vineyards in support of the proposed use.

The proposed structures within the MUP area would total approximately 56,040 square feet (s.f.). This includes the main tasting room and restaurant as well as three additional event/venue areas with supporting facilities, administrative space, and a 282 s.f. pump house; refer to the Major Use Permit Plot Plan (Modification), available under separate cover.

Live Oak Creek, an un-named ephemeral tributary to the San Luis Rey River, flows southerly across the project site, partly as a concrete lined channel and partly as a natural, unlined channel.

1.5 Pre Development Conditions

The 23.7-acre project site is a currently a golf course that has been out of service for multiple years. A majority of the site is pervious grassland with asphalt concrete golf cart paths. An asphalt concrete parking lot and clubhouse are located along the easterly project limits adjacent to Gird Road. In the pre-development condition runoff sheet flows from all areas of the site towards Live Oak Creek and continues southerly as open channel flow to the San Luis Rey River.

See Appendix B for an exhibit detailing the pre-development conditions.

1.6 Post Development Conditions

The project proposes minor grading of pads for proposed structures and decorative ponds. Portions of the site will also be graded for the vineyard areas; however most vine planting areas will follow the existing grade.

The project proposes constructing seven structures with minimal surrounding hardscape in three areas across the 23.7-acre site. The structures will be located outside of the 100-year floodplain

as developed in the report titled "100-Year Floodplain Analysis for: Monserate Winery" (*MBI, October 2018*). Access to the structures will be provided by soil cement roads. Multiple parking areas are proposed and will also be compacted earth surfaces as opposed to traditional impervious hardscape.

A retention pond will be graded to retain runoff from sub-basins 106 and 108. The pond is two feet deep and features a total storage volume of 15,705 cubic feet. The pond is drained by a 24"x24" catch basin located at the bottom of the basin and an associated 8-inch pipe directly connected to the existing concrete channel to prevent erosion. Additionally, the pond features a 6" deep, 36" wide graded spillway for emergency overflow. Runoff discharged through the emergency spillway will convey to the existing concrete channel via a rock-lined (riprap) open channel.

See Appendix C for an exhibit detailing the post development conditions.

1.7 Soils Information

Per the NRCS Web Soil Survey a majority of the project site is hydrologic soil Group "A". Group "A" soils have a high infiltration rate when thoroughly wet. These consist chiefly of moderately deep, excessively well drained sands or gravelly sands. Group A soils have a high rate of water transmission.

1.8 Floodplain Information

The project does not lie within any mapped FEMA flood plain (FIRM Panel FM06073C0480G). The project lies within Zone X (Unshaded), which are the areas outside the SFHA and higher than the elevation of the 0.2-percent annual-chance flood. Refer to Appendix A for a FEMA Firmette of the project area.

The project site has been mapped by the County of San Diego (floodplain and floodway). That previous study from the mid 1990's has been updated in conjunction with this proposed development. Refer to the report titled "100-Year Floodplain Analysis for: Monserate Winery" (*MBI, September 2018*).

1.9 Offsite Flow

Offsite flow enters the project area at numerous points along the western edge of the site as it flows from the surrounding hills towards Live Oak Creek. For this project specific analysis two locations of concentrated offsite flow (from the westerly slopes) have been analyzed to determine the potential impact on proposed nearby structures. These two locations are identified as Location 1 and 2 in Table 2 on page 6 and exhibits in Appendix D.

On the east side of the project, offsite flow (from the easterly residential development) enters the site at three concentrated points through existing 24" pipes beneath Gird Road. The project does not propose any alterations or adjustments to these existing, public storm-drain pipes and headwalls.

The first eastern offsite run-on point is located just north of the northernmost proposed driveway off Gird Road adjacent to Los Sicomoros Lane. A proposed, on-site, private 24" pipe and headwall will capture this run-on and convey beneath the on-site parking lot to Live Oak Creek, resulting in no diversion of flow.

The second and third eastern offsite run-on points are located south of the first. The second location is adjacent to Casablanca Way, the third is just north of the southerly most proposed driveway into the site. Run-on from the second location will convey southerly via an on-site, rock lined channel and confluence with run-on from the third location. A proposed, on-site, private 30" pipe and headwall will capture run-on from these two locations and convey beneath the parking lot to the creek Live Oak Creek just south of the proposed retention basin.

These on-site headwalls and storm drain pipes are private and not required to convey peak flow from the 100-year event without overtopping. In some cases, 100-year peak flow will convey across the site as a combination of pipe and overland flow. The project will not result in a diversion or increase in peak flow, as compared to existing conditions. Nor will proposed improvements contribute to any off-site flooding.

See Appendix D for offsite hydrology calculations and an exhibit detailing offsite flow locations.

Study Objectives

The specific objectives of this study are as follows:

- Quantify the pre and post development 100-year peak flow rates for the project site;
- Demonstrate no increase to project site 100-year peak flow discharge as a result of the proposed improvements;
- Quantify areas of offsite run-on and demonstrate compliance with local and FEMA standards for the proposed structures;
- Demonstrate the proposed improvements will not increase the potential for erosion on the project site or downstream area.

Section 2 Methodology

2.1 Hydrology

Advanced Engineering Solutions (AES – HydroWIN 2013) was used to model the hydrologic characteristics of the project site and off-site tributary area under pre and post development conditions. This software utilizes the Rational Method and conforms to the hydrologic methodologies outlined in the San Diego County Hydrology Manual (SDCHM, June 2003). The Rational Method is a physically based model that calculates peak flow rates (Q) as a function of runoff coefficients (C), rainfall intensities (I), and drainage areas (A):

$$Q = C * I * A$$

Runoff coefficients (c) were established based upon Table 3-1 from page 3-6 of the SDCHM (June 2003). Weighted C value was calculated for sub-basins containing a combination of land-uses. Refer to Appendices B and C for existing and proposed, respectfully.

Time of concentration and rainfall intensities were developed internally within the AES software. The 'San Diego' AES module was used for this analysis and conforms to the methodologies described in the SDCHM (June 2003). Refer to Appendices B and C for existing and proposed condition calculations, respectively.

Area delineations were developed using project specific 1-foot contour topography from an aerial survey performed on July 28, 2018. Refer to the existing and proposed, on-site hydrologic work maps found in Appendices B and C, respectively. Refer to Appendix E for the off-site analysis.

2.2 Hydraulics

For the western offsite run-on areas, Hydraflow Express has been used to determine the normal channel depth of offsite flow as it passes proposed structures. Hydraflow Express utilizes Manning's equation to determine the flow depth using a known Q calculated by AES software.

Bentley's flowmaster software has been used to model proposed pipe capacity baed on normal depth.

Riprap energy dissipaters will be installed downstream of all on-site pipe outfalls. Table 7-1 on page 7-2 of the SDCHDM (Sept. 2014) was used for riprap sizing and is included in Appendix A.

2.3 100-Year Peak Flow Mitigation

The Hydraflow Hydrographs Extension within AutoCAD has been used to model peak flows from the project as they are mitigated by the proposed retention pond. Rick Engineering Company's RatHydro software was used to create hydrographs based on local methodology. The Hydrographs report documents a reduction in peak flow as sub-basins 106 and 108 are routed through the proposed retention pond. Reduction is peak flow was then subtracted from the unmitigated flow rate to achieve the mitigated peak flow rate. Refer to Appendix C for the modelling input and output.

Results

2.4 Hydrologic Results

The following table summarizes the hydrologic results under existing, un-mitigated proposed, and proposed mitigated conditions for the project site's contribution to the watershed. Calculations are included in Appendices B and C.

Table 1. - Summary of Pre vs. Post Development Peak Flow Rates

Discharge Location	C*	I**	A	Q_{100}
	-	(in./hr.)	(ac)	(cfs)
Pre-Development				
Node 112	0.33	2.77	23.7	21.6
Post-Development (Un-Mitigated)				
Node 112	0.41	2.88	23.7	28.0
Post-Development (Mitigated)				
Node 112	0.41	2.88	23.7	20.3
*See Appendix B and C for weighted C value calculations for individual sub-basins **Intensity values generated within AES software using County of San Diego methodology				

Peak flow mitigation is achieved by directing runoff from sub-basins 106 and 108 to the proposed retention basin. Refer to Appendix C for calculations.

2.5 Hydraulic Results

On the eastern edge of the project hydraulically similar storm drain infrastructure is proposed to convey offsite run-on across the site. At the northern run-on point, a private 24" pipe and headwall is proposed to pick up flows from the existing 24" pipe beneath Gird Road. Runoff from the existing middle and southern 24" pipes will be collected by a private 30" pipe. Flowmaster software has been used to estimate the capacity of a 24" pipe at ~24 CFS and the capacity of a 30" pipe at ~44 CFS. During the 100-year event a majority of runoff will be conveyed by the 30" pipe with excess runoff surface flowing across the site to Live Oak Creek. See Appendix D for Flowmaster calculations.

The following table details the normal channel depth of flow from the western run-on areas as it passes by proposed structures. See Appendix D for channel calculations.

Table 2 - Summary of Off-site Flows and Hydraulics

Flow Location	Offsite Q_{100} (cfs)	Channel Width (ft)	Channel Depth (ft)	Normal Depth (ft)	Flow Velocity (ft/s)
Location 1	42.7	75	4	0.15	3.76
Location 2	28.8	66	0.5	0.20	4.34

The following table details rip rap sections proposed on site.

Table 3 – Summary of Rip Rap Areas

Section ID	Q100 (cfs)	V100 (ft/s)	Type	Dimensions LxWxT
1	24.3	7.2	No. 2 Backing	10'x4'x2'
2	10.6	7.0	No. 2 Backing	10'x5'x2'
3	44.1	8.4	No. 2 Backing	10'x5'x2'
4*	10.6	4.2	No. 2 Backing	30'x6'x2'

*Rip rap channel from retention basin spillway to Live Oak Creek

Section 3 Conclusions

The proposed project will not substantially alter the existing drainage pattern of the site, nor cause an increase in 100-year peak flow, as compared to existing conditions. Runoff will continue to flow into Live Oak Creek and flow southerly as open channel flow, consistent with existing conditions. The increase in un-mitigated 100-year peak flow has been mitigated via directing runoff to a retention pond.

Proposed conditions will not substantially alter how off-site flow is conveyed across the site. Proposed structures will be located outside all 100-year floodplain limits, as determined in the "100-Year Floodplain Analysis for: Monserate Winery" (*MBI, October 2018),* as well as the off-site tributaries developed in this project-specific drainage study.

Proposed conditions will not result in an increase the potential for erosion across the site. Proposed sections of rip rap will mitigate the potential for erosion at concentrated discharge points.

Section 4 Declaration of Responsible Charge

I, hereby declare that I am the Civil Engineer of work for this project, that I have exercised responsible charge over the design of the project as defined in Section 6703 of the Business and Professions Code, and that the design is consistent with current design.

I understand that the check of project drawings and specifications by the County of San Diego is confined to a review only and does not relieve me, as Engineer of Work, of my responsibilities for the project design.

Jay H. Sullivan RCE 77445

8-6-2019

Date

Section 5 References

County, S. D. (2014). Hydraulic Design Manual.

County, S. D. (June 2003). *San Diego County Hydrology Manual.*

Diego, C. o. (April 1984). *Drainage Design Manual.* San Diego.

Engineering, G. &. (June 2015). *Model BMP Design Manual.* San Diego.

FEMA. (1997). *Flood Insurance Rate Map.* San Diego.

Soil Survey Staff, N. R. (2018, September 24). *Web Soil Survey.* Retrieved from Web Soil Survey: https://websoilsurvey.sc.egov.usda.gov/

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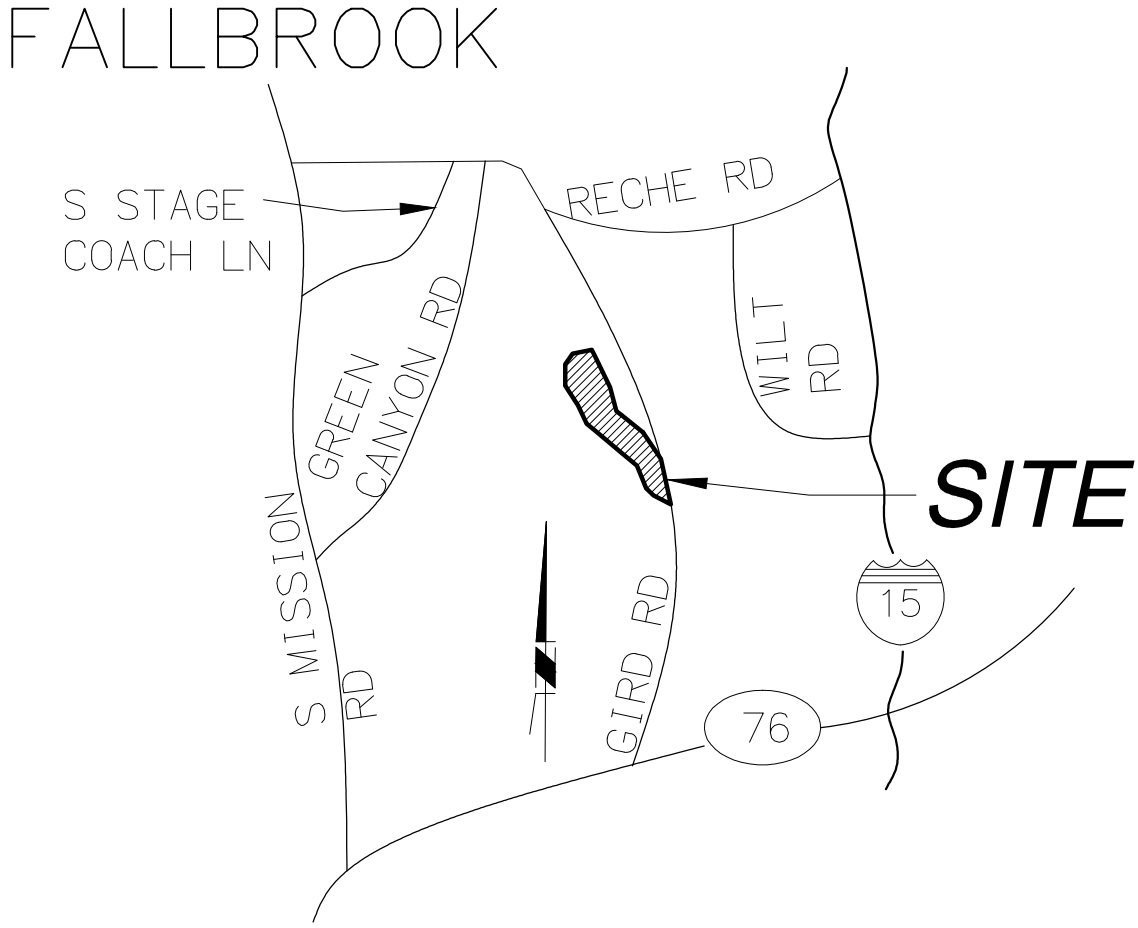
Appendix A – Site Information

Vicinity Map
Rainfall Isopluvials
FEMA FIRM
NRCS WebSoil Survey



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County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

SITE
P6=3.5

Orange County

Riverside County

Imperial County

Mexico

Pacific Ocean

OCEANSIDE
VISTA
CARLSBAD
ESCONDIDO
ENCINITAS
SOLANA BEACH
DEL MAR
POWAY
S.D. COUNTY
SANTEE
SAN DIEGO
EL CAJON
LA MESA
LEMON GROVE
CORONADO
SD
CHULA VISTA
IMPERIAL BEACH

117°30' 117°15' 117°00' 116°45' 116°30' 116°15'
33°30' 33°15' 33°00' 32°45' 32°30'

DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
We Have San Diego Covered!

N W E S

3 0 3 Miles

County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

Isopluvial (inches)

SITE
P24=6.0

Orange County

Riverside County

Imperial County

Mexico

Pacific Ocean

OCEANSIDE
VISTA
CARLSBAD
ESCONDIDO
ENCINITAS
SOLANA BEACH
DEL MAR
POWAY
S.D. COUNTY
SANTEE
SAN DIEGO
EL CAJON
LA MESA
LEMON GROVE
CORONADO
CHULA VISTA
IMPERIAL BEACH
SD

117°30' 117°15' 117°00' 116°45' 116°30' 116°15'
33°30' 33°15' 33°00' 32°45' 32°30'

DPW GIS
Department of Public Works
Geographic Information Services

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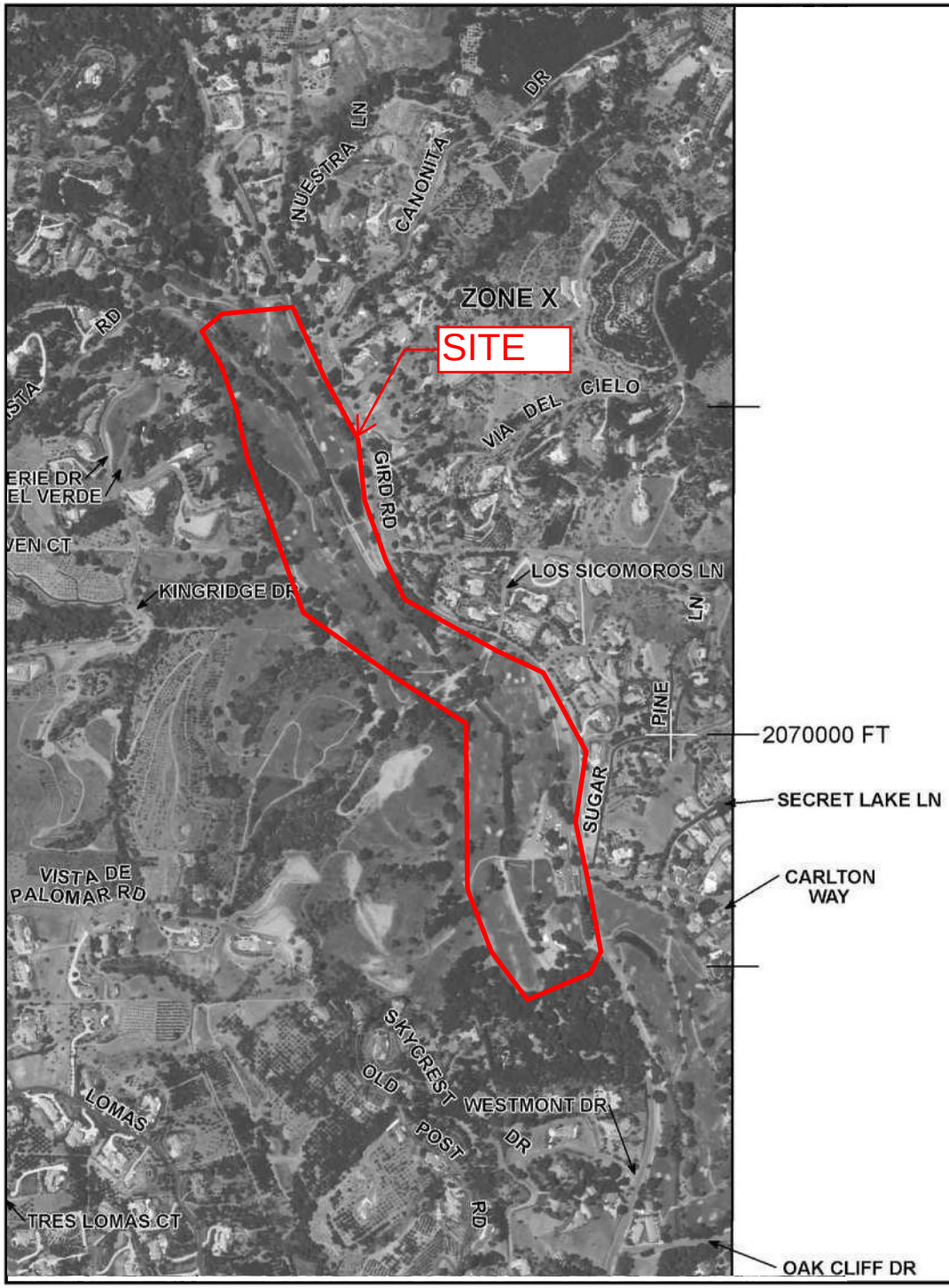
N W E S

3 0 3 Miles

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use		Runoff Coefficient "C"				
			Soil Type			
NRCS Elements	County Elements	% IMPER.	A	B	C	D
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	0.35
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Low Density Residential (LDR)	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).
DU/A = dwelling units per acre
NRCS = National Resources Conservation Service



MAP SCALE 1" = 1000'

500 0 500 1,000 1,500 2,000 FEET

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0480G

FIRM

FLOOD INSURANCE RATE MAP

SAN DIEGO COUNTY, CALIFORNIA

AND INCORPORATED AREAS

PANEL 480 OF 2375

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

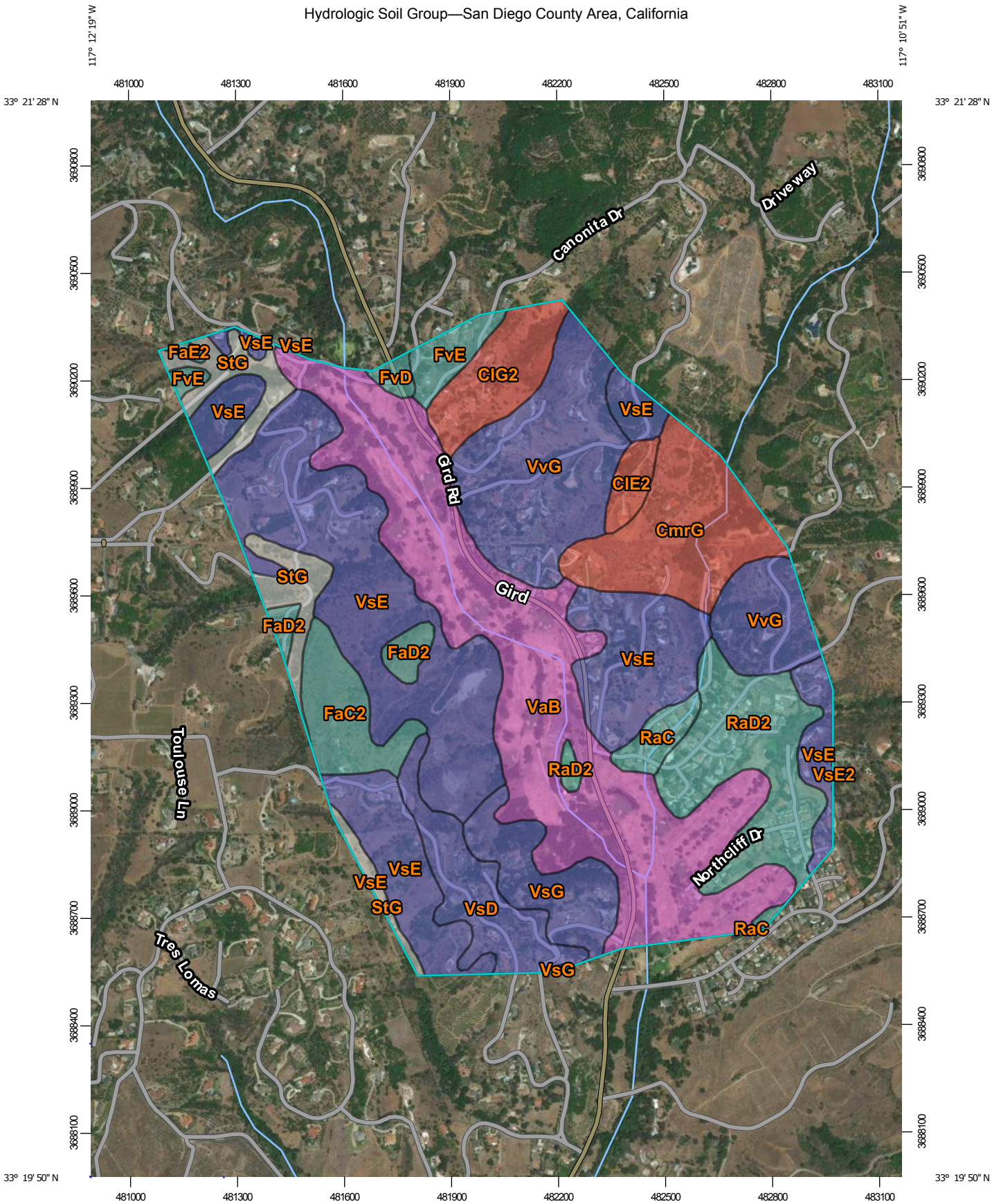
COMMUNITY	NUMBER	PANEL	SUFFIX
SAN DIEGO COUNTY	060284	0480	G

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

MAP NUMBER
06073C0480G

MAP REVISED
MAY 16, 2012

Federal Emergency Management Agency



Map Scale: 1:14,700 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 200 400 800 1200

Feet: 0 500 1000 2000 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N 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.

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: San Diego County Area, California
Survey Area Data: Version 12, Sep 13, 2017

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

Date(s) aerial images were photographed: Dec 31, 2009—Feb 2, 2017

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
ClE2	Cieneba coarse sandy loam, 15 to 30 percent slopes, ero ded	D	5.9	1.0%
ClG2	Cieneba coarse sandy loam, 30 to 65 percent slopes, ero ded	D	20.0	3.3%
CmrG	Cieneba very rocky coarse sandy loam, 30 to 75 percent slopes	D	41.1	6.9%
FaC2	Fallbrook sandy loam, 5 to 9 percent slopes, eroded	C	18.7	3.1%
FaD2	Fallbrook sandy loam, 9 to 15 percent slopes, eroded	C	5.9	1.0%
FaE2	Fallbrook sandy loam, 15 to 30 percent slopes, eroded	C	0.9	0.2%
FvD	Fallbrook-Vista sandy loams, 9 to 15 percent slopes	C	2.5	0.4%
FvE	Fallbrook-Vista sandy loams, 15 to 30 percent slopes	C	9.3	1.6%
RaC	Ramona sandy loam, 5 to 9 percent slopes	C	6.7	1.1%
RaD2	Ramona sandy loam, 9 to 15 percent slopes, eroded	C	44.6	7.4%
StG	Steep gullied land		24.0	4.0%
VaB	Visalia sandy loam, 2 to 5 percent slopes	A	137.2	22.9%
VsD	Vista coarse sandy loam, 9 to 15 percent slopes, MLRA 20	B	24.5	4.1%
VsE	Vista coarse sandy loam, 15 to 30 percent slopes, MLRA 20	B	162.3	27.1%
VsE2	Vista coarse sandy loam, 15 to 30 percent slopes, eroded	B	0.0	0.0%
VsG	Vista coarse sandy loam, 30 to 65 percent slopes, MLRA 20	B	22.2	3.7%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
VvG	Vista rocky coarse sandy loam, 30 to 65 percent slopes	B	72.7	12.1%
Totals for Area of Interest			**598.4**	**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

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INTERNATIONAL

Appendix B – Existing Hydrology

On-Site Hydrologic Work Map
Existing Condition Weighted C Values
On-site AES Output

363 100 SUB-BASIN 100
C=0.27
A=0.40 AC

SUB-BASIN 104
C=0.27
A=1.63 AC

102 362

SUB-BASIN 102
C=0.27
A=3.98 AC

104 349

SUB-BASIN 112
C=0.27
A=3.57 AC

106 346

SUB-BASIN 106
C=0.27
A=2.19 AC

340 108

SUB-BASIN 108
C=0.66
A=3.25 AC

SUB-BASIN 114
C=0.27
A=4.07 AC

110 337

SUB-BASIN 110
C=0.31
A=3.17 AC

SUB-BASIN 116
C=0.27
A=1.44 AC

327 112

A= 23.7 AC
Q100 = 21.6 CFS

LEGEND

- DRAINAGE BOUNDARY (MUP BOUNDARY)
- SUBAREA BOUNDARY
- FLOW PATH
- C=0.00 / A=0.0 — RUN-OFF COEFFICIENT / AREA (ACRES)
- 102 XXX — HYDROLOGY NODE/NODE ELEVATION
- AC (C=0.9)

SCALE 1"=150'

150 75 0 150

SCALE: 1"=150'

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MONSERATE MUP
EXISTING CONDITION HYDROLOGIC WORK MAP

H:\PDATA\160734\CADD\STRMWATER MUP\HYDROLOGIC MAP EXISTING V3.DWG 7/10/2019 3:04 PM

ON-SITE Weighted Runoff Coefficients
EXISTING Condition

** Retrieved from the San Diego County Hydrology Manual (pg 3-6, Table 3-1)*

Sub-Basin 108		
Soil Type A		
Land Use	**Runoff Coefficient**	**Area (acres)**
Impervious Area	0.90	2.01
Pervious Area	0.27	1.24
Semi-Pervious Area	0.34	0.00

Total Area (acres)	**3.25**
Weighted C Value	**0.66**

Sub-Basin 110		
Soil Type A		
Land Use	**Runoff Coefficient**	**Area (acres)**
Impervious Area	0.90	0.19
Pervious Area	0.27	2.98
Semi-Pervious Area	0.34	0.00

Total Area (acres)	**3.17**
Weighted C Value	**0.31**

```
******************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
          (c) Copyright 1982-2013 Advanced Engineering Software (aes)
              Ver. 20.0 Release Date: 06/01/2013  License ID 1264

                            Analysis prepared by:




------------------------------------------------------------------------------
  FILE NAME: C:\AES\MW\EX2.DAT
  TIME/DATE OF STUDY: 10:52 07/09/2019
------------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
------------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   3.500
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.10
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

******************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    102.00 IS CODE =  21
------------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .2700
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
  UPSTREAM ELEVATION(FEET) =    363.00
  DOWNSTREAM ELEVATION(FEET) =    362.00
  ELEVATION DIFFERENCE(FEET) =      1.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =   12.500
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    70.00
           (Reference: Table 3-1B of Hydrology Manual)
```

```
          THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.107
 SUBAREA RUNOFF(CFS) =      0.55
 TOTAL AREA(ACRES) =      0.40   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
 FLOW PROCESS FROM NODE    102.00 TO NODE    104.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    362.00  DOWNSTREAM(FEET) =      0.49
 CHANNEL LENGTH THRU SUBAREA(FEET) =   520.00   CHANNEL SLOPE =  0.6952
 CHANNEL BASE(FEET) =   15.00   "Z" FACTOR =   2.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   4.00
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.695
 *USER SPECIFIED(SUBAREA):
 USER-SPECIFIED RUNOFF COEFFICIENT = .2700
 S.C.S. CURVE NUMBER (AMC II) =   0
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.08
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   4.98
 AVERAGE FLOW DEPTH(FEET) =   0.04   TRAVEL TIME(MIN.) =   1.74
 Tc(MIN.) =   14.24
 SUBAREA AREA(ACRES) =     3.98       SUBAREA RUNOFF(CFS) =    5.04
 AREA-AVERAGE RUNOFF COEFFICIENT =  0.270
 TOTAL AREA(ACRES) =        4.4         PEAK FLOW RATE(CFS) =       5.55

 END OF SUBAREA CHANNEL FLOW HYDRAULICS:
 DEPTH(FEET) =  0.06   FLOW VELOCITY(FEET/SEC.) =   6.31
 LONGEST FLOWPATH FROM NODE    100.00 TO NODE    104.00 =     620.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    104.00 TO NODE    106.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    349.00  DOWNSTREAM(FEET) =    346.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =   330.00   CHANNEL SLOPE =  0.0091
 CHANNEL BASE(FEET) =   15.00   "Z" FACTOR =   2.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   4.00
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.126
 *USER SPECIFIED(SUBAREA):
 USER-SPECIFIED RUNOFF COEFFICIENT = .2700
 S.C.S. CURVE NUMBER (AMC II) =   0
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       6.46
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.74
 AVERAGE FLOW DEPTH(FEET) =   0.24   TRAVEL TIME(MIN.) =   3.15
 Tc(MIN.) =   17.39
 SUBAREA AREA(ACRES) =     1.63       SUBAREA RUNOFF(CFS) =    1.82
 AREA-AVERAGE RUNOFF COEFFICIENT =  0.270
 TOTAL AREA(ACRES) =        6.0         PEAK FLOW RATE(CFS) =       6.70

 END OF SUBAREA CHANNEL FLOW HYDRAULICS:
 DEPTH(FEET) =  0.24   FLOW VELOCITY(FEET/SEC.) =   1.79
 LONGEST FLOWPATH FROM NODE    100.00 TO NODE    106.00 =     950.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    106.00 TO NODE    108.00 IS CODE =  51
----------------------------------------------------------------------------
```

```
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
================================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    346.00  DOWNSTREAM(FEET) =    340.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   560.00   CHANNEL SLOPE =  0.0107
  CHANNEL BASE(FEET) =   15.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   4.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.542
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .2700
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       7.74
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.01
  AVERAGE FLOW DEPTH(FEET) =   0.25   TRAVEL TIME(MIN.) =   4.65
  Tc(MIN.) =   22.04
  SUBAREA AREA(ACRES) =     2.19       SUBAREA RUNOFF(CFS) =    2.09
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.270
  TOTAL AREA(ACRES) =        8.2         PEAK FLOW RATE(CFS) =       7.84

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.25   FLOW VELOCITY(FEET/SEC.) =   1.99
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    108.00 =    1510.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    108.00 TO NODE    108.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.542
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .2700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.2700
  SUBAREA AREA(ACRES) =    3.57   SUBAREA RUNOFF(CFS) =    3.41
  TOTAL AREA(ACRES) =       11.8   TOTAL RUNOFF(CFS) =      11.26
  TC(MIN.) =   22.04

****************************************************************************
  FLOW PROCESS FROM NODE    108.00 TO NODE    110.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    340.00  DOWNSTREAM(FEET) =    337.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   290.00   CHANNEL SLOPE =  0.0103
  CHANNEL BASE(FEET) =   15.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   4.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.355
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .6600
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      14.85
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.50
  AVERAGE FLOW DEPTH(FEET) =   0.38   TRAVEL TIME(MIN.) =   1.93
  Tc(MIN.) =   23.98
  SUBAREA AREA(ACRES) =     3.25       SUBAREA RUNOFF(CFS) =    7.20
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.354
  TOTAL AREA(ACRES) =       15.0         PEAK FLOW RATE(CFS) =      17.86

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
```

```
  DEPTH(FEET) =  0.42   FLOW VELOCITY(FEET/SEC.) =   2.71
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    110.00 =    1800.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    110.00 TO NODE    110.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.355
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .2700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.3364
  SUBAREA AREA(ACRES) =    4.07   SUBAREA RUNOFF(CFS) =    3.69
  TOTAL AREA(ACRES) =       19.1   TOTAL RUNOFF(CFS) =      21.54
  TC(MIN.) =   23.98

****************************************************************************
  FLOW PROCESS FROM NODE    110.00 TO NODE    112.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    337.00  DOWNSTREAM(FEET) =    327.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   610.00   CHANNEL SLOPE =  0.0164
  CHANNEL BASE(FEET) =   15.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.150   MAXIMUM DEPTH(FEET) =   4.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.767
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .3100
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      22.91
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.22
  AVERAGE FLOW DEPTH(FEET) =   1.09   TRAVEL TIME(MIN.) =   8.34
  Tc(MIN.) =   32.32
  SUBAREA AREA(ACRES) =     3.17       SUBAREA RUNOFF(CFS) =    2.72
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.333
  TOTAL AREA(ACRES) =       22.3         PEAK FLOW RATE(CFS) =      21.54

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  1.06   FLOW VELOCITY(FEET/SEC.) =   1.19
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    112.00 =    2410.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    112.00 TO NODE    112.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.767
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .2700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.3288
  SUBAREA AREA(ACRES) =    1.44   SUBAREA RUNOFF(CFS) =    1.08
  TOTAL AREA(ACRES) =       23.7   TOTAL RUNOFF(CFS) =      21.56
  TC(MIN.) =   32.32
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       23.7  TC(MIN.) =     32.32
  PEAK FLOW RATE(CFS)   =      21.56
```

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END OF RATIONAL METHOD ANALYSIS

Michael Baker
INTERNATIONAL

Appendix C – Proposed Hydrology

On-Site Hydrologic Work Map
Proposed Condition Weighted C Values
On-Site AES Unmitigated Output
Rick-Rat Hydrograph
Hydrograph Report

363 100 SUB-BASIN 100
C=0.27
A=0.40 AC

102 362

SUB-BASIN 102
C=0.35
A=3.98 AC

SUB-BASIN 104
C=0.52
A=1.63 AC

104 349

SUB-BASIN 112
C=0.27
A=3.57 AC

106 346

SUB-BASIN 106
C=0.57
A=2.19 AC

340 108

SUB-BASIN 108
C=0.53
A=3.25 AC

SUB-BASIN 114
C=0.33
A=4.07 AC

110 337

SUB-BASIN 110
C=0.45
A=3.17 AC

RETENTION BASIN
15705 CUFT. STORAGE

SUB-BASIN 116
C=0.45
A=1.44 AC

327 112

A= 23.7 AC
Q100 UNMITIGATED=28.0 CFS
Q100 MITIGATED=20.3 CFS

LEGEND

- DRAINAGE BOUNDARY (MUP BOUNDARY)
- SUBAREA BOUNDARY
- FLOW PATH
- C=0.00 A=0.0 — RUN-OFF COEFFICIENT AREA (ACRES)
- 102 XXX — HYDROLOGY NODE/NODE ELEVATION
- PERMEABLE SURFACE (C=0.34)
- SOIL CEMENT (C=0.9)
- DECORATIVE SURFACE (C=0.34)
- PED. WALKWAY (C=0.9)
- AC (C=0.9)
- BUILDING (C=0.9)
- VINYARD AREA
- DECORATIVE POND

100-YEAR PEAK FLOW MITIGATION

PEAK FLOW FROM THE SITE HAS BEEN MITIGATED BY DIRECTING SUB-BASINS 106 AND 108 TO A DETENTION POND. HYDROFLOW HYDROGRAPHS HAS BEEN USED TO MODEL THE PEAK FLOW FROM THE SUB-BASINS TO THE ~15705 CUBIC FOOT POND.THE HYDROGRAPHS OUTPUT DOCUMENTS A REDUCTION IN PEAK FLOW FROM 10.58 CFS TO 2.8 CFS. AS A RESULT, 7.7 CFS HAS BEEN SUBTRACTED FROM THE UNMITIGATED FLOW RATE OF 28.0 CFS TO ACHIEVE A MITIGATED FLOW RATE OF 20.3 CFS

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Phone: (858) 614-5000 · MBAKERINTL.COM

150 75 0 150
SCALE: 1"=150'

SCALE 1"=150'

MONSERATE MUP
PROPOSED CONDITION HYDROLOGIC WORK MAP

H:\PDATA\160734\CADD\STRMWATER MUP\HYDROLOGIC MAP PROPOSED V3.DWG 8/7/2019 2:41 PM

ON-SITE Weighted Runoff Coefficients
PROPOSED Condition

** Retrieved from the San Diego County Hydrology Manual (pg 3-6, Table 3-1)*

Impervious area includes building footprints, AC, pedestrian walkway, and soil cement surfaces
Semi-pervious area inlcudes decomposed granite and decorative paver surfaces.
See Hydrologic work maps for a graphical representation of surface types on site.

Sub-Basin 100		
Soil Type A		
Land Use	**Runoff Coefficient**	**Area (acres)**
Impervious Area	0.90	0.00
Pervious Area	0.27	0.00
Semi-Pervious Area	0.34	0.40

Total Area (acres)	**0.40**
Weighted C Value	**0.34**

Sub-Basin 110		
Soil Type A		
Land Use	**Runoff Coefficient**	**Area (acres)**
Impervious Area	0.90	0.88
Pervious Area	0.27	2.03
Semi-Pervious Area	0.34	0.26

Total Area (acres)	**3.17**
Weighted C Value	**0.45**

Sub-Basin 102		
Soil Type A		
Land Use	**Runoff Coefficient**	**Area (acres)**
Impervious Area	0.90	0.51
Pervious Area	0.27	3.29
Semi-Pervious Area	0.34	0.18

Total Area (acres)	**3.98**
Weighted C Value	**0.35**

Sub-Basin 112		
Soil Type A		
Land Use	**Runoff Coefficient**	**Area (acres)**
Impervious Area	0.90	0.00
Pervious Area	0.27	3.57
Semi-Pervious Area	0.34	0.00

Total Area (acres)	**3.57**
Weighted C Value	**0.27**

Sub-Basin 104		
Soil Type A		
Land Use	**Runoff Coefficient**	**Area (acres)**
Impervious Area	0.90	0.63
Pervious Area	0.27	0.77
Semi-Pervious Area	0.34	0.23

Total Area (acres)	**1.63**
Weighted C Value	**0.52**

Sub-Basin 114		
Soil Type A		
Land Use	**Runoff Coefficient**	**Area (acres)**
Impervious Area	0.90	0.38
Pervious Area	0.27	3.55
Semi-Pervious Area	0.34	0.14

Total Area (acres)	**4.07**
Weighted C Value	**0.33**

Sub-Basin 106		
Soil Type A		
Land Use	**Runoff Coefficient**	**Area (acres)**
Impervious Area	0.90	0.93
Pervious Area	0.27	0.33
Semi-Pervious Area	0.34	0.93

Total Area (acres)	**2.19**
Weighted C Value	**0.57**

Sub-Basin 116		
Soil Type A		
Land Use	**Runoff Coefficient**	**Area (acres)**
Impervious Area	0.90	0.41
Pervious Area	0.27	1.03
Semi-Pervious Area	0.34	0.00

Total Area (acres)	**1.44**
Weighted C Value	**0.45**

Sub-Basin 108		
Soil Type A		
Land Use	**Runoff Coefficient**	**Area (acres)**
Impervious Area	0.90	1.30
Pervious Area	0.27	1.61
Semi-Pervious Area	0.34	0.34

```
**************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
          (c) Copyright 1982-2013 Advanced Engineering Software (aes)
              Ver. 20.0 Release Date: 06/01/2013  License ID 1264

                            Analysis prepared by:




 ************************** DESCRIPTION OF STUDY **************************
* MONSERATE WINERY                                                        *
* PROPOSED CONDITION UNMITIGATED                                          *
*                                                                         *
 *************************************************************************

  FILE NAME: C:\AES\MW\PR2.DAT
  TIME/DATE OF STUDY: 17:25 07/09/2019
--------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
--------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   3.500
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.10
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.    (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)   (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

**************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    102.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==========================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .2700
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
  UPSTREAM ELEVATION(FEET) =    363.00
  DOWNSTREAM ELEVATION(FEET) =    362.00
```

```
 ELEVATION DIFFERENCE(FEET) =      1.00
 SUBAREA OVERLAND TIME OF FLOW(MIN.) =   12.500
 WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
          THE MAXIMUM OVERLAND FLOW LENGTH =    70.00
          (Reference: Table 3-1B of Hydrology Manual)
          THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.107
 SUBAREA RUNOFF(CFS) =      0.55
 TOTAL AREA(ACRES) =      0.40   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
 FLOW PROCESS FROM NODE    102.00 TO NODE    104.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    362.00  DOWNSTREAM(FEET) =      0.49
 CHANNEL LENGTH THRU SUBAREA(FEET) =   520.00   CHANNEL SLOPE =  0.6952
 CHANNEL BASE(FEET) =   15.00   "Z" FACTOR =   2.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   4.00
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.711
 *USER SPECIFIED(SUBAREA):
 USER-SPECIFIED RUNOFF COEFFICIENT = .3500
 S.C.S. CURVE NUMBER (AMC II) =   0
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.83
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   5.21
 AVERAGE FLOW DEPTH(FEET) =   0.05   TRAVEL TIME(MIN.) =   1.66
 Tc(MIN.) =   14.16
 SUBAREA AREA(ACRES) =     3.98       SUBAREA RUNOFF(CFS) =    6.56
 AREA-AVERAGE RUNOFF COEFFICIENT =  0.343
 TOTAL AREA(ACRES) =        4.4         PEAK FLOW RATE(CFS) =       7.07

 END OF SUBAREA CHANNEL FLOW HYDRAULICS:
 DEPTH(FEET) =  0.07   FLOW VELOCITY(FEET/SEC.) =   7.10
 LONGEST FLOWPATH FROM NODE    100.00 TO NODE    104.00 =     620.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    104.00 TO NODE    106.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    349.00  DOWNSTREAM(FEET) =    346.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =   330.00   CHANNEL SLOPE =  0.0091
 CHANNEL BASE(FEET) =   15.00   "Z" FACTOR =   2.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   4.00
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.200
 *USER SPECIFIED(SUBAREA):
 USER-SPECIFIED RUNOFF COEFFICIENT = .5200
 S.C.S. CURVE NUMBER (AMC II) =   0
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       8.85
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.99
 AVERAGE FLOW DEPTH(FEET) =   0.29   TRAVEL TIME(MIN.) =   2.76
 Tc(MIN.) =   16.92
 SUBAREA AREA(ACRES) =     1.63       SUBAREA RUNOFF(CFS) =    3.56
 AREA-AVERAGE RUNOFF COEFFICIENT =  0.391
 TOTAL AREA(ACRES) =        6.0         PEAK FLOW RATE(CFS) =       9.86

 END OF SUBAREA CHANNEL FLOW HYDRAULICS:
 DEPTH(FEET) =  0.30   FLOW VELOCITY(FEET/SEC.) =   2.09
```

```
 LONGEST FLOWPATH FROM NODE    100.00 TO NODE    106.00 =     950.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    106.00 TO NODE    108.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    346.00  DOWNSTREAM(FEET) =    340.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =   560.00   CHANNEL SLOPE =  0.0107
 CHANNEL BASE(FEET) =   15.00   "Z" FACTOR =   2.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   4.00
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.665
 *USER SPECIFIED(SUBAREA):
 USER-SPECIFIED RUNOFF COEFFICIENT = .5700
 S.C.S. CURVE NUMBER (AMC II) =   0
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      12.15
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.34
 AVERAGE FLOW DEPTH(FEET) =   0.33   TRAVEL TIME(MIN.) =   3.98
 Tc(MIN.) =   20.90
 SUBAREA AREA(ACRES) =     2.19       SUBAREA RUNOFF(CFS) =    4.58
 AREA-AVERAGE RUNOFF COEFFICIENT =  0.439
 TOTAL AREA(ACRES) =        8.2         PEAK FLOW RATE(CFS) =      13.18

 END OF SUBAREA CHANNEL FLOW HYDRAULICS:
 DEPTH(FEET) =  0.35   FLOW VELOCITY(FEET/SEC.) =   2.43
 LONGEST FLOWPATH FROM NODE    100.00 TO NODE    108.00 =    1510.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    112.00 TO NODE    108.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.665
 *USER SPECIFIED(SUBAREA):
 USER-SPECIFIED RUNOFF COEFFICIENT = .2700
 S.C.S. CURVE NUMBER (AMC II) =   0
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.3875
 SUBAREA AREA(ACRES) =    3.57   SUBAREA RUNOFF(CFS) =    3.53
 TOTAL AREA(ACRES) =       11.8   TOTAL RUNOFF(CFS) =      16.72
 TC(MIN.) =   20.90

****************************************************************************
 FLOW PROCESS FROM NODE    108.00 TO NODE    110.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    340.00  DOWNSTREAM(FEET) =    337.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =   290.00   CHANNEL SLOPE =  0.0103
 CHANNEL BASE(FEET) =   15.00   "Z" FACTOR =   2.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   4.00
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.481
 *USER SPECIFIED(SUBAREA):
 USER-SPECIFIED RUNOFF COEFFICIENT = .5300
 S.C.S. CURVE NUMBER (AMC II) =   0
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      19.71
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.79
 AVERAGE FLOW DEPTH(FEET) =   0.45   TRAVEL TIME(MIN.) =   1.74
 Tc(MIN.) =   22.64
```

```
  SUBAREA AREA(ACRES) =     3.25       SUBAREA RUNOFF(CFS) =    6.00
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.418
  TOTAL AREA(ACRES) =       15.0         PEAK FLOW RATE(CFS) =      21.87

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.47   FLOW VELOCITY(FEET/SEC.) =   2.92
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    110.00 =    1800.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    114.00 TO NODE    110.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.481
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .3300
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.3995
  SUBAREA AREA(ACRES) =    4.07   SUBAREA RUNOFF(CFS) =    4.68
  TOTAL AREA(ACRES) =       19.1   TOTAL RUNOFF(CFS) =      26.55
  TC(MIN.) =   22.64

****************************************************************************
  FLOW PROCESS FROM NODE    110.00 TO NODE    112.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    337.00  DOWNSTREAM(FEET) =    327.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   610.00   CHANNEL SLOPE =  0.0164
  CHANNEL BASE(FEET) =   15.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.150   MAXIMUM DEPTH(FEET) =   4.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.882
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      28.61
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.32
  AVERAGE FLOW DEPTH(FEET) =   1.24   TRAVEL TIME(MIN.) =   7.71
  Tc(MIN.) =   30.35
  SUBAREA AREA(ACRES) =     3.17       SUBAREA RUNOFF(CFS) =    4.11
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.407
  TOTAL AREA(ACRES) =       22.3         PEAK FLOW RATE(CFS) =      26.55

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  1.19   FLOW VELOCITY(FEET/SEC.) =   1.28
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    112.00 =    2410.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    116.00 TO NODE    112.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.882
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.4093
  SUBAREA AREA(ACRES) =    1.44   SUBAREA RUNOFF(CFS) =    1.87
  TOTAL AREA(ACRES) =       23.7   TOTAL RUNOFF(CFS) =      27.96
```

```
  TC(MIN.) =   30.35
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       23.7  TC(MIN.) =     30.35
  PEAK FLOW RATE(CFS)   =      27.96
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

RATIONAL METHOD HYDROGRAPH PROGRAM

Sub-Basins 106 & 108

RUN DATE 7/9/2019
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 15 MIN.
6 HOUR RAINFALL 3.5 INCHES
BASIN AREA 5.44 ACRES
RUNOFF COEFFICIENT 0.54
PEAK DISCHARGE 10.58 CFS

TIME (MIN) = 0	DISCHARGE (CFS) = 0
TIME (MIN) = 15	DISCHARGE (CFS) = 0.6
TIME (MIN) = 30	DISCHARGE (CFS) = 0.6
TIME (MIN) = 45	DISCHARGE (CFS) = 0.7
TIME (MIN) = 60	DISCHARGE (CFS) = 0.7
TIME (MIN) = 75	DISCHARGE (CFS) = 0.7
TIME (MIN) = 90	DISCHARGE (CFS) = 0.8
TIME (MIN) = 105	DISCHARGE (CFS) = 0.8
TIME (MIN) = 120	DISCHARGE (CFS) = 0.9
TIME (MIN) = 135	DISCHARGE (CFS) = 1
TIME (MIN) = 150	DISCHARGE (CFS) = 1
TIME (MIN) = 165	DISCHARGE (CFS) = 1.2
TIME (MIN) = 180	DISCHARGE (CFS) = 1.3
TIME (MIN) = 195	DISCHARGE (CFS) = 1.6
TIME (MIN) = 210	DISCHARGE (CFS) = 1.8
TIME (MIN) = 225	DISCHARGE (CFS) = 2.6
TIME (MIN) = 240	DISCHARGE (CFS) = 6.5
TIME (MIN) = 255	DISCHARGE (CFS) = 10.58
TIME (MIN) = 270	DISCHARGE (CFS) = 2.1
TIME (MIN) = 285	DISCHARGE (CFS) = 1.4
TIME (MIN) = 300	DISCHARGE (CFS) = 1.1
TIME (MIN) = 315	DISCHARGE (CFS) = 0.9
TIME (MIN) = 330	DISCHARGE (CFS) = 0.8
TIME (MIN) = 345	DISCHARGE (CFS) = 0.7
TIME (MIN) = 360	DISCHARGE (CFS) = 0.7
TIME (MIN) = 375	DISCHARGE (CFS) = 0

Watershed Model Schematic

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

Legend

Hyd.	Origin	Description
1	Manual	8 and 9
2	Reservoir	8 and 9

Hydrograph Summary Report

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

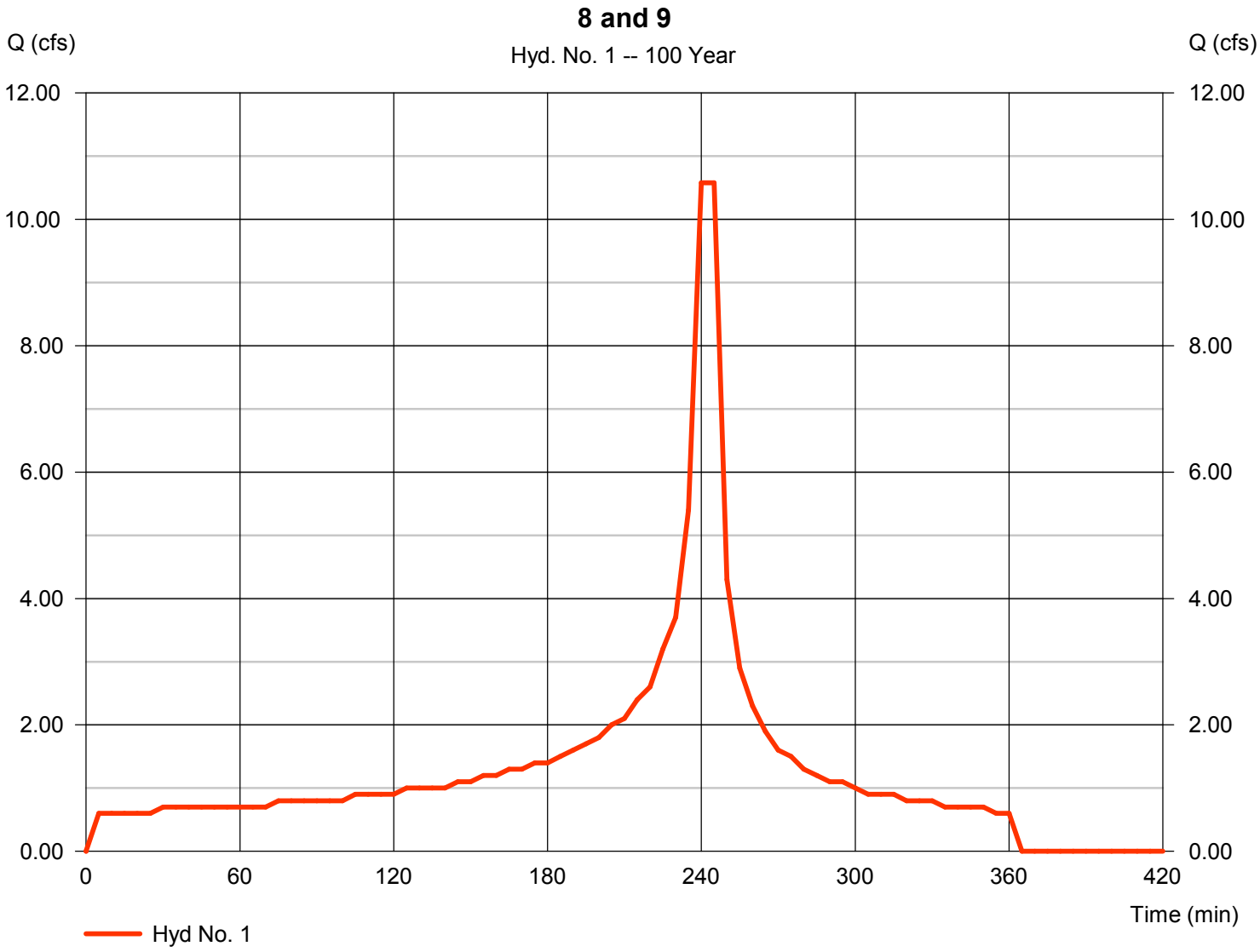
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Manual	10.58	5	240	33,048	------	------	------	8 and 9
2	Reservoir	2.839	5	255	33,046	1	101.21	8,982	8 and 9

Hydrograph Report

Hyd. No. 1

8 and 9

Hydrograph type	= Manual	Peak discharge	= 10.58 cfs
Storm frequency	= 100 yrs	Time to peak	= 240 min
Time interval	= 5 min	Hyd. volume	= 33,048 cuft



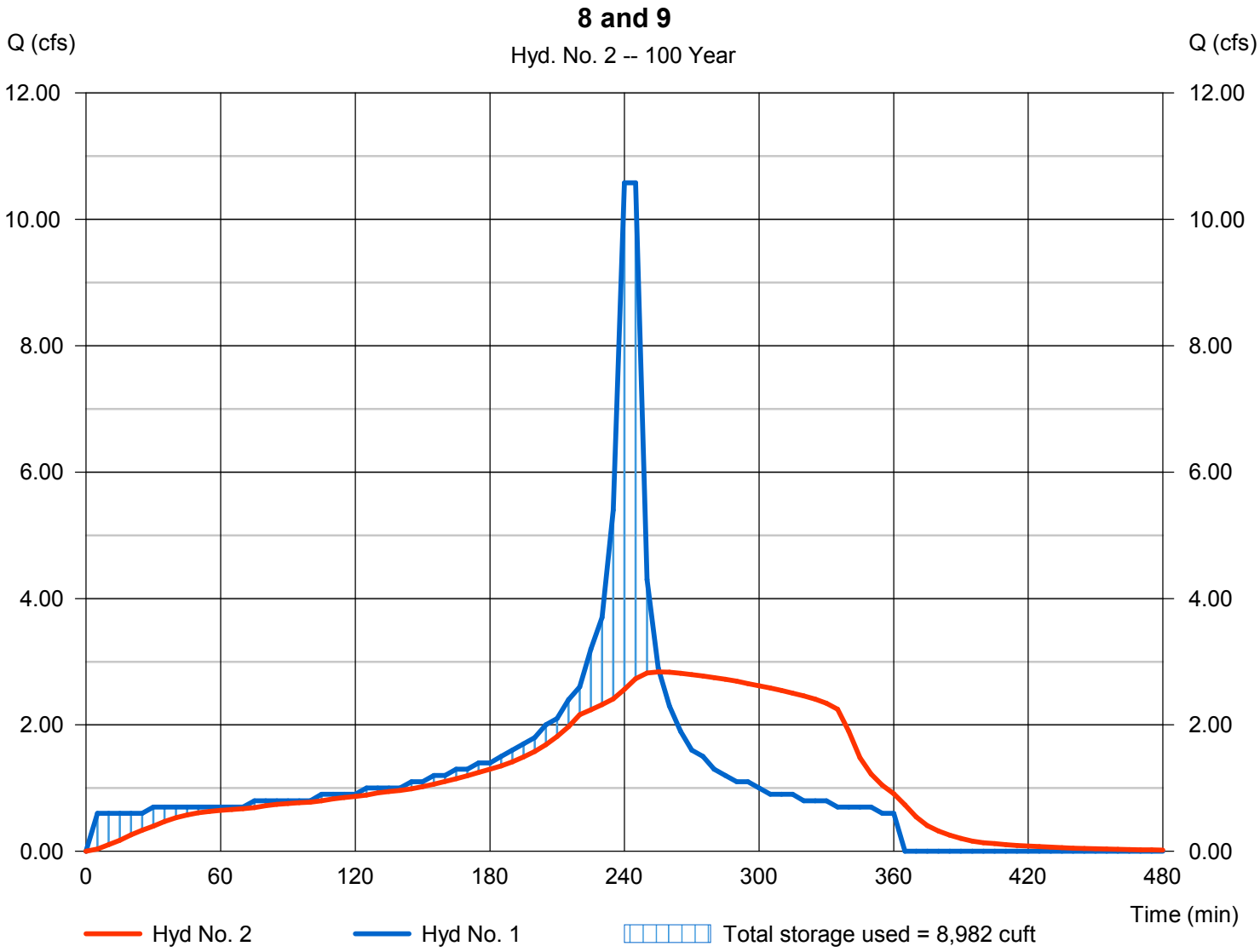
Hydrograph Report

Hyd. No. 2

8 and 9

Hydrograph type	=	Reservoir	Peak discharge	=	2.839 cfs
Storm frequency	=	100 yrs	Time to peak	=	255 min
Time interval	=	5 min	Hyd. volume	=	33,046 cuft
Inflow hyd. No.	=	1 - 8 and 9	Max. Elevation	=	101.21 ft
Reservoir name	=	Pond 1	Max. Storage	=	8,982 cuft

Storage Indication method used.



Pond Report

Pond No. 1 - Pond 1

Pond Data

Contours -User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 100.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	100.00	6,808	0	0
0.50	100.50	7,317	3,531	3,531
1.00	101.00	7,840	3,789	7,321
1.50	101.50	8,381	4,055	11,376
2.00	102.00	8,934	4,329	15,705

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 8.00	0.00	0.00	0.00
Span (in)	= 8.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 98.00	0.00	0.00	0.00
Length (ft)	= 10.00	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	No	No	No

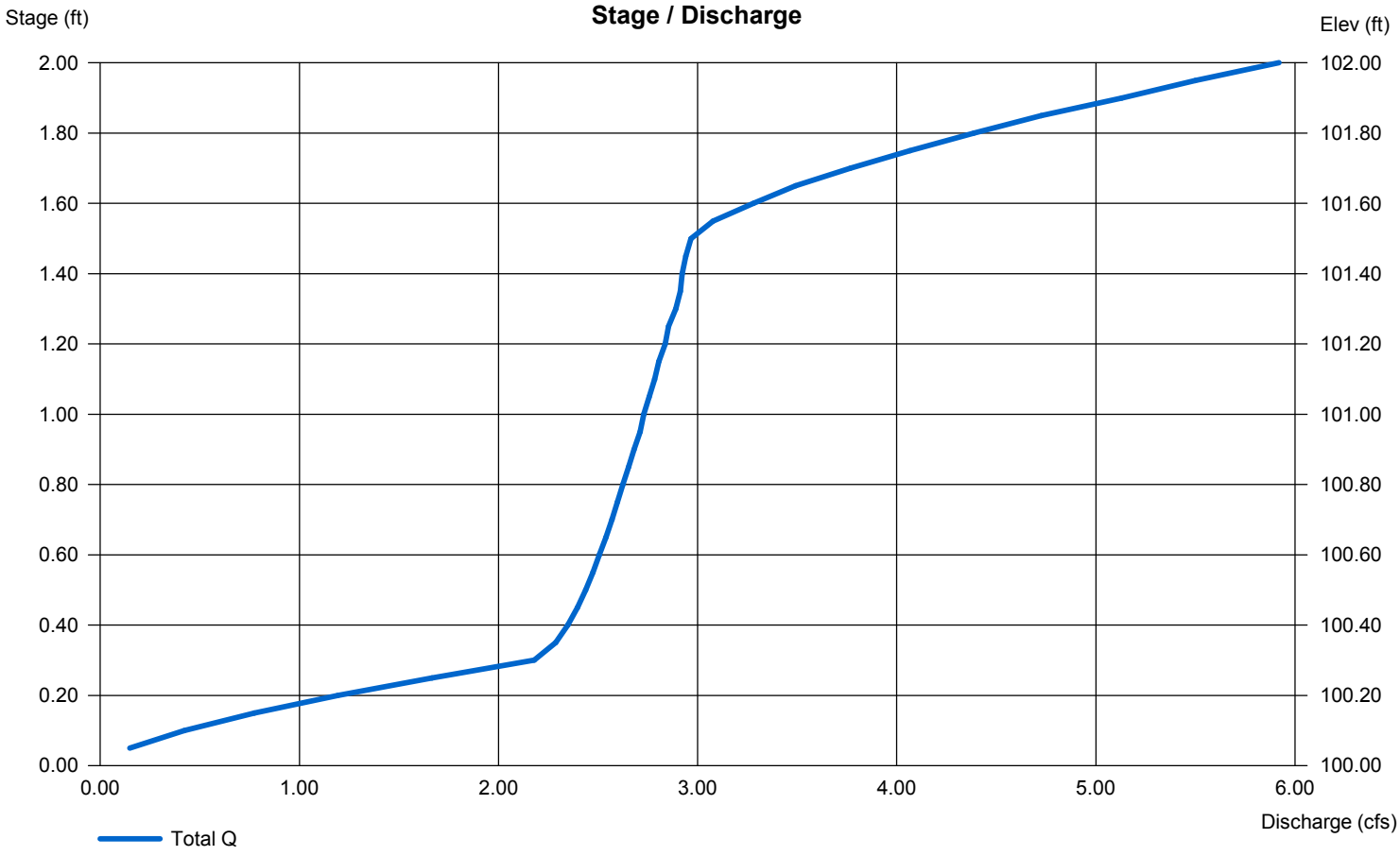
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 4.00	3.00	0.00	0.00
Crest El. (ft)	= 100.00	101.50	0.00	0.00
Weir Coeff.	= 3.33	2.60	3.33	3.33
Weir Type	= 1	Broad	---	---
Multi-Stage	= Yes	No	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).



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Appendix D – Hydraulics

Hydraulic Work Map
Hydraflow Express Input/Output
Off-Site AES

LEGEND

- DRAINAGE BOUNDARY
- SUBAREA BOUNDARY
- FLOW PATH
- IMPERVIOUS AREA

Easterly run-on location 1

Easterly run-on location 2

Easterly run-on location 3

SEE PAGE 2

SEE PAGE 3

SEE PAGE 4

SEE PAGE 5

804

802

800

900

902

904

SUB-BASIN 802
C=0.32
A=22.60

SUB-BASIN 800
C=0.32
A=0.20

SUB-BASIN 900
C=0.32
A=0.20

SUB-BASIN 902
C=0.32
A=11.7

300 150 0 300

SCALE: 1"=300'

SCALE 1"=300'

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MONSERATE MUP
OFFSITE RUN ON + HYDRAULIC MAP
PAGE 1 OF 5

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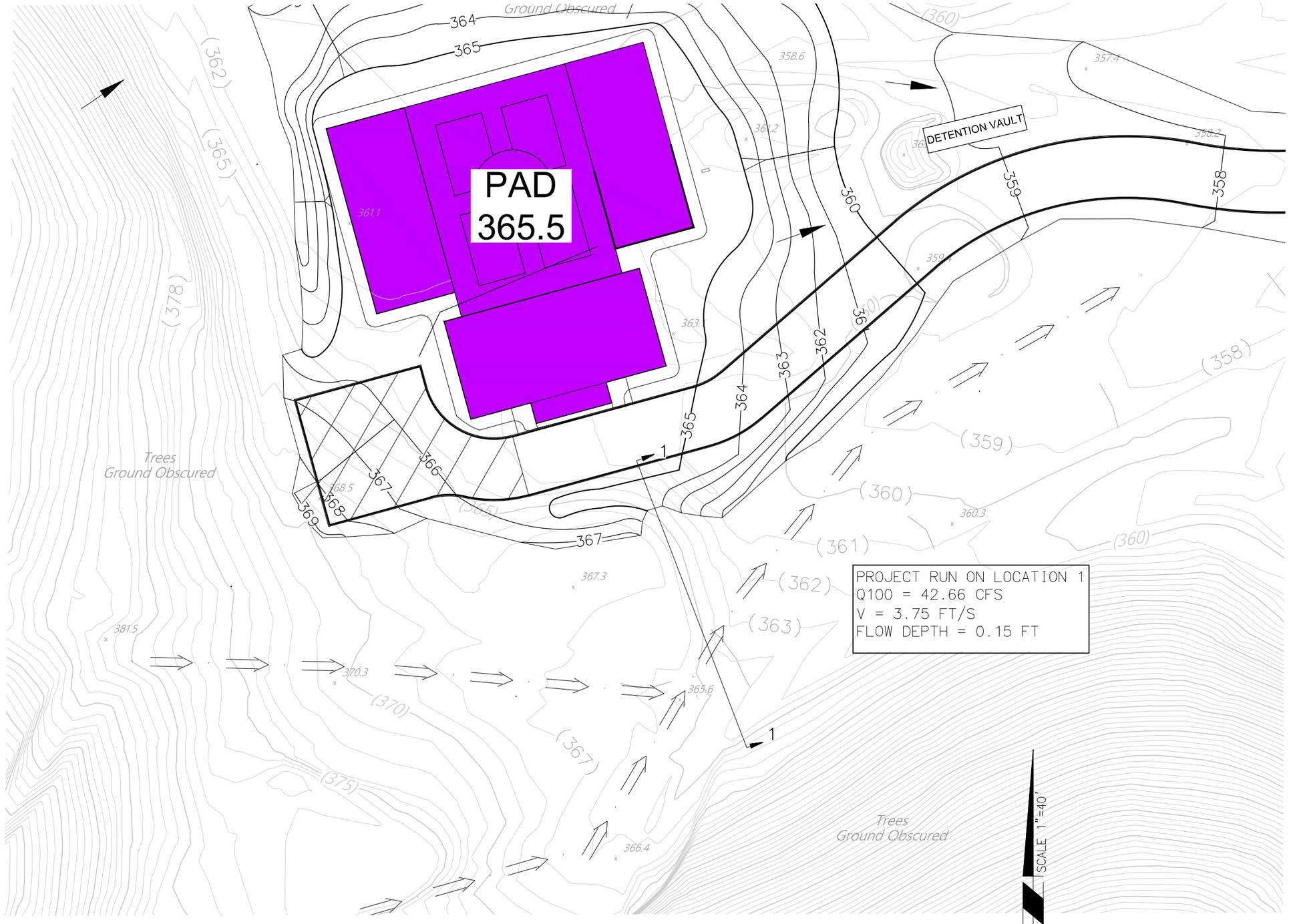

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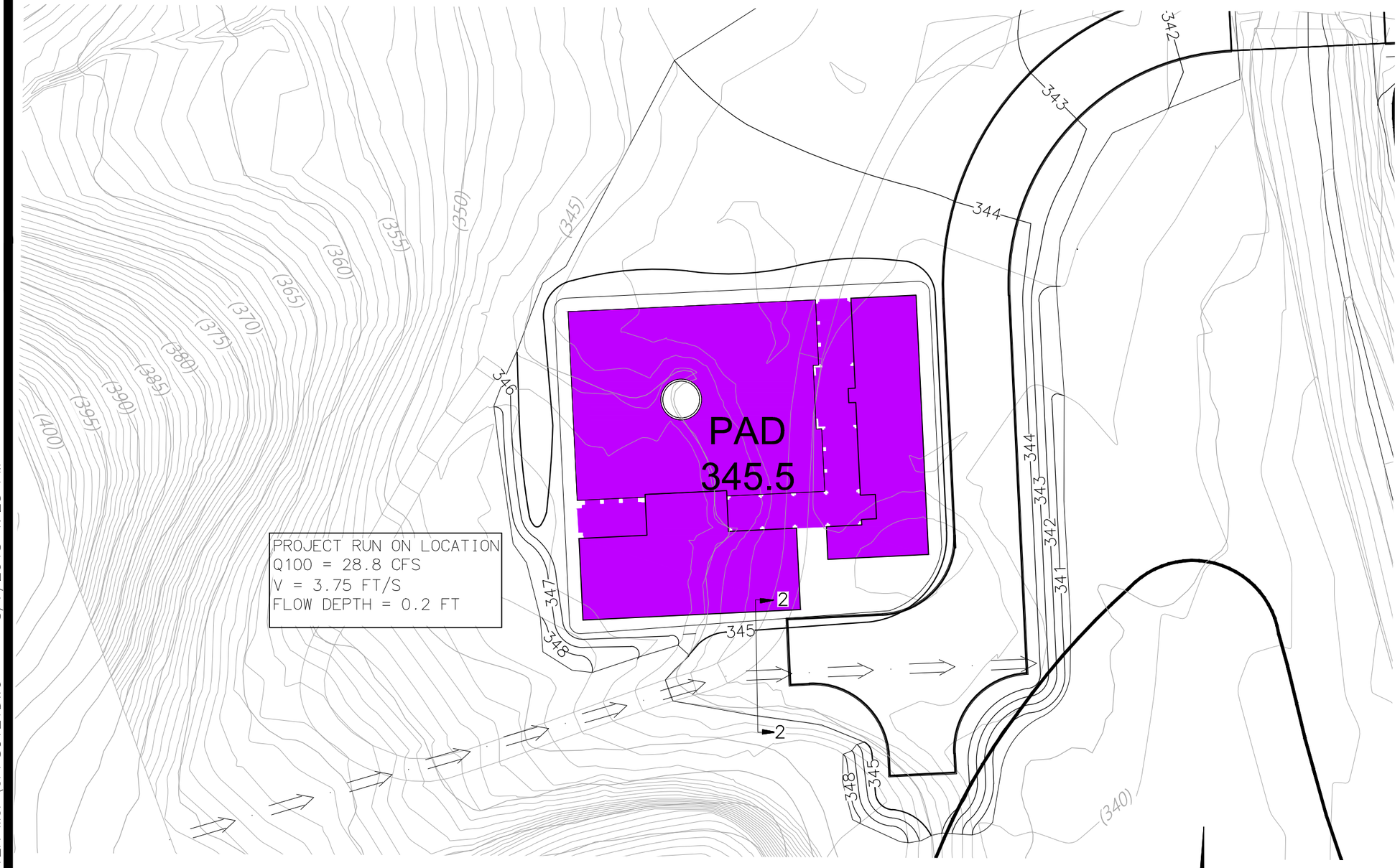
MONSERATE MUP
OFFSITE FLOW LOCATION 1
PAGE 2 OF 3



SCALE 1"=40'

40 20 0 40

SCALE: 1"=40'

MONSERATE MUP
OFFSITE FLOW LOCATION 2
PAGE 3 OF 3

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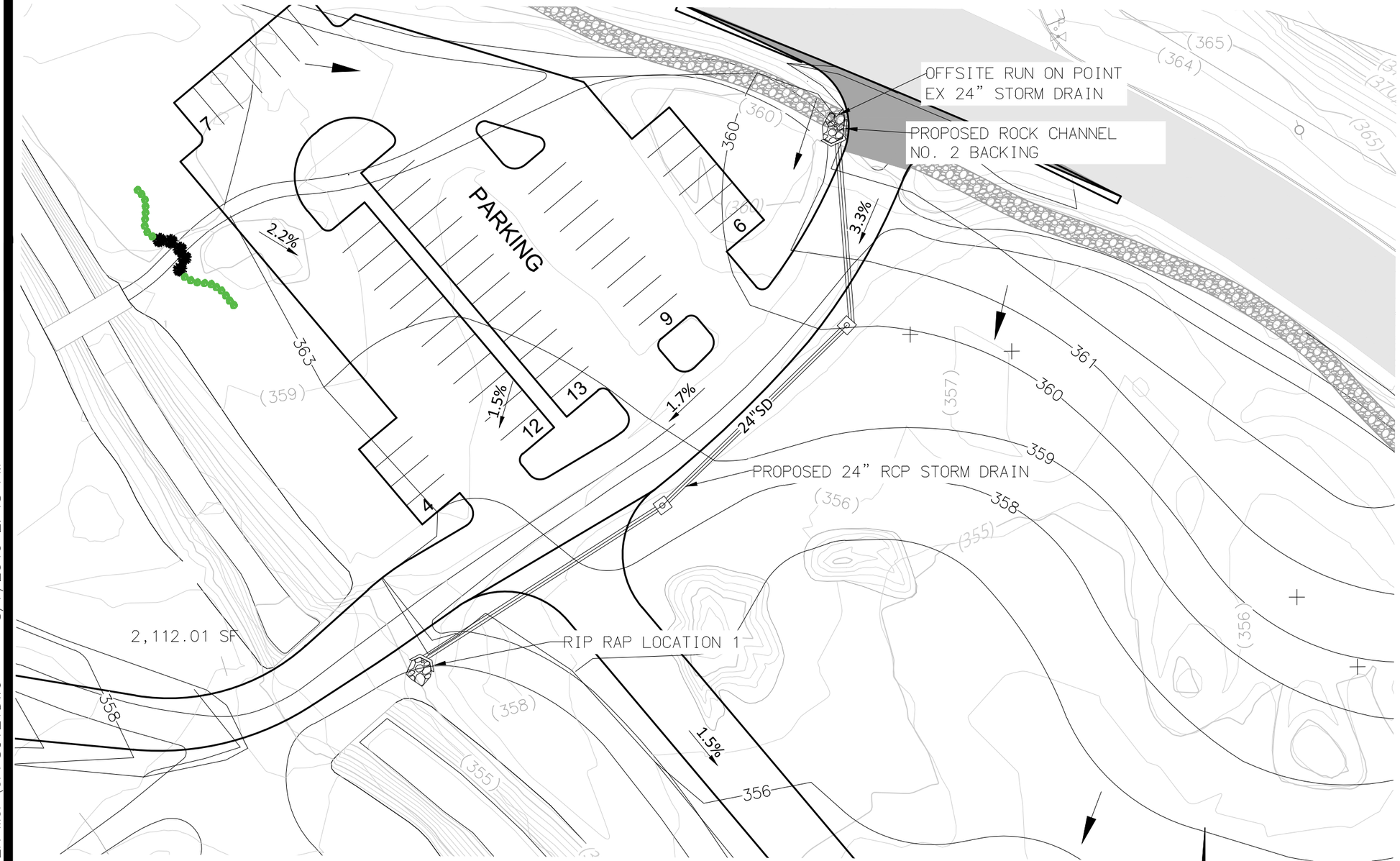

SCALE 1"=40'

40 20 0 40

SCALE: 1"=40'

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MONSERATE MUP
RIP RAP LOCATIONS
PAGE 4 OF 5

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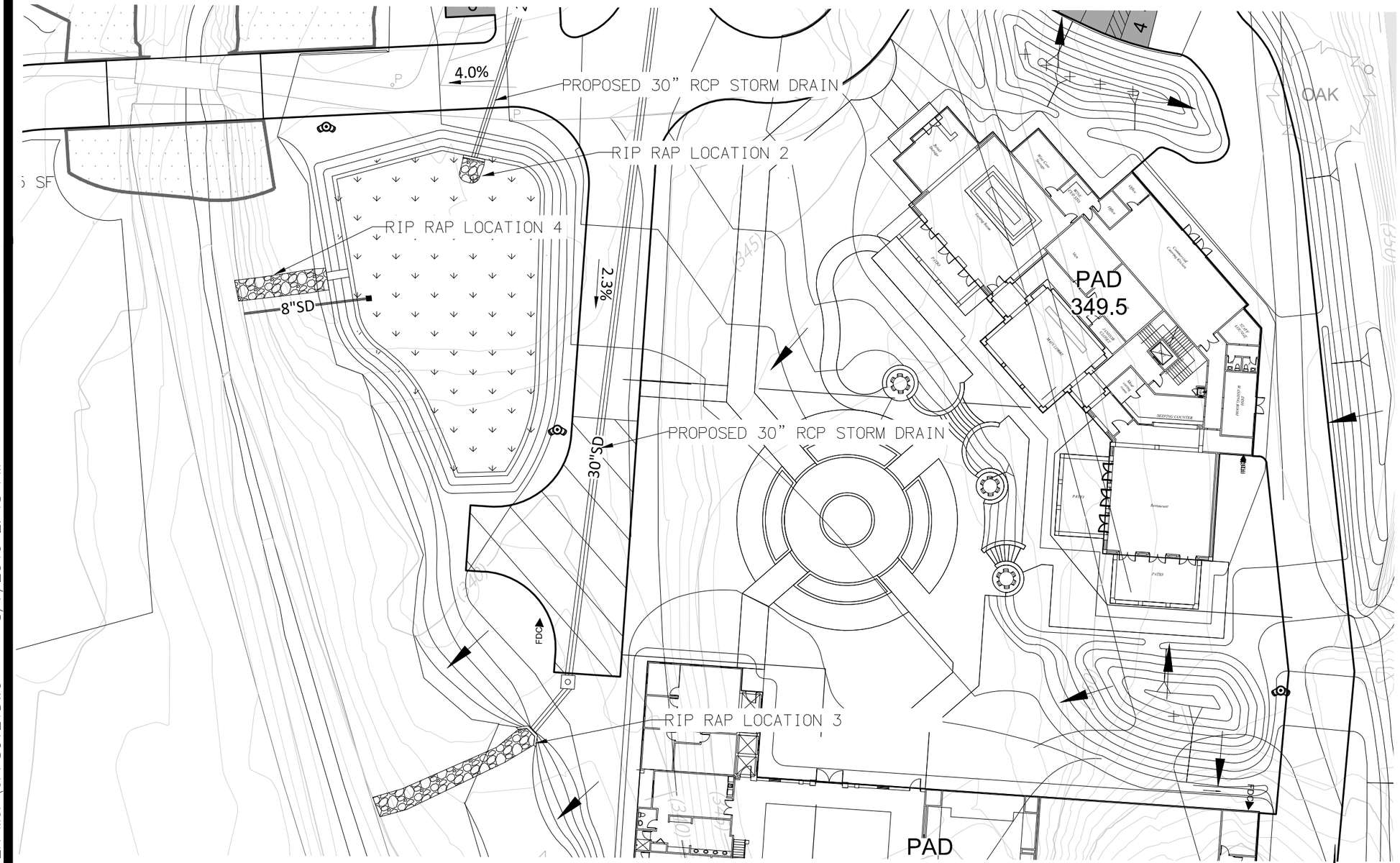

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MONSERATE MUP
RIP RAP LOCATIONS
PAGE 5 OF 5

```
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.517
  WARNING: THE MAXIMUM OVERLAND FLOW SLOPE, 10.%, IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.773
  SUBAREA RUNOFF(CFS) =      0.50
  TOTAL AREA(ACRES) =      0.20   TOTAL RUNOFF(CFS) =      0.50

****************************************************************************
  FLOW PROCESS FROM NODE    802.00 TO NODE    804.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    610.00  DOWNSTREAM(FEET) =    370.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  1600.00   CHANNEL SLOPE =  0.1500
  CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =   5.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   5.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.847
  USER-SPECIFIED RUNOFF COEFFICIENT = .3200
  S.C.S. CURVE NUMBER (AMC II) =  65
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      22.06
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   7.38
  AVERAGE FLOW DEPTH(FEET) =   0.26   TRAVEL TIME(MIN.) =   3.62
  Tc(MIN.) =   10.13
  SUBAREA AREA(ACRES) =    22.60       SUBAREA RUNOFF(CFS) =   42.29
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.320
  TOTAL AREA(ACRES) =       22.8         PEAK FLOW RATE(CFS) =      42.66

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.39   FLOW VELOCITY(FEET/SEC.) =   9.26
  LONGEST FLOWPATH FROM NODE    800.00 TO NODE    804.00 =    1700.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      0.00 TO NODE      0.00 IS CODE =  13
----------------------------------------------------------------------------
  >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    900.00 TO NODE    902.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  USER-SPECIFIED RUNOFF COEFFICIENT = .3200
  S.C.S. CURVE NUMBER (AMC II) =  65
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
  UPSTREAM ELEVATION(FEET) =    635.00
  DOWNSTREAM ELEVATION(FEET) =    625.00
  ELEVATION DIFFERENCE(FEET) =     10.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.517
  WARNING: THE MAXIMUM OVERLAND FLOW SLOPE, 10.%, IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.773
  SUBAREA RUNOFF(CFS) =      0.50
  TOTAL AREA(ACRES) =      0.20   TOTAL RUNOFF(CFS) =      0.50

****************************************************************************
  FLOW PROCESS FROM NODE    902.00 TO NODE    904.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
```

```
  ELEVATION DATA: UPSTREAM(FEET) =    625.00  DOWNSTREAM(FEET) =    365.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   100.00   CHANNEL SLOPE =  2.6000
  CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =   5.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   5.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.693
  USER-SPECIFIED RUNOFF COEFFICIENT = .3200
  S.C.S. CURVE NUMBER (AMC II) =  65
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      14.65
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =  15.82
  AVERAGE FLOW DEPTH(FEET) =   0.09   TRAVEL TIME(MIN.) =   0.11
  Tc(MIN.) =    6.62
  SUBAREA AREA(ACRES) =    11.50       SUBAREA RUNOFF(CFS) =   28.31
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.320
  TOTAL AREA(ACRES) =       11.7         PEAK FLOW RATE(CFS) =      28.80

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.13   FLOW VELOCITY(FEET/SEC.) =  20.07
  LONGEST FLOWPATH FROM NODE    900.00 TO NODE    904.00 =     200.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       11.7  TC(MIN.) =      6.62
  PEAK FLOW RATE(CFS)   =      28.80
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Aug 7 2018

Project Run On Location 1

Trapezoidal

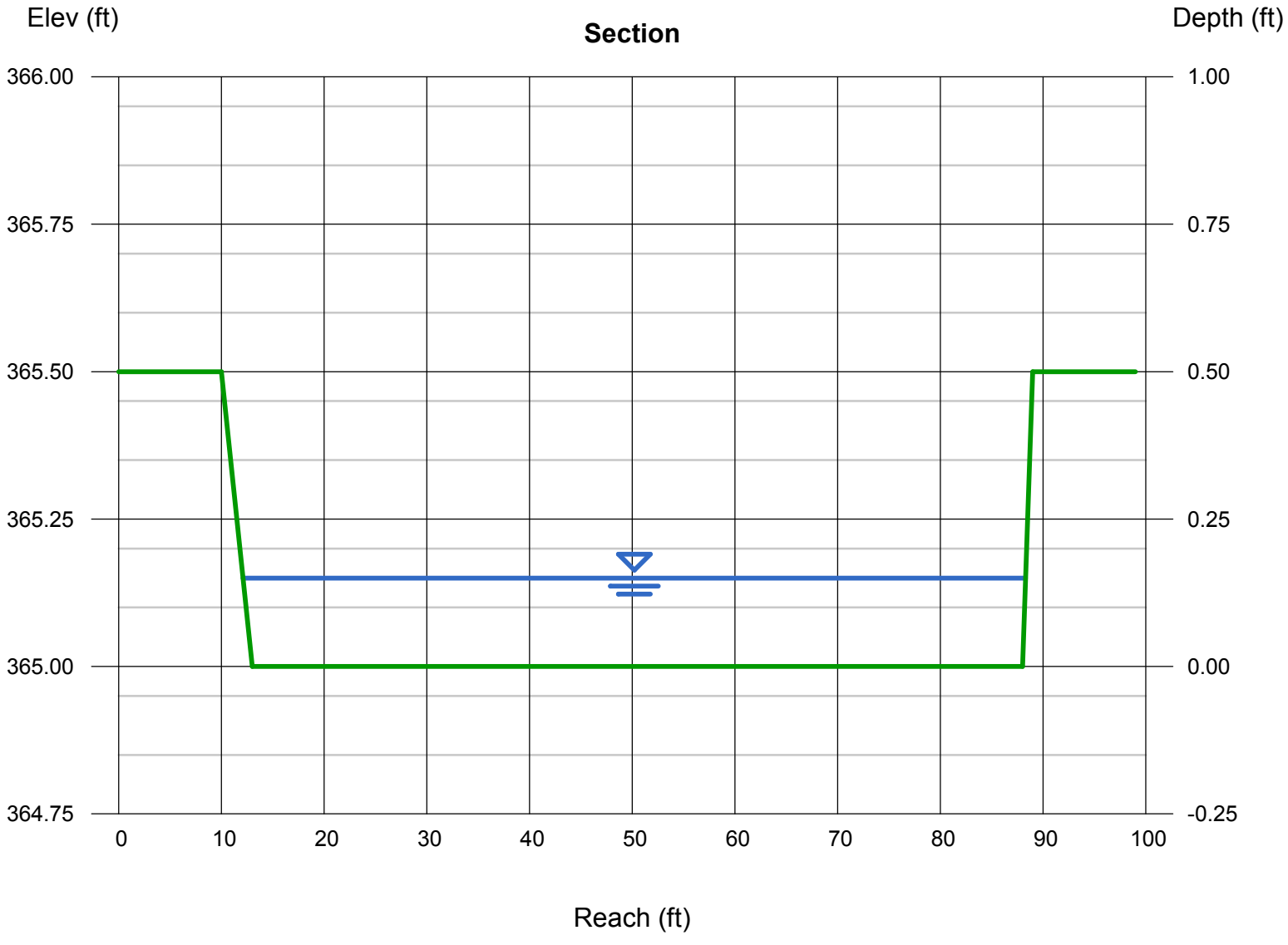
Bottom Width (ft)	= 75.00
Side Slopes (z:1)	= 6.00, 2.00
Total Depth (ft)	= 0.50
Invert Elev (ft)	= 365.00
Slope (%)	= 10.00
N-Value	= 0.035

Calculations

Compute by:	Known Q
Known Q (cfs)	= 42.66

Highlighted

Depth (ft)	= 0.15
Q (cfs)	= 42.66
Area (sqft)	= 11.34
Velocity (ft/s)	= 3.76
Wetted Perim (ft)	= 76.25
Crit Depth, Yc (ft)	= 0.22
Top Width (ft)	= 76.20
EGL (ft)	= 0.37



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Aug 7 2018

RUN ON POINT 1

Trapezoidal

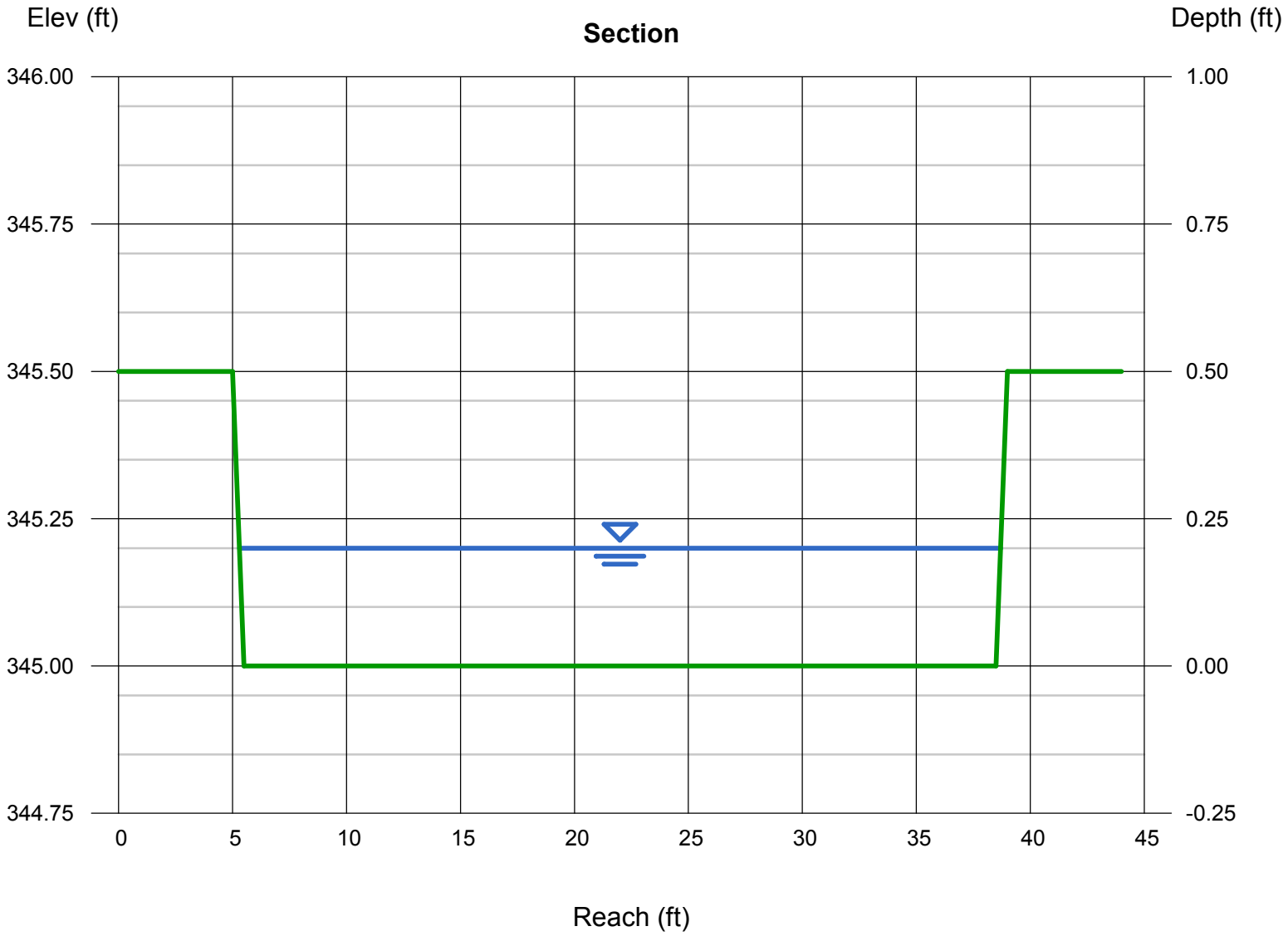
Bottom Width (ft)	= 33.00
Side Slopes (z:1)	= 1.00, 1.00
Total Depth (ft)	= 0.50
Invert Elev (ft)	= 345.00
Slope (%)	= 10.00
N-Value	= 0.035

Calculations

Compute by:	Known Q
Known Q (cfs)	= 28.80

Highlighted

Depth (ft)	= 0.20
Q (cfs)	= 28.80
Area (sqft)	= 6.64
Velocity (ft/s)	= 4.34
Wetted Perim (ft)	= 33.57
Crit Depth, Yc (ft)	= 0.29
Top Width (ft)	= 33.40
EGL (ft)	= 0.49



30" RCP Pipe

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Normal Depth	2.50	ft
Diameter	2.50	ft
Discharge	41.01	ft³/s

Results

Discharge	41.01	ft³/s
Normal Depth	2.50	ft
Flow Area	4.91	ft²
Wetted Perimeter	7.85	ft
Hydraulic Radius	0.63	ft
Top Width	0.00	ft
Critical Depth	2.15	ft
Percent Full	100.0	%
Critical Slope	0.00926	ft/ft
Velocity	8.36	ft/s
Velocity Head	1.08	ft
Specific Energy	3.58	ft
Froude Number	0.00	
Maximum Discharge	44.12	ft³/s
Discharge Full	41.01	ft³/s
Slope Full	0.01000	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	%

30" RCP Pipe

GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.50	ft
Critical Depth	2.15	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00926	ft/ft

24" RCP Pipe

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Normal Depth	2.00	ft
Diameter	2.00	ft
Discharge	22.62	ft³/s

Results

Discharge	22.62	ft³/s
Normal Depth	2.00	ft
Flow Area	3.14	ft²
Wetted Perimeter	6.28	ft
Hydraulic Radius	0.50	ft
Top Width	0.00	ft
Critical Depth	1.69	ft
Percent Full	100.0	%
Critical Slope	0.00946	ft/ft
Velocity	7.20	ft/s
Velocity Head	0.81	ft
Specific Energy	2.81	ft
Froude Number	0.00	
Maximum Discharge	24.33	ft³/s
Discharge Full	22.62	ft³/s
Slope Full	0.01000	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	%

24" RCP Pipe

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	1.69	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00946	ft/ft

24" Pipe to Retention Basin

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	2.50	ft
Discharge	10.58	ft³/s

Results

Normal Depth	0.87	ft
Flow Area	1.51	ft²
Wetted Perimeter	3.15	ft
Hydraulic Radius	0.48	ft
Top Width	2.38	ft
Critical Depth	1.09	ft
Percent Full	34.6	%
Critical Slope	0.00432	ft/ft
Velocity	7.01	ft/s
Velocity Head	0.76	ft
Specific Energy	1.63	ft
Froude Number	1.55	
Maximum Discharge	44.12	ft³/s
Discharge Full	41.01	ft³/s
Slope Full	0.00067	ft/ft
Flow Type	SuperCritical	

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	%
Normal Depth Over Rise	34.65	%
Downstream Velocity	Infinity	ft/s

24" Pipe to Retention Basin

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.87	ft
Critical Depth	1.09	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00432	ft/ft