

HYDROLOGY / HYDRAULICS STUDY

FOR THE:

*Pala Mesa Plaza
3233 Old Highway 395
Fallbrook, CA 92028
APN: 125-050-54-00*

PREPARED FOR:

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Project No: 19-025*

ORIGINAL REPORT PREPARATION DATE:

June 17, 2020

REVISION DATE(S):

June 7, 2022

June 13, 2023

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1.0 PROJECT DESCRIPTION

1.1 Purpose of Study

The purpose of this study is to support the site redevelopment plans for an existing commercial property located in the jurisdictional boundary of the County of San Diego. This study will demonstrate that the post-development 100-year peak runoff will not exceed existing peak runoff rates.

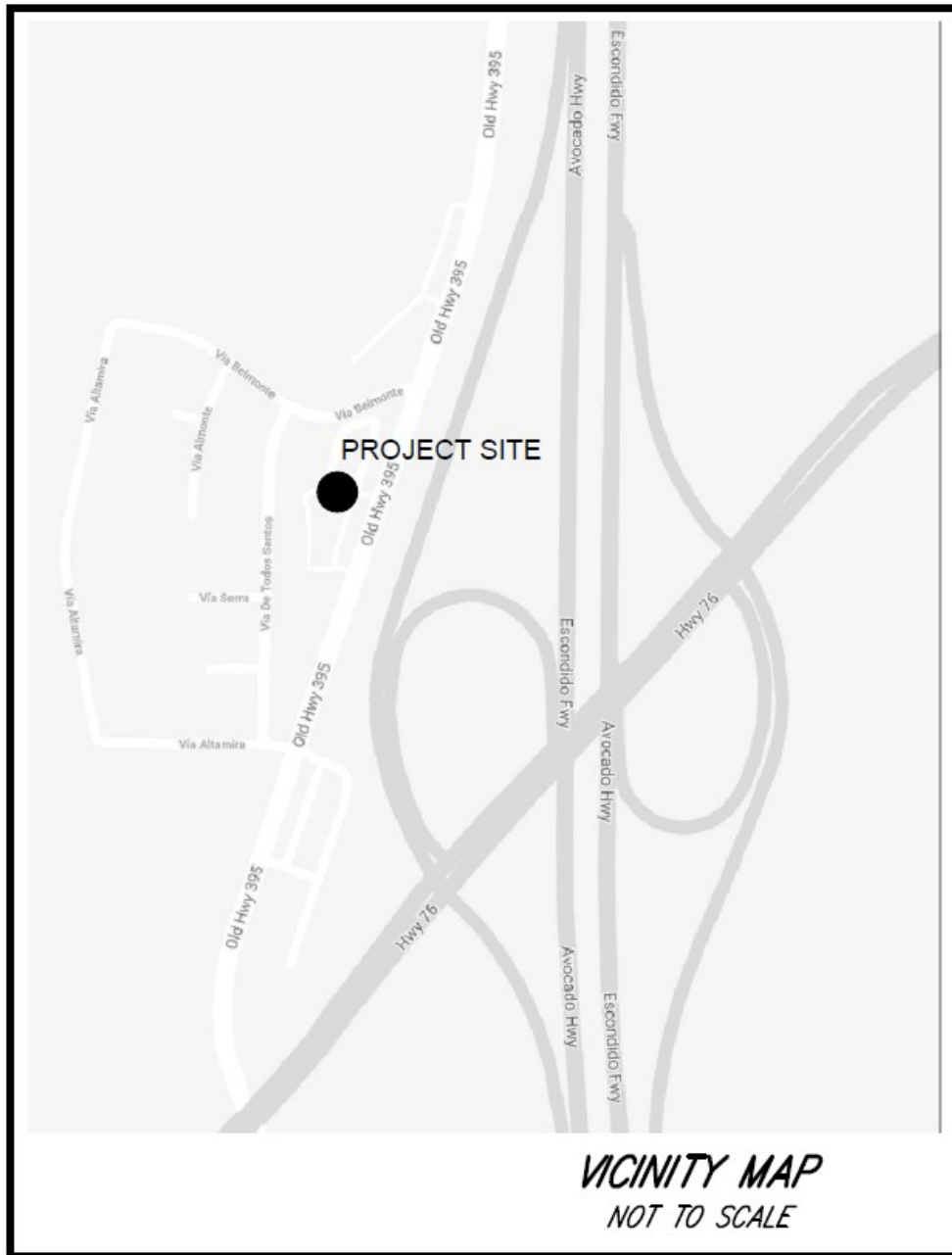
1.2 Project Description

The site is an existing low-density commercial site composed of a small grocery store market, a small hamburger restaurant, and an existing operating landscape nursery. The project fronts onto old highway 395 which bounds the project to the east.

The project proposes to retain the two existing buildings, add two new retail buildings near the northern portion of the site, and add a third convenience store building near the southern point of the site. The convenience store will include a six-pump fuel island. Along with the newly constructed buildings, the project proposes to add reconfigured parking spaces, drive isles and various patio areas and walkways throughout the site. The project will have two access points to Old Highway 395.

2.0 VICINITY MAP

The project is located on the western side of Old Highway 395 just north of the intersection of Interstate 15 and Highway 76 Pala Road, in the county of San Diego, California.



3.0 DESCRIPTION OF WATERSHED

3.1 Pre-Development Topography and Drainage Patterns

The site is an existing low-density commercial site composed of a small grocery store market, a small hamburger restaurant, and an existing operating landscape nursery. The project fronts onto old highway 395 which bounds the project to the east. The project is bounded by Via De Todos Santos to the west, and Via Belmonte to the north. The property drains primarily by overland flow to an existing drain inlet located at about the mid north/south point near the easterly boundary of the site along Old Highway 395. The site is relatively level with a small 2:1 cut slope forming the rear of the property where it meets grade with Via De Todos Santos. According to the Web Soil Survey, the western 25% property is composed of Soils Type A (along the cut slope). The remainder of the property is Soil Type C. The site is well traveled, and compaction of topsoil is estimated to be high. The same runoff factors will be used for the overall project calculations.

The approximately average percentage of impervious of the existing site condition was estimated based on aerial photography and detailed aerial topographic mapping. The approximately average percentage of impervious of the existing site condition is 30%. From Table 3-1 “RUNOFF COEFFICIENTS FOR URBAN AREA”, values of runoff coefficient “C” for 30% impervious are used in the pre-development **onsite** runoff calculations. **The Runoff Coefficient C value is chosen based on the percentage of impervious of the entire site.**

There is a drainage pipe that crosses the site and meets the on-site discharge at the onsite drain inlet at the POC. The drainpipe conveys the discharge of a portion of Via Todos Santos and the tributary offsite area of approximately 5 acres of the neighboring residential subdivision. The approximately average percentage of impervious of this offsite drainage area is 40%. From table 3-1 values of runoff coefficient “C” for 40% impervious are used in the pre-development **offsite** pass-through drainage calculations.

A pre-developed drainage map can be found as Attachment 2 in this report.

3.2 Post-Development Topography and Drainage Patterns

The project proposes to retain the two existing buildings and add two new retail buildings near the northern portion of the site, and a third convenience store building near the southern point of the site. The convenience store will include a six-pump fuel island. Along with the additional new buildings the project proposes to add reconfigured parking spaces, drive isles and various patio areas and walkways throughout the site. The project will have two access points to Old Highway 395.

The project proposed to install several biofiltration basins for storm water quality to incorporate the collection of storm water from the building and parking lot and

direct the storm water through storm water drainage pipes to POC, which is located at the east edge of the study site.

The average impervious square footage of the post-development was estimated based on aerial photography and detailed aerial topographic mapping to be approximately 80% of the site. From table 3-1 “RUNOFF COEFFICIENTS FOR URBAN AREAS”, runoff coefficients for 80% impervious will be used in the post-development runoff calculations.

A post-developed drainage map can be found as Attachment 2 in this report.

At node 107, the proposed connection to the public storm drain system, the flows provide an increase in runoff of 0.391 cfs, therefore, BMP-802 is being used for the peak flow detention. After mitigation, the flows at this proposed connection to the public storm system decreased by 1.378 cfs. Please see the mitigation calculations in Attachment 3g and Hydrograph report in Attachment 5 in this report.

3.3 Hydrologic Unit Contribution

The project is located in the Bonsall Hydrologic Sub Area of the Lower San Luis Rey Hydrologic Area of the San Luis Rey Hydrologic Unit (903.12). The project is tributary to a public storm drain system that discharges to the San Luis Rey River.

A map showing the project location with respect to the hydrologic basin areas can be found in Attachment 2 in this report.

4.0 METHODOLOGY

This report is prepared in accordance with the 2003 San Diego County Hydrology Manual (Hydrology Manual). Based on the overall tributary study area, calculations are based on the Rational Method.

4.1 Hydrology Software

The main program is the “San Diego County Rational Hydrology Program” by CIVILCADD/CIVILDESIGN Engineering Software, 1991-2004 Version 7.4, refereed hereafter as “CIVILD”. This program specifically utilizes the methods prescribed in the County of San Diego Hydrology Manual and is one of the approved programs for the use in the San Diego area.

4.2 Routing Software

Hydraflow Hydrographs Extension for Autodesk Civil 3D, Version 2021 is used for hydrologic routing of the entire project site. The hydrograph developed from the rational method is then manually entered into this software and routed into detention system. The hydrograph report can be found in Attachment 5 in this

report.

4.3 Soils Type Determination

The soils type for the project was determined by mapping the project limits on the EPA Web Soil Survey website. The Web Soil Survey indicates that the entire site is composed of soil types A and C. By observation, Appendix A of the Hydrology Manual supports the use of these two soil types in the calculations.

4.4 Isopluvial Value Determination

The isopluvial values for the 100-year 6 hour and 24-hour storm events were determined by plotting the project's location on the respective exhibits from Appendix B of the Hydrology Manual.

4.5 CEQA Requirements

The proposed project would not substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site. No significant alteration of any stream or river will occur on this site due to grading operations. All defined drainage channels are due to erosive effects of high velocity runoff from the uphill slopes. The development of the site will help mitigate further erosion downstream.

- The proposed project does not create or contribute runoff water which would exceed the capacity of existing or planned storm water drainage systems. The flows from the project leave the site at less than predeveloped rates per the mitigated flow rates shown.
- The proposed project does not place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map, including County Floodplain Maps. No housing is proposed, and no FIRM identified flood hazard areas are located on the parcel.
- The proposed project does not place structures within a 100-year flood hazard area which would impede or redirect flood flows. No FIRM identified flood hazard areas are located on the parcel.
- The proposed project does not expose people or structures to a significant risk of loss, injury or death involving flooding as a result of the failure of a levee or dam. No levees or dams are proposed, and all runoff is being mitigated in properly designed flow control basins with redundancies. This will be noted in the conclusion.

5.0 CALCULATIONS

5.1 Determination of Drainage Area Parameters

The drainage area parameters are determined by delineating the extents and flow direction of runoff from each of the pre and post development drainage areas and measuring the respective changes in elevation, flow length and drainage area acreage. See Attachments 1 and 2 of this report for the respective drainage area exhibits.

5.2 Runoff Coefficient

The runoff coefficients for each of the drainage areas are taken from Table 3-1 of the Hydrology Manual. Based on the EPA Web Soil Survey, this project site is type A and type C soil. The runoff coefficients C are based on the %IMPER. for this project. The runoff coefficients for each of the drainage areas are taken from Table 3-1 of the San Diego County Hydrology Manual. For this project, the approximately average percent of impervious of the post development is 80%.

Table 3-1 is included in the CIVILD software, and the values chosen based on the program input parameters. The output file was checked to ensure that the correct C values are used.

In order to not have a negative impact on the post development downstream facilities, detention structure is needed in this project. The method we are using here on how to use the resulting values of the outflow hydrograph is recalculate the runoff coefficient C value based on fix values of the outflow hydrograph to achieve a C_{out} . The detailed description and calculation of the C_{out} value can be found in Attachment 5 in this report.

5.3 Manning Roughness Coefficient

Three values for the Manning Roughness Coefficient are used in the hydrology calculations. One for the overland flow travel time calculations, second for the pipe flow friction factor, and third for the street section/gutter flow calculations.

For the closed conduit calculations, the value for the roughness coefficient is taken from the Hydraulic Design Manual Table A-2. It is assumed that pipe material of Smooth Plastic Pipe (HPDE and PVC), Spiral Rib Pipe, Reinforced Concrete Pipe (RCP), or a similar material will be used on the project. The Manning's n factor for this class of pipe material is 0.013.

For the paved street surfaces and the gutter flow calculations, a value of 0.013 is used. This is taken from the hydraulic design manual, Table A-1 and Table A-3.

5.4 Rational Method Calculation Summary

The peak runoff values for the 100-year storm are calculated according to the Hydrology Manual rational method. The calculations are performed using the CivilD software. A summary of the initial calculations is summarized in the table below:

Summary Table of Drainage discharges from the Project							
	Node Number	Q100** (cfs)	Area (Acres)	Tc (Min)	V100 (ft/s)	C*	I* (in/hr)
PRE	POC Node 406	34.46	11.192	9.26	19.5	0.5	6.2
POST	POC Node 109	34.17	11.192	9.34	19.34	0.5	6.16
POST MITIGATION	POC Node 109	32.795	11.192	9.33	21.43	0.48	6.17

Table 1: Q-100 Analysis Results

Note: The comparison of our analysis is made about the same discharge points for the project. Drainage discharging from the project to the existing 18 inches pipe.

Note:

*Average rainfall intensity is calculated based on $I = 7.44 * P_6 T_c^{-0.645}$. Average runoff coefficient "C" is calculated based on $Q = CIA$.

** The total discharge here include the public road improvements.

Summary of Post Unmitigated Flows at Each BMP

Basin Node	Area (Acres)	Q100 (cfs)
BMP-103 Node-103	1.020	3.125
BMP-201 Node-202	0.540	4.183
BMP-302 Node-302	0.310	2.230
BMP-401 Node-402	0.180	1.295
BMP-503 Node-503	0.566	2.554
BMP-602 Node-602	0.170	1.223
BMP-702 Node-702	0.320	1.743
BMP-802 Node-802	0.970	2.674

Table 2: Q-100 flows at each basin node

Per Table 1 (see above) the post development flow of 34.17 cfs is lower than the pre-development flow of 34.46 cfs.

CivilD data and output files can be found in Attachment 3 of this report.

By observation of the results in the summary table, the proposed redevelopment of the site will have an overall decrease in the 100-year peak flow discharge from the site.

6.0 CONCLUSION

Based on the results of this report, the project does not increase the 100-year peak flow rate of the mitigated stormwater discharge from the site as flows are lower than those of the Pre-development. The project meets the County of San Diego standards for peak flow control and therefore can be concluded that this project will not impact the existing downstream storm drainage facilities.

This project does not sit within a 100-year flood hazard zone as mapped on the federal Flood Insurance Rate maps for this area.

- The proposed project would not substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site. No significant alteration of any stream or river will occur on this site due to grading

operations. All defined drainage channels are due to erosive effects of high velocity runoff from the uphill slopes. The development of the site will help mitigate further erosion downstream.

- The proposed project does not create or contribute runoff water which would exceed the capacity of existing or planned storm water drainage systems. The flows from the project leave the site at less than predeveloped rates per the mitigated flow rates shown.
- The proposed project does not place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map, including County Floodplain Maps. No housing is proposed, and no FIRM identified flood hazard areas are located on the parcel.
- The proposed project does not place structures within a 100-year flood hazard area which would impede or redirect flood flows. No FIRM identified flood hazard areas are located on the parcel.
- The proposed project does not expose people or structures to a significant risk of loss, injury or death involving flooding as a result of the failure of a levee or dam. No levees or dams are proposed, and all runoff is being mitigated in properly designed flow control basins with redundancies. This will be noted in the conclusion.

7.0 REFERENCES

County of San Diego Hydrology Manual, June 2003
San Diego County Hydraulic Design Manual, September 2014

8.0 Declaration of Responsible Charge

I hereby declare that I am the 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 codes, and that the design is consistent with current design.

I understand that the check of the project drawings and specifications by the City of San Marcos is confined to a review only and does not relieve me, as engineer of work, of my responsibilities for project design.

ENGINEER OF WORK

Excel Engineering
440 State Place
Escondido, CA 92029
Tel — (760)745-8118
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Project Number: 19-025



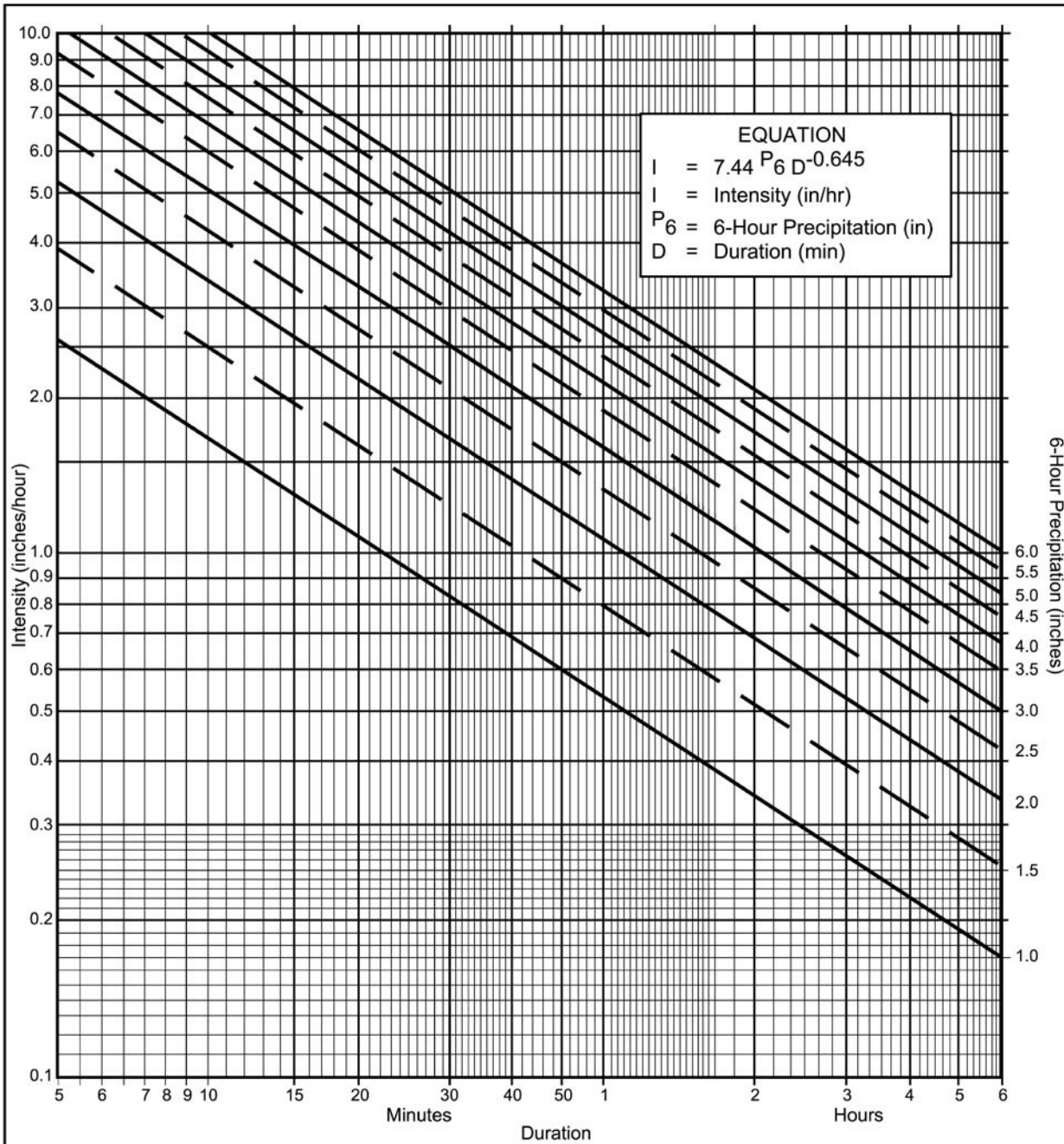


Robert D. Dentino, RCE 45629
Registration Expire: December 31, 2024

4/07/23

Date

ATTACHMENT 1



Directions for Application:

- (1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).
- (2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicable to Desert).
- (3) Plot 6 hr precipitation on the right side of the chart.
- (4) Draw a line through the point parallel to the plotted lines.
- (5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

- (a) Selected frequency _____ year
- (b) $P_6 =$ _____ in., $P_{24} =$ _____, $\frac{P_6}{P_{24}} =$ _____ %⁽²⁾
- (c) Adjusted $P_6^{(2)} =$ _____ in.
- (d) $t_x =$ _____ min.
- (e) $I =$ _____ in./hr.

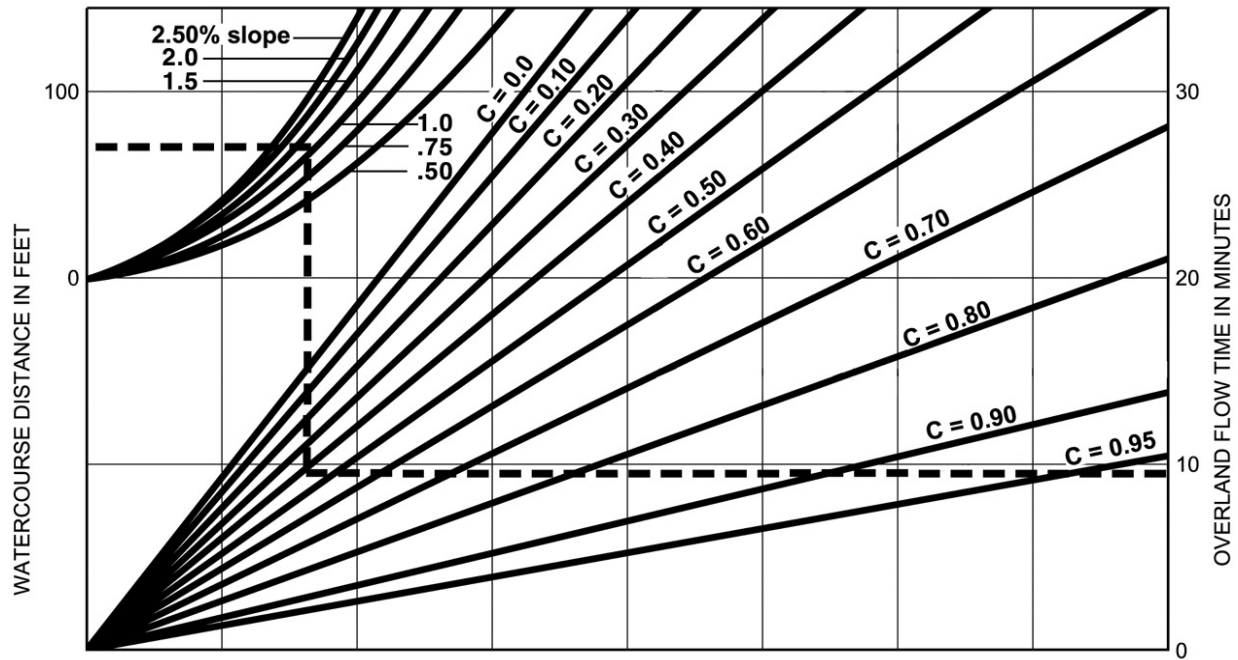
Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE

3-1



EXAMPLE:

Given: Watercourse Distance (D) = 70 Feet
 Slope (s) = 1.3%
 Runoff Coefficient (C) = 0.41
 Overland Flow Time (T) = 9.5 Minutes

$$T = \frac{1.8 (1.1-C) \sqrt{D}}{\sqrt[3]{s}}$$

SOURCE: Airport Drainage, Federal Aviation Administration, 1965

FIGURE

Rational Formula - Overland Time of Flow Nomograph

3-3

**Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS**

Land Use		Runoff Coefficient "C"				
		% IMPER.	Soil Type			
NRCS Elements	County Elements			A	B	C
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

Table 3-2

**MAXIMUM OVERLAND FLOW LENGTH (L_M)
& INITIAL TIME OF CONCENTRATION (T_i)**

Element*	DU/ Acre	.5%		1%		2%		3%		5%		10%	
		L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i
Natural		50	13.2	70	12.5	85	10.9	100	10.3	100	8.7	100	6.9
LDR	1	50	12.2	70	11.5	85	10.0	100	9.5	100	8.0	100	6.4
LDR	2	50	11.3	70	10.5	85	9.2	100	8.8	100	7.4	100	5.8
LDR	2.9	50	10.7	70	10.0	85	8.8	95	8.1	100	7.0	100	5.6
MDR	4.3	50	10.2	70	9.6	80	8.1	95	7.8	100	6.7	100	5.3
MDR	7.3	50	9.2	65	8.4	80	7.4	95	7.0	100	6.0	100	4.8
MDR	10.9	50	8.7	65	7.9	80	6.9	90	6.4	100	5.7	100	4.5
MDR	14.5	50	8.2	65	7.4	80	6.5	90	6.0	100	5.4	100	4.3
HDR	24	50	6.7	65	6.1	75	5.1	90	4.9	95	4.3	100	3.5
HDR	43	50	5.3	65	4.7	75	4.0	85	3.8	95	3.4	100	2.7
N. Com		50	5.3	60	4.5	75	4.0	85	3.8	95	3.4	100	2.7
G. Com		50	4.7	60	4.1	75	3.6	85	3.4	90	2.9	100	2.4
O.P./Com		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
Limited I.		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
General I.		50	3.7	60	3.2	70	2.7	80	2.6	90	2.3	100	1.9

*See Table 3-1 for more detailed description

Table A-2 Average Manning Roughness Coefficients for Closed Conduits³

Reinforced Concrete Pipe (RCP)	0.013
Corrugated Metal Pipe and Pipe Arch	
2-3/8 x 1/2 inch Corrugations	
Unlined	0.024
Half Lined	
Full Flow	0.018
d/D ≥ 0.60	0.016
d/D < 0.60	0.013
Fully Lined	0.013
3 x 1 inch Corrugations	0.027
6 x 2 inch Corrugations	0.032
Spiral Rib Pipe	0.013
Helically Wound Pipe	
18-inch	0.015
24-inch	0.017
30-inch	0.019
36-inch	0.021
42-inch	0.022
48-inch	0.023
Plastic Pipe (HPDE and PVC)	
Smooth	0.013
Corrugated	0.024
Vitrified Clay Pipe	0.014
Cast-Iron Pipe (Uncoated)	0.013
Steel Pipe	0.011
Brick	0.017
Cast-In-Place Concrete Pipe	
Rough Wood Forms	0.017
Smooth Wood or Steel Forms	0.014

³ Based on materials and workmanship required by standard specifications.

Table A-5

Table A-5 Average Manning Roughness Coefficients for Natural Channels

Minor Streams (Surface Width at Flood Stage < 100 ft)

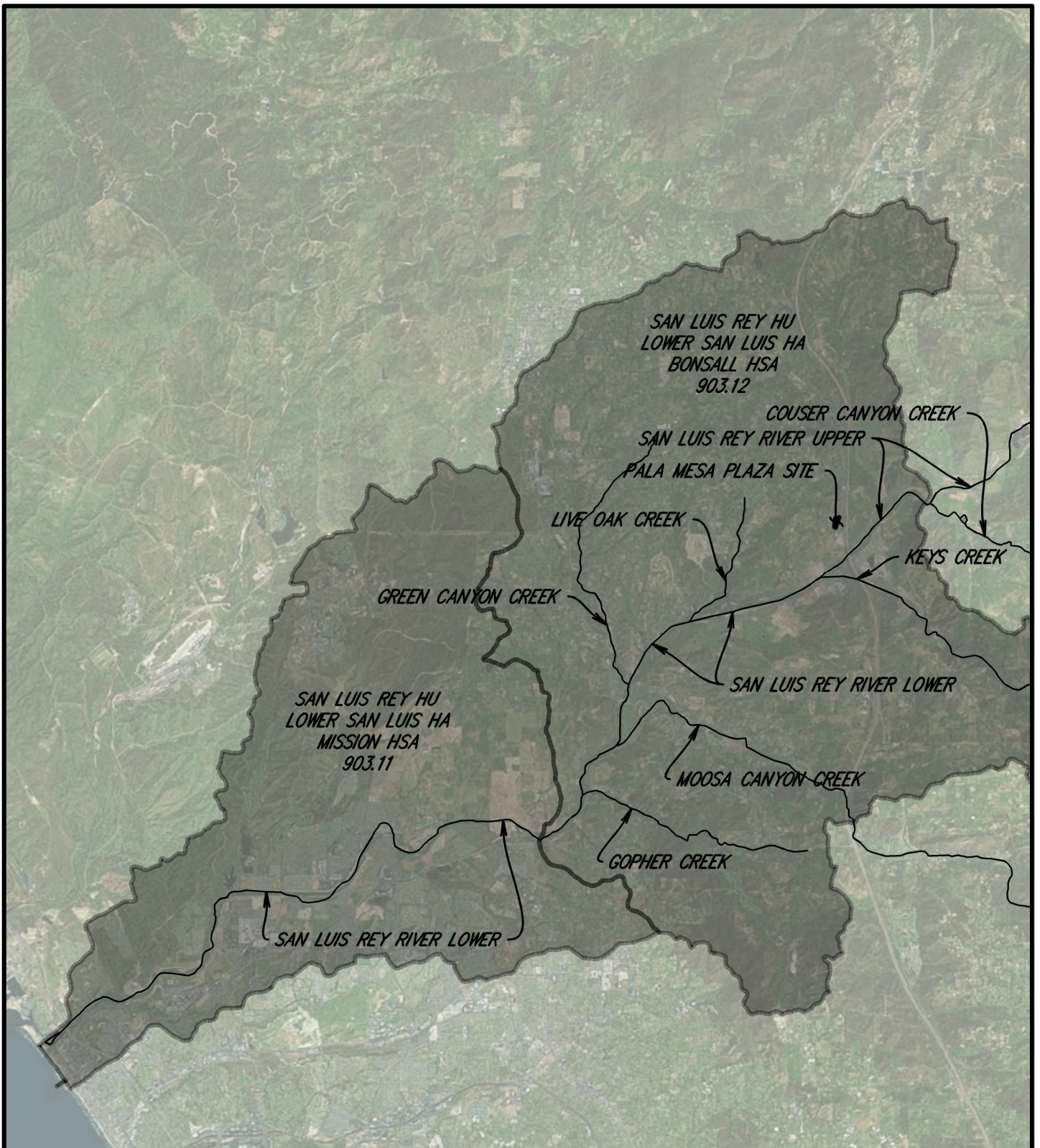
Fairly Regular Section

(A) Some Grass and Weeds, Little or No Brush	0.030
(B) Dense Growth of Weeds, Depth of Flow Materially Greater Than Weed Height.....	0.040
(C) Some Weeds, Light Brush on Banks	0.040
(D) Some Weeds, Heavy Brush on Banks.....	0.060
(E) For Trees within Channel with Branches Submerged at High Stage, Increase All Above Values By.....	0.015
Irregular Section, with Pools, Slight Channel Meander	
Channels (A) to (E) Above, Increase All Values By	0.015
Mountain Streams; No Vegetation in Channel, Banks Usually Steep, Trees and Brush along Banks Submerged at High Stage	
(A) Bottom, Gravel, Cobbles and Few Boulders	0.050
(B) Bottom, Cobbles with Large Boulders	0.060

Flood Plains (Adjacent To Natural Streams)

Pasture, No Brush	
(A) Short Grass.....	0.030
(B) High Grass.....	0.040
Cultivated Areas	
(A) No Crop.....	0.040
(B) Mature Row Crops.....	0.040
(C) Mature Field Crops	0.050
Heavy Weeds, Scattered Brush	0.050
Light Brush and Trees.....	0.060
Medium To Dense Brush	0.090
Dense Willows.....	0.170
Cleared Land with Tree Stumps, 100-150 Per Acre	0.060
Heavy Stand of Timber, Little Undergrowth	
(A) Flood Depth below Branches	0.110
(B) Flood Depth Reaches Branches.....	0.140

ATTACHMENT 2



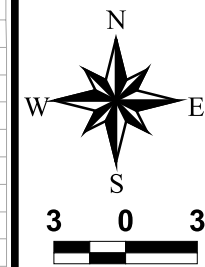
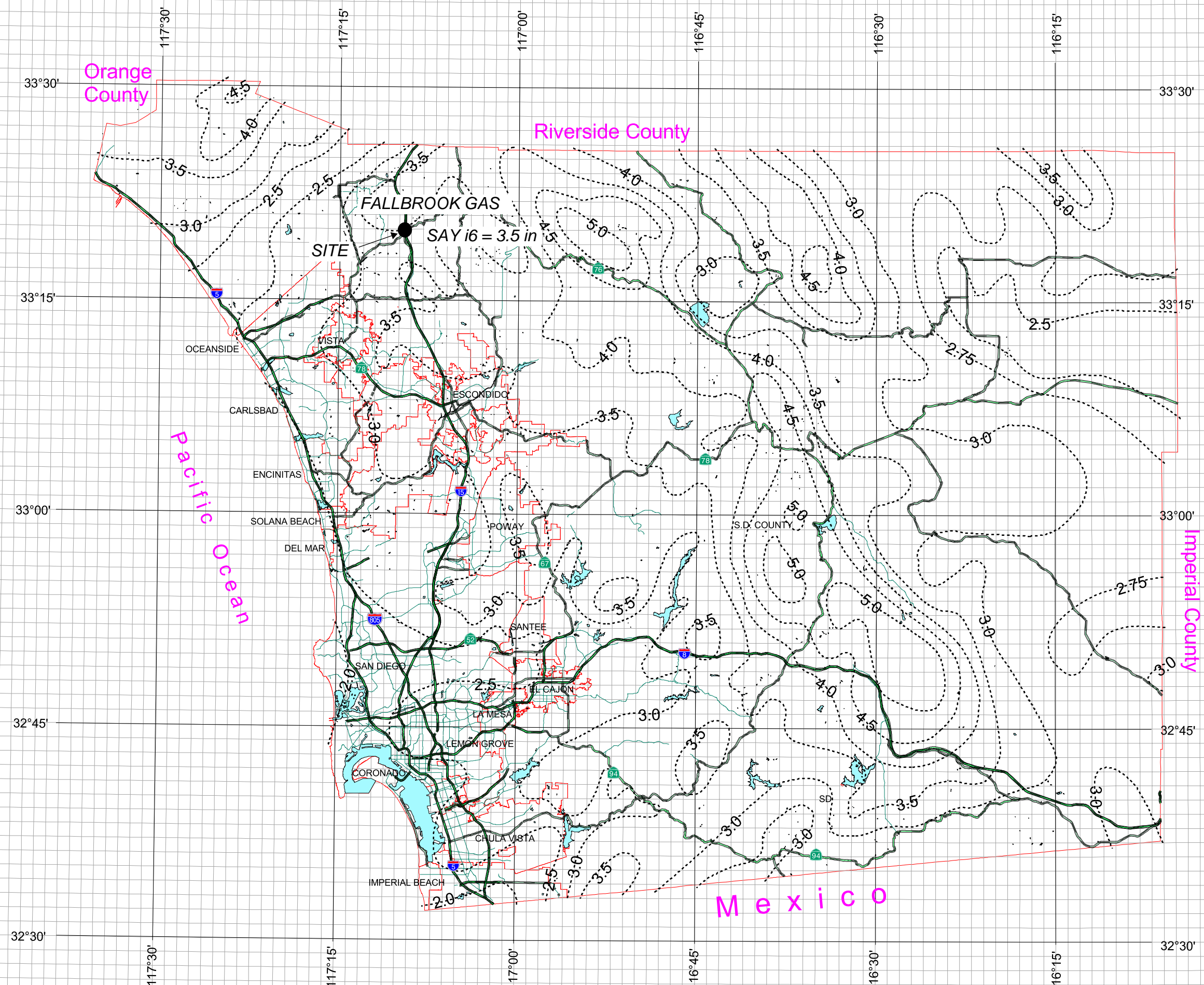
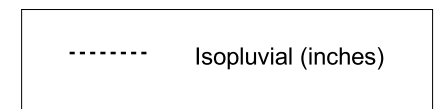
*PALA MESA PLAZA
HYDROLOGIC AREAS*

County of San Diego Hydrology Manual



Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours



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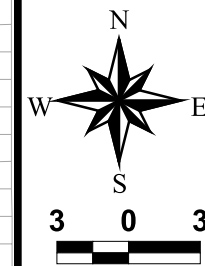
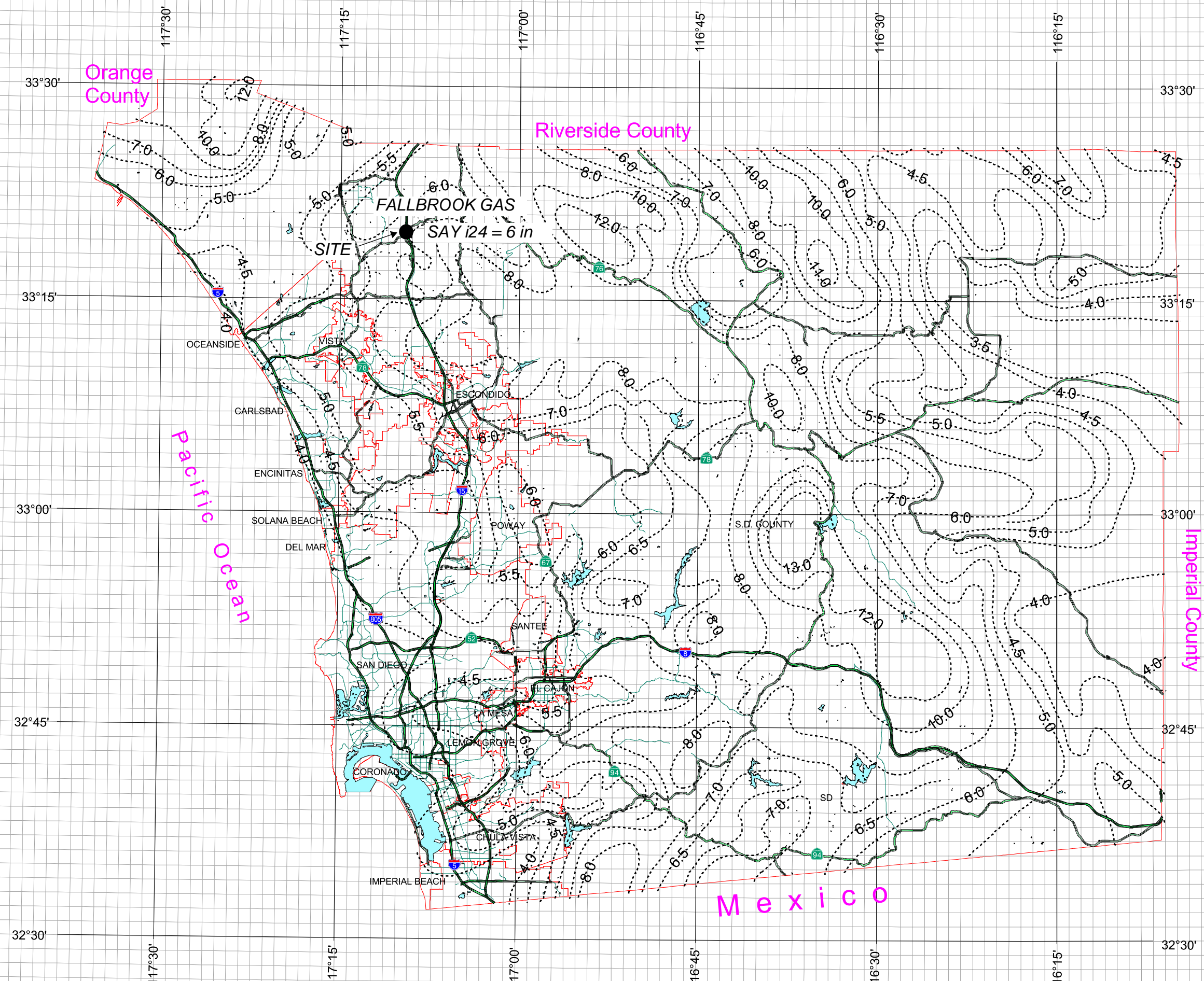
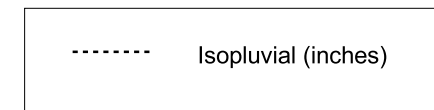
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County of San Diego Hydrology Manual



Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours



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Hydrologic Soil Group—San Diego County Area, California
(19025 Location)



Soil Map may not be valid at this scale.

Map Scale: 1:1,640 if printed on A portrait (8.5" x 11") sheet.



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.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL:
 Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: San Diego County Area, California
 Survey Area Data: Version 14, Sep 16, 2019

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—Oct 22, 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
GrC	Greenfield sandy loam, 5 to 9 percent slopes	A	0.9	19.7%
RaB	Ramona sandy loam, 2 to 5 percent slopes	C	3.5	80.3%
Totals for Area of Interest			4.4	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

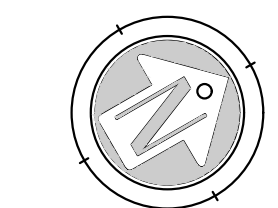
Tie-break Rule: Higher



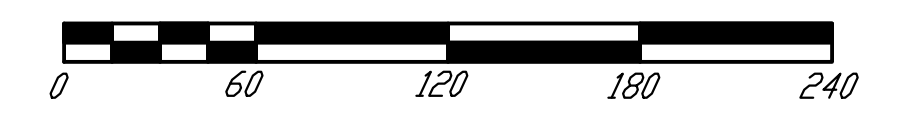
LEGEND

HYD BASIN BOUNDARY	-----
NODE NUMBER	(101)
SURFACE FLOW	----->
PIPE FLOW	----->
STREET FLOW	----->

HYDROLOGIC SOIL GROUP
 THE HYDROLOGIC SOIL GROUPS FOR THIS SITE ARE TYPE (A & C)
 NOTE: APPROXIMATE DEPTH TO GROUNDWATER IS GREATER THAN 20'

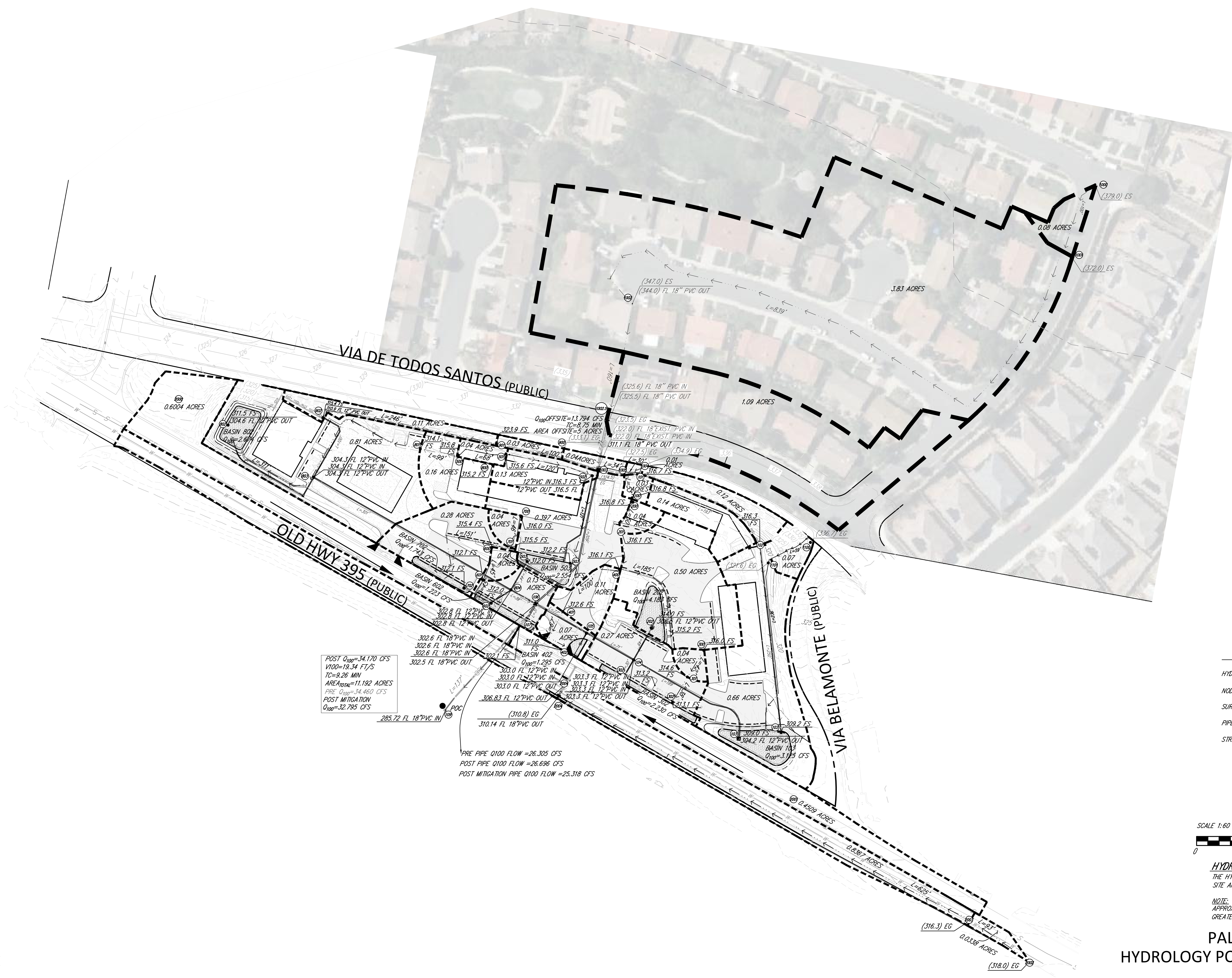


SCALE: 1:60



PALA MESA PLAZA
HYDROLOGY PRE DEVELOPMENT EXHIBIT

K:\19\19025\Engineering\SDP\SDP_01\Storm\Working Files\Hyd\19025-PostDev-current-adjusted200609.dwg 6/13/2023 1:11 PM ORIGINAL PLOT SIZE: -----

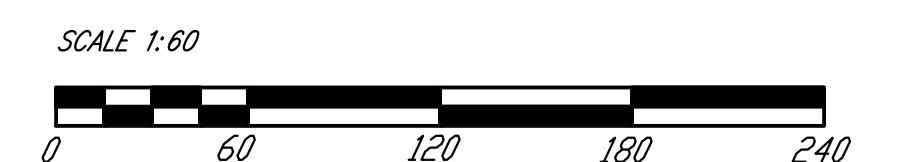
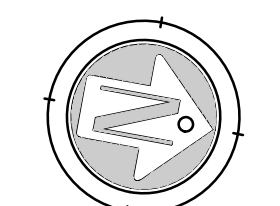


POST Q_{100} = 34.170 CFS
 V_{100} = 19.34 FT/S
 TC = 9.26 MIN
 $AREA_{100}$ = 11.192 ACRES
 $PRE Q_{100}$ = 34.460 CFS
 POST MITIGATION
 Q_{100} = 32.795 CFS

PRE PIPE Q_{100} FLOW = 26.305 CFS
 POST PIPE Q_{100} FLOW = 26.696 CFS
 POST MITIGATION PIPE Q_{100} FLOW = 25.318 CFS

LEGEND

- HYD BASIN BOUNDARY
- NODE NUMBER
- SURFACE FLOW
- PIPE FLOW
- STREET FLOW



HYDROLOGIC SOIL GROUP
THE HYDROLOGIC SOIL GROUPS FOR THIS SITE ARE TYPE (A & C)

NOTE:
APPROXIMATE DEPTH TO GROUNDWATER IS GREATER THAN 20'

**PALA MESA PLAZA
HYDROLOGY POST DEVELOPMENT EXHIBIT**

ATTACHMENT 3

3a. CivilD Pre-Development Calculations

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software, (c)1991-2014 Version 9.0

Rational method hydrology program based on
San Diego County Flood Control Division 2003 hydrology manual
Rational Hydrology Study Date: 05/25/23

19025 Pre Dev
100 Year Study Onsite
19025Pre100Onsite
offsite ud to onsite

***** Hydrology Study Control Information *****

Program License Serial Number 6332

Rational hydrology study storm event year is 100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour, precipitation(inches) = 3.500
24 hour precipitation(inches) = 6.000
P6/P24 = 58.3%
San Diego hydrology manual 'C' values used

Process from Point/Station 101.000 to Point/Station 102.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.900
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.100
Decimal fraction soil group D = 0.000
[MEDIUM DENSITY RESIDENTIAL]
(4.3 DU/A or Less)
Impervious value, Ai = 0.300
Sub-Area C Value = 0.417
Initial subarea total flow distance = 100.000 (Ft.)
Highest elevation = 337.500 (Ft.)
Lowest elevation = 319.900 (Ft.)
Elevation difference = 17.600 (Ft.) Slope = 17.600 %
Top of Initial Area Slope adjusted by User to 30.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 30.00 %, in a development type of
4.3 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration = 3.96 minutes
TC = $[1.8 * (1.1 - C) * \text{distance (Ft.)}^{.5} / (\% \text{ slope}^{(1/3)})]$
TC = $[1.8 * (1.1 - 0.4170) * (100.000^{.5}) / (30.000^{(1/3)})] = 3.96$
Calculated TC of 3.957 minutes is less than 5 minutes,
resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) = 9.222 (In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.417
Subarea runoff = 0.769 (CFS)
Total initial stream area = 0.200 (Ac.)

Process from Point/Station 102.000 to Point/Station 103.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

```

70 Estimated mean flow rate at midpoint of channel = 4.801 (CFS)
71 Depth of flow = 0.279 (Ft.), Average velocity = 2.471 (Ft/s)
72 ***** Irregular Channel Data *****
73 -----
74 Information entered for subchannel number 1 :
75 Point number 'X' coordinate 'Y' coordinate
76 1 0.00 1.00
77 2 25.00 0.00
78 3 50.00 1.00
79 Manning's 'N' friction factor = 0.030
80 -----
81 Sub-Channel flow = 4.801 (CFS)
82 ' ' flow top width = 13.939 (Ft.)
83 ' ' velocity = 2.471 (Ft/s)
84 ' ' area = 1.943 (Sq.Ft)
85 ' ' Froude number = 1.166
86
87 Upstream point elevation = 319.900 (Ft.)
88 Downstream point elevation = 308.700 (Ft.)
89 Flow length = 325.000 (Ft.)
90 Travel time = 2.19 min.
91 Time of concentration = 6.15 min.
92 Depth of flow = 0.279 (Ft.)
93 Average velocity = 2.471 (Ft/s)
94 Total irregular channel flow = 4.801 (CFS)
95 Irregular channel normal depth above invert elev. = 0.279 (Ft.)
96 Average velocity of channel(s) = 2.471 (Ft/s)
97 Adding area flow to channel
98 Rainfall intensity (I) = 8.070 (In/Hr) for a 100.0 year storm
99 Decimal fraction soil group A = 0.200
100 Decimal fraction soil group B = 0.000
101 Decimal fraction soil group C = 0.800
102 Decimal fraction soil group D = 0.000
103 [MEDIUM DENSITY RESIDENTIAL ]
104 (4.3 DU/A or Less )
105 Impervious value, Ai = 0.300
106 Sub-Area C Value = 0.466
107 Rainfall intensity = 8.070 (In/Hr) for a 100.0 year storm
108 Effective runoff coefficient used for total area
109 (Q=KCIA) is C = 0.462 CA = 1.085
110 Subarea runoff = 7.989 (CFS) for 2.150 (Ac.)
111 Total runoff = 8.758 (CFS) Total area = 2.350 (Ac.)
112 Depth of flow = 0.349 (Ft.), Average velocity = 2.871 (Ft/s)
113
114
115 +-----+
116 Process from Point/Station 103.000 to Point/Station 103.000
117 **** CONFLUENCE OF MINOR STREAMS ****
118
119 -----
119 Along Main Stream number: 1 in normal stream number 1
120 Stream flow area = 2.350 (Ac.)
121 Runoff from this stream = 8.758 (CFS)
122 Time of concentration = 6.15 min.
123 Rainfall intensity = 8.070 (In/Hr)
124
125
126 +-----+
127 Process from Point/Station 201.000 to Point/Station 202.000
128 **** INITIAL AREA EVALUATION ****
129
130 -----
130 Decimal fraction soil group A = 0.550
131 Decimal fraction soil group B = 0.000
132 Decimal fraction soil group C = 0.450
133 Decimal fraction soil group D = 0.000
134 [MEDIUM DENSITY RESIDENTIAL ]
135 (4.3 DU/A or Less )
136 Impervious value, Ai = 0.300
137 Sub-Area C Value = 0.442
138 Initial subarea total flow distance = 100.000 (Ft.)

```

```

139 Highest elevation = 326.000 (Ft.)
140 Lowest elevation = 313.000 (Ft.)
141 Elevation difference = 13.000 (Ft.) Slope = 13.000 %
142 Top of Initial Area Slope adjusted by User to 30.000 %
143 INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
144 The maximum overland flow distance is 100.00 (Ft)
145 for the top area slope value of 30.00 %, in a development type of
146 4.3 DU/A or Less
147 In Accordance With Figure 3-3
148 Initial Area Time of Concentration = 3.81 minutes
149  $TC = [1.8 * (1.1 - C) * distance (Ft.)^{.5} / (% slope^{(1/3)})]$ 
150  $TC = [1.8 * (1.1 - 0.4415) * (100.000^{.5}) / (30.000^{(1/3)})] = 3.81$ 
151 Calculated TC of 3.815 minutes is less than 5 minutes,
152 resetting TC to 5.0 minutes for rainfall intensity calculations
153 Rainfall intensity (I) = 9.222 (In/Hr) for a 100.0 year storm
154 Effective runoff coefficient used for area (Q=KCIA) is C = 0.442
155 Subarea runoff = 0.896 (CFS)
156 Total initial stream area = 0.220 (Ac.)
157
158
159 ++++++
160 Process from Point/Station 202.000 to Point/Station 103.000
161 **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
162
163 -----
164 Estimated mean flow rate at midpoint of channel = 3.343 (CFS)
165 Depth of flow = 0.306 (Ft.), Average velocity = 1.425 (Ft/s)
166 ***** Irregular Channel Data *****
167 -----
168 Information entered for subchannel number 1 :
169 Point number 'X' coordinate 'Y' coordinate
170 1 0.00 1.00
171 2 25.00 0.00
172 3 50.00 1.00
173 Manning's 'N' friction factor = 0.030
174 -----
175 Sub-Channel flow = 3.343 (CFS)
176 ' ' flow top width = 15.314 (Ft.)
177 ' ' velocity = 1.425 (Ft/s)
178 ' ' area = 2.345 (Sq.Ft)
179 ' ' Froude number = 0.642
180
181 Upstream point elevation = 313.000 (Ft.)
182 Downstream point elevation = 308.700 (Ft.)
183 Flow length = 425.000 (Ft.)
184 Travel time = 4.97 min.
185 Time of concentration = 8.78 min.
186 Depth of flow = 0.306 (Ft.)
187 Average velocity = 1.425 (Ft/s)
188 Total irregular channel flow = 3.343 (CFS)
189 Irregular channel normal depth above invert elev. = 0.306 (Ft.)
190 Average velocity of channel(s) = 1.425 (Ft/s)
191 Adding area flow to channel
192 Rainfall intensity (I) = 6.411 (In/Hr) for a 100.0 year storm
193 Decimal fraction soil group A = 0.200
194 Decimal fraction soil group B = 0.000
195 Decimal fraction soil group C = 0.800
196 Decimal fraction soil group D = 0.000
197 [MEDIUM DENSITY RESIDENTIAL ]
198 (4.3 DU/A or Less )
199 Impervious value, Ai = 0.300
200 Sub-Area C Value = 0.466
201 Rainfall intensity = 6.411 (In/Hr) for a 100.0 year storm
202 Effective runoff coefficient used for total area
203 (Q=KCIA) is C = 0.463 CA = 0.889
204 Subarea runoff = 4.806 (CFS) for 1.700 (Ac.)
205 Total runoff = 5.702 (CFS) Total area = 1.920 (Ac.)
206 Depth of flow = 0.374 (Ft.), Average velocity = 1.629 (Ft/s)
207

```


208 ++++++

209 Process from Point/Station 103.000 to Point/Station 103.000

210 **** CONFLUENCE OF MINOR STREAMS ****

211

212 Along Main Stream number: 1 in normal stream number 2

213 Stream flow area = 1.920 (Ac.)

214 Runoff from this stream = 5.702 (CFS)

215 Time of concentration = 8.78 min.

216 Rainfall intensity = 6.411 (In/Hr)

217

218

219 ++++++

220 Process from Point/Station 305.000 to Point/Station 305.000

221 **** USER DEFINED FLOW INFORMATION AT A POINT ****

222

223 Decimal fraction soil group A = 1.000

224 Decimal fraction soil group B = 0.000

225 Decimal fraction soil group C = 0.000

226 Decimal fraction soil group D = 0.000

227 [MEDIUM DENSITY RESIDENTIAL]

228 (7.3 DU/A or Less)

229 Impervious value, Ai = 0.400

230 Sub-Area C Value = 0.480

231 Rainfall intensity (I) = 6.428 (In/Hr) for a 100.0 year storm

232 User specified values are as follows:

233 TC = 8.75 min. Rain intensity = 6.43 (In/Hr)

234 Total area = 5.000 (Ac.) Total runoff = 13.794 (CFS)

235

236

237 ++++++

238 Process from Point/Station 305.000 to Point/Station 103.000

239 **** PIPEFLOW TRAVEL TIME (User specified size) ****

240

241 Upstream point/station elevation = 311.100 (Ft.)

242 Downstream point/station elevation = 302.200 (Ft.)

243 Pipe length = 208.00 (Ft.) Slope = 0.0428 Manning's N = 0.013

244 No. of pipes = 1 Required pipe flow = 13.794 (CFS)

245 Given pipe size = 12.00 (In.)

246 NOTE: Normal flow is pressure flow in user selected pipe size.

247 The approximate hydraulic grade line above the pipe invert is

248 29.453 (Ft.) at the headworks or inlet of the pipe(s)

249 Pipe friction loss = 31.169 (Ft.)

250 Minor friction loss = 7.185 (Ft.) K-factor = 1.50

251 Pipe flow velocity = 17.56 (Ft/s)

252 Travel time through pipe = 0.20 min.

253 Time of concentration (TC) = 8.95 min.

254

255

256 ++++++

257 Process from Point/Station 103.000 to Point/Station 103.000

258 **** CONFLUENCE OF MINOR STREAMS ****

259

260 Along Main Stream number: 1 in normal stream number 3

261 Stream flow area = 5.000 (Ac.)

262 Runoff from this stream = 13.794 (CFS)

263 Time of concentration = 8.95 min.

264 Rainfall intensity = 6.336 (In/Hr)

265 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	8.758	6.15	8.070
2	5.702	8.78	6.411
3	13.794	8.95	6.336
Qmax(1) =			
	1.000 *	1.000 *	8.758) +
	1.000 *	0.700 *	5.702) +

```

277      1.000 *      0.687 *      13.794) + =      22.229
278 Qmax (2) =
279      0.794 *      1.000 *      8.758) +
280      1.000 *      1.000 *      5.702) +
281      1.000 *      0.982 *      13.794) + =      26.203
282 Qmax (3) =
283      0.785 *      1.000 *      8.758) +
284      0.988 *      1.000 *      5.702) +
285      1.000 *      1.000 *      13.794) + =      26.305

```

```

287 Total of 3 streams to confluence:
288 Flow rates before confluence point:
289      8.758      5.702      13.794
290 Maximum flow rates at confluence using above data:
291      22.229      26.203      26.305
292 Area of streams before confluence:
293      2.350      1.920      5.000

```

```

294 Results of confluence:
295 Total flow rate =      26.305 (CFS)
296 Time of concentration =      8.947 min.
297 Effective stream area after confluence =      9.270 (Ac.)

```

```

300 +-----+
301 Process from Point/Station      103.000 to Point/Station      309.000
302 **** PIPEFLOW TRAVEL TIME (User specified size) ****

```

```

304 Upstream point/station elevation =      302.200 (Ft.)
305 Downstream point/station elevation =      301.800 (Ft.)
306 Pipe length =      27.00 (Ft.) Slope =      0.0148 Manning's N = 0.013
307 No. of pipes = 1 Required pipe flow =      26.305 (CFS)
308 Given pipe size =      18.00 (In.)
309 NOTE: Normal flow is pressure flow in user selected pipe size.
310 The approximate hydraulic grade line above the pipe invert is
311      6.454 (Ft.) at the headworks or inlet of the pipe(s)
312 Pipe friction loss =      1.693 (Ft.)
313 Minor friction loss =      5.161 (Ft.) K-factor =      1.50
314 Pipe flow velocity =      14.89 (Ft/s)
315 Travel time through pipe =      0.03 min.
316 Time of concentration (TC) =      8.98 min.

```

```

319 +-----+
320 Process from Point/Station      309.000 to Point/Station      406.000
321 **** PIPEFLOW TRAVEL TIME (User specified size) ****

```

```

323 Upstream point/station elevation =      301.800 (Ft.)
324 Downstream point/station elevation =      285.720 (Ft.)
325 Pipe length =      137.00 (Ft.) Slope =      0.1174 Manning's N = 0.013
326 No. of pipes = 1 Required pipe flow =      26.305 (CFS)
327 Given pipe size =      18.00 (In.)
328 Calculated individual pipe flow =      26.305 (CFS)
329 Normal flow depth in pipe =      11.43 (In.)
330 Flow top width inside pipe =      17.33 (In.)
331 Critical depth could not be calculated.
332 Pipe flow velocity =      22.23 (Ft/s)
333 Travel time through pipe =      0.10 min.
334 Time of concentration (TC) =      9.08 min.

```

```

337 +-----+
338 Process from Point/Station      406.000 to Point/Station      406.000
339 **** CONFLUENCE OF MINOR STREAMS ****

```

```

341 Along Main Stream number: 1 in normal stream number 1
342 Stream flow area =      9.270 (Ac.)
343 Runoff from this stream =      26.305 (CFS)
344 Time of concentration =      9.08 min.
345 Rainfall intensity =      6.276 (In/Hr)

```

```

346
347
348 ++++++
349 Process from Point/Station      403.000 to Point/Station      404.000
350 **** INITIAL AREA EVALUATION ****
351
352 -----
353 Decimal fraction soil group A = 0.000
354 Decimal fraction soil group B = 0.000
355 Decimal fraction soil group C = 1.000
356 Decimal fraction soil group D = 0.000
357 [COMMERCIAL area type                ]
358 (General Commercial      )
359 Impervious value, Ai = 0.850
360 Sub-Area C Value = 0.810
361 Initial subarea total flow distance = 94.000 (Ft.)
362 Highest elevation = 318.000 (Ft.)
363 Lowest elevation = 316.300 (Ft.)
364 Elevation difference = 1.700 (Ft.) Slope = 1.809 %
365 Top of Initial Area Slope adjusted by User to 1.400 %
366 INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
367 The maximum overland flow distance is 60.00 (Ft)
368 for the top area slope value of 1.40 %, in a development type of
369 General Commercial
370 In Accordance With Figure 3-3
371 Initial Area Time of Concentration = 3.61 minutes
372 TC = [1.8*(1.1-C)*distance (Ft.)^.5]/(% slope^(1/3)]
373 TC = [1.8*(1.1-0.8100)*( 60.000^.5)/( 1.400^(1/3)]= 3.61
374 Calculated TC of 3.614 minutes is less than 5 minutes,
375 resetting TC to 5.0 minutes for rainfall intensity calculations
376 Rainfall intensity (I) = 9.222 (In/Hr) for a 100.0 year storm
377 Effective runoff coefficient used for area (Q=KCIA) is C = 0.810
378 Subarea runoff = 0.254 (CFS)
379 Total initial stream area = 0.034 (Ac.)
380
381 ++++++
382 Process from Point/Station      404.000 to Point/Station      405.000
383 **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
384
385 -----
386 Estimated mean flow rate at midpoint of channel = 2.197 (CFS)
387 Depth of flow = 0.242 (Ft.), Average velocity = 1.791 (Ft/s)
388 ***** Irregular Channel Data *****
389 -----
390 Information entered for subchannel number 1 :
391 Point number      'X' coordinate      'Y' coordinate
392 1                0.00                0.31
393 2                26.00               0.13
394 3                27.50               0.00
395 4                27.50               0.50
396 Manning's 'N' friction factor = 0.013
397 -----
398 Sub-Channel flow = 2.197 (CFS)
399 ' ' flow top width = 17.814 (Ft.)
400 ' ' velocity= 1.791 (Ft/s)
401 ' ' area = 1.227 (Sq.Ft)
402 ' ' Froude number = 1.203
403
404 Upstream point elevation = 316.300 (Ft.)
405 Downstream point elevation = 310.800 (Ft.)
406 Flow length = 621.000 (Ft.)
407 Travel time = 5.78 min.
408 Time of concentration = 9.39 min.
409 Depth of flow = 0.242 (Ft.)
410 Average velocity = 1.791 (Ft/s)
411 Total irregular channel flow = 2.197 (CFS)
412 Irregular channel normal depth above invert elev. = 0.242 (Ft.)
413 Average velocity of channel(s) = 1.791 (Ft/s)
414 Adding area flow to channel
415 Rainfall intensity (I) = 6.140 (In/Hr) for a 100.0 year storm

```

415 User specified 'C' value of 0.762 given for subarea
 416 Rainfall intensity = 6.140(In/Hr) for a 100.0 year storm
 417 Effective runoff coefficient used for total area
 418 (Q=KCIA) is C = 0.764 CA = 0.665
 419 Subarea runoff = 3.831(CFS) for 0.837(Ac.)
 420 Total runoff = 4.085(CFS) Total area = 0.871(Ac.)
 421 Depth of flow = 0.279(Ft.), Average velocity = 2.078(Ft/s)

424 ++++++
 425 Process from Point/Station 401.000 to Point/Station 406.000
 426 **** SUBAREA FLOW ADDITION ****

428 Rainfall intensity (I) = 6.140(In/Hr) for a 100.0 year storm
 429 Decimal fraction soil group A = 0.100
 430 Decimal fraction soil group B = 0.000
 431 Decimal fraction soil group C = 0.900
 432 Decimal fraction soil group D = 0.000
 433 [MEDIUM DENSITY RESIDENTIAL]
 434 (14.5 DU/A or Less)
 435 Impervious value, Ai = 0.500
 436 Sub-Area C Value = 0.595
 437 Time of concentration = 9.39 min.
 438 Rainfall intensity = 6.140(In/Hr) for a 100.0 year storm
 439 Effective runoff coefficient used for total area
 440 (Q=KCIA) is C = 0.695 CA = 1.022
 441 Subarea runoff = 2.192(CFS) for 0.600(Ac.)
 442 Total runoff = 6.277(CFS) Total area = 1.471(Ac.)

445 ++++++
 446 Process from Point/Station 402.000 to Point/Station 406.000
 447 **** SUBAREA FLOW ADDITION ****

449 Rainfall intensity (I) = 6.140(In/Hr) for a 100.0 year storm
 450 Decimal fraction soil group A = 0.000
 451 Decimal fraction soil group B = 0.000
 452 Decimal fraction soil group C = 1.000
 453 Decimal fraction soil group D = 0.000
 454 [COMMERCIAL area type]
 455 (Neighborhood Commercial)
 456 Impervious value, Ai = 0.800
 457 Sub-Area C Value = 0.780
 458 Time of concentration = 9.39 min.
 459 Rainfall intensity = 6.140(In/Hr) for a 100.0 year storm
 460 Effective runoff coefficient used for total area
 461 (Q=KCIA) is C = 0.715 CA = 1.374
 462 Subarea runoff = 2.160(CFS) for 0.451(Ac.)
 463 Total runoff = 8.437(CFS) Total area = 1.922(Ac.)

466 ++++++
 467 Process from Point/Station 406.000 to Point/Station 406.000
 468 **** CONFLUENCE OF MINOR STREAMS ****

470 Along Main Stream number: 1 in normal stream number 2
 471 Stream flow area = 1.922(Ac.)
 472 Runoff from this stream = 8.437(CFS)
 473 Time of concentration = 9.39 min.
 474 Rainfall intensity = 6.140(In/Hr)
 475 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	26.305	9.08	6.276
2	8.437	9.39	6.140

483 Qmax(1) =

484 1.000 * 1.000 * 26.305) +
 485 1.000 * 0.967 * 8.437) + = 34.460
 486 Qmax (2) =
 487 0.978 * 1.000 * 26.305) +
 488 1.000 * 1.000 * 8.437) + = 34.172
 489

490 Total of 2 streams to confluence:
 491 Flow rates before confluence point:
 492 26.305 8.437

493 Maximum flow rates at confluence using above data:
 494 34.460 34.172

495 Area of streams before confluence:
 496 9.270 1.922

497 Results of confluence:
 498 Total flow rate = 34.460 (CFS)
 499 Time of concentration = 9.080 min.
 500 Effective stream area after confluence = 11.192 (Ac.)
 501

502
 503 ++++++
 504 Process from Point/Station 405.000 to Point/Station 406.000
 505 **** PIPEFLOW TRAVEL TIME (User specified size) ****
 506

507 Upstream point/station elevation = 306.830 (Ft.)
 508 Downstream point/station elevation = 285.720 (Ft.)
 509 Pipe length = 211.00 (Ft.) Slope = 0.1000 Manning's N = 0.013
 510 No. of pipes = 1 Required pipe flow = 34.460 (CFS)
 511 Given pipe size = 18.00 (In.)
 512 NOTE: Normal flow is pressure flow in user selected pipe size.
 513 The approximate hydraulic grade line above the pipe invert is
 514 10.448 (Ft.) at the headworks or inlet of the pipe(s)
 515 Pipe friction loss = 22.700 (Ft.)
 516 Minor friction loss = 8.857 (Ft.) K-factor = 1.50
 517 Critical depth could not be calculated.
 518 Pipe flow velocity = 19.50 (Ft/s)
 519 Travel time through pipe = 0.18 min.
 520 Time of concentration (TC) = 9.26 min.
 521 End of computations, total study area = 11.192 (Ac.)
 522
 523
 524

3b. CivilD Pre-Development Offsite Calculations

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2014 Version 9.0

Rational method hydrology program based on
San Diego County Flood Control Division 2003 hydrology manual
Rational Hydrology Study Date: 01/20/21

19025 Pre Dev
100 Year Study Offsite
19025Pre1000ffsite.rd3

***** Hydrology Study Control Information *****

Program License Serial Number 6332

Rational hydrology study storm event year is 100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour, precipitation(inches) = 3.500
24 hour precipitation(inches) = 6.000
P6/P24 = 58.3%
San Diego hydrology manual 'C' values used

Process from Point/Station 301.000 to Point/Station 302.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[MEDIUM DENSITY RESIDENTIAL]
(7.3 DU/A or Less)
Impervious value, Ai = 0.400
Sub-Area C Value = 0.480
Initial subarea total flow distance = 100.000(Ft.)
Highest elevation = 379.000(Ft.)
Lowest elevation = 372.000(Ft.)
Elevation difference = 7.000(Ft.) Slope = 7.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 7.00 %, in a development type of
7.3 DU/A or Less
In Accordance With Table 3-2
Initial Area Time of Concentration = 6.00 minutes
(for slope value of 5.00 %)
Rainfall intensity (I) = 8.198(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.480
Subarea runoff = 0.315(CFS)
Total initial stream area = 0.080(Ac.)

Process from Point/Station 302.000 to Point/Station 303.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Estimated mean flow rate at midpoint of channel = 5.468(CFS)
Depth of flow = 0.404(Ft.), Average velocity = 5.574(Ft/s)
***** Irregular Channel Data *****

```

70 Information entered for subchannel number 1 :
71 Point number      'X' coordinate      'Y' coordinate
72     1              0.00              2.71
73     2              31.00              0.13
74     3              32.50              0.00
75     4              32.50              0.50
76 Manning's 'N' friction factor = 0.015
77 -----
78 Sub-Channel flow = 5.468(CFS)
79 ' ' flow top width = 4.851(Ft.)
80 ' ' velocity= 5.574(Ft/s)
81 ' ' area = 0.981(Sq.Ft)
82 ' ' Froude number = 2.184
83
84 Upstream point elevation = 372.000(Ft.)
85 Downstream point elevation = 347.000(Ft.)
86 Flow length = 839.000(Ft.)
87 Travel time = 2.51 min.
88 Time of concentration = 8.51 min.
89 Depth of flow = 0.404(Ft.)
90 Average velocity = 5.574(Ft/s)
91 Total irregular channel flow = 5.468(CFS)
92 Irregular channel normal depth above invert elev. = 0.404(Ft.)
93 Average velocity of channel(s) = 5.574(Ft/s)
94 Adding area flow to channel
95 Rainfall intensity (I) = 6.545(In/Hr) for a 100.0 year storm
96 Decimal fraction soil group A = 1.000
97 Decimal fraction soil group B = 0.000
98 Decimal fraction soil group C = 0.000
99 Decimal fraction soil group D = 0.000
100 [MEDIUM DENSITY RESIDENTIAL ]
101 (4.3 DU/A or Less )
102 Impervious value, Ai = 0.300
103 Sub-Area C Value = 0.410
104 Rainfall intensity = 6.545(In/Hr) for a 100.0 year storm
105 Effective runoff coefficient used for total area
106 (Q=KCIA) is C = 0.411 CA = 1.609
107 Subarea runoff = 10.213(CFS) for 3.830(Ac.)
108 Total runoff = 10.528(CFS) Total area = 3.910(Ac.)
109 Depth of flow = 0.517(Ft.), Average velocity = 6.574(Ft/s)
110
111
112 +-----+
113 Process from Point/Station 303.000 to Point/Station 304.000
114 **** PIPEFLOW TRAVEL TIME (User specified size) ****
115
116 Upstream point/station elevation = 344.000(Ft.)
117 Downstream point/station elevation = 325.600(Ft.)
118 Pipe length = 160.00(Ft.) Slope = 0.1150 Manning's N = 0.013
119 No. of pipes = 1 Required pipe flow = 10.528(CFS)
120 Given pipe size = 18.00(In.)
121 Calculated individual pipe flow = 10.528(CFS)
122 Normal flow depth in pipe = 6.70(In.)
123 Flow top width inside pipe = 17.40(In.)
124 Critical Depth = 14.96(In.)
125 Pipe flow velocity = 17.55(Ft/s)
126 Travel time through pipe = 0.15 min.
127 Time of concentration (TC) = 8.66 min.
128
129
130 +-----+
131 Process from Point/Station 304.000 to Point/Station 304.000
132 **** SUBAREA FLOW ADDITION ****
133
134 Rainfall intensity (I) = 6.470(In/Hr) for a 100.0 year storm
135 Decimal fraction soil group A = 1.000
136 Decimal fraction soil group B = 0.000
137 Decimal fraction soil group C = 0.000
138 Decimal fraction soil group D = 0.000

```


139 [MEDIUM DENSITY RESIDENTIAL]
140 (7.3 DU/A or Less)
141 Impervious value, Ai = 0.400
142 Sub-Area C Value = 0.480
143 Time of concentration = 8.66 min.
144 Rainfall intensity = 6.470(In/Hr) for a 100.0 year storm
145 Effective runoff coefficient used for total area
146 (Q=KCIA) is C = 0.426 CA = 2.132
147 Subarea runoff = 3.266(CFS) for 1.090(Ac.)
148 Total runoff = 13.794(CFS) Total area = 5.000(Ac.)
149
150

151 ++++++
152 Process from Point/Station 304.000 to Point/Station 305.000
153 **** PIPEFLOW TRAVEL TIME (User specified size) ****
154

155 Upstream point/station elevation = 325.500(Ft.)
156 Downstream point/station elevation = 322.000(Ft.)
157 Pipe length = 71.00(Ft.) Slope = 0.0493 Manning's N = 0.013
158 No. of pipes = 1 Required pipe flow = 13.794(CFS)
159 Given pipe size = 18.00(In.)
160 Calculated individual pipe flow = 13.794(CFS)
161 Normal flow depth in pipe = 9.96(In.)
162 Flow top width inside pipe = 17.90(In.)
163 Critical Depth = 16.50(In.)
164 Pipe flow velocity = 13.75(Ft/s)
165 Travel time through pipe = 0.09 min.
166 Time of concentration (TC) = 8.75 min.
167 End of computations, total study area = 5.000 (Ac.)
168
169
170

**3c. CivilD Post Development Onsite Reach 1
Calculations**

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2014 Version 9.0

Rational method hydrology program based on
San Diego County Flood Control Division 2003 hydrology manual
Rational Hydrology Study Date: 12/15/21

19025 Post Dev
100 Year Study Reach 1
PostDev100R1.rd3
2021.12.15 Update

***** Hydrology Study Control Information *****

Program License Serial Number 6332

Rational hydrology study storm event year is 100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour, precipitation(inches) = 3.500
24 hour precipitation(inches) = 6.000
P6/P24 = 58.3%
San Diego hydrology manual 'C' values used

Process from Point/Station 100.000 to Point/Station 101.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[MEDIUM DENSITY RESIDENTIAL]
(7.3 DU/A or Less)
Impervious value, Ai = 0.400
Sub-Area C Value = 0.480
Initial subarea total flow distance = 53.000(Ft.)
Highest elevation = 316.800(Ft.)
Lowest elevation = 316.700(Ft.)
Elevation difference = 0.100(Ft.) Slope = 0.189 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 50.00 (Ft)
for the top area slope value of 0.19 %, in a development type of
7.3 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration = 13.75 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^{.5}/(% slope^(1/3))]
TC = [1.8*(1.1-0.4800)*(50.000^{.5})/(0.189^(1/3))] = 13.75
The initial area total distance of 53.00 (Ft.) entered leaves a
remaining distance of 3.00 (Ft.)
Using Figure 3-4, the travel time for this distance is 0.20 minutes
for a distance of 3.00 (Ft.) and a slope of 0.19 %
with an elevation difference of 0.01(Ft.) from the end of the top area
Tt = [11.9*length(Mi)³/(elevation change(Ft.))]^{.385} *60(min/hr)
= 0.203 Minutes
Tt=[(11.9*0.0006³)/(0.01)]^{.385}= 0.20
Total initial area Ti = 13.75 minutes from Figure 3-3 formula plus
0.20 minutes from the Figure 3-4 formula = 13.95 minutes
Rainfall intensity (I) = 4.757(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.480
Subarea runoff = 0.068(CFS)

```

70 Total initial stream area = 0.030(Ac.)
71
72
73 *****
74 Process from Point/Station 101.000 to Point/Station 102.000
75 **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
76
77 -----
78 Estimated mean flow rate at midpoint of channel = 0.228(CFS)
79 Depth of flow = 0.095(Ft.), Average velocity = 0.591(Ft/s)
80 ***** Irregular Channel Data *****
81 -----
82 Information entered for subchannel number 1 :
83 Point number 'X' coordinate 'Y' coordinate
84 1 0.00 0.33
85 2 23.00 0.00
86 3 28.50 0.33
87 Manning's 'N' friction factor = 0.015
88 -----
89 Sub-Channel flow = 0.228(CFS)
90 ' ' flow top width = 8.130(Ft.)
91 ' ' velocity = 0.591(Ft/s)
92 ' ' area = 0.386(Sq.Ft)
93 ' ' Froude number = 0.478
94
95 Upstream point elevation = 316.700(Ft.)
96 Downstream point elevation = 316.300(Ft.)
97 Flow length = 193.000(Ft.)
98 Travel time = 5.44 min.
99 Time of concentration = 19.39 min.
100 Depth of flow = 0.095(Ft.)
101 Average velocity = 0.591(Ft/s)
102 Total irregular channel flow = 0.228(CFS)
103 Irregular channel normal depth above invert elev. = 0.095(Ft.)
104 Average velocity of channel(s) = 0.591(Ft/s)
105 Adding area flow to channel
106 Rainfall intensity (I) = 3.847(In/Hr) for a 100.0 year storm
107 Decimal fraction soil group A = 1.000
108 Decimal fraction soil group B = 0.000
109 Decimal fraction soil group C = 0.000
110 Decimal fraction soil group D = 0.000
111 [MEDIUM DENSITY RESIDENTIAL ]
112 (7.3 DU/A or Less )
113 Impervious value, Ai = 0.400
114 Sub-Area C Value = 0.480
115 Rainfall intensity = 3.847(In/Hr) for a 100.0 year storm
116 Effective runoff coefficient used for total area
117 (Q=KCIA) is C = 0.480 CA = 0.082
118 Subarea runoff = 0.245(CFS) for 0.140(Ac.)
119 Total runoff = 0.314(CFS) Total area = 0.170(Ac.)
120 Depth of flow = 0.107(Ft.), Average velocity = 0.640(Ft/s)
121
122 *****
123 Process from Point/Station 102.000 to Point/Station 102.000
124 **** SUBAREA FLOW ADDITION ****
125
126 -----
127 Rainfall intensity (I) = 3.847(In/Hr) for a 100.0 year storm
128 Decimal fraction soil group A = 1.000
129 Decimal fraction soil group B = 0.000
130 Decimal fraction soil group C = 0.000
131 Decimal fraction soil group D = 0.000
132 [LOW DENSITY RESIDENTIAL ]
133 (1.0 DU/A or Less )
134 Impervious value, Ai = 0.100
135 Sub-Area C Value = 0.270
136 Time of concentration = 19.39 min.
137 Rainfall intensity = 3.847(In/Hr) for a 100.0 year storm
138 Effective runoff coefficient used for total area
139 (Q=KCIA) is C = 0.393 CA = 0.114

```

139 Subarea runoff = 0.125(CFS) for 0.120(Ac.)
140 Total runoff = 0.439(CFS) Total area = 0.290(Ac.)
141
142

143 *****
144 Process from Point/Station 102.000 to Point/Station 103.000
145 **** PIPEFLOW TRAVEL TIME (User specified size) ****
146

147 Upstream point/station elevation = 310.200(Ft.)
148 Downstream point/station elevation = 309.000(Ft.)
149 Pipe length = 250.00(Ft.) Slope = 0.0048 Manning's N = 0.013
150 No. of pipes = 1 Required pipe flow = 0.439(CFS)
151 Given pipe size = 12.00(In.)
152 Calculated individual pipe flow = 0.439(CFS)
153 Normal flow depth in pipe = 3.42(In.)
154 Flow top width inside pipe = 10.84(In.)
155 Critical Depth = 3.28(In.)
156 Pipe flow velocity = 2.37(Ft/s)
157 Travel time through pipe = 1.76 min.
158 Time of concentration (TC) = 21.15 min.
159
160

161 *****
162 Process from Point/Station 103.000 to Point/Station 103.000
163 **** CONFLUENCE OF MINOR STREAMS ****
164

165 Along Main Stream number: 1 in normal stream number 1
166 Stream flow area = 0.290(Ac.)
167 Runoff from this stream = 0.439(CFS)
168 Time of concentration = 21.15 min.
169 Rainfall intensity = 3.637(In/Hr)
170
171

172 *****
173 Process from Point/Station 1100.000 to Point/Station 1101.000
174 **** INITIAL AREA EVALUATION ****
175

176 Decimal fraction soil group A = 1.000
177 Decimal fraction soil group B = 0.000
178 Decimal fraction soil group C = 0.000
179 Decimal fraction soil group D = 0.000
180 [LOW DENSITY RESIDENTIAL]
181 (1.0 DU/A or Less)
182 Impervious value, Ai = 0.100
183 Sub-Area C Value = 0.270
184 Initial subarea total flow distance = 59.000(Ft.)
185 Highest elevation = 336.700(Ft.)
186 Lowest elevation = 321.600(Ft.)
187 Elevation difference = 15.100(Ft.) Slope = 25.593 %
188 INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
189 The maximum overland flow distance is 100.00 (Ft)
190 for the top area slope value of 25.59 %, in a development type of
191 1.0 DU/A or Less
192 In Accordance With Figure 3-3
193 Initial Area Time of Concentration = 5.07 minutes
194 $TC = [1.8 * (1.1 - C) * distance(Ft.)^{0.5} / (% slope^{1/3})]$
195 $TC = [1.8 * (1.1 - 0.2700) * (100.000^{0.5}) / (25.593^{1/3})] = 5.07$
196 Rainfall intensity (I) = 9.140(In/Hr) for a 100.0 year storm
197 Effective runoff coefficient used for area (Q=KCIA) is C = 0.270
198 Subarea runoff = 0.173(CFS)
199 Total initial stream area = 0.070(Ac.)
200
201

202 *****
203 Process from Point/Station 1101.000 to Point/Station 103.000
204 **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
205

206 Estimated mean flow rate at midpoint of channel = 1.544(CFS)
207 Depth of flow = 0.128(Ft.), Average velocity = 3.658(Ft/s)

```

208          ***** Irregular Channel Data *****
209          -----
210 Information entered for subchannel number 1 :
211 Point number      'X' coordinate      'Y' coordinate
212      1              0.00              0.60
213      2              16.00             0.00
214      3              46.00             1.20
215 Manning's 'N' friction factor = 0.015
216          -----
217 Sub-Channel flow = 1.544(CFS)
218 ' ' flow top width = 6.605(Ft.)
219 ' ' velocity= 3.658(Ft/s)
220 ' ' area = 0.422(Sq.Ft)
221 ' ' Froude number = 2.549
222
223 Upstream point elevation = 321.600(Ft.)
224 Downstream point elevation = 309.000(Ft.)
225 Flow length = 236.000(Ft.)
226 Travel time = 1.08 min.
227 Time of concentration = 6.15 min.
228 Depth of flow = 0.128(Ft.)
229 Average velocity = 3.658(Ft/s)
230 Total irregular channel flow = 1.544(CFS)
231 Irregular channel normal depth above invert elev. = 0.128(Ft.)
232 Average velocity of channel(s) = 3.658(Ft/s)
233 Adding area flow to channel
234 Rainfall intensity (I) = 8.073(In/Hr) for a 100.0 year storm
235 Decimal fraction soil group A = 0.100
236 Decimal fraction soil group B = 0.000
237 Decimal fraction soil group C = 0.900
238 Decimal fraction soil group D = 0.000
239 [MEDIUM DENSITY RESIDENTIAL ]
240 (7.3 DU/A or Less )
241 Impervious value, Ai = 0.400
242 Sub-Area C Value = 0.534
243 Rainfall intensity = 8.073(In/Hr) for a 100.0 year storm
244 Effective runoff coefficient used for total area
245 (Q=KCIA) is C = 0.509 CA = 0.371
246 Subarea runoff = 2.825(CFS) for 0.660(Ac.)
247 Total runoff = 2.998(CFS) Total area = 0.730(Ac.)
248 Depth of flow = 0.164(Ft.), Average velocity = 4.317(Ft/s)
249
250
251 +-----+
252 Process from Point/Station 103.000 to Point/Station 103.000
253 **** CONFLUENCE OF MINOR STREAMS ****
254
255 -----
256 Along Main Stream number: 1 in normal stream number 2
257 Stream flow area = 0.730(Ac.)
258 Runoff from this stream = 2.998(CFS)
259 Time of concentration = 6.15 min.
260 Rainfall intensity = 8.073(In/Hr)
261 Summary of stream data:
262
263 Stream No. Flow rate (CFS) TC (min) Rainfall Intensity (In/Hr)
264
265
266 1 0.439 21.15 3.637
267 2 2.998 6.15 8.073
268 Qmax(1) =
269 1.000 * 1.000 * 0.439) +
270 0.451 * 1.000 * 2.998) + = 1.789
271 Qmax(2) =
272 1.000 * 0.291 * 0.439) +
273 1.000 * 1.000 * 2.998) + = 3.125
274
275 Total of 2 streams to confluence:
276 Flow rates before confluence point:

```

```

277         0.439         2.998
278 Maximum flow rates at confluence using above data:
279         1.789         3.125
280 Area of streams before confluence:
281         0.290         0.730
282 Results of confluence:
283 Total flow rate =         3.125(CFS)
284 Time of concentration =         6.145 min.
285 Effective stream area after confluence =         1.020(Ac.)
286
287
288 *****
289 Process from Point/Station         103.000 to Point/Station         104.000
290 **** PIPEFLOW TRAVEL TIME (User specified size) ****
291
292 Upstream point/station elevation =         304.200(Ft.)
293 Downstream point/station elevation =         303.300(Ft.)
294 Pipe length =         189.00(Ft.) Slope =         0.0048 Manning's N =         0.013
295 No. of pipes =         1 Required pipe flow =         3.125(CFS)
296 Given pipe size =         18.00(In.)
297 Calculated individual pipe flow =         3.125(CFS)
298 Normal flow depth in pipe =         8.26(In.)
299 Flow top width inside pipe =         17.94(In.)
300 Critical Depth =         8.07(In.)
301 Pipe flow velocity =         3.95(Ft/s)
302 Travel time through pipe =         0.80 min.
303 Time of concentration (TC) =         6.94 min.
304
305
306 *****
307 Process from Point/Station         104.000 to Point/Station         104.000
308 **** CONFLUENCE OF MINOR STREAMS ****
309
310 Along Main Stream number: 1 in normal stream number 1
311 Stream flow area =         1.020(Ac.)
312 Runoff from this stream =         3.125(CFS)
313 Time of concentration =         6.94 min.
314 Rainfall intensity =         7.462(In/Hr)
315
316
317 *****
318 Process from Point/Station         200.000 to Point/Station         201.000
319 **** INITIAL AREA EVALUATION ****
320
321 Decimal fraction soil group A =         0.050
322 Decimal fraction soil group B =         0.000
323 Decimal fraction soil group C =         0.950
324 Decimal fraction soil group D =         0.000
325 [COMMERCIAL area type
326 (Office Professional
327 Impervious value, Ai =         0.900
328 Sub-Area C Value =         0.839
329 Initial subarea total flow distance =         50.000(Ft.)
330 Highest elevation =         316.800(Ft.)
331 Lowest elevation =         316.200(Ft.)
332 Elevation difference =         0.600(Ft.) Slope =         1.200 %
333 INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
334 The maximum overland flow distance is         60.00 (Ft)
335 for the top area slope value of         1.20 %, in a development type of
336 Office Professional
337 In Accordance With Figure 3-3
338 Initial Area Time of Concentration =         3.42 minutes
339 TC = [1.8*(1.1-C)*distance(Ft.)^.5]/(% slope^(1/3)]
340 TC = [1.8*(1.1-0.8395)*( 60.000^.5)/( 1.200^(1/3)]=         3.42
341 Calculated TC of         3.418 minutes is less than 5 minutes,
342 resetting TC to 5.0 minutes for rainfall intensity calculations
343 Rainfall intensity (I) =         9.222(In/Hr) for a         100.0 year storm
344 Effective runoff coefficient used for area (Q=KCIA) is C =         0.839
345 Subarea runoff =         0.310(CFS)

```

```

346 Total initial stream area = 0.040(Ac.)
347
348
349 *****
350 Process from Point/Station 201.000 to Point/Station 202.000
351 **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
352
353 -----
354 Estimated mean flow rate at midpoint of channel = 2.245(CFS)
355 Depth of flow = 0.209(Ft.), Average velocity = 2.102(Ft/s)
356 ***** Irregular Channel Data *****
357 -----
358 Information entered for subchannel number 1 :
359 Point number 'X' coordinate 'Y' coordinate
360 1 0.00 0.30
361 2 1.50 0.00
362 3 45.50 1.00
363 4 61.50 1.50
364 Manning's 'N' friction factor = 0.015
365 -----
366 Sub-Channel flow = 2.245(CFS)
367 ' ' flow top width = 10.230(Ft.)
368 ' ' velocity= 2.102(Ft/s)
369 ' ' area = 1.068(Sq.Ft)
370 ' ' Froude number = 1.147
371
372 Upstream point elevation = 316.200(Ft.)
373 Downstream point elevation = 314.500(Ft.)
374 Flow length = 185.000(Ft.)
375 Travel time = 1.47 min.
376 Time of concentration = 4.88 min.
377 Depth of flow = 0.209(Ft.)
378 Average velocity = 2.102(Ft/s)
379 Total irregular channel flow = 2.245(CFS)
380 Irregular channel normal depth above invert elev. = 0.209(Ft.)
381 Average velocity of channel(s) = 2.102(Ft/s)
382 Adding area flow to channel
383 Calculated TC of 4.885 minutes is less than 5 minutes,
384 resetting TC to 5.0 minutes for rainfall intensity calculations
385 Rainfall intensity (I) = 9.222(In/Hr) for a 100.0 year storm
386 Decimal fraction soil group A = 0.000
387 Decimal fraction soil group B = 0.000
388 Decimal fraction soil group C = 1.000
389 Decimal fraction soil group D = 0.000
390 [COMMERCIAL area type ]
391 (Office Professional )
392 Impervious value, Ai = 0.900
393 Sub-Area C Value = 0.840
394 Rainfall intensity = 9.222(In/Hr) for a 100.0 year storm
395 Effective runoff coefficient used for total area
396 (Q=KCIA) is C = 0.840 CA = 0.454
397 Subarea runoff = 3.873(CFS) for 0.500(Ac.)
398 Total runoff = 4.183(CFS) Total area = 0.540(Ac.)
399 Depth of flow = 0.264(Ft.), Average velocity = 2.456(Ft/s)
400
401 *****
402 Process from Point/Station 202.000 to Point/Station 104.000
403 **** PIPEFLOW TRAVEL TIME (User specified size) ****
404
405 -----
406 Upstream point/station elevation = 308.500(Ft.)
407 Downstream point/station elevation = 303.300(Ft.)
408 Pipe length = 48.00(Ft.) Slope = 0.1083 Manning's N = 0.013
409 No. of pipes = 1 Required pipe flow = 4.183(CFS)
410 Given pipe size = 12.00(In.)
411 Calculated individual pipe flow = 4.183(CFS)
412 Normal flow depth in pipe = 4.95(In.)
413 Flow top width inside pipe = 11.82(In.)
414 Critical Depth = 10.36(In.)
415 Pipe flow velocity = 13.68(Ft/s)

```



```

415 Travel time through pipe = 0.06 min.
416 Time of concentration (TC) = 4.94 min.
417
418
419 *****
420 Process from Point/Station 202.000 to Point/Station 104.000
421 **** CONFLUENCE OF MINOR STREAMS ****
422
423 -----
424 Along Main Stream number: 1 in normal stream number 2
425 Stream flow area = 0.540(Ac.)
426 Runoff from this stream = 4.183(CFS)
427 Time of concentration = 4.94 min.
428 Rainfall intensity = 9.222(In/Hr)
429
430 *****
431 Process from Point/Station 300.000 to Point/Station 301.000
432 **** INITIAL AREA EVALUATION ****
433
434 -----
435 Decimal fraction soil group A = 0.000
436 Decimal fraction soil group B = 0.000
437 Decimal fraction soil group C = 1.000
438 Decimal fraction soil group D = 0.000
439 [COMMERCIAL area type ]
440 (Neighborhood Commercial )
441 Impervious value, Ai = 0.800
442 Sub-Area C Value = 0.780
443 Initial subarea total flow distance = 42.000(Ft.)
444 Highest elevation = 316.000(Ft.)
445 Lowest elevation = 314.700(Ft.)
446 Elevation difference = 1.300(Ft.) Slope = 3.095 %
447 INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
448 The maximum overland flow distance is 85.00 (Ft)
449 for the top area slope value of 3.10 %, in a development type of
450 Neighborhood Commercial
451 In Accordance With Figure 3-3
452 Initial Area Time of Concentration = 3.64 minutes
453 TC = [1.8*(1.1-C)*distance(Ft.)^0.5]/(% slope^(1/3))
454 TC = [1.8*(1.1-0.7800)*( 85.000^0.5)]/( 3.095^(1/3)]= 3.64
455 Calculated TC of 3.644 minutes is less than 5 minutes,
456 resetting TC to 5.0 minutes for rainfall intensity calculations
457 Rainfall intensity (I) = 9.222(In/Hr) for a 100.0 year storm
458 Effective runoff coefficient used for area (Q=KCIA) is C = 0.780
459 Subarea runoff = 0.288(CFS)
460 Total initial stream area = 0.040(Ac.)
461
462 *****
463 Process from Point/Station 301.000 to Point/Station 302.000
464 **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
465
466 -----
467 Estimated mean flow rate at midpoint of channel = 1.259(CFS)
468 Depth of flow = 0.087(Ft.), Average velocity = 2.583(Ft/s)
469 ***** Irregular Channel Data *****
470 -----
471 Information entered for subchannel number 1 :
472 Point number 'X' coordinate 'Y' coordinate
473 1 0.00 0.50
474 2 0.00 0.00
475 3 64.00 0.50
476 Manning's 'N' friction factor = 0.015
477 -----
478 Sub-Channel flow = 1.259(CFS)
479 ' ' flow top width = 11.169(Ft.)
480 ' ' velocity= 2.583(Ft/s)
481 ' ' area = 0.487(Sq.Ft)
482 ' ' Froude number = 2.180
483
484 Upstream point elevation = 314.700(Ft.)

```

484 Downstream point elevation = 313.000(Ft.)
 485 Flow length = 38.000(Ft.)
 486 Travel time = 0.25 min.
 487 Time of concentration = 3.89 min.
 488 Depth of flow = 0.087(Ft.)
 489 Average velocity = 2.583(Ft/s)
 490 Total irregular channel flow = 1.259(CFS)
 491 Irregular channel normal depth above invert elev. = 0.087(Ft.)
 492 Average velocity of channel(s) = 2.583(Ft/s)
 493 Adding area flow to channel
 494 Calculated TC of 3.889 minutes is less than 5 minutes,
 495 resetting TC to 5.0 minutes for rainfall intensity calculations
 496 Rainfall intensity (I) = 9.222(In/Hr) for a 100.0 year storm
 497 Decimal fraction soil group A = 0.000
 498 Decimal fraction soil group B = 0.000
 499 Decimal fraction soil group C = 1.000
 500 Decimal fraction soil group D = 0.000
 501 [COMMERCIAL area type]
 502 (Neighborhood Commercial)
 503 Impervious value, Ai = 0.800
 504 Sub-Area C Value = 0.780
 505 Rainfall intensity = 9.222(In/Hr) for a 100.0 year storm
 506 Effective runoff coefficient used for total area
 507 (Q=KCIA) is C = 0.780 CA = 0.242
 508 Subarea runoff = 1.942(CFS) for 0.270(Ac.)
 509 Total runoff = 2.230(CFS) Total area = 0.310(Ac.)
 510 Depth of flow = 0.108(Ft.), Average velocity = 2.980(Ft/s)

 514 Process from Point/Station 302.000 to Point/Station 104.000
 515 **** PIPEFLOW TRAVEL TIME (User specified size) ****

517 Upstream point/station elevation = 306.000(Ft.)
 518 Downstream point/station elevation = 303.300(Ft.)
 519 Pipe length = 30.00(Ft.) Slope = 0.0900 Manning's N = 0.013
 520 No. of pipes = 1 Required pipe flow = 2.230(CFS)
 521 Given pipe size = 12.00(In.)
 522 Calculated individual pipe flow = 2.230(CFS)
 523 Normal flow depth in pipe = 3.72(In.)
 524 Flow top width inside pipe = 11.10(In.)
 525 Critical Depth = 7.66(In.)
 526 Pipe flow velocity = 10.75(Ft/s)
 527 Travel time through pipe = 0.05 min.
 528 Time of concentration (TC) = 3.94 min.

 532 Process from Point/Station 104.000 to Point/Station 104.000
 533 **** CONFLUENCE OF MINOR STREAMS ****

535 Along Main Stream number: 1 in normal stream number 3
 536 Stream flow area = 0.310(Ac.)
 537 Runoff from this stream = 2.230(CFS)
 538 Time of concentration = 3.94 min.
 539 Rainfall intensity = 9.222(In/Hr)
 540 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	3.125	6.94	7.462
2	4.183	4.94	9.222
3	2.230	3.94	9.222
Qmax(1) =			
	1.000 *	1.000 *	3.125) +
	0.809 *	1.000 *	4.183) +
	0.809 *	1.000 *	2.230) + = 8.314

```

553 Qmax(2) =
554     1.000 * 0.712 * 3.125) +
555     1.000 * 1.000 * 4.183) +
556     1.000 * 1.000 * 2.230) + =      8.638
557 Qmax(3) =
558     1.000 * 0.567 * 3.125) +
559     1.000 * 0.796 * 4.183) +
560     1.000 * 1.000 * 2.230) + =      7.332

```

```

562 Total of 3 streams to confluence:
563 Flow rates before confluence point:
564     3.125     4.183     2.230
565 Maximum flow rates at confluence using above data:
566     8.314     8.638     7.332
567 Area of streams before confluence:
568     1.020     0.540     0.310

```

```

569 Results of confluence:
570 Total flow rate =      8.638(CFS)
571 Time of concentration =      4.943 min.
572 Effective stream area after confluence =      1.870(Ac.)

```

```

575 *****
576 Process from Point/Station      104.000 to Point/Station      105.000
577 **** PIPEFLOW TRAVEL TIME (User specified size) ****

```

```

579 Upstream point/station elevation = 303.300(Ft.)
580 Downstream point/station elevation = 303.000(Ft.)
581 Pipe length = 71.00(Ft.) Slope = 0.0042 Manning's N = 0.013
582 No. of pipes = 1 Required pipe flow = 8.638(CFS)
583 Given pipe size = 18.00(In.)
584 NOTE: Normal flow is pressure flow in user selected pipe size.
585 The approximate hydraulic grade line above the pipe invert is
586     0.736(Ft.) at the headworks or inlet of the pipe(s)
587 Pipe friction loss = 0.480(Ft.)
588 Minor friction loss = 0.556(Ft.) K-factor = 1.50
589 Pipe flow velocity = 4.89(Ft/s)
590 Travel time through pipe = 0.24 min.
591 Time of concentration (TC) = 5.19 min.

```

```

594 *****
595 Process from Point/Station      105.000 to Point/Station      105.000
596 **** CONFLUENCE OF MINOR STREAMS ****

```

```

598 Along Main Stream number: 1 in normal stream number 1
599 Stream flow area = 1.870(Ac.)
600 Runoff from this stream = 8.638(CFS)
601 Time of concentration = 5.19 min.
602 Rainfall intensity = 9.008(In/Hr)

```

```

605 *****
606 Process from Point/Station      400.000 to Point/Station      401.000
607 **** INITIAL AREA EVALUATION ****

```

```

609 Decimal fraction soil group A = 0.000
610 Decimal fraction soil group B = 0.000
611 Decimal fraction soil group C = 1.000
612 Decimal fraction soil group D = 0.000
613 [HIGH DENSITY RESIDENTIAL ]
614 (43.0 DU/A or Less )
615 Impervious value, Ai = 0.800
616 Sub-Area C Value = 0.780
617 Initial subarea total flow distance = 100.000(Ft.)
618 Highest elevation = 316.100(Ft.)
619 Lowest elevation = 312.600(Ft.)
620 Elevation difference = 3.500(Ft.) Slope = 3.500 %
621 INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:

```

```

622 The maximum overland flow distance is 85.00 (Ft)
623 for the top area slope value of 3.50 %, in a development type of
624 43.0 DU/A or Less
625 In Accordance With Figure 3-3
626 Initial Area Time of Concentration = 3.50 minutes
627  $TC = [1.8 * (1.1 - C) * distance(Ft.)^{.5} / (% slope^{(1/3)})]$ 
628  $TC = [1.8 * (1.1 - 0.7800) * (85.000^{.5}) / (3.500^{(1/3)})] = 3.50$ 
629 The initial area total distance of 100.00 (Ft.) entered leaves a
630 remaining distance of 15.00 (Ft.)
631 Using Figure 3-4, the travel time for this distance is 0.23 minutes
632 for a distance of 15.00 (Ft.) and a slope of 3.50 %
633 with an elevation difference of 0.53(Ft.) from the end of the top area
634  $Tt = [11.9 * length(Mi)^3 / (elevation change(Ft.))]^{.385} * 60(min/hr)$ 
635 = 0.228 Minutes
636  $Tt = [(11.9 * 0.0028^3) / (0.53)]^{.385} = 0.23$ 
637 Total initial area Ti = 3.50 minutes from Figure 3-3 formula plus
638 0.23 minutes from the Figure 3-4 formula = 3.73 minutes
639 Calculated TC of 3.726 minutes is less than 5 minutes,
640 resetting TC to 5.0 minutes for rainfall intensity calculations
641 Rainfall intensity (I) = 9.222(In/Hr) for a 100.0 year storm
642 Effective runoff coefficient used for area (Q=KCIA) is C = 0.780
643 Subarea runoff = 0.791(CFS)
644 Total initial stream area = 0.110(Ac.)
645
646
647 *****
648 Process from Point/Station 401.000 to Point/Station 402.000
649 **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
650
651 -----
652 Estimated mean flow rate at midpoint of channel = 1.043(CFS)
653 Depth of flow = 0.351(Ft.), Average velocity = 4.504(Ft/s)
654 ***** Irregular Channel Data *****
655 -----
656 Information entered for subchannel number 1 :
657 Point number 'X' coordinate 'Y' coordinate
658 1 0.00 1.10
659 2 34.00 0.40
660 3 35.50 0.00
661 4 35.50 0.50
662 Manning's 'N' friction factor = 0.015
663 -----
664 Sub-Channel flow = 1.043(CFS)
665 ' ' flow top width = 1.318(Ft.)
666 ' ' velocity = 4.504(Ft/s)
667 ' ' area = 0.232(Sq.Ft)
668 ' ' Froude number = 1.894
669
670 Upstream point elevation = 312.600(Ft.)
671 Downstream point elevation = 310.600(Ft.)
672 Flow length = 67.000(Ft.)
673 Travel time = 0.25 min.
674 Time of concentration = 3.97 min.
675 Depth of flow = 0.351(Ft.)
676 Average velocity = 4.504(Ft/s)
677 Total irregular channel flow = 1.043(CFS)
678 Irregular channel normal depth above invert elev. = 0.351(Ft.)
679 Average velocity of channel(s) = 4.504(Ft/s)
680 Adding area flow to channel
681 Calculated TC of 3.974 minutes is less than 5 minutes,
682 resetting TC to 5.0 minutes for rainfall intensity calculations
683 Rainfall intensity (I) = 9.222(In/Hr) for a 100.0 year storm
684 Decimal fraction soil group A = 0.000
685 Decimal fraction soil group B = 0.000
686 Decimal fraction soil group C = 1.000
687 Decimal fraction soil group D = 0.000
688 [HIGH DENSITY RESIDENTIAL ]
689 (43.0 DU/A or Less )
690 Impervious value, Ai = 0.800
691 Sub-Area C Value = 0.780

```

691 Rainfall intensity = 9.222(In/Hr) for a 100.0 year storm
 692 Effective runoff coefficient used for total area
 693 (Q=KCIA) is C = 0.780 CA = 0.140
 694 Subarea runoff = 0.503(CFS) for 0.070(Ac.)
 695 Total runoff = 1.295(CFS) Total area = 0.180(Ac.)
 696 Depth of flow = 0.381(Ft.), Average velocity = 4.754(Ft/s)

699 *****
 700 Process from Point/Station 105.000 to Point/Station 105.000
 701 **** CONFLUENCE OF MINOR STREAMS ****

703 Along Main Stream number: 1 in normal stream number 2
 704 Stream flow area = 0.180(Ac.)
 705 Runoff from this stream = 1.295(CFS)
 706 Time of concentration = 3.97 min.
 707 Rainfall intensity = 9.222(In/Hr)
 708 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
------------	-----------------	----------	----------------------------

714	1	8.638	5.19	9.008
715	2	1.295	3.97	9.222
716	Qmax(1) =			
717		1.000 *	1.000 *	8.638) +
718		0.977 *	1.000 *	1.295) + = 9.902
719	Qmax(2) =			
720		1.000 *	0.766 *	8.638) +
721		1.000 *	1.000 *	1.295) + = 7.915

723 Total of 2 streams to confluence:
 724 Flow rates before confluence point:
 725 8.638 1.295
 726 Maximum flow rates at confluence using above data:
 727 9.902 7.915
 728 Area of streams before confluence:
 729 1.870 0.180

730 Results of confluence:
 731 Total flow rate = 9.902(CFS)
 732 Time of concentration = 5.185 min.
 733 Effective stream area after confluence = 2.050(Ac.)

736 *****
 737 Process from Point/Station 105.000 to Point/Station 106.000
 738 **** PIPEFLOW TRAVEL TIME (User specified size) ****

740 Upstream point/station elevation = 303.000(Ft.)
 741 Downstream point/station elevation = 302.500(Ft.)
 742 Pipe length = 77.00(Ft.) Slope = 0.0065 Manning's N = 0.013
 743 No. of pipes = 1 Required pipe flow = 9.902(CFS)
 744 Given pipe size = 12.00(In.)
 745 NOTE: Normal flow is pressure flow in user selected pipe size.
 746 The approximate hydraulic grade line above the pipe invert is
 747 9.149(Ft.) at the headworks or inlet of the pipe(s)
 748 Pipe friction loss = 5.946(Ft.)
 749 Minor friction loss = 3.703(Ft.) K-factor = 1.50
 750 Pipe flow velocity = 12.61(Ft/s)
 751 Travel time through pipe = 0.10 min.
 752 Time of concentration (TC) = 5.29 min.

755 *****
 756 Process from Point/Station 106.000 to Point/Station 106.000
 757 **** CONFLUENCE OF MINOR STREAMS ****

759 Along Main Stream number: 1 in normal stream number 1

```

760 Stream flow area = 2.050(Ac.)
761 Runoff from this stream = 9.902(CFS)
762 Time of concentration = 5.29 min.
763 Rainfall intensity = 8.896(In/Hr)
764
765
766 ++++++
767 Process from Point/Station 804.000 to Point/Station 106.000
768 **** USER DEFINED FLOW INFORMATION AT A POINT ****
769
770 Decimal fraction soil group A = 0.000
771 Decimal fraction soil group B = 0.000
772 Decimal fraction soil group C = 1.000
773 Decimal fraction soil group D = 0.000
774 [HIGH DENSITY RESIDENTIAL ]
775 (43.0 DU/A or Less )
776 Impervious value, Ai = 0.800
777 Sub-Area C Value = 0.780
778 Rainfall intensity (I) = 5.833(In/Hr) for a 100.0 year storm
779 User specified values are as follows:
780 TC = 10.17 min. Rain intensity = 5.83(In/Hr)
781 Total area = 2.190(Ac.) Total runoff = 6.705(CFS)
782
783
784 ++++++
785 Process from Point/Station 106.000 to Point/Station 106.000
786 **** CONFLUENCE OF MINOR STREAMS ****
787
788 Along Main Stream number: 1 in normal stream number 2
789 Stream flow area = 2.190(Ac.)
790 Runoff from this stream = 6.705(CFS)
791 Time of concentration = 10.17 min.
792 Rainfall intensity = 5.833(In/Hr)
793
794
795 ++++++
796 Process from Point/Station 1004.000 to Point/Station 1005.000
797 **** INITIAL AREA EVALUATION ****
798
799 Decimal fraction soil group A = 1.000
800 Decimal fraction soil group B = 0.000
801 Decimal fraction soil group C = 0.000
802 Decimal fraction soil group D = 0.000
803 [LOW DENSITY RESIDENTIAL ]
804 (1.0 DU/A or Less )
805 Impervious value, Ai = 0.100
806 Sub-Area C Value = 0.270
807 Initial subarea total flow distance = 30.000(Ft.)
808 Highest elevation = 334.800(Ft.)
809 Lowest elevation = 327.500(Ft.)
810 Elevation difference = 7.300(Ft.) Slope = 24.333 %
811 Top of Initial Area Slope adjusted by User to 0.189 %
812 INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
813 The maximum overland flow distance is 50.00 (Ft)
814 for the top area slope value of 0.19 %, in a development type of
815 1.0 DU/A or Less
816 In Accordance With Table 3-2
817 Initial Area Time of Concentration = 12.20 minutes
818 (for slope value of 0.50 %)
819 Rainfall intensity (I) = 5.187(In/Hr) for a 100.0 year storm
820 Effective runoff coefficient used for area (Q=KCIA) is C = 0.270
821 Subarea runoff = 0.014(CFS)
822 Total initial stream area = 0.010(Ac.)
823
824
825 ++++++
826 Process from Point/Station 1005.000 to Point/Station 1003.000
827 **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
828

```

```

829 Estimated mean flow rate at midpoint of channel = 0.042(CFS)
830 Depth of flow = 0.111(Ft.), Average velocity = 3.401(Ft/s)
831 ***** Irregular Channel Data *****
832 -----
833 Information entered for subchannel number 1 :
834 Point number 'X' coordinate 'Y' coordinate
835 1 0.00 1.00
836 2 1.00 0.00
837 3 2.00 1.00
838 Manning's 'N' friction factor = 0.015
839 -----
840 Sub-Channel flow = 0.042(CFS)
841 ' ' flow top width = 0.222(Ft.)
842 ' ' velocity= 3.401(Ft/s)
843 ' ' area = 0.012(Sq.Ft)
844 ' ' Froude number = 2.543
845
846 Upstream point elevation = 327.500(Ft.)
847 Downstream point elevation = 324.500(Ft.)
848 Flow length = 34.000(Ft.)
849 Travel time = 0.17 min.
850 Time of concentration = 12.37 min.
851 Depth of flow = 0.111(Ft.)
852 Average velocity = 3.401(Ft/s)
853 Total irregular channel flow = 0.042(CFS)
854 Irregular channel normal depth above invert elev. = 0.111(Ft.)
855 Average velocity of channel(s) = 3.401(Ft/s)
856 Adding area flow to channel
857 Rainfall intensity (I) = 5.142(In/Hr) for a 100.0 year storm
858 Decimal fraction soil group A = 1.000
859 Decimal fraction soil group B = 0.000
860 Decimal fraction soil group C = 0.000
861 Decimal fraction soil group D = 0.000
862 [LOW DENSITY RESIDENTIAL ]
863 (1.0 DU/A or Less )
864 Impervious value, Ai = 0.100
865 Sub-Area C Value = 0.270
866 Rainfall intensity = 5.142(In/Hr) for a 100.0 year storm
867 Effective runoff coefficient used for total area
868 (Q=KCIA) is C = 0.270 CA = 0.014
869 Subarea runoff = 0.055(CFS) for 0.040(Ac.)
870 Total runoff = 0.069(CFS) Total area = 0.050(Ac.)
871 Depth of flow = 0.134(Ft.), Average velocity = 3.856(Ft/s)
872
873
874 *****
875 Process from Point/Station 1003.000 to Point/Station 106.000
876 **** PIPEFLOW TRAVEL TIME (User specified size) ****
877 -----
878 Upstream point/station elevation = 311.100(Ft.)
879 Downstream point/station elevation = 302.600(Ft.)
880 Pipe length = 209.00(Ft.) Slope = 0.0407 Manning's N = 0.013
881 No. of pipes = 1 Required pipe flow = 0.069(CFS)
882 Given pipe size = 18.00(In.)
883 Calculated individual pipe flow = 0.069(CFS)
884 Normal flow depth in pipe = 0.75(In.)
885 Flow top width inside pipe = 7.22(In.)
886 Critical depth could not be calculated.
887 Pipe flow velocity = 2.75(Ft/s)
888 Travel time through pipe = 1.27 min.
889 Time of concentration (TC) = 13.64 min.
890
891
892 *****
893 Process from Point/Station 106.000 to Point/Station 106.000
894 **** CONFLUENCE OF MINOR STREAMS ****
895 -----
896 Along Main Stream number: 1 in normal stream number 3
897 Stream flow area = 0.050(Ac.)

```

898 Runoff from this stream = 0.069(CFS)
 899 Time of concentration = 13.64 min.
 900 Rainfall intensity = 4.828(In/Hr)
 901 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	9.902	5.29	8.896
2	6.705	10.17	5.833
3	0.069	13.64	4.828

910 Qmax(1) =
 911 1.000 * 1.000 * 9.902) +
 912 1.000 * 0.520 * 6.705) +
 913 1.000 * 0.388 * 0.069) + = 13.415

914 Qmax(2) =
 915 0.656 * 1.000 * 9.902) +
 916 1.000 * 1.000 * 6.705) +
 917 1.000 * 0.746 * 0.069) + = 13.250

918 Qmax(3) =
 919 0.543 * 1.000 * 9.902) +
 920 0.828 * 1.000 * 6.705) +
 921 1.000 * 1.000 * 0.069) + = 10.994

922
 923 Total of 3 streams to confluence:
 924 Flow rates before confluence point:
 925 9.902 6.705 0.069
 926 Maximum flow rates at confluence using above data:
 927 13.415 13.250 10.994

928 Area of streams before confluence:
 929 2.050 2.190 0.050

930 Results of confluence:
 931 Total flow rate = 13.415(CFS)
 932 Time of concentration = 5.287 min.
 933 Effective stream area after confluence = 4.290(Ac.)

934
 935
 936 +-----+
 937 Process from Point/Station 106.000 to Point/Station 107.000
 938 **** PIPEFLOW TRAVEL TIME (User specified size) ****

940 Upstream point/station elevation = 302.500(Ft.)
 941 Downstream point/station elevation = 302.100(Ft.)
 942 Pipe length = 31.00(Ft.) Slope = 0.0129 Manning's N = 0.013
 943 No. of pipes = 1 Required pipe flow = 13.415(CFS)
 944 Given pipe size = 18.00(In.)
 945 NOTE: Normal flow is pressure flow in user selected pipe size.
 946 The approximate hydraulic grade line above the pipe invert is
 947 1.448(Ft.) at the headworks or inlet of the pipe(s)
 948 Pipe friction loss = 0.505(Ft.)
 949 Minor friction loss = 1.342(Ft.) K-factor = 1.50
 950 Critical depth could not be calculated.
 951 Pipe flow velocity = 7.59(Ft/s)
 952 Travel time through pipe = 0.07 min.
 953 Time of concentration (TC) = 5.36 min.
 954 End of computations, total study area = 4.290 (Ac.)

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 956
 957

3d. CivilD Post Development Onsite Reach 6 Calculations

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2014 Version 9.0

Rational method hydrology program based on
San Diego County Flood Control Division 2003 hydrology manual
Rational Hydrology Study Date: 09/16/21

19025 Post Dev
100 Year Study Reach 6
PostDev100R6.rd3
2021.09.16 update

***** Hydrology Study Control Information *****

Program License Serial Number 6332

Rational hydrology study storm event year is 100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour, precipitation(inches) = 3.500
24 hour precipitation(inches) = 6.000
P6/P24 = 58.3%
San Diego hydrology manual 'C' values used

Process from Point/Station 600.000 to Point/Station 601.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[HIGH DENSITY RESIDENTIAL]
(43.0 DU/A or Less)
Impervious value, Ai = 0.800
Sub-Area C Value = 0.780
Initial subarea total flow distance = 45.000(Ft.)
Highest elevation = 315.400(Ft.)
Lowest elevation = 312.100(Ft.)
Elevation difference = 3.300(Ft.) Slope = 7.333 %
Top of Initial Area Slope adjusted by User to 7.300 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 95.00 (Ft)
for the top area slope value of 7.30 %, in a development type of
43.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration = 2.89 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5]/(% slope^(1/3)]
TC = [1.8*(1.1-0.7800)*(95.000^.5)]/(7.300^(1/3)]= 2.89
Calculated TC of 2.894 minutes is less than 5 minutes,
resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) = 9.222(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.780
Subarea runoff = 0.288(CFS)
Total initial stream area = 0.040(Ac.)

Process from Point/Station 601.000 to Point/Station 602.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

```

70 Estimated mean flow rate at midpoint of channel = 0.755(CFS)
71 Depth of flow = 0.022(Ft.), Average velocity = 0.371(Ft/s)
72 ***** Irregular Channel Data *****
73 -----
74 Information entered for subchannel number 1 :
75 Point number 'X' coordinate 'Y' coordinate
76 1 0.00 0.50
77 2 0.00 0.00
78 3 91.00 0.00
79 4 91.00 0.50
80 Manning's 'N' friction factor = 0.015
81 -----
82 Sub-Channel flow = 0.755(CFS)
83 ' ' flow top width = 91.000(Ft.)
84 ' ' velocity= 0.371(Ft/s)
85 ' ' area = 2.037(Sq.Ft)
86 ' ' Froude number = 0.437
87
88 Upstream point elevation = 312.100(Ft.)
89 Downstream point elevation = 312.000(Ft.)
90 Flow length = 45.000(Ft.)
91 Travel time = 2.02 min.
92 Time of concentration = 4.92 min.
93 Depth of flow = 0.022(Ft.)
94 Average velocity = 0.371(Ft/s)
95 Total irregular channel flow = 0.755(CFS)
96 Irregular channel normal depth above invert elev. = 0.022(Ft.)
97 Average velocity of channel(s) = 0.371(Ft/s)
98 Adding area flow to channel
99 Calculated TC of 4.917 minutes is less than 5 minutes,
100 resetting TC to 5.0 minutes for rainfall intensity calculations
101 Rainfall intensity (I) = 9.222(In/Hr) for a 100.0 year storm
102 Decimal fraction soil group A = 0.000
103 Decimal fraction soil group B = 0.000
104 Decimal fraction soil group C = 1.000
105 Decimal fraction soil group D = 0.000
106 [HIGH DENSITY RESIDENTIAL ]
107 (43.0 DU/A or Less )
108 Impervious value, Ai = 0.800
109 Sub-Area C Value = 0.780
110 Rainfall intensity = 9.222(In/Hr) for a 100.0 year storm
111 Effective runoff coefficient used for total area
112 (Q=KCIA) is C = 0.780 CA = 0.133
113 Subarea runoff = 0.935(CFS) for 0.130(Ac.)
114 Total runoff = 1.223(CFS) Total area = 0.170(Ac.)
115 Depth of flow = 0.030(Ft.), Average velocity = 0.450(Ft/s)
116
117
118 +-----+
119 Process from Point/Station 602.000 to Point/Station 602.000
120 **** CONFLUENCE OF MINOR STREAMS ****
121 -----
122 Along Main Stream number: 1 in normal stream number 1
123 Stream flow area = 0.170(Ac.)
124 Runoff from this stream = 1.223(CFS)
125 Time of concentration = 4.92 min.
126 Rainfall intensity = 9.222(In/Hr)
127
128
129 +-----+
130 Process from Point/Station 700.000 to Point/Station 701.000
131 **** INITIAL AREA EVALUATION ****
132 -----
133 Decimal fraction soil group A = 0.000
134 Decimal fraction soil group B = 0.000
135 Decimal fraction soil group C = 1.000
136 Decimal fraction soil group D = 0.000
137 [HIGH DENSITY RESIDENTIAL ]
138 (43.0 DU/A or Less )

```

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139 Impervious value, Ai = 0.800
140 Sub-Area C Value = 0.780
141 Initial subarea total flow distance = 46.000(Ft.)
142 Highest elevation = 316.000(Ft.)
143 Lowest elevation = 315.400(Ft.)
144 Elevation difference = 0.600(Ft.) Slope = 1.304 %
145 INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
146 The maximum overland flow distance is 65.00 (Ft)
147 for the top area slope value of 1.30 %, in a development type of
148 43.0 DU/A or Less
149 In Accordance With Figure 3-3
150 Initial Area Time of Concentration = 4.25 minutes
151 TC = [1.8*(1.1-C)*distance(Ft.)^.5]/(% slope^(1/3)]
152 TC = [1.8*(1.1-0.7800)*( 65.000^.5)]/( 1.304^(1/3)]= 4.25
153 Calculated TC of 4.251 minutes is less than 5 minutes,
154 resetting TC to 5.0 minutes for rainfall intensity calculations
155 Rainfall intensity (I) = 9.222(In/Hr) for a 100.0 year storm
156 Effective runoff coefficient used for area (Q=KCIA) is C = 0.780
157 Subarea runoff = 0.288(CFS)
158 Total initial stream area = 0.040(Ac.)
159
160
161 *****
162 Process from Point/Station 701.000 to Point/Station 702.000
163 **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
164
165 -----
166 Estimated mean flow rate at midpoint of channel = 1.057(CFS)
167 Depth of flow = 0.011(Ft.), Average velocity = 0.730(Ft/s)
168 ***** Irregular Channel Data *****
169 -----
170 Information entered for subchannel number 1 :
171 Point number 'X' coordinate 'Y' coordinate
172 1 0.00 0.50
173 2 0.00 0.00
174 3 130.00 0.00
175 4 130.00 0.50
176 Manning's 'N' friction factor = 0.015
177 -----
178 Sub-Channel flow = 1.057(CFS)
179 ' ' flow top width = 130.000(Ft.)
180 ' ' velocity= 0.730(Ft/s)
181 ' ' area = 1.448(Sq.Ft)
182 ' ' Froude number = 1.219
183
184 Upstream point elevation = 315.400(Ft.)
185 Downstream point elevation = 312.100(Ft.)
186 Flow length = 151.000(Ft.)
187 Travel time = 3.45 min.
188 Time of concentration = 7.70 min.
189 Depth of flow = 0.011(Ft.)
190 Average velocity = 0.730(Ft/s)
191 Total irregular channel flow = 1.057(CFS)
192 Irregular channel normal depth above invert elev. = 0.011(Ft.)
193 Average velocity of channel(s) = 0.730(Ft/s)
194 Adding area flow to channel
195 Rainfall intensity (I) = 6.981(In/Hr) for a 100.0 year storm
196 Decimal fraction soil group A = 0.000
197 Decimal fraction soil group B = 0.000
198 Decimal fraction soil group C = 1.000
199 Decimal fraction soil group D = 0.000
200 [HIGH DENSITY RESIDENTIAL ]
201 (43.0 DU/A or Less )
202 Impervious value, Ai = 0.800
203 Sub-Area C Value = 0.780
204 Rainfall intensity = 6.981(In/Hr) for a 100.0 year storm
205 Effective runoff coefficient used for total area
206 (Q=KCIA) is C = 0.780 CA = 0.250
207 Subarea runoff = 1.455(CFS) for 0.280(Ac.)
208 Total runoff = 1.743(CFS) Total area = 0.320(Ac.)

```

208 Depth of flow = 0.015(Ft.), Average velocity = 0.892(Ft/s)

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Process from Point/Station 702.000 to Point/Station 602.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 312.100(Ft.)
Downstream point/station elevation = 312.000(Ft.)
Pipe length = 40.00(Ft.) Slope = 0.0025 Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 1.743(CFS)
Given pipe size = 12.00(In.)
Calculated individual pipe flow = 1.743(CFS)
Normal flow depth in pipe = 9.61(In.)
Flow top width inside pipe = 9.59(In.)
Critical Depth = 6.74(In.)
Pipe flow velocity = 2.59(Ft/s)
Travel time through pipe = 0.26 min.
Time of concentration (TC) = 7.96 min.

Process from Point/Station 602.000 to Point/Station 602.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 0.320(Ac.)
Runoff from this stream = 1.743(CFS)
Time of concentration = 7.96 min.
Rainfall intensity = 6.834(In/Hr)

Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	1.223	4.92	9.222
2	1.743	7.96	6.834
Qmax(1) =			
	1.000 *	1.000 *	1.223) +
	1.000 *	0.618 *	1.743) + = 2.300
Qmax(2) =			
	0.741 *	1.000 *	1.223) +
	1.000 *	1.000 *	1.743) + = 2.649

Total of 2 streams to confluence:

Flow rates before confluence point:

1.223 1.743

Maximum flow rates at confluence using above data:

2.300 2.649

Area of streams before confluence:

0.170 0.320

Results of confluence:

Total flow rate = 2.649(CFS)

Time of concentration = 7.956 min.

Effective stream area after confluence = 0.490(Ac.)

End of computations, total study area = 0.490 (Ac.)

3e. CivilD Post Development Onsite Reach 8 Calculations

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software, (c)1991-2014 Version 9.0

Rational method hydrology program based on
San Diego County Flood Control Division 2003 hydrology manual
Rational Hydrology Study Date: 04/07/23

19025 Post Dev
100 Year Study Reach 8
PostDev100R8.rd3
2021.09.16 update

***** Hydrology Study Control Information *****

Program License Serial Number 6332

Rational hydrology study storm event year is 100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour, precipitation(inches) = 3.500
24 hour precipitation(inches) = 6.000
P6/P24 = 58.3%
San Diego hydrology manual 'C' values used

+++++
Process from Point/Station 800.000 to Point/Station 801.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.100
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.900
Decimal fraction soil group D = 0.000
[MEDIUM DENSITY RESIDENTIAL]
(14.5 DU/A or Less)
Impervious value, Ai = 0.500
Sub-Area C Value = 0.595
Initial subarea total flow distance = 99.000 (Ft.)
Highest elevation = 315.200 (Ft.)
Lowest elevation = 314.100 (Ft.)
Elevation difference = 1.100 (Ft.) Slope = 1.111 %
Top of Initial Area Slope adjusted by User to 1.000 %
Bottom of Initial Area Slope adjusted by User to 1.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 65.00 (Ft)
for the top area slope value of 1.00 %, in a development type of
14.5 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration = 7.33 minutes
 $TC = [1.8 * (1.1 - C) * distance (Ft.)^{.5} / (% slope^{(1/3)})]$
 $TC = [1.8 * (1.1 - 0.5950) * (65.000^{.5}) / (1.000^{(1/3)})] = 7.33$
The initial area total distance of 99.00 (Ft.) entered leaves a
remaining distance of 34.00 (Ft.)
Using Figure 3-4, the travel time for this distance is 0.69 minutes
for a distance of 34.00 (Ft.) and a slope of 1.00 %
with an elevation difference of 0.34 (Ft.) from the end of the top area
 $Tt = [11.9 * length (Mi)^3 / (elevation change (Ft.))]^{.385} * 60 (min/hr)$
= 0.695 Minutes
 $Tt = [(11.9 * 0.0064^3) / (0.34)]^{.385} = 0.69$
Total initial area Ti = 7.33 minutes from Figure 3-3 formula plus
0.69 minutes from the Figure 3-4 formula = 8.02 minutes
Rainfall intensity (I) = 6.797 (In/Hr) for a 100.0 year storm

```

70 Effective runoff coefficient used for area (Q=KCIA) is C = 0.595
71 Subarea runoff = 0.647(CFS)
72 Total initial stream area = 0.160(Ac.)
73
74
75 ++++++
76 Process from Point/Station 801.000 to Point/Station 802.000
77 **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
78
79 -----
79 Estimated mean flow rate at midpoint of channel = 1.706 (CFS)
80 Depth of flow = 0.166 (Ft.), Average velocity = 0.858 (Ft/s)
81 ***** Irregular Channel Data *****
82
83 -----
83 Information entered for subchannel number 1 :
84 Point number 'X' coordinate 'Y' coordinate
85 1 0.00 0.50
86 2 0.00 0.00
87 3 72.00 0.50
88 Manning's 'N' friction factor = 0.030
89
90 -----
90 Sub-Channel flow = 1.706 (CFS)
91 ' ' flow top width = 23.925 (Ft.)
92 ' ' velocity = 0.858 (Ft/s)
93 ' ' area = 1.988 (Sq.Ft)
94 ' ' Froude number = 0.525
95
96 Upstream point elevation = 314.100 (Ft.)
97 Downstream point elevation = 311.500 (Ft.)
98 Flow length = 311.000 (Ft.)
99 Travel time = 6.04 min.
100 Time of concentration = 14.06 min.
101 Depth of flow = 0.166 (Ft.)
102 Average velocity = 0.858 (Ft/s)
103 Total irregular channel flow = 1.706 (CFS)
104 Irregular channel normal depth above invert elev. = 0.166 (Ft.)
105 Average velocity of channel(s) = 0.858 (Ft/s)
106 Adding area flow to channel
107 Rainfall intensity (I) = 4.733 (In/Hr) for a 100.0 year storm
108 Decimal fraction soil group A = 0.400
109 Decimal fraction soil group B = 0.000
110 Decimal fraction soil group C = 0.600
111 Decimal fraction soil group D = 0.000
112 [MEDIUM DENSITY RESIDENTIAL ]
113 (14.5 DU/A or Less )
114 Impervious value, Ai = 0.500
115 Sub-Area C Value = 0.580
116 Rainfall intensity = 4.733 (In/Hr) for a 100.0 year storm
117 Effective runoff coefficient used for total area
118 (Q=KCIA) is C = 0.582 CA = 0.565
119 Subarea runoff = 2.027 (CFS) for 0.810 (Ac.)
120 Total runoff = 2.674 (CFS) Total area = 0.970 (Ac.)
121 Depth of flow = 0.197 (Ft.), Average velocity = 0.960 (Ft/s)
122
123
124 ++++++
125 Process from Point/Station 802.000 to Point/Station 803.000
126 **** PIPEFLOW TRAVEL TIME (User specified size) ****
127
128 -----
128 Upstream point/station elevation = 304.600 (Ft.)
129 Downstream point/station elevation = 304.300 (Ft.)
130 Pipe length = 173.00 (Ft.) Slope = 0.0017 Manning's N = 0.013
131 No. of pipes = 1 Required pipe flow = 2.674 (CFS)
132 Given pipe size = 12.00 (In.)
133 NOTE: Normal flow is pressure flow in user selected pipe size.
134 The approximate hydraulic grade line above the pipe invert is
135 0.944 (Ft.) at the headworks or inlet of the pipe(s)
136 Pipe friction loss = 0.974 (Ft.)
137 Minor friction loss = 0.270 (Ft.) K-factor = 1.50
138 Pipe flow velocity = 3.40 (Ft/s)

```


139 Travel time through pipe = 0.85 min.
140 Time of concentration (TC) = 14.91 min.
141
142

143 ++++++
144 Process from Point/Station 803.000 to Point/Station 803.000
145 **** CONFLUENCE OF MINOR STREAMS ****

147 Along Main Stream number: 1 in normal stream number 1
148 Stream flow area = 0.970 (Ac.)
149 Runoff from this stream = 2.674 (CFS)
150 Time of concentration = 14.91 min.
151 Rainfall intensity = 4.558 (In/Hr)
152
153

154 ++++++
155 Process from Point/Station 900.000 to Point/Station 901.000
156 **** INITIAL AREA EVALUATION ****

158 Decimal fraction soil group A = 1.000
159 Decimal fraction soil group B = 0.000
160 Decimal fraction soil group C = 0.000
161 Decimal fraction soil group D = 0.000
162 [LOW DENSITY RESIDENTIAL]
163 (1.0 DU/A or Less)
164 Impervious value, Ai = 0.100
165 Sub-Area C Value = 0.270
166 Initial subarea total flow distance = 100.000 (Ft.)
167 Highest elevation = 333.100 (Ft.)
168 Lowest elevation = 323.900 (Ft.)
169 Elevation difference = 9.200 (Ft.) Slope = 9.200 %

170 INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
171 The maximum overland flow distance is 100.00 (Ft)
172 for the top area slope value of 9.20 %, in a development type of
173 1.0 DU/A or Less
174 In Accordance With Figure 3-3
175 Initial Area Time of Concentration = 7.13 minutes
176 $TC = [1.8 * (1.1 - C) * distance (Ft.)^{.5} / (% slope^{(1/3)})]$
177 $TC = [1.8 * (1.1 - 0.2700) * (100.000^{.5}) / (9.200^{(1/3)})] = 7.13$
178 Rainfall intensity (I) = 7.335 (In/Hr) for a 100.0 year storm
179 Effective runoff coefficient used for area (Q=KCIA) is C = 0.270
180 Subarea runoff = 0.059 (CFS)
181 Total initial stream area = 0.030 (Ac.)
182
183

184 ++++++
185 Process from Point/Station 901.000 to Point/Station 902.000
186 **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

188 Estimated mean flow rate at midpoint of channel = 0.168 (CFS)
189 Depth of flow = 0.228 (Ft.), Average velocity = 3.226 (Ft/s)
190 ***** Irregular Channel Data *****
191

192 Information entered for subchannel number 1 :
193 Point number 'X' coordinate 'Y' coordinate
194 1 0.00 1.00
195 2 1.00 0.00
196 3 2.00 1.00
197 Manning's 'N' friction factor = 0.016
198

199 Sub-Channel flow = 0.168 (CFS)
200 ' ' flow top width = 0.457 (Ft.)
201 ' ' velocity = 3.226 (Ft/s)
202 ' ' area = 0.052 (Sq.Ft)
203 ' ' Froude number = 1.682
204

205 Upstream point elevation = 323.900 (Ft.)
206 Downstream point elevation = 315.400 (Ft.)
207 Flow length = 246.000 (Ft.)

208 Travel time = 1.27 min.
 209 Time of concentration = 8.40 min.
 210 Depth of flow = 0.228 (Ft.)
 211 **Average** velocity = 3.226 (Ft/s)
 212 Total irregular channel flow = 0.168 (CFS)
 213 Irregular channel normal depth above invert elev. = 0.228 (Ft.)
 214 **Average** velocity of channel (s) = 3.226 (Ft/s)
 215 Adding area flow to channel
 216 Rainfall intensity (I) = 6.599 (In/Hr) for a 100.0 year storm
 217 Decimal fraction soil group A = 1.000
 218 Decimal fraction soil group B = 0.000
 219 Decimal fraction soil group C = 0.000
 220 Decimal fraction soil group D = 0.000
 221 [LOW DENSITY RESIDENTIAL]
 222 (1.0 DU/A or Less)
 223 Impervious value, Ai = 0.100
 224 Sub-Area C Value = 0.270
 225 Rainfall intensity = 6.599 (In/Hr) for a 100.0 year storm
 226 Effective runoff coefficient used for total area
 227 (Q=KCIA) is C = 0.270 CA = 0.038
 228 Subarea runoff = 0.190 (CFS) for 0.110 (Ac.)
 229 Total runoff = 0.249 (CFS) Total area = 0.140 (Ac.)
 230 Depth of flow = 0.265 (Ft.), **Average** velocity = 3.559 (Ft/s)

233 ++++++
 234 Process from Point/Station 902.000 to Point/Station 803.000
 235 **** PIPEFLOW TRAVEL TIME (User specified size) ****

237 Upstream point/station elevation = 310.900 (Ft.)
 238 Downstream point/station elevation = 304.300 (Ft.)
 239 Pipe **length** = 100.00 (Ft.) Slope = 0.0660 Manning's N = 0.013
 240 No. of pipes = 1 Required pipe flow = 0.249 (CFS)
 241 Given pipe size = 12.00 (In.)
 242 Calculated individual pipe flow = 0.249 (CFS)
 243 Normal flow depth in pipe = 1.36 (In.)
 244 Flow top width inside pipe = 7.62 (In.)
 245 Critical Depth = 2.46 (In.)
 246 Pipe flow velocity = 5.07 (Ft/s)
 247 Travel time through pipe = 0.33 min.
 248 Time of concentration (TC) = 8.73 min.

251 ++++++
 252 Process from Point/Station 803.000 to Point/Station 803.000
 253 **** CONFLUENCE OF MINOR STREAMS ****

255 Along Main Stream number: 1 in normal stream number 2
 256 Stream flow area = 0.140 (Ac.)
 257 Runoff from this stream = 0.249 (CFS)
 258 Time of concentration = 8.73 min.
 259 Rainfall intensity = 6.437 (In/Hr)
 260 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	2.674	14.91	4.558
2	0.249	8.73	6.437
Qmax (1) =			
	1.000 *	1.000 *	2.674) +
	0.708 *	1.000 *	0.249) + = 2.851
Qmax (2) =			
	1.000 *	0.586 *	2.674) +
	1.000 *	1.000 *	0.249) + = 1.815

275 Total of 2 streams to confluence:
 276 Flow rates before confluence point:

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277         2.674         0.249
278 Maximum flow rates at confluence using above data:
279         2.851         1.815
280 Area of streams before confluence:
281         0.970         0.140
282 Results of confluence:
283 Total flow rate =         2.851 (CFS)
284 Time of concentration =         14.909 min.
285 Effective stream area after confluence =         1.110 (Ac.)
286
287
288 ++++++
289 Process from Point/Station         803.000 to Point/Station         804.000
290 **** PIPEFLOW TRAVEL TIME (User specified size) ****
291
292 Upstream point/station elevation =         304.300 (Ft.)
293 Downstream point/station elevation =         302.800 (Ft.)
294 Pipe length =         301.00 (Ft.) Slope =         0.0050 Manning's N = 0.013
295 No. of pipes = 1 Required pipe flow =         2.851 (CFS)
296 Given pipe size =         12.00 (In.)
297 NOTE: Normal flow is pressure flow in user selected pipe size.
298 The approximate hydraulic grade line above the pipe invert is
299         0.733 (Ft.) at the headworks or inlet of the pipe(s)
300 Pipe friction loss =         1.926 (Ft.)
301 Minor friction loss =         0.307 (Ft.) K-factor =         1.50
302 Pipe flow velocity =         3.63 (Ft/s)
303 Travel time through pipe =         1.38 min.
304 Time of concentration (TC) =         16.29 min.
305
306
307 ++++++
308 Process from Point/Station         804.000 to Point/Station         804.000
309 **** CONFLUENCE OF MINOR STREAMS ****
310
311 Along Main Stream number: 1 in normal stream number 1
312 Stream flow area =         1.110 (Ac.)
313 Runoff from this stream =         2.851 (CFS)
314 Time of concentration =         16.29 min.
315 Rainfall intensity =         4.305 (In/Hr)
316
317
318 ++++++
319 Process from Point/Station         600.000 to Point/Station         804.000
320 **** USER DEFINED FLOW INFORMATION AT A POINT ****
321
322 Decimal fraction soil group A = 0.000
323 Decimal fraction soil group B = 0.000
324 Decimal fraction soil group C = 1.000
325 Decimal fraction soil group D = 0.000
326 [HIGH DENSITY RESIDENTIAL
327 (43.0 DU/A or Less )
328 Impervious value, Ai = 0.800
329 Sub-Area C Value = 0.780
330 Rainfall intensity (I) =         6.834 (In/Hr) for a 100.0 year storm
331 User specified values are as follows:
332 TC = 7.96 min. Rain intensity =         6.83 (In/Hr)
333 Total area =         0.490 (Ac.) Total runoff =         2.649 (CFS)
334
335
336 ++++++
337 Process from Point/Station         804.000 to Point/Station         804.000
338 **** CONFLUENCE OF MINOR STREAMS ****
339
340 Along Main Stream number: 1 in normal stream number 2
341 Stream flow area =         0.490 (Ac.)
342 Runoff from this stream =         2.649 (CFS)
343 Time of concentration =         7.96 min.
344 Rainfall intensity =         6.834 (In/Hr)
345

```

```

346
347 ++++++
348 Process from Point/Station      500.000 to Point/Station      501.000
349 **** INITIAL AREA EVALUATION ****
350
351 Decimal fraction soil group A = 0.900
352 Decimal fraction soil group B = 0.000
353 Decimal fraction soil group C = 0.100
354 Decimal fraction soil group D = 0.000
355 [HIGH DENSITY RESIDENTIAL          ]
356 (24.0 DU/A or Less          )
357 Impervious value, Ai = 0.650
358 Sub-Area C Value = 0.663
359 Initial subarea total flow distance = 68.000 (Ft.)
360 Highest elevation = 315.800 (Ft.)
361 Lowest elevation = 315.600 (Ft.)
362 Elevation difference = 0.200 (Ft.) Slope = 0.294 %
363 INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
364 The maximum overland flow distance is 50.00 (Ft)
365 for the top area slope value of 0.29 %, in a development type of
366 24.0 DU/A or Less
367 In Accordance With Figure 3-3
368 Initial Area Time of Concentration = 8.36 minutes
369 TC = [1.8*(1.1-C)*distance (Ft.)^.5]/(% slope^(1/3)]
370 TC = [1.8*(1.1-0.6630)*( 50.000^.5)]/( 0.294^(1/3)]= 8.36
371 The initial area total distance of 68.00 (Ft.) entered leaves a
372 remaining distance of 18.00 (Ft.)
373 Using Figure 3-4, the travel time for this distance is 0.68 minutes
374 for a distance of 18.00 (Ft.) and a slope of 0.29 %
375 with an elevation difference of 0.05 (Ft.) from the end of the top area
376 Tt = [11.9*length (Mi)^3]/(elevation change (Ft.))]^.385 *60 (min/hr)
377 = 0.682 Minutes
378 Tt=[(11.9*0.0034^3)]/( 0.05)]^.385= 0.68
379 Total initial area Ti = 8.36 minutes from Figure 3-3 formula plus
380 0.68 minutes from the Figure 3-4 formula = 9.05 minutes
381 Rainfall intensity (I) = 6.291 (In/Hr) for a 100.0 year storm
382 Effective runoff coefficient used for area (Q=KCIA) is C = 0.663
383 Subarea runoff = 0.167 (CFS)
384 Total initial stream area = 0.040 (Ac.)
385
386
387 ++++++
388 Process from Point/Station      501.000 to Point/Station      502.000
389 **** SUBAREA FLOW ADDITION ****
390
391 Rainfall intensity (I) = 6.291 (In/Hr) for a 100.0 year storm
392 Decimal fraction soil group A = 0.900
393 Decimal fraction soil group B = 0.000
394 Decimal fraction soil group C = 0.100
395 Decimal fraction soil group D = 0.000
396 [HIGH DENSITY RESIDENTIAL          ]
397 (43.0 DU/A or Less          )
398 Impervious value, Ai = 0.800
399 Sub-Area C Value = 0.762
400 Time of concentration = 9.05 min.
401 Rainfall intensity = 6.291 (In/Hr) for a 100.0 year storm
402 Effective runoff coefficient used for total area
403 (Q=KCIA) is C = 0.739 CA = 0.126
404 Subarea runoff = 0.623 (CFS) for 0.130 (Ac.)
405 Total runoff = 0.790 (CFS) Total area = 0.170 (Ac.)
406
407
408 ++++++
409 Process from Point/Station      502.000 to Point/Station      503.000
410 **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
411
412 Estimated mean flow rate at midpoint of channel = 1.710 (CFS)
413 Depth of flow = 0.034 (Ft.), Average velocity = 2.019 (Ft/s)
414 ***** Irregular Channel Data *****

```

```

415 -----
416 Information entered for subchannel number 1 :
417 Point number      'X' coordinate      'Y' coordinate
418     1              0.00              0.50
419     2              0.00              0.00
420     3              25.00             0.00
421     4              25.00             0.50
422 Manning's 'N' friction factor = 0.015
423 -----
424 Sub-Channel flow = 1.710 (CFS)
425 '   '   flow top width = 25.000 (Ft.)
426 '   '   velocity = 2.019 (Ft/s)
427 '   '   area = 0.847 (Sq.Ft)
428 '   '   Froude number = 1.933
429
430 Upstream point elevation = 316.600 (Ft.)
431 Downstream point elevation = 312.000 (Ft.)
432 Flow length = 121.000 (Ft.)
433 Travel time = 1.00 min.
434 Time of concentration = 10.05 min.
435 Depth of flow = 0.034 (Ft.)
436 Average velocity = 2.019 (Ft/s)
437 Total irregular channel flow = 1.710 (CFS)
438 Irregular channel normal depth above invert elev. = 0.034 (Ft.)
439 Average velocity of channel(s) = 2.019 (Ft/s)
440 Adding area flow to channel
441 Rainfall intensity (I) = 5.880 (In/Hr) for a 100.0 year storm
442 Decimal fraction soil group A = 0.010
443 Decimal fraction soil group B = 0.000
444 Decimal fraction soil group C = 0.990
445 Decimal fraction soil group D = 0.000
446 [HIGH DENSITY RESIDENTIAL ]
447 (43.0 DU/A or Less )
448 Impervious value, Ai = 0.800
449 Sub-Area C Value = 0.780
450 Rainfall intensity = 5.880 (In/Hr) for a 100.0 year storm
451 Effective runoff coefficient used for total area
452 (Q=KCIA) is C = 0.767 CA = 0.434
453 Subarea runoff = 1.764 (CFS) for 0.396 (Ac.)
454 Total runoff = 2.554 (CFS) Total area = 0.566 (Ac.)
455 Depth of flow = 0.043 (Ft.), Average velocity = 2.369 (Ft/s)
456
457
458 +-----+
459 Process from Point/Station 503.000 to Point/Station 804.000
460 **** PIPEFLOW TRAVEL TIME (User specified size) ****
461
462 Upstream point/station elevation = 307.000 (Ft.)
463 Downstream point/station elevation = 302.800 (Ft.)
464 Pipe length = 44.00 (Ft.) Slope = 0.0955 Manning's N = 0.013
465 No. of pipes = 1 Required pipe flow = 2.554 (CFS)
466 Given pipe size = 12.00 (In.)
467 Calculated individual pipe flow = 2.554 (CFS)
468 Normal flow depth in pipe = 3.93 (In.)
469 Flow top width inside pipe = 11.26 (In.)
470 Critical Depth = 8.22 (In.)
471 Pipe flow velocity = 11.41 (Ft/s)
472 Travel time through pipe = 0.06 min.
473 Time of concentration (TC) = 10.11 min.
474
475
476 +-----+
477 Process from Point/Station 804.000 to Point/Station 804.000
478 **** CONFLUENCE OF MINOR STREAMS ****
479
480 Along Main Stream number: 1 in normal stream number 3
481 Stream flow area = 0.566 (Ac.)
482 Runoff from this stream = 2.554 (CFS)
483 Time of concentration = 10.11 min.

```

484 Rainfall intensity = 5.856 (In/Hr)

485 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	2.851	16.29	4.305
2	2.649	7.96	6.834
3	2.554	10.11	5.856

494 Qmax (1) =
 495 1.000 * 1.000 * 2.851) +
 496 0.630 * 1.000 * 2.649) +
 497 0.735 * 1.000 * 2.554) + = 6.397

498 Qmax (2) =
 499 1.000 * 0.488 * 2.851) +
 500 1.000 * 1.000 * 2.649) +
 501 1.000 * 0.787 * 2.554) + = 6.051

502 Qmax (3) =
 503 1.000 * 0.621 * 2.851) +
 504 0.857 * 1.000 * 2.649) +
 505 1.000 * 1.000 * 2.554) + = 6.593

506
 507 Total of 3 streams to confluence:
 508 Flow rates before confluence point:
 509 2.851 2.649 2.554
 510 Maximum flow rates at confluence using above data:
 511 6.397 6.051 6.593

512 Area of streams before confluence:
 513 1.110 0.490 0.566

514 Results of confluence:
 515 Total flow rate = 6.593 (CFS)
 516 Time of concentration = 10.110 min.
 517 Effective stream area after confluence = 2.166 (Ac.)

518
 519
 520 +++++
 521 Process from Point/Station 804.000 to Point/Station 106.000
 522 **** PIPEFLOW TRAVEL TIME (User specified size) ****

524 Upstream point/station elevation = 302.800 (Ft.)
 525 Downstream point/station elevation = 302.600 (Ft.)
 526 Pipe length = 38.00 (Ft.) Slope = 0.0053 Manning's N = 0.013
 527 No. of pipes = 1 Required pipe flow = 6.593 (CFS)
 528 Given pipe size = 12.00 (In.)
 529 NOTE: Normal flow is pressure flow in user selected pipe size.
 530 The approximate hydraulic grade line above the pipe invert is
 531 2.742 (Ft.) at the headworks or inlet of the pipe(s)
 532 Pipe friction loss = 1.301 (Ft.)
 533 Minor friction loss = 1.641 (Ft.) K-factor = 1.50
 534 Pipe flow velocity = 8.39 (Ft/s)
 535 Travel time through pipe = 0.08 min.
 536 Time of concentration (TC) = 10.19 min.
 537 End of computations, total study area = 2.166 (Ac.)

538
 539
 540

3f. CivilD Post Development Offsite Calculations

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2014 Version 9.0

Rational method hydrology program based on
San Diego County Flood Control Division 2003 hydrology manual
Rational Hydrology Study Date: 01/27/21

19025 Post Dev
100 Year Study Offsite
19025Post1000ffsite.rd3

***** Hydrology Study Control Information *****

Program License Serial Number 6332

Rational hydrology study storm event year is 100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour, precipitation(inches) = 3.500
24 hour precipitation(inches) = 6.000
P6/P24 = 58.3%
San Diego hydrology manual 'C' values used

Process from Point/Station 1000.000 to Point/Station 1001.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[MEDIUM DENSITY RESIDENTIAL]
(7.3 DU/A or Less)
Impervious value, Ai = 0.400
Sub-Area C Value = 0.480
Initial subarea total flow distance = 100.000(Ft.)
Highest elevation = 379.000(Ft.)
Lowest elevation = 372.000(Ft.)
Elevation difference = 7.000(Ft.) Slope = 7.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 7.00 %, in a development type of
7.3 DU/A or Less
In Accordance With Table 3-2
Initial Area Time of Concentration = 6.00 minutes
(for slope value of 5.00 %)
Rainfall intensity (I) = 8.198(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.480
Subarea runoff = 0.315(CFS)
Total initial stream area = 0.080(Ac.)

Process from Point/Station 1001.000 to Point/Station 1002.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Estimated mean flow rate at midpoint of channel = 5.468(CFS)
Depth of flow = 0.404(Ft.), Average velocity = 5.574(Ft/s)
***** Irregular Channel Data *****


```

70 Information entered for subchannel number 1 :
71 Point number      'X' coordinate      'Y' coordinate
72     1              0.00              2.71
73     2              31.00              0.13
74     3              32.50              0.00
75     4              32.50              0.50
76 Manning's 'N' friction factor = 0.015
77 -----
78 Sub-Channel flow = 5.468(CFS)
79 ' ' flow top width = 4.851(Ft.)
80 ' ' velocity= 5.574(Ft/s)
81 ' ' area = 0.981(Sq.Ft)
82 ' ' Froude number = 2.184
83
84 Upstream point elevation = 372.000(Ft.)
85 Downstream point elevation = 347.000(Ft.)
86 Flow length = 839.000(Ft.)
87 Travel time = 2.51 min.
88 Time of concentration = 8.51 min.
89 Depth of flow = 0.404(Ft.)
90 Average velocity = 5.574(Ft/s)
91 Total irregular channel flow = 5.468(CFS)
92 Irregular channel normal depth above invert elev. = 0.404(Ft.)
93 Average velocity of channel(s) = 5.574(Ft/s)
94 Adding area flow to channel
95 Rainfall intensity (I) = 6.545(In/Hr) for a 100.0 year storm
96 Decimal fraction soil group A = 1.000
97 Decimal fraction soil group B = 0.000
98 Decimal fraction soil group C = 0.000
99 Decimal fraction soil group D = 0.000
100 [MEDIUM DENSITY RESIDENTIAL ]
101 (4.3 DU/A or Less )
102 Impervious value, Ai = 0.300
103 Sub-Area C Value = 0.410
104 Rainfall intensity = 6.545(In/Hr) for a 100.0 year storm
105 Effective runoff coefficient used for total area
106 (Q=KCIA) is C = 0.411 CA = 1.609
107 Subarea runoff = 10.213(CFS) for 3.830(Ac.)
108 Total runoff = 10.528(CFS) Total area = 3.910(Ac.)
109 Depth of flow = 0.517(Ft.), Average velocity = 6.574(Ft/s)
110
111
112 +-----+
113 Process from Point/Station 1002.000 to Point/Station 1002.500
114 **** PIPEFLOW TRAVEL TIME (User specified size) ****
115
116 Upstream point/station elevation = 344.000(Ft.)
117 Downstream point/station elevation = 325.600(Ft.)
118 Pipe length = 160.00(Ft.) Slope = 0.1150 Manning's N = 0.013
119 No. of pipes = 1 Required pipe flow = 10.528(CFS)
120 Given pipe size = 18.00(In.)
121 Calculated individual pipe flow = 10.528(CFS)
122 Normal flow depth in pipe = 6.70(In.)
123 Flow top width inside pipe = 17.40(In.)
124 Critical Depth = 14.96(In.)
125 Pipe flow velocity = 17.55(Ft/s)
126 Travel time through pipe = 0.15 min.
127 Time of concentration (TC) = 8.66 min.
128
129
130 +-----+
131 Process from Point/Station 1002.500 to Point/Station 1002.500
132 **** SUBAREA FLOW ADDITION ****
133
134 Rainfall intensity (I) = 6.470(In/Hr) for a 100.0 year storm
135 Decimal fraction soil group A = 1.000
136 Decimal fraction soil group B = 0.000
137 Decimal fraction soil group C = 0.000
138 Decimal fraction soil group D = 0.000

```

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139 [MEDIUM DENSITY RESIDENTIAL ]
140 (7.3 DU/A or Less )
141 Impervious value, Ai = 0.400
142 Sub-Area C Value = 0.480
143 Time of concentration = 8.66 min.
144 Rainfall intensity = 6.470(In/Hr) for a 100.0 year storm
145 Effective runoff coefficient used for total area
146 (Q=KCIA) is C = 0.426 CA = 2.132
147 Subarea runoff = 3.266(CFS) for 1.090(Ac.)
148 Total runoff = 13.794(CFS) Total area = 5.000(Ac.)
149
150
151 ++++++
152 Process from Point/Station 1002.500 to Point/Station 1003.000
153 **** PIPEFLOW TRAVEL TIME (User specified size) ****
154
155 Upstream point/station elevation = 325.500(Ft.)
156 Downstream point/station elevation = 322.000(Ft.)
157 Pipe length = 71.00(Ft.) Slope = 0.0493 Manning's N = 0.013
158 No. of pipes = 1 Required pipe flow = 13.794(CFS)
159 Given pipe size = 18.00(In.)
160 Calculated individual pipe flow = 13.794(CFS)
161 Normal flow depth in pipe = 9.96(In.)
162 Flow top width inside pipe = 17.90(In.)
163 Critical Depth = 16.50(In.)
164 Pipe flow velocity = 13.75(Ft/s)
165 Travel time through pipe = 0.09 min.
166 Time of concentration (TC) = 8.75 min.
167 End of computations, total study area = 5.000 (Ac.)
168
169
170

```

3f. CivilD Post Development Calculations

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software, (c)1991-2014 Version 9.0

Rational method hydrology program based on
San Diego County Flood Control Division 2003 hydrology manual
Rational Hydrology Study Date: 05/25/23

19025 Post Dev
100 Year Study Reach 1
PostDev100R1.rd3
offiste ud to onsite w/main confluence

***** Hydrology Study Control Information *****

Program License Serial Number 6332

Rational hydrology study storm event year is 100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour, precipitation(inches) = 3.500
24 hour precipitation(inches) = 6.000
P6/P24 = 58.3%
San Diego hydrology manual 'C' values used

+++++
Process from Point/Station 100.000 to Point/Station 101.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[MEDIUM DENSITY RESIDENTIAL]
(7.3 DU/A or Less)
Impervious value, Ai = 0.400
Sub-Area C Value = 0.480
Initial subarea total flow distance = 53.000 (Ft.)
Highest elevation = 316.800 (Ft.)
Lowest elevation = 316.700 (Ft.)
Elevation difference = 0.100 (Ft.) Slope = 0.189 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 50.00 (Ft)
for the top area slope value of 0.19 %, in a development type of
7.3 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration = 13.75 minutes
TC = [1.8*(1.1-C)*distance (Ft.)^0.5]/(% slope^(1/3))
TC = [1.8*(1.1-0.4800)*(50.000^0.5)]/(0.189^(1/3))= 13.75
The initial area total distance of 53.00 (Ft.) entered leaves a
remaining distance of 3.00 (Ft.)
Using Figure 3-4, the travel time for this distance is 0.20 minutes
for a distance of 3.00 (Ft.) and a slope of 0.19 %
with an elevation difference of 0.01 (Ft.) from the end of the top area
Tt = [11.9*length (Mi)^3]/(elevation change (Ft.))^0.385 *60 (min/hr)
= 0.203 Minutes
Tt=[(11.9*0.0006^3)]/(0.01)]^0.385= 0.20
Total initial area Ti = 13.75 minutes from Figure 3-3 formula plus
0.20 minutes from the Figure 3-4 formula = 13.95 minutes
Rainfall intensity (I) = 4.757 (In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.480
Subarea runoff = 0.068 (CFS)

```

70 Total initial stream area = 0.030 (Ac.)
71
72
73 ++++++
74 Process from Point/Station 101.000 to Point/Station 102.000
75 **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
76
77 -----
78 Estimated mean flow rate at midpoint of channel = 0.228 (CFS)
79 Depth of flow = 0.095 (Ft.), Average velocity = 0.591 (Ft/s)
80 ***** Irregular Channel Data *****
81 -----
82 Information entered for subchannel number 1 :
83 Point number 'X' coordinate 'Y' coordinate
84 1 0.00 0.33
85 2 23.00 0.00
86 3 28.50 0.33
87 Manning's 'N' friction factor = 0.015
88 -----
89 Sub-Channel flow = 0.228 (CFS)
90 ' ' flow top width = 8.130 (Ft.)
91 ' ' velocity = 0.591 (Ft/s)
92 ' ' area = 0.386 (Sq.Ft)
93 ' ' Froude number = 0.478
94
95 Upstream point elevation = 316.700 (Ft.)
96 Downstream point elevation = 316.300 (Ft.)
97 Flow length = 193.000 (Ft.)
98 Travel time = 5.44 min.
99 Time of concentration = 19.39 min.
100 Depth of flow = 0.095 (Ft.)
101 Average velocity = 0.591 (Ft/s)
102 Total irregular channel flow = 0.228 (CFS)
103 Irregular channel normal depth above invert elev. = 0.095 (Ft.)
104 Average velocity of channel(s) = 0.591 (Ft/s)
105 Adding area flow to channel
106 Rainfall intensity (I) = 3.847 (In/Hr) for a 100.0 year storm
107 Decimal fraction soil group A = 1.000
108 Decimal fraction soil group B = 0.000
109 Decimal fraction soil group C = 0.000
110 Decimal fraction soil group D = 0.000
111 [MEDIUM DENSITY RESIDENTIAL ]
112 (7.3 DU/A or Less )
113 Impervious value, Ai = 0.400
114 Sub-Area C Value = 0.480
115 Rainfall intensity = 3.847 (In/Hr) for a 100.0 year storm
116 Effective runoff coefficient used for total area
117 (Q=KCIA) is C = 0.480 CA = 0.082
118 Subarea runoff = 0.245 (CFS) for 0.140 (Ac.)
119 Total runoff = 0.314 (CFS) Total area = 0.170 (Ac.)
120 Depth of flow = 0.107 (Ft.), Average velocity = 0.640 (Ft/s)
121
122 ++++++
123 Process from Point/Station 102.000 to Point/Station 102.000
124 **** SUBAREA FLOW ADDITION ****
125
126 -----
127 Rainfall intensity (I) = 3.847 (In/Hr) for a 100.0 year storm
128 Decimal fraction soil group A = 1.000
129 Decimal fraction soil group B = 0.000
130 Decimal fraction soil group C = 0.000
131 Decimal fraction soil group D = 0.000
132 [LOW DENSITY RESIDENTIAL ]
133 (1.0 DU/A or Less )
134 Impervious value, Ai = 0.100
135 Sub-Area C Value = 0.270
136 Time of concentration = 19.39 min.
137 Rainfall intensity = 3.847 (In/Hr) for a 100.0 year storm
138 Effective runoff coefficient used for total area
139 (Q=KCIA) is C = 0.393 CA = 0.114

```

139 Subarea runoff = 0.125(CFS) for 0.120(Ac.)
140 Total runoff = 0.439(CFS) Total area = 0.290(Ac.)
141
142

143 ++++++
144 Process from Point/Station 102.000 to Point/Station 103.000
145 **** PIPEFLOW TRAVEL TIME (User specified size) ****

147 Upstream point/station elevation = 310.200(Ft.)
148 Downstream point/station elevation = 309.000(Ft.)
149 Pipe length = 250.00(Ft.) Slope = 0.0048 Manning's N = 0.013
150 No. of pipes = 1 Required pipe flow = 0.439(CFS)
151 Given pipe size = 12.00(In.)
152 Calculated individual pipe flow = 0.439(CFS)
153 Normal flow depth in pipe = 3.42(In.)
154 Flow top width inside pipe = 10.84(In.)
155 Critical Depth = 3.28(In.)
156 Pipe flow velocity = 2.37(Ft/s)
157 Travel time through pipe = 1.76 min.
158 Time of concentration (TC) = 21.15 min.
159
160

161 ++++++
162 Process from Point/Station 103.000 to Point/Station 103.000
163 **** CONFLUENCE OF MINOR STREAMS ****

165 Along Main Stream number: 1 in normal stream number 1
166 Stream flow area = 0.290(Ac.)
167 Runoff from this stream = 0.439(CFS)
168 Time of concentration = 21.15 min.
169 Rainfall intensity = 3.637(In/Hr)
170
171

172 ++++++
173 Process from Point/Station 1100.000 to Point/Station 1101.000
174 **** INITIAL AREA EVALUATION ****

176 Decimal fraction soil group A = 1.000
177 Decimal fraction soil group B = 0.000
178 Decimal fraction soil group C = 0.000
179 Decimal fraction soil group D = 0.000
180 [LOW DENSITY RESIDENTIAL]
181 (1.0 DU/A or Less)
182 Impervious value, Ai = 0.100
183 Sub-Area C Value = 0.270
184 Initial subarea total flow distance = 59.000(Ft.)
185 Highest elevation = 336.700(Ft.)
186 Lowest elevation = 321.600(Ft.)
187 Elevation difference = 15.100(Ft.) Slope = 25.593 %
188 INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
189 The maximum overland flow distance is 100.00 (Ft)
190 for the top area slope value of 25.59 %, in a development type of
191 1.0 DU/A or Less
192 In Accordance With Figure 3-3
193 Initial Area Time of Concentration = 5.07 minutes
194 $TC = [1.8 * (1.1 - C) * distance(Ft.)^{.5} / (% slope^{(1/3)})]$
195 $TC = [1.8 * (1.1 - 0.2700) * (100.000^{.5}) / (25.593^{(1/3)})] = 5.07$
196 Rainfall intensity (I) = 9.140(In/Hr) for a 100.0 year storm
197 Effective runoff coefficient used for area (Q=KCIA) is C = 0.270
198 Subarea runoff = 0.173(CFS)
199 Total initial stream area = 0.070(Ac.)
200
201

202 ++++++
203 Process from Point/Station 1101.000 to Point/Station 103.000
204 **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

206 Estimated mean flow rate at midpoint of channel = 1.544(CFS)
207 Depth of flow = 0.128(Ft.), Average velocity = 3.658(Ft/s)

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276

***** Irregular Channel Data *****

Information entered for subchannel number 1 :
Point number 'X' coordinate 'Y' coordinate
1 0.00 0.60
2 16.00 0.00
3 46.00 1.20
Manning's 'N' friction factor = 0.015

Sub-Channel flow = 1.544 (CFS)
' ' flow top width = 6.605 (Ft.)
' ' velocity = 3.658 (Ft/s)
' ' area = 0.422 (Sq.Ft)
' ' Froude number = 2.549

Upstream point elevation = 321.600 (Ft.)
Downstream point elevation = 309.000 (Ft.)
Flow length = 236.000 (Ft.)
Travel time = 1.08 min.
Time of concentration = 6.15 min.
Depth of flow = 0.128 (Ft.)
Average velocity = 3.658 (Ft/s)
Total irregular channel flow = 1.544 (CFS)
Irregular channel normal depth above invert elev. = 0.128 (Ft.)
Average velocity of channel(s) = 3.658 (Ft/s)

Adding area flow to channel
Rainfall intensity (I) = 8.073 (In/Hr) for a 100.0 year storm
Decimal fraction soil group A = 0.100
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.900
Decimal fraction soil group D = 0.000
[MEDIUM DENSITY RESIDENTIAL]
(7.3 DU/A or Less)
Impervious value, Ai = 0.400
Sub-Area C Value = 0.534
Rainfall intensity = 8.073 (In/Hr) for a 100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.509 CA = 0.371
Subarea runoff = 2.825 (CFS) for 0.660 (Ac.)
Total runoff = 2.998 (CFS) Total area = 0.730 (Ac.)
Depth of flow = 0.164 (Ft.), Average velocity = 4.317 (Ft/s)

++++
Process from Point/Station 103.000 to Point/Station 103.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 0.730 (Ac.)
Runoff from this stream = 2.998 (CFS)
Time of concentration = 6.15 min.
Rainfall intensity = 8.073 (In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	0.439	21.15	3.637
2	2.998	6.15	8.073
Qmax (1) =			
	1.000 *	1.000 *	0.439) +
	0.451 *	1.000 *	2.998) + = 1.789
Qmax (2) =			
	1.000 *	0.291 *	0.439) +
	1.000 *	1.000 *	2.998) + = 3.125

Total of 2 streams to confluence:
Flow rates before confluence point:

```

277         0.439         2.998
278 Maximum flow rates at confluence using above data:
279         1.789         3.125
280 Area of streams before confluence:
281         0.290         0.730
282 Results of confluence:
283 Total flow rate =         3.125 (CFS)
284 Time of concentration =         6.145 min.
285 Effective stream area after confluence =         1.020 (Ac.)
286
287
288 ++++++
289 Process from Point/Station         103.000 to Point/Station         104.000
290 **** PIPEFLOW TRAVEL TIME (User specified size) ****
291
292 Upstream point/station elevation =         304.200 (Ft.)
293 Downstream point/station elevation =         303.300 (Ft.)
294 Pipe length =         189.00 (Ft.) Slope =         0.0048 Manning's N =         0.013
295 No. of pipes =         1 Required pipe flow =         3.125 (CFS)
296 Given pipe size =         18.00 (In.)
297 Calculated individual pipe flow =         3.125 (CFS)
298 Normal flow depth in pipe =         8.26 (In.)
299 Flow top width inside pipe =         17.94 (In.)
300 Critical Depth =         8.07 (In.)
301 Pipe flow velocity =         3.95 (Ft/s)
302 Travel time through pipe =         0.80 min.
303 Time of concentration (TC) =         6.94 min.
304
305
306 ++++++
307 Process from Point/Station         104.000 to Point/Station         104.000
308 **** CONFLUENCE OF MINOR STREAMS ****
309
310 Along Main Stream number: 1 in normal stream number 1
311 Stream flow area =         1.020 (Ac.)
312 Runoff from this stream =         3.125 (CFS)
313 Time of concentration =         6.94 min.
314 Rainfall intensity =         7.462 (In/Hr)
315
316
317 ++++++
318 Process from Point/Station         200.000 to Point/Station         201.000
319 **** INITIAL AREA EVALUATION ****
320
321 Decimal fraction soil group A =         0.050
322 Decimal fraction soil group B =         0.000
323 Decimal fraction soil group C =         0.950
324 Decimal fraction soil group D =         0.000
325 [COMMERCIAL area type
326 (Office Professional
327 Impervious value, Ai =         0.900
328 Sub-Area C Value =         0.839
329 Initial subarea total flow distance =         50.000 (Ft.)
330 Highest elevation =         316.800 (Ft.)
331 Lowest elevation =         316.200 (Ft.)
332 Elevation difference =         0.600 (Ft.) Slope =         1.200 %
333 INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
334 The maximum overland flow distance is         60.00 (Ft)
335 for the top area slope value of         1.20 %, in a development type of
336 Office Professional
337 In Accordance With Figure 3-3
338 Initial Area Time of Concentration =         3.42 minutes
339 TC = [1.8*(1.1-C)*distance (Ft.)^.5]/(% slope^(1/3)]
340 TC = [1.8*(1.1-0.8395)*( 60.000^.5)/( 1.200^(1/3)]=         3.42
341 Calculated TC of         3.418 minutes is less than 5 minutes,
342 resetting TC to 5.0 minutes for rainfall intensity calculations
343 Rainfall intensity (I) =         9.222 (In/Hr) for a         100.0 year storm
344 Effective runoff coefficient used for area (Q=KCIA) is C =         0.839
345 Subarea runoff =         0.310 (CFS)

```



```

346 Total initial stream area =          0.040 (Ac.)
347
348
349 ++++++
350 Process from Point/Station      201.000 to Point/Station      202.000
351 **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
352
353 -----
354 Estimated mean flow rate at midpoint of channel =          2.245 (CFS)
355 Depth of flow =  0.209 (Ft.), Average velocity =  2.102 (Ft/s)
356 ***** Irregular Channel Data *****
357 -----
358 Information entered for subchannel number 1 :
359 Point number      'X' coordinate      'Y' coordinate
360      1              0.00              0.30
361      2              1.50              0.00
362      3              45.50             1.00
363      4              61.50             1.50
364 Manning's 'N' friction factor =  0.015
365 -----
366 Sub-Channel flow =          2.245 (CFS)
367 '      '      flow top width =  10.230 (Ft.)
368 '      '      velocity=  2.102 (Ft/s)
369 '      '      area =  1.068 (Sq.Ft)
370 '      '      Froude number =  1.147
371
372 Upstream point elevation =  316.200 (Ft.)
373 Downstream point elevation =  314.500 (Ft.)
374 Flow length =  185.000 (Ft.)
375 Travel time =  1.47 min.
376 Time of concentration =  4.88 min.
377 Depth of flow =  0.209 (Ft.)
378 Average velocity =  2.102 (Ft/s)
379 Total irregular channel flow =  2.245 (CFS)
380 Irregular channel normal depth above invert elev. =  0.209 (Ft.)
381 Average velocity of channel(s) =  2.102 (Ft/s)
382 Adding area flow to channel
383 Calculated TC of  4.885 minutes is less than 5 minutes,
384 resetting TC to 5.0 minutes for rainfall intensity calculations
385 Rainfall intensity (I) =  9.222 (In/Hr) for a 100.0 year storm
386 Decimal fraction soil group A = 0.000
387 Decimal fraction soil group B = 0.000
388 Decimal fraction soil group C = 1.000
389 Decimal fraction soil group D = 0.000
390 [COMMERCIAL area type ]
391 (Office Professional )
392 Impervious value, Ai = 0.900
393 Sub-Area C Value = 0.840
394 Rainfall intensity =  9.222 (In/Hr) for a 100.0 year storm
395 Effective runoff coefficient used for total area
396 (Q=KCIA) is C = 0.840 CA =  0.454
397 Subarea runoff =  3.873 (CFS) for  0.500 (Ac.)
398 Total runoff =  4.183 (CFS) Total area =  0.540 (Ac.)
399 Depth of flow =  0.264 (Ft.), Average velocity =  2.456 (Ft/s)
400
401 ++++++
402 Process from Point/Station      202.000 to Point/Station      104.000
403 **** PIPEFLOW TRAVEL TIME (User specified size) ****
404
405 -----
406 Upstream point/station elevation =  308.500 (Ft.)
407 Downstream point/station elevation =  303.300 (Ft.)
408 Pipe length =  48.00 (Ft.) Slope =  0.1083 Manning's N = 0.013
409 No. of pipes = 1 Required pipe flow =  4.183 (CFS)
410 Given pipe size =  12.00 (In.)
411 Calculated individual pipe flow =  4.183 (CFS)
412 Normal flow depth in pipe =  4.95 (In.)
413 Flow top width inside pipe =  11.82 (In.)
414 Critical Depth =  10.36 (In.)
415 Pipe flow velocity =  13.68 (Ft/s)

```

```

415 Travel time through pipe = 0.06 min.
416 Time of concentration (TC) = 4.94 min.
417
418
419 +-----+
420 Process from Point/Station 202.000 to Point/Station 104.000
421 **** CONFLUENCE OF MINOR STREAMS ****
422
423 Along Main Stream number: 1 in normal stream number 2
424 Stream flow area = 0.540 (Ac.)
425 Runoff from this stream = 4.183 (CFS)
426 Time of concentration = 4.94 min.
427 Rainfall intensity = 9.222 (In/Hr)
428
429
430 +-----+
431 Process from Point/Station 300.000 to Point/Station 301.000
432 **** INITIAL AREA EVALUATION ****
433
434 Decimal fraction soil group A = 0.000
435 Decimal fraction soil group B = 0.000
436 Decimal fraction soil group C = 1.000
437 Decimal fraction soil group D = 0.000
438 [COMMERCIAL area type ]
439 (Neighborhood Commercial )
440 Impervious value, Ai = 0.800
441 Sub-Area C Value = 0.780
442 Initial subarea total flow distance = 42.000 (Ft.)
443 Highest elevation = 316.000 (Ft.)
444 Lowest elevation = 314.700 (Ft.)
445 Elevation difference = 1.300 (Ft.) Slope = 3.095 %
446 INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
447 The maximum overland flow distance is 85.00 (Ft)
448 for the top area slope value of 3.10 %, in a development type of
449 Neighborhood Commercial
450 In Accordance With Figure 3-3
451 Initial Area Time of Concentration = 3.64 minutes
452 TC = [1.8*(1.1-C)*distance (Ft.)^.5]/(% slope^(1/3)]
453 TC = [1.8*(1.1-0.7800)*( 85.000^.5)]/( 3.095^(1/3)]= 3.64
454 Calculated TC of 3.644 minutes is less than 5 minutes,
455 resetting TC to 5.0 minutes for rainfall intensity calculations
456 Rainfall intensity (I) = 9.222 (In/Hr) for a 100.0 year storm
457 Effective runoff coefficient used for area (Q=KCIA) is C = 0.780
458 Subarea runoff = 0.288 (CFS)
459 Total initial stream area = 0.040 (Ac.)
460
461
462 +-----+
463 Process from Point/Station 301.000 to Point/Station 302.000
464 **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
465
466 Estimated mean flow rate at midpoint of channel = 1.259 (CFS)
467 Depth of flow = 0.087 (Ft.), Average velocity = 2.583 (Ft/s)
468 ***** Irregular Channel Data *****
469
470 -----
471 Information entered for subchannel number 1 :
472 Point number 'X' coordinate 'Y' coordinate
473 1 0.00 0.50
474 2 0.00 0.00
475 3 64.00 0.50
476 Manning's 'N' friction factor = 0.015
477
478 -----
479 Sub-Channel flow = 1.259 (CFS)
480 ' ' flow top width = 11.169 (Ft.)
481 ' ' velocity= 2.583 (Ft/s)
482 ' ' area = 0.487 (Sq.Ft)
483 ' ' Froude number = 2.180
484
485 Upstream point elevation = 314.700 (Ft.)

```

484 Downstream point elevation = 313.000 (Ft.)
 485 Flow length = 38.000 (Ft.)
 486 Travel time = 0.25 min.
 487 Time of concentration = 3.89 min.
 488 Depth of flow = 0.087 (Ft.)
 489 Average velocity = 2.583 (Ft/s)
 490 Total irregular channel flow = 1.259 (CFS)
 491 Irregular channel normal depth above invert elev. = 0.087 (Ft.)
 492 Average velocity of channel(s) = 2.583 (Ft/s)
 493 Adding area flow to channel
 494 Calculated TC of 3.889 minutes is less than 5 minutes,
 495 resetting TC to 5.0 minutes for rainfall intensity calculations
 496 Rainfall intensity (I) = 9.222 (In/Hr) for a 100.0 year storm
 497 Decimal fraction soil group A = 0.000
 498 Decimal fraction soil group B = 0.000
 499 Decimal fraction soil group C = 1.000
 500 Decimal fraction soil group D = 0.000
 501 [COMMERCIAL area type]
 502 (Neighborhood Commercial)
 503 Impervious value, Ai = 0.800
 504 Sub-Area C Value = 0.780
 505 Rainfall intensity = 9.222 (In/Hr) for a 100.0 year storm
 506 Effective runoff coefficient used for total area
 507 (Q=KCIA) is C = 0.780 CA = 0.242
 508 Subarea runoff = 1.942 (CFS) for 0.270 (Ac.)
 509 Total runoff = 2.230 (CFS) Total area = 0.310 (Ac.)
 510 Depth of flow = 0.108 (Ft.), Average velocity = 2.980 (Ft/s)

 514 Process from Point/Station 302.000 to Point/Station 104.000
 515 **** PIPEFLOW TRAVEL TIME (User specified size) ****

517 Upstream point/station elevation = 306.000 (Ft.)
 518 Downstream point/station elevation = 303.300 (Ft.)
 519 Pipe length = 30.00 (Ft.) Slope = 0.0900 Manning's N = 0.013
 520 No. of pipes = 1 Required pipe flow = 2.230 (CFS)
 521 Given pipe size = 12.00 (In.)
 522 Calculated individual pipe flow = 2.230 (CFS)
 523 Normal flow depth in pipe = 3.72 (In.)
 524 Flow top width inside pipe = 11.10 (In.)
 525 Critical Depth = 7.66 (In.)
 526 Pipe flow velocity = 10.75 (Ft/s)
 527 Travel time through pipe = 0.05 min.
 528 Time of concentration (TC) = 3.94 min.

 532 Process from Point/Station 104.000 to Point/Station 104.000
 533 **** CONFLUENCE OF MINOR STREAMS ****

535 Along Main Stream number: 1 in normal stream number 3
 536 Stream flow area = 0.310 (Ac.)
 537 Runoff from this stream = 2.230 (CFS)
 538 Time of concentration = 3.94 min.
 539 Rainfall intensity = 9.222 (In/Hr)
 540 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	3.125	6.94	7.462
2	4.183	4.94	9.222
3	2.230	3.94	9.222
Qmax(1) =			
	1.000 *	1.000 *	3.125) +
	0.809 *	1.000 *	4.183) +
	0.809 *	1.000 *	2.230) + = 8.314

```

553 Qmax (2) =
554     1.000 *    0.712 *    3.125) +
555     1.000 *    1.000 *    4.183) +
556     1.000 *    1.000 *    2.230) + =      8.638
557 Qmax (3) =
558     1.000 *    0.567 *    3.125) +
559     1.000 *    0.796 *    4.183) +
560     1.000 *    1.000 *    2.230) + =      7.332

```

```

562 Total of 3 streams to confluence:
563 Flow rates before confluence point:
564     3.125     4.183     2.230
565 Maximum flow rates at confluence using above data:
566     8.314     8.638     7.332
567 Area of streams before confluence:
568     1.020     0.540     0.310

```

```

569 Results of confluence:
570 Total flow rate =      8.638 (CFS)
571 Time of concentration =    4.943 min.
572 Effective stream area after confluence =    1.870 (Ac.)

```

```

573
574
575 ++++++
576 Process from Point/Station    104.000 to Point/Station    105.000
577 **** PIPEFLOW TRAVEL TIME (User specified size) ****

```

```

579 Upstream point/station elevation =  303.300 (Ft.)
580 Downstream point/station elevation =  303.000 (Ft.)
581 Pipe length =    71.00 (Ft.) Slope =    0.0042 Manning's N = 0.013
582 No. of pipes = 1 Required pipe flow =    8.638 (CFS)
583 Given pipe size =    18.00 (In.)
584 NOTE: Normal flow is pressure flow in user selected pipe size.
585 The approximate hydraulic grade line above the pipe invert is
586     0.736 (Ft.) at the headworks or inlet of the pipe(s)
587 Pipe friction loss =    0.480 (Ft.)
588 Minor friction loss =    0.556 (Ft.) K-factor =    1.50
589 Pipe flow velocity =    4.89 (Ft/s)
590 Travel time through pipe =    0.24 min.
591 Time of concentration (TC) =    5.19 min.

```

```

592
593
594 ++++++
595 Process from Point/Station    105.000 to Point/Station    105.000
596 **** CONFLUENCE OF MINOR STREAMS ****

```

```

598 Along Main Stream number: 1 in normal stream number 1
599 Stream flow area =    1.870 (Ac.)
600 Runoff from this stream =    8.638 (CFS)
601 Time of concentration =    5.19 min.
602 Rainfall intensity =    9.008 (In/Hr)

```

```

603
604
605 ++++++
606 Process from Point/Station    400.000 to Point/Station    401.000
607 **** INITIAL AREA EVALUATION ****

```

```

609 Decimal fraction soil group A = 0.000
610 Decimal fraction soil group B = 0.000
611 Decimal fraction soil group C = 1.000
612 Decimal fraction soil group D = 0.000
613 [HIGH DENSITY RESIDENTIAL
614 (43.0 DU/A or Less )
615 Impervious value, Ai = 0.800
616 Sub-Area C Value = 0.780
617 Initial subarea total flow distance = 100.000 (Ft.)
618 Highest elevation = 316.100 (Ft.)
619 Lowest elevation = 312.600 (Ft.)
620 Elevation difference = 3.500 (Ft.) Slope = 3.500 %
621 INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:

```

```

622 The maximum overland flow distance is 85.00 (Ft)
623 for the top area slope value of 3.50 %, in a development type of
624 43.0 DU/A or Less
625 In Accordance With Figure 3-3
626 Initial Area Time of Concentration = 3.50 minutes
627  $TC = [1.8 * (1.1 - C) * distance (Ft.)^{.5} / (% slope^{(1/3)})]$ 
628  $TC = [1.8 * (1.1 - 0.7800) * (85.000^{.5}) / (3.500^{(1/3)})] = 3.50$ 
629 The initial area total distance of 100.00 (Ft.) entered leaves a
630 remaining distance of 15.00 (Ft.)
631 Using Figure 3-4, the travel time for this distance is 0.23 minutes
632 for a distance of 15.00 (Ft.) and a slope of 3.50 %
633 with an elevation difference of 0.53 (Ft.) from the end of the top area
634  $Tt = [11.9 * length (Mi)^3 / (elevation change (Ft.))]^{.385} * 60 (min/hr)$ 
635 = 0.228 Minutes
636  $Tt = [(11.9 * 0.0028^3) / (0.53)]^{.385} = 0.23$ 
637 Total initial area  $Ti = 3.50$  minutes from Figure 3-3 formula plus
638 0.23 minutes from the Figure 3-4 formula = 3.73 minutes
639 Calculated TC of 3.726 minutes is less than 5 minutes,
640 resetting TC to 5.0 minutes for rainfall intensity calculations
641 Rainfall intensity (I) = 9.222 (In/Hr) for a 100.0 year storm
642 Effective runoff coefficient used for area (Q=KCIA) is  $C = 0.780$ 
643 Subarea runoff = 0.791 (CFS)
644 Total initial stream area = 0.110 (Ac.)
645
646
647 ++++++
648 Process from Point/Station 401.000 to Point/Station 402.000
649 **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
650
651 -----
652 Estimated mean flow rate at midpoint of channel = 1.043 (CFS)
653 Depth of flow = 0.351 (Ft.), Average velocity = 4.504 (Ft/s)
654 ***** Irregular Channel Data *****
655 -----
656 Information entered for subchannel number 1 :
657 Point number 'X' coordinate 'Y' coordinate
658 1 0.00 1.10
659 2 34.00 0.40
660 3 35.50 0.00
661 4 35.50 0.50
662 Manning's 'N' friction factor = 0.015
663 -----
664 Sub-Channel flow = 1.043 (CFS)
665 ' ' flow top width = 1.318 (Ft.)
666 ' ' velocity = 4.504 (Ft/s)
667 ' ' area = 0.232 (Sq.Ft)
668 ' ' Froude number = 1.894
669
670 Upstream point elevation = 312.600 (Ft.)
671 Downstream point elevation = 310.600 (Ft.)
672 Flow length = 67.000 (Ft.)
673 Travel time = 0.25 min.
674 Time of concentration = 3.97 min.
675 Depth of flow = 0.351 (Ft.)
676 Average velocity = 4.504 (Ft/s)
677 Total irregular channel flow = 1.043 (CFS)
678 Irregular channel normal depth above invert elev. = 0.351 (Ft.)
679 Average velocity of channel (s) = 4.504 (Ft/s)
680 Adding area flow to channel
681 Calculated TC of 3.974 minutes is less than 5 minutes,
682 resetting TC to 5.0 minutes for rainfall intensity calculations
683 Rainfall intensity (I) = 9.222 (In/Hr) for a 100.0 year storm
684 Decimal fraction soil group A = 0.000
685 Decimal fraction soil group B = 0.000
686 Decimal fraction soil group C = 1.000
687 Decimal fraction soil group D = 0.000
688 [HIGH DENSITY RESIDENTIAL ]
689 (43.0 DU/A or Less )
690 Impervious value,  $Ai = 0.800$ 
691 Sub-Area C Value = 0.780

```

691 Rainfall intensity = 9.222(In/Hr) for a 100.0 year storm
 692 Effective runoff coefficient used for total area
 693 (Q=KCIA) is C = 0.780 CA = 0.140
 694 Subarea runoff = 0.503(CFS) for 0.070(Ac.)
 695 Total runoff = 1.295(CFS) Total area = 0.180(Ac.)
 696 Depth of flow = 0.381(Ft.), Average velocity = 4.754(Ft/s)

699 ++++++
 700 Process from Point/Station 105.000 to Point/Station 105.000
 701 **** CONFLUENCE OF MINOR STREAMS ****

703 Along Main Stream number: 1 in normal stream number 2
 704 Stream flow area = 0.180(Ac.)
 705 Runoff from this stream = 1.295(CFS)
 706 Time of concentration = 3.97 min.
 707 Rainfall intensity = 9.222(In/Hr)
 708 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
------------	-----------------	----------	----------------------------

714	1	8.638	5.19	9.008
715	2	1.295	3.97	9.222
716	Qmax(1) =			
717		1.000 *	1.000 *	8.638) +
718		0.977 *	1.000 *	1.295) + = 9.902
719	Qmax(2) =			
720		1.000 *	0.766 *	8.638) +
721		1.000 *	1.000 *	1.295) + = 7.915

723 Total of 2 streams to confluence:
 724 Flow rates before confluence point:
 725 8.638 1.295
 726 Maximum flow rates at confluence using above data:
 727 9.902 7.915
 728 Area of streams before confluence:
 729 1.870 0.180
 730 Results of confluence:
 731 Total flow rate = 9.902(CFS)
 732 Time of concentration = 5.185 min.
 733 Effective stream area after confluence = 2.050(Ac.)

736 ++++++
 737 Process from Point/Station 105.000 to Point/Station 106.000
 738 **** PIPEFLOW TRAVEL TIME (User specified size) ****

740 Upstream point/station elevation = 303.000(Ft.)
 741 Downstream point/station elevation = 302.500(Ft.)
 742 Pipe length = 77.00(Ft.) Slope = 0.0065 Manning's N = 0.013
 743 No. of pipes = 1 Required pipe flow = 9.902(CFS)
 744 Given pipe size = 12.00(In.)
 745 NOTE: Normal flow is pressure flow in user selected pipe size.
 746 The approximate hydraulic grade line above the pipe invert is
 747 9.149(Ft.) at the headworks or inlet of the pipe(s)
 748 Pipe friction loss = 5.946(Ft.)
 749 Minor friction loss = 3.703(Ft.) K-factor = 1.50
 750 Pipe flow velocity = 12.61(Ft/s)
 751 Travel time through pipe = 0.10 min.
 752 Time of concentration (TC) = 5.29 min.

755 ++++++
 756 Process from Point/Station 106.000 to Point/Station 106.000
 757 **** CONFLUENCE OF MAIN STREAMS ****

759 The following data inside Main Stream is listed:

```

760 In Main Stream number: 1
761 Stream flow area = 2.050 (Ac.)
762 Runoff from this stream = 9.902 (CFS)
763 Time of concentration = 5.29 min.
764 Rainfall intensity = 8.896 (In/Hr)
765 Program is now starting with Main Stream No. 2
766
767
768 ++++++
769 Process from Point/Station 804.000 to Point/Station 106.000
770 **** USER DEFINED FLOW INFORMATION AT A POINT ****
771
772 -----
773 Decimal fraction soil group A = 0.000
774 Decimal fraction soil group B = 0.000
775 Decimal fraction soil group C = 1.000
776 Decimal fraction soil group D = 0.000
777 [HIGH DENSITY RESIDENTIAL ]
778 (43.0 DU/A or Less )
779 Impervious value, Ai = 0.800
780 Sub-Area C Value = 0.780
781 Rainfall intensity (I) = 5.826 (In/Hr) for a 100.0 year storm
782 User specified values are as follows:
783 TC = 10.19 min. Rain intensity = 5.83 (In/Hr)
784 Total area = 2.170 (Ac.) Total runoff = 6.593 (CFS)
785
786 ++++++
787 Process from Point/Station 106.000 to Point/Station 106.000
788 **** CONFLUENCE OF MAIN STREAMS ****
789
790 -----
791 The following data inside Main Stream is listed:
792 In Main Stream number: 2
793 Stream flow area = 2.170 (Ac.)
794 Runoff from this stream = 6.593 (CFS)
795 Time of concentration = 10.19 min.
796 Rainfall intensity = 5.826 (In/Hr)
797 Program is now starting with Main Stream No. 3
798
799 ++++++
800 Process from Point/Station 1004.000 to Point/Station 1005.000
801 **** INITIAL AREA EVALUATION ****
802
803 -----
804 Decimal fraction soil group A = 1.000
805 Decimal fraction soil group B = 0.000
806 Decimal fraction soil group C = 0.000
807 Decimal fraction soil group D = 0.000
808 [LOW DENSITY RESIDENTIAL ]
809 (1.0 DU/A or Less )
810 Impervious value, Ai = 0.100
811 Sub-Area C Value = 0.270
812 Initial subarea total flow distance = 30.000 (Ft.)
813 Highest elevation = 334.800 (Ft.)
814 Lowest elevation = 327.500 (Ft.)
815 Elevation difference = 7.300 (Ft.) Slope = 24.333 %
816 Top of Initial Area Slope adjusted by User to 0.189 %
817 INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
818 The maximum overland flow distance is 50.00 (Ft)
819 for the top area slope value of 0.19 %, in a development type of
820 1.0 DU/A or Less
821 In Accordance With Table 3-2
822 Initial Area Time of Concentration = 12.20 minutes
823 (for slope value of 0.50 %)
824 Rainfall intensity (I) = 5.187 (In/Hr) for a 100.0 year storm
825 Effective runoff coefficient used for area (Q=KCIA) is C = 0.270
826 Subarea runoff = 0.014 (CFS)
827 Total initial stream area = 0.010 (Ac.)
828

```

```

829 ++++++
830 Process from Point/Station 1005.000 to Point/Station 1003.000
831 **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
832
833 Estimated mean flow rate at midpoint of channel = 0.042 (CFS)
834 Depth of flow = 0.111 (Ft.), Average velocity = 3.401 (Ft/s)
835 ***** Irregular Channel Data *****
836 -----
837 Information entered for subchannel number 1 :
838 Point number 'X' coordinate 'Y' coordinate
839 1 0.00 1.00
840 2 1.00 0.00
841 3 2.00 1.00
842 Manning's 'N' friction factor = 0.015
843 -----
844 Sub-Channel flow = 0.042 (CFS)
845 ' ' flow top width = 0.222 (Ft.)
846 ' ' velocity = 3.401 (Ft/s)
847 ' ' area = 0.012 (Sq.Ft)
848 ' ' Froude number = 2.543
849
850 Upstream point elevation = 327.500 (Ft.)
851 Downstream point elevation = 324.500 (Ft.)
852 Flow length = 34.000 (Ft.)
853 Travel time = 0.17 min.
854 Time of concentration = 12.37 min.
855 Depth of flow = 0.111 (Ft.)
856 Average velocity = 3.401 (Ft/s)
857 Total irregular channel flow = 0.042 (CFS)
858 Irregular channel normal depth above invert elev. = 0.111 (Ft.)
859 Average velocity of channel (s) = 3.401 (Ft/s)
860 Adding area flow to channel
861 Rainfall intensity (I) = 5.142 (In/Hr) for a 100.0 year storm
862 Decimal fraction soil group A = 1.000
863 Decimal fraction soil group B = 0.000
864 Decimal fraction soil group C = 0.000
865 Decimal fraction soil group D = 0.000
866 [LOW DENSITY RESIDENTIAL ]
867 (1.0 DU/A or Less )
868 Impervious value, Ai = 0.100
869 Sub-Area C Value = 0.270
870 Rainfall intensity = 5.142 (In/Hr) for a 100.0 year storm
871 Effective runoff coefficient used for total area
872 (Q=KCIA) is C = 0.270 CA = 0.014
873 Subarea runoff = 0.055 (CFS) for 0.040 (Ac.)
874 Total runoff = 0.069 (CFS) Total area = 0.050 (Ac.)
875 Depth of flow = 0.134 (Ft.), Average velocity = 3.856 (Ft/s)
876
877
878 ++++++
879 Process from Point/Station 1003.000 to Point/Station 1003.000
880 **** CONFLUENCE OF MINOR STREAMS ****
881
882 Along Main Stream number: 3 in normal stream number 1
883 Stream flow area = 0.050 (Ac.)
884 Runoff from this stream = 0.069 (CFS)
885 Time of concentration = 12.37 min.
886 Rainfall intensity = 5.142 (In/Hr)
887
888
889 ++++++
890 Process from Point/Station 1003.000 to Point/Station 1003.000
891 **** USER DEFINED FLOW INFORMATION AT A POINT ****
892
893 Decimal fraction soil group A = 1.000
894 Decimal fraction soil group B = 0.000
895 Decimal fraction soil group C = 0.000
896 Decimal fraction soil group D = 0.000
897 [MEDIUM DENSITY RESIDENTIAL ]

```


898 (7.3 DU/A or Less)
 899 Impervious value, Ai = 0.400
 900 Sub-Area C Value = 0.480
 901 Rainfall intensity (I) = 6.428(In/Hr) for a 100.0 year storm
 902 User specified values are as follows:
 903 TC = 8.75 min. Rain intensity = 6.43(In/Hr)
 904 Total area = 5.000(Ac.) Total runoff = 13.794(CFS)
 905
 906

907 +++++
 908 Process from Point/Station 1003.000 to Point/Station 1003.000
 909 **** CONFLUENCE OF MINOR STREAMS ****
 910

911 Along Main Stream number: 3 in normal stream number 2
 912 Stream flow area = 5.000(Ac.)
 913 Runoff from this stream = 13.794(CFS)
 914 Time of concentration = 8.75 min.
 915 Rainfall intensity = 6.428(In/Hr)
 916 Summary of stream data:
 917

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
------------	-----------------	----------	----------------------------

1	0.069	12.37	5.142
2	13.794	8.75	6.428

924 Qmax(1) =
 925 1.000 * 1.000 * 0.069) +
 926 0.800 * 1.000 * 13.794) + = 11.105
 927 Qmax(2) =
 928 1.000 * 0.708 * 0.069) +
 929 1.000 * 1.000 * 13.794) + = 13.843
 930

931 Total of 2 streams to confluence:
 932 Flow rates before confluence point:
 933 0.069 13.794
 934 Maximum flow rates at confluence using above data:
 935 11.105 13.843
 936 Area of streams before confluence:
 937 0.050 5.000
 938

938 Results of confluence:
 939 Total flow rate = 13.843(CFS)
 940 Time of concentration = 8.750 min.
 941 Effective stream area after confluence = 5.050(Ac.)
 942
 943

944 +++++
 945 Process from Point/Station 1003.000 to Point/Station 106.000
 946 **** PIPEFLOW TRAVEL TIME (User specified size) ****
 947

948 Upstream point/station elevation = 311.100(Ft.)
 949 Downstream point/station elevation = 302.600(Ft.)
 950 Pipe length = 209.00(Ft.) Slope = 0.0407 Manning's N = 0.013
 951 No. of pipes = 1 Required pipe flow = 13.843(CFS)
 952 Given pipe size = 18.00(In.)
 953 Calculated individual pipe flow = 13.843(CFS)
 954 Normal flow depth in pipe = 10.61(In.)
 955 Flow top width inside pipe = 17.71(In.)
 956 Critical Depth = 16.52(In.)
 957 Pipe flow velocity = 12.78(Ft/s)
 958 Travel time through pipe = 0.27 min.
 959 Time of concentration (TC) = 9.02 min.
 960
 961

962 +++++
 963 Process from Point/Station 106.000 to Point/Station 106.000
 964 **** CONFLUENCE OF MAIN STREAMS ****
 965

966 The following data inside Main Stream is listed:

967 In Main Stream number: 3
 968 Stream flow area = 5.050 (Ac.)
 969 Runoff from this stream = 13.843 (CFS)
 970 Time of concentration = 9.02 min.
 971 Rainfall intensity = 6.302 (In/Hr)
 972 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	9.902	5.29	8.896
2	6.593	10.19	5.826
3	13.843	9.02	6.302

981 Qmax (1) =
 982 1.000 * 1.000 * 9.902) +
 983 1.000 * 0.519 * 6.593) +
 984 1.000 * 0.586 * 13.843) + = 21.435

985 Qmax (2) =
 986 0.655 * 1.000 * 9.902) +
 987 1.000 * 1.000 * 6.593) +
 988 0.925 * 1.000 * 13.843) + = 25.877

989 Qmax (3) =
 990 0.708 * 1.000 * 9.902) +
 991 1.000 * 0.885 * 6.593) +
 992 1.000 * 1.000 * 13.843) + = 26.696

994 Total of 3 main streams to confluence:
 995 Flow rates before confluence point:

996 9.902 6.593 13.843

997 Maximum flow rates at confluence using above data:

998 21.435 25.877 26.696

999 Area of streams before confluence:

1000 2.050 2.170 5.050

1003 Results of confluence:

1004 Total flow rate = 26.696 (CFS)
 1005 Time of concentration = 9.023 min.
 1006 Effective stream area after confluence = 9.270 (Ac.)

1009 ++++++
 1010 Process from Point/Station 106.000 to Point/Station 107.000
 1011 **** PIPEFLOW TRAVEL TIME (User specified size) ****

1013 Upstream point/station elevation = 302.500 (Ft.)
 1014 Downstream point/station elevation = 302.100 (Ft.)
 1015 Pipe length = 31.00 (Ft.) Slope = 0.0129 Manning's N = 0.013
 1016 No. of pipes = 1 Required pipe flow = 26.696 (CFS)
 1017 Given pipe size = 18.00 (In.)
 1018 NOTE: Normal flow is pressure flow in user selected pipe size.
 1019 The approximate hydraulic grade line above the pipe invert is
 1020 6.917 (Ft.) at the headworks or inlet of the pipe(s)
 1021 Pipe friction loss = 2.002 (Ft.)
 1022 Minor friction loss = 5.316 (Ft.) K-factor = 1.50
 1023 Pipe flow velocity = 15.11 (Ft/s)
 1024 Travel time through pipe = 0.03 min.
 1025 Time of concentration (TC) = 9.06 min.

1028 ++++++
 1029 Process from Point/Station 107.000 to Point/Station 109.000
 1030 **** PIPEFLOW TRAVEL TIME (User specified size) ****

1032 Upstream point/station elevation = 302.100 (Ft.)
 1033 Downstream point/station elevation = 285.720 (Ft.)
 1034 Pipe length = 137.00 (Ft.) Slope = 0.1196 Manning's N = 0.013
 1035 No. of pipes = 1 Required pipe flow = 26.696 (CFS)

```

1036 Given pipe size =      18.00(In.)
1037 Calculated individual pipe flow =    26.696(CFS)
1038 Normal flow depth in pipe =    11.47(In.)
1039 Flow top width inside pipe =    17.31(In.)
1040 Critical depth could not be calculated.
1041 Pipe flow velocity =     22.47(Ft/s)
1042 Travel time through pipe =     0.10 min.
1043 Time of concentration (TC) =     9.16 min.
1044
1045
1046 ++++++
1047 Process from Point/Station    109.000 to Point/Station    109.000
1048 **** CONFLUENCE OF MINOR STREAMS ****
1049
-----
1050 Along Main Stream number: 1 in normal stream number 1
1051 Stream flow area =     9.270(Ac.)
1052 Runoff from this stream =    26.696(CFS)
1053 Time of concentration =     9.16 min.
1054 Rainfall intensity =     6.241(In/Hr)
1055
1056
1057 ++++++
1058 Process from Point/Station    2002.000 to Point/Station    2003.000
1059 **** INITIAL AREA EVALUATION ****
1060
-----
1061 Decimal fraction soil group A = 0.000
1062 Decimal fraction soil group B = 0.000
1063 Decimal fraction soil group C = 1.000
1064 Decimal fraction soil group D = 0.000
1065 [COMMERCIAL area type
1066 (General Commercial
1067 Impervious value, Ai = 0.850
1068 Sub-Area C Value = 0.810
1069 Initial subarea total flow distance = 93.000(Ft.)
1070 Highest elevation = 318.000(Ft.)
1071 Lowest elevation = 316.300(Ft.)
1072 Elevation difference = 1.700(Ft.) Slope = 1.828 %
1073 Top of Initial Area Slope adjusted by User to 1.400 %
1074 INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
1075 The maximum overland flow distance is 60.00 (Ft)
1076 for the top area slope value of 1.40 %, in a development type of
1077 General Commercial
1078 In Accordance With Figure 3-3
1079 Initial Area Time of Concentration = 3.61 minutes
1080 TC = [1.8*(1.1-C)*distance(Ft.)^0.5]/(% slope^(1/3)]
1081 TC = [1.8*(1.1-0.8100)*( 60.000^0.5)/( 1.400^(1/3))]= 3.61
1082 Calculated TC of 3.614 minutes is less than 5 minutes,
1083 resetting TC to 5.0 minutes for rainfall intensity calculations
1084 Rainfall intensity (I) = 9.222(In/Hr) for a 100.0 year storm
1085 Effective runoff coefficient used for area (Q=KCIA) is C = 0.810
1086 Subarea runoff = 0.254(CFS)
1087 Total initial stream area = 0.034(Ac.)
1088
1089
1090 ++++++
1091 Process from Point/Station    2003.000 to Point/Station    2004.000
1092 **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
1093
-----
1094 Estimated mean flow rate at midpoint of channel = 2.206(CFS)
1095 Depth of flow = 0.250(Ft.), Average velocity = 1.603(Ft/s)
1096 ***** Irregular Channel Data *****
1097
-----
1098 Information entered for subchannel number 1 :
1099 Point number      'X' coordinate      'Y' coordinate
1100      1              0.00              0.31
1101      2             26.00              0.13
1102      3             27.50              0.00
1103      4             27.50              0.50
1104 Manning's 'N' friction factor = 0.015

```

```

1105 -----
1106 Sub-Channel flow = 2.206 (CFS)
1107 ' ' flow top width = 18.940 (Ft.)
1108 ' ' velocity = 1.603 (Ft/s)
1109 ' ' area = 1.376 (Sq.Ft)
1110 ' ' Froude number = 1.048
1111
1112 Upstream point elevation = 316.300 (Ft.)
1113 Downstream point elevation = 310.800 (Ft.)
1114 Flow length = 625.000 (Ft.)
1115 Travel time = 6.50 min.
1116 Time of concentration = 10.11 min.
1117 Depth of flow = 0.250 (Ft.)
1118 Average velocity = 1.603 (Ft/s)
1119 Total irregular channel flow = 2.206 (CFS)
1120 Irregular channel normal depth above invert elev. = 0.250 (Ft.)
1121 Average velocity of channel (s) = 1.603 (Ft/s)
1122 Adding area flow to channel
1123 Rainfall intensity (I) = 5.855 (In/Hr) for a 100.0 year storm
1124 User specified 'C' value of 0.804 given for subarea
1125 Rainfall intensity = 5.855 (In/Hr) for a 100.0 year storm
1126 Effective runoff coefficient used for total area
1127 (Q=KCIA) is C = 0.804 CA = 0.700
1128 Subarea runoff = 3.848 (CFS) for 0.837 (Ac.)
1129 Total runoff = 4.102 (CFS) Total area = 0.871 (Ac.)
1130 Depth of flow = 0.289 (Ft.), Average velocity = 1.862 (Ft/s)
1131
1132
1133 +-----+
1134 Process from Point/Station 2000.000 to Point/Station 109.000
1135 **** SUBAREA FLOW ADDITION ****
1136
1137 -----
1137 Rainfall intensity (I) = 5.855 (In/Hr) for a 100.0 year storm
1138 Decimal fraction soil group A = 0.100
1139 Decimal fraction soil group B = 0.000
1140 Decimal fraction soil group C = 0.900
1141 Decimal fraction soil group D = 0.000
1142 [MEDIUM DENSITY RESIDENTIAL ]
1143 (14.5 DU/A or Less )
1144 Impervious value, Ai = 0.500
1145 Sub-Area C Value = 0.595
1146 Time of concentration = 10.11 min.
1147 Rainfall intensity = 5.855 (In/Hr) for a 100.0 year storm
1148 Effective runoff coefficient used for total area
1149 (Q=KCIA) is C = 0.719 CA = 1.057
1150 Subarea runoff = 2.090 (CFS) for 0.600 (Ac.)
1151 Total runoff = 6.192 (CFS) Total area = 1.471 (Ac.)
1152
1153
1154 +-----+
1155 Process from Point/Station 2001.000 to Point/Station 109.000
1156 **** SUBAREA FLOW ADDITION ****
1157
1158 -----
1158 Rainfall intensity (I) = 5.855 (In/Hr) for a 100.0 year storm
1159 Decimal fraction soil group A = 0.000
1160 Decimal fraction soil group B = 0.000
1161 Decimal fraction soil group C = 1.000
1162 Decimal fraction soil group D = 0.000
1163 [COMMERCIAL area type ]
1164 (Neighborhood Commercial )
1165 Impervious value, Ai = 0.800
1166 Sub-Area C Value = 0.780
1167 Time of concentration = 10.11 min.
1168 Rainfall intensity = 5.855 (In/Hr) for a 100.0 year storm
1169 Effective runoff coefficient used for total area
1170 (Q=KCIA) is C = 0.733 CA = 1.409
1171 Subarea runoff = 2.060 (CFS) for 0.451 (Ac.)
1172 Total runoff = 8.252 (CFS) Total area = 1.922 (Ac.)
1173

```

```

1174
1175 ++++++
1176 Process from Point/Station      109.000 to Point/Station      109.000
1177 **** CONFLUENCE OF MINOR STREAMS ****
1178
1179 Along Main Stream number: 1 in normal stream number 2
1180 Stream flow area =      1.922 (Ac.)
1181 Runoff from this stream =      8.252 (CFS)
1182 Time of concentration =     10.11 min.
1183 Rainfall intensity =      5.855 (In/Hr)
1184 Summary of stream data:
1185
1186 Stream   Flow rate      TC              Rainfall Intensity
1187   No.      (CFS)          (min)          (In/Hr)
1188
1189
1190 1         26.696         9.16           6.241
1191 2          8.252        10.11          5.855
1192 Qmax (1) =
1193      1.000 *      1.000 *      26.696) +
1194      1.000 *      0.906 *      8.252) + =      34.170
1195 Qmax (2) =
1196      0.938 *      1.000 *      26.696) +
1197      1.000 *      1.000 *      8.252) + =      33.297
1198
1199 Total of 2 streams to confluence:
1200 Flow rates before confluence point:
1201      26.696         8.252
1202 Maximum flow rates at confluence using above data:
1203      34.170         33.297
1204 Area of streams before confluence:
1205      9.270         1.922
1206 Results of confluence:
1207 Total flow rate =      34.170 (CFS)
1208 Time of concentration =      9.158 min.
1209 Effective stream area after confluence =      11.192 (Ac.)
1210
1211
1212 ++++++
1213 Process from Point/Station      2004.000 to Point/Station      109.000
1214 **** PIPEFLOW TRAVEL TIME (User specified size) ****
1215
1216 Upstream point/station elevation =  306.830 (Ft.)
1217 Downstream point/station elevation =  285.720 (Ft.)
1218 Pipe length =  211.00 (Ft.) Slope =  0.1000 Manning's N = 0.013
1219 No. of pipes = 1 Required pipe flow =  34.170 (CFS)
1220 Given pipe size =  18.00 (In.)
1221 NOTE: Normal flow is pressure flow in user selected pipe size.
1222 The approximate hydraulic grade line above the pipe invert is
1223      9.918 (Ft.) at the headworks or inlet of the pipe(s)
1224 Pipe friction loss =  22.320 (Ft.)
1225 Minor friction loss =  8.709 (Ft.) K-factor =  1.50
1226 Critical depth could not be calculated.
1227 Pipe flow velocity =  19.34 (Ft/s)
1228 Travel time through pipe =  0.18 min.
1229 Time of concentration (TC) =  9.34 min.
1230 End of computations, total study area =      11.192 (Ac.)
1231
1232
1233

```

3g. CivilD Post Development Mitigation Calculations

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2014 Version 9.0

Rational method hydrology program based on
San Diego County Flood Control Division 2003 hydrology manual
Rational Hydrology Study Date: 06/08/23

19025 Post Dev
100 Year Study Reach 8
MIT
2021.09.16 update

***** Hydrology Study Control Information *****

Program License Serial Number 6332

Rational hydrology study storm event year is 100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour, precipitation(inches) = 3.500
24 hour precipitation(inches) = 6.000
P6/P24 = 58.3%
San Diego hydrology manual 'C' values used

Process from Point/Station 800.000 to Point/Station 802.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

User specified 'C' value of 0.195 given for subarea
Rainfall intensity (I) = 3.045(In/Hr) for a 100.0 year storm
User specified values are as follows:
TC = 27.86 min. Rain intensity = 3.05(In/Hr)
Total area = 0.970(Ac.) Total runoff = 0.577(CFS)

Process from Point/Station 802.000 to Point/Station 803.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 304.600(Ft.)
Downstream point/station elevation = 304.300(Ft.)
Pipe length = 173.00(Ft.) Slope = 0.0017 Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.577(CFS)
Given pipe size = 12.00(In.)
Calculated individual pipe flow = 0.577(CFS)
Normal flow depth in pipe = 5.19(In.)
Flow top width inside pipe = 11.89(In.)
Critical Depth = 3.79(In.)
Pipe flow velocity = 1.77(Ft/s)
Travel time through pipe = 1.63 min.
Time of concentration (TC) = 29.49 min.

Process from Point/Station 803.000 to Point/Station 803.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 0.970(Ac.)
Runoff from this stream = 0.577(CFS)
Time of concentration = 29.49 min.

```

70 Rainfall intensity =      2.936(In/Hr)
71
72
73 *****
74 Process from Point/Station      900.000 to Point/Station      901.000
75 **** INITIAL AREA EVALUATION ****
76
77 Decimal fraction soil group A = 1.000
78 Decimal fraction soil group B = 0.000
79 Decimal fraction soil group C = 0.000
80 Decimal fraction soil group D = 0.000
81 [LOW DENSITY RESIDENTIAL
82 (1.0 DU/A or Less
83 Impervious value, Ai = 0.100
84 Sub-Area C Value = 0.270
85 Initial subarea total flow distance = 100.000(Ft.)
86 Highest elevation = 333.100(Ft.)
87 Lowest elevation = 323.900(Ft.)
88 Elevation difference = 9.200(Ft.) Slope = 9.200 %
89 INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
90 The maximum overland flow distance is 100.00 (Ft)
91 for the top area slope value of 9.20 %, in a development type of
92 1.0 DU/A or Less
93 In Accordance With Figure 3-3
94 Initial Area Time of Concentration = 7.13 minutes
95 TC = [1.8*(1.1-C)*distance(Ft.)^.5]/(% slope^(1/3)]
96 TC = [1.8*(1.1-0.2700)*( 100.000^.5)/( 9.200^(1/3)]= 7.13
97 Rainfall intensity (I) = 7.335(In/Hr) for a 100.0 year storm
98 Effective runoff coefficient used for area (Q=KCIA) is C = 0.270
99 Subarea runoff = 0.059(CFS)
100 Total initial stream area = 0.030(Ac.)
101
102
103 *****
104 Process from Point/Station      901.000 to Point/Station      902.000
105 **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
106
107 Estimated mean flow rate at midpoint of channel = 0.168(CFS)
108 Depth of flow = 0.228(Ft.), Average velocity = 3.226(Ft/s)
109 ***** Irregular Channel Data *****
110 -----
111 Information entered for subchannel number 1 :
112 Point number      'X' coordinate      'Y' coordinate
113 1                  0.00                  1.00
114 2                  1.00                  0.00
115 3                  2.00                  1.00
116 Manning's 'N' friction factor = 0.016
117 -----
118 Sub-Channel flow = 0.168(CFS)
119 ' ' flow top width = 0.457(Ft.)
120 ' ' velocity= 3.226(Ft/s)
121 ' ' area = 0.052(Sq.Ft)
122 ' ' Froude number = 1.682
123
124 Upstream point elevation = 323.900(Ft.)
125 Downstream point elevation = 315.400(Ft.)
126 Flow length = 246.000(Ft.)
127 Travel time = 1.27 min.
128 Time of concentration = 8.40 min.
129 Depth of flow = 0.228(Ft.)
130 Average velocity = 3.226(Ft/s)
131 Total irregular channel flow = 0.168(CFS)
132 Irregular channel normal depth above invert elev. = 0.228(Ft.)
133 Average velocity of channel(s) = 3.226(Ft/s)
134 Adding area flow to channel
135 Rainfall intensity (I) = 6.599(In/Hr) for a 100.0 year storm
136 Decimal fraction soil group A = 1.000
137 Decimal fraction soil group B = 0.000
138 Decimal fraction soil group C = 0.000

```


139 Decimal fraction soil group D = 0.000
 140 [LOW DENSITY RESIDENTIAL]
 141 (1.0 DU/A or Less)
 142 Impervious value, Ai = 0.100
 143 Sub-Area C Value = 0.270
 144 Rainfall intensity = 6.599(In/Hr) for a 100.0 year storm
 145 Effective runoff coefficient used for total area
 146 (Q=K CIA) is C = 0.270 CA = 0.038
 147 Subarea runoff = 0.190(CFS) for 0.110(Ac.)
 148 Total runoff = 0.249(CFS) Total area = 0.140(Ac.)
 149 Depth of flow = 0.265(Ft.), Average velocity = 3.559(Ft/s)

151
 152 +-----+
 153 Process from Point/Station 902.000 to Point/Station 803.000
 154 **** PIPEFLOW TRAVEL TIME (User specified size) ****

155
 156 Upstream point/station elevation = 310.900(Ft.)
 157 Downstream point/station elevation = 304.300(Ft.)
 158 Pipe length = 100.00(Ft.) Slope = 0.0660 Manning's N = 0.013
 159 No. of pipes = 1 Required pipe flow = 0.249(CFS)
 160 Given pipe size = 12.00(In.)
 161 Calculated individual pipe flow = 0.249(CFS)
 162 Normal flow depth in pipe = 1.36(In.)
 163 Flow top width inside pipe = 7.62(In.)
 164 Critical Depth = 2.46(In.)
 165 Pipe flow velocity = 5.07(Ft/s)
 166 Travel time through pipe = 0.33 min.
 167 Time of concentration (TC) = 8.73 min.

168
 169
 170 +-----+
 171 Process from Point/Station 803.000 to Point/Station 803.000
 172 **** CONFLUENCE OF MINOR STREAMS ****

173
 174 Along Main Stream number: 1 in normal stream number 2
 175 Stream flow area = 0.140(Ac.)
 176 Runoff from this stream = 0.249(CFS)
 177 Time of concentration = 8.73 min.
 178 Rainfall intensity = 6.437(In/Hr)
 179 Summary of stream data:

180
 181 Stream Flow rate TC Rainfall Intensity
 182 No. (CFS) (min) (In/Hr)

183
 184
 185 1 0.577 29.49 2.936
 186 2 0.249 8.73 6.437

187 Qmax(1) =
 188 1.000 * 1.000 * 0.577) +
 189 0.456 * 1.000 * 0.249) + = 0.691

190 Qmax(2) =
 191 1.000 * 0.296 * 0.577) +
 192 1.000 * 1.000 * 0.249) + = 0.420

193
 194 Total of 2 streams to confluence:
 195 Flow rates before confluence point:
 196 0.577 0.249

197 Maximum flow rates at confluence using above data:
 198 0.691 0.420

199 Area of streams before confluence:
 200 0.970 0.140

201 Results of confluence:
 202 Total flow rate = 0.691(CFS)
 203 Time of concentration = 29.489 min.
 204 Effective stream area after confluence = 1.110(Ac.)

205
 206
 207 +-----+

```

208 Process from Point/Station      803.000 to Point/Station      804.000
209 **** PIPEFLOW TRAVEL TIME (User specified size) ****
210
211 Upstream point/station elevation =  304.300(Ft.)
212 Downstream point/station elevation =  302.800(Ft.)
213 Pipe length =  301.00(Ft.) Slope =  0.0050 Manning's N = 0.013
214 No. of pipes = 1 Required pipe flow =  0.691(CFS)
215 Given pipe size =  12.00(In.)
216 Calculated individual pipe flow =  0.691(CFS)
217 Normal flow depth in pipe =  4.30(In.)
218 Flow top width inside pipe =  11.51(In.)
219 Critical Depth =  4.15(In.)
220 Pipe flow velocity =  2.73(Ft/s)
221 Travel time through pipe =  1.84 min.
222 Time of concentration (TC) =  31.32 min.
223
224
225 +-----+
226 Process from Point/Station      804.000 to Point/Station      804.000
227 **** CONFLUENCE OF MINOR STREAMS ****
228
229 Along Main Stream number: 1 in normal stream number 1
230 Stream flow area =  1.110(Ac.)
231 Runoff from this stream =  0.691(CFS)
232 Time of concentration =  31.32 min.
233 Rainfall intensity =  2.824(In/Hr)
234
235
236 +-----+
237 Process from Point/Station      600.000 to Point/Station      804.000
238 **** USER DEFINED FLOW INFORMATION AT A POINT ****
239
240 Decimal fraction soil group A = 0.000
241 Decimal fraction soil group B = 0.000
242 Decimal fraction soil group C = 1.000
243 Decimal fraction soil group D = 0.000
244 [HIGH DENSITY RESIDENTIAL
245 (43.0 DU/A or Less )
246 Impervious value, Ai = 0.800
247 Sub-Area C Value = 0.780
248 Rainfall intensity (I) =  6.834(In/Hr) for a 100.0 year storm
249 User specified values are as follows:
250 TC =  7.96 min. Rain intensity =  6.83(In/Hr)
251 Total area =  0.490(Ac.) Total runoff =  2.649(CFS)
252
253
254 +-----+
255 Process from Point/Station      804.000 to Point/Station      804.000
256 **** CONFLUENCE OF MINOR STREAMS ****
257
258 Along Main Stream number: 1 in normal stream number 2
259 Stream flow area =  0.490(Ac.)
260 Runoff from this stream =  2.649(CFS)
261 Time of concentration =  7.96 min.
262 Rainfall intensity =  6.834(In/Hr)
263
264
265 +-----+
266 Process from Point/Station      500.000 to Point/Station      501.000
267 **** INITIAL AREA EVALUATION ****
268
269 Decimal fraction soil group A = 0.900
270 Decimal fraction soil group B = 0.000
271 Decimal fraction soil group C = 0.100
272 Decimal fraction soil group D = 0.000
273 [HIGH DENSITY RESIDENTIAL
274 (24.0 DU/A or Less )
275 Impervious value, Ai = 0.650
276 Sub-Area C Value = 0.663

```

277 Initial subarea total flow distance = 68.000(Ft.)
 278 Highest elevation = 315.800(Ft.)
 279 Lowest elevation = 315.600(Ft.)
 280 Elevation difference = 0.200(Ft.) Slope = 0.294 %
 281 INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
 282 The maximum overland flow distance is 50.00 (Ft)
 283 for the top area slope value of 0.29 %, in a development type of
 284 24.0 DU/A or Less
 285 In Accordance With Figure 3-3
 286 Initial Area Time of Concentration = 8.36 minutes
 287 $TC = [1.8*(1.1-C)*distance(Ft.)^{.5}/(% slope^{(1/3)})]$
 288 $TC = [1.8*(1.1-0.6630)*(50.000^{.5})/((0.294^{(1/3)})]= 8.36$
 289 The initial area total distance of 68.00 (Ft.) entered leaves a
 290 remaining distance of 18.00 (Ft.)
 291 Using Figure 3-4, the travel time for this distance is 0.68 minutes
 292 for a distance of 18.00 (Ft.) and a slope of 0.29 %
 293 with an elevation difference of 0.05(Ft.) from the end of the top area
 294 $Tt = [11.9*length(Mi)^3]/(elevation change(Ft.))]^{.385} *60(\text{min}/\text{hr})$
 295 = 0.682 Minutes
 296 $Tt=[(11.9*0.0034^3)/((0.05))]^{.385}= 0.68$
 297 Total initial area $Ti = 8.36$ minutes from Figure 3-3 formula plus
 298 0.68 minutes from the Figure 3-4 formula = 9.05 minutes
 299 Rainfall intensity (I) = 6.291(In/Hr) for a 100.0 year storm
 300 Effective runoff coefficient used for area (Q=KCIA) is C = 0.663
 301 Subarea runoff = 0.167(CFS)
 302 Total initial stream area = 0.040(Ac.)
 303
 304

305 +++++
 306 Process from Point/Station 501.000 to Point/Station 502.000
 307 **** SUBAREA FLOW ADDITION ****
 308

309 Rainfall intensity (I) = 6.291(In/Hr) for a 100.0 year storm
 310 Decimal fraction soil group A = 0.900
 311 Decimal fraction soil group B = 0.000
 312 Decimal fraction soil group C = 0.100
 313 Decimal fraction soil group D = 0.000
 314 [HIGH DENSITY RESIDENTIAL]
 315 (43.0 DU/A or Less)
 316 Impervious value, $A_i = 0.800$
 317 Sub-Area C Value = 0.762
 318 Time of concentration = 9.05 min.
 319 Rainfall intensity = 6.291(In/Hr) for a 100.0 year storm
 320 Effective runoff coefficient used for total area
 321 (Q=KCIA) is C = 0.739 CA = 0.126
 322 Subarea runoff = 0.623(CFS) for 0.130(Ac.)
 323 Total runoff = 0.790(CFS) Total area = 0.170(Ac.)
 324
 325

326 +++++
 327 Process from Point/Station 502.000 to Point/Station 503.000
 328 **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
 329

330 Estimated mean flow rate at midpoint of channel = 1.710(CFS)
 331 Depth of flow = 0.034(Ft.), Average velocity = 2.019(Ft/s)
 332 ***** Irregular Channel Data *****
 333

334 -----
 334 Information entered for subchannel number 1 :

Point number	'X' coordinate	'Y' coordinate
1	0.00	0.50
2	0.00	0.00
3	25.00	0.00
4	25.00	0.50

340 Manning's 'N' friction factor = 0.015
 341 -----

342 Sub-Channel flow = 1.710(CFS)
 343 ' ' flow top width = 25.000(Ft.)
 344 ' ' velocity= 2.019(Ft/s)
 345 ' ' area = 0.847(Sq.Ft)

```

346      '      '      Froude number =      1.933
347
348 Upstream point elevation =      316.600(Ft.)
349 Downstream point elevation =      312.000(Ft.)
350 Flow length =      121.000(Ft.)
351 Travel time =      1.00 min.
352 Time of concentration =      10.05 min.
353 Depth of flow =      0.034(Ft.)
354 Average velocity =      2.019(Ft/s)
355 Total irregular channel flow =      1.710(CFS)
356 Irregular channel normal depth above invert elev. =      0.034(Ft.)
357 Average velocity of channel(s) =      2.019(Ft/s)
358 Adding area flow to channel
359 Rainfall intensity (I) =      5.880(In/Hr) for a      100.0 year storm
360 Decimal fraction soil group A =      0.010
361 Decimal fraction soil group B =      0.000
362 Decimal fraction soil group C =      0.990
363 Decimal fraction soil group D =      0.000
364 [HIGH DENSITY RESIDENTIAL      ]
365 (43.0 DU/A or Less      )
366 Impervious value, Ai =      0.800
367 Sub-Area C Value =      0.780
368 Rainfall intensity =      5.880(In/Hr) for a      100.0 year storm
369 Effective runoff coefficient used for total area
370 (Q=KCIA) is C =      0.767 CA =      0.434
371 Subarea runoff =      1.764(CFS) for      0.396(Ac.)
372 Total runoff =      2.554(CFS) Total area =      0.566(Ac.)
373 Depth of flow =      0.043(Ft.), Average velocity =      2.369(Ft/s)
374
375

```

```

376 *****
377 Process from Point/Station      503.000 to Point/Station      804.000
378 **** PIPEFLOW TRAVEL TIME (User specified size) ****
379

```

```

380 Upstream point/station elevation =      307.000(Ft.)
381 Downstream point/station elevation =      302.800(Ft.)
382 Pipe length =      44.00(Ft.) Slope =      0.0955 Manning's N =      0.013
383 No. of pipes =      1 Required pipe flow =      2.554(CFS)
384 Given pipe size =      12.00(In.)
385 Calculated individual pipe flow =      2.554(CFS)
386 Normal flow depth in pipe =      3.93(In.)
387 Flow top width inside pipe =      11.26(In.)
388 Critical Depth =      8.22(In.)
389 Pipe flow velocity =      11.41(Ft/s)
390 Travel time through pipe =      0.06 min.
391 Time of concentration (TC) =      10.11 min.
392
393

```

```

394 *****
395 Process from Point/Station      804.000 to Point/Station      804.000
396 **** CONFLUENCE OF MINOR STREAMS ****
397

```

```

398 Along Main Stream number: 1 in normal stream number 3
399 Stream flow area =      0.566(Ac.)
400 Runoff from this stream =      2.554(CFS)
401 Time of concentration =      10.11 min.
402 Rainfall intensity =      5.856(In/Hr)
403 Summary of stream data:
404

```

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	0.691	31.32	2.824
2	2.649	7.96	6.834
3	2.554	10.11	5.856

```

405
406
407
408
409 Qmax(1) =
410      1.000 *      1.000 *      0.691) +
411      0.413 *      1.000 *      2.649) +
412
413
414

```

415 0.482 * 1.000 * 2.554) + = 3.017
 416 Qmax(2) =
 417 1.000 * 0.254 * 0.691) +
 418 1.000 * 1.000 * 2.649) +
 419 1.000 * 0.787 * 2.554) + = 4.834
 420 Qmax(3) =
 421 1.000 * 0.323 * 0.691) +
 422 0.857 * 1.000 * 2.649) +
 423 1.000 * 1.000 * 2.554) + = 5.047
 424

425 Total of 3 streams to confluence:
 426 Flow rates before confluence point:
 427 0.691 2.649 2.554
 428 Maximum flow rates at confluence using above data:
 429 3.017 4.834 5.047
 430 Area of streams before confluence:
 431 1.110 0.490 0.566

432 Results of confluence:
 433 Total flow rate = 5.047(CFS)
 434 Time of concentration = 10.110 min.
 435 Effective stream area after confluence = 2.166(Ac.)
 436

437
 438 *****
 439 Process from Point/Station 804.000 to Point/Station 106.000
 440 **** PIPEFLOW TRAVEL TIME (User specified size) ****
 441

442 Upstream point/station elevation = 302.800(Ft.)
 443 Downstream point/station elevation = 302.600(Ft.)
 444 Pipe length = 38.00(Ft.) Slope = 0.0053 Manning's N = 0.013
 445 No. of pipes = 1 Required pipe flow = 5.047(CFS)
 446 Given pipe size = 12.00(In.)
 447 NOTE: Normal flow is pressure flow in user selected pipe size.
 448 The approximate hydraulic grade line above the pipe invert is
 449 1.524(Ft.) at the headworks or inlet of the pipe(s)
 450 Pipe friction loss = 0.762(Ft.)
 451 Minor friction loss = 0.962(Ft.) K-factor = 1.50
 452 Pipe flow velocity = 6.43(Ft/s)
 453 Travel time through pipe = 0.10 min.
 454 Time of concentration (TC) = 10.21 min.
 455 End of computations, total study area = 2.166 (Ac.)
 456
 457
 458

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2014 Version 9.0

Rational method hydrology program based on
San Diego County Flood Control Division 2003 hydrology manual
Rational Hydrology Study Date: 06/08/23

19025 Post Dev
100 Year Study Reach 1
PostDev100R1.rd3
mit

***** Hydrology Study Control Information *****

Program License Serial Number 6332

Rational hydrology study storm event year is 100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour, precipitation(inches) = 3.500
24 hour precipitation(inches) = 6.000
P6/P24 = 58.3%
San Diego hydrology manual 'C' values used

Process from Point/Station 100.000 to Point/Station 101.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[MEDIUM DENSITY RESIDENTIAL]
(7.3 DU/A or Less)
Impervious value, Ai = 0.400
Sub-Area C Value = 0.480
Initial subarea total flow distance = 53.000(Ft.)
Highest elevation = 316.800(Ft.)
Lowest elevation = 316.700(Ft.)
Elevation difference = 0.100(Ft.) Slope = 0.189 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 50.00 (Ft)
for the top area slope value of 0.19 %, in a development type of
7.3 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration = 13.75 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^{.5}/(% slope^(1/3))]
TC = [1.8*(1.1-0.4800)*(50.000^{.5})/(0.189^(1/3))] = 13.75
The initial area total distance of 53.00 (Ft.) entered leaves a
remaining distance of 3.00 (Ft.)
Using Figure 3-4, the travel time for this distance is 0.20 minutes
for a distance of 3.00 (Ft.) and a slope of 0.19 %
with an elevation difference of 0.01(Ft.) from the end of the top area
Tt = [11.9*length(Mi)³/(elevation change(Ft.))]^{.385} *60(min/hr)
= 0.203 Minutes
Tt=[(11.9*0.0006³)/(0.01)]^{.385}= 0.20
Total initial area Ti = 13.75 minutes from Figure 3-3 formula plus
0.20 minutes from the Figure 3-4 formula = 13.95 minutes
Rainfall intensity (I) = 4.757(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.480
Subarea runoff = 0.068(CFS)

```

70 Total initial stream area = 0.030(Ac.)
71
72
73 *****
74 Process from Point/Station 101.000 to Point/Station 102.000
75 **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
76
77 -----
78 Estimated mean flow rate at midpoint of channel = 0.228(CFS)
79 Depth of flow = 0.095(Ft.), Average velocity = 0.591(Ft/s)
80 ***** Irregular Channel Data *****
81 -----
82 Information entered for subchannel number 1 :
83 Point number 'X' coordinate 'Y' coordinate
84 1 0.00 0.33
85 2 23.00 0.00
86 3 28.50 0.33
87 Manning's 'N' friction factor = 0.015
88 -----
89 Sub-Channel flow = 0.228(CFS)
90 ' ' flow top width = 8.130(Ft.)
91 ' ' velocity = 0.591(Ft/s)
92 ' ' area = 0.386(Sq.Ft)
93 ' ' Froude number = 0.478
94
95 Upstream point elevation = 316.700(Ft.)
96 Downstream point elevation = 316.300(Ft.)
97 Flow length = 193.000(Ft.)
98 Travel time = 5.44 min.
99 Time of concentration = 19.39 min.
100 Depth of flow = 0.095(Ft.)
101 Average velocity = 0.591(Ft/s)
102 Total irregular channel flow = 0.228(CFS)
103 Irregular channel normal depth above invert elev. = 0.095(Ft.)
104 Average velocity of channel(s) = 0.591(Ft/s)
105 Adding area flow to channel
106 Rainfall intensity (I) = 3.847(In/Hr) for a 100.0 year storm
107 Decimal fraction soil group A = 1.000
108 Decimal fraction soil group B = 0.000
109 Decimal fraction soil group C = 0.000
110 Decimal fraction soil group D = 0.000
111 [MEDIUM DENSITY RESIDENTIAL ]
112 (7.3 DU/A or Less )
113 Impervious value, Ai = 0.400
114 Sub-Area C Value = 0.480
115 Rainfall intensity = 3.847(In/Hr) for a 100.0 year storm
116 Effective runoff coefficient used for total area
117 (Q=KCIA) is C = 0.480 CA = 0.082
118 Subarea runoff = 0.245(CFS) for 0.140(Ac.)
119 Total runoff = 0.314(CFS) Total area = 0.170(Ac.)
120 Depth of flow = 0.107(Ft.), Average velocity = 0.640(Ft/s)
121
122 *****
123 Process from Point/Station 102.000 to Point/Station 102.000
124 **** SUBAREA FLOW ADDITION ****
125
126 -----
127 Rainfall intensity (I) = 3.847(In/Hr) for a 100.0 year storm
128 Decimal fraction soil group A = 1.000
129 Decimal fraction soil group B = 0.000
130 Decimal fraction soil group C = 0.000
131 Decimal fraction soil group D = 0.000
132 [LOW DENSITY RESIDENTIAL ]
133 (1.0 DU/A or Less )
134 Impervious value, Ai = 0.100
135 Sub-Area C Value = 0.270
136 Time of concentration = 19.39 min.
137 Rainfall intensity = 3.847(In/Hr) for a 100.0 year storm
138 Effective runoff coefficient used for total area
139 (Q=KCIA) is C = 0.393 CA = 0.114

```

139 Subarea runoff = 0.125(CFS) for 0.120(Ac.)
140 Total runoff = 0.439(CFS) Total area = 0.290(Ac.)
141
142

143 *****
144 Process from Point/Station 102.000 to Point/Station 103.000
145 **** PIPEFLOW TRAVEL TIME (User specified size) ****

147 Upstream point/station elevation = 310.200(Ft.)
148 Downstream point/station elevation = 309.000(Ft.)
149 Pipe length = 250.00(Ft.) Slope = 0.0048 Manning's N = 0.013
150 No. of pipes = 1 Required pipe flow = 0.439(CFS)
151 Given pipe size = 12.00(In.)
152 Calculated individual pipe flow = 0.439(CFS)
153 Normal flow depth in pipe = 3.42(In.)
154 Flow top width inside pipe = 10.84(In.)
155 Critical Depth = 3.28(In.)
156 Pipe flow velocity = 2.37(Ft/s)
157 Travel time through pipe = 1.76 min.
158 Time of concentration (TC) = 21.15 min.
159
160

161 *****
162 Process from Point/Station 103.000 to Point/Station 103.000
163 **** CONFLUENCE OF MINOR STREAMS ****

165 Along Main Stream number: 1 in normal stream number 1
166 Stream flow area = 0.290(Ac.)
167 Runoff from this stream = 0.439(CFS)
168 Time of concentration = 21.15 min.
169 Rainfall intensity = 3.637(In/Hr)
170
171

172 *****
173 Process from Point/Station 1100.000 to Point/Station 1101.000
174 **** INITIAL AREA EVALUATION ****

176 Decimal fraction soil group A = 1.000
177 Decimal fraction soil group B = 0.000
178 Decimal fraction soil group C = 0.000
179 Decimal fraction soil group D = 0.000
180 [LOW DENSITY RESIDENTIAL]
181 (1.0 DU/A or Less)
182 Impervious value, Ai = 0.100
183 Sub-Area C Value = 0.270
184 Initial subarea total flow distance = 59.000(Ft.)
185 Highest elevation = 336.700(Ft.)
186 Lowest elevation = 321.600(Ft.)
187 Elevation difference = 15.100(Ft.) Slope = 25.593 %
188 INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
189 The maximum overland flow distance is 100.00 (Ft)
190 for the top area slope value of 25.59 %, in a development type of
191 1.0 DU/A or Less
192 In Accordance With Figure 3-3
193 Initial Area Time of Concentration = 5.07 minutes
194 $TC = [1.8 * (1.1 - C) * distance(Ft.)^{0.5} / (% slope^{1/3})]$
195 $TC = [1.8 * (1.1 - 0.2700) * (100.000^{0.5}) / (25.593^{1/3})] = 5.07$
196 Rainfall intensity (I) = 9.140(In/Hr) for a 100.0 year storm
197 Effective runoff coefficient used for area (Q=KCIA) is C = 0.270
198 Subarea runoff = 0.173(CFS)
199 Total initial stream area = 0.070(Ac.)
200
201

202 *****
203 Process from Point/Station 1101.000 to Point/Station 103.000
204 **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

206 Estimated mean flow rate at midpoint of channel = 1.544(CFS)
207 Depth of flow = 0.128(Ft.), Average velocity = 3.658(Ft/s)


```

208          ***** Irregular Channel Data *****
209          -----
210 Information entered for subchannel number 1 :
211 Point number      'X' coordinate      'Y' coordinate
212      1              0.00              0.60
213      2              16.00             0.00
214      3              46.00             1.20
215 Manning's 'N' friction factor = 0.015
216          -----
217 Sub-Channel flow = 1.544(CFS)
218 ' ' flow top width = 6.605(Ft.)
219 ' ' velocity= 3.658(Ft/s)
220 ' ' area = 0.422(Sq.Ft)
221 ' ' Froude number = 2.549
222
223 Upstream point elevation = 321.600(Ft.)
224 Downstream point elevation = 309.000(Ft.)
225 Flow length = 236.000(Ft.)
226 Travel time = 1.08 min.
227 Time of concentration = 6.15 min.
228 Depth of flow = 0.128(Ft.)
229 Average velocity = 3.658(Ft/s)
230 Total irregular channel flow = 1.544(CFS)
231 Irregular channel normal depth above invert elev. = 0.128(Ft.)
232 Average velocity of channel(s) = 3.658(Ft/s)
233 Adding area flow to channel
234 Rainfall intensity (I) = 8.073(In/Hr) for a 100.0 year storm
235 Decimal fraction soil group A = 0.100
236 Decimal fraction soil group B = 0.000
237 Decimal fraction soil group C = 0.900
238 Decimal fraction soil group D = 0.000
239 [MEDIUM DENSITY RESIDENTIAL ]
240 (7.3 DU/A or Less )
241 Impervious value, Ai = 0.400
242 Sub-Area C Value = 0.534
243 Rainfall intensity = 8.073(In/Hr) for a 100.0 year storm
244 Effective runoff coefficient used for total area
245 (Q=KCIA) is C = 0.509 CA = 0.371
246 Subarea runoff = 2.825(CFS) for 0.660(Ac.)
247 Total runoff = 2.998(CFS) Total area = 0.730(Ac.)
248 Depth of flow = 0.164(Ft.), Average velocity = 4.317(Ft/s)
249
250
251 +-----+
252 Process from Point/Station 103.000 to Point/Station 103.000
253 **** CONFLUENCE OF MINOR STREAMS ****
254
255 -----
256 Along Main Stream number: 1 in normal stream number 2
257 Stream flow area = 0.730(Ac.)
258 Runoff from this stream = 2.998(CFS)
259 Time of concentration = 6.15 min.
260 Rainfall intensity = 8.073(In/Hr)
261 Summary of stream data:
262
263 Stream No.      Flow rate      TC      Rainfall Intensity
264                (CFS)          (min)      (In/Hr)
265
266 1              0.439          21.15      3.637
267 2              2.998          6.15       8.073
268 Qmax(1) =
269 1.000 * 1.000 * 0.439) +
270 0.451 * 1.000 * 2.998) + = 1.789
271 Qmax(2) =
272 1.000 * 0.291 * 0.439) +
273 1.000 * 1.000 * 2.998) + = 3.125
274
275 Total of 2 streams to confluence:
276 Flow rates before confluence point:

```

```

277         0.439         2.998
278 Maximum flow rates at confluence using above data:
279         1.789         3.125
280 Area of streams before confluence:
281         0.290         0.730
282 Results of confluence:
283 Total flow rate =         3.125(CFS)
284 Time of concentration =         6.145 min.
285 Effective stream area after confluence =         1.020(Ac.)
286
287
288 *****
289 Process from Point/Station         103.000 to Point/Station         104.000
290 **** PIPEFLOW TRAVEL TIME (User specified size) ****
291
292 Upstream point/station elevation =         304.200(Ft.)
293 Downstream point/station elevation =         303.300(Ft.)
294 Pipe length =         189.00(Ft.) Slope =         0.0048 Manning's N =         0.013
295 No. of pipes =         1 Required pipe flow =         3.125(CFS)
296 Given pipe size =         18.00(In.)
297 Calculated individual pipe flow =         3.125(CFS)
298 Normal flow depth in pipe =         8.26(In.)
299 Flow top width inside pipe =         17.94(In.)
300 Critical Depth =         8.07(In.)
301 Pipe flow velocity =         3.95(Ft/s)
302 Travel time through pipe =         0.80 min.
303 Time of concentration (TC) =         6.94 min.
304
305
306 *****
307 Process from Point/Station         104.000 to Point/Station         104.000
308 **** CONFLUENCE OF MINOR STREAMS ****
309
310 Along Main Stream number: 1 in normal stream number 1
311 Stream flow area =         1.020(Ac.)
312 Runoff from this stream =         3.125(CFS)
313 Time of concentration =         6.94 min.
314 Rainfall intensity =         7.462(In/Hr)
315
316
317 *****
318 Process from Point/Station         200.000 to Point/Station         201.000
319 **** INITIAL AREA EVALUATION ****
320
321 Decimal fraction soil group A =         0.050
322 Decimal fraction soil group B =         0.000
323 Decimal fraction soil group C =         0.950
324 Decimal fraction soil group D =         0.000
325 [COMMERCIAL area type
326 (Office Professional
327 Impervious value, Ai =         0.900
328 Sub-Area C Value =         0.839
329 Initial subarea total flow distance =         50.000(Ft.)
330 Highest elevation =         316.800(Ft.)
331 Lowest elevation =         316.200(Ft.)
332 Elevation difference =         0.600(Ft.) Slope =         1.200 %
333 INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
334 The maximum overland flow distance is         60.00 (Ft)
335 for the top area slope value of         1.20 %, in a development type of
336 Office Professional
337 In Accordance With Figure 3-3
338 Initial Area Time of Concentration =         3.42 minutes
339 TC = [1.8*(1.1-C)*distance(Ft.)^.5]/(% slope^(1/3)]
340 TC = [1.8*(1.1-0.8395)*( 60.000^.5)/( 1.200^(1/3)]=         3.42
341 Calculated TC of         3.418 minutes is less than 5 minutes,
342 resetting TC to 5.0 minutes for rainfall intensity calculations
343 Rainfall intensity (I) =         9.222(In/Hr) for a         100.0 year storm
344 Effective runoff coefficient used for area (Q=KCIA) is C =         0.839
345 Subarea runoff =         0.310(CFS)

```

```

346 Total initial stream area = 0.040(Ac.)
347
348
349 *****
350 Process from Point/Station 201.000 to Point/Station 202.000
351 **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
352
353 -----
354 Estimated mean flow rate at midpoint of channel = 2.245(CFS)
355 Depth of flow = 0.209(Ft.), Average velocity = 2.102(Ft/s)
356 ***** Irregular Channel Data *****
357 -----
358 Information entered for subchannel number 1 :
359 Point number 'X' coordinate 'Y' coordinate
360 1 0.00 0.30
361 2 1.50 0.00
362 3 45.50 1.00
363 4 61.50 1.50
364 Manning's 'N' friction factor = 0.015
365 -----
366 Sub-Channel flow = 2.245(CFS)
367 ' ' flow top width = 10.230(Ft.)
368 ' ' velocity= 2.102(Ft/s)
369 ' ' area = 1.068(Sq.Ft)
370 ' ' Froude number = 1.147
371
372 Upstream point elevation = 316.200(Ft.)
373 Downstream point elevation = 314.500(Ft.)
374 Flow length = 185.000(Ft.)
375 Travel time = 1.47 min.
376 Time of concentration = 4.88 min.
377 Depth of flow = 0.209(Ft.)
378 Average velocity = 2.102(Ft/s)
379 Total irregular channel flow = 2.245(CFS)
380 Irregular channel normal depth above invert elev. = 0.209(Ft.)
381 Average velocity of channel(s) = 2.102(Ft/s)
382 Adding area flow to channel
383 Calculated TC of 4.885 minutes is less than 5 minutes,
384 resetting TC to 5.0 minutes for rainfall intensity calculations
385 Rainfall intensity (I) = 9.222(In/Hr) for a 100.0 year storm
386 Decimal fraction soil group A = 0.000
387 Decimal fraction soil group B = 0.000
388 Decimal fraction soil group C = 1.000
389 Decimal fraction soil group D = 0.000
390 [COMMERCIAL area type ]
391 (Office Professional )
392 Impervious value, Ai = 0.900
393 Sub-Area C Value = 0.840
394 Rainfall intensity = 9.222(In/Hr) for a 100.0 year storm
395 Effective runoff coefficient used for total area
396 (Q=KCIA) is C = 0.840 CA = 0.454
397 Subarea runoff = 3.873(CFS) for 0.500(Ac.)
398 Total runoff = 4.183(CFS) Total area = 0.540(Ac.)
399 Depth of flow = 0.264(Ft.), Average velocity = 2.456(Ft/s)
400
401 *****
402 Process from Point/Station 202.000 to Point/Station 104.000
403 **** PIPEFLOW TRAVEL TIME (User specified size) ****
404
405 -----
406 Upstream point/station elevation = 308.500(Ft.)
407 Downstream point/station elevation = 303.300(Ft.)
408 Pipe length = 48.00(Ft.) Slope = 0.1083 Manning's N = 0.013
409 No. of pipes = 1 Required pipe flow = 4.183(CFS)
410 Given pipe size = 12.00(In.)
411 Calculated individual pipe flow = 4.183(CFS)
412 Normal flow depth in pipe = 4.95(In.)
413 Flow top width inside pipe = 11.82(In.)
414 Critical Depth = 10.36(In.)
415 Pipe flow velocity = 13.68(Ft/s)

```

```

415 Travel time through pipe = 0.06 min.
416 Time of concentration (TC) = 4.94 min.
417
418
419 *****
420 Process from Point/Station 202.000 to Point/Station 104.000
421 **** CONFLUENCE OF MINOR STREAMS ****
422
423 -----
424 Along Main Stream number: 1 in normal stream number 2
425 Stream flow area = 0.540(Ac.)
426 Runoff from this stream = 4.183(CFS)
427 Time of concentration = 4.94 min.
428 Rainfall intensity = 9.222(In/Hr)
429
430 *****
431 Process from Point/Station 300.000 to Point/Station 301.000
432 **** INITIAL AREA EVALUATION ****
433
434 -----
435 Decimal fraction soil group A = 0.000
436 Decimal fraction soil group B = 0.000
437 Decimal fraction soil group C = 1.000
438 Decimal fraction soil group D = 0.000
439 [COMMERCIAL area type ]
440 (Neighborhood Commercial )
441 Impervious value, Ai = 0.800
442 Sub-Area C Value = 0.780
443 Initial subarea total flow distance = 42.000(Ft.)
444 Highest elevation = 316.000(Ft.)
445 Lowest elevation = 314.700(Ft.)
446 Elevation difference = 1.300(Ft.) Slope = 3.095 %
447 INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
448 The maximum overland flow distance is 85.00 (Ft)
449 for the top area slope value of 3.10 %, in a development type of
450 Neighborhood Commercial
451 In Accordance With Figure 3-3
452 Initial Area Time of Concentration = 3.64 minutes
453 TC = [1.8*(1.1-C)*distance(Ft.)^0.5]/(% slope^(1/3))
454 TC = [1.8*(1.1-0.7800)*( 85.000^0.5)]/( 3.095^(1/3)]= 3.64
455 Calculated TC of 3.644 minutes is less than 5 minutes,
456 resetting TC to 5.0 minutes for rainfall intensity calculations
457 Rainfall intensity (I) = 9.222(In/Hr) for a 100.0 year storm
458 Effective runoff coefficient used for area (Q=KCIA) is C = 0.780
459 Subarea runoff = 0.288(CFS)
460 Total initial stream area = 0.040(Ac.)
461
462 *****
463 Process from Point/Station 301.000 to Point/Station 302.000
464 **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
465
466 -----
467 Estimated mean flow rate at midpoint of channel = 1.259(CFS)
468 Depth of flow = 0.087(Ft.), Average velocity = 2.583(Ft/s)
469 ***** Irregular Channel Data *****
470 -----
471 Information entered for subchannel number 1 :
472 Point number 'X' coordinate 'Y' coordinate
473 1 0.00 0.50
474 2 0.00 0.00
475 3 64.00 0.50
476 Manning's 'N' friction factor = 0.015
477 -----
478 Sub-Channel flow = 1.259(CFS)
479 ' ' flow top width = 11.169(Ft.)
480 ' ' velocity= 2.583(Ft/s)
481 ' ' area = 0.487(Sq.Ft)
482 ' ' Froude number = 2.180
483
484 Upstream point elevation = 314.700(Ft.)

```

484 Downstream point elevation = 313.000(Ft.)
 485 Flow length = 38.000(Ft.)
 486 Travel time = 0.25 min.
 487 Time of concentration = 3.89 min.
 488 Depth of flow = 0.087(Ft.)
 489 Average velocity = 2.583(Ft/s)
 490 Total irregular channel flow = 1.259(CFS)
 491 Irregular channel normal depth above invert elev. = 0.087(Ft.)
 492 Average velocity of channel(s) = 2.583(Ft/s)
 493 Adding area flow to channel
 494 Calculated TC of 3.889 minutes is less than 5 minutes,
 495 resetting TC to 5.0 minutes for rainfall intensity calculations
 496 Rainfall intensity (I) = 9.222(In/Hr) for a 100.0 year storm
 497 Decimal fraction soil group A = 0.000
 498 Decimal fraction soil group B = 0.000
 499 Decimal fraction soil group C = 1.000
 500 Decimal fraction soil group D = 0.000
 501 [COMMERCIAL area type]
 502 (Neighborhood Commercial)
 503 Impervious value, Ai = 0.800
 504 Sub-Area C Value = 0.780
 505 Rainfall intensity = 9.222(In/Hr) for a 100.0 year storm
 506 Effective runoff coefficient used for total area
 507 (Q=KCIA) is C = 0.780 CA = 0.242
 508 Subarea runoff = 1.942(CFS) for 0.270(Ac.)
 509 Total runoff = 2.230(CFS) Total area = 0.310(Ac.)
 510 Depth of flow = 0.108(Ft.), Average velocity = 2.980(Ft/s)

 514 Process from Point/Station 302.000 to Point/Station 104.000
 515 **** PIPEFLOW TRAVEL TIME (User specified size) ****

517 Upstream point/station elevation = 306.000(Ft.)
 518 Downstream point/station elevation = 303.300(Ft.)
 519 Pipe length = 30.00(Ft.) Slope = 0.0900 Manning's N = 0.013
 520 No. of pipes = 1 Required pipe flow = 2.230(CFS)
 521 Given pipe size = 12.00(In.)
 522 Calculated individual pipe flow = 2.230(CFS)
 523 Normal flow depth in pipe = 3.72(In.)
 524 Flow top width inside pipe = 11.10(In.)
 525 Critical Depth = 7.66(In.)
 526 Pipe flow velocity = 10.75(Ft/s)
 527 Travel time through pipe = 0.05 min.
 528 Time of concentration (TC) = 3.94 min.

 532 Process from Point/Station 104.000 to Point/Station 104.000
 533 **** CONFLUENCE OF MINOR STREAMS ****

535 Along Main Stream number: 1 in normal stream number 3
 536 Stream flow area = 0.310(Ac.)
 537 Runoff from this stream = 2.230(CFS)
 538 Time of concentration = 3.94 min.
 539 Rainfall intensity = 9.222(In/Hr)
 540 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	3.125	6.94	7.462
2	4.183	4.94	9.222
3	2.230	3.94	9.222
Qmax(1) =			
	1.000 *	1.000 *	3.125) +
	0.809 *	1.000 *	4.183) +
	0.809 *	1.000 *	2.230) + = 8.314

```

553 Qmax(2) =
554     1.000 * 0.712 * 3.125) +
555     1.000 * 1.000 * 4.183) +
556     1.000 * 1.000 * 2.230) + =      8.638
557 Qmax(3) =
558     1.000 * 0.567 * 3.125) +
559     1.000 * 0.796 * 4.183) +
560     1.000 * 1.000 * 2.230) + =      7.332

```

```

562 Total of 3 streams to confluence:
563 Flow rates before confluence point:
564     3.125     4.183     2.230
565 Maximum flow rates at confluence using above data:
566     8.314     8.638     7.332
567 Area of streams before confluence:
568     1.020     0.540     0.310

```

```

569 Results of confluence:
570 Total flow rate =      8.638(CFS)
571 Time of concentration =      4.943 min.
572 Effective stream area after confluence =      1.870(Ac.)

```

```

575 *****
576 Process from Point/Station      104.000 to Point/Station      105.000
577 **** PIPEFLOW TRAVEL TIME (User specified size) ****

```

```

579 Upstream point/station elevation = 303.300(Ft.)
580 Downstream point/station elevation = 303.000(Ft.)
581 Pipe length = 71.00(Ft.) Slope = 0.0042 Manning's N = 0.013
582 No. of pipes = 1 Required pipe flow = 8.638(CFS)
583 Given pipe size = 18.00(In.)
584 NOTE: Normal flow is pressure flow in user selected pipe size.
585 The approximate hydraulic grade line above the pipe invert is
586     0.736(Ft.) at the headworks or inlet of the pipe(s)
587 Pipe friction loss = 0.480(Ft.)
588 Minor friction loss = 0.556(Ft.) K-factor = 1.50
589 Pipe flow velocity = 4.89(Ft/s)
590 Travel time through pipe = 0.24 min.
591 Time of concentration (TC) = 5.19 min.

```

```

594 *****
595 Process from Point/Station      105.000 to Point/Station      105.000
596 **** CONFLUENCE OF MINOR STREAMS ****

```

```

598 Along Main Stream number: 1 in normal stream number 1
599 Stream flow area = 1.870(Ac.)
600 Runoff from this stream = 8.638(CFS)
601 Time of concentration = 5.19 min.
602 Rainfall intensity = 9.008(In/Hr)

```

```

605 *****
606 Process from Point/Station      400.000 to Point/Station      401.000
607 **** INITIAL AREA EVALUATION ****

```

```

609 Decimal fraction soil group A = 0.000
610 Decimal fraction soil group B = 0.000
611 Decimal fraction soil group C = 1.000
612 Decimal fraction soil group D = 0.000
613 [HIGH DENSITY RESIDENTIAL ]
614 (43.0 DU/A or Less )
615 Impervious value, Ai = 0.800
616 Sub-Area C Value = 0.780
617 Initial subarea total flow distance = 100.000(Ft.)
618 Highest elevation = 316.100(Ft.)
619 Lowest elevation = 312.600(Ft.)
620 Elevation difference = 3.500(Ft.) Slope = 3.500 %
621 INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:

```

```

622 The maximum overland flow distance is 85.00 (Ft)
623 for the top area slope value of 3.50 %, in a development type of
624 43.0 DU/A or Less
625 In Accordance With Figure 3-3
626 Initial Area Time of Concentration = 3.50 minutes
627  $TC = [1.8 * (1.1 - C) * distance(Ft.)^{.5} / (% slope^{(1/3)})]$ 
628  $TC = [1.8 * (1.1 - 0.7800) * (85.000^{.5}) / (3.500^{(1/3)})] = 3.50$ 
629 The initial area total distance of 100.00 (Ft.) entered leaves a
630 remaining distance of 15.00 (Ft.)
631 Using Figure 3-4, the travel time for this distance is 0.23 minutes
632 for a distance of 15.00 (Ft.) and a slope of 3.50 %
633 with an elevation difference of 0.53(Ft.) from the end of the top area
634  $Tt = [11.9 * length(Mi)^3 / (elevation change(Ft.))]^{.385} * 60(min/hr)$ 
635 = 0.228 Minutes
636  $Tt = [(11.9 * 0.0028^3) / (0.53)]^{.385} = 0.23$ 
637 Total initial area  $Ti = 3.50$  minutes from Figure 3-3 formula plus
638 0.23 minutes from the Figure 3-4 formula = 3.73 minutes
639 Calculated TC of 3.726 minutes is less than 5 minutes,
640 resetting TC to 5.0 minutes for rainfall intensity calculations
641 Rainfall intensity (I) = 9.222(In/Hr) for a 100.0 year storm
642 Effective runoff coefficient used for area (Q=KCIA) is C = 0.780
643 Subarea runoff = 0.791(CFS)
644 Total initial stream area = 0.110(Ac.)
645
646
647 *****
648 Process from Point/Station 401.000 to Point/Station 402.000
649 **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
650
651 -----
652 Estimated mean flow rate at midpoint of channel = 1.043(CFS)
653 Depth of flow = 0.351(Ft.), Average velocity = 4.504(Ft/s)
654 ***** Irregular Channel Data *****
655 -----
656 Information entered for subchannel number 1 :
657 Point number 'X' coordinate 'Y' coordinate
658 1 0.00 1.10
659 2 34.00 0.40
660 3 35.50 0.00
661 4 35.50 0.50
662 Manning's 'N' friction factor = 0.015
663 -----
664 Sub-Channel flow = 1.043(CFS)
665 ' ' flow top width = 1.318(Ft.)
666 ' ' velocity = 4.504(Ft/s)
667 ' ' area = 0.232(Sq.Ft)
668 ' ' Froude number = 1.894
669
670 Upstream point elevation = 312.600(Ft.)
671 Downstream point elevation = 310.600(Ft.)
672 Flow length = 67.000(Ft.)
673 Travel time = 0.25 min.
674 Time of concentration = 3.97 min.
675 Depth of flow = 0.351(Ft.)
676 Average velocity = 4.504(Ft/s)
677 Total irregular channel flow = 1.043(CFS)
678 Irregular channel normal depth above invert elev. = 0.351(Ft.)
679 Average velocity of channel(s) = 4.504(Ft/s)
680 Adding area flow to channel
681 Calculated TC of 3.974 minutes is less than 5 minutes,
682 resetting TC to 5.0 minutes for rainfall intensity calculations
683 Rainfall intensity (I) = 9.222(In/Hr) for a 100.0 year storm
684 Decimal fraction soil group A = 0.000
685 Decimal fraction soil group B = 0.000
686 Decimal fraction soil group C = 1.000
687 Decimal fraction soil group D = 0.000
688 [HIGH DENSITY RESIDENTIAL ]
689 (43.0 DU/A or Less )
690 Impervious value, Ai = 0.800
691 Sub-Area C Value = 0.780

```

691 Rainfall intensity = 9.222(In/Hr) for a 100.0 year storm
 692 Effective runoff coefficient used for total area
 693 (Q=KCIA) is C = 0.780 CA = 0.140
 694 Subarea runoff = 0.503(CFS) for 0.070(Ac.)
 695 Total runoff = 1.295(CFS) Total area = 0.180(Ac.)
 696 Depth of flow = 0.381(Ft.), Average velocity = 4.754(Ft/s)

699 *****
 700 Process from Point/Station 105.000 to Point/Station 105.000
 701 **** CONFLUENCE OF MINOR STREAMS ****

703 Along Main Stream number: 1 in normal stream number 2
 704 Stream flow area = 0.180(Ac.)
 705 Runoff from this stream = 1.295(CFS)
 706 Time of concentration = 3.97 min.
 707 Rainfall intensity = 9.222(In/Hr)
 708 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
------------	-----------------	----------	----------------------------

1	8.638	5.19	9.008
2	1.295	3.97	9.222
Qmax(1) =			
	1.000 *	1.000 *	8.638) +
	0.977 *	1.000 *	1.295) + = 9.902
Qmax(2) =			
	1.000 *	0.766 *	8.638) +
	1.000 *	1.000 *	1.295) + = 7.915

723 Total of 2 streams to confluence:
 724 Flow rates before confluence point:
 725 8.638 1.295
 726 Maximum flow rates at confluence using above data:
 727 9.902 7.915
 728 Area of streams before confluence:
 729 1.870 0.180

730 Results of confluence:
 731 Total flow rate = 9.902(CFS)
 732 Time of concentration = 5.185 min.
 733 Effective stream area after confluence = 2.050(Ac.)

736 *****
 737 Process from Point/Station 105.000 to Point/Station 106.000
 738 **** PIPEFLOW TRAVEL TIME (User specified size) ****

740 Upstream point/station elevation = 303.000(Ft.)
 741 Downstream point/station elevation = 302.500(Ft.)
 742 Pipe length = 77.00(Ft.) Slope = 0.0065 Manning's N = 0.013
 743 No. of pipes = 1 Required pipe flow = 9.902(CFS)
 744 Given pipe size = 12.00(In.)
 745 NOTE: Normal flow is pressure flow in user selected pipe size.
 746 The approximate hydraulic grade line above the pipe invert is
 747 9.149(Ft.) at the headworks or inlet of the pipe(s)
 748 Pipe friction loss = 5.946(Ft.)
 749 Minor friction loss = 3.703(Ft.) K-factor = 1.50
 750 Pipe flow velocity = 12.61(Ft/s)
 751 Travel time through pipe = 0.10 min.
 752 Time of concentration (TC) = 5.29 min.

755 *****
 756 Process from Point/Station 106.000 to Point/Station 106.000
 757 **** CONFLUENCE OF MAIN STREAMS ****

758 The following data inside Main Stream is listed:


```

760 In Main Stream number: 1
761 Stream flow area = 2.050(Ac.)
762 Runoff from this stream = 9.902(CFS)
763 Time of concentration = 5.29 min.
764 Rainfall intensity = 8.896(In/Hr)
765 Program is now starting with Main Stream No. 2
766
767
768 +-----+
769 Process from Point/Station 804.000 to Point/Station 106.000
770 **** USER DEFINED FLOW INFORMATION AT A POINT ****
771
772 -----
773 Decimal fraction soil group A = 0.000
774 Decimal fraction soil group B = 0.000
775 Decimal fraction soil group C = 1.000
776 Decimal fraction soil group D = 0.000
777 [HIGH DENSITY RESIDENTIAL ]
778 (43.0 DU/A or Less )
779 Impervious value, Ai = 0.800
780 Sub-Area C Value = 0.780
781 Rainfall intensity (I) = 5.819(In/Hr) for a 100.0 year storm
782 User specified values are as follows:
783 TC = 10.21 min. Rain intensity = 5.82(In/Hr)
784 Total area = 2.170(Ac.) Total runoff = 5.047(CFS)
785
786 +-----+
787 Process from Point/Station 106.000 to Point/Station 106.000
788 **** CONFLUENCE OF MAIN STREAMS ****
789
790 -----
791 The following data inside Main Stream is listed:
792 In Main Stream number: 2
793 Stream flow area = 2.170(Ac.)
794 Runoff from this stream = 5.047(CFS)
795 Time of concentration = 10.21 min.
796 Rainfall intensity = 5.819(In/Hr)
797 Program is now starting with Main Stream No. 3
798
799 +-----+
800 Process from Point/Station 1004.000 to Point/Station 1005.000
801 **** INITIAL AREA EVALUATION ****
802
803 -----
804 Decimal fraction soil group A = 1.000
805 Decimal fraction soil group B = 0.000
806 Decimal fraction soil group C = 0.000
807 Decimal fraction soil group D = 0.000
808 [LOW DENSITY RESIDENTIAL ]
809 (1.0 DU/A or Less )
810 Impervious value, Ai = 0.100
811 Sub-Area C Value = 0.270
812 Initial subarea total flow distance = 30.000(Ft.)
813 Highest elevation = 334.800(Ft.)
814 Lowest elevation = 327.500(Ft.)
815 Elevation difference = 7.300(Ft.) Slope = 24.333 %
816 Top of Initial Area Slope adjusted by User to 0.189 %
817 INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
818 The maximum overland flow distance is 50.00 (Ft)
819 for the top area slope value of 0.19 %, in a development type of
820 1.0 DU/A or Less
821 In Accordance With Table 3-2
822 Initial Area Time of Concentration = 12.20 minutes
823 (for slope value of 0.50 %)
824 Rainfall intensity (I) = 5.187(In/Hr) for a 100.0 year storm
825 Effective runoff coefficient used for area (Q=KCIA) is C = 0.270
826 Subarea runoff = 0.014(CFS)
827 Total initial stream area = 0.010(Ac.)
828

```

```

829 *****
830 Process from Point/Station 1005.000 to Point/Station 1003.000
831 **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
832
833 Estimated mean flow rate at midpoint of channel = 0.042(CFS)
834 Depth of flow = 0.111(Ft.), Average velocity = 3.401(Ft/s)
835 ***** Irregular Channel Data *****
836 -----
837 Information entered for subchannel number 1 :
838 Point number 'X' coordinate 'Y' coordinate
839 1 0.00 1.00
840 2 1.00 0.00
841 3 2.00 1.00
842 Manning's 'N' friction factor = 0.015
843 -----
844 Sub-Channel flow = 0.042(CFS)
845 ' ' flow top width = 0.222(Ft.)
846 ' ' velocity= 3.401(Ft/s)
847 ' ' area = 0.012(Sq.Ft)
848 ' ' Froude number = 2.543
849
850 Upstream point elevation = 327.500(Ft.)
851 Downstream point elevation = 324.500(Ft.)
852 Flow length = 34.000(Ft.)
853 Travel time = 0.17 min.
854 Time of concentration = 12.37 min.
855 Depth of flow = 0.111(Ft.)
856 Average velocity = 3.401(Ft/s)
857 Total irregular channel flow = 0.042(CFS)
858 Irregular channel normal depth above invert elev. = 0.111(Ft.)
859 Average velocity of channel(s) = 3.401(Ft/s)
860 Adding area flow to channel
861 Rainfall intensity (I) = 5.142(In/Hr) for a 100.0 year storm
862 Decimal fraction soil group A = 1.000
863 Decimal fraction soil group B = 0.000
864 Decimal fraction soil group C = 0.000
865 Decimal fraction soil group D = 0.000
866 [LOW DENSITY RESIDENTIAL ]
867 (1.0 DU/A or Less )
868 Impervious value, Ai = 0.100
869 Sub-Area C Value = 0.270
870 Rainfall intensity = 5.142(In/Hr) for a 100.0 year storm
871 Effective runoff coefficient used for total area
872 (Q=KCIA) is C = 0.270 CA = 0.014
873 Subarea runoff = 0.055(CFS) for 0.040(Ac.)
874 Total runoff = 0.069(CFS) Total area = 0.050(Ac.)
875 Depth of flow = 0.134(Ft.), Average velocity = 3.856(Ft/s)
876
877
878 *****
879 Process from Point/Station 1003.000 to Point/Station 1003.000
880 **** CONFLUENCE OF MINOR STREAMS ****
881
882 Along Main Stream number: 3 in normal stream number 1
883 Stream flow area = 0.050(Ac.)
884 Runoff from this stream = 0.069(CFS)
885 Time of concentration = 12.37 min.
886 Rainfall intensity = 5.142(In/Hr)
887
888
889 *****
890 Process from Point/Station 1003.000 to Point/Station 1003.000
891 **** USER DEFINED FLOW INFORMATION AT A POINT ****
892
893 Decimal fraction soil group A = 1.000
894 Decimal fraction soil group B = 0.000
895 Decimal fraction soil group C = 0.000
896 Decimal fraction soil group D = 0.000
897 [MEDIUM DENSITY RESIDENTIAL ]

```

898 (7.3 DU/A or Less)
 899 Impervious value, Ai = 0.400
 900 Sub-Area C Value = 0.480
 901 Rainfall intensity (I) = 6.428(In/Hr) for a 100.0 year storm
 902 User specified values are as follows:
 903 TC = 8.75 min. Rain intensity = 6.43(In/Hr)
 904 Total area = 5.000(Ac.) Total runoff = 13.794(CFS)
 905
 906

907 +++++
 908 Process from Point/Station 1003.000 to Point/Station 1003.000
 909 **** CONFLUENCE OF MINOR STREAMS ****
 910

911 Along Main Stream number: 3 in normal stream number 2
 912 Stream flow area = 5.000(Ac.)
 913 Runoff from this stream = 13.794(CFS)
 914 Time of concentration = 8.75 min.
 915 Rainfall intensity = 6.428(In/Hr)
 916 Summary of stream data:
 917

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
------------	-----------------	----------	----------------------------

918	1	0.069	12.37	5.142
919	2	13.794	8.75	6.428

924 Qmax(1) =
 925 1.000 * 1.000 * 0.069) +
 926 0.800 * 1.000 * 13.794) + = 11.105
 927 Qmax(2) =
 928 1.000 * 0.708 * 0.069) +
 929 1.000 * 1.000 * 13.794) + = 13.843
 930

931 Total of 2 streams to confluence:
 932 Flow rates before confluence point:
 933 0.069 13.794
 934 Maximum flow rates at confluence using above data:
 935 11.105 13.843
 936 Area of streams before confluence:
 937 0.050 5.000
 938

938 Results of confluence:
 939 Total flow rate = 13.843(CFS)
 940 Time of concentration = 8.750 min.
 941 Effective stream area after confluence = 5.050(Ac.)
 942
 943

944 +++++
 945 Process from Point/Station 1003.000 to Point/Station 106.000
 946 **** PIPEFLOW TRAVEL TIME (User specified size) ****
 947

948 Upstream point/station elevation = 311.100(Ft.)
 949 Downstream point/station elevation = 302.600(Ft.)
 950 Pipe length = 209.00(Ft.) Slope = 0.0407 Manning's N = 0.013
 951 No. of pipes = 1 Required pipe flow = 13.843(CFS)
 952 Given pipe size = 18.00(In.)
 953 Calculated individual pipe flow = 13.843(CFS)
 954 Normal flow depth in pipe = 10.61(In.)
 955 Flow top width inside pipe = 17.71(In.)
 956 Critical Depth = 16.52(In.)
 957 Pipe flow velocity = 12.78(Ft/s)
 958 Travel time through pipe = 0.27 min.
 959 Time of concentration (TC) = 9.02 min.
 960
 961

962 +++++
 963 Process from Point/Station 106.000 to Point/Station 106.000
 964 **** CONFLUENCE OF MAIN STREAMS ****
 965

966 The following data inside Main Stream is listed:

967 In Main Stream number: 3
 968 Stream flow area = 5.050(Ac.)
 969 Runoff from this stream = 13.843(CFS)
 970 Time of concentration = 9.02 min.
 971 Rainfall intensity = 6.302(In/Hr)
 972 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	9.902	5.29	8.896
2	5.047	10.21	5.819
3	13.843	9.02	6.302

981 Qmax(1) =
 982 1.000 * 1.000 * 9.902) +
 983 1.000 * 0.518 * 5.047) +
 984 1.000 * 0.586 * 13.843) + = 20.628

985 Qmax(2) =
 986 0.654 * 1.000 * 9.902) +
 987 1.000 * 1.000 * 5.047) +
 988 0.923 * 1.000 * 13.843) + = 24.306

989 Qmax(3) =
 990 0.708 * 1.000 * 9.902) +
 991 1.000 * 0.884 * 5.047) +
 992 1.000 * 1.000 * 13.843) + = 25.318

994 Total of 3 main streams to confluence:

995 Flow rates before confluence point:
 996 9.902 5.047 13.843

997 Maximum flow rates at confluence using above data:
 998 20.628 24.306 25.318

999 Area of streams before confluence:
 1000 2.050 2.170 5.050

1003 Results of confluence:

1004 Total flow rate = 25.318(CFS)
 1005 Time of concentration = 9.023 min.
 1006 Effective stream area after confluence = 9.270(Ac.)

1009 *****
 1010 Process from Point/Station 106.000 to Point/Station 107.000
 1011 **** PIPEFLOW TRAVEL TIME (User specified size) ****

1013 Upstream point/station elevation = 302.500(Ft.)
 1014 Downstream point/station elevation = 302.100(Ft.)
 1015 Pipe length = 31.00(Ft.) Slope = 0.0129 Manning's N = 0.013
 1016 No. of pipes = 1 Required pipe flow = 25.318(CFS)
 1017 Given pipe size = 18.00(In.)
 1018 NOTE: Normal flow is pressure flow in user selected pipe size.
 1019 The approximate hydraulic grade line above the pipe invert is
 1020 6.181(Ft.) at the headworks or inlet of the pipe(s)
 1021 Pipe friction loss = 1.800(Ft.)
 1022 Minor friction loss = 4.781(Ft.) K-factor = 1.50
 1023 Pipe flow velocity = 14.33(Ft/s)
 1024 Travel time through pipe = 0.04 min.
 1025 Time of concentration (TC) = 9.06 min.

1028 *****
 1029 Process from Point/Station 107.000 to Point/Station 109.000
 1030 **** PIPEFLOW TRAVEL TIME (User specified size) ****

1032 Upstream point/station elevation = 302.100(Ft.)
 1033 Downstream point/station elevation = 285.720(Ft.)
 1034 Pipe length = 137.00(Ft.) Slope = 0.1196 Manning's N = 0.013
 1035 No. of pipes = 1 Required pipe flow = 25.318(CFS)

```

1036 Given pipe size =      18.00(In.)
1037 Calculated individual pipe flow =    25.318(CFS)
1038 Normal flow depth in pipe =    11.06(In.)
1039 Flow top width inside pipe =    17.52(In.)
1040 Critical depth could not be calculated.
1041 Pipe flow velocity =     22.22(Ft/s)
1042 Travel time through pipe =     0.10 min.
1043 Time of concentration (TC) =     9.16 min.
1044
1045
1046 *****
1047 Process from Point/Station    109.000 to Point/Station    109.000
1048 **** CONFLUENCE OF MINOR STREAMS ****
1049
-----
1050 Along Main Stream number: 1 in normal stream number 1
1051 Stream flow area =     9.270(Ac.)
1052 Runoff from this stream =    25.318(CFS)
1053 Time of concentration =     9.16 min.
1054 Rainfall intensity =     6.240(In/Hr)
1055
1056
1057 *****
1058 Process from Point/Station    2002.000 to Point/Station    2003.000
1059 **** INITIAL AREA EVALUATION ****
1060
-----
1061 Decimal fraction soil group A = 0.000
1062 Decimal fraction soil group B = 0.000
1063 Decimal fraction soil group C = 1.000
1064 Decimal fraction soil group D = 0.000
1065 [COMMERCIAL area type                               ]
1066 (General Commercial                               )
1067 Impervious value, Ai = 0.850
1068 Sub-Area C Value = 0.810
1069 Initial subarea total flow distance =   93.000(Ft.)
1070 Highest elevation =  318.000(Ft.)
1071 Lowest elevation =  316.300(Ft.)
1072 Elevation difference =   1.700(Ft.) Slope =  1.828 %
1073 Top of Initial Area Slope adjusted by User to  1.400 %
1074 INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
1075 The maximum overland flow distance is 60.00 (Ft)
1076 for the top area slope value of  1.40 %, in a development type of
1077 General Commercial
1078 In Accordance With Figure 3-3
1079 Initial Area Time of Concentration =   3.61 minutes
1080 TC = [1.8*(1.1-C)*distance(Ft.)^.5]/(% slope^(1/3)]
1081 TC = [1.8*(1.1-0.8100)*( 60.000^.5)/( 1.400^(1/3)]=   3.61
1082 Calculated TC of   3.614 minutes is less than 5 minutes,
1083 resetting TC to 5.0 minutes for rainfall intensity calculations
1084 Rainfall intensity (I) =   9.222(In/Hr) for a  100.0 year storm
1085 Effective runoff coefficient used for area (Q=KCIA) is C = 0.810
1086 Subarea runoff =     0.254(CFS)
1087 Total initial stream area =     0.034(Ac.)
1088
1089
1090 *****
1091 Process from Point/Station    2003.000 to Point/Station    2004.000
1092 **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
1093
-----
1094 Estimated mean flow rate at midpoint of channel =     2.206(CFS)
1095 Depth of flow =   0.250(Ft.), Average velocity =   1.603(Ft/s)
1096 ***** Irregular Channel Data *****
1097 -----
1098 Information entered for subchannel number 1 :
1099 Point number      'X' coordinate      'Y' coordinate
1100      1              0.00              0.31
1101      2             26.00              0.13
1102      3             27.50              0.00
1103      4             27.50              0.50
1104 Manning's 'N' friction factor =   0.015

```

```

1105 -----
1106 Sub-Channel flow = 2.206(CFS)
1107 ' ' flow top width = 18.940(Ft.)
1108 ' ' velocity= 1.603(Ft/s)
1109 ' ' area = 1.376(Sq.Ft)
1110 ' ' Froude number = 1.048
1111
1112 Upstream point elevation = 316.300(Ft.)
1113 Downstream point elevation = 310.800(Ft.)
1114 Flow length = 625.000(Ft.)
1115 Travel time = 6.50 min.
1116 Time of concentration = 10.11 min.
1117 Depth of flow = 0.250(Ft.)
1118 Average velocity = 1.603(Ft/s)
1119 Total irregular channel flow = 2.206(CFS)
1120 Irregular channel normal depth above invert elev. = 0.250(Ft.)
1121 Average velocity of channel(s) = 1.603(Ft/s)
1122 Adding area flow to channel
1123 Rainfall intensity (I) = 5.855(In/Hr) for a 100.0 year storm
1124 User specified 'C' value of 0.804 given for subarea
1125 Rainfall intensity = 5.855(In/Hr) for a 100.0 year storm
1126 Effective runoff coefficient used for total area
1127 (Q=KCIA) is C = 0.804 CA = 0.700
1128 Subarea runoff = 3.848(CFS) for 0.837(Ac.)
1129 Total runoff = 4.102(CFS) Total area = 0.871(Ac.)
1130 Depth of flow = 0.289(Ft.), Average velocity = 1.862(Ft/s)
1131
1132
1133 *****
1134 Process from Point/Station 2000.000 to Point/Station 109.000
1135 **** SUBAREA FLOW ADDITION ****
1136
1137 -----
1137 Rainfall intensity (I) = 5.855(In/Hr) for a 100.0 year storm
1138 Decimal fraction soil group A = 0.100
1139 Decimal fraction soil group B = 0.000
1140 Decimal fraction soil group C = 0.900
1141 Decimal fraction soil group D = 0.000
1142 [MEDIUM DENSITY RESIDENTIAL ]
1143 (14.5 DU/A or Less )
1144 Impervious value, Ai = 0.500
1145 Sub-Area C Value = 0.595
1146 Time of concentration = 10.11 min.
1147 Rainfall intensity = 5.855(In/Hr) for a 100.0 year storm
1148 Effective runoff coefficient used for total area
1149 (Q=KCIA) is C = 0.719 CA = 1.057
1150 Subarea runoff = 2.090(CFS) for 0.600(Ac.)
1151 Total runoff = 6.192(CFS) Total area = 1.471(Ac.)
1152
1153
1154 *****
1155 Process from Point/Station 2001.000 to Point/Station 109.000
1156 **** SUBAREA FLOW ADDITION ****
1157
1158 -----
1158 Rainfall intensity (I) = 5.855(In/Hr) for a 100.0 year storm
1159 Decimal fraction soil group A = 0.000
1160 Decimal fraction soil group B = 0.000
1161 Decimal fraction soil group C = 1.000
1162 Decimal fraction soil group D = 0.000
1163 [COMMERCIAL area type ]
1164 (Neighborhood Commercial )
1165 Impervious value, Ai = 0.800
1166 Sub-Area C Value = 0.780
1167 Time of concentration = 10.11 min.
1168 Rainfall intensity = 5.855(In/Hr) for a 100.0 year storm
1169 Effective runoff coefficient used for total area
1170 (Q=KCIA) is C = 0.733 CA = 1.409
1171 Subarea runoff = 2.060(CFS) for 0.451(Ac.)
1172 Total runoff = 8.252(CFS) Total area = 1.922(Ac.)
1173

```

```

1174
1175 *****
1176 Process from Point/Station      109.000 to Point/Station      109.000
1177 **** CONFLUENCE OF MINOR STREAMS ****
1178
1179 Along Main Stream number: 1 in normal stream number 2
1180 Stream flow area =      1.922(Ac.)
1181 Runoff from this stream =      8.252(CFS)
1182 Time of concentration =     10.11 min.
1183 Rainfall intensity =      5.855(In/Hr)
1184 Summary of stream data:
1185
1186 Stream   Flow rate      TC              Rainfall Intensity
1187   No.     (CFS)          (min)           (In/Hr)
1188
1189
1190 1         25.318         9.16           6.240
1191 2          8.252        10.11          5.855
1192 Qmax(1) =
1193      1.000 *      1.000 *      25.318) +
1194      1.000 *      0.906 *      8.252) + =      32.795
1195 Qmax(2) =
1196      0.938 *      1.000 *      25.318) +
1197      1.000 *      1.000 *      8.252) + =      32.009
1198
1199 Total of 2 streams to confluence:
1200 Flow rates before confluence point:
1201      25.318         8.252
1202 Maximum flow rates at confluence using above data:
1203      32.795         32.009
1204 Area of streams before confluence:
1205      9.270         1.922
1206 Results of confluence:
1207 Total flow rate =      32.795(CFS)
1208 Time of concentration =     9.161 min.
1209 Effective stream area after confluence =      11.192(Ac.)
1210
1211
1212 *****
1213 Process from Point/Station      2004.000 to Point/Station      109.000
1214 **** PIPEFLOW TRAVEL TIME (User specified size) ****
1215
1216 Upstream point/station elevation =  306.830(Ft.)
1217 Downstream point/station elevation =  285.720(Ft.)
1218 Pipe length =  211.00(Ft.) Slope =  0.1000 Manning's N = 0.013
1219 No. of pipes = 1 Required pipe flow =  32.795(CFS)
1220 Given pipe size =  18.00(In.)
1221 Calculated individual pipe flow =  32.795(CFS)
1222 Normal flow depth in pipe =  14.53(In.)
1223 Flow top width inside pipe =  14.20(In.)
1224 Critical depth could not be calculated.
1225 Pipe flow velocity =  21.43(Ft/s)
1226 Travel time through pipe =  0.16 min.
1227 Time of concentration (TC) =  9.33 min.
1228 End of computations, total study area =      11.192 (Ac.)
1229
1230
1231

```

ATTACHMENT 4

4. FEMA Floodplains/Floodways

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The community map repository should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations (BFEs)** and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations (BFEs) shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) Zone 11. The horizontal datum was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at <http://www.ngs.noaa.gov> or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, NNGS12
National Geodetic Survey
SSM3-3 #5202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242 or visit its website at <http://www.ngs.noaa.gov>.

Base map information shown on this FIRM was provided in digital format by the USDA National Agriculture Imagery Program (NAIP). This information was photogrammetrically compiled at a scale of 1:24,000 from aerial photography dated 2009.

This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

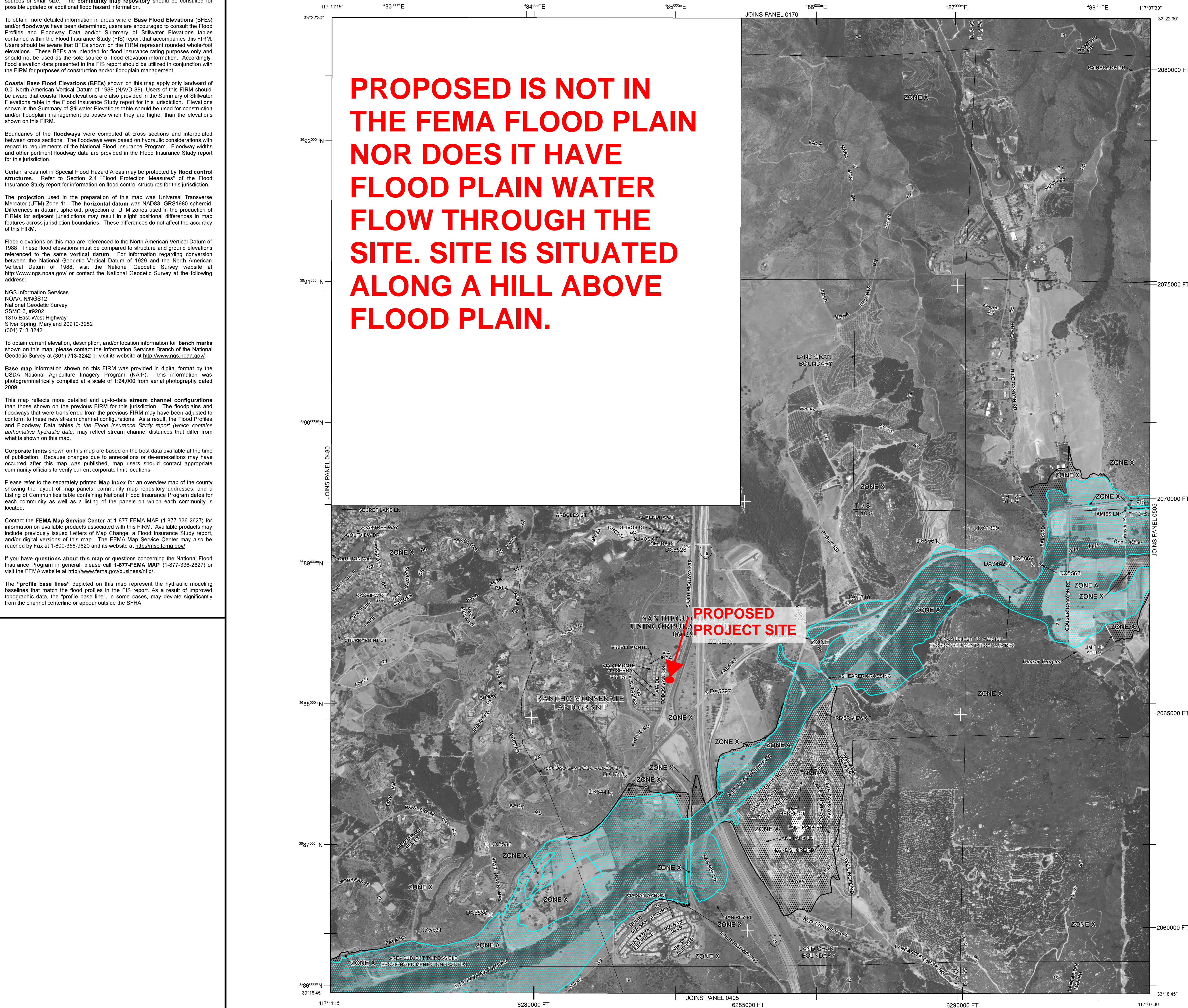
Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels, community map repository addresses, and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1-877-FEMA MAP (1-877-336-2627) for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study report, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9629 and its website at <http://msc.fema.gov>.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call 1-877-FEMA MAP (1-877-336-2627) or visit the FEMA website at <http://www.fema.gov/business/firfi>.

The "profile base lines" depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the "profile base line", in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

PROPOSED IS NOT IN THE FEMA FLOOD PLAIN NOR DOES IT HAVE FLOOD PLAIN WATER FLOW THROUGH THE SITE. SITE IS SITUATED ALONG A HILL ABOVE FLOOD PLAIN.



LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

- ZONE A** No Base Flood Elevations determined.
- ZONE AE** Base Flood Elevations determined.
- ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- ZONE AR** Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- ZONE A99** Areas to be protected from 1% annual chance flood event by a Federal flood protection system under construction; no Base Flood Elevations determined.
- ZONE V** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

- ZONE X** Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

- ZONE X** Areas determined to be outside the 0.2% annual chance floodplain.
- ZONE D** Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% annual chance floodplain boundary
- 0.2% annual chance floodplain boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities
- Base Flood Elevation line and value; elevation in feet*
- Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
June 19, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
May 16, 2012 - to update corporate limits, to add roads and road names, to incorporate previously issued Letters of Map Revision, and to update map elevations to North American Vertical Datum of 1988.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'

Scale bar showing 0 to 2000 feet and 0 to 600 meters.

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0485G

FIRM

FLOOD INSURANCE RATE MAP

SAN DIEGO COUNTY, CALIFORNIA

AND INCORPORATED AREAS

PANEL 485 OF 2375

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
SAN DIEGO COUNTY	060284	0485	G

Notes 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 06073C0485G

MAP REVISED MAY 16, 2012

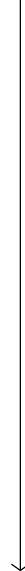
Federal Emergency Management Agency

ATTACHMENT 5

5a. Hydrograph Report

Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023



Legend

<u>Hyd.</u>	<u>Origin</u>	<u>Description</u>
1	Manual	<no description>
2	Reservoir	<no description>

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

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	Manual	-----	-----	-----	-----	-----	-----	-----	-----	2.670	<no description>
2	Reservoir	1	-----	-----	-----	-----	-----	-----	-----	0.577	<no description>

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

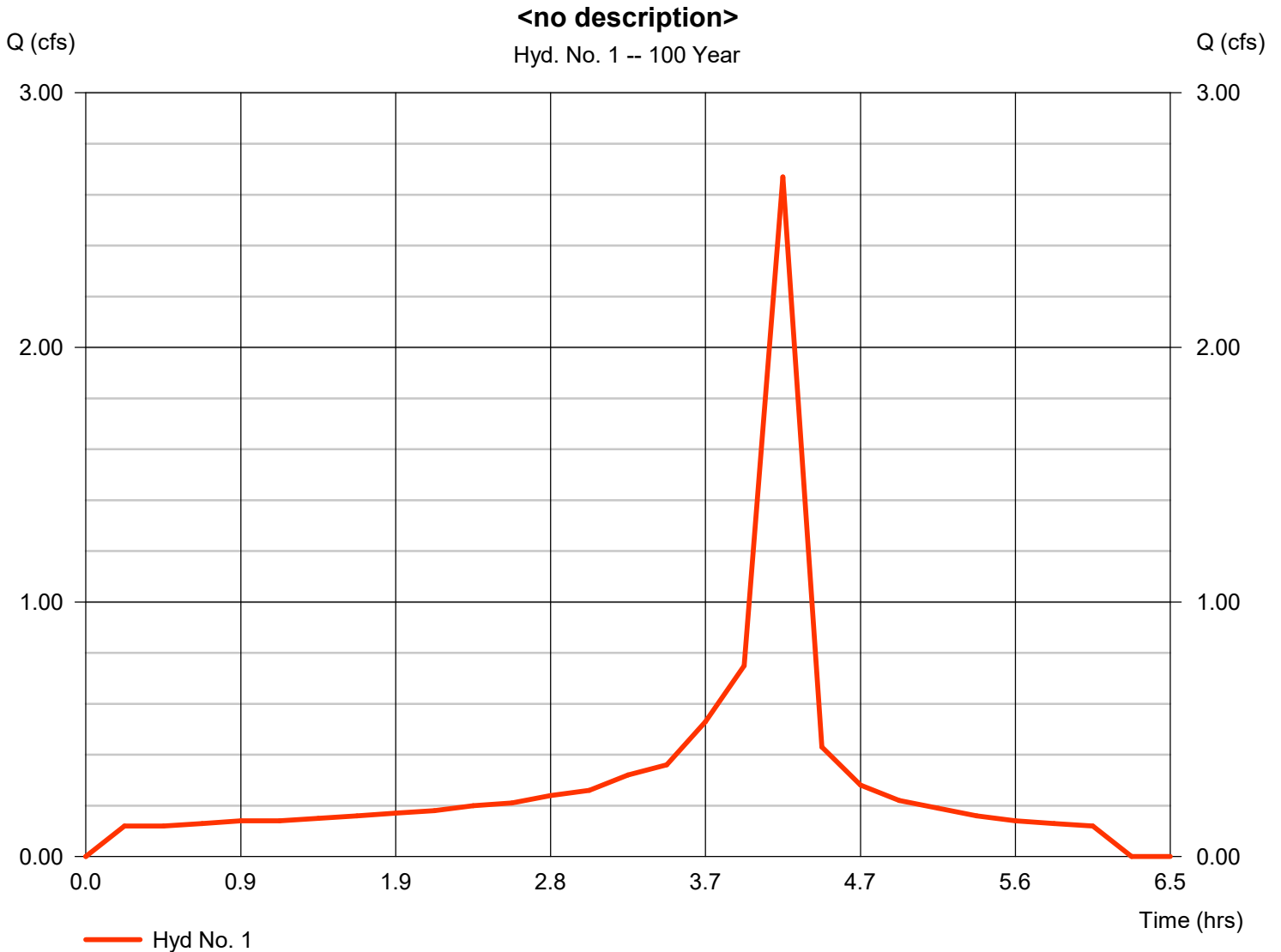
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Manual	2.670	14	252	7,157	-----	-----	-----	<no description>
2	Reservoir	0.577	14	266	7,154	1	311.75	3,118	<no description>
bmp802detention.gpw					Return Period: 100 Year			Monday, 06 / 12 / 2023	

Hydrograph Report

Hyd. No. 1

<no description>

Hydrograph type	= Manual	Peak discharge	= 2.670 cfs
Storm frequency	= 100 yrs	Time to peak	= 4.20 hrs
Time interval	= 14 min	Hyd. volume	= 7,157 cuft



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

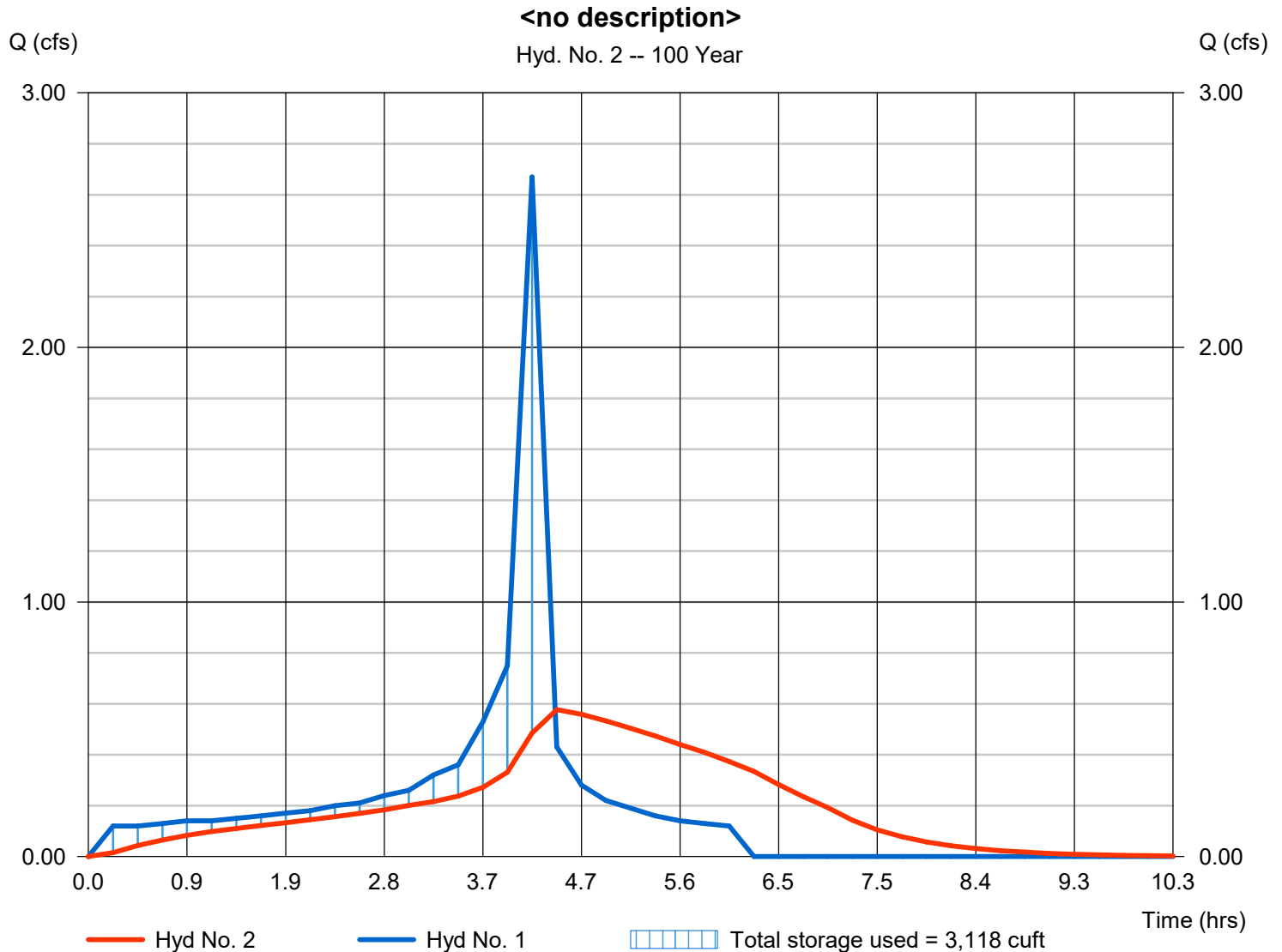
Monday, 06 / 12 / 2023

Hyd. No. 2

<no description>

Hydrograph type	= Reservoir	Peak discharge	= 0.577 cfs
Storm frequency	= 100 yrs	Time to peak	= 4.43 hrs
Time interval	= 14 min	Hyd. volume	= 7,154 cuft
Inflow hyd. No.	= 1 - <no description>	Max. Elevation	= 311.75 ft
Reservoir name	= bmp802	Max. Storage	= 3,118 cuft

Storage Indication method used.



5b. Runoff Coefficient C After Detention Structure

CALCULATION AFTER THE DETENTION STRUCTURE

The purpose of the detention structure is to alter the peak flow and or time to peak of a given storm so it will not have a negative impact on the downstream facilities. There are different methods on how to use the resulting values of the outflow hydrograph.

For the purposes of this example there will be an association of the following values:

Q_{in} = Is equal to the inflow value that will enter the basin before storage

Q_{out} = Is equal to the outflow value that will exit the basin after storage

Tc_{in} = Is equal to the Time of Concentration flowing into the basin before detention

Tc_{out} = Is equal to the Time of Concentration exiting the basin after detention

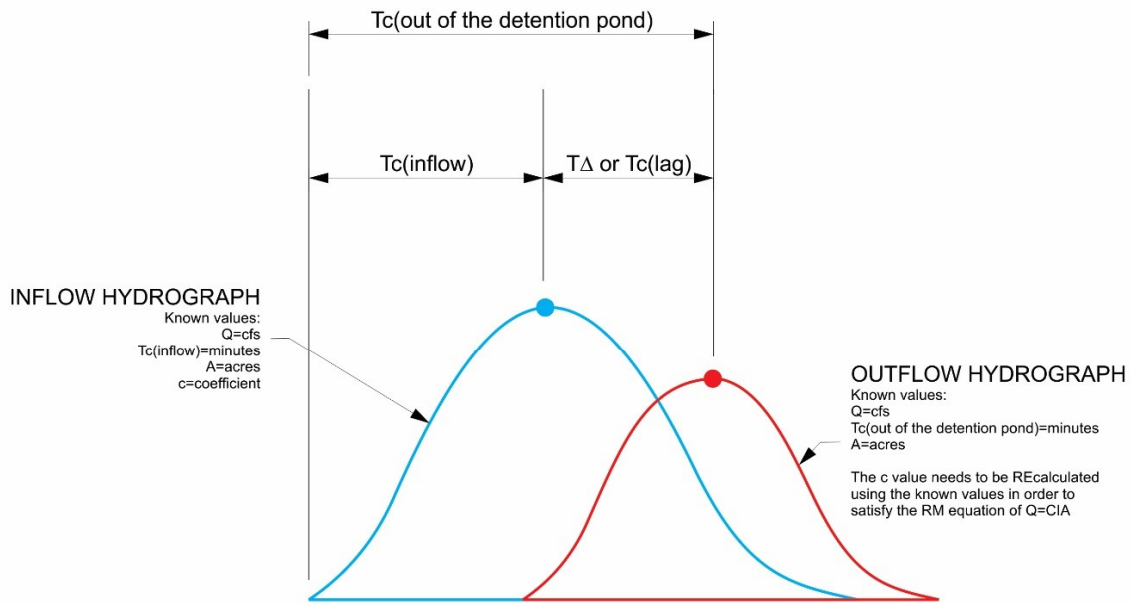
A = Area of the tributary area being examined; (This value does not change)

c_{inflow} = The runoff coefficient going into the basin for detention

c_{out} = The runoff coefficient recalculated taking into account water stored in pond for detention

One method is to keep the value of c_{inflow} and solve for the I =intensity & Tc_{out} (outflow). In this interpretation, we will get a Tc that will not match the value of the Tc_{out} (out of the detention structure) of the outflow hydrograph that was calculated using the detention pond. The Tc Using this method shows a disruption on the oneness & continuity of the outflow hydrograph & the formula $Q=cIA$.

The second method; that is the method we are using is to recalculate the c =coefficient based on the fix values of the outflow hydrograph to achieve a c_{out} . This value uses the c_{inflow} from the flow into the detention basin and then is recalculated by the output of the hydrograph software using $Q=cIA$; translated as $c=Q/IA$. This method preserves the formula $Q=cIA$ & does not alter the Tc_{out} (out of the detention structure). This method shows that in order to maintain mathematical integrity of the rational equation ($Q=CIA$), the detention structure alters the runoff coefficient which is the only unknown in the equation. It is noted that the designer feels it is important to hold the value of Tc and the Q values that are calculated from the hydrograph.



GRAPHICAL DIAGRAM OF THE HYDROGRAPH COMING OUT OF THE DETENTION POND

The routing of the runoff through the detention structure gives us the $Q_{(\text{out of the detention structure})}$ and $T\Delta$ time lag between $Q_{(\text{inflow})}$ & $Q_{(\text{out of the detention structure})}$.

The known fix values coming out of the detention structure are:

- $Q = \text{cfs}$
- $T_{c(\text{out of the detention structure})} = \text{minutes}$
- $A = \text{acres}$
- *Please note that $c = \text{coefficient}$ is not given directly from the resulting hydrograph coming out of the detention pond.*

In order to satisfy the rational equation of $Q = CIA$ (see Section 3 of the 2003 San Diego County Hydrology Manual) coming out of the detention structure, we will calculate the only unknown value of the equation which is the outlet runoff coefficient, $C_{(\text{outlet})}$. By using the $T_{c(\text{out of the detention structure})}$ we can solve for the intensity, I . With the intensity (I) value calculated, we can solve for the outlet runoff coefficient, $C_{(\text{outlet})}$.

The following equations are used in

$$\text{this stage: } Q = CIA$$

$$I = 7.44P_6D^{-0.645}$$

Where:

$Q_{(\text{out of the detention structure})} = \text{runoff (cfs), known value}$

$T_{c(\text{inflow})} = \text{detention structure inflow time of concentration (D)}$
(minutes)

$T\Delta = \text{time lag between } Q_{(\text{inflow})} \text{ \& } Q_{(\text{out of the detention structure})}$

(minutes) $T_{c(\text{out of the detention structure})} = T_{c(\text{inflow})} + T\Delta$ (minutes)

$P_6 = 6$ hour precipitation (inches), known value.

$I =$ intensity (inches/hour), calculated based on the value of $T_{c(\text{out of the detention structure})}$

$A =$ tributary area of the detention structure (acres),

known value $C_{(\text{outflow})} =$ runoff coefficient (unitless),

value to be solved

STORAGE PIPE			
LINE	ITEM	STORAGE PIPE	REMARKS
1	P6 inch	3.5	KNOWN VALUE
2	TC (inflow) mins	14.06	KNOWN VALUE
3	TC (lag) mins	13.8	FROM THE OUTFLOW HYDROGRAPH
4	TC (ouflow) mins	27.86	LINE 2+3
5	I inches/hour	3.045	FROM THE INTENSITY FORMULA
6	Q(outflow)	0.577	KNOWN VALUE
7	A (inflow=outflow)	0.97	KNOWN VALUE
8	c(inflow)	0.582	KNOWN VALUE FROM THE CONTRIBUTING BASIN(S)
9	c(outflow)	0.195	CALCULATED FROM $C=Q/IA$

The preceding highlighted data are then used to continue the calculations downstream of the detention structure.

In summary these are the steps of the calculations presented here:

1. Hydrologic methods of calculation as laid out in the 2003 San Diego Hydrology Manual was used upstream of the detention structure. These includes the methods of determining c , T_c and confluence of a junction. The c values used in the proposed conditions range from “undisturbed natural terrain” to “low & high density residential” whichever is appropriate for the contributing basin.
2. At the outflow of the detention structure, the c value was recalculated using the resulting values of the outflow hydrograph. This method preserves the values of $T_{c(\text{out of the detention structure})}$, A & $Q_{(\text{outflow})}$. Methods and software satisfy the formula $Q=cIA$ & the 2003 San Diego Hydrology Manual. This step shows that in order to maintain mathematical integrity of the rational equation ($Q=CIA$), the detention structure alters the runoff coefficient which is the only unknown in the equation.
3. The values determined in step 2 were used in the continuation of the calculations using the Hydrologic methods of calculation as laid out in the 2003 San Diego Hydrology Manual downstream of the detention structure. These includes the methods of determining c , T_c and confluence of a junction. The c values used in the proposed conditions range from “undisturbed natural terrain” to “low & high density residential” whichever is appropriate for the contributing basin.

End of Report